SINAMICS S120

AC Drive

Manual · 01/2013

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S120
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Manual

(GH6), 01/2013

6SL3097-4AL00-0BP3

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.

Proper use of Siemens products

Note the following:

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

Trademarks

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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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Order number: 6SL3097-4AL00-0BP3
Ⓟ 02/2013 Technical data subject to change

Foreword

SINAMICS documentation

The SINAMICS documentation is organized in the following categories:

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

More information

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

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

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

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

My Documentation Manager

Using the following link, you can find information on how to create your own individual documentation based on Siemens content, and adapt it for your own machine documentation:
http://www.siemens.com/mdm

Training

Using the following link, you can find information on SITRAIN - training from Siemens for products, systems and automation engineering solutions:
http://www.siemens.com/sitrain

FAQs

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

SINAMICS

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

Usage phases and the available tools/documents

Table 1 Usage phases and the available tools/documents

Usage phase	Tools
Orientation	SINAMICS S sales documentation
Planning/engineering	• SIZER configuration tool • Configuration manuals, motors
Decision making/ordering	SINAMICS S Catalogs • SIMOTION, SINAMICS S120 and Motors for Production Machines (Catalog PM 21) • SINAMICS and motors for single-axis drives (catalog D 31) • SINUMERIK & SINAMICS Equipment for Machine Tools (Catalog NC 61) • SINUMERIK 840D sl Type 1B Equipment for Machine Tools (Catalog NC 62)
Configuring/installation	• SINAMICS S120 Equipment Manual for Control Units and Additional System Components • SINAMICS S120 Equipment Manual for Booksize Power Units • SINAMICS S120 Equipment Manual for Chassis Power Units • SINAMICS S120 Manual Liquid Cooled Chassis Power Units • SINAMICS S120 Equipment Manual for AC Drives • SINAMICS S120M Equipment Manual Distributed Drive Technology • MOTION CONTROL Configuration Manual EMC installation guidelines / basic system requirements
Commissioning	• STARTER commissioning tool • SINAMICS S120 Getting Started • SINAMICS S120 Commissioning Manual • SINAMICS S120 CANopen Commissioning Manual • SINAMICS S120 Function Manual • SINAMICS S120 Safety Integrated Function Manual • SINAMICS S120/S150 List Manual
Using/operating	• SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual
Maintenance/Service	• SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual
List of references	• SINAMICS S120/S150 List Manual

Target group

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

Benefits

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

Standard scope

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

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

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

Technical Support

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

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

EC Declarations of Conformity

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

http://support.automation.siemens.com

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

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

http://support.automation.siemens.com

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

Note

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

Note

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

Note

The Equipment Manual describes a desired state which, if maintained, ensures the required level of operational reliability and compliance with EMC limit values.

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

EMC limit values in South Korea

이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

For sellers or other users, please bear in mind that this device is an A-grade electromagnetic wave device. This device is intended to be used in areas other than at home.

The EMC limit values to be complied with for South Korea correspond to the limit values of the EMC product standard for variable-speed electric drives EN 61800-3, Category C2 or limit value class A, Group 1 according to EN55011. By applying suitable supplementary measures, the limit values according to Category C2 or according to limit value class A, Group 1 are maintained. Further, additional measures may be required, for instance, using an additional radio interference suppression filter (EMC filter). The measures for EMC-compliant design of the system are described in detail in this manual respectively in the Installation Guideline EMC.
The measures for EMC-compliant design of the system are described in detail in this manual respectively in the Installation Guideline EMC.
Please note that the final statement on compliance with the standard is given by the respective label attached to the individual unit.

Spare parts

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

Explanation of symbols

Table 2 Symbols

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

Table of contents

1 Safety instructions

1.1 General safety instructions

⚠ DANGER

Danger to life when live parts are touched

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

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

Generally, six steps apply when establishing safety:

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

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

⚠ WARNING

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

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

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

WARNING

Danger to life when live parts are touched on damaged devices

Improper handling of devices can cause damage.

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

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

WARNING

Danger of fire spreading due to inadequate housing

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

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

WARNING

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

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

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

WARNING

Fire hazard for the motor due to overload of the insulation

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

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

⚠ WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

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

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

⚠ WARNING

Danger to life through electric shock due to unconnected cable shields

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

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

1.2 Safety instructions for electromagnetic fields (EMF)

⚠ WARNING

Danger to life from electromagnetic fields

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

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

- Keep a distance of at least 2 m.

1.3 Handling electrostatic sensitive devices (ESD)

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

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 EC Machinery Directive, the machine manufacturer must take into account the following residual risks emanating from the control and drive components of a drive system:

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

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

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

Note

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

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

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

System overview

2

2.1 Field of application

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

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

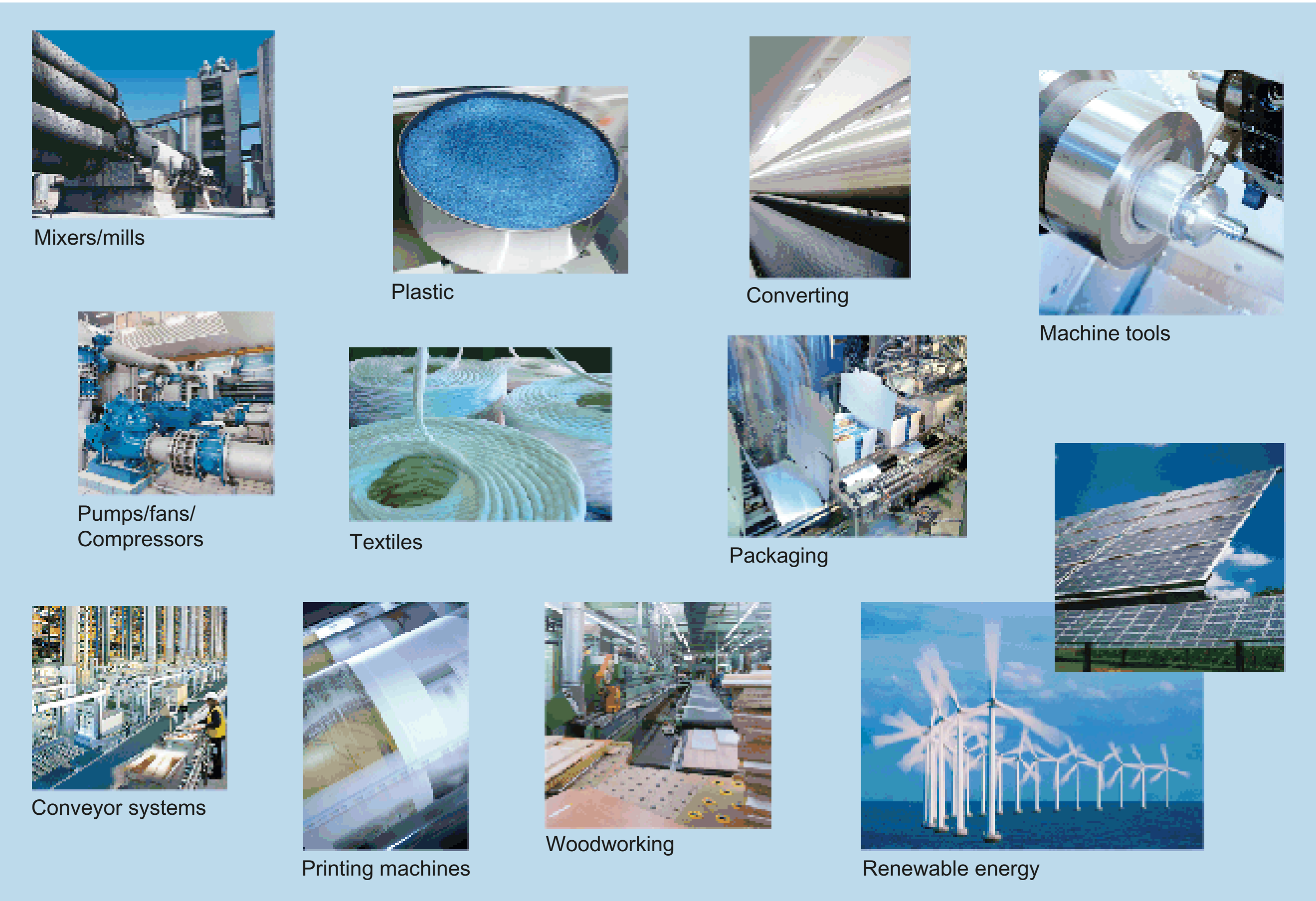


Figure 2-1 SINAMICS applications

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

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

2.2 Platform Concept and Totally Integrated Automation

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

Totally Integrated Automation (TIA) with SINAMICS S120

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

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

SINAMICS S120 is also available with a PROFINET interface. This Ethernet-based bus allows the rapid exchange of control data via PROFINET IO.

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

2.3 Overview, SINAMICS S120 AC Drive

SINAMICS S120 AC Drive is a modular drive system for individual axes and addresses sophisticated drive tasks for an extremely wide range of industrial applications.

Applications include:

- Machine concepts with a central drive (e.g. presses, printing, packaging)
- Modular machine concepts where the machine modules broken down to single axes
- Single-motor drives that when compared to standard drives have a high accuracy, stability and smooth running requirements in machinery and industrial plant construction
- Single-motor drives for transport applications (conveying, raising, lowering)
- Drives without regenerative feedback into the line supply (wire-drawing, extruding)
- Drive groups with high requirements placed on the availability (when the infeed fails, this may not cause all of the axes to fail)

The combination of a power unit (Power Module) and a Control Unit (CU) or a Control Unit Adapter form a single-motor drive in a compact design for machinery and plant construction.

SIZER, a high-performance engineering tool, makes it easier to choose and determine the optimum drive configuration. The drive can be simply commissioned a user-friendly fashion using the STARTER commissioning tool.

SINAMICS S120 AC Drive is supplemented by a wide range of motors. Whether synchronous or induction, whether rotary or linear motors, all motor types are supported by SINAMICS S120 AC Drive.

2.4 SINAMICS S120 components

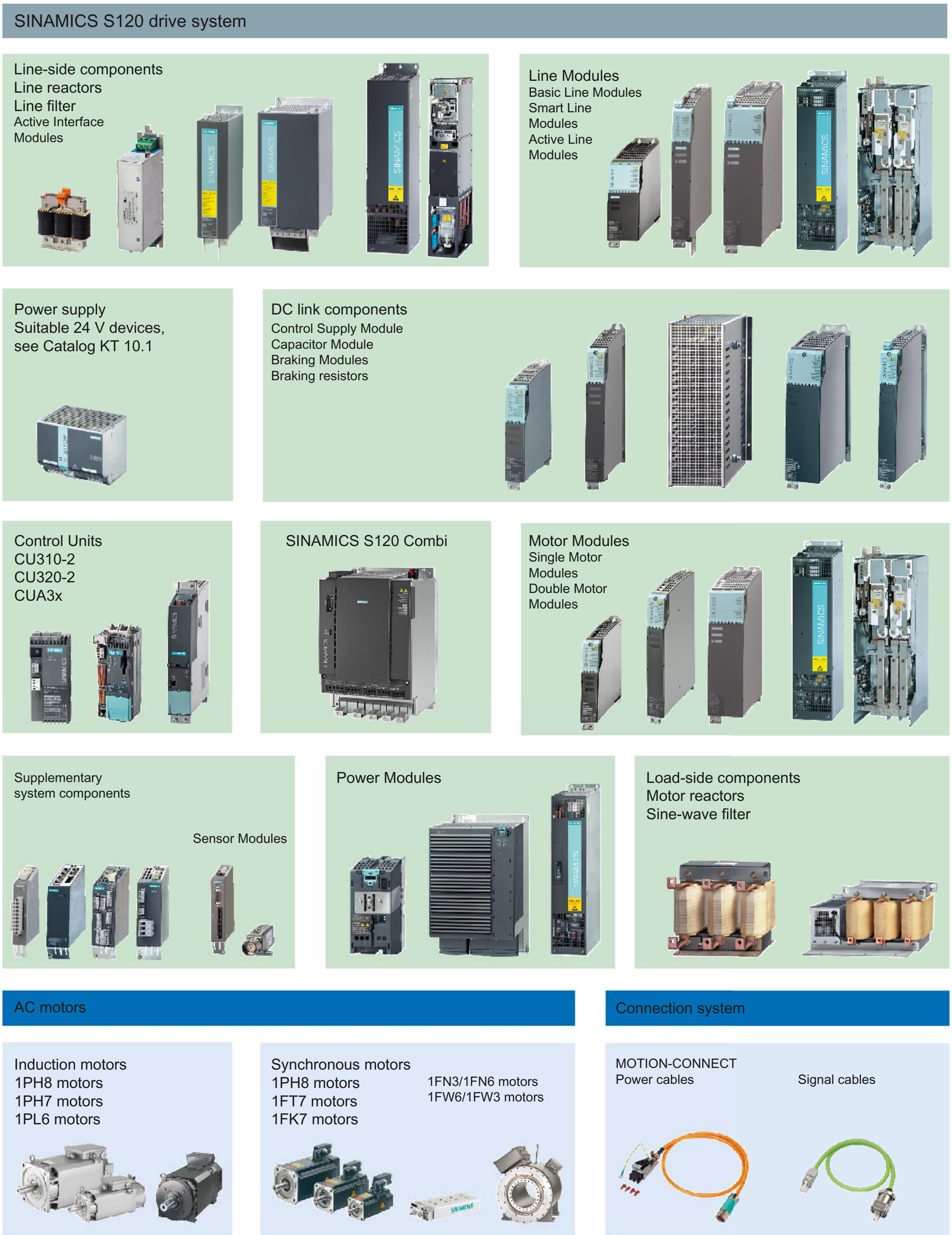


Figure 2-3 SINAMICS S120 component overview

The following system components are available for SINAMICS S120 AC Drive:

- Line-side power components, such as fuses, contactors, reactors and line filters for switching the power supply and complying with EMC regulations.
- Power Modules (either with or without integrated line filter) and an integrated braking chopper to provide power to the connected motor

To address the required functions, SINAMICS S120 AC Drive is equipped with:

- Control Units that provide the drive and technological functions.
- Supplementary system components that enhance functionality and offer different interfaces for encoders and process signals.

The SINAMICS S120 AC Drive components were developed for installation in cabinets.

They have the following features and characteristics:

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

2.5 System data

Table 2- 1 Electrical data

Line supply voltage	
Blocksize format units	1-ph. 200 V to 240 V AC ±10 % 3-ph. 380 V to 480 V AC ±10 %
Chassis format units	380 V to 480 V 3 AC ±10%
Rated pulse frequency	
Blocksize format units	4 kHz
Chassis format units	2 kHz At higher pulse frequencies the corresponding characteristic for current derating must be taken into consideration.
Line frequency	47 Hz to 63 Hz
Output voltage	
Blocksize format units	0 V to rated line supply voltage for 3-ph. 380 V up to 480 V AC units, 0 V to 0.78 of the line supply voltage for 1-ph. 200 V to 240 V AC units.
Chassis format units	0 V to line supply voltage for 3-ph. 380 V to 480 V AC units.
Electronics power supply	24 V DC -15/+20%*), safety extra-low voltage DVC A (PELV)
Short-circuit current rating SCCR in accordance with UL508C (up to 600 V)	• 1.1 kW – 447 kW: 65 kA • 448 kW – 671 kW: 84 kA • 672 kW – 1193 kW: 170 kA • ≥ 1194 kW: 200 kA For chassis components, UL certification applies only in conjunction with the fuses prescribed by Siemens and not with other types or circuit breakers alone.
Radio interference suppression acc. to EN 61800-3	Category C3 (option) Category C2 (option) For systems implemented in conformance with the documentation
Overvoltage category	III according to EN 61800-5-1
Degree of pollution	2 to EN 61800-5-1

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

Table 2- 2 Environmental conditions

Degree of protection	IP20 or IPXXB to EN 60529, open type to UL 508
Protective class line supply circuits Protective class electronic circuits	I (with protective conductor connection) III (safety extra-low voltage DVC A /PELV) acc. to EN 61800-5-1
Type of cooling	• Internal air cooling, power units with forced air cooling using an integrated fan • Liquid cooling

Permissible cooling medium temperature (air) and installation altitude in operation	0 °C to +40 °C and an installation altitude of up to 1000 m without derating, >40 °C to +55 °C, see the characteristic for current derating. Installation altitude >1000 m up to 4000 m, see the characteristic for current derating or Reduction of the ambient temperature by 3.5 K per 500 m.
Chemically active substances	
Long-term storage in the transport packaging	Class 1C2 according to EN 60721-3-1
Transport in the transport packaging	Class 2C2 according to EN 60721-3-2
Operation	Class 3C2 according to EN 60721-3-3
Biological environmental conditions:	
Storage in the transport packaging	Class 1B1 according to EN 60721-3-1
Transport in the transport packaging	Class 2B1 according to EN 60721-3-2
Operation	Class 3B1 according to EN 60721-3-3
Vibratory load	
Long-term storage in the transport packaging	Class 1M2 according to EN 60721-3-1
Transport in the transport packaging	Class 2M3 according to EN 60721-3-2
Operation	Class 2M2 according to EN 60721-3-2 Test values: 10 Hz up to 58 Hz: Constant deflection 0.075 mm 58 Hz to 150 Hz: Constant acceleration 9.81 m/s^2 (1g)
Shock load	
Long-term storage in the transport packaging	Class 1M2 according to EN 60721-3-1
Transport in the transport packaging	Class 2M3 according to EN 60721-3-2
Operation	Class 2M2 to EN 60721-3-2
Blocksize format FSA to FSB	Test values: 147 m/s^2 (15g)/11 ms
Blocksize format FSC to FSF	Test values: 49 m/s^2 (5g)/30 ms
Chassis format	Test values: 98 m/s^2 (10g)/20 ms
Climatic ambient conditions	
Long-term storage in the transport packaging	Class 1K4 according to EN 60721-3-1 Temperature: -25°C to +55°C
Transport in the transport packaging	Class 2K4 according to EN 60721-3-2 Temperature: -40°C to +70°C
Operation	Class 3K3 to EN 60721-3-3 Temperature +0°C to +40°C Relative humidity: 5% to 90% Oil mist, salt mist, ice formation, condensation, dripping water, spray, splash water, water jets are not permitted

Table 2- 3 Certificates

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

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

The Power Modules are dimensioned for operation at an ambient temperature of 40 °C and at the respective specified pulse frequency. The installation altitude without derating is

- up to 1000 m above sea level for Power Modules Booksize and Blocksize Liquid Cooled and
- up to 2000 m above sea level for Power Modules in the chassis format.

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

Table 2- 4 Air pressure for various installation altitudes

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

The output current must be reduced if the modules are operated at ambient temperatures above 40 °C. The maximum permissible ambient temperature for all Power Modules is 55°C.

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 Power Modules must be connected using an isolating transformer. The isolating transformer reduces surge voltages of surge voltage category III in the line supply to surge voltages of surge category II at the line terminals of the Power Modules and thereby conforms to the permissible voltage values for air gaps inside the unit. The design of the secondary line supply system must be as follows:

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

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

Mains connection and line-side power components 3

3.1 Introduction

The following line-side components should be used to connect a SINAMICS drive line-up to the supply network:

- Line disconnector
- Overcurrent protection device (line fuses or circuit breaker)
- Line contactor (this is required for electrical isolation)
- Line filter (optional for Power Module PM340, frame size FSA)
- Line reactor (optional).

The possible supply voltages for the drive line-up are:

- 1-ph. 200 V to 1-ph. 240 V AC +/- 10%
- 3-ph. 380 V to 3-ph. 480 V AC +/- 10%

The following line reactor variants are available:

- 3 versions for blocksize format, frame sizes FSA - FSC (base)
- 5 versions for blocksize format, frame sizes FSD - FSF (3 base and 2 standalone)
- 4 versions for chassis format

The following line filter variants are available:

- Integrated
- External
  - Base
  - Stand-alone

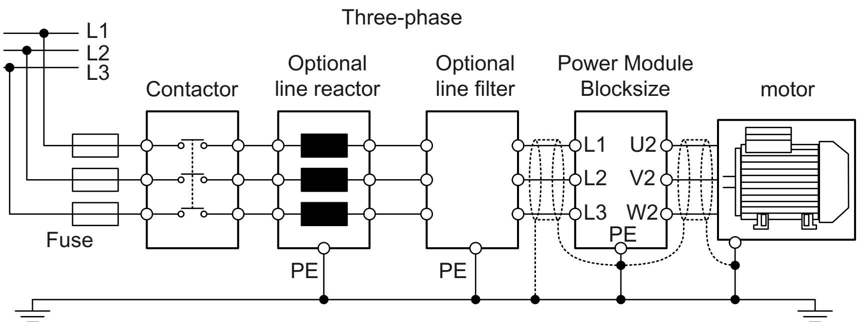


Figure 3-1 Example of a blocksize line connection for Power Modules with no integrated line filter

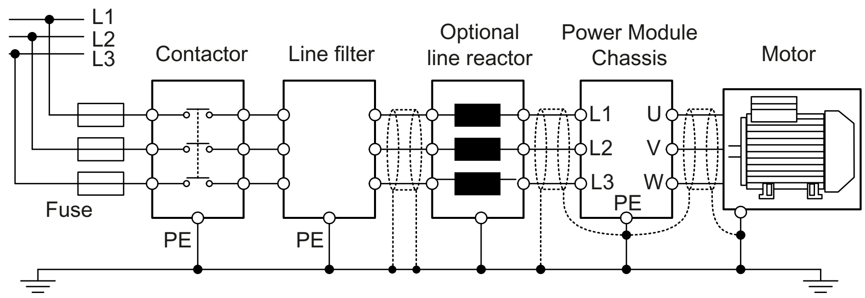


Figure 3-2 Example of a chassis line connection

NOTICE
Damage to the Power Modules as a result of incorrect line reactors/line filters
It is only permissible to use line reactors/line filters that have been authorized by SIEMENS for SINAMICS. Otherwise, the Power Modules could be damaged/destroyed. Further, line harmonics may occur that damage or disturb loads connected to the same line supply.

NOTICE
Connecting Power Modules in the blocksize format with line filters
The Power Modules in blocksize format with line filters are only suitable for direct connection to TN line supplies.

Note

Complying with radio interference voltage limit values

Units in chassis format are only capable of complying with the limit values for interference voltage specified for Category C2 acc. to EN 61800-3 if they are used in conjunction with a line reactor and a line filter.

3.2 Information on the disconnector unit

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

The accessories required for the line disconnecting device must be selected from the manufacturer catalogs. Refer also to catalogs PM21 and NC61.

3.3 Overcurrent protection by means of line fuses and circuit breakers

Line fuses or, preferably, circuit breakers should be used for line/overcurrent protection in order to limit the damage sustained by the Power Module if a fault occurs. LV HRC, D, and DO-type line fuses with a gL characteristic or suitable circuit breakers can be used for this purpose.

> ⚠ WARNING
>
> **Avoid overdimensioning fuses**
>
> It is not permissible to overdimension fuses as this can result in significant levels of danger and also faults.

> NOTICE
>
> **Correctly dimensioning fuses**
>
> When dimensioning fuses, the following requirements must be carefully observed regarding the maximum cable length of circuits:
>
> 1. Short-circuit protection according to IEC 60364-4-43 and -5-52, EN 60204-1, and EN 61800-5-1
> 2. The maximum permissible break time for protection against electric shock in the event of indirect contact (IEC 60364-4-41 and -4–43, EN 61800-5-1, and EN 60204-1)
> 3. maximum permissible voltage drop in operation
>
> The maximum cable length depends primarily on the cable cross-section, material, and insulation, as well as the type and size of the upstream overcurrent protection device.
>
> The minimum value, which is derived from the three requirements, usually has to be strictly observed. This means that the fuses must be designed in such a way that, if a fault occurs, the line fuses trip after 0.4 s with mobile equipment and after 5 s with stationary equipment.

Note

The devices can be connected to supply systems up to 480 V_{AC}, which can supply a maximum of 36 kA symmetrical ("prospective current" according to EN 60269-1).

For further information: See catalog PM 21.

3.4 Using residual-current devices

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

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

> ⚠ WARNING
>
> **Danger to life as a result of electric shock when connected to TT systems without a residual current device**
>
> As a general rule, TT systems are not suitable for tripping the installed overcurrent protection devices within the specified period should an insulation fault occur.
>
> - Always install a residual current device.
> - Preferably use a residual current operated circuit breaker (RCD)

Residual current operated circuit breakers (RCD)

Residual current operated circuit breakers (RCD) can be used in addition to the overcurrent protection devices provided. They prevent excessively high touch currents being maintained. They are the preferred solution for TT systems.

> ⚠ WARNING
>
> **Danger to life as a result of electric shock if unsuitable overcurrent protection devices are used**
>
> Residual current operated circuit breakers alone are not permissible to provide protection against direct and indirect contact.
>
> - Always install residual current operated circuit breakers in addition to suitable overcurrent protection devices.

Note the following conditions when using residual current operated circuit breakers:

- Only use type B delayed tripping, selective AC/DC residual current operated circuit breakers.
- Ensure that the maximum permitted ground resistance of the "selective protection device" is maintained (83 Ω max. for residual current devices with 0.3 A rated differential current).
- It is absolutely imperative that you connect parts of the drive system and the machine that can be touched with the protective conductor of the plant or system.
- The shielded motor cable must not be longer than 50 m.
- Use a separate residual current operated circuit breaker for each Power Module.

- 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 line-up have max. 35 ms delay time time between the closing/opening of the individual main contacts.

If no residual current operated circuit breaker is used, touch protection can be ensured by means of double insulation or by isolating the Power Module from the supply system through a transformer.

3.5 Overvoltage protection

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

3.6 Line contactors

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

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

NOTICE
Switching under load
Do not switch the line contactor when 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 a digital output is used to control the line contactor, its switching capacity must be taken into account.

3.7 Line filter

3.7.1 Description

In combination with a consistent, EMC-compatible system configuration, line filters restrict the conducted interference emitted by the Power Modules to the limit values specified for Category C2 in EN 61800-3. An additional line reactor also needs to be used for Chassis Power Modules to meet the requirements of Category C2.

A line filter (see catalog) must be used for the SINAMICS S120 drive line-up.

Note

All PM340 Power Modules are equipped with an integrated line filter.
Frame size FSA, for line supply voltage 3-ph. 380 V to 480 V AC, is an exception; in this case, an external line filter must be used.

NOTICE

Several loads connected to the same line infeed point

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.

NOTICE

Using third-party filters

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

3.7.2 Safety instructions for line filters

Note

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

⚠ WARNING

Danger of fire through overheating for insufficient ventilation clearances

Insufficient ventilation clearances result in overheating with danger to persons as a result of smoke and fire. Further, the line filter can be thermally damaged.

- Maintain 100 mm ventilation clearances above and below the line filter.

NOTICE

Line filter damage by connecting to impermissible line supplies

Line filters are only suitable for direct connection to TN systems with grounded neutral conductor.

NOTICE

Line filter damage due to interchanged connections

It is not permissible that the input and output connections are interchanged, to avoid damaging the line filter.

Connect the cables as follows:

- incoming line supply cable to LINE L1, L2, L3
- Outgoing cable to the line reactor to LOAD/LAST L1', L2', L3'

NOTICE

Risk of damage or destruction to other loads

Using line filters not released by Siemens AG for SINAMICS can lead to line reactions that can damage or destroy other loads powered from the network.

- Only use line filters described in this manual.

3.7.3 Dimension drawings

Blocksize line filter

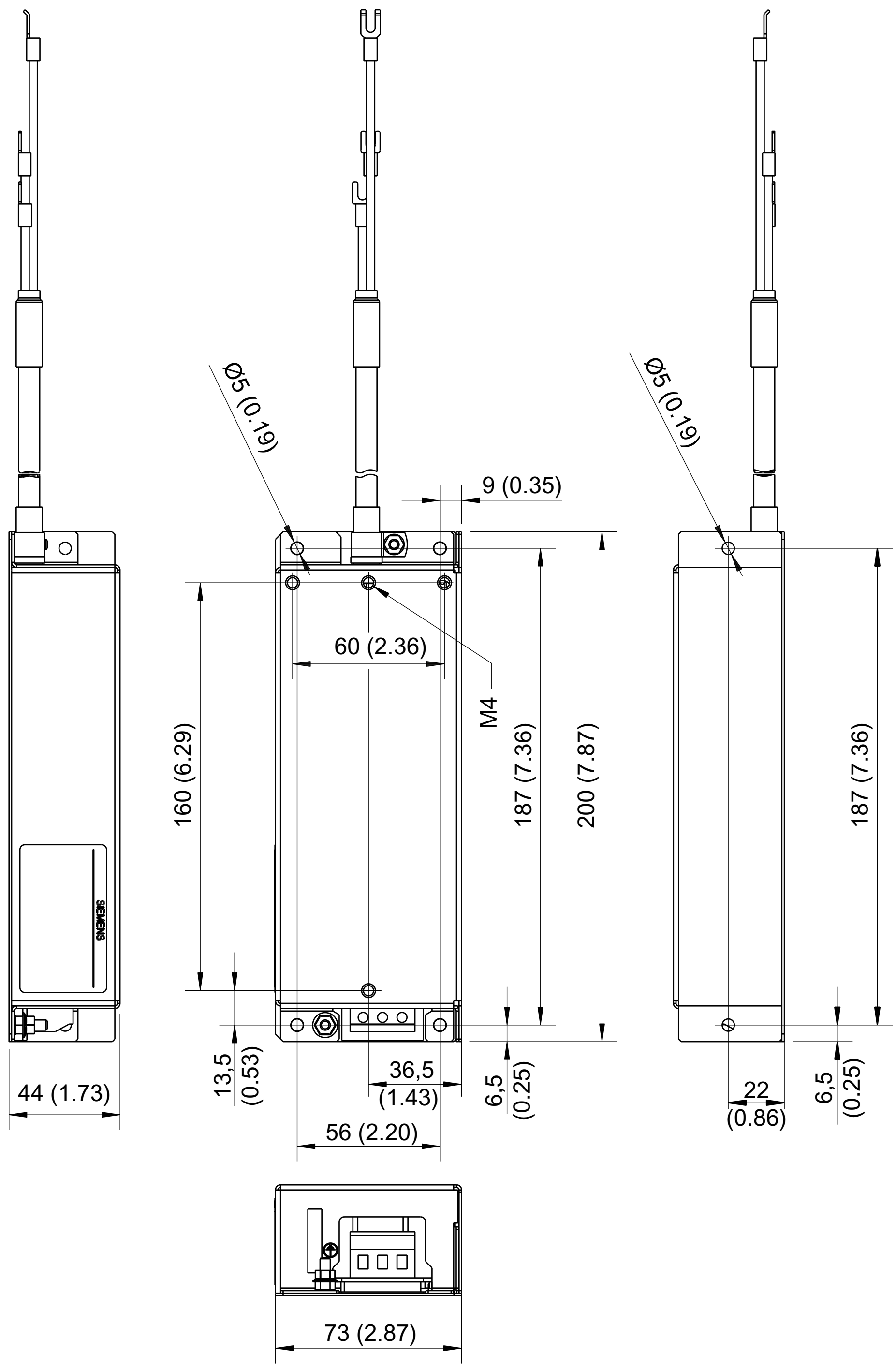


Figure 3-3 Dimension drawing of the line filter, frame size FSA, all data in mm (inches)

Chassis line filter

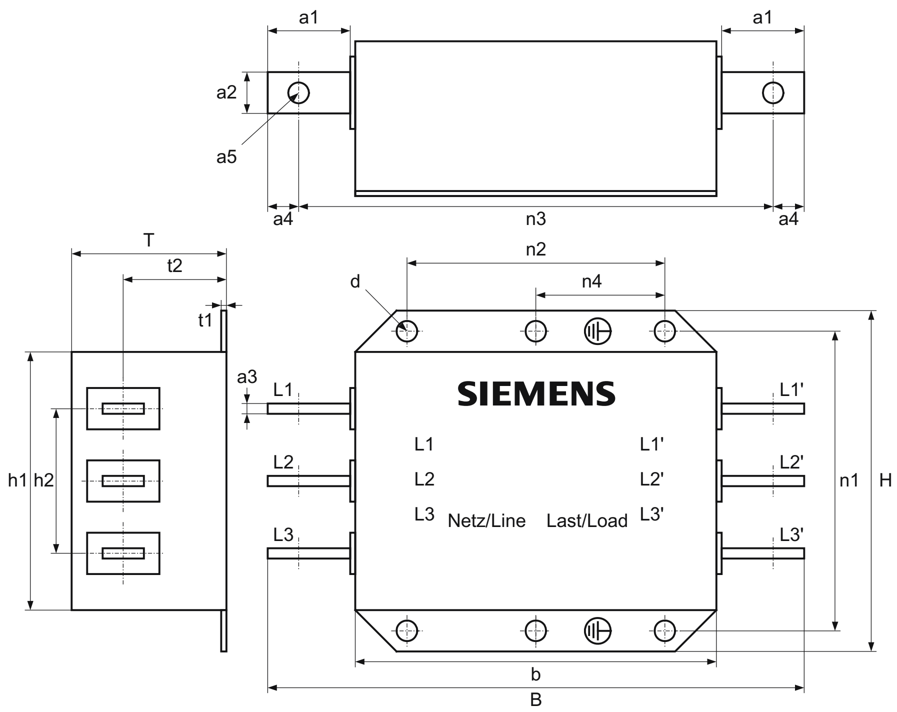


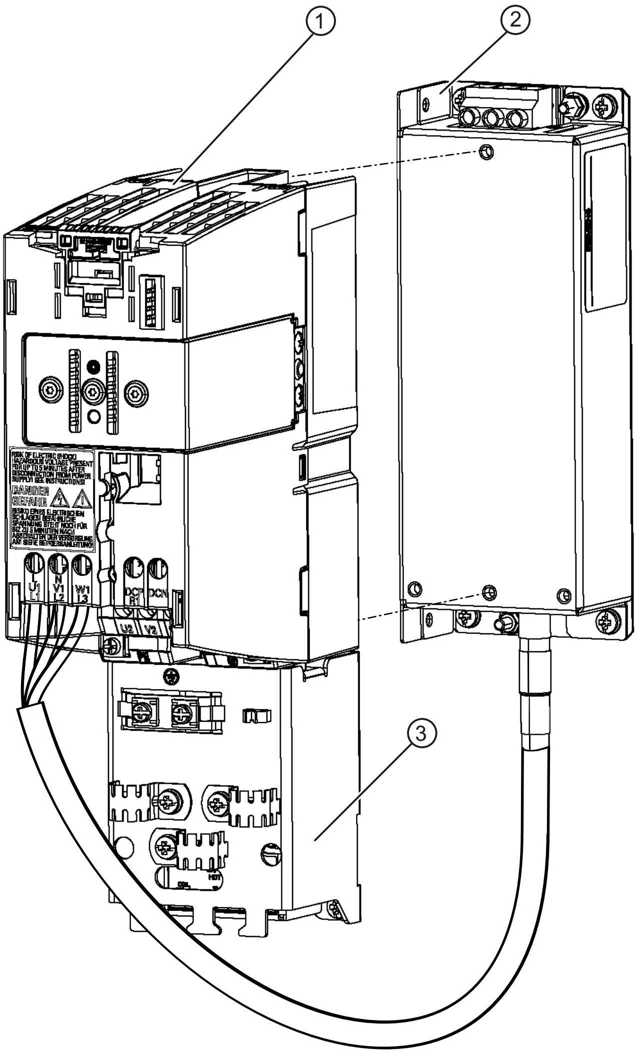
Figure 3-4 Dimension drawing, line filter

Table 3- 1 Dimensions of the line filter, all data in mm and (inches)

6SL3000-	0BE32-5AA0	0BE34-4AA0	0BE36-0AA0
B	360 (14.17)	360 (14.17)	400 (15.74)
H	240 (9.44)	240 (9.44)	265 (10.43)
D	116 (4.56)	116 (4.56)	140 (5.51)
a1	40 (1.57)	40 (1.57)	40 (1.57)
a2	25 (0.98)	25 (0.98)	25 (0.98)
a3	5 (0.19)	5 (0.19)	8 (0.31)
a4	15 (0.59)	15 (0.59)	15 (0.59)
a5	11 (0.43)	11 (0.43)	11 (0.43)
b	270 (10.62)	270 (10.62)	310 (12.20)
h1	200 (7.87)	200 (7.87)	215 (8.46)
h2	100 (3.93)	100 (3.93)	120 (4.72)
t1	2 (0.07)	2 (0.07)	3 (1.18)
t2	78.2 (3.07)	78.2 (3.07)	90 (3.54)
n1 [1)]	220 (8.66)	220 (8.66)	240 (9.44)
n2 [1)]	210 (8.26)	210 (8.26)	250 (9.84)
n3	330 (12.99)	330 (12.99)	370 (14.56)
n4	-	-	125 (4.92)
d	9 (0.35)	9 (0.35)	12 (0.47)

1) Lengths n1 and n2 correspond to the distance between holes

3.7.4 Mounting



① Power Module PM340 frame size FSA
② Line filter
③ Screening kit

Figure 3-5 Mounting: Power Module PM340 (frame size FSA) with screening kit and line filter

3.7.5 Technical data

3.7.5.1 Technical data, Blocksize line filter

Table 3- 2 Technical data, Blocksize line filter

Line supply voltage 3-ph. 380...480 V AC		
Line filter 6SE6400-2FA00-6AD0		
Suitable for Power Module		6SL3210-1SE11-3UA0, 6SL3210-1SE11-7UA0 6SL3210-1SE12-2UA0, 6SL3210-1SE13-1UA0 6SL3210-1SE14-1UA0
Rated current	A	6
Power loss	W	< 5
Line supply connection L1, L2, L3		2.5 mm screw terminals[2]
Load connection U, V, W		Shielded cable 4 x 1.5 mm² (including PE) 0.24 m
PE connection		At the housing with M4 stud
Degree of protection		IP20 or IPXXB
Weight, approx.	kg	0.5

3.7.5.2 Technical data, Chassis line filter

Table 3- 3 Technical data, Chassis line filter

Order number	6SL3000-	0BE32-5AA0	0BE34-4AA0	0BE34-4AA0	0BE34-4AA0	0BE36-0AA0
Suitable for Power Module	6SL3310-	1TE32-1AAx	1TE32-6AAx	1TE33-1AAx	1TE33-8AAx	1TE35-0AAx
Unit rating of the Power Module	kW	110	132	160	200	250
Rated voltage	V	3-ph. 380 V AC -10 % to 3-ph. 480 V AC +10 % (-15 % < 1 min), 47 to 63 Hz				
Rated current	A	250	440	440	440	600
Power loss	kW	0.015	0.047	0.047	0.047	0.053
Line supply/load connection L1, L2, L3 / L1', L2', L3'		M10	M10	M10	M10	M10
PE connection		M8	M8	M8	M8	M10
Degree of protection		IP00	IP00	IP00	IP00	IP00
Dimensions Width Height Depth	 mm mm mm	 360 240 116	 360 240 116	 360 240 116	 360 240 116	 400 265 140
Weight	kg	12.3	12.3	12.3	12.3	19.0

3.8 Line reactors

3.8.1 Description

The line reactors limit low-frequency line harmonics and reduce the load on the rectifiers in the Power Modules. They are used to smooth voltage spikes (line supply faults) or to bridge voltage dips/interruptions when commutating. This is the reason why we recommend line reactors are used in conjunction with PM340 and Chassis Power Modules.

The line reactors for the PM340 in frame sizes FSA to FSE are designed as sub-chassis components.

3.8.2 Safety instructions for line reactors

Note

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

⚠ WARNING

Danger of fire through overheating for insufficient ventilation clearances

Insufficient ventilation clearances can result in overheating with danger to persons as a result of smoke and fire. Further, increased failures can occur and the service life of components shortened.

- Maintain 100 mm ventilation clearances above and below the component.

⚠ CAUTION

Risk of burns resulting from high surface temperatures

The surface temperature of the line reactors may exceed 80 °C. You can be severely burnt when touching the surface.

- Mount the line reactor so that it cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.

NOTICE

Danger of damaging the line reactor by interchanging connections

It is not permissible that the line reactor connections are interchanged:

- Connect the incoming line cable at U1, V1, W1 or L1, N.
- Connect the outgoing cable to the load at 1U2, 1V2, 1W2.

NOTICE
Damage when using components that have not been released
When using components that have not been released, damage or malfunctions can occur at the Power Modules, line reactor or the system itself. Further, line harmonics may occur that damage or disturb loads connected to the same line supply. • Only use line reactors that SIEMENS has authorized for SINAMICS.

Note

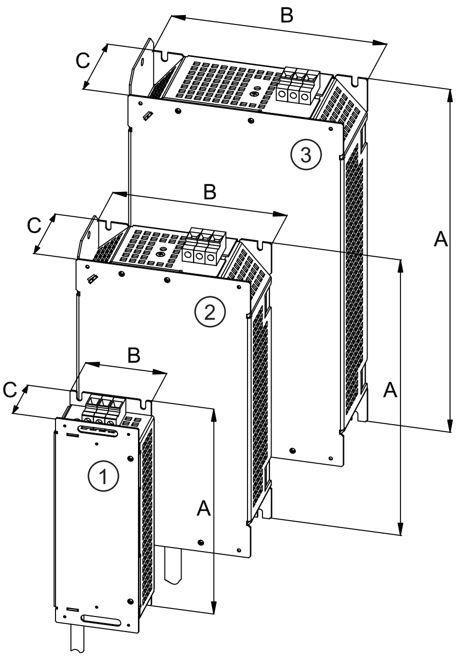
Connection cables

Keep the connecting cables to the Power Module as short as possible (max. 5 m).

If at all possible, only use shielded connection cables.

3.8.3 Dimension drawings

Blocksize line reactors



① Frame size FSA
② Frame size FSB
③ Frame size FSC

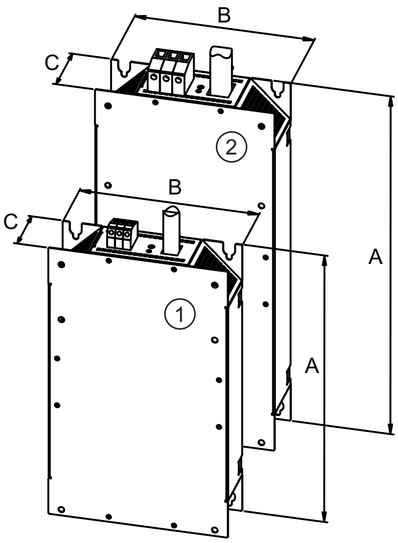
Figure 3-6 Dimension drawing of line reactors, frame sizes FSA, FSB, FSC

Table 3- 4 Dimensions of line reactors, frame size FSA, all data in mm (inches)

Line reactor 6SE6400-	3CC00-4AB3	3CC01-0AB3	3CC00-2AD3	3CC00-4AD3	3CC00-6AD3
Frame size	FSA				
A	200 (7.87)				
B	75 (2.95)				
C	50 (1.96)				

Table 3- 5 Dimensions of line reactors, frame sizes FSB and FSC, all data in mm (inches)

Line reactor 6SL3203-	0CD21-0AA0	0CD21-4AA0	0CD22-2AA0	0CD23-5AA0
Frame size	FSB		FSC	
A	270 (10.62)		336 (13.22)	336 (13.22)
B	153 (6.02)		189 (7.44)	189 (7.44)
C	70 (2.75)		50 (1.96)	80 (3.14)



① Frame size FSD
② Frame size FSE

Figure 3-7 Dimension drawing of line reactors, frame sizes FSD, FSE

Table 3- 6 Dimensions of line reactors, frame sizes FSD and FSE, all data in mm (inches)

Line reactor 6SL3203-	0CJ24-5AA0	0CD25-3AA0	0CJ28-6AA0
Frame size	FSD		FSE
A	455 (17.91)		577 (22.71)
B	275 (10.82)		275 (10.82)
C	83.5 (3.28)		93.5 (3.68)

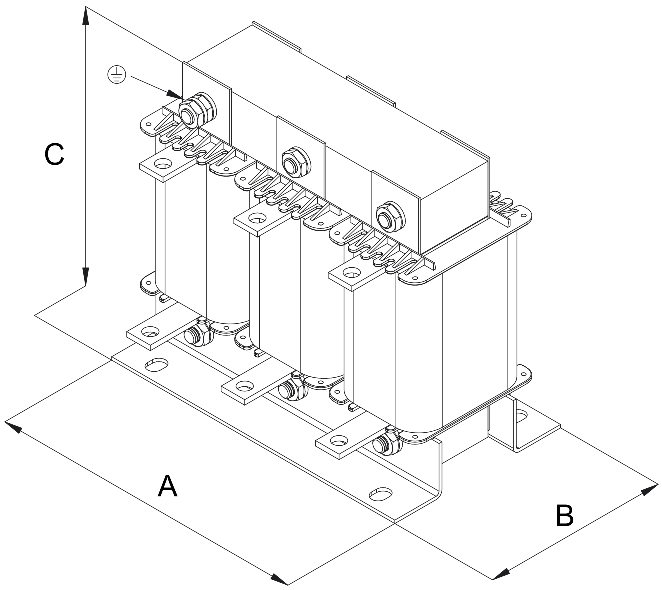
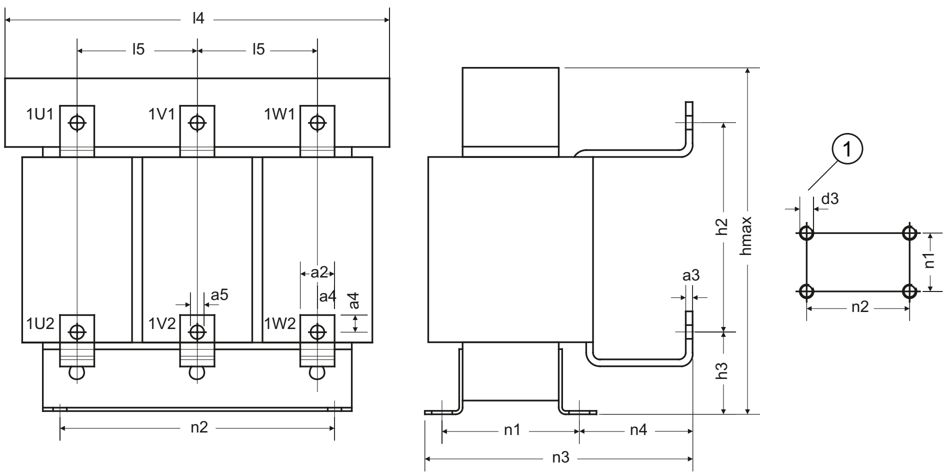


Figure 3-8 Dimension drawing of line reactor, frame size FSF

Table 3- 7 Dimensions of line reactor, frame size FSF, all data in mm (inches)

Line reactor 6SE6400-	3CC11-2FD0	3CC11-7FD0
Frame size	FSF	
A	240 (9.44)	
B	141 (5.55)	
C	228 (8.97)	

Chassis line reactors



① Mounting hole

Figure 3-9 Dimension drawing, line reactors

Table 3- 8 Dimensions of the line reactors, all data in mm (inches)

6SL3000-	0CE32-3AA0	0CE32-8AA0	0CE33-3AA0	0CE35-1AA0
a2	25 (0.98)	25 (0.98)	25 (0.98)	30 (1.18)
a3	5 (0.19)	5 (0.19)	5 (0.19)	6 (0.23)
a4	12.5 (0.49)	12.5 (0.49)	12.5 (0.49)	15 (0.59)
a5	11 (0.43)	11 (0.43)	11 (0.43)	14 (0.55)
l4	270 (10.62)	270 (10.62)	270 (10.62)	300 (11.81)
l5	88 (3.46)	88 (3.46)	88 (3.46)	100 (3.93)
hmax	248 (9.76)	248 (9.76)	248 (9.76)	269 (10.59)
h2	150 (5.90)	150 (5.90)	150 (5.90)	180 (7.08)
h3	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)
n1 1)	101 (3.97)	101 (3.97)	101 (3.97)	118 (4.64)
n2 1)	200 (7.87)	200 (7.87)	200 (7.87)	224 (8.81)
n3	200 (7.87)	200 (7.87)	200 (7.87)	212.5 (8.36)
n3	84.5 (3.32)	84.5 (3.32)	84.5 (3.32)	81 (3.19)
d3	M8	M8	M8	M8

1) Lengths n1 and n2 correspond to the distance between holes

3.8.4 Mounting

The line reactors for Power Modules in frame sizes FSA - FSE are designed as base components. Here, the line reactor is attached to the mounting surface and the Power Module is mounted directly on the line reactor, thus saving space. The cables to the Power Modules are already connected at the line reactor. The line reactor is connected to the line supply through terminals.

When installed, the power supply terminals are at the top on frame sizes FSA to FSC, and at the bottom on frame sizes FSD and FSE.

The line reactors for Power Modules, frame sizes FSF, FX, and GX are, as a result of their weight and their size, mounted separately.

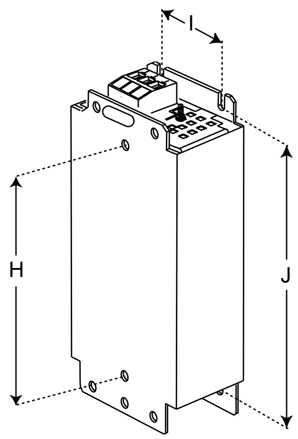


Figure 3-10 Mounting dimensions of line reactor, frame size FSA

Table 3- 9 Mounting dimensions of line reactor, frame size FSA, all data in mm and (inches)

Line reactor 6SE6400-	3CC00-4AB3	3CC01-0AB3	3CC00-2AD3	3CC00-4AD3	3CC00-6AD3
Frame size	FSA				
H	160 (6.29)				
I	56 (2.20)				
J	187 (7.36)				
Fixing screws	M4/1.1 Nm				

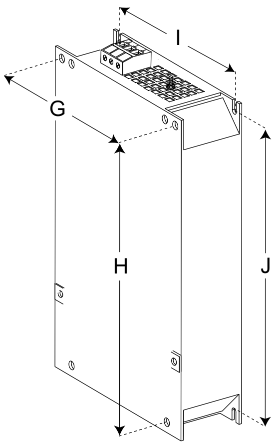


Figure 3-11 Mounting dimensions of line reactor, frame sizes FSB and FSC

Table 3- 10 Mounting dimensions of line reactor, frame sizes FSB and FSC, all data in mm and (inches)

Line reactor 6SL3203-	0CD21-0AA0	0CD21-4AA0	0CD22-2AA0	0CD22-2AA0	0CD23-5AA0
Frame size	FSB			FSC	
G	133 (5.24)			174 (6.85)	
H	258 (10.16)			204 (8.03)	
I	133 (5.24)			156 (6.14)	
J	258 (10.16)			232 (9.13)	
Fixing screws	M4/1.5 Nm			M5/2.25 Nm	

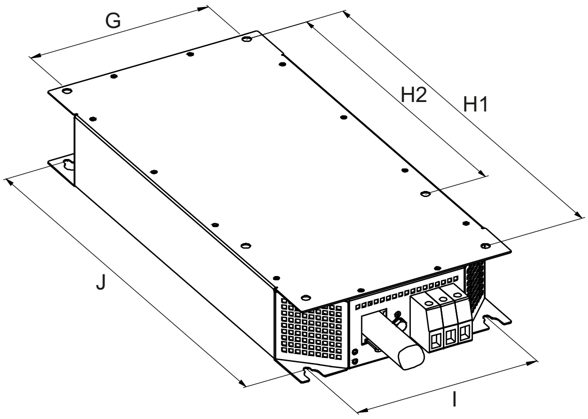


Figure 3-12 Mounting dimensions of line reactor, frame sizes FSD and FSE

Table 3- 11 Mounting dimensions of line reactor, frame sizes FSD and FSE, all data in mm and (inches)

Line reactor 6SL3203-	0CD25-3AA0	0CJ24-5AA0	0CJ28-6AA0
Frame size	FSD		FSE
G	235 (9.25)	235 (9.25)	235 (9.25)
H1	325 (12.79)	325 (12.79)	405 (15.95)
H2	419 (16.50)	419 (16.50)	541 (21.30)
I	235 (9.25)	235 (9.25)	235 (9.25)
J	421 (16.57)	421 (16.57)	544 (21.42)
Fixing screws	4 x M8/13 Nm		4 x M8/13 Nm

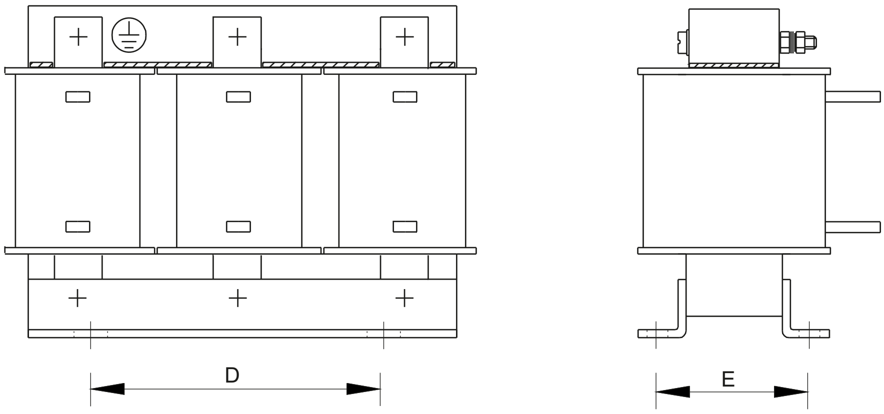


Figure 3-13 Mounting dimensions of line reactor, frame size FSF

Table 3- 12 Mounting dimensions of line reactor, frame size FSF, all data in mm and (inches)

Line reactor 6SE6400-	3CC11-2FD0	3CC11-7FD0
Frame size	FSF	
D	185 (7.28)	
E	95 (3.74)	
Fixing screws	4 x M8/13 Nm	

Mounting examples

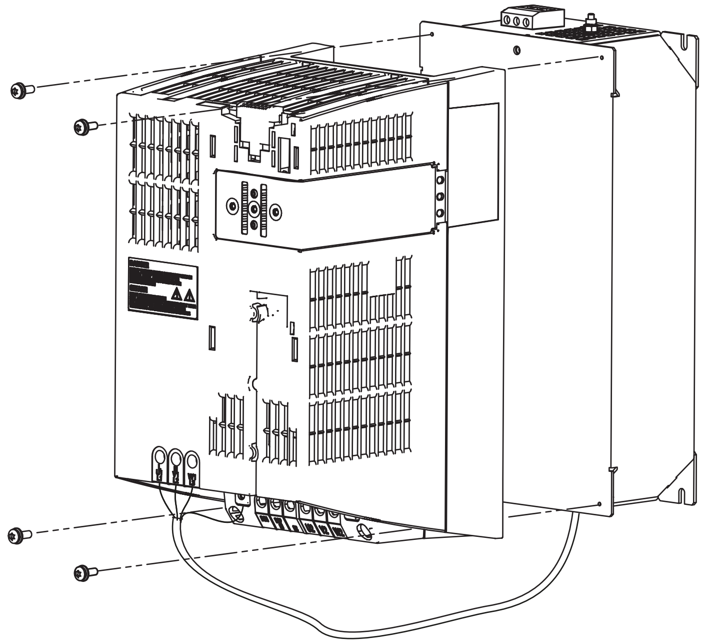
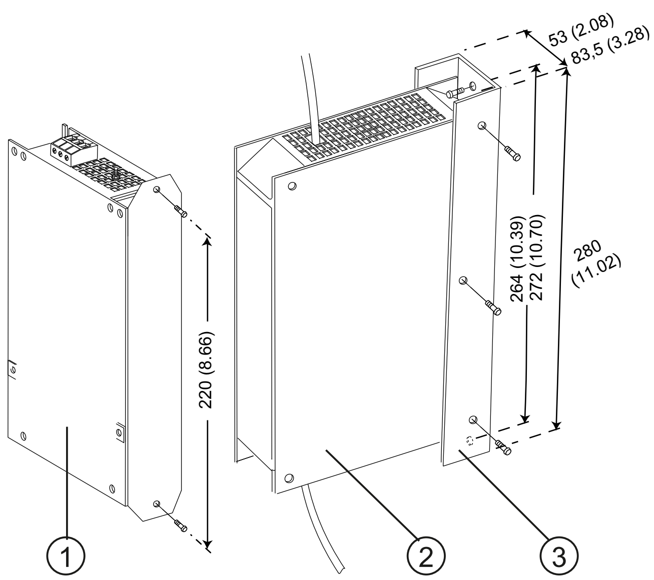


Figure 3-14 Mounting the PM340 with a line reactor, using frame size FSB as an example



① Frame size FSB
② Frame size FSC
③ Lateral mounting bracket

Figure 3-15 Lateral mounting of line reactors for frame sizes FSB and FSC

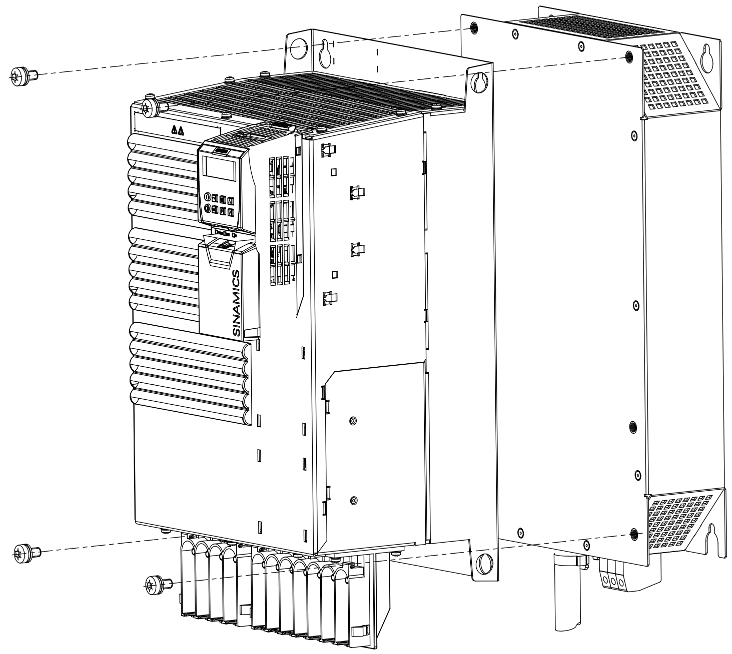
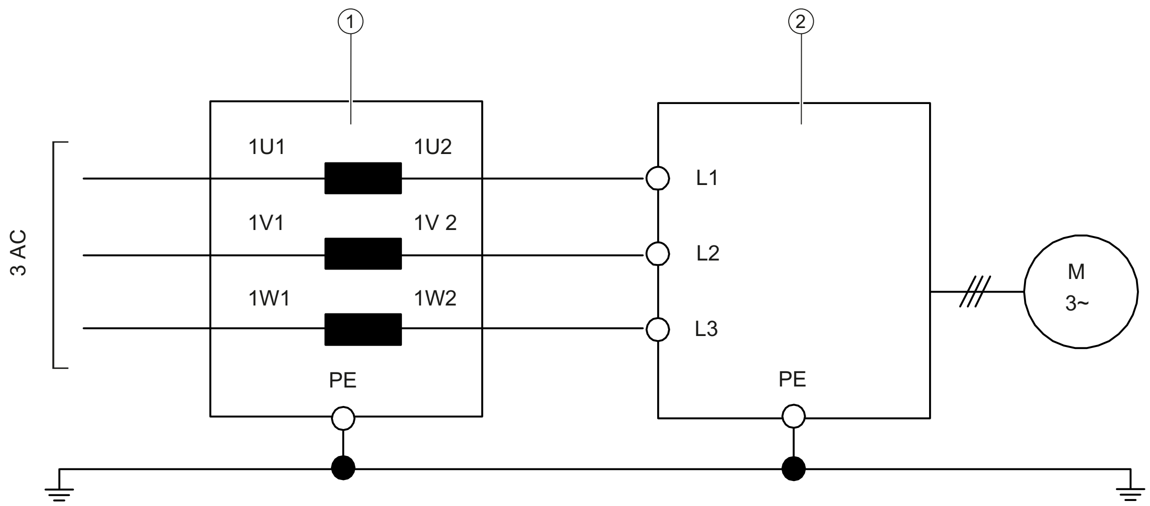


Figure 3-16 Mounting the PM340 with a line reactor, using frame size FSD as an example

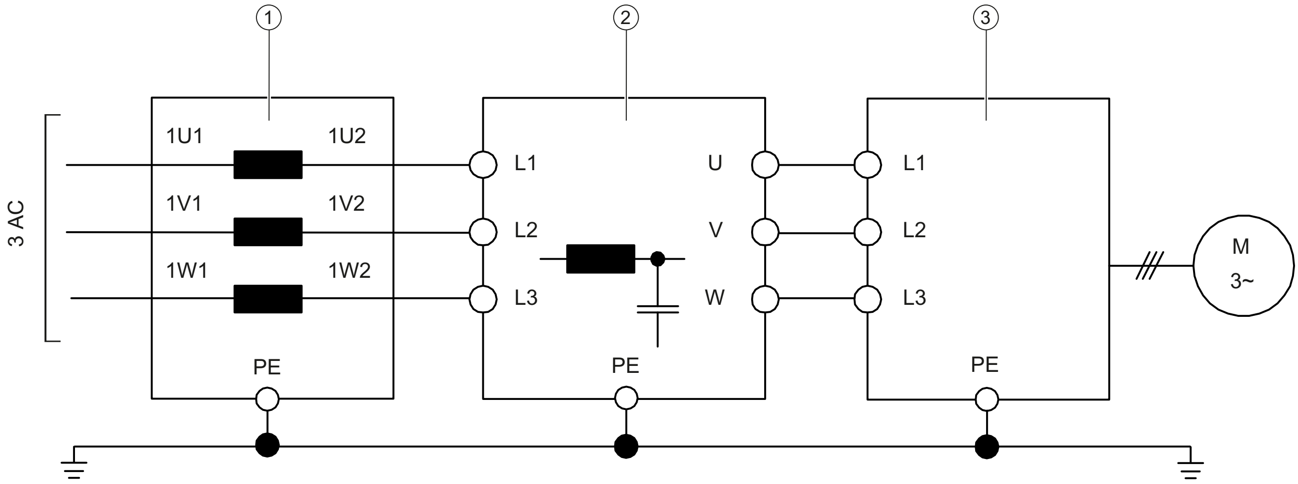
3.8.5 Electrical Connection

Line supply/load connection



① Line reactor
② Power Module

Figure 3-17 Power Module with line filter



① Line reactor
② Line filter
③ Power Module

Figure 3-18 Power Module with line reactor and line filter

3.8.6 Technical data

3.8.6.1 Blocksize line reactors

Table 3- 13 Technical data, blocksize line reactors, frame size FSA

Line supply voltage 1-ph 200 V AC -10 % to 240 V AC +10%			
Order No. 6SE6400-		**3CC00-4AB3**	**3CC01-0AB3**
Suitable for Power Module 6SL3210-		1SB11-0xxx 1SB12-3xxx	1SB14-0xxx
Rated line reactor current	A	3.4	8.1
Power loss 50/60 Hz	W	12.5 / 15	11.5 / 14.5
Line supply connection L1, N		6 mm screw terminals[2]	6 mm screw terminals[2]
Load connection L1, N		Cable 3 x 1.5 mm² (including PE) length approx. 0.38 m	Cable 3 x 1.5 mm² (including PE) length approx. 0.38 m
PE connection		M5 stud	M5 stud
Degree of protection		IP20 or IPXXB	IP20 or IPXXB
Weight	kg	1.3	1.3

Table 3- 14 Technical data, blocksize line reactors, frame size FSA

Line supply voltage 3-ph 380 V AC -10 % to 480 V AC +10 %				
Order No. 6SE6400-		3CC00-2AD3	3CC00-4AD3	3CC00-6AD3
Suitable for Power Module 6SL3210-		1SE11-3UA0 1SE11-7UA0	1SE12-2UA0 1SE13-1UA0	1SE14-1UA0
Rated line reactor current	A	1.9	3.5	4.8
Power loss 50/60 Hz	W	6 / 7	12.5 / 15	7.5 / 9
Line supply connection U1, V1, W1		Screw-type terminal 6 mm²	Screw-type terminal 6 mm²	Screw-type terminal 6 mm²
Load connection 1U2, 1V2, 1W2		Cable 4 x 1.5 mm² Length approx. 0.38 m	Cable 4 x 1.5 mm² Length approx. 0.38 m	Cable 4 x 1.5 mm² Length approx. 0.38 m
PE connection		At the housing with M5 stud	At the housing with M5 stud	At the housing with M5 stud
Degree of protection		IP20 or IPXXB	IP20 or IPXXB	IP20 or IPXXB
Weight	kg	1.2	1.3	1.3

Table 3- 15 Technical data, blocksize line reactors, frame sizes FSB and FSC

Line supply voltage 3-ph 380 V AC -10% to 480 V AC +10%					
Frame size		FSB		FSC	
Order No. 6SL3203-		0CD21-0AA0	0CD21-4AA0	0CD22-2AA0	0CD23-5AA0
Suitable for Power Module 6SL3210-		1SE16-0xxx 1SE17-7xxx	1SE21-0xxx	1SE21-8xxx 1SE22-5xxx	1SE23-2xxx
Rated line reactor current	A	9	11.6	25	31.3
Power loss 50 / 60 Hz	W	9 / 11	27 / 32	98 / 118	37 / 44
Line supply connection U1, V1, W1		Screw-type terminal 6 mm²	Screw-type terminal 6 mm²	Screw-type terminal 6 mm²	Screw-type terminal 6 mm²
Load connection 1U2, 1V2, 1W2		Cable 4 x 1.5 mm² Length approx. 0.46 m	Cable 4 x 1.5 mm² Length approx. 0.46 m	Cable 4 x 2.5 mm² Length approx. 0.49 m	Cable 4 x 2.5 mm² Length approx. 0.49 m
PE connection		At the housing with M5 stud	At the housing with M5 stud	At the housing with M5 stud	At the housing with M5 stud
Degree of protection		IP20 or IPXXB	IP20 or IPXXB	IP20 or IPXXB	IP20 or IPXXB
Weight	kg	3.4	3.4	6.3	6.4

Table 3- 16 Technical data, blocksize line reactors, frame sizes FSD, FSE, and FSF

Line supply voltage 3-ph 380 V AC -10% to 480 V AC +10%						
Frame size		FSD		FSE	FSF	
Order number		6SL3203-0CJ24-5AA0	6SL3203-0CD25-3AA0	6SL3203-0CJ28-6AA0	6SE6400-3CC11-2FD0	6SE6400-3CC11-7FD0
Suitable for Power Module 6SL3210- 6SL3215-		1SE23-8xxx 1SE24-5xxx 1SE23-8UAx	1SE26-0xxx 1SE26-0UAx	1SE27-5xxx 1SE31-0xxx 1SE27-5UAx 1SE31-0UAx	1SE31-1xxx 1SE31-5xxx 1SE31-1UAx	1SE31-8xxx 1SE31-8UAx
Rated line reactor current	A	54	71	105	178	225
Power loss 50/60 Hz	W	90 / 115	90 / 115	170 / 215	280 / 360	280 / 360
Line supply connection U1, V1, W1		Screw-type terminal 16 mm²	Screw-type terminal 16 mm²	Screw-type terminal 50 mm²	Flat connector for M10 cable lug	Flat connector for M10 cable lug
Load connection 1U2, 1V2, 1W2		Cable 4 x 16 mm² Length approx. 0.70 m	Cable 4 x 16 mm² Length approx. 0.70 m	Cable 4 x 35 mm² Length approx. 0.70 m	Flat connector for M10 cable lug	Flat connector for M10 cable lug
PE connection		At the housing with M8 screw	At the housing with M8 screw	At the housing with M8 screw	On housing with M8 bolt	On housing with M8 bolt
Degree of protection		IP20 or IPXXB	IP20 or IPXXB	IP20 or IPXXB	IP00	IP00
Weight	kg	13	13	19	25	25

3.8.6.2 Chassis line reactors

Table 3- 17 Technical specifications, Chassis line reactors

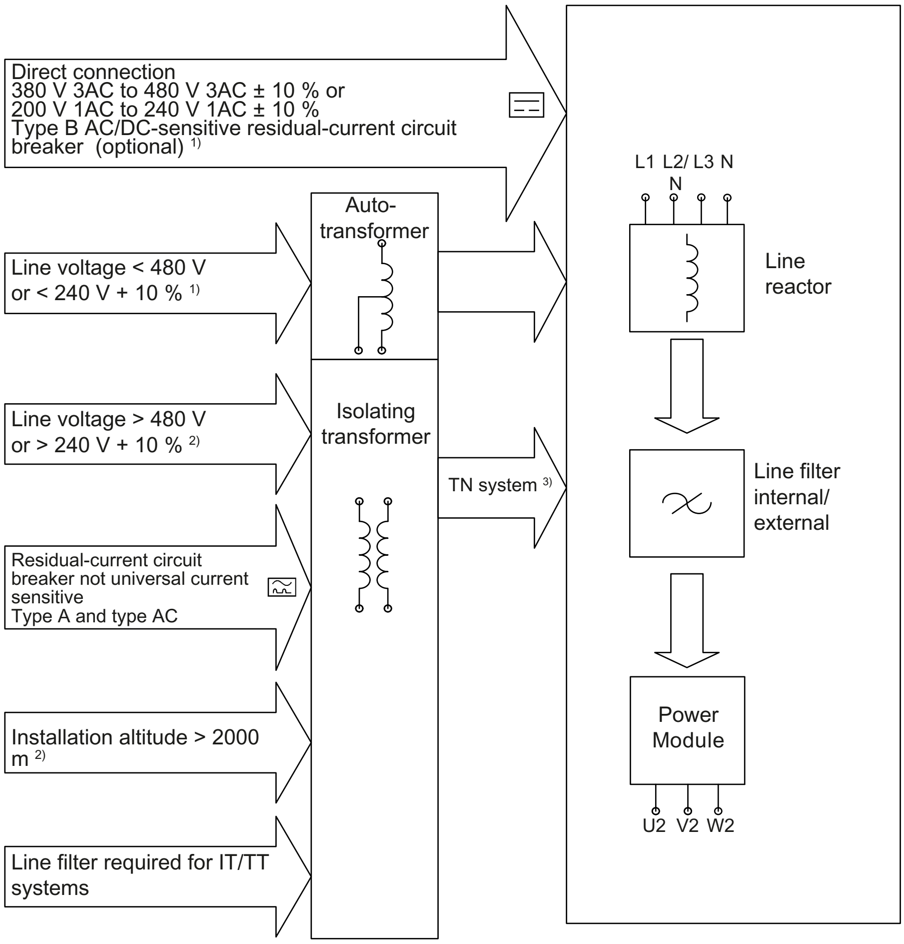
Order number	6SL3000-	0CE32-3AA0	0CE32-8AA0	0CE33-3AA0	0CE35-1AA0	0CE35-1AA0
Suitable for Power Module	6SL3310-	1TE32-1AAx	1TE32-6AAx	1TE33-1AAx	1TE33-8AAx	1TE35-0AAx
Rated current of the Power Module	A	210	260	310	380	490
Rated voltage	V	3-ph. 380 V AC -10% to 3-ph. 480 V AC +10% (-15% < 1 min), 47 to 63 Hz				
I_{thmax}	A	224	278	331	508	508
Power loss	kW	0,274	0,247	0,267	0,365	0,365
Line/load connection 1U1, 1V1, 1W1, 1U2, 1V2, 1W2		M10 connecting lugs	M10 connecting lugs	M10 connecting lugs	M12 connecting lugs	M12 connecting lugs
PE connection		M6 screw	M6 screw	M6 screw	M6 screw	M6 screw
Degree of protection		IP00	IP00	IP00	IP00	IP00
Weight	kg	24,5	26	27,8	38	38

3.9 Line connection variants

3.9.1 Methods of line connection

A distinction is made between:

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



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

Figure 3-19 Overview of line connection variants

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.

In operation 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 grounded neutral point and IT systems, such as systems with a grounded line conductor, an isolating transformer with grounded neutral point (secondary side) must be connected between the supply and the drive system in order to protect the motor insulation from continuous excessive stress.

3.9.2 Operation of the line connection components on the supply line

The SINAMICS S Blocksize drive system is designed to be directly connected to TN, TT line supply systems with grounded neutral conductor or grounded phase conductor as well as to IT line systems with rated voltages from 380 V 3 AC to 480 V 3 AC and 200 V 1 AC to 240 V 1 AC. Operation with line filter is only possible, without having to use additional measures, when connected to TN line supply systems with grounded neutral conductor.

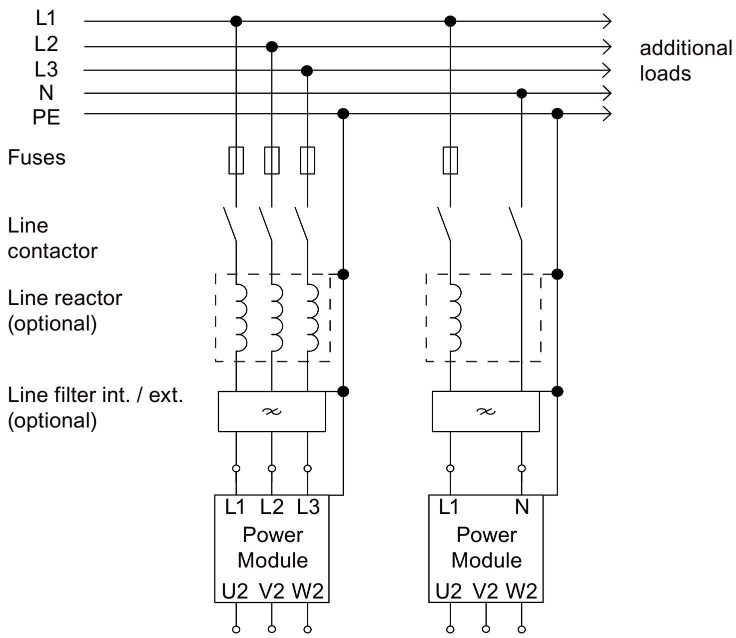


Figure 3-20 Direct operation on the line supply

Operation of single-phase units on the Single Phase Grounded Midpoint line system configuration

The line connection depicted below applies to the operation of single-phase units (1-ph. 230 V AC) on the Single Phase Grounded Midpoint line system configuration commonly used in the USA:

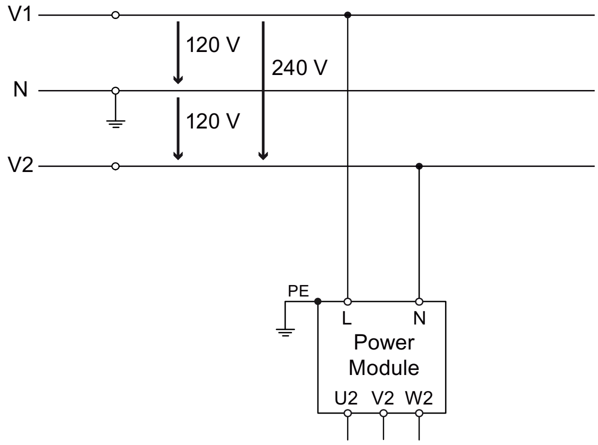


Figure 3-21 Direct operation on single phase grounded midpoint line system configurations

3.9.3 Operation of the line connection components via an autotransformer

An autotransformer can be used to adapt the voltage in the range up to 3-ph. 480 V AC +10 % or 1-ph. 240 V AC +10 %.

⚠ CAUTION
Using an isolating transformer to achieve safe electrical separation
To ensure safe electrical separation, an isolating transformer must be used for voltages greater than 3-ph. 480 V AC and 1-ph. 240 V AC.

Application example:

- The motor insulation must be protected from excessive voltages.

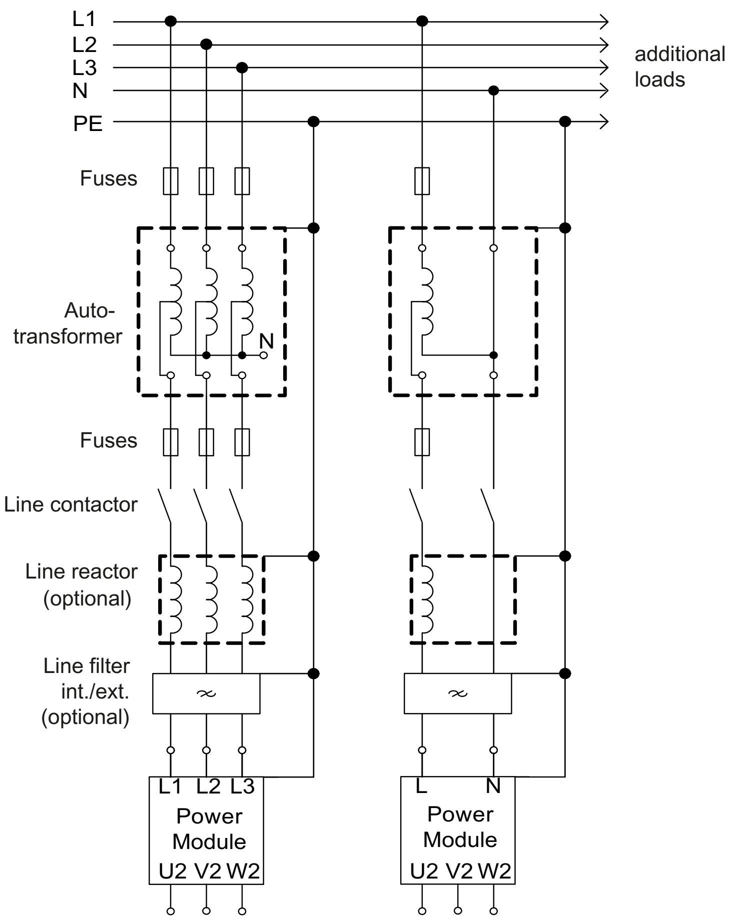


Figure 3-22 Auto-transformers

3.9.4 Operation of the line connection components via an isolating transformer

The isolating transformer converts the type of the line supply type in the plant (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 Power Module and/or the motor is not adequate for the voltages that occur.
- There is no compatibility to an existing residual current device.
- The installation altitude is greater than 2000 m above sea level.
- For all other systems that are not TN line supply systems with grounded neutral conductor, a line filter should always be used.

NOTICE
Using an isolating transformer to achieve safe electrical separation
If the line supply voltage is greater than 3-ph. 480 V AC +10 % or 1-ph. 240 V AC +10 %, it is not permissible that an autotransformer is used.
In order to ensure protective separation, an isolating transformer must always be used.

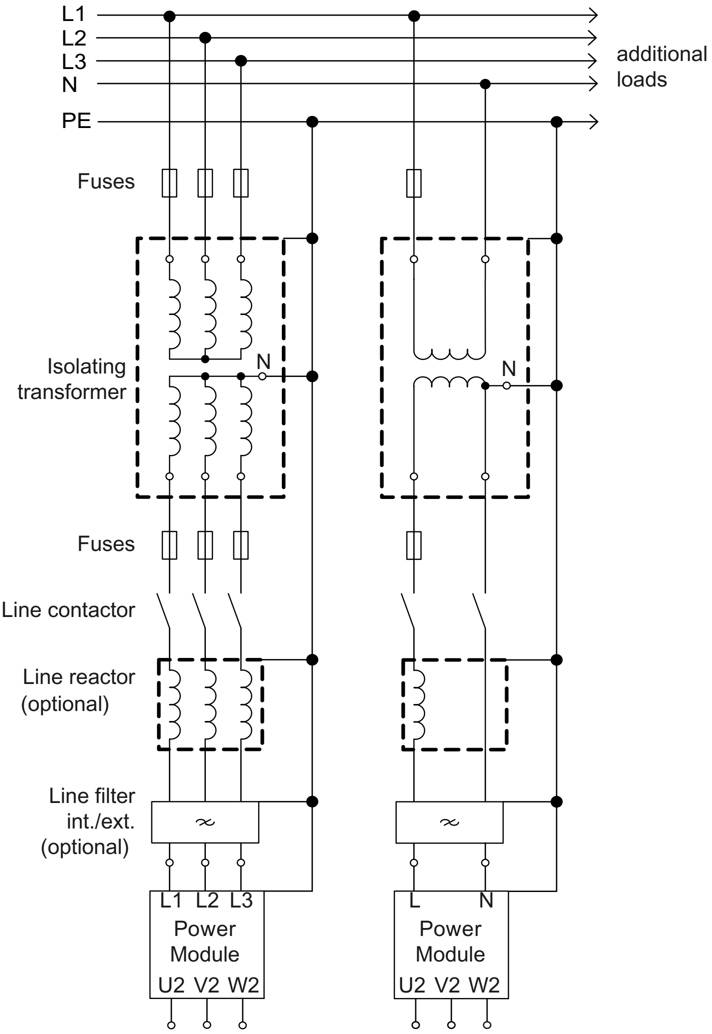


Figure 3-23 Isolating transformer

Power Modules

4

4.1 Safety instructions for Power Modules

Note

When using a Power Module, also observe the safety instructions in Chapter 1.

⚠ DANGER

Danger to life as a result of electric shock caused by residual voltage after shutdown

After disconnecting all the supply voltages, a hazardous voltage will be present in all components for another 5 minutes. Touching live components results in death or severe injury.

- Only carry out work on these components after this time has elapsed.
- Before starting any work, also measure the voltage at the DC link terminals DCP and DCN.

⚠ DANGER

Danger of death as a result of electric shock

Touching live components results in death or severe injury.

- After connecting the line and motor feeder cables to the appropriate terminals, check that the front covers (only frame sizes FSD to FSF) are closed and latched.
- Only connect the Power Module to the supply voltage after these checks have been made.

⚠ DANGER

Danger to life due to electric shock caused by incorrect shielding

Incorrectly connected cable shields and cable cores that are not connected can result in hazardous touch voltages.

- Connect cable shields and unused power cable cores (e.g. brake cores) to PE potential to dissipate charges resulting from capacitive cross-coupling effects.

⚠ WARNING

Danger to life caused by high discharge currents when the external protective conductor is interrupted

Drive components conduct high discharge currents via the protective conductor. When the protective conductor is interrupted, touching live components can result in electric shock, which can lead to death or serious injuries.

- Ensure that the external protective conductor complies with at least one of the following conditions:
  - It is routed so that it is protected against mechanical damage. [1)]
  - For an individual core, it has a cross-section of at least 10 mm² Cu.
  - As core of a multi-core cable, it has a cross-section of at least 2.5 mm² Cu.
  - It has a parallel, second protective conductor with the same cross-section.
  - It corresponds to the local regulations for equipment with increased leakage current.

  [1)] Cables routed in control cabinets or enclosed machine enclosures are considered to be adequately protected against mechanical damage.

⚠ WARNING

Danger to life as a result of a missing grounding/protective grounding of the Power Module

If not correctly grounded, this can lead to extremely hazardous states, which, under certain circumstances, can result in death or severe injury.

- Always ground the Power Module enclosure.

⚠ WARNING

Risk of accident as a result of missing warning labels in the relevant language

Missing warning labels in the relevant language can result in accidents leading to death or severe injury.

- Attach warning labels in the relevant language on components.

⚠ CAUTION

Use in residential environments

In a residential environment the Power Module can cause high-frequency disturbance, which may make interference-suppression measures necessary.

NOTICE

Ensure the correct supply voltage is used

It must be checked as to whether the Power Module is designed for the correct supply voltage. The Power Module can be damaged if it is connected to a higher supply voltage.

Note

Connection authorization

Power 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 Power Modules to the public low-voltage line supply, authorization is required in advance from the local power supply company (utility company) if

- the rated input current of the motor ≤ 16 A per conductor, and
- the rated input current of the motor does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

Note

For a UL-approved system use UL-approved cables only.

4.2 Power Modules Blocksize (PM340)

4.2.1 Description

The Power Modules in blocksize format are designed as follows:

- Line-side diode rectifier
- DC link electrolytic capacitors with pre-charging circuit
- Output inverter
- Braking chopper for (external) braking resistor
- 24 V DC / 1 A power supply
- Gating unit, actual value acquisition
- Fan to cool the power semiconductors

The Power Modules cover the power range from 0.12 kW to 90.0 kW and are available in versions with and without line filter.

Table 4- 1 Overview, Power Modules PM340 (selection)

	
Power Module (230 V) frame size FSA, with and without integrated line filter Power Module (400 V) frame size FSA, without integrated line filter	Power Module frame size FSB, with and without integrated line filter
	
Power Module frame size FSC, with and without integrated line filter	Power Module frame size FSD, with and without integrated line filter

	
Power Module frame size FSE, with and without integrated line filter	Power Module frame size FSF, with and without integrated line filter

4.2.2 Safety instructions for Power Modules blocksize format

Note

When handling/using a Power Module it is imperative that in addition to the safety instructions for Power Modules, you observe the safety instructions in Chapter 1.

WARNING

Danger of fire through overheating caused by insufficient ventilation and installation clearances

Insufficient ventilation and installation clearances result in overheating with danger to persons as a result of smoke and fire. Further, increased failures can occur and the service life of units/systems shortened.

- Always mount Power Modules in a vertical position.
- Maintain the following clearances between the components when mounting 1):
  - Frame size FSA: 30 mm (1.18 inch)
  - Frame size FSB: 40 mm (1.57 inch)
  - Frame size FSC: 50 mm (1.96 inch)
- Maintain the following ventilation clearances above and below the component:
  - Frame sizes FSA and FSB: 100 mm (3.93 inch)
  - Frame size FSC: 125 mm (4.92 inch)
  - Frame sizes FSD and FSE: 300 mm (11.81 inch) and
  - Frame size FSF: 350 mm (13.77 inches).
- Maintain the following ventilation clearances in front of the component:
  - Frame sizes FSB to FSF: 30 mm (1.18 inch)
- Do not install devices in this area that could obstruct the cooling airflow.
- Ensure that the cooling air flow of the Power Modules can flow unrestricted.

1) The Power Modules can be mounted side by side without base components up to an ambient temperature of 40 °C.

In combination with base components and at ambient temperatures of 40 °C to 55 °C, the specified lateral minimum clearances must be observed. Where combinations of different frame sizes are concerned, the longer of the two clearances shall apply.

4.2.3 Interface description

4.2.3.1 Overview

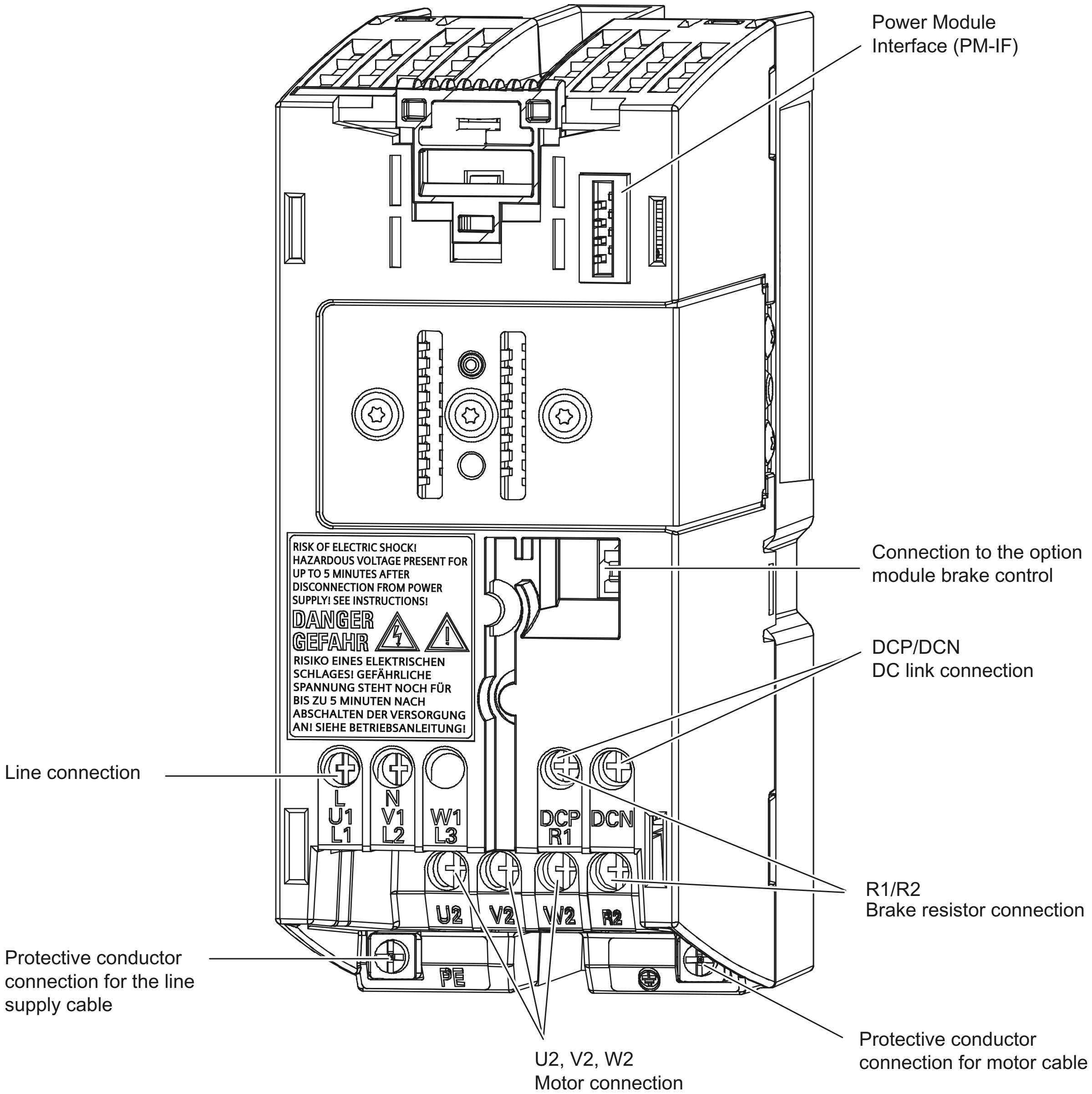


Figure 4-1 PM340, frame size FSA

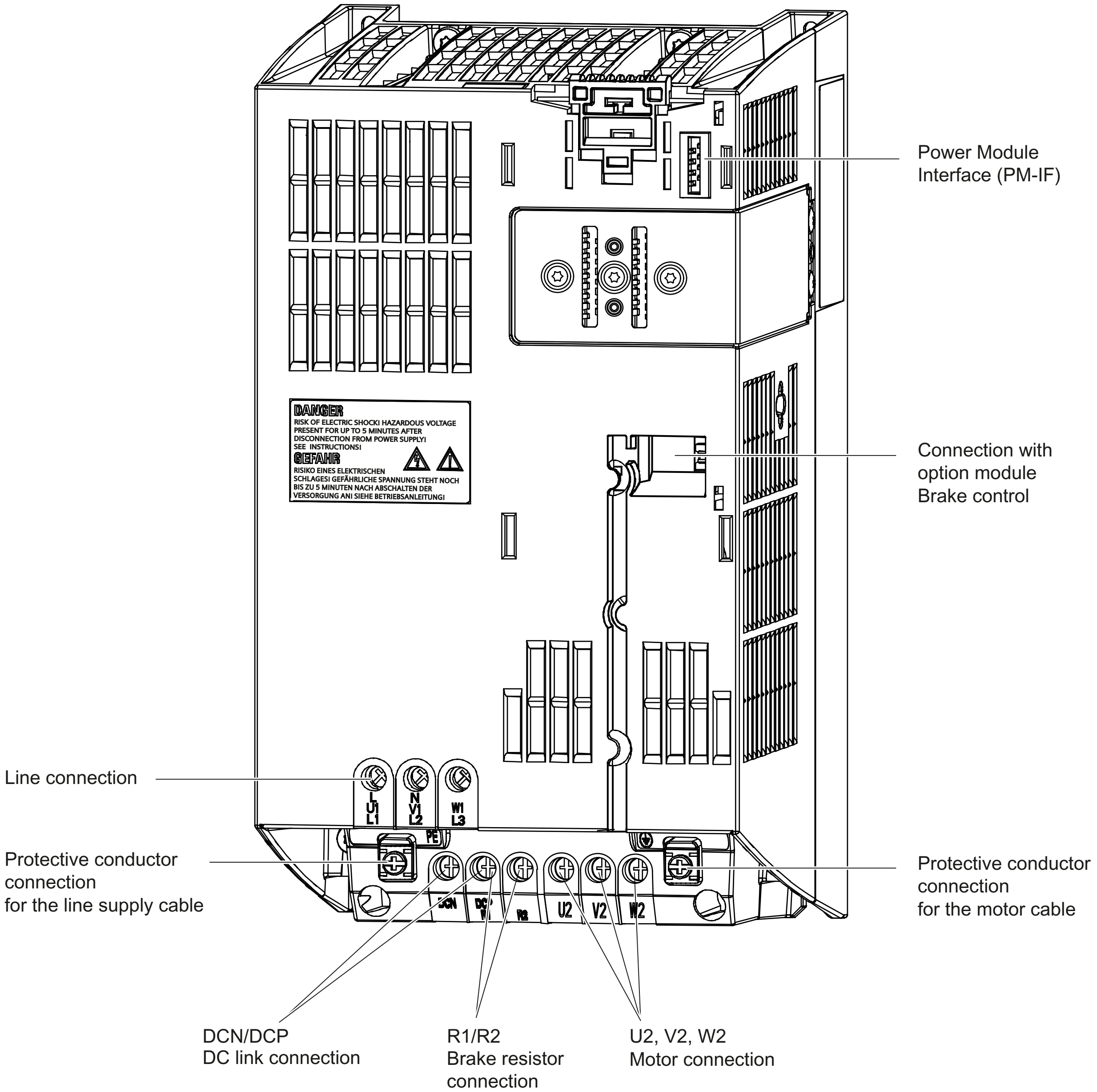


Figure 4-2 PM340, frame size FSB

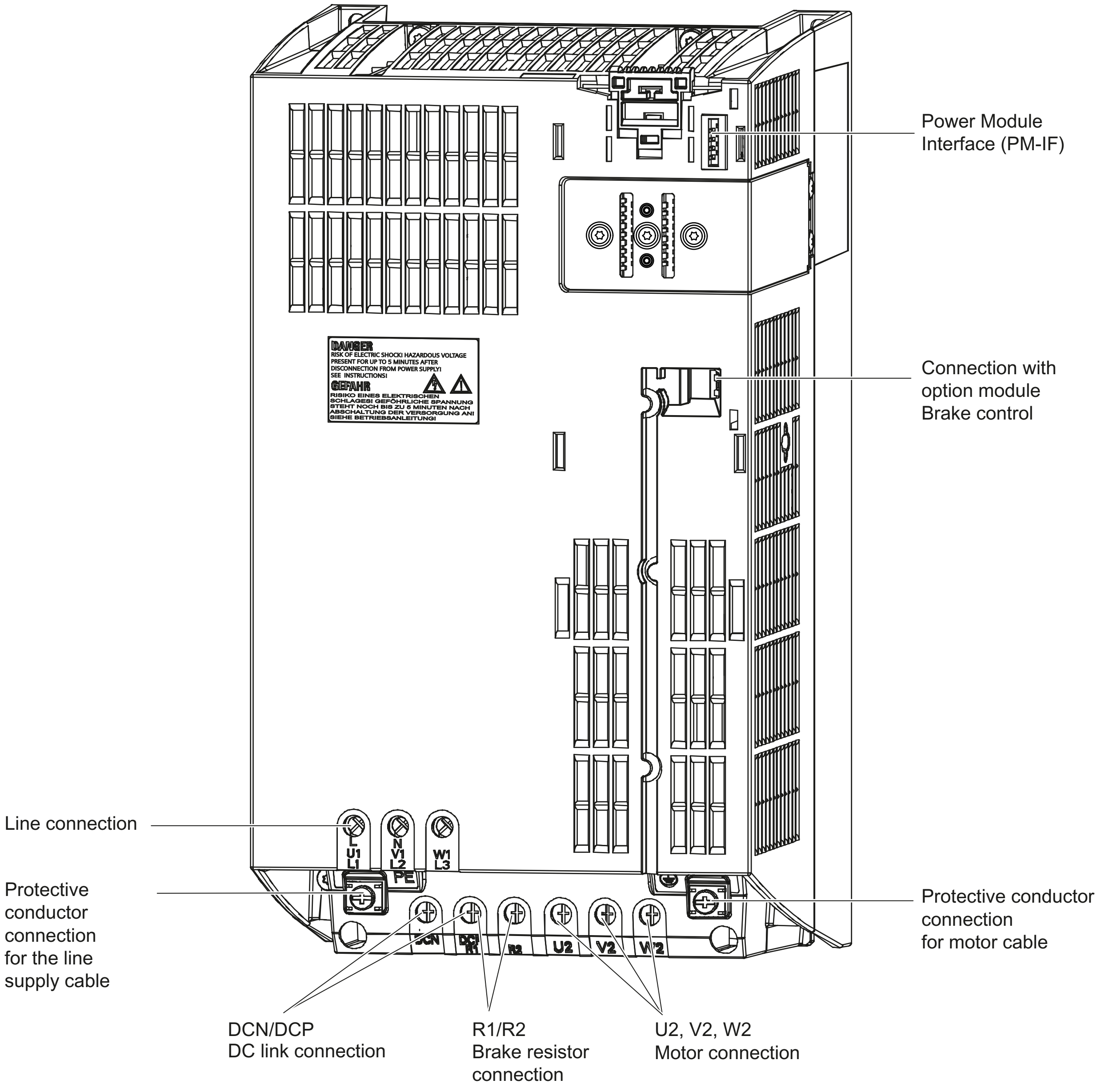


Figure 4-3 PM340, frame size FSC

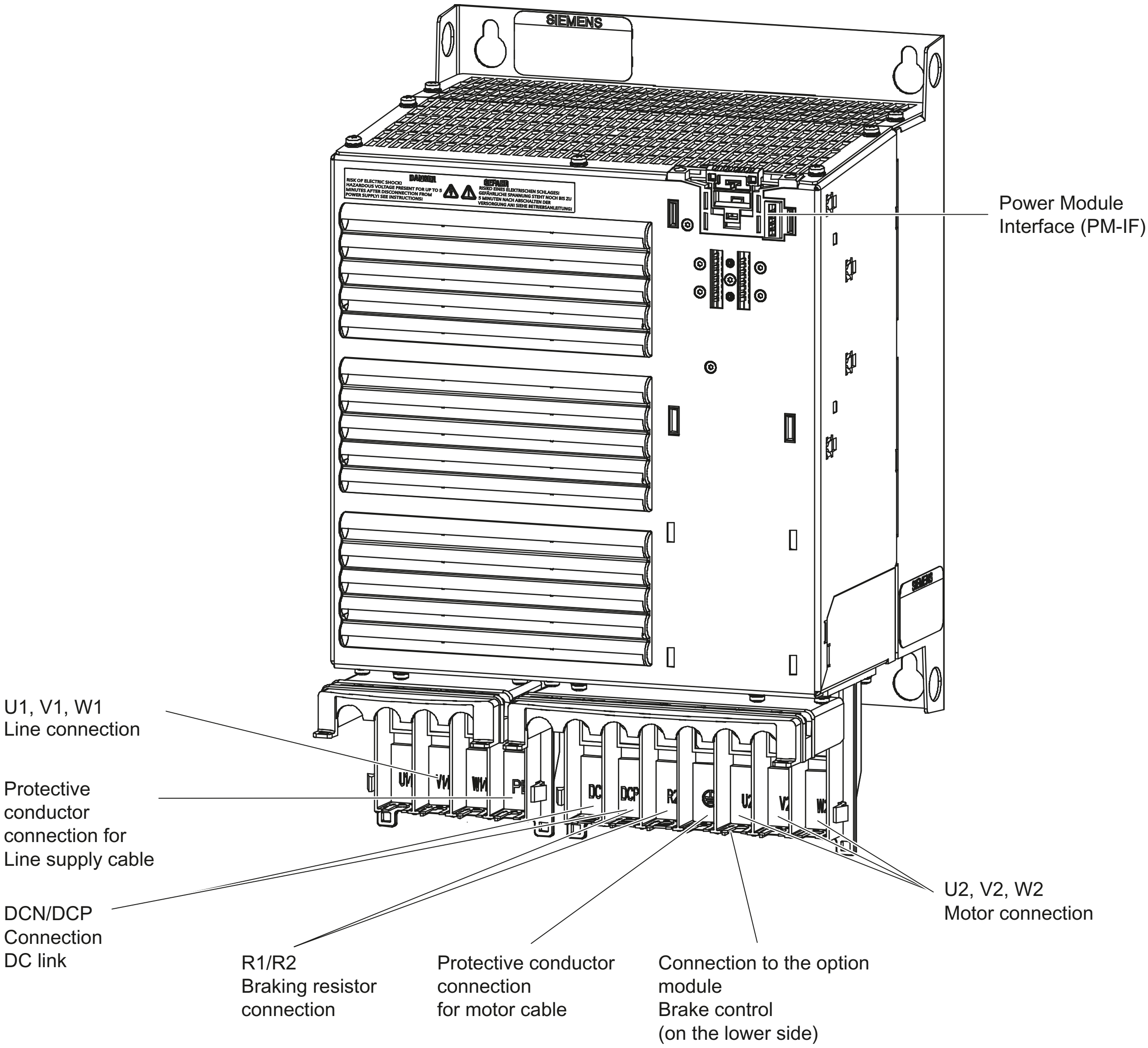


Figure 4-4 PM340, frame size FSD

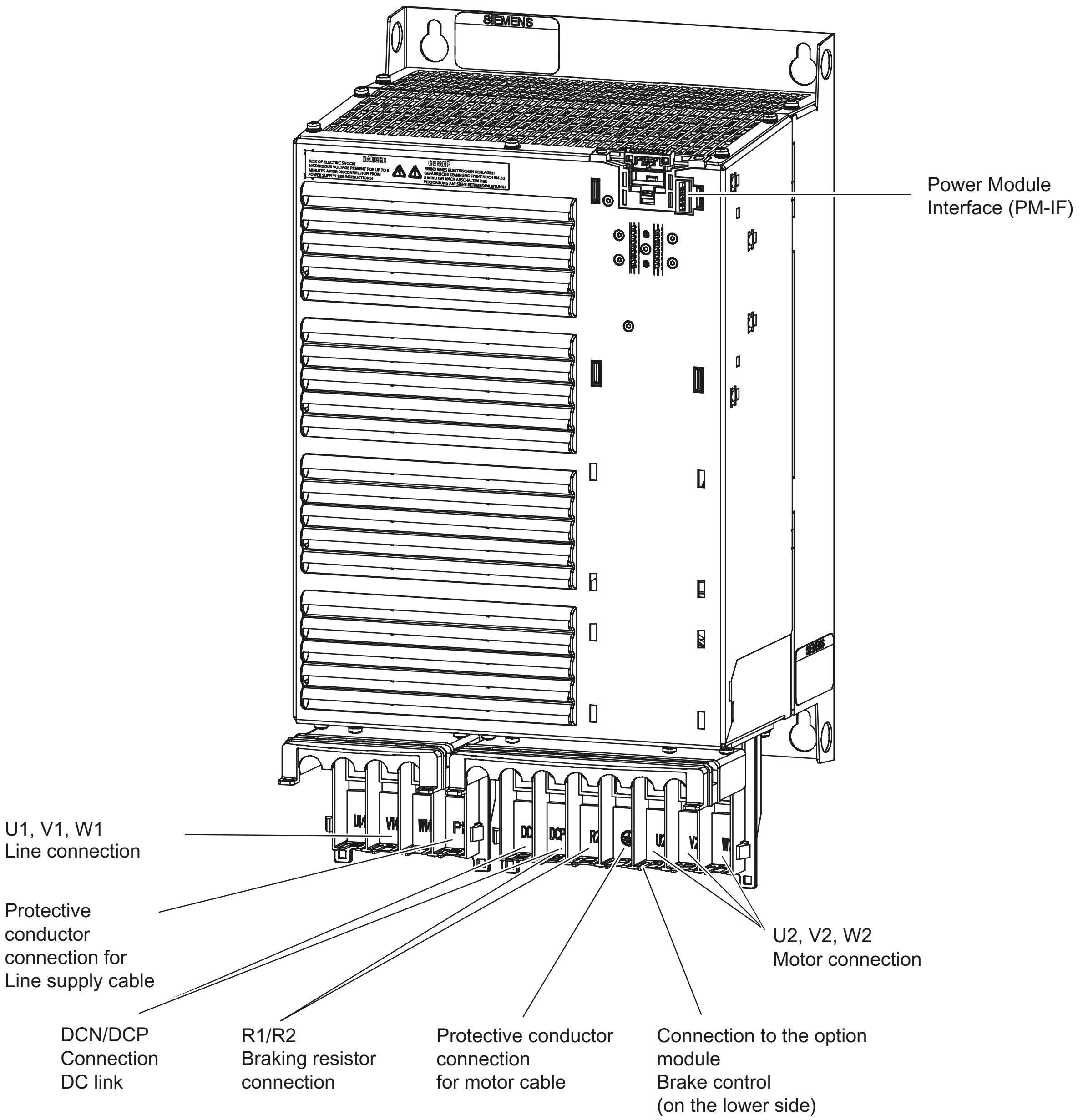


Figure 4-5 PM340, frame size FSE

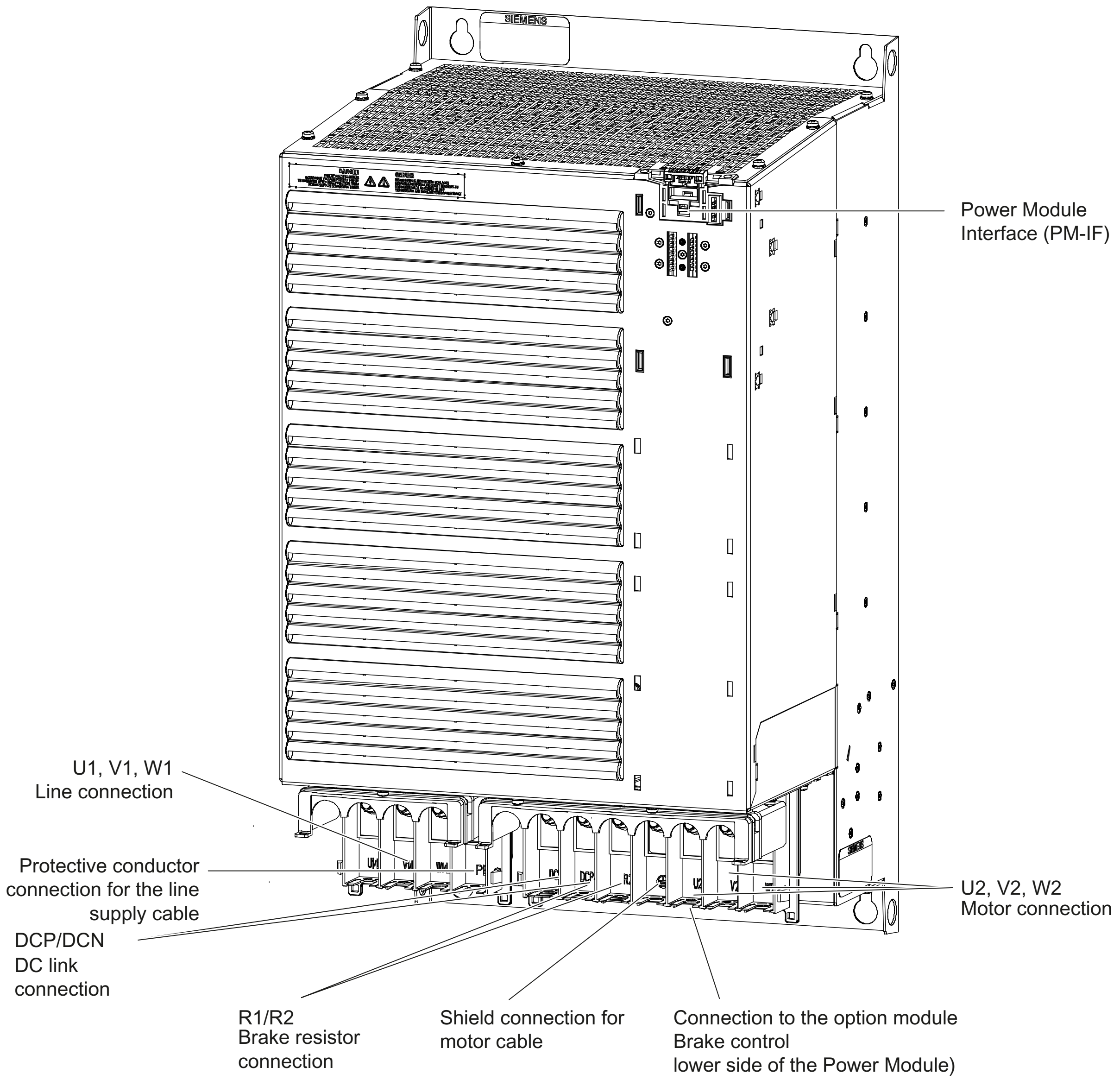


Figure 4-6 PM340, frame size FSF

4.2.3.2 Connection example

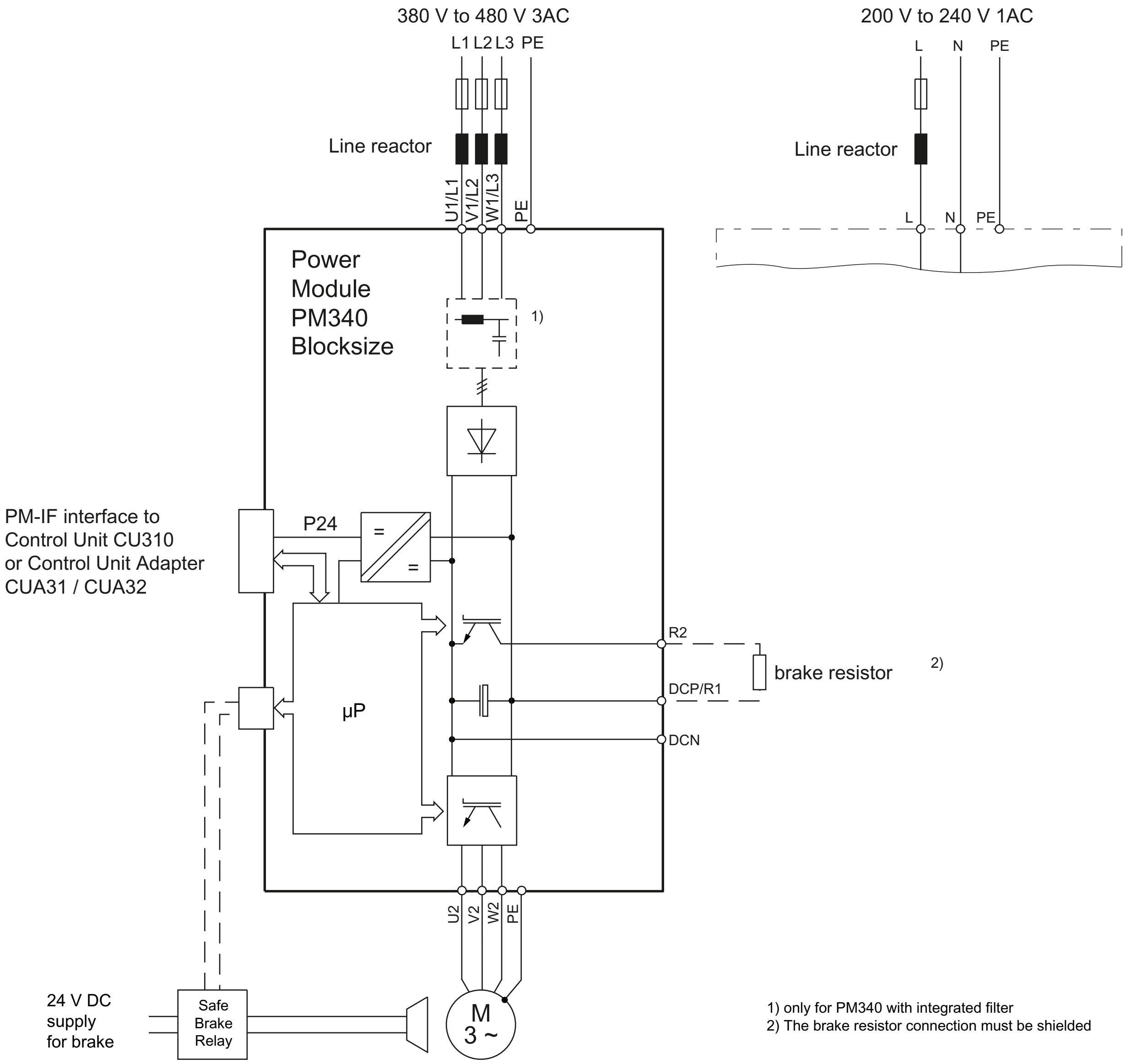
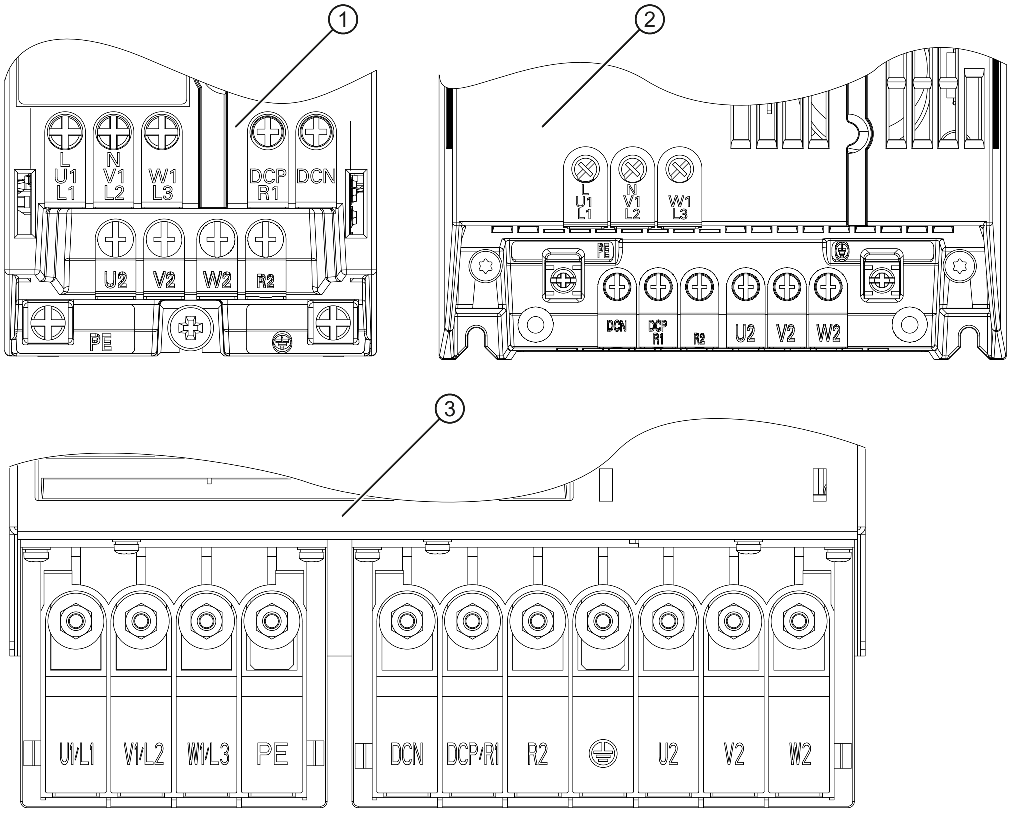


Figure 4-7 PM340 connection example

Arrangement of the line and motor terminals

The following diagram shows the arrangement of the line and motor terminals for frame sizes FSA to FSF of the PM340 Power Module.



① Frame size FSA
② Frame sizes FSB/FSC
③ Frame sizes FSD/FSE/FSF

Figure 4-8 PM340: Arrangement of the line and motor terminals

4.2.3.3 Line supply connection

Table 4- 2 Terminal block, line supply connection 1-ph. 200 V - 240 V AC

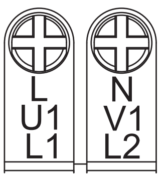
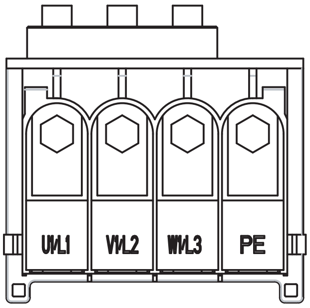
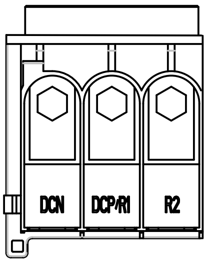
	Terminal	Signal name	Technical data
	1	L	Line phase L
	2	N	Line phase N
Max. conductor cross-section: 2.5 mm²			

Table 4- 3 Terminal block, line supply connection 3-ph. 380 V - 480 V AC

	Terminal	Signal name	Technical data
	1	U1/L1	External conductor L1
	2	V1/L2	External conductor L2
	3	W1/L3	External conductor L3
	4	PE	PE connection

4.2.3.4 Braking resistor and DC link connection

Table 4- 4 Terminal block, braking resistor, and DC link connection

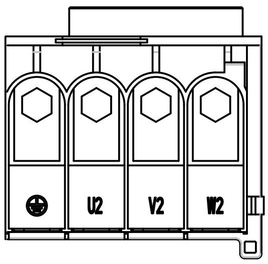
	Terminal	Technical specifications
	DCN	DC link negative
	DCP/R1	DC link positive and positive connection for braking resistor
	R2	Negative connection for the braking resistor

Note

To connect the cable lugs of the brake resistor cable to a PM340 Power Module frame size FSA it is necessary to nip the lug on connection R2 off using a diagonal cutter tool. Take great care to ensure that no pieces of plastic fall into the housing.

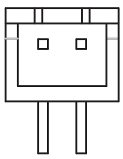
4.2.3.5 Motor connection

Table 4- 5 Terminal block, motor connection

	Terminal	Technical data
	⏚	PE connection
	U2	Motor phase U
	V2	Motor phase V
	W2	Motor phase W

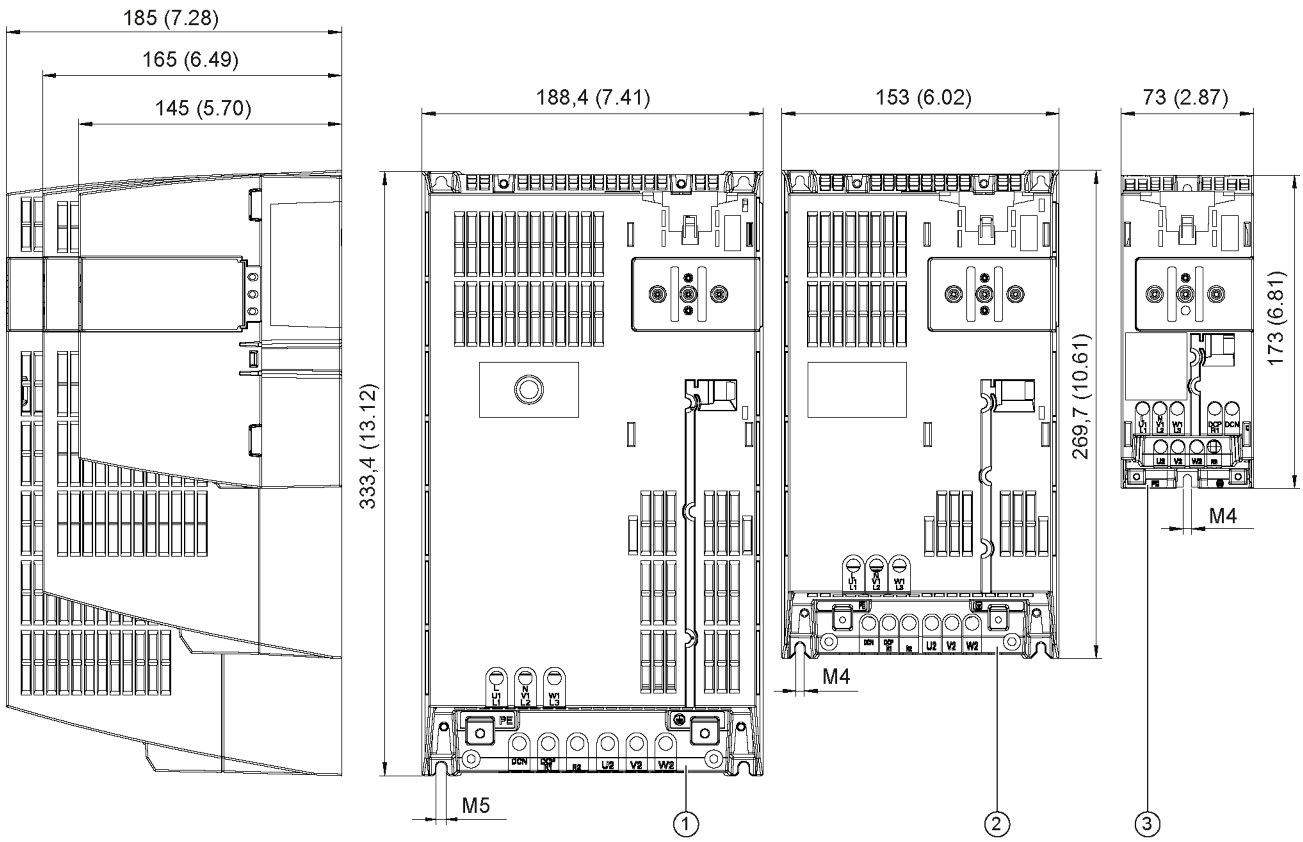
4.2.3.6 Connection to the option module, brake control

Table 4- 6 Connector

	Terminal	Designation	Technical specifications
	1	Low	Low signal, option module brake control at PM340
	2	High	High signal, option module brake control at PM340

4.2.4 Dimension drawings

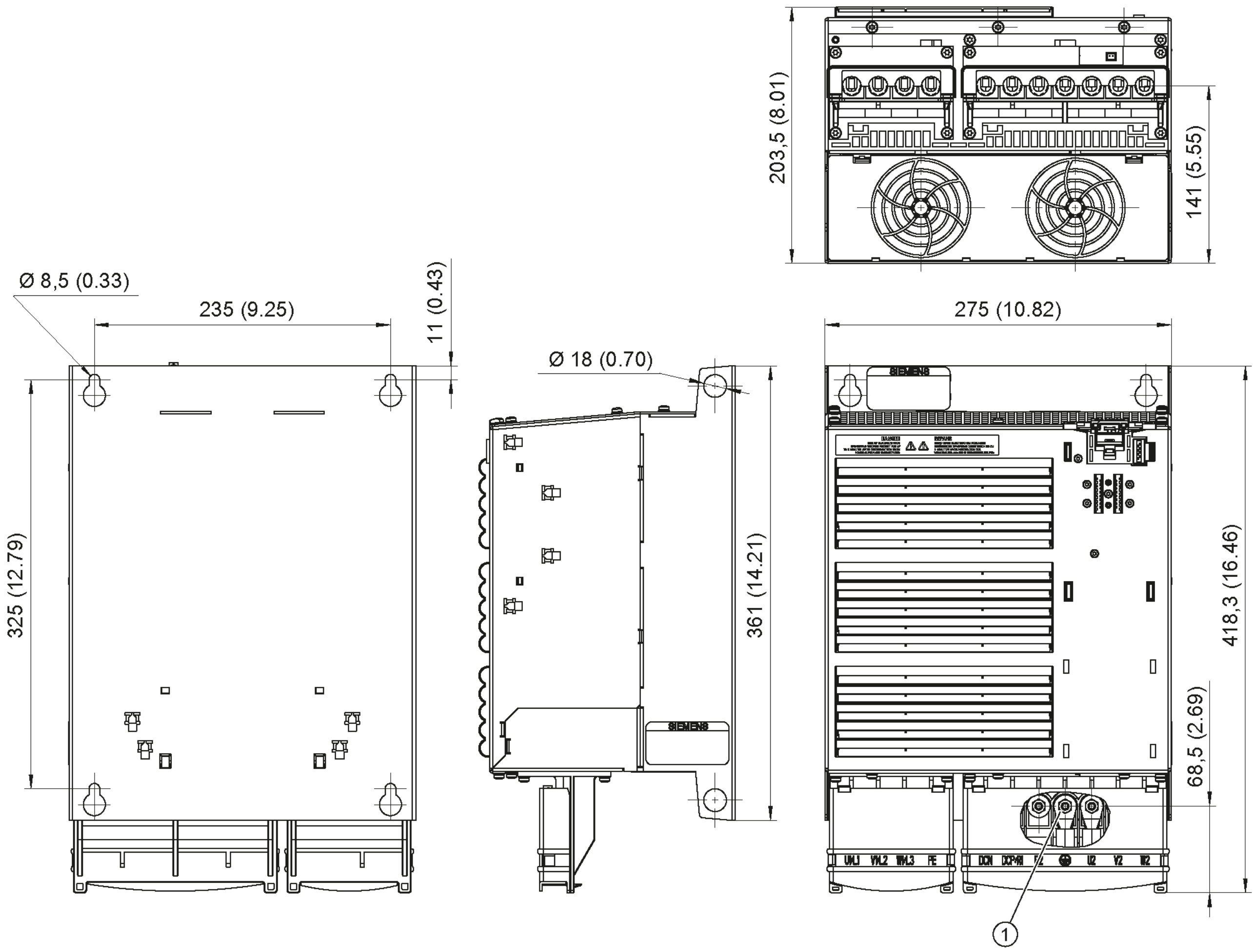
Frame sizes FSA/FSB/FSC



① Frame size FSC
② Frame size FSB
③ Frame size FSA

Figure 4-9 Dimension drawing, PM340 Power Modules, frame sizes FSA, FSB, FSC; all data in mm and (inches)

Frame size FSD



① Connections M6

Figure 4-10 Dimension drawing, PM340 Power Module, frame size FSD (without integrated line filter); all dimensions in mm and (inches)

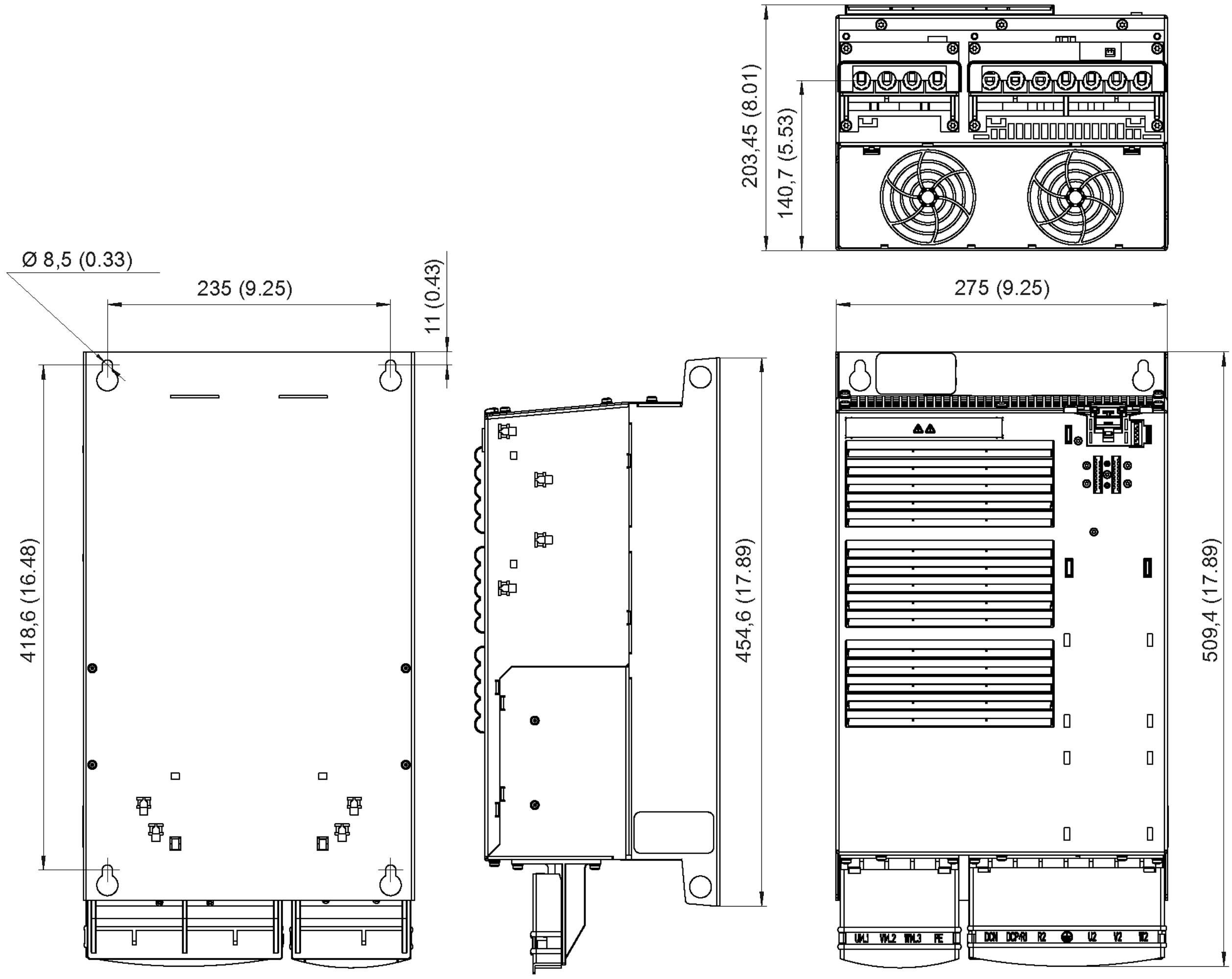
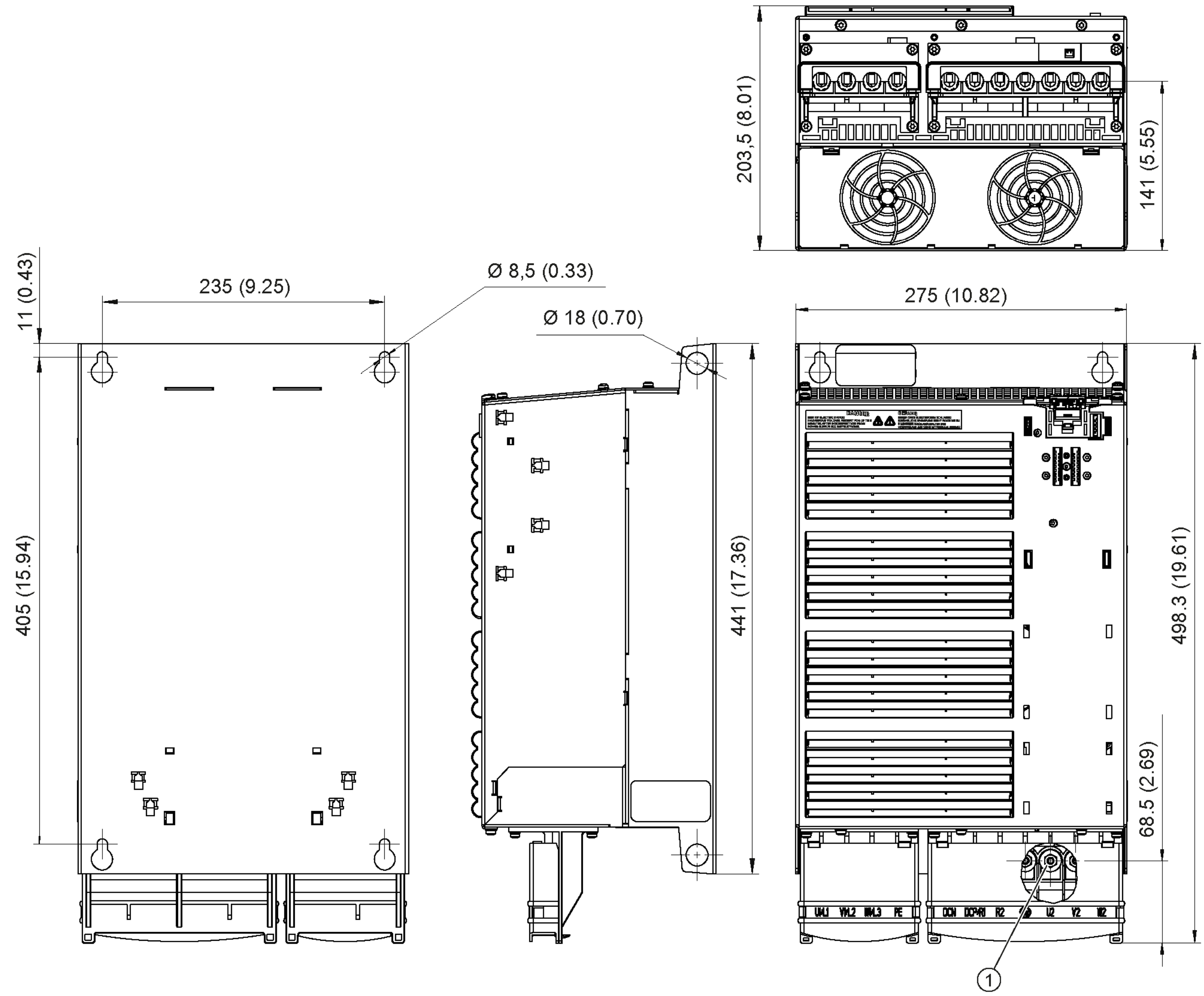


Figure 4-11 Dimension drawing, PM340 Power Module, frame size FSD (with integrated line filter); all dimensions in mm and (inches)

Frame size FSE (without/with integrated line filter)



① Connections M6

Figure 4-12 Dimension drawing, PM340 Power Module, frame size FSE (without integrated line filter); all dimensions in mm and (inches)

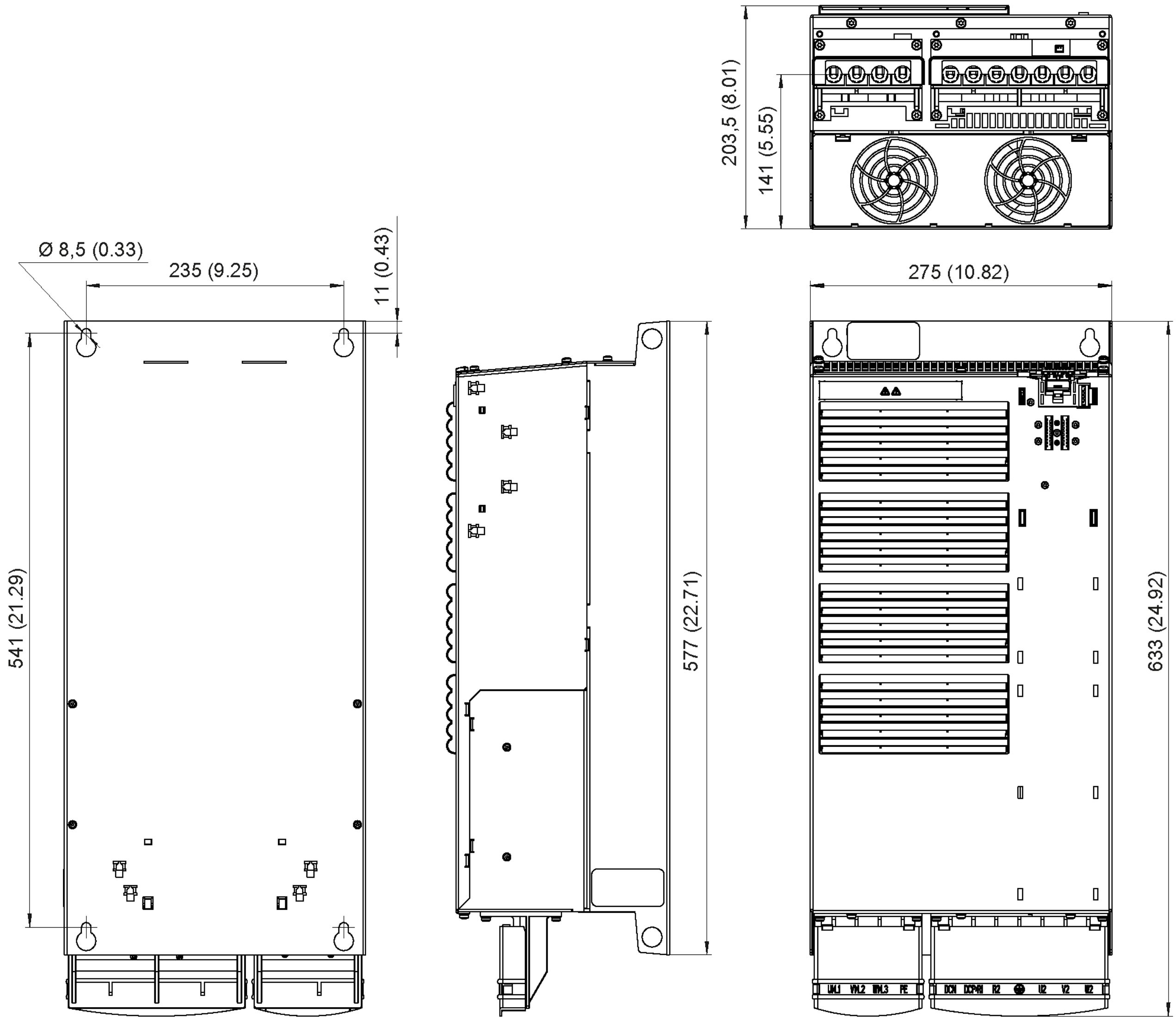
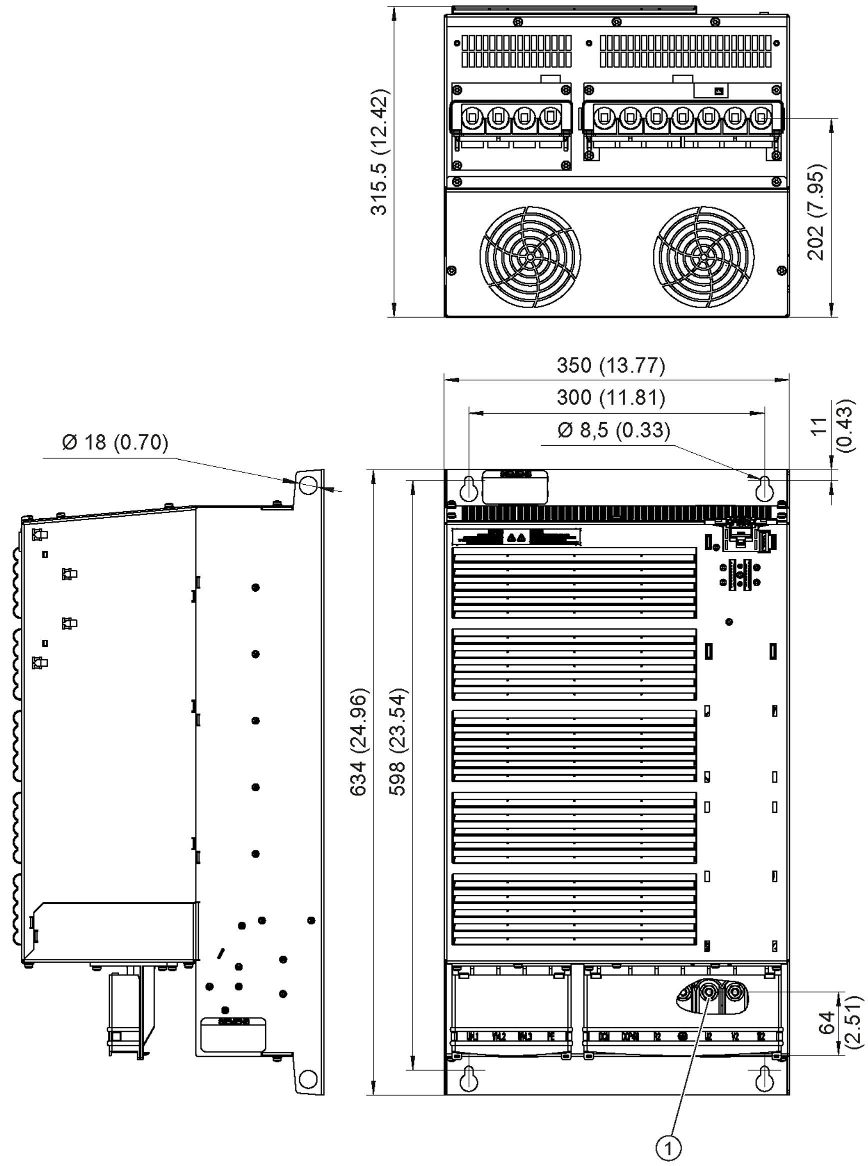


Figure 4-13 Dimension drawing, PM340 Power Module, frame size FSE (with integrated line filter); all dimensions in mm and (inches)

Frame size FSF (without/with integrated line filter)



① Connections M6

Figure 4-14 Dimension drawing, PM340 Power Module, frame size FSF (without integrated line filter); all dimensions in mm and (inches)

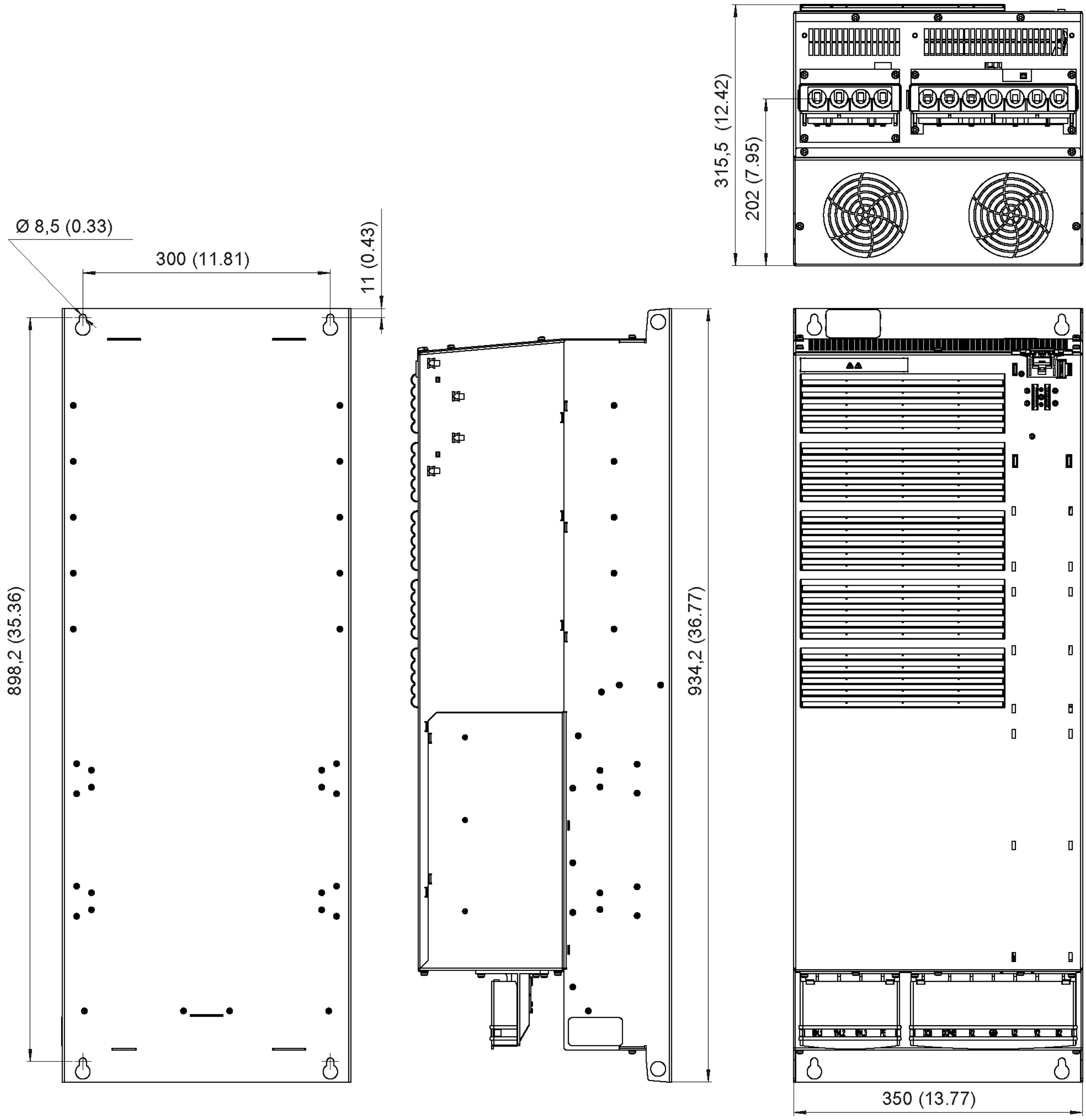


Figure 4-15 Dimension drawing, PM340 Power Module, frame size FSF (with integrated line filter); all dimensions in mm and (inches)

4.2.5 Mounting

4.2.5.1 Mounting dimensions and tightening torques

The mounting dimensions and the tightening torques for fixing the Power Modules are specified in the following table.

Table 4- 7 PM340, dimensions and tightening torques for mounting

Frame size	Height, width, depth		Dimensions (with Control Unit)	Retaining type	Tightening torques
FSA	HxWxD	mm	173 x 73 x 145	2 x M4 studs, 2 x M4 nuts, 2 x M4 washers	2.5 Nm with washers
		Inch	6.81 x 2.87 x 5.71		
FSB	HxWxD	mm	270 x 153 x 165	4 x M4 studs, 4 x M4 nuts, 4 x M4 washers	
		Inch	10.63 x 6.02 x 6.50		
FSC	HxWxD	mm	334 x 189 x 185	4 x M5 studs, 4 x M5 nuts, 4 x M5 washers	
		Inch	13.1 x 7.41 x 7.28		
FSD without line filter	HxWxD	mm	419 x 275 x 204	4 x M6 studs, 4 x M6nuts, 4 x M6 washers	6 Nm with washers
		Inch	16.3 x 10.8 x 8.0		
FSD with integrated line filter	HxWxD	mm	512 x 275 x 204		
		Inch	20.1 x 10.8 x 8.0		
FSE without line filter	HxWxD	mm	499 x 275 x 204		
		Inch	19.6 x 10.8 x 8.0		
FSE with integrated line filter	HxWxD	mm	635 x 275 x 204		
		Inch	25 x 10.8 x 8.0		
FSF without line filter	HxWxD	mm	635 x 350 x 316	4 x M8 studs, 4 x M8 nuts, 4 x M8 washers	13 Nm with washers
		Inch	25.0 x 13.8 x 12.4		
FSF with integrated line filter	HxWxD	mm	934 x 350 x 316		
		Inch	36.8 x 13.8 x 12.4		

Table 4- 8 PM340, load terminals - Tightening torques

Frame size	Tightening torques (Nm)
FSA	1.1
FSB	1.5
FSC	2.25
FSD	6
FSE	6
FSF	13

4.2.5.2 Access to the power supply terminals and motor terminals

Access to the power supply terminals and motor terminals

The line and motor terminals are accessed by releasing the tab on the side of the terminal covers using a suitable screwdriver. The cover can then be pushed upwards and snapped into this position as shown in the following diagram.

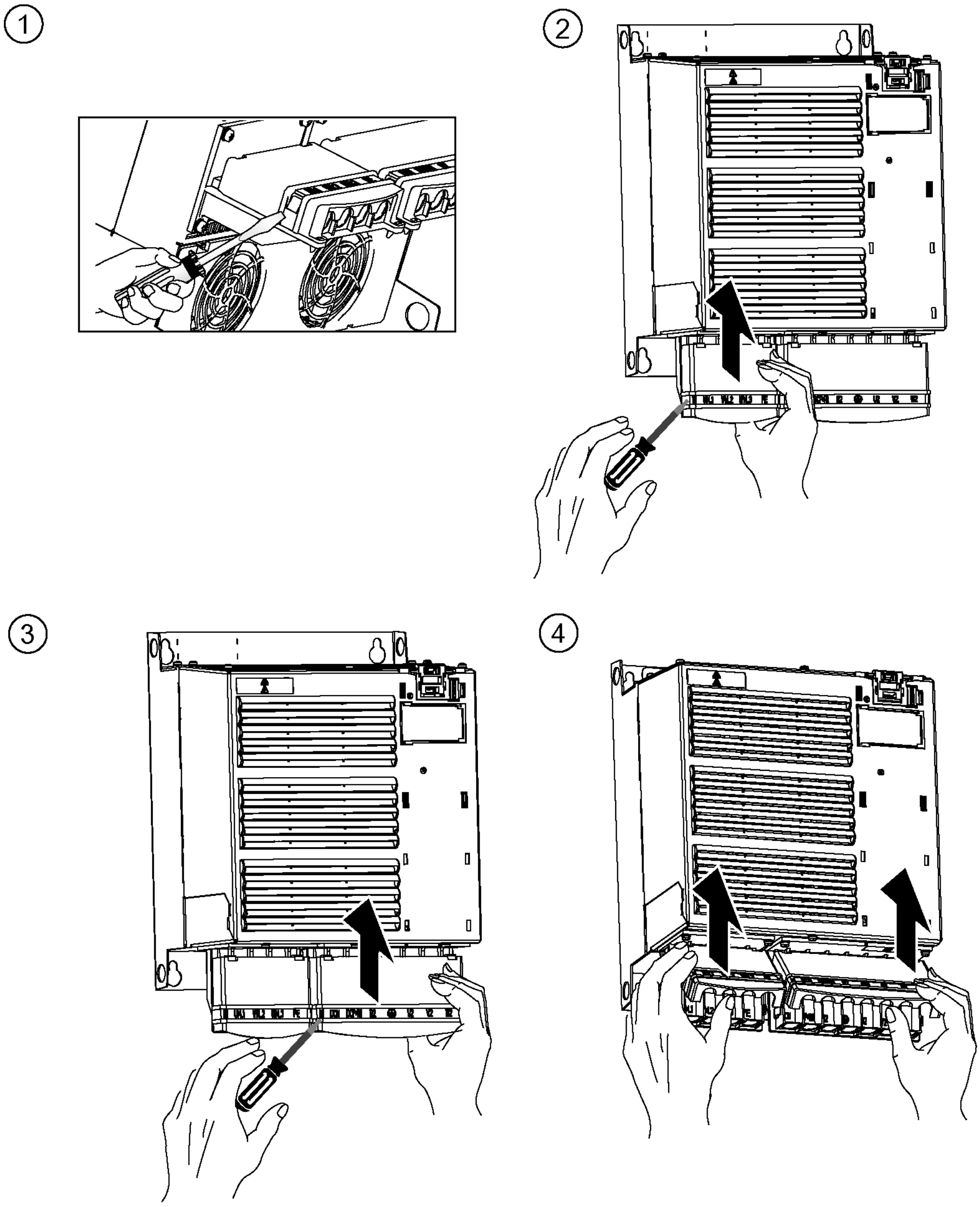


Figure 4-16 Access to the line and motor terminals for Liquid Cooled Power Modules

⚠ DANGER
Once the terminal cover has been removed, the degree of protection of the Power Module is reduced to IP00.

Operation on non-grounded line supply systems (IT)

It is not permissible to use Power Modules with integrated line filter in IT line supply systems.

4.2.6 Technical data

4.2.6.1 Power Modules Blocksize, 1-ph. AC

Table 4- 9 Technical data PM340, FSA (1 AC)

Line supply voltage 1-ph. 200 V to 240 V AC ±10%				
PM340	**6SL3210–**	**1SB11-0UA0**	**1SB12-3UA0**	**1SB14-0UA0**
PM340 with integrated line filter	**6SL3210–**	**1SB11-0AA0**	**1SB12-3AA0**	**1SB14-0AA0**
Output current Rated current I_n Base-load current I_H for S6 operation (40%) I_{s6} Peak current I_{max}	 A A A A	 0,9 0,8 1,4 2,0	 2,3 2,0 3,3 4,6	 3,9 3,4 5,5 7,8
Unit rating based on I_n [1)]	kW	0,12	0,37	0,75
Rated pulse frequency	kHz	4	4	4
Power loss	kW	0,06	0,075	0,11
Cooling air requirement	m³/s	0,005	0,005	0,005
Sound pressure level LpA (1 m)	dB	< 45	< 45	< 45
24 V DC supply for the Control Unit	 A	 1,0	 1,0	 1,0
Rated input current [2)] with/without integrated line reactor	 A	 1,4 / 2,2	 4 / 6	 6,5 / 10
Class J UL fuses Rated current Rated short-circuit current SCCR	 A kA	 6 65	 10 65	 15 65
Circuit breaker type designation EN 60947 rated current	 A	5SJ4206-7HG41 6	5SJ4210-7HG41 10	5SJ4216-7HG41 16
Circuit breaker type designation UL489 / CSA C22.2 No. 5-02 Rated current Rated short-circuit current SCCR	 A kA	5SJ4206-7HG41 6 14	5SJ4210-7HG41 10 14	5SJ4216-7HG41 16 14
Resistance value of the external braking resistor	Ω	> 180	> 180	> 180

Line supply voltage 1-ph. 200 V to 240 V AC ±10%				
PM340	6SL3210–	1SB11-0UA0	1SB12-3UA0	1SB14-0UA0
PM340 with integrated line filter	6SL3210–	1SB11-0AA0	1SB12-3AA0	1SB14-0AA0
Max. cable length to braking resistor	m	15	15	15
Line supply connectionL, N		Screw terminals for cable cross-sections 1.0 to 2.5 mm^2		
Motor connection U2, V2, W2				
DC link connection, connection for braking resistor DCP/R1, DCN, R2				
PE connection		On housing with M4 screw		
Max. motor cable length 3) (without external options)	m	50 (shielded) 75 (unshielded)		
Degree of protection		IP20 or IPXXB		
Weight	kg	1,2	1,3	1,3

1) Rated output of a typical standard induction motor at 230 V.

2) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to u_k = 1%.

3) Max. motor cable length 15 m (shielded) for PM340 Power Modules with integrated line filter to comply with the limit values of EN 61800-3 Category C2.

4.2.6.2 Power Modules Blocksize, 3-ph. AC

Table 4- 10 Technical data PM340, FSA (3 AC 380 V to 480 V ±10 %)

PM340 (without integrated line filter)	6SL3210-	1SE11-3UA0	1SE11-7UA0	1SE12-2UA0	1SE13-1UA0	1SE14-1UA0
Output current Rated current I_n Base-load current I_H for S6 operation (40%) I_{s6} Peak current I_{max}	 A A A A	 1,3 1,1 1,3 2,6	 1,7 1,5 2,0 3,4	 2,2 1,9 2,5 4,4	 3,1 2,7 3,5 6,2	 4,1 3,6 4,5 8,2
Type rating 1) on basis of I_n on basis of I_H	 kW kW	 0,37 0,37	 0,55 0,55	 0,75 0,75	 1,1 1,1	 1,5 1,5
Rated pulse frequency	kHz	4	4	4	4	4
Power loss	kW	0,10	0,10	0,10	0,11	0,11
Cooling air requirement	m^3/s	0,005	0,005	0,005	0,005	0,005
Sound pressure level L_{pA} (1 m)	dB(A)	< 45	< 45	< 45	< 45	< 45
24 V DC supply for the Control Unit	A	1,0	1,0	1,0	1,0	1,0
Rated input current 2) with/without integrated line reactor	A	1,3 / 1,7	1,7 / 2,2	2,2 / 2,6	3,1 / 3,9	4,1 / 4,8

PM340 (without integrated line filter)	6SL3210-	1SE11-3UA0	1SE11-7UA0	1SE12-2UA0	1SE13-1UA0	1SE14-1UA0
UL fuses **Class J** Rated current Rated short-circuit current SCCR	 A kA	 4 65	 4 65	 6 65	 8 65	 10 65
NH fuses **IEC 60947** Rated current	 A	3NA3804 4	3NA3804 4	3NA3801 6	3NA3803 10	3NA3803 10
Circuit-breaker type designation IEC 60947 rated current	 A	3RV2011-1DA10 2.2 - 3.2	3RV2011-1DA10 2.2 - 3.2	3RV2011-1FA10 3.5 - 5	3RV2011-1GA10 4.5 - 6.3	3RV2011-1HA10 5.5 - 8
Resistance value ext. braking resistor	 Ω	 > 390	 > 390	 > 390	 > 390	 > 390
Max. cable length to braking resistor	 m	 15	 15	 15	 15	 15
Line supply connection L1, L2, L3		Screw terminals for cable cross-sections 1.0 to 2.5 mm^2				
Motor connection U2, V2, W2						
DC link connection, connection for braking resistor DCP/R1, DCN, R2						
PE connection		On housing with M4 screw				
Max. motor cable length 3) shielded/unshielded	 m	 50 / 75				
Degree of protection		IP20 or IPXXB				
Weight	kg	1,2	1,2	1,2	1,2	1,2

1) Rated power of a typical standard induction motor at 3 AC 400 V

2) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to u_k = 1%.

3) Max. motor cable length 25 m (shielded) for PM340 Power Modules with integrated line filter to comply with the limit values of EN 61800-3 Category C2.

Table 4- 11 Technical data PM340, FSB (3 AC 380 V to 480 V ±10 %)

PM340	6SL3210-	1SE16-0UA0	1SE17-7UA0	1SE21-0UA0
PM340 with integrated line filter	**6SL3210-**	**1SE16-0AA0**	**1SE17-7AA0**	**1SE21-0AA0**
Output current Rated current I_n Base-load current I_H for S6 operation (40%) I_{s6} Peak current I_{max}	 A A A A	 5,9 5,2 6,4 11,8	 7,7 6,8 8,3 15,4	 10,2 9,1 10,8 20,4
Type rating 1) on basis of I_n on basis of I_H	 kW kW	 2,2 2,2	 3 3	 4 4

PM340	6SL3210-	1SE16-0UA0	1SE17-7UA0	1SE21-0UA0
PM340 with integrated line filter	6SL3210-	1SE16-0AA0	1SE17-7AA0	1SE21-0AA0
Rated pulse frequency	kHz	4	4	4
Power loss	kW	0,14	0,16	0,18
Cooling air requirement	m^3/s	0,009	0,009	0,009
Sound pressure level L_{pA} (1 m)	dB	< 50	< 50	< 50
24 V DC supply for the Control Unit	A	1,0	1,0	1,0
Rated input current [2)] with/without integrated line reactor	A	5,6 / 6,7	7,5 / 8,9	9,8 / 12,4
Class J, UL fuses Rated current Rated short-circuit current SCCR	 A kA	 10 65	 12 65	 15 65
NH fuses IEC 60947 Rated current	 A	3NA3803 10	3NA3805 16	3NA3805 16
Circuit breaker type designation IEC 60947 rated current	 A	3RV2011-1KA10 9 - 12.5	3RV2011-4AA10 11 - 16	3RV2021-4BA10 14 - 20
Resistance value ext. braking resistor	Ω	> 160	> 160	> 160
Max. cable length to braking resistor	m	15	15	15
Line supply connection L1, L2, L3		Screw terminals for cable cross-sections 1.0 to 6 mm^2		
Motor connection U2, V2, W2				
DC link connection, connection for braking resistor DCP/R1, DCN, R2				
PE connection		On housing with M5 screw		
Max. motor cable length [3)] shielded/unshielded	m	50 / 75		
Degree of protection		IP20 or IPXXB		
Weight	kg	4,0	4,0	4,0

1) Rated power of a typical standard induction motor at 3 AC 400 V

2) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to u_k = 1%.

3) Max. motor cable length 25 m (shielded) for PM340 Power Modules with integrated line filter to comply with the limit values of EN 61800-3 Category C2.

Table 4- 12 Technical data PM340, FSC (3 AC 380 V to 480 V ±10 %)

PM340	6SL3210-	1SE21-8UA0	1SE22-5UA0	1SE23-2UA0
PM340 with integrated line filter	**6SL3210-**	**1SE21-8AA0**	**1SE22-5AA0**	**1SE23-2AA0**
Output current Rated current I_n Base-load current I_H for S6 operation (40%) I_{s6} Peak current I_{max}	 A A A A	 18 14 19,6 26,4	 25 21 27,8 38	 32 27 37,1 52
Type rating [1)] on basis of I_n on basis of I_H	 kW kW	 7,5 5,5	 11 7,5	 15 11
Rated pulse frequency	kHz	4	4	4
Power loss	kW	0,24	0,30	0,40
Cooling air requirement	m^3/s	0,038	0,038	0,038
Sound pressure level L_{pA} (1 m)	dB	< 60	< 60	< 60
24 V DC supply for the Control Unit	 A	 1,0	 1,0	 1,0
Rated input current [2)] with/without integrated line reactor	 A	 17,1 / 23,1	 24,6 / 32,6	 33 / 39
Class J, UL fuses Rated current Rated short-circuit current SCCR	 A kA	 25 65	 35 65	 45 65
NH fuses **IEC 60947** Rated current	 A	3NA3810 25	3NA3814 35	3NA3817 40
Circuit breaker type designation **IEC 60947** rated current	 A	3RV1031-4EA10 22 - 32	3RV1031-4FA10 28 - 40	3RV1031-4HA10 40 - 50
Resistance value ext. braking resistor	 Ω	 > 56	 > 56	 > 56
Max. cable length to braking resistor	 m	 15	 15	 15
Line supply connection L1, L2, L3		Screw terminals for cable cross-sections 2.5 to 10 mm^2		
Motor connection U2, V2, W2				
DC link connection, connection for braking resistor DCP/R1, DCN, R2				
PE connection		On housing with M5 screw		
Max. motor cable length [3)] shielded/unshielded	 m	 50 / 75		

PM340	6SL3210-	1SE21-8UA0	1SE22-5UA0	1SE23-2UA0
PM340 with integrated line filter	6SL3210-	1SE21-8AA0	1SE22-5AA0	1SE23-2AA0
Degree of protection		IP20 or IPXXB		
Weight	kg	6,5	6,5	6,5

1) Rated power of a typical standard induction motor at 3 AC 400 V

2) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to u_k = 1%.

3) Max. motor cable length 25 m (shielded) for PM340 Power Modules with integrated line filter to comply with the limit values of EN 61800-3 Category C2.

Table 4- 13 Technical data PM340, FSD (3 AC 380 V to 480 V ±10 %)

PM340	6SL3210-	1SE23-8UA0	1SE24-5UA0	1SE26-0UA0
PM340 with integrated line filter	6SL3210-	1SE23-8AA0	1SE24-5AA0	1SE26-0AA0
Output current Rated current I_n Base-load current I_H for S6 operation (40%) I_{s6} Peak current I_{max}	 A A A A	 38 33 49 64	 45 40 58 76	 60 48 78 90
Type rating 1) on basis of I_n on basis of I_H	 kW kW	 18,5 15	 22 18,5	 30 22
Rated pulse frequency	kHz	4	4	4
Power loss	kW	0,38	0,51	0,69
Cooling air requirement	m^3/s	0,022	0,022	0,039
Sound pressure level L_{pA} (1 m)	dB(A)	< 60	< 60	< 60
24 V DC supply for the Control Unit	 A	 1,0	 1,0	 1,0
Rated input current 2) with/without integrated line reactor	 A	 40 / 46	 47 / 53	 63 / 72
Class J, UL fuses Rated current Rated short-circuit current SCCR	 A kA	3NE1817-0 50 65	3NE1818-0 60 65	3NE1820-0 90 65
NH fuses **IEC 60947** Rated current	 A	3NA3820 50	3NA3822 63	3NA3824 80
Circuit-breaker type designation IEC 60947 rated current	 A	3RV1042-4JA10 45 - 63	3RV1042-4KA10 57 - 75	3RV1042-4MA10 80 - 100
Resistance value of the external braking resistor	 Ω	 > 27	 > 27	 > 27
Max. cable length to braking resistor	 m	 15	 15	 15

PM340	6SL3210-	1SE23-8UA0	1SE24-5UA0	1SE26-0UA0
PM340 with integrated line filter	6SL3210-	1SE23-8AA0	1SE24-5AA0	1SE26-0AA0
Line supply connection L1, L2, L3		Stud M6, connectable cable cross-sections 10 to 50 mm^2		
Motor connection U2, V2, W2				
DC link connection, connection for braking resistor DCP/R1, DCN, R2				
PE connection		At the housing with M6 screw		
Max. motor cable length 3) shielded/unshielded	m	70 / 100		
Degree of protection		IP20 or IPXXB		
Height PM340 with/without integrated line filter	mm (inch)	418,3 (16.47) / 511 (20.11)	418,3 (16.47) / 511 (20.11)	418,3 (16.47) / 511 (20.11)
Weight with/without integrated line filter	kg	15,9 / 19,3	15,9 / 19,3	15,9 / 19,3

1) Rated power of a typical standard induction motor at 3 AC 400 V

2) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to u_k = 1%.

3) Max. motor cable length 25 m (shielded) for PM340 Power Modules with integrated line filter to comply with the limit values of EN 61800-3 Category C2.

Table 4- 14 Technical data PM340, FSE and FSF (3 AC 380 V to 480 V ±10 %)

PM340	6SL3210-	1SE27-5UA0	1SE31-0UA0	1SE31-1UA0	1SE31-5UA0	1SE31-8UA0
PM340 with integrated line filter	6SL3210-	1SE27-5AA0	1SE31-0AA0	1SE31-1AA0	1SE31-5AA0	1SE31-8AA0
Frame size		FSE	FSE	FSF	FSF	FSF
Output current Rated current I_n Base-load current I_H for S6 operation (40%) I_{s6} Peak current I_{max}	 A A A A	 75 65 98 124	 90 80 117 150	 110 95 143 180	 145 115 188 220	 178 155 231 290
Type rating 1) on basis of I_n on basis of I_H	 kW kW	 37 30	 45 37	 55 45	 75 55	 90 75
Rated pulse frequency	kHz	4	4	4	4	4
Power loss	kW	0,99	1,21	1,42	1,93	2,31
Cooling air requirement	m^3/s	0,022	0,039	0,094	0,094	0,117
Sound pressure level L_{pA} (1 m)	dB	< 60	62	< 60	< 60	65
24 V DC supply for the Control Unit	A	1,0	1,0	1,0	1,0	1,0

PM340	6SL3210-	1SE27-5UA0	1SE31-0UA0	1SE31-1UA0	1SE31-5UA0	1SE31-8UA0
PM340 with integrated line filter	6SL3210-	1SE27-5AA0	1SE31-0AA0	1SE31-1AA0	1SE31-5AA0	1SE31-8AA0
Rated input current [2] with/without integrated line reactor	A	78 / 88	94 / 105	115 / 129	151 / 168	186 / 204
UL fuses **Class J** Rated current Rated short-circuit current SCCR	 A kA	3NE1021-0 100 65	3NE1022-0 125 65	3NE1224-0 150 65	3NE1225-0 200 65	3NE1227-0 250 65
NH fuses **IEC 60947** Rated current	A	3NA3830 100	3NA3832 125	3NA3836 160	3NA3140 200	3NA3144 250
Circuit breaker type designation **IEC 60947** rated current	A	3VL1712-1DD33-0AA0 100 - 125	3VL1716-1DD33-0AA0 125 - 160	3VL3720-1DC36-0AA0 160 - 200	3VL3720-1DC36-0AA0 160 - 200	3VL3725-1DC36-0AA0 200 - 250
Resistance value of the external braking resistor	Ω	> 15		> 8,2		
Max. cable length to braking resistor	m	15				
Line supply connection L1, L2, L3		Stud M6, connectable cable cross-sections 10 to 50 mm^2		Stud M8, max. connection cable cross-section 120 mm^2		
Motor connection U2, V2, W2						
DC link connection, connection for braking resistor DCP/R1, DCN, R2						
PE connection		At the housing with M6 screw		At the housing with M8 screw		
Max. motor cable length [3] shielded/unshielded	m	70 / 100				
Degree of protection		IP20 or IPXXB				
Height PM340 with/without integrated line filter	mm (inch)	498,3 (19.62) / 633 (24.92)		634 (24.96) / 934 (36.77)		
Weight with/without integrated line filter	kg	19,8 / 27,1		50,7 / 66,7		

1) Rated power of a typical standard induction motor at 3 AC 400 V

2) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to u_k = 1%.

3) Max. motor cable length 25 m (shielded) for PM340 Power Modules with integrated line filter to comply with the limit values of EN 61800-3 Category C2.

4.2.6.3 Characteristics

Overload capability

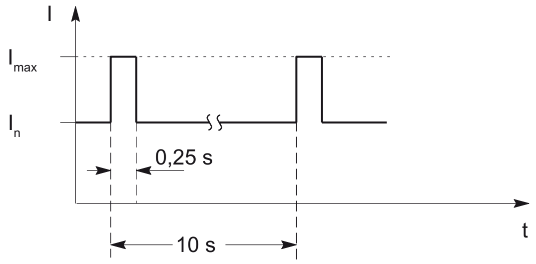


Figure 4-17 Duty cycle with initial load (for servo drives)

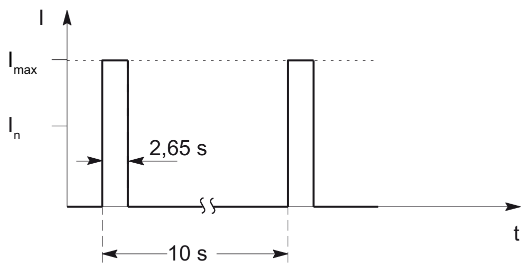


Figure 4-18 Duty cycle without initial load (for servo drives)

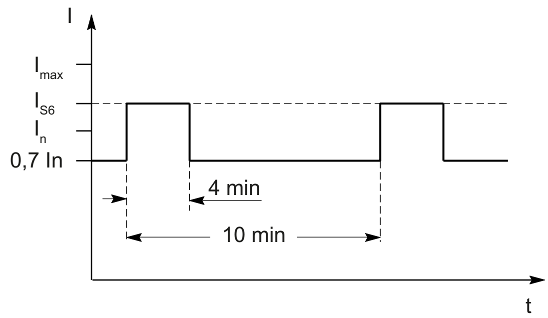


Figure 4-19 S6 duty cycle with initial load (for servo drives)

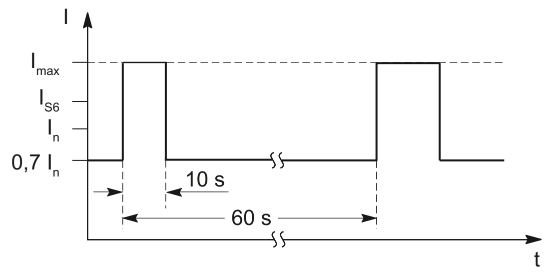


Figure 4-20 Duty cycle with initial load (for servo drives)

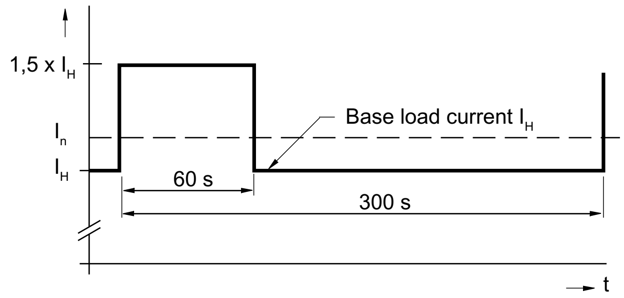


Figure 4-21 Duty cycle with 60 s overload with a duty cycle duration of 300 s

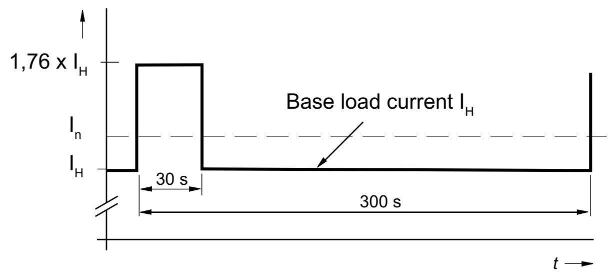


Figure 4-22 Duty cycle with 30 s overload with a duty cycle duration of 300 s

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Note

The short leading edges of the duty cycles shown can only be achieved using speed or torque control.

Derating characteristic for Power Modules in blocksize format

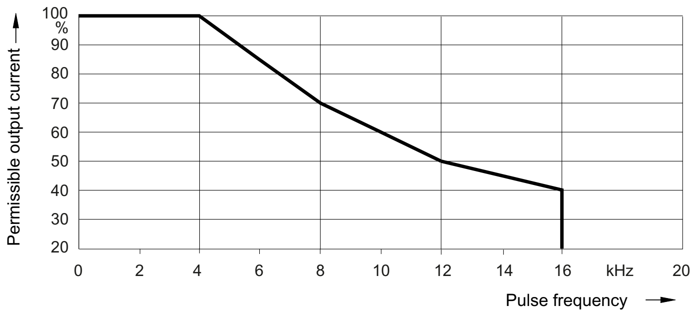

Figure 4-23 Frame sizes FSA to FSE: Output current as a function of the pulse frequency

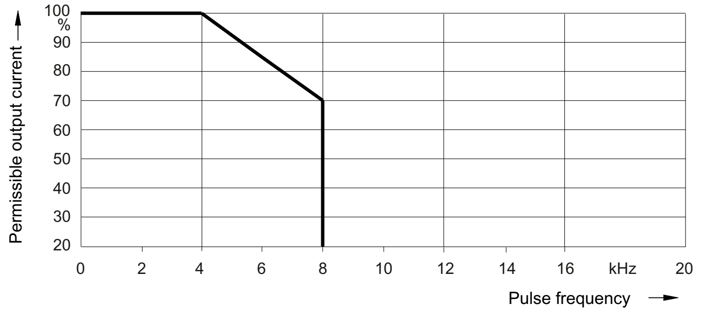

Figure 4-24 Frame size FSF: Output current as a function of the pulse frequency

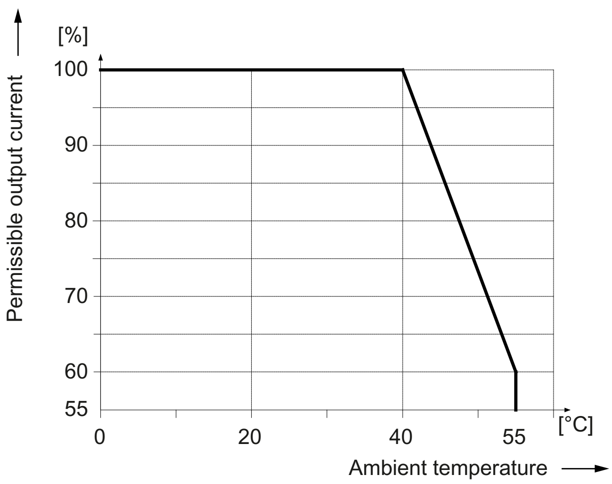

Figure 4-25 Output current as a function of the ambient temperature

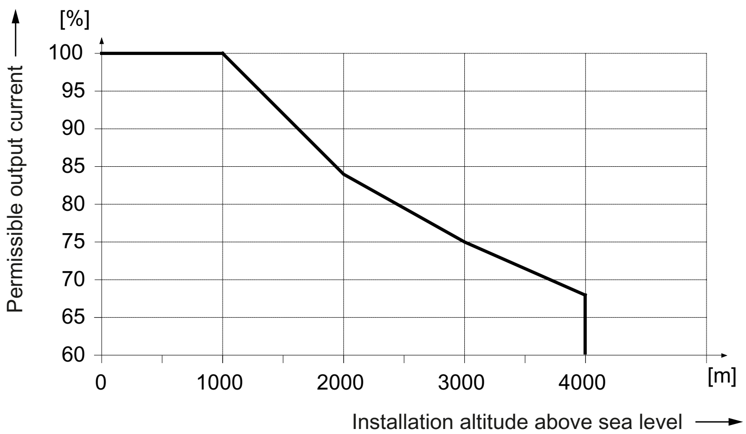

Figure 4-26 Output current as a function of the installation altitude

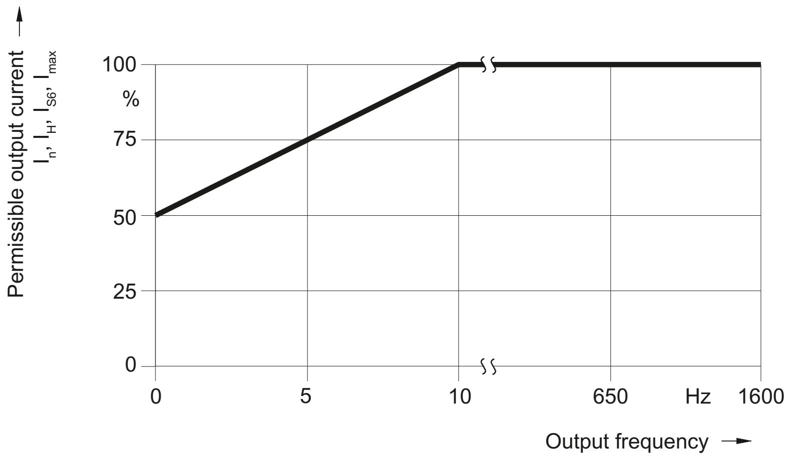

Figure 4-27 Output current as a function of the output frequency

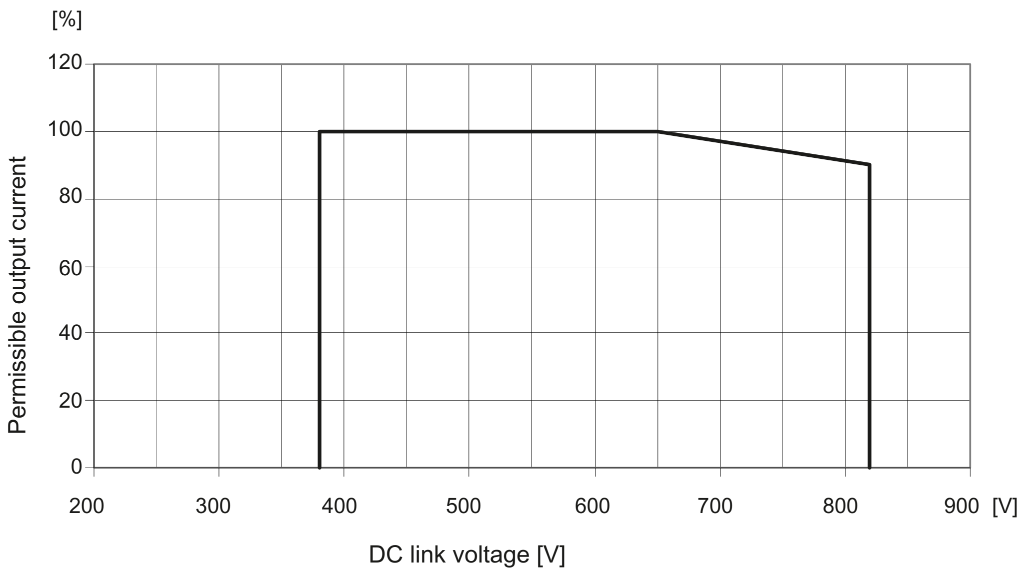

Figure 4-28 Current derating as a function of the DC-link voltage

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

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

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

4.3 Power Modules Blocksize Liquid Cooled (PM340)

4.3.1 Description

The Power Modules in Blocksize Liquid Cooled format (frame sizes FSD - FSF) are designed as follows:

- Line-side diode rectifier
- DC link electrolytic capacitors with pre-charging circuit
- Output inverter
- Braking chopper for (external) braking resistor
- 24 V DC / 1 A power supply
- Gating unit, actual value acquisition
- Internal liquid cooling

The Blocksize Liquid Cooled Power Modules cover the power range from 18.5 kW to 90.0 kW and are available without an integrated line filter.

Table 4- 15 Overview of Liquid Cooled Power Modules PM340

	
Power Module frame size FSD Liquid Cooled	Power Module frame size FSE Liquid Cooled

	
Power Module frame size FSF Liquid Cooled	

4.3.2 Safety instructions for Power Modules Blocksize Liquid Cooled

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Note

When handling/using a Power Module it is imperative that in addition to the safety instructions for Power Modules, you observe the safety instructions in Chapter 1.

⚠ WARNING

Danger of fire through overheating caused by insufficient ventilation and installation clearances

Insufficient ventilation and installation clearances result in overheating with danger to persons as a result of smoke and fire. Further, increased failures can occur and the service life of units/systems shortened.

- Always mount Power Modules in a vertical position.
- Maintain 300 mm ventilation clearances above and below the component.
- Maintain a 30 mm ventilation clearance in front of the component.
- Do not install devices in this area that could obstruct the cooling airflow.
- Ensure that the cooling air flow of the Power Modules can flow unrestricted.

Note

The Power Modules with frame sizes FSD, FSE, and FSF can be mounted without any lateral clearance.

NOTICE

Installation and service work for the coolant-relevant section

The equipment must be safely disconnected from the supply before any installation or service work is carried out on cooling circuit components.

The cooling circuit may only be connected by a trained specialist.

4.3.3 Interface description

4.3.3.1 Overview

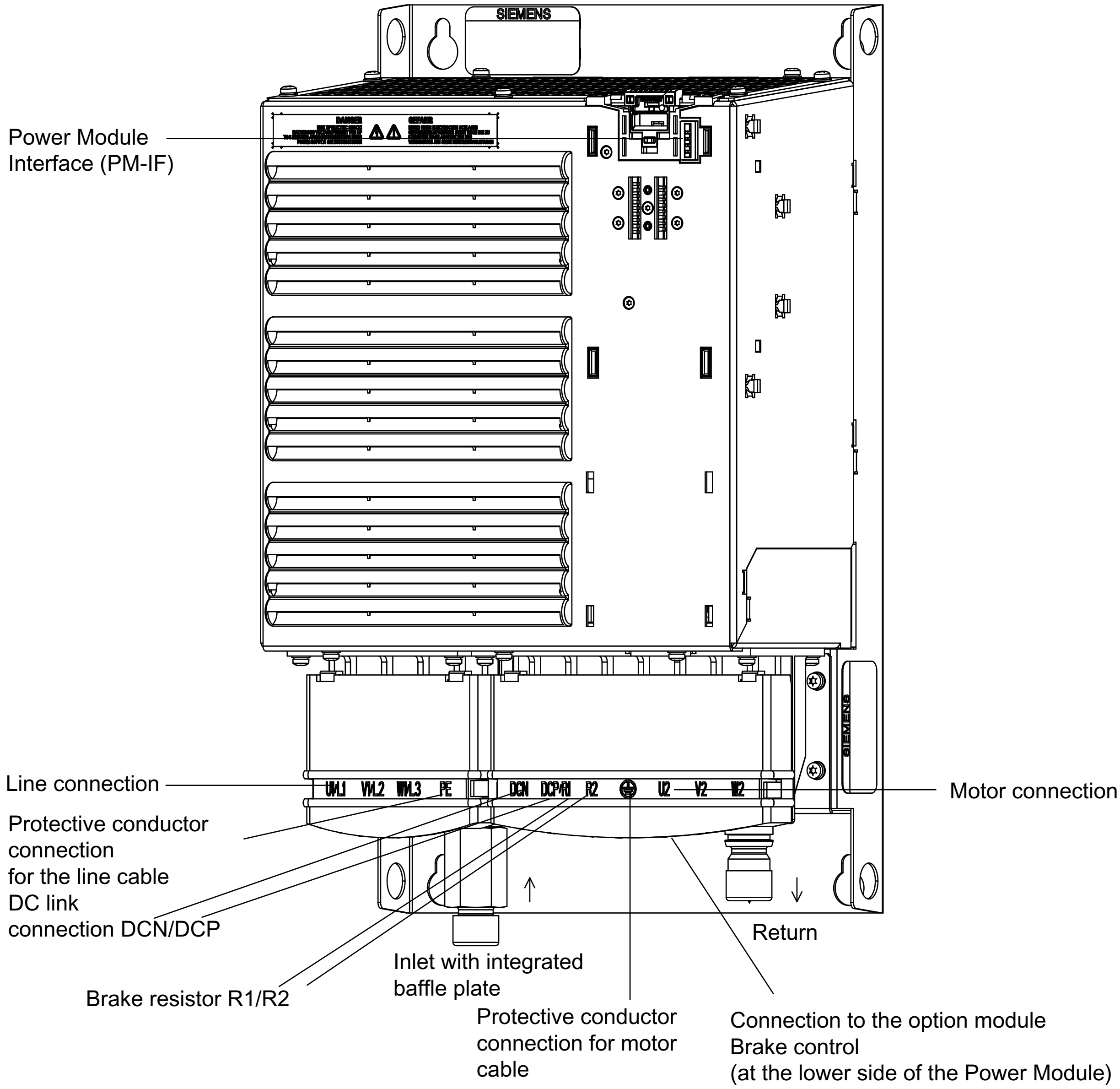


Figure 4-29 Liquid Cooled Power Module PM340 (Example: Frame size FSD)

4.3.3.2 Connection example

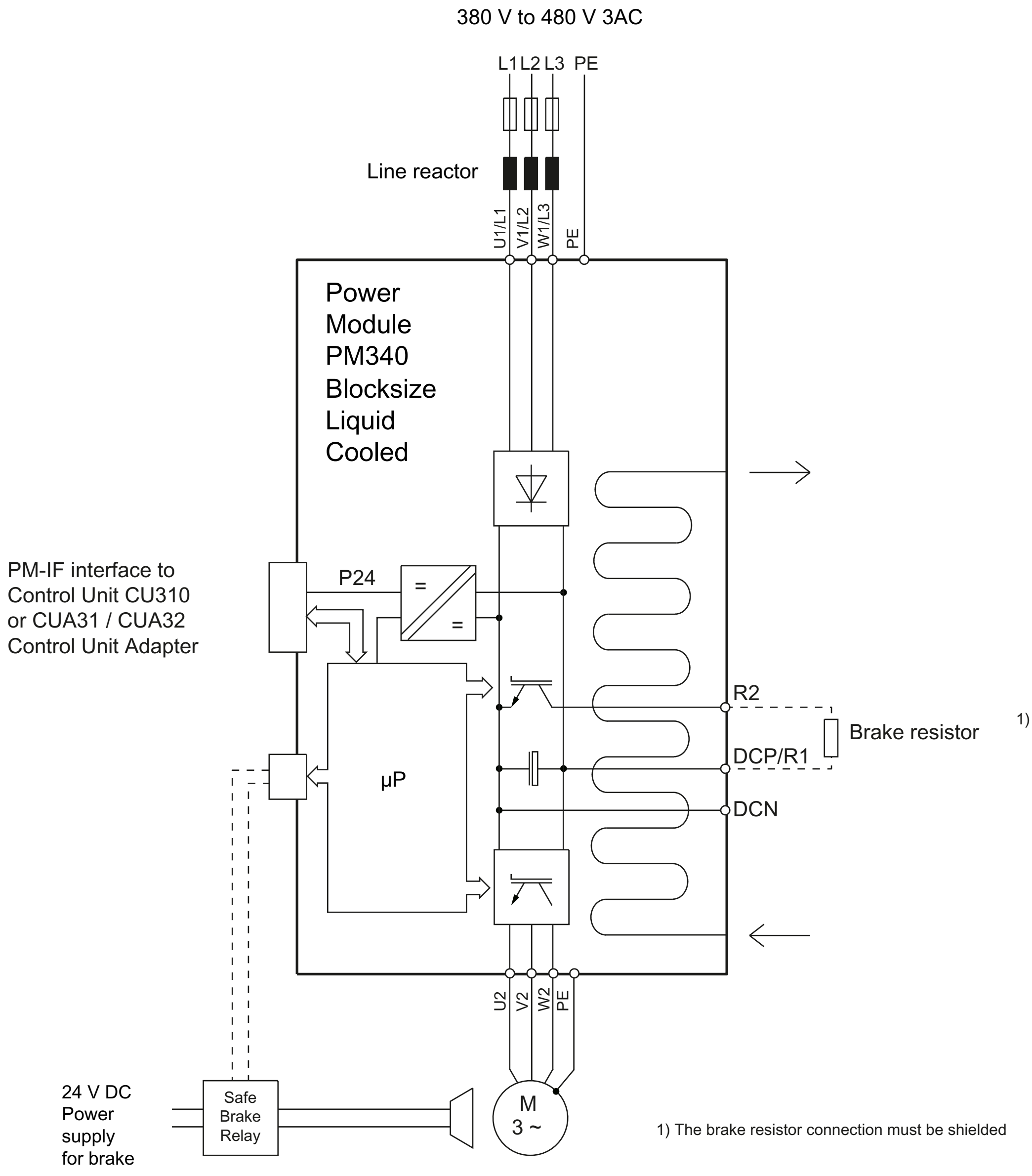
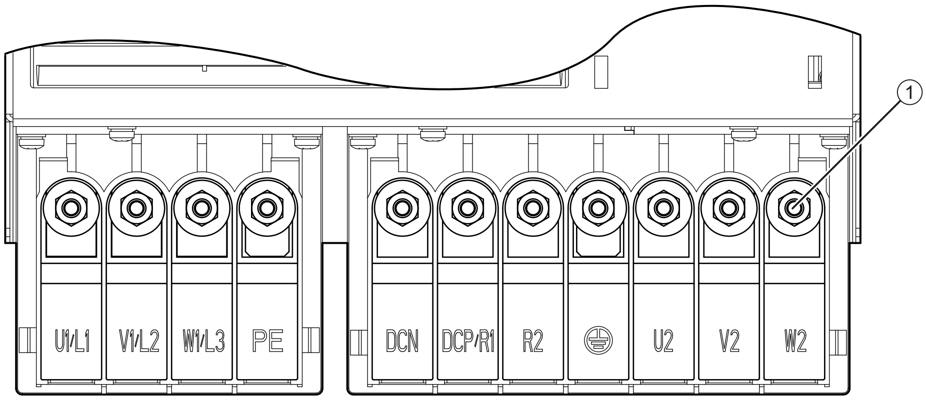


Figure 4-30 Connection example Power Module PM340 Liquid Cooled, 3 AC 380 V to 480 V

Arrangement of the line and motor terminals

The following diagram shows the arrangement of the line and motor terminals for PM340 Power Modules (frame sizes FSD to FSF). The legend contains the tightening torques for the terminals.

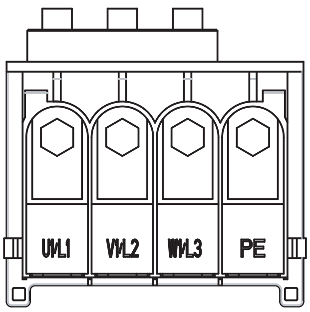


① Frame sizes, FSD/FSE: 6Nm (M6) Frame size FSF: 13 Nm (M8)

Figure 4-31 PM340 Liquid Cooled: Arrangement of the line and motor terminals (frame sizes FSD to FSF)

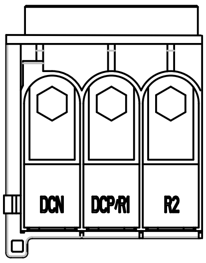
4.3.3.3 Line supply connection

Table 4- 16 Terminal block, line supply connection 3-ph. 380 V - 480 V AC

	Terminal	Signal name	Technical specifications
	1	U1/L1	External conductor L1
	2	V1/L2	External conductor L2
	3	W1/L3	External conductor L3
	4	PE	PE connection

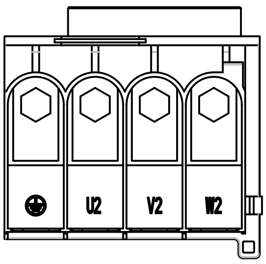
4.3.3.4 Braking resistor and DC link connection

Table 4- 17 Terminal block, braking resistor, and DC link connection

	Terminal	Technical specifications
	DCN	DC link negative
	DCP/R1	DC link positive and positive connection for braking resistor
	R2	Negative connection for the braking resistor

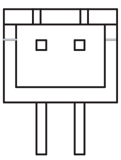
4.3.3.5 Motor connection

Table 4- 18 Terminal block, motor connection 380 V - 480 V 3 AC

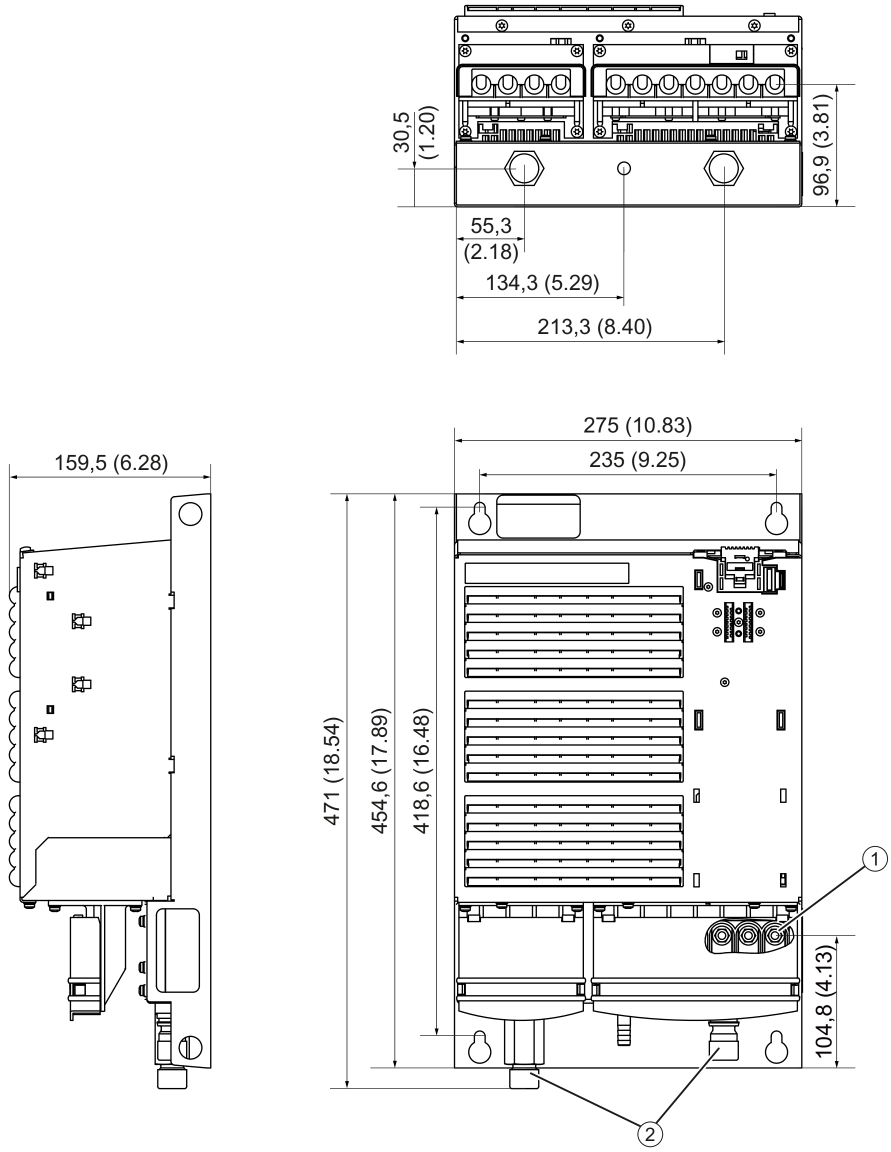
	Terminal	Technical specifications
		PE connection
	U2	Motor phase U
	V2	Motor phase V
	W2	Motor phase W

4.3.3.6 Connection to the option module, brake control

Table 4- 19 Connector

	Terminal	Designation	Technical specifications
	1	Low	Low signal, option module brake control at PM340
	2	High	High signal, option module brake control at PM340

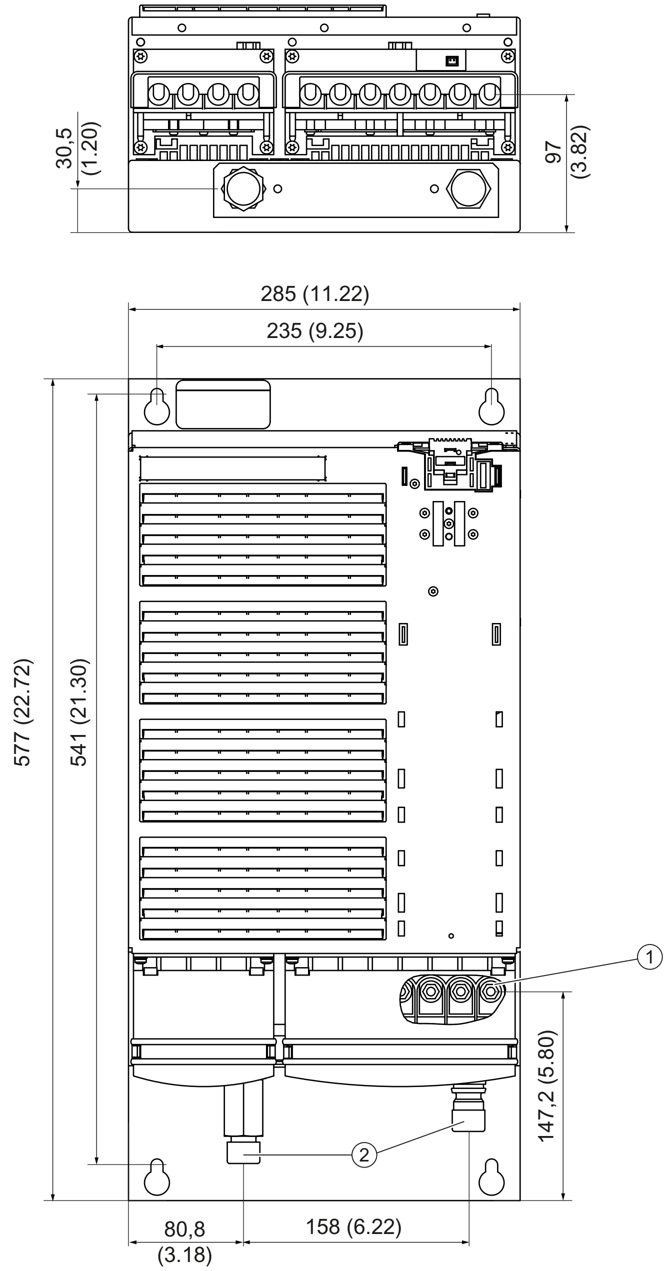
4.3.4 Dimension drawings



① M6 connections, tightening torque: 6 Nm

② Pipe thread ISO 228 G 1/2

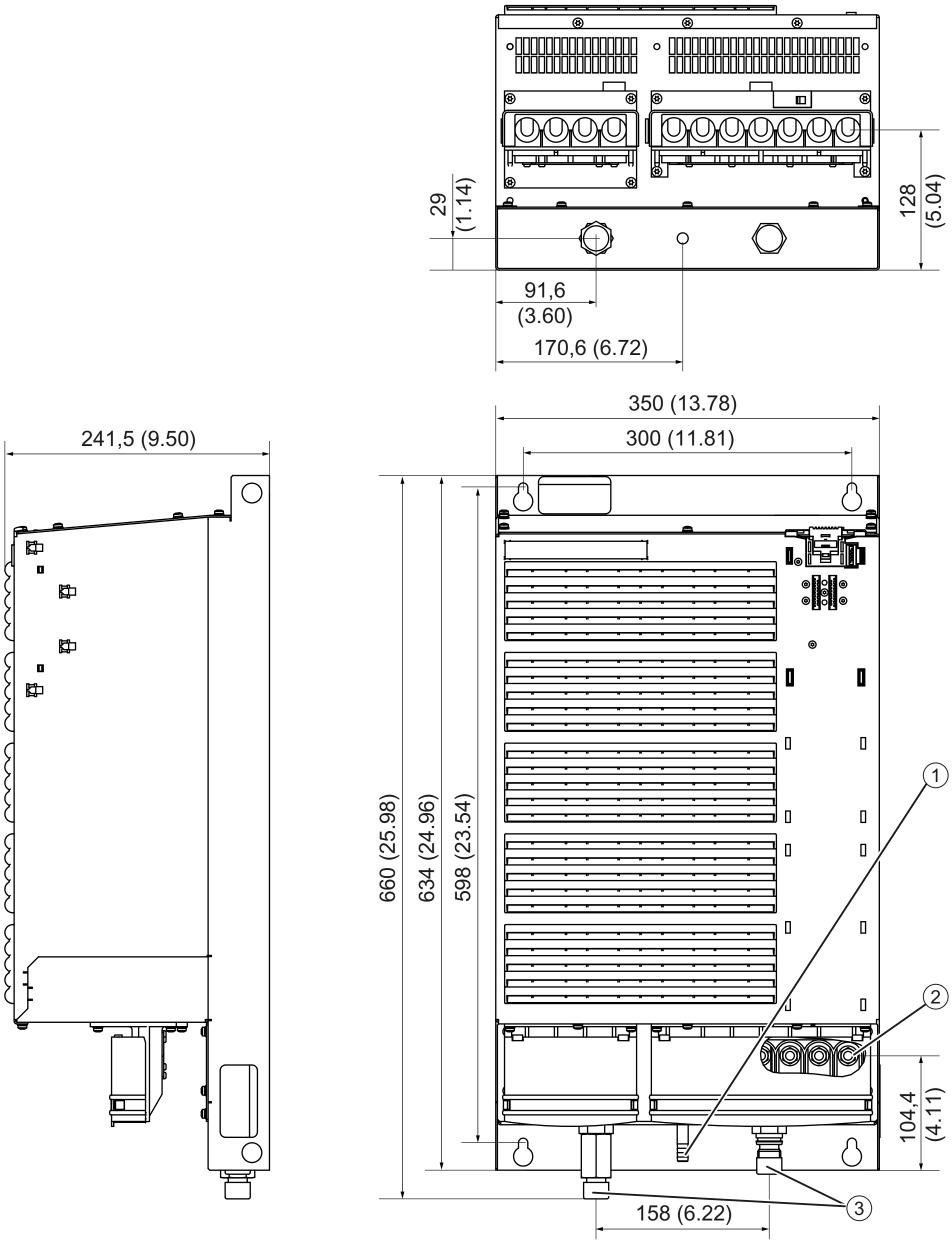
Figure 4-32 Dimension drawing: Liquid Cooled Power Module PM340, frame size FSD, all dimensions in mm (inches)



① M6 connections, tightening torque: 6 Nm

② Pipe thread ISO 228 G 1/2

Figure 4-33 Dimension drawing: Liquid Cooled Power Module PM340, frame size FSE, all dimensions in mm (inches)



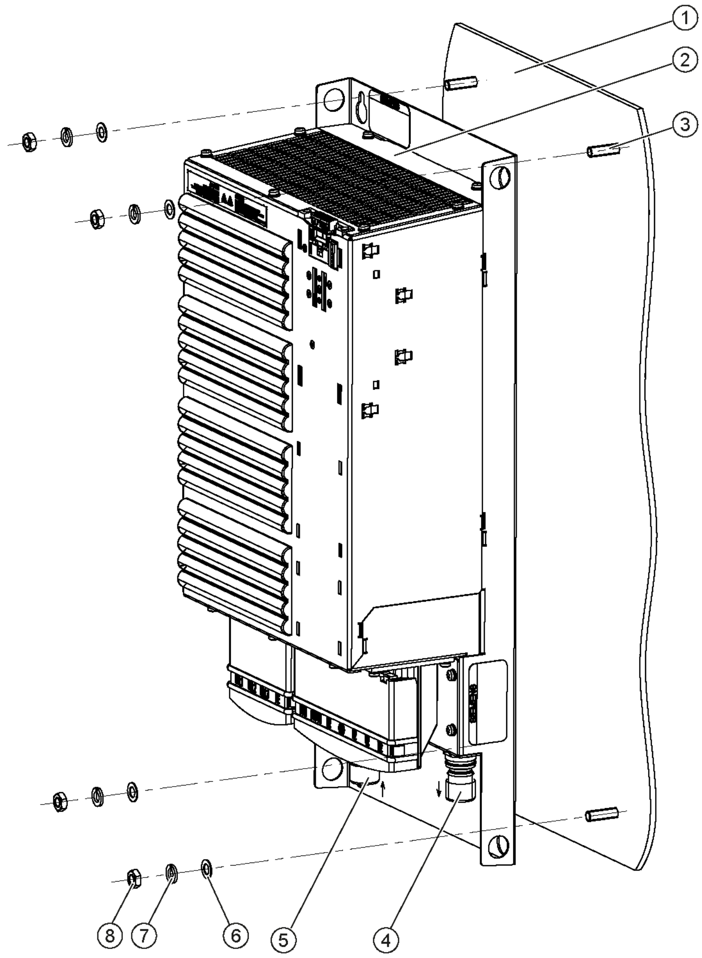
① Hose connection to drain condensation
② M8 connections, tightening torque: 13 Nm
③ Pipe thread ISO 228 G 1/2

Figure 4-34 Dimension drawing: Liquid Cooled Power Module PM340, frame size FSF, all dimensions in mm (inches)

4.3.5 Mounting

The coolant hoses should be connected before the devices are installed.

The diagram shows the installation of the Power Module PM340 Liquid Cooled with integrated heat sink using frame size FSE as an example.



① Mounting panel
② Integrated heat sink
③ Studs (M8)
④ Return
⑤ Inlet
⑥ Washer
⑦ Toothed lock washer
⑧ Nut (M8)

Figure 4-35 Installation of Power Module PM340 Liquid Cooled with integrated heatsink (frame size FSE)

The connections for the coolant are on the underside.
Water connection thread type: Pipe thread ISO 228 G ½ B.

Access to the power supply terminals and motor terminals

The line and motor terminals are accessed by releasing the tab on the side of the terminal covers using a suitable screwdriver. The cover can then be pushed upwards and snapped into this position as shown in the following diagram.

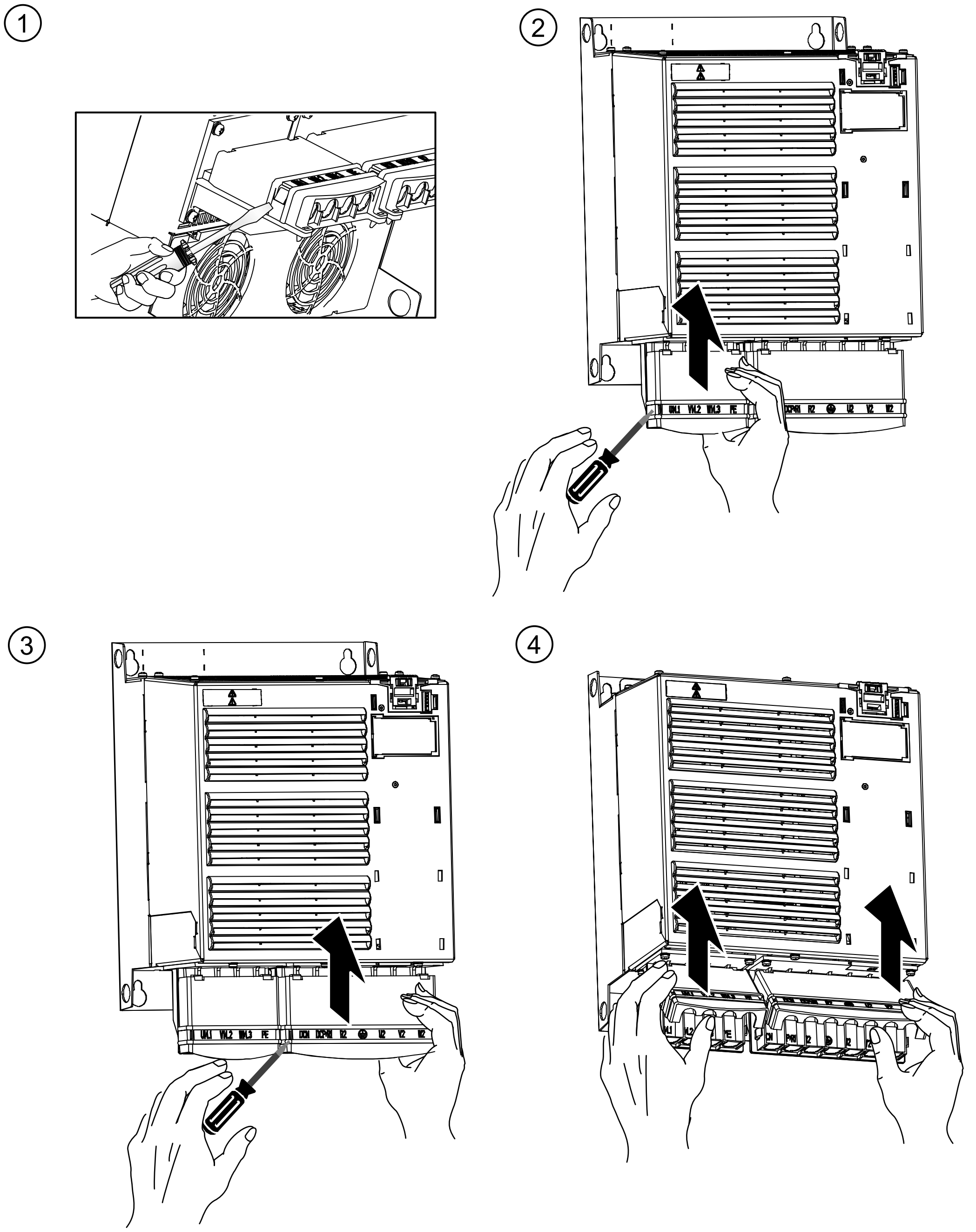


Figure 4-36 Access to the line and motor terminals for Liquid Cooled Power Modules

⚠ DANGER
Once the terminal cover has been removed, the degree of protection of the Power Module is reduced to IP00.

4.3.6 Connection to the cooling circuit

The coolant connection for SINAMICS units is established by means of a 1/2" screwed joint.

The supply and return lines must be connected using a flexible, non-conductive hose, in order to

- Prevent electrochemical corrosion,
- Reduce the transmission of vibrations, and
- Dampen pressure transients in the coolant.

The hose should be about 1.5 m in length (total of supply and return lines).

For information about the coolant and the configuration of the cooling circuit, refer to the chapter titled "Cooling circuit and coolant properties".

4.3.7 Commissioning

Prior to commissioning

Once the devices have been installed and before they are commissioned, the cooling circuit must be checked for leaks.

After commissioning

The recommended servicing procedure for the cooling circuit is to check the fill level and the coolant for discoloration or cloudiness at least once a year.

If the coolant level has dropped, the loss should be corrected on closed or semi-open circuits with a prepared mixture of distilled water and inhibitor or Antifrogen N.

4.3.8 Technical data

Table 4- 20 Technical data PM340 Blocksize Liquid Cooled, FSD

PM340 Power Module	6SL3215-	1SE23-8UAx	1SE26-0UAx
Frame size		FSD	FSD
Output current Rated current I_n Base-load current I_H for S6 operation (40%) I_{s6} Peak current I_{max}	 A A A A	 38 33 49 64	 60 48 78 90
Type rating 1) on basis of I_n on basis of I_H	 kW kW	 18,5 15	 30 22
Rated pulse frequency	kHz	4	4
Power loss total, approx. to ambient air, approx.	 kW kW	 0,38 0,09	 0,69 0,13
Cooling circuit Rated volumetric flow for water at 70 kPa pressure drop Liquid volume of integrated heat exchanger	 l/min l	 8 0,1	 8 0,1
Sound pressure level L_{pA} (1 m)	dB	< 60	< 60
24 V DC supply for the Control Unit	 A	 1,0	 1,0
Rated input current 2) with/without integrated line reactor	 A	 40 / 46	 63 / 72
Class J UL fuses Rated current Rated short-circuit current SCCR	 A kA	 50 65	 90 65
NH fuses Rated current	 A	3NA3820 50	3NA3824 80
Circuit breaker type designation IEC 60947 rated current	 A	3RV1042-4JA10 45 - 63	3RV1042-4MA10 80 - 100
Resistance value of the external braking resistor	 Ω	 > 27	 > 27
Max. cable length to braking resistor	 m	 15	 15
Line supply connection L1, L2, L3		Stud M6, connectable cable cross-sections 10 to 50 mm^2 for ring cable lugs	
Motor connection U2, V2, W2			
DC link connection, connection for braking resistor DCP/R1, DCN, R2			
PE connection			
Max. motor cable length	m	70 (shielded) / 100 (unshielded)	
Degree of protection		IP20 or IPXXB	

PM340 Power Module	6SL3215-	1SE23-8UAx	1SE26-0UAx
Depth - PM340 - PM340 with CU310-2 - PM340 with CUA3x	 mm (inch) mm (inch) mm (inch)	 159,5 (6.28) 225,2 (8.87) 181,3 (7.13)	
Weight with CU310-2	kg kg	10,5 11,5	10,5 11,5

1) Rated power of a typical standard induction motor at 3 AC 400 V

2) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to u_k = 1%

Table 4- 21 Technical data, PM340 Blocksize Liquid Cooled, Part 2

PM340 Power Module	6SL3215-	1SE27-5UAx	1SE31-0UAx	1SE31-1UAx	1SE31-8UAx
Frame size		FSE	FSE	FSF	FSF
Output current Rated current I_n Base-load current I_H for S6 operation (40%) I_{s6} Peak current I_{max}	 A A A A	 75 65 98 124	 90 80 117 150	 110 95 143 180	 178 155 231 290
Type rating 1) on basis of I_n on basis of I_H	 kW kW	 37 30	 45 37	 55 45	 90 75
Rated pulse frequency	kHz	4	4	4	4
Power loss total, approx. to ambient air, approx.	 kW kW	 0,99 0,16	 1,21 0,19	 1,42 0,21	 2,31 0,35
Cooling circuit Rated volumetric flow for water at 70 kPa pressure drop Liquid volume of integrated heat exchanger	 l/min l	 8 0,13	 8 0,13	 8 0,2	 8 0,2
Sound pressure level L_{pA} (1 m)	dB	< 60	62	< 60	65
24 V DC supply for the Control Unit	 A	 1,0	 1,0	 1,0	 1,0
Rated input current 2) with/without integrated line reactor	 A	 78 / 88	 94 / 105	 115 / 129	 186 / 204
Class J UL fuses Rated current Rated short-circuit current SCCR	 A kA	 100 65	 125 65	 150 65	 250 65
NH fuses Rated current	 A	3NA3830 100	3NA3832 125	3NA3836 160	3NA3144 250
Circuit breaker type designation IEC 60947 rated current	 A	3VL1712-1DD33-0AA0 100 - 125	3VL1716-1DD33-0AA0 125 - 160	3VL3720-1DC36-0AA0 160 - 200	3VL3725-1DC36-0AA0 200 - 250

PM340 Power Module	6SL3215-	1SE27-5UAx	1SE31-0UAx	1SE31-1UAx	1SE31-8UAx
Resistance value of the external braking resistor	Ω	> 15		> 8,2	
Max. cable length to braking resistor	m	15			
Line supply connection L1, L2, L3		Stud M6, connectable cable cross-sections 10 to 50 mm² for ring cable lugs		Stud M8, max. connection cable cross-section 120 mm²	
Motor connection U2, V2, W2					
DC link connection, connection for braking resistor DCP/R1, DCN, R2					
PE connection					
Max. motor cable length	m	70 (shielded) / 100 (unshielded)			
Degree of protection		IP20 or IPXXB			
Depth - PM340 - PM340 with CU310-2 - PM340 with CUA3x	 mm (inch) mm (inch) mm (inch)	 159,5 (6.28) 225,2 (8.87) 181,3 (7.13)		 241,5 (9.50) 322,4 (12.69) 263 (10.35)	
Weight with CU310-2	kg	14,8 15,8		29,2 30,2	

1) Rated power of a typical standard induction motor at 3 AC 400 V

2) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to u_k = 1%.

4.3.8.1 Characteristics

Overload capability

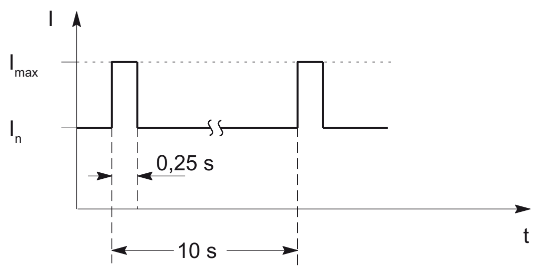


Figure 4-37 Duty cycle with initial load (for servo drives)

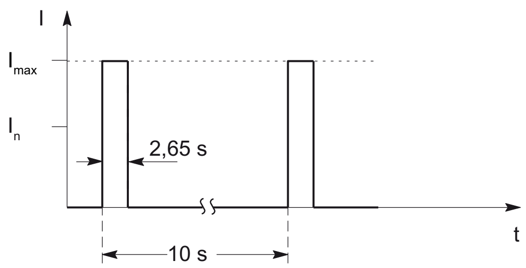


Figure 4-38 Duty cycle without initial load (for servo drives)

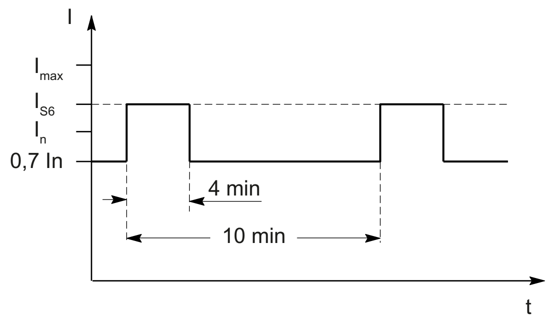


Figure 4-39 S6 duty cycle with initial load (for servo drives)

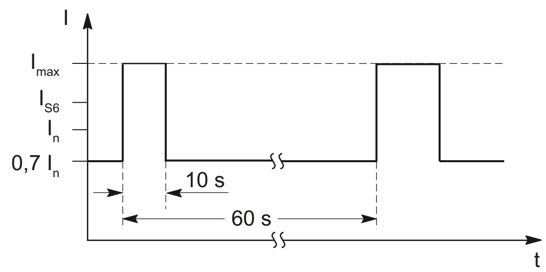


Figure 4-40 Duty cycle with initial load (for servo drives)

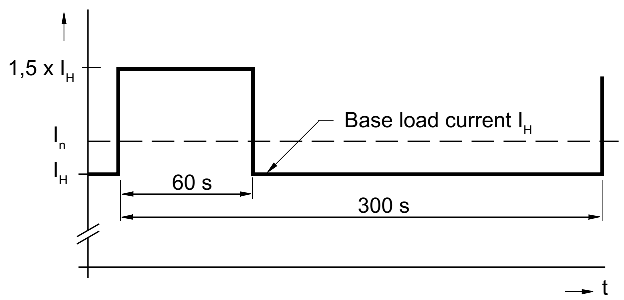


Figure 4-41 Duty cycle with 60 s overload with a duty cycle duration of 300 s

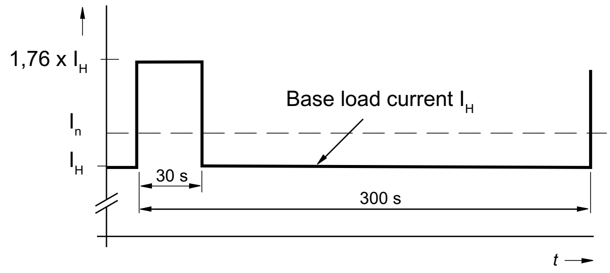


Figure 4-42 Duty cycle with 30 s overload with a duty cycle duration of 300 s

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Note

The short leading edges of the duty cycles shown can only be achieved using speed or torque control.

Derating characteristics for Power Modules in blocksize Liquid Cooled format

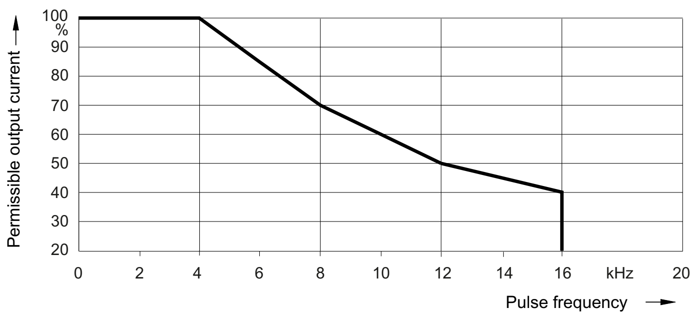


Figure 4-43 Frame sizes FSD and FSE: Output current as a function of the pulse frequency

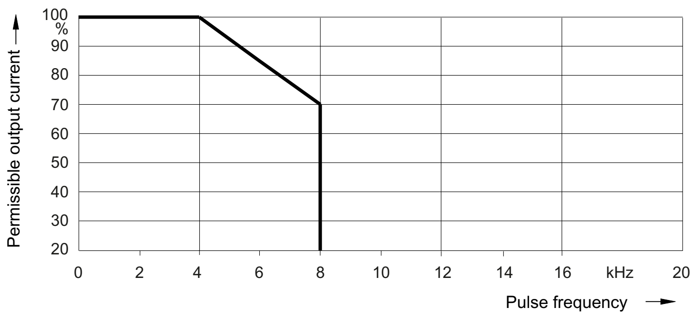


Figure 4-44 Frame size FSF: Output current as a function of the pulse frequency

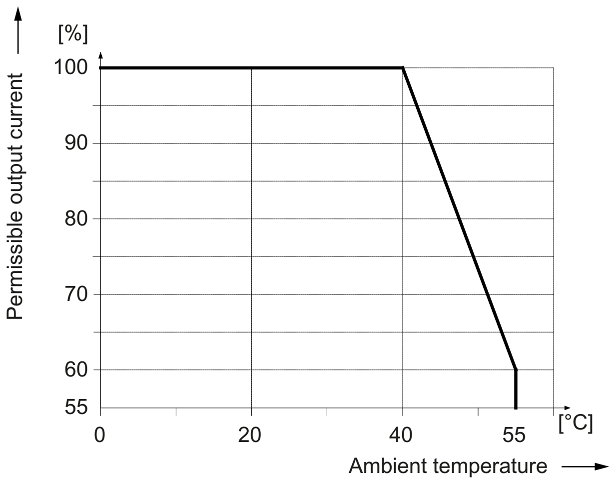


Figure 4-45 Output current as a function of the ambient temperature

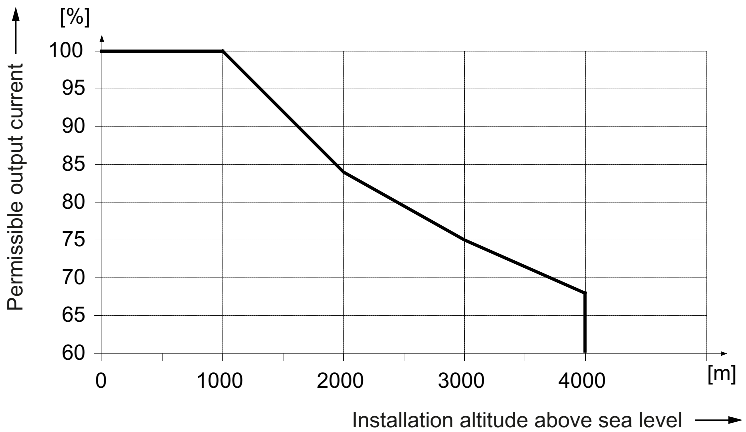


Figure 4-46 Output current as a function of the installation altitude

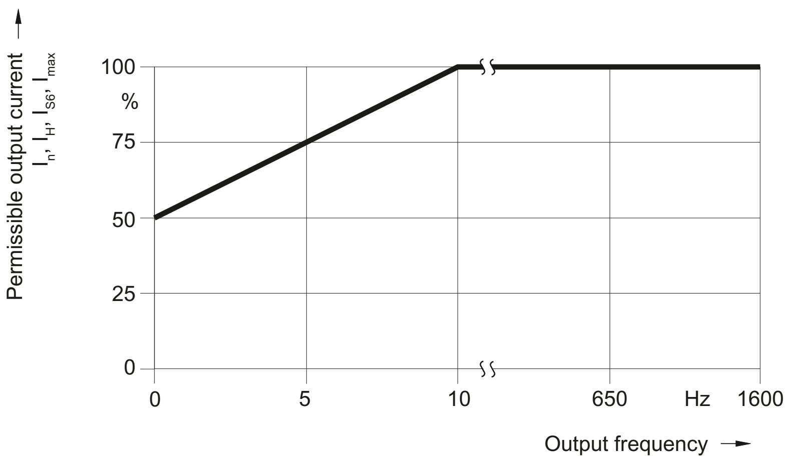


Figure 4-47 Output current as a function of the output frequency

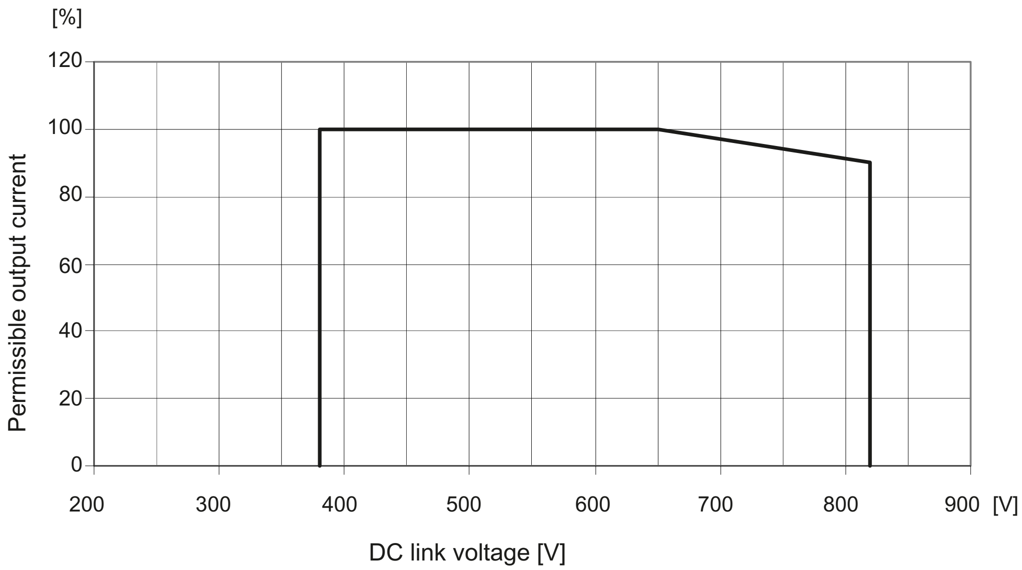


Figure 4-48 Current derating as a function of the DC-link voltage

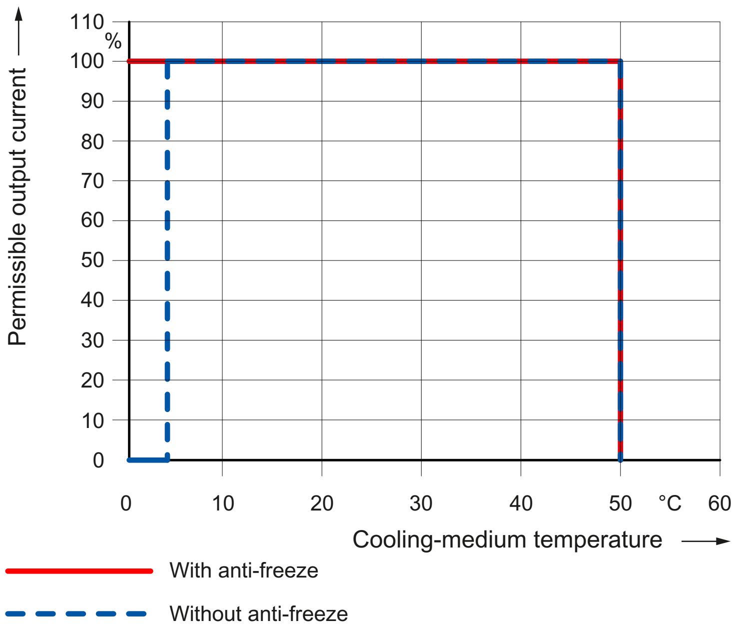


Figure 4-49 Current derating as a function of the ambient temperature

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

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

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

See also: Chapter entitled "Notes on cooling circuit configuration", Table entitled "Drop in pressure with different coolant temperatures."

4.4 Power Modules Chassis

4.4.1 Description

A Power Module is a power unit (frequency inverter) that provides the power supply for the connected motor. A Power Module must be connected to a Control Unit via DRIVE-CLiQ. The open-loop and closed-loop control functions are stored in the Control Unit.

Characteristics of Power Modules

- Version from 210 A to 490 A
- Internal air cooling
- Short-circuit/ground-fault-proof
- Electronic type plate
- Operating status and error status displayed using LEDs
- DRIVE-CLiQ interface for communication with the Control Unit and/or other components in the drive line-up
- Integration in system diagnostics

4.4.2 Safety instructions for Power Modules chassis format

Note

When handling/using a Power Module in the chassis format it is imperative that in addition to the safety instructions for Power Modules, you observe the safety instructions in Chapter 1.

⚠ WARNING

Danger of fire through overheating for insufficient ventilation clearances

Insufficient ventilation clearances result in overheating with danger to persons as a result of smoke and fire. Further, increased failures can occur and the service life of units/systems shortened.

- Observe the cooling clearances above, below, and in front of the component, which are specified in the dimension drawings.

4.4.3 Interface description

4.4.3.1 Overview

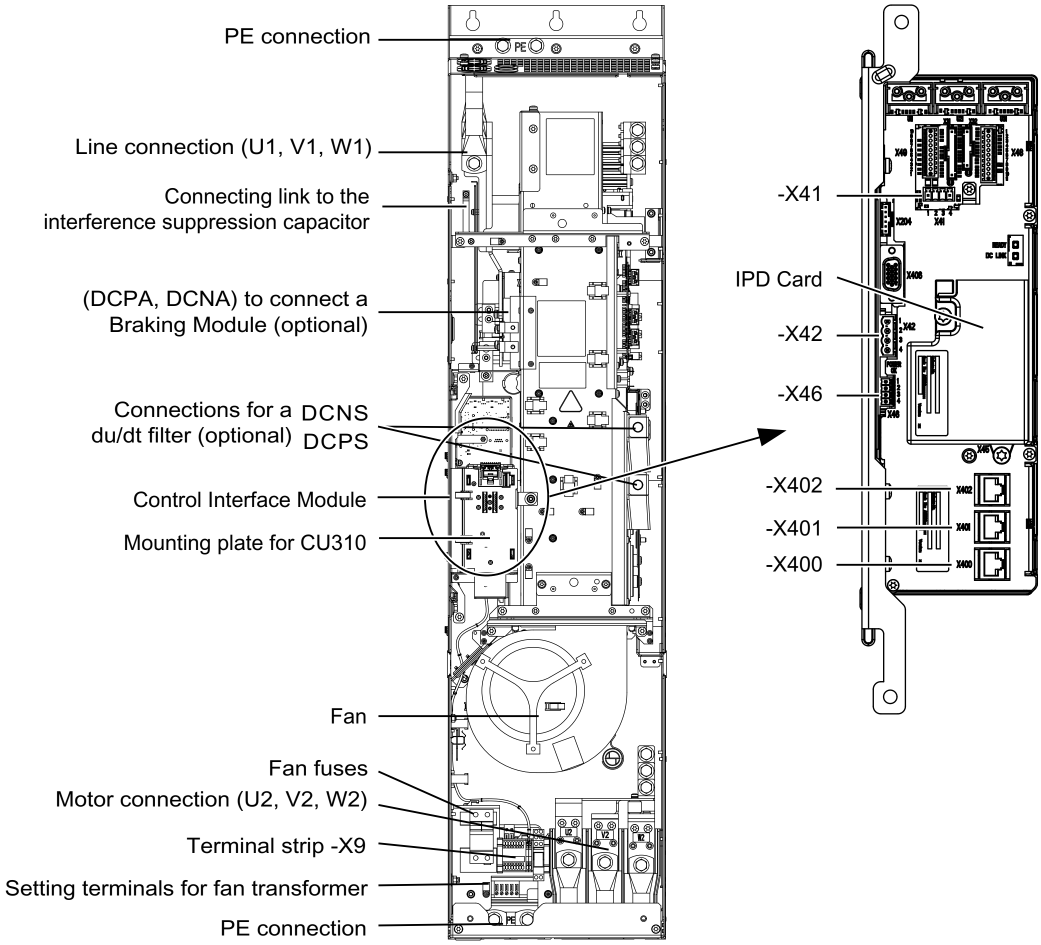


Figure 4-50 Power Module, frame size FX

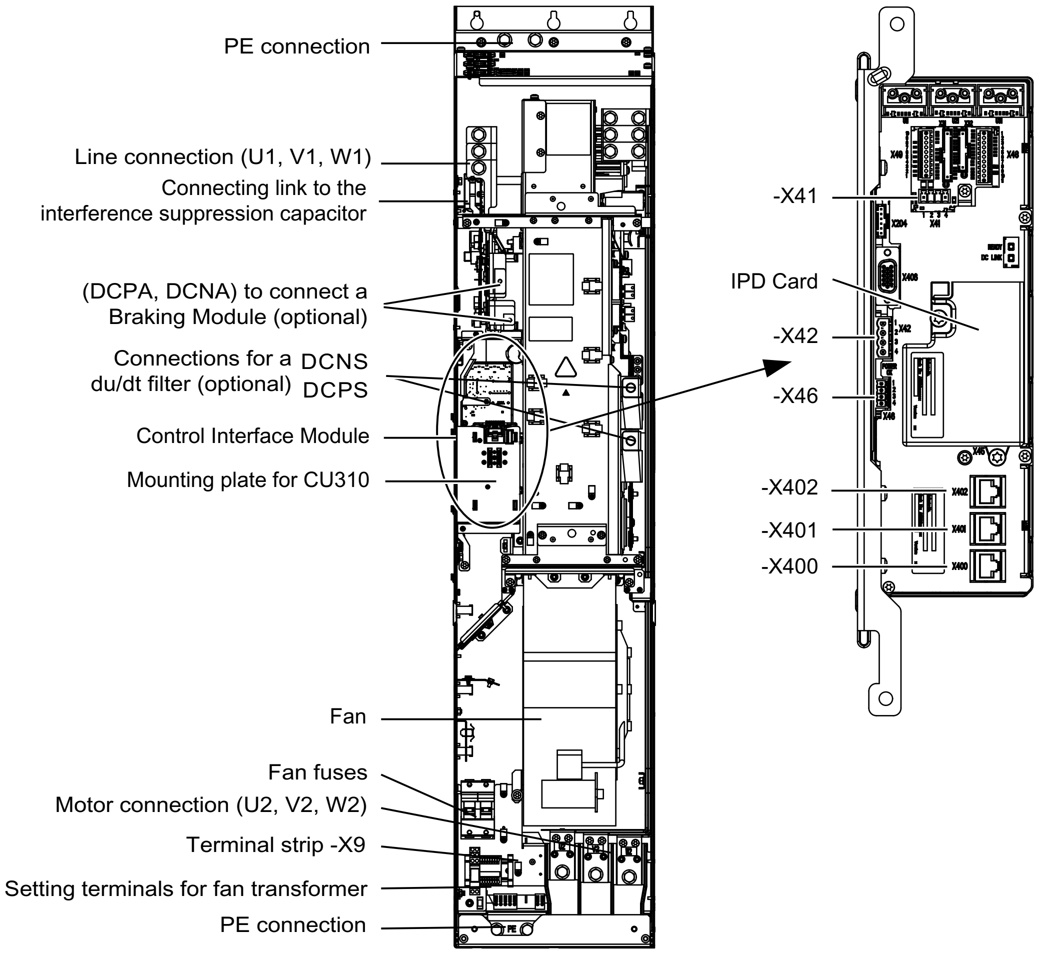


Figure 4-51 Power Module, frame size GX

4.4.3.2 Connection example

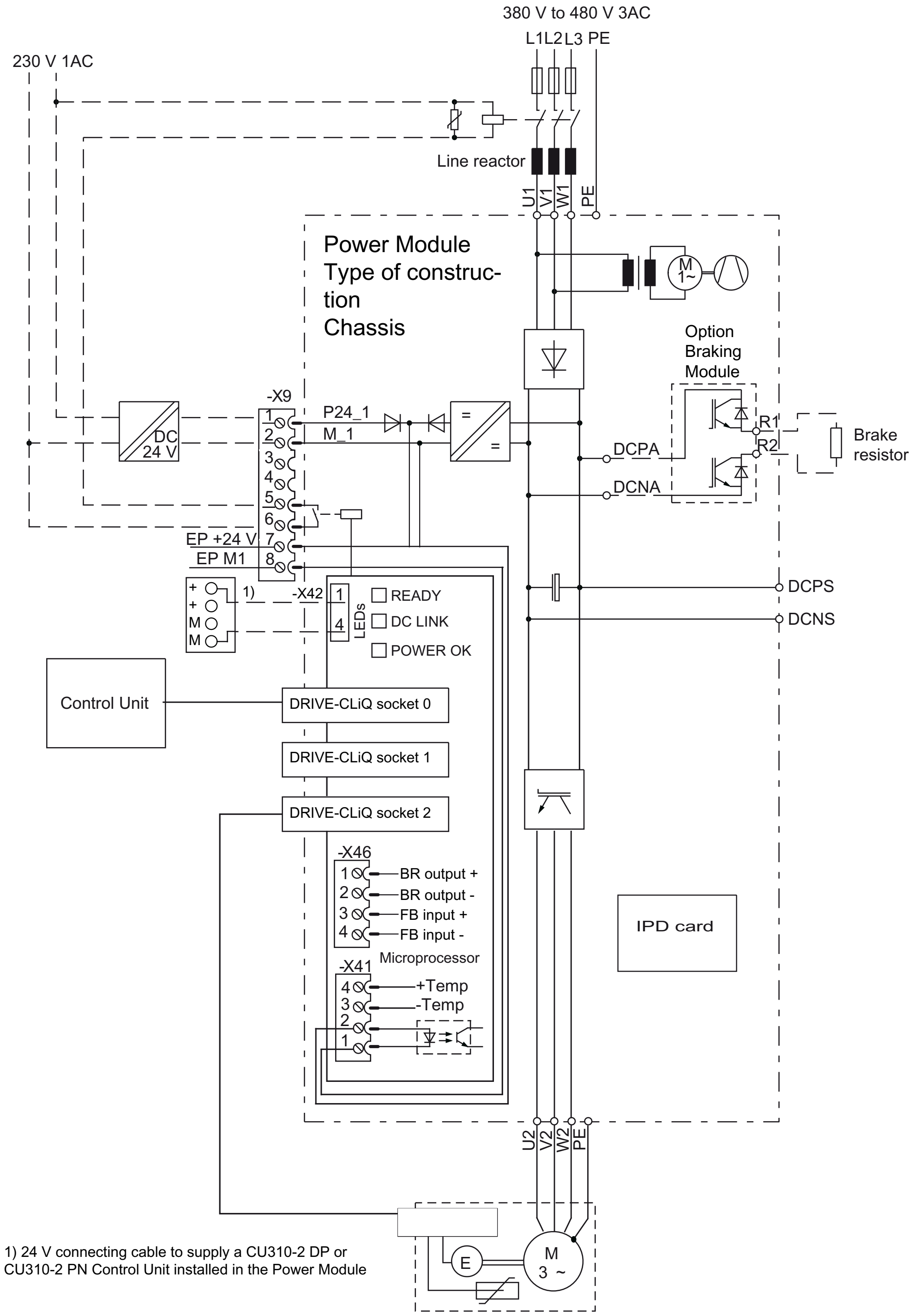
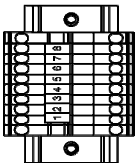


Figure 4-52 Connection example: Power Module chassis

4.4.3.3 Terminal Block X9

Table 4- 22 Terminal block X9

	Terminal	Signal name	Technical specifications
	1	P24V	Voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: max 1.4 A
	2	M	
	3	Reserved, do not use	
	4	Reserved, do not use	
	5	Main contactor	240 V AC/ max. 8 A 30 V DC/ max. 1 A
	6	Main contactor	
	7	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20,8 V - 28.8 V) Current consumption: 10 mA Signal propagation times: L->H: 100 µs H->L: 1000 µs The pulse disable function is only available when Safety Integrated Basic Functions are enabled.
	8	EP M1 (Enable Pulses)	

Note

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

Note

If the "Safe Torque Off" function is selected, 24 V DC must be applied to terminal -X9:7 and terminal -X9:8 must be grounded. Upon removal, pulse inhibit is activated.

4.4.3.4 DCPS, DCNS connection for a dv/dt filter

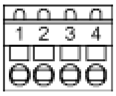
Table 4- 23 DCPS, DCNS

Frame size	Cross-section that can be connected	Terminal screw
FX	1 x 35 mm²	M8
GX	1 x 70 mm²	M8

The connecting cable is fed-out downwards through the Power Module.

4.4.3.5 X41 EP terminal / temperature sensor connection

Table 4- 24 Terminal block -X41

	Terminal	Function	Technical data
	1	EP M1 (Enable Pulses)	Supply voltage: 24 V DC (20.4 V – 28.8 V) Current consumption: 10 mA Signal propagation times: L → H: 100 μs H → L: 1000 μs
	2	EP +24 V (Enable Pulses)	
	3	-Temp	Temperature sensor KTY84-1C130 / PTC / PT100 sensors
	4	+Temp	
Max. connectable cross-section: 1.5 mm²			

⚠ DANGER

Risk of electric shock!

Only temperature sensors that meet the electrical separation 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) must be used.

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

NOTICE

Component damage due to missing shielding

The temperature sensor connection must be shielded. The shielding must be attached to the shield support of the Power Module.

NOTICE

Risk of motor overheating for incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Make sure that you connect the KTY temperature sensor with the correct polarity.

Note

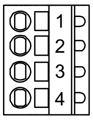
The temperature sensor connection can be used for motors that are equipped with a KTY84-1C130/PTC/PT100 probe in the stator windings.

Note

A cable harness is used to connect terminals -X41:1 and -X41:2 to terminals -X9:8 and -X9:7.

4.4.3.6 X42 terminal strip

Table 4- 25 Terminal block -X42:

	Terminal	Function	Technical data
	1	P24L	Voltage supply for Control Unit, Sensor Module, and Terminal Module (18 to 28.8 V) Maximum load current: 3 A
	2		
	3	M	
	4		
Max. connectable cross-section 2.5 mm²			

Note

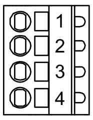
When delivered, terminals 1 and 4 are provided with a connecting cable to supply a CU310-2 DP or CU310-2 PN Control Unit.

⚠ CAUTION

The terminal block is not intended for free 24 V DC availability (for example for supplying further line-side components), as the voltage supply of the Control Interface Module could also be overloaded and operating capability could thus be compromised.

4.4.3.7 X46 Brake control and monitoring

Table 4- 26 Terminal block -X46

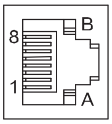
	Terminal	Function	Technical data
	1	BR output +	This interface is intended for the connection of the safe brake adapter.
	2	BR output -	
	3	FB input +	
	4	FB input -	
Max. connectable cross-section 1.5 mm²			

NOTICE

The length of the connecting cable at terminal block -X46 must not exceed 10 m, and the cable must not be brought out outside the control cabinet or control cabinet group.

4.4.3.8 DRIVE-CLiQ interface X400-X402

Table 4- 27 DRIVE-CLiQ interface X400-X402

	Pin	Name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	GND (0 V)	Electronic ground

4.4.3.9 Meaning of the LEDs on the Power Module

Table 4- 28 Meaning of the LEDs "READY" and "DC LINK" on the Control Interface Module on the Power Module

LED state		Description
READY	DC LINK	
Off	Off	The electronics power supply is missing or lies outside permissible tolerance range.
Green	Off	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC-link voltage is present.
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC-link voltage is too high.
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.
Green/Red (0.5 Hz)	---	Firmware is being downloaded.
Green/Red (2 Hz)	---	Firmware download is complete. Wait for POWER ON.
Green/orange or red/orange	---	Identifying whether the component is activated using the LED (p0124) **Note:** Both possibilities depend on the LED status when activated using p0124 = 1.

DANGER

Irrespective of the state of the LED "DC LINK", hazardous DC-link voltages can always be present.

The warning information on the components must be carefully observed!

Table 4- 29 Meaning of the LED "POWER OK" on the Control Interface Module in the Power Module

LED	Color	Status	Description
POWER OK	Green	Off	DC-link voltage < 100 V and voltage at X9:1/2 less than 12 V.
		On	The component is ready for operation.
		Flashing	There is a fault. If the LED continues to flash after you have performed a POWER ON, please contact your Siemens service center.

4.4.4 Dimension drawings

Dimension drawing frame size FX

The cooling clearances to be maintained are indicated by the dotted line.

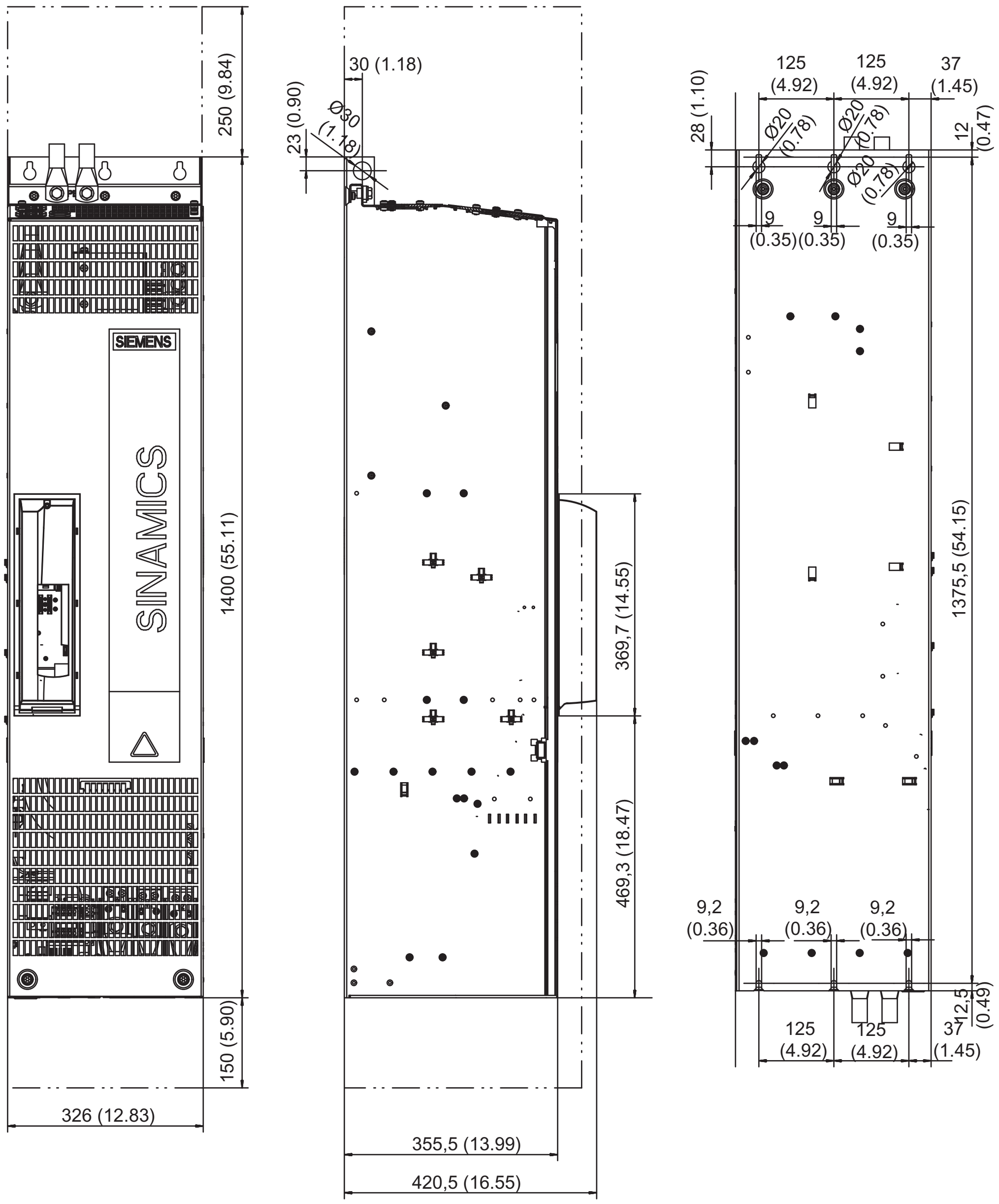


Figure 4-53 Dimension drawing Power Module, frame size FX

Dimension drawing frame size GX

The cooling clearances to be maintained are indicated by the dotted line.

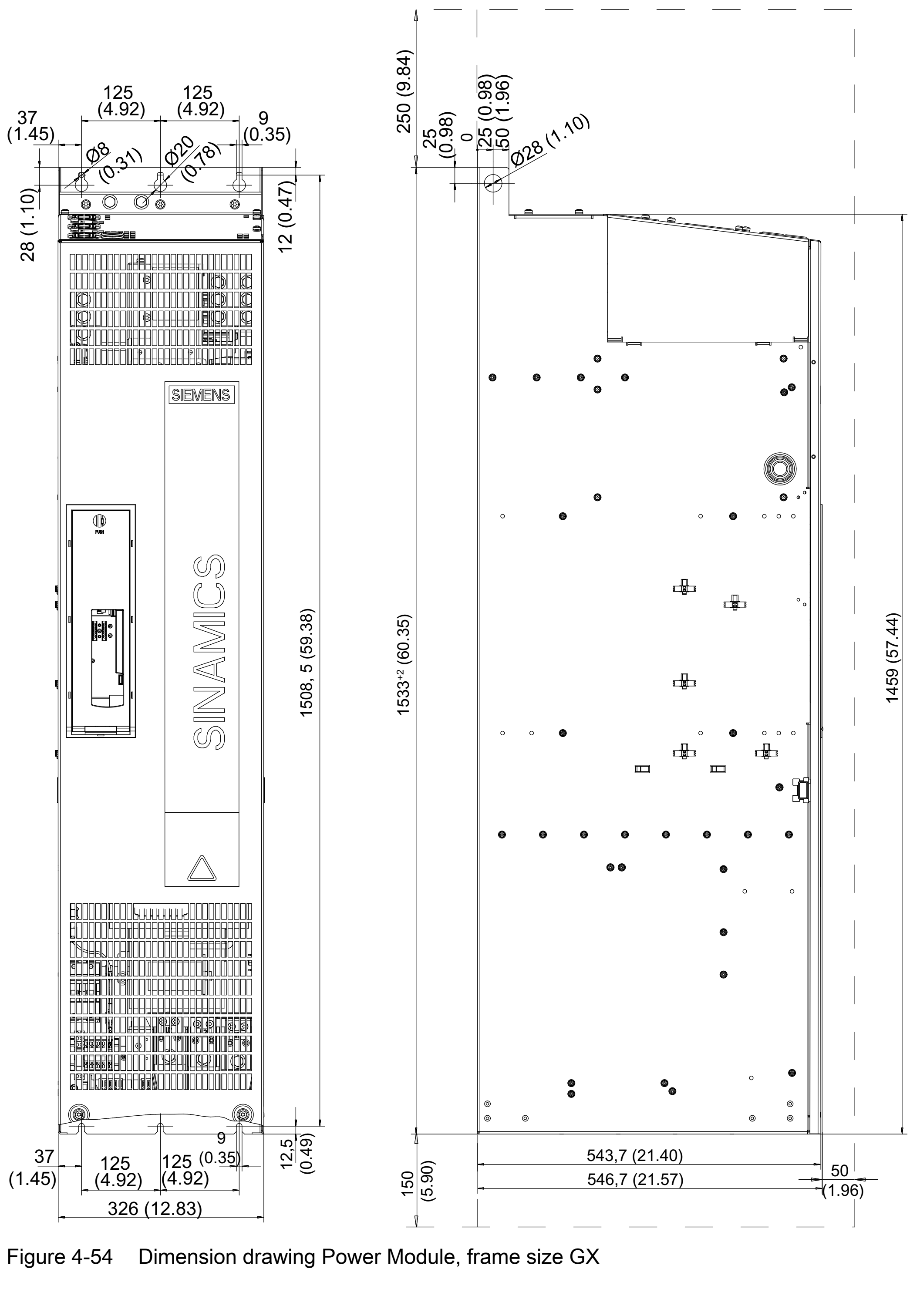


Figure 4-54 Dimension drawing Power Module, frame size GX

4.4.5 Electrical connection

Adjusting the fan voltage (-T10)

The power supply for the device fans (1-ph. 230 V AC) in the Power Module (-T10) is taken from the line supply using a transformer. The mounting position of the transformer is showed in the interface descriptions.
The transformers are fitted with primary taps so that they can be fine-tuned to the line voltage. When delivered, the taps are always set to the highest level. With a low supply voltage, the appropriate transformer tap must be activated.

The connections at the setting terminals must be connected to "0" and the line voltage.

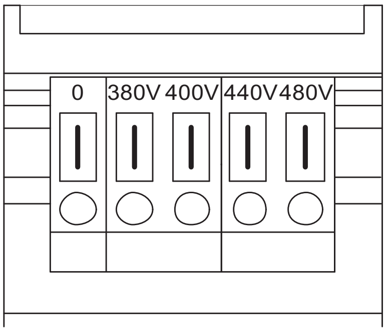


Figure 4-55 Setting terminals for the fan transformers

The supply voltage assignments for making the appropriate setting on the fan transformer are indicated in the following table (factory presetting): 480 V/0 V)

NOTICE
If the terminals are not changed-over to reflect the actual line voltage: • The required cooling level will not provided (risk of overheating) • The fan fuses may blow (overload)

Table 4- 30 Assignment of the existing line voltage for setting at the fan transformer

Line voltage	Tap at the fan transformer (-T10)
380 V ± 10 %	380 V
400 V ± 10 %	400 V
440 V ± 10 %	440 V
480 V ± 10 %	480 V

Remove the connection clip for the interference-suppression capacitor for operation on an ungrounded line supply / IT supply

If the Power Module is operated from a non-grounded line supply (IT system), the connection bracket for the interference suppression capacitor of the Power Module must be removed.

The position of the connection clip can be seen in the overviews of the Power Modules.

Note

Warning label on the connection clip

A yellow warning label is attached to each connection clip so that it is easier to find.

- The warning label must removed from the connection clip (by pulling it off) if the connection clip is to remain in the unit (operation on a grounded line supply).
- The warning label must be removed together with the connection clip if the unit is operated on a non-grounded line supply (IT supply system).

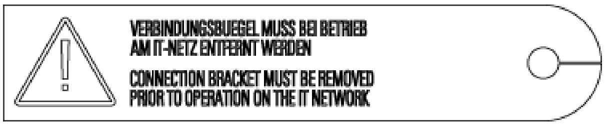


Figure 4-56 Warning label on the connection clip

⚠ WARNING
Failure to remove the connection clip for the interference suppression capacitor for a non-grounded line supply (IT supply system) can cause significant damage to the chassis unit.

4.4.6 Technical data

Table 4- 31 Technical data, Power Modules Chassis

Line voltage 3-ph. 380 V to 480 V AC ±10% (-15% < 1 min)						
Order number	6SL3310–	1TE32-1AA3	1TE32-6AA3	1TE33–1AA3	1TE33-8AA3	1TE35-0AA3
Frame size		FX	FX	GX	GX	GX
Output current rated current I_n base load current I_L base load current I_H for S6 duty (40 %) I_{S6} peak current I_{max}	 A A A A A	 210 205 178 230 307	 260 250 233 285 375	 310 302 277 340 453	 380 370 340 430 555	 490 477 438 540 715
Supply voltages Electronics power supply Overvoltage trip Undervoltage trip	 V_{DC} V_{DC} V_{DC}	 24 (20,4 - 28,8) 820 ± 2 % 424				
Type rating [1)] on basis of I_n on basis of I_H	 kW kW	 110 90	 132 110	 160 132	 200 160	 250 200
Rated pulse frequency without derating with derating	 kHz kHz	 2 8	 2 8	 2 8	 2 8	 2 8
Power loss	kW	2,46	3,27	4,0	4,54	5,78
Cooling air requirement	m³/s	0,17	0,23	0,36	0,36	0,36
Sound pressure level at 50/60 Hz	 dB(A)	 66 / 67	 68 / 72	 68 / 72	 68 / 72	 68 / 72
Rated input current	A	229	284	338	395	509
Current requirement [2)]at 24 V DC, max.	A	0,8	0,8	0,9	0,9	0,9
NH fuses Rated current	 A	3NA3144 250	3NA3250 300	3NA3254 355	3NA3260 400	3NA3372 630
Class J UL fuses Rated current Rated short-circuit current SCCR	 A kA	3NE1227 250 65	3NE1230 300 65	 350 65	 400 65	 600 65
Circuit-breaker type designation IEC 60947 rated current	 A	3VL4725- 1DC36-0AA0 200 - 250	3VL4731- 1DC36-0AA0 250 - 315	3VL4740- 1DC36-0AA0 320 - 400	3VL5750- 1DC36-0AA0 400 - 500	3VL5763- 1DC36-0AA0 500 - 630
Circuit breaker type designation UL489 / CSA C22.2 No. 5-02 Rated current Rated short-circuit current SCCR	 A kA	3VL3125- 3KN30-0AA0 250 65	3VL4130- 3KN30-0AA0 300 65	3VL4135- 3KN30-0AA0 350 65	3VL4140- 3KN30-0AA0 400 65	3VL4560- 3KN30-0AA0 600 65

Line voltage 3-ph. 380 V to 480 V AC ±10% (-15% < 1 min)						
Order number	6SL3310–	1TE32-1AA3	1TE32-6AA3	1TE33–1AA3	1TE33-8AA3	1TE35-0AA3
Line supply connection U1, V1, W1		Flat connector for M10 cable lug, max. connection cross-section 2 x 185 mm²		Flat connector for M10 cable lug, max. connection cross-section 2 x 240 mm²		
Motor connection U2, V2, W2		Flat connector for M10 cable lug, max. connection cross-section 2 x 185 mm²		Flat connector for M10 cable lug, max. connection cross-section 2 x 240 mm²		
DC link connections DCPA, DCNA, (option, Braking Module)		Flat connector for M6 cable lug, connection cross-section 1 x 35 mm²		Flat connector for M6 cable lug, conductor cross-section 1 x 50 mm²		
DC link connections DCPS, DCNS (option, du/dt filter)		Flat connector for M8 cable lug, connection cross-section 1 x 35 mm²		Flat connector for M8 cable lug, conductor cross-section 1 x 70 mm²		
PE connection		Flat connector for M10 cable lug, max. connection cross-section 2 x 185 mm²		Flat connector for M10 cable lug, max. connection cross-section 2 x 240 mm²		
Max. motor cable length 3)	m	300 (shielded) / 450 (unshielded)				
Max. ambient temperature without derating with derating	 °C °C	 40 55	 40 55	 40 55	 40 55	 40 55
Degree of protection		IP 20 or IPXXB				
Width	mm	326	326	326	326	326
Height	mm	1400	1400	1533	1533	1533
Depth	mm	356 4)	356 4)	545	545	545
Weight	kg	104	104	162	162	162

1) Rated power of a typical standard induction motor at 3 AC 400 V

2) Current consumption of Power Module only. If a Control Unit is supplied with 24 V DC from the Power Module, its current consumption must be added.

3) Max. motor cable length 100 m (shielded) in conjunction with a line filter to comply with the EMC limit values of EN 61800-3 Category C2.

4) Depth = 421 mm including front cover when a Control Unit is installed

4.4.6.1 Characteristics

Overload capability

The Power Modules are equipped with an overload reserve e.g. to handle breakaway torques.

In drives with overload requirements, the appropriate base load current must, therefore, be used as a basis for the required load.

The overload data is valid under the precondition that the Power Module is operated with its base load current before and after the overload occurs (a load duration of 300 s is used as a basis here).

Low overload

The base load current for low overload I_L is based on a load duty cycle of 110% for 60 s or 150% for 10 s with a load duty duration of 300 s.

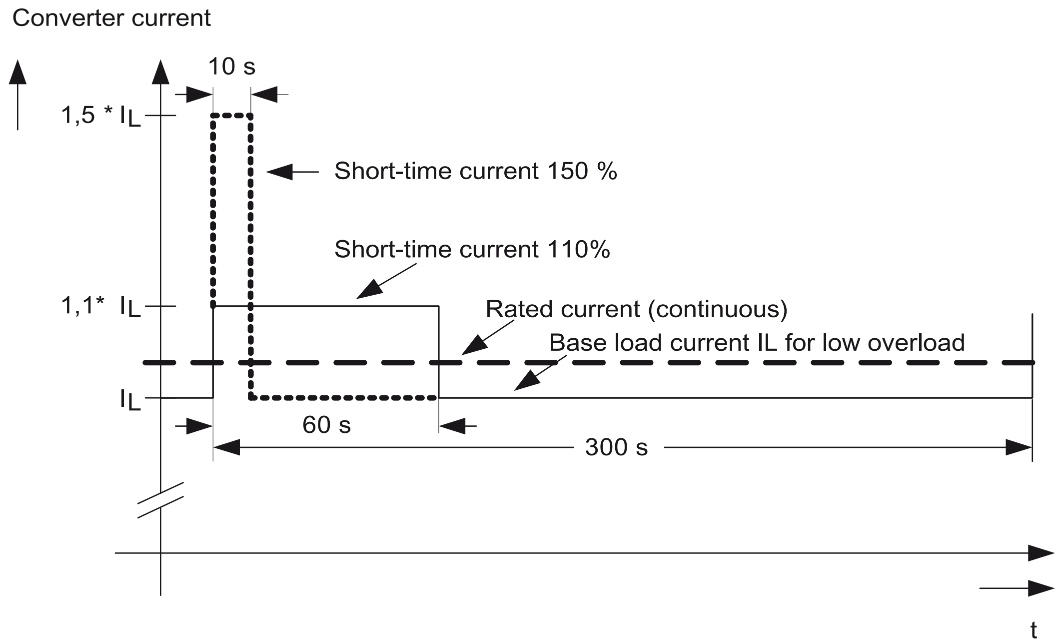


Figure 4-57 Characteristic: Low overload

High overload

The base load current for high overload I_H is based on a load duty cycle of 150% for 60 s or 160% for 10 s with a load duty duration of 300 s.

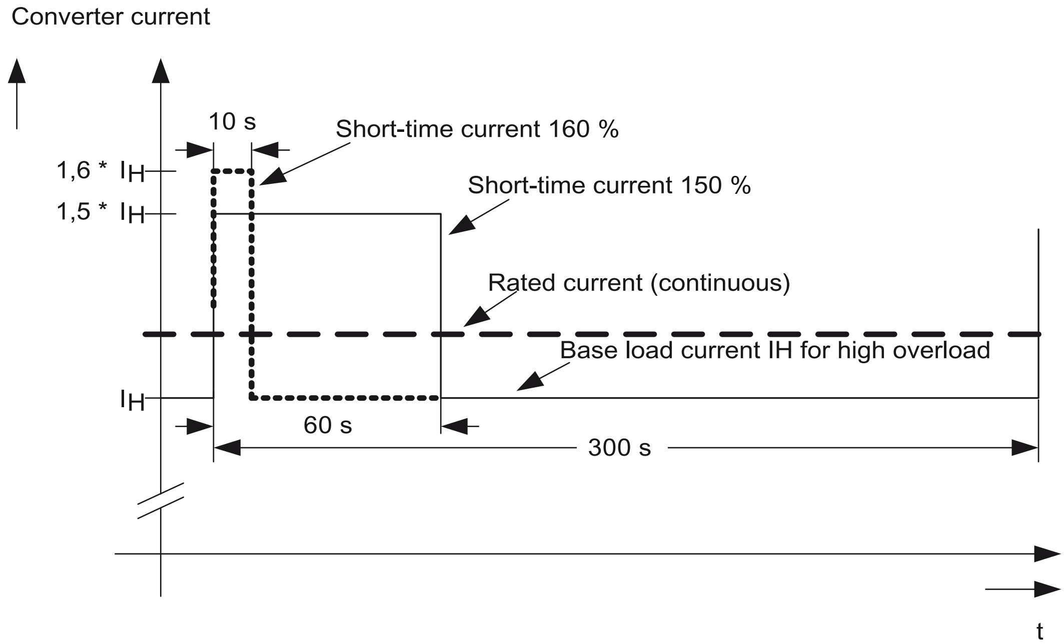


Figure 4-58 Characteristic: High overload

4.4.6.2 Derating

Derating as a function of the installation altitude

At installation altitudes > 2000 m above sea level, it must be taken into account that the air pressure, and therefore air density, decreases as the height increases. This reduces both the cooling effect as well as the insulating strength of the air. As a result of the lower cooling effect, on one hand, the ambient temperature must be reduced, and on the other hand, the power loss in the chassis unit must also be reduced by decreasing the output current; whereby ambient temperatures less than 40 °C can be factored in as countermeasure for compensation.

The following table shows the permissible output currents as a function of installation altitude and ambient temperature (the permissible compensation between installation altitude and ambient temperatures of < 40 °C – inlet air temperature at the air inlet of the chassis unit – is taken into account in the specified values).

The values apply under the precondition that a cooling air flow though the units as stated in the technical data is ensured.

Table 4- 32 Current derating for chassis units as a function of ambient temperature (supply air temperature at the air inlet of the chassis unit) and installation altitude

Installation altitude above sea level in m	Current derating factor (as a % of rated current) at an ambient temperature (air intake temperature) of							
	20 °C	25 °C	30 °C	35 °C	40 °C	45 °C	50 °C	55 °C
0 ... 2000	100 %	100 %	100 %	100 %	100 %	93.3 %	86.7 %	80 %
... 2500	100 %	100 %	100 %	100 %	96.3 %			
... 3000	100 %	100 %	100 %	98.7 %				
... 3500	100 %	100 %	100 %					
... 4000	100 %	100 %	96.3 %					
... 4500	100 %	97.5 %						
... 5000	98.2 %							

At installation altitudes of 2000 m and 5000 m, an isolating transformer is also required to reduce transient overvoltages in accordance with EN 60664-1 required (see also Chapter "Line connection and line-side power components / Derating as a function of installation altitude and ambient temperature").

Derating as a function of the pulse frequency

When the pulse frequency is increased, the derating factor of the output current must be taken into account.
This derating factor must be applied to the currents specified in the technical data.

Table 4- 33 Derating factor of the output current as a function of the pulse frequency

Order No. 6SL3310-...	Power [kW]	Output current for a pulse frequency of 2 kHz [A]	Derating factor for a pulse frequency of 4 kHz	Derating factor for a pulse frequency of 8 kHz
1TE32-1AAx	110	210	82 %	50 %
1TE32-6AAx	132	260	83 %	50 %
1TE33-1AAx	160	310	88 %	50 %
1TE33-8AAx	200	380	87 %	50 %
1TE35-0AAx	250	490	78 %	50 %

Maximum output frequencies achieved by increasing the pulse frequency

By multiplying the rated pulse frequency with a multiple integer, the following output frequencies can be achieved taking into account the derating factors:

Table 4- 34 Maximum output frequencies achieved by increasing the pulse frequency in VECTOR mode

Pulse frequency [kHz]	Maximum output frequency [Hz]
2	160
4	320 1)
8	640 1)

1) The maximum output frequency is limited to 300 Hz due to the closed-loop control (for current controller cycle p0115[0] ≤ 400 μs).

Table 4- 35 Maximum output frequencies achieved by increasing the pulse frequency in SERVO mode

Pulse frequency [kHz]	Maximum output frequency [Hz]
2	300
4	300 / 650 1)

1) The maximum output frequency of 650 Hz can only be achieved for a current controller cycle of 125 μs (factory setting: 250 μs). This is only possible for Power Modules with order numbers 6SL3310–1TExx–xAA3 and firmware version V4.3 or higher.

Operation at low output frequencies

Current derating at lower output frequencies

It is not permissible that the Power Module is operated with its maximum rated current at output frequencies below 10 Hz. Otherwise, its service life could be reduced.

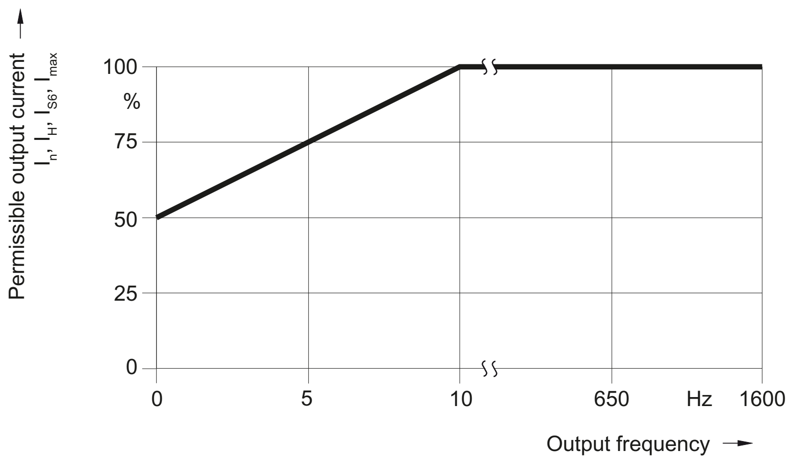


Figure 4-59 Output current as a function of the output frequency

5 DC link components

5.1 Blocksize

5.1.1 Braking resistors

5.1.1.1 Description

The PM340 Power Modules cannot regenerate into the line supply. For regenerative operation, e.g. the braking of a rotating mass, a braking resistor must be connected to convert the resulting energy into heat.

A thermostatic switch monitors the braking resistor for overtemperature and issues a signal on a floating contact if the limit value is exceeded.

5.1.1.2 Safety instructions for blocksize braking resistors

Note

When using braking resistors, also observe the safety instructions in Chapter 1.

WARNING

Risk of fire and device damage as a result of ground fault/short-circuit

The cables to the braking resistor must be routed so that a ground fault or short circuit can be ruled out. A ground fault can result in fire with associated smoke.

- Comply with local installation regulations, which allow this fault to be ruled out.
- Protect the cables from mechanical damage.

In addition, apply one of the following measures:

- Using cables with double insulation.
- Maintain adequate clearance, using spacers, for example.
- Route the cables in separate cable ducts or pipes.

CAUTION

Risk of burns resulting from high surface temperatures

The braking resistor can become very hot. You can be severely burnt when touching the surface.

- Mount the braking resistor so that it cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.
- To prevent adjacent components from suffering damage due to these high temperatures, a clearance of 100 mm must be maintained on all sides of the braking resistor.

5.1.1.3 Connection examples

The braking resistor is connected directly on the Power Module at the terminals DCP/R1 and R2.

The braking resistor must be protected against overheating. A thermostatic switch handles this protective function (included in the scope of supply of each breaking resistor). Evaluate the braking resistor temperature monitoring so that the motor is switched off when the resistor has an overtemperature condition. Two techniques to connect the thermostatic switch are described in the following.

Connect the thermostatic switch to a Control Unit

Connect the thermostatic switch to a free digital input of the Control Unit. Set the function of this digital input to the OFF2 command. If the braking resistor overheats, the Power Module is disconnected from the power supply.

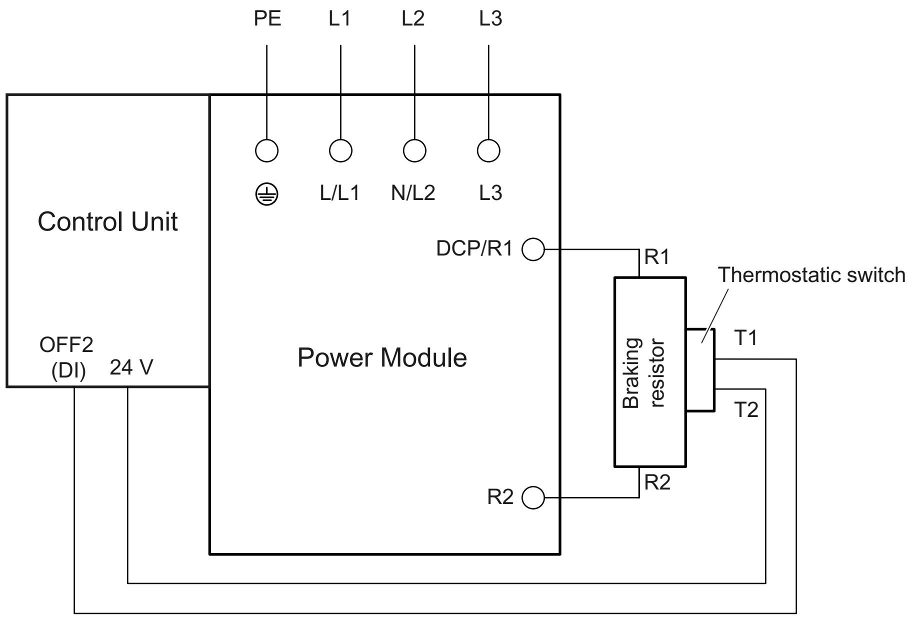


Figure 5-1 Connecting the thermostatic switch on the braking resistor to a Control Unit

Connect the thermostatic switch to a contactor

Establish the power supply to the Power Modules through a contactor which can then shut down the power supply when the resistor overheats. The thermostatic switch is connected in series with the coil feeder cable for the line contactor. The contacts of the thermostatic switch switch close again as soon as the temperature of the braking resistor has fallen below the selected value.

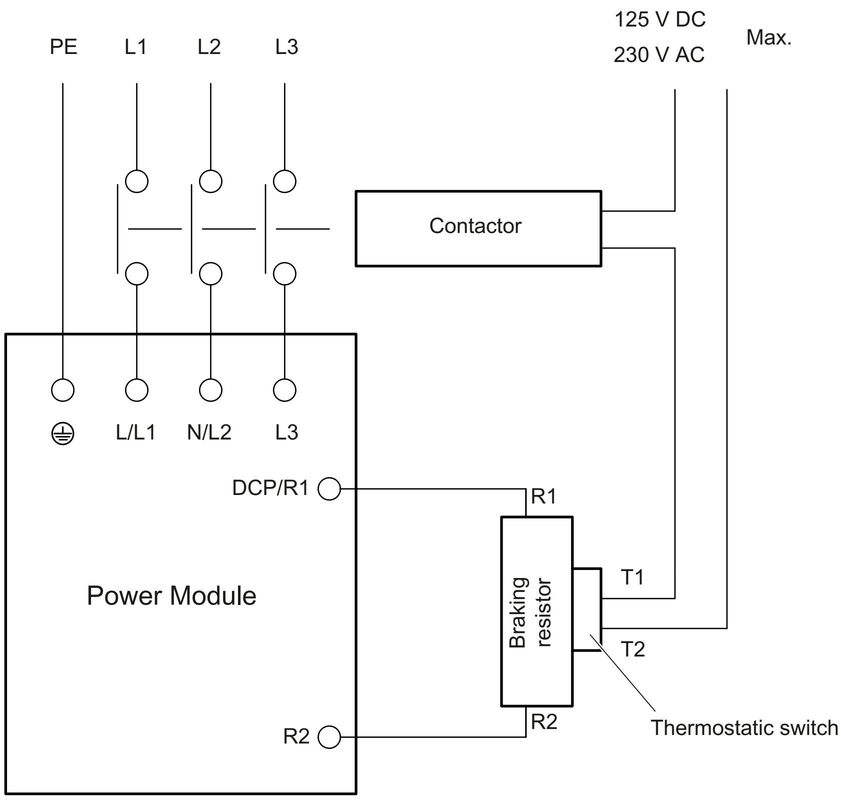


Figure 5-2 Connecting the thermostatic switch on the braking resistor to a contactor

5.1.1.4 Dimension drawings

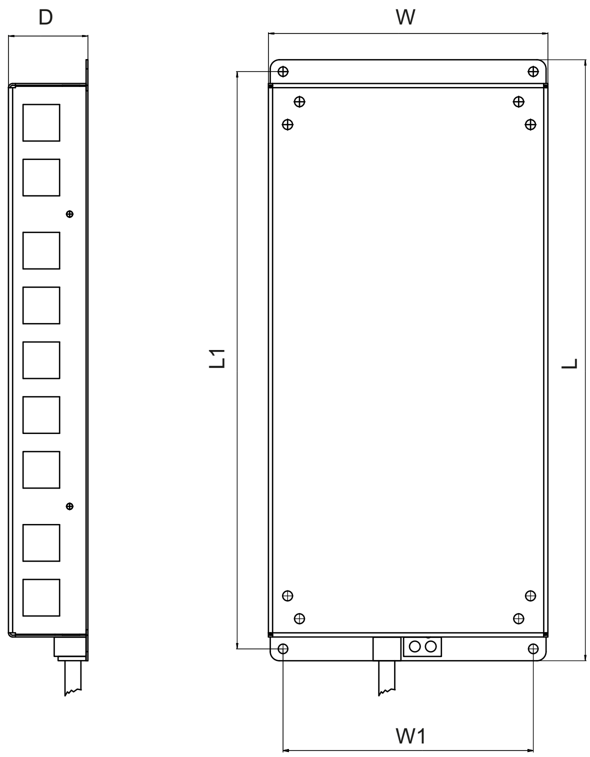


Figure 5-3 Dimension drawing of braking resistor, frame sizes FSA / FSB

Table 5- 1 Dimension drawing in mm (inches)

Order number	6SE6400-4BC05-0AA0	6SE6400-4BD11-0AA0	6SL3201-0BE12-0AA0
Frame size	FSA	FSA	FSB
L	230 (9.05)	230 (9.05)	239 (9.40)
L1	217 (8.54)	217 (8.54)	226 (8.89)
L2	-	-	-
L3	-	-	-
D	43.5 (1.71)	43.5 (1.71)	43.5 (1.71)
D1	-	-	-
D2	-	-	-
W	72 (2.83)	72 (2.83)	149 (5.86)
W1	56 (2.20)	56 (2.20)	133 (5.24)

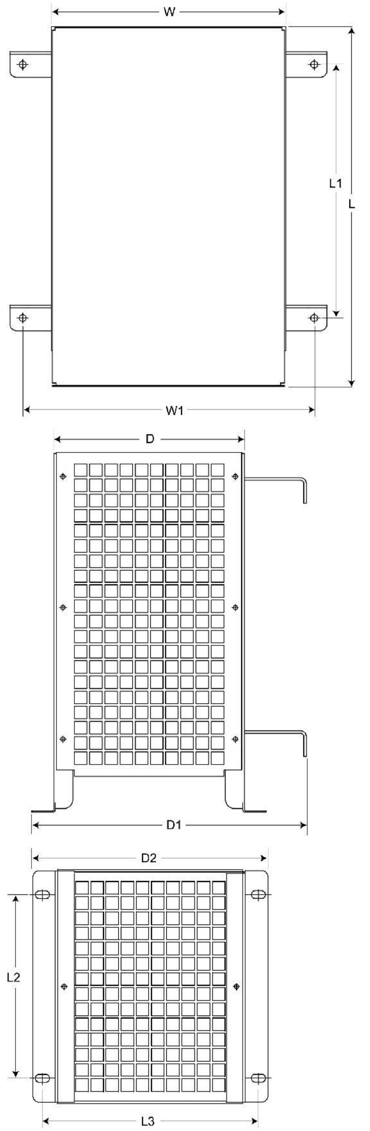


Figure 5-4 Dimension drawing of braking resistor, frame sizes FSC / FSD / FSE / FSF

Table 5- 2 Dimension drawing in mm (inches)

Order number	6SE6400-4BD16-5CA0	6SE6400-4BD21-2DA0	6SE6400-4BD22-2EA0	6SE6400-4BD24-0FA0
Frame size	FSC	FSD	FSE	FSF
L	285 (11.22)	515 (20.27)	645 (25.39)	650 (25.59)
L1	200 (7.87)	350 (13.77)	480 (18.89)	510 (20.07)
L2	145 (5.70)	205 (8.07)	205 (8.07)	270 (10.62)
L3	170 (6.69)	195 (7.67)	195 (7.67)	335 (13.18)
D	150 (5.90)	175 (6.88)	175 (6.88)	315 (12.40)
D1	217 (8.54)	242 (9.52)	242 (9.52)	382 (15.03)
D2	185 (7.28)	210 (8.26)	210 (8.26)	382 (15.03)
W	185 (7.28)	270 (10.62)	270 (10.62)	400 (15.74)
W1	230 (9.05)	315 (12.40)	315 (12.40)	435 (17.12)

5.1.1.5 Installation

The braking resistor for all modules is connected at terminals DCP/R1 and R2. Since it generates heat, it should be mounted to the side of the PM340 Power Modules.

The braking resistors for the FSA and FSB frame sizes are designed as base components. If the PM340 Power Modules of the FSA or FSB frame size are operated without a line reactor, the braking resistors can also be installed under the Power Modules.

The braking resistors for the Power Modules of the FSC to FSF frame sizes should be placed outside the control cabinet or the switchgear room in order to direct the resulting heat loss away from the Power Modules. This reduces the level of air conditioning required.

The braking resistors can be installed horizontally or vertically. The power connections on vertically installed resistors must be at the bottom.

Note

PE connection

The PE connection for the braking resistor is established via the screening kit for frame sizes FSA to FSF.

For installation according to EN 60204-1 and EN 61800-5-1, the PE connection on the housing must be used. The PE conductor in the pigtail is, in this case, not to be used, but can be suitably tied off/cut off.

5.1.1.6 Technical data

Table 5- 3 Technical data, braking resistors, Part 1

Order number		6SE6400-4BC05-0AA0	6SE6400-4BD11-0AA0	6SL3201-0BE12-0AA0	6SE6400-4BD16-5CA0
Suitable for Power Modules of frame size		FSA (1 AC) 1)	FSA (3 AC) 2)	FSB 2)	FSC 2)
Resistance	Ω	180	390	160	56
Unit rating P_{DB}	kW	0.05	0.1	0.2	0.65
Peak power P_{max}	kW	1	1.7	4.0	13
Load duration for peak power T_a	s	27.6	13.8	12.6	13.1
Period duration of braking duty cycle T	s	276	276	252	262
Degree of protection		IP20 or IPXXB	IP20 or IPXXB	IP20 or IPXXB	IP20 or IPXXB
Power connections (including PE)		Pigtail 3 x 1.5 mm² shielded, length 0.5m	Pigtail 3 x 1.5 mm² shielded. length 0.5 m	Pigtail 3 x 1.5 mm² shielded. length 0.5 m	Pigtail 3 x 1.5 mm² shielded, length 0.9 m
Thermostatic switch (NC contact) maximum contact load connecting cable		250 V_{AC}/2.5 A	250 V_{AC}/2.5 A	250 V_{AC}/2.5 A	250 V_{AC}/2.5 A
Weight	kg	1.0	1.0	1.6	3.8

For information about order numbers, refer to chapter: Power Modules, section: Power Modules Blocksize (PM340), technical data,

1) Power Modules Blocksize, 1 AC

2) Power Modules Blocksize, 3 AC

Table 5- 4 Technical data, braking resistors, Part 2

Order number		6SE6400-		
		4BD21-2DA0	4BD22-2EA0	4BD24-0FA0
Suitable for Power Modules of frame size		FSD 1)	FSE 1)	FSF 1)
Resistance	Ω	27	15	8.2
Unit rating P_{DB}	kW	1.2	2.2	4.0
Peak power P_{max}	kW	24	44	80
Load duration for peak power T_a	s	13.6	14.5	13.1
Period duration of braking duty cycle T	s	271	290	252
Degree of protection		IP20 or IPXXB	IP20 or IPXXB	IP20 or IPXXB
Power connections		M6 studs	M6 studs	M6 studs
Thermostatic switch (NC contact) maximum contact load connecting cable		250 V_{AC}/2.5 A	250 V_{AC}/2.5 A	250 V_{AC}/2.5 A
Weight	kg	7.4	10.6	16.7

For information about order numbers, refer to chapter: Power Modules, section: Power Modules Blocksize (PM340), technical data,

1) Power Modules Blocksize, 3 AC

Duty cycles

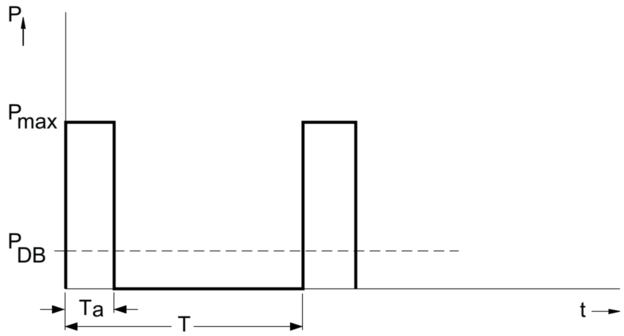


Figure 5-5 Load diagram for the braking resistor, in blocksize format

T [s] period duration of braking duty cycle

T_a [s] load duration for peak power

P_{DB} [W] unit rating of the braking resistor

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

5.2 Chassis

5.2.1 Braking Modules

5.2.1.1 Description

A Braking Module (and an external braking resistor) is required in certain cases when the drive is to be braked or brought to a standstill (e.g. EMERGENCY SWITCHING-OFF Category 1). The Braking Module contains the power electronics and the associated control. The supply voltage for the electronics is taken from the DC link.

During operation, the DC link energy is converted to heat loss in an external braking resistor.

A mounting slot is provided in the Power Module.

Design

The Braking Module in chassis format is installed in a slot within the Power Module and force-cooled by its fan. The Braking Module is connected to the DC link by means of flexible cables, which are supplied as standard.

The Braking Module has as standard, the following interfaces:

- The DC link is connected through flexible cables
- Connecting terminal for external braking resistor
- 1 digital input (inhibit Braking Module with high signal/acknowledge error with negative edge high low)

- 1 digital output (Braking Module defective)
- DIP switch for adjusting the starting threshold

5.2.1.2 Safety instructions for Braking Modules chassis format

Note

When using Braking Modules Chassis also observe the safety instructions in Chapter 1.

DANGER

Danger to life as a result of electric shock caused by residual voltage after shutdown

After disconnecting all the supply voltages, a hazardous voltage will be present in all components for another 5 minutes. Touching live components results in death or severe injury.

- Only carry out work on these components after this time has elapsed.
- Before starting any work, also measure the voltage at the DC link terminals DCP and DCN.

WARNING

Risk of accident as a result of missing warning labels in the relevant language

Missing warning labels in the relevant language can result in accidents leading to death or severe injury.

- Attach warning labels in the relevant language on components.

WARNING

Risk of fire and device damage as a result of ground fault/short-circuit

The cables to the braking resistor must be routed so that a ground fault or short circuit can be ruled out. A ground fault can result in fire with associated smoke.

- Comply with local installation regulations, which allow this fault to be ruled out.
- Protect the cables from mechanical damage.

In addition, apply one of the following measures:

- Using cables with double insulation.
- Maintain adequate clearance, using spacers, for example.
- Route the cables in separate cable ducts or pipes.

NOTICE

Damage when using components that have not been released

If braking resistors are used that have not been released by SIEMENS for SINAMICS, then the braking resistors could be destroyed.

5.2.1.3 Braking Module for frame size FX

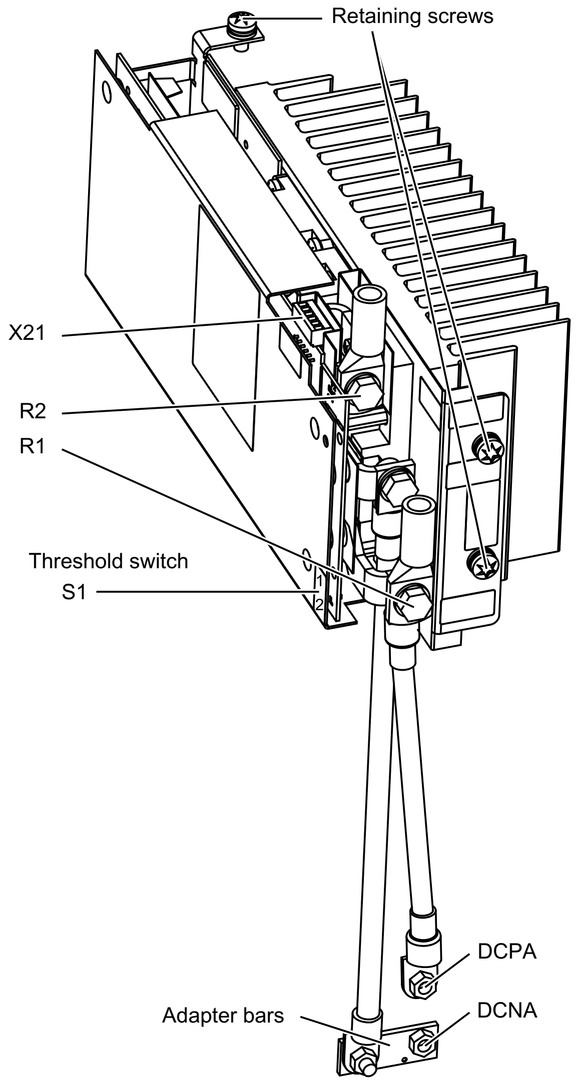


Figure 5-6 Braking Module for Power Module, frame size FX

Note

With this Braking Module, the R1 and DCPA interfaces use the same connection.

5.2.1.4 Braking Module for frame size GX

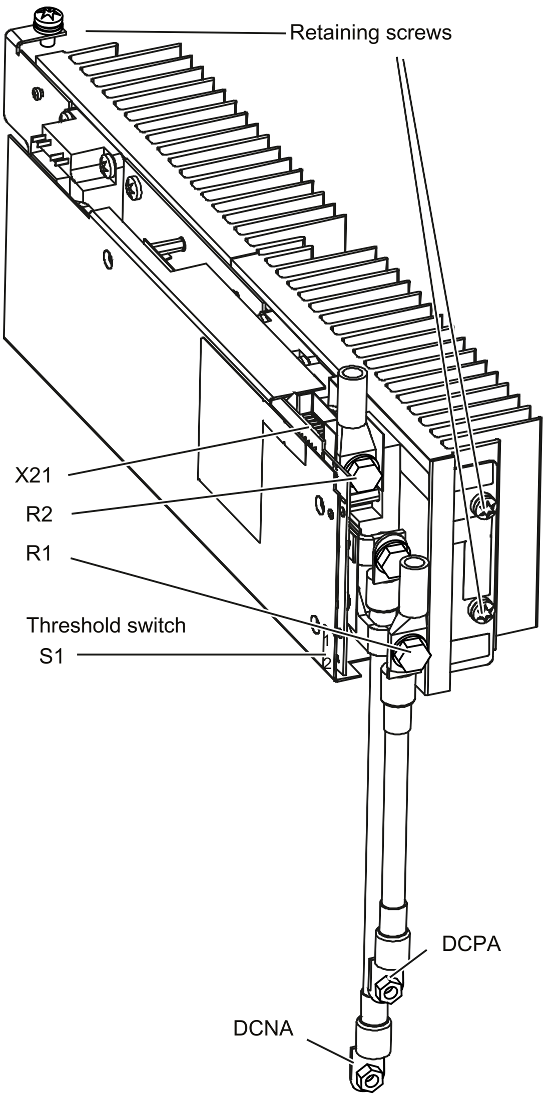


Figure 5-7 Braking Module for Power Module, frame size GX

Note

With this Braking Module, the R1 and DCPA interfaces use the same connection.

5.2.1.5 Connection example

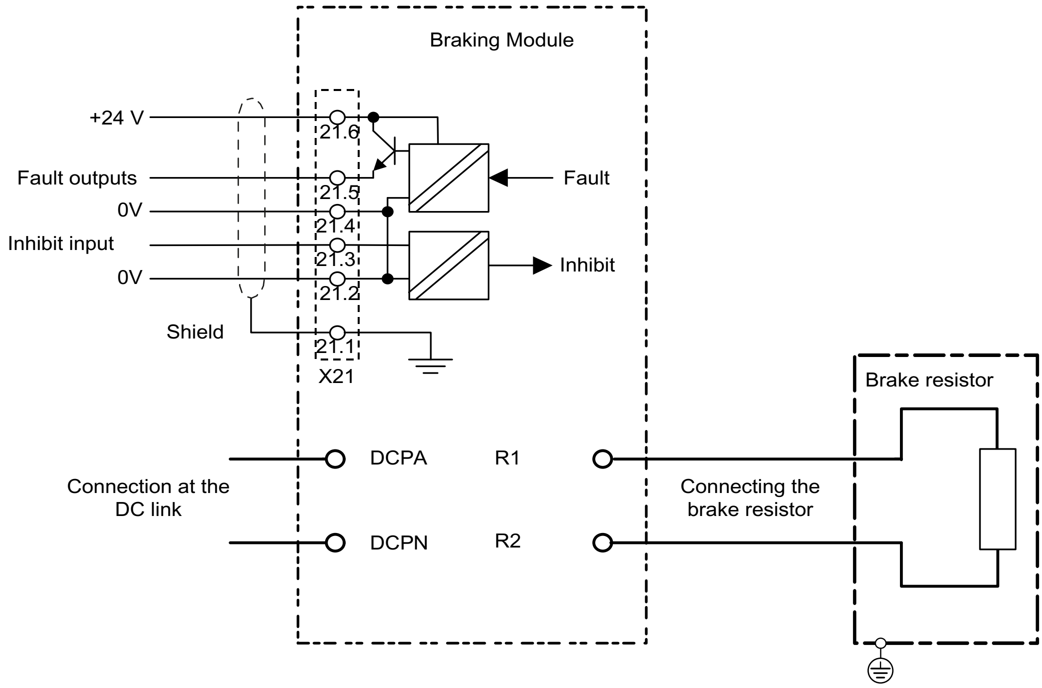


Figure 5-8 Example connection of Braking Module

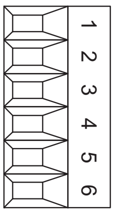
5.2.1.6 Braking resistor connection X1

Table 5- 5 Braking resistor connection

Terminal	Designation
R1	Braking resistor connection R+
R2	Break resistor connection R-
Max. cross-section that can be connected: 50 mm ^{2}	

5.2.1.7 X21 digital inputs/outputs

Table 5- 6 Terminal block X21

	Terminal	Designation [1)]	Technical data
	1	Shield	Shield connection for terminal 2 ... 6
	2	0 V	Low signal level: -3 V to 5 V
	3	DI inhibit input	High signal level: +15 V to 30 V Current drain: 2 mA to 15 mA
	4	0 V	Voltage: 24 V DC Load current: 0.5 A to 0.6 A
	5	DO fault output	
	6	+24 V	Voltage: +18 V to 30 V Typical current consumption (own current consumption): 10 mA at 24 V DC
Max. connectable cross-section 1.5 mm²			

[1)] DI: Digital input; DO: Digital output

Note

When the Braking Module is in the installed state, the individual terminals on its X21 terminal block are positioned as follows: terminal "1" is at the rear, terminal "6" at the front.

Note

Applying a high signal to terminal X21.3 inhibits the Braking Module. On a falling edge, pending error signals are acknowledged.

Note

You will find setting instructions for wiring the signals in the SINAMICS S120 Function Manual.

5.2.1.8 S1 Threshold switch

The response threshold at which the Braking Module is activated and the DC-link voltage generated during braking are specified in the following table.

⚠ WARNING
The threshold switch must only be used when the Power Module is switched off and the DC link capacitors are discharged.

Table 5- 7 Response thresholds of the Braking Modules

Response threshold	Switch position	Comment
673 V	1	774 V is the default factory setting. For line supply voltages of between 3-ph. 380 V and 400 V AC, the response threshold can be set to 673 V to reduce the voltage stress on the motor and Power Module. This does, however, reduce the possible braking power with the square of the voltage $(673/774)^2 = 0.75$. The maximum possible braking power is, therefore, 75%.
774 V	2	

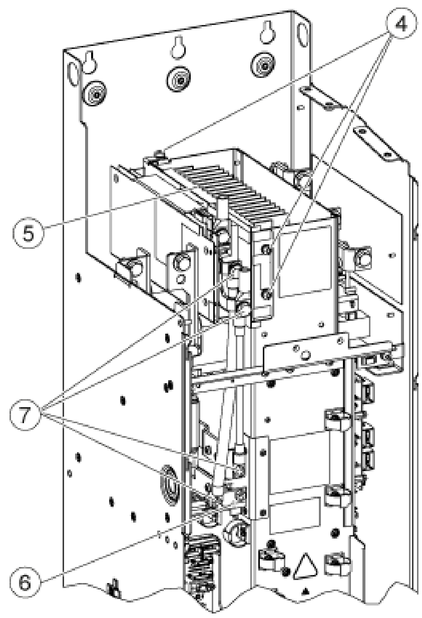
Note

The threshold switches of the Braking Modules are in the following positions when installed:

- Position "1" is up
- Position "2" is down

5.2.1.9 Installing a Braking Module in a Power Module, frame size FX

<table>
<tr><td rowspan="3">
</td><td>①</td><td>Loosen the two M6 screws.
Remove the front cover to the top.</td></tr>
<tr><td>②</td><td>Loosen the two screws from the cover plate at the top and the M6 nut on the left-hand side.
Remove the cover plate at the left.</td></tr>
<tr><td>③</td><td>Loosen the four screws from the cover plate at the top and the three securing screws at the rear.
Remove the cover plate at the top.</td></tr>
</table>



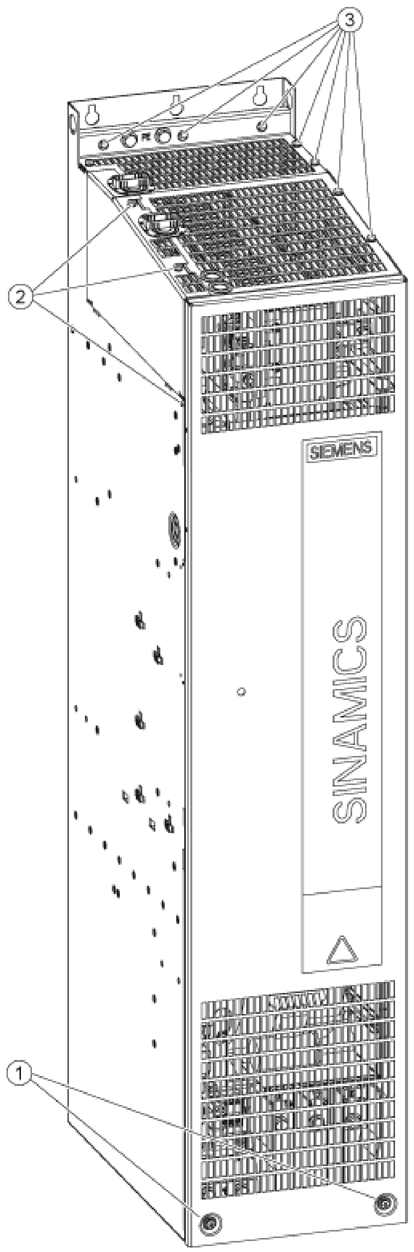
④	Remove the three screws on the blanking cover. Remove the blanking cover.
⑤	Install the Braking Module instead of the blanking cover and secure it with the blanking cover screws that were previously removed.
⑥	Secure the adapter bars at the DCNA connection using a nut, so that the bar can be not twisted. For this purpose, a small bolt is attached to the adapter bar, which must be located on the lower side of the DCNA connection.
⑦	Secure the connecting cable to the DC link with two screws (Braking Module connection) and with two nuts (DC link connection).
	Attach the - cover plate, top - step ③ - cover plate, left - step ② - the front cover - step ①

An opening above the connections for the braking resistor (R1, R2) is provided in the cover for connecting the cable to the braking resistor.

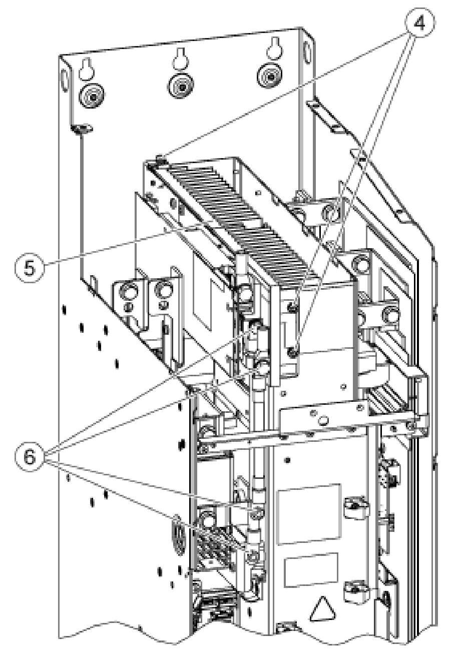
Note

You must carefully observe the specified tightening torques.

5.2.1.10 Installing a Braking Module in a Power Module, frame size GX



①	Loosen the two M6 screws. Remove the front cover to the top.
②	Loosen the two screws from the cover plate at the top and the M6 nut on the left-hand side. Remove the cover plate at the left.
③	Loosen the four screws from the cover plate at the top and the three securing screws at the rear. Remove the cover plate at the top.



	④	Remove the three screws on the blanking cover. Remove the blanking cover.
	⑤	Install the Braking Module instead of the blanking cover and secure it with the blanking cover screws that were previously removed.
	⑥	Secure the connecting cable to the DC link with two screws (Braking Module connection) and with two nuts (DC link connection).
		Attach the - cover plate, top – step ③ - cover plate, left – step ② - the front cover – step ①

An opening above the connections for the braking resistor (R1, R2) is provided in the cover for connecting the cable to the braking resistor.

Note

You must carefully observe the specified tightening torques.

5.2.1.11 Technical data

Table 5- 8 Technical data, Braking Modules

Order number	6SL3300–1AE31-3AA0	6SL3300–1AE32-5AA0
Suitable for installation in Power Modules, frame size	FX	GX
P_{DB} power (unit rating)	25 kW	50 kW
P_{15} power (peak power)	125 kW	250 kW
P_{20} power	100 kW	200 kW
P_{40} power	50 kW	100 kW
Variable response thresholds	774 V (673 V)	774 V (673 V)
Digital input		
Rated voltage	-3 V to 30 V	-3 V to 30 V
Low level (an open digital input is interpreted as "low")	-3 V to 5 V	-3 V to 5 V
High level	15 V to 30 V	15 V to 30 V
Current drain (typical at 24 V DC)	10 mA	10 mA
Max. cross-section that can be connected	1.5 mm²	1.5 mm²
Digital output (continued-short-circuit-proof)		
Rated voltage	24 V DC	24 V DC
Max. load current of the digital output	500 mA	500 mA
Max. cross-section that can be connected	1.5 mm²	1.5 mm²
R1/R2 connection	M8 screw	M8 screw
Max. connection cross-section R1/R2	35 mm²	50 mm²
Weight	3.6 kg	7.3 kg

5.2.2 Braking resistors

5.2.2.1 Description

The braking resistor is used to reduce the excess DC link energy in regenerative operation.

The braking resistor is connected to the Braking Module. The braking resistor is mounted outside the cabinet or switchgear room. This means that the resulting heat loss around the Power Module can be dissipated - and cooling costs/equipment reduced.

Resistors with unit ratings of 25 kW and 50 kW are available.

Braking resistors can be used on Power Modules with a voltage range. This is the reason that the voltage can be changed by setting the response thresholds at the Braking Module to reduce the voltage stress on the motor and Power Module.

A temperature protection switch monitors the braking resistor for overtemperature and issues a signal on a floating contact if the limit value is exceeded.

5.2.2.2 Safety instructions for braking resistors chassis format

Note

When using braking resistors, also observe the safety instructions in Chapter 1.

⚠ WARNING

Danger of fire through overheating for insufficient ventilation clearances

Insufficient ventilation clearances can result in overheating with danger to persons as a result of smoke and fire. Further, increased failures can occur and the service life of units/systems shortened.

- It is essential that you maintain a cooling clearance of 200 mm on all sides of the component (with ventilation grills).

⚠ WARNING

Risk of fire and device damage as a result of ground fault/short-circuit

The cables to the braking resistor must be routed so that a ground fault or short circuit can be ruled out. A ground fault can result in fire with associated smoke.

- Comply with local installation regulations, which allow this fault to be ruled out.
- Protect the cables from mechanical damage.

In addition, apply one of the following measures:

- Using cables with double insulation.
- Maintain adequate clearance, using spacers, for example.
- Route the cables in separate cable ducts or pipes.

⚠ CAUTION

Risk of burns resulting from high surface temperatures

The braking resistor can become very hot. You can be severely burnt when touching the surface.

- Mount the braking resistor so that it cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.

⚠ CAUTION

Risk of fire if the maximum cable length is exceeded

The connecting cables to the Braking Module in the Power Module must be kept as short as possible (max. 100 m).

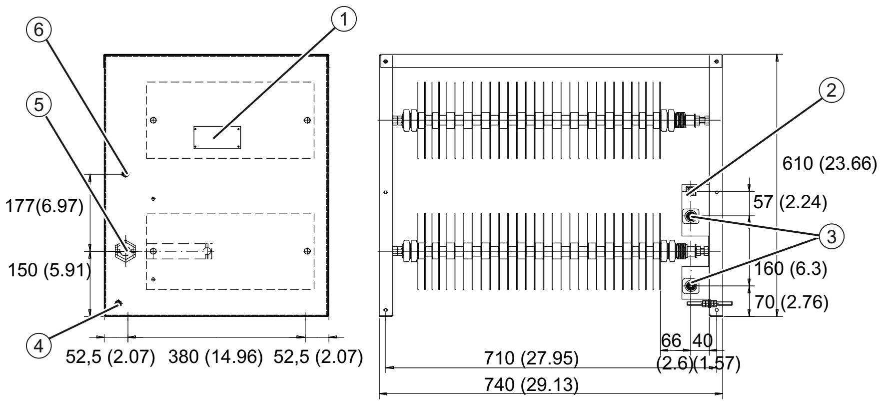
⚠ DANGER

Danger as a result of incorrect installation

There is a risk of fire if braking resistors are incorrectly mounted.

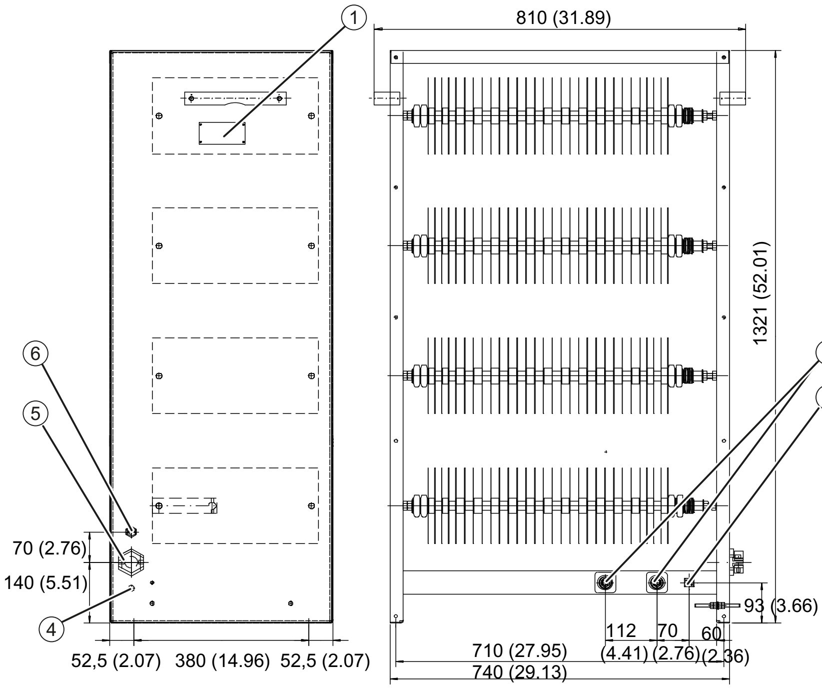
- Only mount braking resistors on a baseplate/floor.
- Mount the braking resistors so that they are in the vertical position and freestanding. Sufficient space must be available for dissipating the energy converted by the braking resistor.
- Maintain sufficient clearance to objects that can burn.
- Do not place any objects on or above the braking resistor.
- Do not install the braking resistor underneath fire detection sensors, since these could be triggered by the resulting heat.
- When mounting outside, provide a canopy to protect against rain and in order to maintain the IP20 degree of protection.

5.2.2.3 Dimension drawing



① Rating plate
② T1/T2 screw terminal (2.5 mm²)
③ Threaded bolt (M8)
④ Ground connection (M8)
⑤ M50
⑥ M12

Figure 5-9 Dimension drawing, 25 kW/125 kW resistor



① Rating plate
② Threaded bolt (M10)
③ T1/T2 screw terminal (2.5 mm²)
④ Ground connection (M10)
⑤ M50
⑥ M12

Figure 5-10 Dimension drawing, 50 kW/250 kW resistor

5.2.2.4 Electrical connection

⚠ WARNING
The Braking Module must only be connected when the Power Module has been disconnected from the power supply and the DC link capacitors have been discharged.

NOTICE
The cables for the braking resistor must be routed to prevent short circuiting and ground faults in accordance with EN 61800-5-2:2007, Table D.1. This can be accomplished, for example, by: • Eliminating the risk of mechanical damage to the cables • Using cables with double insulation • Maintaining adequate clearance, using spacers, for example • Laying the cables in separate cable ducts or pipes

NOTICE
The length of the connecting cables between the Braking Module and external braking resistor must not exceed 100 m.

Recommended cable cross-sections:

- For 25 kW: 35 mm²
- For 50 kW: 50 mm²

Thermostatic switch

A thermostatic switch is installed to protect the braking resistor against overload. Its floating contacts must be integrated in the fault chain on the line side.

Table 5- 9 Thermostatic switch connection

Terminal	Function	Technical specifications
T1	Thermostatic switch connection	Voltage: 250 V AC Load current: Max. 1 A
T2	Thermostatic switch connection	

Max. connectable cross-section: 2.5 mm²

5.2.2.5 Technical data

Table 5- 10 What are the technical data of the braking resistors

Order number	Unit	6SL3000–1BE31-3AA0	6SL3000–1BE32-5AA0
P_{DB} power (unit rating)	kW	25	50
P_{15} power (peak power)	kW	125	250
Max. current	A	189	378
Cable entry		Via cable gland M50	Via cable gland M50
Line connection		Via stud M10	Via stud M10
Max. connectable cable cross-section	mm²	50	70
Degree of protection		IP20	IP20
Width x height x depth	mm	740 x 605 x 485	810 x 1325 x 485
Thermostatic switch (NC contact) maximum contact load connecting cable		240 V_{AC} / 10 A	240 V_{AC} / 10 A
Weight	kg	50	120

Duty cycle

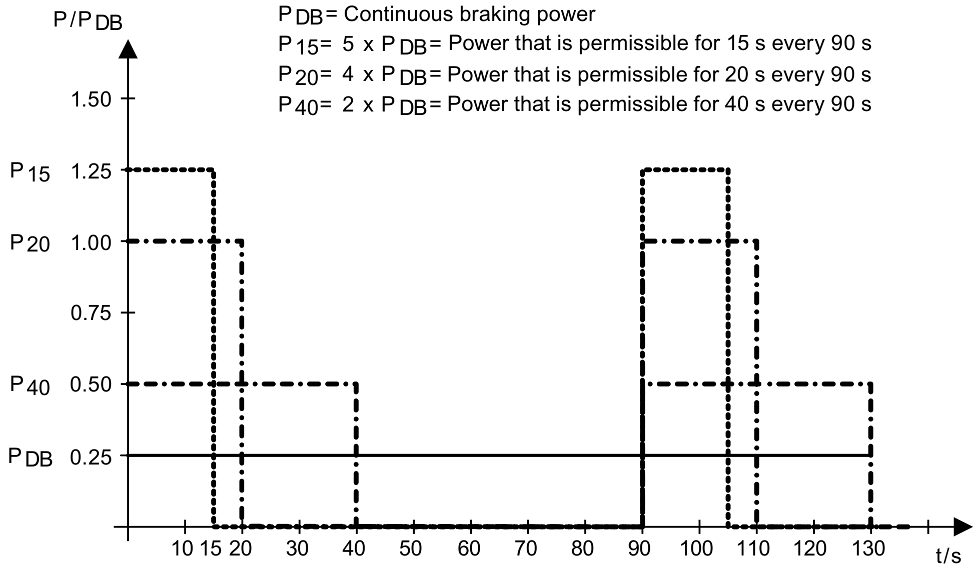


Figure 5-11 Duty cycle for braking resistors

Motor-side power components 6

6.1 Motor reactors

6.1.1 Safety instructions for motor reactors

Note

When using motor reactors, also observe the safety instructions in Chapter 1.

⚠ WARNING

Danger of fire through overheating for insufficient ventilation clearances

Insufficient ventilation clearances can result in overheating with danger to persons as a result of smoke and fire. Further, increased failures can occur and the service life of units/systems shortened.

- It is essential that you maintain 100 mm ventilation clearances above and below the component.

⚠ CAUTION

Risk of burns resulting from high surface temperatures

The motor reactors can become very hot. You can be severely burnt when touching the surface.

- Mount the motor reactors so that they cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.

NOTICE

Risk of damaging the motor reactors by using components that have not been released

When using components that have not been released, damage or malfunctions can occur at the devices or the system itself. There is a risk that the motor reactor will be thermally damaged.

- Only use motor reactors that SIEMENS has authorized for SINAMICS.

NOTICE

Risk of damaging the motor reactors by exceeding the maximum output frequency

The maximum permissible output frequency when motor reactors are used is 150 Hz. The motor reactors can be damaged if the output frequency is exceeded.

- Do not operate the motor reactors above the maximum permissible output frequency of 150 Hz.

NOTICE

Damage if the maximum pulse frequency is exceeded

The maximum permissible pulse frequency when motor reactors are used is 4 kHz.

- Do not operate the motor reactors at the Power Module above the maximum permissible output frequency of 4 kHz.

Note

Keep the connecting cables to the Power Module as short as possible (max. 5 m).

6.1.2 Motor reactors, blocksize

6.1.2.1 Description

Motor reactors reduce the voltage stress on the motor windings by reducing the voltage gradients at the motor terminals that occur when motors are fed from drive converters. At the same time, the capacitive re-charging currents that additionally load the output of the Power Module when longer motor cables are used are simultaneously reduced.

The motor reactors for Power Modules 3-ph. 380 V to 480 V AC are suitable for a pulse frequency of 4 kHz. Higher pulse frequencies are not permissible.

6.1.2.2 Dimension drawings

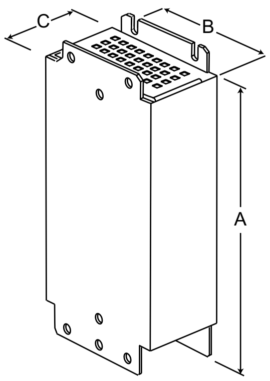
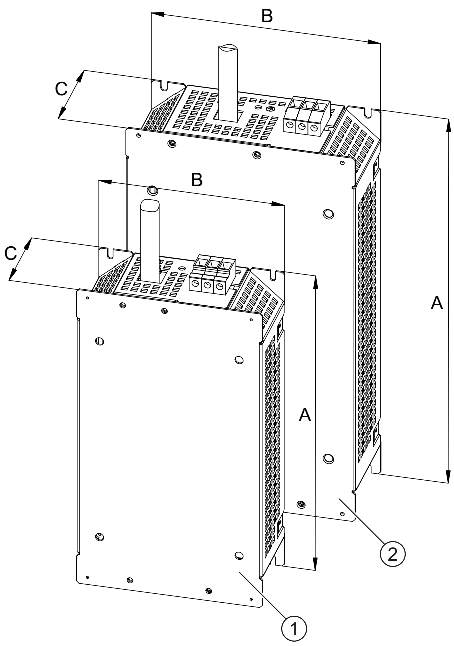


Figure 6-1 Dimension drawing, motor reactor, frame size FSA

Table 6- 1 Dimensions, motor reactor, frame size FSA

Motor reactor 6SE6400-	3TC00-4AD2
Frame size	**FSA**
A in mm (inch)	200 (7.87)
B in mm (inch)	75.5 (2.97)
C in mm (inch)	110 (4.33)

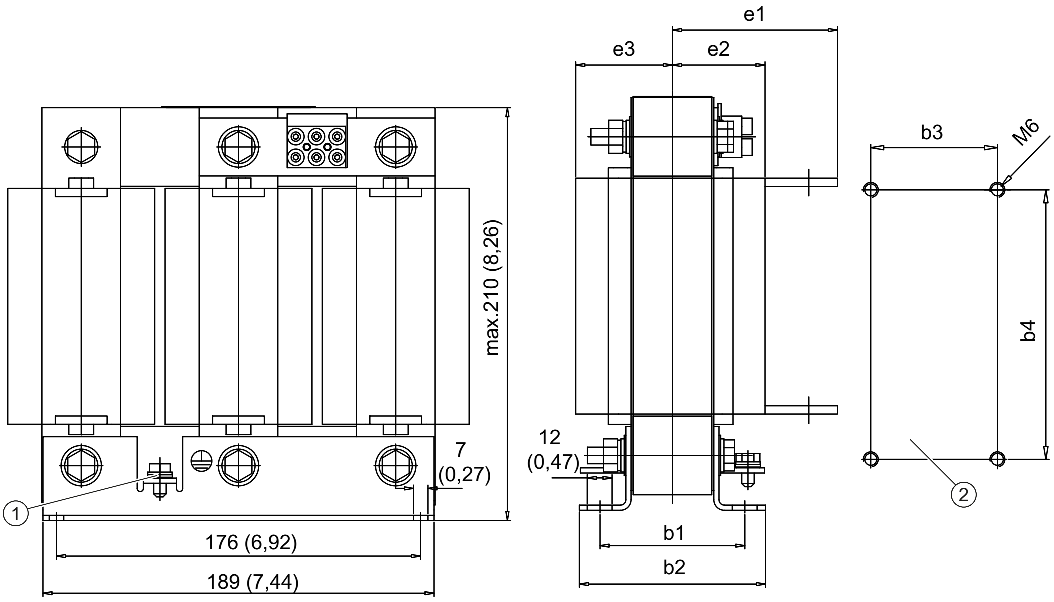


① Frame size FSB
② Frame size FSC

Figure 6-2 Dimension drawing, motor reactor, frame sizes FSB / FSC

Table 6- 2 Dimensions, motor reactor, frame sizes FSB / FSC

Motor reactor 6SL3202-	0AE21-0CA0	0AJ23-2CA0
Frame size	**FSB**	**FSC**
A in mm (inch)	270 (10.62)	334 (13.14)
B in mm (inch)	153 (6.02)	189 (7.44)
C in mm (inch)	70 (2.75)	50 (1.96)

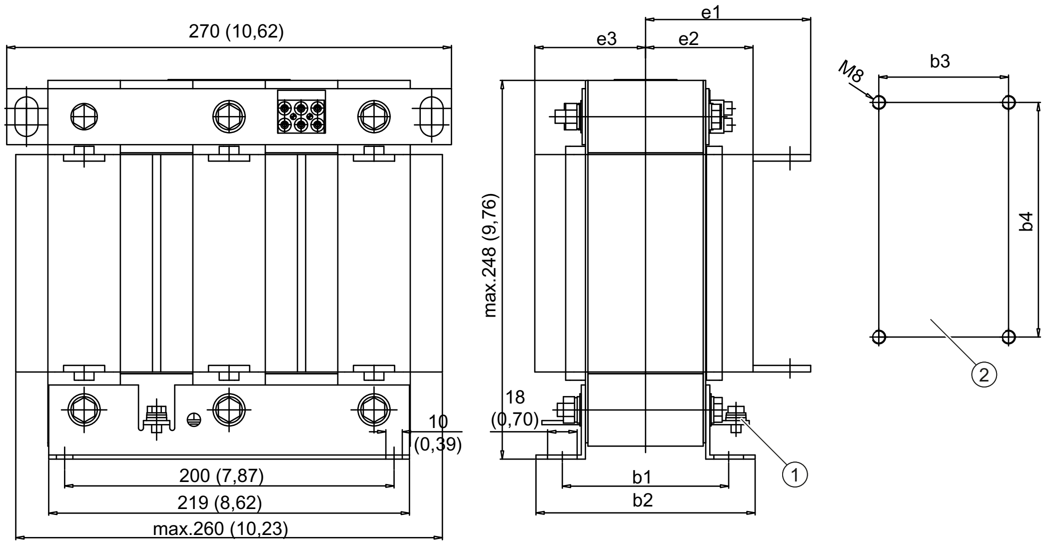


① Protective conductor connection (M6 x 12)
② Mounting hole

Figure 6-3 Dimension drawing, motor reactor, frame size FSD

Table 6- 3 Dimensions, motor reactor, frame size FSD in mm (inch)

Motor reactor 6SE6400-	3TC05-4DD0	3TC03-8DD0
Frame size	FSD	FSD
b1	70 (2.75)	94 (3.70)
b2	91 (3.58)	115 (4.52)
b3	70 (2.75)	94 (3.70)
b4	176 (6.92)	176 (6.92)
e1	91 (3.58)	103 (4.05)
e2	57 (2.24)	69 (2.71)
e3	49 (1.92)	61 (2.40)



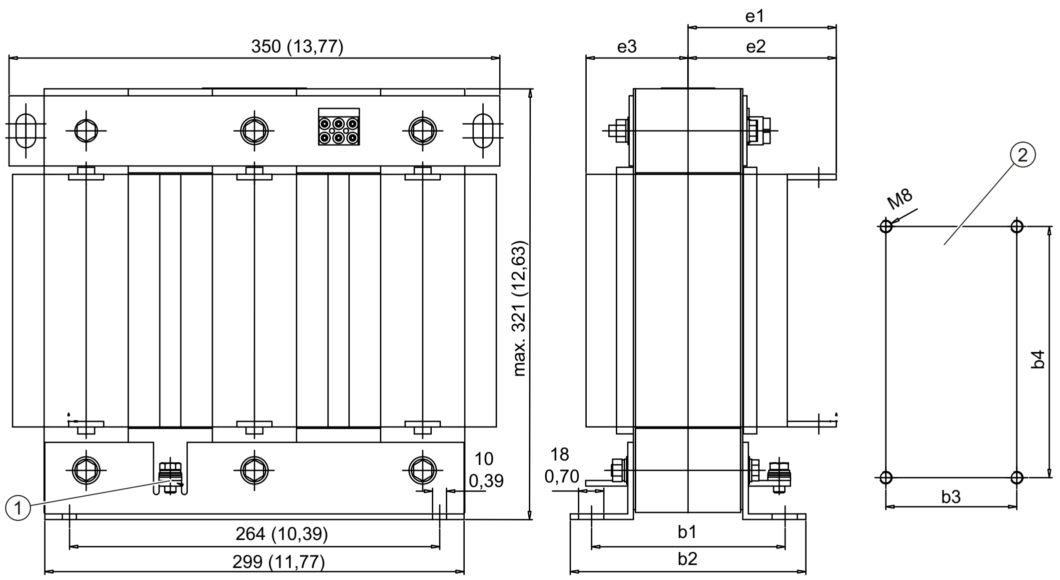
① Protective conductor connection (M 6x12)

② Mounting hole

Figure 6-4 Dimension drawing, motor reactor, frame size FSE

Table 6- 4 Dimensions, motor reactor, frame size FSE in mm (inch)

Motor reactor 6SE6400-	3TC07-5ED0	3TC08-0ED0
Frame size	**FSE**	**FSE**
b1	101 (3.97)	70 (2.75)
b2	133 (5.23)	90 (3.54)
b3	101 (3.97)	70 (2.75)
b4	200 (7.87)	176 (6.92)
e1	110 (4.33)	89 $^{\pm 2}$ (3.50 $^{\pm 0.07}$)
e2	76 (2.99)	79 $^{\pm 2}$ (3.50 $^{\pm 0.07}$)
e3	68 (2.67)	-



① Protective conductor connection (M 8x16)
② Mounting hole

Figure 6-5 Dimension drawing, motor reactor, frame size FSF

Table 6- 5 Dimensions, motor reactor, frame size FSF in mm (inch)

Motor reactor 6SE6400-	3TC14-5FD0	3TC15-4FD0
Frame size	FSF	FSF
b1	138 (5.43)	101 (3.97)
b2	169 (6.65)	121 (4.76)
b3	138 (5.43)	101 (3.97)
b4	264 (10.39)	200 (7.87)
e1	131 (5.15)	119 $^{\pm 2}$ (4.68 $^{\pm 0.07}$)
e2	90 (3.54)	109 $^{\pm 2}$ (4.29 $^{\pm 0.07}$)
e3	78 (3.07)	-

6.1.2.3 Installation

Note

The motor reactor must be installed as close as possible to the Power Module.

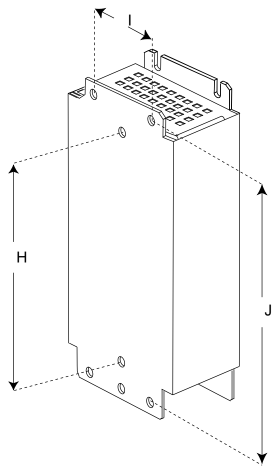
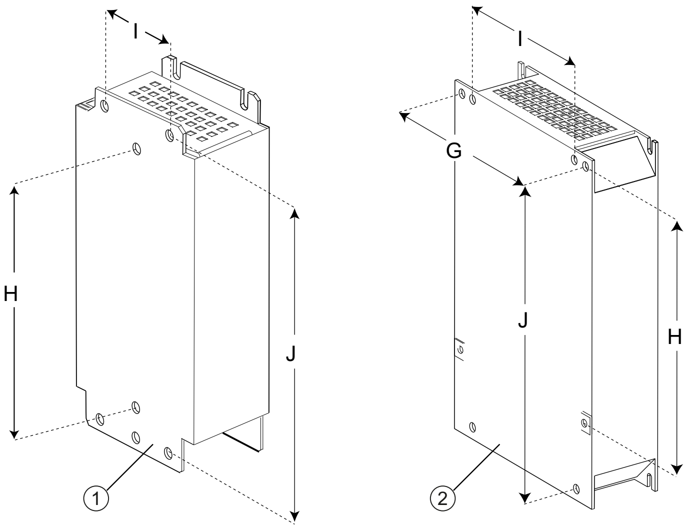


Figure 6-6 Mounting dimensions of motor reactor, frame size FSA

Table 6- 6 Mounting dimensions, motor reactor, frame size FSA in mm (inch)

Motor reactor 6SE6400-	3TC00-4AD2
Frame size	FSA
H	160 (6.29)
I	56 (2.20)
J	187 (7.36)
Tightening torque (Nm)	1.1
Recommended minimum conductor cross-section (mm2))	1
Max. conductor cross-section (mm2))	2.5



① Frame size FSB
② Frame size FSC

Figure 6-7 Mounting dimensions, motor reactors, frame sizes FSB / FSC

Table 6- 7 Mounting dimensions, motor reactors, frame sizes FSB / FSC in mm (inch)

Motor reactor	6SL3202-	0AE21-0CA0	0AJ23-2CA0
Frame size		**FSB**	**FSC**
Power Module	G	138 (5.43)	174 (6.85)
	H	174 (6.85)	204 (8.03)
Mounting surface	I	120 (4.72)	156 (6.14)
	J	200 (7.87)	232 (9.13)
Fixing screw		M4	M5
Tightening torque (Nm)		1.5	2.25
Recommended minimum conductor cross-section ($mm^{2)}$)		1.5	2.5
Max. conductor cross-section ($mm^{2)}$)		6	10

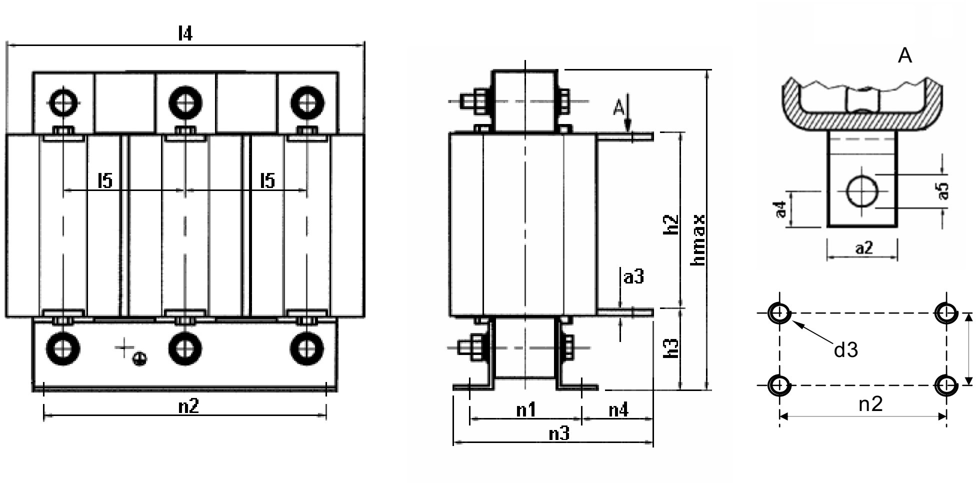


Figure 6-8 Mounting dimensions, motor reactors, frame sizes FSD / FSE / FSF

Table 6- 8 Mounting dimensions, motor reactors, frame sizes FSD / FSE in mm (inch)

Motor reactor	6SE6400-	3TC05-4DD0	3TC03-8DD0	3TC07-5ED0	3TC08-0ED0
Frame size		FSD	FSD	FSE	FSE
Motor reactor	a2	20 (0.78)	20 (0.78)	20 (0.78)	20 (0.78)
	a3	4 (0.15)	4 (0.15)	4 (0.15)	4 (0.15)
	a4	10 (0.39)	10 (0.39)	10 (0.39)	10 (0.39)
	a5	∅6 (0.23)	∅6 (0.23)	∅7 (0.27)	∅7
	l4	225 (8.85)	225 (8.85)	270 (10.62)	225 (8.85)
	l5	76 $^{\pm5}$ (2.99 $^{\pm0.19}$)	76 $^{\pm5}$ (2.99 $^{\pm0.19}$)	88 $^{\pm5}$ (3.46 $^{\pm0.19}$)	76 $^{\pm5}$ (2.99 $^{\pm0.19}$)
	h_{max}	210 (8.26)	210 (8.26)	248 (9.76)	210 (8.26)
	h2	120 $^{\pm2}$ (4.72 $^{\pm0.07}$)	120 $^{\pm2}$ (4.72 $^{\pm0.07}$)	140 $^{\pm2}$ (5.51 $^{\pm0.07}$)	120 $^{\pm2}$ (4.72 $^{\pm0.07}$)
	h3	45 $^{\pm2}$ (1.77 $^{\pm0.07}$)	45 $^{\pm2}$ (1.77 $^{\pm0.07}$)	50 ±2 (1.96 $^{\pm0.07}$)	45 ±2 (1.77 $^{\pm0.07}$)
	n1	70 (2.75)	94 (3.70)	101 (3.97)	70 (2.75)
	n2	176 (6.88)	176 (6.88)	200 (7.87)	176 (6.88)
	n3	max. 140 (5.51)	max. 164	max. 187.5 (7.38)	max. 140 (5.51)
	n4	54 $^{\pm2}$ (2.12 $^{\pm0.07}$)	54 $^{\pm2}$ (2.12 $^{\pm0.07}$)	68.5 $^{\pm2}$ (2.69 $^{\pm0.07}$)	54 $^{\pm2}$ (2.12 $^{\pm0.07}$)
	d3	M6	M6	M8	M6
	PE	M6	M6	M6	M6
Tightening torque [Nm]		3.5-4.0	3.5-4.0	9.5-10.0 3.5-4.0	3.5-4.0

Table 6- 9 Mounting dimensions, motor reactor, frame size FSF in mm (inch)

Motor reactor	6SE6400-	3TC14-5FD0	3TC15-4FD0
Frame size		**FSF**	**FSF**
Motor reactor	a2	20 (0.78)	20 (0.78)
	a3	4 (0.15)	4 (0.15)
	a4	10 (0.39)	10 (0.39)
	a5	∅9 (0.35)	∅9 (0.35)
	l4	357 (14.05)	270 (10.62)
	l5	120 $^{\pm5}$ (4.72 $^{\pm0.19}$)	88 $^{\pm5}$ (3.46 $^{\pm0.19}$)
	h_{max}	321 (12.63)	248 (9.76)
	h2	185 $^{\pm2}$ (7.28 $^{\pm0.07}$)	140 $^{\pm2}$ (5.51 $^{\pm0.07}$)
	h3	60 $^{\pm2}$ (2.36 $^{\pm0.07}$)	50 $^{\pm2}$ (1.96 $^{\pm0.07}$)
	n1	138 (5.43)	101 (3.97)
	n2	264 (10.39)	200 (7.87)
	n3	max. 220.5 (8.68)	max. 187.5 (7.38)
	n4	65.5 $^{\pm2}$ (2.57 $^{\pm0.07}$)	68.5 $^{\pm2}$ (2.69 $^{\pm0.07}$)
	d3	M8	M8
	PE	M8	M6
Tightening torque [Nm]		9.5-10.0	9.5-10.0 3.5-4.0

Mounting Power Modules and motor reactors

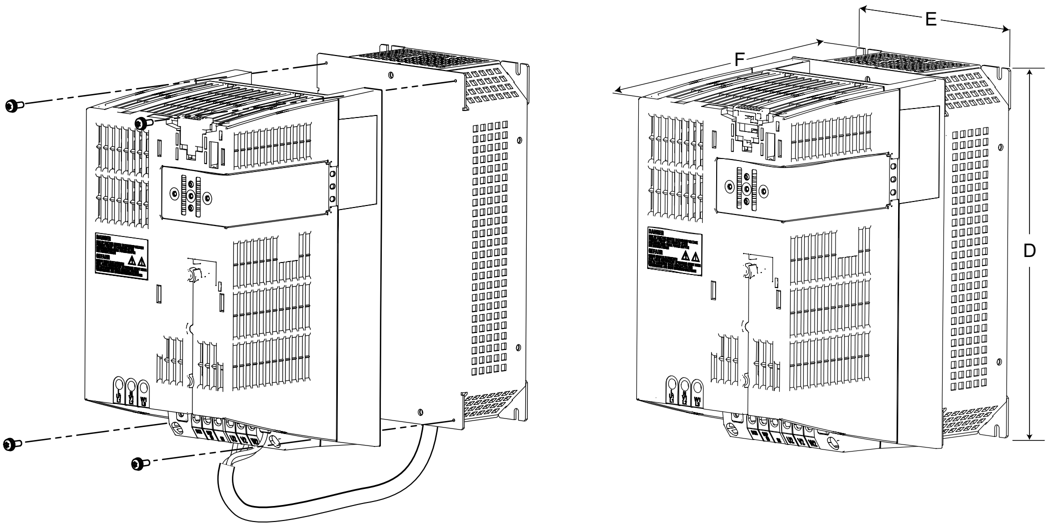
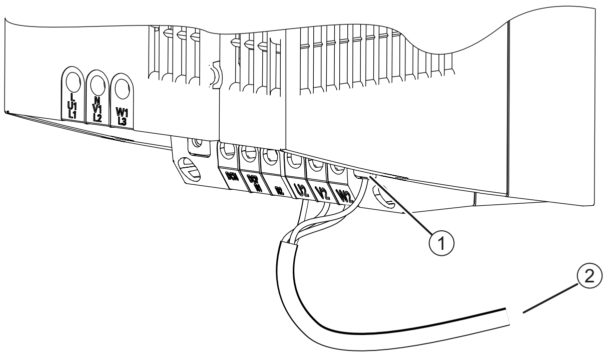


Figure 6-9 Mounting Power Modules and motor reactors, frame sizes FSB / FSC

Table 6- 10 Overall dimensions, PM340 Power Module and motor reactor, frame size FSA / FSB / FSC in mm (inch)

Motor reactor		6SE6400-3TC00-4AD3	6SE6400-3TC00-4AD2	6SL3202-0AE21-0CA0	6SL3202-0AJ23-2CA0
Frame size		FSA	FSA	FSB	FSC
Total dimension of the Power Module and motor reactor	D	200 (7.87)	200 (7.87)	270 (10.62)	334 (13.14)
	E	75.5 (2.97)	75.5 (2.97)	153 (6.02)	189 (7.44)
	F	259 (10.19)	259 (10.19)	235 (9.25)	245 (9.64)

6.1.2.4 Electrical connection



① PE connection
② Motor reactor

Figure 6-10 Electrical connection

6.1.2.5 Technical data

Table 6- 11 Motor reactors for Power Modules 3-ph. 380 V to 480 V AC, frame size FSA

		Motor reactor (for a 4 kHz pulse frequency)				
Order number		**6SE6400-3TC00-4AD2**				
Frame size		FSA	FSA	FSA	FSA	FSA
Suitable for Power Module		6SL3210-1SE11-3UA0	6SL3210-1SE11-7UA0	6SL3210-1SE12-2UA0	6SL3210-1SE13-1UA0	6SL3210-1SE14-1UA0
Rated current	A	4.5				
Power loss	kW	0.005				
Connection to the Power Module		Cable 4 x 1.5 mm^2 Length approx. 0.3 m				
Motor connection		Screw terminals for cable cross-section 6 mm^2				
PE connection		M5 stud				
Max. permissible cable length between motor reactor and motor	m	100 (shielded) 150 (unshielded)				
Degree of protection		IP20 or IPXXB				
Weight, approx.	kg	2				
Rated current I_{rated} of the Power Module	A	1.3	1.7	2.2	3.1	4.1

Table 6- 12 Motor reactors for Power Modules 3-ph. 380 V to 480 V AC, frame sizes FSB and FSC

		Motor reactor (for a 4 kHz pulse frequency)					
Order number		**6SL3202-0AE21-0CA0**			**6SL3202-0AJ23-2CA0**		
Frame size		FSB	FSB	FSB	FSC	FSC	FSC
Suitable for Power Module 6SL3210-		1SE16-0xxx	1SE17-7xxx	1SE21-0xxx	1SE21-8xxx	1SE22-5xxx	1SE23-2xxx
Rated current	A	10			25		
Power loss	kW	0.02			0.06		
Connection to the Power Module		Cable 4 x 1.5 mm^2 Length approx. 0.4 m			Cable 4 x 1.5 mm^2 Length approx. 0.35 m		
Motor connection		Screw-type terminals for cable cross-section 6 mm^2			Screw-type terminals for cable cross-sections 2.5 mm^2 to 10 mm^2		
PE connection		M5 stud			M5 stud		
Max. permissible cable length between motor reactor and motor	m	100 (shielded) 150 (unshielded)					
Degree of protection		IP20 or IPXXB					
Weight, approx.	kg	4.5			9		
Rated current I_{rated} of the Power Module	A	5.9	7.7	10	18	25	32

Table 6- 13 Motor reactors for Power Modules 3-ph. 380 V to 480 V AC, frame sizes FSD and FSE

		Motor reactor (for a 4 kHz pulse frequency)				
Order no. 6SE6400-		3TC05-4DD0	3TC03-8DD0	3TC05-4DD0	3TC08-0ED0	3TC07-5ED0
Frame size		FSD	FSD	FSD	FSE	FSE
Suitable for Power Module 6SL3210- 6SL3215-		1SE23-8xxx 1SE23-8UAx	1SE24-5xxx	1SE26-0xxx 1SE26-0UAx	1SE27-5xxx 1SE27-5UAx	1SE31-0xxx 1SE31-0UAx
Rated current	A	68	45	68	104	90
Power loss	kW	0.2	0.2	0.2	0.17	0.27
Connection to the Power Module		Flat connector for M6 cable lug				
Motor connection		Flat connector for M6 cable lug				
PE connection		M6 screw				
Max. permissible cable length between motor reactor and motor	m	200 (shielded) 300 (unshielded)				
Degree of protection		IP00				
Weight, approx.	kg	11.5	19	11.5	12	27
Rated current I_{rated} of the Power Module	A	38	45	60	75	90

Table 6- 14 Motor reactors for Power Modules 3-ph. 380 V to 480 V AC, frame size FSF

		Motor reactor (for a 4 kHz pulse frequency)		
Order no. 6SE6400-		3TC14-5FD0	3TC15-4FD0	3TC14-5FD0
Frame size		FSF	FSF	FSF
Suitable for Power Module 6SL3210- 6SL3215-		1SE31-1xxx 1SE31-1UAx	1SE31-5xxx	1SE31-8xxx 1SE31-8UAx
Rated current	A	178	178	178
Power loss	kW	0.47	0.25	0.47
Connection to the Power Module		Flat connector for M8 cable lug		
Motor connection		Flat connector for M8 cable lug		
PE connection		M8 screw		
Max. permissible cable length between motor reactor and motor	m	200 (shielded) 300 (unshielded)		
Degree of protection		IP00		
Weight, approx.	kg	57	24	57
Rated current I_{rated} of the Power Module	A	110	145	178

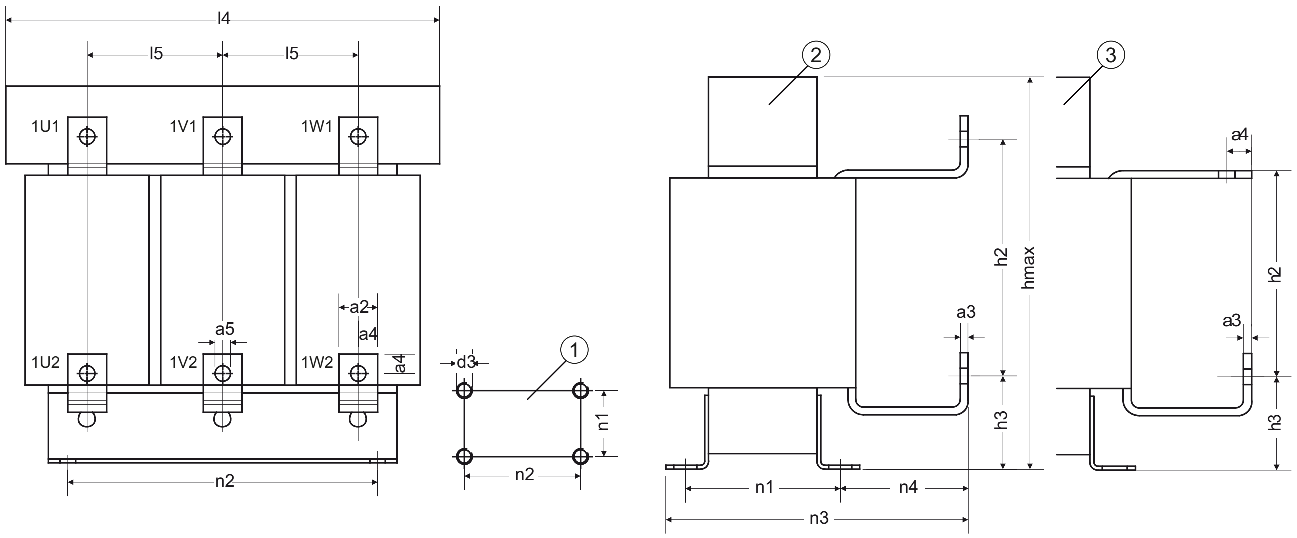
6.1.3 Motor reactors Chassis

6.1.3.1 Description

Motor reactors reduce the voltage stress on the motor windings by reducing the voltage gradients at the motor terminals that occur when motors are fed from drive converters. At the same time, the capacitive charge/discharge currents that also occur on the output of the Motor Module when long motor cables are used are reduced.

Motor reactors can be operated in the VECTOR and SERVO control modes.

6.1.3.2 Dimension drawing



① Mounting hole
② Motor reactor type 1
③ Motor reactor type 2

Figure 6-11 Dimension drawing, motor reactor

6SL3000-	2BE32-1AA0	2BE32-6AA0	2BE33-2AA0	2BE33-8AA0	2BE35-0AA0
Connection type	1	1	1	1	2
a2	25 (0.98)	25 (0.98)	25 (0.98)	25 (0.98)	30 (1.18)
a3	5 (0.19)	5 (0.19)	5 (0.19)	5 (0.19)	6 (0.23)
a4	12.5 (0.49)	12.5 (0.49)	12.5 (0.49)	12.5 (0.49)	15 (0.59)
a5	11 (0.43)	11 (0.43)	11 (0.43)	11 (0.43)	14 (0.55)
I4	300 (11.81)	300 (11.81)	300 (11.81)	300 (11.81)	300 (11.81)
I5	100 (3.93)	100 (3.93)	100 (3.93)	100 (3.93)	100 (3.93)
hmax	285 (11.22)	315 (12.40)	285 (11.22)	285 (11.22)	365 (14.37)
h2	194 (7.63)	227 (8.93)	194 (7.63)	194 (7.63)	245 (9.64)
h3	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)
n1 [1)]	163 (6.41)	183 (7.20)	163 (6.41)	183 (7.20)	183 (7.20)
n2 [1)]	224 (8.81)	224 (8.81)	224 (8.81)	224 (8.81)	224 (8.81)
n3	257 (10.11)	277 (10.90)	257 (10.11)	277 (10.90)	277 (10.90)
n4	79 (3.11)	79 (3.11)	79 (3.11)	79 (3.11)	79 (3.11)
d3	M8	M8	M8	M8	M8

1) Lengths n1 and n2 correspond to the distance between holes.

6.1.3.3 Technical data

Table 6- 15 Technical data, motor reactors

Order number	6SL3000-	2BE32-1AA0	2BE32-6AA0	2BE33-2AA0	2BE33-8AA0	2BE35-0AA0
Suitable for Power Module	6SL3310-	1TE32-1AAx	1TE32-6AAx	1TE33-1AAx	1TE33-8AAx	1TE35-0AAx
Unit rating of the Power Module	kW	110	132	160	200	250
Rated current	A	210	260	310	380	490
Power loss - at 50 Hz - at 150 Hz	 kW kW	 0,436 0,486	 0,454 0,5	 0,422 0,47	 0,447 0,5	 0,448 0,5
Connections - to the Motor Module (1U1, 1V1, 1W1) - to the load (1U2, 1V2, 1W2) - PE		 M10 M10 M8	 M10 M10 M8	 M10 M10 M8	 M10 M10 M8	 M12 M12 M8
Max. permissible cable length between motor reactor and motor - with 1 motor reactor - with 2 motor reactors in series	 m m	 300 (shielded) / 450 (unshielded) 525 (shielded) / 787 (unshielded)				
Degree of protection		IP00	IP00	IP00	IP00	IP00
Dimensions Width Height Depth	 mm mm mm	 300 285 257	 300 315 277	 300 285 257	 300 285 277	 300 365 277
Weight	kg	66	66	66	73	100

6.2 Sinusoidal filter

6.2.1 Sine-wave filter, chassis

6.2.1.1 Description

The sine-wave filter at the output of the Power Module supplies voltages that are virtually sinusoidal at the motor, thereby enabling standard motors to be used without shielded cables and without the need to reduce the power. Non-shielded cables can be used and, if long motor supply cables are used, no additional motor reactors are required.

Sine-wave filters with a power rating of up to 200 kW are available

The pulse frequency of the Power Modules must be set to 4 kHz for the sine-wave filters. This reduces the output current of the Power Module, refer to Chapter "Technical data".

When a sine-wave filter is used, the available output voltage decreases by 15%.

6.2.1.2 Safety instructions for sine-wave filter chassis format

Note

When using sine-wave filters, also observe the safety instructions in Chapter 1.

⚠ WARNING

Danger of fire through overheating for insufficient ventilation clearances

Insufficient ventilation clearances result in overheating with danger to persons as a result of smoke and fire. Further, increased failures can occur and the service life of units/systems shortened.

- It is essential that you maintain 100 mm ventilation clearances above and below the component.

⚠ CAUTION

Risk of burns resulting from high surface temperatures

The sine-wave filters can have surface temperatures of over 80 °C. You can be severely burnt when touching the surface.

- Mount the sine-wave filter so that it cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.

NOTICE

Danger of damaging the sine-wave filter as a result of incorrect connections

It is not permissible that the connections at the sine-wave filter are interchanged:

- incoming line from the Power Module: 1U1, 1V1, 1W1 and
- outgoing line to the load: 1U2, 1V2, 1W2.

NOTICE

Risk of damaging the Power Module by using components that have not been released

When using components that have not been released, damage or malfunctions can occur at the devices or the system itself.

- Only use sine-wave filters that SIEMENS has authorized for SINAMICS.

NOTICE

Risk of damaging the sine-wave filter by exceeding the maximum output frequency

The maximum permissible output frequency when sine-wave filters are used is 150 Hz. The sine-wave filter can be damaged if the output frequency is exceeded.

- When commissioning, you must always activate the sine-wave filter connected to the Power Module (p0230 = 3).

NOTICE

Risk of damaging the sine-wave filter if a motor is not connected

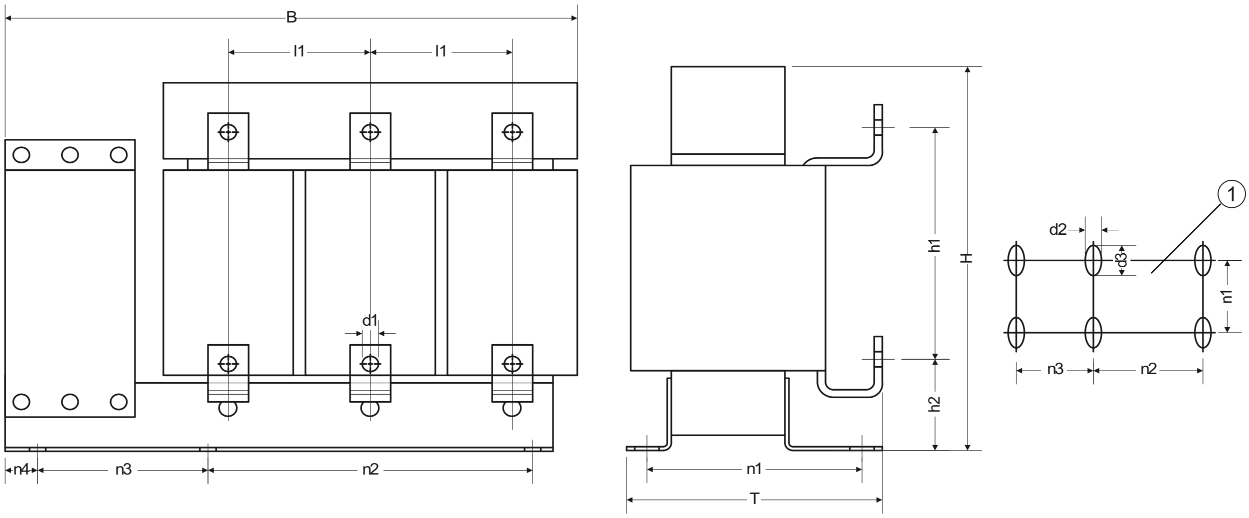
Sine-wave filters, which are operated without a motor being connected, can be damaged or destroyed.

- Never operate a sine-wave filter connected to the Power Module without a connected motor.

Note

Keep the connecting cables to the Power Module as short as possible (max. 5 m).

6.2.1.3 Dimension drawing



① Mounting hole

Figure 6-12 Dimension drawing, sine-wave filter

Table 6- 16 Dimensions, sine-wave filter in mm (inches)

6SL3000-	2CE32-3AA0	2CE32-8AA0	2CE33-3AA0	2CE34-1AA0
B	620 (24.40)	620 (24.40)	620 (24.40)	620 (24.40)
H	300 (11.81)	300 (11.81)	370 (14.56)	370 (14.56)
D	320 (12.59)	320 (12.59)	360 (14.17)	360 (14.17)
l1	140 (5.51)	140 (5.51)	140 (5.51)	140 (5.51)
h1	180 (7.08)	180 (7.08)	220 (8.66)	220 (8.66)
h2	65 (3.34)	65 (3.34)	65 (3.34)	65 (3.34)
n1 1)	280 (11.02)	280 (11.02)	320 (12.59)	320 (12.59)
n2 1)	150 (5.90)	150 (5.90)	150 (5.90)	150 (5.90)
n3 1)	225 (8.85)	225 (8.85)	225 (8.85)	225 (8.85)
n4	105 (4.13)	105 (4.13)	105 (4.13)	105 (4.13)
d1	12 (0.47)	12 (0.47)	12 (0.47)	12 (0.47)
d2	11 (0.43)	11 (0.43)	11 (0.43)	11 (0.43)
d3	22 (0.86)	22 (0.86)	22 (0.86)	22 (0.86)

1) Dimensions n1, n2, n3 correspond to the hole spacing

6.2.1.4 Technical data

Table 6- 17 Technical data, sine-wave filter

Order number	6SL3000-	2CE32-3AA0	2CE32-3AA0	2CE32-8AA0	2CE33-3AA0	2CE34-1AA0
Suitable for Power Module	6SL3310-	1TE32-1AAx	1TE32-6AAx	1TE33-1AAx	1TE33-8AAx	1TE35-0AAx
Unit rating of the Power Module at a 4 kHz pulse frequency	kW	90	110	132	160	200
Rated current	A	225	225	276	333	408
Power loss - at 50 Hz - at 150 Hz	 kW kW	 0.35 0.6	 0.35 0.6	 0.4 0.69	 0.245 0.53	 0.38 0.7
Connections - to the Power Module - to the load - PE		 M10 connecting lugs M10 connecting lugs M10 drill hole				
Max. permissible cable length between sine-wave filter and motor	m	300 (shielded) 450 (unshielded)				
Degree of protection		IP00	IP00	IP00	IP00	IP00
Dimensions Width Height Depth	 mm mm mm	 620 300 320	 620 300 320	 620 300 320	 620 370 360	 620 370 360
Weight, approx.	kg	124	124	127	136	198

6.3 dv/dt filter plus Voltage Peak Limiter

6.3.1 du/dt filter plus Voltage Peak Limiter chassis format

6.3.1.1 Description

The du/dt filter plus Voltage Peak Limiter consists of two components: the du/dt reactor and the voltage limiting network (Voltage Peak Limiter), which limits voltage peaks and returns the energy to the DC link.

The du/dt filters with Voltage Peak Limiter must be used for motors for which the proof voltage of the insulation system is unknown or insufficient. Standard motors of the 1LA5, 1LA6 and 1LA8 series only require them at supply voltages > 500 V +10%.

du/dt filters plus Voltage Peak Limiters limit the rate of voltage rise to values < 500 V/µs and the typical voltage peaks with rated line voltages to the values below (with motor cable lengths of < 150 m):

< 1000 V at V_{line} < 575 V.

Components

The order numbers of the individual components (du/dt reactor and voltage peak limiter) are listed in the following table:

Table 6- 18 du/dt filter with Voltage Peak Limiter, order numbers of the individual components

du/dt filter plus Voltage Peak Limiter	du/dt reactor	voltage peak limiter
6SL3000-2DE32-6AA0	6SL3000-2DE32-6CA0	6SL3000-2DE32-6BA0
6SL3000-2DE35-0AA0	6SL3000-2DE35-0CA0	6SL3000-2DE35-0BA0

WARNING

Risk of damaging the du/dt filter for pulse frequencies >4 kHz

The du/dt filter can be damaged or destroyed in operation if an excessively high pulse frequency is set at the Power Module.

When using a du/dt filter, operate a Power Module with a maximum pulse frequency of 4 kHz.

6.3.1.2 Safety instructions for du/dt filter plus Voltage Peak Limiter

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Note

When using du/dt filters plus Voltage Peak Limiter, also observe the safety instructions in Chapter 1.

⚠ WARNING

Danger to life caused by high discharge currents when the external protective conductor is interrupted

du/dt filters plus Voltage Peak Limiter result in a high discharge current via the protective conductor. When the protective conductor is interrupted, touching live components can result in electric shock, which can lead to death or serious injuries.

- Ensure that there is a good PE connection to the du/dt filter and/or the control cabinet.
- Ensure that the minimum cross-section of the protective ground conductor conforms to the local safety regulations for protective ground conductors for equipment with a high leakage current according to EN 61800-5-1, Chapter 6.3.6.7.
- Ensure that the protective conductor is routed so that it is protected against mechanical damage.

⚠ WARNING

Danger of fire through overheating for insufficient ventilation clearances

Insufficient ventilation clearances result in overheating with danger to persons as a result of smoke and fire. Further, increased failures can occur and the service life of units/systems shortened.

- It is essential that you maintain 100 mm ventilation clearances above and below the component.

⚠ CAUTION

Risk of burns resulting from high surface temperatures

The surface temperatures of du/dt reactors can exceed 80 °C. You can be severely burnt when touching the surface.

- Mount the du/dt reactors so that they cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.

NOTICE

Risk of damaging the Voltage Peak Limiter as a result of incorrect connections

The terminals on the voltage limiting network (Voltage Peak Limiter) must always be connected as follows:

- Connect the cable from the DC link of the Power Module to DCPS, DCNS.
- Connect the cable to the du/dt reactor at 1U2, 1V2, 1W2.

NOTICE

Risk of damaging the du/dt filter by using components that have not been released

When using components that have not been released, damage or malfunctions can occur at the devices or the system itself.

- Only use du/dt filters that SIEMENS has authorized for SINAMICS.

NOTICE

Risk of damaging the du/dt filter by exceeding the maximum output frequency

The maximum permissible output frequency when using du/dt filters plus Voltage Peak Limiter is 150 Hz. The du/dt filter can be damaged if the output frequency is exceeded.

- When commissioning, (p0230 = 2) you must always activate the du/dt filter plus Voltage Peak Limiter connected to the Power Module.

NOTICE

Risk of damage to the du/dt filter if a motor is not connected

du/dt filters plus Voltage Peak Limiter can be damaged or destroyed if the drive is operated without a connected motor.

- Never operate the drives with du/dt filters plus Voltage Peak Limiter without a connected motor.

Note

Keep the connecting cables to the Power Module as short as possible (max. 5 m).

6.3.1.3 Interface description

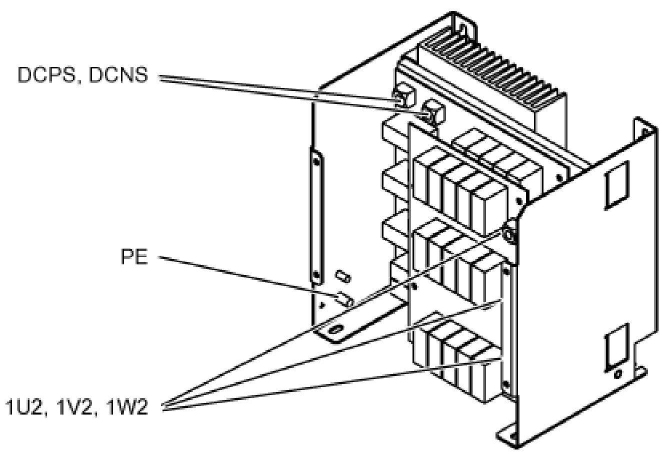


Figure 6-13 Interface overview, voltage peak limiter, type 1

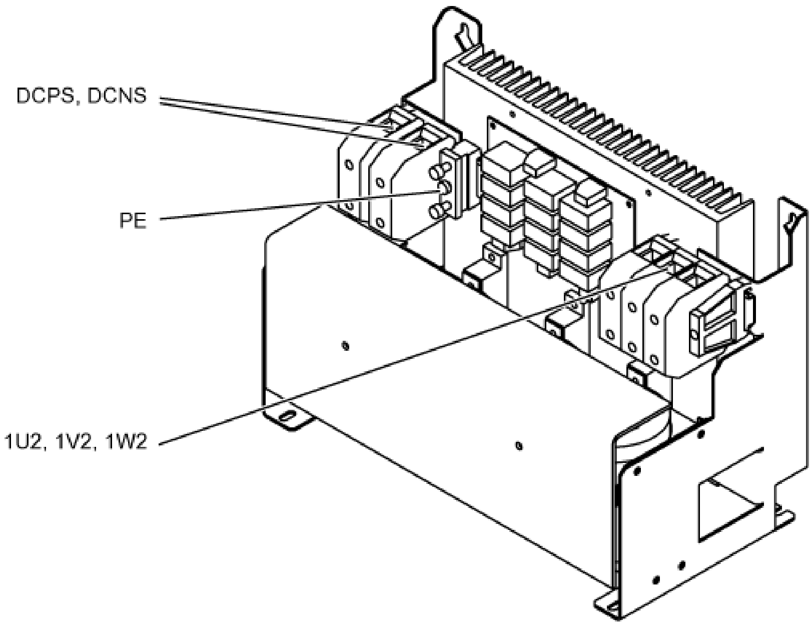


Figure 6-14 Interface overview, voltage peak limiter, type 2

6.3.1.4 Connecting the dv/dt filter plus Voltage Peak Limiter

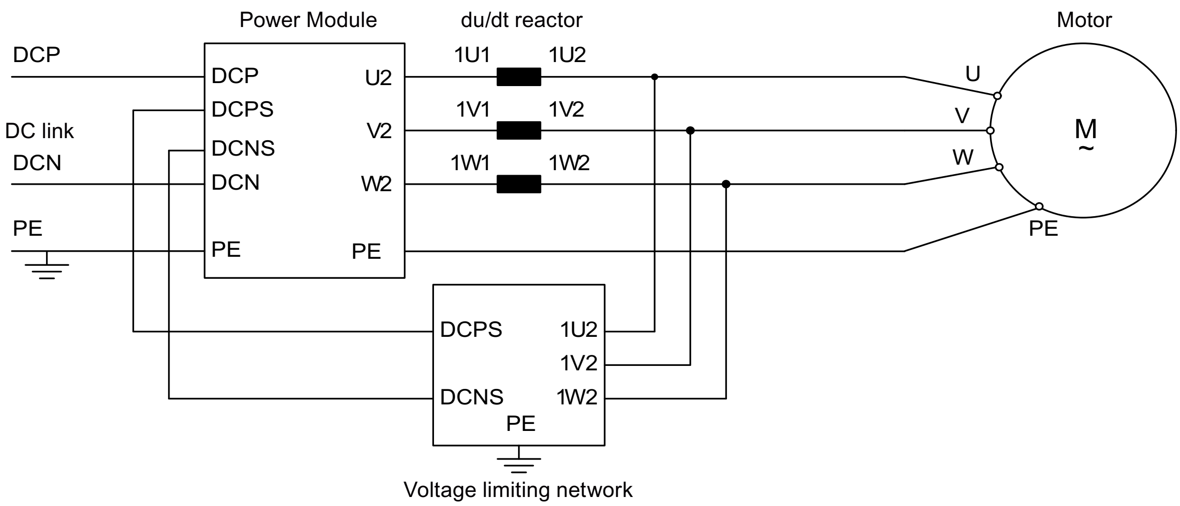


Figure 6-15 Connecting the du/dt filter plus Voltage Peak Limiter

Cable cross-sections

Table 6- 19 Cable cross-sections for connections between a du/dt filter and Power Module

du/dt filter plus Voltage Peak Limiter	Connection to the DC link (DCPS / DCNS) [mm²]	Connection between a du/dt reactor and voltage peak limiter (1U2, 1V2, 1W2) [mm²]
6SL3000-2DE32-6AA0	35	10
6SL3000-2DE35-0AA0	70	16

⚠ WARNING

Risk of fire and device damage as a result of ground fault/short-circuit

The connection to the DC link of the Power Module must be routed so that a ground fault or short circuit can be ruled out. A ground fault can result in fire with associated smoke.

- Comply with local installation regulations, which allow this fault to be ruled out.
- Protect the cables from mechanical damage.

In addition, apply one of the following measures:

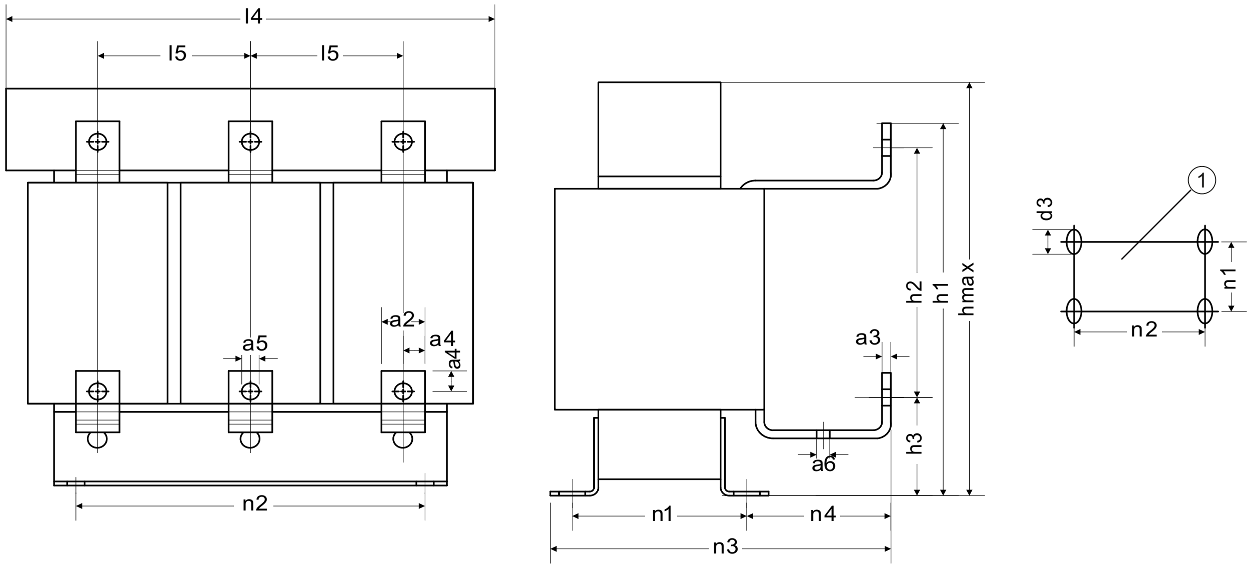
- Using cables with double insulation.
- Maintain adequate clearance, using spacers, for example.
- Route the cables in separate cable ducts or pipes.

Note

Keep the connections as short as possible.

The maximum cable length for the specified connections is 5 m per connection.

6.3.1.5 Dimension drawing, dv/dt reactor



① Mounting hole

Figure 6-16 Dimension drawing, dv/dt reactor

Table 6- 20 Dimensions dv/dt reactor, 380 V - 480 V 3 AC in mm (inch)

6SL3000-	2DE32-6CA0	2DE35-0CA0
a2	25 (0.98)	30 (1.18)
a3	5 (0.19)	6 (0.23)
a4	14 (0.55)	17 (0.66)
a5	10.5 x 14 (0.41 x 0.55)	14 x 18 (0.55 x 0.70)
a6	7 (0.27)	9 (0.35)
l4	410 (16.14)	460 (18.11)
l5	135 (5.31)	152.5 (6.00)
hmax	370 (14.56)	370 (14.56)
h2	258 (10.15)	240 (9.44)
h3	76 (2.99)	83 (3.26)
n1 [1)]	141 (5.55)	182 (7.16)
n2 [1)]	316 (12.44)	356 (14.01)
n3	229 (9.01)	275 (10.82)
n4	72 (2.83)	71 (2.79)
d3	M10 [12 x 18] (0.47 x 0.70)	M12 [15 x 22] (0.59 x 0.86)
[1)] Lengths n1 and n2 correspond to the distance between holes.		

6.3.1.6 Dimension drawing of the voltage peak limiter

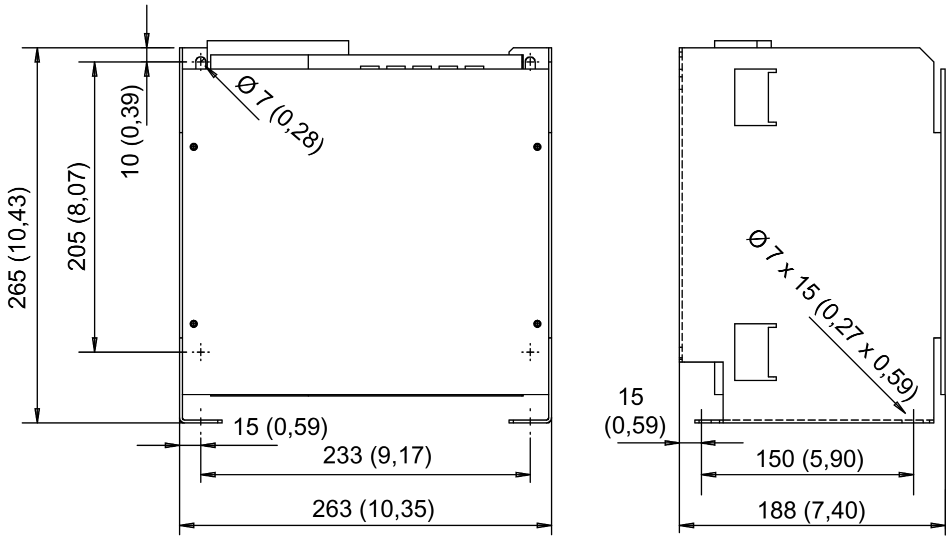


Figure 6-17 Dimension drawing of the voltage peak limiter, type 1

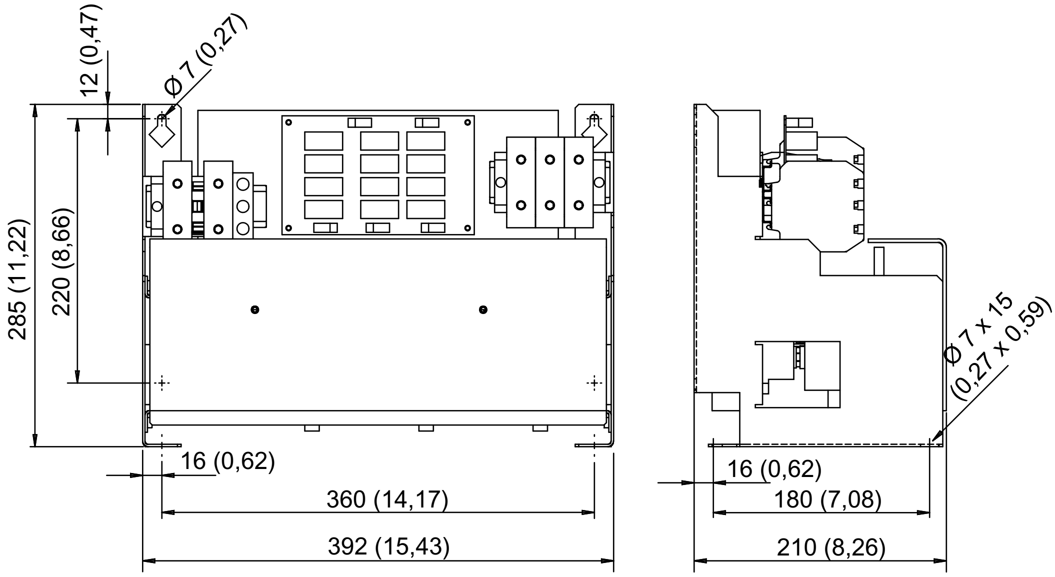


Figure 6-18 Dimension drawing of the voltage peak limiter, type 2

Table 6- 21 Assigning voltage peak limiter to dimension drawings

Voltage peak limiter	Dimension drawing, type
6SL3000-2DE32-6BA0	Type 1
6SL3000-2DE35-0BA0	Type 2

6.3.1.7 Technical data

Table 6- 22 Technical data, dv/dt filter plus Voltage Peak Limiter

Order number	6SL3000-	2DE32-6AA0	2DE35-0AA0
Suitable for Power Module (unit rating)	6SL3310-	1TE32-1AAx (110 kW) 1TE32-6AAx (132 kW)	1TE33-1AAx (160 kW) 1TE33-8AAx (200 kW) 1TE35-0AAx (250 kW)
I_{thmax}	A	260	490
Degree of protection		IP00	IP00
dv/dt reactor			
Power loss - at 50 Hz - at 60 Hz - at 150 Hz	 kW kW kW	 0.701 0.729 0.78	 0.874 0.904 0.963
Connections - to the Power Module - load - PE		 M10 M10 M6	 M12 M12 M6
Max. permissible cable length between dv/dt reactor and motor	m	300 (shielded) 450 (unshielded)	
Dimensions Width Height Depth	 mm mm mm	 410 370 229	 460 370 275
Weight, approx.	kg	66	122
Voltage Peak Limiter			
Power loss - at 50 Hz - at 60 Hz - at 150 Hz	 kW kW kW	 0.029 0.027 0.025	 0.042 0.039 0.036
Connections - to the dv/dt reactor - DC - PE		 M8 M8 M8	 Terminal 70 mm² Terminal 70 mm² Terminal 35 mm²
Dimensions Width Height Depth	 mm mm mm	 265 263 190	 392 285 210
Weight, approx.	kg	6	16

6.4 dv/dt filter compact plus Voltage Peak Limiter

6.4.1 du/dt filter compact plus Voltage Peak Limiter chassis format

6.4.1.1 Description

The du/dt filter compact plus Voltage Peak Limiter has two components: The du/dt reactor and the voltage limiting network (Voltage Peak Limiter). The voltage limiting network cuts-off the voltage peaks and feeds the energy back into the DC link.

The du/dt filter compact plus Voltage Peak Limiter is designed for use with motors for which the voltage strength of the insulation system is unknown or insufficient.

The du/dt filters compact plus Voltage Peak Limiter limit the voltage load on the motor cables to values which correspond to limit value curve A as per IEC/TS 60034-25:2007.

The rate of voltage rise is limited to < 1,600 V/µs, the peak voltages are limited to < 1,400 V.

⚠ WARNING

Risk of thermally damaging du/dt filters for output frequencies <10 Hz in continuous operation

Continuous operation at an output frequency of less than 10 Hz can result in thermal overload and destroy the du/dt filter.

- Only load the du/dt filter for a maximum of 5 min at an output frequency of <10 Hz
- Then, subsequently select operation with an output frequency > 10 Hz for a duration of 5 min.

⚠ WARNING

Risk of damaging du/dt filters compact at pulse frequencies >4 kHz

The du/dt compact filter can be damaged or destroyed in operation if an excessively high pulse frequency is set at the Power Module.

When using a du/dt filter compact, operate a Power Module with a maximum pulse frequency of 4 kHz.

Note

When using a du/dt filter compact plus Voltage Peak Limiter, the pulse frequency can be set in the range between the rated pulse frequency and the maximum pulse frequency.

Note

Current derating at an increased pulse frequency depends on the derating of the associated Power Module.

6.4.1.2 Safety instructions for du/dt filter compact plus Voltage Peak Limiter

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Note

When using du/dt filters compact plus Voltage Peak Limiter, also observe the safety instructions in Chapter 1.

WARNING

Danger to life caused by high discharge currents when the external protective conductor is interrupted

du/dt filters compact plus Voltage Peak Limiter result in a high discharge current via the protective conductor. When the protective conductor is interrupted, touching live components can result in electric shock, which can lead to death or serious injuries.

- Ensure that there is a good PE connection to the du/dt filter and/or the control cabinet.
- Ensure that the minimum cross-section of the protective ground conductor conforms to the local safety regulations for protective ground conductors for equipment with a high leakage current according to EN 61800-5-1, Chapter 6.3.6.7.
- Ensure that the protective conductor is routed so that it is protected against mechanical damage.

WARNING

Danger to life as a result of electric shock if the grounding is either missing or faulty

Touching live components can result in death or severe injury.

- It is essential that you ground every component using the specially marked PE connection.

WARNING

Danger of fire through overheating for insufficient ventilation clearances

Insufficient ventilation clearances result in overheating with danger to persons as a result of smoke and fire. Further, increased failures can occur and the service life of units/systems shortened.

- It is essential that you maintain 100 mm ventilation clearances above and below the component.
- Always mount the du/dt filters compact plus Voltage Peak Limiter in a vertical, upright position, to enable cooling air to flow through the heat sink on the Voltage Peak Limiter from the bottom to the top.

CAUTION

Risk of burns resulting from high surface temperatures

The surface temperatures of du/dt filters compact may exceed 80 °C. You can be severely burnt when touching the surface.

- Mount the du/dt filters so that they cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.

NOTICE

Risk of damaging the du/dt filter compact by using components that have not been released

When using components that have not been released, damage or malfunctions can occur at the devices or the system itself.

- Only use a du/dt filter compact that SIEMENS has authorized for SINAMICS.

NOTICE

Risk of damaging the du/dt filter compact by exceeding the maximum output frequency

The maximum permissible output frequency when using du/dt filters compact plus Voltage Peak Limiter is 150 Hz. The du/dt filter compact can be damaged if the output frequency is exceeded.

- When commissioning, (p0230 = 2) you must always activate the du/dt filter compact plus Voltage Peak Limiter connected to the Power Module.

NOTICE

Risk of damage to the du/dt filter compact if a motor is not connected

du/dt filters compact plus Voltage Peak Limiter can be damaged or destroyed if the drive is operated without a connected motor.

- Never operate the drives with du/dt filters compact plus Voltage Peak Limiter without a connected motor.

Note

Keep the motor cables between the Power Module and the du/dt filter compact, as well as the cables to the DC link as short as possible (max. 5 m).

6.4.1.3 Interface description

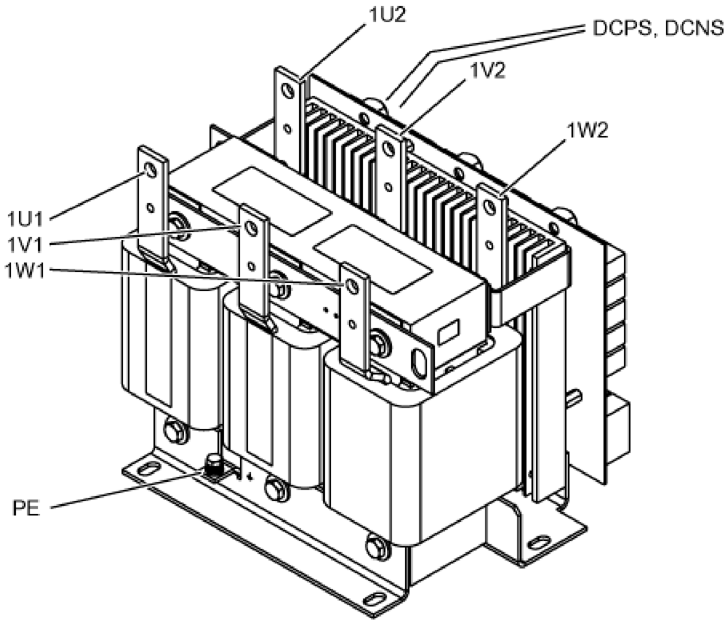


Figure 6-19 Interface overview, dv/dt filter compact plus Voltage Peak Limiter, type 1

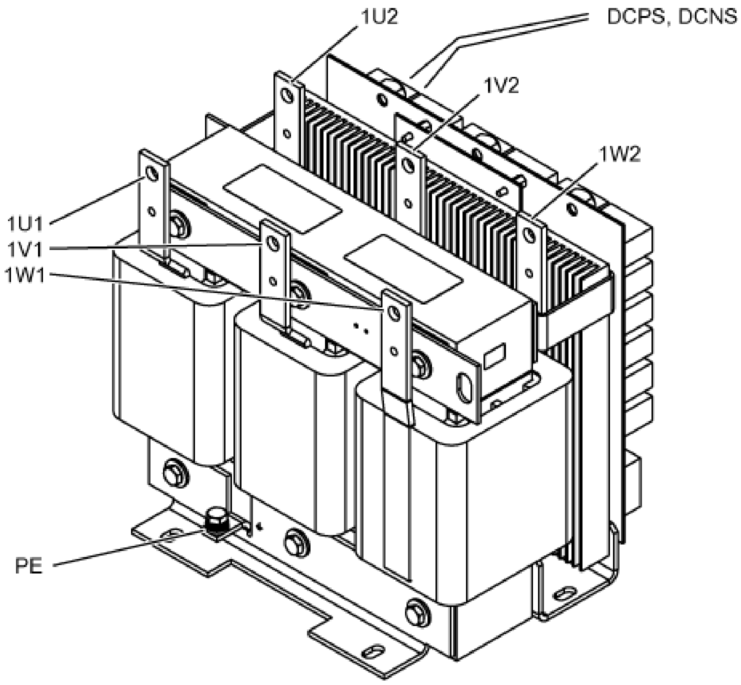


Figure 6-20 Interface overview, dv/dt filter compact plus Voltage Peak Limiter, type 2

6.4.1.4 Connecting the dv/dt filter compact plus Voltage Peak Limiter

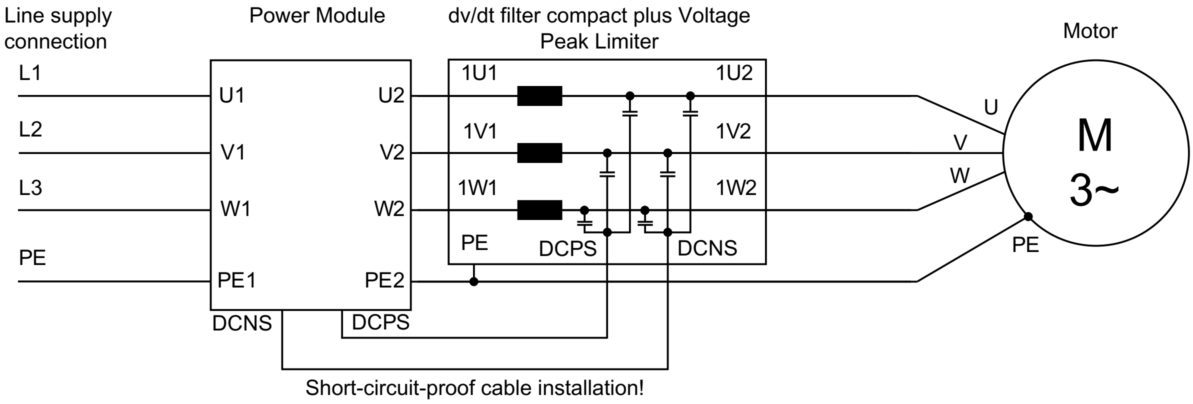


Figure 6-21 Connecting the dv/dt filter compact plus Voltage Peak Limiter

Cable cross-sections

Table 6- 23 Cable cross-sections for connections between a dv/dt filter and Power Module

dv/dt filter compact plus Voltage Peak Limiter	Cross-section [mm²]	Connection on dv/dt filter
6SL3000-2DE32-6EA0	16	M8 screw/12 Nm
6SL3000-2DE35-0EA0	25	M8 screw/12 Nm

NOTICE

The connection to the DC link of the Power Module must be routed according to EN 61800-5-2:2007, Table D.1 in order to rule out short circuiting and ground faults.

This can be accomplished, for example, by:

- Eliminating the risk of mechanical damage to the cables
- Using cables with double insulation
- Maintaining adequate clearance, using spacers, for example
- Laying the cables in separate cable ducts or pipes

Note

The connections should be kept as short as possible.
The maximum cable length between the Power Module and the dv/dt filter compact (motor cables and cables to the DC link) is 5 m.

> **WARNING**
>
> The connections on the dv/dt filter compact have not been designed for the direct mechanical connection of the motor cables.
>
> The customer must take steps to ensure that the mechanical load exerted by the connected cables does not deform these connections.

6.4.1.5 Dimension drawing of dv/dt filter compact plus Voltage Peak Limiter

dv/dt filter compact plus Voltage Peak Limiter, type 1

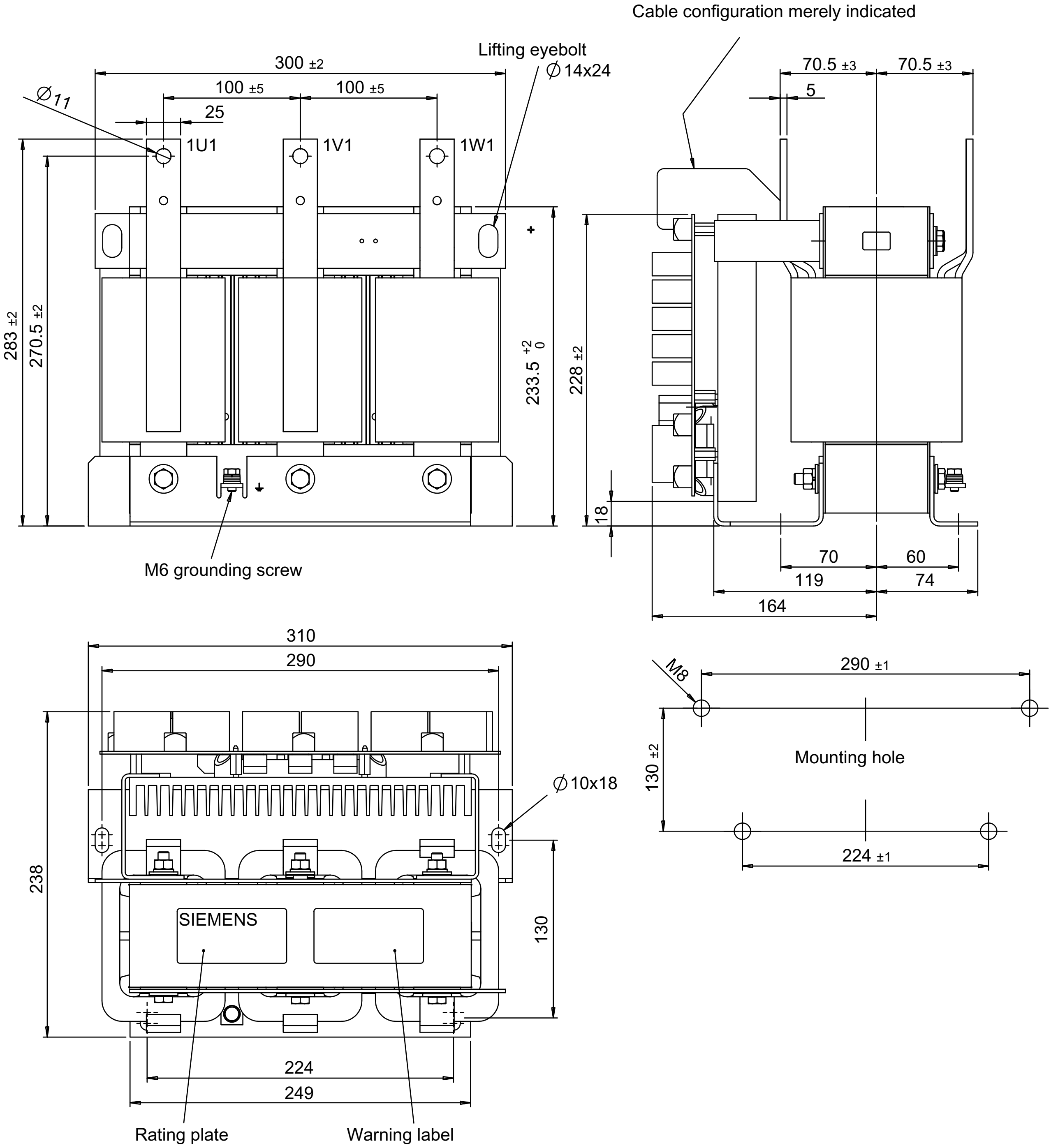


Figure 6-22 Dimension drawing of dv/dt filter compact plus Voltage Peak Limiter, type 1

dv/dt filter compact plus Voltage Peak Limiter, type 2

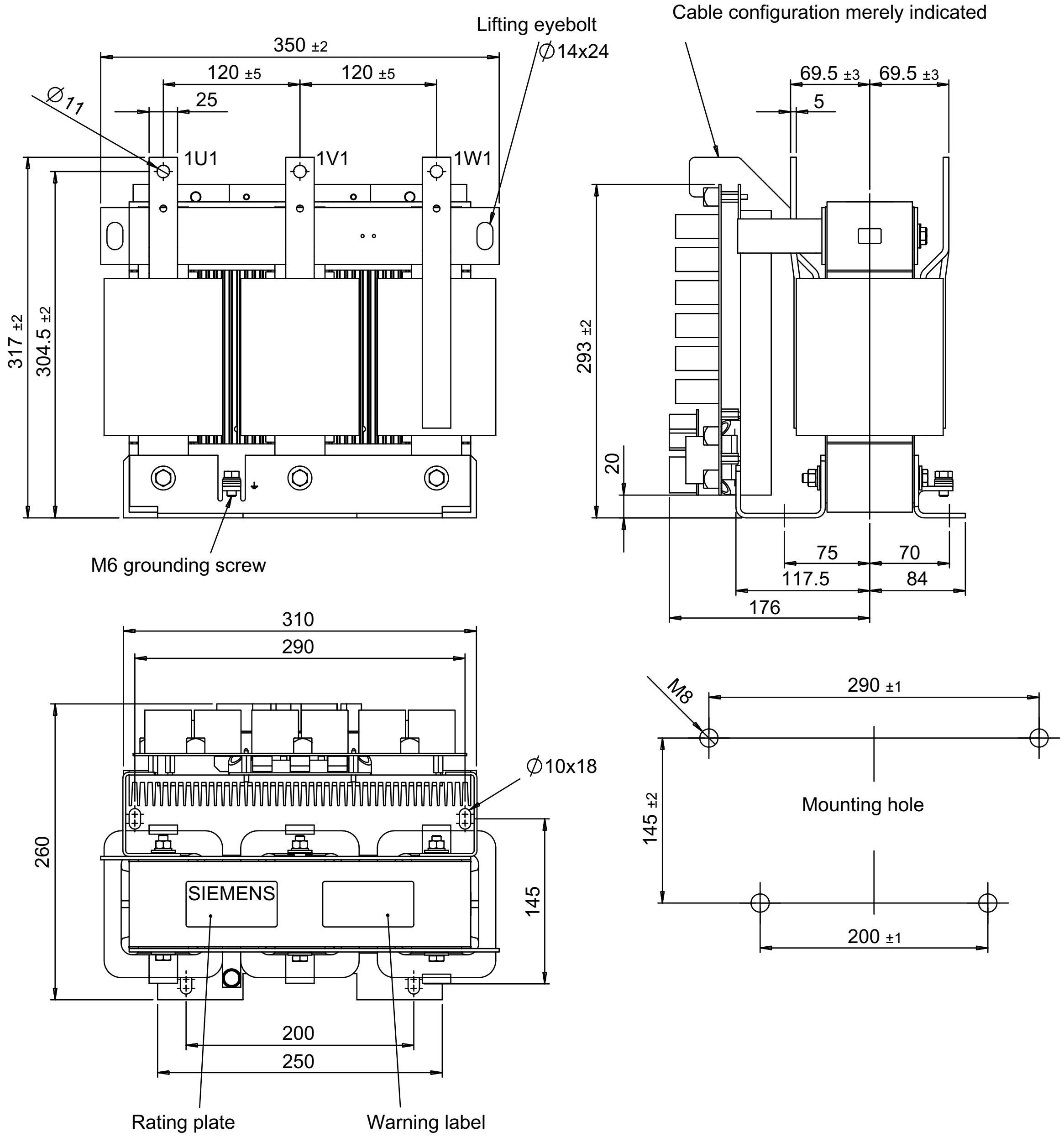


Figure 6-23 Dimension drawing of dv/dt filter compact plus Voltage Peak Limiter, type 2

Table 6- 24 Assignment of the dv/dt filter compact plus Voltage Peak Limiter to the dimension drawings

dv/dt filter compact plus Voltage Peak Limiter	Dimension drawing type
6SL3000-2DE32-6EA0	Type 1
6SL3000-2DE35-0EA0	Type 2

6.4.1.6 Technical data

Table 6- 25 Technical data, dv/dt filter compact plus Voltage Peak Limiter

Order number	6SL3000-	2DE32-6EA0	2DE35-0EA0	
Suitable for Power Module (unit rating)	6SL3310-	1TE32-1AAx (110 kW) 1TE32-6AAx (132 kW)	1TE33-1AAx (160 kW) 1TE33-8AAx (200 kW) 1TE35-0AAx (250 kW)	
I_{thmax}	A	260	490	
Degree of protection		IP00	IP00	
Power loss - at 50 Hz - at 60 Hz - at 150 Hz	 kW kW kW	 0.210 0.215 0.255	 0.290 0.296 0.344	
Connections - 1U1/1V1/1W1 - DCPS/DCNS - 1U2/1V2/1W2 - PE		 For M10 stud For M8 screw For M10 stud M6 screw	 For M10 stud For M8 screw For M10 stud M6 screw	
Max. permissible cable length between dv/dt filter and motor	m	100 (shielded) 150 (unshielded)		
Dimensions Width Height Depth	 mm mm mm	 310 283 238	 350 317 260	
Weight, approx.	kg	41	61	

Control Units, Control Unit Adapters and operating components 7

7.1 Introduction

7.1.1 Control Units

Brief description

The CU310-2 Controller Units are designed for operation connected to a Power Module, in the blocksize or chassis formats.

CU310-2 DP

CU310-2 PN

Features

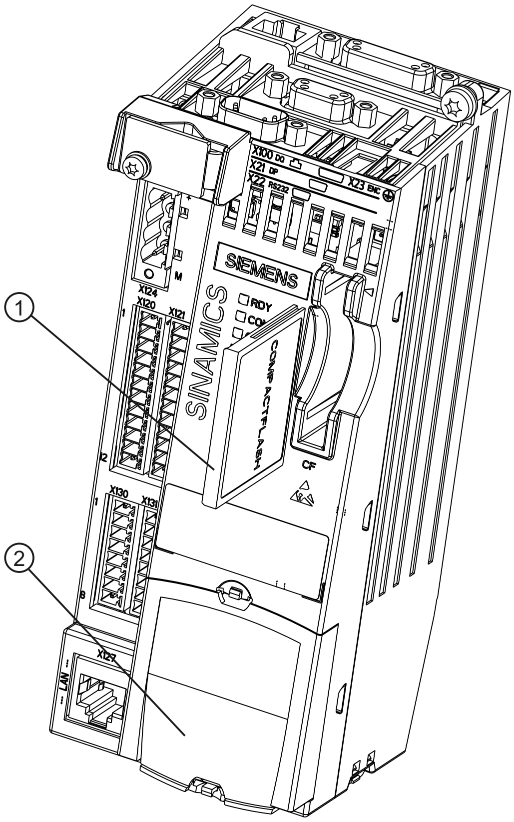
Designation	Features	Order number
CU310-2 DP	- PROFIBUS as an external communications interface - LAN (Ethernet) - TTL/HTL/SSI – encoder evaluation - analog setpoint input	6SL3040-1LA00-0AA0
CU310-2 PN	- 2x PROFINET as an external communications interface - LAN (Ethernet) - TTL/HTL/SSI – encoder evaluation - analog setpoint input	6SL3040-1LA01-0AA0

Memory card

The memory card has the firmware and default parameters for the operation of the Control Unit.

The memory card for the Control Unit must be ordered separately. The order number is 6SL3054-0EE00-1BA0.

Order numbers for memory cards with safety license can be found in Catalog PM21.



① Memory card
② Blanking plate

Figure 7-1 CU310-2 DP: CompactFlash Card slot

7.1.2 Control Unit Adapter

Brief description

Using a Control Unit Adapter, a Power Module can be connected as an additional axis to an existing DC/AC group. A higher-level closed-loop control module is always required.

Control Unit Adapter CUA31

Control Unit Adapter CUA32

Features

Designation	Features	Order number
CUA31	- Addition of an axis	6SL3040-0PA00-0AA1
CUA32	- Addition of an axis - TTL/HTL/SSI encoder evaluation	6SL3040-0PA01-0AA0

7.2 Safety instructions for Control Units and Control Unit Adapters

Note

When handling/using a Control Unit or a Control Unit Adapter, also observe the safety instructions in Chapter 1.

WARNING

Danger of fire through overheating for insufficient ventilation clearances

Insufficient ventilation clearances result in overheating with danger to persons as a result of smoke and fire. Further, increased failures can occur and the service life of units/systems shortened.

- It is essential that you maintain 50 mm ventilation clearances above and below the Control Unit and Control Unit Adapter.
- Ensure that the air openings are not blocked by connecting cables.

NOTICE

Risk of component destruction as a result of high leakage currents

The Control Unit or other PROFIBUS and/or PROFINET nodes can be destroyed, if significant leakage currents flow via the PROFIBUS or PROFINET cable.

- Use a functional equipotential bonding conductor with a cross-section of at least 25 mm^2 between components of a plant or system that are located at a distance from each other.

NOTICE

Failure of components as a result of unshielded or incorrectly routed cables to temperature sensors

For unshielded or incorrectly routed cables it can be expected that noise and interference from the power side will be coupled into the signal processing electronics; this can significantly disturb all signals (fault messages) up to failure of individual components (destruction) of the devices.

- For temperature sensor cables that are routed together with the motor cable only use twisted-pair cables that are separately shielded.
- Always route connecting cables to temperature sensors so that they are shielded.
- Connect the cable shield to ground potential through a large surface area.

NOTICE

Damage when using components that have not been released

When using components that have not been released, damage or malfunctions can occur at the devices or the system itself.

- Only use cables from Siemens for DRIVE-CLiQ connections.

NOTICE

Device damage as a result of dirty DRIVE-CLiQ interfaces

Dirty DRIVE-CLiQ interfaces can result in malfunctions and damage to the device.

- Close unused DRIVE-CLiQ interfaces with blanking covers to prevent the ingress of dirt. Blanking covers are included in the scope of delivery

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Note

Function equipotential bonding for distributed DRIVE-CLiQ nodes

Integrate all of the components that are connected via DRIVE-CLiQ into the function equipotential bonding concept. The connection should be preferably established by mounting on metallic bare machine and plant components that are connected with one another using an equipotential bonding conductor.
Alternatively, you can establish equipotential bonding using a conductor (min. 6 mm²), which as far as possible, is routed in parallel to the DRIVE-CLiQ cable. This involves all distributed DRIVE-CLiQ nodes, for example SMCx0

7.3 Control Unit CU310-2 PN (PROFINET)

7.3.1 Description

The Control Unit CU310-2 PN (PROFINET) is a control module for single drives in which the open-loop and closed-loop control functions of the drive are implemented.
It controls the Power Modules in the blocksize format via the PM-IF interface and is mounted directly on the Power Module. Power Modules Chassis are controlled from the Control Unit via the DRIVE-CLiQ interface. They are installed next to the Power Modules in the control cabinet.

The CU310-2 PN is hot-pluggable. It can be used with firmware version 4.4 or higher.

The table shows an overview of the interfaces on the CU310-2 PN.

Table 7- 1 Overview of the CU310-2 PN interfaces

Type	Quantity
Isolated digital inputs	11
Non-isolated digital inputs/outputs	8
Isolated digital output	1
Non-isolated analog input	1
DRIVE-CLiQ interface	1
PROFINET interfaces	2
Serial interface (RS232)	1
Encoder interface (HTL/TTL/SSI)	1
LAN (Ethernet)	1
Temperature sensor input	1
EP terminal	1
Measuring sockets	3

7.3.2 Interface description

7.3.2.1 Overview

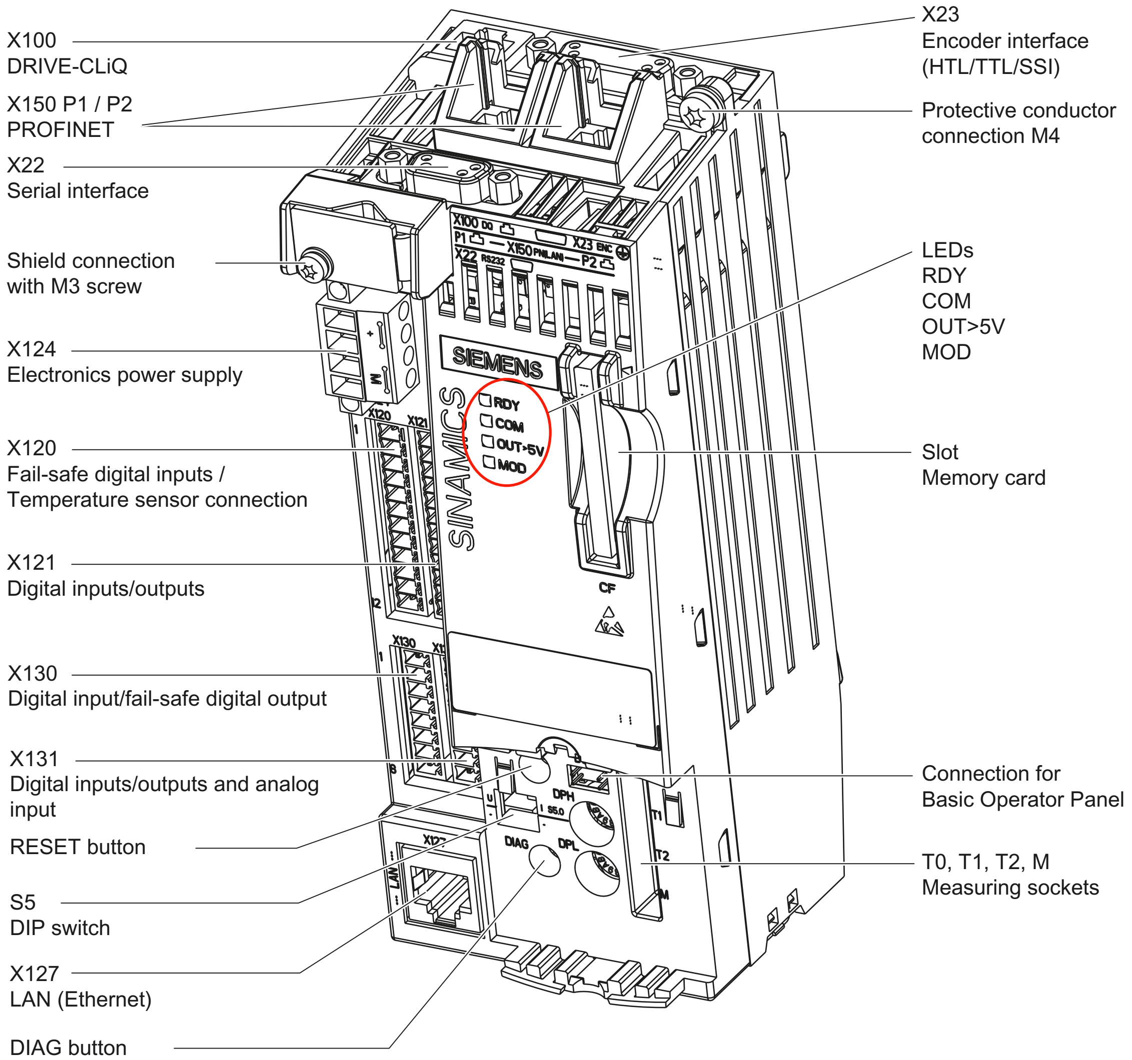


Figure 7-2 CU310-2 PN overview of interfaces

Note

The PROFIBUS address switch on the CU310-2 PN has no function.

The interface to the Power Module is located at the rear of the CU310-2 PN.

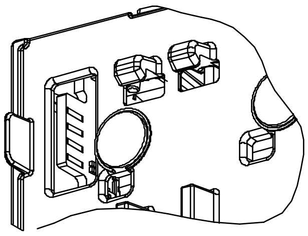
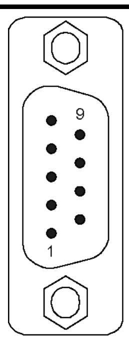


Figure 7-3 CU310-2 PN interface to the Power Module (PM-IF)

7.3.2.2 X22 serial interface (RS232)

Table 7- 2 X22 serial interface (RS232)

	Pin	Signal name	Technical data
	1	Reserved, do not use	
	2	XRXD_RS232	Receive data
	3	XTXD_RS232	Transmit data
	4	Reserved, do not use	
	5	M	Ground
	6	Reserved, do not use	
	7	Reserved, do not use	
	8	Reserved, do not use	
	9	Reserved, do not use	
Connector type	9-pin SUB D connector		

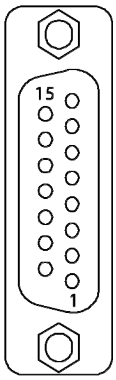
Features

The maximum data rate is:

- 120 kBaud at a load capacity of 1.0 nF
- 20 kBaud at a load capacity of 2.5 nF

7.3.2.3 X23 HTL/TTL/SSI encoder interface

Table 7- 3 X23 HTL/TTL/SSI encoder interface

	Pin	Signal name	Technical data
	1	+Temp	KTY or PTC input
	2	SSI_CLK	SSI clock, positive
	3	SSI_XCLK	SSI clock, negative
	4	P encoder 5 V / 24 V	Encoder supply
	5	P encoder 5 V / 24 V	
	6	P_Sense	Sense input, encoder supply
	7	M	Ground, encoder supply
	8	M (-Temp)	Ground for KTY or PTC
	9	M_Sense	Ground sense input
	10	RP	R track positive
	11	RN	R track negative
	12	BN	B track negative
	13	BP	B track positive
	14	AN_SSI_XDAT	A track negative/SSI data negative
	15	AP_SSI_DAT	A track positive/SSI data positive
Connector type	15-pin Sub-D socket		
Measuring current via temperature sensor connection: 2 mA			

NOTICE

Risk of motor overheating for incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Make sure that you connect the KTY temperature sensor with the correct polarity.

Note

There are two ways of connecting the temperature sensor:

1. via X120, terminals 1 and 2
2. via X23, pins 1 and 8

Encoders that can be connected

Note

Use of bipolar and unipolar encoders

If at all possible, use bipolar encoders.

When using unipolar encoders, the unused negative track signals can either be connected or connected to ground. This results in different switching thresholds.

Table 7- 4 Specification of measuring systems that can be connected

Parameter	Designation	Threshold	Min.	Type	Max.	Unit
Permissible signal level in the bipolar mode (parameter p0405.1=1); (TTL, SSI, HTL bipolar at X23)[1)2)]	U_{diff}		2,0		Vcc	V
Permissible signal frequency	f_S		-		500	kHz
Required edge clearance	t_{min}		100		-	ns
Permissible zero pulse (with T_s = $1/f_s$)	Length		$¼ \cdot T_s$		$¾ \cdot T_s$	
	Center of the pulse position		50	135	220	Degrees
Switching threshold in the unipolar mode (parameter p0405.0=0) and signals AN_SSI_XDAT, BN, RN at X23 connected to M_Encoder	$U_{(Switch)}$	High (p0405.4=1)	8,4	10,6	13,1	V
		Low (p0405.4=0)	3,5	4,8	6,3	V
Switching thresholds in the unipolar mode (parameter p0405.0=0) and signals AN_SSI_XDAT, BN, RN not connected to X23	$U_{(Switch)}$	High (p0405.4=1)	9	11,3	13,8	V
		Low (p0405.4=0)	5,9	7,9	10,2	V

1) Other signal levels according to the RS422 specification

2) The absolute level of the individual signals varies between 0 V and Vcc of the measuring system.

Encoder cables

Encoder type	Maximum encoder cable length in m
TTL [1)]	100
HTL unipolar [2)]	100
HTL bipolar	300
SSI [3)]	up to 100 (depending on the baud rate)

1) 100 m with remote sense

2) The bipolar connection should always be used as a result of the more rugged transfer technology. The unipolar connection should only be used if the encoder type does not output push-pull signals.

3) For the cable length, see the diagram "Maximum cable length as a function of the SSI baud rate for SSI encoders"

Note

Prefabricated cable for 5 V TTL encoder

When using a 5 V TTL encoder (6FX encoder), use the connecting cable 6FX8002-2CR00-...
.

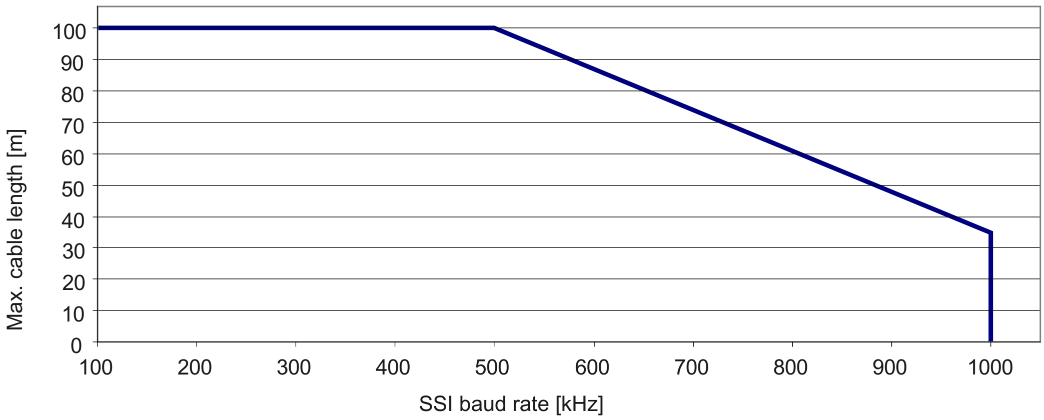
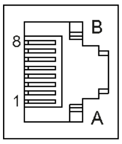


Figure 7-4 Maximum cable length as a function of the SSI baud rate for SSI encoders

7.3.2.4 X100 DRIVE-CLiQ interface

Table 7- 5 X100 DRIVE-CLiQ interface

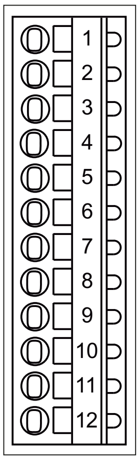
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronic ground
Connector type	RJ45 socket		

The blanking cover for the DRIVE-CLiQ port is included in the scope of delivery.

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

7.3.2.5 X120 digital inputs (fail-safe)/EP terminal/temperature sensor

Table 7- 6 X120 fail-safe digital inputs/temperature sensor input



	Terminal	Designation 1)		Technical data
	1	+Temp		Temperature sensors: KTY84-1C130/PTC Measuring current via temperature sensor connection: 2 mA
	2	-Temp		
	3	DI 16	F-DI 0	Voltage: - 3 V to +30 V Current consumption, typical: 6 mA at 24 V DC Input delay (typ.): 2) For "0" → "1": 50 µs For "1" → "0": 150 µs Level (incl. ripple): High level: 15 V to 30 V Low level: -3 V to +5 V
	4	DI17+ / EP +24 V3 (Enable Pulses)		
	5	DI17- / EP M3 (Enable Pulses)		
	6	DI 18	F-DI 1	
	7	DI 19+		
	8	DI 19-		
	9	DI 20	F-DI 2	Electrical isolation: M1: Reference potential for DO16, DI16, DI18 and DI20 DI17-/DI19-/DI21-: Reference potential for DI17/DI19/DI21
	10	DI 21+		
	11	DI 21-		
	12	M1		
Max. connectable cross-section: 1.5 mm² Type: Spring-loaded terminal 1 (see Chapter "Control cabinet installation and EMC / connection system"				

1) DI: Digital input; DO: Digital output; F-DI: Fail-safe digital input

2) Pure hardware delay

Fail-safe digital inputs

An F-DI consists of a digital input and a second digital input to which the cathode of the optocoupler is connected.

Temperature sensor input

NOTICE
Risk of motor overheating for incorrectly connected KTY temperature sensor A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats. • Make sure that you connect the KTY temperature sensor with the correct polarity.

Further information regarding the temperature sensor may be found in the SINAMICS S120 Commissioning Manual, "Temperature sensors for SINAMICS components" section.

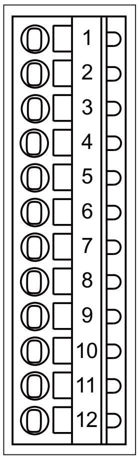
The maximum length of the temperature sensor cable is 300 m. The cables must be shielded. For cable lengths >100 m, cables with a cross-section of ≥1 mm² must be used.

EP terminal

The pulse inhibit function (EP) is only available when Safety Integrated Basic Functions are enabled.

7.3.2.6 X121 digital inputs/outputs

Table 7- 7 X121 digital inputs and bidirectional digital inputs/outputs

	Terminal	Designation 1)	Technical data
	1	DI 0	Voltage: -3 V to +30 V DC Typical current consumption: 6 mA at 24 V Electrical isolation: via optocoupler Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V (for ≤ 2 mA) Input delay (typ.): For "0" → "1": 50 μs For "1" → "0": 150 μs protected against polarity reversal
	2	DI 1	
	3	DI 2	
	4	DI 3	
	5	M2	Reference potential for digital inputs DI 0 to DI 3
	6	M	Ground reference for the electronics
	7	DI/DO 8	**As input:** Voltage: -3 V to +30 V DC Typical current consumption: 5 mA at 24 V Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V (for ≤ 2 mA) DI/DO 8, 9, 10, and 11 are rapid inputs 2) Input delay (typ.): For "0" → "1": 5 μs For "1" → "0": 50 μs **As output:** Voltage: 24 V DC Max. load current per output: 500 mA Output delay (typ. / max.)3): For "0" → "1": 150 μs / 400 μs For "1" → "0": 75 μs / 100 μs Short-circuit, ground fault, overload proof Automatic switch on again after overload trip Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	8	DI/DO 9	
	9	M	
	10	DI/DO 10	
	11	DI/DO 11	
	12	M	
Max. connectable cross-section: 1.5 mm^2 Type: Spring-loaded terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

1) DI: Digital input; DI/DO: Bidirectional digital input/output

2) The rapid inputs can be used as probe inputs or as inputs for the external zero mark

3) Data for: V_{cc} = 24 V; load 48 Ω; high ("1") = 90% V_{out}; low ("0") = 10% V_{out}

Note

An open input is interpreted as "low".

Terminal M2 must be connected so that the digital inputs (DI0 ... DI3) can be used. This is achieved by:

- also routing the ground reference of the digital inputs, or
- a jumper to terminal M. This removes the electrical isolation for these digital inputs.

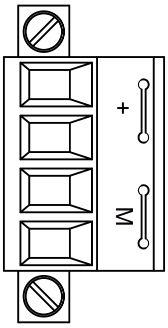
Note

A 24 V supply voltage must be connected to terminal X124 for the digital outputs to be used.

If momentary interruptions in the voltage occur in the 24 V supply, the digital outputs are deactivated until the interruption has been rectified.

7.3.2.7 X124 Electronics power supply

Table 7- 8 X124 Electronics power supply

	Terminal	Designation	Technical data
	+	Electronics power supply	Voltage: 24 V DC (20.4 V to 28.8 V) Current consumption: Max. 1.0 A (without DRIVE-CLiQ or digital outputs) Max. current via jumper in connector: 20 A
	+	Electronics power supply	
	M	Electronic ground	
	M	Electronic ground	
Max. connectable cross-section: 2.5 mm^2 Type: Screw terminal 2 (see Chapter, "Control cabinet installation and EMC/connection system")			

The screw terminal must be tightly screwed using a flat-bladed screwdriver.

The maximum cable length that can be connected is 10 m.

If the 24 V supply is not connected, the digital outputs of the following interfaces cannot be used:

- X121 (DO8 to DO11)
- X131 (DO12 to DO 15)

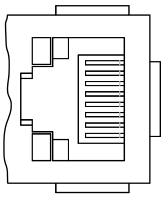
Note

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

The current consumption increases by the value for the DRIVE-CLiQ participant and digital outputs.

7.3.2.8 X127 LAN (Ethernet)

Table 7- 9 X127 LAN (Ethernet)

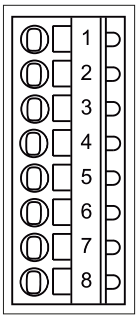
	Pin	Signal name	Technical data
	1	TXP	Ethernet transmit data +
	2	TXN	Ethernet transmit data -
	3	RXP	Ethernet receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Ethernet receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
Connector type	RJ45 socket		

Note

The Ethernet interface supports Auto MDI(X). It is therefore possible to use both crossed and uncrossed cables to connect the devices.

7.3.2.9 X130 digital input (fail safe) digital output

Table 7- 10 X130 digital input / fail-safe digital output

	Terminal	Designation 1)		Technical data
	1	DI 22+		Voltage: -3 V to +30 V DC Typical current consumption: 6 mA at 24 V Electrical isolation: via optocoupler Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V (for ≤ 2 mA) Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs protected against polarity reversal
	2	DI 22-		
	3	M2		Reference potential for digital inputs DI 0 to DI 3
	4	M		Ground reference for the electronics
	5	M1		Reference potential for DI 16, DI 18, DI 20 and DO 16
	6	24 V1		Power supply for DO 16
	7	DO 16+	F-DO 0 2)	Voltage: 24 V DC Max. load current per output: 500 mA Output delay (typ. / max.): For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Short-circuit, ground fault, overload proof Automatic switch on again after overload trip
	8	DO 16-		
Max. connectable cross-section: 1.5 mm² Type: Spring-loaded terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")				

1) DI: Digital input/DO: Digital output

2) F-DO: Fail-safe digital output

Fail-safe digital output

The F-DO consists of a high-side switch and a low-side switch.

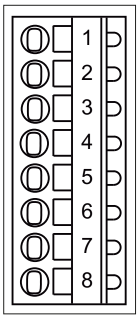
For applications without the safety function, the high-side switch may be used as an additional digital output. The low side switch is not available.

Note

If the 24 V supply is briefly interrupted, the digital output is deactivated until the interruption has been rectified.

7.3.2.10 X131 digital inputs/outputs and analog input

Table 7- 11 X131 bidirectional digital inputs/outputs and analog input

	Terminal	Designation 1)	Technical data
	1	DI/DO 12	**As input:** Voltage: -3 V to +30 V DC Typical current consumption: 5 mA at 24 V Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V (for ≤ 2 mA) DI/DO 12, 13, 14, and 15 are rapid inputs 2) Input delay (typ.): For "0" → "1": 5 μs For "1" → "0": 50 μs **As output:** Voltage: 24 V DC Max. load current per output: 500 mA Output delay (typ. / max.)3): For "0" → "1": 150 μs / 400 μs For "1" → "0": 75 μs / 100 μs Short-circuit, ground fault, overload proof Automatic switch on again after overload trip Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	2	DI/DO 13	
	3	M	
	4	DI/DO 14	
	5	DI/DO 15	
	6	M	Electronic ground
	7	AI 0+	The analog input can be switched between a current or voltage input using DIP switch S5. **Common-mode range**: ±12 V **As voltage input**: -10 V to +10 V; R_i > 100 kΩ Resolution: 12 bit + sign (with respect to the maximum range that can be resolved) -11 V to +11 V) **As current input**: -20 mA to +20 mA; Ri = 250 Ω Resolution: 11 bit + sign (with respect to the maximum range that can be resolved) +22 mA to -22 mA)
	8	AI 0-	
Max. connectable cross-section: 1.5 mm² Type: Spring-loaded terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

1) DI/DO: bidirectional digital input/output; AI: Analog input

2) The rapid inputs can be used as probe inputs or as inputs for the external zero mark.

3) Data for: V_{cc} = 24 V; load 48 Ω; high ("1") = 90% V_{out}; low ("0") = 10% V_{out}

Note

Permissible voltage values at the analog input

The common-mode range must not be violated in order to avoid incorrect results of the analog-digital conversion. This means that the analog differential voltage signals can have a maximum offset voltage of +/- 15 V with respect to the reference potential.

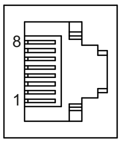
Note

A 24 V supply must be connected to terminal X124 for the digital outputs to be used.

If momentary interruptions in the voltage occur in the 24 V supply, the digital outputs are deactivated until the interruption has been rectified.

7.3.2.11 X150 P1/P2 PROFINET

Table 7- 12 X150 P1 and X150 P2 PROFINET

	Pin	Signal name	Technical data
	1	RXP	Receive data +
	2	RXN	Receive data -
	3	TXP	Transmit data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	TXN	Transmit data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
Connector type:	RJ45 socket		
Data rate:	100 Mbits or 10 Mbits		

Note

The PROFINET interfaces support Auto MDI(X). It is therefore possible to use both crossed and uncrossed cables to connect the devices.

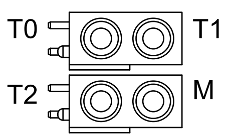
For diagnostic purposes, the two PROFINET interfaces are each equipped with a green and a yellow LED. The table shows the status information these indicate.

Table 7- 13 LED states on the X150 P1/P2 PROFINET interface

LED	Color	Status	Description
Link port	-	OFF	Missing or faulty link
	Green	Continuous light	10 or 100 Mbit link available
Activity port	-	OFF	No activity
	Yellow	Flashing	Data is being received or sent at port x

7.3.2.12 Measuring sockets

Table 7- 14 Measuring sockets T0, T1, T2

	Socket	Function	Technical data
	T0	Measuring socket 0	Voltage: 0 V to 5 V Resolution: 8 bits Load current: max. 3 mA Continued-short-circuit-proof The reference potential is terminal M
	T1	Measuring socket 1	
	T2	Measuring socket 2	
	M	Ground	
The measuring sockets are only suitable for bunch pin plugs with a diameter of 2 mm.			

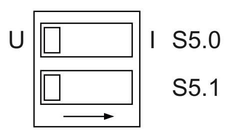
Note

Measuring sockets support commissioning and diagnosis. It must not be connected for normal operation.

7.3.2.13 S5 DIP switch

DIP switch S5 is used to switch the analog input between voltage input or current input. It is located under the blanking cover (see Section: "Overview", illustration: "CU310-2 xx interface overview").

Table 7- 15 DIP switch S5 - switchover between voltage/current

	Switch	Function
	S5.0	Switchover between voltage (U) / current (I)
	S5.1	Not assigned

7.3.2.14 DIAG button

The DIAG pushbutton is reserved for service functions.

7.3.2.15 RESET button

Pressing the RESET button restarts the CU310-2 PN after expiry of a preset time. A data backup is run at the same time. This means that all the settings are retained.

7.3.2.16 Memory card

Inserting the memory card

Use only memory cards manufactured by Siemens to run the CU310-2 PN.

NOTICE
Only insert or remove a memory card if the control unit is in a voltage-free state. This avoids data loss and possible shut down of the system. The memory card is sensitive to ESD. Observe the ESD regulations when removing and inserting the memory card.

Insert the memory card into the CU310-2 PN so that the arrow on the card's label (on the left, next to the word Siemens) points to the arrow on the device.

Figure 7-5 CU310-2 PN Inserting the memory card

The memory card in a faulty CU310-2 PN

If you are returning a faulty CU310-2 PN to Siemens, remove the memory card and keep it in a safe place.
This will mean that all your saved data (firmware, licenses, parameters) will be available to you immediately again to commission a replacement unit.

7.3.3 Connection examples

CU310-2 PN without safety function

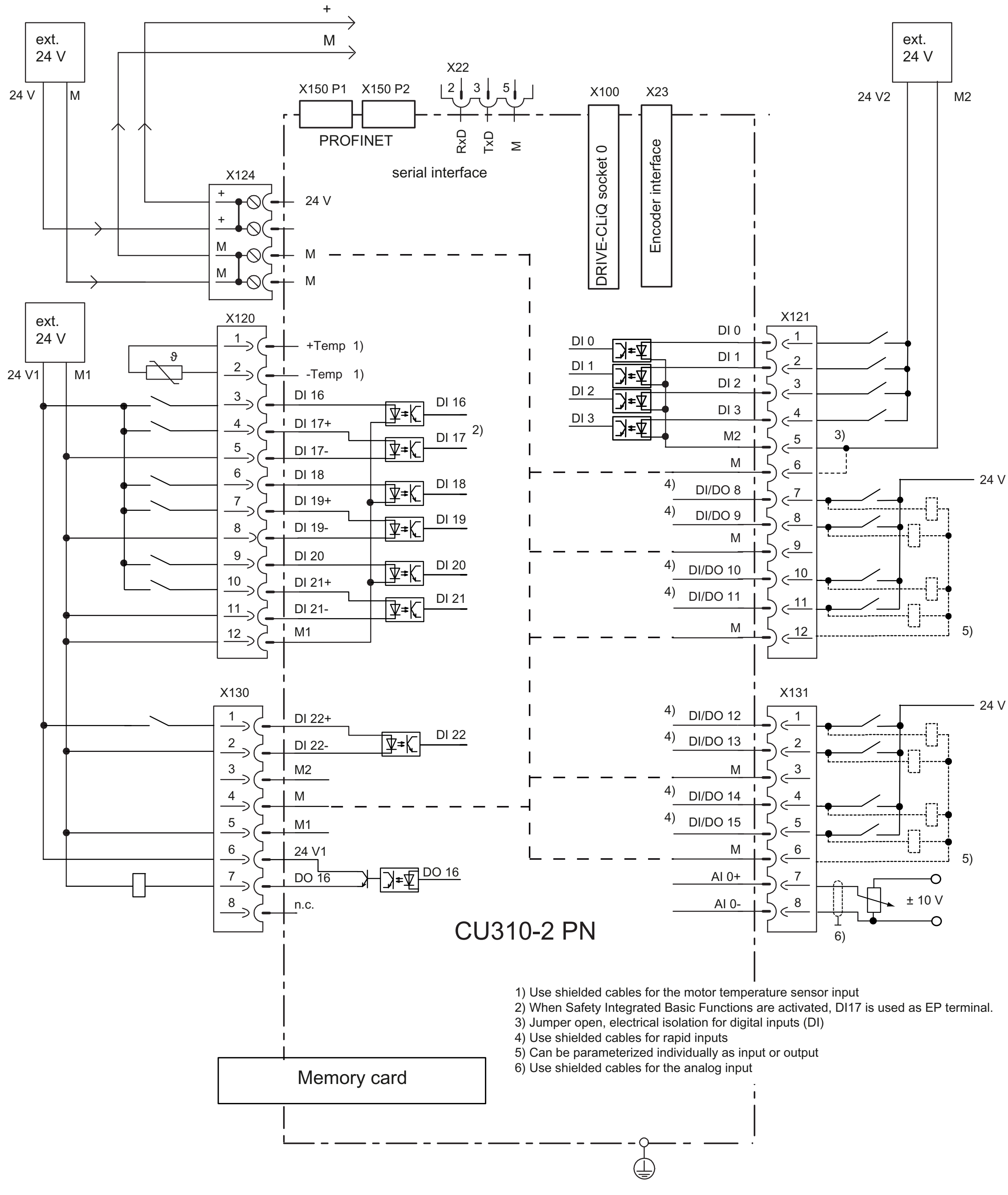


Figure 7-6 Connection example, CU310-2 PN without safety function

CU310-2 PN with safety function

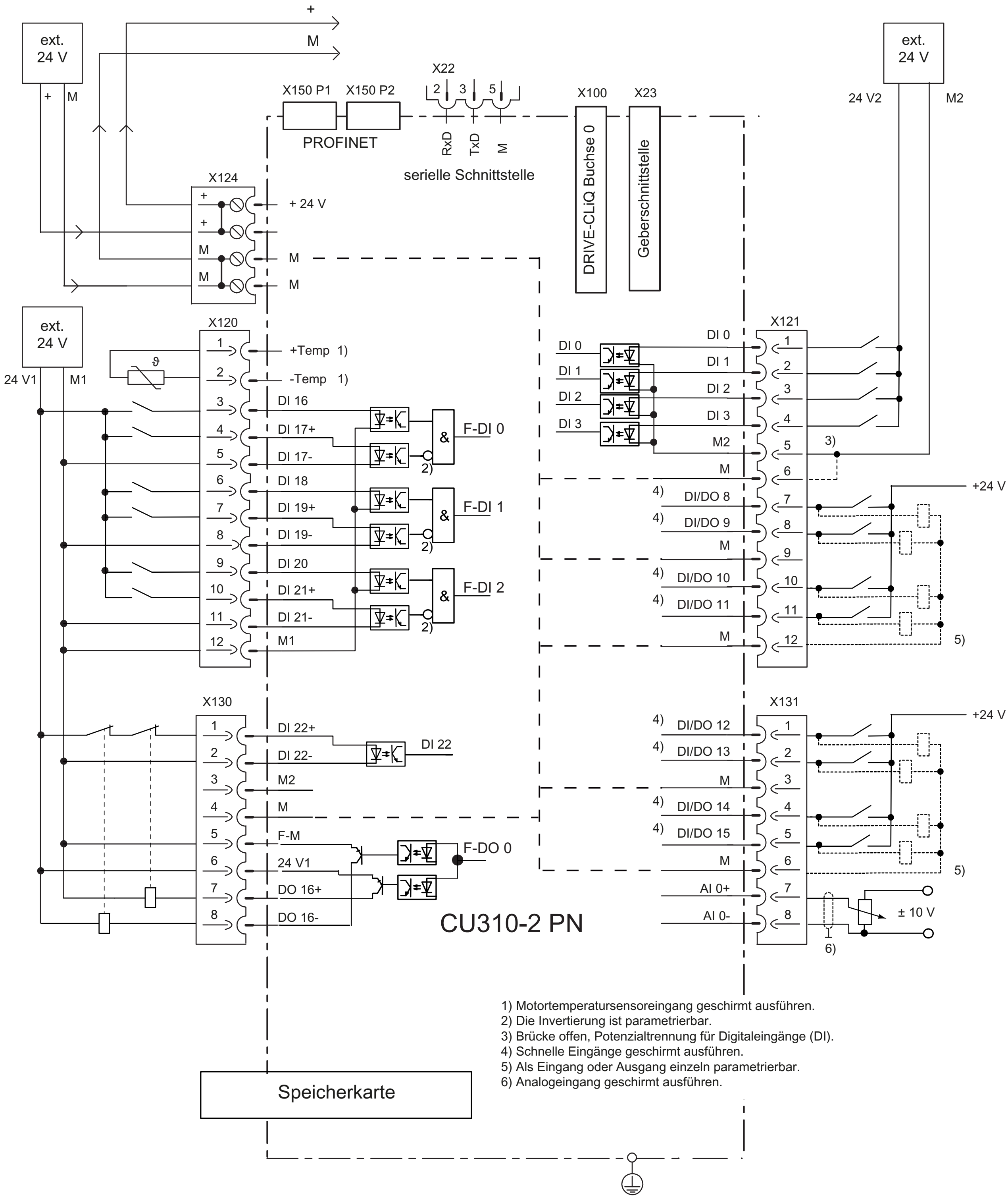


Figure 7-7 Connection example, CU310-2 PN with safety function

7.3.4 Meaning of the LEDs

7.3.4.1 Function of the LEDs

There are four LEDs on the front panel of the CU310-2 PN's housing (see section: "Overview", illustration: "CU310-2 PN overview of interfaces").

Table 7- 16 LEDs

RDY	Ready
COM	Status of the fieldbus communication
OUT>5V	Encoder current supply > 5 V (TTL/HTL)
MOD	Operating mode (reserved)

The various LEDs are switched on and off as the control unit is powered up (depending on the phase the system is currently running through). When switched on, the color of the LEDs shows the status of the corresponding power-up phase (see section: "LED display during power up").

In the event of a fault, power up will be ended in the corresponding phase. The LEDs that are switched on retain their color at this particular instant in time, so that the fault can be determined based on the combination of LEDs that are switched on (bright) and switched off (dark).

All the LEDs go out briefly if the CU310-2 PN has powered up without error. The system is ready for operation when the LED "RDY" is permanently green.

All the LEDs are controlled by the software loaded during operation (see section: "LED display during operation").

7.3.4.2 Behavior of the LEDs while booting

Table 7- 17 Load software

LED				State	Comment
RDY	COM	OUT>5V	MOD		
Orange	Orange	Orange	Orange	POWER ON	All LEDs light up for approx. 1 s
Red	Red	Off	Off	Hardware reset	After pressing the RESET button the LEDs light up for approx. 1 s
Red	Red	Off	Off	BIOS loaded	-
Red flashing light 2 Hz	Red	Off	Off	BIOS error	Error occurred while loading the BIOS
Red flashing light 2 Hz	Red flashing light 2 Hz	Off	Off	File error	Memory card not inserted or faulty
					Software on memory card not present or corrupted

Table 7- 18 Firmware

LED				State	Comment
RDY	COM	OUT>5V	MOD		
Red	Orange	Off	Off	Firmware loading	COM-LED flashing without specific flashing frequency
Red	Off	Off	Off	Firmware loaded	-
Off	Red	Off	Off	Firmware check (no CRC error)	-
Red Flashing light 0.5 Hz	Red Flashing light 0.5 Hz	Off	Off	Firmware check (CRC error)	CRC is incorrect
Orange	Off	Off	Off	Firmware initialization	-

7.3.4.3 Behavior of the LEDs in the operating state

Table 7- 19 Description of the LEDs during operation of the CU310-2 PN

LED	Color	State	Description / cause	Remedy
RDY (READY)	-	Off	Electronic power supply is missing or outside permissible tolerance range.	Check the power supply
	Green	Continuous light	The unit is ready for operation. Cyclic DRIVE-CLiQ communication is in progress.	-
		Flashing light 0.5 Hz	Commissioning / reset	-
		Flashing light 2 Hz	Writing to the memory card.	-
	Red	Flashing light 2 Hz	General errors	Check parameter assignment / configuration
	Red / green	Flashing light 0.5 Hz	The control unit is ready for operation, but there are no software licenses.	Install the missing licenses.
	Orange	Flashing light 0.5 Hz	The firmware of the DRIVE-CLiQ components is being updated.	-
		Flashing light 2 Hz	DRIVE-CLiQ component firmware update completed. Waiting for POWER ON of the corresponding components.	Switch on the component.
	Green / orange or red / orange	Flashing light 2 Hz	Detection of the component via LED is activated (p0124[0]). **Note:** Both options depend on the LED state when activating via p0124[0] = 1.	-

LED	Color	State	Description / cause	Remedy
COM	-	Off	Cyclic communication is not (yet) running. **Note:** The PROFIdrive is ready for communication when the Control Unit is ready for operation (see LED: RDY).	-
	Green	Continuous light	Cyclic communication is taking place.	-
		Flashing light 0.5 Hz	Cyclic communication is not fully established yet. **Possible causes:** - The controller is not transmitting any setpoints. - In isochronous mode, the controller is not sending a GC (Global Control) or is sending a defective GC.	-
	Red	Flashing light 0.5 Hz	The PROFIBUS master is sending a faulty parameter assignment or the configuration file is corrupted.	Modify the configuration between the master / controller and Control Unit.
		Flashing light 2 Hz	Cyclic bus communication has been interrupted or could not be established.	Rectify the bus communication fault.
MOD	-	Off	-	-
OUT > 5 V	-	Off	-	-
	Orange	Continuous light	The voltage of the electronic power supply for the measuring system is 24 V. 1)	

1) Make sure that the connected encoder is designed for a 24 V supply. Connecting a 5 V encoder to a 24 V supply can result in destruction of the encoder electronics.

7.3.5 Dimension drawing

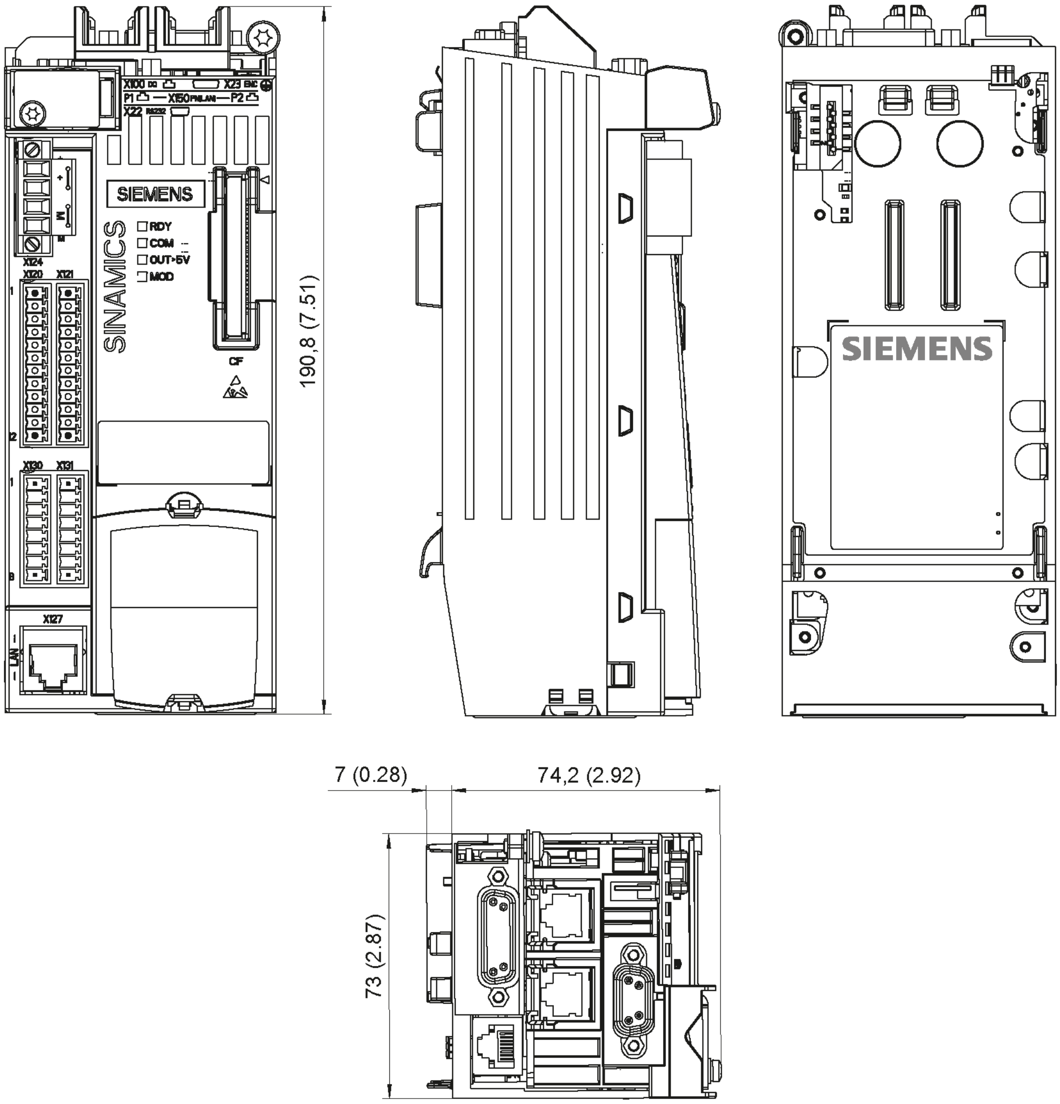


Figure 7-8 Dimension drawing, Control Unit CU310-2 PN, all data in mm (inches)

7.3.6 Technical data

Table 7- 20 Technical data for CU310-2 PN

6SL3040-1LA01-0AA0	Unit	Value
Electronics power supply		
Voltage Current (without DRIVE-CLiQ and digital outputs) Power loss	V_{DC} A_{DC} W	24 DC (20.4 – 28.8) 0.8 <20
Maximum DRIVE-CLiQ cable length	m	100
PE/ground connection	On housing with M4/3 Nm screw	
Response time	The response time of digital inputs/outputs depends on the evaluation. 1)	
Weight	kg	0.95

1) Information is given in the manual: SINAMICS S List Manual – "Function diagrams" chapter.

7.4 Control Unit CU310-2 DP (PROFIBUS)

7.4.1 Description

The CU310-2 DP Control Unit (PROFIBUS) is a control module for single-motor drives in which the open-loop and closed-loop control functions of the drive are implemented. It controls the Power Modules in the blocksize format via the PM-IF interface. Power Modules Chassis are controlled from the Control Unit via the DRIVE-CLiQ interface.

The CU310-2 DP is hot-pluggable. It can be used with firmware version 4.4 or higher.

The table shows an overview of the interfaces on the CU310-2 DP.

Table 7- 21 Overview of interfaces on the CU310-2 DP

Type	Quantity
Isolated digital inputs	11
Non-isolated digital inputs/outputs	8
Isolated digital output	1
Non-isolated analog input	1
DRIVE-CLiQ interface	1
PROFIBUS interface	1
Serial interface (RS232)	1
Encoder interface (HTL/TTL/SSI)	1
LAN (Ethernet)	1
Temperature sensor input	1
EP terminal	1
Measuring sockets	3

7.4.2 Interface description

7.4.2.1 Overview

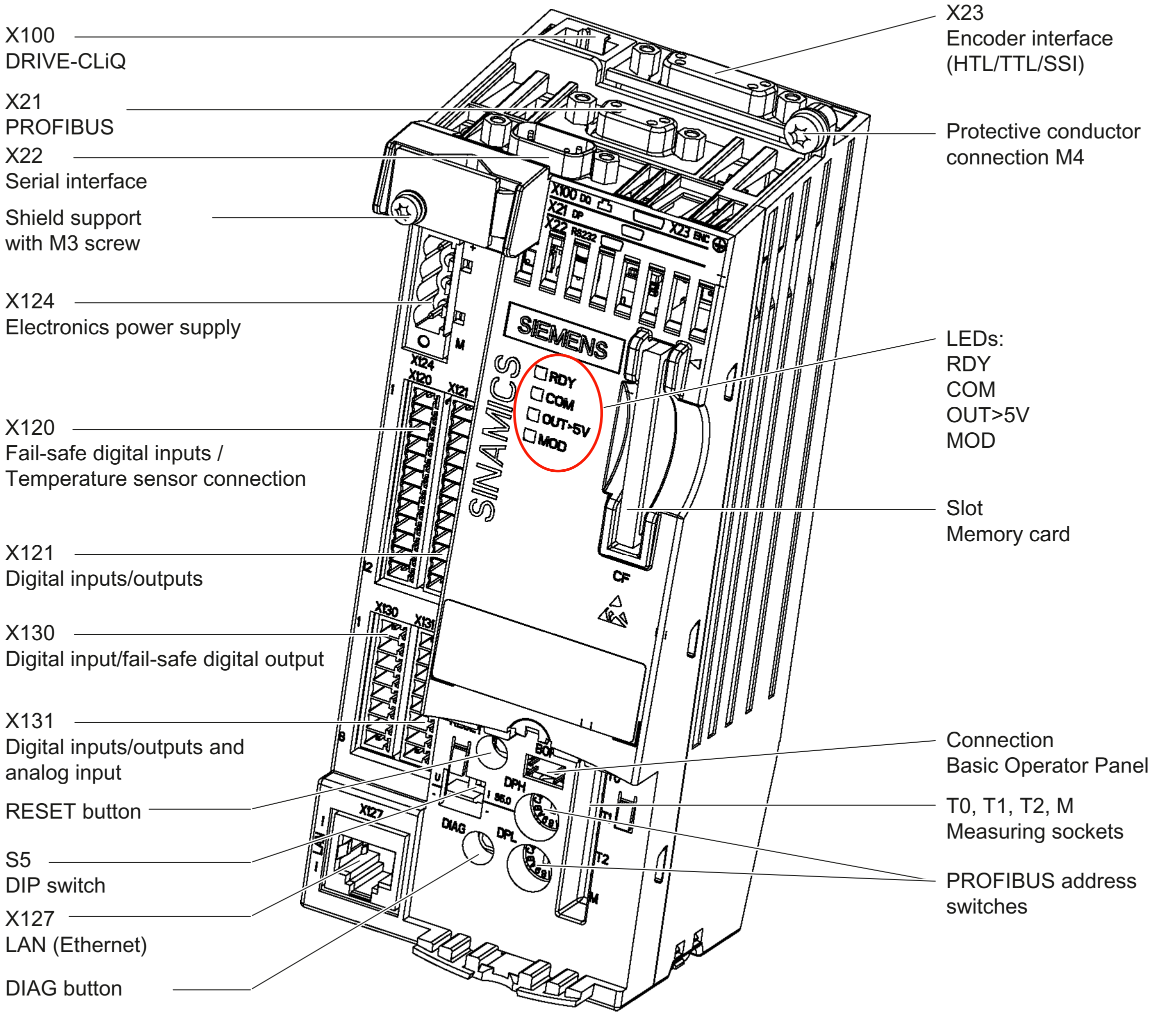


Figure 7-9 CU310-2 DP interface overview

The interface to the Power Module is located at the rear of the CU310-2 DP.

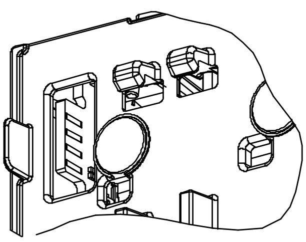
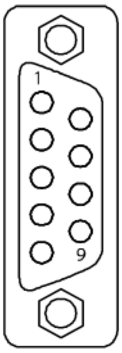


Figure 7-10 CU310-2 DP interface to the Power Module (PM-IF)

7.4.2.2 X21 PROFIBUS

The PROFIBUS interface X21 can be operated isochronously.

Table 7- 22 X21 PROFIBUS interface

	Pin	Signal name	Meaning	Range
	1	-	Not assigned	
	2	M24_SERV	Teleservice supply, 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	Teleservice supply, + (24 V))	24 V (20.4 V to 28.8 V)
	8	RxD/TxD-N	Receive/transmit data N (A)	RS485
	9	-	Not assigned	
Connector type	9-pin Sub-D socket			

Note

A teleservice adapter can be connected to the PROFIBUS interface X21 for remote diagnostics.
The power supply for the teleservice (terminals 2 and 7) can have a max. load of 150 mA.

NOTICE

Equipotential bonding conductor

An equipotential bonding cable with a cross-section of at least 25 mm² must be used between parts of an installation remote from one another.
If this is not observed, then significant leakage currents will flow through the PROFIBUS cable which will destroy the Control Unit or other PROFIBUS participants.

PROFIBUS connector

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

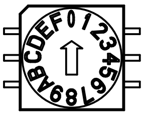
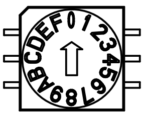
The terminating resistors are activated in the connector.

The cable shield must be connected at both ends over large-surface area contacts.

7.4.2.3 PROFIBUS address switch

The PROFIBUS address for the CU310-2 DP is set as a hexadecimal value on two rotary coding switches.
Values may be set between 0_{dec} (00_{hex}) and 127_{dec}($7F_{hex}$).
The upper rotary coding switch (H) is used to set the hexadecimal value for 16^1 and the lower rotary coding switch (L) is used to set the hexadecimal value for 16^0.

Table 7- 23 PROFIBUS address switch

Rotary coding switches	Significance	Examples		
		21_{dec}	35_{dec}	126_{dec}
		15_{hex}	23_{hex}	$7E_{hex}$
 DP H	$16^1 = 16$	1	2	7
 DP L	$16^0 = 1$	5	3	E

Setting the PROFIBUS address

The factory setting for the rotary coding switches is 0_{dec} (00_{hex}).

There are two ways to set the PROFIBUS address:

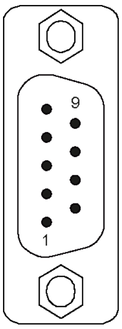
1. Via p0918
   - To set the bus address for a PROFIBUS node using STARTER, first set the rotary code switches to 0_{dec} (00_{hex}) and 127_{dec} ($7F_{hex}$).
   - Then use parameter p0918 to set the address to a value between 1 and 126.
2. Using the PROFIBUS address switch
   - The PROFIBUS address is set manually to a value between 1 and 126 on the two rotary coding switches. In this case, p0918 is only used to read the address.

Note

The rotary coding switches used to set the PROFIBUS address are found beneath the blanking cover (see section: "Overview", illustration: "CU310-2 DP Interface overview).

7.4.2.4 X22 serial interface (RS232)

Table 7- 24 X22 serial interface (RS232)

	Pin	Signal name	Technical data
	1	Reserved, do not use	
	2	XRXD_RS232	Receive data
	3	XTXD_RS232	Transmit data
	4	Reserved, do not use	
	5	M	Ground
	6	Reserved, do not use	
	7	Reserved, do not use	
	8	Reserved, do not use	
	9	Reserved, do not use	
Connector type	9-pin SUB D connector		

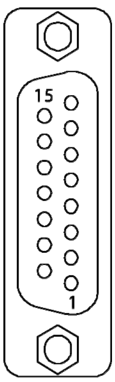
Features

The maximum data rate is:

- 120 kBaud at a load capacity of 1.0 nF
- 20 kBaud at a load capacity of 2.5 nF

7.4.2.5 X23 HTL/TTL/SSI encoder interface

Table 7- 25 X23 HTL/TTL/SSI encoder interface

	Pin	Signal name	Technical data
	1	+Temp	KTY or PTC input
	2	SSI_CLK	SSI clock, positive
	3	SSI_XCLK	SSI clock, negative
	4	P encoder 5 V / 24 V	Encoder supply
	5	P encoder 5 V / 24 V	
	6	P_Sense	Sense input, encoder supply
	7	M	Ground, encoder supply
	8	M (-Temp)	Ground for KTY or PTC
	9	M_Sense	Ground sense input
	10	RP	R track positive
	11	RN	R track negative
	12	BN	B track negative
	13	BP	B track positive
	14	AN_SSI_XDAT	A track negative/SSI data negative
	15	AP_SSI_DAT	A track positive/SSI data positive
Connector type	15-pin Sub-D socket		
Measuring current via temperature sensor connection: 2 mA			

NOTICE
Risk of motor overheating for incorrectly connected KTY temperature sensor
A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats. • Make sure that you connect the KTY temperature sensor with the correct polarity.

Note

There are two ways of connecting the temperature sensor:

1. via X120, terminals 1 and 2
2. via X23, pins 1 and 8

Encoders that can be connected

Note

Use of bipolar and unipolar encoders

If at all possible, use bipolar encoders.

When using unipolar encoders, the unused negative track signals can either be connected or connected to ground. This results in different switching thresholds.

Table 7- 26 Specification of measuring systems that can be connected

Parameter	Designation	Threshold	Min.	Type	Max.	Unit
Permissible signal level in the bipolar mode (parameter p0405.1=1); (TTL, SSI, HTL bipolar at X23)1)2)	U_{diff}		2,0		Vcc	V
Permissible signal frequency	f_S		-		500	kHz
Required edge clearance	t_{min}		100		-	ns
Permissible zero pulse (with $T_s = 1/f_s$)	Length		$¼ \cdot T_s$		$¾ \cdot T_s$	
	Center of the pulse position		50	135	220	Degrees
Switching threshold in the unipolar mode (parameter p0405.0=0) and signals AN_SSI_XDAT, BN, RN at X23 connected to M_Encoder	$U_{(Switch)}$	High (p0405.4=1)	8,4	10,6	13,1	V
		Low (p0405.4=0)	3,5	4,8	6,3	V
Switching thresholds in the unipolar mode (parameter p0405.0=0) and signals AN_SSI_XDAT, BN, RN not connected to X23	$U_{(Switch)}$	High (p0405.4=1)	9	11,3	13,8	V
		Low (p0405.4=0)	5,9	7,9	10,2	V

1) Other signal levels according to the RS422 specification

2) The absolute level of the individual signals varies between 0 V and Vcc of the measuring system.

Encoder cables

Encoder type	Maximum encoder cable length in m
TTL 1)	100
HTL unipolar 2)	100
HTL bipolar	300
SSI 3)	up to 100 (depending on the baud rate)

1) 100 m with remote sense

2) The bipolar connection should always be used as a result of the more rugged transfer technology. The unipolar connection should only be used if the encoder type does not output push-pull signals.

3) For the cable length, see the diagram "Maximum cable length as a function of the SSI baud rate for SSI encoders"

Note

Prefabricated cable for 5 V TTL encoder

When using a 5 V TTL encoder (6FX encoder), use the connecting cable 6FX8002-2CR00-...
.

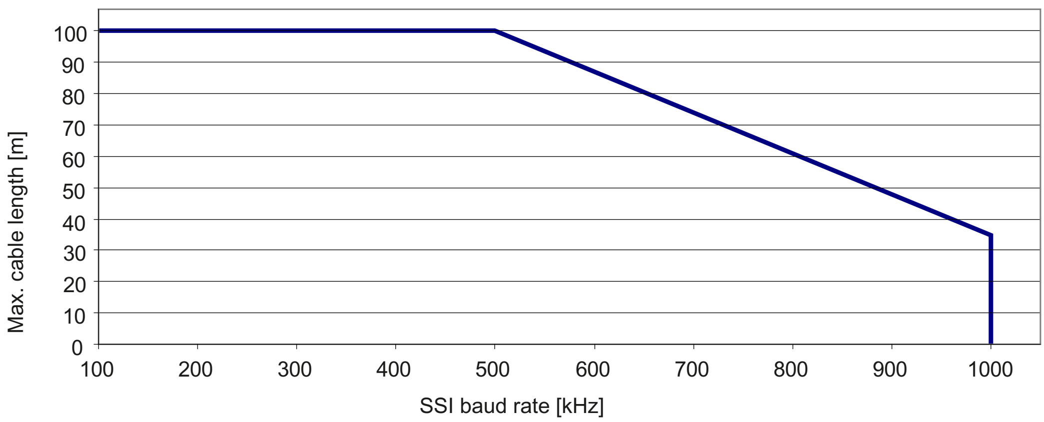
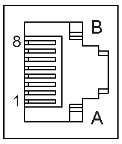


Figure 7-11 Maximum cable length as a function of the SSI baud rate for SSI encoders

7.4.2.6 X100 DRIVE-CLiQ interface

Table 7- 27 X100 DRIVE-CLiQ interface

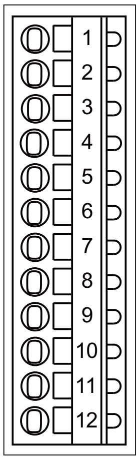
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronic ground
Connector type	RJ45 socket		

The blanking cover for the DRIVE-CLiQ port is included in the scope of delivery.

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

7.4.2.7 X120 digital inputs (fail-safe)/EP terminal/temperature sensor

Table 7- 28 X120 fail-safe digital inputs/temperature sensor input

	Terminal	Designation [1)]		Technical data
	1	+Temp		Temperature sensors: KTY84-1C130/PTC Measuring current via temperature sensor connection: 2 mA
	2	-Temp		
	3	DI 16	F-DI 0	Voltage: - 3 V to +30 V Current consumption, typical: 6 mA at 24 V DC Input delay (typ.): [2)] For "0" → "1": 50 µs For "1" → "0": 150 µs Level (incl. ripple): High level: 15 V to 30 V Low level: -3 V to +5 V
	4	DI17+ / EP +24 V3 (Enable Pulses)		
	5	DI17- / EP M3 (Enable Pulses)		
	6	DI 18	F-DI 1	
	7	DI 19+		
	8	DI 19-		
	9	DI 20	F-DI 2	Electrical isolation: M1: Reference potential for DO16, DI16, DI18 and DI20 DI17-/DI19-/DI21-: Reference potential for DI17/DI19/DI21
	10	DI 21+		
	11	DI 21-		
	12	M1		
Max. connectable cross-section: 1.5 mm^2 Type: Spring-loaded terminal 1 (see Chapter "Control cabinet installation and EMC / connection system"				

1) DI: Digital input; DO: Digital output; F-DI: Fail-safe digital input

2) Pure hardware delay

Fail-safe digital inputs

An F-DI consists of a digital input and a second digital input to which the cathode of the optocoupler is connected.

Temperature sensor input

NOTICE
Risk of motor overheating for incorrectly connected KTY temperature sensor A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats. • Make sure that you connect the KTY temperature sensor with the correct polarity.

Further information regarding the temperature sensor may be found in the SINAMICS S120 Commissioning Manual, "Temperature sensors for SINAMICS components" section.

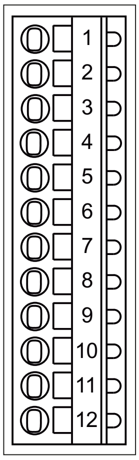
The maximum length of the temperature sensor cable is 300 m. The cables must be shielded. For cable lengths >100 m, cables with a cross-section of ≥1 mm^2 must be used.

EP terminal

The pulse inhibit function (EP) is only available when Safety Integrated Basic Functions are enabled.

7.4.2.8 X121 digital inputs/outputs

Table 7- 29 X121 digital inputs and bidirectional digital inputs/outputs

	Terminal	Designation 1)	Technical data
	1	DI 0	Voltage: -3 V to +30 V DC Typical current consumption: 6 mA at 24 V Electrical isolation: via optocoupler Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V (for ≤ 2 mA) Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs protected against polarity reversal
	2	DI 1	
	3	DI 2	
	4	DI 3	
	5	M2	Reference potential for digital inputs DI 0 to DI 3
	6	M	Ground reference for the electronics
	7	DI/DO 8	**As input:** Voltage: -3 V to +30 V DC Typical current consumption: 5 mA at 24 V Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V (for ≤ 2 mA) DI/DO 8, 9, 10, and 11 are rapid inputs 2) Input delay (typ.): For "0" → "1": 5 µs For "1" → "0": 50 µs **As output:** Voltage: 24 V DC Max. load current per output: 500 mA Output delay (typ. / max.)3): For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Short-circuit, ground fault, overload proof Automatic switch on again after overload trip Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	8	DI/DO 9	
	9	M	
	10	DI/DO 10	
	11	DI/DO 11	
	12	M	
Max. connectable cross-section: 1.5 mm² Type: Spring-loaded terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")			

1) DI: Digital input; DI/DO: Bidirectional digital input/output

2) The rapid inputs can be used as probe inputs or as inputs for the external zero mark

3) Data for: V_{cc} = 24 V; load 48 Ω; high ("1") = 90% V_{out}; low ("0") = 10% V_{out}

Note

An open input is interpreted as "low".

Terminal M2 must be connected so that the digital inputs (DI0 ... DI3) can be used. This is achieved by:

- also routing the ground reference of the digital inputs, or
- a jumper to terminal M. This removes the electrical isolation for these digital inputs.

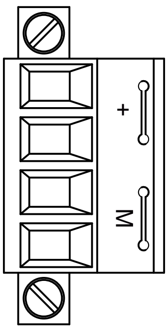
Note

A 24 V supply voltage must be connected to terminal X124 for the digital outputs to be used.

If momentary interruptions in the voltage occur in the 24 V supply, the digital outputs are deactivated until the interruption has been rectified.

7.4.2.9 X124 Electronics power supply

Table 7- 30 X124 Electronics power supply

	Terminal	Designation	Technical data
	+	Electronics power supply	Voltage: 24 V DC (20.4 V to 28.8 V) Current consumption: Max. 1.0 A (without DRIVE-CLiQ or digital outputs) Max. current via jumper in connector: 20 A
	+	Electronics power supply	
	M	Electronic ground	
	M	Electronic ground	
Max. connectable cross-section: 2.5 mm² Type: Screw terminal 2 (see Chapter, "Control cabinet installation and EMC/connection system")			

The screw terminal must be tightly screwed using a flat-bladed screwdriver.

The maximum cable length that can be connected is 10 m.

If the 24 V supply is not connected, the digital outputs of the following interfaces cannot be used:

- X121 (DO8 to DO11)
- X131 (DO12 to DO 15)

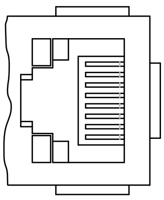
Note

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

The current consumption increases by the value for the DRIVE-CLiQ participant and digital outputs.

7.4.2.10 X127 LAN (Ethernet)

Table 7- 31 X127 LAN (Ethernet)

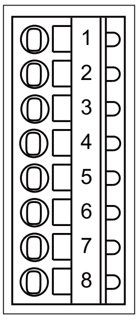
	Pin	Signal name	Technical data
	1	TXP	Ethernet transmit data +
	2	TXN	Ethernet transmit data -
	3	RXP	Ethernet receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Ethernet receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
Connector type	RJ45 socket		

Note

The Ethernet interface supports Auto MDI(X). It is therefore possible to use both crossed and uncrossed cables to connect the devices.

7.4.2.11 X130 digital input (fail safe) digital output

Table 7- 32 X130 digital input / fail-safe digital output

	Terminal	Designation [1]		Technical data
	1	DI 22+		Voltage: -3 V to +30 V DC Typical current consumption: 6 mA at 24 V Electrical isolation: via optocoupler Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V (for ≤ 2 mA) Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs protected against polarity reversal
	2	DI 22-		
	3	M2		Reference potential for digital inputs DI 0 to DI 3
	4	M		Ground reference for the electronics
	5	M1		Reference potential for DI 16, DI 18, DI 20 and DO 16
	6	24 V1		Power supply for DO 16
	7	DO 16+	F-DO 0 [2]	Voltage: 24 V DC Max. load current per output: 500 mA Output delay (typ. / max.): For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Short-circuit, ground fault, overload proof Automatic switch on again after overload trip
	8	DO 16-		
Max. connectable cross-section: 1.5 mm² Type: Spring-loaded terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")				

1) DI: Digital input/DO: Digital output

2) F-DO: Fail-safe digital output

Fail-safe digital output

The F-DO consists of a high-side switch and a low-side switch.

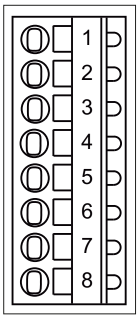
For applications without the safety function, the high-side switch may be used as an additional digital output. The low side switch is not available.

Note

If the 24 V supply is briefly interrupted, the digital output is deactivated until the interruption has been rectified.

7.4.2.12 X131 digital inputs/outputs and analog input

Table 7- 33 X131 bidirectional digital inputs/outputs and analog input

<table>
<tr><th></th><th>Terminal</th><th>Designation [1]</th><th>Technical data</th></tr>
<tr><td rowspan="8"></td><td>1</td><td>DI/DO 12</td><td rowspan="5">As input:
Voltage: -3 V to +30 V DC
Typical current consumption: 5 mA at 24 V
Level (incl. ripple)
High level: 15 V to 30 V
Low level: -3 V to 5 V (for ≤ 2 mA)
DI/DO 12, 13, 14, and 15 are rapid inputs [2]
Input delay (typ.):
For "0" → "1": 5 μs
For "1" → "0": 50 μs
As output:
Voltage: 24 V DC
Max. load current per output: 500 mA
Output delay (typ. / max.)[3]:
For "0" → "1": 150 μs / 400 μs
For "1" → "0": 75 μs / 100 μs
Short-circuit, ground fault, overload proof
Automatic switch on again after overload trip
Switching frequency:
For resistive load: Max. 100 Hz
For inductive load: Max. 0.5 Hz
For lamp load: Max. 10 Hz
Maximum lamp load: 5 W</td></tr>
<tr><td>2</td><td>DI/DO 13</td></tr>
<tr><td>3</td><td>M</td></tr>
<tr><td>4</td><td>DI/DO 14</td></tr>
<tr><td>5</td><td>DI/DO 15</td></tr>
<tr><td>6</td><td>M</td><td>Electronic ground</td></tr>
<tr><td>7</td><td>AI 0+</td><td rowspan="2">The analog input can be switched between a current or voltage input using DIP switch S5.
Common-mode range: ±12 V
As voltage input: -10 V to +10 V; R_i > 100 kΩ
Resolution: 12 bit + sign (with respect to the maximum range that can be resolved) -11 V to +11 V)
As current input: -20 mA to +20 mA; Ri = 250 Ω
Resolution: 11 bit + sign (with respect to the maximum range that can be resolved) +22 mA to -22 mA)</td></tr>
<tr><td>8</td><td>AI 0-</td></tr>
<tr><td colspan="4">Max. connectable cross-section: 1.5 mm^2
Type: Spring-loaded terminal 1 (see Chapter "Control cabinet installation and EMC / connection system")</td></tr>
</table>

1) DI/DO: bidirectional digital input/output; AI: Analog input

2) The rapid inputs can be used as probe inputs or as inputs for the external zero mark.

3) Data for: V_{cc} = 24 V; load 48 Ω; high ("1") = 90% V_{out}; low ("0") = 10% V_{out}

Note

Permissible voltage values at the analog input

The common-mode range must not be violated in order to avoid incorrect results of the analog-digital conversion. This means that the analog differential voltage signals can have a maximum offset voltage of +/- 15 V with respect to the reference potential.

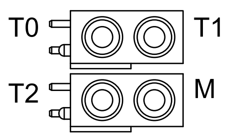
Note

A 24 V supply must be connected to terminal X124 for the digital outputs to be used.

If momentary interruptions in the voltage occur in the 24 V supply, the digital outputs are deactivated until the interruption has been rectified.

7.4.2.13 Measuring sockets

Table 7- 34 Measuring sockets T0, T1, T2

	Socket	Function	Technical data
	T0	Measuring socket 0	Voltage: 0 V to 5 V Resolution: 8 bits Load current: max. 3 mA Continued-short-circuit-proof The reference potential is terminal M
	T1	Measuring socket 1	
	T2	Measuring socket 2	
	M	Ground	
The measuring sockets are only suitable for bunch pin plugs with a diameter of 2 mm.			

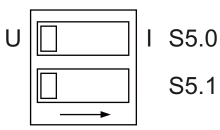
Note

Measuring sockets support commissioning and diagnosis. It must not be connected for normal operation.

7.4.2.14 S5 DIP switch

DIP switch S5 is used to switch the analog input between voltage input or current input. It is located under the blanking cover (see Section: "Overview", illustration: "CU310-2 xx interface overview").

Table 7- 35 DIP switch S5 - switchover between voltage/current

	Switch	Function
	S5.0	Switchover between voltage (U) / current (I)
	S5.1	Not assigned

7.4.2.15 DIAG button

The DIAG pushbutton is reserved for service functions.

7.4.2.16 RESET button

Pressing the RESET button restarts the CU310-2 DP after expiry of a preset time. A data backup is run at the same time. This means that all the settings are retained.

7.4.2.17 Memory card

Inserting the memory card

Use only memory cards manufactured by Siemens to run the CU310-2 DP.

NOTICE
Only insert or remove a memory card if the control unit is in a voltage-free state. This avoids data loss and possible shut down of the system. The memory card is sensitive to ESD. Observe the ESD regulations when removing and inserting the memory card.

Insert the memory card into the CU310-2 DP so that the arrow on the card's label (on the left, next to the word Siemens) points to the arrow on the device.

Figure 7-12 CU310-2 DP Inserting the memory card

The memory card in a faulty CU310-2 DP

If you are returning a faulty CU310-2 DP to Siemens, remove the memory card and keep it in a safe place.
This will mean that all your saved data (firmware, licenses, parameters) will be available to you immediately again to commission a replacement unit.

7.4.3 Connection examples

CU310-2 DP without safety function

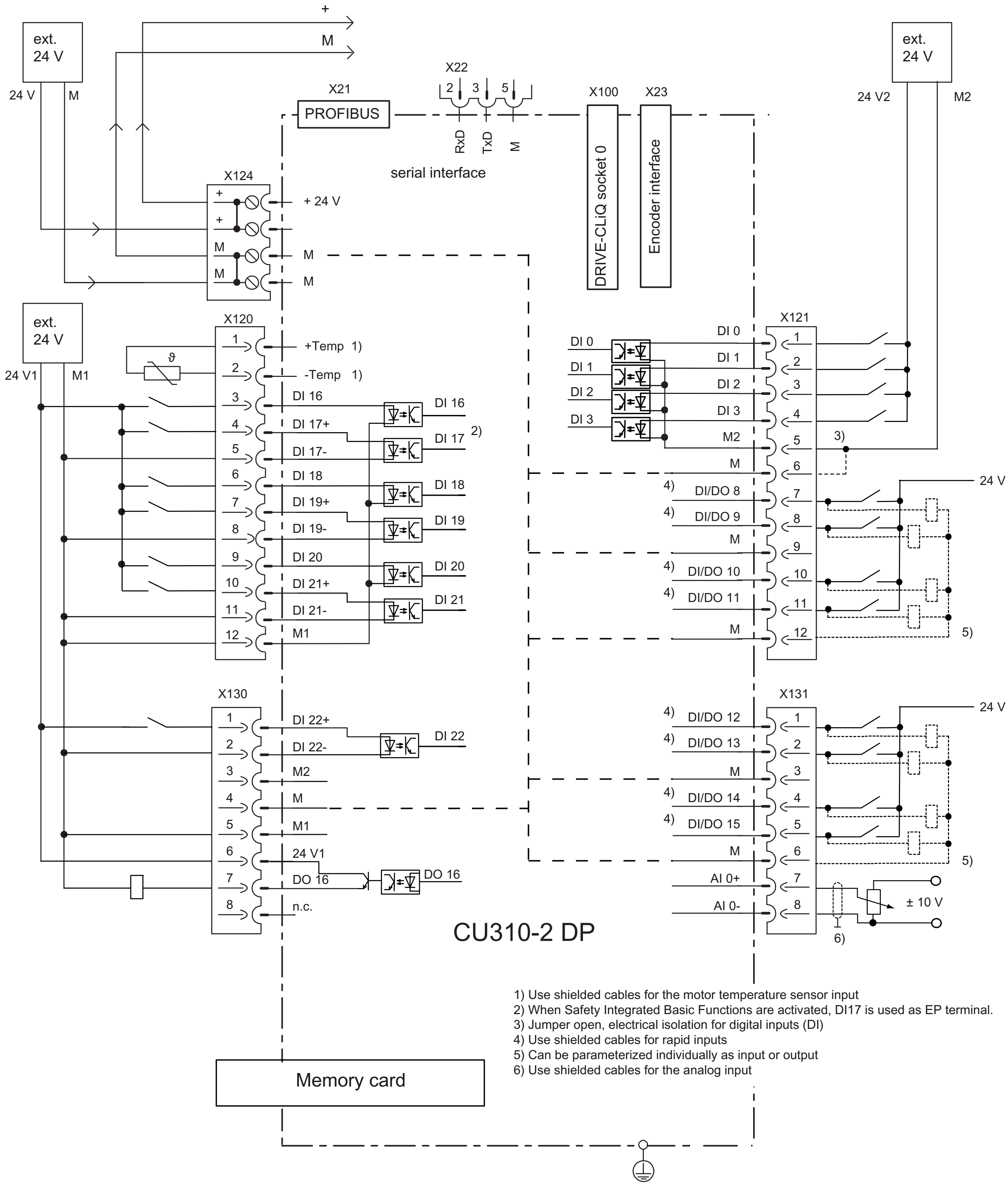


Figure 7-13 Connection example, CU310-2 DP without safety function

CU310-2 DP with safety function

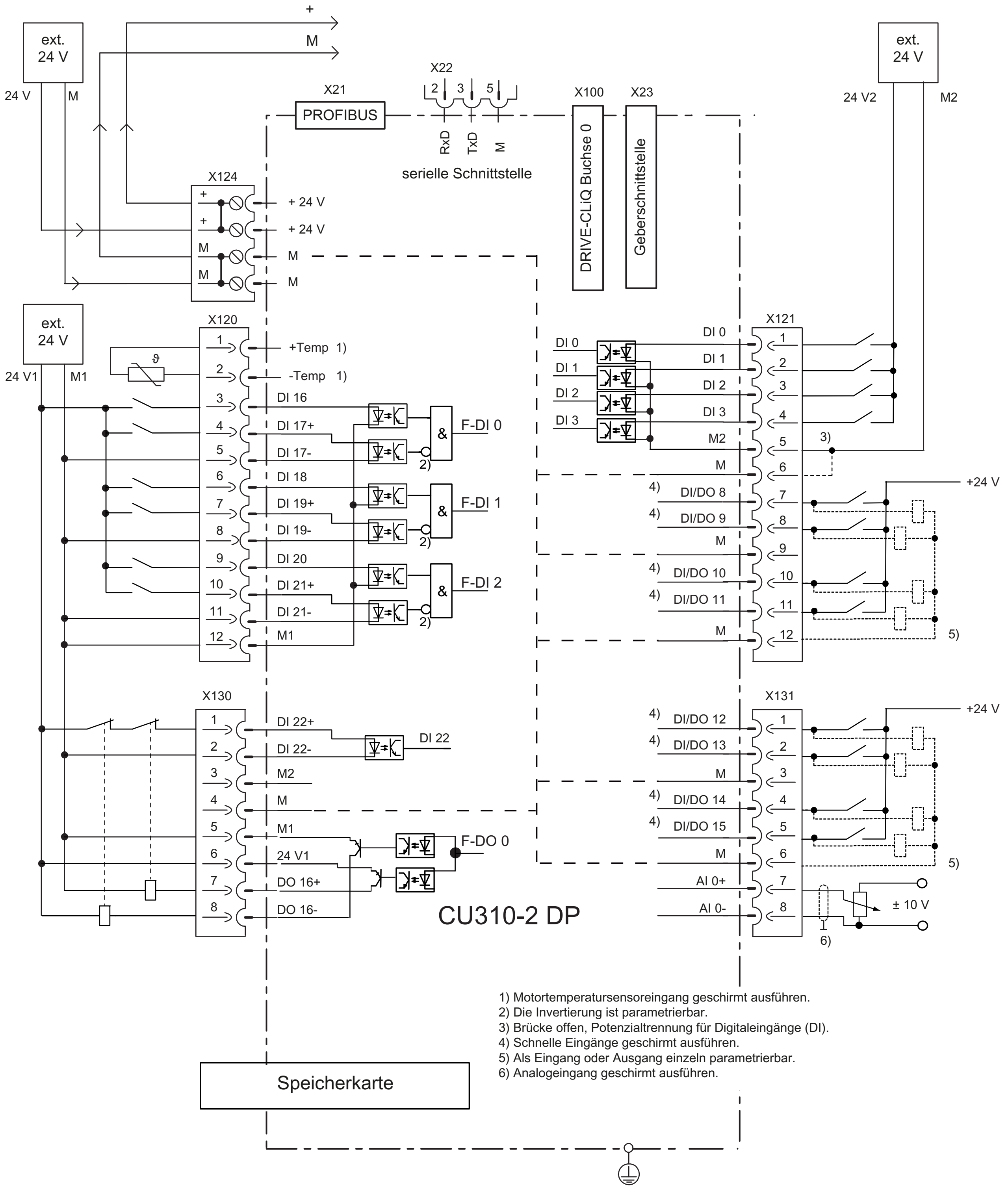


Figure 7-14 Connection example, CU310-2 DP with safety function

7.4.4 Meaning of the LEDs

7.4.4.1 Function of the LEDs

There are four LEDs on the front panel of the CU310-2 DP's housing (see section: "Overview", illustration: "CU310-2 DP Interface overview").

Table 7- 36 LEDs

RDY	Ready
COM	Status of the fieldbus communication
OUT>5V	Encoder current supply > 5 V (TTL/HTL)
MOD	Operating mode (reserved)

The various LEDs are switched on and off as the control unit is powered up (depending on the phase the system is currently running through). When switched on, the color of the LEDs shows the status of the corresponding power-up phase (see section: "LED display during power up").

In the event of a fault, power up will be ended in the corresponding phase. The LEDs that are switched on retain their color at this particular instant in time, so that the fault can be determined based on the combination of LEDs that are switched on (bright) and switched off (dark).

All the LEDs go out briefly if the CU310-2 DP has powered up without error. The system is ready for operation when the LED "RDY" is permanently green.

All the LEDs are controlled by the software loaded during operation (see section: "LED display during operation").

7.4.4.2 Behavior of the LEDs during booting

Table 7- 37 Load software

LED				State	Comment
RDY	COM	OUT>5V	MOD		
Orange	Orange	Orange	Orange	POWER ON	All LEDs light up for approx. 1 s
Red	Red	Off	Off	Hardware reset	After pressing the RESET button the LEDs light up for approx. 1 s
Red	Red	Off	Off	BIOS loaded	-
Red flashing light 2 Hz	Red	Off	Off	BIOS error	Error occurred while loading the BIOS
Red flashing light 2 Hz	Red flashing light 2 Hz	Off	Off	File error	Memory card not inserted or faulty Software on memory card not present or corrupted

Table 7- 38 Firmware

LED				State	Comment
RDY	COM	OUT>5V	MOD		
Red	Orange	Off	Off	Firmware loading	COM-LED flashing without specific flashing frequency
Red	Off	Off	Off	Firmware loaded	-
Off	Red	Off	Off	Firmware check (no CRC error)	-
Red Flashing light 0.5 Hz	Red Flashing light 0.5 Hz	Off	Off	Firmware check (CRC error)	CRC is incorrect
Orange	Off	Off	Off	Firmware initialization	-

7.4.4.3 Behavior of the LEDs in the operating state

Table 7- 39 Description of the LEDs during operation of the CU310-2 DP

LED	Color	State	Description / cause	Remedy
RDY (READY)	-	Off	Electronic power supply is missing or outside permissible tolerance range.	Check the power supply
	Green	Continuous light	The unit is ready for operation. Cyclic DRIVE-CLiQ communication is in progress.	-
		Flashing light 0.5 Hz	Commissioning / reset	-
		Flashing light 2 Hz	Writing to the memory card.	-
	Red	Flashing light 2 Hz	General errors	Check parameter assignment / configuration
	Red / green	Flashing light 0.5 Hz	The Control Unit is ready for operation, but there are no software licenses.	Install the missing licenses.
	Orange	Flashing light 0.5 Hz	The firmware of the DRIVE-CLiQ components is being updated.	-
		Flashing light 2 Hz	DRIVE-CLiQ component firmware update completed. Waiting for POWER ON of the corresponding components.	Switch on the component.
	Green / orange or red / orange	Flashing light 2 Hz	Detection of the component via LED is activated (p0124[0]). **Note:** Both options depend on the LED state when activating via p0124[0] = 1.	-

LED	Color	State	Description / cause	Remedy
COM	-	Off	Cyclic communication is not (yet) running. **Note:** The PROFIdrive is ready for communication when the Control Unit is ready for operation (see LED: RDY).	-
	Green	Continuous light	Cyclic communication is taking place.	-
		Flashing light 0.5 Hz	Cyclic communication is not fully established yet. **Possible causes:** - The controller is not transmitting any setpoints. - In isochronous mode, the controller is not sending a GC (Global Control) or is sending a defective GC.	-
	Red	Flashing light 0.5 Hz	The PROFIBUS master is sending a faulty parameter assignment or the configuration file is corrupted.	Modify the configuration between the master / controller and Control Unit.
		Flashing light 2 Hz	Cyclic bus communication has been interrupted or could not be established.	Rectify the bus communication fault.
MOD	-	Off	-	-
OUT > 5 V	-	Off	-	-
	Orange	Continuous light	The voltage of the electronic power supply for the measuring system is 24 V. 1)	

1) Make sure that the connected encoder is designed for a 24 V supply. Connecting a 5 V encoder to a 24 V supply can result in destruction of the encoder electronics.

7.4.5 Dimension drawing

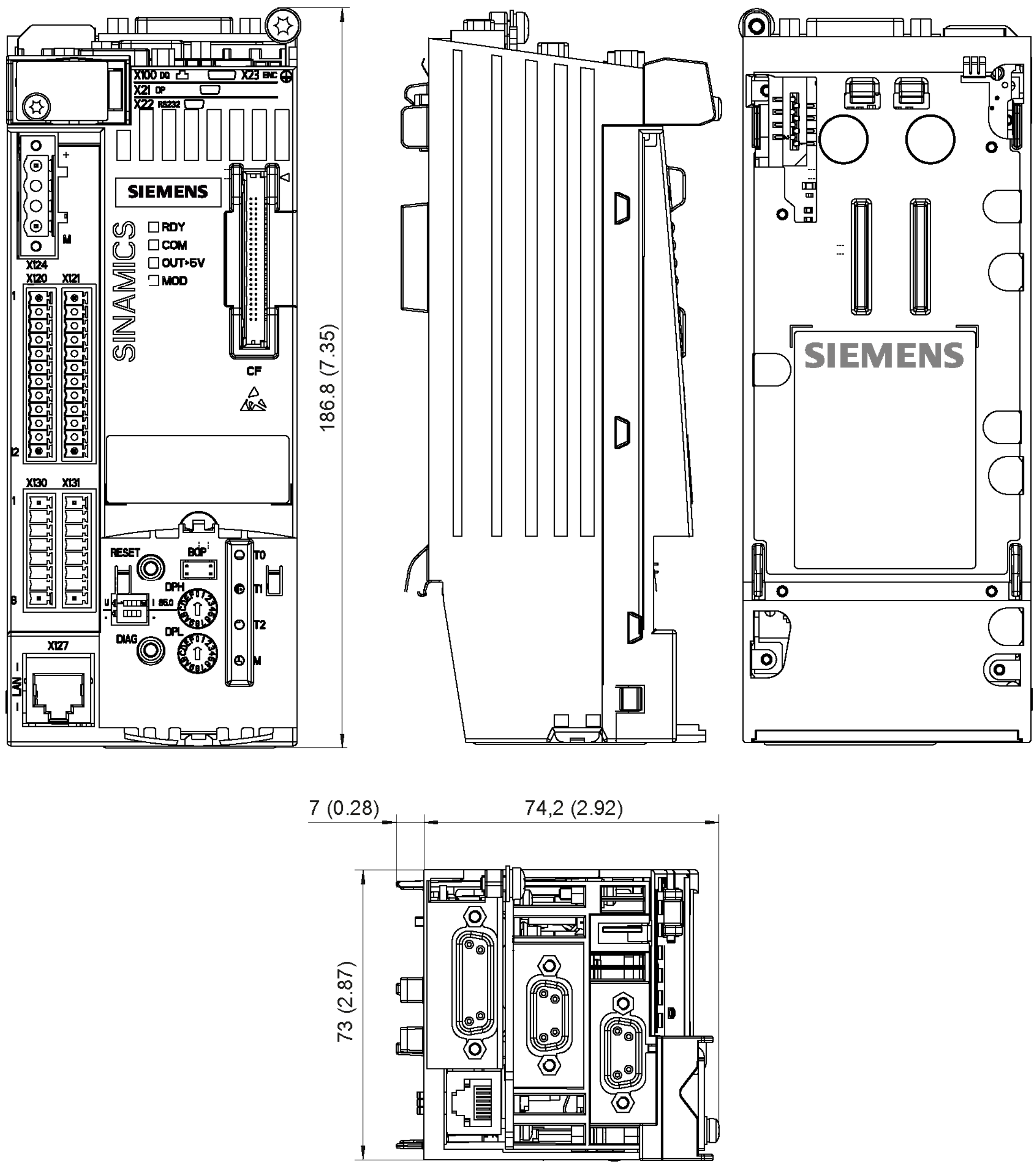


Figure 7-15 Dimension drawing, Control Unit CU310-2 DP, all data in mm (inches)

7.4.6 Technical data

Table 7- 40 Technical data of the CU310-2 DP

6SL3040-1LA00-0AA0	Unit	Value
Electronics power supply Voltage Current (without DRIVE-CLiQ and digital outputs) Power loss	 V_{DC} A_{DC} W	 24 DC (20.4 – 28.8) 0.8 <20
Maximum DRIVE-CLiQ cable length	m	100
PE/ground connection	On housing with M4/3 Nm screw	
Response time	The response time of digital inputs/outputs depends on the evaluation. 1)	
Weight	kg	0.95

1) Information is given in the manual: SINAMICS S List Manual – "Function diagrams" chapter.

7.5 Control Unit Adapter CUA31

7.5.1 Description

The CUA31 Control Unit Adapter is used to connect a Power Module blocksize to an existing DC/AC group with a higher-level control module, e.g. a CU320-2. Since the closed-loop control is realized externally, for operation, a SINAMICS, SIMOTION or SINUMERIK closed-loop control is always required for several axes.

The Control Unit Adapter CUA31 has the following interfaces (ports):

Table 7- 41 Interface overview of the CUA31

Type	Number
DRIVE-CLiQ interface	3
EP terminal/temperature sensor	1
Power Module Interface (PM-IF)	1
24 V electronics power supply	1

7.5.2 Interface description

7.5.2.1 Overview

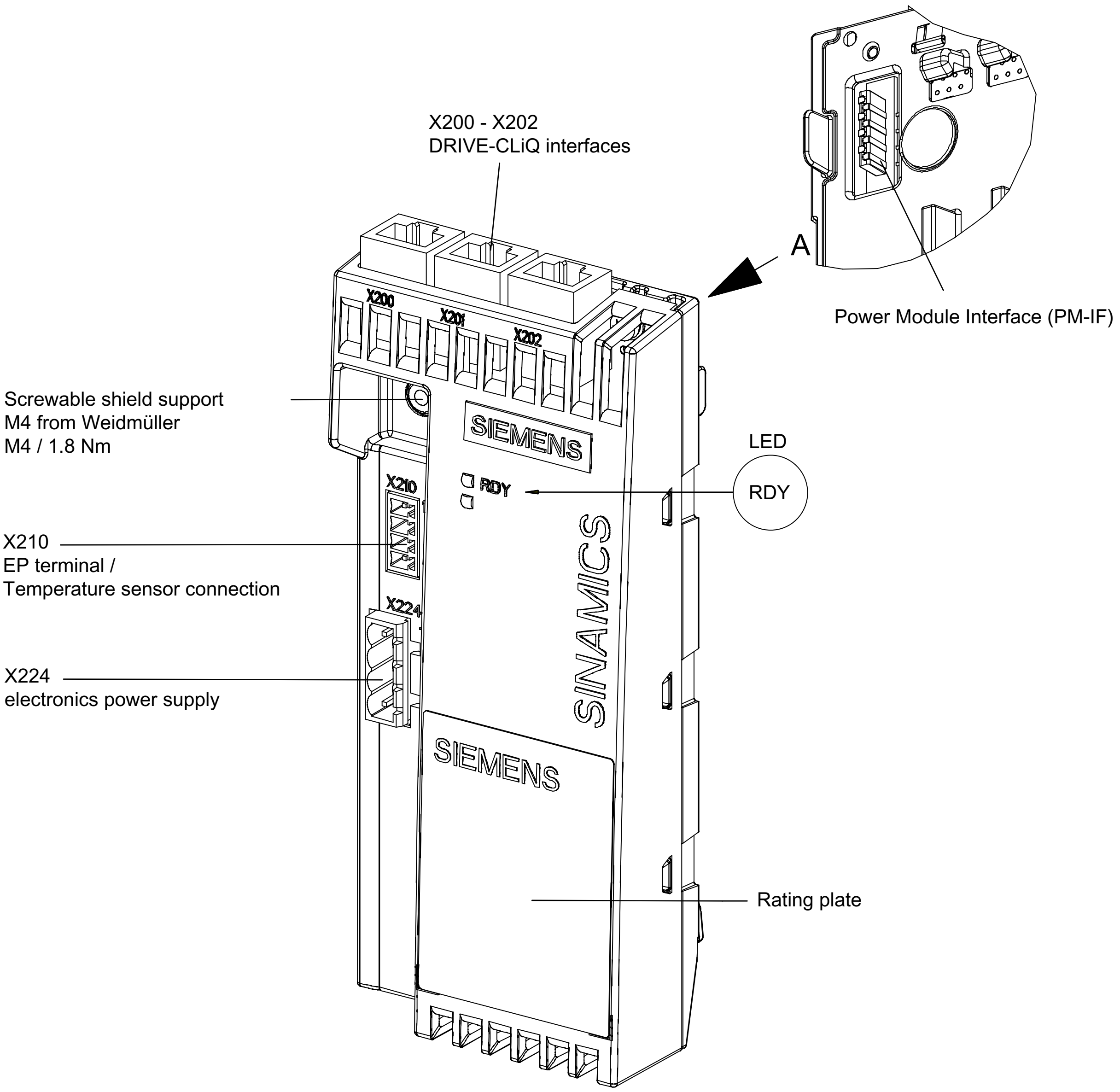
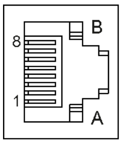


Figure 7-16 Interface overview of the CUA31

7.5.2.2 X200-X202 DRIVE-CLiQ interfaces

Table 7- 42 X200-X202 DRIVE-CLiQ interfaces

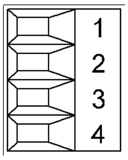
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronic ground
Connector type	RJ45 socket		

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

Blanking plate from the Yamaichi company, order number: Y-ConAS-13

7.5.2.3 X210 EP terminal / temperature sensor

Table 7- 43 X210 EP terminal / temperature sensor input

	Terminal	Function	Technical data
	1	+ Temp 1)	Temperature sensor KTY84–1C130/PTC
	2	- Temp 1)	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
	4	EP M1 (Enable Pulses)	
Max. connectable cross-section 1.5 mm² Type: Screw terminal 1 (see Chapter "Control cabinet installation/Connection system")			

1) Further information can be found in the Commissioning Manual: SINAMICS S120, Chapter "Temperature sensors for SINAMICS components".

Temperature sensor input

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

NOTICE
Risk of motor overheating for incorrectly connected KTY temperature sensor
A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.
• Make sure that you connect the KTY temperature sensor with the correct polarity.

The maximum length of the temperature sensor cable is 300 m. The cables must be shielded. For cable lengths >100 m, cables with a cross-section of ≥1 mm² must be used.

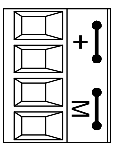
"Safe standstill" function

If the "Safe standstill" function is selected, a 24 V DC voltage must be connected to terminals 3 and 4. Upon removal, pulse inhibit is activated.

⚠ 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!

7.5.2.4 X224 electronics power supply

Table 7- 44 X224 electronics power supply

	Terminal	Function	Technical data
	+	Electronics power supply	Voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: max. 0.8 A (without DRIVE-CLiQ) Max. current via jumper in connector: 20 A
	+	Electronics power supply	
	M	Electronic ground	
	M	Electronic ground	
Max. connectable cross-section: 2.5 mm² Type: Screw terminal 2 (see Chapter, "Control cabinet installation and EMC/connection system")			

Note

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

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

7.5.3 Connection example

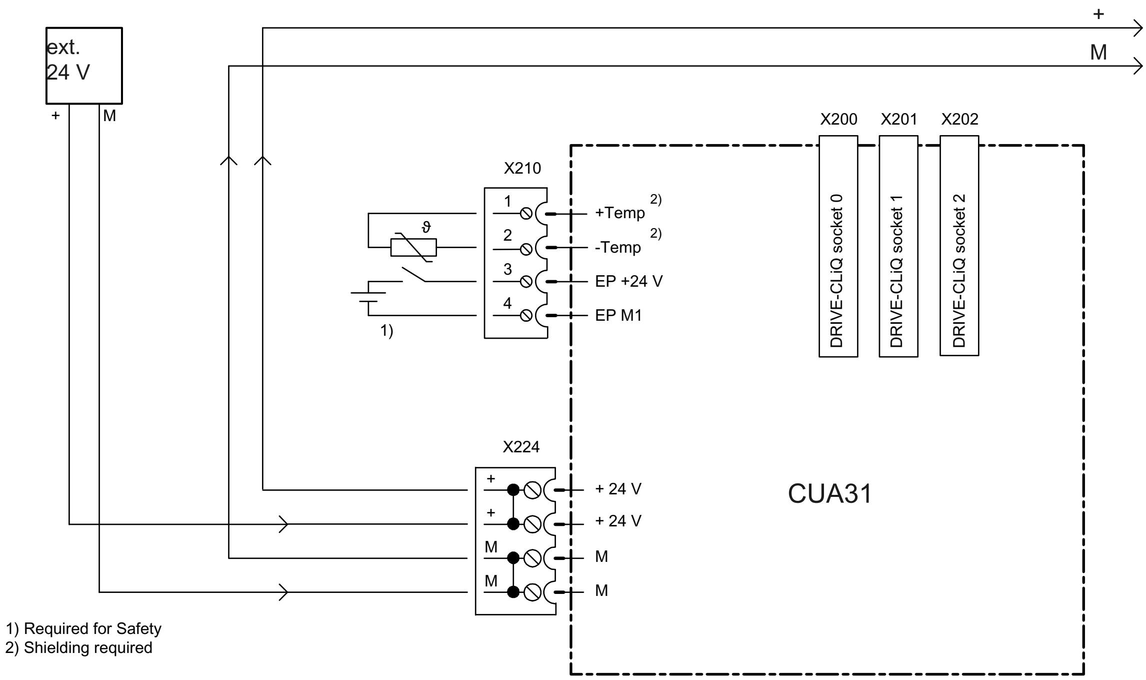


Figure 7-17 Connection example, CUA31

7.5.4 Meaning of the LEDs

Table 7- 45 Meaning of the LEDs at the Control Unit Adapter 31

LED	Color	Status	Description
RDY (READY)	Red	Continuous light	At least one fault is present in this component.
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.

Cause and rectification of faults

Information about the cause and rectification of faults can be found in the SINAMICS S120 Commissioning Manual.

7.5.5 Dimension drawing

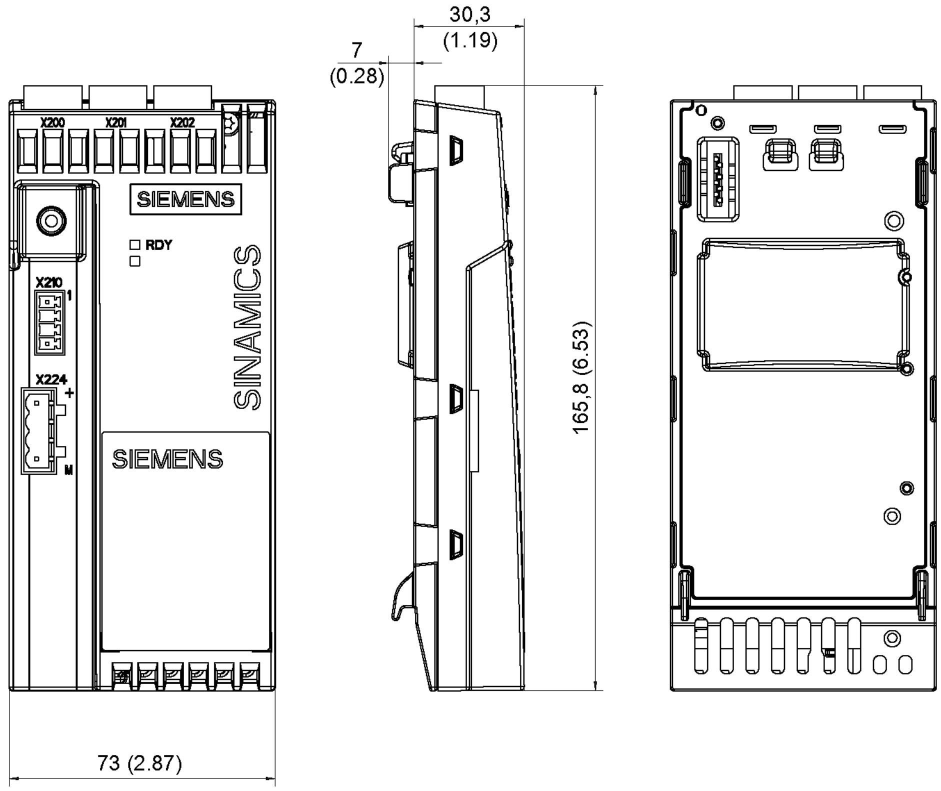


Figure 7-18 Dimension drawing of Control Unit Adapter CUA31, all data in mm and (inches)

7.5.6 Technical data

Table 7- 46 Technical data CUA31

6SL3040-0PA00-0AA0 / 6SL3040-0PA00-0AA1	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 DC (20.4 – 28.8)
Current (without DRIVE-CLiQ)	A_{DC}	0.1
Power loss	W	2.4
Maximum DRIVE-CLiQ cable length		
CUA31 with order number 6SL3040-0PA00-0AA0	m	50
CUA31 from order number 6SL3040-0PA00-0AA1	m	100
Weight	kg	0.31

7.6 Control Unit Adapter CUA32

7.6.1 Description

The Control Unit Adapter CUA32 is used to connect a Power Module blocksize to an existing DC/AC group with a higher-level control module, e.g. a CU320-2. Since the closed-loop control is realized externally, for operation, a SINAMICS, SIMOTION or SINUMERIK closed-loop control is always required for several axes.

The CUA32 offers additional encoder interface (HTL / TTL / SSI).

The Control Unit Adapter CUA32 has the following interfaces (ports):

Table 7- 47 Interface overview of the CUA32

Type	Number
DRIVE-CLiQ interface	3
EP terminal/temperature sensor	1
Power Module Interface (PM-IF)	1
24 V electronics power supply	1
Encoder interface (HTL/TTL/SSI(1))	1

1) Only SSI encoders without incremental tracks can be operated on the CUA32.

7.6.2 Interface description

7.6.2.1 Overview

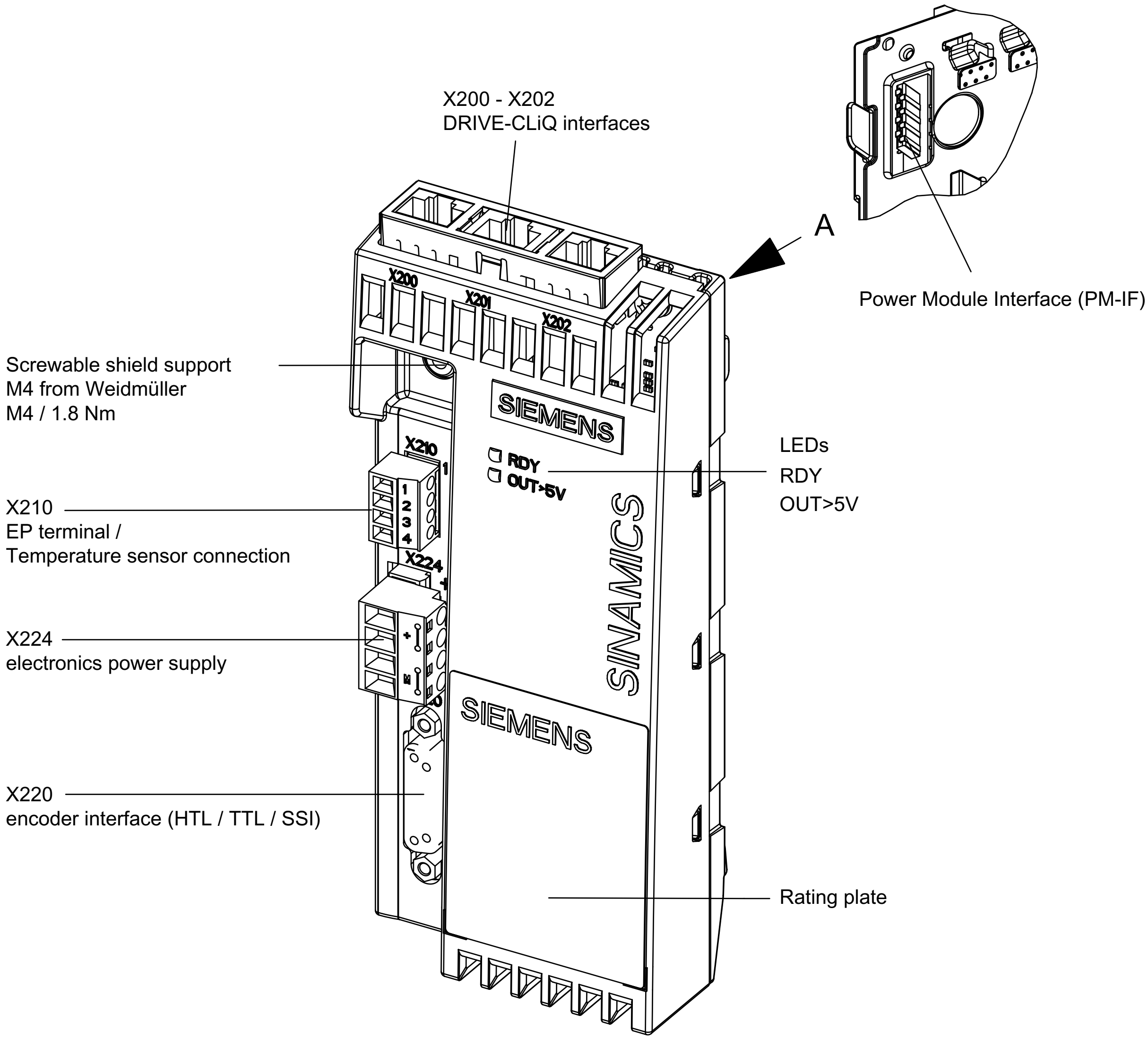
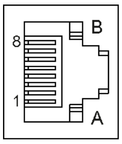


Figure 7-19 Interface overview CUA32

7.6.2.2 X200-X202 DRIVE-CLiQ interfaces

Table 7- 48 X200-X202 DRIVE-CLiQ interfaces

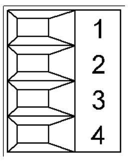
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronic ground
Connector type	RJ45 socket		

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

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

7.6.2.3 X210 EP terminal / temperature sensor

Table 7- 49 X210 EP terminal / temperature sensor input

	Terminal	Function	Technical data
	1	+ Temp 1)	Temperature sensor KTY84–1C130/PTC
	2	- Temp 1)	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 μs H → L: 1000 μs
	4	EP M1 (Enable Pulses)	
Max. connectable cross-section 1.5 mm² Type: Screw terminal 1 (see Chapter "Control cabinet installation/Connection system")			

1) Further information can be found in the Commissioning Manual: SINAMICS S120, Chapter "Temperature sensors for SINAMICS components".

Temperature sensor input

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

NOTICE
Risk of motor overheating for incorrectly connected KTY temperature sensor
A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.
• Make sure that you connect the KTY temperature sensor with the correct polarity.

The maximum length of the temperature sensor cable is 300 m. The cables must be shielded. For cable lengths >100 m, cables with a cross-section of ≥1 mm^2 must be used.

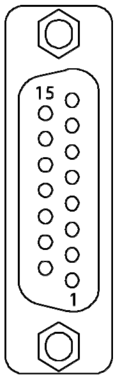
"Safe standstill" function

If the "Safe standstill" function is selected, a 24 V DC voltage must be connected to terminals 3 and 4. Upon removal, pulse inhibit is activated.

⚠ 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!

7.6.2.4 X220 HTL/TTL/SSI encoder interface

Table 7- 50 X220 HTL/TTL/SSI encoder interface

	Pin	Signal name	Technical data
	1	+Temp	KTY or PTC input
	2	SSI_CLK	SSI clock, positive
	3	SSI_XCLK	SSI clock, negative
	4	P encoder 5 V / 24 V	Encoder supply
	5	P encoder 5 V / 24 V	Encoder supply
	6	P sense	Sense input, encoder supply
	7	M encoder (M)	Ground, encoder supply
	8	-Temp	Ground for KTY or PTC
	9	M sense	Ground sense input
	10	RP	R track positive
	11	RN	R track negative
	12	BN	B track negative
	13	BP	B track positive
	14	AN_SSI_XDAT	A track negative/SSI data negative
	15	AP_SSI_DAT	A track positive/SSI data positive
Connector type	15-pin sub D connector		

NOTICE

Risk of motor overheating for incorrectly connected KTY temperature sensor

A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.

- Make sure that you connect the KTY temperature sensor with the correct polarity.

Table 7- 51 Specification of measuring systems that can be connected

Parameter	Designation	Threshold	Min.	Type	Max.	Unit
High signal level (TTL bipolar at X220)	U_{Hdiff}		2		5	V
Low signal level (TTL bipolar at X220)	U_{Ldiff}		-5		-2	V
High signal level (HTL unipolar)	U_H	High	17		V_{CC}	V
		Low	10		V_{CC}	V
Low signal level (HTL unipolar)	U_L	High	0		7	V
		Low	0		2	V
High signal level (HTL bipolar)	U_{Hdiff}		3		V_{CC}	V
Low signal level (HTL bipolar)	U_{Ldiff}		$-V_{CC}$		-3	V
High signal level (SSI bipolar at X220)	U_{Hdiff}		2		5	V
Low signal level (SSI bipolar at X220)	U_{Ldiff}		-5		-2	V
Signal frequency	f_S		-		500	kHz
Edge clearance	t_{min}		100		-	ns
Zero pulse (with $T_s = 1/f_s$)	Length		$¼ \cdot T_s$		$¾ \cdot T_s$	
	Center of the pulse position		50	135	220	Degrees

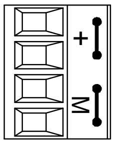
Note

We recommend that bipolar encoders are used.

When uni-polar encoders are used, the 15-pin sub D connector should be opened and the unused inverse signals (AN Pin14, BN Pin12 and RN Pin11) connected to ground (Pin7).

7.6.2.5 X224 electronics power supply

Table 7- 52 X224 electronics power supply

	Terminal	Function	Technical data
	+	Electronics power supply	Voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: max. 0.8 A (without DRIVE-CLiQ and encoder) Max. current via jumper in connector: 20 A
	+	Electronics power supply	
	M	Electronic ground	
	M	Electronic ground	
Max. connectable cross-section: 2.5 mm² Type: Screw terminal 2 (see Chapter, "Control cabinet installation and EMC/connection system")			

Note

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

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

7.6.3 Connection example

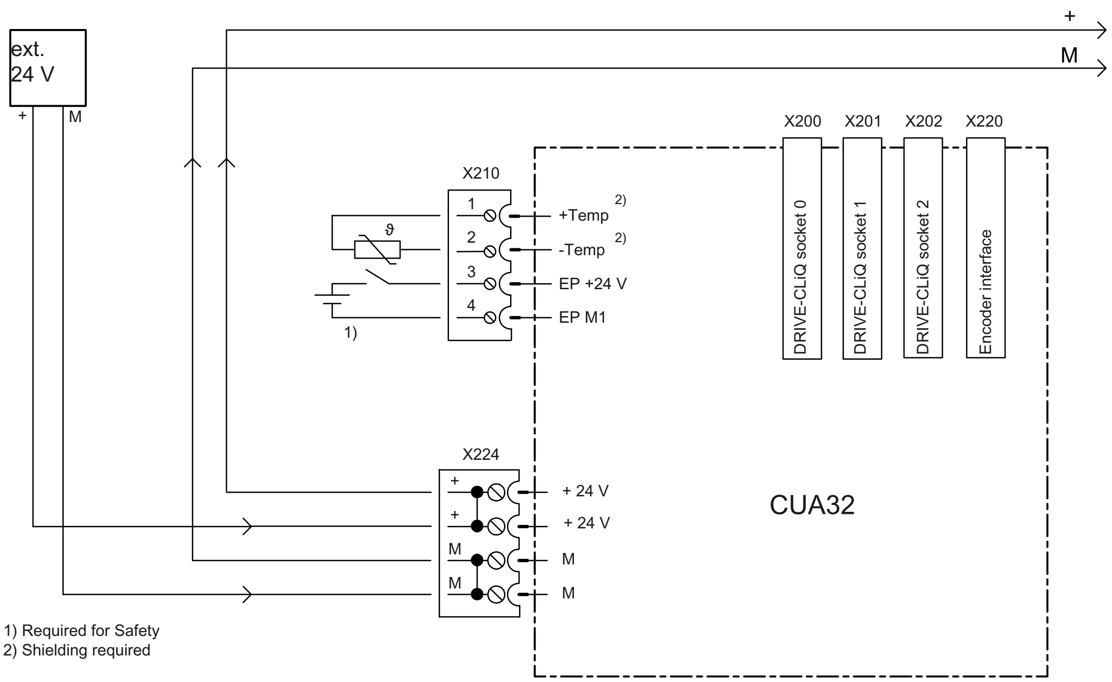


Figure 7-20 Connection example for CUA32

7.6.4 Meaning of the LEDs

Table 7- 53 Meaning of the LEDs on the Control Unit Adapter CUA32

LED	Color	Status	Description
RDY (READY)	Red	Continuous light	At least one fault is present in this component.
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
OUT > 5V	-	Off	Electronics power supply is missing or outside permissible tolerance range. Power supply: ≤5 V.
	Orange	continuous light	Electronics power supply for measuring system available. Power supply: >5 V. **Caution** You must ensure that the connected encoder can be operated with a 24 V power supply. If an encoder that is designed for a 5 V power supply is operated with a 24 V power supply, this can destroy the encoder electronics.

Cause and rectification of faults

Information about the cause and rectification of faults can be found in the SINAMICS S120 Commissioning Manual.

7.6.5 Dimension drawing

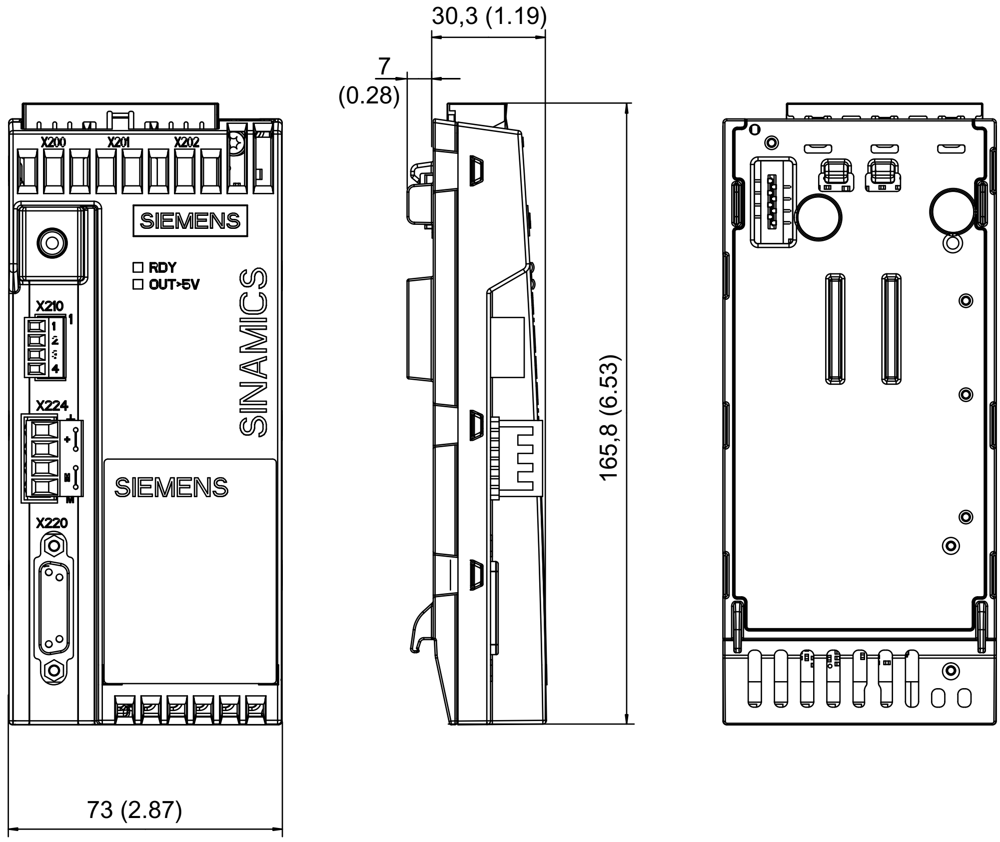


Figure 7-21 Dimension drawing of Control Unit Adapter CUA32, all data in mm and (inches)

7.6.6 Technical data

Table 7- 54 Technical data CUA32

6SL3040-0PA01-0AA0	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 DC (20.4 – 28.8)
Current (without DRIVE-CLiQ and encoder)	A_{DC}	0.11
maximum current consumption of encoder	mA	400
Power loss	W	2.6
Maximum DRIVE-CLiQ cable length	m	100
Weight	kg	0.32

7.7 Installing Control Units and Control Unit Adapters

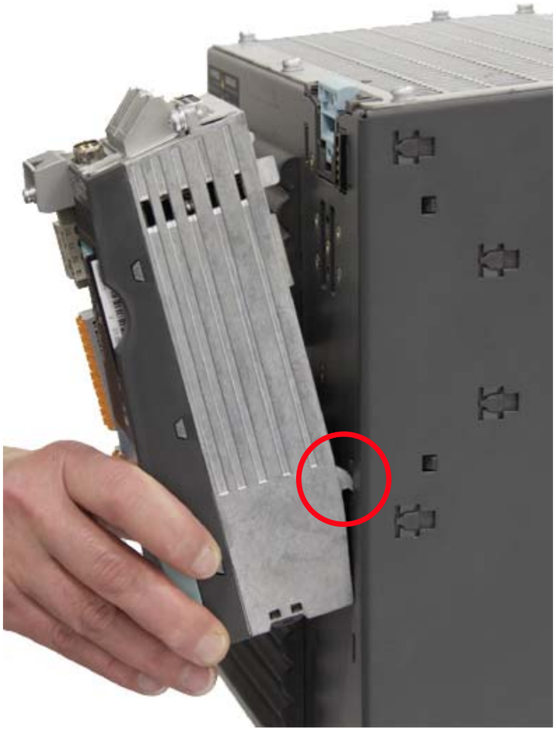
Power Module blocksize

Control Unit (CU310-2 PN / DP) and Control Unit Adapter (CUA31 / CUA32) can be mounted onto Power Modules blocksize of any size. Communication between the devices is realized via the PM-IF interface.

Mounting

1. Mount the Control Unit / the Control Unit Adapter on the PM.
2. Press the Control Unit / the Control Unit Adapter back until it latches into the blue interlocking lug.

The diagrams show the Control Unit / Control Unit Adapter mounted on the PM340 (frame size FSD), using the CU310-2 PN as an example.

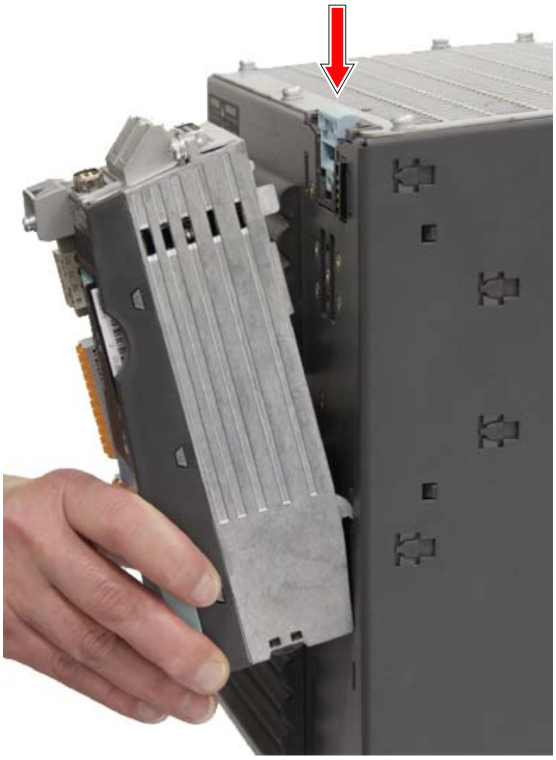


Placing the CU310-2 PN on the PM340

PM340 with CU310-2 PN fitted

Removal

1. Press the blue locking latch downwards (see arrow).
2. Remove the Control Unit/Control Unit Adapter towards the front.



Removing the CU310-2 PN from the PM340

Power Module Chassis

1. Connect the DRIVE-CLiQ interfaces of Power Module Chassis and the Control Unit / Control Unit Adapter.
   The DRIVE-CLiQ interface of the Power Module Chassis is located behind the mounting plate.
2. Mount the Control Unit/Control Unit Adapter on the mounting plate.

7.8 Basic Operator Panel BOP20

7.8.1 Description

The Basic Operator Panel BOP20 is a basic operator panel with six keys and a backlit display unit. The BOP20 can be inserted on the CU310-2 DP and CU310-2 PN SINAMICS Control Units and operated.

The BOP20 supports the following functions:

- Input of parameters and activation of functions
- Display of operating modes, parameters, alarms and faults

7.8.2 Interface description

Figure 7-22 Basic Operator Panel BOP20

Overview of displays and keys

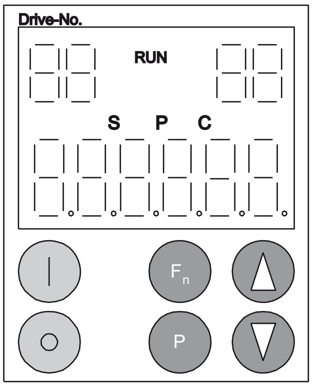


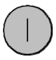
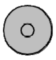
Figure 7-23 Overview of displays and keys

Table 7- 55 Displays

Display	Meaning
top left 2 positions	The active drive object of the BOP is displayed here. The displays and key operations always refer to this drive object.
RUN	Is lit (bright) if the displayed drive is in the RUN state (in operation).
top right 2 positions	The following is displayed in this field: • More than 6 digits: Characters that are still present but are invisible (e.g. "r2" —> 2 characters to the right are invisible, "L1" —> 1 character to the left is invisible) • Faults: Selects/displays other drives with faults • Designation of BICO inputs (bi, ci) • Designation of BICO outputs (bo, co) Source object of a BICO interconnection to a drive object different than the active one.
S	Is (bright) if at least one parameter was changed and the value was not transferred into the non-volatile memory.
P	Is lit (bright) if, for a parameter, the value only becomes effective after pressing the P key.
C	Is light (bright) if at least one parameter was changed and the calculation for consistent data management has still not been initiated.
Below, 6 position	Displays, e.g. parameters, indices, faults and alarms.

BOP20 keyboard

Table 7- 56 Assignment of the BOP20 keyboard

Key	Name	Meaning
	ON	Powering-up the drives for which the command "ON/OFF1", "OFF2" or "OFF3" should come from the BOP.
	OFF	Powering-down the drives for which the commands "ON/OFF1", "OFF2" or "OFF3" should come from the BOP.
		Note: The effectiveness of these keys can be defined using the appropriate BICO parameterization (e.g. using these keys, it is possible to simultaneously control all of the axes that have been configured). The structure of the BOP control word corresponds to the structure of the PROFIBUS control word.
FN	Functions	The meaning of these keys depends on the actual display. **Note:** The effectiveness of this key to acknowledge faults can be defined using the appropriate BiCo parameterization.
P	Parameter	The meaning of these keys depends on the actual display.
△	Raise	The keys are dependent on the actual display and are used to raise or lower values.
▽	Lower	

7.8.3 Mounting

Note

When the BOP20 is inserted or withdrawn out of the CU310-2, make sure that it is correctly aligned and straight and neither skewed to the top nor the bottom.
This avoids damaging the BOP20 interface on the CU310-2.

Mounting

The diagrams show how to mount the Basic Operator Panel BOP20 on a CU310-2.

				
1.	To remove the blanking cover, press the latching cams of the cover together simultaneously and pull the cover straight out.	2.	Press the latching cams on the BOP20 together simultaneously and push the BOP20 straight into the housing of the CU310-2 until you hear it latch into position.	CU310-2 with mounted BOP20.

Note

The BOP20 may be inserted or withdrawn while the Control Unit is operational.

Removal

1. Simultaneously press the latching cams on the BOP20.
2. Keep the latching cams pressed together and pull the BOP20 straight out.
3. Insert the blanking cover.

Display and operator controls of the BOP20

For information about display and operator controls of the BOP20, refer the SINAMICS S120 Commissioning Manual.

Supplementary system components and encoder system integration

8

8.1 Sensor Module Cabinet-Mounted SMC10

8.1.1 Description

The Sensor Module Cabinet-Mounted SMC10 evaluates encoder signals and transmits the speed, actual position value, rotor position and, if necessary, the motor temperature via DRIVE-CLiQ to the Control Unit.

The SMC10 is used to evaluate sensor signals from resolvers.

8.1.2 Safety instructions for Sensor Modules Cabinet-Mounted

Note

In addition, you should strictly observe the safety instructions in Chapter 1.

NOTICE
Connecting and disconnecting encoder cables
Only disconnect or connect encoder cables to Siemens motors when they are in a no-voltage condition. When using direct measuring systems (third-party encoders), ask the manufacturer whether it is permissible to disconnect/connect under voltage.

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

NOTICE
Maximum number of encoder systems that can be connected
Only one encoder system may be connected per Sensor Module

NOTICE

Use of original accessories from Siemens

Only use cables from Siemens for DRIVE-CLiQ connections.

Note

Function equipotential bonding for distributed DRIVE-CLiQ nodes

Integrate all of the components that are connected via DRIVE-CLiQ into the function equipotential bonding concept. The connection should be preferably established by mounting on metallic bare machine and plant components that are connected with one another using an equipotential bonding conductor.
Alternatively, you can establish equipotential bonding using a conductor (min. 6 mm^2), which as far as possible, is routed in parallel to the DRIVE-CLiQ cable. This involves all distributed DRIVE-CLiQ nodes, for example SMCx.

Note

Protecting unused DRIVE-CLiQ interfaces

Close all unused DRIVE-CLiQ interfaces using blanking covers. Blanking covers are included in the scope of delivery.

8.1.3 Interface description

8.1.3.1 Overview

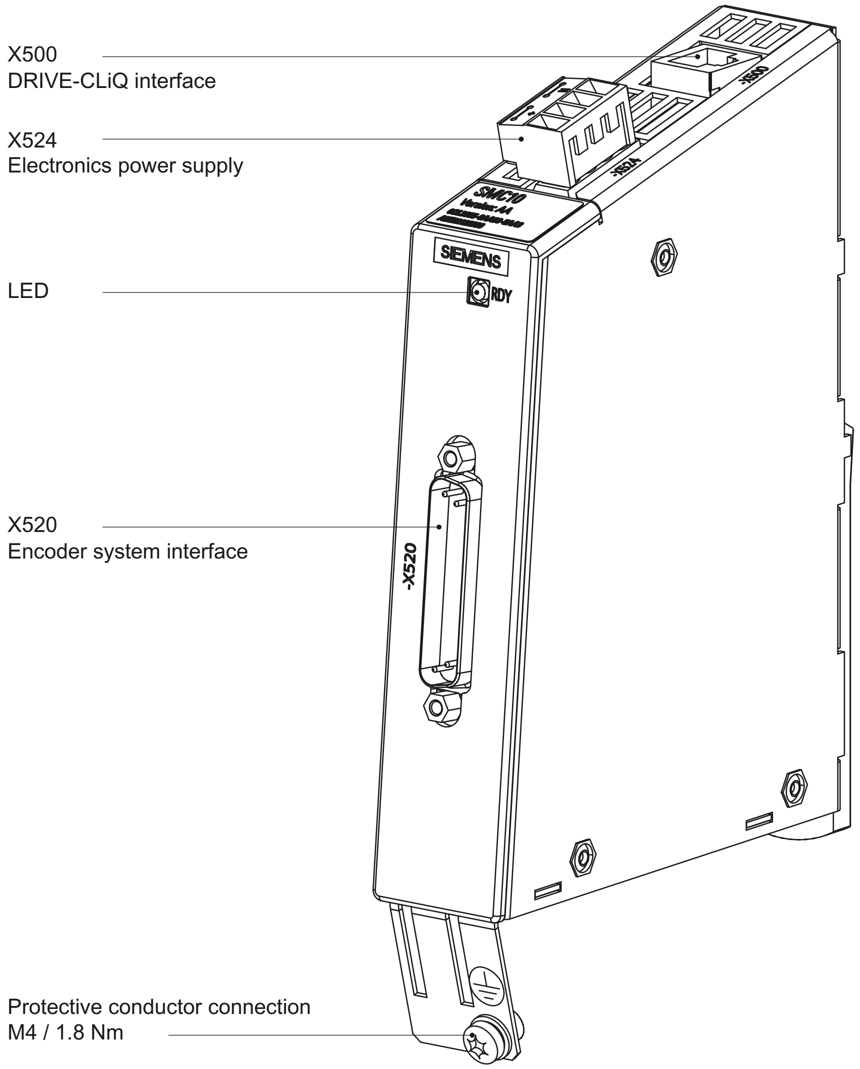
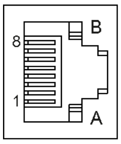


Figure 8-1 Interface overview for the SMC10

8.1.3.2 X500 DRIVE-CLiQ interface

Table 8- 1 X500 DRIVE-CLiQ interface

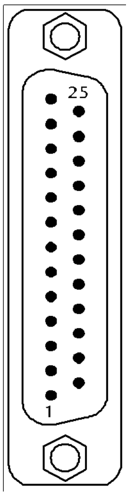
	Pin	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	Reserved, do not use	
	B	M (0 V)	Electronics ground
Connector type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

The blanking cover for the DRIVE-CLiQ port is included in the scope of delivery.

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

8.1.3.3 X520 encoder system interface

Table 8- 2 X520: Encoder system interface

	Pin	Signal name	Technical data
	1	Reserved, do not use	
	2	Reserved, do not use	
	3	S2	Resolver signal A (sin+)
	4	S4	Inverted resolver signal A (sin-)
	5	Ground	Ground (for internal shield)
	6	S1	Resolver signal B (cos+)
	7	S3	Inverted resolver signal B (cos-)
	8	Ground	Ground (for internal shield)
	9	R1	Resolver excitation positive
	10	Reserved, do not use	
	11	R2	Resolver excitation negative
	12	Reserved, do not use	
	13	+ Temp	Motor temperature sensing KTY84-1C130 (KTY+) Temperature sensor KTY84-1C130 / PTC
	14	Reserved, do not use	
	15	Reserved, do not use	
	16	Reserved, do not use	
	17	Reserved, do not use	
	18	Reserved, do not use	
	19	Reserved, do not use	
	20	Reserved, do not use	
	21	Reserved, do not use	
	22	Reserved, do not use	
	23	Reserved, do not use	
	24	Ground	Ground (for internal shield)
	25	- Temp	Motor temperature sensing KTY84-1C130 (KTY-) Temperature sensor KTY84-1C130 / PTC
Connector type:	25-pin SUB D connector		
Measuring current via temperature sensor connection: 2 mA			

NOTICE
Risk of motor overheating for incorrectly connected KTY temperature sensor
A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats. • Make sure that you connect the KTY temperature sensor with the correct polarity.

⚠ DANGER

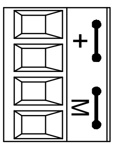
Risk of electric shock!

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!

8.1.3.4 X524 electronics power supply

Table 8- 3 X524 electronics power supply

	Terminal	Function	Technical specifications
	+	Electronics power supply	Voltage: 24 V (20.4 V – 28.8 V) Current consumption: Max. 0.35 A Maximum current via jumper in connector: 20 A
	+	Electronics power supply	
	M	Electronics ground	
	M	Electronics ground	
Max. connectable cross-section: 2.5 mm² Type: Screw terminal 2 (see Appendix)			

Note

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

8.1.4 Meaning of the LEDs

Table 8- 4 Meaning of LEDs on the Sensor Module Cabinet-Mounted SMC10

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

Cause and rectification of faults

The following documents contain information about the cause of faults and how they can be rectified:

SINAMICS S120 Commissioning Manual (IH1)

SINAMICS S120/S150, List Manual (LH1)

8.1.5 Dimension drawing

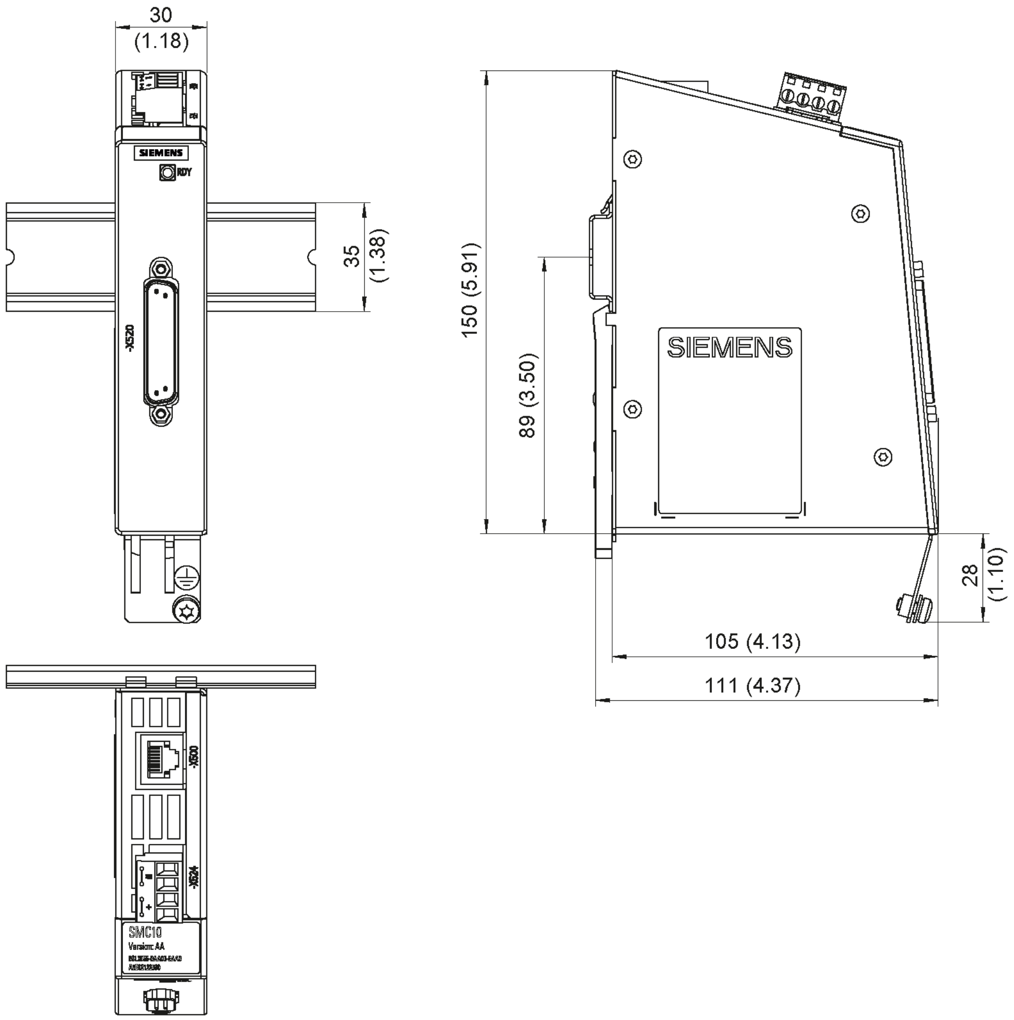


Figure 8-2 Dimension drawing of the Sensor Module Cabinet SMC10, all dimensions in mm and (inches)

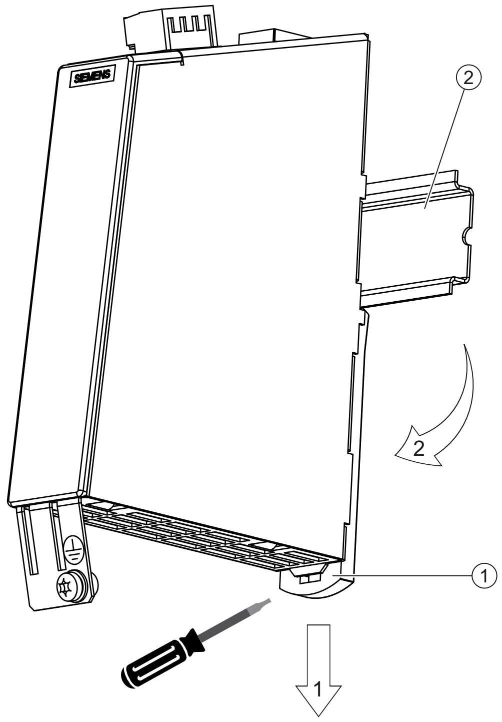
8.1.6 Installation

Installation

1. Slightly tilt the component backwards and attach it to the mounting rail using the hook.
2. Swivel the component on the mounting rail until the mounting slide at the rear audibly latches
3. Shift the components on the mounting rail to the left or right until they reach their final position

Removal

1. First shift the mounting slide downwards at the lug to release the interlocking with the mounting rail
2. Swivel the component towards the front and then remove it upwards from the mounting rail



① Mounting slide
② Mounting rail

Figure 8-3 Removal of a component from a DIN rail

8.1.7 Technical data

Table 8- 5 Technical data

6SL3055-0AA00-5AAx	Unit	Value
Electronics power supply Voltage Current (without encoder system) Current (with encoder system) Power loss	 V_{DC} A_{DC} A_{DC} W	 24 DC (20.4 – 28.8) ≤ 0.20 ≤ 0.35 ≤ 10
Specification Transformation ratio of the resolver (ü) Excitation voltage on the SMC10 when ü=0.5 Amplitude monitoring threshold (secondary tracks) of the SMC10	 V_{rms} V_{rms}	 0.5 4.1 1
Excitation voltage (cannot be parameterized)	V_{rms}	4.1
Excitation frequency (synchronized to the current controller clock cycle)	kHz	5 to 16
PE/ground connection		At the housing with M4/1.8 Nm screw
Max. encoder cable length	m	130
Weight	kg	0.45
Degree of protection		IP20 or IPXXB

Table 8- 6 Max. frequency that can be evaluated (speed)

Resolver		Max. speed resolver / motor		
Number of poles	Number of pole pairs	8 kHz/125 μsec	4 kHz/250 μsec	2 kHz/500 μsec
2-pole	1	120000 rpm	60000 rpm	30000 rpm
4-pole	2	60000 rpm	30000 rpm	15000 rpm
6-pole	3	40000 rpm	20000 rpm	10000 rpm
8-pole	4	30000 rpm	15000 rpm	7500 rpm

The ratio between the ohmic resistance R and the inductance L (the primary winding of the resolver) determines whether the resolver can be evaluated with the SMC10. See the following diagram:

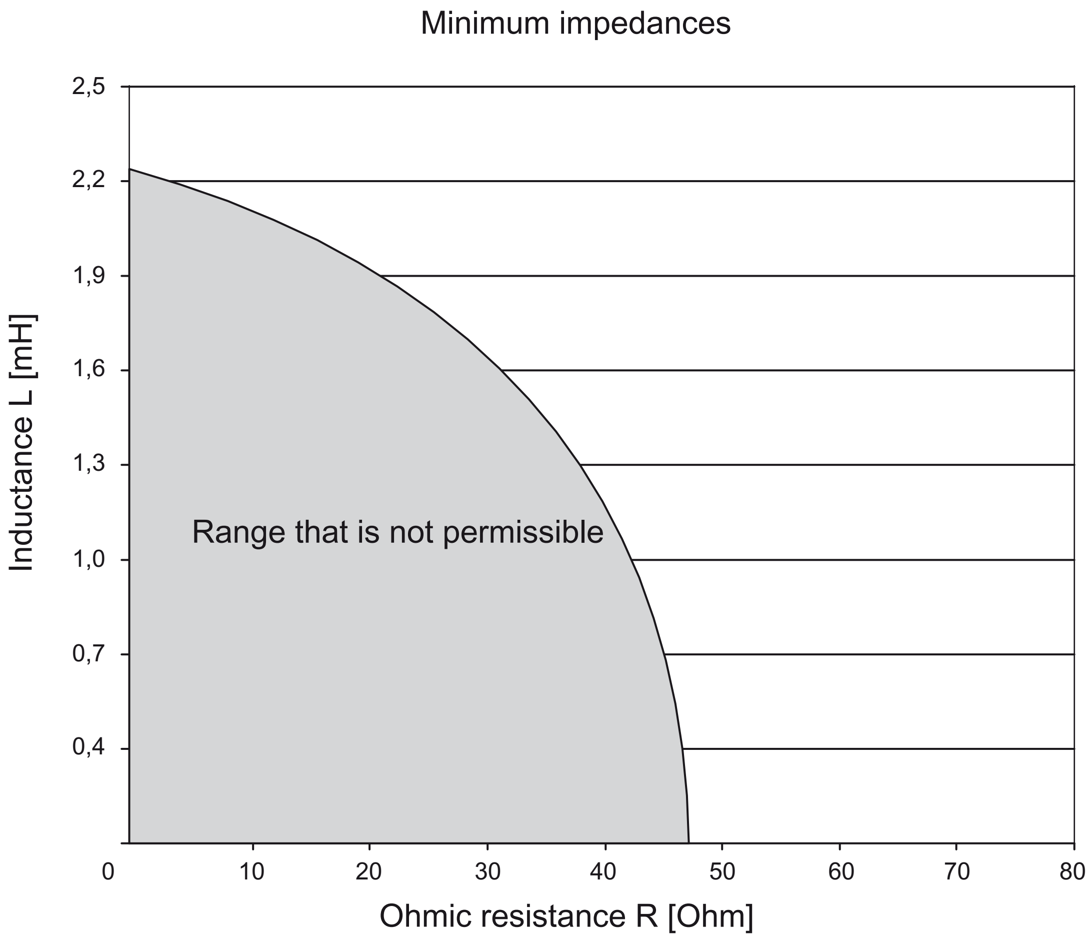


Figure 8-4 Connectable impedances with an excitation frequency f = 5000 Hz

8.2 Sensor Module Cabinet-Mounted SMC20

8.2.1 Description

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

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

8.2.2 Safety instructions for Sensor Modules Cabinet-Mounted

Note

In addition, you should strictly observe the safety instructions in Chapter 1.

NOTICE

Connecting and disconnecting encoder cables

Only disconnect or connect encoder cables to Siemens motors when they are in a no-voltage condition.

When using direct measuring systems (third-party encoders), ask the manufacturer whether it is permissible to disconnect/connect under voltage.

NOTICE

Risk of equalizing currents via the electronics ground

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

NOTICE

Maximum number of encoder systems that can be connected

Only one encoder system may be connected per Sensor Module

NOTICE

Use of original accessories from Siemens

Only use cables from Siemens for DRIVE-CLiQ connections.

Note

Function equipotential bonding for distributed DRIVE-CLiQ nodes

Integrate all of the components that are connected via DRIVE-CLiQ into the function equipotential bonding concept. The connection should be preferably established by mounting on metallic bare machine and plant components that are connected with one another using an equipotential bonding conductor.
Alternatively, you can establish equipotential bonding using a conductor (min. 6 mm²), which as far as possible, is routed in parallel to the DRIVE-CLiQ cable. This involves all distributed DRIVE-CLiQ nodes, for example SMCx.

Note

Protecting unused DRIVE-CLiQ interfaces

Close all unused DRIVE-CLiQ interfaces using blanking covers. Blanking covers are included in the scope of delivery.

8.2.3 Interface description

8.2.3.1 Overview

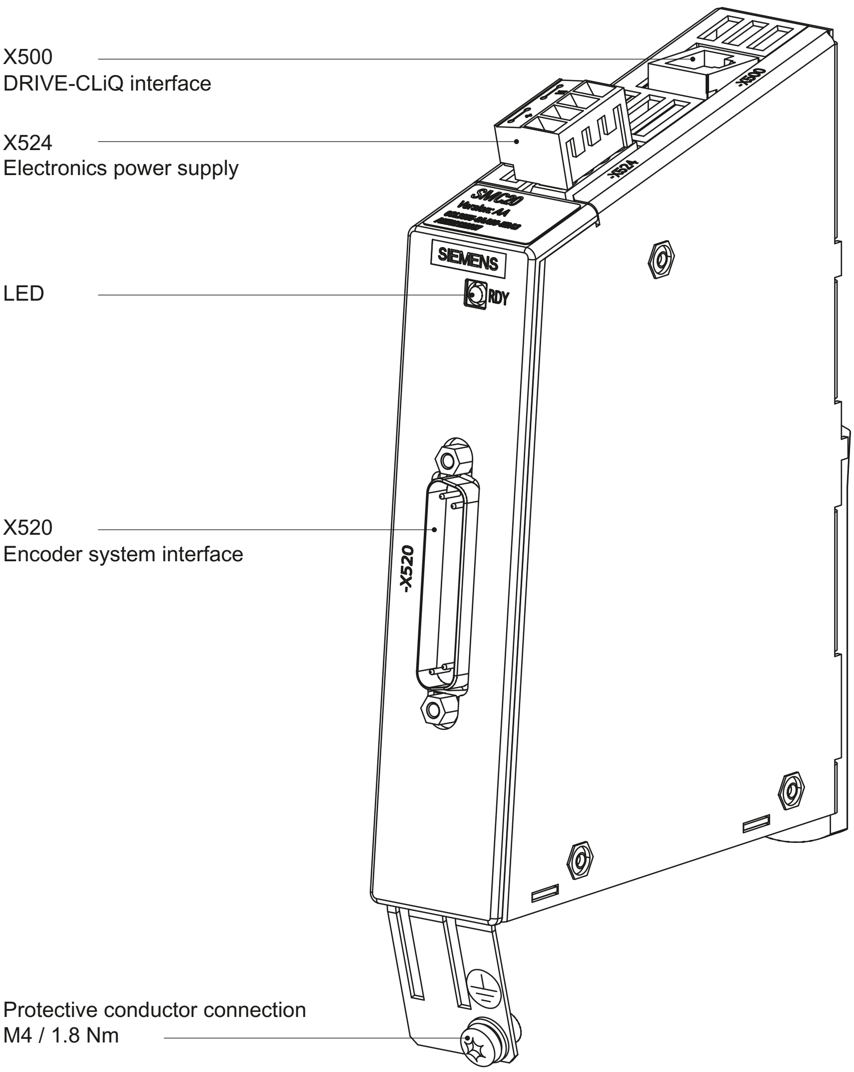
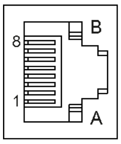


Figure 8-5 Interface description of the SMC20

8.2.3.2 X500 DRIVE-CLiQ interface

Table 8- 7 X500 DRIVE-CLiQ interface

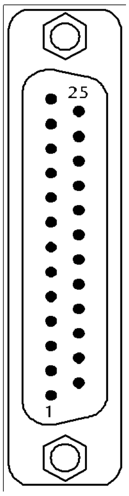
	Pin	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	Reserved, do not use	
	B	M (0 V)	Electronics ground
Connector type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

The blanking cover for the DRIVE-CLiQ port is included in the scope of delivery.

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

8.2.3.3 X520 encoder system interface

Table 8- 8 X520: Encoder system interface

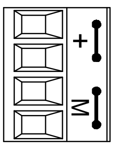
	Pin	Signal name	Technical data
	1	P encoder	Encoder power supply
	2	M encoder	Ground, encoder power supply
	3	A	Incremental signal A
	4	A*	Inverse incremental signal A
	5	Ground	Ground (for internal shield)
	6	B	Incremental signal B
	7	B*	Inverse incremental signal B
	8	Ground	Ground (for internal shield)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

NOTICE
Risk of motor overheating for incorrectly connected KTY temperature sensor
A KTY temperature sensor connected with incorrect polarity cannot detect if the motor overheats.
• Make sure that you connect the KTY temperature sensor with the correct polarity.

⚠ 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!

8.2.3.4 X524 electronics power supply

Table 8- 9 X524 electronics power supply

	Terminal	Function	Technical data
	+	Electronics power supply	Voltage: 24 V (20.4 V – 28.8 V) Current consumption: Max. 0.35 A Maximum current via jumper in connector: 20 A
	+	Electronics power supply	
	M	Electronic ground	
	M	Electronic ground	
Max. connectable cross-section: 2.5 mm² Type: Screw-type terminal 2 (refer to the chapter titled "Connection methods" as regards control cabinet installation)			

Note

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

8.2.4 Meaning of the LEDs

Table 8- 10 Meaning of LEDs on the Sensor Module Cabinet-Mounted SMC20

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

Cause and rectification of faults

The following documents contain information about the cause of faults and how they can be rectified:

SINAMICS S120 Commissioning Manual (IH1)

SINAMICS S120/S150, List Manual (LH1)

8.2.5 Dimension drawing

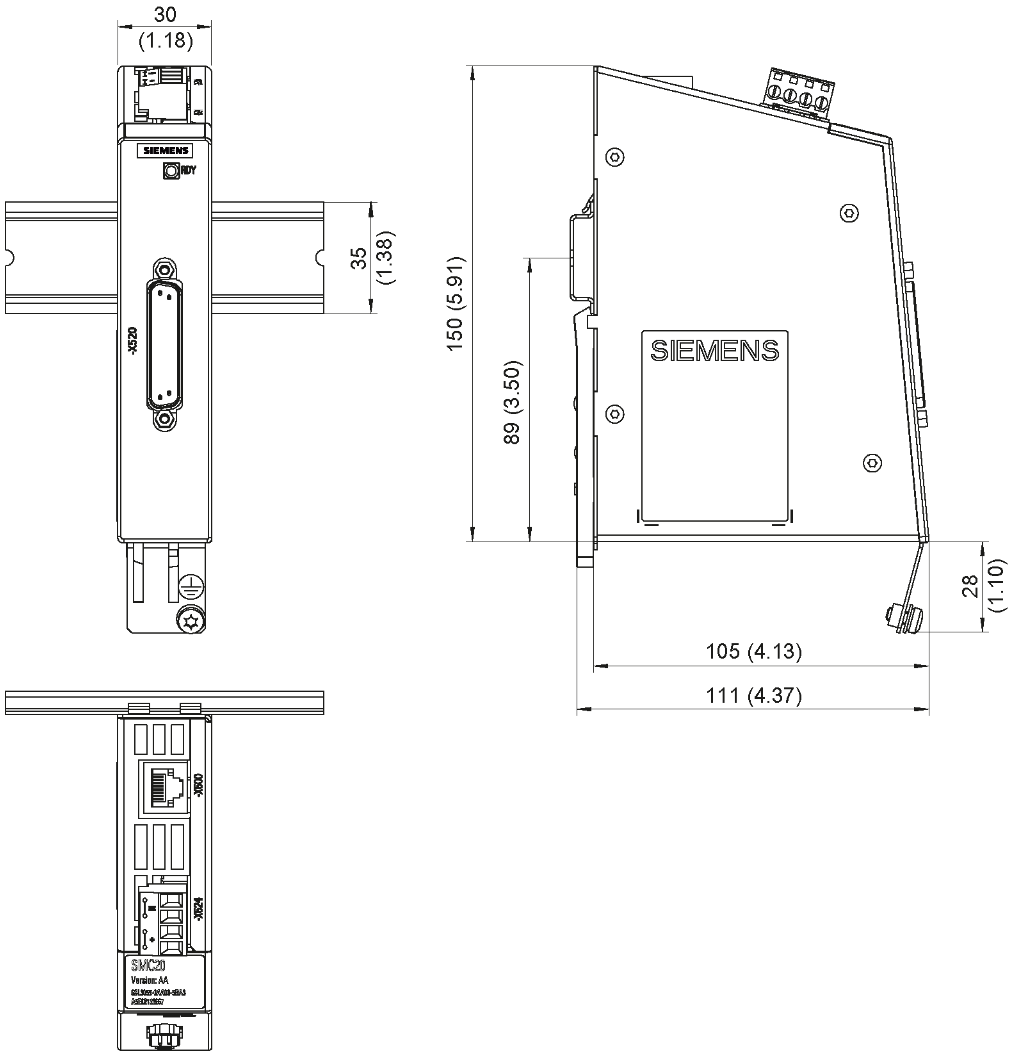


Figure 8-6 Dimension drawing of the Sensor Module Cabinet SMC20, all data in mm and (inches)

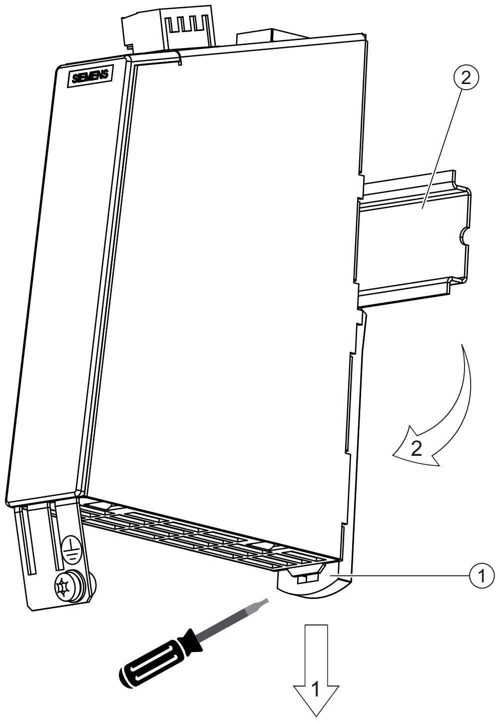
8.2.6 Installation

Installation

1. Slightly tilt the component backwards and attach it to the mounting rail using the hook.
2. Swivel the component on the mounting rail until the mounting slide at the rear audibly latches
3. Shift the components on the mounting rail to the left or right until they reach their final position

Removal

1. First shift the mounting slide downwards at the lug to release the interlocking with the mounting rail
2. Swivel the component towards the front and then remove it upwards from the mounting rail



① Mounting slide
② Mounting rail

Figure 8-7 Removal of a component from a DIN rail

8.2.7 Technical data

Table 8- 11 Technical data

6SL3055-0AA00-5BAx	Unit	Value
Electronics power supply Voltage Current (without encoder system) Current (with encoder system) Power loss	 V_{DC} A_{DC} A_{DC} W	 24 V DC (20.4 – 28.8) ≤ 0.20 ≤ 0.35 ≤ 10
Encoder system power supply Voltage Current	 $V_{encoder}$ $A_{encoder}$	 5 V DC (with Remote Sense) 1) 0.35
Encoder frequency that can be evaluated ($f_{encoder}$)	kHz	≤ 500
SSI baud rate 2)	kHz	100 - 1000 3)
Max. encoder cable length	m	100
PE/ground connection		At the housing with M4/1.8 Nm screw
Weight	kg	0,45
Degree of protection		IP20 or IPXXB

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

2) Only possible for SSI encoders with 5 V supply

3) See the diagram "Maximum cable length as a function of the SSI baud rate for SSI encoders"

Note

Current controller clock cycle

For a current controller clock cycle of 31.25 µs, use an SMC20 with order number 6SL3055-0AA00-5BA3.

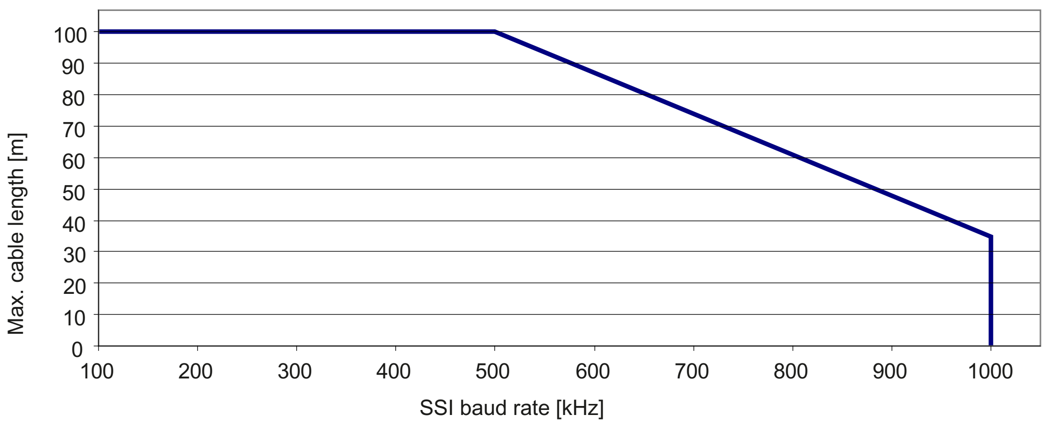


Figure 8-8 Maximum cable length as a function of the SSI baud rate for SSI encoders

8.3 Option module, brake control

8.3.1 Introduction

A brake control option module (Safe Brake Relay) is required for operating motors with holding brakes.

The brake control option module is the electrical interface between the CU/PM340 and the brake of a motor.

This is installed in the screening kit (see Chapter: "Accessories", "Screening kit") or alternatively on the rear control cabinet panel.

8.4 Safe Brake Relay

8.4.1 Introduction

A Safe Brake Relay is required for operating motors with holding brakes up to 2 A.

The Safe Brake Relay is the interface between the CU / Power Modules booksize and the 24 V DC motor brake.

The motor brake is electronically controlled.
The supply voltage for the motor brake must be separately connected to the Safe Brake Relay. A regulated power supply is required, whose rated value (to compensate for the voltage drop in the supply cable for the 24 V DC motor brake coil) can be set to 26 V (e.g. SITOP modular).

Table 8- 12 Interface overview the Safe Brake Relay

Type	Number
Connection for the solenoid of the motor brake	1
Connection for a 24 V DC power supply	1
Connection for the pre-fabricated (CTRL) to the Power Module, blocksize format	1

The Safe Brake Relay is supplied with the pre-fabricated cable to connect to the Power Module and all of the customer connectors.

The Safe Brake Relay is installed in the screening kit (see Chapter: "Accessories", "screening kit") or alternatively on the rear control cabinet panel.

8.4.2 Safety instructions for Safe Brake Relays

Note

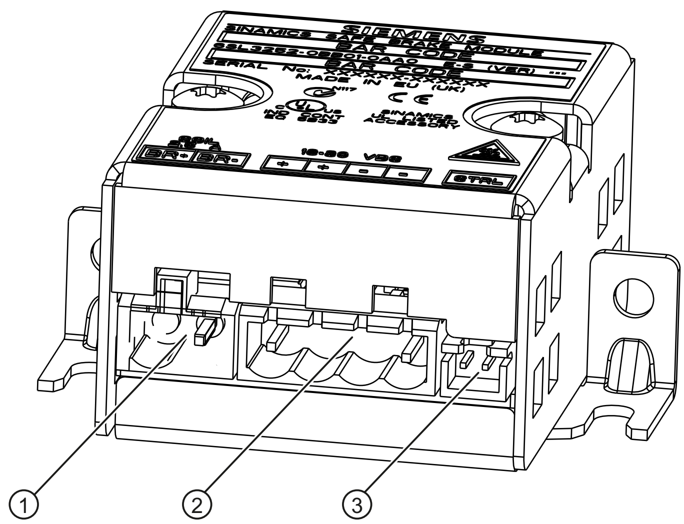
A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars. The voltage tolerances of the motor holding brakes and the voltage drops of the connection cables must be taken into account.

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

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

8.4.3 Interface description

8.4.3.1 Overview

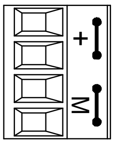


① Connection for the solenoid of the motor brake
② Connection for the 24 V DC power supply
③ Connection for the pre-fabricated (CTRL) to the Power Module, blocksize format

Figure 8-9 Interface description: Safe Brake Relay

8.4.3.2 X524 electronics power supply

Table 8- 13 X524 electronics power supply

	Terminal	Function	Technical data
	+	Electronics power supply	Voltage: 24 V (20.4 V – 28.8 V) Current consumption: max. 0.3 A (without motor holding brake) Maximum current via jumper in connector: 20 A
	+	Electronics power supply	
	M	Electronic ground	
	M	Electronic ground	
Max. connectable cross-section: 2.5 mm² Type: Screw terminal 2 (see Appendix)			

Note

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

8.4.3.3 Brake connection

Table 8- 14 Connector

Designation	Technical specifications
Brake connection	Relay output (close)
PE connection	M4 / 3 Nm

8.4.4 Connection example

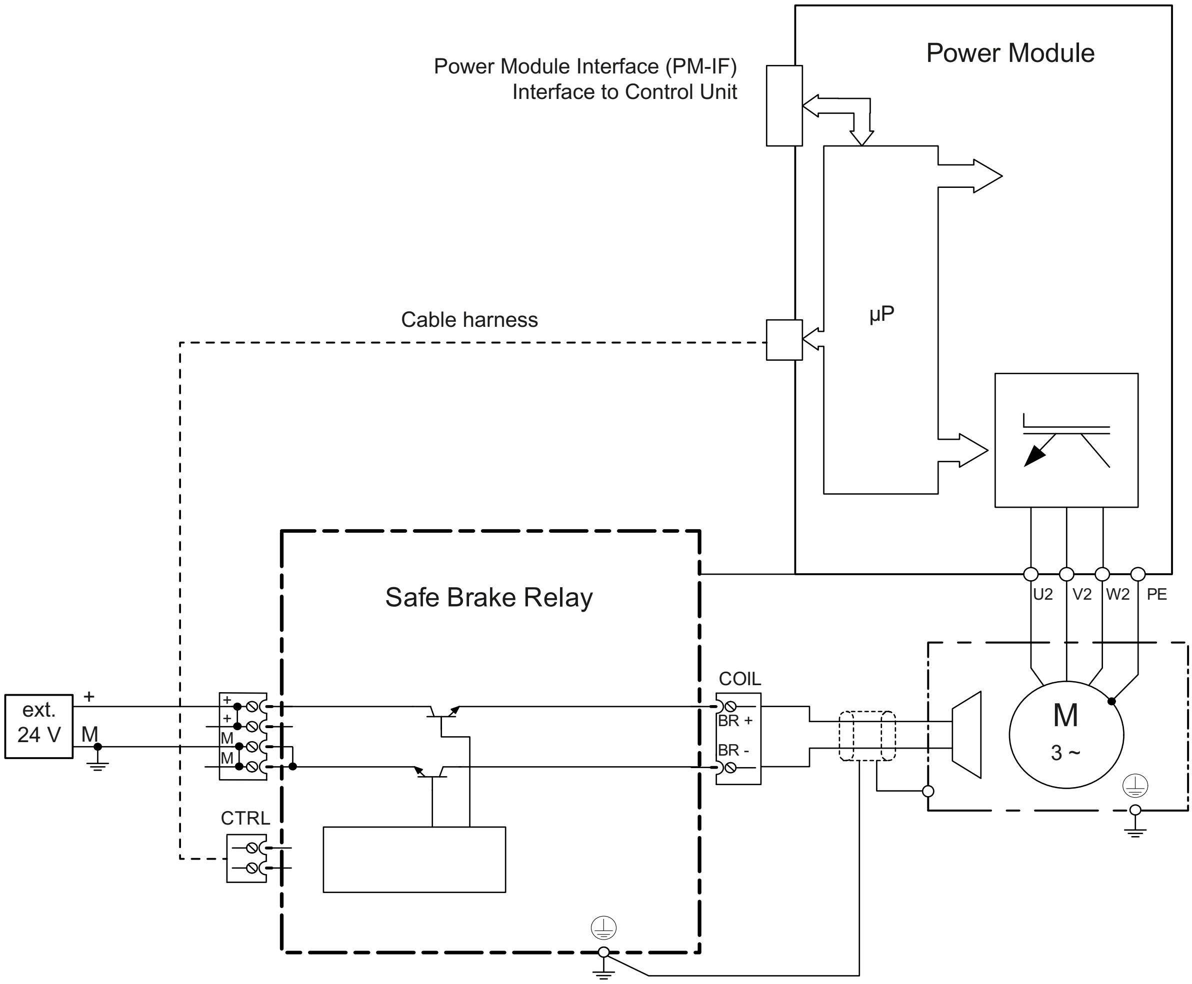


Figure 8-10 Safe Brake Relay connection example

8.4.5 Dimension drawing

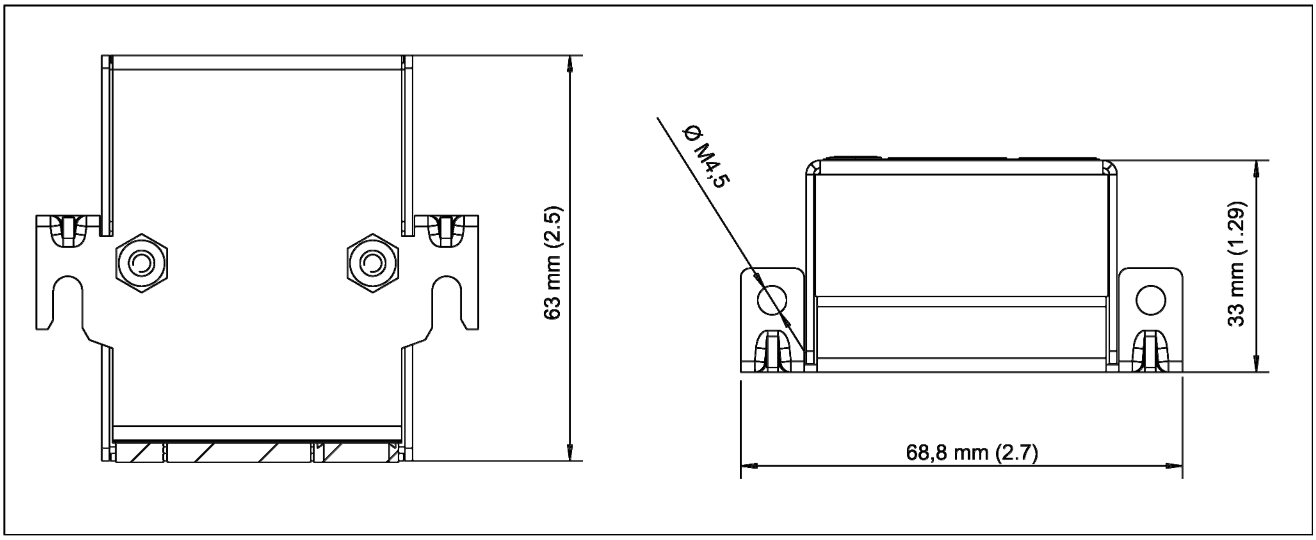
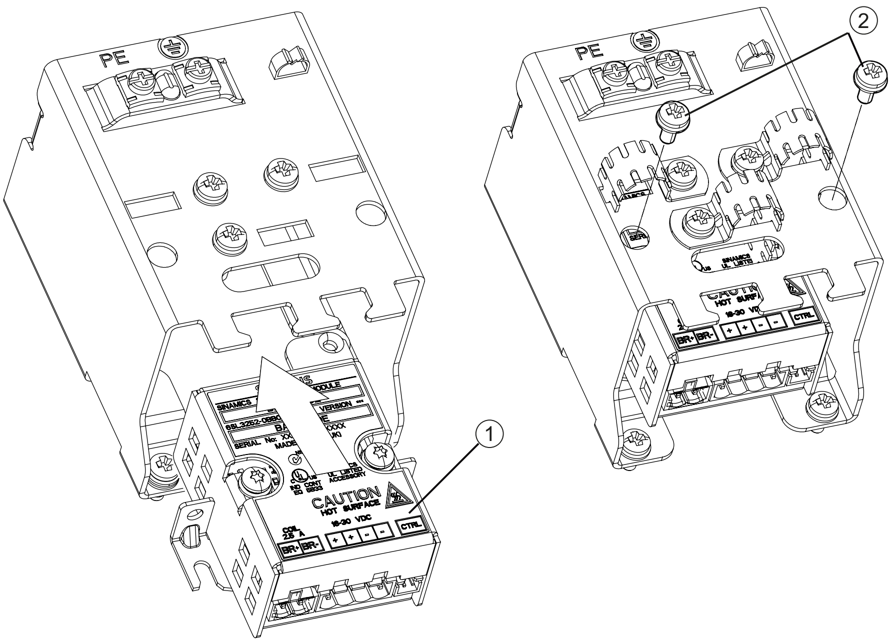


Figure 8-11 Dimension drawing of Safe Brake Relay, all data in mm and (inches)

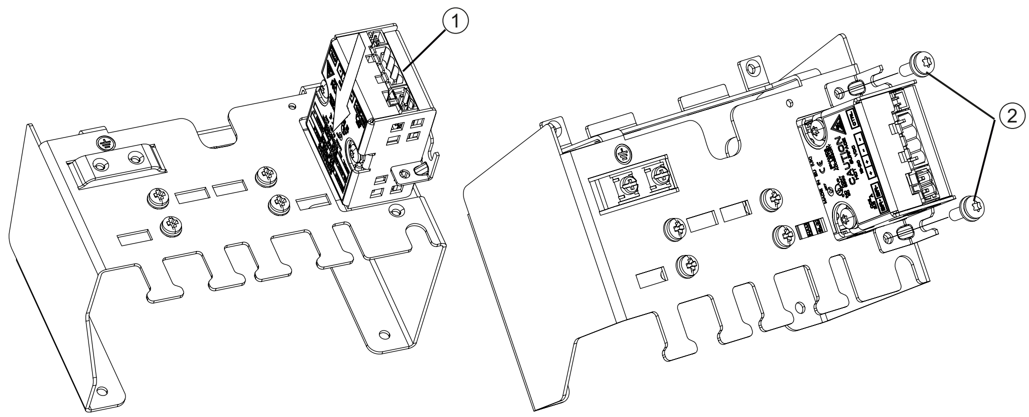
8.4.6 Mounting

The Safe Brake Relay can be installed below the Power Module on the screening kit.



① Safe Brake Relay
② Fixing screws

Figure 8-12 Installing the Safe Brake Relay and screening kit (frame size FSA)



① Safe Brake Relay
② Fixing screws

Figure 8-13 Installing the Safe Brake Relay and screening kit (frame sizes FSB / FSC)

8.4.7 Technical data

Table 8- 15 Technical data

6SL3252-0BB01-0AA0	Unit	
Power supply	V	20.4 to 28.8 V DC Recommended nominal value of the power supply 26 V DC (to equalize and compensate for the voltage drop along the feeder cable to the 24 V DC solenoid of the motor brake)
Current requirement, max. Motor brake at 24 V DC	 A A	 2 0.05 + current requirement of the motor brake
Conductor cross section, max.	mm^2	2.5
Dimensions (W x H x D)	mm	69 x 63 x 33
Weight	kg	approx. 0,17

8.5 Safe Brake Adapter 230 V AC

8.5.1 Description

The Safe Brake Adapter (SBA) is required to implement Safe Brake Control (SBC) in conjunction with Power Modules in the chassis format.

The Safe Brake Control (SBC) is a safety function, that is used in safety-related applications, e.g. in presses or in rolling mills. In the no-current state, the brake acts on the motor of the drive using spring force. The brake is released (opened) when current flows through it (=low active).

Power must be connected to terminal X12 on the Safe Brake Adapter.

For controlling the brake, a connection must be established between terminal X14 on the Safe Brake Adapter and the motor holding brake.

For the control, a connection must be established between the Safe Brake Adapter and the Control Interface Module.
The cable harness with order number 6SL3060-4DX04-0AA0 can be used.

Fast de-energization

In some cases, DC brakes are operated with an upstream brake rectifier (230 V AC input side) for fast de-energization. Some brake rectifiers are equipped with two additional connections for switching the brake load on the DC side. This allows the brake coil to be quickly de-energized, i.e. braking starts earlier.

The Safe Brake Adapter supports such fast de-energization via the two additional connections for X15.1 and X15.2. This function does not belong to the safe brake control.

8.5.2 Safety instructions for Safe Brake Adapters

NOTICE
Damage to the Safe Brake Adapter when connecting a 24 V DC brake
If a 24 V DC brake is connected to the Safe Brake Adapter 230 V AC on the system side, then this can cause damage to the Safe Brake Adapter. This can result in the following undesirable effects: • Closing the brake is not displayed on the LEDS. • The fuse is ruptured. • The contact service life of the relay is reduced.

Note

The integrated safety functions, starting from the Safety Integrated (SI) input terminals of the SINAMICS components (Control Unit, Motor Module), satisfy the requirements according to EN 61800-5-2, EN 60204-1, DIN EN ISO 13849-1 Category 3 (formerly EN 954-1) for Performance Level (PL) d and IEC 61508 SIL2.

With the Safe Brake Adapter, the requirements specified in EN 61800-5-2, EN 60204-1, DIN EN ISO 13849-1 Category 3 (formerly EN954-1) as well as for Performance Level (PL) d and IEC 61508 SIL 2 are fulfilled.

8.5.3 Interface description

8.5.3.1 Overview

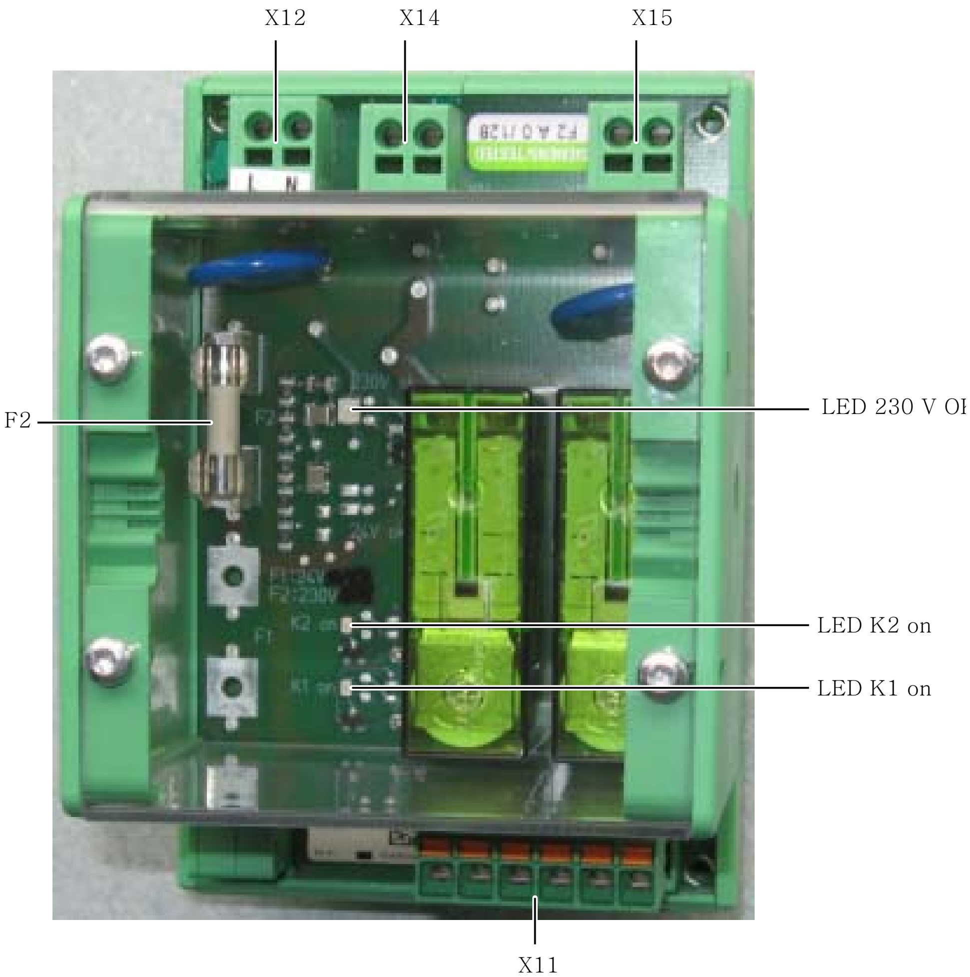


Figure 8-14 Interface overview, Safe Brake Adapter 230 V AC

F2 fuse

Type of spare fuse: 2 A, time-lag

8.5.3.2 X11 interface to the Control Interface Module

Table 8- 16 X11 interface to the Control Interface Module

Terminal	Signal	Description	Technical data
X11.1	BR+	Control channel 1	Connection to Control Interface Board, X46.1
X11.2	BR-	Control channel 2	Connection to Control Interface Board, X46.2
X11.3	FB+	Relay feedback signal	Connection to Control Interface Board, X46.3
X11.4	FB-	Ground of the relay feedback signal	Connection to Control Interface Board, X46.4
X11.5	P24	P24 of the auxiliary voltage to supply the feedback signal	Connection to Control Interface Board, X42.2
X11.6	M	Ground of the auxiliary voltage	Connection to Control Interface Board, X42.3
Max. connectable cross-section: 2.5 mm²			

⚠ WARNING

Cable to the Control Interface Module

The maximum permissible cable length between the Safe Brake Adapter 230 V AC and the Control Interface module is 10 m.

It is recommended that the cable harness (length: 4 m) with order number 6SL3060-4DX04-0AA0 is used.

The cable must be routed in accordance with ISO 13849-2, Table D.4.

8.5.3.3 X12 230 V AC power supply

Table 8- 17 X12 230 V AC power supply

Terminal	Signal	Technical data
X12.1	L	Supply voltage: 230 V AC
X12.2	N	Current consumption: 2 A
Max. connectable cross-section: 2.5 mm²		

8.5.3.4 X14 load connection

Table 8- 18 X14 load connection

Terminal	Signal	Technical data
X14.1	BR L	Supply voltage: 230 V AC
X14.2	BR N	Current consumption: 2 A
Max. connectable cross-section: 2.5 mm²		

> ⚠ WARNING
>
> **Maximum cable length of the brake control**
>
> The maximum permissible cable length between the Safe Brake Adapter 230 V AC and the brake is 300 m. Information for precise calculation of the maximum cable length can be found in the Configuration Manual: SINAMICS-Low Voltage.

8.5.3.5 X15 fast de-energization

Table 8- 19 X15 fast de-energization

Terminal	Signal	Technical data
X15.1	AUX 1	Supply voltage: 230 V AC
X15.2	AUX 2	Current consumption
Max. connectable cross-section: 2.5 mm²		

8.5.4 Connection example

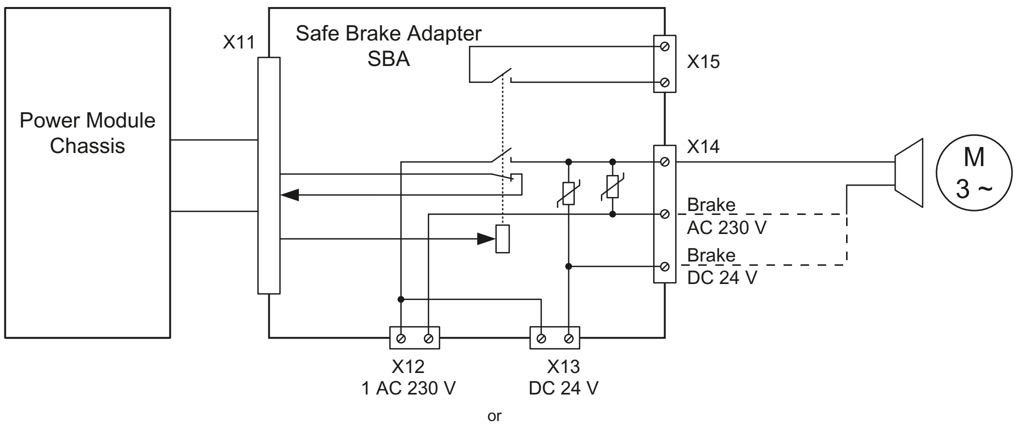


Figure 8-15 Connection example for a Safe Brake Adapter

8.5.5 Dimension drawing

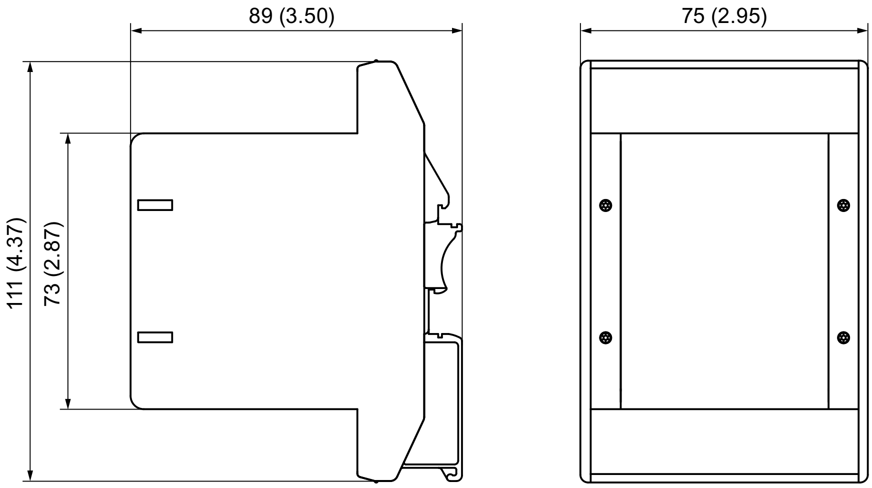


Figure 8-16 Dimension drawing of Safe Brake Adapter, all data in mm and (inches)

8.5.6 Mounting

Safe Brake Adapter

The Safe Brake Adapter is designed for mounting on a rail in accordance with EN 60715

Housing cover after replacing the fuse

An adhesive label is provided on the housing cover indicating the position of the connector. You should attach the housing cover so that the labeling on the label matches the connectors.

8.5.7 Technical data

Table 8- 20 Technical data

6SL3355-2DX00-1AA0	Unit	Value
Electronics power supply (power supply via the Control Interface Module)	V_{DC}	24 V DC (20.4 – 28.8)
Power supply Motor holding brake	V_{AC}	230 V AC
Current consumption, max. Motor holding brake Fast de-energization	 A A	 2 2
Weight	kg	0.25

Accessories 9

9.1 DRIVE-CLiQ cabinet bushing

9.1.1 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.

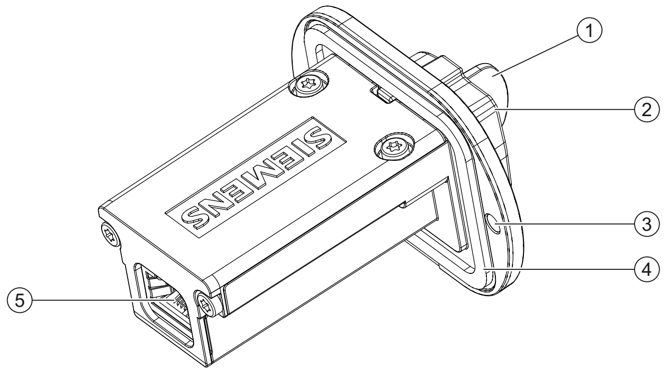
Note

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

9.1.2 Interface description

9.1.2.1 Overview

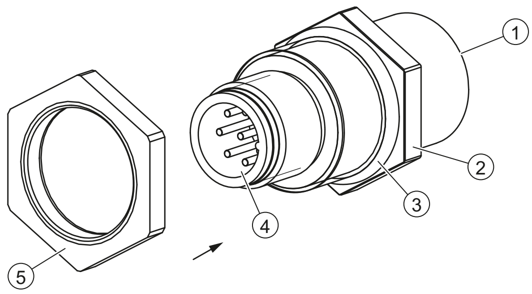
DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ cables with RJ45 plug



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 9-1 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 9-2 Interface overview, DRIVE-CLiQ cabinet bushing M12

9.1.3 Dimension drawings

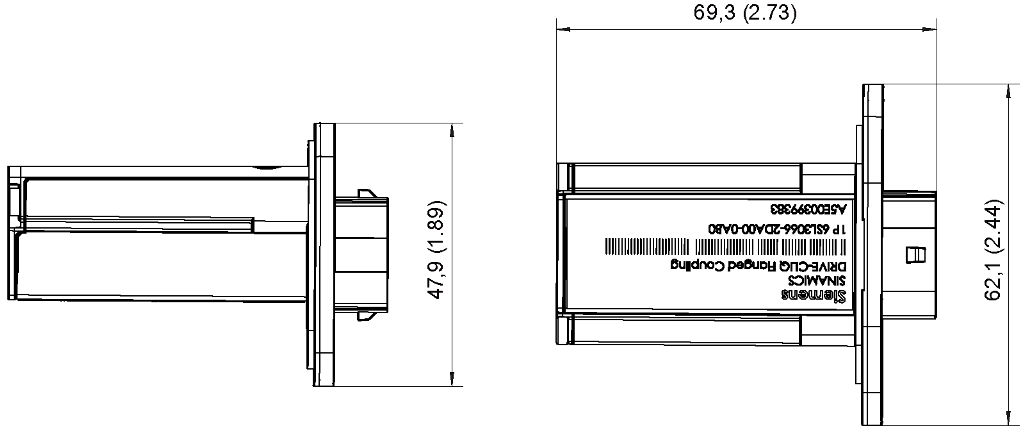
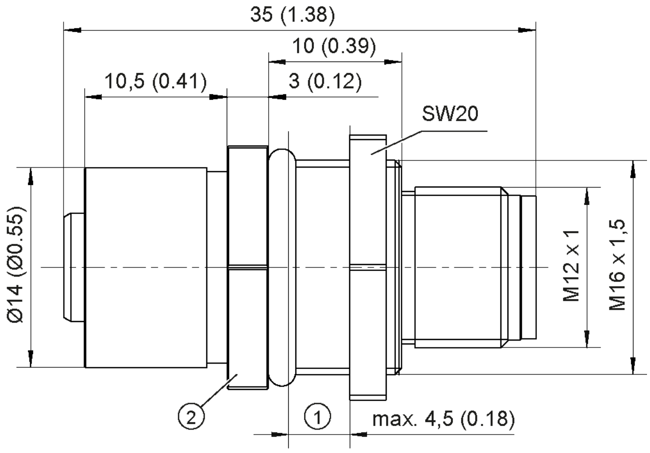


Figure 9-3 Dimension drawing of the DRIVE-CLiQ cabinet bushing RJ45, all dimensions in mm and (inches)



① Cabinet panel

② Flange, SW18

Figure 9-4 Dimension drawing of the DRIVE-CLiQ cabinet bushing M12, all dimensions in mm and (inches)

9.1.4 Mounting

9.1.4.1 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.

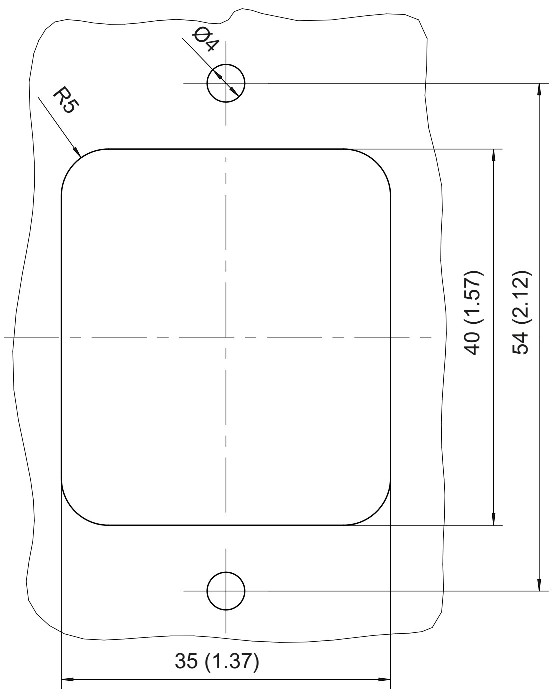
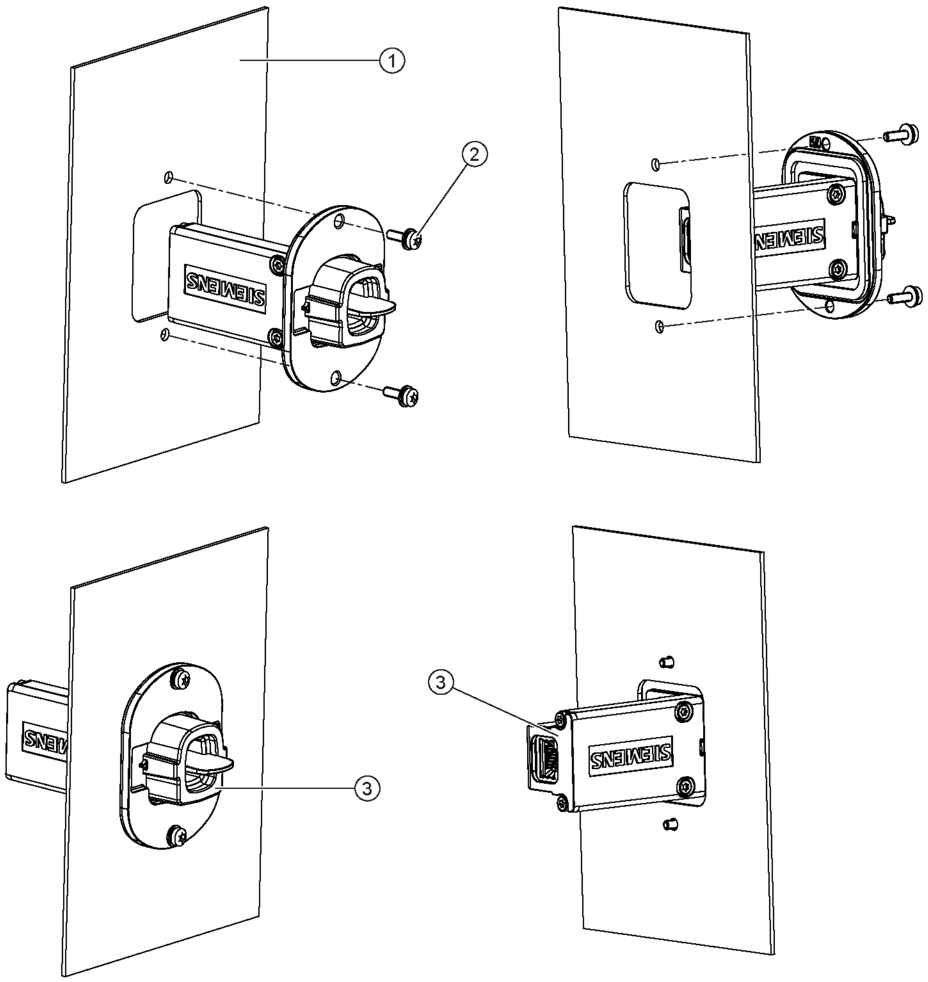


Figure 9-5 Cut-out for the cabinet

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.



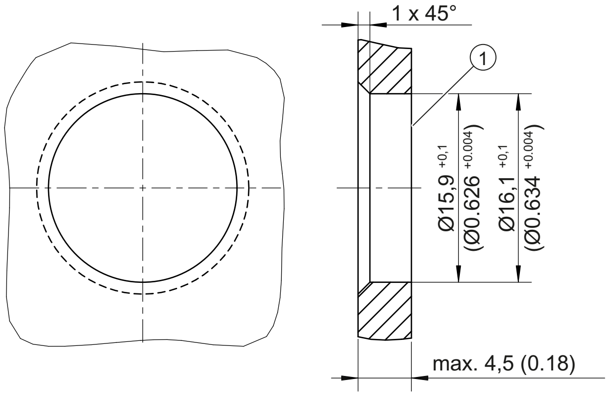
① Control cabinet panel
② M3 screw, tightening torque 0.8 Nm
③ DRIVE-CLiQ cabinet bushing RJ45

Figure 9-6 Mounting DRIVE-CLiQ cabinet bushings for cables with RJ45 connectors

9.1.4.2 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.

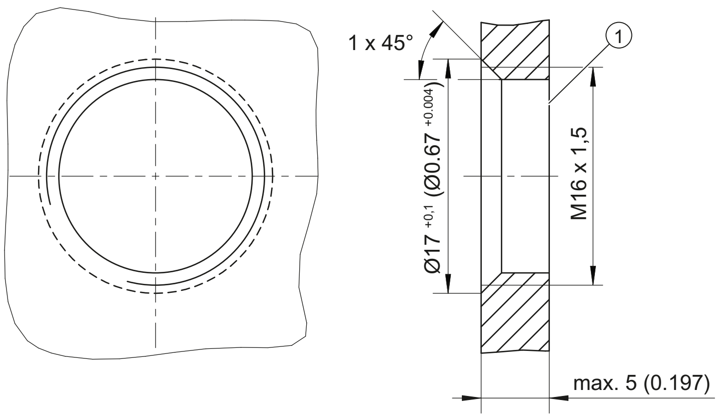
Mounting from the inside using an O ring that can be screwed



① Through-hole with chamfer

Figure 9-7 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

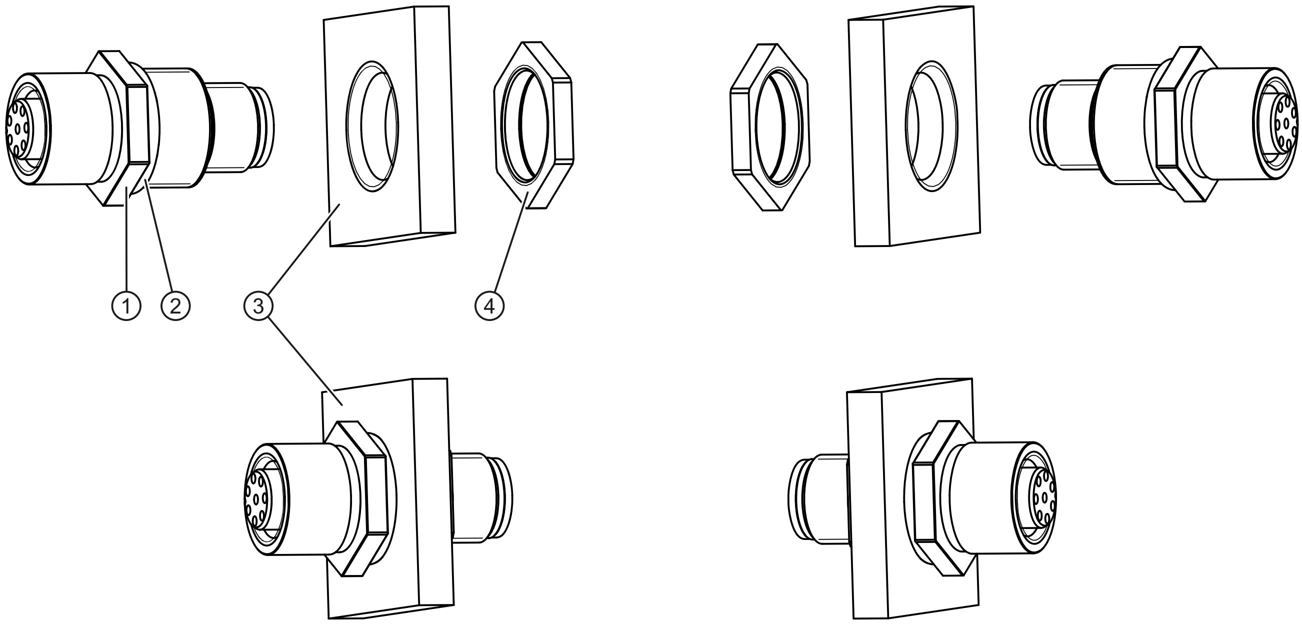


① Threaded hole with chamfer

Figure 9-8 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 9-9 Mounting DRIVE-CLiQ cabinet bushings for cables with M12 connectors

9.1.5 Technical data

Table 9- 1 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

9.2 DRIVE-CLiQ coupling

9.2.1 Description

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

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

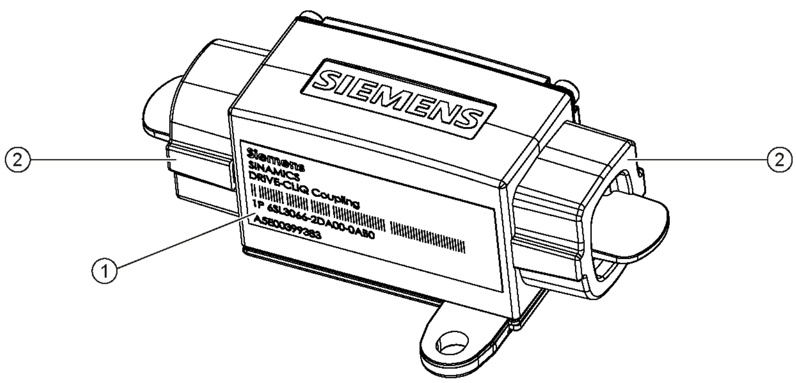
You can find information on the permissible cable length in the chapter "DRIVE-CLiQ signal cables".

Note

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

9.2.2 Interface description

9.2.2.1 Overview



① Rating plate
② Protective cap, Yamaichi, order number: Y-ConAS-24-S

Figure 9-10 Interface overview, DRIVE-CLiQ coupling

9.2.3 Dimension drawing

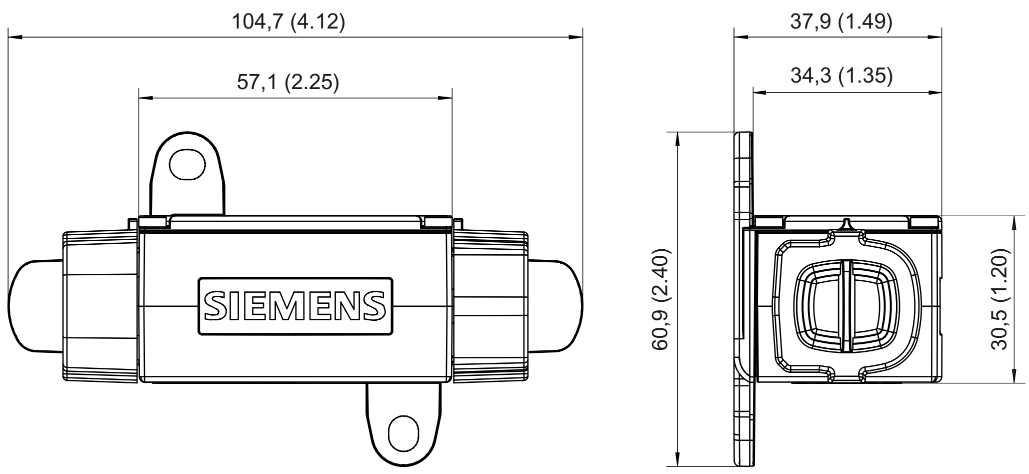
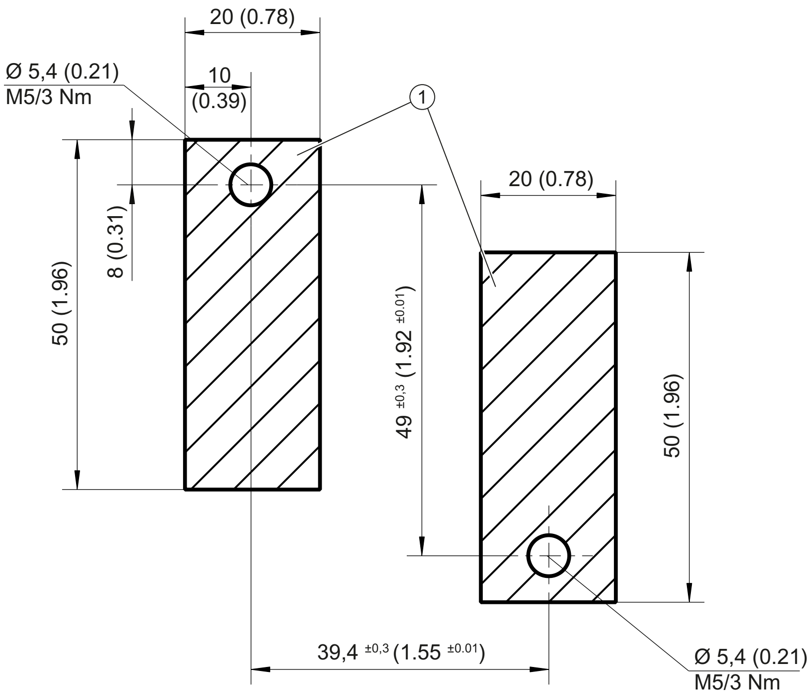


Figure 9-11 Dimension drawing of the DRIVE-CLiQ coupling, all dimensions in mm and (inches)

9.2.4 Mounting



① Contact surface

Figure 9-12 Hole drilling pattern for installation

Mounting

1. Attach the DRIVE-CLiQ coupling to the mounting surface as shown in the drilling pattern.
2. Remove the protective caps of the DRIVE-CLiQ coupling.
3. Latch the DRIVE-CLiQ connectors at both sides of the DRIVE-CLiQ coupling.

9.2.5 Technical data

Table 9- 2 Technical data

DRIVE-CLiQ coupling 6SL3066-2DA00-0AB0	Unit	
Weight	kg	0,272
Degree of protection	IP67 acc. to EN 60529	

9.3 Screening kit

9.3.1 Description

A screening kit is offered as an optional shield support for Power Modules in frame sizes FSA to FSF. It is used to connect the shields of two power cables. The screening kit is screwed directly onto the panel of the control cabinet for frame sizes FSA to FSC. For frame sizes FSD to FSF, it is attached to the Power Module.

For frame sizes FSB and FSC, the screening kit accessories pack contains a ferrite core for damping high-frequency cable disturbances.

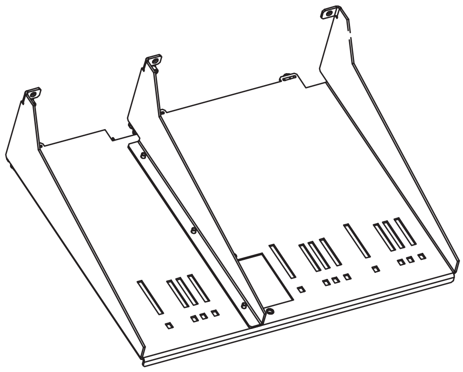


Figure 9-13 Screening kit for attachment to a Power Module, frame size FSD/FSE

Table 9- 3 Overview, screening kits for Power Modules frame sizes FSA to FSF

PM340 frame size	FSA	FSB	FSC	FSD	FSE	FSF
6SL3262-	1AA00-0BA0	1AB00-0DA0 (with ferrite core)	1AC00-0DA0 (with ferrite core)	1AD00-0DA0	1AD00-0DA0	1AF00-0DA0

9.3.2 Dimension drawings

9.3.2.1 Screening kits

Dimension drawings, screening kit, frame sizes FSA to FSC

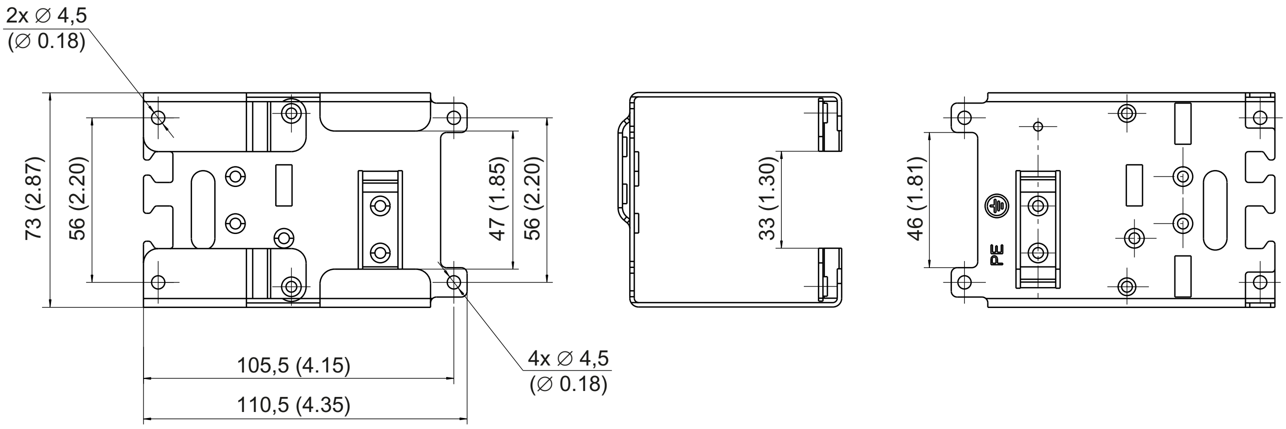


Figure 9-14 Dimension drawing, screening kit, frame size FSA, all data in mm (inches)

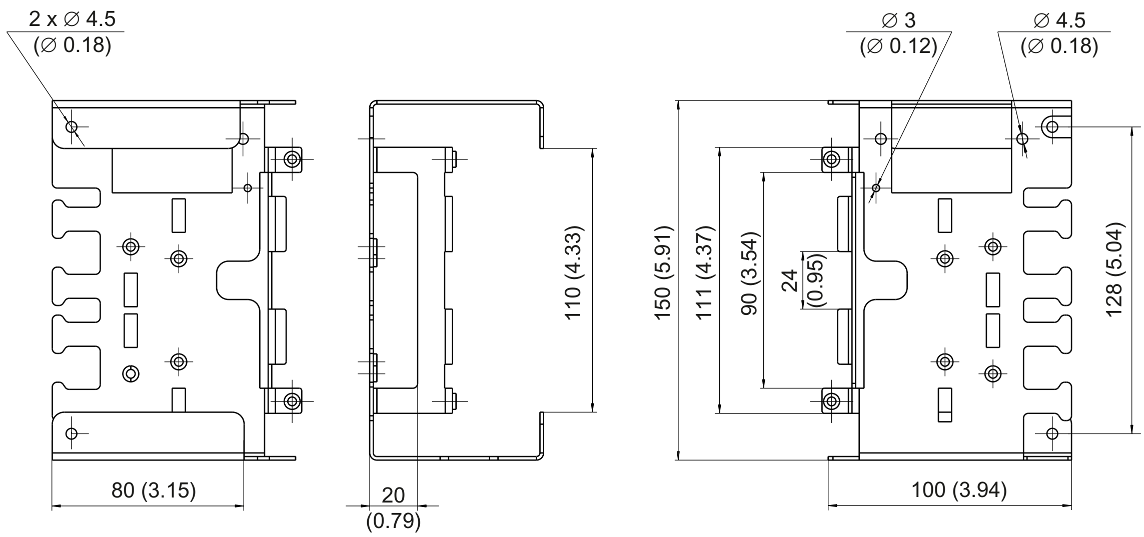


Figure 9-15 Dimension drawing, screening kit, frame size FSB, all data in mm (inches)

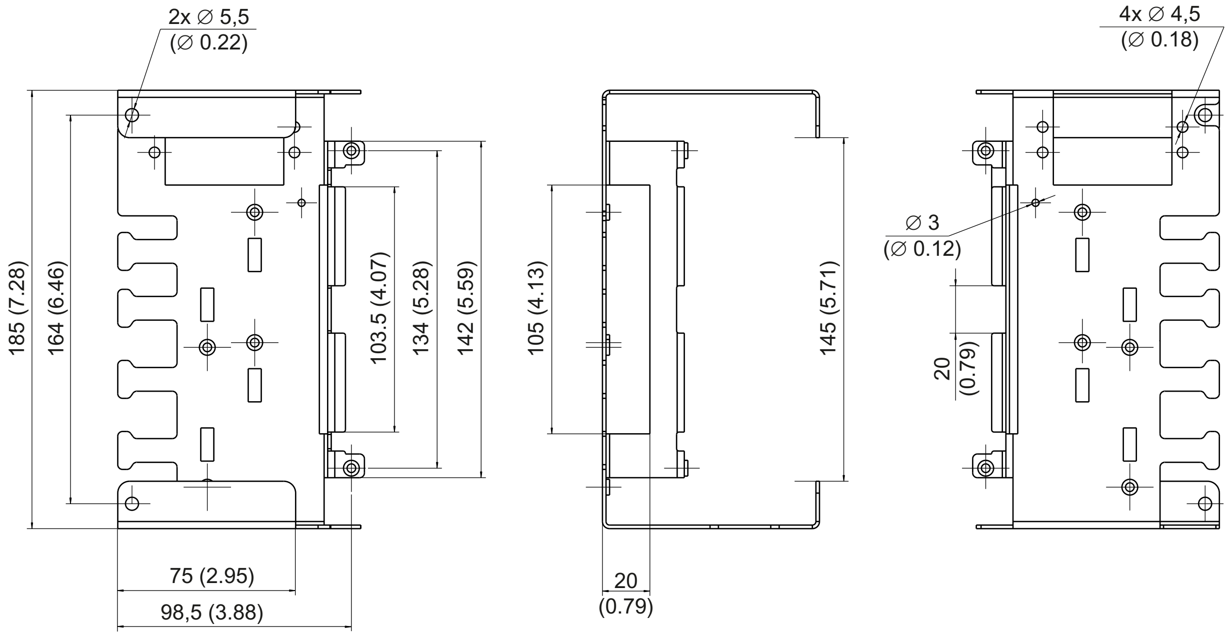


Figure 9-16 Dimension drawing, screening kit, frame size FSC, all data in mm (inches)

9.3.2.2 Power Modules blocksize with screening kit

Dimension drawings, Power Modules with screening kit, frame sizes FSA to FSF

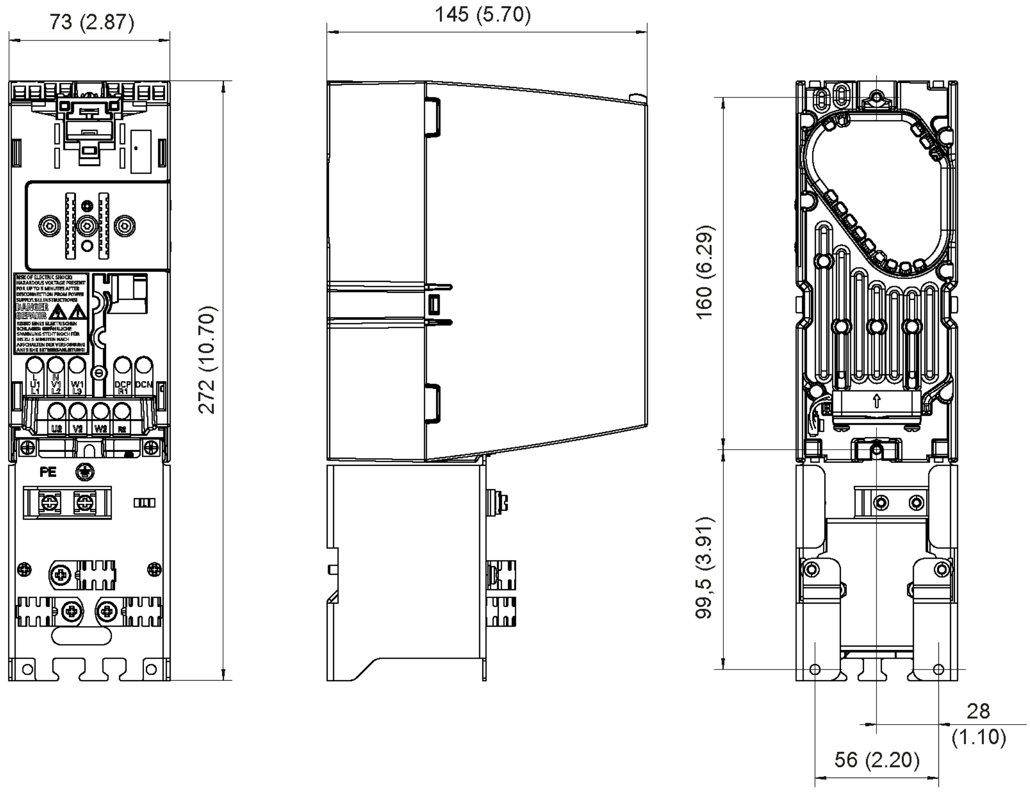


Figure 9-17 Dimension drawing, PM340 Power Module with screening kit, frame size FSA, dimensions in mm (inches)

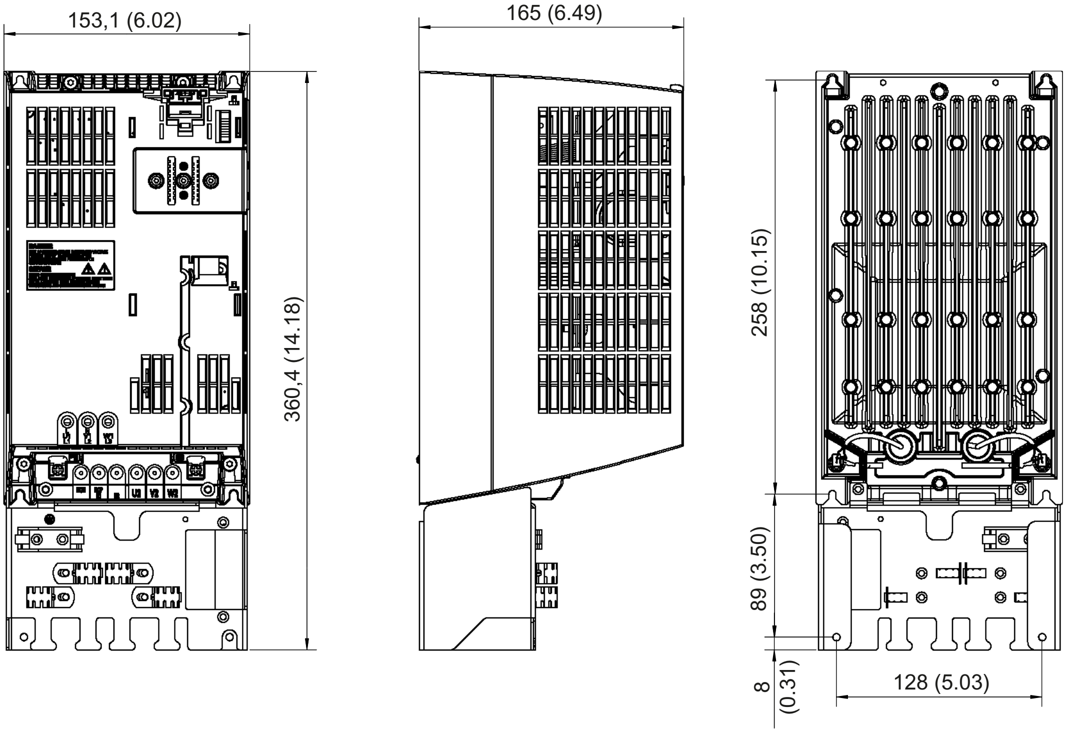


Figure 9-18 Dimension drawing, PM340 Power Module with screening kit, frame size FSB, dimensions in mm (inches)

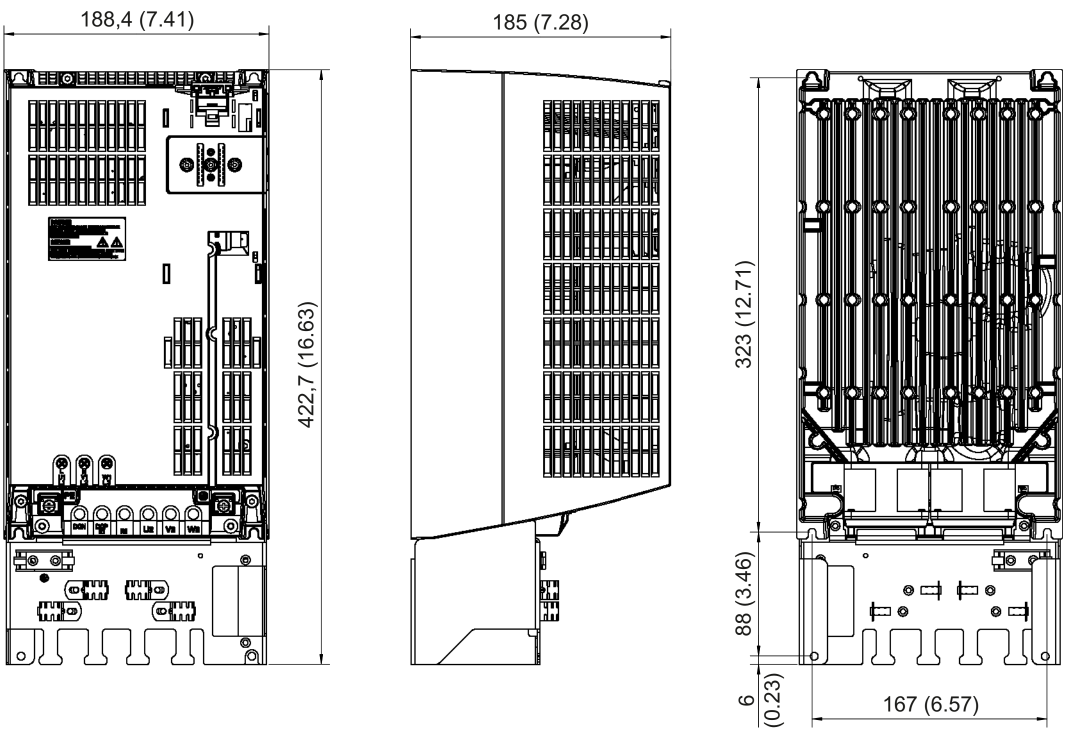


Figure 9-19 Dimension drawing, PM340 Power Module with screening kit, frame size FSC, dimensions in mm (inches)

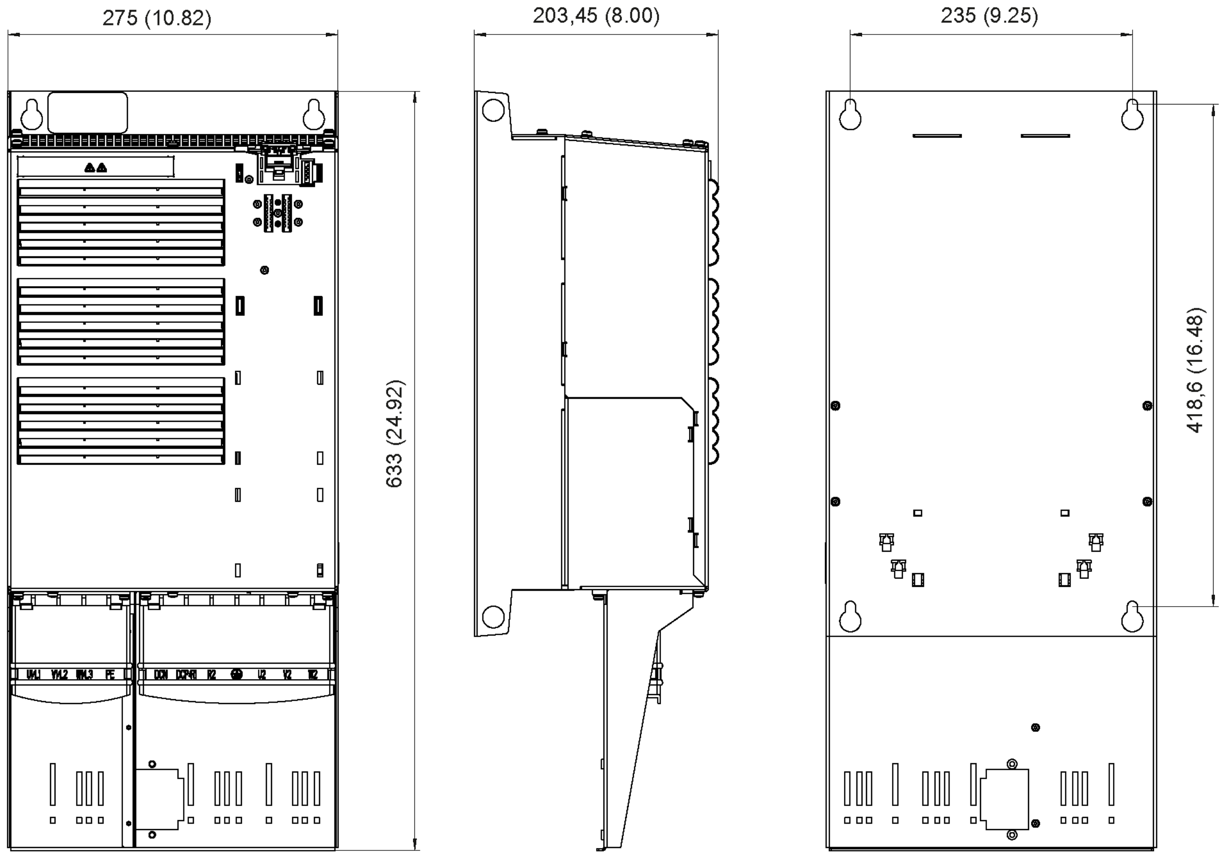


Figure 9-20 Dimension drawing, PM340 Power Module with screening kit, frame size FSD with integrated line filter, dimensions in mm (inches)

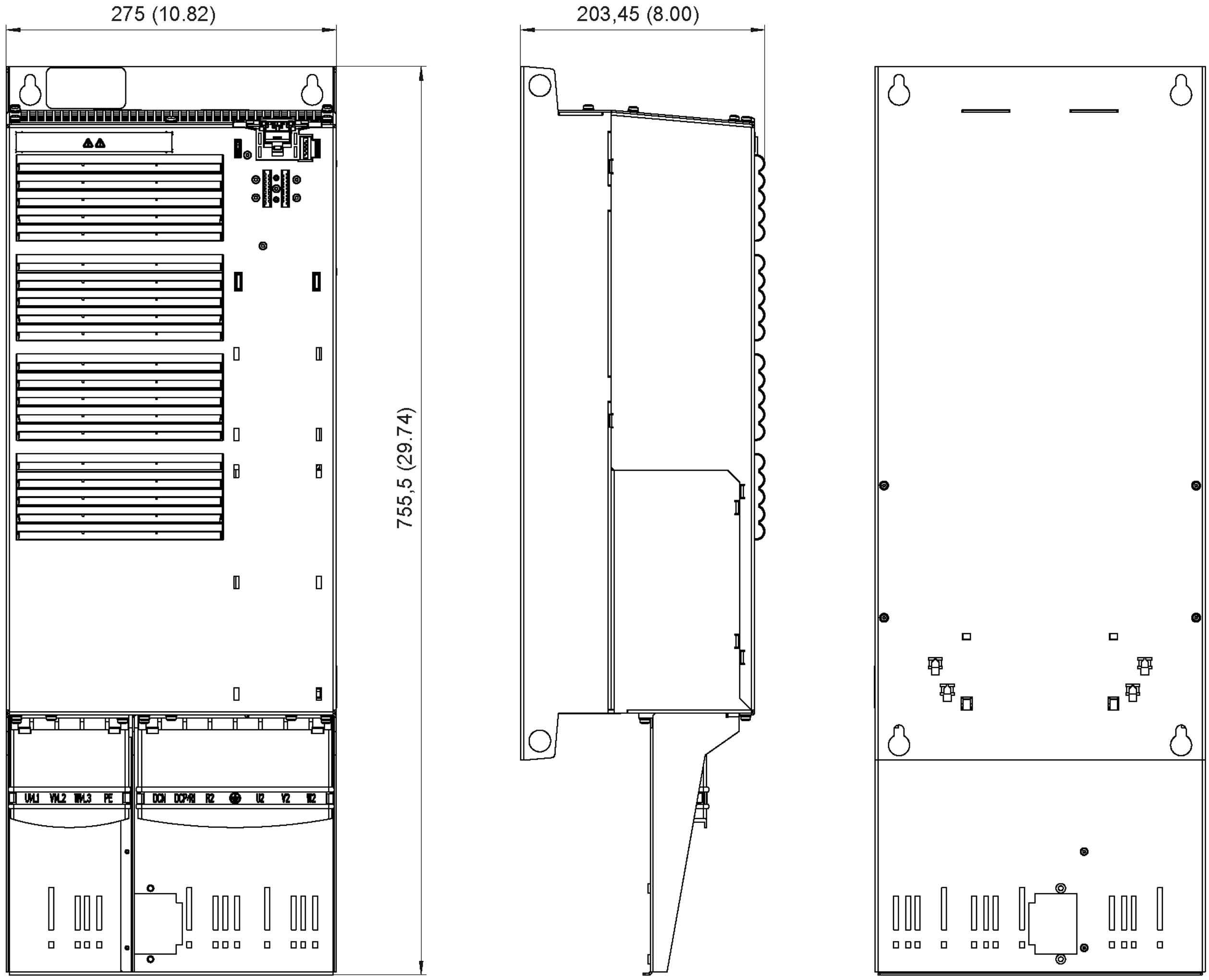


Figure 9-21 Dimension drawing, PM340 Power Module with screening kit, frame size FSE with integrated line filter, dimensions in mm (inches)

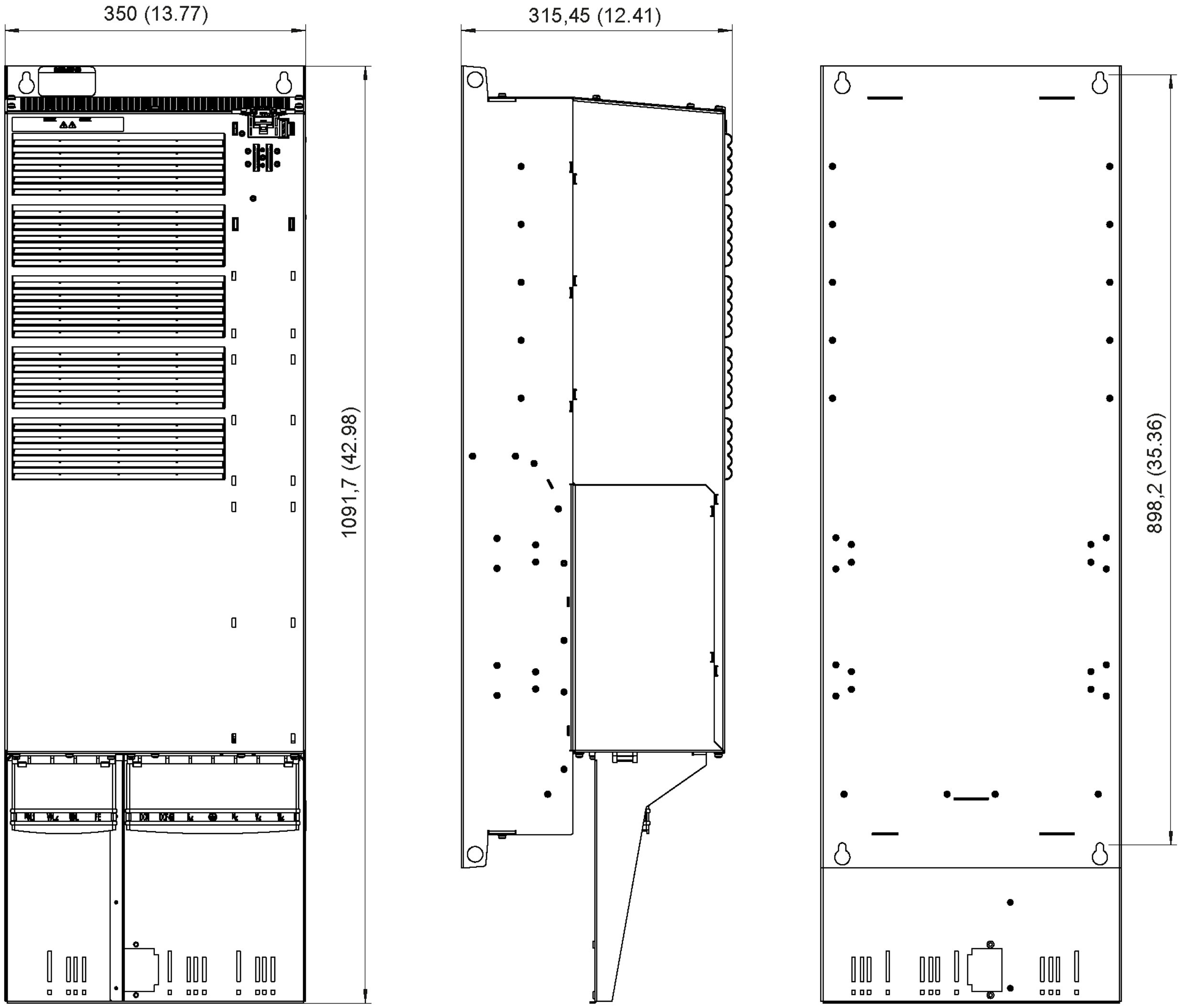


Figure 9-22 Dimension drawing, PM340 Power Module with screening kit, frame size FSF with integrated line filter, all dimensions in mm (inches)

9.3.3 Mounting

9.3.3.1 Power Modules Blocksize

The diagrams show the mounting of screening kits on Power Modules with various frame sizes.

Frame size FSA

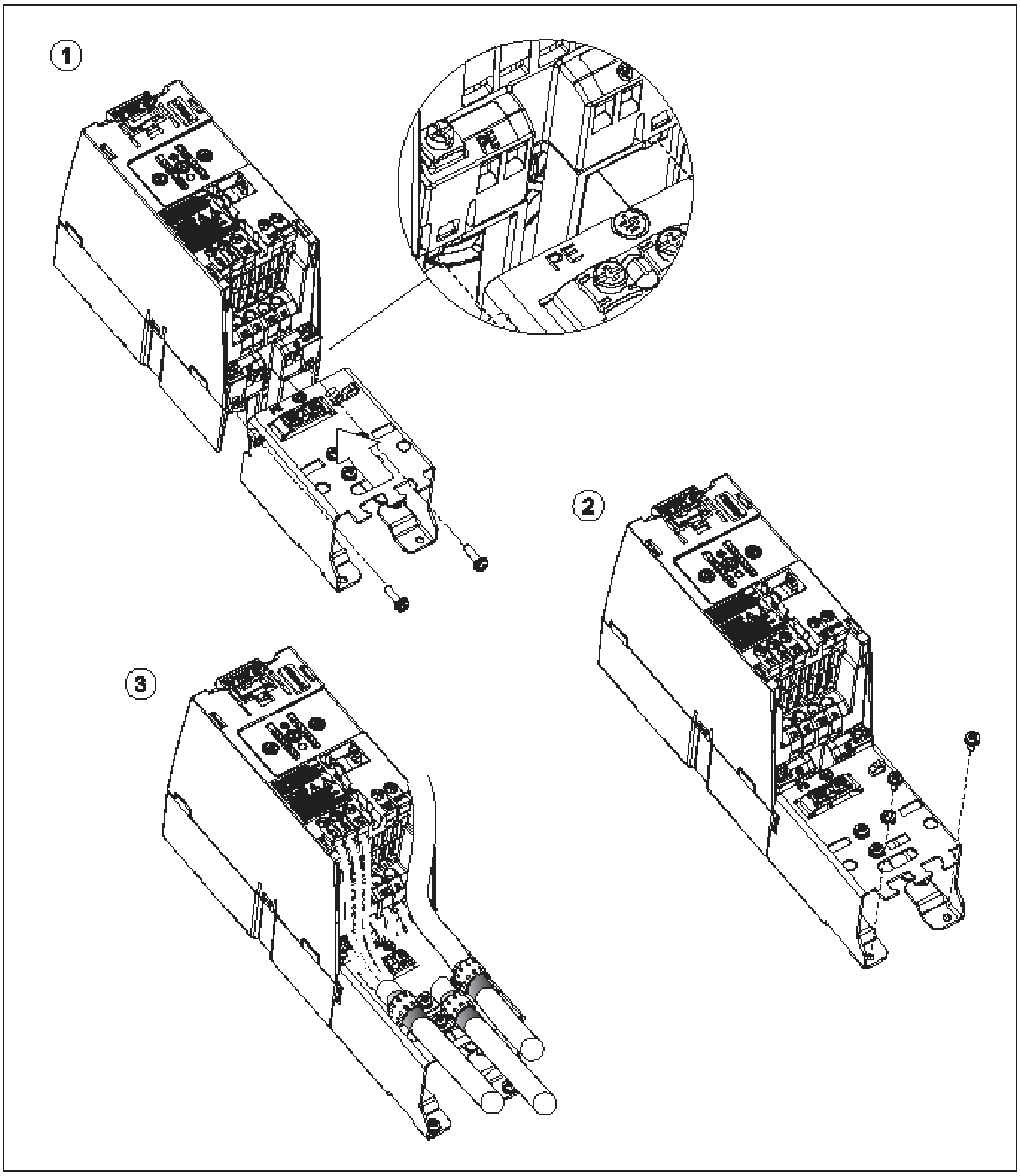
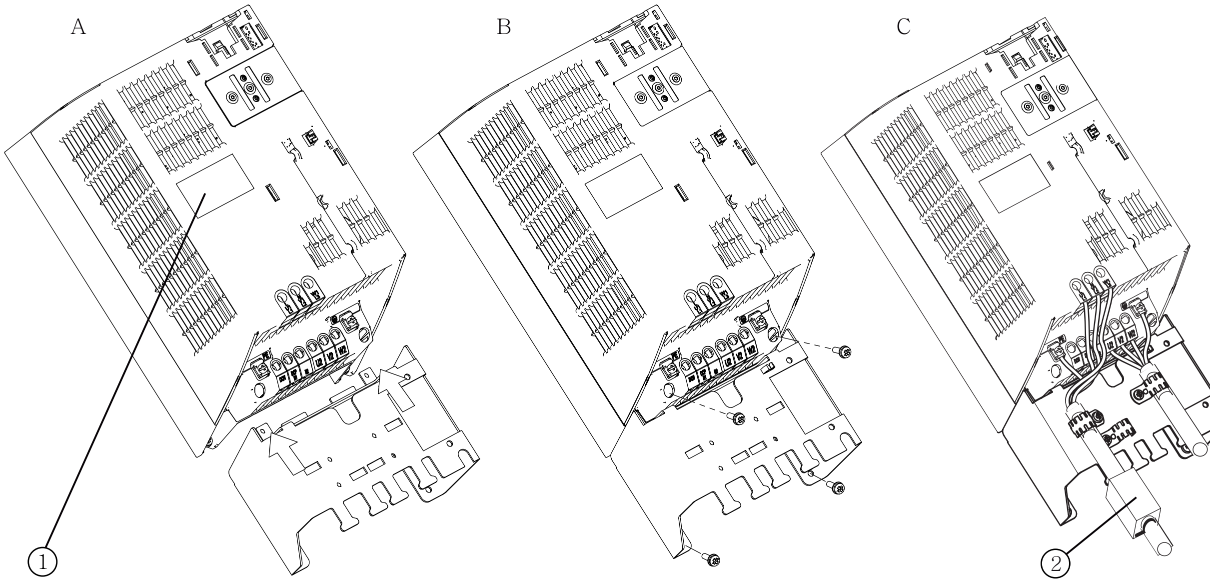


Figure 9-23 Mounting: Screening kit on a Power Module (FSA)

Frame sizes FSB/FSC

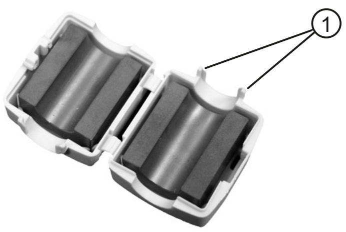


① Rating plate
② Ferrite core

Figure 9-24 Mounting: Screening kit and ferrite core on a Power Module (FSB / FSC)

Mounting the ferrite core

The ferrite core supplied should be attached to the line cable in order to dampen radio cable disturbances. The open ferrite core shown in the figure below is placed around the cable and snapped together in order to close it. The neck of the core (see the U-shaped collar in the figure below) enables the core to clamp onto the cable automatically, thus fixing it in position.



① Collar (U shape)

Figure 9-25 Ferrite core, open

If the core does not sit securely in position on the cable (due to the cable having a small diameter), a cable tie can be lashed tightly around the cable next to the closed ferrite core in order to prevent the ferrite from moving along the cable.

Frame sizes FSD/FSE

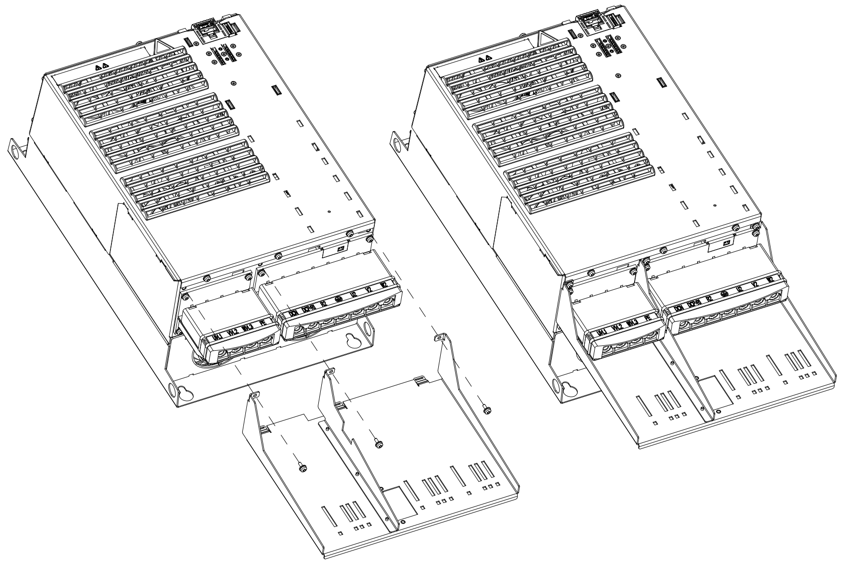


Figure 9-26 Mounting: Screening kit on a Power Module (FSD/FSE)

Frame size FSF

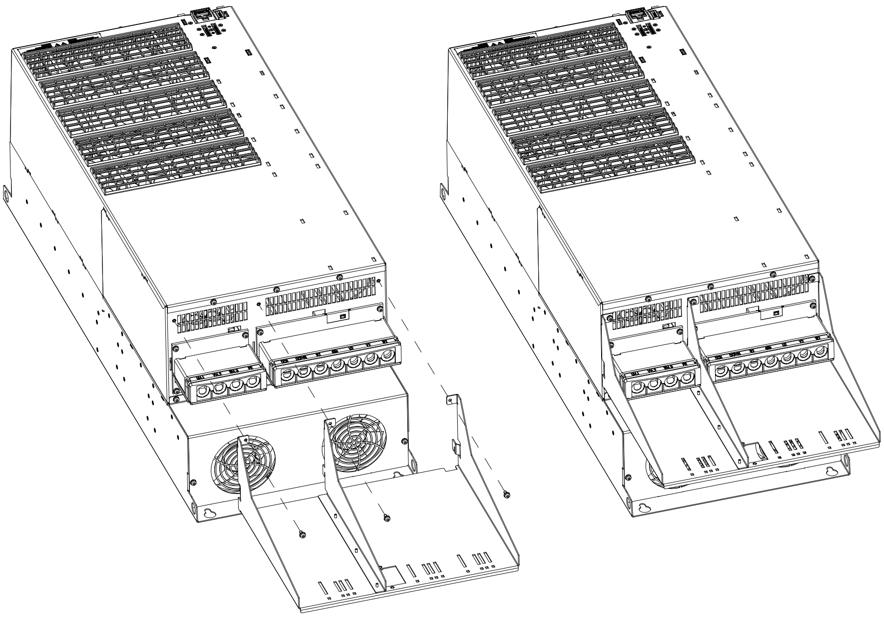


Figure 9-27 Mounting: Screening kit on a Power Module (FSF)

9.3.3.2 Blocksize Liquid Cooled Power Modules

Frame sizes FSD and FSE

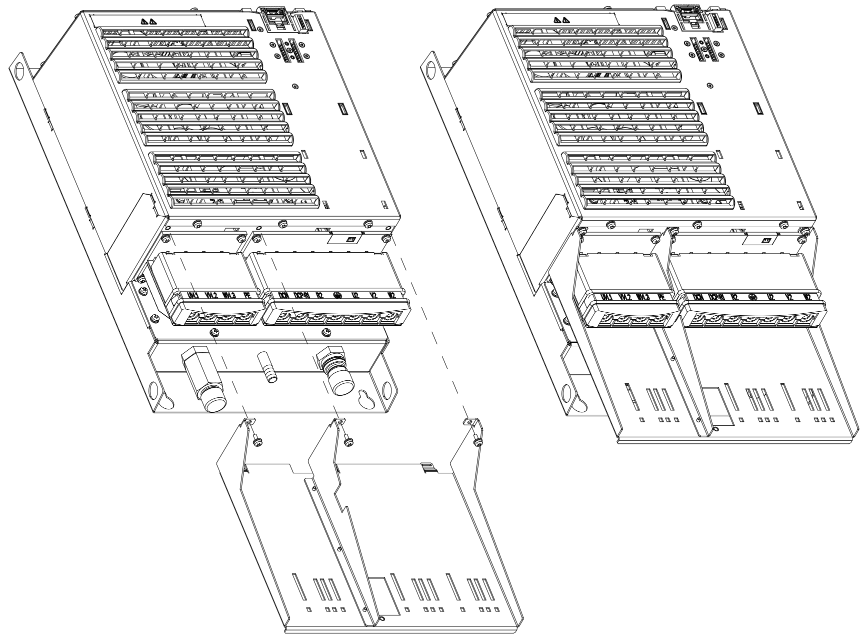


Figure 9-28 Mounting: Screening kit on a Liquid Cooled Power Module PM340, frame sizes FSD / FSE

Frame size FSF

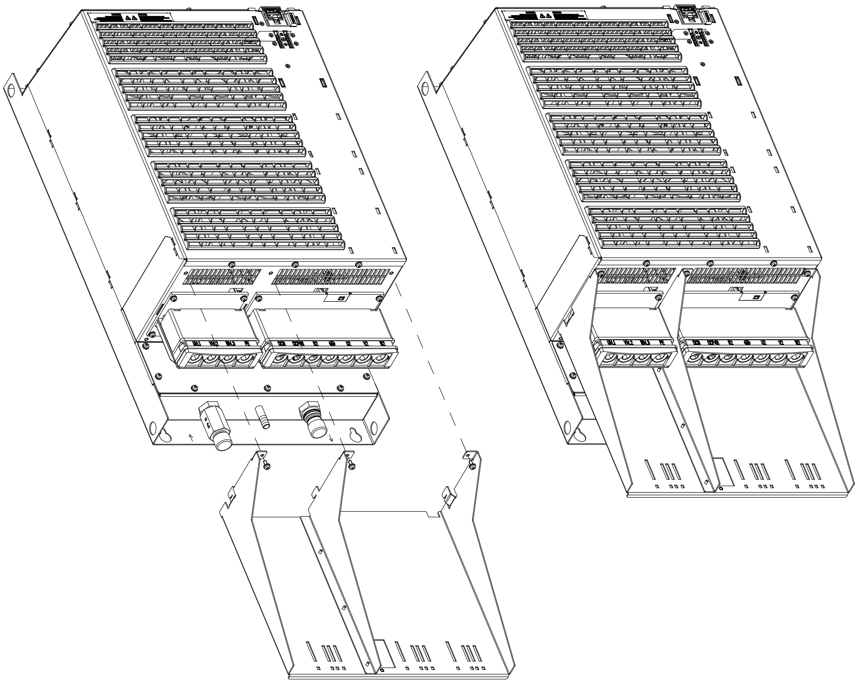
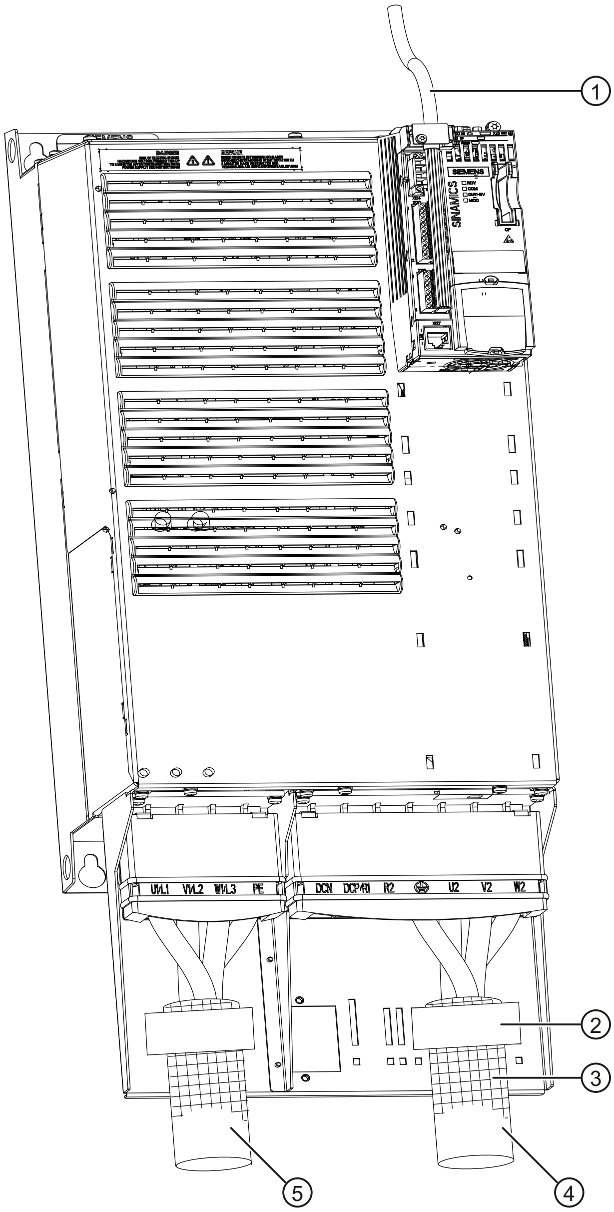


Figure 9-29 Mounting: Screening kit on a Liquid Cooled Power Module PM340, frame size FSF

9.3.3.3 Power cable connection

The diagram shows the connection of the power cables at the screening kit using the Power Module PM340, frame size FSD/FSE as an example.



① Signal cable
② Mounting clip
③ Protective braided shield
④ Motor cable
⑤ Line supply cable

Figure 9-30 Power Module PM340 (frame size: FSD/FSE) with Control Unit and screening kit

Cabinet design and EMC for components, Blocksize format 10

10.1 General information

The SINAMICS S components are designed in accordance with degree of protection IP20 or IPXXB acc. to EN 60529 and as open-type devices to UL 50. This ensures protection against electric shock.
To ensure protection against mechanical stress and climatic conditions too, the components should only be operated in housing, cabinets or enclosed electrical operating areas that fulfill at least degree of protection IP54 and, as enclosure type 12, are designed to UL 50.

Prefabricated MOTION-CONNECT cables are recommended.

Note

Functional safety of SINAMICS components

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

Installation in a cabinet with degree of protection IP54B according to EN 60529 is advisable to ensure the safety functions of Safety Integrated are not compromised.

Low-voltage switchgear and controlgear assemblies

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

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

Safety of machinery

Electrical equipment of machines

Part 1: General requirements

All information for device selection in this section applies to

- Operation in a TN system
- Operating voltage range from 200 V 1-ph. AC to 440 V 3-ph. AC

10.2 Safety instructions for control panel manufacturing

⚠ WARNING

Danger to life caused by high discharge currents when the external protective conductor is interrupted

Drive components conduct high discharge currents via the protective conductor. When the protective conductor is interrupted, touching live components can result in electric shock, which can lead to death or serious injuries.

- Ensure that the external protective conductor complies with at least one of the following conditions:
  – It is routed so that it is protected against mechanical damage. [1)]
  – For an individual core, it has a cross-section of at least 10 mm² Cu.
  – As core of a multi-core cable, it has a cross-section of at least 2.5 mm² Cu.
  – It has a parallel, second protective conductor with the same cross-section.
  – It corresponds to the local regulations for equipment with increased leakage current.

  [1)] Cables routed in control cabinets or enclosed machine enclosures are considered to be adequately protected against mechanical damage.

⚠ WARNING

Danger to life as a result of electric shock for incorrectly routed brake cables

When routing brake cables without safe electrical separation, the insulation can fail resulting in electric shock.

- Connect the holding brake using the MOTION-CONNECT cable intended for the purpose.
- Only use third-party cables that have brake cores with safe electrical separation or separately route the brake cores with safe electrical separation.

⚠ WARNING

Danger to life due to electric shock caused by incorrect shielding

Incorrectly connected cable shields and cable cores that are not connected can result in hazardous touch voltages.

- Connect cable shields and unused power cable cores (e.g. brake cores) to PE potential to dissipate charges resulting from capacitive cross-coupling effects.

⚠ WARNING

Risk of fire due to overheating when permissible cable lengths are exceeded

Excessively long cable lengths can cause components to overheat with the associated risk of fire. It is not permissible that the cable lengths (e.g. motor cable) listed in the technical data are exceeded:

- Individual cable lengths of power cables
- Total cable length of all power cables

NOTICE
Risk of short-circuit caused by foreign bodies
When installing the equipment in cabinets, the ventilation slots must be covered to prevent drill swarf, wire end ferrules, and the like from falling into the housing.
Safety regulations governing shock protection must be observed. See also EN 60204–1.

10.3 Notes on electromagnetic compatibility (EMC)

Requirements to implement EMC are listed in EN 61000-6-2, EN 61000-6-4, EN 61800-3, EN 60204-1 and in the Configuration Manual, EMC installation guideline (order number 6FC5297-0AD30-0□P□). Conformance with the EMC Directive of the EC can be ensured by following the measures described in the Configuration Manual, EMC installation guideline. When mounting components in cabinets, in order to fulfill the EMC Directive, the following conditions must be additionally observed:

- Connected to TN line supply systems with grounded neutral point
- SINAMICS line filter (optional for frame size FSA)
- Observance of information about cable shielding and equipotential bonding
- Only the recommended Siemens power and signal cables are used
- Only cables from Siemens may be used for DRIVE-CLiQ connections.

For MOTION-CONNECT cables, refer to catalog PM21

NOTICE
If couplings or cabinet glands are needed for the DRIVE-CLiQ connections, only the DRIVE-CLiQ coupling and DRIVE-CLiQ cabinet gland, described in the Chapter Accessories, may be used.

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

10.4 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:

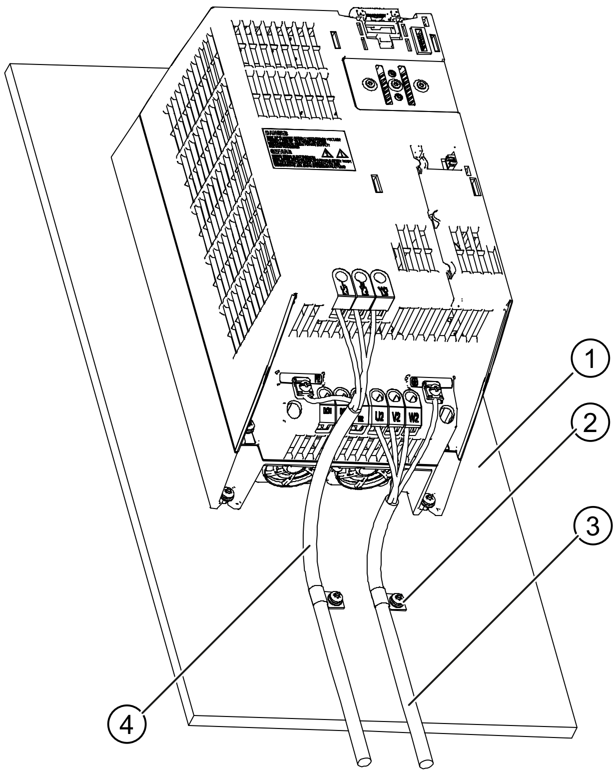
- Power supply cables from line filter via line reactor to Power Module
- All motor cables (if necessary, including cables for motor holding brake)

- 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 PE conductor connection of the individual components must have 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 the 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.



① Rear metal panel
② Clip to secure the shield of the motor and line cable to the rear metal panel
③ Motor cable (shielded)
④ Line supply input (shielded)

Figure 10-1 Shielding of a Power Module PM340

Alternatively, the cable shields can be connected to them metal mounting plate using pipe clamps and serrated rails. The cable length between the shield contact point and the terminals for cable conductors must be kept as short as possible.

Screening kits with pre-prepared clip contacts are available for connecting the shields of power cables used for Power Modules.

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

Avoid, where possible, routing non-shielded 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.

Routing 24 V cables

When routing 24 V cables, the following must also be observed:

- A maximum of 1 conductor pair may be bundled together.
- 24 V conductors must be routed separately from other cables and conductors that could conduct the operating current.
- 24 V cables must never be routed parallel to power cables.
- 24 V cables as well as power cables should be routed to the components so that they never cover ventilation slots

Conditions of use for 24 V cables

- Ambient temperature 55 °C
- Limit conductor temperature, ≤ 70 °C for operation with the rated load current
- Cable length max.:
  - 10 m for the 24 V supply cables
  - 30 m for signal lines without additional connections

10.5 24 V DC Supply Voltage

10.5.1 General

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

1. The load voltage of the Control Unit digital outputs.
   The Control Units are supplied with power via the PM-IF. 24 V must also be connected in the following cases:
   - Commissioning / diagnostics when the Power Module power supply is switched-out.
   - Using the digital outputs CU310-2
2. The electronics of the Sensor Module
3. The Safe Brake Relay (motor holding brake)

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

Note

The user should provide the electronics power supply as described in Chapter "System data" in this documentation.

When connecting to a "DC power supply" in the sense of EN 60204-1:1997, Chapter 4.3.3, functional faults can occur due to the voltage interruptions that are permitted there.

NOTICE
Damage if there is no overvoltage protection
If other consumers are connected to the power supply, connected inductance devices (contactors, relays) must be fitted with suitable overvoltage protection circuits.

Note

A regulated DC power supply is required to operate motors with a built-in holding brake. The power is supplied via the 24 V connection (Safe Brake Relay). The voltage tolerances of the motor holding brakes (24 V ±10%) and the voltage drops of the connecting cables must be taken into account.

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

- Use of Siemens three-phase motors
- Using Siemens MOTION-CONNECT power cables
- Motor cable lengths: max. 100 m

10.5.2 Overcurrent protection

The cables on the primary and secondary sides of the 24 V supply unit must be protected against overcurrent.

Primary side protection must be implemented according to the manufacturer's instructions.

Secondary side protection depends on the prevailing situation. Please note the following:

- Loading due to loads, including simultaneity factor depending on machine operation
- Current carrying capacity of the conductors used and cables in normal and short-circuit conditions
- Ambient temperature
- Cable bundling (routing cables in a common duct)
- Cable routing method according to EN 60204-1

The overcurrent protection devices can be determined according to EN 60204-1, Section 14.

Circuit breakers from Siemens Catalogs LV 1 and LV 1T are recommended as overcurrent protection devices on the primary side.
Miniature circuit breakers or SITOP select 6EP1961-2BA00 are recommended as overcurrent protection devices on the secondary side. The miniature circuit breakers can also be selected from Siemens LV 1 and LV 1T Catalogs.

Miniature circuit breakers are recommended as overcurrent protection devices for the cables and busbars. The ground potential M must be connected to the protective conductor system (DVC A).

When selecting the miniature circuit breaker, the following standards must be carefully observed:

- EN 61800-5-1
- EN 60204-1
- IEC 60364-5-52
- IEC 60287-1 to -3
- EN 60228
- UL 508C

Table 10- 1 MCBs by conductor cross-section and temperature

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

The tripping characteristic of the circuit-breaker is selected so that loads remain protected against the maximum current that occurs in the event of a short circuit of the power supply unit.

10.5.3 Overvoltage protection

Overvoltage protection devices are needed if long cables are used.

- Supply cables > 10 m
- Signal cables > 30 m

The following Weidmüller overvoltage protectors are recommended for protecting the components' 24 V power supply and the 24 V signal cables from overvoltage:

Table 10- 2 Recommendations for overvoltage protection

DC power supply	24 V signal cables
Weidmüller Item no.: PU III R 24V Order number: 8860360000	Weidmüller Item no.: MCZ OVP TAZ Order number: 844915 0000

The overvoltage protectors must always be placed next to the area to be protected, e.g. at the entry point to the control cabinet.

10.5.4 Typical 24 V current consumption of the components

A separate 24 V power supply must be used for the SINAMICS S120 drive line-up.

The following table can be used to calculate the 24 V DC power supply. The values for typical current consumption are used as a basis for configuration.

Table 10- 3 Overview of 24 V DC current consumption

Component	Typical current consumption [A_{DC}]
Control Units and Control Unit Adapters	
CU310-2 DP without load For each digital output	0.8 0.1
CU310-2 PN without load For each digital output	0.8 0.1
CUA31 without DRIVE-CLiQ	0.15
CUA32 without DRIVE-CLiQ or encoder Encoder (max.)	0.15 0.4
DRIVE-CLiQ and brake	
DRIVE-CLiQ (e.g. motors with DRIVE-CLiQ interface)	0.19
Brake (e.g. motor holding brake)	Typ. 0.4 to 1.1; max. 2
Sensor Module Cabinet	
SMC10 without/with encoder system	0.20 / 0.35
SMC20 without/with encoder system	0.20 / 0.35
Sensor Module External	
SME20 without/with encoder system	0.15 / 0.25

Component	Typical current consumption [A_{DC}]
SME25 without/with encoder system	0.15 / 0.25
SME120 without/with encoder system	0.20 / 0.30
SME125 without/with encoder system	0.20 / 0.30

10.5.5 Selecting power supply units

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

Table 10- 4 Recommended SITOP Power

<table>
<tr><th>Rated output current [A]</th><th>Phases</th><th>Rated input voltage [V]
Working voltage range [V]</th><th>Short-circuit current [A]</th><th>Order number</th></tr>
<tr><td>5</td><td>1 / 2</td><td>120 - 230/230 - 500
85 - 264/176 - 550 AC</td><td>Approx. 5.5 (power up), typ. 15 for 25 ms (operation)</td><td>6EP1333-3BA00-8AC0</td></tr>
<tr><td>10</td><td>1 / 2</td><td>120 - 230/230 - 500
85 - 264/176 - 550 AC</td><td>Approx. 12 (power up), typ. 30 for 25 ms (operation)</td><td>6EP1334-3BA00-8AB0</td></tr>
<tr><td rowspan="2">20</td><td>1 / 2</td><td>120/230
85 - 132/176 - 264 AC</td><td rowspan="2">Approx. 23 (power up), typ. 60 for 25 ms (operation)</td><td>6EP1336-3BA00-8AA0</td></tr>
<tr><td>3</td><td>230/400 to 288/500
320 - 550 3 AC</td><td>6EP1436-3BA00-8AA0</td></tr>
<tr><td rowspan="2">40</td><td>1 / 2</td><td>120/230
85 - 132/176 - 264 AC</td><td rowspan="2">Approx. 46 (power up), typ. 120 for 25 ms (operation)</td><td>6EP1337-3BA00-8AA0</td></tr>
<tr><td>3</td><td>230/400 to 288/500
320 - 550 3 AC</td><td>6EP1437-3BA00-8AA0</td></tr>
</table>

Table 10- 5 Recommendation for Control Supply Module

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

Refer also to Catalog PM21 or NC61.

⚠ WARNING
When using external power supplies, e.g. SITOP, the following points must be observed: • The ground potential M must be connected to the protective conductor terminal (DVC A). • The power supply must be mounted close to the drive line-up. Ideally, they should be mounted on a common mounting plate. If different mounting plates are used, their electrical interconnection must comply with the EMC installation guideline. This installation guideline covers protection against electric shock, protection against fire, and best possible electromagnetic compatibility.

10.6 Connection Methods

10.6.1 DRIVE-CLiQ signal cables

10.6.1.1 Overview

To connect DRIVE-CLiQ components, various pre-assembled and non-assembled DRIVE-CLiQ signal cables are available. The following pre-assembled DRIVE-CLiQ signal cables will be discussed in more detail in the next sections:

- Signal cables without 24 V cores with RJ45 connectors
- MOTION-CONNECT signal cables with RJ45 connectors
- MOTION-CONNECT signal cables with RJ45 connector and M12 socket

Table 10- 6 Overview of pre-assembled DRIVE-CLiQ signal cables

Type of DRIVE-CLiQ signal cable	24 V cores	Degree of protection		Connector type
		IP20	IP67	
6SL3060-4A.. 6FX2002-1DC..	--	x	x	RJ45
6FX5002-2DC00.. to .. -2DC20.. 6FX8002-2DC00.. to .. -2DC20..	x	x	x	RJ45
6FX5002-2DC30.. 6FX8002-2DC30..	x	X (RJ45)	X (M12)	RJ45 / M12

10.6.1.2 DRIVE-CLiQ signal cables without 24 V DC cores

Pre-assembled DRIVE-CLiQ signal cables without 24 V DC cores are used to connect components with DRIVE-CLiQ connection, which have a separate or external 24 V DC power supply. They are mainly intended for use in control cabinets. The signal cables are available with RJ45 connectors in degrees of protection IP20 and IP67.

Table 10- 7 Actual cable lengths of DRIVE-CLiQ bridges

DRIVE-CLiQ bridge	Cable length L 1)
50 mm	110 mm
100 mm	160 mm
150 mm	210 mm
200 mm	260 mm
250 mm	310 mm
300 mm	360 mm
350 mm	410 mm

1) Cable length without connector

Cable lengths from 600 mm and higher are used to connect to other applications (e.g. establish a 2nd line in the drive line-up, establish wiring in a star configuration etc.)

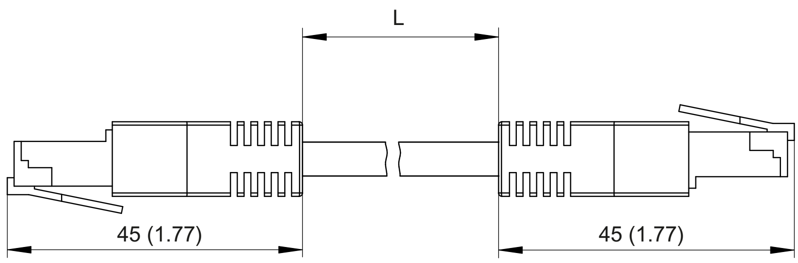


Figure 10-2 DRIVE-CLiQ signal cables without 24 V DC cores (IP20)

10.6.1.3 DRIVE-CLiQ signal cables MOTION-CONNECT with RJ45 connectors

The MOTION-CONNECT DRIVE-CLiQ signal cables with RJ45 plugs have 24 V DC cores. They are used for components with DRIVE-CLiQ connection if higher requirements must be complied with, such as mechanical stress and resistance to oil. For example, the signal cables are used for connections outside the control cabinet

The maximum length of the DRIVE-CLiQ MOTION-CONNECT signal cables with RJ45 plugs is:

- 100 m for MOTION-CONNECT 500 cables
- 75 m for MOTION-CONNECT 800PLUS cables

The signal cables are available in degrees of protection IP20 and IP67.

Note

DRIVE-CLiQ cabinet bushing for RJ45 connectors

For information on the cabinet bushings, refer to Chapter "DRIVE-CLiQ cabinet bushings".

10.6.1.4 DRIVE-CLiQ signal cables MOTION-CONNECT with RJ45 plug and M12 socket

The MOTION-CONNECT DRIVE-CLiQ signal cables with RJ45 plug and M12 socket have 24 V DC cores. They establish the connection between components with a DRIVE-CLiQ connection and a direct measuring system equipped with DRIVE-CLiQ ASIC with 8-pin M12 connector. Measuring systems from third-party manufacturers can be directly connected to the SINAMICS S120.

Basic cable

The pre-assembled basic cable has eight cores, of which four are used for data transmission and two for the 24 V supply. It is used to convert from a RJ45 plug (IP20) to an M12 socket (IP67).

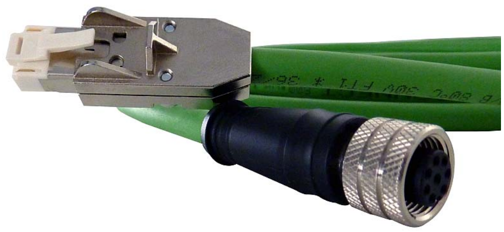


Figure 10-3 DRIVE-CLiQ basic cable with RJ45 plug and M12 socket

Extension

The pre-assembled extension of a basic cable has an M12 plug (IP67) and an M12 socket (IP67).

Figure 10-4 DRIVE-CLiQ extension with M12 plug and M12 socket

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Note

Maximum number of extensions

A maximum of two extensions can be used. More than two extensions can result in data transfer errors.

Note

Maximum permissible total cable length

The maximum permissible total cable length between the measuring system and of the RJ45 socket of the SINAMICS S120 device is 30 m. For a longer total cable length data transfer errors may occur. This is the reason that no additional extension can be connected to a 30 m long basic cable.

Note

DRIVE-CLiQ cabinet bushing with M12 plug

For information on the cabinet bushings, refer to Chapter "DRIVE-CLiQ cabinet bushings".

10.6.1.5 Comparison of DRIVE-CLiQ signal cables

DRIVE-CLiQ signal cables are designed for various applications. The following table provides an overview of the most important properties.

Table 10- 8 Properties of DRIVE-CLiQ signal cables

DRIVE-CLiQ signal cable	DRIVE-CLiQ	DRIVE-CLiQ MOTION-CONNECT 500	DRIVE-CLiQ MOTION-CONNECT 800PLUS
Approvals			
VDE cURus or UR/CSA UR-CSA File No. 1) in conformance with RoHS	Yes UL STYLE 2502/CSA-N.210.2-M90 Yes Yes	Yes UL STYLE 2502/CSA-N.210.2-M90 Yes Yes	Yes UL STYLE 2502/CSA-N.210.2-M90 Yes Yes
Rated voltage V_0/V in accordance with EN 50395	30 V	30 V	30 V
Test voltage, rms	500 V	500 V	500 V
Operating temperature at the surface			
Permanently installed Moveable	-20 to +80 °C -	-20 to +80°C 0 to 60°C	-20 to +80°C -20 to +60°C
Tensile load, max.			
Permanently installed Moveable	45 N/mm² -	80 N/mm² 30 N/mm²	50 N/mm² 20 N/mm²
Smallest bending radius			
Permanently installed Moveable	50 mm -	35 mm 125 mm	35 mm 75 mm
Torsional stress	-	30°/m absolute	30°/m absolute
Bending operations	-	100000	10 million
Max. traversing speed	-	30 m/min	300 m/min
Max. acceleration	-	2 m/s²	50 m/s² (3 m traversing distance) 2)
insulation material	CFC/silicone-free	CFC/silicone-free	CFC/halogen/silicone-free IEC 60754-1 / DIN VDE 0472-815
Oil resistance	EN 60811-2-1	EN 60811-2-1 (mineral oil only)	EN 60811-2-1
Protective jacket	PVC Gray RAL 7032	PVC DESINA color green RAL 6018	PUR, HD22.10 S2 (VDE 0282, Part 10) DESINA color green, RAL 6018
Flame retardant	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3

1) The File Number is printed on the cable jacket.

2) Characteristic curves for accelerating can be found in Catalog D31 in Chapter "MOTION-CONNECT connection system".

10.6.1.6 Combined use of MOTION-CONNECT 500 and MOTION-CONNECT 800PLUS

In principle, MOTION-CONNECT 500 cables and MOTION-CONNECT 800PLUS cables be used together.

Basic cables and extensions for MOTION-CONNECT cables with RJ45 plug and M12 socket can be combined without any restrictions.

For the combined use of MOTION-CONNECT cables with RJ45 connectors, the conditions below apply.

Use of DRIVE-CLiQ couplings

DRIVE-CLiQ couplings are used to combine MOTION-CONNECT 500 cables and MOTION-CONNECT 800PLUS cables with RJ45 plugs. The maximum permissible cable length is calculated as follows:

$\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5\ m \leq 100\ m$

ΣMC500: Total length of all MC500 cable segments (fixed routing)

ΣMC800PLUS: Total length of all MC800PLUS cable segments (tow chain)

n_c: Number of DRIVE-CLiQ couplings (max. 0..3)

With this combination, DRIVE-CLiQ cables with a maximum length of over 75 m can also implemented for applications involving a tow chain.

Table 10- 9 Examples of maximum cable lengths when using a DRIVE-CLiQ coupling

ΣMC500 (fixed routing)	87 m	80 m	66 m	54 m	40 m	30 m	20 m	10 m	5 m
ΣMC800PLUS (tow chain)	5 m	10 m	20 m	30 m	40 m	48 m	55 m	63 m	66 m
ΣMC500+ ΣMC800PLUS	92 m	90 m	86 m	84 m	80 m	78 m	75 m	73 m	71 m

Using a DRIVE CLiQ Hub Module

A DRIVE-CLiQ Hub Module (DMC20 or DME20) can be used to double the maximum permissible cable length for MOTION-CONNECT cables with RJ45 plugs. After the hub, the same length conditions apply as before the hub.

$\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5\ m \leq 100\ m$ before the hub

$\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5\ m \leq 100\ m$ after the hub

It is possible to connect two DRIVE-CliQ Hub Modules in series (cascade connection).

10.6.2 Power cables for motors

10.6.2.1 Configuring the cable length

Where a longer motor cable is required, a higher rating of Power Module must be selected or the permissible continuous output current $I_{continuous}$ must be reduced in relation to the rated output current I_{rated}. The following configuration applies to Power Modules blocksize:

Table 10- 10 Permissible cable lengths for shielded motor cables

PM340 Power Module	Length of the MOTION-CONNECT motor cable (shielded)			
Rated output current I_N	> 50 … 100 m	> 100 … 150 m	> 150 … 200 m	> 200 m
1.3 A 1.7 A 2.2 A 3.1 A 4.1 A	Not permissible	Not permissible	Not permissible	Not permissible
5.9 A 7.7 A	$I_{max} \leq 1.1 \times I_{rated}$ $I_{continuous} \leq 0.6 \times I_{rated}$	Not permissible	Not permissible	Not permissible
10.2 A	$I_{max} \leq 1.2 \times I_{rated}$ $I_{continuous} \leq 0.7 \times I_{rated}$	Not permissible	Not permissible	Not permissible
18 A	$I_{max} \leq 1.2 \times I_{rated}$ $I_{continuous} \leq 0.7 \times I_{rated}$	$I_{max} \leq 0.7 \times I_{rated}$ $I_{continuous} \leq 0.45 \times I_{rated}$	Not permissible	Not permissible
25 A 32 A	$I_{max} \leq 1.5 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$	$I_{max} \leq 1.3 \times I_{rated}$ $I_{continuous} \leq 0.8 \times I_{rated}$	Not permissible	Not permissible
38 A 45 A 60 A	$I_{max} \leq 1.6 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$ 1)	$I_{max} \leq 1.5 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$	$I_{max} \leq 1.4 \times I_{rated}$ $I_{continuous} \leq 0.85 \times I_{rated}$	Not permissible
75 A 90 A	Always permitted	$I_{max} \leq 1.6 \times I_{rated}$ $I_{continuous} \leq 0.95 \times I_{rated}$	$I_{max} \leq 1.5 \times I_{rated}$ $I_{continuous} \leq 0.9 \times I_{rated}$	Not permissible
110 A 145 A 178 A	Always permitted	Not permissible	Not permissible	Not permissible

1) Up to 70 m, always permissible

The permissible cable length for an unshielded motor cable is 150 % of the length for a shielded motor cable.

Motor reactors can also be installed in order to permit the use of longer motor cables.

10.6.2.2 Comparison of MOTION-CONNECT power cables

MOTION-CONNECT 500 power cables are mainly suitable for permanent routing. MOTION-CONNECT 800PLUS power cables fulfill all of the high mechanical requirements for use in tow chains. They are resistant to cutting oils.

Table 10- 11 Comparison of the MOTION-CONNECT 500 and MOTION-CONNECT 800PLUS power cables

Power cable	MOTION-CONNECT 500	MOTION-CONNECT 800PLUS
Approvals		
VDE 1) cURus or UR/CSA UR-CSA File No. 2) in conformance with RoHS	Yes UL758-CSA-C22.2-N.210.2-M90 Yes Yes	Yes UL758-CSA-C22.2-N.210.2-M90 Yes Yes
Rated voltage V_0/V in accordance with EN 50395		
Supply cores Signal cores	600 V / 1000 V 24 V (EN) 1000 V (UL/CSA)	600 V / 1000 V 24 V (EN) 1000 V (UL/CSA)
Test voltage, rms		
Supply cores Signal cores	4 kV 2 kV	4 kV 2 kV
Operating temperature at the surface		
Permanently installed Moveable	-20 to +80°C 0 to 60°C	-50 to +80°C -20 to +60°C
Tensile load, max.		
Permanently installed Moveable	50 N/mm^2 20 N/mm^2	50 N/mm^2 20 N/mm^2
Smallest bending radius		
Permanently routed moving 3)	5 x D_{max} approx. 18 x D_{max}	4 x D_{max} approx. 8 x D_{max}
Torsional stress	30°/m absolute	30°/m absolute
Bending operations	100000	10 million from 10 mm^2: 3 million
Max. traversing speed	30 m/min	Up to 300 m/min
Max. acceleration	2 m/s^2	50 m/s^2 (3 m) 4)
insulation material	CFC/silicone-free	CFC/halogen/silicone-free IEC 60754-1 / DIN VDE 0472-815
Oil resistance	EN 60811-2-1 (mineral oil only)	EN 60811-2-1
Protective jacket	PVC DESINA color, orange RAL 2003	PUR, HD22.10 S2 (VDE 0282, Part 10) DESINA color, orange, RAL 2003
Flame retardant	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3

1) The registration number is printed on the cable jacket.

2) The File Number is printed on the cable jacket.

3) Detailed information on D_{max} as well as the lowest permissible bending radius are provided in Catalog D31 in Chapter 13 "Connection system MOTION-CONNECT".

4) Characteristic curves for accelerating can be found in Catalog D31 in Chapter "MOTION-CONNECT connection system".

10.6.3 Current-carrying capacity and derating factors for power cables and signal cables

The current-carrying capacity of PVC/PUR-insulated copper cables is specified for routing types B1, B2 and C under continuous operating conditions in the table with reference to an ambient air temperature of 40 °C. For other ambient temperatures, the values must be corrected by the factors listed in the "Derating factors for deviating ambient temperatures" table.

Table 10- 12 Current carrying capacity according to EN 60204-1 for 40 °C ambient temperature

Cross-section	Current carrying capacity, effective; AC 50/60 Hz or DC For routing type		
mm^2	B1 A	B2 A	C A
Electronics			
0,20	–	4,3	4,4
0,50	–	7,5	7,5
0,75	–	9	9,5
Power			
0,75	8,6	8,5	9,8
1,00	10,3	10,1	11,7
1,50	13,5	13,1	15,2
2,50	18,3	17,4	21
4	24	23	28
6	31	30	36
10	44	40	50
16	59	54	66
25	77	70	84
35	96	86	104
50	117	103	125
70	149	130	160
95	180	165	194
120	208	179	225

Table 10- 13 Current carrying capacity according to IEC 60364-5-52 for 40 °C ambient temperature

Cross-section	Current carrying capacity, effective; AC 50/60 Hz or DC For routing type		
Power			
150	–	–	344
185	–	–	392
> 185	Values must be taken from the standard		

Routing types

B1 Cables in conduits or installation ducts

B2 Multi-core cables in conduits or installation ducts

C Cables along walls/panels, without conduits or installation ducts

Table 10- 14 Derating factors for deviating ambient temperatures

Ambient air temperature [°C]	Derating factor according to EN 60204-1, Table D1
30	1,15
35	1,08
40	1,00
45	0,91
50	0,82
55	0,71
60	0,58

10.6.4 Spring-loaded terminals

Table 10- 15 Spring-loaded terminals

Spring-loaded terminal type			
1	Connectable conductor cross-sections	Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve	0.14 mm² to 1.5 mm² 0.25 mm² to 1.5 mm² 0.25 mm² to 0.5 mm²
	Insulation stripping length	9 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	

10.6.5 Screw terminals

Connectable conductor cross-sections of screw terminals

The type of screw terminal can be taken from the interface description of the particular component.

Table 10- 16 Screw terminals

Screw terminal type			
1	Connectable conductor cross-sections	Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve	0.14 mm² to 1.5 mm² 0.25 mm² to 1.5 mm² 0.25 mm² to 0.5 mm²
	Insulation stripping length	7 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	
	Tightening torque	0.22 to 0.25 Nm	
2	Connectable conductor cross-sections	Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve	0.2 mm² to 2.5 mm² 0.25 mm² to 1 mm² 0.5 mm² to 1 mm²
	Insulation stripping length	7 mm	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 to 0.6 Nm	

10.7 Protective connection and equipotential bonding

Protective connections

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

The protective conductor connection of the SINAMICS components must be connected to the protective conductor connection of the control cabinet as follows:

Table 10- 17 Conductor cross-section for copper protective connections

Line supply cable in mm^2	Copper protective connection in mm^2
Up to 16 mm^2	The same as the line supply cable
From 16 mm^2 to 35 mm^2	16 mm^2
From 35 mm^2	0.5 x line supply cable

For materials other than copper, the cross-section should be increased so that as a minimum, the same conductivity is attained.

All system components and machine parts must be incorporated in the protection concept.

The protective connection (PE connection) of the motors used must be established through the motor cable. For EMC reasons, the shield of the motor cable should be connected through a large surface area both at the Power Module as well as at the motor.

The drive line-up must be arranged on a common bright mounting plate in order to comply with the EMC limit values. The mounting plate must be connected to the protective conductor connection of the control cabinet through a low impedance.

Copper cables with appropriate cross-sections (>2.5 mm^2) must be used for the ground connection of PROFIBUS nodes.

For more information about grounding PROFIBUS, see:
http://www.profibus.com/fileadmin/media/wbt/WBT_Assembly_V10_Dec06/index.html

Functional equipotential bonding

A mounting plate, which is connected with the protective conductor connection of the control cabinet through a low impedance connection, simultaneously serves as the functional equipotential bonding surface. This means that no additional functional equipotential bonding is required within the drive line-up.

If a common bright mounting plate is not available, then equally good functional equipotential bonding must be established using cable cross-sections as listed in the table above or, as a minimum, with the same conductivity.

When installing components on standard mounting rails, the data listed in the table also apply to the functional equipotential bonding. If only smaller connection cross-sections are permissible at the components, then the largest possible cross-section should be used, e.g. 6 mm^2 for SMC. These requirements also apply to distributed components located outside the control cabinet.

NOTICE
Damage to PROFIBUS nodes as a result of high leakage currents
A functional 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. If an equipotential bonding conductor is not used, high leakage currents that could destroy the Control Unit or other PROFIBUS nodes can be conducted via the PROFIBUS cable.

No functional equipotential bonding conductors are required for PROFIBUS inside a control cabinet. For PROFIBUS connections between different buildings or parts of buildings, a functional equipotential bonding must be routed in parallel to the PROFIBUS cable. The following cross-sections must be observed in accordance with IEC 60364-5-54:

- Copper 6 mm²
- Aluminum 16 mm²
- Steel 50 mm²

Additional information about equipotential bonding for PROFIBUS can be found at:
http://www.profibus.com/fileadmin/media/wbt/WBT_Assembly_V10_Dec06/index.html

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Note

If the above information about functional equipotential bonding is not taken into account, this can cause the fieldbus interfaces to malfunction or devices to malfunction.

Note

PROFINET

For installation guidelines and information of protective grounding and equipotential bonding for all PROFINET types and topologies, refer to DOWNLOADS at:
http://www.profibus.com

10.8 Arrangement of components and equipment

10.8.1 General

The arrangement of the components and equipment takes account of

- Space requirements
- Cable routing
- Bending radiuses of the connecting cables
  MOTION-CONNECT cables, refer to catalog PM21
- Heat dissipation
- EMC

Components are usually located centrally in a cabinet.

Always observe the mounting clearances necessary above and below the components.

10.8.2 Mounting

The components should be mounted on a conductive mounting surface to ensure low impedance between the component and the mounting surface. Mounting plates with a galvanized surface are suitable.

Figure 10-5 Mounting the CU310-2 onto a Power Module PM340 (frame size FSD)

Mounting Power Modules with base components

Many system components are designed as base components for PM340 Power Modules in frame sizes FSA to FSE. In such cases, the base component is installed on the mounting surface and the PM340 Power Module in front of it, in order to save space.

Table 10- 18 Available base components

	FSA	FSB	FSC	FSD	FSE
Line filter	x	-	-	-	-
Line reactor	x	x	x	x	x
Brake resistor	x	x			
Motor reactor	x	x	x		

x.. base installation possible

-.. Not available as an external component (use a Power Module with an integrated line filter)

Up to two base components can be mounted in front of one another. For configurations involving more than two base-type components (e.g. line reactor + motor reactor + braking resistor), the individual components must be mounted to the side of the Power Module.

The following mounting sequence applies to frame sizes FSA to FSC:

Table 10- 19 Mounting sequence for base components, starting from the wall of the control cabinet

Frame size	Mounting sequence
FSA	**Without external line filter:** Motor reactor - line reactor - PM340
	With external line filter: Line reactor - line filter - PM340 or Motor reactor - line filter - PM340
FSB	Motor reactor - line reactor - PM340
FSC	Motor reactor - line reactor - PM340

Note

Mounting brake resistors

Brake resistors for Power Modules should be mounted next to the Power module or outside the control cabinet as a result of the high level of heat generated.

Wiring rules for DRIVE-CLiQ

Further information may be found in the: SINAMICS Commissioning Manual.

10.9 Information on control cabinet cooling

10.9.1 General

Electrical cabinets can be cooled, using among other things the following:

- filtered fans
- heat exchangers or
- cooling units.

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

The air routing within the electrical cabinet and the cooling clearances specified here must be observed. No other components or cables must be located in these areas.

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

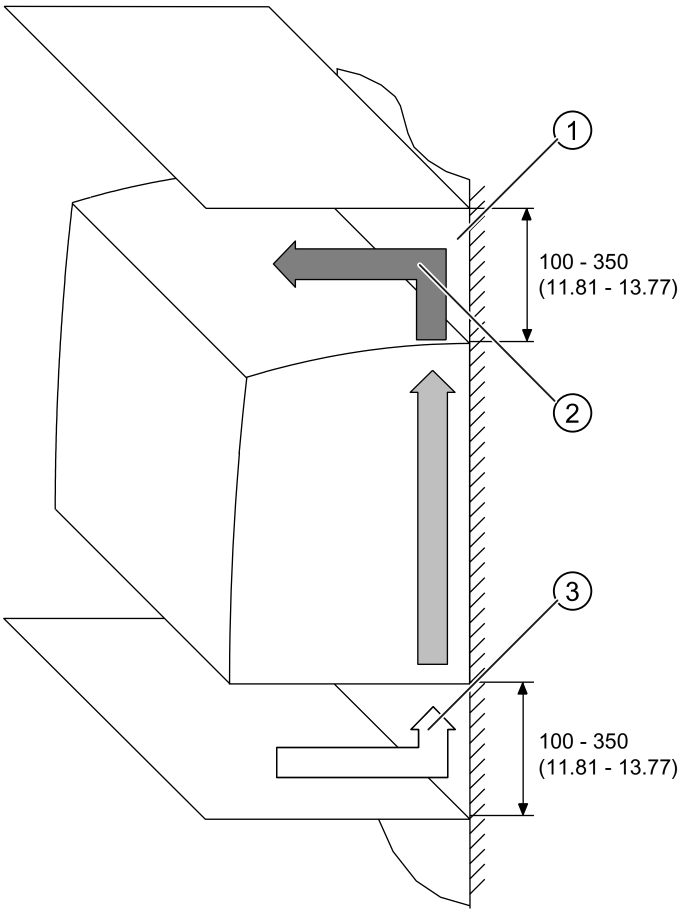
You must take into account the following specifications when mounting/installing SINAMICS components:

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

Table 10- 20 Cooling clearances around the components

Component	Clearance above and below in mm and (inches)	Lateral clearance in mm and (inches)	Clearance in front of the component
CU310-2 DP	50 (1.97)		
CU310-2 PN	50 (1.97)		
CUA31	50 (1.97)		
SMCxx	50 (1.97)		
Line filter	100 (3.93)		
Line reactor	100 (3.93)		
PM340 blocksize, frame size FSA	100 (3.93)	30 (1.18) 1)	
PM340 blocksize, frame size FSB	100 (3.93)	40 (1.57) 1)	30 (1.18)
PM340 blocksize, frame size FSC	125 (4.92)	50 (1.97) 1)	30 (1.18)
PM340 blocksize, frame sizes FSD and FSE	300 (11.81)		30 (1.18)
PM340 blocksize, frame size FSF	350 (13.77)		30 (1.18)

1) The Power Modules can be mounted side by side without base components up to an ambient temperature of 40 °C. In combination with base components and at ambient temperatures of 40 °C to 55 °C, the specified lateral minimum clearances must be observed. Where combinations of different frame sizes are concerned, the longer of the two clearances shall apply.



① Mounting surface
② Discharged air
③ Air intake

Figure 10-6 Cooling clearances

10.9.2 Ventilation

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

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

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

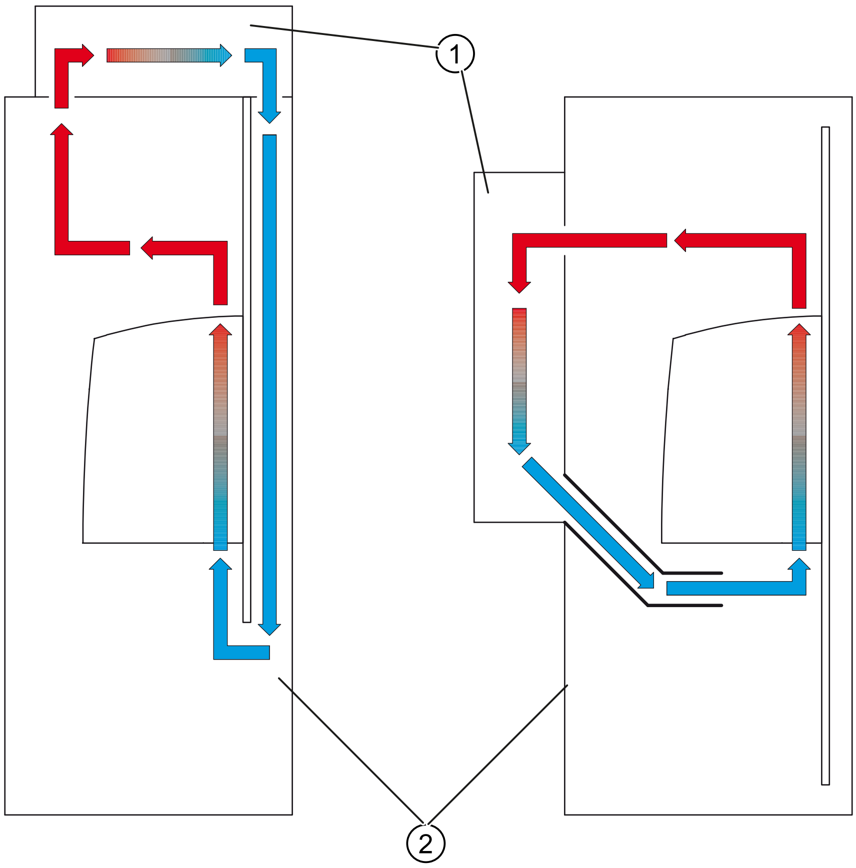
Note

Cables must not be routed on the components; the ventilation meshes must not be covered.

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

Note

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



① Cooling units.
② Control cabinet

Figure 10-7 Examples of cabinet ventilation

NOTICE
The air guidance and arrangement of the cooling equipment must be chosen in such a way as to prevent condensation from forming. If necessary, cabinet enclosure heating may have to be installed.

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

10.9.3 Power loss of components in rated operation

10.9.3.1 General

The tables below show the power loss for components during rated operation. The characteristic values apply for the following conditions:

- Line supply voltage for Power Modules 1-ph. 200 V AC to 3-ph. 380 V to 480 V AC ±10 %.
- Rated pulse frequency of Blocksize Power Modules, 4 kHz
- Rated pulse frequency of Power Modules Chassis, 2 kHz
- Operating components at their unit rating

10.9.3.2 Power loss of Control Units, Control Unit Adapters and Sensor Modules

Table 10- 21 Overview of power loss during rated operation for Control Units, Control Unit Adapters, Sensor Modules

Component	Unit	Power loss
Control Units		
CU310-2 DP	W	< 20
CU310-2 PN	W	20
Control Unit Adapter		
CUA31	W	2.4
CUA32	W	2.6
Sensor Modules		
SMC10	W	< 10
SMC20	W	< 10

10.9.3.3 Power loss for line reactors and line filters

Table 10- 22 Overview of power loss during rated operation for line reactors and line filters

Rated output current I_{rated}	Frame size	Line voltage	Unit	Power loss 50/60 Hz
Line reactors for Blocksize PM340				
0.9 A/2.3 A	FSA	1-ph. 200 to 240 V AC	W	12.5/15
3.9 A	FSA	1-ph. 200 to 240 V AC	W	11.5/14.5
1.3 A/1.7 A	FSA	3-ph. 380 to 480 V AC	W	6/7
2.2 A/3.1 A	FSA	3-ph. 380 to 480 V AC	W	12.5/15
4.1 A	FSA	3-ph. 380 to 480 V AC	W	7.5/9
5.9 A/7.7 A	FSB	3-ph. 380 to 480 V AC	W	9/11
10.2 A	FSB	3-ph. 380 to 480 V AC	W	27/32
18 A/25 A	FSC	3-ph. 380 to 480 V AC	W	98/118
32 A	FSC	3-ph. 380 to 480 V AC	W	37/44
38 A/45 A/60 A	FSD	3-ph. 380 to 480 V AC	W	90/115
75 A/90 A	FSE	3-ph. 380 to 480 V AC	W	170/215
110A/145 A/178 A	FSF	3-ph. 380 to 480 V AC	W	280/360
Line reactors for Chassis Power Modules				
210 A	FX	3-ph. 380 to 480 V AC	W	274
260 A	FX	3-ph. 380 to 480 V AC	W	247
310 A	GX	3-ph. 380 to 480 V AC	W	267
380 A	GX	3-ph. 380 to 480 V AC	W	365
490 A	GX	3-ph. 380 to 480 V AC	W	365
Line filters for Blocksize PM340	FSA	3-ph. 380 to 480 V AC	W	< 5
Line filters for Chassis Power Modules				
210 A/260 A	FX	3-ph. 380 to 480 V AC	W	49
310 A/380 A	GX	3-ph. 380 to 480 V AC	W	49
490 A	GX	3-ph. 380 to 480 V AC	W	55

10.9.3.4 Power loss for Power Modules

Table 10- 23 Overview of power loss during rated operation for Power Modules

Rated output current I_{rated}/Unit rating based on I_{rated}	Frame size	Line voltage	Unit	Power loss
Blocksize PM340				
0.9 A/0.12 kW	FSA	1-ph. 200 to 240 V AC	kW	0.06
2.3 A/0.37 kW	FSA	1-ph. 200 to 240 V AC	kW	0.075
3.9 A/0.75 kW	FSA	1-ph. 200 to 240 V AC	kW	0.11
1.3 A/0.37 kW	FSA	3-ph. 380 to 480 V AC	kW	0.10
1.7 A/0.55 kW	FSA	3-ph. 380 to 480 V AC	kW	0.10
2.2 A/0.75 kW	FSA	3-ph. 380 to 480 V AC	kW	0.10
3.1 A/1.1 kW	FSA	3-ph. 380 to 480 V AC	kW	0.11
4.1 A/1.5 kW	FSA	3-ph. 380 to 480 V AC	kW	0.11
5.9 A/2.2 kW	FSB	3-ph. 380 to 480 V AC	kW	0.14
7.7 A/3 kW	FSB	3-ph. 380 to 480 V AC	kW	0.16
10.2 A/4 kW	FSB	3-ph. 380 to 480 V AC	kW	0.18
18 A/7.5 kW	FSC	3-ph. 380 to 480 V AC	kW	0.24
25 A/11 kW	FSC	3-ph. 380 to 480 V AC	kW	0.30
32 A/15 kW	FSC	3-ph. 380 to 480 V AC	kW	0.40
38 A/18.5 kW	FSD	3-ph. 380 to 480 V AC	kW	0.38
45 A/22 kW	FSD	3-ph. 380 to 480 V AC	kW	0.51
60 A/30 kW	FSD	3-ph. 380 to 480 V AC	kW	0.69
75 A/37 kW	FSE	3-ph. 380 to 480 V AC	kW	0.99
90 A/45 kW	FSE	3-ph. 380 to 480 V AC	kW	1.21
110 A/55 kW	FSF	3-ph. 380 to 480 V AC	kW	1.42
145 A/75 kW	FSF	3-ph. 380 to 480 V AC	kW	1.93
178 A/90 kW	FSF	3-ph. 380 to 480 V AC	kW	2.31
Blocksize Liquid Cooled PM340				
38 A/18.5 kW	FSD	3-ph. 380 to 480 V AC	kW	0.09 1)
60 A/30 kW	FSD	3-ph. 380 to 480 V AC	kW	0.13 1)
75 A/37 kW	FSE	3-ph. 380 to 480 V AC	kW	0.16 1)
90 A/45 kW	FSE	3-ph. 380 to 480 V AC	kW	0.19 1)
110 A/55 kW	FSF	3-ph. 380 to 480 V AC	kW	0.21 1)
178 A/90 kW	FSF	3-ph. 380 to 480 V AC	kW	0.35 1)
Power Modules Chassis				
210 A/110 kW	FX	3-ph. 380 to 480 V AC	kW	2.46
260 A/132 kW	FX	3-ph. 380 to 480 V AC	kW	3.27
310 A/160 kW	GX	3-ph. 380 to 480 V AC	kW	4.0
380 A/200 kW	GX	3-ph. 380 to 480 V AC	kW	4.54
490 A/250 kW	GX	3-ph. 380 to 480 V AC	kW	5.78

1) Power lost to the ambient air

10.10 Insulation test

Insulation test

In accordance with EN 60204-1, an insulation test must be performed on the machine/system.

This can be performed either by

- insulation resistance testing or
- voltage testing

.

⚠ WARNING
Disconnect the machine/system from the power supply prior to testing.

Insulation resistance testing

Insulation resistance testing should be preferred. The insulation resistance for the test must not be lower than 1 MΩ Testing is carried out with 500 V DC between the main-circuit conductors [1)] and the protective conductor system. Testing may be carried out on individual sections of the system.

Exception: A lower resistance value is permissible for certain components of the electrical equipment; however, the value must not be lower than 50 kΩ.

SINAMICS components are covered by this exception. They must therefore be disconnected during testing and tested separately.

Voltage testing

⚠ WARNING
Test equipment to EN61180-2 should be used for voltage testing.

The rated frequency for the test voltage must be 50 Hz or 60 Hz.

The maximum test voltage must be either twice the rated voltage value for the equipment power supply or 1000 V. The larger of the two values should be used. The maximum test voltage must be applied between the conductors of the main circuits [1)] and the protective conductor system for approx. 1 s.

Components and devices that are not rated to withstand this test voltage must be disconnected prior to testing.

Components and devices that are voltage tested according to their product standard may be disconnected during testing.

The SINAMICS components are voltage-tested to EN 61800-5-1 and must be be disconnected during this test.
If they cannot be disconnected, the input and output terminals must be shorted and a bypass installed. In this case, a DC voltage that is 1.5 times the AC test voltage should be used for testing.

1) Main circuits are circuits that are electrically connected to the line voltage.

Cooling circuit and coolant properties 11

11.1 Cooling circuit requirements

Technical cooling circuits can be divided into three systems:

1. Closed cooling circuits (recommended)
   In closed systems, the circuit coolant is separated from the surrounding atmosphere, which prevents the ingress of oxygen. The coolant is only routed through the SINAMICS devices, the components required for cooling and, if necessary, a motor. The heat is dissipated to the atmosphere indirectly by means of heat exchangers. The system should ideally function without losing any coolant and, once filled, should not need any water to be added. The composition of the coolant can be adjusted as required (e.g. by using desalinated water and adding anti-corrosion agents). It either does not change at all during operation, or changes only in a defined manner.
   The closed cooling circuit is recommended as a standard solution.
2. Open cooling circuit
   The coolant is routed not only through the SINAMICS devices and components required for cooling, but also through external devices.
   The heat transferred to the circuit coolant evaporates via a cooling tower. This evaporation causes the coolant to become more concentrated (densification) because water molecules escape, while dissolved substances remain in the coolant. During operation, therefore, the composition of the coolant changes significantly, which means that it must be monitored and topped up continuously.
3. Semi-open cooling circuit
   Oxygen can only enter the coolant via the pressure compensator. Otherwise, see 1.
   Semi-open cooling circuits are permitted.

11.1.1 Cooling system requirements

Open cooling systems must never be used for liquid-cooled Power Modules. A closed cooling circuit with a membrane expansion tank (MET), safety valve (SV), and heat exchanger (HE) is recommended, which connects the cooling circuit to an external cooler (refer also to the chapter titled "Using heat exchangers").

Requirements

- A particle filter (particle size < 100 μm) must be installed in the cooling circuit's supply line to prevent foreign particles from being washed in.
- Mixed installations should be avoided wherever possible.
- The permissible pressures in the cooling system must be observed.
- Cavitation must be prevented in the cooling system.
- Equipotential bonding must be provided between the components in the cooling system.

- The customer must take measures to protect the devices against condensation
- An anti-corrosion agent and, if necessary, a biocide should be mixed into the coolant.
- If there is a risk of frost, preventive measures must be taken during operation, storage, and transportation (e.g. emptying and blowing out with air, additional heating).
- The requirements of the coolant in terms of its properties (temperature, chemical characteristics, etc.) must be observed.

Recommendations

- To ensure mechanical decoupling, the devices should be connected by means of hoses.
- To prevent blockages and corrosion, you are advised to install a flushback filter in the circuit (so that residues can be rinsed out when the system is running).
- The power units should be connected to the cooling circuit by means of shut-off fittings so that they can be disconnected from the cooling circuit for servicing or repair without having to empty the entire cooling system. A cooling water hose (EPDM) can be used to connect the shut-off fitting to the power unit. The coolant connections must never be closed if cooling liquid is still present in the device. Reason: If the cooling fluid expands due to heat, the pressure can build up beyond permissible levels and cause the heat sink to burst.

11.1.2 Cooling circuit configuration

The liquid-cooled Power Modules are designed to be connected in parallel to the cooling circuit. The pressure drop in the joint supply and return lines is to be kept at negligible levels by choosing a sufficiently large pipe diameter.

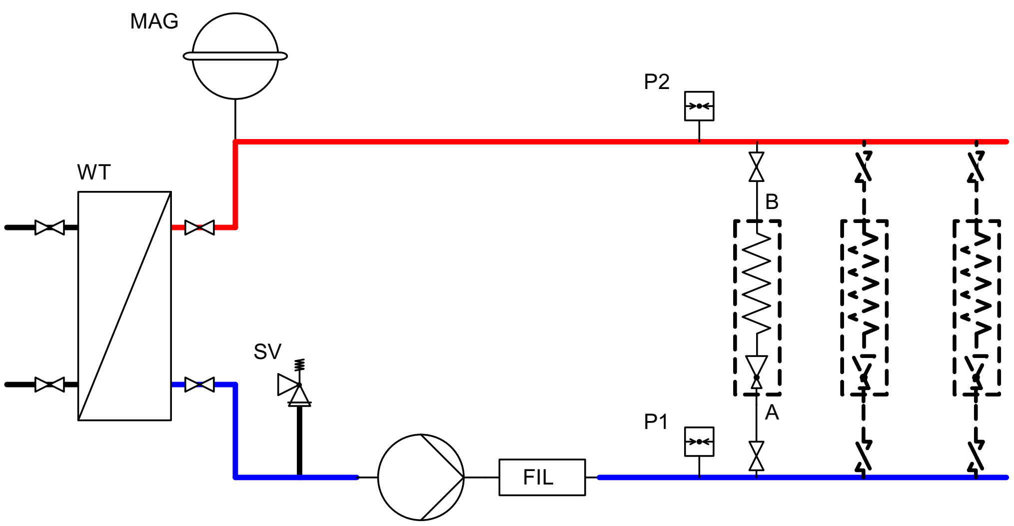


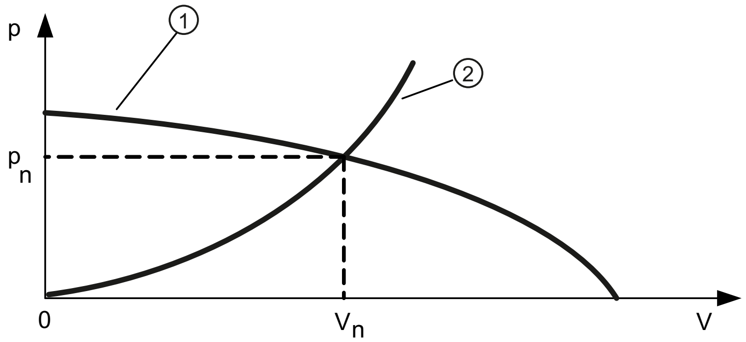
Figure 11-1 Example of a closed cooling circuit

The supply line (P1) has a differential pressure p compared to the return line (P2); this pressure must be in the range 70 kPa to 200 kPa. This ensures that every connected unit has the required volume of cooling liquid flowing through it. Pressure P1 and P2 with respect to the atmosphere must not exceed 600 kPa.

A pump's pressure depends on the volumetric flow, so the pressure created will depend on the number of components which are connected. At the minimum differential pressure p1 (measured between the supply and return lines of the individual component), the volume of coolant required to enable the component to achieve its unit rating or rated current is to flow through each component. At the maximum differential pressure p2 (measured between the supply and return lines of the individual component), the volumetric flow must not result in damage to the component, for example by means of cavitation. If necessary, pressure reducing valves such as baffle plates will have to be installed in the piping; these must be easy to access, clean, and/or replace.

When the pump is switched off, static pressure occurs in the system. The static pressure can be influenced by the primary pressure of the membrane expansion tank (MET) and should be at least 30 kPa on the pump's suction side. If the static pressure is too low, the pump may be damaged due to cavitation during operation. If necessary, note any differing minimum pressure values from the pump manufacturer. When components are installed at different heights, the geodesic pressure caused by the height difference must be taken into account (1 m height difference corresponds to 10 kPa).

When the pump is switched on, a (location-dependent) flow pressure is present in the cooling circuit, which must be determined from the pump characteristic curve and the volume-flow-dependent pressure drop. Characteristics have been specified for the pressure drop of the Power Modules. The pressure drop in the filter and, if applicable, an additional pressure drop in the connection pipes must be added to this pressure drop (70 kPa for H_2O). Up to 50 kPa must be added for the pressure drop in a (contaminated) filter and in connection pipes. The intersection of the pump characteristic curve and the pressure drop of the whole cooling system yields the volumetric flow V_{rated} of the coolant at this operating point.



① Pump characteristic curve
② Pressure drop in the cooling system

Figure 11-2 Pump characteristic curve

Permissible system pressure

The maximum permissible system pressure is 600 kPa.
If a pump that is capable of exceeding this maximum permissible system pressure is used, the customer must take steps (e.g. safety valve p ≤ 600 kPa, pressure control, or similar) to ensure that the maximum pressure limit is not exceeded.

Permissible pressure difference

The maximum permissible pressure difference for a heat sink is 200 kPa. Higher pressure differences significantly increase the risk of cavitation and abrasion. The lowest possible differential pressure between the coolant in the supply and return lines should be selected to allow pumps with a flat characteristic to be used.

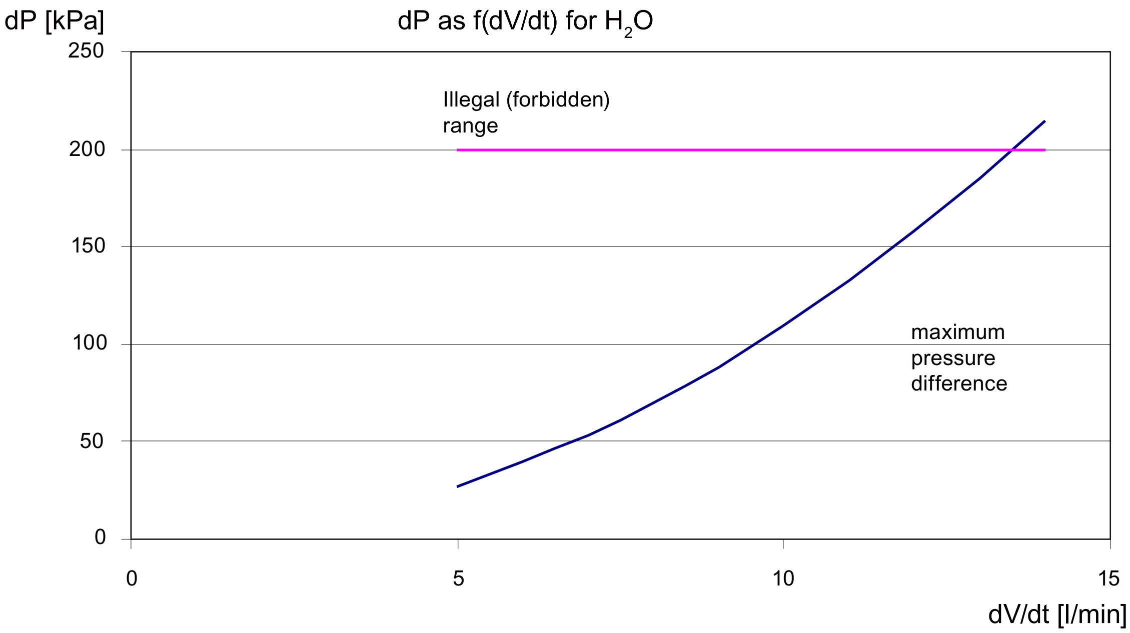


Figure 11-3 Pressure difference as a function of volumetric flow

Pressure difference and pressure drop when using coolant mixtures

If a mixture of Antifrogen N and H_2O is used as a coolant, the rated pressure must be calculated according to the mixing ratio. The following table specifies the pressure drop across components at different coolant temperatures for a coolant with mixing ratio 45 % Antifrogen N.

Table 11- 1 Pressure drop at different coolant temperatures for Antifrogen N/H_2O: 45 %

dV/dt H_2O [l/min]	dP H_2O [kPa]	dP Antifrogen N 0 °C [kPa]	dP Antifrogen N 20 °C [kPa]	dP Antifrogen N 45 °C [kPa]	dP Antifrogen N 50 °C [kPa]
8	70	121	97	81	78

The characteristic curves for the pressure drop across the heatsinks as a function of volumetric flow vary depending on the temperature and the Antifrogen N / water coolant mix.

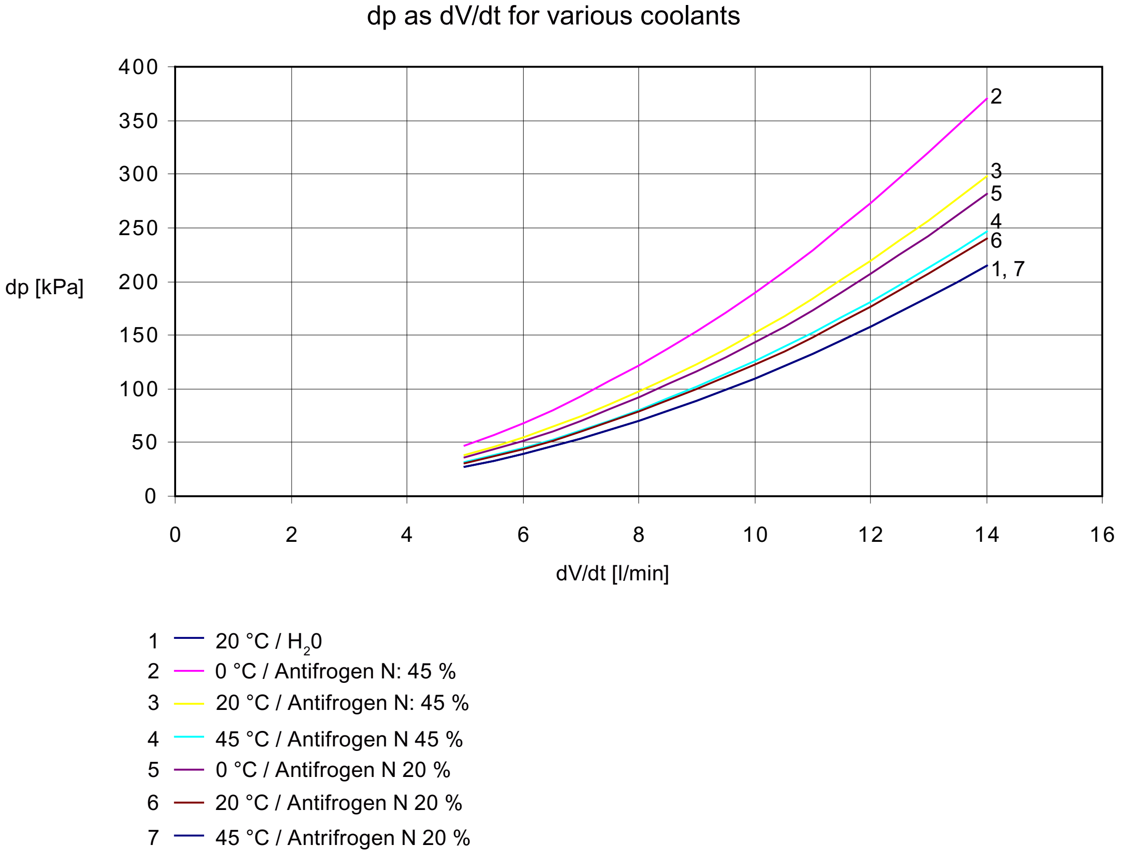


Figure 11-4 Pressure difference as a function of volumetric flow for various coolants and temperatures

Operating pressure

The **operating pressure** must be set according to the flow conditions in the supply and return lines of the cooling circuit. The required coolant flow rate per time unit must be set according to the technical data of the components. The components are normalized to a rated pressure of 70 kPa (for coolant type H_2O) via a baffle plate.

Layout of the components

The components should be laid out in the system in such a way that the overall length of the supply and drain lines is the same for every SINAMICS component.

Water cooling systems with series-connected SINAMICS devices are not permitted.

Dimensioning the cooling circuit

Recommendation for dimensioning the cooling circuit:

The differential pressure between the supply and return lines should be selected so that:

$\Sigma dPi < dP_{Syst} < \Sigma dPi + 30$ kPa

The individual pressure drops Pi represent the pressure drops of components (heat exchanger, piping, 70 kPa for the SINAMICS devices connected in parallel, valves, dirt traps, pipe bends, etc.).

Coolant pipes must be routed with extreme care. The pipes must never come into contact with electrically live components. An insulation clearance of > 13 mm must always be maintained between pipes and live parts. The pipes must be securely mounted and checked for leaks.

11.1.3 Installation

A closed stainless-steel cooling circuit, preferably combined with monitoring of the coolant quality, is strongly recommended to ensure the longest possible service life for the heat sink.

NOTICE
Coolant pipes must be routed with extreme care. The pipes must be securely mounted and checked for leaks. They must never come into contact with live components.

Materials and connections

To minimize the electrochemical processes taking place in the cooling system, the materials must be coordinated with one another accordingly. For this reason, mixed installations (i.e. a combination of different materials, such as copper, brass, iron, zinc, or halogenated plastic (PVC hoses and seals)) should not be used or should be limited to an absolute minimum.

The valves and connections required in the cooling system must be made of stainless steel (V2A or V4A steel; NIROSTA austenite).

The following materials can be used for the cooling system piping:

- Pipes and corrugated piping made of stainless steel (V2A or V4A steel; NIROSTA austenite)
- Hoses made of EPDM / EPDM with an electrical resistance $<10^9$ ohms (e.g. Semperflex FKD; the Semperit company)
- DEMITEL® hoses made of PE / EPDM (the Telle company)
- Secure with clips that comply with DIN2871, available from Telle, for example.

All control cabinets must be designed with a PE bar and a good electrical connection must be established between them.

Note

The sealing materials must be free of chlorides, graphite, and carbon (Viton® or EPDM).

Teflon-based seals are not permitted.

Note

When non-conductive hoses are used, particular attention must be paid to the equipotential bonding of all components. (Refer to the chapter titled "Equipotential bonding".)

Note

Once installed, the cooling system must be checked to ensure that it is properly sealed.

11.1.4 Preventing cavitation

The following applies to all cooling circuits:

- The cooling circuit must always be designed in such a way that the pressure compensator is located on the suction side of the pump (if possible, directly on the pump).
- The minimum pressure on the suction side of the pump must be approximately 30 kPa, or the geodesic height from the reservoir to the pump suction side must be > 3 m.
- The pressure drop across a SINAMICS device must not exceed 200 kPa in continuous operation, otherwise the high volumetric flow can increase the risk of cavitation and/or abrasion damage.
- The guidelines provided in "Information about configuring cooling circuits" below regarding series connections and maximum pressure must also be followed.

11.1.5 Commissioning

When commissioning the cooling water circuit, the following sequence must be observed:

- Ventilate the heat sink the first time the devices are filled.
- Remove the fixing glands located in front of the vent valve.
- Perform ventilation.
- Close the vent valve.
- Screw the fixing glands tight again.
- Check the seals.
- Set the operating pressure according to the flow conditions of the cooling water system in the supply and return lines.
- Set the required cooling water flow rate per time unit.

NOTICE
Ventilation must only be performed when the system is at zero voltage.

11.2 Coolant requirements

11.2.1 Coolant properties

Water or a water/anti-freeze mixture that meets the relevant requirements can be used as a cooling medium. The cooling medium must be chemically neutral, clean, and not contain any solids.

The cooling water must fulfill the following requirements over the long term:

- Chemically neutral, clean, and free of solids
- Max. inlet temperature: 50 °C
- Max. outlet temperature: 55 °C
- System pressure 600 kPa
- Max. size of any particles transported: 100 µm
- pH value: 6.0 to 8.0
- Chlorides < 200 ppm
- Sulfates < 600 ppm
- Loose materials < 340 ppm
- Total hardness < 170 ppm
- Electrical conductivity < 500 µS/cm

Note

Condensation must not be allowed to form on the SINAMICS S120 equipment as a result of supercooling. The temperature of the cooling water may have to be regulated.

Note

The heat sink is made of non-seawater-proof material, which means that it must not be cooled directly with seawater.

Note

Tap water is not generally suitable for use in the cooling circuit. It can be mixed with de-ionized water. Losses must always be replenished with de-ionized water.

The cooling water should be checked 3 months after the cooling circuit is filled for the first time and, subsequently, once a year. If the cooling water becomes cloudy, is colored, or becomes contaminated by mould spores, the cooling circuit must be cleaned and refilled.

An inspection glass should be provided in the cooling circuit to make it easier to check the cooling water.

11.2.2 Anti-corrosion additives (inhibitors)

Inhibitor without anti-freeze effect

Nalco 00GE056 (the Nalco company) must be used as anti-corrosion agent. The concentration of anti-corrosion agent in the cooling water should be between 2,000 ppm and 2,500 ppm (200 to 250 ml/100 liters of cooling water).

A prerequisite for the inhibitor is the specified coolant, which must not contain any magnesium carbonate. Control kits can be ordered from Nalco to check the inhibitor concentration.

11.2.3 Anti-freeze additives

Antifrogen N (the Clariant company) is recommended as antifreeze. The proportion of antifreeze must be between 20% and 30%. This ensures frost protection in temperatures down to -10 °C.

Note

If the proportion of antifreeze added is greater than 30%, this can inhibit the transfer of heat and prevent the units from functioning correctly.

Note

Cooling water mixtures with Antifrogen N are highly conductive. In the event of leakage, the insulating systems must be cleaned.

Note

When EPDM hoses are used, oily anti-corrosion-agent additives must not be used because such additives can corrode and destroy EPDM.

Note

You must always bear in mind that the kinematic viscosity of the cooling water changes when antifreeze is added, which means that the pump power must be adjusted accordingly.

Antifrogen N contains corrosion inhibitors which permanently protect the metal in the cooling system against corrosion. The proportion of Antifrogen N should always be >20%, otherwise the mixture becomes corrosive.

Inhibitors and Antifrogen N must not be mixed.

11.2.4 Biocide additives (only if required)

Closed cooling circuits with soft water (°DH>4) are susceptible to microbes. The risk of corrosion caused by microbes is virtually non-existent in chlorinated drinking water systems.

If Antifrogen N antifreeze is used with a concentration of 20% or higher, it can be assumed that there is an adequate biocide effect.

The following types of bacteria are encountered in practice:

- Slime-forming bacteria
- Corrosive bacteria
- Iron-depositing bacteria

The type of bacteria determines the suitability of a biocide. At least one water analysis per year (to determine the number of bacterial colonies) is recommended. Suitable biocides are available, for example, from Nalco (Manufacturer: Nalco).

- We recommend adding intermittent doses of Nalco N 77352 (Nalco company) twice a month.
  Dosage quantity 5 – 15 mg/100 liters of cooling water. This product has no adverse effect on Nalco 00GE056 corrosion inhibitor.

Note

The type of bacteria determines the biocide.

The manufacturer's recommendations must be followed as regards the dosage and compatibility with any inhibitor used.

Biocides and Antifrogen N must not be mixed.

11.3 Anti-condensation measures

The customer must take measures to protect the devices against condensation.

Condensation occurs when the inlet temperature of the coolant is significantly lower than room temperature (ambient temperature). The permissible temperature difference between coolant and air varies as a function of the relative humidity φ of the ambient air. The air temperature at which the aqueous phase precipitates is referred to as the "dew point".

The table below shows the dew points (in °C) for an atmospheric pressure of 100 kPa (≈ installation altitude: 0 to 500 m). If the temperature of the coolant is below the specified value, condensation may occur (i.e. the coolant temperature must always be ≥ the dew point temperature).

Table 11- 2 Dew point temperature as a function of relative air humidity φ and room temperature at an installation altitude of 0 m.

T room [°C]	Φ=20%	Φ=30%	Φ=40%	Φ=50%	Φ=60%	Φ=70%	Φ=80%	Φ=85%	Φ=90%	Φ=95%	Φ=100%
10	<0	<0	<0	0.2	2.7	4.8	6.7	7.6	8.4	9.2	10
20	<0	2	6	9.3	12	14.3	16.4	17.4	18.3	19.1	20
25	0.6	6.3	10.5	13.8	16.7	19.1	21.2	22.2	23.2	24.1	24.9
30	4.7	10.5	14.9	18.4	21.3	23.8	26.1	27.1	28.1	29	29.9
35	8.7	14.8	19.3	22.9	26	28.6	30.9	32	33	34	34.9
38	11.1	17.4	22	25.7	28.8	31.5	33.8	34.9	36	36.9	37.9
40	12.8	19.1	23.7	27.5	30.6	33.4	35.8	36.9	37.9	38.9	39.9
45	16.8	23.3	28.2	32	35.3	38.1	40.6	41.8	42.9	43.9	44.9
50	20.8	27.5	32.6	36.6	40	42.9	45.5	46.6	47.8	48.9	49.9
55	24.9	31.9	37.1	41.2	44.7	47.7	50.4	51.7	52.8	53.9	55

The dew point also depends on the absolute pressure (i.e. the installation altitude).

The dew points for low atmospheric pressure are lower than those at an altitude of 0 m (i.e. it is always acceptable to calculate the coolant supply temperature for an altitude of 0 m).

For short periods of condensation in Power Modules PM340 Liquid Cooled, framed size FSF, the condensate may be collected inside the components and removed by a hose (see dimensional drawing).

11.4 Equipotential bonding

All components in the cooling system (SINAMICS units, heat exchanger, piping system, pump, pressure compensator, etc.) must be connected to an equipotential bonding system. A copper bar or stranded copper with the appropriate conductor cross-sections must be used for this purpose to eliminate electrochemical processes.

If the installation comprises more than one control cabinet, they must be bolted together with good conductivity (e.g. bolt cabinet cross-beams together directly at several points to establish a conductive connection). This eliminates potential differences and, in turn, the risk of electrochemical corrosion. A PE bar must be installed in every cabinet (including the recooling system) and the individual bars interconnected.

Service and maintenance 12

12.1 Safety instructions for service and maintenance

Note

For all service and maintenance work, also observe the safety instructions in Chapter 1.

⚠ WARNING

Danger of death when live parts are touched

The devices are operated with hazardous voltages. Touching live components can result in death or severe injury.

- Only work on the device if you are appropriately qualified to do so.
- You must carry out all connection work in the no-voltage state.
- Dangerously high voltage levels are still present in the cabinet up to five minutes after it has been disconnected due to the DC link capacitors. Therefore, only open the device after the appropriate waiting time has expired. Before starting any work, after the waiting time has elapsed, carefully measure the voltage. The voltage can be measured between the DC link terminals DCP and DCN and must be below 42.2 V DC.
- The power and control terminals may have hazardous voltage levels even when the motor is not running. Be extremely careful when carrying out work on the opened device.

⚠ WARNING

Danger of death from the external power supply

If the auxiliary 230 V AC supplies are present, then a hazardous voltage is present at the components even when the main switch is in the open state.

⚠ WARNING

Risk of accident when incorrectly lifting and transporting devices and components

Serious injury or even death and substantial material damage can occur if the devices are not lifted or transported properly.

- Transport, mount and remove the devices and components only if you have been trained to do so.
- Take into account that the devices and components are in some cases heavy and top-heavy; take the necessary precautionary measures.

12.2 Service and maintenance for components, Blocksize format

12.2.1 Replacing hardware components

Note

Hardware components may only be replaced when in the no-voltage state!

The following components can be replaced with replacement/exchange components with the same Order No.:

- Power Modules
- DRIVE-CLiQ components
- Control Units

12.2.2 Replacing the fan CU310-2 DP and CU310-2 PN

The fan is found on the underside of the CU310-2. It switches itself on according to the internal temperature in the unit.

If the internal temperature of the CU310-2 (CU parameter r0037[0]) exceeds the permissible limit value, the following warning message is issued:
A1009: CU warning: Control Unit overtemperature

In this event, check whether

1. the control cabinet temperature is in the permissible range,
2. free convection is possible,
3. the fan is blocked by dirt or foreign bodies.
4. the fan can rotate freely.

The warning message will be cleared as soon as the fault is rectified and the temperature falls below the permissible limit.

Note

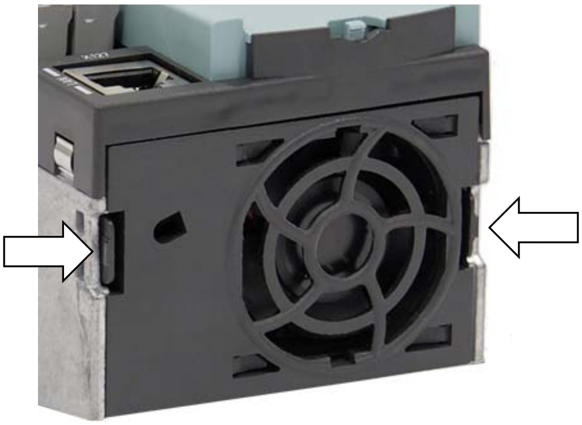
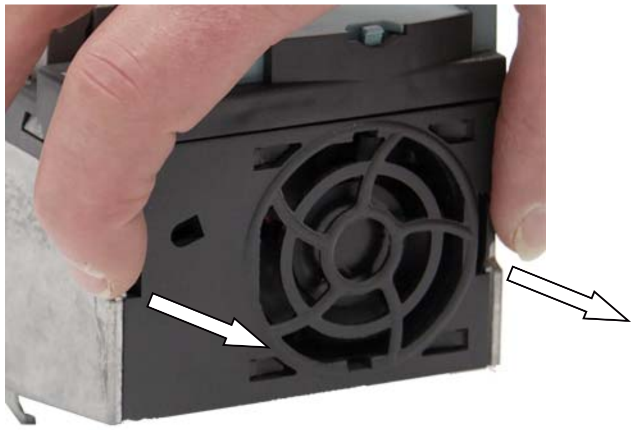
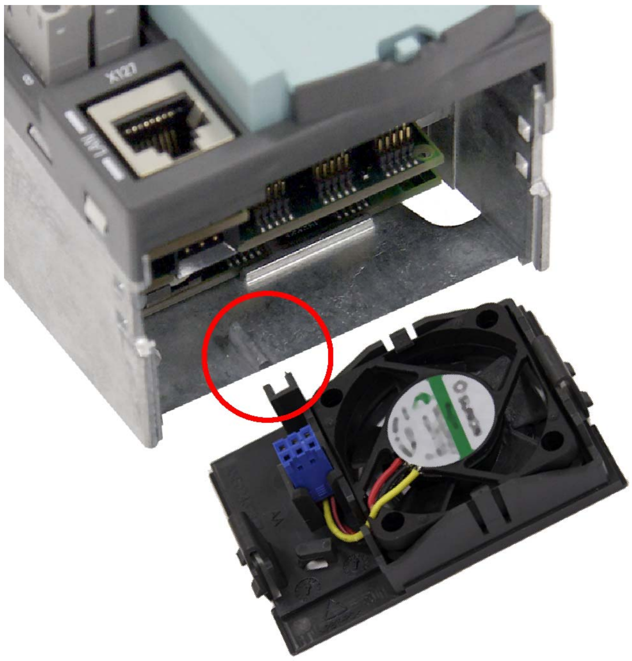
If the fan does not rotate and all the sources of the fault (items 1 to 4) can be excluded, then the fan is faulty and must be replaced.

Replacing the fan

The fan is available as a spare part and has the order number: 6SL3064-1AC00-0AA0.

⚠ CAUTION

The fan on the CU310-2 control unit may only be replaced by qualified skilled personnel and strictly in accordance with ESD guidelines.

1.	Disconnect the drive line-up from the power supply.		
2.	Remove the CU310-2 from the drive line-up (see "CU310-2 DP/CU310-2 PN chapter, section: "Mounting").		
			
3.	Release the snap hooks on the left and right sides of fan by pressing them inwards.	4.	Remove the fan forwards out of the CU310-2's housing.
			

5.	Locate the centering frame of the replacement fan on the mounting cam of the CU310-2.	6.	Slide the replacement fan onto the mounting cam in the Control Unit. Ensure that the fan connector fits into the centering frame of the PC board. Engage the two snap hooks at the fan in the Control Unit housing.
7.	Fit the CU310-2 to the drive line-up.		

12.2.3 Replacing the fan on the PM340

Fans are available as spare parts for all frame sizes of PM340.

Note

Only trained personnel may replace the fan, observing ESD guidelines.

Preconditions

1. Disconnect the PM340 from the power supply.
2. Remove the device or the drive line-up.

Frame sizes FSA/FSB/FSC

Note

You will require a cross-tip screwdriver to remove and install the fan of the PM340 for frame sizes FSA to FSC.

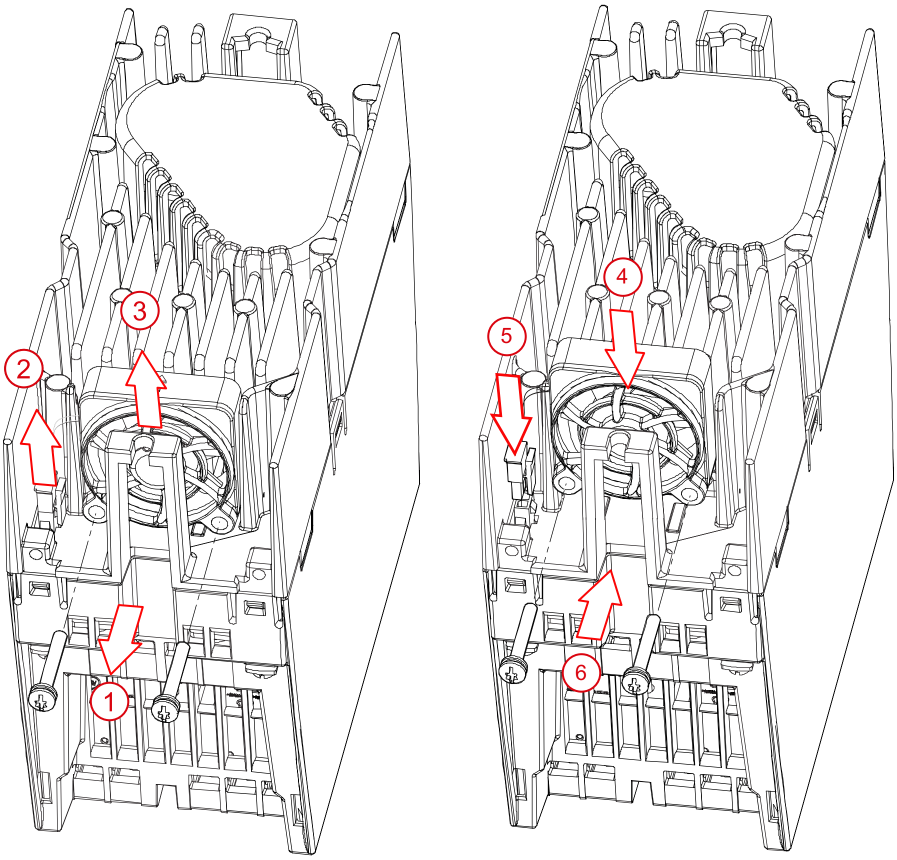


Figure 12-1 PM340 fan replacement, frame size FSA

1. Remove the fixing screws.
2. Remove the connector.
3. Remove the fan.
4. Insert the new fan.
5. Insert the connector.
6. Tighten the mounting screws (0.4 Nm tightening torque).

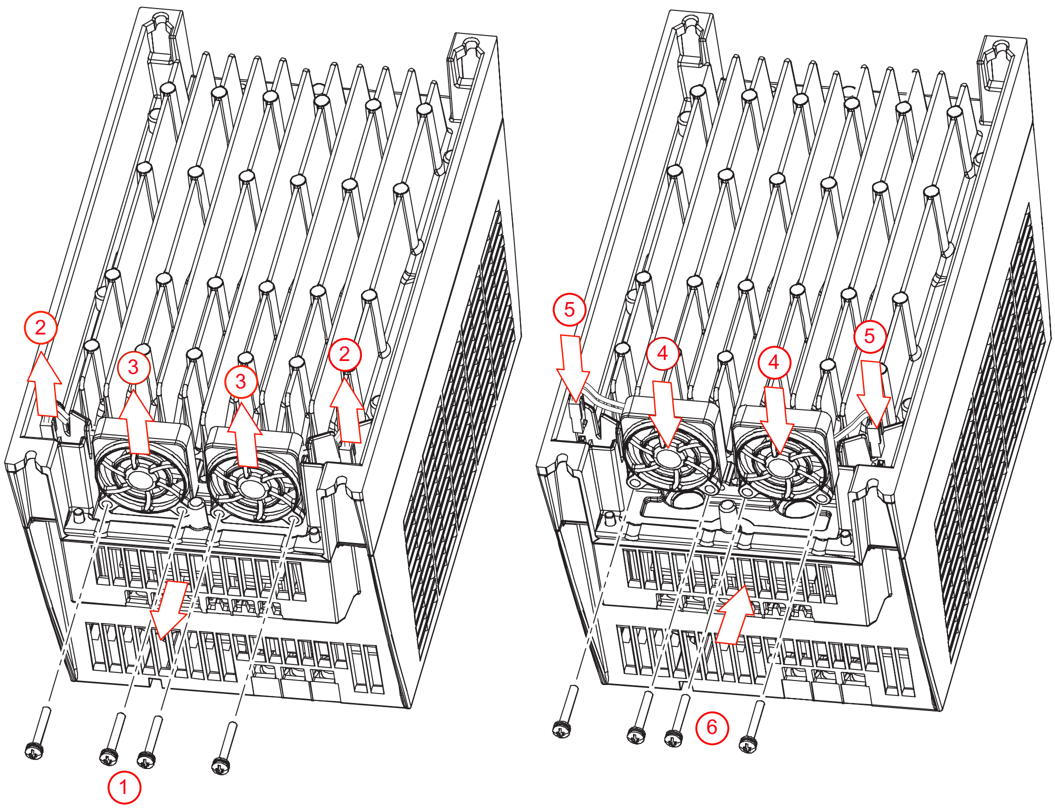


Figure 12-2 PM340 fan replacement, frame size FSB/FSC (0.4 Nm tightening torque)

Frame sizes FSD/FSE

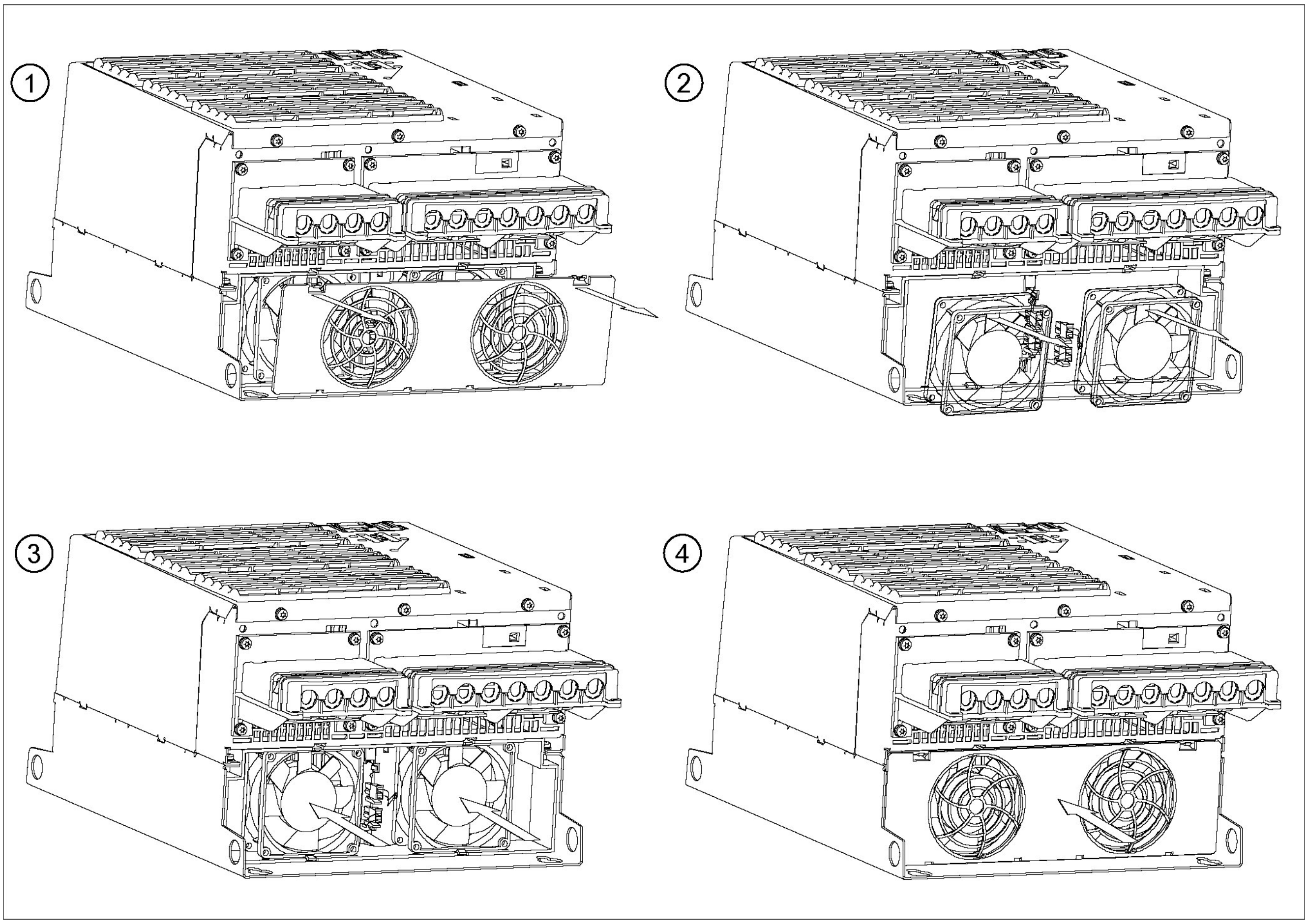


Figure 12-3 PM340 fan replacement, frame sizes FSD/FSE

1. Remove the cover.
2. Remove both connectors and both fans.
3. Insert the new fans and reattach both connectors.
4. Close the cover.

Frame size FSF

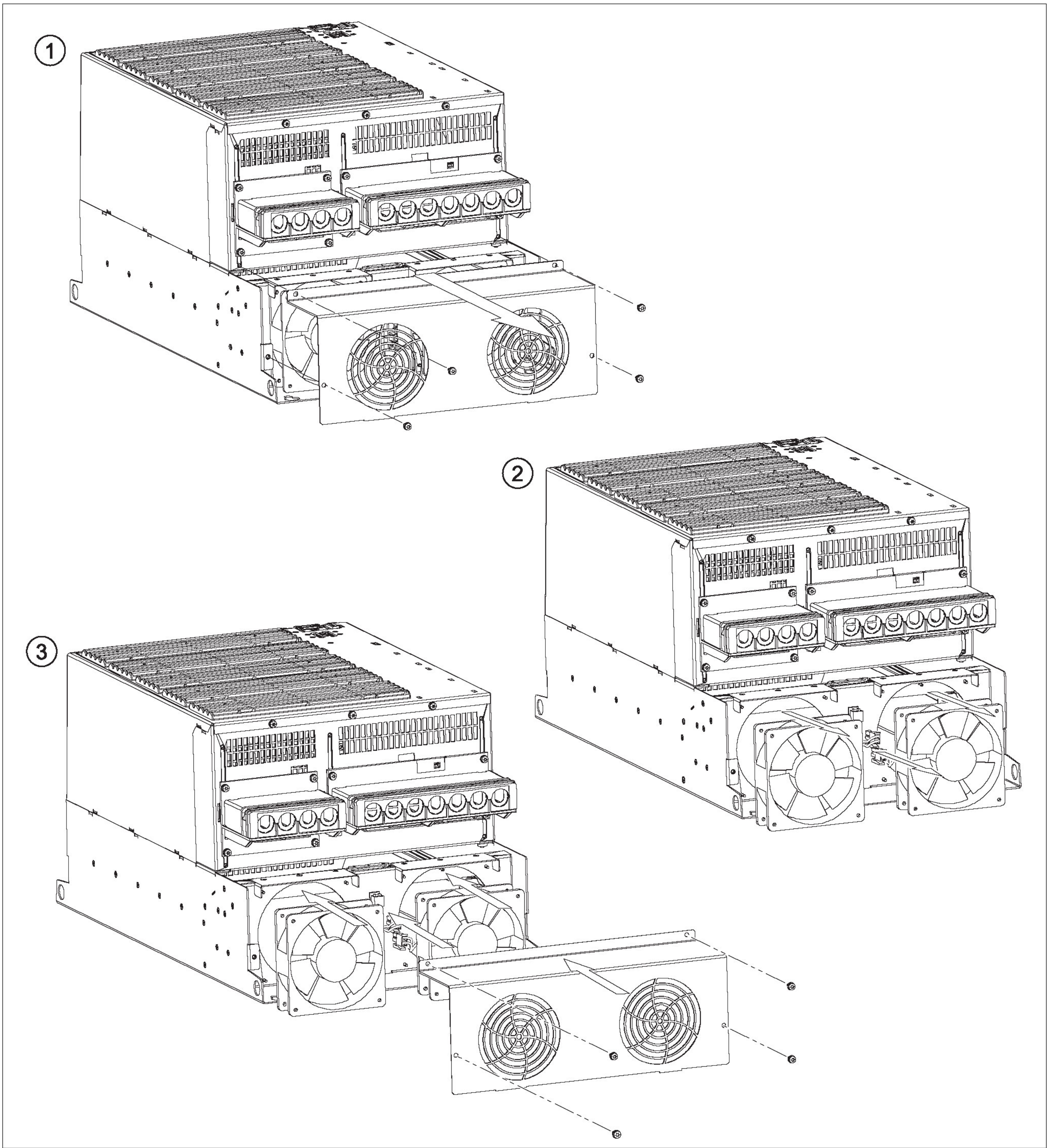


Figure 12-4 PM340 fan replacement, frame size FSF

1. Unfasten the screws and remove the cover.
2. Remove both connectors and both fans.
3. Insert the new fans, attach both connectors, close the cover and fasten the screws (3.0 Nm tightening torque).

12.3 Service and maintenance for Chassis format components

Maintenance is intended to ensure that the equipment remains in the specified condition. Dirt and contamination must be removed regularly and parts subject to wear replaced.

The following points must generally be observed.

Dust deposits

Dust deposits inside the device must be removed at regular intervals (or at least once a year) by qualified personnel in line with the relevant safety regulations. The device must be cleaned using a brush and vacuum cleaner. Areas that cannot be easily reached must be cleaned with dry compressed air (max. 100 kPa).

Ventilation

The ventilation openings in the device must never be obstructed. The fans must be checked to make sure that they are functioning correctly.

Cable and screw terminals

Cable and screw terminals must be checked regularly to ensure that they are secure in position, and if necessary, retightened. Cabling must be checked for defects. Defective parts must be replaced immediately.

Note

The actual intervals at which maintenance procedures are to be performed depend on the installation conditions (cabinet environment) and the operating conditions.

Siemens offers its customers support in the form of a service contract. For further details, contact your regional office or sales office.

12.3.1 Maintenance

Servicing involves activities and procedures for maintaining and restoring the operating condition of the devices.

Required tools

The following tools are required for replacing components:

- Spanner or socket spanner (w/f 10)
- Spanner or socket spanner (w/f 13)
- Spanner or socket spanner (w/f 16/17)
- Spanner or socket spanner (w/f 18/19)
- Hexagon-socket spanner (size 8)
- Torque wrench up to 50 Nm
- Screwdriver size 1 / 2
- Screwdriver Torx T20
- Screwdriver Torx T30

Tightening torques for current-carrying parts

When securing connections for current-carrying parts (line supply, motor connections, busbars), you must observe the following tightening torques.

Table 12- 1 Tightening torques for connecting current-carrying parts

Screw	Torque
M6	6 Nm
M8	13 Nm
M10	25 Nm
M12	50 Nm

12.3.2 Installation equipment

Description

The installation equipment is used to install and remove the power blocks for Power Modules in the Chassis format.

It is used as an installation aid, which is placed in front of and secured to the module. The telescopic guide support allows the withdrawable device to be adjusted according to the height at which the power blocks are installed. Once the mechanical and electrical connections have been removed, the power block can be removed from the module, whereby the power block is guided and supported by the guide rails on the withdrawable devices.

Figure 12-5 Installation equipment

Order No.

Order number for the installation device: 6SL3766-1FA00-0AA0.

12.3.3 Replacing components

12.3.3.1 Replacing the Powerblock, Power Module, frame size FX

Replacing the Powerblock

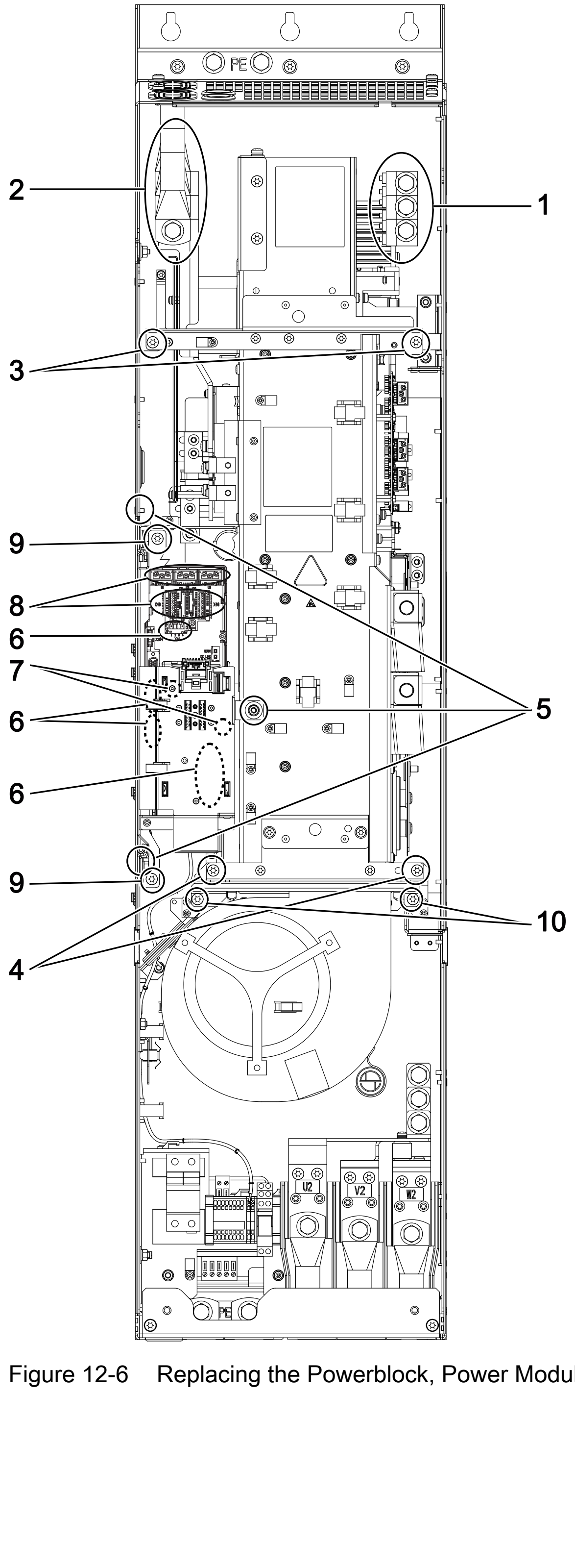


Figure 12-6 Replacing the Powerblock, Power Module, frame size FX

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Powerblock
- Remove the front cover

Removal steps

The steps for the removal procedure are numbered in accordance with the previous diagram.

1. Unscrew the connection to the outgoing motor section (3 screws).
2. Unscrew the connection to the mains supply (3 screws).
3. Remove the retaining screws at the top (2 screws).
4. Remove the retaining screws at the bottom (2 screws).
5. Remove the retaining nuts of the supporting plate for the Control Unit and then remove the supporting plate itself (3 nuts).
6. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (6 connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
7. Take out the retaining screws for the IPD card (2 screws) and remove the IPD card from plug -X45 on the Control Interface Module.
8. Disconnect the plug-in connections for the fiber-optic cables and signal cables (5 plugs).
9. Remove the retaining screws of the plug-in module (2 screws) and carefully remove the plug-in module.
   When removing the plug-in module, 5 additional plugs (2 at the top, 3 at the bottom) must be removed one after the other.
10. Unscrew the 2 retaining screws for the fan and attach the mounting device for the Powerblock at this position.

You can now remove the Powerblock.

⚠ CAUTION
The power block weighs approx. 70 kg! When removing the power block, ensure that you do not damage any signal cables.

Installation steps

Installing is the same as removing, however in the reverse order.

⚠ CAUTION
You must carefully observe the specified tightening torques.
Carefully insert the plug connections and ensure that they are secure.
The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

Note

Connection clip to the interference-suppression capacitor

The connection clip to the interference-suppression capacitor is mounted on the spare power block together with a yellow warning label.

Please note the information in the chapter "Electrical connection" of the corresponding device.

12.3.3.2 Replacing the Powerblock, Power Module, frame size GX

Replacing the powerblock

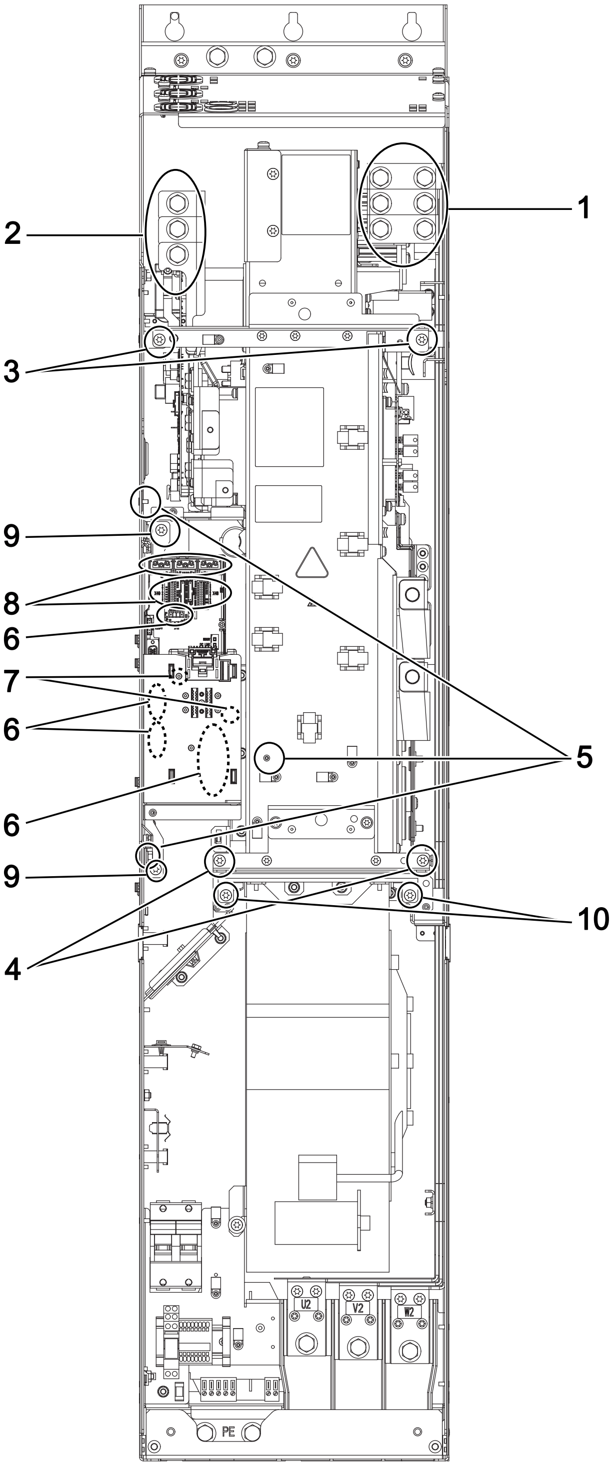


Figure 12-7 Replacing the Powerblock, Power Module, frame size GX

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Powerblock
- Remove the front cover

Removal steps

The steps for the removal procedure are numbered in accordance with the previous diagram.

1. Unscrew the connection to the motor outgoing feeder (6 screws).
2. Unscrew the connection to the mains supply (3 screws).
3. Remove the retaining screws at the top (2 screws).
4. Remove the retaining screws at the bottom (2 screws).
5. Remove the retaining nuts of the supporting plate for the Control Unit and then remove the supporting plate itself (3 nuts).
6. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (6 connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
7. Take out the retaining screws for the IPD card (2 screws) and remove the IPD card from plug -X45 on the Control Interface Module.
8. Disconnect the plug-in connections for the fiber-optic cables and signal cables (5 plugs).
9. Remove the retaining screws of the plug-in module (2 screws) and carefully remove the plug-in module.
   When removing the plug-in module, 5 additional plugs (2 at the top, 3 at the bottom) must be removed one after the other.
10. Unscrew the 2 retaining screws for the fan and attach the mounting device for the Powerblock at this position.

You can now remove the Powerblock.

⚠ CAUTION
The power block weighs approx. 102 kg! When removing the power block, ensure that you do not damage any signal cables.

Installation steps

Installing is the same as removing, however in the reverse order.

⚠ CAUTION
You must carefully observe the specified tightening torques. Carefully insert the plug connections and ensure that they are secure. The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

Note

Connection clip to the interference-suppression capacitor

The connection clip to the interference-suppression capacitor is mounted on the spare power block together with a yellow warning label.

Please note the information in the chapter "Electrical connection" of the corresponding device.

12.3.3.3 Replacing the Control Interface Module, Power Module, frame size FX

Replacing the Control Interface Module

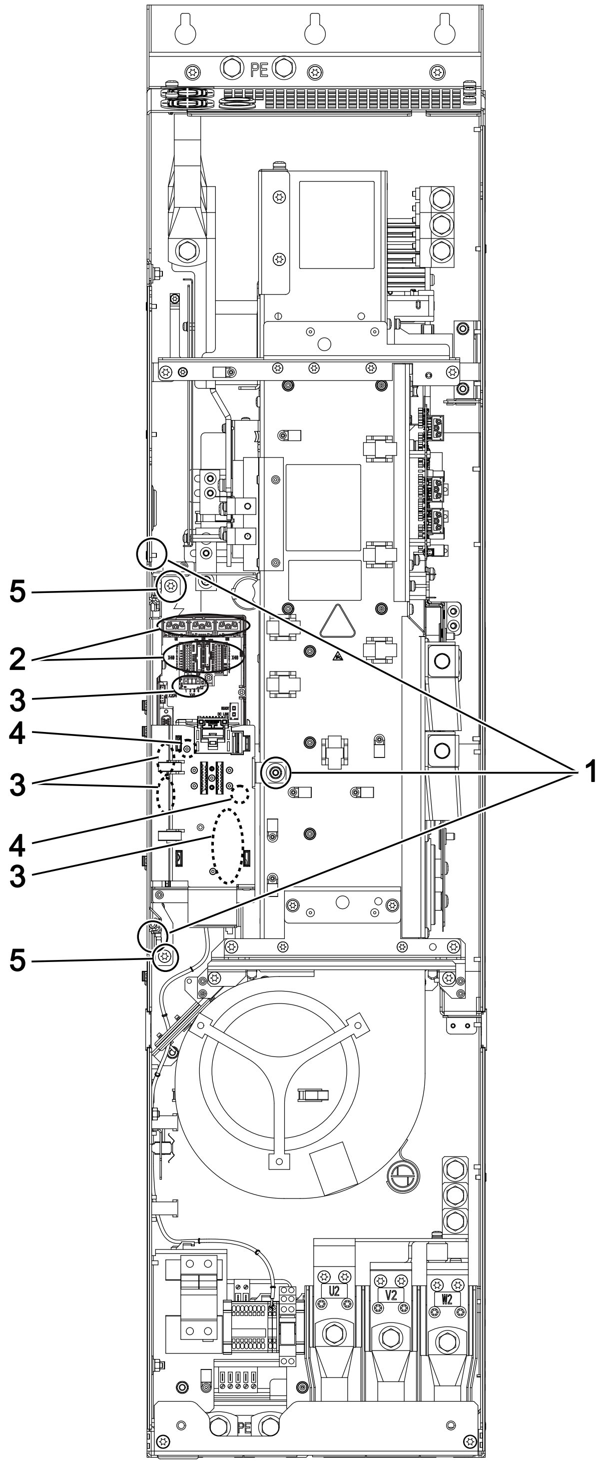


Figure 12-8 Replacing the Control Interface Module, Power Module, frame size FX

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Powerblock
- Remove the front cover

Removal steps

The steps for the removal procedure are numbered in accordance with the previous diagram.

1. Remove the retaining nuts of the supporting plate for the Control Unit and then remove the supporting plate itself (3 nuts).
2. Disconnect the plug-in connections for the fiber-optic cables and signal cables (5 plugs).
3. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (6 connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
4. Take out the retaining screws for the IPD card (2 screws) and remove the IPD card from plug -X45 on the Control Interface Module.
5. Remove the retaining screws for the Control Interface Module (2 screws).
   When removing the Control Interface Module, 5 additional plugs (2 at the top, 3 at the bottom) must be removed one after the other.

⚠ CAUTION
When removing, ensure that you do not damage any signal cables.

Installation steps

Installing is the same as removing, however in the reverse order.

⚠ CAUTION
You must carefully observe the specified tightening torques. Carefully insert the plug connections and ensure that they are secure. The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

12.3.3.4 Replacing the Control Interface Module, Power Module, frame size GX

Replacing the Control Interface Module

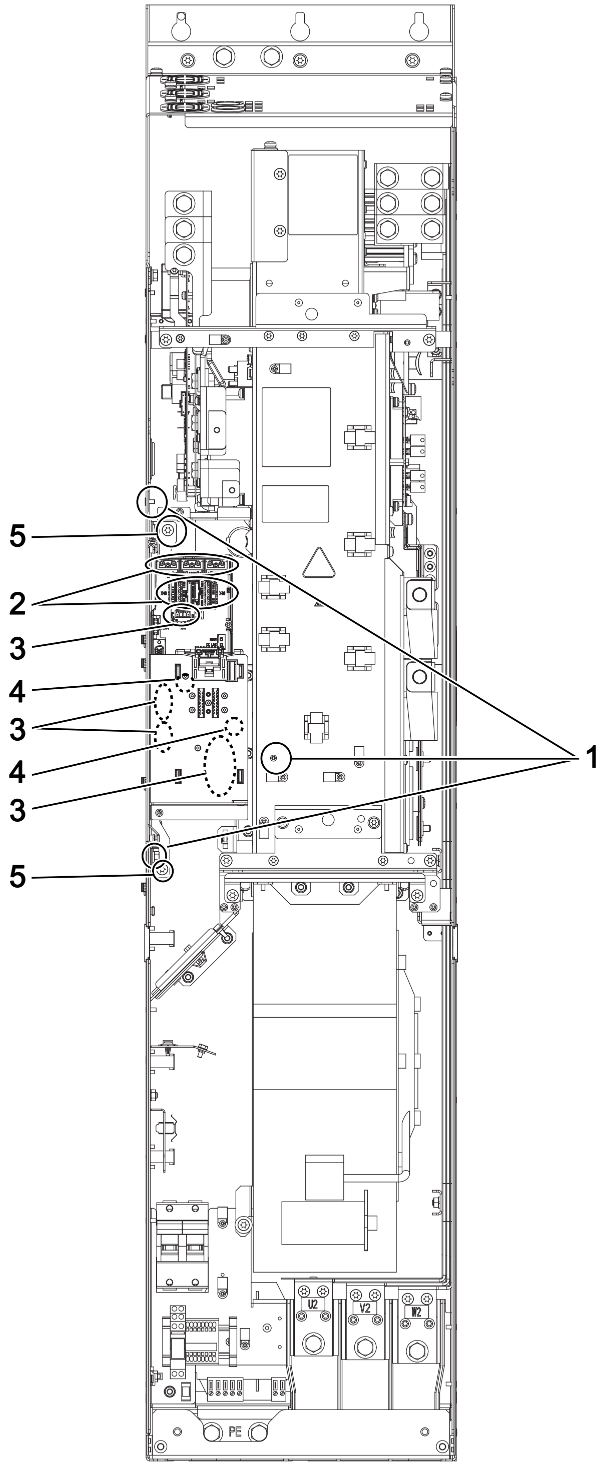


Figure 12-9 Replacing the Control Interface Module, Power Module, frame size GX

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Powerblock
- Remove the front cover

Removal steps

The steps for the removal procedure are numbered in accordance with the previous diagram.

1. Remove the retaining nuts of the supporting plate for the Control Unit and then remove the supporting plate itself (3 nuts).
2. Disconnect the plug-in connections for the fiber-optic cables and signal cables (5 plugs).
3. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (6 connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
4. Take out the retaining screws for the IPD card (2 screws) and remove the IPD card from plug -X45 on the Control Interface Module.
5. Remove the retaining screws for the Control Interface Module (2 screws).
   When removing the Control Interface Module, 5 additional plugs (2 at the top, 3 at the bottom) must be removed one after the other.

⚠ CAUTION
When removing, ensure that you do not damage any signal cables.

Installation steps

Installing is the same as removing, however in the reverse order.

⚠ CAUTION
You must carefully observe the specified tightening torques. Carefully insert the plug connections and ensure that they are secure. The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

12.3.3.5 Replacing the fan, Power Module, frame size FX

Replacing the fan

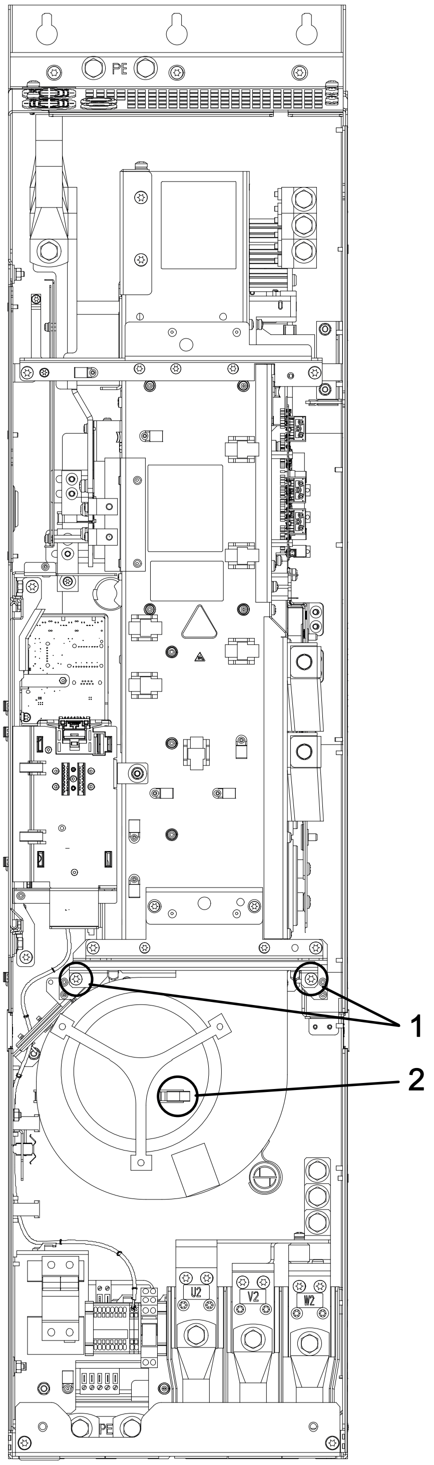


Figure 12-10 Replacing the fan, Power Module, frame size FX

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables, including ambient temperature and the degree of cabinet protection and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the device is available.

Preparatory steps

- Disconnect the drive line-up from the power supply.
- Allow unimpeded access.
- Remove the front cover.

Removal

The steps for the removal procedure are numbered in accordance with the previous diagram.

1. Remove the retaining screws for the fan (2 screws).
2. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

NOTICE
When removing the fan, ensure that the cables are not damaged.

Installation

To re-install the fan, carry out the above steps in reverse order.

NOTICE
You must observe the specified tightening torques. Carefully re-establish the plug connections and ensure that they are secure.

12.3.3.6 Replacing the fan, Power Module, frame size GX

Replacing the fan

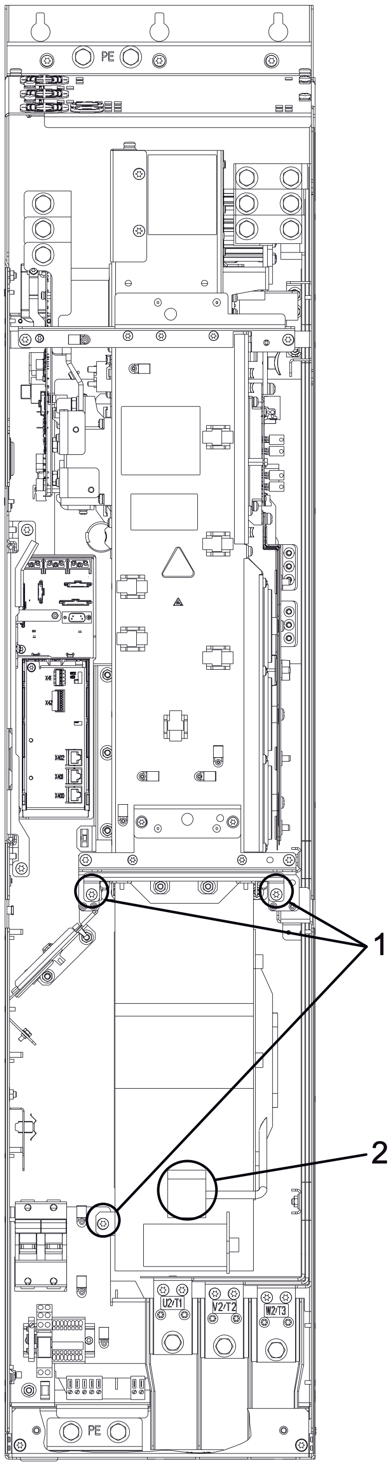


Figure 12-11 Replacing the fan, Power Module, frame size GX

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables, including ambient temperature and the degree of cabinet protection and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the device is available.

Preparatory steps

- Disconnect the drive line-up from the power supply.
- Allow unimpeded access.
- Remove the front cover.

Removal

The steps for the removal procedure are numbered in accordance with the previous diagram.

1. Remove the retaining screws for the fan (3 screws).
2. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

NOTICE
When removing the fan, ensure that the cables are not damaged.

Installation

To re-install the fan, carry out the above steps in reverse order.

NOTICE
You must observe the specified tightening torques. Carefully re-establish the plug connections and ensure that they are secure.

12.4 Forming the DC link capacitors

⚠ CAUTION

If the Power Modules are kept in storage for more than two years, the DC link capacitors have to be reformed. If this is not performed, the units could be damaged when they are switched on.

If the cabinet is commissioned within two years of its date of manufacture, the DC link capacitors do not need to be reformed. The date of manufacture can be taken from the serial number on the rating plate.

Note

It is important that the storage period is calculated from the date of manufacture and not from the date that the equipment was shipped.

Date of manufacture

The date of manufacture can be determined from the following assignment to the serial number (e.g. T-**S9**2067000015 for 2004, September):

Table 12- 2 Production year and month

Character	Year of manufacture	Character	Month of manufacture
S	2004	1 to 9	January to September
D	2005	O	October
U	2006	N	November
V	2007	D	December
W	2008		
X	2009		
A	2010		
B	2011		
C	2012		
D	2013		
E	2014		

The serial number is found on the rating plate.

When DC link capacitors are formed, a defined voltage is connected to them and a defined current flows so that the appropriate capacitor characteristics are re-established for them to be re-used as DC link capacitors.

Forming circuit

The forming circuit can be established using incandescent lamps or alternatively, resistors.

Components required for reforming outside the drive line-up

- 1 fuse switch, triple 400 V / 10 A or double 230 V / 10 A
- Cable 1.5 mm²
- 3 incandescent lamps 230 V/100 W for a line voltage of 380 to 480 V 3-ph AC. Alternatively, use three 1 kΩ / 100 W resistors (e.g. GWK150J1001KLX000 from Vishay) instead of the incandescent lamps.
- 2 incandescent lamps 230 V/100 W for a line voltage of 200 to 240 V 1-ph AC. Alternatively, use 2 1 kΩ / 100 W resistors (e.g. GWK150J1001KLX000 from Vishay) instead of the incandescent lamps.
- Various Small components, such as lamp socket, etc.

⚠ DANGER
Dangerously high voltage levels are still present in the cabinet up to 5 minutes after it has been disconnected due to the DC link capacitors. It is only permissible to work on the equipment or at the DC link terminals after this time has expired.

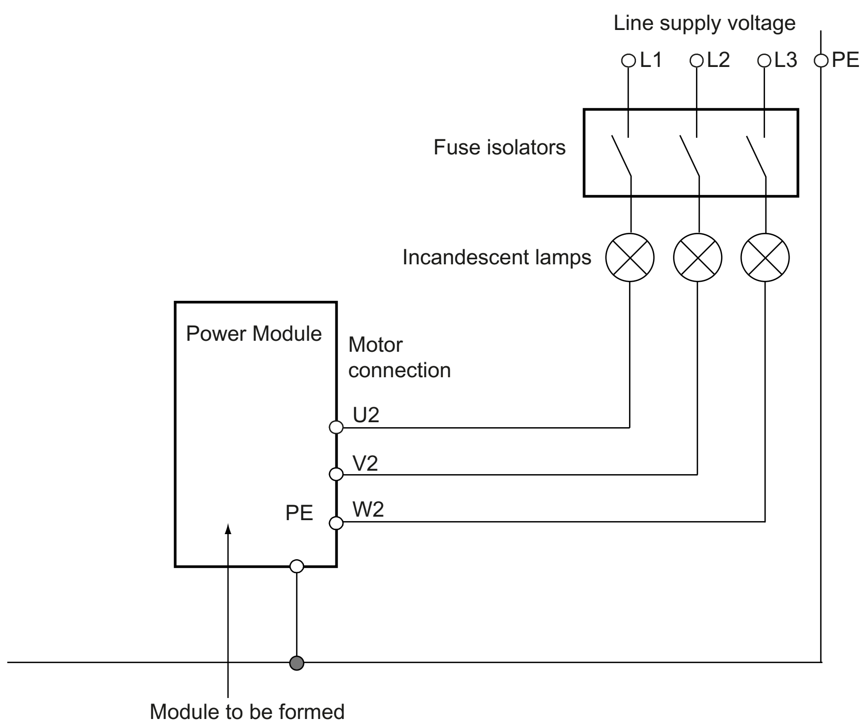


Figure 12-12 Forming circuit for 3-ph AC Power Modules with incandescent lamps

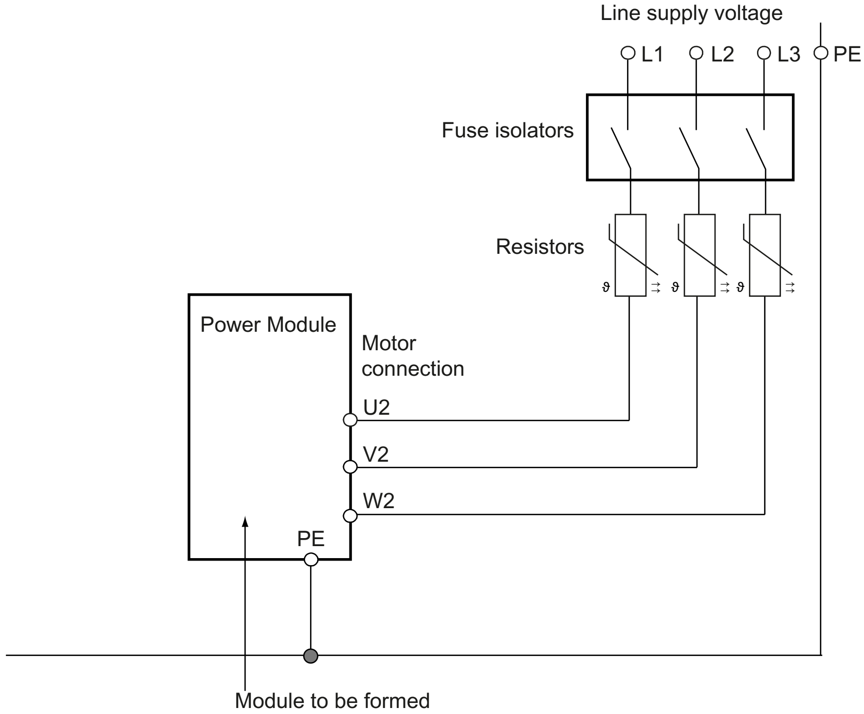


Figure 12-13 Forming circuit for 3-ph AC Power Modules with resistors

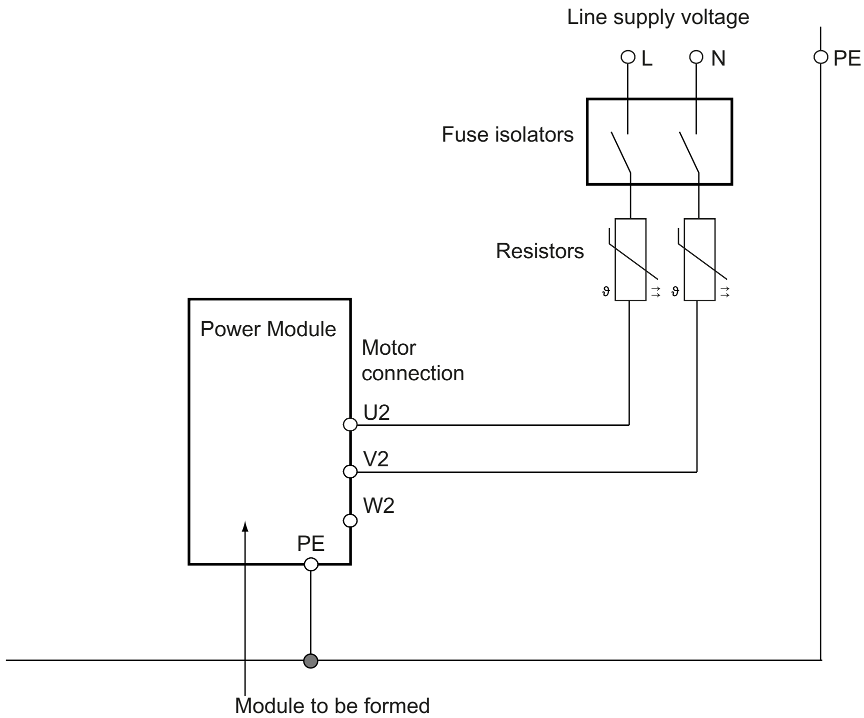


Figure 12-14 Forming circuit for 1-ph AC Power Modules with resistors

Procedure

- Make sure that the device **does not** receive a power-on command (e.g. from the keyboard or terminal block).
- Connect the forming circuit.
- While forming, the incandescent lamps must become less bright or go completely dark. If the incandescent lamps continue to be brightly lit, a fault has occurred in the drive unit or in the wiring.
- To form using resistors, the modules must remain in the circuit for approx. 1h. The resistors will become very hot if there is a fault in the unit (surface temperature > 80°C).

12.5 Spare parts

Spare parts are available on the Internet at:

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

12.6 Recycling and disposal

The applicable national guidelines must be observed when disposing of the product.

The products described in this Equipment Manual are extensively recyclable on account of the low-toxic composition of the materials used. For environmentally-compliant recycling and disposal of your electronic waste, please contact a company for the disposal of electronic waste.

Appendix A

A

A.1 List of abbreviations

Note:

The following list of abbreviations includes all abbreviations and their meanings used in the entire SINAMICS user documentation.

Abbreviation	Source of abbreviation	Meaning
A		
A...	Alarm	Alarm
AC	Alternating Current	Alternating current
ADC	Analog Digital Converter	Analog digital converter
AI	Analog Input	Analog input
AIM	Active Interface Module	Active Interface Module
ALM	Active Line Module	Active Line Module
AO	Analog Output	Analog output
AOP	Advanced Operator Panel	Advanced Operator Panel
APC	Advanced Positioning Control	Advanced Positioning Control
AR	Automatic Restart	Automatic restart
ASC	Armature Short Circuit	Armature short circuit
ASCII	American Standard Code for Information Interchange	American standard code for information interchange
ASM	Asynchronmotor	Induction motor
B		
BERO	-	Contactless proximity switch
BI	Binector Input	Binector input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit	Germany's Institute for Occupational Safety and Health
BICO	Binector Connector Technology	Binector connector technology
BLM	Basic Line Module	Basic Line Module
BO	Binector Output	Binector output
BOP	Basic Operator Panel	Basic Operator Panel

Abbreviation	Source of abbreviation	Meaning
C		
C	Capacitance	Capacitance
C...	-	Safety message
CAN	Controller Area Network	Serial bus system
CBC	Communication Board CAN	Communication board CAN
CD	Compact Disc	Compact Disc
CDC	Crosswise data comparison	Crosswise data comparison
CDS	Command Data Set	Command data set
CF Card	CompactFlash Card	CompactFlash Card
CI	Connector Input	Connector input
CLC	Clearance Control	Clearance control
CNC	Computer Numerical Control	Computer numerical control
CO	Connector Output	Connector output
CO/BO	Connector Output/Binector Output	Connector/binector output
COB ID	CAN Object Identification	CAN Object identification
COM	Common contact of a changeover relay	Center contact of a changeover contact
COMM	Commissioning	Commissioning
CP	Communication Processor	Communication processor
CPU	Central Processing Unit	Central processing unit
CRC	Cyclic Redundancy Check	Cyclic redundancy check
CSM	Control Supply Module	Control Supply Module
CU	Control Unit	Control Unit
CUA	Control Unit Adapter	Control Unit Adapter
CUD	Control Unit DC MASTER	Control Unit DC MASTER
D		
DAC	Digital Analog Converter	Digital analog converter
DC	Direct Current	DC current
DC link	DC link	DC link
DCB	Drive Control Block	Drive Control Block
DCC	Drive Control Chart	Drive Control Chart
DCC	Data Cross Check	Crosswise data comparison
DCN	Direct Current Negative	DC current negative
DCP	Direct Current Positive	DC current positive
DDS	Drive Data Set	Drive data set
DI	Digital Input	Digital input
DI/DO	Digital Input/Digital Output	Digital input/output bidirectional
DMC	DRIVE-CLiQ Hub Module Cabinet	DRIVE-CLiQ Hub Module Cabinet
DME	DRIVE-CLiQ Hub Module External	DRIVE-CLiQ Hub Module External
DO	Digital Output	Digital output
DO	Drive Object	Drive object

Abbreviation	Source of abbreviation	Meaning
DP	Decentralized Peripherals	Distributed IOs
DPRAM	Dual Ported Random Access Memory	Memory with dual access ports
DRAM	Dynamic Random Access Memory	Dynamic memory
DRIVE-CLiQ	Drive Component Link with IQ	Drive Component Link with IQ
DSC	Dynamic Servo Control	Dynamic Servo Control
E		
EASC	External Armature Short Circuit	External armature short circuit
EDS	Encoder Data Set	Encoder data set
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ELCB	Earth Leakage Circuit Breaker	Earth leakage circuit breaker
ELP	Earth Leakage Protection	Earth leakage protection
EMC	Electromagnetic Compatibility	Electromagnetic compatibility
EMF	Electromagnetic Force	Electromagnetic force
EMC	Electromagnetic compatibility	Electromagnetic compatibility
EN	European standard	European standard
EnDat	Encoder Data Interface	Encoder interface
EP	Enable Pulses	Pulse enable
EPOS	Einfachpositionierer	Basic positioner
ES	Engineering System	Engineering System
ESB	Equivalent circuit diagram	Equivalent circuit diagram
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ESR	Extended Stop and Retract	Extended stop and retract
F		
F...	Fault	Fault
FAQs	Frequently Asked Questions	Frequently asked questions
FBL	Free Blocks	Free function blocks
FCC	Function Control Chart	Function Control Chart
FCC	Flux Current Control	Flux current control
FD	Function Diagram	Function diagram
F-DI	Failsafe Digital Input	Fail-safe digital input
F-DO	Failsafe Digital Output	Fail-safe digital output
FEM	Fremderregter Synchronmotor	Separately excited synchronous motor
FEPROM	Flash EPROM	Non volatile read and write memory
FG	Function Generator	Function generator
FI	-	Fault current
FOC	Fiber-Optic Cable	Fiber-optic cable
FP	Function diagram	Function diagram
FPGA	Field Programmable Gate Array	Field Programmable Gate Array

Abbreviation	Source of abbreviation	Meaning
FW	Firmware	Firmware
G		
GB	Gigabyte	Gigabyte
GC	Global Control	Global Control Telegram (Broadcast Telegramm)
GND	Ground	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as G)
GSD	Generic Station Description	Generic station description: Describes the characteristics of a PROFIBUS slave
GSV	Gate Supply Voltage	Gate Supply Voltage
GUID	Globally Unique Identifier	Globally unique identifier
H		
HF	High Frequency	High frequency
HFD	Hochfrequenzdrossel	High-frequency reactor
HMI	Human Machine Interface	Human machine interface
HTL	High-Threshold Logic	Logic with a high fault threshold
HW	Hardware	Hardware
I		
I/O	Input/Output	Input/output
I2C	Inter-Integrated Circuit	Internal serial data bus
IASC	Internal Armature Short Circuit	Internal armature short circuit
IBN	Inbetriebnahme	Commissioning
ID	Identifier	Identification
IE	Industrial Ethernet	Industrial Ethernet
IEC	International Electrotechnical Commission	International Electrotechnical Commission
IF	Interface	Interface
IGBT	Insulated Gate Bipolar Transistor	Insulated gate bipolar transistor
IGCT	Integrated Gate-Controlled Thyristor	Semiconductor power switch with integrated control electrode
IL	Impulslöschung	Pulse cancelation
IP	Internet Protocol	Internet Protocol
IPO	Interpolator	Interpolator
IT	Isolé Terré	Non-grounded three-phase power supply
IVP	Internal Voltage Protection	Internal voltage protection
J		
JOG	Jogging	Jogging

Abbreviation	Source of abbreviation	Meaning
K		
KIP	Kinetische Pufferung	Kinetic buffering
Kp	-	Proportional gain
KTY	-	Special temperature sensor
L		
L	-	Formula symbol for inductance
LED	Light Emitting Diode	Light Emitting Diode
LIN	Linear motor	Linear motor
LSB	Least Significant Bit	Least significant bit
LSC	Line-Side Converter	Line-side converter
LSS	Line Side Switch	Line side switch
LU	Length Unit	Length unit
M		
M	-	Formula symbol for torque
M	Masse	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as GND)
MB	Megabyte	Megabyte
MCC	Motion Control Chart	Motion Control Chart
MDS	Motor Data Set	Motor data set
MLFB	Maschinenlesbare Fabrikatebezeichnung	Machine-Readable Product Code
MMC	Man-Machine Communication	Man-machine communication
MMC	Micro Memory Card	Micro memory card
MSB	Most Significant Bit	Most significant bit
MSC	Motor-Side Converter	Motor-side converter
MSCY_C1	Master Slave Cycle Class 1	Cyclic communication between master (Class 1) and slave
MSR	Motorstromrichter	Motor-side converter
MT	Machine Tool	Machine tool
N		
N. C.	Not Connected	Not connected
N...	No Report	No message or internal message
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie	Standardization association for measurement and control in the chemical industry
NC	Normally Closed (contact)	NC contact
NC	Numerical Control	Numerical control
NEMA	National Electrical Manufacturers Association	Standardization body in the US
NM	Nullmarke	Zero mark
NO	Normally Open (contact)	NO contact

Abbreviation	Source of abbreviation	Meaning
NSR	Netzstromrichter	Line-side converter
NVRAM	Non-Volatile Random Access Memory	Non-volatile read/write memory
O		
OA	Open Architecture	Open Architecture
OC	Operating Condition	Operating condition
OEM	Original Equipment Manufacturer	Original Equipment Manufacturer
OLP	Optical Link Plug	Fiber-optic bus connector
OMI	Option Module Interface	Option module interface
P		
p...	-	Adjustable parameters
PB	PROFIBUS	PROFIBUS
PC	Position Controller	Position Controller
PcCtrl	PC Control	Control for master
PD	PROFIdrive	PROFIdrive
PDS	Power unit Data Set	Power unit data set
PE	Protective Earth	Protective earth
PELV	Protective Extra Low Voltage	Protective extra low voltage
PEM	Permanenterregter Synchronmotor	Permanent-magnet synchronous motor
PG	Programmiergerät	Programming device
PI	Proportional Integral	Proportional integral
PID	Proportional Integral Differential	Proportional integral differential
PLC	Programmable Logic Controller	Programmable logic controller
PLL	Phase-Locked Loop	Phase-locked loop
PN	PROFINET	PROFINET
PNO	PROFIBUS Nutzerorganisation	PROFIBUS user organization
PPI	Point-to-Point Interface	Point-to-point interface
PRBS	Pseudo Random Binary Signal	White noise
PROFIBUS	Process Field Bus	Serial data bus
PS	Power Supply	Power supply
PSA	Power Stack Adapter	Power Stack Adapter
PTC	Positive Temperature Coefficient	Positive temperature coefficient
PTP	Point-To-Point	Point-to-Point
PWM	Pulse Width Modulation	Pulse width modulation
PZD	Prozessdaten	Process data
R		
r...	-	Display parameters (read-only)
RAM	Random Access Memory	Read/write memory
RCCB	Residual Current Circuit Breaker	Residual current operated circuit breaker
RCD	Residual Current Device	Residual current operated circuit breaker
RCM	Residual Current Monitor	Residual current monitor

Abbreviation	Source of abbreviation	Meaning
RFG	Ramp-Function Generator	Ramp-function generator
RJ45	Registered Jack 45	Term for an 8-pin socket system for data transmission with shielded or non-shielded multi-wire copper cables
RKA	Rückkühlanlage	Cooling unit
RO	Read Only	Read only
RPDO	Receive Process Data Object	Receive process data object
RS232	Recommended Standard 232	Interface standard for cable-connected serial data transmission between a sender and receiver (also known under EIA232)
RS485	Recommended Standard 485	Interface standard for a cable-connected differential, parallel, and/or serial bus system (data transmission between a number of senders and receivers, also known under EIA485)
RTC	Real Time Clock	Real time clock
RZA	Raumzeigerapproximation	Space vector approximation
S		
S1	-	Uninterrupted duty
S3	-	Intermittent duty
SBC	Safe Brake Control	Safe brake control
SBH	Sicherer Betriebshalt	Safe operating stop
SBR	-	Safe acceleration monitoring
SCA	Safe Cam	Safe cam
SD Card	SecureDigital Card	Secure digital memory card
SE	Sicherer Software-Endschalter	Safe software limit switch
SG	Sicher reduzierte Geschwindigkeit	Safely reduced speed
SGA	Sicherheitsgerichteter Ausgang	Safety-related output
SGE	Sicherheitsgerichteter Eingang	Safety-related input
SH	Sicherer Halt	Safe standstill
SI	Safety Integrated	Safety Integrated
SIL	Safety Integrity Level	Safety Integrity Level
SLM	Smart Line Module	Smart Line Module
SLP	Safely-Limited Position	Safely-limited position
SLS	Safely Limited Speed	Safely limited speed
SLVC	Sensorless Vector Control	Vector control without encoder
SM	Sensor Module	Sensor Module
SMC	Sensor Module Cabinet	Sensor Module Cabinet
SME	Sensor Module External	Sensor Module External
SN	Sicherer Software-Nocken	Safe software cam
SOS	Safe Operating Stop	Safe operating stop

Abbreviation	Source of abbreviation	Meaning
SP	Service Pack	Service pack
SPC	Setpoint Channel	Setpoint channel
SPI	Serial Peripheral Interface	Serial interface for connecting peripherals
SS1	Safe Stop 1	Safe stop 1 (monitored for time and ramping up)
SS2	Safe Stop 2	Safe stop 2
SSI	Synchronous Serial Interface	Synchronous serial interface
SSM	Safe Speed Monitor	Safe feedback for speed monitoring (n < nx)
SSP	SINAMICS Support Package	SINAMICS support package
STO	Safe Torque Off	Safe torque off
STW	Steuerwort	Control word
T		
TB	Terminal Board	Terminal Board
TIA	Totally Integrated Automation	Totally Integrated Automation
TM	Terminal Module	Terminal module
TN	Terre Neutre	Grounded three-phase supply network
Tn	-	Integral time
TPDO	Transmit Process Data Object	Transmit process data object
TT	Terre Terre	Grounded three-phase supply network
TTL	Transistor-Transistor Logic	Transistor-transistor logic
Tv	-	Rate time
U		
u.d.	under development	Under development: This feature is not cur- rently available
UL	Underwriters Laboratories Inc.	Underwriters Laboratories Inc.
UPS	Uninterruptible Power Supply	Uninterruptible power supply
UTC	Universal Time Coordinated	Universal time coordinated
V		
VC	Vector Control	Vector control
Vdc	-	DC link voltage
VdcN	-	Partial DC link voltage negative
VdcP	-	Partial DC link voltage positive
VDE	Verband Deutscher Elektrotechniker	Association of German electrical engineers
VDI	Verein Deutscher Ingenieure	Association of German Engineers
VPM	Voltage Protection Module	Voltage Protection Module
Vpp	Volt peak-to-peak	Volt peak-to-peak
VSM	Voltage Sensing Module	Voltage Sensing Module

Abbreviation	Source of abbreviation	Meaning
X		
XML	Extensible Markup Language	Standard language for Web publishing and document management
Z		
ZM	Zero Mark	Zero mark
ZSW	Zustandswort	Status word

SINAMICS documentation overview

General documentation / catalogs

SINAMICS – G110
D11.1
Converter chassis units
0.12 kW to 3 kW

SINAMICS – G130, G150
D11
Converter chassis units
Converter cabinet units

SIMOTION SINAMICS – S120
PM21
SIMOTION, SINAMICS S120 and
Motors for Production Machines

SINAMICS – S120, S150
D21.3
SINAMICS S120
Chassis Format Units and Cabinet Modules
SINAMICS S150
Converter cabinet units

Manufacturer / service documentation

SINAMICS – G110
Getting Started
Operating Instructions
List Manual

SINAMICS – G120, G120C
Getting Started
Operating Instructions
Hardware Installation Manual
Function Manual Safety Integrated
List Manual

SINAMICS – G130
Operating Instructions
List Manual

SINAMICS – G150
Operating Instructions
List Manual

SINAMICS – GM150, SM120 / SM150, GL150, SL150
Operating Instructions
List Manual

Manufacturer / service documentation

SINAMICS – S110
Equipment Manual
Getting Started
Function Manual
List Manual

SINAMICS – S120
Getting Started
Commissioning Manual
Commissioning Manual for CANopen
Function Manual for Drive Functions
Function Manual for Safety Integrated
Function Manual DCC
List Manual

SINAMICS – S120
Equipment Manual for Control Units and
Supplementary Components
Equipment Manual for Booksize Power Units
Equipment Manual for Chassis Power Units
Equipment Manual for Chassis Liquid
Cooled Power Units
Manual for Cabinet Modules
Manual for AC Drives

SINAMICS – S150
Operating Instructions
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Manufacturer / service documentation

SINAMICS Motors
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