SINAMICS S120

AC Drive

Manual 11/2009

SINAMICS

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SINAMICS

S120
AC Drive

Manual

(GH6), 11/2009
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Legal information

Warning notice system

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

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

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

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

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

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

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

⚠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 adhered to. The information in the relevant documentation must be observed.

Trademarks

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

Disclaimer of Liability

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

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Foreword

SINAMICS Documentation

The SINAMICS documentation is organized in 2 parts:

- General documentation/catalogs
- Manufacturer/service documentation

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

- Ordering documentation

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

- Downloading documentation

Further links for downloading files from Service & Support

- Researching documentation online

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

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

http:// www.siemens.com/mdm

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

- Training and FAQs

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

Usage phases and the available tools/documents

Table 1 Usage phase and the available tools/documents

Usage phase	Tools/documents
Orientation	SINAMICS S Sales Documentation
Planning/configuration	SIZER engineering tool Configuration Manuals, Motors
Decision making/ordering	SINAMICS S catalogs
Installation/assembly	• SINAMICS S120 Manual for AC Drives
Commissioning	• STARTER parameterization and commissioning tool • SINAMICS S120 Commissioning Manual • SINAMICS S List Manual
Usage/operation	• SINAMICS S120 Function Manual • SINAMICS S List Manual
Maintenance/servicing	• SINAMICS S120 Commissioning Manual • SINAMICS S List Manual • SINAMICS S120 Manual for AC Drives

Target group

This documentation is aimed at machine manufacturers, planners, fitters, commissioning engineers, and service engineers who use SINAMICS.

Benefits

This documentation contains the comprehensive information about parameters, function diagrams and faults and alarms required to commission and service the system.

This manual should be used in addition to the other manuals and tools provided for the product.

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 not described in this documentation might be able to be executed in the drive system. This does not, however, represent an obligation to supply such functions with a new control or when servicing.
- Functions can be described in the documentation that are not available in a particular product version of the drive system. The functionality of the supplied drive system should only be taken from the ordering documentation.
- Extensions or changes made by the machine manufacturer must be documented by the machine manufacturer.

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

Search tools

The following guides are provided to help you locate information in this manual:

1. General table of contents for the complete manual (after the preface).
2. List of abbreviations
3. References.
4. Index

Technical Support

If you have any questions, please contact our hotline:

	Europe/Africa
Telephone	+49 180 5050 - 222
Fax	+49 180 5050 - 223
€0.14/min. from German landlines (maximum €0.42/min. for calls made from cell phones within Germany)	
Internet	http://www.siemens.de/automation/support-request

	America
Telephone	+1 423 262 2522
Fax	+1 423 262 2200
E-mail	mailto:techsupport.sea@siemens.com

	Asia/Pacific
Telephone	+86 1064 757575
Fax	+86 1064 747474
E-mail	mailto:support.asia.automation@siemens.com

Note

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

Spare parts

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

Questions about the documentation

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

Fax	+49 9131 98 2176
E-mail	mailto:docu.motioncontrol@siemens.com

A fax form is at the end of this document.

Internet address for SINAMICS

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

Test verification documents

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

EC Declarations of Conformity

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

- in the Internet:
  http://support.automation.siemens.com
  under the Product/Order No. 15257461
- at the relevant regional office of the I DT MC Business Unit of Siemens AG

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

- in the Internet:
  http://support.automation.siemens.com
  under the Product/Order No. 22383669

Note

When operated in dry areas, SINAMICS equipment conforms to the Low-Voltage Directive 73/23/EEC and 2006/95/EC.

Note

In the configuration specified in the corresponding EC Declaration of Conformity regarding EMC requirements and when the EMC installation guideline (order no. 6FC5297-0AD30-0*P2) is observed, SINAMICS devices fulfill EMC Directive 89/336/EEC and 2004/108/EC. (*A: German; *B: English)

Note

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

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

ESD information

CAUTION

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

Regulations for handling ESD components:

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

Personnel may only come into contact with electronic components, if

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

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

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

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

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

Measurements can only be taken on electronic boards when the measuring device is grounded (e.g. via protective conductors) or when the measuring probe is briefly discharged before measurements are taken with an isolated measuring device (e.g. touching a bare metal housing).

Safety information

DANGER
Commissioning is absolutely prohibited until it has been completely ensured that the machine, in which the components described here are to be installed, is in full compliance with the provisions of the EC Machinery Directive. Only suitably qualified personnel may assemble, commission, and maintain SINAMICS S devices. The personnel must take into account the information provided in the technical customer documentation for the product, and be familiar with and observe the specified danger and warning notices. Operational electrical equipment and motors have parts and components which are at hazardous voltage levels, that if touched, can result in severe bodily injury or death. All work on the electrical system must be carried out when the system has been disconnected from the power supply. In combination with the drive system, the motors are generally approved for operation on TN and TT systems with a 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 HD 60364-4-41, it is recommended that the first fault should be eliminated as quickly as practically possible. In systems with a grounded external conductor, an isolating transformer with grounded neutral point (secondary side) must be connected between the supply and the drive system to protect the motor insulation from excessive stress. The majority of TT systems have a grounded external conductor, so in this case an isolating transformer must be used.

DANGER
Correct and safe operation of SINAMICS S drive units assumes correct transportation in the transportation packaging, correct long-term storage in the transport packaging, setup and installation, as well as careful operation and maintenance. The details in the Catalogs and proposals also apply to the design of special equipment versions. In addition to the danger and warning information provided in the technical customer documentation, the applicable national, local, and system-specific regulations and requirements must be taken into account. To ensure compliance with EN 61800-5-1 and UL 508, only safety extra-low voltages from the electronics modules may be connected to connections and terminals.

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

⚠ DANGER
Electrical, magnetic, and electromagnetic fields (EMF) occurring during operation can pose a danger to people in the direct vicinity of the product, especially people with pacemakers, implants, or similar. The relevant directives and standards must be observed by the machine/plant operators and people present in the vicinity of the product. These are, for example, EMF Directive 2004/40/EEC and standards EN 12198-1 to -3 applying to the European Economic Area (EEA) and in Germany the accident prevention regulation BGV 11 and the associated rule BGR 11 "Electromagnetic fields" from the German employer's liability accident insurance association. These state that a hazard analysis must drawn up for every workplace, from which measures for reducing dangers and their impact on people are derived and applied, and exposure and danger zones are defined and observed. The relevant safety notes in each chapter must be observed.

⚠ DANGER
As part of routine tests, SINAMICS S components will undergo a voltage test in accordance with EN 61800-5-1. Before the voltage test is performed on the electrical equipment of machines acc. to EN 60204-1, Section 19.4, all connectors of SINAMICS equipment must be disconnected/unplugged to prevent the equipment from being damaged. Motors should be connected-up corresponding to the circuit diagram supplied with the motor (refer to the connection examples, Motor Modules). They must not be connected directly to the three-phase supply because this will damage them.

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

Explanation of symbols

Table 2 Symbols

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

Residual risks of power drive systems

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

1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example:
   - Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology
   - Response times of the controller and drive
   - Operating and/or ambient conditions not within the scope of the specification
   - Parameterization, programming, cabling, and installation errors
   - Use of radio devices / cellular phones in the immediate vicinity of the controller
   - External influences / damage
2. Exceptional temperatures as well as emissions of light, noise, particles, or gas caused by, for example:
   - Component malfunctions
   - Software errors
   - Operating and/or ambient conditions not within the scope of the specification
   - External influences / damage
3. Hazardous shock voltages caused by, for example:
   - Component malfunctions
   - Influence of electrostatic charging
   - Induction of voltages in moving motors
   - Operating and/or ambient conditions not within the scope of the specification
   - Condensation / conductive contamination
   - External influences / damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc. if they are too close.
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly.

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

Table of contents

System overview

1

1.1 Field of application

SINAMICS is the new family of drives from Siemens for industrial machines and plant construction. SINAMICS offers solutions for all drive tasks:

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

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

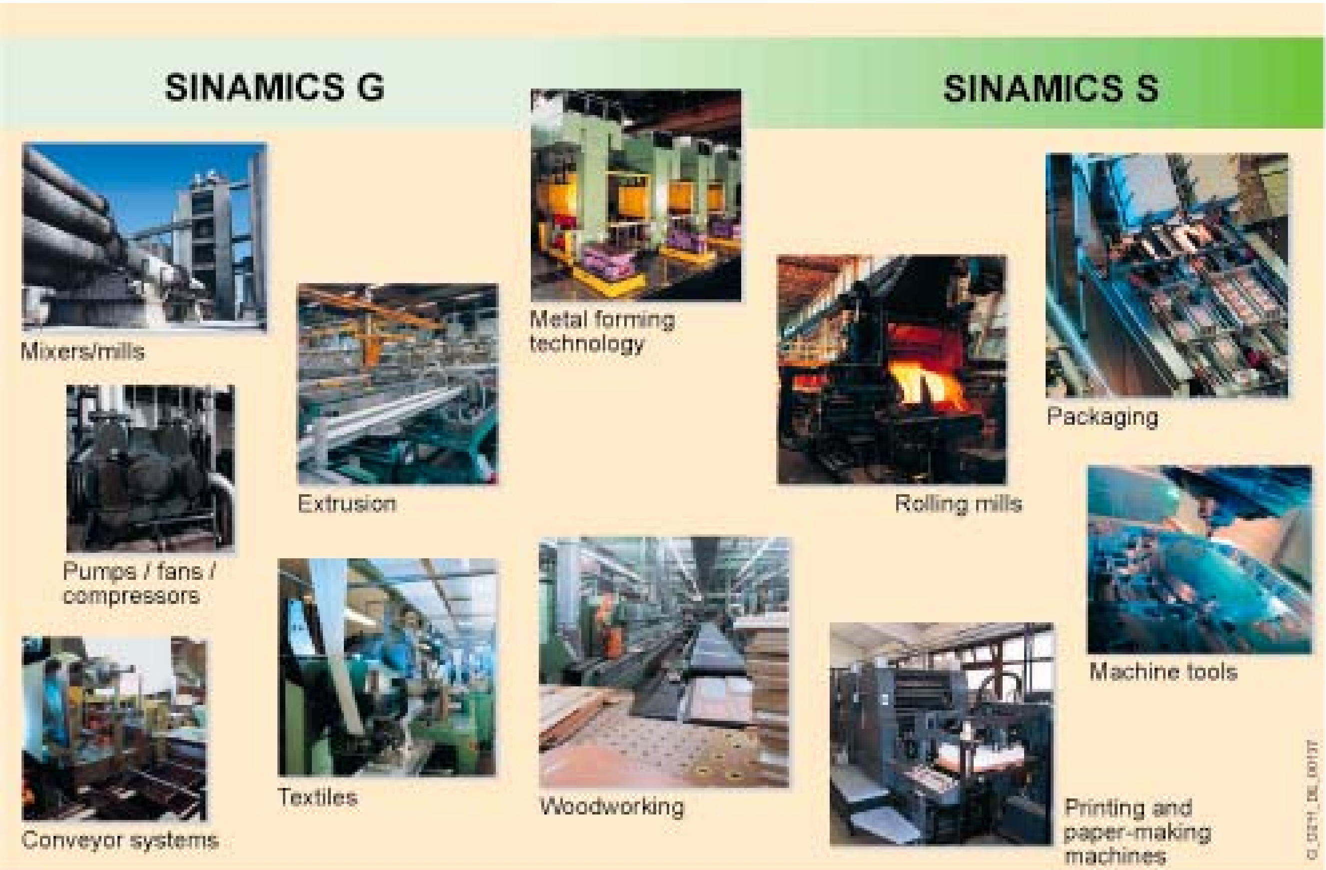


Figure 1-1 SINAMICS applications

1.2 Platform concept and Totally Integrated Automation

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

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

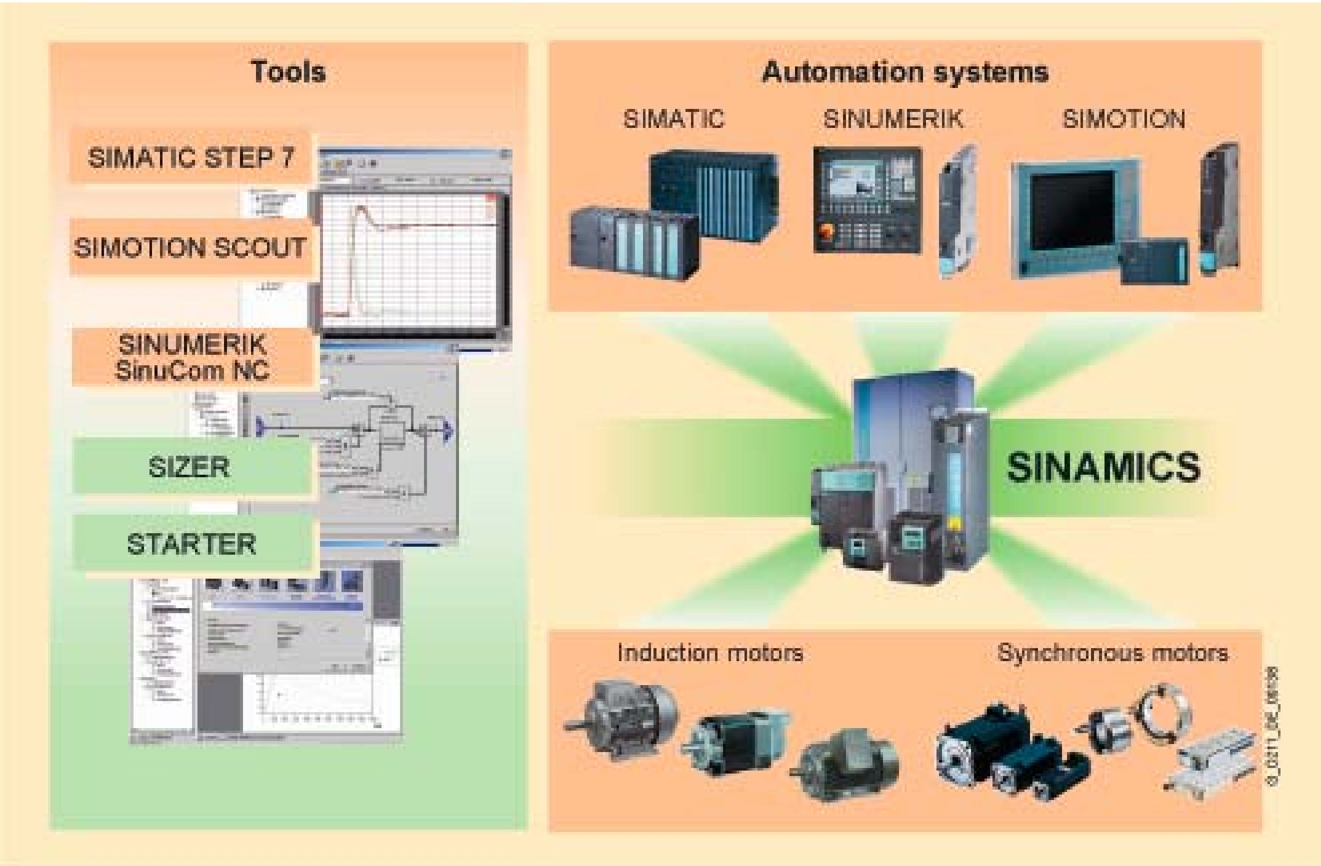


Figure 1-2 SINAMICS as part of the Siemens modular automation system

1.3 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.

1.4 SINAMICS S120 components

Figure 1-3 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

1.5 System data

Table 1- 1 General technical specifications

Electrical data	
Line supply voltage Blocksize format units Chassis format units	 1-ph. 200 V to 240 V AC ±10 % 3-ph. 380 V to 480 V AC ±10 % 3-ph. 380 V to 480 V AC ±10 % Above 2000 m installation altitude, refer to the characteristic for voltage de-rating.
Rated pulse frequency Blocksize format units Chassis format units	 4 kHz 2 kHz At higher pulse frequencies, the associated characteristic for current de-rating must be taken into account.
Line frequency	47 Hz to 63 Hz
Output voltage Blocksize format units Chassis format units	 0 V to rated line supply voltage at 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. 0 V to line supply voltage for 3-ph. 380 V to 480 V AC units.
Electronic 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 acc. to EN 60664-1
Degree of pollution	2 acc. to 60664-1

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

Environmental conditions	
Note for the safety functions of Safety Integrated: 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.	
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

Permissible cooling medium temperature (air) and installation altitude in operation	0 °C to +40 °C and an installation altitude of up to 1,000 m without derating, >40 °C to +55 °C, see the characteristic for current derating. Installation altitude >1,000 m up to 4,000 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 • Transport in the transport packaging • Operation	 Class 1C2 to EN 60721-3-1 Class 2C2 to EN 60721-3-2 Class 3C2 to EN 60721-3-3
Biological environmental conditions: • Storage in the transport packaging • Transport in the transport packaging • Operation	 Class 1B1 to EN 60721-3-1 Class 2B1 to EN 60721-3-2 Class 3B1 to EN 60721-3-3
Vibratory load • Long-term storage in the transport packaging • Transport in the transport packaging – All units and components except for chassis format – Chassis format • Operation	 Class 1M2 acc. to EN 60721-3-1 Class 2M3 acc. to EN 60721-3-2 Class 2M2 acc. to EN 60721-3-2 Test values: 10 Hz to 58 Hz: Constant deflection 0.075 mm; 58 Hz to 150 Hz: Constant acceleration 9.81 m/s² (1 × g)
Shock load • Long-term storage in the transport packaging • Transport in the transport packaging – All units and components except for chassis format – Chassis format • Operation – Blocksize format FSA to FSC – Blocksize format FSD to FSF – Chassis format	 Class 1M2 acc. to EN 60721-3-1 Class 2M3 acc. to EN 60721-3-2 Class 2M2 acc. to EN 60721-3-2 Test values: 147 m/s² (15 x g)/11 ms 49 m/s² (5 x g)/30 ms 98 m/s² (10 x g)/20 ms
Climatic ambient conditions • Long-term storage in the transport packaging • Transport in the transport packaging • Operation	 Class 1K4 acc. to EN 60721-3-1 Temperature -25 °C to +55 °C Class 2K4 acc. to EN 60721-3-2 Temperature -40 °C to +70 °C Class 3K3 acc. to EN 60721-3-3 Temperature +0 °C to +40 °C Relative/absolute air humidity 5% to 90% / 25 g/m³ Oil mist, salt mist, formation of ice, moisture condensation, dripping, spraying, splashing water, and water jets not permissible

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

1.6 Standards

Note

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

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

Table 1- 2 Fundamental, application-relevant standards in succession: EN, IEC/ISO, DIN, VDE

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

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

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

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

Line-side power components 2

2.1 Introduction

The line connection for a SINAMICS drive line-up comprises an optional line reactor and an optional line filter:

- Line supply voltages:
  - 1-ph. 200 V to 1-ph. 240 V AC +/- 10%.
  - 3-ph. 380 V to 3-ph. 480 V AC +/- 10%.
- Line reactor versions:
  - 3 versions for blocksize format, frame sizes FSA - FSC (sub-chassis).
  - 5 versions for blocksize format, frame sizes FSD - FSF (3 sub-chassis and 2 standalone).
  - 4 versions for chassis format
- Line filter versions:
  - Integrated
  - External
    - Sub-chassis
    - Standalone

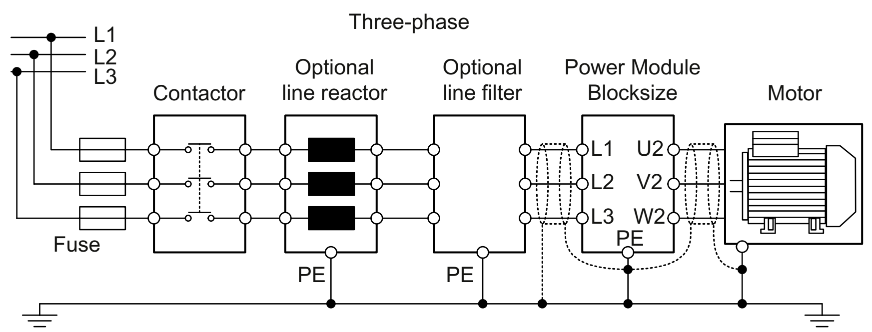


Figure 2-1 Example of a blocksize line connection for Power Modules with no integrated line filter

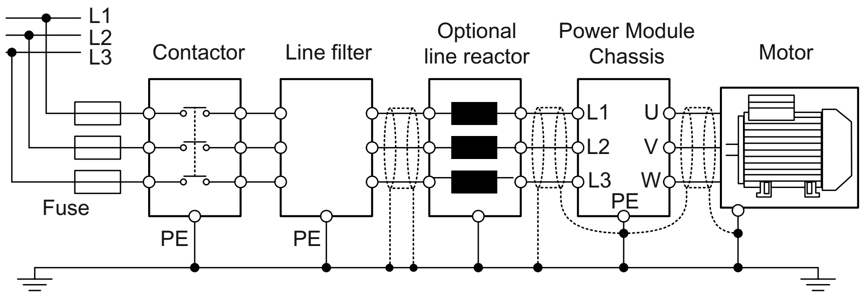


Figure 2-2 Example of a chassis line connection

Note

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.

CAUTION

The following can occur if line reactors/line filters are used, which have not been approved for SINAMICS by SIEMENS:

- the Power Modules could be damaged/destroyed.
- Line reactions can occur that can damage or interfere with other loads powered from the same network.

CAUTION

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

2.2 Line connection variants

2.2.1 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:

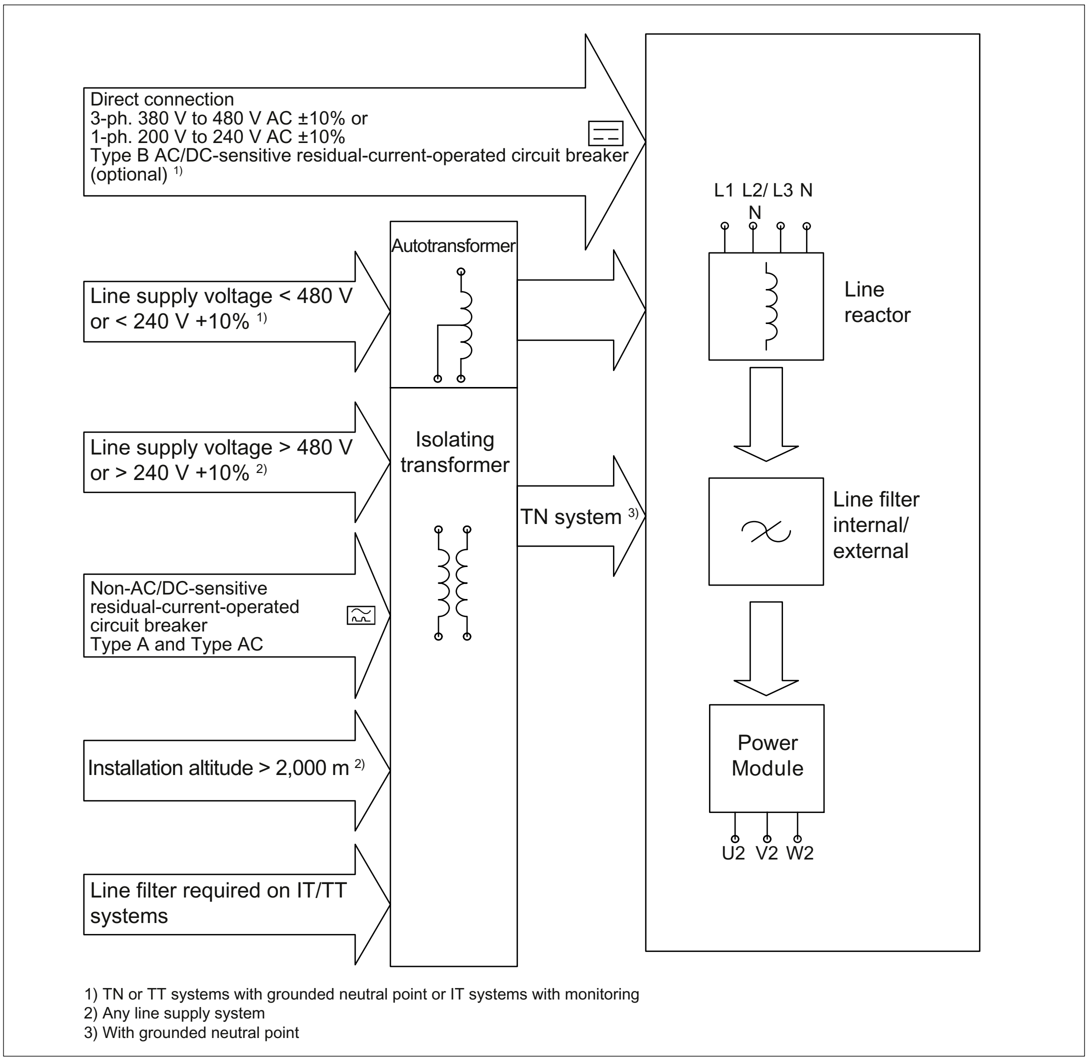


Figure 2-3 Overview of line connection variants

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.

2.2.2 Operation of the Line Connection Components on the Supply Network

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 3-ph. 380 V to 480 V AC and 1-ph. 200 V to 240 V 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.

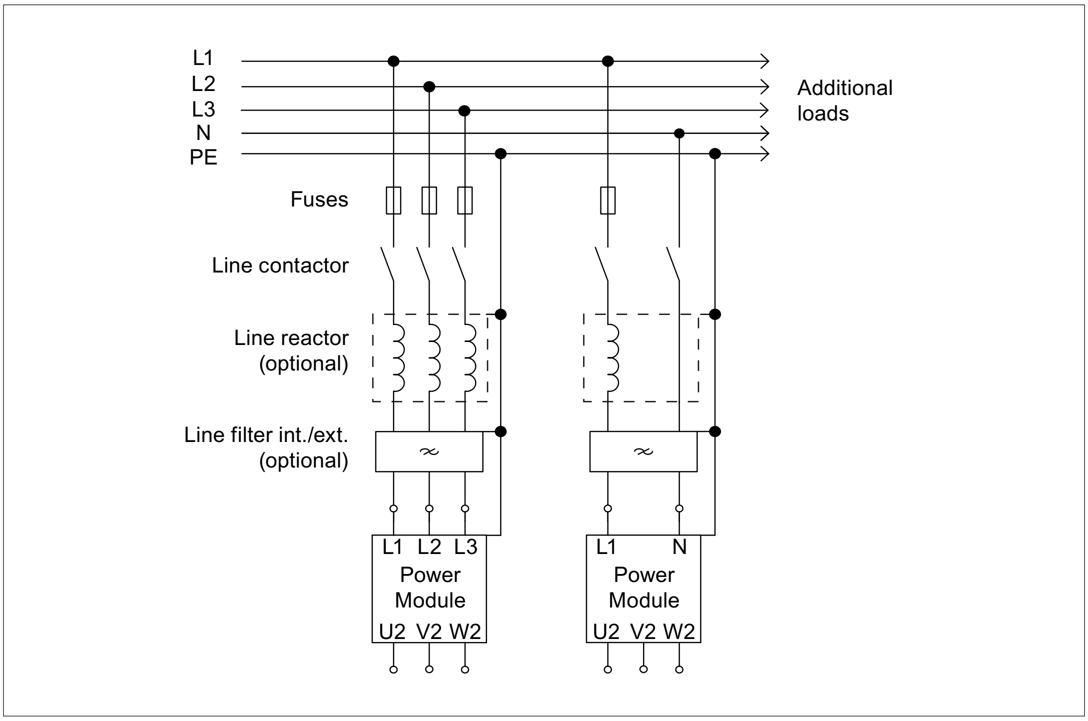


Figure 2-4 Direct operation on the line supply

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:

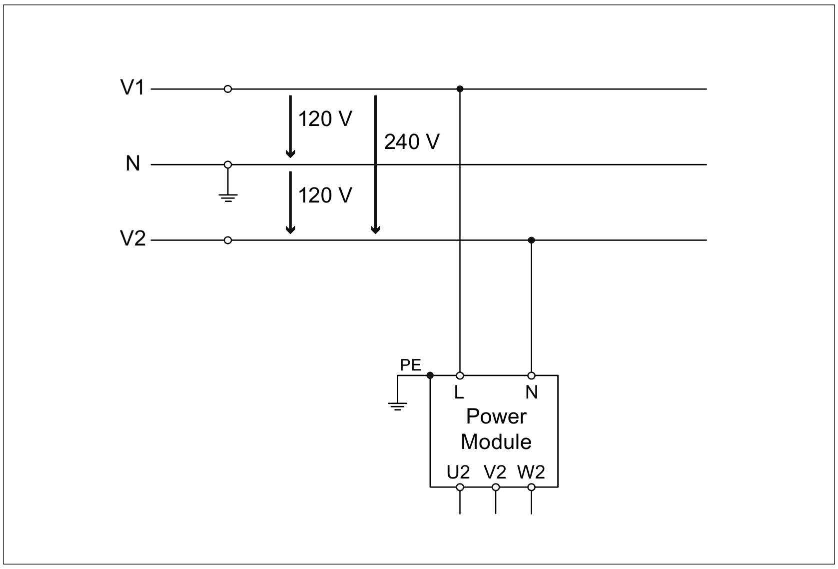


Figure 2-5 Direct operation on Single Phase Grounded Midpoint line system configuration

2.2.3 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
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.

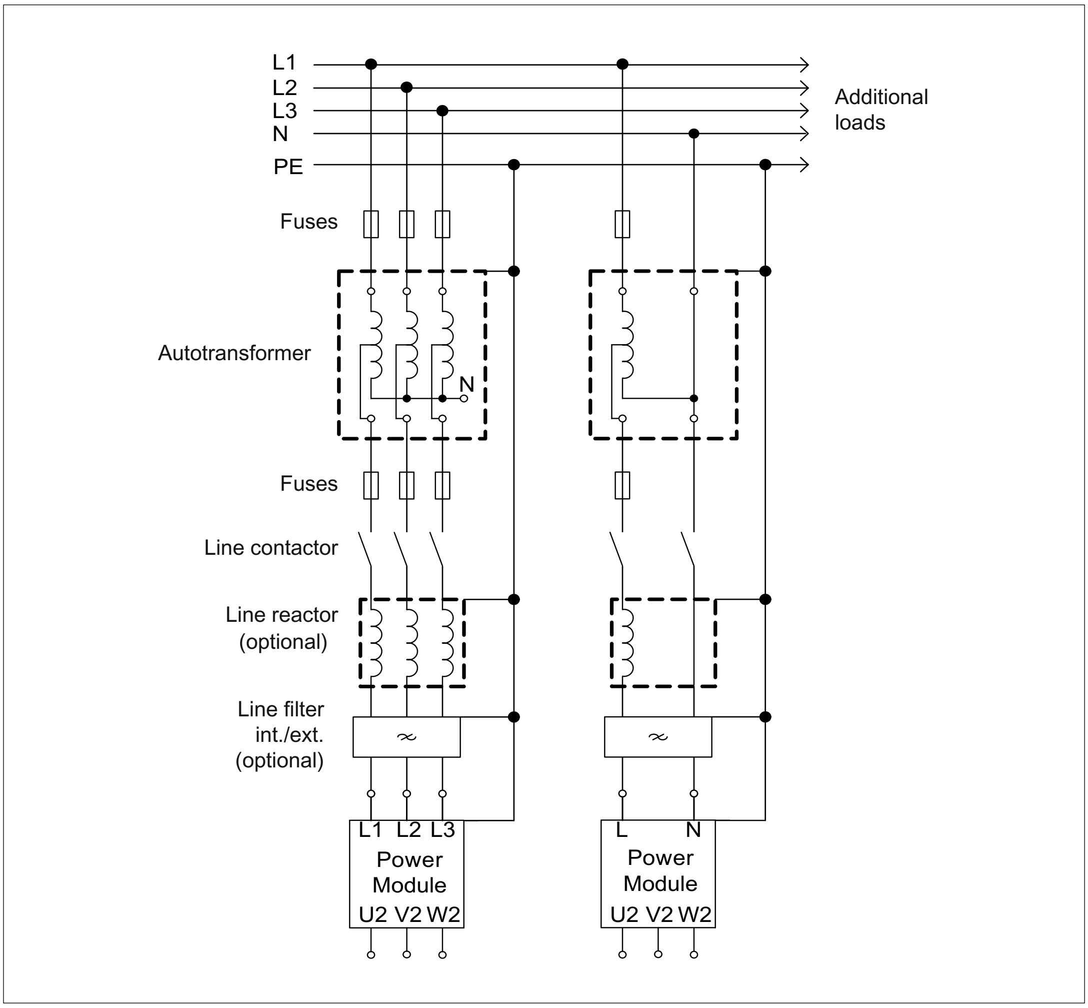


Figure 2-6 Autotransformer

2.2.4 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 line supply) to a TN line supply. Additional voltage adaptation to the permissible voltage tolerance range is possible.

An isolating transformer must be used in the following cases:

- The insulation of the Power Module and/or the motor is not adequate for the voltages that occur.
- There is no compatibility to an existing residual-current protective 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.

CAUTION
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.

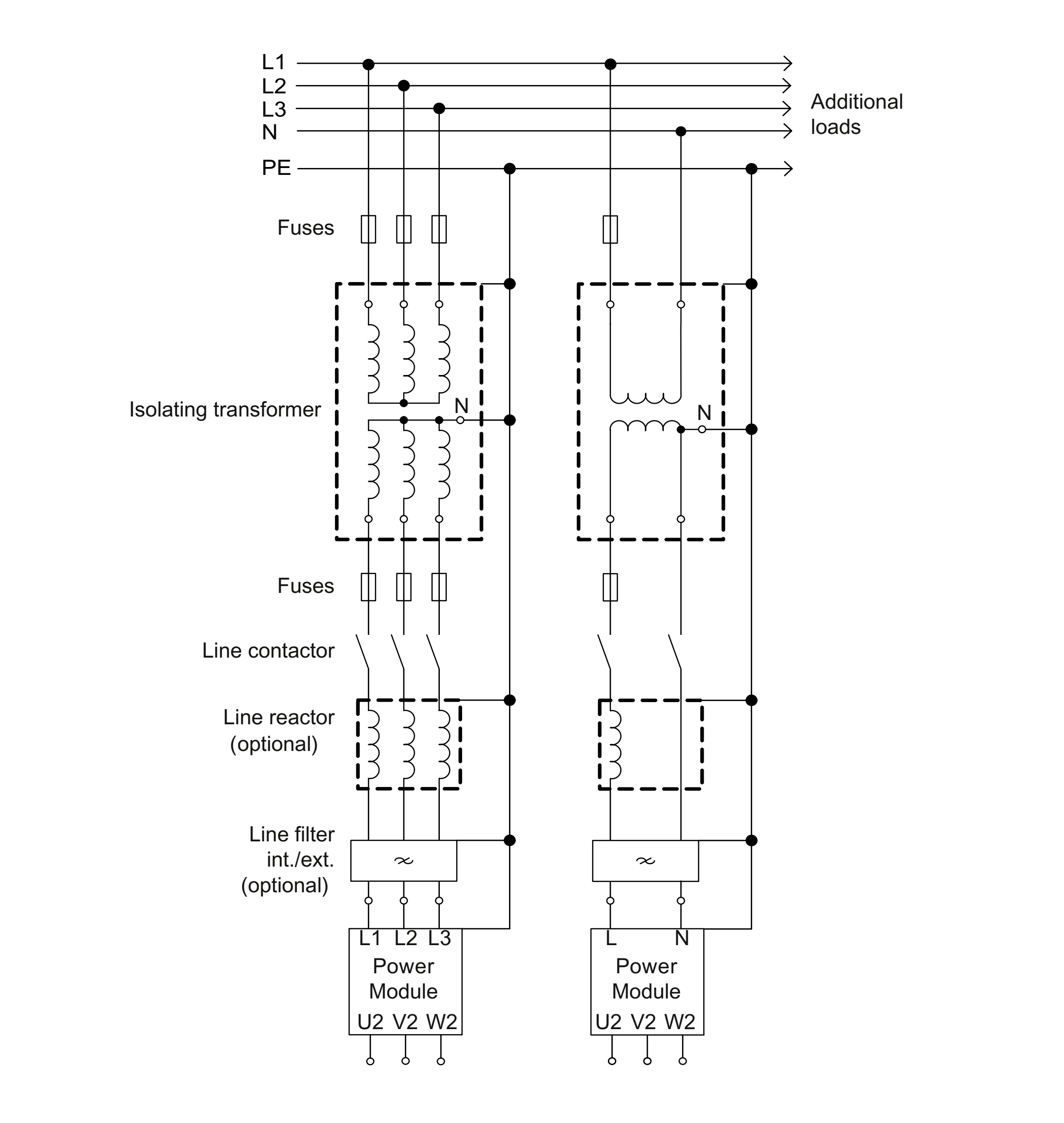


Figure 2-7 Isolating transformer

2.3 Line filter

2.3.1 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 acc. to EN 61800-3. An additional line reactor also needs to be used if Chassis Power Modules are to meet the requirements of Category C2.

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.

2.3.2 Safety information

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

⚠ WARNING
The cooling clearances of 100 mm above and below the components must be observed. This prevents thermal overload of the line filter.

⚠ WARNING
The connections must not be interchanged: • Incoming line cable to LINE/NETZ L1, L2, L3 • Outgoing cable to the line reactor to LOAD/LAST L1', L2', L3' Non-observance may damage the line filter

⚠ CAUTION
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.

2.3.3 Dimension drawings

Blocksize line filter

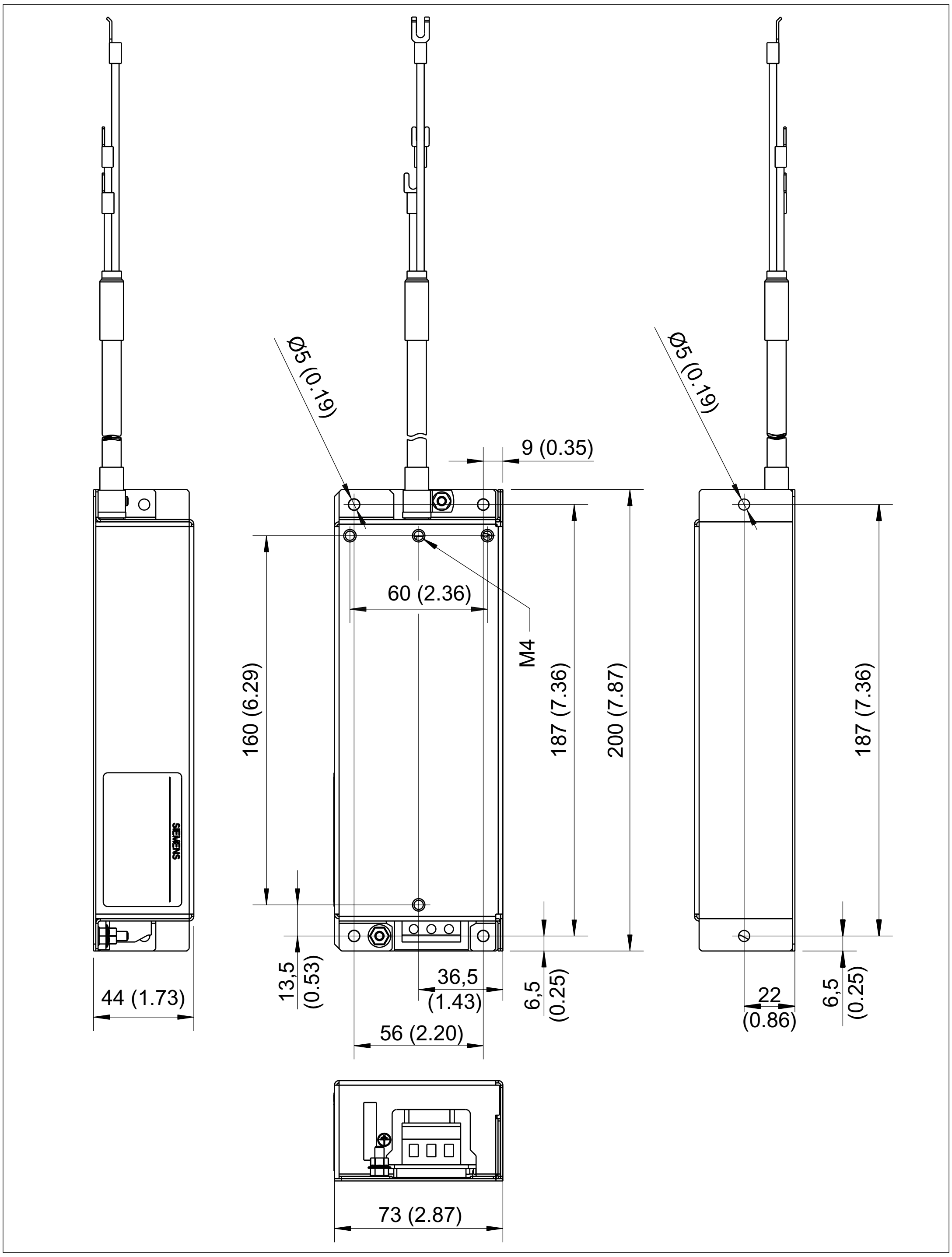


Figure 2-8 Dimension drawing of line filter, frame size FSA, all data in mm and (inches)

Chassis line filter

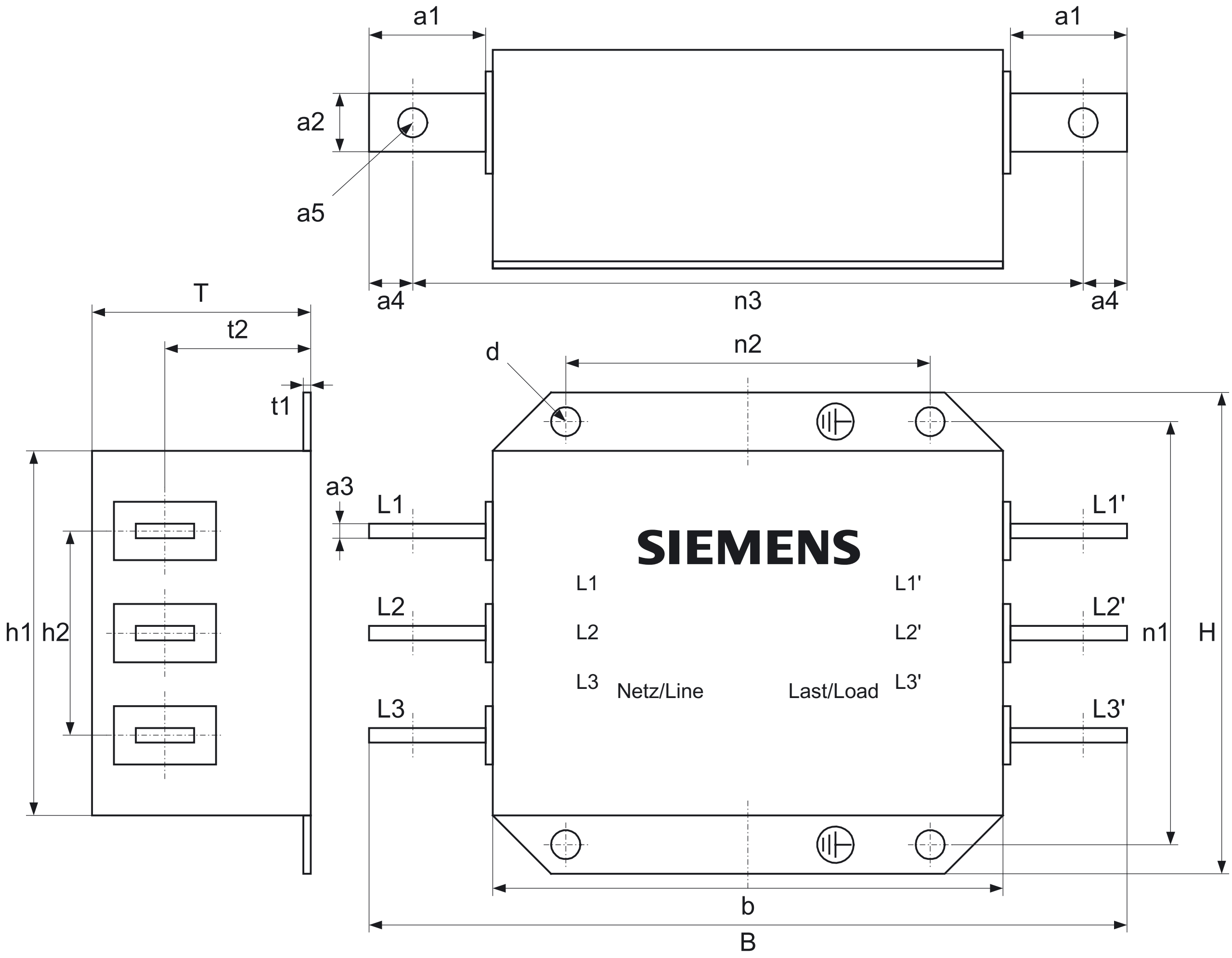


Figure 2-9 Dimension drawing, line filter

Table 2- 1 Dimensions of the line filter, all data in mm and (inches)

6SL3000-	0BE32-5AA0	0BE34-4AA0	0BE36-0AA0
W	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)
d	9 (0.35)	9 (0.35)	12 (0.47)

1) Dimensions n1 and n2 correspond to the hole spacing

2.3.4 Installation

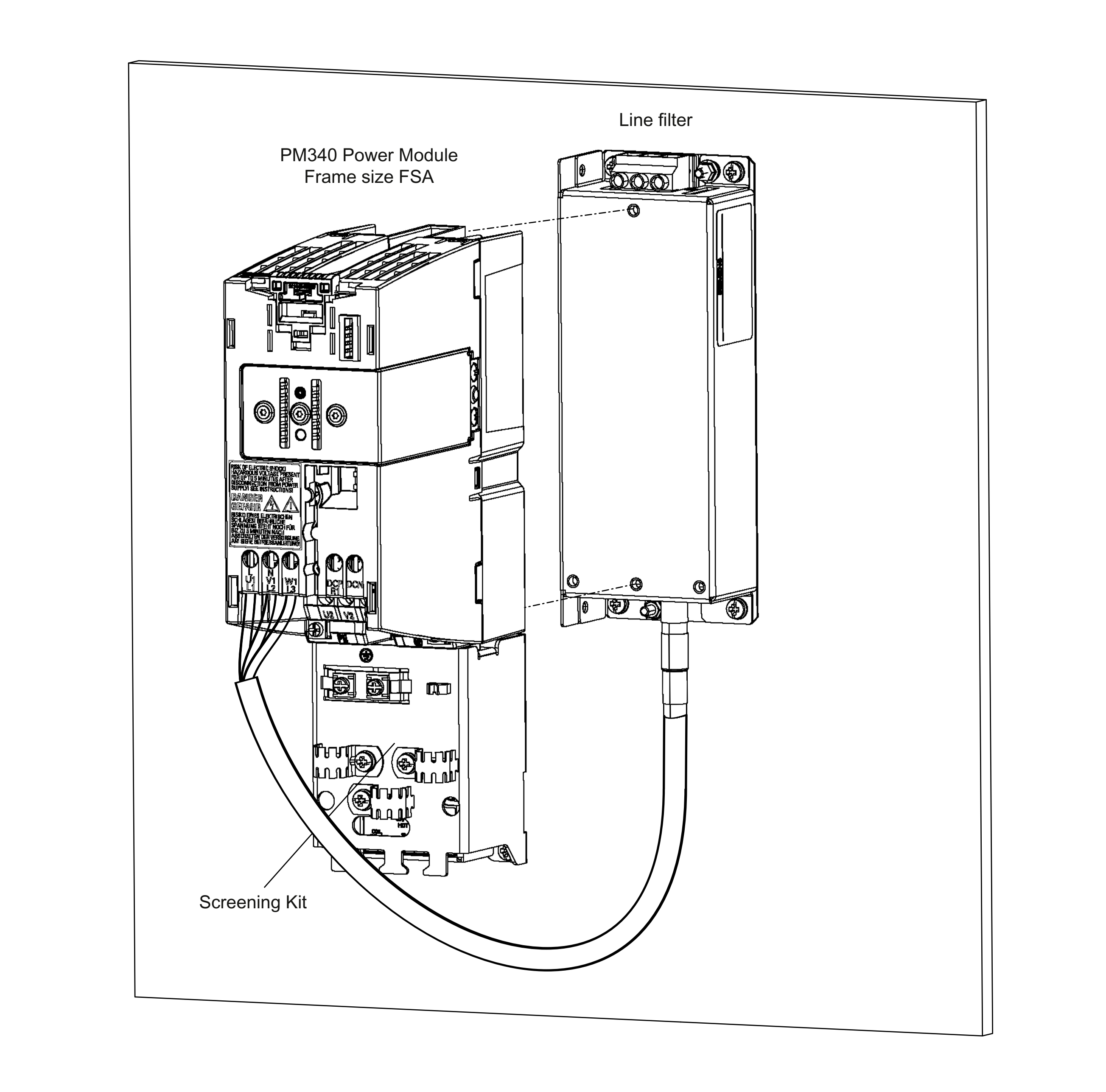


Figure 2-10 Mounting: Power Module PM340 frame size FSA with Screening Kit and line filter

2.3.5 Technical specifications

2.3.5.1 Technical data, Blocksize line filter

Table 2- 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 mm² screw terminals
PE connection		At the housing with M4 stud
Load connection U, V, W		Shielded cable 3 x 2.5 mm² 0.4 m long
Degree of protection		IP20 or IPXXB
Weight, approx.	kg	0.5

2.3.5.2 Technical data, Chassis line filter

Table 2- 3 Technical specifications, 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
Rated power 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	0.049	0.049	0.049	0.049	0.055
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

2.4 Line reactors

2.4.1 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.

2.4.2 Safety information

⚠ WARNING

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

Note

The connecting cables to the Power Module must be as short as possible (max. 5 m).
If possible, they should be shielded.

⚠ WARNING

The connections must not be interchanged:

- Incoming line cable at U1, V1, W1 or L1, N and
- Outgoing cable to the load 1U2, 1V2, 1W2.

CAUTION

When using line reactors that have not been approved by SIEMENS for SINAMICS, the following can occur:

- the Power Modules could be damaged/destroyed.
- Line harmonics that may interfere with or damage other loads connected to the same line supply.

⚠ CAUTION

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

2.4.3 Dimension drawings

Blocksize line reactors

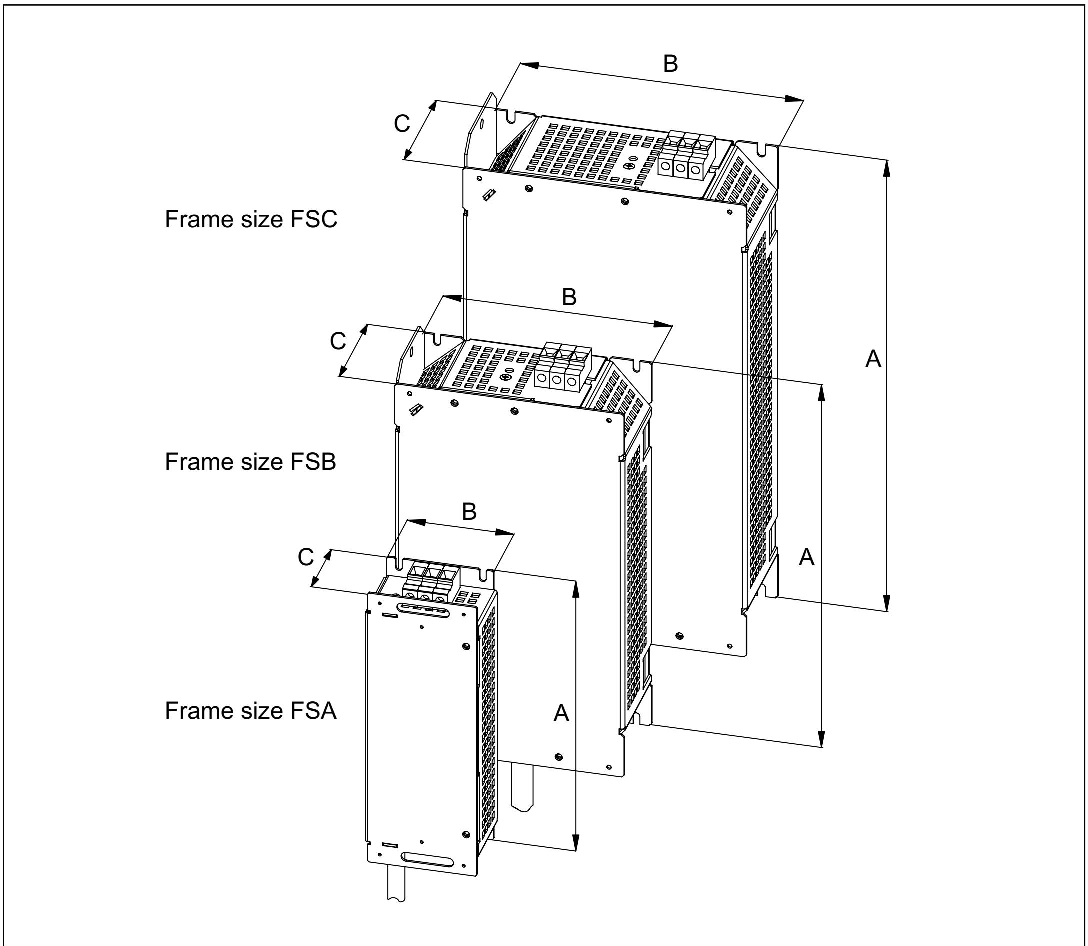


Figure 2-11 Dimension drawing of line reactors, frame sizes FSA, FSB, and FSC

Table 2- 4 Dimensions of line reactors, 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				
A	200 (7.87)				
B	75 (2.95)				
C	50 (1.96)				

Table 2- 5 Dimensions of line reactors, frame sizes FSB and FSC, all data in mm and (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)

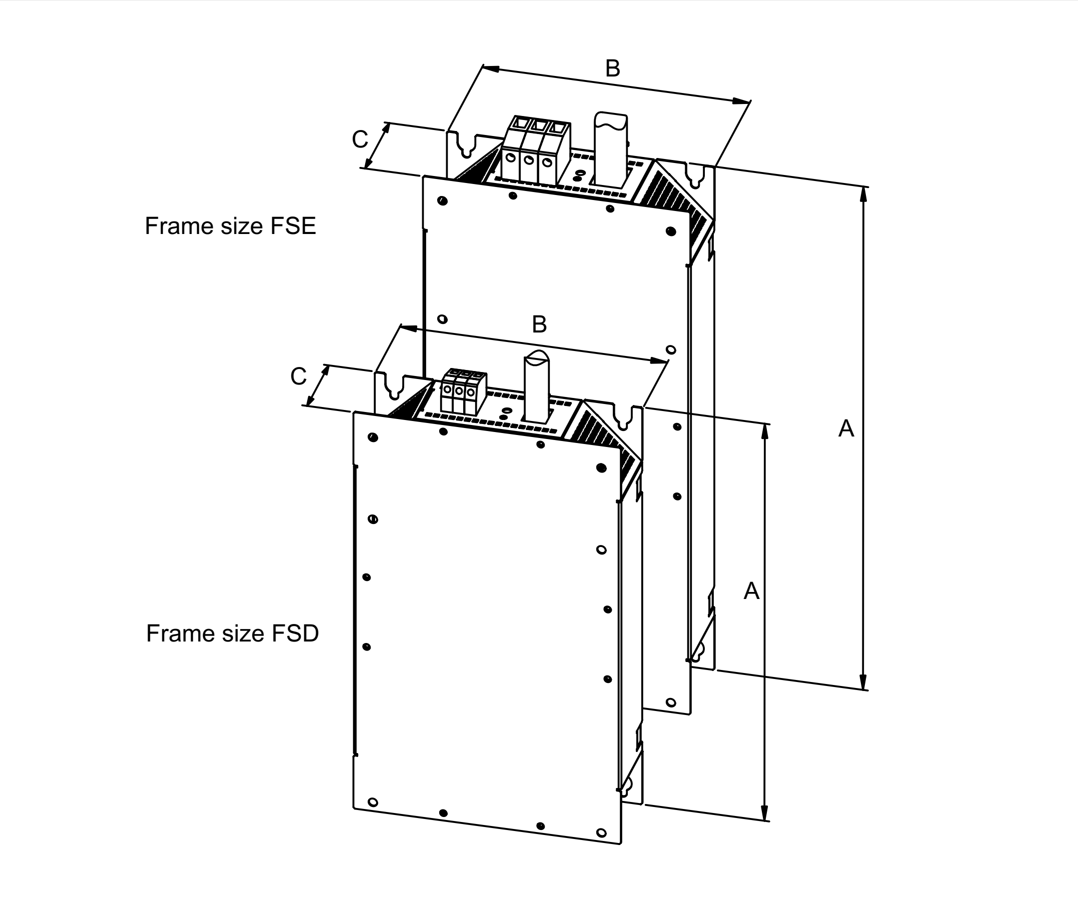


Figure 2-12 Dimension drawing of line reactors, frame sizes FSD and FSE

Table 2- 6 Dimensions of line reactors, frame sizes FSD and FSE, all data in mm and (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)

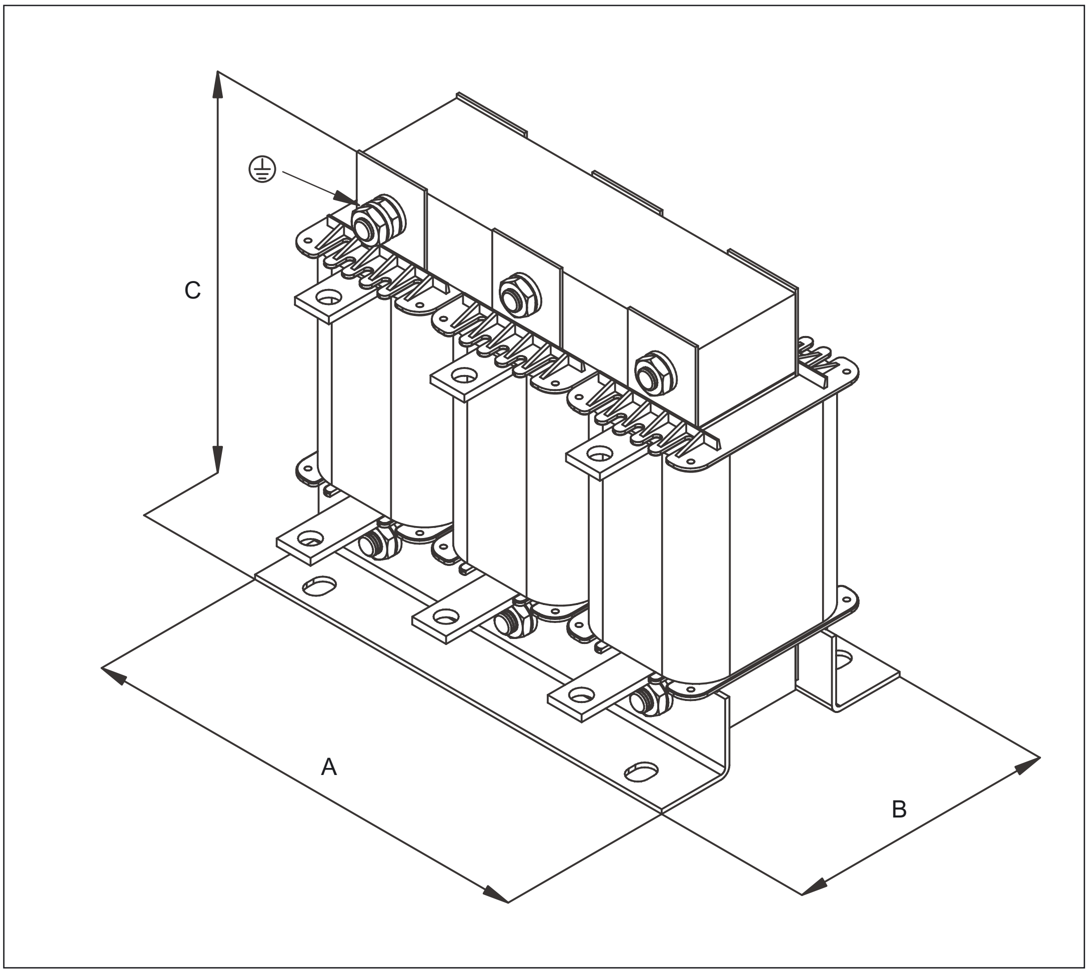


Figure 2-13 Dimension drawing of line reactor, frame size FSF

Table 2- 7 Dimensions of line reactor, frame size FSF, all data in mm and (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

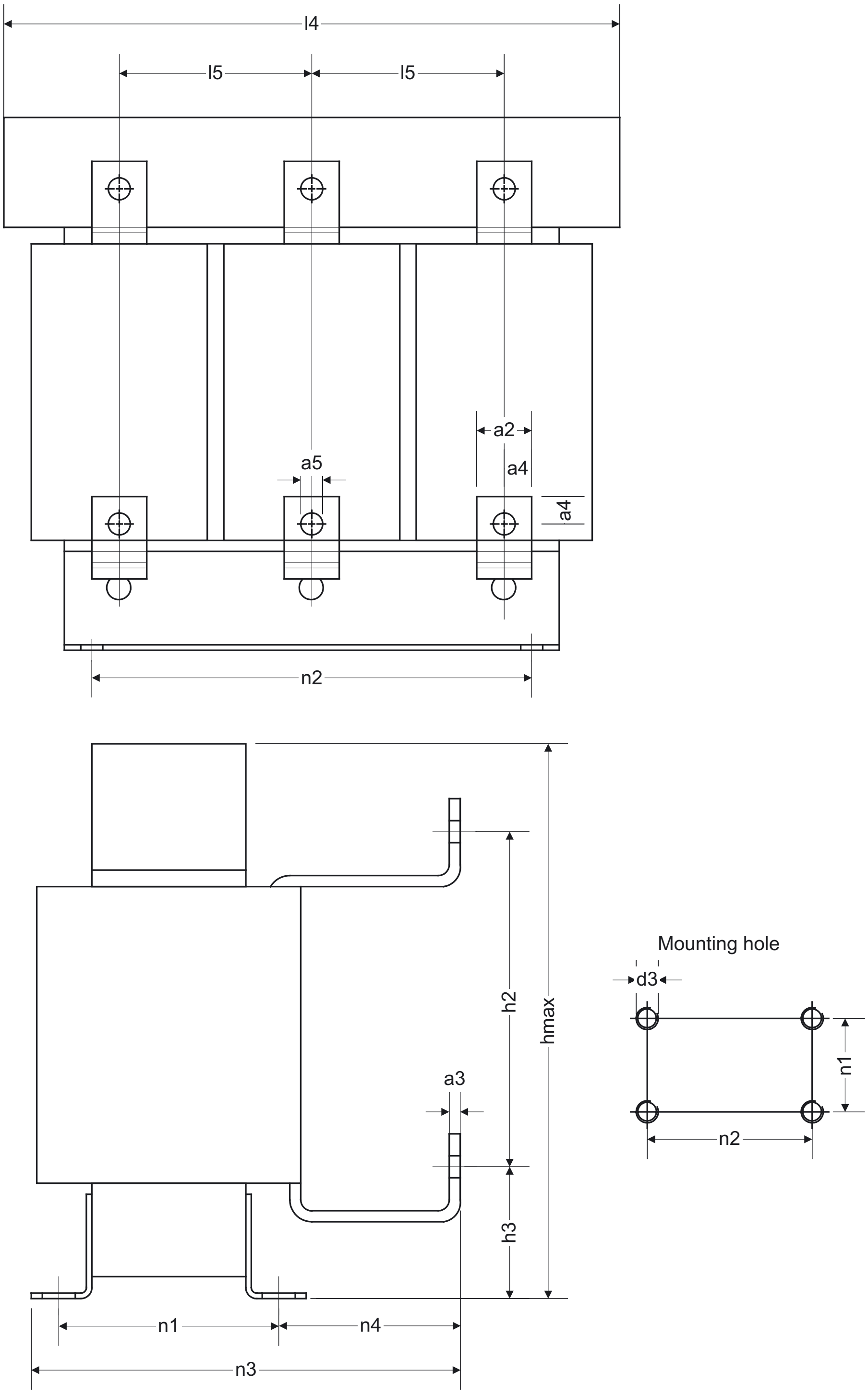


Figure 2-14 Dimension drawing, line reactors

Table 2- 8 Dimensions of the line reactors, all data in mm and (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) Dimensions n1 and n2 correspond to the hole spacing

2.4.4 Installation

The line reactors for Power Modules in frame sizes FSA - FSE are designed as sub-chassis 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.

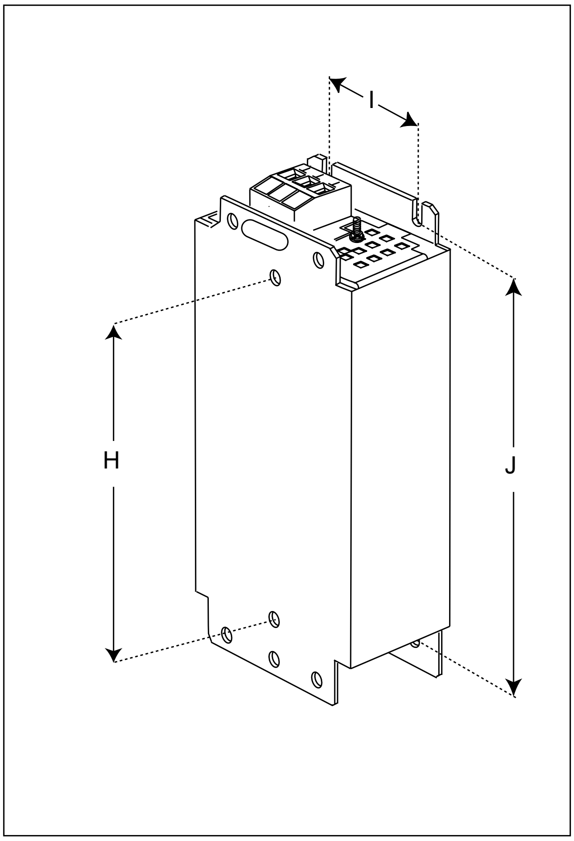


Figure 2-15 Mounting dimensions of line reactor, frame size FSA

Table 2- 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				

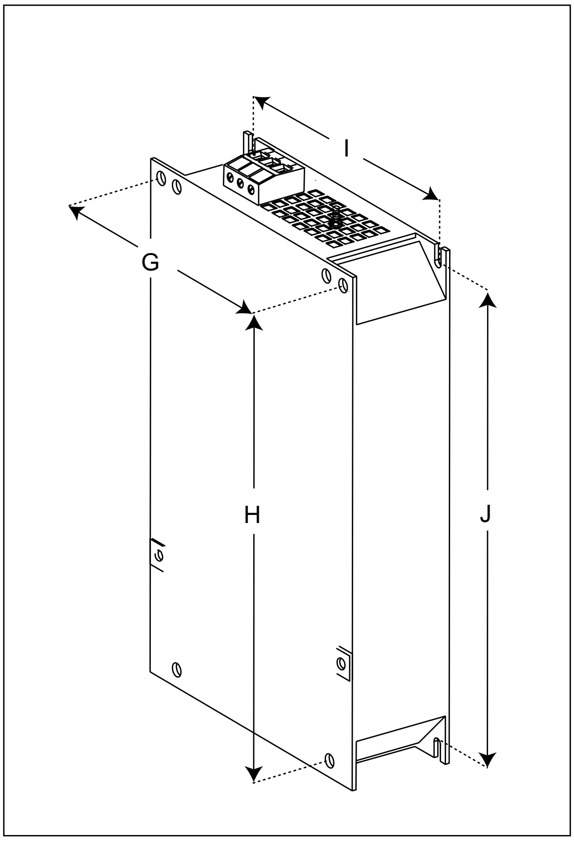


Figure 2-16 Mounting dimensions of line reactor, frame sizes FSB and FSC

Table 2- 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	

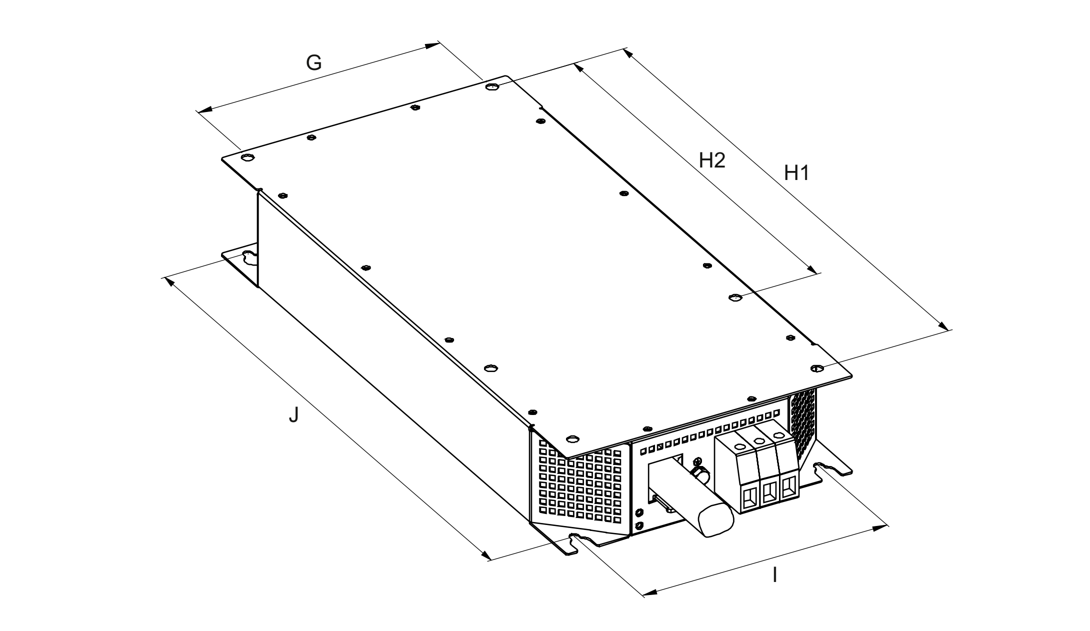


Figure 2-17 Mounting dimensions of line reactor, frame sizes FSD and FSE

Table 2- 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

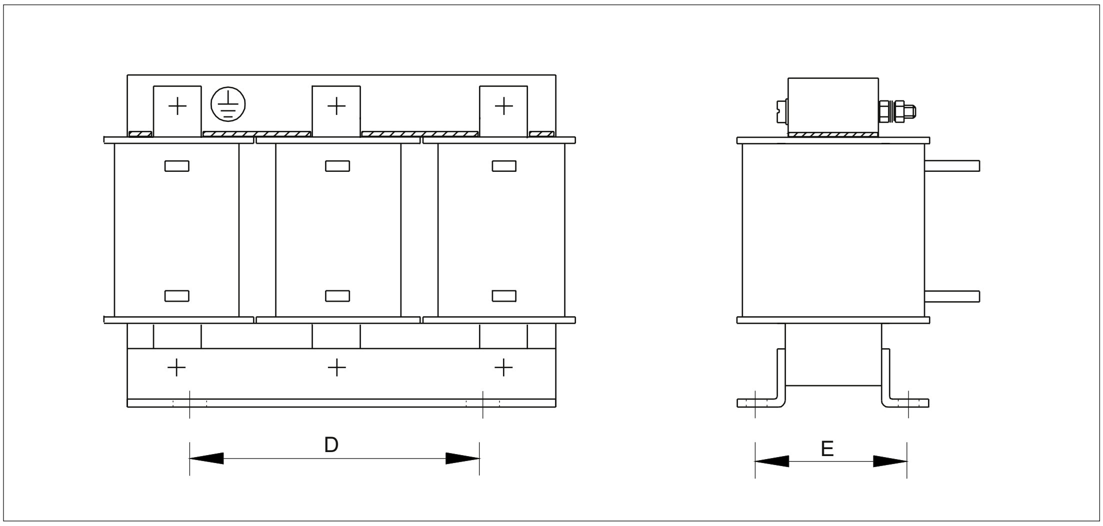


Figure 2-18 Mounting dimensions of line reactor, frame size FSF

Table 2- 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

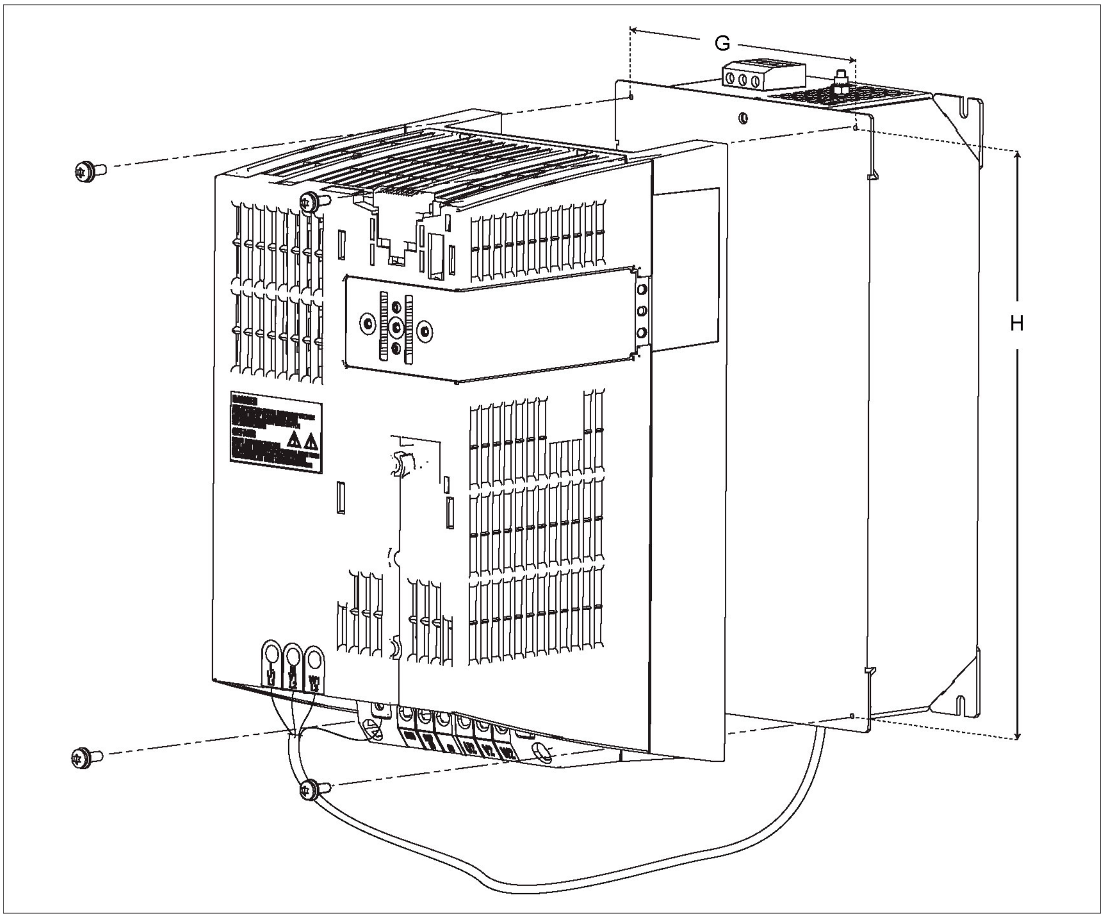


Figure 2-19 Mounting the PM340 with a line reactor, using frame size FSB as an example

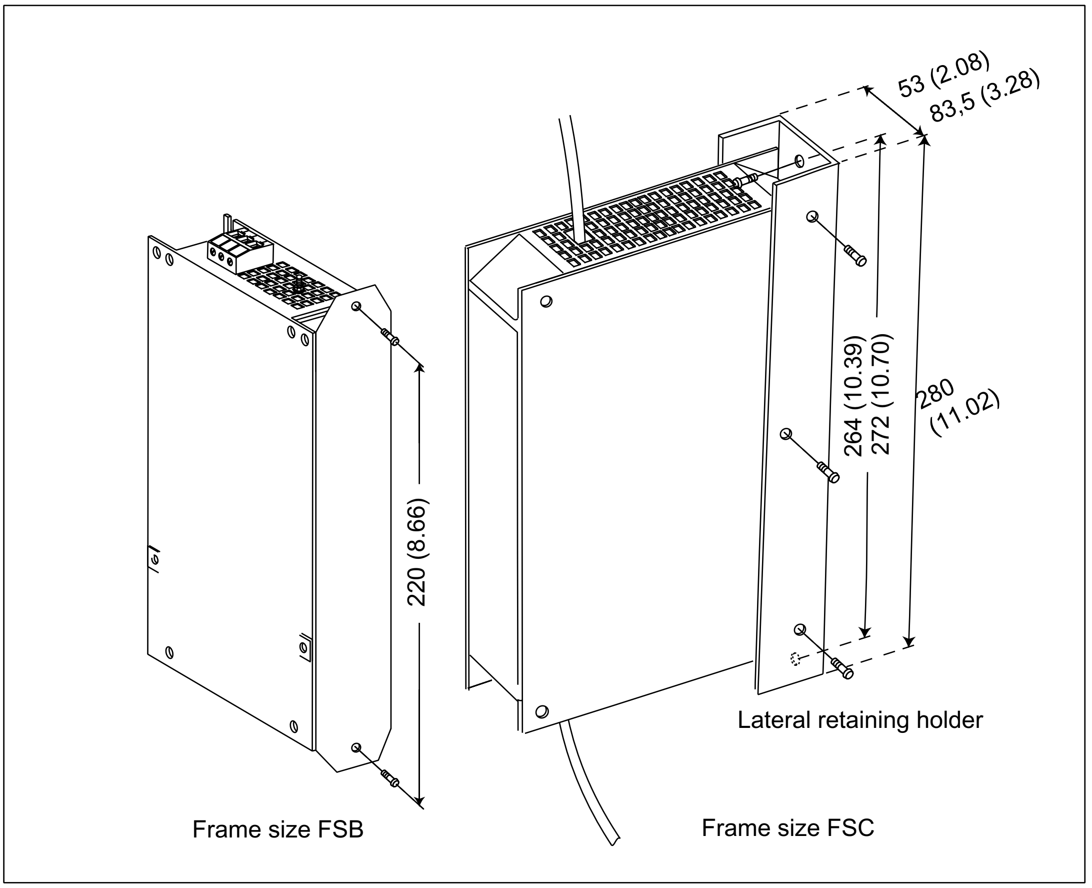


Figure 2-20 Lateral mounting of line reactors for frame sizes FSB and FSC

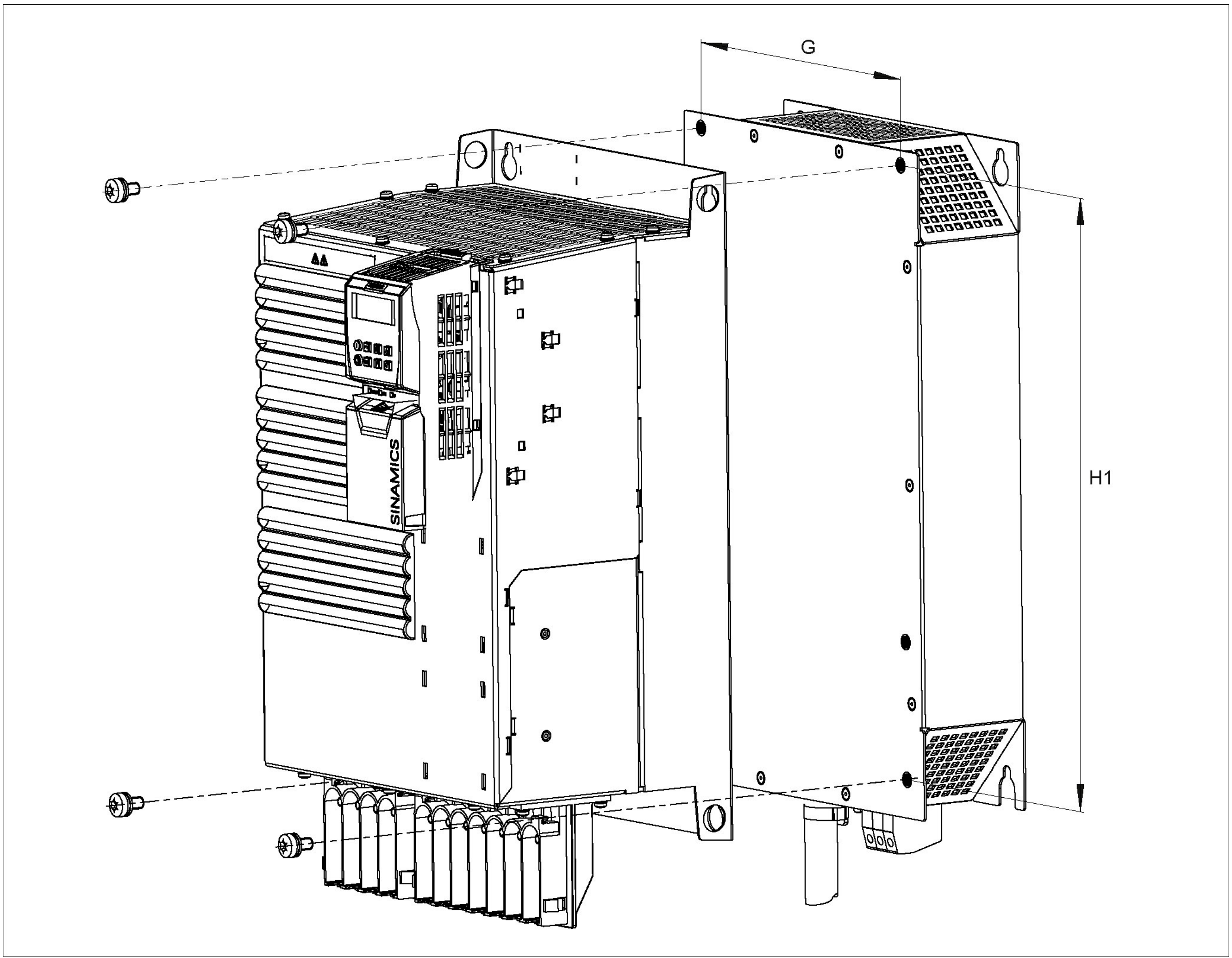


Figure 2-21 Mounting the PM340 with a line reactor, using frame size FSD as an example

2.4.5 Electrical connection

Line supply/load connection

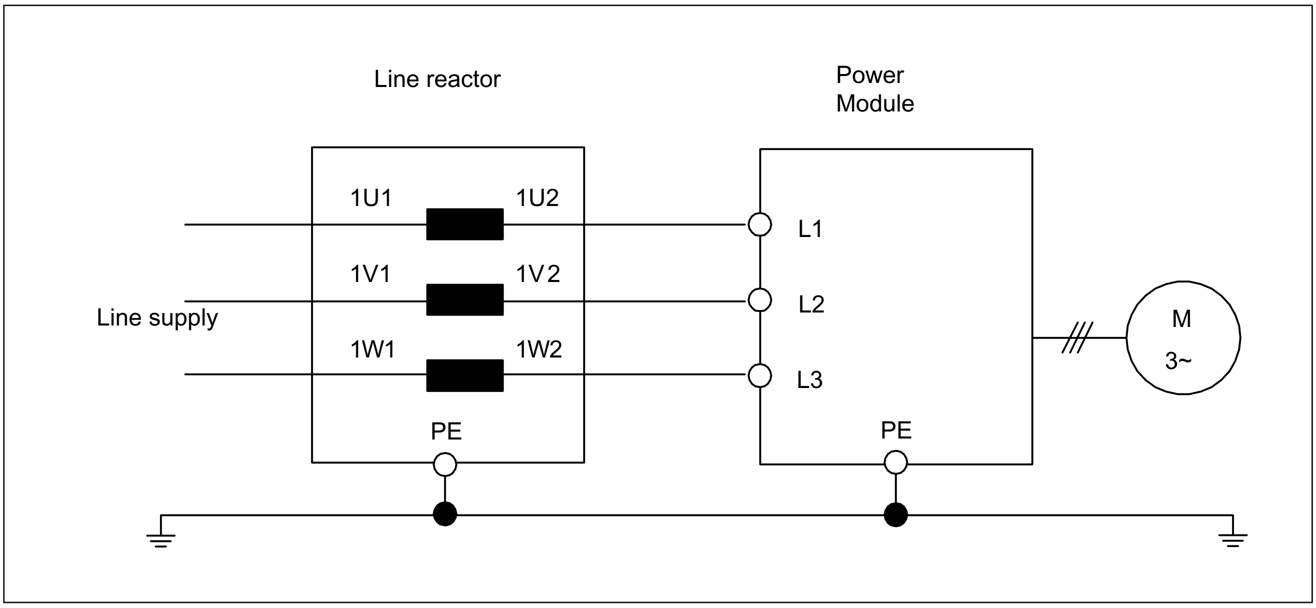


Figure 2-22 Power Module with line filter

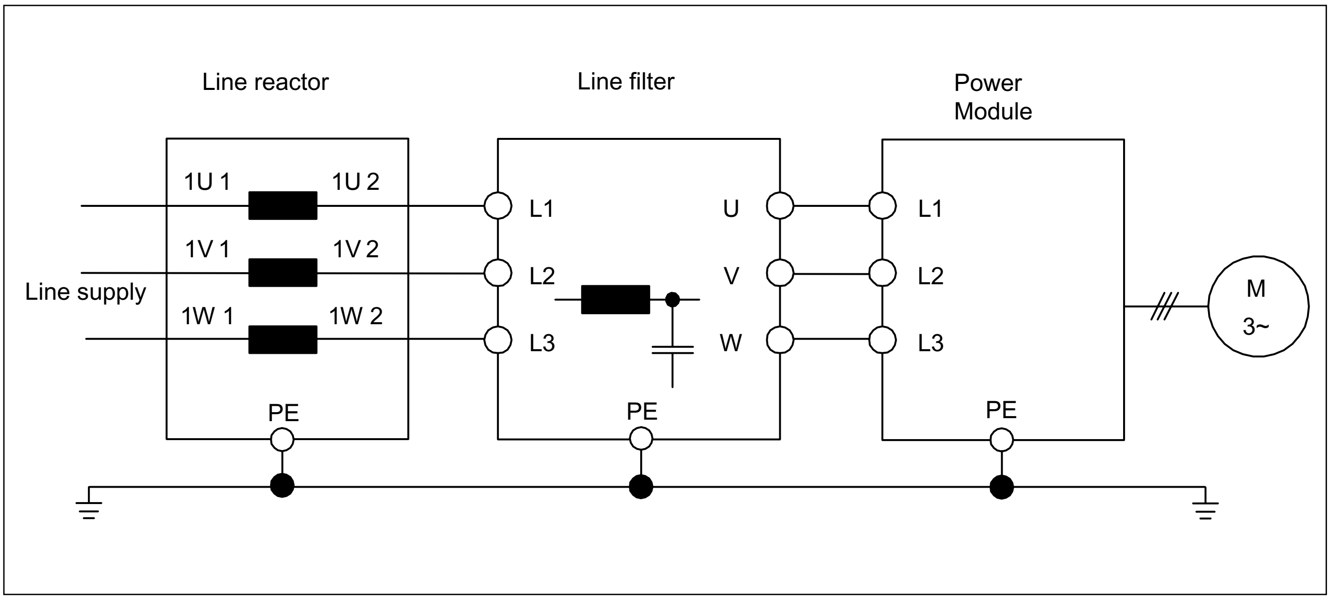


Figure 2-23 Power Module Blocksize with line reactor and line filter

2.4.6 Technical specifications

2.4.6.1 Blocksize line reactors

Table 2- 13 Technical specifications, 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 mm² screw terminals	6 mm² screw terminals
Load connection 1U2, 1V2, 1W2		Cable 3 x 1.5 mm² Length approx. 0.38 m	Cable 3 x 1.5 mm² 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 2- 14 Technical specifications, 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 2- 15 Technical specifications, 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 2- 16 Technical specifications, 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

2.4.6.2 Chassis line reactors

Table 2- 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 supply/load connection		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

Power Modules

3

3.1 Power Modules Blocksize (PM340)

3.1.1 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 3- 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

3.1.2 Safety information

CAUTION

During transport and during storage, Power Modules must be protected against mechanical shock and vibration. It is also important to protect the unit against water (rain) and against excessively high/excessively low temperatures.

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.

WARNING

In a residential environment this product can cause radio disturbances, which may make interference-suppression measures necessary.

DANGER

Grounding/protective grounding of the Power Module

The Power Module housing must always be grounded. If the Power Module is not correctly grounded, then extremely hazardous states can occur, which under certain circumstances, can result in death.

DANGER

It must be checked as to whether the Power Module is designed for the correct power supply - higher supply voltages may not be connected to the Power Module.

DANGER

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 then may the Power Module be connected to the power supply.

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

⚠ DANGER
Once all the supply voltages have been disconnected, a hazardous voltage may be present in the power unit for up to 5 minutes. The cover for the terminals may only be opened after this time has definitely elapsed. When opening the protective cover, you must activate the release. A suitable tool (e.g. screwdriver) must be used for this purpose. Damaged components must not be used, otherwise this could result in secondary damage or accidents.

⚠ DANGER
The hazard warning in the local language for the DC link discharge time must be affixed to the component. A set of labels bearing this warning in 16 languages is provided with the component.

⚠ DANGER
The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection on the cabinet or machine must be implemented in accordance with one of the following measures: • Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al • stationary connection and automatic shutdown of the power supply if the protective conductor is interrupted

WARNING

Cooling and mounting clearances for Power Modules

Power Modules must be mounted in the vertical position.

The following clearances must be observed 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)

The following cooling clearances must be observed 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).

The following cooling clearances must be observed in front of the component:

- frame sizes FSB to FSF: 30 mm (1.18 inch)

Devices, that could restrict the cooling air flow may not be mounted/installed in this area. It must be carefully ensured that the cooling air flow of the Power Modules can flow unrestricted.

1) The Power Modules can be mounted side by side without sub-chassis components up to an ambient temperature of 40 °C.
In combination with sub-chassis 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.

DANGER

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

Non-observance can cause lethal shock voltages.

3.1.3 Interface description

3.1.3.1 Overview

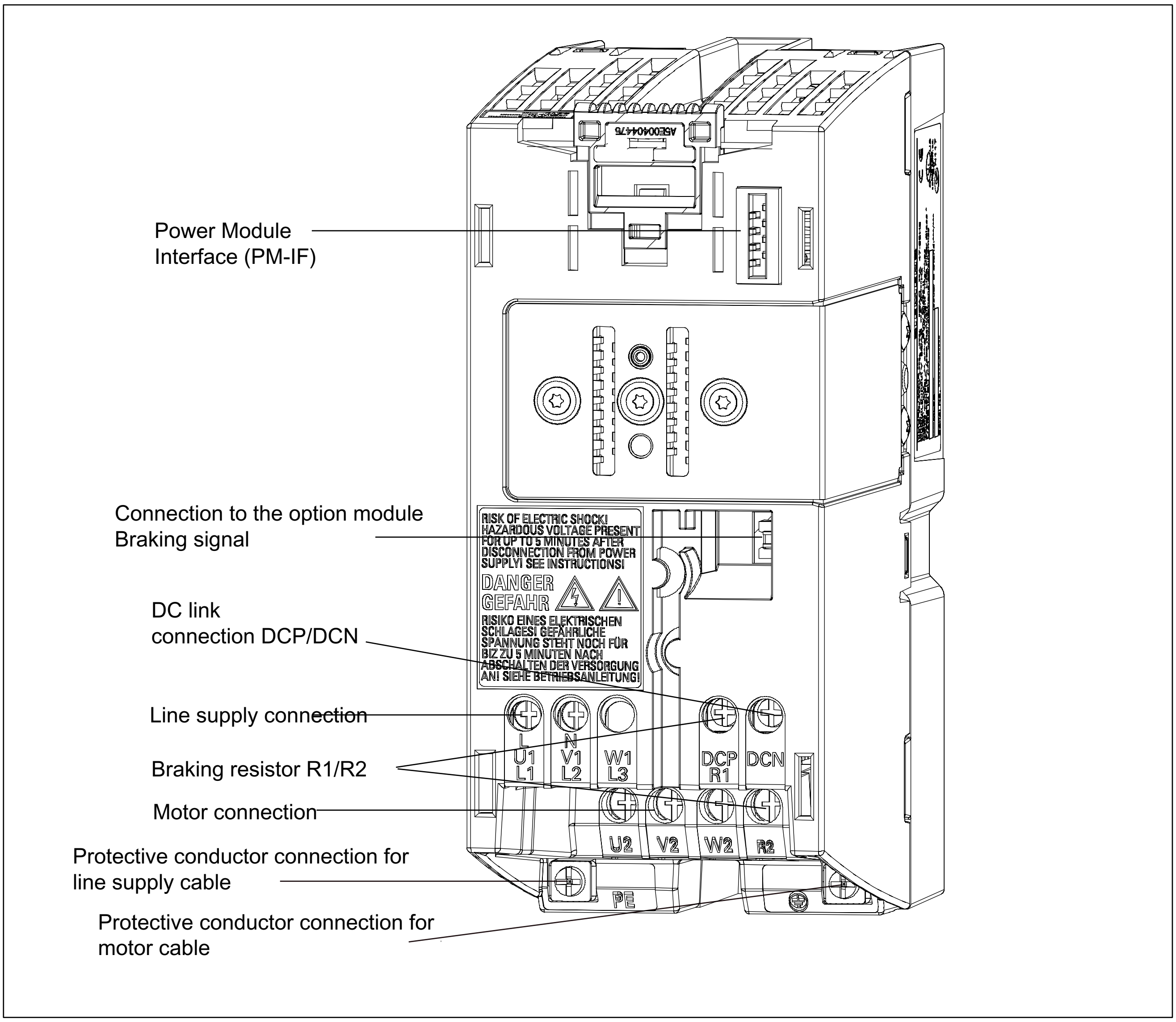


Figure 3-1 PM340, frame size FSA

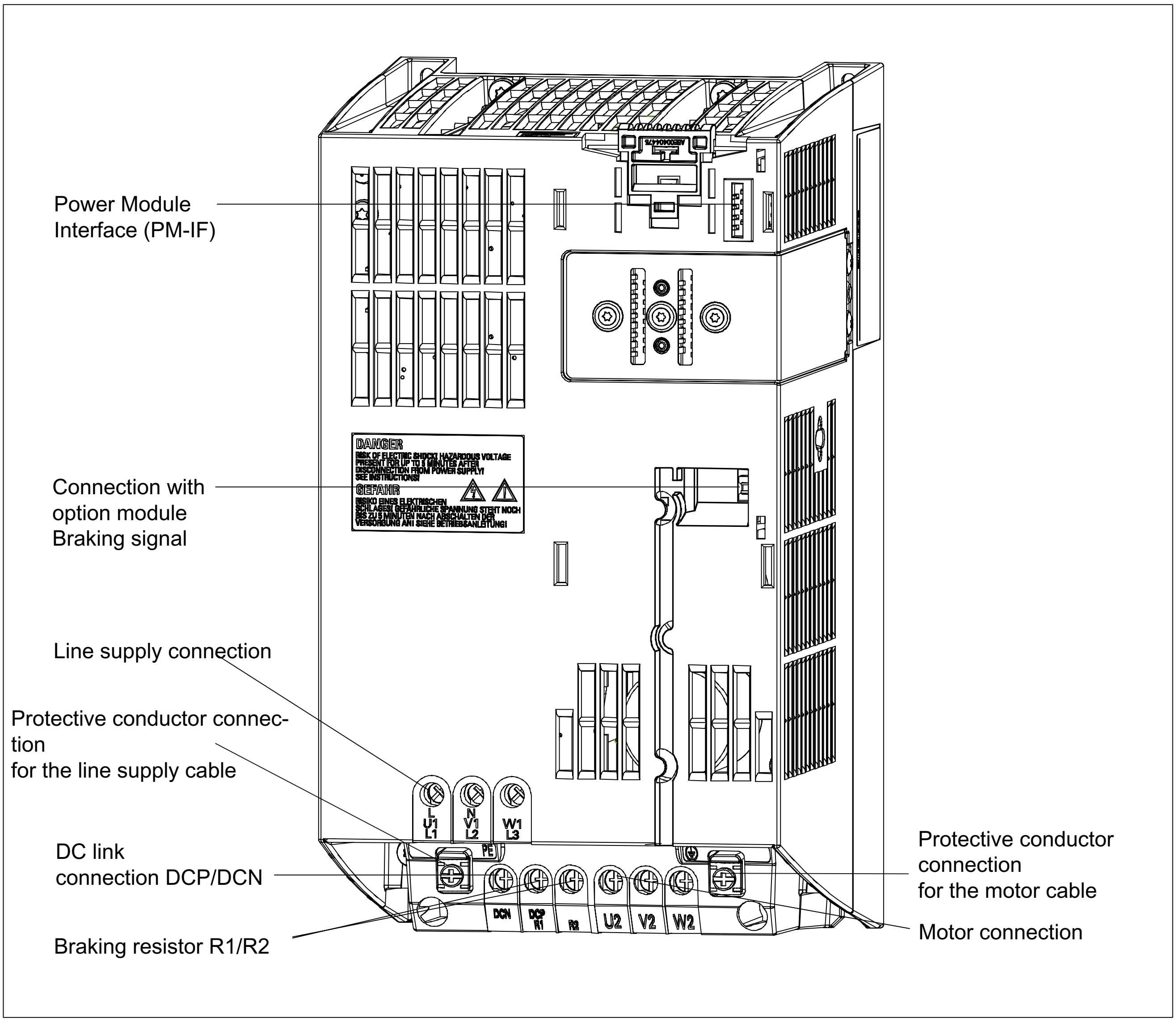


Figure 3-2 PM340, frame size FSB

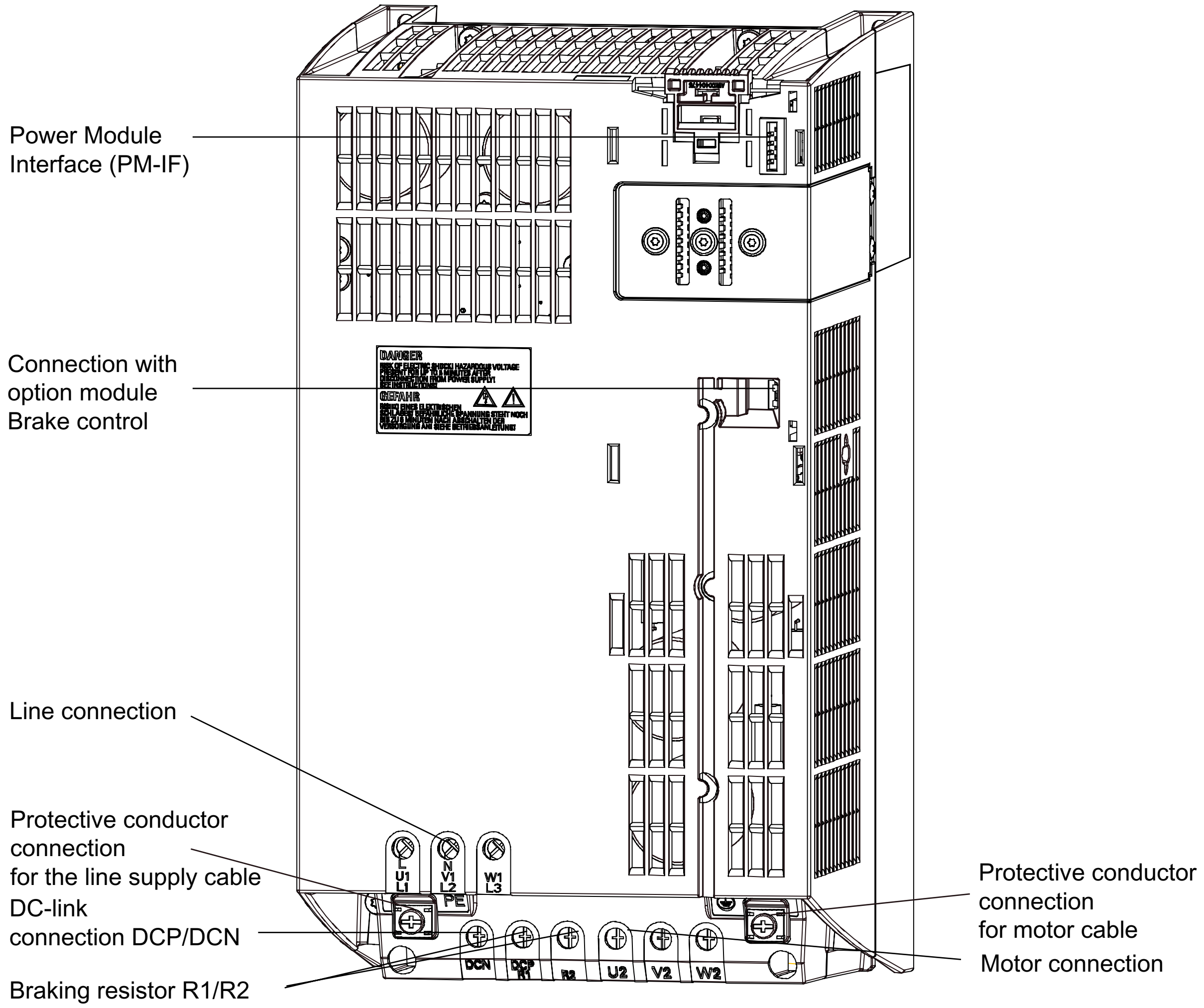


Figure 3-3 PM340, frame size FSC

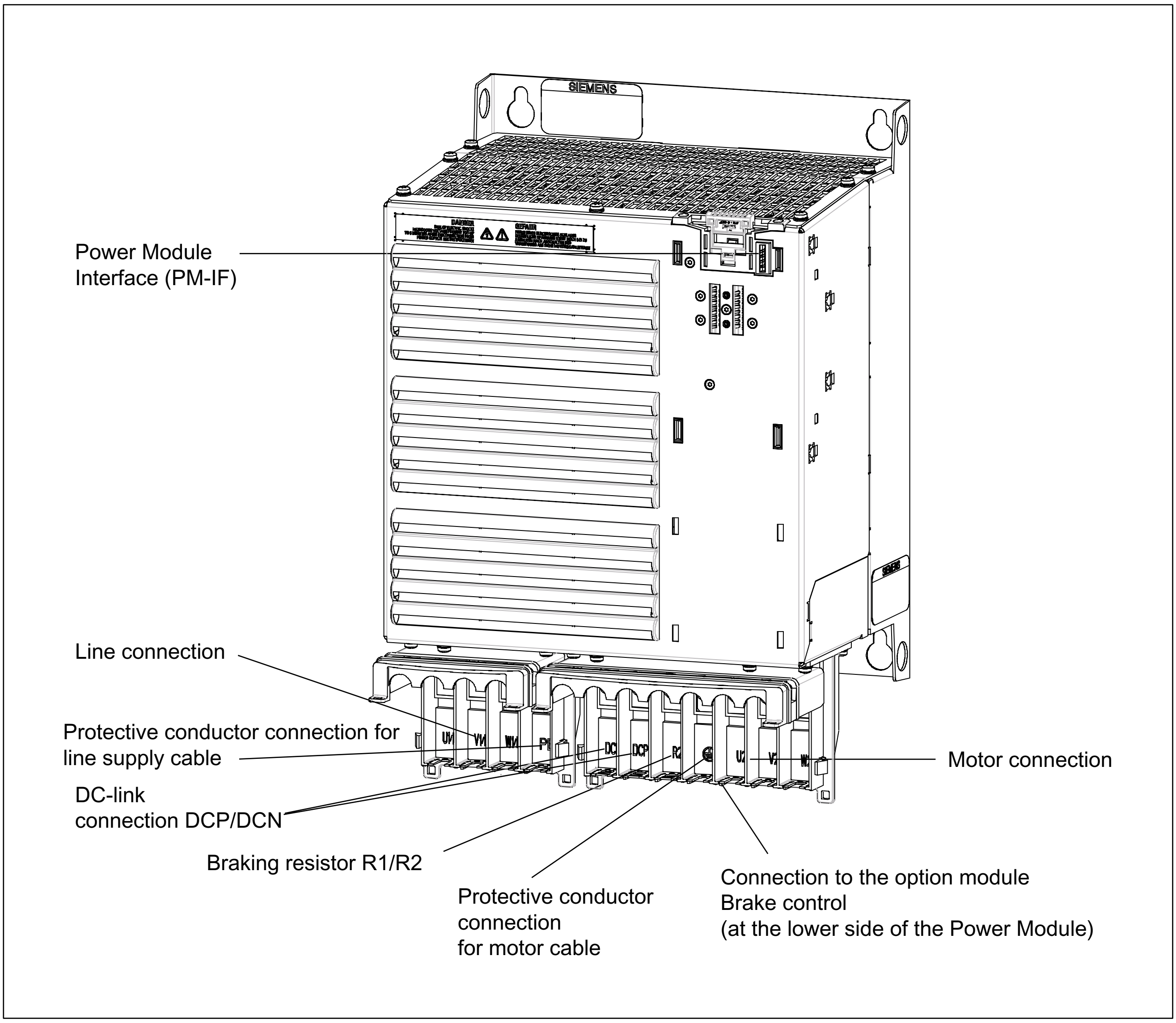


Figure 3-4 PM340, frame size FSD

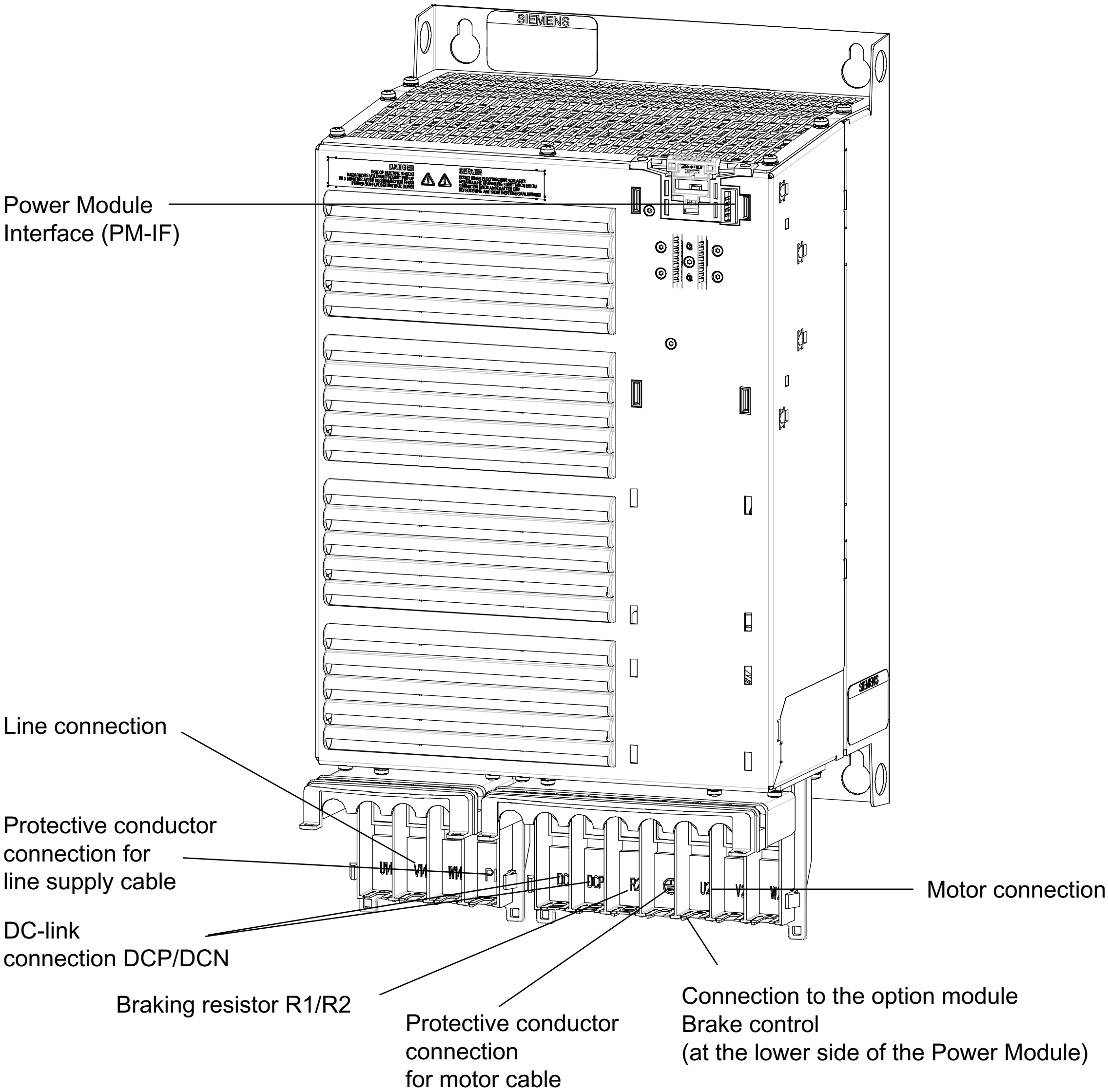


Figure 3-5 PM340, frame size FSE

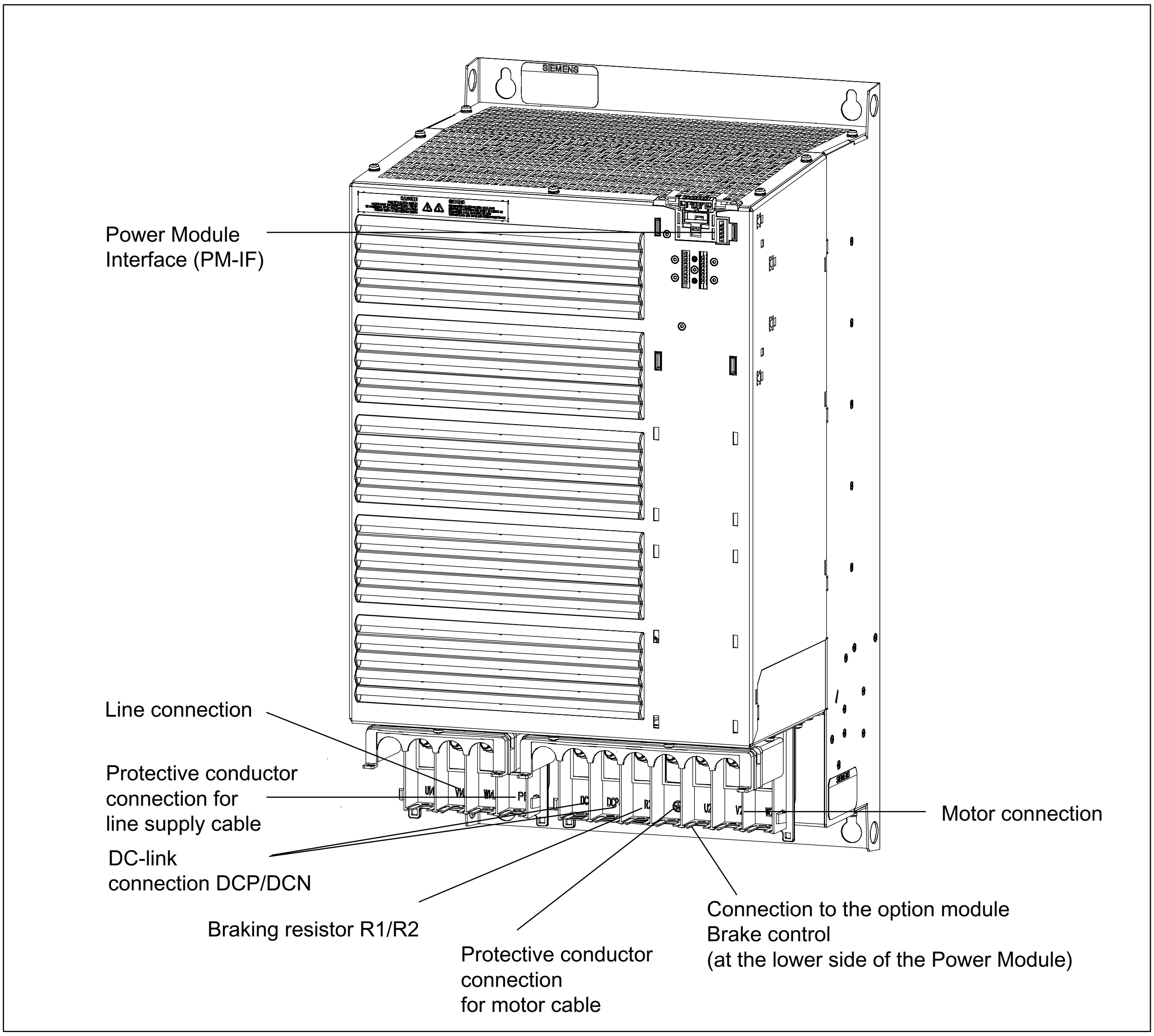


Figure 3-6 PM340, frame size FSF

3.1.3.2 Connection example

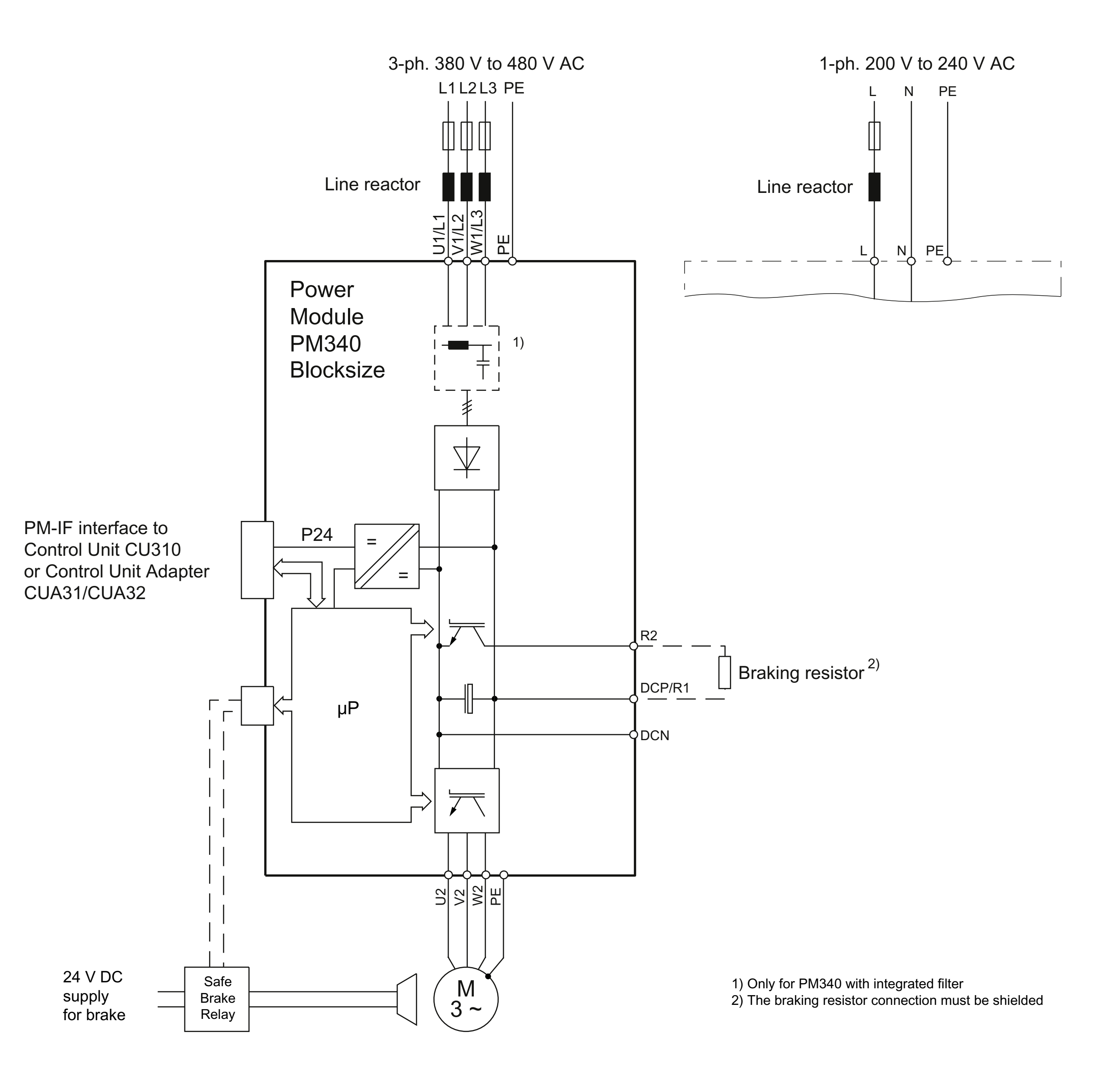


Figure 3-7 PM340 connection example

Arrangement of the line supply 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. The diagram also includes the terminal tightening torques.

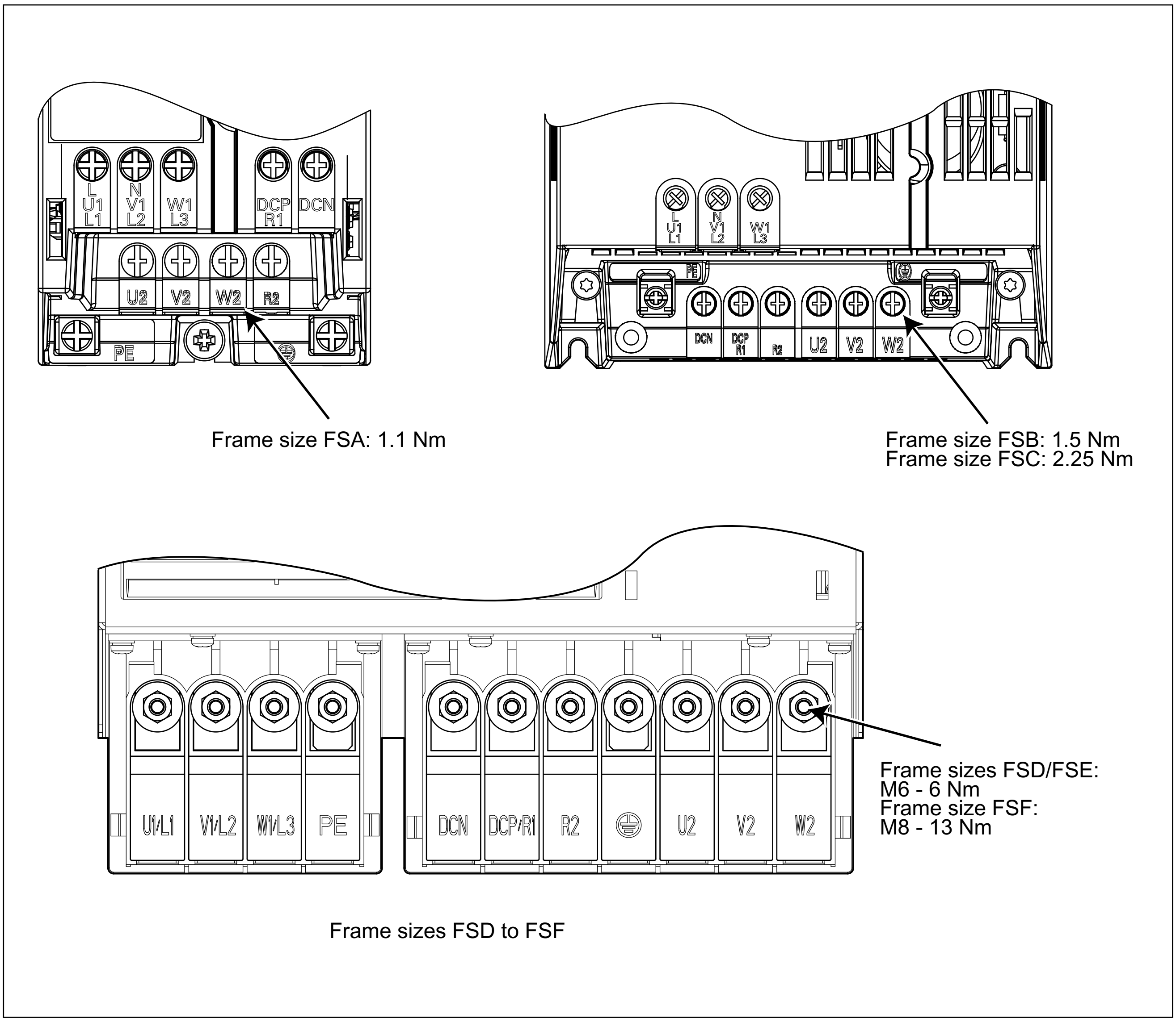


Figure 3-8 Arrangement of the line supply and motor terminals for the PM340

3.1.3.3 Line supply connection

Table 3- 2 Terminal block, line supply connection 1-ph. 200 V - 240 V AC

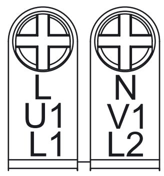
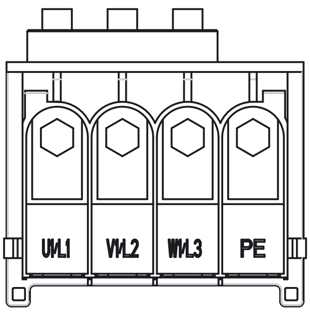
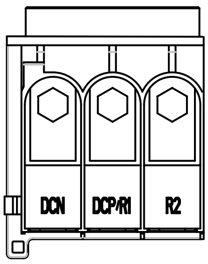
	Terminal	Signal name	Technical specifications
	1	L	Line phase L
	2	N	Line phase N
Max. conductor cross-section: 2.5 mm²			

Table 3- 3 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

3.1.3.4 Braking resistor and DC link connection

Table 3- 4 Terminal block, braking resistor, and DC link connection

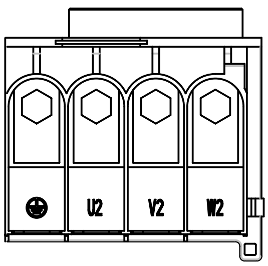
	Terminal	Technical specifications
	DCN	DC link negative
	DCP/R1	DC link positive and positive connection for braking resistor
	R2	Negative connection for the braking resistor

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.

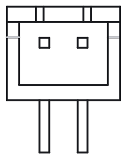
3.1.3.5 Motor connection

Table 3- 5 Terminal block, motor connection 200 V - 240 V 1 AC and 380 V - 480 V 3 AC

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

3.1.3.6 Connection to the option module, brake control

Table 3- 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

3.1.4 Dimension drawings

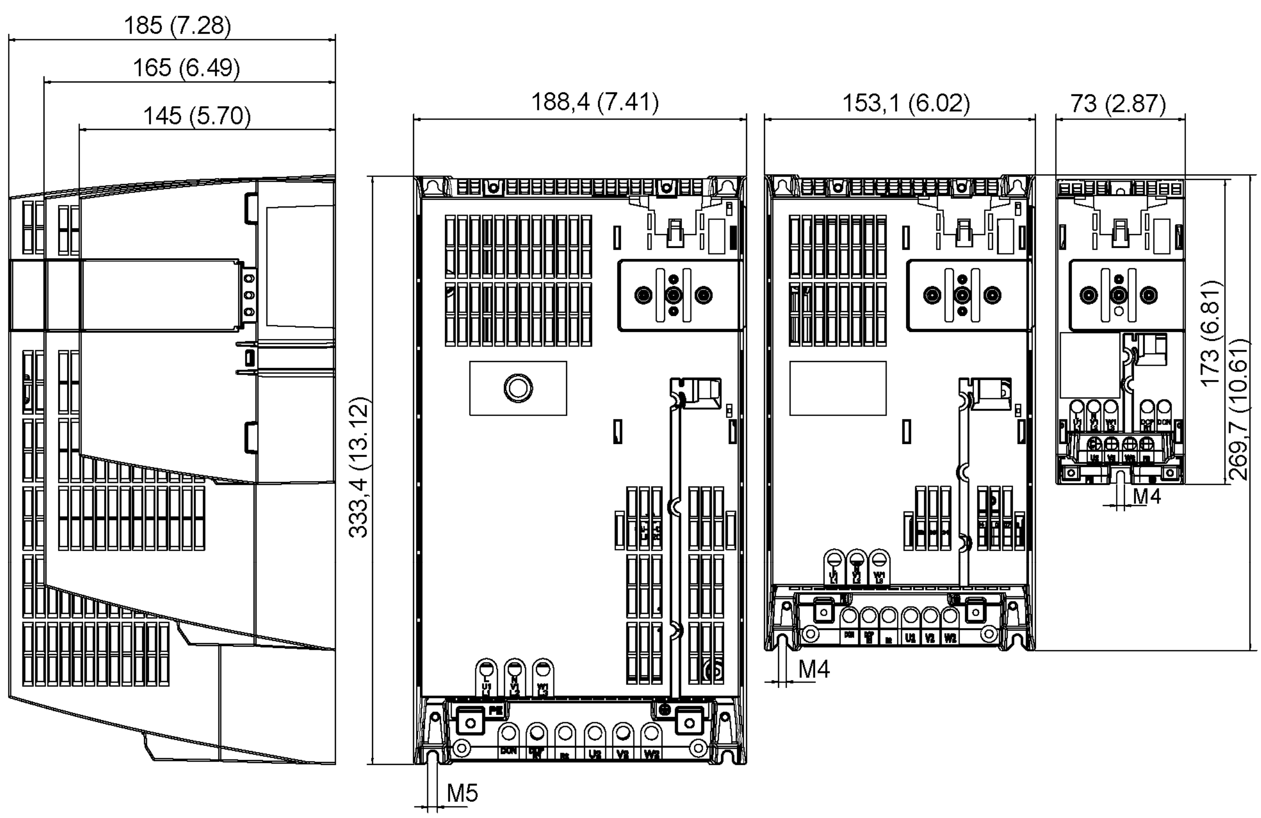


Figure 3-9 Dimension drawings, Power Module PM340

Frame size FSC Frame size FSB Frame size FSA

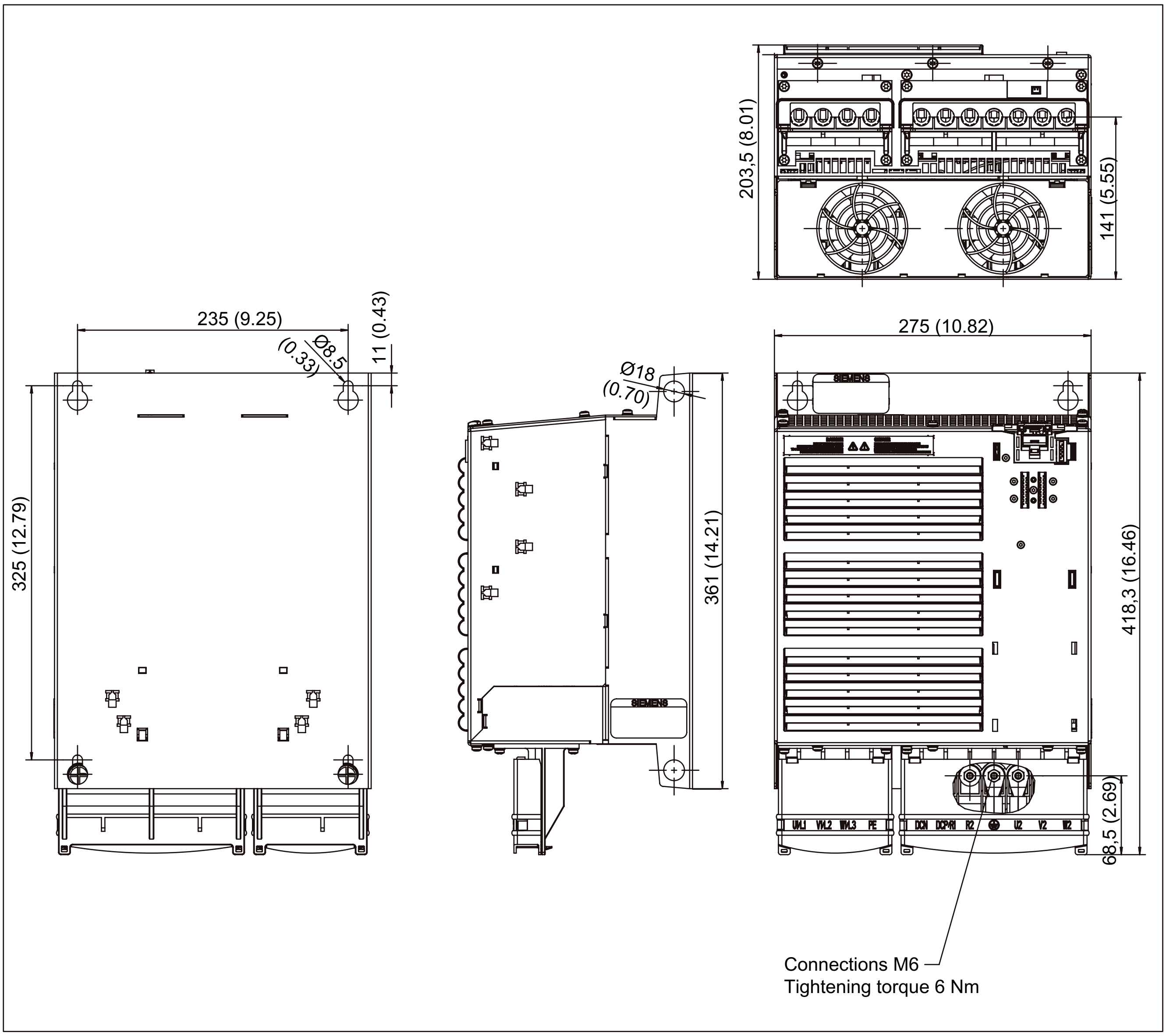


Figure 3-10 Dimension drawing: Power Module PM340, frame size FSD

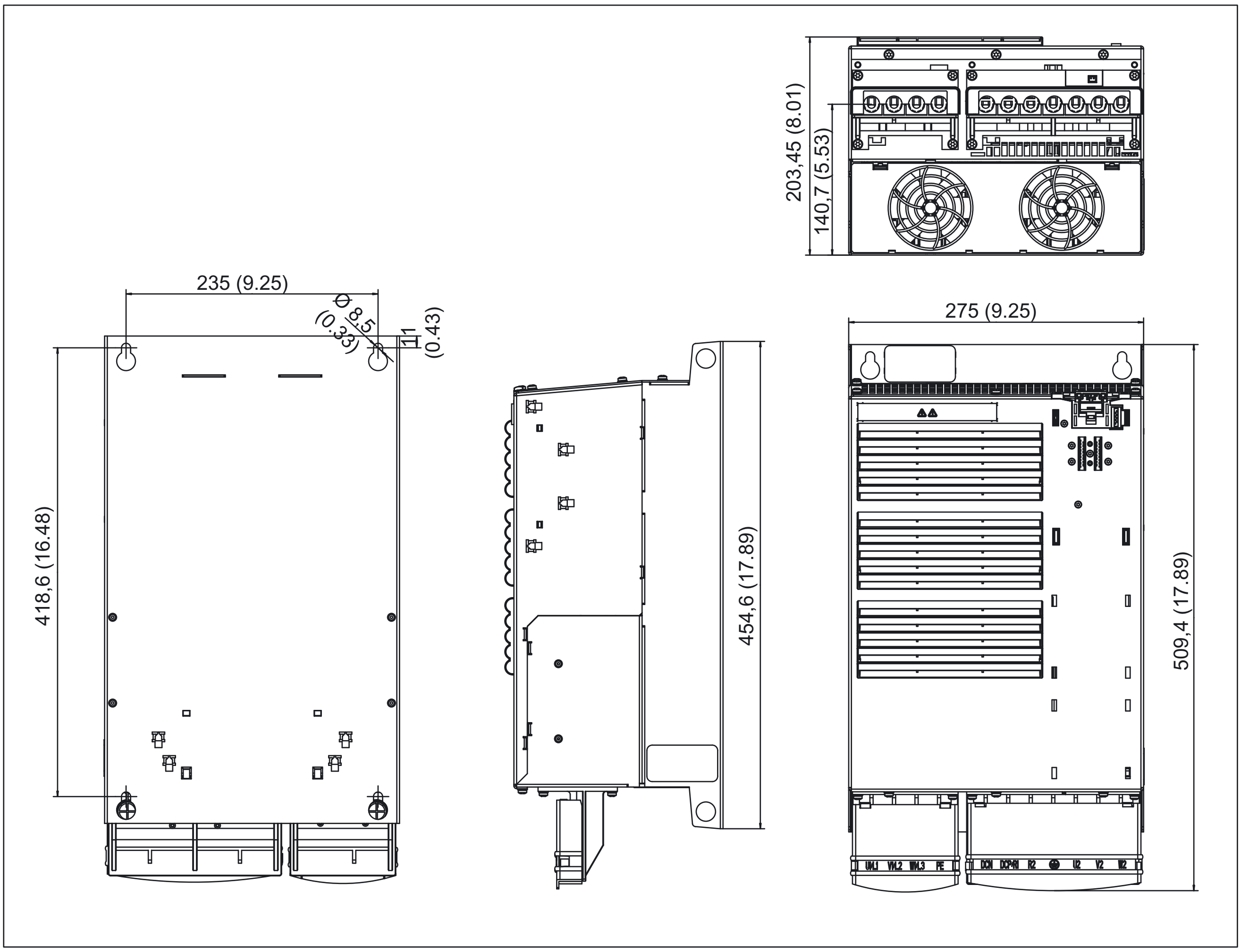


Figure 3-11 Dimension drawing: Power Module PM340 with integrated line filter, frame size FSD

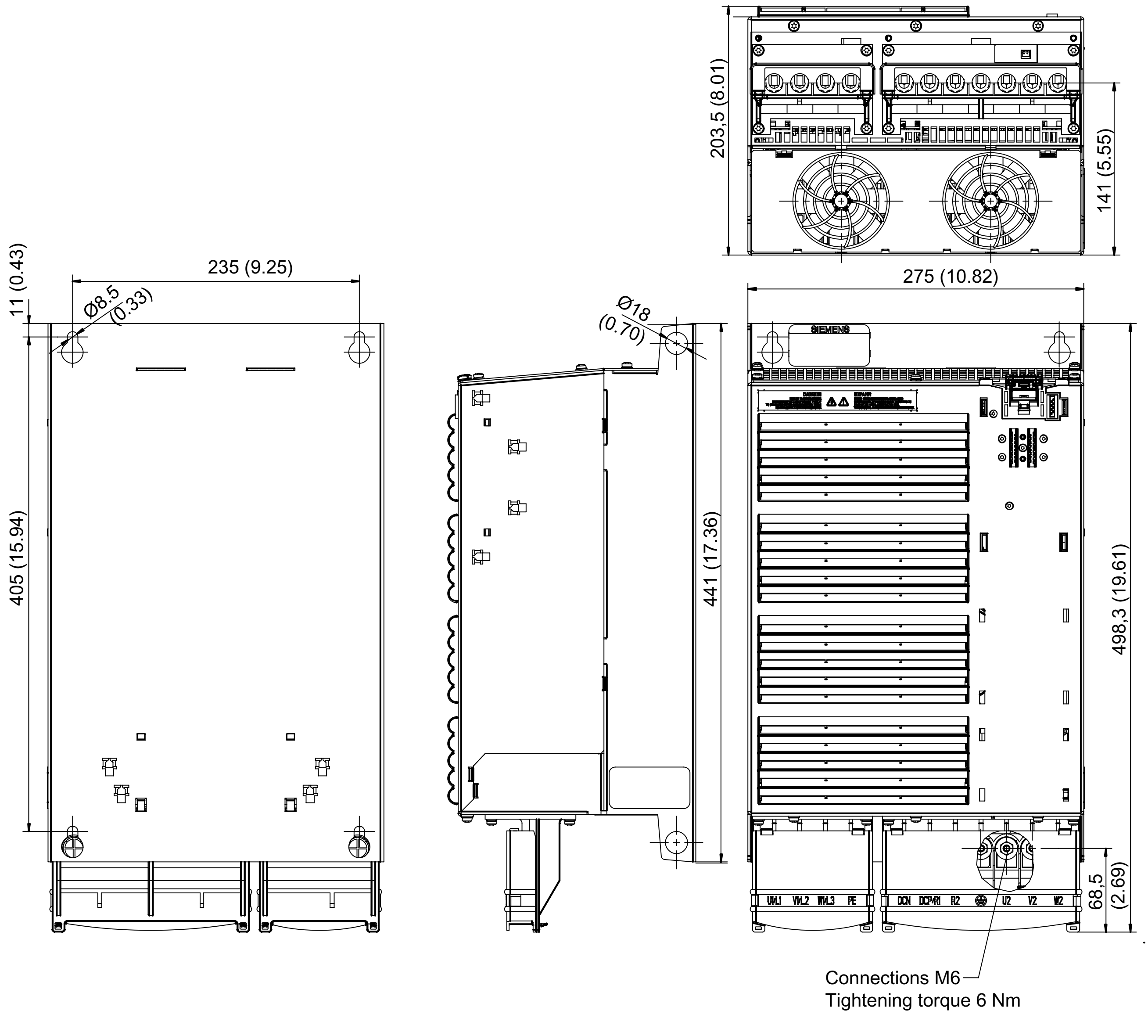


Figure 3-12 Dimension drawing: Power Module PM340, frame size FSE

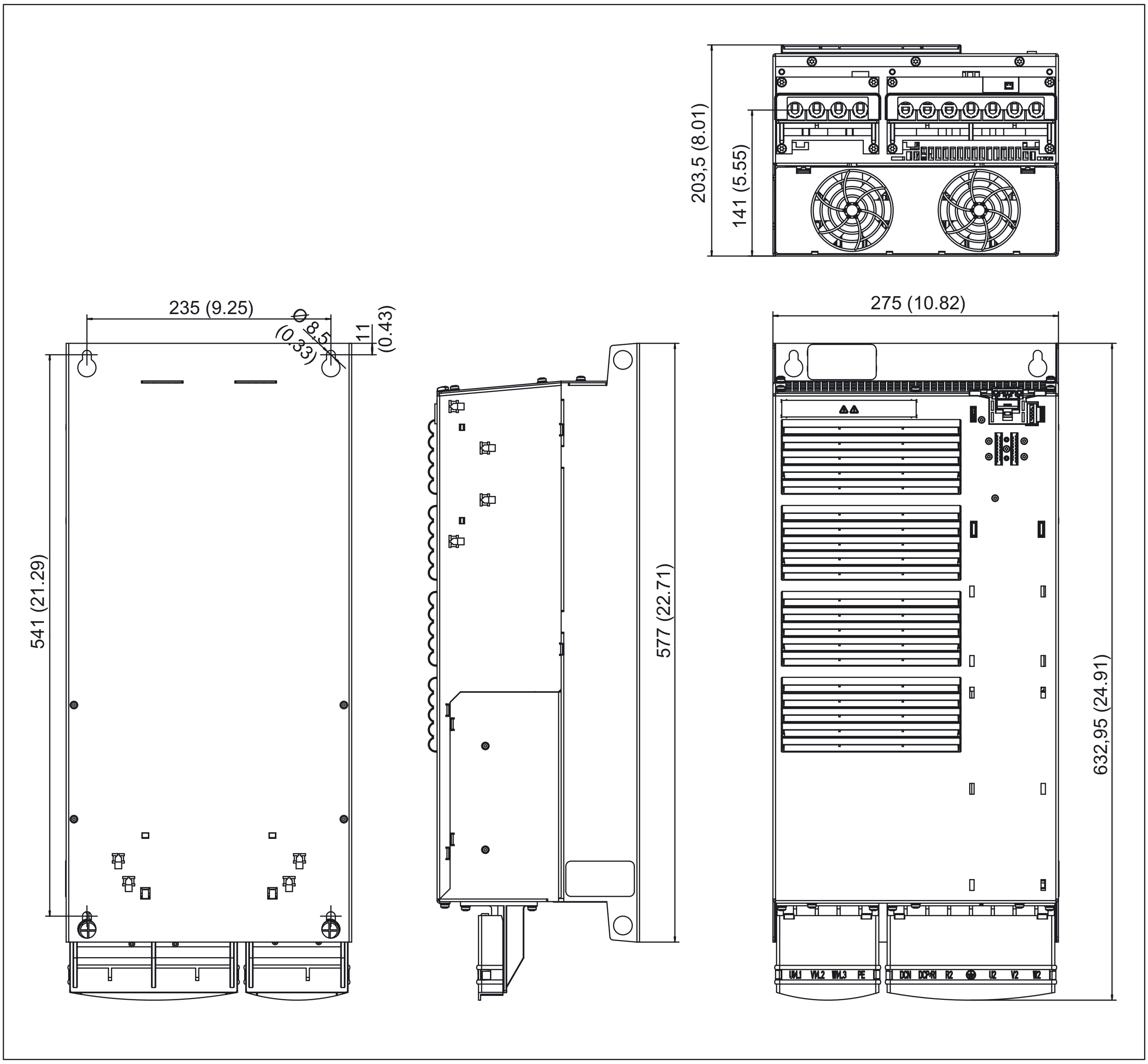


Figure 3-13 Dimension drawing: Power Module PM340 with integrated line filter, frame size FSE

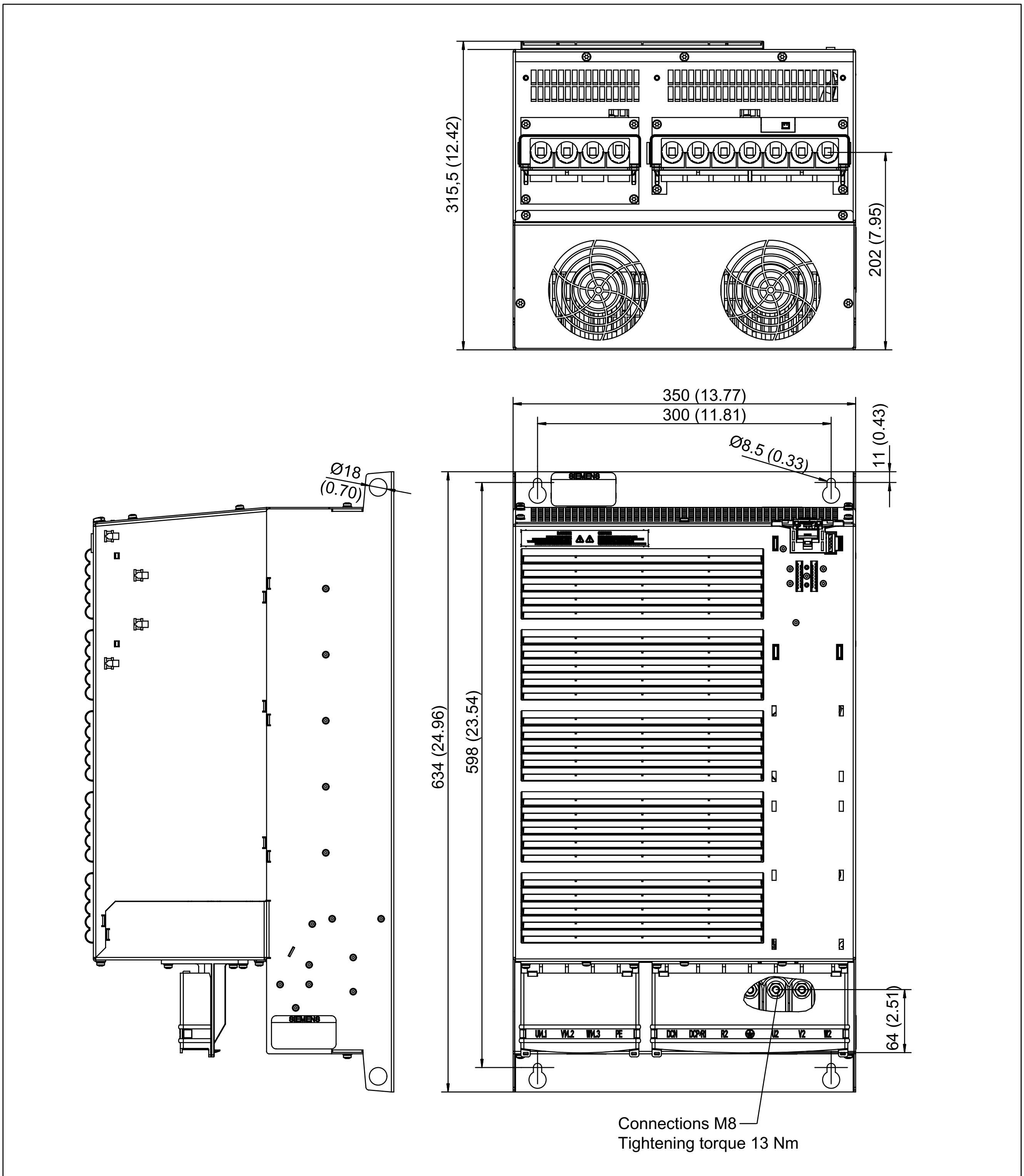


Figure 3-14 Dimension drawing: Power Module PM340, frame size FSF

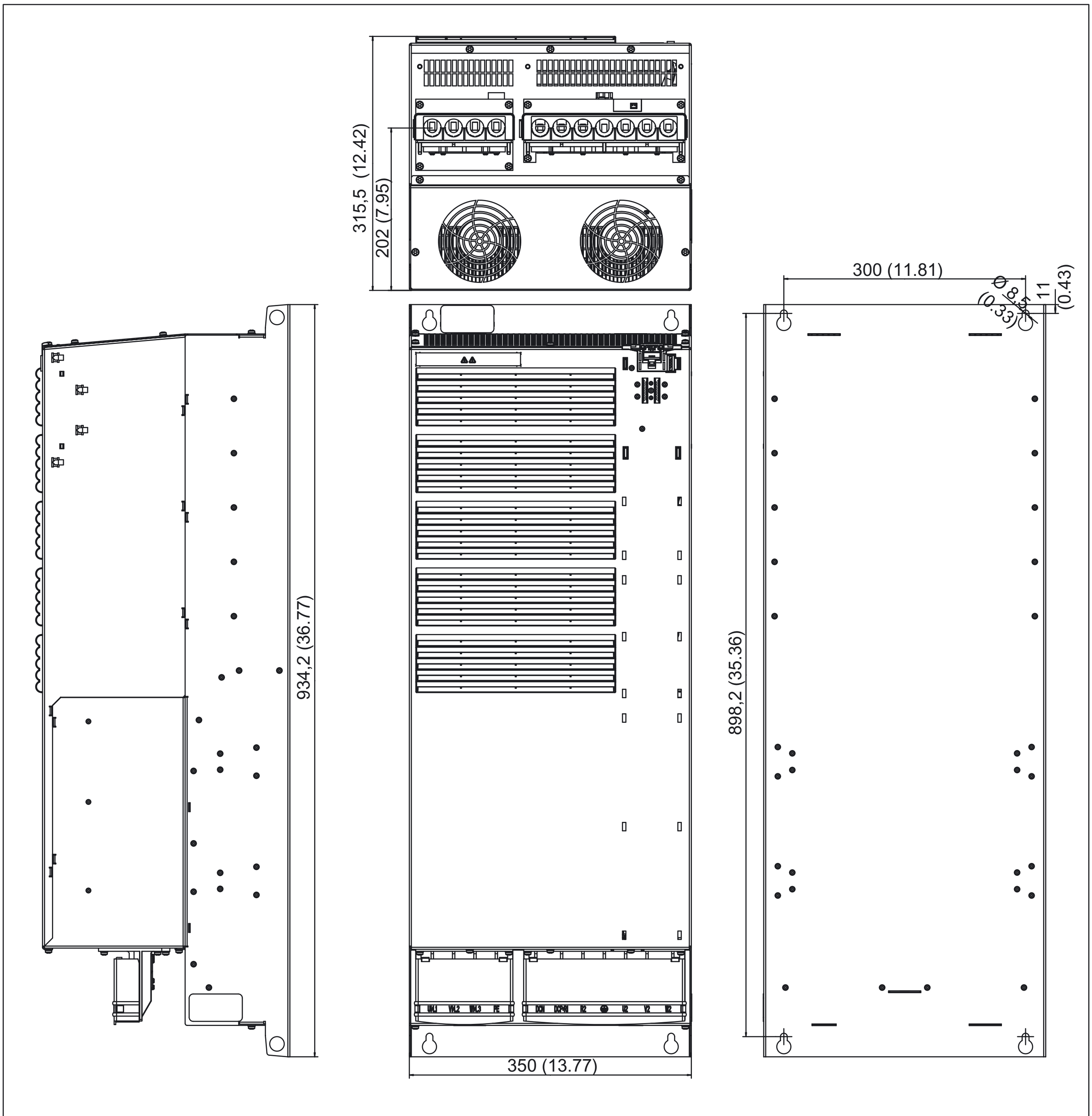


Figure 3-15 Dimension drawing: Power Module PM340 with integrated line filter, frame size FSF

3.1.5 Mounting

3.1.5.1 Drilling patterns

Drilling templates for frame sizes FSA to FSC

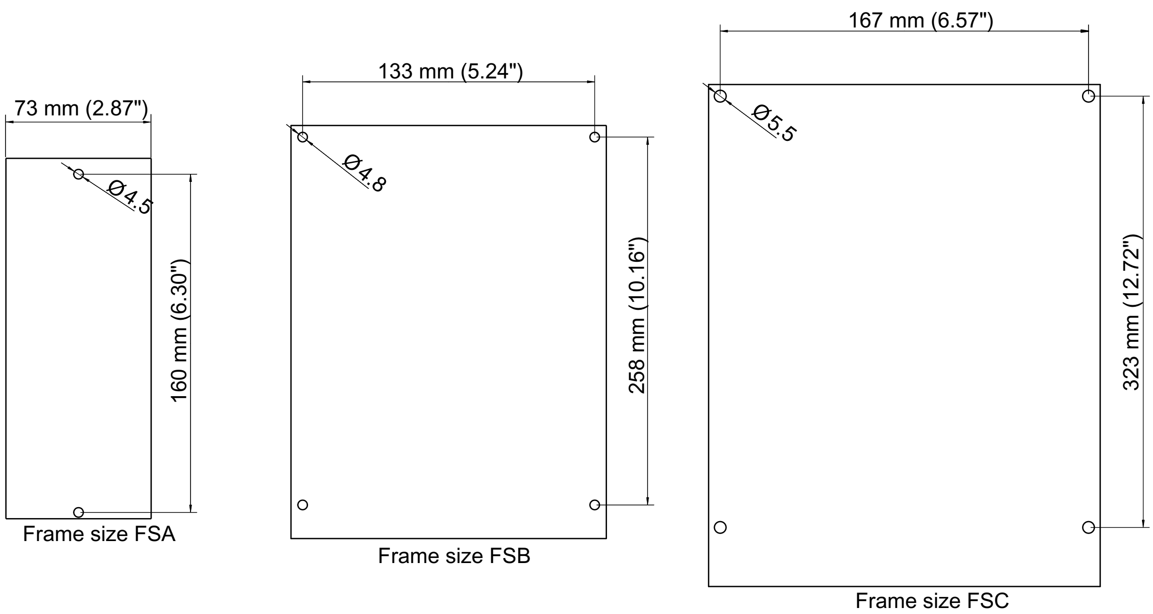


Figure 3-16 Drilling templates for frame sizes FSA to FSC

Drilling templates for frame sizes FSD to FSF

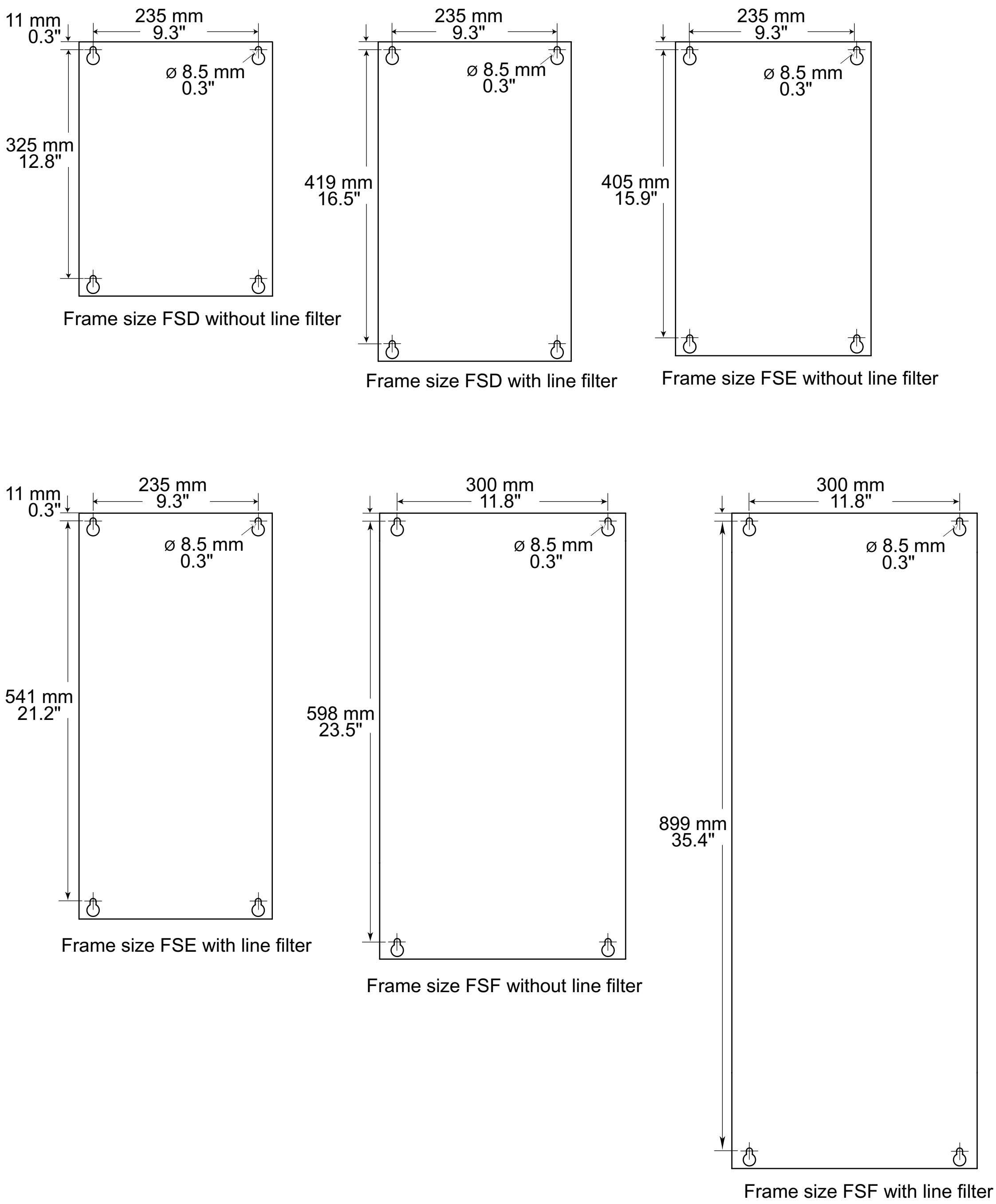


Figure 3-17 Drilling templates for frame sizes FSD to FSF - with and without line filter

3.1.5.2 Mounting dimensions and tightening torques

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

Table 3- 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
		Inches	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	
		Inches	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	
		Inches	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 M6 nuts, 4 x M6 washers	6 Nm with washers
		Inches	16.3 x 10.8 x 8.0		
FSD with integrated line filter	HxWxD	mm	512 x 275 x 204		
		Inches	20.1 x 10.8 x 8.0		
FSE without line filter	HxWxD	mm	499 x 275 x 204		
		Inches	19.6 x 10.8 x 8.0		
FSE with integrated line filter	HxWxD	mm	635 x 275 x 204		
		Inches	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
		Inches	25.0 x 13.8 x 12.4		
FSF with integrated line filter	HxWxD	mm	934 x 350 x 316		
		Inches	36.8 x 13.8 x 12.4		

Table 3- 8 PM340, load terminals - Tightening torques

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

3.1.5.3 Access to the power supply terminals and motor terminals

For frame sizes FSD to FSF, the terminals are accessed by releasing the tongue at the side of the terminal covers using a suitable flat screwdriver. The cover can then be pushed upwards and engaged in this position as shown in the following diagram.

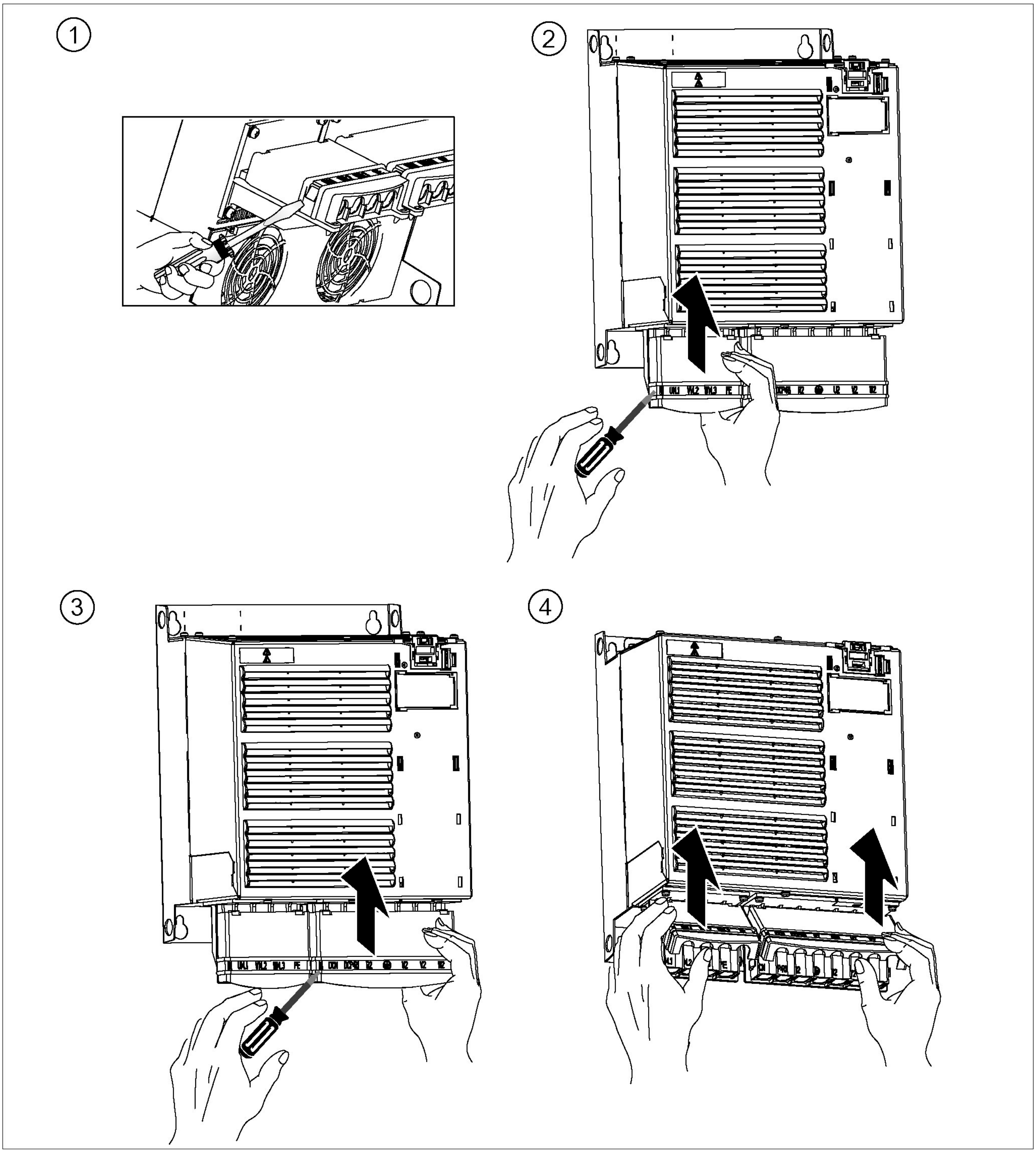


Figure 3-18 Access to the line and motor terminals for frame sizes FSD to FSF

⚠ 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.

3.1.6 Technical data

Table 3- 9 Technical specifications PM340, Part 1

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**
Frame size		FSA	FSA	FSA
Rated output current I_n	A	0.9	2.3	3.9
Base load current I_H	A	0.8	2.0	3.4
Output current for S6 duty (40%) I_{s6}	A	1.4	3.3	5.5
Max. output current I_{max}	A	2.0	4.6	7.8
Rated power based on I_n	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	m^3/s	0.005	0.005	0.005
Sound pressure level	dB(A)	< 45	< 45	< 45
24 V DC power supply for the Control Unit	A	1.0	1.0	1.0
Rated input current[1)] - with line reactor - without line reactor	A	 1.4 2.2	 4 6	 6.5 10
Class J UL safety 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
Max. cable length to braking resistor	m	15	15	15
Line supply connection L, N		Screw-type 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		at the housing with M 4 screw		
Max. motor cable length [2)] (without external options)	m	50 (shielded) 75 (unshielded)		

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**
Degree of protection		IP20 or IPXXB		
Weight	kg	1.2	1.3	1.3

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

2) 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.

Table 3- 10 Technical specifications PM340, Part 2

Line supply voltage 3-ph. 380 V to 480 V AC ±10%						
PM340	**6SL3210-**	**1SE11-3UA0**	**1SE11-7UA0**	**1SE12-2UA0**	**1SE13-1UA0**	**1SE14-1UA0**
PM340 with integrated line filter	-	-	-	-	-	-
Frame size		FSA	FSA	FSA	FSA	FSA
Rated output current I_{rated}	A	1.3	1.7	2.2	3.1	4.1
Base load current I_H	A	1.1	1.5	1.9	2.7	3.6
Output current for S6 duty (40%) I_{S6}	A	1.3	2.0	2.5	3.5	4.5
Max. output current I_{max}	A	2.6	3.4	4.4	6.2	8.2
Rated power based on I_{rated}	kW	0.37	0.55	0.75	1.1	1.5
Rated power based on I_H	kW	0.37	0.55	0.75	1.1	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	dB(A)	< 45	< 45	< 45	< 45	< 45
24 V DC power supply for the Control Unit	A	1.0	1.0	1.0	1.0	1.0
Rated input current 1) - with line reactor - without line reactor	A	 1.3 1.7	 1.7 2.2	 2.2 2.6	 3.1 3.9	 4.1 4.8
Class J UL safety fuses Rated current Rated short-circuit current SCCR	 A kA	 4 65	 4 65	 6 65	 8 65	 10 65
LV HRC safety fuses Rated current	 A	3NA3 804 4	3NA3 804 4	3NA3 801 6	3NA3 803 10	3NA3 803 10

Line supply voltage 3-ph. 380 V to 480 V AC ±10%						
PM340	6SL3210-	1SE11-3UA0	1SE11-7UA0	1SE12-2UA0	1SE13-1UA0	1SE14-1UA0
PM340 with integrated line filter	-	-	-	-	-	-
Circuit breaker type designation EN 60947 Rated current	 A	3RV1021-1DA10 2.2 - 3.2	3RV1021-1DA10 2.2 - 3.2	3RV1021-1FA10 3.5 - 5	3RV1021-1GA10 4.5 - 6.3	3RV1021-1HA10 5.5 - 8
Resistance value of the external 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		at the housing with M 4 screw				
Max. motor cable length 2)	m	50 (shielded) 75 (unshielded)				
Degree of protection		IP20 or IPXXB				
Weight	kg	1.2	1.2	1.2	1.2	1.2

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

2) 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 3- 11 Technical specifications PM340, Part 3

Line supply voltage 3-ph. 380 V to 480 V AC ±10%						
PM340	6SL3210-	1SE16-0UA0	1SE17-7UA0	1SE21-0UA0	1SE21-8AA0	1SE22-5UA0
PM340 with integrated line filter	6SL3210-	1SE16-0AA0	1SE17-7AA0	1SE21-0AA0	1SE21-8UA0	1SE22-5AA0
Frame size		FSB	FSB	FSB	FSC	FSC
Rated output current I_{rated}	A	5.9	7.7	10.2	18	25
Base load current I_H	A	5.2	6.8	9.1	14	21
Output current for S6 duty (40%) I_{S6}	A	6.4	8.3	10.8	19.6	27.8
Max. output current I_{max}	A	11.8	15.4	20.4	26.4	38
Rated power based on I_{rated}	kW	2.2	3	4	7.5	11

Line supply voltage 3-ph. 380 V to 480 V AC ±10%						
PM340	6SL3210-	1SE16-0UA0	1SE17-7UA0	1SE21-0UA0	1SE21-8AA0	1SE22-5UA0
PM340 with integrated line filter	6SL3210-	1SE16-0AA0	1SE17-7AA0	1SE21-0AA0	1SE21-8UA0	1SE22-5AA0
Rated power based on I_H	kW	2.2	3	4	5.5	7.5
Rated pulse frequency	kHz	4	4	4	4	4
Power loss	kW	0.14	0.16	0.18	0.24	0.30
Cooling air requirement	m^3/s	0.009	0.009	0.009	0.038	0.038
Sound pressure level	dB(A)	< 50	< 50	< 50	< 60	< 60
24 V DC power supply for the Control Unit	A	1.0	1.0	1.0	1.0	1.0
Rated input current[1)] - with line reactor - without line reactor	A	 5.6 6.7	 7.5 8.9	 9.8 12.4	 17.1 23.1	 24.6 32.6
Class J UL safety fuses Rated current Rated short-circuit current SCCR	 A kA	 10 65	 12 65	 15 65	 25 65	 35 65
Safety fuses NH Rated current	 A	3NA3 803 10	3NA3 805 16	3NA3 805 16	3NA3 810 25	3NA3 814 35
Circuit breaker type designation EN 60947 Rated current	 A	3RV1021-1KA10 9 - 12.5	3RV1021-4AA10 11 - 16	3RV1021-4BA10 14 - 20	3RV1031-4EA10 22 - 32	3RV1031-4FA10 28 - 40
Resistance value of the external braking resistor	Ω	> 160	> 160	> 160	> 56	> 56
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 6 mm^2			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		at the housing with M 5 screw				
Max. motor cable length [2)]	m	50 (shielded) 75 (unshielded)				

Line supply voltage 3-ph. 380 V to 480 V AC ±10%						
PM340	6SL3210-	1SE16-0UA0	1SE17-7UA0	1SE21-0UA0	1SE21-8AA0	1SE22-5UA0
PM340 with integrated line filter	6SL3210-	1SE16-0AA0	1SE17-7AA0	1SE21-0AA0	1SE21-8UA0	1SE22-5AA0
Degree of protection		IP20 or IPXXB				
Weight	kg	4.0	4.0	4.0	6.5	6.5

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

2) 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 3- 12 Technical specifications PM340, Part 4

Line supply voltage 3-ph. 380 V to 480 V AC ±10%						
PM340	6SL3210-	1SE23-2UA0	1SE23-8UA0	1SE24-5UA0	1SE26-0UA0	1SE27-5UA0
PM340 with integrated line filter	6SL3210-	1SE23-2AA0	1SE23-8AA0	1SE24-5AA0	1SE26-0AA0	1SE27-5AA0
Frame size		FSC	FSD	FSD	FSD	FSE
Rated output current I_{rated}	A	32	38	45	60	75
Base load current I_H	A	27	33	40	48	65
Output current for S6 duty (40%) I_{S6}	A	37.1	49	58	78	98
Max. output current I_{max}	A	52	64	76	90	124
Rated power based on I_{rated}	kW	15	18.5	22	30	37
Rated power based on I_H	kW	11	15	18.5	22	30
Rated pulse frequency	kHz	4	4	4	4	4
Power loss	kW	0.40	0.38	0.51	0.69	0.99
Cooling air requirement	l / s	54.9	54.9	54.9	54.9	2 x 54.9
Sound pressure level	dB(A)	< 60	< 60	< 60	< 60	< 60
24 V DC power supply for the Control Unit	A	1.0	1.0	1.0	1.0	1.0
Rated input current[1)] - with line reactor - without line reactor	A	 33 39	 40 46	 47 53	 63 72	 78 88
Class J UL safety fuses Rated current Rated short-circuit current SCCR	 A kA	 45 65	 50 65	 60 65	 90 65	 100 65
LV HRC safety fuses Rated current	 A	3NA3 817 40	3NA3 820 50	3NA3 822 63	3NA3 824 80	3NA3 830 100

Line supply voltage 3-ph. 380 V to 480 V AC ±10%						
PM340	6SL3210-	1SE23-2UA0	1SE23-8UA0	1SE24-5UA0	1SE26-0UA0	1SE27-5UA0
PM340 with integrated line filter	6SL3210-	1SE23-2AA0	1SE23-8AA0	1SE24-5AA0	1SE26-0AA0	1SE27-5AA0
Circuit breaker type designation EN 60947 Rated current	 A	3RV1031-4HA10 40 - 50	3RV1042-4JA10 45 - 63	3RV1042-4KA10 57 - 75	3RV1042-4MA10 80 - 100	3VL1712-1DD33-0AA0 100 - 125
Circuit breaker type designation UL 489/CSA C22.2 No. 5-02 Rated current Rated short-circuit current SCCR	 A kA	--	--	--	3VL2191-3KN30-0AA0 90 65	3VL2110-3KN30-0AA0 100 65
Resistance value of the external braking resistor	Ω	> 56	> 27	> 27	> 27	> 15
Max. cable length to braking resistor	m	15	15	15	15	15
Line supply connection L1, L2, L3		Screw terminals for cable cross-sections 2.5 to 10 mm²	Stud M6, connectable cable cross-sections 10 to 50 mm²			
Motor connection U2, V2, W2						
DC link connection, connection for braking resistor DCP/R1, DCN, R2						
PE connection		at the housing with M 5 screw	at the housing with M6 screw			
Max. motor cable length 2)	m	50 (shielded) 75 (unshielded)	70 (shielded) 100 (unshielded)			
Degree of protection		IP20 or IPXXB				
Height PM340 without/with integrated line filter	mm	333.4 (13.12)	418.3 (16.47)/ 511 (20.11)	418.3 (16.47)/ 511 (20.11)	418.3 (16.47)/ 511 (20.11)	498.3 (19.62)/ 633 (24.92)
Weight without/with integrated line filter	kg	6.5/6.5	15.9/19.3	15.9/19.3	15.9/19.3	19.8/27.1

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

2) 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 3- 13 Technical specifications PM340, Part 5

Line supply voltage 3-ph. 380 V to 480 V AC ±10%					
PM340	**6SL3210-**	**1SE31-0UA0**	**1SE31-1UA0**	**1SE31-5UA0**	**1SE31-8UA0**
PM340 with integrated line filter	**6SL3210-**	**1SE31-0AA0**	**1SE31-1AA0**	**1SE31-5AA0**	**1SE31-8AA0**
Frame size		FSE	FSF	FSF	FSF
Rated output current I_{rated}	A	90	110	145	178
Base load current I_H	A	80	95	115	155
Output current for S6 duty (40%) I_{S6}	A	117	143	188	231
Max. output current I_{max}	A	150	180	220	290
Rated power based on I_{rated}	kW	45	55	75	90
Rated power based on I_H	kW	37	45	55	75
Rated pulse frequency	kHz	4	4	4	4
Power loss	kW	1.21	1.42	1.93	2.31
Cooling air requirement	l / s	2 x 54.9	150	150	150
Sound pressure level	dB(A)	62	< 60	< 60	65
24 V DC power supply for the Control Unit	A	1.0	1.0	1.0	1.0
Rated input current[1)] - with line reactor - without line reactor	 A	 94 105	 115 129	 151 168	 186 204
Class J UL safety fuses Rated current Rated short-circuit current SCCR	 A kA	 125 65	 150 65	 200 65	 250 65
Safety fuses NH Rated current	 A	3NA3 832 125	3NA3 836 160	3NA3 140 200	3NA3 144 250
Circuit breaker type designation EN 60947 Rated current	 A	3VL1716-1DD33-0AA0 125 - 160	3VL3720-1DC36-0AA0 160 - 200	3VL3720-1DC36-0AA0 160 - 200	3VL3725-1DC36-0AA0 200 - 250
Circuit breaker type designation UL 489/CSA C22.2 No. 5-02 Rated current Rated short-circuit current SCCR	 A kA	3VL2112-3KN30-0AA0 125 65	3VL2115-3KN30-0AA0 150 65	3VL3120-3KN30-0AA0 200 65	3VL3125-3KN30-0AA0 250 65
Resistance value of the external braking resistor	Ω	> 15	> 8.2	> 8.2	> 8.2
Max. cable length to braking resistor	m	15	15	15	15

Line supply voltage 3-ph. 380 V to 480 V AC ±10%					
PM340	6SL3210-	1SE31-0UA0	1SE31-1UA0	1SE31-5UA0	1SE31-8UA0
PM340 with integrated line filter	6SL3210-	1SE31-0AA0	1SE31-1AA0	1SE31-5AA0	1SE31-8AA0
Line supply connection L1, L2, L3		Stud M6, connectable cable cross-sections 10 to 50 mm²	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		at the housing with M6 screw	At the housing with M8 screw		
Max. motor cable length 2)	m	70 (shielded) 100 (unshielded)			
Degree of protection		IP20 or IPXXB			
Height PM340 without/with integrated line filter	mm	498.3 (19.62)/633 (24.92)	634 (24.96)/ 934 (36.77)	634 (24.96)/ 934 (36.77)	634 (24.96)/ 934 (36.77)
Weight without/with integrated line filter	kg	19.8/27.1	50.7/66.7	50.7/66.7	50.7/66.7

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

2) 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.

3.1.6.1 Characteristics

Overload capability

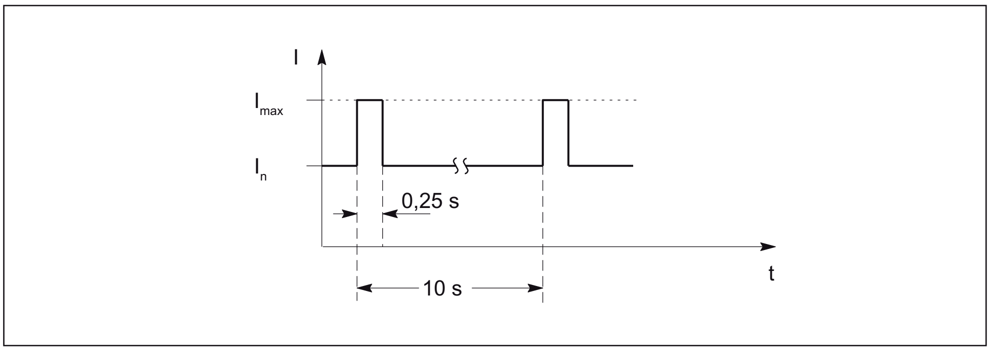


Figure 3-19 Duty cycle with initial load (for servo drives)

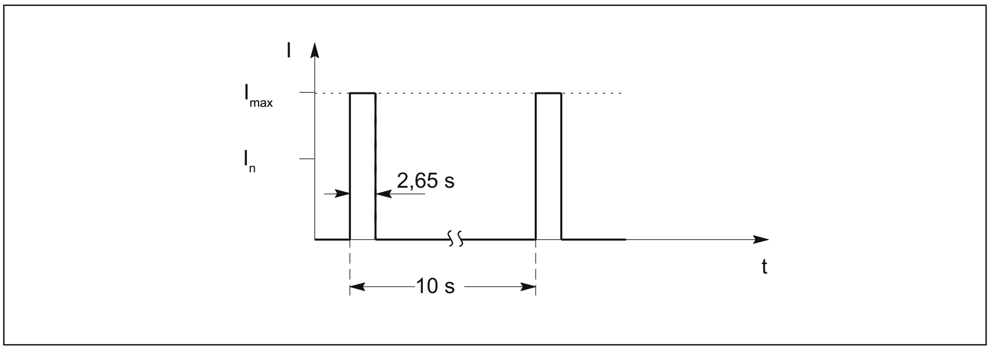


Figure 3-20 Duty cycle without initial load (for servo drives)

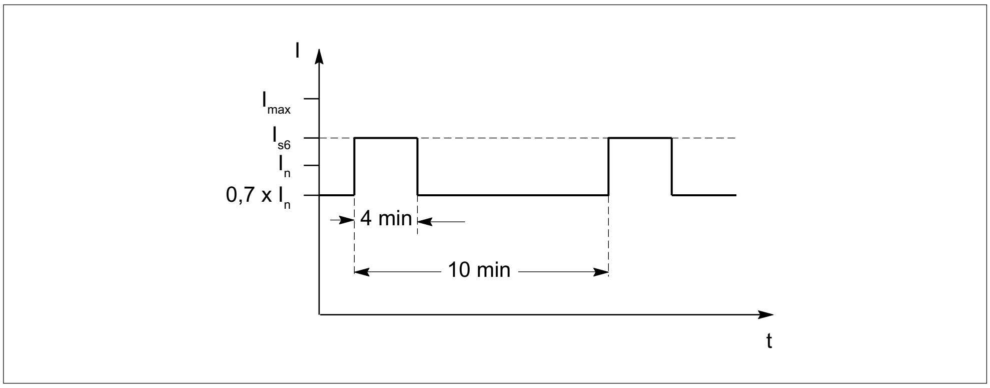


Figure 3-21 S6 duty cycle with initial load (for servo drives)

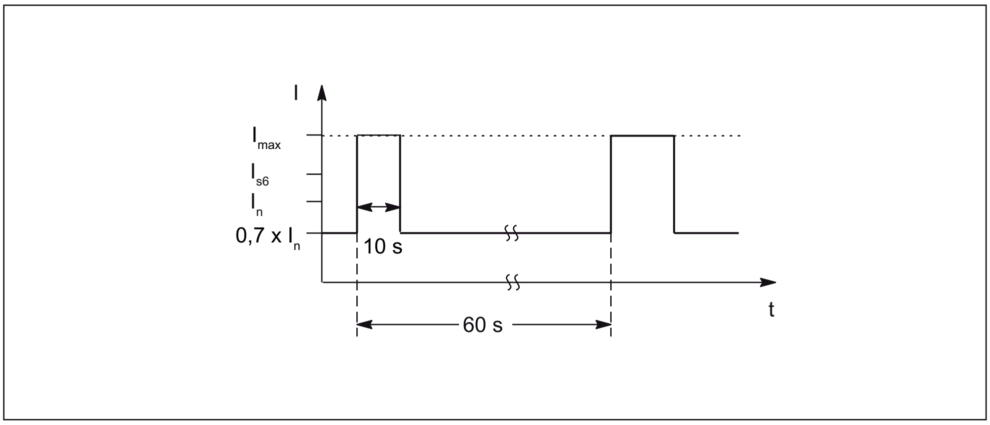


Figure 3-22 Duty cycle with initial load (for servo drives)

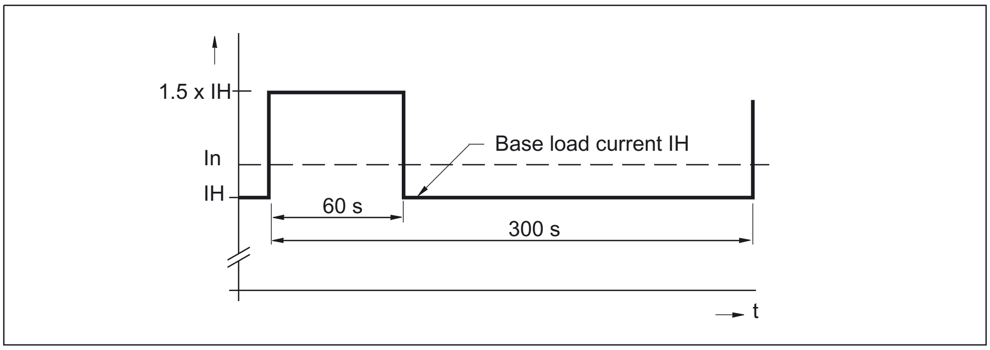


Figure 3-23 Duty cycle with 60 s overload with a duty cycle duration of 300 s

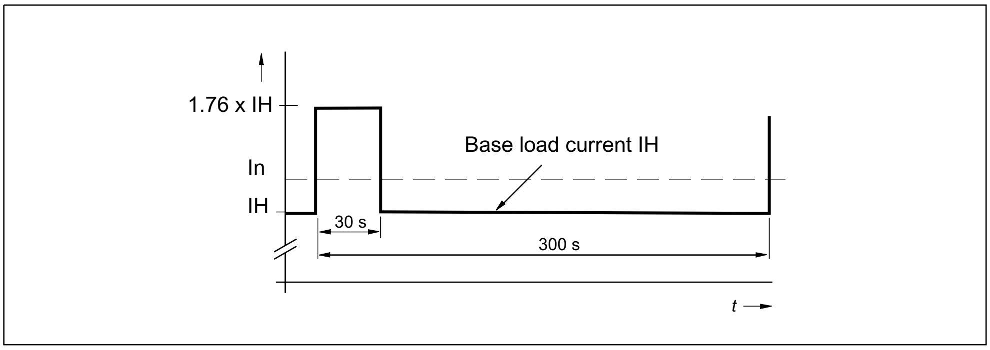


Figure 3-24 Duty cycle with 30 s overload with a duty cycle duration of 300 s

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 3-25 Frame sizes FSA to FSE: Output current as a function of the pulse frequency

Figure 3-26 Frame size FSF: Output current as a function of the pulse frequency

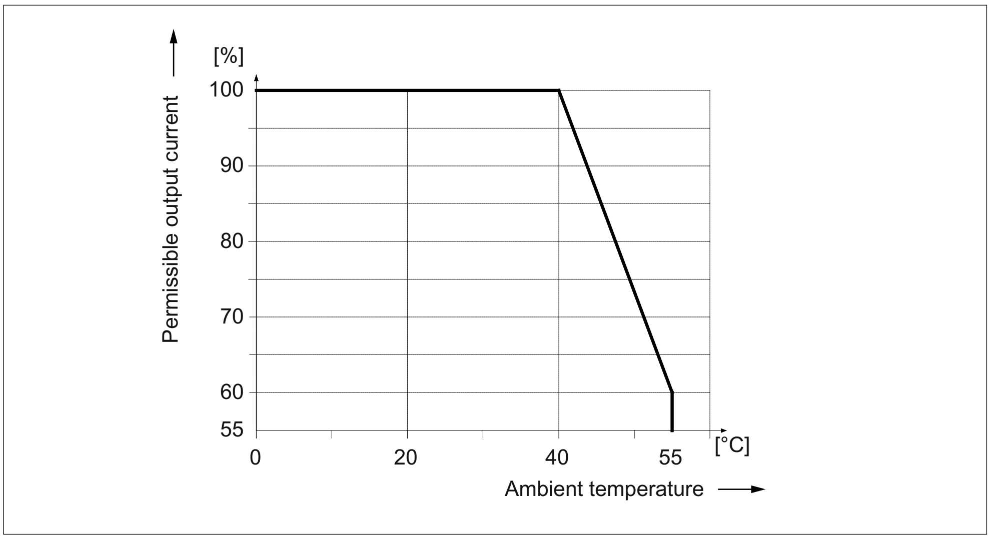


Figure 3-27 Output current as a function of the ambient temperature

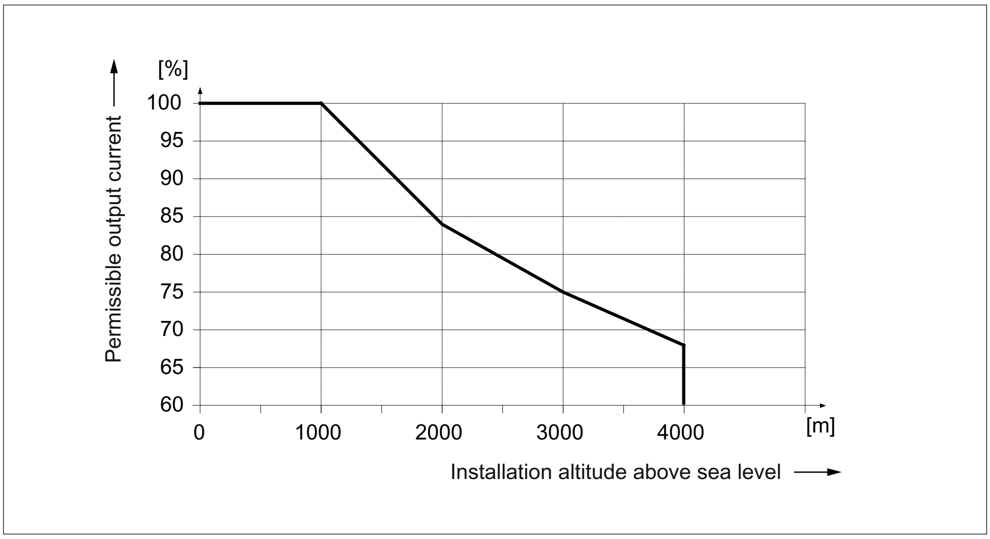


Figure 3-28 Output current as a function of the installation altitude

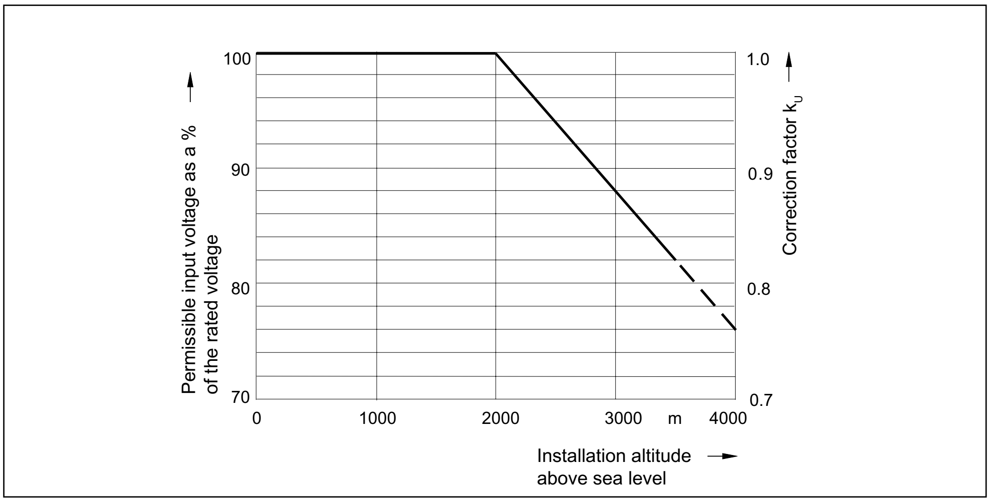


Figure 3-29 Voltage derating as a function of the installation altitude

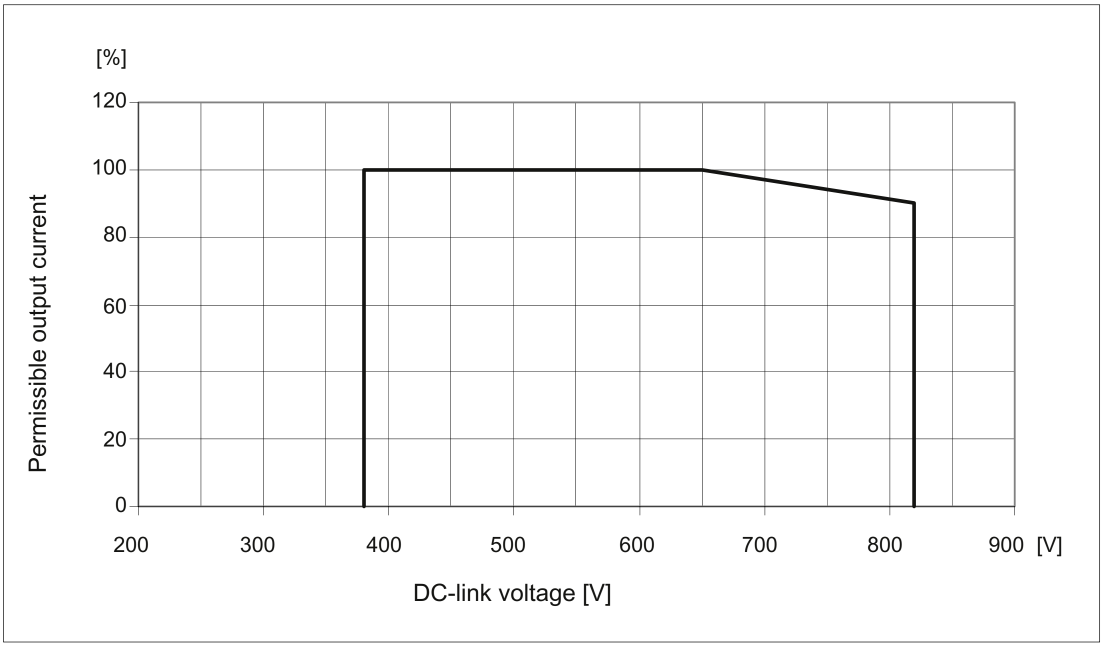


Figure 3-30 Current derating as a function of the DC-link voltage

3.2 Power Modules Blocksize Liquid Cooled (PM340)

3.2.1 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 3- 14 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	

3.2.2 Safety information

⚠ CAUTION

During transport and during storage, Power Modules must be protected against mechanical shock and vibration. It is also important to protect the unit against water (rain) and against excessively high/excessively low temperatures.

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 a machine with integrated Power Modules is connected to the public network, authorization is required from the local power supply company if the rated input current of the machine does not fulfill the requirements of EN 61000-3-2 with respect to current harmonics.

⚠ WARNING
In a residential environment this product can cause radio disturbances, which may make interference-suppression measures necessary.

⚠ DANGER
Grounding/protective grounding of the Power Module The Power Module housing must always be grounded. If the Power Module is not correctly grounded, then extremely hazardous states can occur, which under certain circumstances, can result in death.

⚠ DANGER
It must be checked as to whether the Power Module is designed for the correct power supply - higher supply voltages may not be connected to the Power Module.

⚠ DANGER
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 then may the Power Module be connected to the power supply.

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

⚠ DANGER
Once all the supply voltages have been disconnected, a hazardous voltage may be present in the power unit for up to 5 minutes. The cover for the terminals may only be opened after this time has definitely elapsed. When opening the protective cover, you must activate the release. A suitable tool (e.g. screwdriver) must be used for this purpose. Damaged components must not be used, otherwise this could result in secondary damage or accidents.

⚠ DANGER

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

- stationary connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- stationary connection and automatic shutdown of the power supply if the protective conductor is interrupted

⚠ DANGER

The hazard warning in the local language for the DC link discharge time must be affixed to the component. A set of labels bearing this warning in 16 languages is provided with the component.

⚠ WARNING

Power Modules must be mounted in the vertical position.

For the Liquid Cooled Power Modules, a cooling clearance of 300 mm (11.81 inch) must be maintained above and below the component.

Cooling clearances of 30 mm (1.18 inch) must be observed in front of the component.

Devices, that could restrict the cooling air flow may not be mounted/installed in this area. It must be carefully ensured 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.

⚠ DANGER

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

Non-observance can cause lethal shock voltages.

⚠ WARNING

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.

3.2.3 Interface description

3.2.3.1 Overview

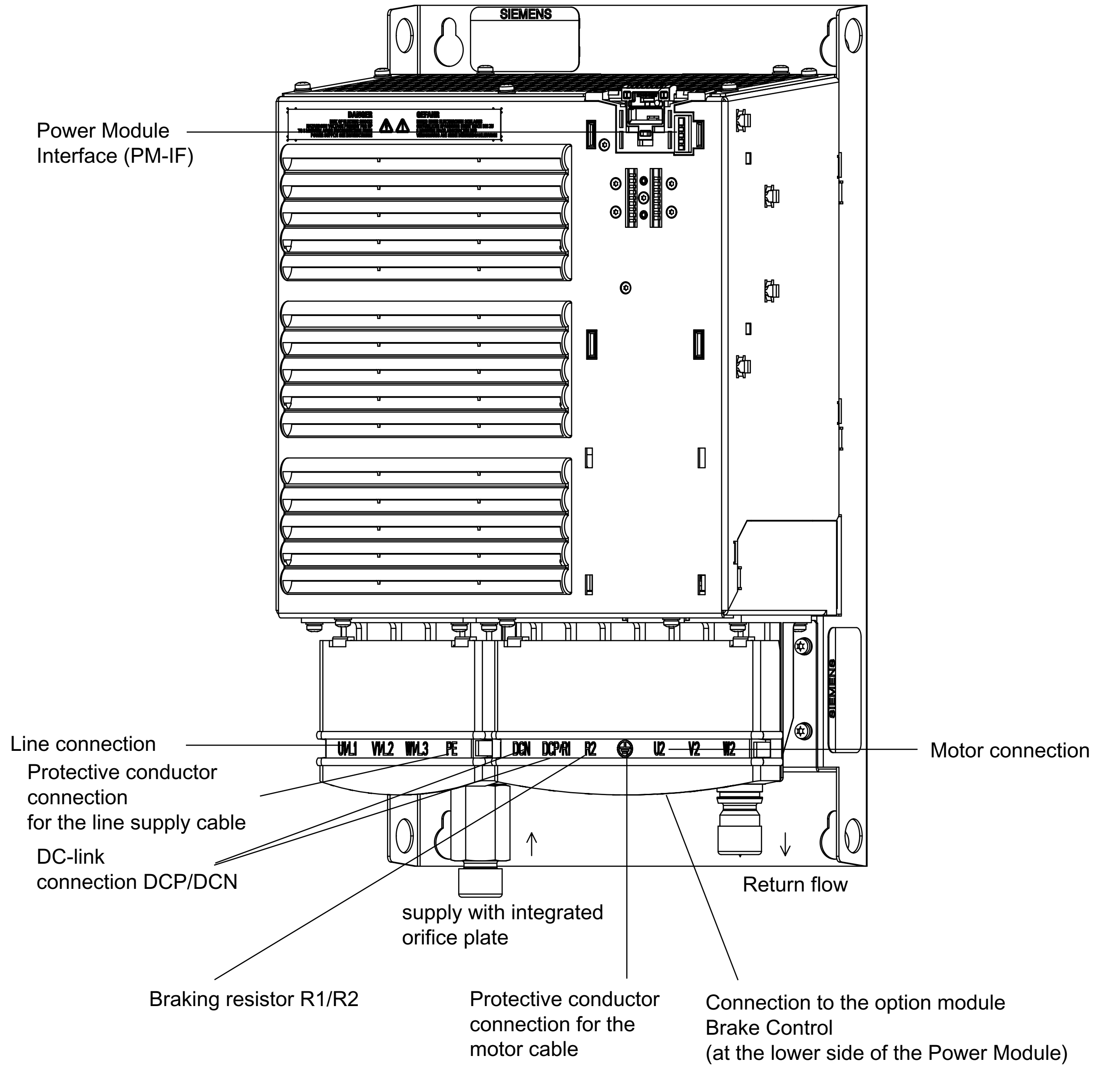


Figure 3-31 Liquid Cooled Power Module PM340 (Example: Frame size FSD)

3.2.3.2 Connection example

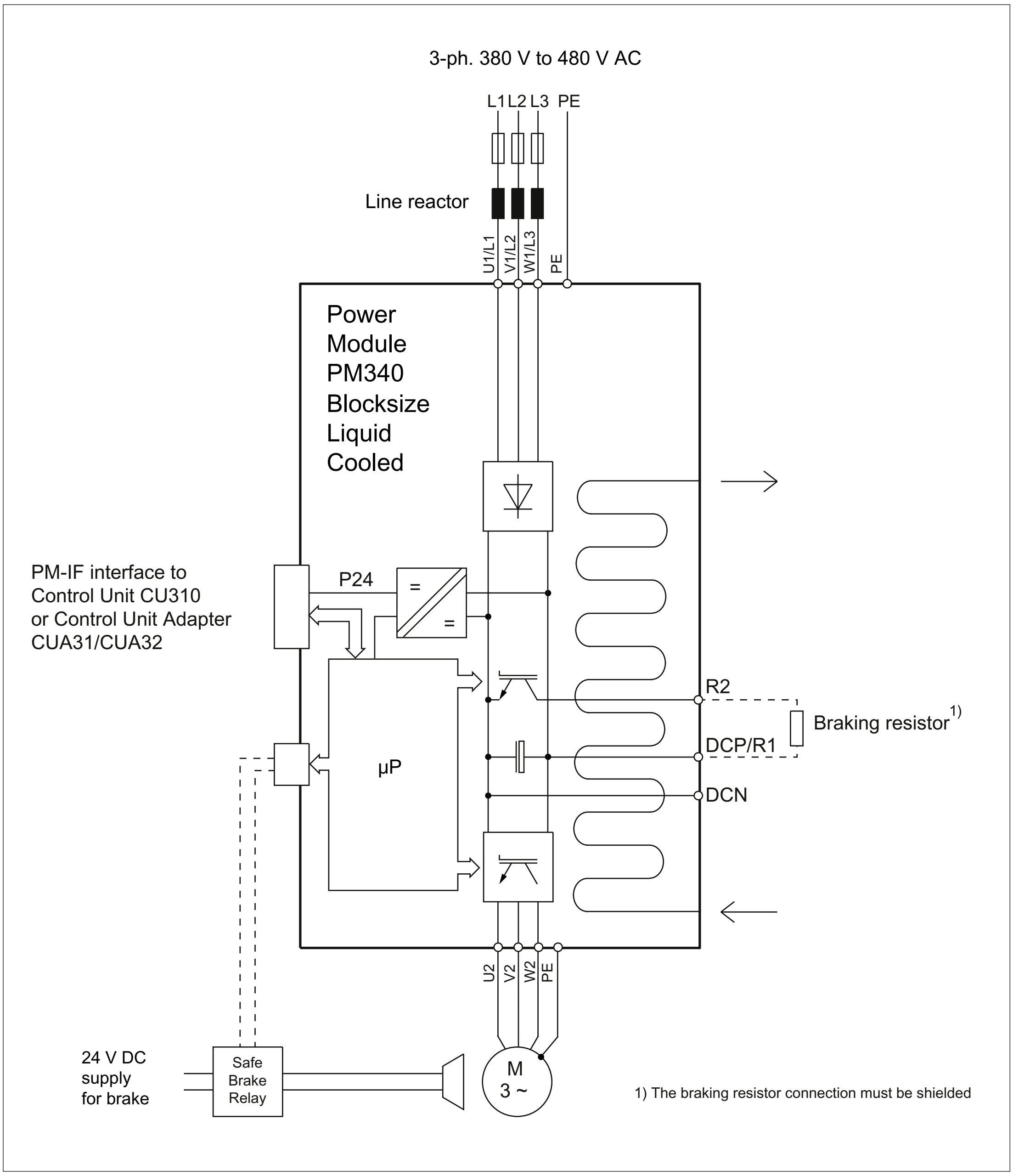


Figure 3-32 Connection example Power Module PM340 Liquid Cooled, 3 AC 380 V to 480 V

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 diagram also includes the terminal tightening torques.

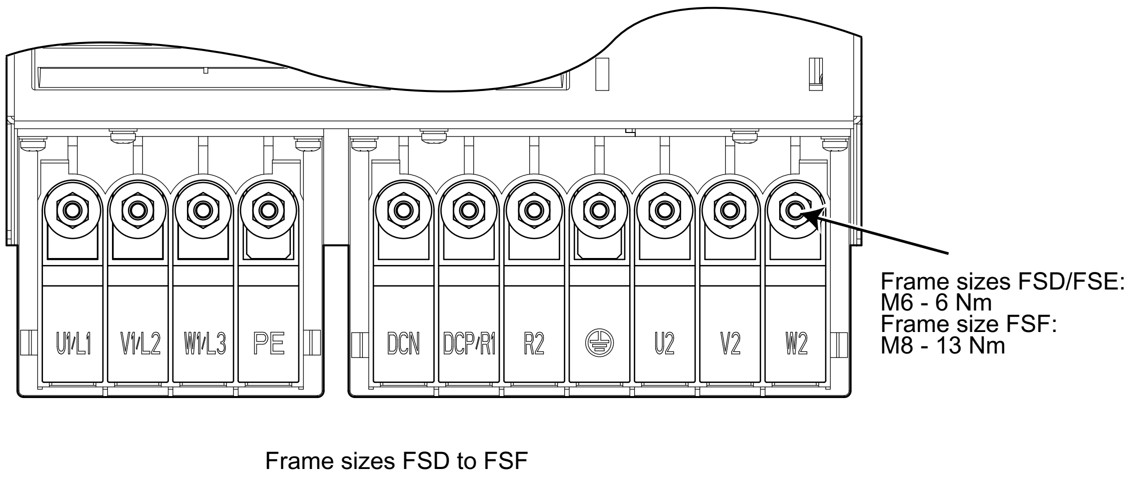
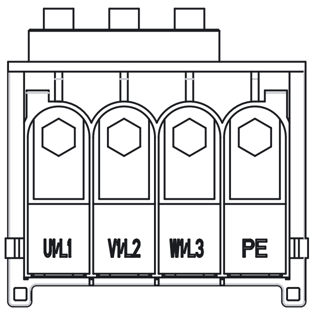


Figure 3-33 Arrangement of the line supply and motor terminals for the PM340

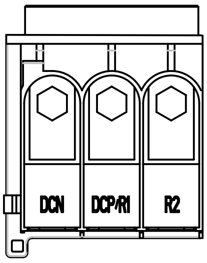
3.2.3.3 Line supply connection

Table 3- 15 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

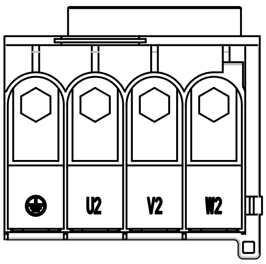
3.2.3.4 Braking resistor and DC link connection

Table 3- 16 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

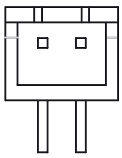
3.2.3.5 Motor connection

Table 3- 17 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

3.2.3.6 Connection to the option module, brake control

Table 3- 18 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

3.2.4 Dimension drawings

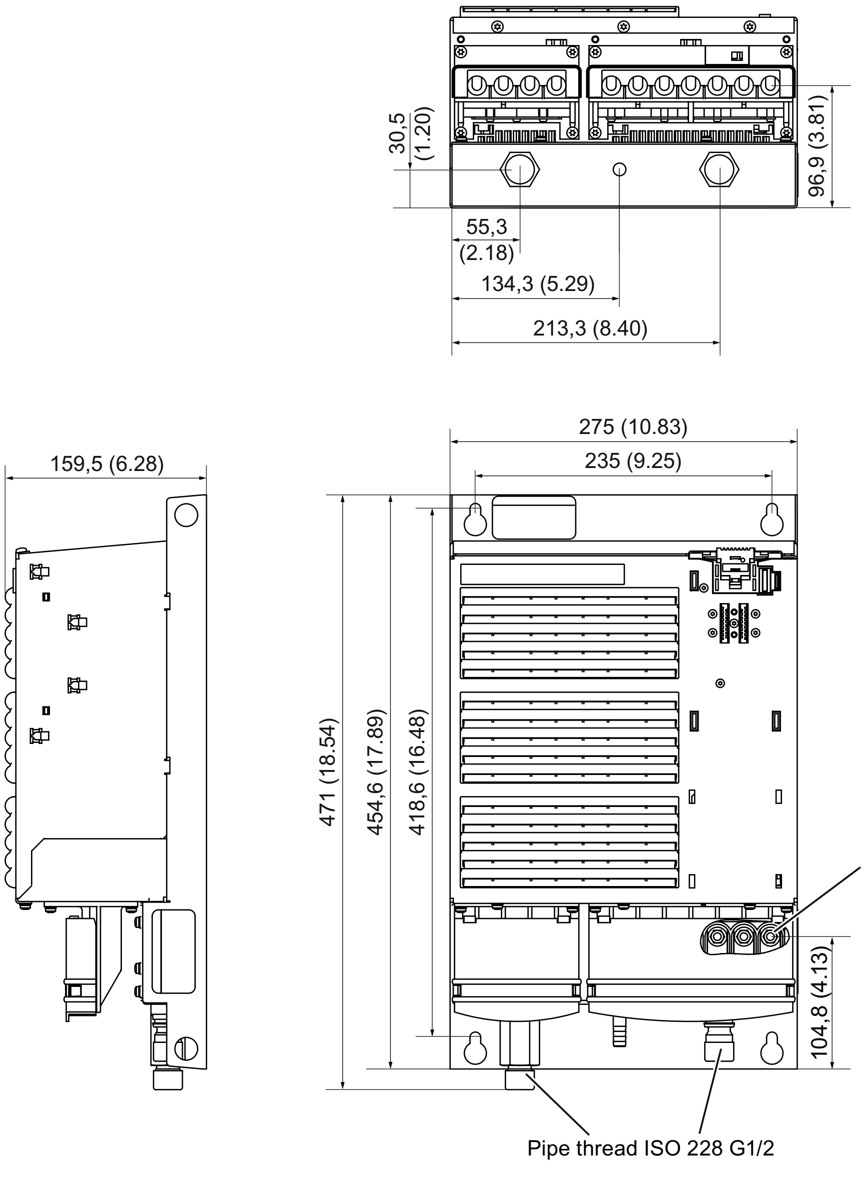


Figure 3-34 Dimension drawing of Liquid Cooled Power Module PM340, frame size FSD, all dimensions in mm and (inches)

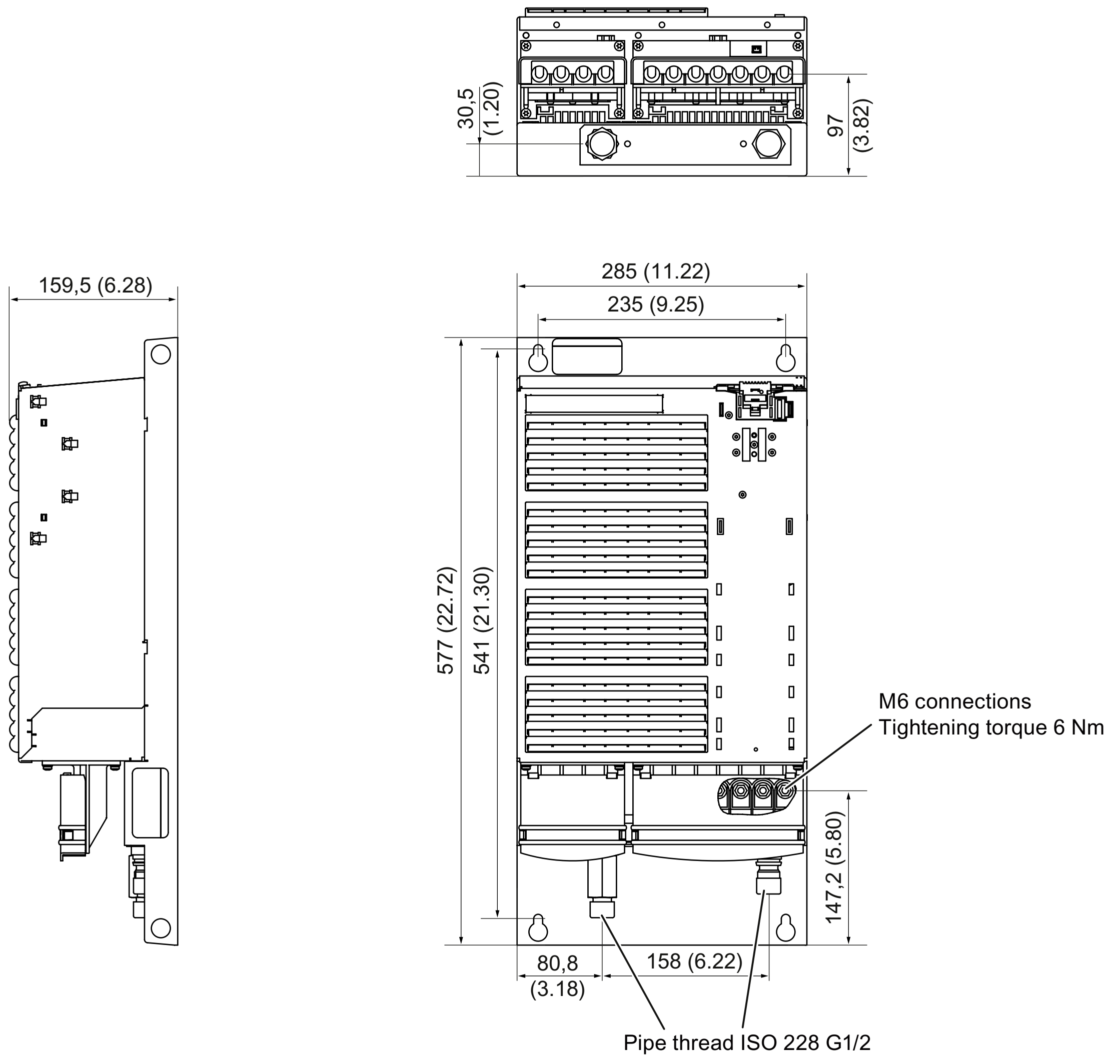


Figure 3-35 Dimension drawing of Liquid Cooled Power Module PM340, frame size FSE, all dimensions in mm and (inches)

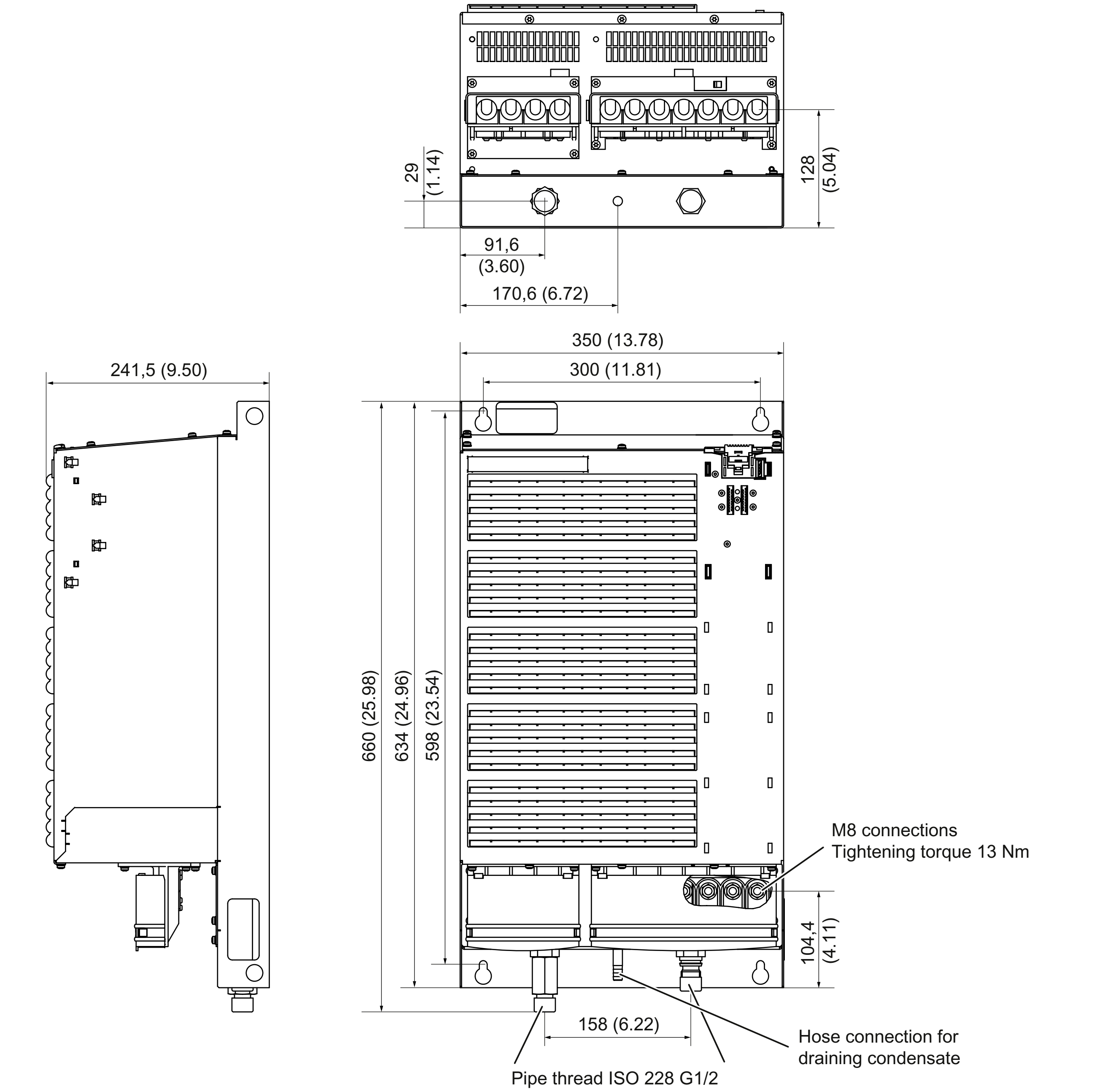


Figure 3-36 Dimension drawing of Liquid Cooled Power Module PM340, frame size FSF, all dimensions in mm and (inches)

3.2.5 Installation

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

3.2.5.1 Drilling patterns

Hole drilling templates for frame sizes FSD to FSF

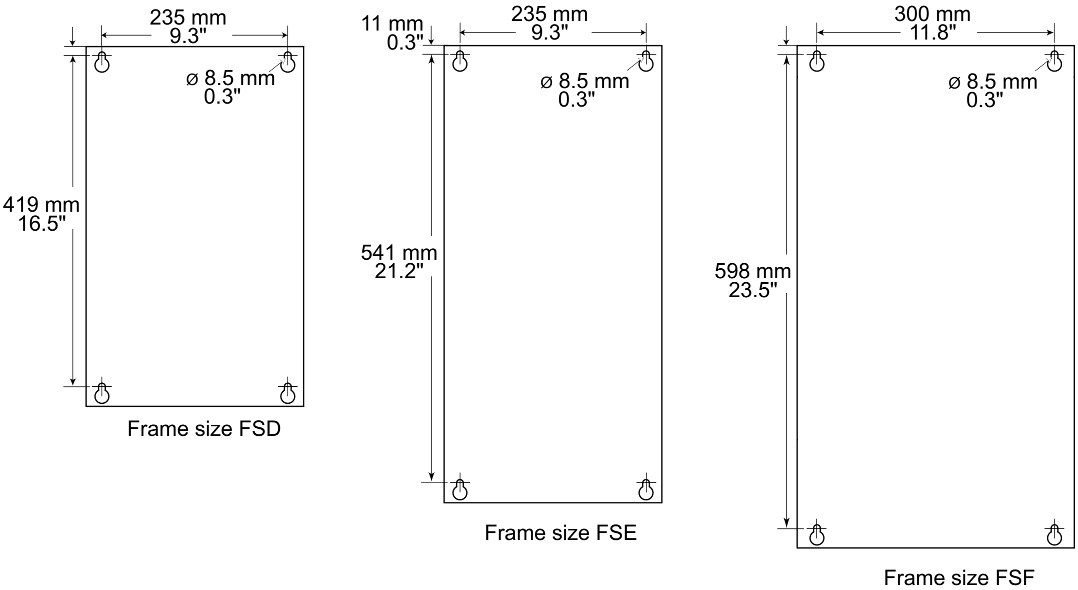


Figure 3-37 Hole drilling templates for frame sizes FSD to FSF

3.2.5.2 Installation

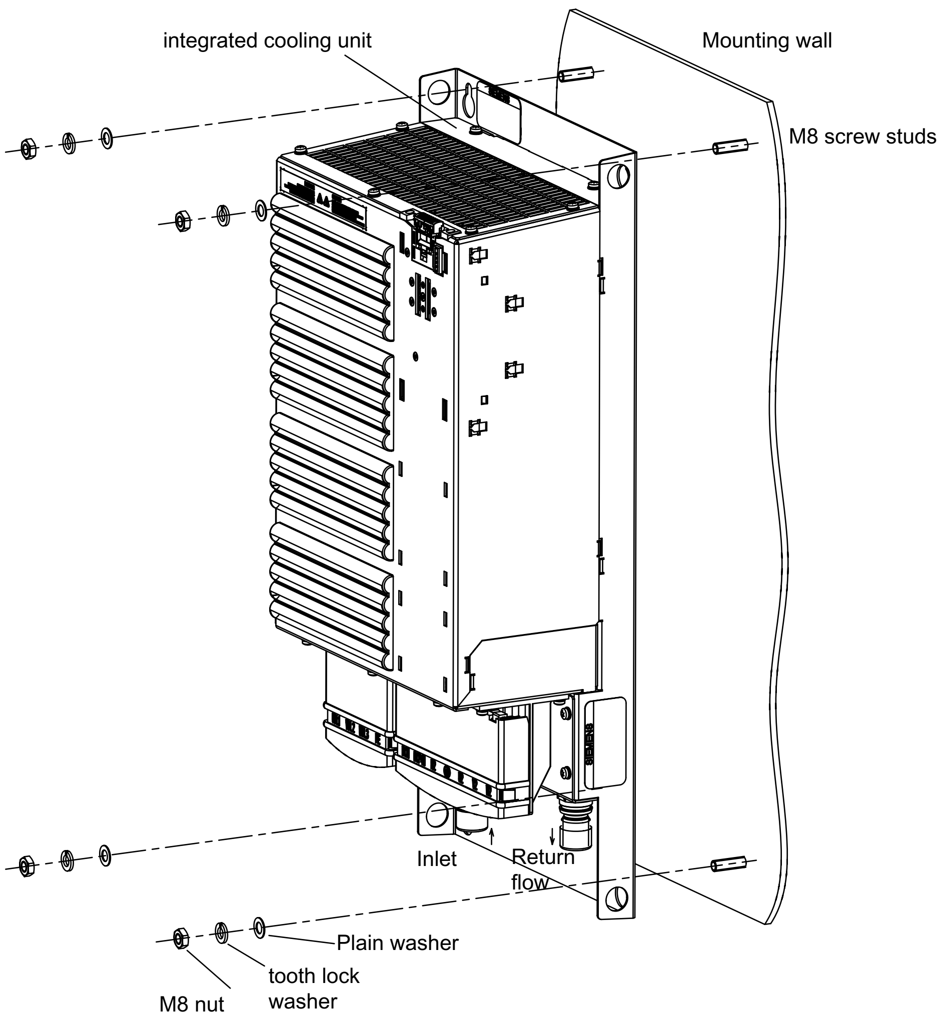


Figure 3-38 Installation of Power Module PM340 Liquid Cooled with integrated cooling unit (example: frame size FSE)

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

3.2.5.3 Access to the power supply terminals and motor terminals

For frame sizes FSD to FSF, the terminals are accessed by releasing the tongue at the side of the terminal covers using a suitable flat screwdriver. The cover can then be pushed upwards and engaged in this position as shown in the following diagram.

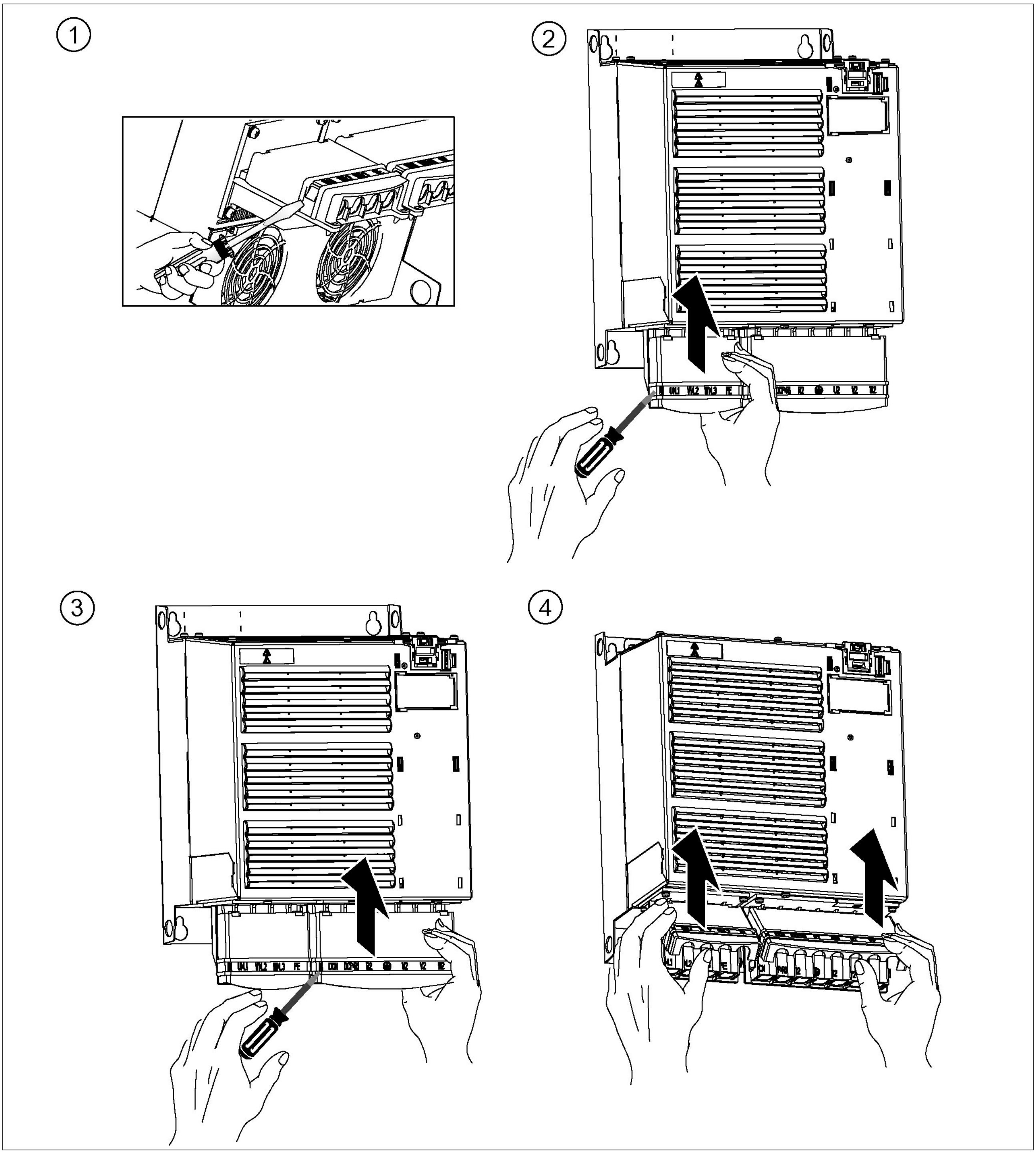


Figure 3-39 Access to the line and motor terminals for frame sizes FSD to FSF

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

3.2.6 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".

3.2.7 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.

3.2.8 Technical specifications

Table 3- 19 Technical specifications for Liquid Cooled Power Modules PM340, blocksize format, Part 1

PM340 Power Module	6SL3215-	1SE23-8UAx	1SE26-0UAx	1SE27-5UAx
Frame size		FSD	FSD	FSE
Rated output current I_n	A	38	60	75
Base load current I_H	A	33	48	65
Output current for S6 duty (40%) I_{S6}	A	49	78	98
Max. output current I_{max}	A	64	90	124
Rated power based on I_n	kW	18.5	30	37
Rated power based on I_H	kW	15	22	30
Rated pulse frequency	kHz	4	4	4
Power loss	kW	0.38	0.69	0.99
Power loss to ambient air, approx.	kW	0.09	0.13	0.16
Coolant requirements	l/min	8	8	8
Sound pressure level	dB(A)	< 60	< 60	< 60
24 V DC power supply for the Control Unit	A	1.0	1.0	1.0
Rated input current [1)] - with line reactor - without line reactor	A	 40 46	 63 72	 78 88
Class J UL safety fuses Rated current Rated short-circuit current SCCR	 A kA	 50 65	 90 65	 100 65
Safety fuses NH Rated current	 A	3NA3 820 50	3NA3 824 80	3NA3 830 100
Circuit breaker type designation EN 60947 Rated current	 A	3RV1042-4JA10 45 - 63	3RV1042-4MA10 80 - 100	3VL1712-1DD33-0AA0 100 - 125
Circuit breaker type designation UL489 / CSA C22.2 No. 5-02 Rated current Rated short-circuit current SCCR	 A kA	--	3VL2191-3KN30-0AA0 90 65	3VL2110-3KN30-0AA0 100 65
Resistance value of the external braking resistor	Ohms	> 27	> 27	> 15
Max. cable length to braking resistor	m	15	15	15
Line supply connection L1, L2, L3		Stud M6, connectable cable cross-sections 10 to 50 mm² for ring cable lugs		
Motor connection U2, V2, W2				
DC link connection, connection for braking resistor DCP/R1, DCN, R2				
PE connection		M6 studs		

PM340 Power Module	6SL3215-	1SE23-8UAx	1SE26-0UAx	1SE27-5UAx
Max. motor cable length	m	70 (shielded) 100 (unshielded)		
Degree of protection		IP20 or IPXXB		
Depth - PM340 - PM340 with Control Unit CU310 - PM340 with CUA31 - PM340 with CUA32	mm	 159.5 (6.28) 240.4 (9.46) 181.3 (7.13) 181.3 (7.13)		
Weight with CU310	kg	10.5 11.5	10.5 11.5	14.8 15.8

1) The input current depends on the motor load and line impedance. The input currents apply for rated power loading (based on Irated) for a line impedance corresponding to u_k = 1%.

Table 3- 20 Technical specifications for Liquid Cooled Power Modules PM340, blocksize format, Part 2

PM340 Power Module	6SL3215-	1SE31-0UAx	1SE31-1UAx	1SE31-8UAx
Frame size		FSE	FSF	FSF
Rated output current I_{rated}	A	90	110	178
Base load current I_H	A	80	95	155
Output current for S6 duty (40%) I_{S6}	A	117	143	231
Max. output current I_{max}	A	150	180	290
Rated power based on I_{rated}	kW	45	55	90
Rated power based on I_H	kW	37	45	75
Rated pulse frequency	kHz	4	4	4
Power loss	kW	1.21	1.42	2.31
Power loss to ambient air, approx.	kW	0.19	0.21	0.35
Coolant requirements	l/min	8	8	8
Sound pressure level	dB(A)	62	< 60	65
24 V DC power supply for the Control Unit	A	1.0	1.0	1.0
Rated input current[1)] - with line reactor - without line reactor	A	 94 105	 115 129	 186 204
Class J UL safety fuses Rated current Rated short-circuit current SCCR	 A kA	 125 65	 150 65	 250 65
Safety fuses NH Rated current	 A	3NA3 832 125	3NA3 836 160	3NA3 144 250
Circuit breaker type designation EN 60947 Rated current	 A	3VL1716-1DD33-0AA0 125 - 160	3VL3720-1DC36-0AA0 160 - 200	3VL3725-1DC36-0AA0 200 - 250
Circuit breaker type designation UL489 / CSA C22.2 No. 5-02 Rated current Rated short-circuit current SCCR	 A kA	3VL2112-3KN30-0AA0 125 65	3VL2115-3KN30-0AA0 150 65	3VL3125-3KN30-0AA0 250 65

<table>
<tr><th>PM340 Power Module</th><th>6SL3215-</th><th>1SE31-0UAx</th><th>1SE31-1UAx</th><th>1SE31-8UAx</th></tr>
<tr><td>Resistance value of the external braking resistor</td><td>Ohms</td><td>> 15</td><td>> 8.2</td><td>> 8.2</td></tr>
<tr><td>Max. cable length to braking resistor</td><td>m</td><td>15</td><td>15</td><td>15</td></tr>
<tr><td>Line supply connection
L1, L2, L3</td><td></td><td rowspan="4">Stud M6,
connectable cable cross-sections 10 to 50 mm² for ring cable lugs</td><td colspan="2" rowspan="4">Stud M8,
max. connection cable cross-section 120 mm²</td></tr>
<tr><td>Motor connection
U2, V2, W2</td><td></td></tr>
<tr><td>DC link connection, connection for braking resistor DCP/R1, DCN, R2</td><td></td></tr>
<tr><td>PE connection</td><td></td></tr>
<tr><td>Max. motor cable length</td><td>m</td><td colspan="3">70 (shielded)
100 (unshielded)</td></tr>
<tr><td>Degree of protection</td><td></td><td colspan="3">IP20 or IPXXB</td></tr>
<tr><td>Depth
- PM340
- PM340 with Control Unit CU310
- PM340 with CUA31
- PM340 with CUA32</td><td>mm</td><td>
159.5 (6.28)
240.4 (9.46)
181.3 (7.13)
181.3 (7.13)</td><td>
241.5 (9.50)
322.5 (12.69)
263 (10.35)
263 (10.35)</td><td>
241.5 (9.50)
322.5 (12.69)
263 (10.35)
263 (10.35)</td></tr>
<tr><td>Weight
with CU310</td><td>kg</td><td>14.8
15.8</td><td>29.2
30.2</td><td>29.2
30.2</td></tr>
</table>

1) The input current depends on the motor load and line impedance. The input currents apply for rated power loading (based on Irated) for a line impedance corresponding to u_k = 1%.

3.2.8.1 Characteristics

Overload capability

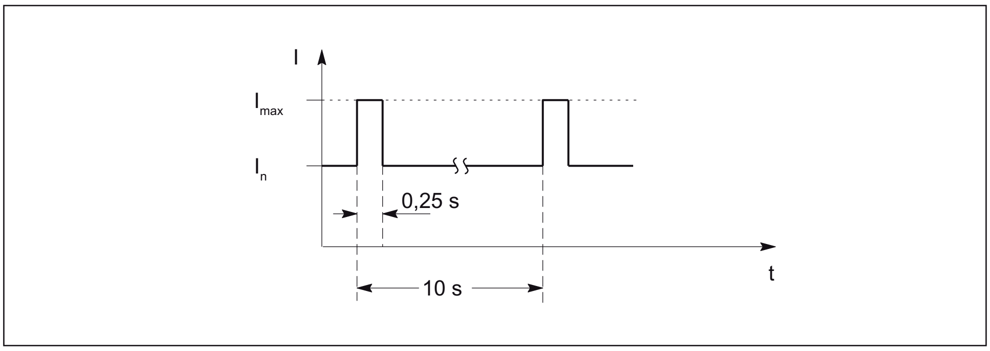


Figure 3-40 Duty cycle with initial load (for servo drives)

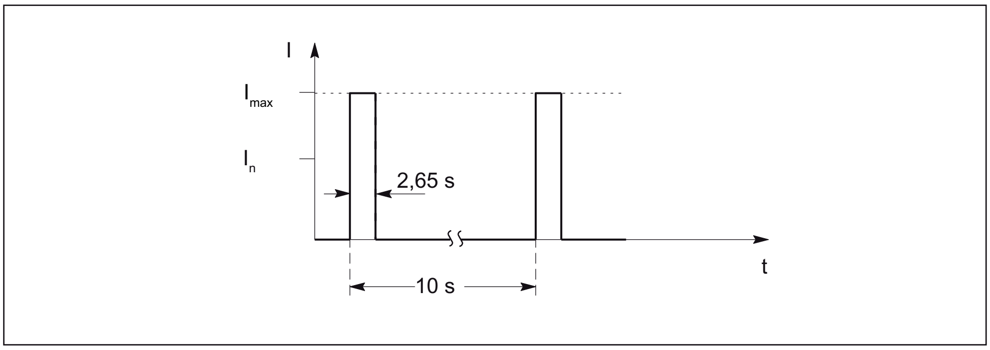


Figure 3-41 Duty cycle without initial load (for servo drives)

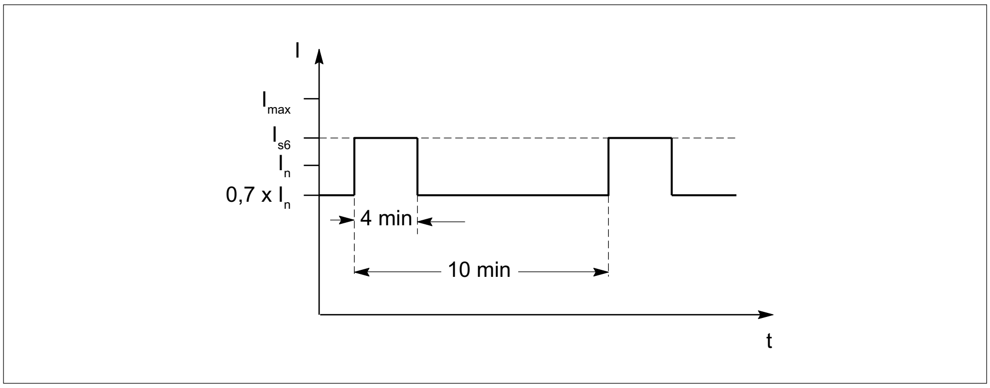


Figure 3-42 S6 duty cycle with initial load (for servo drives)

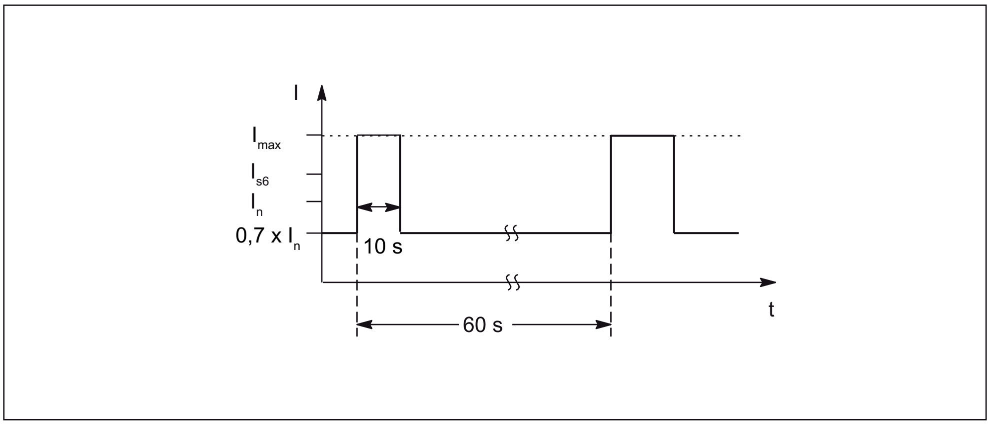


Figure 3-43 Duty cycle with initial load (for servo drives)

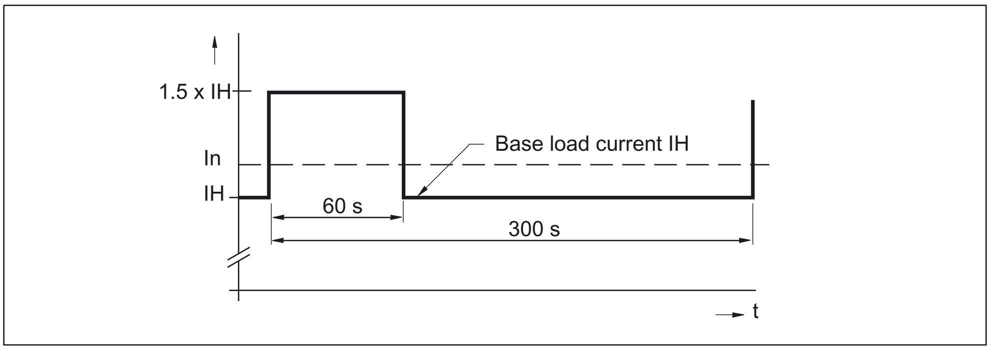


Figure 3-44 Duty cycle with 60 s overload with a duty cycle duration of 300 s

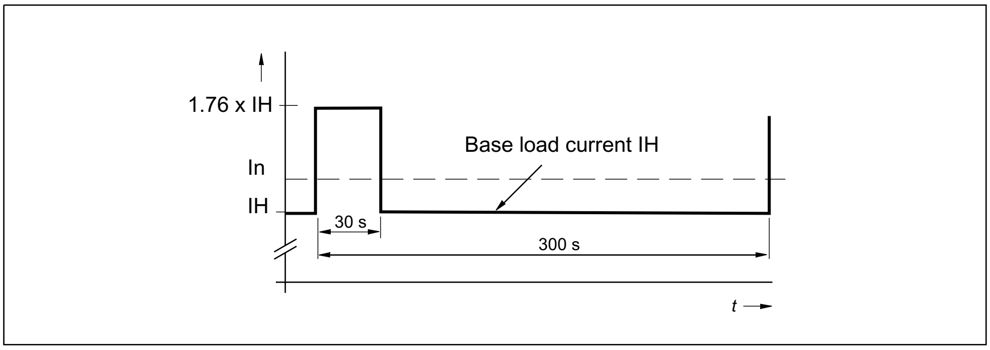


Figure 3-45 Duty cycle with 30 s overload with a duty cycle duration of 300 s

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 3-46 Frame sizes FSD and FSE: Output current as a function of the pulse frequency

Figure 3-47 Frame size FSF: Output current as a function of the pulse frequency

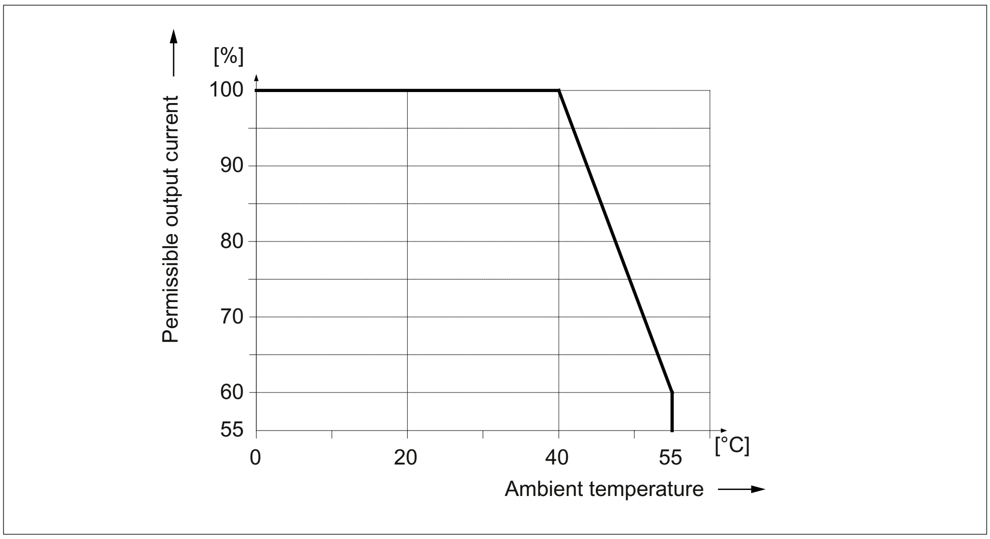


Figure 3-48 Output current as a function of the ambient temperature

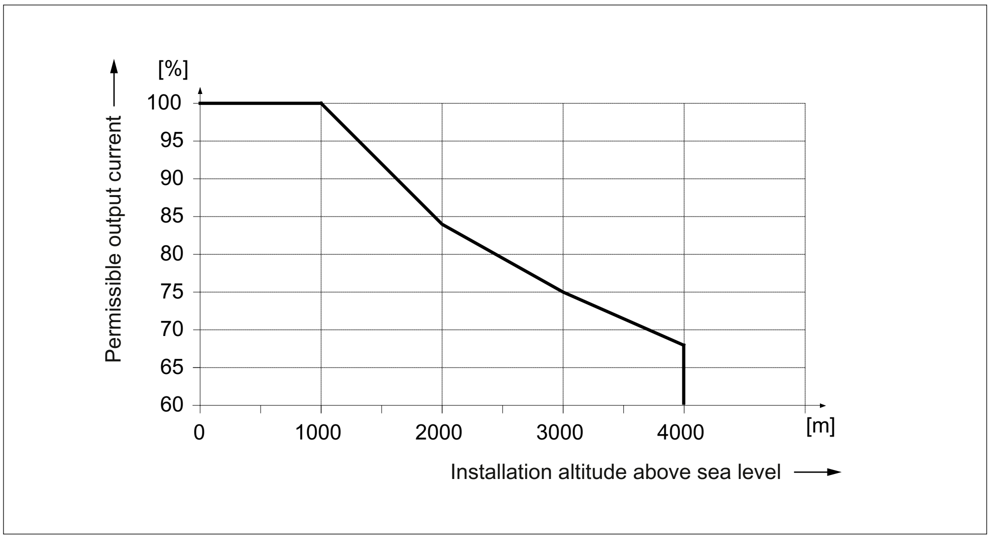


Figure 3-49 Output current as a function of the installation altitude

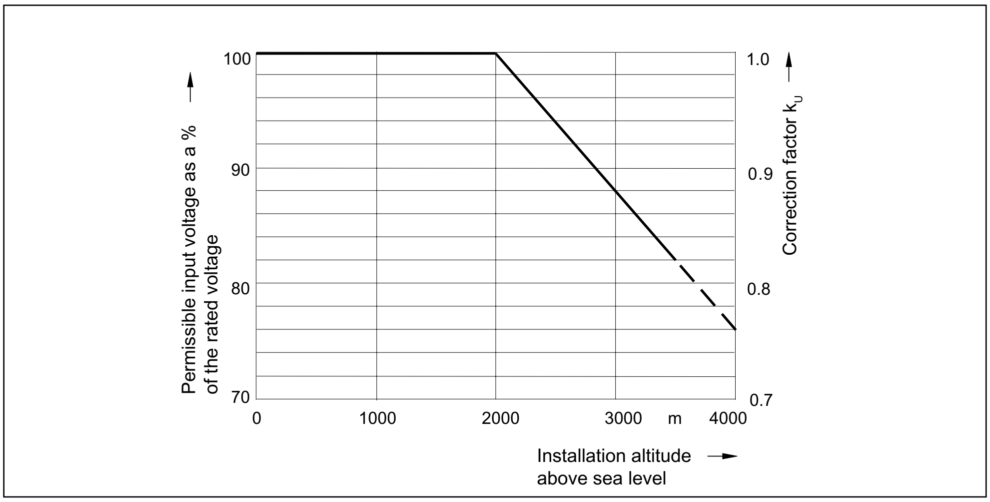


Figure 3-50 Voltage derating as a function of the installation altitude

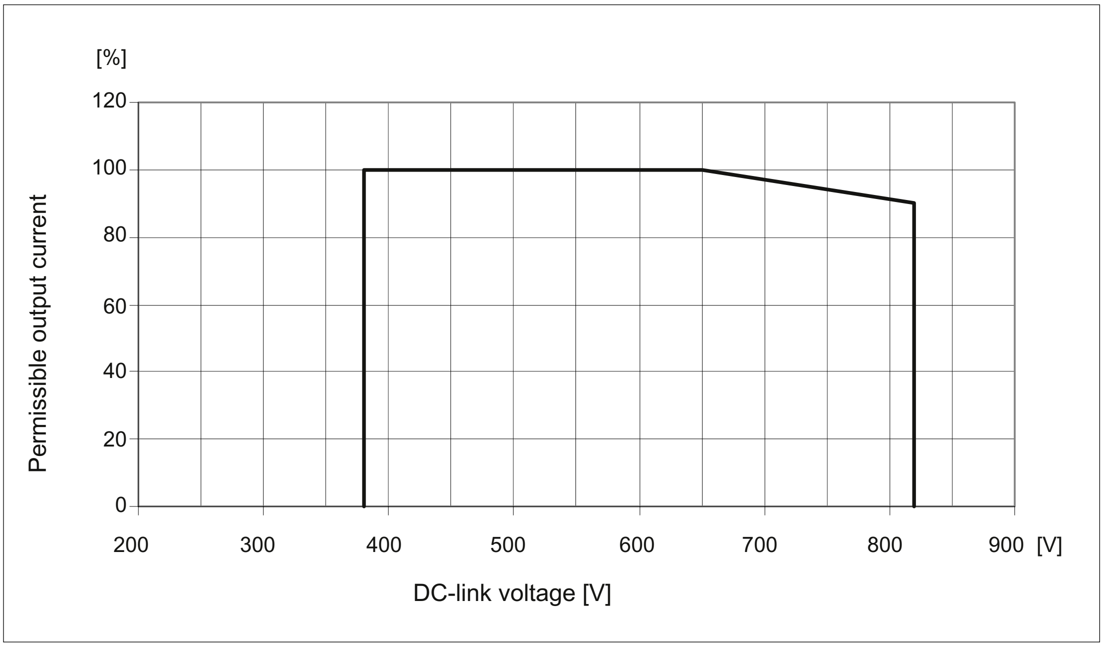


Figure 3-51 Current derating as a function of the DC-link voltage

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

3.3 Power Modules Chassis

3.3.1 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

3.3.2 Safety information

⚠DANGER
After disconnecting all the supply voltages, a hazardous voltage will be present at all Power Modules for another 5 minutes. Work cannot be carried out until this time has elapsed.

⚠DANGER
The DC link discharge voltage hazard warning in the local language must be attached to all of the components.

⚠WARNING
The cooling clearances above, below, and in front of the component, which are specified in the dimension drawings, must be observed.

⚠WARNING
In a residential environment this product can cause radio disturbances, which may make interference-suppression measures necessary.

⚠ DANGER
Cable shields and unused power cable conductors must be connected to PE potential to prevent capacitive cross-talk charges. Non-observance can cause lethal shock voltages.

3.3.3 Interface description

3.3.3.1 Overview

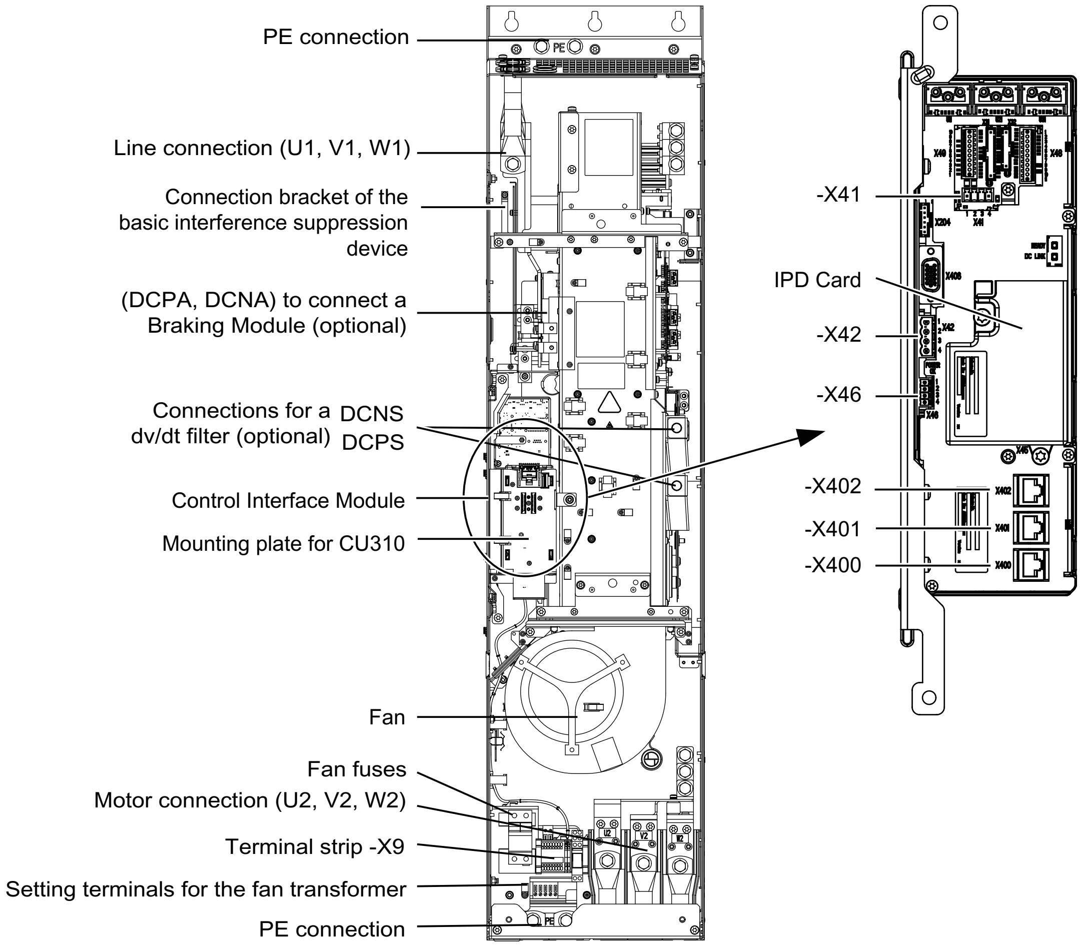


Figure 3-52 Power Module, frame size FX, with order number 6SL3310-1TE32-xAA3

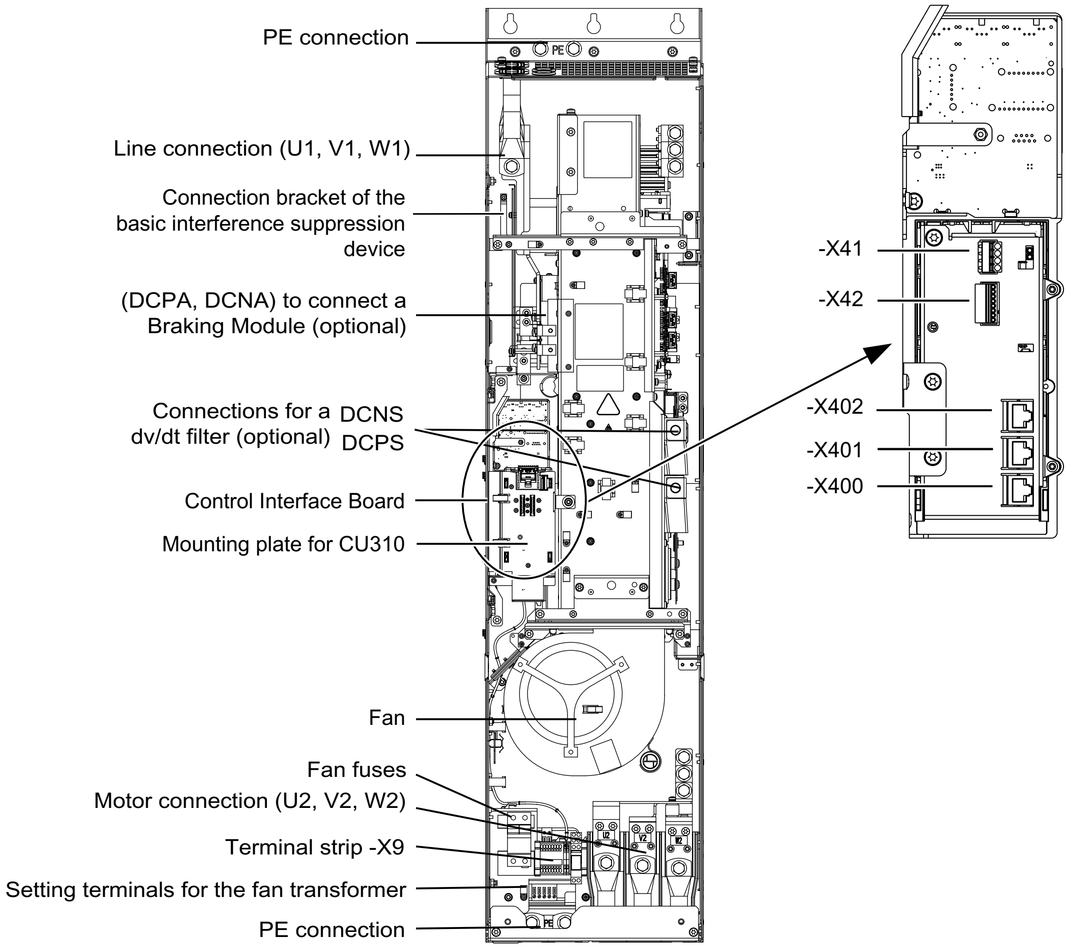


Figure 3-53 Power Module, frame size FX, with order number 6SL3310-1TE32-xAA0

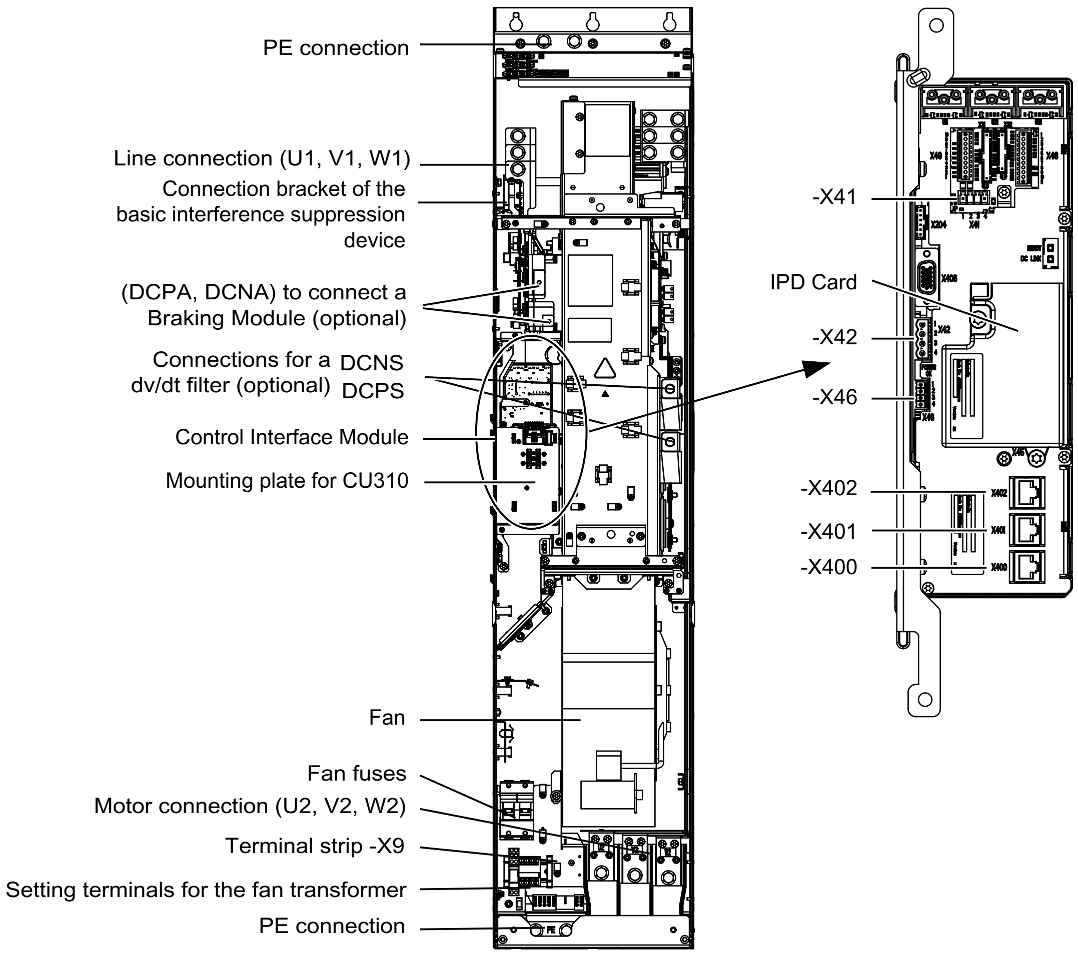


Figure 3-54 Power Module, frame size GX, with order number 6SL3310-1TE3x-xAA3

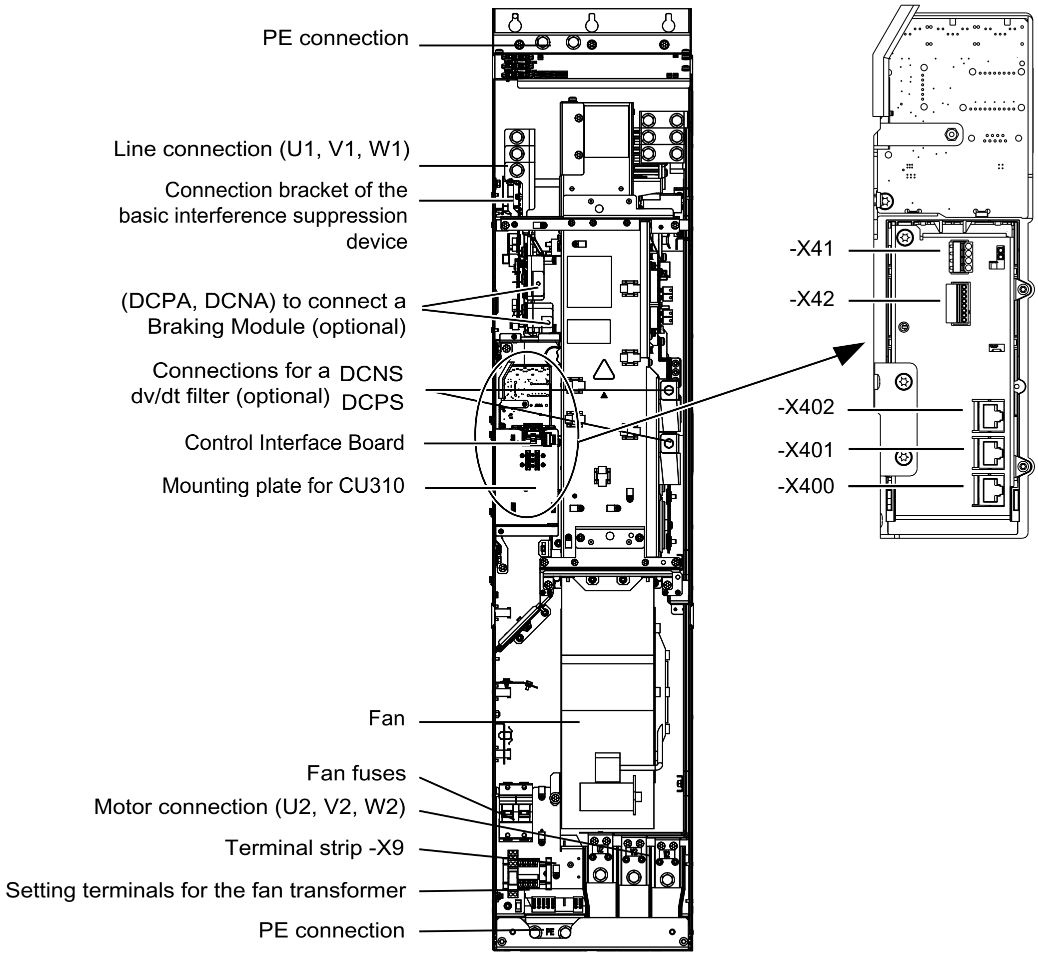


Figure 3-55 Power Module, frame size GX, with order number 6SL3310-1TE3x-xAA0

3.3.3.2 Sample connection

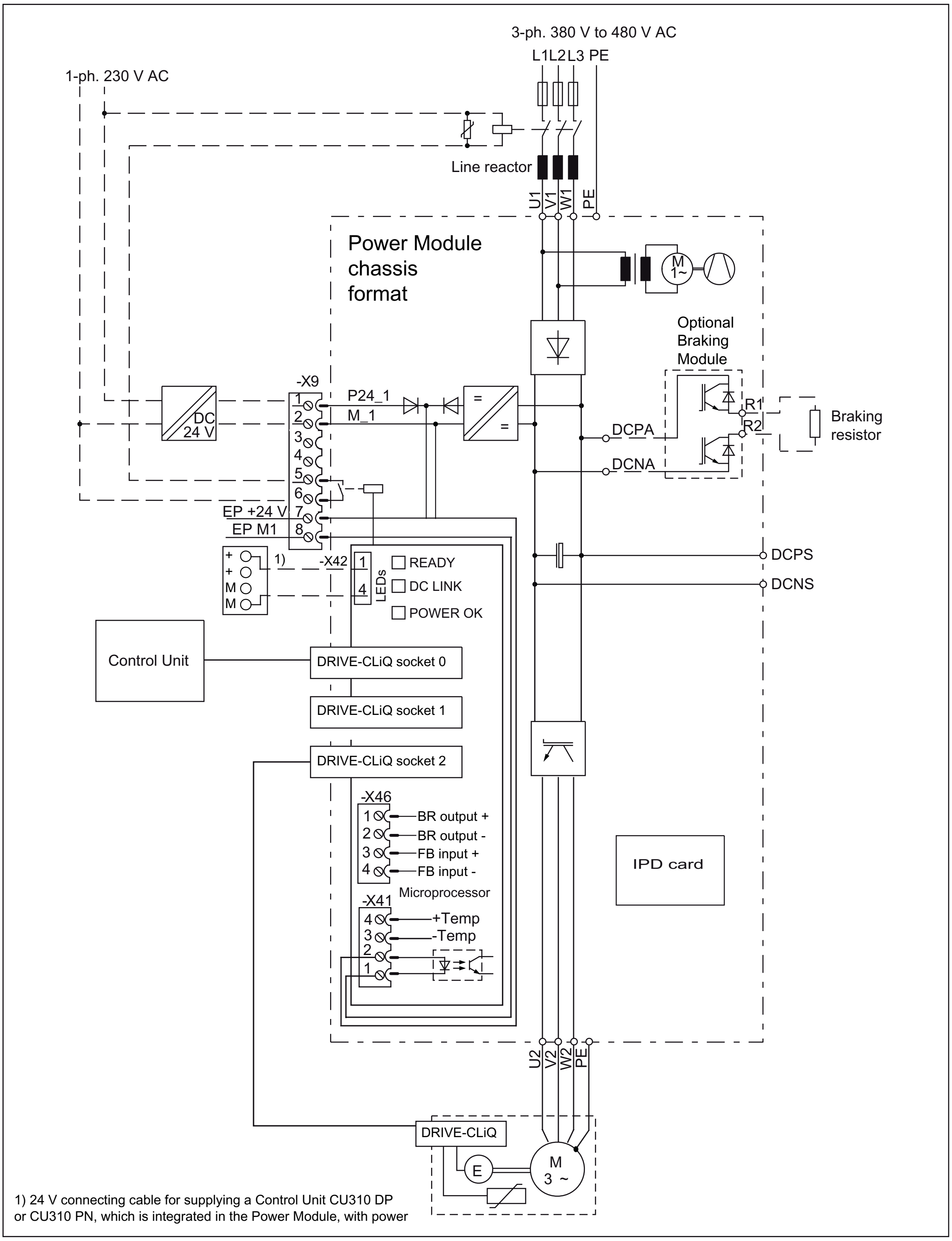


Figure 3-56 Connection example: Power Module built-in unit with order number 6SL3310-1TE3x-xAA3

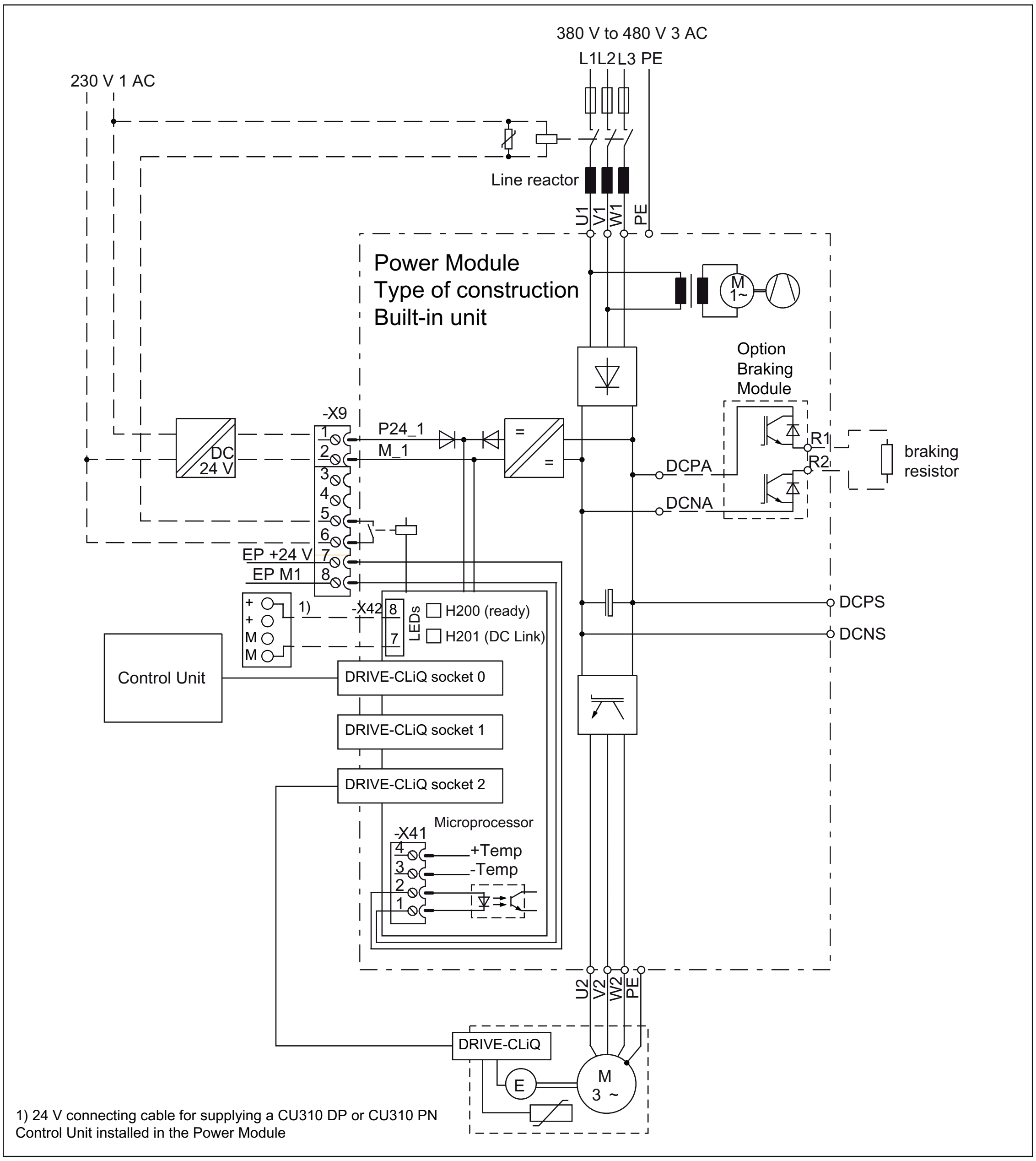
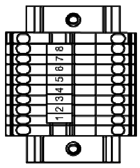


Figure 3-57 Connection example: Power Module built-in unit with order number 6SL3310-1TE3x-xAA0

3.3.3.3 Terminal block X9

Table 3- 21 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)	

NOTICE

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.

3.3.3.4 DCPS, DCNS connection for a dv/dt filter

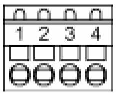
Table 3- 22 DCPS, DCNS

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.

3.3.3.5 X41 EP terminal / temperature sensor connection

Table 3- 23 Terminal block -X41, with order number 6SL3310–1TE3x–xAA3

	Terminal	Function	Technical specifications
	1	EP M1 (enable pulses)	Supply voltage: 24 V DC (20.4 V to 28.8 V) Current consumption: 10 mA Signal propagation delays: L → H 100 µs H → L: 1,000 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!

CAUTION

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

NOTICE

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

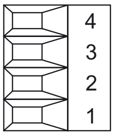
Note

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.

Table 3- 24 Terminal block -X41, with order number 6SL3310-1TE3x-xAA0

	Terminal	Function	Technical specifications
	4	+Temp	Temperature sensor KTY84-1C130 / PTC
	3	-Temp	
	2	EP +24 V (Enable Pulses)	Connected to terminal -X9:7
	1	EP M1 (Enable Pulses)	Connected to terminal -X9:8
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!

CAUTION

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

NOTICE

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

Note

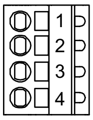
The temperature sensor connection can be used for motors that are equipped with a KTY84-1C130/PTC probe in the stator windings.

Note

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

3.3.3.6 X42 terminal strip

Table 3- 25 Terminal block -X42, with order numbers 6SL3310–1TE3x–xAA3

	Terminal	Function	Technical specifications
	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			

With order numbers 6SL3310–1TE3x–xAA0: Reserved, do not use!

Note

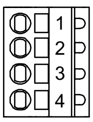
In their delivery condition, terminals 1 and 4 are provided with a connecting cable to supply a CU310 DP or CU310 PN Control Unit.

⚠ 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.

3.3.3.7 X46 Brake control and monitoring

Table 3- 26 Terminal block -X46, brake control and monitoring; 6SL3310–1TE3x–xAA3

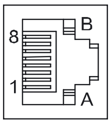
	Terminal	Function	Technical specifications
	1	BR output +	This interface is intended for the connection of the safe brake adapter.
	2	BR output -	
	3	FB input +	
	4	FB input -	
Max. connectable cross-section 1.5 mm²			

CAUTION

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.

3.3.3.8 DRIVE-CLiQ interface X400-X402

Table 3- 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

3.3.3.9 Meaning of the LEDs on the Power Module

Note

The following table only applies to Power Modules with order number 6SL3310-1TE3x-xAA3

Table 3- 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 3- 29 Meaning of the LED "POWER OK" on the Control Interface Module in the Power Module

LED	Color	State	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 light	There is a fault. If the LED continues to flash after you have performed a POWER ON, please contact your Siemens service center.

Note

The following table only applies to Power Modules with order number 6SL3310-1TE3x-xAA0

Table 3- 30 Meaning of the LEDs "READY" and "DC LINK" on the Control Interface Board on the Power Module

LED state		Description
H200 (ready)	H201 (DC Link)	
Off	Off	The electronic power supply is missing or outside the 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

Independent of the state of LED "H201", hazardous DC-link voltages can always be available.

The warning information on the component must be carefully observed!

3.3.4 Dimension drawings

Dimension drawing frame size FX

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

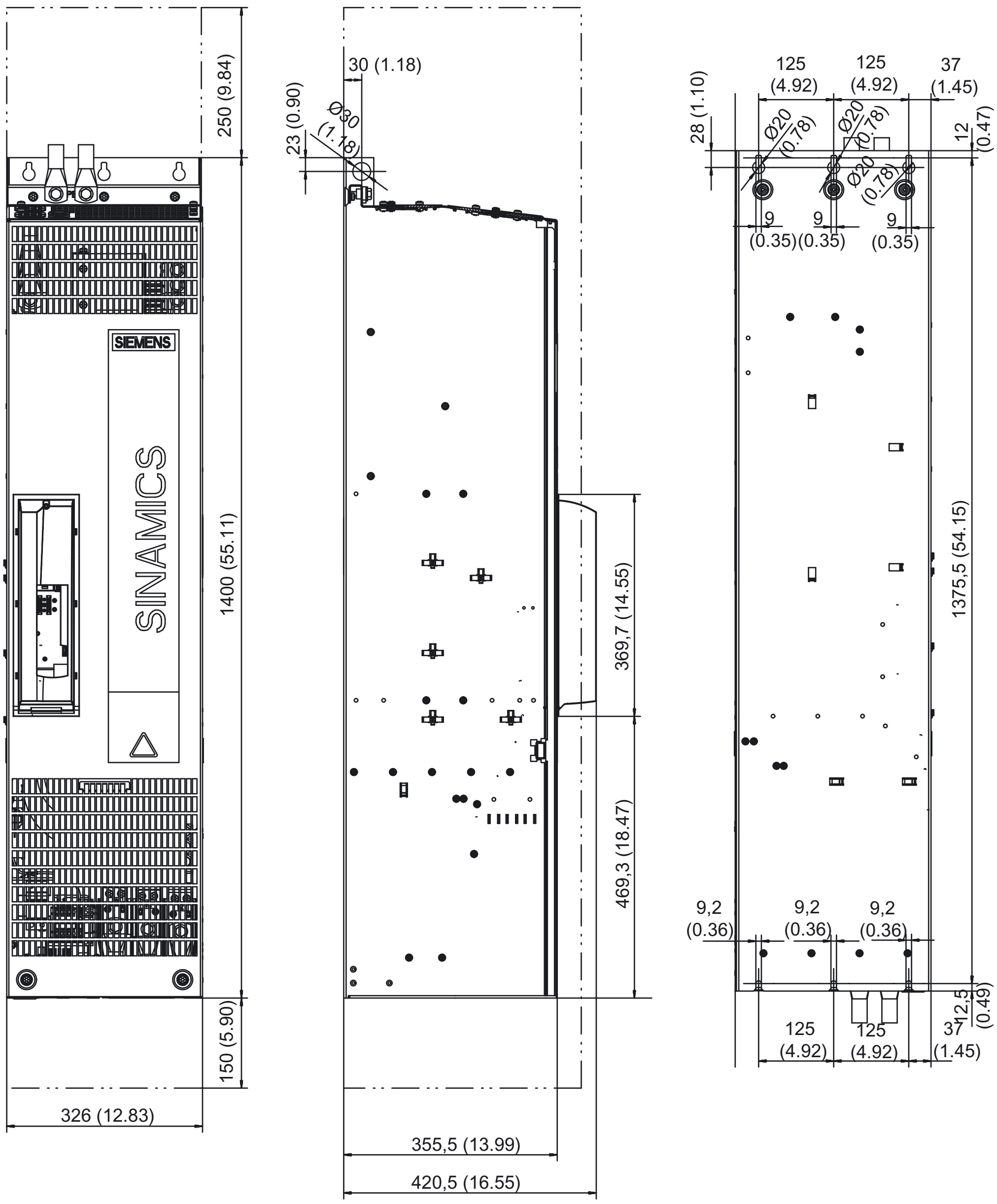


Figure 3-58 Dimension drawing Power Module, frame size FX

Dimension drawing frame size GX

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

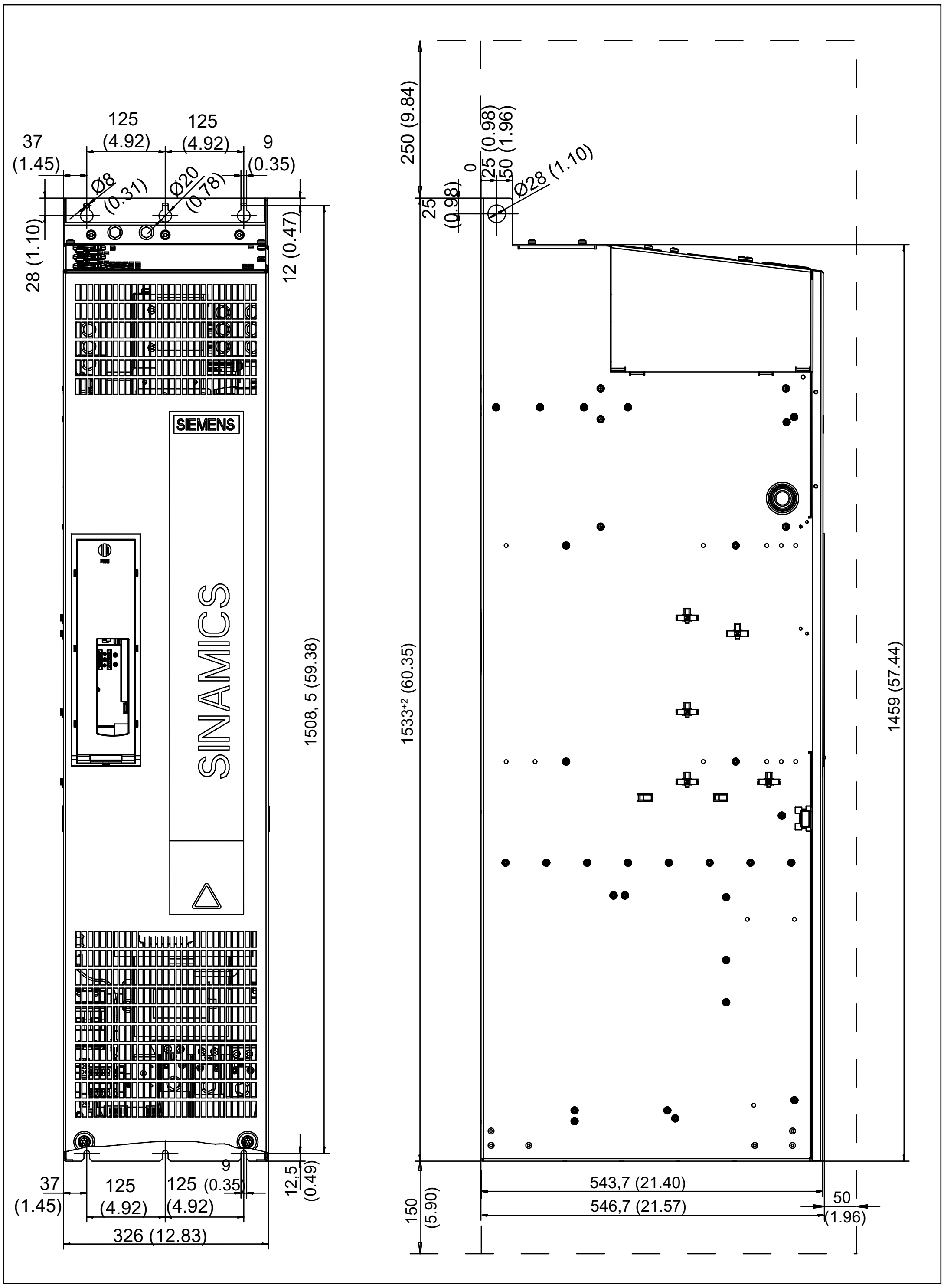


Figure 3-59 Dimension drawing Power Module, frame size GX

3.3.5 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 transformers. The locations of the transformers are indicated in the interface descriptions.
The transformers are fitted with primary taps so that they can be fine-tuned to the line supply 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 supply voltage.

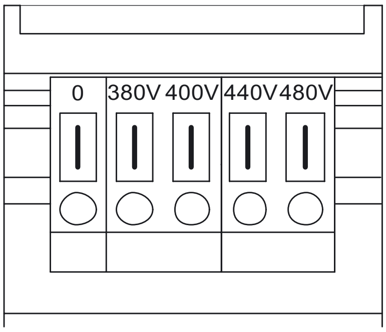


Figure 3-60 Setting terminals for the fan transformers

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)

CAUTION

If the terminals are not changed-over to reflect the actual line supply voltage:

- The required cooling level will not provided (risk of overheating)
- The fan fuses may blow (overload)

Table 3- 31 Assignment of the existing line supply voltage for setting at the fan transformer

Line supply 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

Removing the connection bracket for the interference suppression capacitor with operation from an ungrounded supply

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

For the position of the connection bracket, see the Power Module overview section.

⚠ WARNING
Failing to remove the connection bracket for the interference suppression capacitor on a non-grounded network/IT system can cause significant damage to the built-in unit.

3.3.6 Technical data

Table 3- 32 Technical specifications, Chassis Power Modules

Line supply voltage 3-ph. 380 V to 480 V AC ±10% (-15% < 1 min)						
Order number	**6SL3310–**	**1TE32-1AA0 1TE32-1AA3**	**1TE32-6AA0 1TE32-6AA3**	**1TE33–1AA0 1TE33–1AA3**	**1TE33-8AA0 1TE33-8AA3**	**1TE35-0AA0 1TE35-0AA3**
Rated output current I_n	A	210	260	310	380	490
Base load current I_L	A	205	250	302	370	477
Base load current I_H	A	180	233	277	340	438
Output current for S6 duty (40 %) I_{S6}	A	230	285	340	430	540
Max. output current I_{max}	A	307	375	453	555	715
Supply voltages Electronic power supply Overvoltage trip Undervoltage trip	 V_{DC} V_{DC} V_{DC}	 24 (20.4 - 28.8) 820 ± 2 % 424				
Rated power based on I_{rated}	kW	110	132	160	200	250
Rated power based on I_H	kW	90	110	132	160	200
Max. rated pulse frequency without derating	kHz	2	2	2	2	2
Max. rated pulse frequency with derating	kHz	8	8	8	8	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	218	270	322	395	510
Electronic power consumption (24 V DC)	A	0.8	0.8	0.9	0.9	0.9
Class J UL safety fuses Rated current Rated short-circuit current SCCR	 A kA	 250 65	 300 65	 350 65	 400 65	 600 65
Safety fuses NH Rated current	 A	3NA3144 250	3NA3250 300	3NA3254 355	3NA3260 400	3NA3372 630
Circuit breaker type designation EN 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 UL 489/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 supply connection U1, V1, W1		Flat connector for M10 cable lug, max. connection cross-section 2 x 185 mm²				
Motor connection U2, V2, W2		Flat connector for M10 cable lug, max. connection cross-section 2 x 185 mm²				

Line supply voltage 3-ph. 380 V to 480 V AC ±10% (-15% < 1 min)						
Order number	**6SL3310–**	**1TE32-1AA0 1TE32-1AA3**	**1TE32-6AA0 1TE32-6AA3**	**1TE33–1AA0 1TE33–1AA3**	**1TE33-8AA0 1TE33-8AA3**	**1TE35-0AA0 1TE35-0AA3**
DC link connections DCPA, DCNA, (option Braking Module)		Flat connector for M8 cable lug, connection cross-section 1 x 35 mm²	Flat connector for M8 cable lug, connection cross-section 1 x 35 mm²	Flat connector for M8 cable lug, connection cross-section 1 x 50 mm²	Flat connector for M8 cable lug, connection cross-section 1 x 50 mm²	Flat connector for M8 cable lug, connection cross-section 1 x 50 mm²
DC link connections DCPS, DCNS (option dv/dt filter)		Flat connector for M8 cable lug, connection cross-section 1 x 35 mm²	Flat connector for M8 cable lug, connection cross-section 1 x 35 mm²	Flat connector for M8 cable lug, connection cross-section 1 x 70 mm²	Flat connector for M8 cable lug, connection cross-section 1 x 70 mm²	Flat connector for M8 cable lug, connection cross-section 1 x 70 mm²
PE connection		Flat connector for M10 cable lug, max. connection cross-section 2 x 185 mm²				
Max. motor cable length[1)]	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	IP 20 or IPXXB	IP 20 or IPXXB	IP 20 or IPXXB	IP 20 or IPXXB
Width	mm	326	326	326	326	326
Height	mm	1400	1400	1533	1533	1533
Depth	mm	356	356	545	545	545
Frame size		FX	FX	GX	GX	GX
Weight	kg	104	104	162	162	162

1) 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.

3.3.6.1 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 criterion for overload is that the drive 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.

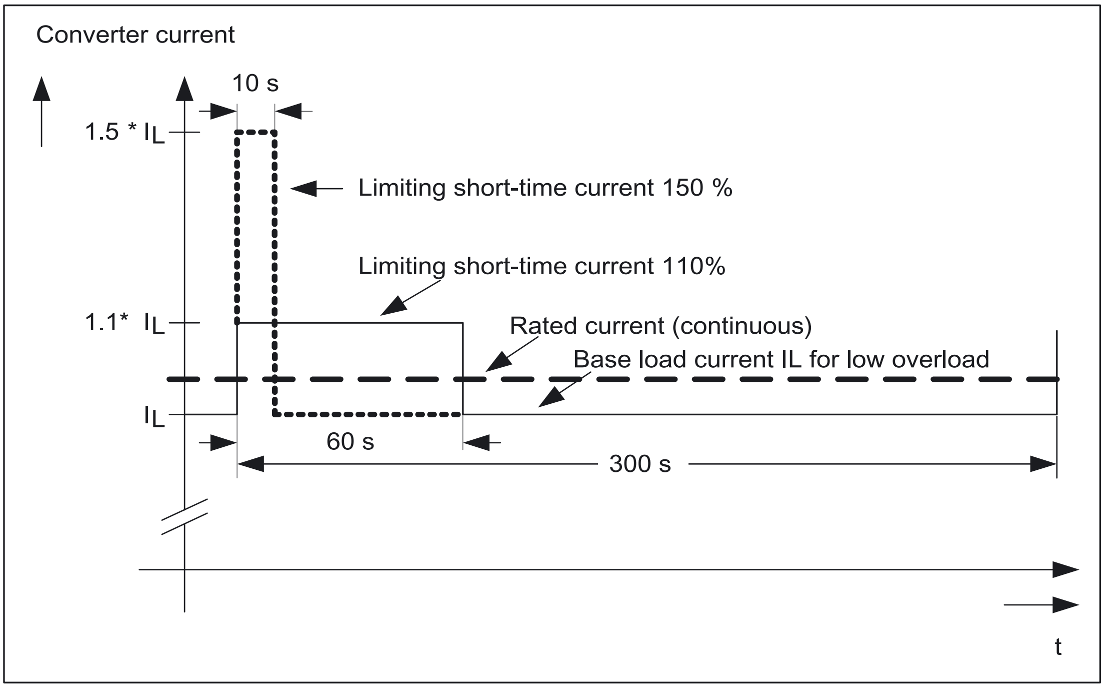


Figure 3-61 Low overload

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.

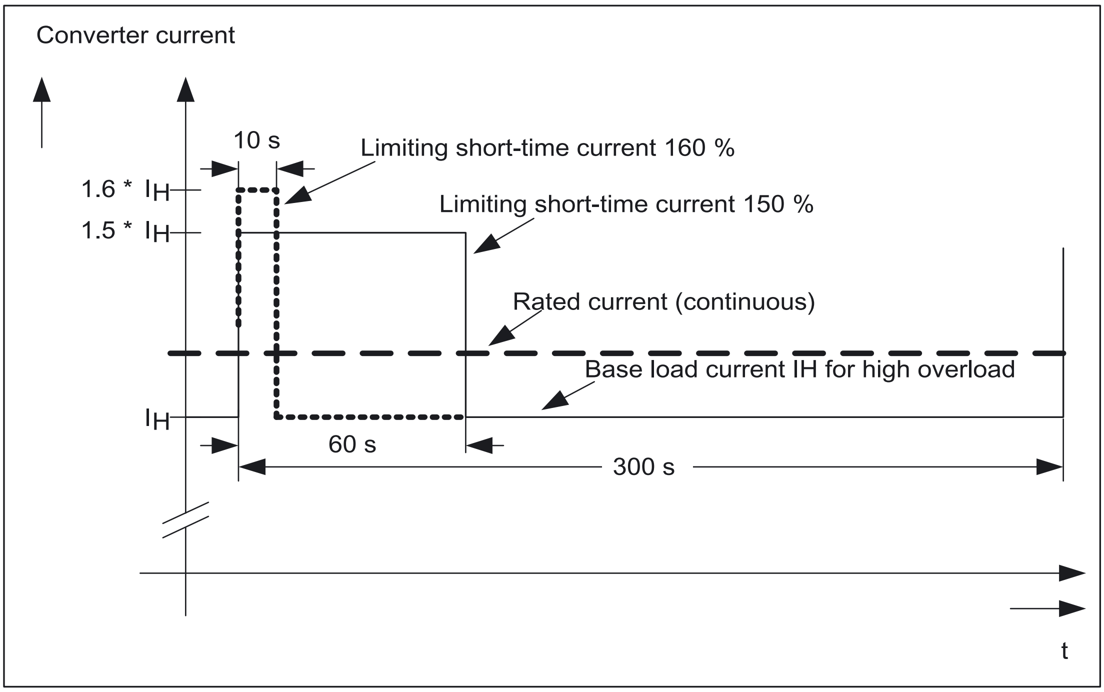


Figure 3-62   High overload

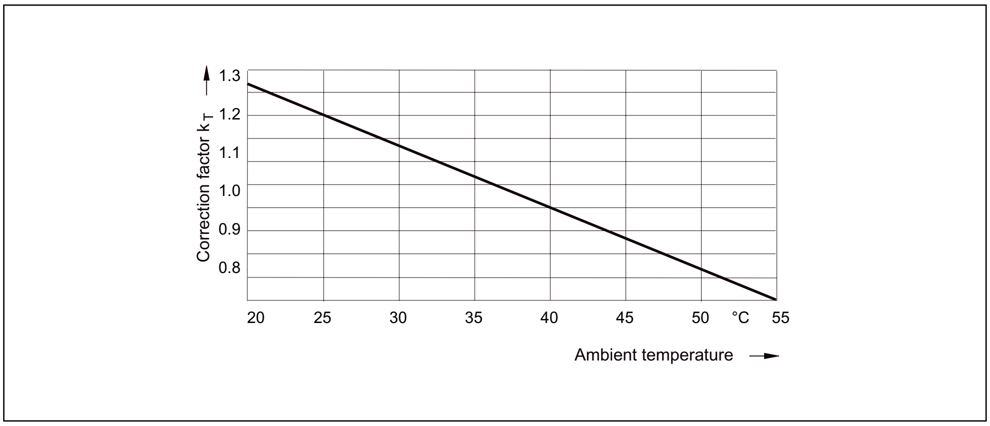


Figure 3-63   Current correction factor as a function of ambient temperature

Note: A factor $k_T > 1.0$ is only to be taken into account in conjunction with the current correction factor k_I depending on the installation altitude.

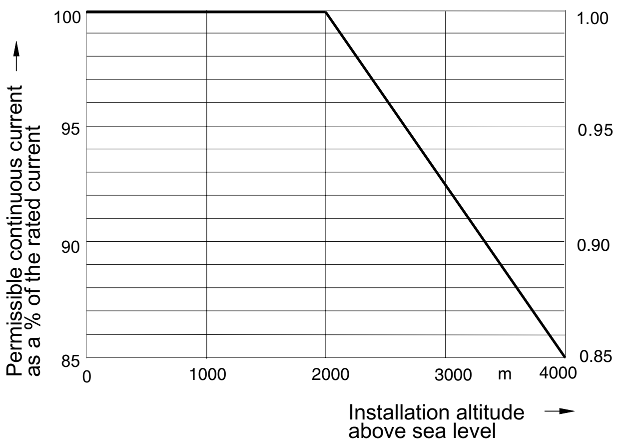


Figure 3-64 Current correction factor as a function of installation altitude

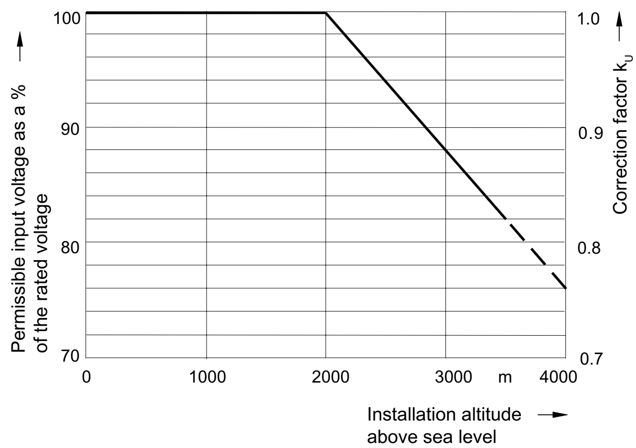


Figure 3-65 Voltage correction factor as a function of installation altitude

3.3.6.2 Current de-rating 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 3- 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 3- 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 3- 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.

DC link components 4

4.1 Blocksize

4.1.1 Braking resistors

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

4.1.1.2 Safety information

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

Protecting the resistance

The power supply to the Power Modules must be established through a contactor which can then shut down the power supply when the resistor overheats.

A temperature protection switch handles the protective function (this is supplied with each break resistor). This is connected in series with the coil feeder cable for the main contactor.

The contacts of the temperature protection switch close again as soon as the resistor temperature has fallen below the selected value.

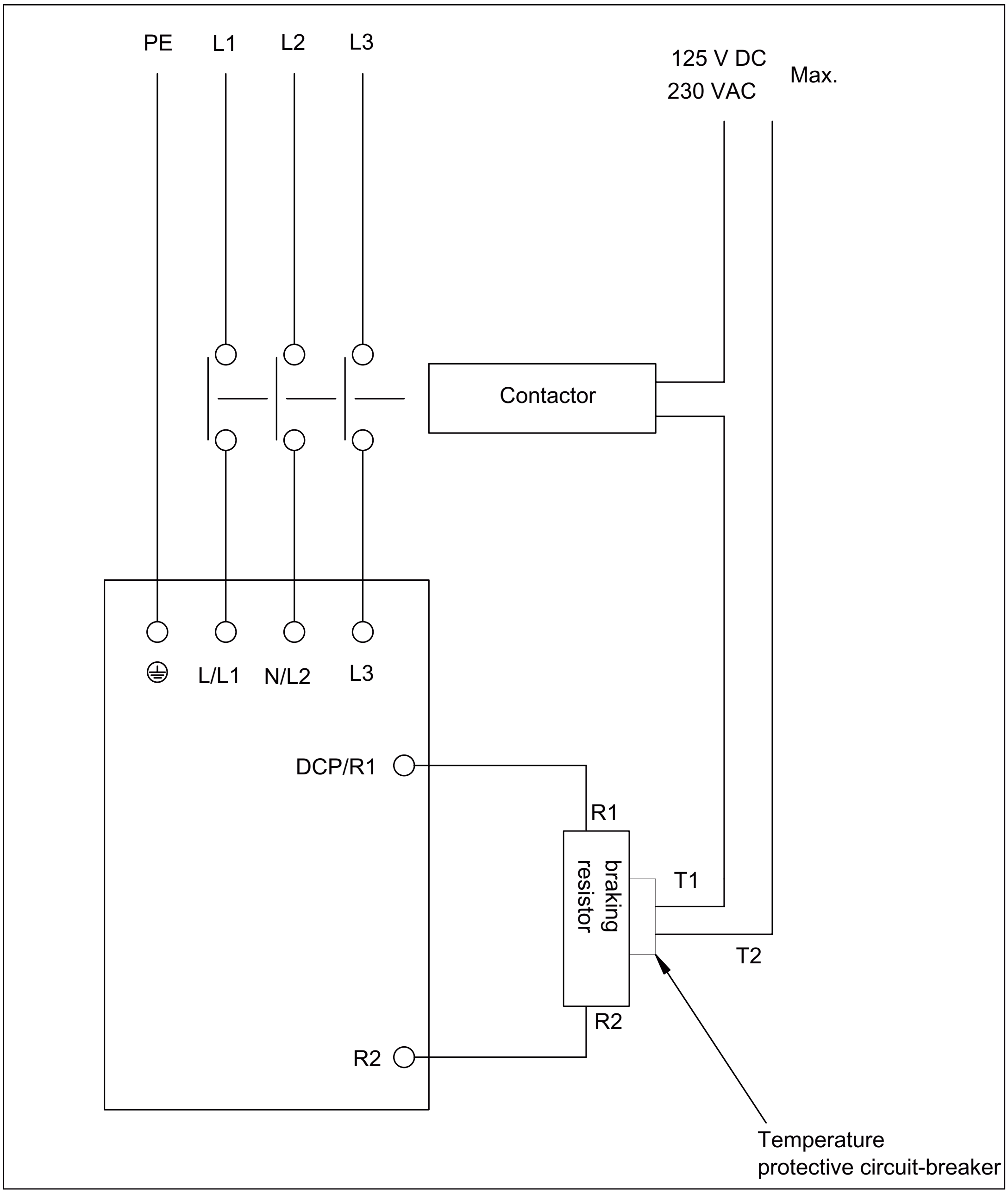


Figure 4-1 Connection example: Braking resistor

4.1.1.3 Dimension drawings

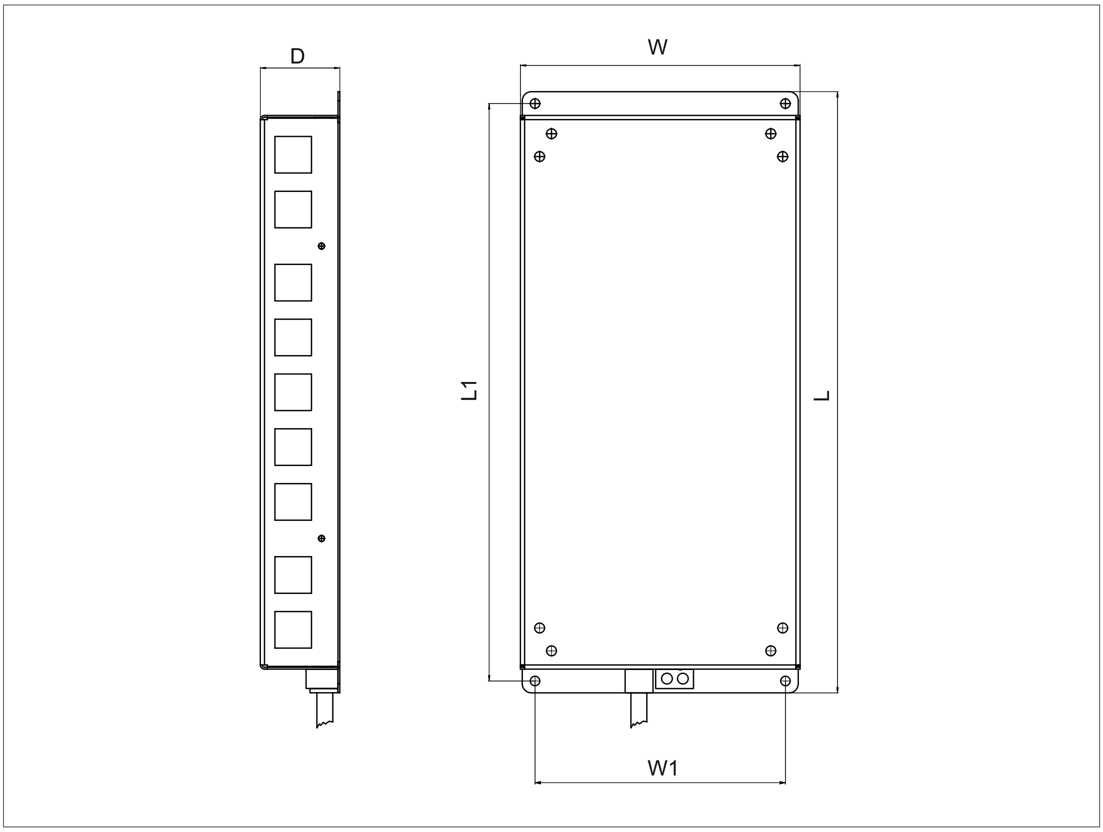


Figure 4-2 Dimension drawing of braking resistor, frame sizes FSA and FSB

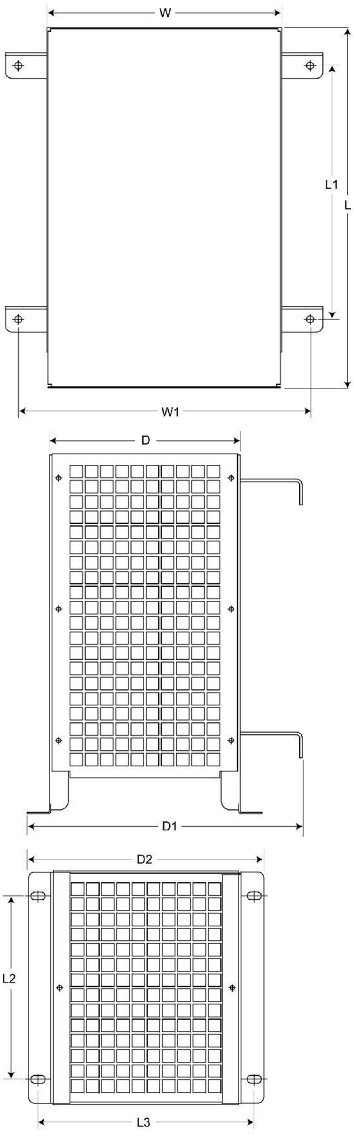


Figure 4-3 Dimension drawing of braking resistor, frame sizes FSC, FSD, FSE, FSF

Table 4- 1 Dimensions of braking resistor, all data in mm and (inches), Part 1

Order number	6SE6400-4BC05-0AA0	6SE6400-4BD11-0AA0	6SL3201-0BE12-0AA0	6SE6400-4BD16-5CA0
Frame size	FSA	FSA	FSB	FSC
L	230 (9.05)	230 (9.05)	239 (9.40)	285 (11.22)
L1	217 (8.54)	217 (8.54)	226 (8.89)	200 (7.87)
L2	-	-	-	145 (5.70)
L3	-	-	-	170 (6.69)
D	43.5 (1.71)	43.5 (1.71)	43.5 (1.71)	150 (5.90)
D1	-	-	-	217 (8.54)
D2	-	-	-	185 (7.28)
W	72 (2.83)	72 (2.83)	149 (5.86)	185 (7.28)
W1	56 (2.20)	56 (2.20)	133 (5.24)	230 (9.05)

Table 4- 2 Dimensions of braking resistor, all data in mm and (inches), Part 2

Order number	6SE6400-4BD21-2DA0	6SE6400-4BD22-2EA0	6SE6400-4BD24-0FA0
Frame size	FSD	FSE	FSF
L	515 (20.27)	645 (25.39)	650 (25.59)
L1	350 (13.77)	480 (18.89)	510 (20.07)
L2	205 (8.07)	205 (8.07)	270 (10.62)
L3	195 (7.67)	195 (7.67)	335 (13.18)
D	175 (6.88)	175 (6.88)	315 (12.40)
D1	242 (9.52)	242 (9.52)	382 (15.03)
D2	210 (8.26)	210 (8.26)	382 (15.03)
W	270 (10.62)	270 (10.62)	400 (15.74)
W1	315 (12.40)	315 (12.40)	435 (17.12)

4.1.1.4 Mounting

The braking resistor 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 sub-chassis 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.

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.

Note

PE connection

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

4.1.1.5 Technical data

Table 4- 3 Technical specifications, 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	FSA	FSB	FSC
Resistance	Ω	180	390	160	56
Rated power 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		Cable 3 x 2.5 mm^2 shielded, length 0.4 m	Cable 3 x 2.5 mm^2 shielded, length 0.5 m	Cable 3 x 2.5 mm^2 shielded, length 0.5 m	Cable 3 x 2.5 mm^2 shielded, length 0.9 m
Thermoswitch (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

Table 4- 4 Technical specifications, braking resistors, Part 2

Order number	6SE6400-	4BD21-2DA0	4BD22-2EA0	4BD24-0FA0
Suitable for Power Modules of frame size		FSD	FSE	FSF
Resistance	Ω	27	15	8.2
Rated power 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
Thermoswitch (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

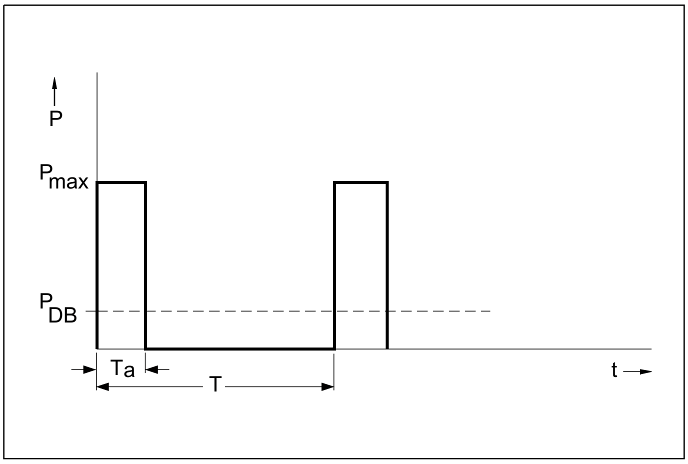


Figure 4-4 Load diagram for the braking resistor, Blocksize format

T [s] period duration of braking duty cycle

T_a [s] load duration for peak power

P_{DB} [W] rated power of the braking resistor

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

4.2 Chassis

4.2.1 Braking Modules

4.2.1.1 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

4.2.1.2 Safety information

⚠ DANGER

After disconnecting all the supply voltages, a hazardous voltage will be present in all components for another 5 minutes. Work may not be carried out on the components until after this time has elapsed.

Before starting work, you should also measure the voltage after the 5 minutes have elapsed! The voltage can be measured on DC link terminals DCP and DCN.

⚠ DANGER

The DC link discharge voltage hazard warning in the local language must be attached to all of the components.

⚠ DANGER

The connection to the braking resistors must be short-circuit/ground-fault proof.

⚠ WARNING

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

4.2.1.3 Braking Module for frame size FX

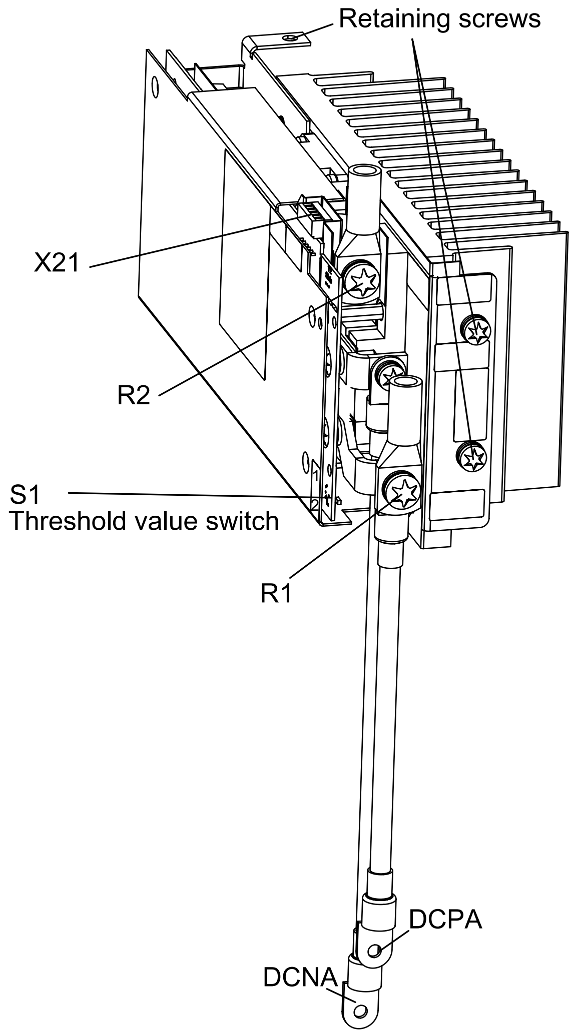


Figure 4-5 Braking Module for Power Module, frame size FX

Note

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

4.2.1.4 Braking Module for type GX

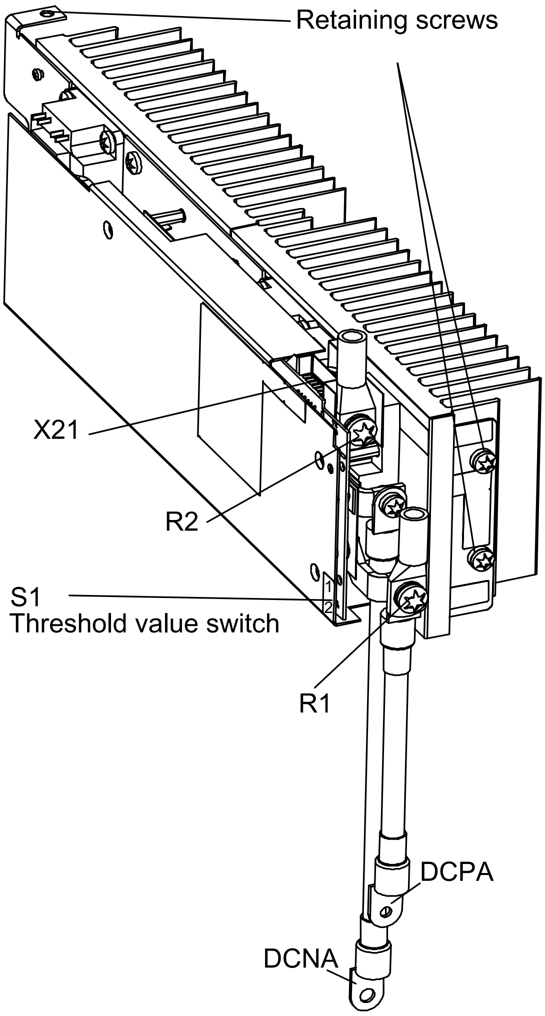


Figure 4-6 Braking Module for Power Module, frame size GX

Note

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

4.2.1.5 Sample connection

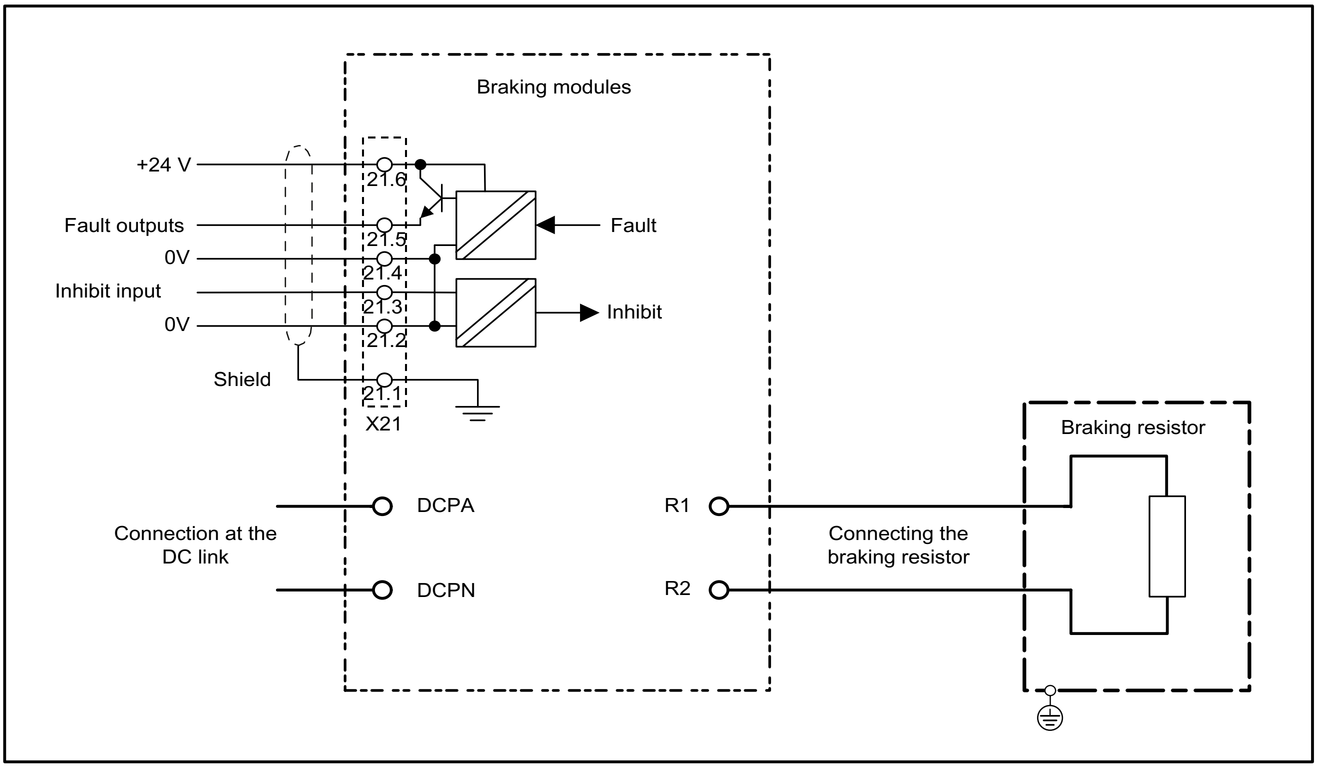


Figure 4-7 Example connection of Braking Module

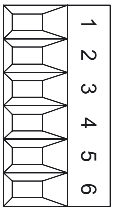
4.2.1.6 Braking resistor connection X1

Table 4- 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}	

4.2.1.7 X21 digital inputs/outputs

Table 4- 6 Terminal block X21

	Terminal	Designation [1)]	Technical specifications
	1	Shield	Shield connection for terminal 2 ... 6
	2	0 V	Low signal level: -3 V to 5 V High signal level: +15 V to 30 V Current drain: 2 mA to 15 mA
	3	DI inhibit input	
	4	0 V	Voltage: 24 V DC Load current: 0.5 mA to 0.6 mA
	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 mm^2			

[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.

4.2.1.8 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 4- 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	

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

Figure 4-8 Installing a Braking Module in a Power Module, frame size FX – steps 1 - 3

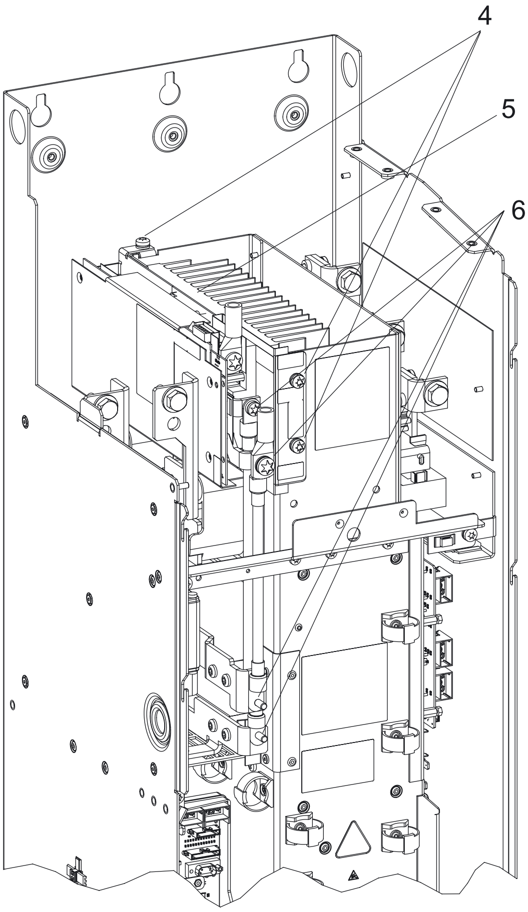


Figure 4-9 Installing a Braking Module in a Power Module, frame size FX – steps 4 - 6

Installing the Braking Module

The steps for the installation procedure are numbered in accordance with the diagrams in front of them.

1. Unscrew the 2 M6 screws from the front cover and lift off the cover.
2. Unscrew the 2 screws from the upper cover plate.
   Unscrew the 1 M6 nut on the left-hand side.
   Remove the left-hand cover.
3. Unscrew the 4 screws from the upper cover plate.
   Unscrew the 3 screws from the rear cut-out sections.
   Remove the top cover.
4. Unscrew the 3 screws for the blanking plate.
   Remove the plate.
5. Insert the Braking Module where the cover used to be and secure it using the 3 screws (step 4).
6. Secure the connection cable to the DC link with 2 screws (Braking Module connection) and 2 nuts (DC link connection).

Carry out the subsequent steps in reverse order from steps 1 – 3.

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 observe the specified tightening torques.

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

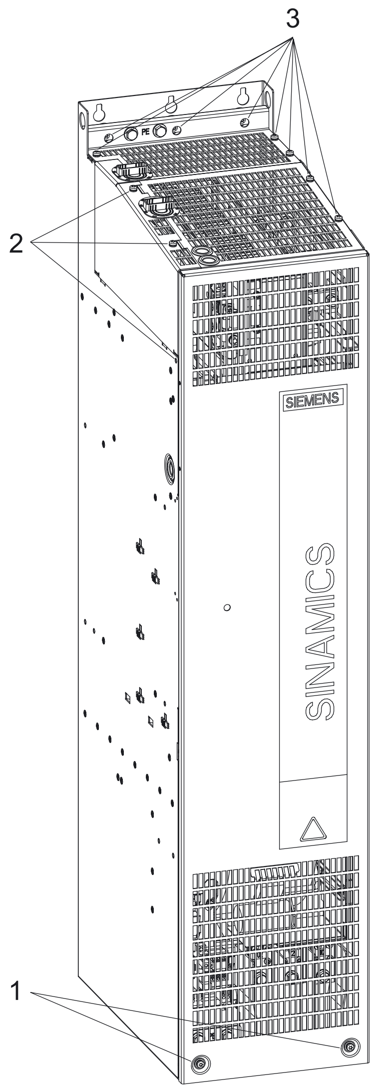


Figure 4-10 Installing a Braking Module in a Power Module, frame size GX – steps 1 - 3

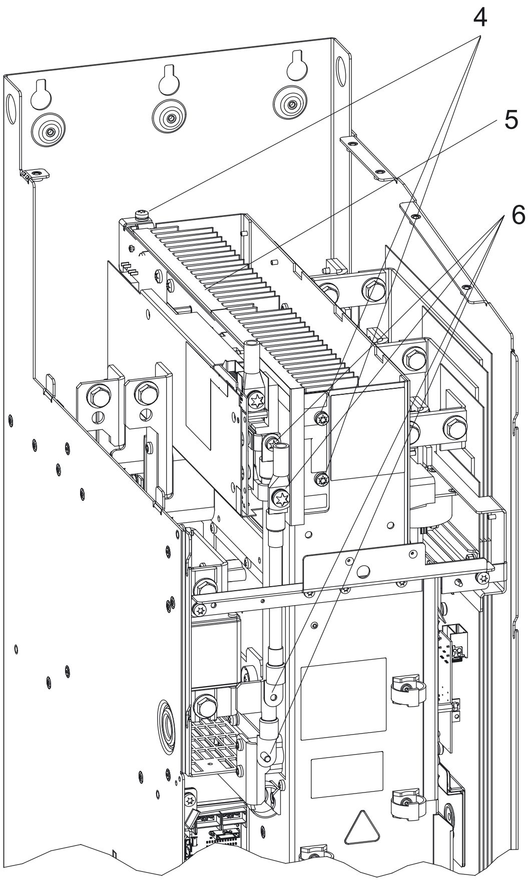


Figure 4-11 Installing a Braking Module in a Power Module, frame size GX – steps 4 - 6

Installing the Braking Module

The steps for the installation procedure are numbered in accordance with the diagrams in front of them.

1. Unscrew the 2 M6 screws from the front cover and lift off the cover.
2. Unscrew the 2 screws from the upper cover plate.
   Unscrew the 1 M6 nut on the left-hand side.
   Remove the left-hand cover.
3. Unscrew the 4 screws from the upper cover plate.
   Unscrew the 3 screws from the rear cut-out sections.
   Remove the top cover.
4. Unscrew the 3 screws for the blanking plate.
   Remove the plate.
5. Insert the Braking Module where the cover used to be and secure it using the 3 screws (step 4).
6. Secure the connection cable to the DC link with 2 screws (Braking Module connection) and 2 nuts (DC link connection).

Carry out the subsequent steps in reverse order from steps 1 – 3.

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 observe the specified tightening torques.

4.2.1.11 Technical data

Table 4- 8 Technical data, Braking Modules

Order No.	6SL3300–1AE31-3AA0	6SL3300–1AE32-5AA0
Suitable for installation in Power Modules, frame size	FX	GX
P_{DB} power (rated power)	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

4.2.2 Braking resistors

4.2.2.1 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 rated powers 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.

4.2.2.2 Safety information

⚠ WARNING
A cooling clearance of 200 m must be maintained on all sides of the component (with ventilation meshes).

⚠ DANGER
The braking resistor cables must be laid in such a way that they are short-circuit and ground-fault proof.

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

⚠ DANGER
The braking resistors are only suitable for base mounting. Sufficient space must be available for dissipating the energy converted by the braking resistor. A sufficient distance from flammable objects must be maintained. The braking resistor must be vertically installed as a free-standing unit. Objects must not be placed on or anywhere above the braking resistor. The braking resistor should not be installed underneath fire detection systems, since these could be triggered by the resulting heat. For outdoor installation, a hood should be provided to protect the braking resistor against precipitation (in accordance with degree of protection IP20). The surface temperature of the braking resistors may exceed 80 °C.

4.2.2.3 Dimension drawing

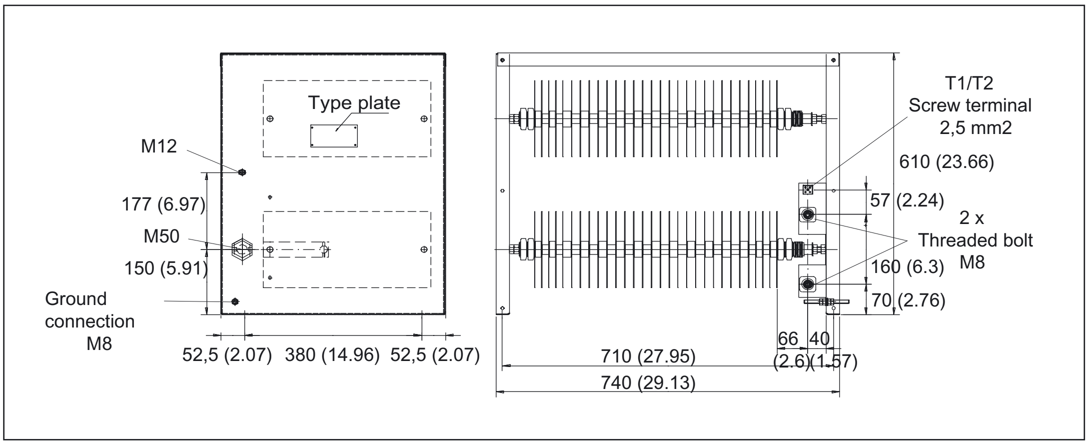


Figure 4-12 Dimension drawing, 25 kW/125 kW resistor

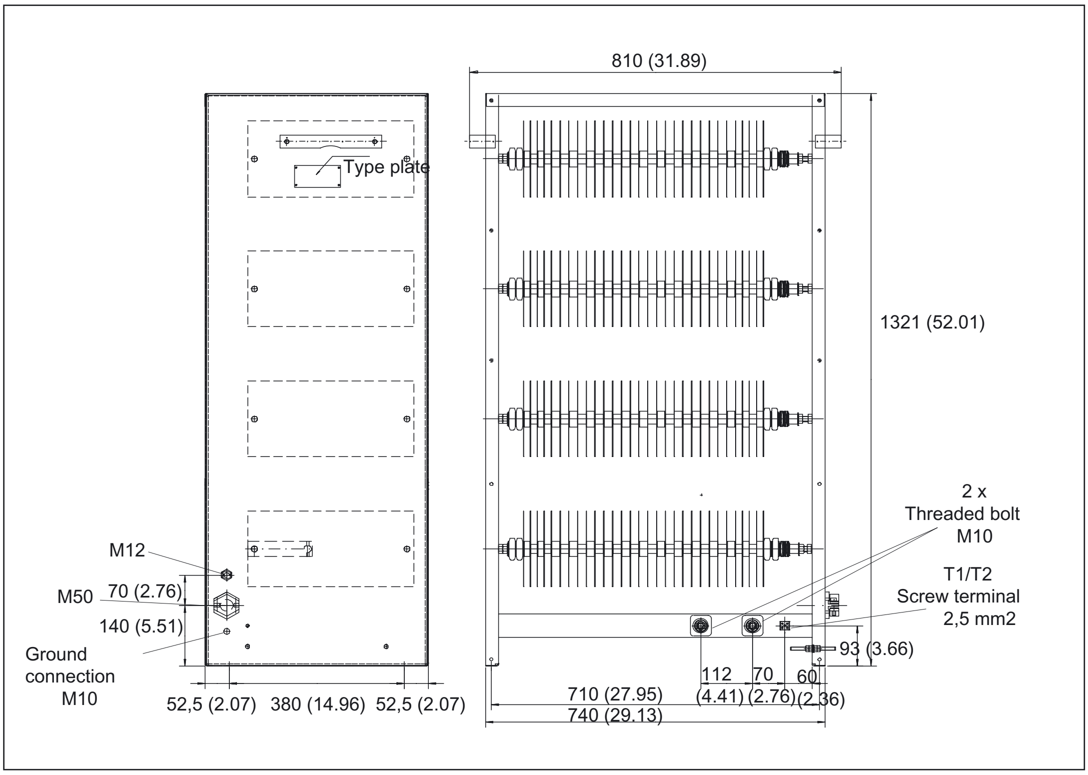


Figure 4-13 Dimension drawing, 50 kW/250 kW resistor

4.2.2.4 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.

CAUTION
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

CAUTION
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 4- 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

4.2.2.5 Technical data

Table 4- 10 What are the technical data of the braking resistors

Order No.:	Units	6SL3000–1BE31-3AA0	6SL3000–1BE32-5AA0
P_{DB} power (rated power)	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	740 x 1325 x 485
Thermoswitch (NC contact) maximum contact load connecting cable		240 V_{AC} / 10 A	240 V_{AC} / 10 A
Weight	kg	50	120

Duty cycle

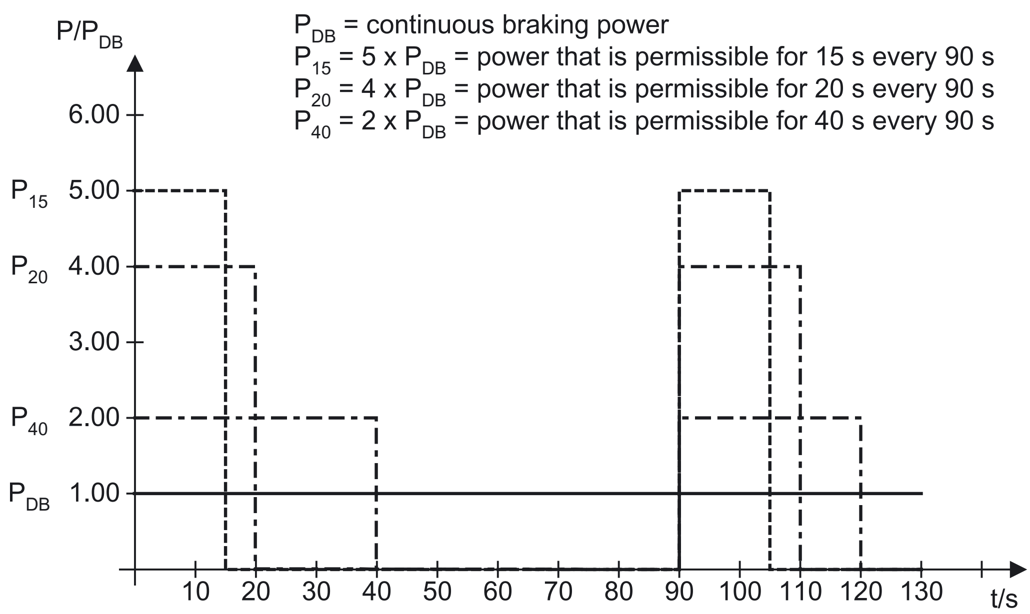


Figure 4-14 Duty cycle for braking resistors

Motor-side power components 5

5.1 Motor reactors

5.1.1 Blocksize

5.1.1.1 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.

5.1.1.2 Safety information

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

Note

The connecting cables to the Power Module must be kept as short as possible (max. 5 m).

CAUTION
When using motor reactors that SIEMENS has not approved for SINAMICS, then these can thermally damage the reactor.

⚠ CAUTION
The surface temperature of the motor reactors can exceed 80 °C.

CAUTION
The maximum permissible output frequency when motor reactors are used is 150 Hz.

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

5.1.1.3 Dimension drawings

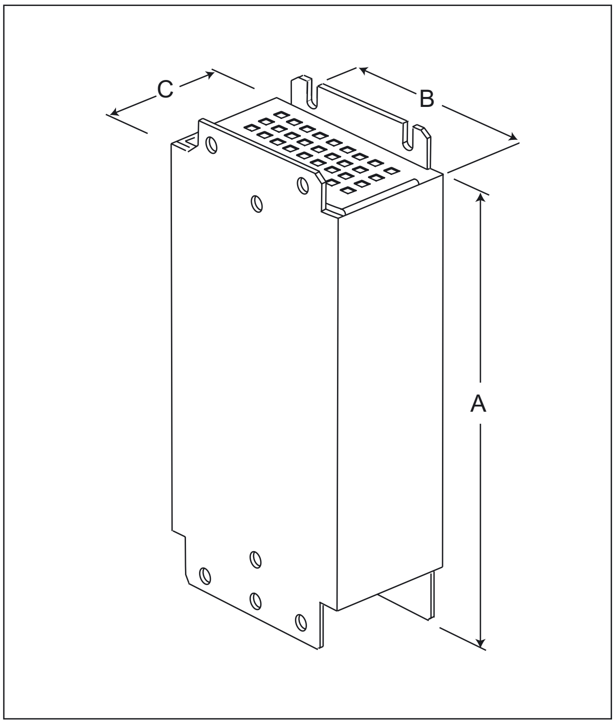


Figure 5-1 Dimension drawing: Motor reactor, frame size FSA

Table 5- 1 Total dimensions: Motor reactor, frame size FSA, all data in mm and (inches)

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

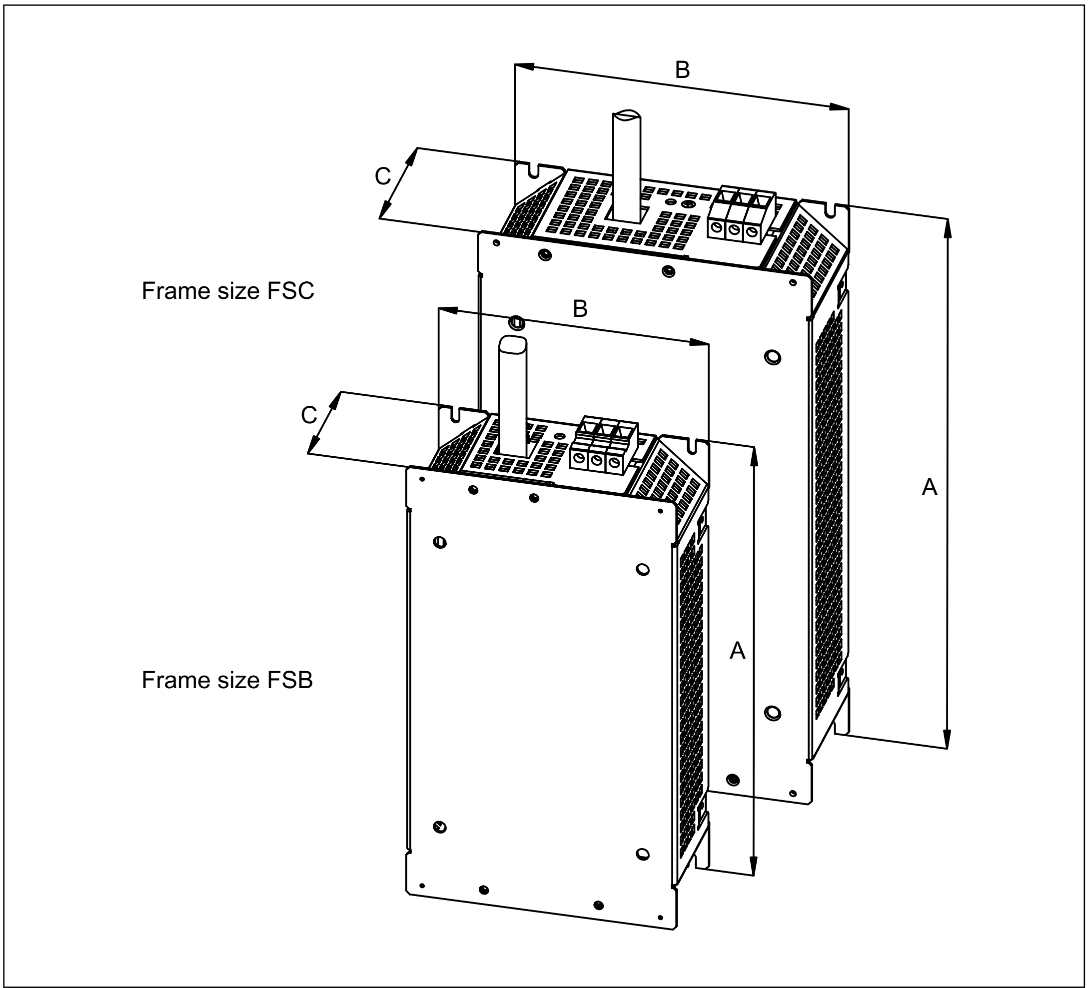


Figure 5-2 Dimension drawing: Motor reactor, frame sizes FSB and FSC

Table 5- 2 Total dimensions: Motor reactor, frame sizes FSB and FSC

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

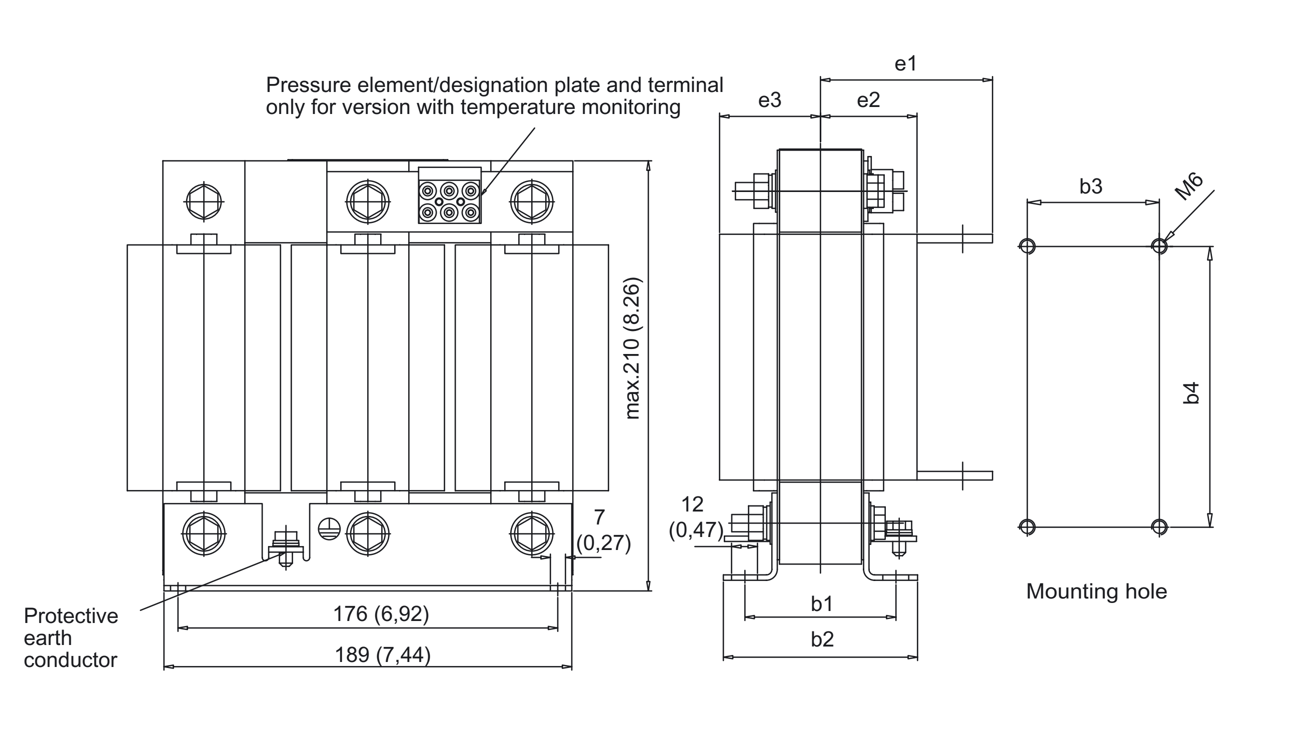


Figure 5-3 Dimension drawing: Motor reactor, frame size FSD

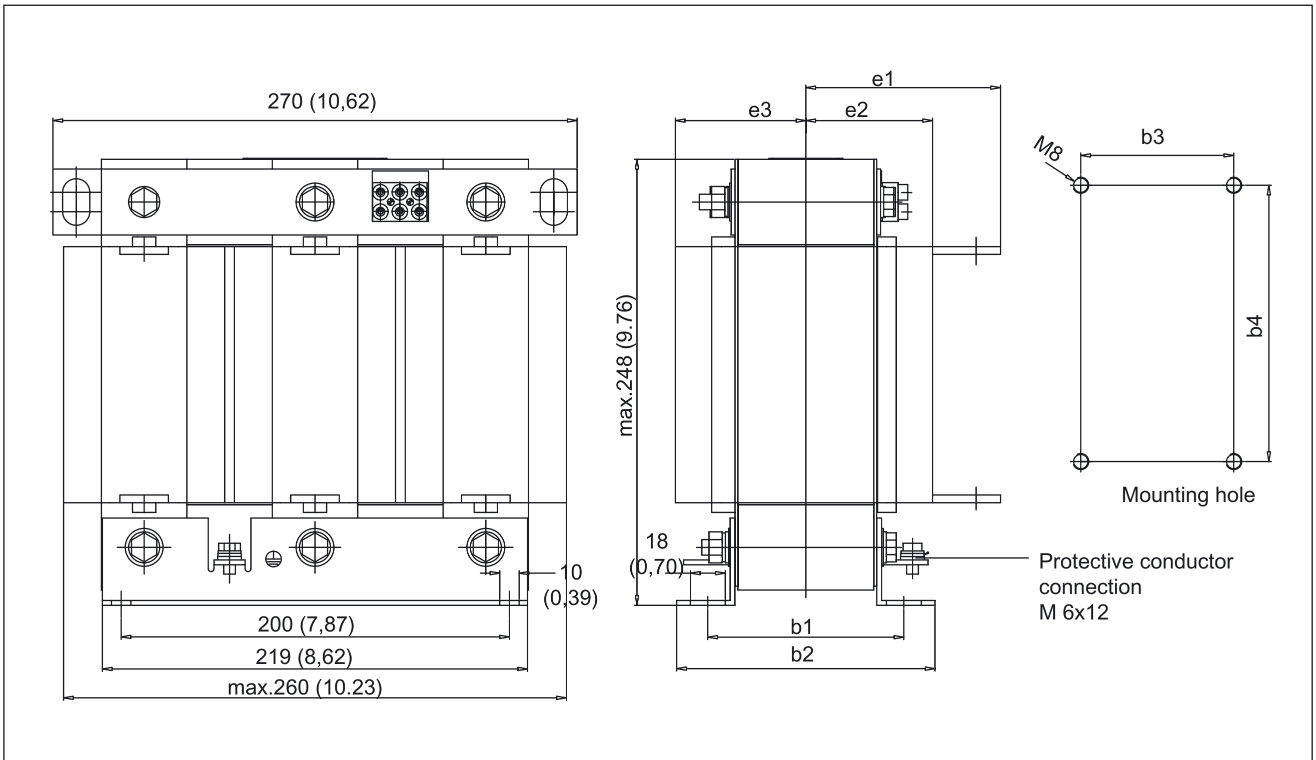


Figure 5-4 Dimension drawing: Motor reactor, frame size FSE

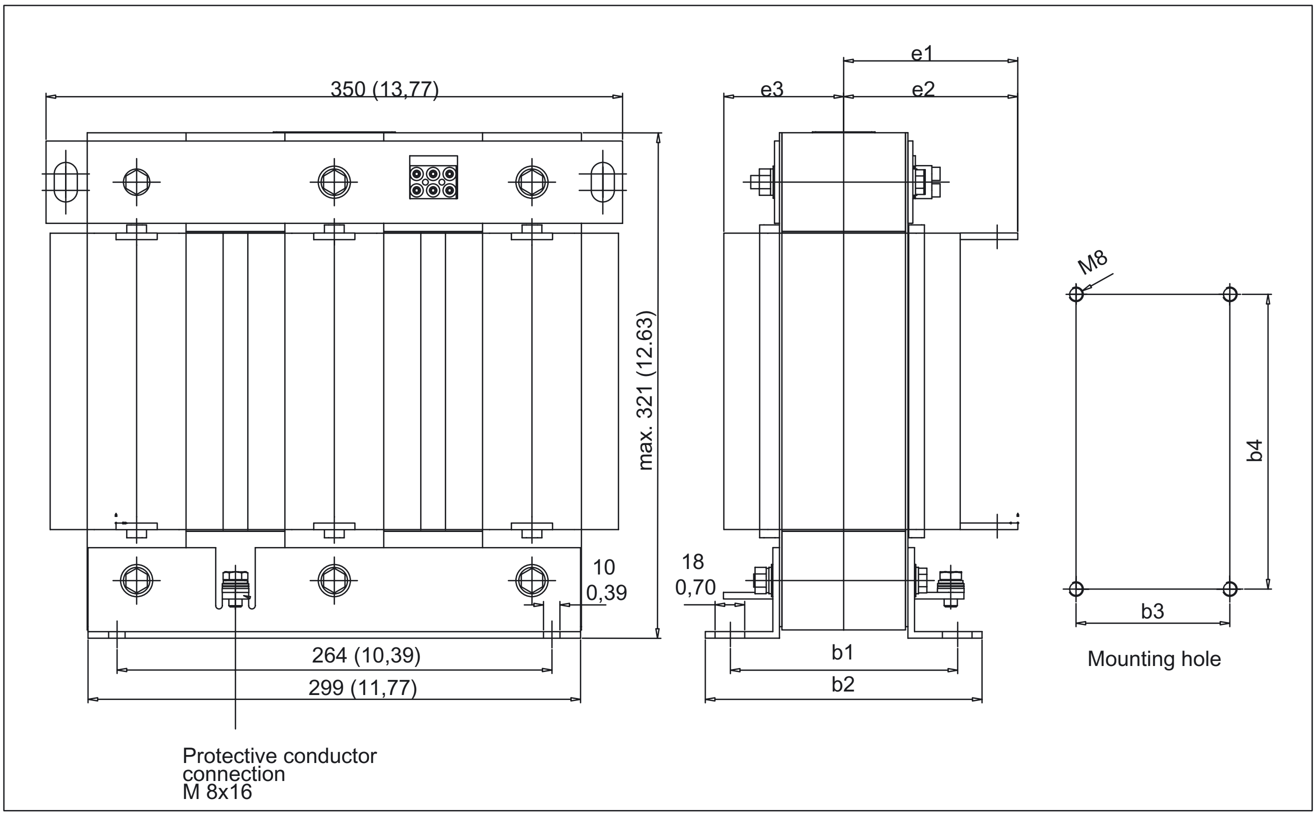


Figure 5-5 Dimension drawing: Motor reactor, frame size FSF

Table 5- 3 Total dimensions: Motor reactor, frame sizes FSD, FSE, all data in mm and (inches)

Motor reactor 6SE6400-	3TC05-4DD0	3TC03-8DD0	3TC07-5ED0	3TC08-0ED0
Frame size	FSD	FSD	FSE	FSE
b1	70 (2.75)	94 (3.70)	101 (3.97)	70 (2.75)
b2	91 (3.58)	115 (4.52)	133 (5.23)	90 (3.54)
b3	70 (2.75)	94 (3.70)	101 (3.97)	70 (2.75)
b4	176 (6.92)	176 (6.92)	200 (7.87)	176 (6.92)
e1	91 (3.58)	103 (4.05)	110 (4.33)	89 ± 2 (3.50 ± 0.07)
e2	57 (2.24)	69 (2.71)	76 (2.99)	79 ± 2 (3.50 ± 0.07)
e3	49 (1.92)	61 (2.40)	68 (2.67)	-

Table 5- 4 Total dimensions: Motor reactor, frame size FSF, all data in mm and (inches)

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 ± 2 (4.68 ± 0.07)
e2	90 (3.54)	109 ± 2 (4.29 ± 0.07)
e3	78 (3.07)	-

5.1.1.4 Mounting

Note

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

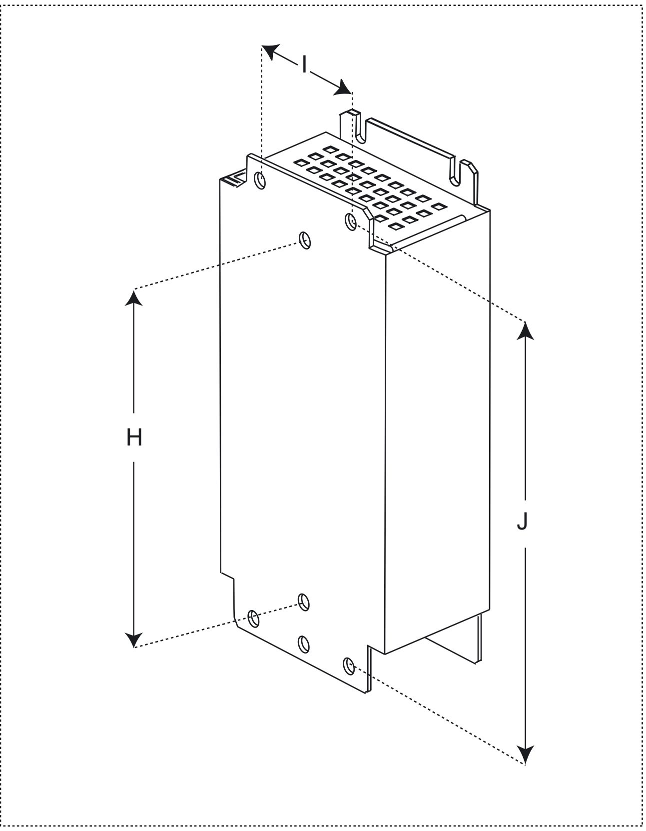


Figure 5-6 Mounting dimensions of motor reactor, frame size FSA

Table 5- 5 Mounting dimensions of motor reactor, frame size FSA, all data in mm and (inches)

Motor reactor 6SE6400-	3TC00-4AD2
Frame size	FSA
H	160 (6.29)
I	56 (2.20)
J	187 (7.36)

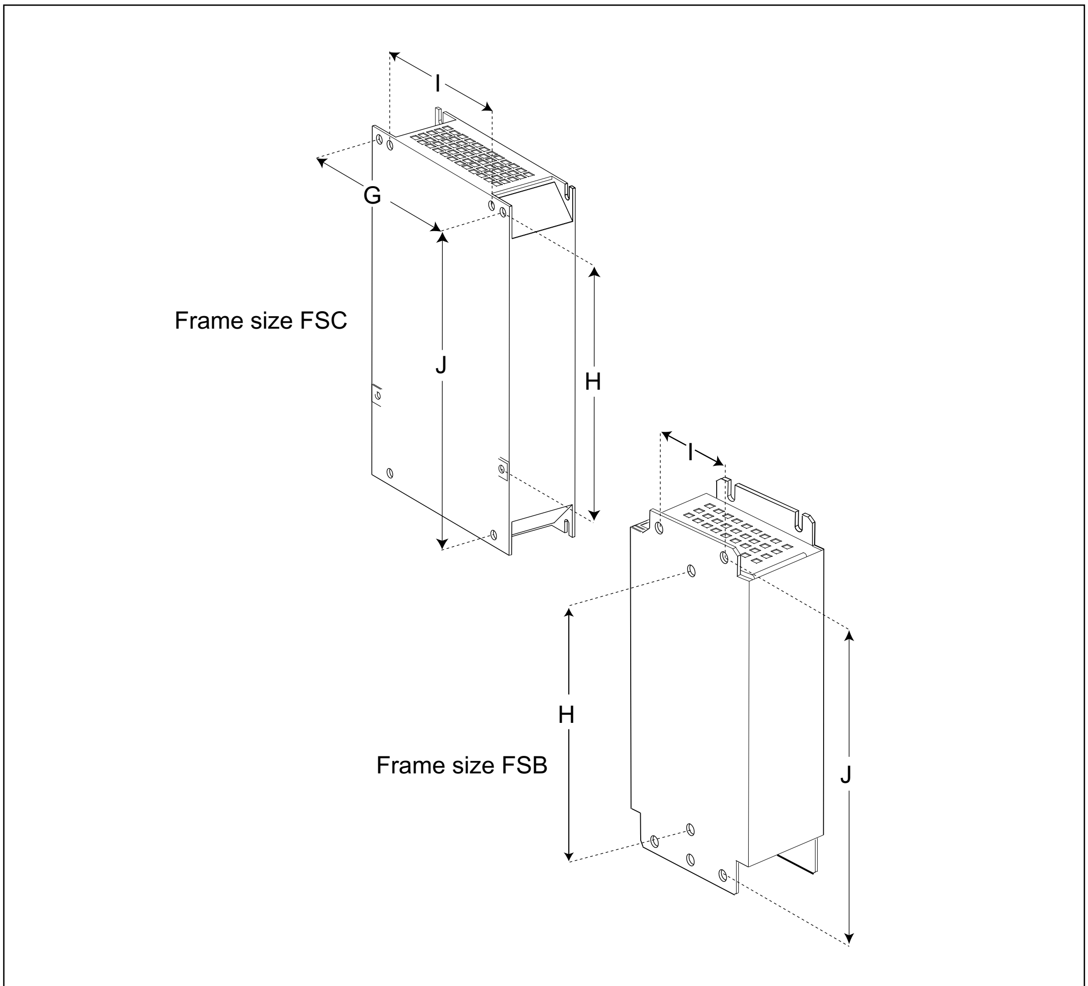


Figure 5-7 Mounting dimensions of motor reactors, frame sizes FSB and FSC

Table 5- 6 Mounting dimensions of motor reactors, frame sizes FSB and FSC, all data in mm and (inches)

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

Cable cross-section and terminal tightening torques Terminals for wiring on site

Frame size	FSA	FSB	FSC
Tightening torque [Nm]	1.1	1.5	2.25
Recommended minimum conductor cross-section [mm^2]	1	1.5	2.5
Highest conductor cross-section [mm^2]	2.5	6	10

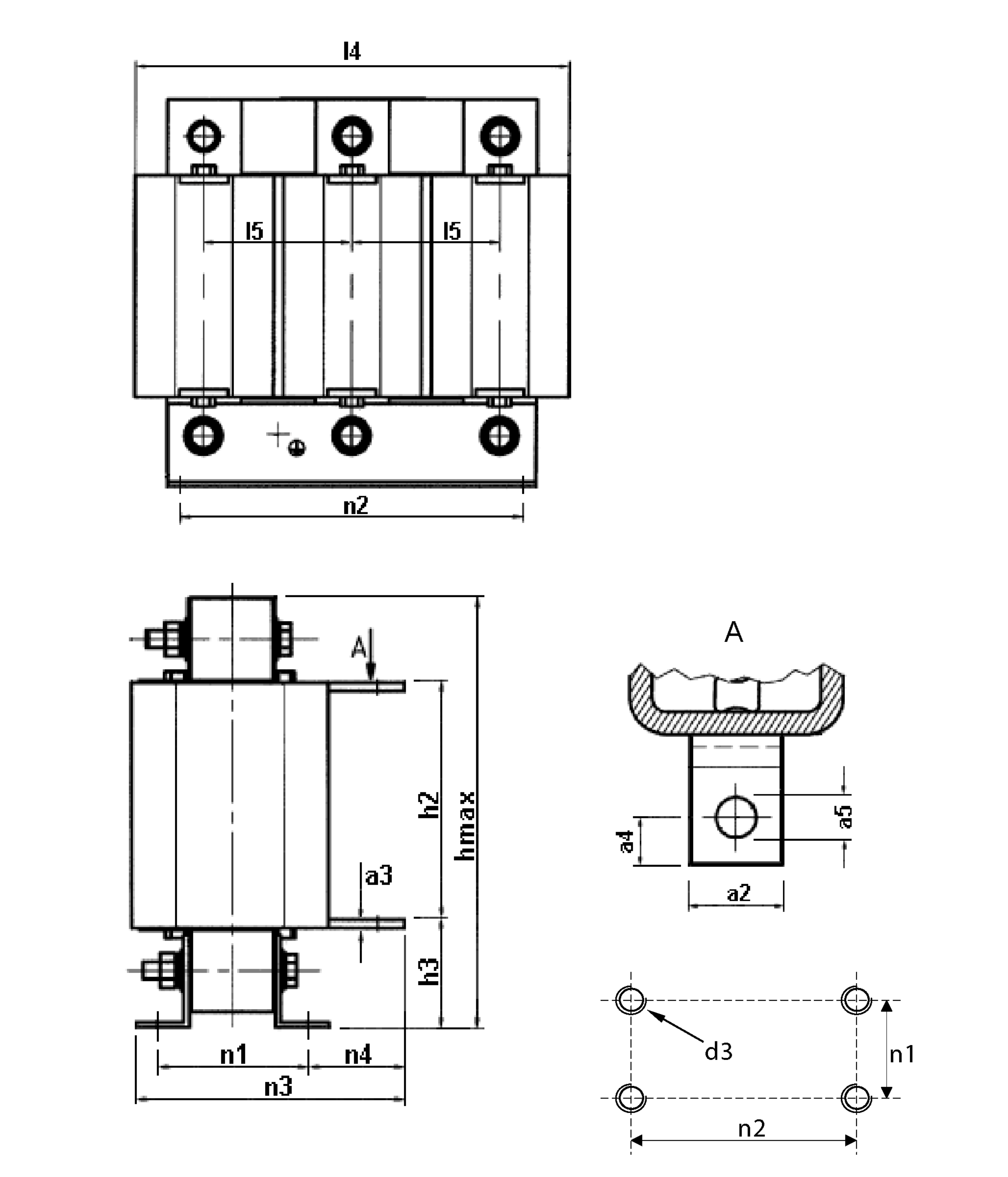


Figure 5-8 Mounting dimensions of motor reactors, frame sizes FSD, FSE, FSF

Table 5- 7 Mounting dimensions of motor reactors, frame sizes FSD, FSE, all data in mm and (inches)

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 ±5 (2.99 ±0.19)	76 ±5 (2.99 ±0.19)	88 ±5 (3.46 ±0.19)	76 ±5 (2.99 ±0.19)
	hmax	210 (8.26)	210 (8.26)	248 (9.76)	210 (8.26)
	h2	120 ±2 (4.72 ±0.07)	120 ±2 (4.72 ±0.07)	140 ±2 (5.51 ±0.07)	120 ±2 (4.72 ±0.07)
	h3	45 ±2 (1.77 ±0.07)	45 ±2 (1.77 ±0.07)	50 ±2 (1.96 ±0.07)	45 ±2 (1.77 ±0.07)
	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 ±2 (2.12 ±0.07)	54 ±2 (2.12 ±0.07)	68.5 ±2 (2.69 ±0.07)	54 ±2 (2.12 ±0.07)
	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 5- 8 Mounting dimensions of motor reactor, frame size FSF, all data in mm and (inches)

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 ±5 (4.72 ±0.19)	88 ±5 (3.46 ±0.19)
	hmax	321 (12.63)	248 (9.76)
	h2	185 ±2 (7.28 ±0.07)	140 ±2 (5.51 ±0.07)
	h3	60 ±2 (2.36 ±0.07)	50 ±2 (1.96 ±0.07)
	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 ±2 (2.57 ±0.07)	68.5 ±2 (2.69 ±0.07)
	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

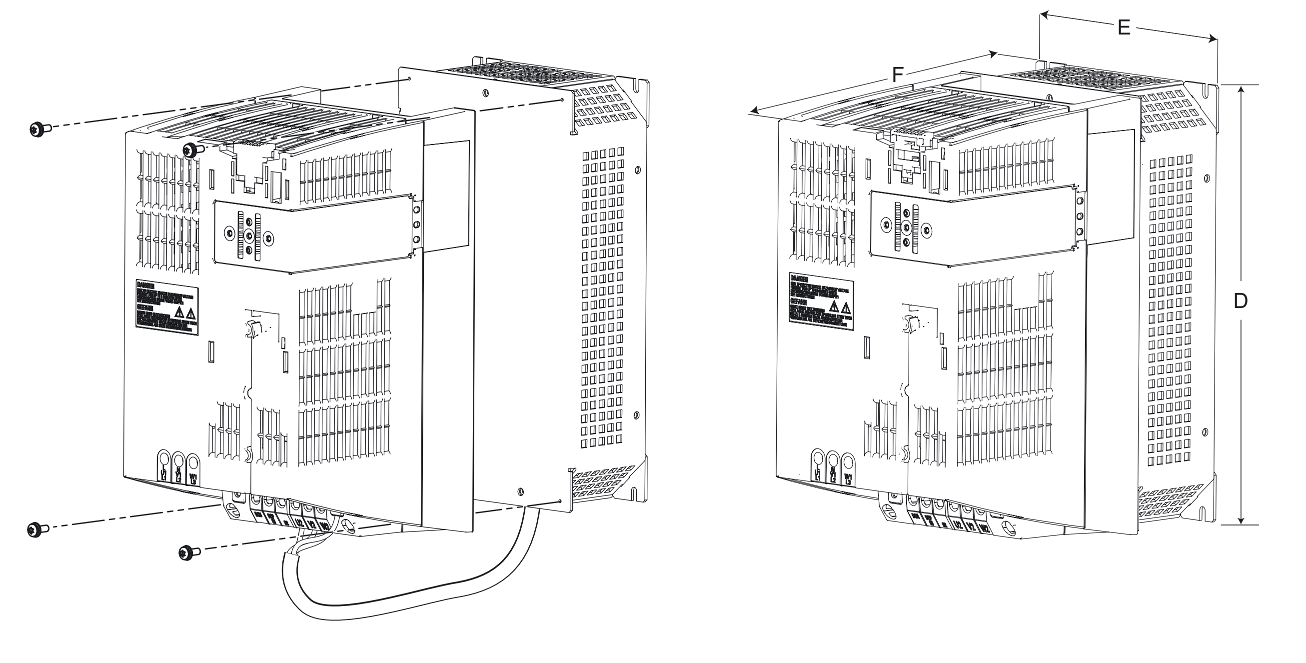


Figure 5-9 Mounting Power Modules and motor reactors, frame sizes FSB and FSC

Table 5- 9 Total dimensions, PM340 Power Module and motor reactor, frame sizes FSA, FSB, and FSC, all data in mm and (inches)

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)

5.1.1.5 Electrical connection

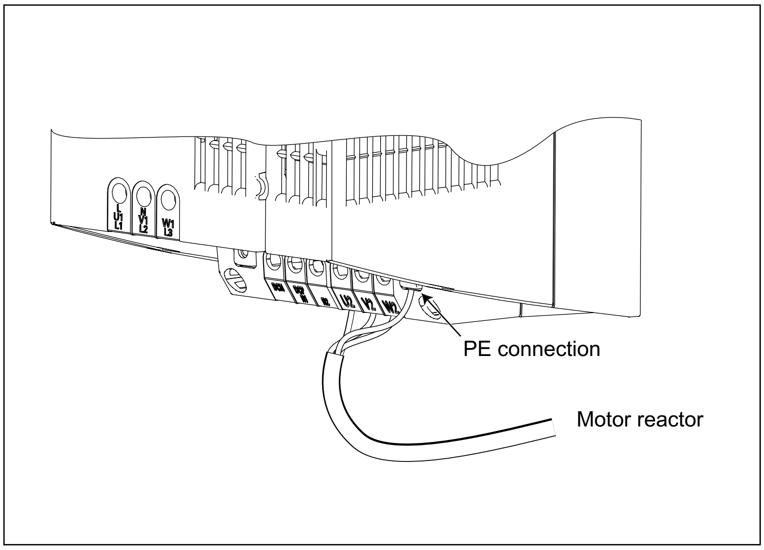


Figure 5-10 Electrical connection

5.1.1.6 Technical data

Table 5- 10 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)			100 (shielded) 225 (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 5- 11 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 5- 12 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 5- 13 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

5.1.2 Chassis

5.1.2.1 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.

5.1.2.2 Safety information

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

Note

The connecting cables to the Power Module must be kept as short as possible (max. 5 m).

CAUTION
When using motor reactors that SIEMENS has not approved for SINAMICS, then these can thermally damage the reactor.

⚠ CAUTION
The surface temperature of the motor reactors can exceed 80 °C.

CAUTION
The maximum permissible output frequency when motor reactors are used is 150 Hz.

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

5.1.2.3 Dimension drawing

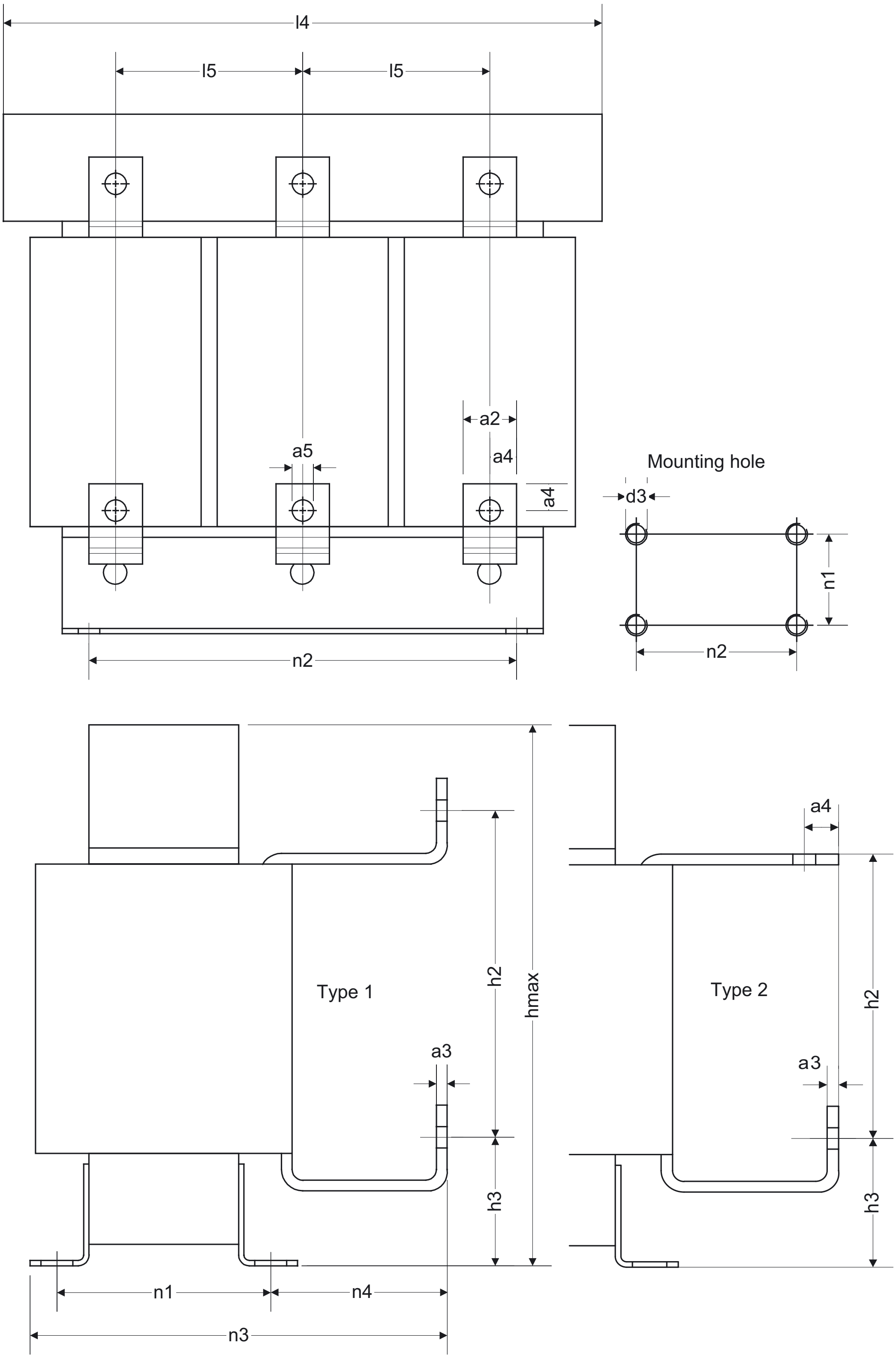


Figure 5-11 Dimension drawing, motor reactor

Table 5- 14 Dimensions of motor reactors, all data in mm and (inches)

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)
l4	300 (11.81)	300 (11.81)	300 (11.81)	300 (11.81)	300 (11.81)
l5	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

5.1.2.4 Technical data

Table 5- 15 Technical specifications, 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
Rated power of the Power Module	kW	110	132	160	200	250
Rated current	A	210	260	310	380	490
Power loss	kW	0.486	0.5	0.47	0.5	0.5
Connections - to the Power Module - to the load - PE		 M10 M10 M8	 M10 M10 M8	 M10 M10 M8	 M10 M10 M8	 M12 M12 M8
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

5.2 Sinusoidal filter

5.2.1 Chassis

5.2.1.1 Description

The sinusoidal 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.

Sinusoidal 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 specifications.

When a sinusoidal filter is used, the available output voltage decreases by 15 %.

5.2.1.2 Safety information

⚠ WARNING

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

Note

The connecting cables to the Power Module must be kept as short as possible (max. 5 m).

CAUTION

It is not permissible that the connections are interchanged:

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

Non-observance may damage the sine-wave filter.

CAUTION

If sine-wave filters are used that have not been approved for SINAMICS by SIEMENS, the Power Modules may be damaged or may malfunction.

⚠ CAUTION
The sinusoidal filters can have surface temperatures of over 80 °C.

CAUTION
If a sine-wave filter is connected to the Power Module, the converter must be activated during commissioning (p0230 = 3) to prevent the filter from being destroyed. If a sine-wave filter is connected to the Power Module, the Power Module must not be operated without a connected motor, as otherwise the filter may be destroyed.

⚠ CAUTION
The maximum permissible output frequency when sine-wave filters are used is 150 Hz.

5.2.1.3 Dimension drawing

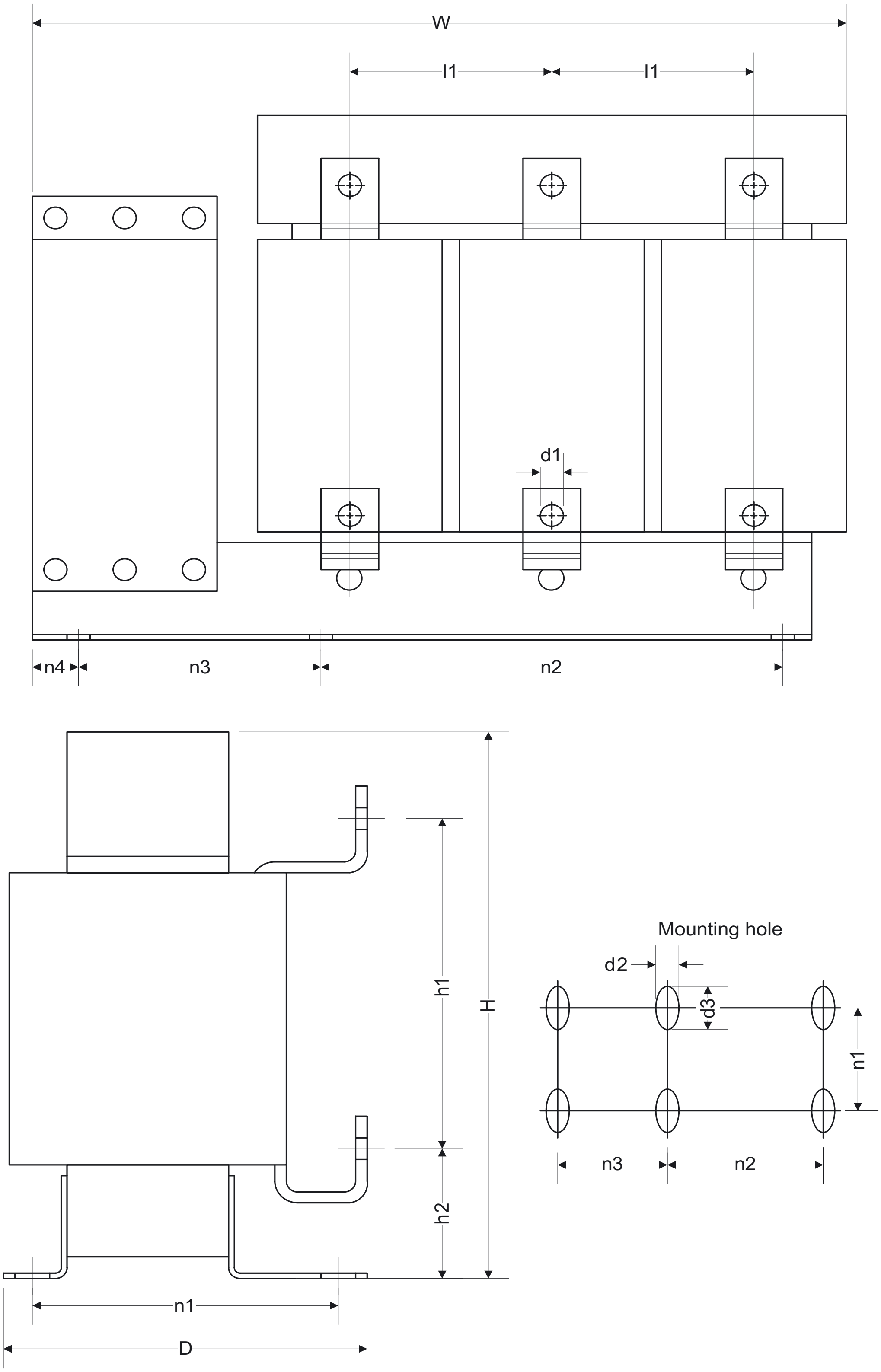


Figure 5-12 Dimension drawing, sinusoidal filter

Table 5- 16 Dimensions of the sinusoidal filters, all data in mm and (inches)

6SL3000-	2CE32-3AA0	2CE32-8AA0	2CE33-3AA0	2CE34-1AA0
W	620 (24.40)	620 (24.40)	620 (24.40)	620 (24.40)
H	320 (12.59)	320 (12.59)	360 (14.17)	360 (14.17)
D	300 (11.81)	300 (11.81)	370 (14.56)	370 (14.56)
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) The lengths n1, n2 and n3 correspond to the drill hole spacing

5.2.1.4 Technical data

Table 5- 17 Technical specifications, 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
Power 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				
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

5.3 dv/dt filter plus Voltage Peak Limiter

5.3.1 Chassis

5.3.1.1 Description

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

The dv/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%.

Dv/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 (dv/dt reactor and voltage peak limiter) are listed in the following table:

Table 5- 18 dv/dt filter with Voltage Peak Limiter, order numbers of the individual components

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

⚠ WARNING

When a dv/dt filter is used, the pulse frequency of the Power Module must not exceed 4 kHz. If a higher value is set, this could destroy the dv/dt filter.

5.3.1.2 Safety information

WARNING

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

Note

The connecting cables to the Power Module must be kept as short as possible (max. 5 m).

CAUTION

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

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

Failure to connect the terminals correctly could damage the voltage peak limiter.

CAUTION

When using dv/dt filters that SIEMENS has not approved for SINAMICS, then these dv/dt filters can be thermally damaged.

CAUTION

The surface temperature of the dv/dt reactors may exceed 80 °C.

CAUTION

If a dv/dt filter compact plus Voltage Peak Limiter is connected to the Power Module, it is essential that it is activated during commissioning (p0230 = 2).

CAUTION

The maximum permissible output frequency when using dv/dt filters is 150 Hz.

DANGER

dv/dt filters plus Voltage Peak Limiter discharge a high leakage current to the protective ground conductor. Due to the high leakage current associated with dv/dt filters, they or the relevant control cabinet must be permanently connected to PE.

According to EN 61800-5-1, Section 6.3.6.7, the minimum cross-section of the protective ground conductor must conform to the local safety regulations for protective ground conductors for equipment with a high leakage current.

5.3.1.3 Interface description

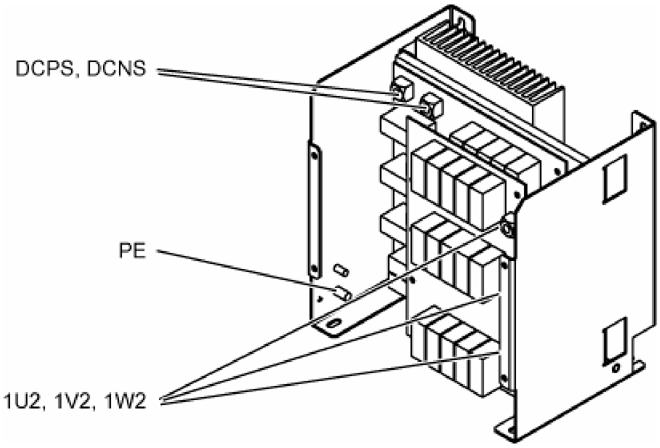


Figure 5-13 Interface overview, voltage peak limiter, type 1

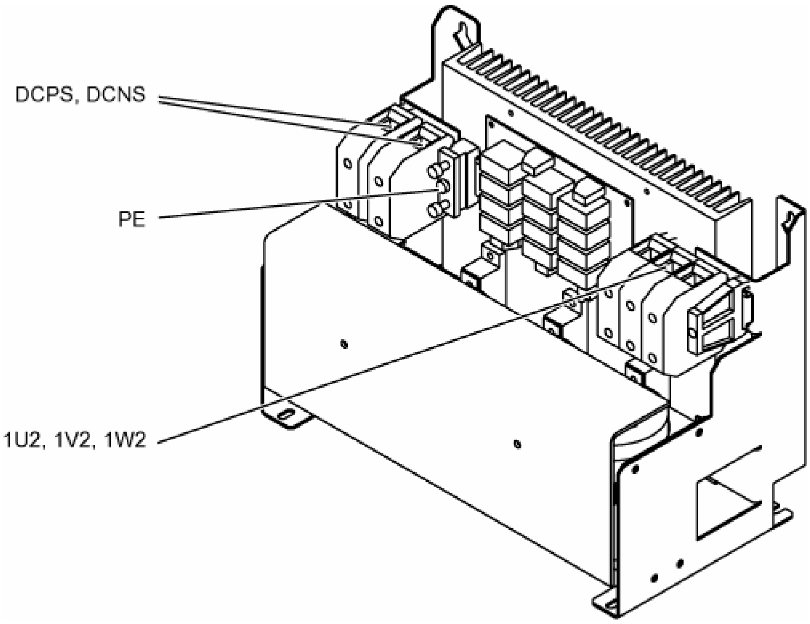


Figure 5-14 Interface overview, voltage peak limiter, type 2

5.3.1.4 Connecting the dv/dt filter plus Voltage Peak Limiter

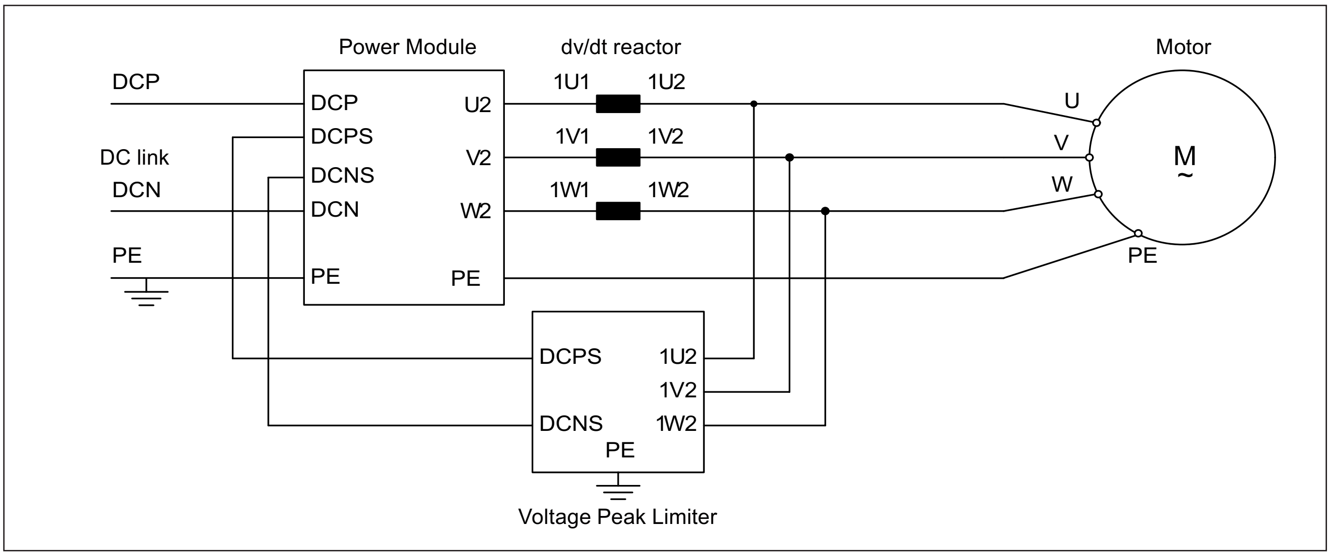


Figure 5-15 Connecting the dv/dt filter plus Voltage Peak Limiter

Cable cross-sections

Table 5- 19 Cable cross-sections for connections between a dv/dt filter and Power Module

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

CAUTION

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 for the specified connections is 5 m per connection.

5.3.1.5 Dimension drawing, dv/dt reactor

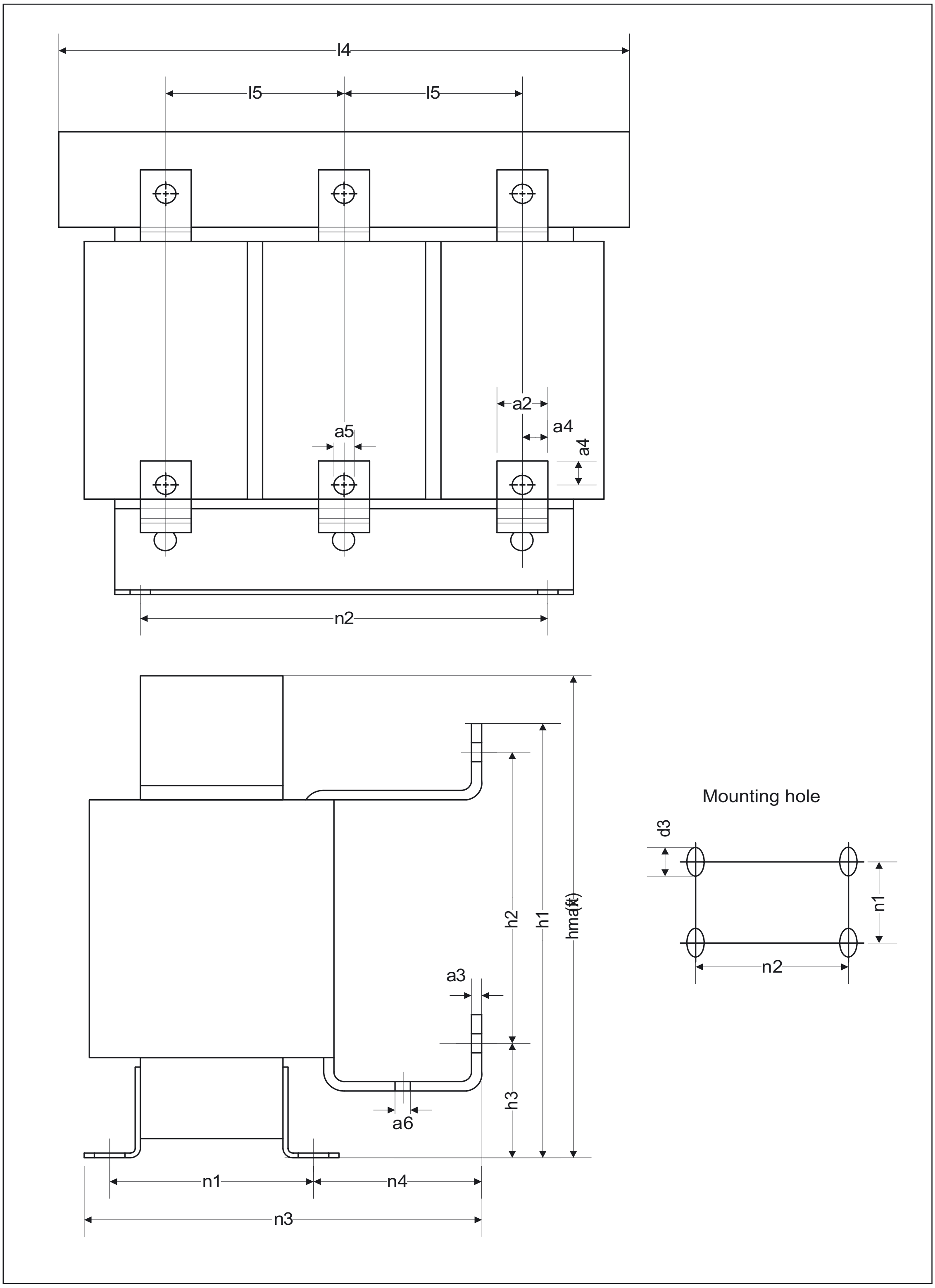


Figure 5-16 Dimension drawing, dv/dt reactor

Table 5- 20 Dimensions dv/dt reactor, 3-ph. 380 V – 480 V AC, all data in mm and (inches)

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		

5.3.1.6 Dimension drawing of the voltage peak limiter

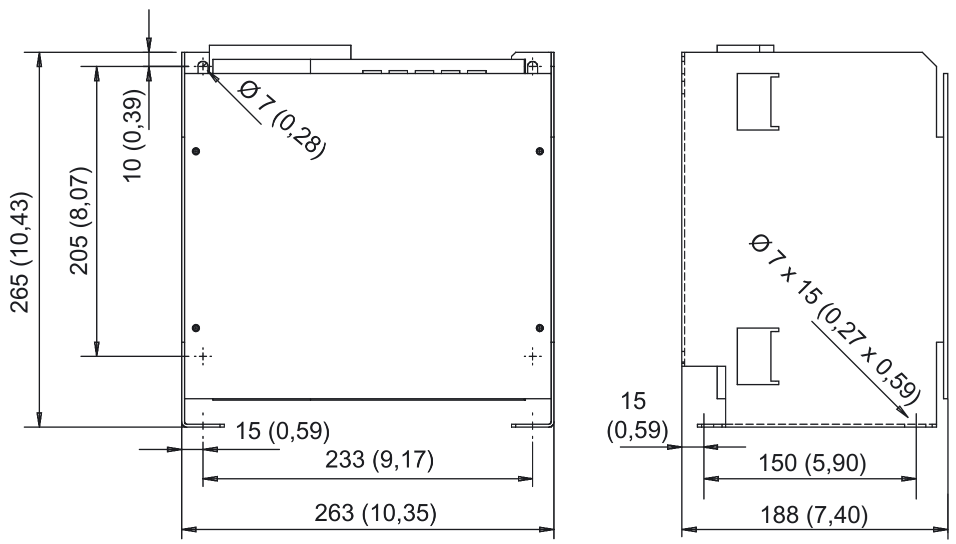


Figure 5-17 Dimension drawing of the voltage peak limiter, type 1

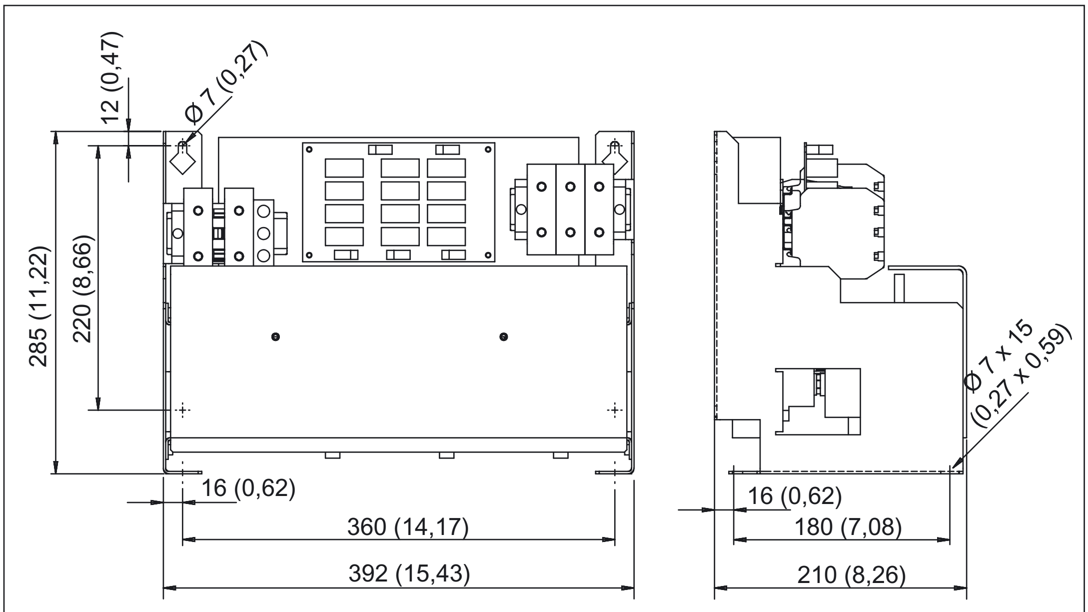


Figure 5-18 Dimension drawing of the voltage peak limiter, type 2

Table 5- 21 Assigning voltage peak limiter to dimension drawings

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

5.3.1.7 Technical data

Table 5- 22 Technical specifications, dv/dt filter plus Voltage Peak Limiter

Order number	6SL3000-	2DE32-6AA0	2DE35-0AA0	
Suitable for Power Module (rated power)	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	

5.4 dv/dt filter compact plus Voltage Peak Limiter

5.4.1 Chassis

5.4.1.1 Description

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

When a dv/dt filter compact plus Voltage Peak Limiter is used, the drive must not be operated in uninterrupted duty with an output frequency lower than 10 Hz.

A maximum load duration of 5 minutes at an output frequency lower than 10 Hz is permissible, provided that the drive is operated with an output frequency higher than 10 Hz for a period of 5 minutes thereafter.

Uninterrupted duty at an output frequency lower than 10 Hz can produce thermal overload and destroy the dv/dt filter.

WARNING

When a dv/dt filter compact is used, the pulse frequency of the Power Module must not exceed 4 kHz. If a higher pulse frequency is set, then this could destroy the dv/dt filter.

Note

It is permissible to set pulse frequencies in the range between the rated pulse frequency and the relevant maximum pulse frequency when a dv/dt filter compact plus Voltage Peak Limiter is used.

Note

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

5.4.1.2 Safety information

CAUTION
The cooling clearances of 100 mm above and below the components must be observed. The dv/dt filters compact plus Voltage Peak Limiter may only be mounted in a vertical position, to enable cooling air to flow through the heat sink on the Voltage Peak Limiter from the bottom to the top.

Note

The motor cables between the Power Module and the dv/dt filter compact, as well as the cables to the DC link, must be kept as short as possible (max. 5 m).

CAUTION
When using dv/dt filters that SIEMENS has not approved for SINAMICS, then these dv/dt filters can be thermally damaged.

⚠ CAUTION
The surface temperature of the dv/dt filter compact may exceed 80 °C.

CAUTION
If a dv/dt filter compact plus Voltage Peak Limiter is connected to the Power Module, it is essential that it is activated during commissioning (p0230 = 2).

CAUTION
The maximum permissible output frequency when using dv/dt filters compact plus Voltage Peak Limiter is 150 Hz.

⚠ DANGER
dv/dt filters plus Voltage Peak Limiter discharge a high leakage current to the protective ground conductor. Due to the high leakage current associated with dv/dt filters, they or the relevant control cabinet must be permanently connected to PE. According to EN 61800-5-1, Section 6.3.6.7, the minimum cross-section of the protective ground conductor must conform to the local safety regulations for protective ground conductors for equipment with a high leakage current.

⚠ DANGER
Each component must be grounded via the PE connection specifically marked for this purpose.

5.4.1.3 Interface description

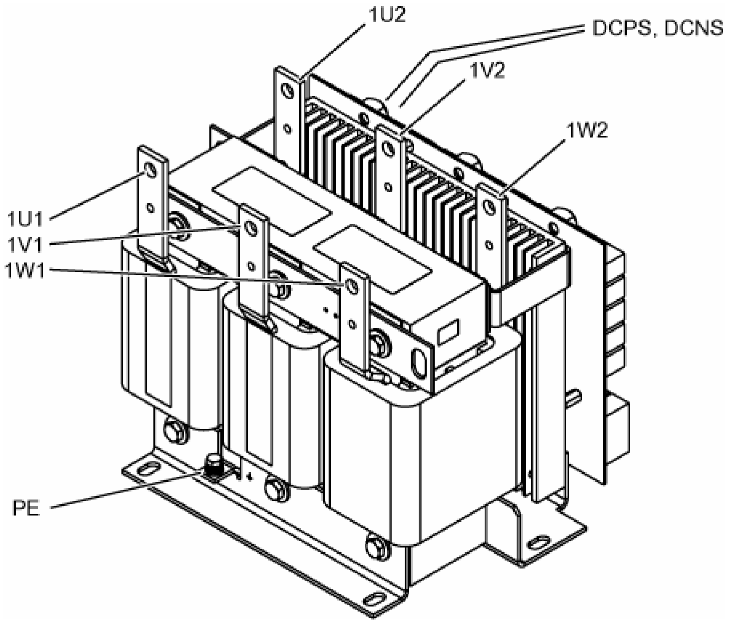


Figure 5-19 Interface overview, dv/dt filter compact plus Voltage Peak Limiter, type 1

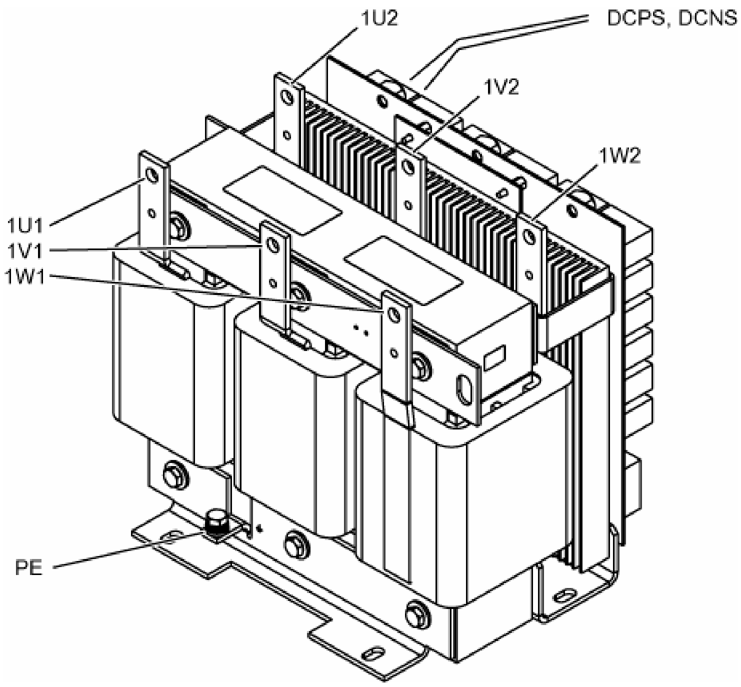


Figure 5-20 Interface overview, dv/dt filter compact plus Voltage Peak Limiter, type 2

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

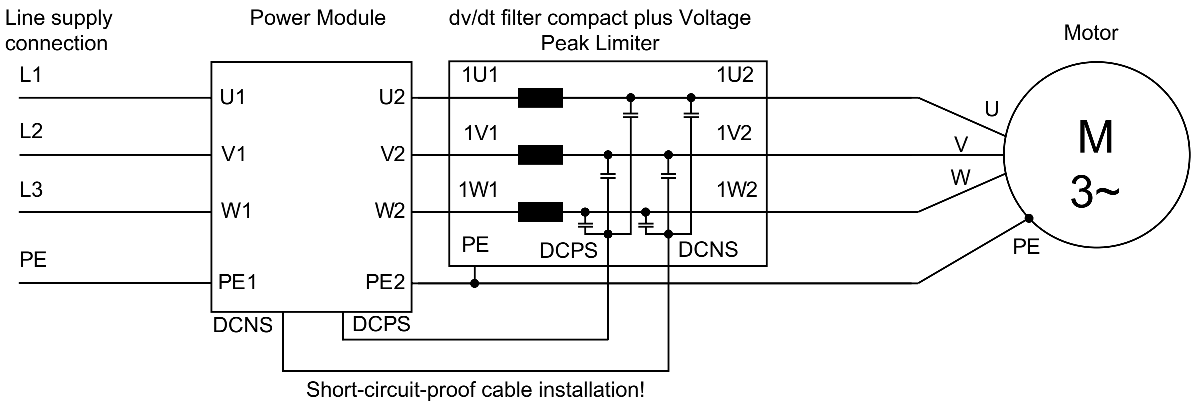


Figure 5-21 Connecting the dv/dt filter compact plus Voltage Peak Limiter

Cable cross-sections

Table 5- 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

CAUTION

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.

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

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

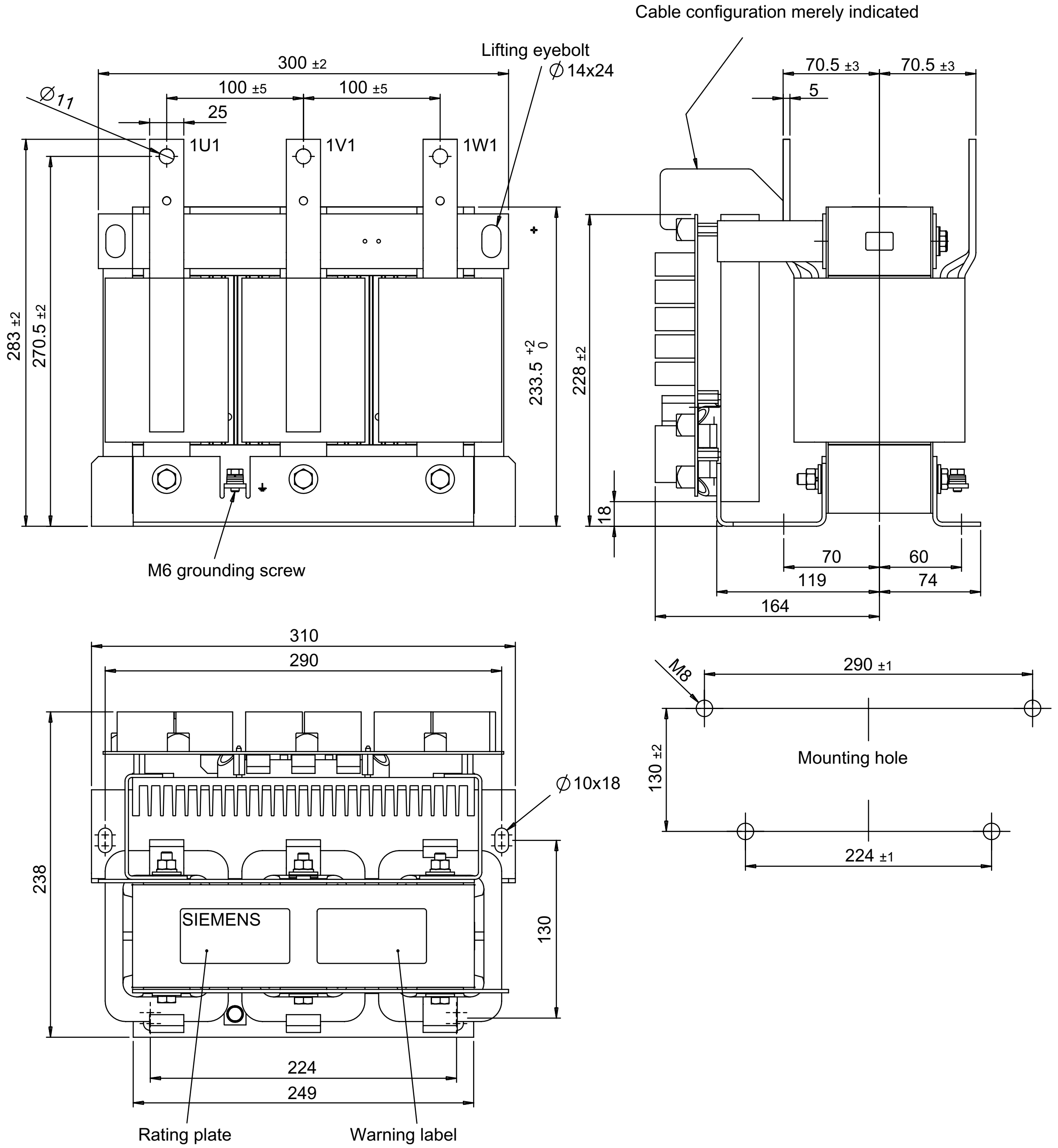


Figure 5-22 Dimension drawing of dv/dt filter compact plus Voltage Peak Limiter, type 1

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

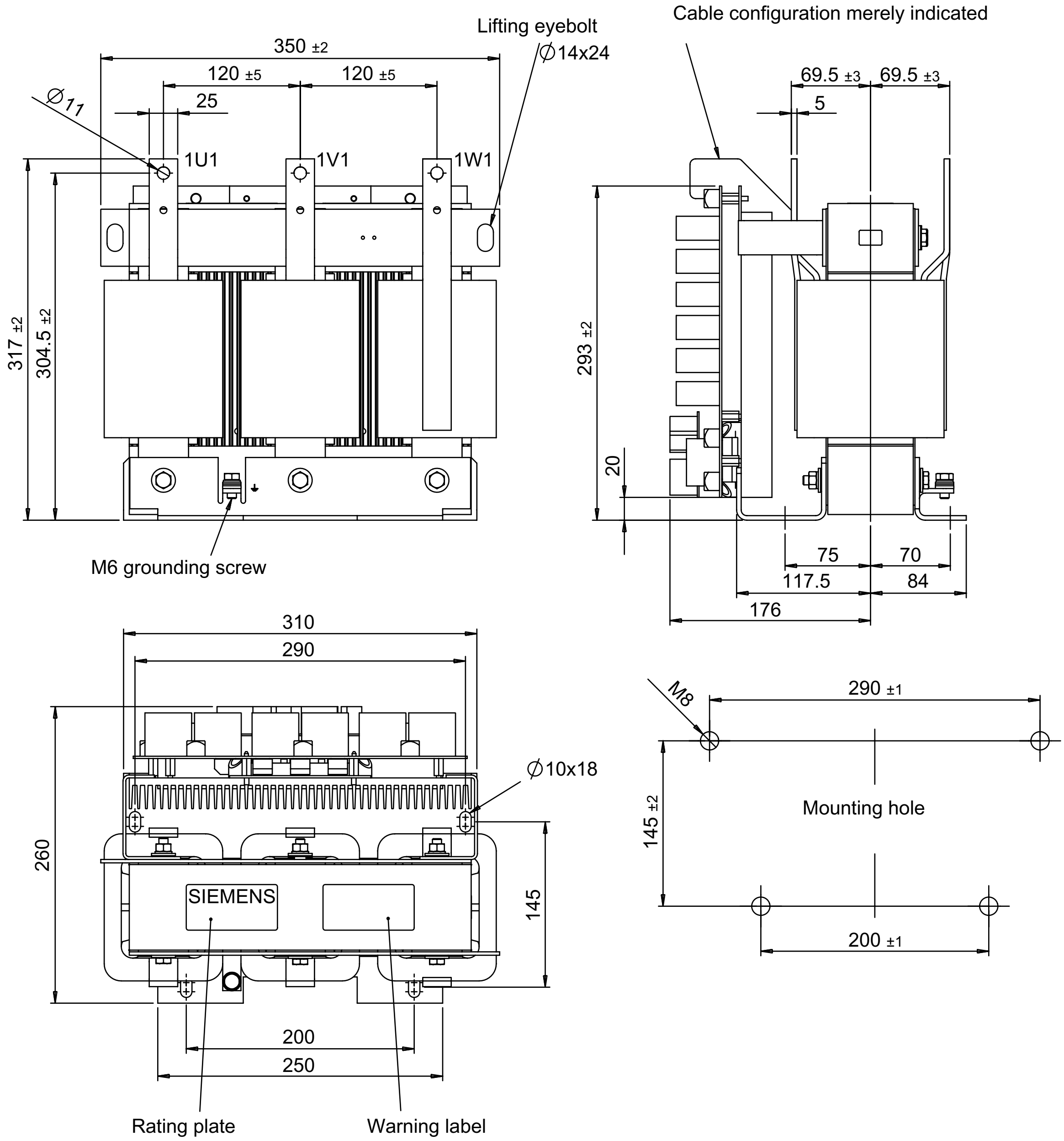


Figure 5-23 Dimension drawing of dv/dt filter compact plus Voltage Peak Limiter, type 2

Table 5- 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

5.4.1.6 Technical specifications

Table 5- 25 Technical specifications, dv/dt filter compact plus Voltage Peak Limiter

Order number	6SL3000-	2DE32-6EA0	2DE35-0EA0	
Suitable for Power Module (rated power)	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 6

6.1 Introduction

Description

SINAMICS S120 AC Drive Control Units are designed for use with blocksize format or chassis format Power Modules.

Advantages

1. The control module **Control Unit CU310 DP** provides the PROFIBUS external communications interface and a TTL/HTL/SSI encoder evaluation circuit.
2. The **Control Unit CU310 PN** provides two PROFINET interfaces and a TTL/HTL/SSI encoder evaluation circuit.
3. Power Modules can also be connected to the multi-axis **Control Unit Adapter CUA31** using the adapter module. The combination of a modular power unit and a Control Unit Adapter CUA31 is used to extend an existing DC/AC drive line-up with Control Unit by one axis.
4. Power Modules can also be connected to the multi-axis Control Unit via the **CUA32 Control Unit Adapter**. The combination of a modular power unit and a CUA32 Control Unit Adapter is used to extend an existing DC/AC drive line-up with Control Unit by one axis and also provides a TTL/HTL/SSI encoder evaluation circuit.

Note

The firmware and parameter settings are stored on the CompactFlash card, which is plugged into the Control Unit CU310.

	
Control Unit CU310 DP	Control Unit CU310 PN
	
Control Unit Adapter CUA31	Control Unit Adapter CUA32

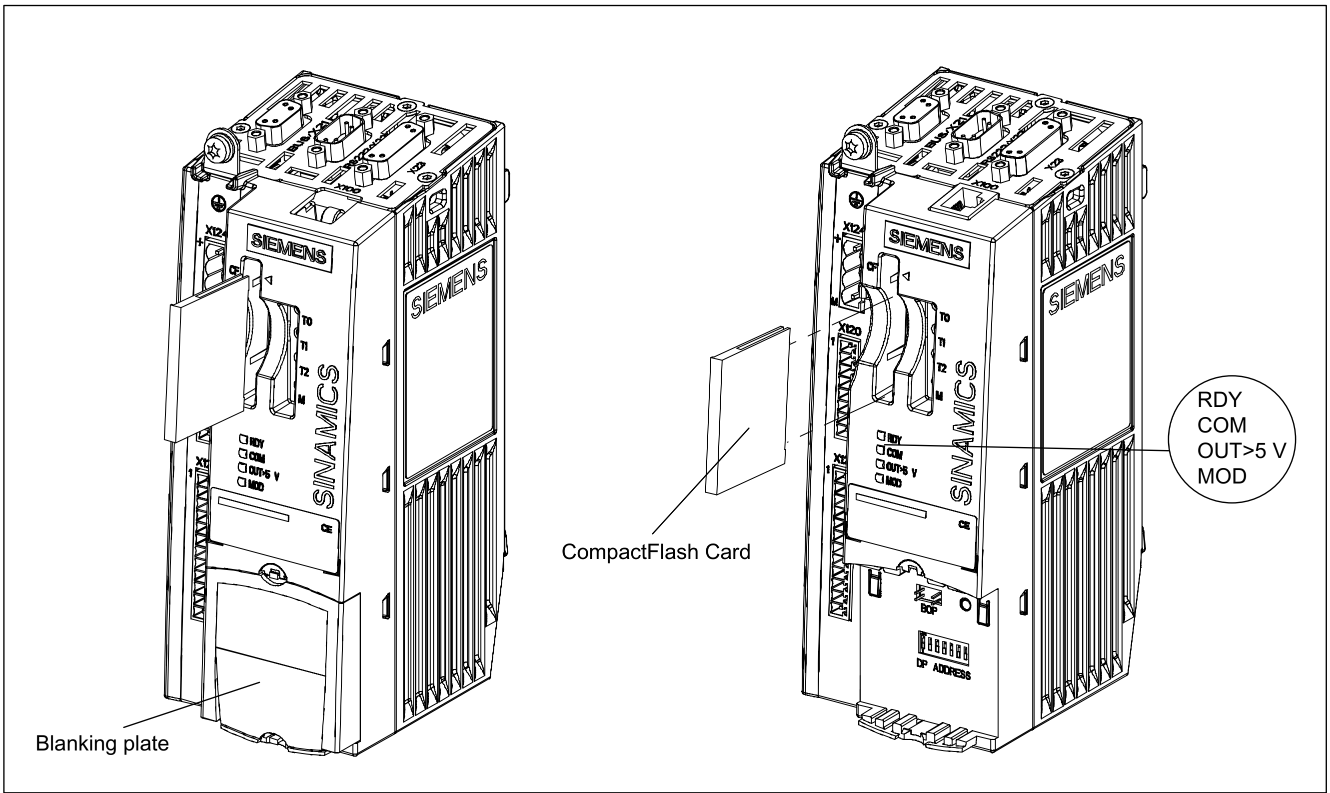


Figure 6-1 Slot for the CompactFlash card on a CU310 Control Unit

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Note

The Control Unit and the CompactFlash card must be ordered separately.

6.2 Control Unit CU310 DP (PROFIBUS)

6.2.1 Description

The Control Unit 310 DP (PROFIBUS) is the component in which the open-loop and closed-loop control functions of a drive are implemented.

The CU310 DP has the following interfaces (ports):

Table 6- 1 Overview of the CU310 interfaces

Type	Number
Digital inputs	4
Digital inputs/outputs	4
DRIVE-CLiQ interfaces	1
PROFIBUS interface	1
Serial interface (RS232)	1
Power Module Interface (PM-IF)	1
Encoder interface (HTL/TTL/SSI)	1
EP terminals/temperature sensor	1
24 V electronics power supply	1
Test sockets	3+1
Interface for BOP	1

Note

For test purposes, the fan also runs in the cold state at regular intervals.

6.2.2 Safety information

Note

The CompactFlash card may only be inserted and removed from the Control Unit when in the no-voltage condition.

⚠ WARNING

The cooling clearances of 50 mm above and below the components must be observed. It is not permissible that the connecting cables cover the cooling openings.

6.2.3 Interface description

6.2.3.1 Overview

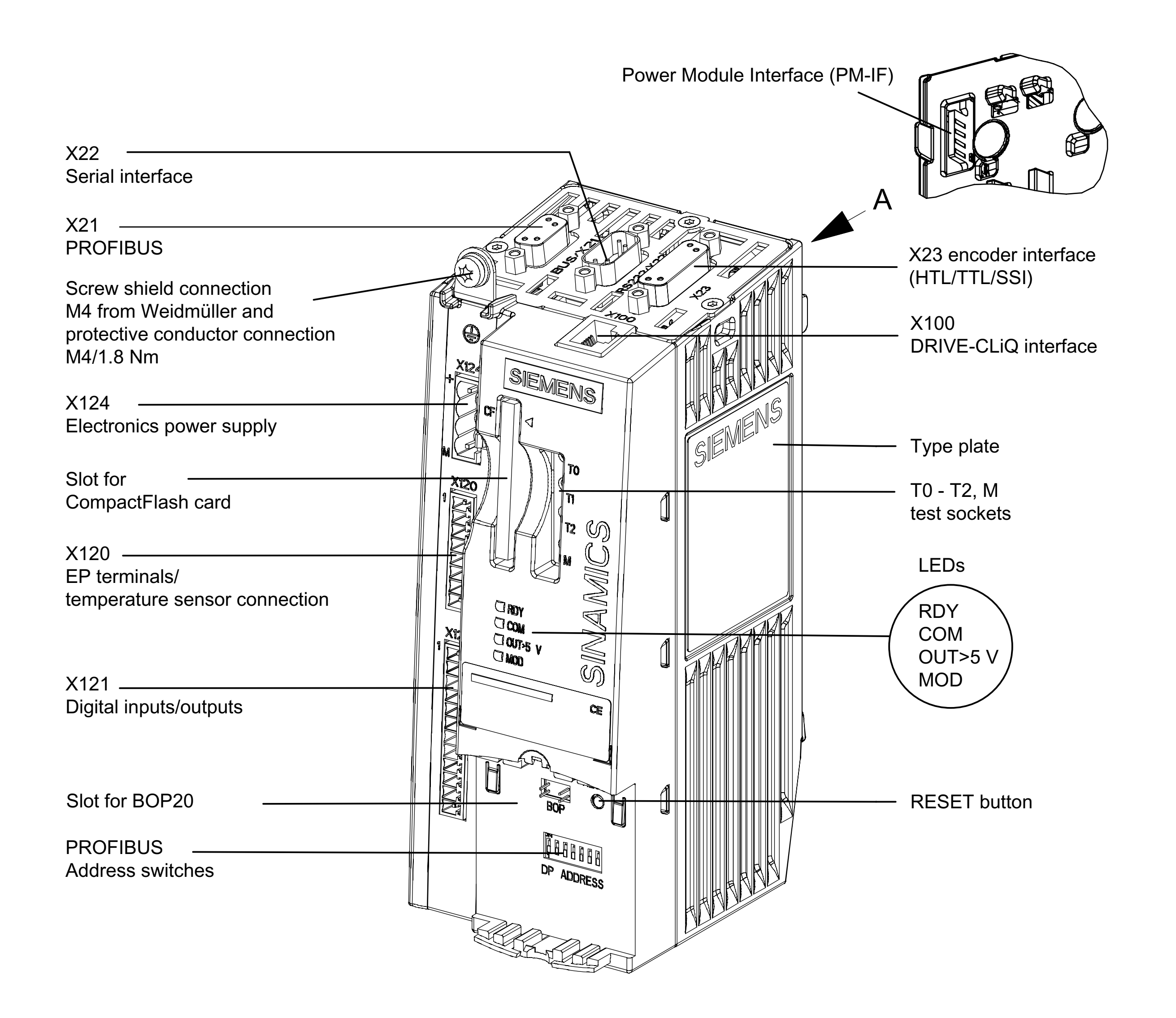


Figure 6-2 Description of the CU310 DP interfaces (ports)

6.2.3.2 Sample connection

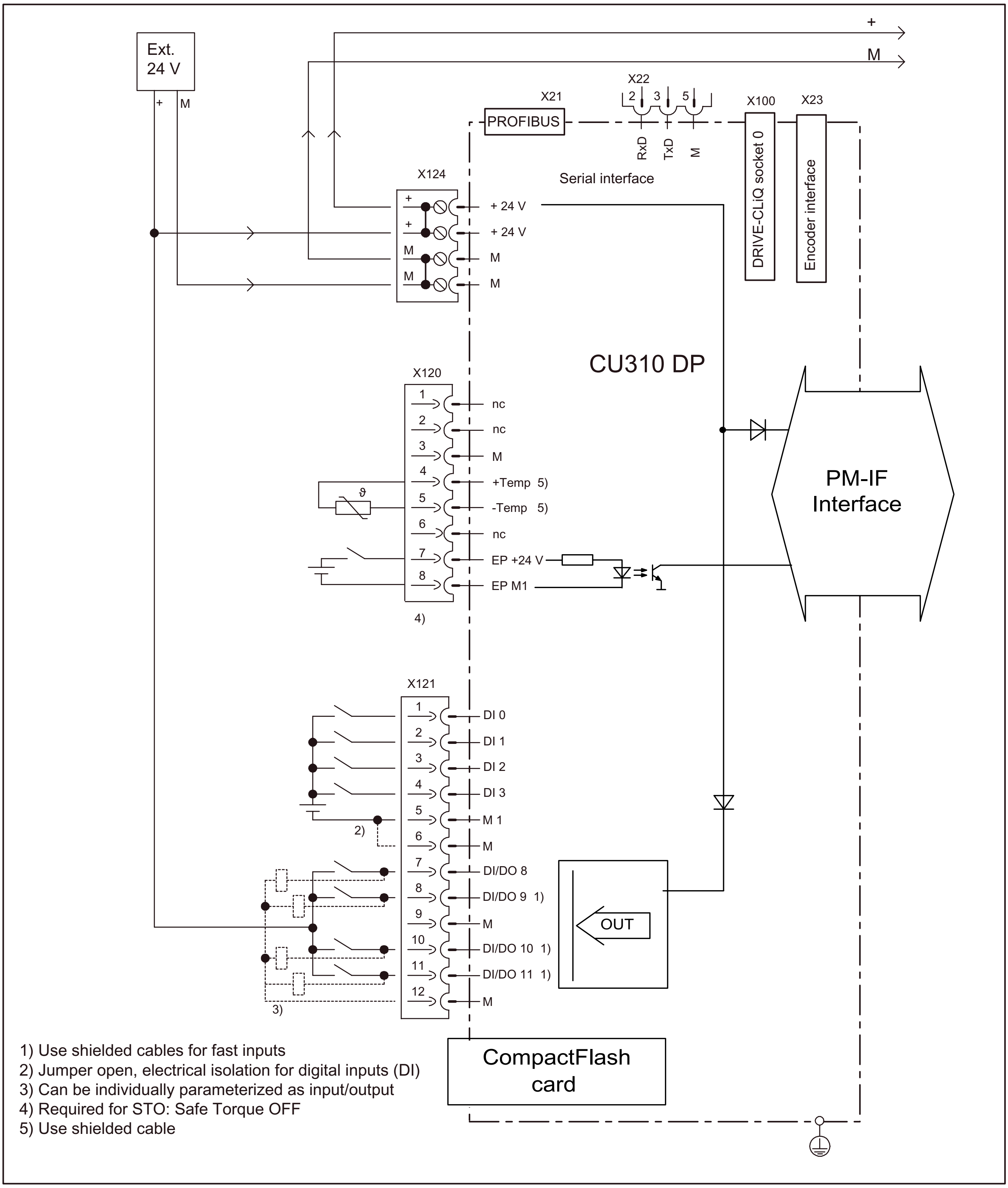
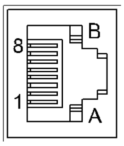


Figure 6-3 Connection example CU310 DP

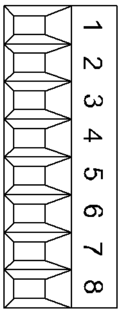
6.2.3.3 X100 DRIVE-CLiQ interface

Table 6- 2 DRIVE-CLiQ interface

	Pin	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Connector type: RJ45 socket; blanking plate for DRIVE-CLiQ interface included in the scope of delivery; blanking plate (50 pieces) order number: 6SL3066-4CA00-0AA0			

6.2.3.4 X120 EP terminals / temperature sensor

Table 6- 3 Terminal block X120

	Terminal	Function	Technical specifications
	1	Reserved, do not use	
	2	Reserved, do not use	
	3	M	Ground
	4	+Temp 1)	KTY or PTC input
	5	-Temp 1)	Ground for KTY or PTC
	6	Reserved, do not use	
	7	EP +24 V 2)	Safe standstill input (+)
	8	EP M1 2)	Safe standstill input (-)
Max. connectable cross-section 1.5 mm^2			

1) This is the only temperature channel for Order No. 6SL3040-0LA00-0AA0.
For Order No. 6SL3040-0LA00-0AA1, this is the second temperature channel (T2), which can be used as single channel dependent on the parameterization or in combination with the first temperature channel (T1, refer to X23).

2) The EP terminals must be wired on the Power Module on chassis units.

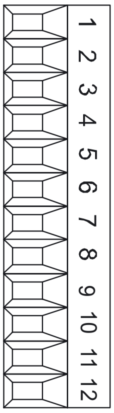
NOTICE
The KTY temperature sensor/the PTC must be connected with the correct polarity.

Further information on the temperature sensors can be found in the following literature:
Literature: /IH1/ SINAMICS S120, Commissioning Manual, Chapter "Temperature sensors for SINAMICS components."

⚠ 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!

6.2.3.5 X121 digital inputs/outputs

Table 6- 4 Terminal block X121

	Terminal	Designation[1)]	Technical specifications
	1	DI 0	Voltage: -3 V to +30 V DC Typical current consumption: 10 mA at 24 V Electrical isolation: The reference potential is terminal M1 Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V Input delay (typ.): L → H: 50 μs H → L: 150 μs
	2	DI 1	
	3	DI 2	
	4	DI 3	
	5	M1	
	6	M	
	7	DI/DO 8	**As input:** Voltage: -3 V to +30 V DC Typical current consumption: 10 mA at 24 V Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V DI/DO 9 to 11 are "rapid inputs" [2)] Input delay (typ.) inputs/"rapid inputs": L → H: 50 μs/5 μs H → L: 100 μs/50 μs **As output:** Voltage: 24 V DC Max. load current per output: 500 mA Continued-short-circuit-proof Output delay (typ./max.) [3)] L → H: 150 μs/400 μs H → L: 75 μs/100 μs 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: Screw-type terminal 1 (refer to the chapter titled "Connection methods" as regards control cabinet installation)			

1) DI: digital input; DI/DO: Bidirectional digital input/output; M: Electronics ground M1: ground reference

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}

NOTICE
An open input is interpreted as "low". To enable the digital inputs (DI) to function, terminal M1 must be connected. This is achieved by: 1. Providing the ground reference of the digital inputs, or 2. A jumper to terminal M. Caution: This removes the electrical isolation for these digital inputs.

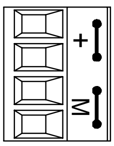
Note

A 24 V voltage supply must be connected to terminal X124 so that the digital outputs can be used.

If a momentary interruption in the voltage occurs in the 24 V supply, the digital outputs will be deactivated until the interruption has been rectified.

6.2.3.6 Electronics power supply X124

Table 6- 5 Terminal block X124

	Terminal	Designation	Technical specifications
	+	Electronic power supply	Voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: max. 0.8 A (without DRIVE-CLiQ or digital outputs) Max. current via jumper in connector: 20 A
	+	Electronic 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)			

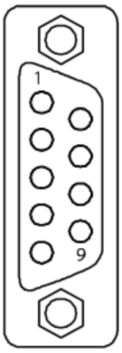
Note

The two "+" 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.

6.2.3.7 X21 PROFIBUS

Table 6- 6 PROFIBUS interface X21

	Pin	Signal name	Meaning	Range
	1	-	Not assigned	
	2	M24_SERV	Supply for teleservice, ground	0 V
	3	RxD/TxD–P	Receive/transmit data P (B)	RS485
	4	CNTR–P	Control signal	TTL
	5	DGND	PROFIBUS data reference potential	
	6	VP	Power supply plus	5 V + -10 %
	7	P24_SERV	Supply for teleservice, + (24 V)	24 V (20.4 V - 28.8 V)
	8	RxD/TxD–N	Receive/transmit data N (A)	RS485
	9	-	Not assigned	
Type: 9-pin SUB-D female				

Note

A teleservice adapter can be connected to the PROFIBUS interface (X21) for remote diagnosis purposes.
The power supply for the teleservice terminals 2 and 7 withstands a max. load and continued short-circuit current of 150 mA.

⚠ CAUTION

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

PROFIBUS connector

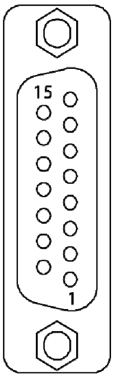
At the first and last node (device) in a line, the terminating resistors must be switched-in in order to ensure disturbance/noise-free communications.

The terminating resistors are activated in the connector.

The cable shield must be connected at both ends over large-surface area contacts.

6.2.3.8 X23 HTL/TTL/SSI encoder interface

Table 6- 7 Encoder connection X23

	Pin	Signal name	Technical specifications
	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 power supply
	5	P encoder 5 V/24 V	Encoder power supply
	6	P sense	Sense input of encoder power supply
	7	M encoder (M)	Ground for encoder power 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
Type: 15-pin sub D connector			

*to Pin 1 / Pin 8: These signals are only assigned from Order No. 6SL3040-0LA00-0AA1. The associated temperature channel (T1) can be parameterized as an individual channel or in combination with the second temperature channel (T2) at interface X120 (for parameterization information, refer to the Commissioning Manual).
Re. pin 2 / pin 3: These signals are only assigned from Order No. 6SL3040-0LA00-0AA1.

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

Table 6- 8 Specification of measuring systems that can be connected

Parameter	Designation	Threshold	Min.	Type	Max.	Unit
High signal level (TTL bipolar at X23)[1]	U_{Hdiff}		2		5	V
Low signal level (TTL bipolar at X23)[1]	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)[2]	U_{Hdiff}		3		V_{CC}	V
Low signal level (HTL bipolar)[2]	U_{Ldiff}		$-V_{CC}$		-3	V
High signal level (SSI bipolar at X23)[1][3]	U_{Hdiff}		2		5	V
Low signal level (SSI bipolar at X23)[1][3]	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		$\frac{1}{4} \cdot T_s$		$\frac{3}{4} \cdot T_s$	
	Center of the pulse position		50	135	220	Degrees

[1] Other signal levels according to the RS422 standard.

[2] The absolute level of the individual signals varies between 0 V and V_{CC} of the measuring system.

[3] Only from Order No. 6SL3040-0LA00-0AA1 and Firmware 2.5 SP1.

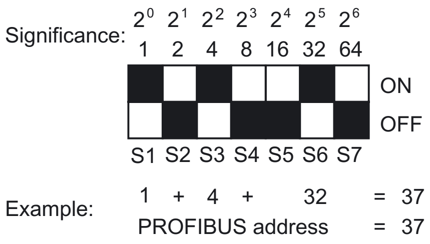
Note

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).

6.2.3.9 PROFIBUS address switches

Table 6- 9 PROFIBUS address switches

Technical specifications	Switch	Significance
	S1	$2^0 = 1$
	S2	$2^1 = 2$
	S3	$2^2 = 4$
	S4	$2^3 = 8$
	S5	$2^4 = 16$
	S6	$2^5 = 32$
	S7	$2^6 = 64$

Note

The factory setting of the DIP switch is 0 or 127. Parameter p0918 can be used to set the bus address for PROFIBUS to values between 1 and 126. The address can also be set manually to values between 1 and 126 using the DIP switch. Then, it is only possible to read the address with p0918.

The address switch is behind the blanking plate. The blanking plate is part of the scope of supply.

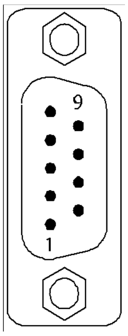
Setting the PROFIBUS address

The following reference contains further information about setting the PROFIBUS address:

Reference: /IH1/ SINAMICS S120 Commissioning Manual.

6.2.3.10 X22 serial interface (RS232)

Table 6- 10 Serial interface (RS-232-C) X140

	Pin	Designation	Technical data
	2	RxD	Receive data
	3	TxD	Transmit data
	5	Ground	Ground reference
Type: 9-pin SUB D connector			

6.2.3.11 Measuring sockets

Table 6- 11 Measuring sockets T0, T1, and T2

Socket	Function	Technical specifications
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

The test sockets are provided as a support to commissioning and diagnostics; they must not be connected for normal operation.

6.2.3.12 Slot for the CompactFlash card

Figure 6-4 Slot for CompactFlash card

CAUTION
The CompactFlash card may only be inserted as shown in the figure (arrow top right). The CompactFlash card may only be inserted or removed when the Control Unit is in a no-voltage condition. When returning a defective Control Unit, remove the CompactFlash card and keep it for insertion in the replacement unit.

6.2.3.13 Description of the LEDs on the Control Unit

Description of the LED statuses

The different statuses that arise during the booting procedure are indicated by means of the LEDs on the Control Unit.

- The duration of the individual statuses varies.
- If an error occurs, booting is aborted and the cause of the error is indicated via the LEDs.
  Remedy: Insert the appropriate CompactFlash card with the correct software and parameters.
- Once the unit has been successfully booted, all the LEDs are switched off briefly.
- Once the unit has been booted, the LEDs are driven via the loaded software.

Behavior of the LEDs during booting

Table 6- 12 Load software 1

LED				Status	Comment
RDY	COM	OUT>5V	MOD		
red	red	red	off	Reset	–
red 2 Hz	red	red	off	Error	• CompactFlash card not inserted or • Load software 2 has not been installed on the CompactFlash card or is defective.

Table 6- 13 Load software 2

LED				Status	Comment
RDY	COM	OUT>5V	MOD		
off	red	red	off	Loaded	–
off	orange	red	off	Running	–
off	red 2 Hz	red	off	Error file	Software on the CompactFlash card is incomplete or defective.
off	red 0.5 Hz	red	off	Error crc	CRC invalid.
off	off	red	off	Firmware loaded	–

Table 6- 14 Firmware

LED				Status	Comment
RDY	COM	OUT>5V	MOD		
off	off	off	off	Initializing	–
alternating				Running	refer to the following table

Table 6- 15 Description of the LEDs after booting of the CU310

LED	Color	Status	Description, cause	Remedy
RDY (READY)	-	OFF	Electronic power supply is missing or outside permissible tolerance range.	-
	Green	Continuous	The component is ready and cyclic DRIVE-CLiQ communication takes place or the Control Unit waits for first commissioning.	-
		Flashing 2 Hz	Writing to the memory card.	-
	Red	Continuous	At least one fault is present in this component.	Remedy and acknowledge fault
		Flashing 2 Hz	Boot error	Make sure that the CompactFlash card has been inserted properly. Replace the CompactFlash card. Replace Control Unit. Carry out a POWER ON.
	Green/ red	Flashing 0.5 Hz	• Control Unit 310 is ready for operation. However there are no software licenses. • CompactFlash card not available.	Obtain licenses Insert CompactFlash card
	Orange	Continuous	DRIVE-CLiQ communication is being established.	-
		Flashing 0.5 Hz	Updating the firmware of the DRIVE-CLiQ components.	-
		Flashing 2 Hz	The component firmware has been fully updated, wait for POWER ON of the particular component	Carry out a POWER ON for the component in question
	Green/ orange or red/ orange	Flashing 1 Hz	Detection of the component via LED is activated (p0124[0]). **Note:** Both options depend on the LED status when module recognition is activated via p0124[0] = 1.	-
COM PROFIdrive cyclic operation	-	OFF	Cyclic communication is not (yet) running. **Note:** The PROFIdrive is ready for communication when the Control Unit is ready for operation (see RDY LED).	-
	Green	Continuous	Cyclic communication is taking place.	-
		Flashing 0.5 Hz	Cyclic communication is not yet running fully. Possible reasons: • The controller is not transferring any setpoints. • During isochronous operation, no global control (GC) or a faulty global control (GC) is transferred by the controller.	-
	Red	Continuous	Cyclic communication has been interrupted.	Rectify fault

LED	Color	Status	Description, cause	Remedy
	Orange	Flashing 2 Hz	Firmware checksum error (CRC error)	Make sure that the CompactFlash card has been inserted properly. Replace the CompactFlash card. Replace the Control Unit. Carry out a POWER ON.
OUT>5 V	-	OFF	Electronic power supply is missing or outside permissible tolerance range. Voltage supply 5 V	-
	Orange	Continuous	Electronic power supply for measuring system available. Power supply >5 V. **Important:** Make sure that the connected encoder can be operated with a 24 V power supply. If an encoder that is designed for a 5 V supply is operated with a 24 V supply, this can destroy the encoder electronics.	-
MOD	-	OFF	Reserved	-

6.2.4 Dimension drawing

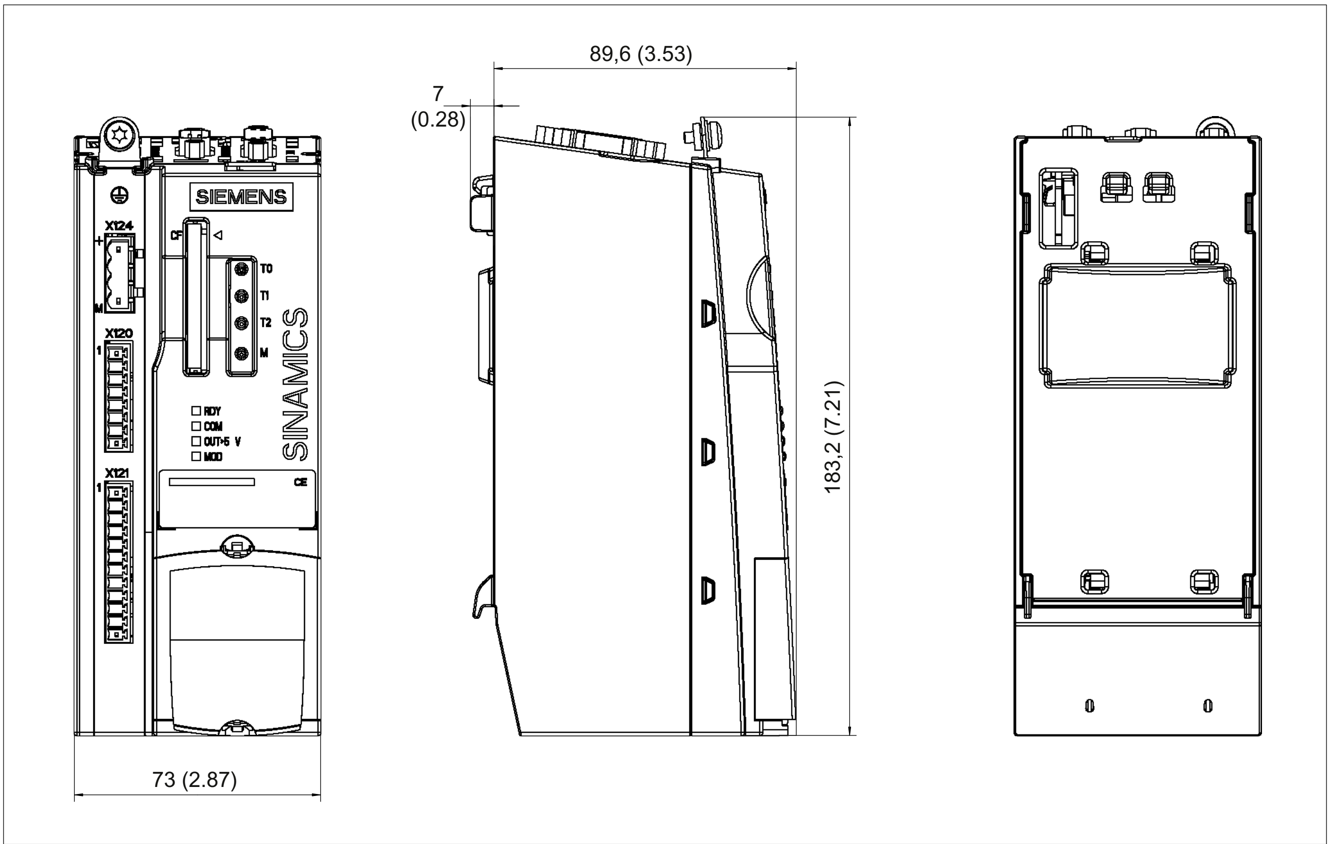


Figure 6-5 Dimension drawing of CU310 DP, all data in mm and (inches)

6.2.5 Mounting the CU310 on the Power Module Blocksize

As soon as the Power Module has been been correctly installed, the Control Unit can be attached to the Power Module.

	
Snap the CU310 onto the Power Module PM340 (frame size FSD)	Power Module PM340 (frame size FSD) with CU310

The procedure when mounting the Control Unit on the Power Module is independent of the frame size of the Power Modules.

Removing the Control Unit

Removing the CU310 from the Power Module PM340 (frame size FSD)

In order to remove the Control Unit from the Power Module, the blue release lever, as shown in the diagram, must be pressed downwards and the Control Unit swung-out to the front.

6.2.6 Mounting the CU310 in the Power Module Chassis

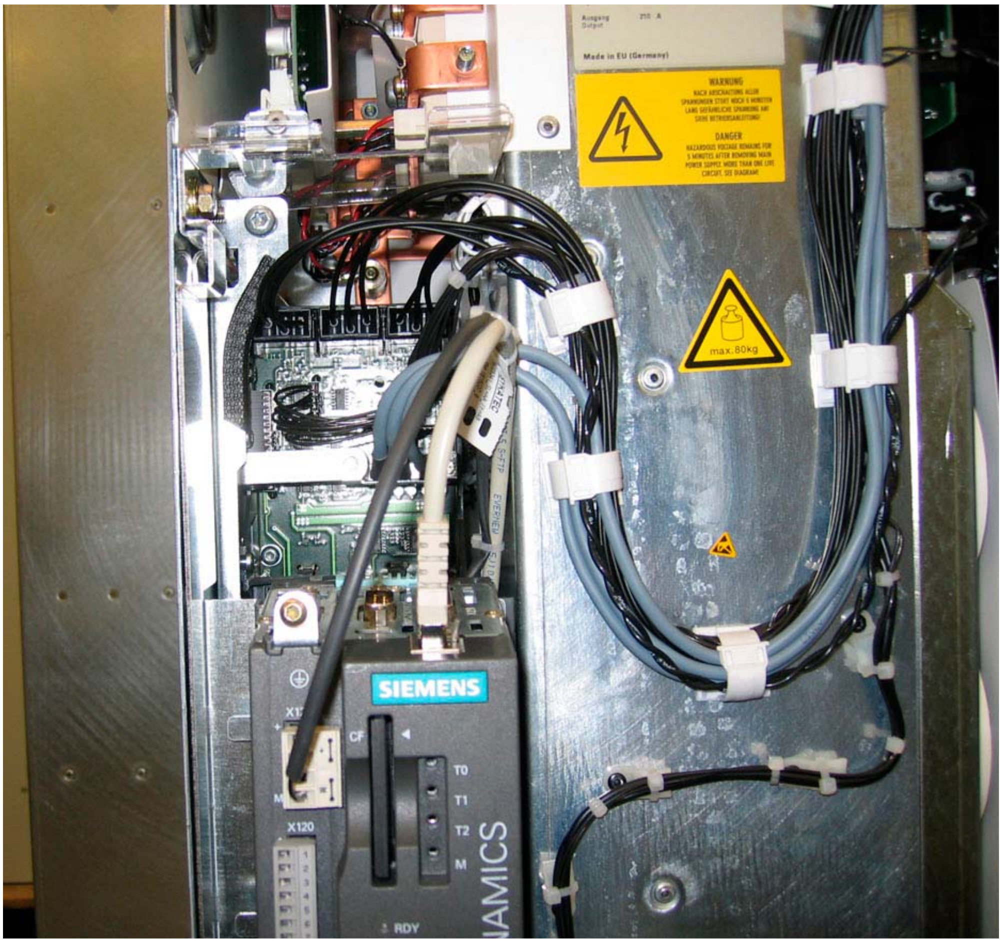


Figure 6-6 Mounting the CU310 in the Power Module chassis format, frame size FX

The DRIVE-CLiQ cable and the cable for the 24 V supply must be correctly routed so that the front flap can close.

Note

For the Power Module, a connecting cable is also supplied for the power supply of the CU310. Customers must connect-up this cable.

This means that the CU310 no longer has to be supplied from an external 24 V DC.

6.2.7 Technical data

Table 6- 16 Technical specifications CU310 DP

	Unit	Value
Electronics power supply Voltage Current (without DRIVE-CLiQ and digital outputs) Power loss Maximum DRIVE-CLiQ cable length	 V_{DC} A_{DC} W m	 24 DC (20.4 – 28.8) 0.8 <20 100
PE/ground connection	On housing with M4/3 Nm screw	
Response time	The response time of digital inputs/outputs depends on the evaluation (refer to the function diagram). **Reference:** /LH1/ SINAMICS S List Manual, Chapter "Function diagrams".	
Weight	kg	0.95

6.3 Control Unit CU310 PN (PROFINET)

6.3.1 Description

The Control Unit 310 PN (PROFINET) is the control module in which the open-loop and closed-loop control functions of a drive are implemented.

The CU310 PN has the following interfaces (ports):

Table 6- 17 Overview of the CU310 PN interfaces (ports)

Type	Number
Digital inputs	4
Digital inputs/outputs	4
DRIVE-CLiQ interface	1
PROFINET interfaces	2
Serial interface (RS232)	1
Power Module Interface (PM-IF)	1
Encoder interface (HTL/TTL/SSI)	1
EP terminals/temperature sensor	1
24 V electronics power supply	1
Test sockets	3+1
Interface for BOP	1

6.3.2 Safety information

Note

The CompactFlash card may only be inserted and removed from the Control Unit when in the no-voltage condition.

WARNING

The cooling clearances of 50 mm above and below the components must be observed. It is not permissible that the connecting cables cover the cooling openings.

6.3.3 Interface description

6.3.3.1 Overview

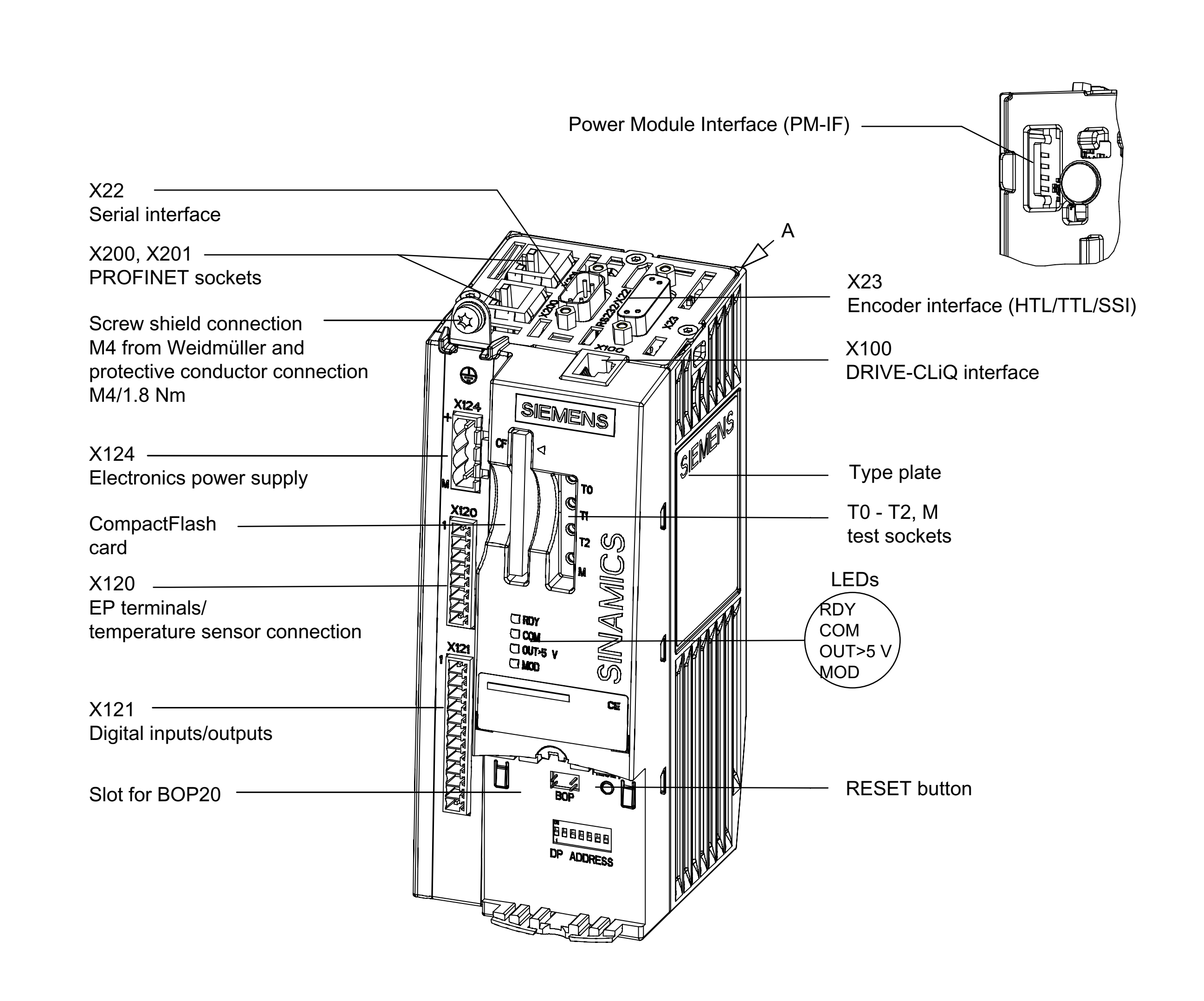
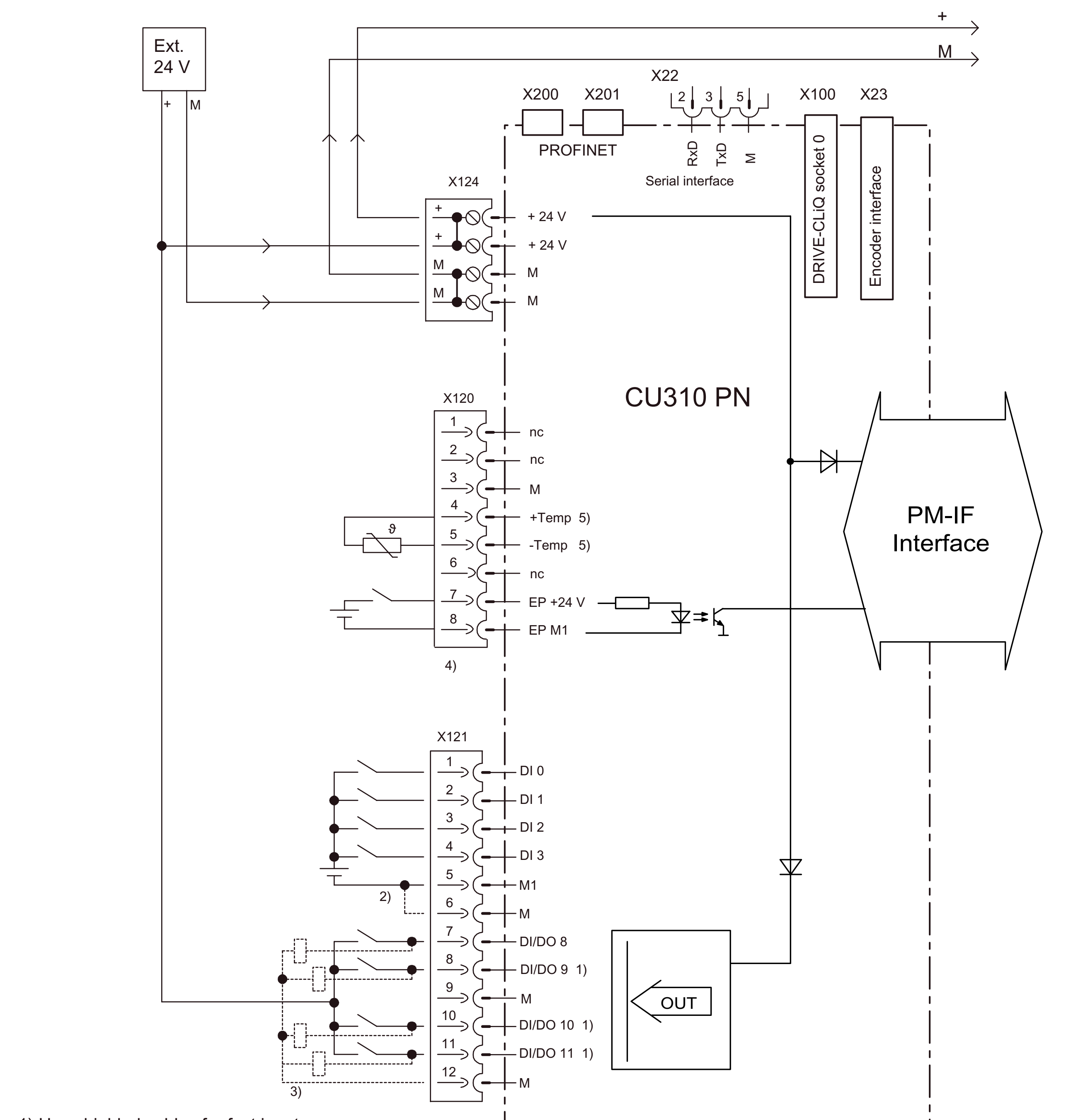


Figure 6-7 Description of the CU310 PN interfaces

Note

The PROFIBUS address switch is present for the CU310 PN, however it has not function.

6.3.3.2 Sample connection

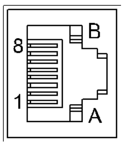


1) Use shielded cables for fast inputs
2) Jumper open, electrical isolation for digital inputs (DI)
3) Can be individually parameterized as input/output
4) Required for STO: Safe Torque OFF
5) Use shielded cable

Figure 6-8 Connection example CU310 PN

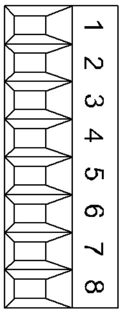
6.3.3.3 X100 DRIVE-CLiQ interface

Table 6- 18 DRIVE-CLiQ interface

	Pin	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	GND (0 V)	Electronic ground
Blanking cover on DRIVE-CLiQ interface: Yamaichi, Order No.: Y-ConAS-13 The maximum DRIVE-CLiQ cable length is 100 m.			

6.3.3.4 X120 EP terminals / temperature sensor

Table 6- 19 Terminal block X120

	Terminal	Function	Technical specifications
	1	Reserved, do not use	
	2	Reserved, do not use	
	3	M	Ground
	4	+Temp [1)]	KTY or PTC input
	5	-Temp [1)]	Ground for KTY or PTC
	6	Reserved, do not use	
	7	EP +24 V [2)]	Safe standstill input (+)
	8	EP M1 [2)]	Safe standstill input (-)
Max. connectable cross-section 1.5 mm^2			

[1)]This is the only temperature channel for Order No. 6SL3040-0LA01-0AA0.
For Order No. 6SL3040-0LA01-0AA1, this is the second temperature channel (T2), which can be used as single channel dependent on the parameterization or in combination with the first temperature channel (T1, refer to X23).

[2)] The EP terminals must be wired on the Power Module on chassis units.

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

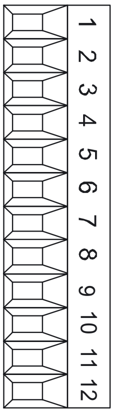
Further information on the temperature sensors can be found in the following literature:

Reference: /IH1/ SINAMICS S120, Commissioning Manual, Chapter "Temperature sensors for SINAMICS components."

⚠ 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!

6.3.3.5 X121 digital inputs/outputs

Table 6- 20 Terminal block X121

	Terminal	Designation[1)]	Technical specifications
	1	DI 0	Voltage: -3 V to +30 V DC Typical current consumption: 10 mA at 24 V Electrical isolation: The reference potential is terminal M1 Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V Input delay (typ.): L → H: 50 μs H → L: 150 μs
	2	DI 1	
	3	DI 2	
	4	DI 3	
	5	M1	
	6	M	
	7	DI/DO 8	**As input**: Voltage: -3 V to +30 V DC Typical current consumption: 10 mA at 24 V Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V DI/DO 9 to 11 are "rapid inputs" [2)] Input delay (typ.) inputs/"rapid inputs": L → H: 50 μs/5 μs H → L: 100 μs/50 μs **As output**: Voltage: 24 V DC Max. load current per output: 500 mA Continued-short-circuit-proof Output delay (typ./max.) [3)] L → H: 150 μs/400 μs H → L: 75 μs/100 μs 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: Screw-type terminal 1 (refer to the chapter titled "Connection methods" as regards control cabinet installation)			

1) DI: digital input; DI/DO: Bidirectional digital input/output; M: electronic ground; M1: ground reference

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}

NOTICE
An open input is interpreted as "low". To enable the digital inputs (DI) to function, terminal M1 must be connected. This is achieved by: 1. Providing the ground reference of the digital inputs, or 2. A jumper to terminal M. Caution: This removes the electrical isolation for these digital inputs.

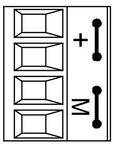
Note

A 24 V voltage supply must be connected to terminal X124 so that the digital outputs can be used.

If a momentary interruption in the voltage occurs in the 24 V supply, the digital outputs will be deactivated until the interruption has been rectified.

6.3.3.6 Electronics power supply X124

Table 6- 21 Terminal block X124

	Terminal	Function	Technical specifications
	+	Electronic power supply	Voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: max. 0.8 A (without DRIVE-CLiQ or digital outputs) Max. current via jumper in connector: 20 A
	+	Electronic power supply	
	M	Electronic ground	
	M	Electronic ground	
Max. connectable cross-section: 2.5 mm^2 Type: Screw-type terminal 2 (refer to the chapter titled "Connection methods" as regards control cabinet installation)			

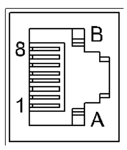
Note

The two "+" 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.

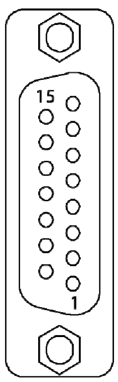
6.3.3.7 X200 - X201 PROFINET

Table 6- 22 PROFINET interfaces X200 - X201

	Pin	Signal name	Meaning
	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	
Connector type: RJ45plus socket Cable type: PROFINET			

6.3.3.8 X23 HTL/TTL/SSI encoder interface

Table 6- 23 Encoder connection X23

	Pin	Signal name	Technical specifications
	1	+Temp*	KTY or PTC input
	2	SSI_CLK*	SSI clock, positive
	3	SSI_XCLK*	SSI clock, negative
	4	P encoder	Encoder power supply
	5	P encoder	Encoder power supply
	6	P sense	Remote sense encoder power supply (P)
	7	M	Electronic ground
	8	-Temp*	Ground for KTY or PTC
	9	M sense	Remote sense encoder power supply (N)
	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
Type: 15-pin sub D connector			

*to Pin 1 / Pin 8: These signals are only assigned from Order No. 6SL3040-0LA01-0AA1. The associated temperature channel (T1) can be parameterized as an individual channel or in combination with the second temperature channel (T2) at interface X120 (for parameterization information, refer to the Commissioning Manual).
Re. pin 2 / pin 3: These signals are only assigned from Order No. 6SL3040-0LA01-0AA1.

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

Table 6- 24 Specification of measuring systems that can be connected

Parameter	Designation	Threshold	Min.	Type	Max.	Unit
High signal level (TTL bipolar at X23)[1]	U_{Hdiff}		2		5	V
Low signal level (TTL bipolar at X23)[1]	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) [2]	U_{Hdiff}		3		V_{CC}	V
Low signal level (HTL bipolar) [2]	U_{Ldiff}		$-V_{CC}$		-3	V
High signal level (SSI bipolar at X23)[1][3]	U_{Hdiff}		2		5	V
Low signal level (SSI bipolar at X23)[1][3]	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		$\frac{1}{4} \cdot T_s$		$\frac{3}{4} \cdot T_s$	
	Center of the pulse position		50	135	220	Degrees

[1] Other signal levels according to the RS422 standard.

[2] The absolute level of the individual signals varies between 0 V and V_{CC} of the measuring system.

[3] Only from Order No. 6SL3040-0LA01-0AA1 and Firmware 2.5 SP1.

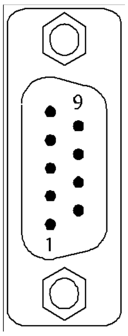
Note

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).

6.3.3.9 X22 serial interface (RS232)

Table 6- 25 Serial interface (RS-232-C) X140

	Pin	Designation	Technical data
 	2	RxD	Receive data
	3	TxD	Transmit data
	5	Ground	Ground reference
Type: 9-pin SUB D connector			

6.3.3.10 Measurement sockets T0, T1, and T2

Table 6- 26 Measurement sockets T0, T1, and T2

Socket	Function	Technical specifications
T0	Measurement 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	Measurement socket 1	
T2	Measurement socket 2	
M	Ground	
The measurement sockets are only suitable for bunch pin plugs with a diameter of 2 mm.		

Note

The test sockets are provided as a support to commissioning and diagnostics; they must not be connected for normal operation.

6.3.3.11 Description of the LEDs on the Control Unit

Description of the LED statuses

The different statuses that arise during the booting procedure are indicated by means of the LEDs on the Control Unit.

- The duration of the individual statuses varies.
- If an error occurs, booting is aborted and the cause of the error is indicated via the LEDs. Remedy: Insert the appropriate CompactFlash card with the correct software and parameters.
- Once the unit has been successfully booted, all the LEDs are switched off briefly.
- Once the unit has been booted, the LEDs are driven via the loaded software.

Behavior of the LEDs during booting

Table 6- 27 Load software 1

LED				Status	Comment
RDY	COM	OUT>5V	MOD		
red	red	red	off	Reset	–
red 2 Hz	red	red	off	Error	• CompactFlash card not inserted or • Load software 2 has not been installed on the CompactFlash card or is defective.

Table 6- 28 Load software 2

LED				Status	Comment
RDY	COM	OUT>5V	MOD		
off	red	red	off	Loaded	–
off	orange	red	off	Running	–
off	red 2 Hz	red	off	Error file	Software on the CompactFlash card is incomplete or defective.
off	red 0.5 Hz	red	off	Error crc	CRC invalid.
off	off	red	off	Firmware loaded	–

Table 6- 29 Firmware

LED				Status	Comment
RDY	COM	OUT>5V	MOD		
off	off	off	off	Initializing	–
alternating				Running	refer to the following table

Table 6- 30 Description of the LEDs after booting of the CU310

LED	Color	Status	Description, cause	Remedy
RDY (READY)	-	OFF	Electronic power supply is missing or outside permissible tolerance range.	-
	Green	Continuous	The component is ready and cyclic DRIVE-CLiQ communication takes place or the Control Unit waits for first commissioning.	-
		Flashing 2 Hz	Writing to the memory card.	-
	Red	Continuous	At least one fault is present in this component.	Remedy and acknowledge fault
		Flashing 2 Hz	Boot error	Make sure that the CompactFlash card has been inserted properly. Replace the CompactFlash card. Replace Control Unit. Carry out a POWER ON.
	Green/ red	Flashing 0.5 Hz	• Control Unit 310 is ready for operation. However there are no software licenses. • CompactFlash card not available.	Obtain licenses Insert CompactFlash card
	Orange	Continuous	DRIVE-CLiQ communication is being established.	-
		Flashing 0.5 Hz	Updating the firmware of the DRIVE-CLiQ components.	-
		Flashing 2 Hz	The component firmware has been fully updated, wait for POWER ON of the particular component	Carry out a POWER ON for the component in question
	Green/ orange or red/ orange	Flashing 1 Hz	Detection of the component via LED is activated (p0124[0]). **Note:** Both options depend on the LED status when module recognition is activated via p0124[0] = 1.	-
COM PROFIdrive cyclic operation	-	OFF	Cyclic communication is not (yet) running. **Note:** The PROFIdrive is ready for communication when the Control Unit is ready for operation (see RDY LED).	-
	Green	Continuous	Cyclic communication is taking place.	-
		Flashing 0.5 Hz	Cyclic communication is not yet running fully. Possible reasons: • The controller is not transferring any setpoints. • During isochronous operation, no global control (GC) or a faulty global control (GC) is transferred by the controller.	-
	Red	Continuous	Cyclic communication has been interrupted.	Rectify fault

LED	Color	Status	Description, cause	Remedy
	Orange	Flashing 2 Hz	Firmware checksum error (CRC error)	Make sure that the CompactFlash card has been inserted properly. Replace the CompactFlash card. Replace the Control Unit. Carry out a POWER ON.
OUT>5 V	-	OFF	Electronic power supply is missing or outside permissible tolerance range. Voltage supply 5 V	-
	Orange	Continuous	Electronic power supply for measuring system available. Power supply >5 V. **Important:** Make sure that the connected encoder can be operated with a 24 V power supply. If an encoder that is designed for a 5 V supply is operated with a 24 V supply, this can destroy the encoder electronics.	-
MOD	-	OFF	Reserved	-

6.3.4 Dimension drawing

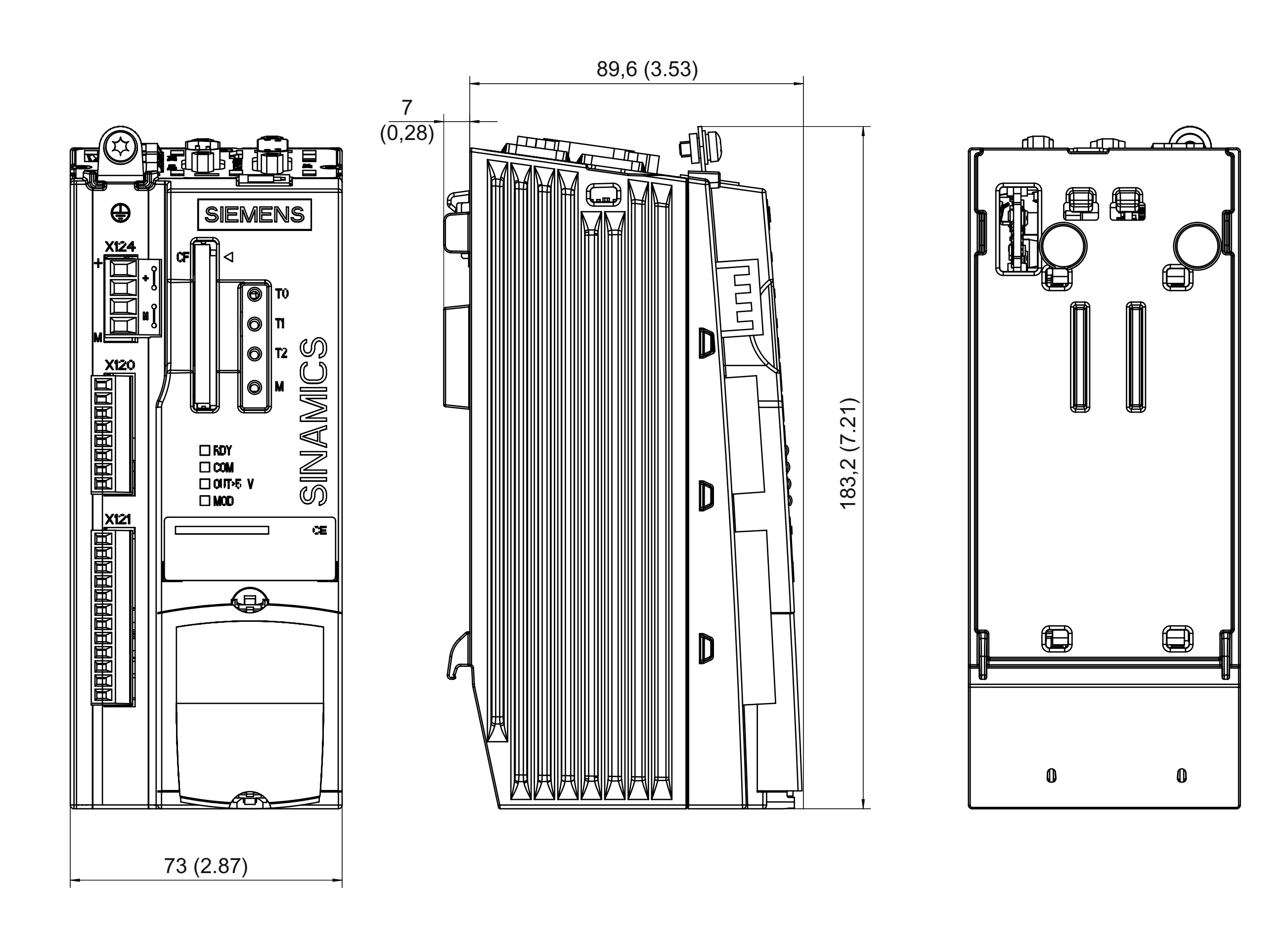


Figure 6-9 Dimension drawing of CU310 PN, all data in mm and (inches)

6.3.5 Mounting the CU310 on the Power Module Blocksize

As soon as the Power Module has been been correctly installed, the Control Unit can be attached to the Power Module.

	
Snap the CU310 onto the Power Module PM340 (frame size FSD)	Power Module PM340 (frame size FSD) with CU310

The procedure when mounting the Control Unit on the Power Module is independent of the frame size of the Power Modules.

Removing the Control Unit

Removing the CU310 from the Power Module PM340 (frame size FSD)

In order to remove the Control Unit from the Power Module, the blue release lever, as shown in the diagram, must be pressed downwards and the Control Unit swung-out to the front.

6.3.6 Technical data

Table 6- 31 Technical specifications CU310 PN

	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 (refer to the function diagram). **Reference:** /LH1/ SINAMICS S List Manual, Chapter "Function diagrams".	
Weight	kg	0.99

6.4 Control Unit Adapter CUA31

6.4.1 Description

The Control Unit Adapter CUA31 combined with a modular power unit is used to extend an existing DC/AC drive line-up e.g. with CU320 by one drive.

The closed-loop control is externally implemented. This is the reason that a SINAMICS, SIMOTION or SINUMERIK closed-loop control is always required for operation.

The Control Unit Adapter CUA31 has the following interfaces (ports):

Table 6- 32 Interface overview of the CUA31

Type	Number
DRIVE-CLiQ interfaces	3
EP terminal/temperature sensor	1
Power Module Interface (PM-IF)	1
24 V electronics power supply	1

6.4.2 Safety information

WARNING

The cooling clearances of 50 mm above and below the components must be observed. It is not permissible that the connecting cables cover the cooling openings.

6.4.3 Interface description

6.4.3.1 Overview

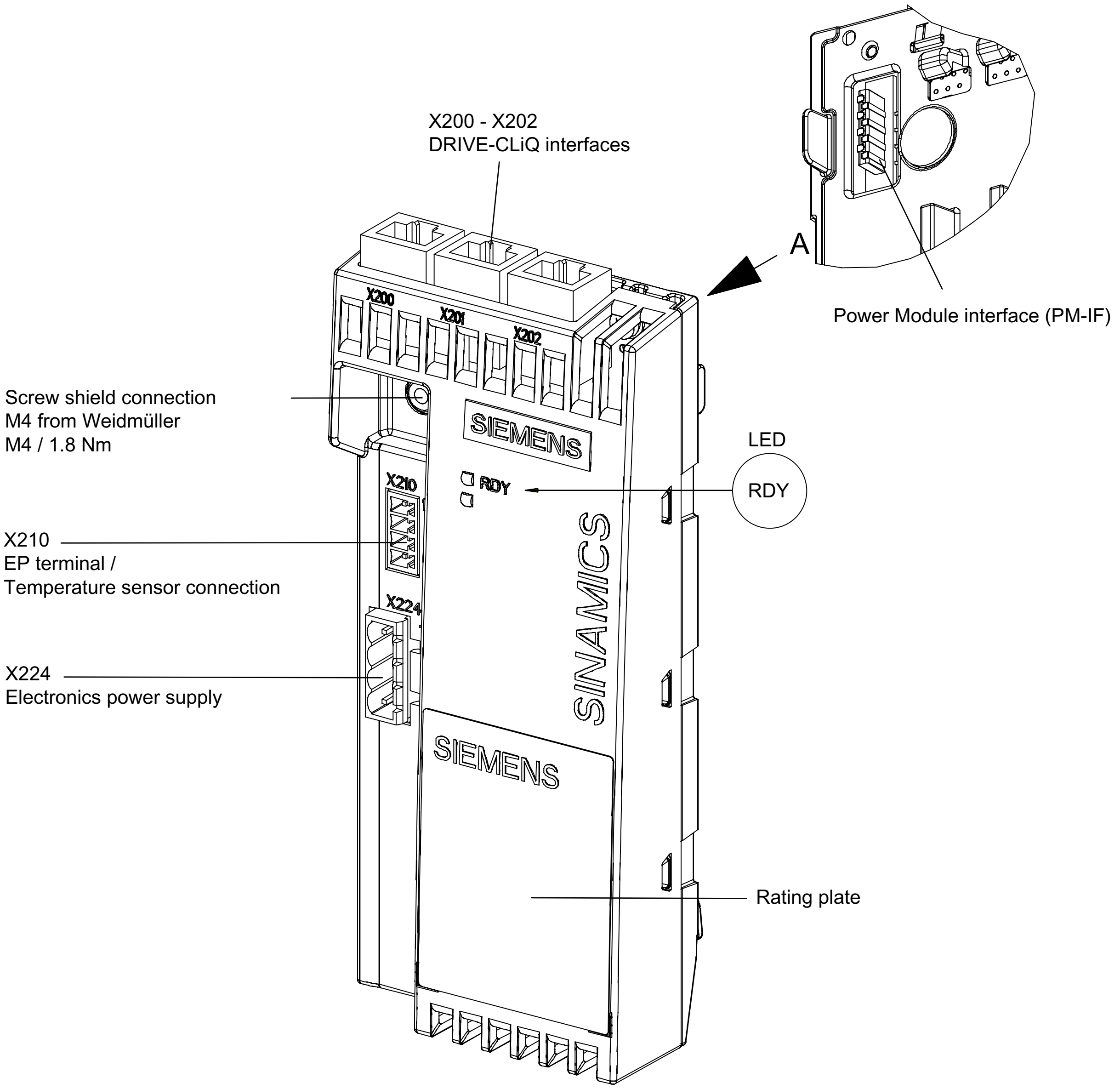


Figure 6-10 Interface description CUA31

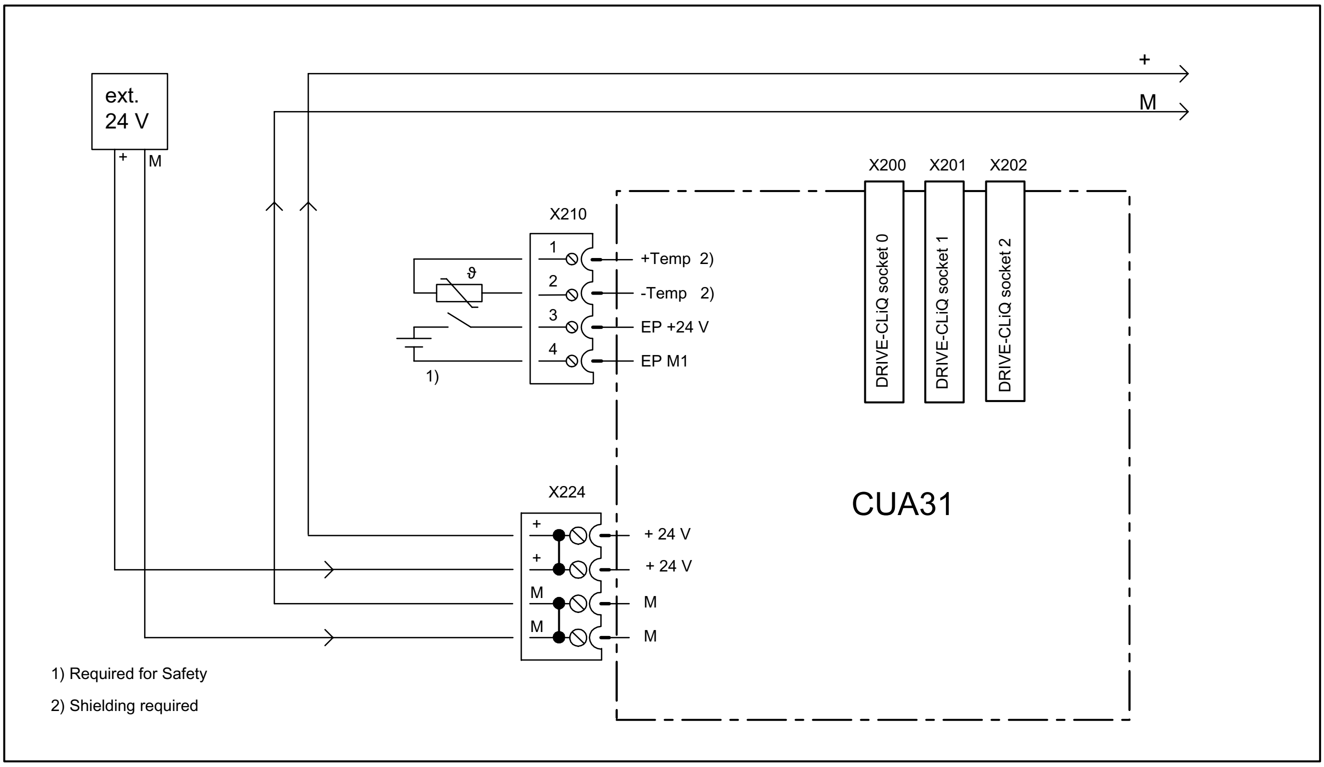
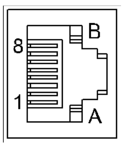


Figure 6-11 Connection example, CUA31

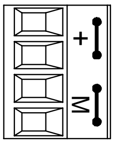
6.4.3.2 X200 - X202 DRIVE-CLiQ interface

Table 6- 33 DRIVE-CLiQ interface

	Pin	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	W	M (0 V)	Electronics ground
Blanking cover on DRIVE-CLiQ interface: Yamaichi, order no.: Y-ConAS-13			

6.4.3.3 X224 electronics power supply

Table 6- 34 Terminal block X224

	Terminal	Function	Technical specifications
	+	Electronic 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
	+	Electronic 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)			

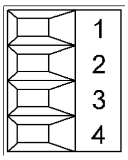
Note

The two "+" 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.

6.4.3.4 X210 EP terminals / temperature sensor

Table 6- 35 Terminal strip X210

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

* Further reading: /IH1/ SINAMICS S120, Commissioning Manual, Chapter "Temperature sensors for SINAMICS components".

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

Note

The temperature sensor is required for motors whose temperature value is not transmitted by DRIVE-CLiQ.
If the "Safe standstill" function is selected, 24 V DC must be applied 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!

6.4.3.5 Description of the LEDs on the Control Unit Adapter CUA31

Table 6- 36 Description of the LEDs at the Control Unit Adapter 31

LED	Color	State	Description
RDY (READY)	Red	Steady light	At least one fault is present in this component.
	Green	Steady light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.

Cause and rectification of faults

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

Reference: /IH1/ SINAMICS S120 Commissioning Manual.

6.4.4 Dimension drawing

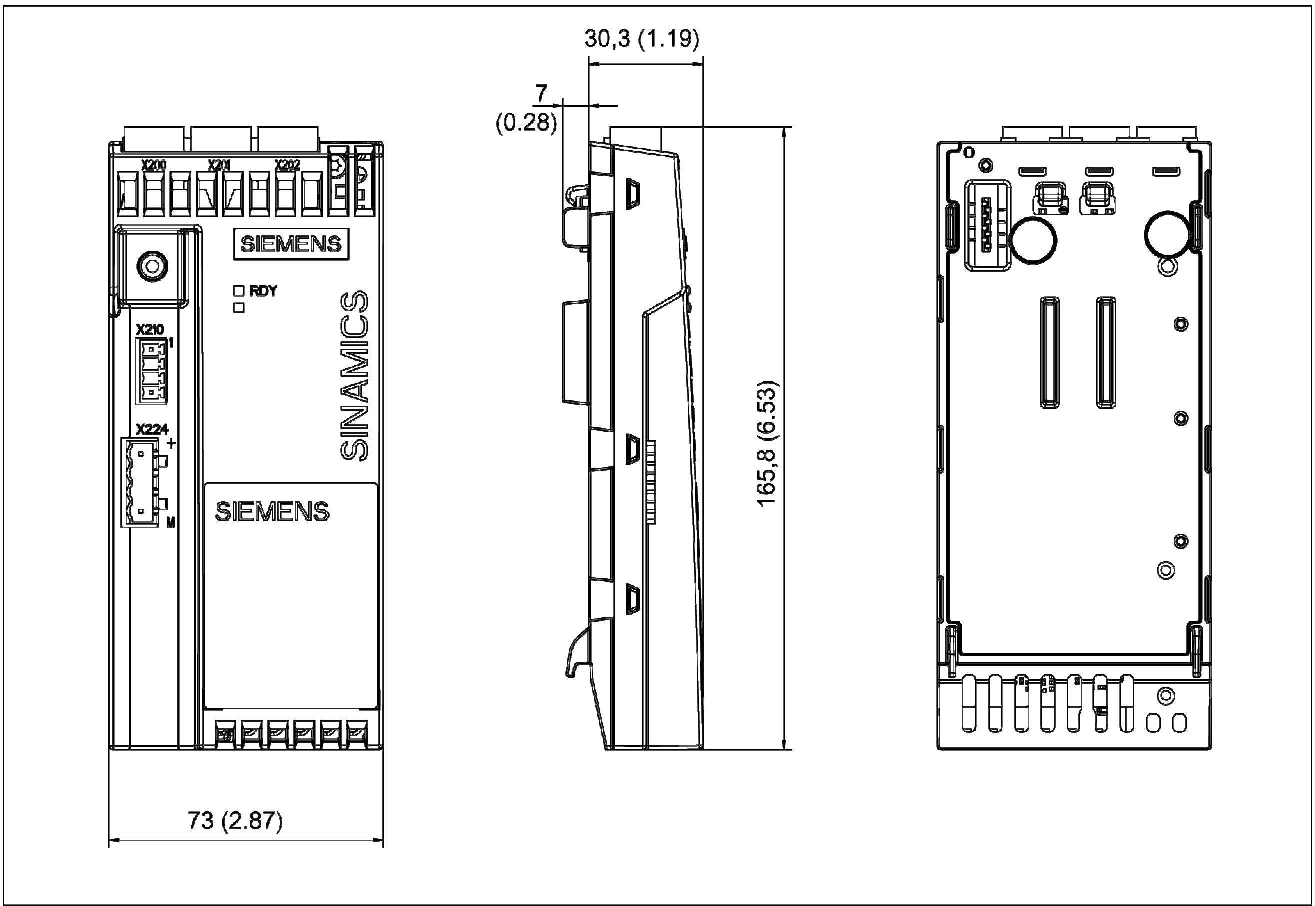


Figure 6-12 Dimension drawing of Control Unit Adapter CUA31, all data in mm and (inches)

6.4.5 Mounting

	
Snapping the CUA31 onto the Power Module 340 (frame size FSD)	Power Module 340 (frame size FSD) and CUA31

Removing the Control Unit Adapters CUA31

Removing the CUA31 from the Power Module 340 (frame size FSD)

In order to remove the Control Unit Adapter CUA31 from the Power Module, the blue release lever, as shown in the diagram, must be pressed downwards and the Control Unit Adapter CUA31 is swung-out to the front.

6.4.6 Technical data

Table 6- 37 Technical specifications CUA31

	Unit	Value
Electronic power supply		
Voltage Current (without DRIVE-CLiQ) Power loss	V_{DC} A_{DC} W	24 DC (20.4 – 28.8) 0.1 2.4
Maximum DRIVE-CLiQ cable length CUA31 with order number 6SL3040-0PA00-0AA0 CUA31 from order number 6SL3040-0PA00-0AA1	 m m	 50 100
Weight	kg	0.31

6.5 CUA32 Control Unit Adapter

6.5.1 Description

The CUA32 Control Unit Adapter combined with a modular power unit is used to extend an existing DC/AC drive line-up e.g. with CU320 by one drive. It also provides an encoder interface (HTL / TTL / SSI).

The closed-loop control is externally implemented. This is the reason that a SINAMICS, SIMOTION or SINUMERIK closed-loop control is always required for operation.

The CUA32 Control Unit Adapter has the following interfaces (ports):

Table 6- 38 Interface overview of the CUA32

Type	Number
DRIVE-CLiQ interfaces	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.

6.5.2 Safety information

⚠ WARNING
The cooling clearances of 50 mm above and below the components must be observed. It is not permissible that the connecting cables cover the cooling openings.

6.5.3 Interface description

6.5.3.1 Overview

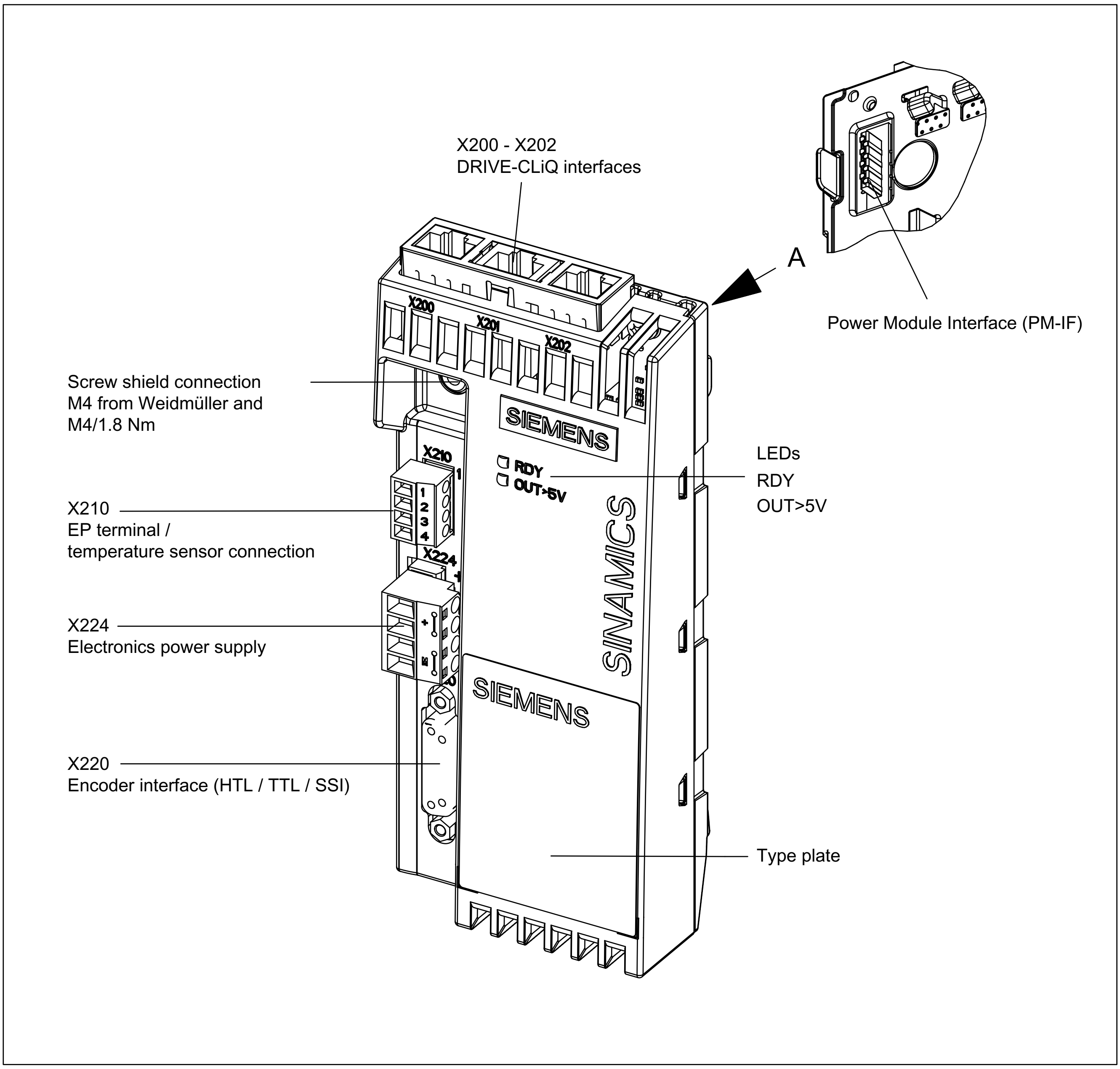


Figure 6-13 Interface description CUA32

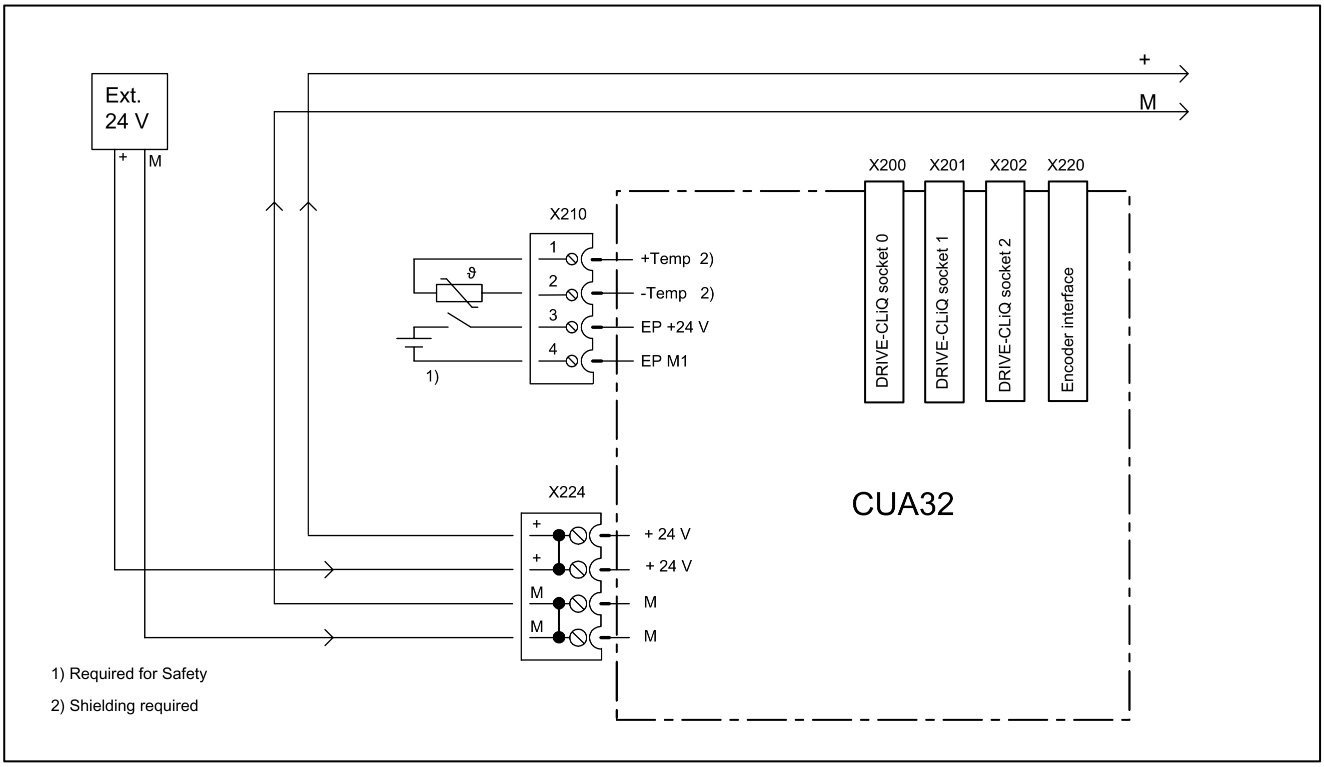
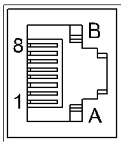


Figure 6-14 Connection example for CUA32

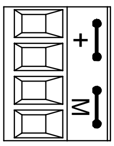
6.5.3.2 X200 - X202 DRIVE-CLiQ interface

Table 6- 39 DRIVE-CLiQ interface

	Pin	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Connector type: RJ45 socket; blanking plate for DRIVE-CLiQ interface included in the scope of delivery; blanking plate (50 pieces) order number: 6SL3066-4CA00-0AA0			

6.5.3.3 X224 electronics power supply

Table 6- 40 Terminal block X224

	Terminal	Function	Technical specifications
	+	Electronic 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
	+	Electronic 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)			

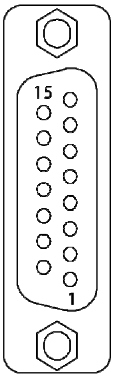
Note

The two "+" 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.

6.5.3.4 X220 HTL/TTL/SSI encoder interface

Table 6- 41 Encoder connection X220

	Pin	Signal name	Technical specifications
	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 power supply
	5	P encoder 5 V/24 V	Encoder power supply
	6	P sense	Sense input of encoder power supply
	7	M encoder (M)	Ground for encoder power 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
Type: 15-pin sub D connector			

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

Table 6- 42 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

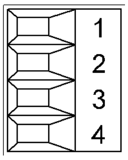
Note

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).

6.5.3.5 X210 EP terminals / temperature sensor

Table 6- 43 Terminal strip X210

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

* Further reading: /IH1/ SINAMICS S120, Commissioning Manual, Chapter "Temperature sensors for SINAMICS components".

NOTICE

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

Note

The temperature sensor is required for motors whose temperature value is not transmitted by DRIVE-CLiQ.
If the "Safe standstill" function is selected, 24 V DC must be applied 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!

6.5.3.6 Description of the LEDs on the CUA32 Control Unit Adapter

Table 6- 44 Description of the LEDs on the CUA32 Control Unit Adapter

LED	Color	Status	Description
RDY (READY)	Red	Continuous	At least one fault is present in this component.
	Green	Continuous	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	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

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

Reference: /IH1/ SINAMICS S120 Commissioning Manual.

6.5.4 Dimension drawing

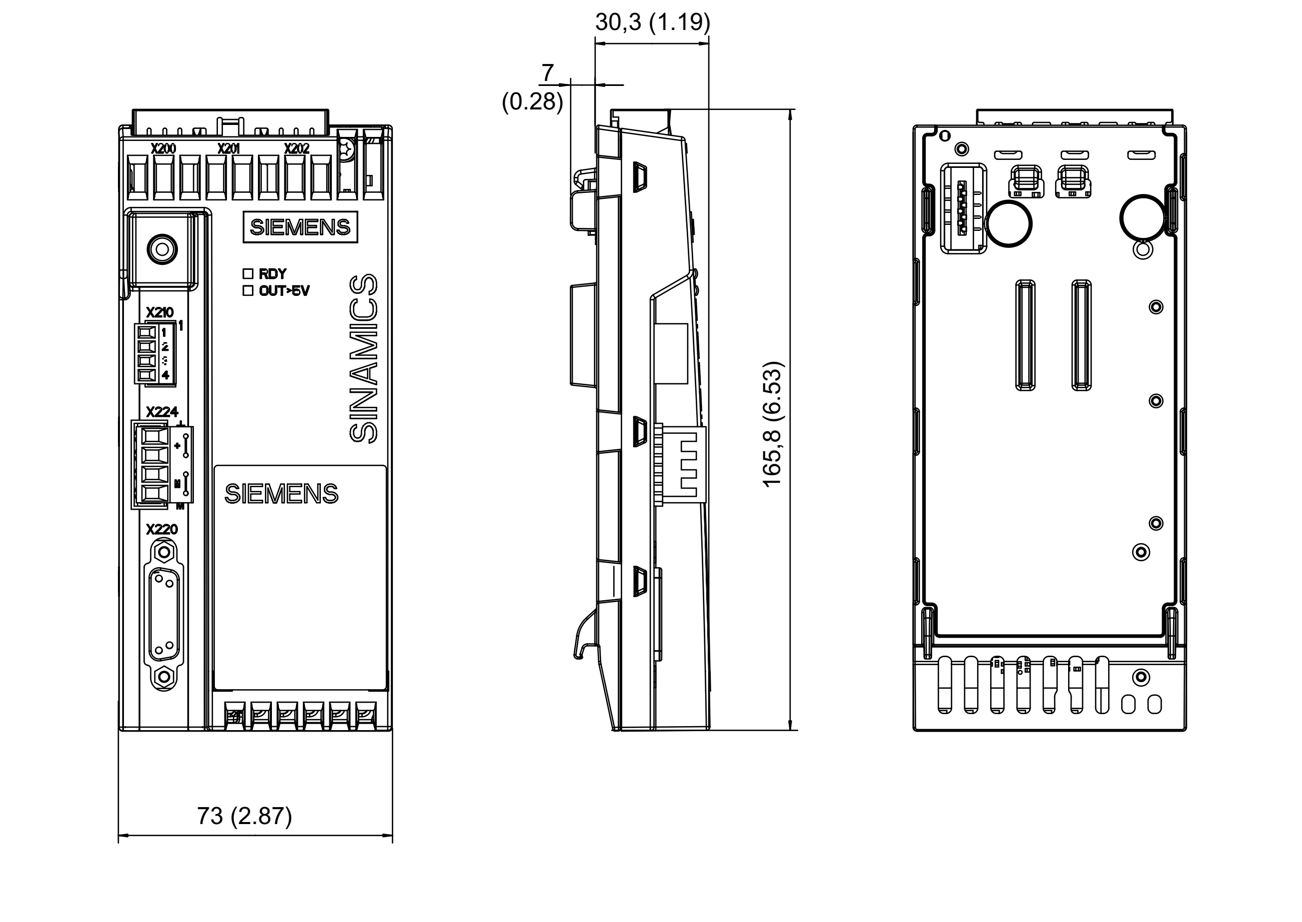


Figure 6-15 Dimension drawing of Control Unit Adapter CUA32, all data in mm and (inches)

6.5.5 Assembly

See Section "CUA31 Assembly".

6.5.6 Technical data

Table 6- 45 Technical specifications CUA32

	Unit	Value
Electronic 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

Supplementary system components and encoder system integration

7

7.1 Overview

Table 7- 1 Overview of the functional capability of supplementary system components with CU310 DP or CU310 PN

	CU310 DP	CU310 PN
BOP20	X	X
TM15	X	X
TM31	X	X
TM41	X	X
TM54F	X[1)]	X[1)]
DMC20	X	X
VSM10	X	X
SMC10	X	X
SMC20	X	X
SMC30	X	X
SME20	X	X
SME25	X	X
SME120	X	X
SME125	X	X

1) As of firmware V2.5.1

Additional information on the supplementary system components is provided in the following:
Reference: /GH1/ SINAMICS S120 Equipment Manual for Control Units and Additional System Components

7.2 Basic Operator Panel BOP20

7.2.1 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 SINAMICS Control Unit CU310 DP / PN and operated.

The BOP20 supports the following functions:

- Input of parameters and activation of functions
- Display of operating modes, parameters, alarms and faults

7.2.2 Interface description

Figure 7-1 Basic Operator Panel BOP20

Overview of displays and keys

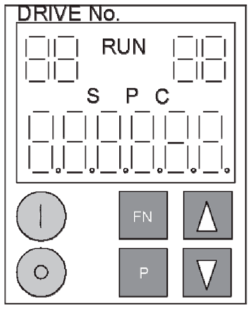


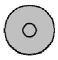
Figure 7-2 Overview of displays and keys

Table 7- 2 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 present but cannot be seen (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 lit (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 lit (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- 3 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.
	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.
	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	

Displays and operating the BOP20

Information about the displays and using the BOP20 is provided in the following reference:

Reference: /IH1/ SINAMICS S120 Commissioning Manual.

7.2.3 Mounting

Table 7- 4 Mounting

	
1. CU310 and BOP20	2. Press the latching cams of the blanking cover together
	
3. Remove the dummy cover	4. Locate the BOP20

Note

The Basic Operator Panel BOP20 may be inserted and withdrawn while the Control Unit is operational.

7.3 Sensor Module Cabinet-Mounted SMC10

7.3.1 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.

7.3.2 Safety information

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

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

Note

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

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

7.3.3 Interface description

7.3.3.1 Overview

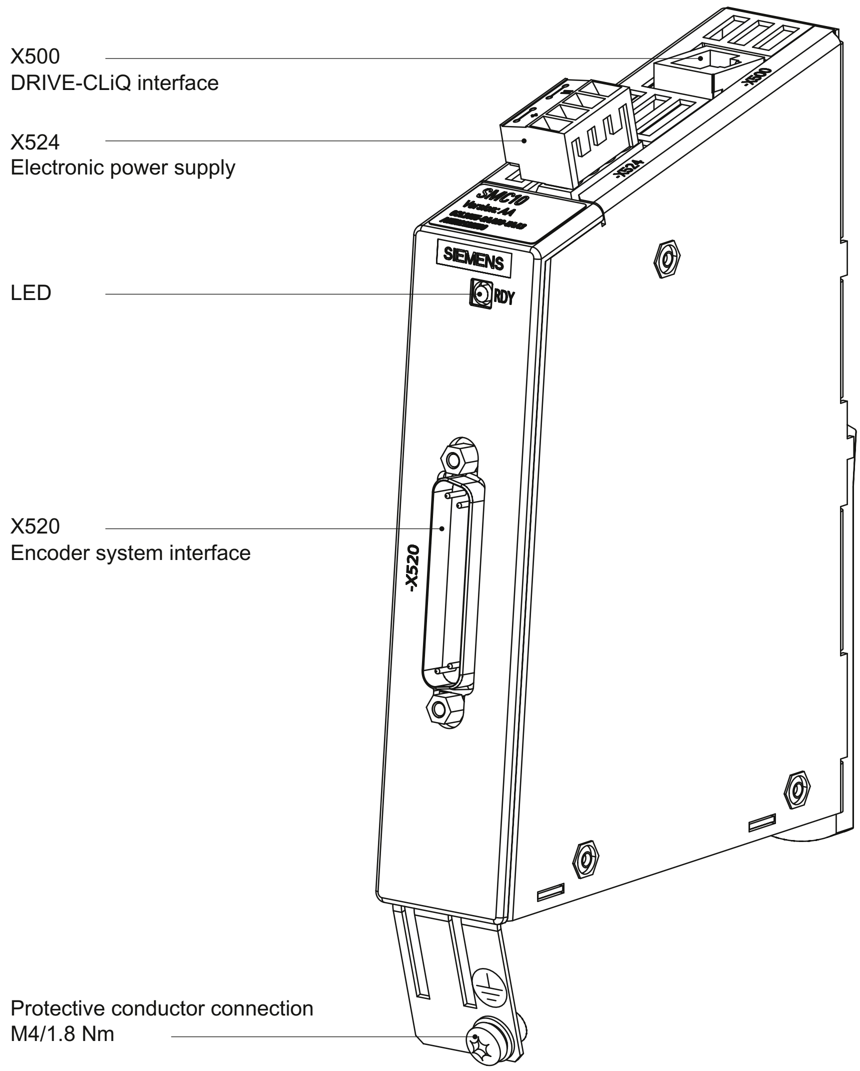


Figure 7-3 Interface description of the SMC10, 30 mm wide, order number: 6SL3055-0AA00-5AA3

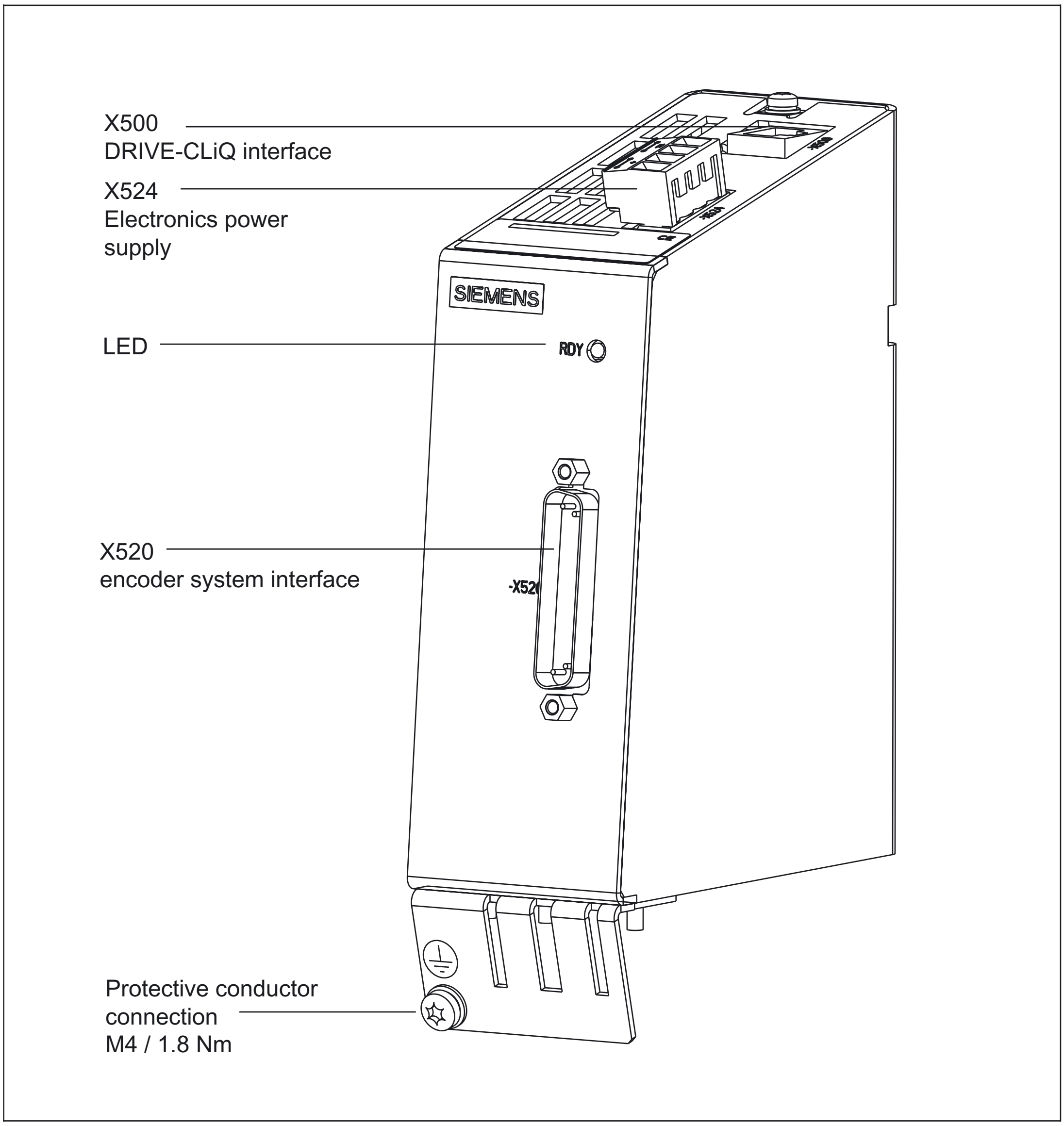
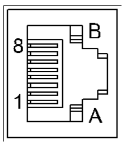


Figure 7-4 Interface description of the SMC10, 50 mm wide, order number: 6SL3055-0AA00-5AA0

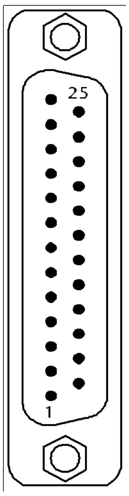
7.3.3.2 DRIVE-CLiQ interface X500

Table 7- 5 DRIVE-CLiQ interface X500

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

7.3.3.3 X520 encoder system interface

Table 7- 6 X520 encoder system interface

	Pin	Signal name	Technical specifications
	1	Reserved, do not use	
	2	Reserved, do not use	
	3	S2	Resolver signal A (sin+)
	4	S4	Inverse resolver signal A (sin-)
	5	Ground	Ground (for internal shield)
	6	S1	Resolver signal B (cos+)
	7	S3	Inverse 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 measurement 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 measurement KTY84-1C130 (KTY-) Temperature sensor KTY84-1C130 / PTC

⚠ DANGER

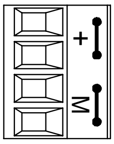
Risk of electric shock!

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!

7.3.3.4 X524 Electronics power supply

Table 7- 7 X524 terminal block

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

7.3.3.5 Meaning of LEDs on the Sensor Module Cabinet-Mounted SMC10

Table 7- 8 Sensor Module Cabinet-Mounted SMC10 – description of the LEDs

LED	Color	Status	Description, cause	Remedy
RDY READY	-	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	At least one fault is present in this component. 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 reference contains further information about the cause and rectification of faults:

References: /IH1/ SINAMICS S, Commissioning Manual

7.3.4 Dimension drawings

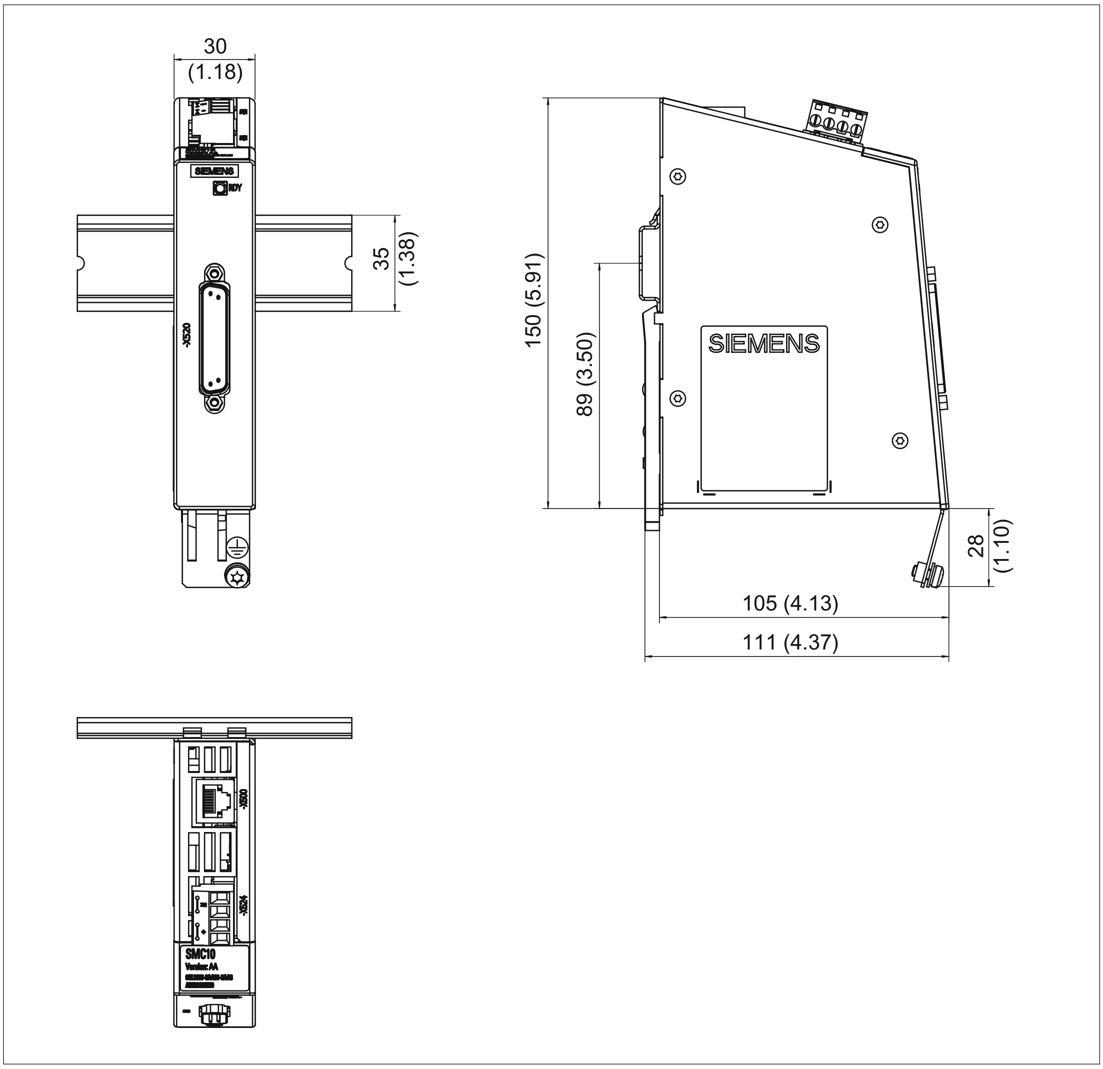


Figure 7-5 Dimension drawing of the Sensor Module Cabinet SMC10, 30 mm wide, all data in mm and (inches); order number: 6SL3055-0AA00-5AA3

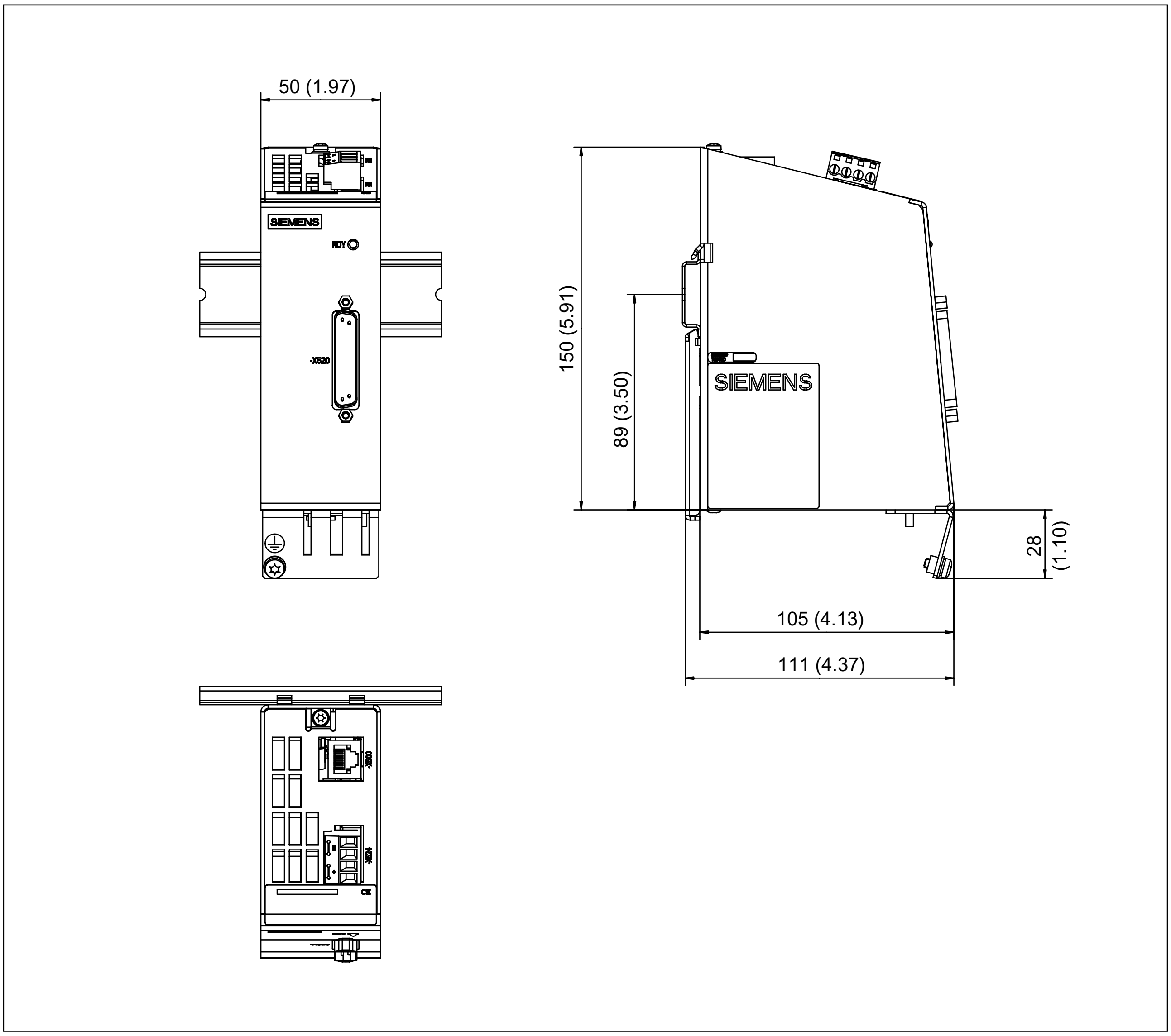


Figure 7-6 Dimension drawing of the Sensor Module Cabinet SMC10, 50 mm wide, all data in mm and (inches); order number: 6SL3055-0AA00-5AA0

7.3.5 Installation

Installation

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

Removal

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

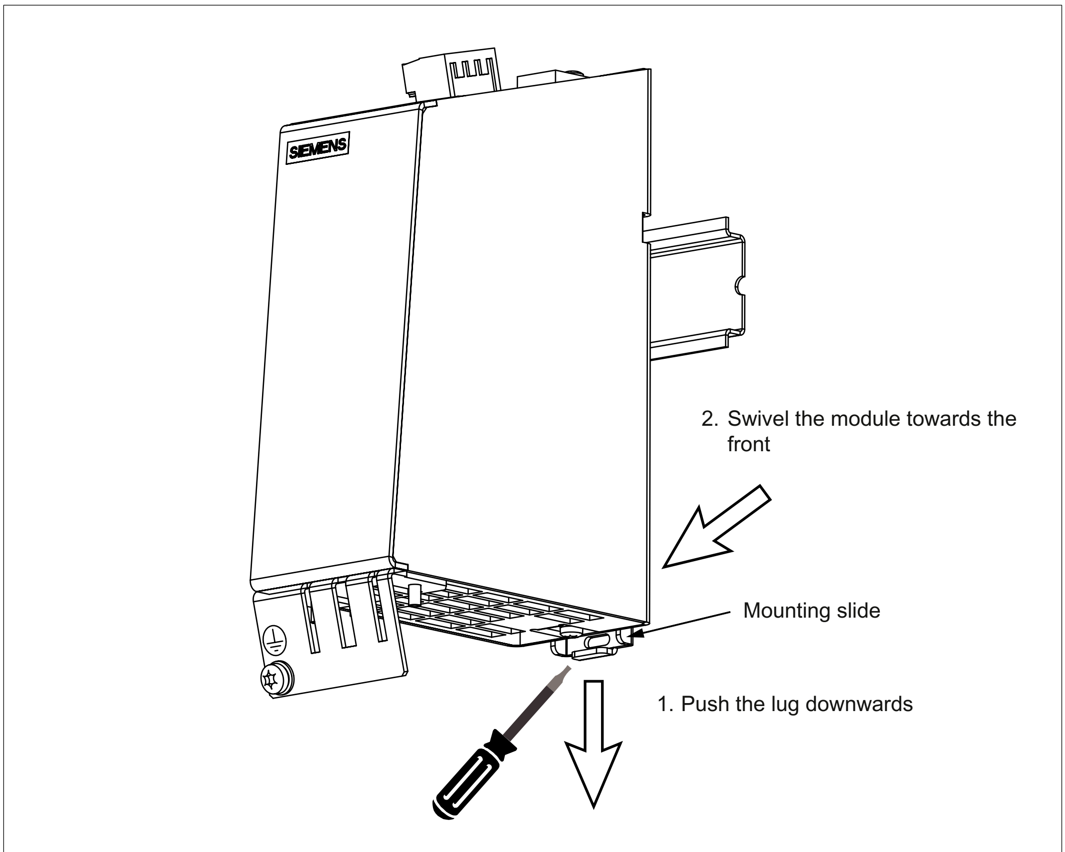


Figure 7-7 Removal of a component from a DIN rail

7.3.6 Technical data

Table 7- 9 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 (order number 6SL3055-0AA00-5AA3) 5 to 10 (order number 6SL3055-0AA00-5AA0)
PE/ground connection		On housing with M4/1.8 Nm screw
Max. encoder cable length	m	130
Weight	kg	0.45 (order number 6SL3055-0AA00-5AA3) 0.8 (order number 6SL3055-0AA00-5AA0)
Degree of protection		IP20 or IPXXB

Table 7- 10 Max. frequency that can be evaluated (speed)

Resolver		Max. speed resolver / motor		
Number of poles	Number of pole pairs	8kHz/125 μsec	4kHz/250 μsec	2kHz/500 μsec
2-pole	1	120,000 rpm	60,000 rpm	30,000 rpm
4-pole	2	60,000 rpm	30,000 rpm	15,000 rpm
6-pole	3	40,000 rpm	20,000 rpm	10,000 rpm
8-pole	4	30,000 rpm	15,000 rpm	7,500 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:

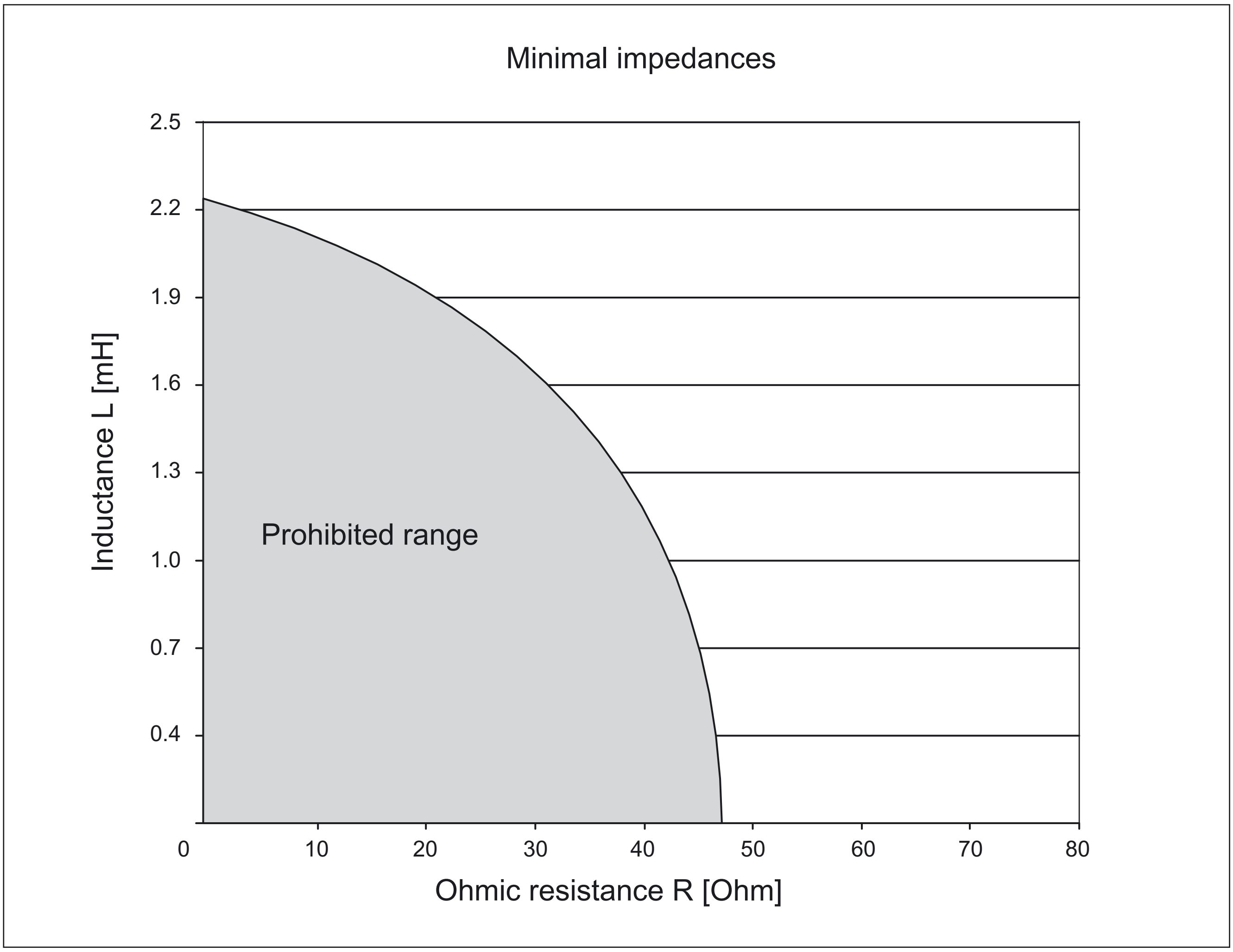


Figure 7-8 Connectable impedances with an excitation frequency f = 5000 Hz

7.4 Sensor Module Cabinet-Mounted SMC20

7.4.1 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.

7.4.2 Safety information

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

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

Note

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

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

7.4.3 Interface description

7.4.3.1 Overview

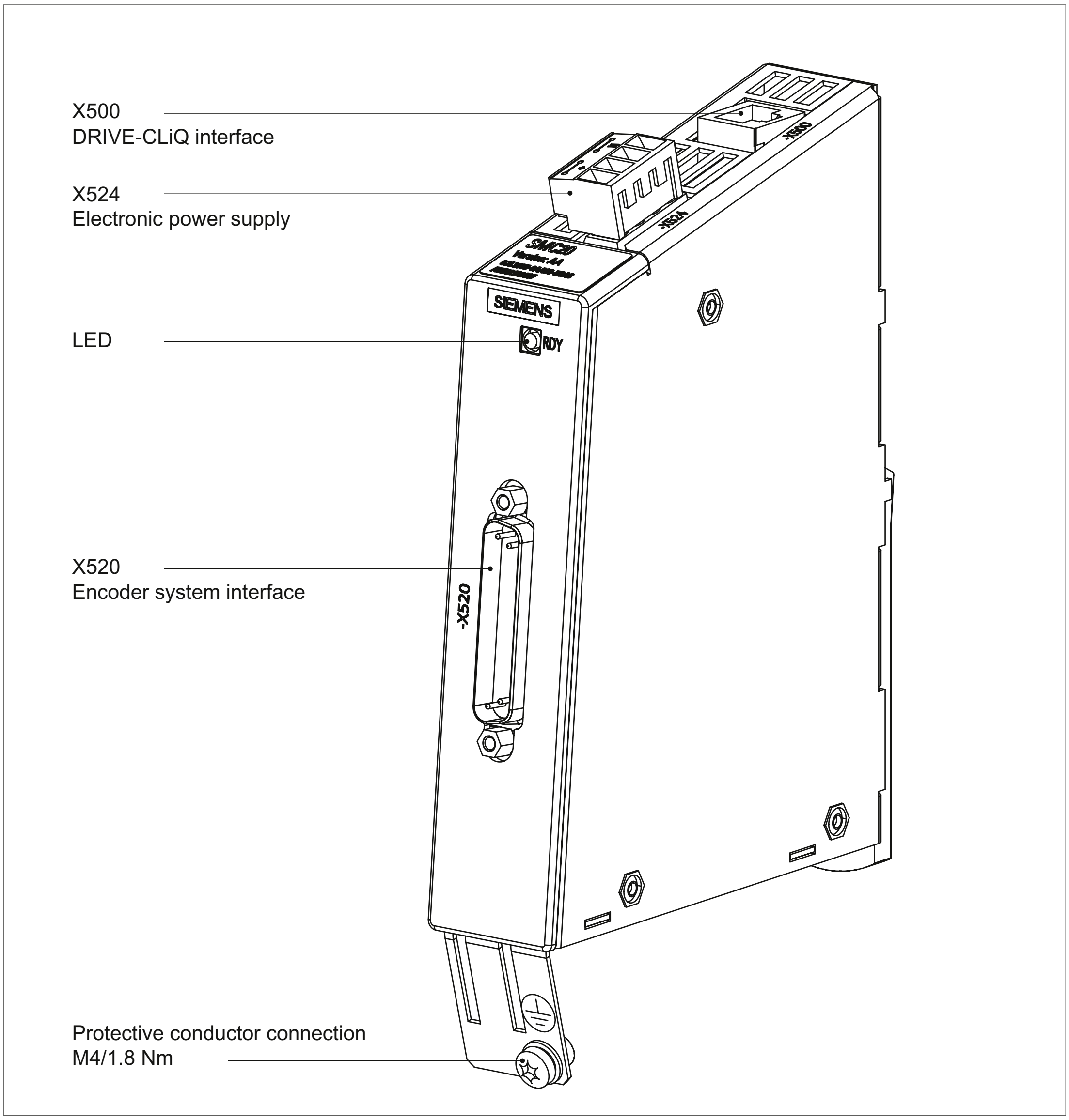
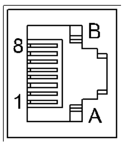


Figure 7-9 Interface description of the SMC20

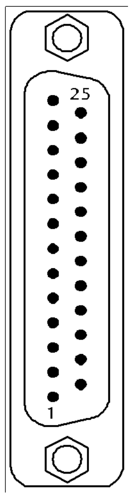
7.4.3.2 DRIVE-CLiQ interface X500

Table 7- 11 DRIVE-CLiQ interface X500

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

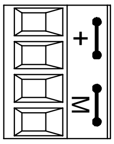
7.4.3.3 X520 encoder system interface

Table 7- 12 X520 encoder system interface

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

7.4.3.4 Electronic power supply X524

Table 7- 13 Terminal block X524

	Terminal	Function	Technical specifications
	+	Electronic 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
	+	Electronic 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 "+" or "M" terminals are jumpered in the connector. This ensures that the supply voltage is looped through.

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!

7.4.3.5 Meaning of LEDs on the Sensor Module Cabinet-Mounted SMC20

Table 7- 14 Sensor Module Cabinet-Mounted SMC20 – description of the LEDs

LED	Color	Status	Description, cause	Remedy
RDY READY	-	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	At least one fault is present in this component. **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 reference contains further information about the cause and rectification of faults:

References: /IH1/ SINAMICS S, Commissioning Manual

7.4.4 Dimension drawing

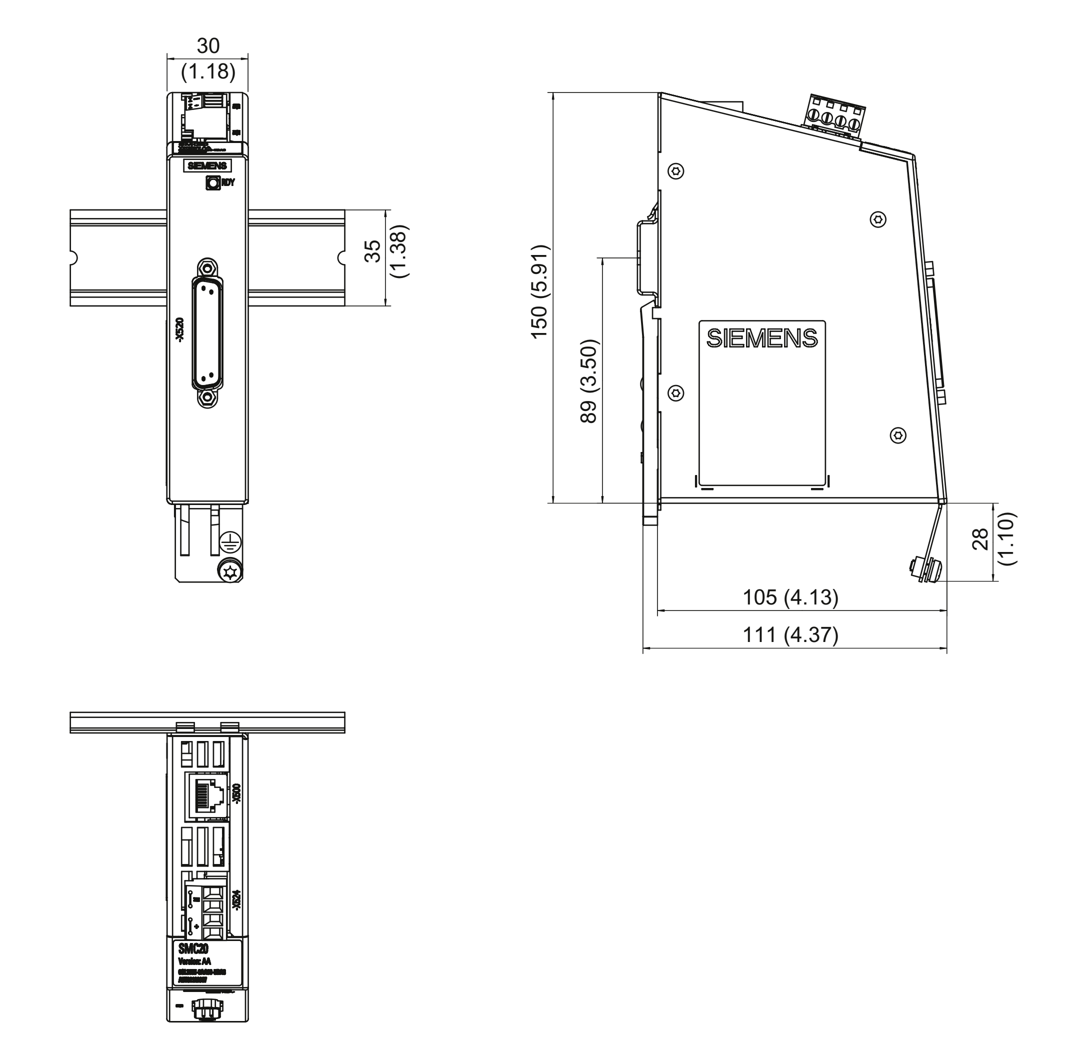


Figure 7-10 Dimension drawing of the Sensor Module Cabinet SMC20, all data in mm and (inches)

7.4.5 Installation

Installation

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

Removal

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

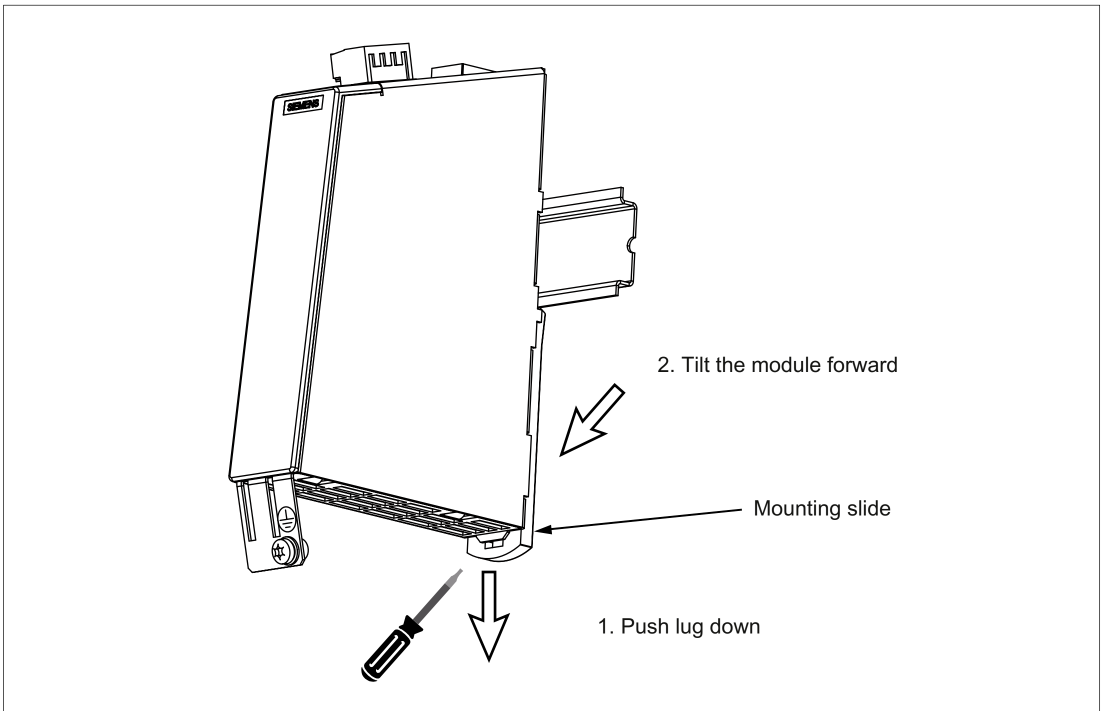


Figure 7-11 Removal of a component from a DIN rail

7.4.6 Technical data

Table 7- 15 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 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 (6SL3055-0AA00-5BA2) 100 - 250 (6SL3055-0AA00-5BA3)
Max. encoder cable length	m	100
PE/ground connection		On housing with M4/1.8 Nm screw
Weight	kg	0.45
Degree of protection		IP20 or IPXXB

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

2) Only possible for SSI encoders with 5 V supply

7.5 Option module, brake control

7.5.1 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 mounted in the Screening Kit (refer to the Chapter "Screening Kit") or alternatively at the rear cabinet panel.

7.5.2 Safe Brake Relay

The Safe Brake Relay can be used in conjunction with Power Modules in blocksize format to trigger a 24 V DC motor brake.

The brake is electronically controlled. All holding brakes can be used up to 2 A. To operate the brake, it is necessary to connect the supply voltage for the brake separately at the brake control option module. In this case, a regulated power supply is required whose rated value (to equalize and compensate for the voltage drop along the supply cable for the 24 V DC motor brake coil) can be set to 26 V (e.g. SITOP modular).

Table 7- 16 Overview of the Safe Brake Relay interfaces

Type	Number
Connection for the solenoid of the motor brake	1
Connection for 24 V DC supply	1
Connection for the pre-fabricated (CTRL) to the Power Module, Blocksize format	1

The Safe Brake Relay is shipped with the pre-fabricated cable to connect to the Power Module and all of the customer connectors.

7.5.2.1 Safety information

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

7.5.2.2 Interface description

Overview

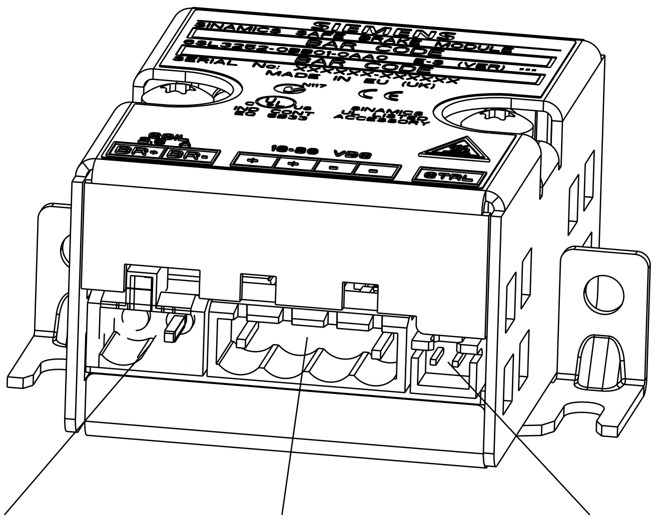


Figure 7-12 Interface description: Safe Brake Relay

Connection example

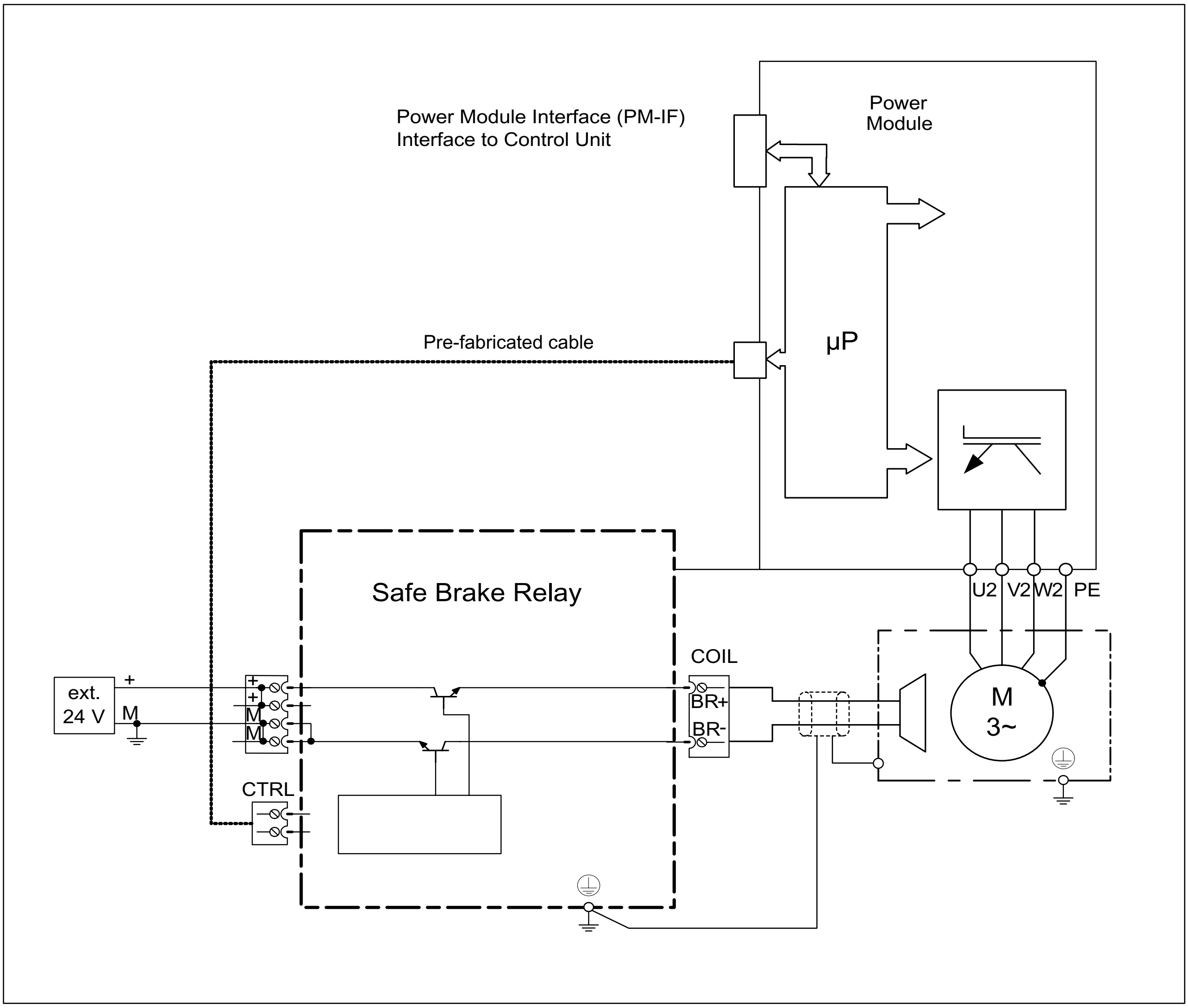
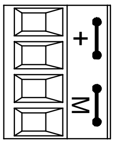


Figure 7-13 Safe Brake Relay connection example

Electronics power supply X524

Table 7- 17 Terminal block X524

	Terminal	Function	Technical specifications
	+	Electronic power supply	Voltage: 24 V (20.4 V – 28.8 V)
	+	Electronic power supply	Current consumption: max. 0.3 A (without motor holding brake)
	M	Electronic ground	Maximum current via jumper in connector: 20 A at 55°C
	M	Electronic 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.

Brake connection

Table 7- 18 Connector

Designation	Technical specifications
Brake connection	Relay output (close)
PE connection	M4 / 3 Nm

7.5.2.3 Dimension drawing

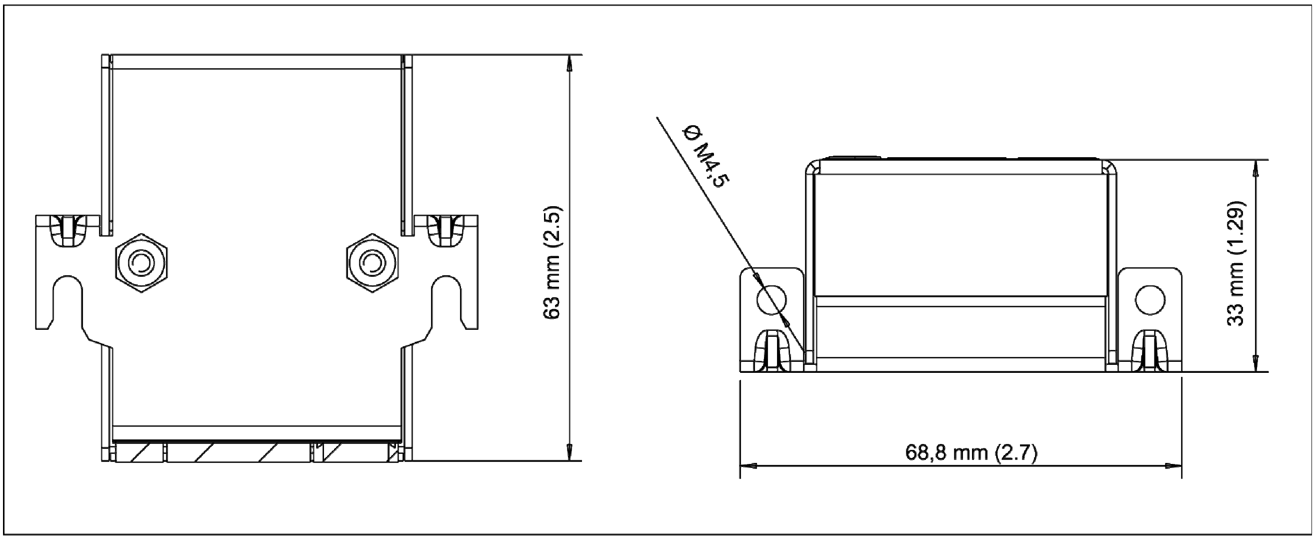


Figure 7-14 Dimension drawing of Safe Brake Relay, all data in mm and (inches)

7.5.2.4 Mounting

The Safe Brake Relay can be mounted below the Power Module on the Screening Kit.

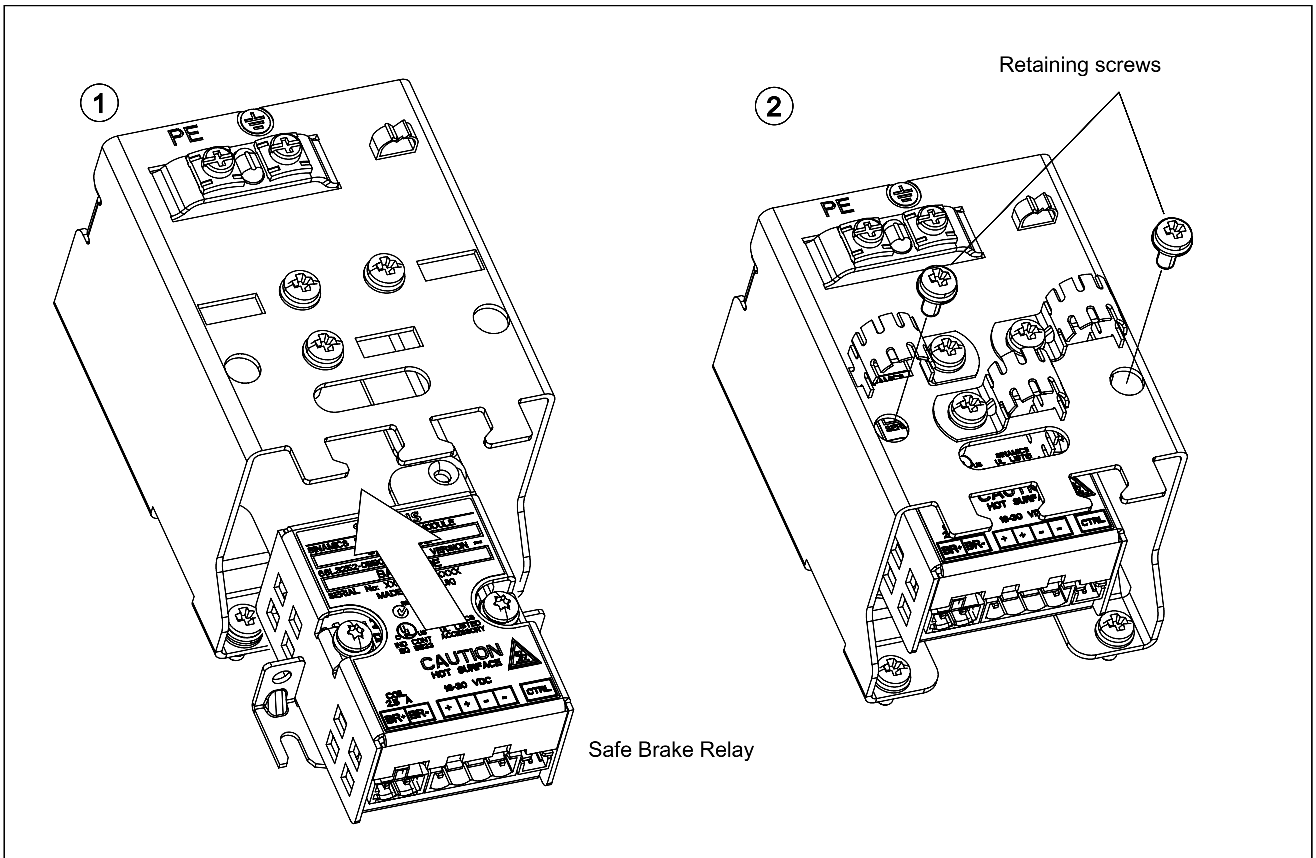


Figure 7-15 Mounting the Safe Brake Relay on the Screening Kit (frame size FSA)

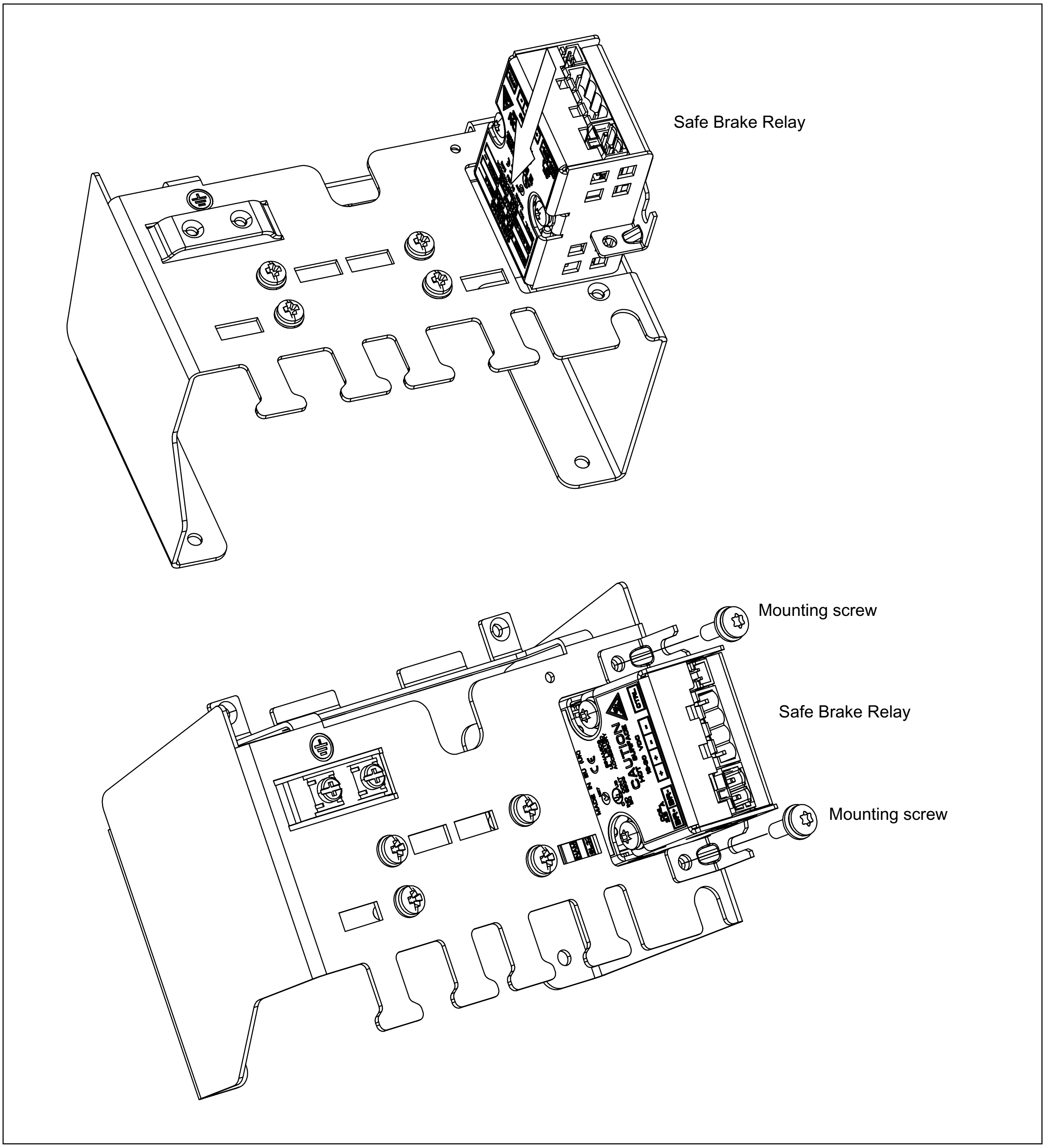


Figure 7-16 Mounting the Safe Brake Relay on the Screening Kit (frame sizes FSB and FSC)

7.5.2.5 Technical data

Safe Brake Relay	
Power supply	20.4 to 28.8 V DC Recommended rated value of the supply voltage 26 V DC (to equalize and compensate for the voltage drop along the supply cable to the 24 V DC motor brake coil)
Max. permissible current drain of the motor brake	2 A
Max. current requirements (at 24 V DC)	0.05 A + the current drain of the motor brake
Max. connectable cross section	2.5 mm^2
Weight, approx.	0.17 kg

Accessories 8

8.1 DRIVE-CLiQ cabinet gland

8.1.1 Description

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

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

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

8.1.2 Safety information

Note

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

8.1.3 Interface description

8.1.3.1 Overview

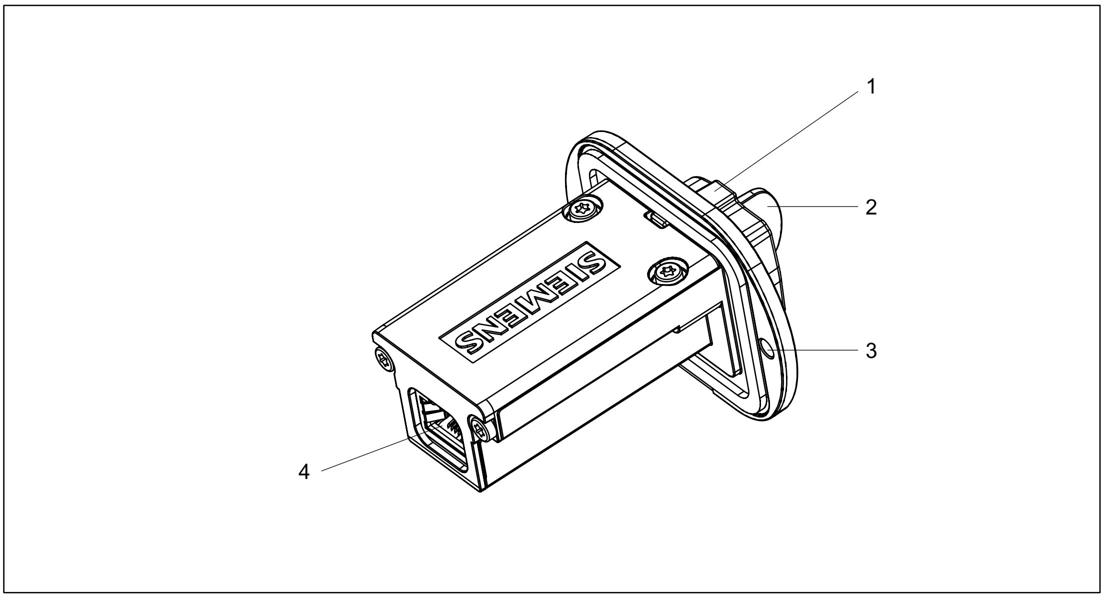


Figure 8-1 DRIVE-CLiQ cabinet bushing

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

8.1.4 Dimension drawing

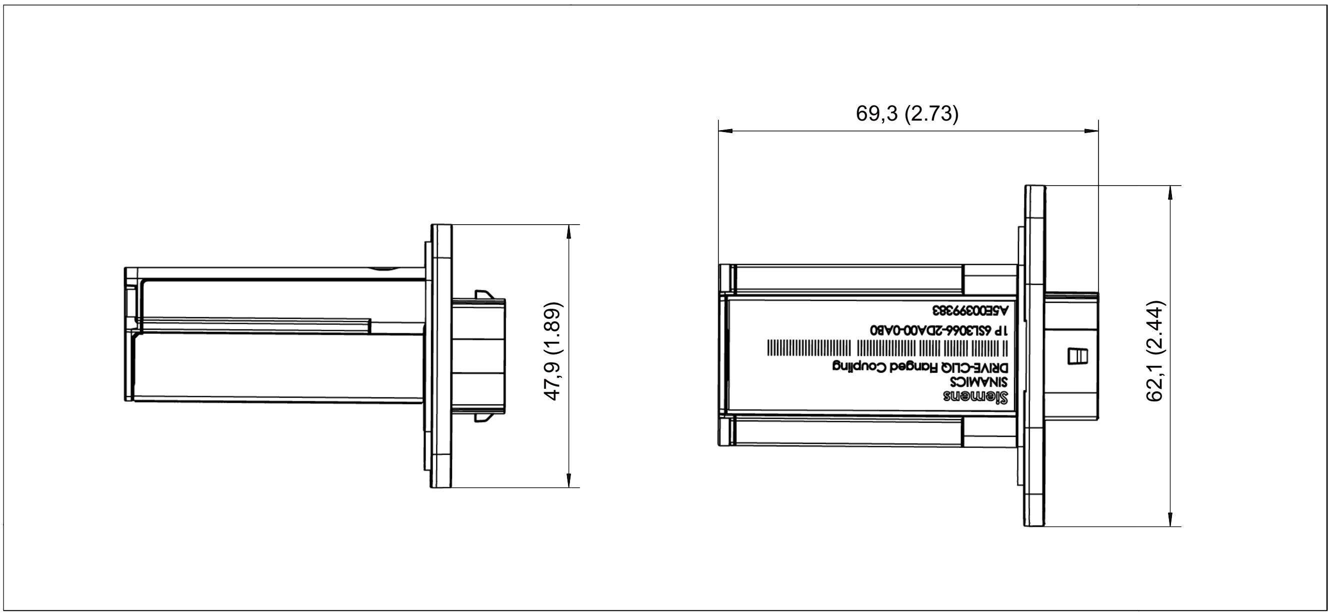


Figure 8-2 Dimension drawing of the DRIVE-CLiQ cabinet bushing, all dimensions in mm and (inches)

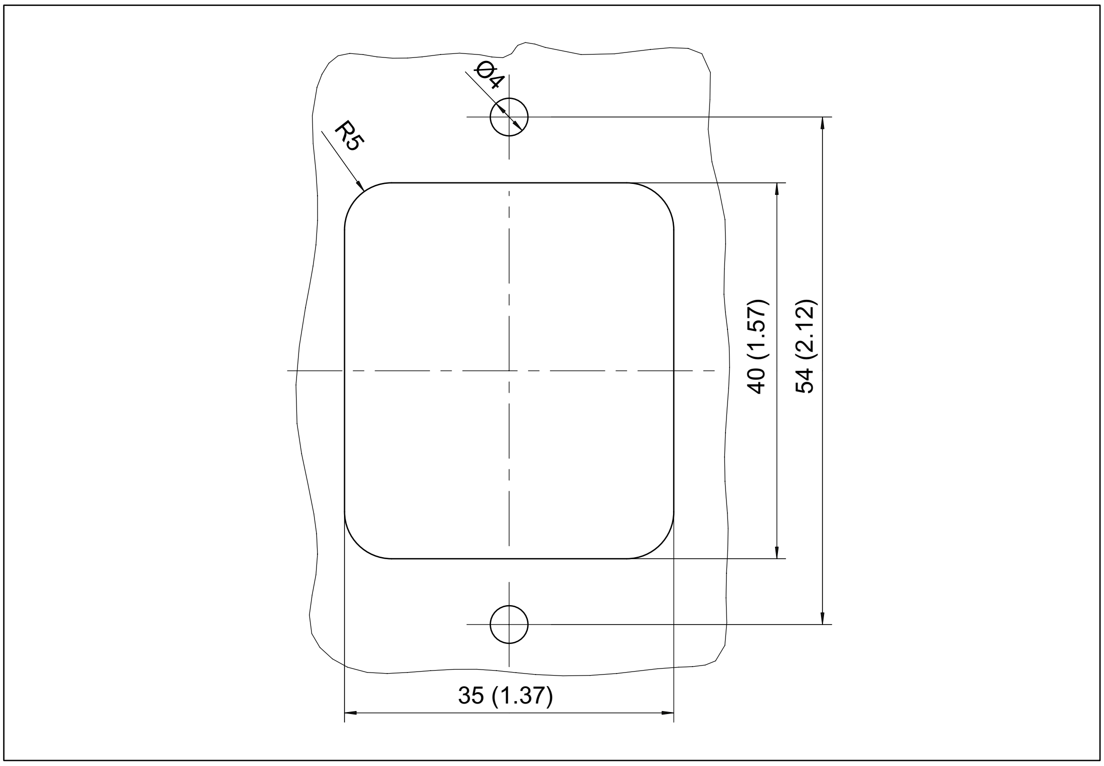


Figure 8-3 Cut-out for the cabinet

8.1.5 Installation

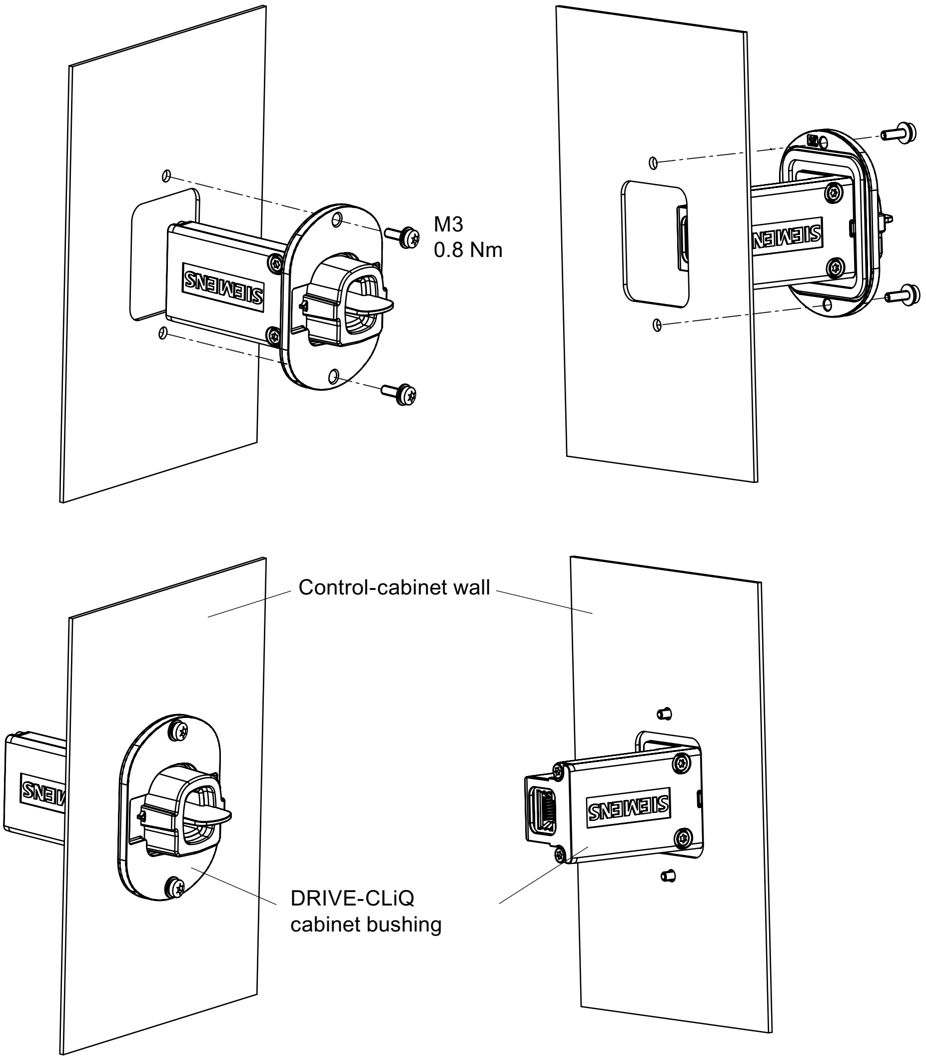


Figure 8-4 DRIVE-CLiQ cabinet bushing

Installation

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

8.1.6 Technical data

Table 8- 1 Technical data

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

8.2 DRIVE-CLiQ coupling

8.2.1 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 cable".

8.2.2 Safety information

Note

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

8.2.3 Interface description

8.2.3.1 Overview

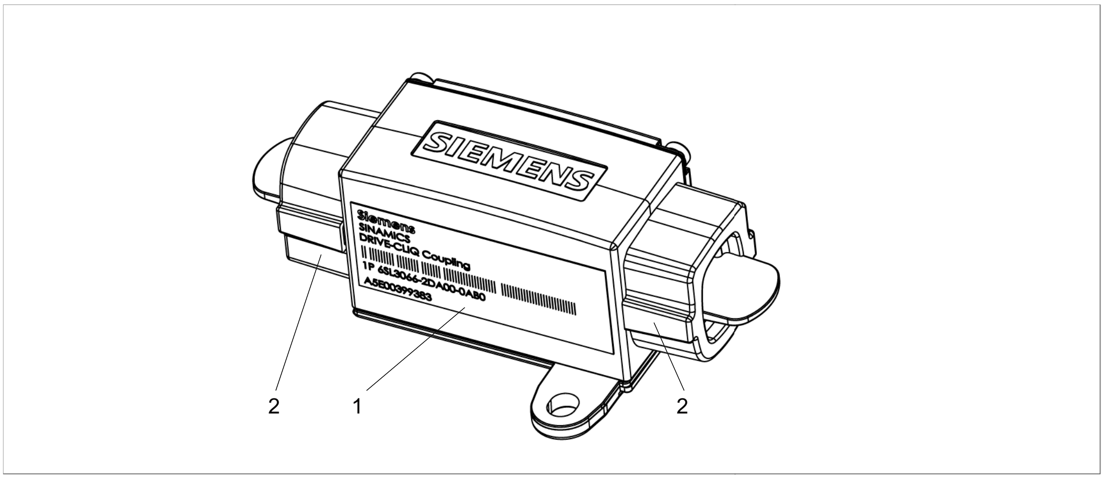


Figure 8-5 DRIVE-CLiQ coupling

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

8.2.4 Dimension drawing

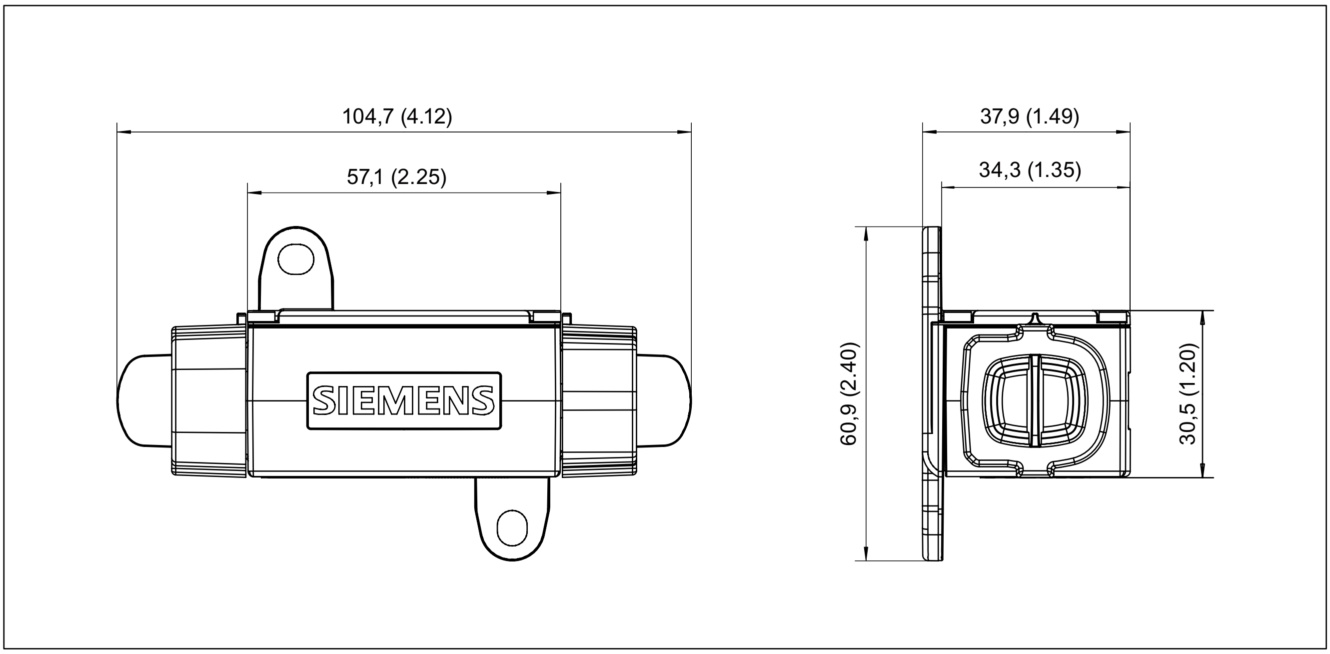


Figure 8-6 Dimension drawing of the DRIVE-CLiQ coupling, all dimensions in mm and (inches)

8.2.5 Installation

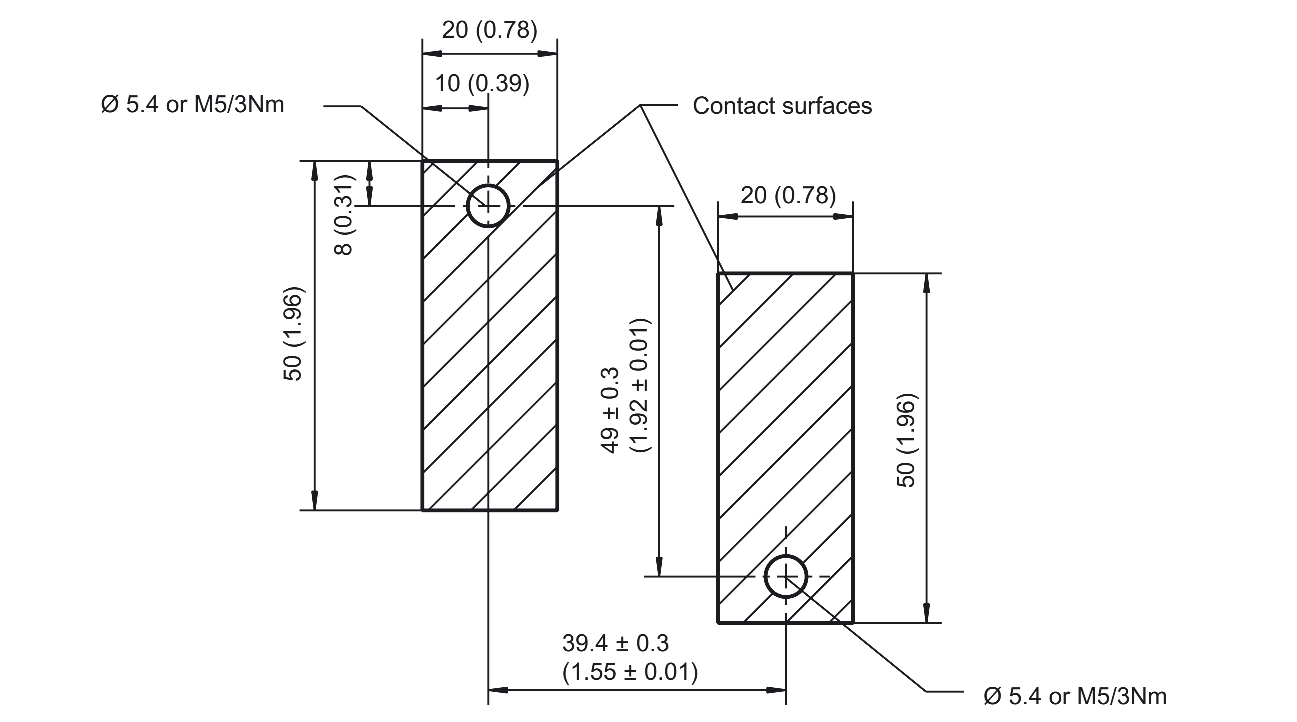


Figure 8-7 Hole drilling pattern for installation

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

8.2.6 Technical data

Table 8- 2 Technical data

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

8.3 Screening Kit

8.3.1 Description

A Screening Kit is offered as an optional shield support for Power Modules in frame sizes FSA to FSF. It provides shield support for the power cables. The Screening Kit is screwed directly onto the wall of the control cabinet for frame sizes FSA to FSC. With 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 radio cable disturbances.

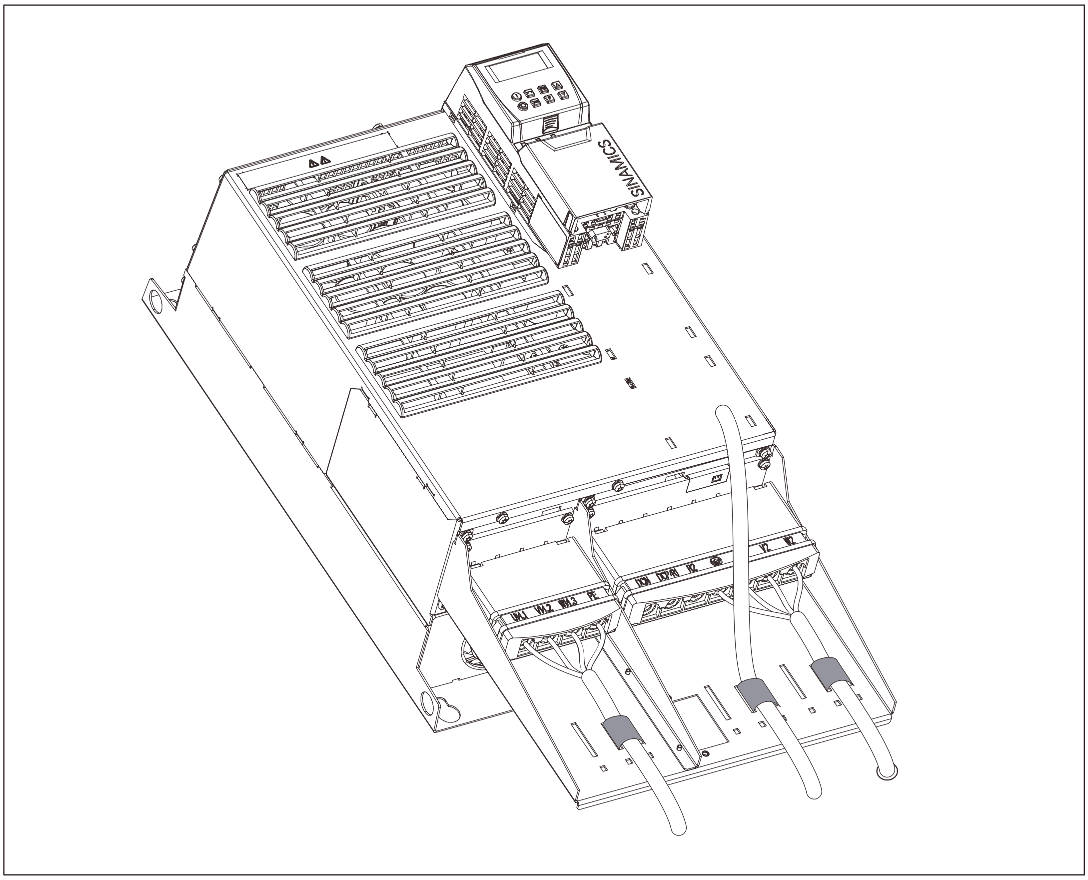


Figure 8-8 Power Module PM340 (frame sizes FSD, FSE) with CUA31 and Screening Kit

Table 8- 3 Overview of Screening Kits

PM340 frame size	FSA	FSB	FSC	FSD	FSE	FSF
Screening Kit 6SL3262-	1AA00-0BA0	1AB00-0DA0 (with ferrite core)	1AC00-0DA0 (with ferrite core)	1AD00-0DA0	1AD00-0DA0	1AF00-0DA0

8.3.2 Dimension drawings

8.3.2.1 Screening Kits

Dimension drawings of Screening Kits, frame sizes FSA to FSC

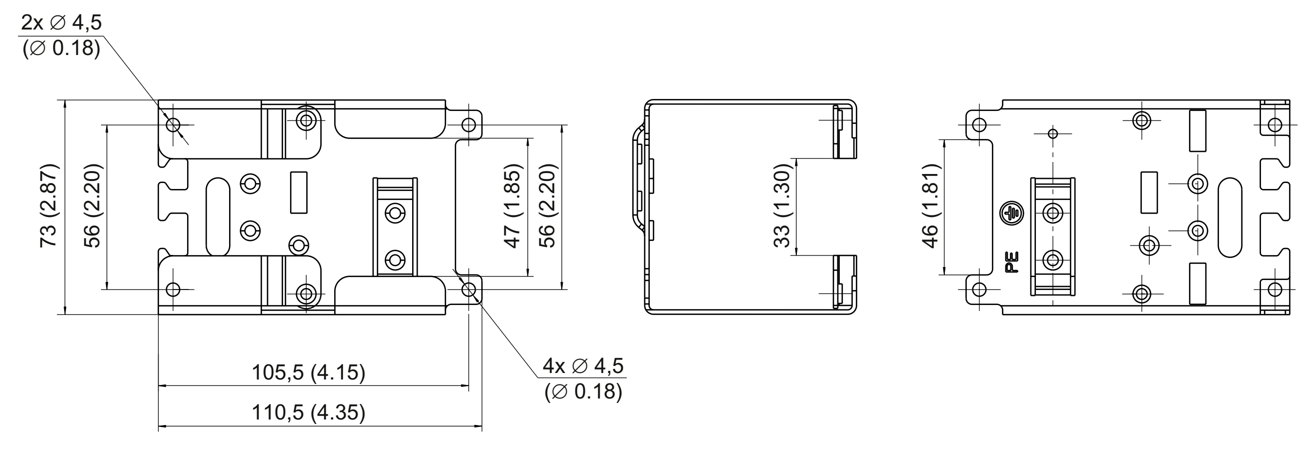


Figure 8-9 Dimension drawing of Screening Kit, frame size FSA, all data in mm and (inches)

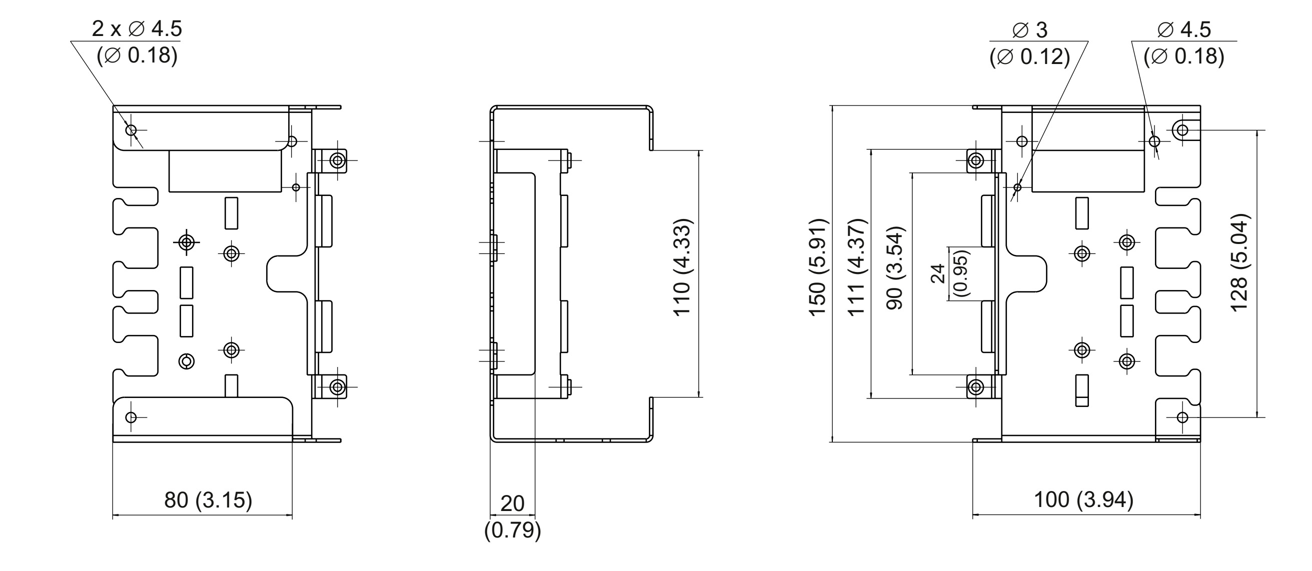


Figure 8-10 Dimension drawing of Screening Kit, frame size FSB, all data in mm and (inches)

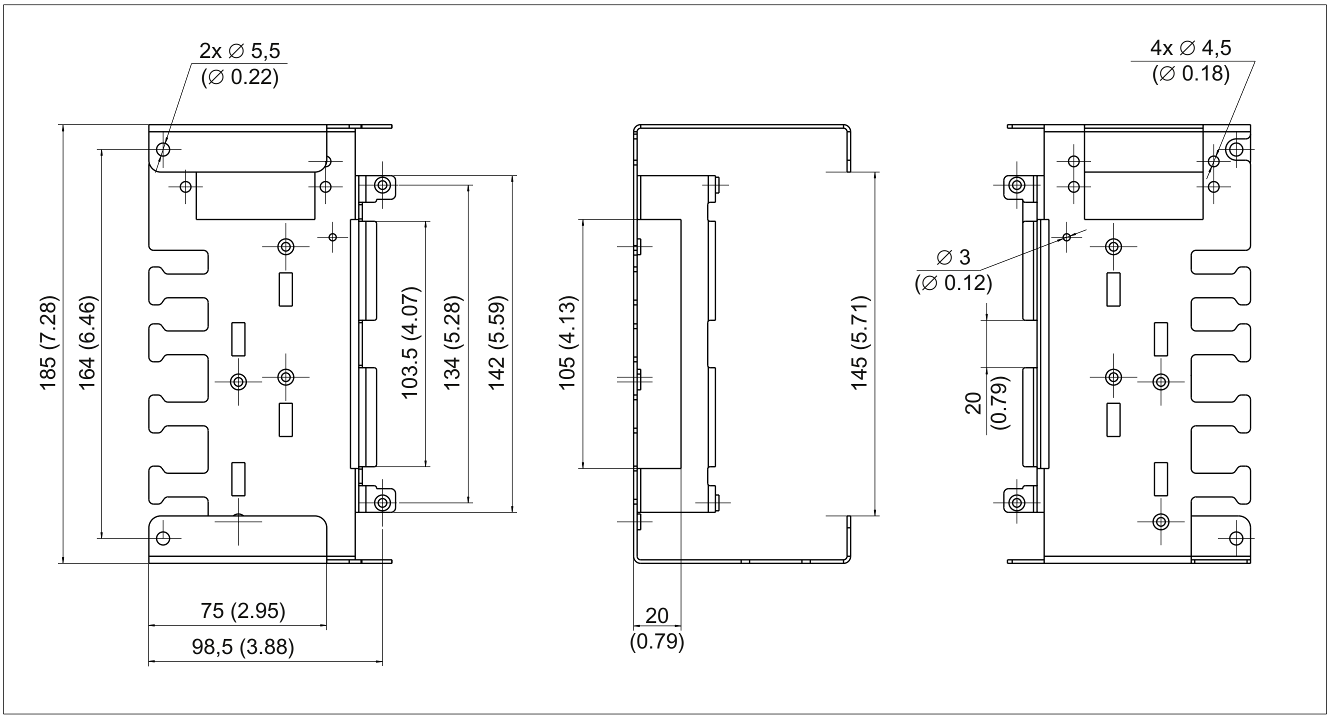


Figure 8-11 Dimension drawing of Screening Kit, frame size FSC, all data in mm and (inches)

8.3.2.2 Blocksize Power Modules with Screening Kits

Dimension drawings of Power Modules with Screening Kit, frame sizes FSA to FSF

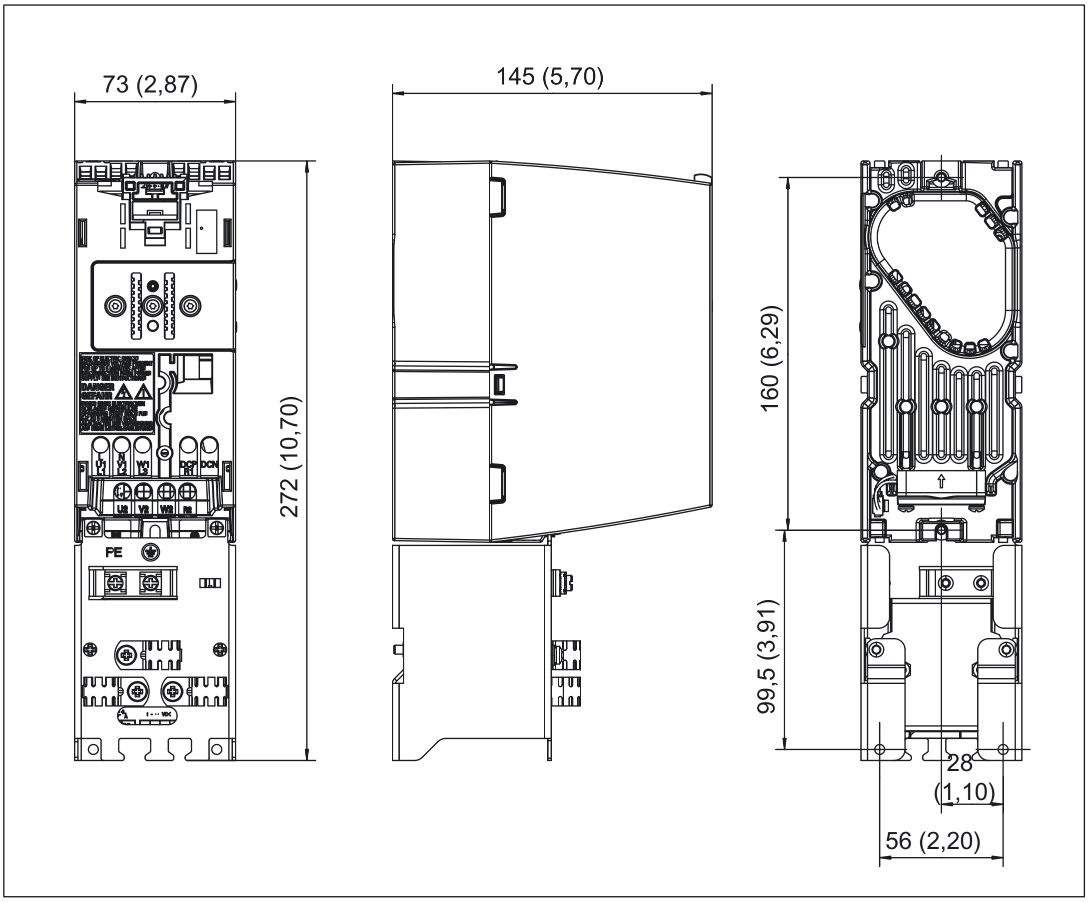


Figure 8-12 Dimension drawing of PM340 Power Module with Screening Kit, frame size FSA, all dimensions in mm and (inches)

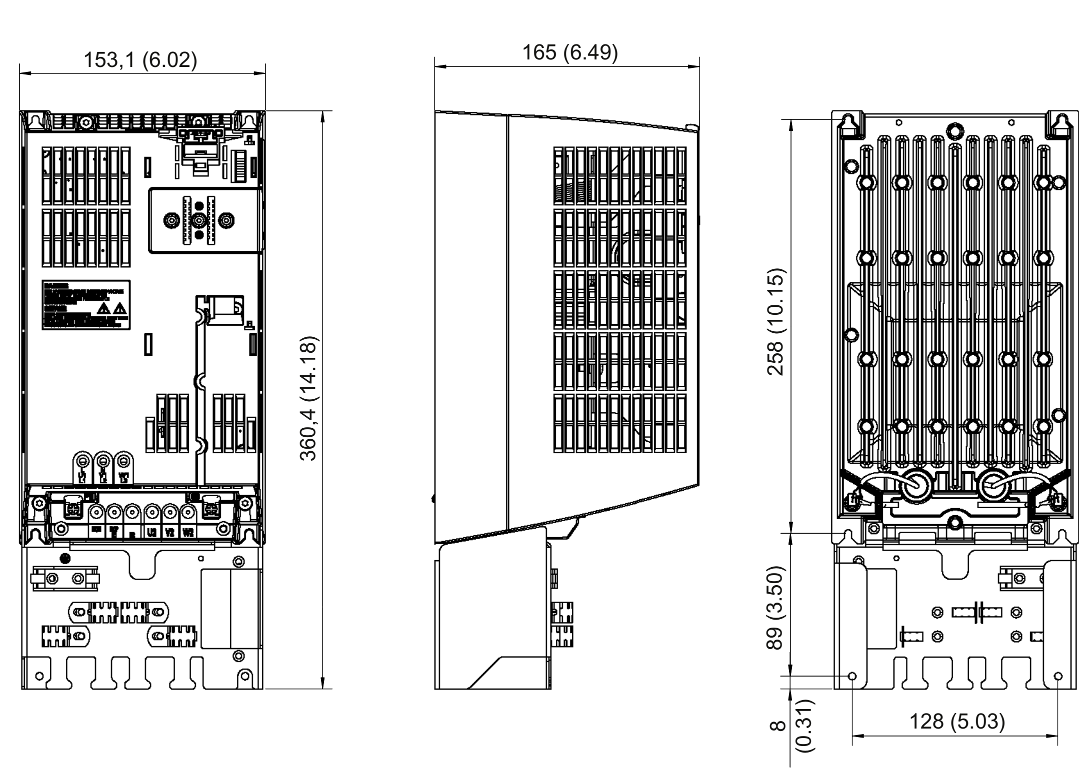


Figure 8-13 Dimension drawing of PM340 Power Module with Screening Kit, frame size FSB, all dimensions in mm and (inches)

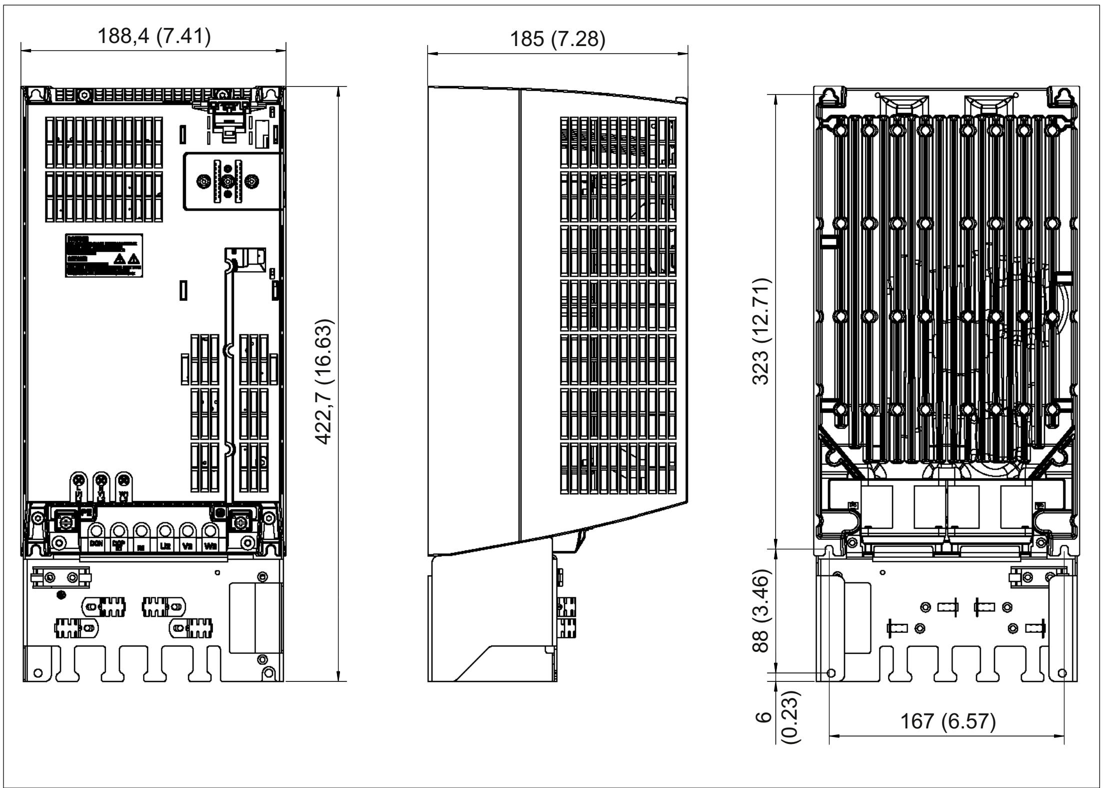


Figure 8-14 Dimension drawing of PM340 Power Module with Screening Kit, frame size FSC, all dimensions in mm and (inches)

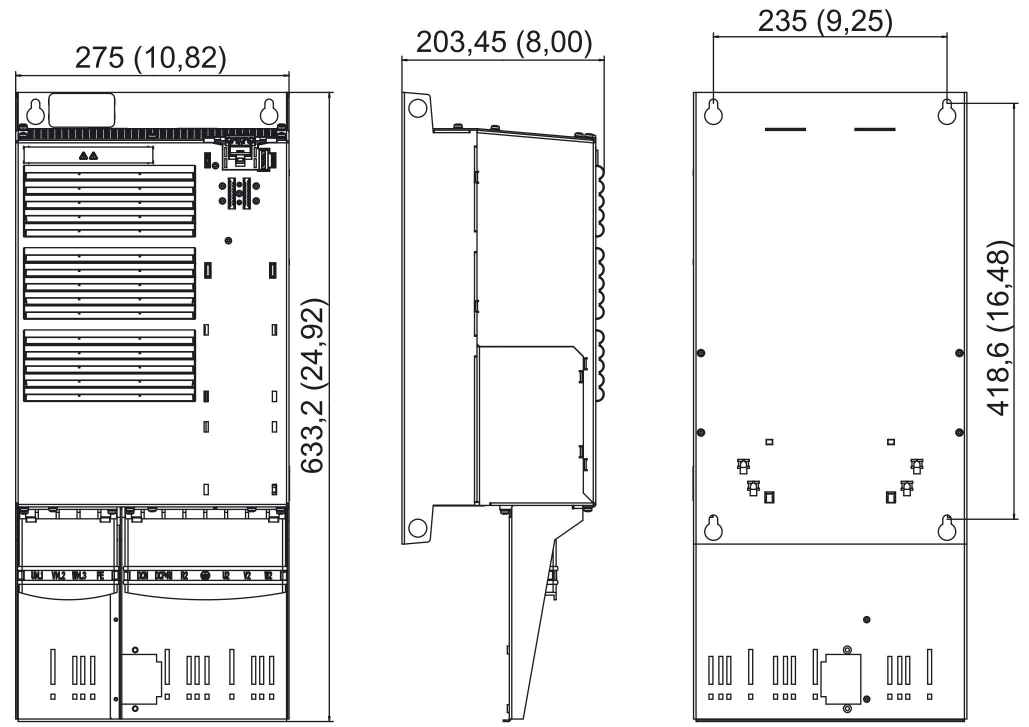


Figure 8-15 Dimension drawing of PM340 Power Module with Screening Kit, frame size FSD, all dimensions in mm and (inches)

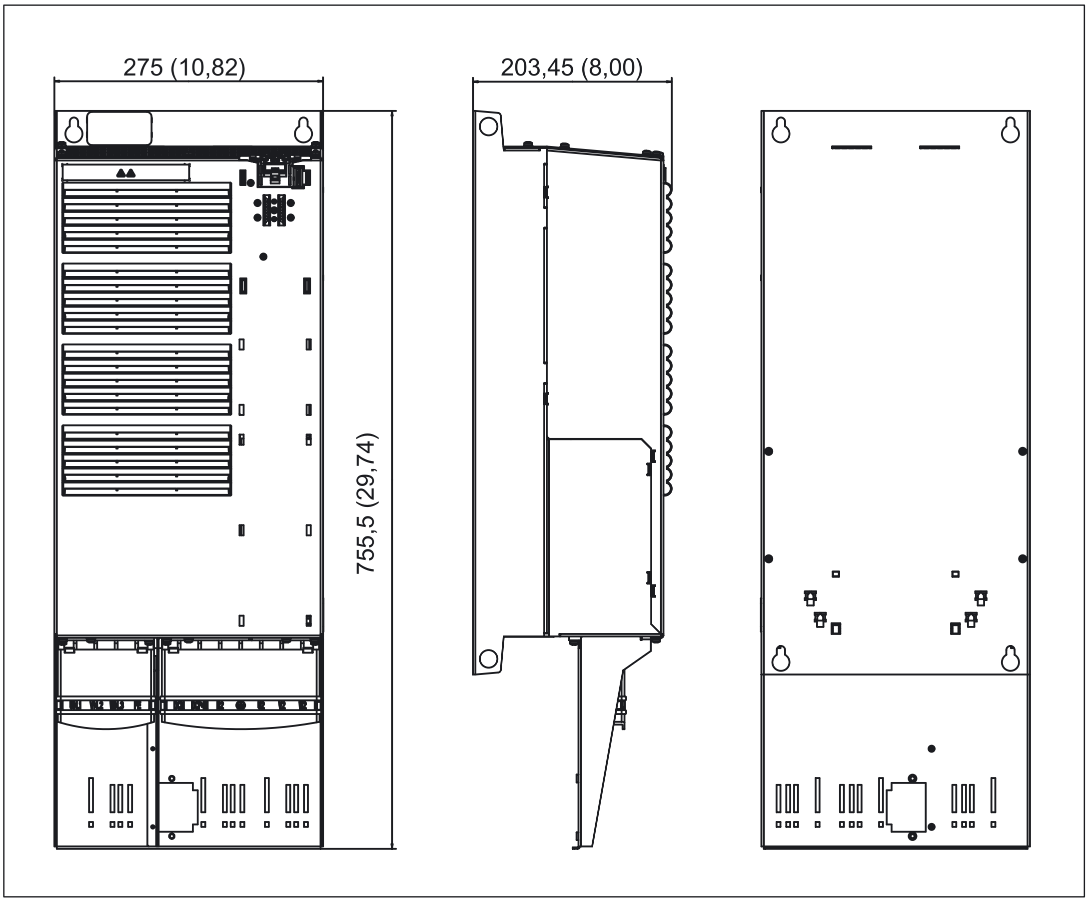


Figure 8-16 Dimension drawing: PM340 Power Module with Screening Kit, frame size FSE, all dimensions in mm and (inches)

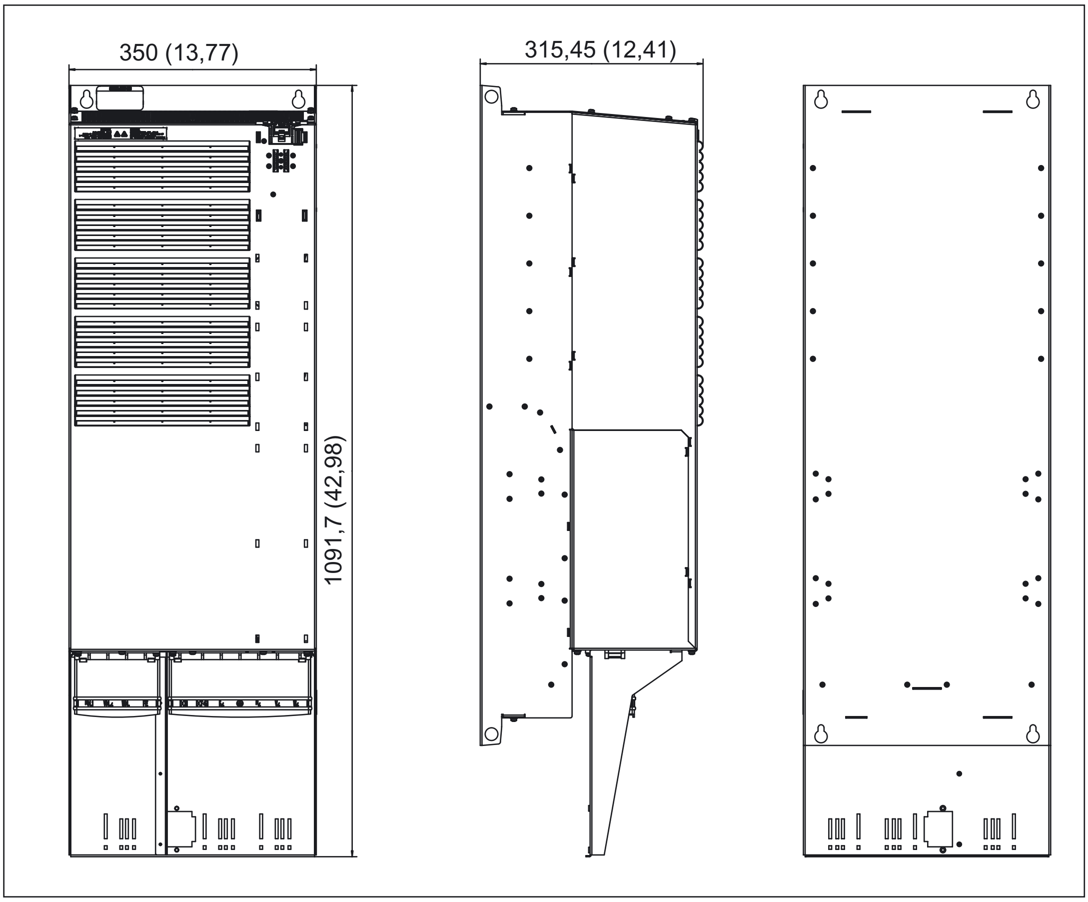


Figure 8-17 Dimension drawing: PM340 Power Module with Screening Kit, frame size FSF, all dimensions in mm and (inches)

8.3.3 Mounting

Frame size FSA

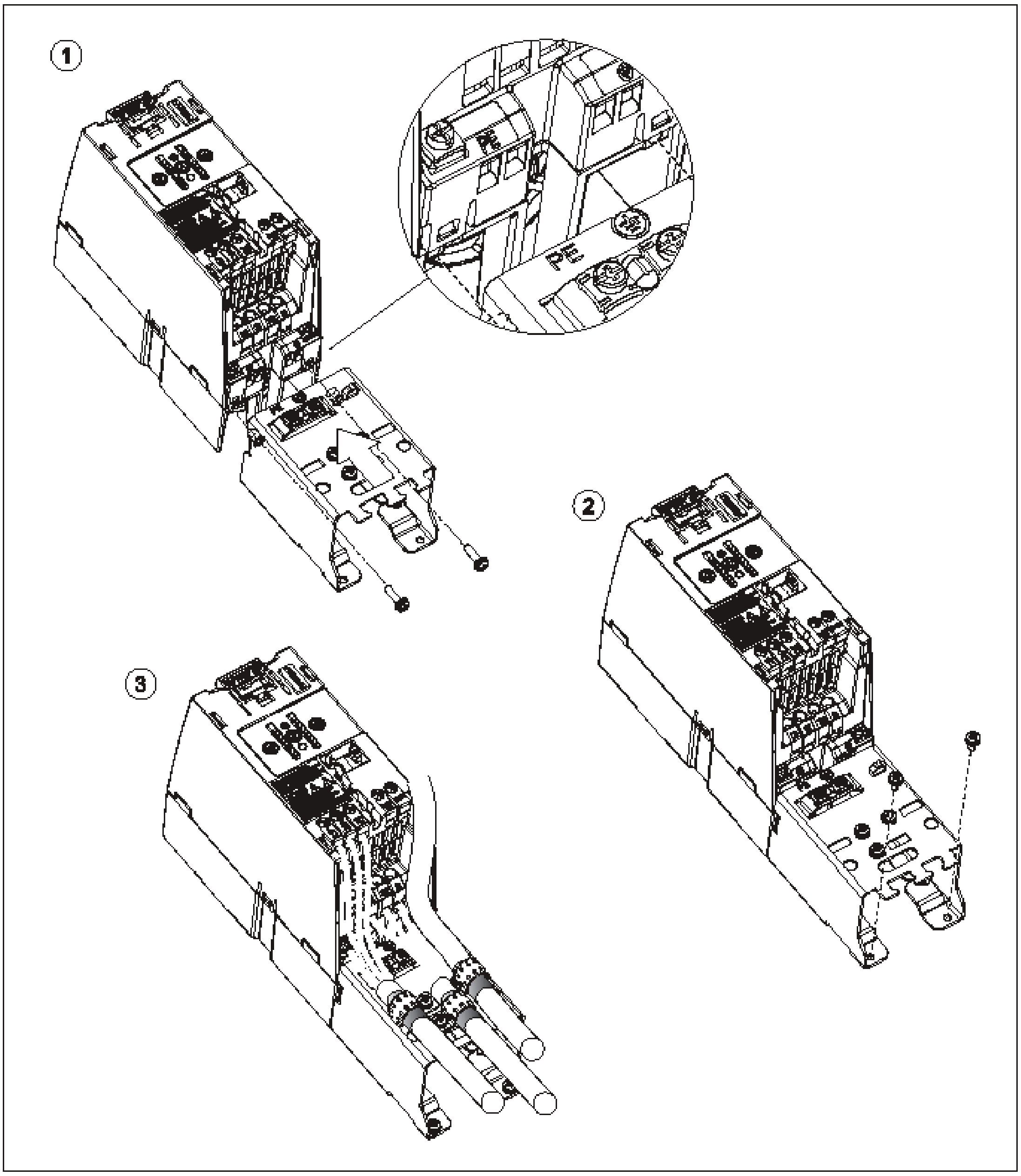


Figure 8-18 Mounting a Screening Kit on a Power Module of frame size FSA

Frame sizes FSB and FSC

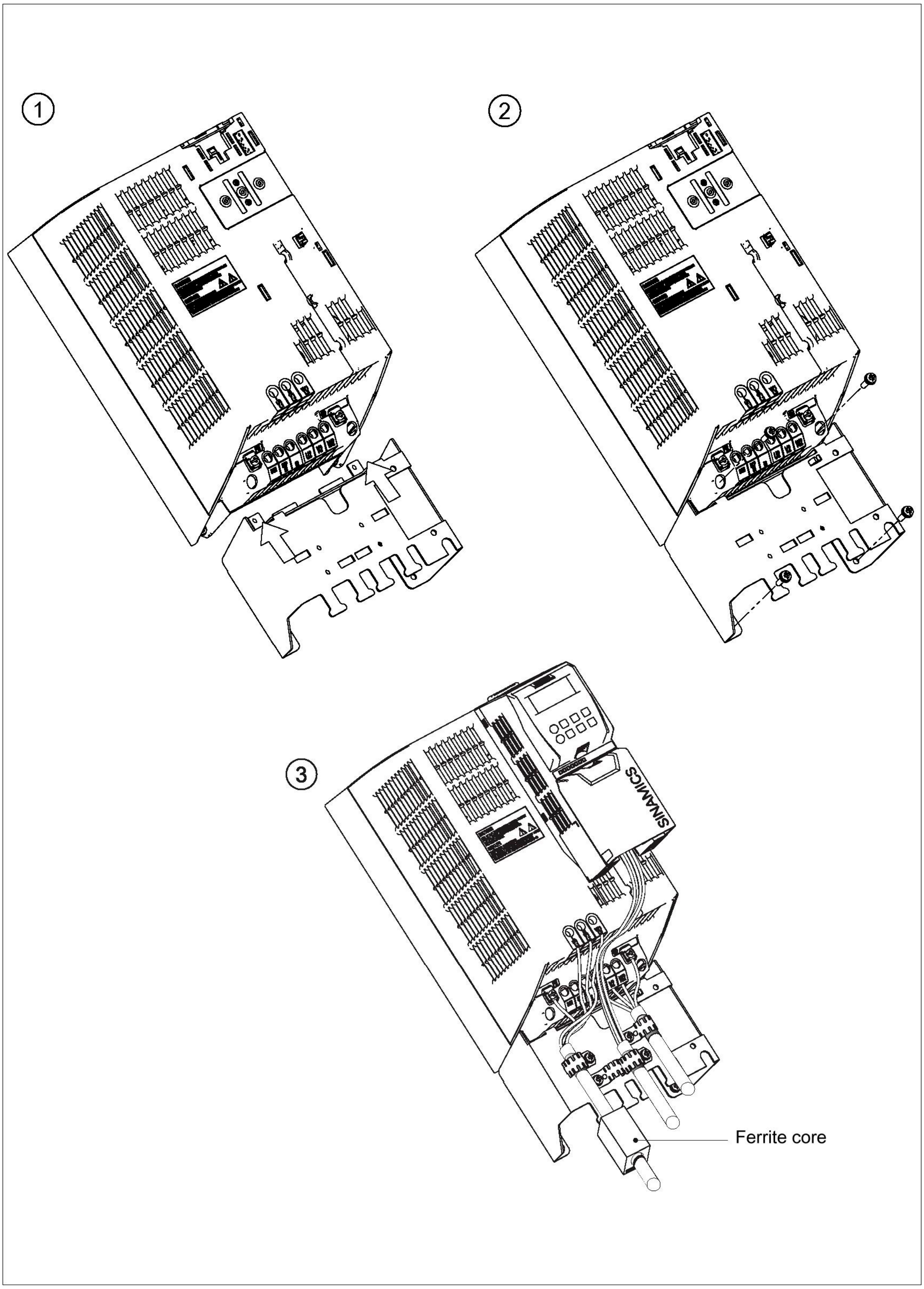


Figure 8-19 Mounting a Screening Kit and ferrite core on a Power Module of frame sizes FSB and FSC

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.

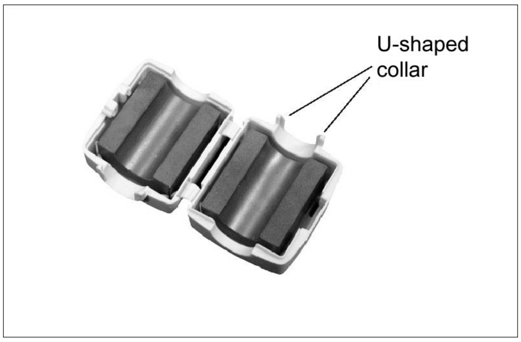


Figure 8-20 Ferrite core, open

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 and FSE

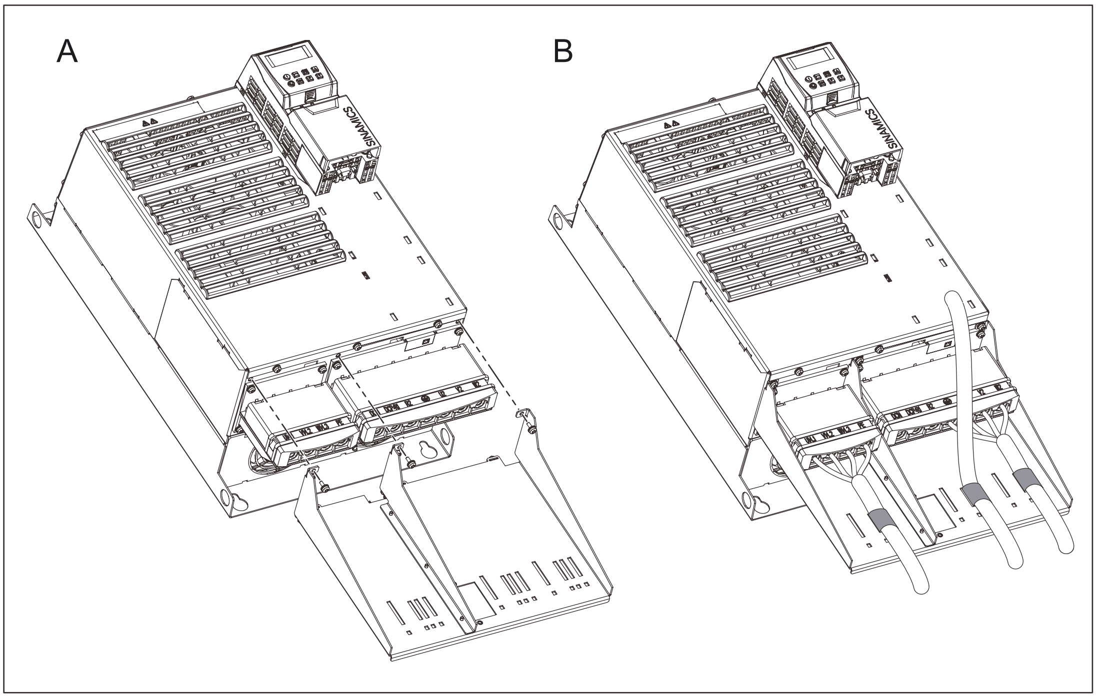


Figure 8-21 Mounting a Screening Kit on a Power Module of frame sizes FSD and FSE

Frame size FSF

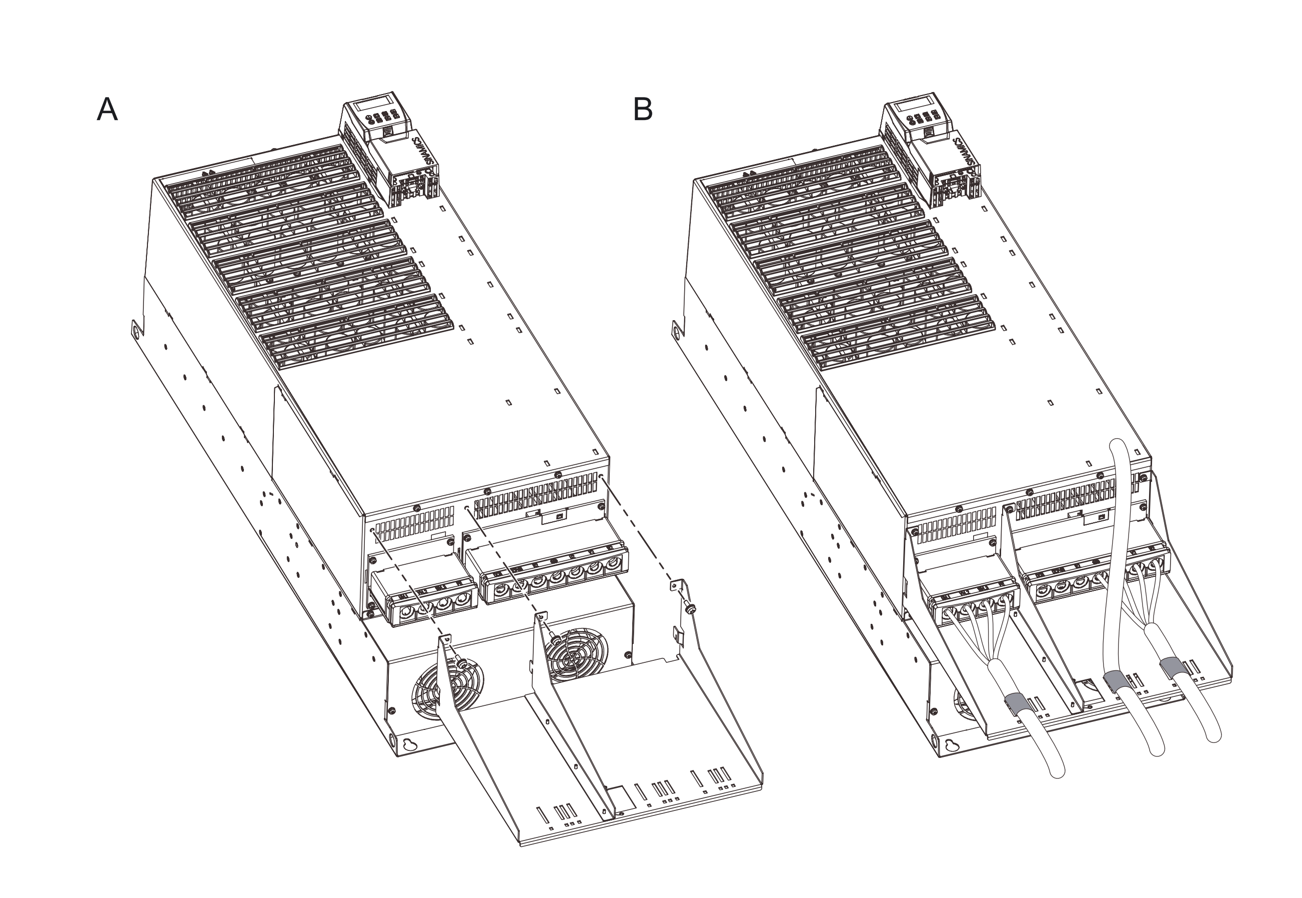


Figure 8-22 Mounting a Screening Kit on a Power Module of frame size FSF

8.3.3.1 Blocksize Liquid Cooled Power Modules

Frame sizes FSD and FSE

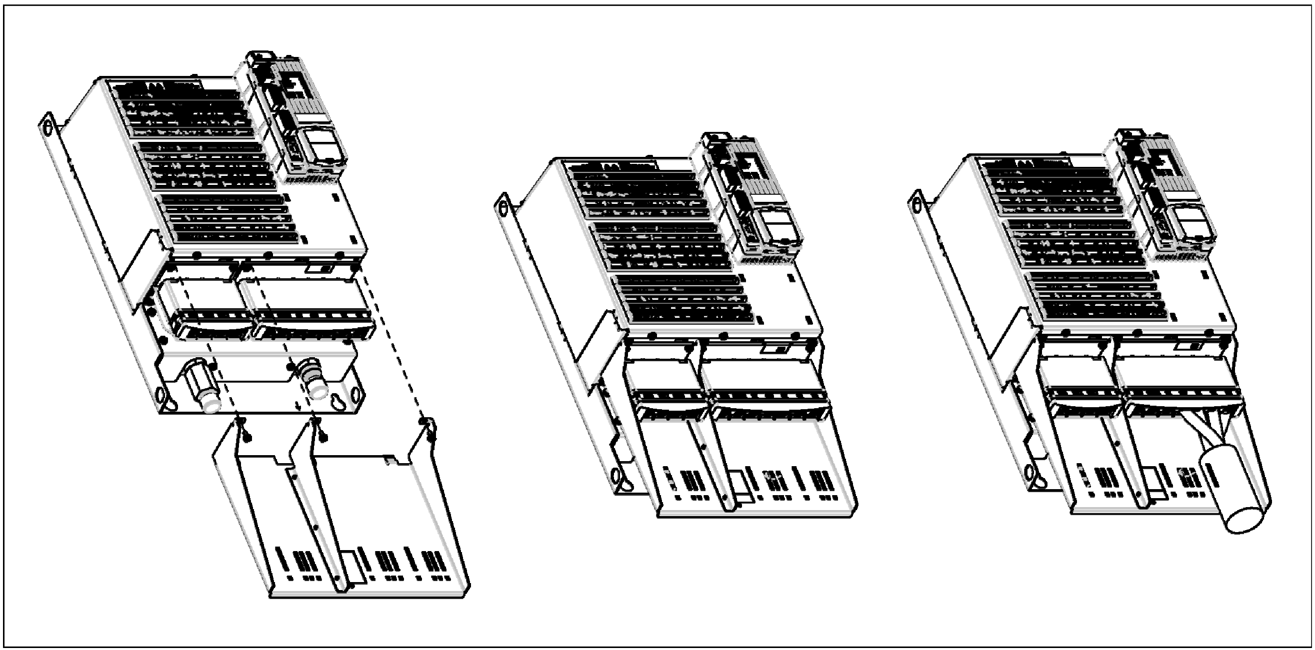


Figure 8-23 Mounting a Screening Kit on a Liquid Cooled Power Module PM340, frame sizes FSD and FSE

Frame size FSF

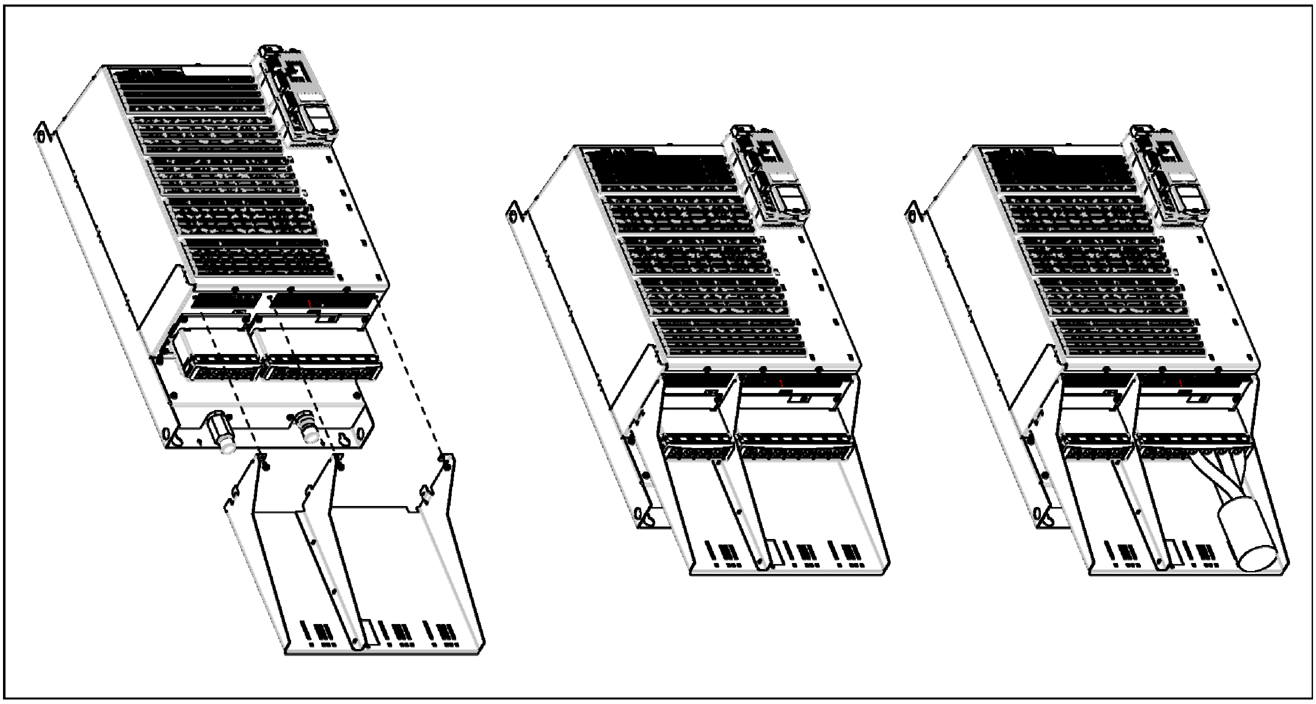


Figure 8-24 Mounting a Screening Kit on a Liquid Cooled Power Module PM340, frame size FSF

Cabinet design and EMC for components, Blocksize format

9

9.1 Information

9.1.1 General

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 shocks. To ensure protection against mechanical stress and climatic conditions too, the components should only be operated in housing/cabinets/rooms that fulfill at least degree of protection IP54 and, as enclosure types, are designed to UL 50.

Prefabricated MOTION-CONNECT cables are recommended.

The Safety Integrated safety function:

The components must be protected against conducted contamination (e.g. by installing them in a cabinet with degree of protection IP54).
Provided that conducted interference can be prevented at the installation site, the degree of protection for the cabinet can be decreased accordingly.

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 1-ph. 200 V AC to 3-ph. 440 V AC

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

9.1.2 Safety information

Note

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

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

CAUTION

To ensure that the encoder system works properly, you are advised to use the original Siemens accessories from catalog PM 21.

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

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

After an intermediate terminal (caused by a terminal block, for example), it is best to continue routing using the approved MOTION-CONNECT cables.

CAUTION

The conductor pair for the motor holding brake must be themselves shielded (braided shield). For MOTION-CONNECT cables, this is provided by the inner shield.

⚠ WARNING

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

Non-observance can cause lethal shock voltages.

⚠ DANGER

To protect against electric shock the components should only be operated in closed electrical operating areas or in cabinets. Furthermore, an internal protective conductor connection of the components is absolutely essential.

The components generate high leakage currents in the protective conductor. In order to ensure protection against electric shocks if the external protective conductor is interrupted, one of the following measures must be implemented for the external connection:

- stationary connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- stationary connection and automatic shutdown of the power supply if the protective conductor is interrupted

9.2 Selecting the line-side units and components required to operate SINAMICS

9.2.1 General

The following components are required to connected to the line supply:

- Disconnector unit
- Overcurrent protection device (line fuse or circuit breaker)
- Line contactor (this is required for electrical isolation)
- Line filter (optional for Power Module PM340, frame size FSA)
- Line reactor (in the chapter titled "Line-side power components")

For information on overvoltage protection, refer to the chapter titled "Overvoltage protection".

9.2.2 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 EN 60204-1, Section 5.3. The relevant technical specifications 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.

9.2.3 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.

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

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

NOTICE
Fuses that can operate across the maximum cable length within a circuit must be rated in accordance with the requirements for: 1. Short-circuit protection (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. The maximum permissible voltage drop during 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 line supplies up to 480 V_{AC}, which can supply a maximum of 36 kA symmetrical ("uninfluenced current" acc. to EN 60269-1).

For further information: See catalog PM 21.

9.2.4 Using residual-current devices

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

NOTICE
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. Since TT systems do not generally meet this requirement, residual-current devices must always be installed for this type of system.

Residual-current-operated circuit breakers (RCD)

Residual-current-operated circuit breakers (RCD) prevent an excessively high touch current being maintained.

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

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

- It is only permissible to use a delayed tripping, selective AC/DC-sensitive residual-current-operated circuit breaker, type B.
- The max. permitted grounding resistance of the "selective protective device" must be observed (83 Ω max. for residual-current devices with 0.3 A rated differential current).
- Accessible parts of the Power Drive System and the machine must be connected to the system's protective ground conductor.
- The shielded motor cable must not be longer than 50 m.
- A separate residual-current device must be used for each Power Module.
- Only one residual-current device may be connected in series (cascading is not permitted).
- Switching elements (disconnector units, contactors) for connecting and disconnecting the Power Drive System have a 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 via a transformer.

9.2.5 Overvoltage protection

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

9.2.6 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.

CAUTION

Line contactors must not be switched under load.

Note

To limit the switching overvoltage, the contactor coil must be connected to an overvoltage limiter (e.g. flywheel diode or varistor).

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

9.2.7 Line filter

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

Refer to the chapters titled "Line filters" and "Line-side power components" for information on selecting and connecting suitable separate line filters for Power Modules of frame sizes FSA, FX, and GX.

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

Note

According to product standard EN 61800-3, RFI suppression 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 machinery to be operated with the drive products and the installed suppression elements, e.g. line filters, are CE/EMC-compliant before the machines are approved for delivery.

9.3 24 V DC Supply Voltage

9.3.1 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. 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
If other consumers are connected to the power supply, connected inductance devices (contactors, relays) must be fitted with suitable overvoltage protection circuits.

NOTICE
A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage 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 • Use of Siemens MOTION-CONNECT power cables • Motor cable lengths: max. 100 m

9.3.2 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 9- 1 Recommended SITOP Power

Rated output current [A]	Phases	Rated input voltage [V] Working voltage range [V]	Short-circuit current [A]	Order number
5	1 / 2	120 - 230/230 - 500 85 - 264/176 - 550 AC	Approx. 5.5 (power up), typ. 15 for 25 ms (operation)	6EP1333-3BA00-8AC0
10	1 / 2	120 - 230/230 - 500 85 - 264/176 - 550 AC	Approx. 12 (power up), typ. 30 for 25 ms (operation)	6EP1334-3BA00-8AB0
20	1 / 2	120/230 85 - 132/176 - 264 AC	Approx. 23 (power up), typ. 60 for 25 ms (operation)	6EP1336-3BA00-8AA0
	3	230/400 to 288/500 320 - 550 3 AC		6EP1436-3BA00-8AA0
40	1 / 2	120/230 85 - 132/176 - 264 AC	Approx. 46 (power up), typ. 120 for 25 ms (operation)	6EP1337-3BA00-8AA0
	3	230/400 to 288/500 320 - 550 3 AC		6EP1437-3BA00-8AA0

Table 9- 2 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	6SL3100-1DE22-0AA0

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 installed close to the drive line-up.

Ideally, they should be installed 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.

9.3.3 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 9- 3 Overview of 24 V DC current consumption

Component	Typical current consumption [A_{DC}]
Control Units and Control Unit Adapters	
CU310 DP without load Per digital output	0.8 0.1
CU310 PN without load Per 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
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

9.3.4 Overcurrent protection

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

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

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

Circuit breakers from the Siemens LV 1 and LV 1T catalogs are recommended as overcurrent protection devices on the primary side, and miniature circuit breakers or SITOP select 6EP1961-2BA00 as overcurrent protection devices on the secondary side. The miniature circuit breakers can also be selected from the Siemens LV 1 and LV 1T catalogs.

Miniature circuit breakers are recommended as overcurrent protective device for cables and busbars. The ground potential M must be connected to the protective conductor system (DVC A).
When selecting the 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 and UL 508C.

In so doing, the following conditions for the conductors/cables must be carefully taken into consideration:

- Ambient temperature 55 °C
- Limiting conductor temperature ≥ 75 °C for operation with the rated load current
- Maximum cable length:
  - 10 m for the supply supply cables
  - 30 m for signal lines

In addition, the conductors/cables should be routed so that

- Max. 1 conductor pair is bundled, and
- The 24 V conductors/cables must be routed separately from other cables and conductors that can conduct operating currents.

Table 9- 4 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 MCBs must be selected to match the loads to be protected and the maximum current provided by the supply unit in the event of a short circuit.

9.3.5 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 supply and the 24 V signal cables from overvoltage:

Table 9- 5 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
Weidmüller GmbH & Co. KG An der Talle 89 33102 Paderborn, Germany Phone +49 (0)5252 960 0 Fax +49 (0)5252 960 116 http://www.weidmueller.com	

The overvoltage protectors must always be placed next to the area to be protected, e.g. at the entry point to the control cabinet.

9.4 Arrangement of components and equipment

9.4.1 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.

9.4.2 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 9-1 Mounting the CU310 onto the Power Module PM340 (frame size FSD)

Mounting Power Modules with sub-chassis components

Many system components are designed as sub-chassis components for PM340 Power Modules in frame sizes FSA to FSE. In such cases, the sub-chassis component is installed on the mounting surface and the PM340 Power Module in front of it, in order to save space.

Table 9- 6 Available sub-chassis components

	FSA	FSB	FSC	FSD	FSE
Line filter	x	-	-	-	-
Line reactor	x	x	x	x	x
Braking resistor	x	x			
Motor reactor	x	x	x		

x.. Sub-chassis installation possible

-.. Not available as an external component (use a Power Module with an integrated line filter)

Up to two sub-chassis components can be mounted in front of one another. For configurations involving more than two sub-chassis-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 9- 7 Mounting sequence for sub-chassis 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

NOTICE
The braking resistor must always be mounted next to the Power Module, as it can get very hot.

Wiring rules for DRIVE-CLiQ

Refer to /IH1/ SINAMICS Commissioning Manual.

9.5 Information about electromagnetic compatibility (EMC) and cable routing

9.5.1 General

Requirements to implement EMC are listed in EN 61000-6-2, EN 61000-6-4, EN 61800-3, EN 60204-1 and in the EMC Design Directives - Order No. 6FC5297-0AD30-0*P2.
(*A: German, *B: English). Conformance with the EMC Directive of the EC can be secured by following the measures described in the EMC Design Directives.
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

CAUTION
If couplings or cabinet glands are needed for the DRIVE-CLiQ connections, only the DRIVE-CLiQ coupling and DRIVE-CLiQ cabinet gland, described in the Chapter Accessories, may be used.

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

9.5.2 Cable Shielding and Routing

In order to comply with the EMC requirements, certain cables must be routed apart from other cables and from certain components. To full EMC requirements, the following cables must be used with shields:

- 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.

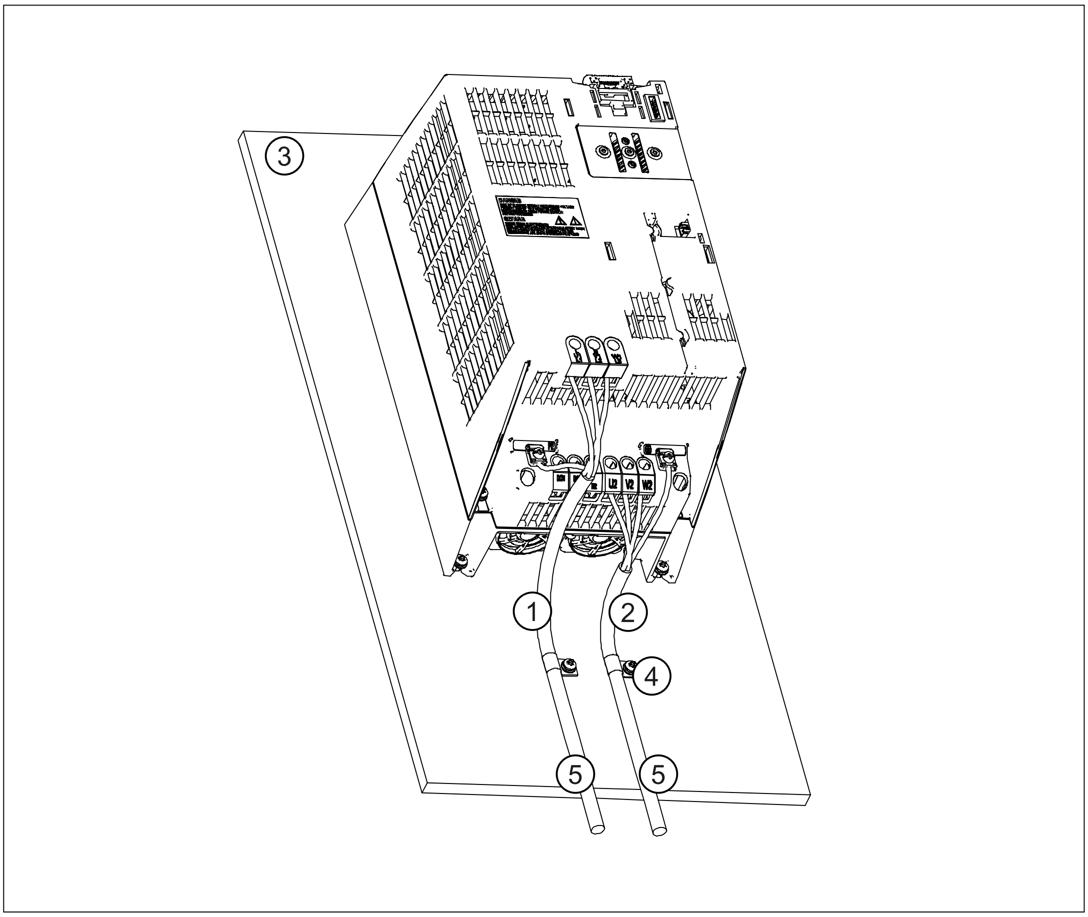


Figure 9-2 Shielding of a Power Module PM340

1. Line supply input
2. Motor cable
3. Rear metal panel
4. Use suitable clamps/clips to reliably connect the shield of the motor and field cable to the rear metal panel.
5. Shielded cable

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.

Shield connection plates with pre-prepared clip contacts are available for connecting the shields for power cables of 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.

9.5.3 Signal cables and 24 V supply cables

If you are using unshielded signal cables and 24 V supply cables (e.g. 24 V infeed with external supply), the following cable lengths are permissible:

- 24 V supply cables: max. length 10 m
- Signal cables: max. length 30 m without supplementary RC circuit

For longer lengths, the user must connect a suitable protective circuit up in order to provide overvoltage protection (refer to the chapter titled "Protection against overvoltage").

CAUTION
The connected signal and power cables must be routed in such a way that they do not cover the ventilation slots.

CAUTION
Non-shielded signal cables must not be routed parallel to power cables.

9.5.4 Equipotential bonding

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

The machinery construction OEM must carefully ensure that all of the conditions regarding the assignment of the ground cable, ground connecting cables, protective conductor and potential bonding cable connections and terminals are clearly specified in his Technical User/Manufacturer Documentation, are clearly specified (this is especially important if there are several protective conductor/potential bonding conductor connections/terminals in the unit). It is especially important to note that the connections for potential bonding cables that exist in parallel to connections for protective connecting cables may not be used to loop-through the protective connecting cable.

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

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

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

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

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

Create a low-impedance ground connection for additional control cabinets, system components, and distributed units with the largest possible cross-section (at least 16 mm²). Other system and machine components must also be integrated in the concept for equipotential bonding conductors. The protective ground conductor for the motors used must be connected via a protective ground conductor within the motor cable.

NOTICE
If the above information about equipotential bonding is not taken into account, this can cause fieldbus interfaces or other units to malfunction.

9.6 Connection methods

9.6.1 Screw terminals

Connectable conductor cross-sections of screw terminals

Table 9- 8 Screw terminals

Screw terminal type			
1	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.14 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 wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.2 mm² to 2.5 mm² 0.25 mm² to 1 mm² 0.5 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	

9.7 Information on control cabinet cooling

9.7.1 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.

CAUTION
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 9- 9 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 DP	50 (1.97)		
CU310 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 sub-chassis components up to an ambient temperature of 40 °C. In combination with sub-chassis 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.

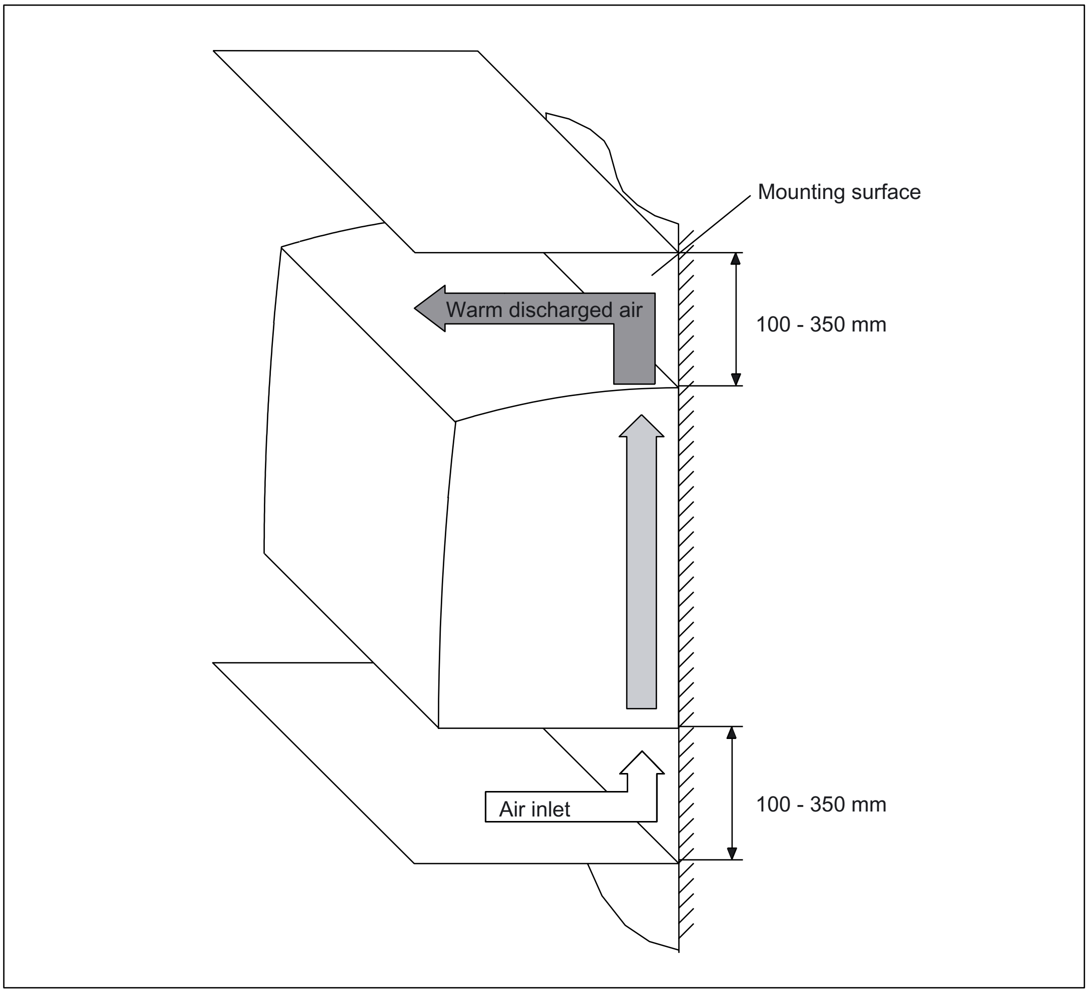


Figure 9-3 Cooling clearances

9.7.2 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.

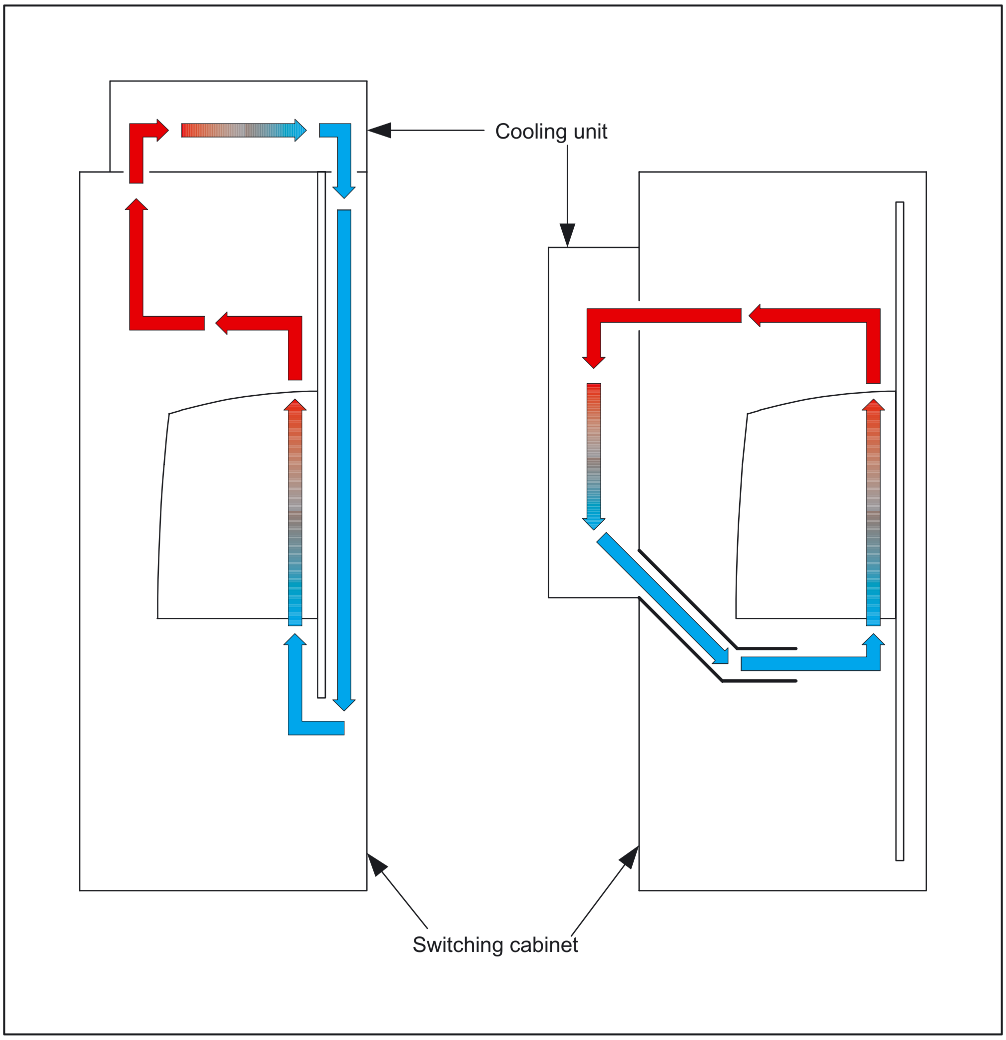


Figure 9-4 Examples of cabinet ventilation

CAUTION
The air guidance and arrangement of the cooling equipment must be chosen in such a way as to prevent condensation from forming. If necessary, cabinet enclosure heating may have to be installed.

If air conditioners are used, the relative air humidity of the expelled air increases as the air in the air conditioner cools and may exceed the dew point. If the relative humidity of the air entering the SINAMICS equipment is over 80% for an extended period of time, the insulation in the equipment may fail to function properly due to electrochemical reactions (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.

9.7.3 Power loss of components in rated operation

9.7.3.1 General information

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 Chassis Power Modules, 2 kHz
- Operating components at their rated power

9.7.3.2 Power loss for Control Units, Control Unit Adapters, and Sensor Modules

Table 9- 10 Overview of power loss during rated operation for Control Units, Control Unit Adapters, Sensor Modules

Component	Unit	Power loss
Control Units		
CU310 DP	W	< 20
CU310 PN	W	20
Control Unit Adapter		
CUA31	W	2.4
CUA32	W	2.6
Sensor Modules		
SMC10	W	< 10
SMC20	W	< 10

9.7.3.3 Power loss for line reactors and line filters

Table 9- 11 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

9.7.3.4 Power loss for Power Modules

Table 9- 12 Overview of power loss during rated operation for Power Modules

Rated output current I_{rated}/Rated power 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)]
Chassis Power Modules				
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

Cooling circuit and coolant properties 10

10.1 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.

10.1.1 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.

10.1.2 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.

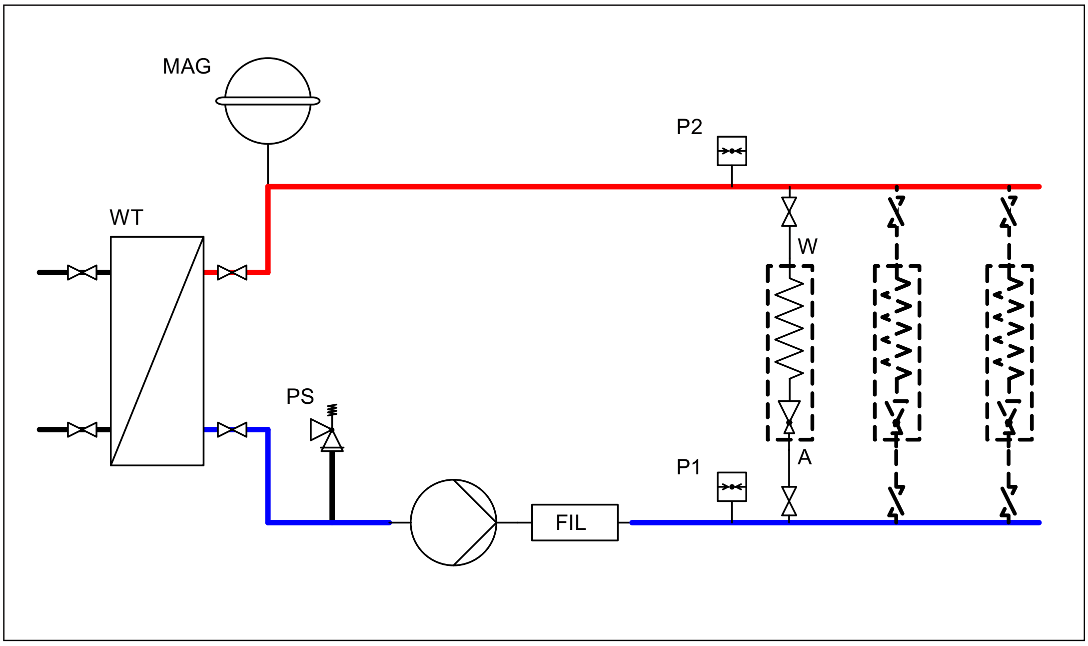


Figure 10-1 Example of a closed cooling circuit

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 rated power 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.

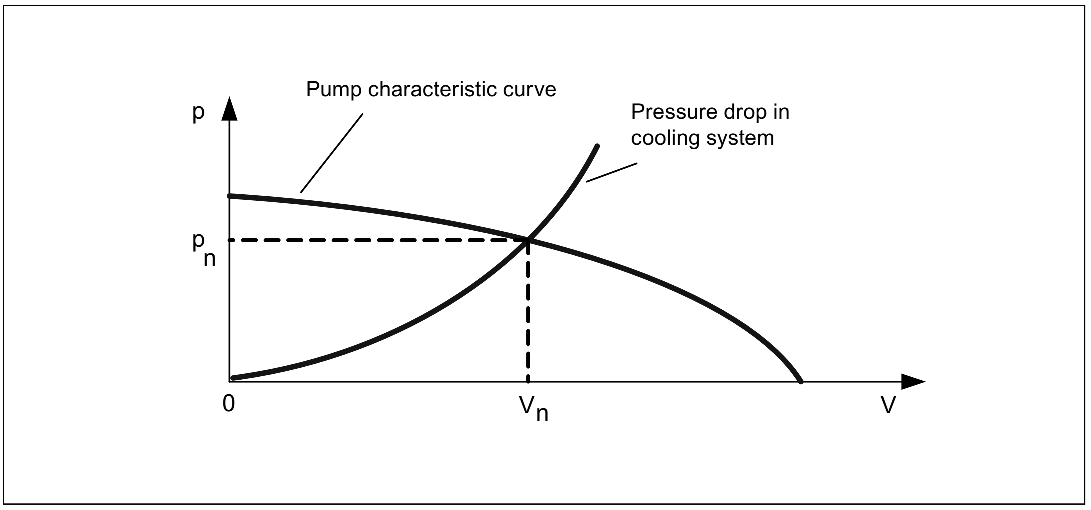


Figure 10-2 Pump characteristic curve

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.

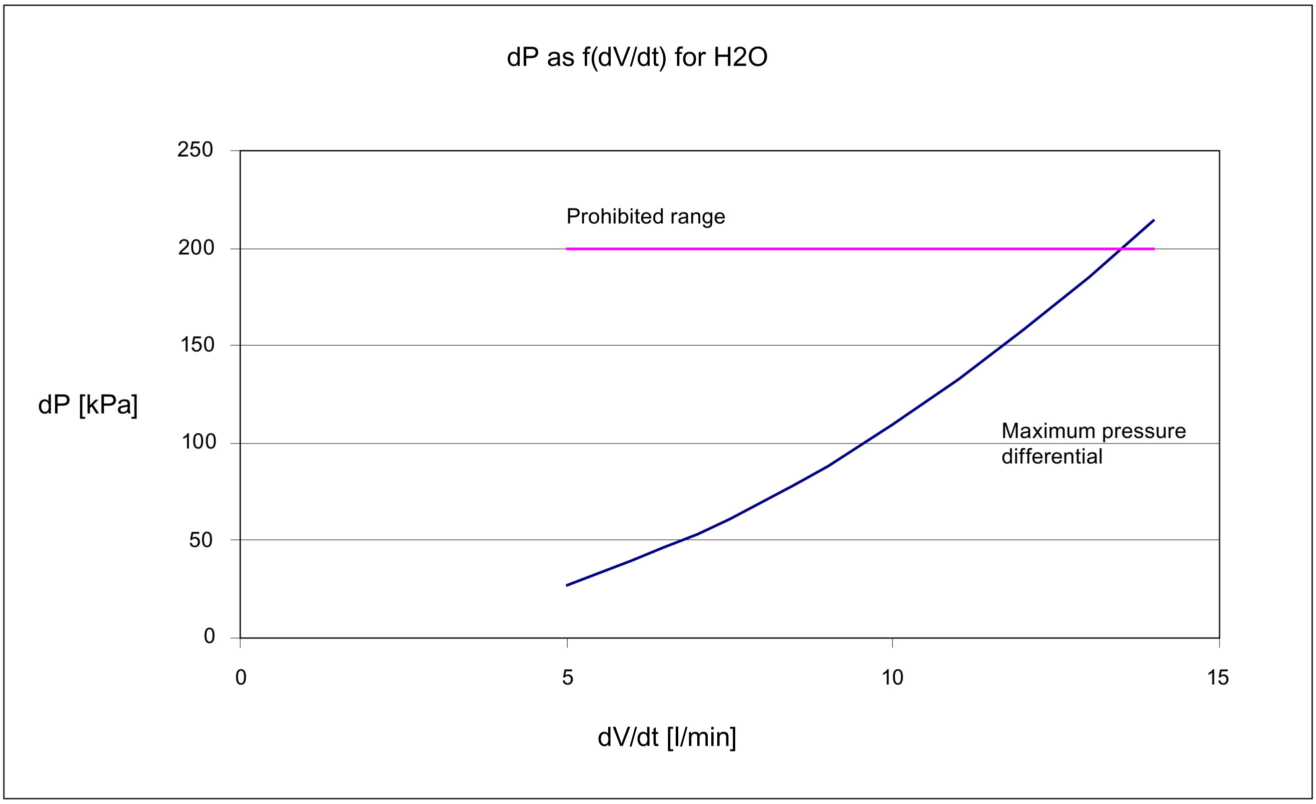


Figure 10-3 Pressure difference as a function of volumetric flow

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 10- 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.

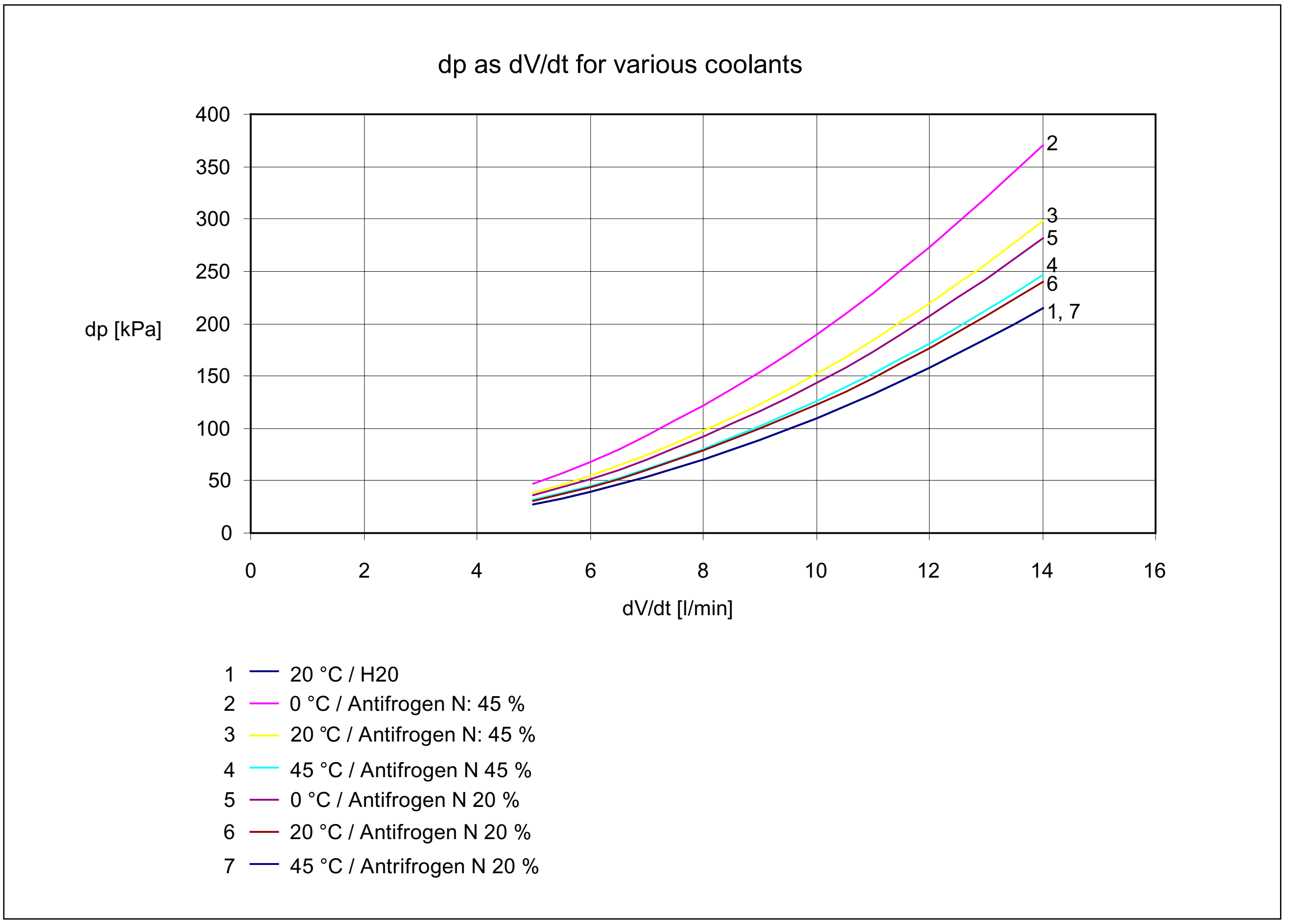


Figure 10-4 Pressure difference as a function of volumetric flow for various coolants and temperatures

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.

10.1.3 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.

CAUTION
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 by Semperit; http://www.semperit.at)
- DEMITEL® hoses made of PE/EPDM (Telle; http://www.telle.de)
- 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.

NOTICE
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.

10.1.4 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.

10.1.5 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.

CAUTION
Ventilation must only be performed when the system is at zero voltage.

10.2 Coolant requirements

10.2.1 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

NOTICE
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.

NOTICE
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, although 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.

10.2.2 Anti-corrosion additives (inhibitors)

Inhibitor without anti-freeze effect

Nalco 00GE056 (ONDEO Nalco; http://www.ondeonalco.com) must be used as an 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.

10.2.3 Anti-freeze additives

Antifrogen N (Clariant; http://www.clariant.com) is recommended as an antifreeze. The proportion of antifreeze must be between 20% and 30%. This ensures frost protection in temperatures down to -10 °C.

NOTICE
If the proportion of antifreeze added is greater than 30%, this can inhibit the transfer of heat and prevent the units from functioning correctly.

NOTICE
Cooling water mixtures with Antifrogen N are highly conductive. In the event of leakage, the insulating systems must be cleaned.

NOTICE
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.

10.2.4 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 partial doses of Nalco N 77352 (ONDEO Nalco; http://www.ondeonalco.com) twice a month, rather than adding an entire dose all at once (i.e. to introduce pauses in the dosing process).
  Dosage: 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.

10.3 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 10- 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

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).

10.4 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 11

11.1 Safety information

⚠ DANGER
Only Siemens customer service, repair centers that have been authorized by Siemens or authorized personnel may repair drive equipment. Al of the persons involved must have in-depth knowledge of all of the warnings and operating instructions as listed in this Manual. All damaged parts or components must be replaced. Spare parts are available on the Internet at: http://support.automation.siemens.com/WW/view/en/16612315

⚠ DANGER
Before starting any work, after the specified 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.

⚠ DANGER
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.

11.2 Service and maintenance for components, Blocksize format

11.2.1 Replacing hardware components

NOTICE
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

11.2.2 Replacing the fan on the CU310 PN and CU310 DP

The CU310 fans switch on depending on the internal module temperature. If the temperature reaches an impermissible value, this is signaled by a warning:
A1009: CU warning: Control Unit overtemperature

In this case, the temperature (CU parameter r0037[0]) of the CU310 has exceeded the specified limit value.

Remedy:

- Check the supply air for the CU310
  - Does the control cabinet temperature fall within the permitted range?
  - Is natural convection possible?
- Check the fan for the CU310
  - Is the fan failing to rotate, despite the warning?
  - Is the fan blocked by dirt/foreign bodies?

The warning will automatically disappear as soon as the limit value is undershot.

If the fan fails to rotate despite a warning being present, it is faulty and must be replaced. The fan can be ordered as a spare part using order number 6SL3064-0AC00-0AA0.

> ⚠ **CAUTION**
>
> The fan on the Control Unit CU310 may only be replaced by qualified skilled personnel and strictly in accordance with ESD guidelines.
> - The module must be in a de-energized state.
> - Use a flat-bladed screwdriver with an extremely thin blade; be careful not to damage the plastic enclosure.
> - Avoid making contact with the printed circuit board.

Replacing the fan

1. Remove all connectors from the component, then remove the component from the drive line-up.
2. Use a flat-bladed screwdriver to carefully release all seven snap hooks on the front plate (three on the left, three on the right, one at the bottom).

Figure 11-1 Lateral snap hooks on a CU310 DP

3. Remove the front plate.
   The fan is located underneath the module.

4. Remove the cable connector (1) for the fan. To do this, press the release and the connector together gently and remove the connector.

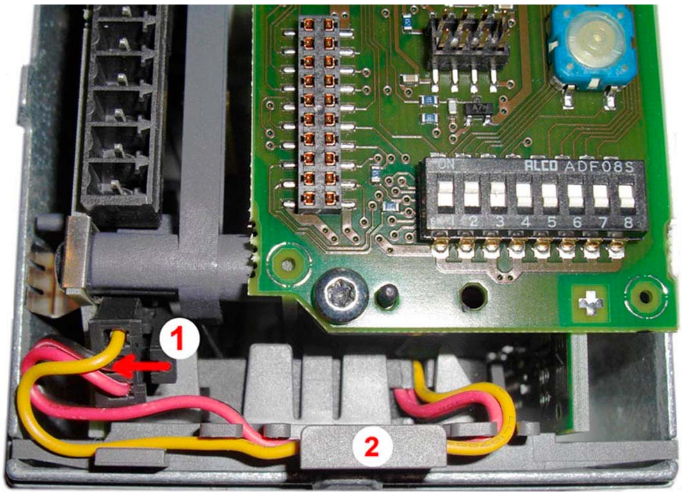


Figure 11-2 CU310 DP - View without front plate

5. Carefully remove the fan using the plastic lug (2).
6. Insert the new fan and reattach the cable connector until it engages.
7. Check the position of the fan cables to ensure that they cannot become jammed when the front plate is reattached.
8. Replace the front plate and re-engage all seven snap hooks.

11.2.3 Replacing the fan on the PM340

For all frame sizes of PM340, the fans are accessible from the outside. For frame sizes FSA to FSC, a Phillips screwdriver is required for replacing fans.
The fan can be ordered as a spare part.

NOTICE
Only trained personnel may replace the fan on a PM340, observing ESD guidelines.
The component must be in a de-energized state.
The component must have been removed from the drive line-up in order to replace the fan.

Replacing the fan on a PM340, frame sizes FSA, FSB, and FSC

1. Remove the fan's fixing screws underneath the Power Module.
2. Remove the cable connector.
3. Take out the faulty fan.
4. Insert the new fan.
5. Reattach the cable connector.
6. Screw the fixing screws in.

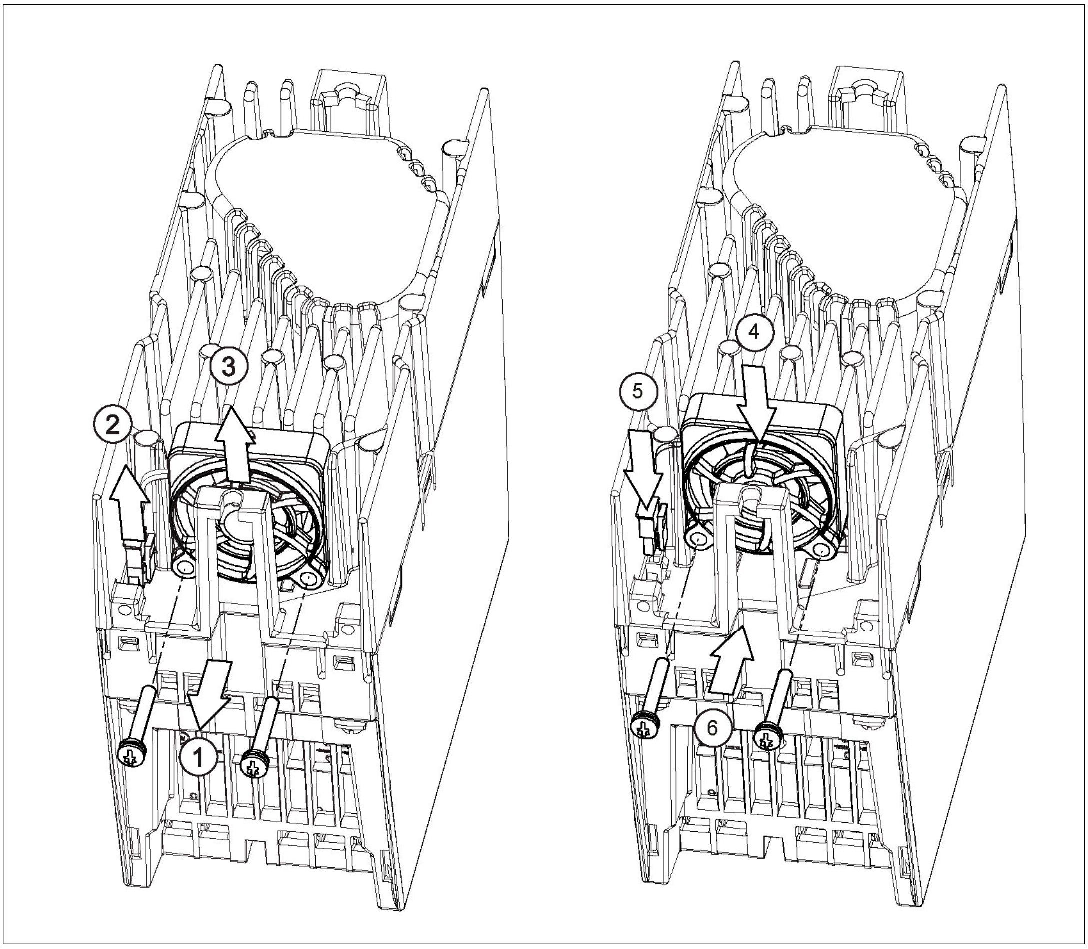


Figure 11-3 Replacing the fan on a Power Module PM340, frame size FSA (tightening torque 0.4 Nm)

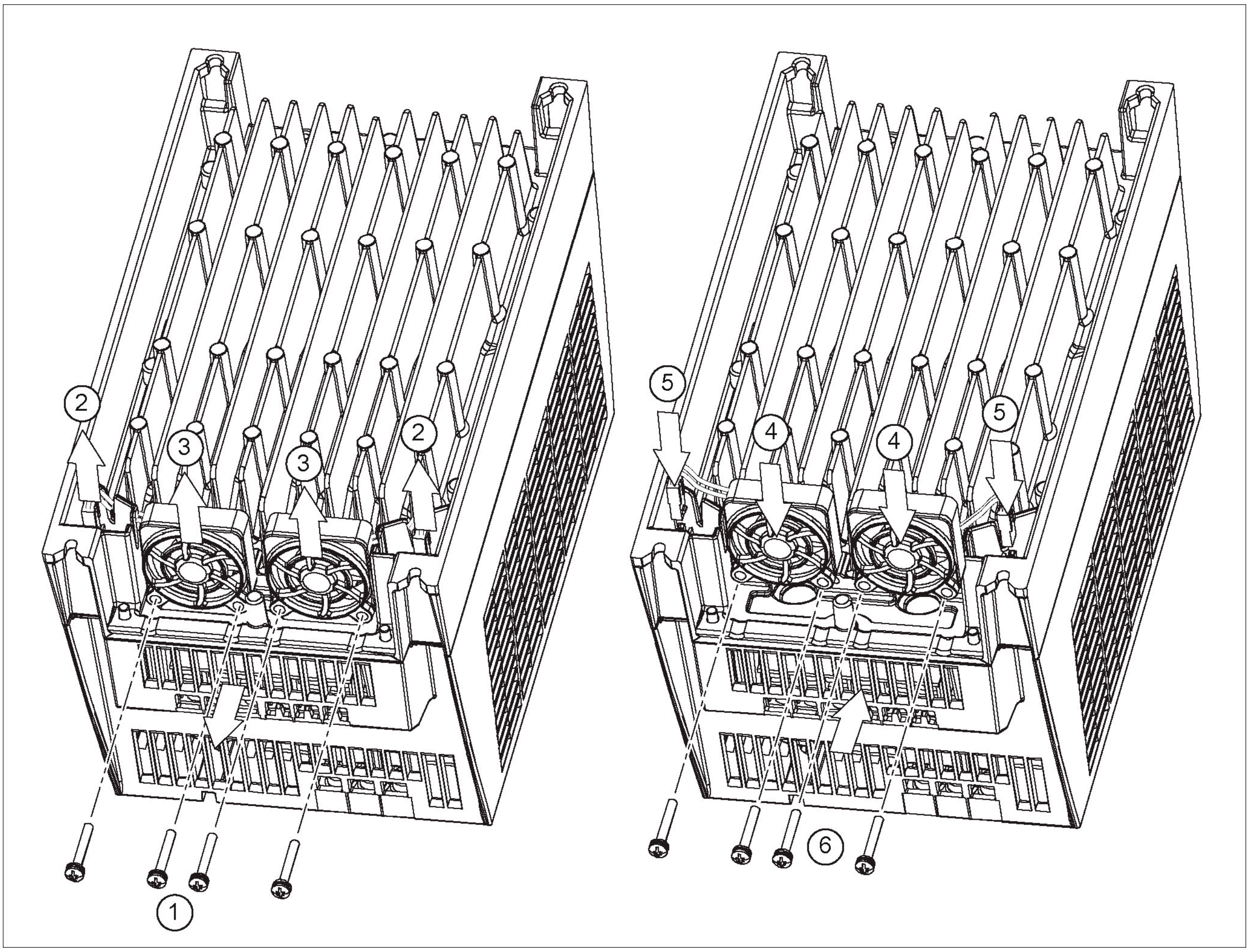


Figure 11-4 Replacing the fan on a Power Module PM340, frame sizes FSB and FSC (tightening torque 0.4 Nm)

Replacing the fan on a PM340, frame sizes FSD and FSE

1. Removing the cover using a suitable tool.
2. Withdraw the two connectors shown and lift-out the fan.
3. Use the new fan and insert both connectors.
4. Close the protective cover.

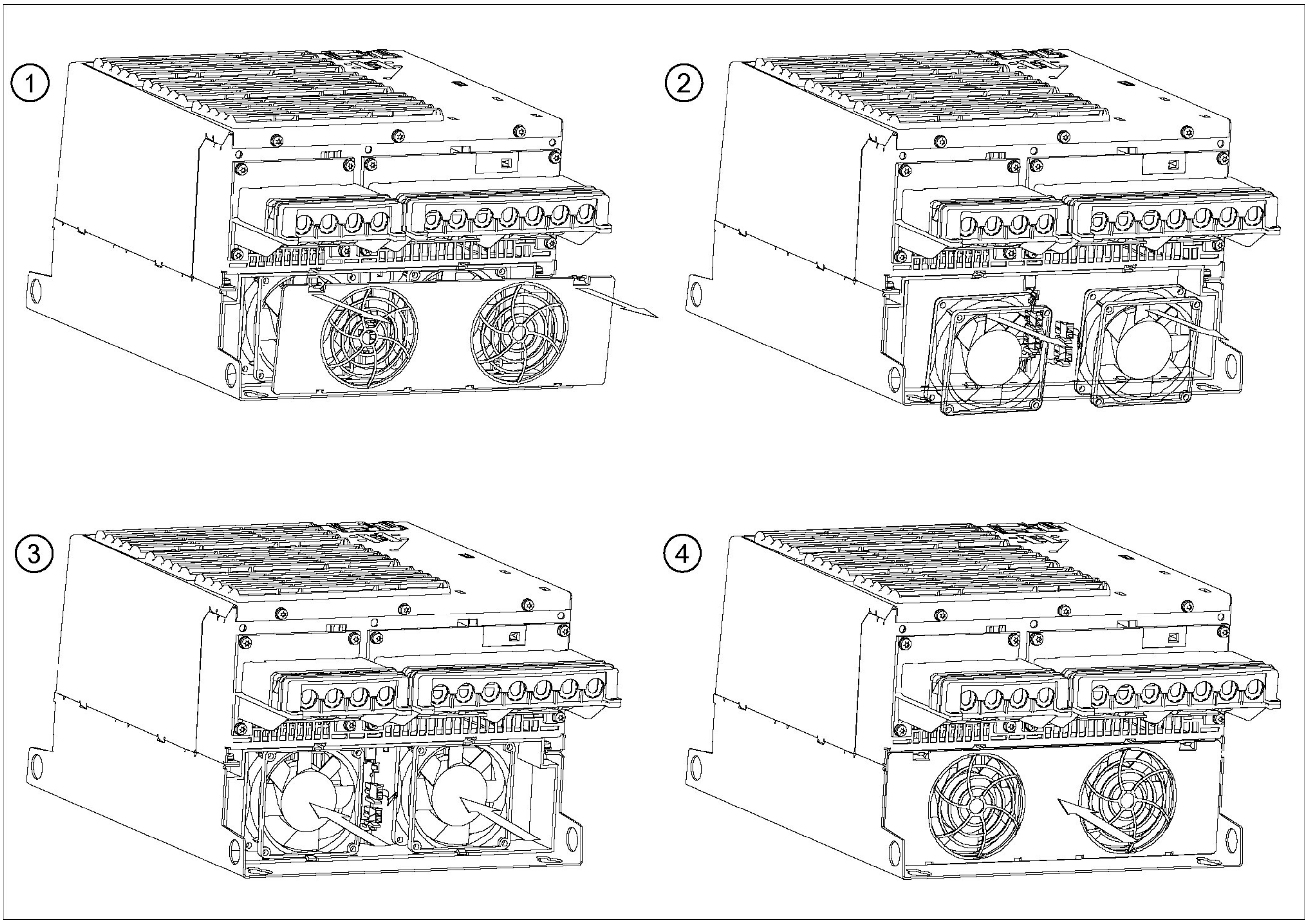


Figure 11-5 Replacing a fan for a Power Module PM340, frame sizes FSD and FSE

Replacing the fan on a PM340 of frame size FSF

1. Release the screws and remove the cover.
2. Withdraw the two connectors shown and lift-out the fan.
3. Insert the new fan, locate both connectors, close the cover and tighten the screws (tightening torque, 3.0 Nm).

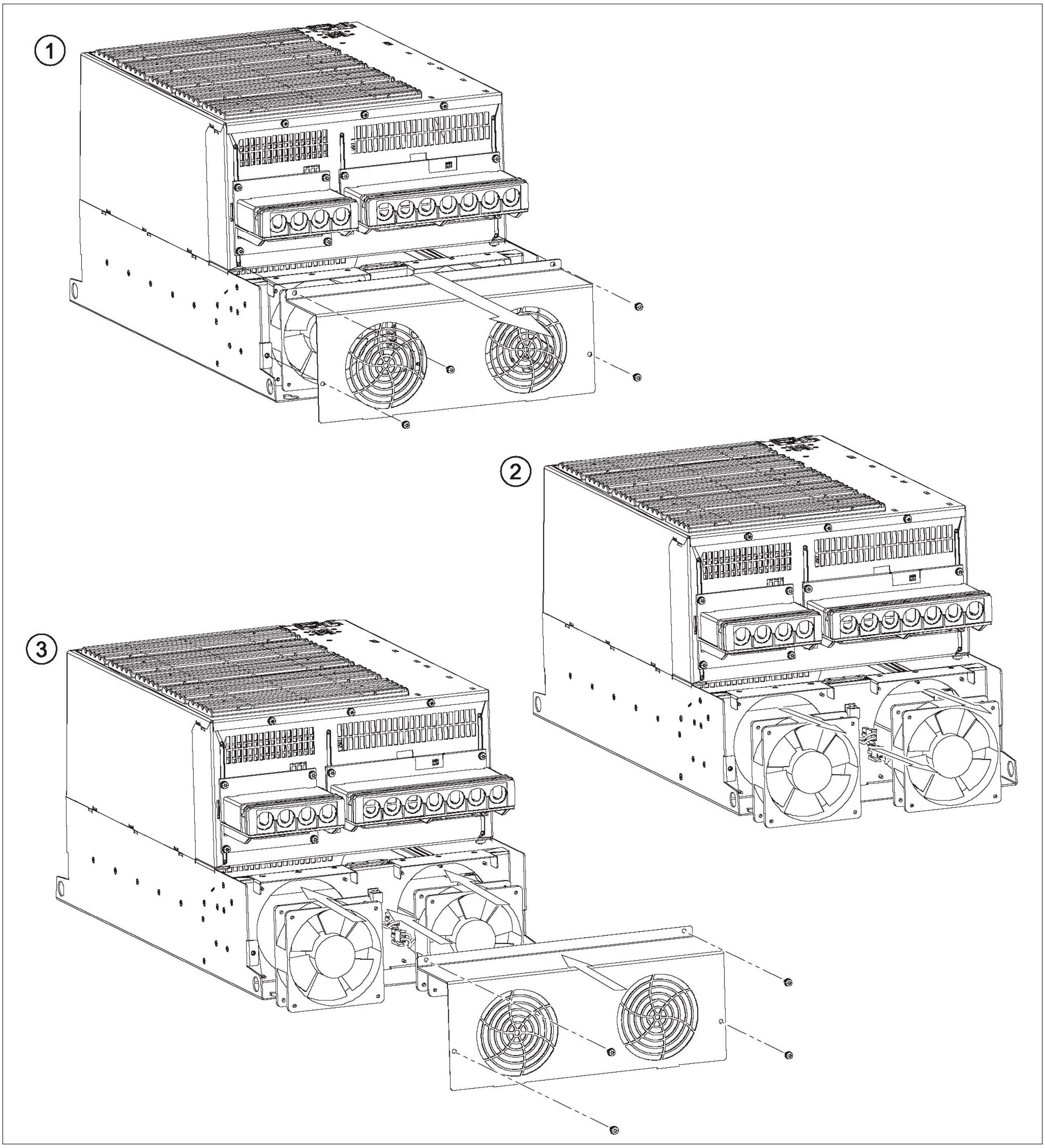


Figure 11-6 Replacing the fan for a Power Module PM340, frame size FSF

11.3 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.

11.3.1 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 11- 1 Tightening torques for connecting current-carrying parts

Screw	Torque
M6	6 Nm
M8	13 Nm
M10	25 Nm
M12	50 Nm

11.3.2 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 11-7 Installation equipment

Order No.

Order number for the installation device: 6SL3766-1FA00-0AA0.

11.3.3 Replacing components

11.3.3.1 Safety information

DANGER

When transporting the devices and replacing components, note the following:

- Some of the devices and components are heavy or top heavy.
- Due to their weight, the devices must be handled with care by trained personnel.
- Serious injury or even death and substantial material damage can occur if the devices are not lifted or transported properly.

DANGER

The equipment is operated with hazardous voltages

All connection wok must be carried-out in a no-voltage condition!

All work on the units must be carried out by trained personnel only. Death, serious injury, or substantial material damage can result if these warnings are not taken into account.

Work on an open device must be carried out with extreme caution because external supply voltages may be present. The power and control terminals may be live even when the motor is not running.

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. For this reason, the cabinet should not be opened until after a reasonable period of time has elapsed.

11.3.3.2 Replacing the Powerblock, Power Module, frame size FX

Replacing the Powerblock

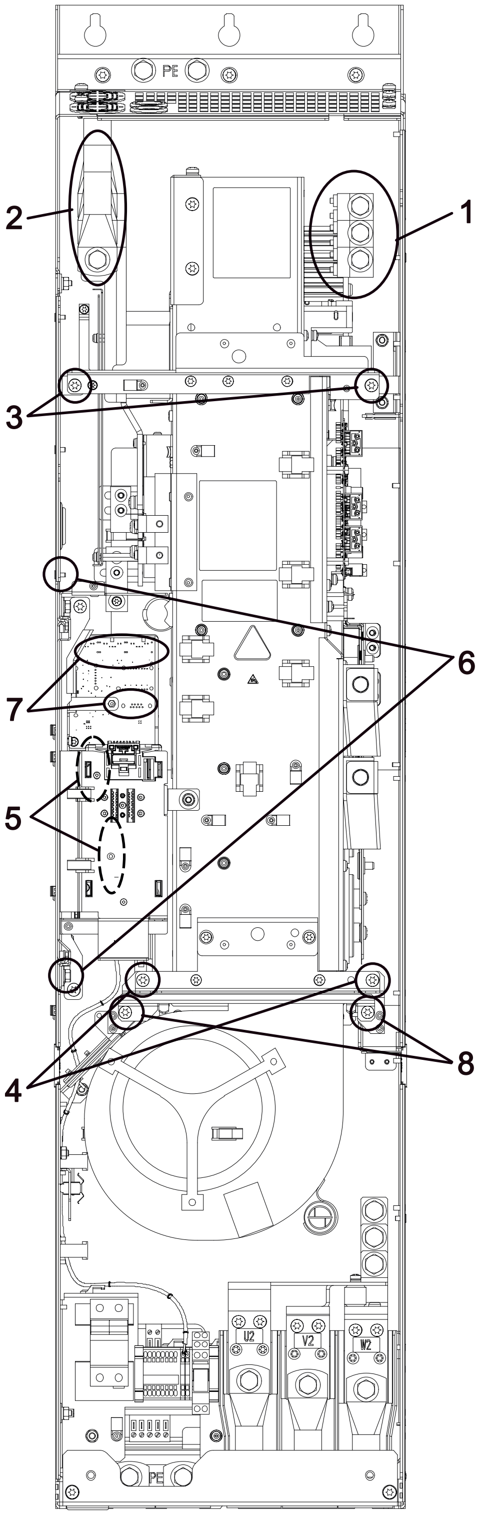


Figure 11-8 Replacing the Powerblock, Power Module, frame size FX

Note

This Programming and Operating Manual is only applicable to Power Modules with order numbers 6SL3310-1TE3x-xAA0.

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Powerblock
- Remove the front cover

Removal

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 line 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 DRIVE-CLiQ cables and connections on –X41 / –X42 (5 plugs).
6. Remove the retaining elements of the electronic module (2 nuts) and carefully remove the electronics module.
   When removing the plug-in module, 5 additional connectors (2 at the top, 3 at the bottom) must be removed one after the other.
7. Disconnect the plugs for the fiber optic cables and signal cables (5 plugs).
8. Unscrew the two retaining screws for the fan and attach the tool for de-installing the powerblock at this position.

You can now remove the powerblock.

⚠ CAUTION
When removing the powerblock, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

You must observe the specified tightening torques.

Carefully re-establish the plug connections and ensure that they are secure.

The fiber-optic cable plugs must be reinstalled in their original slot. Fiber-optic cables and sockets are labeled appropriately to allow the correct assignment (U11, U21, U31).

Replacing the Powerblock

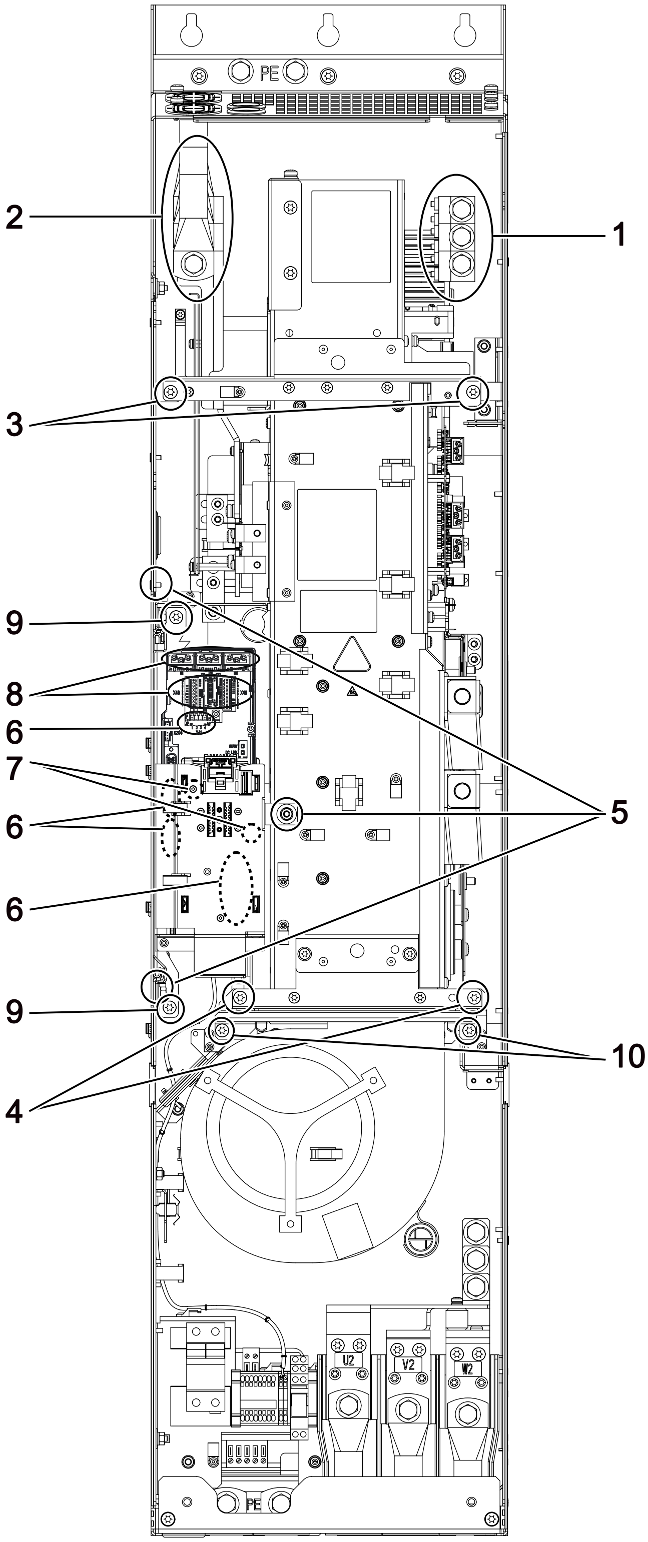


Figure 11-9 Replacing the Powerblock, Power Module, frame size FX

Note

This Programming and Operating Manual is only applicable to Power Modules with order numbers 6SL3310-1TE3x-xAA3.

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Powerblock
- Remove the front cover

Removal

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 the DRIVE-CLiQ cables and connections on –X41 / –X42 / –X46 (6 plugs).
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 two retaining screws for the fan and attach the mounting device for the Powerblock at this position.

You can now remove the Powerblock.

⚠ CAUTION
When removing the Powerblock, ensure that you do not damage any signal cables.

Installation

For installation, carry out the above steps in reverse order.

CAUTION

You must observe the specified tightening torques.

Carefully establish the plug-in connections and then ensure that they are secure.

The fiber-optic cable plugs must be reinstalled in their original slot. Fiber-optic cables and sockets are labeled appropriately to allow the correct assignment (U11, U21, U31).

11.3.3.3 Replacing the Powerblock, Power Module, frame size GX

Replacing the Powerblock

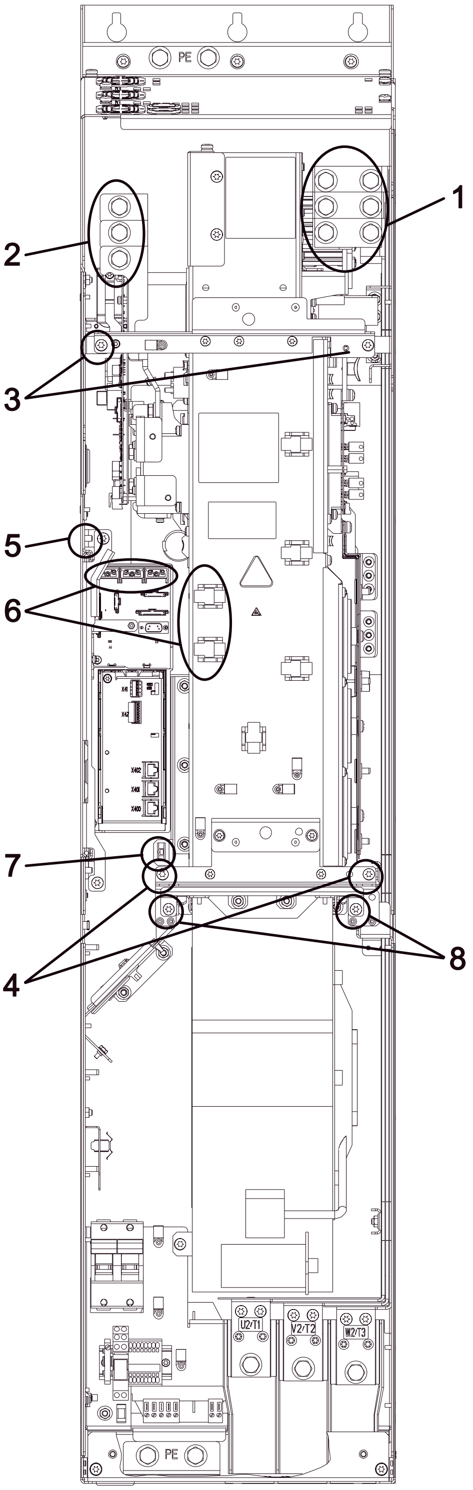


Figure 11-10 Replacing the Powerblock, Power Module, frame size GX

Note

This Programming and Operating Manual is only applicable to Power Modules with order numbers 6SL3310-1TE3x-xAA0.

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Powerblock
- Remove the front cover

Removal

The steps for the removal procedure are numbered in accordance with the above figure.

1. Unscrew the connection to the motor feeder (6 screws).
2. Unscrew the connection to the line 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 element of the electronic module (1 nut) and carefully remove the electronics module.
   When removing the plug-in module, 5 additional connectors (2 at the top, 3 at the bottom) must be removed one after the other.
6. Disconnect the connectors for the fiber optic cables (5 plugs) and release the cable connection for the signal cables (2 connectors).
7. Disconnect the plug for the thermocouple.
8. Unscrew the two retaining screws for the fan and attach the tool for de-installing the powerblock at this position.

You can now remove the powerblock.

CAUTION
When removing the powerblock, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION
You must observe the specified tightening torques. Carefully re-establish the plug connections and ensure that they are secure. The fiber-optic cable plugs must be reinstalled in their original slot. Fiber-optic cables and sockets are labeled appropriately to allow the correct assignment (U11, U21, U31).

Replacing the Powerblock

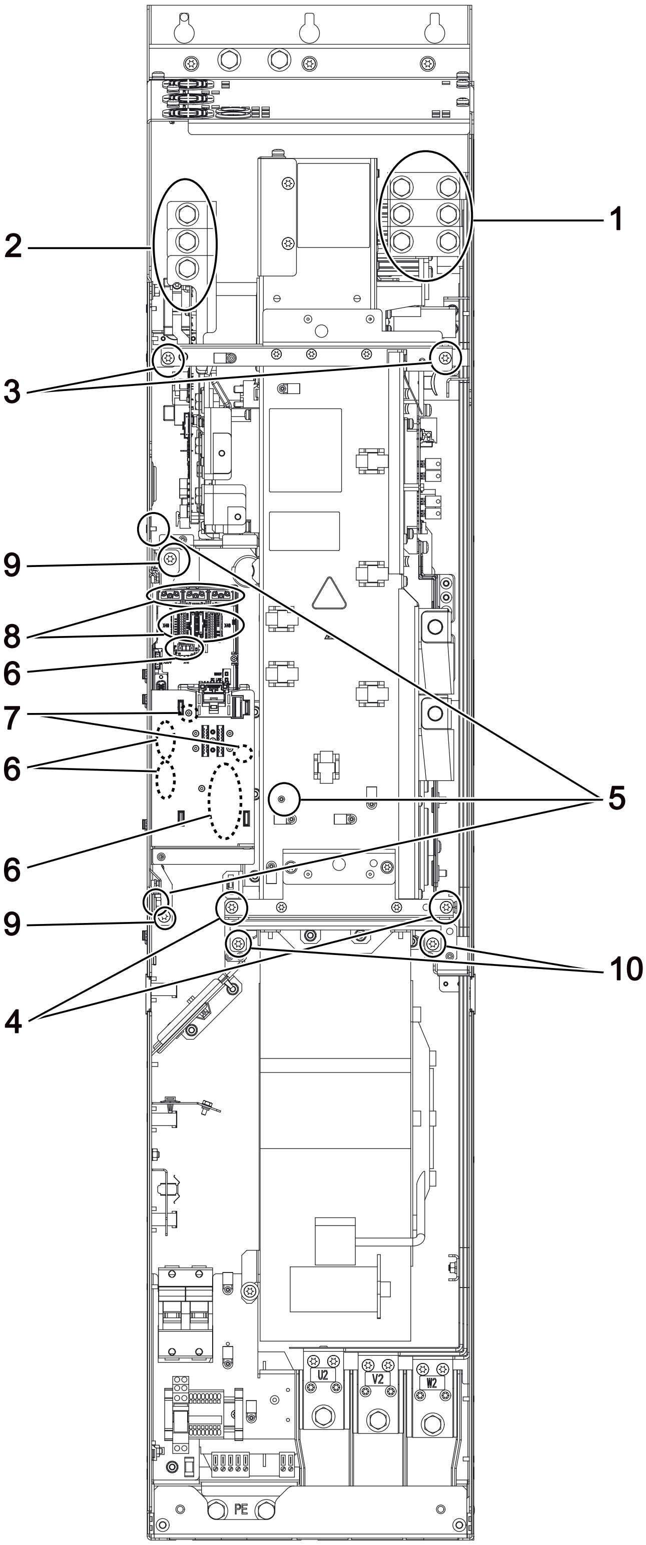


Figure 11-11 Replacing the Powerblock, Power Module, frame size GX

Note

This Programming and Operating Manual is only applicable to Power Modules with order numbers 6SL3310-1TE3x-xAA3.

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Powerblock
- Remove the front cover

Removal

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 the DRIVE-CLiQ cables and connections on –X41 / –X42 / –X46 (6 plugs).
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 two retaining screws for the fan and attach the equipment for assembling the Powerblock at this position.

You can now remove the Powerblock.

⚠ CAUTION
When removing the Powerblock, ensure that you do not damage any signal cables.

Installation

For installation, carry out the above steps in reverse order.

CAUTION

You must observe the specified tightening torques.

Carefully establish the plug-in connections and then 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).

11.3.3.4 Replacing the Control Interface Module, Power Module, frame size FX

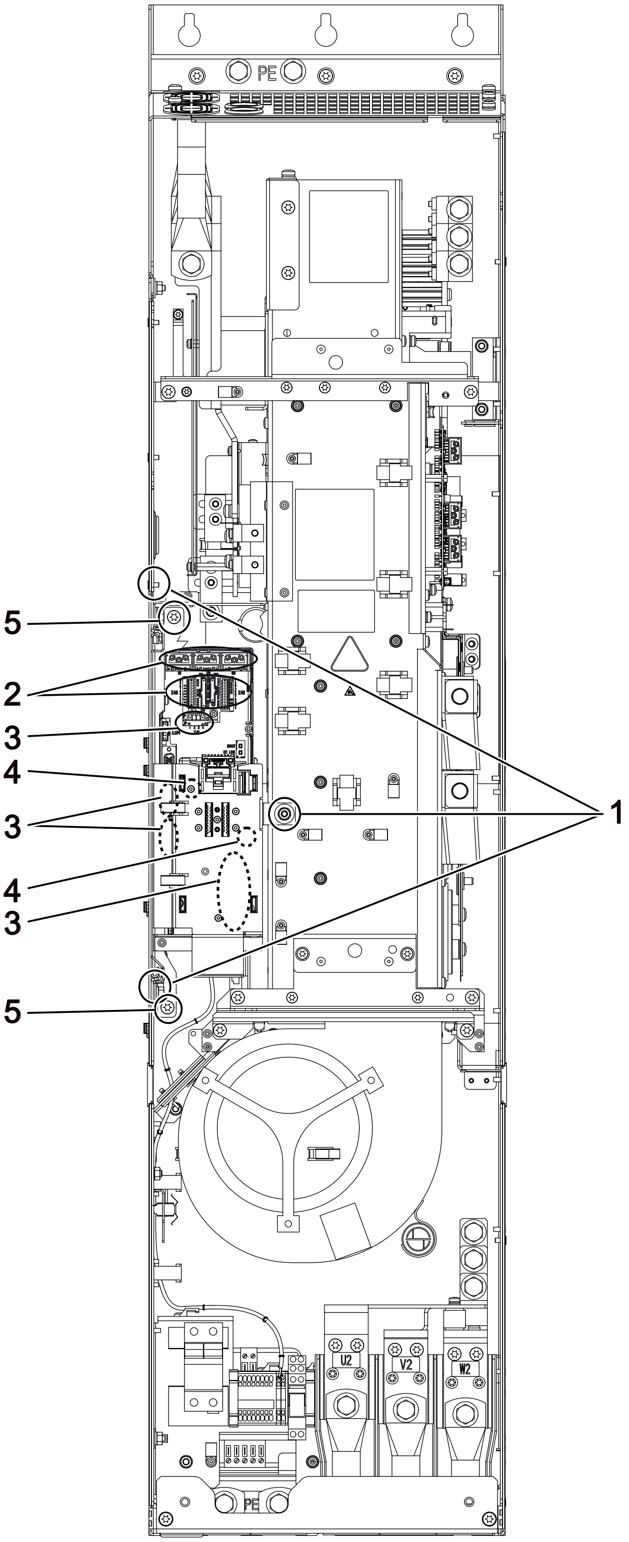


Figure 11-12 Replacing the Control Interface Module, Power Module, frame size FX

Note

This Programming and Operating Manual is only applicable to Power Modules with order numbers 6SL3310-1TE3x-xAA3.

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Powerblock
- Remove the front cover

Removal

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 the DRIVE-CLiQ cables and connections on –X41 / –X42 / –X46 (6 plugs).
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 the unit, ensure that you do not damage any signal cables.

Installation

For installation, carry out the above steps in reverse order.

⚠ CAUTION
You must observe the specified tightening torques. Carefully establish the plug-in connections and then 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).

11.3.3.5 Replacing the Control Interface Board, Power Module, frame size FX

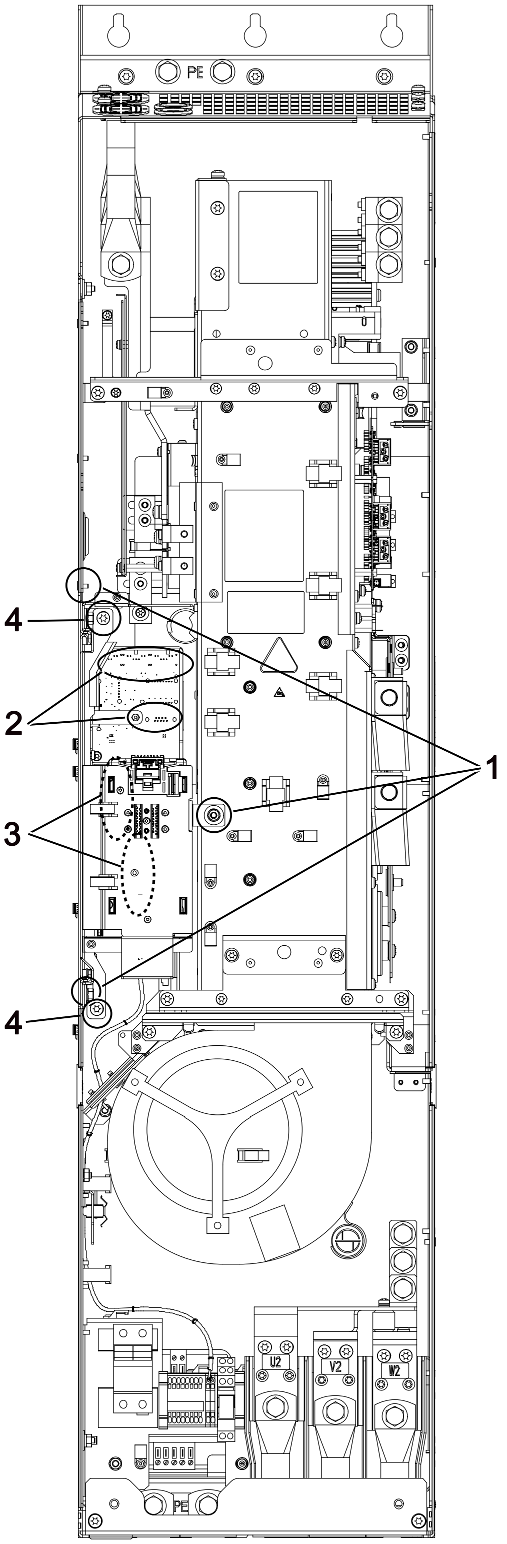


Figure 11-13 Replacing the Control Interface Board, Power Module, frame size FX

Note

This Programming and Operating Manual is only applicable to Power Modules with order numbers 6SL3310-1TE3x-xAA0.

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Powerblock
- Remove the front cover

Removal

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 the DRIVE-CLiQ cables and connections on –X41 / –X42 (5 plugs).
4. Remove the retaining screws for the plug-in module (2 screws).
   When removing the plug-in module, 5 additional plugs (2 at the top, 3 at the bottom) must be removed one after the other.

⚠ CAUTION
When removing the plug-in module, ensure that you do not damage any signal cables.

The Control Interface Board can then be removed from the plug-in module.

Installation

For installation, carry out the above steps in reverse order.

⚠ CAUTION
You must observe the specified tightening torques. Carefully establish the plug-in connections and then 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).

11.3.3.6 Replacing the Control Interface Module, Power Module, frame size GX

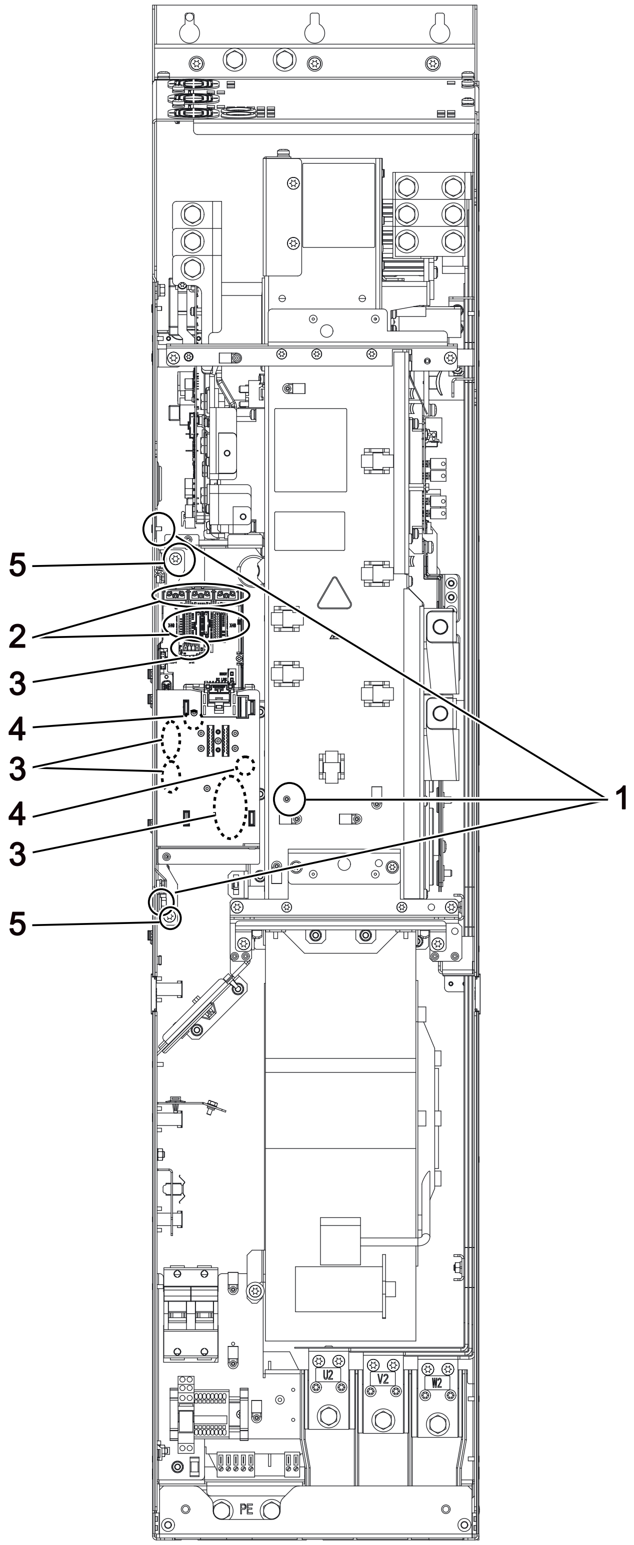


Figure 11-14 Replacing the Control Interface Module, Power Module, frame size GX

Note

This Programming and Operating Manual is only applicable to Power Modules with order numbers 6SL3310-1TE3x-xAA3.

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Powerblock
- Remove the front cover

Removal

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 the DRIVE-CLiQ cables and connections on –X41 / –X42 / –X46 (6 plugs).
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 the unit, ensure that you do not damage any signal cables.

Installation

For installation, carry out the above steps in reverse order.

⚠ CAUTION
You must observe the specified tightening torques. Carefully establish the plug-in connections and then 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).

11.3.3.7 Replacing the Control Interface Board, Power Module, frame size GX

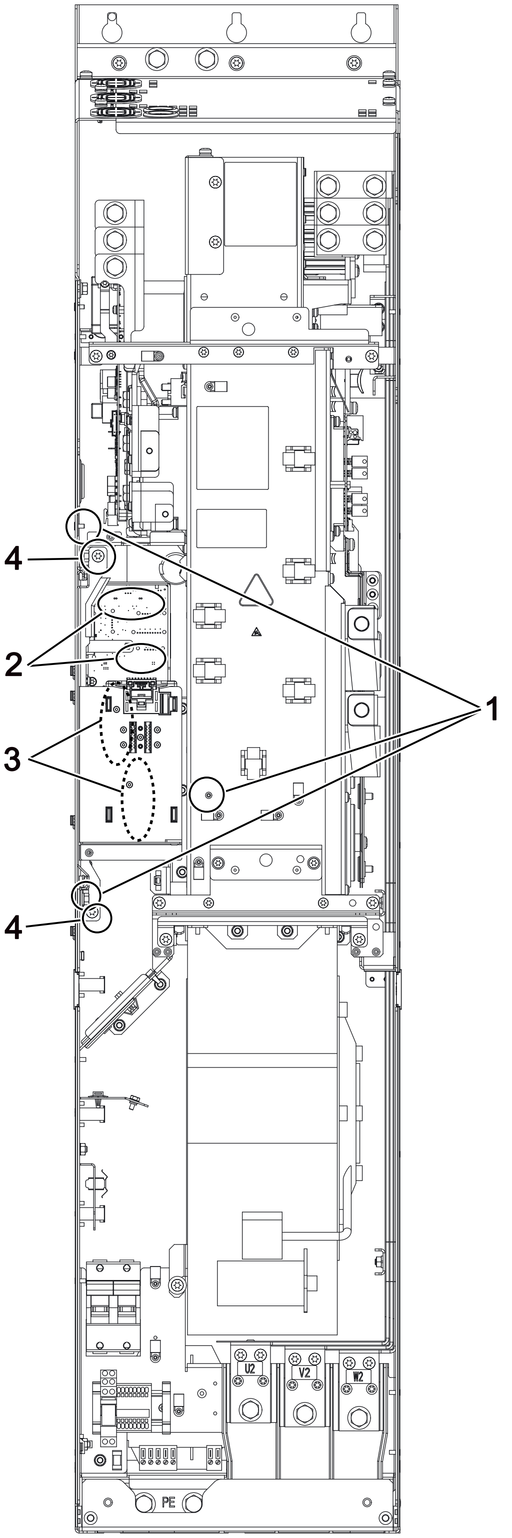


Figure 11-15 Replacing the Control Interface Board, Power Module, frame size GX

Note

This Programming and Operating Manual is only applicable to Power Modules with order numbers 6SL3310-1TE3x-xAA0.

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Powerblock
- Remove the front cover

Removal

The steps for the removal procedure are numbered in accordance with the above figure.

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 the DRIVE-CLiQ cables and connections on –X41 / –X42 (5 plugs).
4. Remove the retaining screws for the plug-in module (2 screws).
   When removing the plug-in module, 5 additional plugs (2 at the top, 3 at the bottom) must be removed one after the other.

CAUTION
When removing the plug-in module, ensure that you do not damage any signal cables.

The Control Interface Board can then be removed from the plug-in module.

Installation

For installation, carry out the above steps in reverse order.

CAUTION
You must observe the specified tightening torques. Carefully establish the plug-in connections and then 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).

11.3.3.8 Replacing the fan, Power Module, frame size FX

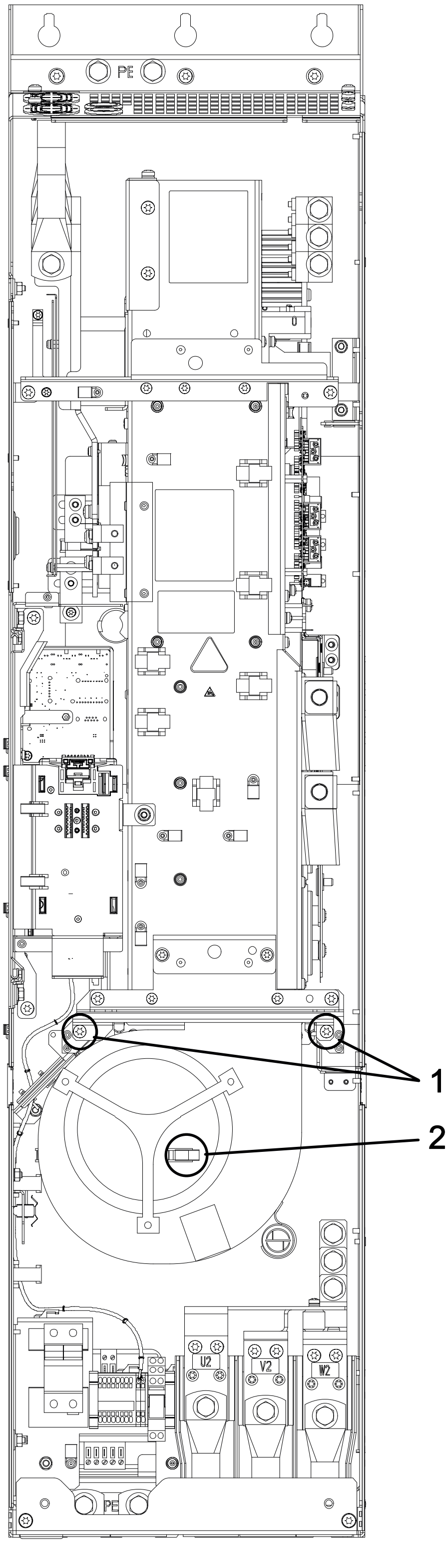


Figure 11-16 Replacing the fan, Power Module, frame size FX

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.

CAUTION
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.

CAUTION
You must observe the specified tightening torques. Carefully re-establish the plug connections and ensure that they are secure.

11.3.3.9 Replacing the fan, Power Module, frame size GX

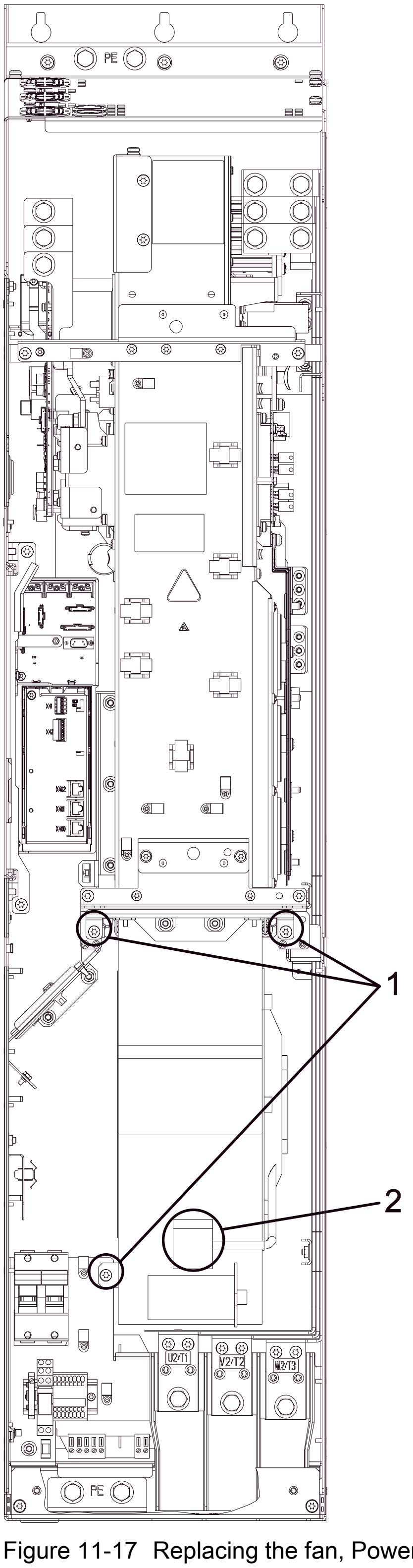


Figure 11-17 Replacing the fan, Power Module, frame size GX

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.

CAUTION
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.

CAUTION
You must observe the specified tightening torques. Carefully re-establish the plug connections and ensure that they are secure.

11.4 Spare parts

Spare parts are available on the Internet at:

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

11.5 Disposal

The relevant national environmental regulations must be respected when disposing of devices!

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	Induction motor	Induction motor
B		
OC	Operating Condition	Operating condition
BERO	-	Contactless proximity switch
BI	Binector Input	Binector input
BIA	Germany's Institute for Occupational Safety and Health	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
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
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
DP	Decentralized Peripherals	Distributed IOs
DPRAM	Dual Ported Random Access Memory	Memory with dual access ports

Abbreviation	Source of abbreviation	Meaning
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
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	Basic positioner	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	Separately excited synchronous motor	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
FW	Firmware	Firmware
G		
GB	Gigabyte	Gigabyte

Abbreviation	Source of abbreviation	Meaning
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	High-frequency reactor	High-frequency reactor
RFG	Ramp-Function Generator	Ramp-function generator
HMI	Human Machine Interface	Human machine interface
HTL	High-Threshold Logic	Logic with a high fault threshold
HW	Hardware	Hardware
I		
u.d.	under development	Under development: This feature is not currently available
I/O	Input/Output	Input/output
I2C	Inter-Integrated Circuit	Internal serial data bus
IASC	Internal Armature Short Circuit	Internal armature short circuit
IBN	Commissioning	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	Pulse cancelation	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
K		
CDC	Crosswise data comparison	Crosswise data comparison
KIP	Kinetic buffering	Kinetic buffering
Kp	-	Proportional gain
KTY	-	Special temperature sensor

Abbreviation	Source of abbreviation	Meaning
L		
L	-	Formula symbol for inductance
LED	Light Emitting Diode	Light Emitting Diode
LIN	Linear motor	Linear motor
PC	Position Controller	Position Controller
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
FOC	Fiber-Optic Cable	Fiber-optic cable
M		
M	-	Formula symbol for torque
M	Ground	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as GND)
MB	Megabyte	Megabyte
MCC	Motion Control Chart	Motion Control Chart
MDS	Motor Data Set	Motor data set
MLFB	Machine-Readable Product Code	Machine-Readable Product Code
MMC	Man-Machine Communication	Man-machine communication
MMC	Micro Memory Card	Micro memory card
MSB	Most Significant Bit	Most significant bit
MSC	Motor-Side Converter	Motor-side converter
MSCY_C1	Master Slave Cycle Class 1	Cyclic communication between master (Class 1) and slave
MSR	Motor-side converter	Motor-side converter
MT	Probe	Probe
N		
N. C.	Not Connected	Not connected
N...	No Report	No message or internal message
NAMUR	Standardization association for measurement and control in the chemical industry	Standardization association for measurement and control in the chemical industry
NC	Normally Closed (contact)	NC contact
NC	Numerical Control	Numerical control
NEMA	National Electrical Manufacturers Association	Standardization body in the US
NM	Zero mark	Zero mark
NO	Normally Open (contact)	NO contact
NSR	Line-side converter	Line-side converter
NVRAM	Non-Volatile Random Access Memory	Non-volatile read/write memory

Abbreviation	Source of abbreviation	Meaning
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
PcCtrl	PC Control	Control for master
PD	PROFIdrive	PROFIdrive
PDS	Power unit Data Set	Power unit data set
PE	Protective Earth	Protective earth
PELV	Protective Extra Low Voltage	Protective extra low voltage
PEM	Permanent-magnet synchronous motor	Permanent-magnet synchronous motor
PG	Programming device	Programming device
PI	Proportional Integral	Proportional integral
PID	Proportional Integral Differential	Proportional integral differential
PLC	Programmable Logic Controller	Programmable logic controller
PLL	Phase-Locked Loop	Phase-locked loop
PN	PROFINET	PROFINET
PNO	PROFIBUS user organization	PROFIBUS user organization
PPI	Point-to-Point Interface	Point-to-point interface
PRBS	Pseudo Random Binary Signal	White noise
PROFIBUS	Process Field Bus	Serial data bus
PS	Power Supply	Power supply
PSA	Power Stack Adapter	Power Stack Adapter
PTC	Positive Temperature Coefficient	Positive temperature coefficient
PTP	Point-To-Point	Point-to-Point
PWM	Pulse Width Modulation	Pulse width modulation
PZD	Process data	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
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

Abbreviation	Source of abbreviation	Meaning
RKA	Cooling unit	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	Space vector approximation	Space vector approximation
S		
S1	-	Uninterrupted duty
S3	-	Intermittent duty
SBC	Safe Brake Control	Safe brake control
SBH	Safe operating stop	Safe operating stop
SBR	-	Safe acceleration monitoring
SCA	Safe Cam	Safe cam
SD Card	SecureDigital Card	Secure digital memory card
SE	Safe software limit switch	Safe software limit switch
SG	Safely reduced speed	Safely reduced speed
SGA	Safety-related output	Safety-related output
SGE	Safety-related input	Safety-related input
SH	Safe standstill	Safe standstill
SI	Safety Integrated	Safety Integrated
SIL	Safety Integrity Level	Safety Integrity Level
SLM	Smart Line Module	Smart Line Module
SLP	Safely-Limited Position	Safely-limited position
SLS	Safely Limited Speed	Safely limited speed
SLVC	Sensorless Vector Control	Vector control without encoder
SM	Sensor Module	Sensor Module
SMC	Sensor Module Cabinet	Sensor Module Cabinet
SME	Sensor Module External	Sensor Module External
SN	Safe software cam	Safe software cam
SOS	Safe Operating Stop	Safe operating stop
SP	Service Pack	Service pack
SPC	Setpoint Channel	Setpoint channel
SPI	Serial Peripheral Interface	Serial interface for connecting peripherals
PLC	Programmable Logic Controller	Programmable logic control

Abbreviation	Source of abbreviation	Meaning
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	Control word	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		
UL	Underwriters Laboratories Inc.	Underwriters Laboratories Inc.
UPS	Uninterruptible Power Supply	Uninterruptible power supply
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
W		
AR	Automatic restart	Automatic restart
MT	Machine Tool	Machine tool
X		
XML	Extensible Markup Language	Standard language for Web publishing and document management

Abbreviation	Source of abbreviation	Meaning
Z		
DC link	DC link	DC link
ZM	Zero Mark	Zero mark
ZSW	Status word	Status word

SINAMICS documentation overview

General documentation/catalogs

SINAMICS G110
D11.1
Inverter Chassis Units
0.12 kW to 3 kW

SINAMICS G130, G150
D11
Drive Converter Chassis Units
Drive Converter Cabinet Units

SIMOTION SINAMICS S120
PM21
SIMOTION, SINAMICS S120 and
Motors for Production Machines

SINAMICS S120, S150
D21.3
SINAMICS S120 Chassis Units
Chassis Format Units and Cabinet Modules
SINAMICS S150
Converter Cabinet Units

Manufacturer/service documentation

SINAMICS G110
Getting Started
Operating Instructions
List Manual

SINAMICS G120
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, 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 Drive Functions
Function Manual Safety Integrated
Function Manual DCC
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SINAMICS S120
Equipment Manual for Control Units and
Additional Components
Equipment Manual for Booksize Power Units
Equipment Manual for Chassis Power Units
Equipment Manual for Chassis Liquid
Cooled Power Units
Equipment Manual Cabinet Modules
Equipment Manual AC Drive

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