

Equipment Manual 06/2008

SINAMICS S120
AC Drive

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S120 AC Drive

Manual

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Safety Guidelines

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 device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

| |
|--|
|  WARNING |
| This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance. |

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.

Foreword

SINAMICS Documentation

The SINAMICS documentation is organized in 2 parts:

- General documentation / catalogs
- Manufacturer/service documentation

A monthly overview of publications with the available languages is available on the Internet at:

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

Follow menu items "Support" → "Technical Documentation" → "Ordering Documentation" → "Printed Documentation"

The Internet version of DOConCD (DOConWEB) is available in the Internet:

<http://www.automation.siemens.com/doconweb>

Information on the range of training courses and FAQs (Frequently Asked Questions) are available in the Internet:

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

Follow the menu item "Support".

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 | <ul style="list-style-type: none"> • SINAMICS S120 Equipment Manual for Control Units and Supplementary System Components • SINAMICS S120 Equipment Manual Power Modules Booksize • SINAMICS S120 Equipment Manual Power Modules in chassis format • SINAMICS S150 operating instructions |
| Commissioning | <ul style="list-style-type: none"> • STARTER parameterization and commissioning tool • SINAMICS S120 Getting Started • SINAMICS S120 Commissioning Manual • SINAMICS S120 CANopen Commissioning Manual • SINAMICS S List Manual • SINAMICS S150 operating instructions |

| Usage phase | Tools/documents |
|-----------------------|--|
| Usage / operation | <ul style="list-style-type: none">• SINAMICS S120 Commissioning Manual• SINAMICS S List Manual• SINAMICS S150 operating instructions |
| Maintenance/servicing | <ul style="list-style-type: none">• SINAMICS S120 Commissioning Manual• SINAMICS S List Manual• SINAMICS S150 operating instructions |

Target group

This documentation is aimed at machine manufacturers, commissioning engineers, and service personnel 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 |
| 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 719 990 |
| Fax | +86 1064 747 474 |
| E-mail | mailto:adsupport.asia@siemens.com |

Note

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

Calls are charged (e.g. € 0.14/min from land lines within Germany). Tariffs of other telephone providers may differ.

Spare parts

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

Questions about the documentation

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

| | |
|--------|---|
| Fax | +49 9131 98 63315 |
| 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>.

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
- with the responsible branch office of the A&D MC Business Division 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□P□) is observed, SINAMICS devices fulfill EMC Directive 89/336/EEG and 2004/108/EG.

ESD information

| |
|---|
|  CAUTION |
| <p>Electrostatic sensitive devices (ESDs) are individual components, integrated circuits, or boards that may be damaged by either electrostatic fields or electrostatic discharge.</p> <p>Regulations for handling ESD components:</p> <p>When handling components, make sure that personnel, workplaces, and packaging are well earthed.</p> <p>Personnel may only come into contact with electronic components, if</p> <ul style="list-style-type: none">• They are grounded with an ESD wrist band, or• They are in ESD areas with conductive flooring, ESD shoes or ESD grounding straps. <p>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.</p> <p>Electronic boards must not come into contact with plastics or items of clothing containing synthetic fibers.</p> <p>Boards must only be placed on conductive surfaces (work surfaces with ESD surface, conductive ESD foam, ESD packing bag, ESD transport container).</p> <p>Do not place boards near display units, monitors, or television sets (minimum distance from screen: 10 cm).</p> <p>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).</p> |

Safety information

| |
|---|
|  DANGER |
| <p>Commissioning must not start until you have ensured that the machine, in which the components described here are installed, complies with the Machinery Directive 98/37/EC.</p> <p>Only appropriately qualified personnel may mount/install, commission and service the SINAMICS S units.</p> <p>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.</p> <p>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.</p> <p>All work on the electrical system must be carried out when the system has been disconnected from the power supply.</p> |

 **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

The symbols are in accordance with IEC 617-2.

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 the 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. Operational electrical, magnetic, and electromagnetic fields that can pose a risk to people with a pacemaker and/or implants or metallic objects if they are too close.
5. Release of environmentally hazardous materials and emissions during improper operation and / or improper disposal of components.

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

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System overview

1.1 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.

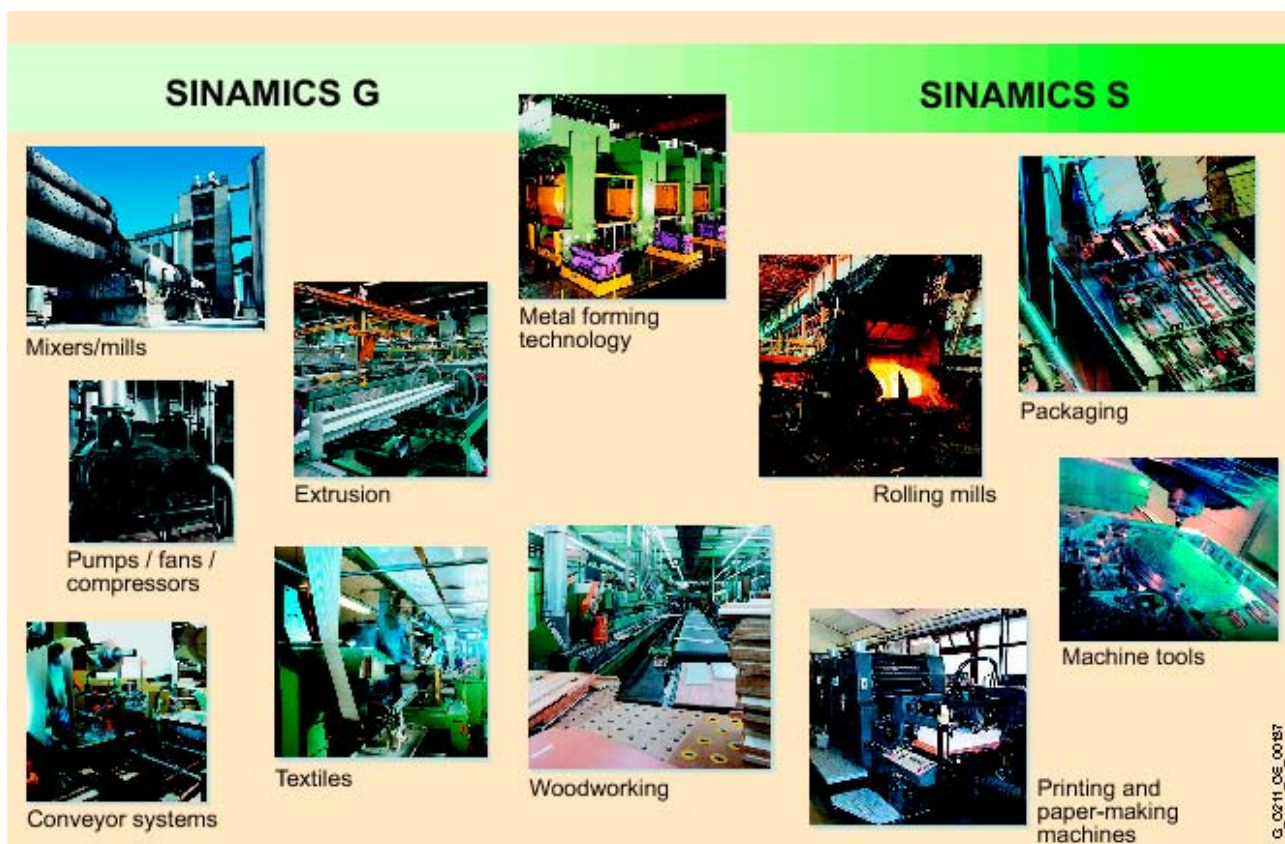


Figure 1-1 SINAMICS applications

1.2 Versions

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

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

1.3 Platform concept and Totally Integrated Automation

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

SINAMICS is 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.

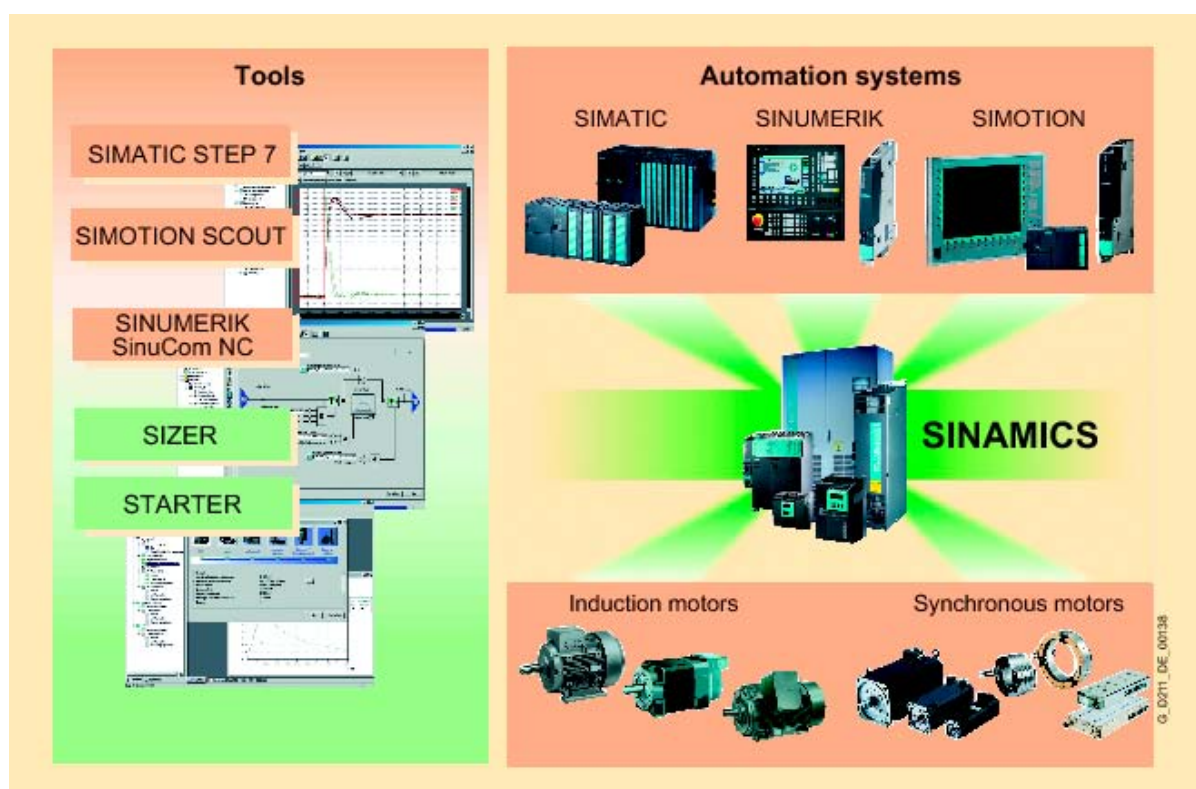


Figure 1-2 SINAMICS as part of the Siemens modular automation system

1.4 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.

1.5 SINAMICS S120 components

This overview includes components from SINAMICS S120 AC Drive.



Figure 1-3 Component overview, SINAMICS S120 AC Drive

The following power components are available:

- 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

1.6 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. |
| Electronics power supply | 24 V DC $-15/+20$ % ^{*)} , safety extra-low voltage DVC A (PELV) |
| Short-circuit current rating SCCR in accordance with UL508C (up to 600 V) | <ul style="list-style-type: none"> • 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 (standard) 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 may have to be taken into account ($-2/+10$ %).

1.6 System data

| | |
|--|--|
| 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 up to 1000 m installation altitude without derating, >40 °C up to +55 °C, refer to the characteristic for current derating. Installation altitude >1000 m up to 4000 m, refer to the characteristic for current derating or reduce the ambient temperature by 3.5 K per 500 m. |
| Chemically active substances <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Long-term storage in the transport packaging Transport in the transport packaging Operation | Class 1M2 acc. to EN 60721-3-1 Class 2M3 acc. to EN 60721-3-2 Test values: 10 Hz to 58 Hz 0.075 mm; 58 Hz to 200 Hz 1 g |
| Shock load <ul style="list-style-type: none"> Long-term storage in the transport packaging Transport in the transport packaging Operation | Class 1M2 acc. to EN 60721-3-1 Class 2M3 acc. to EN 60721-3-2 Test values: 15 g / 11 ms |
| Climatic ambient conditions <ul style="list-style-type: none"> 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/m ³ 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 |

1.7 Standards

Table 1-2 Essentially the application-relevant standards

| Standards | Title |
|---------------------------|---|
| EN ISO 12100-1 | Safety of Machinery; General Design Guidelines; Part 1: Basic terminology, methodology |
| EN ISO 12100-2 | Safety of Machinery; General Design Guidelines; Part 2: Technical Principles and Specifications |
| EN 563 | Safety of machinery; temperature of services that can be touched; ergonomic data to define temperature limit values for hot surfaces |
| EN 954-1 / ISO 13849-1 | Safety of machinery; safety-related parts of control systems; Part 1: General Design Principles |
| EN 1037 | Safety of machinery; avoiding unexpected starting |
| EN 60146-1-1 | Semiconductor converters; general requirements and line-commutated converters; Part 1-1: Defining the basic requirements |
| EN 60204-1 | Electrical equipment of machines; Part 1: General definitions |
| EN 60228 | Conductors for cables and insulated conductors; guidelines for the limiting dimensions of round cables |
| EN 60269-1 | Low-voltage fuses - Part 1: General requirements |
| 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 |
| EN 60529 | Degrees of protection provided by enclosures (IP code) |
| EN 60664-X | Insulation coordination for equipment within low-voltage systems Part 1: Principles, requirements and tests Part 3: Use of coating, potting or moulding for protection against pollution |
| 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 61000-6-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 | Protection against electric shock; Common aspects for installation and equipment |
| EN 61158 | Digital data communications for measurement and control - Fieldbus for use in industrial control systems |
| EN 61800-2 | 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 | Adjustable-speed electrical power drive systems; Part 3: EMC - Requirements and specific test methods |

| Standards | Title |
|------------------------------------|--|
| EN 61800-5-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 |
| VDE 0100 Teil X (IEC 60364-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 470: Protection for safety; use of protection for safety Part 450: Protection for safety, protection against undervoltage 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 |
| DIN EN ISO 9001 | Quality management systems - requirements |
| UL 50 | Enclosures for Electrical Equipment |
| UL 508 | Industrial Control Equipment |
| UL 508C | Safety for Power Conversion Equipment |

Line-side power components

2.1 Introduction

The line connection for a SINAMICS blocksize 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 frame sizes FSA - FSC (chassis).
 - 5 versions for frame sizes FSD - FSF (3 chassis and 2 standalone).
- Line filter versions:
 - Integrated
 - External
 - chassis
 - standalone

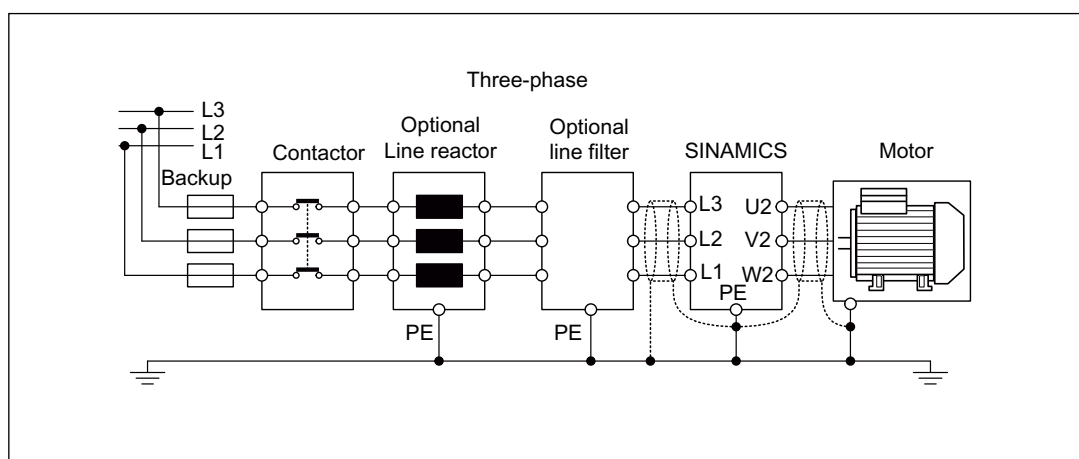


Figure 2-1 Example of a blocksize line connection

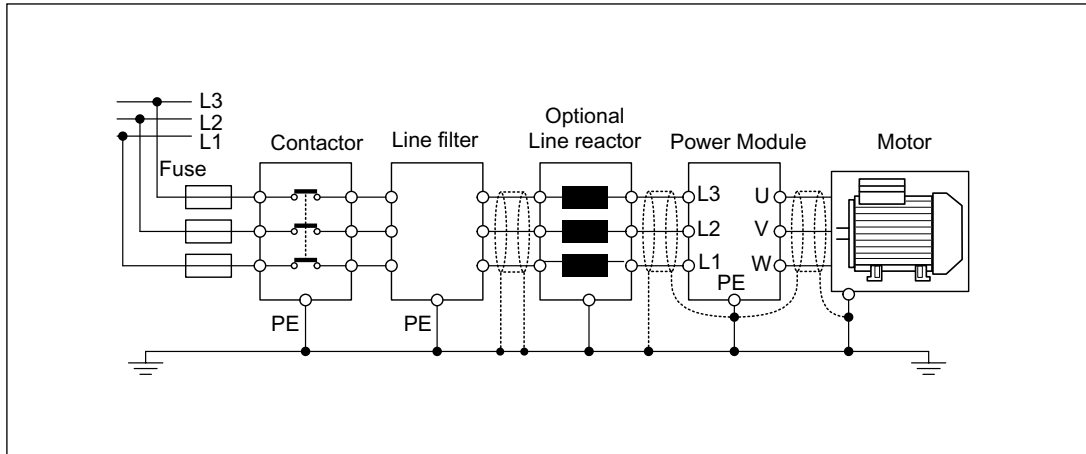


Figure 2-2 Example of a chassis line connection

Note

The limit values for the radio interference voltage are only complied with when a line reactor and a line filter, Category C2 acc. to EN 61800-3, are used.

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
- Operation of the Line Connection Components via an Autotransformer
- Operation of the Line Connection Components via an Isolating Transformer

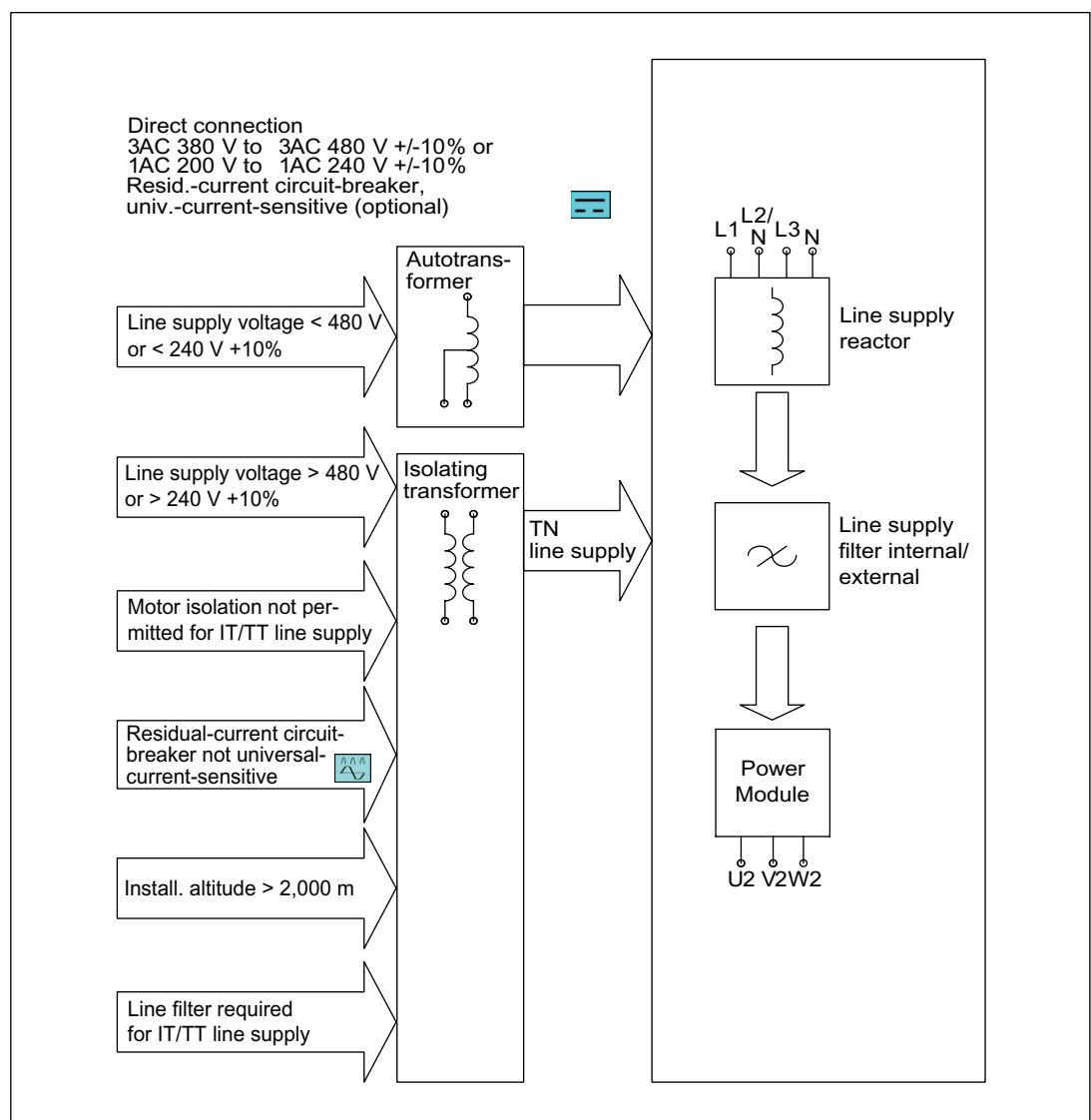


Figure 2-3 Overview of line connection variants

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.

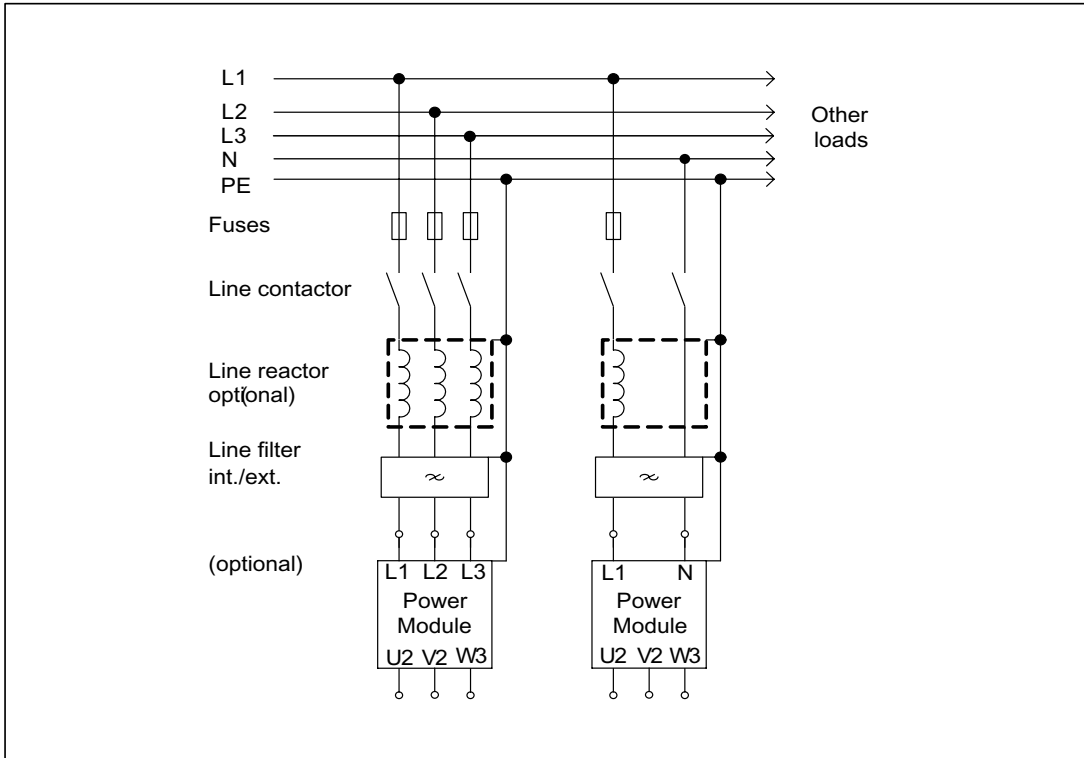


Figure 2-4 Direct operation on the line supply

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 protective separation, an isolating transformer must be used for voltages greater than 3-ph. 480 V AC +10 % and 1-ph. 240 V AC +10 %.

Application example:

- The motor insulation must be protected from excessive voltages.

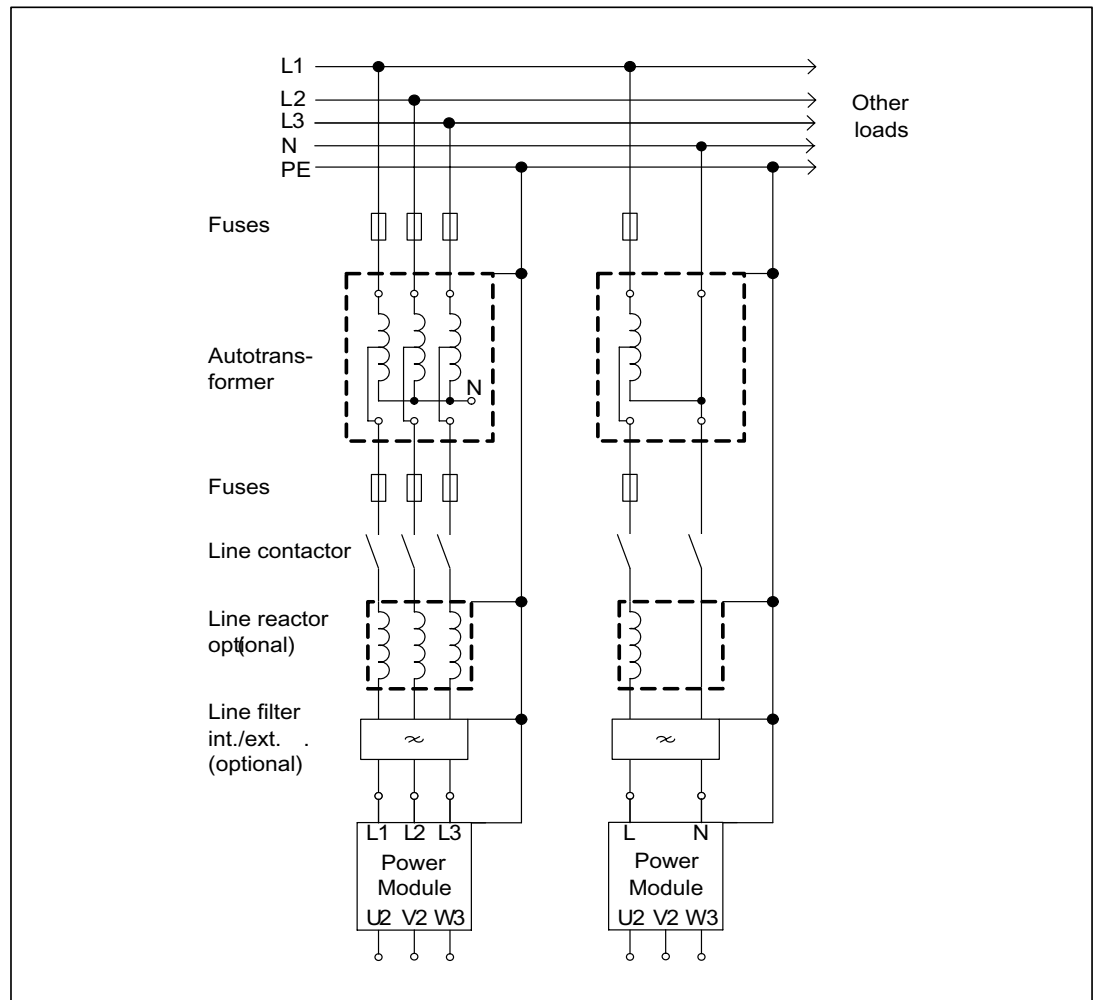


Figure 2-5 Autotransformer

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. |

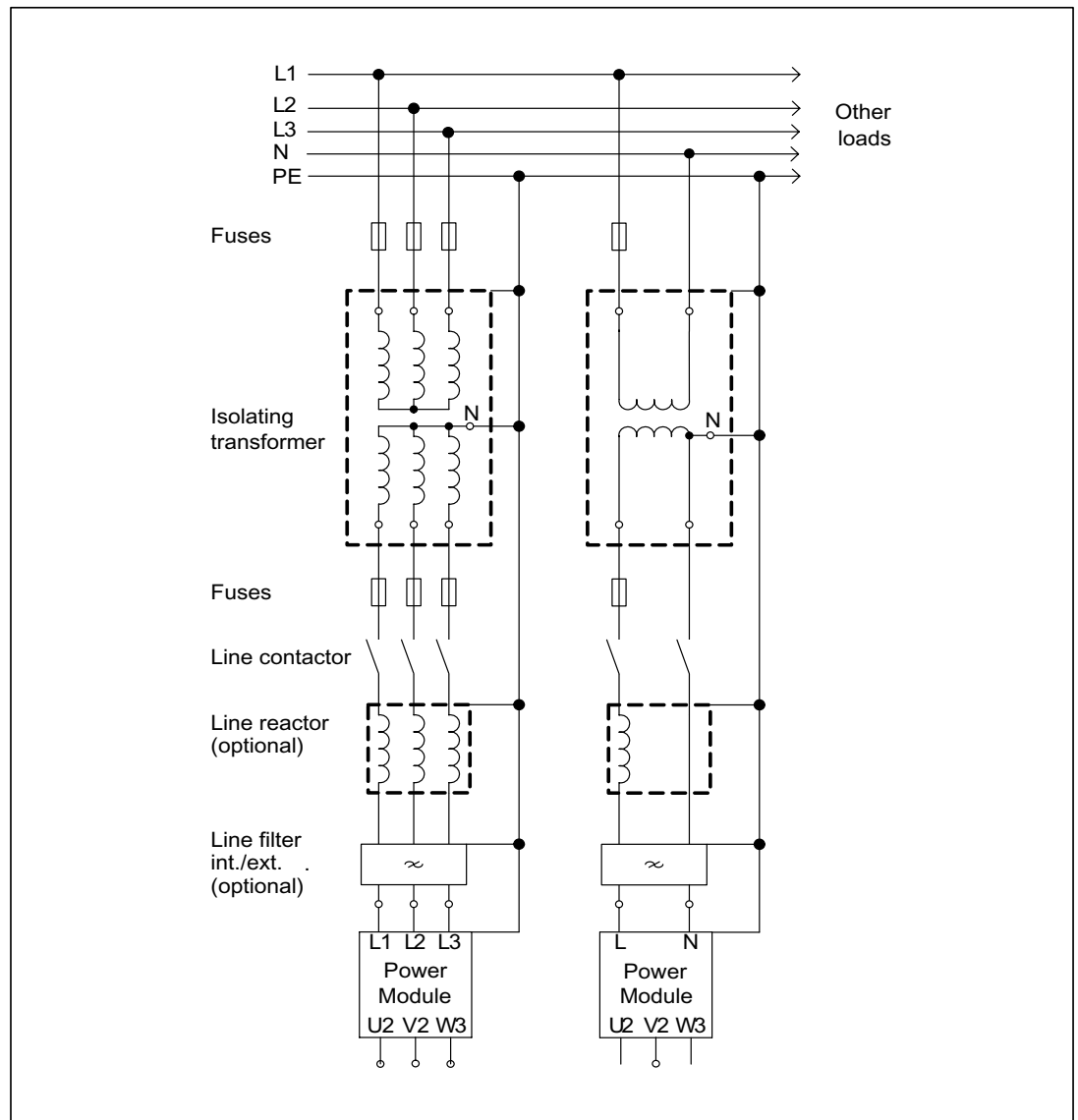


Figure 2-6 Isolating transformer

2.3 Line filter

2.3.1 Description

In conjunction with line reactors and a consequential implementation of the plant/system configuration according to the EMC guidelines (Order No.: 6FC5297-□AD30-0AP□), line filters limit the cable-borne noise and disturbances emitted from Ppower Modules to permissible values for the industrial environment at the installation location.

Note

All PM340 Power Modules are available with and without an integrated line filter. Frame size FSA, 400 V, is an exception, as this always requires an external line filter.

2.3.2 Safety information

 **DANGER**

Line filters are suitable for direct connection to TN line supplies 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 drawing, Blocksize

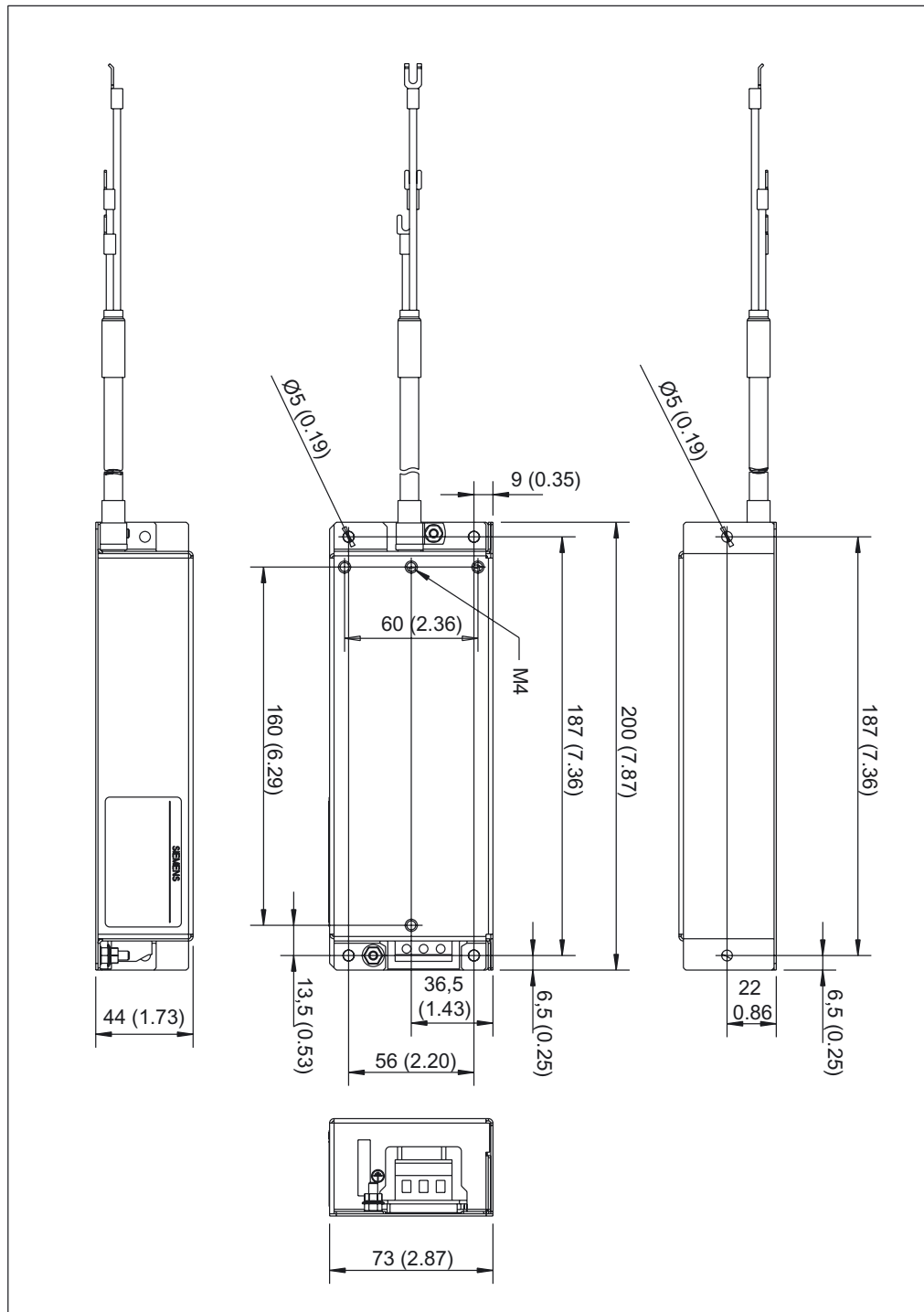


Figure 2-7 Dimension drawing: Line filter, frame size FSA

2.3.4 Dimension drawing, Chassis

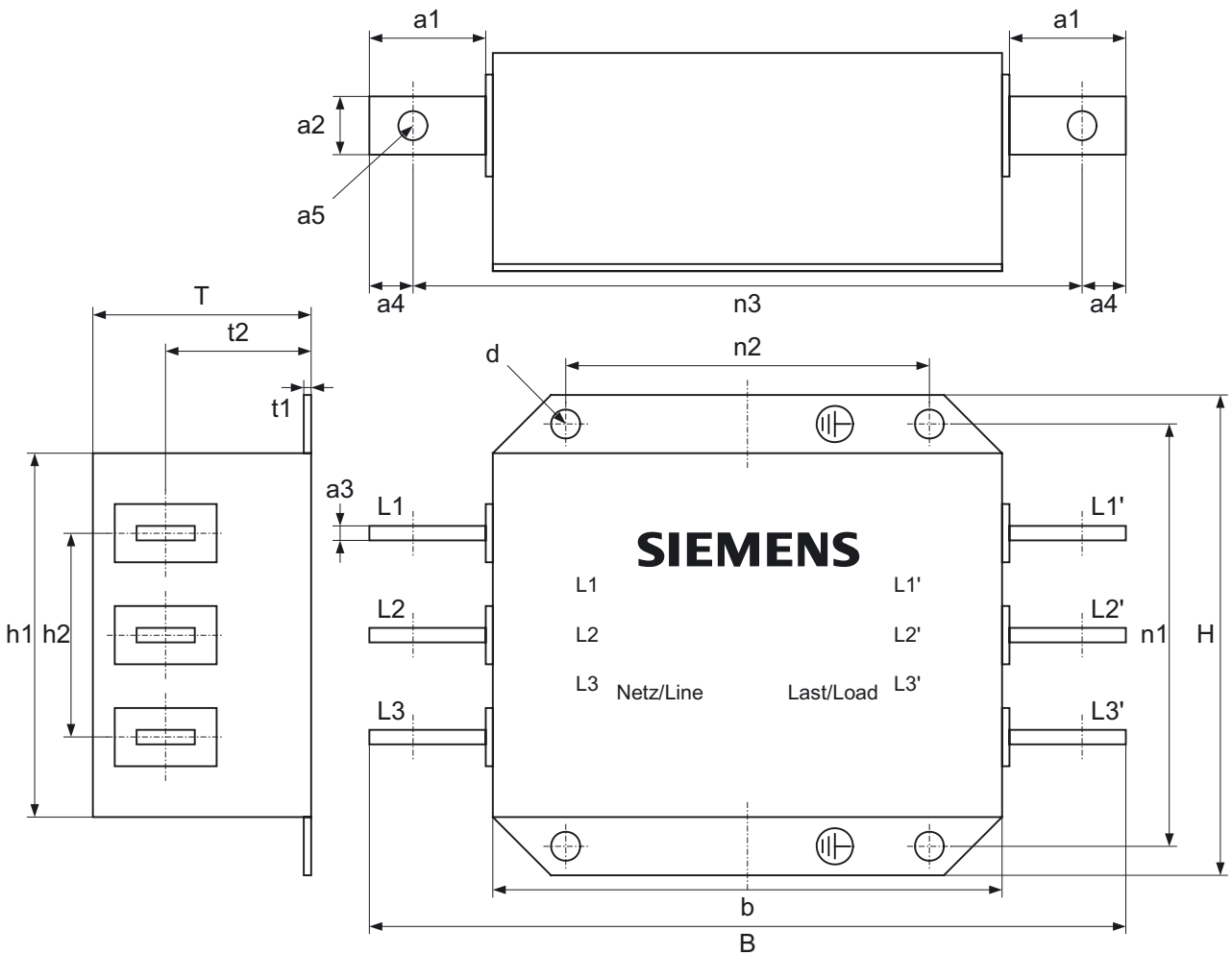


Figure 2-8 Dimension drawing, line filter

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

| 6SL3000- | OBE32-5AA0 | OBE34-4AA0 | OBE36-0AA0 |
|----------|-------------|-------------|-------------|
| W | 330 (12,99) | 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) |

| 6SL3000- | 0BE32-5AA0 | 0BE34-4AA0 | 0BE36-0AA0 |
|------------------|-------------|-------------|-------------|
| 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) Lengths n1 and n2 correspond to the distance between holes

2.3.5 Installation

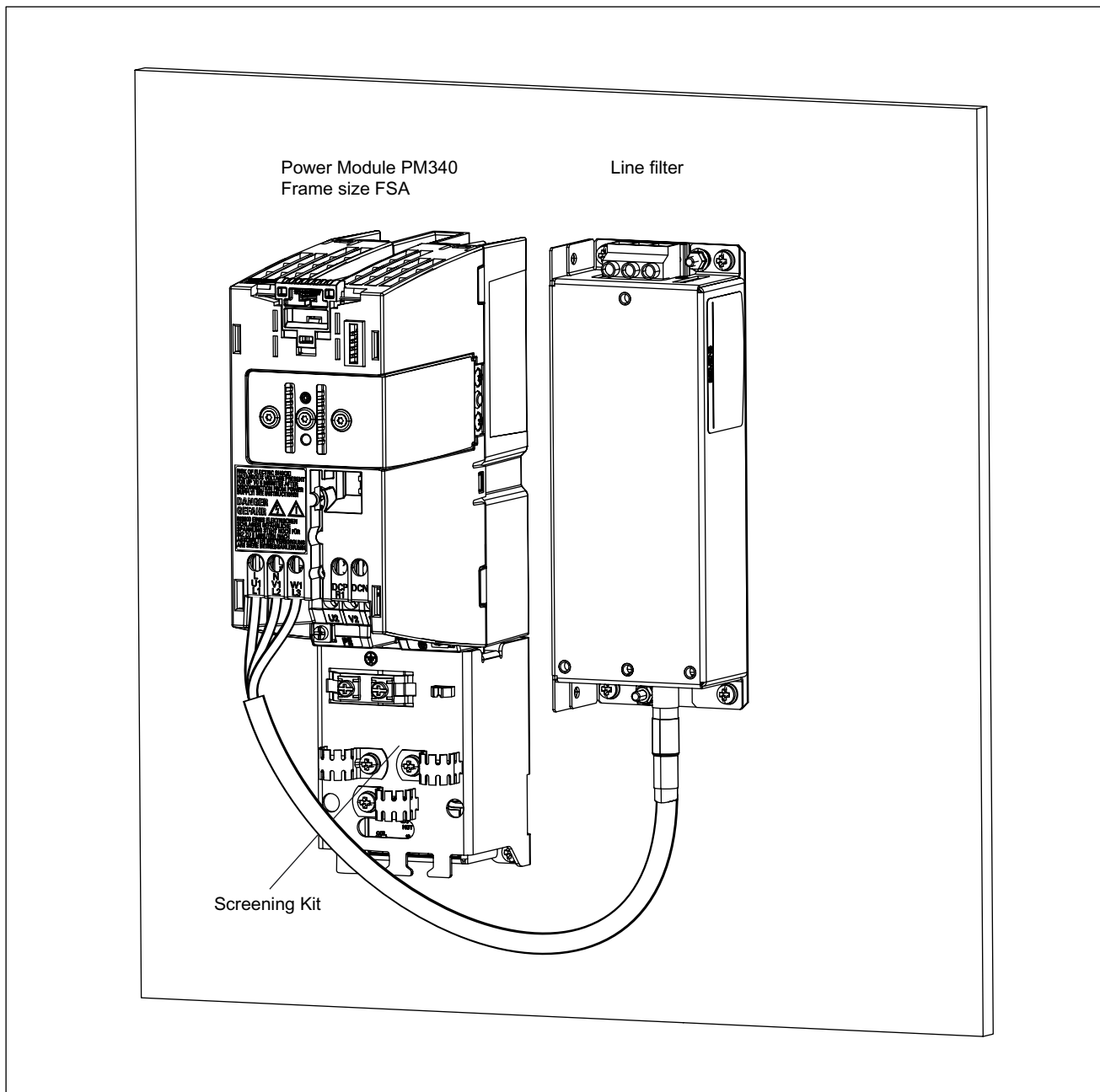


Figure 2-9 Mounting: Power Module PM340 frame size FSA with Screening Kit and line filter

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

2.3.7 Technical data, Chassis line filter

Table 2-3 Technical specifications, Chassis line filter

| Order no. | 6SL3000- | 0BE32-5AA0 | 0BE34-4AA0 | 0BE34-4AA0 | 0BE34-4AA0 | 0BE36-0AA0 |
|---|----------|---|------------|------------|------------|------------|
| Suitable for Power Module | 6SL3310- | 1TE32-1AA0 | 1TE32-6AA0 | 1TE33-1AA0 | 1TE33-8AA0 | 1TE35-0AA0 |
| 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 |
| Degree of protection | | IP00 | IP00 | IP00 | IP00 | IP00 |
| Dimensions | | | | | | |
| Width | mm | 360 | 360 | 360 | 360 | 400 |
| Height | mm | 240 | 240 | 240 | 240 | 265 |
| Depth | mm | 116 | 116 | 116 | 116 | 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 lower-frequency harmonics that are fed back into the line supply. They are used to smooth voltage spikes (line supply faults) or to bridge voltage dips/interruptions when commutating. This is the reason that we recommend line reactors in conjunction with PM340 and Power Module Chassis.

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: |
|---|

- | |
|---|
| <ul style="list-style-type: none">- Incoming line cable to 1U1, 1V1, 1W1, 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: |
|--|

- | |
|---|
| <ul style="list-style-type: none">- 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

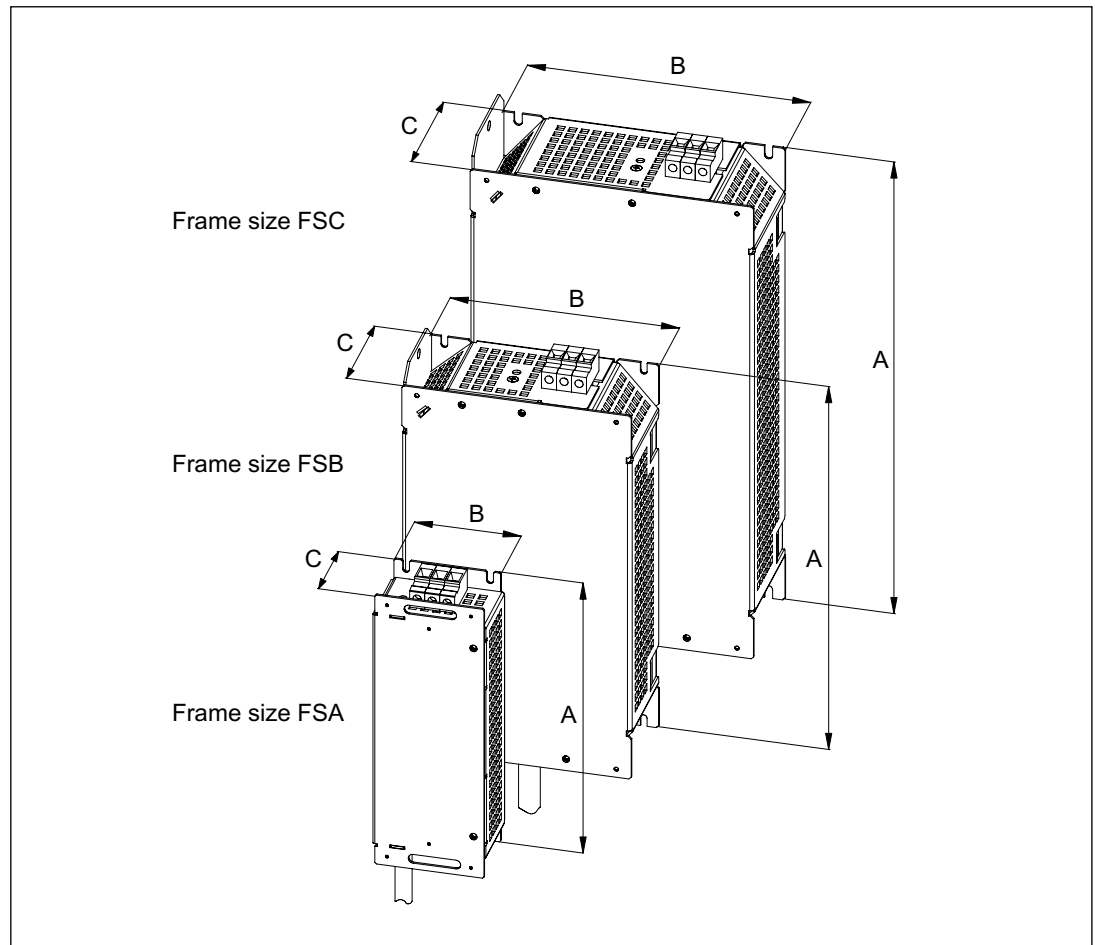


Figure 2-10 Dimension drawing: Line reactor, frame sizes FSA, FSB and FSC

Table 2-4 Total and retaining dimensions, line reactors, Part 1

| Line reactor 6SE6400- | 3CC00-4AB3 | 3CC01-0AB3 | 3CC00-2AD3 | 3CC00-4AD3 | 3CC00-6AD3 |
|--------------------------------|------------|------------|------------|------------|------------|
| Suitable for Power Module | 1SB11-0xxx | 1SB14-0xxx | 1SE11-3UA0 | 1SE12-2UA0 | 1SE14-1UA0 |
| 6SL3210- | 1SB12-3xxx | | 1SE11-7UA0 | 1SE13-1UA0 | |
| Frame size | FSA | | | | |
| Dimension A in mm and (inches) | 200 (7,87) | | | | |
| Dimension B in mm and (inches) | 75 (2,95) | | | | |
| Dimension C in mm and (inches) | 50 (1,96) | | | | |

2.4 Line reactors

Table 2-5 Total and retaining dimensions, line reactors, Part 2

| Line reactor | 6SL3203-0CD21-0AA0 | 6SL3203-0CD21-4AA0 |
|---------------------------------------|--------------------------|--------------------|
| Suitable for Power Module 6SL3210- | 1SE16-0xxx 1SE17-7xxx | 1SE21-0xxx |
| Frame size | FSB | |
| Dimension A in mm and (inches) | 270 (10, 62) | |
| Dimension B in mm and (inches) | 153 (6,02) | |
| Dimension C in mm and (inches) | 70 (2,75) | |

Table 2-6 Total and retaining dimensions, line reactors, Part 3

| Line reactor 6SL3203- | 0CD22-2AA0 | 0CD23-5AA0 |
|---------------------------------------|--------------------------|-------------|
| Suitable for Power Module 6SL3210- | 1SE21-8xxx 1SE22-5xxx | 1SE23-2xxx |
| Frame size | FSC | |
| Dimension A in mm and (inches) | 336 (13,22) | 336 (13,22) |
| Dimension B in mm and (inches) | 189 (7,44) | 189 (7,44) |
| Dimension C in mm and (inches) | 50 (1,96) | 80 (3,14) |

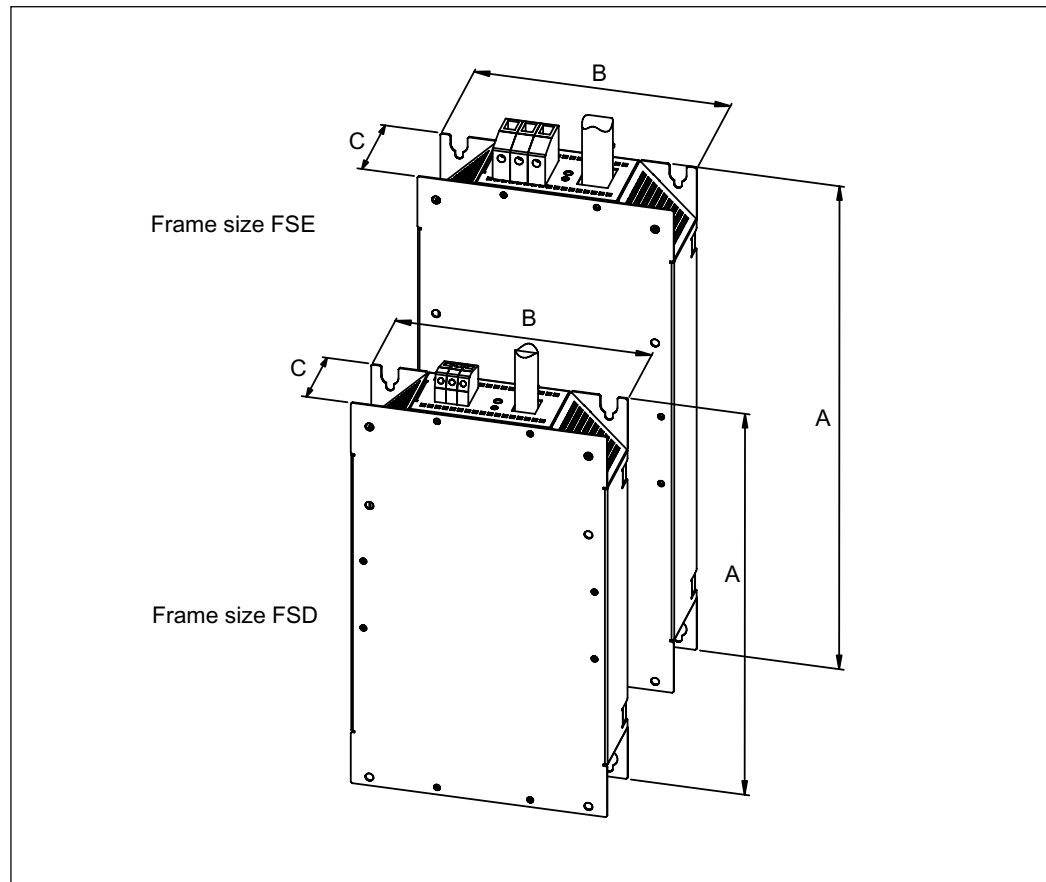


Figure 2-11 Dimension drawing: Line reactor, frame sizes FSD and FSE

Table 2-7 Total and retaining dimensions, line reactor

| Line reactor 6SL3203- 6SL3210- | 0CJ24-5AA0 1SE23-8xxx 1SE24-5xxx | 0CD25-3AA0 1SE26-0xxx | 0CJ28-6AA0 1SE27-5xxx 1SE31-0xxx |
|-----------------------------------|--|--------------------------|--|
| Frame size | FSD | | FSE |
| Dimension A in mm and (inches) | 455 (17,91) | | 577 (22,71) |
| Dimension B in mm and (inches) | 275 (10,82) | | 275 (10,82) |
| Dimension C in mm and (inches) | 83,5 (3,28) | | 93,5 (3,68) |

2.4 Line reactors

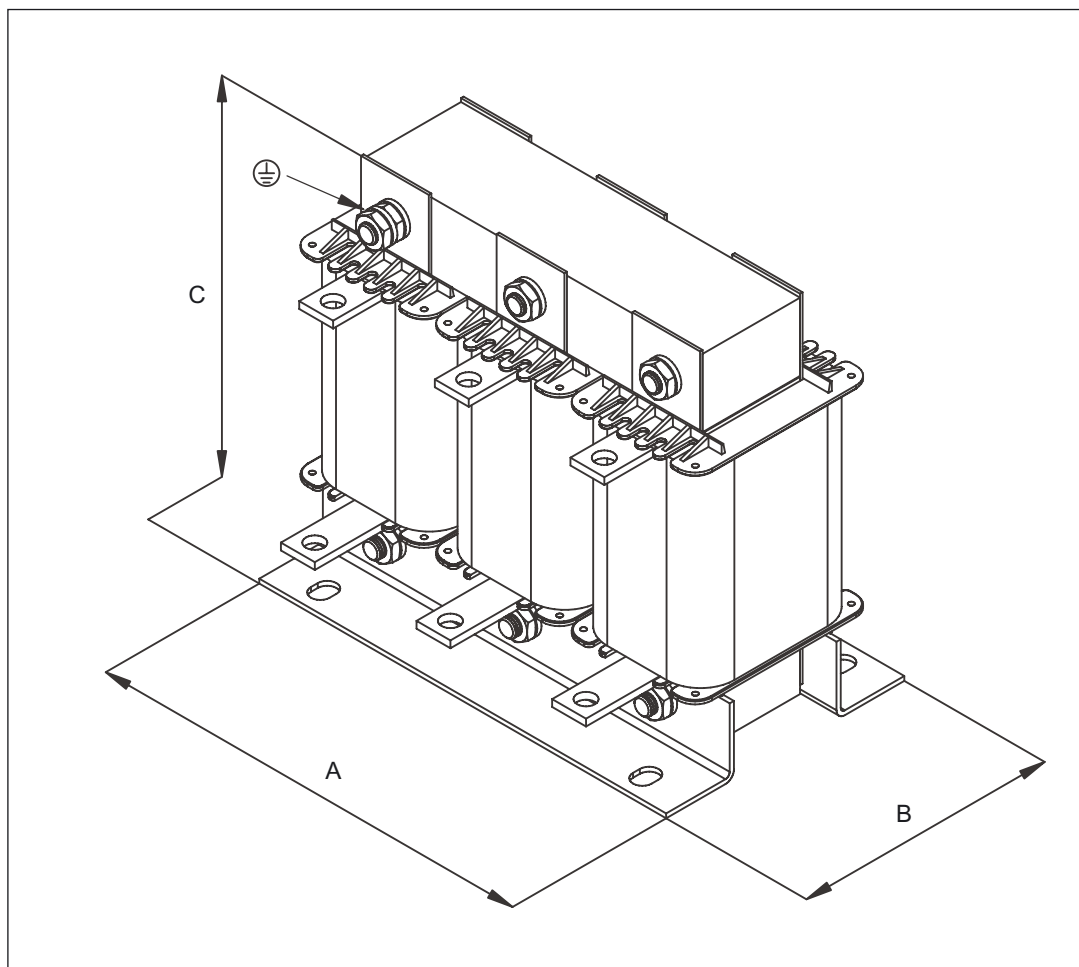


Figure 2-12 Dimension drawing: Line reactor, frame size FSF

Table 2-8 Total and retaining dimensions, line reactor

| Line reactor 6SE6400- Suitable for Power Module 6SL3210- | 3CC11-2FD0 1SE31-1xxx 1SE31-5xxx | 3CC11-7FD0 1SE31-8xxx |
|--|--|--------------------------|
| Frame size | FSF | |
| Dimension A in mm and (inches) | 240 (9,44) | |
| Dimension B in mm and (inches) | 141 (5,55) | |
| Dimension C in mm and (inches) | 228 (8,97) | |

2.4.4 Dimension drawing, Chassis line reactor

Dimension drawing of the line reactors

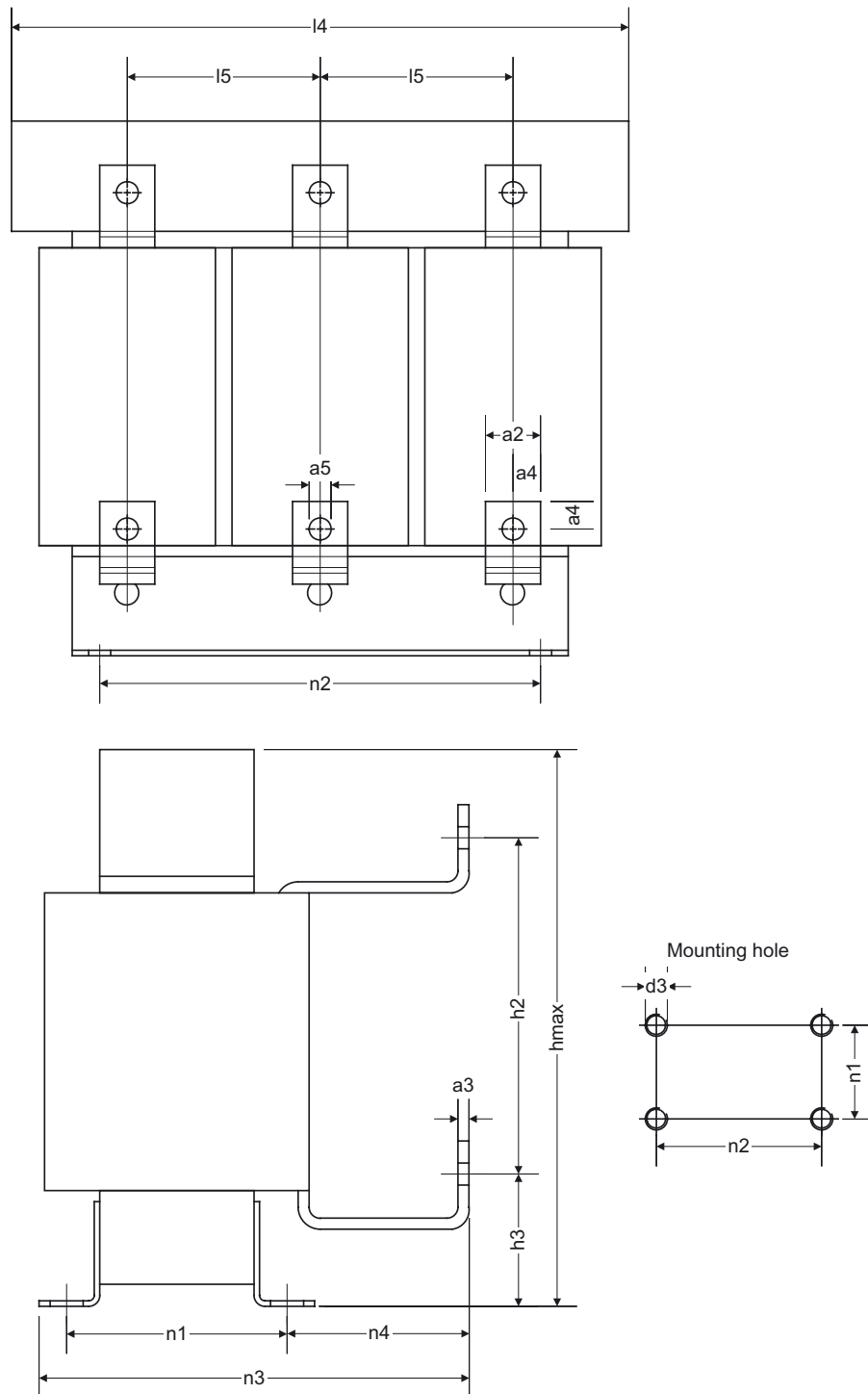


Figure 2-13 Dimension drawing, line reactors

2.4 Line reactors

Table 2-9 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) Lengths n1 and n2 correspond to the distance between holes

2.4.5 Installation

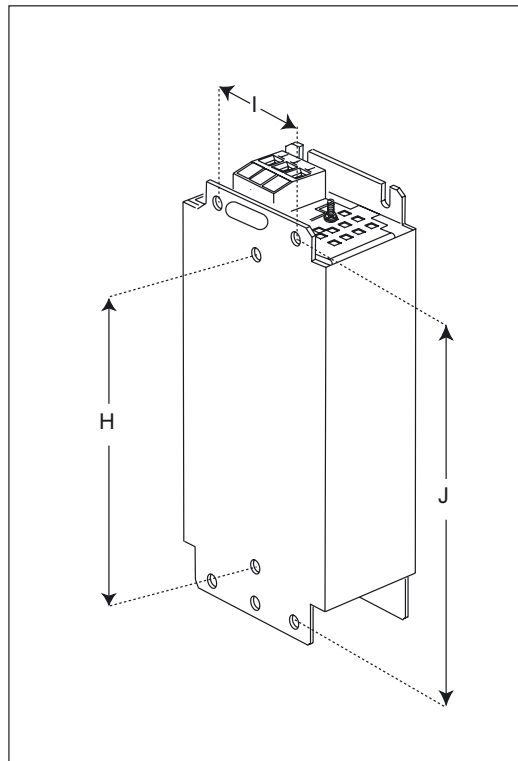


Figure 2-14 Mounting: Line reactor, frame size FSA

Table 2-10 Overall and retaining dimensions, line reactor, Part 1, all data in mm and (inches)

| Line reactors 6SE6400- | 3CC00-4AB3 | 3CC01-0AB3 | 3CC00-2AD3 | 3CC00-4AD3 | 3CC00-6AD3 |
|--|--|--------------------------|--------------------------|--------------------------|------------|
| Suitable for Power Module 6SL3210- | 1SB11-0UA0 1SB11-0AA0 1SB12-3UA0 1SB12-3AA0 | 1SB14-0UA0 1SB14-0AA0 | 1SE11-3UA0 1SE11-7UA0 | 1SE12-2UA0 1SE13-1UA0 | 1SE14-1UA0 |
| Frame size | FSA | | | | |
| H | 160 (6,29) | | | | |
| I | 56 (2,20) | | | | |
| J | 187 (7,36) | | | | |
| | Retaining screw M4 / 1.1 Nm Cable cross-section: 1.0 - 2 mm ²). | | | | |

2.4 Line reactors

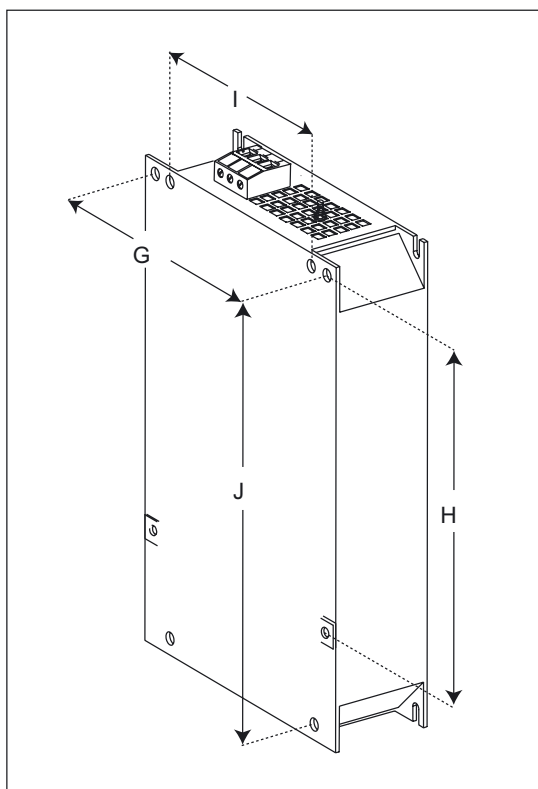


Figure 2-15 Mounting: Line reactor, frame sizes FSB and FSC

Table 2-11 Total and retaining dimensions, line reactor, Part 2, all data in mm and (inches)

| Line reactors 6SL3203- | 0CD21-0AA0 | 0CD21-4AA0 | 0CD22-2AA0 | 0CD22-2AA0 | 0CD23-5AA0 |
|---------------------------------------|---|--------------------------|--|---|--------------------------|
| Suitable for Power Module 6SL3210- | 1SE16-0UA0 1SE16-0AA0 1SE17-7UA0 1SE17-7AA0 | 1SE21-0UA0 1SE21-0AA0 | 1SE21-8UA0 1SE21-8AA0 1SE22-5UA0 1SE22-5AA0 | 1SE21-8UA0 1SE21-8AA0 1SE22-5UA0 1SE22-5AA0 | 1SE23-2UA0 1SE23-2AA0 |
| Frame size | FSB | | | FSC | |
| G | 138 (5,43) | | | 174 (6,85) | |
| H | 174 (6,85) | | | 204 (8,03) | |
| I | 120 (4,72) | | | 156 (6,14) | |
| J | 200 (7,87) | | | 232 (9,13) | |
| | Retaining screw M4 / 1.5 Nm Cable cross-section: 1.5 - 6 mm ² . | | | Retaining screw M5 / 2.25 Nm Cable cross-section: 2.5 - 10 mm ² . | |

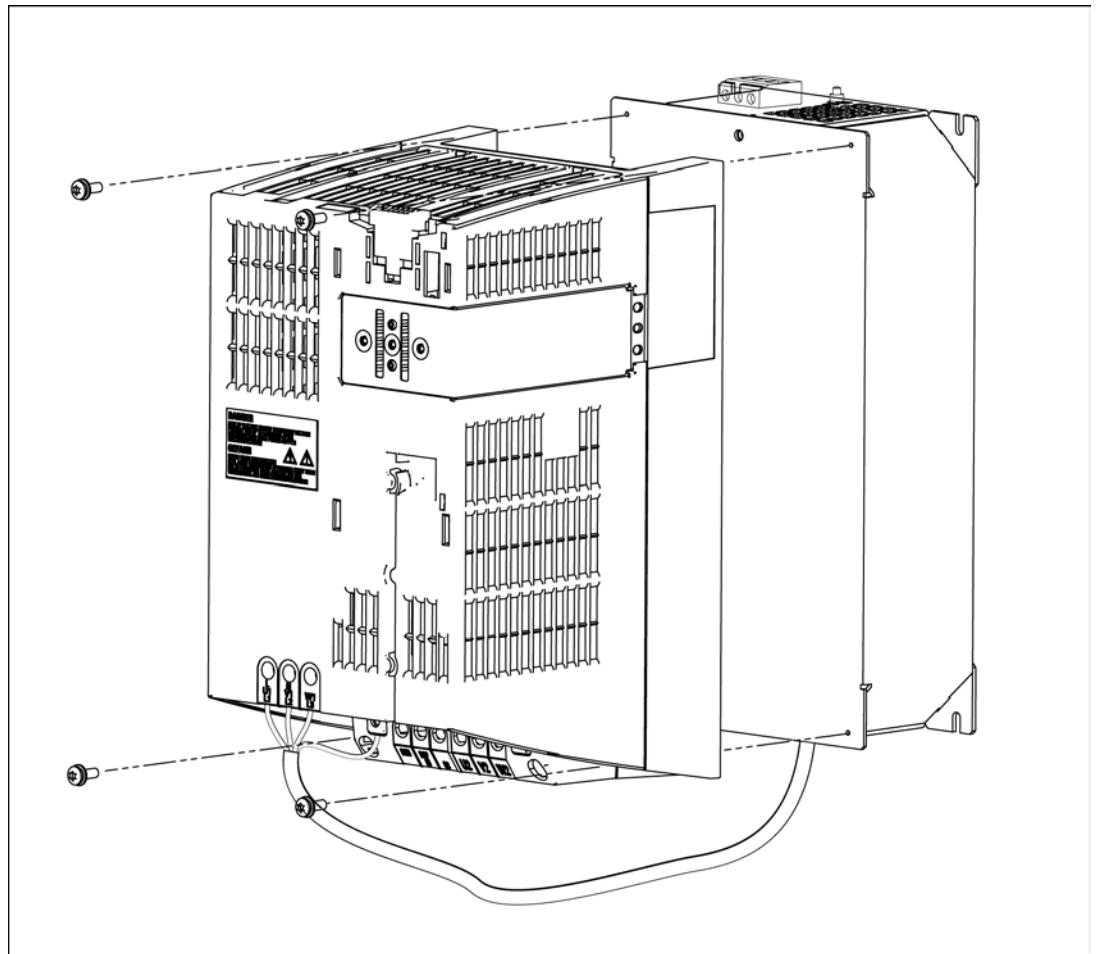


Figure 2-16 Mounting: PM340 and line reactor, frame size FSB

2.4 Line reactors

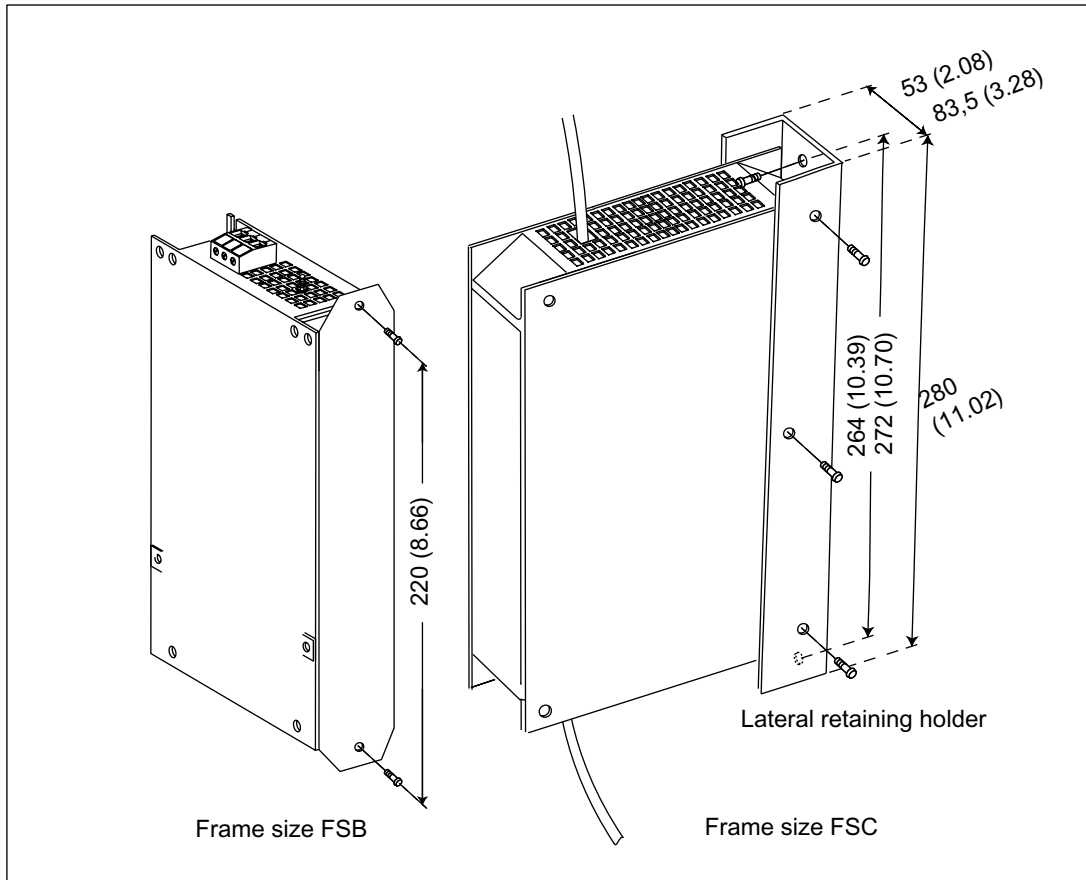


Figure 2-17 Side mounting: Line reactors, frame sizes FSB and FSC

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

The line reactor is retained on the mounting surface and the Power Module is mounted on the line reactor in a space-saving fashion. The cables to the Power Modules are already connected at the line reactor.

The line reactor is connected to the line supply through terminals.

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

2.4.6 Electrical Connection

Line supply/load connection

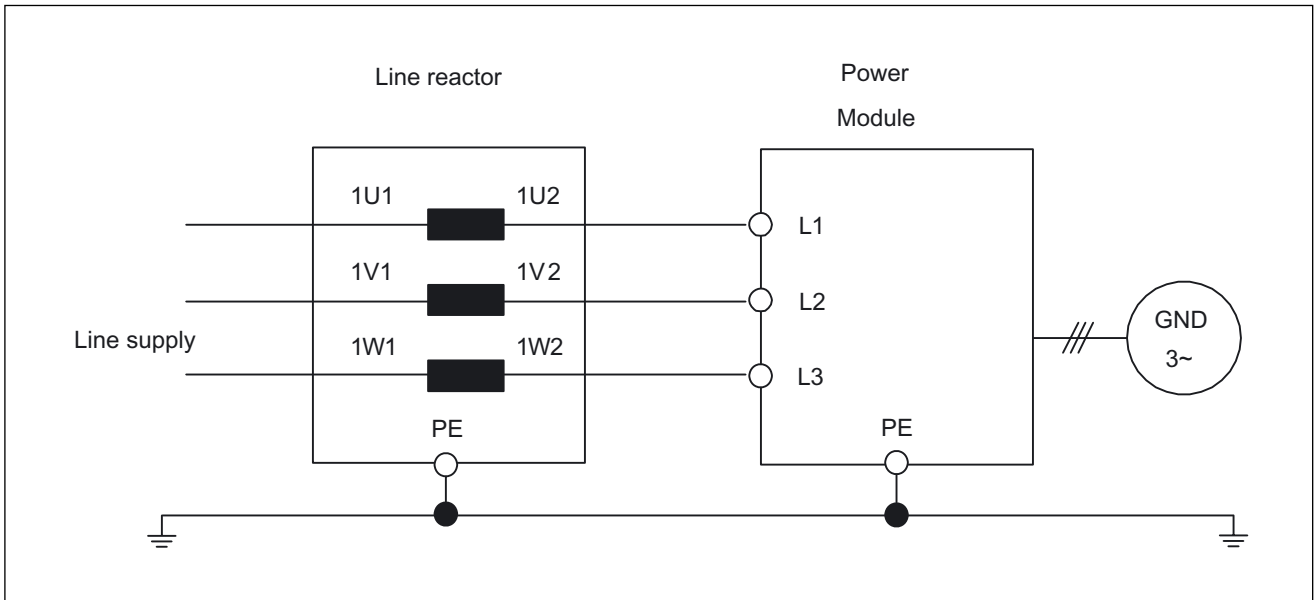


Figure 2-18 Power Module with line filter

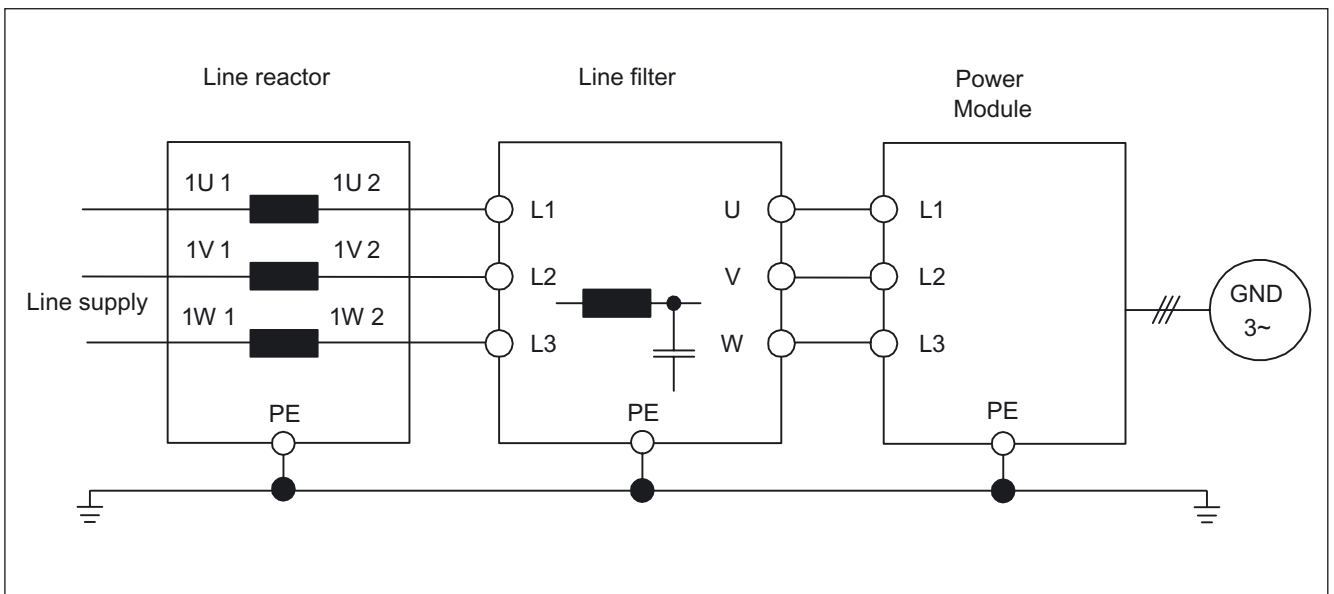


Figure 2-19 Power Module Blocksize with line reactor and line filter

2.4.7 Technical data, Blocksize

Table 2-12 Technical data, blocksize line reactors, Part 1

| 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 U1, V1, W1 | | 6 mm screw terminals ² | 6 mm screw terminals ² |
| Load connection 1U2, 1V2, 1W2 | | Cable 3 x 1.5 mm ² | Cable 3 x 1.5 mm ² |
| PE connection | | M5 stud | M5 stud |
| Degree of protection | | IP20 or IPXXB | IP20 or IPXXB |
| Weight | kg | 1,3 | 1,3 |

Table 2-13 Technical data, Blocksize line reactors, Part 2

| Line supply voltage 3-ph 380 V AC -10 % to 480 V AC +10 % | | | | | |
|---|----|---|---|---|---|
| Order No. | | 6SE6400- 3CC00-2AD3 | 6SE6400- 3CC00-4AD3 | 6SE6400- 3CC00-6AD3 | 6SL3203- 0CD21-0AA0 |
| Suitable for Power Module 6SL3210- | | 1SE11-3UA0 1SE11-7UA0 | 1SE12-2UA0 1SE13-1UA0 | 1SE14-1UA0 | 1SE16-0xxx 1SE17-7xxx |
| Rated line reactor current | A | 1,9 | 3,5 | 4,8 | 9 |
| Power loss 50 / 60 Hz | W | 6 / 7 | 12,5 / 15 | 7,5 / 9 | 9 / 11 |
| Line supply connection U1, V1, W1 | | 6 mm screw terminals ² | 6 mm screw terminals ² | 6 mm screw terminals ² | 6 mm screw terminals ² |
| Load connection 1U2, 1V2, 1W2 | | Cable 4 x 1.5 mm ² Length approx. 0.38 m | Cable 4 x 1.5 mm ² Length approx. 0.38 m | Cable 4 x 1.5 mm ² Length approx. 0.38 m | Cable 4 x 1.5 mm ² Length approx. 0.46 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 | 1,2 | 1,3 | 1,3 | 3,4 |

Table 2-14 Technical data, Blocksize line reactors, Part 3

| Line supply voltage 3-ph 380 V AC -10 % to 480 V AC +10 % | | | | | |
|---|----|--|--|--|---|
| Order No. 6SL3203- | | 0CD21-4AA0 | 0CD22-2AA0 | 0CD23-5AA0 | 0CJ24-5AA0 |
| Suitable for Power Module 6SL3210- | | 1SE21-0xxx | 1SE21-8xxx 1SE22-5xxx | 1SE23-2xxx | 1SE23-8xxx 1SE24-5xxx |
| Rated line reactor current | A | 11,6 | 25 | 31,3 | 54 |
| Power loss 50 / 60 Hz | W | 27 / 32 | 98 / 118 | 37 / 44 | 90 / 115 |
| Line supply connection U1, V1, W1 | | 6 mm screw terminals ² | 6 mm screw terminals ² | 6 mm screw terminals ² | 16 mm screw terminals ² |
| Load connection 1U2, 1V2, 1W2 | | Cable 4 x 1.5 mm ² Length approx. 0.46 m | Cable 4 x 2.5 mm ² Length approx. 0.49 m | Cable 4 x 2.5 mm ² Length approx. 0.49 m | Cable 4 x 16 mm ² Length approx. 0.70 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 M8 screw |
| Degree of protection | | IP20 or IPXXB | IP20 or IPXXB | IP20 or IPXXB | IP20 or IPXXB |
| Weight | kg | 3,4 | 6,3 | 6,4 | 13 |

Table 2-15 Technical data, blocksize line reactors, Part 4

| Line supply voltage 3-ph 380 V AC -10 % to 480 V AC +10 % | | | | | |
|---|----|---|---|----------------------------------|----------------------------------|
| Order No. | | 6SL3203- 0CD25-3AA0 | 6SL3203- 0CJ28-6AA0 | 6SE6400- 3CC11-2FD0 | 6SE6400- 3CC11-7FD0 |
| Suitable for Power Module 6SL3210- | | 1SE26-0xxx | 1SE27-5xxx 1SE31-0xxx | 1SE31-1xxx 1SE31-5xxx | 1SE31-8xxx |
| Rated line reactor current | A | 71 | 105 | 178 | 225 |
| Power loss 50 / 60 Hz | W | 90 / 115 | 170 / 215 | 280 / 360 | 280 / 360 |
| Line supply connection U1, V1, W1 | | 16 mm screw terminals ² | 50 mm screw terminals ² | Flat connector for M10 cable lug | Flat connector for M10 cable lug |
| Load connection 1U2, 1V2, 1W2 | | Cable 4 x 16 mm ² Length approx. 0.70 m | Cable 4 x 35 mm ² 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 | On housing with M8 bolt | On housing with M8 bolt |
| Degree of protection | | IP20 or IPXXB | IP20 or IPXXB | IP00 | IP00 |
| Weight | kg | 13 | 19 | 25 | 25 |

2.4.8 Technical data, Chassis

Table 2-16 Technical specifications, Chassis line reactors

| Order no. | 6SL3000- | 0CE32-3AA0 | 0CE32-8AA0 | 0CE33-3AA0 | 0CE35-1AA0 | 0CE35-1AA0 |
|-----------------------------------|----------|--|---------------------|---------------------|---------------------|---------------------|
| Suitable for Power Module | 6SL3310- | 1TE32-1AA0 | 1TE32-6AA0 | 1TE33-1AA0 | 1TE33-8AA0 | 1TE35-0AA0 |
| Rated current of the Power Module | A | 210 | 260 | 310 | 380 | 380 |
| 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 |
| Degree of protection | | IP00 | IP00 | IP00 | IP00 | IP00 |
| Weight | kg | 24,5 | 26 | 27,8 | 38 | 38 |

Power Modules

3.1 Power Modules Blocksize (PM340)

3.1.1 Description




The Power Modules in blocksize format are designed as follows:

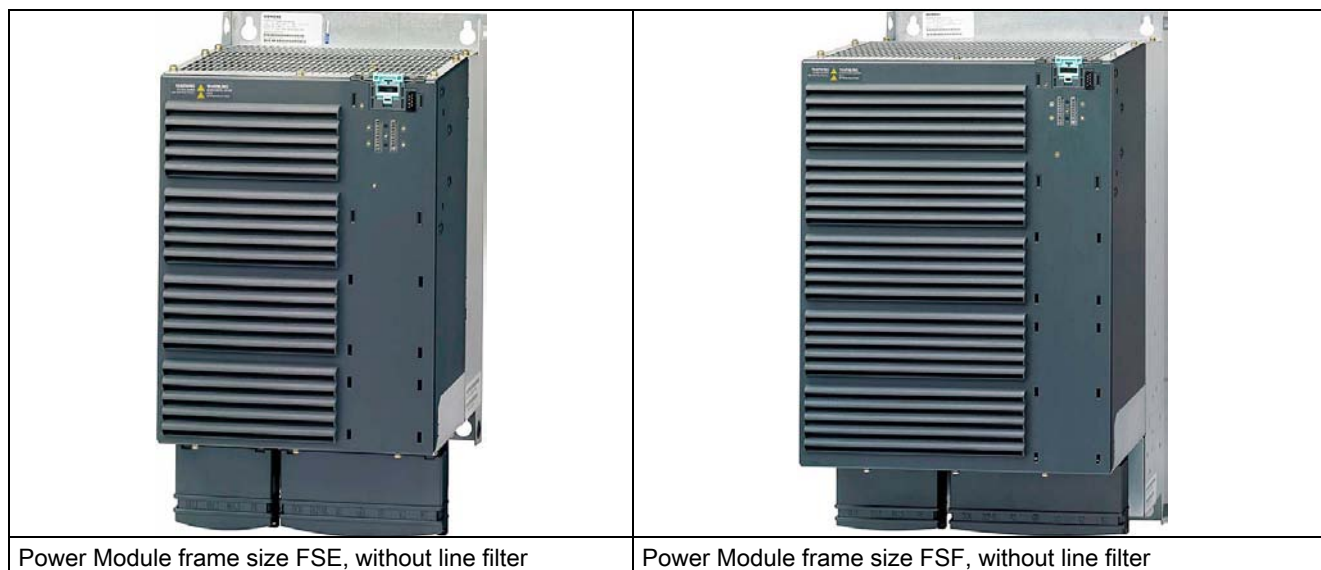
- Line side diode rectifier
- DC link electrolytic capacitors with pre-charging circuit
- Output inverter
- Braking chopper for (external) braking resistor
- Power supply 24 V DC / 1 A
- Gating unit, actual value sensing
- Fan to cool the power semiconductors

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.

3.1 Power Modules Blocksize (PM340)

Table 3-1 Overview, Power Modules PM340 (selection)

| | |
|---|--|
|  |  |
| <p>Power Module (230 V) frame size FSA, with and without integrated line filter Power Module (400 V) frame size FSA, without integrated line filter</p> | <p>Power Module frame size FSB, with and without integrated line filter</p> |
|  |  |
| <p>Power Module frame size FSC, with and without integrated line filter</p> | <p>Power Module frame size FSD, without line filter</p> |



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.

 **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 copper conductors 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 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:

- stationary connection and protective conductor connection by means of $\geq 10 \text{ mm}^2 \text{ Cu}$ or $\geq 16 \text{ mm}^2 \text{ Al}$
- stationary connection and installation of a second protective conductor with the same cross-section as the first protective conductor
- stationary connection and automatic shutdown of the power supply if the protective conductor is interrupted
- Connection with a plug connector for industrial applications in accordance with EN 60309 and a minimum protective conductor cross-section of $\geq 2.5 \text{ mm}^2 \text{ Cu}$ as part of a multi-core supply cable with appropriate strain relief.

 **WARNING**

Power Modules must be mounted in the vertical position.

For the Power Modules, the following cooling clearances must be maintained above and below the component:

- frame sizes FSA and FSB: 100 mm (3.93 inch),
- frame size FSC: 125 mm (4.92 inches),
- frame sizes FSD and FSE: 300 mm (11.81 inches) and
- frame size FSF: 350 mm (13.77 inches).

When mounting the Power Modules, the following clearances must be maintained between the components:

- frame size FSB: 40 mm (1.57 inch)
- frame size FSC: 50 mm (1.96 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.

Note

Power Modules of frame sizes FSA, 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.

3.1.3 Interface description

3.1.3.1 Overview

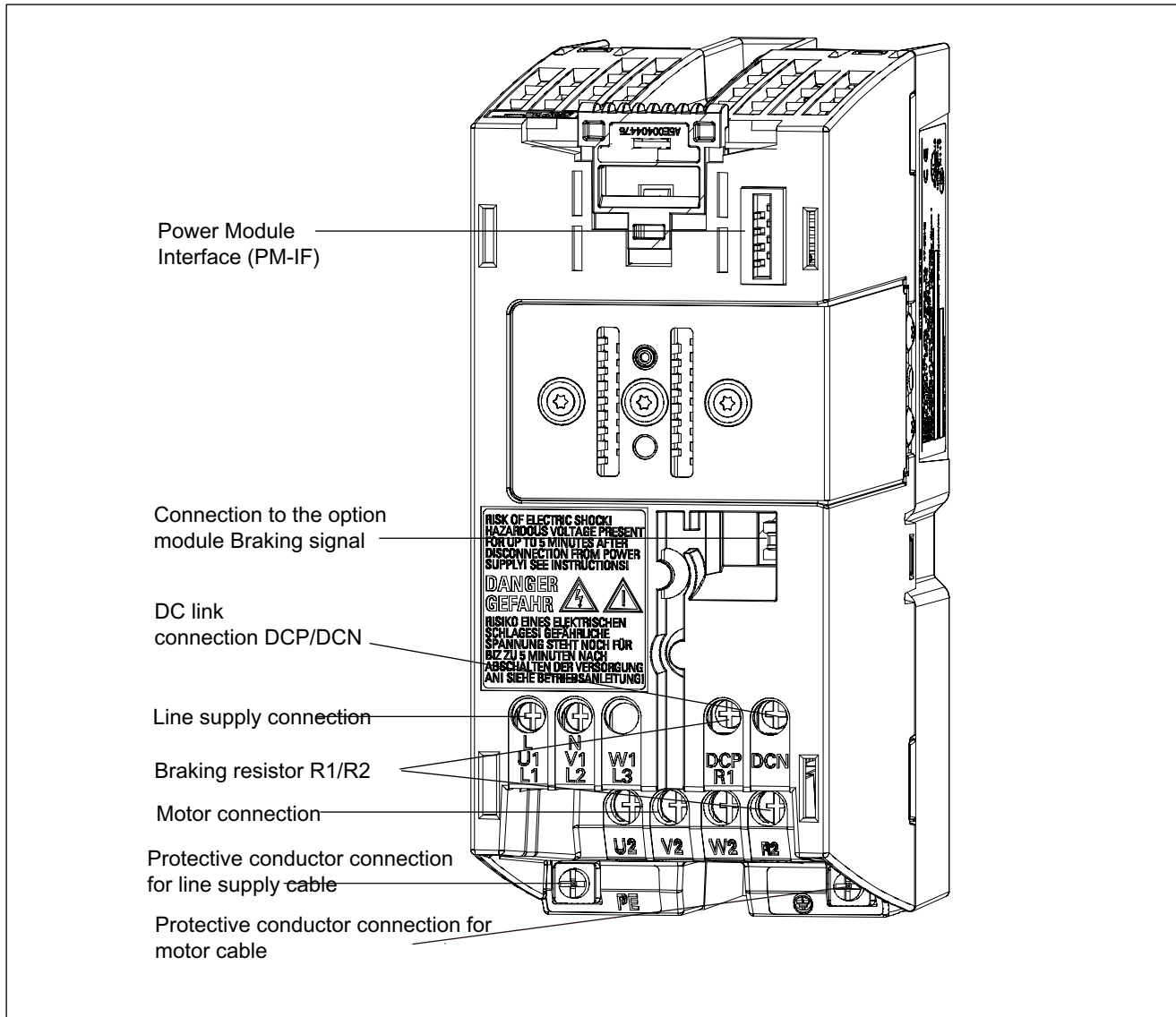


Figure 3-1 PM340, frame size FSA

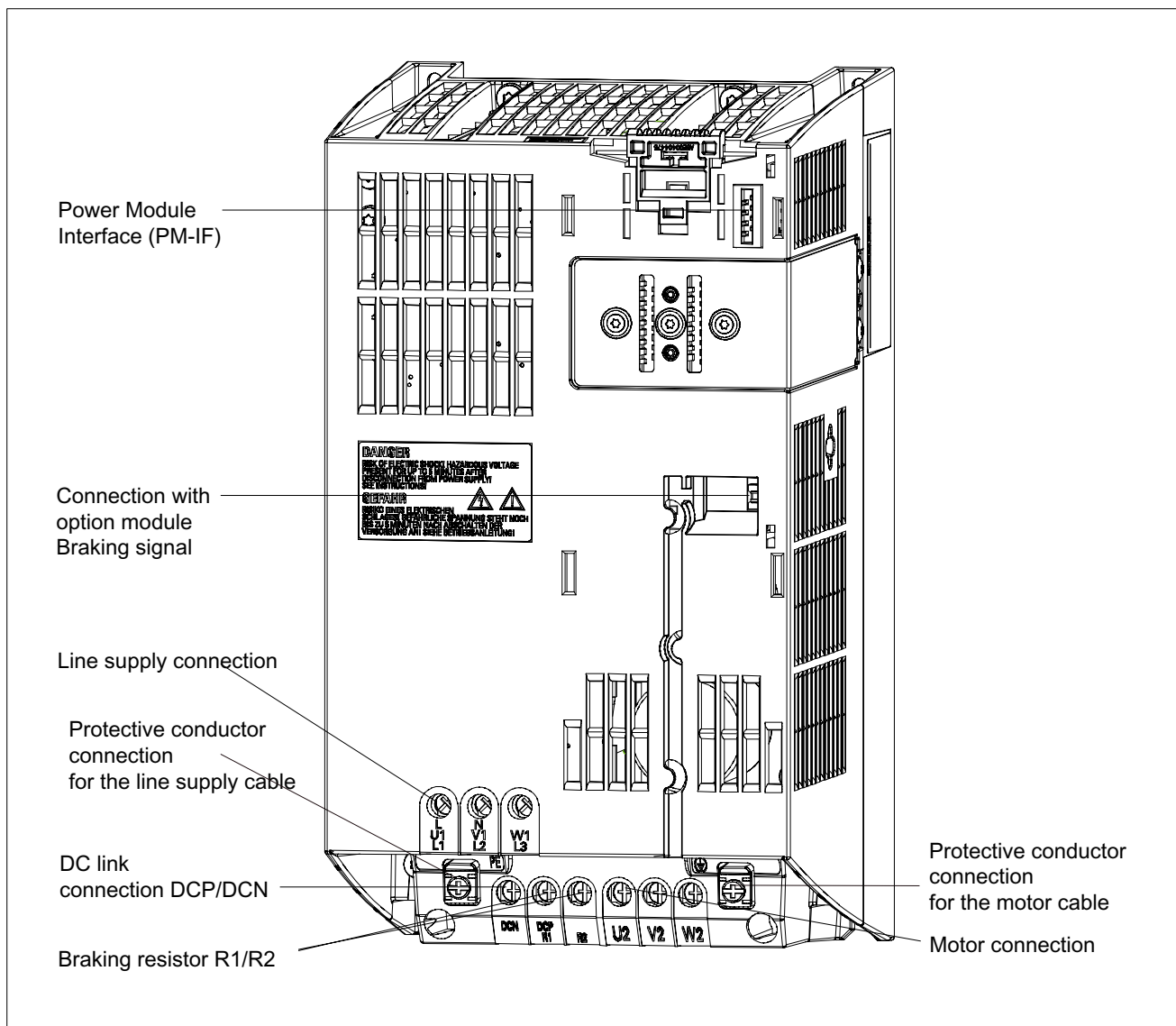


Figure 3-2 PM340, frame size FSB

3.1 Power Modules Blocksize (PM340)

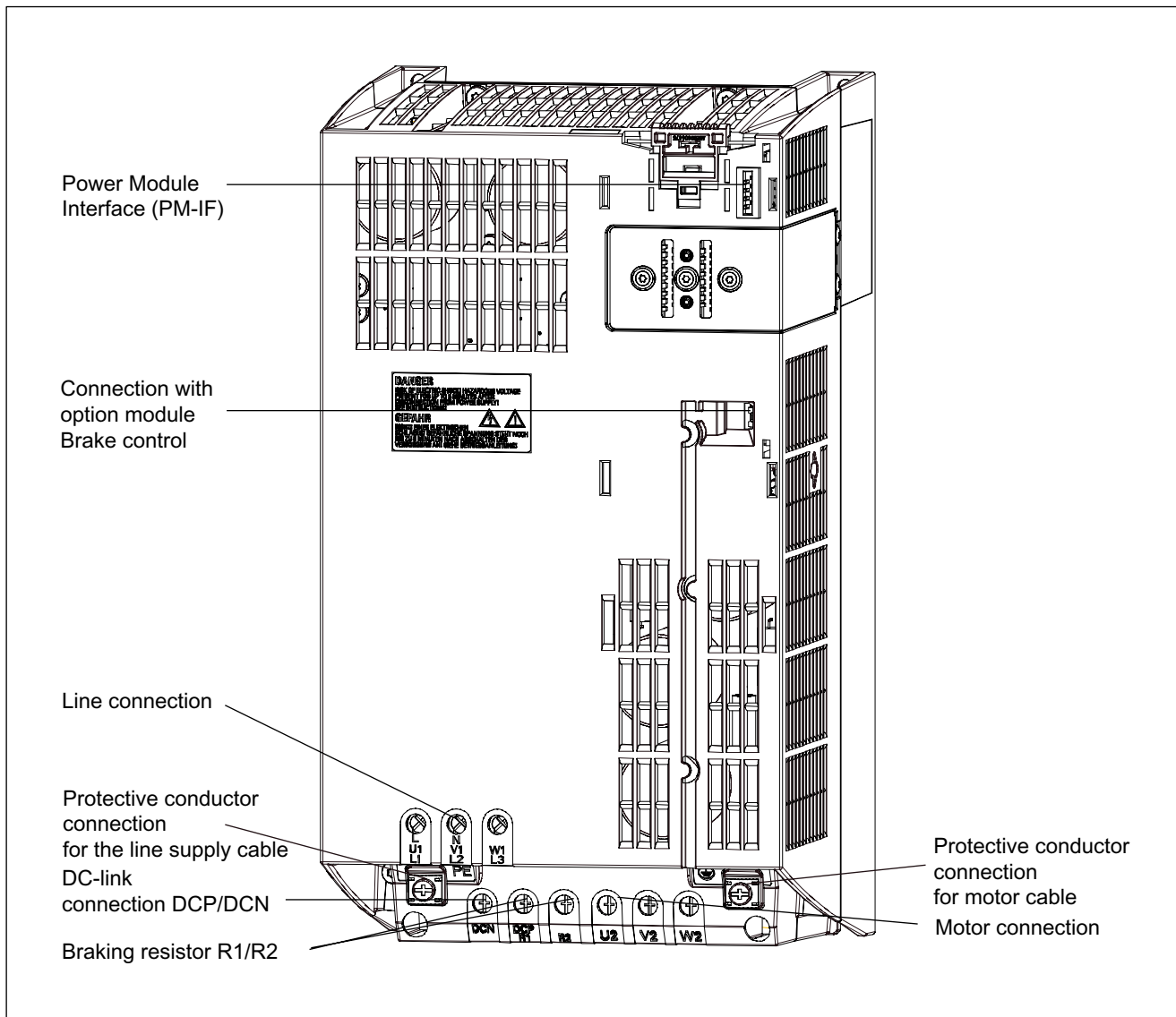


Figure 3-3 PM340, frame size FSC

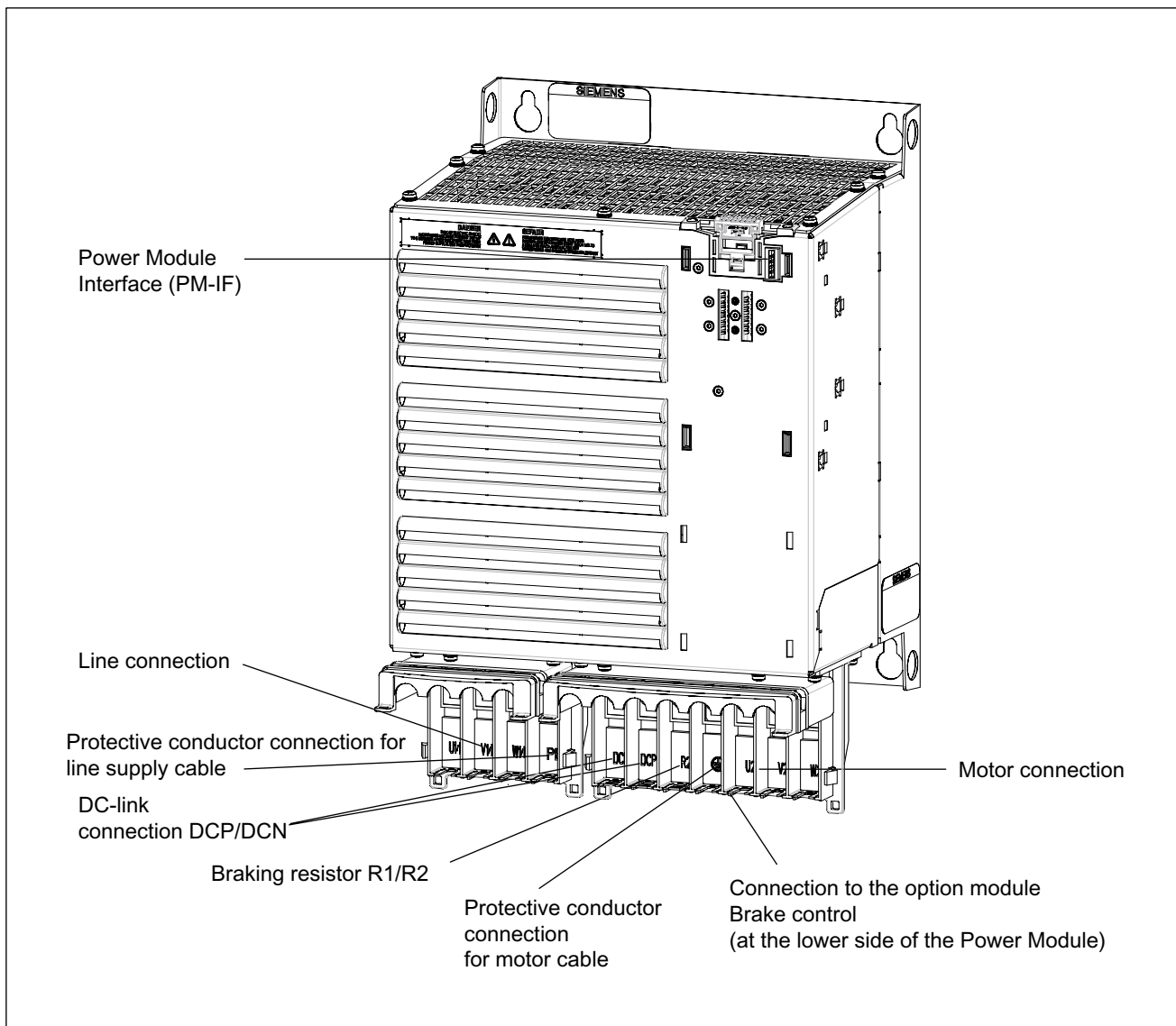


Figure 3-4 PM340, frame size FSD

3.1 Power Modules Blocksize (PM340)

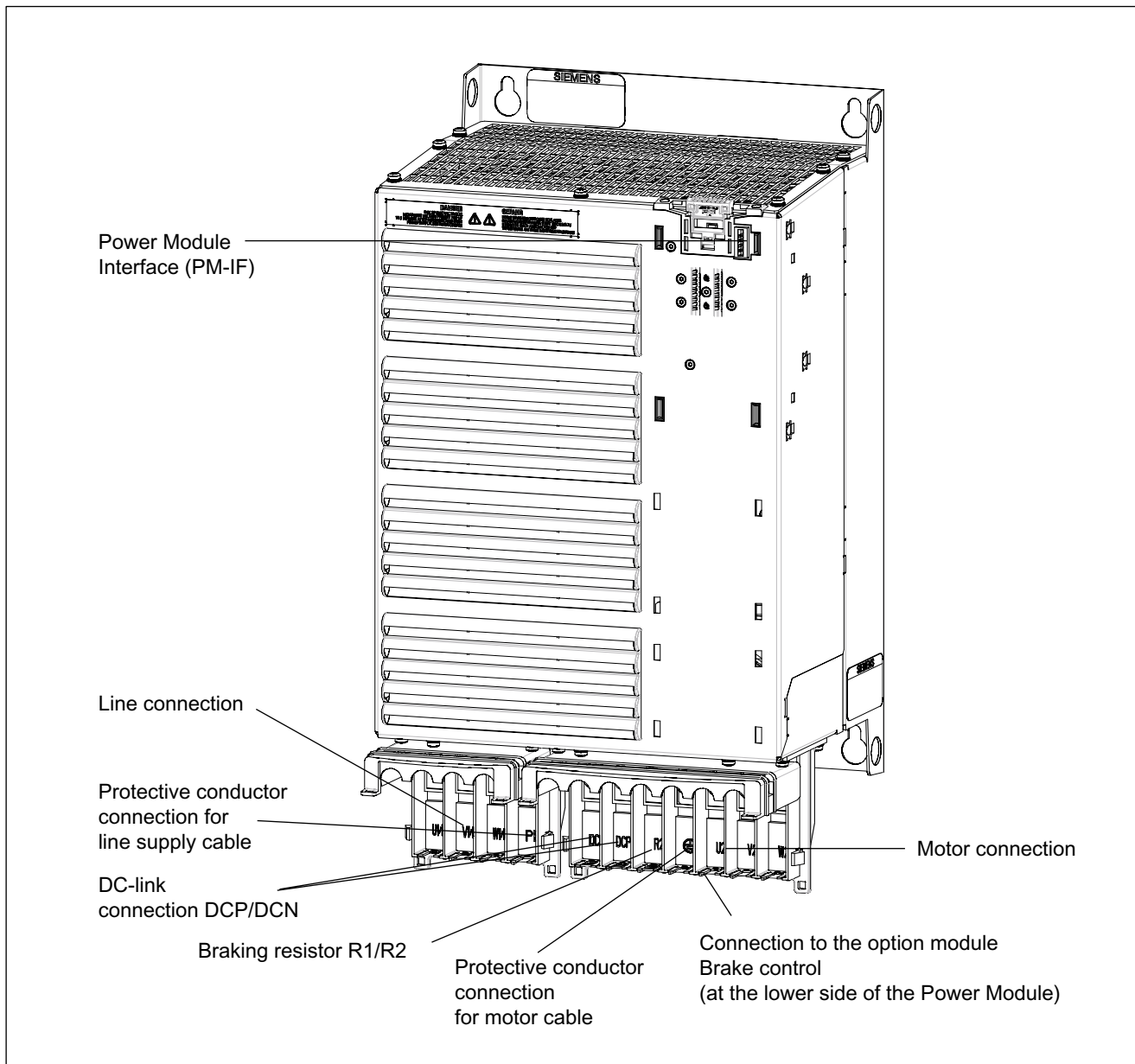


Figure 3-5 PM340, frame size FSE

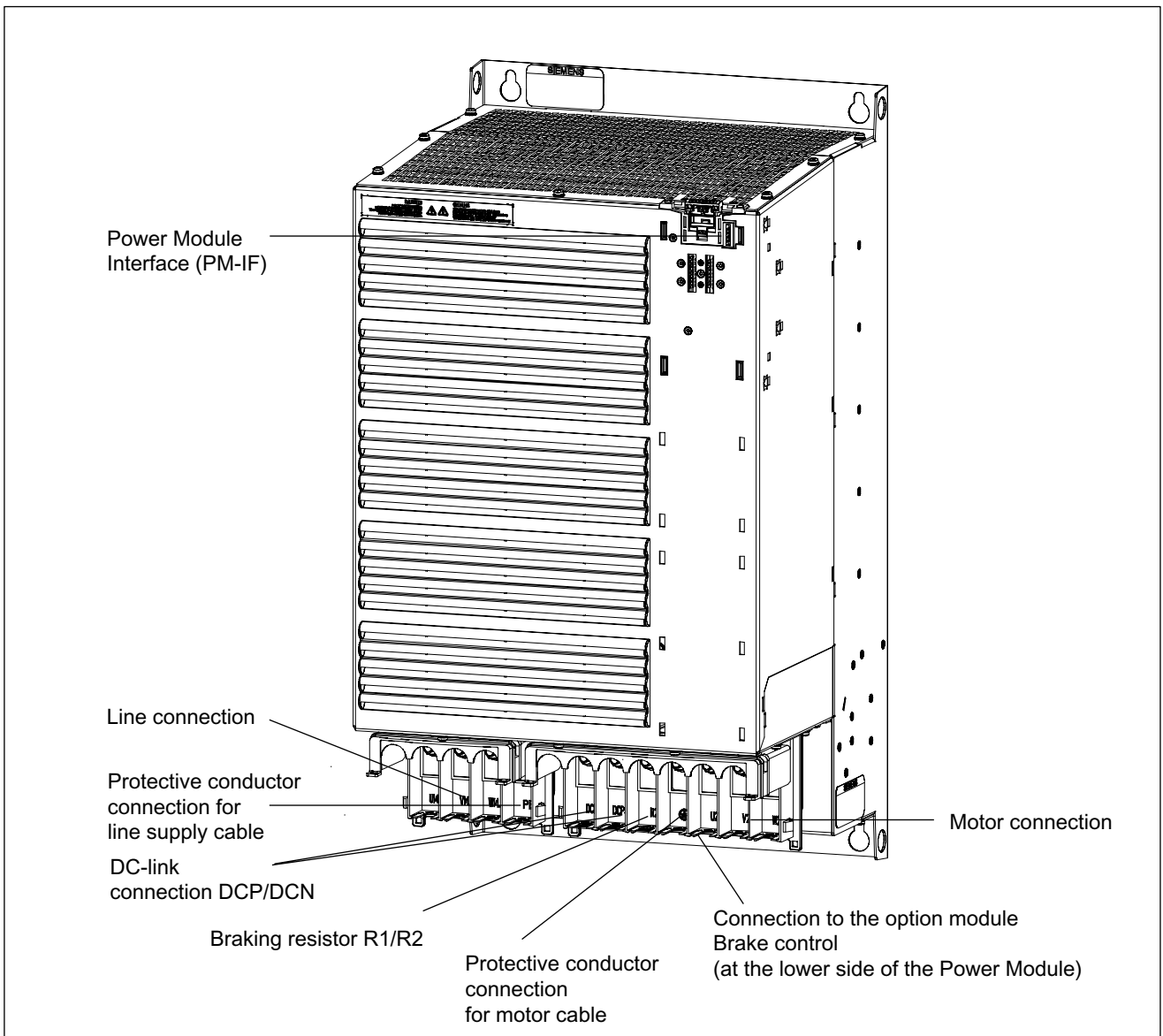


Figure 3-6 PM340, frame size FSF

3.1 Power Modules Blocksize (PM340)

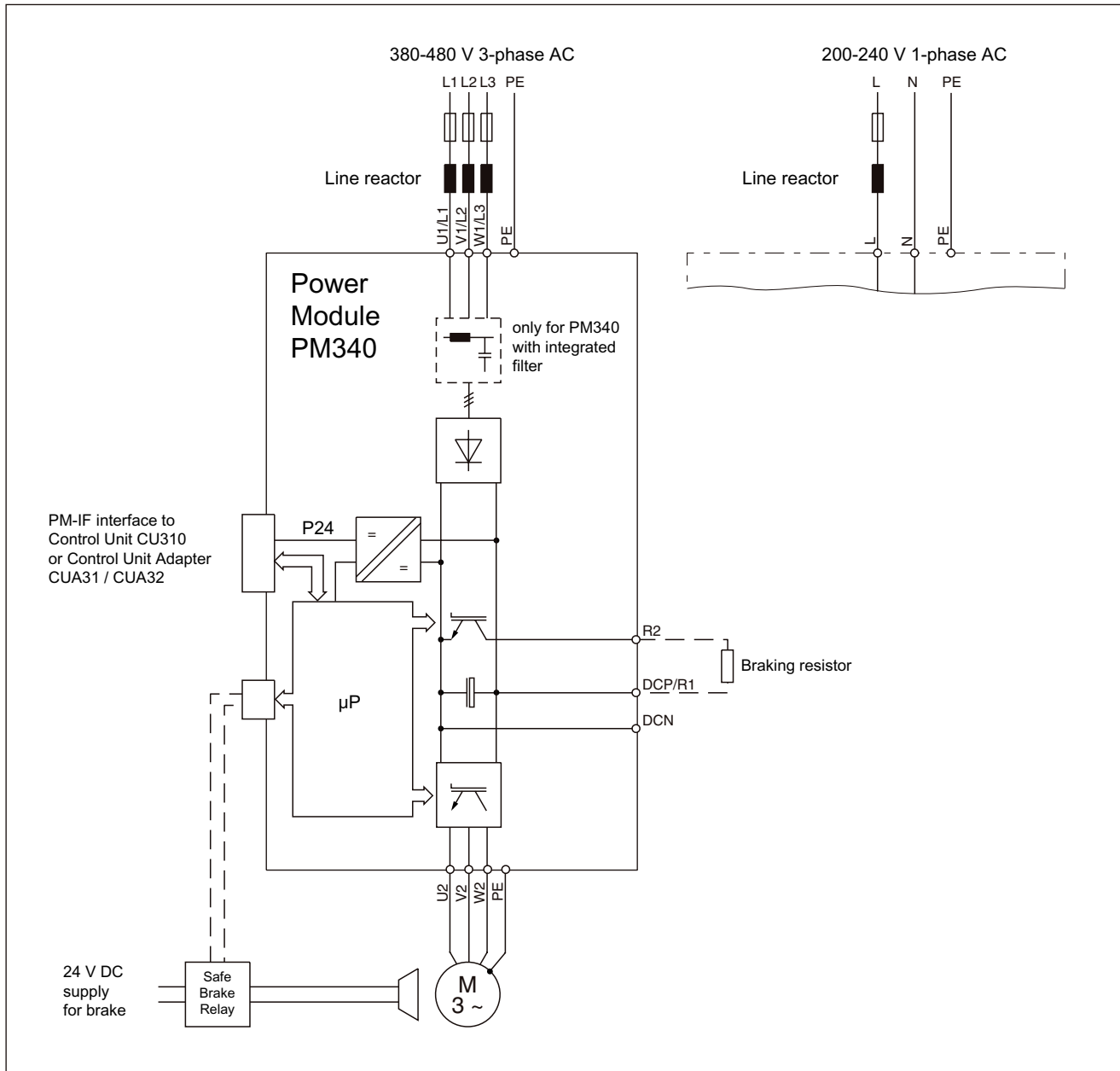


Figure 3-7 PM340 connection example

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.

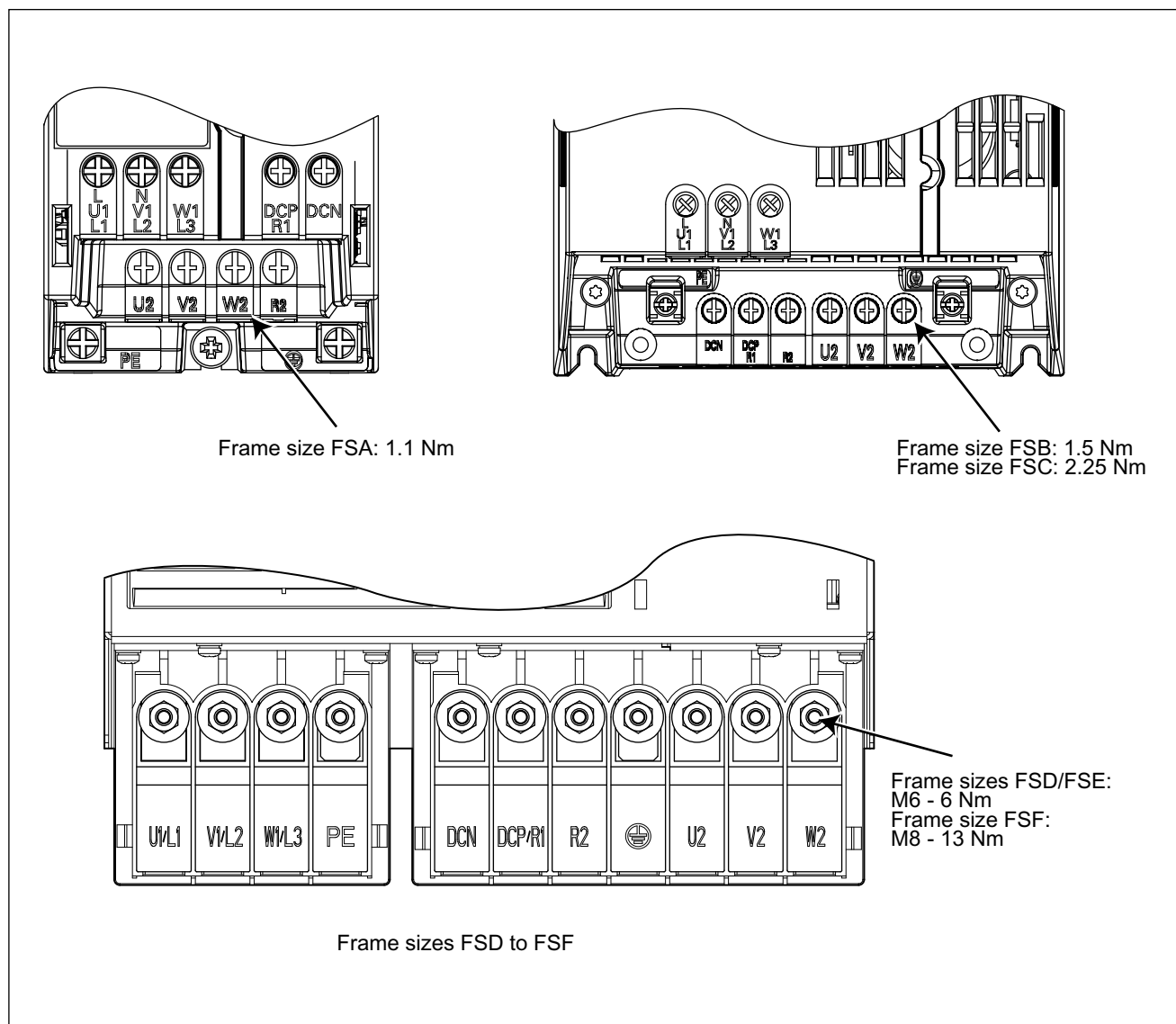


Figure 3-8 Arrangement of the line supply and motor terminals for the PM340

3.1 Power Modules Blocksize (PM340)

3.1.3.2 Line supply connection

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

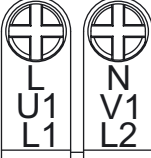
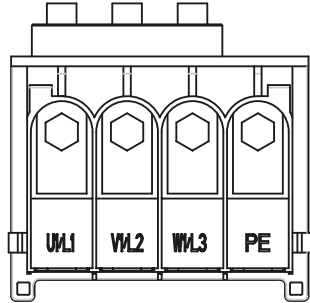
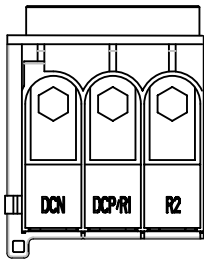
| | Terminal | Signal name | Technical specifications |
|---|----------|-------------|--------------------------|
|  | 1 | L | Line phase L |
| | 2 | N | Line phase N |
| Max. conductor cross-section: 2.5 mm ² | | | |

Table 3-3 Terminal strip, 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 |

3.1.3.3 Braking resistor and DC link connection

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

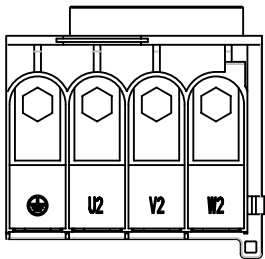

| | Terminal | Technical specifications |
|---|----------|---|
|  | DCN | DC link negative |
| | DCP/R1 | DC link positive and positive connection for braking resistor |
| | R2 | Negative connection for the braking resistor |

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.

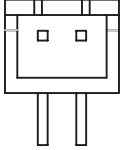
3.1.3.4 Motor connection

Table 3-5 Terminal strip, 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 |

3.1.3.5 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

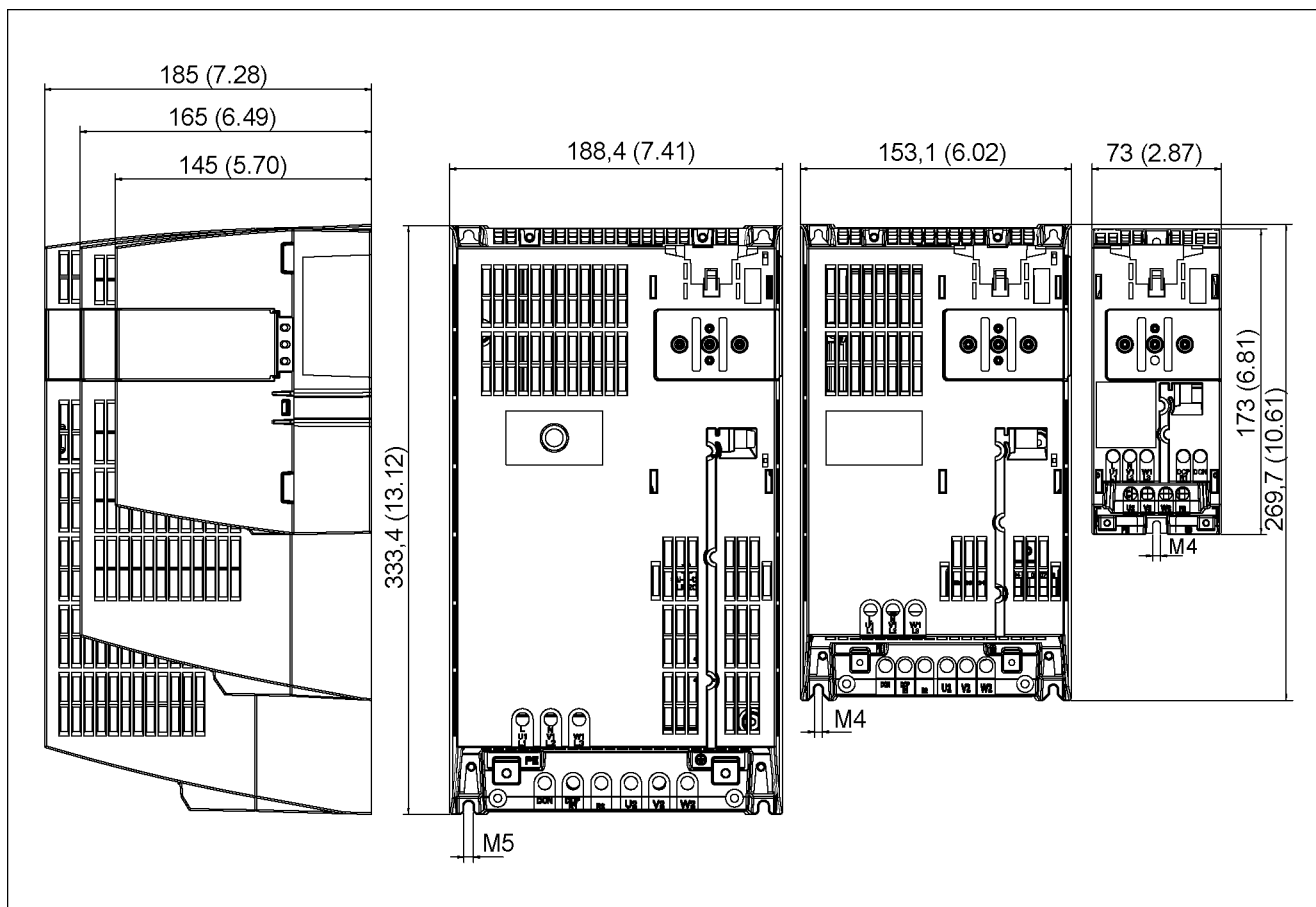


Figure 3-9 Dimension drawings, Power Module PM340

Frame size FSC

Frame size FSB

Frame size FSA

3.1 Power Modules Blocksize (PM340)

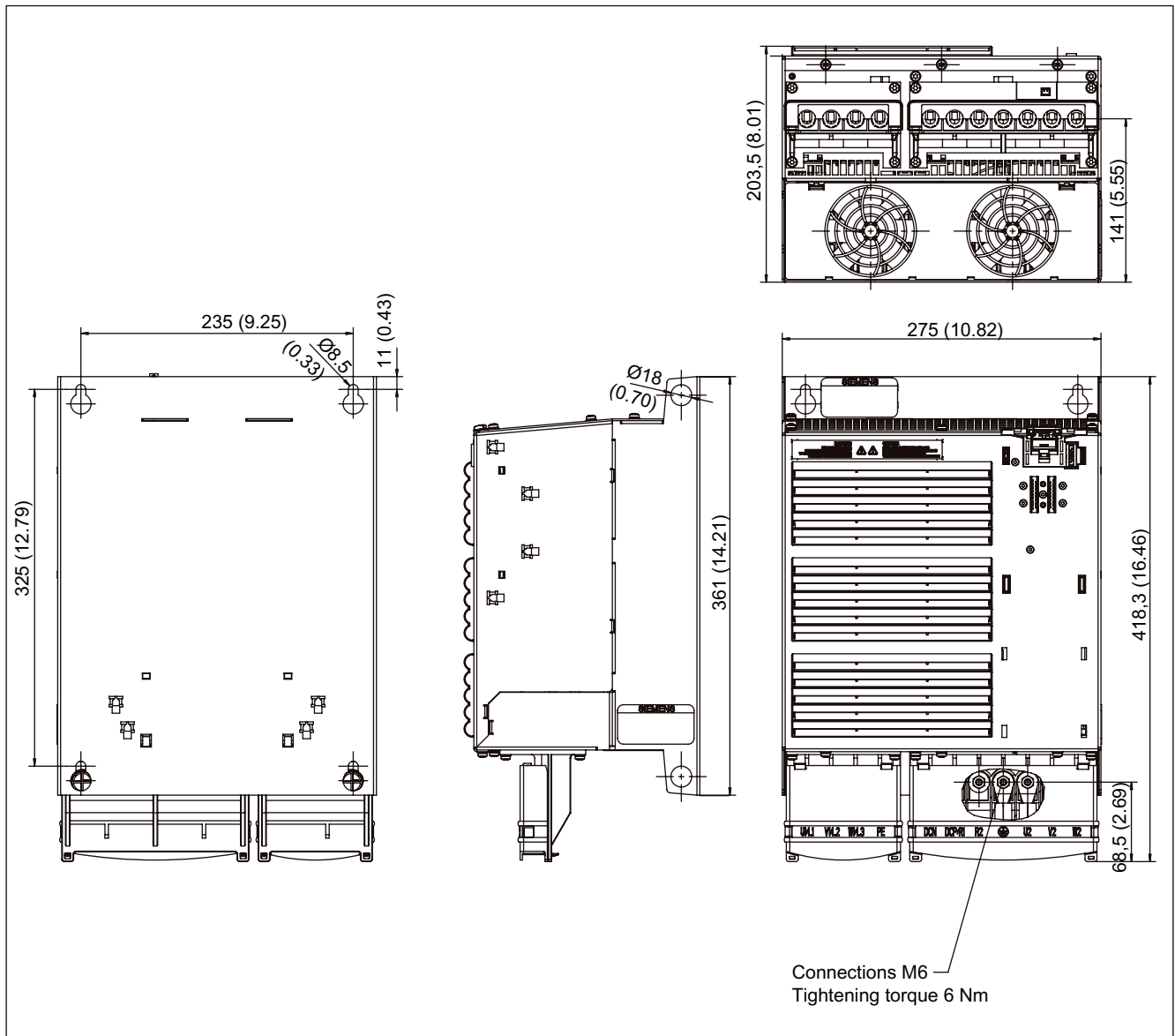


Figure 3-10 Dimension drawing: Power Module PM340, frame size FSD

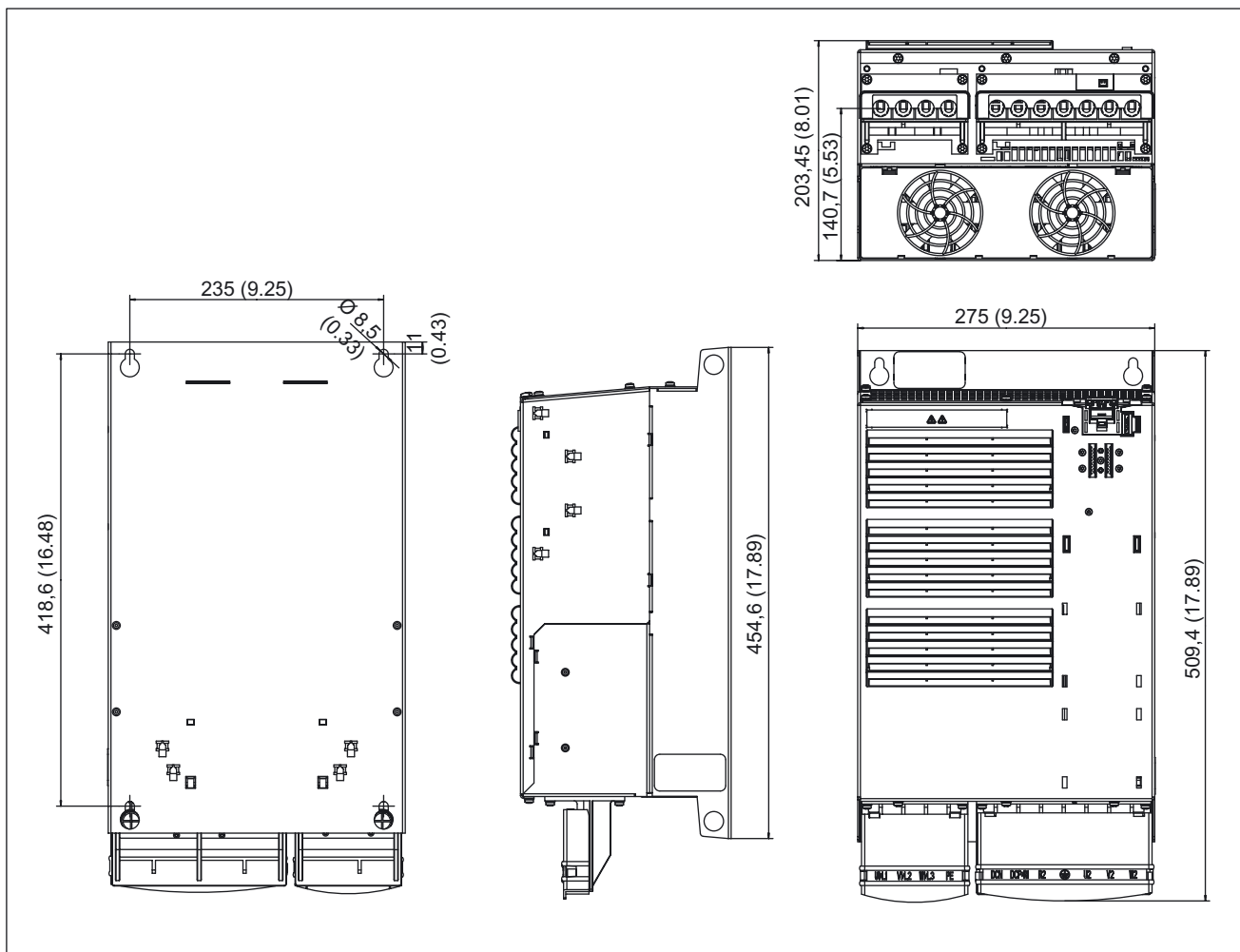


Figure 3-11 Dimension drawing: Power Module PM340 with integrated line filter, frame size FSD

3.1 Power Modules Blocksize (PM340)

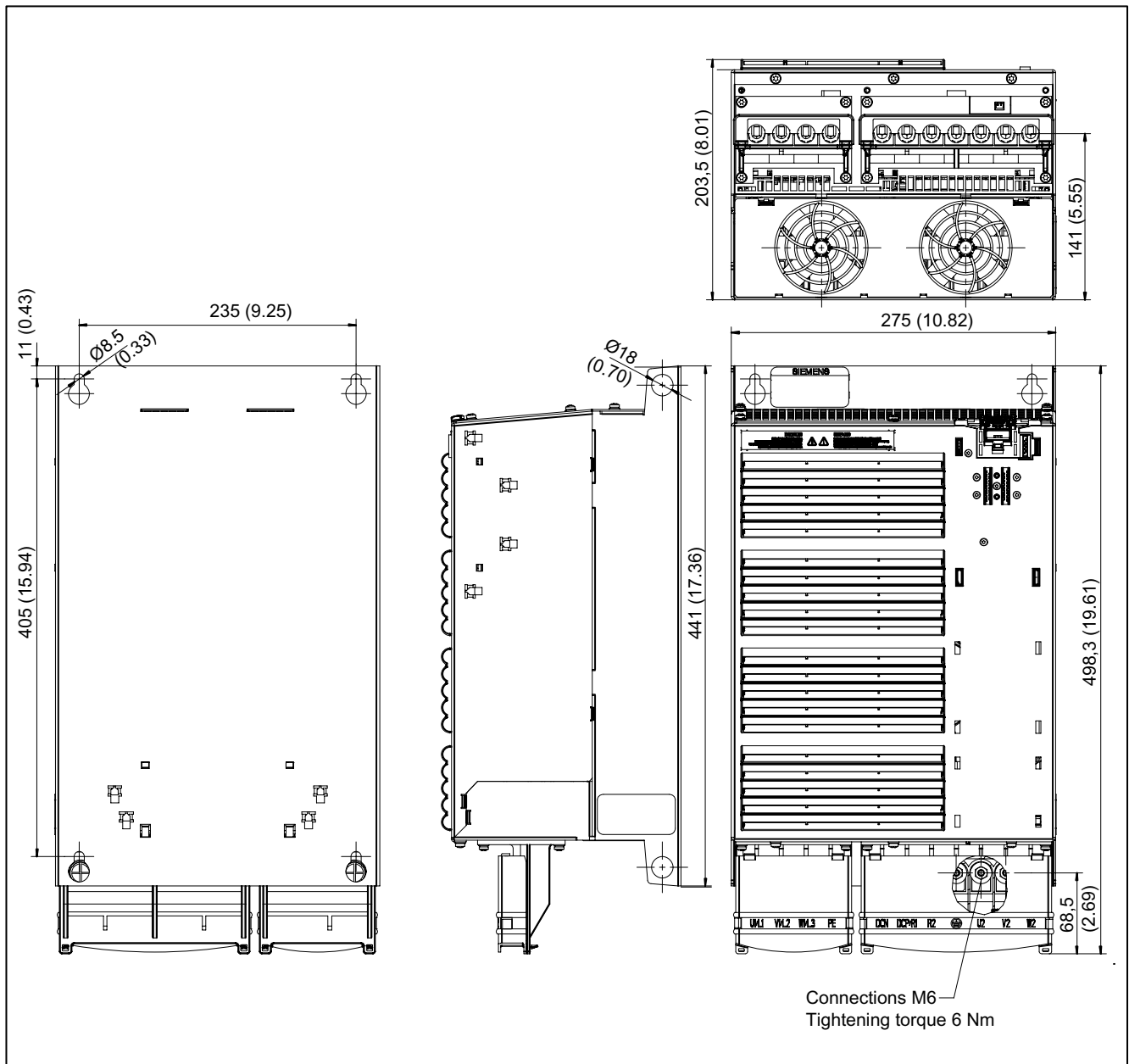


Figure 3-12 Dimension drawing: Power Module PM340, frame size FSE

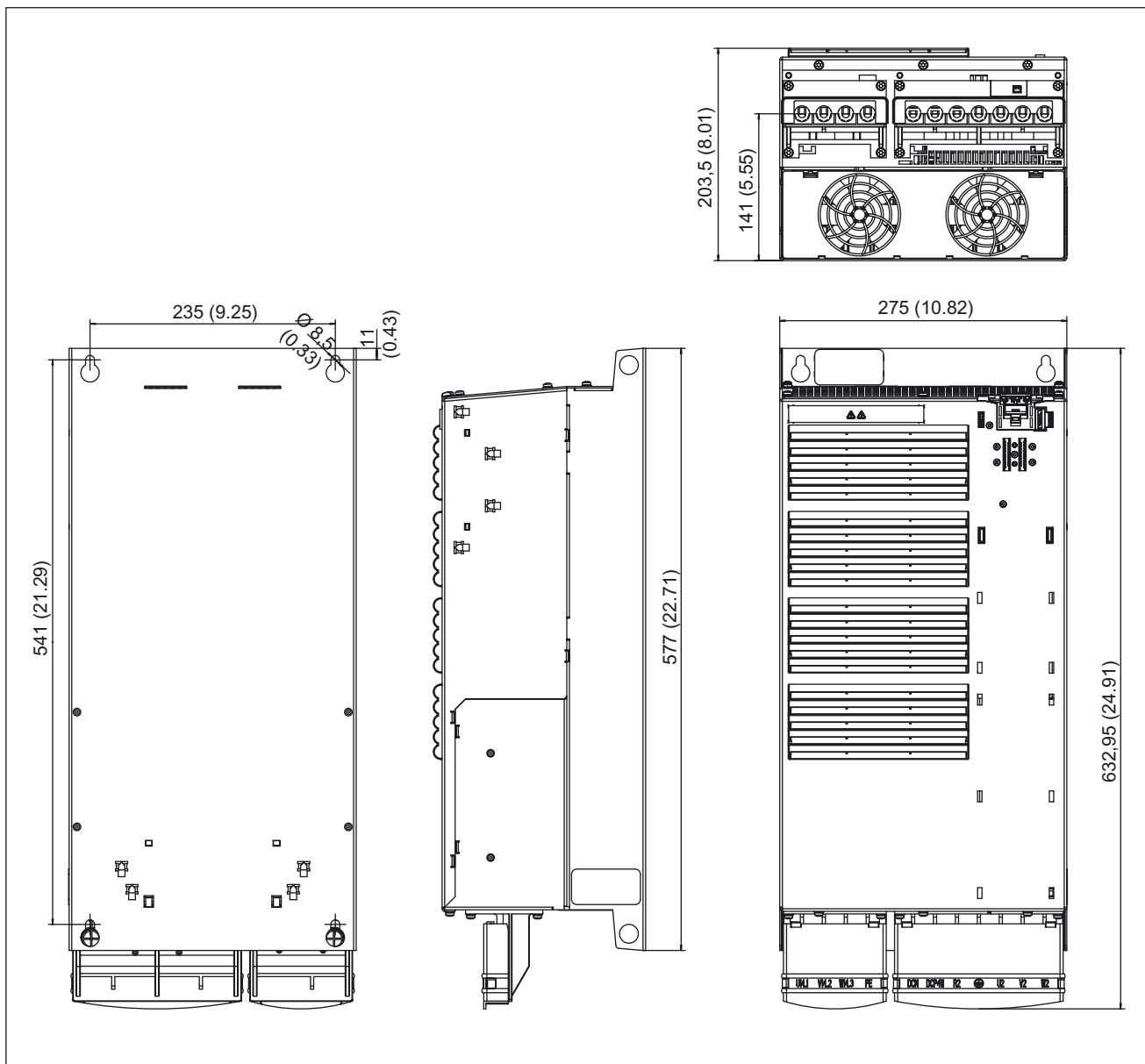


Figure 3-13 Dimension drawing: Power Module PM340 with integrated line filter, frame size FSE

3.1 Power Modules Blocksize (PM340)

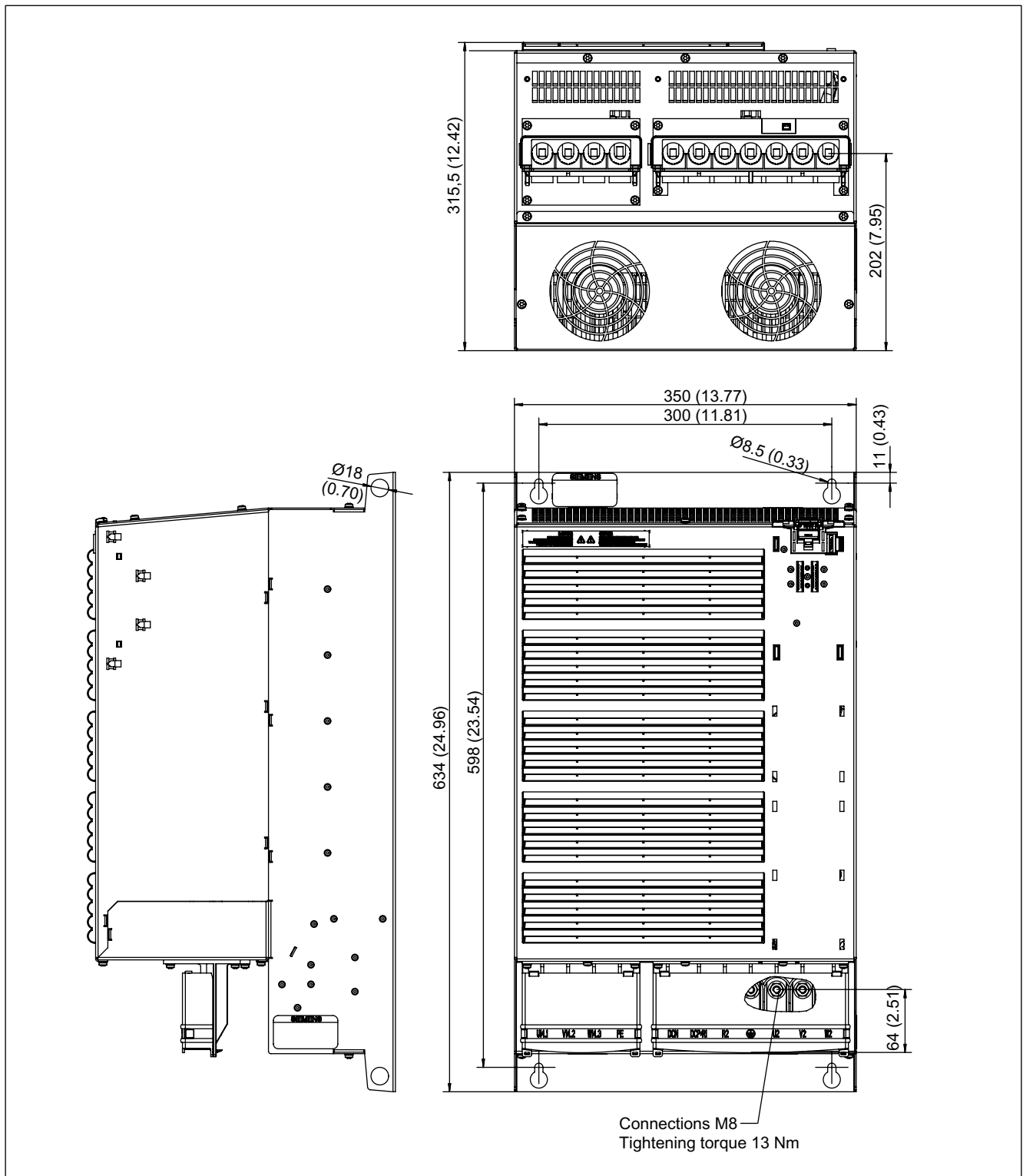


Figure 3-14 Dimension drawing: Power Module PM340, frame size FSF

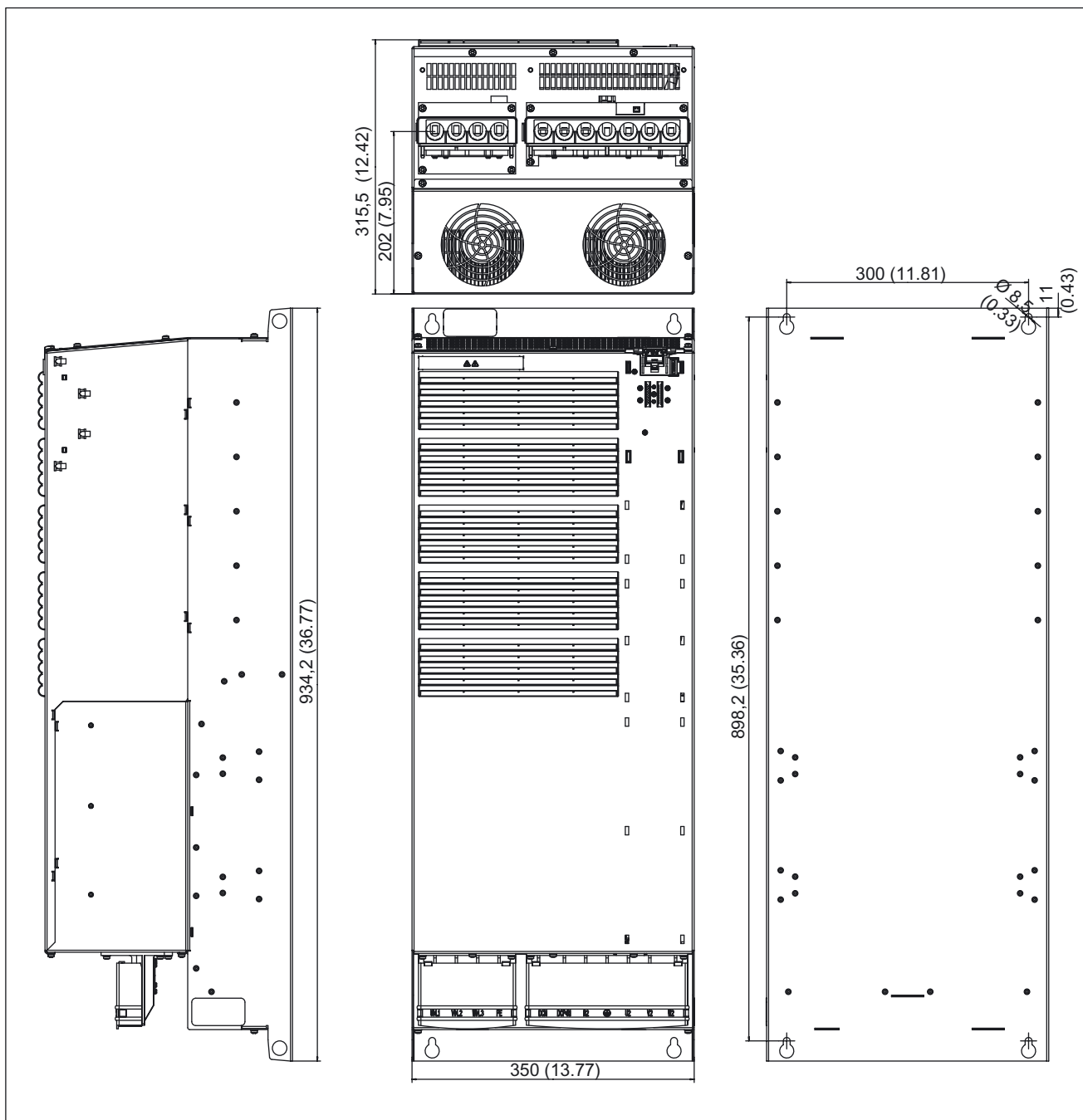


Figure 3-15 Dimension drawing: Power Module PM340 with integrated line filter, frame size FSF

3.1.5 Mounting

Drilling templates for frame sizes FSA and FSC

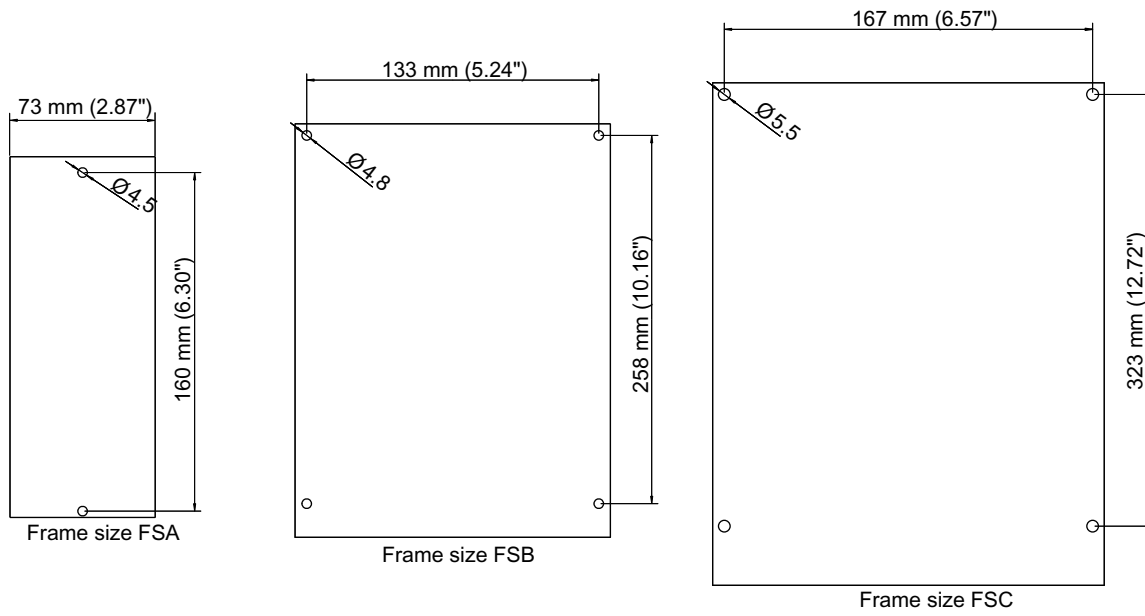


Figure 3-16 Drilling templates for frame sizes FSA and FSC

Drilling templates for frame sizes FSD to FSF

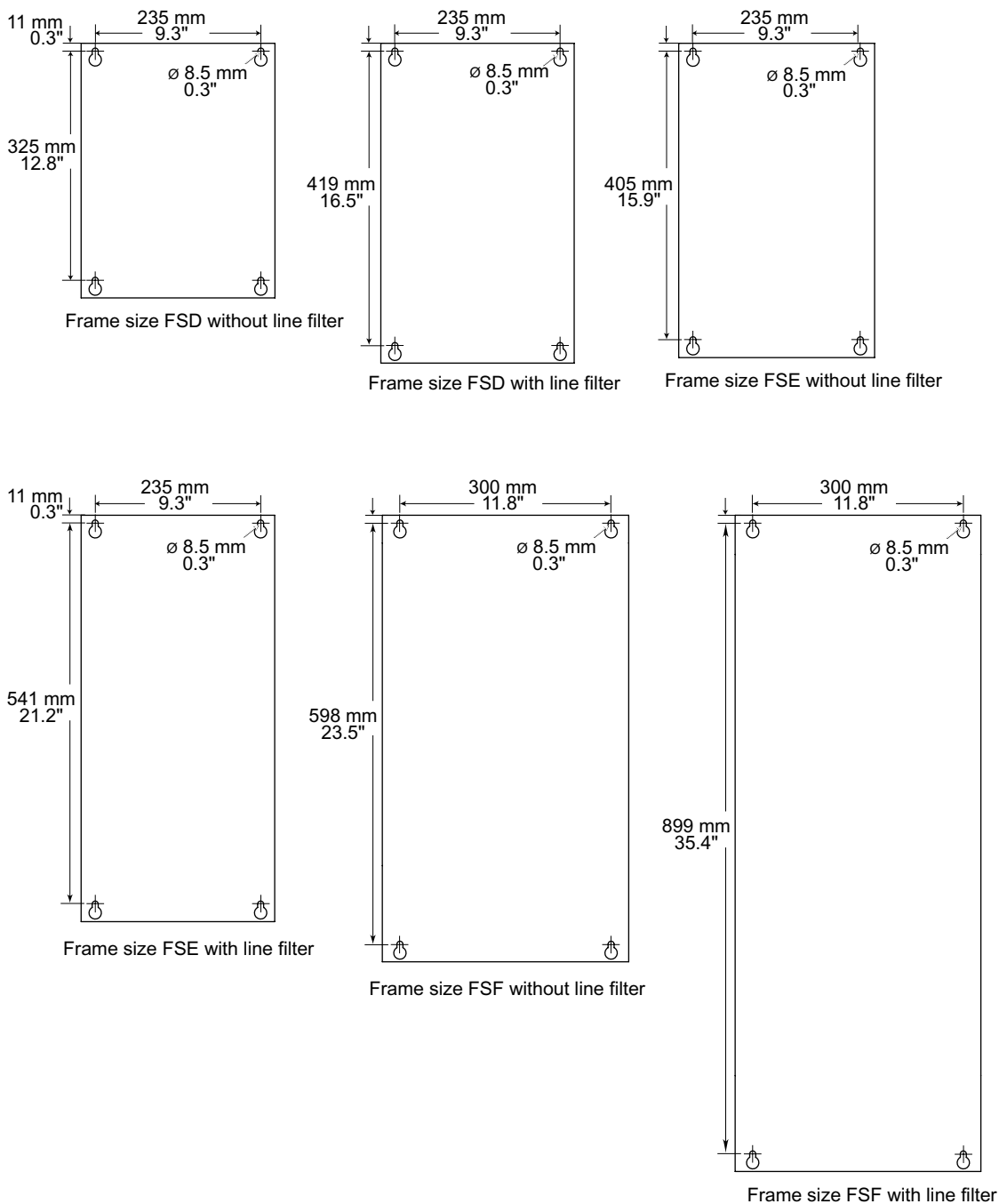


Figure 3-17 Drilling templates for frame sizes FSD to FSF - with and without line filter

3.1 Power Modules Blocksize (PM340)

The dimensions and the tightening torques when retaining the Power Modules are specified in the following table.

Table 3-7 PM340, dimensions and tightening torques when 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 M6nuts, 4 x M6 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 |
| | | 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 |

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.

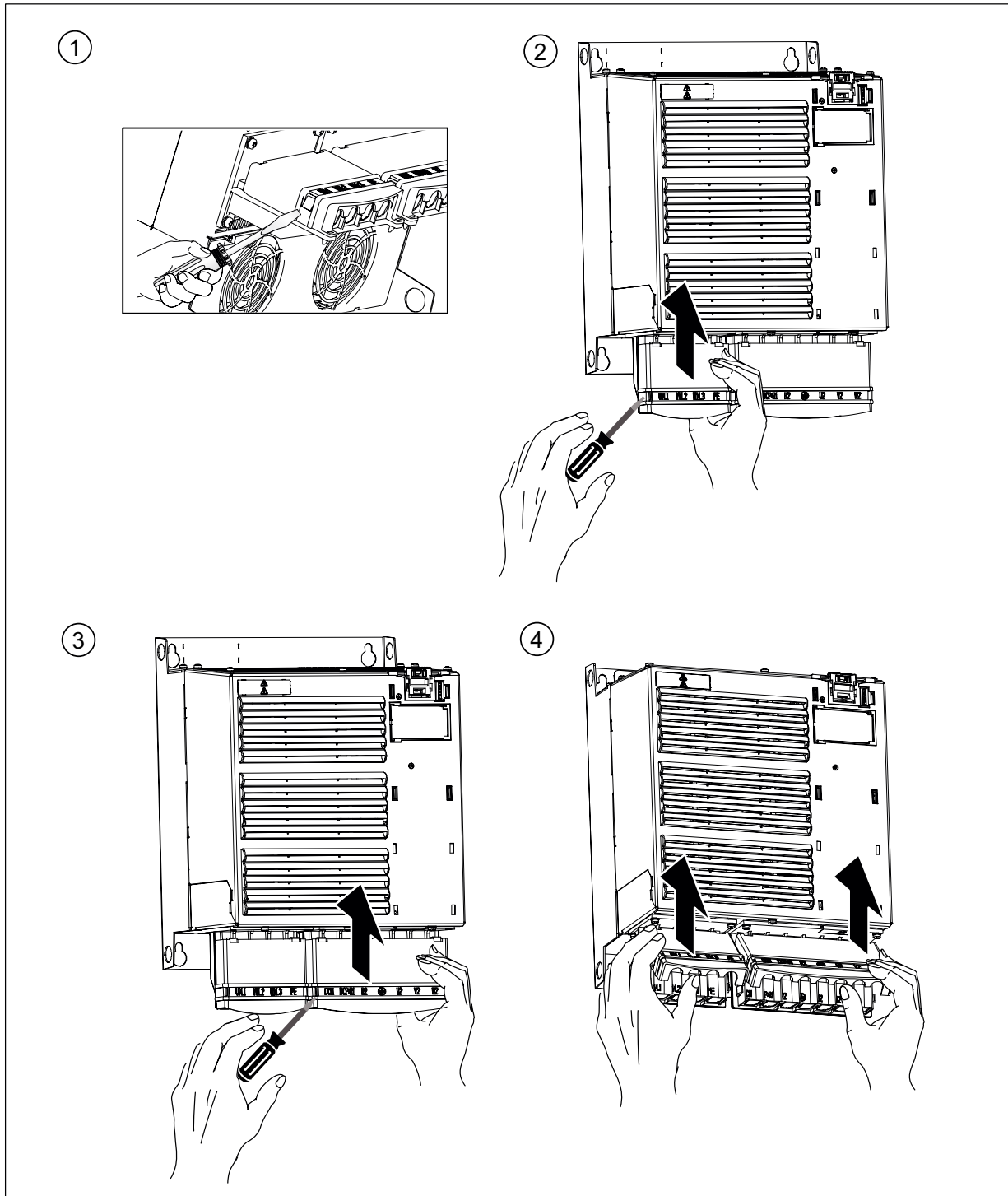


Figure 3-18 Access to the line and motor terminals for frame sizes FSD to FSF



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 data PM340, Part 1

| Line supply voltage 1-ph. 200 V to 240 V AC \pm 10%. | | | | |
|---|-------------------|---|---------------------------|---------------------------|
| PM340 | 6SL3210– | 1SB11-0UA0 | 1SB12-3UA0 | 1SB14-0UA0 |
| PM340 with integrated line filter | 6SL3210– | 1SB11-0AA0 | 1SB12-3AA0 | 1SB14-0AA0 |
| 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 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 IEC 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 | Ohms | > 180 | > 180 | > 180 |
| Max. cable length to braking resistor | m | 15 | 15 | 15 |
| Line supply connection L, N | | Screw terminals for cable cross-sections 1.0 to 2.5 mm ² | | |
| Motor connection U2, V2, W2 | | | | |
| DC link connection, connection for braking resistor DCP/R1, DCN, R2 | | | | |
| PE connection | | at the housing with M 4 screw | | |
| Max. motor cable length ²⁾ (without external options) | m | 50 (shielded) 75 (unshielded) | | |
| Degree of protection | | IP20 or IPXXB | | |
| Frame size | | FSA | FSA | FSA |
| 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 load with the rated power (based on I_n) for a line impedance corresponding to $u_k = 1\%$.

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

Power Modules

3.1 Power Modules Blocksize (PM340)

Table 3-10 Technical data 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 | - | - | - | - | - | - |
| Rated output current I _n | 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 _n | 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 supply for the Control Unit | A | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 |
| Rated input current ¹⁾ | A | | | | | |
| - with line reactor | | 1,3 | 1,7 | 2,2 | 3,1 | 4,1 |
| - without line reactor | | 1,7 | 2,2 | 2,6 | 3,9 | 4,8 |
| Class J UL safety fuses | A | 4 | 4 | 6 | 8 | 10 |
| Rated current | kA | 65 | 65 | 65 | 65 | 65 |
| Rated short-circuit current SCCR | | | | | | |
| NH Safety fuses | A | 3NA3 804 | 3NA3 804 | 3NA3 801 | 3NA3 803 | 3NA3 803 |
| Rated current | | 4 | 4 | 6 | 10 | 10 |
| Circuit-breaker type designation IEC 60947 | | 3RV1021-1DA10 | 3RV1021-1DA10 | 3RV1021-1FA10 | 3RV1021-1GA10 | 3RV1021-1HA10 |
| Rated current | A | 2.2 - 3.2 | 2.2 - 3.2 | 3.5 - 5 | 4.5 - 6.3 | 5.5 - 8 |
| Resistance value of the external braking resistor | Ohms | > 390 | > 390 | > 390 | > 390 | > 390 |
| Max. cable length to braking resistor | m | 15 | 15 | 15 | 15 | 15 |
| Line supply connection L, N | | Screw terminals for cable cross-sections 1.0 to 2.5 mm ² | | | | |
| Motor connection U2, V2, W2 | | | | | | |
| DC link connection, connection for braking resistor DCP/R1, DCN, R2 | | | | | | |
| PE connection | | at the housing with M 4 screw | | | | |
| Max. motor cable length ²⁾ | m | 50 (shielded) 75 (unshielded) | | | | |
| Degree of protection | | IP20 or IPXXB | | | | |
| Frame size | | FSA | FSA | FSA | FSA | FSA |
| Weight | kg | 1,2 | 1,2 | 1,2 | 1,2 | 1,2 |

3.1 Power Modules Blocksize (PM340)

1) The input current depends on the motor load and line impedance. The input currents apply for a load with the rated power (based on I_n) 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 maintain the limit values of EN 61800-3 Category C2.

Table 3-11 Technical data PM340, Part 3

| Line supply voltage 3-ph. 380 V to 480 V AC $\pm 10\%$. | | | | | | |
|--|-------------------|--|--------------------------|--------------------------|---|--------------------------|
| 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 output current I_n | 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_n | kW | 2,2 | 3 | 4 | 7,5 | 11 |
| 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 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 IEC 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 | Ohms | > 160 | > 160 | > 160 | > 56 | > 56 |
| Max. cable length to braking resistor | m | 15 | 15 | 15 | 15 | 15 |
| Line supply connection L, N | | 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 | | | | |

Power Modules

3.1 Power Modules Blocksize (PM340)

| Line supply voltage 3-ph. 380 V to 480 V AC \pm 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 |
| Max. motor cable length ²⁾ | m | 50 (shielded) 75 (unshielded) | | | | |
| Degree of protection | | IP20 or IPXXB | | | | |
| Frame size | | FSB | FSB | FSB | FSC | FSC |
| 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 a load with the rated power (based on I_n) for a line impedance corresponding to $uk = 1\%$.

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

Table 3-12 Technical data PM340, Part 4

| Line supply voltage 3-ph. 380 V to 480 V AC \pm 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 |
| Rated output current I_n | 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_n | 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 supply for the Control Unit | A | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 |
| Rated input current ¹⁾ | A | | | | | |
| - with line reactor | | 33 | 40 | 47 | 63 | 78 |
| - without line reactor | | 39 | 46 | 53 | 72 | 88 |
| Class J UL safety fuses | | | | | | |
| Rated current | A | 45 | 50 | 60 | 90 | 100 |
| Rated short-circuit current SCCR | kA | 65 | 65 | 65 | 65 | 65 |
| Safety fuses NH | | 3NA3 817 | 3NA3 820 | 3NA3 822 | 3NA3 824 | 3NA3 830 |
| Rated current | A | 40 | 50 | 63 | 80 | 100 |
| Circuit-breaker type designation IEC 60947 | | 3RV1031-4HA10 | 3RV1042-4JA10 | 3RV1042-4KA10 | 3RV1042-4MA10 | 3VL1712-1DD33-0AA0 |
| Rated current | A | 40 - 50 | 45 - 63 | 57 - 75 | 80 - 100 | 100 - 125 |

| Line supply voltage 3-ph. 380 V to 480 V AC \pm 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 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 | > 56 | > 27 | > 27 | > 27 | > 15 |
| Max. cable length to braking resistor | m | 15 | 15 | 15 | 15 | 15 |
| Line supply connection L, N | | Screw terminals for cable cross-sections 2.5 to 10 mm ² | Stud M6, connectable cable cross-sections 10 to 35 mm ² | | | |
| Motor connection U2, V2, W2 | | | | | | |
| DC link connection, connection for braking resistor DCP/R1, DCN, R2 | | | | | | |
| PE connection | | | | | | |
| Max. motor cable length ²⁾ | m | 50 (shielded) 75 (unshielded) | 70 (shielded) 100 (unshielded) | | | |
| Degree of protection | | IP20 or IPXXB | | | | |
| Height PM 340 with integrated line filter | mm | 333,4 (13.12) | 511 (20.11) | 511 (20.11) | 511 (20.11) | 633 (24.92) |
| Frame size | | FSC | FSD | FSD | FSD | FSE |
| Weight without line filter/ 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 a load with the rated power (based on I_n) 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 maintain the limit values of EN 61800-3 Category C2.

Table 3-13 Technical data PM340, Part 5

| Line supply voltage 3-ph. 380 V to 480 V AC \pm 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 |
| Rated output current I_n | 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_n | kW | 45 | 55 | 75 | 90 |

Power Modules

3.1 Power Modules Blocksize (PM340)

| 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 |
| 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 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 IEC 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 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 | 3VL3120-3KN30-0AA0 200 65 | 3VL3125-3KN30-0AA0 250 65 |
| Resistance value of the external braking resistor | Ohms | > 15 | > 8,2 | > 8,2 | > 8,2 |
| Max. cable length to braking resistor | m | 15 | 15 | 15 | 15 |
| Line supply connection L, N | | Stud M6, connectable cable cross-sections 10 to 35 mm ² | Stud M8, max. connection cable cross-section 120 mm ² | | |
| Motor connection U2, V2, W2 | | | | | |
| DC link connection, connection for braking resistor DCP/R1, DCN, R2 | | | | | |
| PE connection | | at the housing with M6 screw | At the housing with M8 screw | | |
| Max. motor cable length ²⁾ | m | 70 (shielded) 100 (unshielded) | | | |
| Degree of protection | | IP20 or IPXXB | | | |
| Height PM 340 with integrated line filter | mm | 633 (24.92) | 934 (36.77) | 934 (36.77) | 934 (36.77) |
| Frame size | | FSE | FSF | FSF | FSF |
| Weight without line filter/ 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 a load with the rated power (based on I_n) 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 maintain the limit values of EN 61800-3 Category C2.

Interrelationship between the pulse frequency and current de-rating

Table 3-14 Current de-rating depending on the pulse frequency

| Order No. | Line voltage | Rated output current | Power (high overload) | Output current in A at a switching frequency of: | | | | | | |
|--------------|-------------------|----------------------|-----------------------|--|-------|--------------|--------|---------------|--------|---------------|
| | | | | 4 kHz | 6 kHz | 8 kHz 70% | 10 kHz | 12 kHz 50% | 14 kHz | 16 kHz 40% |
| 6SL3210 - | | A | [kW] | | | | | | | |
| 1SB11-0UA0 | 1-ph. 230 V AC | 0,9 | 0,12 | 0,9 | 0,7 | 0,54 | 0,4 | 0,3 | 0,3 | 0,2 |
| 1SB12-3UA0 | | 2,3 | 0,37 | 2,3 | 1,8 | 1,3 | 1,1 | 0,9 | 0,8 | 0,6 |
| 1SB14-0UA0 | | 3,9 | 0,75 | 3,9 | 3,1 | 2,3 | 1,9 | 1,5 | 1,3 | 1,1 |
| 1SE11-3UA0 | 3-ph. 400 V AC | 1,3 | 0,37 | 1,3 | - | 0,91 | - | 0,65 | - | 0,52 |
| 1SE11-7UA0 | | 1,7 | 0,55 | 1,7 | - | 1,19 | - | 0,85 | - | 0,68 |
| 1SE12-2UA0 | | 2,2 | 0,75 | 2,2 | - | 1,54 | - | 1,1 | - | 0,88 |
| 1SE13-1UA0 | | 3,1 | 1,1 | 3,1 | - | 2,17 | - | 1,55 | - | 1,24 |
| 1SE14-1UA0 | | 4,1 | 1,5 | 4,1 | - | 2,87 | - | 2,05 | - | 1,64 |
| 1SE16-0UA0 | | 5,9 | 2,2 | 5,9 | - | 4,13 | - | 2,95 | - | 2,36 |
| 1SE17-7UA0 | | 7,7 | 3 | 7,7 | - | 5,39 | - | 3,85 | - | 3,08 |
| 1SE21-0UA0 | | 10 | 4 | 10 | - | 7 | - | 5 | - | 4 |
| 1SE21-8UA0 | | 18 | 5,5 | 18 | - | 12,6 | - | 9 | - | 7,02 |
| 1SE22-5UA0 | | 25 | 7,5 | 25 | - | 17,5 | - | 12,5 | - | 10 |
| 1SE23-2UA0 | | 32 | 15,0 | 32,0 | 30,4 | 28,8 | 25,6 | 22,4 | 19,2 | 16,0 |
| 1SE23-8UA0 | | 38 | 18,5 | 38,0 | 34,2 | 30,4 | 26,6 | 22,8 | 19,0 | 15,2 |
| 1SE24-5UA0 | | 45 | 22,0 | 45,0 | 40,5 | 36,0 | 31,5 | 27,0 | 22,5 | 18,0 |
| 1SE26-0UA0 | | 60 | 30,0 | 62,0 | 58,9 | 55,8 | 49,6 | 43,4 | 37,2 | 31,0 |

3.1 Power Modules Blocksize (PM340)

| Order No. | Line voltage | Rated output current | Power (high overload) | Output current in A at a switching frequency of: | | | | | | |
|--------------|--------------|----------------------|-----------------------|--|-------|--------------|--------|---------------|--------|---------------|
| | | | | 4 kHz | 6 kHz | 8 kHz 70% | 10 kHz | 12 kHz 50% | 14 kHz | 16 kHz 40% |
| 6SL3210 - | | A | [kW] | | | | | | | |
| 1SE27-5UA0 | | 75 | 37,0 | 75,0 | 67,5 | 60,0 | 52,5 | 45,0 | 37,5 | 30,0 |
| 1SE31-0UA0 | | 90 | 45,0 | 90,0 | 76,5 | 63,0 | 51,8 | 40,5 | 33,8 | 27,0 |
| 1SE31-1UA0 | | 110 | 55,0 | 110,0 | 93,5 | 77,0 | 63,3 | 49,5 | 41,3 | 33,0 |
| 1SE31-5UA0 | | 145 | 75,0 | 145,0 | 112,4 | 79,8 | 68,9 | 58,0 | 50,8 | 43,5 |
| 1SE31-8UA0 | | 178 | 15,0 | 32,0 | 30,4 | 28,8 | 25,6 | 22,4 | 19,2 | 16,0 |

Overload capability

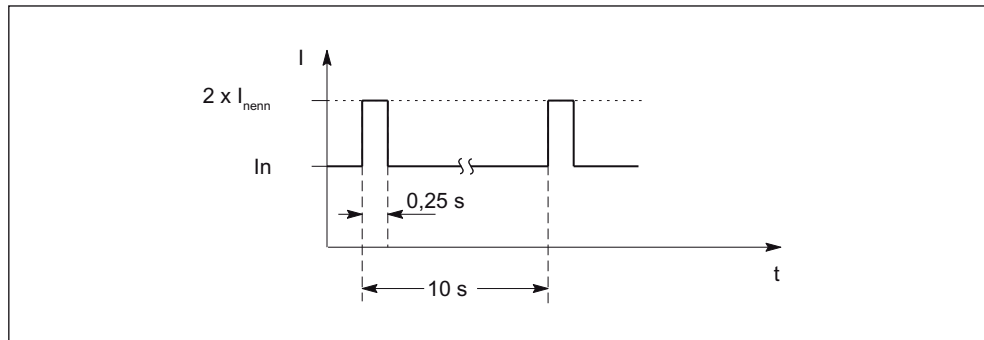


Figure 3-19 Load cycle with pre-load condition (for servo drives)

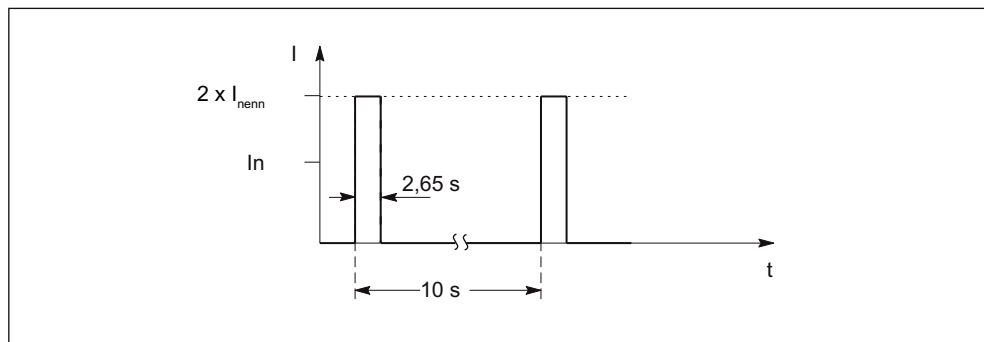


Figure 3-20 Load cycle without pre-load condition (for servo drives)

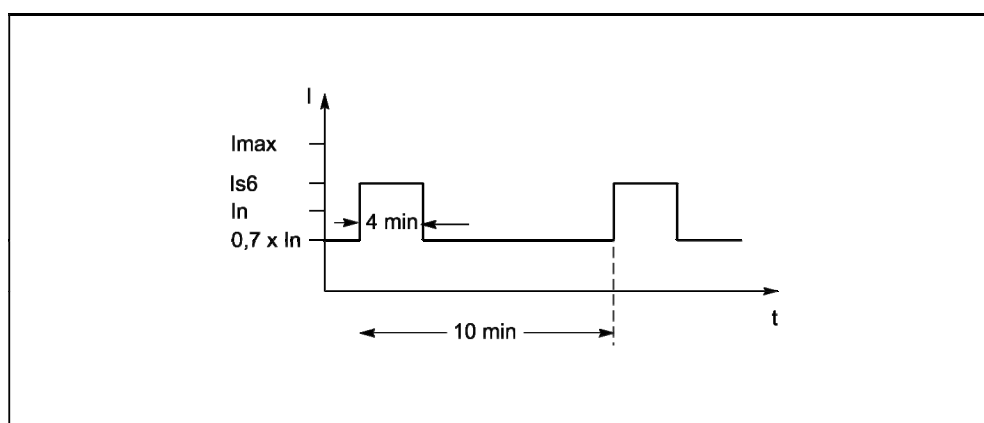


Figure 3-21 S6 load cycle with pre-load condition (for servo drives)

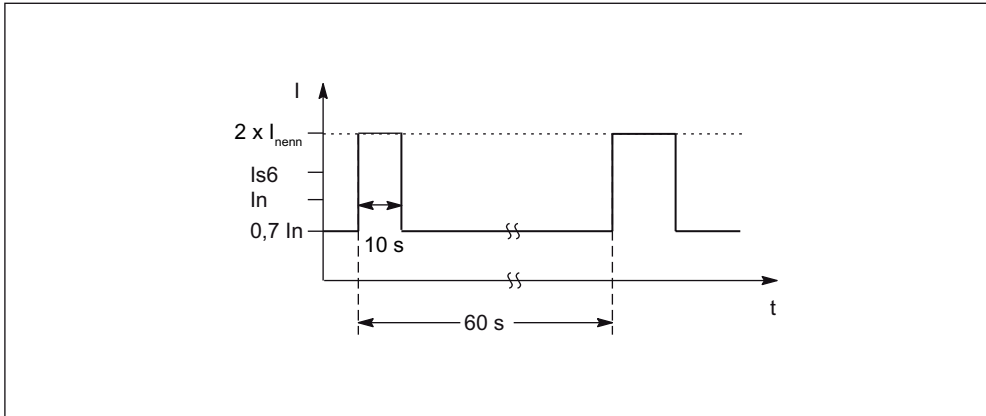


Figure 3-22 Load cycle with pre-load condition (for servo drives)

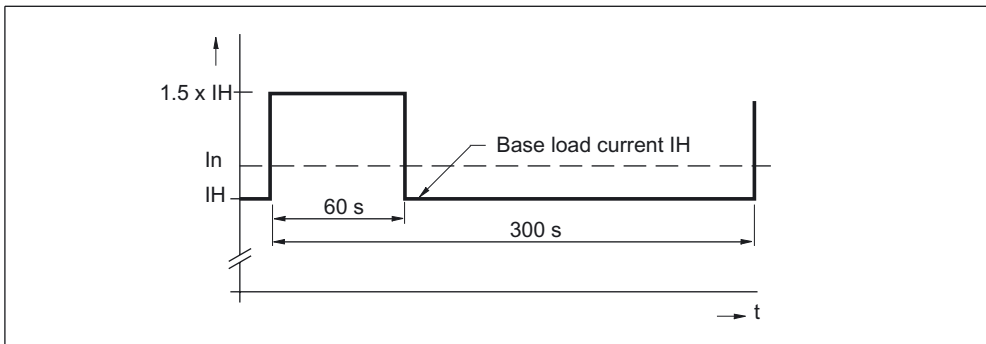


Figure 3-23 Load cycle with 60 s overload with a load cycle period of 300 s

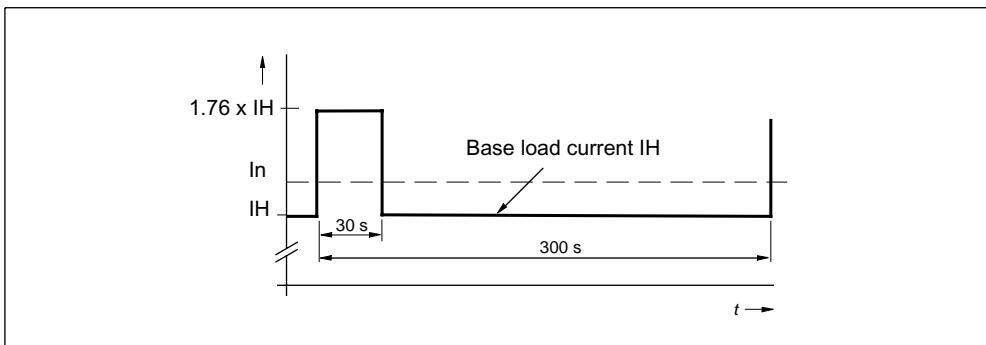


Figure 3-24 Load cycle with 30 s overload with a load cycle period of 300 s

Derating characteristic for Power Modules in blocksize format

Note

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

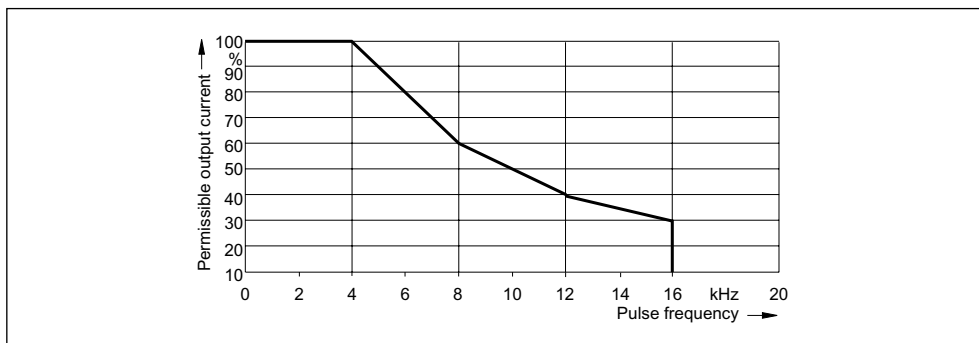


Figure 3-25 Output current as a function of pulse frequency

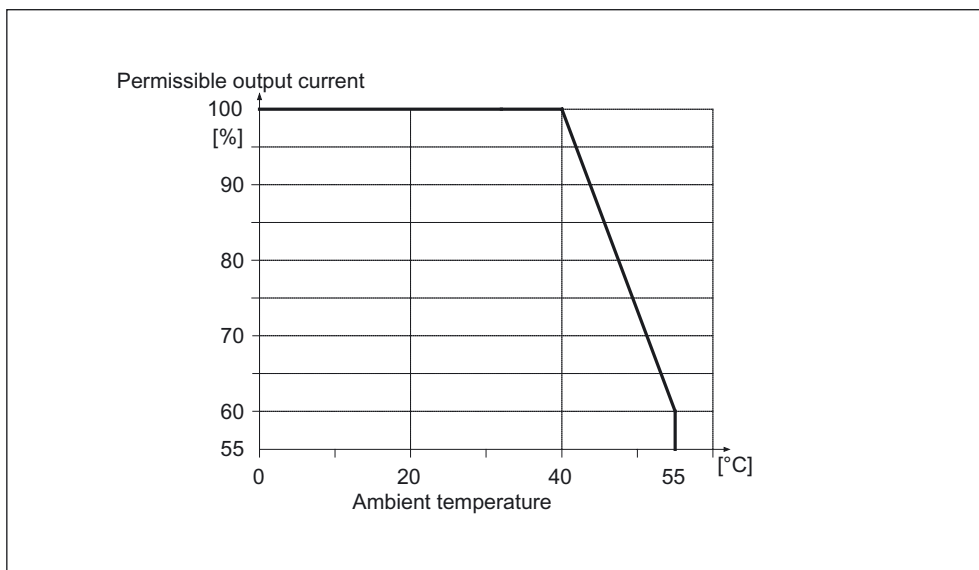


Figure 3-26 Output power as a function of ambient temperature

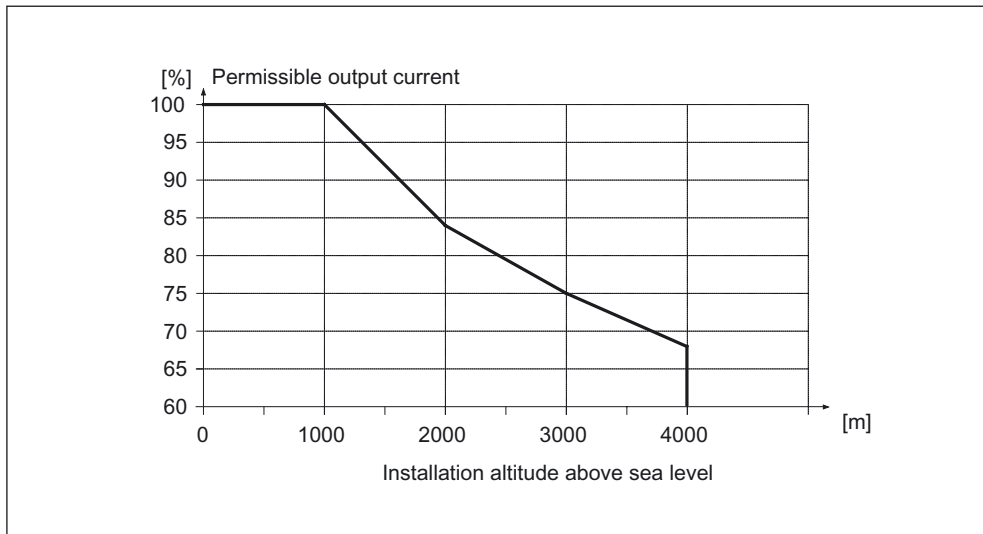


Figure 3-27 Output power as a function of installation altitude

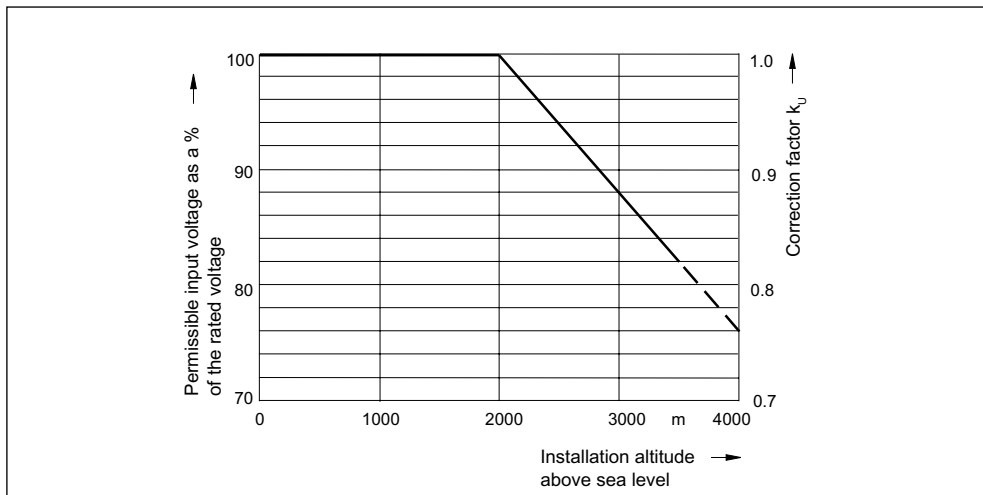


Figure 3-28 Voltage correction factor as a function of installation altitude

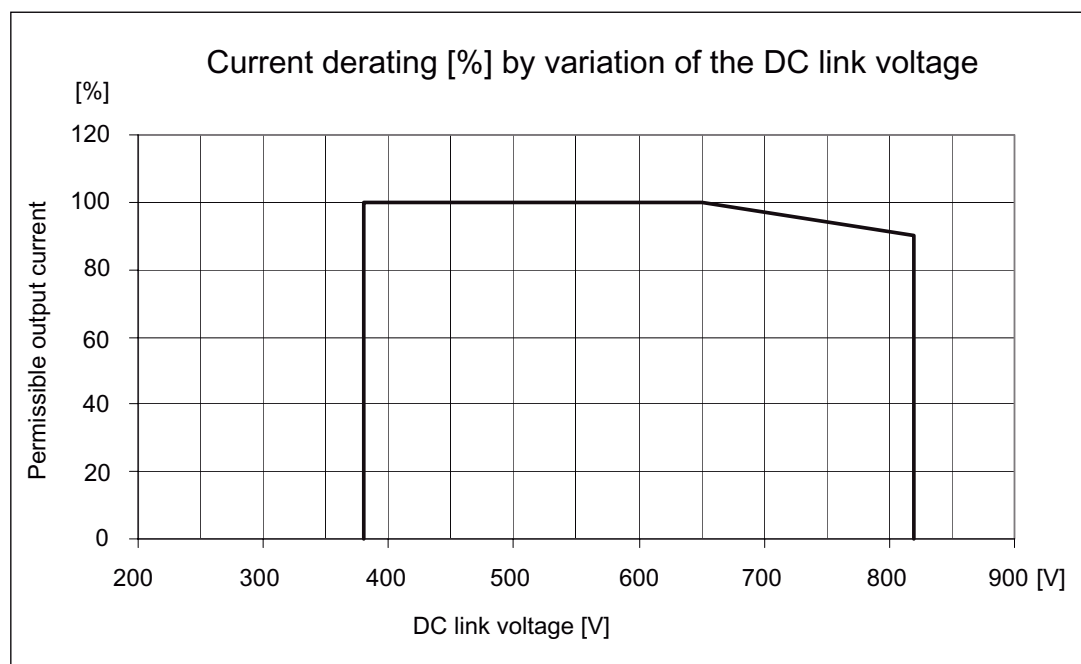


Figure 3-29 Current derating by variation of the DC link voltage

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 also without an integrated line filter.

Table 3-15 Overview of Liquid Cooled Power Modules PM340

| | |
|---|---|
|  |  |
| <p>Power Module frame size FSD Liquid Cooled</p> | <p>Power Module frame size FSE Liquid Cooled</p> |
|  | |
| <p>Power Module frame size FSF Liquid Cooled</p> | |

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.

 **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 UL-approved systems, only MOTION-CONNECT lines can be used and the fuses tested for UL approval must be installed (see "Technical specifications").

 **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 $\geq 10 \text{ mm}^2 \text{ Cu}$ or $\geq 16 \text{ mm}^2 \text{ Al}$
- stationary connection and installation of a second protective conductor with the same cross-section as the first protective conductor
- stationary connection and automatic shutdown of the power supply if the protective conductor is interrupted
- Connection with a plug connector for industrial applications in accordance with EN 60309 and a minimum protective conductor cross-section of $\geq 2.5 \text{ mm}^2 \text{ Cu}$ as part of a multi-core supply cable with appropriate strain relief.

 **DANGER**

The hazard warning in the local language for the DC link discharge time must be affixed to the component. A set of labels 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 100 mm (3.93 inches) must be maintained above and below 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

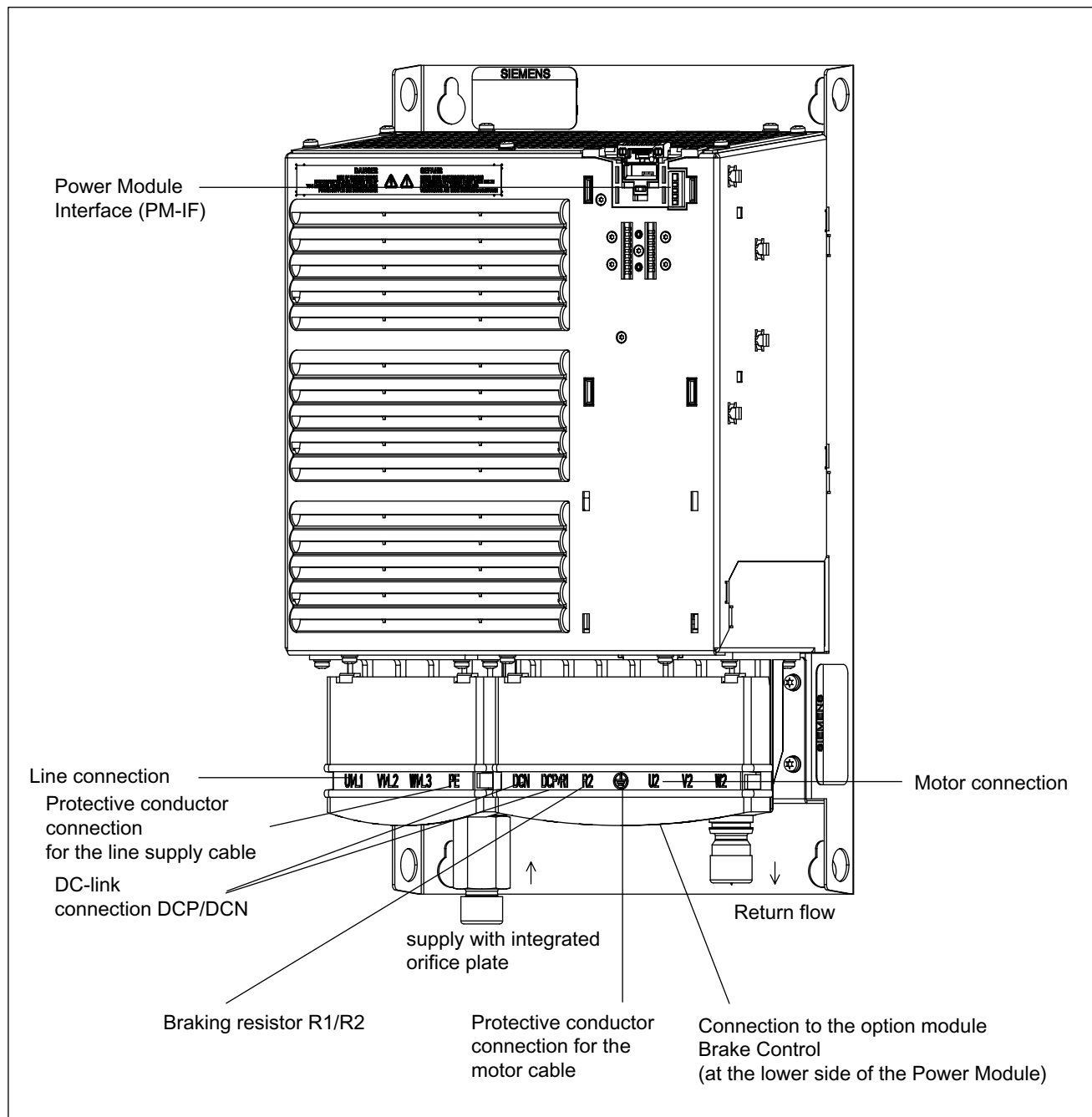


Figure 3-30 Liquid Cooled Power Module PM340 (Example: Frame size FSD)

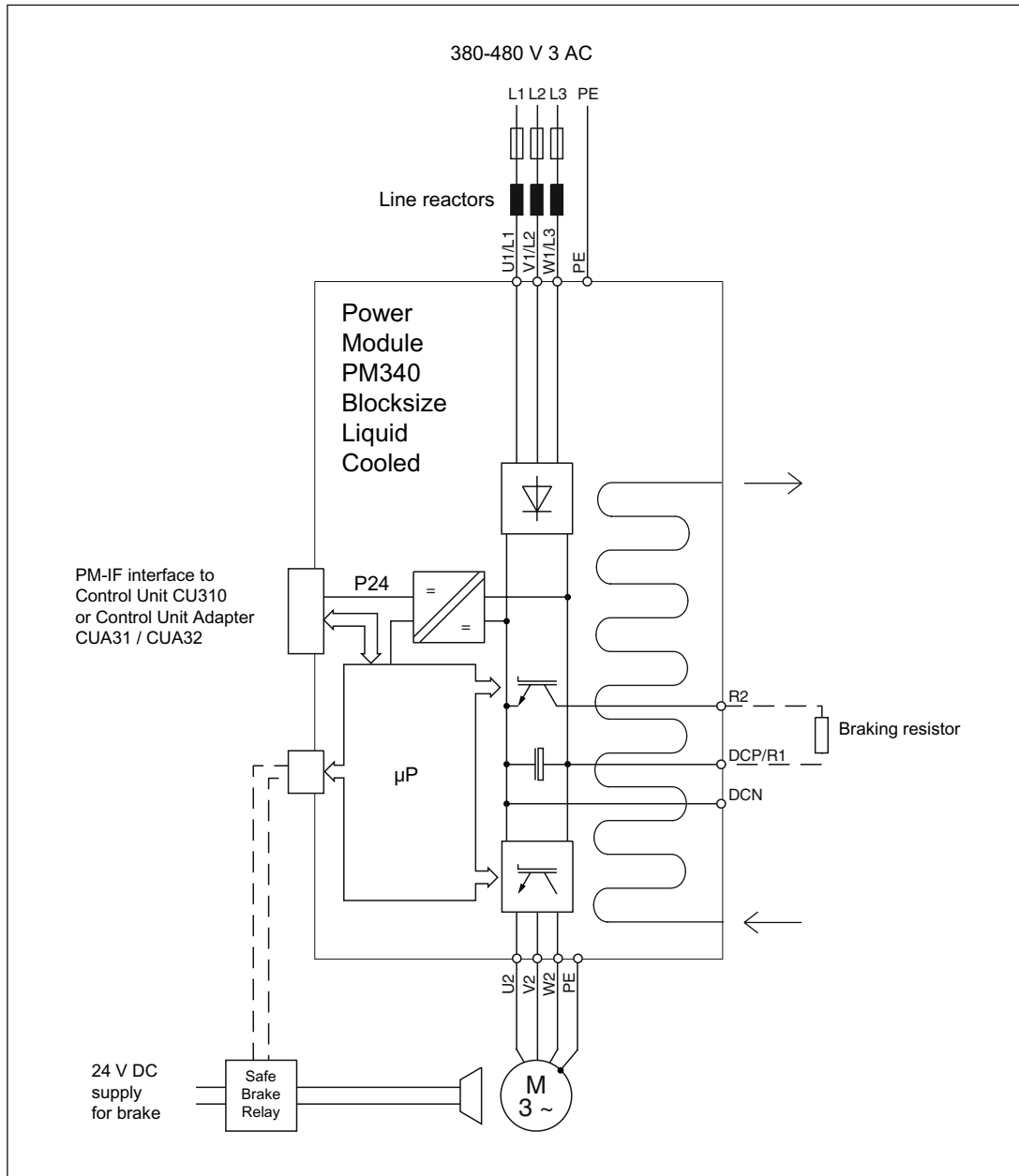


Figure 3-31 Connection example Power Module PM340 Liquid Cooled, 3 AC 380 V to 480 V

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.

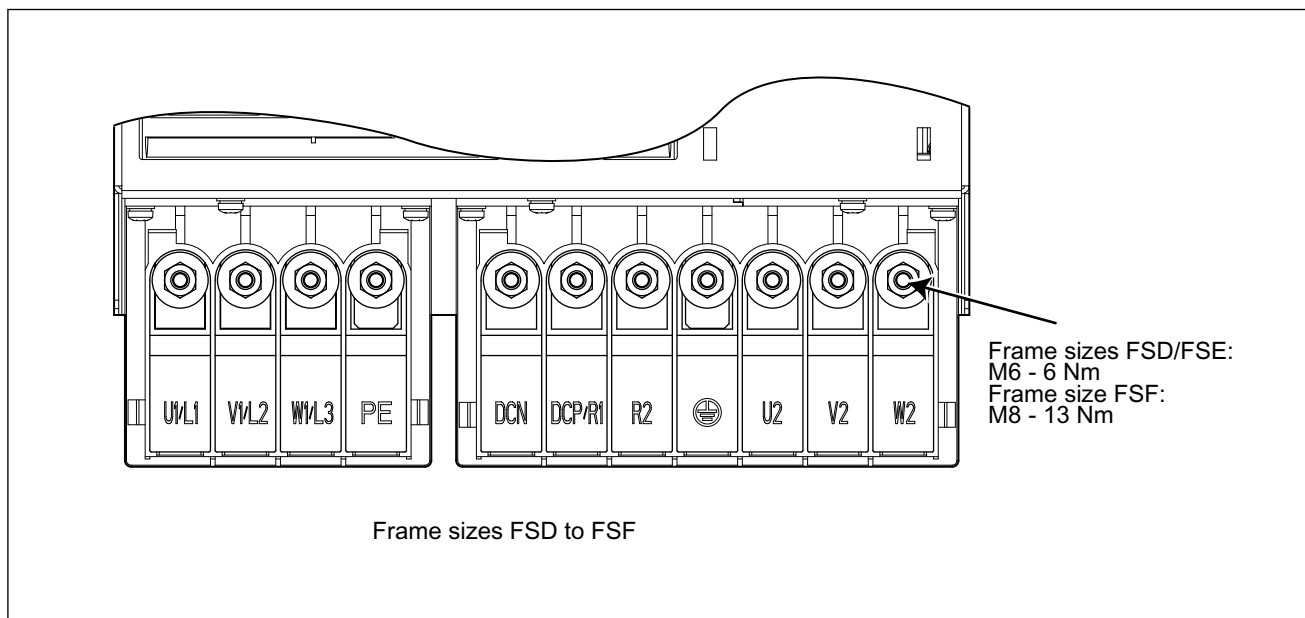


Figure 3-32 Arrangement of the line supply and motor terminals for the PM340

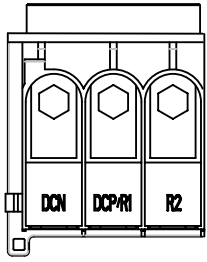
3.2.3.2 Line supply connection

Table 3-16 Terminal strip, 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 |

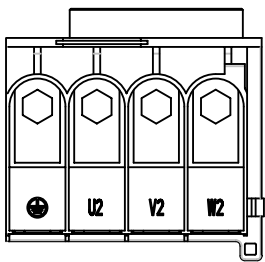

3.2.3.3 Braking resistor and DC link connection

Table 3-17 Terminal strip, 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 |

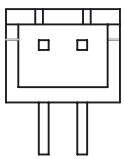
3.2.3.4 Motor connection

Table 3-18 Terminal strip, 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 |

3.2.3.5 Connection to the option module, brake control

Table 3-19 Connector

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

3.2.4 Dimension drawings

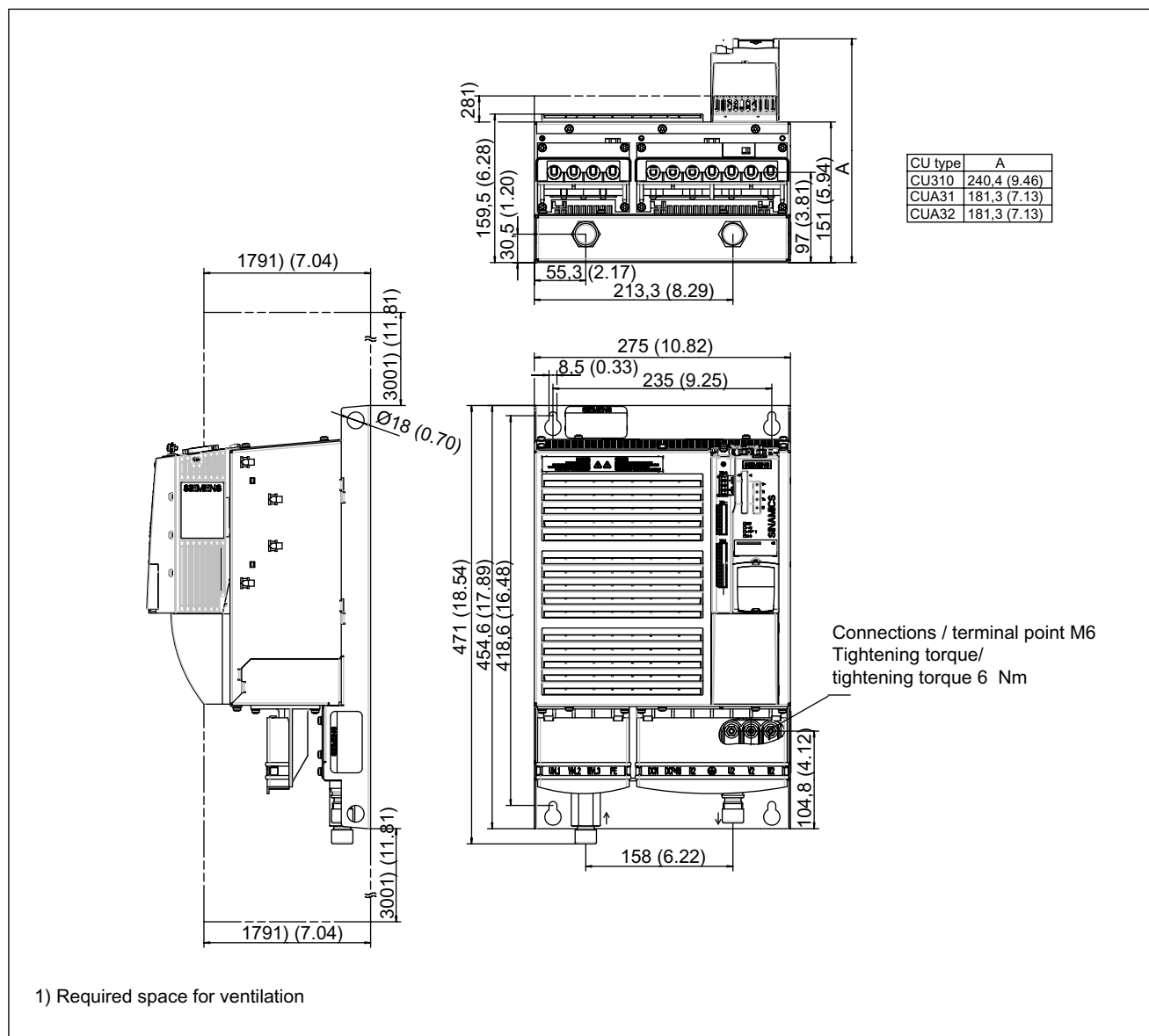


Figure 3-33 Dimension drawing: Power Module PM340, frame size FSD Liquid Cooled

3.2 Power Modules Blocksize Liquid Cooled (PM340)

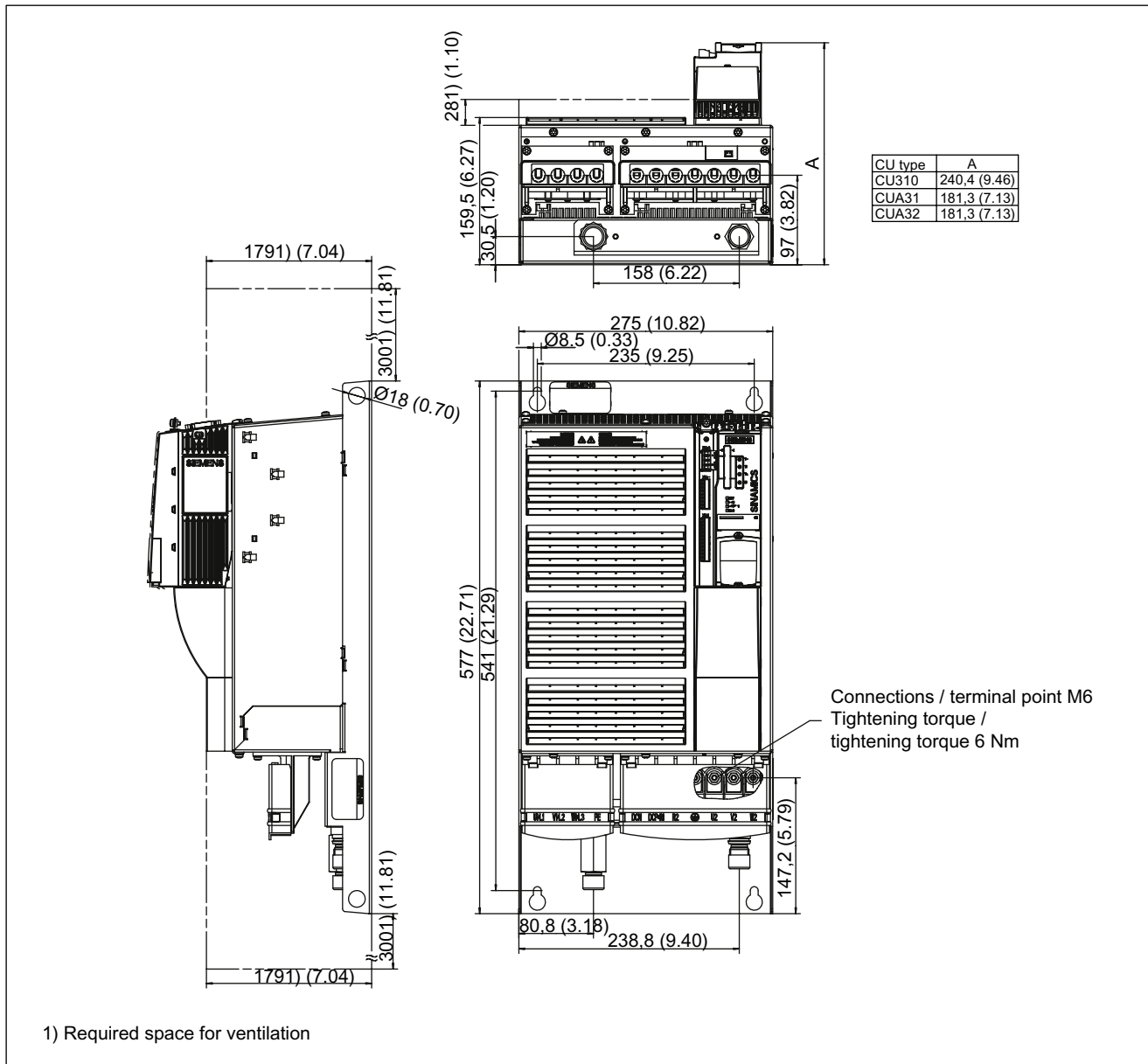


Figure 3-34 Dimension drawing: Power Module PM340, frame size FSE Liquid Cooled

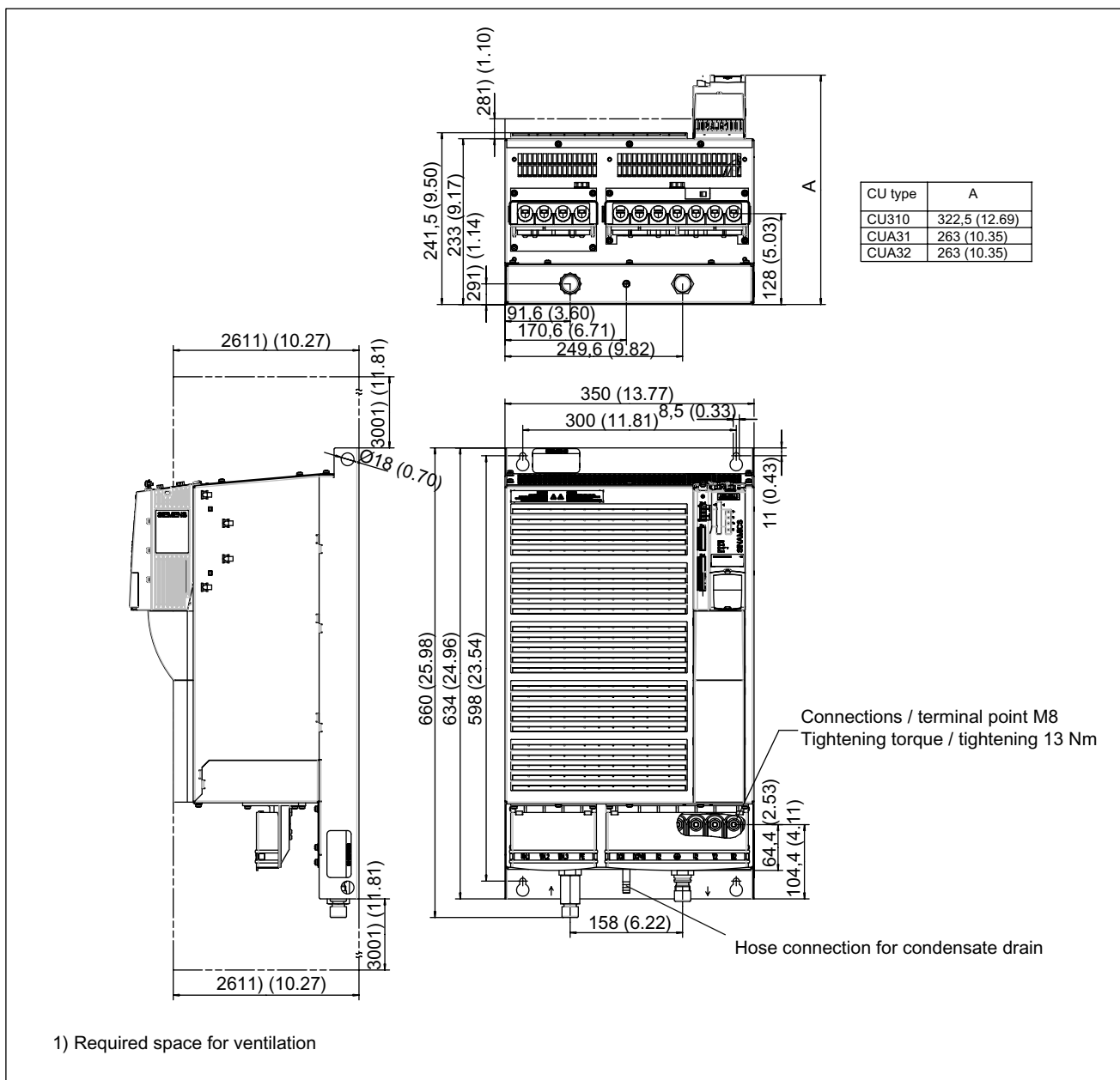


Figure 3-35 Dimension drawing: Power Module PM340, frame size FSF Liquid Cooled

3.2.5 Installation

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

Hole drilling templates for frame sizes FSD to FSF

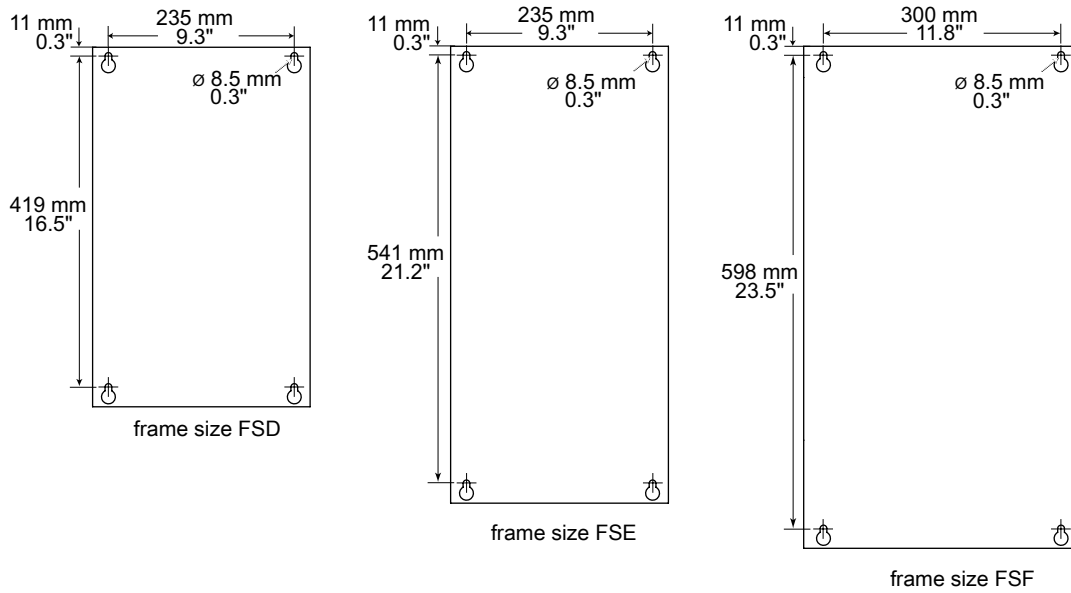


Figure 3-36 Hole drilling templates for frame sizes FSD to FSF

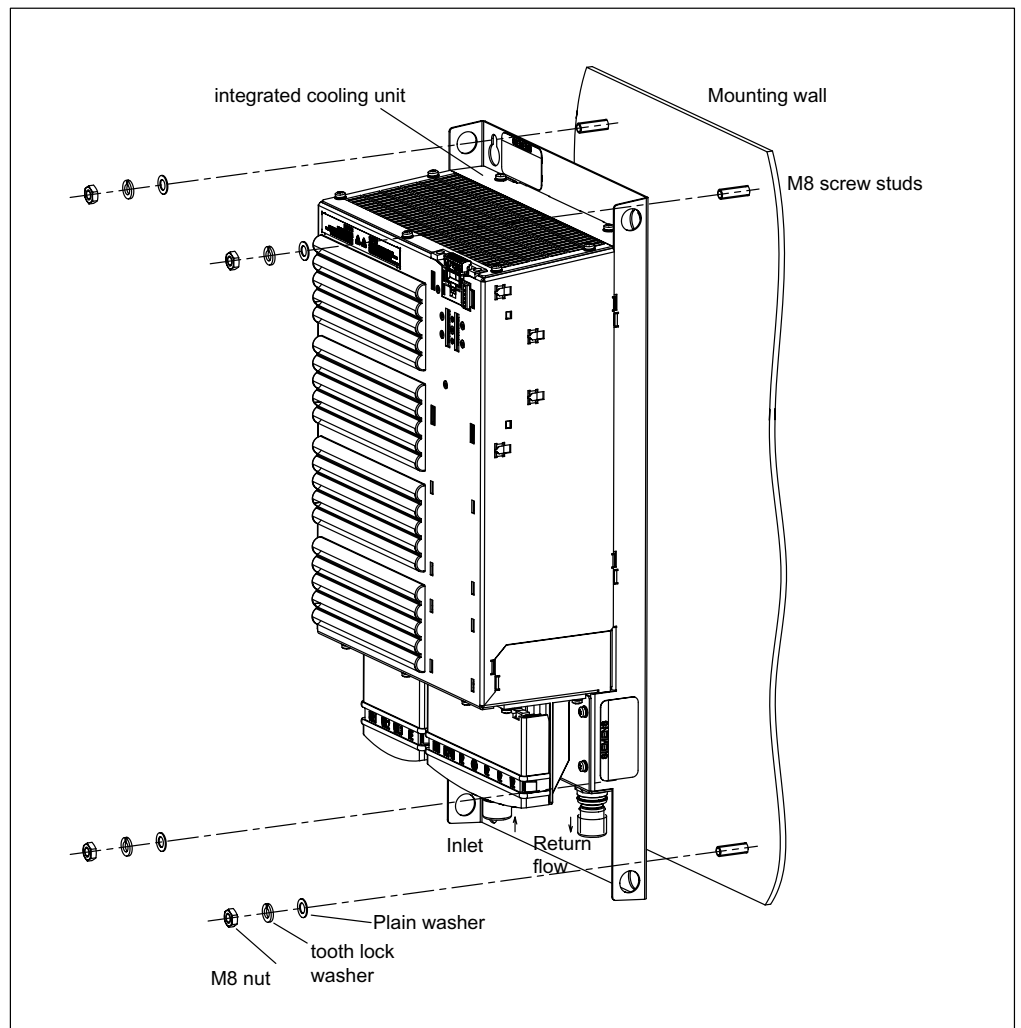


Figure 3-37 Installation of Power Module PM340 Liquid Cooled with integrated cooling unit (example: frame size FSE)

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

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.

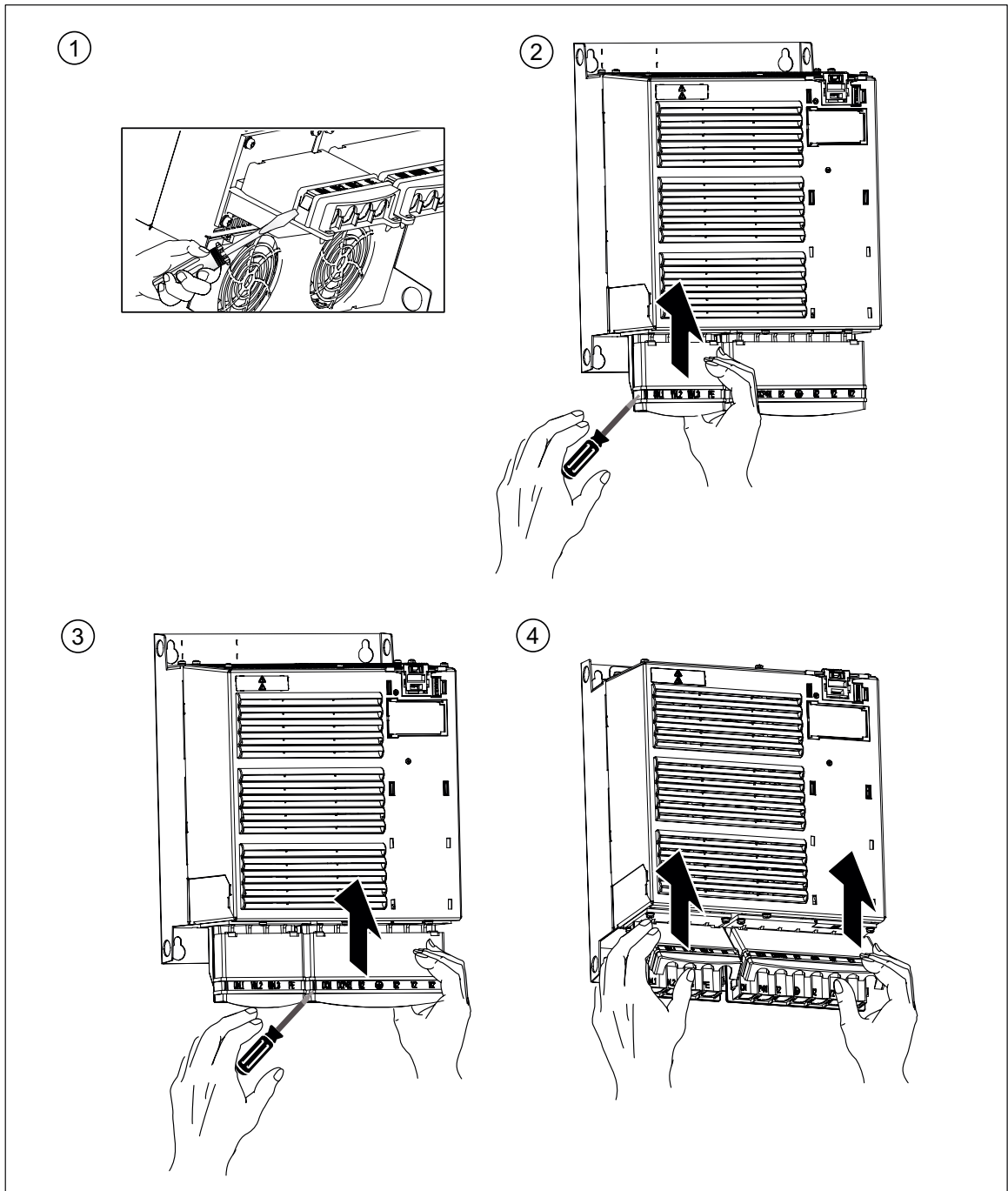


Figure 3-38 Access to the line and motor terminals for frame sizes FSD to FSF



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

3.2.6 Electrical connection

When connecting the SINAMICS S120 Liquid Cooled devices, you should use cables with the cross-sections specified in the relevant technical specifications.

The coolant connection is established by means of 1/2" coupling. The supply and return connections on SINAMICS devices must be established by means of a flexible, non-conductive hose 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).

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 3-20 Technical specifications for Power Modules PM340 format Blocksize Liquid Cooled, Part1

| PM340 Power Module | 6SL3215- | 1SE23-0AA0 | 1SE26-0AA0 | 1SE27-5UA0 |
|---|----------|---|--------------------|--------------------|
| 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 supply for the Control Unit | A | 1,0 | 1,0 | 1,0 |
| Rated input current ¹⁾ | A | | | |
| - with line reactor | | 40 | 63 | 78 |
| - without line reactor | | 46 | 72 | 88 |
| Class J UL safety fuses | | | | |
| Rated current | A | 50 | 90 | 100 |
| Rated short-circuit current SCCR | kA | 65 | 65 | 65 |
| Safety fuses NH | | 3NA3 820 | 3NA3 824 | 3NA3 830 |
| Rated current | A | 50 | 80 | 100 |
| Circuit-breaker type designation IEC 60947 | | 3RV1042-4JA10 | 3RV1042-4MA10 | 3VL1712-1DD33-0AA0 |
| Rated current | A | 45 - 63 | 80 - 100 | 100 - 125 |
| Circuit-breaker type designation UL489 / CSA C22.2 No. 5-02 | | -- | 3VL2191-3KN30-0AA0 | 3VL2110-3KN30-0AA0 |
| Rated current | A | | 90 | 100 |
| Rated short-circuit current SCCR | kA | | 65 | 65 |
| Resistance value of the external braking resistor | Ohms | > 27 | > 27 | > 15 |
| Max. cable length to braking resistor | m | 15 | 15 | 15 |
| Line connection L1, L2, L3 | | Stud M6, connectable cable cross-sections 10 to 50 mm ² for ring cable lugs | | |
| Motor connection U2, V2, W2 | | | | |
| DC link connection, connection for braking resistor DCP/R1, DCN, R2 | | | | |
| PE connection | | M6 studs | | |
| Max. motor cable length | m | 70 (shielded) 100 (unshielded) | | |
| Degree of protection | | IP20 or IPXXB | | |
| Depth | | 159,5 (6.28) 240,4 (9.46) 181,3 (7.13) 181,3 (7.13) | | |
| - PM340 | mm | | | |
| - PM340 with Control Unit CU310 | | | | |
| - PM340 with CUA31 | | | | |
| - PM340 with CUA32 | | | | |
| Frame size | | FSD | FSD | FSE |

3.2 Power Modules Blocksize Liquid Cooled (PM340)

| PM340 Power Module | 6SL3215- | 1SE23-0AA0 | 1SE26-0AA0 | 1SE27-5UA0 |
|--------------------|----------|--------------|--------------|--------------|
| 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 a load with the rated power (based on I_n) for a line impedance corresponding to $u_k = 1\%$.

Table 3-21 Technical specifications for Power Modules PM340 format Blocksize Liquid Cooled, Part 2

| PM340 Power Module | 6SL3215- | 1SE31-0UA0 | 1SE31-1UA0 | 1SE31-8UA0 |
|--|----------|---|---|---------------------------------|
| Rated output current I_n | 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_n | 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 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 IEC 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 | 125 65 | 150 65 | 250 65 |
| Resistance value of the external braking resistor | Ohms | > 15 | > 8,2 | > 8,2 |
| Max. cable length to braking resistor | m | 15 | 15 | 15 |
| Line connection L1, L2, L3 | | Stud M6, connectable cable cross-sections 10 to 50 mm ² for ring cable lugs | Stud M8, max. connection cable cross-section 120 mm ² | |
| Motor connection U2, V2, W2 | | | | |
| DC link connection, connection for braking resistor DCP/R1, DCN, R2 | | | | |
| PE connection | | | | |
| Max. motor cable length | m | 70 (shielded) 100 (unshielded) | | |
| Degree of protection | | IP20 or IPXXB | | |

| PM340 Power Module | 6SL3215- | 1SE31-0UA0 | 1SE31-1UA0 | 1SE31-8UA0 |
|---------------------------------|----------|--------------|---------------|---------------|
| Depth | | | | |
| - PM340 | | 159,5 (6.28) | 241,5 (9.50) | 241,5 (9.50) |
| - PM340 with Control Unit CU310 | mm | 240,4 (9.46) | 322,5 (12.69) | 322,5 (12.69) |
| - PM340 with CUA31 | | 181,3 (7.13) | 263 (10.35) | 263 (10.35) |
| - PM340 with CUA32 | | 181,3 (7.13) | 263 (10.35) | 263 (10.35) |
| Frame size | | FSE | FSF | FSF |
| Weight | kg | 14,8 | 29,2 | 29,2 |
| With CU310 | | 15,8 | 30,2 | 30,2 |

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

Overload capability

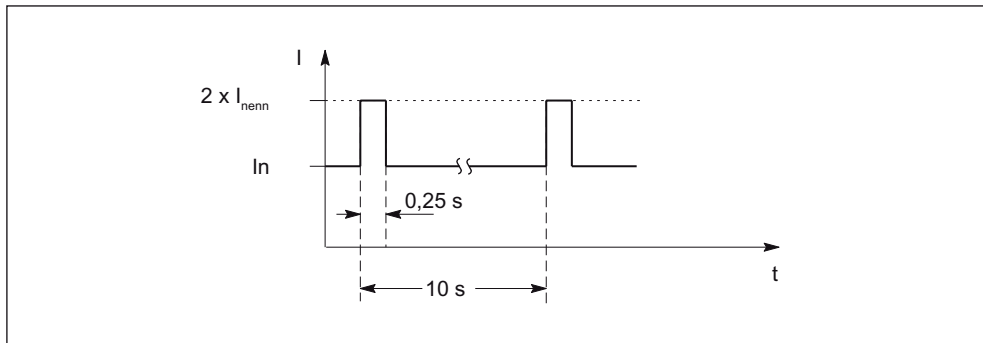


Figure 3-39 Load cycle with pre-load condition (for servo drives)

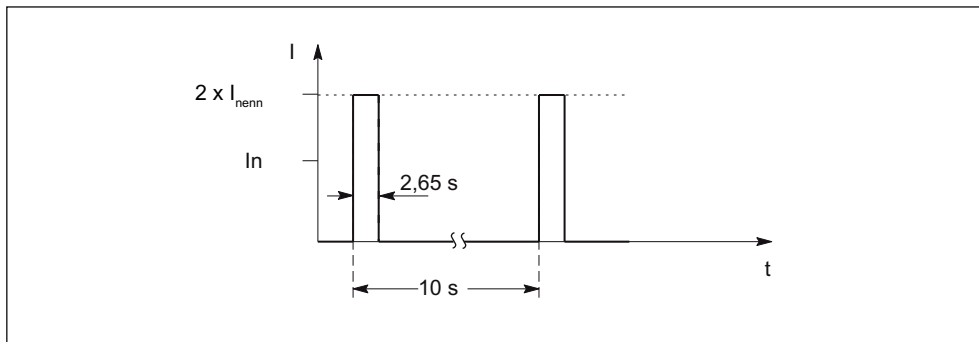


Figure 3-40 Load cycle without pre-load condition (for servo drives)

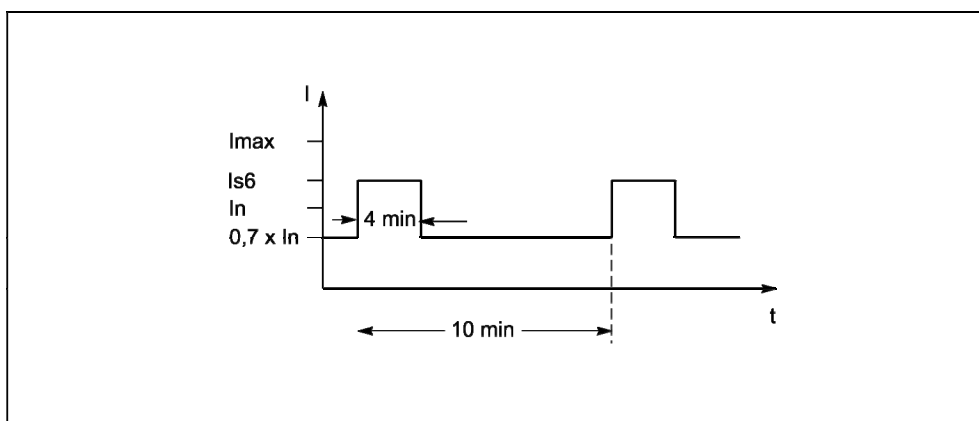


Figure 3-41 S6 load cycle with pre-load condition (for servo drives)

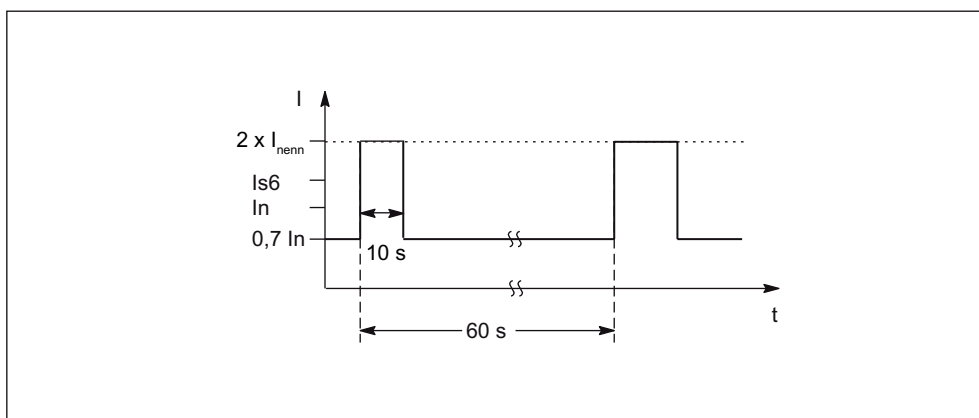


Figure 3-42 Load cycle with pre-load condition (for servo drives)

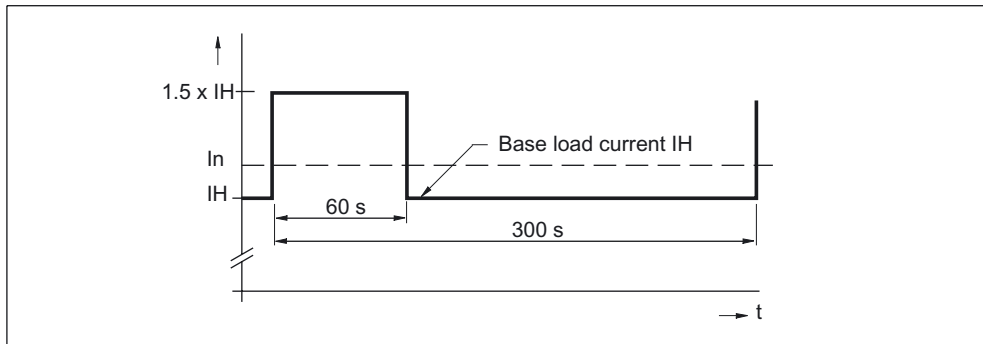


Figure 3-43 Load cycle with 60 s overload with a load cycle period of 300 s

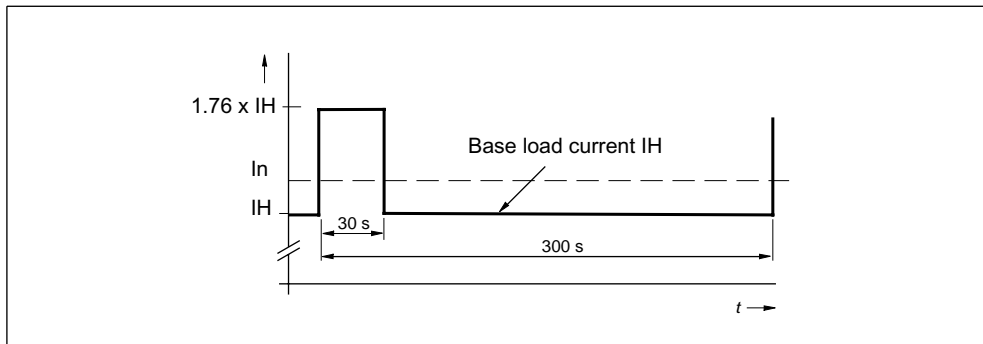


Figure 3-44 Load cycle with 30 s overload with a load cycle period of 300 s

Derating characteristics for Power Modules in blocksize Liquid Cooled format

Note

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

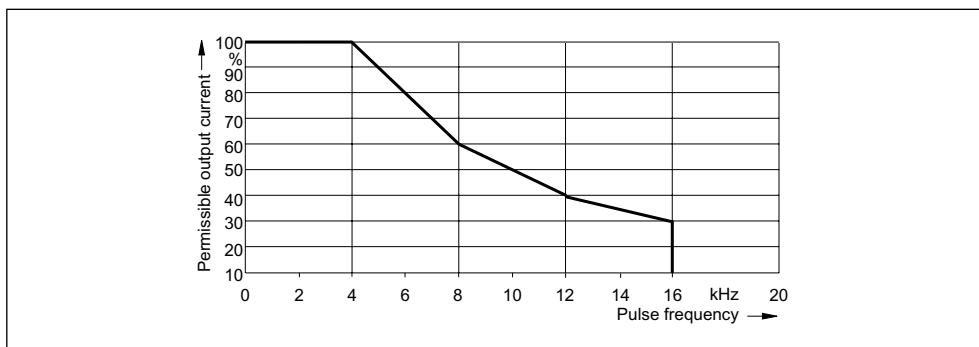


Figure 3-45 Output current as a function of pulse frequency

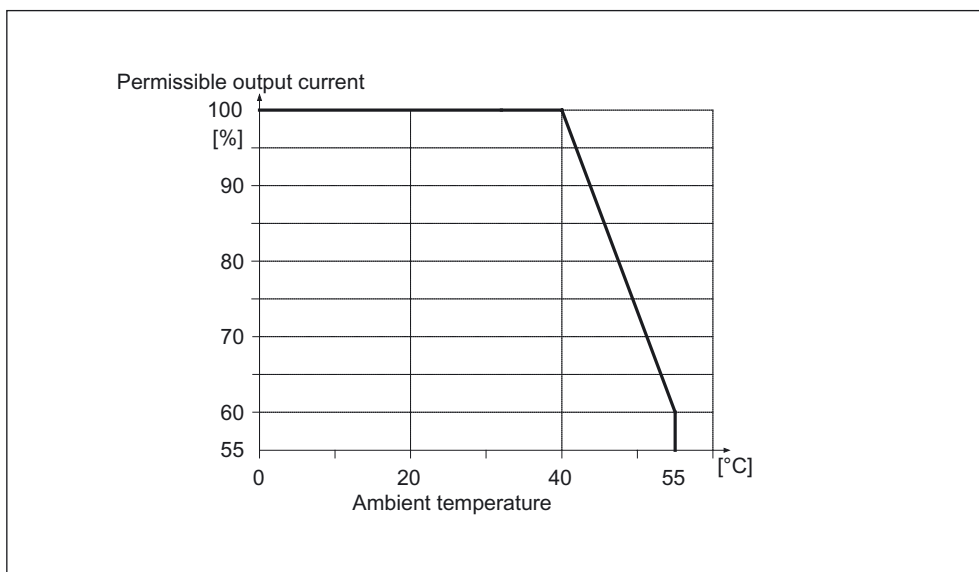


Figure 3-46 Output power as a function of ambient temperature

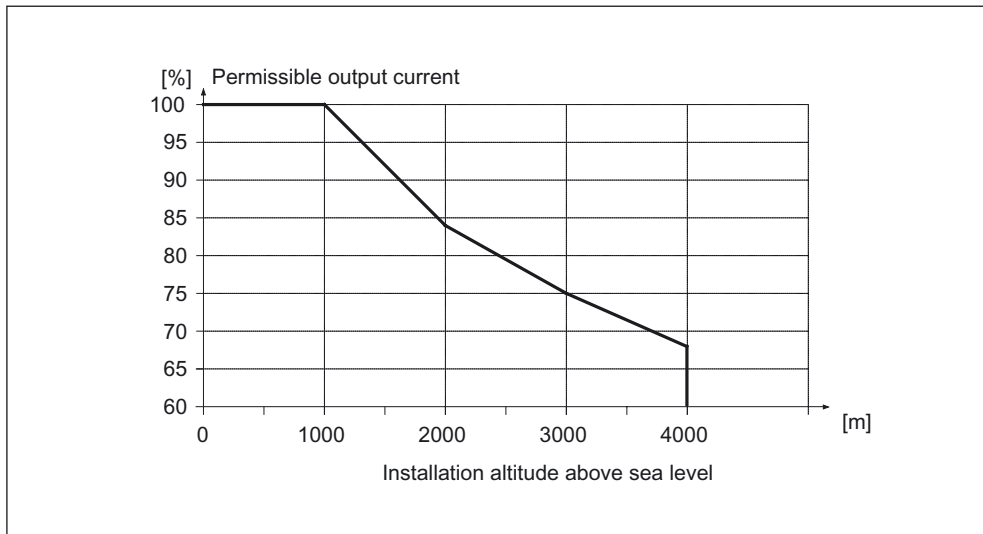


Figure 3-47 Output power as a function of installation altitude

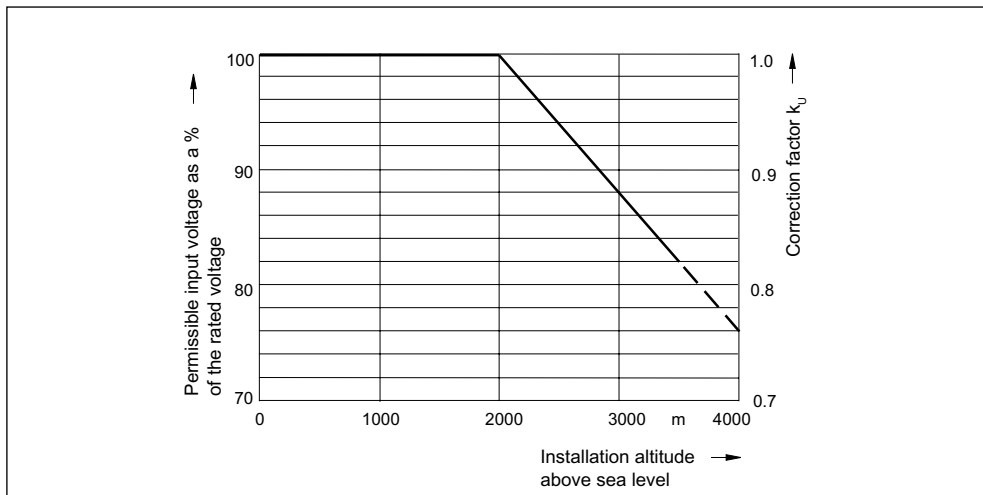


Figure 3-48 Voltage correction factor as a function of installation altitude

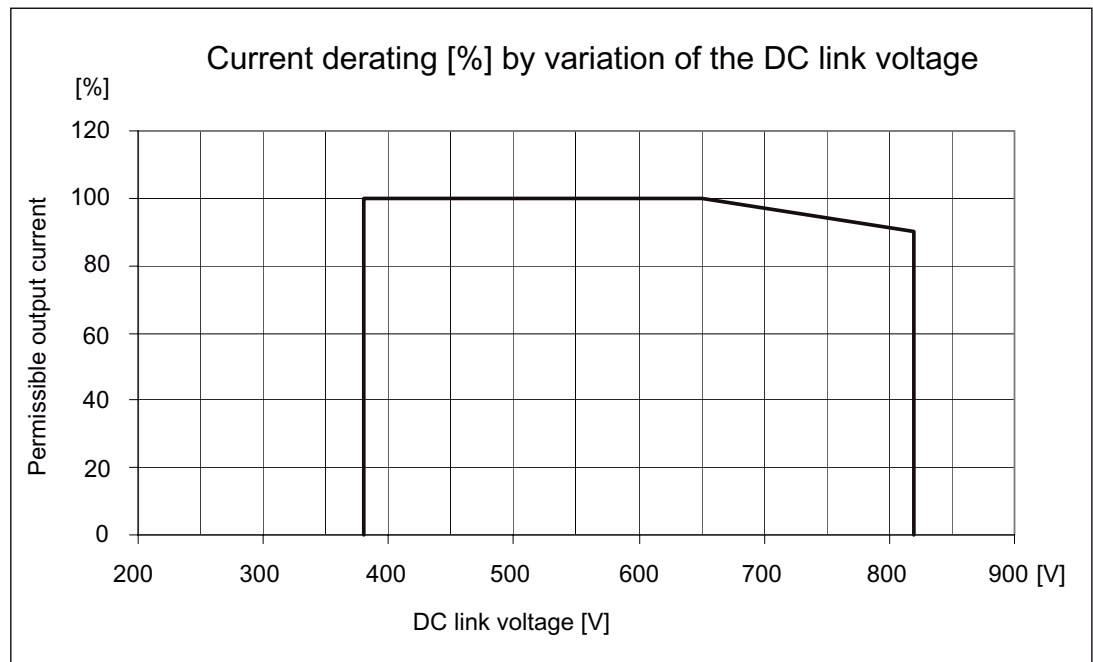


Figure 3-49 Current derating by variation of the DC link voltage

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. |

| |
|--|
|  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

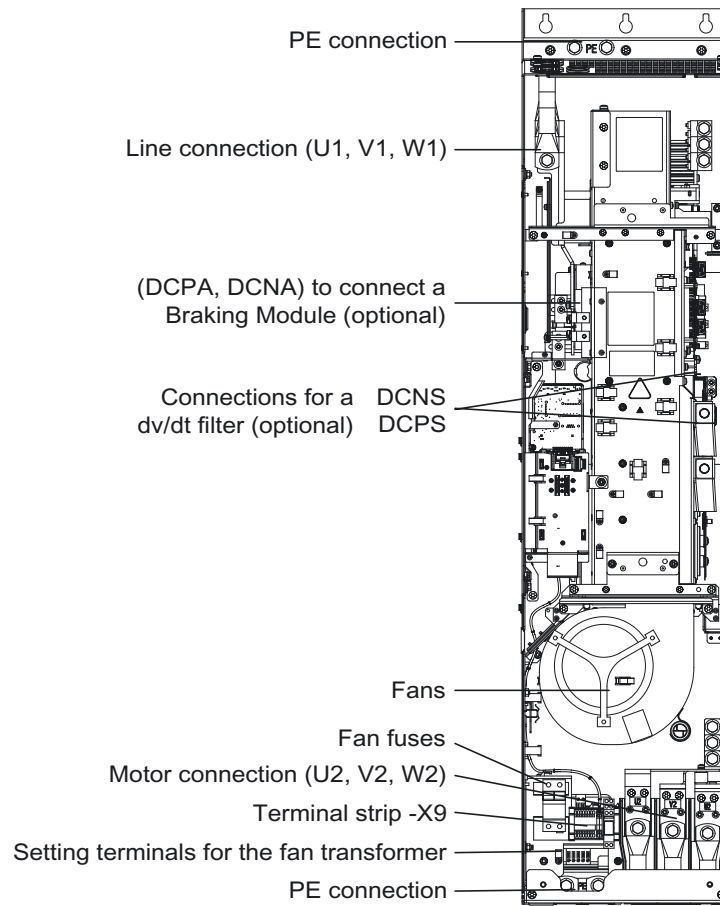


Figure 3-50 Power Module, frame size FX

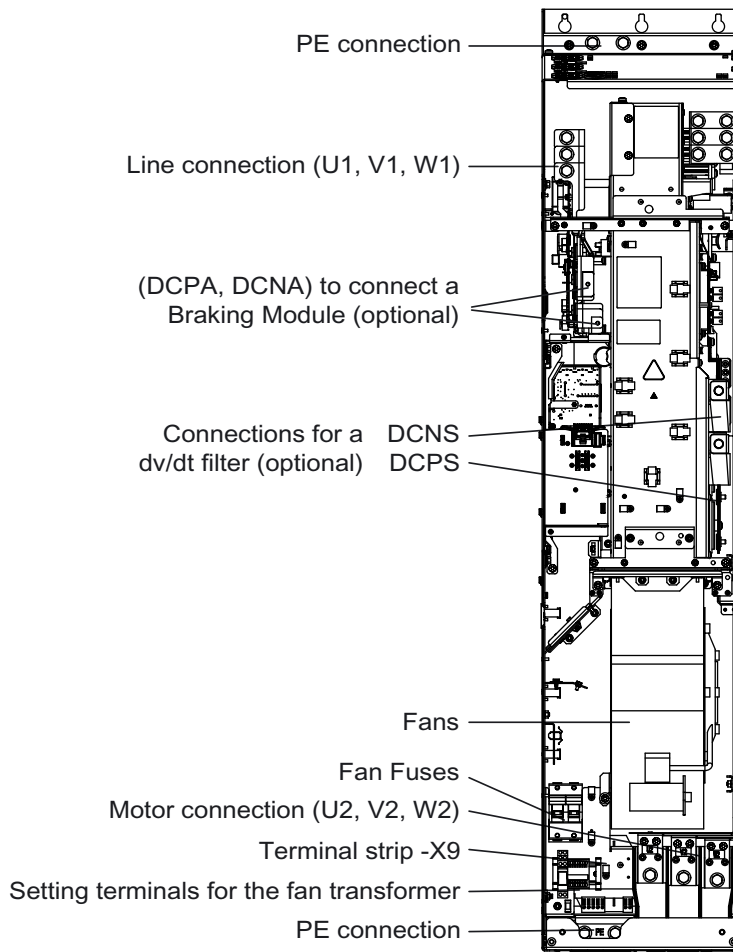


Figure 3-51 Power Module, frame size GX

3.3.3.2 Sample connection

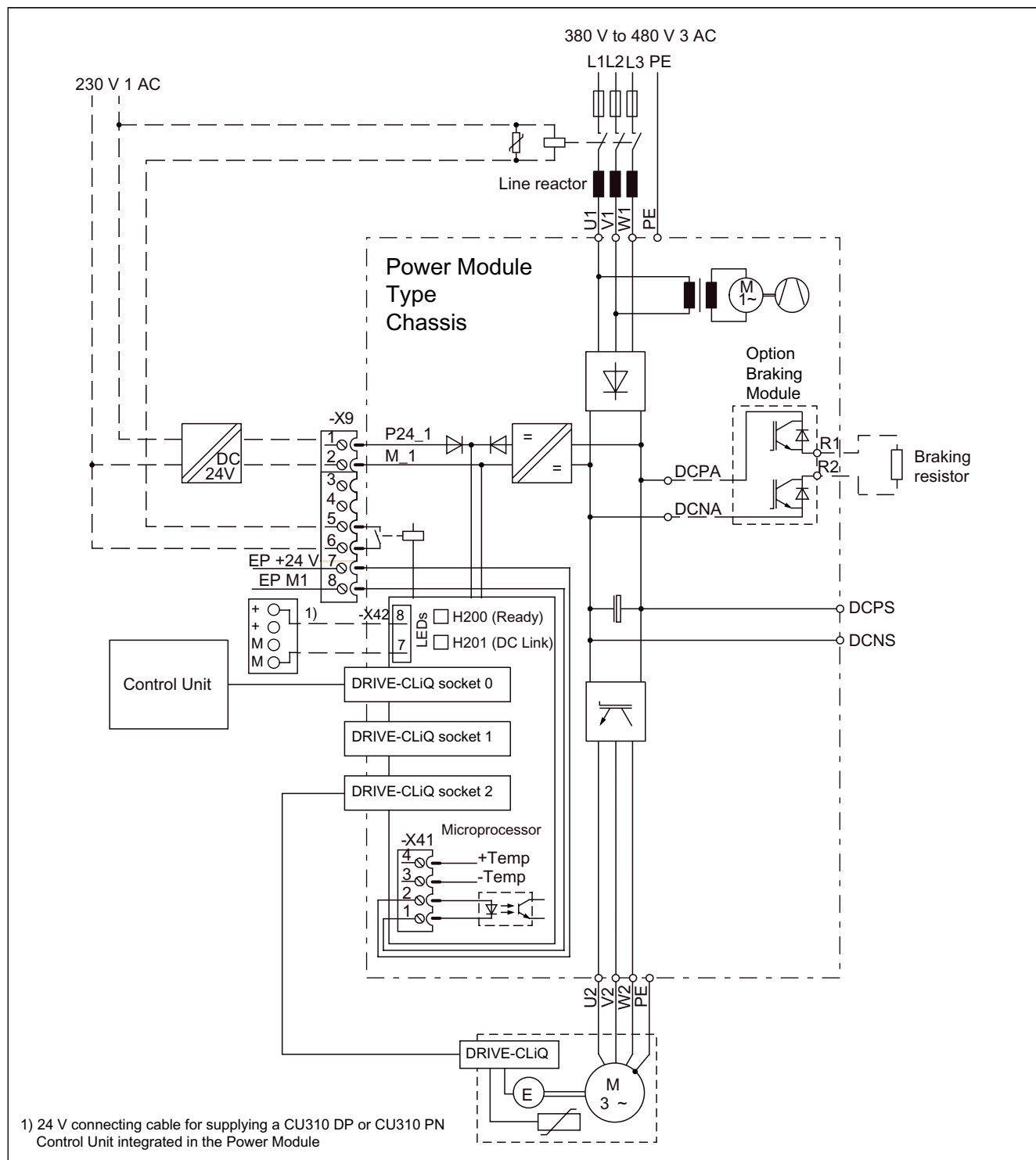
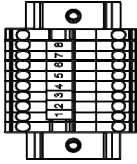


Figure 3-52 Connection example: Power Module Chassis

3.3.3.3 Terminal Block X9

Table 3-22 Terminal strip 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. 1A |
| | 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 |
| | 8 | EP M1 (Enable Pulses) | |

Note

For operation, 24 V DC must be connected to terminal 7 and ground to terminal 8. Upon removal, pulse inhibit is activated.

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

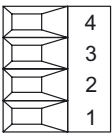
Table 3-23 DCPS, DCNS

| Frame size | Cross-section that can be connected | Terminal screw |
|------------|-------------------------------------|----------------|
| FX | 1 x 35 mm ² | M8 |
| GX | 1 x 70 mm ² | M8 |

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

3.3.3.5 X41 EP terminals / temperature sensor

Table 3-24 Terminal strip X41

| | Terminal | Function | Technical specifications |
|---|----------|----------------------|--------------------------------------|
|  | 4 | +Temp | Temperature sensor KTY84-1C130 / PTC |
| | 3 | -Temp | |
| | 2 | Reserved, do not use | |
| | 1 | Reserved, do not use | |

Max. connectable cross-section: 1.5 mm² (AWG 14)

NOTICE

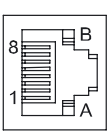
The KTY temperature sensor must be connected with the correct polarity.

Note

The temperature sensor can be used for motors equipped with a KTY84-1C130 measurement sensor in the stator windings.

3.3.3.6 DRIVE-CLiQ Interface X400-X402


Table 3-25 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 |

3.3.3.7 Meaning of the LEDs on the Power Module

Table 3-26 Single Motor Module / Double Motor Module / Power Module - description of the LEDs

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

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

3.3.4 Dimension drawings

Dimension drawing frame size FX

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

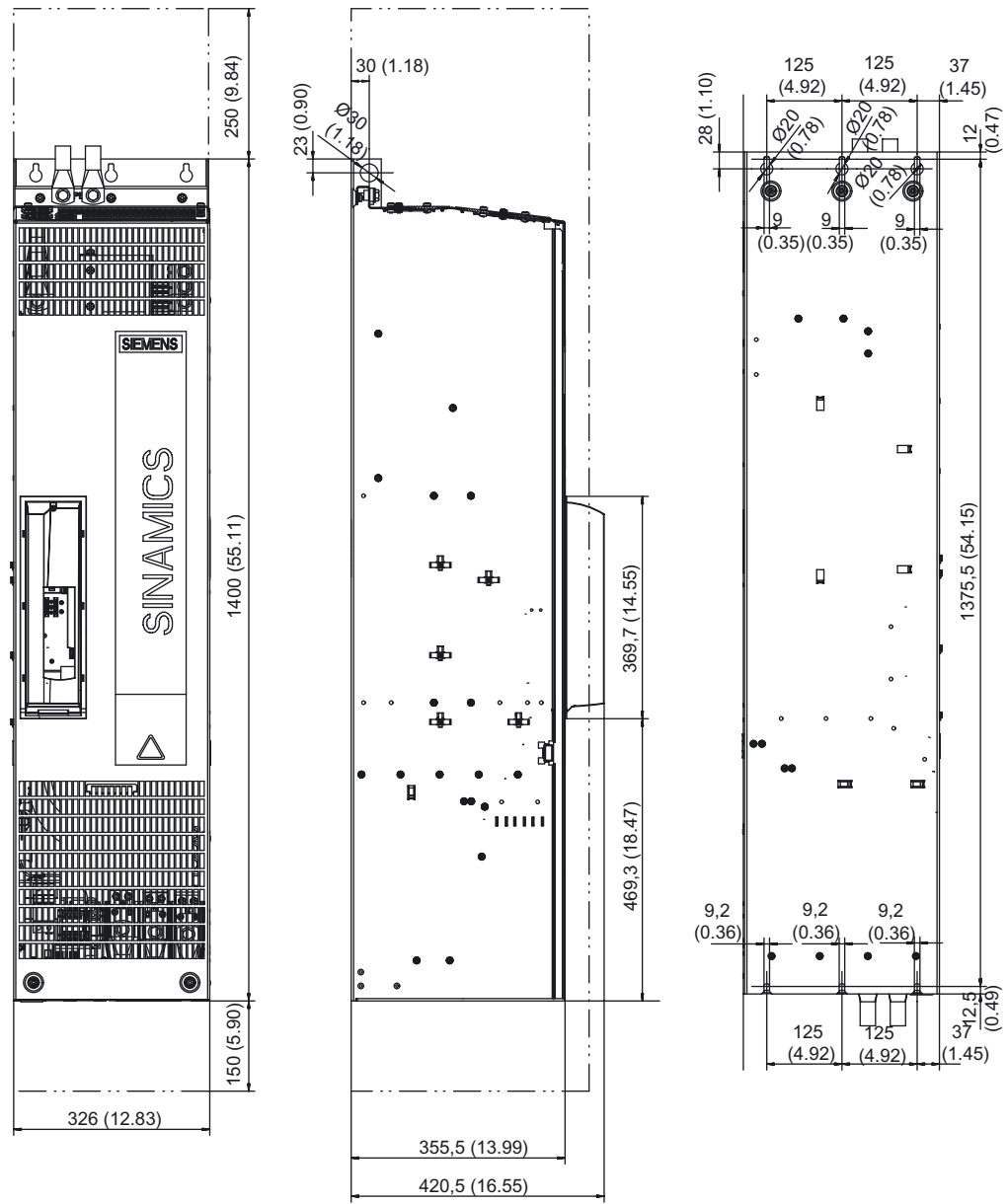


Figure 3-53 Dimension drawing Power Module, frame size FX

Dimension drawing frame size GX

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

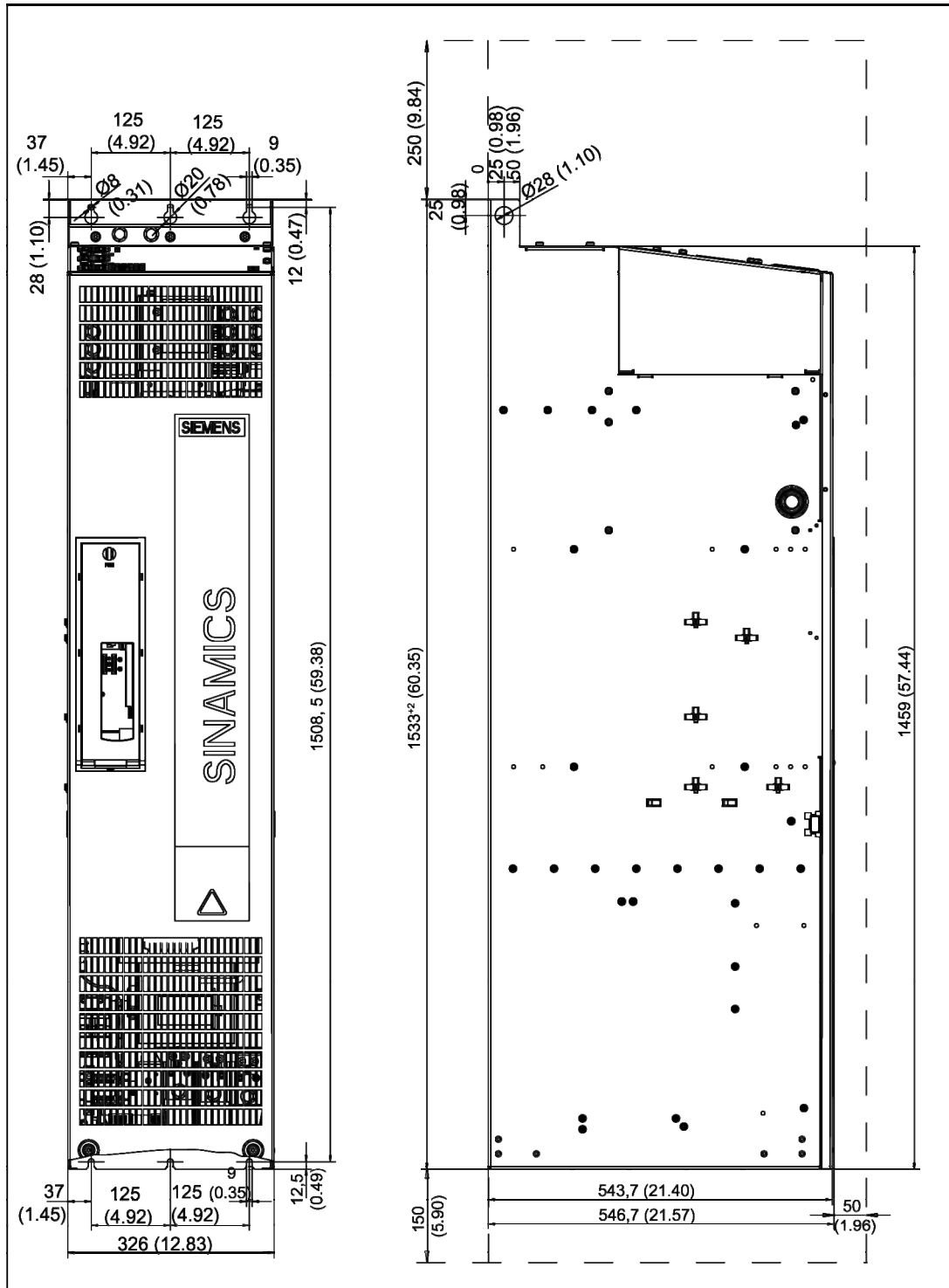


Figure 3-54 Dimension drawing Power Module, frame size GX

3.3.5 Mounting the CU310 in the Power Module Chassis

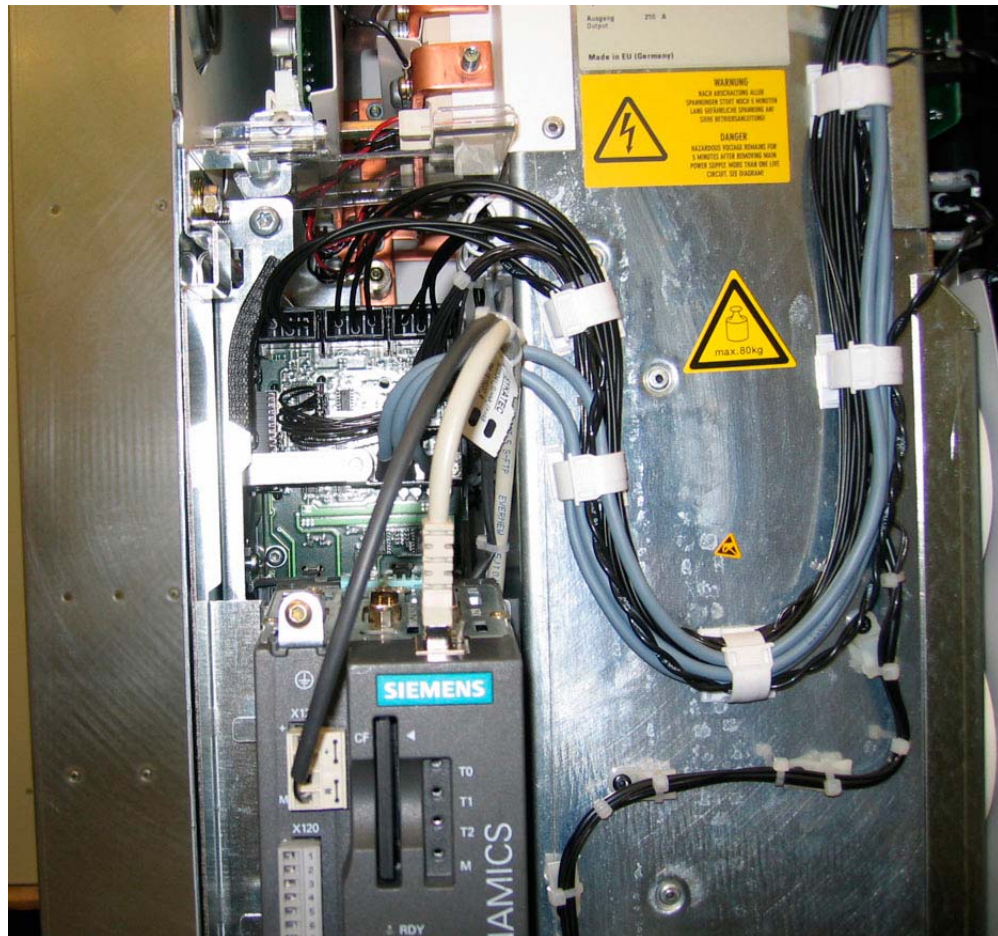


Figure 3-55 Mounting the CU310 in the Power Module chassis format, frame size FX

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.

3.3.6 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.

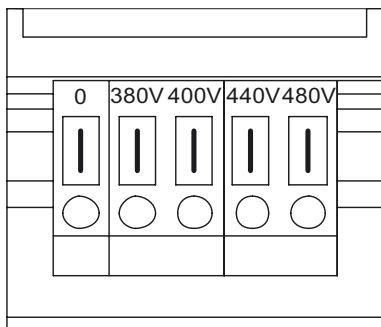


Figure 3-56 Setting terminals for the fan transformers

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: | |
| <ul style="list-style-type: none"> • The required cooling level will not provided (risk of overheating) • The fan fuses may blow (overload) | |

Table 3-27 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 |

3.3.7 Technical data

Table 3-28 Technical specifications, Power Modules in chassis format

| Line supply voltage 3-ph. 380 V to 480 V AC $\pm 10\%$ ($-15\% < 1$ min) | | | | | | |
|---|-------------------|---|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Order no.: | 6SL3310- | 1TE32-1AA0 | 1TE32-6AA0 | 1TE33-1AA0 | 1TE33-8AA0 | 1TE35-0AA0 |
| 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 | | | | | | |
| Electronics power supply | V_{DC} | 24 (20,4 - 28,8) | | | | |
| Overvoltage trip | V_{DC} | $820 \pm 2\%$ | | | | |
| Undervoltage trip | V_{DC} | 424 | | | | |
| Rated power based on I_n | 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 | m ³ /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 |
| Electronics current drain (24 V DC) | A | 0,8 | 0,8 | 0,9 | 0,9 | 0,9 |
| Class J UL safety fuses | | | | | | |
| Rated current | A | 250 | 300 | 350 | 400 | 600 |
| Rated short-circuit current | kA | 65 | 65 | 65 | 65 | 65 |
| SCCR | | | | | | |
| Safety fuses NH | | | | | | |
| Rated current | A | 3NA3144 250 | 3NA3250 300 | 3NA3254 355 | 3NA3260 400 | 3NA3372 630 |
| Circuit-breaker type designation IEC 60947 | | | | | | |
| Rated current | A | 3VL4725-1DC36-0AA0 200 - 250 | 3VL4731-1DC36-0AA0 250 - 315 | 3VL4740-1DC36-0AA0 320 - 400 | 3VL5750-1DC36-0AA0 400 - 500 | 3VL5763-1DC36-0AA0 500 - 630 |
| Circuit-breaker type designation UL489 / CSA C22.2 No. 5-02 | | | | | | |
| Rated current | A | 3VL3125-3KN30-0AA0 250 | 3VL4130-3KN30-0AA0 300 | 3VL4135-3KN30-0AA0 350 | 3VL4140-3KN30-0AA0 400 | 3VL4560-3KN30-0AA0 600 |
| Rated short-circuit current | kA | 65 | 65 | 65 | 65 | 65 |
| SCCR | | | | | | |
| Line supply connection U1, V1, W1 | | Flat connector for M10 cable lug, max. connection cross-section 2 x 185 mm ² | | | | |
| Motor connection U2, V2, W2 | | Flat connector for M10 cable lug, max. connection cross-section 2 x 185 mm ² | | | | |

3.3 Power Modules Chassis

| Line supply voltage 3-ph. 380 V to 480 V AC $\pm 10\%$ (-15% < 1 min) | | | | | | |
|---|----------|---|--|--|--|--|
| Order no.: | 6SL3310- | 1TE32-1AA0 | 1TE32-6AA0 | 1TE33-1AA0 | 1TE33-8AA0 | 1TE35-0AA0 |
| DC link connections DCPA, DCNA, (option Braking Module) | | Flat connector for M8 cable lug, connection cross-section 1 x 35 mm ² | Flat connector for M8 cable lug, connection cross-section 1 x 35 mm ² | Flat connector for M8 cable lug, connection cross-section 1 x 50 mm ² | Flat connector for M8 cable lug, connection cross-section 1 x 50 mm ² | Flat connector for M8 cable lug, connection cross-section 1 x 50 mm ² |
| DC link connections DCPS, DCNS (option dv/dt filter) | | Flat connector for M8 cable lug, connection cross-section 1 x 35 mm ² | Flat connector for M8 cable lug, connection cross-section 1 x 35 mm ² | Flat connector for M8 cable lug, connection cross-section 1 x 70 mm ² | Flat connector for M8 cable lug, connection cross-section 1 x 70 mm ² | Flat connector for M8 cable lug, connection cross-section 1 x 70 mm ² |
| PE connection | | Flat connector for M10 cable lug, max. connection cross-section 2 x 185 mm ² | | | | |
| Max. motor cable length ¹⁾ | m | 300 (shielded) 450 (non-shielded) | | | | |
| Max. ambient temperature without derating | °C | 40 | 40 | 40 | 40 | 40 |
| with derating | °C | 55 | 55 | 55 | 55 | 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 maintain the EMC limit values of EN 61800-3 Category C2.

3.3.7.1 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.

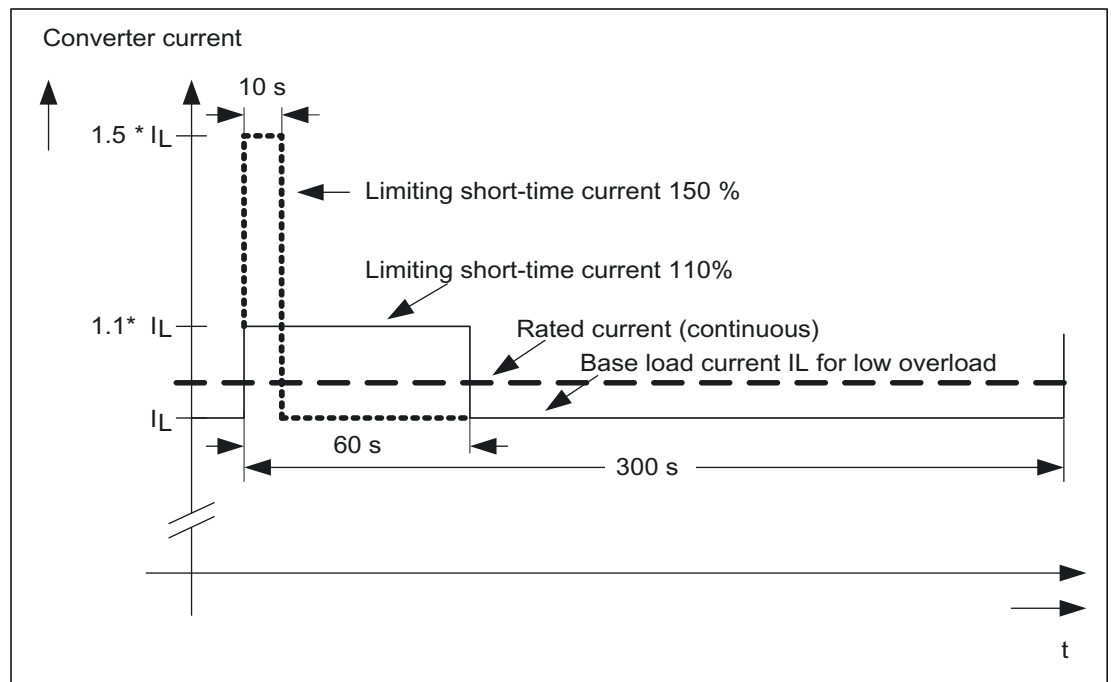


Figure 3-57 Low overload

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.

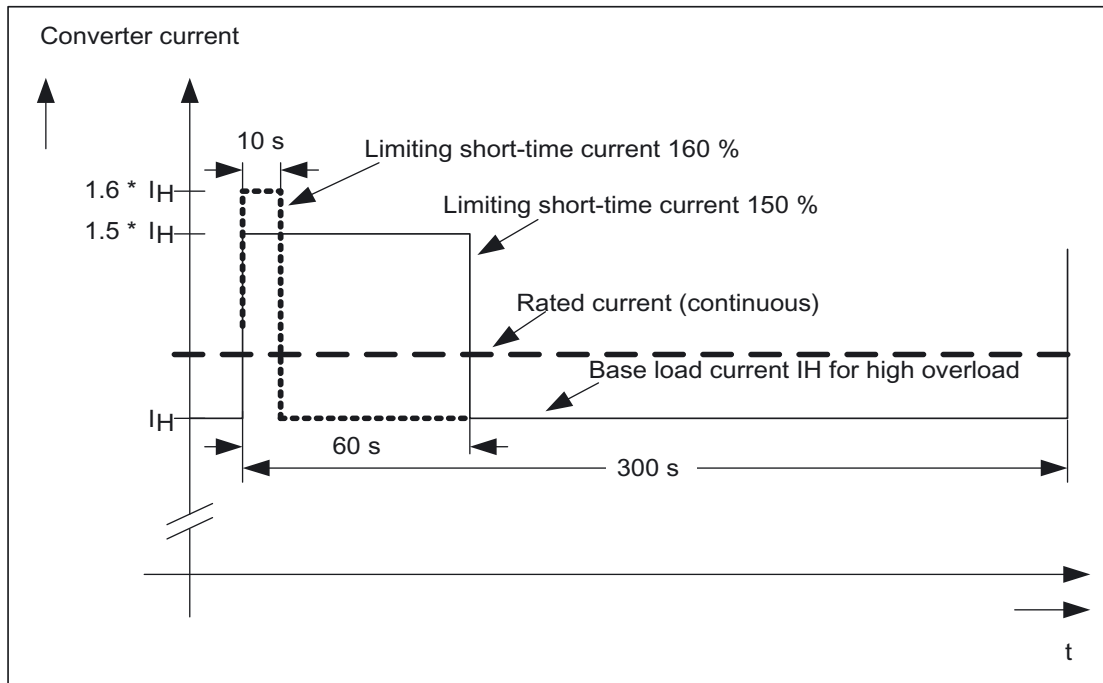


Figure 3-58 High overload

3.3.7.2 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 3-29 Derating factor of the output current as a function of the pulse frequency

| Order No. 6SL3310-... | Output current for a pulse frequency of 2 kHz [A] | Permissible output current for a pulse frequency of 2.5 kHz as a % of I_n | Derating factor for a pulse frequency of 4 kHz | Derating factor for a pulse frequency of 8 kHz |
|--------------------------|---|---|--|--|
| 1TE32-1AA0 | 210 | 95 % | 82 % | 50 % |
| 1TE32-6AA0 | 260 | 95 % | 83 % | 50 % |
| 1TE33-1AA0 | 310 | 97 % | 88 % | 50 % |
| 1TE33-8AA0 | 380 | 96 % | 87 % | 50 % |
| 1TE35-0AA0 | 490 | 94 % | 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 3-30 Maximum output frequencies achieved by increasing the pulse frequency

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

¹ Due to the closed-loop control, the maximum output frequency is limited to 300 Hz.

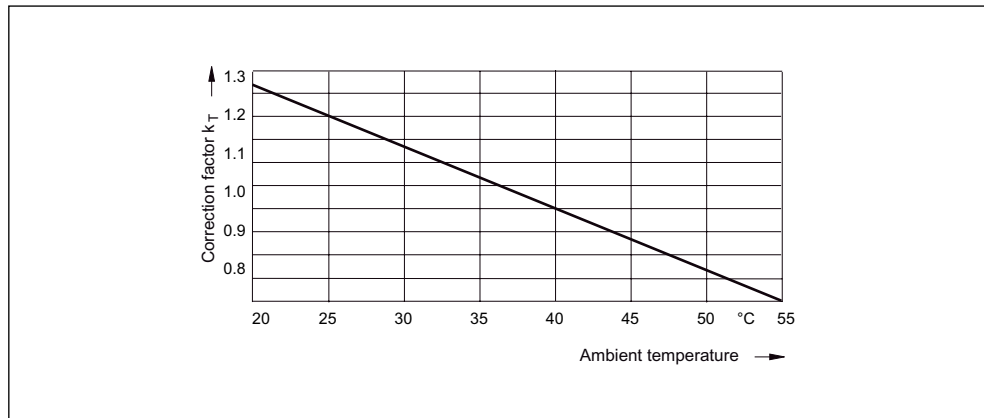


Figure 3-59 Current correction factor as a function of ambient temperature

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

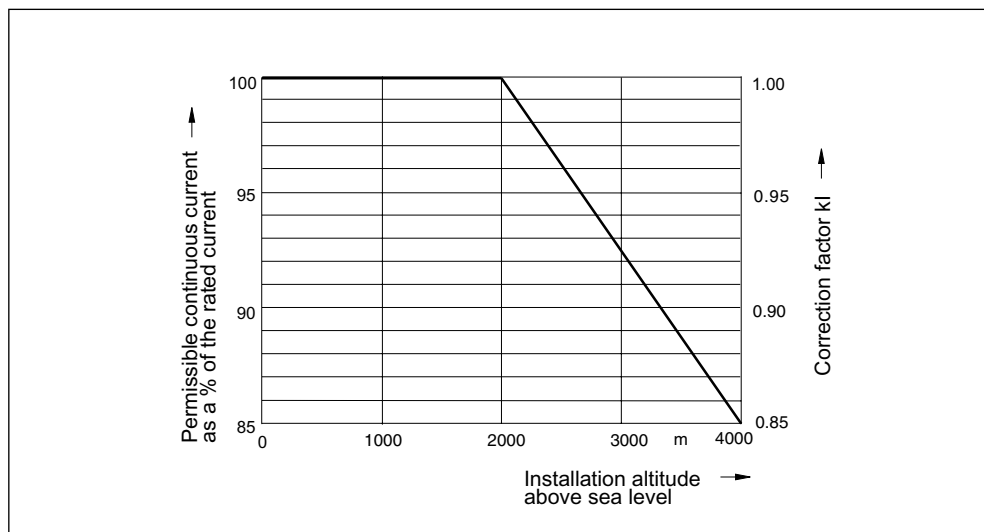


Figure 3-60 Current correction factor as a function of installation altitude

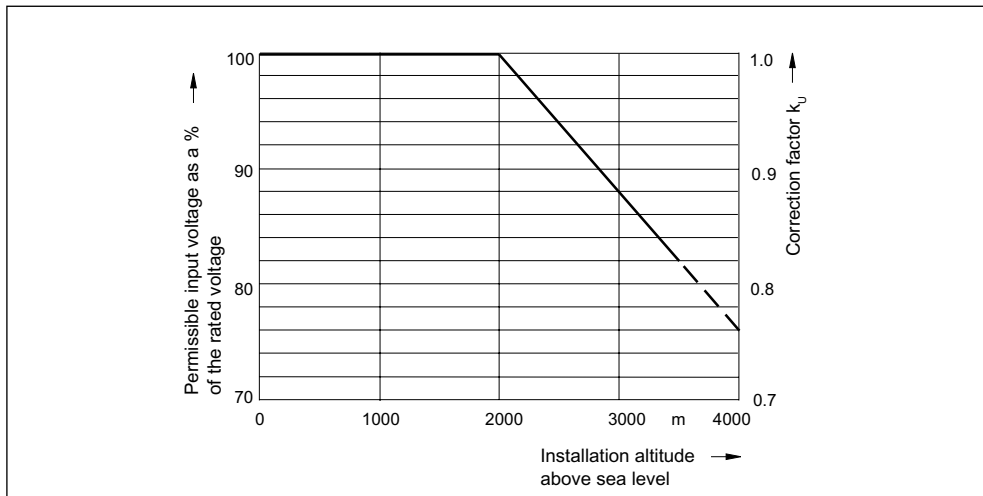


Figure 3-61 Voltage correction factor as a function of installation altitude

DC link components

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



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.

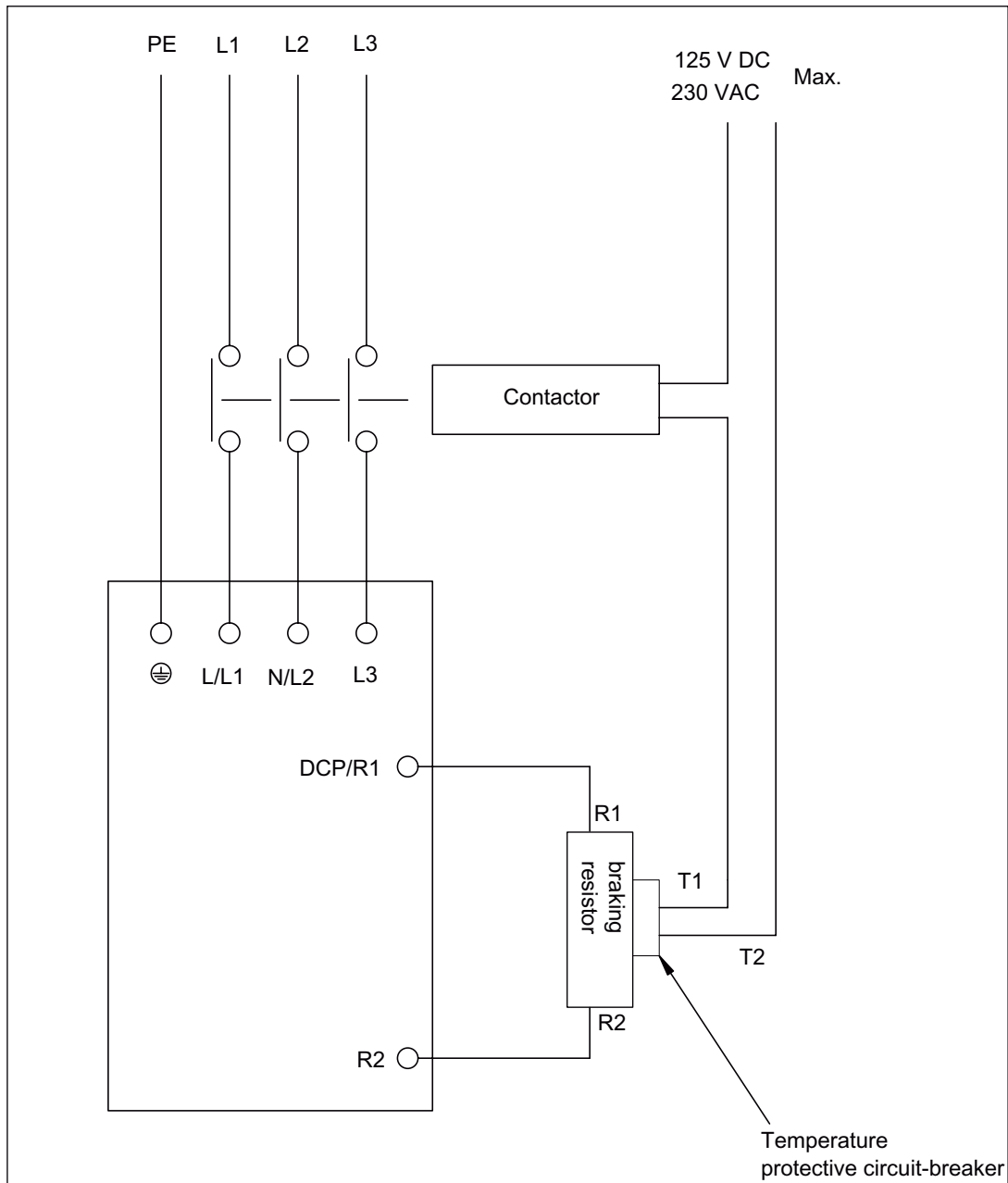


Figure 4-1 Connection example: Braking resistor

4.1.1.3 Dimension drawings

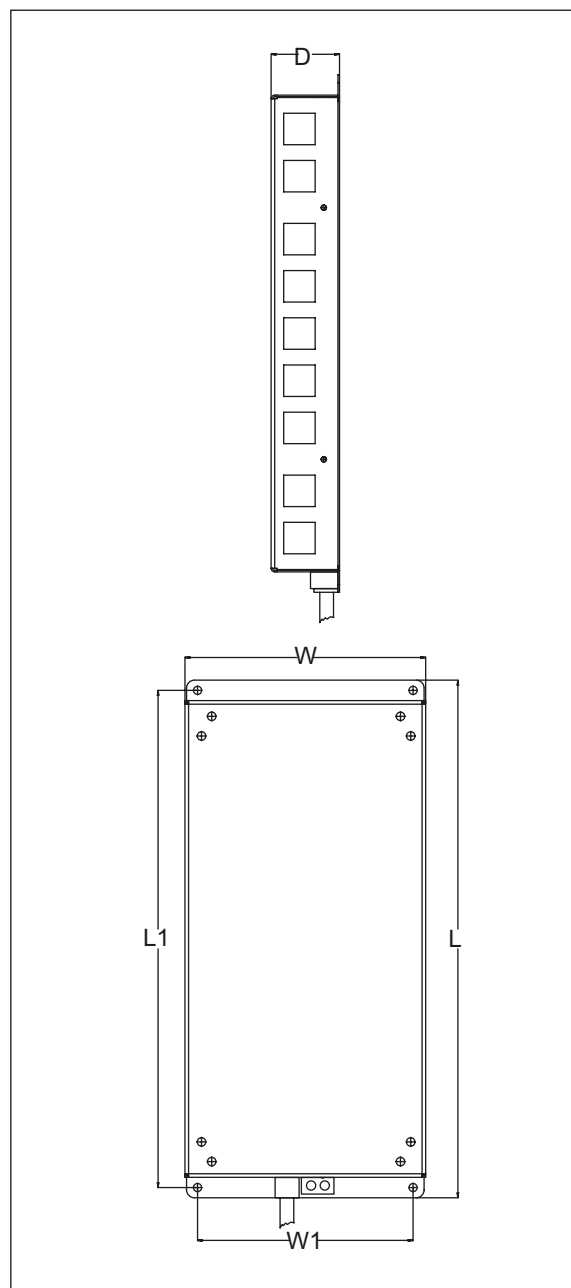


Figure 4-2 Dimension drawing: Braking resistor, frame sizes FSA and FSB

4.1 Blocksize

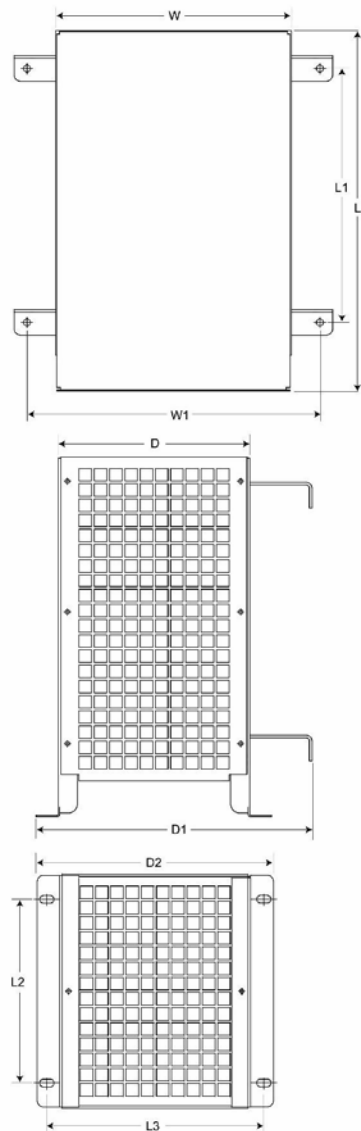


Figure 4-3 Dimension drawing: Braking resistor, frame sizes FSC, FSD, FSE, FSF

Table 4-1 Dimension data: Braking resistor, all data in mm and (inches), Part 1

| Order No. 6SE6400- | 4BC05-0AA0 | 4BD11-0AA0 | 4BD12-0BA0 | 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) |

| Order No. 6SE6400- | 4BC05-0AA0 | 4BD11-0AA0 | 4BD12-0BA0 | 4BD16-5CA0 |
|-----------------------|------------|------------|------------|------------|
| Frame size | FSA | FSA | FSB | FSC |
| D2 | - | - | - | 185 (7,28) |
| W | 72 (2,83) | 72 (2,83) | 149 (5,86) | 185 (7,28) |
| W1 | 56 (2,20) | 56 (2,20) | 138 (5,43) | 230 (9,05) |

Table 4-2 Dimension data: Braking resistor, all data in mm and (inches), Part 2

| Order No. 6SE6400- | 4BD21-2DA0 | 4BD22-2EA0 | 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.

The braking resistors can be installed at the side next to 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 line reactor, the braking resistors can also be installed under the Power Modules.

The braking resistors can be installed horizontally or vertically. The 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.

4.1 Blocksize

4.1.1.5 Technical data

Table 4-3 Technical data, braking resistors, Part 1

| Order No. | | 6SE6400-4BC05-0AA0 | 6SE6400-4BD11-0AA0 | 6SL3201-0BE12-0AA0 | 6SE6400-4BD16-5CA0 |
|---|-----|--|--|--|--|
| Resistance | Ohm | 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 data, braking resistors, Part 2

| Order No. | | 6SE6400- | 4BD21-2DA0 | 4BD22-2EA0 | 4BD24-0FA0 |
|---|-----|----------|-----------------------------|-----------------------------|-----------------------------|
| Resistance | Ohm | | 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} / 0.2 A |
| Weight | kg | | 7.4 | 10.6 | 16.7 |

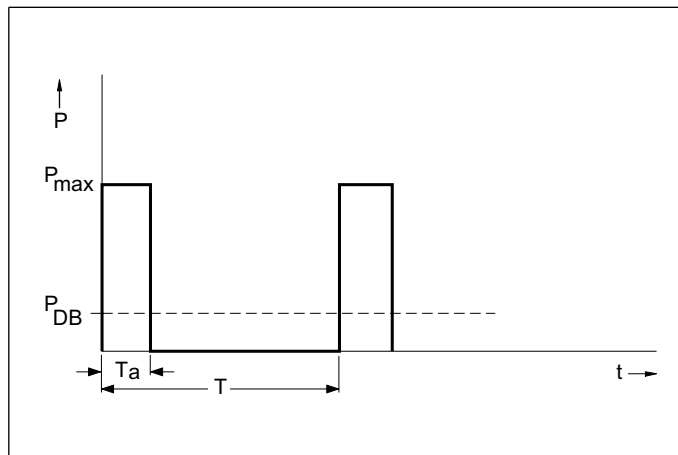


Figure 4-4 Load diagram for the braking resistor, Blocksize format

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)

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

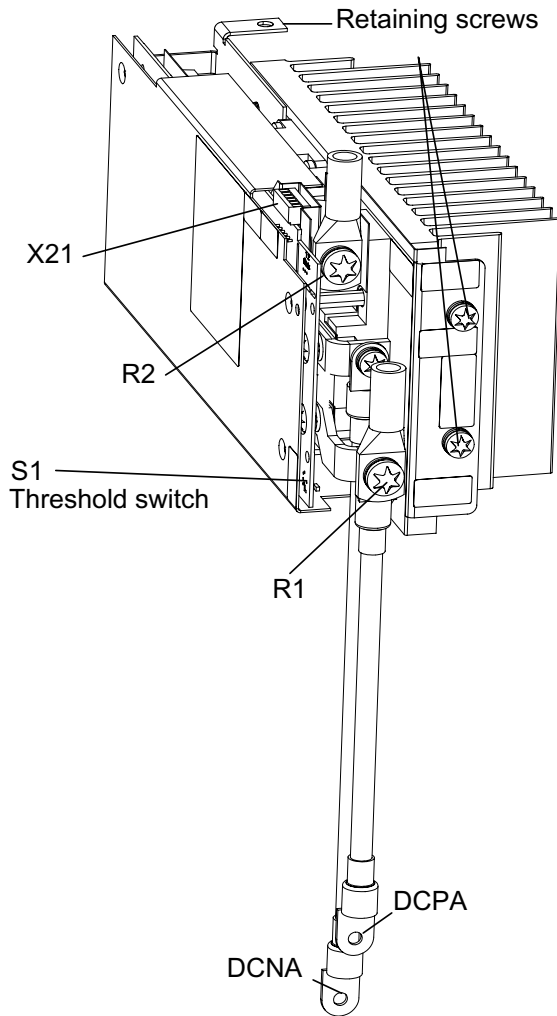


Figure 4-5 Braking Module for Power Module, frame size FX

4.2.1.4 Braking Module for type GX

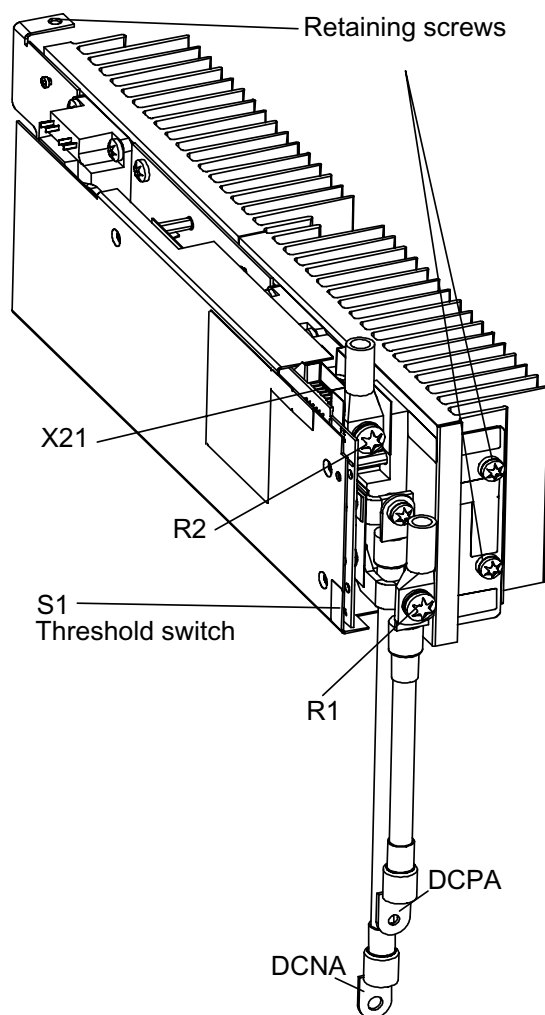


Figure 4-6 Braking Module for Power Module, frame size GX

4.2.1.5 Sample connection

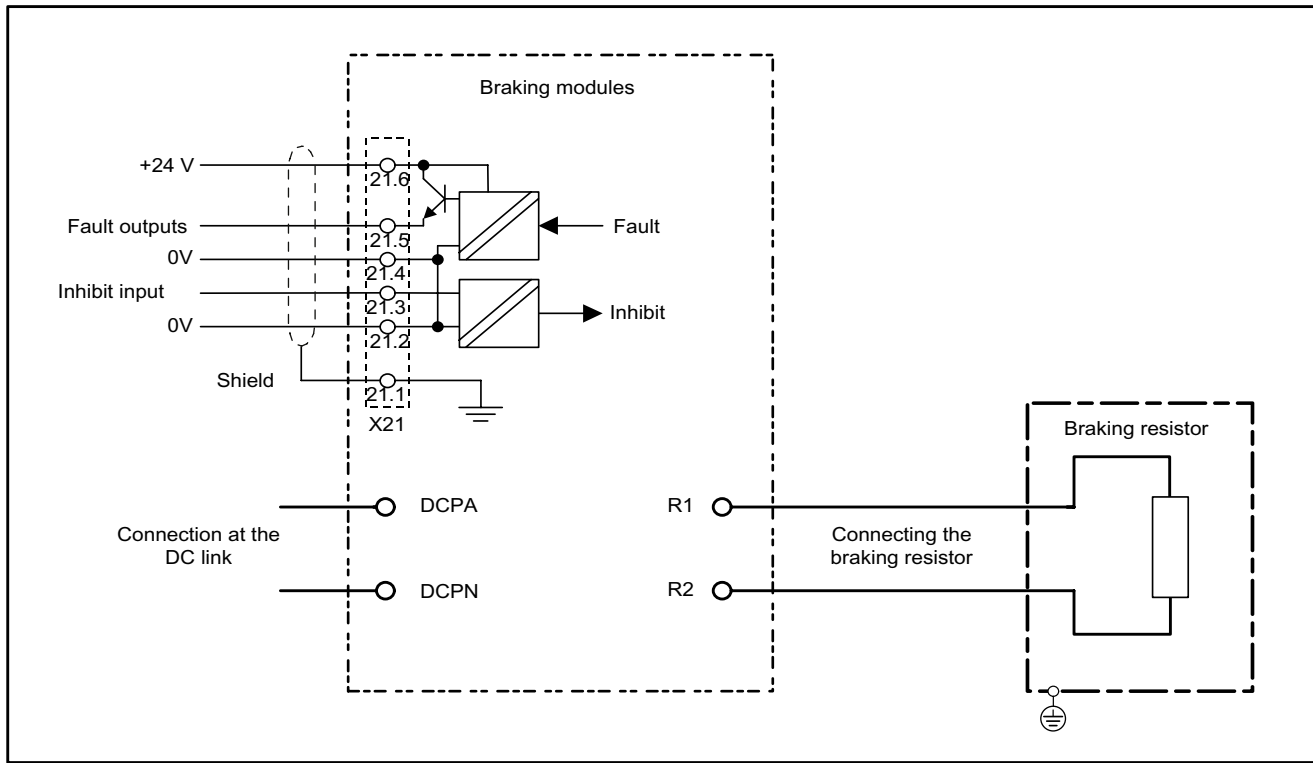


Figure 4-7 Example connection of Braking Module

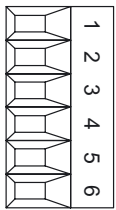
4.2.1.6 Braking resistor connection X1

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 |
| | 3 | DI inhibit input | High signal level: +15 V to 30 V Current drain: 2 mA to 15 mA |
| | 4 | 0 V | Voltage: 24 V DC |
| | 5 | DO fault output | Load current: 0.5 mA to 0.6 mA |
| | 6 | +24 V | Voltage: +18 V to 30 V Typical current consumption (own current consumption): 10 mA at 24 V DC |

Max. connectable cross-section 1.5 mm²

¹⁾ DI: Digital input; DO: Digital output

Note

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

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 $(677/774)^2 = 0.75$. 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

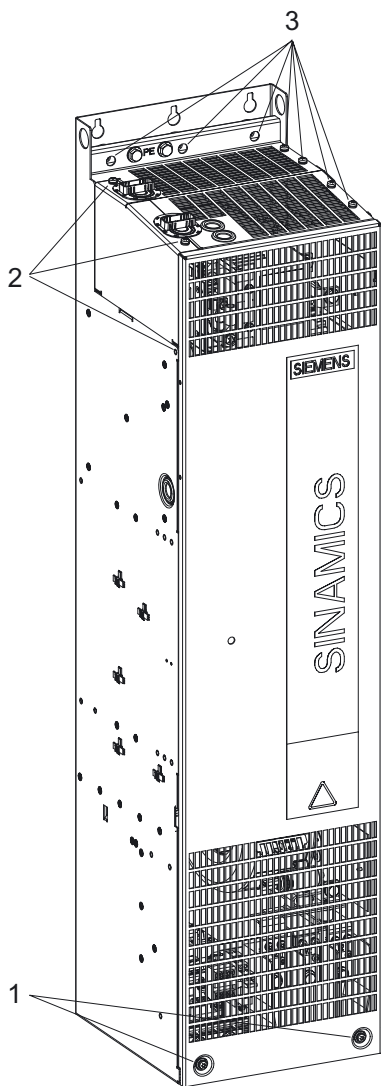


Figure 4-8 Installing a Braking Module in a Power Module, frame size FX – steps 1 - 3

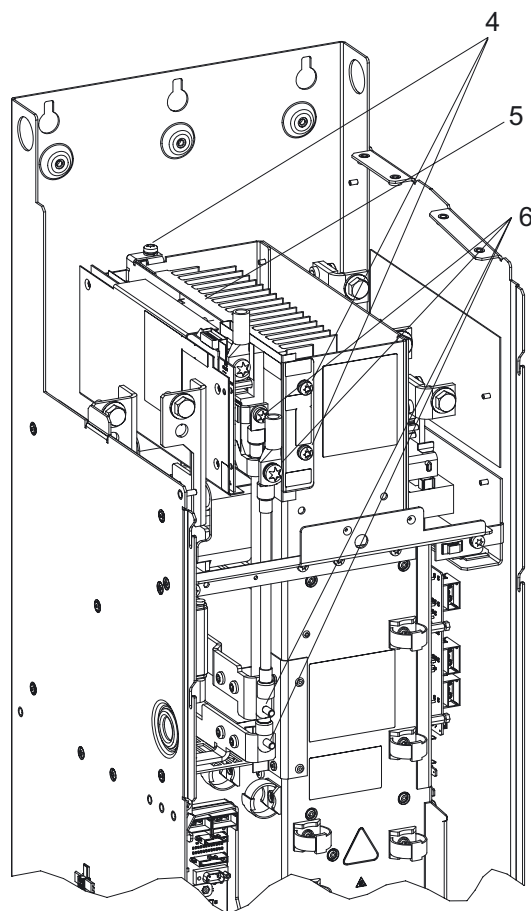


Figure 4-9 Installing a Braking Module in a Power Module, frame size FX – steps 4 - 6

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

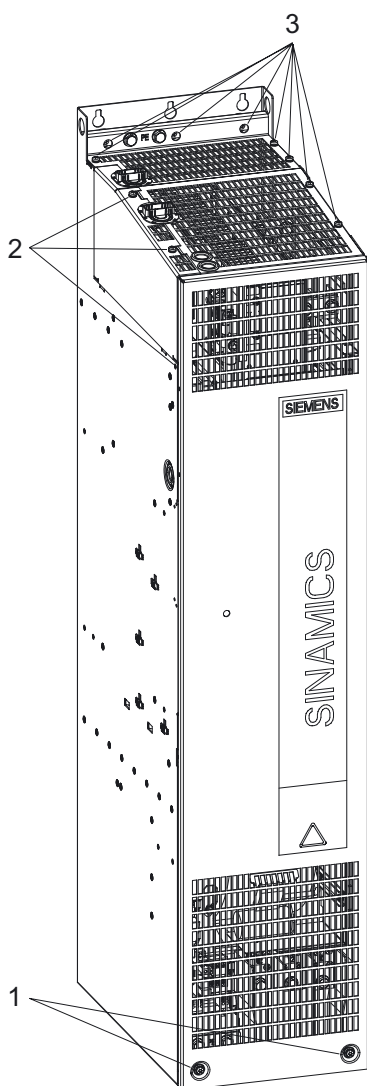


Figure 4-10 Installing a Braking Module in a Power Module, frame size GX – steps 1 - 3

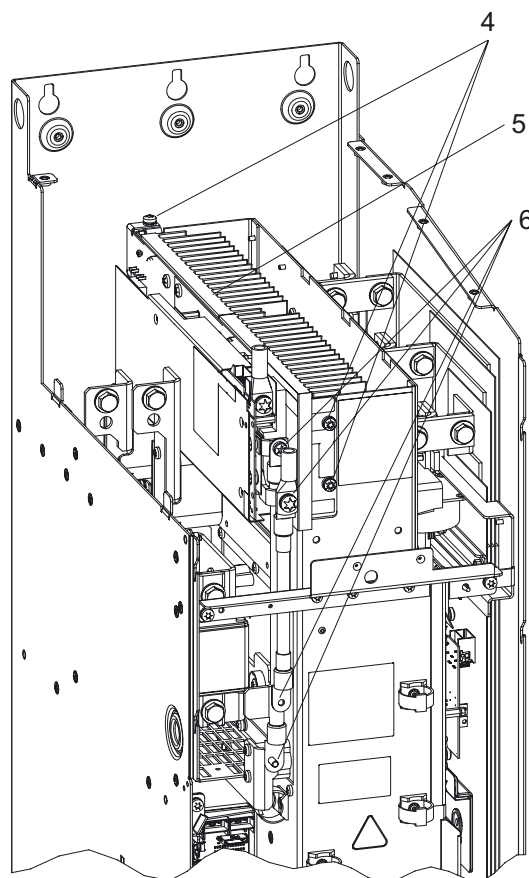


Figure 4-11 Installing a Braking Module in a Power Module, frame size GX – steps 4 - 6

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 mm ² (AWG 14) | 1.5 mm ² (AWG 14) |
| 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 mm ² (AWG 14) | 1.5 mm ² (AWG 14) |
| R1/R2 connection | M8 screw | M8 screw |
| Max. connection cross-section R1/R2 | 35 mm ² | 50 mm ² |
| 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 mm 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 mm).

 **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

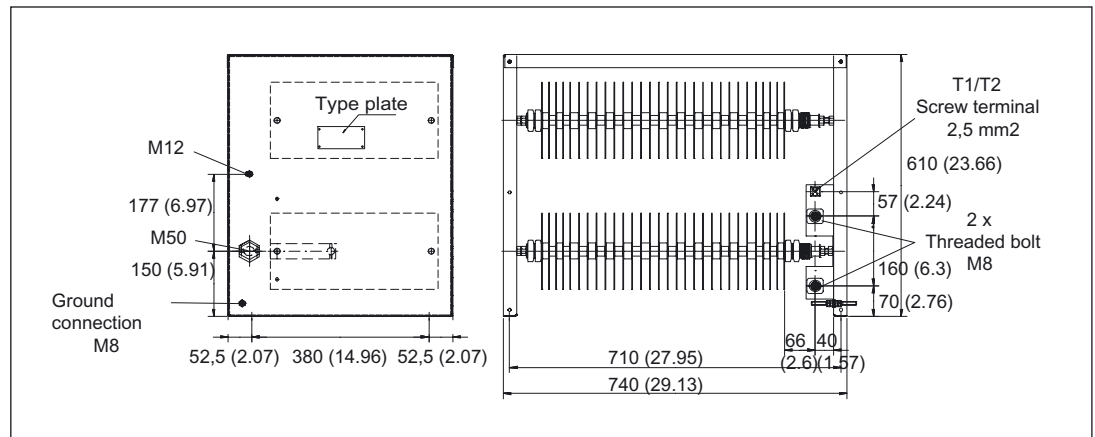


Figure 4-12 Dimension drawing, 25 kW/125 kW resistor

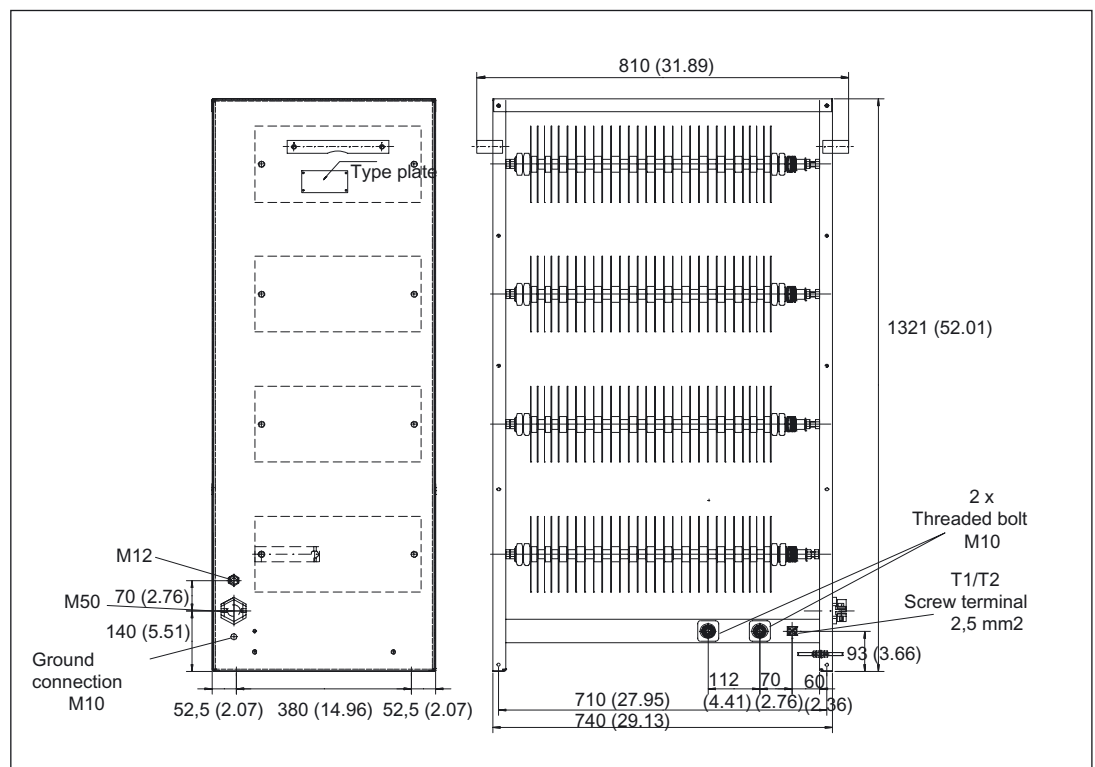



Figure 4-13 Dimension drawing, 50 kW/250 kW resistor

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 braking resistor cables must be laid in such a way that they are short-circuit and ground-fault proof. 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: 50 mm²
- For 50 kW: 70 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 |
|----------|--------------------------------|
| T1 | Thermostatic switch connection |
| 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 | mm ² | 50 | 70 |
| Degree of protection | | IP 20 | IP 20 |
| 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

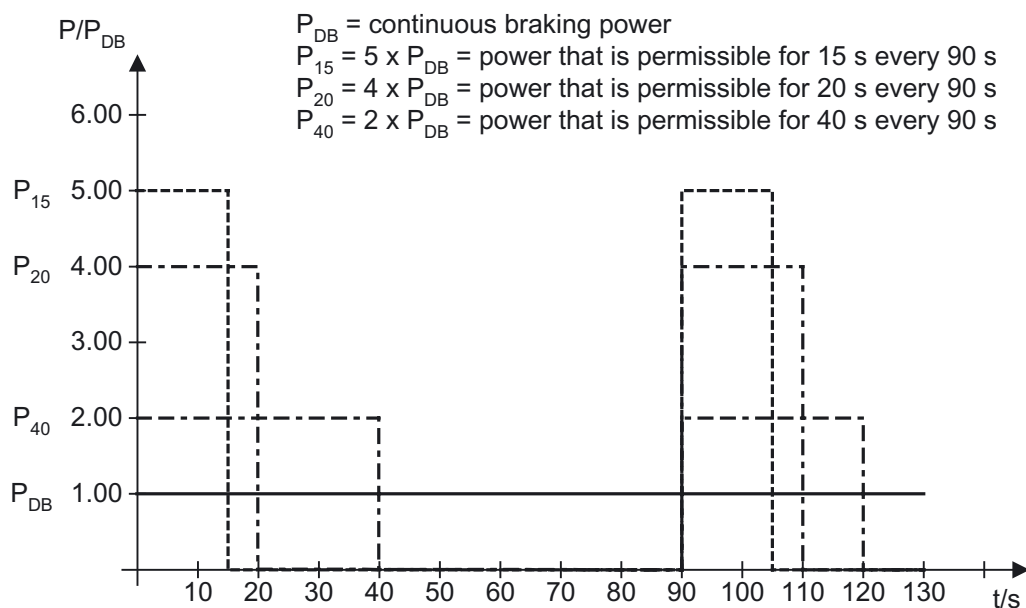


Figure 4-14 Duty cycle for braking resistors

Motor-side power components

5.1 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.

5.1.1.3 Dimension drawings

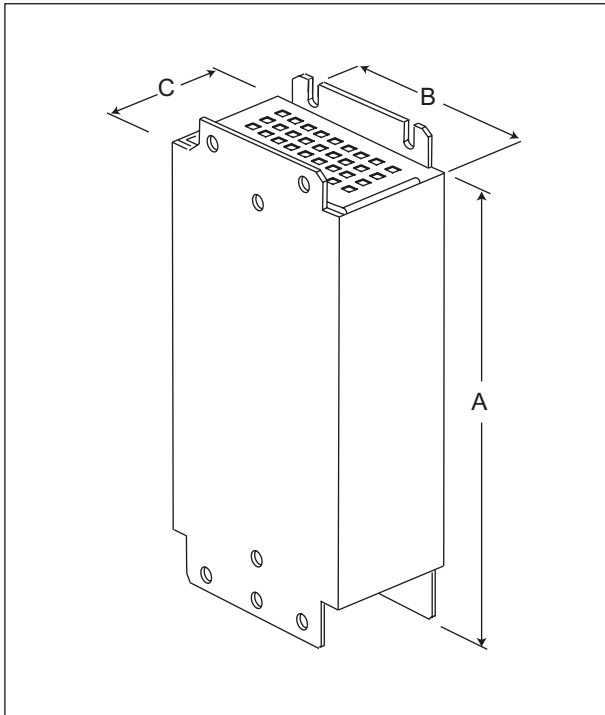


Figure 5-1 Dimension drawing: Motor reactor, frame size FSA

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) |

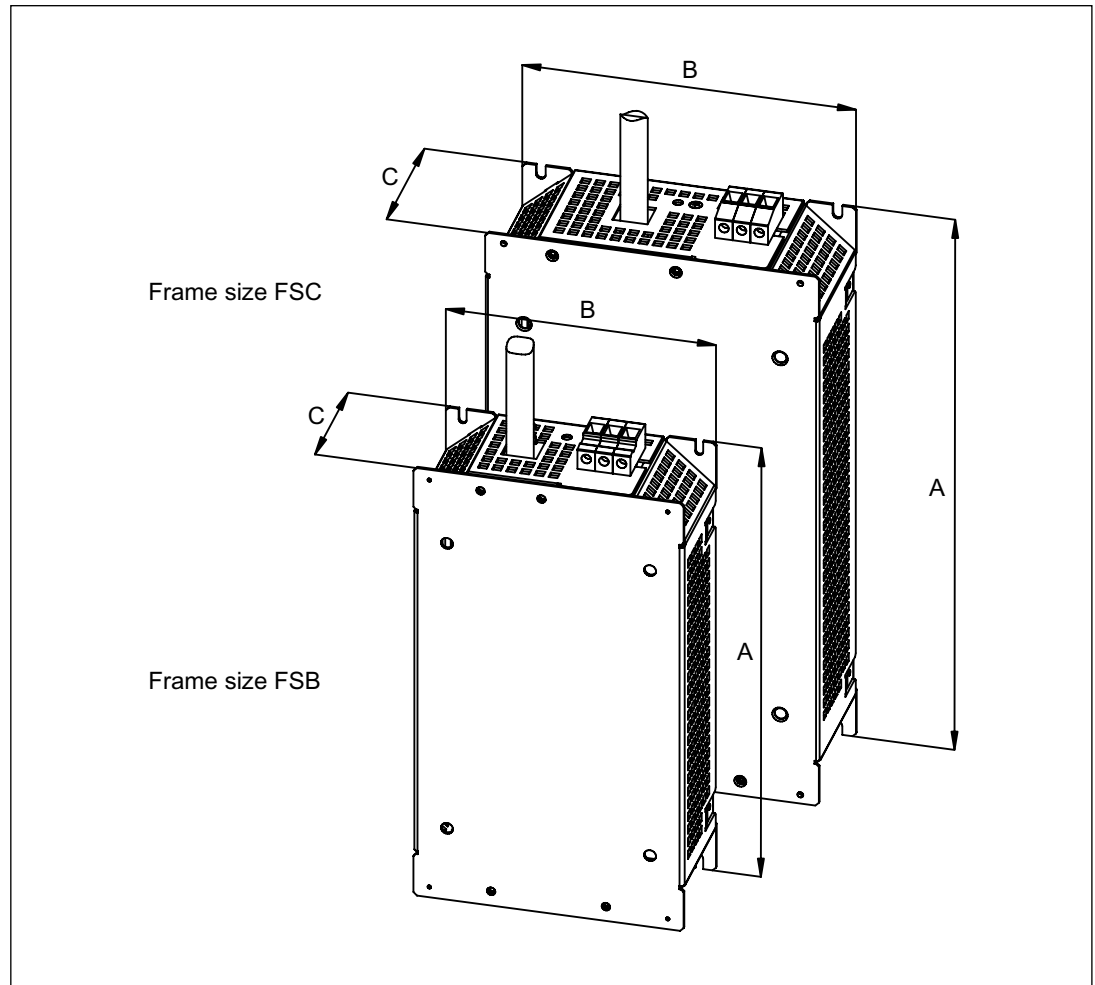


Figure 5-2 Dimension drawing: Motor reactor, frame sizes FSB and FSC

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

| Motor reactor | 0AE21-0CA0 | 0AJ23-2CA0 |
|--------------------------------|-------------|-------------|
| 6SL3202- | FSB | FSC |
| 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) |

5.1 Motor reactors

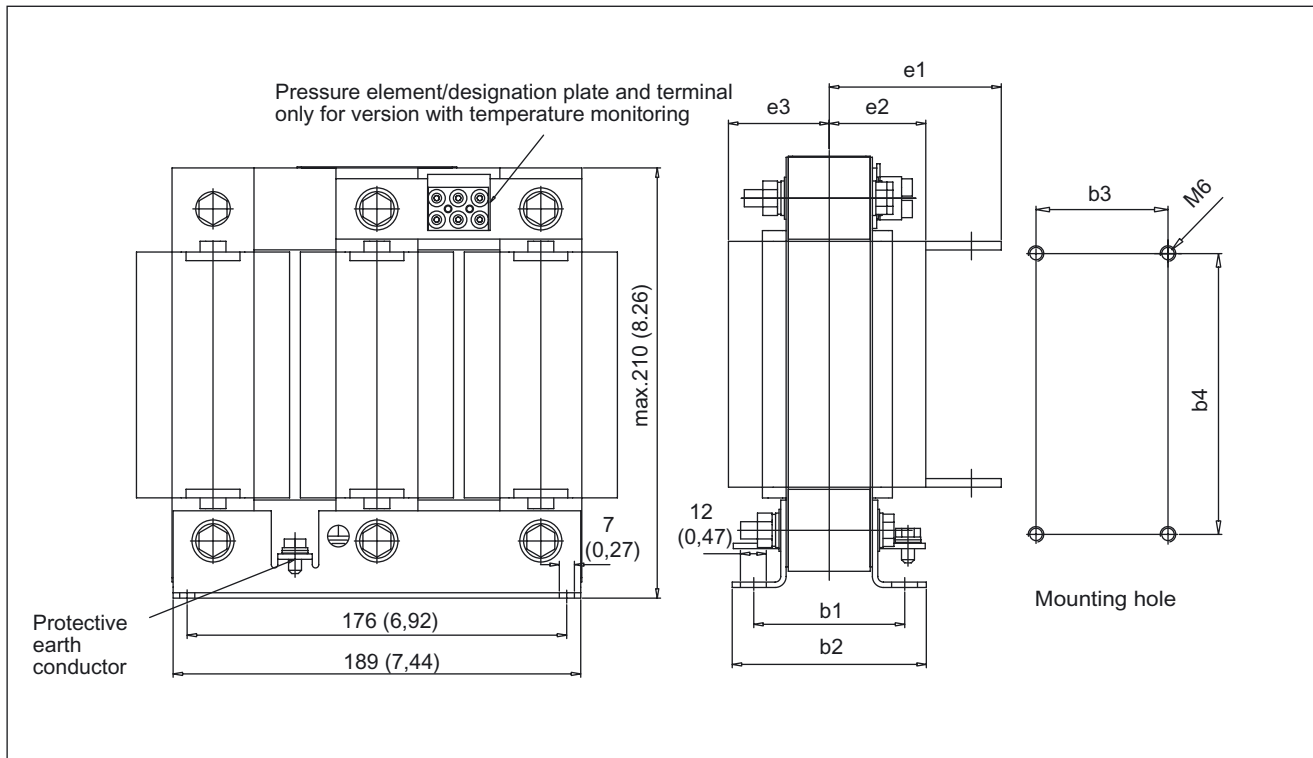


Figure 5-3 Dimension drawing: Motor reactor, frame size FSD

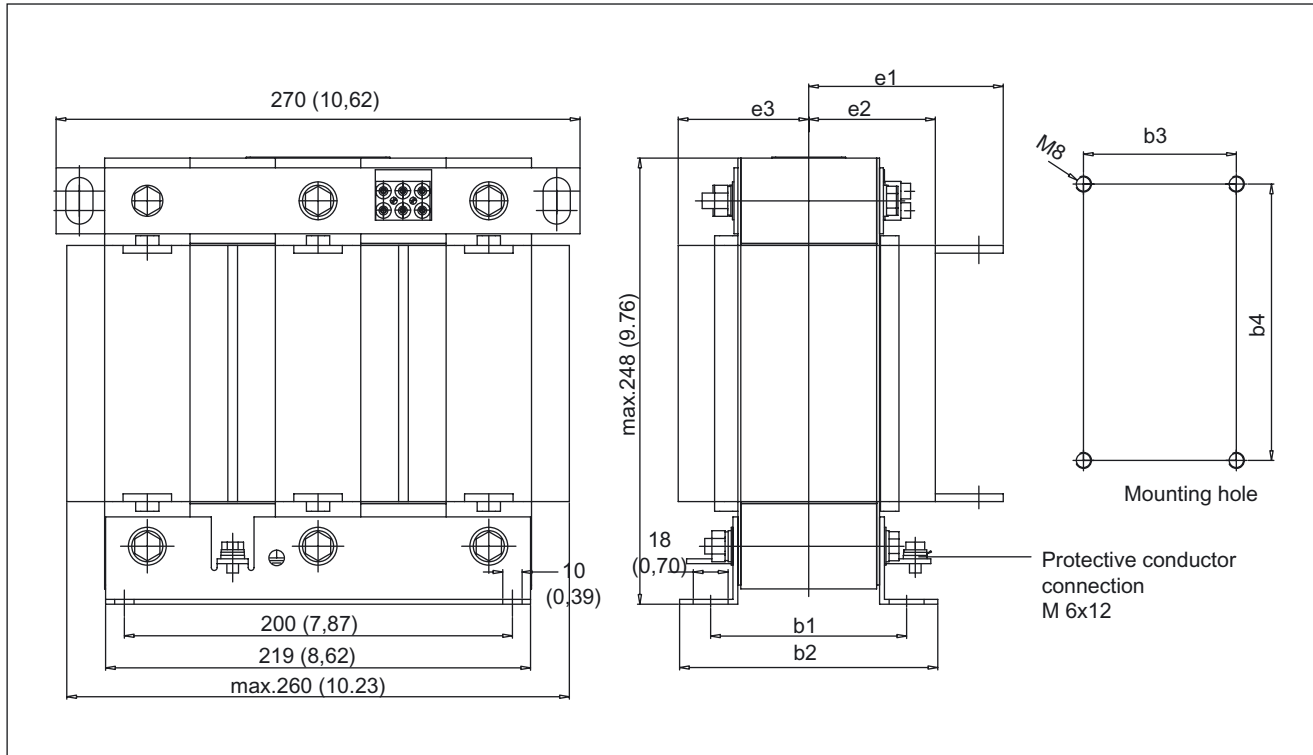


Figure 5-4 Dimension drawing: Motor reactor, frame size FSE

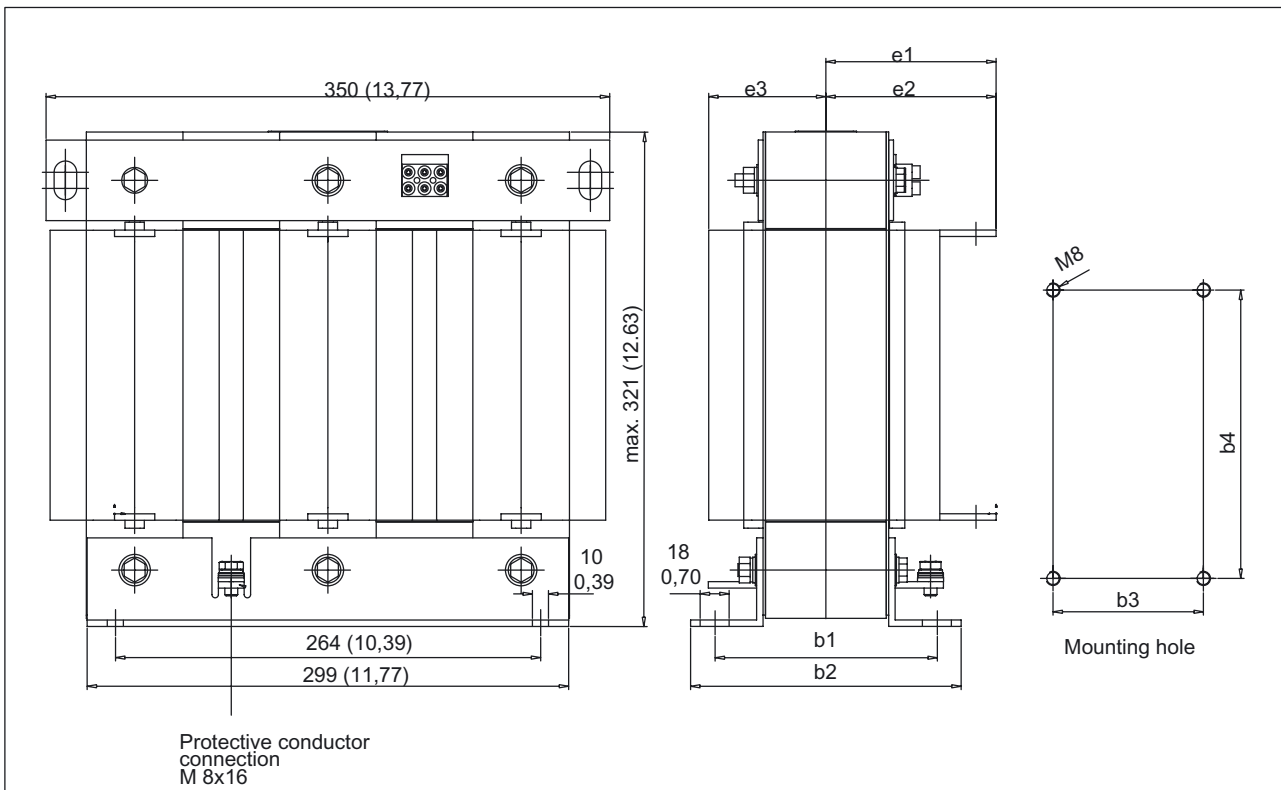


Figure 5-5 Dimension drawing: Motor reactor, frame size FSF

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

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

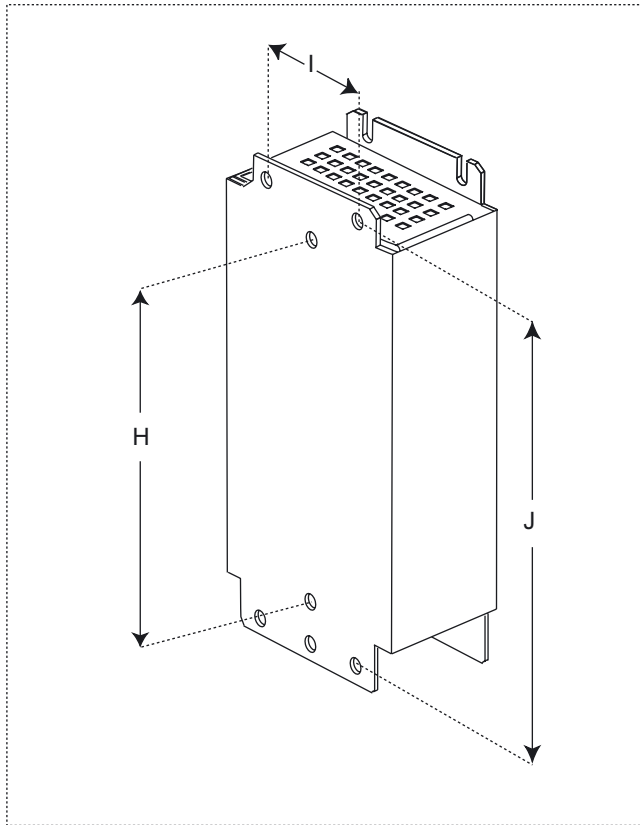


Figure 5-6 Mounting: Motor reactor, frame size FSA

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

| | |
|--|--|
| Motor reactor 6SE6400- | 3TC00-4AD2 |
| Suitable for Power Module 6SL3210- | 1SE11-3UA0 1SE11-7UA0 1SE12-2UA0 1SE13-1UA0 1SE14-1UA0 |
| Frame size | FSA |
| H | 160 (6,29) |
| I | 56 (2,20) |
| J | 187 (7,36) |

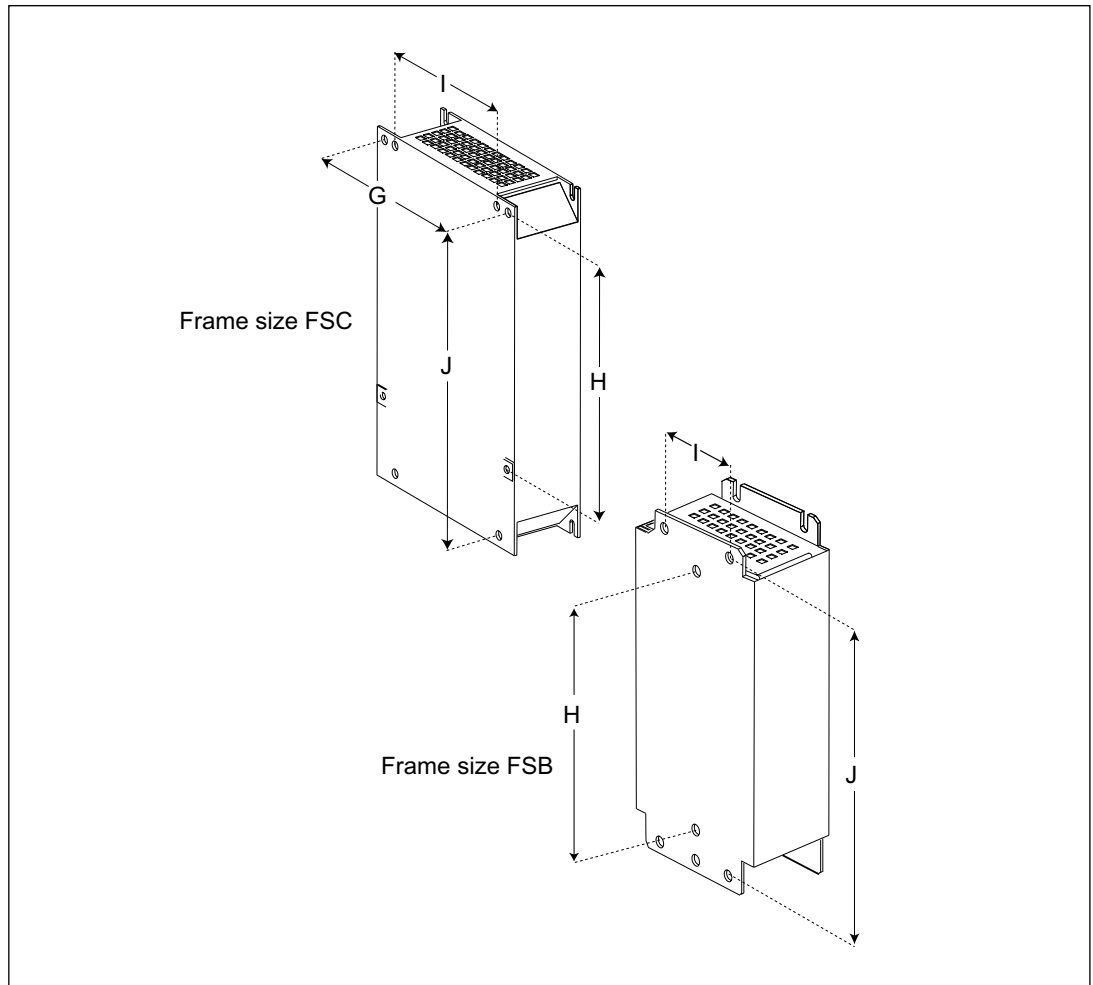


Figure 5-7 Mounting: Motor reactor, frame sizes FSB and FSC

Table 5-6 Mounting: Motor reactor, frame sizes FSB and FSC, all data in mm and (inches)

| Motor reactor | 6SL3202- | 0AE21-0CA0 | 0AJ23-2CA0 |
|---------------------------|----------|--|--|
| Suitable for Power Module | 6SL3210- | 1SE16-0UA0 1SE17-7UA0 1SE21-0UA0 | 1SE21-8UA0 1SE22-5UA0 1SE23-2UA0 |
| 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 |

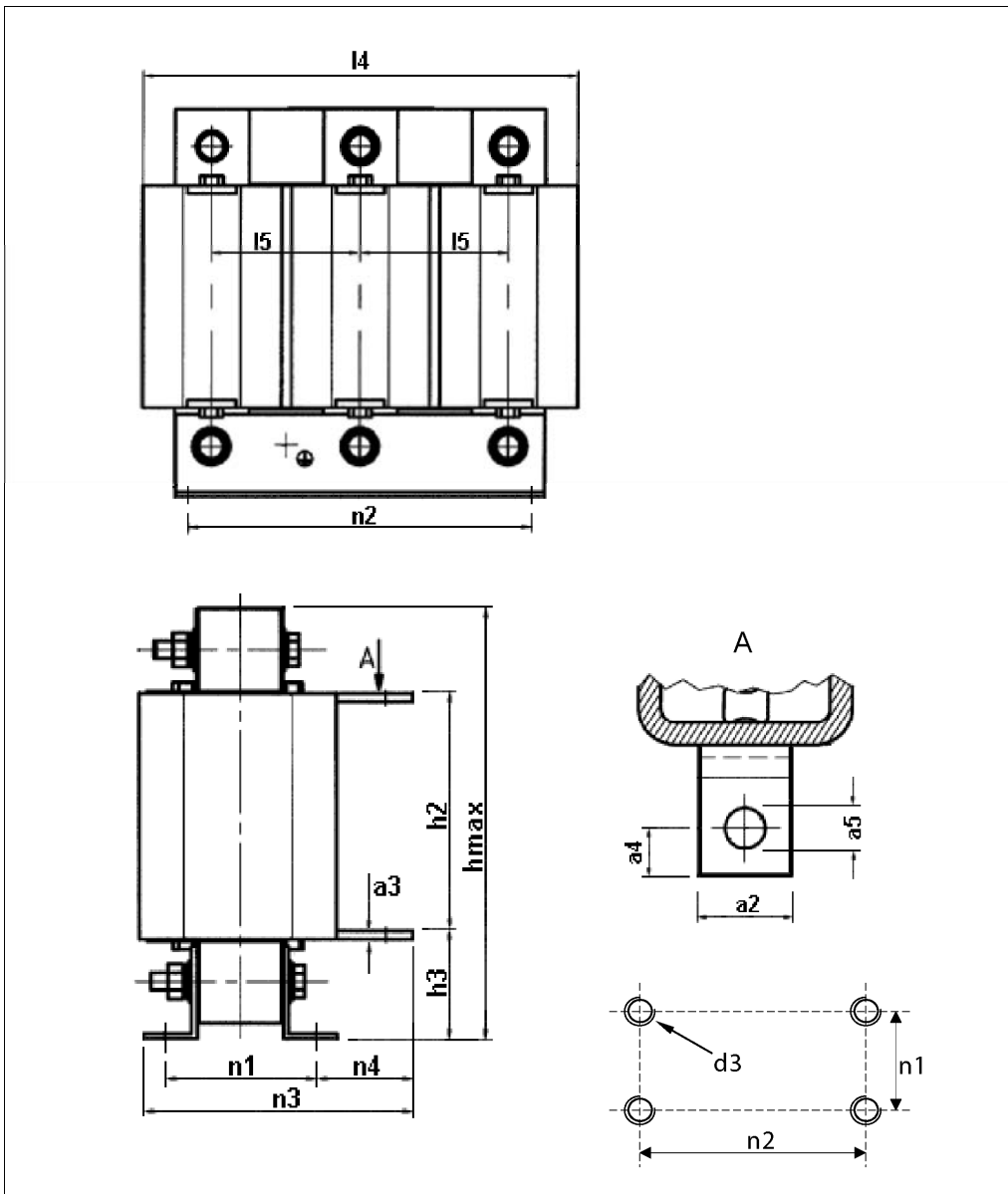


Figure 5-8 Mounting: Motor reactor, frame sizes FSD, FSE, FSF

Table 5-7 Mounting: Motor reactor, frame sizes FSD, FSE, all data in mm and (inches)

| Motor reactor | 6SE6400- | 3TC05-4DD0 | 3TC03-8DD0 | 3TC07-5ED0 | 3TC08-0ED0 |
|---------------------------|----------|--------------------------|------------|------------|------------|
| Suitable for Power Module | 6SL3210- | 1SE23-8UA0 1SE26-0UA0 | 1SE24-5UA0 | 1SE27-5UA0 | 1SE31-0UA0 |
| 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 |

5.1 Motor reactors

| Motor reactor | 6SE6400- | 3TC05-4DD0 | 3TC03-8DD0 | 3TC07-5ED0 | 3TC08-0ED0 |
|---------------------------|----------|--------------------------|---------------------|----------------------|---------------------|
| Suitable for Power Module | 6SL3210- | 1SE23-8UA0 1SE26-0UA0 | 1SE24-5UA0 | 1SE27-5UA0 | 1SE31-0UA0 |
| Frame size | | FSD | FSD | FSE | FSE |
| Motor reactor | I4 | 225 (8.85) | 225 (8.85) | 270 (10.62) | 225 (8.85) |
| | I5 | 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: Motor reactor, frame size FSF, all data in mm and (inches)

| Motor reactor | 6SE6400- | 3TC14-5FD0 | 3TC15-4FD0 |
|---------------------------|----------|----------------------|----------------------|
| Suitable for Power Module | 6SL3210- | 1SE31-1UA0 | 1SE31-5UA0 |
| 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) |
| | I4 | 357 (14.05) | 270 (10.62) |
| | I5 | 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

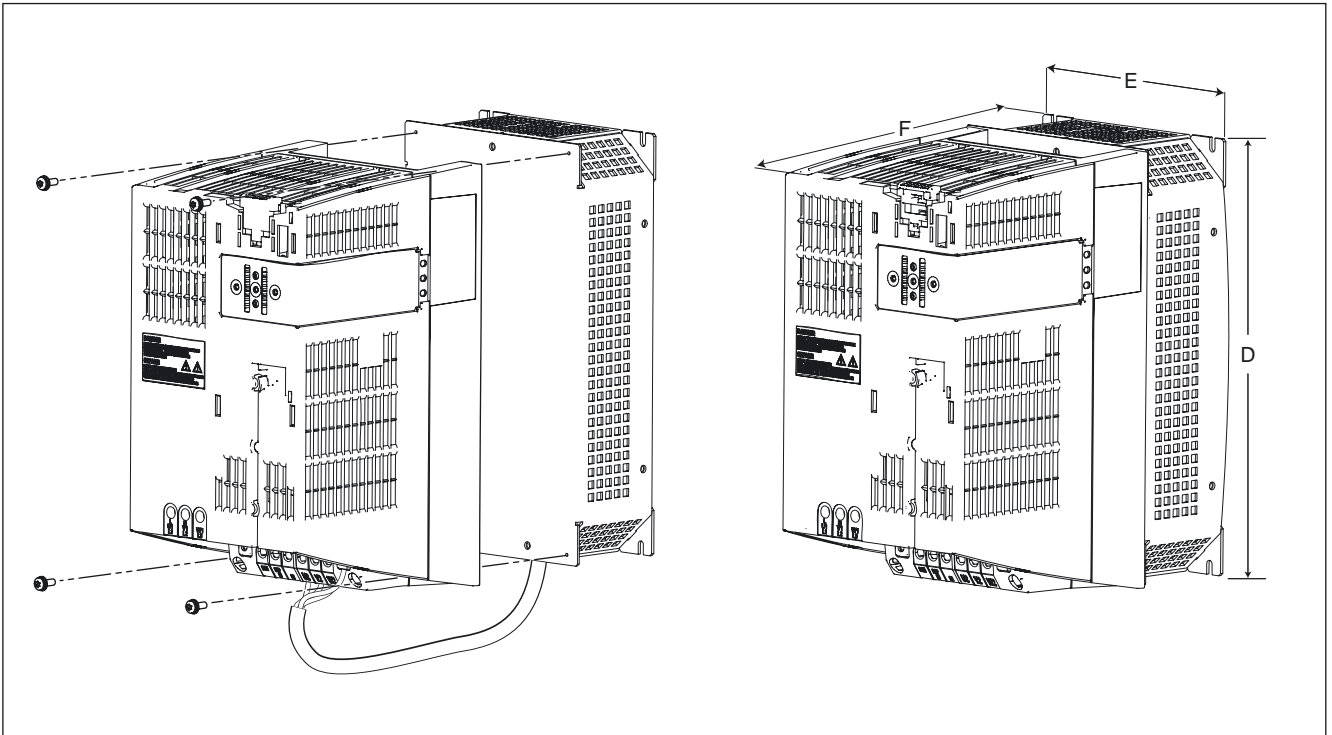


Figure 5-9 Mounting Power Modules and motor reactors, frame sizes FSB and FSC

Table 5-9 Total dimensions, Power Module 340 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 |
|---|----------|--------------------|--|--|--|
| Suitable for Power Module | 6SL3210- | 1SB11-0UA0 | 1SE11-3UA0 1SE11-7UA0 1SE12-2UA0 1SE13-1UA0 1SE14-1UA0 | 1SE16-0UA0 1SE17-7UA0 1SE21-0UA0 | 1SE21-8UA0 1SE22-5UA0 1SE23-2UA0 |
| 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

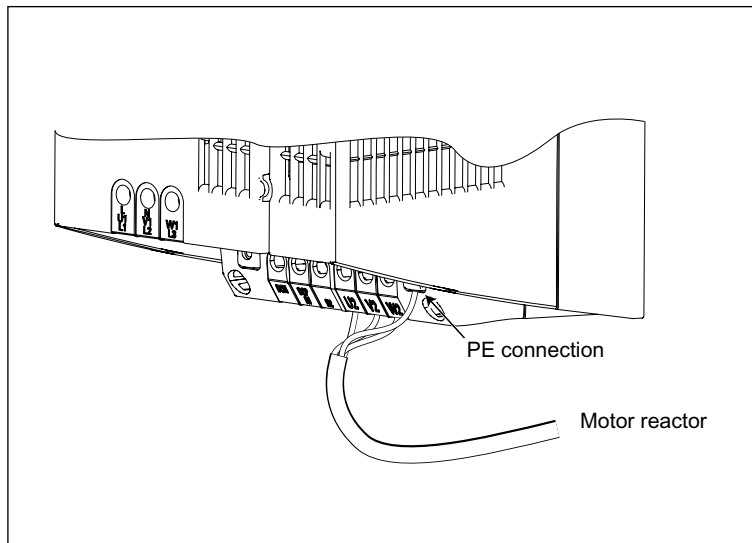


Figure 5-10 Electrical connection

5.1.1.6 Technical data

Table 5-10 Motor reactors for Power Modules 3-ph. 380 V to 480 V AC, Part 1

| | | Motor reactor (for a 4 kHz pulse frequency) | | | | | | |
|---|------|---|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--|--|
| | | 6SE6400-3TC00-4AD2 | | | | | 6SL3202-0AE21-0CA0 | |
| Rated current | A | 4,5 | | | | | 10 | |
| Power loss | kW | 0,005 | | | | | 0,02 | |
| Connection to the Power Module | | Cable 4 x 1.5 mm ² Length approx. 0.3 m | | | | | Cable 4 x AWG14 (1.5 mm ²) Length approx. 0.4 m | |
| Motor connection | | Screw terminals for cable cross-section 6 mm ² | | | | | Screw terminals for cable cross-section 6 mm ² | |
| PE connection | | M5 stud | | | | | M5 stud | |
| Max. permissible cable length between motor reactor and motor | m | 100 (shielded) 150 (non-shielded) | 100 (shielded) 150 (non-shielded) | 100 (shielded) 150 (non-shielded) | 100 (shielded) 225 (non-shielded) | 100 (shielded) 225 (non-shielded) | 100 (shielded) 150 (non-shielded) | |
| Degree of protection | | IP20 or IPXXB | IP20 or IPXXB | IP20 or IPXXB | IP20 or IPXXB | IP20 or IPXXB | IP20 or IPXXB | |
| Weight, approx. | kg | 2 | | | | | 4,5 | |
| Suitable for Power Module, blocksize format | Type | 6SL3210-1SE11-3UA0 | 6SL3210-1SE11-7UA0 | 6SL3210-1SE12-2UA0 | 6SL3210-1SE13-1UA0 | 6SL3210-1SE14-1UA0 | 6SL3210-1SE16-0UA0 6SL3210-1SE16-0AA0 | |
| Rated current I _n (power) of the Power Module | A | 1,3 | 1,7 | 2,2 | 3,1 | 4,1 | 5,9 | |
| Frame size | | FSA | FSA | FSA | FSA | FSA | FSB | |

5.1 Motor reactors

Table 5-11 Motor reactors for Power Modules 3-ph. 380 V to 480 V AC, Part 2

| | | Motor reactor (for a 4 kHz pulse frequency) | | | | | |
|---|------|--|--|--|--|--|--|
| | | 6SL3202-0AE21-0CA0 | | 6SL3202-0AJ23-2CA0 | | | 6SE6400-3TC05-4DD0 |
| Rated current | A | 10 | | 25 | | | 68 |
| Power loss | kW | 0,02 | | 0,06 | | | 0,2 |
| Connection to the Power Module | | Cable 4 x AWG14 (1.5 mm ²) Length approx. 0.4 m | | Cable 4 x AWG14 (1.5 mm ²) Length approx. 0.35 m | | | Flat connector for M6 cable lug |
| Motor connection | | Screw terminals for cable cross-section 6 mm ² | | Screw terminals for cable cross-sections 2.5 to 10 mm ² | | | Flat connector for M6 cable lug |
| PE connection | | M5 stud | | M5 stud | | | M6 screw |
| Max. permissible cable length between motor reactor and motor | m | 100 (shielded) 150 (non-shielded) | 100 (shielded) 150 (non-shielded) | 100 (shielded) 150 (non-shielded) | 100 (shielded) 150 (non-shielded) | 100 (shielded) 150 (non-shielded) | 200 (shielded) 300 (non-shielded) |
| Degree of protection | | IP20 or IPXXB | | IP20 or IPXXB | | | IP00 |
| Weight, approx. | kg | 4,5 | | 9 | | | 11,5 |
| Suitable for Power Module, blocksize format | Type | 6SL3210-1SE17-7UA0 6SL3210-1SE17-7AA0 | 6SL3210-1SE21-0UA0 6SL3210-1SE21-0AA0 | 6SL3210-1SE21-8UA0 6SL3210-1SE21-8AA0 | 6SL3210-1SE22-5UA0 6SL3210-1SE22-5AA0 | 6SL3210-1SE23-2UA0 6SL3210-1SE23-2AA0 | 6SL3210-1SE23-8UA0 6SL3210-1SE23-8AA0 |
| Rated current I _n (power) of the Power Module | A | 7,7 | 10 | 18 | 25 | 32 | 38 |
| Frame size | | FSB | FSB | FSC | FSC | FSC | FSD |

Table 5-12 Motor reactors for Power Modules 3-ph. 380 V to 480 V AC, Part 3

| | | Motor reactor (for a 4 kHz pulse frequency) | | | | | |
|---|------|---|--|--|--|--|--|
| | | 6SE6400-3TC03-8DD0 | 6SE6400-3TC05-4DD0 | 6SE6400-3TC08-0ED0 | 6SE6400-3TC07-5ED0 | 6SE6400-3TC14-5FD0 | 6SE6400-3TC15-4FD0 |
| Rated current | A | 45 | 68 | 104 | 90 | 178 | 178 |
| Power loss | kW | 0,2 | 0,2 | 0,17 | 0,28 | 0,47 | 0,25 |
| Connection to the Power Module | | Flat connector for M6 cable lug | Flat connector for M6 cable lug | Flat connector for M6 cable lug | Flat connector for M6 cable lug | Flat connector for M8 cable lug | Flat connector for M8 cable lug |
| Motor connection | | Flat connector for M6 cable lug | Flat connector for M6 cable lug | Flat connector for M6 cable lug | Flat connector for M6 cable lug | Flat connector for M8 cable lug | Flat connector for M8 cable lug |
| PE connection | | M6 screw | M6 screw | M6 screw | M6 screw | M8 screw | M6 screw |
| Max. permissible cable length between the motor reactor and motor for line supply voltages 380 V to 400 V for line supply voltages 401 V to 480 V | m | 200 (shielded) 300 (non-shielded) | 200 (shielded) 300 (non-shielded) | 200 (shielded) 300 (non-shielded) | 200 (shielded) 300 (non-shielded) | 200 (shielded) 300 (non-shielded) | 200 (shielded) 300 (non-shielded) |
| Degree of protection | | IP00 | IP00 | IP00 | IP00 | IP00 | IP00 |
| Weight, approx. | kg | 19 | 11,5 | 12 | 27 | 57 | 24 |
| Suitable for Power Module, blocksize format | Type | 6SL3210-1SE24-5UA0 6SL3210-1SE24-5AA0 | 6SL3210-1SE26-0UA0 6SL3210-1SE26-0AA0 | 6SL3210-1SE27-5UA0 6SL3210-1SE27-5AA0 | 6SL3210-1SE31-0UA0 6SL3210-1SE31-0AA0 | 6SL3210-1SE31-1UA0 6SL3210-1SE31-1AA0 | 6SL3210-1SE31-5UA0 6SL3210-1SE31-5AA0 |
| Rated current In (power) of the Power Module | A | 45 | 60 | 75 | 90 | 110 | 145 |
| Frame size | | FSD | FSD | FSE | FSE | FSF | FSF |

Table 5-13 Motor reactors for Power Modules 3-ph. 380 V to 480 V AC, Part 4

| | | Motor reactor (for a 4 kHz pulse frequency) |
|---|------|---|
| | | 6SE6400-3TC14-5FD0 |
| Rated current | A | 178 |
| Power loss | kW | 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 the motor reactor and motor for line supply voltages 380 V to 400 V for line supply voltages 401 V to 480 V | m | 200 (shielded) 300 (non-shielded) |
| Degree of protection | | IP00 |
| Weight, approx. | kg | 57 |
| Suitable for Power Module, blocksize format | Type | 6SL3210-1SE31-8UA0 6SL3210-1SE31-8AA0 |
| Rated current In (power) of the Power Module | A | 178 |
| Frame size | | FSF |

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. |
|--|

5.1.2.3 Dimension drawing

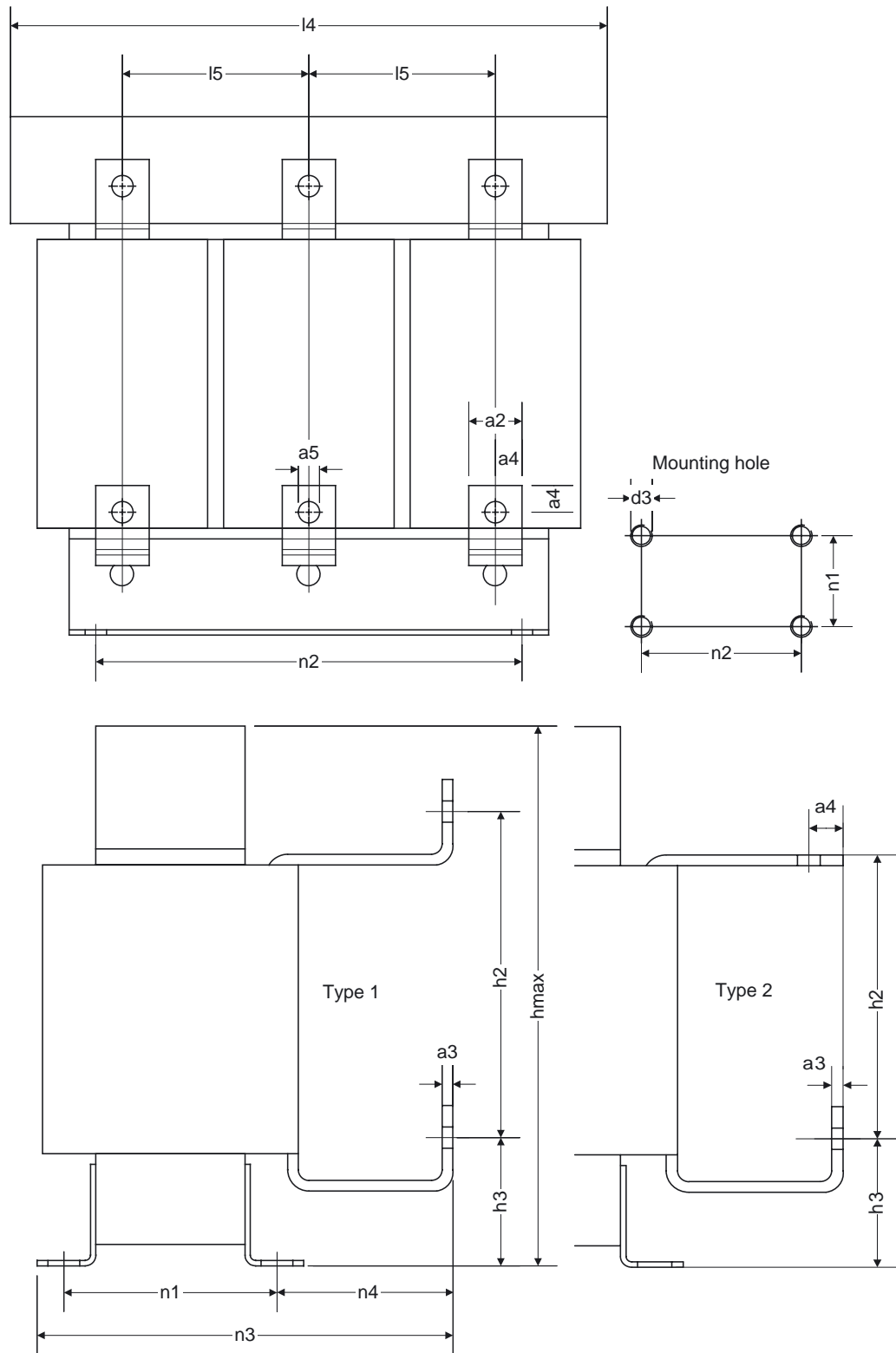


Figure 5-11 Dimension drawing, motor reactor

5.1 Motor reactors

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 no. | 6SL3000- | 2BE32-1AA0 | 2BE32-6AA0 | 2BE33-2AA0 | 2BE33-8AA0 | 2BE35-0AA0 |
|---|----------|------------------|------------------|------------------|------------------|------------------|
| Suitable for Power Module | 6SL3310- | 1TE32-1AA0 | 1TE32-6AA0 | 1TE33-1AA0 | 1TE33-8AA0 | 1TE35-0AA0 |
| 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 | mm | 300 | 300 | 300 | 300 | 300 |
| Height | mm | 285 | 315 | 285 | 285 | 365 |
| Depth | mm | 257 | 277 | 257 | 277 | 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 |
|----------------|

| |
|---|
| Using sinusoidal filters that have not been approved by SIEMENS for SINAMICS can: |
|---|

- | |
|---|
| <ul style="list-style-type: none"> • damage/destroy the Power Modules • cause line harmonics that may interfere with or damage other loads connected to the same line supply. |
|---|

| |
|--|
|  CAUTION |
|--|

| |
|---|
| The sinusoidal filters can have surface temperatures of over 80 °C. |
|---|

5.2.1.3 Dimension drawing

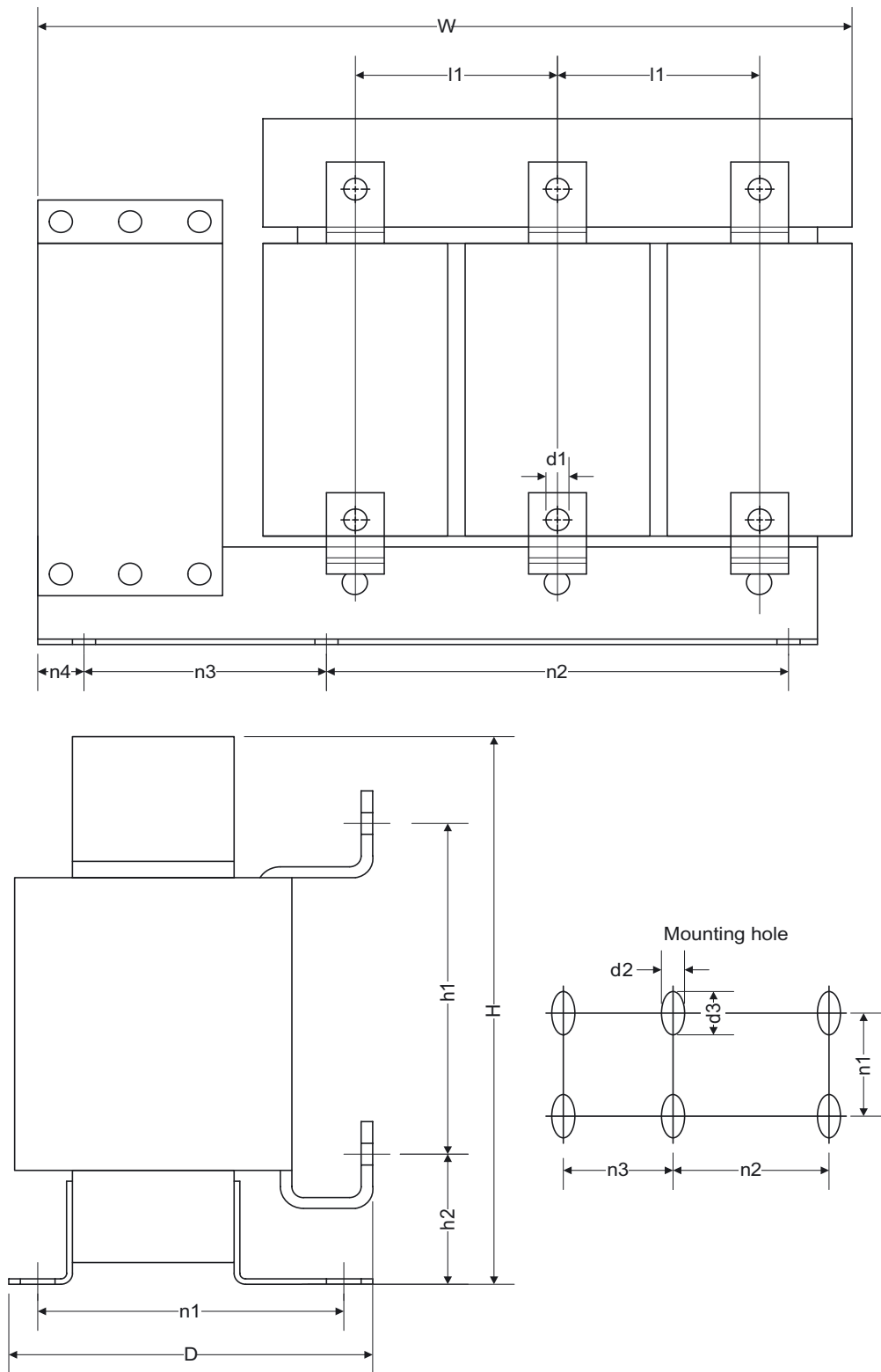


Figure 5-12 Dimension drawing, sinusoidal filter

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, sinusoidal filter

| Order no. | 6SL3000- | 2CE32-3AA0 | 2CE32-3AA0 | 2CE32-8AA0 | 2CE33-3AA0 | 2CE34-1AA0 |
|---|----------|--|-------------|-------------|---------------|-------------|
| Suitable for Power Module | 6SL3310- | 1TE32-1AA0 | 1TE32-6AA0 | 1TE33-1AA0 | 1TE33-8AA0 | 1TE35-0AA0 |
| Power rating of the Power Module at a 4 kHz pulse frequency | kW | 90 | 110 | 132 | 160 | 200 |
| Output current at a 4 kHz pulse frequency | 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 | | M10 connecting lugs M10 connecting lugs | | | | |
| Degree of protection | | IP00 | IP00 | IP00 | IP00 | IP00 |
| Dimensions | | | | | | |
| Width | mm | 620 | 620 | 620 | 620 | 620 |
| Height | mm | 300 | 300 | 300 | 370 | 370 |
| Depth | mm | 320 | 320 | 320 | 360 | 360 |
| Weight, approx. | kg | 124 | 124 | 127 | 136 | 198 |

5.3 dv/dt filter

5.3.1 Chassis

5.3.1.1 Description

The dv/dt filter with 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 voltage strength 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%.

The dv/dt filter with Voltage Peak Limiter limits the voltage gradient to values < 500 V/μs and the typical transients 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 Nos. of the individual components (dv/dt reactor and voltage limiting network) are listed in the following table:

Table 5-18 dv/dt filter with Voltage Peak Limiter, Order Nos. of the individual components

| dv/dt filter plus Voltage Peak Limiter | dv/dt reactor | Voltage limiting network |
|--|--------------------|--------------------------|
| 6SL3000-2DE32-6AA0 | 6SL3000-2DE32-6CA0 | 6SL3000-2DE32-6BA0 |
| 6SL3000-2DE35-0AA0 | 6SL3000-2DE35-0CA0 | 6SL3000-2DE35-0BA0 |

5.3.1.2 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:

- dv/dt reactor
 - Incoming cable from the Power Modules to 1U1, 1V1, 1W1, and
 - Outgoing cable to the load 1U2, 1V2, 1W2.
- Voltage Peak Limiter (VPL)
 - Cable from the DC link of the Power Module at DCPS, DCNS and
 - Cable to the dv/dt reactor 1U2, 1V2, 1W2.

If this is not observed, then there is a danger of damage to the dv/dt reactor and the voltage limiting network.

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

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

5.3.1.3 Interface description

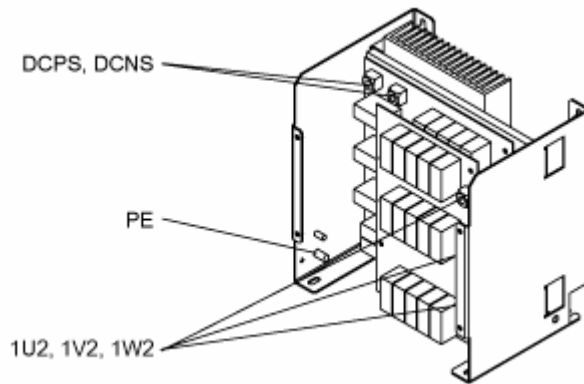


Figure 5-13 Interface overview, voltage limiting network, type 1

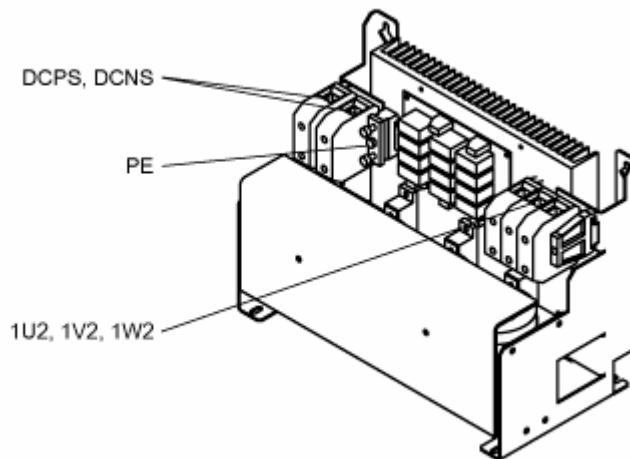


Figure 5-14 Interface overview, voltage limiting network, type 2

5.3.1.4 Connecting the dv/dt filter with Voltage Peak Limiter

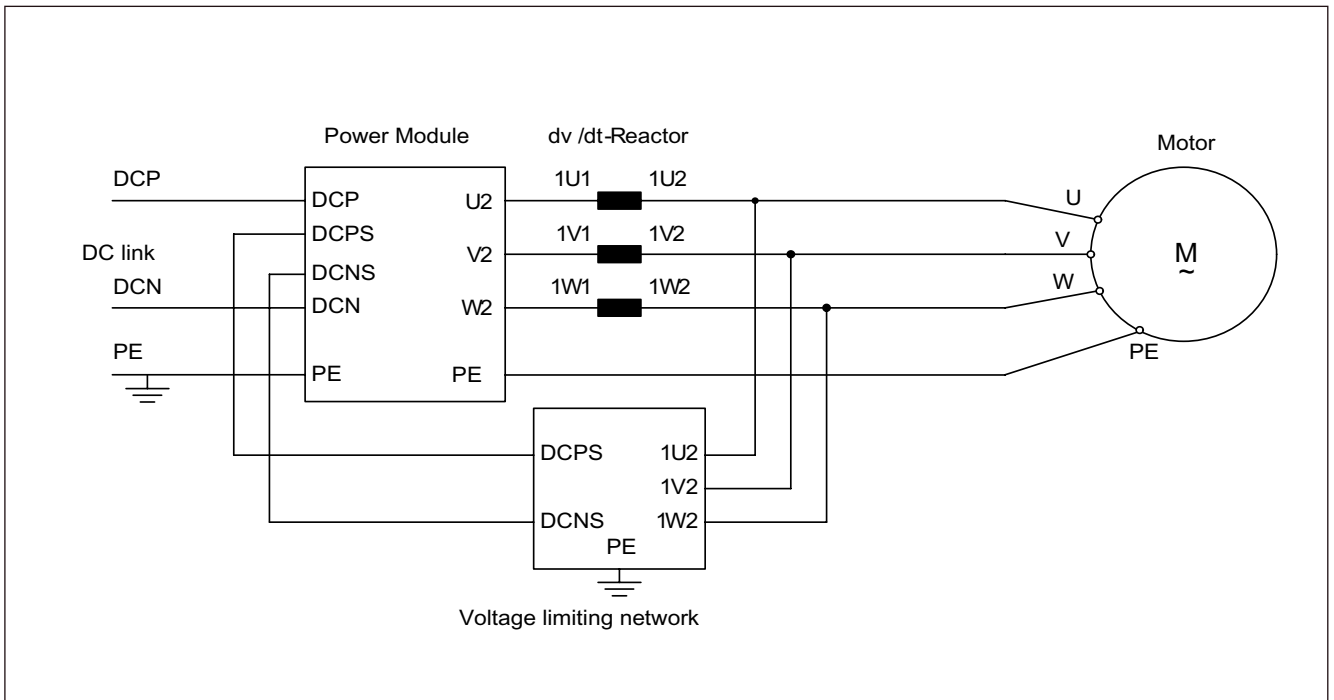


Figure 5-15 Connecting the dv/dt filter with Voltage Peak Limiter

Cable cross-sections

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

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

Note

The connections should be kept as short as possible.

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

5.3.1.5 Dimension drawing, dv/dt reactor

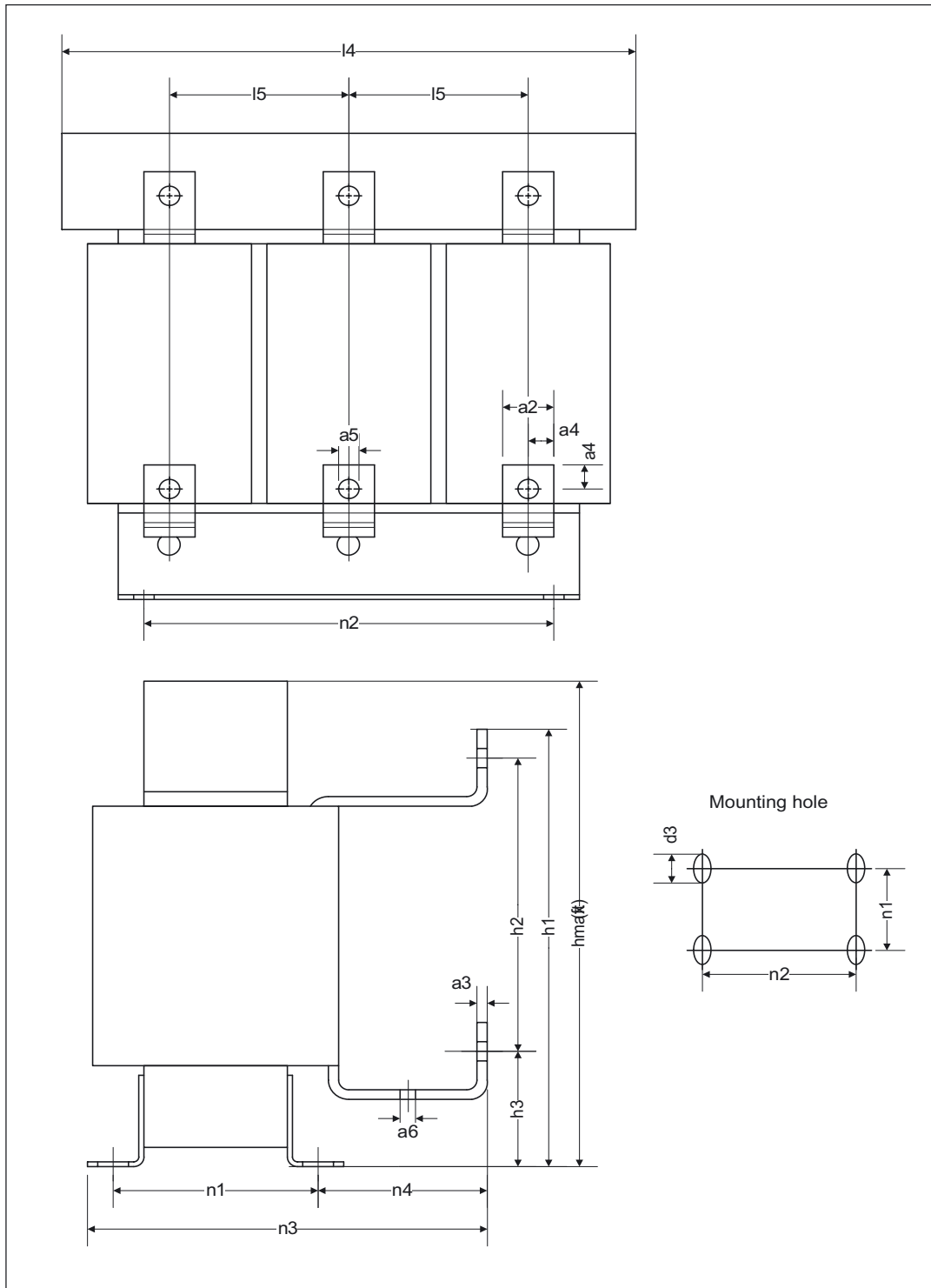


Figure 5-16 Dimension drawing, dv/dt reactor

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 Voltage Peak Limiter

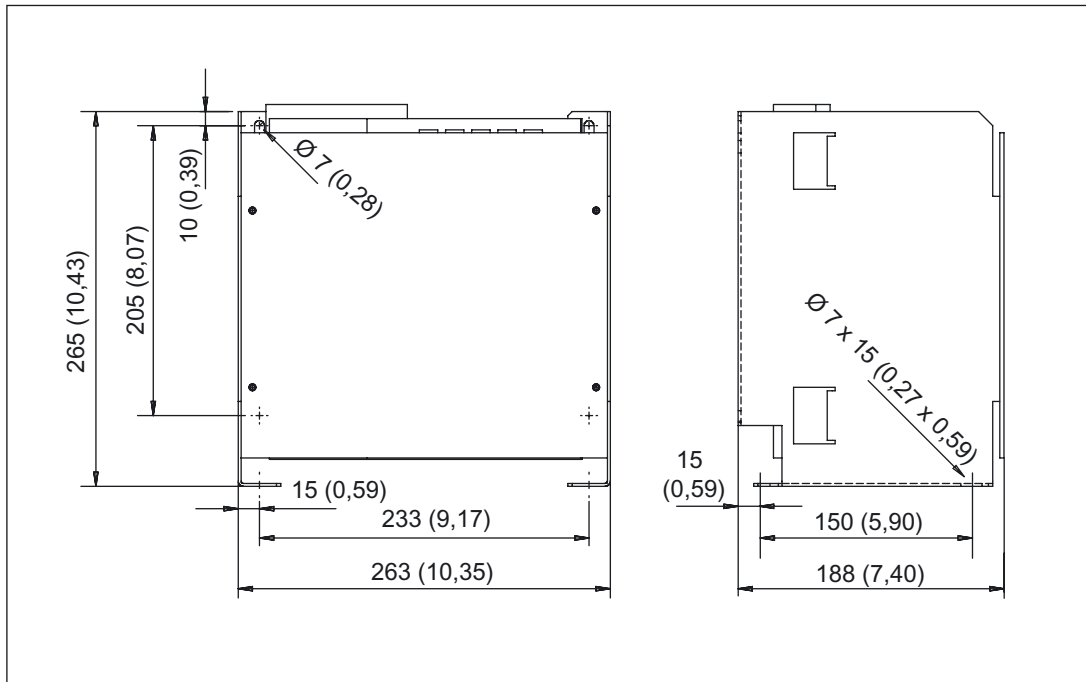


Figure 5-17 Dimension drawing of Voltage Peak Limiter, type 1

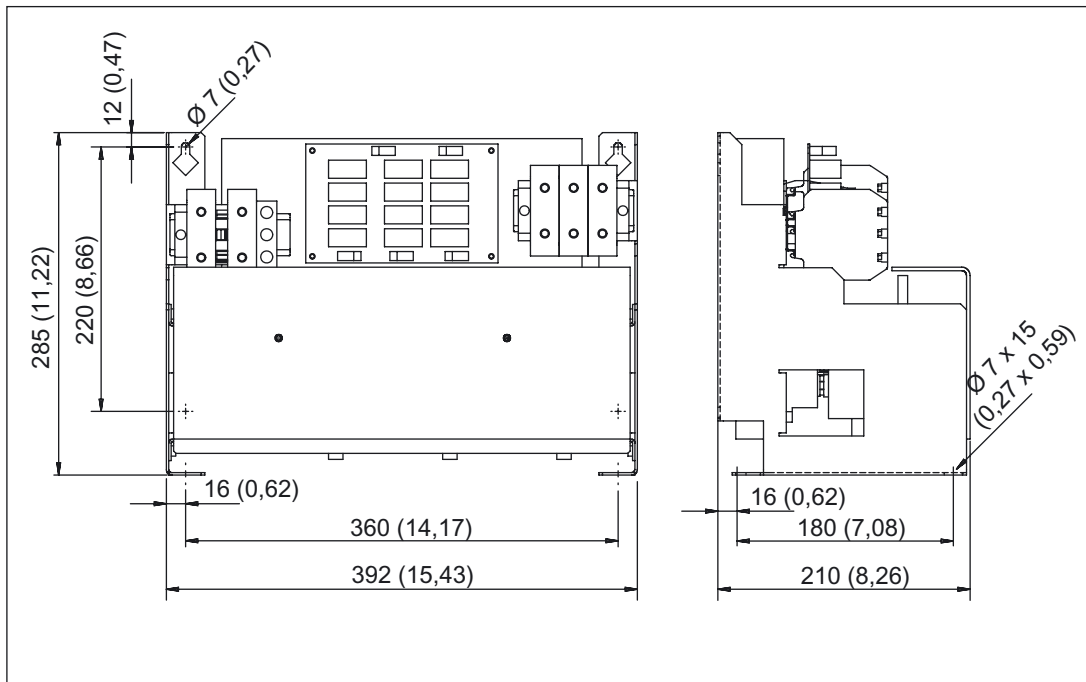


Figure 5-18 Dimension drawing of Voltage Peak Limiter, type 2

Table 5-21 Assigning voltage limiting networks to dimension drawings

| Voltage limiting network | Dimension drawing, type |
|--------------------------|-------------------------|
| 6SL3000-2DE32-6BA0 | Type 1 |
| 6SL3000-2DE35-0BA0 | Type 2 |

5.3.1.7 Technical data

Table 5-22 Technical specifications for the dv/dt filter with Voltage Peak Limiter, 3-ph. 380 V – 480 V AC, Part 1

| Order no.: | 6SL3000- | 2DE32-6AA0 | 2DE32-6AA0 | 2DE35-0AA0 |
|---|----------|--------------------------------------|------------------|---|
| Suitable for Power Module | 6SL3310- | 1TE32-1AA0 | 1TE32-6AA0 | 1TE33-1AA0 |
| Rated power of the Power Module | kW | 110 | 132 | 160 |
| dv/dt reactor | | | | |
| I_{thmax} | A | 260 | 260 | 490 |
| Power loss, typical | kW | 0,573 | 0,573 | 0,696 |
| Connections - to the Motor Module - load - PE | | M10 M10 M6 | M10 M10 M6 | M12 M12 M6 |
| Max. permissible cable length between dv/dt reactor and motor | m | 300 (shielded) 450 (non-shielded) | | |
| Degree of protection | | IP00 | IP00 | IP00 |
| Dimensions | | | | |
| Width | mm | 410 | 410 | 460 |
| Height | mm | 370 | 370 | 370 |
| Depth | mm | 229 | 229 | 275 |
| Weight, approx. | kg | 66 | 66 | 122 |
| Voltage Peak Limiter (VPL) | | | | |
| Power loss, typical | kW | 0,029 | 0,029 | 0,042 |
| Connections - to the dv/dt reactor - DC - PE | | M8 M8 M8 | M8 M8 M8 | Terminal 70 mm ² Terminal 70 mm ² Terminal 35 mm ² |
| Degree of protection | | IP00 | IP00 | IP00 |
| Dimensions | | | | |
| Width | mm | 265 | 265 | 392 |
| Height | mm | 263 | 263 | 285 |
| Depth | mm | 190 | 190 | 210 |
| Weight, approx. | kg | 6 | 6 | 16 |

5.3 dv/dt filter

Table 5-23 Technical specifications for the dv/dt filter with Voltage Peak Limiter, 3-ph. 380 V – 480 V AC, Part 2

| Order no.: | 6SL3000- | 2DE35-0AA0 | 2DE35-0AA0 | |
|---|----------|---|---|--|
| Suitable for Power Module | 6SL3310- | 1TE33-8AA0 | 1TE35-0AA0 | |
| Rated power of the Power Module | kW | 200 | 250 | |
| dv/dt reactor | | | | |
| I_{thmax} | A | 490 | 490 | |
| Power loss, typical | kW | 0,696 | 0,696 | |
| Connections - to the Motor Module - load - PE | | M12 M12 M6 | M12 M12 M6 | |
| Max. permissible cable length between dv/dt reactor and motor | m | 300 (shielded) 450 (non-shielded) | | |
| Degree of protection | | IP00 | IP00 | |
| Dimensions | | | | |
| Width | mm | 460 | 460 | |
| Height | mm | 370 | 370 | |
| Depth | mm | 275 | 275 | |
| Weight, approx. | kg | 122 | 122 | |
| Voltage Peak Limiter (VPL) | | | | |
| Power loss, typical | kW | 0,042 | 0,042 | |
| Connections - to the dv/dt reactor - DC - PE | | Terminal 70 mm ² Terminal 70 mm ² Terminal 35 mm ² | Terminal 70 mm ² Terminal 70 mm ² Terminal 35 mm ² | |
| Degree of protection | | IP00 | IP00 | |
| Dimensions | | | | |
| Width | mm | 392 | 392 | |
| Height | mm | 285 | 285 | |
| Depth | mm | 210 | 210 | |
| Weight, approx. | kg | 16 | 16 | |

Control Units

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 **CU310 DP Control Unit** provides the PROFIBUS external communications interface and a TTL/HTL/SSI encoder evaluation circuit.
2. The **CU310 PN Control Unit** 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

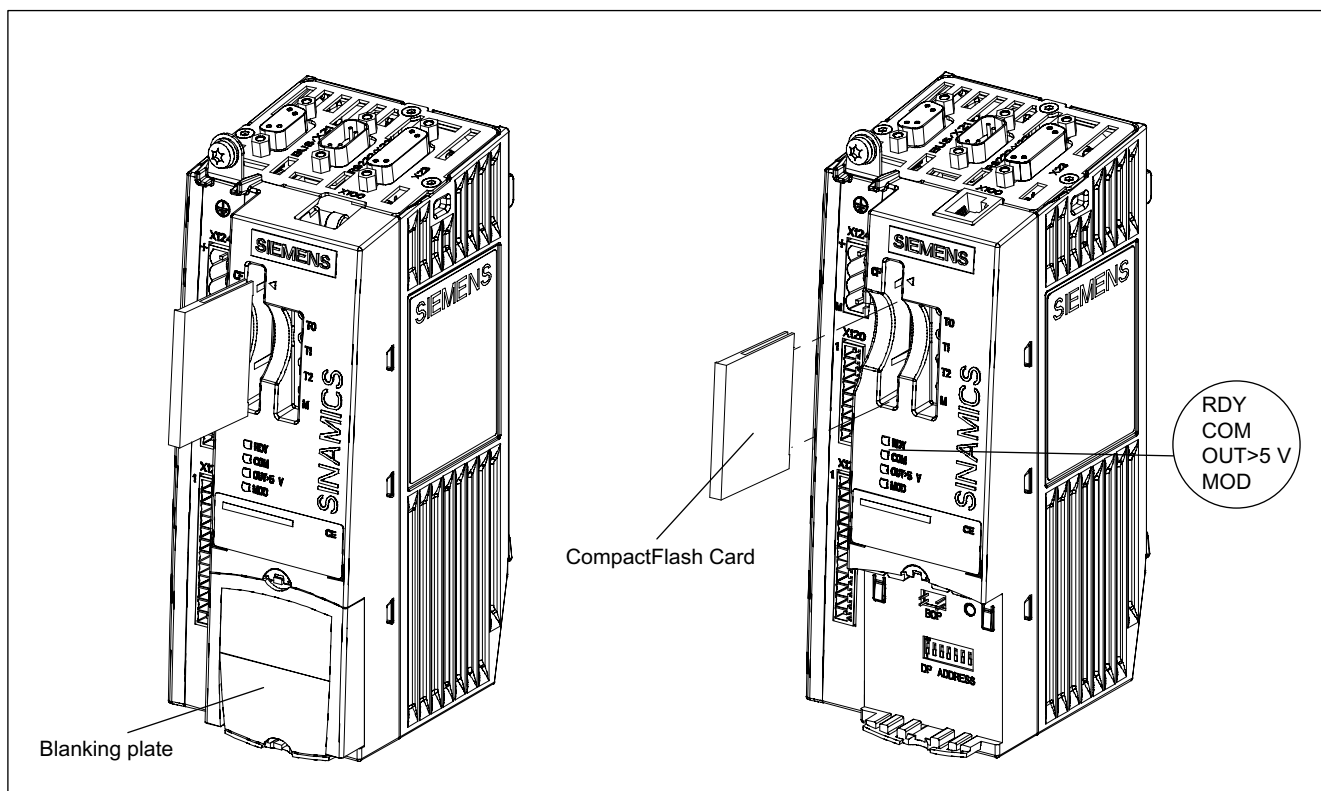


Figure 6-1 Slot for the CompactFlash card on a CU310 Control Unit

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

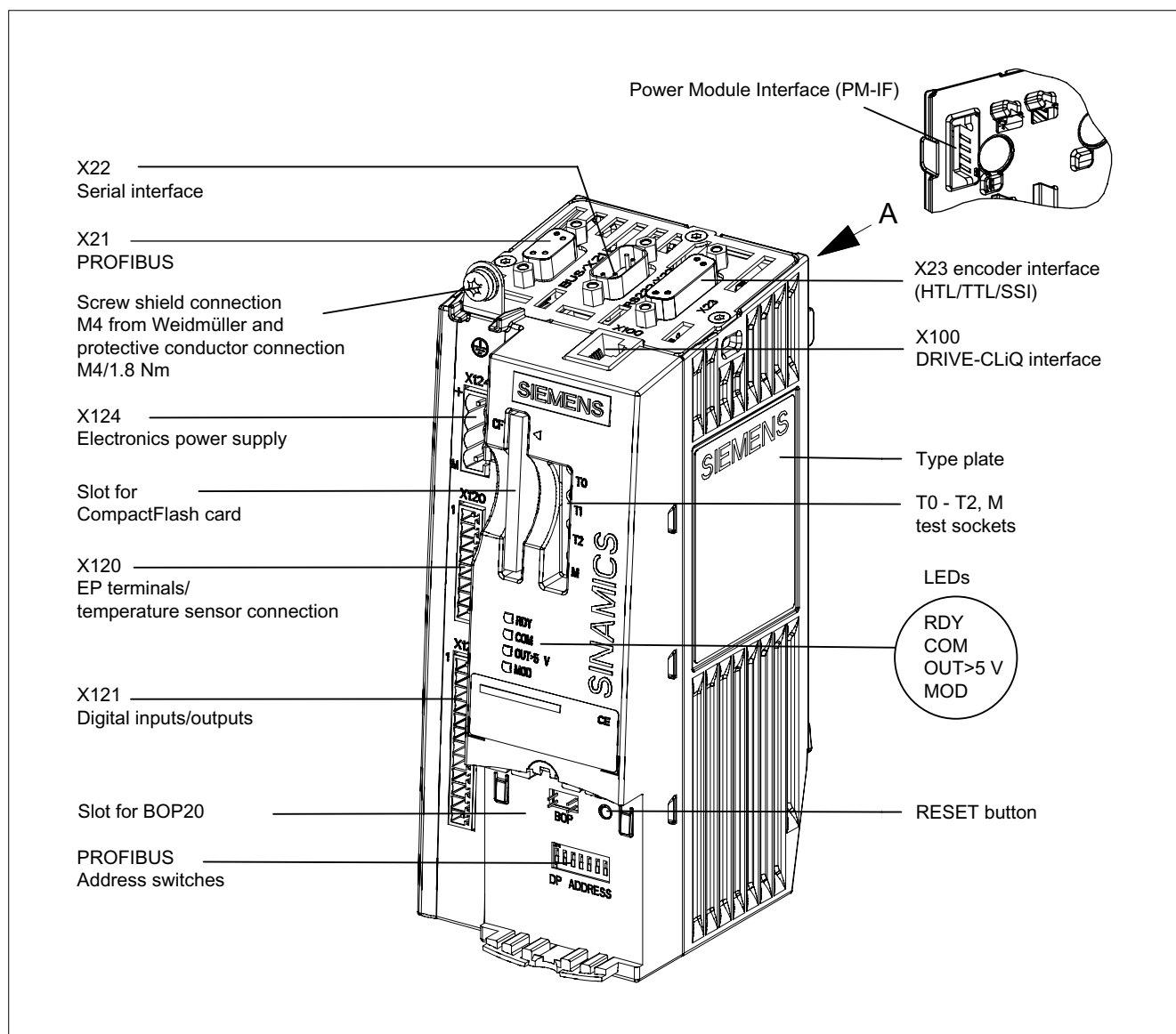


Figure 6-2 Description of the CU310 DP interfaces (ports)

6.2.3.2 Sample connection

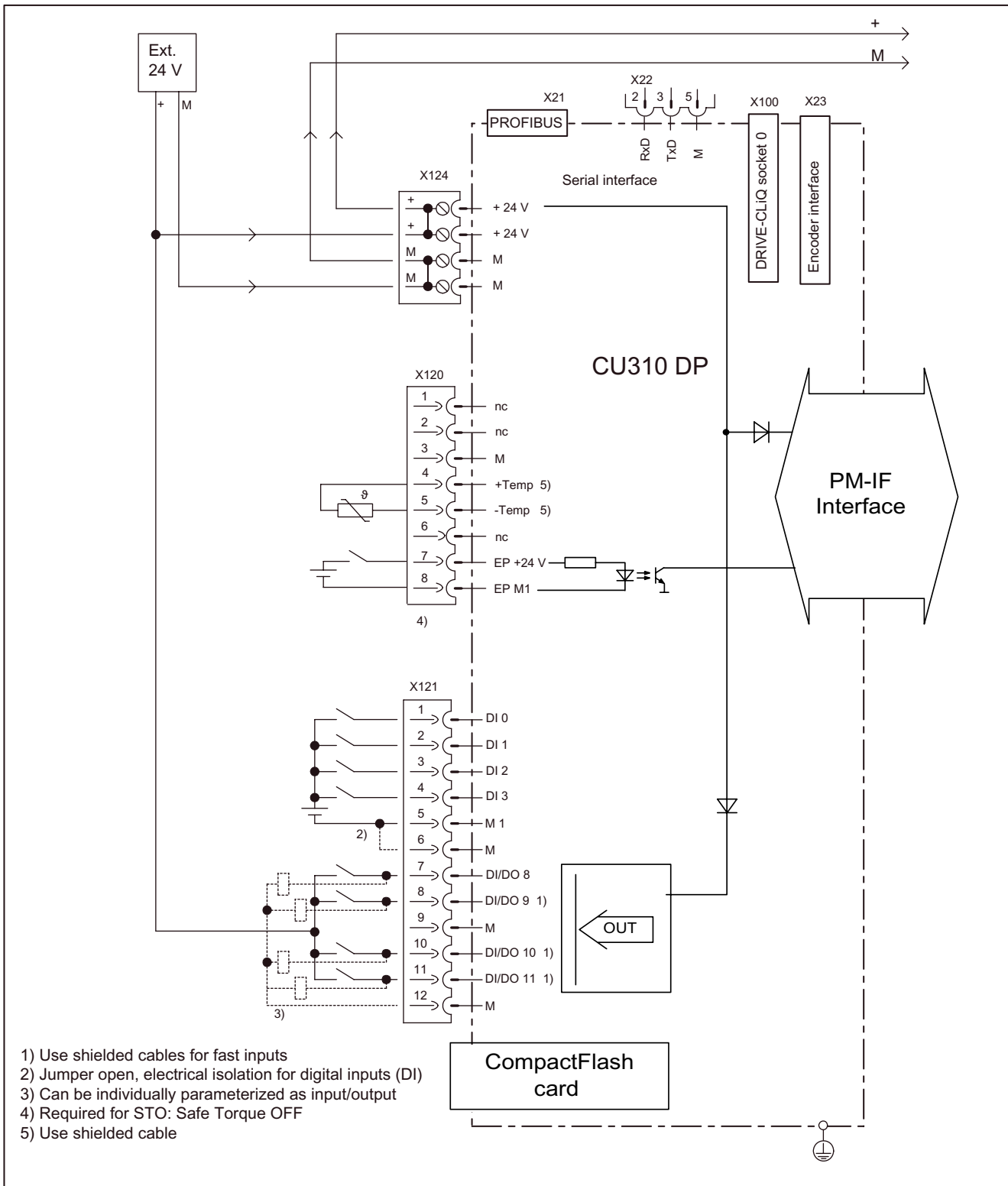
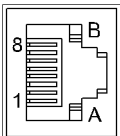


Figure 6-3 Connection example CU310 DP

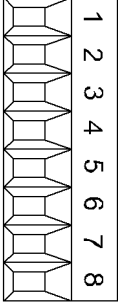
6.2.3.3 X100 DRIVE-CLiQ interface

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 | |
| | W | M (0 V) | Electronics ground | |
| | Blanking plate for DRIVE-CLiQ interface: Yamaichi, Order No.: Y-ConAS-13 | | | |

6.2.3.4 X120 EP terminals / temperature sensor

Table 6-3 Terminal strip 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).

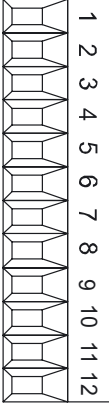
²⁾ The EP terminals must be wired on the Power Module on chassis units.

| |
|---|
| 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."

6.2.3.5 X121 digital inputs/outputs

Table 6-4 Terminal strip X121

| | Terminal | Designation ¹⁾ | Technical specifications |
|--|----------|---------------------------|---|
|  | 1 | DI 0 | Voltage: -3 V to 30 V Typical current consumption: 10 mA at 24 V DC Isolation: The reference potential is terminal M1 Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V |
| | 2 | DI 1 | |
| | 3 | DI 2 | |
| | 4 | DI 3 | |
| | 5 | M1 | Signal propagation times: L → H approx. 50 μs H → L: approx. 100 μs |
| | 6 | M | |
| | 7 | DI/DO 8 | As input: Voltage: -3 V to 30 V Typical current consumption: 10 mA at 24 V DC Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V Terminal numbers 8, 10, and 11 are "fast inputs" Signal propagation times for inputs/"fast inputs": L → H: approx. 50 μs/5 μs H → L: approx. 100 μs/50 μs As output: Voltage: 24 V DC Max. load current per output: 500 mA Continued-short-circuit-proof Signal propagation times of the outputs: L → H: approx. 150 μs |
| | 8 | DI/DO 9 | |
| | 9 | M | |
| | 10 | DI/DO 10 | |
| | 11 | DI/DO 11 | |
| | 12 | M | |
| Max. connectable cross-section: 1.5 mm ² Type: Spring-loaded terminal 1 (see Appendix A) | | | |

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

NOTICE

An open input is interpreted as "low".

The "fast inputs" can be used in conjunction with a measuring system for position sensing.

To enable digital inputs (DI) 0 to 3 to function, terminal M1 must be connected. This can be done as follows:

Connect the digital inputs' ground reference, or a jumper to terminal M. This removes the electrical isolation for these digital inputs.

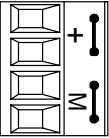
Note

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

If the 24 V supply is briefly interrupted, then the digital outputs are de-activated during this time.

6.2.3.6 Electronics power supply X124

Table 6-5 Terminal block X124

| | Terminal | Function | Technical specifications |
|--|----------|--------------------------|---|
|  | + | Electronics 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 at 55 °C |
| | + | Electronics power supply | |
| | M | Electronic ground | |
| | M | Electronic ground | |
| Max. connectable cross-section: 2.5 mm ² Type: Screw terminal 2 (see Appendix A) | | | |

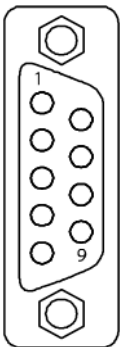
Note

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

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

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

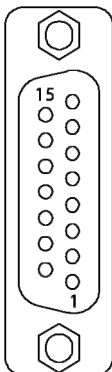
At the first and last node (device) in a line, the terminating resistors must be switched-in in order to ensure disturbance/noise-free communications.

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 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⁾ | $U_{H,diff}$ | | 2 | | 5 | V |
| Low signal level (TTL bipolar at X23) ¹⁾ | $U_{L,diff}$ | | -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⁾ | $U_{H,diff}$ | | 3 | | V_{CC} | V |
| Low signal level (HTL bipolar) ²⁾ | $U_{L,diff}$ | | $-V_{CC}$ | | -3 | V |
| High signal level (SSI bipolar at X23) ¹⁾³⁾ | $U_{H,diff}$ | | 2 | | 5 | V |
| Low signal level (SSI bipolar at X23) ¹⁾³⁾ | $U_{L,diff}$ | | -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 | | | | | | | | | | | | | | |
|--|------------|--------------|-------|-------|-------|-------|-------|---|---|---|---|----|----|----|----|-----------|
| <p>Significance:</p> <table style="margin-left: 20px;"> <tr> <td>2^0</td><td>2^1</td><td>2^2</td><td>2^3</td><td>2^4</td><td>2^5</td><td>2^6</td> </tr> <tr> <td>1</td><td>2</td><td>4</td><td>8</td><td>16</td><td>32</td><td>64</td> </tr> </table>  <p>S1 S2 S3 S4 S5 S6 S7</p> <p>Example: 1 + 4 + 32 = 37 PROFIBUS address = 37</p> | 2^0 | 2^1 | 2^2 | 2^3 | 2^4 | 2^5 | 2^6 | 1 | 2 | 4 | 8 | 16 | 32 | 64 | S1 | $2^0 = 1$ |
| | 2^0 | 2^1 | 2^2 | 2^3 | 2^4 | 2^5 | 2^6 | | | | | | | | | |
| | 1 | 2 | 4 | 8 | 16 | 32 | 64 | | | | | | | | | |
| | 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 PROFIBUS address switches are defaulted to 0 or 127. In these two settings, addresses are assigned via parameters.

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

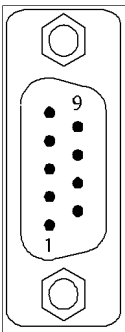
Setting the PROFIBUS address

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 Measurement sockets T0, T1, and T2

Table 6-11 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 |
| T1 | Measurement socket 1 | |
| T2 | Measurement socket 2 | |
| M | Ground | The reference potential is terminal M |
| 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.

6.2.3.12 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

The individual statuses during booting are indicated via the LEDs on the Control Unit (CU310).

- 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.

The description of the LEDs after booting applies.

Control Unit 310 - behavior of the LEDs during booting

Table 6-12 Load software 1

| LED | | | | Status | Comment |
|----------|-----|-----|-----|--------|---|
| RDY | DP1 | OPT | MOD | | |
| red | red | red | off | Reset | – |
| red 2 Hz | red | red | off | error | <ul style="list-style-type: none"> • 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 | DP1 | OPT | 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 | DP1 | OPT | MOD | | |
| off | off | off | off | initializing | – |
| alternating | | | | Running | refer to the following table |

Table 6-15 Control Unit 310 – description of the LEDs after booting

| LED | Color | Status | Description, cause | Remedy |
|---------------------------------------|---------------------------------------|---------------------------|---|--|
| RDY (READY) | - | OFF | Electronics 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 CompactFlash 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. | Obtain licenses. |
| | Orange | Continuous | DRIVE-CLiQ communication is being established. | - |
| | | Flashing 0.5 Hz | Updating the firmware of the DRIVE-CLiQ components. | - |
| | | 2 Hz flashing light | Firmware update is complete for components. Wait for POWER ON for the components in question | Turn POWER ON for the components in question |
| | Green/ orange or red/ orange | 1 Hz flashing light | Component detection via LED is activated (p0124[0]). Note: Both options depend on the LED status when component recognition is activated via p0124[0] = 1. | - |
| COM PROFIdrive cyclic operation | - | OFF | Cyclic communication has not (yet) taken place. Note: The PROFIdrive is ready to communicate when the Control Unit is ready to operate (see LED RDY). | - |
| | Green | Continuous | Cyclic communication is taking place. | - |
| | | Flashing 0.5 Hz | Cyclic communication is not yet running fully. Possible reasons: <ul style="list-style-type: none"> 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. | Remedy fault |

| LED | Color | Status | Description, cause | Remedy |
|---------|--------|------------------|---|--|
| | Orange | Flashing 2 Hz | Firmware CRC error. | Make sure that the CompactFlash card has been inserted properly. Replace the CompactFlash Card. Replace Control Unit. Carry-out a POWER ON. |
| OUT>5 V | - | OFF | Electronics power supply is missing or outside permissible tolerance range. Voltage supply 5 V | - |
| | Orange | Continuous | Electronics 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

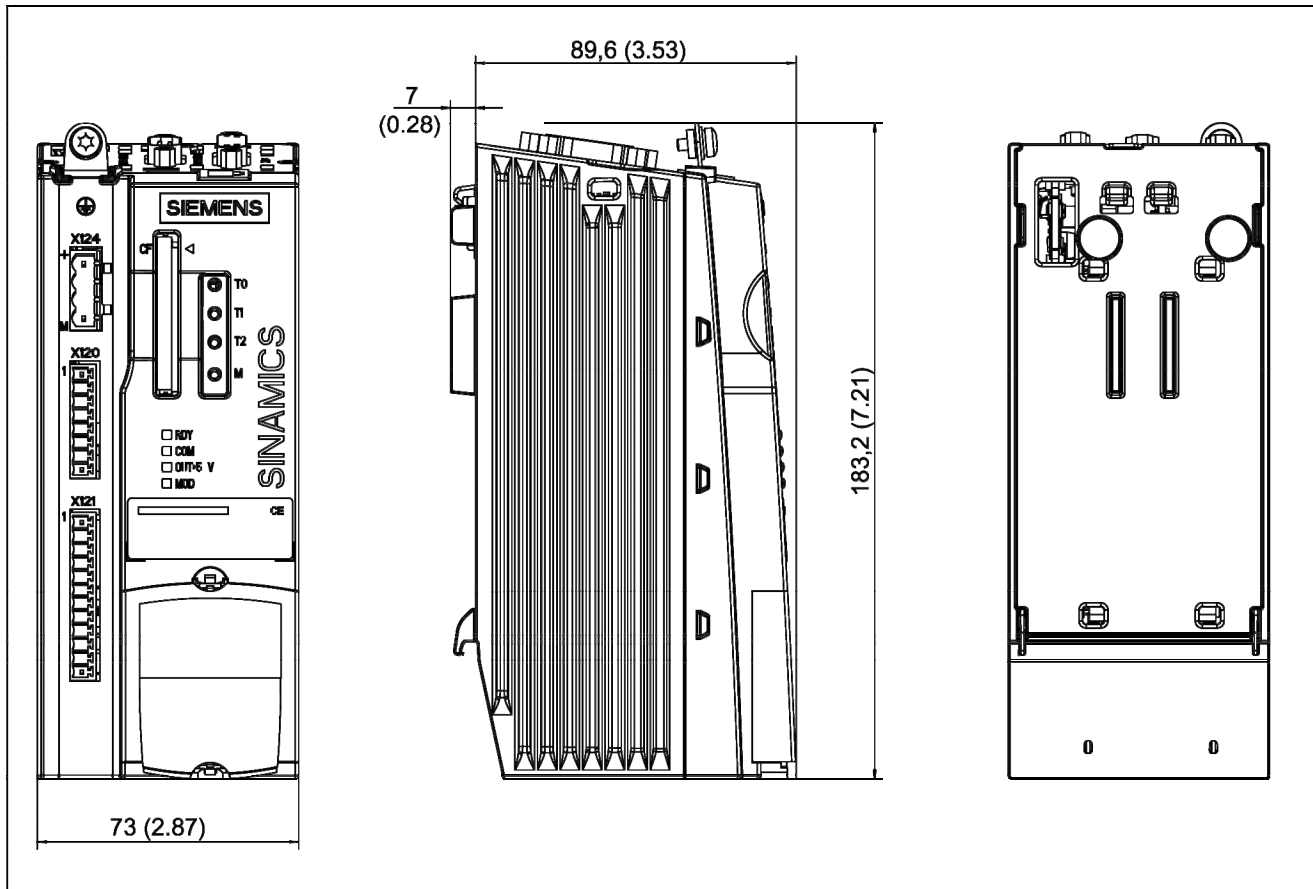


Figure 6-5 Dimension drawing CU310 DP

6.2.5 Mounting the CU310 on the Power Module Blocksize

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



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

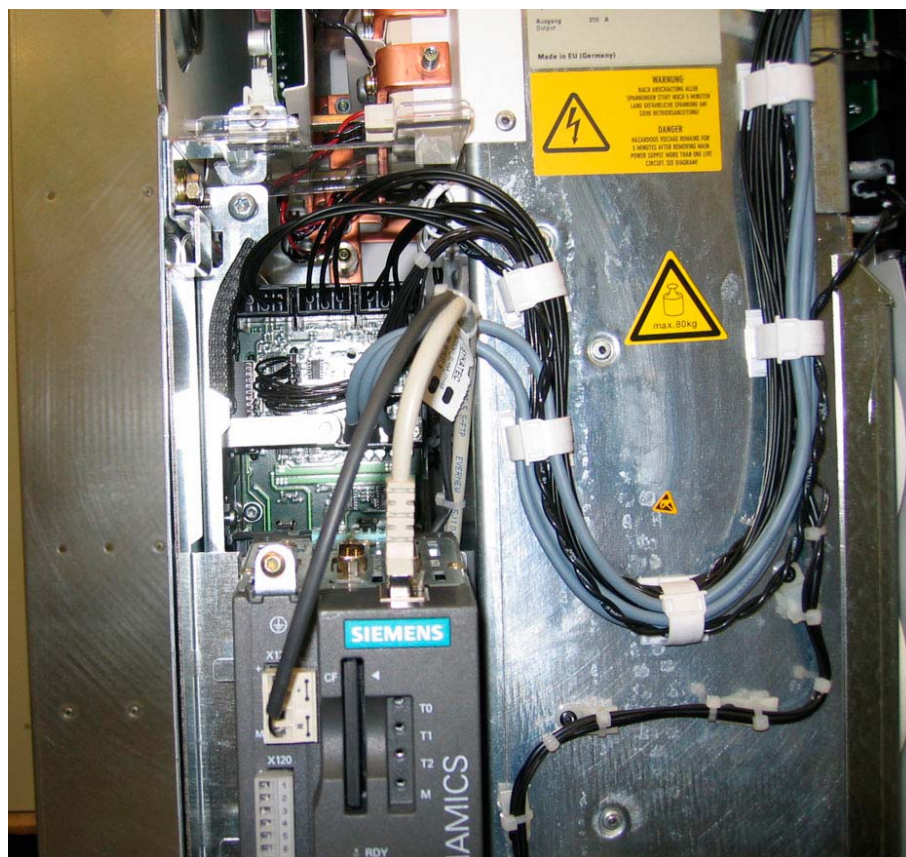


Figure 6-6 Mounting the CU310 in the Power Module chassis format, frame size FX

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 | V _{DC} | 24 DC (20.4 – 28.8) |
| Current (without DRIVE-CLiQ and digital outputs) | A _{DC} | 0.8 |
| Power loss | W | <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 | 0,95 |

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 |

Available from approx. 07/2006.

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

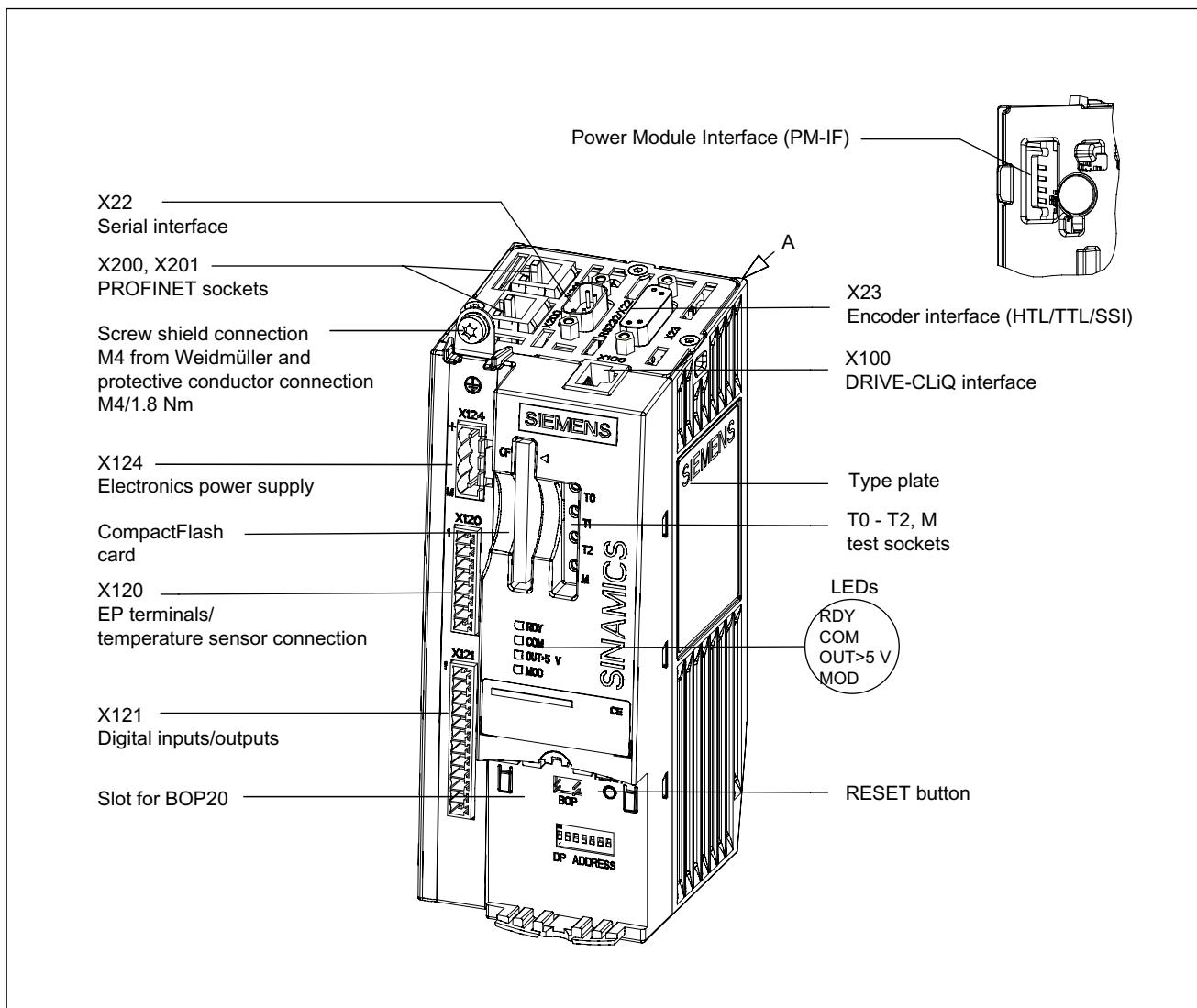


Figure 6-7 Description of the CU310 PN interfaces

Note

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

6.3.3.2 Sample connection

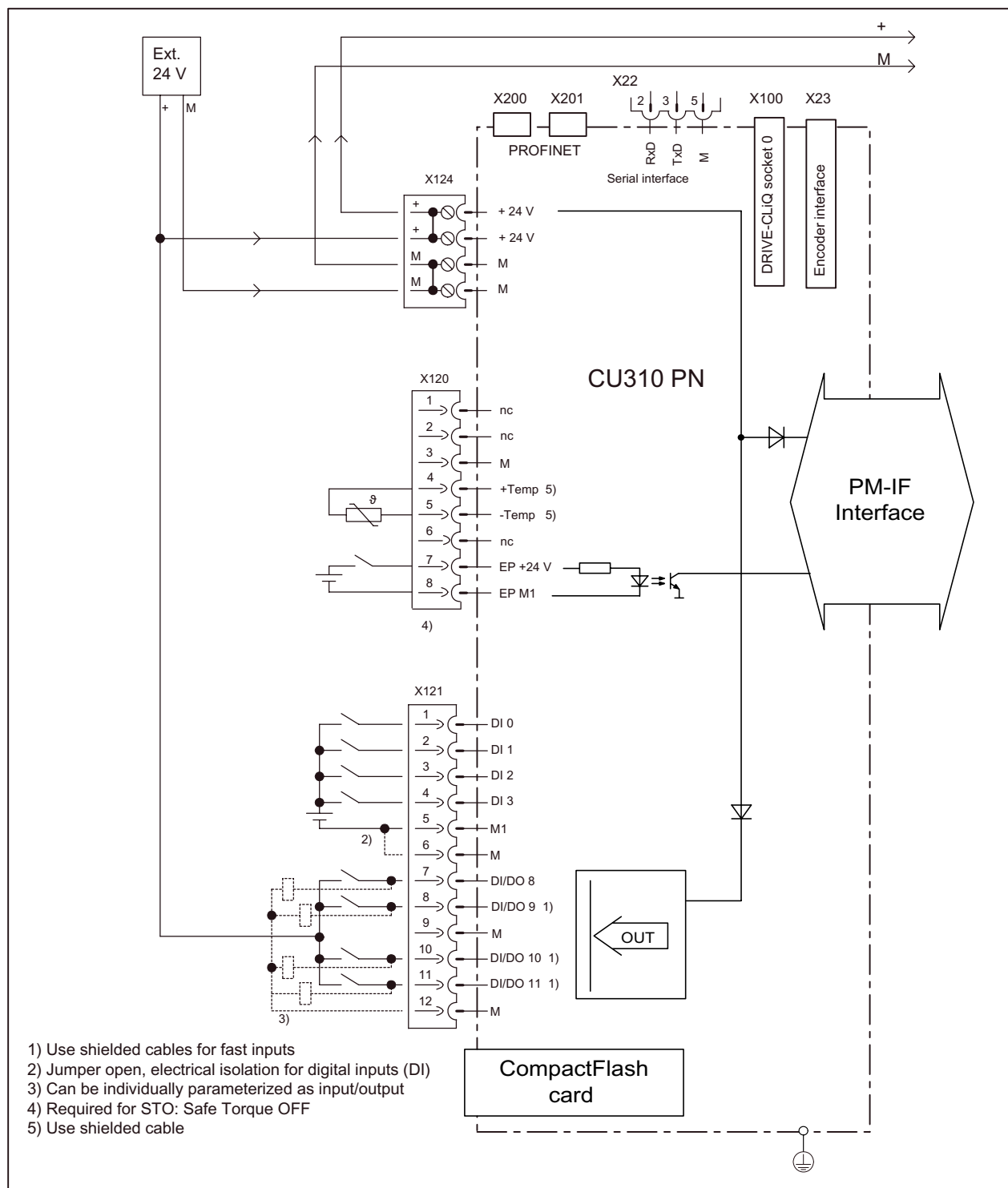
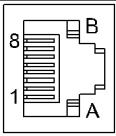


Figure 6-8 Connection example CU310 PN

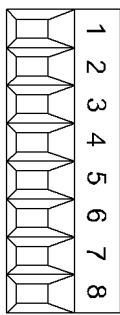
6.3.3.3 X100 DRIVE-CLiQ interface

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 plate for 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 strip 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 mm²

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

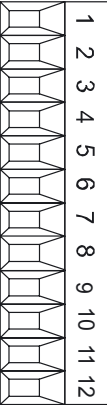
The KTY temperature sensor/the PTC must be connected with the correct polarity.

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."

6.3.3.5 X121 digital inputs/outputs

Table 6-20 Terminal strip X121

| | Terminal | Designation ¹⁾ | Technical specifications |
|--|----------|---------------------------|---|
|  | 1 | DI 0 | Voltage: -3 V to 30 V Typical current consumption: 10 mA at 24 V DC Isolation: The reference potential is terminal M1 Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V |
| | 2 | DI 1 | |
| | 3 | DI 2 | |
| | 4 | DI 3 | |
| | 5 | M1 | Signal propagation times: L → H approx. 50 µs H → L: approx. 100 µs |
| | 6 | M | |
| | 7 | DI/DO 8 | As input: Voltage: -3 V to 30 V Typical current consumption: 10 mA at 24 V DC Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V Terminal numbers 8, 10, and 11 are "fast inputs" Signal propagation times for inputs/"fast inputs": L → H: approx. 50 µs/5 µs H → L: approx. 100 µs/50 µs As output: Voltage: 24 V DC Max. load current per output: 500 mA Continued-short-circuit-proof Signal propagation times of the outputs: L → H: approx. 150 µs |
| | 8 | DI/DO 9 | |
| | 9 | M | |
| | 10 | DI/DO 10 | |
| | 11 | DI/DO 11 | |
| | 12 | M | |
| Max. connectable cross-section: 1.5 mm ² Type: Spring-loaded terminal 1 (see Appendix A) | | | |

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

NOTICE

An open input is interpreted as "low".

The "fast inputs" can be used in conjunction with a measuring system for position sensing.

To enable digital inputs (DI) 0 to 3 to function, terminal M1 must be connected. This can be done as follows:

Connect the digital inputs' ground reference, or a jumper to terminal M. This removes the electrical isolation for these digital inputs.

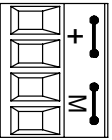
Note

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

If the 24 V supply is briefly interrupted, then the digital outputs are de-activated during this time.

6.3.3.6 Electronics power supply X124

Table 6-21 Terminal block X124

| | Terminal | Function | Technical specifications |
|--|----------|--------------------------|--|
|  | + | Electronics 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 at 55 °C |
| | + | Electronics power supply | |
| | M | Electronic ground | |
| | M | Electronic ground | |
| Max. cross-section that can be connected: 2.5 mm ² Type: Screw terminal 2 (see Appendix A) | | | |

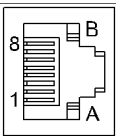
Note

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

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

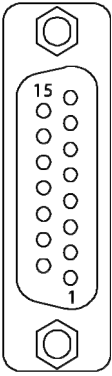
6.3.3.7 X200 - X201 PROFINET

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 | PENC | Encoder power supply |
| | 5 | PENC | Encoder power supply |
| | 6 | PSENSE | Remote sense encoder power supply (P) |
| | 7 | M | Electronics ground |
| | 8 | -Temp* | Ground for KTY or PTC |
| | 9 | MSENSE | 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 | | ¼ · T _s | | ¾ · 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.

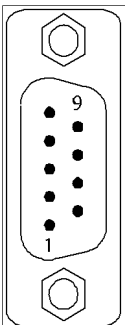
Note

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 |
| T1 | Measurement socket 1 | |
| T2 | Measurement socket 2 | |
| M | Ground | The reference potential is terminal M |
| 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

The individual statuses during booting are indicated via the LEDs on the Control Unit (CU310).

- 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.

The description of the LEDs after booting applies.

Control Unit 310 - behavior of the LEDs during booting

Table 6-27 Load software 1

| LED | | | | Status | Comment |
|----------|-----|-----|-----|--------|---|
| RDY | DP1 | OPT | MOD | | |
| red | red | red | off | Reset | – |
| red 2 Hz | red | red | off | error | <ul style="list-style-type: none"> • 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 | DP1 | OPT | 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 | DP1 | OPT | MOD | | |
| off | off | off | off | initializing | – |
| alternating | | | | Running | refer to the following table |

Table 6-30 Control Unit 310 – description of the LEDs after booting

| LED | Color | Status | Description, cause | Remedy |
|---------------------------------------|---------------------------|---|---|--|
| RDY (READY) | - | OFF | Electronics 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 CompactFlash 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. | Obtain licenses. |
| | Orange | Continuous | DRIVE-CLiQ communication is being established. | - |
| | | Flashing 0.5 Hz | Updating the firmware of the DRIVE-CLiQ components. | - |
| | | 2 Hz flashing light | Firmware update is complete for components. Wait for POWER ON for the components in question | Turn POWER ON for the components in question |
| Green/ orange or red/ orange | 1 Hz flashing light | Component detection via LED is activated (p0124[0]). Note: Both options depend on the LED status when component recognition is activated via p0124[0] = 1. | - | |
| COM PROFIdrive cyclic operation | - | OFF | Cyclic communication has not (yet) taken place. Note: The PROFIdrive is ready to communicate when the Control Unit is ready to operate (see LED RDY). | - |
| | Green | Continuous | Cyclic communication is taking place. | - |
| | | Flashing 0.5 Hz | Cyclic communication is not yet running fully. Possible reasons: <ul style="list-style-type: none"> 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. | Remedy fault |

| LED | Color | Status | Description, cause | Remedy |
|---------|--------|------------------|---|--|
| | Orange | Flashing 2 Hz | Firmware CRC error. | Make sure that the CompactFlash card has been inserted properly. Replace the CompactFlash Card. Replace Control Unit. Carry-out a POWER ON. |
| OUT>5 V | - | OFF | Electronics power supply is missing or outside permissible tolerance range. Voltage supply 5 V | - |
| | Orange | Continuous | Electronics 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

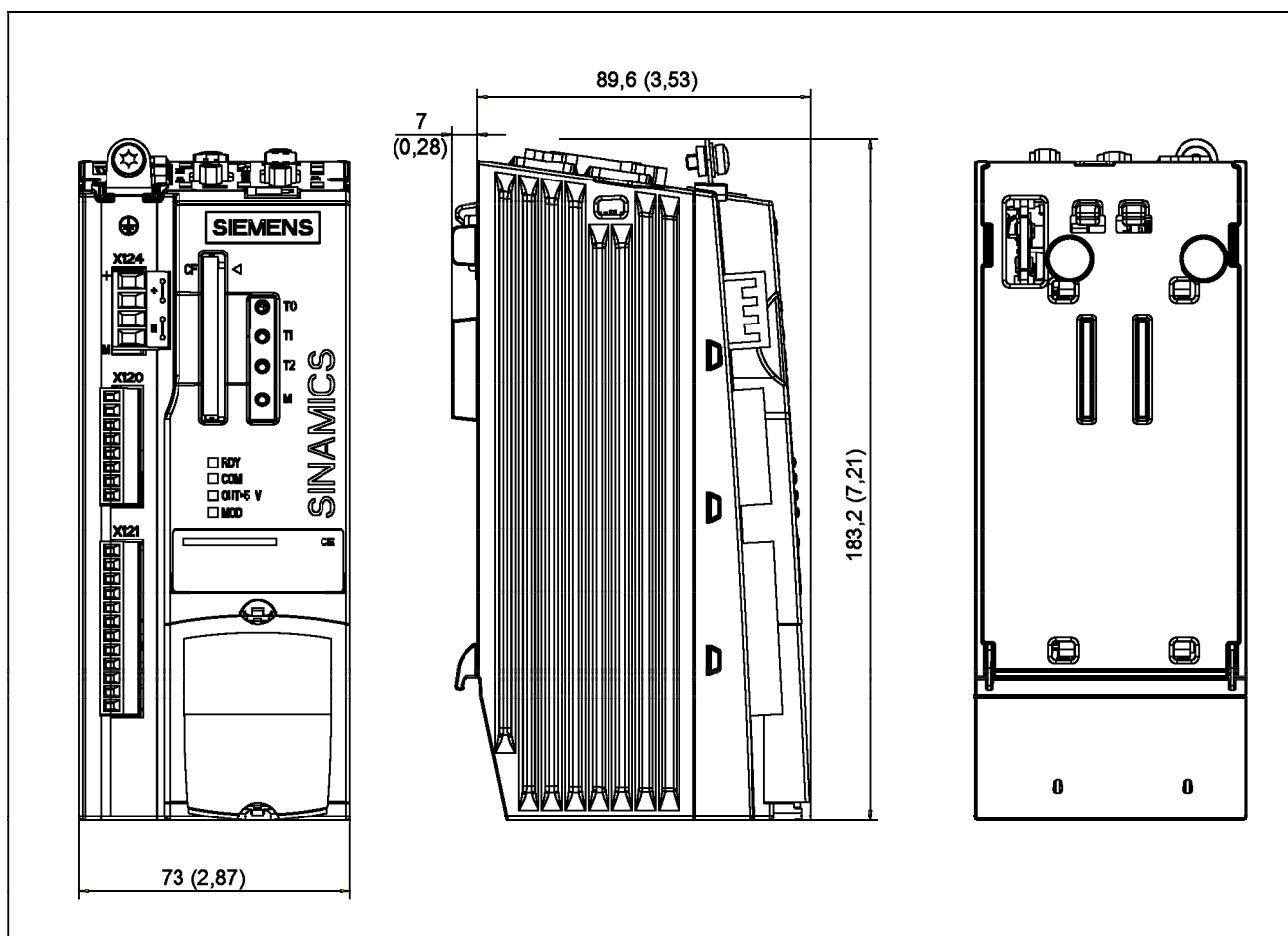
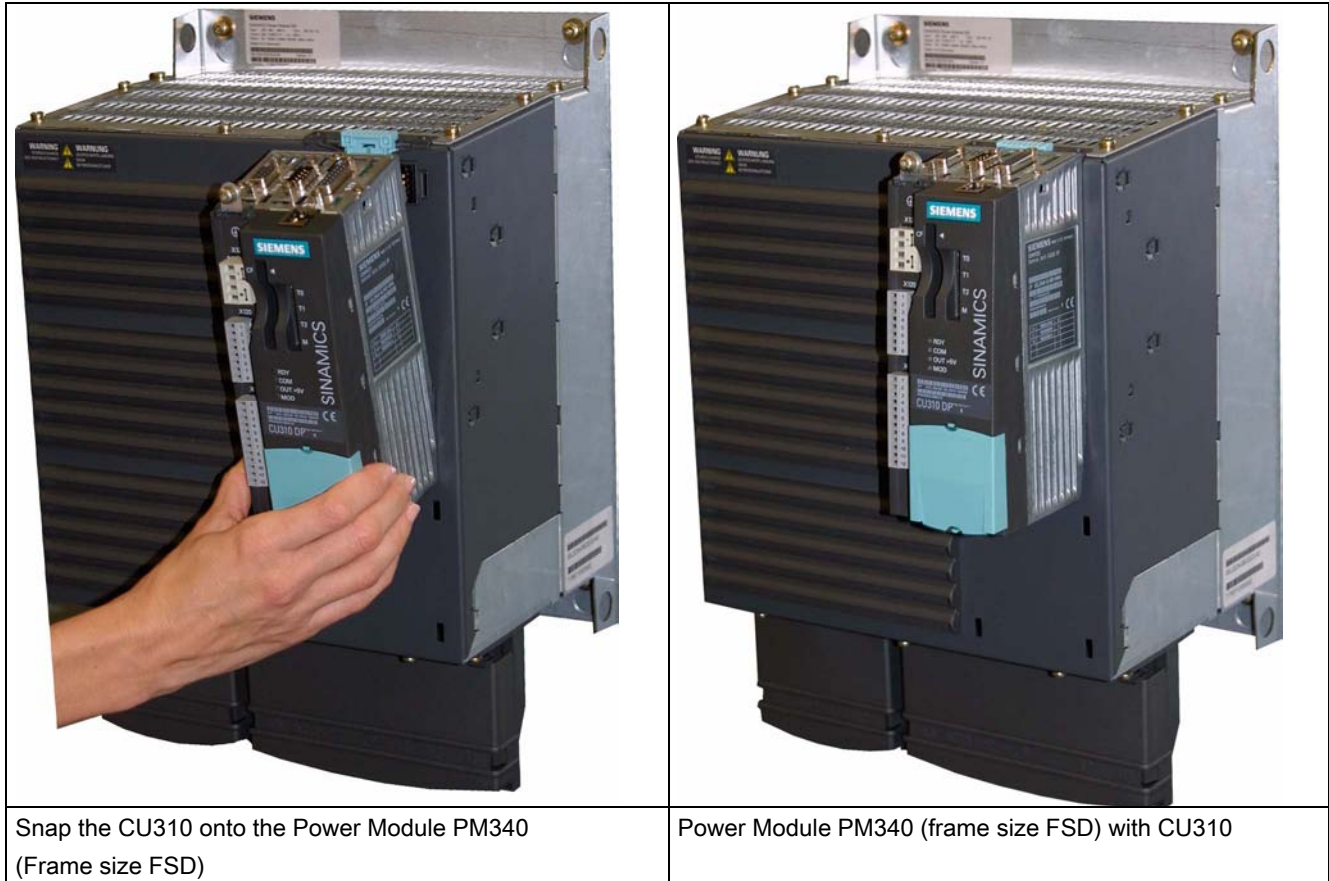


Figure 6-9 Dimension drawing, CU310 PN

6.3.5 Mounting the CU310 on the Power Module Blocksize

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



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 | V _{DC} | 24 DC (20.4 – 28.8) |
| Current (without DRIVE-CLiQ and digital outputs) | A _{DC} | 0.8 |
| Power loss | W | 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

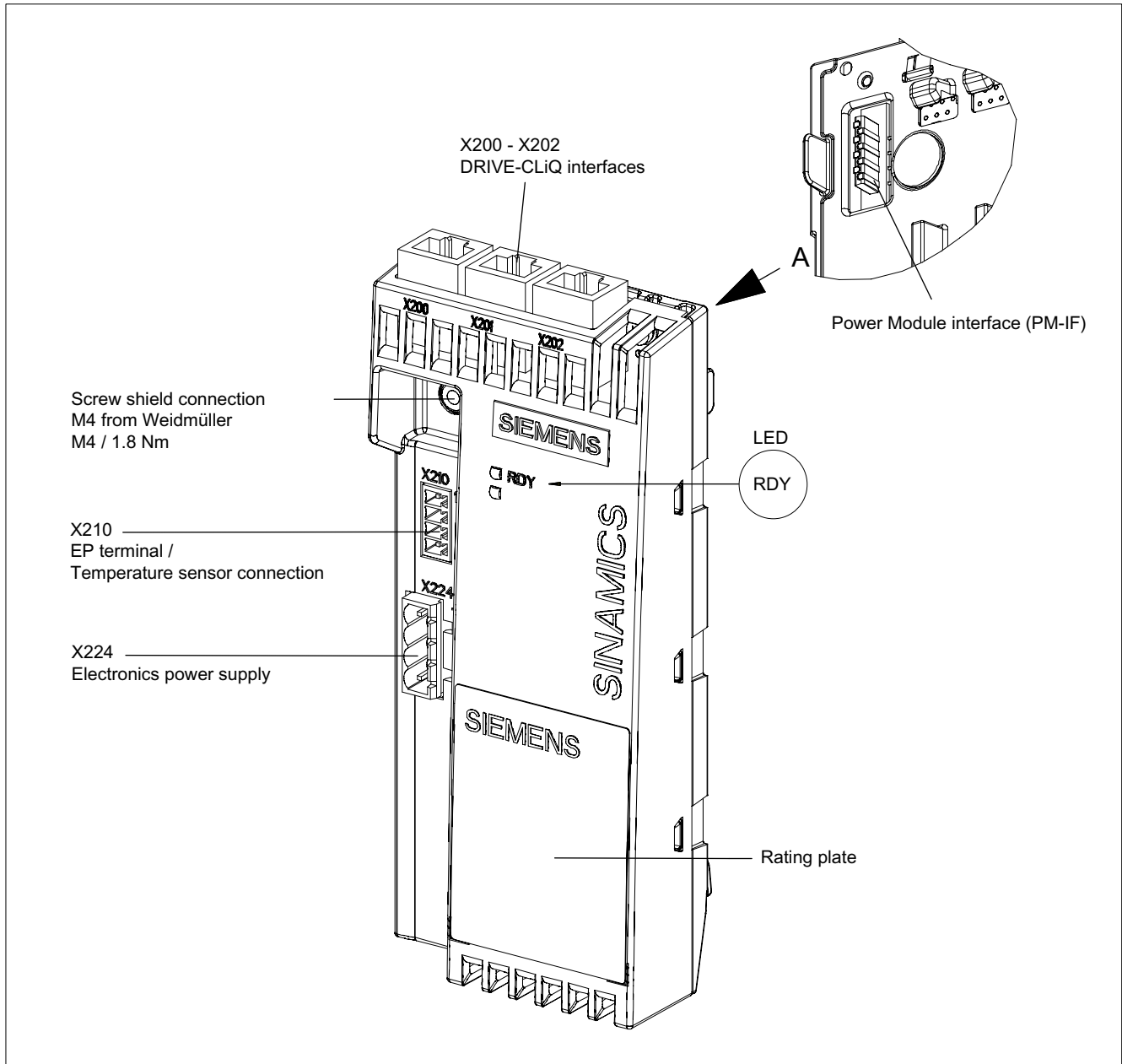


Figure 6-10 Interface description CUA31

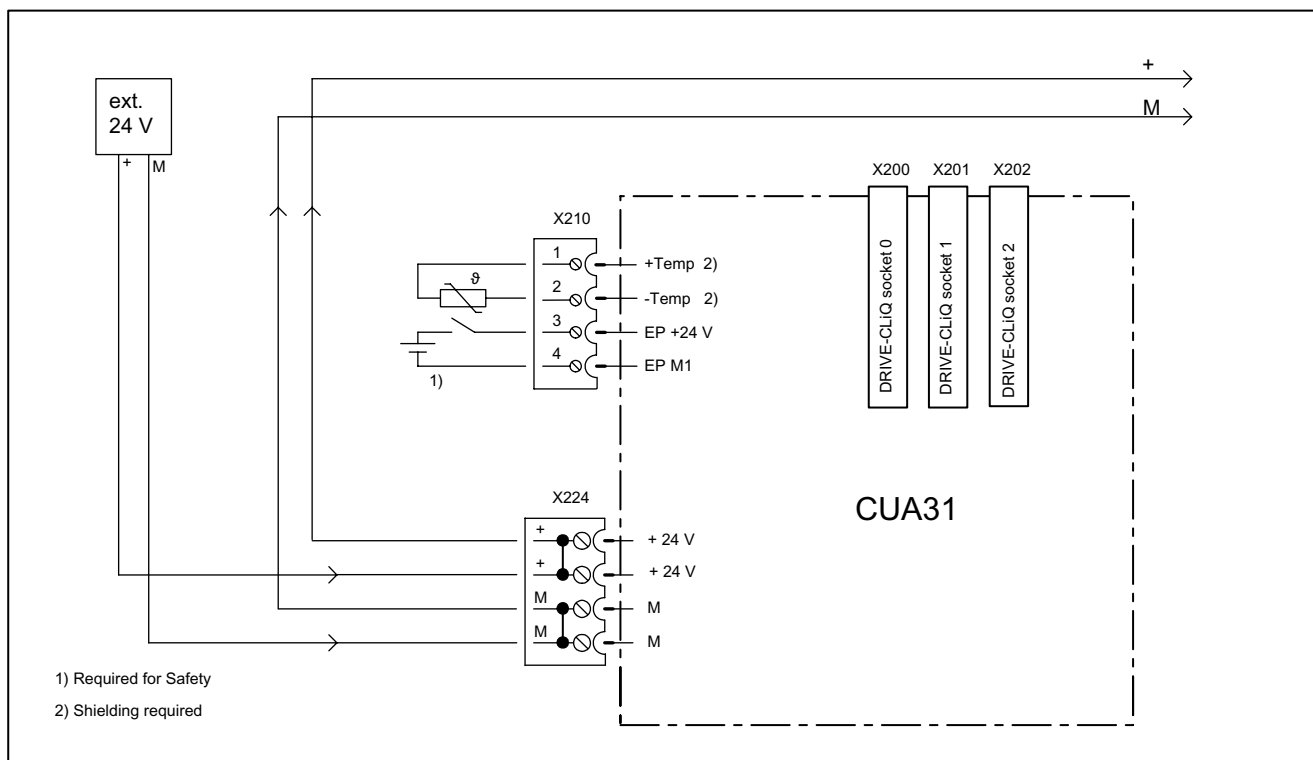


Figure 6-11 Connection example, CUA31

6.4.3.2 X200 - X202 DRIVE-CLiQ interface

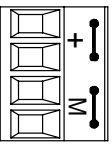
Table 6-33 DRIVE-CLiQ interface

| | 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 plate for DRIVE-CLiQ interface: Yamaichi, order no.: Y-ConAS-13

6.4.3.3 X224 electronics power supply

Table 6-34 Terminal strip X224

| | Terminal | Function | Technical specifications |
|--|----------|--------------------------|--|
|  | + | Electronics power supply | Voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: max. 0.8 A (without DRIVE-CLiQ) Max. current via jumper in connector: 20 A at 55 °C |
| | + | Electronics power supply | |
| | M | Electronics ground | |
| | M | Electronics ground | |
| Max. connectable cross-section: 2.5 mm ² Type: Screw terminal 2 (see Appendix A) | | | |

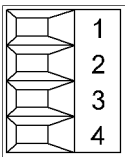
Note

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

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

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 mm ² 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 "Sicherer Halt" function is selected, 24 V DC must be applied to terminals 3 and 4.
 Upon removal, pulse inhibit is activated.

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

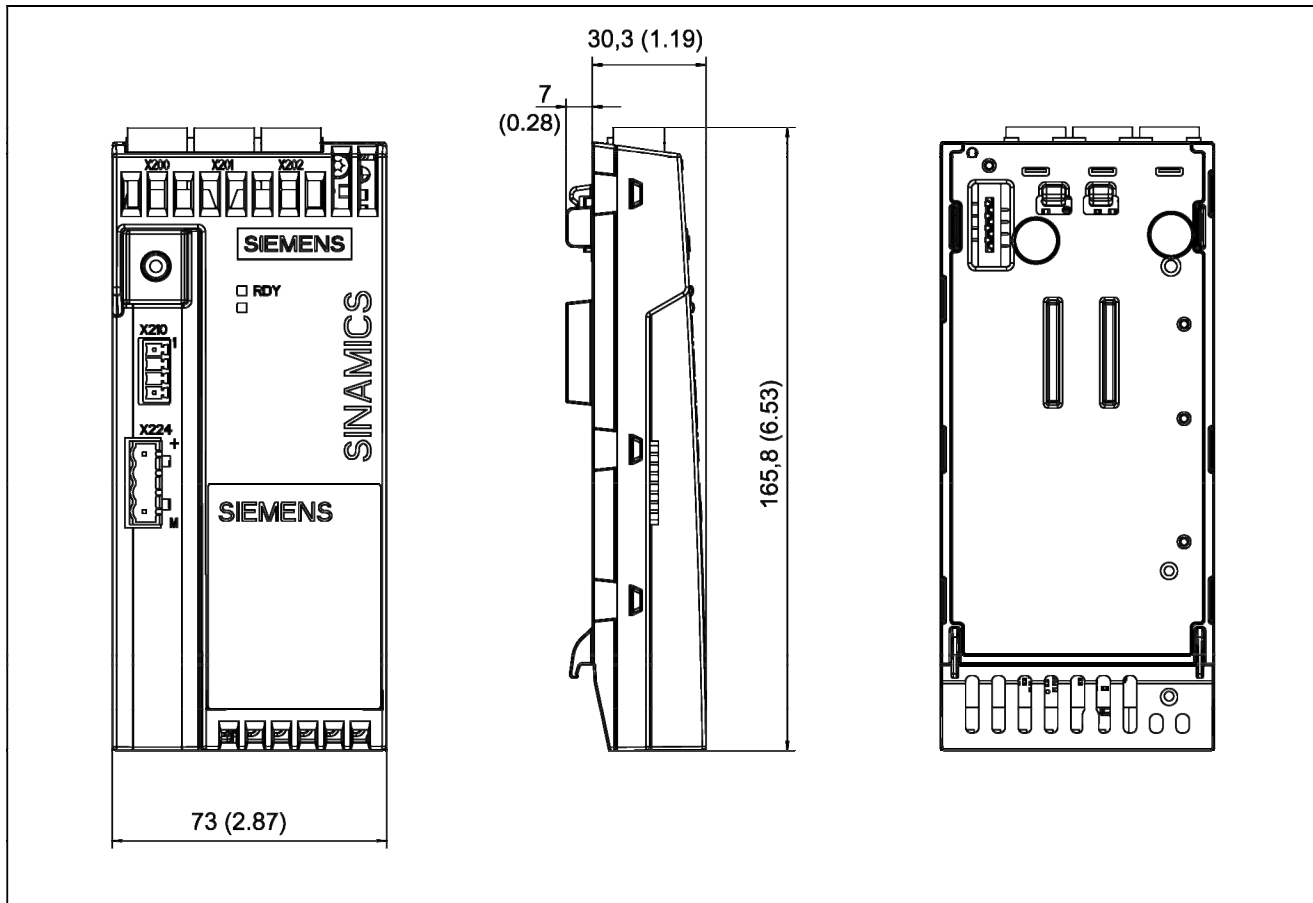
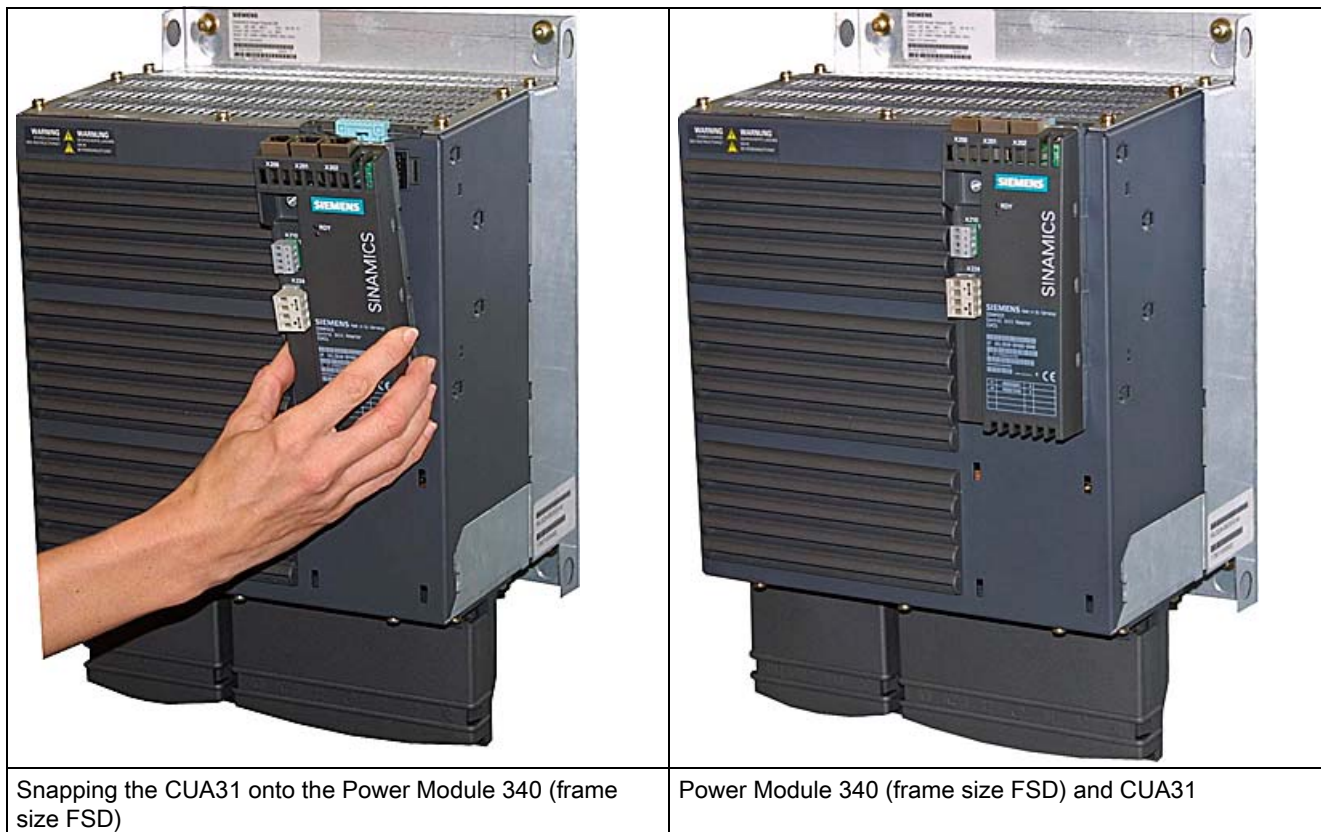


Figure 6-12 Dimension drawing of the Control Unit Adapter CUA31

6.4.5 Mounting



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 |
|---|-----------------|---------------------|
| Electronics power supply | | |
| Voltage | V _{DC} | 24 DC (20.4 – 28.8) |
| Current (without DRIVE-CLiQ) | A _{DC} | 0.1 |
| Power loss | W | 2.4 |
| For CUA31 with order no. 6SL3040-0PA00-0AA0, the maximum DRIVE-CLiQ connection length is | m | 50 |
| For CUA31 as of order no. 6SL3040-0PA00-0AA1, the maximum DRIVE-CLiQ connection length is | m | 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 |

¹Only 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

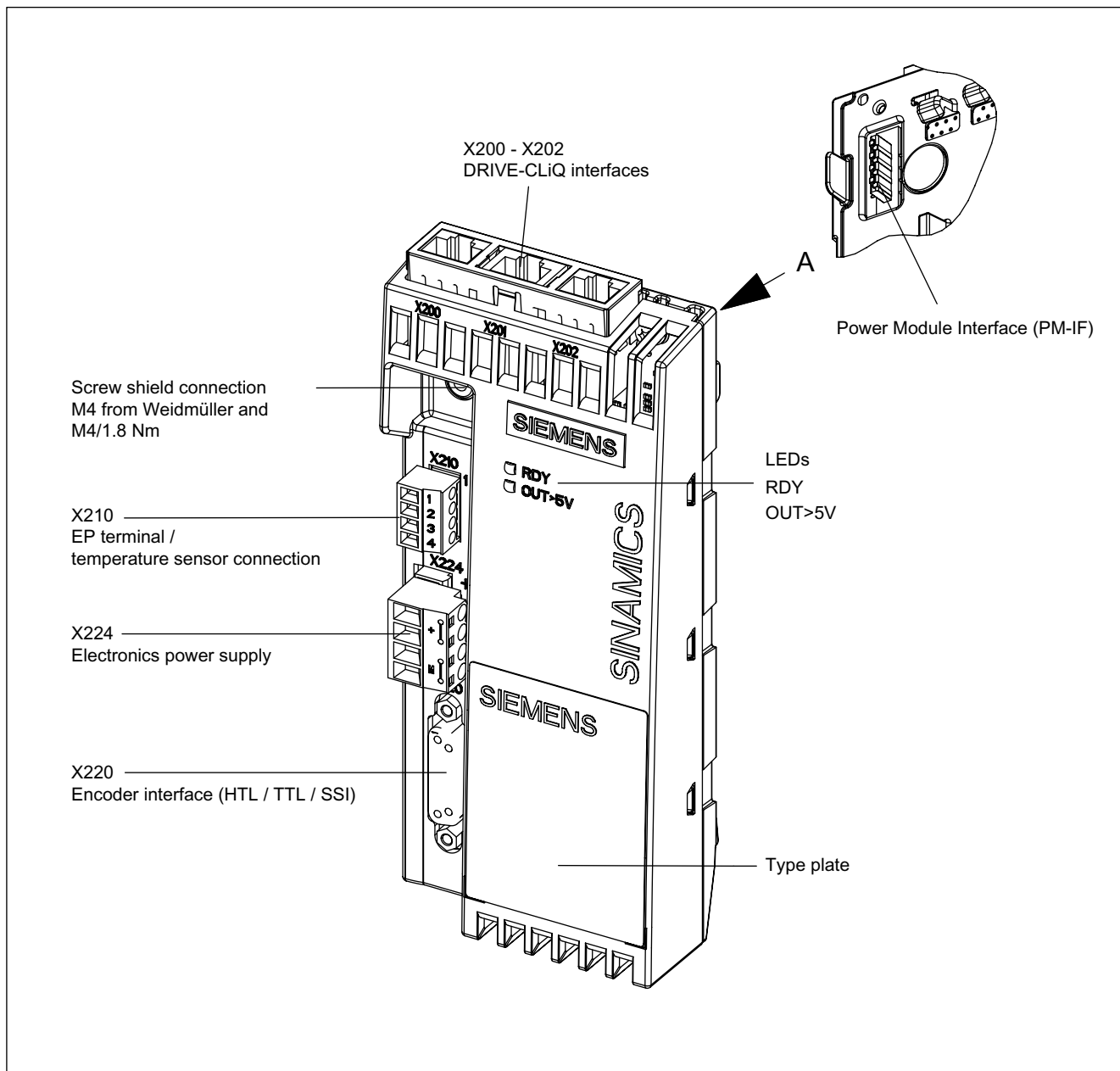


Figure 6-13 Interface description CUA32

6.5 CUA32 Control Unit Adapter

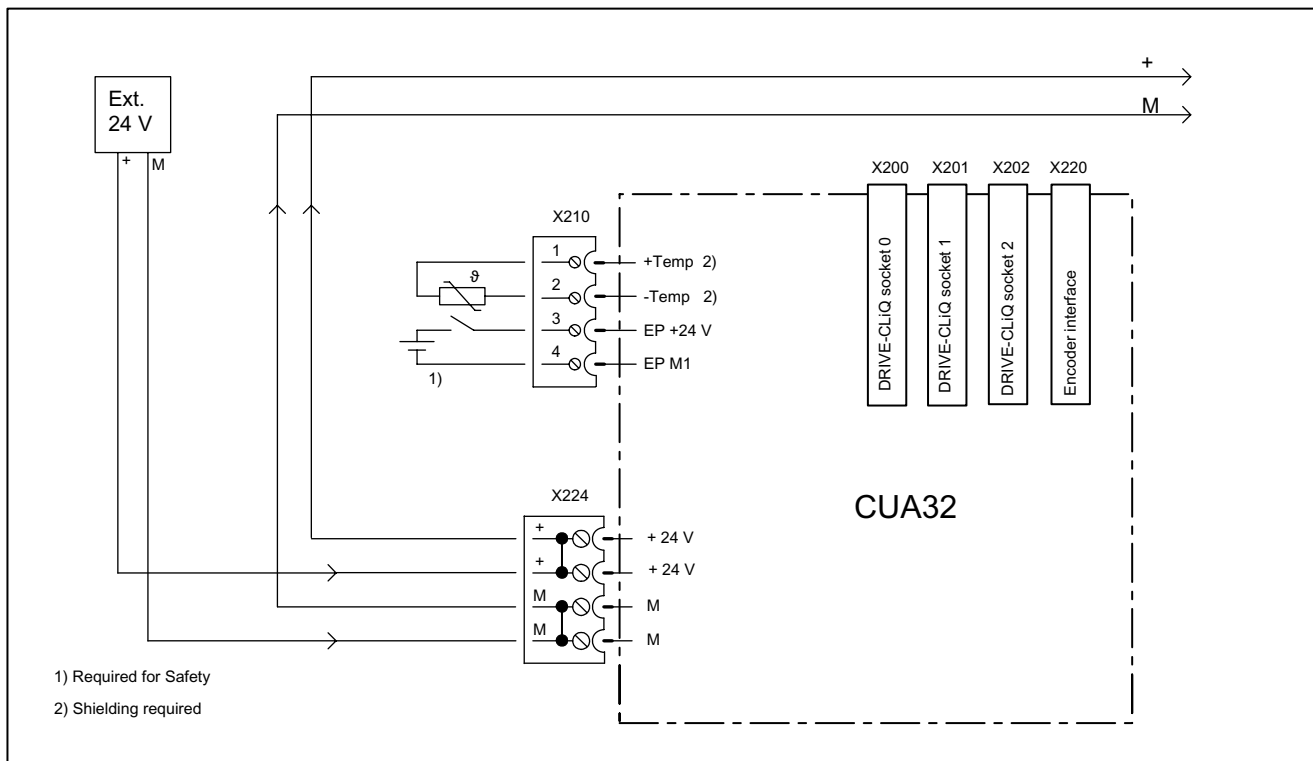


Figure 6-14 Connection example for CUA32

6.5.3.2 X200 - X202 DRIVE-CLiQ interface

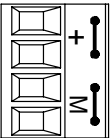
Table 6-39 DRIVE-CLiQ interface

| | 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 |
| | W | M (0 V) | Electronics ground |

Blanking plate for DRIVE-CLiQ interface: Yamaichi, Order No.: Y-ConAS-13

6.5.3.3 X224 electronics power supply

Table 6-40 Terminal strip X224

| | Terminal | Function | Technical specifications |
|--|----------|--------------------------|--|
|  | + | Electronics power supply | Voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: max. 0.8 A (without DRIVE-CLiQ and encoder) Max. current via jumper in connector: 20 A at 55 °C |
| | + | Electronics power supply | |
| | M | Electronics ground | |
| | M | Electronics ground | |
| Max. connectable cross-section: 2.5 mm ² Type: Screw terminal 2 (see Appendix A) | | | |

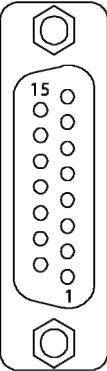
Note

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

The current consumption increases by the value for the DRIVE-CLiQ node 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 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 | | $\frac{1}{4} \cdot T_s$ | | $\frac{3}{4} \cdot T_s$ | |
| | Center of the pulse position | | 50 | 135 | 220 | Degrees |

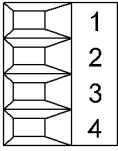
Note

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 mm ² 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 "Sicherer Halt" function is selected, 24 V DC must be applied to terminals 3 and 4.
 Upon removal, pulse inhibit is activated.

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

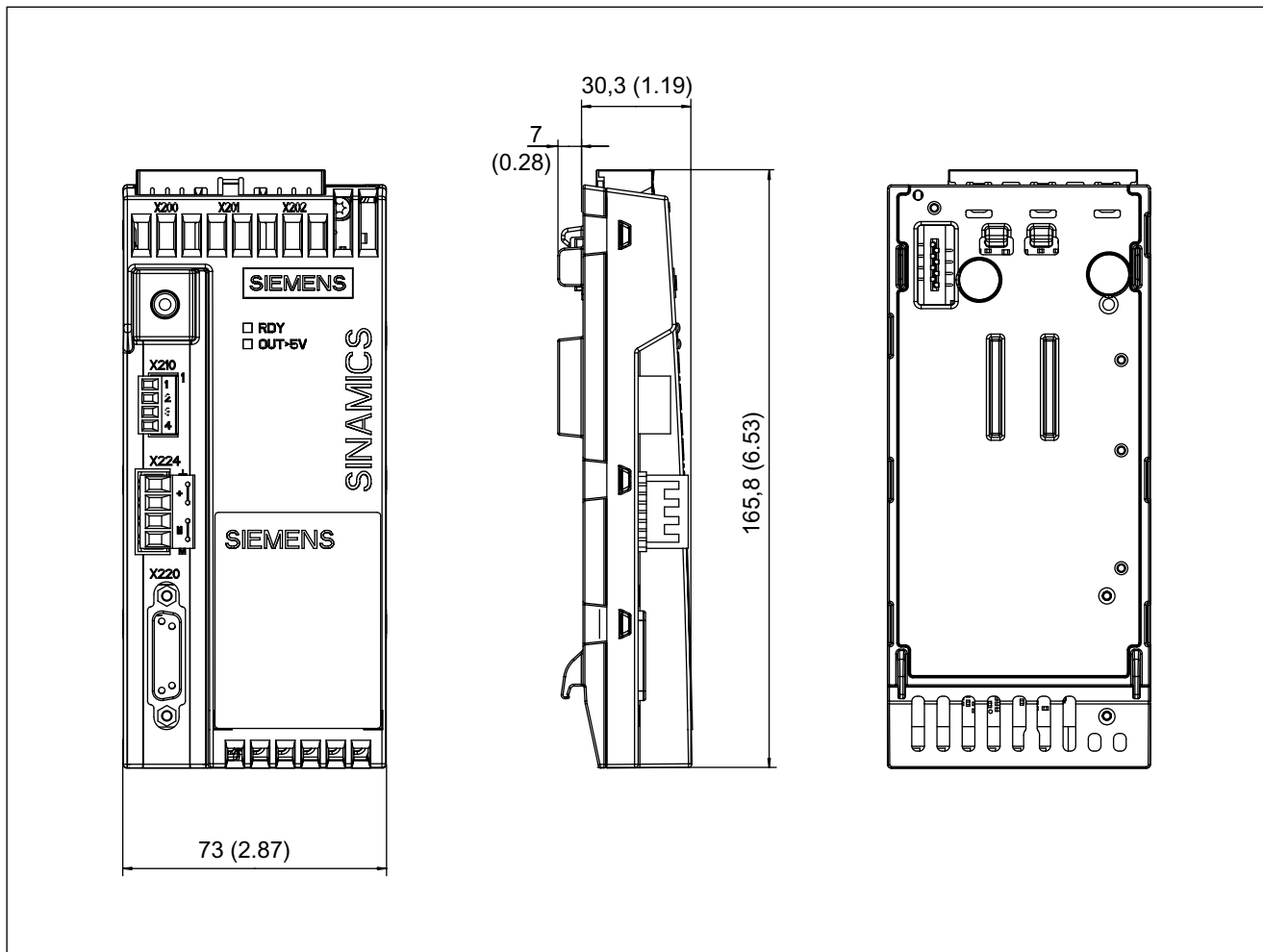


Figure 6-15 Dimension drawing of the CUA32 Control Unit Adapter

6.5.5 Assembly

See Section "CUA31 Assembly".

6.5.6 Technical data

Table 6-45 Technical specifications CUA32

| | Unit | Value |
|--|-----------------|---------------------|
| Electronics power supply | | |
| Voltage | V _{DC} | 24 DC (20.4 – 28.8) |
| Current (without DRIVE-CLiQ and encoder) | A _{DC} | 0.11 |
| maximum current consumption of encoder | mA | 400 |
| Power loss | W | 2.6 |
| Maximum DRIVE-CLiQ cable length | m | 100 |
| Weight | kg | 0,32 |

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 |
| CBC10 | – | – |
| CBE20 | – | – |
| TB30 | – | – |
| 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 additional system components is provided in the following reference:

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

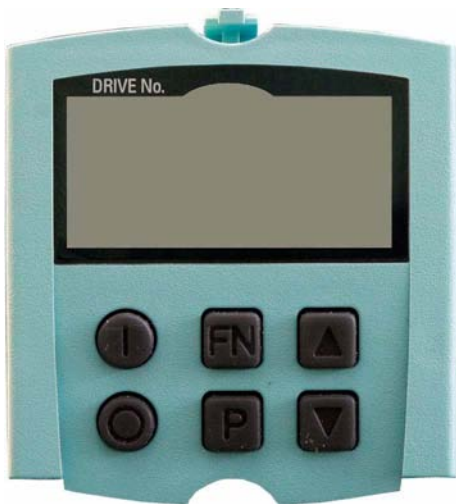


Figure 7-1 Basic Operator Panel BOP20

Overview of displays and keys

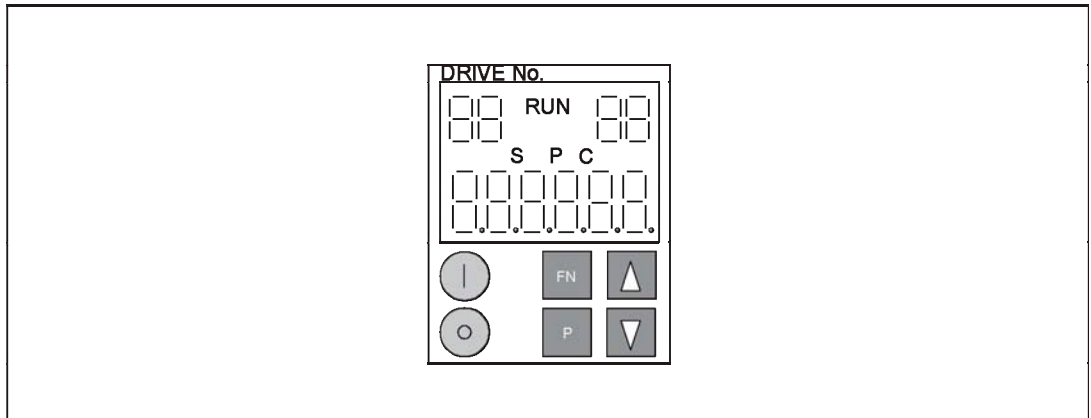








Figure 7-2 Overview of displays and keys

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: <ul style="list-style-type: none"> • 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 (bright) if at least one parameter was changed and the value was not transferred into the non-volatile memory. |
| P | Is lit (bright) if, for a parameter, the value only becomes effective after pressing the P key. |
| C | Is light (bright) if at least one parameter was changed and the calculation for consistent data management has still not been initiated. |
| Below, 6 position | Displays, e.g. parameters, indices, faults and alarms. |

BOP20 keyboard

Table 7-3 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. |
| | | <p>Note:</p> <p>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).</p> <p>The structure of the BOP control word corresponds to the structure of the PROFIBUS control word.</p> |
|  | Functions | <p>The significance of these keys depends on the actual display.</p> <p>Note:</p> <p>The effectiveness of this key to acknowledge faults can be defined using the appropriate BiCo parameterization.</p> |
|  | Parameter | The significance 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

| | |
|---|--|
|  A hand is shown holding a light blue BOP20 panel in front of a Siemens SINAMICS CU310 DP control unit. The unit has various terminals labeled X10, X12, X1, X2, X3, X4, X5, X6, X7, X8, X9, X11, X13, X14, X15, X16, X17, X18, X19, X20, X21, X22, X23, X24, X25, X26, X27, X28, X29, X30, X31, X32, X33, X34, X35, X36, X37, X38, X39, X40, X41, X42, X43, X44, X45, X46, X47, X48, X49, X50, X51, X52, X53, X54, X55, X56, X57, X58, X59, X60, X61, X62, X63, X64, X65, X66, X67, X68, X69, X70, X71, X72, X73, X74, X75, X76, X77, X78, X79, X80, X81, X82, X83, X84, X85, X86, X87, X88, X89, X90, X91, X92, X93, X94, X95, X96, X97, X98, X99, X100. |  A hand is shown pressing the two light blue bars of the dummy cover together, securing it in front of the control unit. |
| <p>1. CU310 and BOP20</p> | <p>2. Press the bars of the dummy cover together</p> |
|  A hand is shown pulling the light blue dummy cover away from the control unit, revealing the BOP20 panel. |  A hand is shown pointing to the BOP20 panel, which is now visible on the control unit. |
| <p>3. Remove the dummy cover</p> | <p>4. Locate the BOP20</p> |

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.

Table 7-5 Specification

| | Value |
|--|------------------|
| Transmission ratio of the resolver | $\ddot{u} = 0.5$ |
| Exciting voltage on the SMC10 when $\ddot{u}=0.5$ | 4.1 Vrms |
| Amplitude monitoring threshold (secondary tracks) of the SMC10 | 1 Vrms |

The excitation voltage is 4.1 V rms and cannot be parameterized.

The excitation frequency is synchronized to the current controller clock cycle and lies in the range between 5 kHz and 10 kHz.

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:

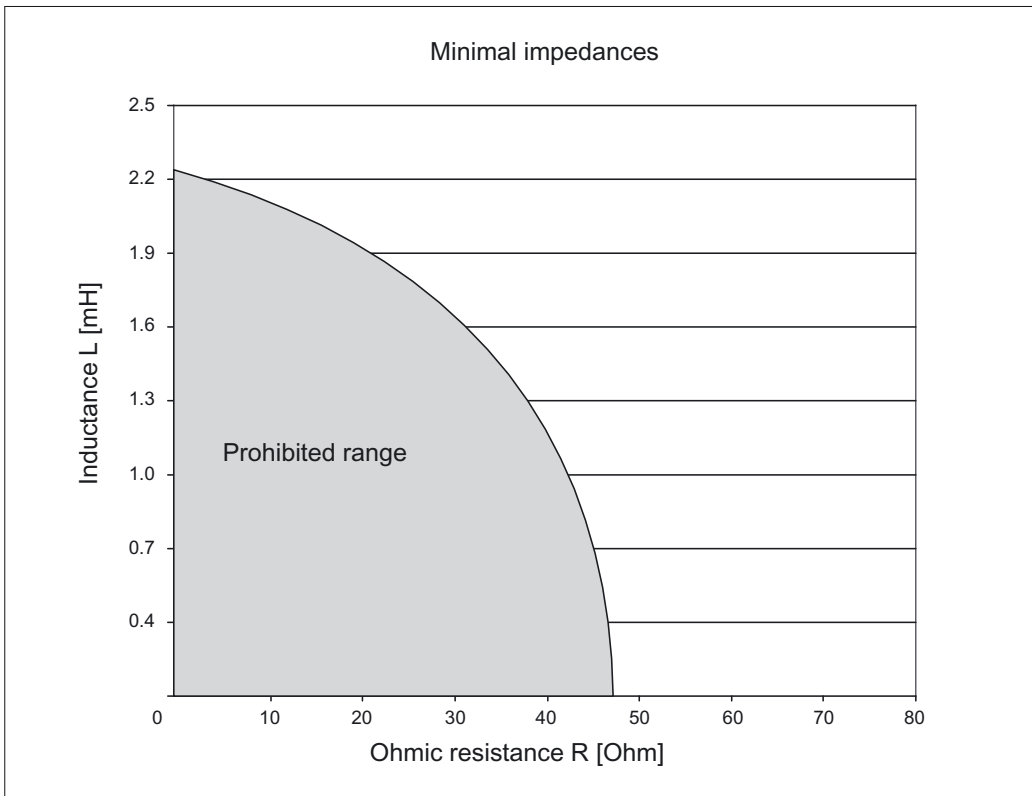


Figure 7-3 Connectable impedances with an exciting frequency $f = 5000$ Hz

The maximum sensor cable length is 130 m.

7.3.2 Safety Information

| |
|--|
|  WARNING |
|--|

| |
|---|
| The 50 mm clearances above and below the components must be observed. |
|---|

| |
|---------------|
| NOTICE |
|---------------|

| |
|---|
| Only one measuring system can be connected to each Sensor Module. |
|---|

Note

There may be no electrical connection between the measuring system housing and the measuring system electronics (this requirement is fulfilled for most encoder systems). If this is not carefully observed, then under certain circumstances the system will not be able to reach the required noise immunity (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 chassis potential at both ends over a large surface area. Temperature sensor cables that are routed together with the motor cable must be twisted in pairs and shielded separately. |
|---|

7.3.3 Interface description

7.3.3.1 Overview

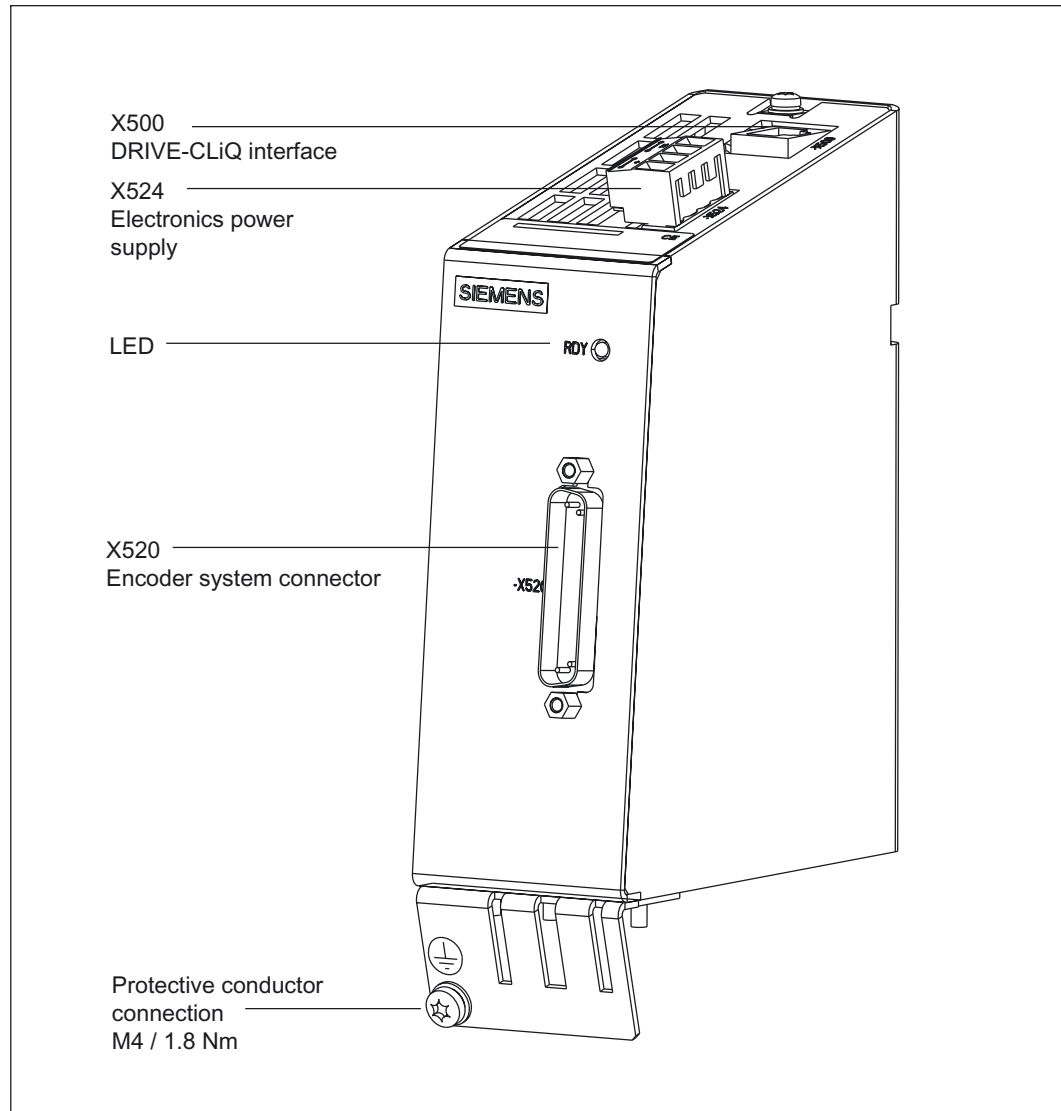
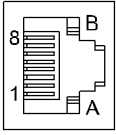


Figure 7-4 Interface description of the SMC10

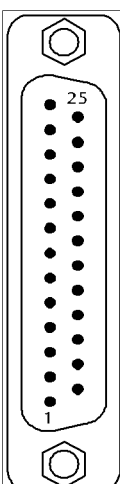
7.3.3.2 DRIVE-CLiQ interface X500

Table 7-6 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) | Electronic ground |

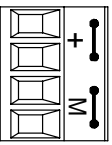
7.3.3.3 X520 sensor system

Table 7-7 Sensor interface X520

| | 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 |

7.3.3.4 Electronics power supply X524

Table 7-8 Terminal block X524

| | 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 at 55°C |
| | + | Electronics power supply | |
| | M | Electronic ground | |
| | M | Electronic ground | |
| Max. connectable cross-section: 2.5 mm ² Type: Screw terminal 2 (see Appendix) | | | |

Note

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

7.3.3.5 Meaning of LEDs on the Sensor Module Cabinet 10 / 20 (SMC10 / SMC20)

Table 7-9 Sensor Module Cabinet 10 / 20 (SMC10 / 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 | The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. | - |
| | Orange | Continuous | DRIVE-CLiQ communication is being established. | - |
| | Red | Continuous | At least one fault is present in this component. Note: LED is driven irrespective of the corresponding messages being 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:

Reference: /IH1/ SINAMICS Commissioning Manual.

7.3.4 Dimension drawing

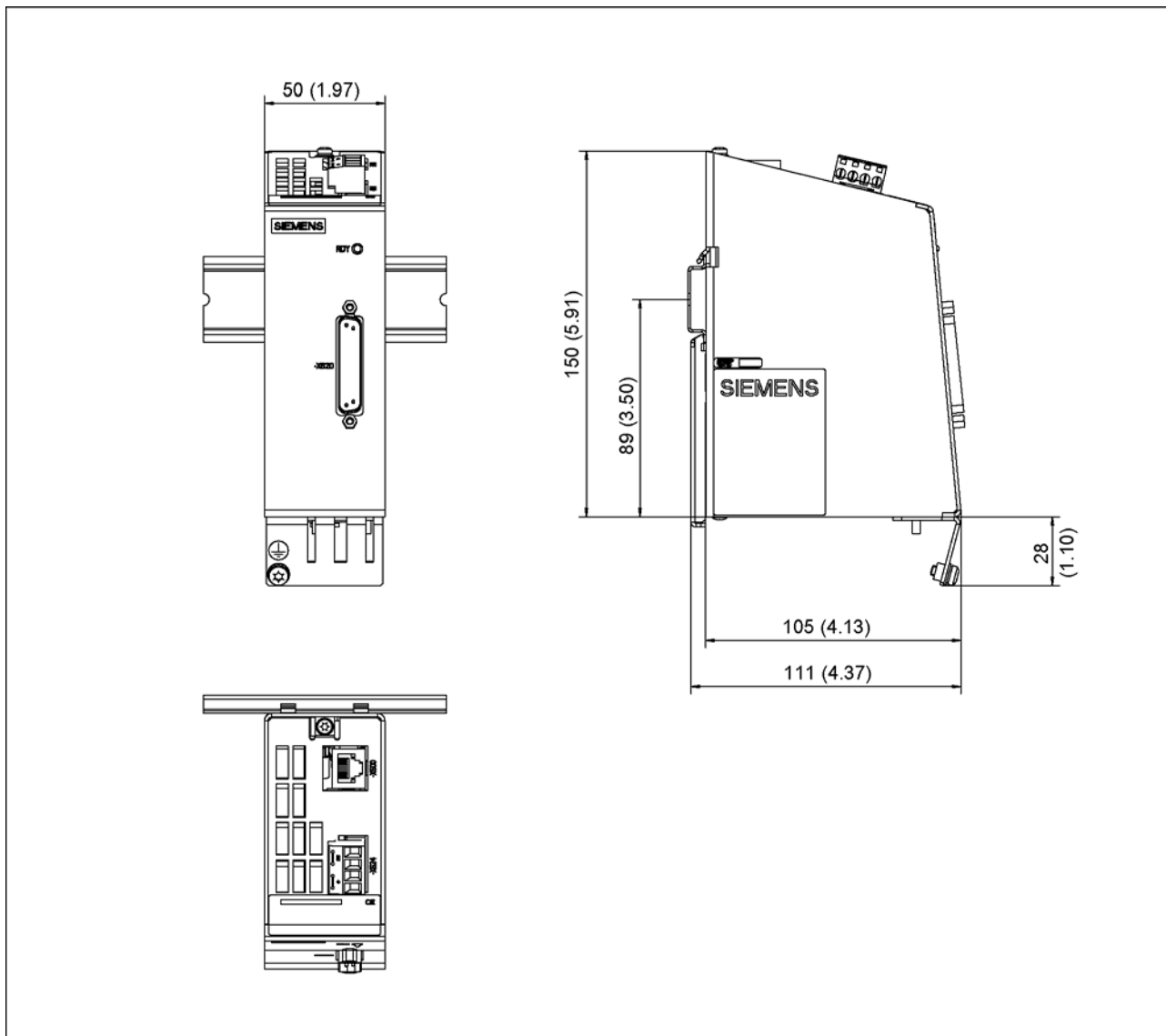


Figure 7-5 Dimension drawing of the SMC10

7.3.5 Installation

Installation

1. Place the component on the DIN rail.
2. Snap the component on to the DIN rail. Make sure that the mounting slides at the rear latch into place.
3. You can now move the component on the DIN rail to the left or to the right to its final position.

Removal

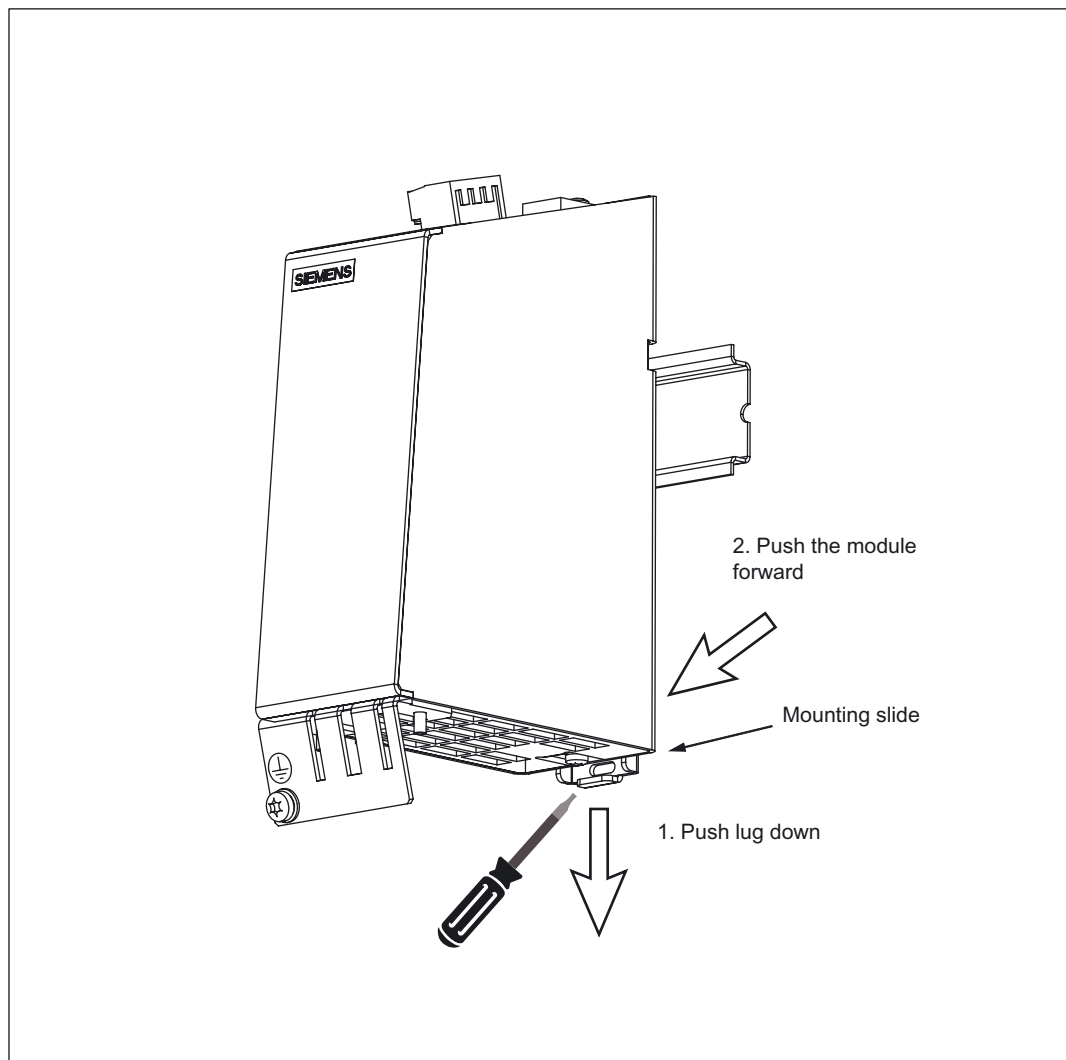


Figure 7-6 Releasing the component from a DIN rail

7.3.6 Technical data

Table 7-10 Technical specifications

| Sensor Module Cabinet-Mounted SMC10 6SL3055-0AA00-5AAx | Designation | Unit | Value |
|---|---------------|---|---------------------|
| Electronics power supply | | | |
| Voltage | V_{DC} | V | 24 DC (20.4 – 28.8) |
| Current (without measuring system) | A_{DC} | A | ≤ 0.20 |
| Current (with measuring system) | A_{DC} | A | ≤ 0.35 |
| Power loss | W | W | ≤ 10 |
| Measuring system power supply | | Refer to table "Specifications" | |
| Voltage | | | |
| Current | | | |
| Encoder frequency that can be evaluated | $f_{encoder}$ | Refer to the table "Max. frequency that can be evaluated (speed)" | |
| PE/ground connection | | On housing with M4/1.8 Nm screw | |
| Weight | | kg | 0,8 |
| Degree of protection | | IP20 or IPXXB | |

Table 7-11 Max. frequency that can be evaluated (speed)

| Resolver | | Max. speed resolver / motor | | |
|-----------------|----------------------|-----------------------------|----------------------|----------------------|
| Number of poles | Number of pole pairs | 8kHz / 125 μ sec | 4kHz / 250 μ sec | 2kHz / 500 μ sec |
| 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 |

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.

Encoders that can be connected are incremental SIN/COS (1 Vpp) and absolute encoders with EnDat and SSI.

7.4.2 Safety information

| |
|--|
|  WARNING |
|--|

| |
|---|
| The 50 mm clearances above and below the components must be observed. |
|---|

| |
|---------------|
| NOTICE |
|---------------|

| |
|---|
| Only one measuring system can be connected to each Sensor Module. |
|---|

Note

There may be no electrical connection between the measuring system housing and the measuring system electronics (this requirement is fulfilled for most encoder systems). If this is not carefully observed, then under certain circumstances the system will not be able to reach the required noise immunity (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 chassis potential at both ends over a large surface area. Temperature sensor cables that are routed together with the motor cable must be twisted in pairs and shielded separately. |
|---|

7.4.3 Interface description

7.4.3.1 Overview

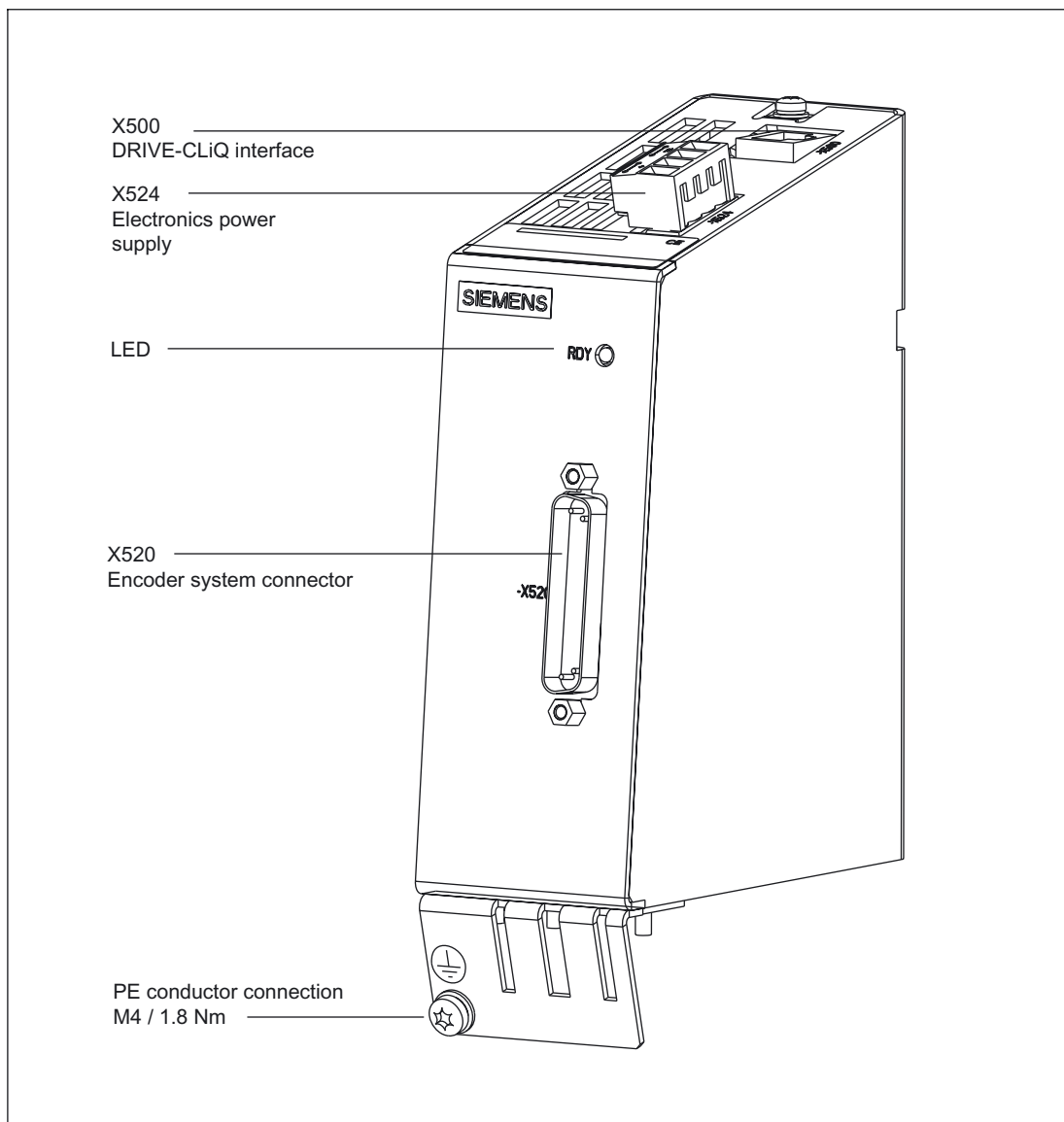
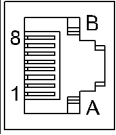


Figure 7-7 Interface description of the SMC20

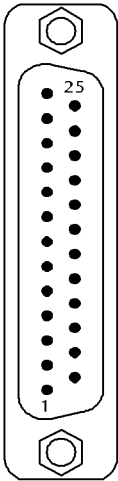
7.4.3.2 DRIVE-CLiQ interface X500

Table 7-12 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) | Electronic ground |

7.4.3.3 X520 sensor system

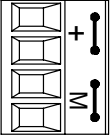
Table 7-13 Sensor interface X520



| 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 | 5 V Sense | Sense input encoder power supply |
| 15 | Data | Data, EnDat interface, SSI data |
| 16 | 0 V 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 value 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 Electronics power supply X524

Table 7-14 Terminal block X524

| | 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 at 55°C |
| | + | Electronics power supply | |
| | M | Electronic ground | |
| | M | Electronic ground | |
| Max. connectable cross-section: 2.5 mm ² Type: Screw terminal 2 (see Appendix A) | | | |

Note

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

7.4.3.5 Meaning of LEDs on the Sensor Module Cabinet 10 / 20 (SMC10 / SMC20)

Table 7-15 Sensor Module Cabinet 10 / 20 (SMC10 / 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 | The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. | - |
| | Orange | Continuous | DRIVE-CLiQ communication is being established. | - |
| | Red | Continuous | At least one fault is present in this component. Note: LED is driven irrespective of the corresponding messages being 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:

Reference: /IH1/ SINAMICS Commissioning Manual.

7.4.4 Dimension drawing

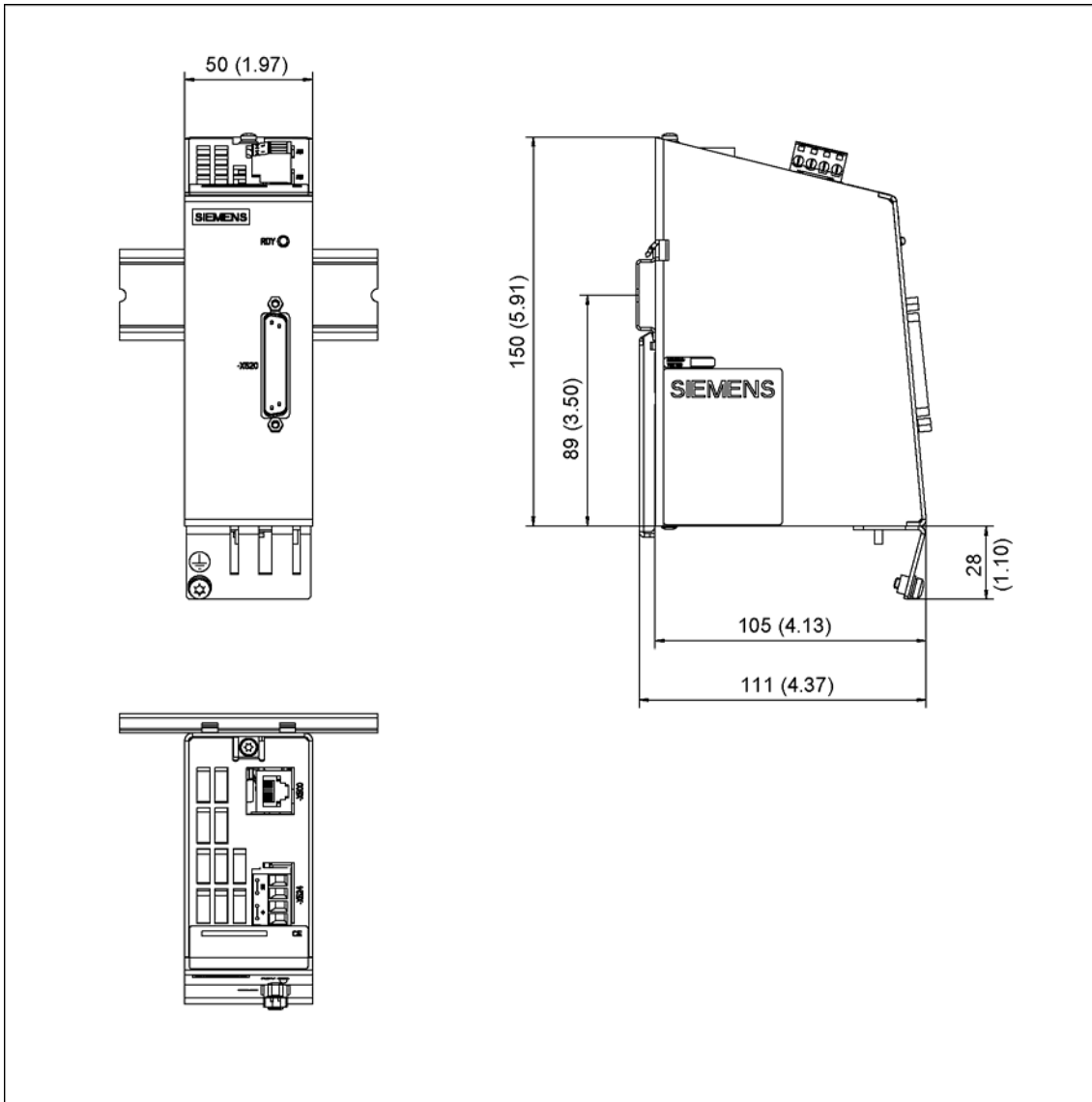


Figure 7-8 Dimension drawing of the SMC20

7.4.5 Installation

Installation

1. Place the component on the DIN rail.
2. Snap the component on to the DIN rail. Make sure that the mounting slides at the rear latch into place.
3. You can now move the component on the DIN rail to the left or to the right to its final position.

Removal

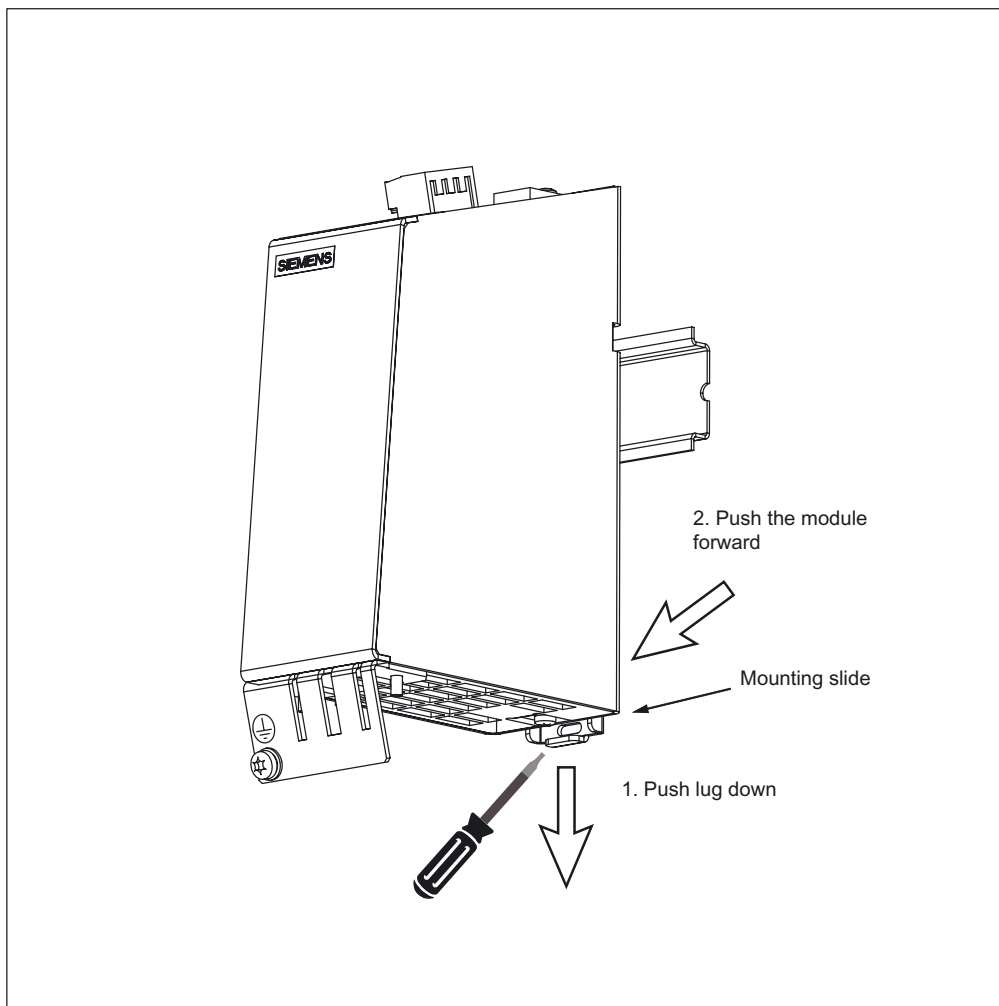


Figure 7-9 Releasing the component from a DIN rail

7.4.6 Technical Specifications

Table 7-16 Technical data

| Sensor Module Cabinet-Mounted SMC20 6SL3055-0AA00-5BAx | Designation | Unit | Value |
|---|---------------|-----------------------------------|----------------------------|
| Electronics power supply | | | |
| Voltage | V_{DC} | V | 24 DC (20.4 – 28.8) |
| Current (without measuring system) | A_{DC} | A | ≤ 0.20 |
| Current (with measuring system) | A_{DC} | A | ≤ 0.35 |
| SSI baud rate | kHz | kHz | 100 |
| Power loss | W | W | ≤ 10 |
| Measuring system power supply | | | |
| Voltage | $V_{encoder}$ | V | 5 V DC (with Remote Sense) |
| Current | $A_{encoder}$ | A | 0.35 |
| Encoder frequency that can be evaluated | $f_{encoder}$ | kHz | ≤ 500 |
| Max. encoder cable length | | m | 100 |
| PE/ground connection | | On housing with M4 / 1.8 Nm screw | |
| Weight | | kg | 0,8 |
| Degree of protection | | IP20 or IPXXB | |

7.5 Option modules, 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 in conjunction with Power Modules of the Blocksize format can be used 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 power supply voltage for the brake separately at the option module brake control. In this case, a regulated power supply is required whose rated value (to balance the voltage drop in the supply cable for the 24 V DC motor brake coil) can be set to 26 V (e.g. SITOP modular).

Table 7-17 Overview of the Safe Brake Relay interfaces

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

The Safe Brake Relay is 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 power supply 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 power supply for the brake remains within the permissible range when the following conditions are fulfilled:

- Using Siemens three-phase motors
- Using Siemens MOTION-CONNECT power cables
- Motor cable lengths: max. 100 m

7.5.2.2 Interface description

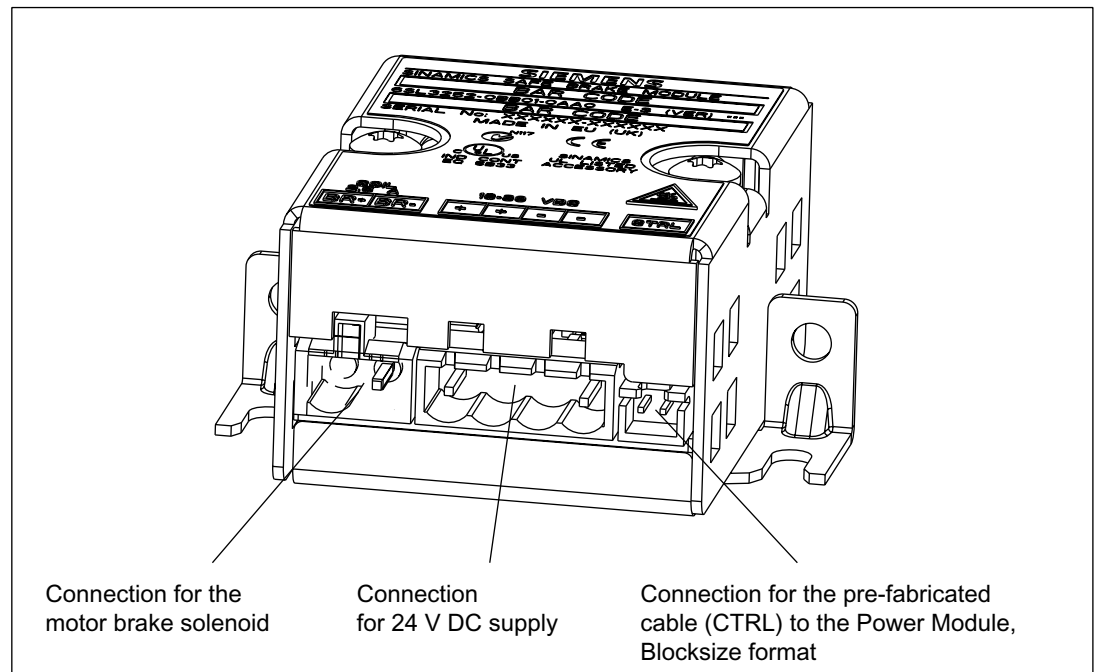


Figure 7-10 Interface description: Safe Brake Relay

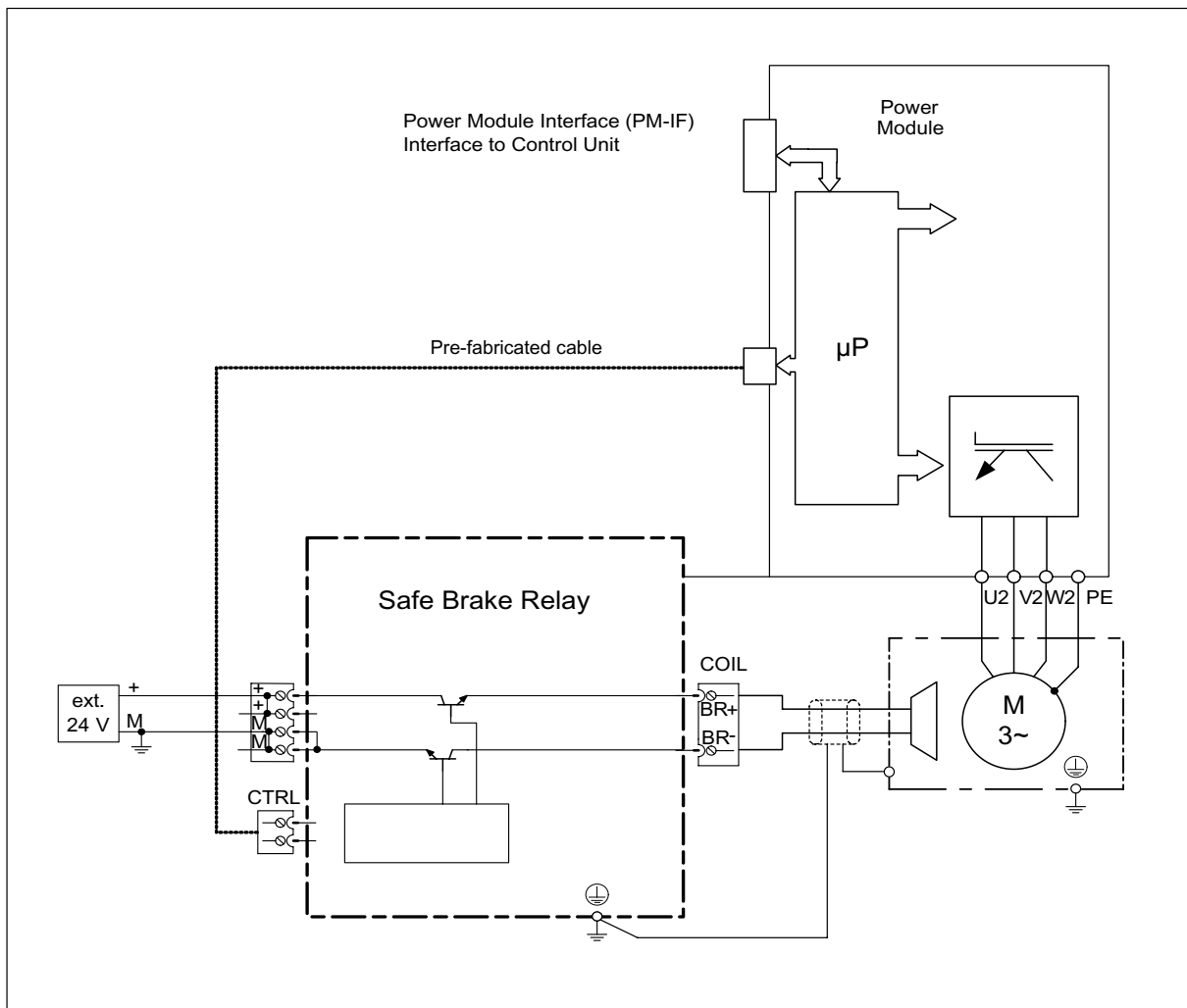
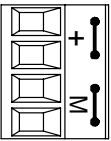


Figure 7-11 Connection example: Safe Brake Relay

Electronics power supply X524

Table 7-18 Terminal block X524

| | Terminal | Function | Technical specifications |
|--|----------|--------------------------|---|
|  | + | Electronics power supply | Voltage: 24 V (20.4 V – 28.8 V) |
| | + | Electronics power supply | |
| | M | Electronic ground | Maximum current via jumper in connector: 20 A at 55°C |
| | M | Electronic ground | |
| Max. cross-section that can be connected: 2.5 mm ² Type: Screw terminal 2 (see Appendix) | | | |

Note

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

Brake connection

Table 7-19 Connector

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

7.5.2.3 Dimension drawing

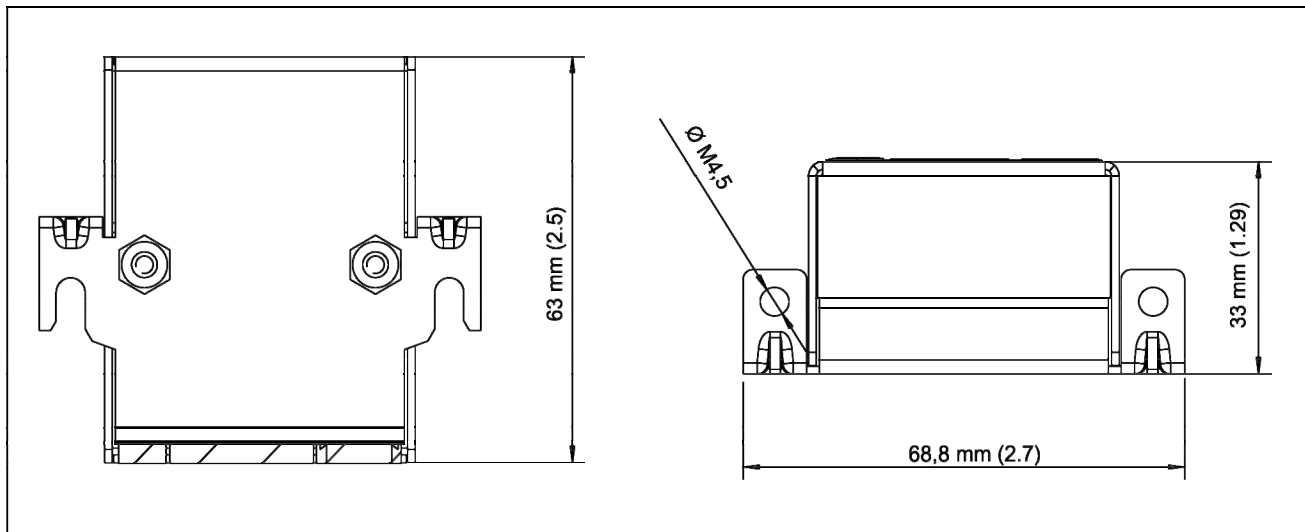


Figure 7-12 Dimension drawing: Safe Brake Relay

7.5.2.4 Mounting

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

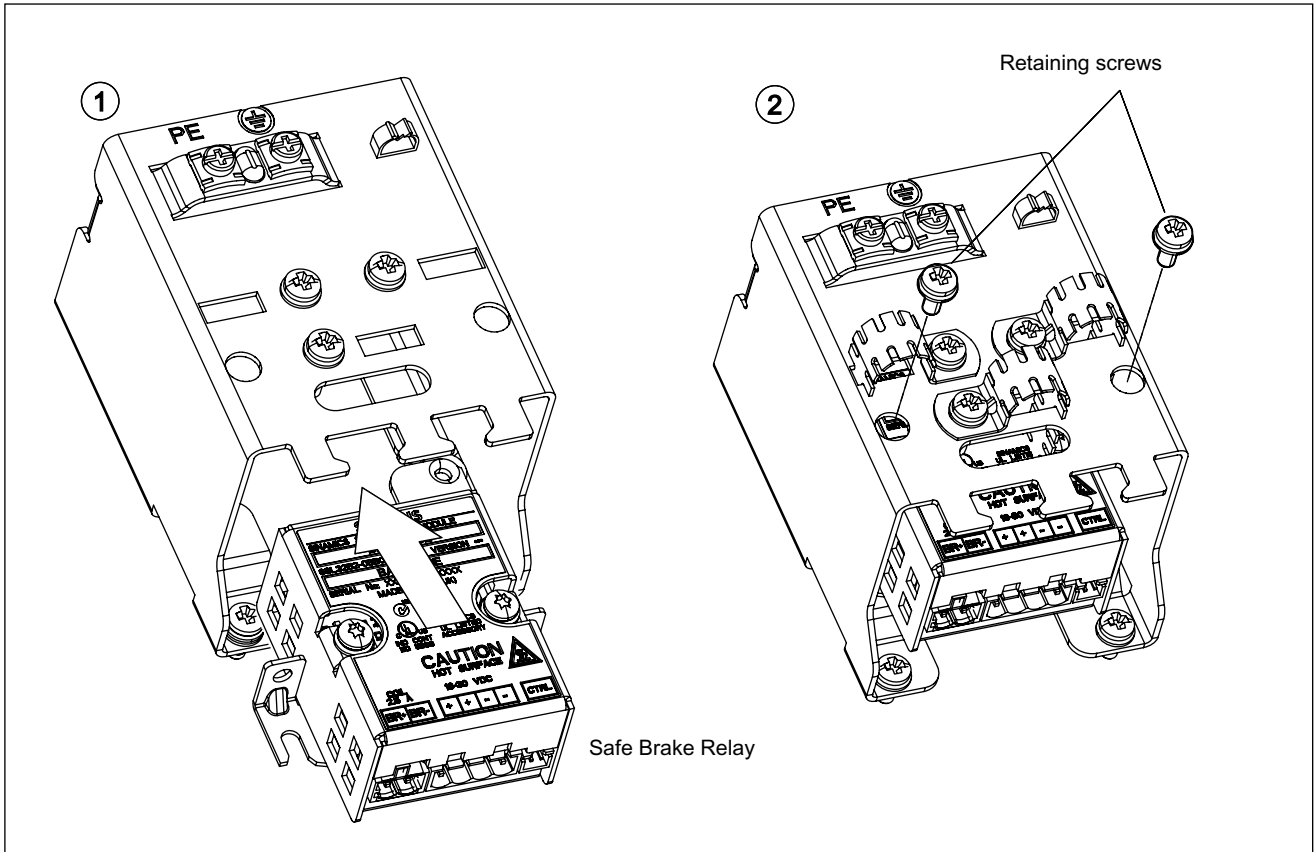


Figure 7-13 Mounting the Safe Brake Relay on the Screening Kit (frame size FSA)

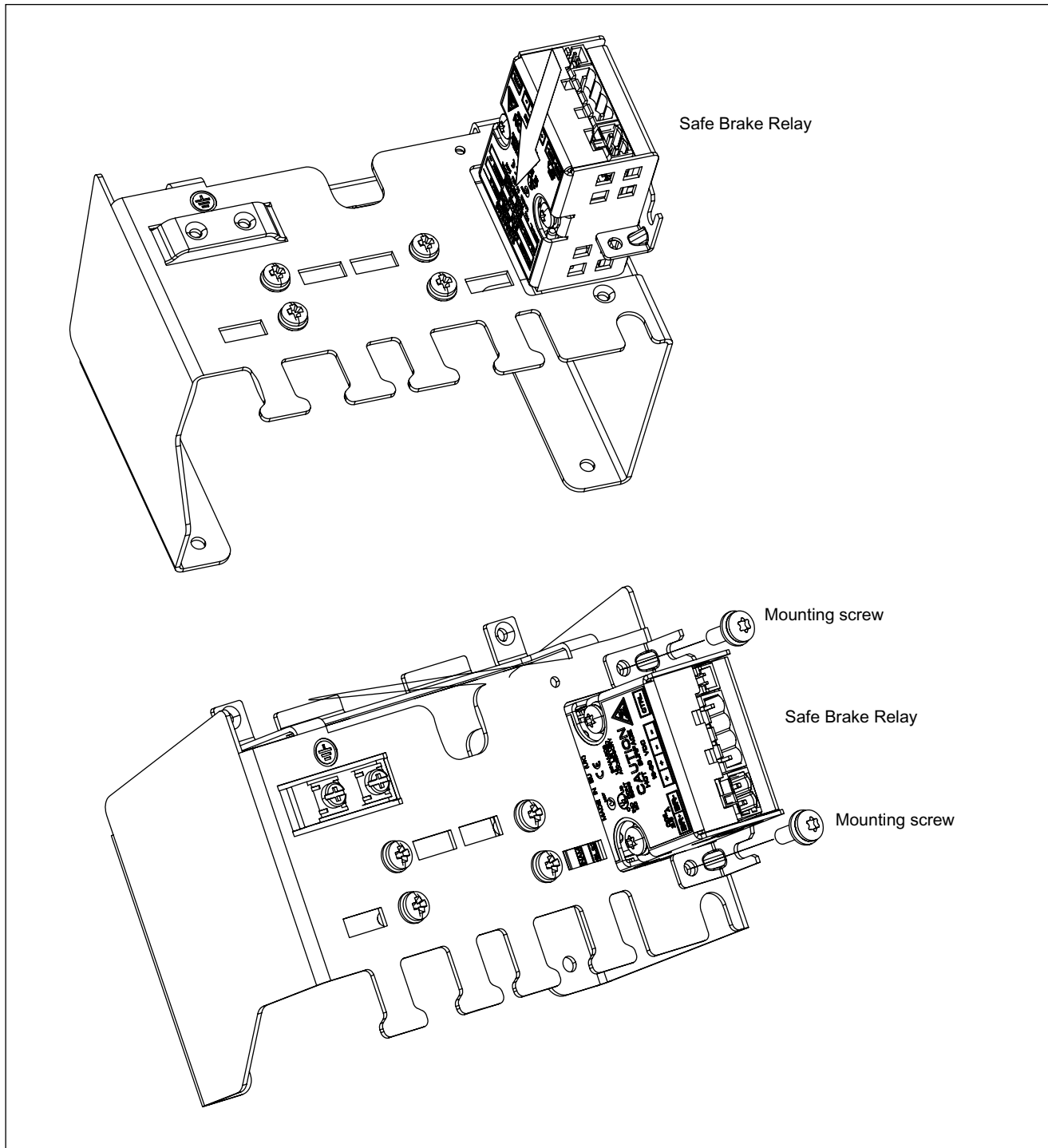


Figure 7-14 Mounting the Safe Brake Relay on the Screening Kit (frame sizes FSB and FSC)

7.5.2.5 Technical data

| Safe Brake Relay | |
|---|---|
| Power supply | 20.4 to 28.8 V DC Recommended nominal value of the power supply 26 V DC (to equalize and compensate for the voltage drop along the feeder cable to the 24 V DC solenoid of the motor brake) |
| 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

8.1 DRIVE-CLiQ cabinet gland

8.1.1 Description

The DRIVE-CLiQ cabinet gland is used to connect two DRIVE-CLiQ cables and can be installed in a cabinet panel.

At the interface outside the cabinet, a DRIVE-CLiQ connection is implemented with degree of protection IP67 acc. to EN 60529; however, on the other hand inside the cabinet, a connection with degree of protection IP20 or IPXXB acc. to EN 60529. The interface between the cabinet panel and DRIVE-CLiQ cabinet gland should have degree of protection IP54 acc. 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 Siemens cables should be used for DRIVE-CLiQ connections.

8.1.3 Interface description

8.1.3.1 Overview

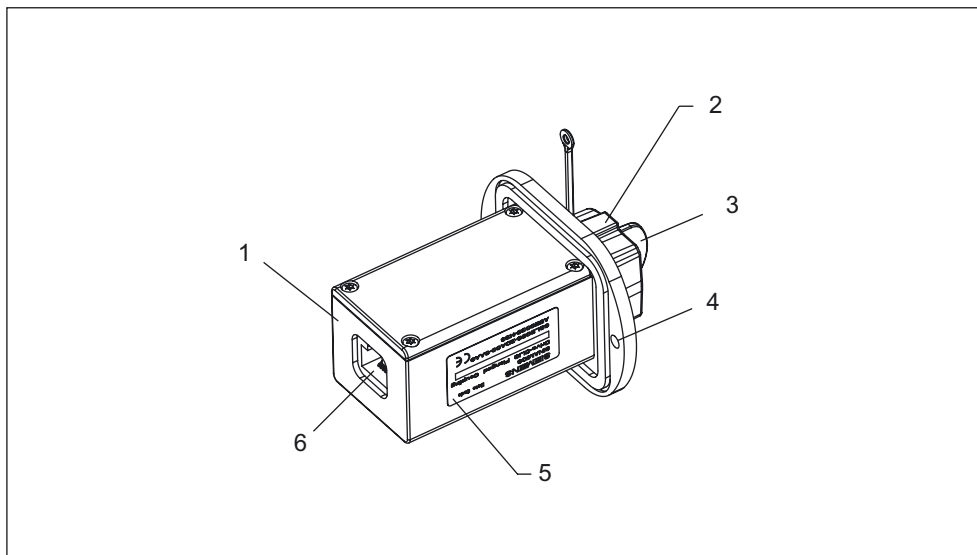


Figure 8-1 DRIVE-CLiQ cabinet gland

| | |
|---|---|
| 1 | DRIVE-CLiQ cabinet gland |
| 2 | Covering cap, Yamaichi, order no.: Y-ConAS-24-S |
| 3 | IP67 acc. to EN 60529 interface |
| 4 | Mounting holes |
| 5 | Rating plate |
| 6 | IP20 or IPXXB acc. to EN 60529 interface |

8.1.4 Dimension drawing

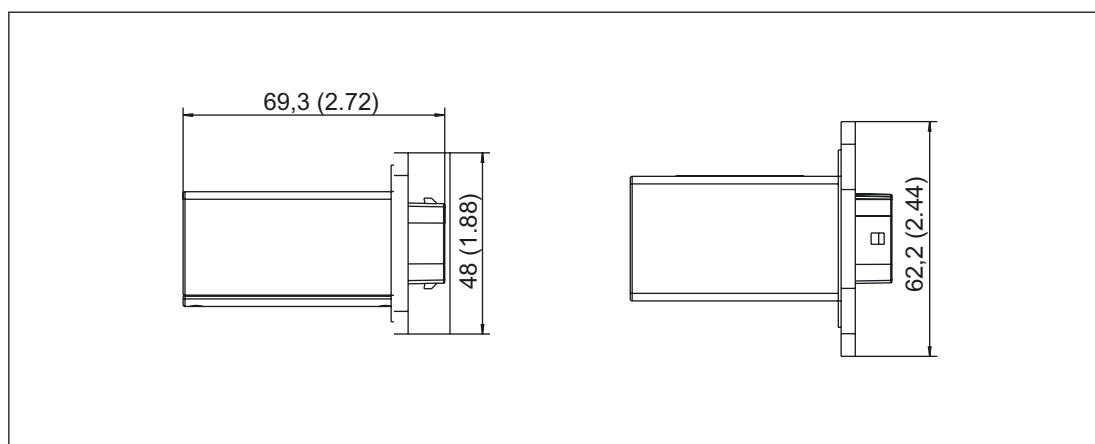


Figure 8-2 Dimensions of the DRIVE-CLiQ cabinet gland, all dimensions in mm and (inches)

| Accessories | W [mm] | D [mm] | H [mm] |
|--------------------------------------|-------------|-------------|-----------|
| DRIVE-CLiQ cabinet gland (with seal) | 69,3 (2.72) | 62,2 (2.44) | 48 (1.88) |

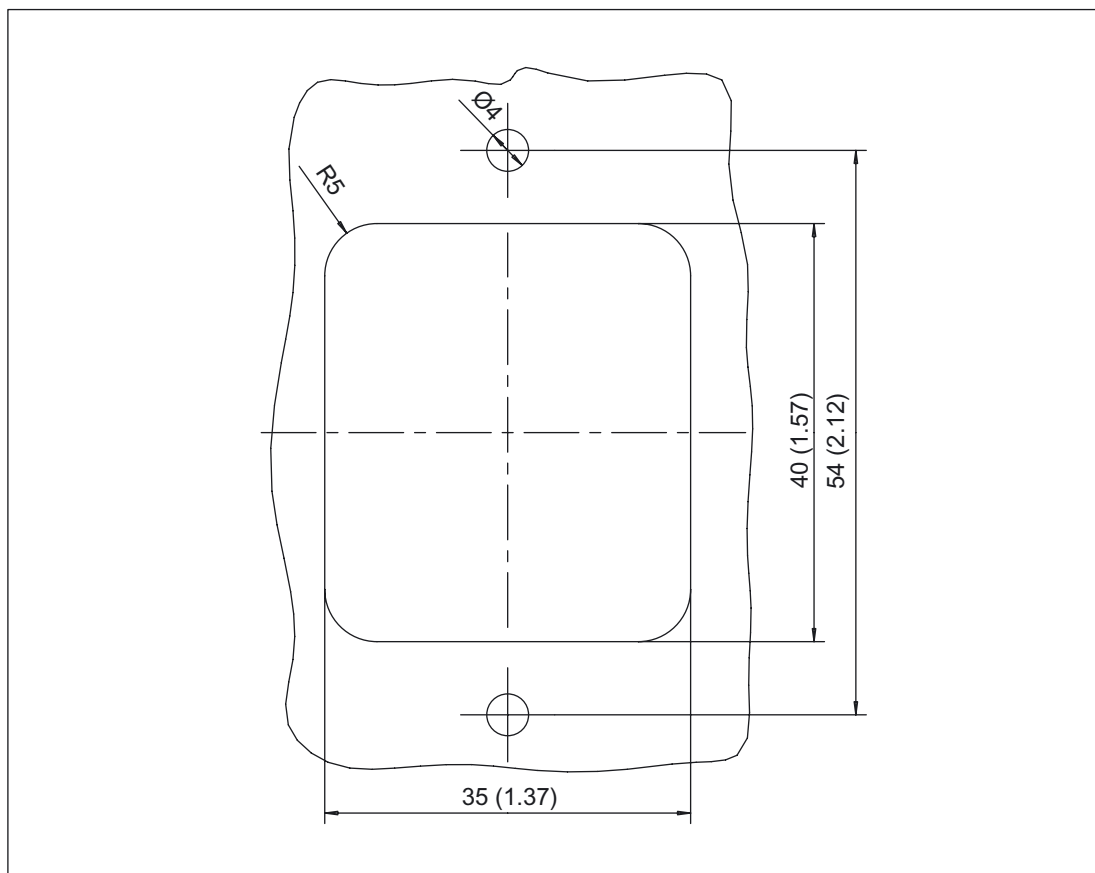


Figure 8-3 Cut-out for the cabinet

8.1.5 Mounting

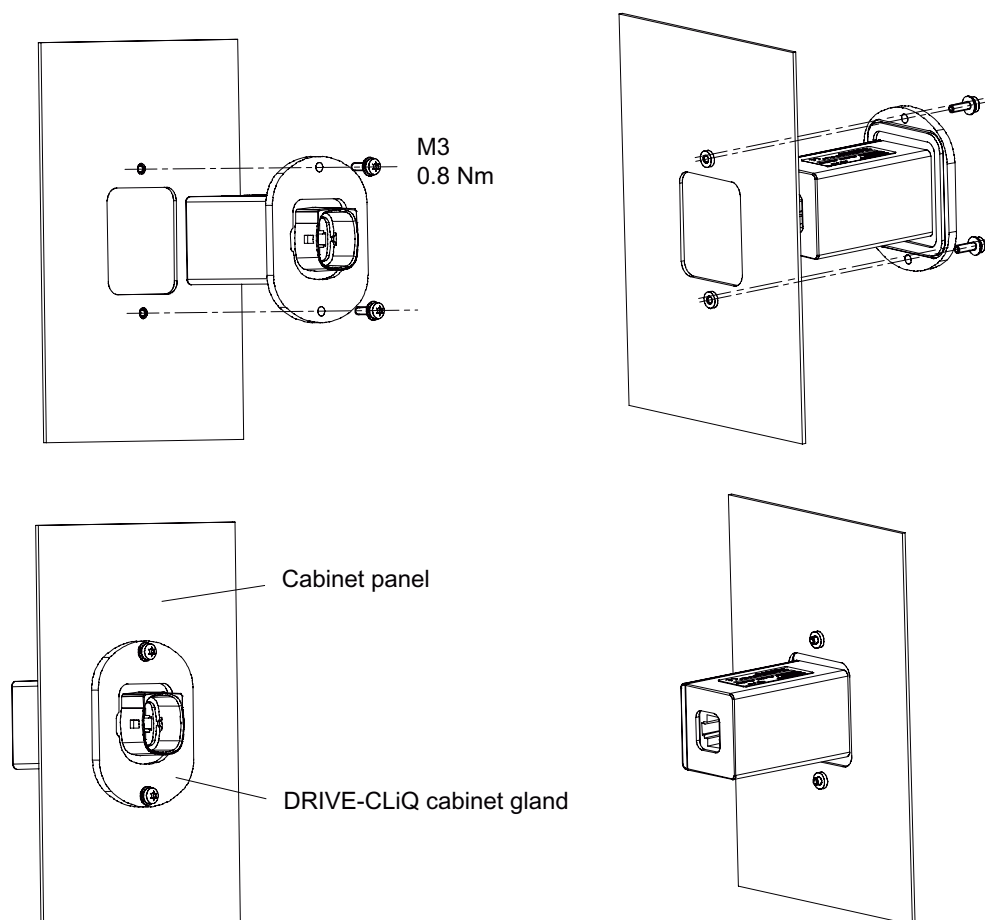


Figure 8-4 DRIVE-CLiQ cabinet gland

Installation

1. Make an opening in the cabinet panel according to the Chapter "Dimension drawing" for the DRIVE-CLiQ cabinet gland.
2. Insert the components from the outer side of the cabinet through the opening in the cabinet.
3. Secure the DRIVE-CLiQ cabinet gland to the outer cabinet panel using two M3 screws and two nuts. In order to ensure good electromagnetic compatibility, a good electrical connection must be established between the DRIVE-CLiQ cabinet gland and the cabinet panel.

8.1.6 Technical data

Table 8-1 Technical data

| DRIVE-CLiQ cabinet gland 6SL3066-2DA00-0AAx | Unit | |
|--|---|-------|
| Weight | kg | 0,135 |
| 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.

8.2.2 Safety Information

Note

Only Siemens cables should be used for DRIVE-CLiQ connections.

8.2.3 Interface description

8.2.3.1 Overview

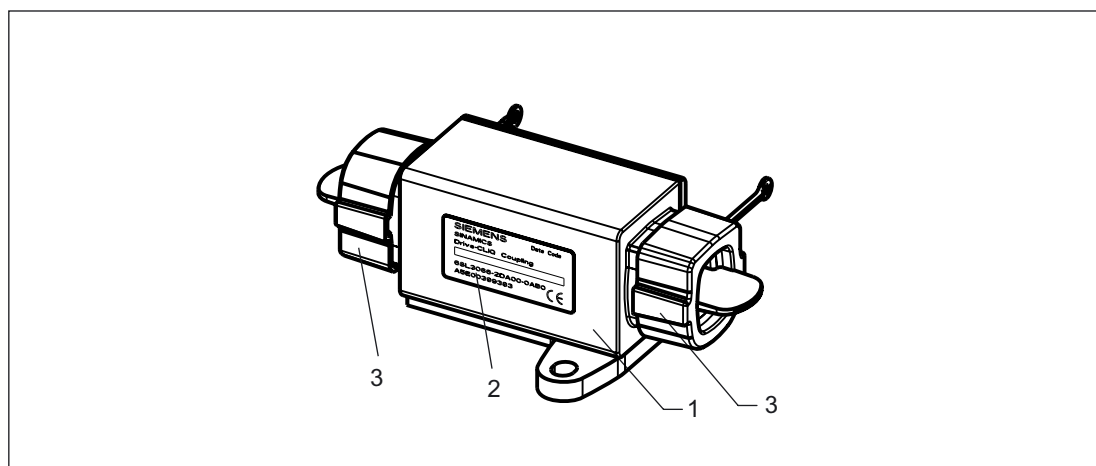


Figure 8-5 DRIVE-CLiQ coupling

| | |
|---|--|
| 1 | DRIVE-CLiQ coupling |
| 2 | Rating plate |
| 3 | Covering caps, Yamaichi, Order No.: Y-ConAS-24-S |

8.2.4 Dimension drawing

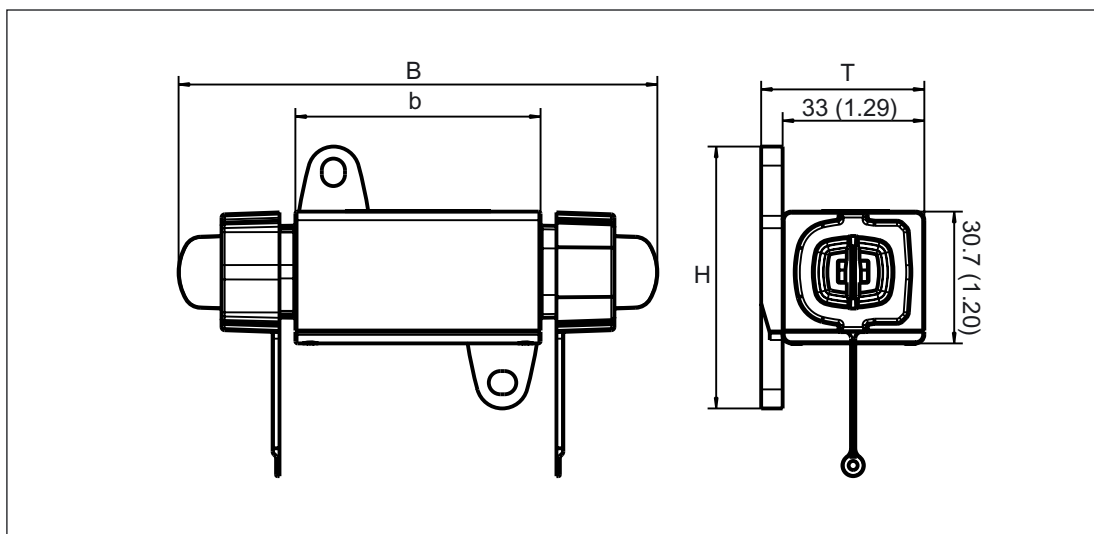


Figure 8-6 Dimension drawing, DRIVE-CLiQ coupling

Table 8-2 Dimensions of the DRIVE-CLiQ coupling, all data in mm and (inches)

| Accessories | W [mm] | b [mm] | H [mm] | D [mm] |
|---------------------|--------------|-------------|-----------|-----------|
| DRIVE-CLiQ coupling | 111,5 (4.38) | 57,1 (2.24) | 61 (2.40) | 38 (1.49) |

8.2.5 Installation

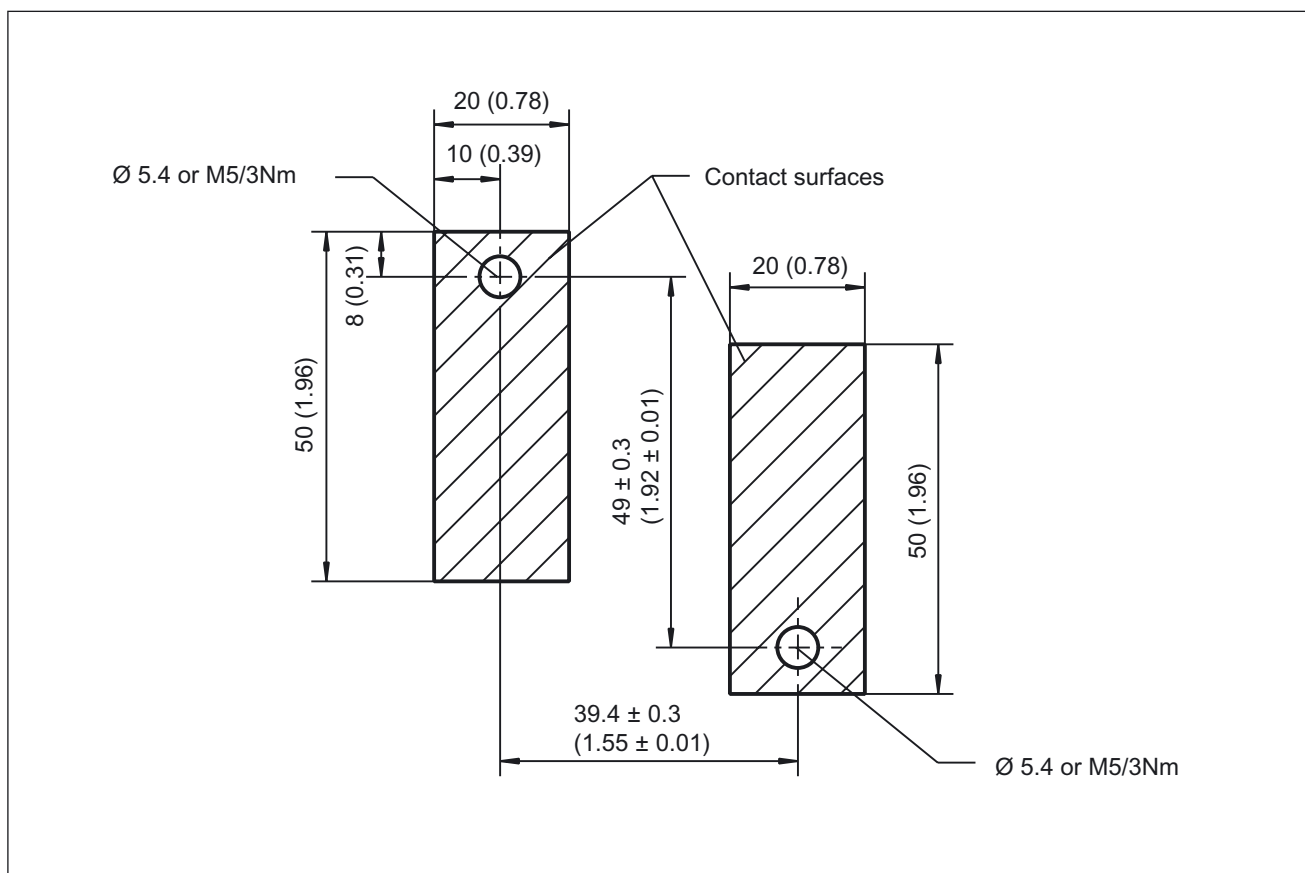


Figure 8-7 Hole drilling template for installation

1. Fit the DRIVE-CLiQ coupling to the mounting surface in accordance with the drilling template.
2. Remove the protective caps on the DRIVE-CLiQ coupling.
3. Insert the DRIVE-CLiQ connector at both ends of the DRIVE-CLiQ coupling.

8.2.6 Technical data

Table 8-3 Technical data

| DRIVE-CLiQ coupling 6FX2003-0DC1x | Unit | |
|--------------------------------------|-----------------------|------|
| Weight | kg | 0,14 |
| Degree of protection | IP67 acc. to EN 60529 | |

8.3 Screening Kit

Shielding methods

A Screening Kit is available as option for all frame sizes to connect the shield. This Screening Kit is used to connect the shield of power cables. For frame sizes FSA to FSC, the Screening Kit is directly mounted on the electrical cabinet panel and for frame sizes FSD to FSF, it is screwed to the Power Module.

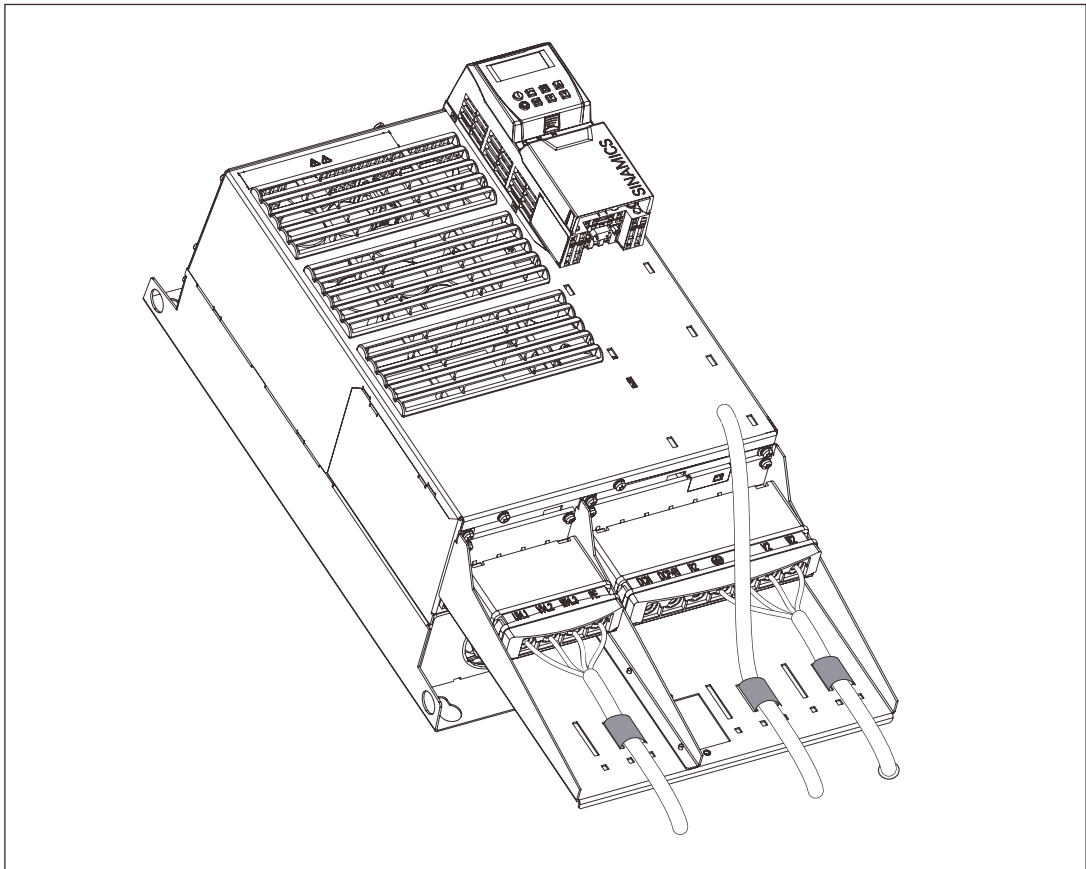


Figure 8-8 Power Module PM340 (frame sizes FSD, FSE) with CUA31 and Screening Kit

Table 8-4 Overview, Screening Kit

| Screening Kit 6SL3262- | 1AA00-0BA0 | 1AB00-0DA0 | 1AC00-0DA0 | 1AD00-0DA0 | 1AD00-0DA0 | 1AF00-0DA0 |
|---------------------------|------------|------------|------------|------------|------------|------------|
| for PM340 Frame size | FSA | FSB | FSC | FSD | FSE | FSF |

8.3.1 Dimension drawings

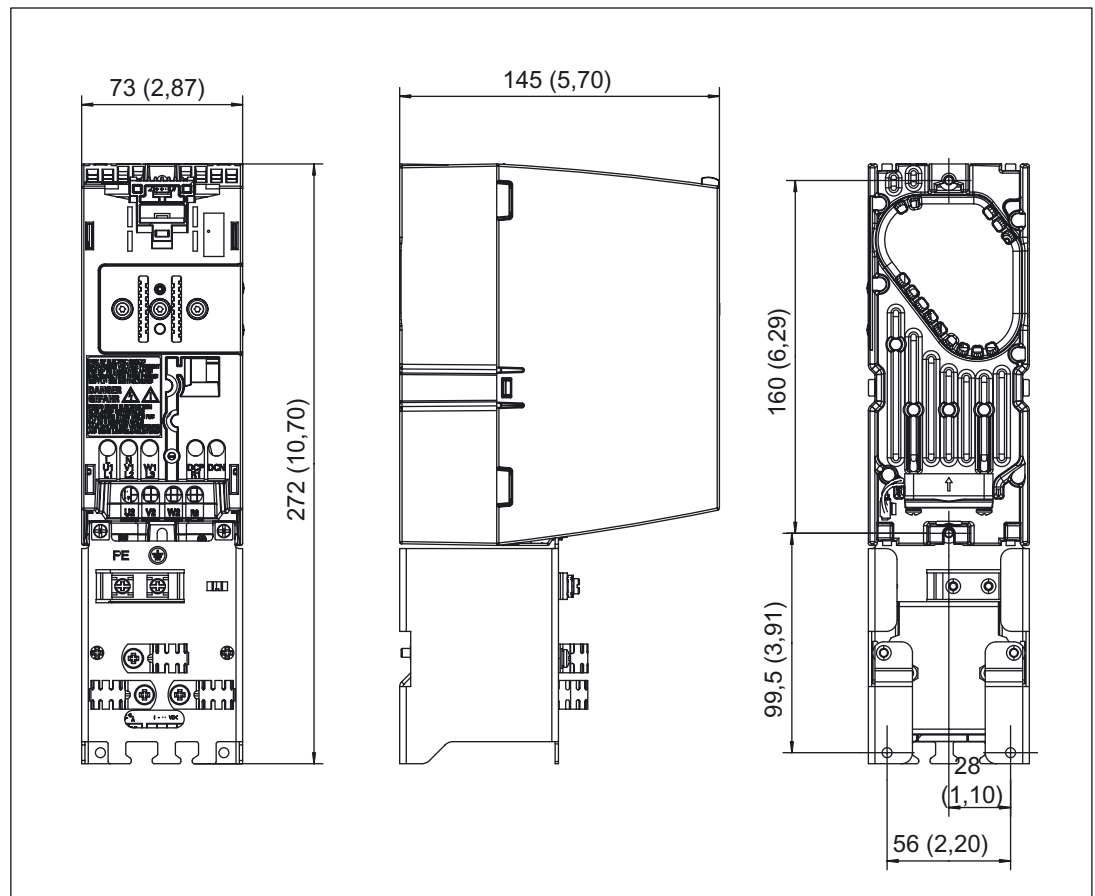


Figure 8-9 Dimension drawing: Power Module PM340 with Screening Kit and Brake Relay, frame size FSA

8.3 Screening Kit

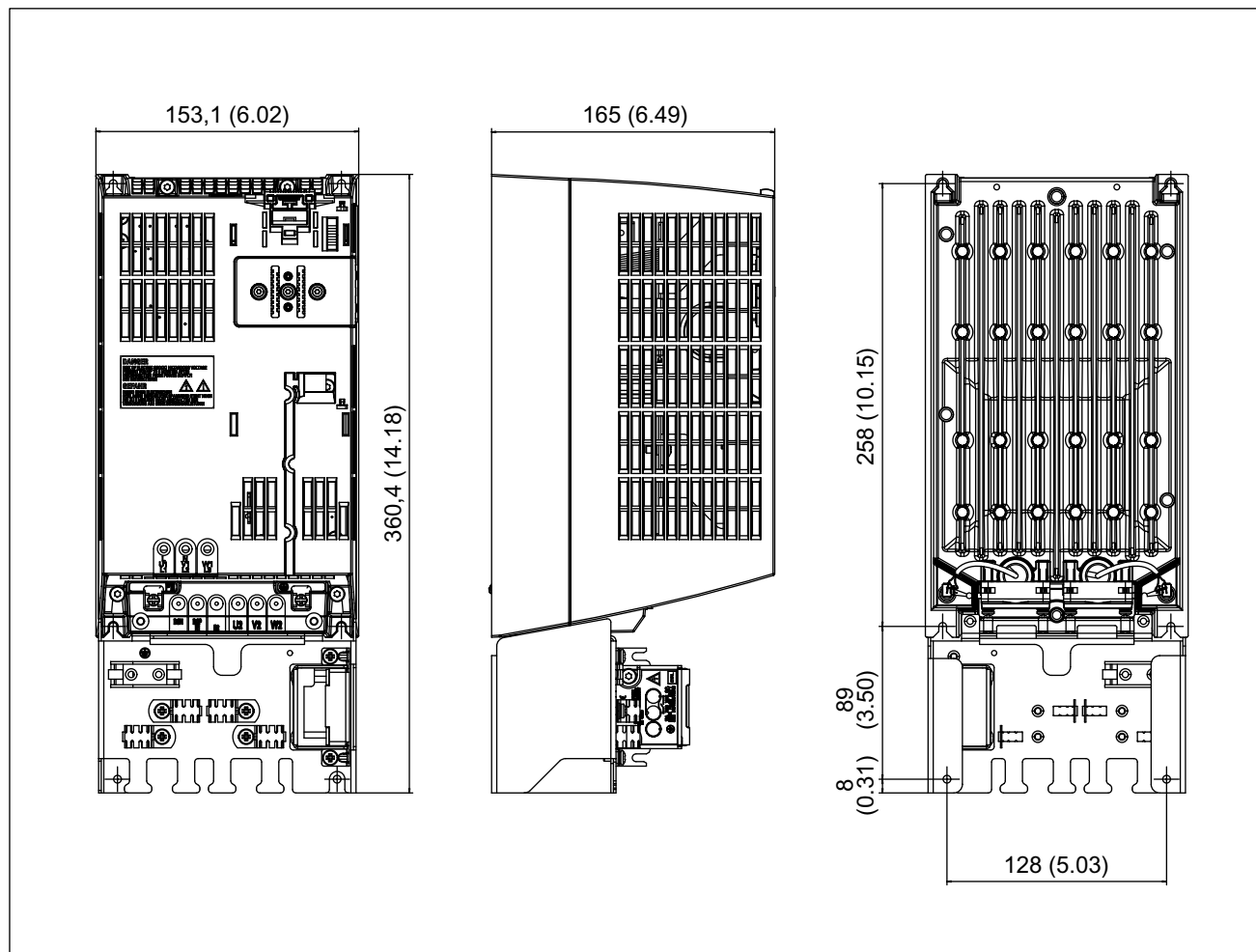


Figure 8-10 Dimension drawing: Power Module PM340 with Screening Kit and Brake Relay, frame size FSB

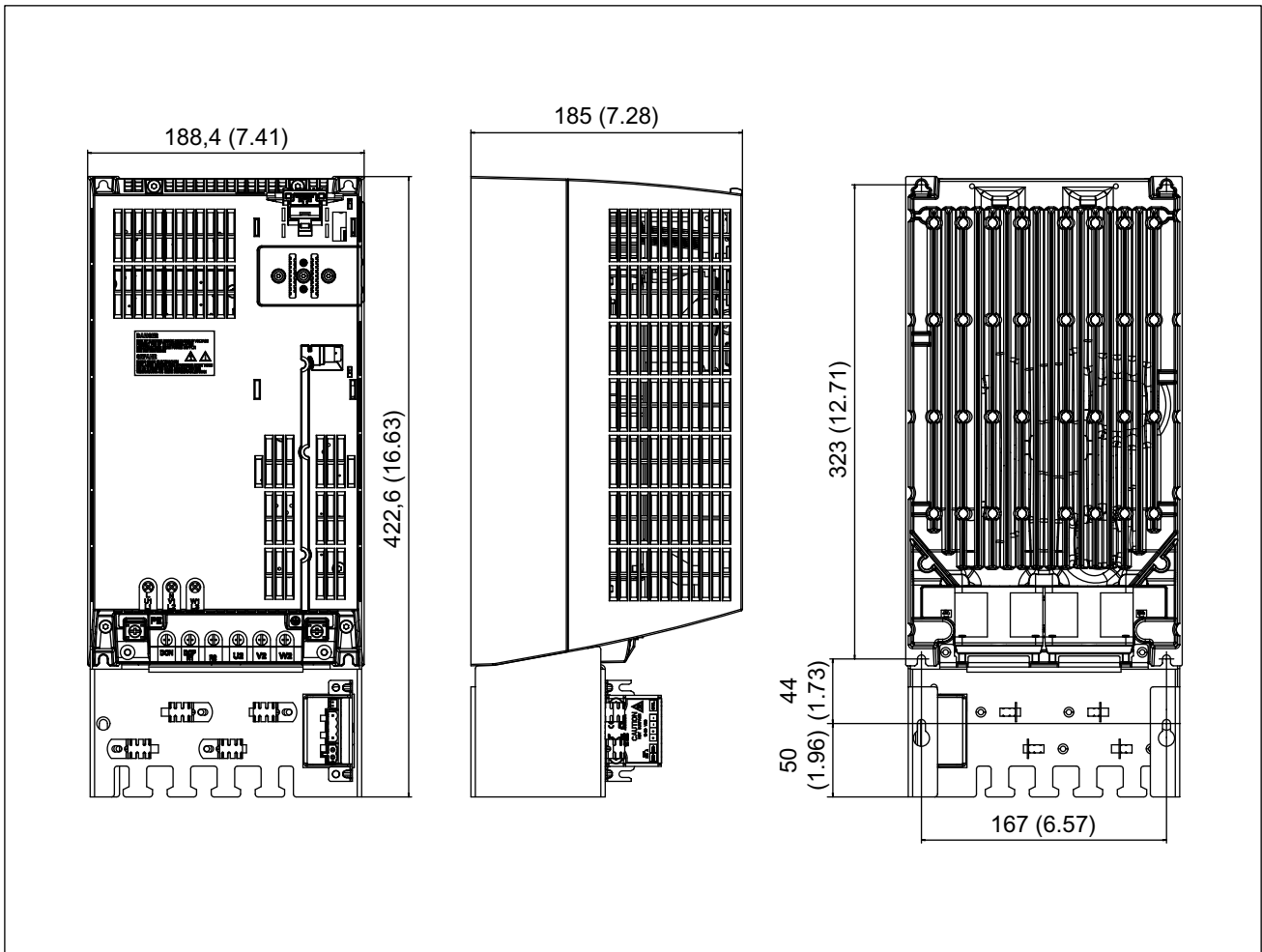


Figure 8-11 Dimension drawing: Power Module PM340 with Screening Kit and Brake Relay, frame size FSC

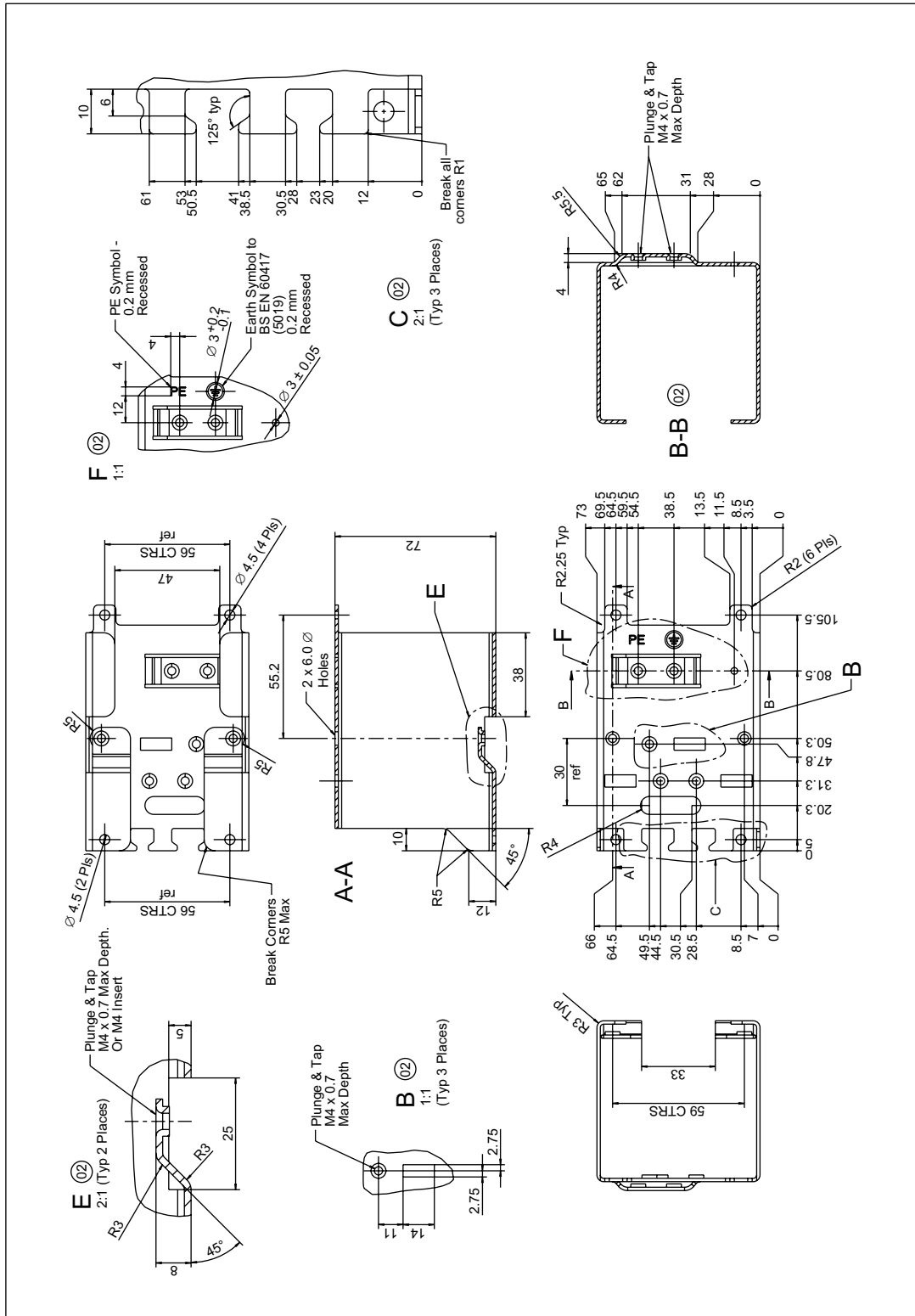


Figure 8-12 Dimension drawing: Screening Kit, frame size FSA

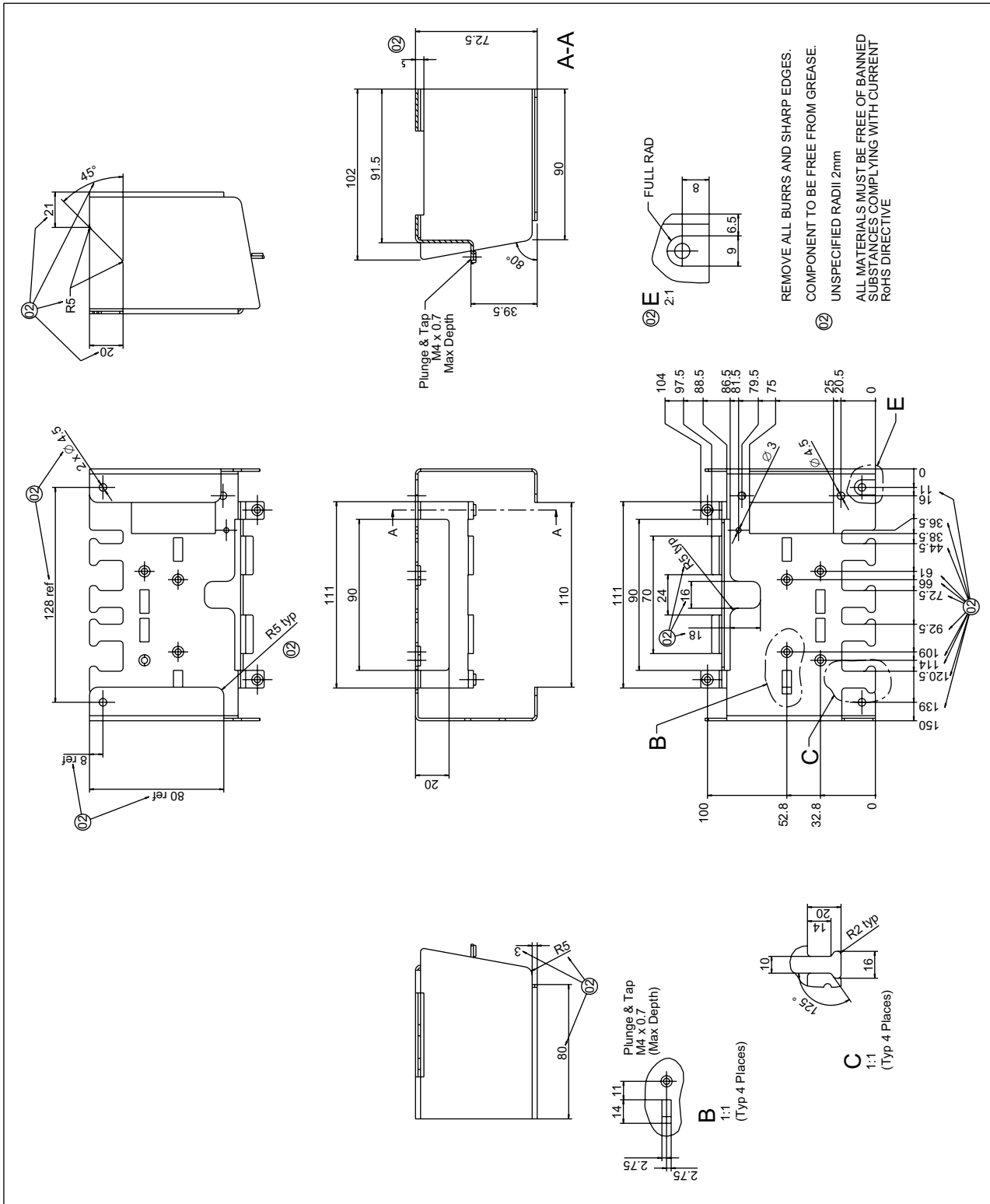


Figure 8-13 Dimension drawing: Screening Kit, frame size FSB

8.3 Screening Kit

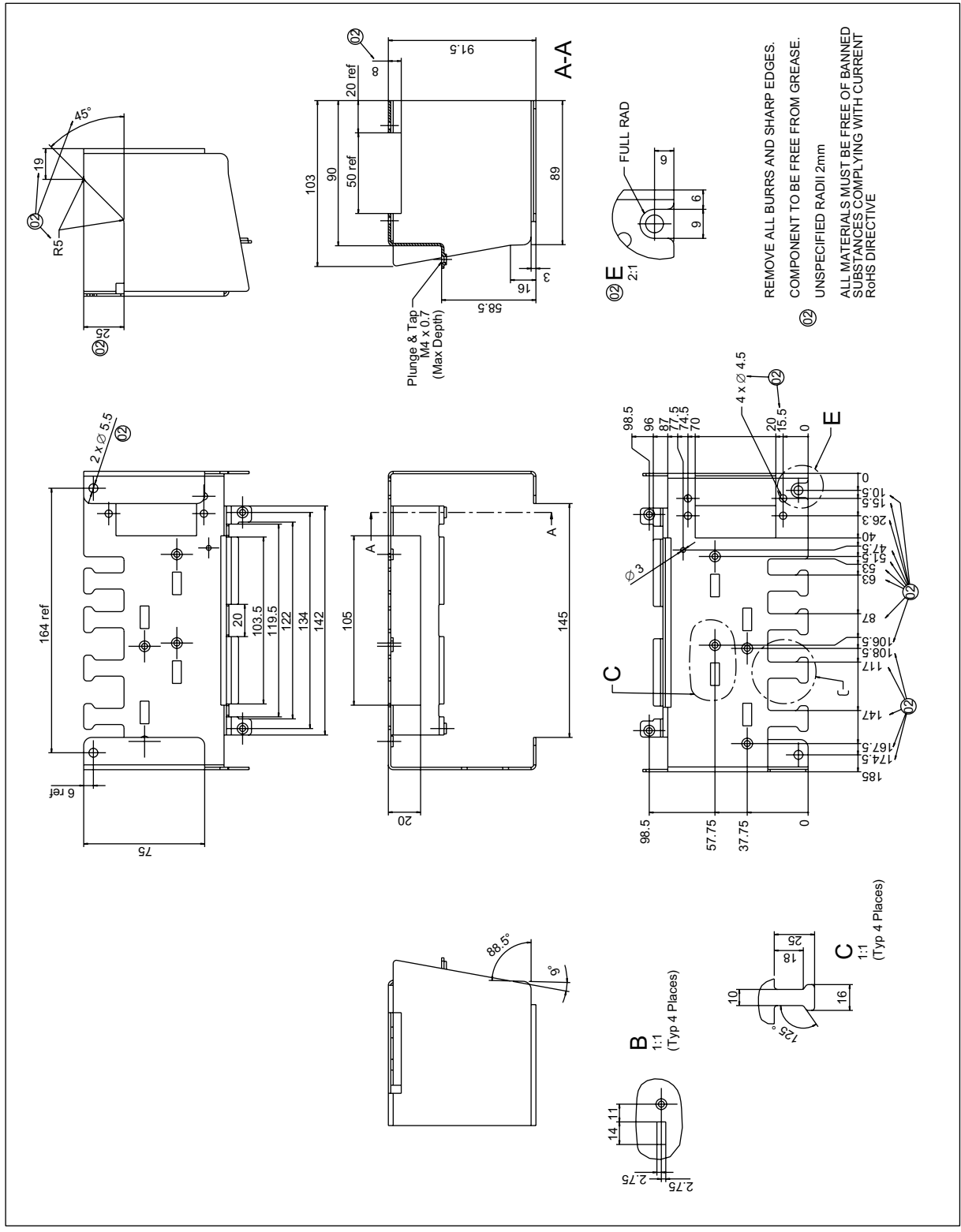


Figure 8-14 Dimension drawing: Screening Kit, frame size FSC

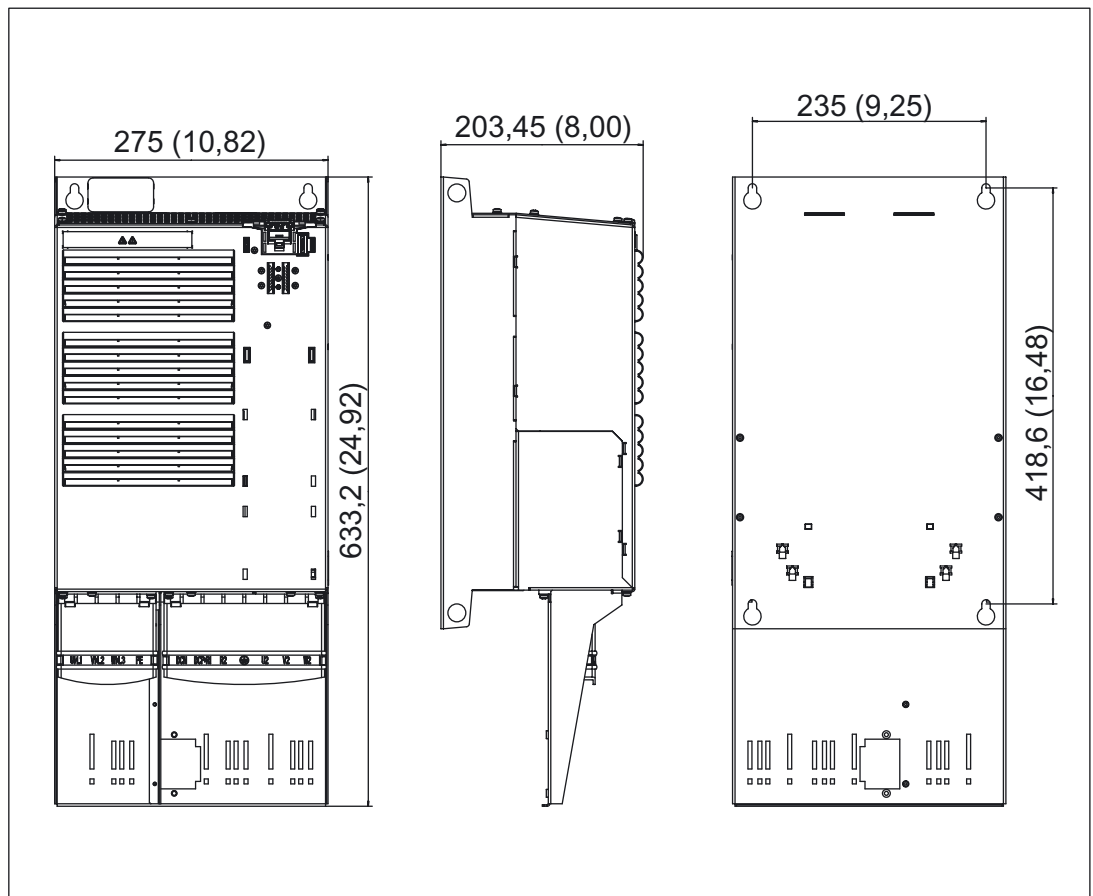


Figure 8-15 Dimension drawing: Power Module PM340 with Screening Kit, frame size FSD

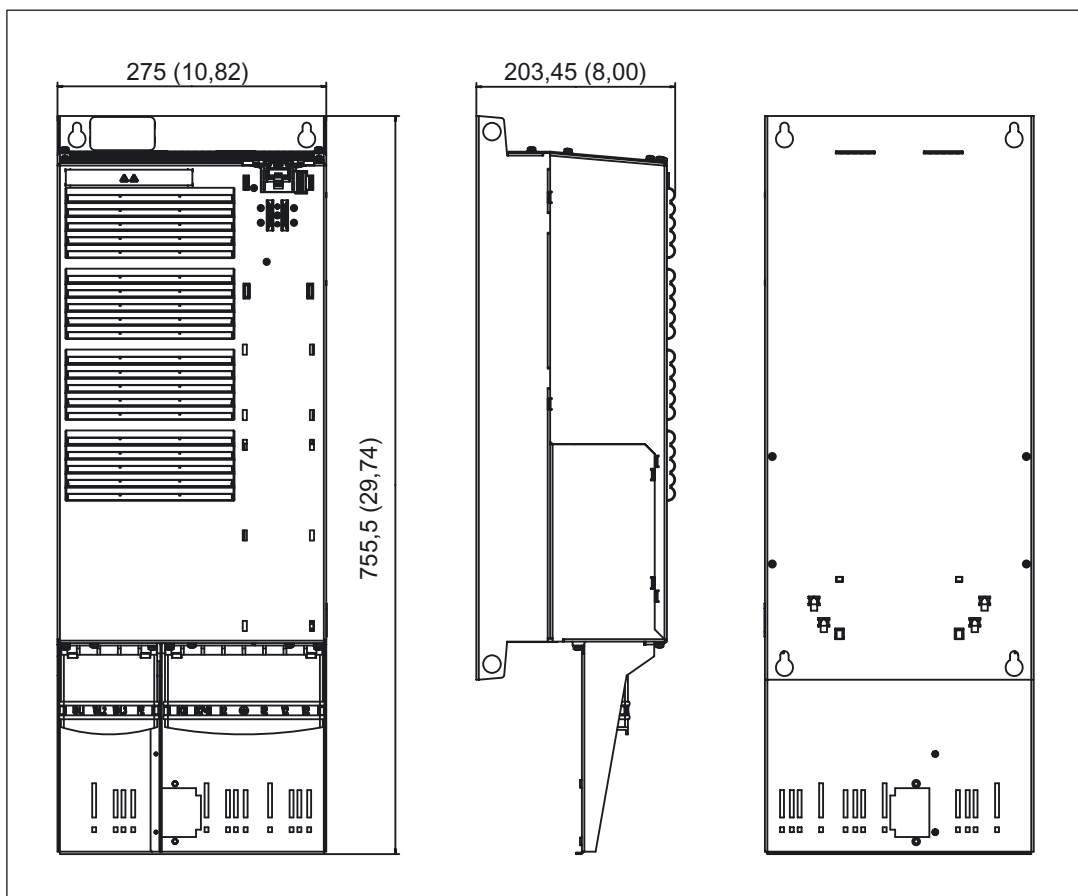


Figure 8-16 Dimension drawing: Power Module PM340 with Screening Kit, frame size FSE

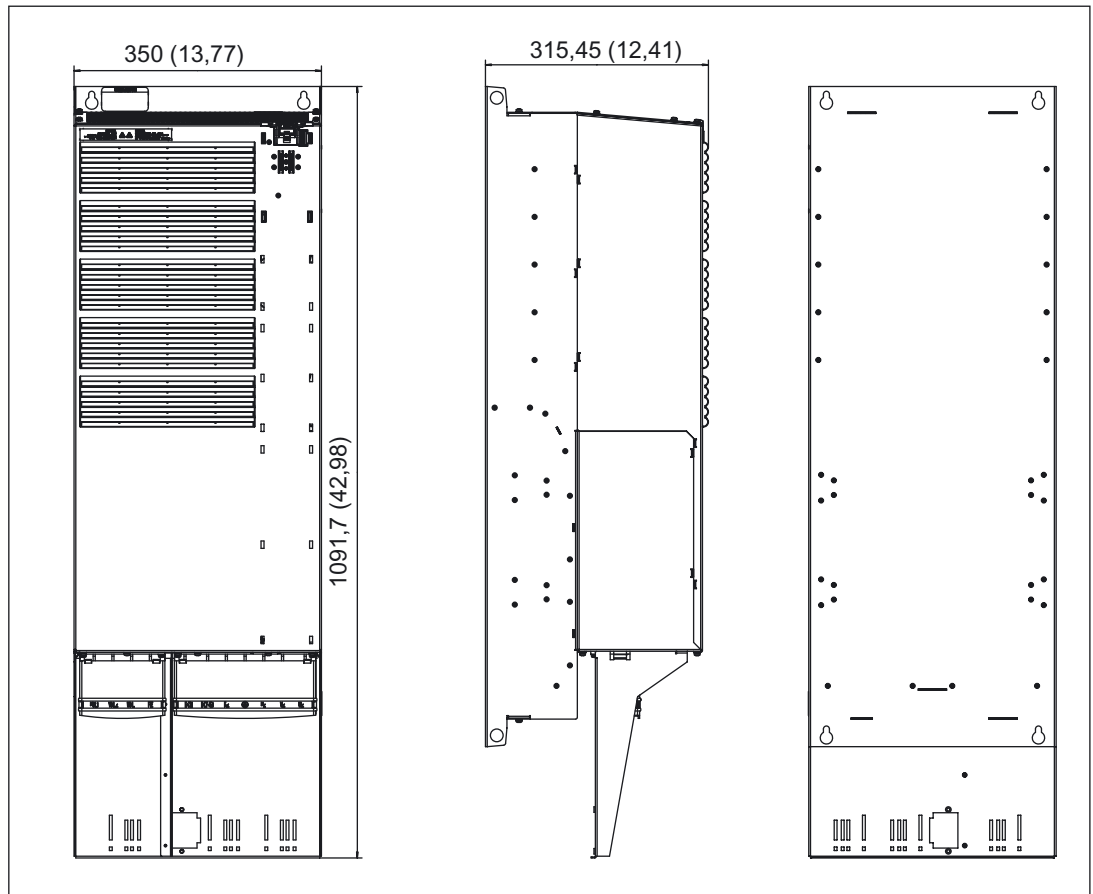


Figure 8-17 Dimension drawing: Power Module PM340 with Screening Kit, frame size FSF

8.3.2 Mounting

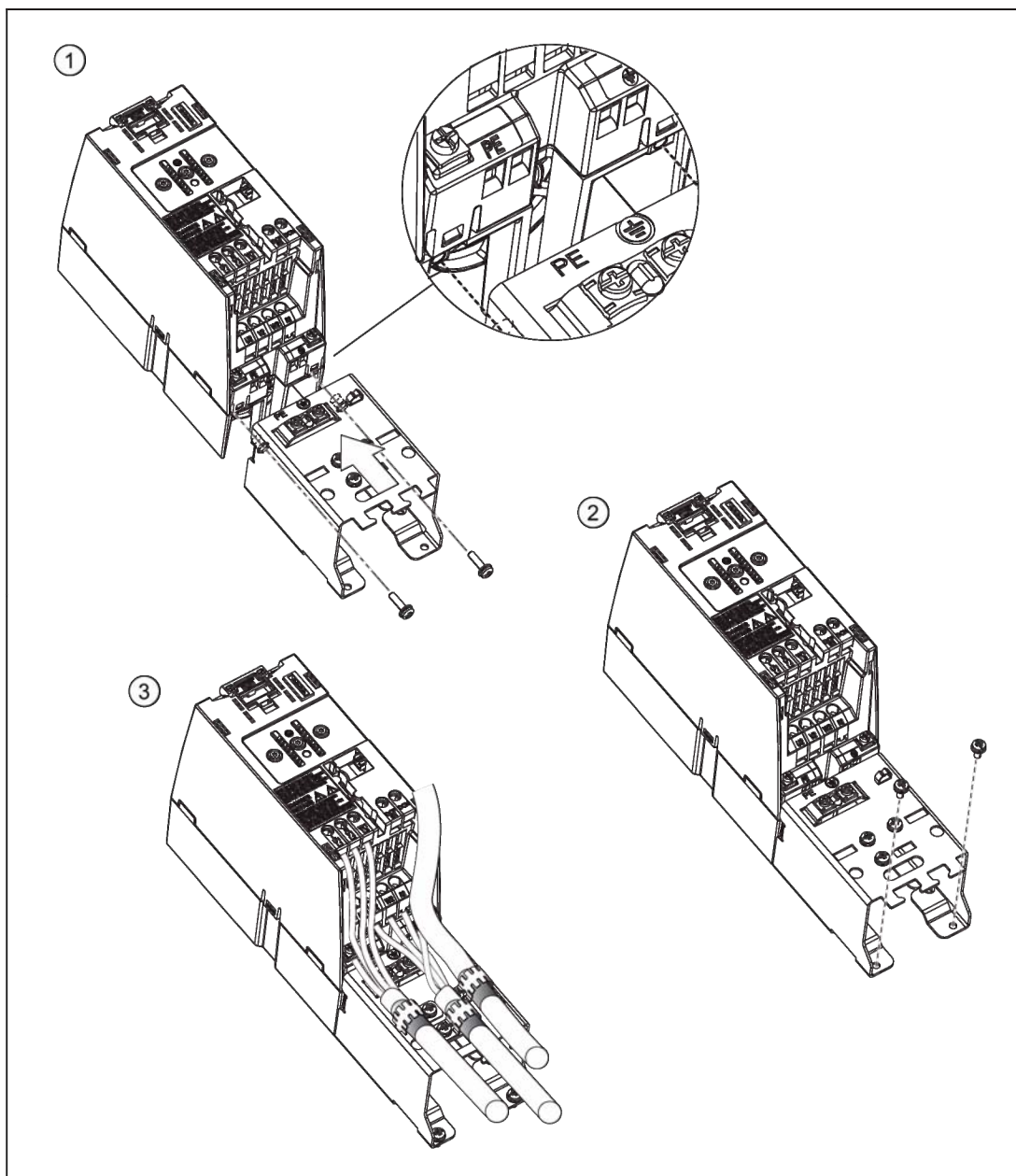


Figure 8-18 Mounting: Power Module PM340, frame size FSA, with Screening Kit

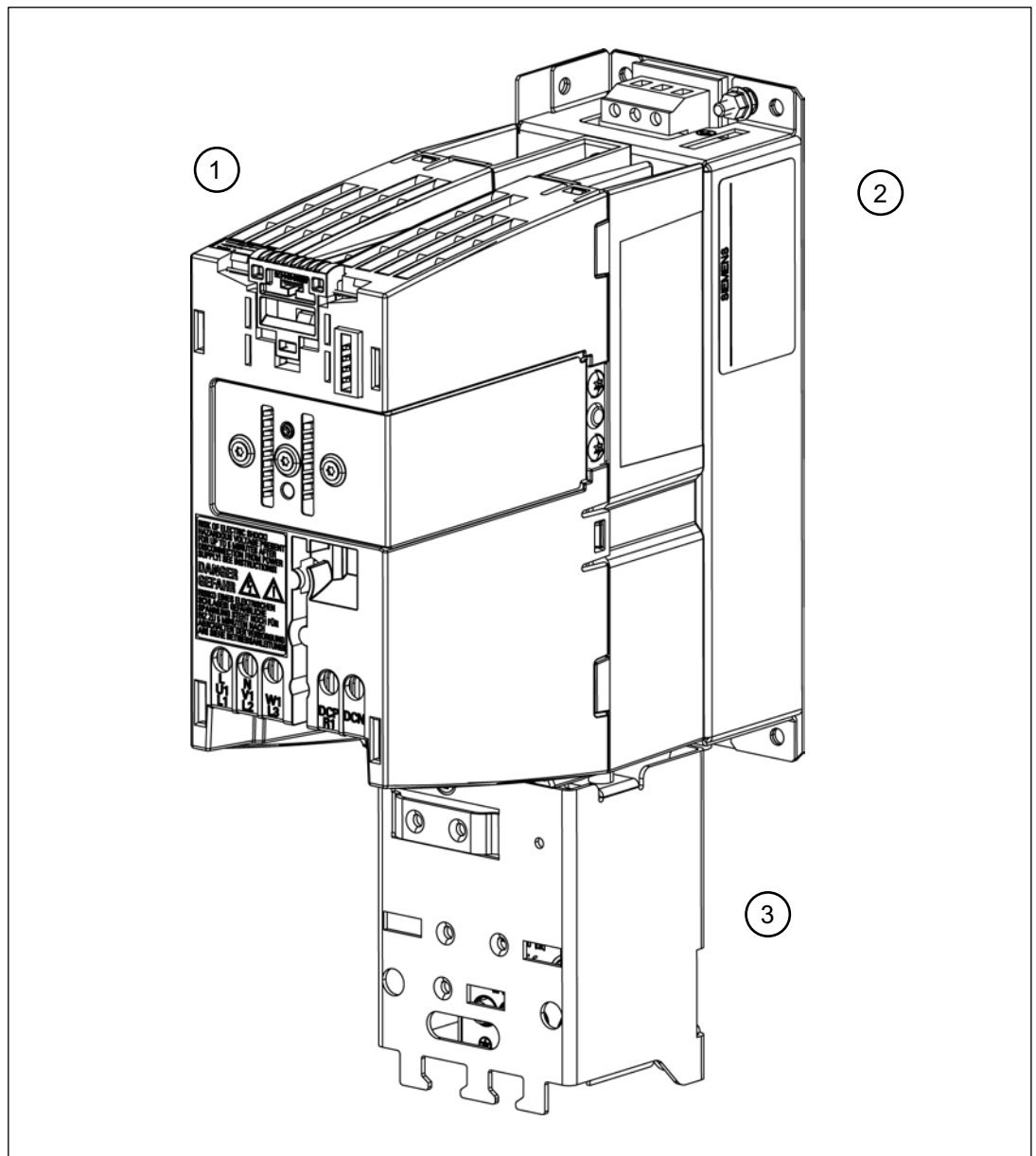


Figure 8-19 Power Module PM340, frame size FSA, with line filter and Screening Kit

1. Power Module PM340 frame size FSA
2. Line filters
3. Screening Kit

8.3 Screening Kit

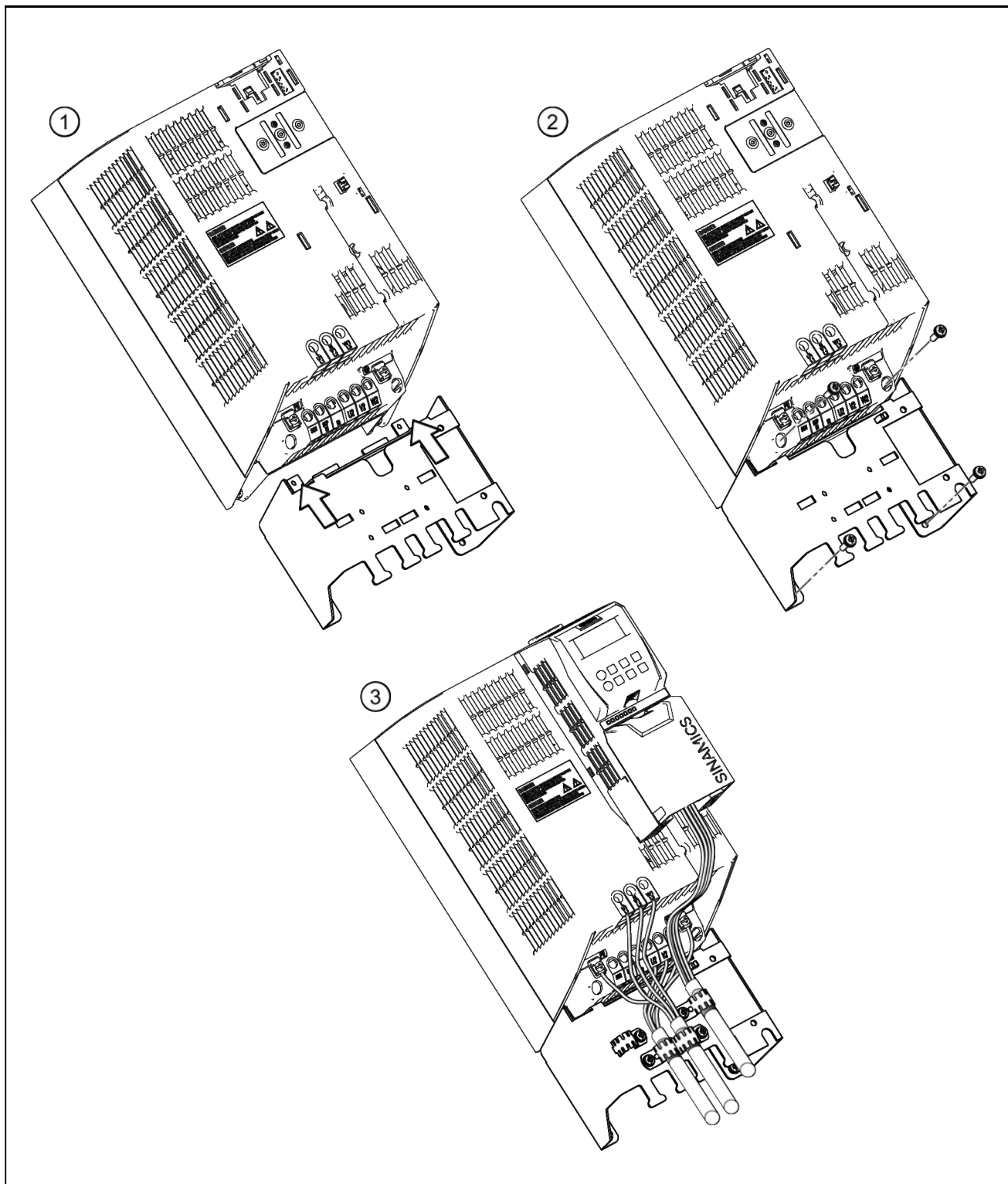


Figure 8-20 Mounting: Power Module PM340, frame sizes FSB and FSC, with Screening Kit

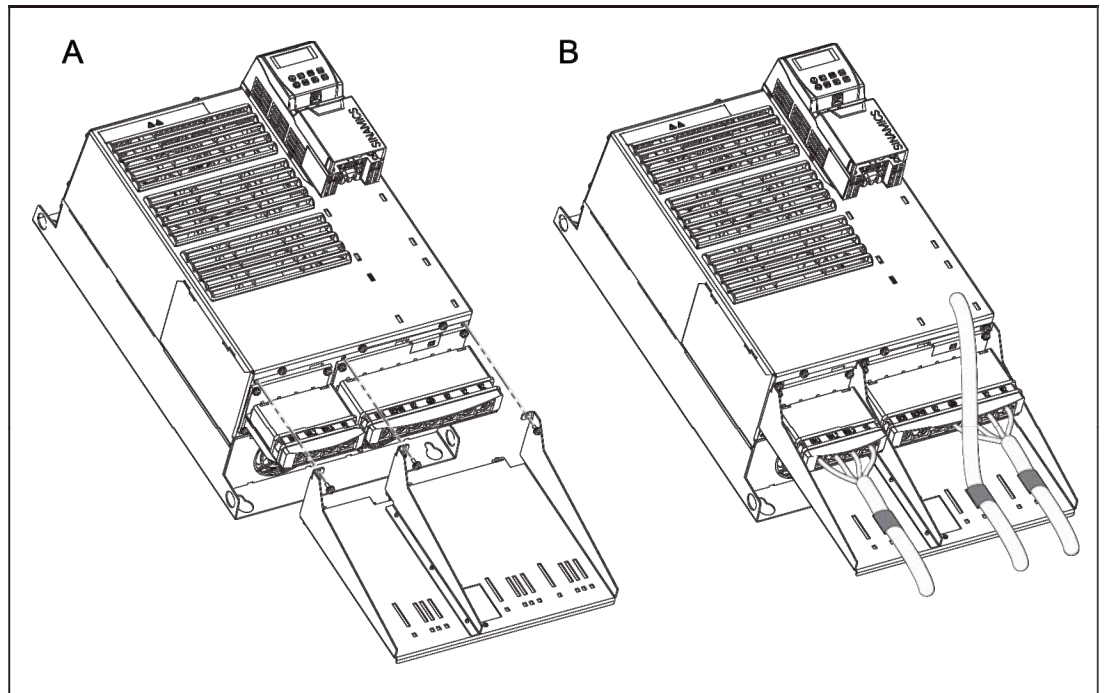


Figure 8-21 Mounting: Power Module PM340, frame sizes FSD and FSE, with Screening Kit

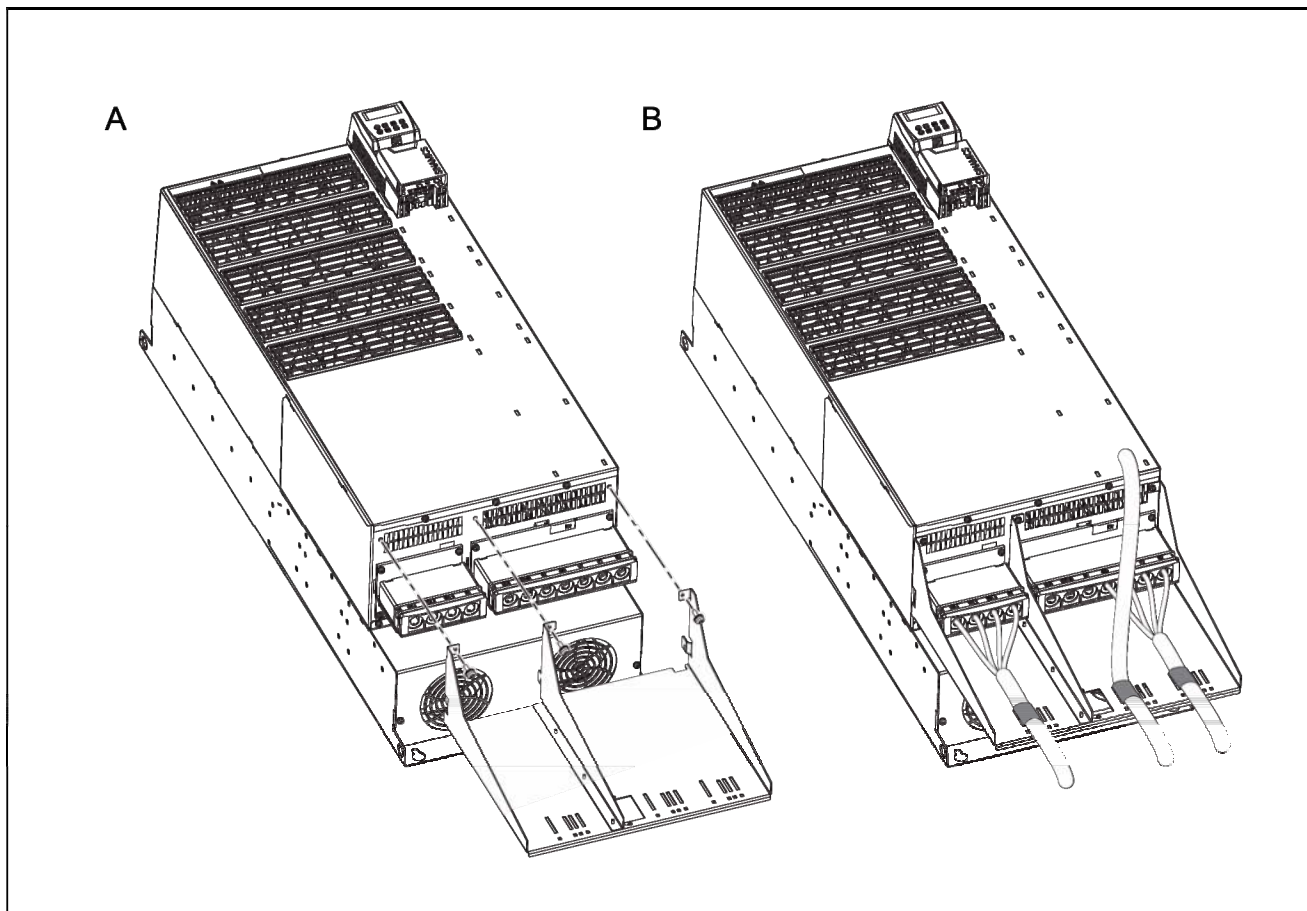


Figure 8-22 Mounting: Power Module PM340, frame size FSF, with Screening Kit

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.

Note for the safety functions of Safety Integrated:

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 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 |
|--|
| <p>To ensure that the encoder system works properly, you are advised to use the original Siemens accessories from catalog PM 21.</p> <p>Only motors with a safe electrically isolated holding brake may be connected. The brake conductors must also be safely electrically isolated.</p> <p>If the motor power cable is connected to intermediate terminals, the power cables and brake cables must be routed apart (≥ 300 mm).</p> <p>After an intermediate terminal (e.g. due to a terminal block), it is best to continue routing using the approved MOTION-CONNECT cable.</p> |

| CAUTION |
|--|
| <p>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.</p> |

|  WARNING |
|--|
| <p>Cable shields and unused conductors of power cables (e.g. brake conductors) must be connected to PE potential.</p> <p>Non-observance can cause lethal shock voltages.</p> |

 **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 $\geq 10 \text{ mm}^2$ Cu or $\geq 16 \text{ mm}^2$ Al
- stationary connection and installation of a second protective conductor with the same cross-section as the first protective conductor.
- stationary connection and automatic shutdown of the power supply if the protective conductor is interrupted
- Connection with a plug connector for industrial applications according to EN 60309 and a minimum protective conductor cross-section of $\geq 2.5 \text{ mm}^2$ Cu as part of a multi-core supply cable with appropriate strain relief.

9.2 Selection of Devices Required for Operating SINAMICS

9.2.1 General

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

- Line disconnecting device
- Line fuse
- Line contactor (this is required for electrical isolation)
- Line filter (optional for Power Module PM340, frame size FSA)
- Line reactor (refer to Chapter Line supply connection)

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

9.2.2 Information about line disconnecting devices

The line disconnecting device for the electrical equipment may be used for correct isolation of the drive line-up from the power supply. This line disconnecting device must be designed for the electrical equipment of machines in accordance with the requirements of EN 60204-1, Section 5.3. The relevant technical specifications must be taken into consideration for the purpose of selecting the device. Other consumers of the electrical equipment must also be taken into consideration when the device is selected.

The accessories required for the line disconnecting device must be selected from the manufacturer catalogs. See also catalog PM 21.

9.2.3 Over current protection using line fuses or circuit-breakers

The cables for the drive line-up power supply must be protected against over currents. NH, D, and DO-type fuses with a gL characteristic or suitable circuit-breakers can be used for this purpose.

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).

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|  WARNING |
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|---|
| During operation from networks with low short-circuit power (e.g. trial operation, operation with isolating transformer), 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 to provide protection against electric shock after indirect contact and in the event of short-circuits. |
|---|

For further information: See catalog PM 21.

9.2.4 Line filter

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

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| NOTICE |
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| 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. |
|--|

In conjunction with line reactors and a systematic plant configuration, line filters limit the conducted interference emitted by the power modules to the limit values of category C2 to EN 61800-3. Line filters are only suitable for direct connection to TN systems.

Note

According to product standard IEC61800-3 RI suppression commensurate with the relevant operating conditions must be provided and is 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.

9.2.5 Line Contactors

Line contactors are required to provide electrical isolation between the drive line-up and the line 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.

Note

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

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|  CAUTION |
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| Line contactors must not be switched under load. |
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When the digital output is used to control the line contactor, its making/breaking capacity must be taken into account.

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 over current.

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.

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| NOTICE |
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| If other consumers are connected to the power supply, connected inductance devices (contactors, relays) must be fitted with suitable overvoltage protection circuits. |
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| NOTICE |
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| A regulated DC power supply is required to operate motors with a built-in holding brake. The power is supplied via the 24 V connection (Safe Brake Relay). The voltage tolerances of the motor holding brakes and the voltage drops of the connection cables must be taken into account. |
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|---|
| The DC power supply should be set to 26 V. This ensures that the power supply for the brake remains within the permissible range when the following conditions are fulfilled: |
|---|

- | |
|--|
| <ul style="list-style-type: none">• Using Siemens three-phase motors• Using 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] | Input voltage range [V] | Short-circuit current [A] | Order No. |
|--------------------------|-------------------------|---------------------------|---------------|
| 5 | 2 AC 85-132/170 – 550 | 5,5 | 6EP1333-3BA00 |
| 10 | 2 AC 85-132/176 – 550 | 30 for 25 ms | 6EP1334-3BA00 |
| 20 | 3-ph. 320 – 550 V AC | 23 | 6EP1336-3BA00 |
| 40 | 3-ph. 320 – 550 V AC | 46 | 6EP1337-3BA00 |

Table 9-2 Recommendation for Control Supply Module

| Rated output current [A] | Input voltage range [V] | Short-circuit current [A] | Order No. |
|--------------------------|--|---------------------------|--------------------|
| 20 | 3-ph. 380 V AC -10% (-15% < 1 min) to 3-ph. 480 V AC+10% DC 300 – 800 | < 24 | 6SL3100-1DE22-0AA0 |

See catalog PM 21.

| |
|---|
|  WARNING |
| When an external power supply is used, e.g. SITOP, the ground potential must be connected to the protective conductor system (DVC A). |

9.3.3 24 V component current consumption

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}] |
|--|--|
| CU320 | 0.8 |
| CU310 DP for each digital output | 0.8 |
| CU310 PN for each digital output | 0.8 |
| CUA31 for each digital output | 0.15 |
| DRIVE-CLiQ (e.g. motors with DRIVE-CLiQ interface) | Typ. 0.25, max. 0.45 |
| Brake (e.g. motor holding brake) | Typ. 0.4 to 1.1; max. 2 |
| Sensor Module Cabinet | |
| SMC10 | 0.2 |
| SMC20 | 0.2 |
| Sensor Module External | |
| SME20 | 0.11 |
| SME25 | 0.11 |
| SME120 | 0.16 |
| SME125 | 0.16 |

9.3.4 Over current Protection

Cables on both the primary and the secondary side of the power supply unit must be protected from over current. 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 over current protection devices.

Circuit-breakers from the Siemens LV 1 and LV 1T catalogs are recommended as over current protection devices on the primary side, and miniature circuit-breakers or SITOP select 6EP1961-2BA00 as over current 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 over current 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
- Cable length max.:
 - 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.

9.4 Arrangement of components and equipment

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

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 connection cables
MOTION-CONNECT lines, see D21.1 catalog
- 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)

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-□AD30-0AP□. 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 see catalog D21.1

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



A suitable PE conductor must be connected to all devices in protection class I.

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 non-shielded cables are used between the line connection point and line filter, make sure that no interfering cables are routed in parallel.

The cable shields must be connected as close to the conductor terminal connections as possible to ensure a low-impedance connection with cabinet ground.

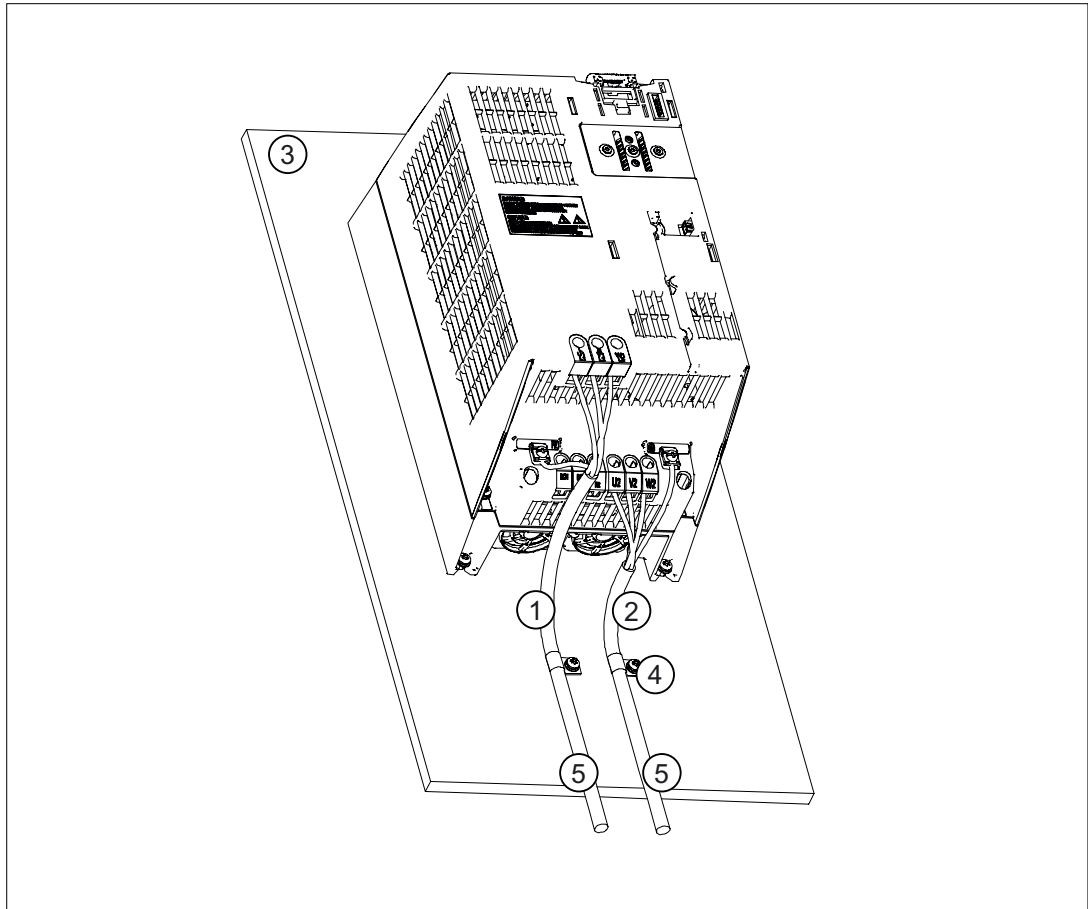


Figure 9-2 Shielding of a Power Module PM340

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 lines (shielded and non-shielded) connected to the drive line-up, must be routed as far as possible away from strong external magnetic fields (e.g. transformers, line reactors). In both cases, a distance of ≥ 300 mm is usually sufficient.

Signal and DC power supply cables

Operating non-shielded signal and DC power supply cables (e.g. 24 V externally supplied):

- DC power supply cables: Max. permissible length: 10 m
- Non-shielded signal cables: Max. permissible length: 30 m (without additional wiring)

For greater lengths, suitable wiring must be connected by the user to provide overvoltage protection. For example:

Table 9-5 Recommendations for overvoltage protection

| DC power supply | 24 V signal cables |
|--|-------------------------------------|
| Weidmüller Type no.: PU DS 24V 16A | Weidmüller Type no.: MCZ OVP TAZ |
| Weidmüller GmbH & Co. KG An der Talle 89 33102 Paderborn Tel. 05252/960-0 Fax 05252/960-116 http://www.weidmueller.com | |

CAUTION

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

CAUTION

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

9.5.3 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.

9.6 Connection Methods

9.6.1 Screw terminals

Connectable conductor cross-sections of screw terminals

Table 9-6 Screw terminals

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

9.7 Information on 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.

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|----------------|
| CAUTION |
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| 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 9-7 Cooling clearances around the components

| Component | Clearance above and below in mm and (inches) | Lateral clearance in mm and (inches) |
|--|--|--------------------------------------|
| CU310 DP | 50 (1.97) | 0 |
| CU310 PN | 50 (1.97) | 0 |
| CUA31 | 50 (1.97) | 0 |
| SMCxx | 50 (1.97) | 0 |
| Line filters | 100 (3.93) | |
| Line reactor | 100 (3.93) | 0 |
| PM340 blocksize, frame size FSA | 100 (3.93) | 30 (1.18) |
| PM340 blocksize, frame size FSB | 100 (3.93) | 40 (1.57) |
| PM340 blocksize, frame size FSC | 125 (4.92) | 50 (1.97) |
| PM340 blocksize, frame sizes FSD and FSE | 300 (11.81) | 0 |
| PM340 blocksize, frame size FSF | 350 (13.77) | 0 |

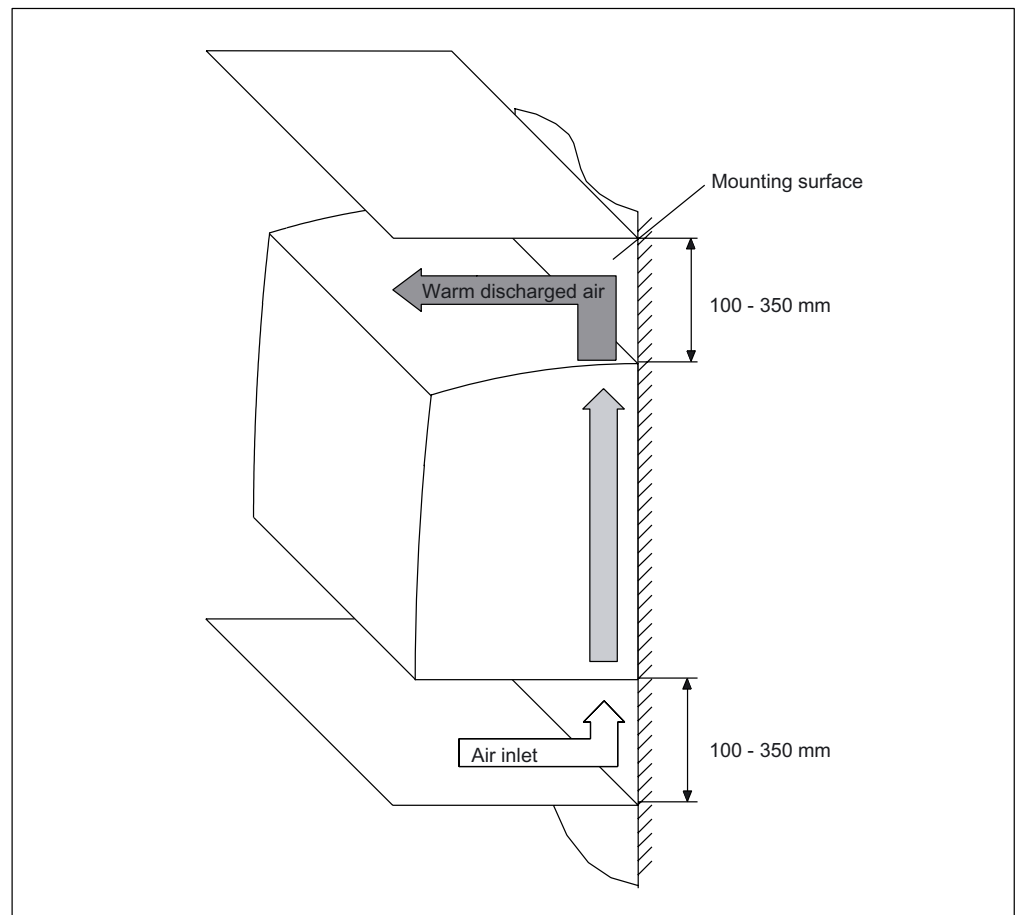


Figure 9-3 Cooling clearances

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.

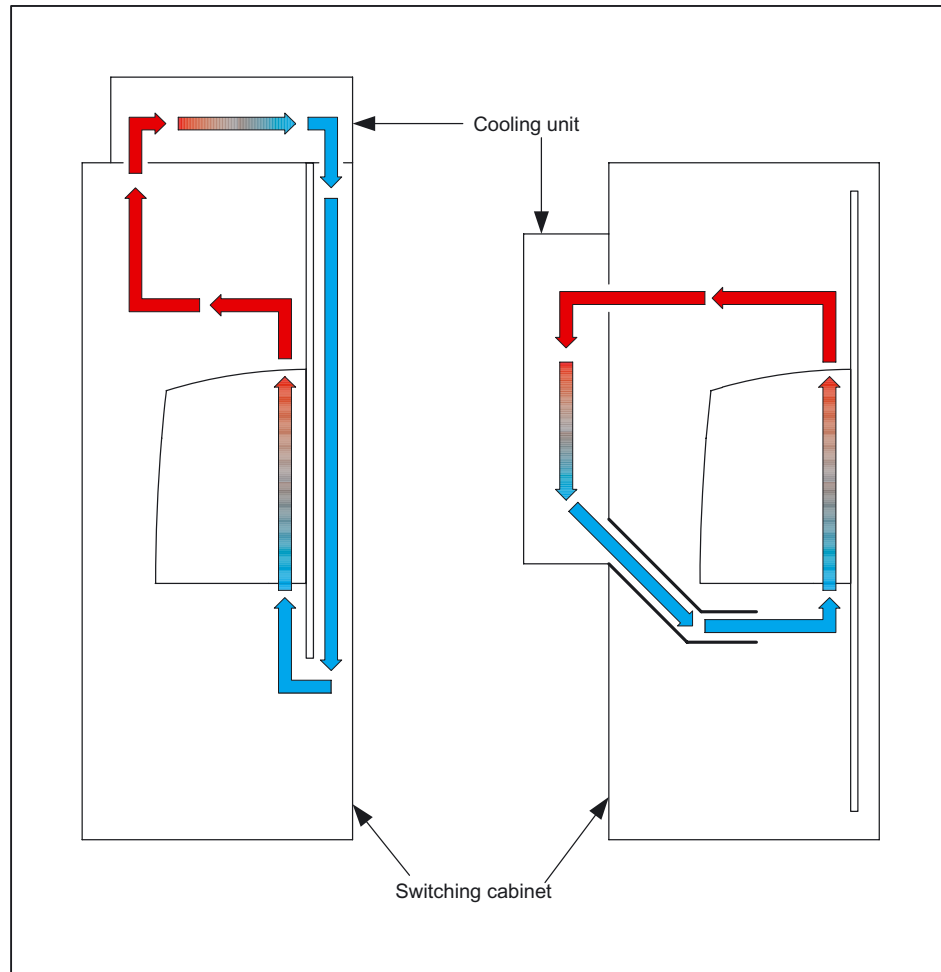


Figure 9-4 Examples of cabinet ventilation

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 equipment. This reduces the relative air humidity to uncritical values.

9.7.3 Power Loss of Components in Rated Operation

The following table shows the power loss for components. 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 $\pm 10\%$
- Pulse frequency of the Power Modules 4 kHz
- Rated pulse frequency of the Power Modules 8 kHz
- Operating components at their rated power

Table 9-8 Overview of power losses

| | Unit | Power loss |
|--|------|--|
| Control Units | | |
| CU320 | W | 20 |
| CU310 DP | W | 20 |
| CU310 PN | W | 20 |
| CUA31 | W | 7.2 |
| Line reactors for Power Modules Blocksize | W | Refer to Line reactors, Chapter "Technical data". |
| Line filter for Power Modules Blocksize | W | Refer to Line filter, Chapter "Technical data". |
| PM340 | W | Refer to Power Modules, Chapter "Technical data". |
| Sensor Modules | | |
| SMC10 | W | < 10 |
| SMC20 | W | < 10 |

Cooling circuit and coolant properties

10.1 Cooling circuit requirements

Technical cooling circuits can be divided into three systems:

1. Closed cooling circuits (recommended)

In closed systems, the circuit water 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 heat dissipation 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 circuit water and, once filled, should not require any added water. The composition of the cooling water 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 heat dissipation, but also through external devices.

The heat given off to the circuit water evaporates via a cooling tower. This evaporation causes the circuit water to become more concentrated (densification) because water molecules escape while dissolved substances remain in the circuit water. During operation, therefore, the composition of the water changes significantly, which means that it must be monitored and topped up continuously.

Open cooling circuits are permitted.

3. Semi-open cooling circuit

Oxygen can only enter the coolant via the pressure compensator. Otherwise, see 1. Semi-open cooling circuits are permitted.

A closed cooling circuit with a membrane-pressure compensator (MAG), safety valve (SV) and heat exchanger (WT), which couples the cooling circuit with an external re cooler, is recommended (see also "Materials and water composition").

The liquid-cooled Power Modules are designed to be connected in parallel to the cooling circuit, whereby the pressure drop in the joint supply and return lines is to be kept at negligible levels by choosing a sufficiently large pipe diameter. The differential pressure between the supply (P1) and return (P2) must remain between 70 kPa and 200 kPa. This ensures that each of the connected devices receives the required cooling liquid flow rate. Pressure P1 and P2 with respect to the atmosphere must not exceed 600 kPa.

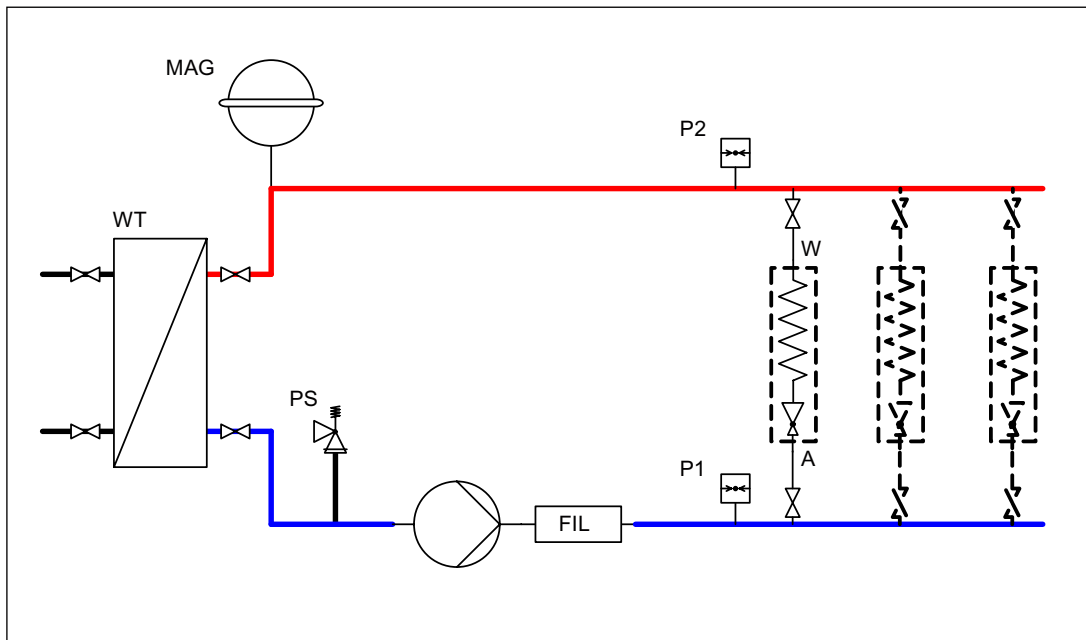


Figure 10-1 Example: Closed cooling circuit

$P1 - P2 = 70 \text{ kPa} \dots 200 \text{ kPa}$ (in operation)

$P2 \leq P1 \leq 600 \text{ kPa}$

A filter must be installed in the cooling circuit supply line to prevent foreign particles from being washed in. Recommended nominal filter mesh: 100 μm .

The liquid-cooled Power Modules should be connected to the cooling circuit by means of shut-off valves so that they can be disconnected from the cooling circuit for servicing or repair without the need to empty the entire cooling system. A cooling water hose (EPDM) can be used to connect the shut-off valve and unit. Coolant connections A and B must never be closed if cooling liquid is still present in the device. Reason: if the cooling fluid expands due to heating, the pressure can build up beyond permissible levels and cause the integrated heat exchanger to burst.

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-pressure compensator (MAG) and should be at least 30 kPa at the intake side of the pump. 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. For the pressure drop for the Power Modules, characteristic curves are specified to which the pressure drop in the filter and, if necessary, further pressure drops in connection pipes must be added. 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 system yields the volume flow V_n of the coolant at this operating point.

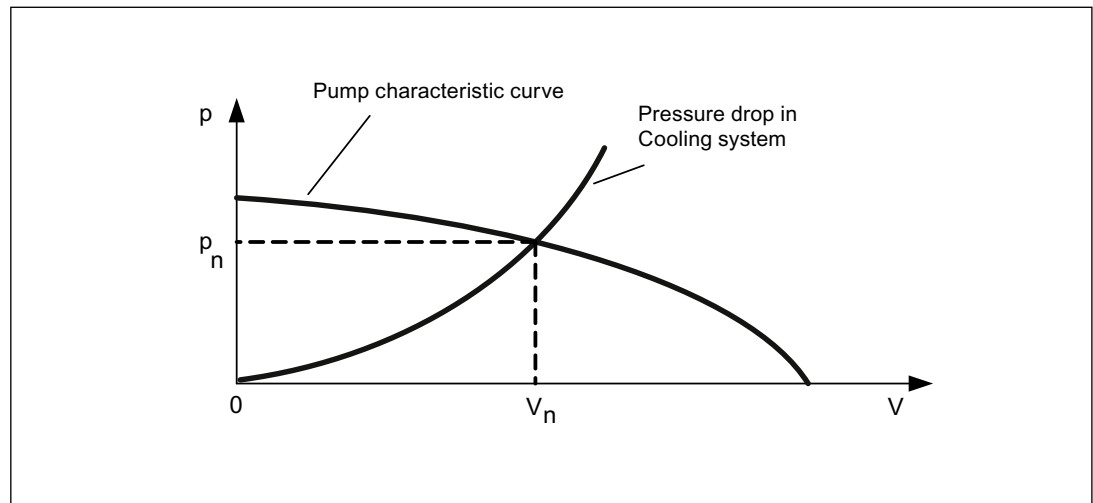


Figure 10-2 Pump characteristic curve

10.1.1 Pressure

The maximum system pressure is 600 kPa. The lowest possible pressure should be selected to allow pumps with a flat characteristic to be used.

The maximum permissible differential pressure for a heatsink is 200 kPa.

The layout must be selected so that the total length of supply and drain pipe is equal for each SINAMICS unit or motor.

Water cooling systems with series-connected modules and/or modules and motors are not permitted because the increased volumetric flow increases the risk of cavitation and abrasion. This arrangement is only acceptable if the pressure difference for each device does not exceed 200 kPa.

10.1.2 Installation

The following requirements must be observed during installation:

- Seals must be free of chloride, graphite, and rust.
- Permissible sealing materials: Viton, AFM34, and EPDM.

Note

Teflon-based seals are not permitted.

To ensure mechanical decoupling, the devices should be connected by means of hoses.

Recommendation for hose type:

- EPDM hoses with an electrical conductivity $>10^9$ ohms, e.g. Semperflex FKD supplied by Semperit, or
- DEMITEL made of PE / EPDM supplied by Telle
- Secure with clips that comply with DIN2871, available from Telle, for example.

Recommendation for installation:

- A closed stainless steel cooling circuit is recommended to ensure the longest possible service life of the cooling unit.
- Cooling circuit pipes, fittings made of ABS, stainless steel (Nirosta) or common steel (ST37).
- 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).

10.1.3 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.

10.1.4 Information about configuring cooling circuits

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 specifications of the equipment. The units are normalized to a rated pressure of 70,000 Pa (for coolant type H₂O) via an orifice.

If a mixture of Antifrogen N and H₂O 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 for various coolant temperatures

| PM340 Liquid Cooled | dV/dt H ₂ O [l/min] | dP H ₂ O [Pa] | dP Antifrogen N 45 % 0 °C [Pa] | dP Antifrogen N 45 % 20 °C [Pa] | dP Antifrogen N 45 % 45 °C [Pa] | dP Antifrogen N 45 % 50 °C [Pa] |
|------------------------------|--------------------------------|--------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Power Module, frame size FSD | 8 | 66700 | 115300 | 92700 | 76700 | 74700 |
| Power Module, frame size FSE | 8 | 69100 | 119500 | 96000 | 79400 | 77300 |
| Power Module, frame size FSF | 8 | 69500 | 120200 | 96600 | 79900 | 77800 |

The maximum permissible pressure (with respect to the atmosphere) in the heatsink and, in turn, the cooling circuit must not exceed 600 kPa. If a pump whose maximum pressure exceeds this value is used, steps must be taken (e.g. safety valve $p \leq 600$ kPa, pressure control) to ensure that the maximum pressure limit is not exceeded.

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.

10.1 Cooling circuit requirements

The maximum differential pressure across a heat sink is 200 kPa. Higher differential pressures significantly increase the risk of cavitation and abrasion.

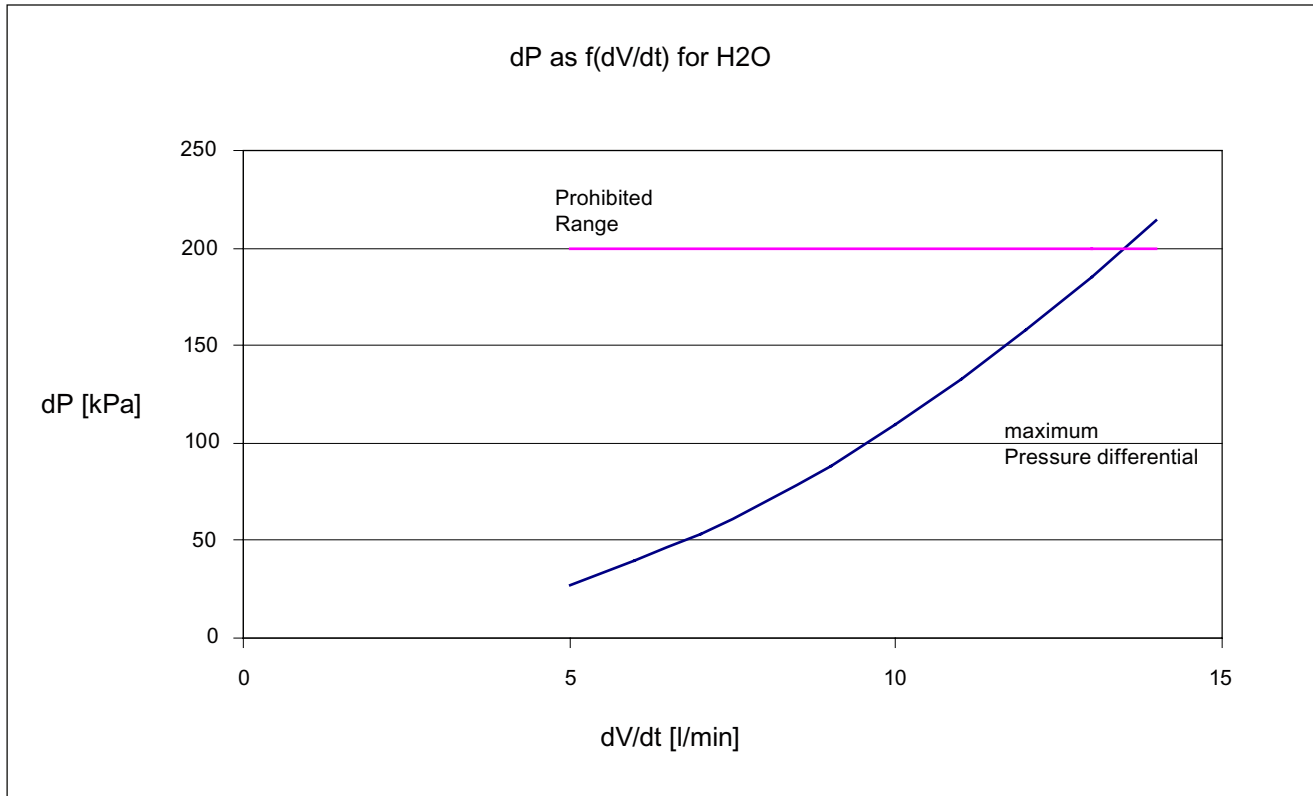


Figure 10-3 Pressure difference as a function of volumetric flow

Water cooling systems with series-connected SINAMICS devices cannot be recommended for the following reasons:

- The risk of cavitation and abrasion increases as a result of the high total volumetric flow.
- SINAMICS S120 cannot be connected in series because the total volumetric flow needed for any series-connected configuration requires system pressures in the range of 600 kPa or above.

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.

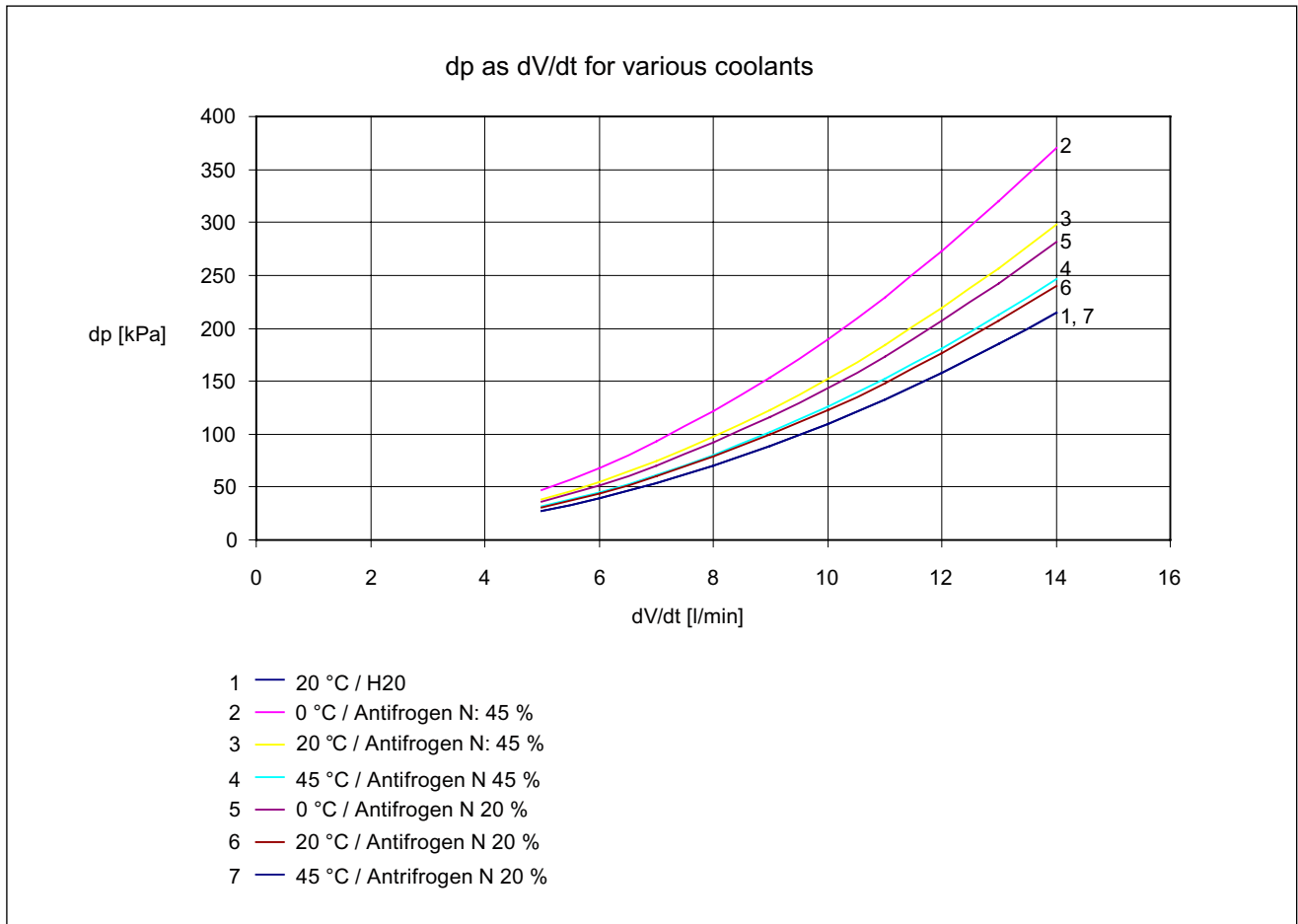


Figure 10-4 Pressure difference as a function of the volumetric flow for Power Modules PM340 Liquid Cooled, frame sizes FSD to FSF

Recommendation for dimensioning the cooling circuit:

The differential pressure between the supply and return lines should be selected so that:

$$\sum dP_i < dP_{\text{Syst}} < \sum dP_i + 30 \text{ kPa}$$

The individual pressure drops P_i represent the pressure drops of components (heat exchanger, piping, 70 kPa for the SINAMICS units 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 $> 13 \text{ mm}$ must always be maintained between pipes and live parts. The pipes must be securely mounted and checked for leaks.

10.2 Coolant requirements

Properties of the cooling medium

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
- Conductivity value < 500 µs/cm

Note

Normal tap water does not generally fulfill these requirements, although it can be mixed with de-ionized water. Losses must always be replenished with de-ionized water.

Operating pressures must not exceed 600 kPa.

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| NOTICE |
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| 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. |
|---|

A particle filter (particle size < 100 µm) must be installed in the cooling water circuit.

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 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.

10.3 Anti-corrosion additives (inhibitors)

Inhibitor without anti-freeze effect

The NALCO 00GE056 inhibitor (Manufacturer: Nalco) must always be used in a mixing ratio of 0.2 % to 0.25 %. 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.

10.4 Anti-freeze additives

Anti-freeze protection

Antifrogen N (Manufacturer: Clariant) with a proportion X of $20 \% < X \leq 45 \%$ is the anti-freeze used. Coolants containing 45 % Antifrogen N are anti-freeze-protected down to -30°C .

Antifrogen N contains anti-corrosion inhibitors that permanently protect the metal in the cooling system against corrosion.

It is particularly important to ensure that the proportion of Antifrogen N is always $>20 \%$ when a system is refilled, otherwise the mixture becomes corrosive.

Inhibitors and Antifrogen N must not be mixed.

10.5 Biocide additives (only if required)

Biocide

Closed cooling circuits with soft water ($^{\circ}\text{DH}>4$) are susceptible to microbes. The risk of corrosion caused by microbes is virtually non-existent in chlorinated drinking water systems.

No strain of bacteria can survive if $>20\%$ Antifrogen N is added.

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).

Note

The type of bacteria determines the biocide.

The manufacturer's recommendations must be followed regarding dosage and compatibility with any inhibitor used.

Biocides and Antifrogen N must not be mixed.

Antifrogen N has a biocidal effect even at the minimum required concentration of $>20\%$.

10.6 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 (\approx 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 \geq 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] | $\phi=20\%$ | $\phi=30\%$ | $\phi=40\%$ | $\phi=50\%$ | $\phi=60\%$ | $\phi=70\%$ | $\phi=80\%$ | $\phi=85\%$ | $\phi=90\%$ | $\phi=90\%$ | $\phi=100\%$ |
|----------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|
| 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).

10.7 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

11.1 Safety information

 **DANGER**

Only Siemens customer service, repair centers that have been authorized by Siemens or authorized personnel may repair drive equipment. All 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 only using parts and components that are listed in the relevant spare parts list.

 **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 Spare parts

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

11.3 Service and maintenance for components, Blocksize format

11.3.1 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

11.3.2 Replacing the fan

- CU310 DP: The CU310 DP fan must only be replaced by trained personnel who strictly adhere to ESD instructions.
When the fan is replaced, the plastic housing must be removed by releasing all of the catches one after another using a slotted screwdriver. After pressing the release clip, the fan connectors can be removed without the need for any other tools. The fan can then be withdrawn from the front and replaced.
At the same time, a qualified specialist should reset the fan's operating hours counter to "0".
The fan can be ordered as a spare part.
- CU310 PN: The CU310 DP fan must only be replaced by trained personnel who strictly adhere to ESD instructions.
When the fan is replaced, the plastic housing must be removed by releasing all of the catches one after another using a slotted screwdriver. After pressing the release clip, the fan connectors can be removed without the need for any other tools. The fan can then be withdrawn from the front and replaced.
At the same time, a qualified specialist should reset the fan's operating hours counter to "0".
The fan can be ordered as a spare part.
- PM340: For all frame sizes, 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.
- The CUA31 does not have a fan.

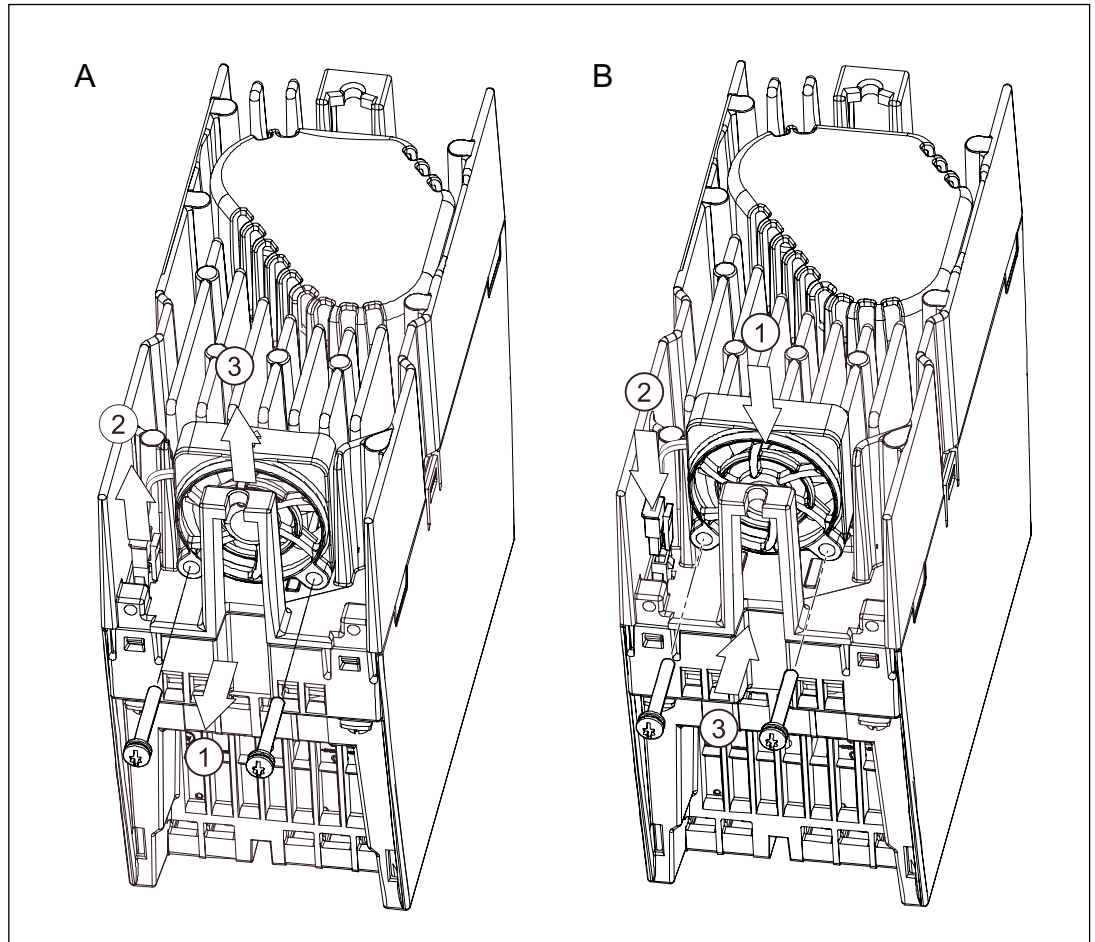


Figure 11-1 Replacing the fan for a Power Module PM340, frame size FSA

(tightening torque 0.4 Nm)

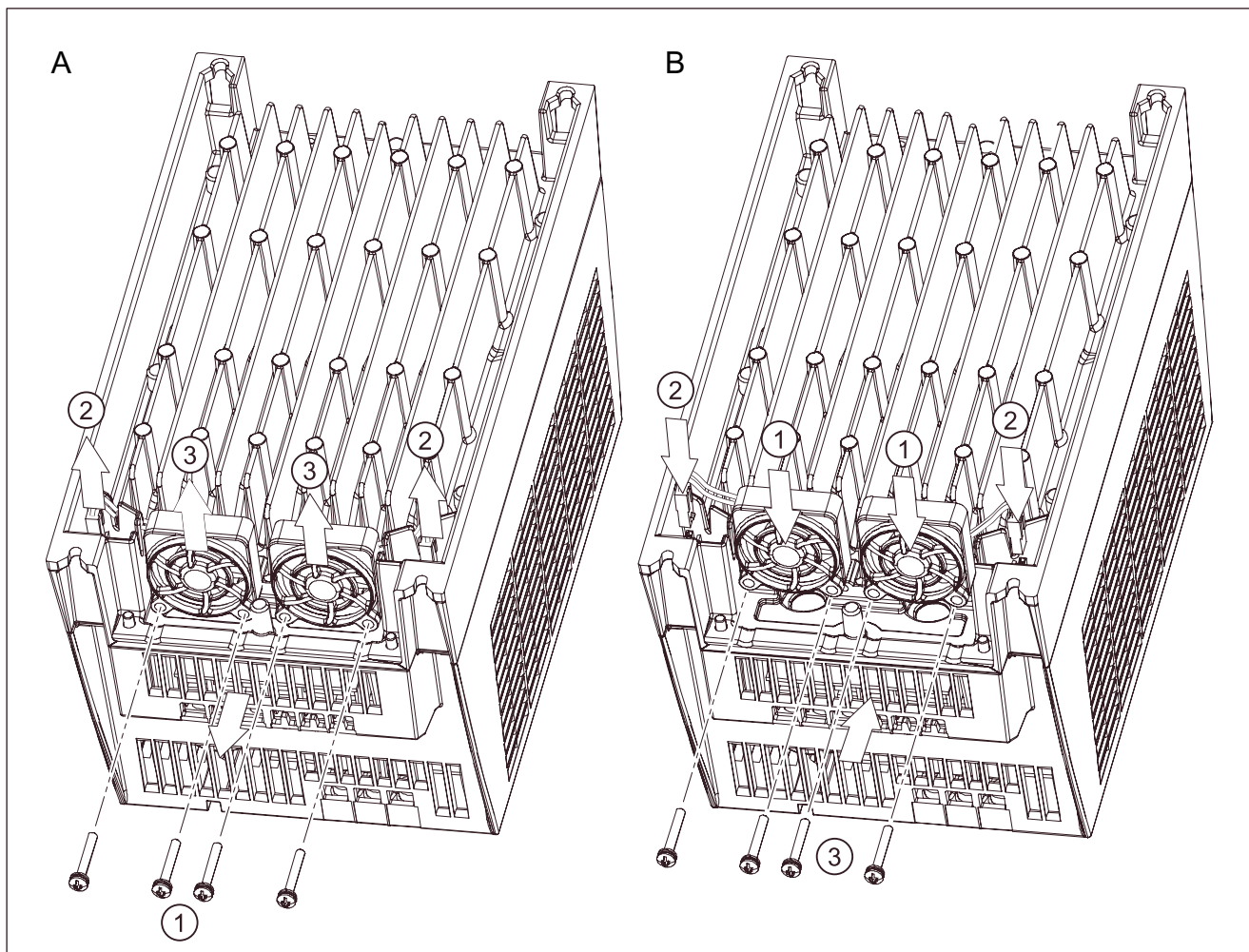


Figure 11-2 Replacing a fan for a Power Module PM340, frame sizes FSB and FSC

(tightening torque 0.4 Nm)

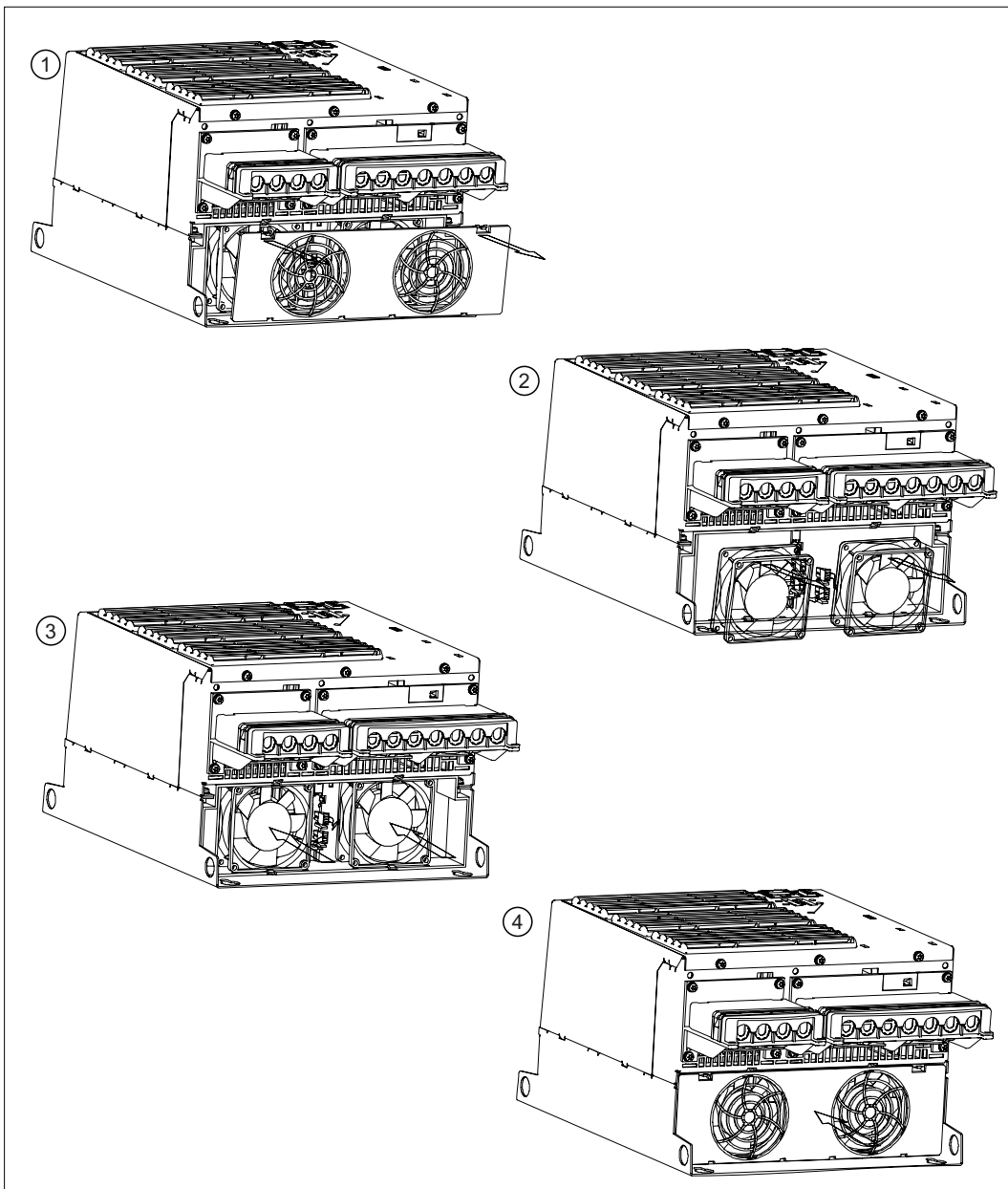


Figure 11-3 Replacing a fan for a Power Module PM340, frame sizes FSD and FSE

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.

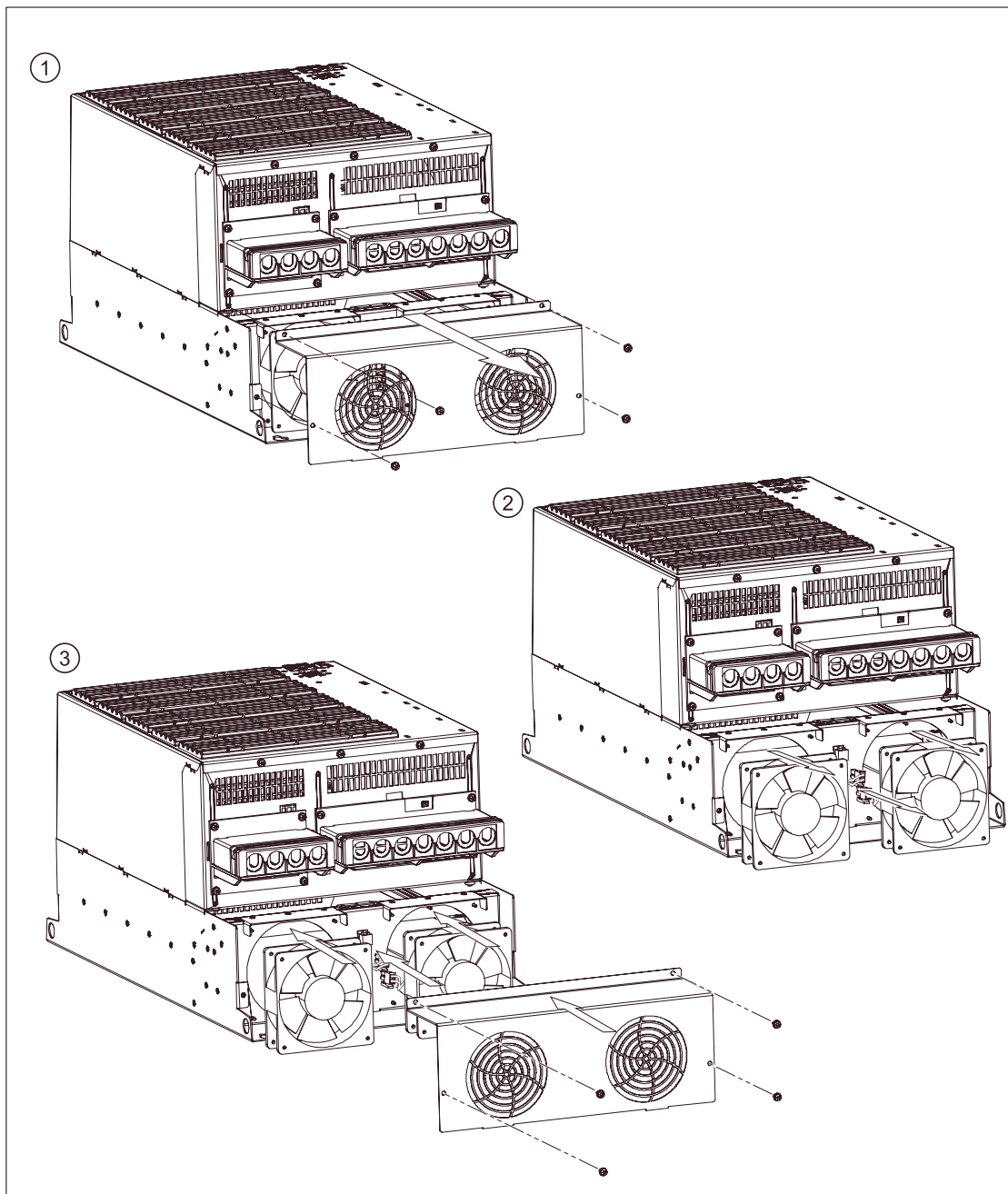


Figure 11-4 Replacing the fan for a Power Module PM340, frame size FSF

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

11.4 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.

11.4.1 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 |

11.4.2 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 11-5 Installation equipment


Order No.

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

11.4.3 Replacing components

11.4.3.1 Safety information

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|--|
|  DANGER |
| <p>When transporting the devices and replacing components, note the following:</p> <ul style="list-style-type: none">• 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 |
| <p>The equipment is operated with hazardous voltages</p> <p>All connection work must be carried-out in a no-voltage condition!</p> <p>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.</p> <p>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.</p> <p>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.</p> |

11.4.3.2 Replacing the Powerblock, Power Module, frame size FX

Replacing the Powerblock

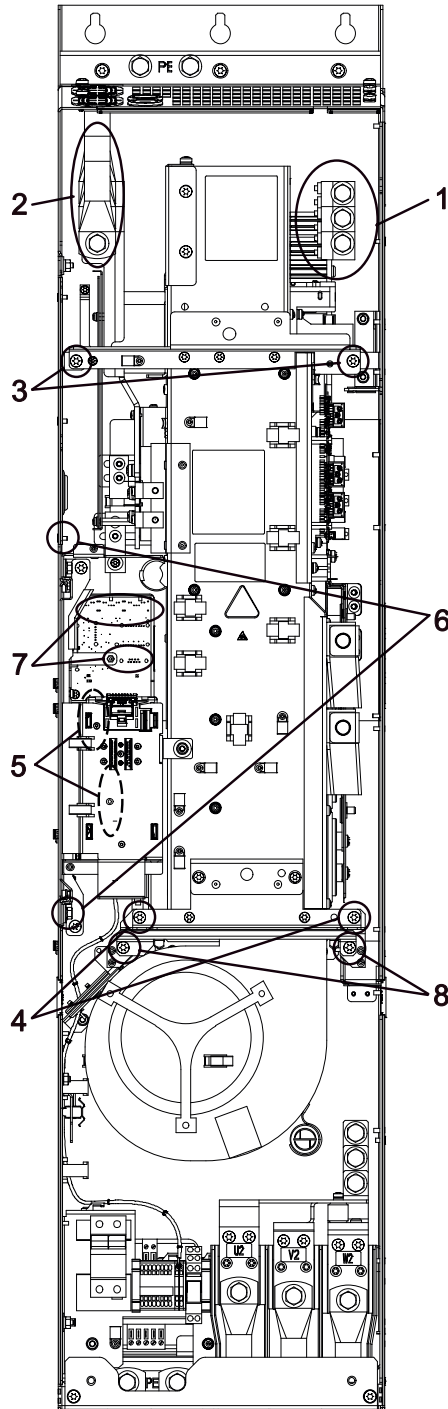


Figure 11-6 Replacing the Powerblock, Power Module, frame size FX

Preparatory steps


- Disconnect the drive line-up from the power supply.
- Allow unimpeded access to the power block.
- 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 electronics 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 power block at this position.

You can now remove the power block.

| |
|--|
|  CAUTION |
| When removing the power block, 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. |

11.4.3.3 Replacing the Powerblock, Power Module, frame size GX

Replacing the Powerblock

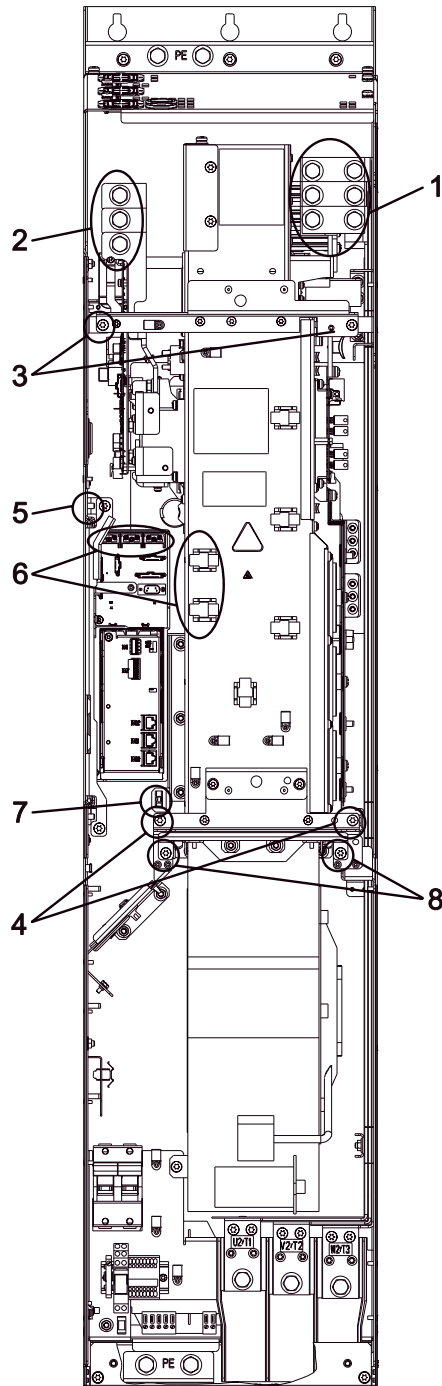


Figure 11-7 Replacing the Powerblock, Power Module, frame size GX

Preparatory steps

- Disconnect the drive line-up from the power supply.
- Allow unimpeded access to the power block.
- Remove the front cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 8 3.

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 retaining element of the electronic module (1 nut) and carefully remove the electronics module.
When removing the electronics 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 power block at this position.

You can now remove the power block.

| |
|----------------|
| CAUTION |
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| |
|---|
| When removing the power block, ensure that you do not damage any signal cables. |
|---|

Installation

To re-install the fan, carry out the above steps in reverse order.

| |
|----------------|
| CAUTION |
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| |
|--|
| You must observe the specified tightening torques. Carefully re-establish the plug connections and ensure that they are secure. |
|--|

11.4.3.4 Replacing the fan, Power Module, frame size FX

Replacing the fan

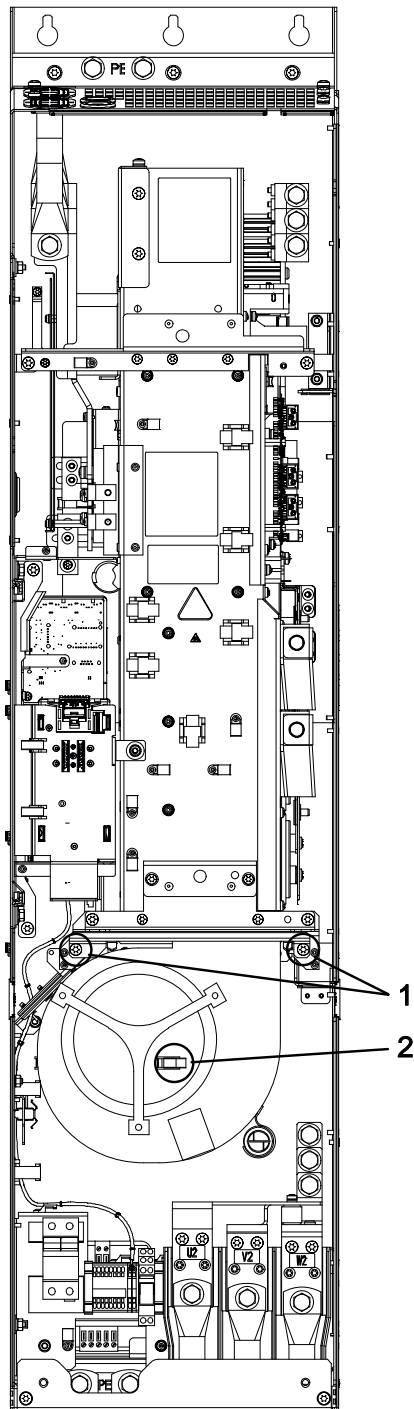


Figure 11-8 Replacing the fan, Power Module, frame size FX

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. |

11.4.3.5 Replacing the fan, Power Module, frame size GX

Replacing the fan

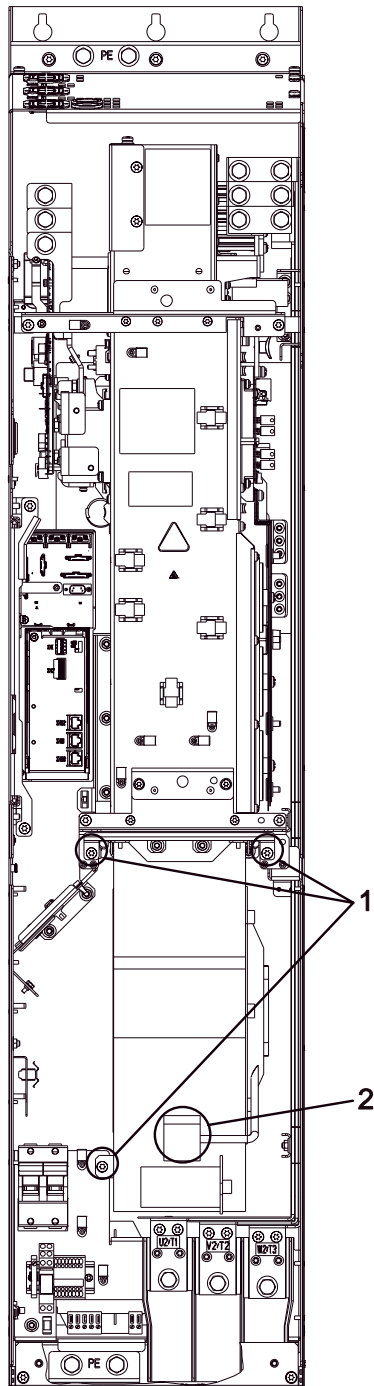


Figure 11-9 Replacing the fan, Power Module, frame size GX

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. |

Appendix A

A

A.1 List of abbreviations

Note:

The following list of abbreviations contains the abbreviations and their meanings used in the entire SINAMICS user documentation.

| Abbreviation | Derivation of abbreviation | Meaning |
|--------------|---|--|
| A | | |
| A... | Alarm | Alarm |
| AC | Alternating Current | Alternating current |
| ADC | Analog Digital Converter | Analog digital converter |
| AI | Analog Input | Analog input |
| AIM | Active Interface Module | Active Interface Module |
| ALM | Active Line Module | Active Line Module |
| AO | Analog Output | Analog output |
| AOP | Advanced Operator Panel | Advanced Operator Panel |
| APC | Advanced Positioning Control | Advanced positioning control |
| AR | Automatic Restart | Automatic restart |
| ASC | Armature Short-Circuit | Armature short-circuit |
| ASCII | American Standard Code for Information Interchange | American Standard Code for Information Interchange |
| ASM | Asynchronmotor | Induction motor |
| B | | |
| BERO | - | Tradename for a type of contactless proximity switch |
| BI | Binector Input | Binector input |
| BIA | Berufsgenossenschaftliches Institut für Arbeitssicherheit | German Institute for Occupational Safety |
| 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 | Derivation of abbreviation | Meaning |
|--------------|---------------------------------------|--|
| C | | |
| C | Capacitance | Capacitance |
| C... | - | Safety message |
| CAN | Controller Area Network | Serial bus system |
| CBC | Communication Board CAN | CAN communication board |
| 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 output/Binector output |
| COB-ID | CAN Object-Identification | CAN object identification |
| COM | Common contact of a change-over relay | Common contact of a change-over relay |
| COMM | Commissioning | Commissioning |
| CP | Communications Processor | Communications 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 |
| D | | |
| DAC | Digital Analog Converter | Digital Analog Converter |
| DC | Direct Current | Direct current |
| DCB | Drive Control Block | Drive Control Block |
| DCC | Drive Control Chart | Drive Control Chart |
| DCC | Data Cross-Check | Data cross-check |
| DCN | Direct Current Negative | Direct current negative |
| DCP | Direct Current Positive | Direct current positive |
| DDS | Drive Data Set | Drive data set |
| DI | Digital Input | Digital input |
| DI/DO | Digital Input/Digital Output | Bidirectional digital input/digital output |
| 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 | Distributed I/Os | Distributed I/Os |
| DPRAM | Dual-Port Random Access Memory | Dual-Port Random Access Memory |

| Abbreviation | Derivation of abbreviation | Meaning |
|---------------------|-----------------------------------|------------------------------------|
| DRAM | Dynamic Random Access Memory | Dynamic Random Access 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 |
| 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 |
| EN | Europäische Norm | European Standard |
| EnDat | Encoder-Data-Interface | Encoder interface |
| EP | Enable Pulses | Enable Pulses |
| EPOS | Einfachpositionierer | Basic positioner |
| ES | Engineering System | Engineering system |
| ESB | Ersatzschaltbild | Equivalent circuit diagram |
| ESD | Electrostatic Sensitive Devices | Electrostatic sensitive devices |
| ESR | Extended Stop and Retract | Extended stop and retract |
| F | | |
| F... | Fault | Fault |
| FAQ | 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 | Failsafe digital input |
| F-DO | Failsafe Digital Output | Failsafe digital output |
| FEM | Fremderregter Synchronmotor | Separate-field synchronous motor |
| FEPROM | Flash-EPROM | Non-volatile write and read memory |
| FG | Function Generator | Function generator |
| FI | - | Fault current |
| FO | Fiber-Optic Cable | Fiber optic cable |
| FPGA | Field Programmable Gate Array | Field Programmable Gate Array |
| FW | Firmware | Firmware |

| Abbreviation | Derivation of abbreviation | Meaning |
|--------------|---|--|
| G | | |
| GB | Gigabyte | Gigabyte |
| GC | Global Control | Global Control Telegram (Broadcast Telegram) |
| GND | Ground | Reference potential for all signal and operating voltages, usually defined with 0 V (also designated as M) |
| GSD | Gerätstammdatei | Device master file: describes the features of a PROFIBUS slave |
| GSV | Gate Supply Voltage | Gate supply voltage |
| GUID | Globally Unique Identifier | Globally unique identifier |
| H | | |
| HF | High Frequency | High frequency |
| HFD | Hochfrequenzdrossel | High-frequency reactor |
| HMI | Human Machine Interface | Human Machine Interface |
| HTL | High-Threshold Logic | High-threshold logic |
| HW | Hardware | Hardware |
| I | | |
| I/O | Input/Output | Input/Output |
| I2C | Inter Integrated Circuit | Internal serial data bus |
| IASC | Internal Armature Short-Circuit | Internal armature short-circuit |
| ID | Identifier | Identifier |
| IEC | International Electrotechnical Commission | International standard in electrical engineering |
| IF | Interface | Interface |
| IGBT | Insulated Gate Bipolar Transistor | Bipolar transistor with insulated control electrode |
| IGCT | Integrated Gate-Controlled Thyristor | Semiconductor circuit-breaker with integrated control electrode |
| IL | Impulslöschung | Pulse suppression |
| IP | Internet Protocol | Internet Protocol |
| IPO | Interpolator | Interpolator |
| IT | Isolé Terré | Insulated three-phase supply system |
| IVP | Internal Voltage Protection | Internal voltage protection |
| J | | |
| JOG | Jogging | Jogging |
| K | | |
| KIP | Kinetische Pufferung | Kinetic buffering |

| Abbreviation | Derivation of abbreviation | Meaning |
|--------------|--|--|
| Kp | - | Proportional gain |
| KTY | - | Special temperature sensor |
| L | | |
| L | - | Formula symbol for inductance |
| LED | Light Emitting Diode | Light Emitting Diode |
| LIN | Linearmotor | Linear motor |
| LR | Lageregler | 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 |
| M | | |
| M | - | Formula symbol for torque |
| M | Masse | Reference potential for all signal and operating voltages, usually defined with 0 V (also designated as GND) |
| MB | Megabyte | Megabyte |
| MCC | Motion Control Chart | Motion Control Chart |
| MDS | Motor Data Set | Motor data set |
| MLFB | Maschinenlesbare Fabrikatebezeichnung | Machine-readable product designation |
| 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 |
| MT | Messtaster | Probe |
| N | | |
| N. C. | Not Connected | Not connected |
| N... | No Report | No report or internal message |
| NAMUR | Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie | Standardization association for measurement and control in chemical industries |
| NC | Normally Closed (contact) | Normally Closed (contact) |
| NC | Numerical Control | Numerical control |
| NEMA | National Electrical Manufacturers Association | Standards association in USA |
| NO | Normally Open (contact) | Normally Open (contact) |
| O | | |
| OA | Open Architecture | Open Architecture |

| Abbreviation | Derivation of abbreviation | Meaning |
|---------------------|------------------------------------|---|
| OC | Operating Condition | Operating condition |
| OEM | Original Equipment Manufacturer | Original Equipment Manufacturer |
| OLP | Optical Link Plug | Optical link plug |
| OMI | Option Module Interface | Option Module Interface |
| P | | |
| p... | - | Setting parameter |
| PB | PROFIBUS | PROFIBUS |
| PcCtrl | PC Control | Master control |
| PD | PROFdrive | PROFdrive |
| PDS | Power unit Data Set | Power unit data set |
| PE | Protective Earth | Protective Earth |
| PELV | Protective Extra Low Voltage | Protective Extra Low Voltage |
| PEM | Permanenterregter Synchronmotor | Permanent-field synchronous motor |
| PG | Programmiergerät | Programming device |
| PI | Proportional Integral | Proportional Integral |
| PID | Proportional Integral Differential | Proportional Integral Differential |
| PLC | Programmable Logic Controller | Programmable logic controller |
| PLL | Phase-Locked Loop | Phase-Locked Loop |
| PN | PROFINET | PROFINET |
| PNO | PROFIBUS Nutzerorganisation | PROFIBUS User Organization (PROFIBUS International) |
| PPI | Point to Point Interface | Point to point interface |
| PRBS | Pseudo Random Binary Signal | Pseudo Random Binary Signal |
| PROFIBUS | Process Field Bus | Serial data bus |
| PS | Power Supply | Power supply |
| PSA | Power Stack Adapter | Power stack adapter |
| PTC | Positive Temperature Coefficient | Positive Temperature Coefficient |
| PTP | Point-To-Point | Point-to-point |
| PWM | Pulse Width Modulation | Pulse width modulation |
| PZD | Prozessdaten | Process data |
| Q | | |
| R | | |
| r... | - | Display parameter (read only) |
| RAM | Random Access Memory | Read and write memory |
| RCCB | Residual Current Circuit Breaker | Residual current circuit breaker |
| RCD | Residual Current Device | Residual current device |
| RFG | Ramp-Function Generator | Ramp-function generator |

| Abbreviation | Derivation of abbreviation | Meaning |
|---------------------|-----------------------------------|--|
| RJ45 | Registered Jack 45 | Describes an 8-pole connector system for data transfer with shielded or unshielded multicore copper cables |
| RKA | Rückkühlanlage | Cooling unit |
| RO | Read Only | Read only |
| RPDO | Receive Process Data Object | Receive Process Data Object |
| RS232 | Recommended Standard 232 | Interface standard for conducted serial data transfer between a transmitter and a receiver (also designated as EIA232) |
| RS485 | Recommended Standard 485 | Interface standard for a conducted differential, parallel and/or serial bus system (data transfer between several transmitters and receivers, also designated as EIA485) |
| RTC | Real Time Clock | Real time clock |
| S | | |
| S1 | - | Continuous duty |
| S3 | - | Intermittent duty |
| SBC | Safe Brake Control | Safe brake control |
| SBH | Sicherer Betriebshalt | Safe Operating Stop |
| SBR | - | Safe Acceleration Monitor |
| SCA | Safe Cam | Safe cam |
| SD Card | SecureDigital Card | Secure Digital Card |
| SE | Sicherer Software-Endschalter | Safe software limit switch |
| SG | Sicher reduzierte Geschwindigkeit | Safely reduced speed |
| SGA | Sicherheitsgerichteter Ausgang | Safety-related output |
| SGE | Sicherheitsgerichteter Eingang | Safety-related input |
| SH | Sicherer Halt | Safe standstill |
| SP | 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 | Sensorless Vector Control |
| SM | Sensor Module | Sensor Module |
| SMC | Sensor Module Cabinet | Sensor Module Cabinet |
| SME | Sensor Module External | Sensor Module External |
| SN | Sicherer Software-Nocken | Safe software cam |
| SOS | Safe Operating Stop | Safe operating stop |
| SP | Service Pack | Service pack |
| SPC | Setpoint Channel | Setpoint channel |

| | | |
|----------|------------------------------------|---|
| SPI | Serial Peripheral Interface | Serial I/O interface |
| SS1 | Safe Stop 1 | Safe Stop 1 (time-monitored, ramp-monitored) |
| SS2 | Safe Stop 2 | Safe Stop 2 |
| SSI | Synchronous Serial Interface | Synchronous serial interface |
| SSM | Safe Speed Monitor | Safe feedback from speed monitor ($n < nx$) |
| SSR | Safe Stop Ramp | Safe brake ramp |
| STO | Safe Torque Off | Safely switched-off torque |
| STW | Steuerwort | Control word |
| SVA | Space-vector approximation | Space-vector approximation |
| 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 system |
| Tn | - | Integral time |
| TPDO | Transmit Process Data Object | Transmit Process Data Object |
| TT | Terre Terre | Grounded three-phase supply system |
| TTL | Transistor-Transistor Logic | Transistor-Transistor-Logic |
| Tv | - | Derivative action time |
| U | | |
| UL | Underwriters Laboratories Inc. | Underwriters Laboratories Inc. |
| UPS | Uninterruptible Power Supply | Uninterruptible power supply |
| 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 | | |
| WZM | Werkzeugmaschine | Machine tool |
| X | | |
| XML | Extensible Markup Language | Extensible Markup Language (standard language for Web publishing and document management) |

Y

Z

ZK Zwischenkreis

DC link

ZM Zero Mark

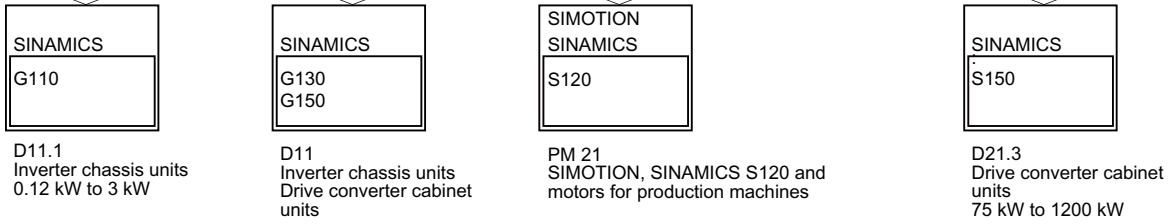
Zero mark

ZSW Zustandswort

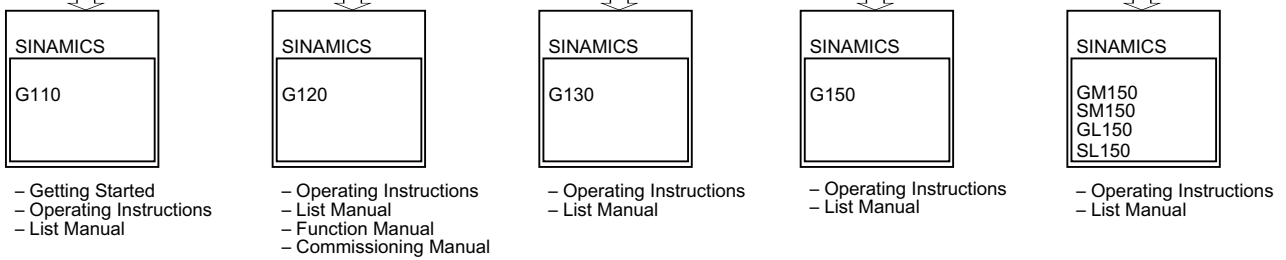
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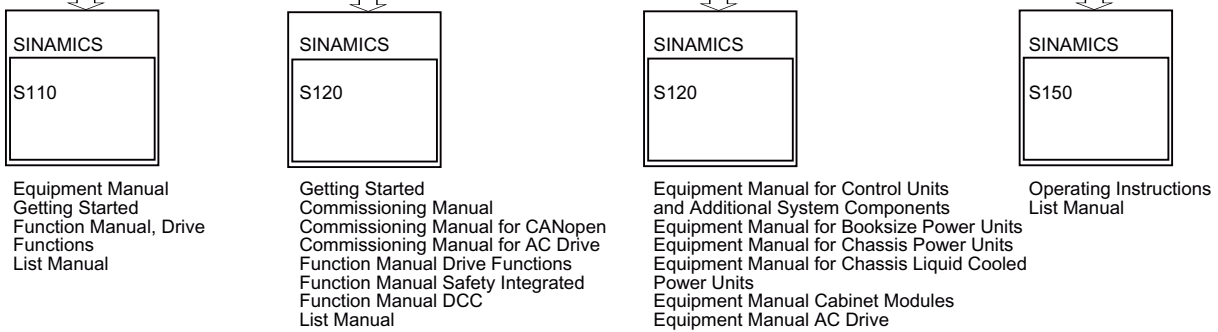
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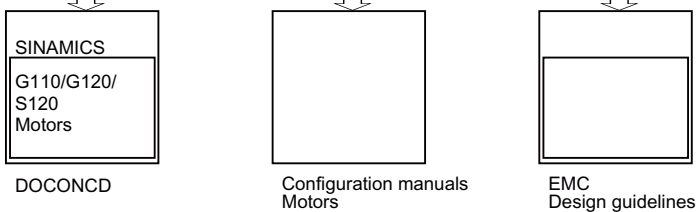
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Suggestions and/or corrections

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