

# SINAMICS S110

Manual · 01/2011

SINAMICS

**SIEMENS**



# SIEMENS

## SINAMICS

### S110 Manual

Manual

#### Preface




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## Legal information

### Warning notice system

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

 <b>DANGER</b>
indicates that death or severe personal injury <b>will</b> result if proper precautions are not taken.
 <b>WARNING</b>
indicates that death or severe personal injury <b>may</b> result if proper precautions are not taken.
 <b>CAUTION</b>
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.
<b>CAUTION</b>
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.
<b>NOTICE</b>
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.


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

### Qualified Personnel

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

### Proper use of Siemens products

Note the following:

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

### Trademarks

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

### Disclaimer of Liability

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

# Preface

## SINAMICS Documentation

The SINAMICS documentation is organized in the following categories:

- General documentation/catalogs
- User documentation
- Manufacturer/Service documentation

## More information

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

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

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

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

## My Documentation Manager

Using the following link, you can find information on how to create your own individual documentation based on Siemens' content, and adapt it for your own machine documentation:

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

## Training

Using the following link, you can find information on SITRAIN - training from Siemens for products, systems and automation engineering solutions:

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

## FAQs

You can find Frequently Asked Questions in the Service&Support pages under **Product Support**:

<http://support.automation.siemens.com>

## SINAMICS

You can find information on SINAMICS at:

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

### 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 configuration tool Configuration Manuals, Motors
Decision making/ordering	SINAMICS S Catalogs
Installation/assembly	<ul style="list-style-type: none"> <li>• SINAMICS S110 Equipment Manual</li> </ul>
Commissioning	<ul style="list-style-type: none"> <li>• STARTER commissioning tool</li> <li>• SINAMICS S110 Getting Started</li> <li>• SINAMICS S110 Function Manual Drive Functions</li> <li>• SINAMICS S110 List Manual</li> </ul>
Usage/operation	<ul style="list-style-type: none"> <li>• SINAMICS S110 Function Manual Drive Functions</li> <li>• SINAMICS S110 List Manual</li> </ul>
Maintenance/service	<ul style="list-style-type: none"> <li>• SINAMICS S110 Function Manual Drive Functions</li> <li>• SINAMICS S110 List Manual</li> <li>• SINAMICS S110 Equipment Manual</li> </ul>

### Target group

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

### Benefits

This manual describes all the information, procedures and operational instructions required for commissioning and servicing SINAMICS S110.

## 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.

## Technical Support

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

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

## EC Declaration of Conformity

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

<http://support.automation.siemens.com>

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

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

<http://support.automation.siemens.com>

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

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### Note

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

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### Note

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

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**Note**

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

Should there be any deviation from the requirements in the Equipment Manual, appropriate actions (e.g. measurements) must be taken to check/prove that the required level of operational reliability and compliance with EMC limit values are ensured.

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**Spare parts**

You can find spare parts on the Internet at:


<http://support.automation.siemens.com/WW/view/en/16612315>


**Test certificates**

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



## ESD information

 <b>CAUTION</b>
<p>Electrostatic sensitive devices (ESD) are single components, integrated circuits or devices that can be damaged by electrostatic fields or electrostatic discharges.</p> <p>Regulations for handling ESD components:</p> <p>When handling components, make sure that personnel, workplaces, and packaging are well grounded.</p> <p>Personnel may only come into contact with electronic components, if</p> <ul style="list-style-type: none"><li>• They are grounded with an ESD wrist band, or</li><li>• They are in ESD areas with conductive flooring, ESD shoes or ESD grounding straps.</li></ul> <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>Electronic boards may not be placed near display units, monitors, or televisions (minimum distance from the screen &gt; 10 cm).</p> <p>Measurements must only be taken on boards when the measuring instrument is grounded (via protective conductors, for example) or the measuring probe is briefly discharged before measurements are taken with an isolated measuring device (for example, touching a bare metal housing).</p>

 <b>DANGER</b>
<p>Electrical, magnetic and electromagnetic fields (EMF) that occur during operation can pose a danger to persons who are present in the direct vicinity of the product - especially persons with pacemakers, implants, or similar devices.</p> <p>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 in 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 Insurance Association.</p> <p>These state that a hazard analysis must drawn up for every workplace, from which measures for reducing dangers and their impact on persons are derived and applied, and exposure and danger zones are defined and observed.</p> <p>The relevant safety notes in each chapter must be observed.</p>

## General safety guidelines

 **DANGER**

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

Only appropriately qualified personnel may install, commission, and maintain SINAMICS S devices.

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

Operational electrical equipment and motors have parts and components which are at hazardous voltage levels, that if touched, can result in severe bodily injury or death.

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

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

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

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

 **DANGER**

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

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

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

According to EN 61800-5-1 and UL 508, only safely isolated protective extra low voltages may be connected to any of the connections or terminals on the electronics modules.

 **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 met, other protective measures with regard to electric shock must be taken, e.g. touch protection.

**⚠ 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 18.4, all connectors of SINAMICS S equipment must be disconnected/unplugged to prevent the equipment from being damaged.

Motors should be connected up in accordance with the circuit diagram supplied with the motor (refer to the connection examples for Power 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 cell phones 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

### Residual risks of power drive systems

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

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

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

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

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

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

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**Note**

**Functional safety of SINAMICS components**

The components must be protected against conductive contamination (e.g. by installing them in a cabinet with degree of protection IP54B to EN 60529).

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

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



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# System overview

## 1.1 Field of application

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

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

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

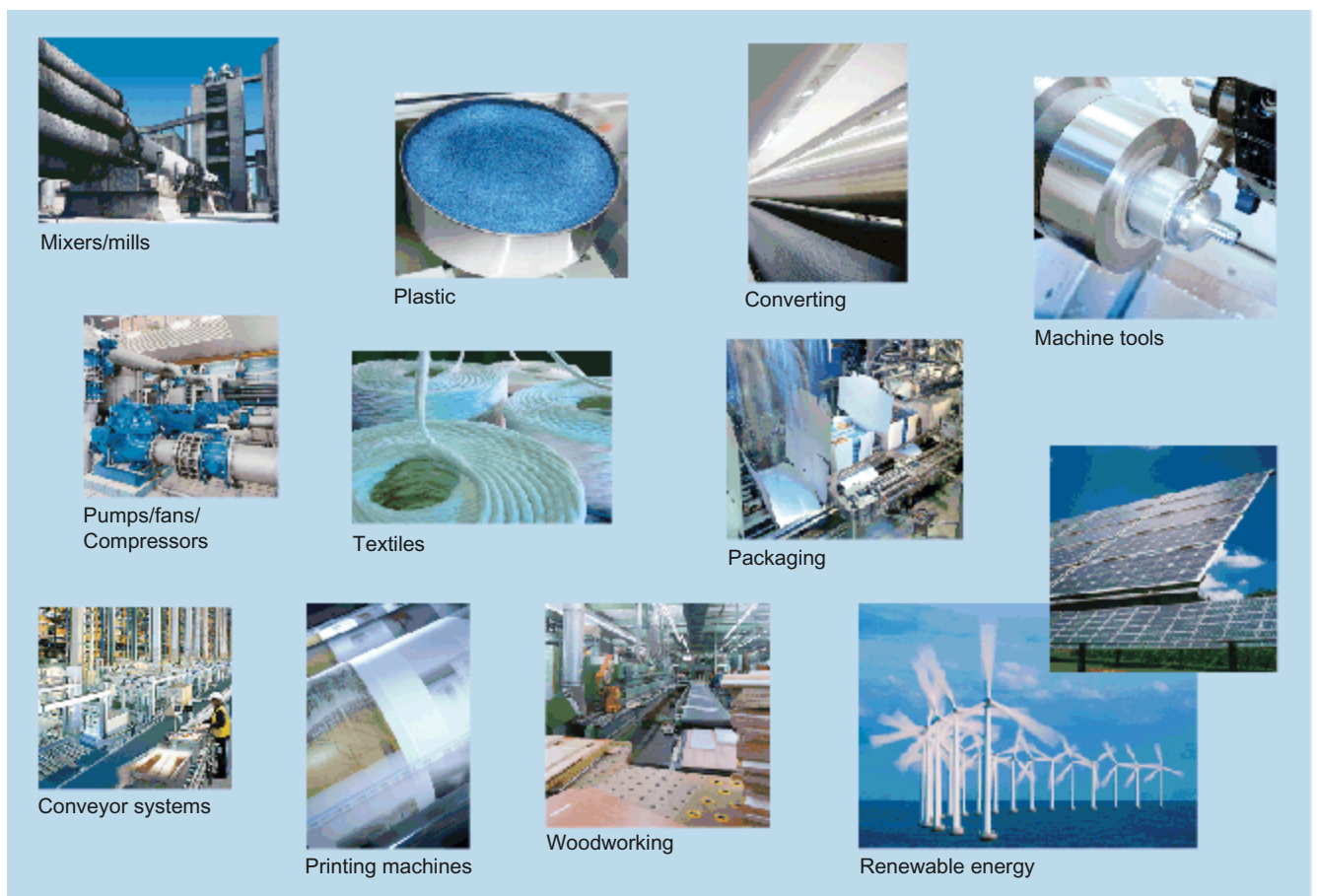


Figure 1-1 SINAMICS applications

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

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

## 1.2 Platform concept and Totally Integrated Automation

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

### Totally Integrated Automation (TIA) with SINAMICS S110

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

SINAMICS S110 supports PROFIBUS DP, the standard field bus of the TIA system. It provides a high-performance, system-wide communication network which links all automation components: HMI, controls, drives and I/O devices.

SINAMICS S110 is also available with a PROFINET interface. This Ethernet-based bus allows the rapid exchange of control data via PROFINET IO.



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

## 1.3 Overview of SINAMICS S110

SINAMICS S110 is the "simple servo" in the range of SINAMICS AC Drives. As a modular drive system for single axes in "servo" control mode, it is primarily used for simple positioning tasks in a wide range of industrial applications.

Typical areas of application for positioning, setting up and referencing include:

- Simple infeed tasks (e.g. rotary indexing tables)
- Handling technology, robotics
- Pick & place tasks
- Printing and paper machines
- Packaging machines

As a combination of a power unit (Power Module) and a Control Unit (CU) the SINAMICS S110 forms a single-motor drive in a compact format 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 S110 can be used to operate synchronous and induction motors. Direct drives, such as linear and torque motors, can only be operated with SINAMICS S120.



## 1.4 System data

Table 1- 1 General technical data

<b>Electrical data</b>	
Line supply voltage: Blocksize format units	1-ph. 200 V to 240 V AC $\pm 10$ % 3-ph. 380 V to 480 V AC $\pm 10$ %
Rated pulse frequency: Blocksize format units	4 kHz
Line frequency	47 Hz to 63 Hz
Output voltage: Blocksize 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.
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"> <li>• 1.1 kW – 447 kW: 65 kA</li> <li>• 448 kW – 671 kW: 84 kA</li> <li>• 672 kW – 1193 kW: 170 kA</li> <li>• <math>\geq 1194</math> kW: 200 kA</li> </ul>
Radio interference suppression acc. to EN 61800-3	Category C3 (option) Category C2 (option) for systems implemented in conformance with the documentation
Overvoltage category	III acc. to EN 60664-1
Degree of pollution	2 acc. to 60664-1

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

<b>Environmental conditions</b>	
Degree of protection	IP20 or IPXXB acc. to EN 60529, open type acc. to UL 508
Protective class line supply circuits Protective class electronic circuits	I (with protective conductor connection) III (safety extra-low voltage DVC A /PELV) acc. to EN 61800-5-1
Type of cooling	Internal air cooling, power units with forced air cooling using an integrated fan
Permissible cooling medium temperature (air) and installation altitude in operation	0 °C to +40 °C and an installation altitude of up to 1,000 m without derating, >40 °C to 55 °C, see the characteristic for current derating. Installation altitude >1,000 m and up to 4,000 m, see the characteristic for current derating or reduction of the ambient temperature by 3.5 K per 500 m.
Chemically active substances <ul style="list-style-type: none"> <li>• Long-term storage in the transport packaging</li> <li>• Transport in the transport packaging</li> <li>• Operation</li> </ul>	Class 1C2 to EN 60721-3-1 Class 2C2 to EN 60721-3-2 Class 3C2 to EN 60721-3-3

## System overview

### 1.4 System data

<p>Biological environmental conditions:</p> <ul style="list-style-type: none"> <li>• Storage in the transport packaging</li> <li>• Transport in the transport packaging</li> <li>• Operation</li> </ul>	<p>Class 1B1 to EN 60721-3-1  Class 2B1 to EN 60721-3-2  Class 3B1 to EN 60721-3-3</p>
<p>Vibratory load</p> <ul style="list-style-type: none"> <li>• Long-term storage in the transport packaging</li> <li>• Transport in the transport packaging</li> <li>• Operation</li> </ul>	<p>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</p>
<p>Shock load</p> <ul style="list-style-type: none"> <li>• Long-term storage in the transport packaging</li> <li>• Transport in the transport packaging</li> <li>• Operation</li> </ul>	<p>Class 1M2 acc. to EN 60721-3-1  Class 2M3 acc. to EN 60721-3-2  Test values: 15 g / 11 ms</p>
<p>Climatic ambient conditions</p> <ul style="list-style-type: none"> <li>• Long-term storage in the transport packaging</li> <li>• Transport in the transport packaging</li> <li>• Operation</li> </ul>	<p>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 humidity 5% to 90%  ≤ 60%, in environments which contain corrosive gases and/or dust.  Oil mist, saline fog, ice, condensation, dripping water, spray water, and splashes or jets of water are not permissible.</p>

<b>Certificates</b>	
Declarations of Conformity	CE (Low-Voltage and EMC Directive)
Approvals	cULus

## 1.5 Derating as a function of the installation altitude and ambient temperature

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

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

Table 1- 2 Air pressure for various installation altitudes

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

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

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

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

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

## 1.6 Standards

### Note

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

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

Table 1-3 Fundamental, application-relevant standards in succession: EN, IEC/ISO, DIN, VDE

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

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

*System overview*

*1.6 Standards*

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

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

## Mains connection and line-side power components

### 2.1 Introduction

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

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

The possible supply voltages for the drive line-up are

- 1-ph. 200 V to 1-ph. 240 V AC  $\pm$  10%
- 3-ph. 380 V to 3-ph. 480 V AC  $\pm$  10%

The following line reactor variants are available:

- 3 versions for frame sizes FSA - FSC (chassis)
- 5 versions for frame sizes FSD - FSF (3 chassis and 2 standalone)

The following line filter variants are available:

- Integrated
- External
  - Base
  - Standalone

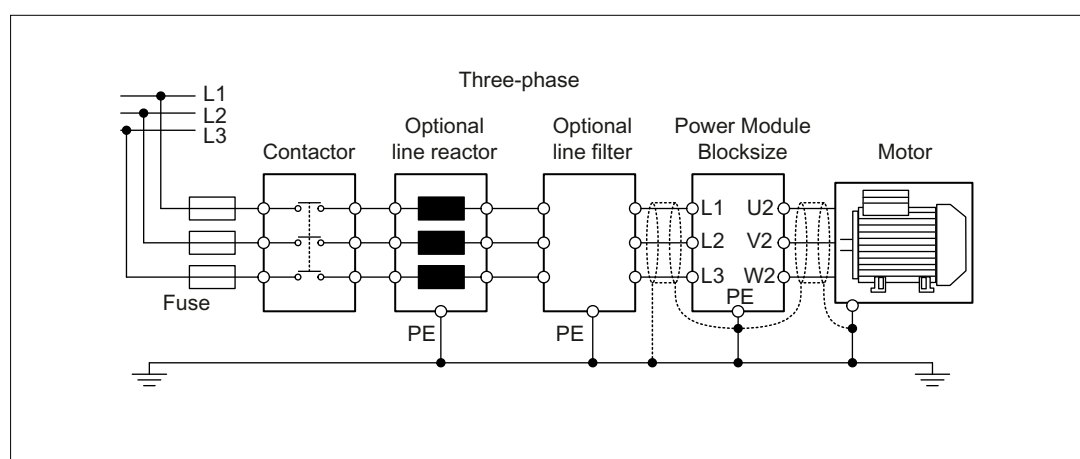


Figure 2-1 Example of a line connection for Power Modules blocksize with no integrated line filter

---

**Note**

Compliance with limit values for interference voltage under Category C2 acc. to EN 61800-3 can only be assured if a line filter is used.

---

<b>CAUTION</b>
----------------

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

- |  |
|--|
| <ul style="list-style-type: none"> <li>- the Power Modules could be damaged/destroyed.</li> <li>- Line reactions can occur that can damage or interfere with other loads powered from the same network.</li> </ul> |
|--|

<b>CAUTION</b>
----------------

<p>The Power Modules in blocksize format with line filters are only suitable for direct connection to TN line supplies.</p>
---



## **2.2 Information on the disconnecter unit**

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

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

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

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

### DANGER

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

### WARNING

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

### NOTICE

Fuses that can operate across the maximum cable length within a circuit must be rated in accordance with the requirements for:

1. Short-circuit protection (IEC 60364-4-43 and -5-52, EN 60204-1, and EN 61800-5-1)
2. The maximum permissible break time for protection against electric shock in the event of indirect contact (IEC 60364-4-41 and -4-43, EN 61800-5-1, and EN 60204-1)
3. The maximum permissible voltage drop during operation

The maximum cable length depends primarily on the cable cross-section, material, and insulation, as well as the type and size of the upstream overcurrent protection device.

The minimum value, which is derived from the three requirements, usually has to be strictly observed. This means that the fuses must be designed in such a way that, if a fault occurs, the line fuses trip after 0.4 s with mobile equipment and after 5 s with stationary equipment.

### Note

The devices can be connected to line supplies up to 480 V<sub>AC</sub>, which can supply a maximum of 36 kA symmetrical ("uninfluenced current" acc. to EN 60269-1).

For further information: See catalog PM 21.

## 2.4 Using residual-current devices

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

### NOTICE

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

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

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

### DANGER

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

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

- It is only permissible to use a delayed tripping, selective AC/DC-sensitive residual-current-operated circuit breaker, type B.
- The max. permitted grounding resistance of the "selective protective device" must be observed (83  $\Omega$  max. for residual-current devices with 0.3 A rated differential current).
- Accessible parts of the Power Drive System and the machine must be connected to the system's protective ground conductor.
- The shielded motor cable must not be longer than 50 m.
- A separate residual-current device must be used for each Power Module.
- Only one residual-current device may be connected in series (cascading is not permitted).
- Switching elements (disconnecter units, contactors) for connecting and disconnecting the Power Drive System have a max. 35 ms delay time time between the closing/opening of the individual main contacts.

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

## 2.5 Overvoltage protection

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

## 2.6 Line contactors

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

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



Line contactors must not be switched under load.

### Note

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

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

## 2.7 Line filter

### 2.7.1 Description

In conjunction with a suitably EMC-compliant system configuration, line filters limit the conducted interference emitted by the Power Modules to the limit values of Category C2 acc. to EN 61800-3.

A separate line filter (see catalog) must be used for the SINAMICS S110 drive line-up.

---

#### Note

All PM340 Power Modules are available with integrated line filters.

This does not apply, however, to frame size FSA for a 3-ph. 380 to 480 V AC line supply voltage; an external line filter is required here.

---

NOTICE
--------

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

---

#### Note

According to product standard EN 61800-3, RFI suppression commensurate with the relevant rated conditions must be provided and is a legal requirement in the EU (EMC Directive). Line filters and/or 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.

---

## 2.7.2 Safety information

 **DANGER**

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

 **WARNING**


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

 **WARNING**

The connections must not be interchanged:

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

Non-observance may damage the line filter

 **CAUTION**

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

2.7.3 Dimension drawing

Blocksize line filter

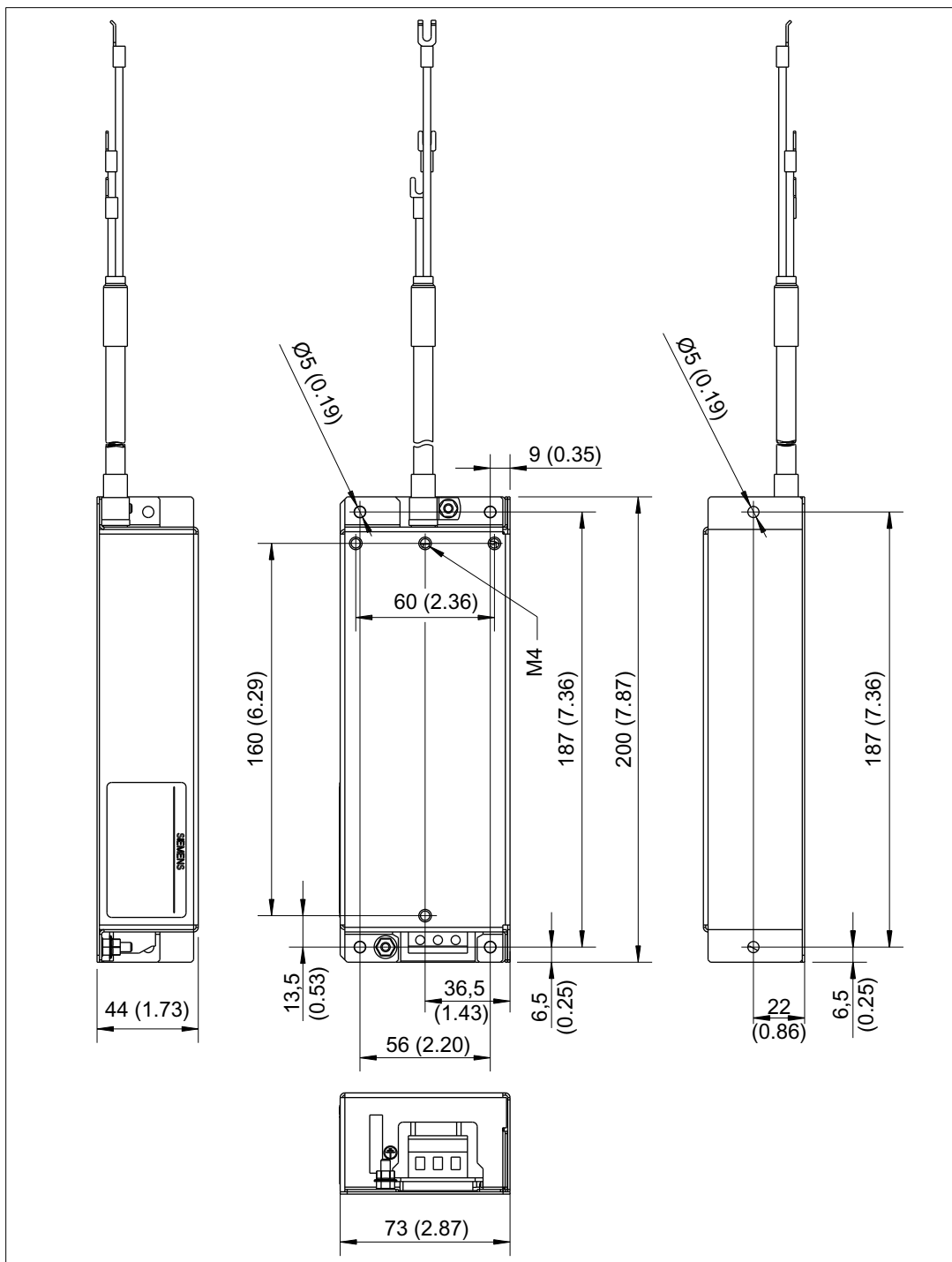


Figure 2-2 Dimension drawing of line filter, frame size FSA, all data in mm and (inches)



## 2.7.4 Installation

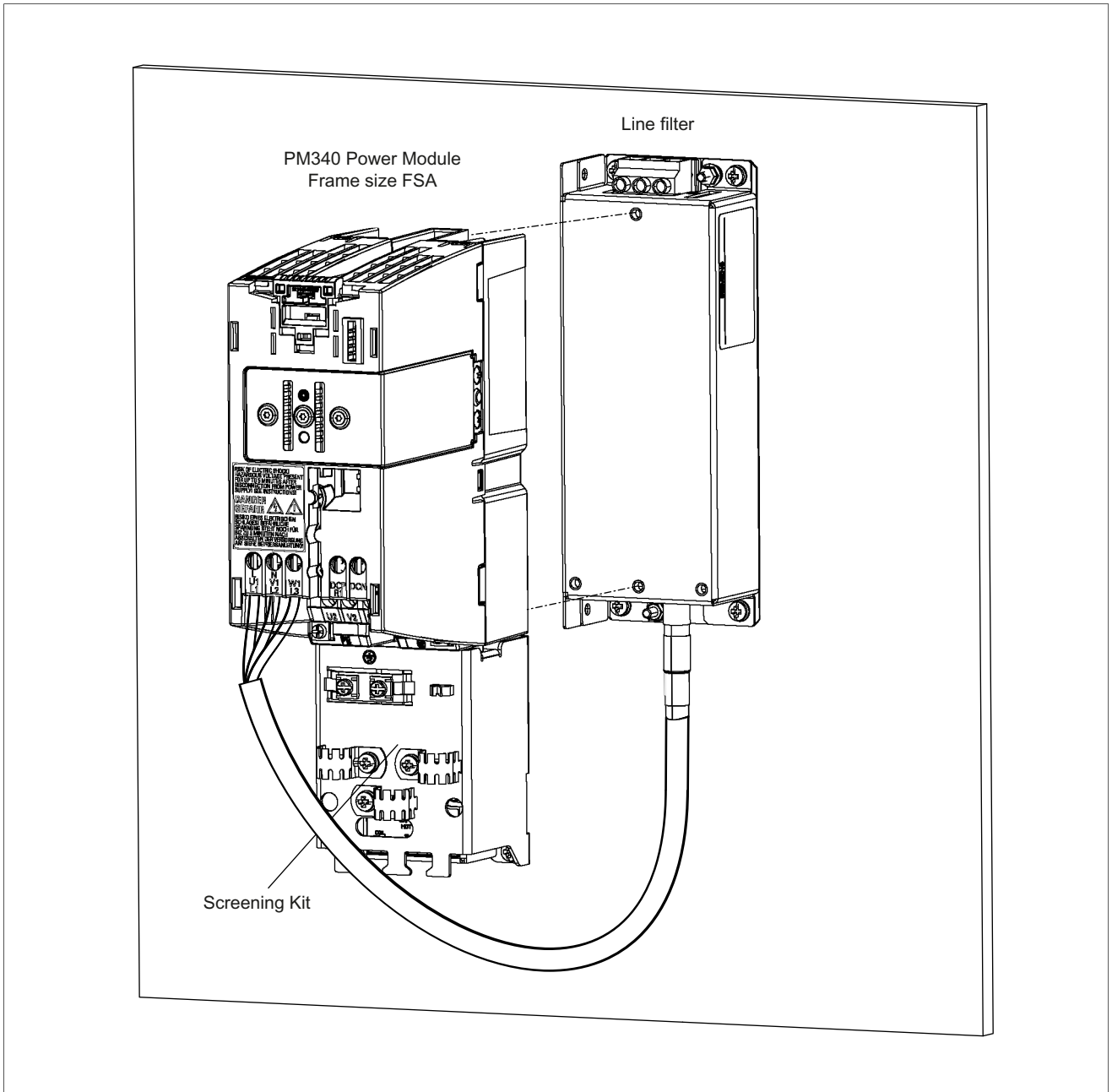


Figure 2-3 Mounting: Power Module PM340 frame size FSA with Screening Kit and line filter

*Mains connection and line-side power components*

*2.7 Line filter*

**2.7.5 Technical data, Blocksize line filter**

Table 2- 1 Technical data, Blocksize line filter

<b>Line supply voltage 3-ph. 380...480 V AC</b>		
<b>Line filter 6SE6400-2FA00-6AD0</b>		
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 <sup>2</sup>
PE connection		At the housing with M4 stud
Load connection U, V, W		Shielded cable 3 x 2.5 mm <sup>2</sup> 0.4 m long
Degree of protection		IP20 or IPXXB
Weight, approx.	kg	0.5


## 2.8 Line reactors

### 2.8.1 Description

The line reactors limit low-frequency line harmonics and reduce the load on the rectifiers in the Power Modules. They are used to smooth voltage spikes (line supply faults) or to bridge voltage dips/interruptions when commutating. We therefore recommend the use of line reactors with PM340 Power Modules.


The line reactors are sub-chassis components.

### 2.8.2 Safety information


 <b>WARNING</b>
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.

 <b>WARNING</b>
The connections must not be interchanged:
- Incoming line cable at U1, V1, W1 or L1, N and
- Outgoing cable to the load 1U2, 1V2, 1W2.

<b>CAUTION</b>
When using line reactors that have not been approved by SIEMENS for SINAMICS, the following can occur:
- the Power Modules could be damaged/destroyed.
- Line harmonics that may interfere with or damage other loads connected to the same line supply.

 <b>CAUTION</b>
The surface temperature of the line reactors may exceed 80 °C.

### 2.8.3 Dimension drawings

#### Blocksize line reactors

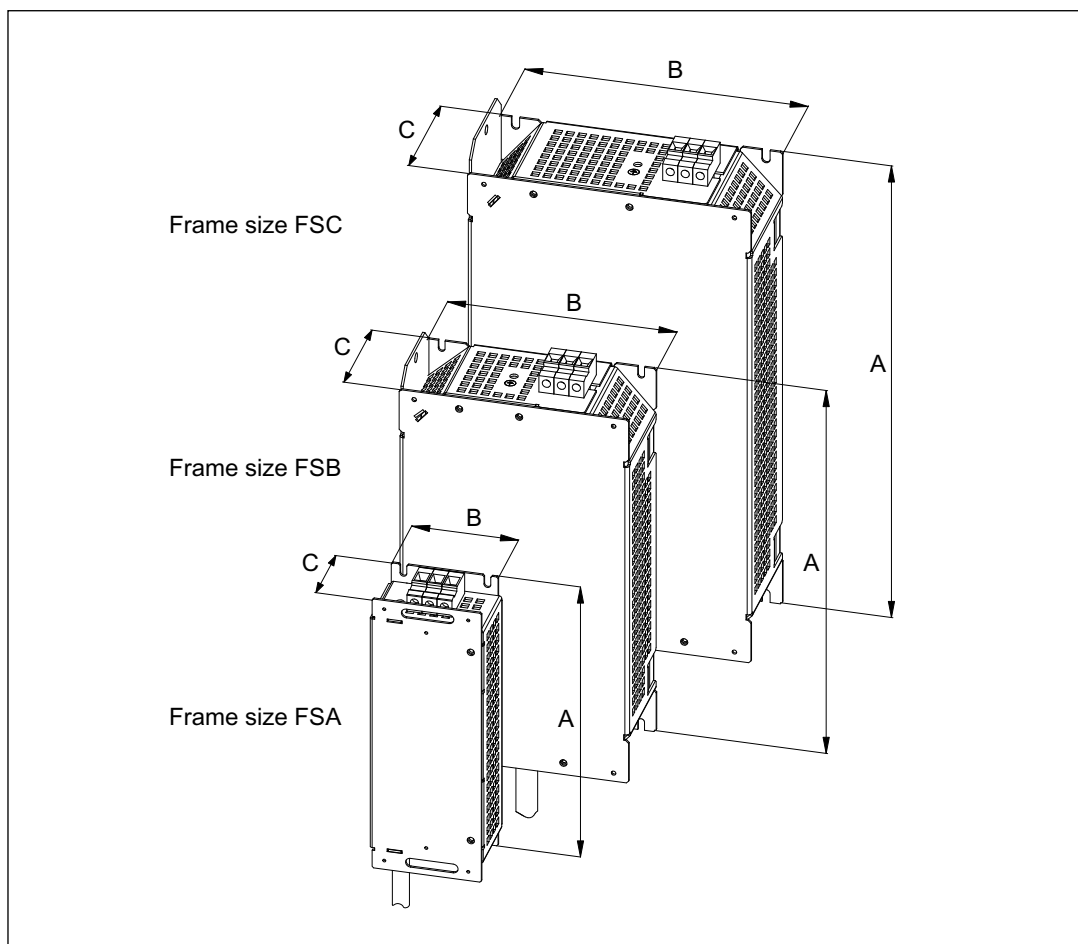


Figure 2-4 Dimension drawing of line reactors, frame sizes FSA, FSB, and FSC

Table 2- 2 Dimensions of line reactors, frame size FSA, all data in mm and (inches)

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

Table 2- 3 Dimensions of line reactors, frame sizes FSB and FSC, all data in mm and (inches)

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

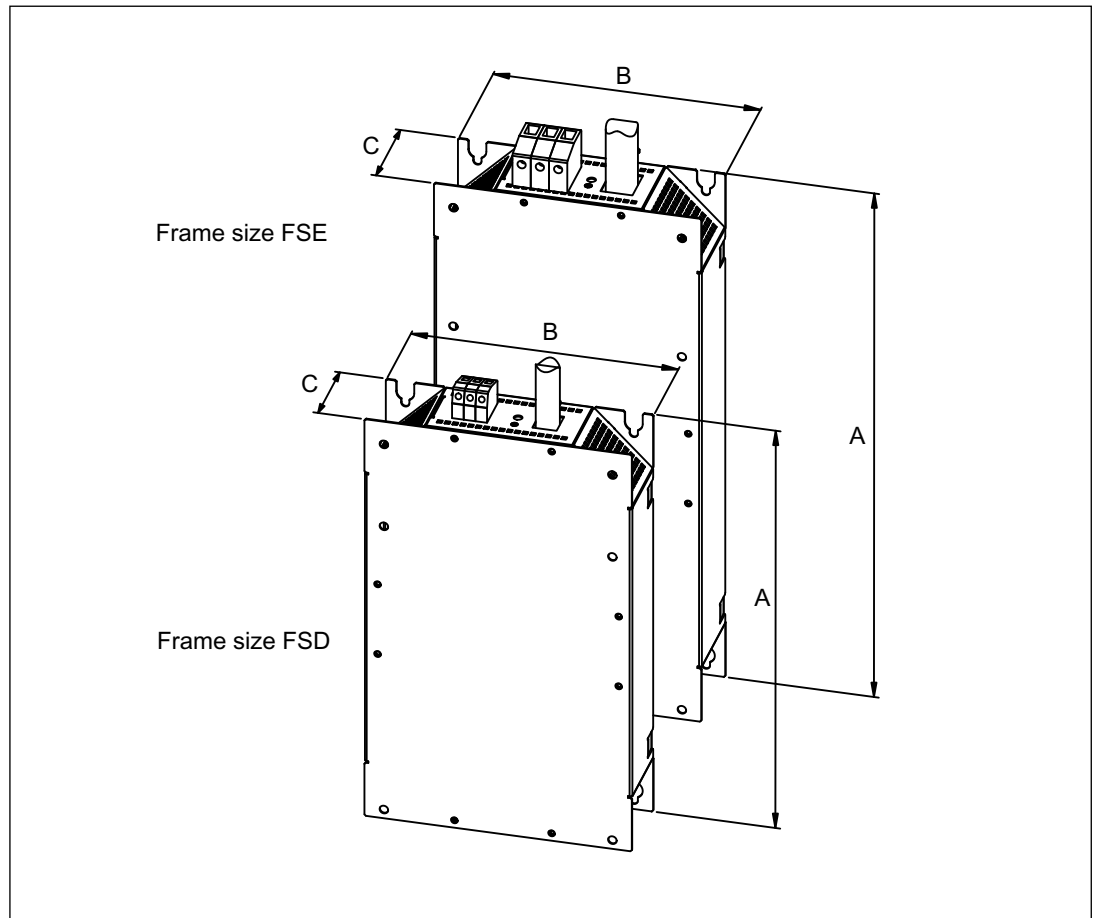


Figure 2-5 Dimension drawing of line reactors, frame sizes FSD and FSE

Table 2- 4 Dimensions of line reactors, frame sizes FSD and FSE, all data in mm and (inches)

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

2.8 Line reactors

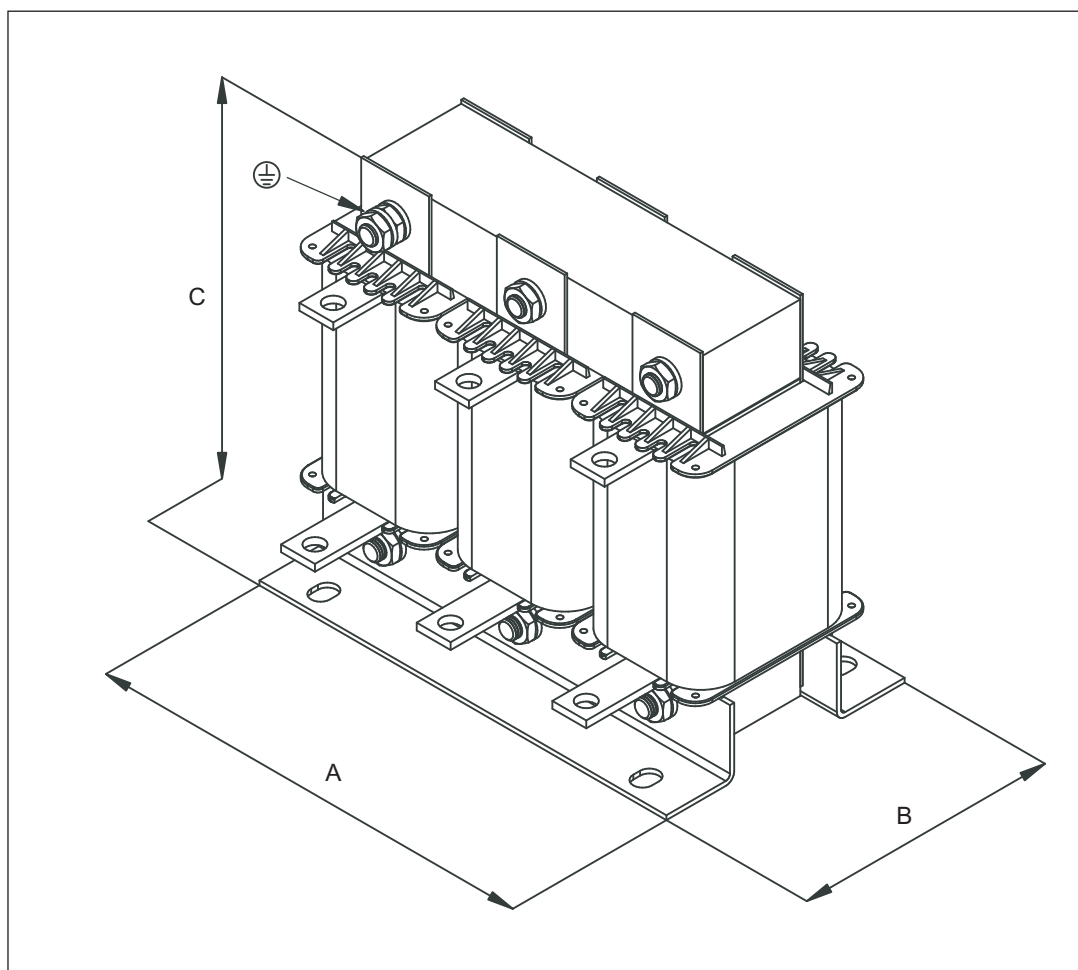


Figure 2-6 Dimension drawing of line reactor, frame size FSF

Table 2- 5 Dimensions of line reactor, frame size FSF, all data in mm and (inches)

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

### 2.8.4 Installation

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

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

Given their weight and their size, the line reactors for Power Modules with frame size FSF are mounted separately.

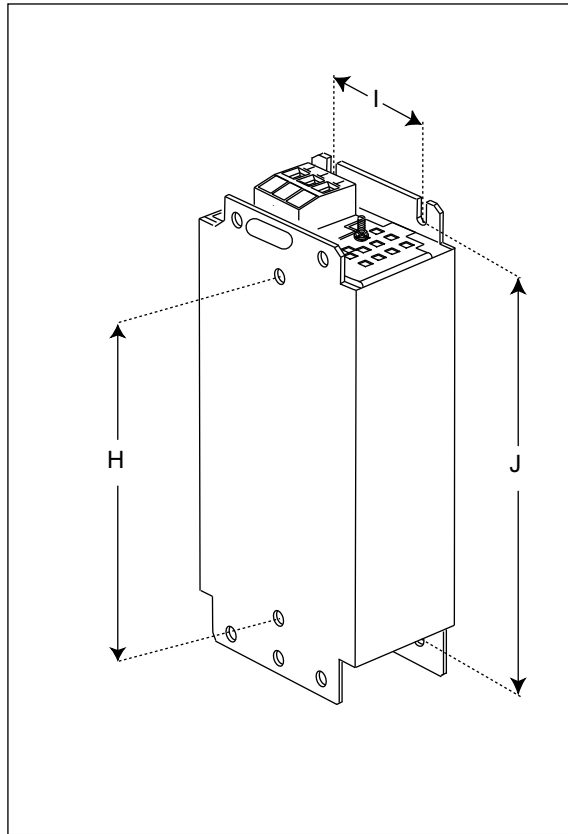


Figure 2-7 Mounting dimensions for line reactors with frame size FSA

Table 2- 6 Mounting dimensions for line reactors with frame size FSA, all data in mm and (inches)

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

2.8 Line reactors

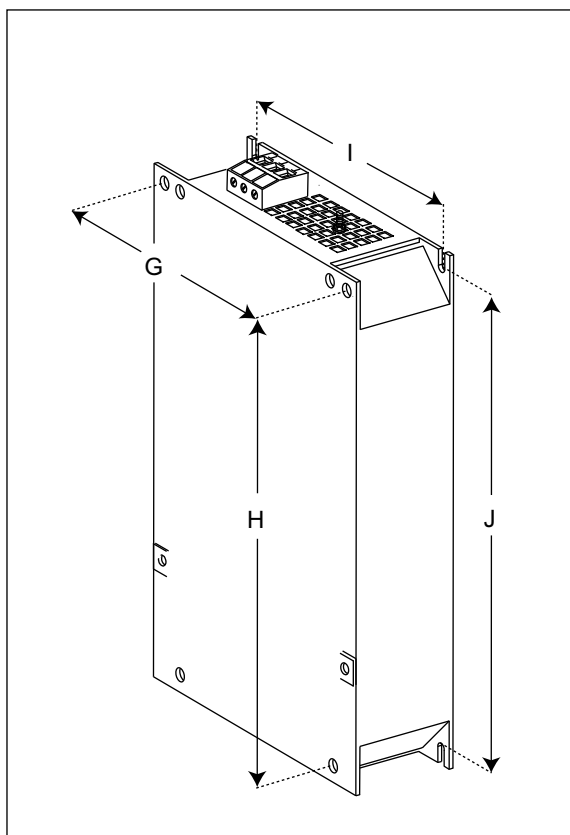


Figure 2-8 Mounting dimensions for line reactors with frame sizes FSB and FSC

Table 2-7 Mounting dimensions for line reactors with frame sizes FSB and FSC, all data in mm and (inches)

Line reactor 6SL3203-	0CD21-0AA0	0CD21-4AA0	0CD22-2AA0	0CD22-2AA0	0CD23-5AA0
Frame size	FSB			FSC	
G	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)	
Securing screws	M4/1.5 Nm			M5/2.25 Nm	



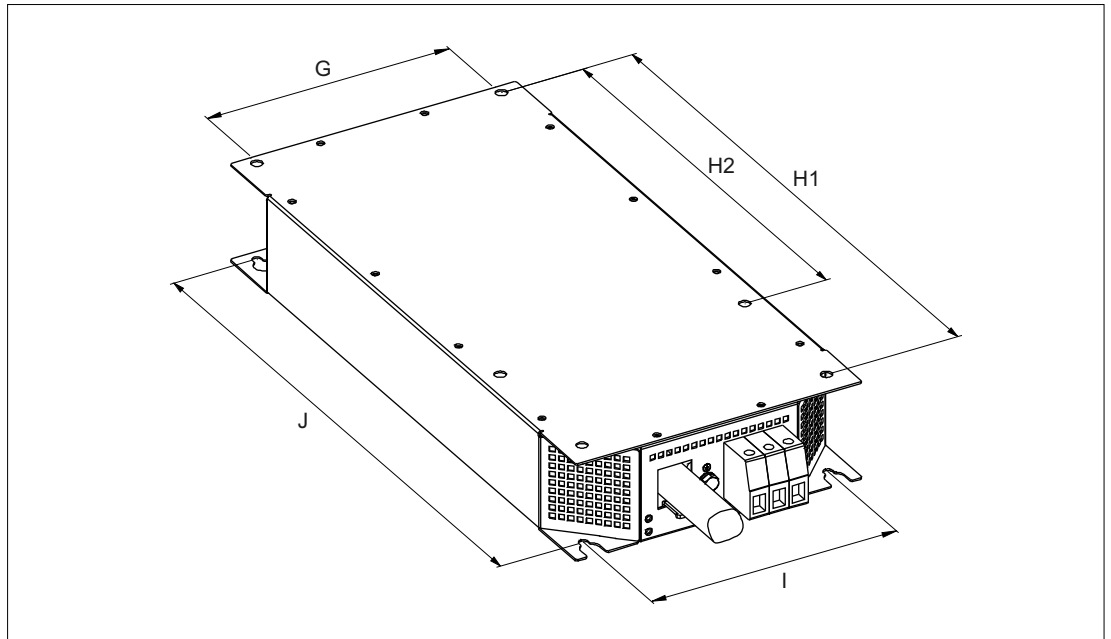


Figure 2-9 Mounting dimensions for line reactors with frame sizes FSD and FSE

Table 2- 8 Mounting dimensions for line reactors with frame sizes FSD and FSE, all data in mm and (inches)

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

2.8 Line reactors

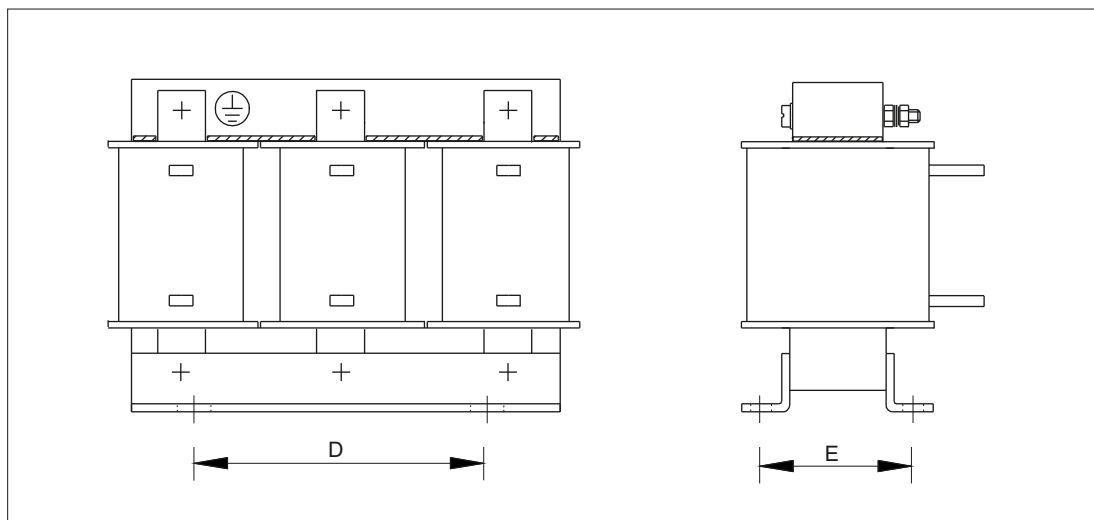


Figure 2-10 Mounting dimensions for line reactors with frame size FSF

Table 2- 9 Mounting dimensions for line reactors with frame size FSF, all data in mm and (inches)

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

Mounting examples

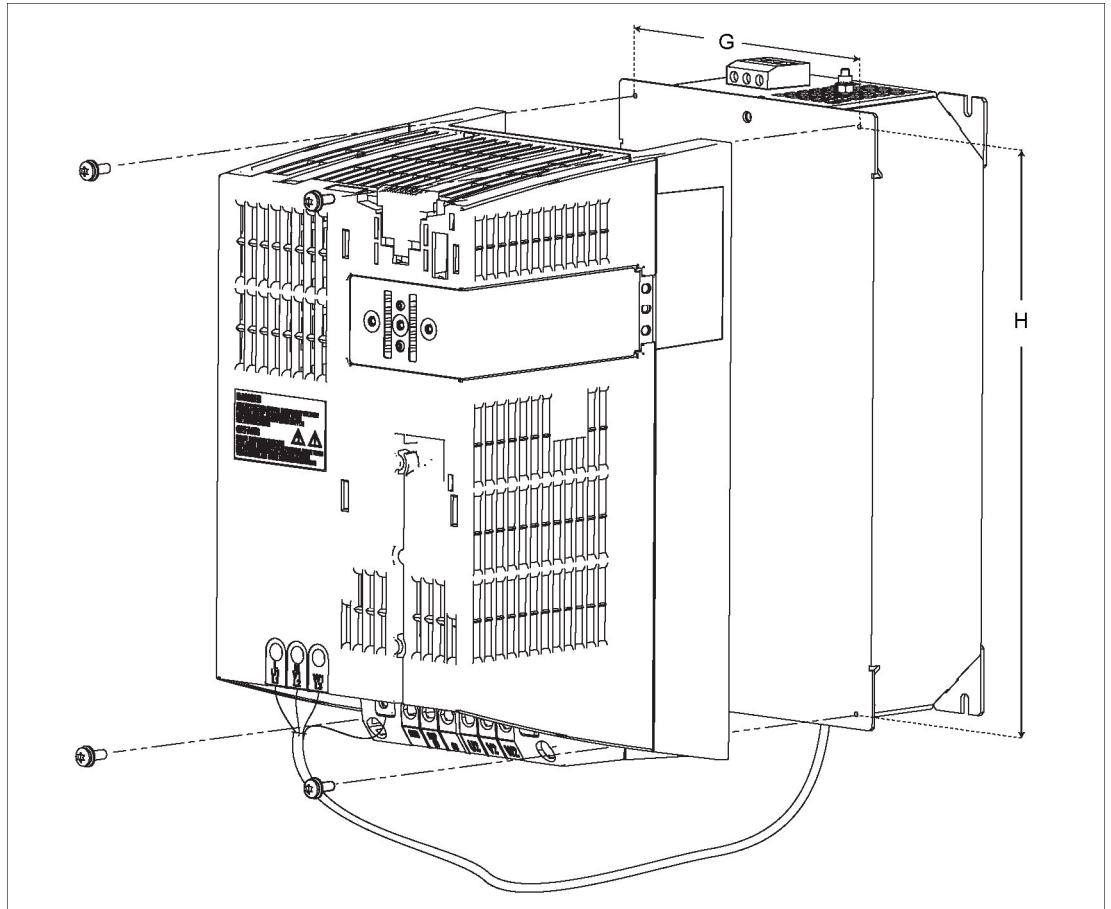


Figure 2-11 Mounting of PM340 with line reactor (based on frame size FSB)

2.8 Line reactors

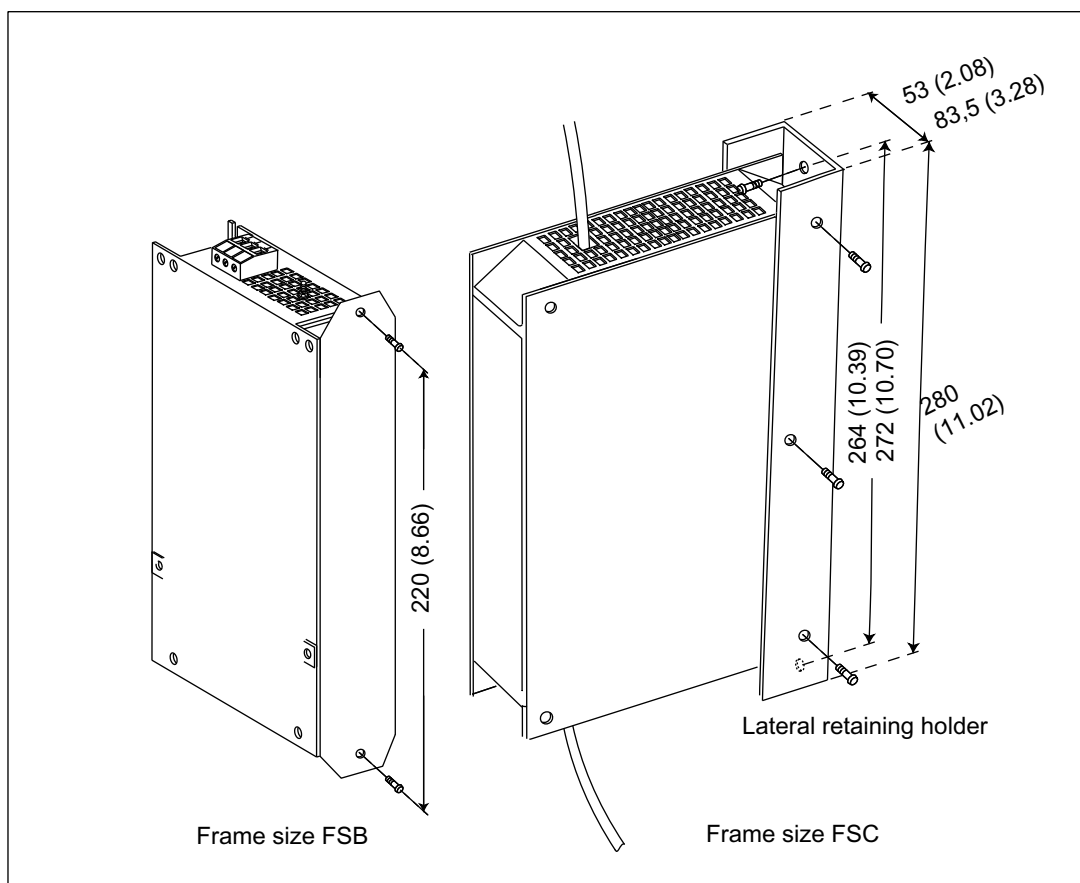


Figure 2-12 Side mounting of line reactors with frame sizes FSB and FSC

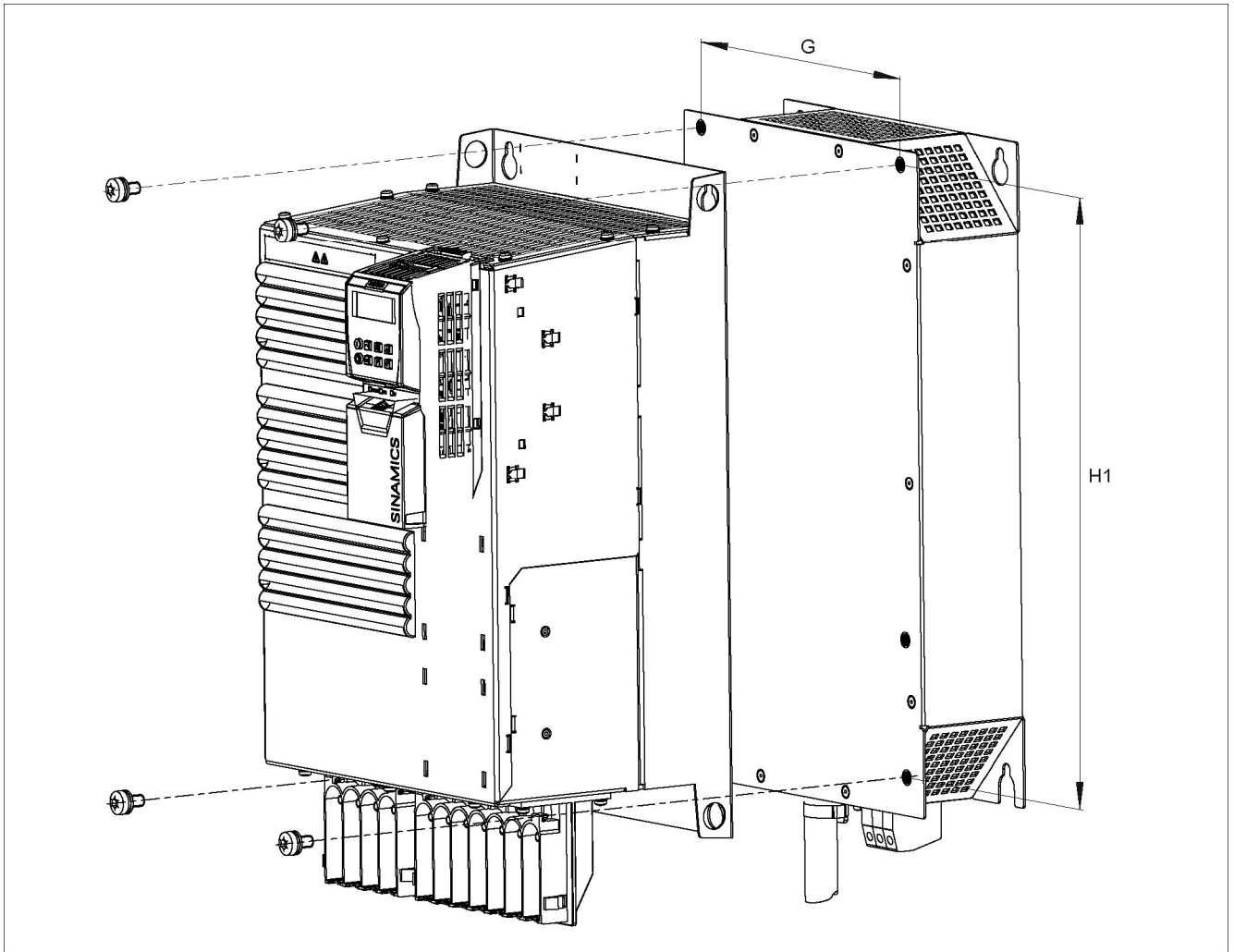


Figure 2-13 Mounting of PM340 with line reactor (based on frame size FSD)

### 2.8.5 Electrical Connection

#### Line supply/load connection

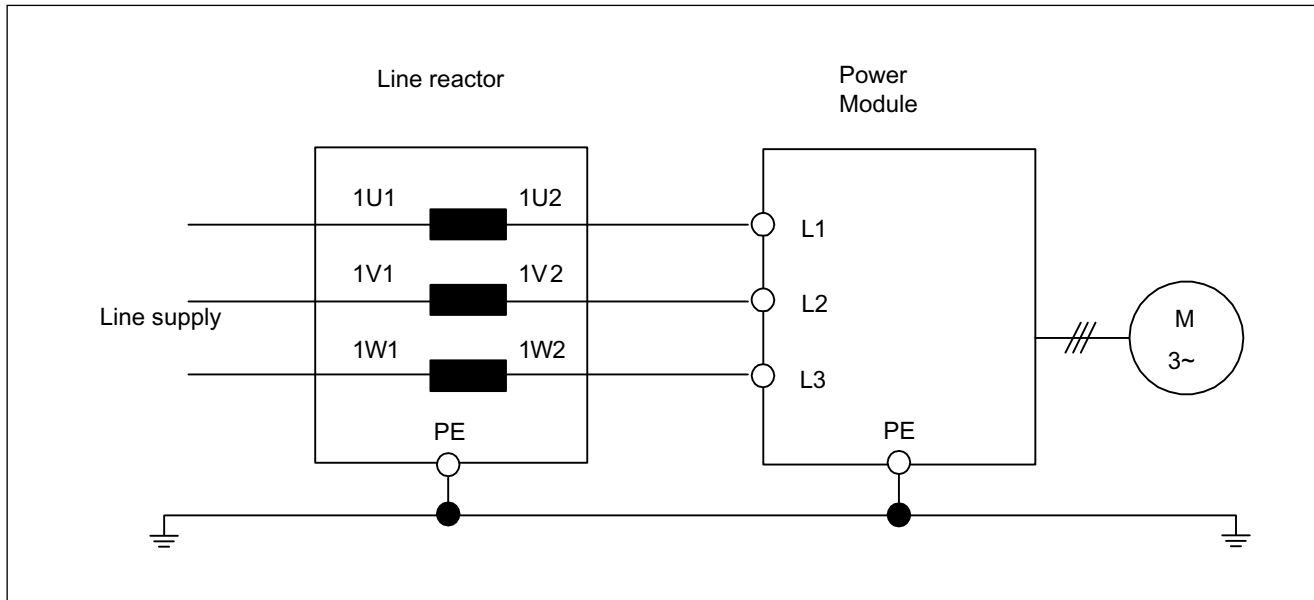


Figure 2-14 Power Module with line filter

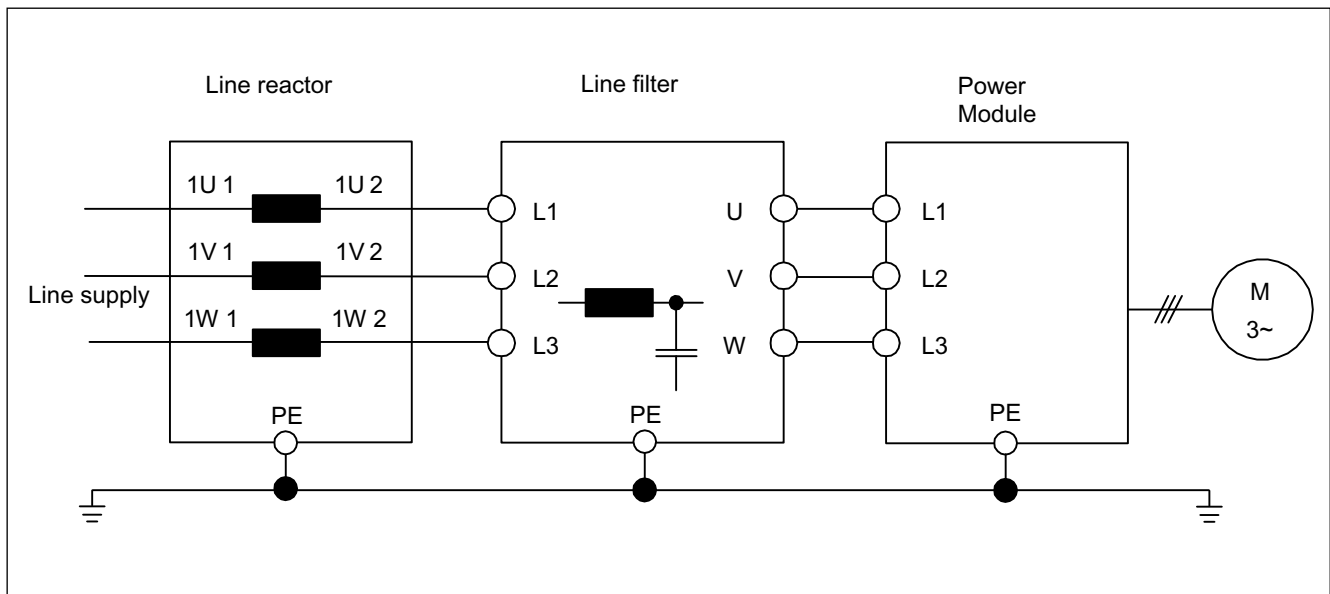


Figure 2-15 Power Module Blocksize with line reactor and line filter

## 2.8.6 Technical data, Blocksize

Table 2- 10 Technical specifications, blocksize line reactors, frame size FSA

Line supply voltage 1-ph 200 V AC -10 % to 240 V AC +10%			
Order No. 6SE6400-		3CC00-4AB3	3CC01-0AB3
Suitable for Power Module 6SL3210-		1SB11-0xxx 1SB12-3xxx	1SB14-0xxx
Rated line reactor current	A	3.4	8.1
Power loss 50 / 60 Hz	W	12.5/15	11.5/14.5
Line supply connection L1, N		6 mm screw terminals <sup>2</sup>	6 mm screw terminals <sup>2</sup>
Load connection 1U2, 1V2, 1W2		Cable 3 x 1.5 mm <sup>2</sup> Length approx. 0.38 m	Cable 3 x 1.5 mm <sup>2</sup> Length approx. 0.38 m
PE connection		M5 stud	M5 stud
Degree of protection		IP20 or IPXXB	IP20 or IPXXB
Weight	kg	1.3	1.3

Table 2- 11 Technical specifications, blocksize line reactors, frame size FSA

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

Mains connection and line-side power components

2.8 Line reactors

Table 2- 12 Technical specifications, blocksize line reactors, frame sizes FSB and FSC

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

Table 2- 13 Technical specifications, blocksize line reactors, frame sizes FSD, FSE, and FSF

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



## 2.9 Line connection variants

### 2.9.1 Methods of line connection

A distinction is made between:

- Direct operation of the line connection components on the supply system
- Operation of the Line Connection Components via an Autotransformer
- Operating line connection components via an isolating transformer

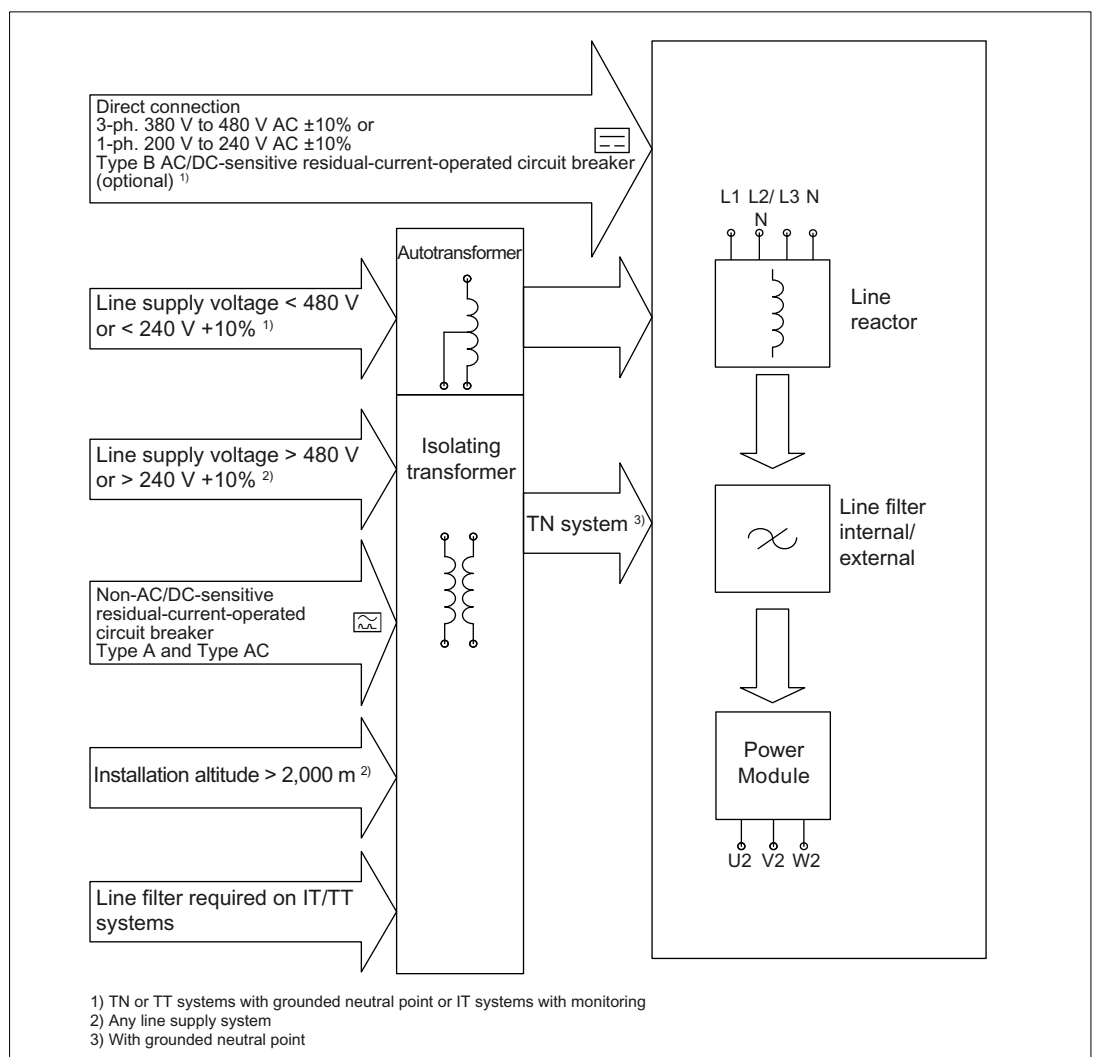


Figure 2-16 Overview of line connection variants

**Note**

**Line connection of motors**

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

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

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

**2.9.2 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.

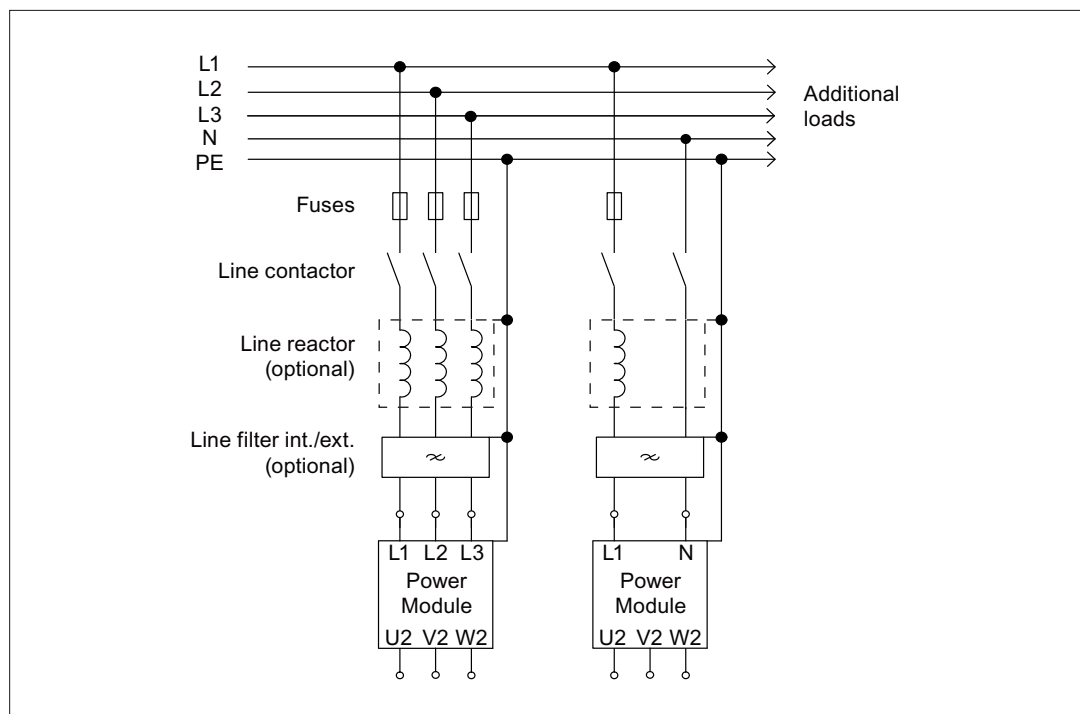


Figure 2-17 Direct operation on the line supply

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

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

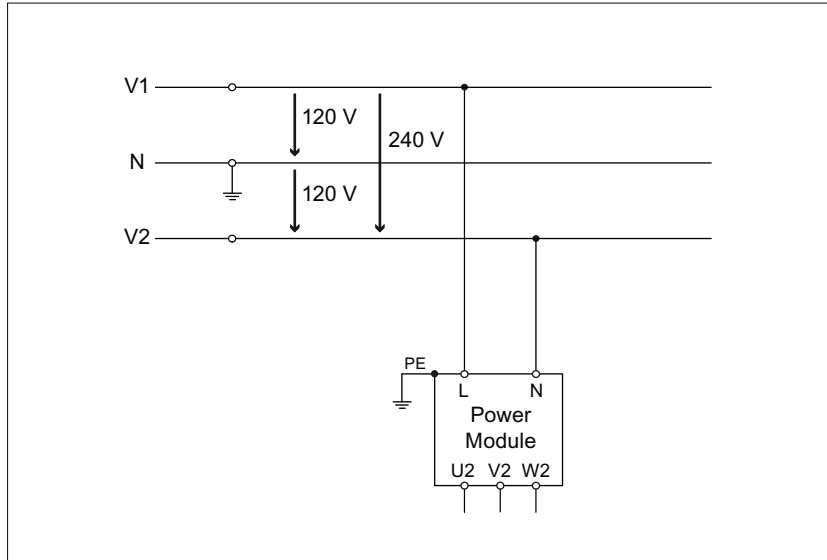


Figure 2-18 Direct operation on Single Phase Grounded Midpoint line system configuration

### 2.9.3 Operation of the Line Connection Components via an Autotransformer

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

**CAUTION**

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

Application example:

- The motor insulation must be protected from excessive voltages.

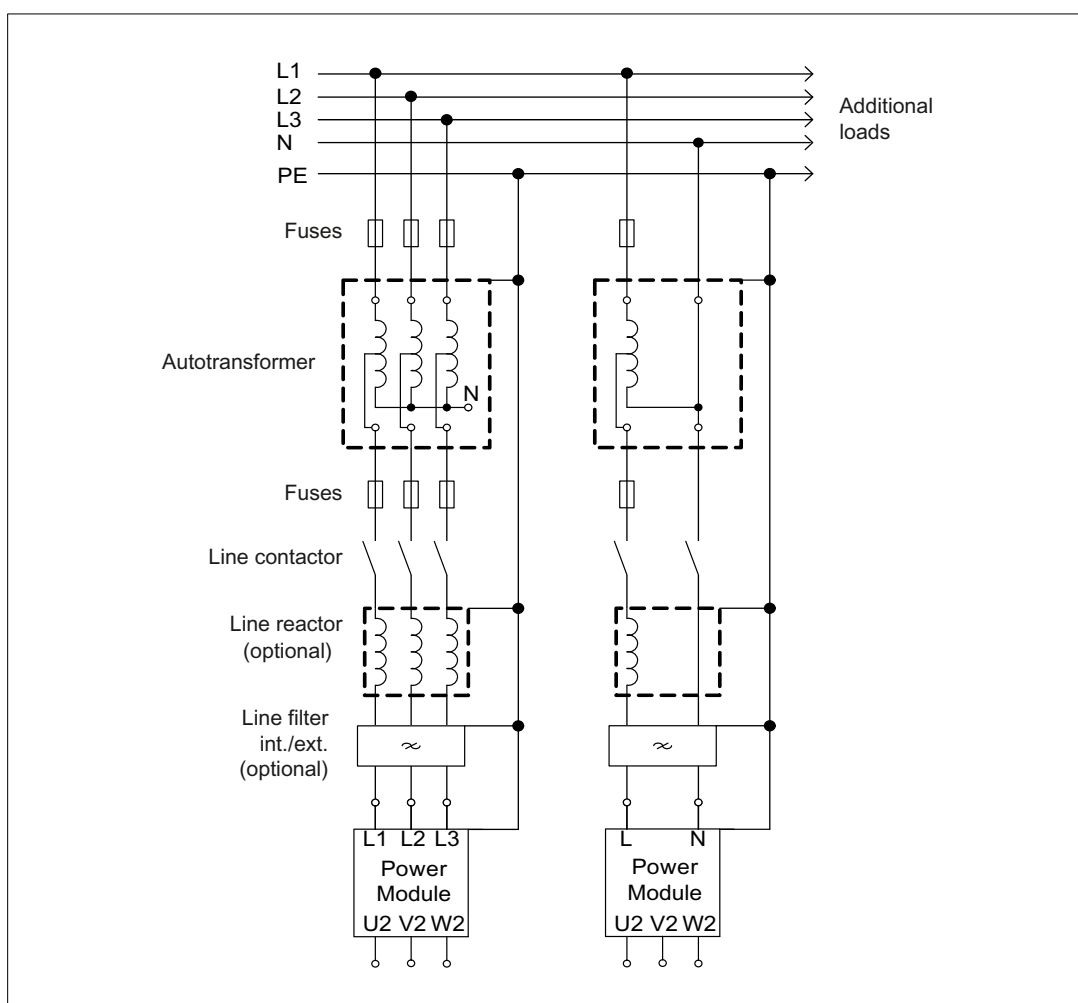


Figure 2-19 Autotransformer

## 2.9.4 Operation of the Line Connection Components via an Isolating Transformer

The isolating transformer converts the type of the line supply type in the plant (e.g. IT/TT 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.

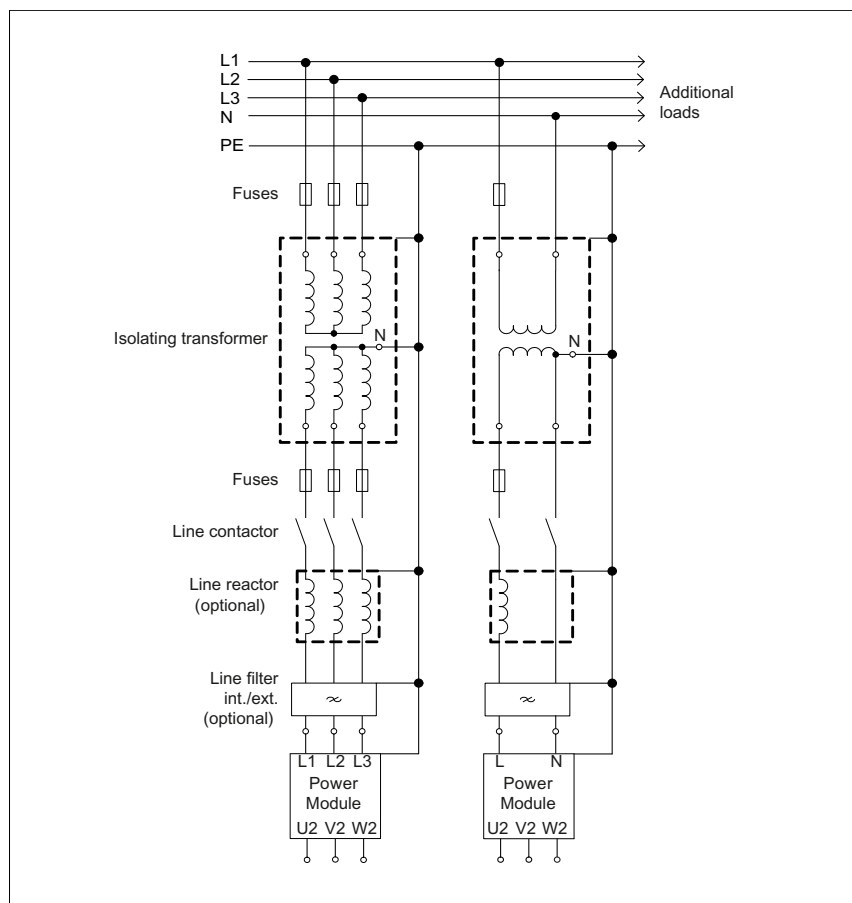


Figure 2-20 Isolating transformer

*Mains connection and line-side power components*

---

*2.9 Line connection variants*

## 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
- 24 V DC / 1 A power supply
- Gating unit, actual value acquisition
- Fan to cool the power semiconductors





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

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

	
<p>Power Module (230 V) frame size FSA, with and without integrated line filter</p> <p>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>

Power Modules

3.1 Power Modules Blocksize (PM340)

	
<p>Power Module frame size FSC, with and without integrated line filter</p>	<p>Power Module frame size FSD, with and without integrated line filter</p>
	
<p>Power Module frame size FSE, with and without integrated line filter</p>	<p>Power Module frame size FSF, with and without integrated line filter</p>



### 3.1.2 Safety information

 <b>CAUTION</b>
--

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  $\leq 16$  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.

 <b>WARNING</b>
--

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

 <b>DANGER</b>
---

**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.

 <b>DANGER</b>
---

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.
---

 <b>DANGER</b>
---

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.
--

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

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

 **DANGER**

Once all the supply voltages have been disconnected, a hazardous voltage may be present in the power unit for up to 5 minutes. The cover for the terminals may only be opened after this time has definitely elapsed.

When opening the protective cover, you must activate the release. A suitable tool (e.g. screwdriver) must be used for this purpose.

Damaged components must not be used, otherwise this could result in secondary damage or accidents.

 **DANGER**

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

 **DANGER**

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

- Fixed connection and protective conductor connection by means of  $\geq 10 \text{ mm}^2 \text{ Cu}$  or  $\geq 16 \text{ mm}^2 \text{ Al}$
- stationary connection and automatic shutdown of the power supply if the protective conductor is interrupted

 **WARNING****Cooling and mounting clearances for Power Modules**

Power Modules must be mounted in the vertical position.

The following clearances must be observed between the components when mounting <sup>1)</sup>:

- frame size FSA: 30 mm (1.18 inch)
- frame size FSB: 40 mm (1.57 inch)
- frame size FSC: 50 mm (1.96 inch)

The following cooling clearances must be observed above and below the component:

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

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

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

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

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

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

 **DANGER**

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

Non-observance can cause lethal shock voltages.

Power Modules

3.1 Power Modules Blocksize (PM340)

3.1.3 Interface description

3.1.3.1 Overview

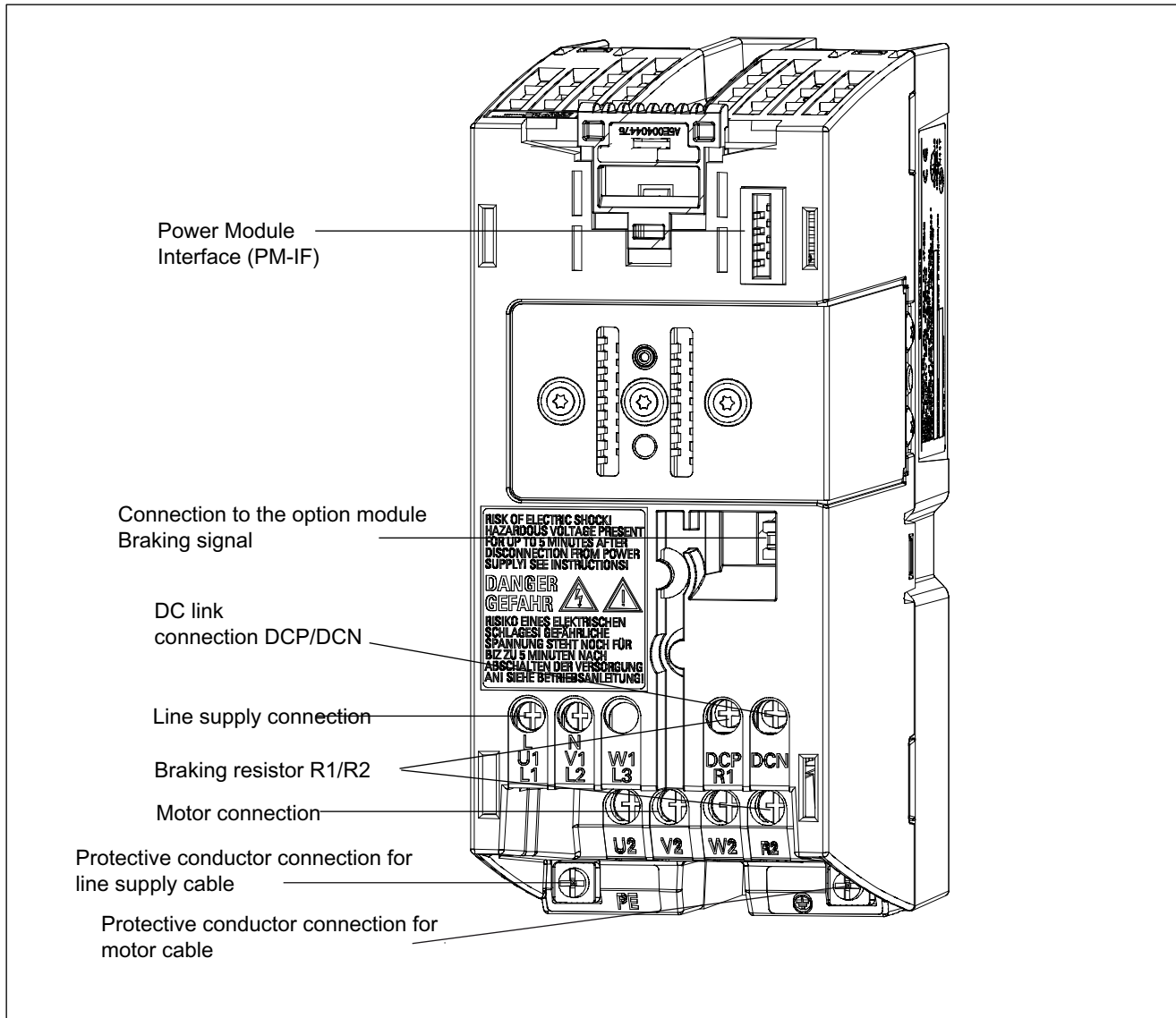


Figure 3-1 PM340, frame size FSA

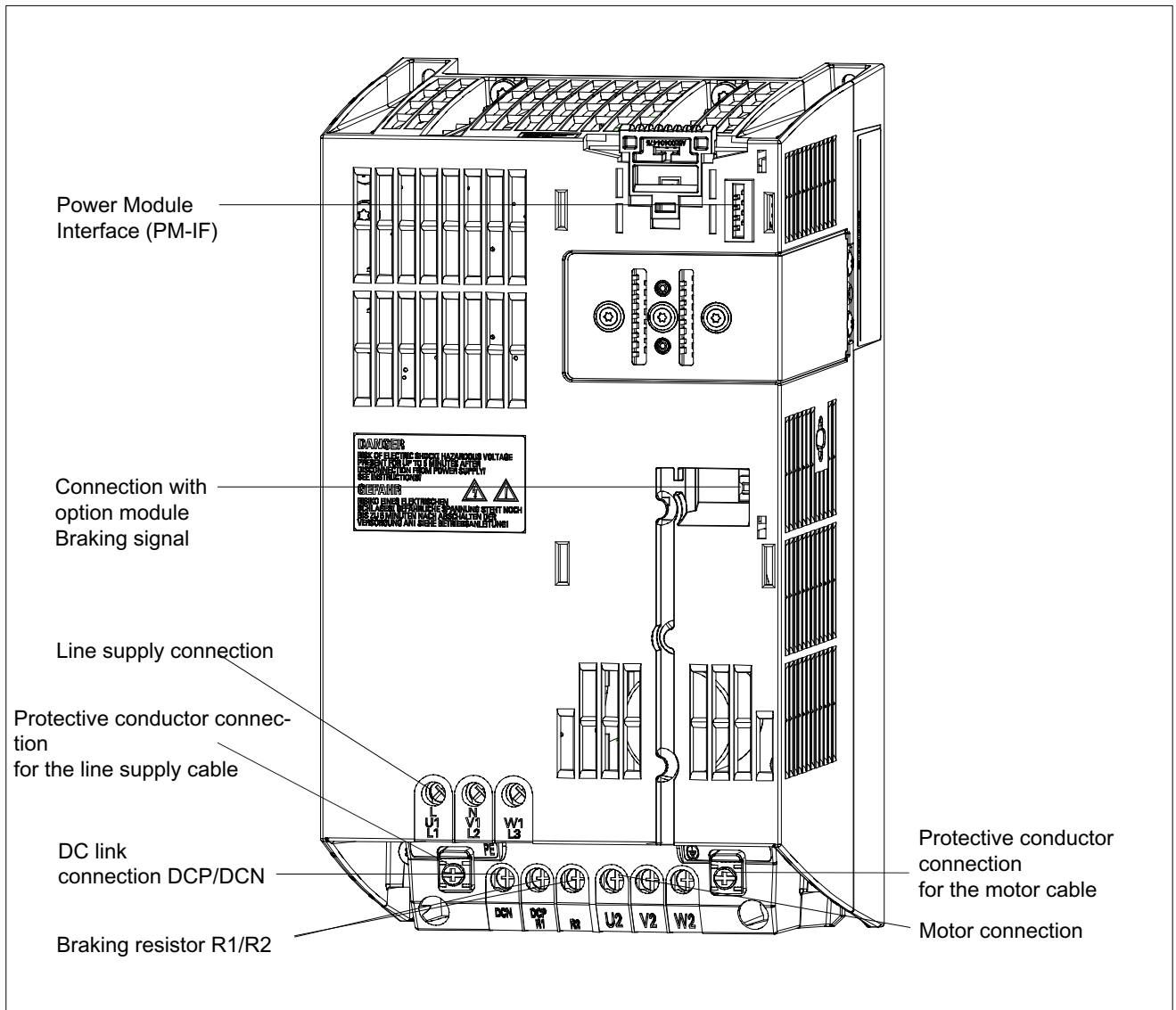


Figure 3-2 PM340, frame size FSB

Power Modules

3.1 Power Modules Blocksize (PM340)

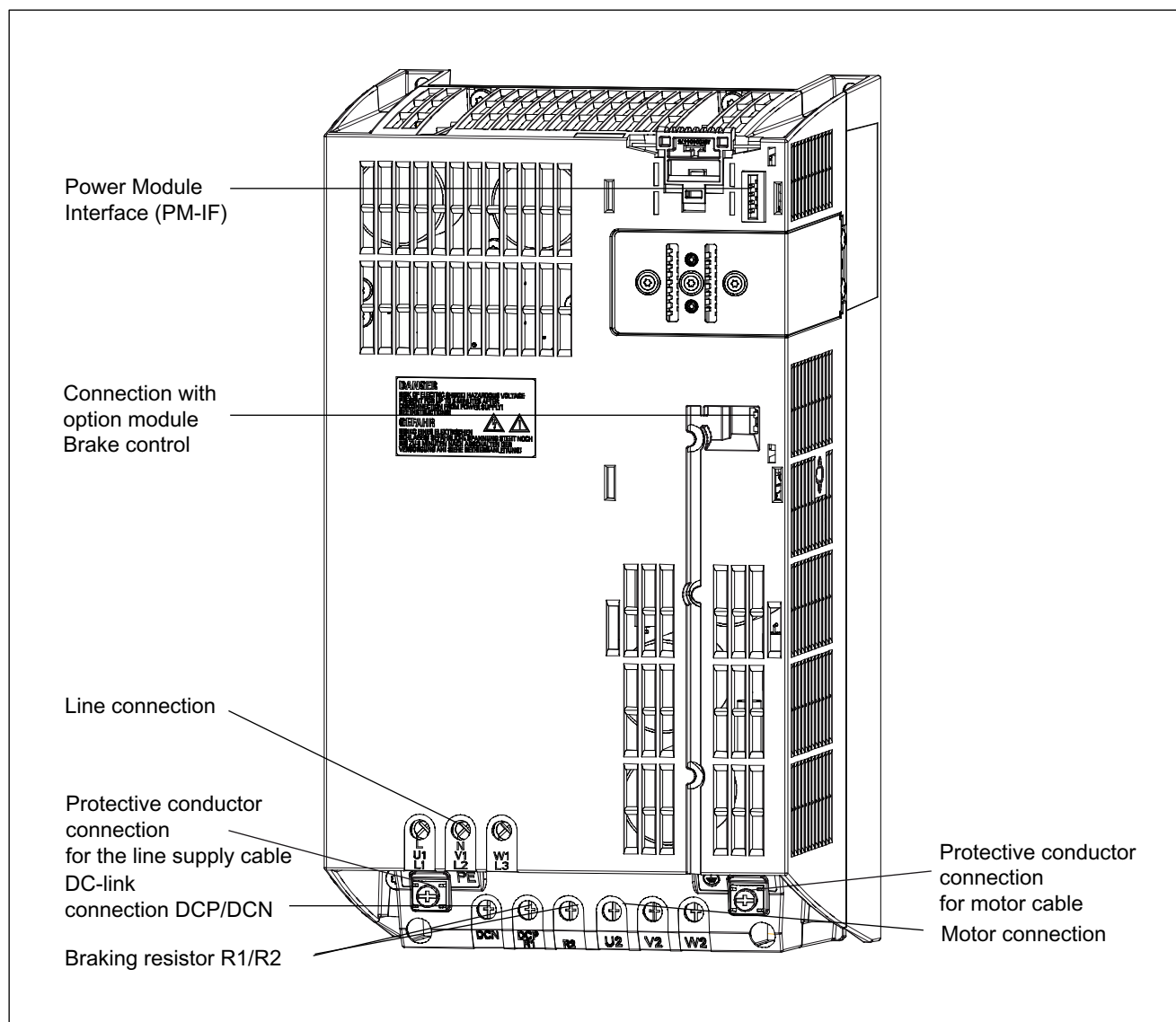


Figure 3-3 PM340, frame size FSC

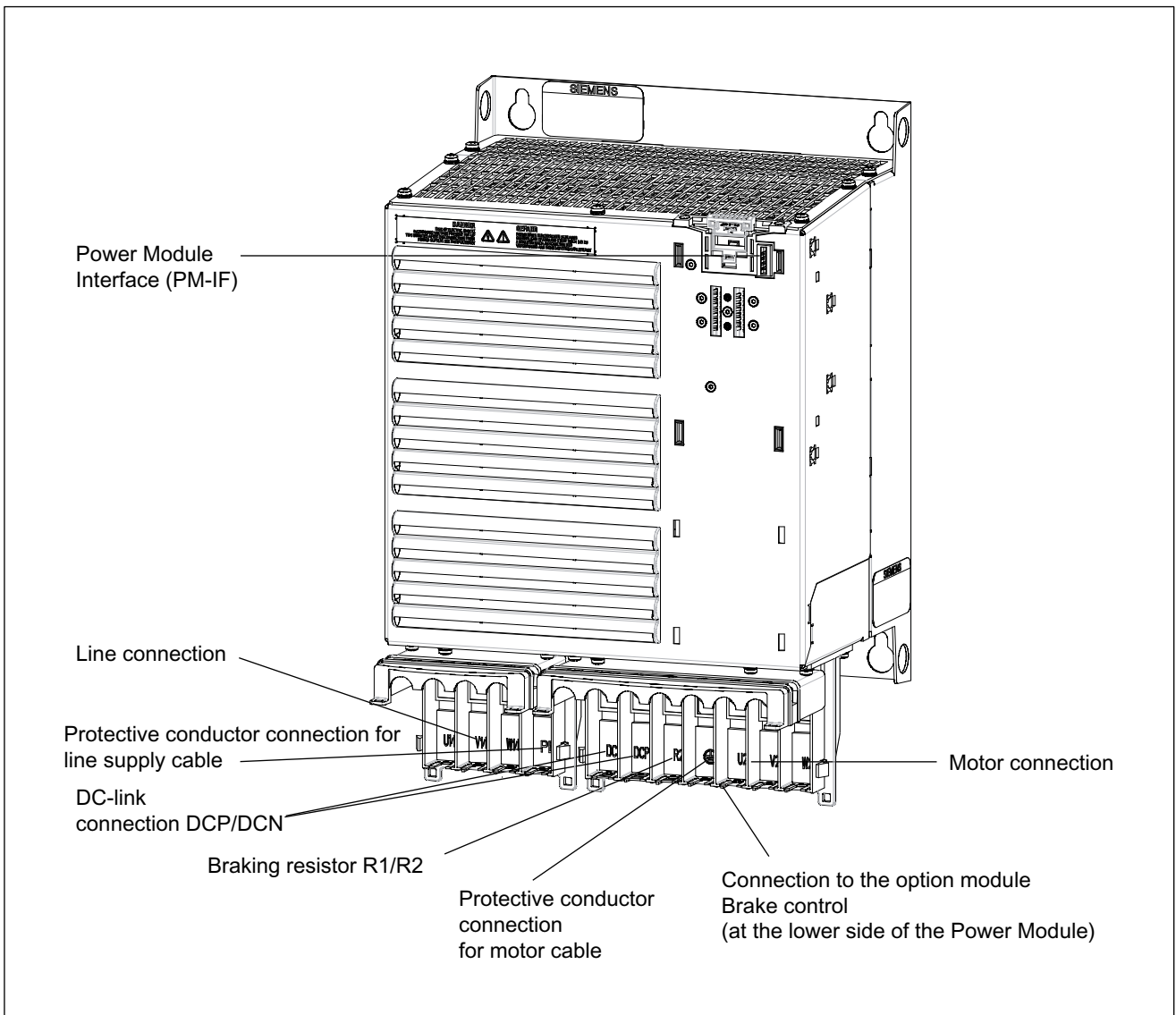


Figure 3-4 PM340, frame size FSD

Power Modules

3.1 Power Modules Blocksize (PM340)

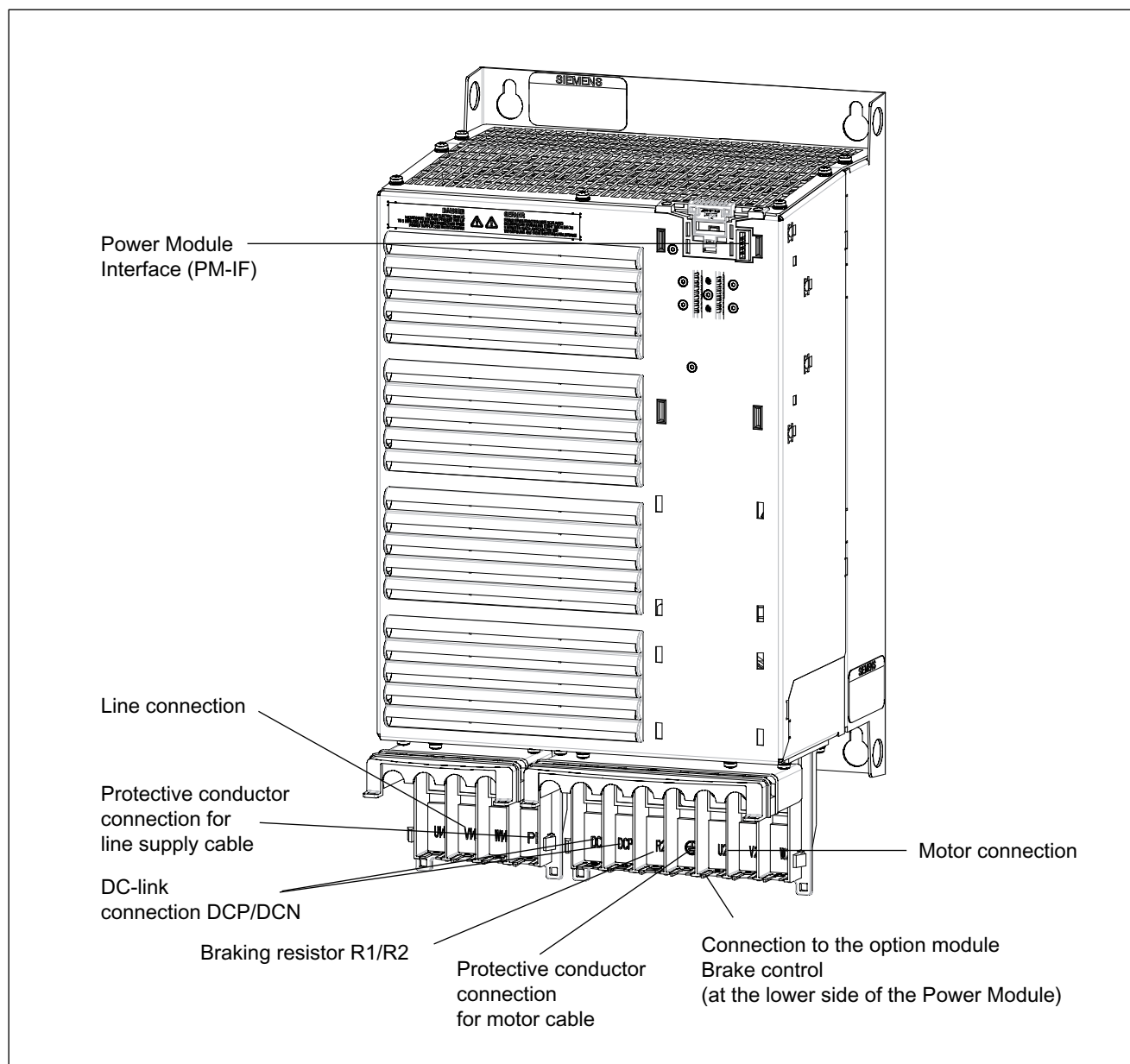


Figure 3-5 PM340, frame size FSE



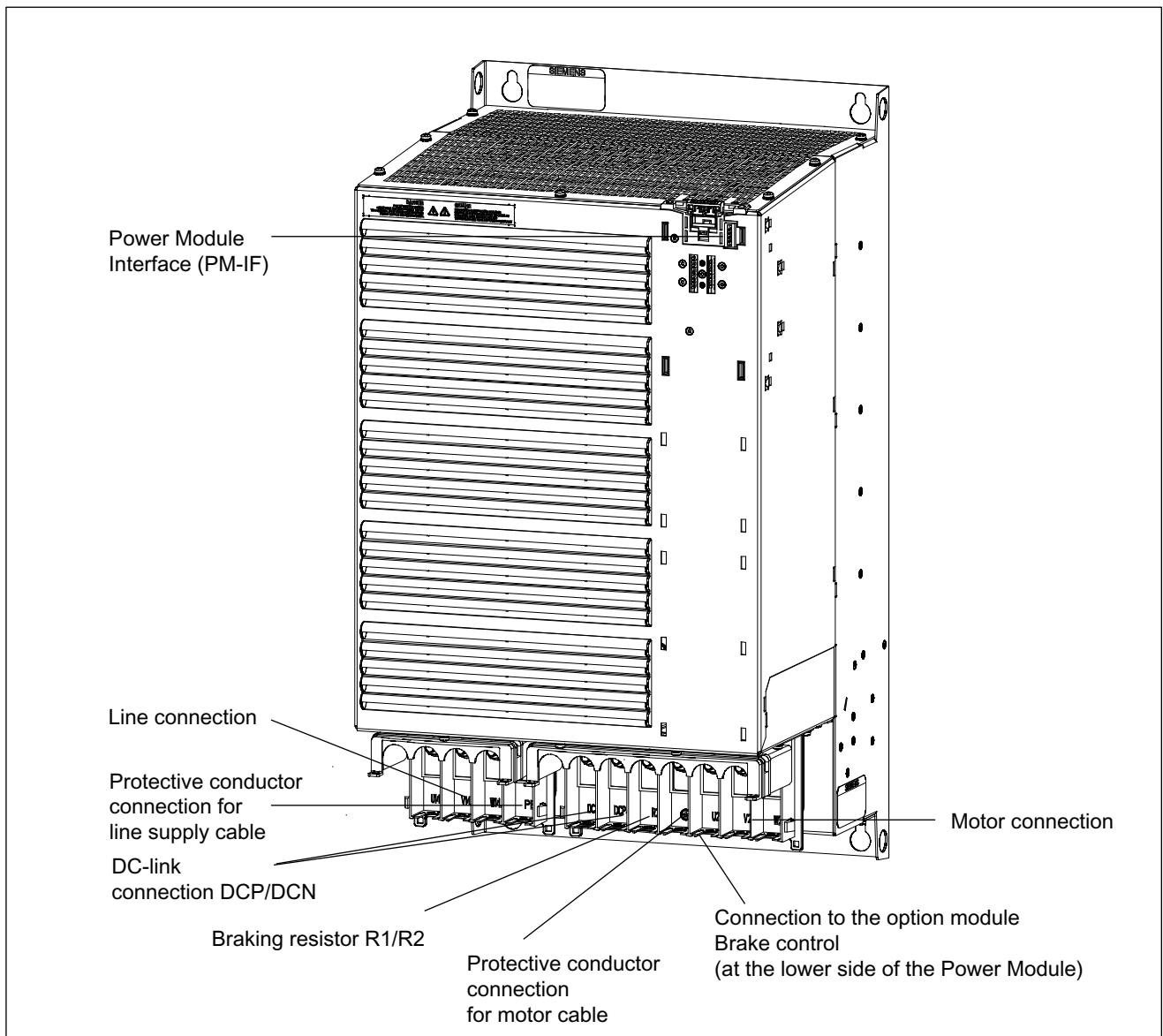


Figure 3-6 PM340, frame size FSF

Power Modules

3.1 Power Modules Blocksize (PM340)

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.

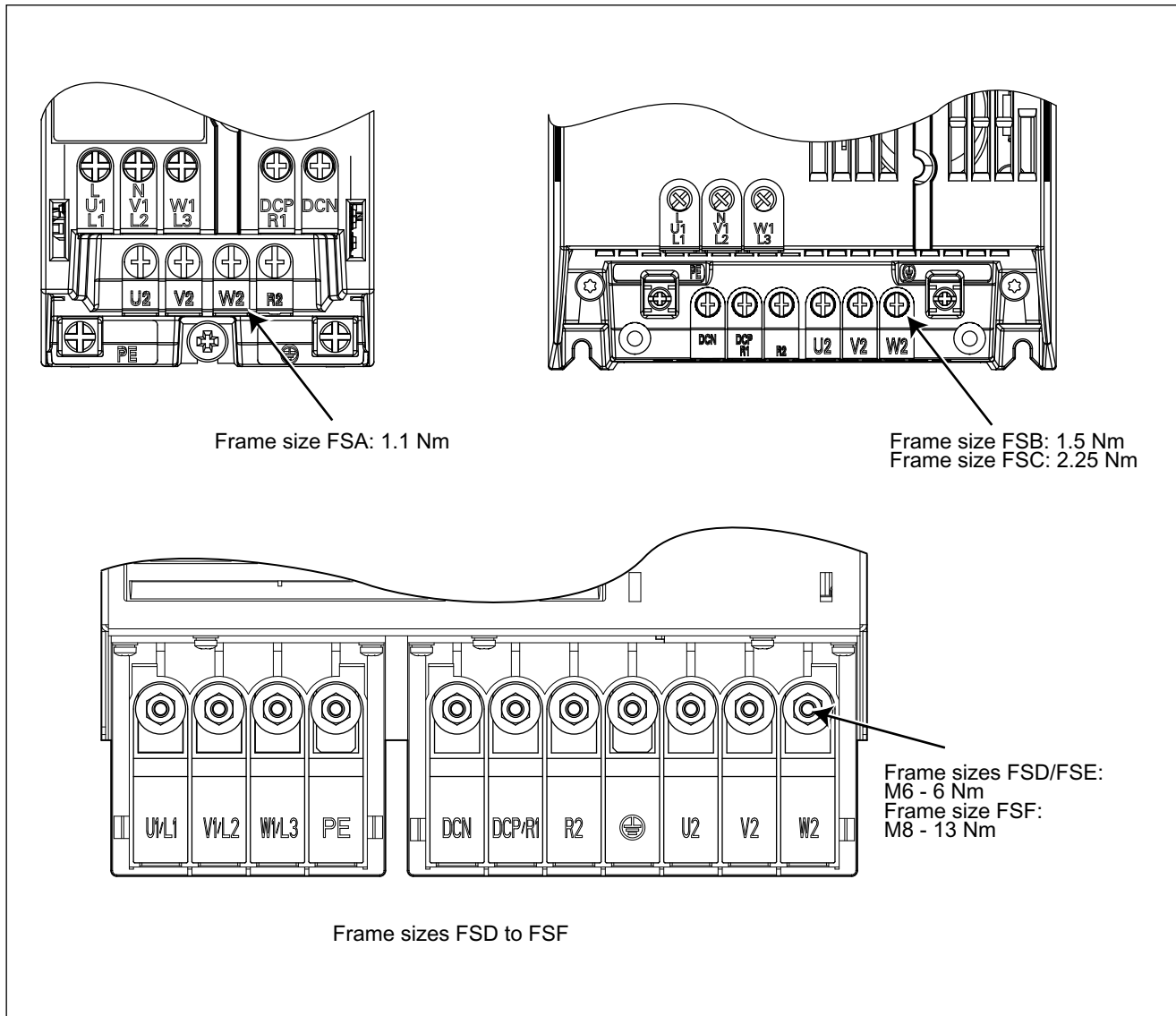


Figure 3-7 Arrangement of the line supply and motor terminals for the PM340

### 3.1.3.2 Line supply connection

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

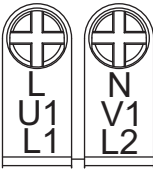
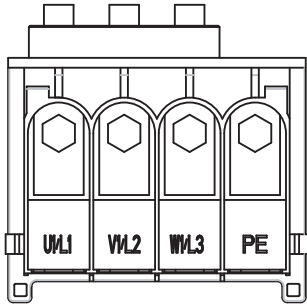
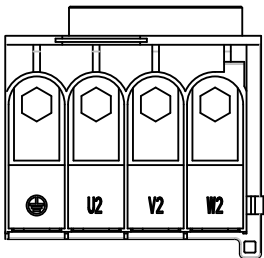

	Terminal	Signal name	Technical specifications
	1	L	Line phase L
	2	N	Line phase N
Max. conductor cross-section: 2.5 mm <sup>2</sup>			

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

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

### 3.1.3.3 Motor connection

Table 3-4 Terminal block, motor connection 200 V - 240 V 1 AC and 380 V - 480 V 3 AC

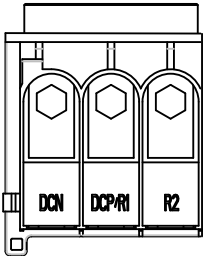
	Terminal	Technical specifications
		PE connection
	U2	Motor phase U
	V2	Motor phase V
	W2	Motor phase W

Power Modules

3.1 Power Modules Blocksize (PM340)

3.1.3.4 Braking resistor and DC link connection

Table 3- 5 Terminal block, braking resistor, and DC link connection

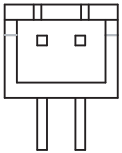
	Terminal	Technical specifications
	DCN	DC link negative
	DCP/R1	DC link positive and positive connection for braking resistor
	R2	Negative connection for the braking resistor

**Note**

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

3.1.3.5 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 Example connections

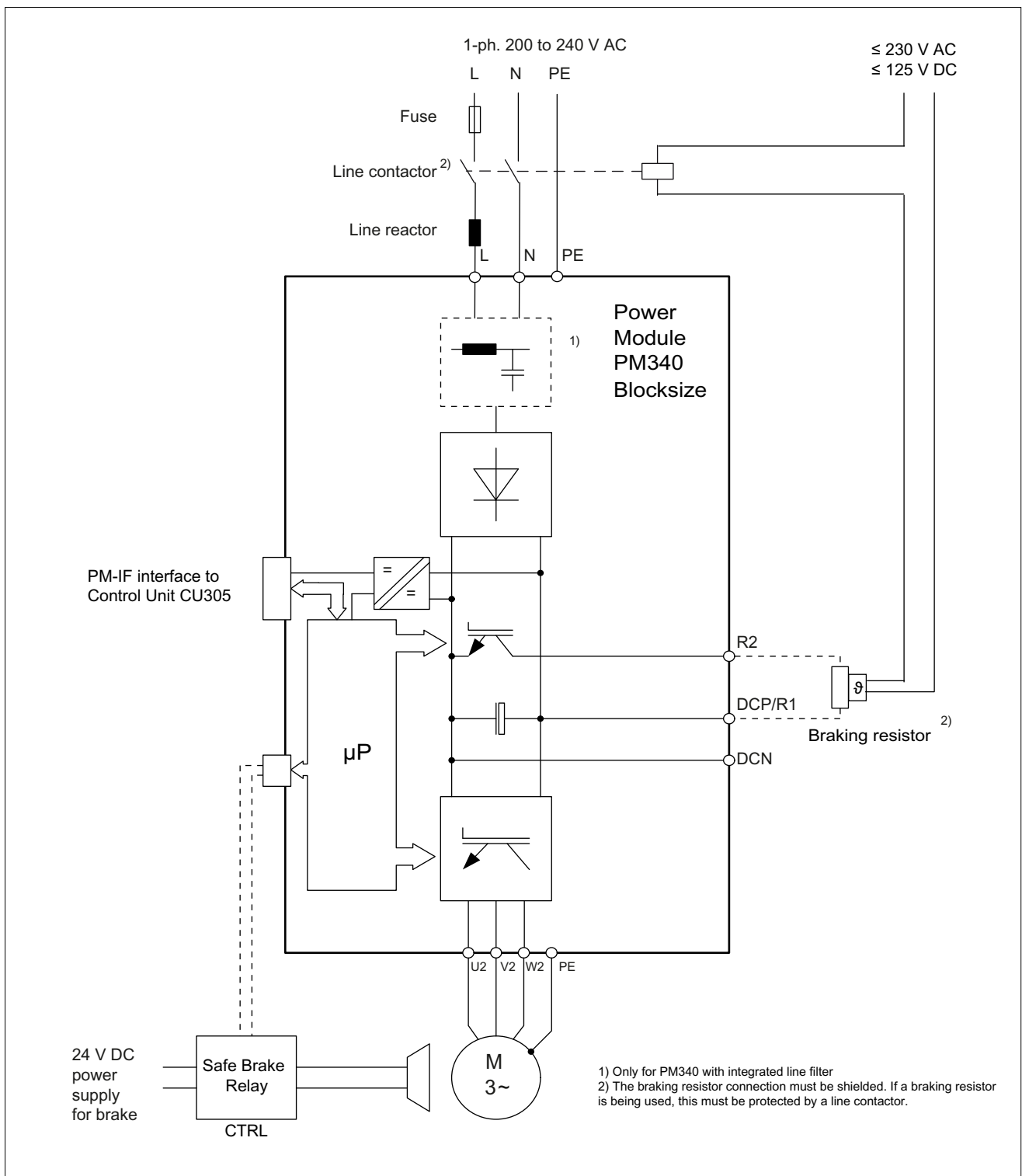


Figure 3-8 Connection example PM340, 1-ph. 200 V - 240 V AC

Power Modules

3.1 Power Modules Blocksize (PM340)

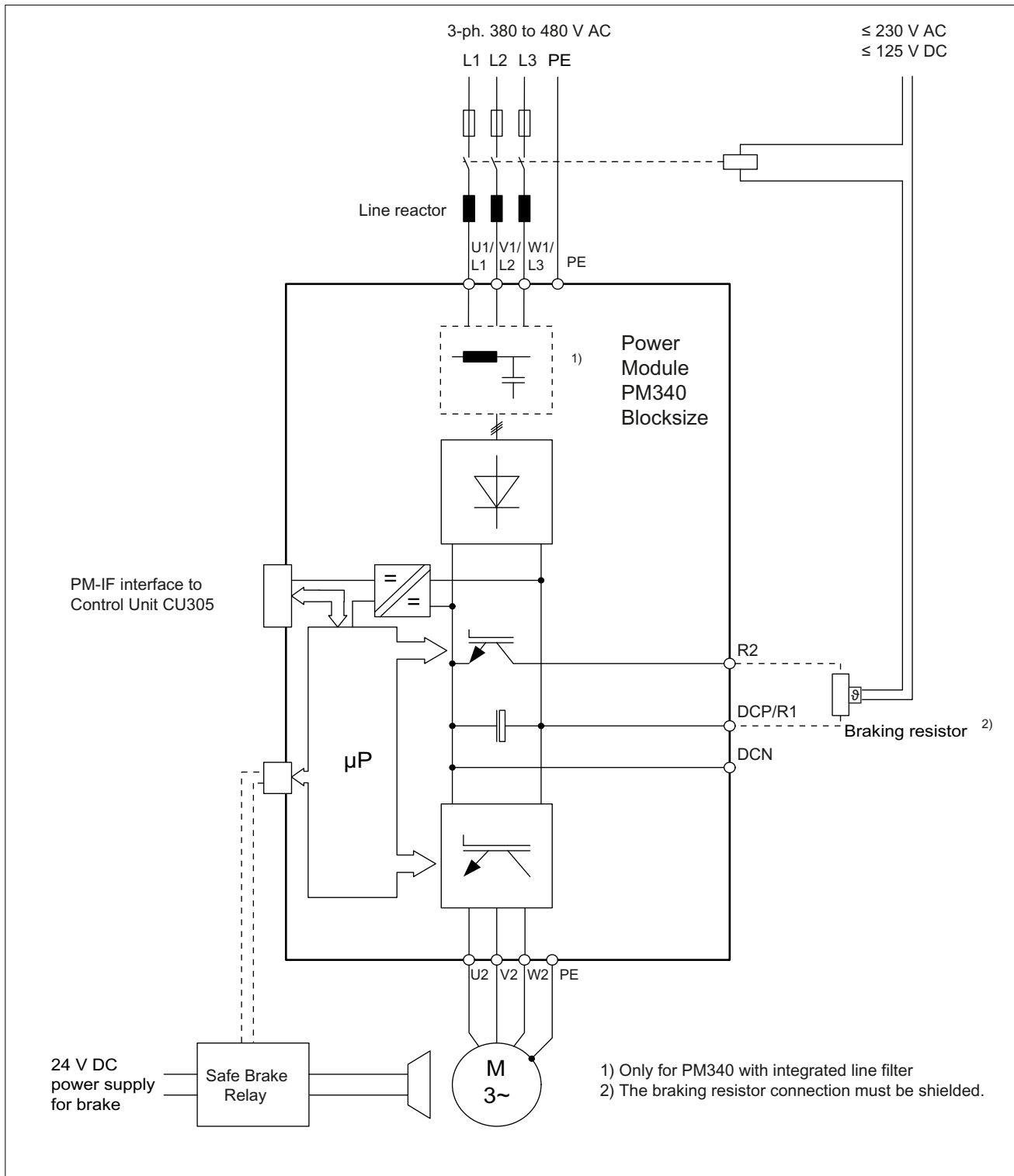


Figure 3-9 Connection example PM340, 3-ph. 380 V - 480 V AC

3.1.5 Dimension drawings

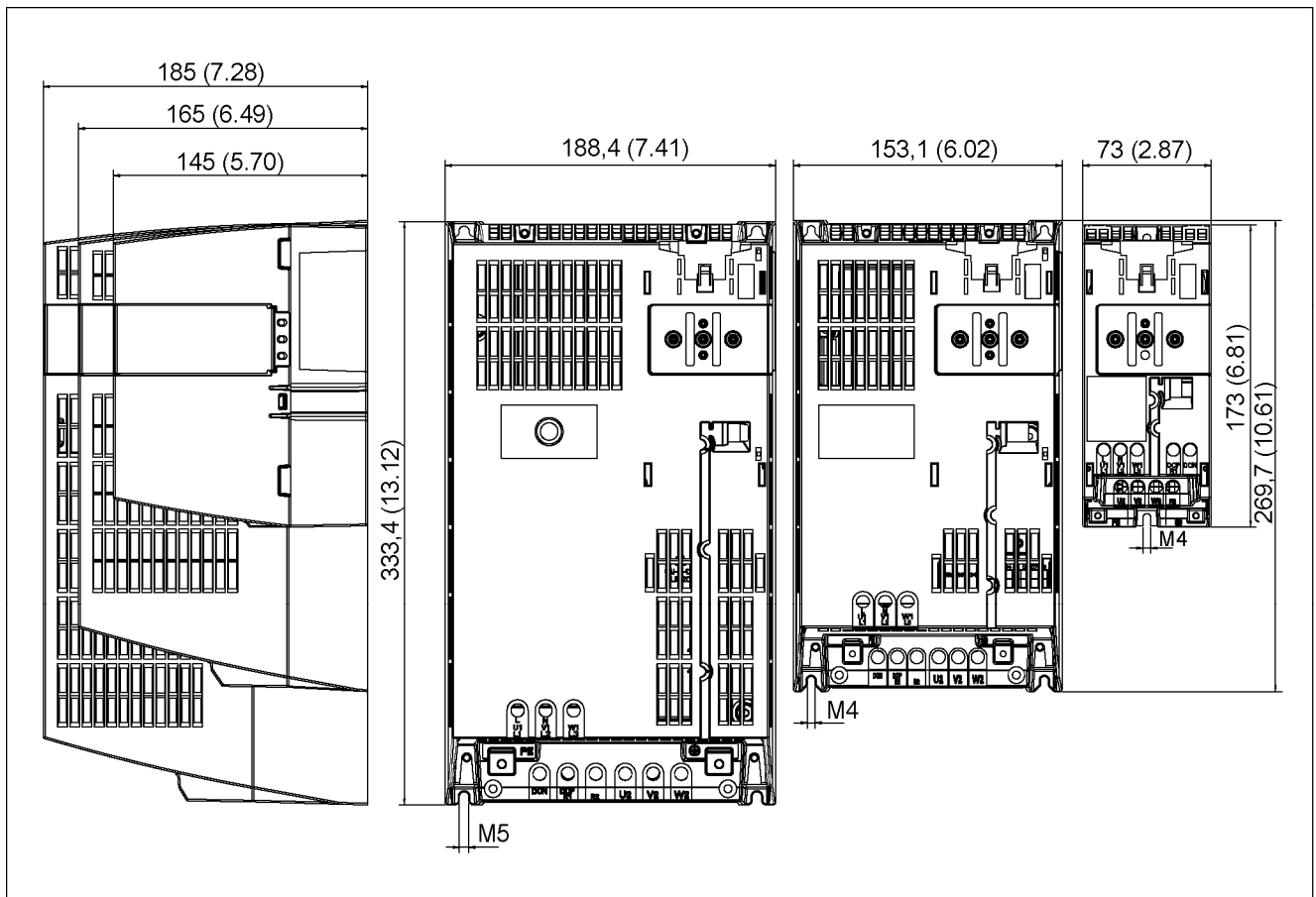


Figure 3-10 Dimension drawings, Power Module PM340

Frame size FSC

Frame size FSB

Frame size FSA

Power Modules

3.1 Power Modules Blocksize (PM340)

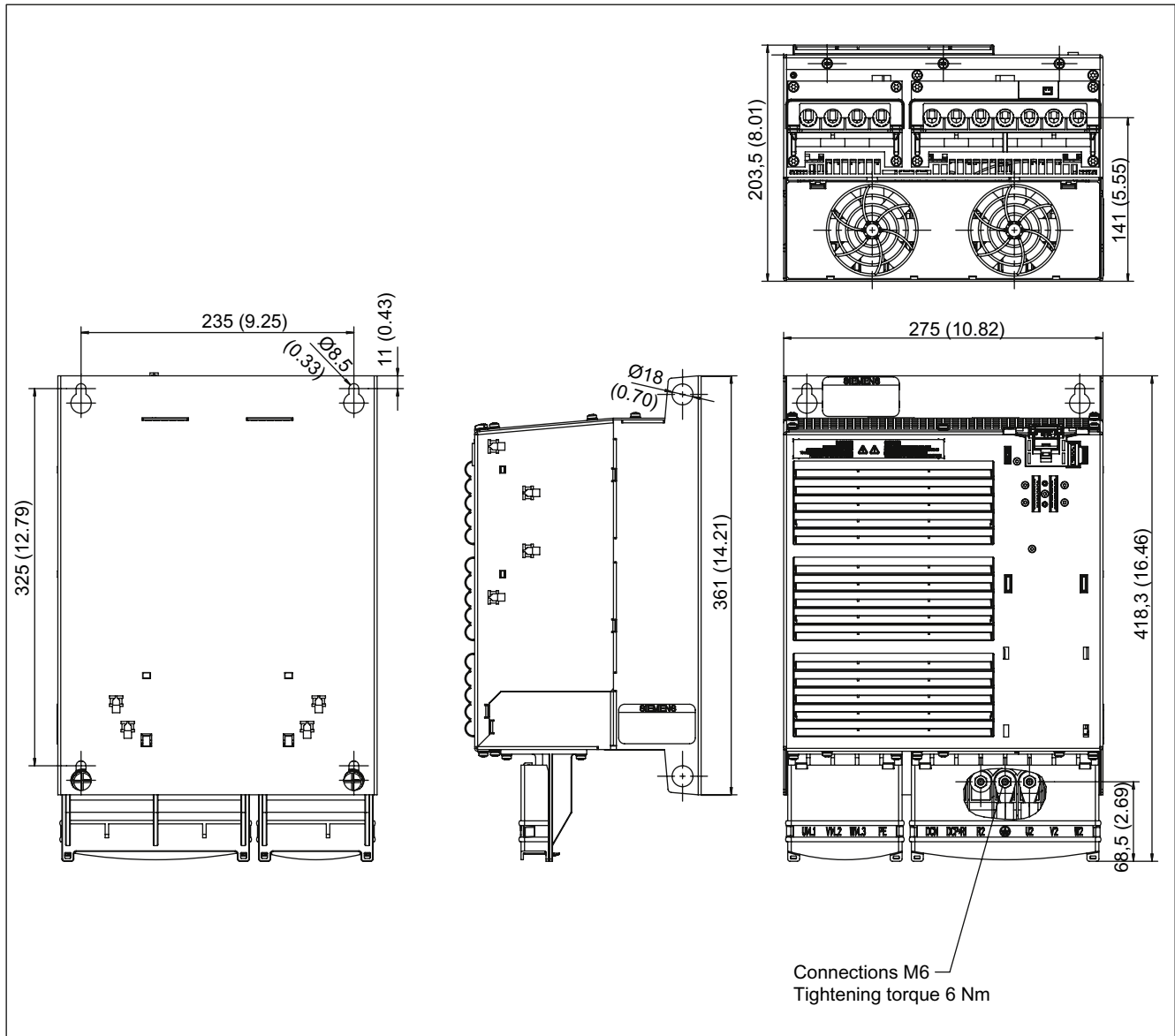


Figure 3-11 Dimension drawing: Power Module PM340, frame size FSD



3.1 Power Modules Blocksize (PM340)

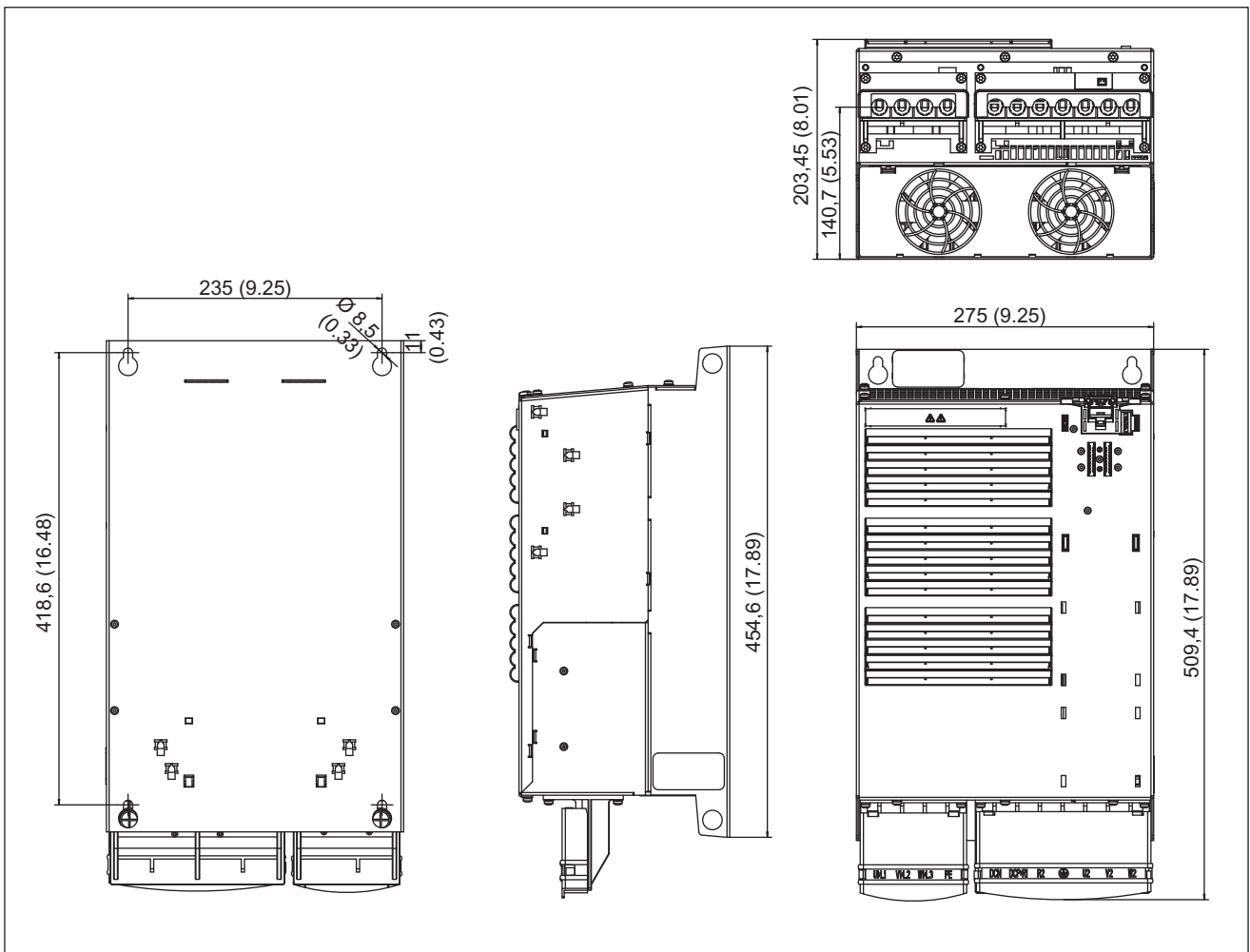


Figure 3-12 Dimension drawing: Power Module PM340 with integrated line filter, frame size FSD

Power Modules

3.1 Power Modules Blocksize (PM340)

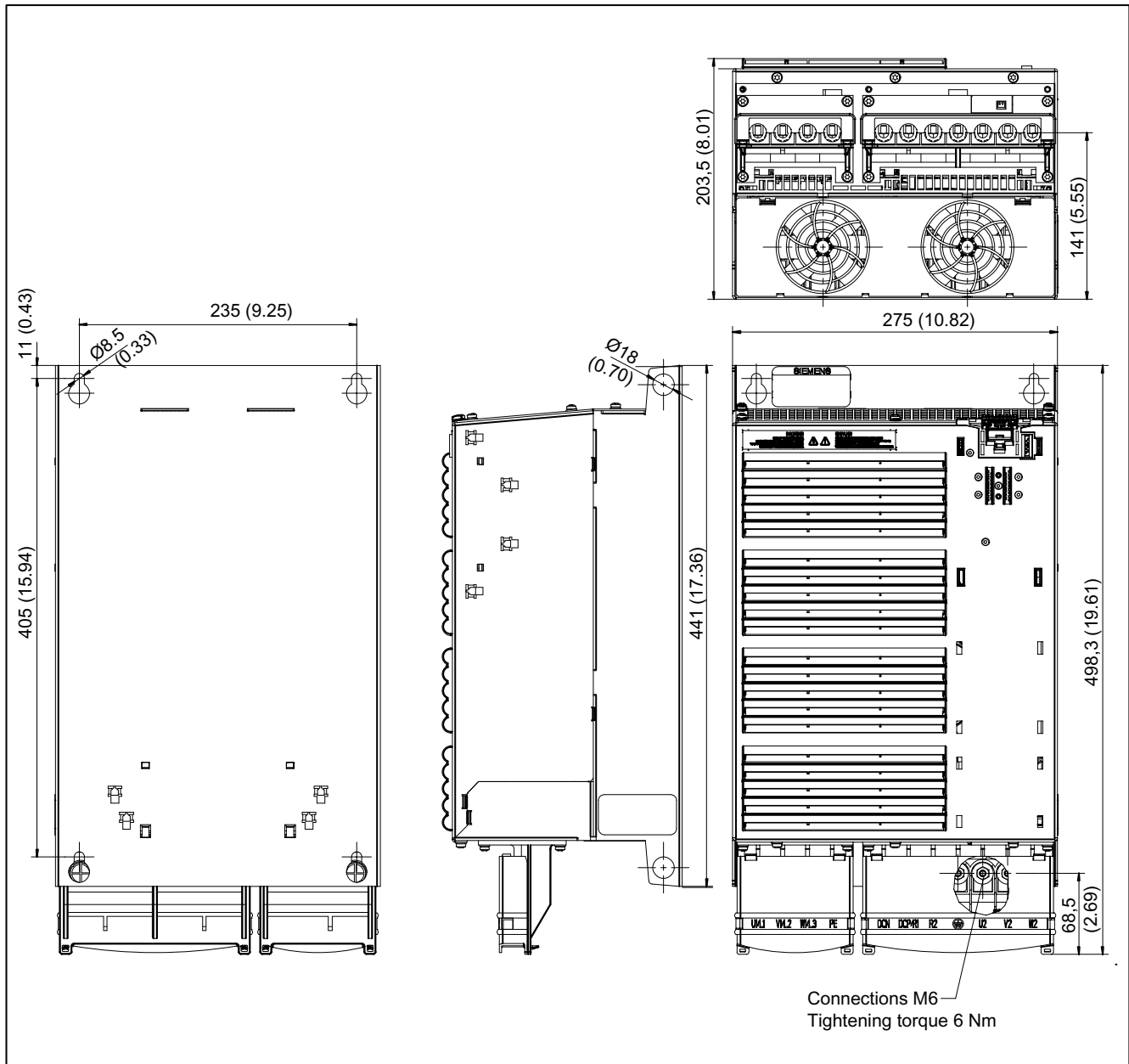


Figure 3-13 Dimension drawing: Power Module PM340, frame size FSE

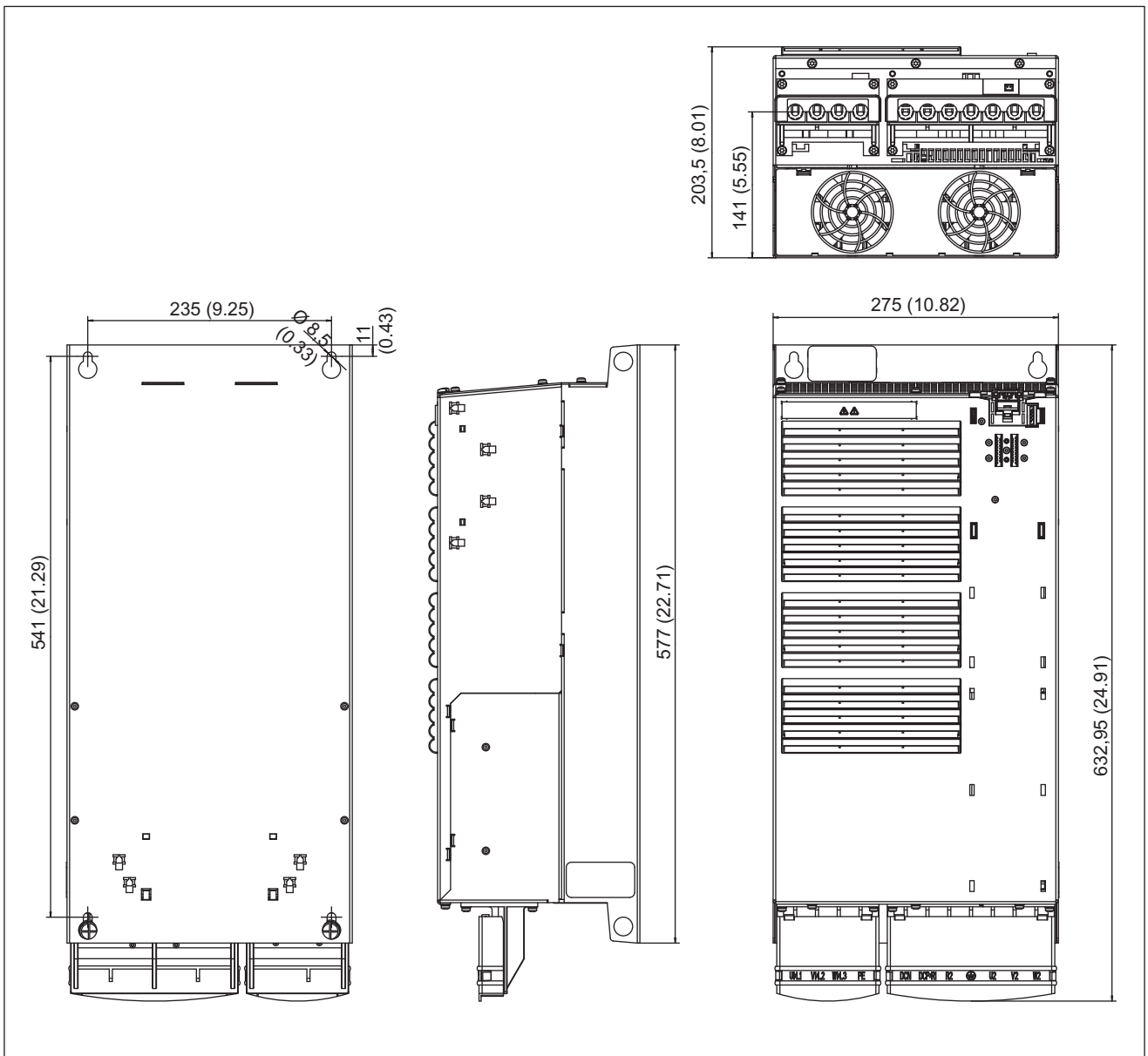


Figure 3-14 Dimension drawing: Power Module PM340 with integrated line filter, frame size FSE

Power Modules

3.1 Power Modules Blocksize (PM340)

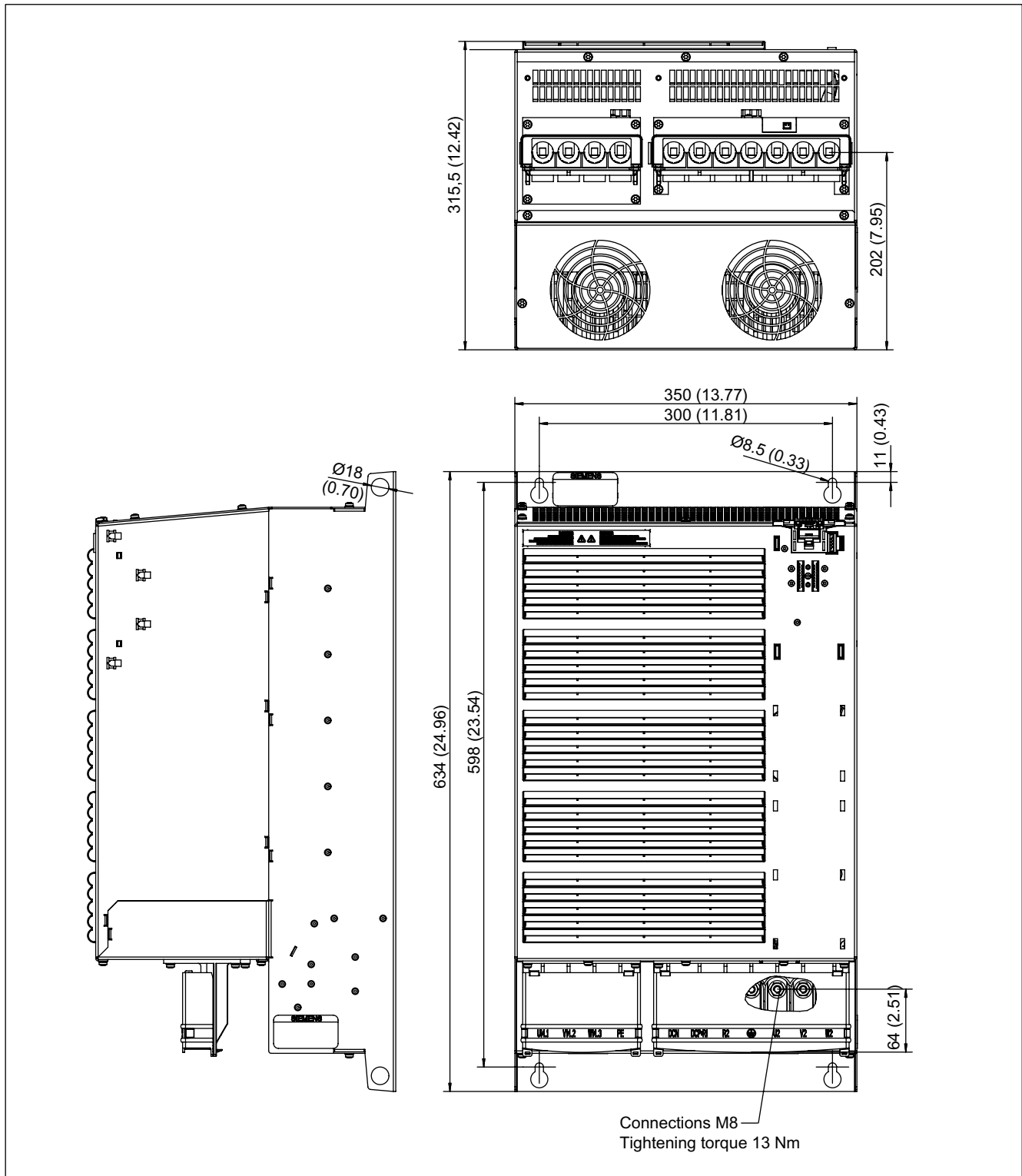


Figure 3-15 Dimension drawing: Power Module PM340, frame size FSF

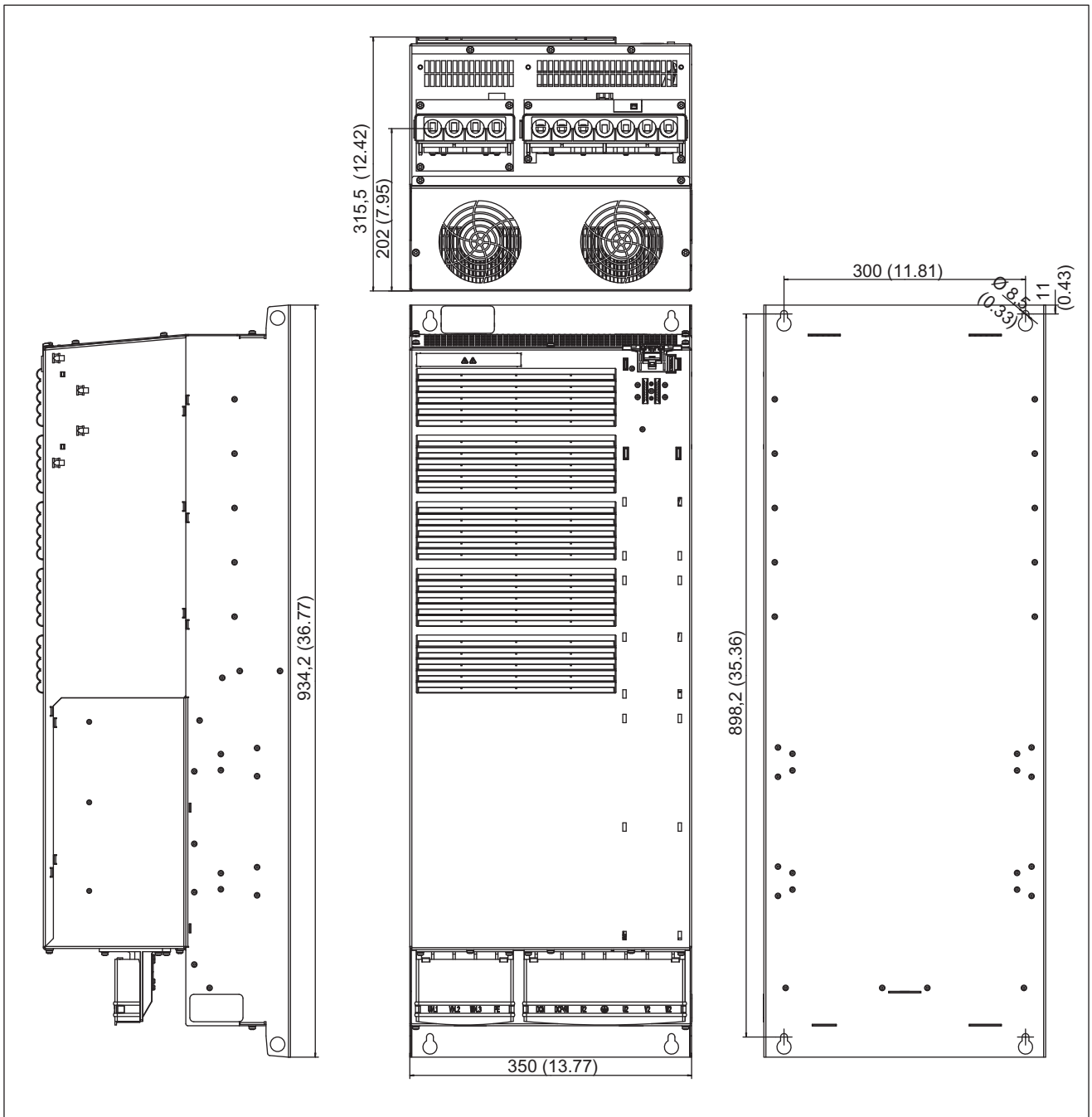


Figure 3-16 Dimension drawing: Power Module PM340 with integrated line filter, frame size FSF

### 3.1.6 Mounting

#### 3.1.6.1 Drilling patterns

##### Drilling templates for frame sizes FSA and FSC

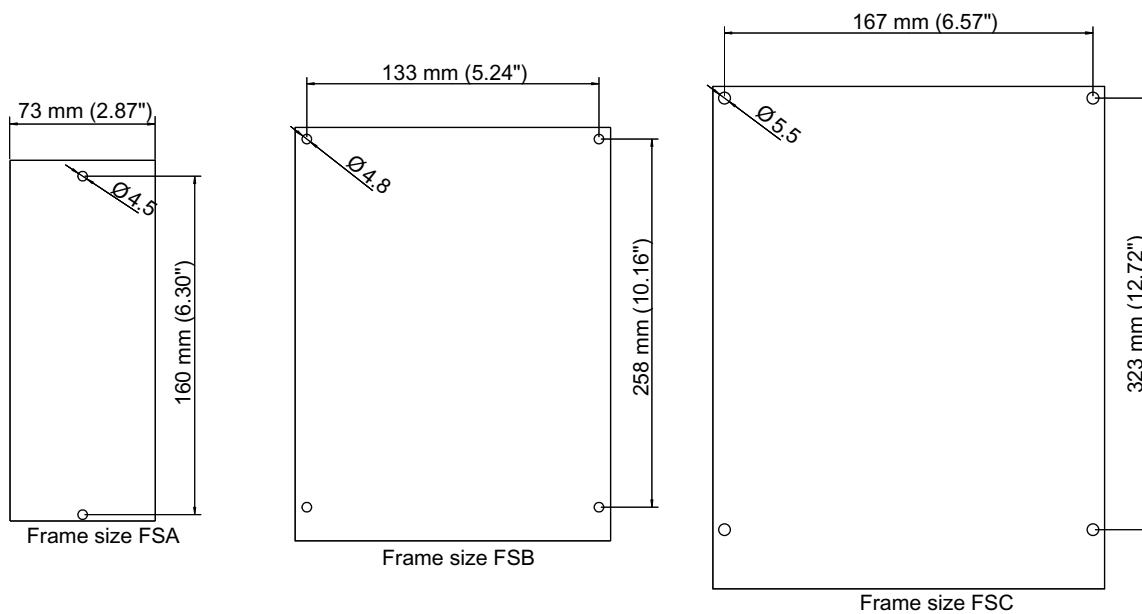


Figure 3-17 Drilling templates for frame sizes FSA and FSC

Drilling templates for frame sizes FSD to FSF

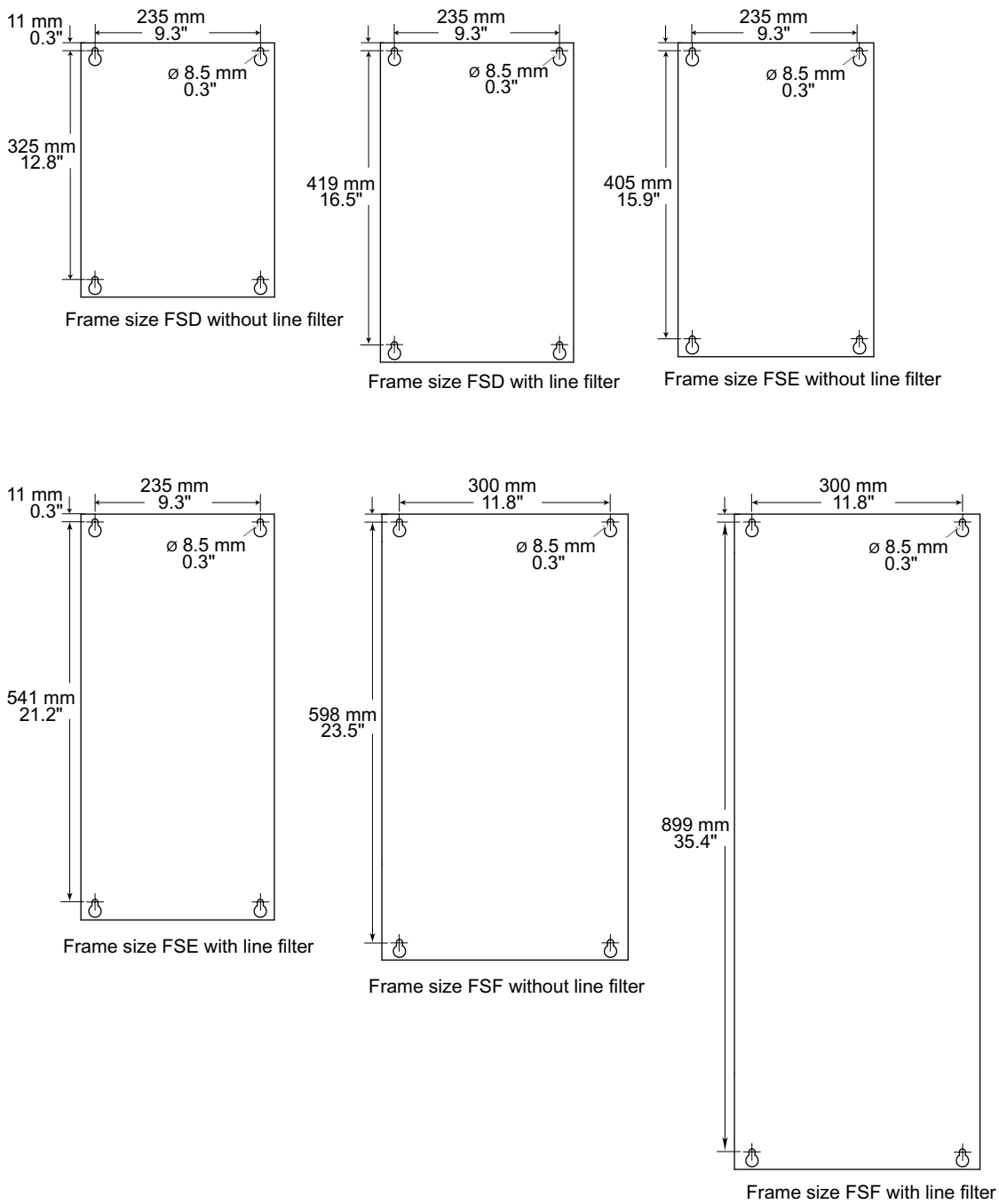


Figure 3-18 Drilling templates for frame sizes FSD to FSF - with and without line filter

## Power Modules

### 3.1 Power Modules Blocksize (PM340)

#### 3.1.6.2 Mounting dimensions and tightening torques

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

Table 3-7 PM340, dimensions and tightening torques for mounting

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

Table 3- 8 PM340, load terminals - Tightening torques

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



### 3.1.6.3 Access to the power supply terminals and motor terminals

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

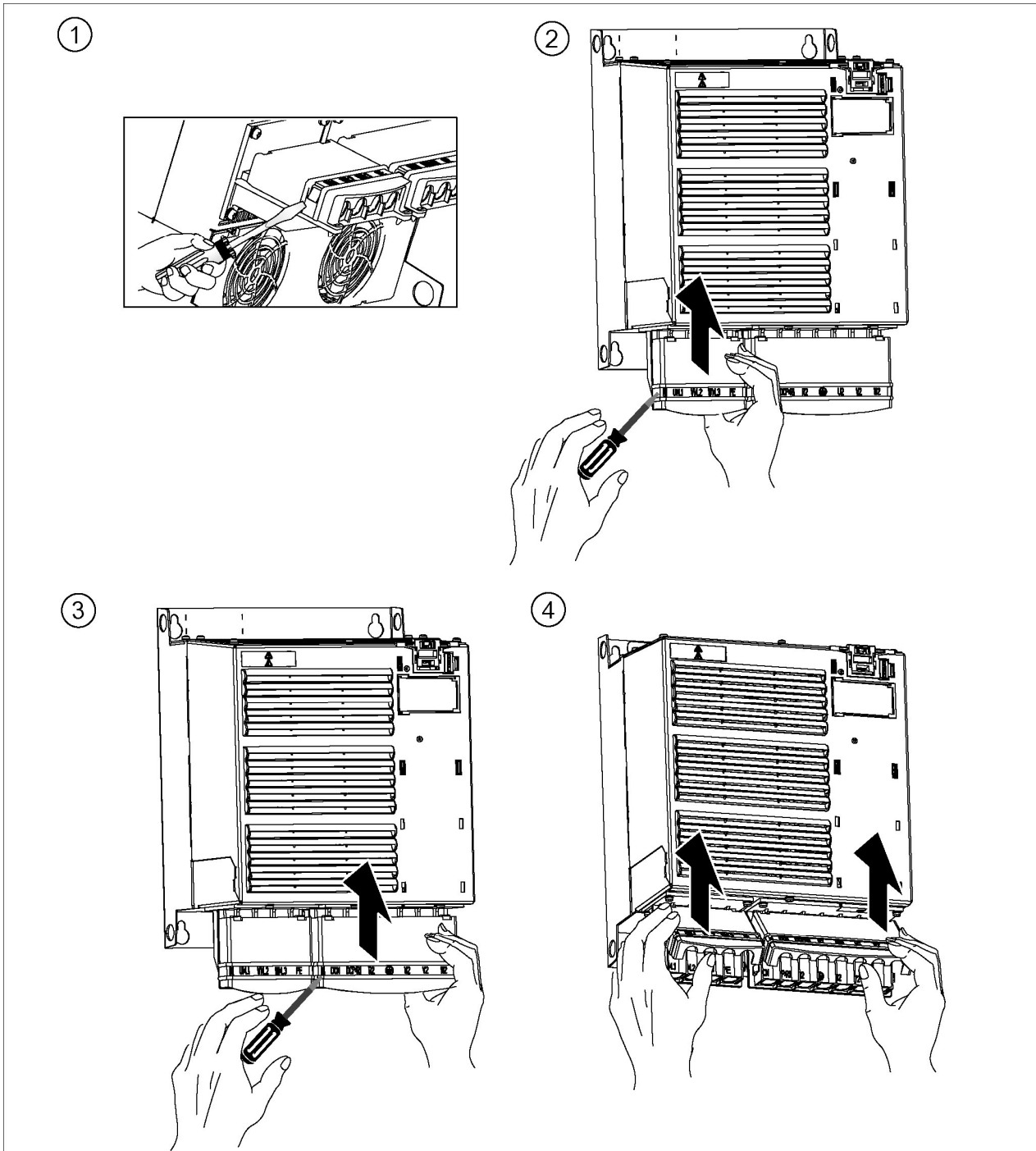


Figure 3-19 Access to the line and motor terminals for frame sizes FSD to FSF

## Power Modules

### 3.1 Power Modules Blocksize (PM340)



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.

### 3.1.7 Technical data

#### 3.1.7.1 Power Modules Blocksize, 1-ph. AC

Table 3-9 Technical data PM340, 1-ph. AC

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
Frame size		FSA	FSA	FSA
<b>Output current</b>				
Rated current $I_n$	A	0.9	2.3	3.9
Base-load current $I_H$	A	0.8	2.0	3.4
for S6 operation (40%) $I_{S6}$	A	1.4	3.3	5.5
Peak current $I_{max}$	A	2.0	4.6	7.8
<b>Unit rating based on <math>I_n</math><sup>1)</sup></b>	kW	0.12	0.37	0.75
<b>Rated pulse frequency</b>	kHz	4	4	4
<b>Power loss</b>	kW	0.06	0.075	0.11
<b>Cooling air requirement</b>	m <sup>3</sup> /s	0.005	0.005	0.005
<b>Sound pressure level LpA (1 m)</b>	dB	< 45	< 45	< 45
<b>24 V DC supply for the Control Unit</b>	A	1.0	1.0	1.0
<b>Rated input current<sup>2)</sup> without/with integrated line reactor</b>	A	1.4 / 2.2	4 / 6	6.5 / 10
<b>Class J UL safety fuses</b>				
Rated current	A	6	10	15
Rated short-circuit current SCCR	kA	65	65	65
<b>Circuit breaker type designation EN 60947</b>				
Rated current	A	6	10	16

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
<b>Circuit breaker type designation</b> UL489 / CSA C22.2 No. 5-02		5SJ4206-7HG41	5SJ4210-7HG41	5SJ4216-7HG41
Rated current	A	6	10	16
Rated short-circuit current SCCR	kA	14	14	14
<b>Resistance value</b> of the external braking resistor	$\Omega$	> 180	> 180	> 180
<b>Max. cable length</b> to braking resistor	m	15	15	15
<b>Line supply connection</b> L, N		Screw-type terminals for cable cross-sections 1.0 to 2.5 mm <sup>2</sup>		
<b>Motor connection</b> U2, V2, W2				
<b>DC link connection, connection for braking resistor</b> DCP/R1, DCN, R2				
<b>PE connection</b>		at the housing with M 4 screw		
<b>Max. motor cable length</b> <sup>3)</sup> (without external options)	m	50 (shielded) 75 (unshielded)		
<b>Degree of protection</b>		IP20 or IPXXB		
<b>Weight</b>	kg	1.2	1.3	1.3

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

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

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

Table 3- 10 Technical data PM340, 3-ph. AC, Part 1

Line supply voltage 3-ph. 380 V to 480 V AC $\pm 10\%$						
PM340	6SL3210-	1SE11-3UA0	1SE11-7UA0	1SE12-2UA0	1SE13-1UA0	1SE14-1UA0
PM340 with integrated line filter	-	-	-	-	-	-
<b>Frame size</b>		FSA	FSA	FSA	FSA	FSA
<b>Output current</b>						
Rated 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
for S6 operation (40%) $I_{s6}$	A	1.3	2.0	2.5	3.5	4.5
Peak current $I_{max}$	A	2.6	3.4	4.4	6.2	8.2
<b>Unit rating</b> <sup>1)</sup>						
on basis of $I_n$	kW	0.37	0.55	0.75	1.1	1.5
on basis of $I_H$	kW	0.37	0.55	0.75	1.1	1.5
<b>Rated pulse frequency</b>	kHz	4	4	4	4	4
<b>Power loss</b>	kW	0.10	0.10	0.10	0.11	0.11
<b>Cooling air requirement</b>	m <sup>3</sup> /s	0.005	0.005	0.005	0.005	0.005
<b>Sound pressure level</b> $L_{pA}$ (1 m)	dB(A)	< 45	< 45	< 45	< 45	< 45

## Power Modules

### 3.1 Power Modules Blocksize (PM340)

Line supply voltage 3-ph. 380 V to 480 V AC $\pm 10\%$						
PM340	6SL3210-	1SE11-3UA0	1SE11-7UA0	1SE12-2UA0	1SE13-1UA0	1SE14-1UA0
PM340 with integrated line filter	-	-	-	-	-	-
24 V DC supply for the Control Unit	A	1.0	1.0	1.0	1.0	1.0
Rated input current <sup>2)</sup> without/with integrated line reactor	A	1.3 / 1.7	1.7 / 2.2	2.2 / 2.6	3.1 / 3.9	4.1 / 4.8
<b>Class J UL safety fuses</b> Rated current Rated short-circuit current SCCR	A kA	4 65	4 65	6 65	8 65	10 65
<b>Safety fuses NH</b> Rated current	A	3NA3 804 4	3NA3 804 4	3NA3 801 6	3NA3 803 10	3NA3 803 10
<b>Circuit breaker type designation EN 60947</b> Rated current	A	3RV1021-1DA10 2.2 - 3.2	3RV1021-1DA10 2.2 - 3.2	3RV1021-1FA10 3.5 - 5	3RV1021-1GA10 4.5 - 6.3	3RV1021-1HA10 5.5 - 8
Resistance value of the external braking resistor	$\Omega$	> 390	> 390	> 390	> 390	> 390
Max. cable length to braking resistor	m	15	15	15	15	15
Line supply connection L1, L2, L3		Screw terminals for cable cross-sections 1.0 to 2.5 mm <sup>2</sup>				
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 <sup>3)</sup> shielded/unshielded	m	50 / 75				
Degree of protection		IP20 or IPXXB				
Weight	kg	1.2	1.2	1.2	1.2	1.2

1) Rated output of a typical standard induction motor at 400 V 3-ph. AC.

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

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

Table 3- 11 Technical data PM340, 3-ph. AC, Part 2

Line supply voltage 3-ph. 380 V to 480 V AC $\pm 10\%$						
PM340	6SL3210-	1SE16-0UA0	1SE17-7UA0	1SE21-0UA0	1SE21-8UA0	1SE22-5UA0
PM340 with integrated line filter	6SL3210-	1SE16-0AA0	1SE17-7AA0	1SE21-0AA0	1SE21-8AA0	1SE22-5AA0
Frame size		FSB	FSB	FSB	FSC	FSC
<b>Output current</b>						
Rated 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
for S6 operation (40%) $I_{S6}$	A	6.4	8.3	10.8	19.6	27.8
Peak current $I_{max}$	A	11.8	15.4	20.4	26.4	38
<b>Unit rating</b> <sup>1)</sup>						
on basis of $I_n$	kW	2.2	3	4	7.5	11
on basis of $I_H$	kW	2.2	3	4	5.5	7.5
<b>Rated pulse frequency</b>	kHz	4	4	4	4	4
<b>Power loss</b>	kW	0.14	0.16	0.18	0.24	0.30
<b>Cooling air requirement</b>	m <sup>3</sup> /s	0.009	0.009	0.009	0.038	0.038
<b>Sound pressure level <math>L_{pA}</math></b> (1 m)	dB	< 50	< 50	< 50	< 60	< 60
<b>24 V DC supply</b> for the Control Unit	A	1.0	1.0	1.0	1.0	1.0
<b>Rated input current</b> <sup>2)</sup> without/with integrated line reactor	A	5.6 / 6.7	7.5 / 8.9	9.8 / 12.4	17.1 / 23.1	24.6 / 32.6
<b>Class J UL safety fuses</b>						
Rated current	A	10	12	15	25	35
Rated short-circuit current SCCR	kA	65	65	65	65	65
<b>Safety fuses NH</b>						
Rated current	A	3NA3 803 10	3NA3 805 16	3NA3 805 16	3NA3 810 25	3NA3 814 35
<b>Circuit breaker type designation</b> EN 60947						
Rated current	A	3RV1021- 1KA10 9 - 12.5	3RV1021- 4AA10 11 - 16	3RV1021- 4BA10 14 - 20	3RV1031- 4EA10 22 - 32	3RV1031- 4FA10 28 - 40
<b>Resistance value</b> of the external braking resistor	$\Omega$	> 160	> 160	> 160	> 56	> 56
<b>Max. cable length</b> to braking resistor	m	15	15	15	15	15
<b>Line supply connection</b> L1, L2, L3		Screw terminals for cable cross-sections 1.0 to 6 mm <sup>2</sup>			Screw terminals for cable cross-sections 2.5 to 10 mm <sup>2</sup>	
<b>Motor connection</b> U2, V2, W2						
<b>DC link connection, connection for braking resistor</b> DCP/R1, DCN, R2						
<b>PE connection</b>		at the housing with M 5 screw				
<b>Max. motor cable length</b> <sup>3)</sup> shielded/unshielded	m	50 / 75				

## 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	1SE21-8UA0	1SE22-5UA0
PM340 with integrated line filter	6SL3210-	1SE16-0AA0	1SE17-7AA0	1SE21-0AA0	1SE21-8AA0	1SE22-5AA0
Degree of protection		IP20 or IPXXB				
Weight	kg	4.0	4.0	4.0	6.5	6.5

- 1) Rated output of a typical standard induction motor at 400 V 3-ph. AC.
- 2) The input current depends on the motor load and line impedance. The input currents apply for unit rating loading (based on  $I_{rated}$ ) for a line impedance corresponding to  $u_k = 1\%$ .
- 3) Max. motor cable length 25 m (shielded) for PM340 Power Modules with integrated line filter to comply with the limit values of EN 61800-3 Category C2.

Table 3- 12 Technical data PM340, 3-ph. AC, Part 3

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
Frame size		FSC	FSD	FSD	FSD	FSE
<b>Output current</b>						
Rated current $I_n$	A	32	38	45	60	75
Base-load current $I_H$	A	27	33	40	48	65
for S6 operation (40%) $I_{S6}$	A	37.1	49	58	78	98
Peak current $I_{max}$	A	52	64	76	90	124
<b>Unit rating</b> <sup>1)</sup>						
on basis of $I_n$	kW	15	18.5	22	30	37
on basis of $I_H$	kW	11	15	18.5	22	30
<b>Rated pulse frequency</b>	kHz	4	4	4	4	4
<b>Power loss</b>	kW	0.40	0.38	0.51	0.69	0.99
<b>Cooling air requirement</b>	l/s	54.9	54.9	54.9	54.9	2 x 54.9
<b>Sound pressure level <math>L_{pA}</math></b> (1 m)	dB(A)	< 60	< 60	< 60	< 60	< 60
<b>24 V DC supply</b> for the Control Unit	A	1.0	1.0	1.0	1.0	1.0
<b>Rated input current</b> <sup>2)</sup> without/with integrated line reactor	A	33 / 39	40 / 46	47 / 53	63 / 72	78 / 88
<b>Class J UL safety fuses</b>						
Rated current	A	45	50	60	90	100
Rated short-circuit current SCCR	kA	65	65	65	65	65
<b>Safety fuses NH</b>						
Rated current	A	3NA3 817 40	3NA3 820 50	3NA3 822 63	3NA3 824 80	3NA3 830 100
<b>Circuit breaker type designation EN 60947</b>						
Rated current	A	3RV1031- 4HA10 40 - 50	3RV1042- 4JA10 45 - 63	3RV1042- 4KA10 57 - 75	3RV1042- 4MA10 80 - 100	3VL1712- 1DD33-0AA0 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
<b>Circuit breaker type designation</b> 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
<b>Resistance value</b> of the external braking resistor	$\Omega$	> 56	> 27	> 27	> 27	> 15
<b>Max. cable length</b> to braking resistor	m	15	15	15	15	15
<b>Line supply connection</b> L1, L2, L3		Screw terminals for cable cross-section 2.5 to 10 mm <sup>2</sup>	Stud M6, connectable cable cross-sections 10 to 50 mm <sup>2</sup>			
<b>Motor connection</b> U2, V2, W2						
<b>DC link connection, connection for braking resistor</b> DCP/R1, DCN, R2						
<b>PE connection</b>		at the housing with M 5 screw	at the housing with M6 screw			
<b>Max. motor cable length</b> <sup>3)</sup> shielded/unshielded	m	50 / 75	70 / 100			
<b>Degree of protection</b>		IP20 or IPXXB				
<b>Height</b> PM340 without/with integrated line filter	mm	333.4 (13.12)	418.3 (16.47) / 511 (20.11)	418.3 (16.47) / 511 (20.11)	418.3 (16.47) / 511 (20.11)	498.3 (19.62) / 633 (24.92)
<b>Weight</b> without/with integrated line filter	kg	6.5 / 6.5	15.9 / 19.3	15.9 / 19.3	15.9 / 19.3	19.8 / 27.1

1) Rated output of a typical standard induction motor at 400 V 3-ph. AC.

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

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

Power Modules

3.1 Power Modules Blocksize (PM340)

Table 3- 13 Technical data PM340, 3-ph. AC, Part 4

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
Frame size		FSE	FSF	FSF	FSF
<b>Output current</b>					
Rated current $I_n$	A	90	110	145	178
Base-load current $I_H$	A	80	95	115	155
for S6 operation (40%) $I_{S6}$	A	117	143	188	231
Peak current $I_{max}$	A	150	180	220	290
<b>Unit rating</b> <sup>1)</sup>					
on basis of $I_n$	kW	45	55	75	90
on basis of $I_H$	kW	37	45	55	75
<b>Rated pulse frequency</b>	kHz	4	4	4	4
<b>Power loss</b>	kW	1.21	1.42	1.93	2.31
<b>Cooling air requirement</b>	l/s	2 x 54.9	150	150	150
<b>Sound pressure level <math>L_{pA}</math></b> (1 m)	dB	62	< 60	< 60	65
<b>24 V DC supply</b> for the Control Unit	A	1.0	1.0	1.0	1.0
<b>Rated input current</b> <sup>2)</sup> without/with integrated line reactor	A	94 / 105	115 / 129	151 / 168	186 / 204
<b>Class J UL safety fuses</b>					
Rated current	A	125	150	200	250
Rated short-circuit current SCCR	kA	65	65	65	65
<b>Safety fuses NH</b>					
Rated current	A	3NA3 832 125	3NA3 836 160	3NA3 140 200	3NA3 144 250
<b>Circuit breaker type designation</b> <b>EN 60947</b>					
Rated current	A	3VL1716-1DD33-0AA0 125 - 160	3VL3720-1DC36-0AA0 160 - 200	3VL3720-1DC36-0AA0 160 - 200	3VL3725-1DC36-0AA0 200 - 250
<b>Circuit breaker type designation</b> <b>UL489 / CSA C22.2 No. 5-02</b>					
Rated current	A	3VL2112-3KN30-0AA0 125	3VL2115-3KN30-0AA0 150	3VL3120-3KN30-0AA0 200	3VL3125-3KN30-0AA0 250
Rated short-circuit current SCCR	kA	65	65	65	65
<b>Resistance value</b> of the external braking resistor	$\Omega$	> 15	> 8.2	> 8.2	> 8.2
<b>Max. cable length</b> to braking resistor	m	15	15	15	15



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
Line supply connection L1, L2, L3		Stud M6, connectable cable cross-sections 10 to 50 mm <sup>2</sup>	Stud M8, max. connection cable cross-section 120 mm <sup>2</sup>		
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 <sup>3)</sup> shielded/unshielded	m	70 / 100			
Degree of protection		IP20 or IPXXB			
Height PM340 without/with integrated line filter	mm	498.3 (19.62) / 633 (24.92)	634 (24.96) / 934 (36.77)	634 (24.96) / 934 (36.77)	634 (24.96) / 934 (36.77)
Weight without/with integrated line filter	kg	19.8 / 27.1	50.7 / 66.7	50.7 / 66.7	50.7 / 66.7

- 1) Rated output of a typical standard induction motor at 400 V 3-ph. AC.
- 2) The input current depends on the motor load and line impedance. The input currents apply for unit rating loading (based on  $I_{rated}$ ) for a line impedance corresponding to  $u_k = 1\%$ .
- 3) Max. motor cable length 25 m (shielded) for PM340 Power Modules with integrated line filter to comply with the limit values of EN 61800-3 Category C2.

### 3.1.7.2 Characteristics

#### Overload capability

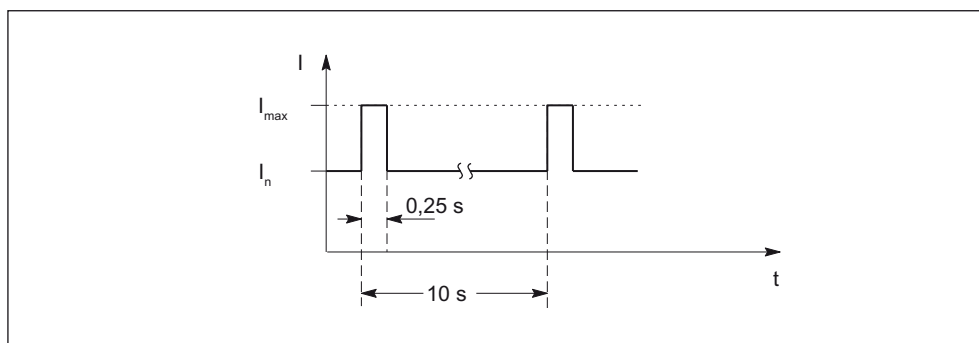


Figure 3-20 Duty cycle with initial load (for servo drives)

Power Modules

3.1 Power Modules Blocksize (PM340)

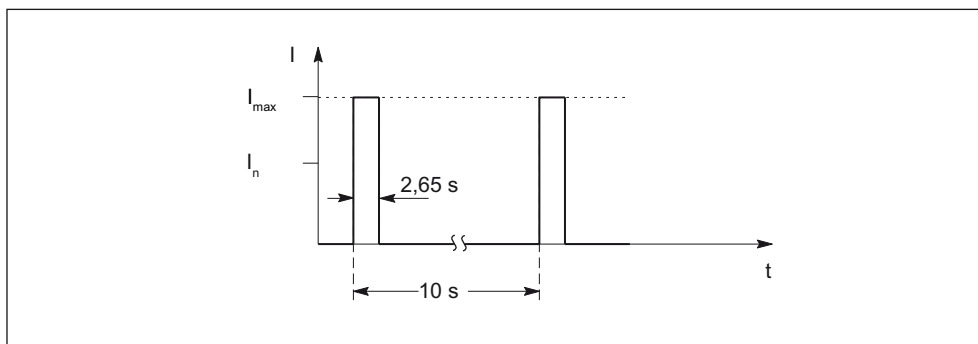


Figure 3-21 Duty cycle without initial load (for servo drives)

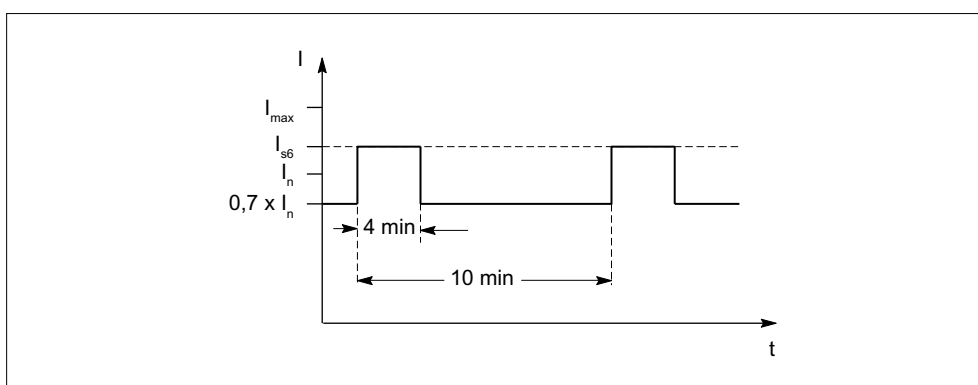


Figure 3-22 S6 duty cycle with initial load (for servo drives)

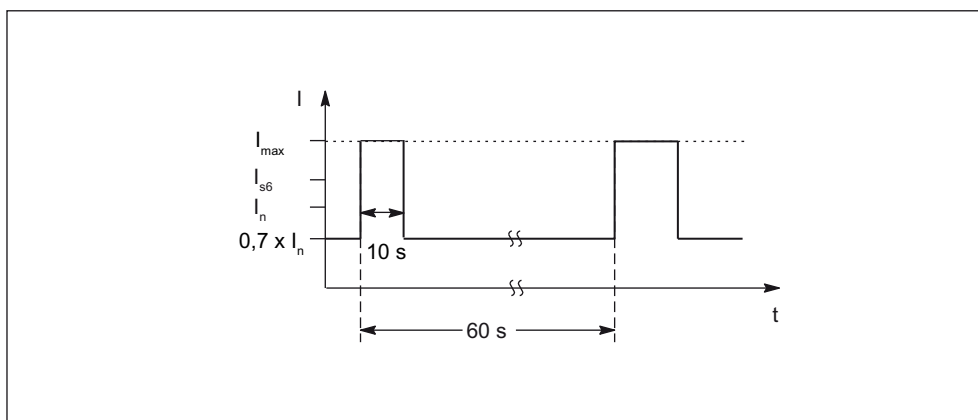


Figure 3-23 Duty cycle with initial load (for servo drives)

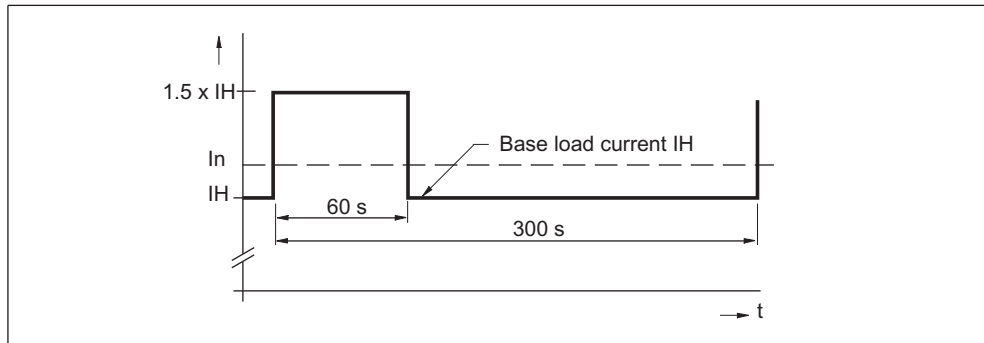


Figure 3-24 Duty cycle with 60 s overload with a duty cycle duration of 300 s

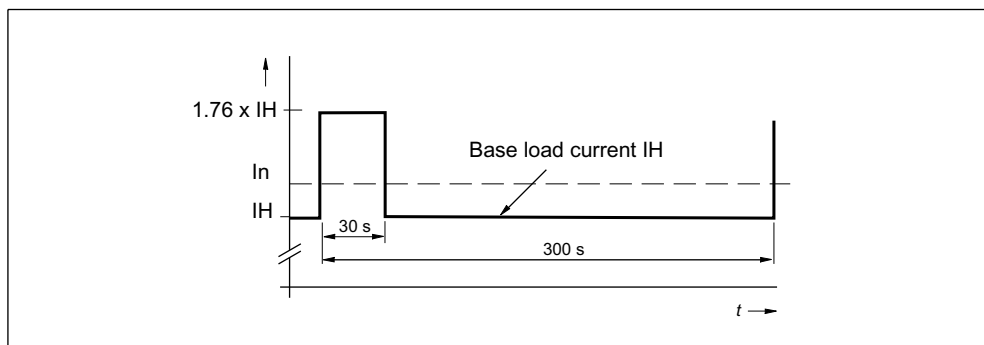


Figure 3-25 Duty cycle with 30 s overload with a duty cycle duration of 300 s

**Note**

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

**Derating characteristic for Power Modules in blocksize format**

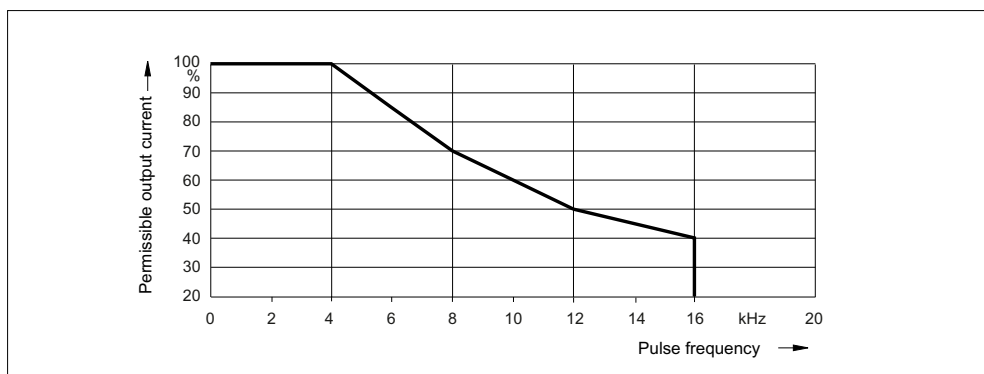


Figure 3-26 Frame sizes FSA to FSE: Output current as a function of the pulse frequency

Power Modules

3.1 Power Modules Blocksize (PM340)

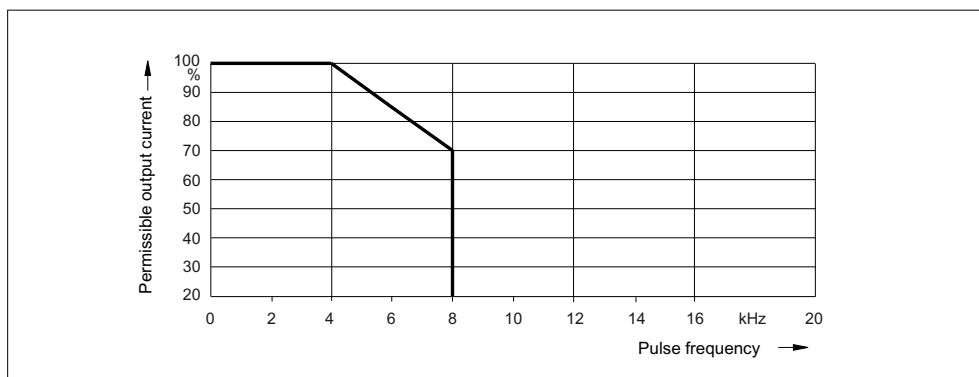


Figure 3-27 Frame size FSF: Output current as a function of the pulse frequency

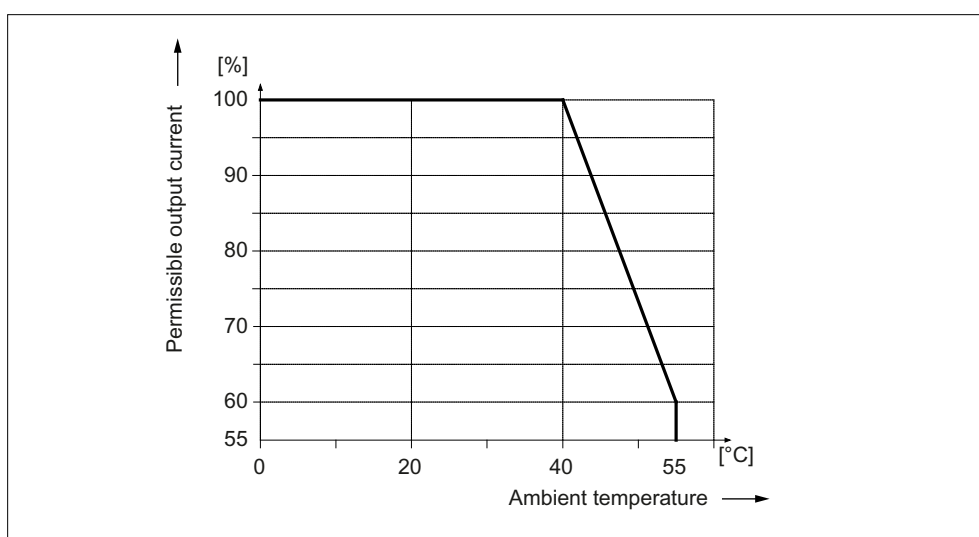


Figure 3-28 Output current as a function of the ambient temperature

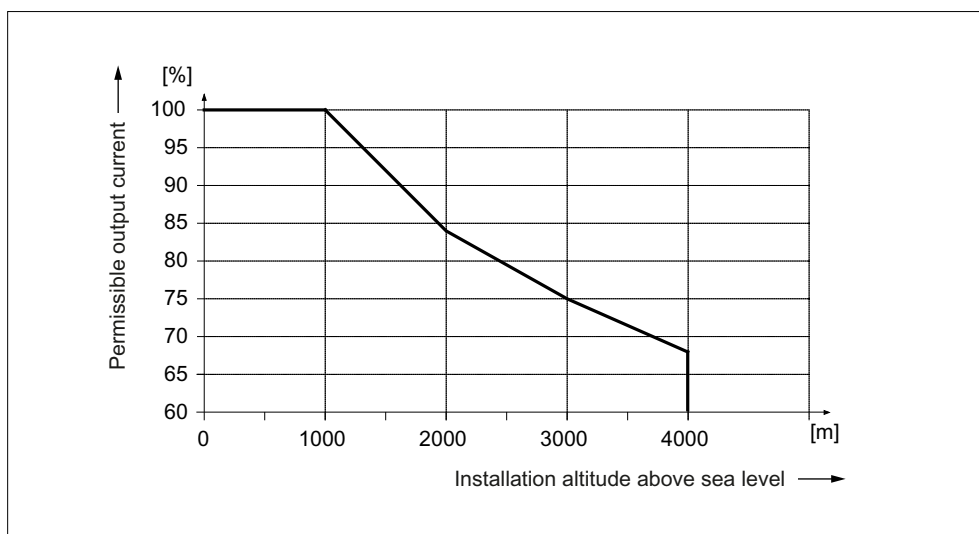


Figure 3-29 Output current as a function of the installation altitude

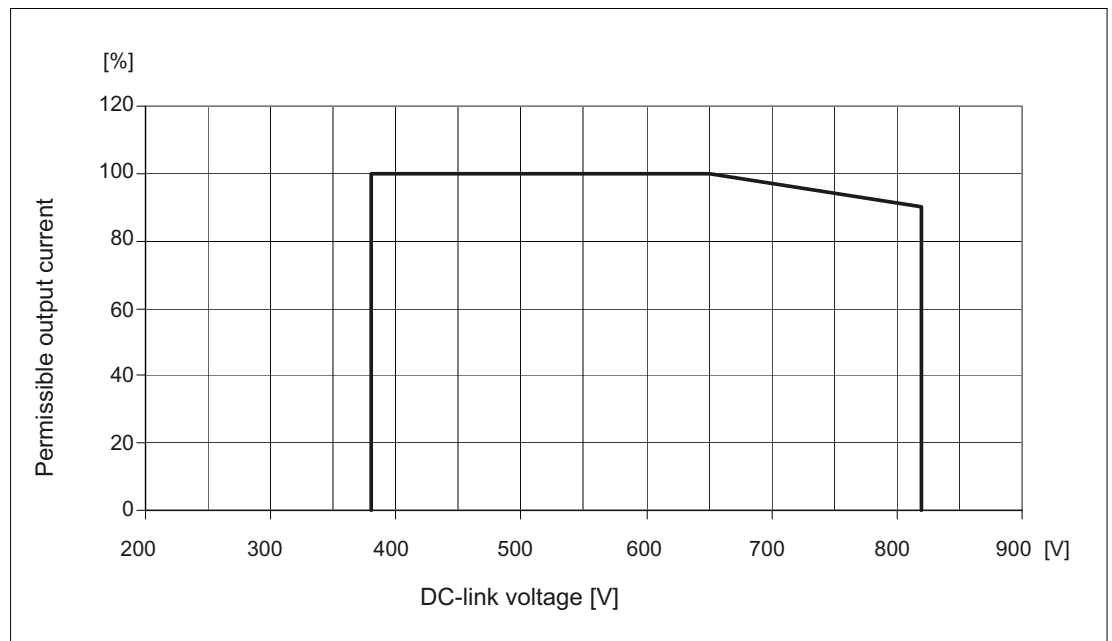


Figure 3-30 Current derating as a function of the DC-link voltage

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

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

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

Power Modules

3.1 Power Modules Blocksize (PM340)

3.1.7.3 Current derating depending on the pulse frequency

Interrelationship between the pulse frequency and current de-rating

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

Order No.	Line supply voltage	Rated current	Power (low overload)	Output current in A at a pulse frequency of:						
				4 kHz	6 kHz 85%	8 kHz 70 %	10 kHz 60%	12 kHz 50 %	14 kHz 45%	16 kHz 40 %
6SL3210		A	[kW]							
<b>FSA</b>	1-ph. 230 V AC									
1SB11-0UA0		0.9	0.12	0.9	0.76	0.63	0.54	0.45	0.40	0.36
1SB12-3UA0		2.3	0.37	2.3	1.96	1.61	1.38	1.15	1.03	0.92
1SB14-0UA0		3.9	0.75	3.9	3.31	2.73	2.34	1.95	1.75	1.56
<b>FSA</b>	3-ph. 400 V AC									
1SE11-3UA0		1.3	0.37	1.3	1.10	0.91	1.78	0.65	0.58	0.52
1SE11-7UA0		1.7	0.55	1.7	1.44	1.19	1.02	0.85	0.76	0.68
1SE12-2UA0		2.2	0.75	2.2	1.87	1.54	1.32	1.1	0.99	0.88
1SE13-1UA0		3.1	1.1	3.1	2.63	2.17	1.86	1.55	1.39	1.24
1SE14-1UA0		4.1	1.5	4.1	3.48	2.87	2.46	2.05	1.84	1.64
<b>FSB</b>										
1SE16-0UA0		5.9	2.2	5.9	5.01	4.13	3.54	2.95	2.65	2.36
1SE17-7UA0		7.7	3	7.7	6.54	5.39	4.62	3.85	3.46	3.08
1SE21-0UA0		10.2	4	10.2	8.67	7.14	6.12	5.1	4.59	4.08
<b>FSC</b>										
1SE21-8UA0	18	5.5	18	15.3	12.6	10.8	9	8.1	7.2	
1SE22-5UA0	25	7.5	25	21.25	17.5	15	12.5	11.25	10	
1SE23-2UA0	32	15	32	27.2	22.4	19.2	16	14.4	12.8	
<b>FSD</b>										
1SE23-8UA0	38	18.5	38	32.3	26.6	22.8	19	17.1	15.2	

Order No.	Line supply voltage	Rated current	Power (low overload)	Output current in A at a pulse frequency of:						
				4 kHz	6 kHz 85%	8 kHz 70 %	10 kHz 60%	12 kHz 50 %	14 kHz 45%	16 kHz 40 %
6SL3210		A	[kW]							
1SE24-5UA0		45	22	45	38.25	31.5	27	22.5	20.25	18
1SE26-0UA0		60	30	60	51	42	36	30	27	24
<b>FSE</b>										
1SE27-5UA0		75	37	75	63.75	52.5	45	37.5	33.75	30
1SE31-0UA0		90	45	90	76.5	63	54	45	40.5	36
<b>FSF</b>										
1SE31-1UA0		110	55	110	93.5	77	-	-	-	-
1SE31-5UA0		145	75	145	123.3	101.5	-	-	-	-
1SE31-8UA0		178	90	178	151.3	124.6	-	-	-	-

## 3.2 Power Modules Blocksize Liquid Cooled (PM340)


### 3.2.1 Description

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

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

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

Table 3- 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>





### 3.2.2 Safety information

 **CAUTION**

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

**Note**

**Connection authorization**

Power Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

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

 **WARNING**

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

 **DANGER**

**Grounding/protective grounding of the Power Module**

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

 **DANGER**

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

 **DANGER**

After connecting the line and motor feeder cables to the appropriate terminals, check that the front covers (only frame sizes FSD to FSF) are closed and latched. Only then may the Power Module be connected to the power supply.

**NOTICE**

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

 **DANGER**

Once all the supply voltages have been disconnected, a hazardous voltage may be present in the power unit for up to 5 minutes. The cover for the terminals may only be opened after this time has definitely elapsed.

When opening the protective cover, you must activate the release. A suitable tool (e.g. screwdriver) must be used for this purpose.

Damaged components must not be used, otherwise this could result in secondary damage or accidents.

 **DANGER**

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

- stationary connection and protective conductor connection by means of  $\geq 10 \text{ mm}^2 \text{ Cu}$  or  $\geq 16 \text{ mm}^2 \text{ Al}$
- stationary connection and automatic shutdown of the power supply if the protective conductor is interrupted

 **DANGER**

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

 **WARNING**

Power Modules must be mounted in the vertical position.

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

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

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

**Note**

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

 **DANGER**

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

Non-observance can cause lethal shock voltages.

 **WARNING**

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

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

### 3.2.3 Interface description

#### 3.2.3.1 Overview

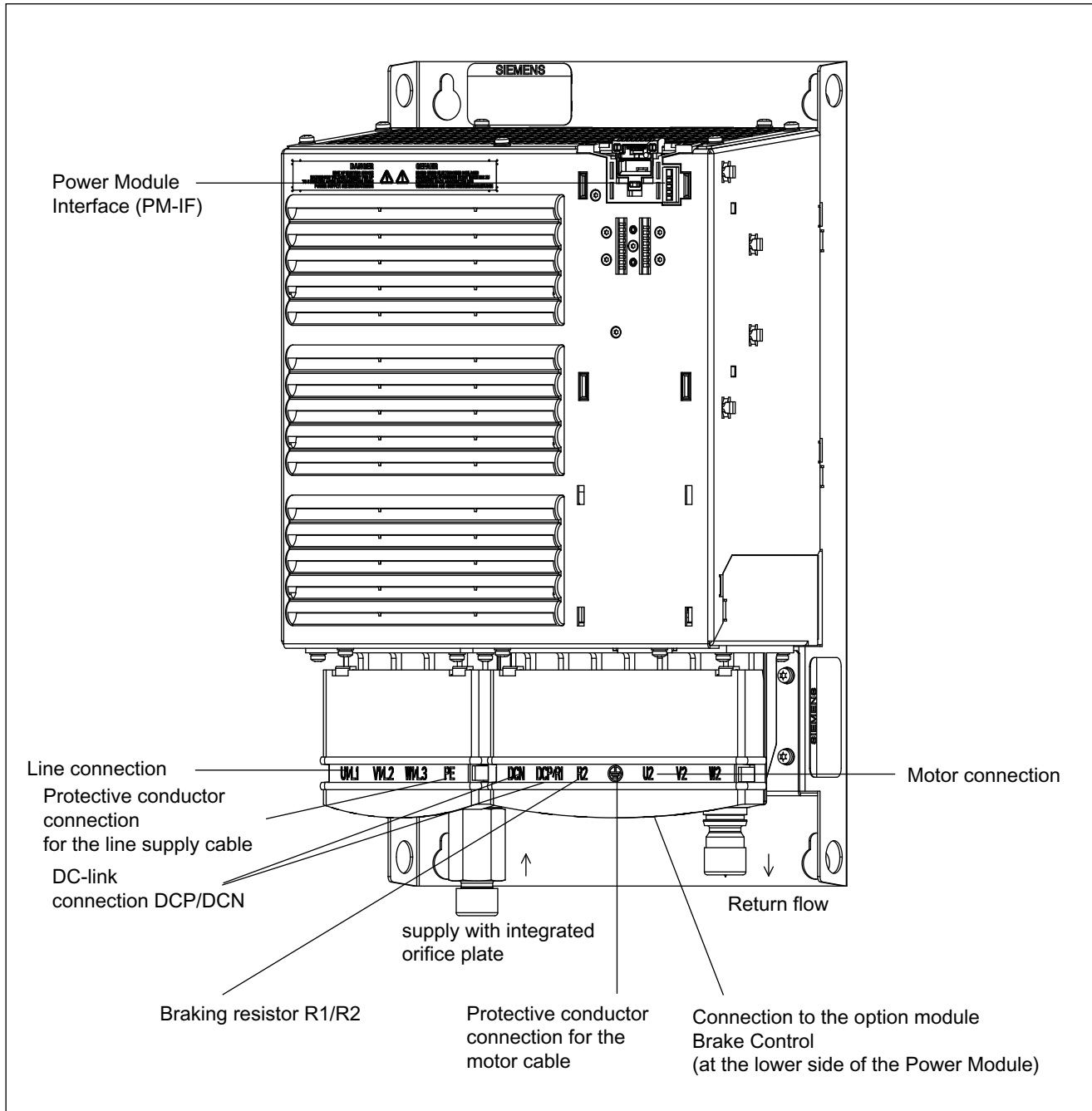


Figure 3-31 Liquid Cooled Power Module PM340 (Example: Frame size FSD)

3.2.3.2 Connection example

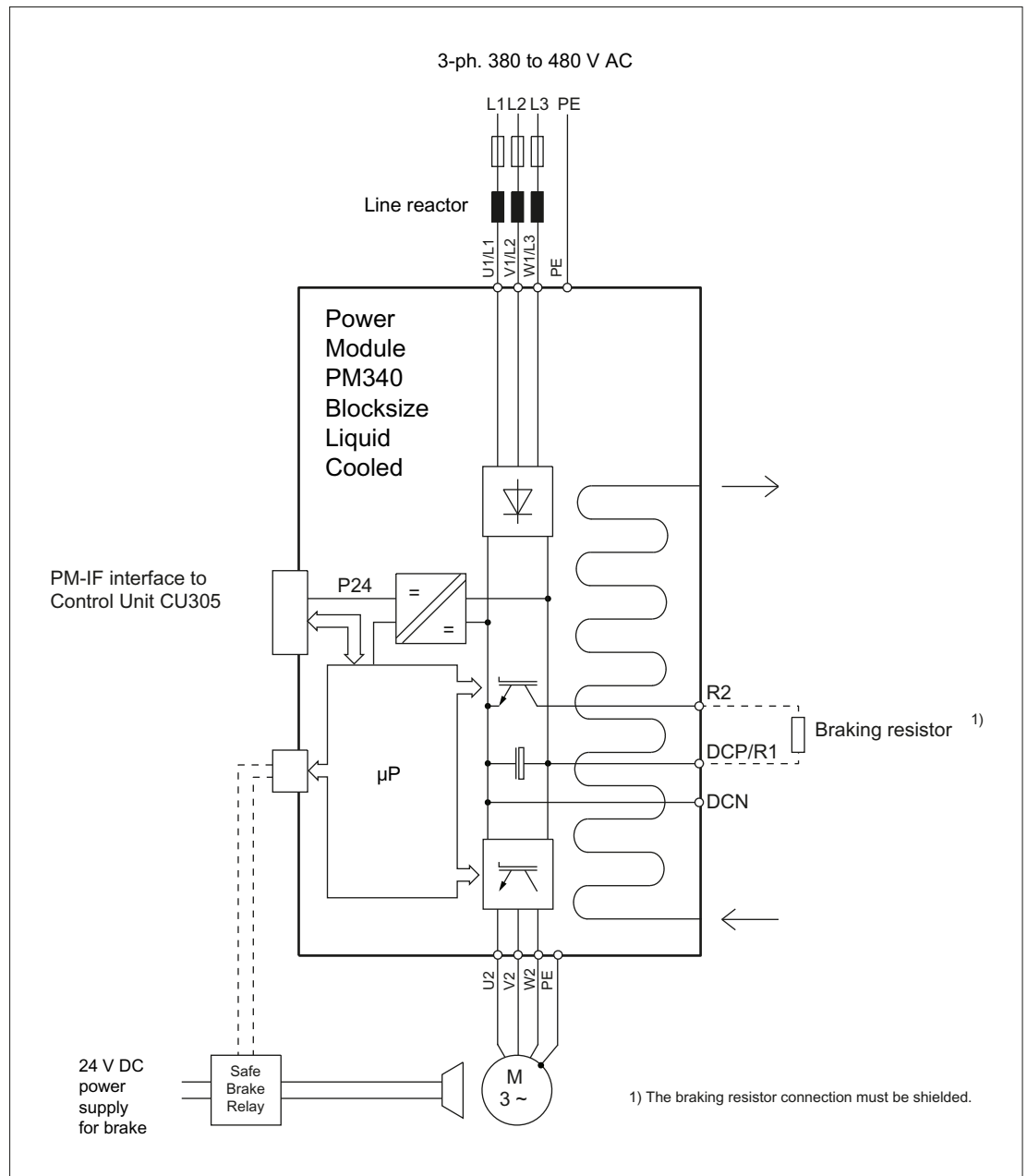


Figure 3-32 Connection example, Liquid Cooled Power Module PM340, 3-ph. 380 to 480 V AC

Power Modules

3.2 Power Modules Blocksize Liquid Cooled (PM340)

Arrangement of the line and motor terminals

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

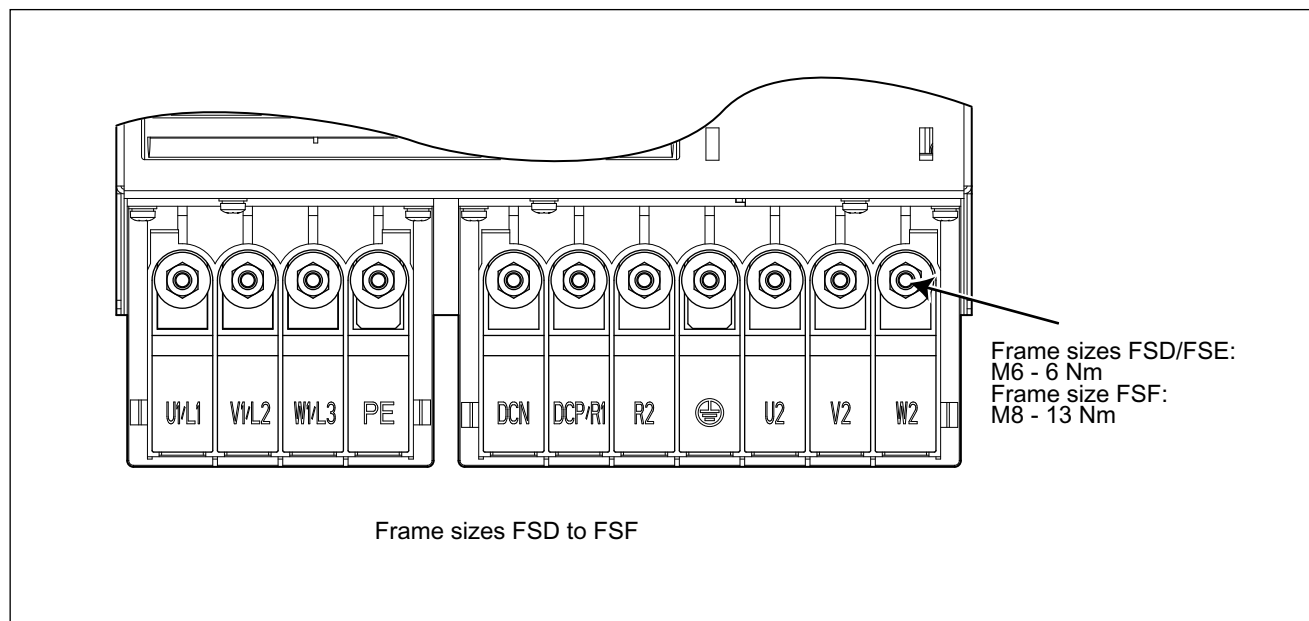


Figure 3-33 Arrangement of the line supply and motor terminals for the PM340

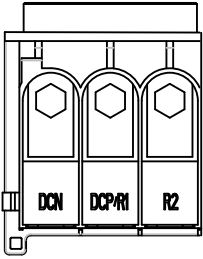
3.2.3.3 Line supply connection

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

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

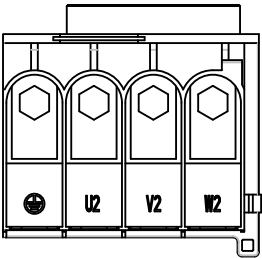

### 3.2.3.4 Braking resistor and DC link connection

Table 3- 17 Terminal block, braking resistor, and DC link connection

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

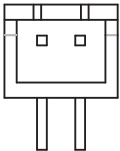
### 3.2.3.5 Motor connection

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

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

### 3.2.3.6 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

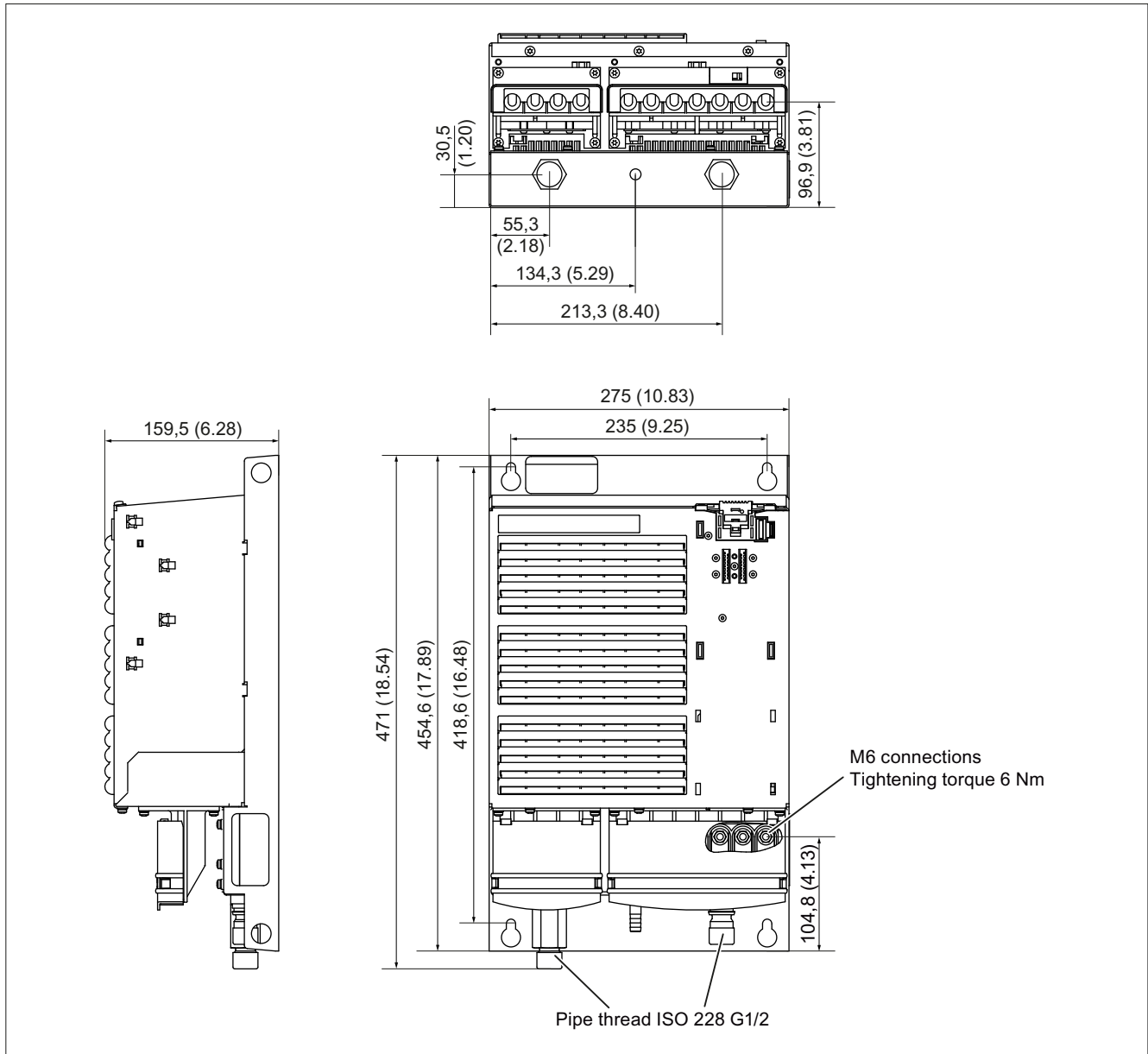


Figure 3-34 Dimension drawing of Liquid Cooled Power Module PM340, frame size FSD, all dimensions in mm and (inches)



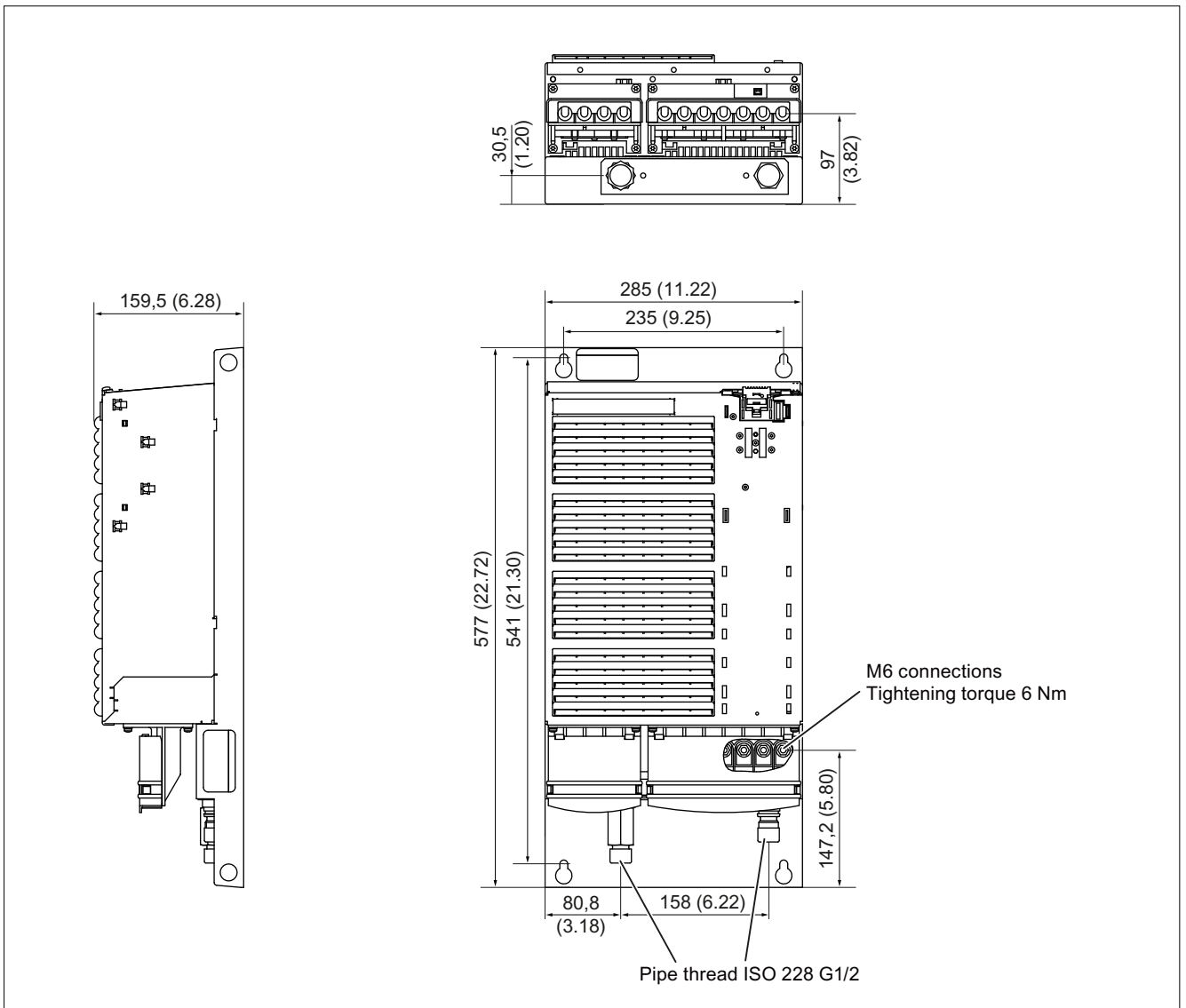


Figure 3-35 Dimension drawing of Liquid Cooled Power Module PM340, frame size FSE, all dimensions in mm and (inches)

Power Modules

3.2 Power Modules Blocksize Liquid Cooled (PM340)

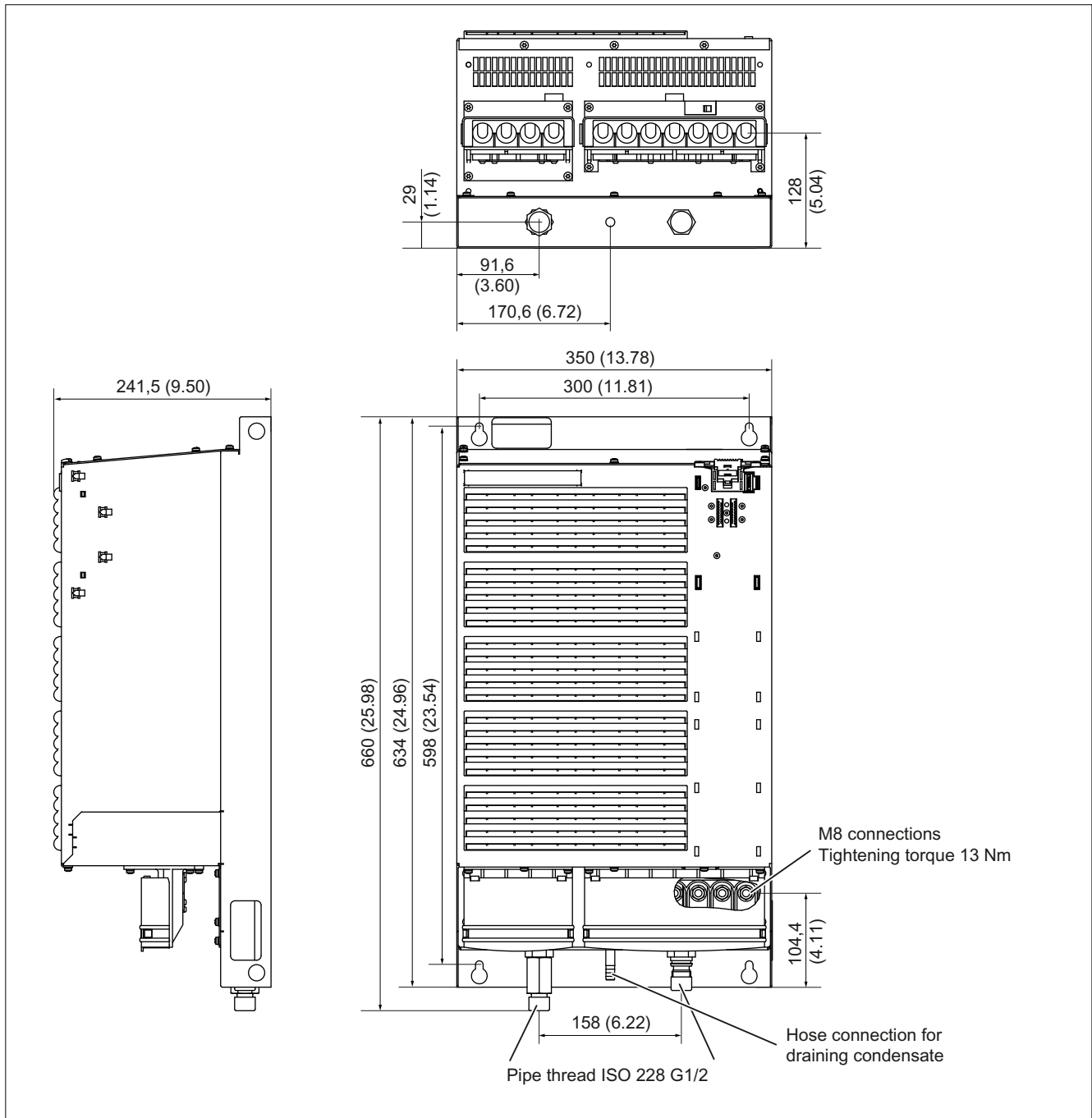


Figure 3-36 Dimension drawing of Liquid Cooled Power Module PM340, frame size FSF, all dimensions in mm and (inches)

3.2.5 Installation

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

### 3.2.5.1 Drilling patterns

#### Hole drilling templates for frame sizes FSD to FSF

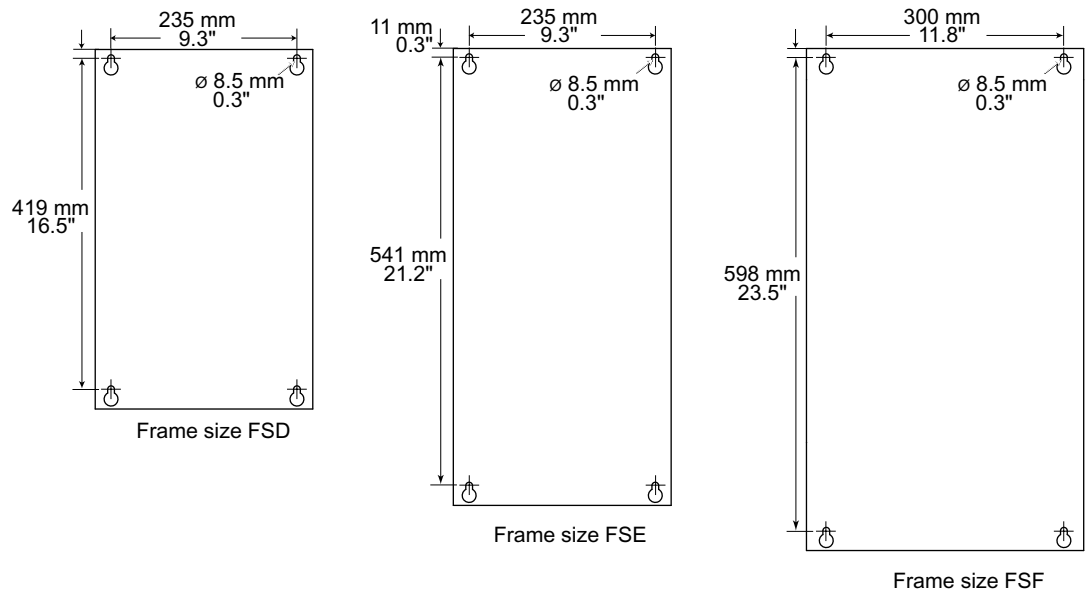


Figure 3-37 Hole drilling templates for frame sizes FSD to FSF

3.2.5.2 Installation

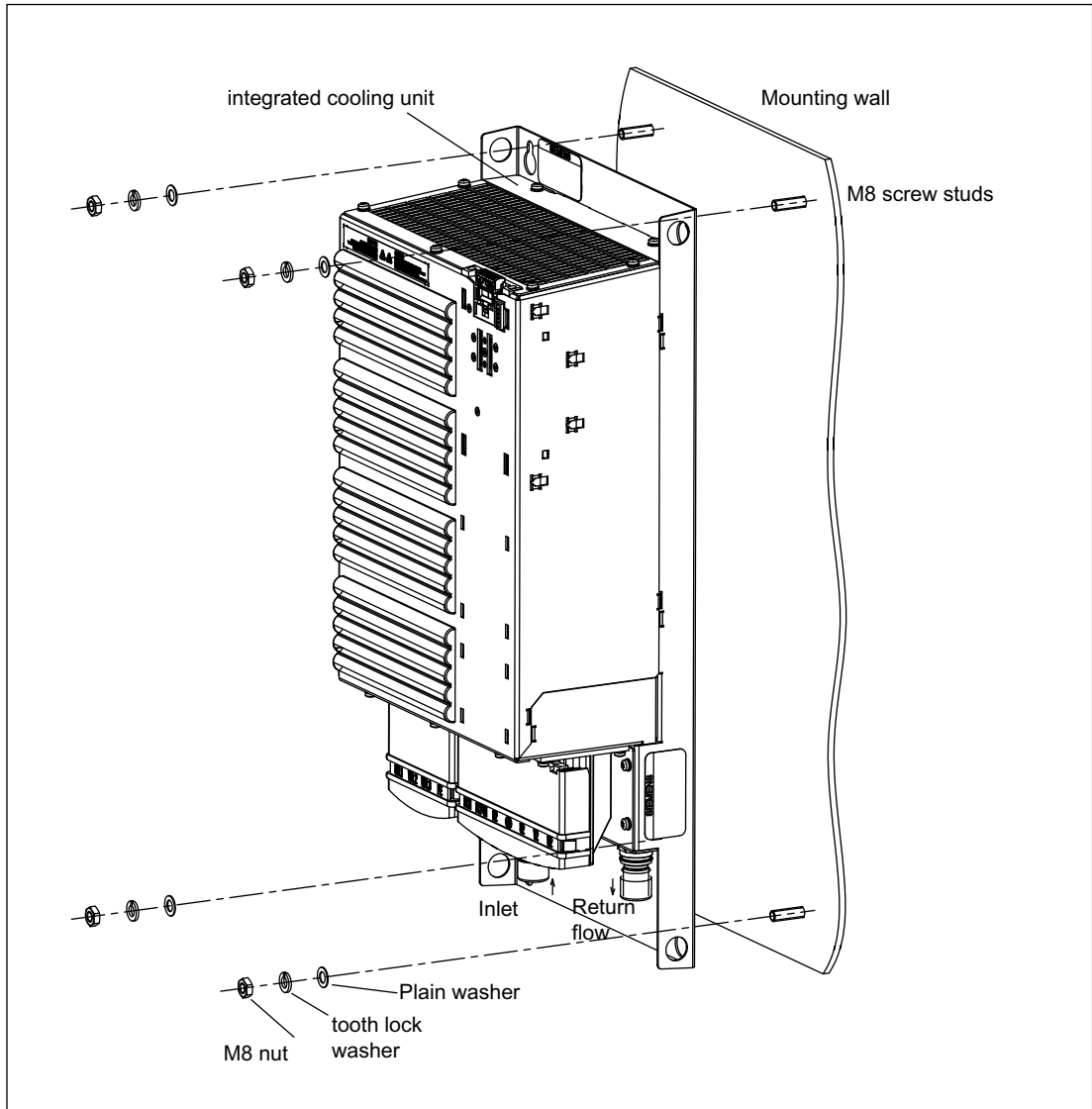


Figure 3-38 Installation of Power Module PM340 Liquid Cooled with integrated cooling unit (example: frame size FSE)

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

### 3.2.5.3 Access to the power supply terminals and motor terminals

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

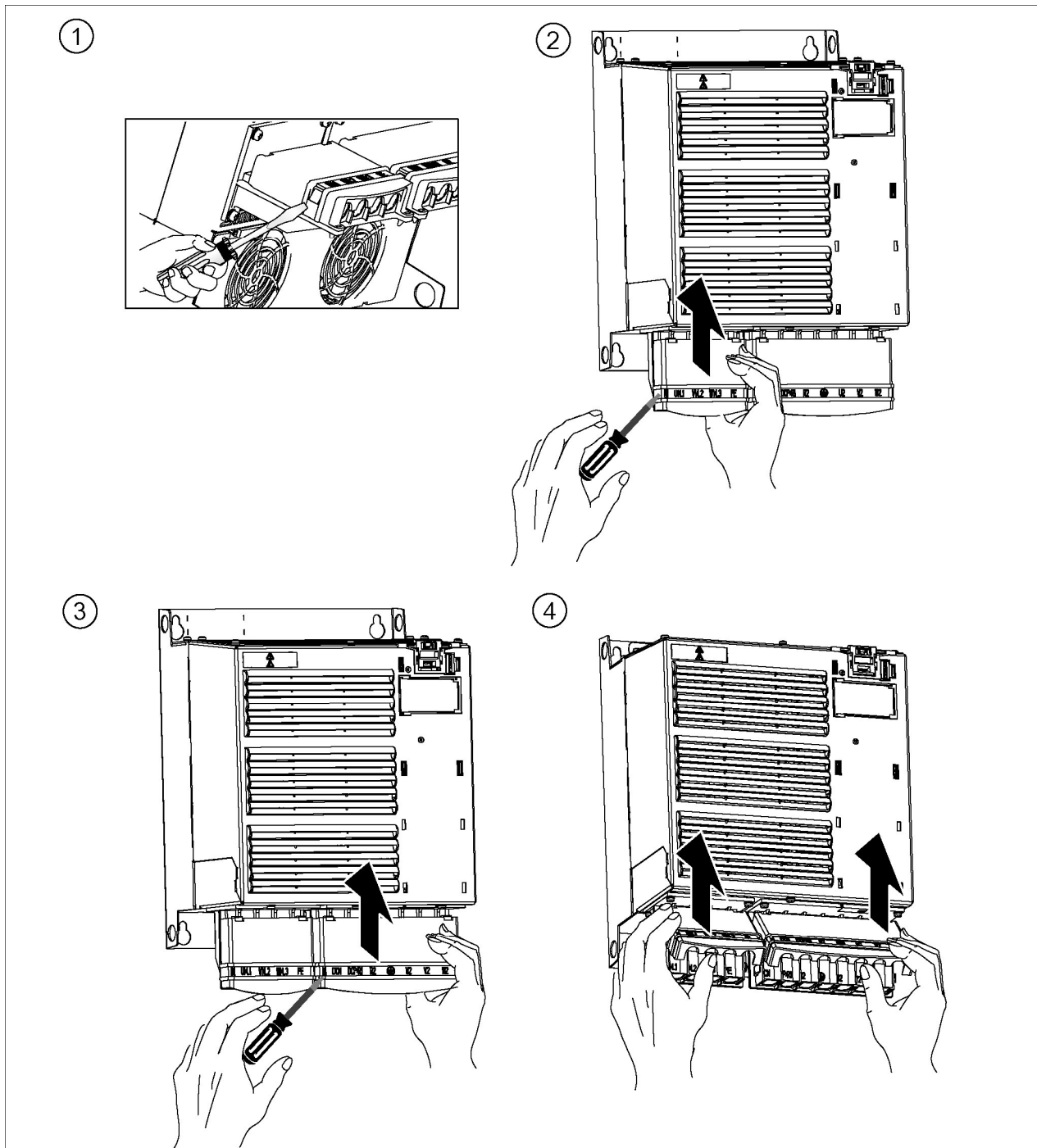


Figure 3-39 Access to the line and motor terminals for frame sizes FSD to FSF



**DANGER**

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

### 3.2.6 Connection to the cooling circuit

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

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

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

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

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

### 3.2.7 Commissioning

#### Prior to commissioning

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

#### After commissioning

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

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

### 3.2.8 Technical data

Table 3- 20 Technical data Blocksize Liquid Cooled PM340, Part 1

PM340 Power Module	6SL3215-	1SE23-8UAx	1SE26-0UAx	1SE27-5UAx
<b>Frame size</b>		FSD	FSD	FSE
<b>Output current</b>				
Rated current $I_n$	A	38	60	75
Base-load current $I_H$	A	33	48	65
for S6 operation (40%) $I_{S6}$	A	49	78	98
Peak current $I_{max}$	A	64	90	124
<b>Unit rating</b> <sup>1)</sup>				
on basis of $I_n$	kW	18.5	30	37
on basis of $I_H$	kW	15	22	30
<b>Rated pulse frequency</b>	kHz	4	4	4
<b>Power loss</b>				
total, approx.	kW	0.38	0.69	0.99
to ambient air, approx.	kW	0.09	0.13	0.16
<b>Cooling circuit</b>				
Rated volumetric flow for water at 70 kPa pressure drop	l/min	8	8	8
Liquid volume of integrated heat exchanger	l	0.1	0.1	0.13
<b>Sound pressure level <math>L_{pA}</math> (1 m)</b>	dB	< 60	< 60	< 60
<b>24 V DC supply</b> for the Control Unit	A	1.0	1.0	1.0
<b>Rated input current</b> <sup>2)</sup> without/with integrated line reactor	A	40 / 46	63 / 72	78 / 88
<b>Class J UL safety fuses</b>				
Rated current	A	50	90	100
Rated short-circuit current SCCR	kA	65	65	65
<b>Safety fuses NH</b>				
Rated current	A	3NA3 820 50	3NA3 824 80	3NA3 830 100
<b>Circuit breaker type designation EN 60947</b>				
Rated current	A	3RV1042-4JA10 45 - 63	3RV1042-4MA10 80 - 100	3VL1712-1DD33-0AA0 100 - 125
<b>Circuit breaker type designation UL489 / CSA C22.2 No. 5-02</b>				
Rated current	A	--	3VL2191-3KN30-0AA0 90	3VL2110-3KN30-0AA0 100
Rated short-circuit current SCCR	kA		65	65
<b>Resistance value</b> of the external braking resistor	$\Omega$	> 27	> 27	> 15
<b>Max. cable length</b> to braking resistor	m	15	15	15

Power Modules

3.2 Power Modules Blocksize Liquid Cooled (PM340)

PM340 Power Module	6SL3215-	1SE23-8UAx	1SE26-0UAx	1SE27-5UAx
Line supply connection L1, L2, L3		Stud M6, connectable cable cross-sections 10 to 50 mm <sup>2</sup> 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				
- PM340	mm	159.5 (6.28)		
- PM340 with CU305 PN	mm	229.4 (9.03)		
- PM340 with CU305 DP/CAN	mm	214.1 (8.43)		
Weight	kg	10.5	10.5	14.8
with CU305	kg	11.5	11.5	15.8

- 1) Rated output of a typical standard induction motor at 400 V 3-ph. AC
- 2) The input current depends on the motor load and line impedance. The input currents apply for unit rating loading (based on  $I_{rated}$ ) for a line impedance corresponding to  $u_k = 1\%$

Table 3- 21 Technical data PM340 Blocksize Liquid Cooled, Part 2

PM340 Power Module	6SL3215-	1SE31-0UAx	1SE31-1UAx	1SE31-8UAx
Frame size		FSE	FSF	FSF
Output current				
Rated current $I_n$	A	90	110	178
Base-load current $I_H$	A	80	95	155
for S6 operation (40%) $I_{S6}$	A	117	143	231
Peak current $I_{max}$	A	150	180	290
Unit rating <sup>1)</sup>				
on basis of $I_n$	kW	45	55	90
on basis of $I_H$	kW	37	45	75
Rated pulse frequency	kHz	4	4	4
Power loss				
total, approx.	kW	1.21	1.42	2.31
to ambient air, approx.	kW	0.19	0.21	0.35
Cooling circuit				
Rated volumetric flow for water at 70 kPa pressure drop	l/min	8	8	8
Liquid volume of integrated heat exchanger	l	0.13	0.2	0.2
Sound pressure level $L_{pA}$ (1 m)	dB	62	< 60	65
24 V DC supply for the Control Unit	A	1.0	1.0	1.0
Rated input current <sup>2)</sup>				
without/with integrated line reactor	A	94 / 105	115 / 129	186 / 204



PM340 Power Module	6SL3215-	1SE31-0UAx	1SE31-1UAx	1SE31-8UAx
<b>Class J UL safety fuses</b>				
Rated current	A	125	150	250
Rated short-circuit current SCCR	kA	65	65	65
<b>Safety fuses NH</b>		3NA3 832	3NA3 836	3NA3 144
Rated current	A	125	160	250
<b>Circuit breaker type designation EN 60947</b>		3VL1716-1DD33-0AA0	3VL3720-1DC36-0AA0	3VL3725-1DC36-0AA0
Rated current	A	125 - 160	160 - 200	200 - 250
<b>Circuit breaker type designation UL489 / CSA C22.2 No. 5-02</b>		3VL2112-3KN30-0AA0	3VL2115-3KN30-0AA0	3VL3125-3KN30-0AA0
Rated current	A	125	150	250
Rated short-circuit current SCCR	kA	65	65	65
<b>Resistance value of the external braking resistor</b>	$\Omega$	> 15	> 8.2	> 8.2
<b>Max. cable length to braking resistor</b>	m	15	15	15
<b>Line supply connection</b> L1, L2, L3		Stud M6, connectable cable cross-sections 10 to 50 mm <sup>2</sup> for ring cable lugs	Stud M8, max. connection cable cross-section 120 mm <sup>2</sup>	
<b>Motor connection</b> U2, V2, W2				
<b>DC link connection, connection for braking resistor</b> DCP/R1, DCN, R2				
<b>PE connection</b>				
<b>Max. motor cable length</b>	m	70 (shielded) / 100 (unshielded)		
<b>Degree of protection</b>		IP20 or IPXXB		
<b>Depth</b>				
- PM340	mm	159.5 (6.28)	241.5 (9.50)	241.5 (9.50)
- PM340 with CU305 PN	mm	229.4 (9.03)	311.4 (12.26)	311.4 (12.26)
- PM340 with CU305 DP/CAN	mm	214.1 (8.43)	296.1 (11.66)	296.1 (11.66)
<b>Weight</b>				
with CU305	kg	14.8	29.2	29.2
	kg	15.8	30.2	30.2

1) Rated output of a typical standard induction motor at 400 V 3-ph. AC.

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

### 3.2.8.1 Characteristics

#### Overload capability

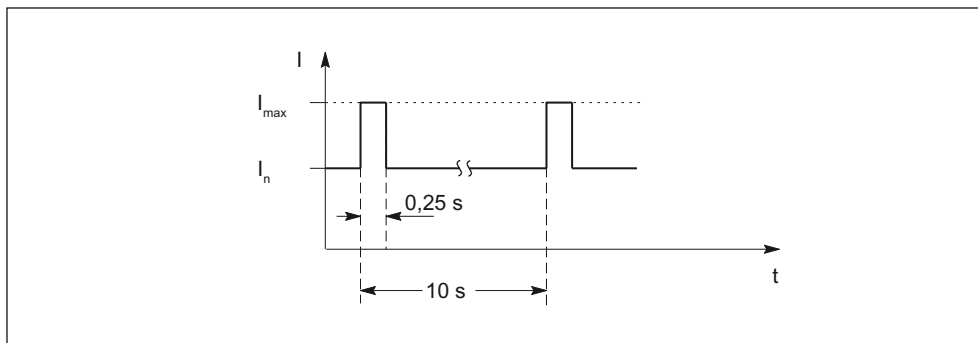


Figure 3-40 Duty cycle with initial load (for servo drives)

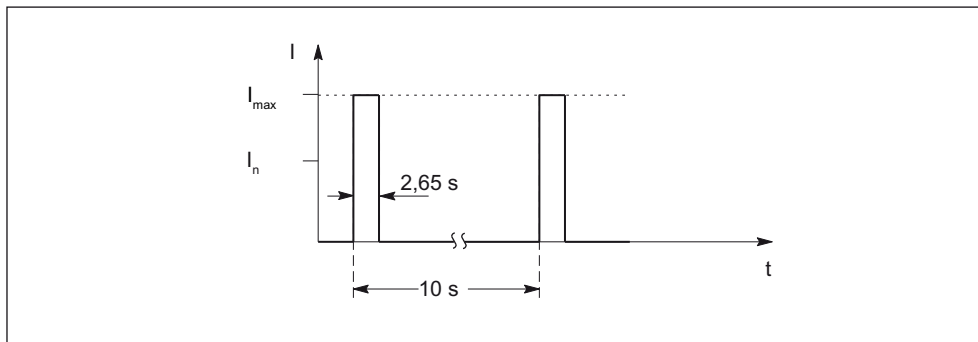


Figure 3-41 Duty cycle without initial load (for servo drives)

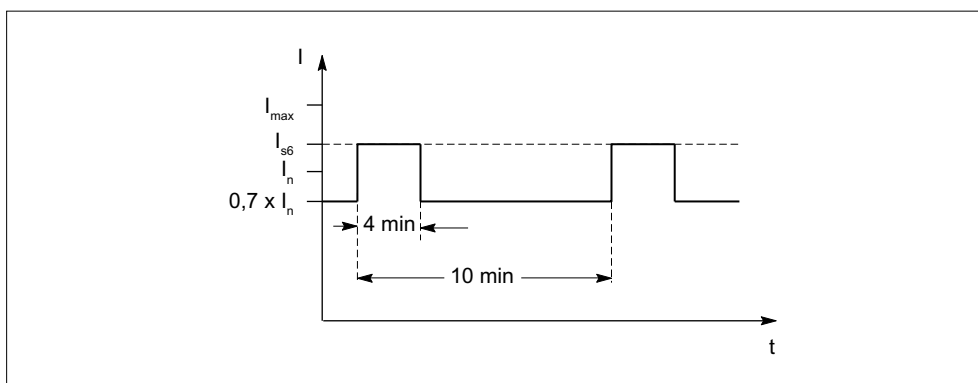


Figure 3-42 S6 duty cycle with initial load (for servo drives)

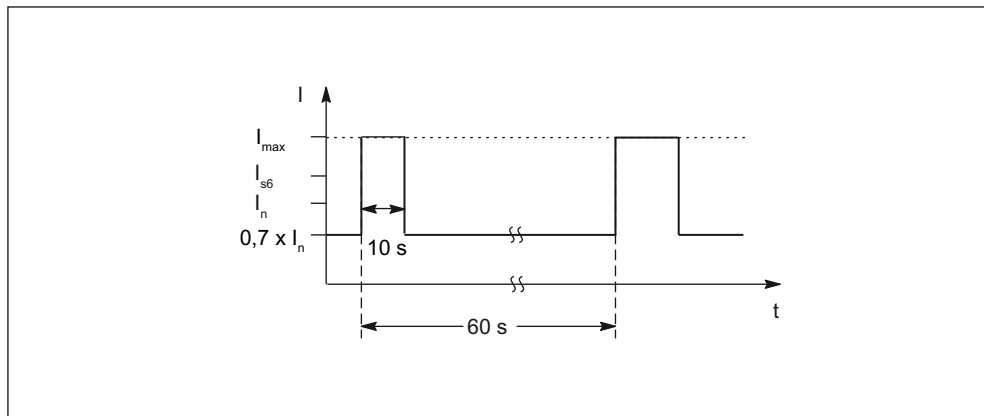


Figure 3-43 Duty cycle with initial load (for servo drives)

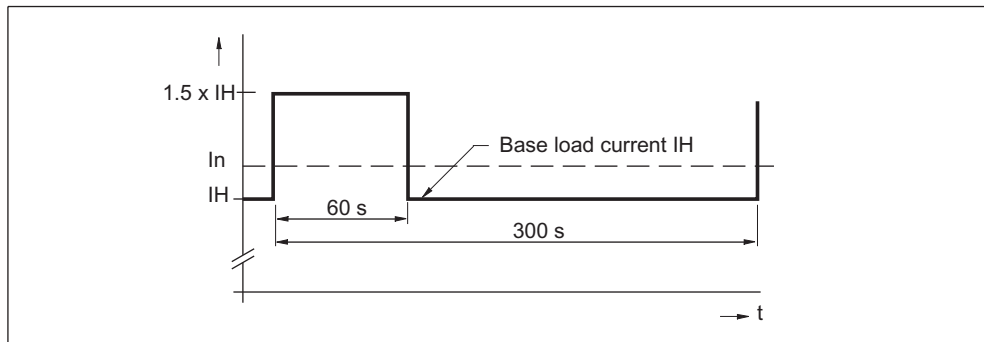


Figure 3-44 Duty cycle with 60 s overload with a duty cycle duration of 300 s

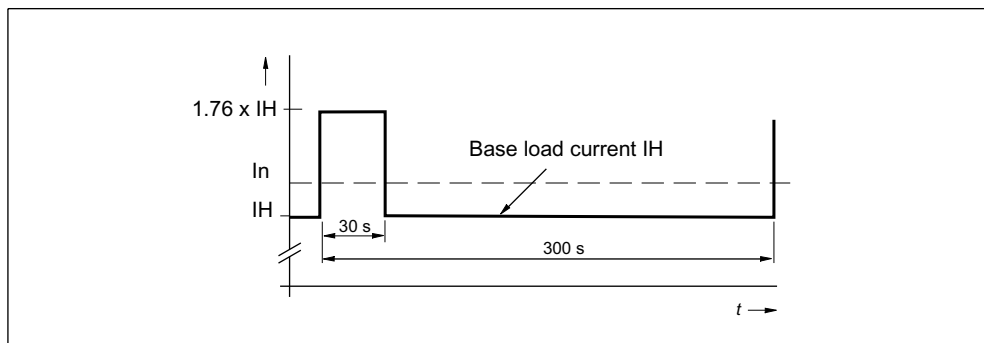


Figure 3-45 Duty cycle with 30 s overload with a duty cycle duration of 300 s

**Note**

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

Derating characteristics for Power Modules in blocksize Liquid Cooled format

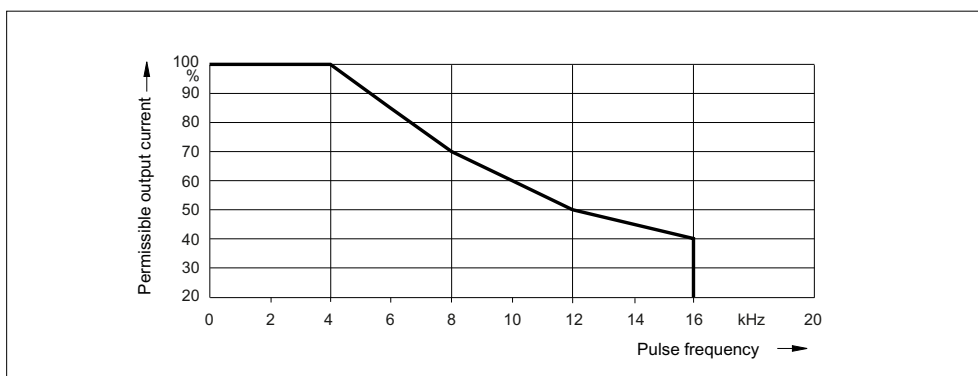


Figure 3-46 Frame sizes FSD and FSE: Output current as a function of the pulse frequency



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

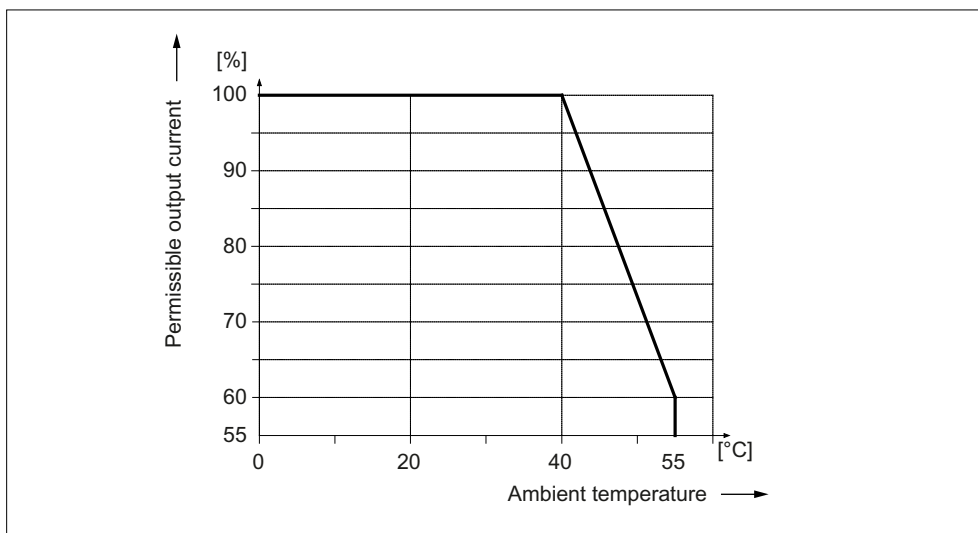


Figure 3-48 Output current as a function of the ambient temperature

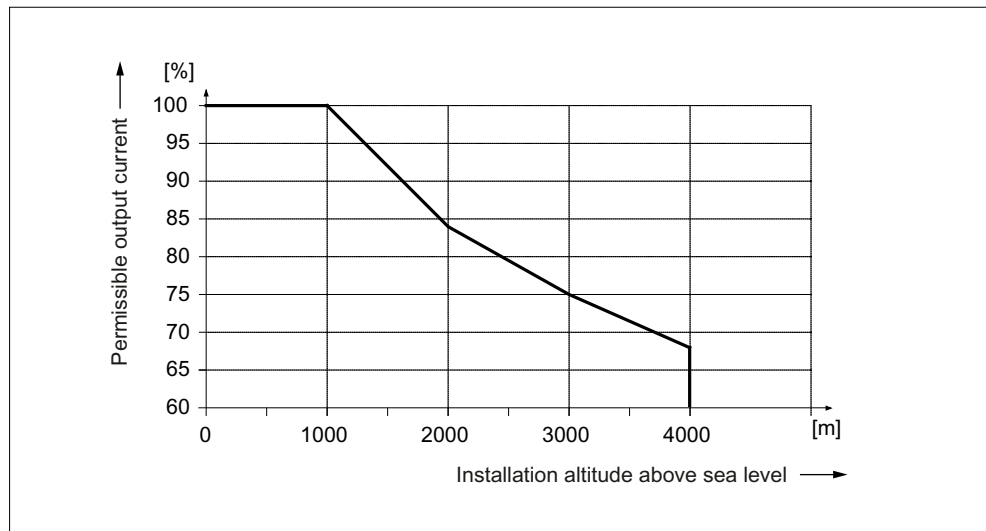


Figure 3-49 Output current as a function of the installation altitude

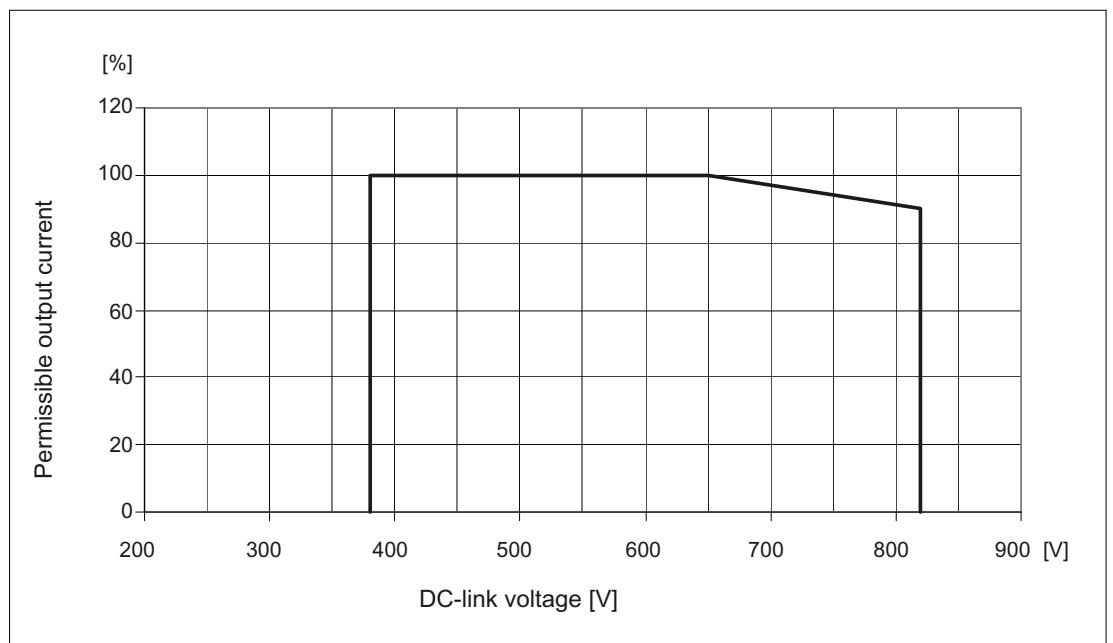


Figure 3-50 Current derating as a function of the DC-link voltage

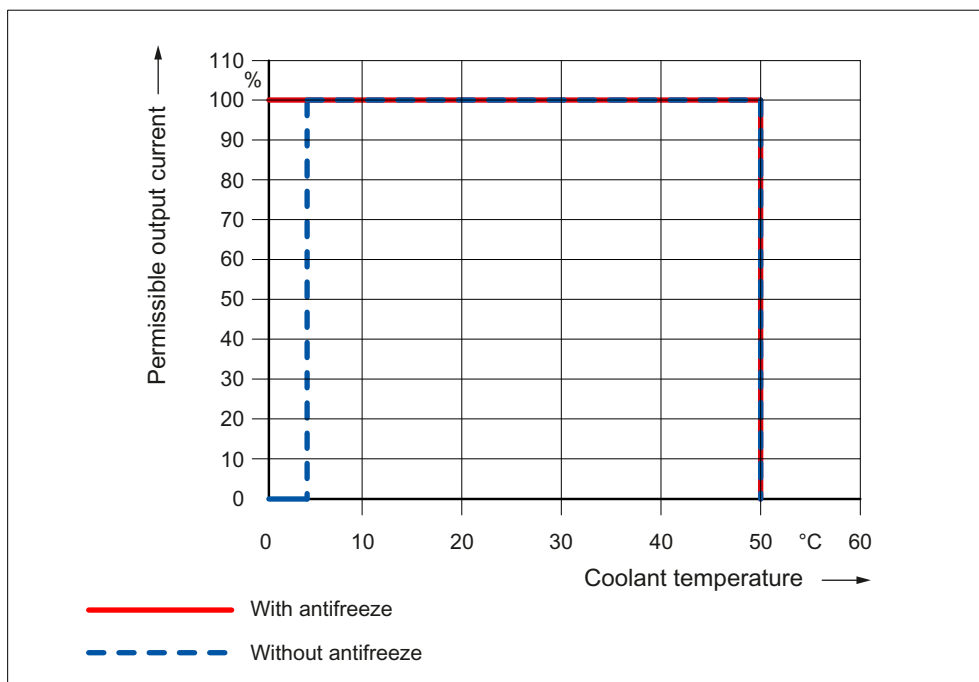


Figure 3-51 Current derating as a function of the ambient temperature

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

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

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

## DC link components

### 4.1 Braking resistors

#### 4.1.1 Description

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

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

#### 4.1.2 Safety information



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

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

The braking resistor must be protected against overheating. A thermostatic switch handles this protective function (included in the scope of supply of each braking resistor). There are two ways of using this thermostatic switch to protect the braking resistor.

**Connect the thermoswitch to a Control Unit**

Connect the thermoswitch to a free digital input of the Control Unit. If the braking resistor overheats, the Power Module is disconnected from the power supply. Then, the digital input must be assigned to enable deactivation using an OFF2 command.

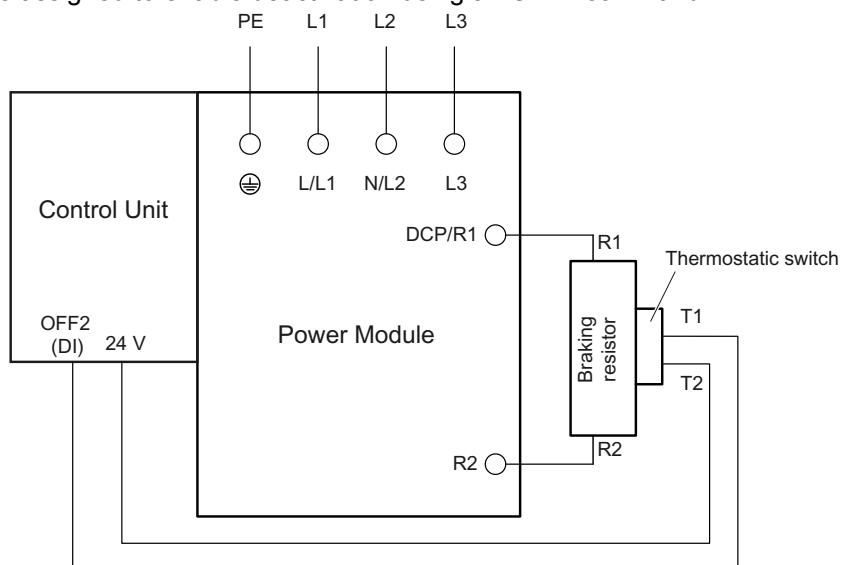


Figure 4-1 Connecting the thermoswitch on the braking resistor to a Control Unit

**Connect the thermoswitch to a contactor**

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

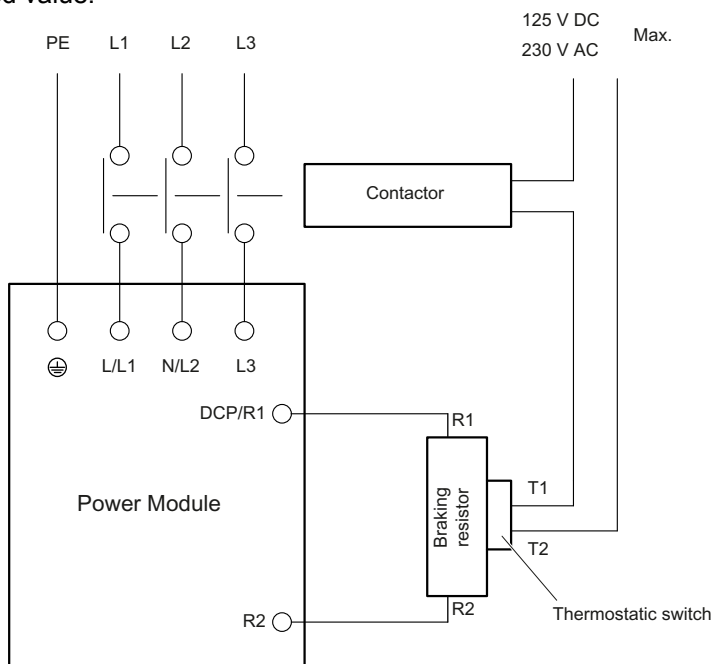


Figure 4-2 Connecting the thermoswitch on the braking resistor to a contactor



### 4.1.3 Dimension drawings

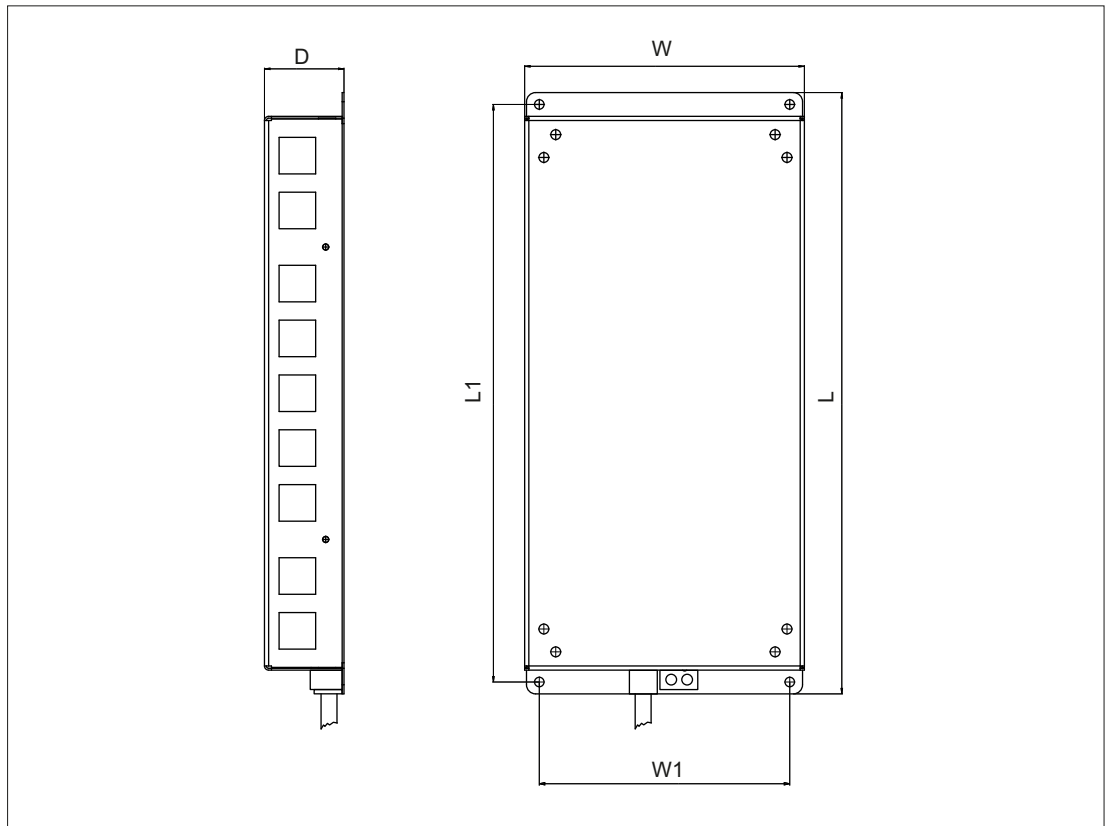


Figure 4-3 Dimension drawing of braking resistor, frame sizes FSA and FSB

DC link components

4.1 Braking resistors

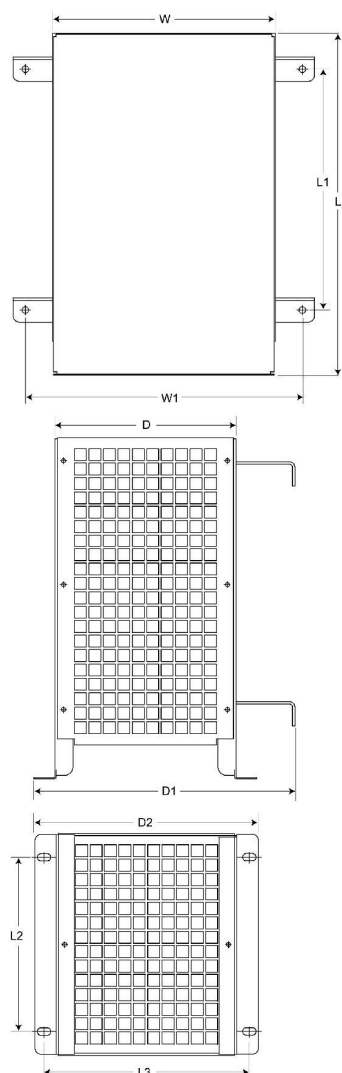


Figure 4-4 Dimension drawing of braking resistor, frame sizes FSC, FSD, FSE, FSF

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

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

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

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

#### 4.1.4 Mounting

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

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

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

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

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#### Note

##### PE connection

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

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DC link components

4.1 Braking resistors

4.1.5 Technical data

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

Order number		6SE6400-4BC05-0AA0	6SE6400-4BD11-0AA0	6SL3201-0BE12-0AA0	6SE6400-4BD16-5CA0
Suitable for Power Modules of frame size		FSA	FSA	FSB	FSC
Resistance	Ω	180	390	160	56
Unit rating P <sub>DB</sub>	kW	0.05	0.1	0.2	0.65
Peak power P <sub>max</sub>	kW	1	1.7	4.0	13
Load duration for peak power T <sub>a</sub>	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 <sup>2</sup> shielded, length 0.5m	Cable 3 x 2.5 mm <sup>2</sup> shielded, length 0.5 m	Cable 3 x 2.5 mm <sup>2</sup> shielded, length 0.4 m	Cable 3 x 2.5 mm <sup>2</sup> shielded, length 0.8 m
Thermoswitch (NC contact) maximum contact load connecting cable		250 V <sub>AC</sub> /2.5 A	250 V <sub>AC</sub> /2.5 A	250 V <sub>AC</sub> /2.5 A	250 V <sub>AC</sub> /2.5 A
Weight	kg	1.0	1.0	1.6	3.8

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

Order number		6SE6400-	4BD21-2DA0	4BD22-2EA0	4BD24-0FA0
Suitable for Power Modules of frame size			FSD	FSE	FSF
Resistance	Ω		27	15	8.2
Unit rating P <sub>DB</sub>	kW		1.2	2.2	4.0
Peak power P <sub>max</sub>	kW		24	44	80
Load duration for peak power T <sub>a</sub>	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 <sub>AC</sub> /2.5 A	250 V <sub>AC</sub> /2.5 A	250 V <sub>AC</sub> /2.5 A
Weight	kg		7.4	10.6	16.7

## Duty cycles

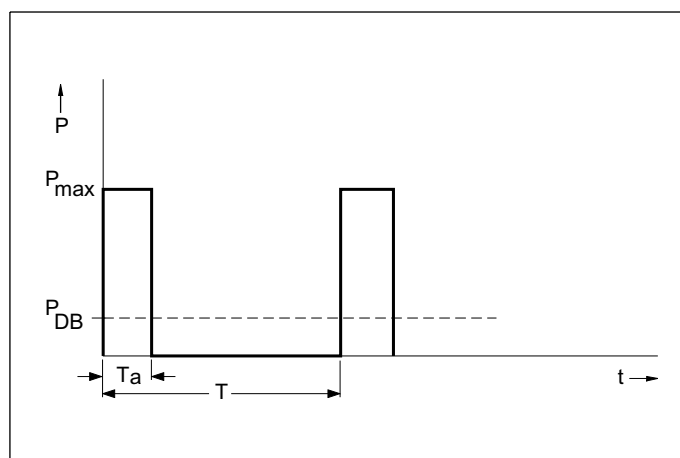


Figure 4-5 Load diagram for the braking resistor, in blocksize format

$T$  [s] period duration of braking duty cycle

$T_a$  [s] load duration for peak power

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

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

*DC link components*

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*4.1 Braking resistors*

## Motor-side power components


### 5.1 Motor reactors (blocksize)

#### 5.1.1 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.


#### 5.1.2 Safety information

 <b>WARNING</b>
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).

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

 <b>CAUTION</b>
The surface temperature of the motor reactors can exceed 80 °C.

<b>CAUTION</b>
The maximum permissible output frequency when motor reactors are used is 150 Hz.

<b>CAUTION</b>
The maximum permissible pulse frequency when motor reactors are used is 4 kHz.

### 5.1.3 Dimension drawings

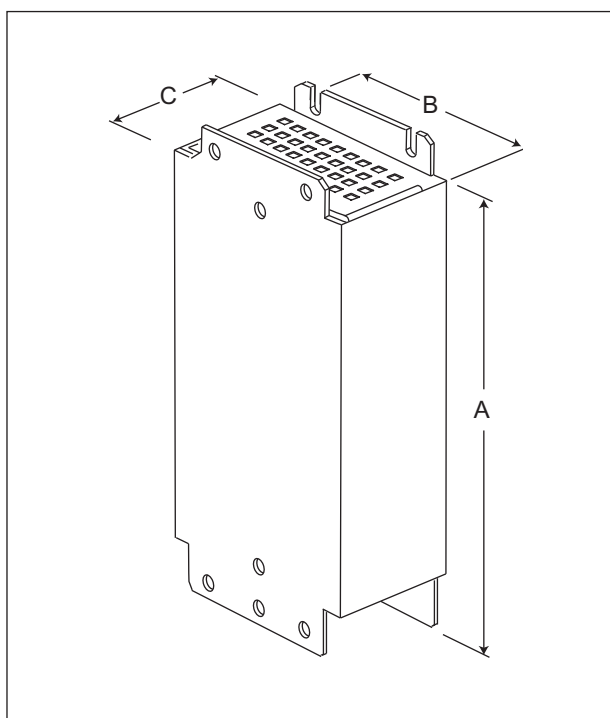


Figure 5-1 Dimension drawing: Motor reactor, frame size FSA

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

<b>Motor reactor</b>	<b>3TC00-4AD2</b>
<b>6SE6400-</b>	
<b>Frame size</b>	<b>FSA</b>
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)



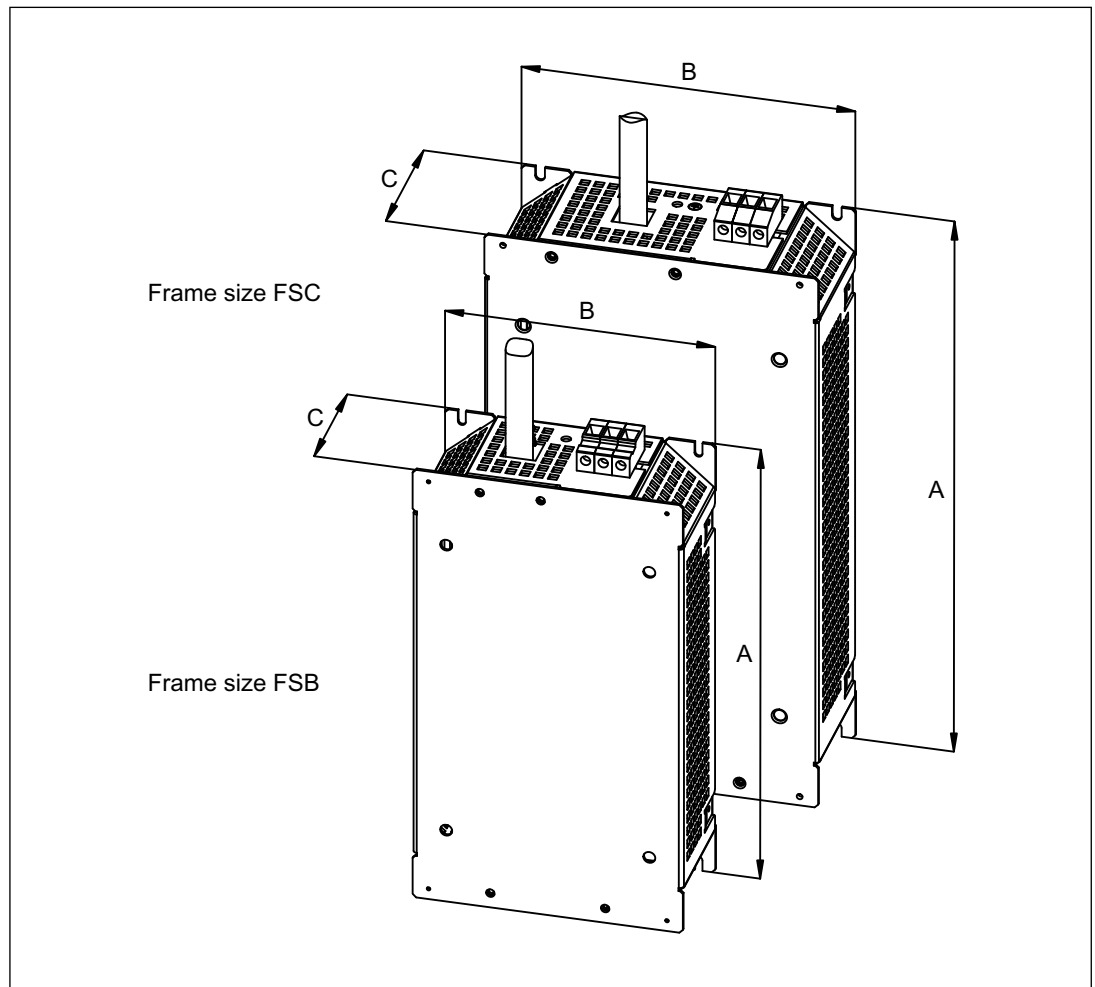


Figure 5-2 Dimension drawing: Motor reactor, frame sizes FSB and FSC

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

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

Motor-side power components

5.1 Motor reactors (blocksize)

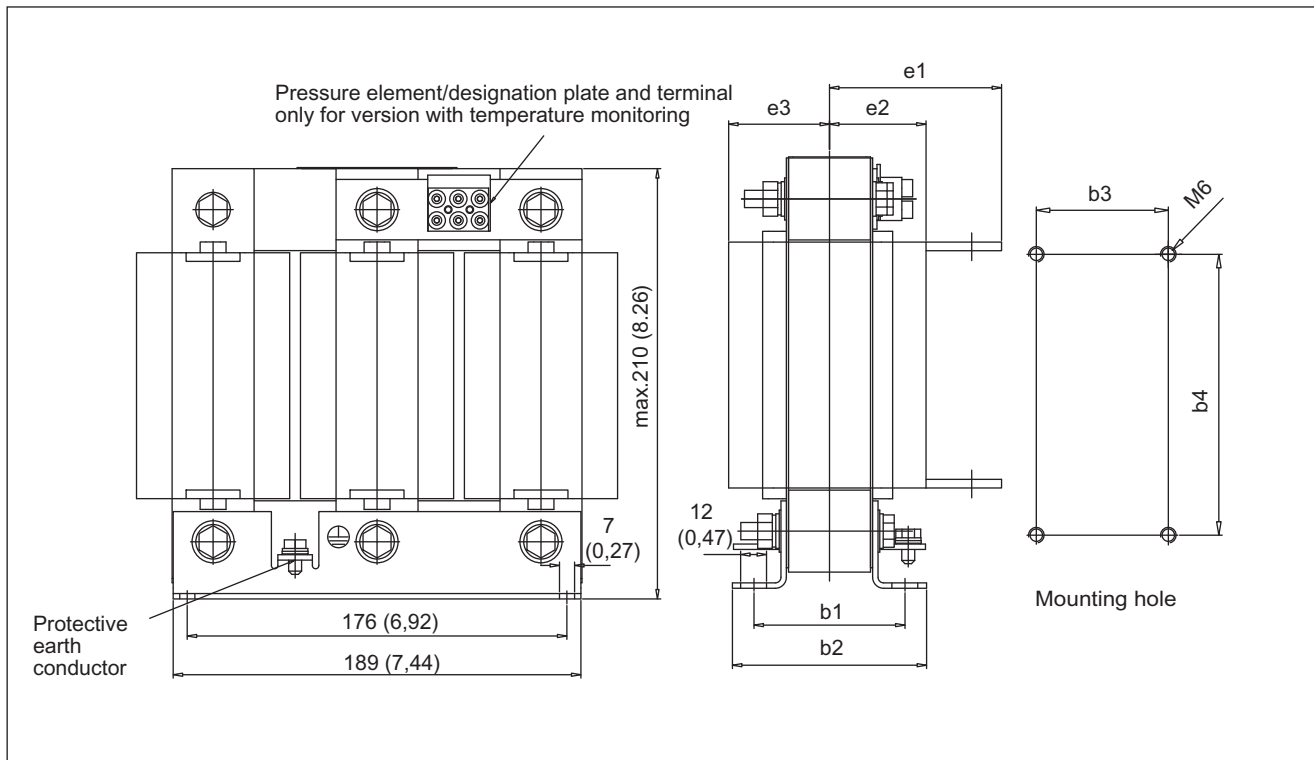


Figure 5-3 Dimension drawing: Motor reactor, frame size FSD

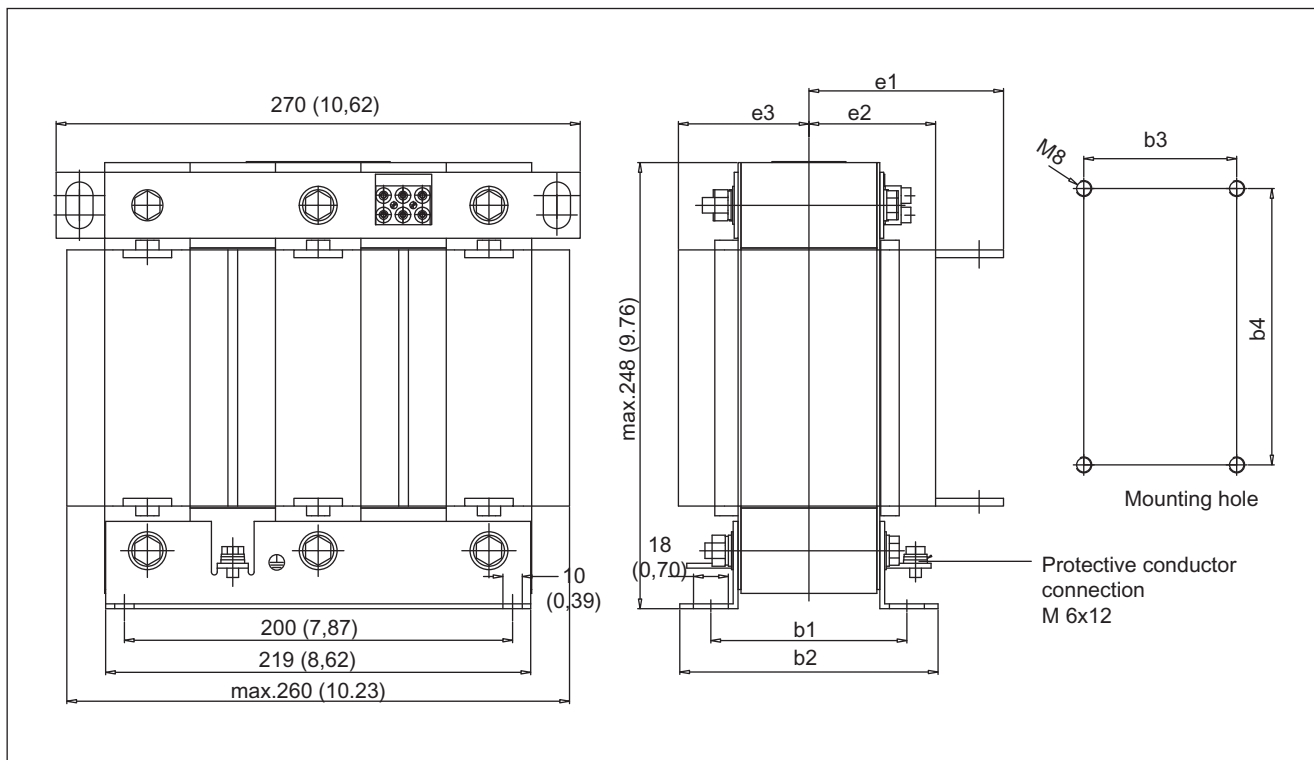


Figure 5-4 Dimension drawing: Motor reactor, frame size FSE

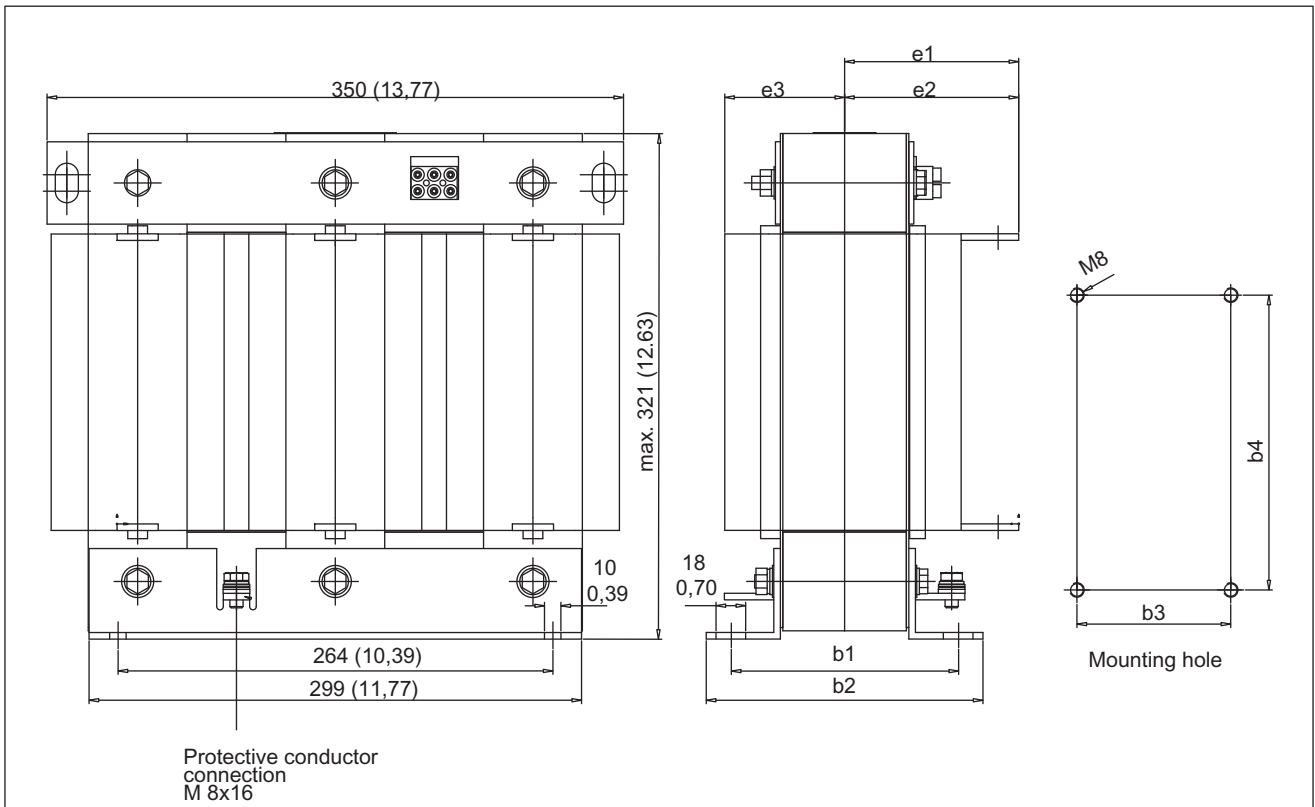


Figure 5-5 Dimension drawing: Motor reactor, frame size FSF

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)	-

*Motor-side power components*

*5.1 Motor reactors (blocksize)*

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)	-

## 5.1.4 Mounting

### Note

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

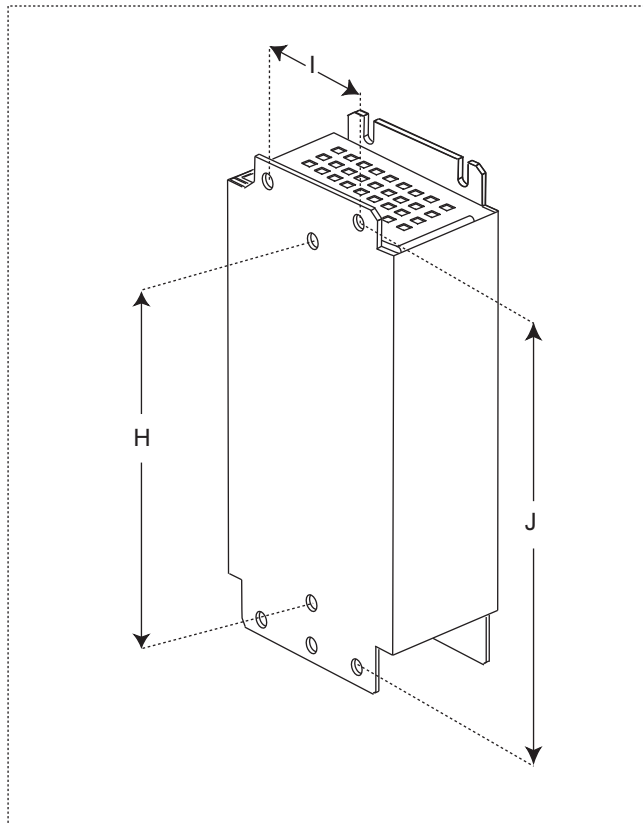


Figure 5-6 Mounting dimensions of motor reactor, frame size FSA

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

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

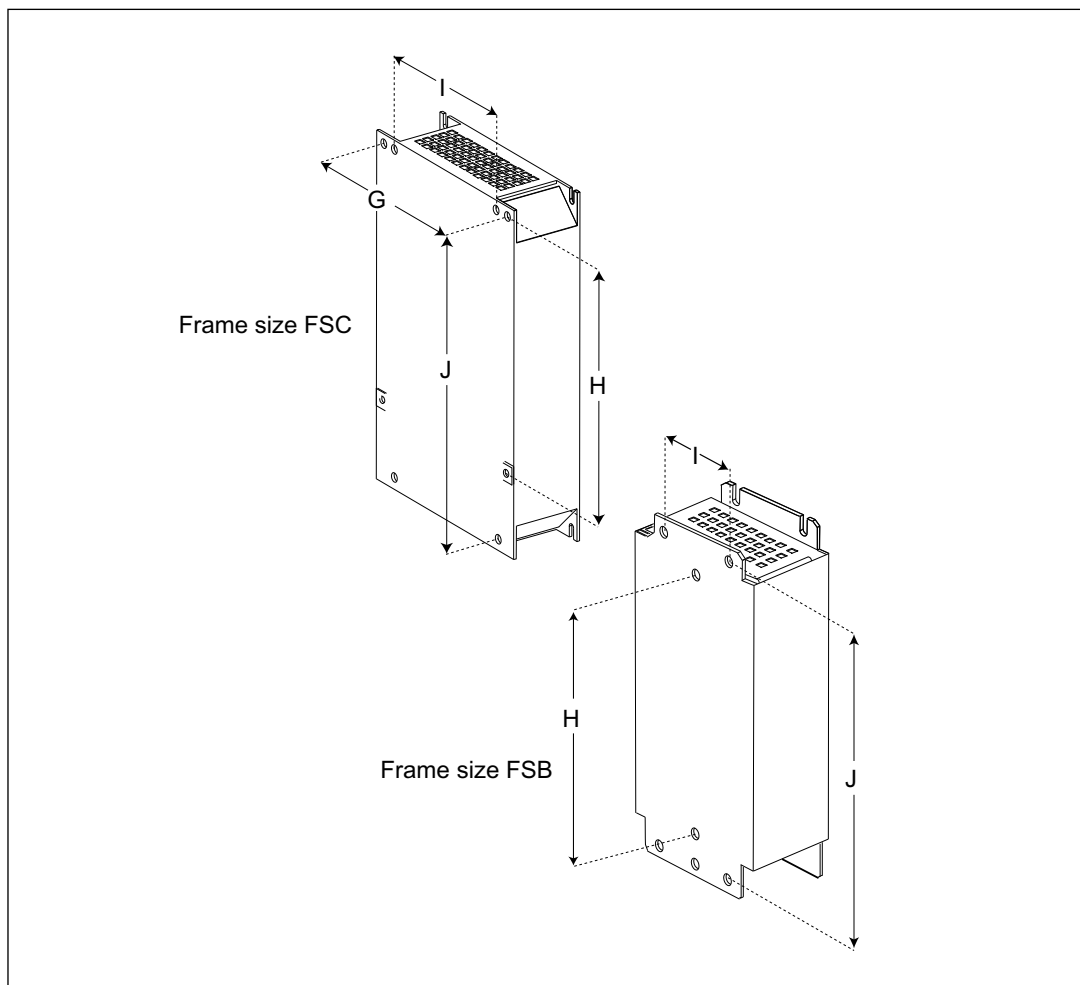


Figure 5-7 Mounting dimensions of motor reactors, frame sizes FSB and FSC

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

Motor reactor	6SL3202-	0AE21-0CA0	0AJ23-2CA0
Frame size		FSB	FSC
Power Module	G	138 (5.43)	174 (6.85)
	H	174 (6.85)	204 (8.03)
Mounting surface	I	120 (4.72)	156 (6.14)
	J	200 (7.87)	232 (9.13)
Fixing screw		M4	M5

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

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

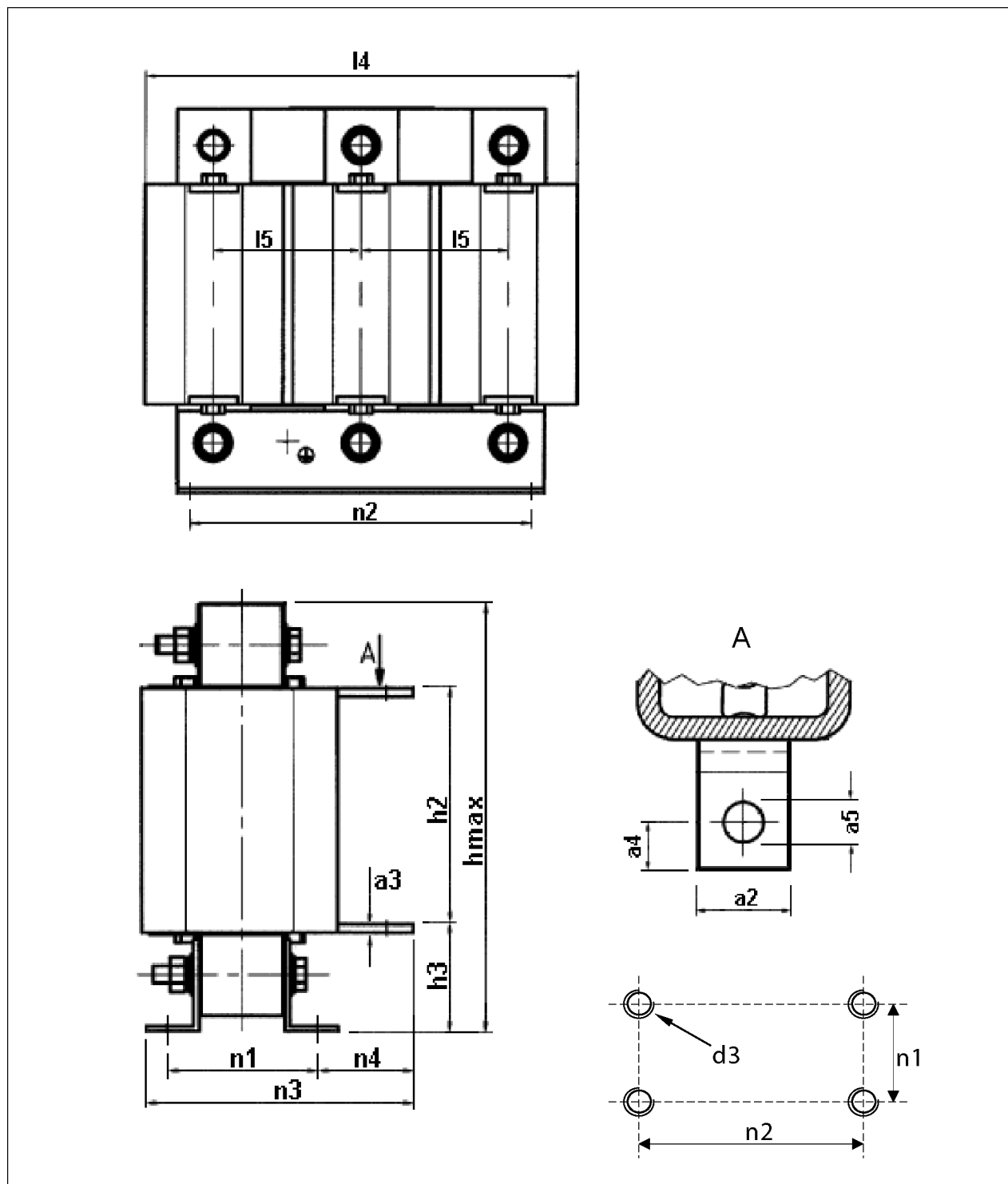


Figure 5-8 Mounting dimensions of motor reactors, frame sizes FSD, FSE, FSF



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

Motor reactor	6SE6400-	3TC05-4DD0	3TC03-8DD0	3TC07-5ED0	3TC08-0ED0
Frame size		FSD	FSD	FSE	FSE
Motor reactor	a2	20 (0.78)	20 (0.78)	20 (0.78)	20 (0.78)
	a3	4 (0.15)	4 (0.15)	4 (0.15)	4 (0.15)
	a4	10 (0.39)	10 (0.39)	10 (0.39)	10 (0.39)
	a5	∅6 (0.23)	∅6 (0.23)	∅7 (0.27)	∅7
	l4	225 (8.85)	225 (8.85)	270 (10.62)	225 (8.85)
	l5	76 ±5 (2.99 ±0.19)	76 ±5 (2.99 ±0.19)	88 ±5 (3.46 ±0.19)	76 ±5 (2.99 ±0.19)
	hmax	210 (8.26)	210 (8.26)	248 (9.76)	210 (8.26)
	h2	120 ±2 (4.72 ±0.07)	120 ±2 (4.72 ±0.07)	140 ±2 (5.51 ±0.07)	120 ±2 (4.72 ±0.07)
	h3	45 ±2 (1.77 ±0.07)	45 ±2 (1.77 ±0.07)	50 ±2 (1.96 ±0.07)	45 ±2 (1.77 ±0.07)
	n1	70 (2.75)	94 (3.70)	101 (3.97)	70 (2.75)
	n2	176 (6.88)	176 (6.88)	200 (7.87)	176 (6.88)
	n3	max. 140 (5.51)	max. 164	max. 187.5 (7.38)	max. 140 (5.51)
	n4	54 ±2 (2.12 ±0.07)	54 ±2 (2.12 ±0.07)	68.5 ±2 (2.69 ±0.07)	54 ±2 (2.12 ±0.07)
		d3	M6	M6	M8
	PE	M6	M6	M6	M6
Tightening torque [Nm]		3.5-4.0	3.5-4.0	9.5-10.0 3.5-4.0	3.5-4.0

Table 5- 8 Mounting dimensions of motor reactor, frame size FSF, all data in mm and (inches)

Motor reactor	6SE6400-	3TC14-5FD0	3TC15-4FD0
Frame size		FSF	FSF
Motor reactor	a2	20 (0.78)	20 (0.78)
	a3	4 (0.15)	4 (0.15)
	a4	10 (0.39)	10 (0.39)
	a5	∅9 (0.35)	∅9 (0.35)
	l4	357 (14.05)	270 (10.62)
	l5	120 ±5 (4.72 ±0.19)	88 ±5 (3.46 ±0.19)
	hmax	321 (12.63)	248 (9.76)
	h2	185 ±2 (7.28 ±0.07)	140 ±2 (5.51 ±0.07)
	h3	60 ±2 (2.36 ±0.07)	50 ±2 (1.96 ±0.07)
	n1	138 (5.43)	101 (3.97)
	n2	264 (10.39)	200 (7.87)
	n3	max. 220.5 (8.68)	max. 187.5 (7.38)
	n4	65.5 ±2 (2.57 ±0.07)	68.5 ±2 (2.69 ±0.07)
		d3	M8
	PE	M8	M6
Tightening torque [Nm]		9.5-10.0	9.5-10.0 3.5-4.0

### Mounting Power Modules and motor reactors

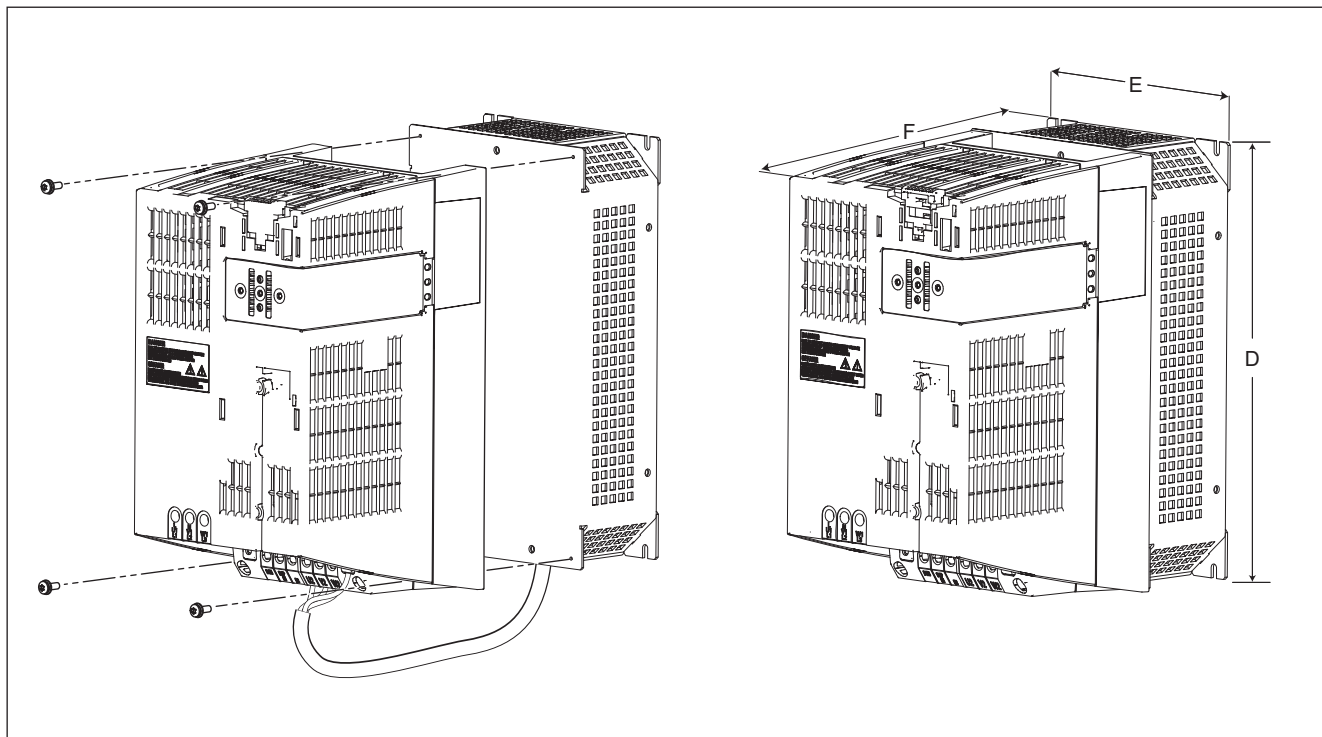


Figure 5-9 Mounting Power Modules and motor reactors, frame sizes FSB and FSC

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

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

### 5.1.5 Electrical connection

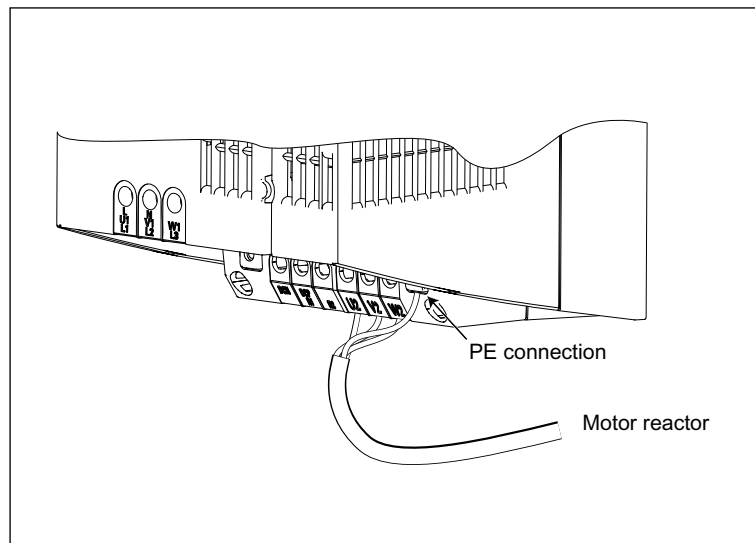


Figure 5-10 Electrical connection

Motor-side power components

5.1 Motor reactors (blocksize)

5.1.6 Technical data

Table 5- 10 Motor reactors for Power Modules 3-ph. 380 V to 480 V AC, frame size FSA

		Motor reactor (for a 4 kHz pulse frequency)				
Order number		6SE6400-3TC00-4AD2				
Frame size		FSA	FSA	FSA	FSA	FSA
Suitable for Power Module		6SL3210-1SE11-3UA0	6SL3210-1SE11-7UA0	6SL3210-1SE12-2UA0	6SL3210-1SE13-1UA0	6SL3210-1SE14-1UA0
Rated current	A	4.5				
Power loss	kW	0.005				
Connection to the Power Module		Cable 4 x 1.5 mm <sup>2</sup> Length approx. 0.3 m				
Motor connection		Screw terminals for cable cross-section 6 mm <sup>2</sup>				
PE connection		M5 stud				
Max. permissible cable length between motor reactor and motor	m	100 (shielded) 150 (unshielded)			100 (shielded) 225 (unshielded)	
Degree of protection		IP20 or IPXXB				
Weight, approx.	kg	2				
Rated current I <sub>rated</sub> of the Power Module	A	1.3	1.7	2.2	3.1	4.1

Table 5- 11 Motor reactors for Power Modules 3-ph. 380 V to 480 V AC, frame sizes FSB and FSC

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

Table 5- 12 Motor reactors for Power Modules 3-ph. 380 V to 480 V AC, frame sizes FSD and FSE

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

Table 5- 13 Motor reactors for Power Modules 3-ph. 380 V to 480 V AC, frame size FSF

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

*Motor-side power components*

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*5.1 Motor reactors (blocksize)*

## CU305 Control Units

### 6.1 Description

The Control Units

- CU305 PN (PROFINET)
- CU305 DP (PROFIBUS)
- CU305 CAN

are components in which the open-loop and closed-loop control functions for a drive are implemented.

The table below shows an overview of the interfaces of the CU305 Control Units.

Table 6- 1 Number of interface for CU305 PN/CU305 DP/CU305 CAN

Type	CU305 PN	CU305 DP	CU305 CAN
Digital inputs/outputs <sup>1)</sup>	4	4	4
Digital inputs, electrically isolated	5	5	5
Failsafe digital inputs (F-DI) <sup>2)</sup>	3	3	3
Analog input	1	1	1
Failsafe digital output (F-DO) <sup>3)</sup>	1	1	1
DRIVE-CLiQ interface	1	1	1
PROFINET interface	2	--	--
PROFIBUS interface	--	1	--
CAN interface	--	--	1
Serial interface (RS232)	1	1	1
Power Module Interface (PM-IF)	1	1	1
Encoder interface (HTL/TTL/SSI)	1	1	1
Motor temperature sensor input	1	1	1
24 V electronics power supply	1	1	1
Test sockets	2	2	2
Interface for BOP	1	1	1

1) The bidirectional inputs are designed as "rapid inputs" and can be used for BEROs (3-core) or measuring probes.

2) If the safety functions of the Control Unit are not being used, the failsafe digital inputs can be used as 6 additional electrically isolated digital inputs.

3) If the safety functions of the Control Unit are not being used, the failsafe digital input can be used as 1 additional electrically isolated digital input.

**Note**

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

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

**Interface overview classified according to terminal**

Terminal	CU305 PN	CU305 DP	CU305 CAN
Specific interfaces			
X150 P1 / X150 P2	PROFINET	-	-
X126	-	PROFIBUS	CAN
Identical interfaces			
X100	DRIVE-CLiQ		
X124	Electronics power supply		
X130	Failsafe digital inputs		
X131	Failsafe digital inputs/outputs		
X132	Digital inputs/outputs, analog input		
X133	Digital inputs, motor temperature sensor input		
X23	Encoder interface (HTL/TTL/SSI)		
X22	Serial interface (RS232)		
X520 / X521 / X522	Test sockets		



## 6.2 Safety information

 <b>WARNING</b>
--

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.
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## 6.3 Interfaces

### 6.3.1 CU305 PN (PROFINET)

#### 6.3.1.1 Overview CU305 PN

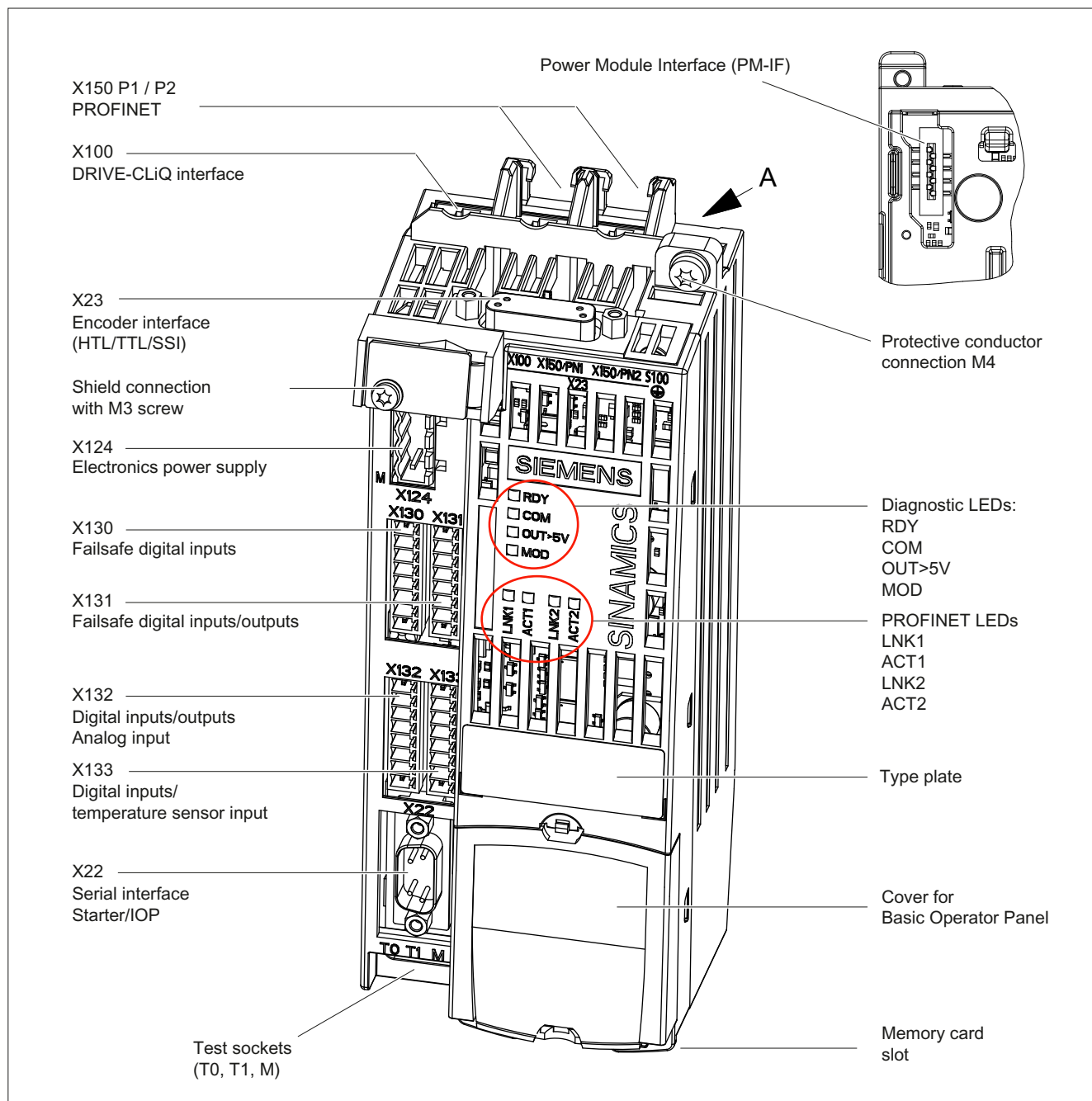


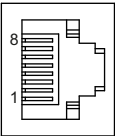
Figure 6-1 Interface overview for CU305 PN

**Note**

The address switches, which are located beneath the cover for the Basic Operator Panel BOP, have no function for the CU305 PN.

**6.3.1.2 X150 P1 / P2 PROFINET**

Table 6- 2 X150 P1 and X150 P2 PROFINET

	Pin	Signal name	Technical specifications
	1	RXP	Receive data +
	2	RXN	Receive data -
	3	TXP	Transmit data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	TXN	Transmit data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
Connector type:	RJ45 socket		
Data rate:	100 Mbits or 10 Mbits		

**Note**

The PROFINET interfaces support Auto MDI(X). It is therefore possible to use both crossed and uncrossed cables to connect the devices.

There are four LEDs on the front panel of the CU305 PN to display status information about the PROFINET interfaces (see section: "Interface overview", Figure: "CU305 PN interface overview").

The table shows the status information these indicate.

Table 6- 3 LED states on the X150 P1/P2 PROFINET interface

LED	Color	Status	Description
LNKx	-	OFF	Missing or faulty link
	Green	0.5 Hz flashing light	Connection establishment
		Continuous	10 or 100 Mbit link available
ACTx	-	OFF	No activity
	Yellow	Flashing light	Sending or receiving data to/from port x

6.3.2 CU305 DP (PROFIBUS)

6.3.2.1 Overview CU305 DP

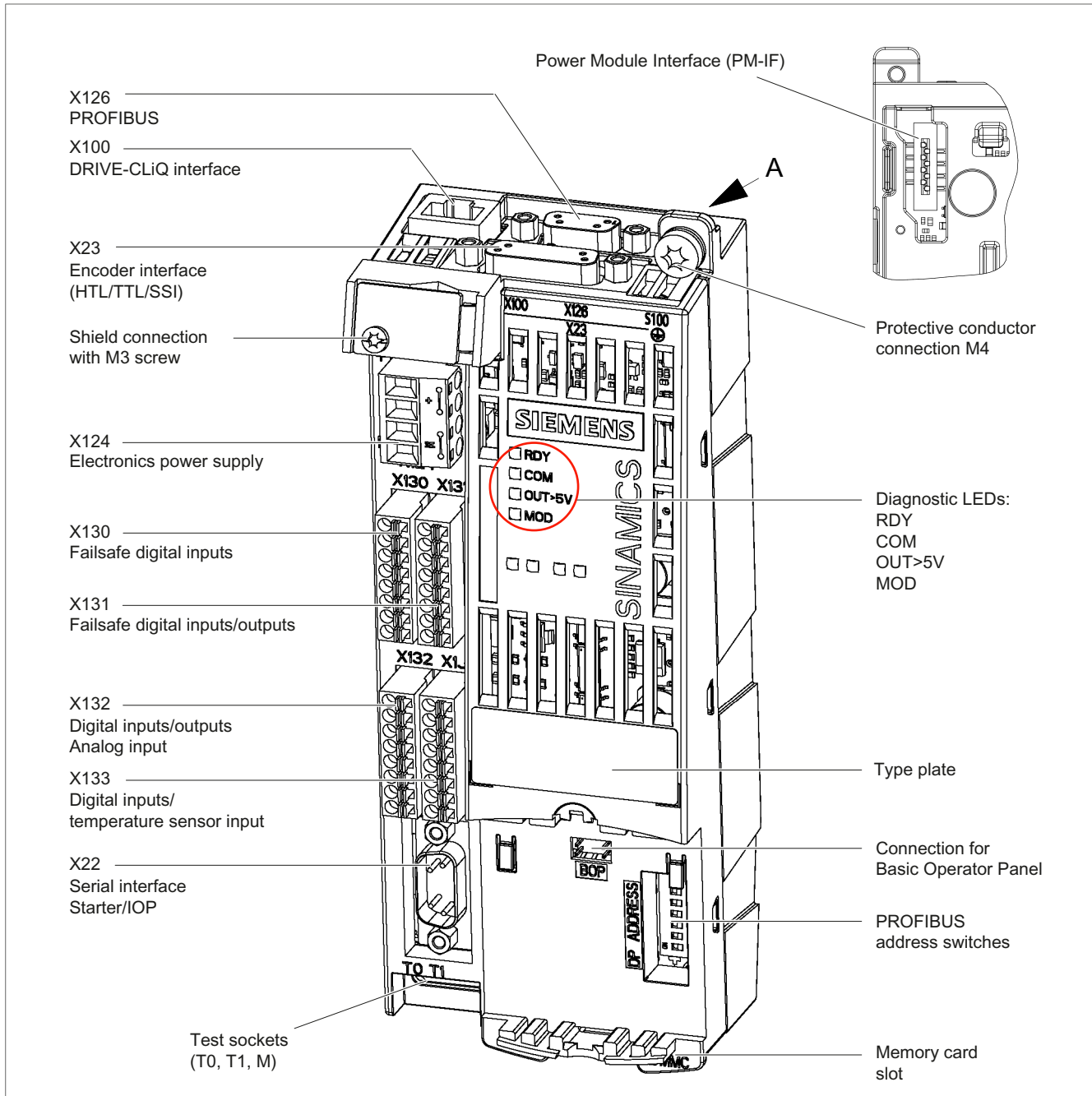
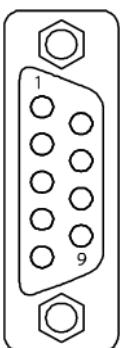


Figure 6-2 Description of the CU305 DP interfaces (ports)

### 6.3.2.2 X126 PROFIBUS/USS interface

Table 6- 4 X126 PROFIBUS/USS interface

	Pin	Signal name	Technical specifications
	1	Reserved, do not use	
	2	M	Ground to P24_SERV
	3	1RS_DP	RS485 differential signal
	4	1RTS_DP	Request To Send
	5	1M	Ground to 1P5
	6	1P5	5 V power supply for bus terminal, external, short circuit-proof
	7	P24_SERV	24 V for teleservice, short circuit-proof, 150 mA max.
	8	1XRS_DP	RS485 differential signal
	9	Reserved, do not use	

Type: 9-pin SUB D socket

**⚠ CAUTION**

No CAN cables may be connected to the X126 interface. If CAN cables are connected, the CU305 DP and other CAN bus nodes could be seriously damaged.

#### Communication with USS protocol via RS485

Interface X126 can also be used for communication with USS involving up to 32 nodes. The software in the STARTER is used to change the PROFIBUS factory setting to USS. During operation as a USS interface, only terminals 3, 5, and 8 are used.

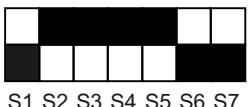
Please refer to the SINAMICS S110 Function Manual for information on configuration.

### 6.3.2.3 PROFIBUS/USS address switch

With the CU305 DP, the address switch can be used to set both PROFIBUS addresses and USS addresses. Operation via USS is only possible if the factory setting in the STARTER of PROFIBUS is changed to USS.

The factory setting for the address switch is 0 or 127. The address switch is located behind the blanking plate. The blanking plate is part of the scope of supply.

Table 6- 5 PROFIBUS/USS address switch

Technical specifications	Switch	Significance
<p>Significance: <math>2^0</math> <math>2^1</math> <math>2^2</math> <math>2^3</math> <math>2^4</math> <math>2^5</math> <math>2^6</math>            1 2 4 8 16 32 64</p>  <p>S1 S2 S3 S4 S5 S6 S7</p> <p>ON OFF</p> <p>Example: <math>2 + 4 + 8 + 16 = 30</math>            PROFIBUS/USS address = 30</p>	S1	$2^0 = 1$
	S2	$2^1 = 2$
	S3	$2^2 = 4$
	S4	$2^3 = 8$
	S5	$2^4 = 16$
	S6	$2^5 = 32$
	S7	$2^6 = 64$

#### Setting the PROFIBUS address

1. Setting via parameter p0918
  - The STARTER is used to set the bus address for a PROFIBUS node to a value between 1 and 126. This is only possible if the address switch is set to 0 or 127 (factory setting).
2. Manual setting
  - The address switch (DIP switch) is used to manually set the bus address to a value between 1 and 126. In this case, p0918 is only used to read the address.

#### Setting the USS address

1. Setting via parameter p2021
  - The STARTER is also used to set the bus address for USS nodes to a value between 0 and 30. This is only possible if the address switch is set to 0 or 127 (factory setting).
2. Manual setting
  - The address switch (DIP switch) is used to manually set the address to a value between 0 and 30. If addresses are set manually to values >30, the setting will revert to the value set in parameter p2021 or the default value.

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#### Note

A value of 0 is used as the address for USS if no other address has been saved in parameter p2021.

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### 6.3.3 CU305 CAN

#### 6.3.3.1 Overview CU305 CAN

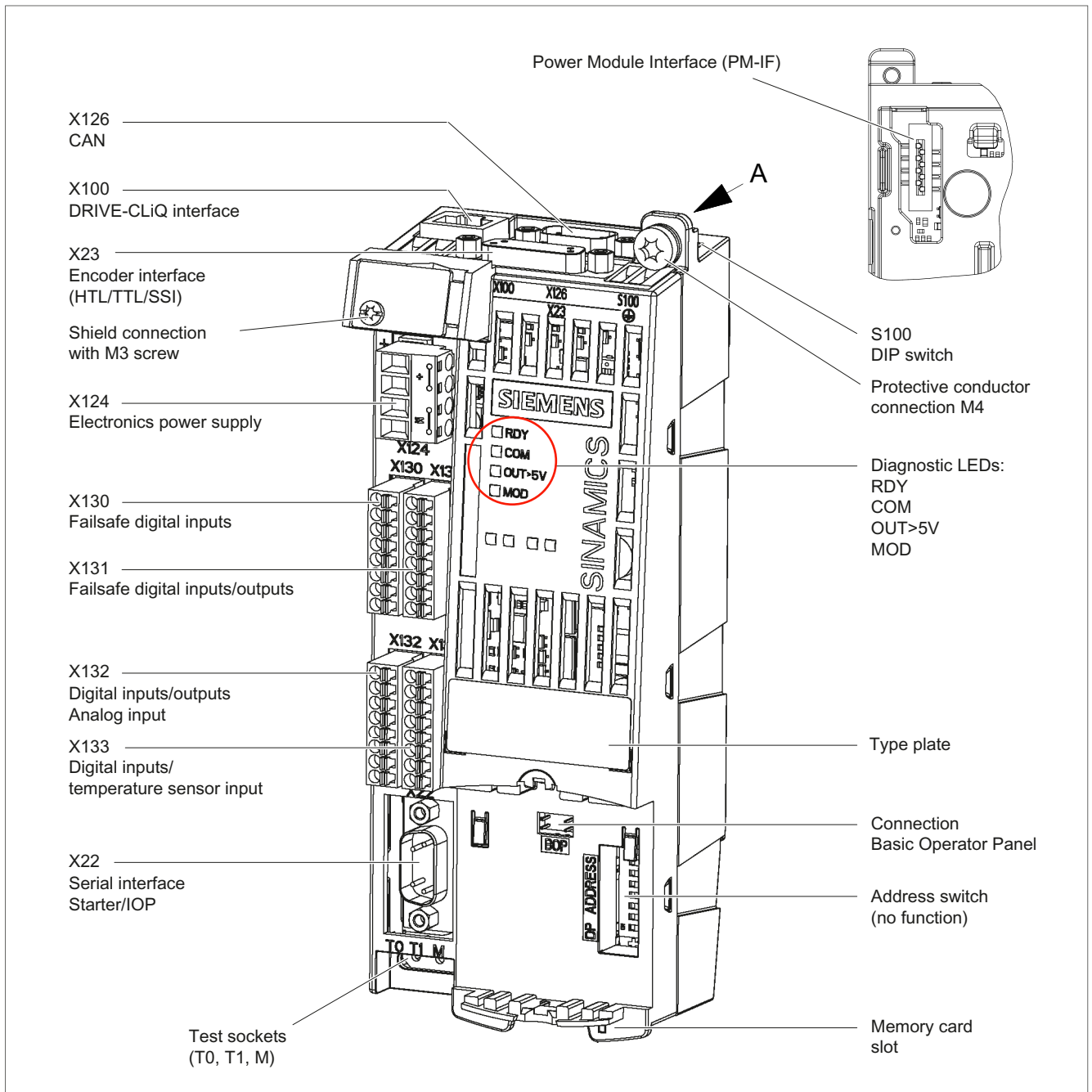
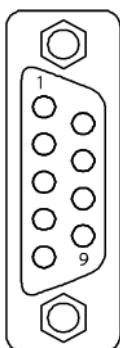



Figure 6-3 Interface description CU305 CAN

### 6.3.3.2 X126 CAN interface

Table 6- 6 X126 CAN interface

	Pin	Signal name	Technical specifications
	1	Reserved, do not use	
	2	CAN_L	CAN signal
	3	CAN_GND	CAN ground
	4	Reserved, do not use	
	5	CAN_SHL	Optional shield
	6	CAN_GND	CAN ground
	7	CAN_H	CAN signal
	8	Reserved, do not use	
	9	Reserved, do not use	

Type: 9-pin SUB D socket

 <b>CAUTION</b>
<p>If the CAN interface is connected to the PROFIBUS connector, then this can destroy the CAN interface.</p>

### 6.3.3.3 S100 DIP switch

Table 6- 7 DIP switch

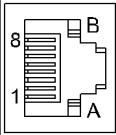
Switch	Function	Switch setting		Default
2	Bus terminating resistor 120 Ohm	Off	Inactive	Off
		On	Active	
1	Ungrounded, grounded operation	Off	Ground-free operation	Off
		On	Operation with ground	



## 6.3.4 Common interfaces for CU305 PN/DP/CAN

### 6.3.4.1 X100 DRIVE-CLiQ interface

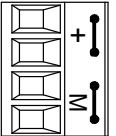
Table 6- 8 DRIVE-CLiQ interface

	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)	Electronics ground

Connector type: RJ45 socket; blanking plate for DRIVE-CLiQ interface included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0  
The maximum DRIVE-CLiQ cable length is 100 m.

### 6.3.4.2 Electronics power supply X124

Table 6- 9 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 (incl. 0.35A for HTL encoders, without DRIVE-CLiQ and digital outputs) Max. current via jumper in connector: 20 A
	+	Electronics power supply	
	M	Electronic ground	
	M	Electronic ground	

Max. connectable cross-section: 2.5 mm<sup>2</sup>  
Type: Screw-type terminal (see Appendix A)

#### Note

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

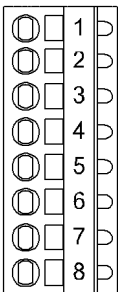
**Note**

An additional external electronics power supply via terminal X124 is required in two cases:

- If the digital outputs DO 8 to DO 11 are in use, the power supply needs to be connected to X124.
- The electronics power supply to the CU305 is supplied using the Power Module. If the CU305 needs to remain functional when the Power Module is switched off, the power supply needs to be connected to X124.

**6.3.4.3 X130 failsafe digital inputs**

Table 6- 10 Terminal block X130

	Terminal	Designation	Technical specifications
	1	DI 16	Input characteristics in accordance with IEC61131-2, Type 1
	2	DI 17+	
	3	DI 17-	
	4	DI 18	Typical current consumption: 6 mA at 24 V DC Electrical isolation: The reference potential is terminal M1
	5	DI 19+	
	6	DI 19-	Permissible level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V
	7	24 V1	Additional external power supply for connecting DI 16/DI 18 to ground M1. See also "Example of circuits for the F-DI/F-DO..." in the chapter titled "Example connections".
	8	M1	Reference potential for the failsafe digital inputs/outputs
<p>An F-DI consists of one digital input and a second digital input where the cathode of the optocoupler is also fed out.                      F-DI 0 = terminals 1, 2, and 3 (DI 16, DI 17+, and DI 17-)                      F-DI 1 = terminals 4, 5, and 6 (DI 18, DI 19+, and DI 19-)</p>			
<p>Max. connectable cross-section: 1.5 mm<sup>2</sup>                      Type: Spring-loaded terminal 1 (see Appendix A)</p>			

1) DI: Digital input; F-DI: Failsafe digital input

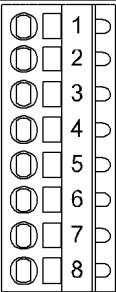
<b>NOTICE</b>
An open input is interpreted as "low".

**Note**

If M1 is connected to M (X124 or X132), the system is no longer electrically isolated.

## 6.3.4.4 X131 failsafe digital inputs/outputs

Table 6- 11 Terminal block X131

	Terminal	Designation <sup>1)</sup>	Technical specifications
	1	DI 20	Input characteristics in accordance with IEC61131-2, Type 1
	2	DI 21+	
	3	DI 21-	
	4	DI 22	Typical current consumption: 6 mA at 24 V DC Electrical isolation: The reference potential is terminal M1
	5	DO 16+	Permissible level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V
	6	DO 16-	
	7	24 V1	Maximum load current: 500 mA Max. leakage current: 0.5 mA Short-circuit protected load types: resistive, capacitive, inductive Switching frequency: For inductive load: Max. 0.5 Hz Maximum lamp load: 2 W DO 16+: Current sourcing DO 16-: Sink output
	8	M1	Additional external power supply for DO 16+, terminal X131/5. See also "Example of circuits for the F-DI/F-DO..." in the chapter titled "Example connections".
			Reference potential for the failsafe digital inputs/ outputs
<p>An F-DI consists of one digital input and a second digital input where the cathode of the optocoupler is also fed out. The F-DO consists of two digital outputs connected to an external 24 V power supply. F-DI 2 = terminals 1, 2, and 3 (DI 20, DI 21+, and DI 21-) F-DO 0 = terminals 5 and 6 (DO 16+ and DO 16-)</p>			
<p>Max. connectable cross-section: 1.5 mm<sup>2</sup> Type: Spring-loaded terminal 1 (see Appendix A)</p>			

1) DI: digital input, DO: Digital output; F-DI: Failsafe digital input; (F-DO) Failsafe digital output

**Note**

The failsafe digital output (DO 16+, DO 16-) switches off retentively in the event of a short-circuit.

6.3.4.5 X132 Digital inputs/outputs, analog input

Table 6- 12 Terminal block X132

	Terminal	Designation <sup>1)</sup>	Technical specifications
	1	DI/DO 8	<b>As input:</b> input characteristics in accordance with IEC 61131-2, Type 1 All digital inputs are floating. The reference potential is M. Typical current consumption: 7 mA at 24 V DC Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V DI 8, 9, 10, and 11 are "rapid inputs" <sup>2)</sup> Signal propagation times: For "0" → "1": 4 μs For "1" → "0": approx. 4 μs <b>As output:</b> Maximum load current: 100 mA Max. leakage current: 0.5 mA Short-circuit protected, automatic restart after short-circuit Load types: Resistive, capacitive, inductive Switching frequency: For inductive load: Max. 0.5 Hz Maximum lamp load: 2 W
	2	DI/DO 9	
	3	DI/DO 10	
	4	DI/DO 11	
	5	M	Reference potential for the digital inputs/outputs and the analog input
	6	M	
	7	AI +	Differential input voltage: -10 to +10 V, maximum resolvable range: -11 to +11 V Common mode range: -15 V to +15 V Resolution 13 bits
	8	AI -	
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Spring-loaded terminal 1 (see Appendix A)			

1) DI/DO: bidirectional digital input/output, AI: analog input; M: Electronic ground

2) The rapid inputs can be used as probe inputs or as inputs for the external zero mark

<b>CAUTION</b>
The common mode range may not be violated. This means that the analog differential voltage signals can have a maximum offset voltage of +/- 15 V with respect to the reference potential. If the range is violated, incorrect results may occur during analog/digital conversion.

<b>NOTICE</b>
An open input is interpreted as "low".

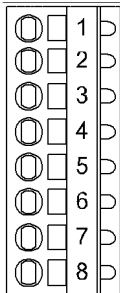
**Note**

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.

**6.3.4.6 X133 digital inputs, motor temperature sensor input**

Table 6- 13 Terminal block X133

	Terminal	Designation <sup>1)</sup>	Technical specifications
	1	DI 0	Input characteristics in accordance with IEC61131-2, Type 1 Typical current consumption: 6 mA at 24 V DC Electrical isolation: The reference potential is terminal M2. Permissible 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	M2	Reference potential M2
	6	M2	
	7	+ Temp	Motor temperature measurement KTY84-1C130 (KTY+) Temperature sensor connection KTY84-1C130 / PTC
	8	M (- Temp)	Ground for KTY or PTC
Max. connectable cross-section: 1.5 mm <sup>2</sup> Type: Spring-loaded terminal 1 (see Appendix A)			

1) DI: Digital input

**NOTICE**

An open input is interpreted as "low".

**NOTICE**

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

**Note**

There are two ways of connecting the temperature sensor:

1. via X133, terminal 7 and 8
2. via X23, pin 1 and 8

However, only one temperature sensor may be connected as otherwise the parallel circuit will be recorded and incorrect temperature values will be generated.

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

### 6.3.4.7 X23 HTL/TTL/SSI encoder interface

Table 6- 14 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	Ground for encoder power supply
	8	M (- Temp)	Ground for KTY or PTC
	9	M_Sense	Ground sense input
	10	RP	R track positive
	11	RN	R track negative
	12	BN	B track negative
	13	BP	B track positive
	14	AN_SSI_XDAT	A track negative / SSI data negative
	15	AP_SSI_DAT	A track positive / SSI data positive

Type: 15-pin sub D connector

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

**Note**

There are two ways of connecting the temperature sensor:

1. via X133, terminal 7 and 8
2. via X23, pin 1 and 8

However, only one temperature sensor may be connected as otherwise the parallel circuit will be recorded and incorrect temperature values will be generated.

**Note**

**We recommend that bipolar encoders are used.**

When using unipolar encoders the unused negative track signals can either be left unconnected or connected to ground. This results in two different operating points.

Table 6- 15 Specification, measuring systems that can be connected

Parameter	Designation	Threshold	Min.	Type	Max.	Unit
Permissible signal level in bipolar mode (parameter p0405.1=1); (TTL, SSI, HTL bipolar at X23) <sup>1)2)</sup>	$U_{diff}$		2.0		Vcc	V
Permissible signal frequency	$f_s$		-		500	kHz
Required edge clearance	$t_{min}$		100		-	ns
Permissible zero pulse (with $T_s = 1/f_s$ )	Length		$\frac{1}{4} \cdot T_s$		$\frac{3}{4} \cdot T_s$	
	Center of the pulse position		50	135	220	Degrees
Operating point in unipolar mode (parameter p0405.0=0) and signals AN_SSI_XDAT, BN, RN at X23 connected to M_Encoder	$U_{(Switch)}$	High (p0405.4=1)	8.4	10.6	13.1	V
		Low (p0405.4=0)	3.5	4.8	6.3	V
Operating points in unipolar mode (parameter p0405.0=0) and signals AN_SSI_XDAT, BN, RN not connected to X23	$U_{(Switch)}$	High (p0405.4=1)	9	11.3	13.8	V
		Low (p0405.4=0)	5.9	7.9	10.2	V

1) Other signal levels according to the RS422 specification

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

**NOTICE****Prefabricated cable for 5 V - TTL encoder**

If a 5 V - TTL encoder (6FX encoder) is used, the connecting cable 6FX8002-2CR00-.... has to be used.

Table 6- 16 Maximum encoder cable length

Encoder type	Maximum encoder cable length in m
TTL <sup>1)</sup>	100
HTL unipolar <sup>2)</sup>	100
HTL bipolar	300

1) 100 m with remote sense

2) Because the physical transmission properties are more robust, the bipolar connection should always be used. The unipolar connection should only be used if the encoder type does not output push-pull signals.

**Connection example 1: HTL encoder, bipolar, with reference signal**

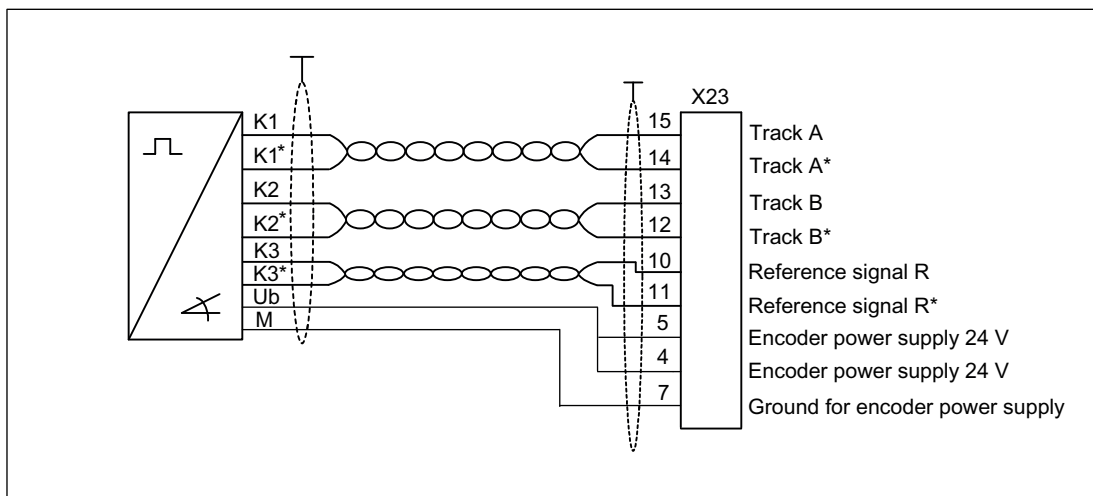


Figure 6-4 Connection example 1: HTL encoder, bipolar, with reference signal

Signal cables must be twisted in pairs in order to improve noise immunity against induced noise.

**Connection example 2: HTL encoder, unipolar, with reference signal**

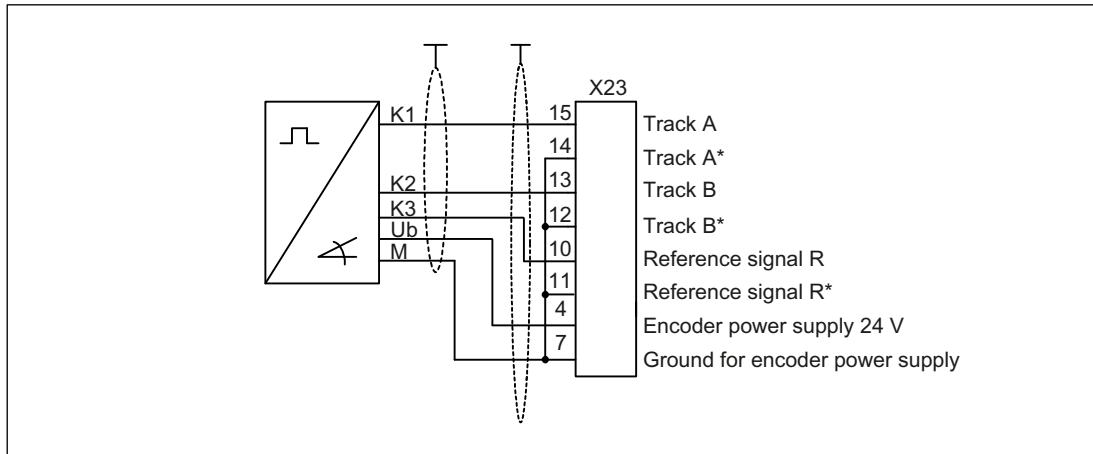


Figure 6-5 Connection example 2: HTL encoder, unipolar, with reference signal <sup>1)</sup>

<sup>1)</sup> Because the physical transmission media is more robust, the bipolar connection should always be used. The unipolar connection should only be used if the encoder type does not output push-pull signals.



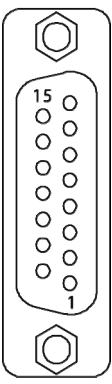
### 6.3.4.8 Pulse/direction interface

#### Setpoint value specification with HTL level

Thanks to the pulse/direction interface, SINAMICS S110 can be used for simple positioning tasks on a controller. Connection to the controller is via internal encoder interface X23 of the CU305.

The controller gives the drive two signals: A pulse sequence with a pulse/pause ratio of 50:50 and a directional signal.

Table 6- 17 Setpoint value specification with HTL level

	Pin	Signal name	Technical data
	1 to 6	Not relevant	–
	7	M	Ground
	8 to 12	Not relevant	–
	13	BP Pulse/direction interface: Direction	B track positive
	14	Not relevant	–
	15	AP_DAT Pulse/direction interface: Pulse	A track positive
Type: 15-pin SUB D connector			

The required settings for the pulse/direction interface need to be made in the STARTER. Please refer to the SINAMICS S110 Function Manual for details.

#### Connection example

The image below shows an example of how to connect a pulse/direction interface with HTL level to interface X23 of a Control Unit CU305.

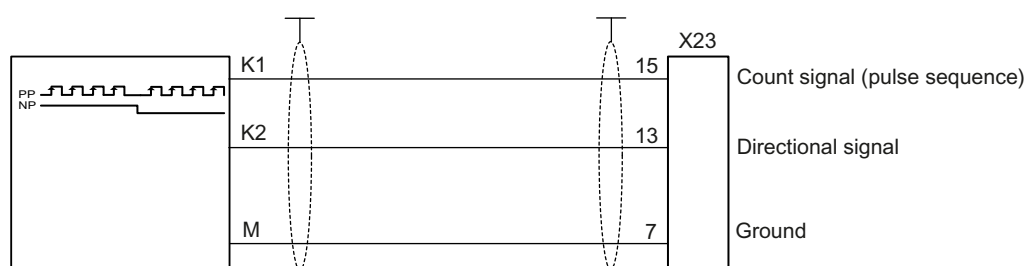


Figure 6-6 Connection of a pulse/direction interface with HTL level to interface X23

**Setpoint value specification: Sensor signal with TTL level**

This sections shows an example of how to connect bipolar TTL encoders to the pulse/direction interface of Control Unit CU305. Connection to the controller supports setpoint value specification via A track and B track.

Table 6- 18 Setpoint value specification: Sensor signal with TTL level

	Pin	Signal name	Technical data
	1 to 6	Not relevant	–
	7	M	Ground
	8 to 11	Not relevant	–
	12	Setpoint value specification, sensor signal	B track negative
	13		B track positive
	14	Setpoint value specification, sensor signal	A track negative
	15		A track positive

Type: 15-pin SUB D connector

The required settings for the pulse/direction interface need to be made in the STARTER. Please refer to the SINAMICS S110 Function Manual for details.

**Connection example**

The image below shows an example of how to connect TTL encoders to interface X23 of a Control Unit CU305 for setpoint value specification via A track and B track.

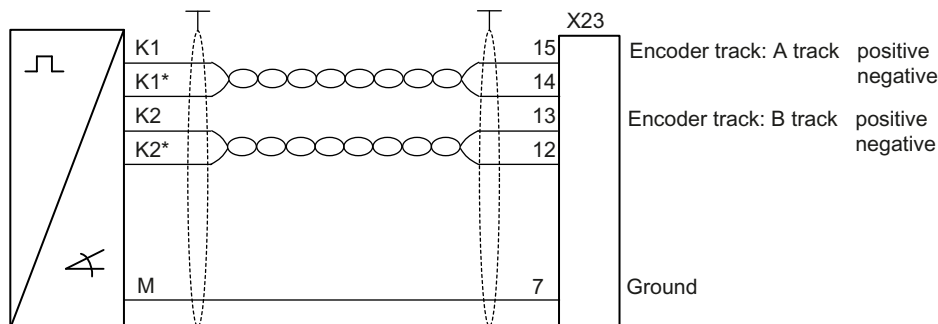
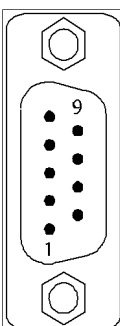


Figure 6-7 Connection of TTL encoders to interface X23 for setpoint value specification via A track and B track

### 6.3.4.9 X22 serial interface (RS232)

Table 6- 19 Serial interface (RS232)

	Pin	Signal name	Technical data
	1	Reserved, do not use	
	2	RxD	Receive data
	3	TxD	Transmit data
	4	Reserved, do not use	
	5	Ground	Ground reference
	5	Reserved, do not use	
	6	Reserved, do not use	
	7	Reserved, do not use	
	8	Reserved, do not use	
	9	Reserved, do not use	

Type: 9-pin SUB D connector

### 6.3.4.10 X520/521/522 measuring sockets

Table 6- 20 Measuring sockets X520, X521 and X522

Socket	Function	Technical specifications
T0	Measuring socket 0	Voltage: 0 V to 5 V Resolution: 8 bits Load current: max. 3 mA Continued-short-circuit-proof
T1	Measuring socket 1	
M	Ground for measuring sockets	

The measuring sockets are only suitable for bunch pin plugs with a diameter of 2 mm.

#### Note

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

### 6.3.4.11 Memory card slot

A memory card is needed in the following cases:

1. Saving parameters  
Parameters are saved on the memory card and can simply be copied onto the new CU305 if the component needs to be replaced.
2. Firmware update  
It is easy to perform a firmware update using a memory card.
3. License carrier  
The license is stored on the memory card.

---

**Note**

The CU305 can be operated without the memory card. The memory card only needs to be inserted into the CU305 because it is the license carrier for the Safety functions.

---

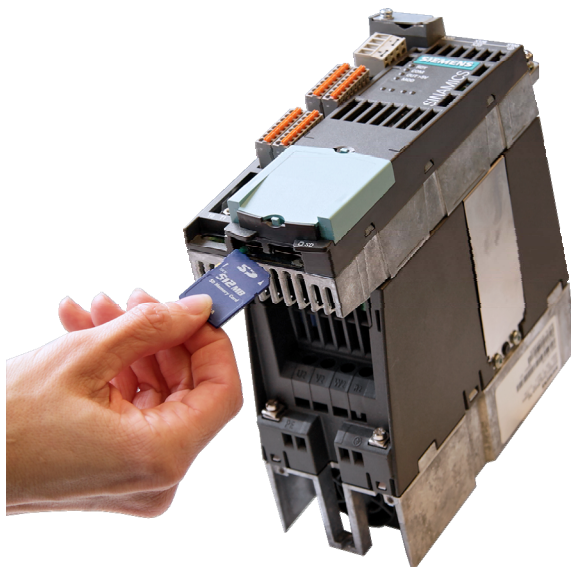


Figure 6-8 Memory card slot

**CAUTION**

The memory card may only be inserted as shown in the figure (arrow top right).  
 The memory card should not be removed or inserted while data is being saved.  
 When returning a defective Control Unit, remove the memory card and keep it for insertion in the replacement unit. This is important otherwise the data on the memory card (parameters, firmware, licenses, and so on) may be lost.

**Working with the memory card**

For more detailed information on how to use the memory card, please refer to the SINAMICS S110 Function Manual.

## 6.4 Connection examples

### Connection examples without a safety function

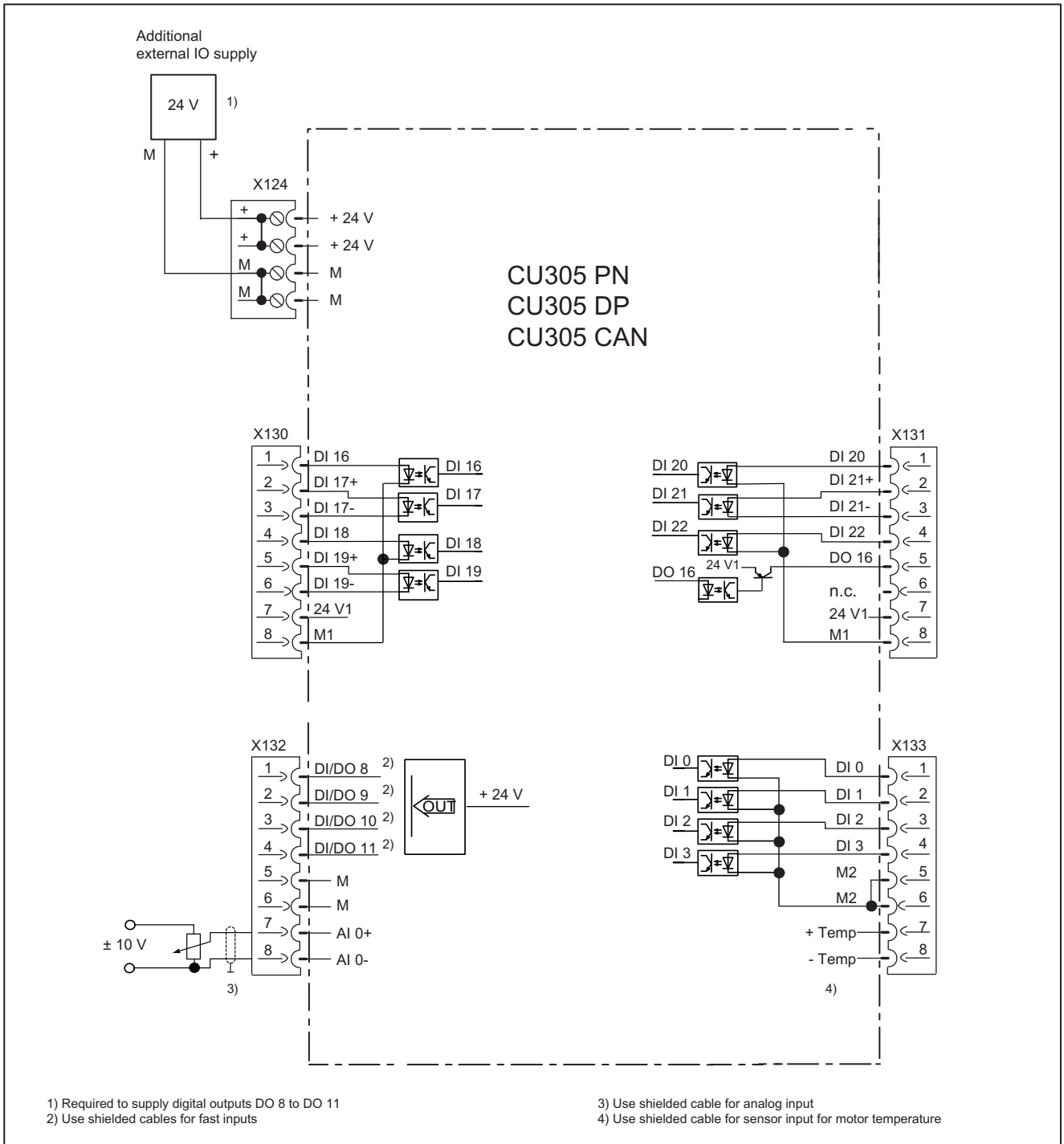


Figure 6-9 Internal connections of the CU305 without the safety function

CU305 Control Units

6.4 Connection examples

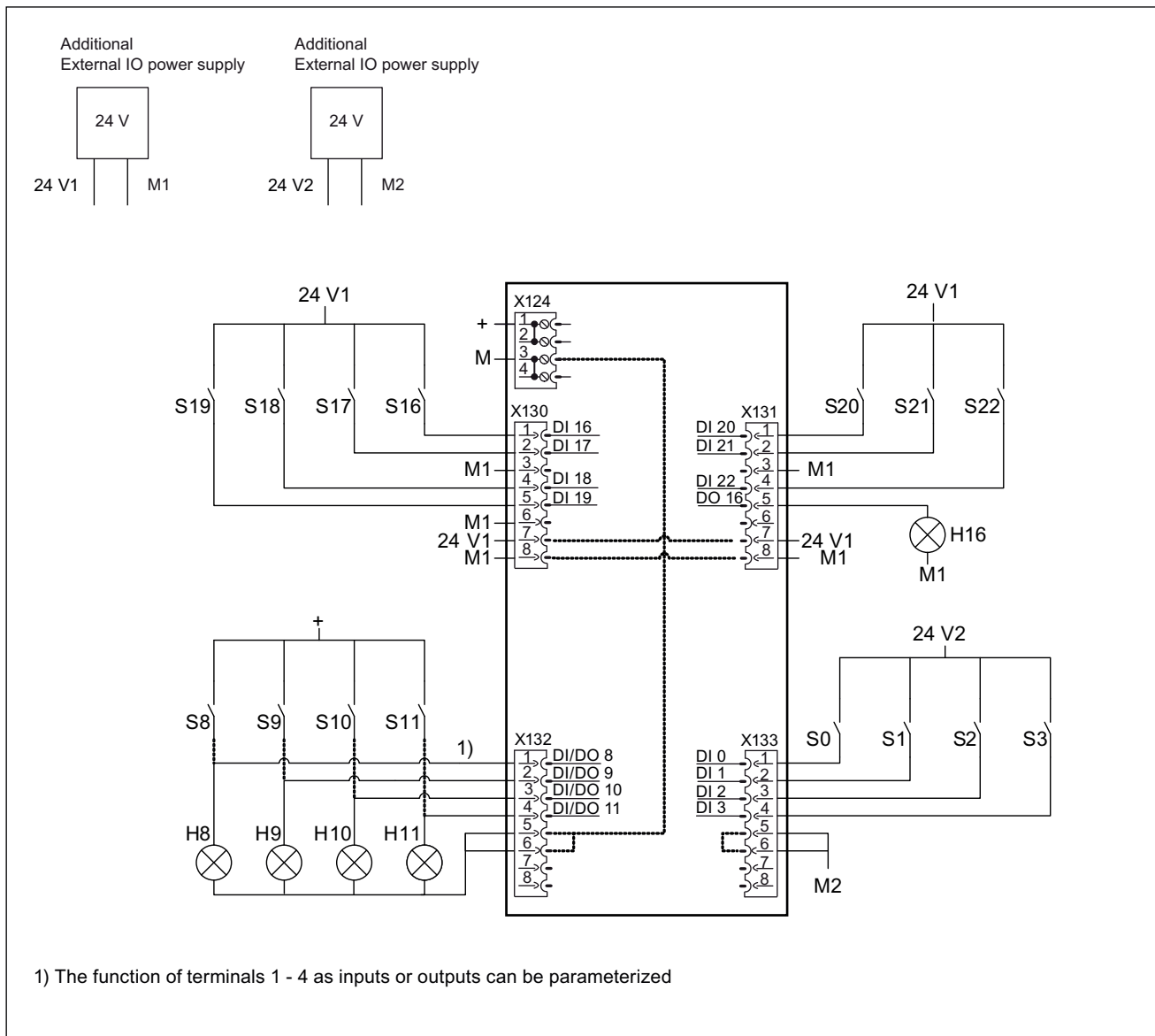
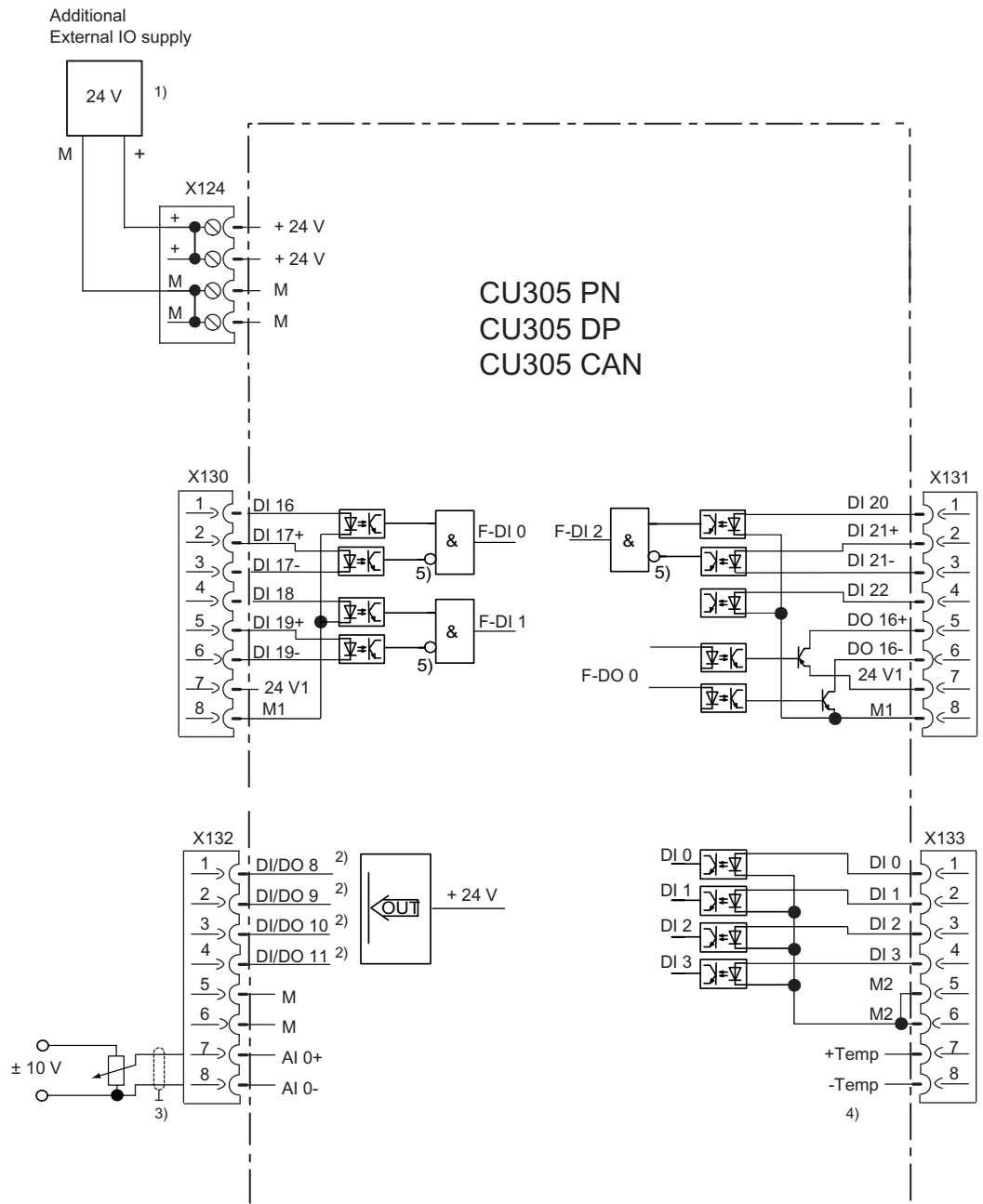


Figure 6-10 Example of circuits for the DI/DO without the safety function

Connection examples with a safety function



- 1) Required for supply of the digital outputs DO 8 to DO 11
- 2) Use shielded cables for fast inputs
- 3) Use shielded cable for analog input
- 4) Use shielded cable for motor temperature sensor input
- 5) The inversion can be parameterized

Figure 6-11 Internal connections of the CU305 with the safety function

CU305 Control Units

6.4 Connection examples

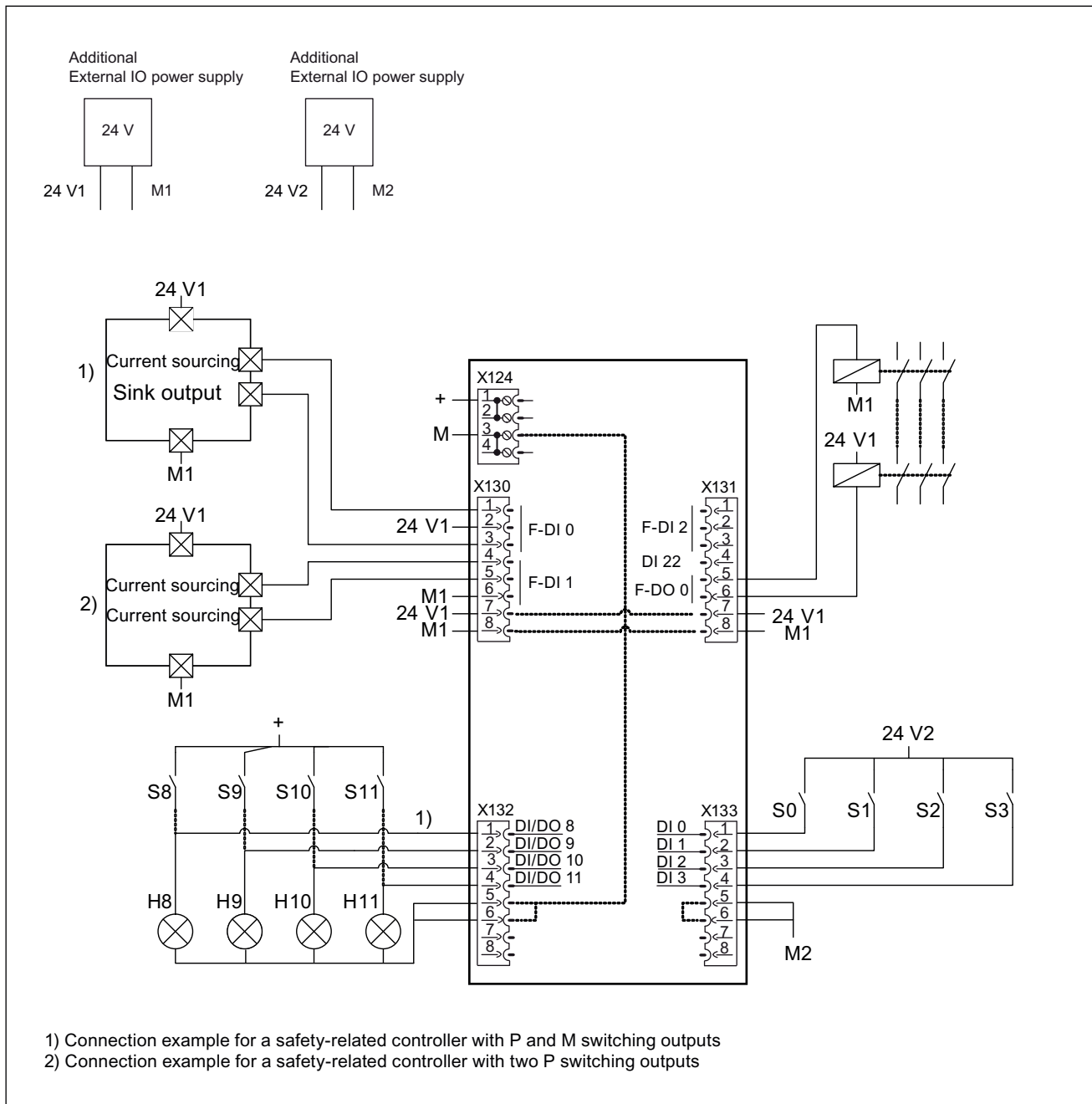


Figure 6-12 Example of circuits for the F-DI/F-DO with the safety function

Further information about connections can be found in the manual:  
SINAMICS S110 Function Manual Drive Functions



## 6.5 Meaning of LEDs

There are four LEDs on the front panel of the CU305 housing.

RDY	Ready
COM	Option Board
OUT>5V	Encoder current supply > 5 V (TTL/HTL)
MOD	Operating mode (reserved)

The various LEDs are switched on and off as the control unit is powered up (depending on the phase the system is currently running through). When switched on, the color of the LEDs shows the status of the corresponding power-up phase (see section: "LED display during power up").

In the event of a fault, power up will be ended in the corresponding phase. The LEDs switched on retain their current colors so that the fault can be determined on the basis of the combination of the colored lights that are lit and unlit.

Once the CU305 has booted correctly, all the LEDs are switched off briefly. The system is ready to operate when the "RDY" LED lights up green permanently.

All the LEDs are controlled by the software loaded during operation (see section: "LED display" during operation).

---

### Note

#### Fault code with BOP inserted

If the fault code F01018 appears on the display when the BOP is inserted, this means that power up of the CU305 has been aborted due to a software fault or incorrect parameterization. The device is reset in this case and automatically restarted using the factory settings.

---

### 6.5.1 Behavior of the LEDs during booting

#### Loading

Table 6- 21 Load software

LED				Status	Comment
RDY	COM	OUT>5V	MOD		
Orange	Orange	OFF	Red	Reset	Hardware reset
Red	Red	OFF	OFF	BIOS loaded	-
Red 2 Hz	Red	OFF	OFF	BIOS error	Error occurred while loading the BIOS
Red 2 Hz	Red 2 Hz	OFF	OFF	File error	Memory card not inserted or faulty Software on memory card not present or corrupted

Table 6- 22 Firmware

LED				Status	Comment
RDY	COM	OUT>5V	MOD		
Red	Orange	OFF	OFF	Firmware loading	COM-LED flashing without specific flashing frequency
Red	OFF	OFF	OFF	Firmware loaded	-
OFF	Red	OFF	OFF	Firmware check (no CRC error)	-
Red 0.5 Hz	Red 0.5 Hz	OFF	OFF	Firmware check (CRC error)	CRC is incorrect
Orange	OFF	OFF	OFF	Firmware initialization	-

## Update

Table 6- 23 Firmware update from memory card

LED				Status	Comment
RDY	COM	OUT>5V	MOD		
Red	Orange	OFF	OFF	Firmware update	COM-LED flashing without specific flashing frequency
Red 2 Hz	Red	OFF	OFF	Firmware update failed	Check whether the memory card is inserted or replace the memory card.
Red 0.5 Hz	Red 0.5 Hz	OFF	OFF	Firmware update complete, waiting for POWER ON	-
Red 2 Hz	Red	OFF	OFF	Firmware check (CRC error)	CRC is incorrect.
Red 2 Hz	Red 2 Hz	OFF	OFF	Firmware or memory card incompatible	Check the firmware version or memory card.

### 6.5.2 Behavior of the LEDs in the operating state

Table 6- 24 Control Unit CU305 – description of the LEDs in the operating state

LED	Color	Status	Description/cause	Remedy
RDY (READY)	-	OFF	Electronic power supply is missing or outside permissible tolerance range.	Check the power supply
	Green	Continuous	The unit is ready for operation. Cyclic DRIVE-CLiQ communication is in progress.	-
		0.5 Hz flashing light	Commissioning/reset	-
		2 Hz flashing light	Writing to the memory card.	-
	Red	Flashing 2 Hz	General errors	Check parameter assignment/configuration.
	Red/green	Flashing 0.5 Hz	The control unit is ready for operation, but there are no software licenses.	Install the missing licenses.
	Orange	Flashing 0.5 Hz	Updating the firmware of the DRIVE-CLiQ components.	-
		Flashing 2 Hz	DRIVE-CLiQ component firmware update completed. Waiting for POWER ON of the corresponding components.	Switch on the component.
	Green/orange or Red/orange	Flashing 2 Hz	Detection of the component via LED is activated (p0124[0]). <b>Note:</b> Both options depend on the LED status when module recognition is activated via p0124[0] = 1.	-

## CU305 Control Units

### 6.5 Meaning of LEDs

LED	Color	Status	Description/cause	Remedy
COM CU305 DP CU305 PN	-	OFF	Cyclic communication is not (yet) running. <b>Note:</b> The PROFIdrive is ready for communication when the Control Unit is ready for operation (see LED: RDY).	-
	Green	Continuous	Cyclic communication is taking place.	-
		Flashing 0.5 Hz	Full cyclic communication is not yet taking place. <sup>1)</sup>	-
	Red	Flashing 0.5 Hz	The PROFIBUS master is sending a faulty parameter assignment or the configuration is incorrect.	Modify the configuration between master/controller and control unit.
Flashing 2 Hz		Cyclic bus communication has been interrupted or could not be established	Rectify the fault in bus communication.	
COM CU305 CAN	-	OFF	Electronics power supply is missing or outside permissible tolerance range. Communication Board defective or not inserted.	-
	Green	Continuous	OPERATIONAL	-
		Flashing 2.5 Hz	PREOPERATIONAL No PDO communication possible.	-
		Single flash	STOPPED Only NMT communication possible.	-
	Red	Continuous	BUS OFF	Check the baud rate and cabling.
		Single flash	ERROR PASSIVE MODE The error counter for "error passive" has reached the value 127.	Check the baud rate and cabling.
Double flash		Error Control Event a Guard Event has occurred.	Check the connection to CANopen master.	
MOD	-	OFF	Operating state (reserved)	-
OUT > 5 V	-	OFF	-	-
	Orange	Continuous	The voltage of the electronics power supply for the measuring system is 24 V. <sup>1)</sup>	-

1) Make sure that the encoder connected is designed for a 24 V supply. Connecting a 5 V encoder to a 24 V supply can result in destruction of the encoder electronics.

## 6.6 Dimension drawings

### 6.6.1 Dimension drawing, CU305 PN

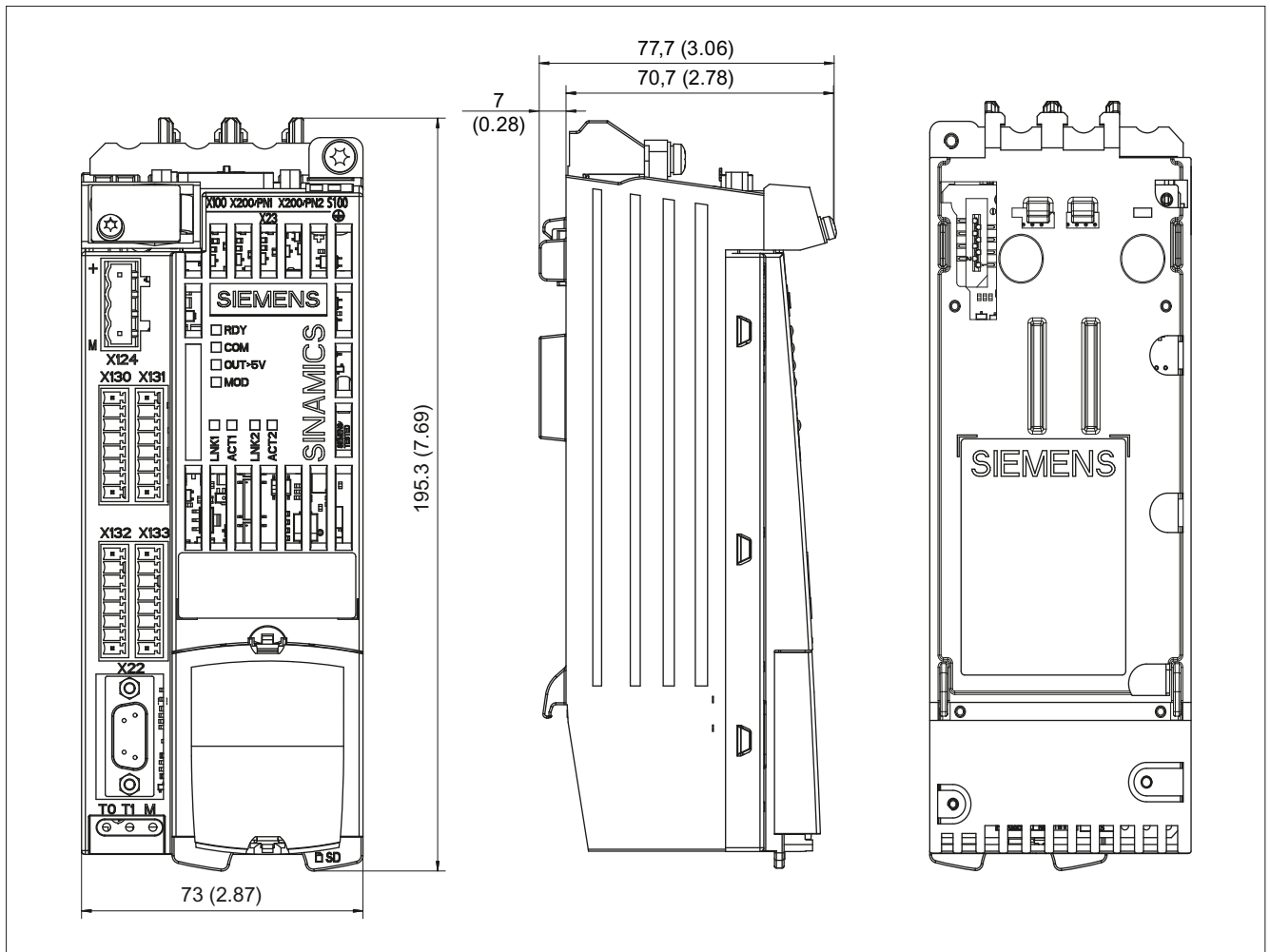


Figure 6-13 Dimension drawing of Control Unit CU305 PN, all data in mm and (inches)

CU305 Control Units  
6.6 Dimension drawings

6.6.2 Dimension drawing CU305 DP/CAN

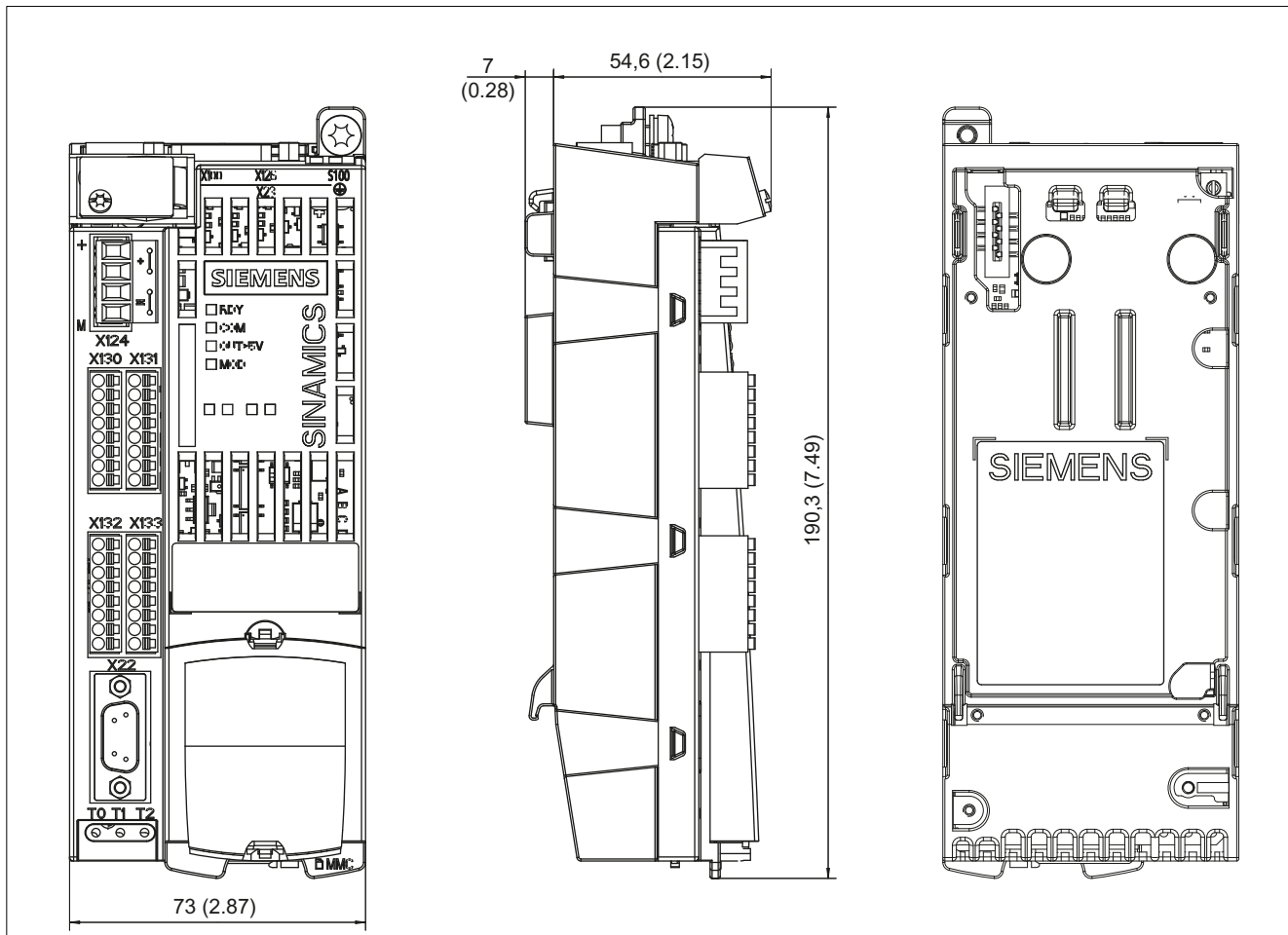
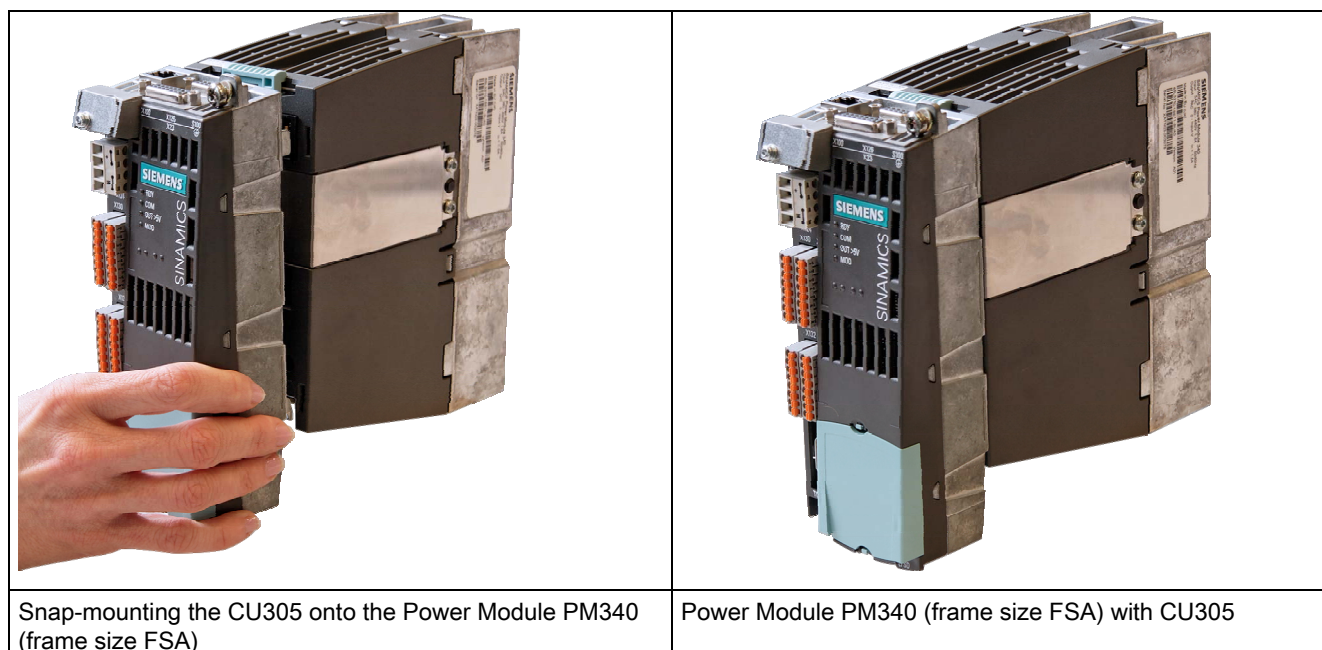


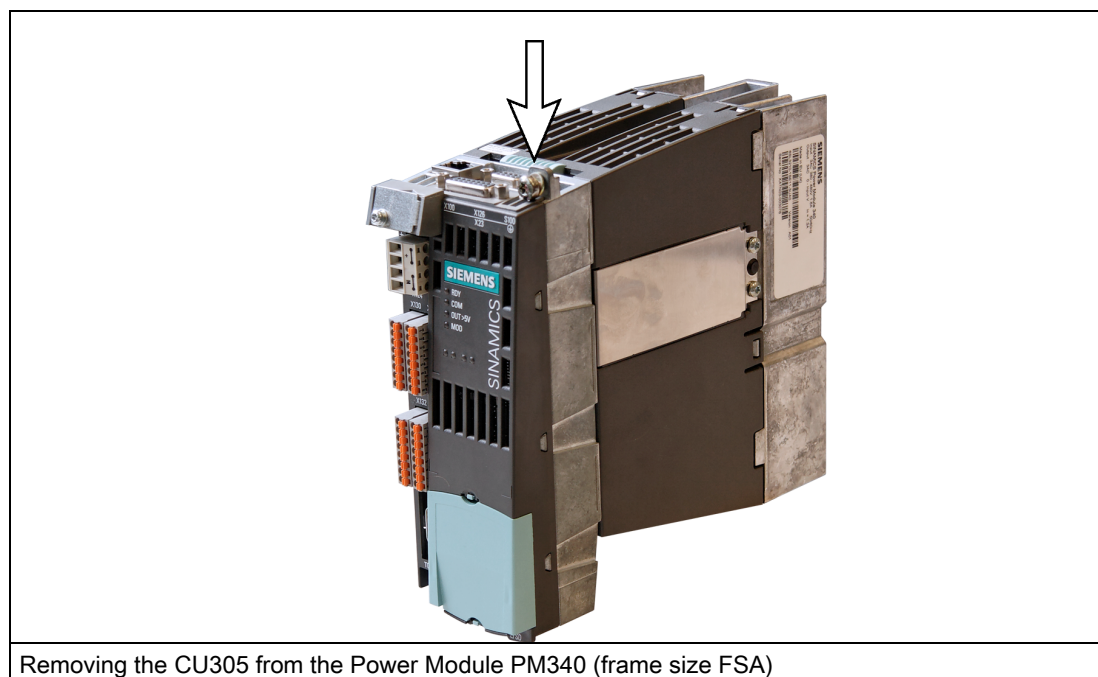
Figure 6-14 Dimension drawing of Control Unit CU305 DP and CU305 CAN, all data in mm and (inches)

## 6.7 Mounting



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



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.

## 6.8 Technical data

Table 6- 25 Technical data for CU305 PN/DP/CAN

	Unit	Value
Electronics power supply		
Voltage	V <sub>DC</sub>	24 (20.4 – 28.8)
Current consumption (without DRIVE-CLiQ and digital outputs)	A <sub>DC</sub>	0.8
Power loss	W	<20
Measuring system power supply		
Voltage	V <sub>DC</sub>	TTL: 5 V (with or without Remote Sense) HTL: V <sub>DC</sub> - 1 V
Current	A <sub>DC</sub>	0.35
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). Further information can be found in the manual: SINAMICS S, List Manual, Chapter "Function diagrams".	
Weight	kg	0.95



# Supplementary system components and encoder system integration

# 7

## 7.1 Basic Operator Panel BOP20

### 7.1.1 Description

The Basic Operator Panel BOP20 contains six keys and a backlit display unit. The BOP20 can be plugged onto a SINAMICS Control Unit and operated.

**The following functions are possible with the BOP:**

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

### 7.1.2 Interface description



Figure 7-1 Basic Operator Panel BOP20

Overview of displays and keys

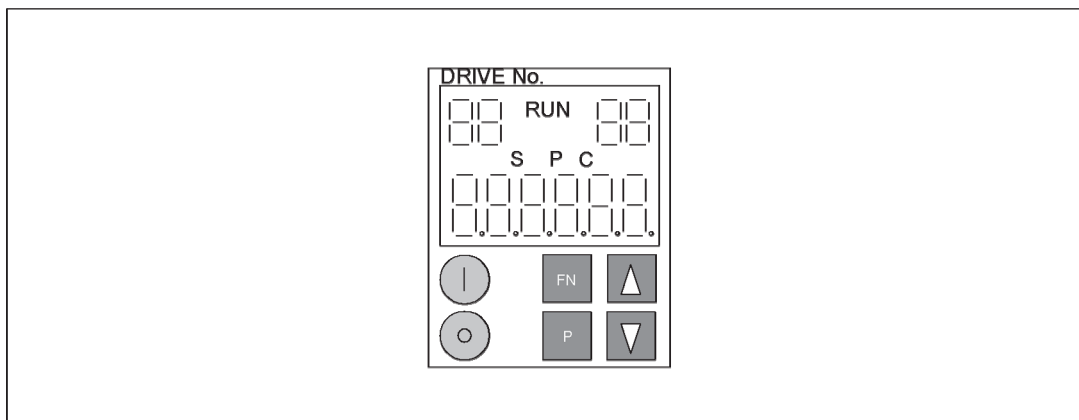








Figure 7-2 Overview of displays and keys

Table 7- 1 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"> <li>• 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)</li> <li>• Faults: Selects/displays other drives with faults</li> <li>• Designation of BICO inputs (bi, ci)</li> <li>• Designation of BICO outputs (bo, co)</li> </ul> Source object of a BICO interconnection to a drive object different than the active one.
S	Is lit (bright) if at least one parameter was changed and the value was not transferred into the non-volatile memory.
P	Is lit (bright) if, for a parameter, the value only becomes effective after pressing the P key.
C	Is lit (bright) if at least one parameter was changed and the calculation for consistent data management has still not been initiated.
Below, 6 position	Displays, e.g. parameters, indices, faults and alarms.

## BOP20 keyboard

Table 7- 2 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><b>Note:</b></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 meaning of these keys depends on the actual display.</p> <p><b>Note:</b></p> <p>The effectiveness of this key to acknowledge faults can be defined using the appropriate BiCo parameterization.</p>
	Parameter	The meaning of these keys depends on the actual display.
	Raise	The keys are dependent on the actual display and are used to raise or lower values.
	Lower	


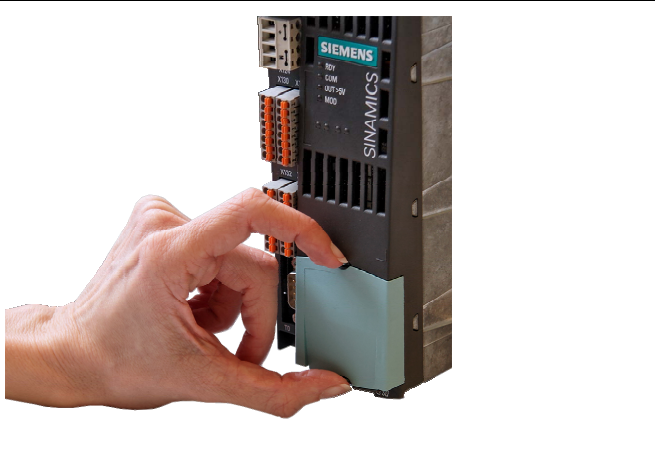


### 7.1.3 Installation

**NOTICE**

Make sure that you insert and withdraw the BOP20 straight into/out of the CU305 and that it is not tilted up or down.  
This prevents damage to the interface for the BOP20 at the CU305.

#### Mounting

The photographs show how to mount the Basic Operator Panel BOP20 on a CU305.

	
1. BOP20 and Control Unit CU305	2. Press the latching cams of the cover together simultaneously.
	
3. To remove the blanking cover, press the latching cams of the cover together simultaneously and pull the cover straight out.	4. Press the latching cams on the BOP20 together simultaneously and push the BOP20 straight into the housing of the CU305 until you hear it latch into position.

**Note**

The BOP20 may be inserted or withdrawn while the Control Unit is operational.

## **Dismantling**

1. Press the latching cams of the BOP20 together simultaneously.
2. Keep the latching cams pressed together and pull the BOP20 straight out.
3. Insert the blanking cover.

## **Display and operator controls of the BOP20**

For information about display and operator controls of the BOP20, refer the SINAMICS S120 Commissioning Manual.

## 7.2 Sensor Module Cabinet-Mounted SMC10

### 7.2.1 Description

The Sensor Module Cabinet-Mounted SMC10 evaluates encoder signals and transmits the speed, actual position value, rotor position and, if necessary, the motor temperature via DRIVE-CLiQ to the Control Unit.

The SMC10 is used to evaluate sensor signals from resolvers.

### 7.2.2 Safety information

 <b>WARNING</b>
--

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

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

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

**Note**

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

 <b>CAUTION</b>
--

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

## 7.2.3 Interface description

### 7.2.3.1 Overview

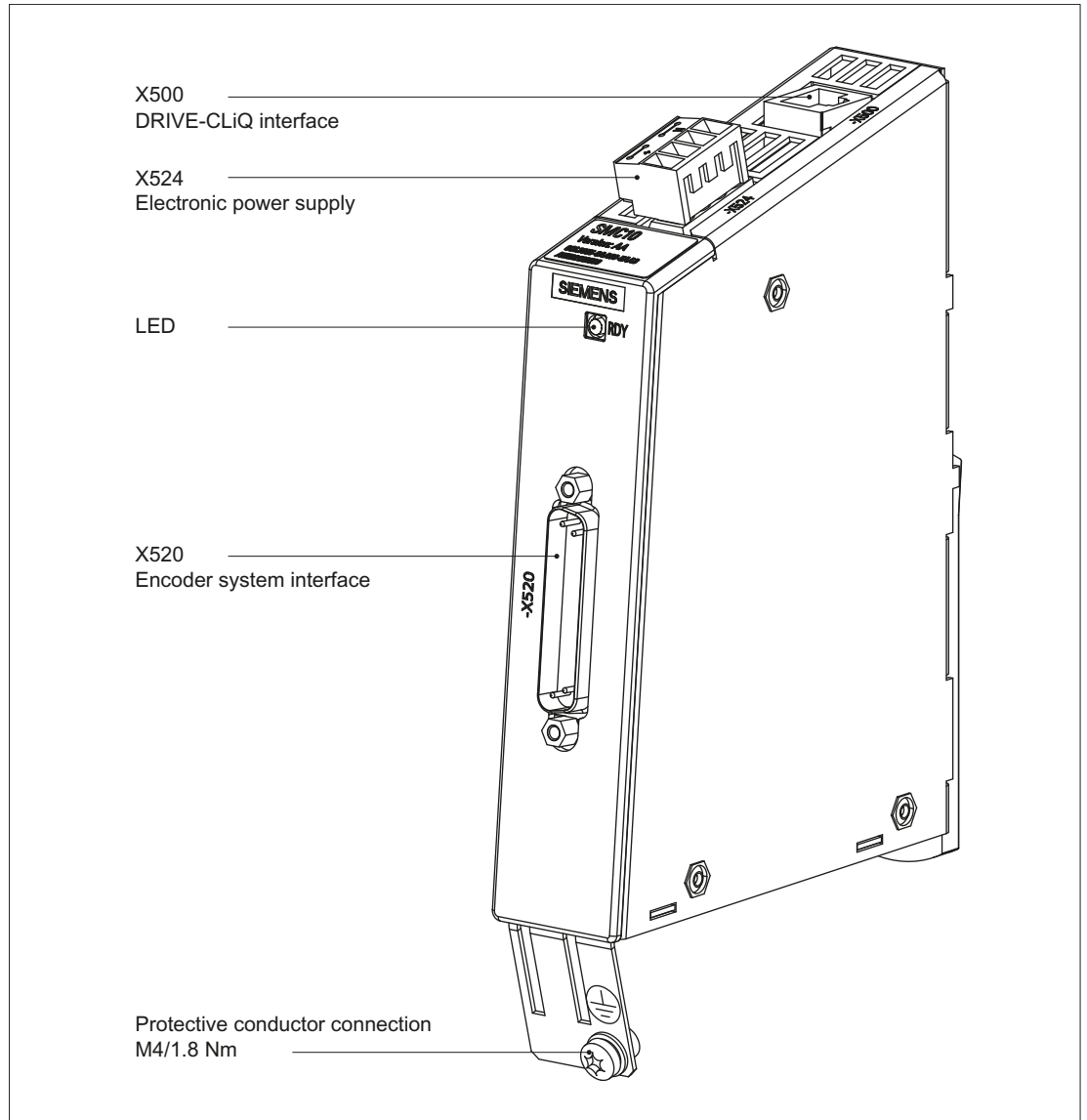


Figure 7-3 Interface description of the SMC10

### 7.2.3.2 DRIVE-CLiQ interface X500

Table 7- 3 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

Connector type: RJ45 socket; blanking plate for DRIVE-CLiQ interface included in the scope of delivery; blanking plate (50 pieces) Order no.: 6SL3066-4CA00-0AA0

### 7.2.3.3 X520 encoder system interface

Table 7- 4 X520 encoder system interface

	Pin	Signal name	Technical specifications
	1	Reserved, do not use	
	2	Reserved, do not use	
	3	S2	Resolver signal A (sin+)
	4	S4	Inverted resolver signal A (sin-)
	5	Ground	Ground (for internal shield)
	6	S1	Resolver signal B (cos+)
	7	S3	Inverted resolver signal B (cos-)
	8	Ground	Ground (for internal shield)
	9	R1	Resolver excitation positive
	10	Reserved, do not use	
	11	R2	Resolver excitation negative
	12	Reserved, do not use	
	13	+ Temp	Motor temperature 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	



	Pin	Signal name	Technical specifications
	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

Connector type: SUB-D, 25-pole

**NOTICE**

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

 **DANGER**

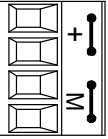
**Risk of electric shock!**

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

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

**7.2.3.4 X524 Electronics power supply**

Table 7- 5 X524 terminal block

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

Max. connectable cross-section: 2.5 mm<sup>2</sup>  
 Type: Screw-type terminal (see Appendix A)

**Note**

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

**Cause and rectification of faults**

Further information about the causes of faults and how to remedy them may be found in the manual: SINAMICS S120 Commissioning Manual.

**7.2.4 Meaning of the LED**

Table 7- 6 Meaning of LEDs on the Sensor Module Cabinet-Mounted SMC10

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

**Cause and rectification of faults**

The following documents contain information about the cause of faults and how they can be rectified:

SINAMICS S120 Commissioning Manual (IH1)

SINAMICS S120/S150, List Manual (LH1)

## 7.2.5 Dimension drawing

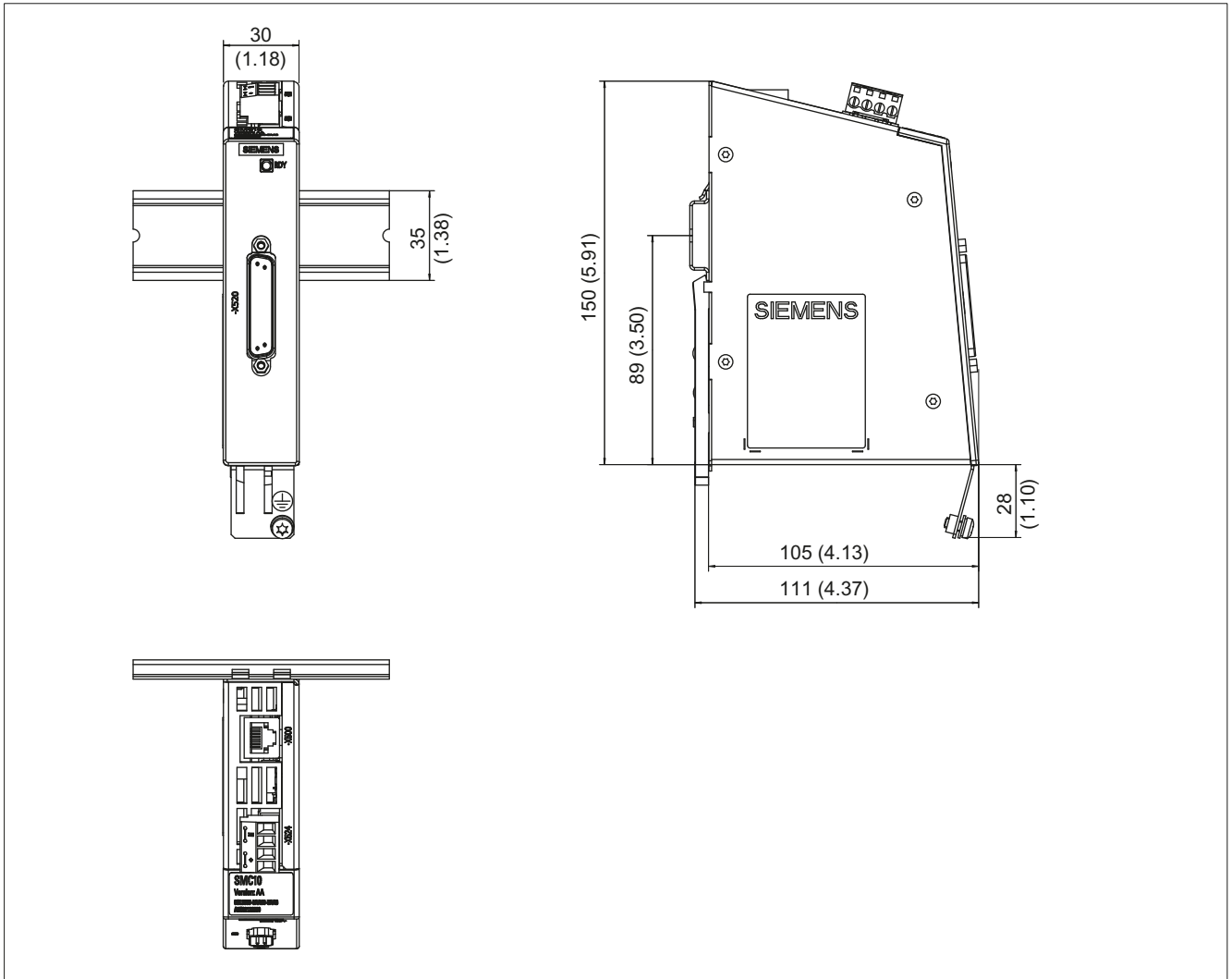


Figure 7-4 Dimension drawing of the Sensor Module Cabinet SMC10, all dimensions in mm and (inches)

## 7.2.6 Mounting

### Installation

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

## Removal

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

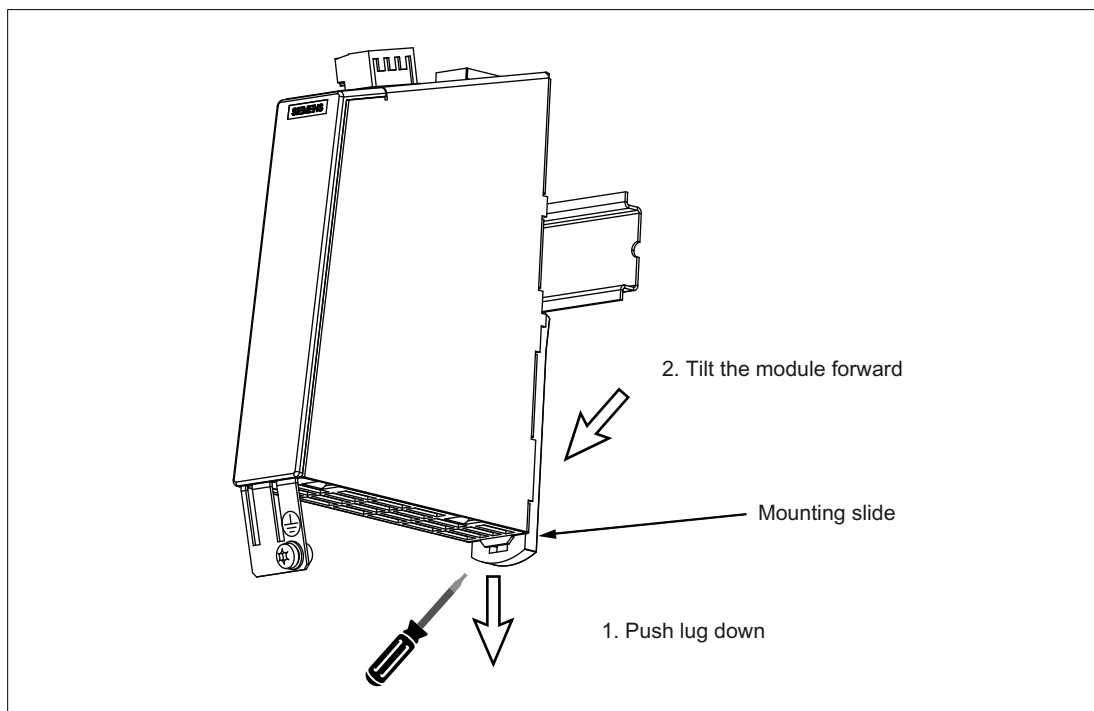


Figure 7-5 Removal of a component from a DIN rail

## 7.2.7 Technical data

Table 7- 7 Technical data

6SL3055-0AA00-5AAx	Unit	Value
<b>Electronics power supply</b>		
Voltage	V <sub>DC</sub>	24 DC (20.4 – 28.8)
Current (without encoder system)	A <sub>DC</sub>	≤ 0.20
Current (with encoder system)	A <sub>DC</sub>	≤ 0.35
Power loss	W	≤ 10
<b>Specification</b>		
Transformation ratio of the resolver ( $\ddot{u}$ )		0.5
Excitation voltage on the SMC10 when $\ddot{u}=0.5$	V <sub>rms</sub>	4.1
Amplitude monitoring threshold (secondary tracks) of the SMC10	V <sub>rms</sub>	1
Excitation voltage (cannot be parameterized)	V <sub>rms</sub>	4.1
Excitation frequency (synchronized to the current controller clock cycle)	kHz	5 to 16
PE/ground connection		On housing with M4/1.8 Nm screw
Max. encoder cable length	m	130
Weight	kg	0.45
Degree of protection		IP20 or IPXXB

Table 7- 8 Max. frequency that can be evaluated (speed)

Resolver		Max. speed resolver / motor		
Number of poles	Number of pole pairs	8kHz/125 $\mu$ sec	4kHz/250 $\mu$ sec	2kHz/500 $\mu$ 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

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:

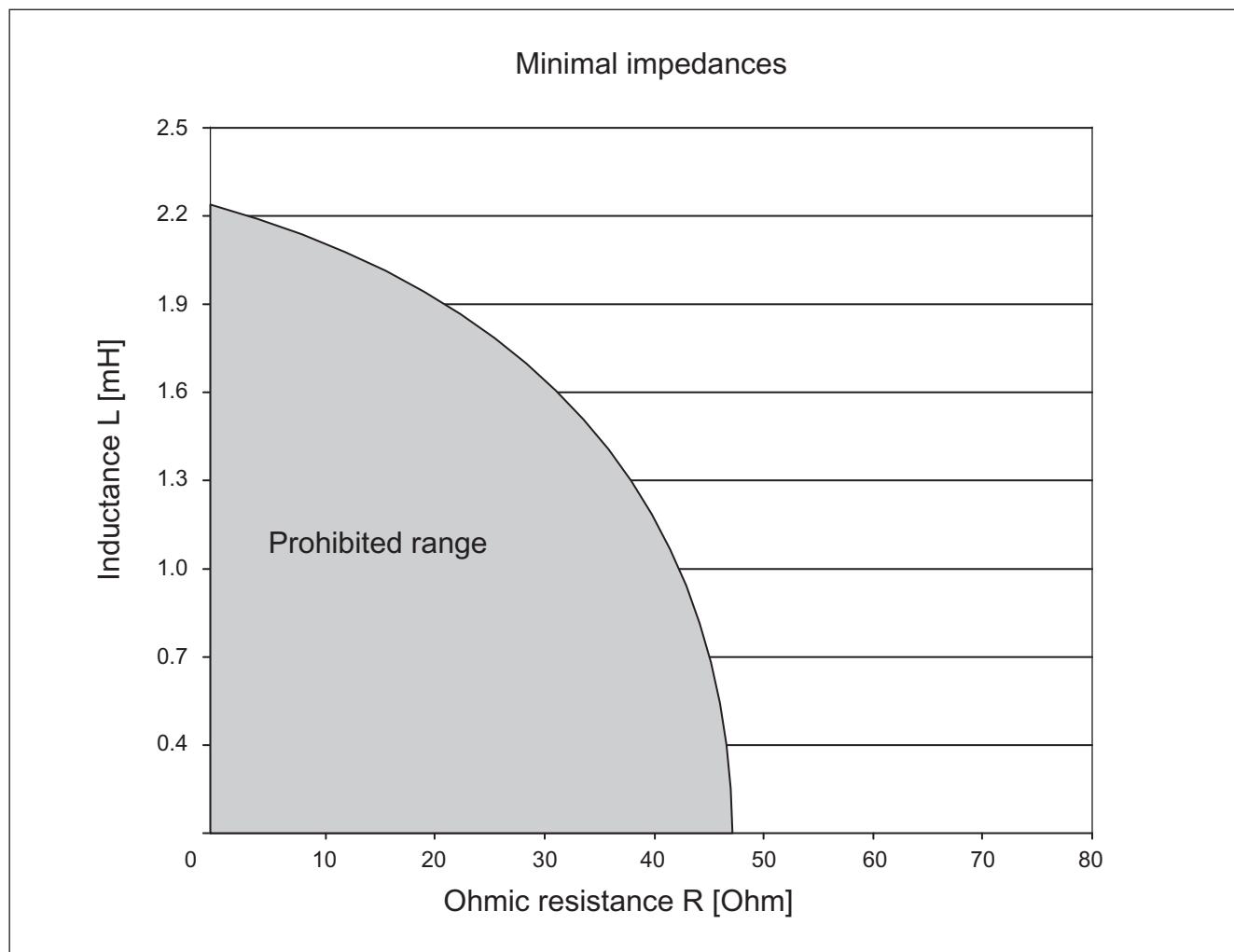


Figure 7-6 Connectable impedances with an excitation frequency  $f = 5000$  Hz


## 7.3 Sensor Module Cabinet-Mounted SMC20

### 7.3.1 Description

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

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


### 7.3.2 Safety information

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

<b>NOTICE</b>
Only one encoder system may be connected per Sensor Module.

#### Note

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

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

### 7.3.3 Interface description

#### 7.3.3.1 Overview

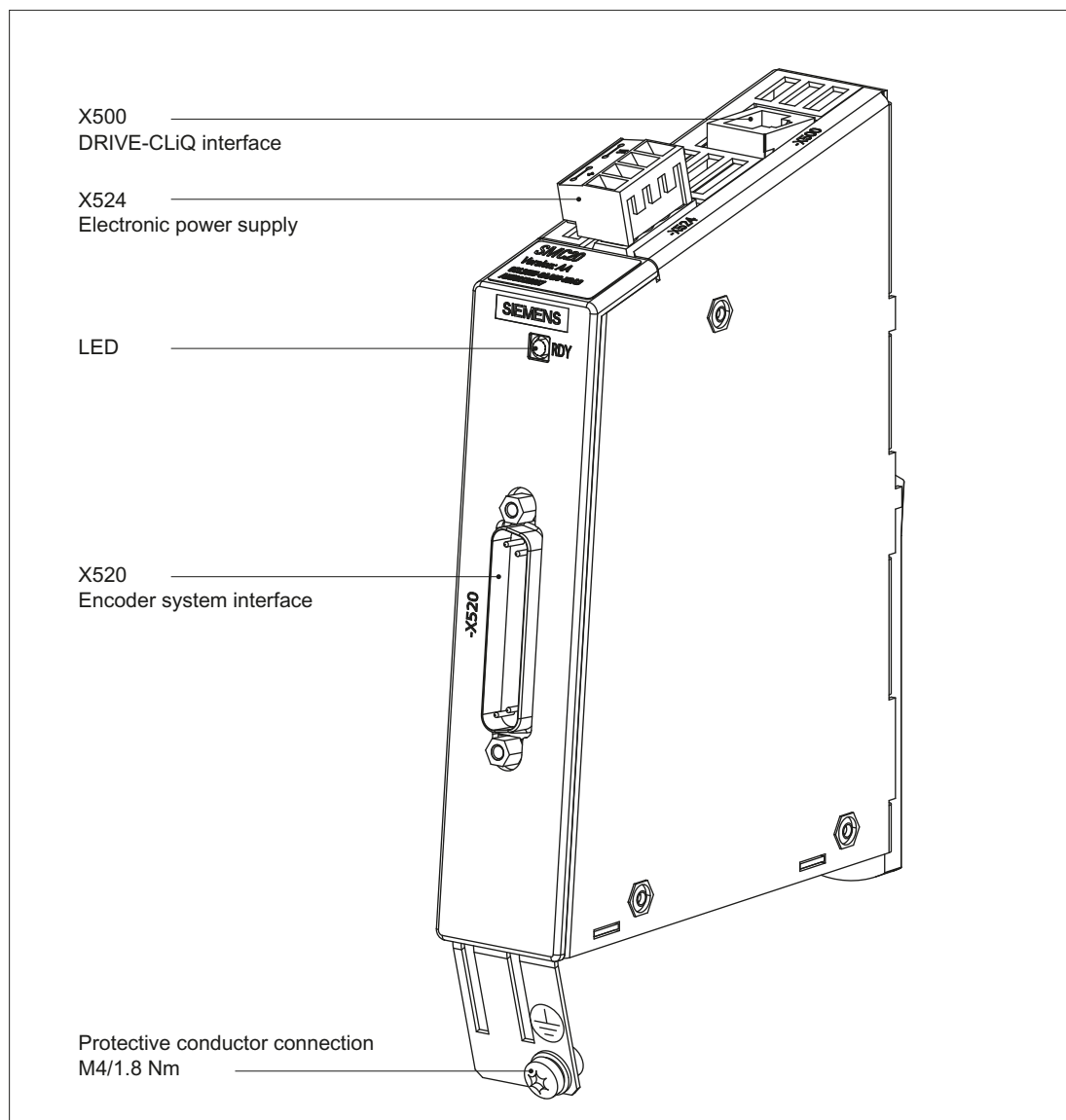
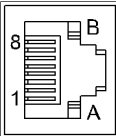


Figure 7-7 Interface description of the SMC20



### 7.3.3.2 DRIVE-CLiQ interface X500

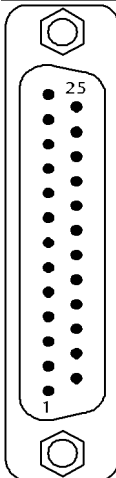
Table 7- 9 DRIVE-CLiQ interface X500

	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

Connector type: RJ45 socket; blanking plate for DRIVE-CLiQ interface included in the scope of delivery; blanking plate (50 pieces) Order no.: 6SL3066-4CA00-0AA0

### 7.3.3.3 X520 encoder system interface

Table 7- 10 X520 encoder system interface

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

Supplementary system components and encoder system integration

7.3 Sensor Module Cabinet-Mounted SMC20

	Pin	Signal name	Technical specifications
	19	C	Absolute track signal C
	20	C*	Inverse absolute track signal C
	21	D	Absolute track signal D
	22	D*	Inverse absolute track signal D
	23	Data*	Inverse data, EnDat interface, Inverse SSI data
	24	Ground	Ground (for internal shield)
	25	- Temp	Motor temperature measurement KTY84-1C130 (KTY-) Temperature sensor KTY84-1C130 / PTC

**NOTICE**

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



**DANGER**

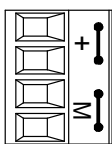
**Risk of electric shock!**

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

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

7.3.3.4 Electronics power supply X524

Table 7- 11 X524 terminal block

	Terminal	Function	Technical specifications
	+	Electronic power supply	Voltage: 24 V (20.4 V – 28.8 V)
	+	Electronic power supply	Current consumption: Max. 0.35 A
	M	Electronic ground	Maximum current via jumper in connector: 20 A
	M	Electronic ground	
Max. connectable cross-section: 2.5 mm <sup>2</sup> Type: Screw-type terminal (see Appendix A)			

**Note**

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

### Cause and rectification of faults

Further information about the causes of faults and how to remedy them may be found in the manual: SINAMICS S120 Commissioning Manual.

### 7.3.4 Meaning of the LED

Table 7- 12 Meaning of LEDs on the Sensor Module Cabinet-Mounted SMC20

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

### Cause and rectification of faults

The following documents contain information about the cause of faults and how they can be rectified:

SINAMICS S120 Commissioning Manual (IH1)

SINAMICS S120/S150, List Manual (LH1)

### 7.3.5 Dimension drawing

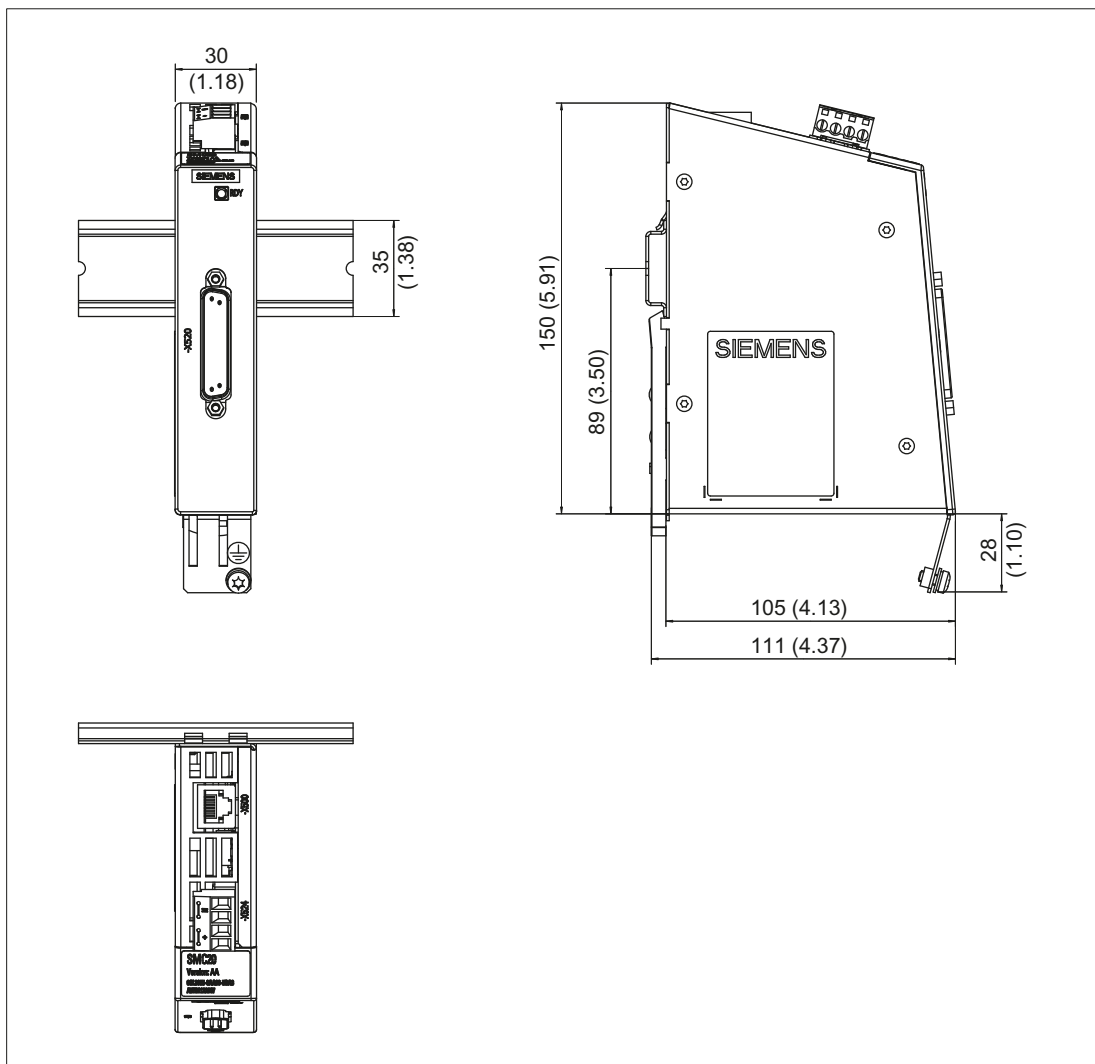


Figure 7-8 Dimension drawing of the Sensor Module Cabinet SMC20, all data in mm and (inches)

### 7.3.6 Mounting

#### Installation

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

## Removal

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

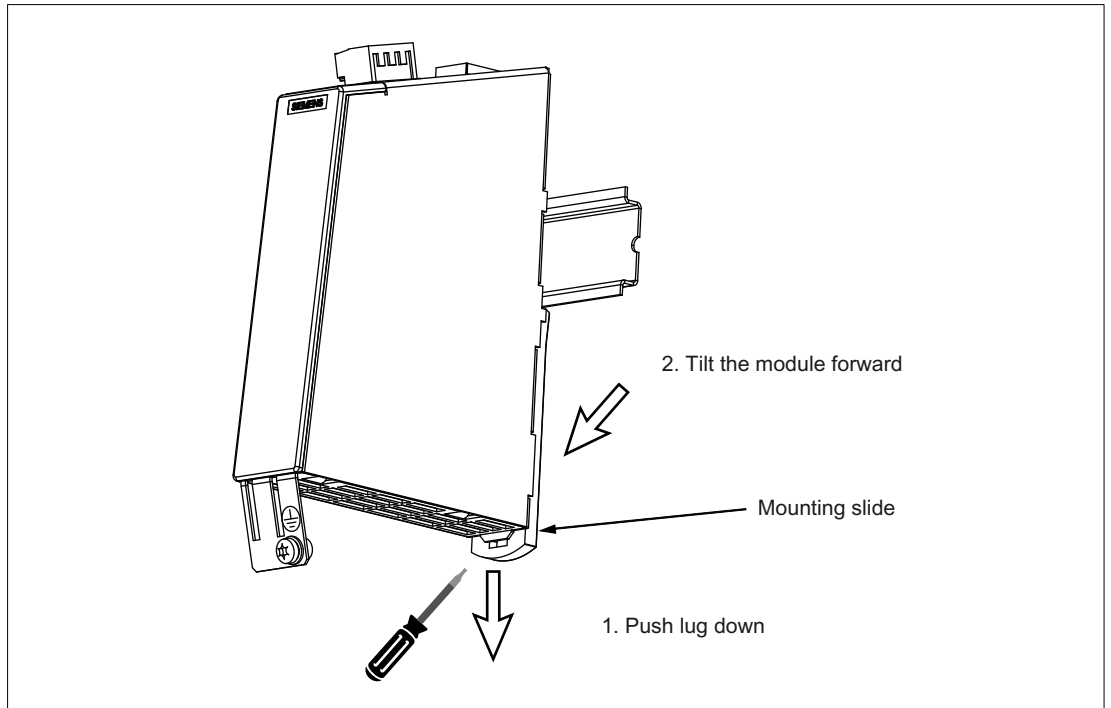


Figure 7-9 Removal of a component from a DIN rail

### 7.3.7 Technical data

Table 7- 13 Technical data

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

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

2) Only possible for SSI encoders with 5 V supply

**NOTICE**

**Current controller clock cycle**

When a current controller clock cycle of 31.25 μs is used, a SMC20 with MLFB 6SL3055-0AA00-5BA3 must be used.

## 7.4 Sensor Module Cabinet-Mounted SMC30


### 7.4.1 Description

The Sensor Module Cabinet-Mounted SMC30 evaluates encoder signals and transmits the speed, actual position value and, if necessary, the motor temperature and reference point via DRIVE-CLiQ to the Control Unit.

The SMC30 is used to evaluate encoder signals from encoders with TTL, HTL, or SSI interfaces.

A combination of TTL/HTL signal and SSI absolute signal is possible at terminals X521/X531, if both signals are derived from the same measured variable.

### 7.4.2 Safety information


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

<b>NOTICE</b>
Only one encoder system may be connected per Sensor Module.

#### Note

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

<b>CAUTION</b>
When the encoder system is connected via terminals, make sure that the cable shield is connected to the component.

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

### 7.4.3 Interface description

#### 7.4.3.1 Overview

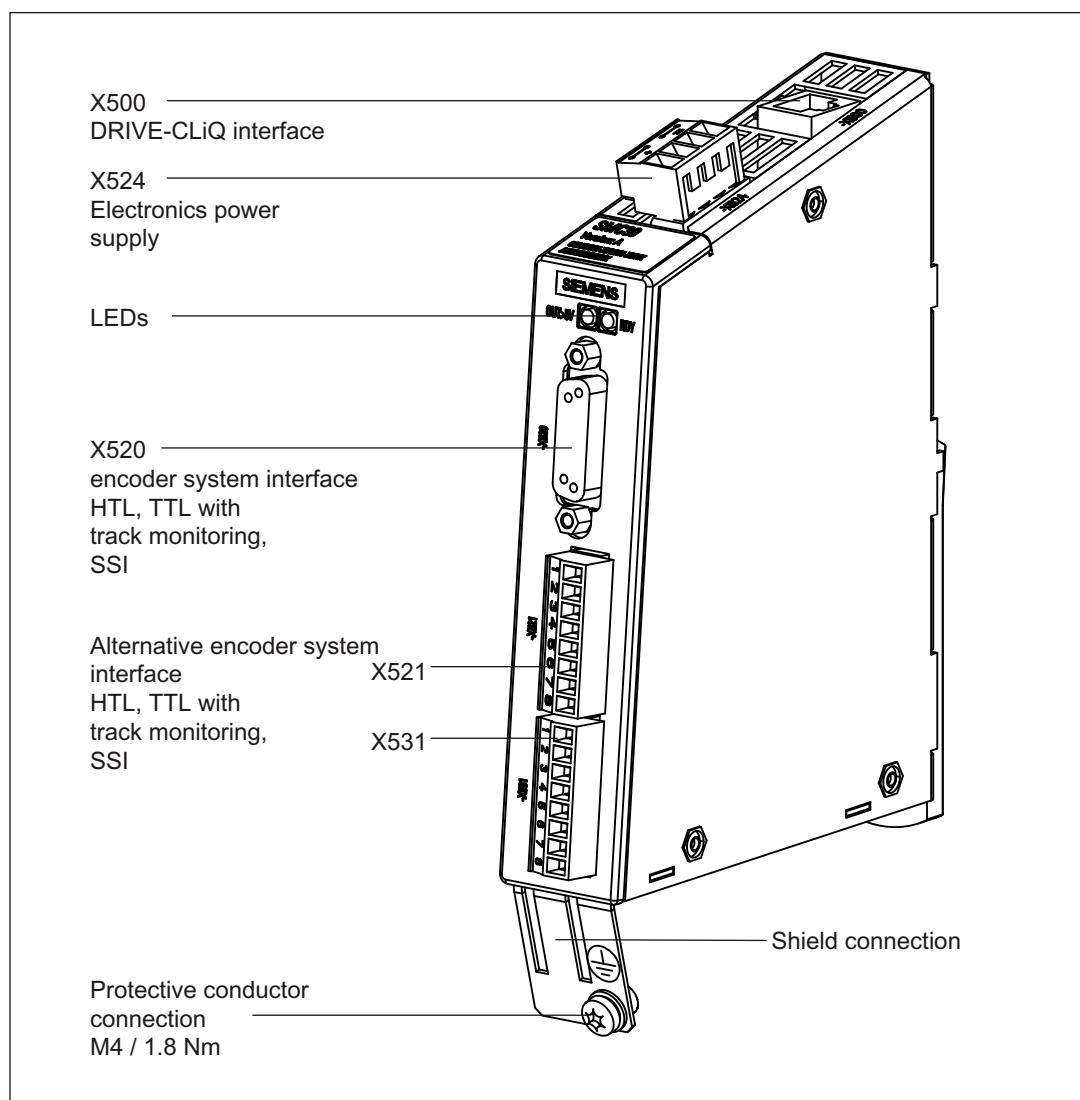
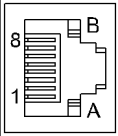


Figure 7-10 Interface description of the SMC30



### 7.4.3.2 DRIVE-CLiQ interface X500

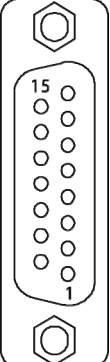
Table 7- 14 DRIVE-CLiQ interface X500

	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

Connector type: RJ45 socket; blanking plate for DRIVE-CLiQ interface included in the scope of delivery; blanking plate (50 pieces) Order no.: 6SL3066-4CA00-0AA0

### 7.4.3.3 X520 encoder system interface

Table 7- 15 X520 encoder system interface

	Pin	Signal name	Technical specifications
	1	Reserved, do not use + Temp	Motor temperature sensing KTY84-1C130 (KTY+) Temperature sensor KTY84-1C130/PTC/bimetallic switch with NC contact
	2	Clock	SSI clock
	3	Clock*	Inverse SSI clock
	4	P encoder 5 V / 24 V	Encoder power supply
	5	P encoder 5 V / 24 V	
	6	P sense	Sense input encoder power supply
	7	M encoder (M)	Ground for encoder power supply
	8	Reserved, do not use - Temp	Motor temperature sensing KTY84-1C130 (KTY-) Temperature sensor KTY84-1C130/PTC/bimetallic switch with NC contact
	9	M sense	Ground sense input
	10	R	Reference signal R
	11	R*	Inverse reference signal R
	12	B*	Inverse incremental signal B
	13	B	Incremental signal B
	14	A* / data*	Inverse incremental signal A/inverse SSI data
	15	A / data	Incremental signal A/SSI data

Connector type: SUB-D female, 15-pin

**CAUTION**

The encoder supply can be parameterized to 5 V or 24 V. The sensor may be destroyed if you enter the wrong parameters.

**NOTICE**

The KTY temperature sensor must be connected with the correct polarity. For details of how to parameterize the KTY temperature sensors, refer to the SINAMICS S120 Function Manual (FH1) in the Chapter "Monitoring and protective functions/Thermal motor monitoring".



**DANGER**

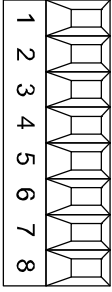
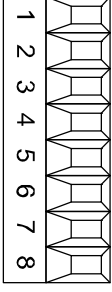
**Risk of electric shock!**

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

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

### 7.4.3.4 X521 / X531 alternative encoder system interface


Table 7- 16 X521 / X531 alternative encoder system interface

	Pin	Designation	Technical specifications
X521 	1	A	Incremental signal A
	2	A*	Inverse incremental signal A
	3	B	Incremental signal B
	4	B*	Inverse incremental signal B
	5	R	Reference signal R
	6	R*	Inverse reference signal R
	7	CTRL	Control signal
	8	M	Ground
X531 	1	P_Encoder 5 V / 24 V	Encoder power supply
	2	M_Encoder	Ground for encoder power supply
	3	- Temp	Motor temperature sensing KTY84-1C130 (KTY-) Temperature sensor KTY84-1C130/PTC/bimetallic switch with NC contact
	4	+ Temp	Motor temperature sensing KTY84-1C130 (KTY+) Temperature sensor KTY84-1C130/PTC/bimetallic switch with NC contact
	5	Clock	SSI clock
	6	Clock*	Inverse SSI clock
	7	Data	SSI data
	8	Data*	Inverse SSI data
Max. connectable cross-section: 1.5 mm <sup>2</sup> When using unipolar HTL encoders, at the terminal block A*, B*, R* must be connected to (jumper) M_Encoder (X531) <sup>1)</sup> .			

1) Because the physical transmission media is more robust, the bipolar connection should always be used. The unipolar connection should only be used if the encoder type does not output push-pull signals.

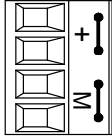
<p><b>CAUTION</b></p> <p>When the encoder system is connected via terminals, make sure that the cable shield is connected to the component. Refer to the Chapter "Electrical connection".</p>
---

<p><b>NOTICE</b></p> <p>The KTY temperature sensor must be connected with the correct polarity. For details of how to parameterize the KTY temperature sensors, refer to the SINAMICS S120 Function Manual (FH1) in the Chapter "Monitoring and protective functions/Thermal motor monitoring".</p>
---

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

### 7.4.3.5 X524 Electronics power supply

Table 7- 17 X524 terminal block

	Terminal	Function	Technical specifications
	+	Electronic power supply	Voltage: 24 V (20.4 V – 28.8 V)
	+	Electronic power supply	Current consumption: Max. 0.35 A
	M	Electronic ground	Maximum current via jumper in connector: 20 A
	M	Electronic ground	
Max. connectable cross-section: 2.5 mm <sup>2</sup> Type: Screw-type terminal (see Appendix A)			

#### Note

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

### 7.4.4 Connection examples

#### Connection example 1: HTL encoder, bipolar, with reference signal

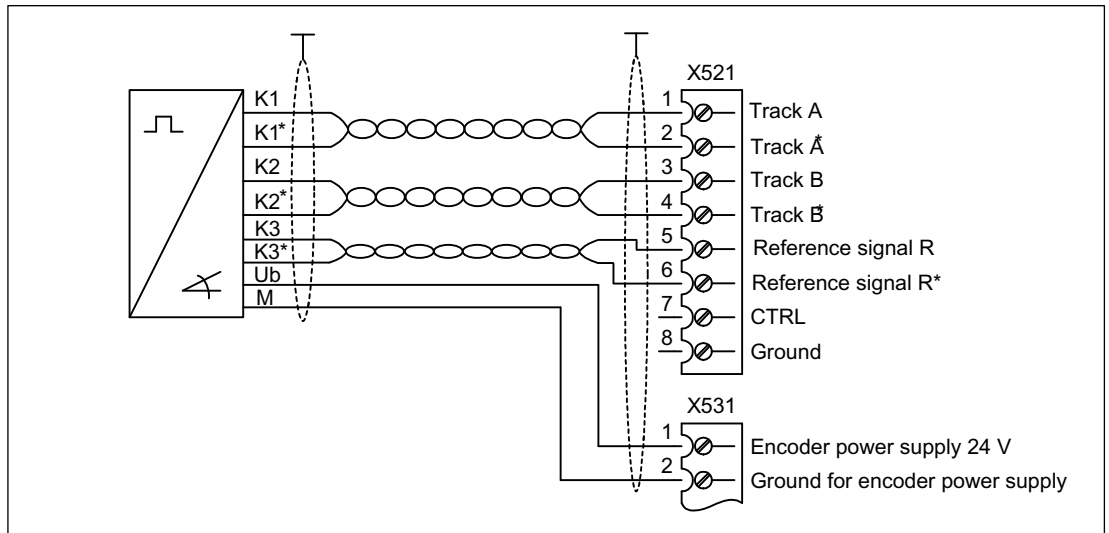


Figure 7-11 Connection example 1: HTL encoder, bipolar, with reference signal

Signal cables must be twisted in pairs in order to improve noise immunity against induced noise.

#### Connection example 2: HTL encoder, unipolar, with reference signal

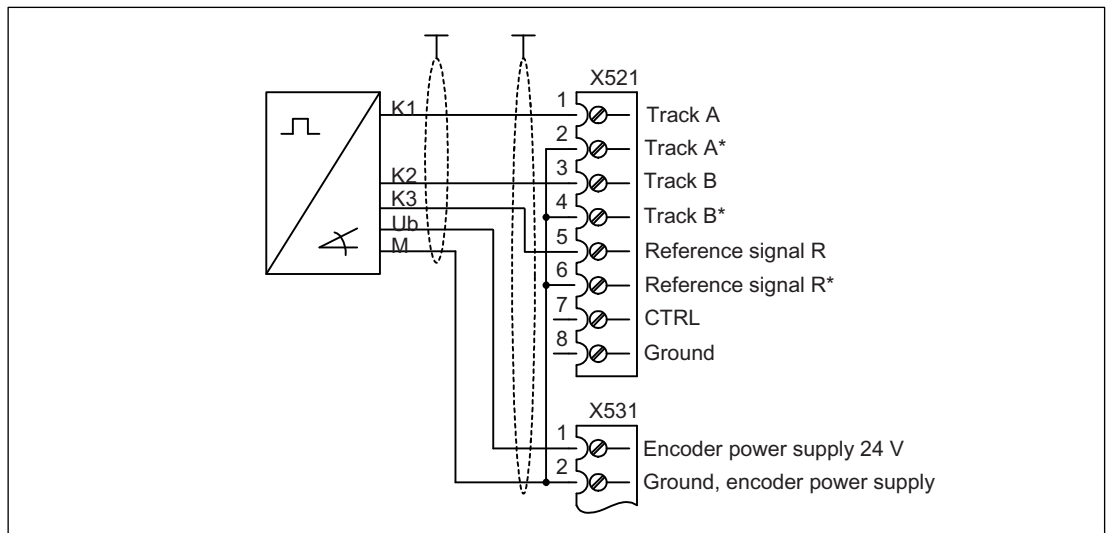


Figure 7-12 Connection example 2: HTL encoder, unipolar, with reference signal<sup>1)</sup>

<sup>1)</sup> Because the physical transmission media is more robust, the bipolar connection should always be used. The unipolar connection should only be used if the encoder type does not output push-pull signals.

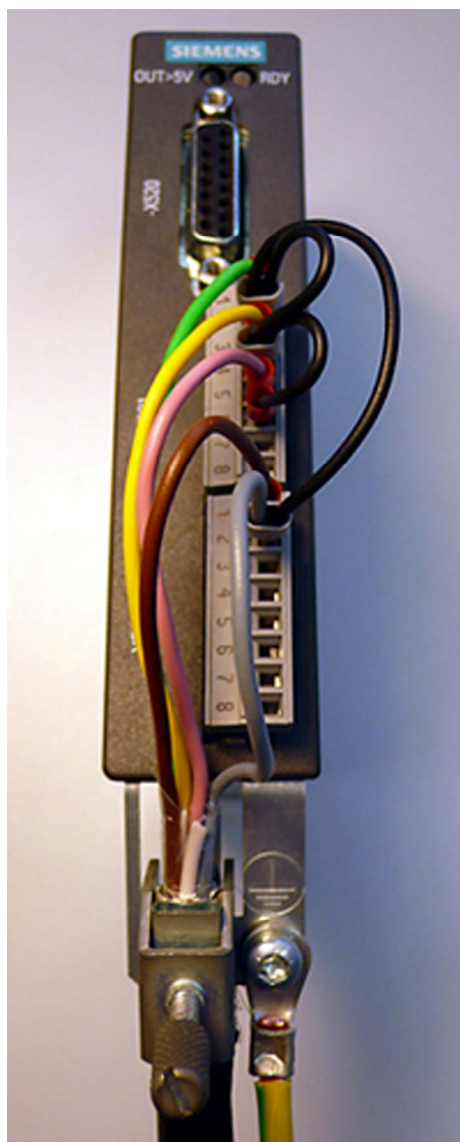


Figure 7-13 Photo of connection example 2: SMC30, 30 mm wide

Note: Diagram of the wire jumpers to connect unipolar HTL encoders with reference signal

## 7.4.5 Meaning of LEDs

### Cause and rectification of faults

The following documents contain information about the cause of faults and how they can be rectified:

SINAMICS S120 Commissioning Manual (IH1)

SINAMICS S120/S150, List Manual (LH1)

Table 7- 18 Meaning of LEDs on the Sensor Module Cabinet SMC30

LED	Color	Status	Description, cause	Remedy
RDY READY	-	Off	Electronics power supply is missing or outside permissible tolerance range.	-
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	-
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	-
	Red	Continuous light	At least one fault is present in this component. <b>Note:</b> The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
	Green/ red	Flashing 0.5 Hz	Firmware is being downloaded.	-
	Green/ red	Flashing 2 Hz	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
	Green/ orange or Red/ orange	Flashing light	Component recognition via LED is activated (p0144). <b>Note:</b> Both options depend on the LED status when component recognition is activated via p0144 = 1.	-
OUT > 5 V	-	Off	Electronics power supply is missing or outside permissible tolerance range. Power supply $\leq$ 5 V.	-
	Orange	Continuous light	Electronics power supply for encoder system available. Power supply > 5 V. <b>Important:</b> 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.	-

### 7.4.6 Dimension drawing

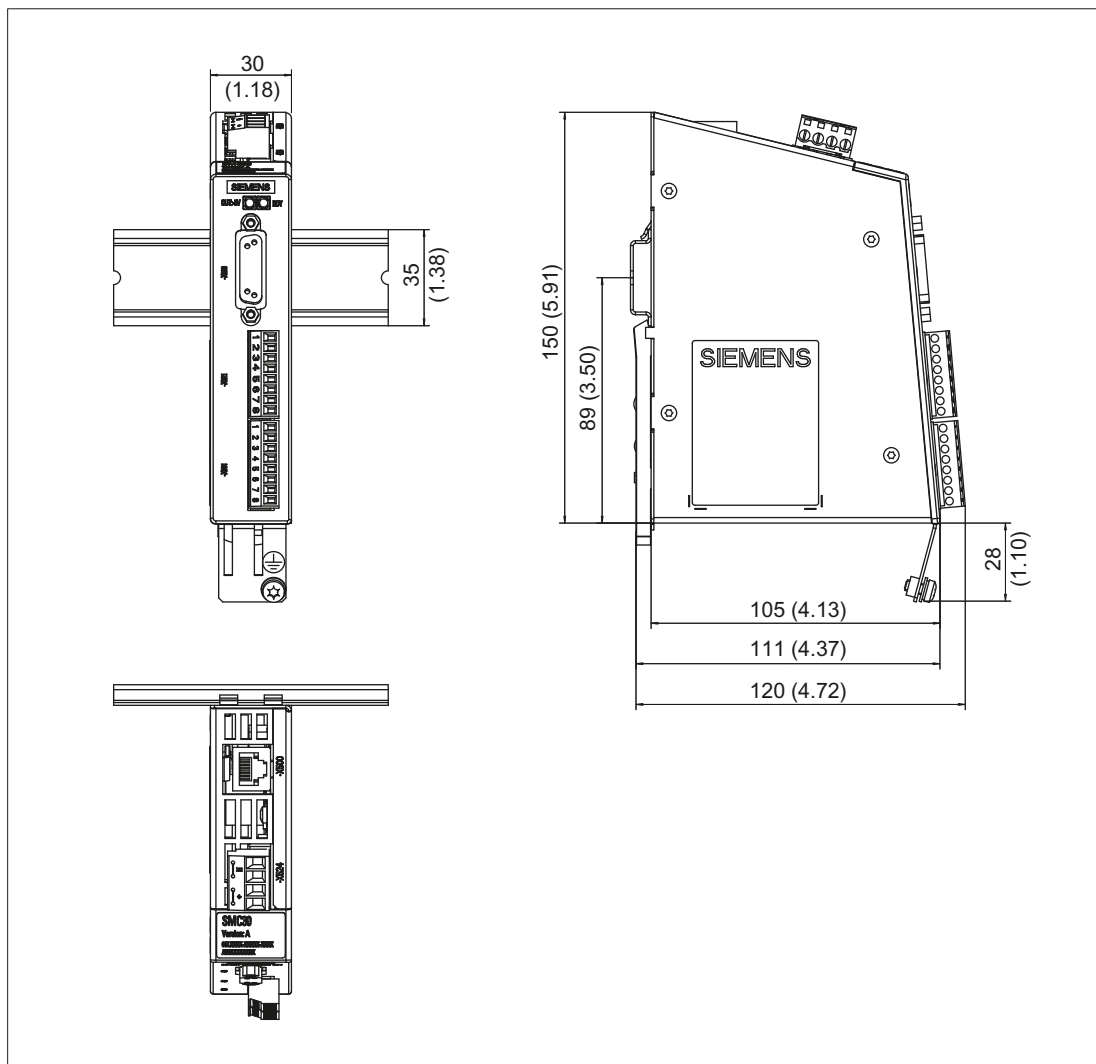


Figure 7-14 Dimension drawing of the Sensor Module Cabinet SMC30, all data in mm and (inches)

### 7.4.7 Mounting

#### Installation

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



## Removal

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

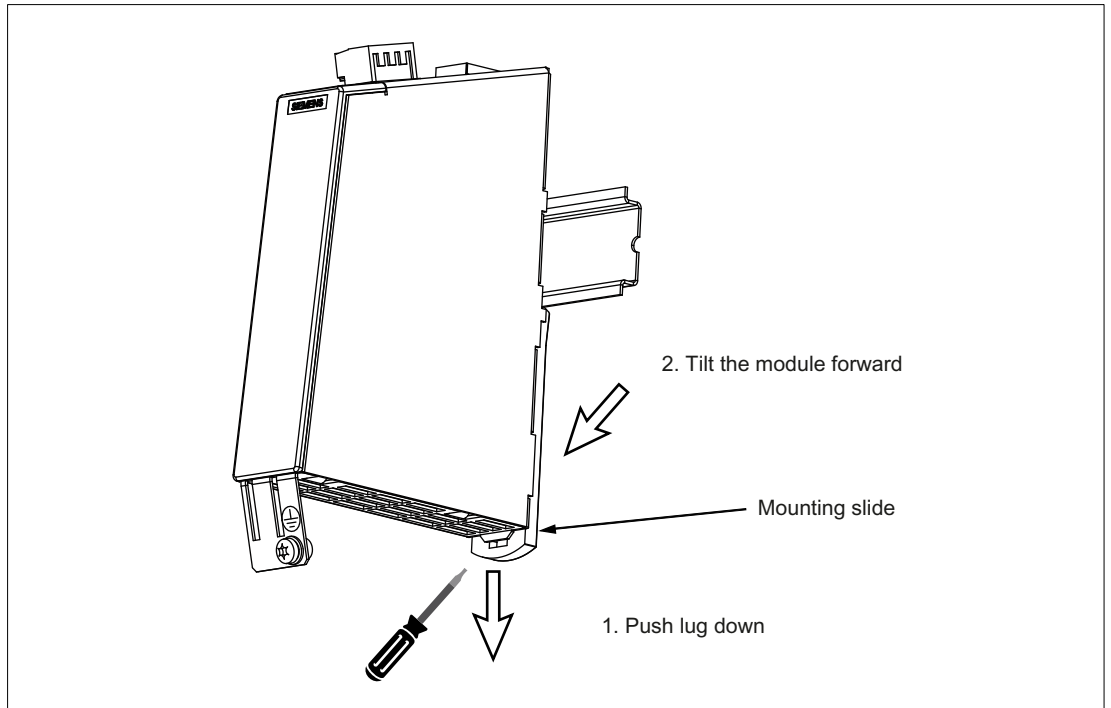


Figure 7-15 Removal of a component from a DIN rail

### 7.4.8 Protective conductor connection and shield support

Shield contacts are only required if the system is connected to X521/X531.

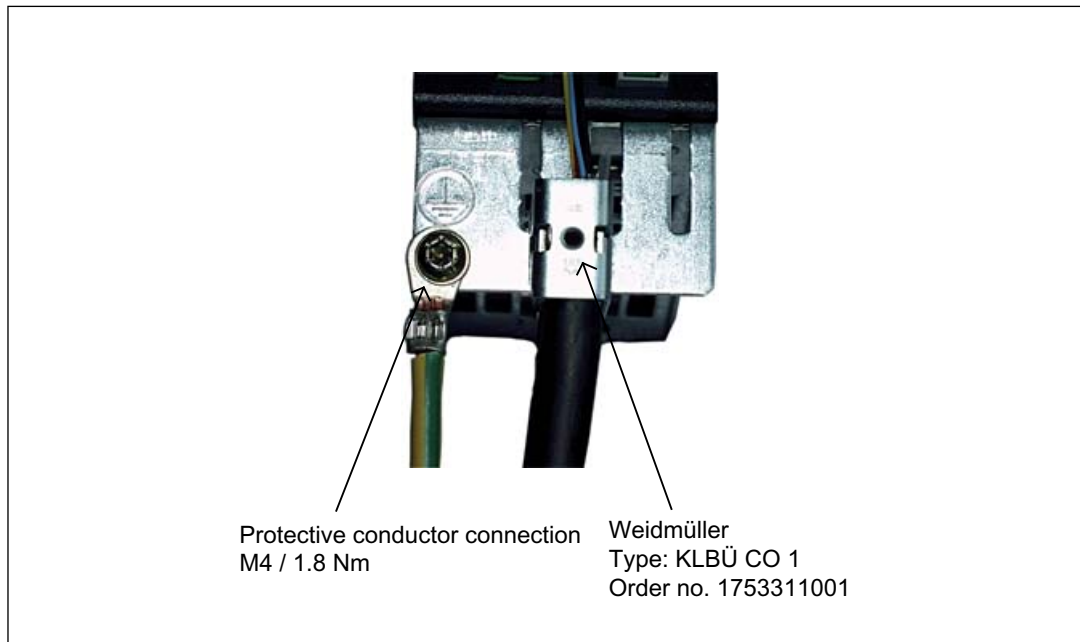


Figure 7-16 Shield contacts for the SMC30

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

The bending radii of the cables must be taken into account (see MOTION-CONNECT description).

**NOTICE**

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

## 7.4.9 Technical Specifications

Table 7- 19 Technical data

6SL3055-0AA00-5CAx	Unit	Value
<b>Electronics power supply</b>		
Voltage	$V_{DC}$	24 DC (20.4 – 28.8)
Current (without encoder system)	$A_{DC}$	$\leq 0.20$
Current (with encoder system)	$A_{DC}$	$\leq 0.55$
Power loss	W	$\leq 10$
<b>Encoder system power supply</b>		
Voltage	$V_{encoder}$	5 VDC (with or without Remote Sense) <sup>1)</sup> or $V_{DC} - 1 V$
Current	$A_{encoder}$	0.35
Encoder frequency that can be evaluated ( $f_{encoder}$ )	kHz	$\leq 300$
SSI baud rate	kHz	100 - 250
PE/ground connection		On housing with M4/1.8 Nm screw
Weight		0.45
Degree of protection		IP20 or IPXXB

1) A controller compares the encoder system supply voltage - sensed via the Remote Sense cables - with the reference supply voltage of the encoder system, and adjusts the supply voltage for the encoder system at the output of the drive module until the required supply voltage is obtained directly at the encoder system (only for 5 V encoder system power supply). Remote Sense only to X520.

Table 7- 20 Specification of encoder systems that can be connected

Parameter	Designation	Threshold	Min.	Max.	Unit
High signal level (TTL bipolar at X520 or X521/X531) <sup>1)</sup>	$U_{Hdiff}$		2	5	V
Low signal level (TTL bipolar at X520 or X521/X531) <sup>1)</sup>	$U_{Ldiff}$		-5	-2	V
Signal level high (HTL unipolar)	$U_H^{3)}$	High	17	$V_{CC}$	V
		Low	10	$V_{CC}$	V
Signal level low (HTL unipolar)	$U_L^{3)}$	High	0	7	V
		Low	0	2	V
High signal level (HTL bipolar) <sup>2)</sup>	$U_{Hdiff}$		3	$V_{CC}$	V
Low signal level (HTL bipolar) <sup>2)</sup>	$U_{Ldiff}$		$-V_{CC}$	-3	V
High signal level (SSI bipolar at X520 or X521/X531) <sup>1)</sup>	$U_{Hdiff}$		2	5	V
Low signal level (SSI bipolar at X520 or X521/X531) <sup>1)</sup>	$U_{Ldiff}$		-5	-2	V
Signal frequency	$f_s$		-	300	kHz
Edge clearance	$t_{min}$		100	-	ns

Supplementary system components and encoder system integration

7.4 Sensor Module Cabinet-Mounted SMC30

Parameter	Designation	Threshold	Min.	Max.	Unit
"Zero pulse inactive time" (before and after A=B=high)	t <sub>Lo</sub>		640	(t <sub>ALo-BHi</sub> - t <sub>Hi</sub> )/2 <sup>4)</sup>	ns
"Zero pulse active time" (while A=B=high and beyond) <sup>5)</sup>	t <sub>Hi</sub>		640	t <sub>ALo-BHi</sub> - 2*t <sub>Lo</sub> <sup>4)</sup>	ns

- 1) Other signal levels according to the RS 422 standard.
- 2) The absolute level of the individual signals varies between 0 V and VCC of the encoder system.
- 3) Only with order number 6SL3055-0AA00-5CA2 and firmware version 2.5 SP1 or higher can this value be configured using software. For older firmware releases and Order Nos. less than 6SL3055-0AA00-5CA2 then the "low" threshold applies.
- 4) t<sub>ALo-BHi</sub> is not a specified value, but is the time between the falling edge of track A and the next but one rising edge of track B.
- 5) Further information on setting the "Zero pulse active time" can be found in the manual: SINAMICS S120, Function Manual, tolerant encoder monitoring for SMC30

Table 7- 21 Encoders that can be connected

	X520 (SUB-D)	X521 (terminal)	X531 (terminal)	Track monitoring	Remote Sense <sup>2)</sup>
HTL bipolar 24 V	No/yes	Yes		No/yes	No
HTL unipolar 24 V <sup>1)</sup>	No/yes	Yes (however, a bipolar connection is recommended) <sup>1)</sup>		No	No
TTL bipolar 24 V	Yes	Yes		Yes	No
TTL bipolar 5 V	Yes	Yes		Yes	To X520
SSI 24 V/5 V	Yes	Yes		No	No
TTL unipolar	No				

- 1) Because the physical transmission media is more robust, the bipolar connection should always be used. The unipolar connection should only be used if the encoder type does not output push-pull signals.
- 2) A controller compares the encoder system supply voltage - sensed via the Remote Sense cables - with the reference supply voltage of the encoder system, and adjusts the supply voltage for the encoder system at the output of the drive module until the required supply voltage is obtained directly at the encoder system (only for 5 V encoder system power supply).

Table 7- 22 Maximum encoder cable length

Encoder type	Maximum encoder cable length in m
TTL <sup>1)</sup>	100
HTL unipolar <sup>2)</sup>	100
HTL bipolar	300
SSI	100

- 1) For TTL encoders at X520 → Remote Sense → 100 m
- 2) Because the physical transmission properties are more robust, the bipolar connection should always be used. The unipolar connection should only be used if the encoder type does not output push-pull signals.

For encoders with a 5 V supply at X521/X531, the cable lengths depend on the encoder current (for 0.5 mm<sup>2</sup> cable cross-sections):

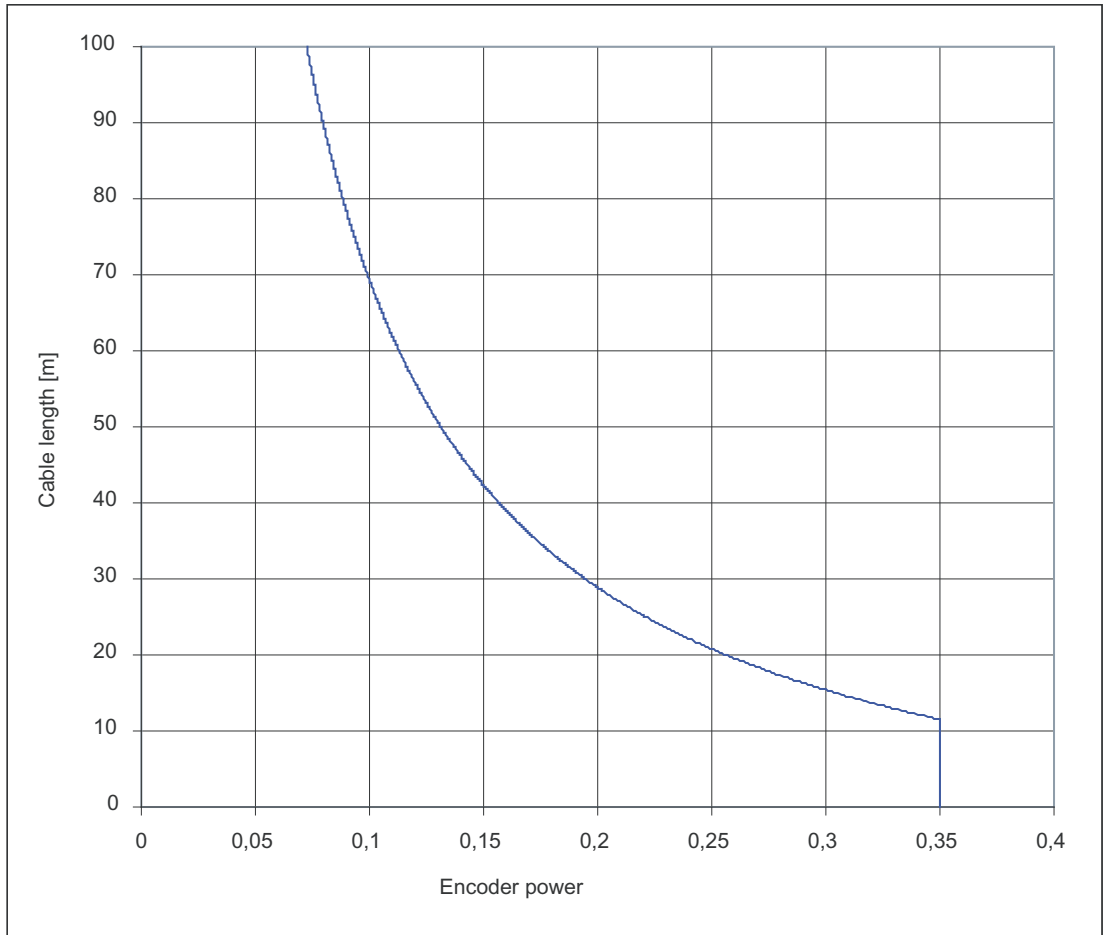


Figure 7-17 Max. cable length as a function of the encoder current drawn

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

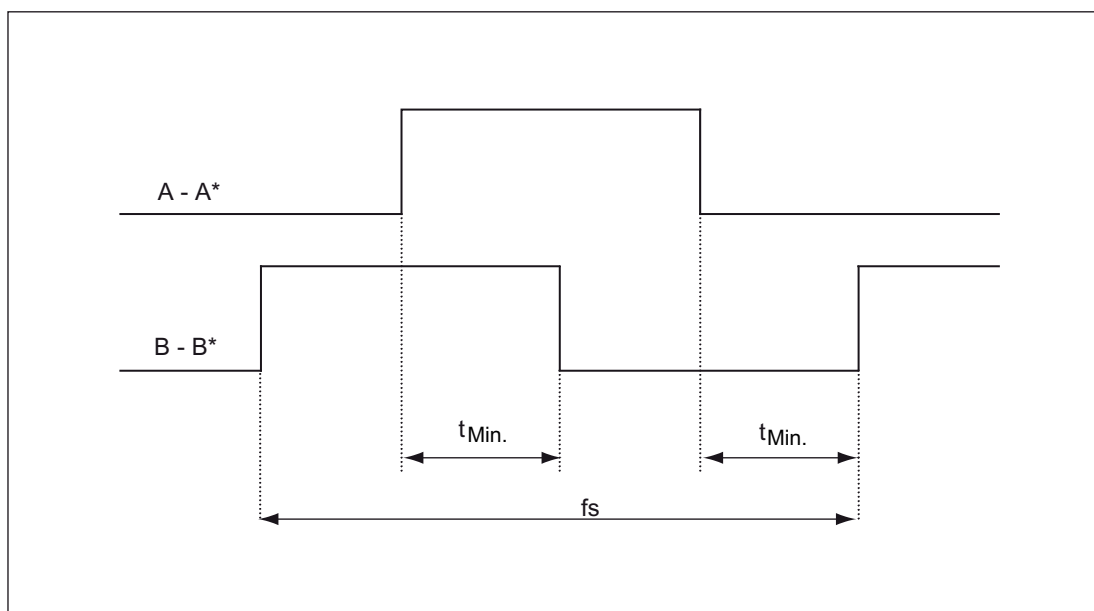


Figure 7-18 Signal characteristic of track A and track B between two edges: Time between two edges with pulse encoders

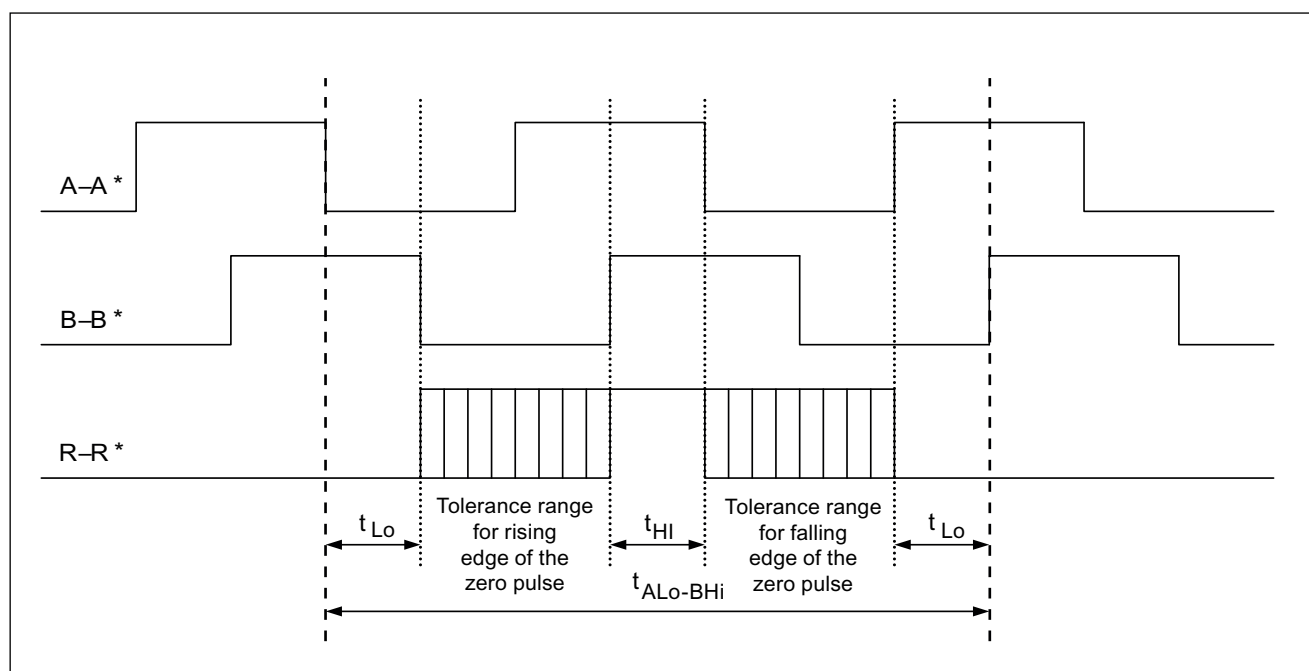


Figure 7-19 Position of the zero pulse to the track signals

## 7.5 Option modules, braking signal

### 7.5.1 Introduction

A brake control option module (Safe Brake Relay) is required for operating motors with holding brakes.

The brake control option module is the electrical interface between the CU/PM340 and the brake of a motor.

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

### 7.5.2 Safe Brake Relay

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

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

Table 7- 23 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

Overview

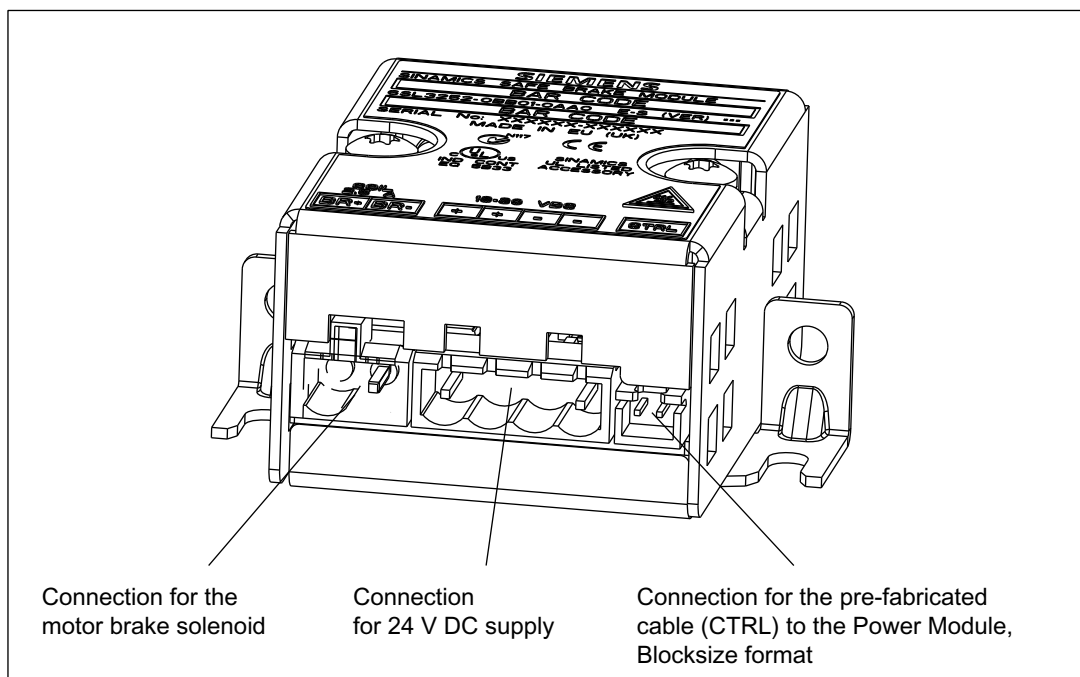
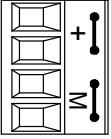


Figure 7-20 Interface description: Safe Brake Relay



## Electronics power supply X524

Table 7- 24 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
	M	Electronic ground	
Max. connectable cross-section: 2.5 mm <sup>2</sup> Type: Screw-type terminal (see Appendix A)			

### Note

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

## Brake connection

Table 7- 25 Connector

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

7.5.2.3 Connection example

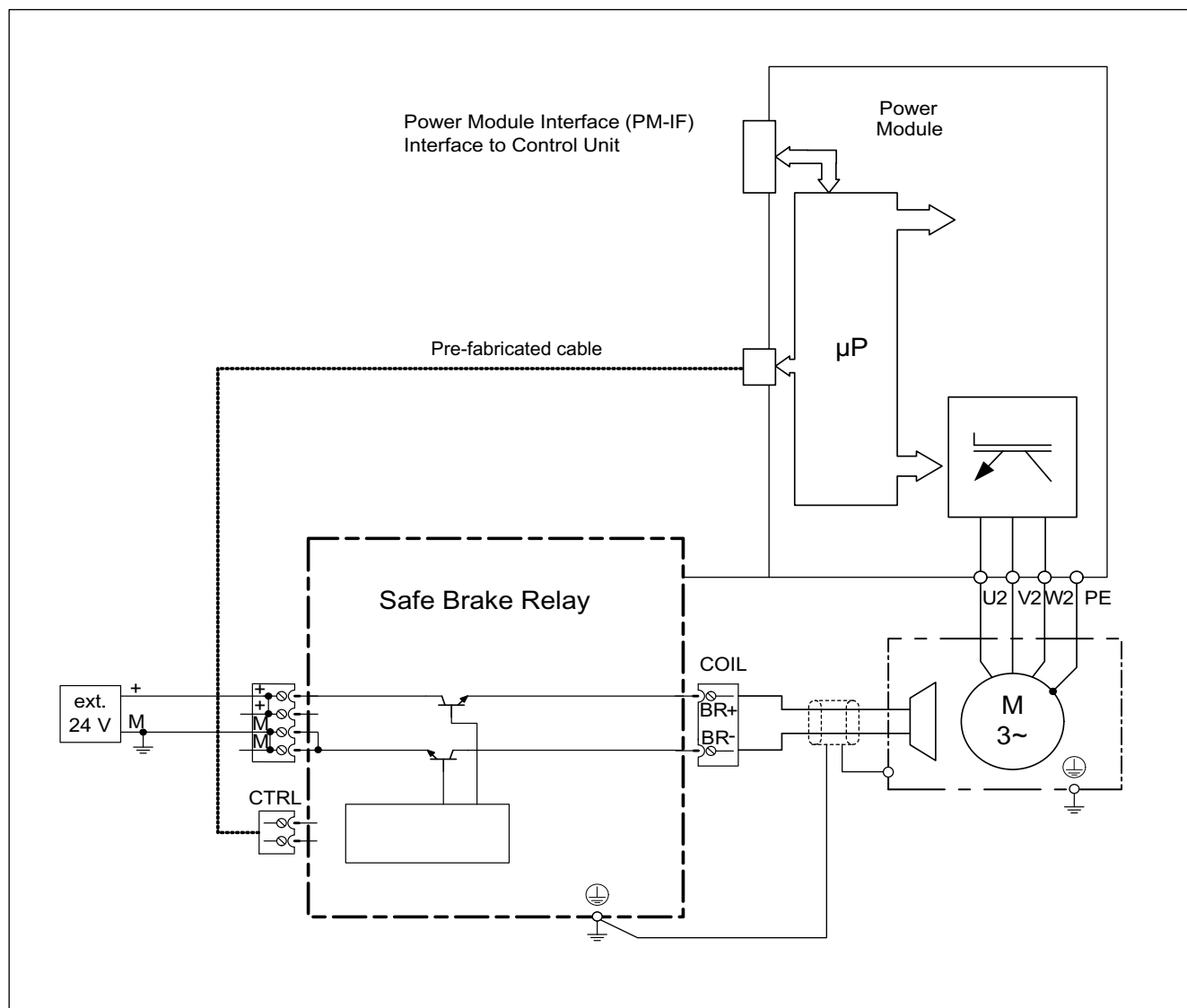


Figure 7-21 Safe Brake Relay connection example

7.5.2.4 Dimension drawing

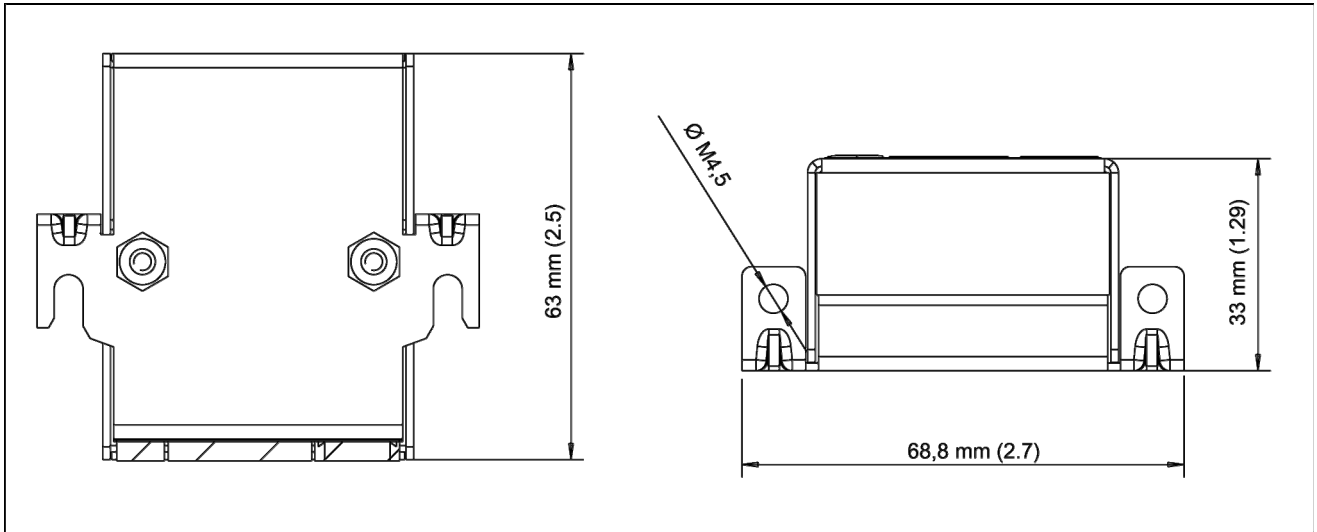


Figure 7-22 Dimension drawing of Safe Brake Relay, all data in mm and (inches)

### 7.5.2.5 Mounting

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

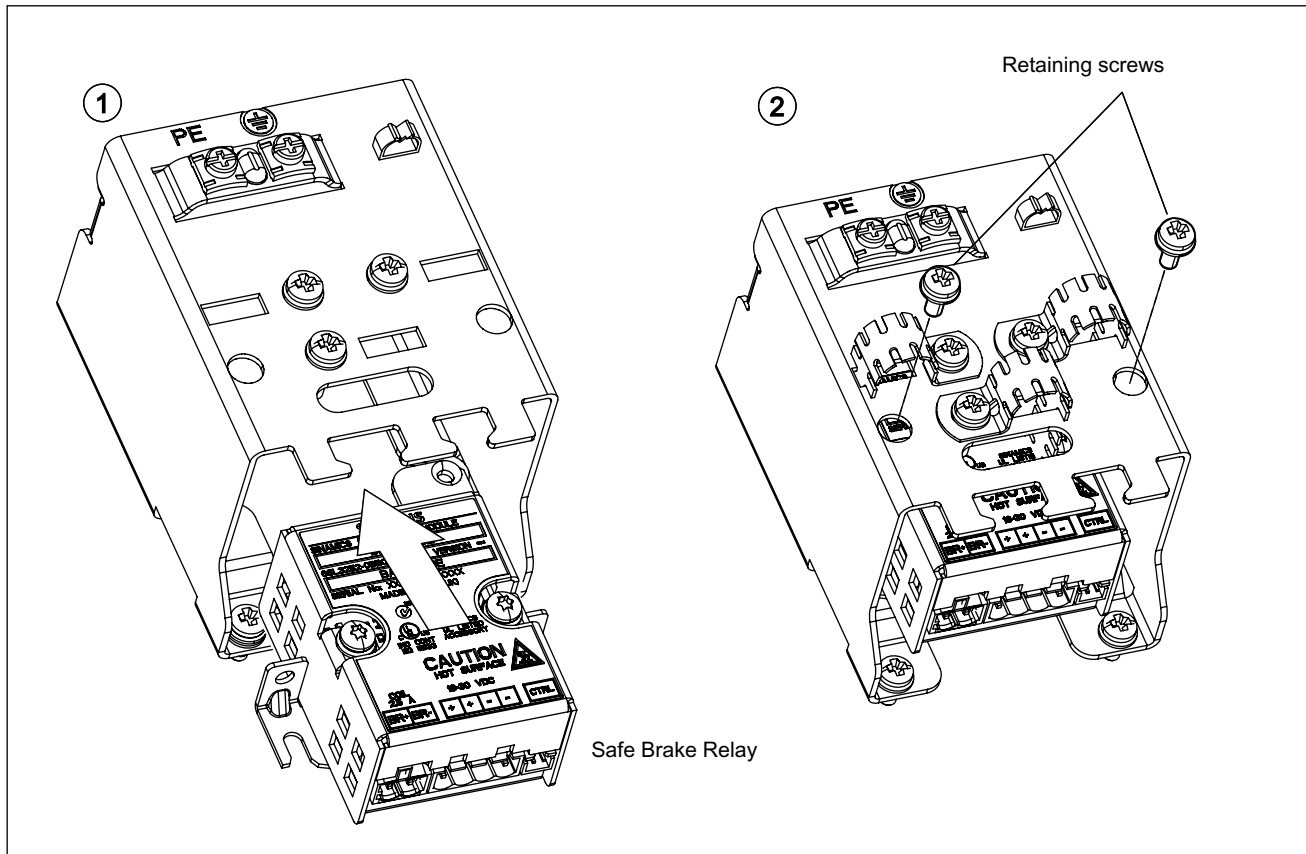


Figure 7-23 Mounting the Safe Brake Relay on the Screening Kit (frame size FSA)

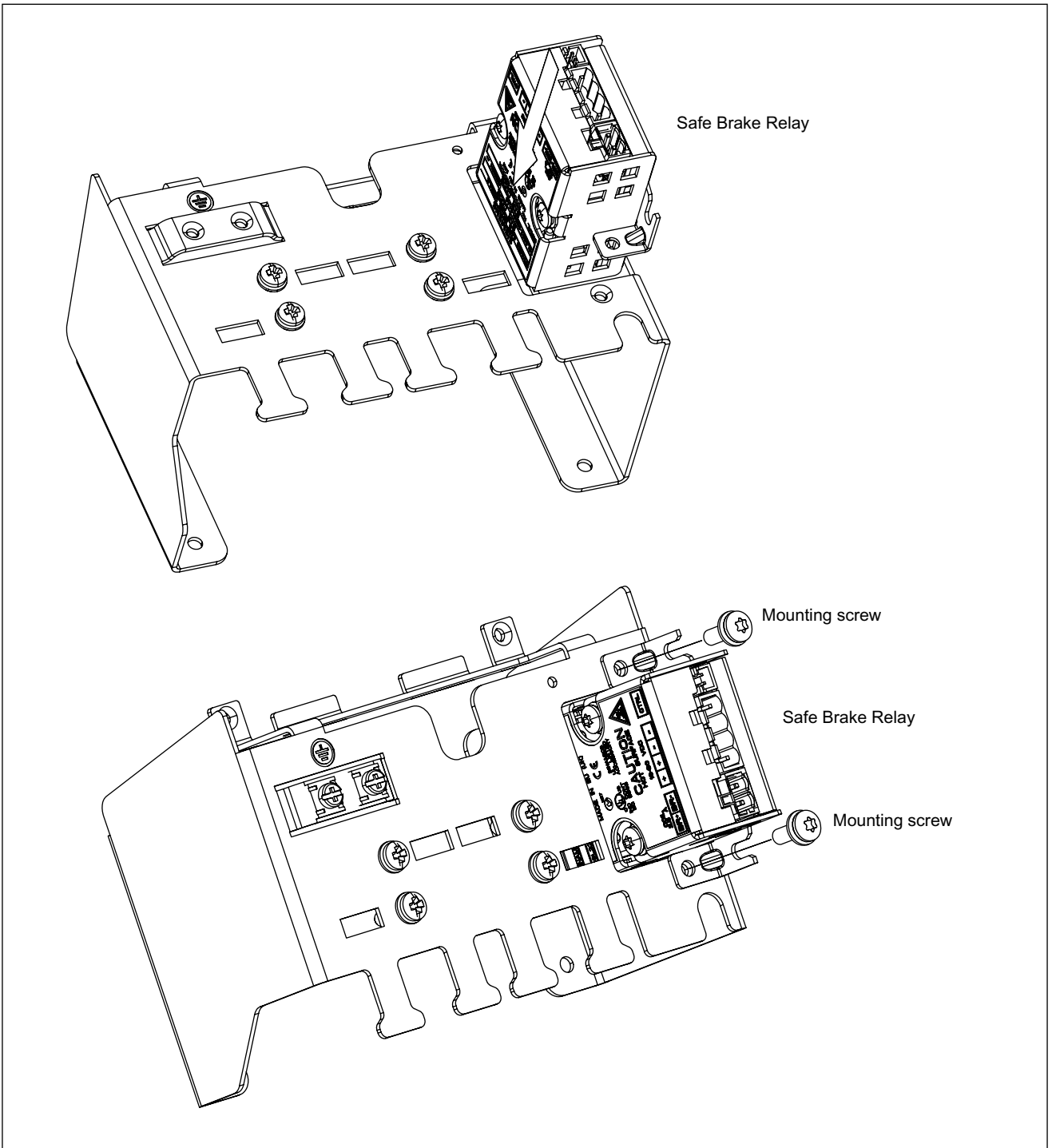


Figure 7-24 Mounting the Safe Brake Relay on the Screening Kit (frame sizes FSB and FSC)

### 7.5.2.6 Technical data

<b>Safe Brake Relay</b>	
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 <sup>2</sup>
Weight, approx.	0.17 kg

## Accessories

### 8.1 DRIVE-CLiQ cabinet gland

#### 8.1.1 Description

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

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

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

#### 8.1.2 Safety Information

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**Note**

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

---

### 8.1.3 Interface description

#### 8.1.3.1 Overview

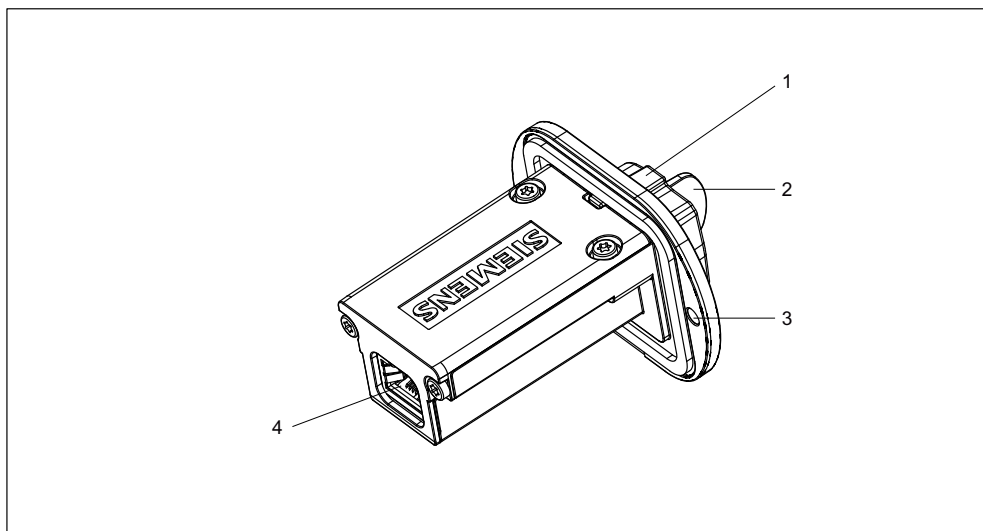


Figure 8-1 DRIVE-CLiQ cabinet bushing

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

### 8.1.4 Dimension drawing

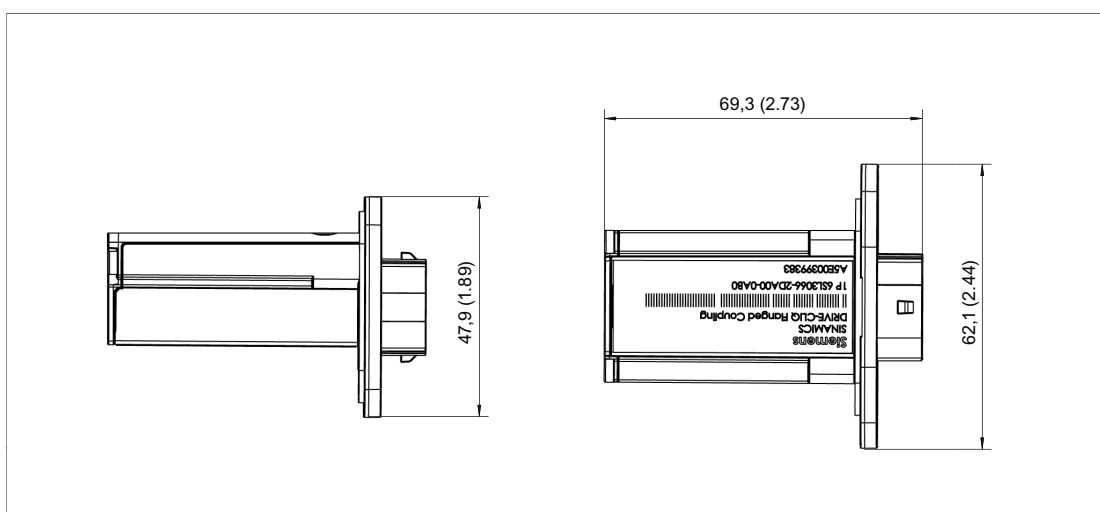


Figure 8-2 Dimension drawing of the DRIVE-CLiQ cabinet bushing, all dimensions in mm and (inches)



## 8.1.5 Installation

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

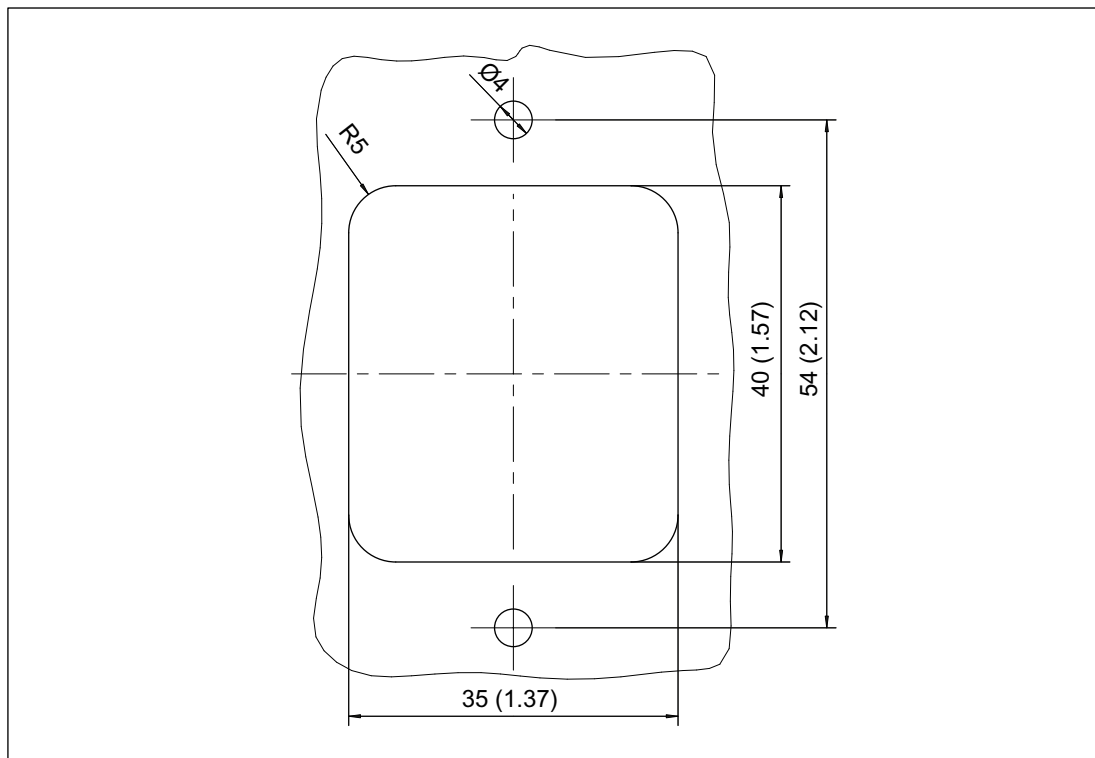


Figure 8-3 Cut-out for the cabinet

### Installation

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

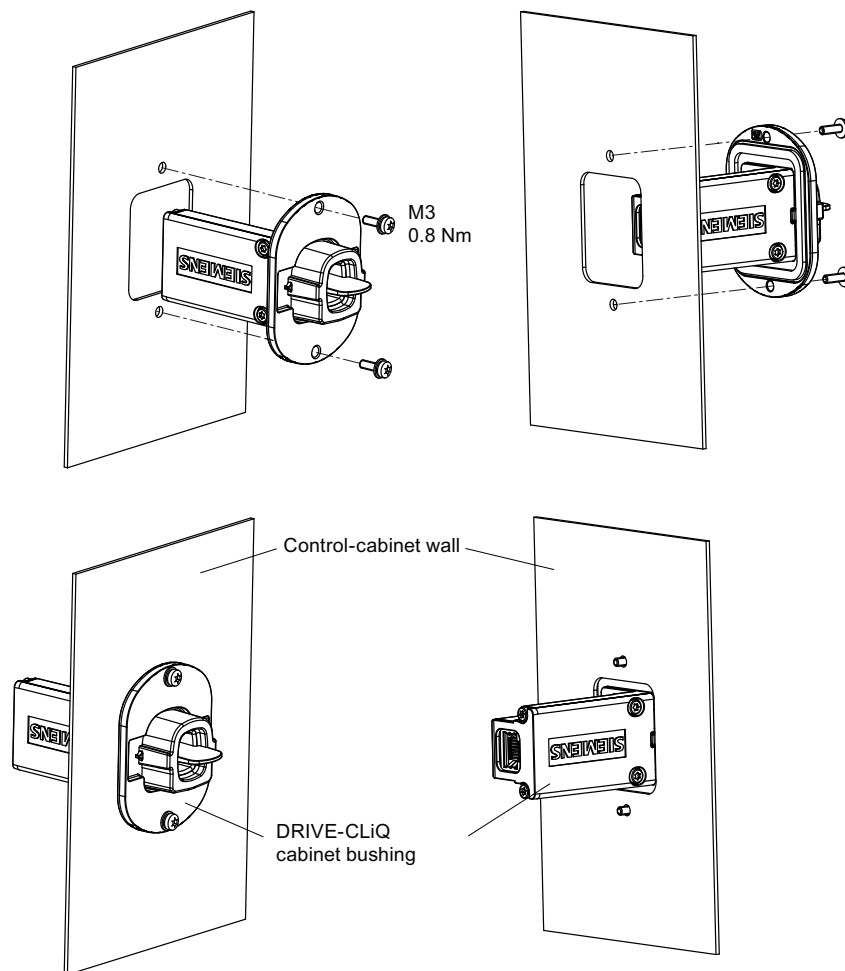


Figure 8-4 Installing the DRIVE-CLiQ cabinet bushing

### 8.1.6 Technical data

Table 8- 1 Technical data

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

## 8.2 DRIVE-CLiQ coupling

### 8.2.1 Description

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

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

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

### 8.2.2 Safety information

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#### Note

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

---

### 8.2.3 Interface description

#### 8.2.3.1 Overview

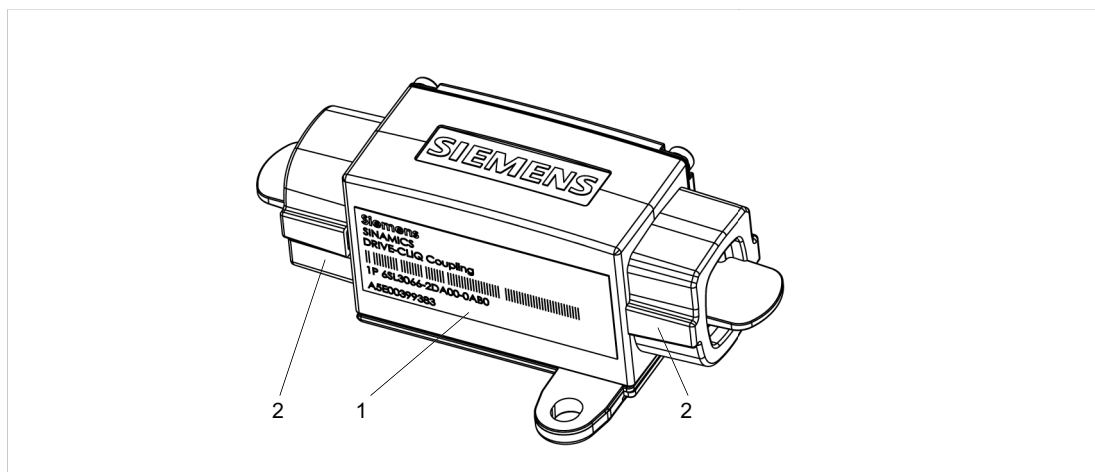


Figure 8-5 DRIVE-CLiQ coupling

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

8.2.4 Dimension drawing

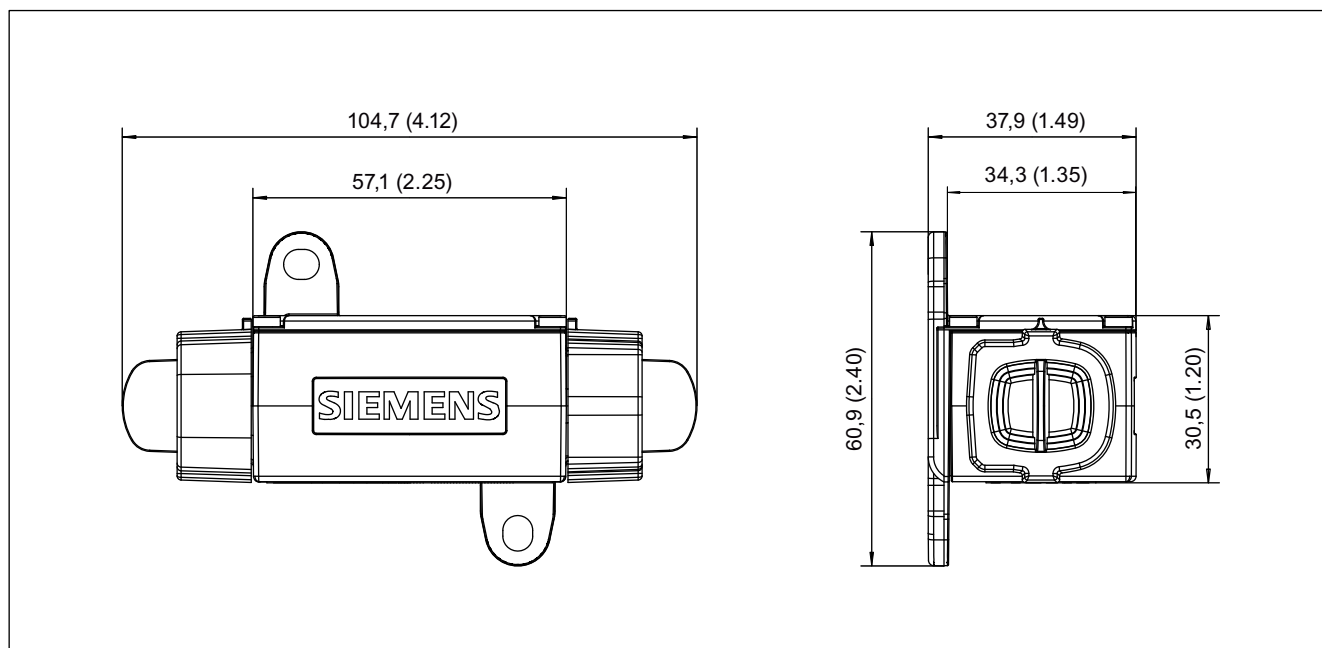


Figure 8-6 Dimension drawing of the DRIVE-CLiQ coupling, all dimensions in mm and (inches)

## 8.2.5 Installation

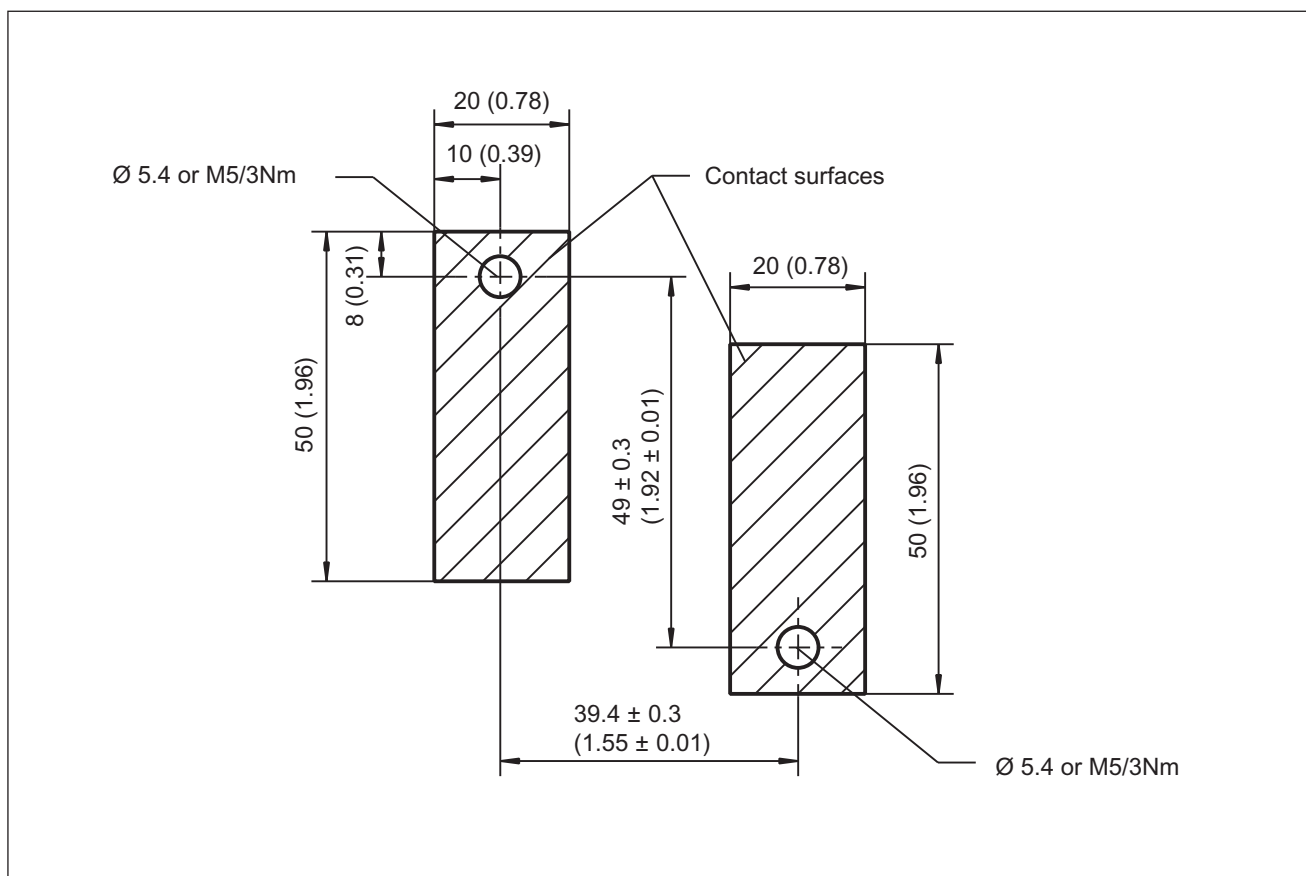


Figure 8-7 Hole drilling pattern for installation

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

## 8.2.6 Technical data

Table 8- 2 Technical data

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

## 8.3 Screening Kit

### 8.3.1 Description

A Screening Kit is offered as an optional shield support for Power Modules in frame sizes FSA to FSF. It provides shield support for the power cables. The Screening Kit is screwed directly onto the wall of the control cabinet for frame sizes FSA to FSC. With frame sizes FSD to FSF, it is attached to the Power Module. For frame sizes FSB and FSC, the Screening Kit accessories pack contains a ferrite core for damping radio cable disturbances.

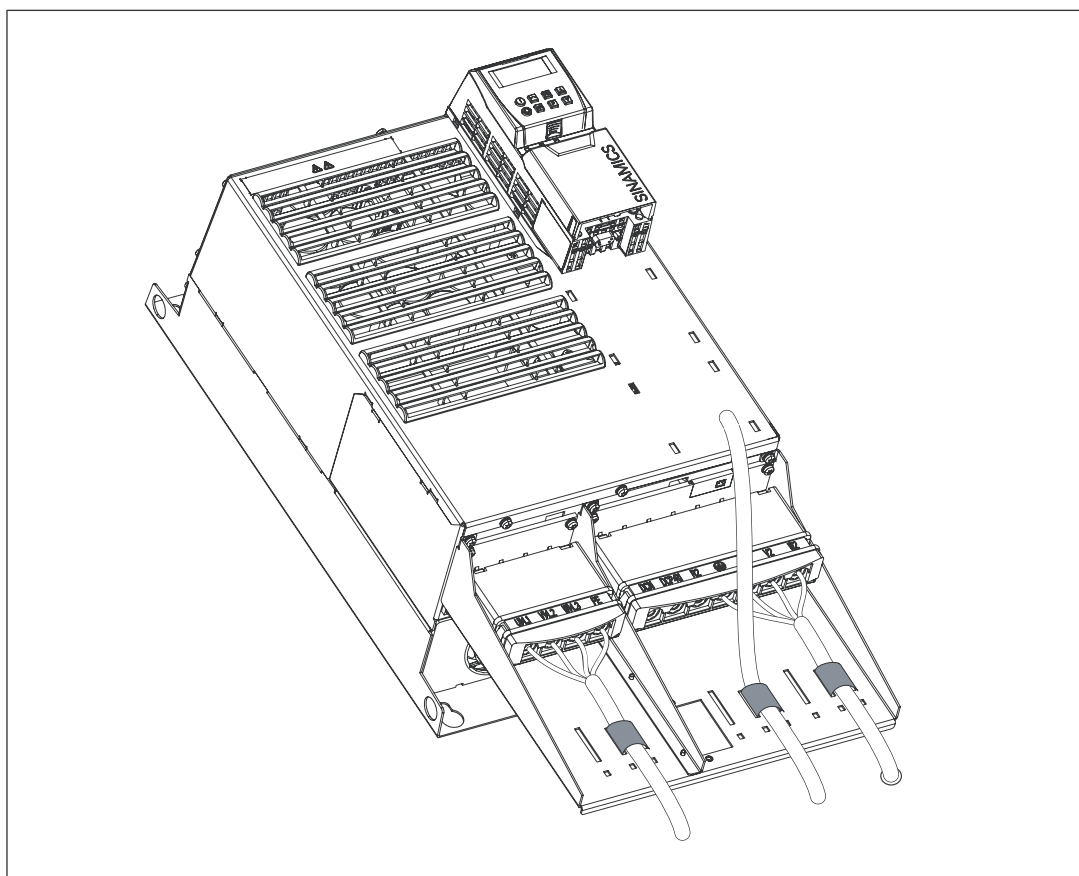


Figure 8-8 Power Module PM340 (frame sizes FSD, FSE) with CUA31 and Screening Kit

Table 8- 3 Overview of Screening Kits

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

## 8.3.2 Dimension drawings

### 8.3.2.1 Screening Kits

#### Dimension drawings of Screening Kits, frame sizes FSA to FSC

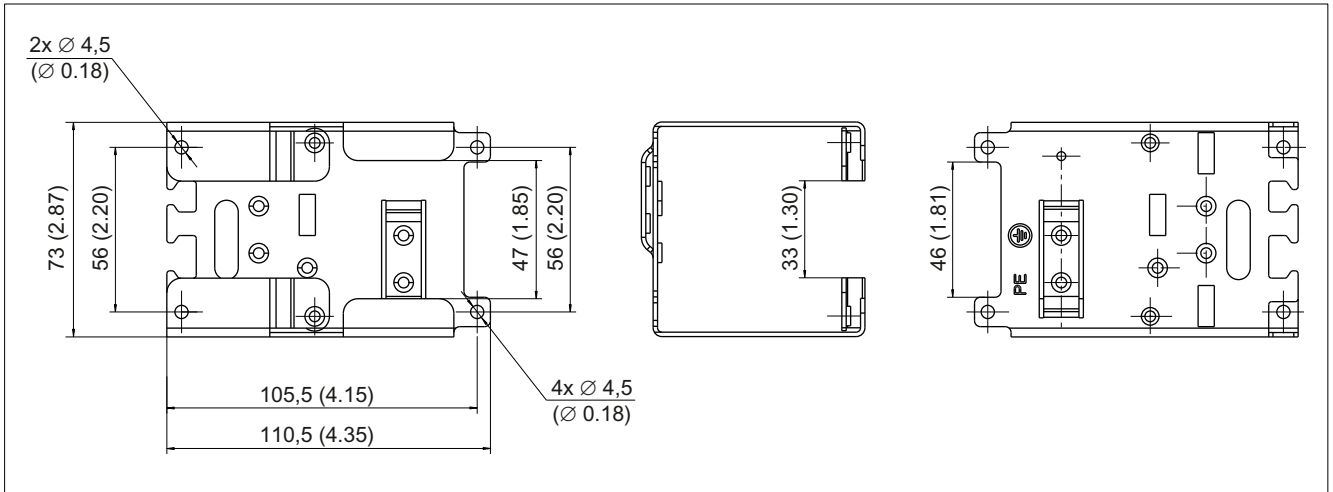


Figure 8-9 Dimension drawing of Screening Kit, frame size FSA, all data in mm and (inches)

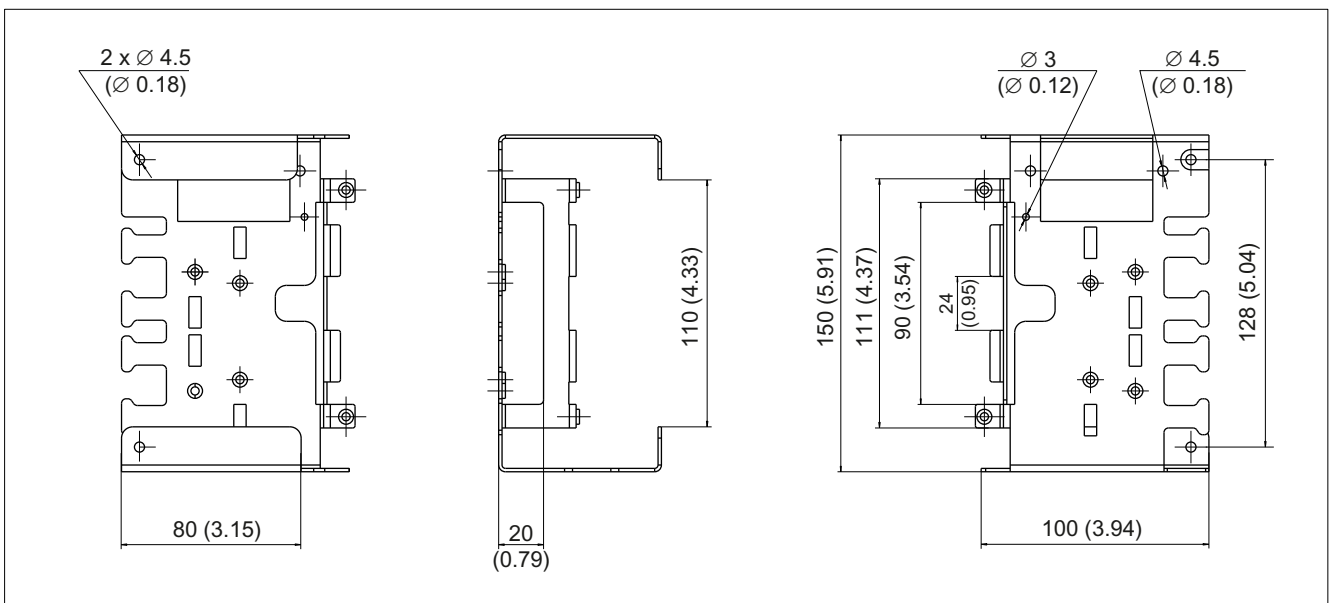


Figure 8-10 Dimension drawing of Screening Kit, frame size FSB, all data in mm and (inches)

Accessories

8.3 Screening Kit

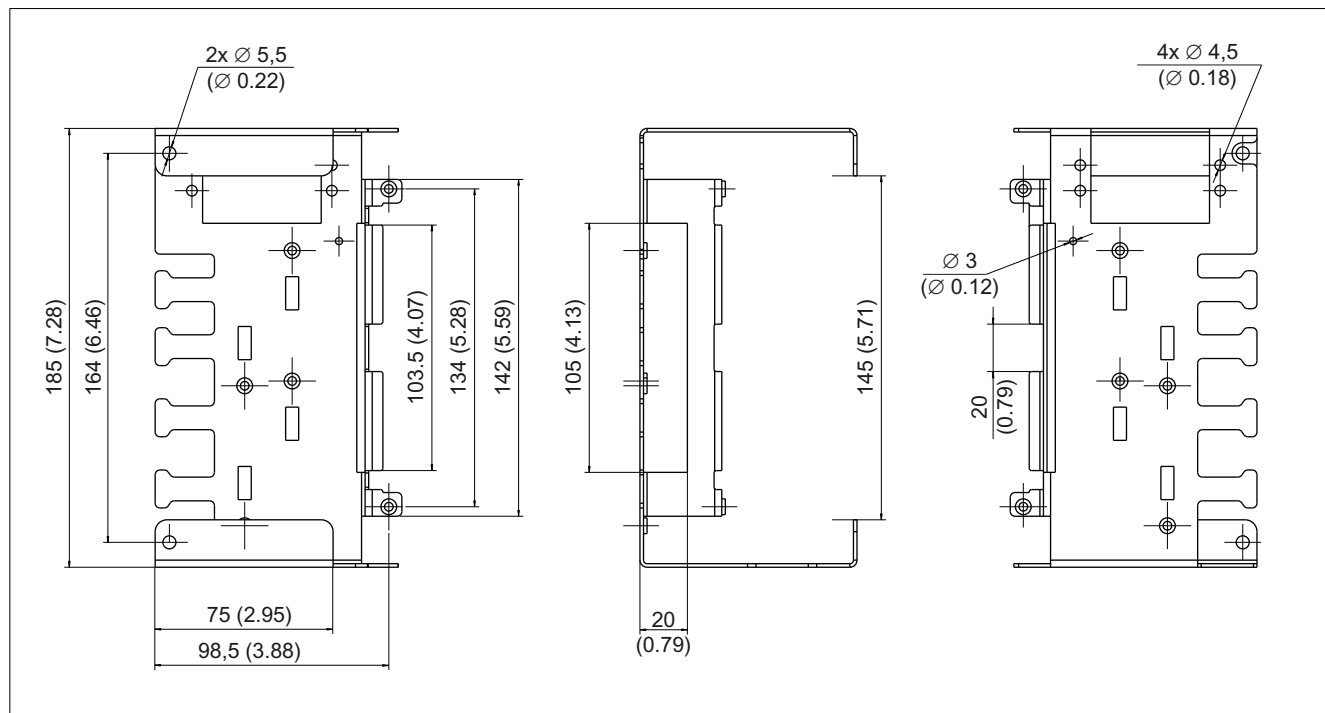


Figure 8-11 Dimension drawing of Screening Kit, frame size FSC, all data in mm and (inches)



### 8.3.2.2 Blocksize Power Modules with Screening Kits

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

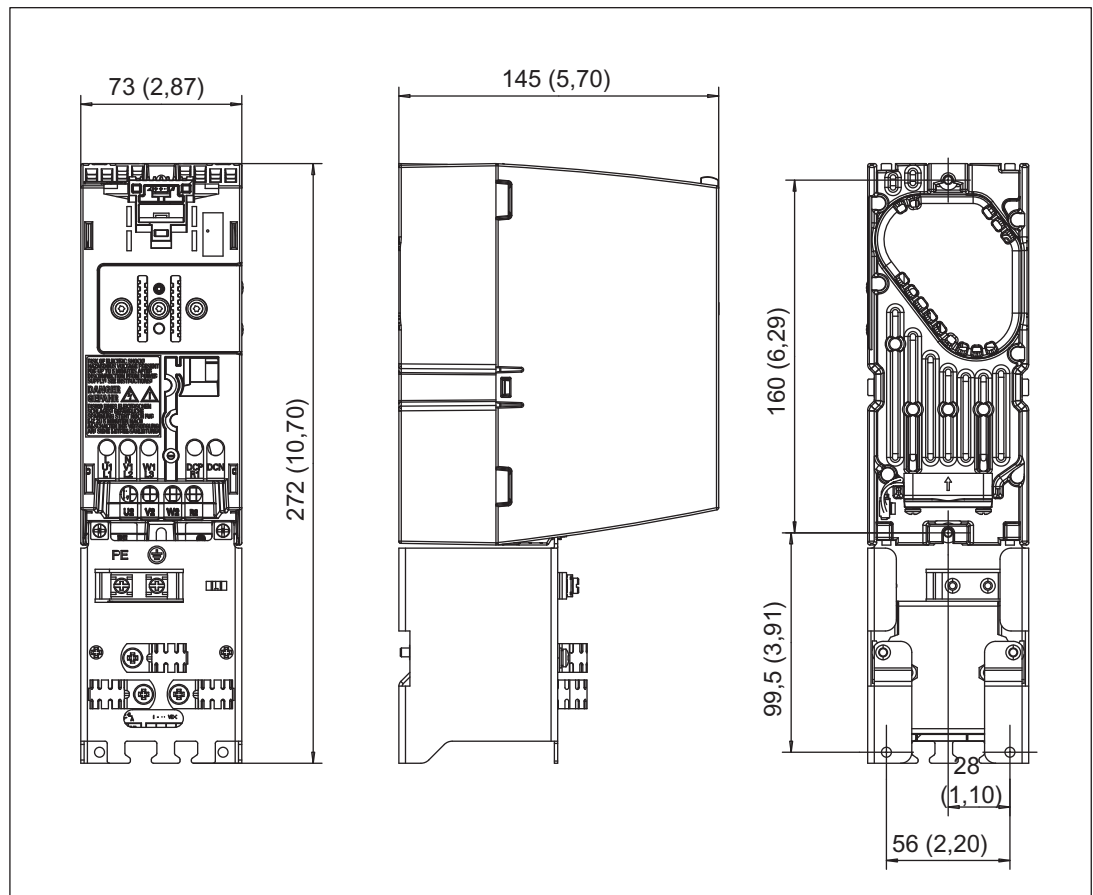


Figure 8-12 Dimension drawing of PM340 Power Module with Screening Kit, frame size FSA, all dimensions in mm and (inches)

Accessories

8.3 Screening Kit

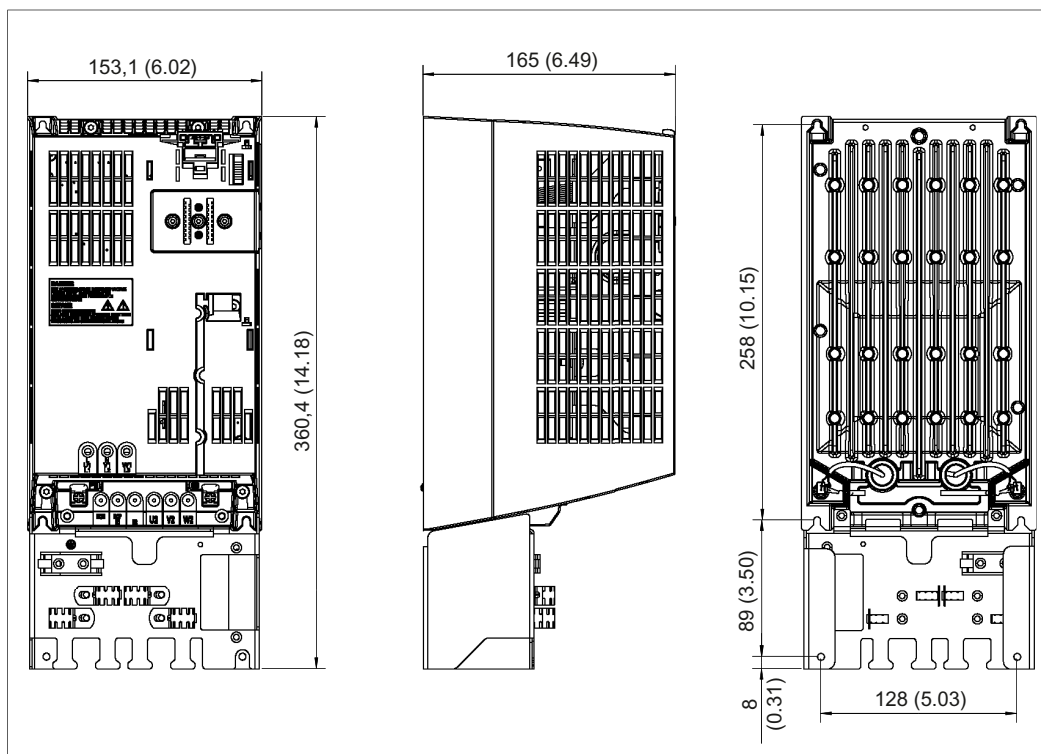


Figure 8-13 Dimension drawing of PM340 Power Module with Screening Kit, frame size FSB, all dimensions in mm and (inches)

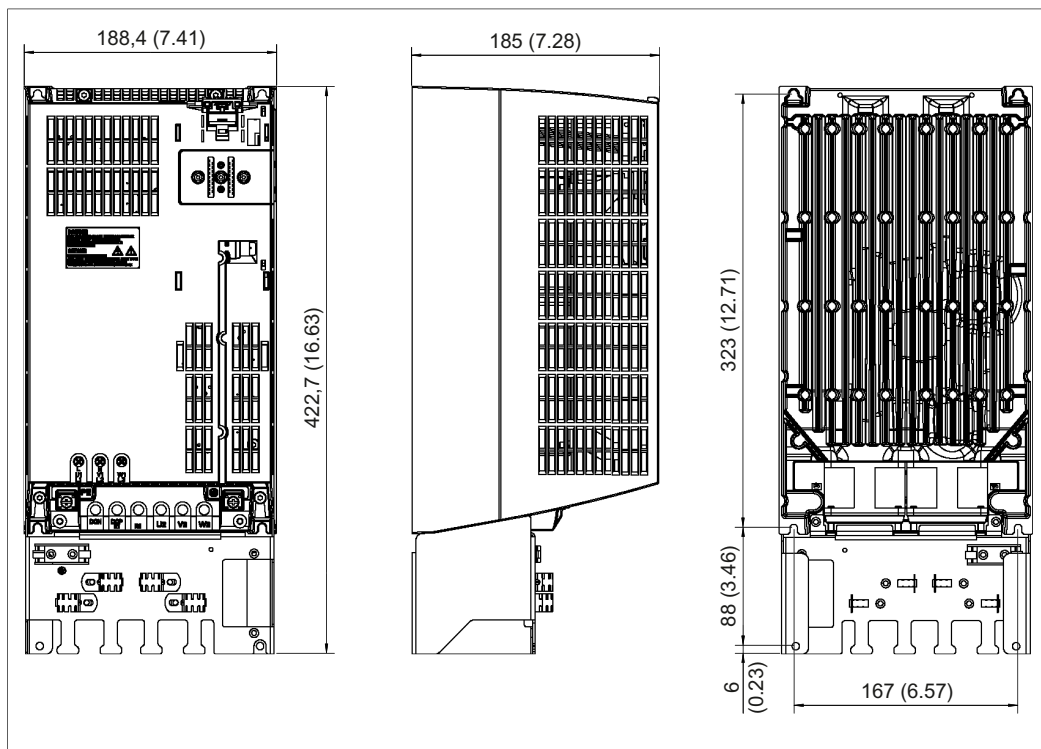


Figure 8-14 Dimension drawing of PM340 Power Module with Screening Kit, frame size FSC, all dimensions in mm and (inches)

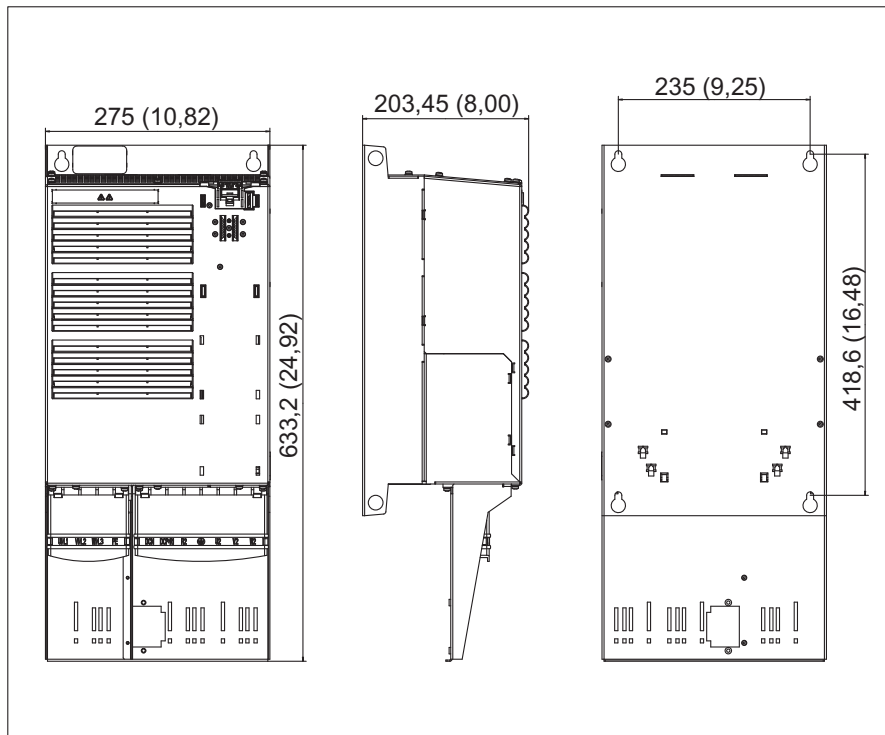


Figure 8-15 Dimension drawing of PM340 Power Module with Screening Kit, frame size FSD, all dimensions in mm and (inches)

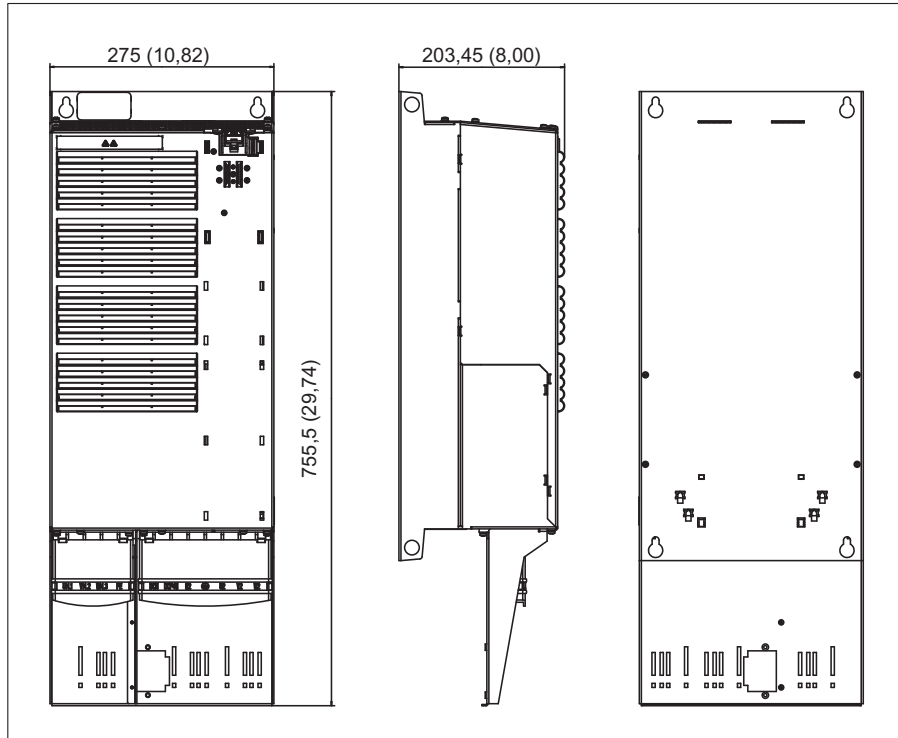


Figure 8-16 Dimension drawing: PM340 Power Module with Screening Kit, frame size FSE, all dimensions in mm and (inches)

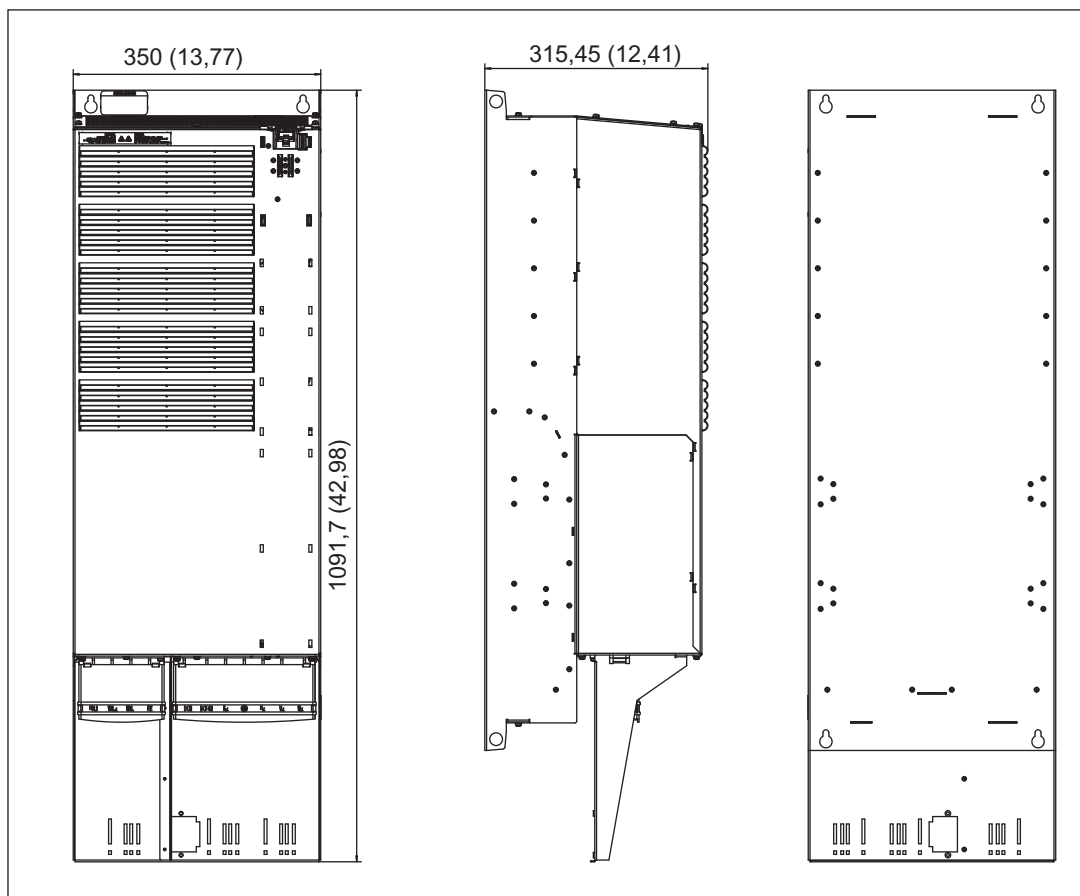


Figure 8-17 Dimension drawing: PM340 Power Module with Screening Kit, frame size FSF, all dimensions in mm and (inches)

### 8.3.3 Mounting

#### 8.3.3.1 Overview

Frame size FSA

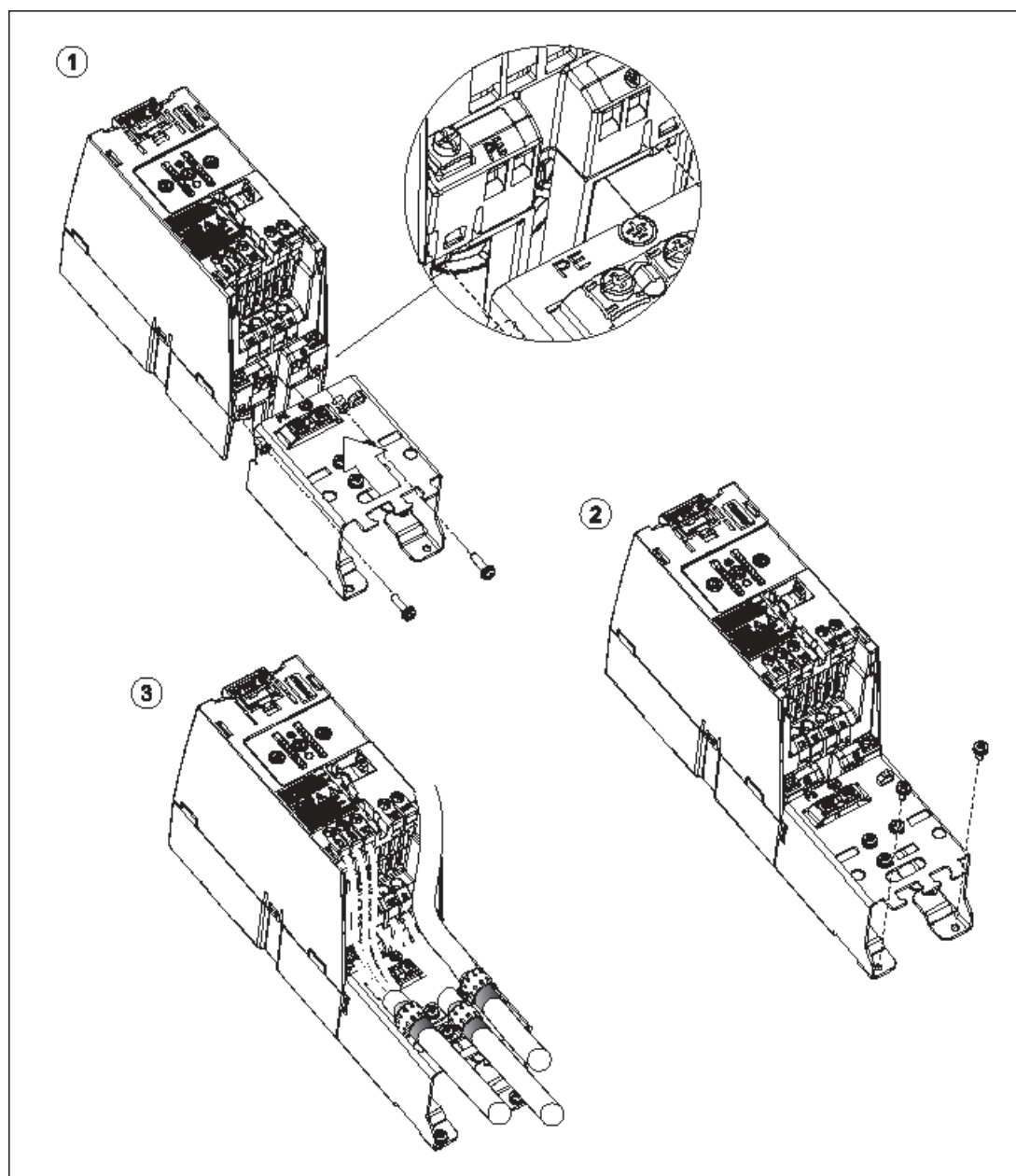


Figure 8-18 Mounting a Screening Kit on a Power Module of frame size FSA

Frame size FSB/FSC

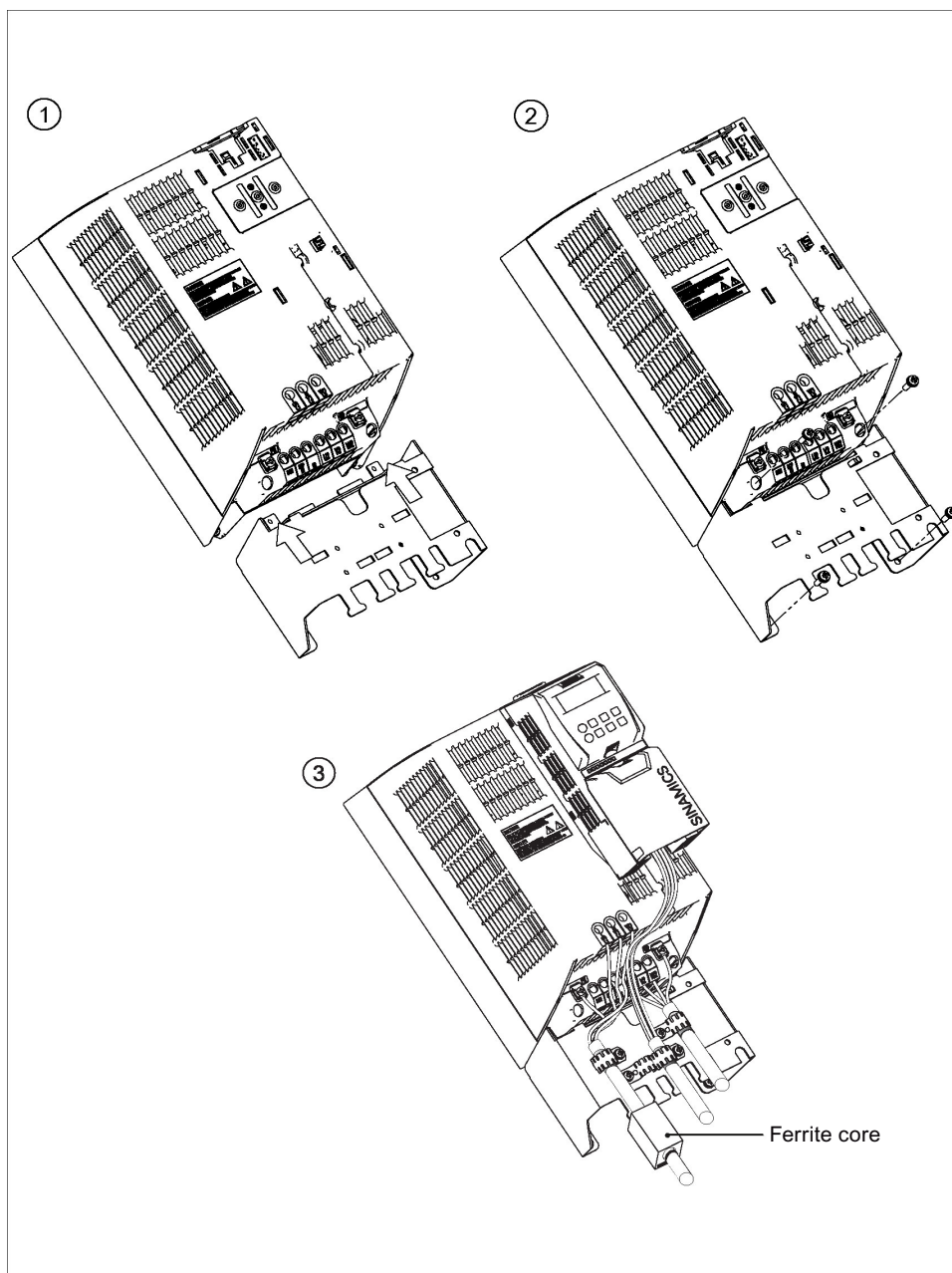


Figure 8-19 Mounting a Screening Kit and ferrite core on a Power Module of frame sizes FSB and FSC

### Mounting the ferrite core

The ferrite core supplied should be attached to the line cable in order to dampen radio cable disturbances. The open ferrite core shown in the figure below is placed around the cable and snapped together in order to close it. The neck of the core (see the U-shaped collar in the figure below) enables the core to clamp onto the cable automatically, thus fixing it in position.

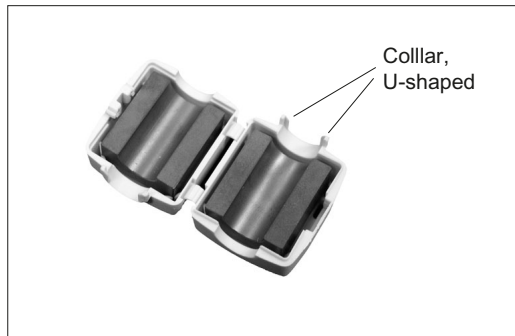


Figure 8-20 Ferrite core, open

If the core does not sit securely in position on the cable (due to the cable having a small diameter), a cable tie can be lashed tightly around the cable next to the closed ferrite core in order to prevent the ferrite from moving along the cable.

### Frame sizes FSD/FSE

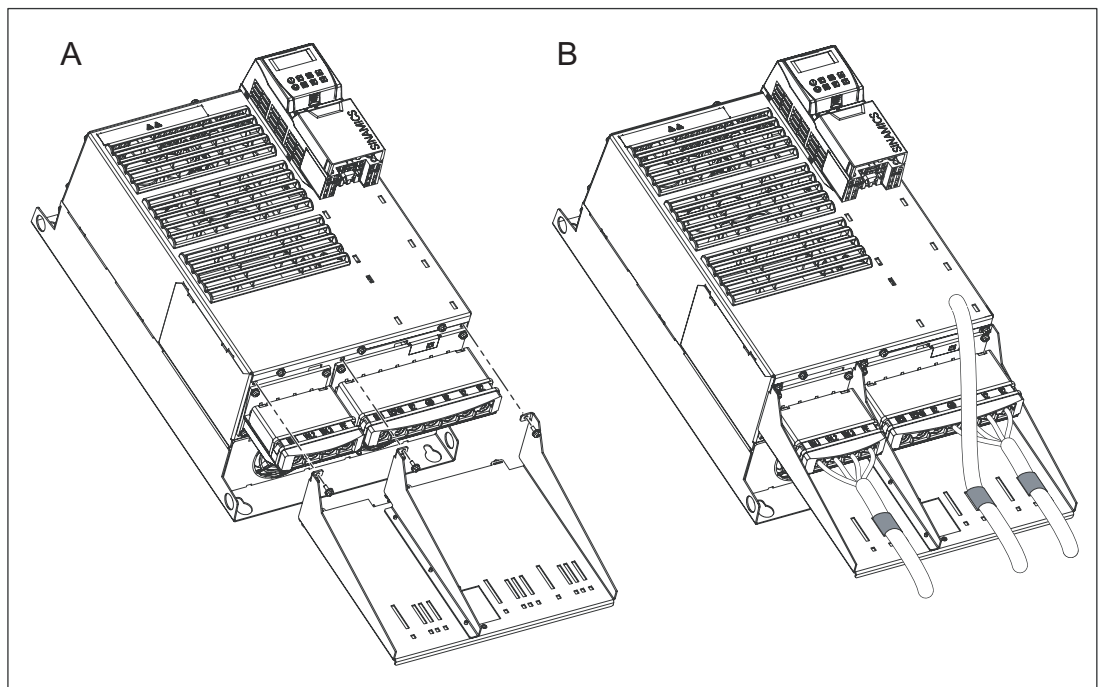


Figure 8-21 Mounting a Screening Kit on a Power Module of frame sizes FSD and FSE

Frame size FSF

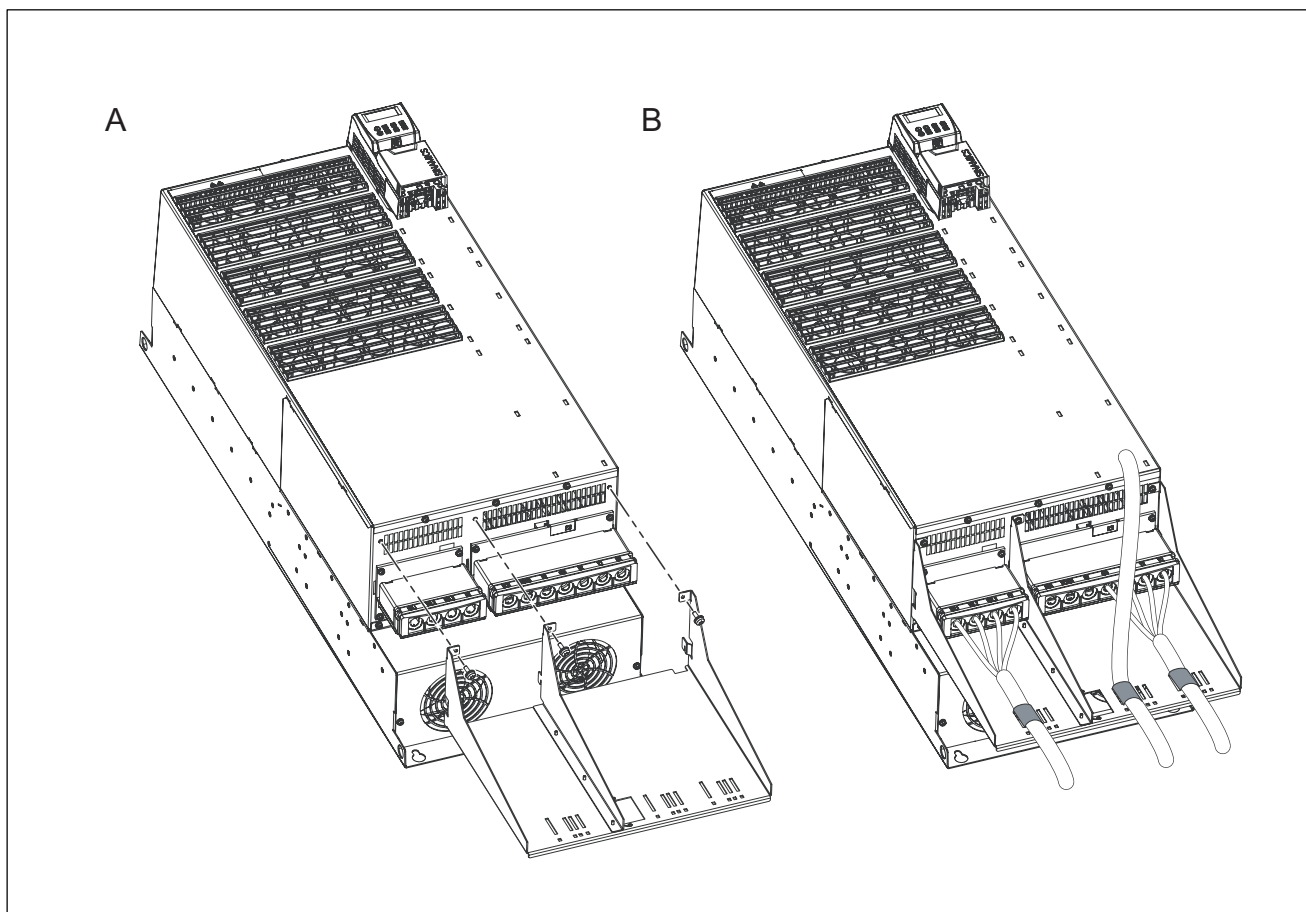


Figure 8-22 Mounting a Screening Kit on a Power Module of frame size FSF



### 8.3.3.2 Blocksize Liquid Cooled Power Modules

#### Frame sizes FSD and FSE

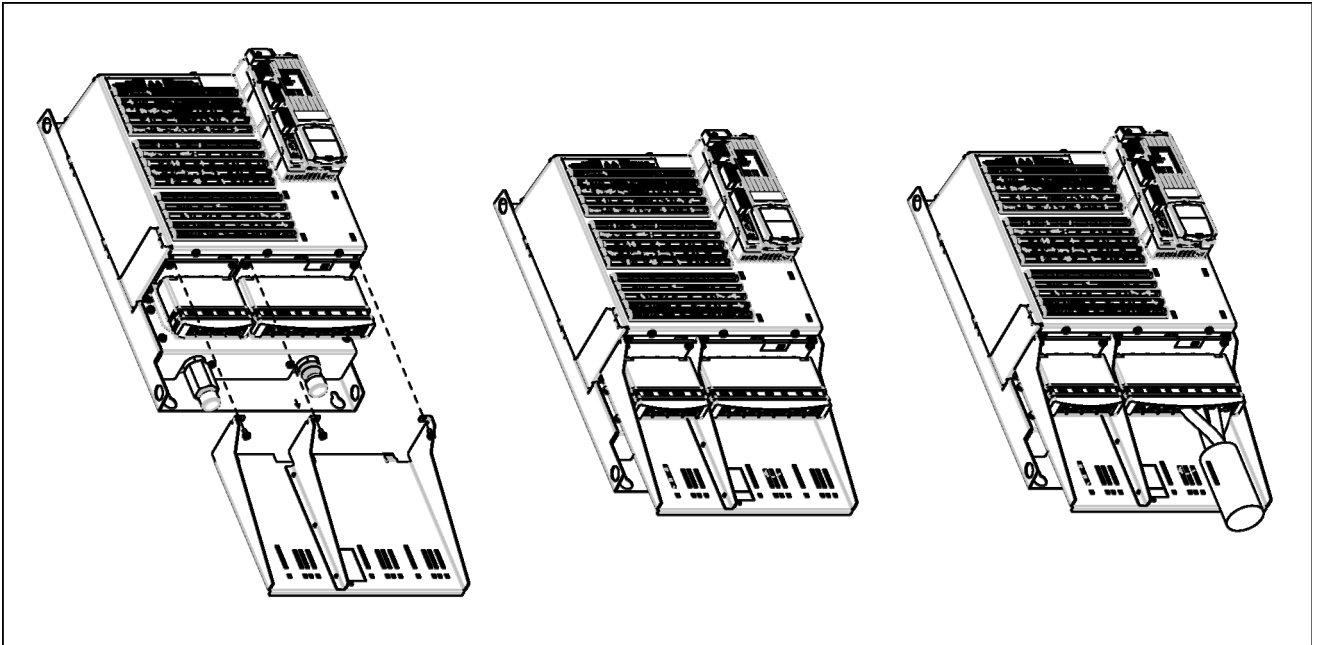


Figure 8-23 Mounting a Screening Kit on a Liquid Cooled Power Module PM340, frame sizes FSD and FSE

#### Frame size FSF

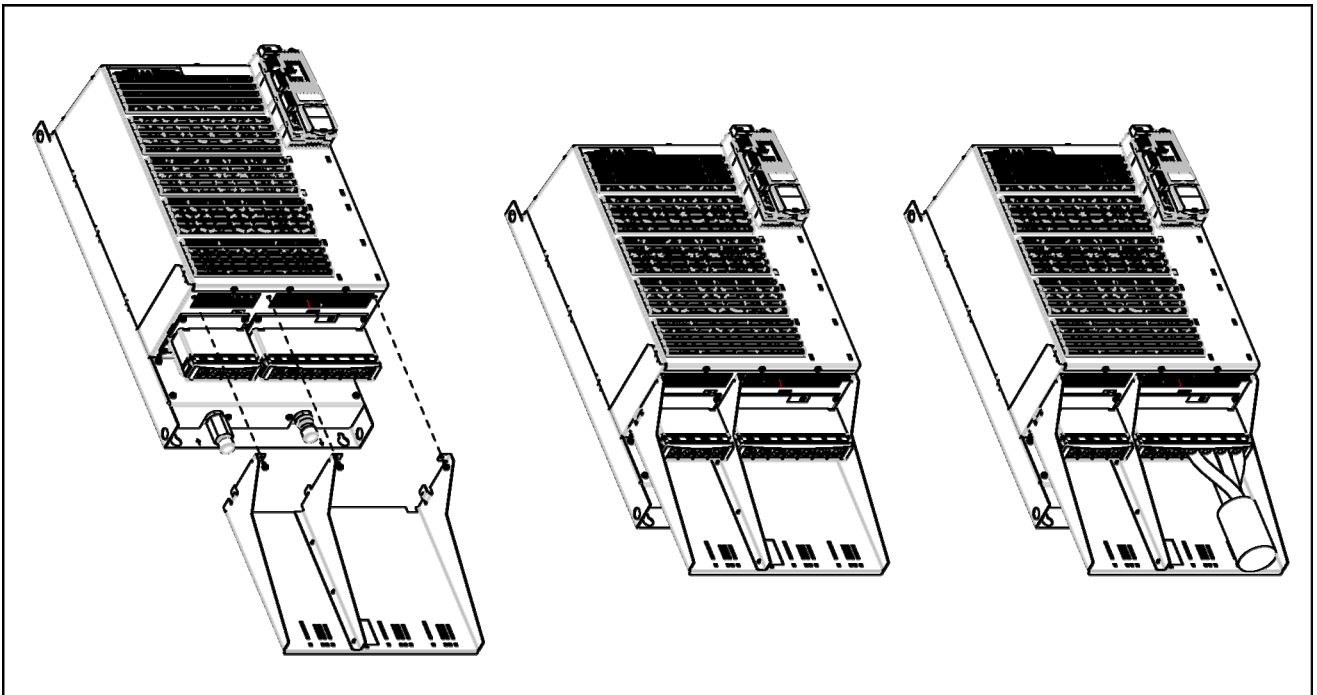


Figure 8-24 Mounting a Screening Kit on a Liquid Cooled Power Module PM340, frame size FSF

*Accessories*

---

*8.3 Screening Kit*

## 9.1 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 shock.

To ensure protection against mechanical stress and climatic conditions too, the components should only be operated in housing, cabinets or enclosed electrical operating areas that fulfill at least degree of protection IP54 and, as enclosure type 12, are designed to UL 50.

Prefabricated MOTION-CONNECT cables are recommended.

---

### Note

#### Functional safety of SINAMICS components

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

Installation in a cabinet with degree of protection IP54B according to EN 60529 is advisable to ensure the safety functions of Safety Integrated are not compromised.

---

#### Low-voltage switchgear and controlgear assemblies

Part 1: Type-tested and partially type-tested low-voltage switchgear and controlgear assemblies

If the SINAMICS S drive line-up is used for the electrical equipment of machines, the applicable requirements of EN 60204-1 must also be adhered to.

#### Safety of machinery

Electrical equipment of machines

Part 1: General requirements

All information for device selection in this section applies to

- Operation in a TN system
- Operating voltage range from 200 V 1-ph. AC to 440 V 3-ph. AC

## 9.2 Safety information

 **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 automatic shutdown of the power supply if the protective conductor is interrupted

 **DANGER**

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

**CAUTION**

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

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

If the motor power cable is connected to intermediate terminals, the power cables and brake cables must be routed apart ( $\geq 300 \text{ mm}$ ).

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

**CAUTION**

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

 **WARNING**

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

Non-observance can cause lethal shock voltages.

**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.

---

### 9.3 Notes on electromagnetic compatibility (EMC)

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

When mounting components in cabinets, in order to fulfill the EMC directive, the following conditions must be additionally observed:

- Connected to TN line supply systems with grounded neutral point
- SINAMICS line filter (optional for frame size FSA)
- Observance of information about cable shielding and equipotential bonding
- Only the recommended Siemens power and signal cables are used
- Only cables from Siemens may be used for DRIVE-CLiQ connections.

For MOTION-CONNECT cables, refer to catalog PM21

<b>CAUTION</b>
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.

 <b>DANGER</b>
If the shielding procedures described and the specified cable lengths are not observed, the machine may not operate properly.

## 9.4 Cable Shielding and Routing

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

- Power supply cables from line filter via line reactor to Power Module
- All motor cables (if necessary, including cables for motor holding brake)
- Cables for "fast inputs" of the Control Unit
- Cables for analog direct voltage/current signals
- Signal cables for sensors
- Cables for temperature sensors

 <b>DANGER</b>
---

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

The PE conductor connection of the individual components must have at least 4 mm <sup>2</sup> .
---

Alternative measures (e.g. routing behind mounting plates, suitable clearances) can also be used provided they have similar results. This excludes measures that relate to the design, installation, and routing of motor power cables and signal cables. If unshielded cables are used between the line supply connection point and the line filter, make sure that no interfering cables are routed in parallel.

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

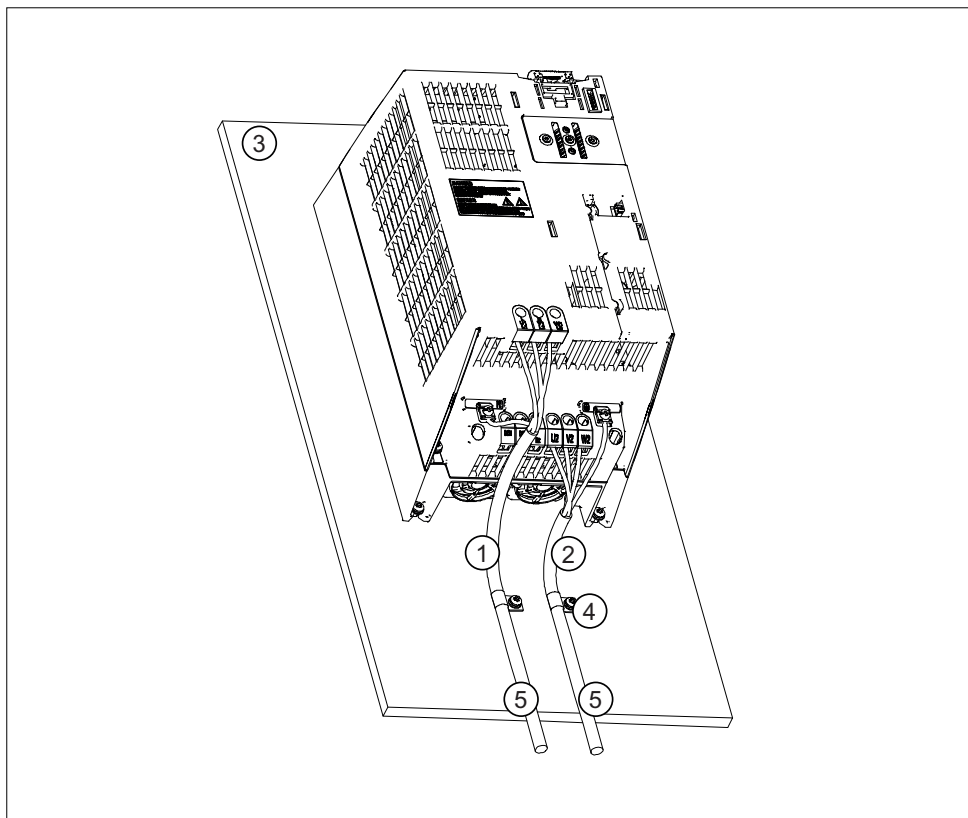


Figure 9-1 Shielding of a Power Module PM340

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 steel sheets (e.g. between the mounting plate and back wall) should provide adequate shielding.

Avoid, where possible, routing non-shielded cables, connected to the drive line-up, in the immediate vicinity of noise sources, e.g. transformers. Signal cables (shielded and unshielded) connected to the drive line-up must be laid at a great distance from strong external magnetic sources (e.g. transformers, line reactors). In both cases, a distance of  $\geq 300$  mm is usually sufficient.



## 9.5 24 V DC Supply Voltage

### 9.5.1 General

The 24 V DC voltage is required for the power supply of:

1. The load voltage of the Control Unit digital outputs.  
The Control Units are supplied with power via the PM-IF. 24 V must also be connected in the following cases:
  - Commissioning / diagnostics when the Power Module power supply is switched-out.
  - Using the digital outputs CU305
2. The electronics of the Sensor Module
3. The Safe Brake Relay (motor holding brake)

Other loads can be connected to these power supply units if they are separately protected from overcurrent.

---

#### Note

The user should provide the electronics power supply as described in Chapter "System data" in this documentation.

When connecting to a "DC power supply" in the sense of EN 60204-1:1997, Chapter 4.3.3, functional faults can occur due to the voltage interruptions that are permitted there.

---

<b>NOTICE</b>
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If other consumers are connected to the power supply, connected inductance devices (contactors, relays) must be fitted with suitable overvoltage protection circuits.
---

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

A regulated DC power supply is required to operate motors with a built-in holding brake. The power is supplied via the 24 V connection (Safe Brake Relay). The voltage tolerances of the motor holding brakes ( $24\text{ V} \pm 10\%$ ) 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:
---

- |  |
|--|
| <ul style="list-style-type: none"><li>• Using Siemens three-phase motors</li><li>• Using Siemens MOTION-CONNECT power cables</li><li>• Motor cable lengths: max. 100 m</li></ul> |
|--|

### 9.5.2 Overcurrent Protection

Cables that are located on the primary and the primary side of the power supply unit must be protected from overcurrent.

Primary side protection conforms to the manufacturer's instructions.

Secondary side protection depends on the practical circumstances. Make sure you observe these points:

- Loading due to loads, including 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 (laying cables in the duct)
- Cable laying method according to EN 60204-1

<b>CAUTION</b>
<b>Laying of cables</b>
Lay connected signal and supply cables such that the ventilation slots on the devices are not covered.
Do not lay non-shielded cables parallel to power cables.

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

Circuit breakers from the Siemens LV 1 and LV 1T catalogs are recommended as overcurrent protection devices on the primary side.

Miniature circuit breakers or SITOP select 6EP1961-2BA00 are recommended as overcurrent protection devices on the secondary side.

Miniature circuit breakers are recommended as overcurrent protection devices for the cables and busbars. They can be selected from the Siemens LV 1 and LV 1T catalogs.

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:

Standards		
EN 61800-5-1	EN 60204-1	IEC 60364-5-52
IEC 60287-1 to -3	EN 60228	UL 508C

Conditions	
Ambient temperature 55 °C	
Limiting conductor temperature $\geq 75$ °C for operation with the rated load current	
Maximum cable length:	10 m for the 24 V supply cables
	30 m for signal lines without additional connections

Lay the cables so that

- no more than 1 conductor pair is bundled
- Route 24 V conductors/cables separately from cables and conductors that can conduct operating currents.

Table 9- 1    MCBs by conductor cross-section and temperature

<b>Conductor cross-section</b>	<b>Max. value up to 40 °C</b>	<b>Max. value up to 55 °C</b>
1.5 mm <sup>2</sup>	10 A	6 A
2.5 mm <sup>2</sup>	16 A	10 A
4 mm <sup>2</sup>	25 A	16 A
6 mm <sup>2</sup>	32 A	20 A

Select the tripping characteristic of the MCBs to protect the loads against the maximum current provided in the event of a short circuit of the supply unit.

### 9.5.3    Overvoltage protection

Overvoltage protection devices are needed if long cables are used.

- Supply cables > 10 m
- Signal cables > 30 m

The following Weidmüller overvoltage protectors are recommended for protecting the components' 24 V power supply and the 24 V signal cables from overvoltage:

Table 9- 2    Recommendations for overvoltage protection

<b>DC power supply</b>	<b>24 V signal cables</b>
Weidmüller Item no.: PU III R 24V Order number: 8860360000	Weidmüller Item no.: MCZ OVP TAZ Order number: 844915 0000
Weidmüller GmbH & Co. KG An der Talle 89 33102 Paderborn, Germany Phone +49 (0)5252 960 0 Fax +49 (0)5252 960 116 <a href="http://www.weidmueller.com">http://www.weidmueller.com</a>	

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

### 9.5.4 Typical 24 V current consumption of the components

A separate 24 V power supply must be used for the SINAMICS S110 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 <sub>dc</sub> ]
<b>Control Units</b>	
CU305 PN without load	0.8
Per digital output	0.1
CU305 DP without load	0.8
Per digital output	0.1
CU305 CAN without load	0.8
Per digital output	0.1
<b>DRIVE-CLiQ and brake</b>	
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
<b>Sensor Module Cabinet</b>	
SMC10 without/with encoder system	0.20 / 0.35
SMC20 without/with encoder system	0.20 / 0.35
SMC30 without/with encoder system	0.20 / 0.55
<b>Sensor Module External</b>	
SME20 without/with encoder system	0.15 / 0.25
SME25 without/with encoder system	0.15 / 0.25
SME120 without/with encoder system	0.20 / 0.30
SME125 without/with encoder system	0.20 / 0.30

## 9.5.5 Selecting power supply units

You are advised to use the devices in the following table. These devices meet the applicable requirements of EN 60204-1.


Table 9- 4 Recommended SITOP Power

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

Table 9- 5 Recommendation for Control Supply Module

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

Refer also to Catalog PM21 or NC61.

 <b>WARNING</b>
<p>When using external power supplies, e.g. SITOP, the following points must be observed:</p> <ul style="list-style-type: none"> <li>• The ground potential M must be connected to the protective conductor terminal (DVC A).</li> <li>• The power supply must be installed close to the drive line-up.</li> </ul> <p>Ideally, they should be installed on a common mounting plate. If different mounting plates are used, their electrical interconnection must comply with the EMC installation guideline.</p> <p>This installation guideline covers protection against electric shock, protection against fire, and best possible electromagnetic compatibility.</p>

## 9.6 Arrangement of components and equipment

### 9.6.1 General

The arrangement of the components and equipment takes account of

- Space requirements
- Cable routing
- Bending radiuses of the connecting cables  
MOTION-CONNECT cables, refer to catalog PM21
- Heat dissipation
- EMC

Components are usually located centrally in a cabinet.

Always observe the mounting clearances necessary above and below the components.

### 9.6.2 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.

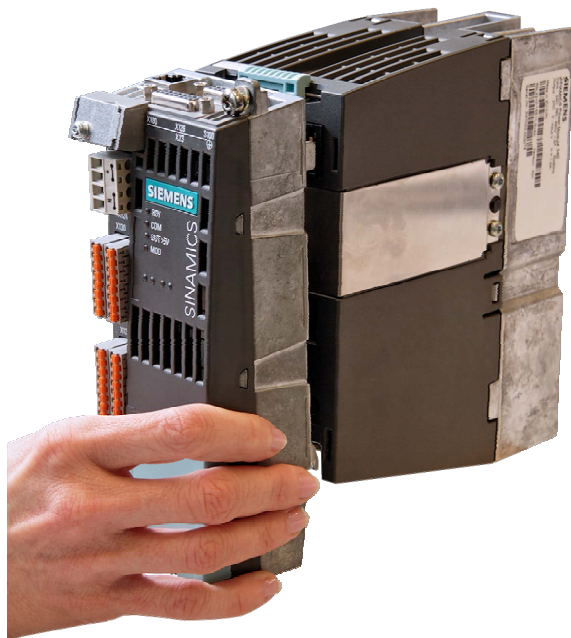


Figure 9-2 Mounting the CU305 onto the Power Module PM340 (frame size FSA)

### Mounting Power Modules with sub-chassis components

A large number of system components are designed as sub-chassis components for PM340 Power Modules with frame sizes FSA to FSE. In such cases, the sub-chassis components are mounted on the mounting surface, with the PM340 Power Module mounted in front in order to save space.

Table 9- 6 Available sub-chassis components

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

x = can be used as a sub-chassis component

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

Up to two sub-chassis components can be mounted in front of one another. For configurations involving more than two sub-chassis-type components (e.g. line reactor + motor reactor + braking resistor), individual components must be mounted to the side of the Power Module.

The following mounting sequence applies to frame sizes FSA to FSC:

Table 9- 7 Mounting sequence for sub-chassis components, starting from the cabinet wall

Frame size	Mounting sequence
FSA	<b>Without an external line filter:</b> Motor reactor - line reactor - PM340
	<b>With external line filter:</b> Line reactor - line filter - PM340 or motor reactor - line filter - PM340
FSB	Motor reactor - line reactor - PM340
FSC	Motor reactor - line reactor - PM340

<b>NOTICE</b>
The braking resistor must always be mounted to the side of the Power Module, as it can get very hot.

### Wiring rules for DRIVE-CLiQ

Further information can be found in the manual:  
 SINAMICS S110 Function Manual Drive Functions

## 9.7 Protective connection and equipotential bonding

### Protective connections

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

The protective conductor connection of the SINAMICS components must be connected to the protective conductor connection of the control cabinet as follows:

Table 9- 8 Conductor cross-section for copper protective connections

Line supply cable in mm <sup>2</sup>	Copper protective connection in mm <sup>2</sup>
Up to 16 mm <sup>2</sup>	The same as the line supply cable
From 16 mm <sup>2</sup> to 35 mm <sup>2</sup>	16 mm <sup>2</sup>
From 35 mm <sup>2</sup>	0.5 x line supply cable

For materials other than copper, the cross-section should be increased so that as a minimum, the same conductivity is attained.

All system components and machine parts must be incorporated in the protection concept.

The protective connection for the motors used must be established through the motor cable. For EMC reasons, these protective connections should be made at the Power Module.

The drive line-up must be arranged on a common bright mounting plate in order to comply with the EMC limit values. The mounting plate must be connected to the protective conductor connection of the control cabinet through a low impedance.

Copper cables with appropriate cross-sections (>2.5 mm<sup>2</sup>) must be used for the ground connection of PROFIBUS nodes.

For more information about grounding PROFIBUS, see:

[http://www.profibus.com/fileadmin/media/wbt/WBT\\_Assembly\\_V10\\_Dec06/start.html](http://www.profibus.com/fileadmin/media/wbt/WBT_Assembly_V10_Dec06/start.html)

### Equipotential bonding

A mounting plate serves simultaneously as an equipotential bonding surface. This means that no additional equipotential bonding is required within the drive line-up.

If a common bright mounting plate is not available, then equally good equipotential bonding must be established using cable cross-sections as listed in the table above or, as a minimum, with the same conductivity.



When installing components on standard mounting rails, the data listed in the table also apply to the equipotential bonding. If only smaller connection cross-sections are permissible at the components, then the largest possible cross-section should be used, e.g. 6 mm<sup>2</sup> for SMC. These requirements also apply to distributed components located outside the control cabinet.

 **CAUTION**

An equipotential bonding conductor with a cross-section of at least 25 mm<sup>2</sup> must be used between components in a system that are located at a distance from each other. If an equipotential bonding conductor is not used, high leakage currents that could destroy the Control Unit or other PROFIBUS nodes can be conducted via the PROFIBUS cable.

No equipotential bonding conductors are required for PROFIBUS inside a control cabinet. For PROFIBUS connections between different buildings or parts of buildings, an equipotential bonding must be laid parallel to the PROFIBUS cable. The following cross-sections must be observed in accordance with IEC 60364-5-54:

- Copper 6 mm<sup>2</sup>
- Aluminium 16 mm<sup>2</sup>
- Steel 50 mm<sup>2</sup>

For more information about equipotential bonding for PROFIBUS, see:

[http://www.profibus.com/fileadmin/media/wbt/WBT\\_Assembly\\_V10\\_Dec06/start.html](http://www.profibus.com/fileadmin/media/wbt/WBT_Assembly_V10_Dec06/start.html)

**NOTICE**

If the above information about equipotential bonding is not taken into account, this can cause the field bus interfaces to malfunction or devices to malfunction.

**Note**

**PROFINET**

For installation guidelines and information of protective grounding and equipotential bonding for all PROFINET types and topologies, refer to DOWNLOADS at:

<http://www.profibus.com>

## 9.8 Notes on electrical cabinet cooling

### 9.8.1 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.

<b>CAUTION</b>
If you do not observe the guidelines for installing SINAMICS equipment in the cabinet, this can reduce the service life of the equipment and result in premature component failure.

You must take into account the following specifications when mounting/installing SINAMICS components:

- Cooling clearance
- Cable routing
- Air guidance, air-conditioner

Table 9- 9 Cooling clearances around the components

Component	Clearance above and below in mm and (inches)	Lateral clearance in mm and (inches)
CU305 PN	50 (1.97)	0
CU305 DP	50 (1.97)	0
CU305 CAN	50 (1.97)	0
SMCxx	50 (1.97)	0
Line filter	100 (3.93)	
Line reactor	100 (3.93)	0
PM340 blocksize, frame size FSA	100 (3.93)	30 (1.18) <sup>1)</sup>
PM340 blocksize, frame size FSB	100 (3.93)	40 (1.57) <sup>1)</sup>
PM340 blocksize, frame size FSC	125 (4.92)	50 (1.97) <sup>1)</sup>
PM340 blocksize, frame sizes FSD and FSE	300 (11.81)	0
PM340 blocksize, frame size FSF	350 (13.77)	0

<sup>1)</sup> Only applies at ambient temperatures >40° C or where sub-chassis components are being used (e.g. line reactors) below the PM340. Otherwise, the clearance is 0 mm.

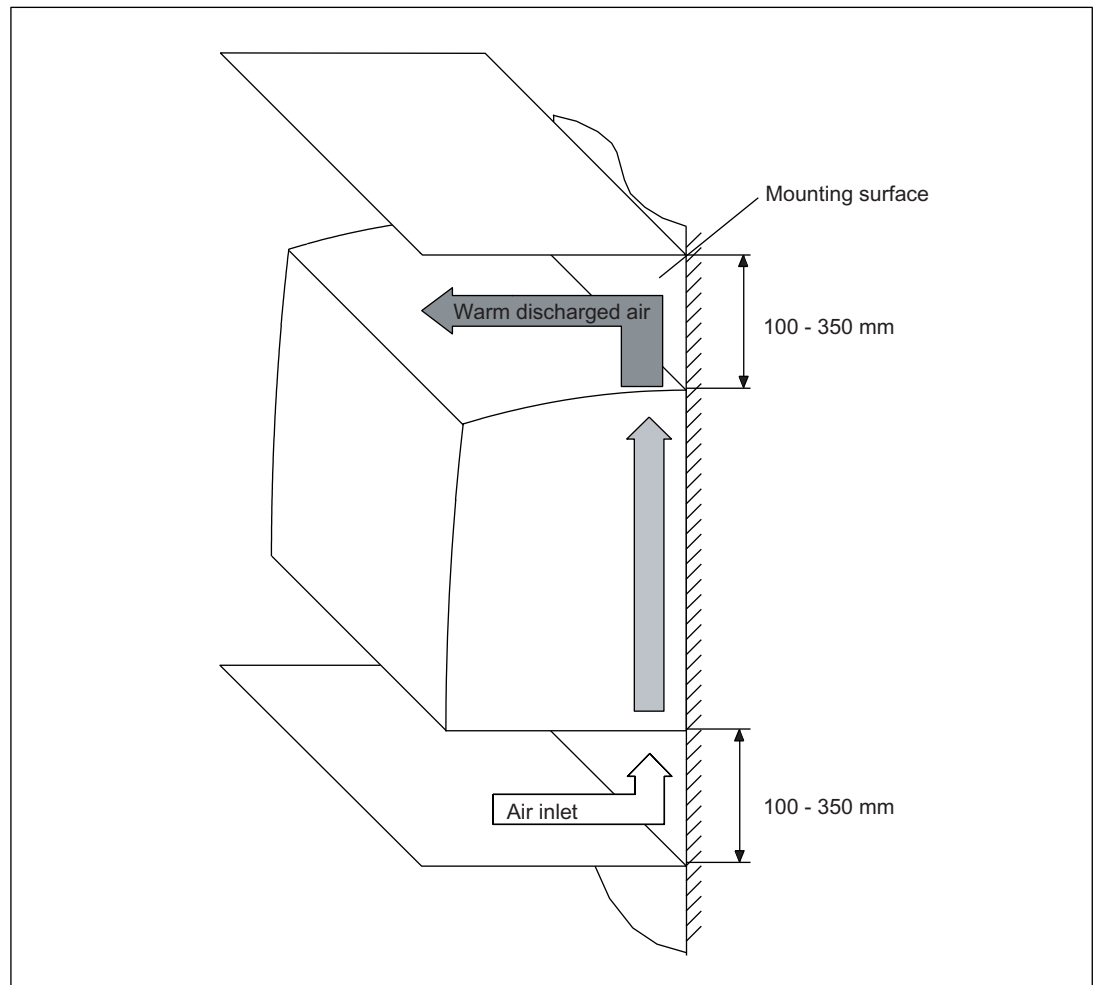


Figure 9-3 Cooling clearances

## 9.8.2 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.

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**Note**

The distance between the blow-out aperture of the air conditioner and the electronic equipment must be at least 200 mm.

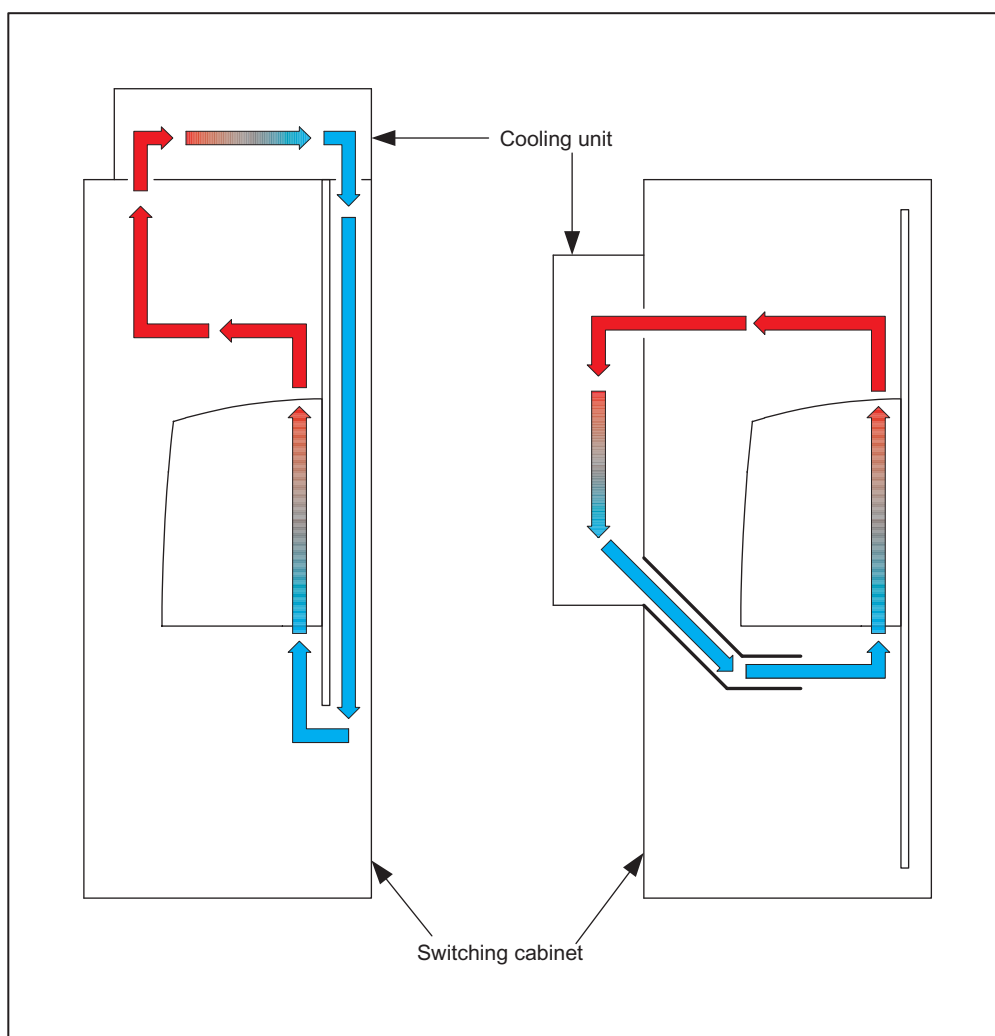


Figure 9-4 Examples of cabinet ventilation

**CAUTION**

The air guidance and arrangement of the cooling equipment must be chosen in such a way as to prevent condensation from forming.

If necessary, cabinet enclosure heating may have to be installed.

If air conditioners are used, the relative air humidity of the expelled air increases as the air in the air conditioner cools and may exceed the dew point. If the relative humidity of the air entering the SINAMICS equipment is over 80% for an extended period of time, the insulation in the equipment may fail to function properly due to electrochemical reactions (refer to System Overview). Using air baffle plates, for example, you must ensure that the cold air expelled from the air conditioner mixes with warm air in the cabinet before it enters the unit. This reduces the relative air humidity to uncritical values.

### 9.8.3 Power loss of components during rated operation

#### 9.8.3.1 General information

The tables below give details of power loss for components during rated operation. The characteristic values apply for the following conditions:

- Line supply voltage for Power Modules 1-ph. 200 V AC to 3-ph. 380 V to 480 V AC  $\pm 10$  %.
- Rated pulse frequency of the Power Modules 4 kHz
- Operating components at their unit rating

#### 9.8.3.2 Power loss for Control Units and Sensor Modules

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

Component	Unit	Power loss
<b>Control Units</b>		
CU305 PN	W	< 20
CU305 DP	W	< 20
CU305 CAN	W	< 20
<b>Sensor Modules</b>		
SMC10	W	< 10
SMC20	W	< 10
SMC30	W	< 10

### 9.8.3.3 Power loss for line reactors and line filters

Table 9- 11 Overview of power loss during rated operation for line reactors and line filters

Rated output current $I_n$	Frame size	Line supply voltage	Unit	Power loss 50/60 Hz
<b>Line reactors for Blocksize PM340</b>				
0.9 A/2.3 A	FSA	1-ph. 200 to 240 V AC	W	12.5/15
3.9 A	FSA	1-ph. 200 to 240 V AC	W	11.5/14.5
1.3 A/1.7 A	FSA	3-ph. 380 to 480 V AC	W	6 / 7
2.2 A/3.1 A	FSA	3-ph. 380 to 480 V AC	W	12.5/15
4.1 A	FSA	3-ph. 380 to 480 V AC	W	7.5/9
5.9 A/7.7 A	FSB	3-ph. 380 to 480 V AC	W	9 / 11
10.2 A	FSB	3-ph. 380 to 480 V AC	W	27 / 32
18 A/25 A	FSC	3-ph. 380 to 480 V AC	W	98 / 118
32 A	FSC	3-ph. 380 to 480 V AC	W	37 / 44
38 A/45 A/60 A	FSD	3-ph. 380 to 480 V AC	W	90 / 115
75 A/90 A	FSE	3-ph. 380 to 480 V AC	W	170 / 215
110 A/145 A/178 A	FSF	3-ph. 380 to 480 V AC	W	280 / 360
<b>Line filters for Blocksize PM340</b>	FSA	3-ph. 380 to 480 V AC	W	< 5

## 9.8.3.4 Power loss for Power Modules

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

Rated output current $I_{rated}$ /Unit rating based on $I_{rated}$	Frame size	Line supply voltage	Unit	Power loss
<b>Blocksize PM340</b>				
0.9 A/0.12 kW	FSA	1-ph. 200 to 240 V AC	W	60
2.3 A/0.37 kW	FSA	1-ph. 200 to 240 V AC	W	75
3.9 A/0.75 kW	FSA	1-ph. 200 to 240 V AC	W	110
1.3 A/0.37 kW	FSA	3-ph. 380 to 480 V AC	W	100
1.7 A/0.55 kW	FSA	3-ph. 380 to 480 V AC	W	100
2.2 A/0.75 kW	FSA	3-ph. 380 to 480 V AC	W	100
3.1 A/1.1 kW	FSA	3-ph. 380 to 480 V AC	W	110
4.1 A/1.5 kW	FSA	3-ph. 380 to 480 V AC	W	110
5.9 A/2.2 kW	FSB	3-ph. 380 to 480 V AC	W	140
7.7 A/3 kW	FSB	3-ph. 380 to 480 V AC	W	160
10.2 A/4 kW	FSB	3-ph. 380 to 480 V AC	W	180
18 A/7.5 kW	FSC	3-ph. 380 to 480 V AC	W	240
25 A/11 kW	FSC	3-ph. 380 to 480 V AC	W	300
32 A/15 kW	FSC	3-ph. 380 to 480 V AC	W	400
38 A/18.5 kW	FSD	3-ph. 380 to 480 V AC	W	380
45 A/22 kW	FSD	3-ph. 380 to 480 V AC	W	510
60 A/30 kW	FSD	3-ph. 380 to 480 V AC	W	690
75 A/37 kW	FSE	3-ph. 380 to 480 V AC	W	990
90 A/45 kW	FSE	3-ph. 380 to 480 V AC	W	1210
110 A/55 kW	FSF	3-ph. 380 to 480 V AC	W	1420
145 A/75 kW	FSF	3-ph. 380 to 480 V AC	W	1930
178 A/90 kW	FSF	3-ph. 380 to 480 V AC	W	2310
<b>Blocksize Liquid Cooled PM340</b>				
38 A/18.5 kW	FSD	3-ph. 380 to 480 V AC	W	90 <sup>1)</sup>
60 A/30 kW	FSD	3-ph. 380 to 480 V AC	W	130 <sup>1)</sup>
75 A/37 kW	FSE	3-ph. 380 to 480 V AC	W	160 <sup>1)</sup>
90 A/45 kW	FSE	3-ph. 380 to 480 V AC	W	190 <sup>1)</sup>
110 A/55 kW	FSF	3-ph. 380 to 480 V AC	W	210 <sup>1)</sup>
178 A/90 kW	FSF	3-ph. 380 to 480 V AC	W	350 <sup>1)</sup>

1) Power loss to ambient air





## Cooling circuit and coolant properties

### 10.1 Cooling circuit requirements

#### 10.1.1 Technical cooling circuits

Technical cooling circuits can be divided into three systems:

1. **Closed cooling circuits (recommended)**

In closed systems, the circuit coolant is separated from the surrounding atmosphere, which prevents the ingress of oxygen. The coolant is only routed through the SINAMICS devices, the components required for cooling and, if necessary, a motor. The heat is dissipated to the atmosphere indirectly by means of heat exchangers. The system should ideally function without losing any coolant and, once filled, should not need any water to be added. The composition of the coolant can be adjusted as required (e.g. by using desalinated water and adding anti-corrosion agents). It either does not change at all during operation, or changes only in a defined manner.

The closed cooling circuit is recommended as a standard solution.

2. **Open cooling circuit**

The coolant is routed not only through the SINAMICS devices and components required for cooling, but also through external devices.

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

3. **Semi-open cooling circuit**

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

#### 10.1.2 Cooling system requirements

Open cooling systems must never be used for liquid-cooled Power Modules. A closed cooling circuit with a membrane expansion tank (MET), safety valve (SV), and heat exchanger (HE) is recommended, which connects the cooling circuit to an external cooler (refer also to the chapter titled "Using heat exchangers").

## Requirements

- A particle filter (particle size < 100 µm) must be installed in the cooling circuit's supply line to prevent foreign particles from being washed in.
- Mixed installations should be avoided wherever possible.
- The permissible pressures in the cooling system must be observed.
- Cavitation must be prevented in the cooling system.
- Equipotential bonding must be provided between the components in the cooling system.
- The customer must take measures to protect the devices against condensation
- An anti-corrosion agent and, if necessary, a biocide should be mixed into the coolant.
- If there is a risk of frost, preventive measures must be taken during operation, storage, and transportation (e.g. emptying and blowing out with air, additional heating).
- The requirements of the coolant in terms of its properties (temperature, chemical characteristics, etc.) must be observed.

## Recommendations

- To ensure mechanical decoupling, the devices should be connected by means of hoses.
- To prevent blockages and corrosion, you are advised to install a flushback filter in the circuit (so that residues can be rinsed out when the system is running).
- The power units should be connected to the cooling circuit by means of shut-off fittings so that they can be disconnected from the cooling circuit for servicing or repair without having to empty the entire cooling system. A cooling water hose (EPDM) can be used to connect the shut-off fitting to the power unit. The coolant connections must never be closed if cooling liquid is still present in the device. Reason: If the cooling fluid expands due to heat, the pressure can build up beyond permissible levels and cause the heat sink to burst.

### 10.1.3 Cooling circuit configuration

The liquid-cooled Power Modules are designed to be connected in parallel to the cooling circuit. The pressure drop in the joint supply and return lines is to be kept at negligible levels by choosing a sufficiently large pipe diameter.

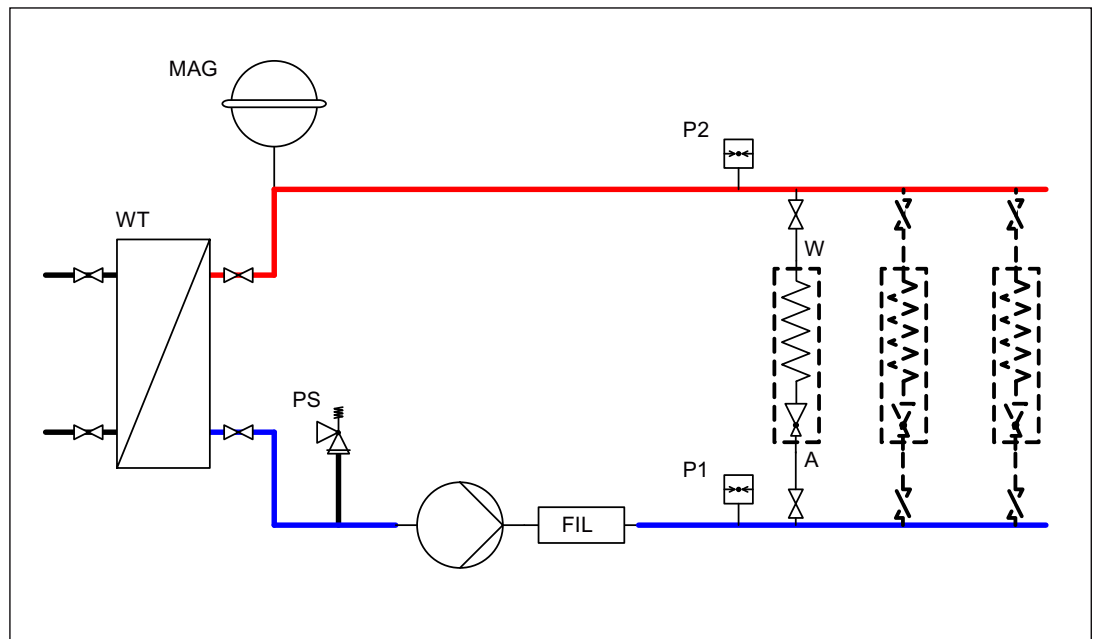


Figure 10-1 Example of a closed cooling circuit

The supply line (P1) has a differential pressure  $p$  compared to the return line (P2); this pressure must be in the range 70 kPa to 200 kPa. This ensures that every connected unit has the required volume of cooling liquid flowing through it. Pressure P1 and P2 with respect to the atmosphere must not exceed 600 kPa.

A pump's pressure depends on the volumetric flow, so the pressure created will depend on the number of components which are connected. At the minimum differential pressure  $p_1$  (measured between the supply and return lines of the individual component), the volume of coolant required to enable the component to achieve its unit rating or rated current is to flow through each component. At the maximum differential pressure  $p_2$  (measured between the supply and return lines of the individual component), the volumetric flow must not result in damage to the component, for example by means of cavitation. If necessary, pressure reducing valves such as baffle plates will have to be installed in the piping; these must be easy to access, clean, and/or replace.

When the pump is switched off, static pressure occurs in the system. The static pressure can be influenced by the primary pressure of the membrane expansion tank (MET) and should be at least 30 kPa on the pump's suction side. If the static pressure is too low, the pump may be damaged due to cavitation during operation. If necessary, note any differing minimum pressure values from the pump manufacturer. When the geodesic pressure caused by the height difference must be taken into account (1 m height difference corresponds to 10 kPa).

Cooling circuit and coolant properties

10.1 Cooling circuit requirements

When the pump is switched on, a (location-dependent) flow pressure is present in the cooling circuit, which must be determined from the pump characteristic curve and the volume-flow-dependent pressure drop. Characteristics have been specified for the pressure drop of the Power Modules. The pressure drop in the filter and, if applicable, an additional pressure drop in the connection pipes must be added to this pressure drop (70 kPa for H<sub>2</sub>O). Up to 50 kPa must be added for the pressure drop in a (contaminated) filter and in connection pipes. The intersection of the pump characteristic curve and the pressure drop of the whole cooling system yields the volumetric flow  $V_{rated}$  of the coolant at this operating point.

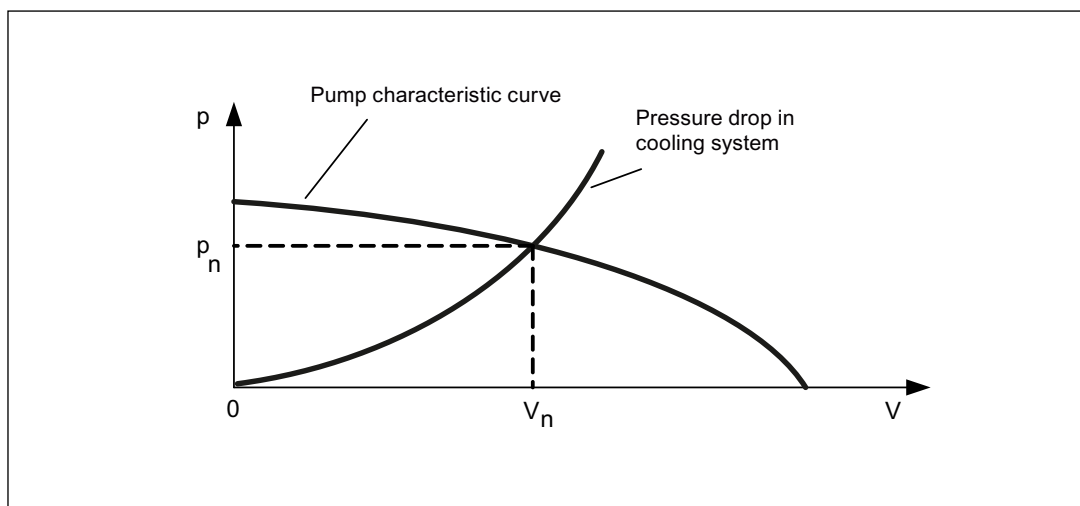


Figure 10-2 Pump characteristic curve

Permissible system pressure

The maximum permissible system pressure is 600 kPa. If a pump that is capable of exceeding this maximum permissible system pressure is used, the customer must take steps (e.g. safety valve  $p \leq 600$  kPa, pressure control, or similar) to ensure that the maximum pressure limit is not exceeded.

### Permissible pressure difference

The maximum permissible pressure difference for a heat sink is 200 kPa. Higher pressure differences significantly increase the risk of cavitation and abrasion. The lowest possible differential pressure between the coolant in the supply and return lines should be selected to allow pumps with a flat characteristic to be used.

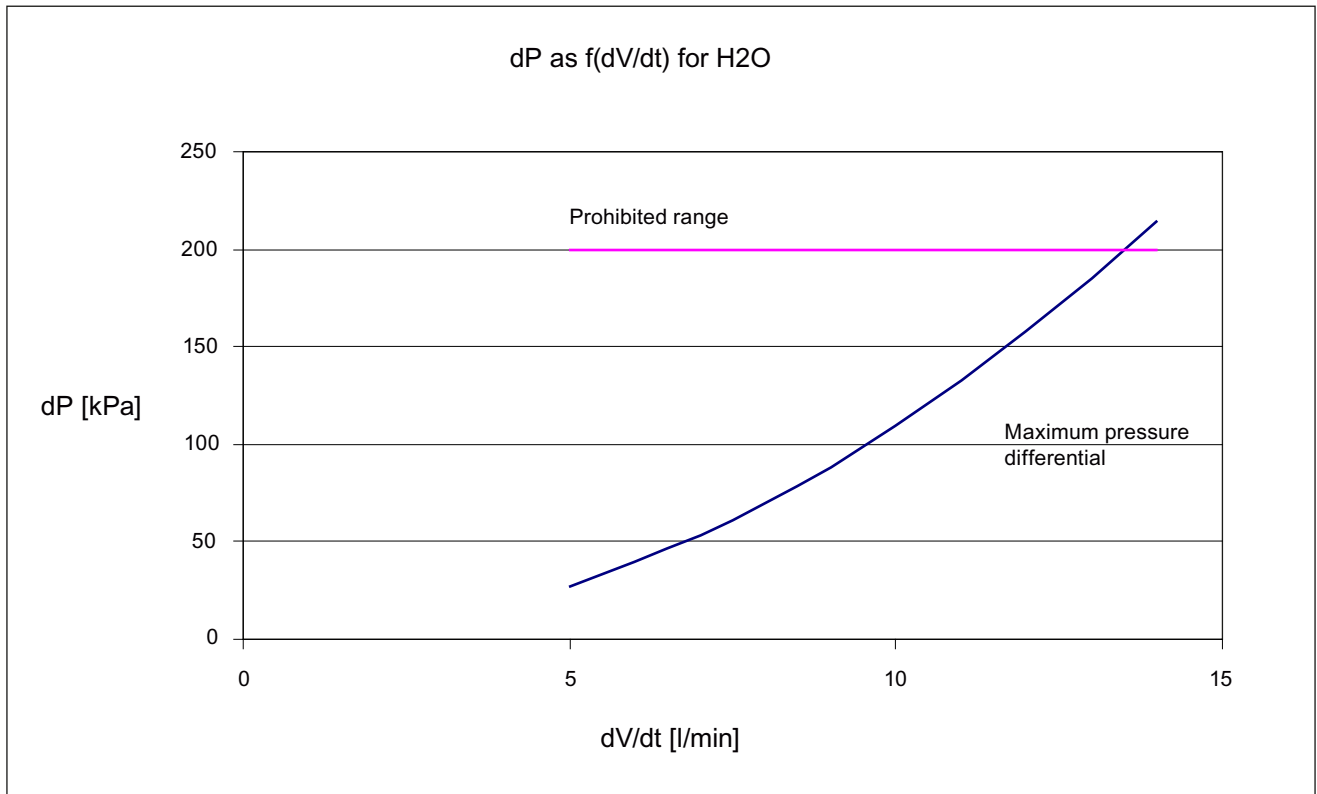


Figure 10-3 Pressure difference as a function of volumetric flow

### Pressure difference and pressure drop when using coolant mixtures

If a mixture of Antifrogen N and H<sub>2</sub>O is used as a coolant, the rated pressure must be calculated according to the mixing ratio. The following table specifies the pressure drop across components at different coolant temperatures for a coolant with mixing ratio 45 % Antifrogen N.

Table 10- 1 Pressure drop at different coolant temperatures for Antifrogen N/H<sub>2</sub>O: 45 %

dV/dt H <sub>2</sub> O [l/min]	dP H <sub>2</sub> O [kPa]	dP Antifrogen N 0 °C [kPa]	dP Antifrogen N 20 °C [kPa]	dP Antifrogen N 45 °C [kPa]	dP Antifrogen N 50 °C [kPa]
8	70	121	97	81	78

The characteristic curves for the pressure drop across the heatsinks as a function of volumetric flow vary depending on the temperature and the Antifrogen N / water coolant mix.

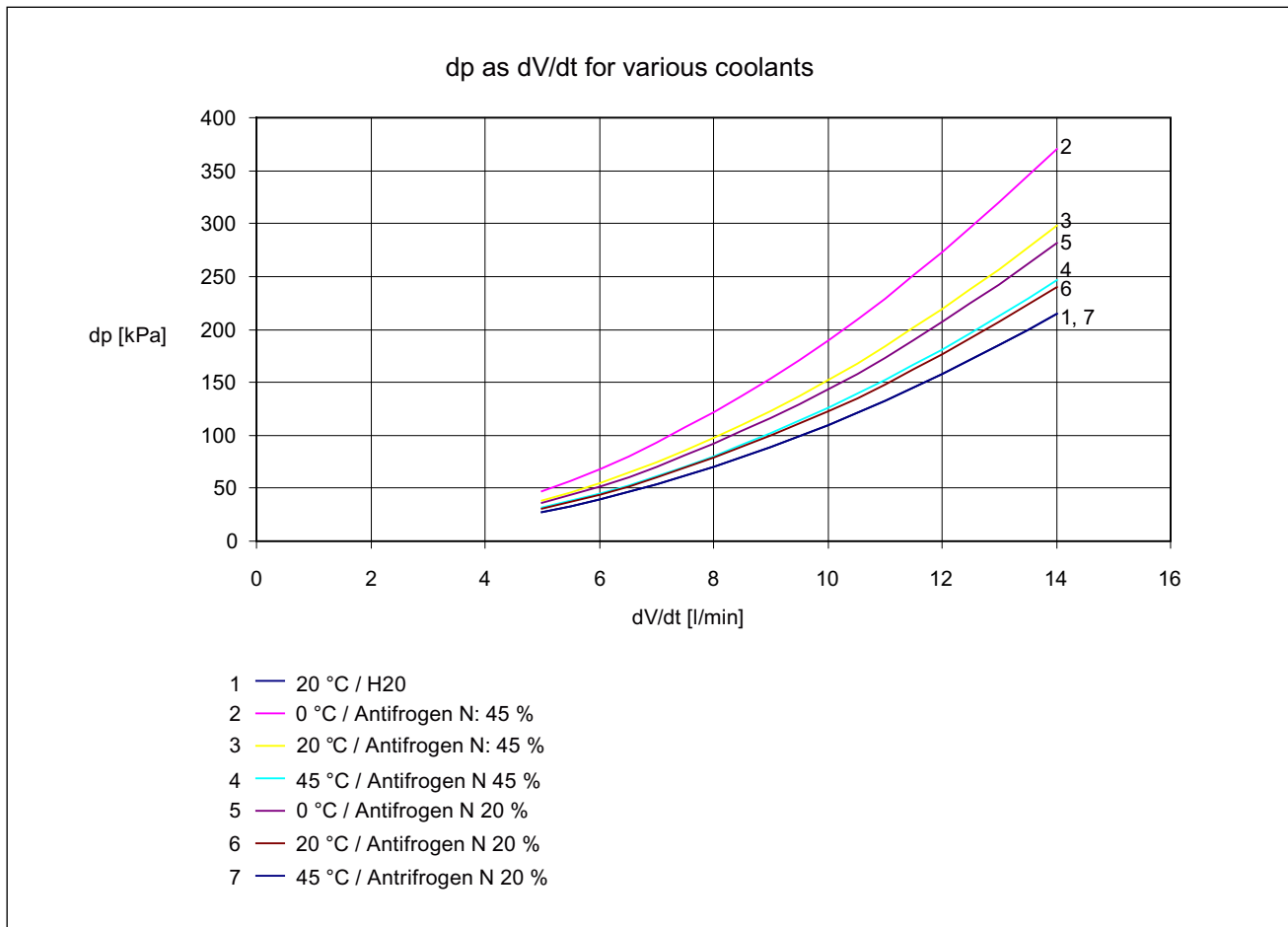


Figure 10-4 Pressure difference as a function of volumetric flow for various coolants and temperatures

### Operating pressure

The **operating pressure** must be set according to the flow conditions in the supply and return lines of the cooling circuit. The required coolant flow rate per time unit must be set according to the technical data of the components. The components are normalized to a rated pressure of 70 kPa (for coolant type H<sub>2</sub>O) via a baffle plate.

### Layout of the components

The components should be laid out in the system in such a way that the overall length of the supply and drain lines is the same for every SINAMICS component.

Water cooling systems with series-connected SINAMICS devices are not permitted.

### Dimensioning the cooling circuit

Recommendation for dimensioning the cooling circuit:

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

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

The individual pressure drops  $P_i$  represent the pressure drops of components (heat exchanger, piping, 70 kPa for the SINAMICS devices connected in parallel, valves, dirt traps, pipe bends, etc.).

Coolant pipes must be routed with extreme care. The pipes must never come into contact with electrically live components. An insulation clearance of  $> 13$  mm must always be maintained between pipes and live parts. The pipes must be securely mounted and checked for leaks.

#### 10.1.4 Installation

A closed stainless-steel cooling circuit, preferably combined with monitoring of the coolant quality, is strongly recommended to ensure the longest possible service life for the heat sink.

CAUTION
Coolant pipes must be routed with extreme care. The pipes must be securely mounted and checked for leaks. They must never come into contact with live components.

#### Materials and connections

To minimize the electrochemical processes taking place in the cooling system, the materials must be coordinated with one another accordingly. For this reason, mixed installations (i.e. a combination of different materials, such as copper, brass, iron, zinc, or halogenated plastic (PVC hoses and seals)) should not be used or should be limited to an absolute minimum.

The valves and connections required in the cooling system must be made of stainless steel (V2A or V4A steel; NIROSTA austenite).

The following materials can be used for the cooling system piping:

- Pipes and corrugated piping made of stainless steel (V2A or V4A steel; NIROSTA austenite)
- Hoses made of EPDM/EPDM with an electrical resistance  $< 10^9$  ohms (e.g. Semperflex FKD by Semperit; <http://www.semperit.at>)
- DEMITEL® hoses made of PE/EPDM (Telle; <http://www.telle.de>)
- Secure with clips that comply with DIN2871, available from Telle, for example.

All control cabinets must be designed with a PE bar and a good electrical connection must be established between them.

NOTICE
The sealing materials must be free of chlorides, graphite, and carbon (Viton® or EPDM). Teflon-based seals are not permitted.

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**Note**

When non-conductive hoses are used, particular attention must be paid to the equipotential bonding of all components. (Refer to the chapter titled "Equipotential bonding".)

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**Note**

Once installed, the cooling system must be checked to ensure that it is properly sealed.

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### 10.1.5 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.

### 10.1.6 Commissioning

When commissioning the cooling water circuit, the following sequence must be observed:

- Ventilate the heat sink the first time the devices are filled.
- Remove the fixing glands located in front of the vent valve.
- Perform ventilation.
- Close the vent valve.
- Screw the fixing glands tight again.
- Check the seals.
- Set the operating pressure according to the flow conditions of the cooling water system in the supply and return lines.
- Set the required cooling water flow rate per time unit.

<b>CAUTION</b>
Ventilation must only be performed when the system is at zero voltage.



## 10.2 Coolant requirements

### 10.2.1 Coolant properties

Water or a water/anti-freeze mixture that meets the relevant requirements can be used as a cooling medium. The cooling medium must be chemically neutral, clean, and not contain any solids.

The cooling water must fulfill the following requirements over the long term:

- Chemically neutral, clean, and free of solids
- Max. inlet temperature: 50 °C
- Max. outlet temperature: 55 °C
- System pressure 600 kPa
- Max. size of any particles transported: 100 µm
- pH value: 6.0 to 8.0
- Chlorides < 200 ppm
- Sulfates < 600 ppm
- Loose materials < 340 ppm
- Total hardness < 170 ppm
- Electrical conductivity < 500 µS/cm

**NOTICE**

Condensation must not be allowed to form on the SINAMICS S110 equipment as a result of supercooling. The temperature of the cooling water may have to be regulated.

**NOTICE**

The heat sink is made of non-seawater-proof material, which means that it must not be cooled directly with seawater.

**Note**

Tap water is not generally suitable for use in the cooling circuit. It can be mixed with de-ionized water. Losses must always be replenished with de-ionized water.

The cooling water should be checked 3 months after the cooling circuit is filled for the first time and, subsequently, once a year. If the cooling water becomes cloudy, is colored, or becomes contaminated by mould spores, the cooling circuit must be cleaned and refilled.

An inspection glass should be provided in the cooling circuit to make it easier to check the cooling water.

### 10.2.2 Anti-corrosion additives (inhibitors)

#### Inhibitor without anti-freeze effect

Nalco 00GE056 (ONDEO Nalco; <http://www.ondeonalco.com>) must be used as an anti-corrosion agent. The concentration of anti-corrosion agent in the cooling water should be between 2,000 ppm and 2,500 ppm (200 to 250 ml/100 liters of cooling water).

A prerequisite for the inhibitor is the specified coolant, which must not contain any magnesium carbonate. Control kits can be ordered from Nalco to check the inhibitor concentration.

### 10.2.3 Anti-freeze additives

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

<b>NOTICE</b>
If the proportion of antifreeze added is greater than 30%, this can inhibit the transfer of heat and prevent the units from functioning correctly.
<b>NOTICE</b>
Cooling water mixtures with Antifrogen N are highly conductive. In the event of leakage, the insulating systems must be cleaned.
<b>NOTICE</b>
When EPDM hoses are used, oily anti-corrosion-agent additives must not be used because such additives can corrode and destroy EPDM.

#### Note

You must always bear in mind that the kinematic viscosity of the cooling water changes when antifreeze is added, which means that the pump power must be adjusted accordingly.

Antifrogen N contains corrosion inhibitors which permanently protect the metal in the cooling system against corrosion. The proportion of Antifrogen N should always be >20%, otherwise the mixture becomes corrosive.

Inhibitors and Antifrogen N must not be mixed.

#### 10.2.4 Biocide additives (only if required)

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

If Antifrogen N antifreeze is used with a concentration of 20% or higher, it can be assumed that there is an adequate biocide effect.

The following types of bacteria are encountered in practice:

- Slime-forming bacteria
- Corrosive bacteria
- Iron-depositing bacteria

The type of bacteria determines the suitability of a biocide. At least one water analysis per year (to determine the number of bacterial colonies) is recommended. Suitable biocides are available, for example, from Nalco (Manufacturer: Nalco).

- We recommend adding partial doses of Nalco N 77352 (ONDEO Nalco; <http://www.ondeonalco.com>) twice a month, rather than adding an entire dose all at once (i.e. to introduce pauses in the dosing process).  
Dosage: 5 – 15 mg/100 liters of cooling water. This product has no adverse effect on Nalco 00GE056 corrosion inhibitor.

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#### Note

The type of bacteria determines the biocide.

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

Biocides and Antifrogen N must not be mixed.

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## 10.3 Anti-condensation measures

The customer must take measures to protect the devices against condensation.

Condensation occurs when the inlet temperature of the coolant is significantly lower than room temperature (ambient temperature). The permissible temperature difference between coolant and air varies as a function of the relative humidity  $\phi$  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  $\phi$  and room temperature at an installation altitude of 0 m.

T room [°C]	$\phi=20\%$	$\phi=30\%$	$\phi=40\%$	$\phi=50\%$	$\phi=60\%$	$\phi=70\%$	$\phi=80\%$	$\phi=85\%$	$\phi=90\%$	$\phi=95\%$	$\phi=100\%$
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).

## **10.4 Equipotential bonding**

All components in the cooling system (SINAMICS units, heat exchanger, piping system, pump, pressure compensator, etc.) must be connected to an equipotential bonding system. A copper bar or stranded copper with the appropriate conductor cross-sections must be used for this purpose to eliminate electrochemical processes.


If the installation comprises more than one control cabinet, they must be bolted together with good conductivity (e.g. bolt cabinet cross-beams together directly at several points to establish a conductive connection). This eliminates potential differences and, in turn, the risk of electrochemical corrosion. A PE bar must be installed in every cabinet (including the recooling system) and the individual bars interconnected.


*Cooling circuit and coolant properties*


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*10.4 Equipotential bonding*

## 11.1 Safety information

 <b>DANGER</b>
<p>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.</p> <p>All damaged parts or components must be replaced. Spare parts are available on the Internet at: <a href="http://support.automation.siemens.com/WW/view/en/16612315">http://support.automation.siemens.com/WW/view/en/16612315</a></p>

 <b>DANGER</b>
<p>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.</p>

 <b>DANGER</b>
<p>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.</p>

## 11.2 Service and maintenance for components, Blocksize format

### 11.2.1 Replacing hardware components

<b>NOTICE</b>
Hardware components may only be replaced when in the no-voltage state!

The following components can be replaced with replacement/exchange components with the same Order No.:

- Power Modules
- DRIVE-CLiQ components
- Control Units

### 11.2.2 Replacing the fan

Fans are available as spare parts for all frame sizes of PM340.

<b>NOTICE</b>
Only trained personnel may replace the fan, observing ESD guidelines.

**Preconditions**

1. Disconnect the PM340 from the power supply.
2. Remove the device or the drive line-up.



**Frame size FSA/FSB/FSC****Note**

You will require a cross-tip screwdriver to remove and install the fan of the PM340 for frame sizes FSA to FSC.

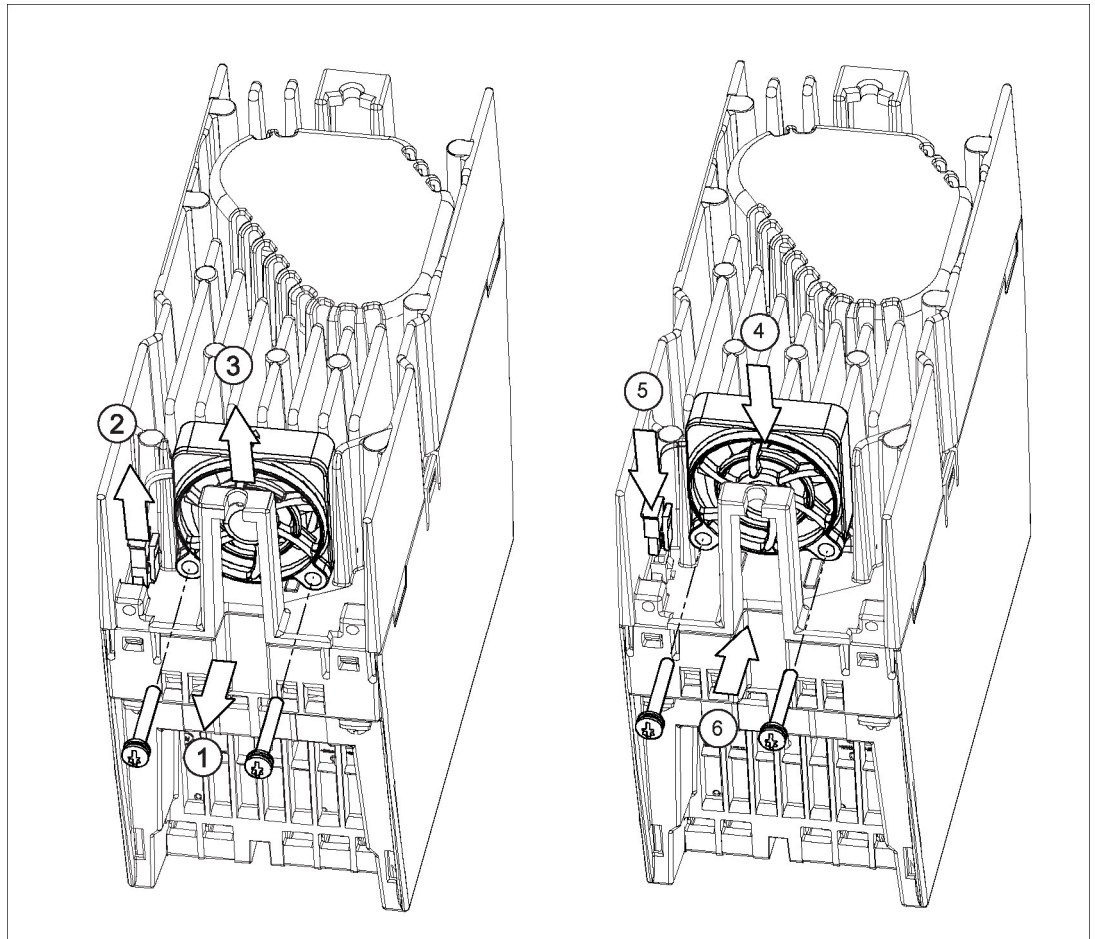


Figure 11-1 PM340 fan replacement, frame size FSA

1. Remove the fixing screws.
2. Remove the connector.
3. Remove the fan.
4. Insert the new fan.
5. Insert the connector.
6. Tighten the mounting screws (0.4 Nm tightening torque).

Service and maintenance

11.2 Service and maintenance for components, Blocksize format

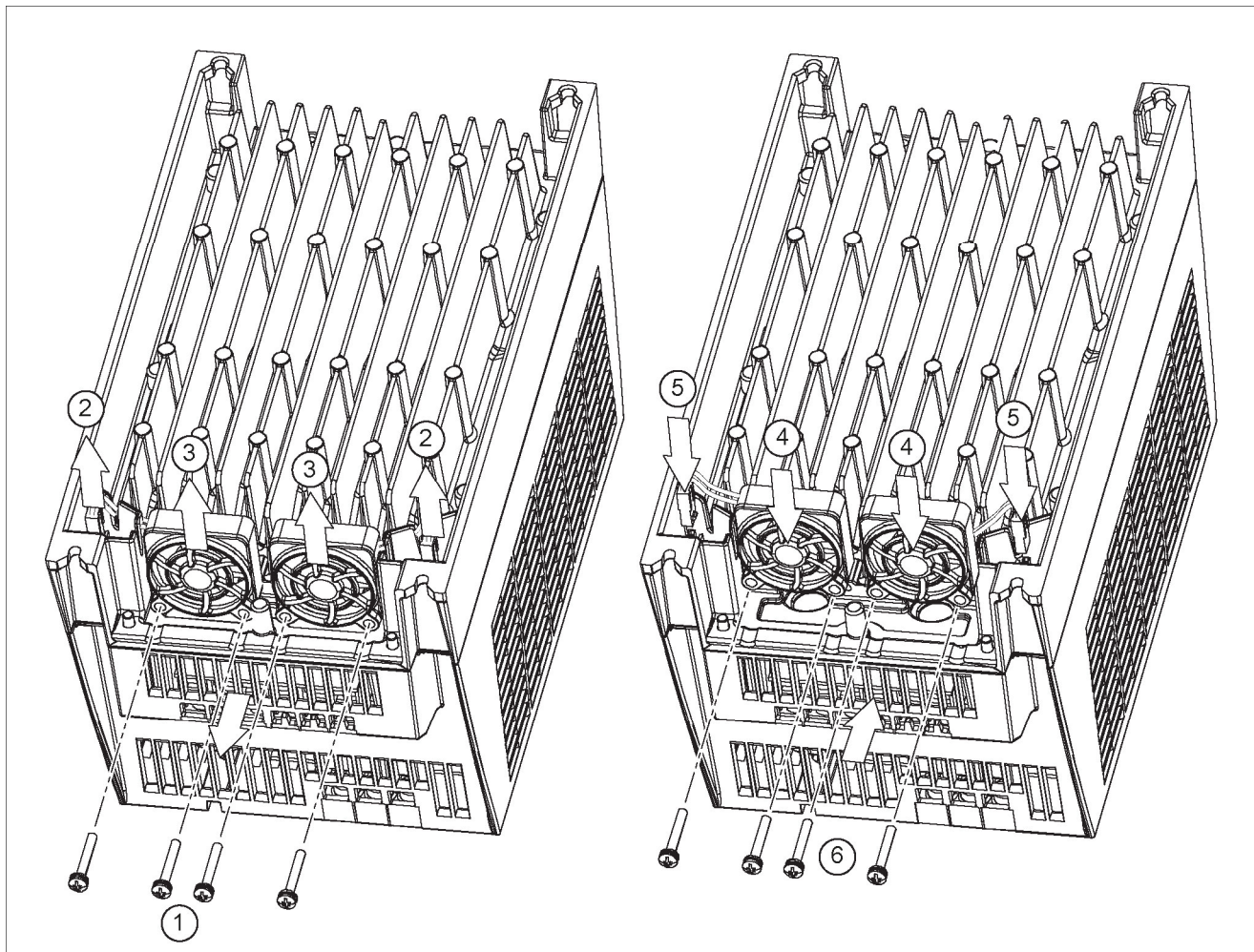


Figure 11-2 PM340 fan replacement, frame size FSB/FSC (0.4 Nm tightening torque)

## Frame sizes FSD/FSE

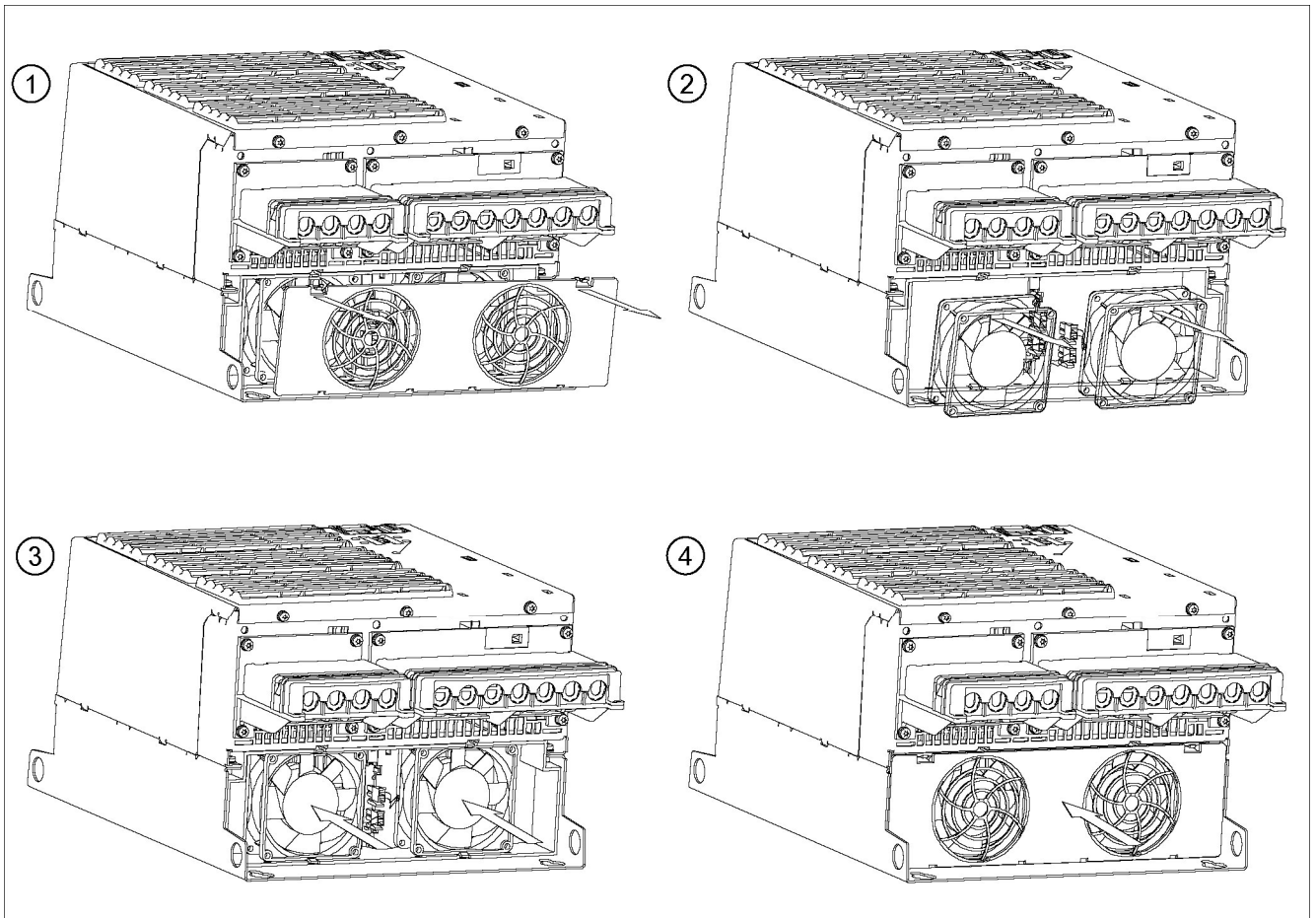


Figure 11-3 PM340 fan replacement, frame sizes FSD/FSE

1. Remove the cover.
2. Remove both connectors and both fans.
3. Insert the new fans and reattach both connectors.
4. Close the cover.

Frame size FSF

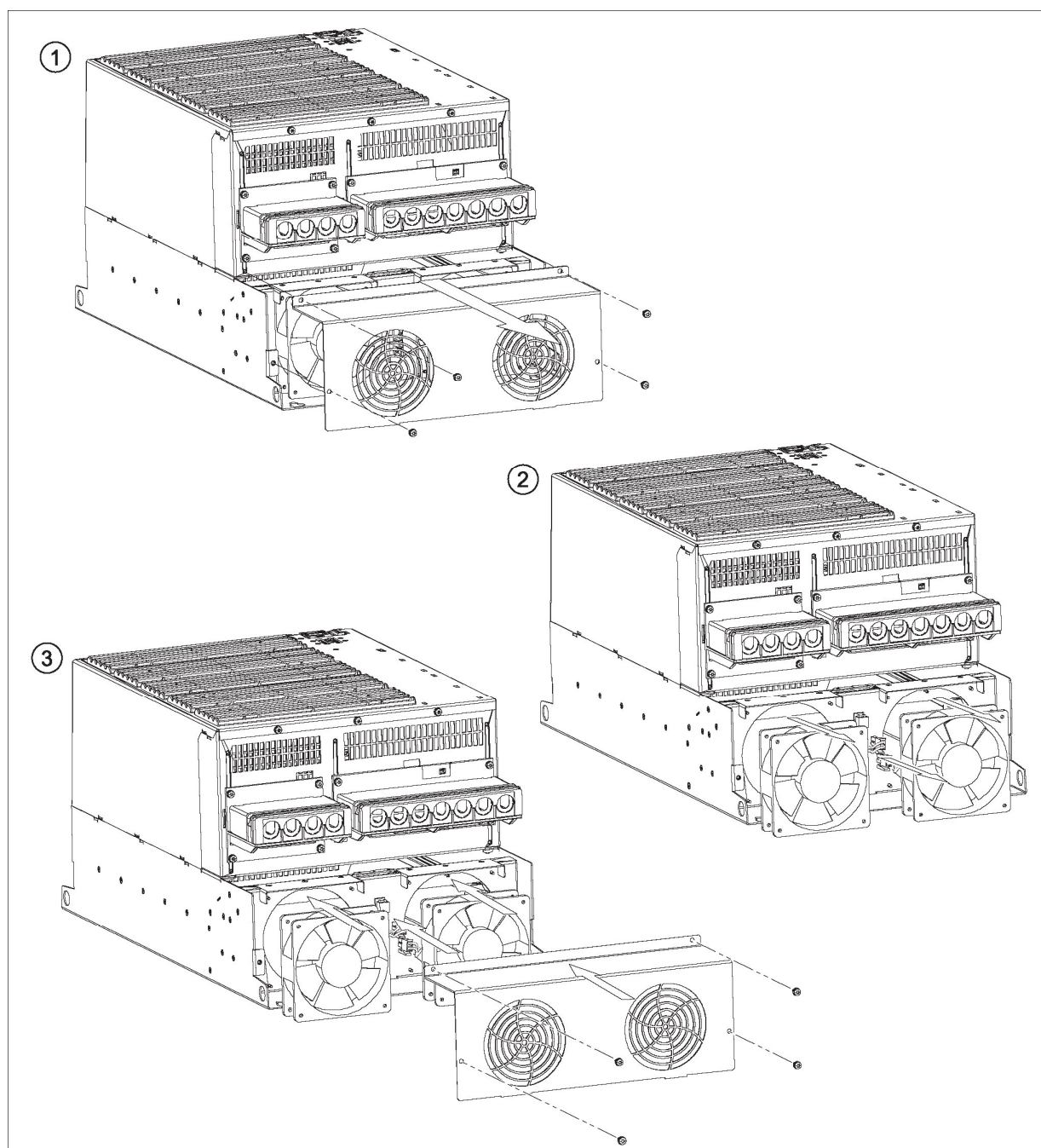


Figure 11-4 PM340 fan replacement, frame size FSF

1. Unfasten the screws and remove the cover.
2. Remove both connectors and both fans.
3. Insert the new fans, attach both connectors, close the cover and fasten the screws (3.0 Nm tightening torque).

## 11.3 Forming the DC link capacitors

 **CAUTION**

If the Power Modules are kept in storage for more than two years, the DC link capacitors have to be reformed. If this is not performed, the units could be damaged when they are switched on.

If the cabinet is commissioned within two years of its date of manufacture, the DC link capacitors do not need to be reformed. The date of manufacture can be taken from the serial number on the rating plate.

**Note**

It is important that the storage period is calculated from the date of manufacture and not from the date that the equipment was shipped.

### Date of manufacture

The date of manufacture can be determined from the following assignment to the serial number (e.g. T-S92067000015 for 2004, September):

Table 11- 1 Production year and month

Character	Year of manufacture	Character	Month of manufacture
S	2004	1 to 9	January to September
T	2005	O	October
U	2006	N	November
V	2007	D	December
W	2008		
X	2009		
A	2010		
B	2011		

The serial number is found on the rating plate.

When DC link capacitors are formed, a defined voltage is connected to them and a defined current flows so that the appropriate capacitor characteristics are re-established for them to be re-used as DC link capacitors.

### Forming circuit

The forming circuit can be established using incandescent lamps or alternatively, resistors.

#### Components required for reforming outside the drive line-up

- 1 fuse switch, triple 400 V / 10 A or double 230 V / 10 A
- Cable 1.5 mm<sup>2</sup>
- 3 incandescent lamps 230 V/100 W for a line voltage of 380 to 480 V 3-ph AC.  
Alternatively, use three 1 kΩ / 100 W resistors (e.g. GWK150J1001KLX000 from Vishay) instead of the incandescent lamps.
- 2 incandescent lamps 230 V/100 W for a line voltage of 200 to 240 V 1-ph AC.  
Alternatively, use 2 1 kΩ / 100 W resistors (e.g. GWK150J1001KLX000 from Vishay) instead of the incandescent lamps.
- Various Small components, such as lamp socket, etc.

**DANGER**

Dangerously high voltage levels are still present in the cabinet up to 5 minutes after it has been disconnected due to the DC link capacitors. It is only permissible to work on the equipment or at the DC link terminals after this time has expired.

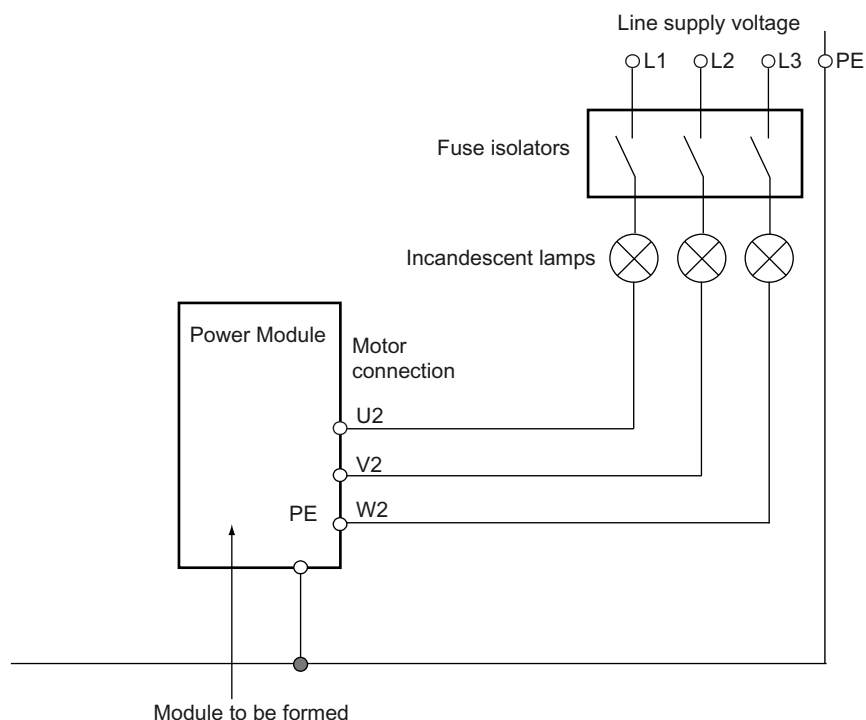


Figure 11-5 Forming circuit for 3-ph AC Power Modules with incandescent lamps

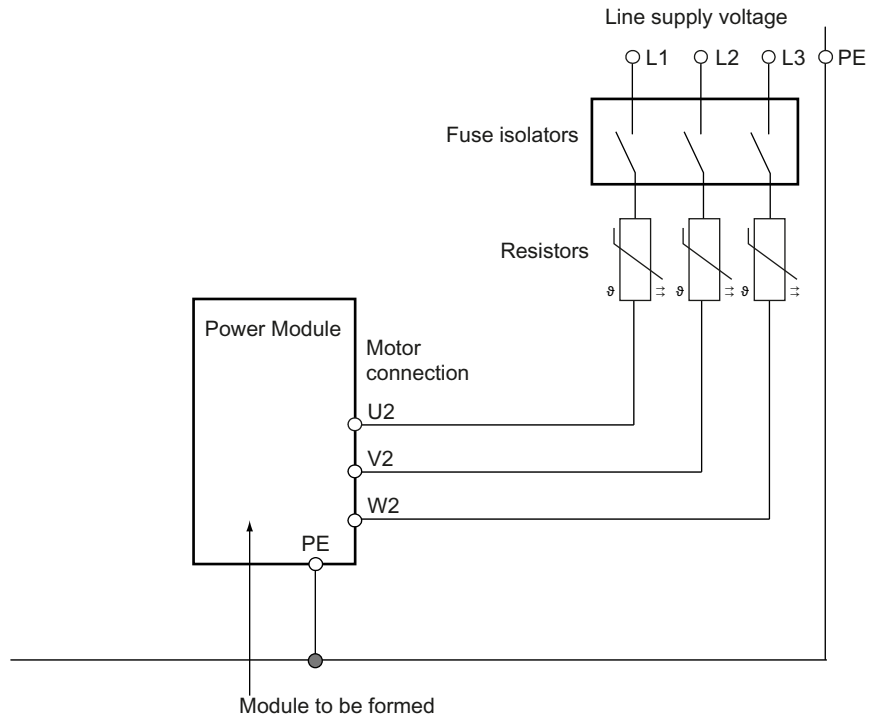


Figure 11-6 Forming circuit for 3-ph AC Power Modules with resistors

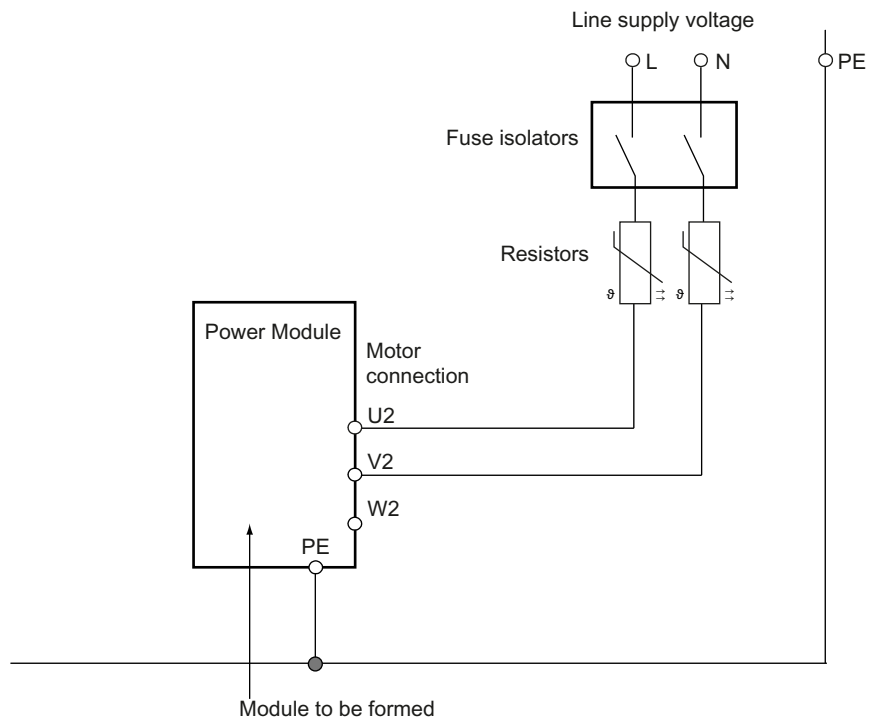


Figure 11-7 Forming circuit for 1-ph AC Power Modules with resistors

**Procedure**

- Make sure that the device **does not** receive a power-on command (e.g. from the keyboard or terminal block).
- Connect the forming circuit.
- While forming, the incandescent lamps must become less bright or go completely dark. If the incandescent lamps continue to be brightly lit, a fault has occurred in the drive unit or in the wiring.
- To form using resistors, the modules must remain in the circuit for approx. 1h. The resistors will become very hot if there is a fault in the unit (surface temperature > 80°C).



## **11.4 Spare parts**

Spare parts are available on the Internet at:

<http://support.automation.siemens.com/WW/view/en/16612315>

## **11.5 Recycling and disposal**

The applicable national guidelines must be observed when disposing of the product.

The products described in this manual are extensively recyclable on account of the low-toxic composition of the materials used. For environmentally-compliant recycling and disposal of your electronic waste, please contact a company for the disposal of electronic waste.

## Appendix A

### A.1 Spring-loaded terminals/screw terminal

#### Connectable conductor cross-sections of spring-loaded terminals

The type of spring-loaded terminal can be taken from the interface description of the particular component.

Table A- 1 Spring-loaded terminals

Spring-loaded 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 <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 0.5 mm <sup>2</sup>
	Insulation stripping length	9 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	
2	Connectable conductor cross-sections	Flexible	0.08 mm <sup>2</sup> to 2.5 mm <sup>2</sup>
	Insulation stripping length	8 to 9 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	

#### Connectable conductor cross-sections of the screw terminal

Table A- 2 Screw terminal

Screw terminal		
Connectable conductor cross-sections	Rigid, flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.08 mm <sup>2</sup> to 2.5 mm <sup>2</sup> 0.5 mm <sup>2</sup> to 2.5 mm <sup>2</sup> 0.5 mm <sup>2</sup> to 1.5 mm <sup>2</sup>
Insulation stripping length	7 mm	
Tool	Screwdriver 0.6 x 3.5 mm	
Tightening torque	0.5 to 0.6 Nm	

*Appendix A*

---

*A.1 Spring-loaded terminals/screw terminal*

## Appendix B

### B.1 List of abbreviations

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**Note:**

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

---

Abbreviation	Source of abbreviation	Meaning
<b>A</b>		
A...	Alarm	Alarm
AC	Alternating Current	Alternating current
ADC	Analog Digital Converter	Analog digital converter
AI	Analog Input	Analog input
AIM	Active Interface Module	Active Interface Module
ALM	Active Line Module	Active Line Module
AO	Analog Output	Analog output
AOP	Advanced Operator Panel	Advanced Operator Panel
APC	Advanced Positioning Control	Advanced Positioning Control
AR	Automatic Restart	Automatic restart
ASC	Armature Short Circuit	Armature short circuit
ASCII	American Standard Code for Information Interchange	American standard code for information interchange
ASM	Asynchronmotor	Induction motor
<b>B</b>		
BERO	-	Contactless proximity switch
BI	Binector Input	Binector input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit	Germany's Institute for Occupational Safety and Health
BICO	Binector Connector Technology	Binector connector technology
BLM	Basic Line Module	Basic Line Module
BO	Binector Output	Binector output
BOP	Basic Operator Panel	Basic Operator Panel

## Appendix B

### B.1 List of abbreviations

Abbreviation	Source of abbreviation	Meaning
<b>C</b>		
C	Capacitance	Capacitance
C...	-	Safety message
CAN	Controller Area Network	Serial bus system
CBC	Communication Board CAN	Communication board CAN
CD	Compact Disc	Compact Disc
CDC	Crosswise data comparison	Crosswise data comparison
CDS	Command Data Set	Command data set
CF Card	CompactFlash Card	CompactFlash Card
CI	Connector Input	Connector input
CLC	Clearance Control	Clearance control
CNC	Computer Numerical Control	Computer numerical control
CO	Connector Output	Connector output
CO/BO	Connector Output/Binector Output	Connector/binector output
COB ID	CAN Object Identification	CAN Object identification
COM	Common contact of a changeover relay	Center contact of a changeover contact
COMM	Commissioning	Commissioning
CP	Communication Processor	Communication processor
CPU	Central Processing Unit	Central processing unit
CRC	Cyclic Redundancy Check	Cyclic redundancy check
CSM	Control Supply Module	Control Supply Module
CU	Control Unit	Control Unit
CUA	Control Unit Adapter	Control Unit Adapter
CUD	Control Unit DC MASTER	Control Unit DC MASTER
<b>D</b>		
DAC	Digital Analog Converter	Digital analog converter
DC	Direct Current	DC current
DC link	DC link	DC link
DCB	Drive Control Block	Drive Control Block
DCC	Drive Control Chart	Drive Control Chart
DCC	Data Cross Check	Crosswise data comparison
DCN	Direct Current Negative	DC current negative
DCP	Direct Current Positive	DC current positive
DDS	Drive Data Set	Drive data set
DI	Digital Input	Digital input
DI/DO	Digital Input/Digital Output	Digital input/output bidirectional
DMC	DRIVE-CLiQ Hub Module Cabinet	DRIVE-CLiQ Hub Module Cabinet
DME	DRIVE-CLiQ Hub Module External	DRIVE-CLiQ Hub Module External
DO	Digital Output	Digital output
DO	Drive Object	Drive object

<b>Abbreviation</b>	<b>Source of abbreviation</b>	<b>Meaning</b>
DP	Decentralized Peripherals	Distributed IOs
DPRAM	Dual Ported Random Access Memory	Memory with dual access ports
DRAM	Dynamic Random Access Memory	Dynamic memory
DRIVE-CLiQ	Drive Component Link with IQ	Drive Component Link with IQ
DSC	Dynamic Servo Control	Dynamic Servo Control
<b>E</b>		
EASC	External Armature Short Circuit	External armature short circuit
EDS	Encoder Data Set	Encoder data set
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ELCB	Earth Leakage Circuit Breaker	Earth leakage circuit breaker
ELP	Earth Leakage Protection	Earth leakage protection
EMC	Electromagnetic Compatibility	Electromagnetic compatibility
EMF	Electromagnetic Force	Electromagnetic force
EMC	Electromagnetic compatibility	Electromagnetic compatibility
EN	European standard	European standard
EnDat	Encoder Data Interface	Encoder interface
EP	Enable Pulses	Pulse enable
EPOS	Einfachpositionierer	Basic positioner
ES	Engineering System	Engineering System
ESB	Equivalent circuit diagram	Equivalent circuit diagram
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ESR	Extended Stop and Retract	Extended stop and retract
<b>F</b>		
F...	Fault	Fault
FAQs	Frequently Asked Questions	Frequently asked questions
FBL	Free Blocks	Free function blocks
FCC	Function Control Chart	Function Control Chart
FCC	Flux Current Control	Flux current control
FD	Function Diagram	Function diagram
F-DI	Failsafe Digital Input	Fail-safe digital input
F-DO	Failsafe Digital Output	Fail-safe digital output
FEM	Fremderregter Synchronmotor	Separately excited synchronous motor
FEPROM	Flash EPROM	Non volatile read and write memory
FG	Function Generator	Function generator
FI	-	Fault current
FOC	Fiber-Optic Cable	Fiber-optic cable
FP	Function diagram	Function diagram
FPGA	Field Programmable Gate Array	Field Programmable Gate Array

## Appendix B

### B.1 List of abbreviations

Abbreviation	Source of abbreviation	Meaning
FW	Firmware	Firmware
<b>G</b>		
GB	Gigabyte	Gigabyte
GC	Global Control	Global Control Telegram (Broadcast Telegramm)
GND	Ground	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as G)
GSD	Generic Station Description	Generic station description: Describes the characteristics of a PROFIBUS slave
GSV	Gate Supply Voltage	Gate Supply Voltage
GUID	Globally Unique Identifier	Globally unique identifier
<b>H</b>		
HF	High Frequency	High frequency
HFD	Hochfrequenzdrossel	High-frequency reactor
HMI	Human Machine Interface	Human machine interface
HTL	High-Threshold Logic	Logic with a high fault threshold
HW	Hardware	Hardware
<b>I</b>		
I/O	Input/Output	Input/output
I2C	Inter-Integrated Circuit	Internal serial data bus
IASC	Internal Armature Short Circuit	Internal armature short circuit
IBN	Inbetriebnahme	Commissioning
ID	Identifier	Identification
IE	Industrial Ethernet	Industrial Ethernet
IEC	International Electrotechnical Commission	International Electrotechnical Commission
IF	Interface	Interface
IGBT	Insulated Gate Bipolar Transistor	Insulated gate bipolar transistor
IGCT	Integrated Gate-Controlled Thyristor	Semiconductor power switch with integrated control electrode
IL	Impulslöschung	Pulse cancelation
IP	Internet Protocol	Internet Protocol
IPO	Interpolator	Interpolator
IT	Isolé Terré	Non-grounded three-phase power supply
IVP	Internal Voltage Protection	Internal voltage protection
<b>J</b>		
JOG	Jogging	Jogging



Abbreviation	Source of abbreviation	Meaning
<b>K</b>		
KIP	Kinetische Pufferung	Kinetic buffering
Kp	-	Proportional gain
KTY	-	Special temperature sensor
<b>L</b>		
L	-	Formula symbol for inductance
LED	Light Emitting Diode	Light Emitting Diode
LIN	Linear motor	Linear motor
LSB	Least Significant Bit	Least significant bit
LSC	Line-Side Converter	Line-side converter
LSS	Line Side Switch	Line side switch
LU	Length Unit	Length unit
<b>M</b>		
M	-	Formula symbol for torque
M	Masse	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as GND)
MB	Megabyte	Megabyte
MCC	Motion Control Chart	Motion Control Chart
MDS	Motor Data Set	Motor data set
MLFB	Maschinenlesbare Fabrikatebezeichnung	Machine-Readable Product Code
MMC	Man-Machine Communication	Man-machine communication
MMC	Micro Memory Card	Micro memory card
MSB	Most Significant Bit	Most significant bit
MSC	Motor-Side Converter	Motor-side converter
MSCY_C1	Master Slave Cycle Class 1	Cyclic communication between master (Class 1) and slave
MSR	Motorstromrichter	Motor-side converter
MT	Machine Tool	Machine tool
<b>N</b>		
N. C.	Not Connected	Not connected
N...	No Report	No message or internal message
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie	Standardization association for measurement and control in the chemical industry
NC	Normally Closed (contact)	NC contact
NC	Numerical Control	Numerical control
NEMA	National Electrical Manufacturers Association	Standardization body in the US
NM	Nullmarke	Zero mark
NO	Normally Open (contact)	NO contact

## Appendix B

### B.1 List of abbreviations

Abbreviation	Source of abbreviation	Meaning
NSR	Netzstromrichter	Line-side converter
NVRAM	Non-Volatile Random Access Memory	Non-volatile read/write memory
<b>O</b>		
OA	Open Architecture	Open Architecture
OC	Operating Condition	Operating condition
OEM	Original Equipment Manufacturer	Original Equipment Manufacturer
OLP	Optical Link Plug	Fiber-optic bus connector
OMI	Option Module Interface	Option module interface
<b>P</b>		
p...	-	Adjustable parameters
PB	PROFIBUS	PROFIBUS
PC	Position Controller	Position Controller
PcCtrl	PC Control	Control for master
PD	PROFIdrive	PROFIdrive
PDS	Power unit Data Set	Power unit data set
PE	Protective Earth	Protective earth
PELV	Protective Extra Low Voltage	Protective extra low voltage
PEM	Permanenterregter Synchronmotor	Permanent-magnet synchronous motor
PG	Programmiergerät	Programming device
PI	Proportional Integral	Proportional integral
PID	Proportional Integral Differential	Proportional integral differential
PLC	Programmable Logic Controller	Programmable logic controller
PLL	Phase-Locked Loop	Phase-locked loop
PN	PROFINET	PROFINET
PNO	PROFIBUS Nutzerorganisation	PROFIBUS user organization
PPI	Point-to-Point Interface	Point-to-point interface
PRBS	Pseudo Random Binary Signal	White noise
PROFIBUS	Process Field Bus	Serial data bus
PS	Power Supply	Power supply
PSA	Power Stack Adapter	Power Stack Adapter
PTC	Positive Temperature Coefficient	Positive temperature coefficient
PTP	Point-To-Point	Point-to-Point
PWM	Pulse Width Modulation	Pulse width modulation
PZD	Prozessdaten	Process data
<b>R</b>		
r...	-	Display parameters (read-only)
RAM	Random Access Memory	Read/write memory
RCCB	Residual Current Circuit Breaker	Residual current operated circuit breaker
RCD	Residual Current Device	Residual current operated circuit breaker
RCM	Residual Current Monitor	Residual current monitor

<b>Abbreviation</b>	<b>Source of abbreviation</b>	<b>Meaning</b>
RFG	Ramp-Function Generator	Ramp-function generator
RJ45	Registered Jack 45	Term for an 8-pin socket system for data transmission with shielded or non-shielded multi-wire copper cables
RKA	Rückkühlanlage	Cooling unit
RO	Read Only	Read only
RPDO	Receive Process Data Object	Receive process data object
RS232	Recommended Standard 232	Interface standard for cable-connected serial data transmission between a sender and receiver (also known under EIA232)
RS485	Recommended Standard 485	Interface standard for a cable-connected differential, parallel, and/or serial bus system (data transmission between a number of senders and receivers, also known under EIA485)
RTC	Real Time Clock	Real time clock
RZA	Raumzeigerapproximation	Space vector approximation
<b>S</b>		
S1	-	Uninterrupted duty
S3	-	Intermittent duty
SBC	Safe Brake Control	Safe brake control
SBH	Sicherer Betriebshalt	Safe operating stop
SBR	-	Safe acceleration monitoring
SCA	Safe Cam	Safe cam
SD Card	SecureDigital Card	Secure digital memory card
SE	Sicherer Software-Endschalter	Safe software limit switch
SG	Sicher reduzierte Geschwindigkeit	Safely reduced speed
SGA	Sicherheitsgerichteter Ausgang	Safety-related output
SGE	Sicherheitsgerichteter Eingang	Safety-related input
SH	Sicherer Halt	Safe standstill
SI	Safety Integrated	Safety Integrated
SIL	Safety Integrity Level	Safety Integrity Level
SLM	Smart Line Module	Smart Line Module
SLP	Safely-Limited Position	Safely-limited position
SLS	Safely Limited Speed	Safely limited speed
SLVC	Sensorless Vector Control	Vector control without encoder
SM	Sensor Module	Sensor Module
SMC	Sensor Module Cabinet	Sensor Module Cabinet
SME	Sensor Module External	Sensor Module External
SN	Sicherer Software-Nocken	Safe software cam
SOS	Safe Operating Stop	Safe operating stop

## Appendix B

### B.1 List of abbreviations

Abbreviation	Source of abbreviation	Meaning
SP	Service Pack	Service pack
SPC	Setpoint Channel	Setpoint channel
SPI	Serial Peripheral Interface	Serial interface for connecting peripherals
SS1	Safe Stop 1	Safe stop 1 (monitored for time and ramping up)
SS2	Safe Stop 2	Safe stop 2
SSI	Synchronous Serial Interface	Synchronous serial interface
SSM	Safe Speed Monitor	Safe feedback for speed monitoring (n < nx)
SSP	SINAMICS Support Package	SINAMICS support package
STO	Safe Torque Off	Safe torque off
STW	Steuerwort	Control word
<b>T</b>		
TB	Terminal Board	Terminal Board
TIA	Totally Integrated Automation	Totally Integrated Automation
TM	Terminal Module	Terminal module
TN	Terre Neutre	Grounded three-phase supply network
Tn	-	Integral time
TPDO	Transmit Process Data Object	Transmit process data object
TT	Terre Terre	Grounded three-phase supply network
TTL	Transistor-Transistor Logic	Transistor-transistor logic
Tv	-	Rate time
<b>U</b>		
u.d.	under development	Under development: This feature is not currently available
UL	Underwriters Laboratories Inc.	Underwriters Laboratories Inc.
UPS	Uninterruptible Power Supply	Uninterruptible power supply
UTC	Universal Time Coordinated	Universal time coordinated
<b>V</b>		
VC	Vector Control	Vector control
Vdc	-	DC link voltage
VdcN	-	Partial DC link voltage negative
VdcP	-	Partial DC link voltage positive
VDE	Verband Deutscher Elektrotechniker	Association of German electrical engineers
VDI	Verein Deutscher Ingenieure	Association of German Engineers
VPM	Voltage Protection Module	Voltage Protection Module
Vpp	Volt peak-to-peak	Volt peak-to-peak
VSM	Voltage Sensing Module	Voltage Sensing Module

<b>Abbreviation</b>	<b>Source of abbreviation</b>	<b>Meaning</b>
<b>X</b>		
XML	Extensible Markup Language	Standard language for Web publishing and document management
<b>Z</b>		
ZM	Zero Mark	Zero mark
ZSW	Zustandswort	Status word

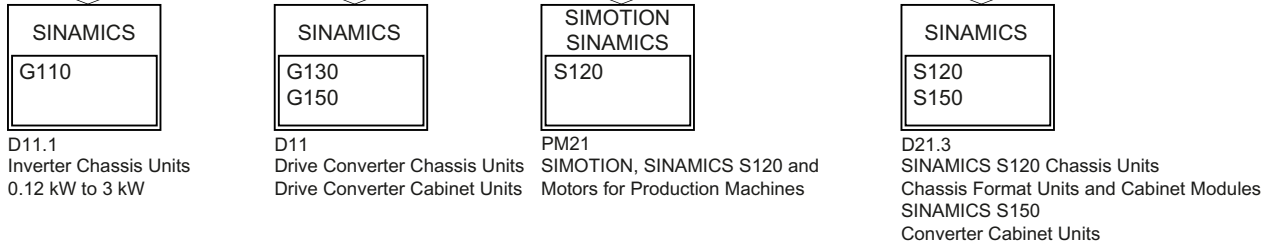
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*B.1 List of abbreviations*

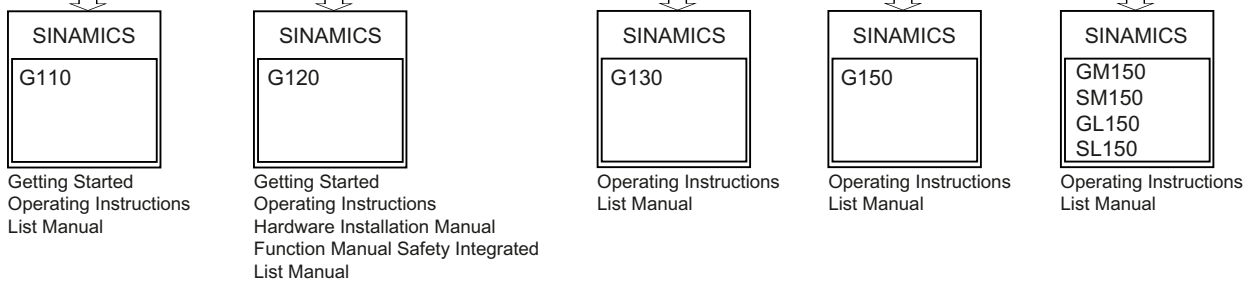
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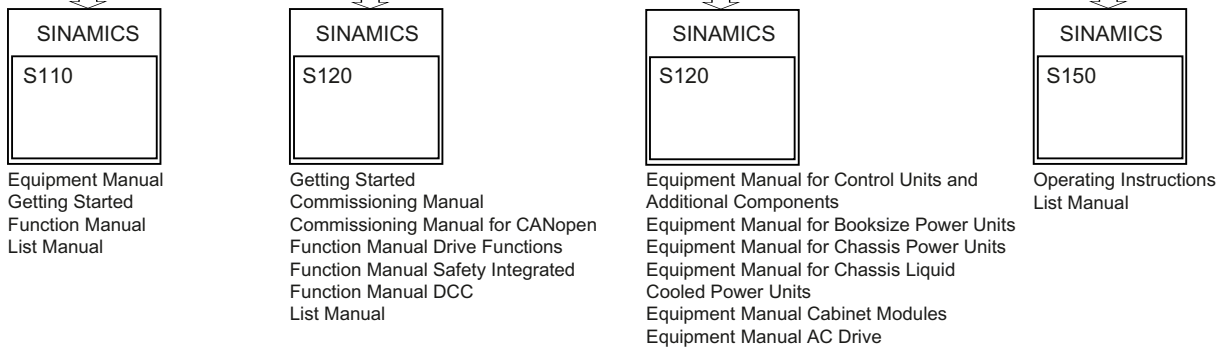
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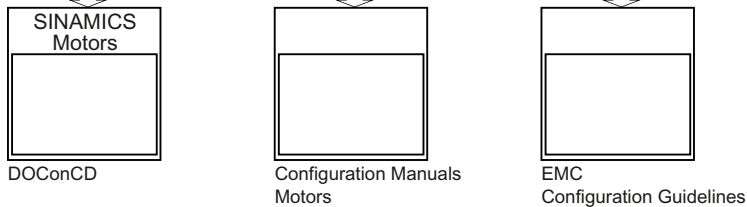
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