SIEMENS

Equipment Manual

SINAMICS

S120

Water-cooled chassis power units for common cooling circuits

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www.siemens.com/drives

Промэлектроника, sales@prom-elec.com

SIEMENS

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Manual

08/2017

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Legal information

Warning notice system

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

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

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

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

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

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

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

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Disclaimer of Liability

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

Siemens AG
Division Process Industries and Drives
Postfach 48 48
90026 NÜRNBERG
GERMANY

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Preface

SINAMICS documentation

The SINAMICS documentation is organized in the following categories:

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

Additional information

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

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

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

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

My Documentation Manager

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

Training

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

FAQs

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

SINAMICS

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

Usage phases and the available tools/documents

Table 1 Usage phases and the available tools/documents

Usage phase	Tools
Orientation	SINAMICS S sales documentation
Planning/engineering	• SIZER engineering tool • Configuration manuals, motors
Decision making/ordering	SINAMICS S120 catalogs • SINAMICS S120 and SIMOTICS (Catalog D 21.4) • SINAMICS S120 Chassis Units and Cabinet Modules, SINAMICS S150 Converter Cabinet Units (Catalog D 21.3)
Configuring/installation	• SINAMICS S120 Manual for Control Units and Additional System Components • SINAMICS S120 Manual for Booksize Power Units • SINAMICS S120 Manual for Chassis Power Units, Air-cooled • SINAMICS S120 Manual for Chassis Power Units, Liquid-cooled • SINAMICS S120 Equipment Manual water-cooled chassis power units for common cooling circuits • SINAMICS S120 Manual for AC Drives • SINAMICS S120M Manual Distributed Drive Technology
Commissioning	• STARTER Commissioning Tool • SINAMICS S120 Getting Started • SINAMICS S120 Commissioning Manual • SINAMICS S120 CANopen Commissioning Manual • SINAMICS S120 Function Manual Drive Functions • SINAMICS S120 Safety Integrated Function Manual • SINAMICS S120/S150 List Manual
Using/operating	• SINAMICS S120 Commissioning Manual • SINAMICS S120 Function Manual Drive Functions • SINAMICS S120/S150 List Manual
Maintenance/Service	• SINAMICS S120 Manual for Control Units and Additional System Components • SINAMICS S120 Manual for Booksize Power Units • SINAMICS S120 Manual for Chassis Power Units, Air-cooled • SINAMICS S120 Manual for Chassis Power Units, Liquid-cooled • SINAMICS S120 Equipment Manual water-cooled chassis power units for common cooling circuits • SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual
List of references	• SINAMICS S120/S150 List Manual

Target group

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

Benefits

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

Standard scope

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

- Other functions 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 controller or when servicing.
- The documentation can also contain descriptions of functions that are not available in a particular product version of the drive system. The functionalities of the supplied drive system should only be taken from the ordering documentation.
- Extensions or changes made by the machine manufacturer must be documented by the machine manufacturer.

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

Technical support

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

https://support.industry.siemens.com/sc/ww/en/sc/2090

EC declaration of conformity

The EC Declaration of Conformity for the EMC Directive and the Low-Voltage Directive are available on the Internet at:

https://support.industry.siemens.com/cs/ww/en/ps/13231/cert

Alternatively, you can contact the Siemens office in your region in order to obtain the EC Declaration of Conformity.

Note

Complying with the low-voltage directive

In the operational state – and when installed in dry electrical rooms – SINAMICS S devices are in compliance with 2014/35/EU.

Note

Fulfilling the EMC Directive

SINAMICS S units fulfill EMC Directive 2014/30/EU in the configuration specified in the associated EC Declaration of Conformity for EMC and when the EMC installation guideline provided in the Configuration Manual with Article No. 6FC5297-0AD30-0AP3 is implemented.

Note

Machinery directive

With safety functions for Safety Integrated, the devices fulfill the requirements according to the machinery directive 2006/42/EC.

Note

Ensuring reliable operation

The manual describes a desired state. The required reliable operation and the compliance with EMC limit values can only be ensured when this is maintained.

Spare parts

Spare parts are available on the Internet at:
https://support.industry.siemens.com/sc/de/en/sc/2110

Test certificates

Test certificates for functional safety functions ("Safety Integrated") can be found at:

https://support.industry.siemens.com/cs

An up-to-date list of currently certified components is also available on request from your local Siemens office. If you have any questions relating to certifications that have not yet been completed, please ask your Siemens contact.

Note on the design of a UL-approved system

Note

Design of a UL-approved system

For a UL-approved system use 60/75° C copper conductors only.

Table of contents

1 Fundamental safety instructions

1.1 General safety instructions

DANGER

Danger to life due to live parts and other energy sources

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

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

Generally, six steps apply when establishing safety:

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

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

WARNING

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

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

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

⚠WARNING

Danger to life when live parts are touched on damaged devices

Improper handling of devices can cause damage.

For damaged devices, hazardous voltages can be present at the enclosure or at exposed components; if touched, this can result in death or severe injury.

- Ensure compliance with the limit values specified in the technical data during transport, storage and operation.
- Do not use any damaged devices.

⚠WARNING

Danger to life through electric shock due to unconnected cable shields

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

- As a minimum, connect cable shields and the cores of power cables that are not used (e.g. brake cores) at one end at the grounded housing potential.

⚠WARNING

Danger to life due to electric shock when not grounded

For missing or incorrectly implemented protective conductor connection for devices with protection class I, high voltages can be present at open, exposed parts, which when touched, can result in death or severe injury.

- Ground the device in compliance with the applicable regulations.

⚠WARNING

Danger to life due to electric shock when opening plug connections in operation

When opening plug connections in operation, arcs can result in severe injury or death.

- Only open plug connections when the equipment is in a no-voltage state, unless it has been explicitly stated that they can be opened in operation.

NOTICE

Material damage due to loose power connections

Insufficient tightening torques or vibration can result in loose electrical connections. This can result in damage due to fire, device defects, or malfunctions.

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

WARNING

Danger to life due to fire spreading if housing is inadequate

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

- Install devices without a protective enclosure in a metal control cabinet (or protect the device by another equivalent measure) in such a way that contact with fire is prevented.
- Ensure that smoke can only escape via controlled and monitored paths.

WARNING

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

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

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

WARNING

Danger to life due to the motor catching fire in the event of insulation overload

There is a greater load on the motor insulation through a ground fault in an IT system. If the insulation fails, it is possible that death or severe injury can occur as a result of smoke and fire.

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

WARNING

Danger to life due to fire if overheating occurs because of insufficient ventilation clearances

Inadequate ventilation clearances can cause overheating of components with subsequent fire and smoke. This can cause severe injury or even death. This can also result in increased downtime and reduced service lives for devices/systems.

- Ensure compliance with the specified minimum clearance as ventilation clearance for the respective component.

⚠ WARNING

Danger of an accident occurring due to missing or illegible warning labels

Missing or illegible warning labels can result in accidents involving death or serious injury.

- Check that the warning labels are complete based on the documentation.
- Attach any missing warning labels to the components, in the national language if necessary.
- Replace illegible warning labels.

NOTICE

Device damage caused by incorrect voltage/insulation tests

Incorrect voltage/insulation tests can damage the device.

- Before carrying out a voltage/insulation check of the system/machine, disconnect the devices as all converters and motors have been subject to a high voltage test by the manufacturer, and therefore it is not necessary to perform an additional test within the system/machine.

⚠ WARNING

Danger to life due to inactive safety functions

Inactive or non-adapted safety functions can trigger machine malfunctions that can cause serious injury or death.

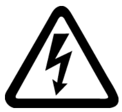
- Observe the information in the appropriate product documentation before commissioning.
- Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.
- Ensure that the safety functions used in your drives and automation tasks are adjusted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

Note

Important safety instructions for Safety Integrated functions

If you want to use Safety Integrated functions, you must observe the safety instructions in the Safety Integrated manuals.

1.2 Safety instructions for electromagnetic fields (EMF)



WARNING

Danger to life from electromagnetic fields

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

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

- Ensure that the persons involved are the necessary distance away (minimum 2 m).

1.3 Handling electrostatic sensitive devices (ESD)

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

NOTICE

Damage through electric fields or electrostatic discharge

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

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

1.4 Industrial security

Note

Industrial security

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens products and solutions represent only one component of such a concept.

The customer is responsible for preventing unauthorized access to its plants, systems, machines and networks. Systems, machines and components should only be connected to the company's network or the internet if and to the extent necessary and with appropriate security measures (e.g. use of firewalls and network segmentation) in place.

Additionally, Siemens' guidance on appropriate security measures should be taken into account. For more information about industrial security, please visit:

Industrial security (http://www.siemens.com/industrialsecurity).

Siemens' products and solutions undergo continuous development to make them more secure. Siemens expressly recommends that updates are carried out as soon as they become available and that only the current product versions are used. Use of product versions that are no longer supported, and failure to apply latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed at: Industrial security (http://www.siemens.com/industrialsecurity).

⚠ WARNING

Danger to life as a result of unsafe operating states resulting from software manipulation

Software manipulation (e.g. viruses, trojans, malware or worms) can cause unsafe operating states in your system that may lead to death, serious injury, and property damage.

- Keep the software up to date.
- Incorporate the automation and drive components into a state-of-the-art, integrated industrial security concept for the installation or machine.
- Make sure that you include all installed products into the integrated industrial security concept.
- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.

Note

Industrial security Configuration Manual

You can find a Configuration Manual on the topic of industrial security at this address (https://support.industry.siemens.com/cs/ww/en/view/108862708).

1.5 Residual risks of power drive systems

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

1. Unintentional movements of the driven machine or system components during commissioning, operation, maintenance, and repairs caused by, for example:
   - Hardware and/or software errors in the sensors, control system, actuators and cables and connections
   - Response times of the controller and drive
   - Operation and/or environmental conditions outside the specification
   - Condensation/conductive pollution
   - Parameterization, programming, cabling, and installation errors
   - Use of wireless devices/mobile phones in the immediate vicinity of electronic components
   - External influence/damage
   - X-ray, ionizing radiation and cosmic radiation
2. Unusually high temperatures - including open flames - as well as the emission of light, noise, particles, gases, etc. can occur inside and outside the components under fault conditions caused by, for example:
   - Component malfunctions
   - Software errors
   - Operation and/or environmental conditions outside the specification
   - External influence/damage
3. Hazardous shock voltages caused by, for example:
   - Component malfunctions
   - Influence of electrostatic charging
   - Induction of voltages in moving motors
   - Operation and/or environmental conditions outside the specification
   - Condensation/conductive pollution
   - External influence/damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc. if they are too close.
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly

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

System overview

2

2.1 The SINAMICS range of drives

Field of application

SINAMICS is the comprehensive 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 single 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 for the manufacture of wind turbines
- Servo drives with a high dynamic performance for machine tools, as well as packaging and printing machines

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

Variants

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

- SINAMICS V
  From both the hardware perspective as well as the functionality, these converters focus on the essential issues. The result is a high degree of ruggedness with low investment costs.
  Operation is directly at the converter without requiring any additional engineering tools. SINAMICS V is especially suitable for applications where no special drive-related know-how is required.
- SINAMICS G
  In operation, SINAMICS G converters fully leverage their technological strength. Users benefit from a standard but at the same time straightforward operating concept.
  This minimizes training and service costs. Another impressive feature of the SINAMICS G range is its optimum price-performance ratio.
- SINAMICS S
  SINAMICS S converters have been specially developed for use in complex machine and plant engineering applications – and to meet the demands of a broad range of motion control tasks. One essential feature is especially: The highest level of standardized engineering.

Platform concept

All SINAMICS versions are based on a platform concept. Common 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 without system gaps.

The different SINAMICS versions can be easily combined with each other.

Totally Integrated Automation and communication

SINAMICS is an integral component of Siemens Totally Integrated Automation. The integrated and seamless SINAMICS system covering engineering, data management, and communication at the automation level ensures solutions with low associated costs in conjunction with the SIMATIC, SIMOTION, and SINUMERIK control systems.

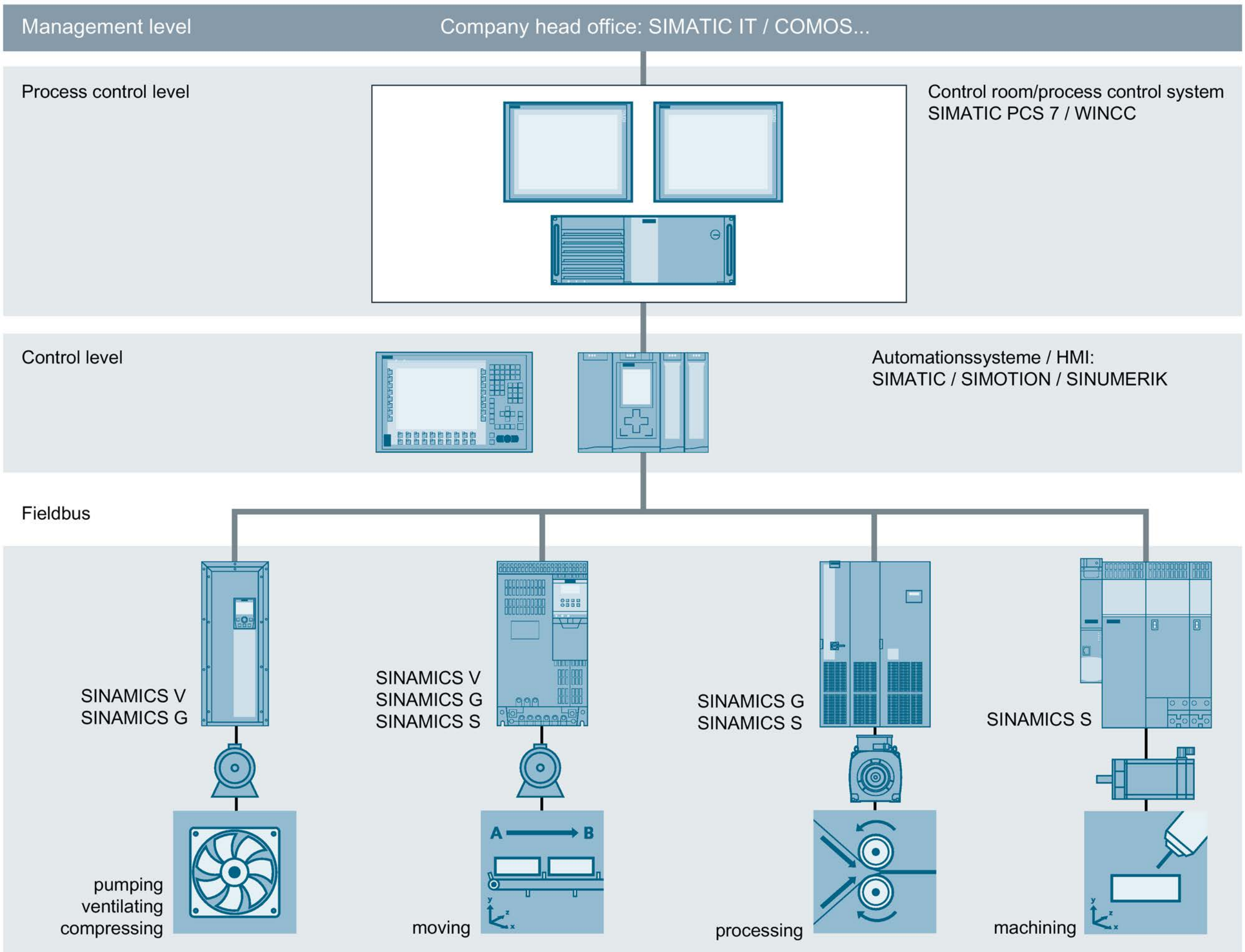


Figure 2-2 SINAMICS in the automation environment

Depending on the application, the appropriate converter can be selected and incorporated in the automation concept. With this in mind, the converters are clearly subdivided into their different applications. A wide range of communication options (depending on the drive type) are available for establishing a communication link to the automation system:

- PROFINET
- EtherNet/IP
- PROFIBUS
- AS-interface
- USS
- CANopen
- Modbus RTU
- BacNet MS/TP

Quality management according to DIN EN ISO 9001

SINAMICS is able to meet the highest requirements in terms of quality. Comprehensive quality assurance measures in all development and production processes ensure a consistently high level of quality.

It goes without saying that our quality management system is certified by an independent authority in accordance with EN ISO 9001.

Universal applications

SINAMICS meets the requirements of relevant international standards and regulations - from the EN European standards through IEC to UL and cULus.

System properties

The SINAMICS range is characterized by the following system properties:

- Standard and seamless functionality based on a platform concept
- Standardized engineering
- High degree of flexibility and combination capability
- Wide range of power ratings
- Designed for global use
- SINAMICS Safety Integrated
- Higher economic efficiency and effectiveness
- High energy efficiency
- Wide range of coupling options to higher-level control systems
- Totally Integrated Automation

2.2 SINAMICS S120 drive system

Overview

SINAMICS S120 is the modular drive system with vector and servo control that is ideal for sophisticated drive tasks in plant and machine construction.

Multi-axis drive solutions with higher-level motion control can be implemented with the modular SINAMICS S120 system just the same as solutions for single-axis drives.

Covering a power range from 0.12 kW to 5700 kW and various control modules with a graduated range of functionality, the modular SINAMICS S120 system can be used to simply and quickly create a precisely tailored drive configuration – for almost any sophisticated drive application.

For SINAMICS S120, the drive intelligence is combined with closed-loop control functions in the Control Units.

These units are capable of controlling drives in the vector, servo and V/f modes. They also perform the speed and torque control functions plus other intelligent drive functions for all drive axes.

Using the closed-loop control techniques available, both synchronous as well as induction motors can be operated, and therefore the complete range of low-voltage motors from Siemens.

Integrated PROFIBUS DP interfaces ensure easy integration into complete automation solutions. PROFINET is another of the fieldbus interfaces supported by the system.

Benefits

SINAMICS S120 sets itself apart through:

- Can be universally used in high-performance single and multi-axis applications
- Can be freely combined to create customized solutions
- Wide range of power ratings
- Wide range of functions
- SINAMICS Safety Integrated functions
- Supports various cooling types (air/liquid-cooled)
- Supports various infeed concepts
- Can be simply integrated into higher-level automation and IT environments
- User-friendly engineering
- Ease of handling
- Simple installation
- Practical connection system
- Auto-configuration with electronic rating plates

Control Units

The closed-loop control intelligence for all the drive axes integrated in the multi-axis group is combined in the Control Units. They also feature drive-related inputs/outputs and interfaces for communicating with higher-level control systems. Control Units are available with different functional scopes and with various performance levels.

DRIVE-CLiQ – the digital interface between the components

SINAMICS S120 components, including motors and encoders, are equipped with the high-performance DRIVE-CLiQ system interface.
Line and Motor Modules for example are connected to the Control Unit – and Terminal Modules and Sensor Modules to the drive system via DRIVE-CLiQ – simply and efficiently. Motors that also have this interface can be directly connected to the drive system.

Converter boards (Sensor Modules) for converting standard encoder signals to DRIVE-CLiQ are available for third-party motors or retrofit applications.

The electronic rating plate

Electronic type plates in every component represent a digital link to the SINAMICS S120 drive system. They allow all drive components to be automatically identified via the DRIVE-CLiQ link.

The electronic type plate contains all the relevant technical data about that particular component. In addition to the technical data, the type plate includes logistical data (manufacturer ID, article number and ID). Since this data can be called up electronically on site or remotely, all the components used in a machine can always be individually identified, which helps simplify servicing.

SINAMICS S120 components

The SINAMICS S120 components are primarily used for multi-axis drive tasks.

The following power components are available:

- **Line-side power components**, such as fuses, contactors, line reactors and line filters for switching the power supply and complying with EMC regulations.
- **Power Modules**, which function as both a power infeed and an inverter.
- **Line Modules**, which supply power centrally to the DC link.
- **DC link components** (optional), which stabilize the DC link voltage
- **Motor Modules**, which act as inverters, receive power from the DC link, and supply the connected motors.
- **Motor-side components**, such as sine-wave filters, motor reactors, and dv/dt filters for reducing the voltage loads on the motor windings.

To carry out the required functions, SINAMICS S120 is equipped with:

- A **Control Unit** that handles drive and technological functions across all axes.
- **Additional system components** that enhance functionality and offer different interfaces for encoders and process signals.

SINAMICS S120 components were developed for installation in cabinets. They have the following features and characteristics:

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

Boundary conditions for use

The Power Modules, Active Interface Modules, Active Line Modules and Motor Modules are designed for connection to a liquid coolant circuit which must be provided by the customer.

The design of this cooling water circuit is an important factor in determining the operational reliability and service life of the equipment and the entire installation.

The main criteria are described in the following chapters.

Advantages of water cooling over air cooling

Water cooling dissipates heat much more efficiently than air cooling. As a result, water-cooled units are much more compact than air-cooled units with the same power rating. Since the heat losses generated by the electronic components are almost completely dissipated by the cooling water, only very small cooling fans are required. This means that the devices are quiet in operation. Due to their compact dimensions and almost negligible cooling air requirement, water-cooled units are the preferred solution wherever installation space is restricted and/or the ambient operating conditions are rough. With water cooling, closed electrical cabinets with degrees of protection up to IP55 can be easily implemented.

2.3 Technical specifications

Technical data

Unless specified otherwise, the following technical specifications are valid for all the following components of the water-cooled SINAMICS S120 drive system.

Table 2- 1 General technical data

Electrical data	
Line supply voltage	• 3 AC 380 V -10% (-15% < 1 min) ... 3 AC 480 V +10% • 3 AC 500 V -10% (-15% < 1 min) ... 3 AC 690 V +10%
Line frequency	47 ... 63 Hz
Output voltage	0 to line connection voltage, depending on the type of infeed. With an Active Line Module, it is also possible to achieve a higher output voltage.
Output frequency	Vector control: 0 ... 550 Hz [1)] Servo control: 0 ... 550 Hz [1)] V/f control: 0 ... 550 Hz [1)]
Electronics power supply	24 V DC (20.4V ... 28.8V) implemented as PELV circuit in accordance with EN 61800-5-1 Ground = Negative polarity grounded via the electronics
Short-circuit current rating per IEC, in conjunction with the specified fuses or circuit breakers	• 1.1 ... 447 kW: 65 kA • 448 ... 671 kW: 84 kA • 672 ... 1193 kW: 170 kA • >1194 kW: 200 kA
Rated short-circuit current SCCR (Short Circuit Current Rating) in accordance with UL508C (up to 600V), in conjunction with the specified fuses or circuit-breakers	• 1.1 ... 447 kW: 65 kA • 448 ... 671 kW: 84 kA • 672 ... 1193 kW: 170 kA • >1194 kW: 200 kA
Frequency with which the DC link is precharged	Max. 1 precharge every 3 minutes
Interference suppression	Category C3 (second environment) according to EN 61800-3
Overvoltage category	Class III according to EN 61800-5-1
Mechanical data	
Vibratory load • Transport [2)] • Operation	 • EN 60721-3-2, class 2M2 • Test values according to EN 60068-2-6 test Fc: – 10 ... 58 Hz with constant deflection = 0.075 mm – 58 Hz with constant acceleration = 9.81 m/s² (1g)
Shock load • Transport [2)] • Operation	 • EN 60721-3-2, class 2M2 • Test values according to EN 60068-2-27 test Ea: 98 m/s² (10g) / 20ms

Ambient conditions	
Degree of protection	IP00 according to EN 60529 (IP20, without taking into account the connecting busbars)
Protection class	Class I (with protective conductor system) and class III (PELV) according to EN 61800-5-1
Touch protection	EN 50274 and DGUV regulation 3 when used for the intended purpose
Cooling method according to EN 60146-1-1	• Power Modules, Active Line Modules, Motor Modules: **WE** – W: Water cooling – E: Forced cooling, drive device outside the equipment • Active Interface Modules: **WE** – W: Water cooling – E: Forced cooling, drive device outside the equipment • Line reactors, sine-wave filters, motor reactors, dv/dt filters with Voltage Peak Limiter: **AN** – A: Air cooling – N : Natural cooling (convection)
Cooling circuit • Max. system pressure with respect to atmosphere • Pressure drop at the heat sink at rated volumetric flow • Recommended pressure range • The cooling water intake temperature	 • 600 kPa • 70 kPa • 80 ... 150 kPa (is applicable for water as coolant) • Dependent on ambient temperature, no condensation permitted – 0 ... 38 °C without derating, > 38 ... 43 °C see derating characteristics – (temperature range between 0 °C and 5 °C - only with antifreeze; antifreeze: Antifrogen N, Antifrogen L and Dowcal 100)
Permissible ambient temperature (air) in operation	• Depending on the cooling water intake temperature, condensation is not permissible: – 0 ... 45 °C without derating – > 45 ... 50 °C, refer to derating characteristics
Climatic ambient conditions	
• Storage [2)] • Transport [2)] • Operation	• Class 1K4 according to EN 60721-3-1, temperature -25 ... +55 °C max. Air humidity 95 % • Class 2K4 according to EN 60721-3-2, temperature -25 ... +70 °C, max. humidity, 95% at +40 °C • better than Class 3K3 according to EN 60721-3-3, Relative humidity: 5 … 95 % (no condensation) Oil mist, salt mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted
Environmental class/harmful chemical substances	
• Storage [2)] • Transport [2)] • Operation	• Class 1C2 according to EN 60721-3-1 • Class 2C2 according to EN 60721-3-2 • Class 3C2 according to EN 60721-3-3

Organic/biological influences	
• Storage [2)] • Transport [2)] • Operation	• Class 1B1 according to EN 60721-3-1 • Class 2B1 according to EN 60721-3-2 • Class 3B1 according to EN 60721-3-3
Degree of pollution	2 according to EN 61800-5-1 The devices may only be operated in environments with degree of pollution 2; the following guidelines should be applied, especially to avoid condensation: A ventilated enclosure equipped with filter must be used to provide forced ventilation. This means that ventilation is realized using one or several fans in the enclosure that provide a positive air intake and discharge. The other alternative is to use heating devices to constantly heat the air in the enclosure or to use heat generated by continuously energizing the equipment, with interruptions so that the air does not cool down to the point where condensation can occur.
The Safety Integrated safety function: The components must be protected against conductive contamination, e.g. by installing them in a cabinet with degree of protection IP54B according to EN 60529. Provided that conducted interference can be prevented at the installation site, the degree of protection for the cabinet can be decreased accordingly.	
Installation altitude	• > 2000 m above sea level without derating • > 2000 m above sea level, see derating characteristics
Certificates	
Conformity	- EMC Directive No. 2014/30/EU - Low-Voltage Directive No. 2014/35/EU - Machinery Directive No. 2006/42/EC for functional safety
Standards	EN 61800-5-1, EN 60204-1, EN 61800-3, EN 60146-1-1
Approvals (only up to 600V 3AC)	cULus (File Nos.: E192450, E214113, E253831, E203250)

1) Depending on the system configuration, higher output frequencies are possible.

2) In transport packaging

NOTICE
Damage to the device through incorrect storage and transport of water-cooled devices
The storage and transport of water-cooled devices that have not been completely emptied can result in damage to the device through freezing. • Always empty the water-cooled devices completely before storage or transport.

2.4 Standards

Note

Information on the listed standards

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

Standards*	Title
EN ISO 3744	Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free acoustic field over a reflecting plane
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

Standards*	Title
EN 60269-1 IEC 60269-1 DIN EN 60269-1 VDE 0636-1	Low-voltage fuses; Part 1: General requirements
IEC 60287-1 to -3	Cables - Calculation of the current carrying capacity Part 1: Current carrying capacity equations (100 % load factor) and calculating the losses Part 2: Thermal resistance - Part 3: Main sections for operating conditions
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 overcurrent 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: Cables, conductors, busbars Part 540: Grounding, 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

Standards*	Title
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
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
UL61800-5-1 CSA 22.2 No. 274-13	Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety requirements – Electrical, thermal and energy

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

2.5 Basic structure of a drive system based on water-cooled SINAMICS S120

2.5.1 Structure of a drive system with water-cooled SINAMICS S120 and Power Module

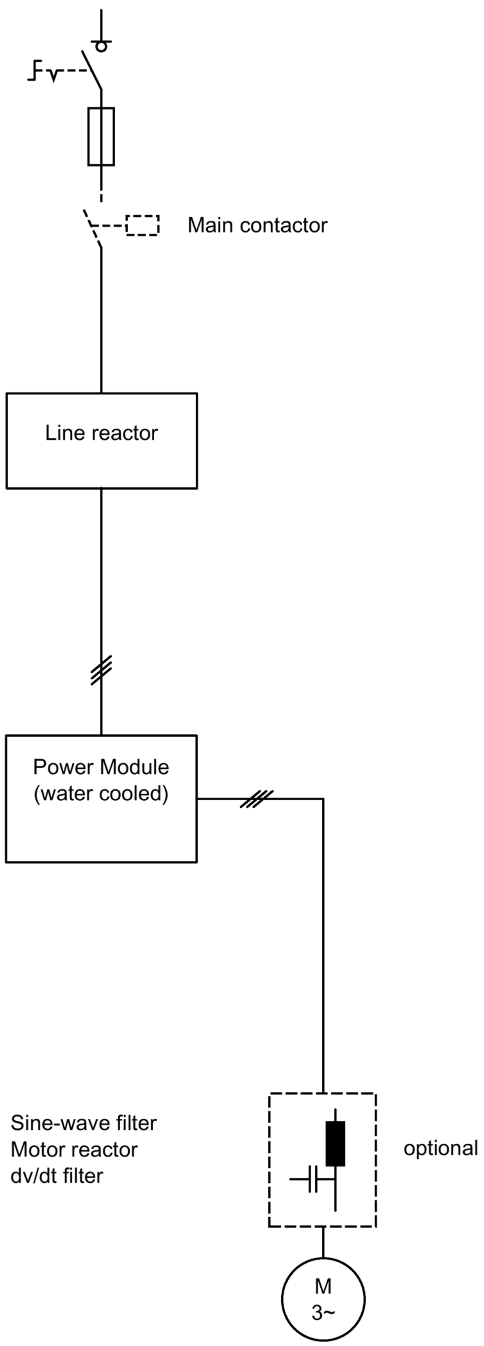


Figure 2-3 Principle structure of a drive system with water-cooled SINAMICS S120 and Power Module

2.5.2 Structure of a drive system with water-cooled SINAMICS S120 and controlled infeed

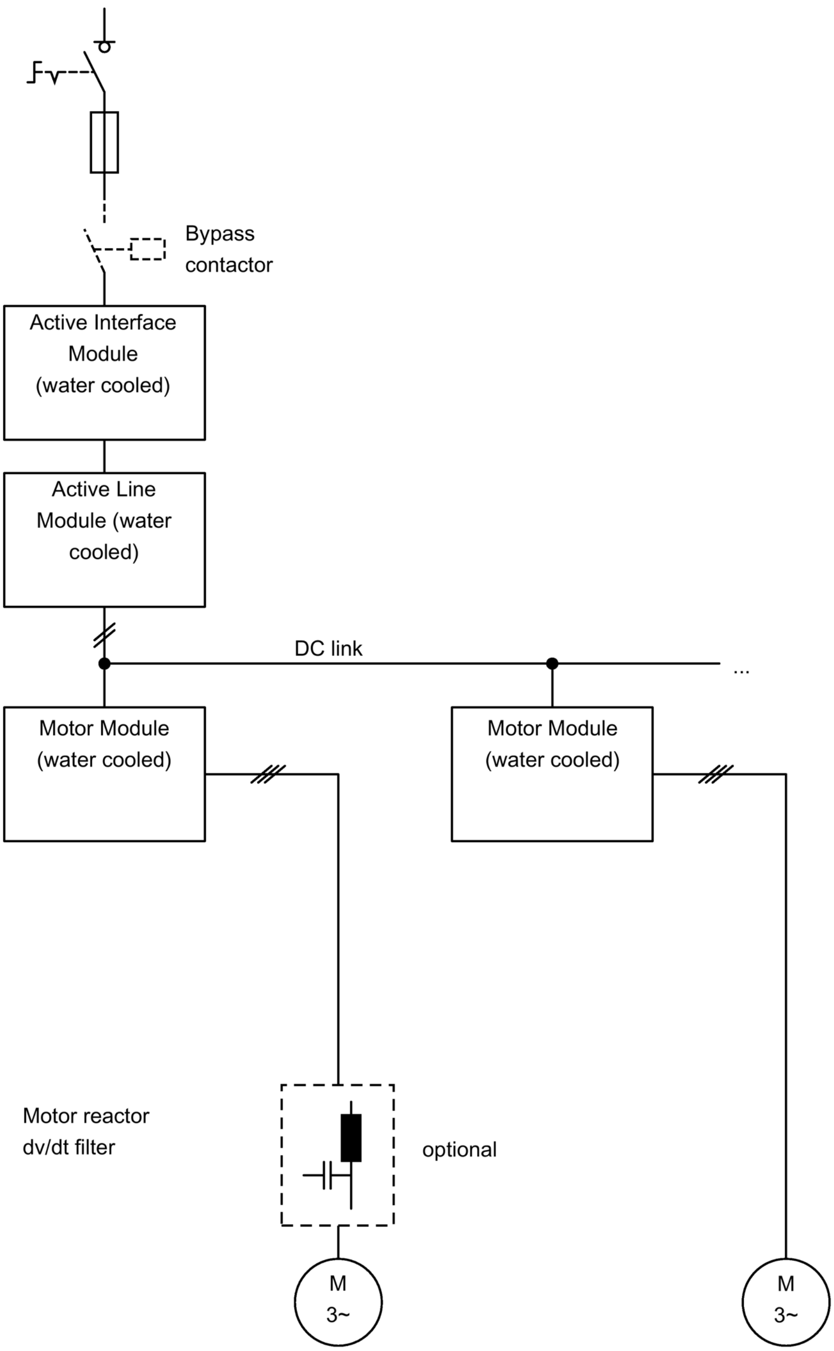


Figure 2-4 Principle structure of a drive system with water-cooled SINAMICS S120 and controlled infeed

Line-side power components 3

3.1 Line reactors for Power Modules

3.1.1 Description

The line reactors limit low-frequency line harmonics and reduce the load on the semiconductors in the Power Modules. A line reactor is not required where the effective supply impedance equals uk > 3 %.

3.1.2 Safety information

⚠ WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

The non-observance of the fundamental safety instructions and residual risks stated in Chapter 1 can result in accidents with severe injuries or death.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

⚠ CAUTION

Risk of burns due to high surface temperature of the line reactor

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

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

NOTICE
Damage to the system caused by the use of inappropriate and not approved line reactors
Inappropriate and not approved line reactors can damage the Power Modules.
Line harmonics that damage/disturb other loads connected to the same line supply can also occur.
• Only use line reactors that are listed in this Manual.

Note

Malfunctions through magnetic fields

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

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

Note

Length of connecting cables

The connection lines between line reactor and Power Module must be kept as short as possible (max. 5 m).

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

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

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

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

3.1.3 Dimension drawing

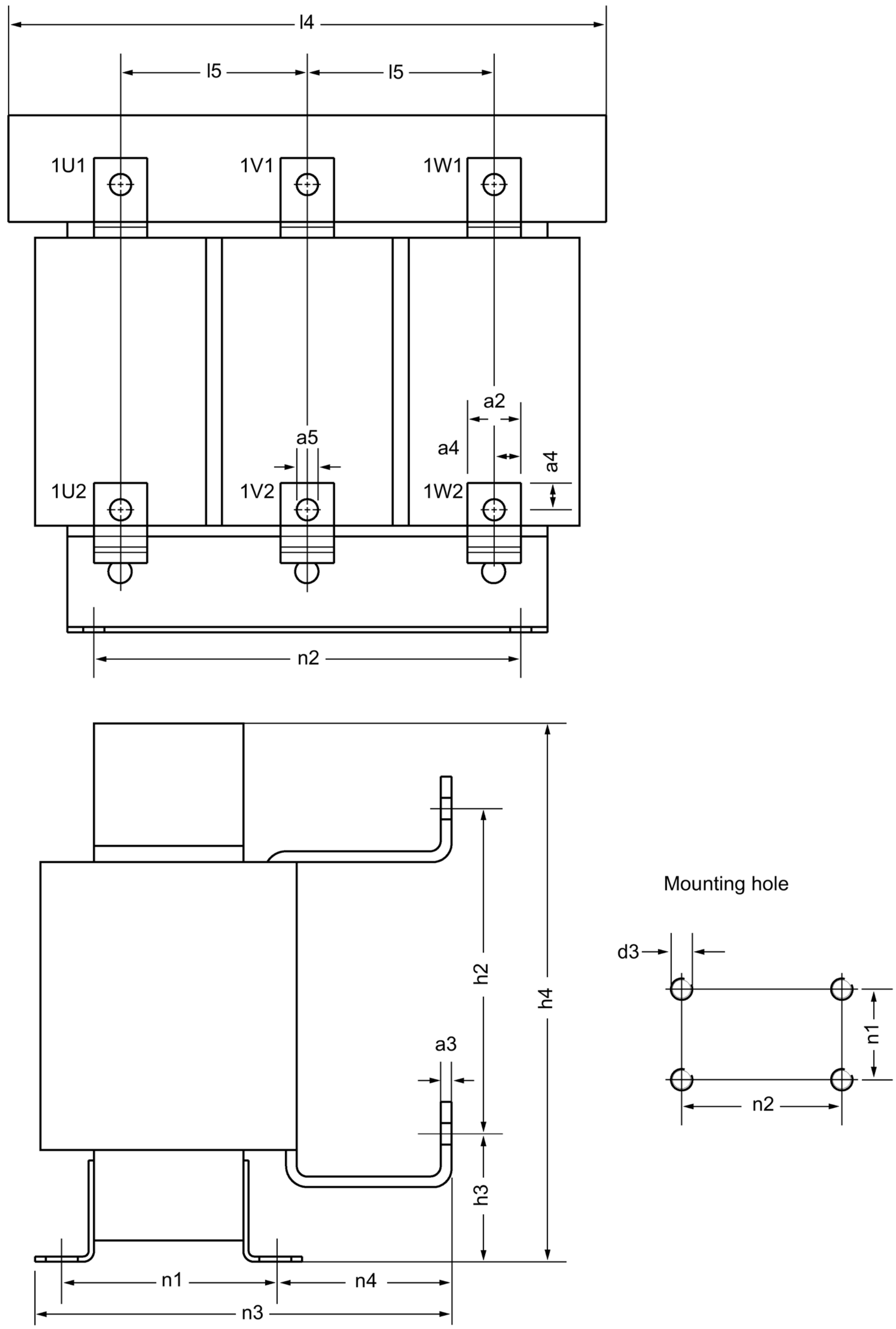


Figure 3-1 Dimension drawing of line reactor for Power Modules

Table 3- 1 Dimensions of line reactors for Power Modules (all data in mm)

6SL3000-	0CE32-3AA0	0CE32-8AA0	0CE33-3AA0	0CE35-1AA0	
a2	25	25	25	30	
a3	5	5	5	6	
a4	12.5	12.5	12.5	15	
a5	11	11	11	14	
l4	270	270	270	300	
l5	88	88	88	100	
h2	150	150	150	180	
h3	60	60	60	60	
h4	248	248	248	269	
n1 [1)]	101	101	101	118	
n2 [1)]	200	200	200	224	
n3	200	200	200	212.5	
n4	84.5	84.5	84.5	81	
d3	M8	M8	M8	M8	

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

3.1.4 Technical data

Table 3- 2 Technical data of line reactors for Power Modules

Article number	6SL3000-	0CE32-3AA0	0CE32-8AA0	0CE33-3AA0	0CE35-1AA0
Suitable for Power Module	6SL3315-	1TE32-1AAx	1TE32-6AAx	1TE33-1AAx	1TE35-0AAx
Type rating of the Power Module	kW	110	132	160	250
Rated voltage	V	3 AC 380 –10 % (-15 % < 1 min) to 3 AC 480 +10 %			
I_{thmax}	A	224	278	331	508
Power loss	kW	0.274	0.247	0.267	0.365
Line/load connection 1U1, 1V1, 1W1, 1U2, 1V2, 1W2		M10 connecting lugs	M10 connecting lugs	M10 connecting lugs	M12 connecting lugs
PE connection		M6 screw	M6 screw	M6 screw	M6 screw
Degree of protection		IP00	IP00	IP00	IP00
Dimensions Width Height Depth	 mm mm mm	 270 248 200	 270 248 200	 270 248 200	 300 269 212.5
Weight	kg	24.5	26	27.8	38

3.2 Active Interface Modules

3.2.1 Description

Water-cooled Active Interface Modules are used in conjunction with water-cooled Active Line Modules in the chassis format. The water-cooled Active Interface Modules include a Clean Power Filter with basic RI suppression, the pre-charging circuit for the Active Line Module, the line voltage sensing circuit and monitoring sensors.

The bypass contactor must be provided separately for frame size JIL.

The vast majority of line harmonics are suppressed by the Clean Power Filter.

The water-cooled Active Interface Modules include:

- Clean Power Filter
- Filter reactor
- Pre-charging circuit
- Line voltage sensing module VSM10

The Active Interface Modules comprise the following components:

- Filter reactor
- Filter module
- Associated connection elements (pressure hose, cable, hose connections)

Components

The article numbers of the individual components (filter reactor and filter module) are listed in the following table:

Table 3- 3 Active Interface Modules, article numbers of the individual components

Active Interface Module	Filter reactor	Filter module
Line voltage 3 AC 380 ... 480 V		
6SL3305-7TE41-0AA7	6SL3005-0DE41-4AA7	6SL3005-0FE41-4AA7
Line voltage 3 AC 500 ... 690 V		
6SL3305-7TG41-0AA7	6SL3005-0DG41-3AA7	6SL3005-0FG41-0AA7
6SL3305-7TG41-3AA7	6SL3005-0DG41-3AA7	6SL3005-0FG41-3AA7
6SL3305-7TG41-6AA7	6SL3005-0DG41-6AA7	6SL3005-0FG41-6AA7

3.2.2 Safety information

WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

The non-observance of the fundamental safety instructions and residual risks stated in Chapter 1 can result in accidents with severe injuries or death.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

WARNING

Danger to life through electric shock due to unconnected cable shields

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

- Attach the cable shields at both ends to the grounded housing potential.

WARNING

Danger to life due to high leakage currents caused by an interrupted external protective conductor

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

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

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

WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

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

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

⚠WARNING

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

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

- Attach the component warning labels in the national language.

⚠CAUTION

Risk of burns due to high surface temperature of the filter reactor

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

- Mount the filter reactors so that contact is not possible. If this is not possible, attach clearly visible and understandable warning notices at hazardous positions.
- To prevent adjacent components from suffering damage due to these high temperatures, maintain a ventilation clearance of at least 140 mm above the filter reactors.

NOTICE

Material damage caused by mechanically stressed busbars and coolant connections

Mechanically stressed busbars and coolant connections can damage the device.

- Do not use the busbars and liquid coolant connections protruding from the device as handles or as support surfaces during transport.

NOTICE

Damage to the device through operation of the Active Interface Module without Active Line Module

If the Active Interface Module is operated without the associated Active Line Module, it can be damaged.

- Only operate the Active Interface Module in conjunction with the associated Active Line Module.

NOTICE

Damage to the Active Interface Modules when operated without coolant

If the Active Interface Module is operated without liquid coolant, even when operated under no-load conditions, the Active Interface Module can be damaged.

- Only operate the Active Interface Module with a filled and functioning cooling circuit.

Note

Cable lengths

The connecting cables between the filter reactor and the filter module must be kept as short as possible (max. 2 m).

3.2.3 Interface description

3.2.3.1 Overview

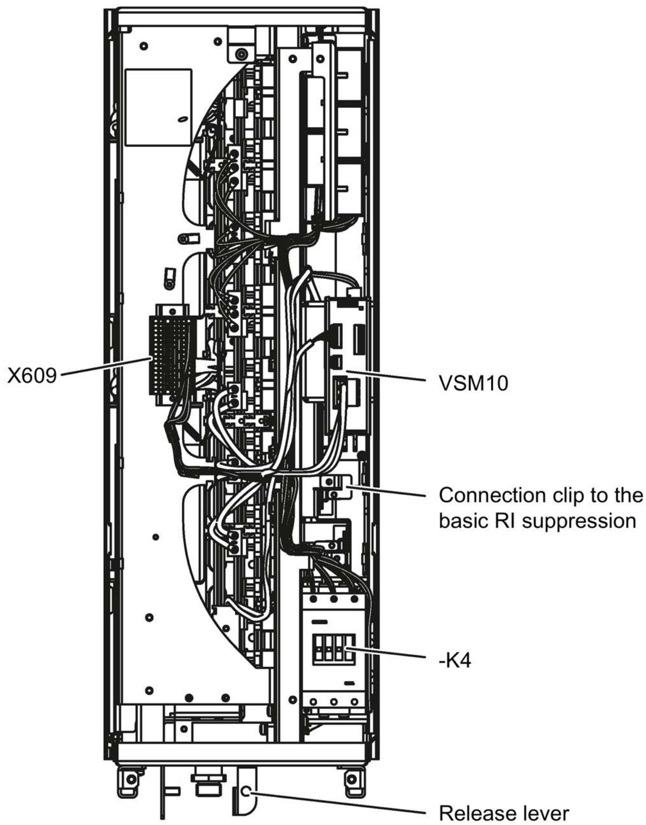


Figure 3-2 Overview, filter module, frame size JIL

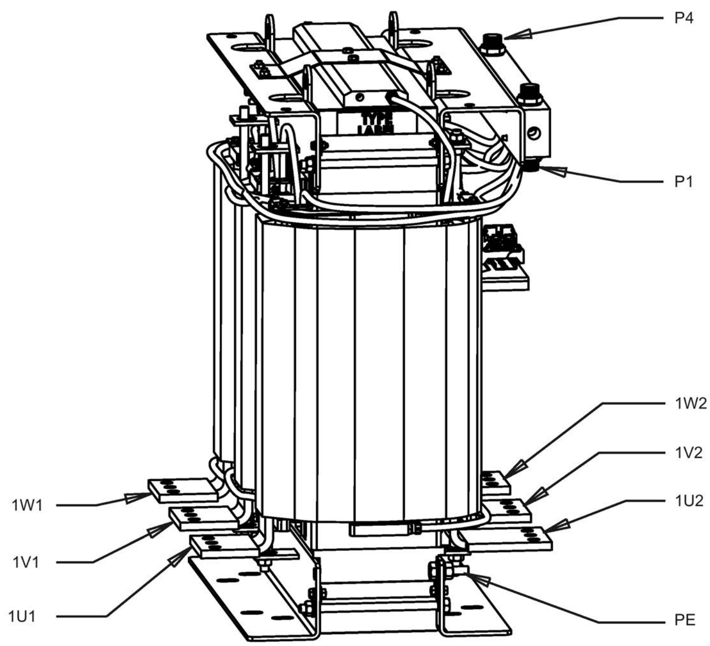
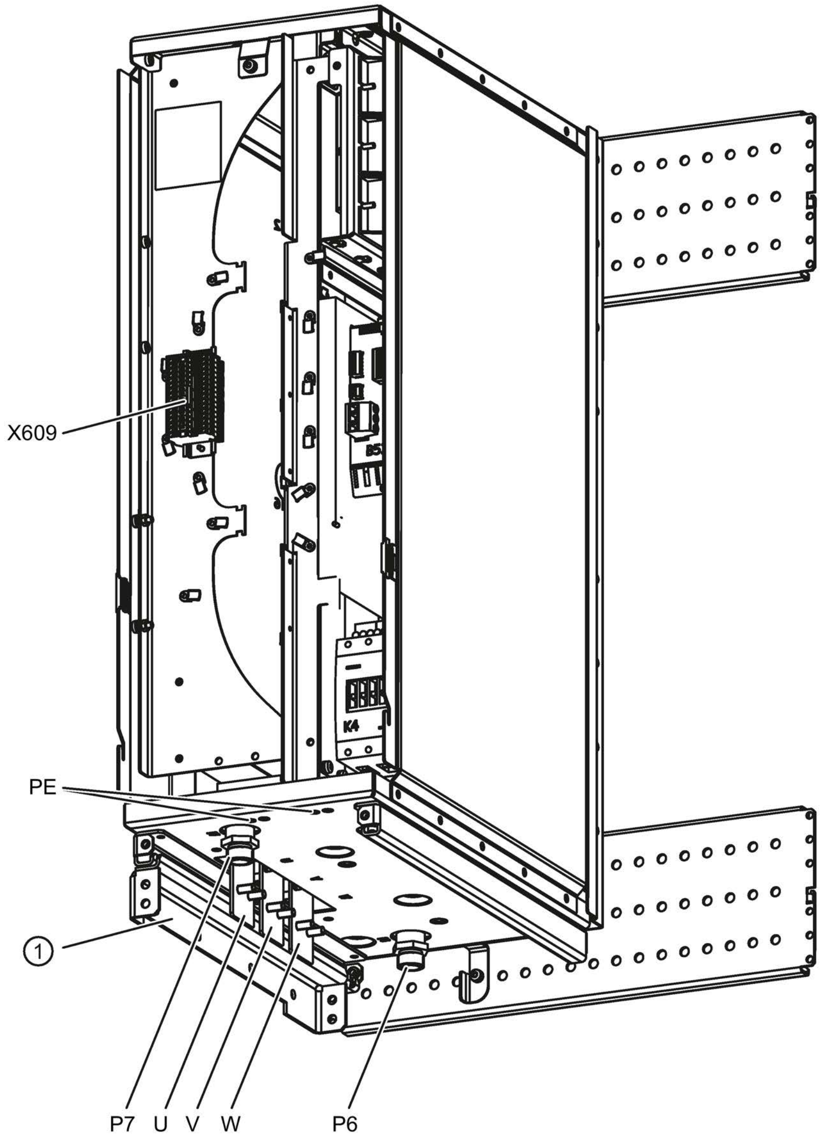


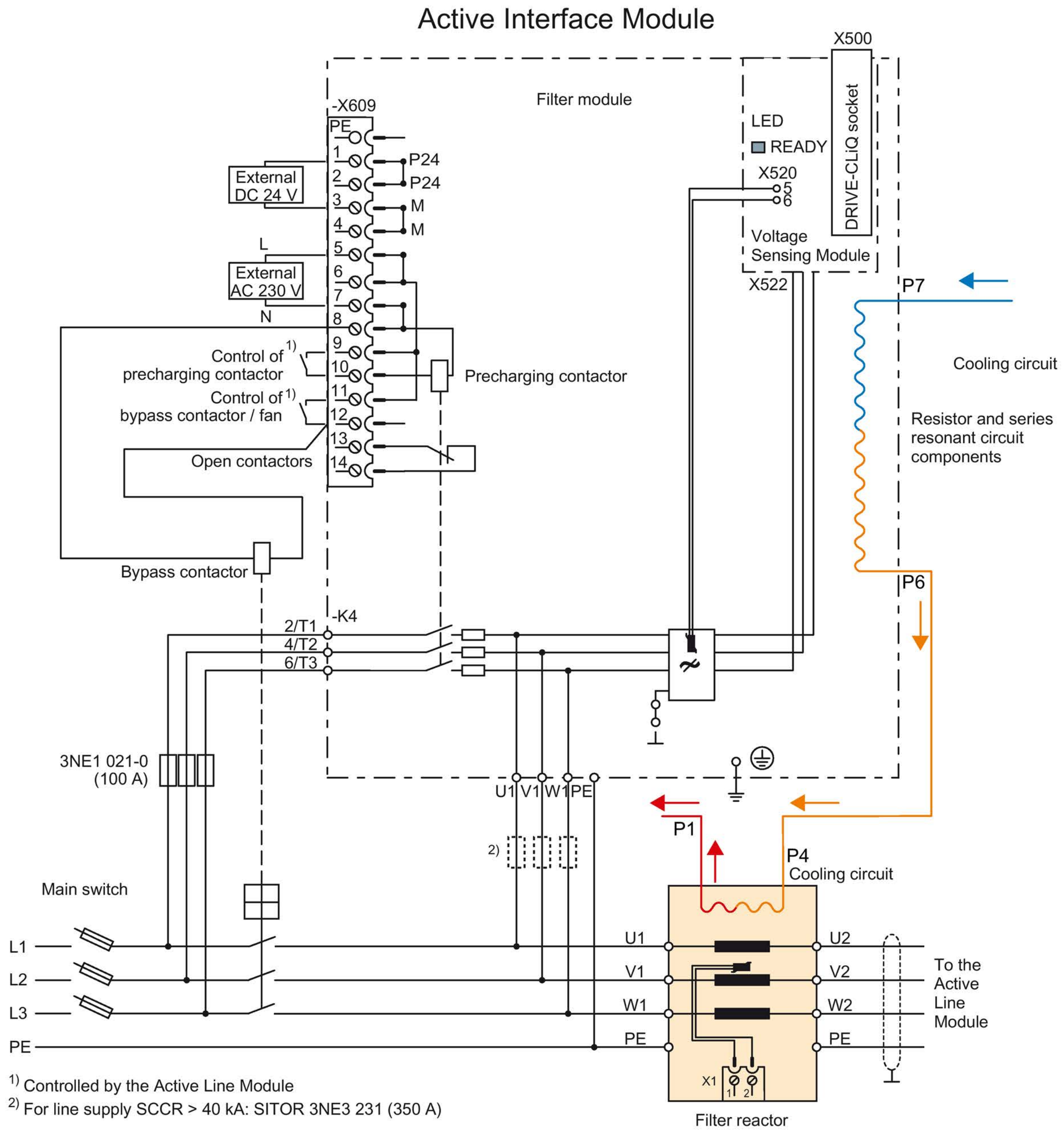
Figure 3-3 Interface overview filter reactor, frame size JIL



① Support plate for the filter reactor is not included in the scope of delivery

Figure 3-4 Interface overview filter module, frame size JIL

3.2.3.2 Electrical connection example



1) Controlled by the Active Line Module

2) For line supply SCCR > 40 kA: SITOR 3NE3 231 (350 A)

Figure 3-5 Electrical connection example of water-cooled Active Interface Module, frame size JIL

Note

Cooling circuit interconnection

The cooling circuit interconnection is strictly specified, as shown in the following diagram.

NOTICE
Damage to the device through different phase sequence in the pre-charging and main circuits Different phase sequences in the pre-charging and main circuits can overload and destroy the pre-charging resistors of the Active Interface Module during the brief overlap period, where both contactors are simultaneously closed. • Close the power cables in the pre-charging and main circuits with the same phase sequence.

3.2.3.3 Line/load connection

Table 3- 4 Filter reactor connections

Terminals	Designations
Line connection: U1, V1, W1 Load connection: U2, V2, W2	Voltage: • 3 AC 380 V -10% (-15% < 1 min) ... 3 AC 480 V +10% • 3 AC 500 V -10% (-15% < 1 min) ... 3 AC 690 V +10% Frequency: 47 ... 63 Hz Connection lug: M12/50 Nm for busbar connection
PE connection	Connecting thread: M10 / 25 Nm for cable lugs in accordance with DIN 46234 / DIN 46235 [1)]

1) Dimensions for connecting alternative cable lugs, see "Cable lugs" in the Appendix.

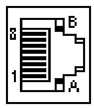
Table 3- 5 Filter module connections

Terminals	Designations
K4: 2/T1, 4/T2, 6/T3	Connection for pre-charging circuit directly on pre-charging contactor: 2 x 35mm² max. (3RT1044)
PE connection	Connection lug: M8 / 13 Nm for cable lugs in accordance with DIN 46234 / DIN 46235 [1)]

1) Dimensions for connecting alternative cable lugs, see "Cable lugs" in the Appendix.

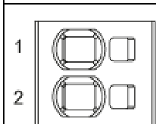
3.2.3.4 DRIVE-CLiQ interface X500

Table 3- 6 DRIVE-CLiQ interface X500

	PIN	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces (50 pcs.) Article number: 6SL3066-4CA00-0AA0			

3.2.3.5 X530 neutral point grounding

Table 3- 7 Neutral point grounding X530

	Terminal	Designation	Technical data
	1	Neutral point of the voltage sensing	Jumper inserted: Grounded measurement Jumper not inserted: isolated measurement
	2	Ground potential	

The Voltage Sensing Module is supplied with inserted jumper. When delivered, the neutral point is connected to the protective conductor via the connector jumper. Current can flow to PE. This connection is removed by removing the connector jumper. The measurement is then electrically isolated.

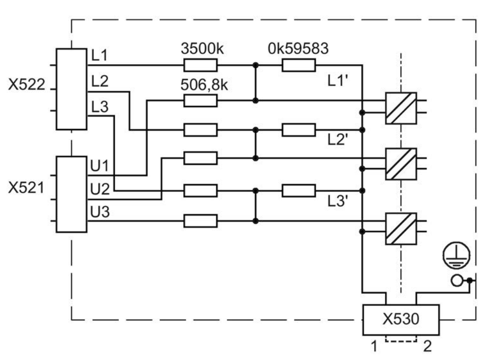
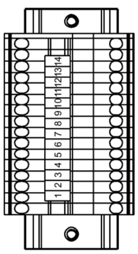


Figure 3-6 Internal circuit of the VSM10 Voltage Sensing Module

When the Active Interface Module is operated on an ungrounded line system (IT system), the connection clip must be removed, see "Electrical connection (Page 64)".

3.2.3.6 X609 terminal strip

Table 3- 8 Terminal strip X609

	Terminal	Designation	Technical data	
	PE	PE	PE connection	
	1	P24	External 24 V DC supply Voltage: 24 V DC (20.4 ... 28.5 V) Current consumption: max. 0.25 A	
	2	P24		
	3	M		
	4	M		
	5	L	Voltage: 230 V AC (195.5 ... 264.5 V) Current consumption: max. 4 A	
	6	L		
	7	N		
	8	N		
	9	Pre-charging contactor–A1	Voltage: 230 V AC (195.5 ... 264.5 V) Current consumption: max. 4 A	To Active Line Module, X9:5
	10	Pre-charging contactor–A2		To Active Line Module, X9:6
	11	Bypass contactor–A1	Voltage: 230 V AC (195.5 ... 264.5 V) Current consumption: max. 6 A	To Active Line Module, X9:3
	12	Bypass contactor–A2		To Active Line Module, X9:4
	13	Contactor feedback signal 1	Voltage: 230 V AC (195.5 ... 264.5 V) Max. permissible current: 6 A	
	14	Contactor feedback signal 2		
	PE	PE	PE connection	
Max. connectable cross-section: 2.5 mm²				

3.2.3.7 X1 temperature sensor connection at the filter reactor

Table 3- 9 Terminal strip X1 at filter reactor

Terminal	Designations
1	PT1000 temperature sensor connection
2	
Max. connectable cross-section: 2.5 mm²	

Note

When operating the Active Interface Module, it is not necessary to evaluate the temperature sensor at the filter reactor.
In the filter module cooling circuit, a water-cooled resistor has an integrated PT1000 temperature sensor, which is internally evaluated by the VSM10.

The following temperature thresholds apply for additional filter reactor temperature monitoring:

- Alarm: 140 °C
- Fault: 150 °C

3.2.3.8 Meaning of the LED on the Voltage Sensing Module (VSM) in the Active Interface Module

Table 3- 10 Description of the LED on the Voltage Sensing Module (VSM) in the Active Interface Module

LED	Color	Status	Description
RDY	---	Off	The electronics power supply is missing or lies outside the permissible tolerance range.
	Green	Continu-ous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	Continu-ous light	DRIVE-CLiQ communication is being established.
	Red	Continu-ous light	This component has at least one fault. **Remark:** The LED is activated irrespective of whether the corresponding messages have been reconfigured.
	Green/red	Flashing 0.5 Hz	Firmware is being downloaded.
		2 Hz flashing light	Firmware download is complete. Waiting for POWER ON.
	Green / orange or red / orange	2 Hz flashing light	Detection of the components via LED is activated (p0144). **Remark:** Both options depend on the LED status when module recognition is activated via p0144 = 1.

3.2.4 Dimension drawing

Dimension drawing, filter reactor

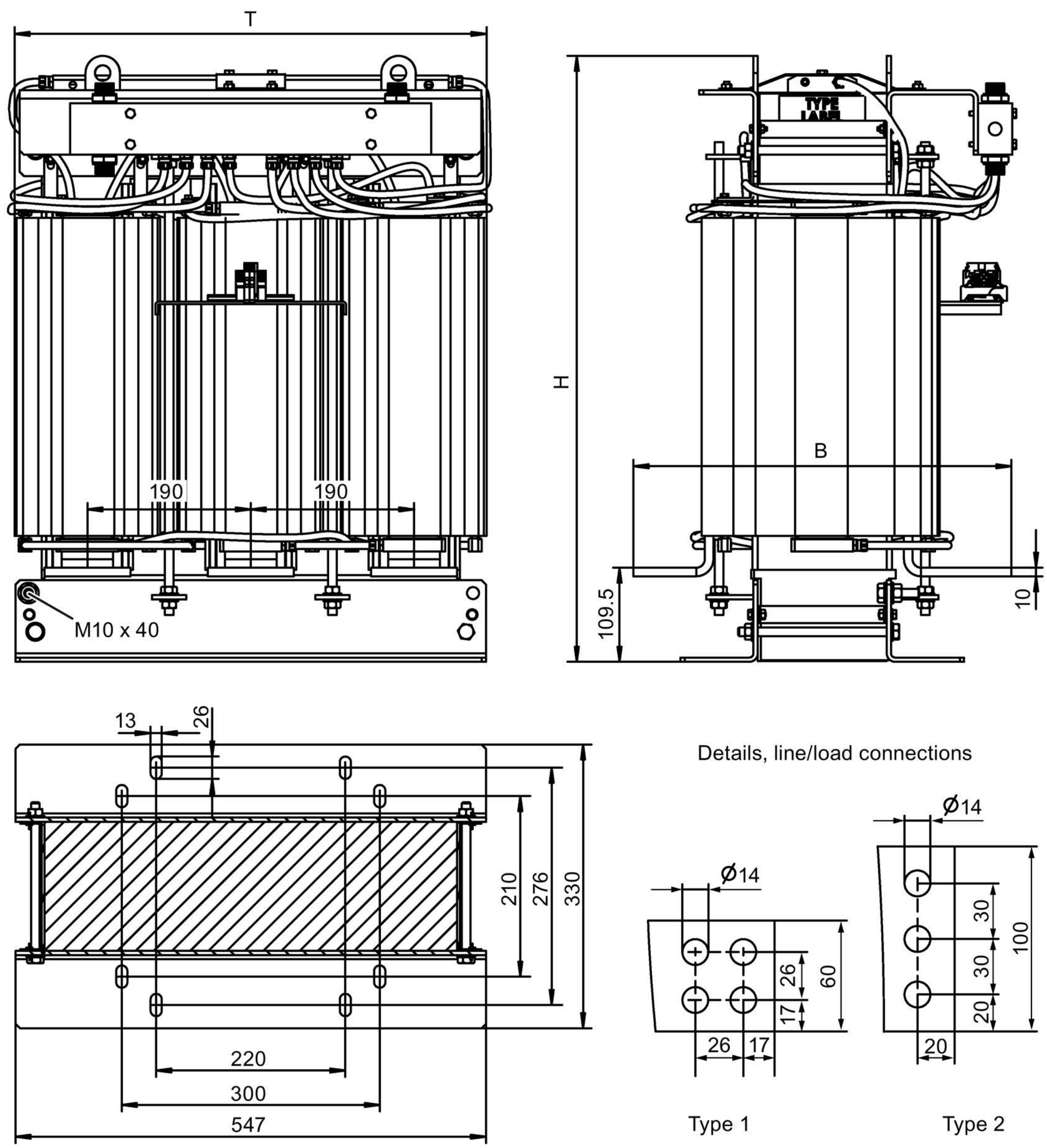


Figure 3-7 Dimension drawing, filter reactor frame size JIL

Table 3- 11 Dimensions of the filter reactors (all values in mm)

6SL3005-	0DE41-4AA7	0DG41-3AA7	0DG41-6AA7
W	382	440	440
H	698	705	705
D	<575	<575	<575
Connection type	Type 1	Type 2	Type 2

Dimension drawing, filter module

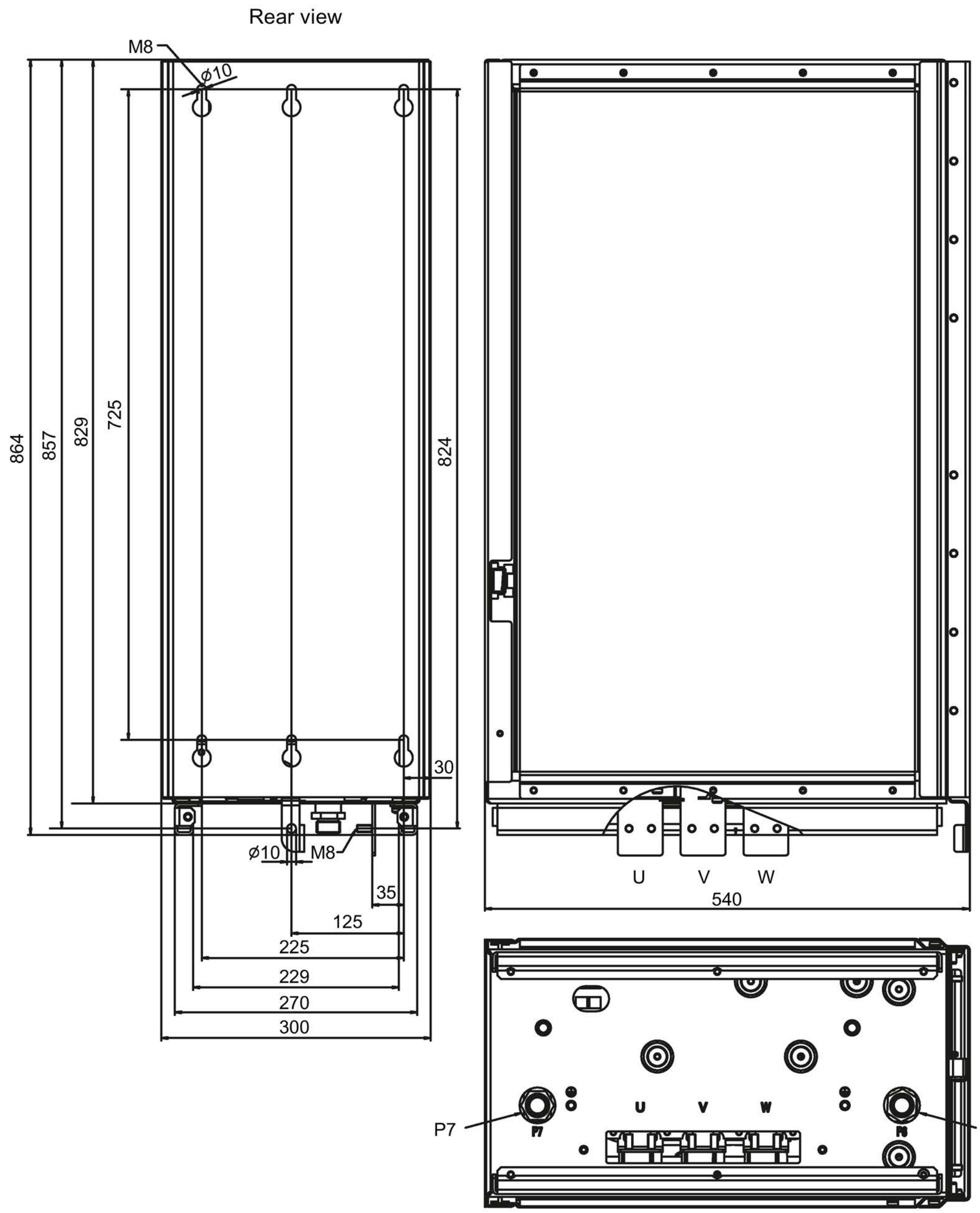


Figure 3-8 Dimension drawing, filter module, frame size JIL

3.2.5 Installation

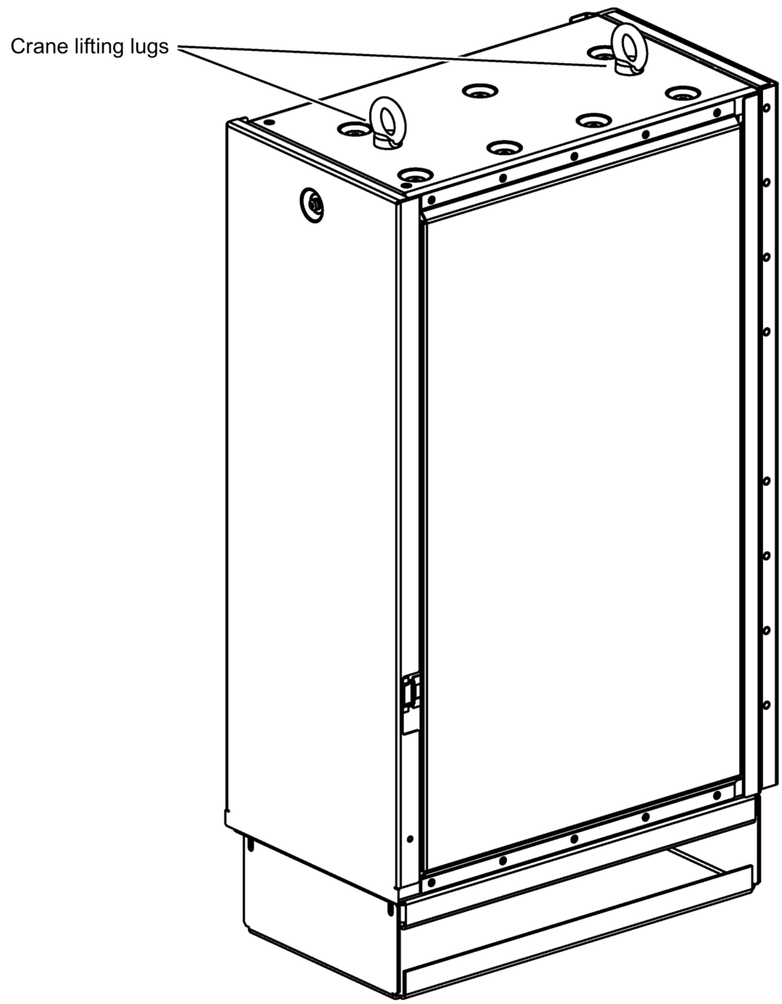


Figure 3-9 Crane lifting lugs/screw coupling points to mechanically support the filter module

Crane lifting lugs

The filter reactor and filter module are fitted with crane lifting lugs as standard when shipped. The units can be hoisted using these lugs and transported from the pallet to the installation location.

Note

Filter module transport in the horizontal position

The filter module can be transported in the horizontal position.

NOTICE
Damage to the device due to improper transport
Improper transport can mechanically stressed the housing or busbars, which can result in damage to the device. • Use a lifting harness with vertical ropes or chains during transport. • Do not use the busbars as handles or for attaching a lifting harness. • Only tighten the crane lifting lugs by hand. Remove the crane lifting lugs after the installation, but keep them for later use.

Remove the transport plate of the filter module

A transport plate is mounted on the underside of the filter module for transport ("1" in the following diagram). To remove the filter module from the packaging and during transport, it can be placed down on the transport plate.
Before being mounted at the installation location, the transport plate must be removed; to do this the 4 screws ("2" in the diagram) must be released and the transport plate removed.

⚠CAUTION
Risk of injury due to toppling when placing down on the transport plate
A filter module placed down on the transport plate can topple over therefore causing injury. • When the filter module is placed down on the transport plate, ensure that it cannot topple over.

NOTICE
The device can be damaged when placing down on the floor after removing the transport plate
After removing the transport plate, placing the device down on the floor can damage it as a result of mechanical stress applied to the busbars. • After removing the transport plate do not place the filter module on the floor.

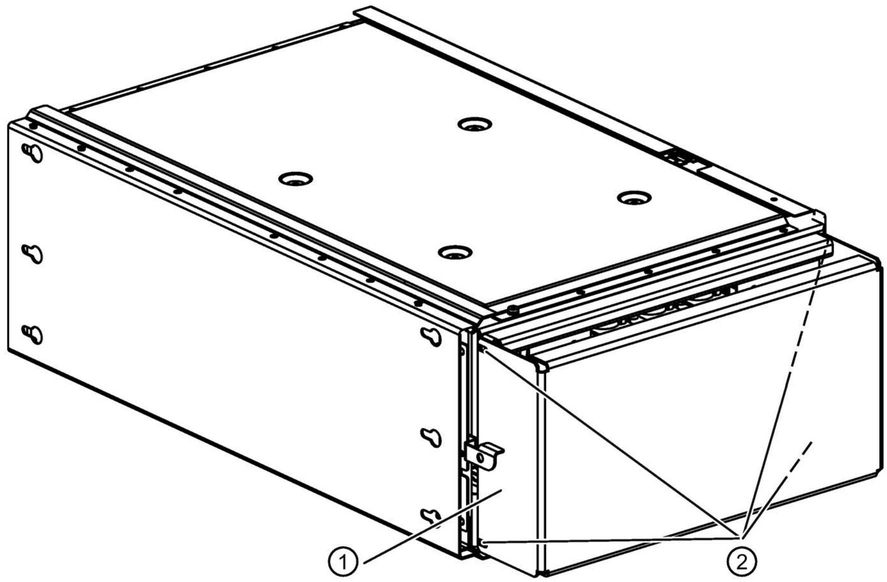


Figure 3-10 Transport plate on the underside of the filter module

Mounting the filter module

The filter module is mounted using a mounting plate, which is attached to the rear of the electrical cabinet. The mounting plate has a mechanism to lock the filter module to the plate; this is activated by moving the lever on the lower side once the filter module is in place. After locking, the lever must be kept in position using a locking screw.

Refer to Chapter "Dimension drawing (Page 54)" for the dimensions of the mounting plate.

After mounting and locking the filter module on the mounting plate, struts must be attached to the front to provide mechanical support.

Note

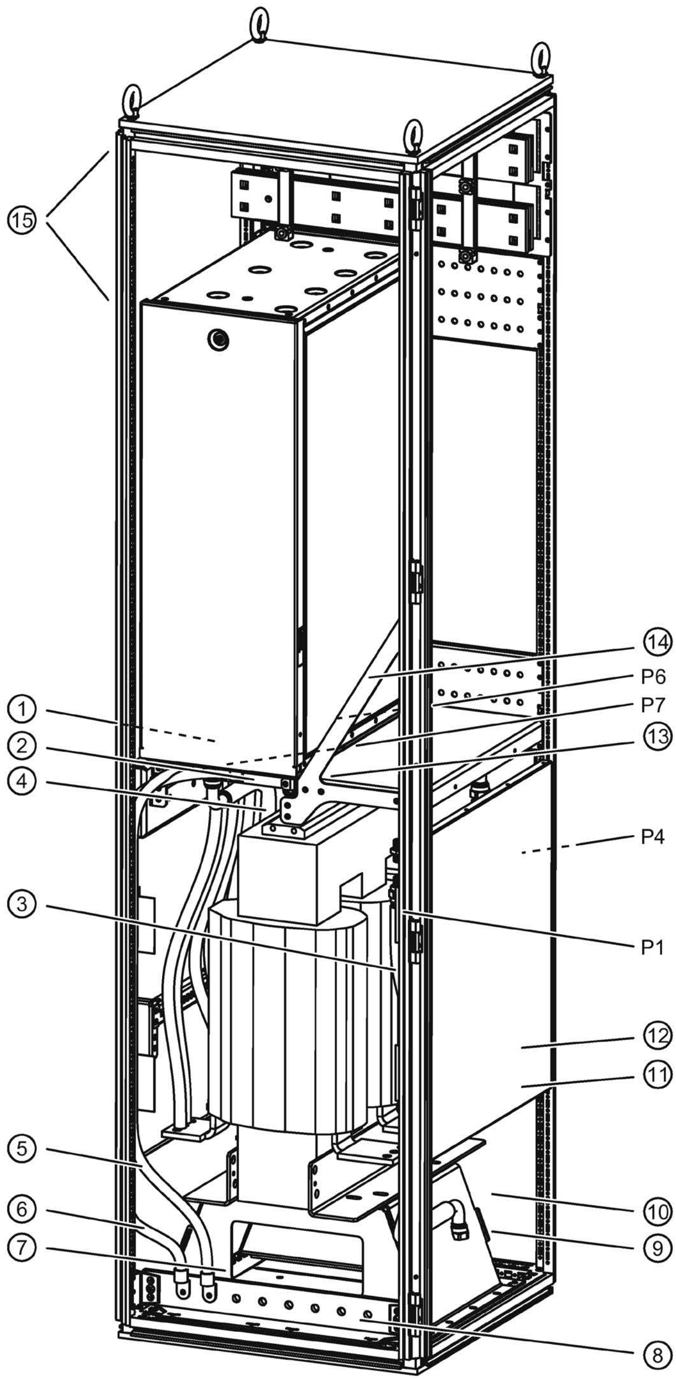
Mounting equipment for power units

The mounting equipment for power units can be used to mount the filter module, see "Mounting equipment for power units (Page 282)".

3.2.6 Notes on installation in a control cabinet

A typical control cabinet design is shown in the following that shows the mounting of the main components (filter reactor and filter module) with the supplied pressure hoses and connecting cables.

Electrical cabinet example



①	Connections (U1, V1, W1) at the filter module to establish the connection to the line side of the filter reactor (U1, V1, W1)
②	Partition plate (not included in the scope of supply) to stabilize the thermally insulating mat between the filter reactor and the filter module (⑬)
③	Hose between the return and filter reactor (P1)
④	Hose between the intake and filter module (P7)
⑤, ⑥	PE connection between the PE rail and filter module
⑦	Support plate (not included in the scope of supply) for the filter reactor
⑧	PE rail (not included in the scope of supply)
⑨	Intake (not included in the scope of supply)
⑩	Return (not included in the scope of supply)
⑪	Holding plate for lateral insulating mats, attached to all 4 sides of the cabinet (not included in the scope of supply)
⑫	Lateral insulating mats, attached to all 4 sides of the cabinet (not included in the scope of supply)
⑬	Insulating mat between the filter reactor and filter module (not included in the scope of supply)
⑭	Mounting bracket (not included in the scope of supply) to mount the partition plate between the filter reactor and the filter module (⑬)
①	Mounting space for DC busbars, 200 mm high

Figure 3-11 Typical control cabinet design, Rittal TS8, cabinet width 600 mm

The dimensions of the typical cabinet (Rittal TS8) are (width x height x depth) 600 mm x 2200 mm x 600 mm

There must be a minimum clearance of 970 mm between the lower edge of the transport plate (⑦) and the lower edge of the filter module.

The insulating mat between the filter reactor and the filter module is made of "AF/Armaflex AF-19MM/EA" and has the following properties:

- Thickness: 19 mm
- Thermal conductivity: ≤ 0.033 W/(m x K)
- Upper application temperature: 110 °C
- UL certification
- Self-adhesive

The entries for the cables and hoses should be made so that there is no heat loss (e.g. cross-shaped cuts).

The lateral insulating mats are made of "HT/Armaflex HT-10-99/E" and have the following properties:

- Thickness: 10 mm
- Thermal conductivity: ≤ 0.042 W/(m x K)
- Upper application temperature: 150 °C
- UL certification
- Not self-adhesive (are held by the lugs of the lateral holding plate)

Additional insulating mats made of the same material should be attached to the front and rear of the control cabinet.

Note

Use of thermally insulating mats

In the electrical cabinet design shown as example, thermally insulating mats must be used in order to maintain the following boundary conditions:

- The thermally insulating mats ensure that the power loss specified in the technical data is dissipated to the coolant, and the specified power loss to the environment is not exceeded.
- The lateral thermally insulating mats (⑫) prevent the adjacent cabinets and/or doors from becoming too hot.
- The thermally insulating mat between the filter reactor and filter module (⑬) prevents the filter module from overheating as a result of the power loss in the filter reactor.

⚠ WARNING

Risk of fire due to ground fault/short-circuit

Inadequate installation of the cables between the filter reactor and the filter module can result in a ground fault/short-circuit and place persons at risk as a result of the associated smoke and fire.

- Apply the local installation regulations to avoid this fault.
- Protect the cables against mechanical damage.
- Also implement one of the following measures:
  – Use cables with double insulation.
  – Maintain adequate clearance, e.g. by using spacers.
  – Lay the cables in separate cable ducts or conduits.

Installation kit for Active Interface Module in Rittal TS8

An installation kit for installing an Active Interface Module in a Rittal TS8 electrical cabinet can be ordered under Article No. 6SL3065-1FJ00-0AA0.

The installation kit includes the following components:

- Support plate for the filter reactor
- Holding plates for the lateral insulating mats
- Insulating mat between the filter reactor and the filter module
- Insulating mats
- Support bracket
- Insulation materials (screws, nuts)
- Installation instructions

3.2.7 Cooling circuit connections

Scope of supply

The unassembled connecting hose is supplied with the loose parts so that it can be adapted to the local conditions.

Six hose connections (straight and angled) with the associated gaskets are also supplied.

Enough connection hose is supplied so that the filter reactor and the filter module can be installed as shown in Section "Notes on installation in a control cabinet (Page 59)".

Connection diagram

The cooling circuit connections can be taken from the connection example.

Establishing the connections

If the components and the cooling water feed are arranged as described above, then the supplied unassembled pressure hose can be used.

If a different arrangement is used, connecting hoses of the same quality must be used:

- Hose diameter 3/4"
- Pressure rating, minimum 12 bar
- Maximum hose length 2 m
- Non-conductive, resistance 1 MΩ/m

The hose connections must be fastened with the gaskets with a tightening torque of 30 Nm:

- The straight hose connection is intended for P1.
- The angled hose connections are intended for P4, P6 and P7.

The hoses must be fastened to the hose connections with two hose clamps each with a tightening torque of 3 Nm.

After assembly, the tightness must be tested with a pressure test.

⚠ WARNING

Danger to life from electric shock due to insufficient insulating clearance

Incorrect routing of the coolant lines can result in insufficient insulating clearance to live parts and can cause death or serious injury.

- Route the coolant pipes very carefully.
- Make sure that the coolant lines do not come into contact with live parts and that an insulation clearance (clearances and creepage distances) of >13 mm is always maintained.
- Mechanically secure the coolant lines and check that they have no leaks.

Note

Checking the hose lines

The inspection intervals depend on the prevailing ambient conditions.

The following points should be noted for the coolant hoses:

- Damage through abrasion points
- Embrittlement (e.g. forming of cracks)
- Leaks
- The hose slipping out of the coupling
- Deformations that do not comply with the natural shape of the hose (e.g. separation of layers and blistering)
- Exceeding the storage and use times
  In accordance with the accepted rules and standards, we recommend a testing cycle of five years with the appropriate test pressure (twice the operating pressure).

Note

Replacement seal

The seals for the screwed connections can be used only once when the cooling circuit is first assembled. The seals must be replaced if the circuit is disassembled and assembled again.

The replacement seal is commercially available as flat Viton polymer seal with hardness 75 (+/-5) Shore A (Viton is the commercial name for elastomers with the abbreviations FPM and FKM). The dimensions are as follows: Outer diameter 26 mm, inner diameter 15 mm, thickness 1.5 mm.

3.2.8 Electrical connection

Scope of delivery

Six cables to electrically connect the filter reactor with the filter module and two cables to ground the filter module are included in the scope delivery:

- 6 cables (cross-section 95 mm², reinforced insulation), 820 mm long to connect the filter module (U1, V1, W1) with the line side of the filter reactor (U1, V1, W1).
  The filter module has cable lug connections with diameters for M8 screws
- 2 cables, yellow/green (cross-sections 120 mm²), 1100 mm long for the ground connection (PE) of the filter module

Sufficient cable is supplied so that the filter reactor and the filter module can be installed as shown in Section "Notes on installation in a control cabinet (Page 59)".

The ground connection at the filter module must be realized at both PE connections.

Establishing the connections

If the components are arranged as described above, then the cables supplied can be used.

If a different arrangement is used, cables of the same quality must still be used.

⚠WARNING
Risk of fire and damage to equipment due to short-circuit / ground fault The cables to the filter module must be routed so that a ground fault or short-circuit can be ruled out. A ground fault can result in fire with associated smoke. • Protect the cables from mechanical damage • Comply with local installation regulations that enable this fault to be ruled out. In addition, apply one of the following measures: • Use cables with double insulation. • Maintain adequate clearance, e.g. using spacers. • Route the cables in separate cable ducts or pipes.

Operating an Active Interface Module on a non-grounded line supply (IT system)

When the device is operated on a non-grounded line supply (IT system), the integrated basic interference suppression modules must be deactivated by removing a connection clip.

Note

Warning label on the connection clip

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

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

Figure 3-12 Warning label on the connection clip

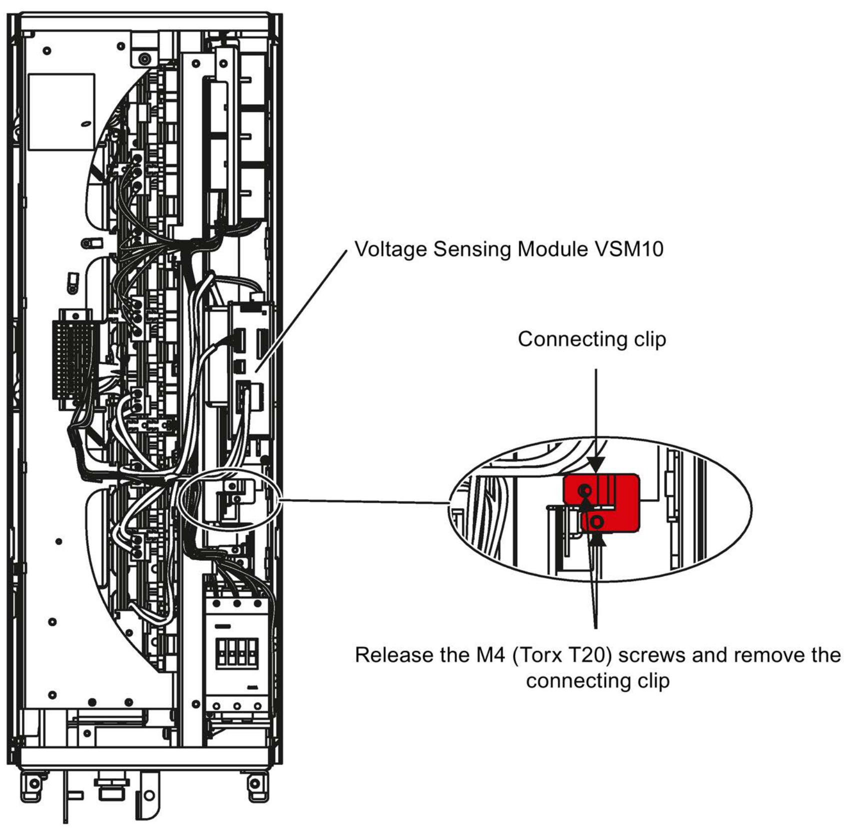
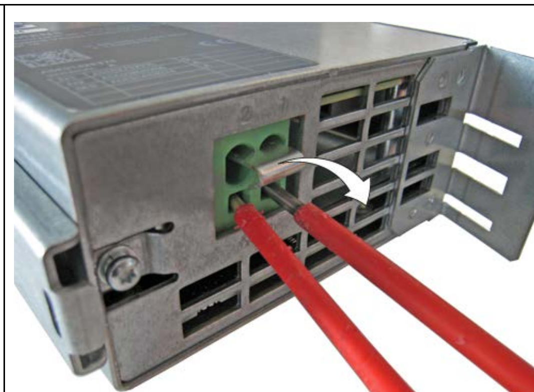


Figure 3-13 Connection clip at the filter module

NOTICE
Damage to the device through not removing the connection clip with a non-grounded line supply Failure to remove the connection clip to the basic interference suppression module on a non-grounded line supply (IT system) can cause significant damage to the device. • With a non-grounded line supply (IT system), remove the connection clip to the basic interference suppression module.

Removing the connector jumper in the VSM10 Voltage Sensing Module

When operating the Active Interface Module on a non-grounded line supply (IT system), at the Voltage Sensing Module (VSM10), remove the plug-in jumper in terminal X530 at the lower side of the component.
Use two screwdrivers or another suitable tool to relieve the holding springs in the terminal and then withdraw the plug-in jumper.

	
Terminal X530 with connector jumper	Relieve the springs and withdraw the connector jumper

3.2.9 Technical data

Table 3- 12 Technical data for Active Interface Modules, 380 V ... 480 V 3 AC

Article number	6SL3305–	7TE41–4AA7	7TE41–4AA7		
Suitable for Active Line Module Rated power of Active Line Module	6SL3335- kW	7TE41-0AA7 630	7TE41-4AA7 900		
Rated current	A	1405	1405		
Supply voltages - Line voltage - Line frequency - Electronics power supply	 V_{ACrms} Hz V_{DC}	 3 AC 380 –10 % (-15 % < 1 min) ... 3 AC 480 +10 % 47 ... 63 Hz 24 (20.4 ... 28.8)			
DC link capacitance of the drive line-up, max.	 µF	 230400	 230400		
Electronics current consumption (24 V DC)	A	0.17	0.17		
Bypass contactor [1]		3WL1112- 2BB34-4AN2-Z Z=C22 [3]	3WL1116- 2BB34-4AN2-Z Z=C22 [3]		
Max. coolant temperature - without derating - with derating	 °C °C	 45 50	 45 50		
Rated flow rate for water with 70 kPa pressure drop	l/min	10	10		
Sound pressure level L_{pA} (1 m) at 50/60 Hz	 dB(A)	 71 / 71	 71 / 71		
Frame size		JIL	JIL		
Filter reactor					
Article number	6SL3005-	0DE41-4AA7	0DE41-4AA7		
Cooling method		Water cooling system with integrated heat exchanger manufactured out of a copper-nickel alloy			
Power loss, max. [2] - At 50 Hz 690 V - At 60 Hz 575 V - Dissipated to the ambient air	 kW kW kW	 6.0 6.0 0.9	 8.6 8.6 0.9		
Liquid volumes - Integrated reactor cooler - Hoses supplied	 dm³ dm³/m	 0.6 0.285	 0.6 0.285		
Rated flow rate for water with 70 kPa pressure drop	l/min	10	10		
Coolant connections Return and connection to filter module		Pipe thread ISO 228 - G 3/4 B (external thread 3/4", flat-sealing)			
Tightening torque for coolant connections	Nm	6	6		
Line/load connection U1, V1, W1 / U2, V2, W2		Flat connection for M12 screw	Flat connection for M12 screw		
PE connection		M10 bolts	M10 bolts		

Article number	**6SL3305–**	**7TE41–4AA7**	**7TE41–4AA7**		
Max. connection cross-section - line connection (U1, V1, W1) - load connection (U2, V2, W2) - to the filter Module (U1, V1, W1) - PE connection	 mm² mm² mm² mm²	 1500 1500 2 x 95 1 x 240	 1500 1500 2 x 95 1 x 240		
Degree of protection		IP00	IP00		
Dimensions - Width - Height - Depth	 mm mm mm	 382 698 <575	 382 698 <575		
Weight	kg	299	299		
Filter module					
Article number	6SL3005-	0FE41-4AA7	0FE41-4AA7		
Cooling method		Water cooling system with integrated heat exchanger manufactured out of a copper-nickel alloy			
Power loss, max. 2) - At 50 Hz 690 V - At 60 Hz 575 V - Dissipated to the ambient air	 kW kW kW	 3.6 3.6 0.15	 3.6 3.6 0.15		
Liquid volumes of the filter module	dm³	1	1		
Coolant connections Intake and connection to filter reactor		Pipe thread ISO 228 - G 3/4 B (external thread 3/4", flat-sealing)			
Tightening torque for coolant connections	Nm	6	6		
Max. connection cross-sections - to the filter reactor (U1, V1, W1) - PE connection	 mm² mm²	 2 x 95 2 x 120	 2 x 95 2 x 120		
Degree of protection		IP00	IP00		
Dimensions - Width - Height - Depth	 mm mm mm	 300 864 540	 300 864 540		
Weight	kg	160	160		

1) Bypass contactor is not included, must be provided separately.

2) The specified power loss is the maximum value at 100% utilization level. The value in normal operation is lower.

3) The circuit breaker is controlled by the sequence control of the Active Line Module, and it is not permissible that it is manually closed. Therefore, we recommend that the circuit breaker is equipped with a locking set 3WL9111-0BA21-0AA0.

Table 3- 13 Technical data for Active Interface Modules, 500 V ... 690 V 3 AC

Article number	**6SL3305–**	**7TG41–0AA7**	**7TG41–3AA7**	**7TG41–6AA7**	
Suitable for Active Line Module Rated power of Active Line Module	6SL3335- kW	7TG41-0AA7 1100 7TG38-1AA7 900	7TG41-3AA7 1400	7TG41-6AA7 1700	
Rated current	A	1025	1270	1560	
Supply voltages - Line voltage - Line frequency - Electronics power supply	 V_{ACrms} Hz V_{DC}	 3 AC 500 –10% (-15% < 1 min) ... 3 AC 690 +10% 47 ... 63 Hz 24 (20.4 ... 28.8)			
DC link capacitance of the drive line-up, max.	 µF	 153600	 153600	 210000	
Electronics current consumption (24 V DC)	A	0.17	0.17	0.17	
Bypass contactor 1)		3WL1212- 4BB34-4AN2-Z Z=C22 3)	3WL1216- 4BB34-4AN2-Z Z=C22 3)	3WL1216- 4BB34-4AN2-Z Z=C22 3)	
Max. coolant temperature - without derating - with derating	 °C °C	 45 50	 45 50	 45 50	
Rated flow rate for water with 70 kPa pressure drop	l/min	10	10	16	
Sound pressure level L_{pA} (1 m) at 50/60 Hz	 dB(A)	 71 / 71	 71 / 71	 71 / 71	
Frame size		JIL	JIL	JIL	
Filter reactor					
Article number	6SL3005-	0DG41-3AA7	0DG41-3AA7	0DG41-6AA7	
Cooling method		Water cooling system with integrated heat exchanger manufactured out of a copper-nickel alloy			
Power loss, max. 2) - At 50 Hz 690 V - At 60 Hz 575 V - Dissipated to the ambient air	 kW kW kW	 6.2 6.2 0.6	 9.3 9.3 0.95	 11 11 1.15	
Liquid volumes - Integrated reactor cooler - Hoses supplied	 dm³ dm³/m	 0.6 0.285	 0.6 0.285	 0.6 0.285	
Rated flow rate for water with 70 kPa pressure drop	l/min	10	10	10	
Coolant connections Return and connection to filter module		Pipe thread ISO 228 - G 3/4 B (external thread 3/4", flat-sealing)			
Tightening torque for coolant connections	Nm	6	6	6	
Line/load connection U1, V1, W1 / U2, V2, W2		Flat connection for M12 screw	Flat connection for M12 screw	Flat connection for M12 screw	
PE connection		M10 bolts	M10 bolts	M10 bolts	

Article number	6SL3305–	7TG41–0AA7	7TG41–3AA7	7TG41–6AA7	
Max. connection cross-section - line connection (U1, V1, W1) - load connection (U2, V2, W2) - to the filter Module (U1, V1, W1) - PE connection	 mm² mm² mm² mm²	 1500 1500 2 x 95 1 x 240	 1500 1500 2 x 95 1 x 240	 1500 1500 2 x 95 1 x 240	
Degree of protection		IP00	IP00	IP00	
Dimensions - Width - Height - Depth	 mm mm mm	 440 705 <575	 440 705 <575	 440 705 <580	
Weight	kg	365	365	460	
Filter module					
Article number	6SL3005-	0FG41-0AA7	0FG41-3AA7	0FG41-6AA7	
Cooling method		Water cooling system with integrated heat exchanger manufactured out of a copper-nickel alloy			
Power loss, max. 2) - At 50 Hz 690 V - At 60 Hz 575 V - Dissipated to the ambient air	 kW kW kW	 5.0 5.0 0.15	 5.0 5.0 0.15	 7.5 7.5 0.15	
Liquid volumes of the filter module	dm³	1	1	1	
Coolant connections Intake and connection to filter reactor		Pipe thread ISO 228 - G 3/4 B (external thread 3/4", flat-sealing)			
Tightening torque for coolant connections	Nm	6	6	6	
Max. connection cross-sections - to the filter reactor (U1, V1, W1) - PE connection	 mm² mm²	 2 x 95 2 x 120	 2 x 95 2 x 120	 2 x 95 2 x 120	
Degree of protection		IP00	IP00	IP00	
Dimensions - Width - Height - Depth	 mm mm mm	 300 864 540	 300 864 540	 300 864 540	
Weight	kg	160	160	160	

1) Bypass contactor is not included, must be provided separately.

2) The specified power loss is the maximum value at 100% utilization level. The value in normal operation is lower.

3) The circuit breaker is controlled by the sequence control of the Active Line Module, and it is not permissible that it is manually closed. Therefore, we recommend that the circuit breaker is equipped with a locking set 3WL9111-0BA21-0AA0.

3.2.9.1 Derating factors as a function of coolant temperature

Water cooled SINAMICS S120 devices are suitable for water or a mixture of water and an antifreeze as coolant, corresponding to Section Antifreeze + biocide (Page 262).

When water is used as a coolant, the units can supply 100% output current at temperatures between 5 °C and 38 °C. The maximum output current decreases linearly to 90% at temperatures between 38 °C and 43 °C.

When water and an antifreeze mixture described above is used as a coolant, the units can supply 100% output current at temperatures between 0 °C and 38 °C. The maximum output current decreases linearly to 90% at temperatures between 38 °C and 43 °C.

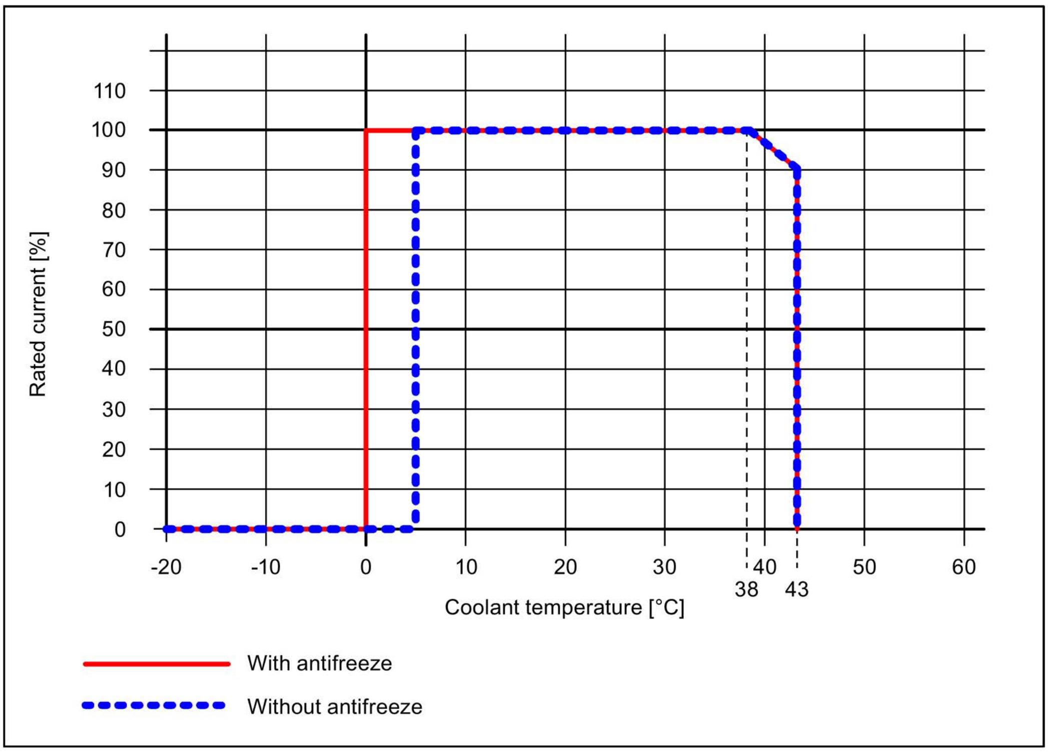


Figure 3-14 Maximum output current as a function of coolant temperature

3.2.9.2 Derating factors as a function of the ambient temperature

The units can supply 100 % output current at an ambient air temperature of between 0 °C and 45 °C. The maximum output current decreases linearly to 90 % at ambient air temperatures of between 45 °C and 50 °C.

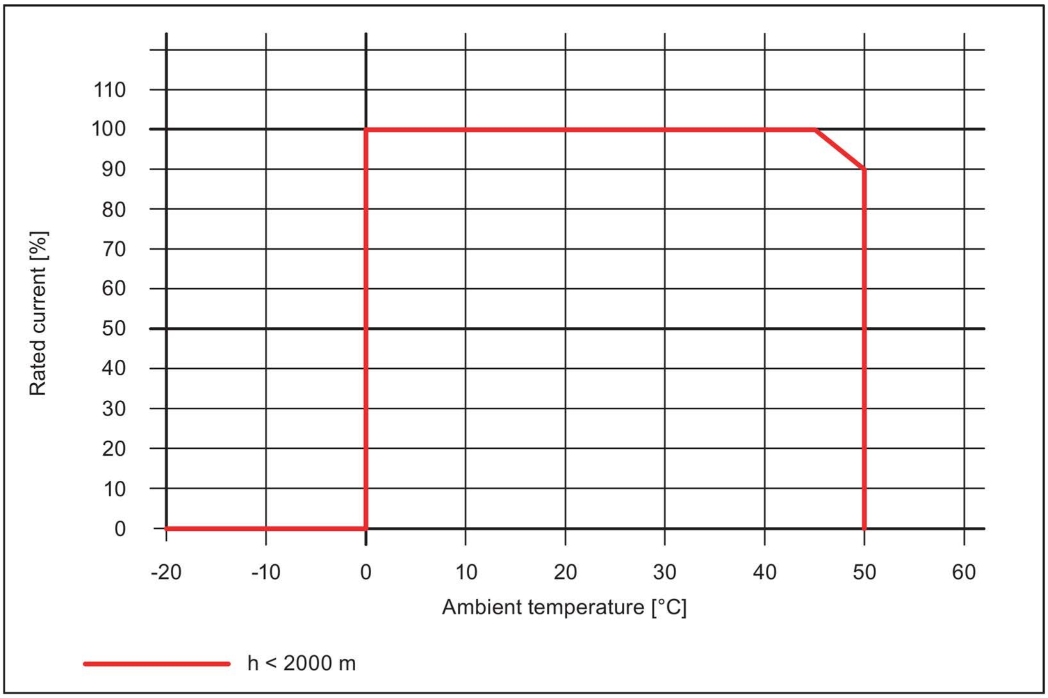


Figure 3-15 Maximum current as a function of ambient temperature

3.2.9.3 Derating factors as a function of installation altitude

When the units are operated at an installation altitude with reduced air pressure, the derating characteristic shown below applies to the output current or the ambient air temperature.

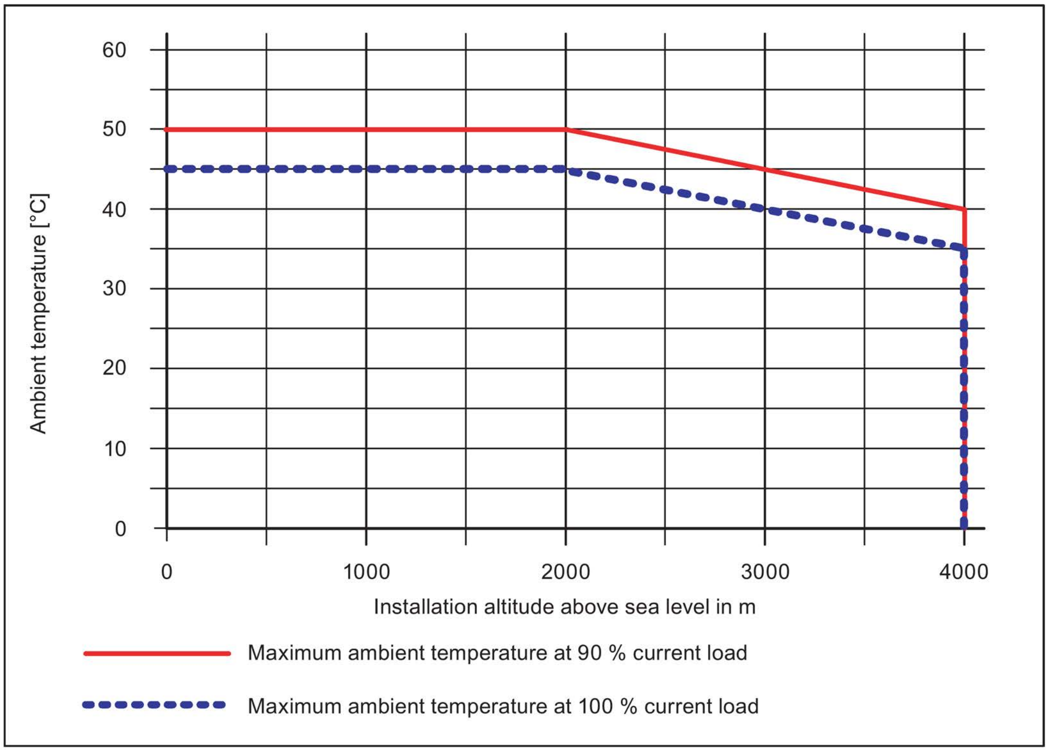


Figure 3-16 Maximum ambient temperature as a function of installation altitude

At installation altitudes above 2000 m (6562 ft), the line voltage must not exceed certain limits to ensure that surge voltages can be insulated in accordance with IEC 61800-5-1 for surge voltage category III. If the line voltage is higher than this limit at installation altitudes > 2000 m (6562 ft), measures must be taken to reduce transient category III surge voltages to category II values, e.g. equipment must be supplied via an isolating transformer.

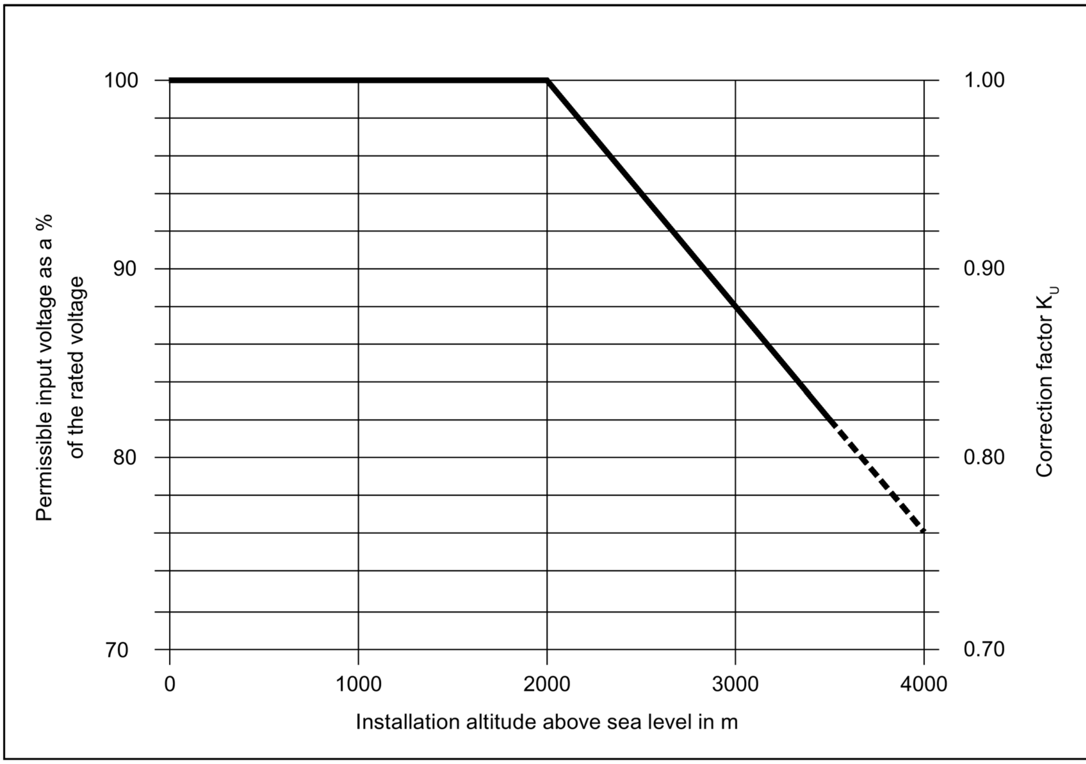


Figure 3-17 Voltage correction factor K_T as a function of the installation altitude

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Note

Rated voltage

Refer to the maximum line voltage under "Connection voltages" in the technical data for details of the rated voltage.

Note

Input voltage range that can be actually used

The dashed line represents a theoretical characteristic of the correction factor. The devices have an undervoltage threshold, which leads to shutdown when the voltage drops below it. Consequently, the input voltage range that is actually usable has a lower limit.

3.2.9.4 Parameterization

The thresholds for the temperature monitoring must be carefully checked and parameterized correctly for safe operation:

- Alarm threshold p3667: 60 °C
- Trip threshold p3668:
  - Line voltage 3 AC 380 ... 480 V: 65 °C
  - Line voltage 3 AC 500 ... 690 V: 70 °C

Note

Note regarding STARTER V4.4.1

The product is supported from STARTER version V4.4.1.

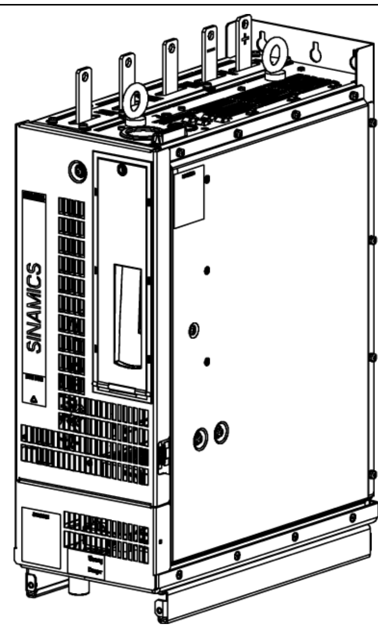
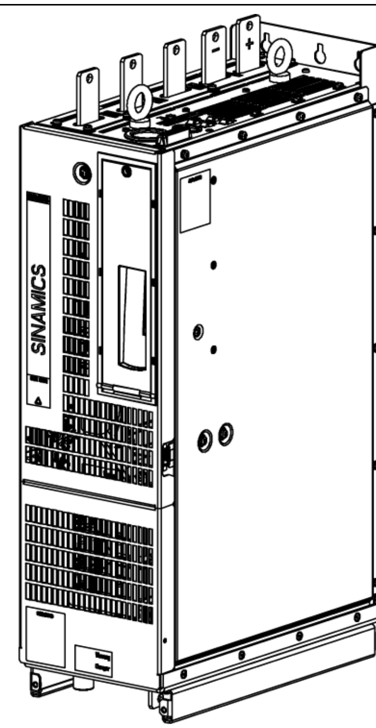
Power Modules

4

4.1 Description

A Power Module is a power unit (frequency converter) that provides the power supply for the connected motor. The power from the 3-phase system is supplied via the 6-pulse rectifier. The output inverter produces a 3-phase, variable-voltage, variable-frequency system. A Power Module must be connected to a Control Unit via DRIVE-CLiQ. The open-loop and closed-loop control functions are stored in the Control Unit.

Table 4- 1 Power Modules

	
Frame size FL	Frame size GL

Characteristics of Power Modules

- Design for 380 V 3 AC to 480 V 3 AC from 210 A to 490 A
- Suitable for TN, TT, and IT supply systems
- Liquid cooling
- Short-circuit/ground-fault-proof
- Electronic rating plate
- Operating status and error status via LEDs
- DRIVE-CLiQ interface for communication with the Control Unit and/or other components in the drive line-up.
- Integration in system diagnostics
- The Power Modules communicate with the higher-level Control Unit via DRIVE-CLiQ. The Control Unit in this case could be a CU310-2, CU320-2 or a SIMOTION D Control Unit.
- An external 24 V DC power supply is required to operate liquid-cooled Power Modules.
- The correct line reactor must be connected in series to achieve category C3 EMC conformance in accordance with EN 61800.

The volumetric flow of the coolant is monitored by the software. If the volumetric flow is continuously lower than the setpoint, an alarm (A5005) is first displayed. If this alarm remains active continually for the next 5 minutes, a fault message (F30047) is activated which shuts down the unit.

The fans for the internal electronic circuitry are only switched on when required.

The fans are switched on and off as a function of several factors (e.g. heat sink temperature, ambient temperature, output current, duty cycle, ...) which means that fan operating cycles cannot be calculated directly.

4.2 Safety information

WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

The non-observance of the fundamental safety instructions and residual risks stated in Chapter 1 can result in accidents with severe injuries or death.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

DANGER

Danger to life due to electric shock and fire hazard caused by overcurrent protective equipment tripping too late

Overcurrent protective equipment that trips too late or not all can cause electric shock or fire.

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

DANGER

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

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

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

- Only open the device after five minutes have elapsed.
- Measure the voltage before starting work on the DCP and DCN DC-link terminals.

WARNING

Danger to life due to high leakage currents caused by an interrupted external protective conductor

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

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

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

WARNING

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

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

- Attach the component warning labels in the national language.

WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

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

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

CAUTION

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

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

- Ensure that the total length of the power cables (motor supply cables and DC-link cables) does not exceed the values specified in the technical data.

NOTICE

Material damage caused by mechanically loaded busbars and liquid coolant connections

Mechanically loaded busbars and liquid coolant connections can cause damage on the device.

- Do not use the busbars and liquid coolant connections protruding from the device as handles or as support surfaces during transport.

NOTICE

Material damage caused by loose power connections

Insufficient tightening torques or vibration can result in faulty electrical connections. This can cause fire damage or functional faults.

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

NOTICE

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

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

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

NOTICE

Damage through use of incorrect DRIVE-CLiQ cables

Damage or malfunctions can occur on the devices or system when DRIVE-CLiQ cables are used that are either incorrect or have not been approved for this purpose.

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

4.3 Interface description

4.3.1 Overview

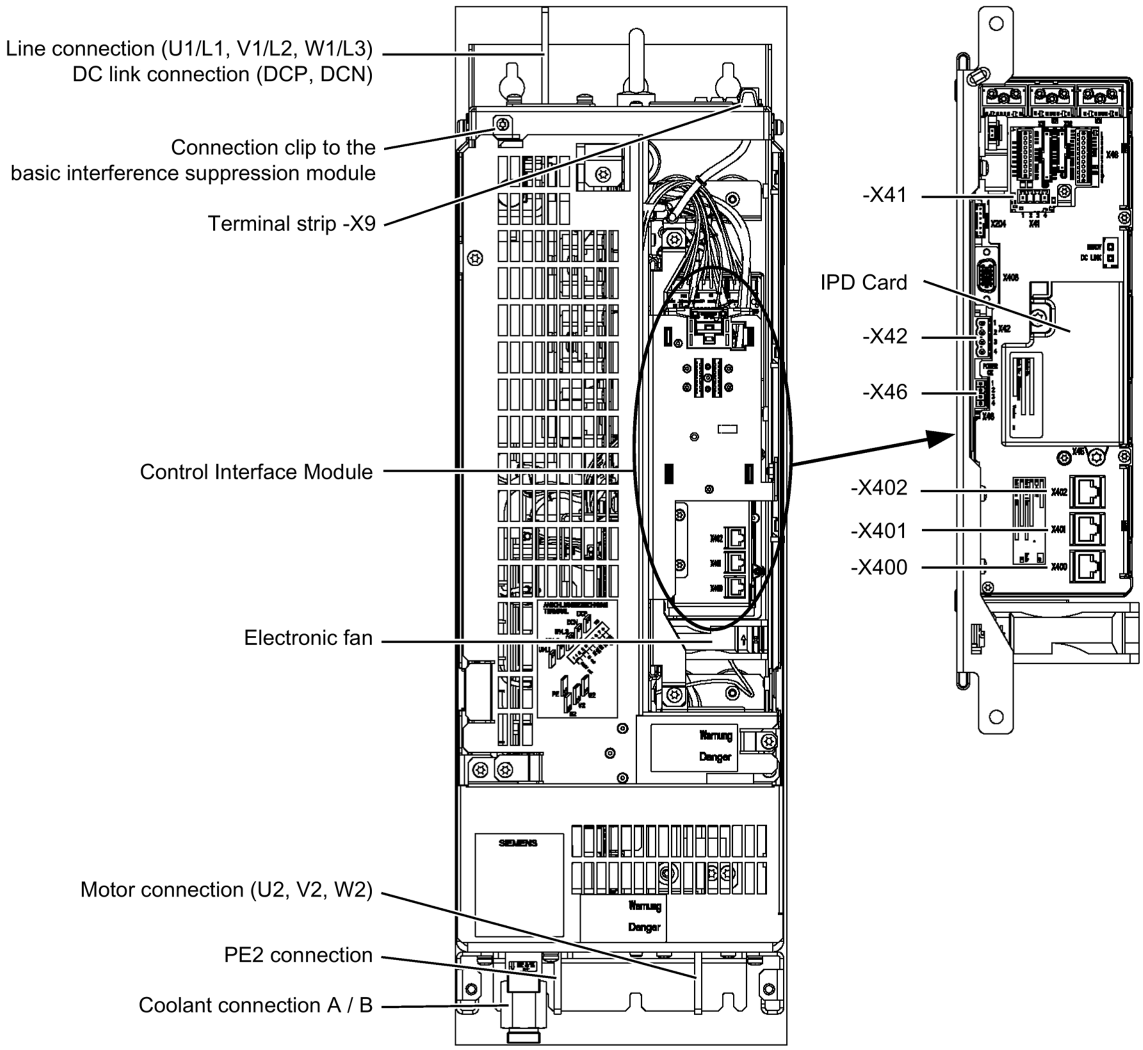


Figure 4-1 Power Module, frame size FL

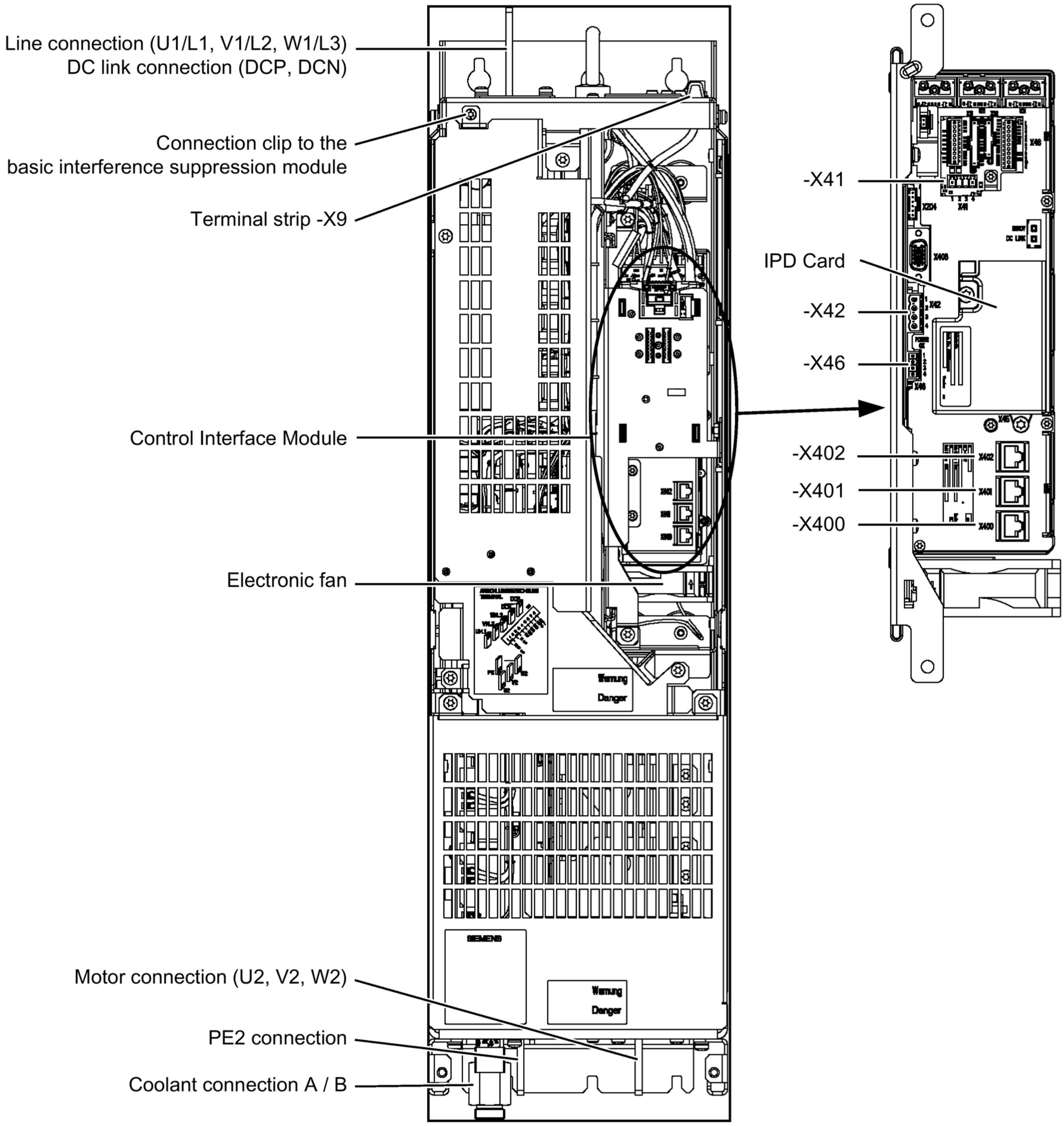


Figure 4-2 Power Module, frame size GL

4.3.2 Connection example

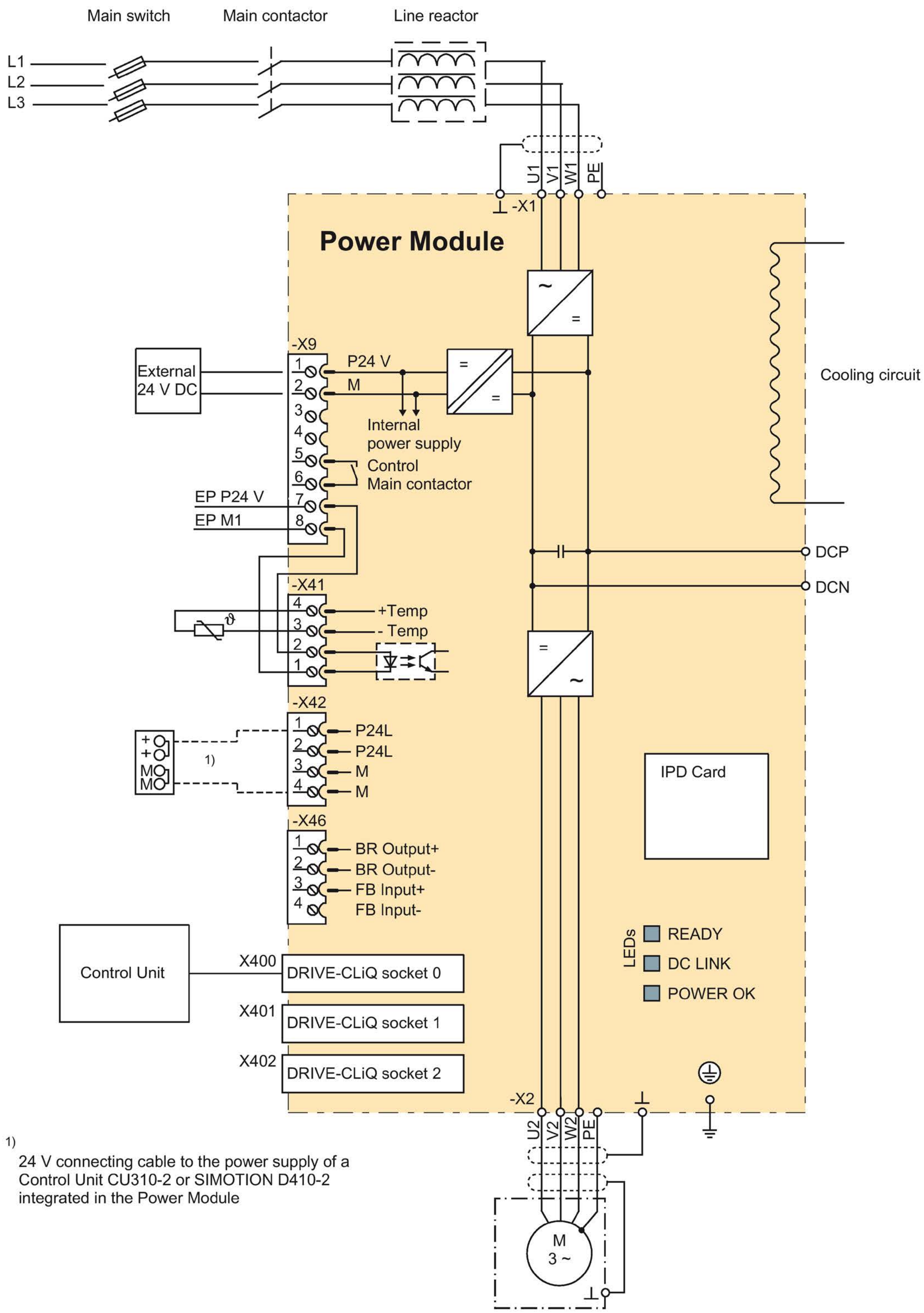


Figure 4-3 Connection example for Power module

4.3.3 Line/DC link/motor connection

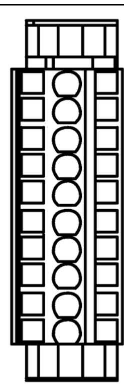
Table 4- 2 Line/DC link/motor connection for Power Module

Terminals	Technical specifications
U1/L1, V1/L2, W1/L3 3 AC power input	Voltage: 3 AC 380 V -10 % (-15 % < 1 min) ... 3 AC 480 V +10 % Frequency: 47 ... 63 Hz Connecting lugs: d = 13 mm (M12/50 Nm) for cable lugs in accordance with DIN 46234 / DIN 46235 1)
DC link connection DCP, DCN	Voltage: 1.35 x V_{line} Connecting lugs: d = 13 mm (M12/50 Nm) for cable lugs in accordance with DIN 46234 / DIN 46235 1)
U2, V2, W2 3 AC power output	Voltage: 0 V 3 AC to 0.72 x DC link voltage Connecting lugs: d = 13 mm (M12/50 Nm) for cable lugs in accordance with DIN 46234 / DIN 46235 1)
PE connection	Connecting lugs: d = 13 mm (M12/50 Nm) for cable lugs in accordance with DIN 46234 / DIN 46235 1)

1) Dimensions for connecting alternative cable lugs, see "cable lugs" in the appendix.

4.3.4 X9 terminal strip

Table 4- 3 Terminal strip X9

	Terminal	Signal name	Technical data
	1	P24 V	External 24 V DC supply Voltage: 24 VDC (20.4 ... 28.8 V) Power consumption: See Technical data
	1	P24 V	
	2	M	
	2	M	
	3	Reserved, do not use	
	4		
	5	Main contactor control	240 V AC: 8 A max. 30 V DC: max. 1 A isolated
	6		
	7	EP +24 V (Enable Pulses)	Supply voltage: 24 VDC (20.4 ... 28.8 V) Power consumption: 10 mA The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	8	EP M1 (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2			

Note

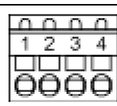
EP terminals only for Safety Integrated Basic Functions

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

> **Note**
>
> **Looping through the supply voltage**
>
> The two "P24 V" or "M" terminals are jumpered in the connector. This ensures that the supply voltage is looped through, even when the connector is removed.

4.3.5 X41 EP terminal / temperature sensor connection

Table 4- 4 Terminal strip X41

	Terminal	Function	Technical data
	1	EP M1 (Enable Pulses)	Connected to terminal -X9:8
	2	EP +24 V (Enable Pulses)	Connected to terminal -X9:7
	3	-Temp	Temperature sensor connection KTY84-1C130 / PT100 / PT1000 / PTC
	4	+Temp	
Max. connectable cross-section: 1.5 mm^2			

WARNING

Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Only use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

NOTICE

Device failure as a result of unshielded or incorrectly routed cables to temperature sensors

Unshielded or incorrectly routed cables to temperature sensors can result in interference being coupled into the signal processing electronics from the power side. This can result in significant disturbance of all signals (fault messages) up to failure of individual components (destruction of the devices).

- Only use shielded cables as temperature sensor cables.
- If temperature sensor cables are routed together with the motor cable, use separately shielded cables twisted in pairs.
- Connect the cable shield to ground potential through a large surface area.
- Recommendation: Use suitable Motion Connect cables.

NOTICE
Damage to motor in the event of incorrectly connected KTY temperature sensor
If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor. • Connect a KTY temperature sensor with the correct polarity.

Note

The temperature sensor connection can be used for motors that are equipped with a KTY84-1C130, PT100, PT1000 or PTC measuring sensor in the stator windings.

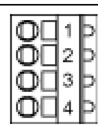
Note

Connection to terminal strip -X9

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

4.3.6 X42 terminal strip

Table 4- 5 Terminal strip X42 voltage supply for Control Unit, Sensor Module and Terminal Module

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

Note

The terminal strip supplies power to the CU310 Control Unit via a cable harness supplied with the device.

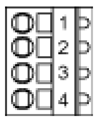
Note

Connection options of terminal strip X42

The terminal strip is not intended to supply other 24 VDC loads (for example, for supplying other components on the plant/system side), as the voltage supply of the Control Interface Module could also be overloaded and result in malfunctions.

4.3.7 X46 Brake control and monitoring

Table 4- 6 Terminal strip X46 brake control and monitoring

	Terminal	Function	Technical data
	1	BR output +	Brake connection
	2	BR output -	Supply voltage: 24 V DC Max. load current: 0.2 mA
	3	FB input +	
	4	FB input -	
Max. connectable cross-section: 1.5 mm²			

Note

The interface is intended for connection of the Safe Brake Adapter.

⚠WARNING

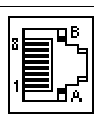
Fire hazard due to overheating when permissible connection cable lengths are exceeded

Excessively long connection cables on terminal strip X46 can cause components to overheat with the associated risk of fire and smoke.

- Limit the length of the connecting cables to a maximum of 10 m.
- The connection cable must not be led out the control cabinet or control cabinet group.

4.3.8 DRIVE-CLiQ interfaces X400, X401, X402

Table 4- 7 DRIVE-CLiQ interfaces X400, X401, X402

	PIN	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces (50 pcs.) Article number: 6SL3066-4CA00-0AA0			

4.3.9 Cooling circuit connections

Table 4- 8 Cooling circuit connections

Connection	Technical data
Coolant connection A: Intake	Pipe thread ISO 228 - G 3/4 B (external thread 3/4", flat-sealing)
Coolant connection B: Return	
Tightening torque	60 Nm

Note

Replacement seal

The seals for the screwed connections can be used only once when the cooling circuit is first assembled. The seals must be replaced if the circuit is disassembled and assembled again.

The replacement seal is commercially available as flat Viton polymer seal with hardness 75 (+/-5) Shore A (Viton is the commercial name for elastomers with the abbreviations FPM and FKM). The dimensions are as follows: Outer diameter 26 mm, inner diameter 15 mm, thickness 1.5 mm.

4.3.10 Meaning of the LEDs on the Control Interface Module in the Power Module

Table 4- 9 Meaning of the LEDs "READY" and "DC LINK" on the Control Interface Module in the Power Module

LED, state		Description
READY	**DC LINK**	
Off	Off	The electronics power supply is missing or out of tolerance.
Green	--- [1]	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC-link voltage is present.
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage lies outside the permitted tolerance range.
Orange	Orange	DRIVE-CLiQ communication is being established.
Red	--- [1]	This component has at least one fault. **Remark:** The LED is activated irrespective of whether the corresponding messages have been reconfigured.
Flashing light 0.5 Hz: green/red	--- [1]	Firmware is being downloaded.
Flashing light 2 Hz: green/red	--- [1]	Firmware download is complete. Waiting for POWER ON.
Flashing light 2 Hz: green/orange or red/orange	--- [1]	Detection of the components via LED is activated (p0124). Note: Both options depend on the LED status when module recognition is activated via p0124 = 1.

1) Irrespective of the status of the LED "DC LINK"

Table 4- 10 Meaning of the LED "POWER OK" on the Control Interface Module in the Power Module

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

⚠WARNING

Danger of death when live parts of the DC link are touched

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED. This means that when live parts are touched, this can result in death or serious injury.

- Observe the warning information on the component.

4.4 Dimension drawing

Dimension drawing for frame size FL

The mandatory cooling clearances are indicated by the dotted line.

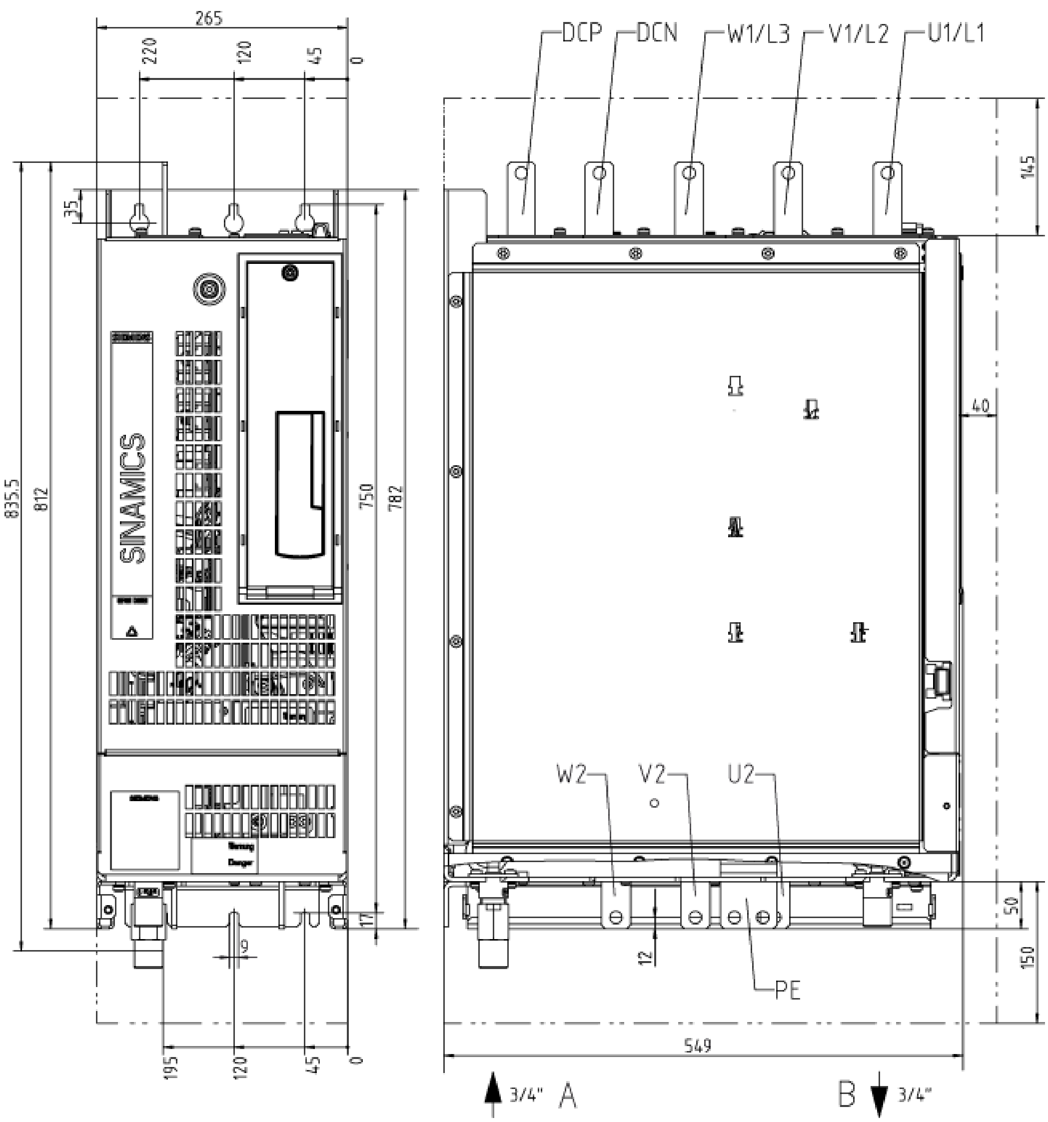


Figure 4-4 Dimension drawing Power Module, frame size FL, front view, side view

Dimension drawing for frame size GL

The mandatory cooling clearances are indicated by the dotted line.

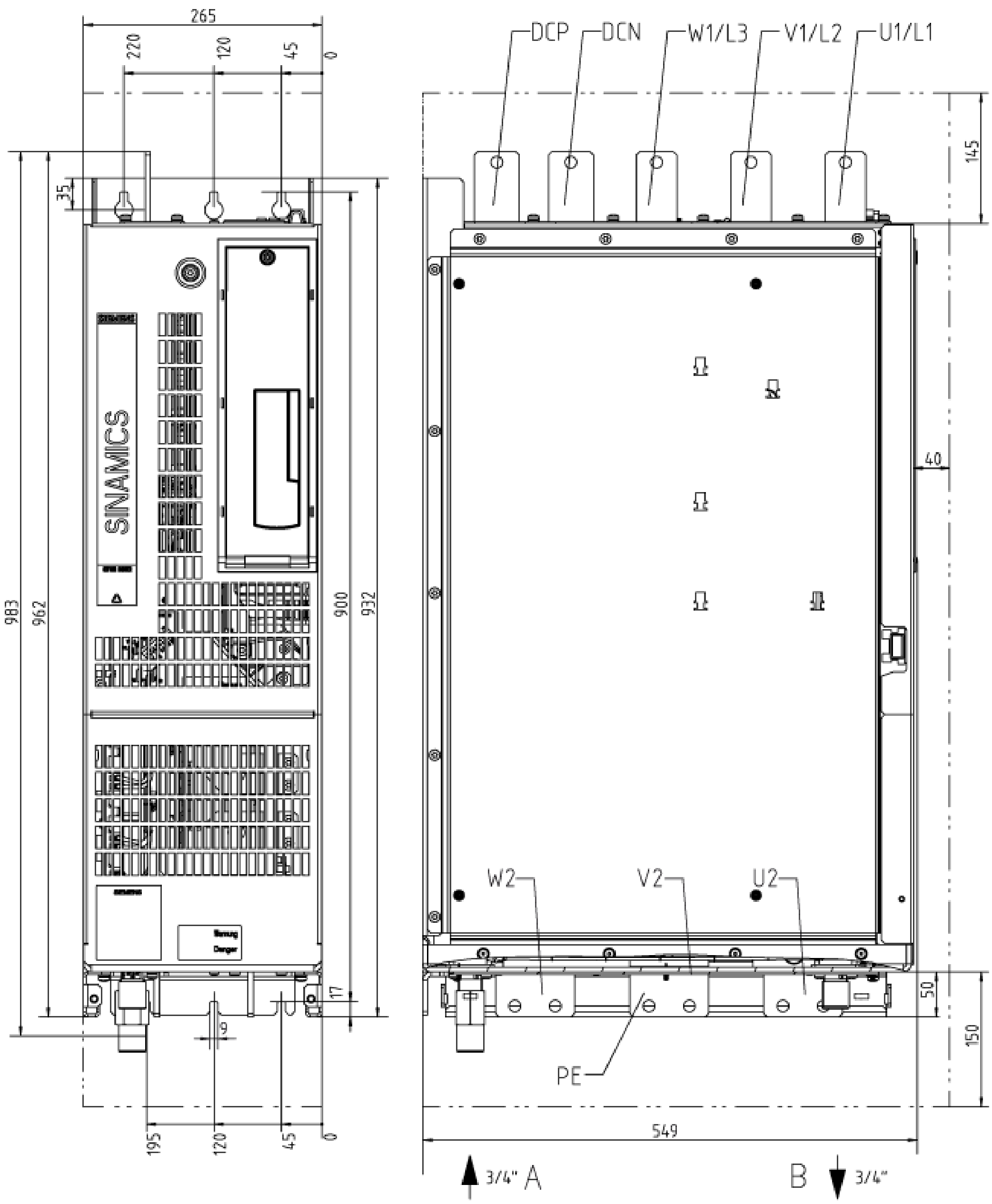


Figure 4-5 Dimension drawing Power Module, frame size GL. Front view, side view

4.5 Installation

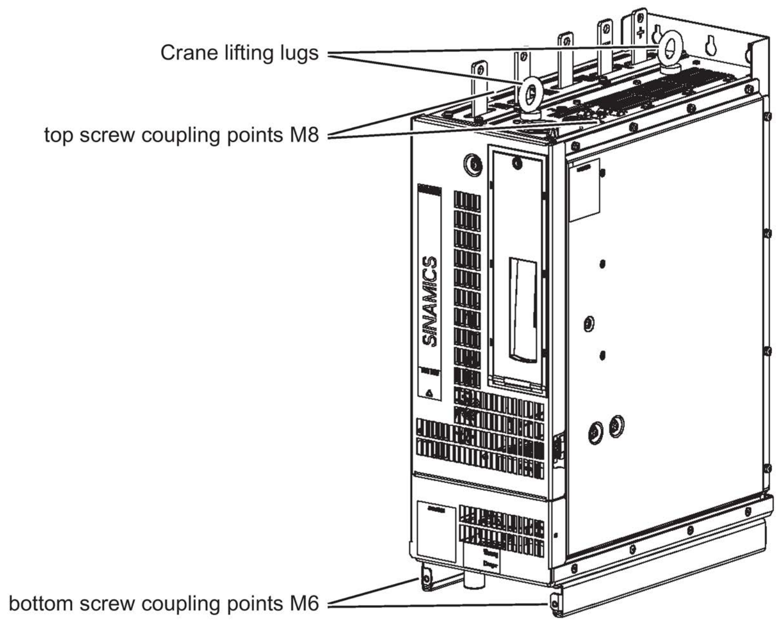


Figure 4-6 Crane lifting lugs / screw coupling points for mechanical support

Crane lifting lugs

Power Modules are fitted with crane lifting lugs as standard when shipped. The units can be hoisted using these lugs and transported from the pallet to the installation location.

Note

Transport in the horizontal position

Transport in the horizontal position is permissible.

It is not permissible to screw the crane lifting lug into the thread at the lower side of the Power Module.

NOTICE
Damage to the device due to improper transport Improper transport can cause mechanical loads on the housing or busbars which can result in damage to the device. • Use a lifting harness with vertical ropes or chains during transport. • Do not use the busbars as handles or for fastening a lifting harness. • Only tighten the crane lifting lugs by hand. Remove the crane lifting lugs after the installation, but keep them for later use.

Screw coupling points for mechanical support

The Power Modules are provided with screw coupling points at the top and bottom so that they can be connected to modules mounted adjacently.

Protection guard

A protection guard is mounted on the bottom of the Power Module ("1" in the diagram below) for use during transportation. The Power Module can be placed down on this protection guard while it is removed from the packaging and during transportation.
Before the module is installed at its final location, this guard must be removed. To do this, remove the four screws ("2" in the diagram) and remove the guard.

> ⚠ **CAUTION**
>
> **Risk of injury due to toppling when placing down on the protection guard**
>
> A module placed down on the protection guard can topple over therefore causing injury.
>
> - When the module is placed down on the production guard, ensure that it cannot topple over.

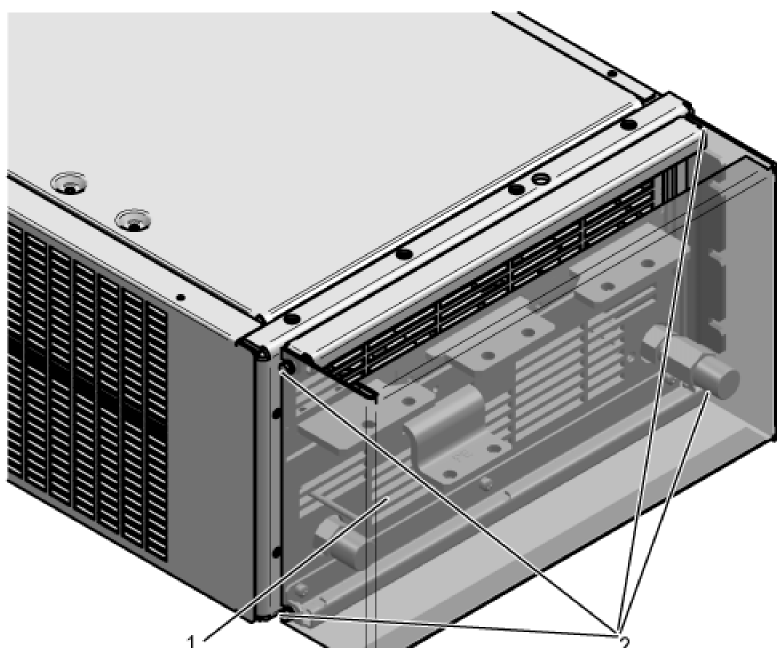


Figure 4-7 Protection guard

4.6 Electrical connection

Operating a Power Module on a non-grounded supply system/IT system

If the device is operated on a non-grounded line supply (IT system), the connection clip to the basic interference suppression module must be removed.

To do so, loosen the two screws ("1" in the following diagram) and remove the connection bracket. Once you have loosened the screws, turn the connection bracket to the side (to the right) first and then pull it forwards out of the unit.

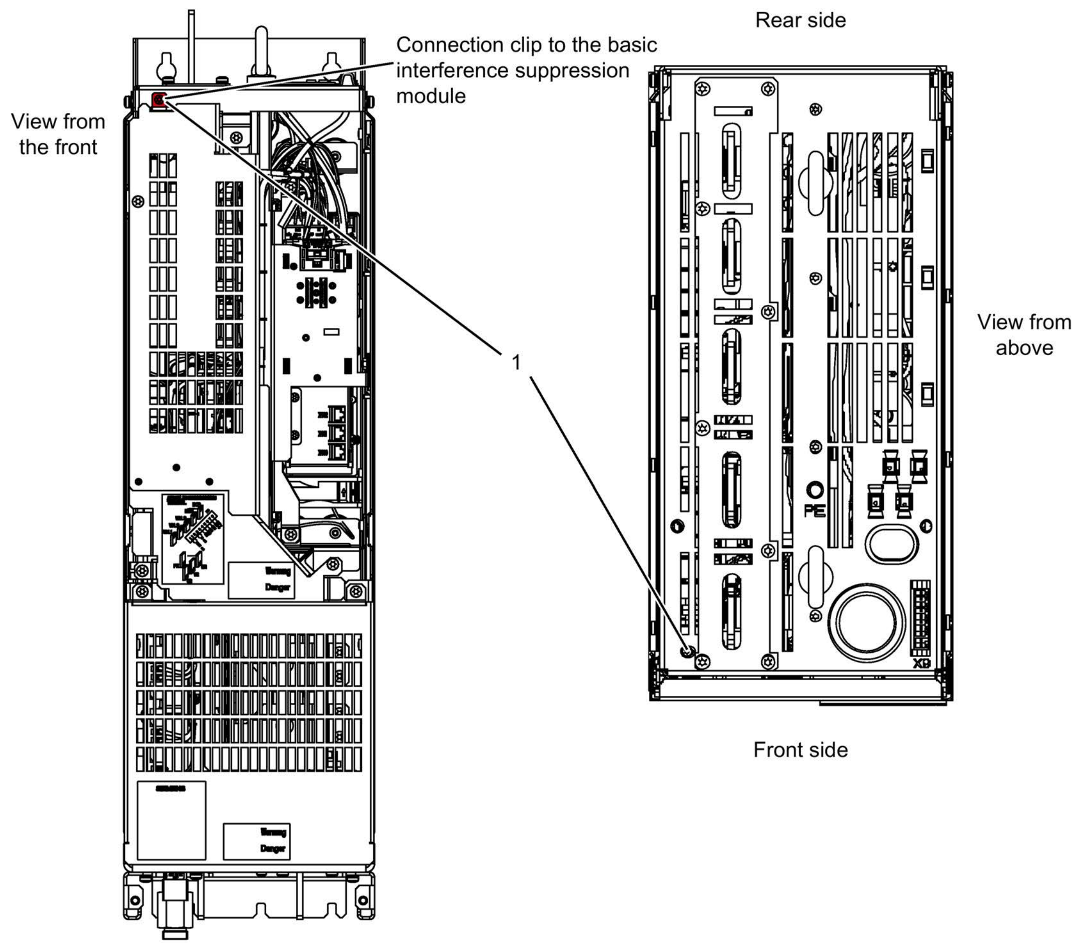


Figure 4-8 Removing the connection clip to the basic interference suppression module

NOTICE
Damage to the device through not removing the connection clip with a non-grounded line supply Failure to remove the connection clip to the basic interference suppression module on a non-grounded line supply (IT system) can cause significant damage to the device. • With a non-grounded line supply (IT system), remove the connection clip to the basic interference suppression module.

4.7 Technical specifications

Table 4- 11 Technical data, Power Modules, 380 V ... 480 V 3 AC

Article number	6SL3315–	1TE32-1AA3	1TE32–6AA3	1TE33–1AA3	1TE35–0AA3
Type rating - Based on I_L (50 Hz 400 V) [1)] - Based on I_H (50 Hz 400 V) [1)] - Based on I_L (60 Hz 460 V) [2)] - Based on I_H (60 Hz 460 V) [2)]	 kW kW HP HP	 110 90 150 150	 132 110 200 200	 160 132 250 200	 250 200 400 350
Output current - Rated current $I_{N A}$ - Base load current I_L - Base load current I_H - Max. output current $I_{max A}$	 A A A A	 210 205 178 307	 260 250 233 375	 310 302 277 453	 490 477 438 715
Supply voltages - Line voltage - Line frequency - Electronics power supply - DC-link voltage - Output voltage	 V_{ACrms} Hz V_{DC} V_{DC} V_{ACrms}	 3 AC 380 –10% (-15% < 1 min) ... 3 AC 480 +10% 47 ... 63 Hz 24 (20.4 ... 28.8) 1.35 x U_{line} 0 ... 0.72 x DC-link voltage			
Input current - Rated current $I_{N E}$ - Maximum current $I_{max E}$	 A A	 230 336	 285 411	 340 496	 540 788
Rated pulse frequency - Max. pulse frequency without derating - Max. pulse frequency with derating	kHz kHz kHz	2 2 8	2 2 8	2 2 8	2 2 8
Electronics current consumption (24 V DC)	A	1.4	1.4	1.5	1.5
Cooling method		Liquid cooling with integrated stainless steel heat exchanger			
Power loss, max. [3)] - At 50 Hz 400 V - At 60 Hz 460 V - Dissipated to the ambient air	 kW kW kW	 2.42 2.6 0.06	 3.04 3.2 0.07	 3.4 3.6 0.09	 5.43 5.7 0.14
Max. coolant temperature - Without derating - With derating	 ° C ° C	 45 50	 45 50	 45 50	 45 50
Rated flow rate	l/min	9	9	12	12
Pressure drop, typical at the rated flow rate [4)]	Pa	70000	70000	70000	70000
Liquid volume of integrated heat exchanger	dm^3	0.52	0.52	0.88	0.88
Sound pressure level L_{pA} (1 m) at 50/60 Hz	 dB(A)	 52	 52	 52	 52
Line/DC link/motor connection		Flat connection for M12 screw			
Max. connection cross-section - Line connection (U1/L1, V1/L2, W1/L3) - DC-link connection (DCP, DCN) - Motor connection (U2, V2, W2) - PE connection	 mm² mm² mm² mm²	 2 x 95 2 x 95 2 x 95 2 x 95	 2 x 95 2 x 95 2 x 95 2 x 95	 2 x 240 2 x 240 2 x 240 2 x 240	 2 x 240 2 x 240 2 x 240 2 x 240
Max. cable length	m	300 (shielded) / 450 (unshielded)			

Article number	**6SL3315–**	**1TE32-1AA3**	**1TE32–6AA3**	**1TE33–1AA3**	**1TE35–0AA3**
Degree of protection		IP00	IP00	IP00	IP00
Dimensions - Width - Height - Depth	 mm mm mm	 265 836 549	 265 836 549	 265 983 549	 265 983 549
Frame size		FL	FL	GL	GL
Weight	kg	77	77	108	108
Recommended fuse 5) - Number per phase (connected in parallel) - Rated current - Frame size acc. to IEC 60269	 A 	3NE1230-2 1 315 1	3NE1331-2 1 350 1	3NE1333-2 1 450 2	3NE1230-2 2 315 1
Minimum short-circuit current 6)	A	3000	3600	4400	8000

1) Rated power of a typical standard induction motor based on I_L or I_H at 400 V 3 AC 50 Hz.

2) Rated power of a typical standard induction motor based on I_L or I_H at 460 V 3 AC 60 Hz.

3) The specified power loss is the maximum value at 100% utilization level. The value in normal operation is lower.

4) This value applies to the water coolant option; for other coolant types, see Chapter "Cooling circuit and coolant properties".

5) To achieve a UL-approved system, it is absolutely essential to use the fuse types specified in the table.

6) Minimum current required for reliable triggering of the protective devices.

4.7.1 Overload capability

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

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

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

Another precondition is that the Power Module is operated at its factory-set pulse frequency at output frequencies > 10 Hz.

Low overload

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

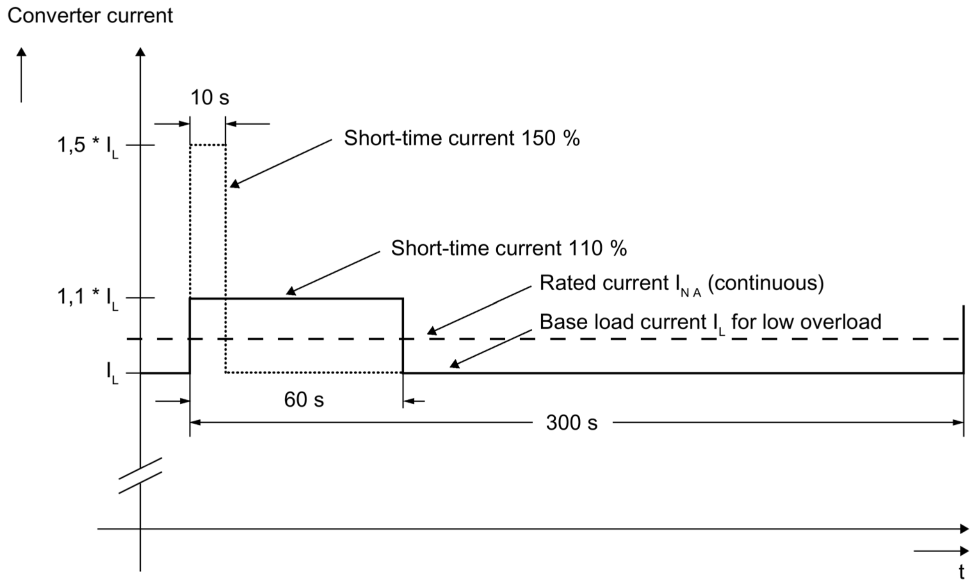


Figure 4-9 Low overload

High overload

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

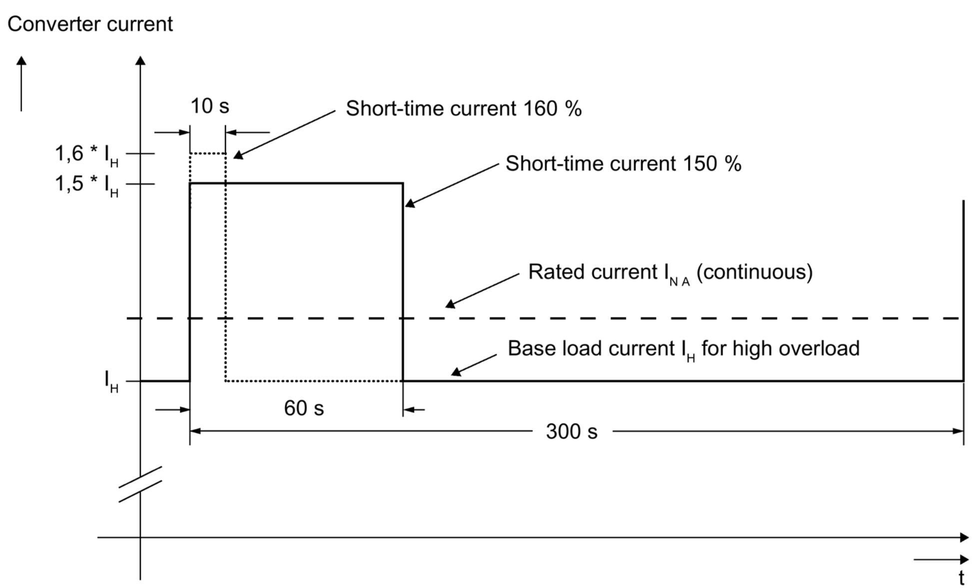


Figure 4-10 High overload

4.7.2 Derating factors as a function of coolant temperature

The SINAMICS S120 liquid -cooled devices are suitable for H_2O or a mixture of H_2O and an antifreeze as coolant, corresponding to Section Antifreeze + biocide (Page 262).

When H_2O is used as a coolant, the units can supply 100% output current at temperatures between 5° C and 45° C. The maximum output current decreases linearly to 90% at temperatures between 45° C and 50° C.

When H_2O and an antifreeze mixture described above is used as a coolant, the units can supply 100% output current at temperatures between 0° C and 45° C. The maximum output current decreases linearly to 90% at temperatures between 45° C and 50° C.

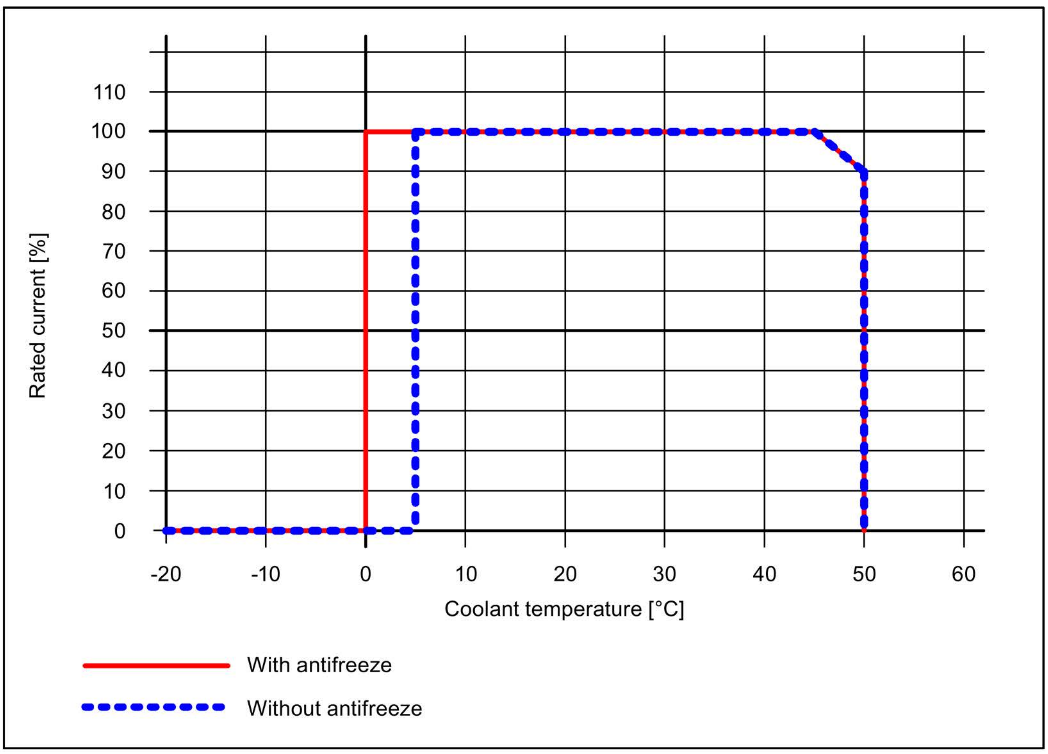


Figure 4-11 Maximum output current as a function of coolant temperature

4.7.3 Derating factors as a function of the ambient temperature

The units can supply 100 % output current at an ambient air temperature of between 0 °C and 45 °C. The maximum output current decreases linearly to 90 % at ambient air temperatures of between 45 °C and 50 °C.

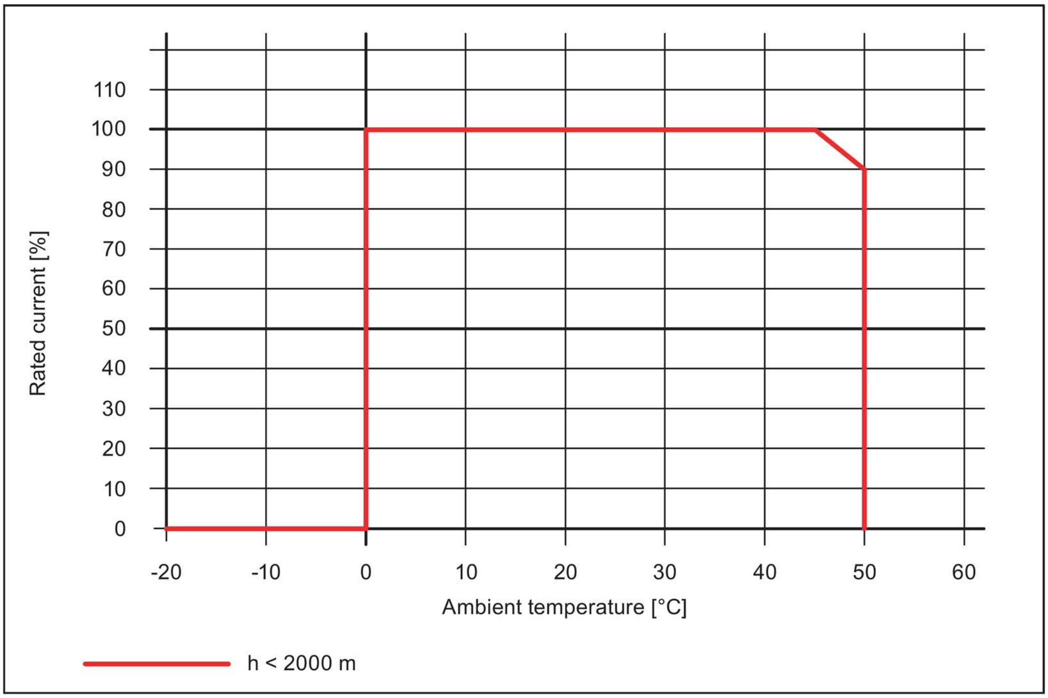


Figure 4-12 Maximum current as a function of ambient temperature

4.7.4 Derating factors as a function of installation altitude

When the units are operated at an installation altitude with reduced air pressure, the derating characteristic shown below applies to the output current or the ambient air temperature.

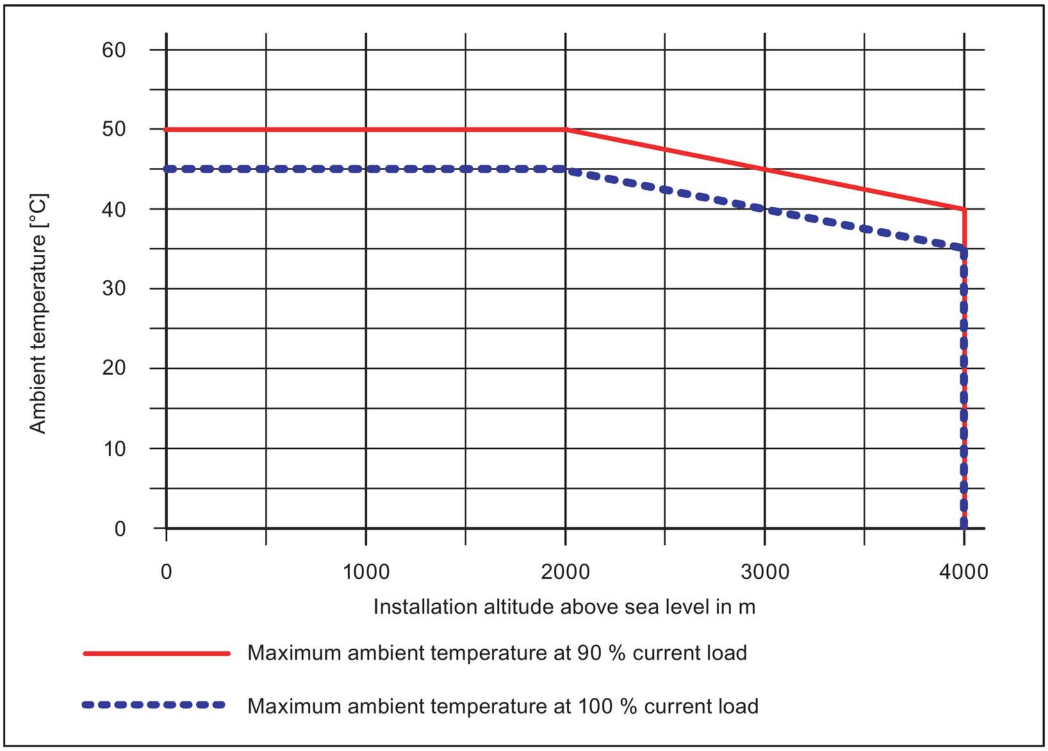


Figure 4-13 Maximum ambient temperature as a function of installation altitude

At installation altitudes above 2000 m (6562 ft), the line voltage must not exceed certain limits to ensure that surge voltages can be insulated in accordance with IEC 61800-5-1 for surge voltage category III. If the line voltage is higher than this limit at installation altitudes > 2000 m (6562 ft), measures must be taken to reduce transient category III surge voltages to category II values, e.g. equipment must be supplied via an isolating transformer.

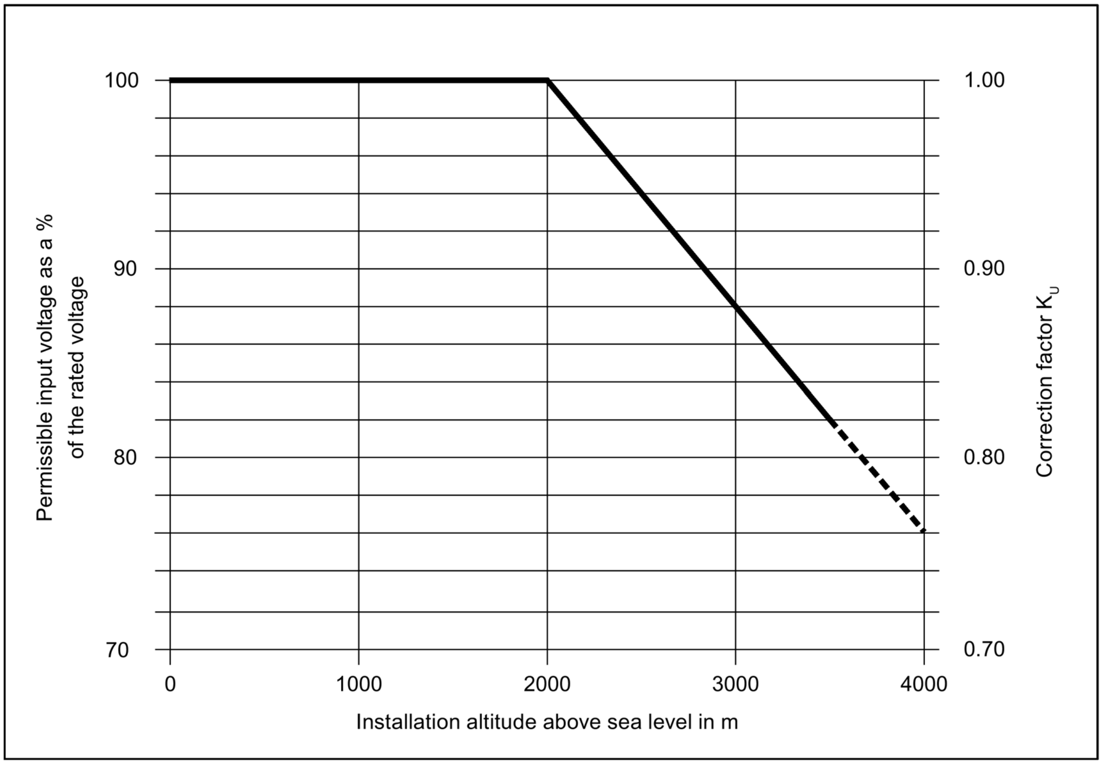


Figure 4-14 Voltage correction factor K_T as a function of the installation altitude

---

Note

Rated voltage

Refer to the maximum line voltage under "Connection voltages" in the technical data for details of the rated voltage.

Note

Input voltage range that can be actually used

The dashed line represents a theoretical characteristic of the correction factor. The devices have an undervoltage threshold, which leads to shutdown when the voltage drops below it. Consequently, the input voltage range that is actually usable has a lower limit.

4.7.5 Current derating as a function of the pulse frequency

When the pulse frequency is increased, the derating factor of the output current must be taken into account.

This derating factor must be applied to the currents specified in the technical data.

Table 4- 12 Derating factor of the output current as a function of the pulse frequency

Article No.	Type rating	Output current at 2 kHz	Derating factor at the pulse frequency				
6SL3315-...	[kW]	[A]	2.5 kHz	4 kHz	5 kHz	7.5 kHz	8 kHz
1TE32-1AA3	110	210	95 %	82 %	74 %	54 %	50 %
1TE32-6AA3	132	260	95 %	83 %	74 %	54 %	50 %
1TE33-1AA3	160	310	97 %	88 %	78 %	54 %	50 %
1TE35-0AA3	250	490	94 %	78 %	71 %	53 %	50 %

Note

Derating factors for pulse frequencies in the range between fixed values

For pulse frequencies in the range between the specified fixed values, the relevant derating factors can be determined by linear interpolation.

Maximum output frequencies achieved by increasing the pulse frequency

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

Table 4- 13 Maximum output frequencies achieved by increasing the pulse frequency in VECTOR mode

Pulse frequency [kHz]	Maximum output frequency [Hz]
2	160
2.5	200
4	320

Table 4- 14 Maximum output frequencies achieved by increasing the pulse frequency in SERVO mode

Pulse frequency [kHz]	Maximum output frequency [Hz]
2	300
4	300 / 550 [1)]

[1)] Depending on the system configuration, higher frequencies are possible.

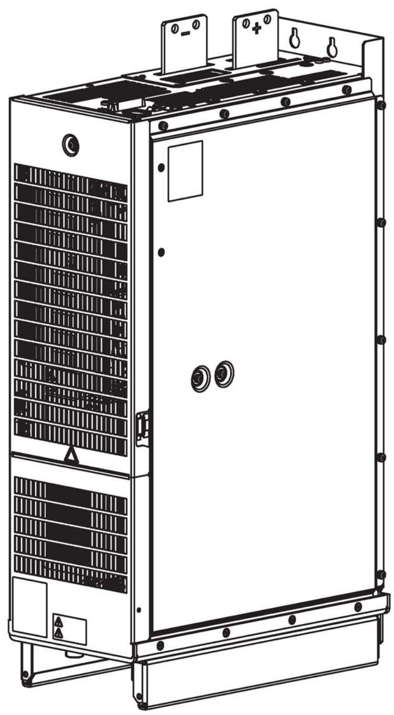
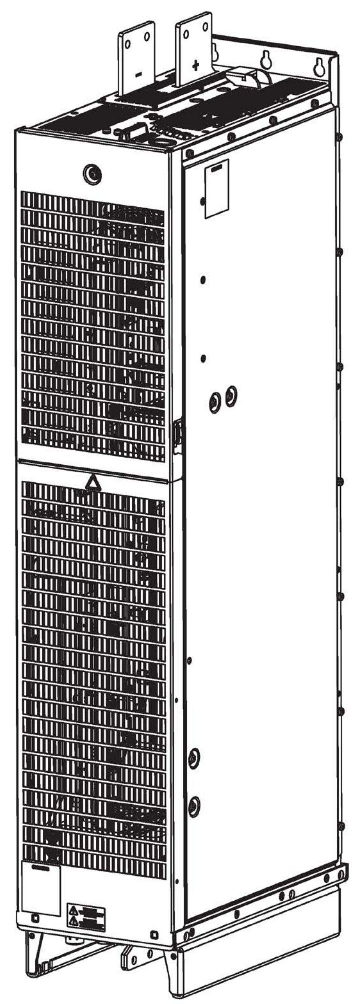
Active Line Modules 5

5.1 Description

The self-commutating infeed / regenerative feedback units act as step-up converters and generate a stabilized DC link voltage that is 1.5x greater (factory setting) than the rated line supply voltage. In this way, the connected Motor Modules are isolated from the line voltage. This improves the dynamic response and control quality because line tolerances and fluctuations do not affect the motor voltage.

If required, the Active Line Modules can also provide reactive power compensation.

Table 5- 1 Overview of Active Line Modules

	
Frame size HXL	Frame size JXL

Active Infeed components

An Active Infeed comprises an Active Interface Module and an Active Line Module.

In the case of an Active Infeed with an Active Line Module of frame sizes HXL or JXL, the bypass contactor is not included in the associated Active Interface Module, but must be provided separately. The Active Interface Modules and Active Line Modules of this frame size have degree of protection IP00.

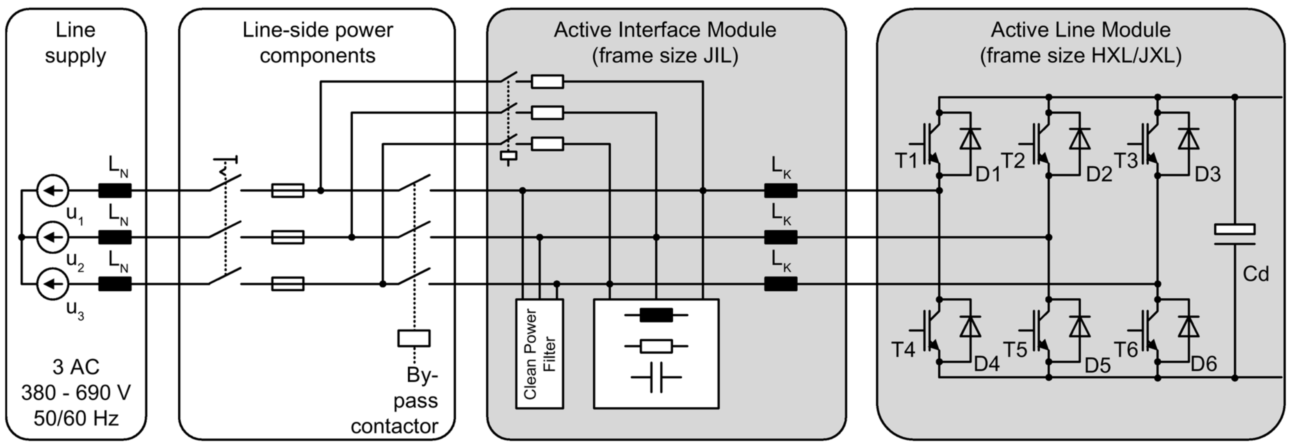


Figure 5-1 Overview of Active Infeeds, frame sizes JIL/HXL and JIL/JXL

Operating principle

One or more Motor Modules can be connected to the power supply network via the Active Line Module. The Active Line Module provides a constant DC link voltage for the Motor Modules. This ensures that they are not influenced by line voltage fluctuations. The regenerative feedback capability of the Active Line Module can be deactivated by parameterization.

The Active Line Module is suitable for direct operation both on TN and on IT and TT systems.

With the motors operating as generators, the Active Line Module feeds regenerative energy into the supply network.

The Active Line Module is used for:

- Machines with high dynamic drive requirements
- Frequent braking cycles and high braking energy.

The volumetric flow of the coolant is monitored by the software. If the volumetric flow is continuously lower than the setpoint, an alarm (A5005) is first displayed. If this alarm remains active continually for the next 5 minutes, a fault message (F30047) is activated which shuts down the unit.

The fans for the internal device electronics are only switched on when required.
The fans are switched on and off as a function of several factors (e.g. heat sink temperature, ambient temperature, output current, duty cycle, ...) which means that fan operating cycles cannot be calculated directly.

An external 24 V DC power supply is required to operate water-cooled Active Line Modules.

Parallel connection of Active Line Modules to increase power rating

Up to four Active Line Modules with the same power rating can be connected in parallel in order to increase power.

The following rules must be observed when connecting Active Line Modules in parallel:

- Up to 4 identical Active Line Modules can be connected in parallel.
- A common Control Unit is required whenever the modules are connected in parallel.
- With multiple infeeds, power must be supplied to the systems from a common infeed point (i.e. different supply systems are not permitted).
- A derating factor of 5% must be taken into consideration, regardless of the number of modules connected in parallel.

Note

Mixed operation is not possible

It is only possible to connect identical power units in parallel if all power units have the same hardware version. Mixed operation between a power unit with Control Interface Module (Article No. 6SL33xx-xxxxx–xAA7) and a power unit with Control Interface Board (Article No. 6SL33xx-xxxxx–xAA0) is not possible.

5.2 Safety information

> ⚠ WARNING
>
> **Danger to life if the fundamental safety instructions and remaining risks are not carefully observed**
>
> The non-observance of the fundamental safety instructions and residual risks stated in Chapter 1 can result in accidents with severe injuries or death.
>
> - Adhere to the fundamental safety instructions.
> - When assessing the risk, take into account residual risks.

> ⚠ DANGER
>
> **Danger to life due to electric shock and fire hazard caused by overcurrent protective equipment tripping too late**
>
> Overcurrent protective equipment that trips too late or not all can cause electric shock or fire.
>
> - To protect personnel and for fire protection purposes, at the infeed point, the short-circuit rating and loop impedance must match the specifications in the documentation for the installed overcurrent protection devices to trip within the specified time.

> ⚠ DANGER
>
> **Danger to life through electric shock due to a high DC-link voltage**
>
> As long as the Line Module is connected to the line supply, the DC link is charged with a high voltage. Contact with components can result in death or serious injury.
>
> - Isolate the Line Module from the line supply during installation of maintenance work, e.g. via the line contactor or main switch.

> ⚠ DANGER
>
> **Danger to life through electric shock due to the residual charge of the DC-link capacitors**
>
> Because of the DC-link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off.
>
> Contact with live parts can result in death or serious injury.
>
> - Only open the device after five minutes have elapsed.
> - Measure the voltage before starting work on the DCP and DCN DC-link terminals.

⚠WARNING

Danger to life due to high leakage currents caused by an interrupted external protective conductor

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

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

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

⚠WARNING

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

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

- Attach the component warning labels in the national language.

⚠WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

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

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

⚠CAUTION

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

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

- Ensure that the total length of the power cables (motor supply cables and DC-link cables) does not exceed the values specified in the technical data.

NOTICE

Material damage caused by mechanically stressed busbars and coolant connections

Mechanically stressed busbars and coolant connections can damage the device.

- Do not use the busbars and liquid coolant connections protruding from the device as handles or as support surfaces during transport.

NOTICE

Material damage caused by loose power connections

Insufficient tightening torques or vibration can result in faulty electrical connections. This can cause fire damage or functional faults.

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

NOTICE

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

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

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

NOTICE

Damage through use of incorrect DRIVE-CLiQ cables

Damage or malfunctions can occur on the devices or system when DRIVE-CLiQ cables are used that are either incorrect or have not been approved for this purpose.

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

Note

Operation on line supplies where energy recovery is not possible

In line supply systems without energy recovery capability (e.g. a diesel generator), device faults can occur as the braking energy cannot be dissipated.

- For line supplies without regenerative feedback capability (e.g. diesel generator), deactivate the regenerative feedback capability of the Line Modules using the appropriate parameter (see SINAMICS S120/S150 List Manual).
- The braking energy must then be dissipated via an additional Braking Module with braking resistor in the drive line-up.

5.3 Interface description

5.3.1 Overview

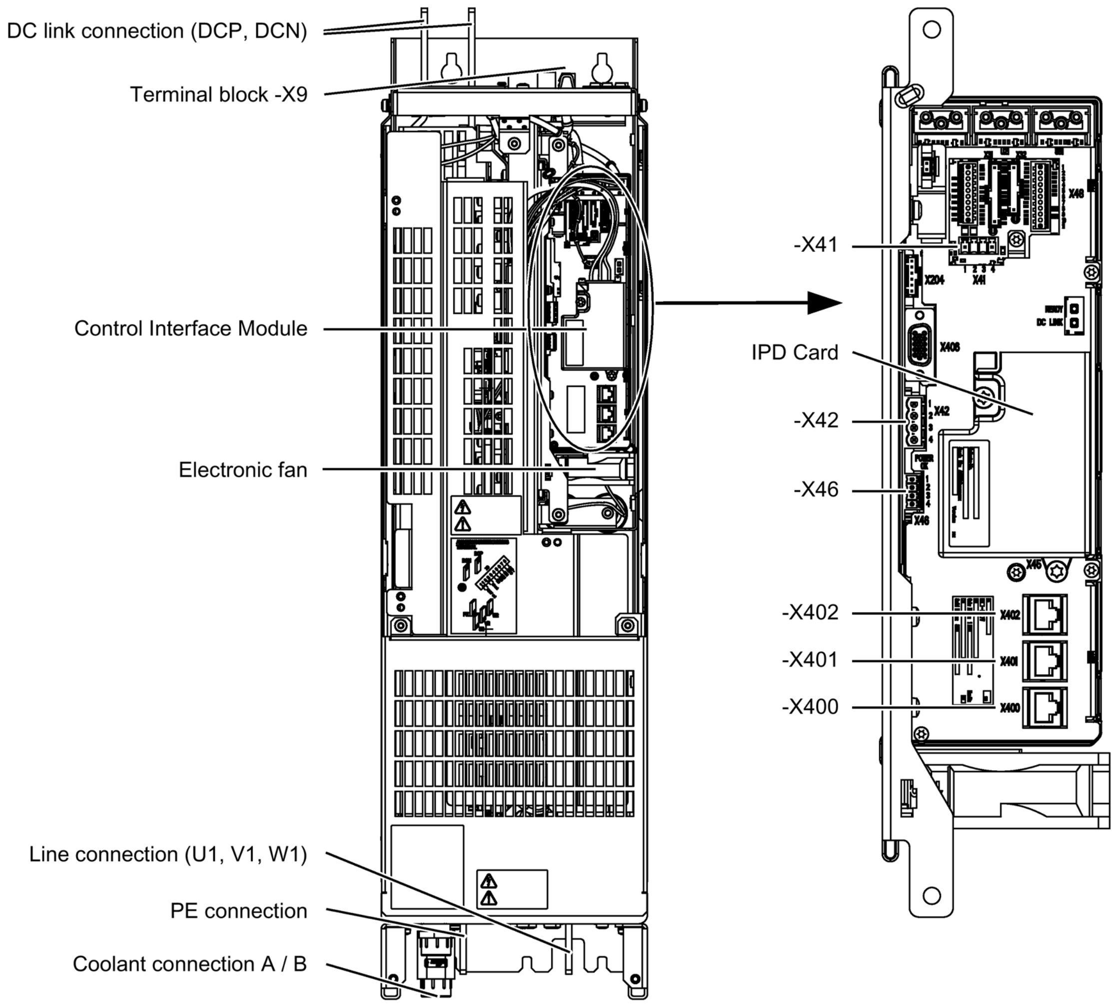


Figure 5-2 Active Line Module, frame size HXL

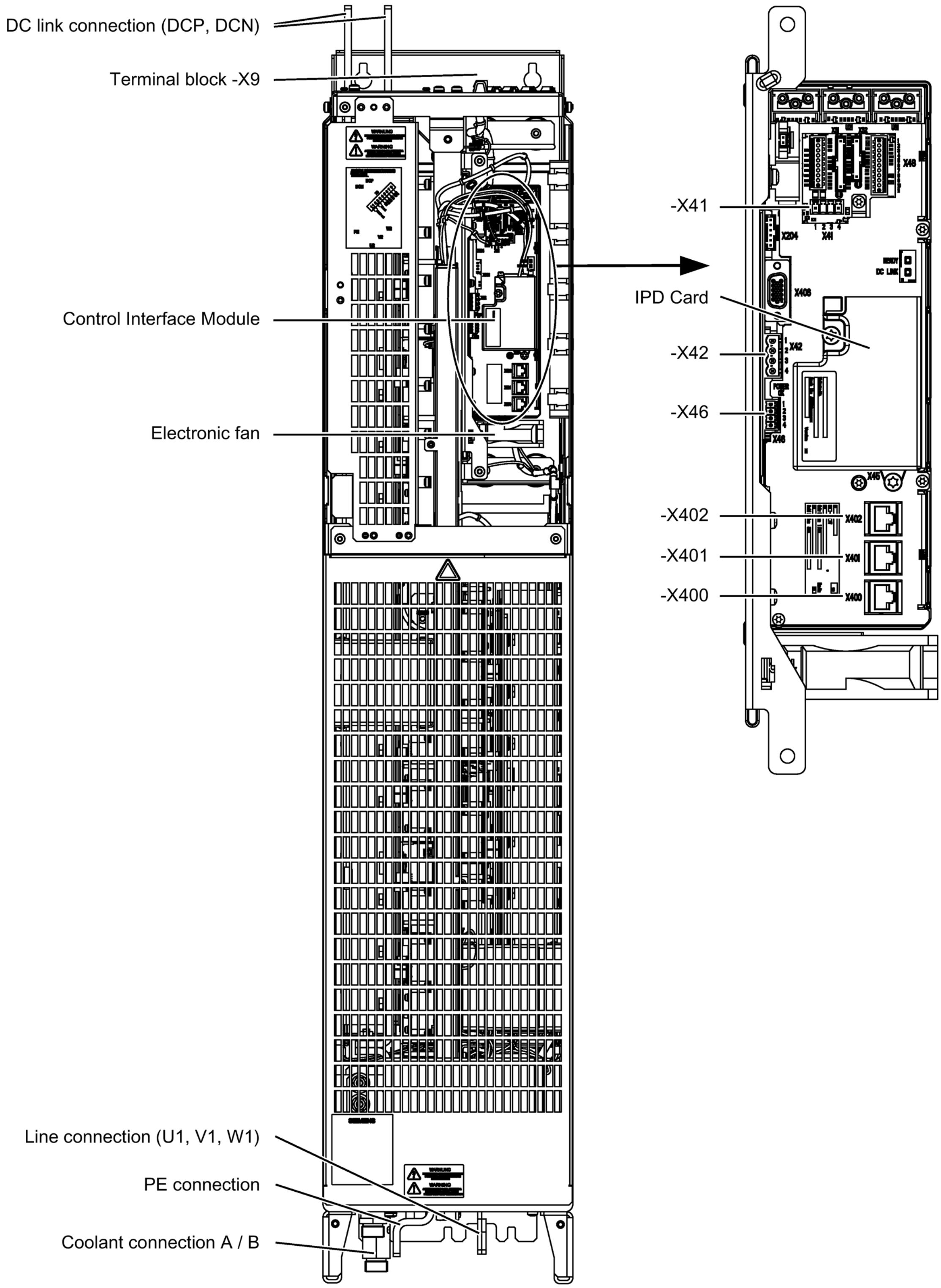


Figure 5-3 Active Line Module, frame size JXL

5.3.2 Connection example

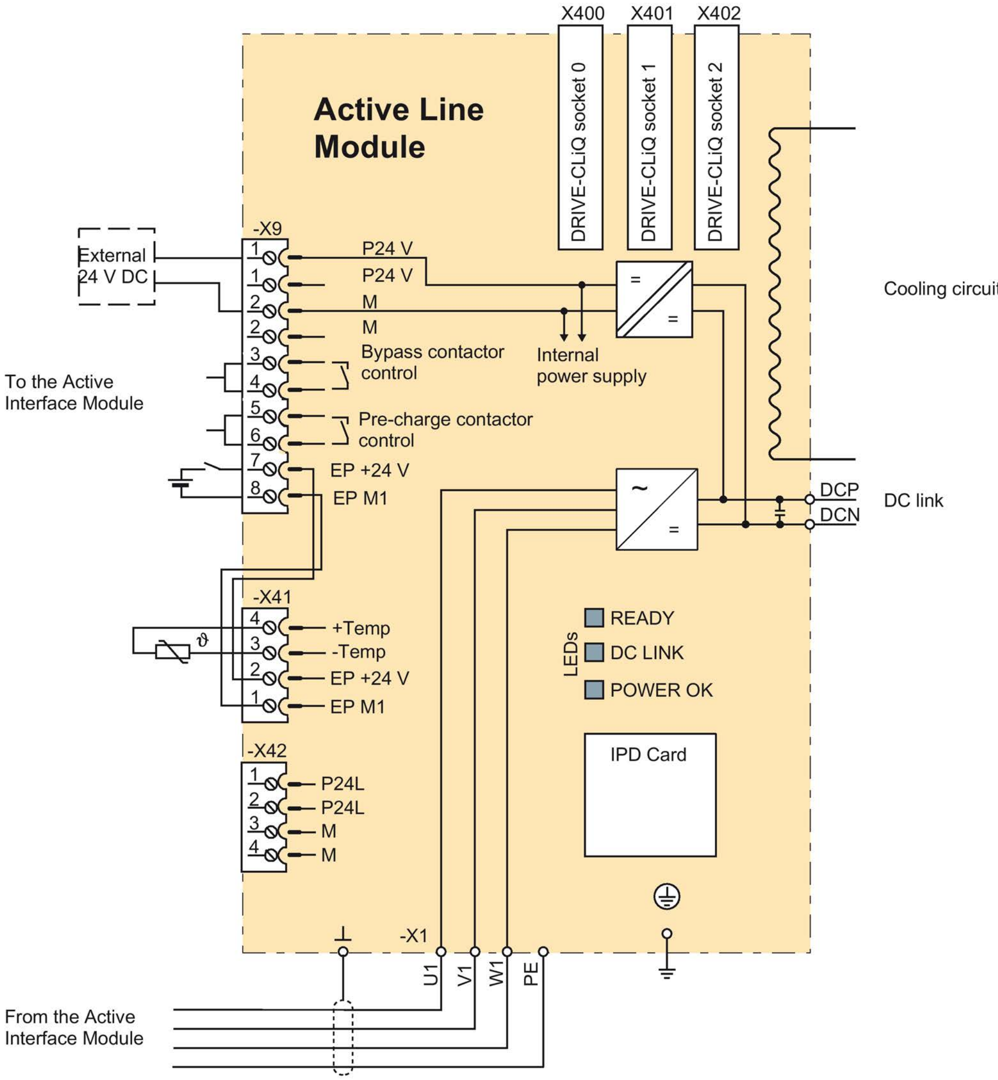


Figure 5-4 Example connection of Active Line Module

5.3.3 Line/load connection

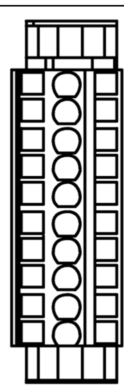
Table 5- 2 Line/load connection of the Active Line Module

Terminals	Technical specifications
U1, V1, W1 3 AC power input	Voltage: • 3 AC 380 V -10 % (-15 % < 1 min) ... 3 AC 480 V +10 % • 3 AC 500 V -10 % (-15 % < 1 min) ... 3 AC 690 V +10 % Frequency: 47 ... 63 Hz Connecting lugs: • Frame size HXL: d = 13 mm (M12/50 Nm) for cable lugs in accordance with DIN 46234 / DIN 46235 1) • Frame size JXL: d = 13 mm (M12/50 Nm) for busbar connection
DCP, DCN DC power output	Voltage: • 570 ... 720 V DC • 750 ... 1035 V DC Connecting lugs: d = 13 mm (M12/50 Nm) for busbar connection
PE connection	Connecting lugs: • Frame size HXL: d = 13 mm (M12/50 Nm) for cable lugs in accordance with DIN 46234 / DIN 46235 1) • Frame size JXL: d = 13 mm (M12/50 Nm) for busbar connection

1) Dimensions for connecting alternative cable lugs, see "cable lugs" in the appendix.

5.3.4 X9 terminal strip

Table 5- 3 Terminal strip X9

	Terminal	Signal name	Technical data
	1	P24 V	External 24 V DC supply Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: See Technical data
	1	P24 V	
	2	M	
	2	M	
	3	Bypass contactor control	for Active Interface Module, -X609;11
	4		for Active Interface Module,-X609;12
	5	Pre-charge contactor control	for Active Interface Module, -X609;9
	6		for Active Interface Module, -X609;10
	7	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: 10 mA
	8	EP M1 (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2			

Note

Connection to terminals 7 and 8

For operation, 24 V DC must be connected to terminal 7 and ground to terminal 8. Pulse suppression is activated when removed.

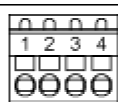
Note

Looping through the supply voltage

The two "P24 V" or "M" terminals are jumpered in the connector. This ensures that the supply voltage is looped through, even when the connector is removed.

5.3.5 X41 EP terminal / temperature sensor connection

Table 5- 4 Terminal strip X41

	Terminal	Function	Technical data
	1	EP M1 (Enable Pulses)	Connected to terminal -X9:8
	2	EP +24 V (Enable Pulses)	Connected to terminal -X9:7
	3	- Temp	Temperature sensor connection KTY84-1C130 / PT1000 / PTC
	4	+ Temp	
Max. connectable cross-section: 1.5 mm²			

WARNING

Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Only use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

NOTICE

Device failure as a result of unshielded or incorrectly routed cables to temperature sensors

Unshielded or incorrectly routed cables to temperature sensors can result in interference being coupled into the signal processing electronics from the power side. This can result in significant disturbance of all signals (fault messages) up to failure of individual components (destruction of the devices).

- Only use shielded cables as temperature sensor cables.
- If temperature sensor cables are routed together with the motor cable, use separately shielded cables twisted in pairs.
- Connect the cable shield to ground potential through a large surface area.
- Recommendation: Use suitable Motion Connect cables.

NOTICE

Damage to motor in the event of incorrectly connected KTY temperature sensor

If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.

- Connect a KTY temperature sensor with the correct polarity.

Note

The temperature sensor connection can be used for motors that are equipped with a KTY84-1C130, PT1000 or PTC measuring sensor in the stator windings.

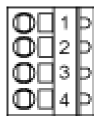
Note

Connection to terminal strip -X9

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

5.3.6 X42 terminal strip

Table 5- 5 Terminal strip X42 voltage supply for Control Unit, Sensor Module and Terminal Module

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

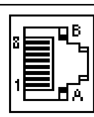
Note

Connection options of terminal strip X42

The terminal strip is not intended to generally provide a 24 V DC supply (for example for supplying additional components on the plant or system side), as the voltage supply of the Control Interface Module could also be overloaded and the correct functioning could thus be compromised.

5.3.7 DRIVE-CLiQ interfaces X400, X401, X402

Table 5- 6 DRIVE-CLiQ interfaces X400, X401, X402

	PIN	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces (50 pcs.) Article number: 6SL3066-4CA00-0AA0			

5.3.8 Cooling circuit connections

Table 5- 7 Cooling circuit connections

Connection	Technical data
Coolant connection A: Intake	Pipe thread ISO 228 - G 3/4 B (external thread 3/4", flat-sealing)
Coolant connection B: Return	
Tightening torque	60 Nm

Note

Replacement seal

The seals for the screwed connections can be used only once when the cooling circuit is first assembled. The seals must be replaced if the circuit is disassembled and assembled again.

The replacement seal is commercially available as flat Viton polymer seal with hardness 75 (+/-5) Shore A (Viton is the commercial name for elastomers with the abbreviations FPM and FKM). The dimensions are as follows: Outer diameter 26 mm, inner diameter 15 mm, thickness 1.5 mm.

5.3.9 Meaning of the LEDs on the Control Interface Module in the Active Line Module

Table 5- 8 Meaning of the LEDs "READY" and "DC LINK" on the Control Interface Module in the Active Line Module

LED, state		Description
READY	DC LINK	
Off	Off	The electronics power supply is missing or out of tolerance.
Green	--- 1)	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC-link voltage is present.
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage lies outside the permitted tolerance range.
Orange	Orange	DRIVE-CLiQ communication is being established.
Red	--- 1)	This component has at least one fault. **Remark:** The LED is activated irrespective of whether the corresponding messages have been reconfigured.
Flashing light 0.5 Hz: green/red	--- 1)	Firmware is being downloaded.
Flashing light 2 Hz: green/red	--- 1)	Firmware download is complete. Waiting for POWER ON.
Flashing light 2 Hz: green/orange or red/orange	--- 1)	Detection of the components via LED is activated (p0124). Note: Both options depend on the LED status when module recognition is activated via p0124 = 1.

1) Irrespective of the status of the LED "DC LINK"

Table 5- 9 Meaning of the LED "POWER OK" on the Control Interface Module in the Active Line Module

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

WARNING

Danger of death when live parts of the DC link are touched

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED. This means that when live parts are touched, this can result in death or serious injury.

- Observe the warning information on the component.

5.4 Dimension drawing

Dimension drawing, frame size HXL

The mandatory cooling clearances are indicated by the dotted line.

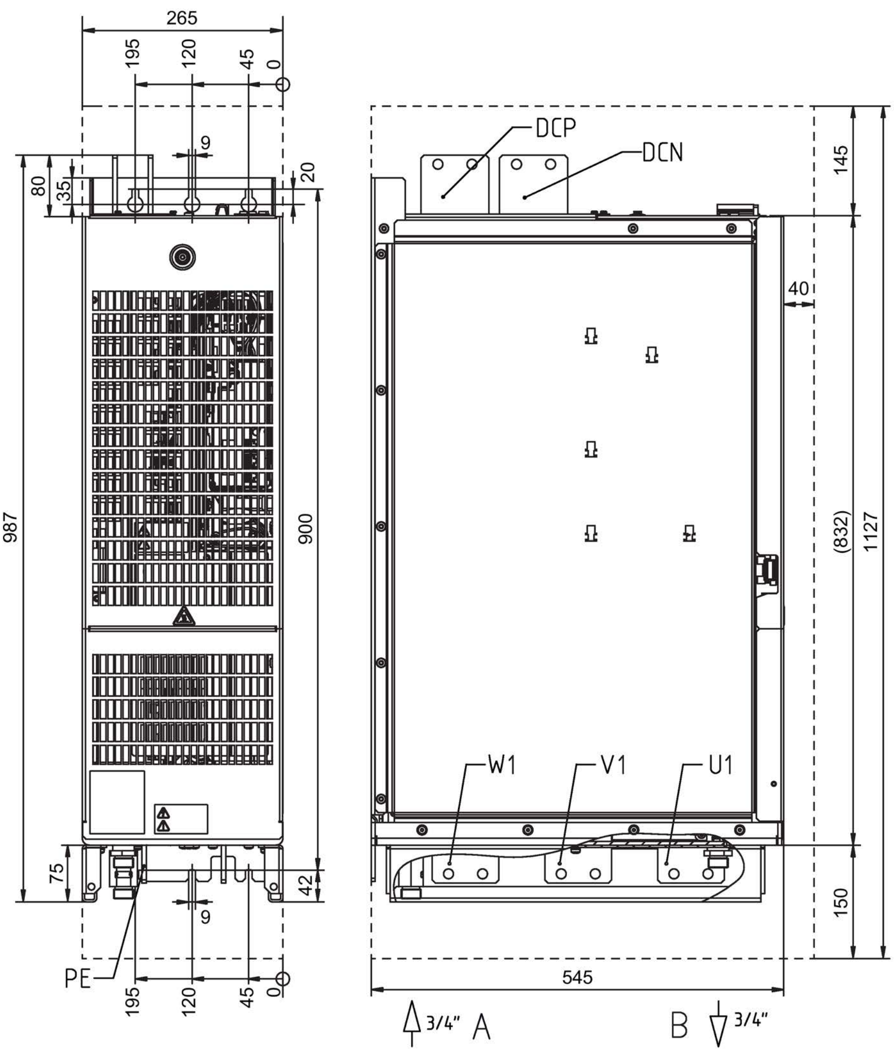


Figure 5-5 Dimension drawing Active Line Module, frame size HXL Front view, side view

Dimension drawing for frame size JXL

The mandatory cooling clearances are indicated by the dotted line.

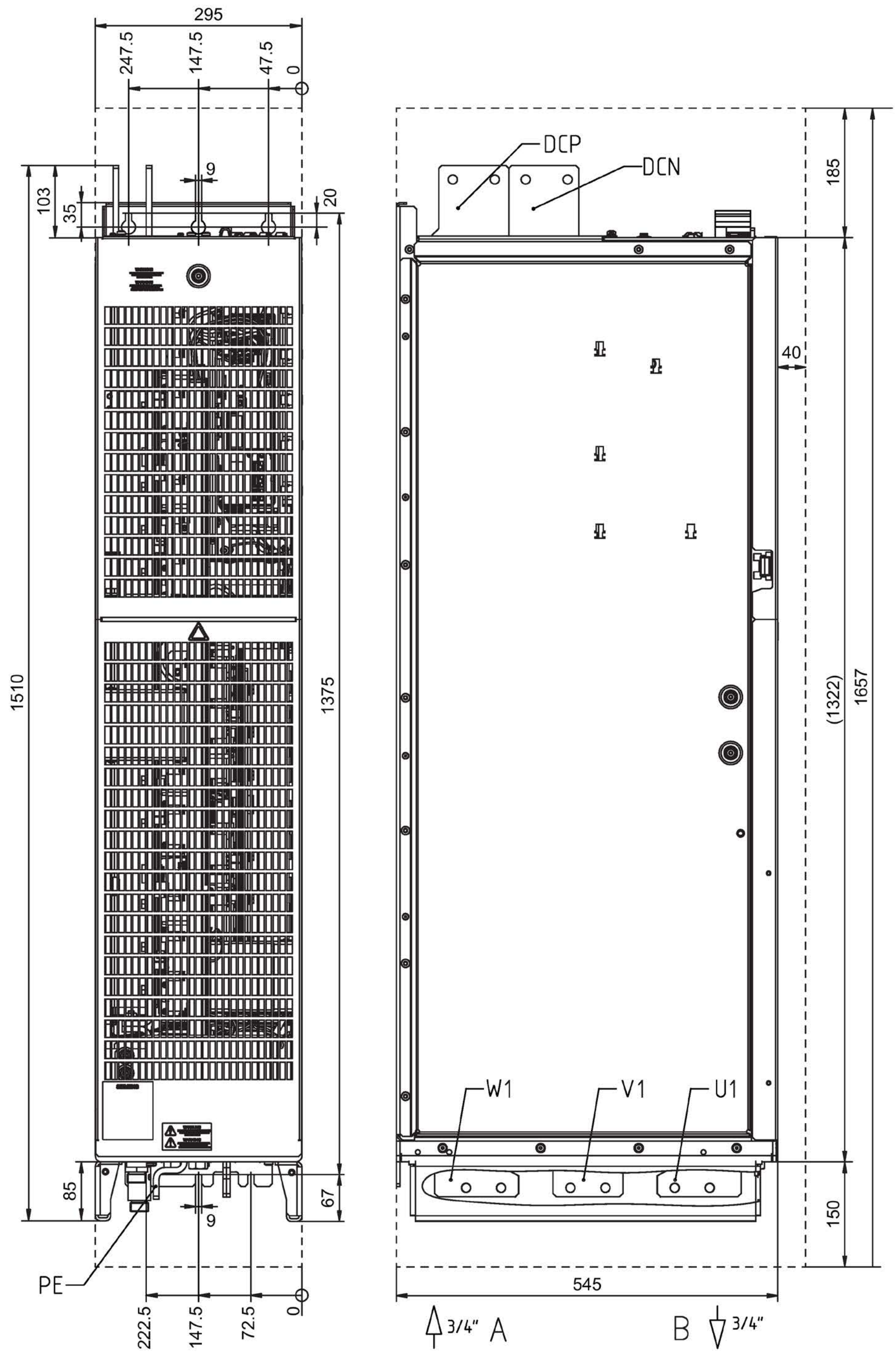


Figure 5-6 Dimension drawing, Active Line Module, frame size JXL, Article No. 6SL3335-7TE41-0AA7, 6SL3335-7TE41-4AA7, 6SL3335-7TG41-0AA7, 6SL3335-7TG41-3AA7. Front view, side view

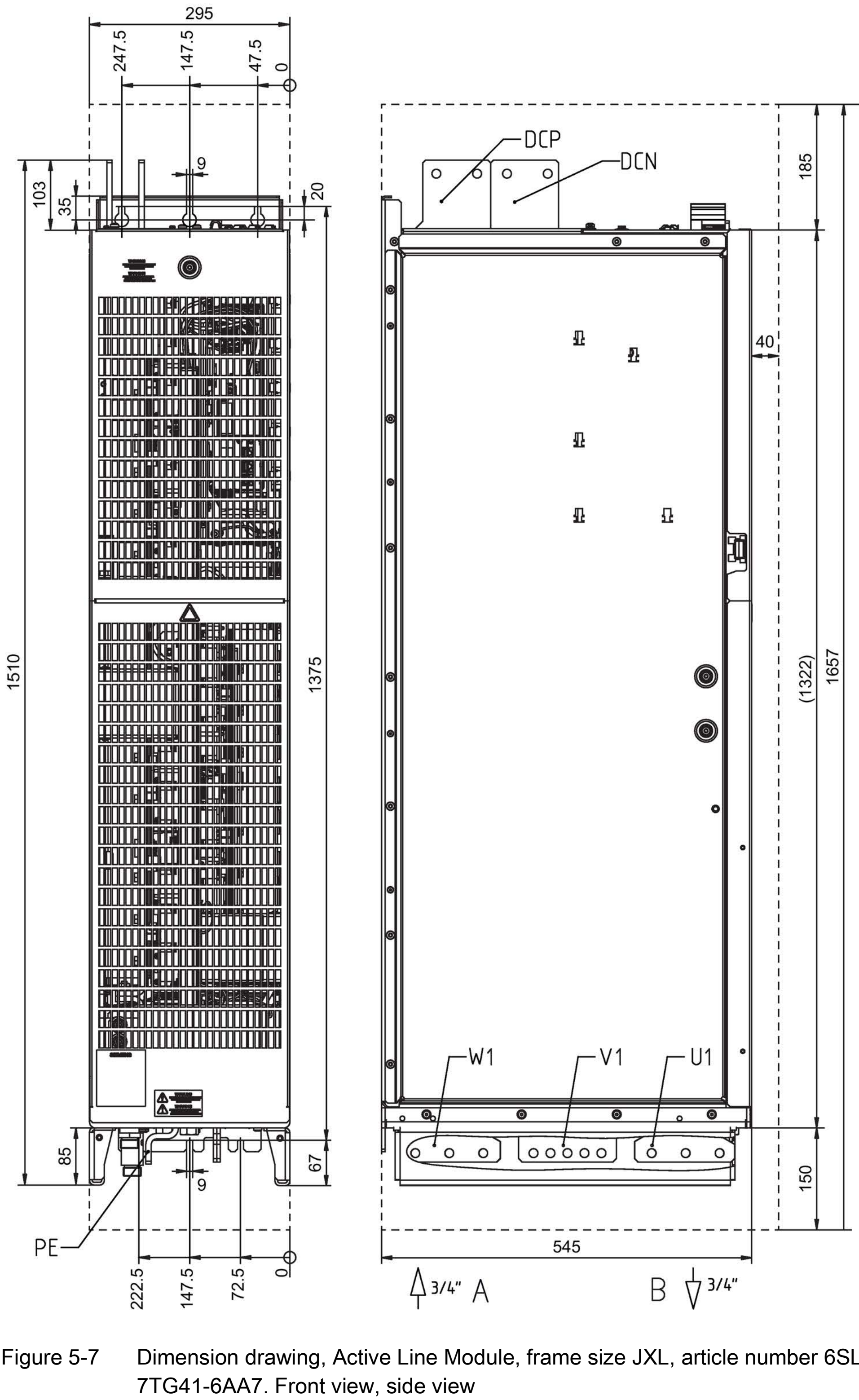


Figure 5-7 Dimension drawing, Active Line Module, frame size JXL, article number 6SL3335-7TG41-6AA7. Front view, side view

5.5 Installation

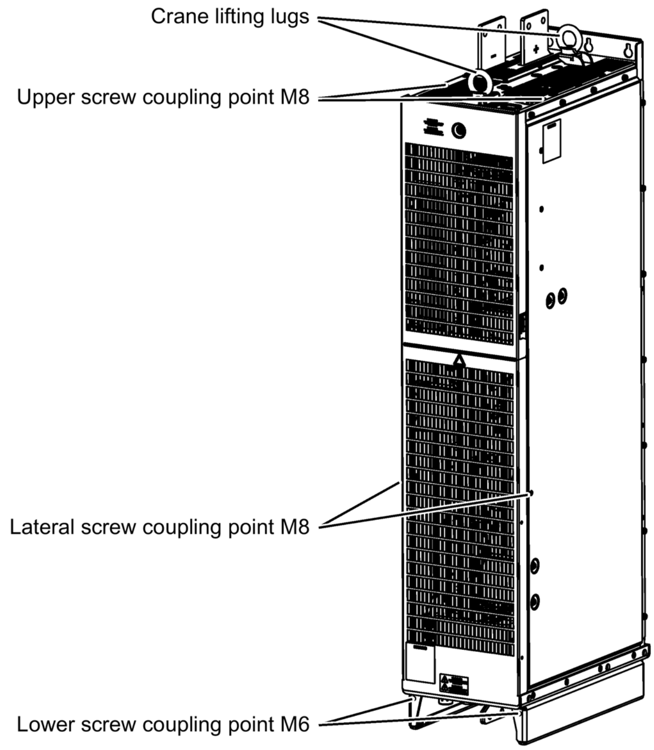


Figure 5-8 Crane lifting lugs / screw coupling points for mechanical support

Rail profiles on the underside of the device

Rail profiles are provided at the lower side of the device, that are used to place down the devices during transport at the mounting location - and for installation and removal.

Note

Mounting equipment for power units

The mounting equipment for power units can be used to mount the Active Line Module, see "Mounting equipment for power units (Page 282)".

Crane lifting lugs

Active Line Modules are fitted with crane lifting lugs as standard when shipped. The units can be hoisted using these lugs and transported from the pallet to the installation location.

Note

Transport in the horizontal position

Transport in the horizontal position is permissible.

It is not permissible to screw the crane lifting lug into the thread at the lower side of the Line Module.

NOTICE
Damage to the device due to improper transport Improper transport can cause mechanical loads on the housing or busbars which can result in damage to the device. • Use a lifting harness with vertical ropes or chains during transport. • Do not use the busbars as handles or for fastening a lifting harness. • Only tighten the crane lifting lugs by hand. Remove the crane lifting lugs after the installation, but keep them for later use.

Screw coupling points for mechanical support

Since the Active Line Modules are housed in a very slim enclosure, they need to be mechanically supported against lateral movement and vibration if they are installed in a control cabinet. Screw coupling points are provided on the top and bottom, as well as at the side panels of the units for this purpose.

If several modules are mounted adjacent to one another, they can be interconnected via the screw coupling points. When a single module is installed, lateral support can be provided by means of reinforcing plates inserted between the module and the cabinet.

5.6 Technical specifications

Table 5- 10 Technical data, Active Line Modules, 3 AC 380 ... 480 V

Article number	6SL3335–	7TE41–0AA7	7TE41–4AA7		
Rated power - At $I_{L\,DC}$ (50Hz 400V) - At $I_{H\,DC}$ (50Hz 400V) - At $I_{L\,DC}$ (60Hz 460V) - At $I_{H\,DC}$ (60Hz 460V)	 kW kW HP HP	 630 545 900 800	 900 780 1250 1000		
DC-link current - Rated current $I_{N\,DC}$ - Base load current $I_{L\,DC}$ - Rated current $I_{H\,DC}$ - Maximum current $I_{max\,DC}$ 1)	 A A A A	 1100 1075 982 1654	 1573 1534 1401 2361		
Supply voltages - Line voltage - Line frequency - Electronic power supply - DC-link voltage	 V_{ACrms} Hz V_{DC} V_{DC}	 3 AC 380 -10% (-15% < 1 min) ... 3 AC 480 +10% 47 ... 63Hz 24 (20.4 ... 28.8) 1.5 x U_{line}			
Infeed/regenerative feedback current - Rated current $I_{N\,E}$ - Maximum current $I_{max\,E}$ 2)	 A A	 985 1477	 1405 2107		
Pulse frequency	kHz	2.5	2.5		
Electronics current consumption (24 V DC)	A	1.6	1.6		
Cooling method		Water cooling system with integrated heat exchanger manufactured out of a copper-nickel alloy			
Power loss, max. 3) - At 50 Hz 400 V - At 60 Hz 460 V - Dissipated to the ambient air	 kW kW kW	 7.9 8.53 0.44	 10.2 11.19 0.62		
Max. coolant temperature - Without derating - With derating	 ° C ° C	 45 50	 45 50		
Rated flow rate	l/min	27	27		
Pressure drop, typical at the rated flow rate 4)	Pa	70000	70000		
Liquid volume of integrated heat exchanger	dm³	1.56	1.56		
DC link capacitance - Active Line Module - Drive line-up, max.	 µF µF	 18900 230400	 28800 230400		
Sound pressure level L_{pA} (1 m) at 50/60 Hz	 dB(A)	 56	 56		
Line/load connection		Flat connection for M12 screw			
Max. connection cross-sections - Line connection (U1, V1, W1) - DC-link connection (DCP, DCN) - PE connection	 mm² mm² mm²	 Busbar Busbar Busbar	 Busbar Busbar Busbar		

Article number	6SL3335–	7TE41–0AA7	7TE41–4AA7		
Max. cable length (total of all motor cables and DC link) - Shielded - Unshielded	 m m	 3900 5850	 3900 5850		
Degree of protection		IP00	IP00		
Dimensions - Width - Height - Depth	 mm mm mm	 295 1510 545	 295 1510 545		
Frame size		JXL	JXL		
Weight	kg	230	230		
Recommended fuse - Number per phase (connected in parallel) - Rated current - Frame size acc. to IEC 60269	 A 	3NE1436-2 2 630 3	3NE1448-2 2 850 3		
Minimum short-circuit current [6)]	A	16000	21000		

1) Valid for a 5s duty cycle (overload duration) and a duty cycle duration of 300s based on the rated DC-link current.

2) Valid for a 5s duty cycle (overload duration) and a duty cycle duration of 300s based on the rated infeed/regenerative feedback current.

3) The specified power loss is the maximum value at 100% utilization level. The value in normal operation is lower.

4) This value applies to the water coolant option; for other coolant types, see Chapter "Cooling circuit and coolant properties".

5) To achieve a UL-approved system, it is absolutely essential to use the fuse types specified in the table.

6) Minimum current required so that protective devices reliably respond and trip.

Table 5- 11 Technical data for Active Line Modules, 3 AC 500 V ... 690 V

Article number	6SL3335–	7TG38-1AA7	7TG41–0AA7	7TG41–3AA7	7TG41-6AA7
Rated power					
- At $I_{L\,DC}$ (50Hz 690V)	kW	900	1100	1400	1700
- At $I_{H\,DC}$ (50Hz 690V)	kW	670	1000	1215	1490
- At $I_{L\,DC}$ (50Hz 500V)	kW	620	780	965	1180
- At $I_{H\,DC}$ (50Hz 500V)	kW	485	710	880	1080
- At $I_{L\,DC}$ (60Hz 575V)	HP	975	1250	1500	1855
- At $I_{H\,DC}$ (60Hz 575V)	HP	765	1000	1250	1530
DC-link current					
- Rated current $I_{N\,DC}$	A	907	1147	1422	1740
- Base load current $I_{L\,DC}$	A	883	1118	1386	1700
- Rated current $I_{H\,DC}$	A	808	936	1266	1550
- Maximum current $I_{max\,DC}$ 1)	A	1360	1722	2133	2620
Supply voltages					
- Line voltage	V_{ACrms}	3 AC 500 -10% (-15% < 1 min) ... 3 AC 690 +10%			
- Line frequency	Hz	47 ... 63Hz			
- Electronic power supply	V_{DC}	24 (20.4 ... 28.8)			
- DC-link voltage	V_{DC}	1.5 x U_{line}			
Infeed/regenerative feedback current					
- Rated current $I_{N\,E}$	A	810	1025	1270	1560
- Maximum current $I_{max\,E}$ 2)	A	1214	1537	1905	2055
Pulse frequency	kHz	2.5	2.5	2.5	2.5
Electronics current consumption (24 V DC)	A	1.6	1.6	1.46	1.5
Cooling method		Water cooling system with integrated heat exchanger manufactured out of a copper-nickel alloy			
Power loss, max. 3)					
- At 50 Hz 690 V	kW	8.5	10.9	13.55	17.96
- At 60 Hz 575 V	kW	7.4	9.53	11.85	15.7
- Dissipated to the ambient air	kW	0.22	0.53	0.57	0.79
Max. coolant temperature					
- Without derating	°C	45	45	45	45
- With derating	°C	50	50	50	50
Rated flow rate	l/min	16	27	27	27
Pressure drop, typical at the rated flow rate 4)	Pa	70000	70000	70000	70000
Liquid volume of integrated heat exchanger	dm³	0.74	1.56	1.56	1.56
DC link capacitance					
- Active Line Module	µF	10500	16000	19330	21000
- Drive line-up, max.	µF	153600	153600	153600	210000
Sound pressure level					
L_{pA} (1 m) at 50/60 Hz	dB(A)	54	56	56	56
Line/load connection		Flat connection for M12 screw			
Max. connection cross-sections					
- Line connection (U1, V1, W1)	mm²	4 x 185	Busbar	Busbar	Busbar
- DC-link connection (DCP, DCN)	mm²	Busbar	Busbar	Busbar	Busbar
- PE connection	mm²	4 x 185	Busbar	Busbar	Busbar

Article number	6SL3335–	7TG38-1AA7	7TG41–0AA7	7TG41–3AA7	7TG41-6AA7
Max. cable length (total of all motor cables and DC link) - Shielded - Unshielded	 m m	 2250 3375	 2250 3375	 2250 3375	 2250 3375
Degree of protection		IP00	IP00	IP00	IP00
Dimensions - Width - Height - Depth	 mm mm mm	 265 987 545	 295 1510 545	 295 1510 545	 295 1510 545
Frame size		HXL	JXL	JXL	JXL
Weight	kg	125	230	230	240
Recommended fuse - Number per phase (connected in parallel) - Rated current - Frame size acc. to IEC 60269	 A 	3NE1435-2 2 560 3	3NE1436-2 2 630 3	3NE1438-2 [5] 2 800 3	3NE1436-2 3 630 3
Minimum short-circuit current [6]	A	12600	16000	20000	24000

[1] Valid for a 5s duty cycle (overload duration) and a duty cycle duration of 300s based on the rated DC-link current.

[2] Valid for a 5s duty cycle (overload duration) and a duty cycle duration of 300s based on the rated infeed/regenerative feedback current.

[3] The specified power loss is the maximum value at 100% utilization level. The value in normal operation is lower.

[4] This value applies to the water coolant option; for other coolant types, see Chapter "Cooling circuit and coolant properties".

[5] To achieve a UL-approved system, it is absolutely essential to use the fuse types specified in the table.

[6] Minimum current required for reliable triggering of the protective devices.

5.6.1 Overload capability

The Active Line Modules have an overload reserve.

The criterion for overload is that the Active Line Module is operated with its base load current before and after the overload occurs (a load duration of 300 s is used as a basis here).

High overload

The base load current for a high overload I_{H_DC} is based on a duty cycle of 150 % for 60 s; the max. current I_{max_DC} can flow for 5 s.

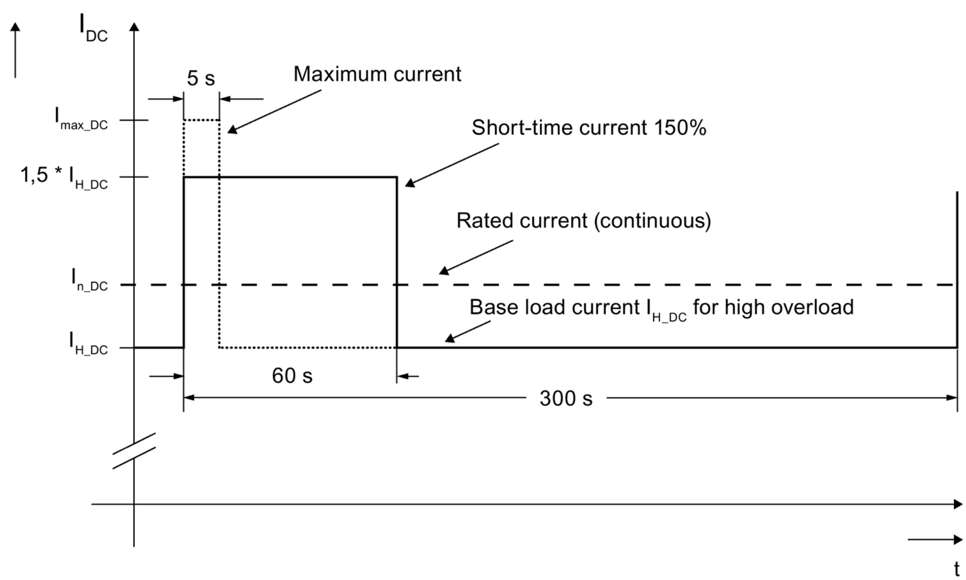


Figure 5-9 High overload

5.6.2 Derating factors as a function of coolant temperature

Water cooled SINAMICS S120 devices are suitable for water or a mixture of water and an antifreeze as coolant, corresponding to Section Antifreeze + biocide (Page 262).

When water is used as a coolant, the units can supply 100% output current at temperatures between 5 °C and 38 °C. The maximum output current decreases linearly to 90% at temperatures between 38 °C and 43 °C.

When water and an antifreeze mixture described above is used as a coolant, the units can supply 100% output current at temperatures between 0 °C and 38 °C. The maximum output current decreases linearly to 90% at temperatures between 38 °C and 43 °C.

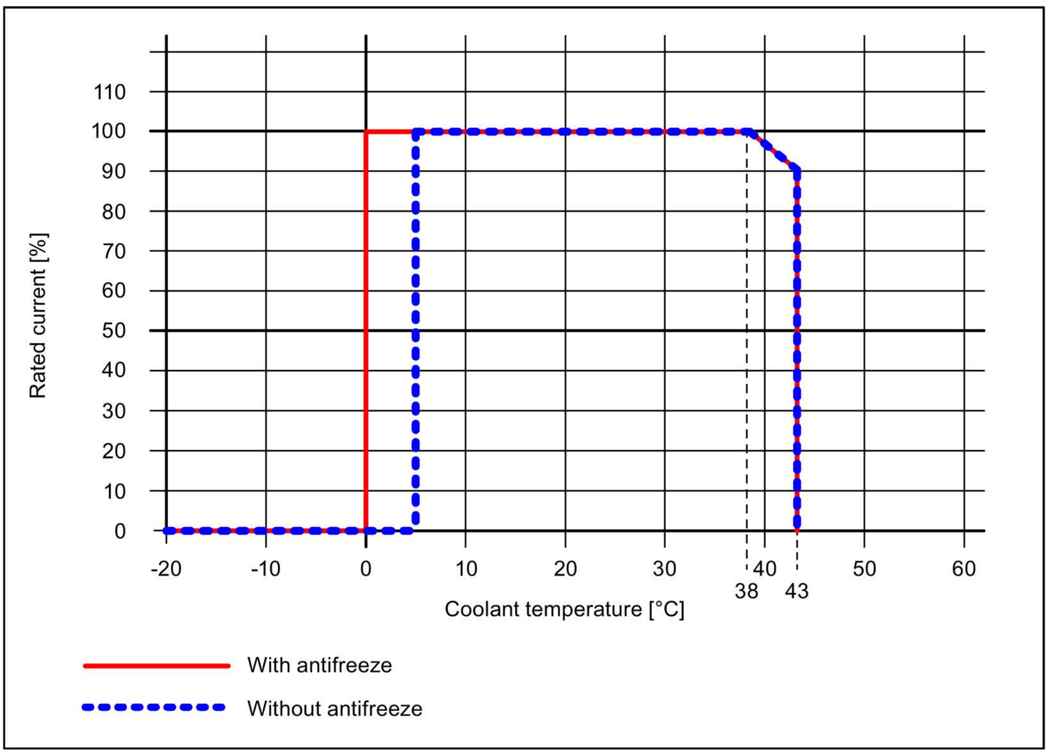


Figure 5-10 Maximum output current as a function of coolant temperature

5.6.3 Derating factors as a function of the ambient temperature

The units can supply 100 % output current at an ambient air temperature of between 0 °C and 45 °C. The maximum output current decreases linearly to 90 % at ambient air temperatures of between 45 °C and 50 °C.

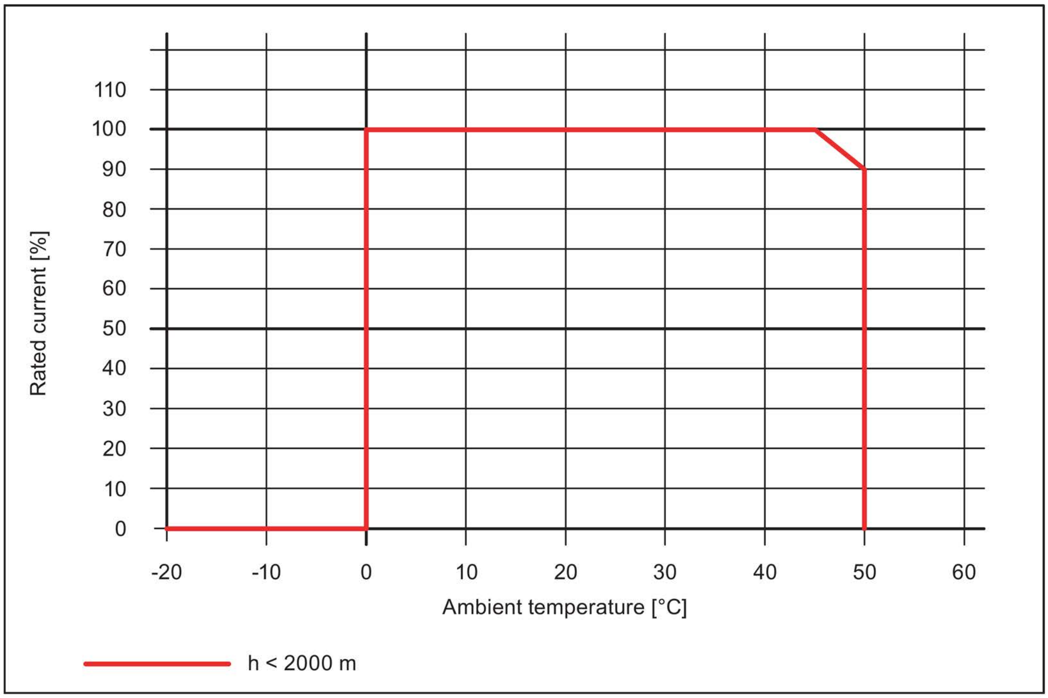


Figure 5-11 Maximum current as a function of ambient temperature

5.6.4 Derating factors as a function of installation altitude

When the units are operated at an installation altitude with reduced air pressure, the derating characteristic shown below applies to the output current or the ambient air temperature.

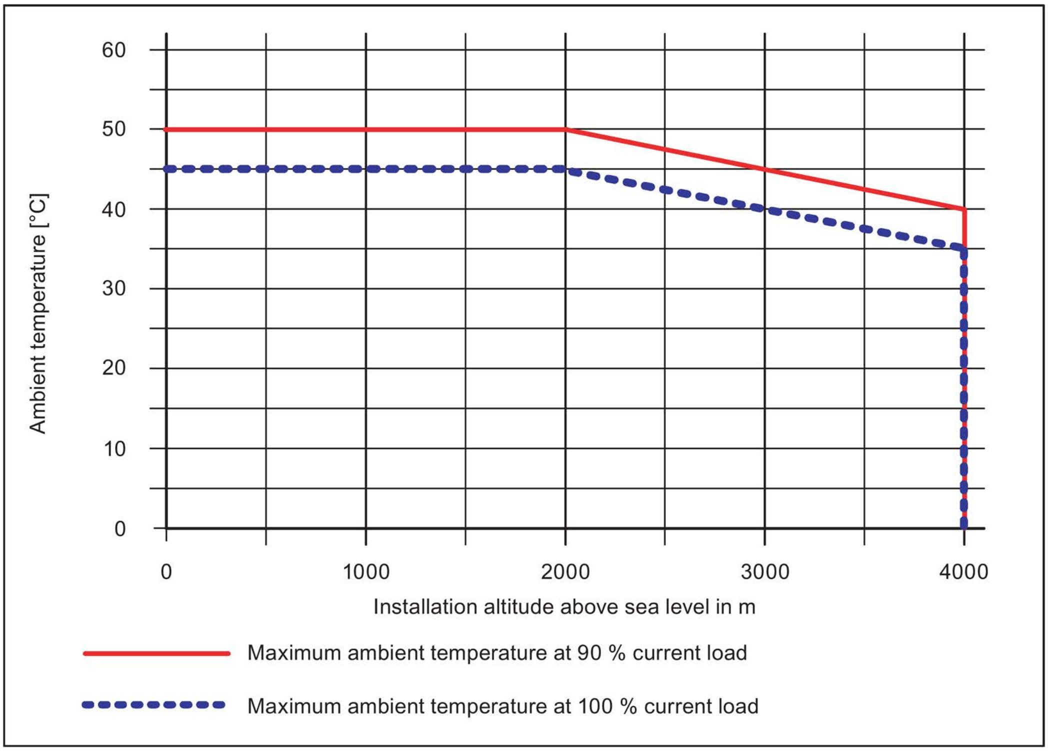


Figure 5-12 Maximum ambient temperature as a function of installation altitude

At installation altitudes above 2000 m (6562 ft), the line voltage must not exceed certain limits to ensure that surge voltages can be insulated in accordance with IEC 61800-5-1 for surge voltage category III. If the line voltage is higher than this limit at installation altitudes > 2000 m (6562 ft), measures must be taken to reduce transient category III surge voltages to category II values, e.g. equipment must be supplied via an isolating transformer.

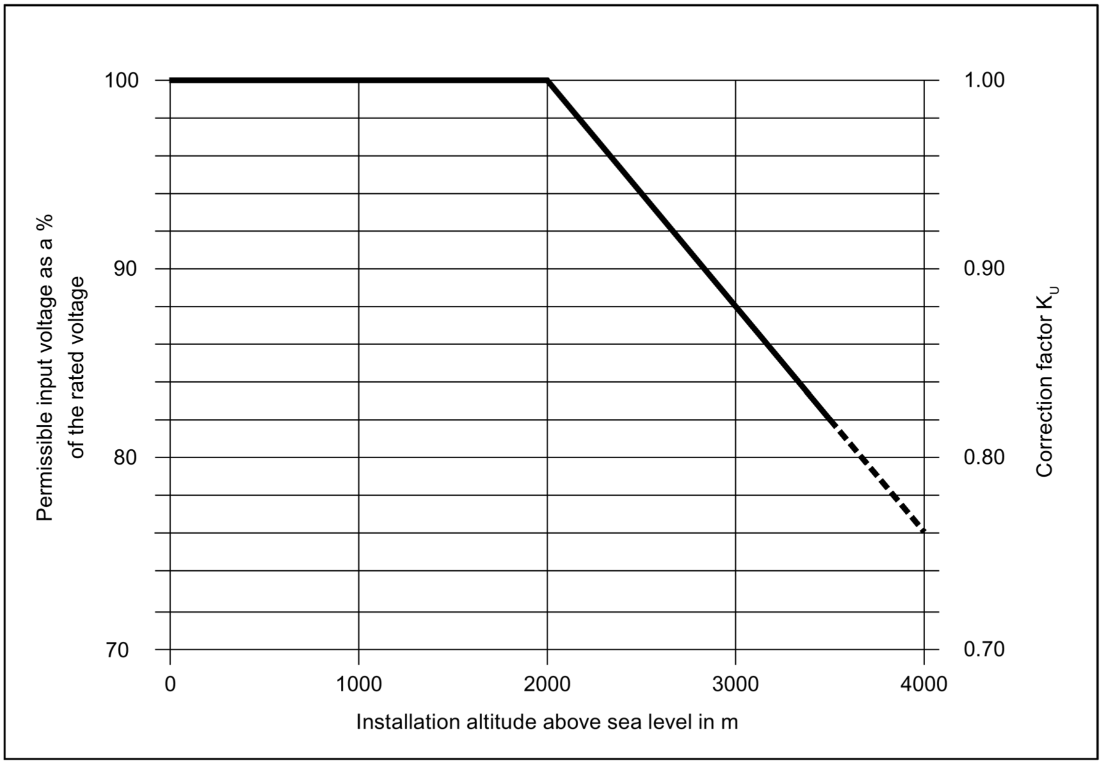


Figure 5-13 Voltage correction factor K_T as a function of the installation altitude

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Note

Rated voltage

Refer to the maximum line voltage under "Connection voltages" in the technical data for details of the rated voltage.

Note

Input voltage range that can be actually used

The dashed line represents a theoretical characteristic of the correction factor. The devices have an undervoltage threshold, which leads to shutdown when the voltage drops below it. Consequently, the input voltage range that is actually usable has a lower limit.

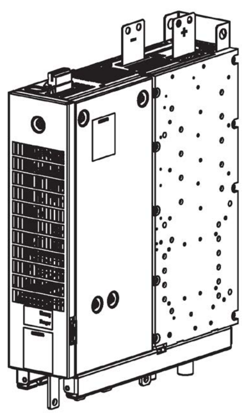
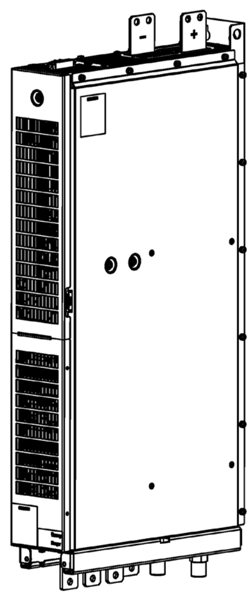
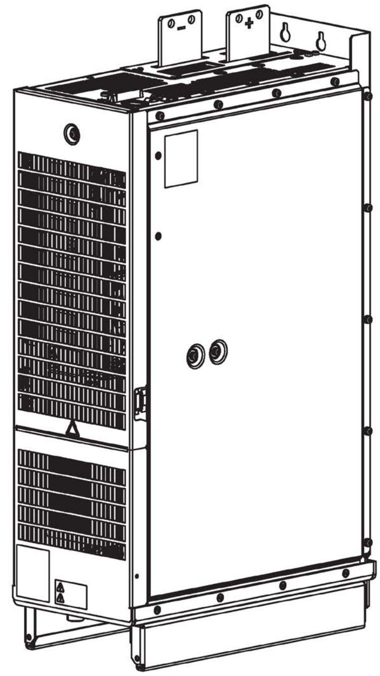
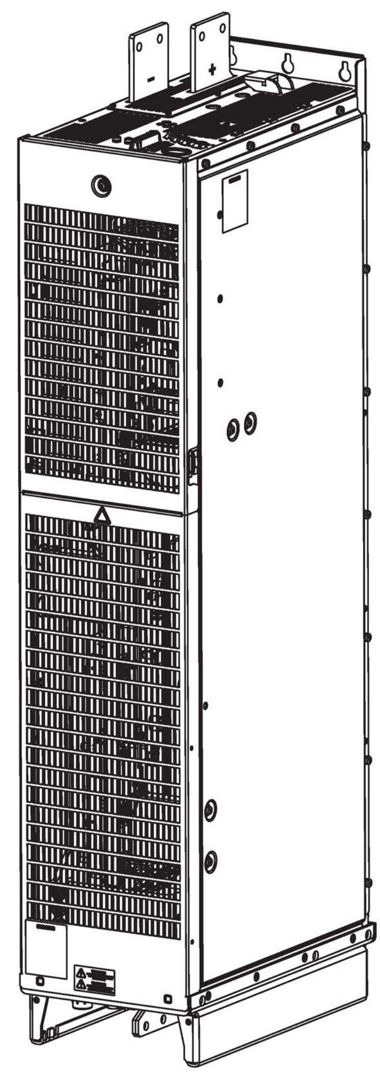
Motor Modules

6

6.1 Description

A Motor Module is a power unit (DC-AC inverter) that provides the power supply for the motor connected to it. Power is supplied by means of the DC link of the drive unit. A Motor Module must be connected to a Control Unit via DRIVE-CLiQ. The open-loop and closed-loop control functions are stored in the Control Unit.

Table 6- 1 Overview of Motor Modules

			
Frame size FXL	Frame size GXL	Frame size HXL	Frame size JXL

Characteristics of the Motor Modules

- Version for 510 ... 720 V DC (line voltage 380 ... 480 V 3 AC) from 110 to 1405 A
  Version for 675 ... 1035 V DC (line voltage 500 ... 690 V 3 AC) from 90 to 1560 A
- Water cooling
- Short-circuit/ground-fault-proof
- Electronic rating plate
- Operating status and error status via LEDs
- DRIVE-CLiQ interface for communication with the Control Unit and/or other components in the drive line-up.
- Integration in system diagnostics
- An external 24 V DC power supply is required to operate water-cooled Motor Modules.

The volumetric flow of the coolant is monitored by the software. If the volumetric flow is continuously lower than the setpoint, an alarm (A5005) is first displayed. If this alarm remains active continually for the next 5 minutes, a fault message (F30047) is activated which shuts down the unit.

The fans for the internal electronic circuitry are only switched on when required.

The fans are switched on and off as a function of several factors (e.g. heat sink temperature, ambient temperature, output current, duty cycle, ...) which means that fan operating cycles cannot be calculated directly.

6.2 Safety information

⚠WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

The non-observance of the fundamental safety instructions and residual risks stated in Chapter 1 can result in accidents with severe injuries or death.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

⚠DANGER

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

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

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

- Only open the device after five minutes have elapsed.
- Measure the voltage before starting work on the DCP and DCN DC-link terminals.

⚠WARNING

Danger to life due to high leakage currents caused by an interrupted external protective conductor

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

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

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

⚠WARNING

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

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

- Attach the component warning labels in the national language.

⚠ WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

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

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

⚠ CAUTION

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

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

- Ensure that the total length of the power cables (motor supply cables and DC-link cables) does not exceed the values specified in the technical data.

NOTICE

Material damage caused by mechanically stressed busbars and coolant connections

Mechanically stressed busbars and coolant connections can damage the device.

- Do not use the busbars and liquid coolant connections protruding from the device as handles or as support surfaces during transport.

NOTICE

Material damage caused by loose power connections

Insufficient tightening torques or vibration can result in faulty electrical connections. This can cause fire damage or functional faults.

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

NOTICE

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

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

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

NOTICE
Damage through use of incorrect DRIVE-CLiQ cables
Damage or malfunctions can occur on the devices or system when DRIVE-CLiQ cables are used that are either incorrect or have not been approved for this purpose. • Only use suitable DRIVE-CLiQ cables that have been approved by Siemens for the particular application.

6.3 Interface description

6.3.1 Overview

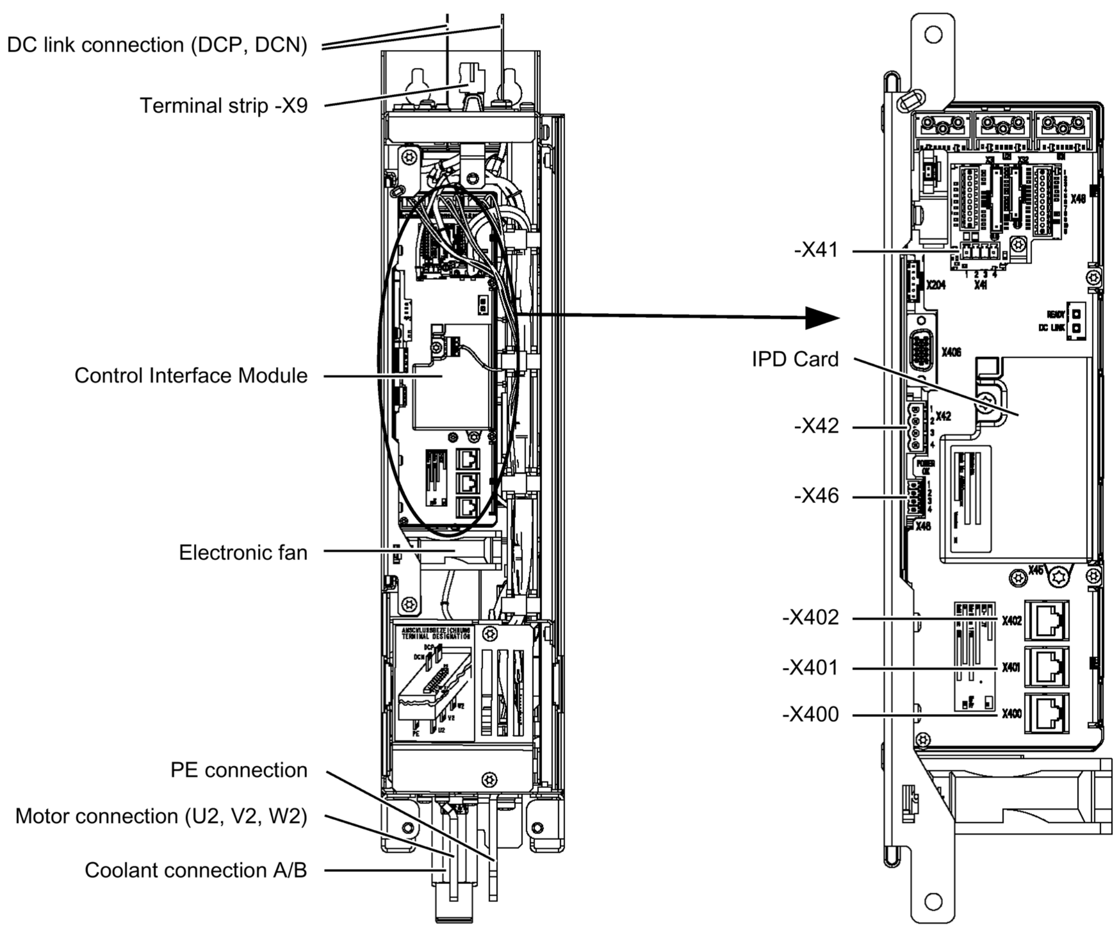


Figure 6-1 Motor Module, frame size FXL

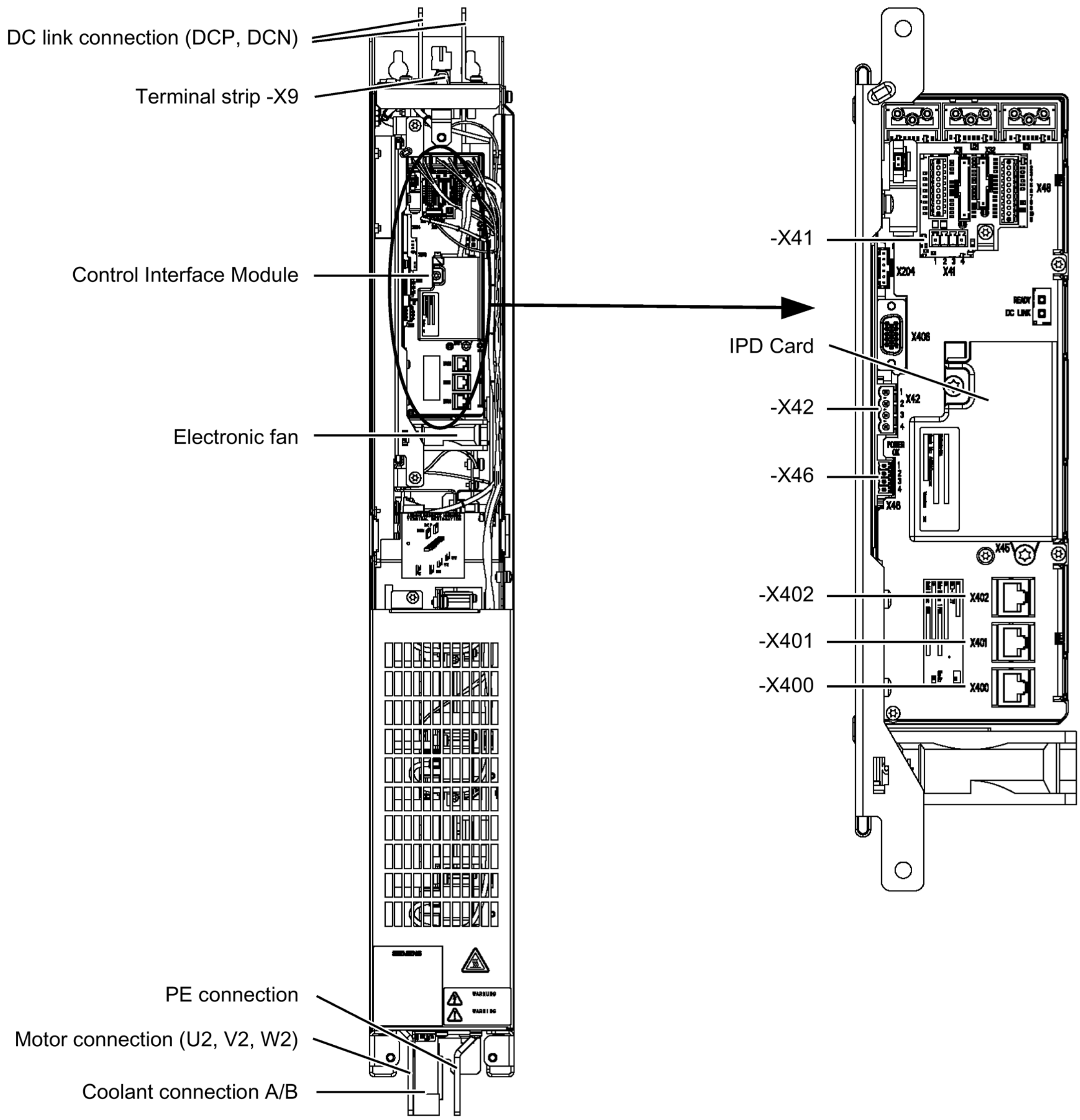


Figure 6-2 Motor Module, frame size GXL

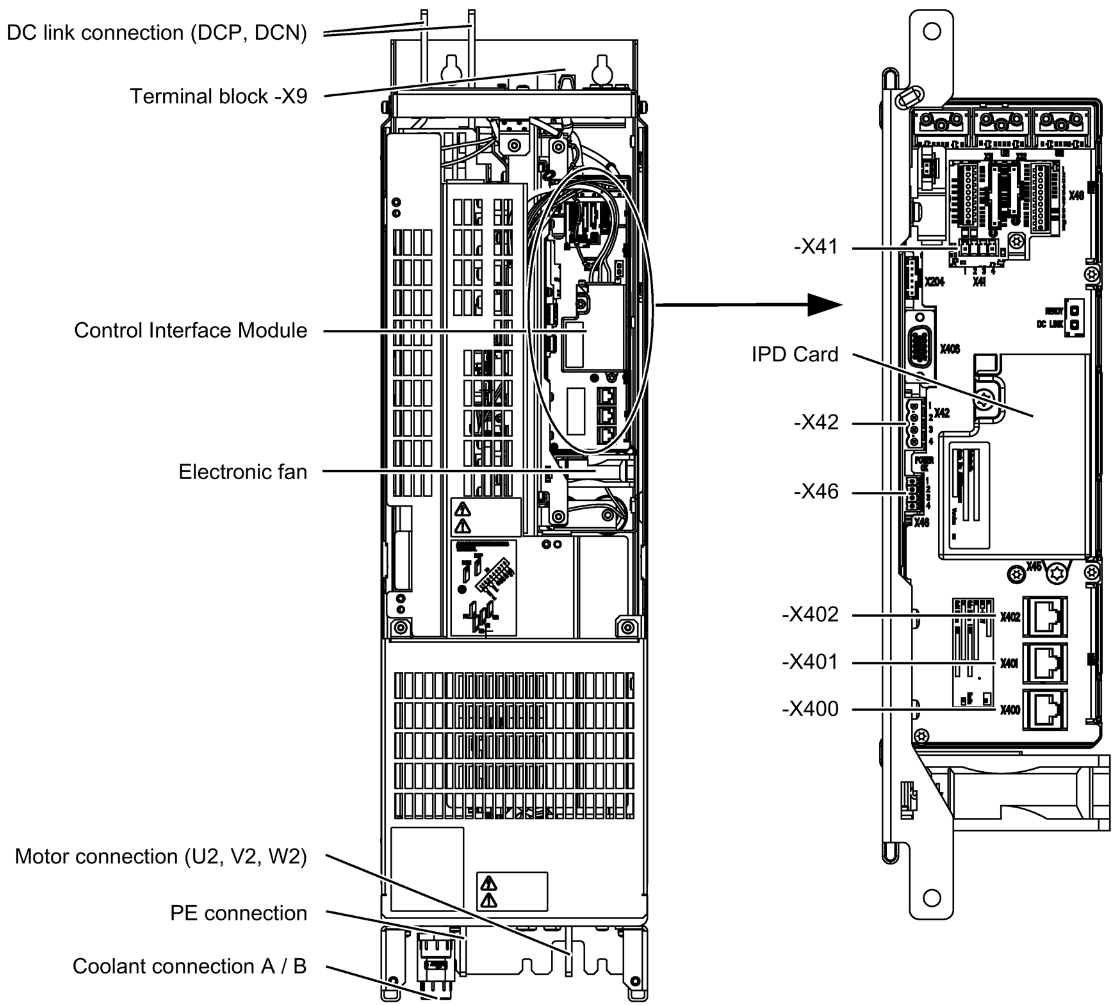


Figure 6-3 Motor Module, frame size HXL

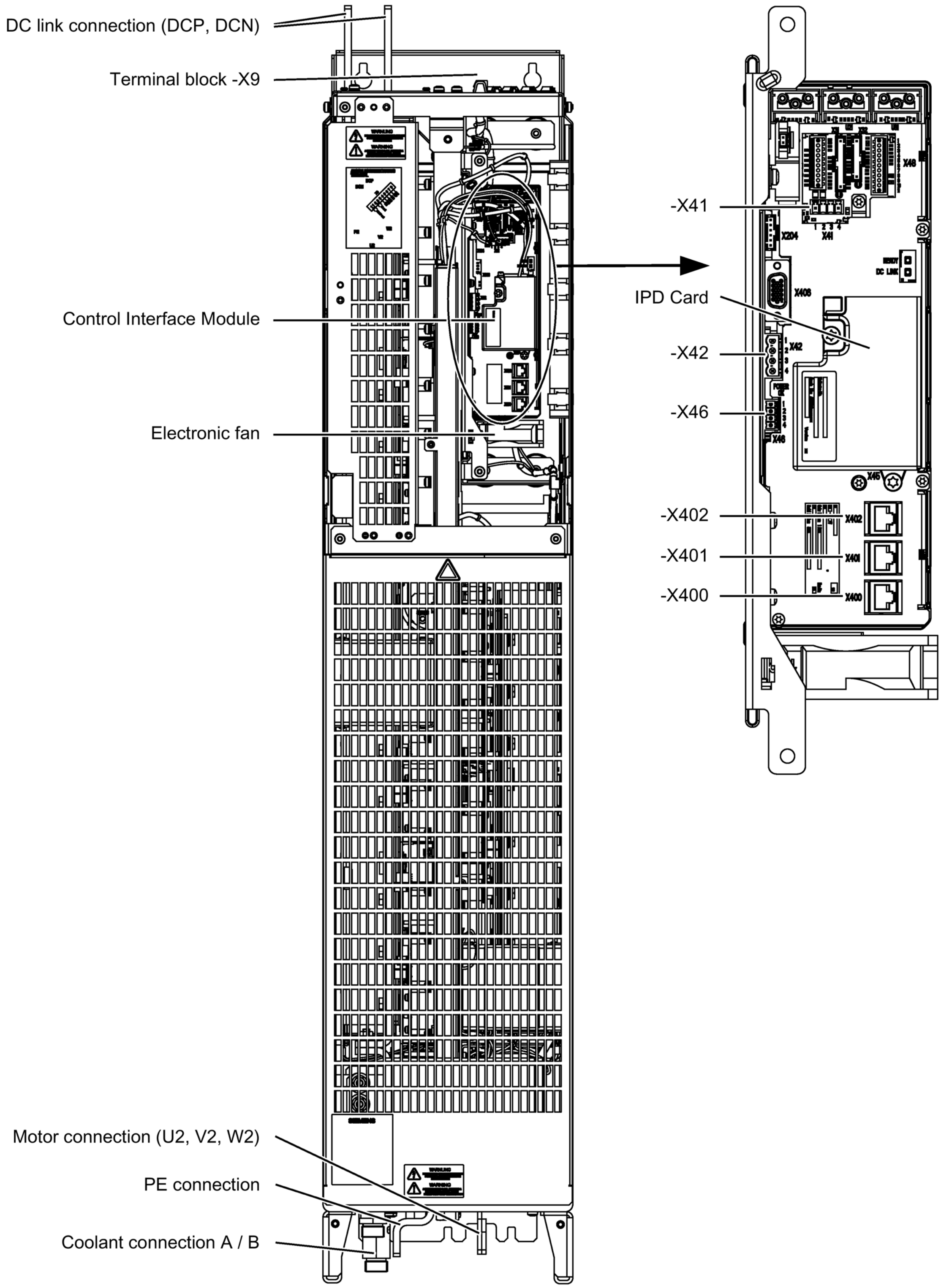


Figure 6-4 Motor Module, frame size JXL

6.3.2 Connection example

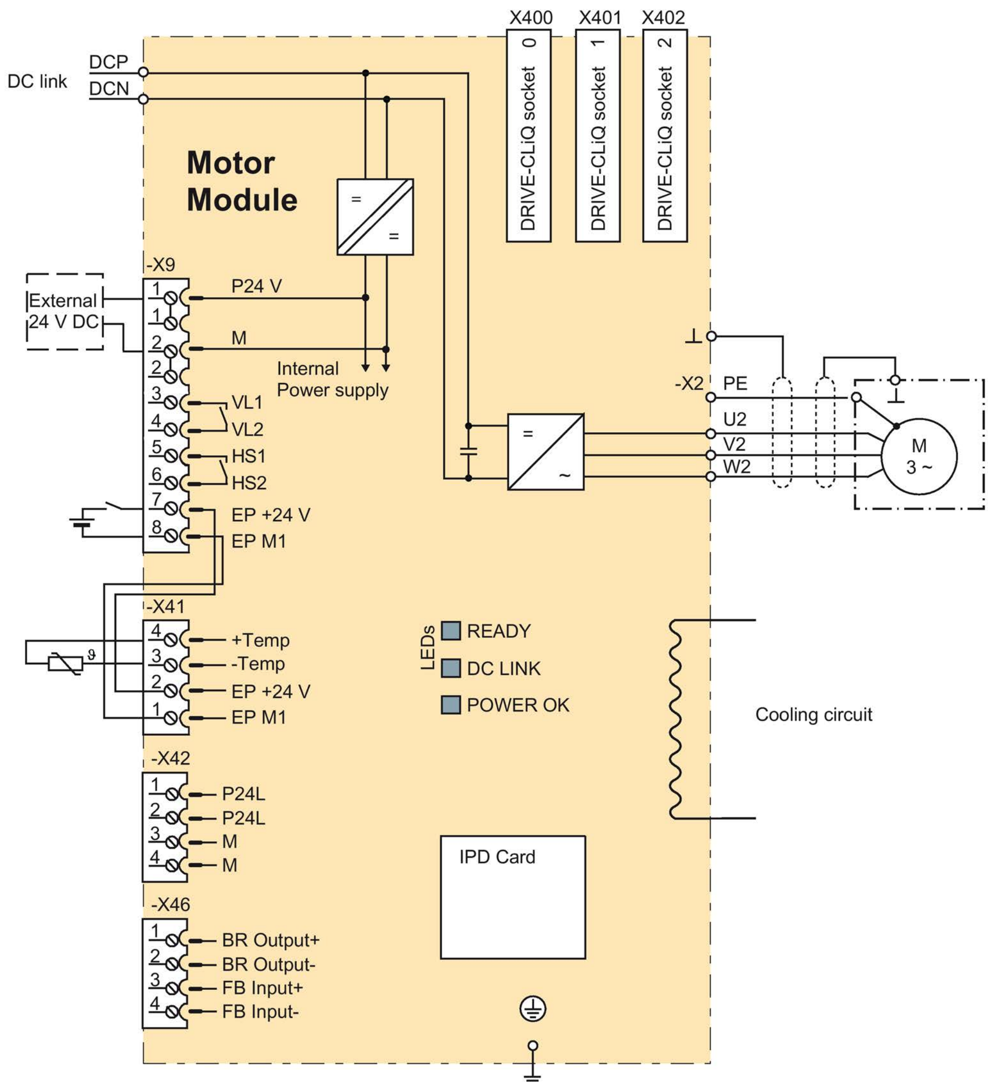


Figure 6-5 Connection example Motor Module

6.3.3 DC link/motor connection

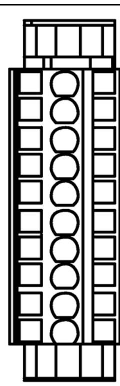
Table 6- 2 DC link/motor connection of the Motor Module

Terminals	Technical data
DCP, DCN DC power input	Voltage: • 510 ... 720 VDC • 675 ... 1035 VDC Connecting lugs: d = 13 mm (M12/50 Nm) for busbar connection
U2, V2, W2 3 AC power output	Voltage: • 0 V 3 AC to 0.72 x DC-link voltage Connecting lugs: • Frame sizes FXL, GXL, HXL: d = 13 mm (M12/50 Nm) for cable lugs in accordance with DIN 46234 / DIN 46235 [1)] • Frame size JXL: d = 13 mm (M12/50 Nm) for busbar connection
PE connection	Connecting lugs: • Frame sizes FXL, GXL, HXL: d = 13 mm (M12/50 Nm) for cable lugs in accordance with DIN 46234 / DIN 46235 [1)] • Frame size JXL: d = 13 mm (M12/50 Nm) for busbar connection

[1)] Dimensions for connecting alternative cable lugs, see "Cable lugs" in the Appendix.

6.3.4 X9 terminal strip

Table 6- 3 Terminal strip X9

	Terminal	Signal name	Technical data
	1	P24 V	24 VDC (20.4 ... 28.8 V) Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: See Technical data
	1	P24 V	
	2	M	
	2	M	
	3	VL1	240 V AC: 8 A max. 24 V DC: max. 1 A isolated
	4	VL2	
	5	HS1	240 V AC: 8 A max. 24 V DC: max. 1 A isolated
	6	HS2	
	7	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: 10 mA The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	8	EP M1 (Enable Pulses)	
Max. connectable cross-section: 1.5 mm²			

Note

EP terminals only for Safety Integrated Basic Functions

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

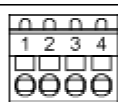
Note

Looping through the supply voltage

The two "P24 V" or "M" terminals are jumpered in the connector. This ensures that the supply voltage is looped through, even when the connector is removed.

6.3.5 X41 EP terminal / temperature sensor connection

Table 6- 4 Terminal strip X41

	Terminal	Function	Technical data
	1	EP M1 (Enable Pulses)	Connected to terminal -X9:8
	2	EP +24 V (Enable Pulses)	Connected to terminal -X9:7
	3	-Temp	Temperature sensor connection KTY84-1C130 / PT100 / PT1000 / PTC
	4	+Temp	
Max. connectable cross-section: 1.5 mm²			

WARNING

Danger to life due to electric shock in the event of voltage flashovers at the temperature sensor

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Only use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

NOTICE

Device failure as a result of unshielded or incorrectly routed cables to temperature sensors

Unshielded or incorrectly routed cables to temperature sensors can result in interference being coupled into the signal processing electronics from the power side. This can result in significant disturbance of all signals (fault messages) up to failure of individual components (destruction of the devices).

- Only use shielded cables as temperature sensor cables.
- If temperature sensor cables are routed together with the motor cable, use separately shielded cables twisted in pairs.
- Connect the cable shield to ground potential through a large surface area.
- Recommendation: Use suitable Motion Connect cables.

NOTICE

Damage to motor in the event of incorrectly connected KTY temperature sensor

If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.

- Connect a KTY temperature sensor with the correct polarity.

Note

The temperature sensor connection can be used for motors that are equipped with a KTY84-1C130, PT100, PT1000 or PTC measuring sensor in the stator windings.

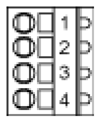
Note

Connection to terminal strip -X9

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

6.3.6 X42 terminal strip

Table 6- 5 Terminal strip X42 voltage supply for Control Unit, Sensor Module and Terminal Module

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

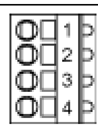
Note

Connection options of terminal strip X42

The terminal strip is not intended to generally provide a 24 V DC supply (for example for supplying additional components on the plant or system side), as the voltage supply of the Control Interface Module could also be overloaded and the correct functioning could thus be compromised.

6.3.7 X46 Brake control and monitoring

Table 6- 6 Terminal strip X46 brake control and monitoring

	Terminal	Function	Technical data
	1	BR output +	Brake connection
	2	BR output -	Supply voltage: 24 V DC Max. load current: 0.2 mA
	3	FB input +	
	4	FB input -	
Max. connectable cross-section: 1.5 mm²			

Note

The interface is intended for connection of the Safe Brake Adapter.

⚠ WARNING

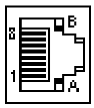
Fire hazard due to overheating when permissible connection cable lengths are exceeded

Excessively long connection cables on terminal strip X46 can cause components to overheat with the associated risk of fire and smoke.

- Limit the length of the connecting cables to a maximum of 10 m.
- The connection cable must not be led out the control cabinet or control cabinet group.

6.3.8 DRIVE-CLiQ interfaces X400, X401, X402

Table 6- 7 DRIVE-CLiQ interfaces X400, X401, X402

	PIN	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces (50 pcs.) Article number: 6SL3066-4CA00-0AA0			

6.3.9 Cooling circuit connections

Table 6- 8 Cooling circuit connections

Connection	Technical data
Coolant connection A: Intake	Pipe thread ISO 228 - G 3/4 B (external thread 3/4", flat-sealing)
Coolant connection B: Return	
Tightening torque	60 Nm

Note

Replacement seal

The seals for the screwed connections can be used only once when the cooling circuit is first assembled. The seals must be replaced if the circuit is disassembled and assembled again.

The replacement seal is commercially available as flat Viton polymer seal with hardness 75 (+/-5) Shore A (Viton is the commercial name for elastomers with the abbreviations FPM and FKM). The dimensions are as follows: Outer diameter 26 mm, inner diameter 15 mm, thickness 1.5 mm.

6.3.10 Meaning of the LEDs on the Control Interface Module in the Motor Module

Table 6- 9 Meaning of the LEDs "READY" and "DC LINK" on the Control Interface Module in the Motor Module

LED, state		Description
READY	**DC LINK**	
Off	Off	The electronics power supply is missing or out of tolerance.
Green	--- 1)	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC-link voltage is present.
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage lies outside the permitted tolerance range.
Orange	Orange	DRIVE-CLiQ communication is being established.
Red	--- 1)	This component has at least one fault. **Remark:** The LED is activated irrespective of whether the corresponding messages have been reconfigured.
Flashing light 0.5 Hz: green/red	--- 1)	Firmware is being downloaded.
Flashing light 2 Hz: green/red	--- 1)	Firmware download is complete. Waiting for POWER ON.
Flashing light 2 Hz: green/orange or red/orange	--- 1)	Detection of the components via LED is activated (p0124). Note: Both options depend on the LED status when module recognition is activated via p0124 = 1.

1) Irrespective of the status of the LED "DC LINK"

Table 6- 10 Meaning of the LED "POWER OK" on the Control Interface Module in the Motor Module

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

WARNING

Danger of death when live parts of the DC link are touched

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED. This means that when live parts are touched, this can result in death or serious injury.

- Observe the warning information on the component.

6.4 Dimension drawing

Dimension drawing, frame size FXL

The mandatory cooling clearances are indicated by the dotted line.

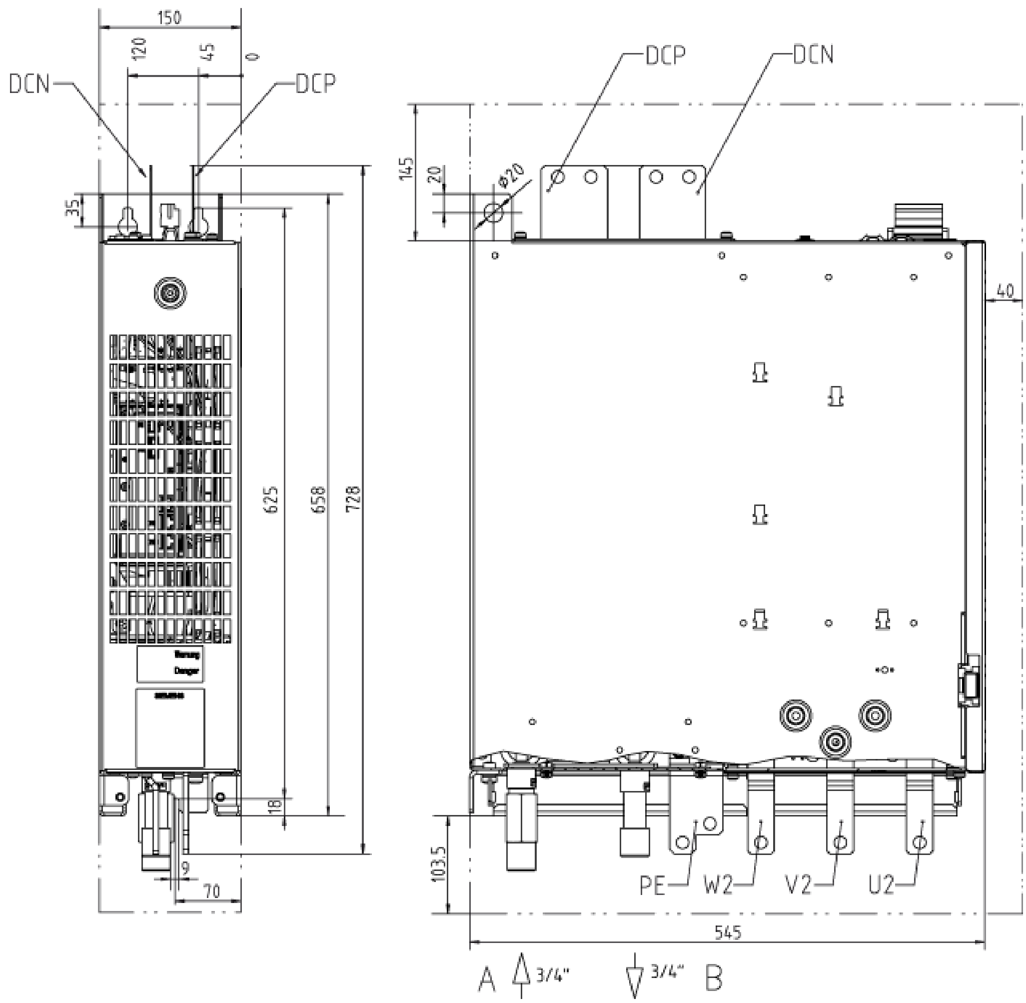


Figure 6-6 Dimension drawing Motor Module, frame size FXL. Front view, side view

Dimension drawing for frame size GXL

The mandatory cooling clearances are indicated by the dotted line.

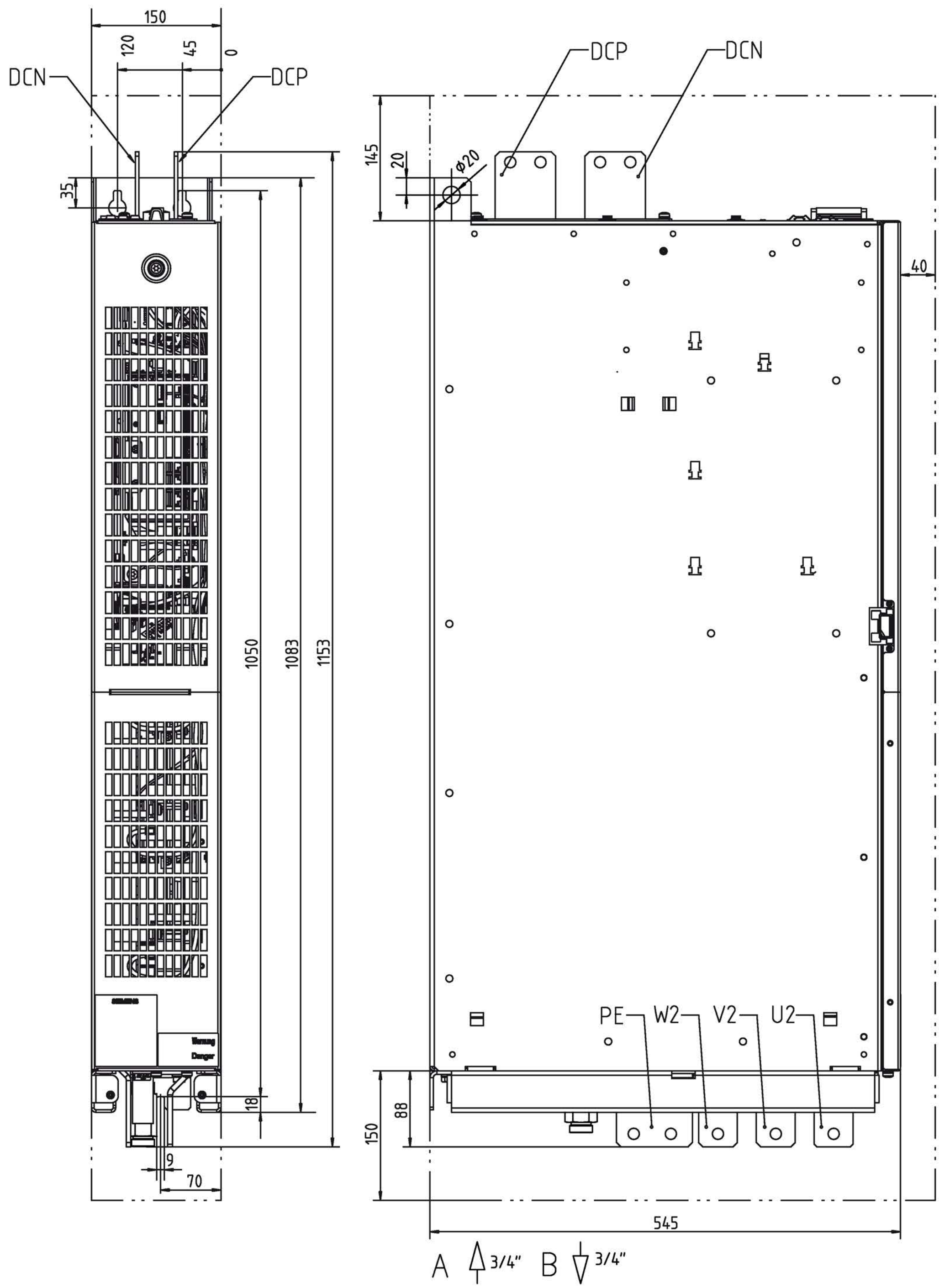


Figure 6-7 Dimension drawing Motor Module, frame size GXL. Front view, side view

Dimension drawing, frame size HXL

The mandatory cooling clearances are indicated by the dotted line.

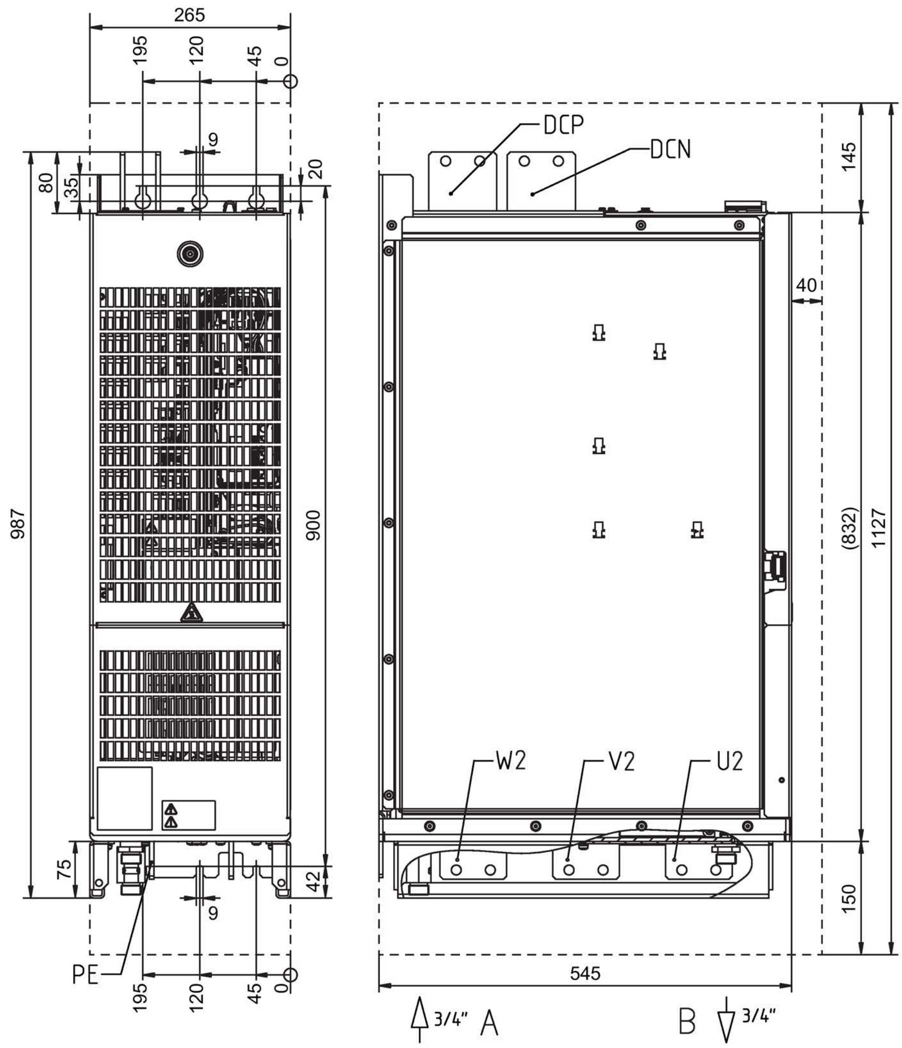


Figure 6-8 Dimension drawing Motor Module, frame size HXL. Front view, side view

Dimension drawing for frame size JXL

The mandatory cooling clearances are indicated by the dotted line.

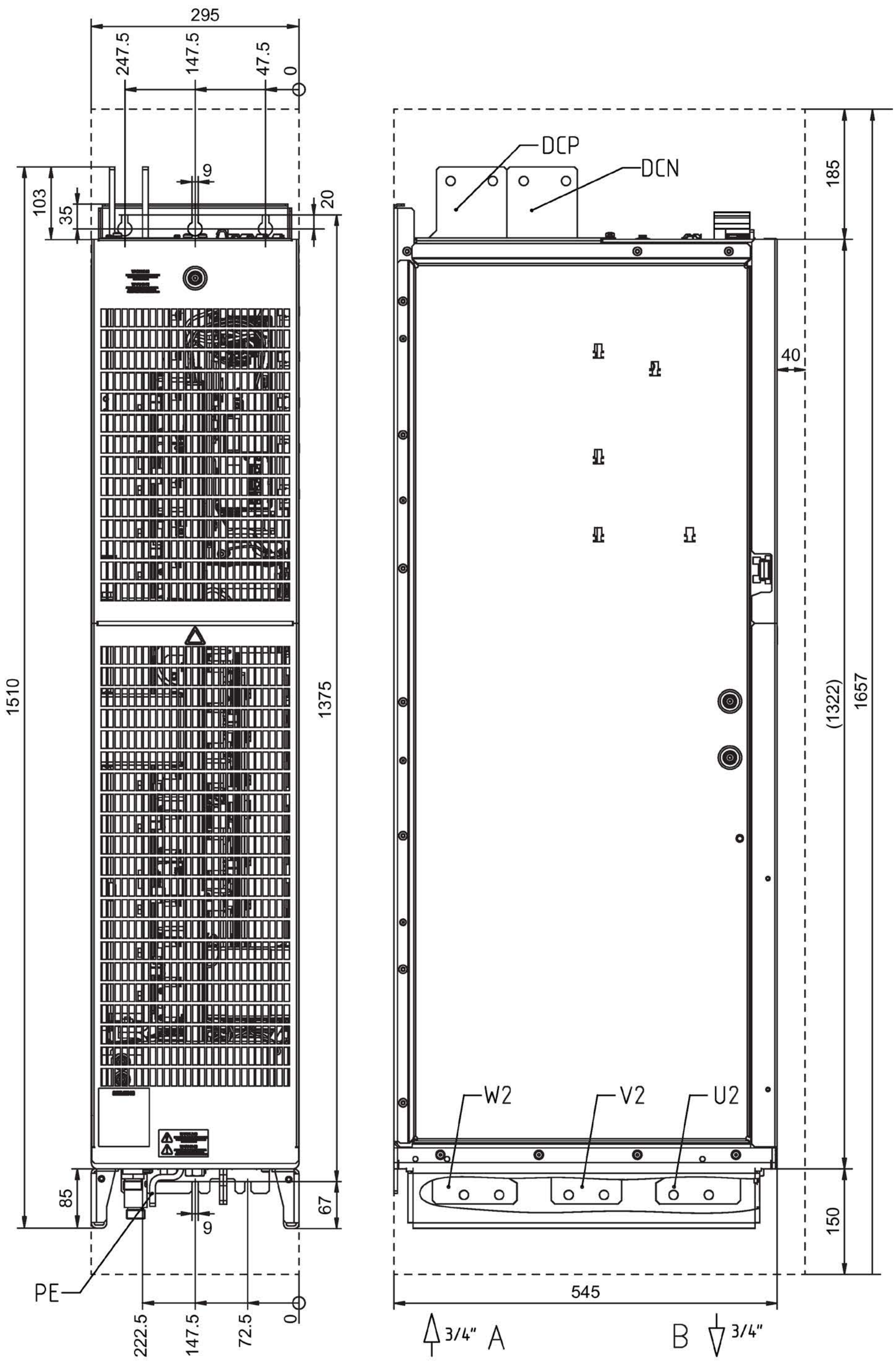


Figure 6-9 Dimension drawing Motor Module, frame size JXL, Article number 6SL3325-1TE41-0AA7, 6SL3325-1TE41-4AA7, 6SL3325-1TG38-1AA7, 6SL3325-1TG41-0AA7, 6SL3325-1TG41-2AA73, 6SL3325-1TG41-3AA7. Front view, side view

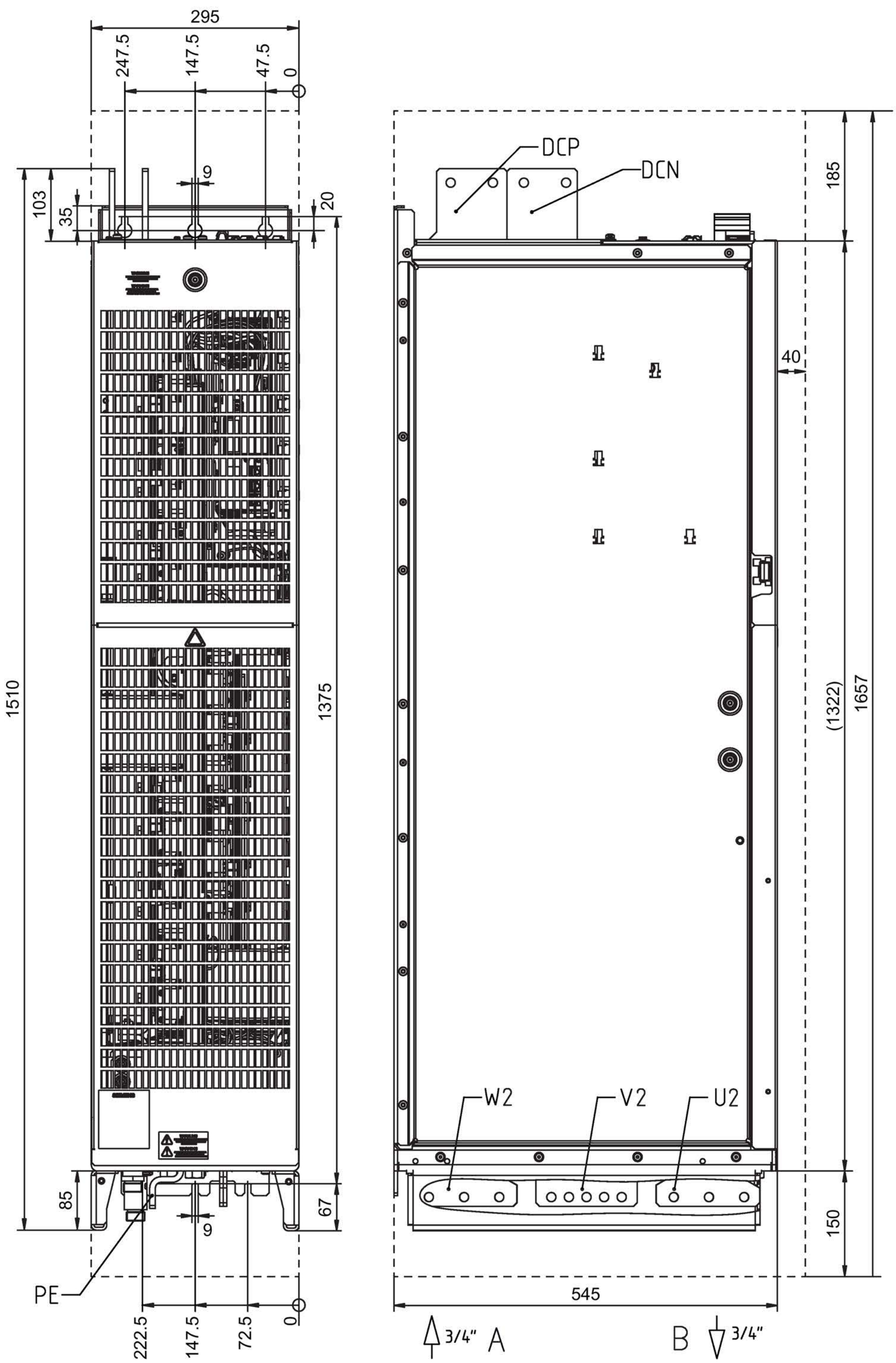


Figure 6-10 Dimension drawing Motor Module, frame size JXL, Article number 6SL3325-1TG41-6AA7. Front view, side view

6.5 Installation

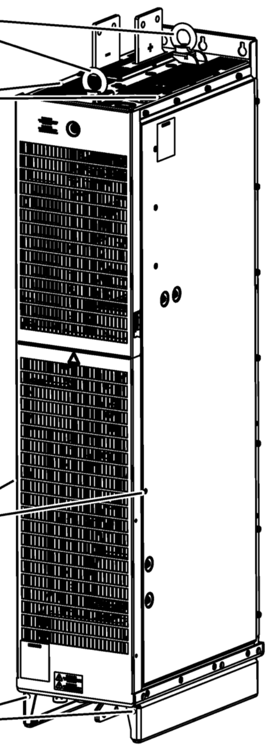


Figure 6-11 Crane lifting lugs / screw coupling points for mechanical support

Protection guard for frame sizes FXL and GXL

A protection guard is mounted on the bottom of the Motor Module ("1" in the diagram below) which is used when the device is being transported. The Motor Module can be placed down on this protection guard while it is removed from the packaging and during transportation. Before the module is installed at its final location, this guard must be removed. To do this, remove the 4 screws ("2" in the diagram) and remove the guard.

⚠ CAUTION

Risk of injury due to toppling when placing down on the protection guard

A module placed down on the protection guard can topple over therefore causing injury.

- When the module is placed down on the production guard, ensure that it cannot topple over.

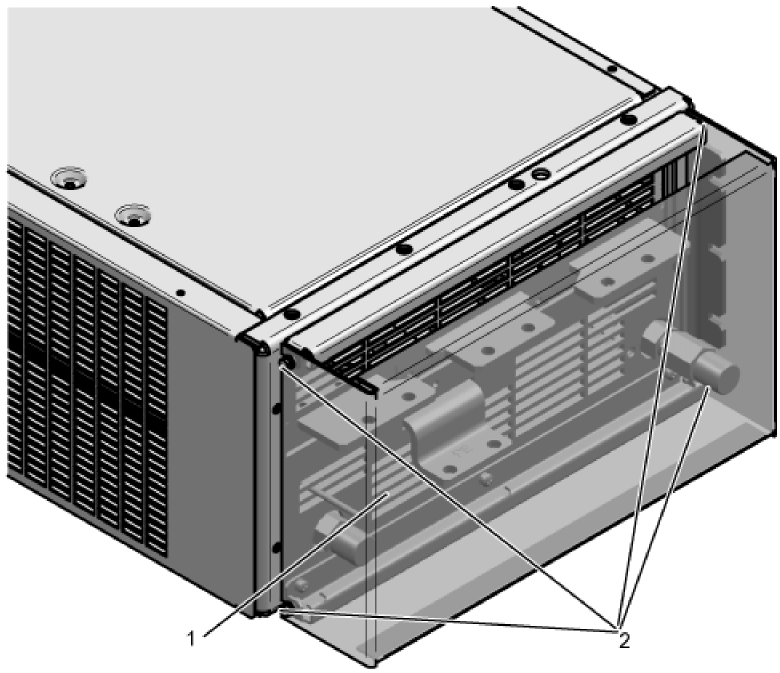


Figure 6-12 Protection guard

Note

Mounting equipment for power units

The mounting equipment for the power units can be used to mount the Motor Module, see "Mounting equipment for power units (Page 282)".

Rail profiles on the underside of the device for frame sizes HXL and JXL

Rail profiles are provided at the lower side of the device, that are used to place down the devices during transport at the mounting location - and for installation and removal.

Note

Mounting equipment for power units

The mounting equipment for the power units can be used to mount the Motor Module, see "Mounting equipment for power units (Page 282)".

Crane lifting lugs

Motor Modules are fitted with crane lifting lugs as standard when shipped. The units can be hoisted using these lugs and transported from the pallet to the installation location.

Note

Transport in the horizontal position

Transport in the horizontal position is permissible.

It is not permissible to screw the crane lifting lug into the thread at the lower side of the Motor Module.

NOTICE
Damage to the device due to improper transport
Improper transport can cause mechanical loads on the housing or busbars which can result in damage to the device. • Use a lifting harness with vertical ropes or chains during transport. • Do not use the busbars as handles or for fastening a lifting harness. • Only tighten the crane lifting lugs by hand. Remove the crane lifting lugs after the installation, but keep them for later use.

Screw coupling points for mechanical support

Since the Motor Modules are housed in a very narrow enclosure, they need to be mechanically supported against lateral movement and vibration if they are installed in a control cabinet. Screw coupling points are provided on the top and bottom, as well as at the side panels of the units for this purpose.

If several modules are mounted adjacent to one another, they can be interconnected via the screw coupling points. When a single module is installed, lateral support can be provided by means of reinforcing plates inserted between the module and the cabinet.

6.6 Technical specifications

Table 6- 11 Technical data for Motor Modules, 510 ... 720 V DC (line voltage 380 ... 480 V3 AC), Part 1

Article number	6SL3325–	1TE32-1AA3	1TE32–6AA3	1TE33-1AA3	1TE35–0AA3
Type rating - Based on I_L (50 Hz 400 V) 1) - Based on I_H (50 Hz 400 V) 1) - Based on I_L (60 Hz 460 V) 2) - Based on I_H (60 Hz 460 V) 2)	 kW kW HP HP	 110 90 150 150	 132 110 200 200	 160 132 250 200	 250 200 400 350
Output current - Rated current $I_{N A}$ - Base load current I_L - Base load current I_H - Max. output current $I_{max A}$	 A A A A	 210 205 178 307	 260 250 233 375	 310 302 277 453	 490 477 438 715
DC link current - Rated current $I_{N DC}$ when fed via - Basic Line Module - Active Line Module - Base load current $I_{L DC}$ when fed via - Basic Line Module - Active Line Module - Base load current $I_{H DC}$ when fed via - Basic Line Module - Active Line Module	 A A A A A A	 256 230 250 225 227 195	 317 287 305 274 284 255	 380 340 368 331 338 303	 600 538 581 522 534 480
Supply voltages - Electronics power supply - DC link voltage - Output voltage	 V_{DC} V_{DC} V_{ACrms}	 24 (20.4 ... 28.8) 510 ... 720 0 to 0.72 x DC link voltage			
DC link capacitance	µF	4800	5800	8400	9600
Rated pulse frequency - Max. pulse frequency without derating - Max. pulse frequency with derating	kHz kHz kHz	2 2 8	2 2 8	2 2 8	2 2 8
Electronics current consumption (24 V DC)	A	1.4	1.4	1.5	1.5
Cooling method		Liquid cooling with integrated stainless steel heat exchanger			
Power loss, max. 3) - At 50 Hz 400 V - At 60 Hz 460 V - Dissipated to the ambient air	 kW kW kW	 1.61 1.68 0.06	 1.95 2.06 0.07	 2.29 2.38 0.09	 3.56 3.74 0.14
Max. coolant temperature - without derating - with derating	 °C °C	 45 50	 45 50	 45 50	 45 50
Rated flow rate	l/min	9	9	12	12
Pressure drop, typical at the rated flow rate 4)	Pa	70000	70000	70000	70000
Liquid volume of integrated heat exchanger	dm³	0.31	0.31	0.91	0.91
Sound pressure level L_{pA} (1 m) at 50/60 Hz	 dB(A)	 52	 52	 52	 52

Article number	6SL3325–	1TE32-1AA3	1TE32–6AA3	1TE33-1AA3	1TE35–0AA3
DC link/motor connection		Flat connection for M12 screw			
Max. conductor cross-sections - DC link connection (DCP, DCN) - Motor connection (U2, V2, W2) - PE connection	 mm² mm² mm²	 Busbar 2 x 95 2 x 95	 Busbar 2 x 95 2 x 95	 Busbar 2 x 240 2 x 240	 Busbar 2 x 240 2 x 240
Max. cable length	m	300 (shielded) / 450 (unshielded)			
Degree of protection		IP00	IP00	IP00	IP00
Dimensions - Width - Height - Depth	 mm mm mm	 150 746 545	 150 746 545	 150 1172 545	 150 1172 545
Frame size		FXL	FXL	GXL	GXL
Weight	kg	41	41	80	80
Recommended fuse acc. to IEC - Number per phase (connected in parallel) - Rated current - Frame size acc. to IEC 60269	 A 	3NE3230-0B 1 315 1	3NE3232-0B 1 400 1	3NE3233 1 450 1	3NE3336 1 630 2
Recommended fuse acc. to UL 5) Type 3NE3 - Number per phase (connected in parallel) - Rated current - Frame size acc. to IEC 60269	 A 	 3NE3230-0B 1 315 1	 3NE3232-0B 1 400 1	 3NE3233 1 450 1	 3NE3336 1 630 2
Type 3NB1/3NB2 - rated current	 A	3NB1231- 4KK11 315	3NB1234- 4KK11 400	3NB1337- 4KK11 500	3NB1345- 4KK11 800

1) Rated power of a typical 6-pole standard induction motor based on I_L or I_H at 400 V 3AC 50 Hz.

2) Rated power of a typical 6-pole standard induction motor based on I_L or I_H at 460 V 3AC 60Hz.

3) The specified power loss is the maximum value for a 100% utilization level. The value in normal operation is lower.

4) This value applies to the water coolant option; for other coolant types, see Chapter "Cooling circuit and coolant properties".

5) To achieve a UL-approved system, it is absolutely essential to use the fuse types specified in the table.

Table 6- 12 Technical data for Motor Modules, 510 ... 720 V DC (line voltage 380 ... 480 V 3 AC), Part 2

Article number	6SL3325–	1TE37-5AA7	1TE41-0AA7	1TE41–2AA7	1TE41–4AA7
Type rating					
- Based on I_L (50 Hz 400 V) [1]	kW	400	560	710	800
- Based on I_H (50 Hz 400 V) [1]	kW	315	450	630	710
- Based on I_L (60 Hz 460 V) [2]	HP	600	800	1000	1150
- Based on I_H (60 Hz 460 V) [2]	HP	450	700	900	1000
Output current					
- Rated current $I_{N\,A}$	A	745	985	1260	1405
- Base load current I_L	A	725	960	1230	1370
- Base load current I_H	A	570	860	1127	1257
- Max. output current $I_{max\,A}$	A	1087	1440	1845	2055
DC link current					
- Rated current $I_{N\,DC}$ when fed via					
- Basic Line Module	A	894	1202	1512	1714
- Active Line Module	A	805	1080	1361	1544
- Base load current $I_{L\,DC}$ when fed via					
- Basic Line Module	A	871	1170	1474	1670
- Active Line Module	A	784	1051	1326	1500
- Base load current $I_{H\,DC}$ when fed via					
- Basic Line Module	A	795	1048	1345	1532
- Active Line Module	A	716	942	1211	1377
Supply voltages					
- Electronics power supply	V_{DC}	24 (20.4 ... 28.8)			
- DC link voltage	V_{DC}	510 ... 720			
- Output voltage	V_{ACrms}	0 to 0.72 x DC link voltage			
DC link capacitance	µF	17400	21000	29000	29000
Rated pulse frequency	kHz	1.25	1.25	1.25	1.25
- Max. pulse frequency without derating	kHz	1.25	1.25	1.25	1.25
- Max. pulse frequency with derating	kHz	7.5	7.5	7.5	7.5
Electronics current consumption (24 V DC)	A	1.6	1.46	1.46	1.46
Cooling method		Water cooling system with integrated heat exchanger manufactured out of a copper-nickel alloy			
Power loss, max. [3]					
- At 50 Hz 400 V	kW	5.1	7.9	9.15	10.2
- At 60 Hz 460 V	kW	5.61	8.55	10.05	11.2
- Dissipated to the ambient air	kW	0.2	0.44	0.56	0.62
Max. coolant temperature					
- without derating	°C	45	45	45	45
- with derating	°C	50	50	50	50
Rated flow rate	l/min	16	27	27	27
Pressure drop, typical at the rated flow rate [4]	Pa	70000	70000	70000	70000
Liquid volume of integrated heat exchanger	dm³	0.74	1.56	1.56	1.56
Sound pressure level L_{pA} (1 m) at 50/60 Hz	dB(A)	54	56	56	56

Article number	6SL3325–	1TE37-5AA7	1TE41-0AA7	1TE41–2AA7	1TE41–4AA7
DC link/motor connection		Flat connection for M12 screw			
Max. conductor cross-sections - DC link connection (DCP, DCN) - Motor connection (U2, V2, W2) - PE connection	 mm² mm² mm²	 Busbar 4 x 185 4 x 185	 Busbar Busbar Busbar	 Busbar Busbar Busbar	 Busbar Busbar Busbar
Max. cable length	m	300 (shielded) / 450 (unshielded)			
Degree of protection		IP00	IP00	IP00	IP00
Dimensions - Width - Height - Depth	 mm mm mm	 265 987 545	 295 1510 545	 295 1510 545	 295 1510 545
Frame size		HXL	JXL	JXL	JXL
Weight	kg	125	230	230	230
Recommended fuse acc. to IEC - Number per phase (connected in parallel) - Rated current - Frame size acc. to IEC 60269	 A 	3NE3334-0B 2 [6)] 500 2	3NE3336 2 6) 630 2	3NE3340-8 2 [6)] 900 2	3NE3340-8 2 [6)] 900 2
Recommended fuse acc. to UL [5)] Type 3NE3 Number per phase (connected in parallel) - Rated current - Frame size acc. to IEC 60269 Type 3NB1/3NB2 - rated current	 A A	 -- 3NB2350- 4KK16 1000	 3NE3336 2 [6)] 630 2 3NB2355- 4KK16 1400	 -- 3NB2364- 4KK17 2100	 3NE3340-8 2 [6)] 900 2 3NB2364- 4KK17 2100

1) Rated power of a typical 6-pole standard induction motor based on I_L or I_H at 400 V 3AC 50 Hz.

2) Rated power of a typical 6-pole standard induction motor based on I_L or I_H at 460 V 3AC 60Hz.

3) The specified power loss is the maximum value at 100% utilization level. The value in normal operation is lower.

4) This value applies to the water coolant option; for other coolant types, see Chapter "Cooling circuit and coolant properties".

5) To achieve a UL-approved system, it is absolutely essential to use the fuse types specified in the table.

6) When using fuses connected in parallel in each phase, if one fuse ruptures, then all of the fuses must be replaced.

Table 6- 13 Technical data for Motor Modules, DC 675 ... 1035 V (line voltage 3 AC 500 ... 690 V), Part 1

Article number	6SL3325–	1TG31-0AA3	1TG31–5AA3	1TG32-2AA3	1TG33–3AA3
Type rating					
- Based on I_L (50 Hz 690 V) [1)]	kW	90	132	200	315
- Based on I_H (50 Hz 690 V) [1)]	kW	75	110	160	250
- Based on I_L (50 Hz 500 V) [1)]	kW	55	90	132	200
- Based on I_H (50 Hz 500 V) [1)]	kW	55	90	132	200
- Based on I_L (60 Hz 575 V) [2)]	HP	75	150	200	300
- Based on I_H (60 Hz 575 V) [2)]	HP	75	125	200	250
Output current					
- Rated current $I_{N A}$	A	100	150	215	330
- Base load current I_L	A	95	142	208	320
- Base load current I_H	A	89	134	192	280
- Max. output current $I_{max A}$	A	142	213	312	480
DC link current					
- Rated current $I_{N DC}$ when fed via					
- Basic Line Module	A	122	183	263	403
- Active Line Module	A	110	165	237	363
- Base load current $I_{L DC}$ when fed via					
- Basic Line Module	A	116	173	253	390
- Active Line Module	A	105	156	229	352
- Base load current $I_{H DC}$ when fed via					
- Basic Line Module	A	108	163	234	341
- Active Line Module	A	98	147	211	308
Supply voltages					
- Electronics power supply	V_{DC}	24 (20.4 ... 28.8)			
- DC link voltage	V_{DC}	675 ... 1035			
- Output voltage	V_{ACrms}	0 to 0.72 x DC link voltage			
DC link capacitance	µF	2800	2800	4200	5800
Rated pulse frequency	kHz	1.25	1.25	1.25	1.25
- Max. pulse frequency without derating	kHz	1.25	1.25	1.25	1.25
- Max. pulse frequency with derating	kHz	7.5	7.5	7.5	7.5
Electronics current consumption (24 V DC)	A	1	1	1.5	1.5
Cooling method		Liquid cooling with integrated stainless steel heat exchanger			
Power loss, max. [3)]					
- At 50 Hz 690 V	kW	1.15	1.64	2.34	3.38
- At 60 Hz 575 V	kW	1.02	1.45	2.05	2.96
- Dissipated to the ambient air	kW	0.06	0.07	0.09	0.12
Max. coolant temperature					
- without derating	°C	45	45	45	45
- with derating	°C	50	50	50	50
Rated flow rate	l/min	9	9	12	12
Pressure drop, typical at the rated flow rate [4)]	Pa	70000	70000	70000	70000
Liquid volume of integrated heat exchanger	dm³	0.31	0.31	0.91	0.91
Sound pressure level L_{pA} (1 m) at 50/60 Hz	dB(A)	52	52	52	52

Article number	6SL3325–	1TG31-0AA3	1TG31–5AA3	1TG32-2AA3	1TG33–3AA3
DC link/motor connection		Flat connection for M12 screw			
Max. conductor cross-sections - DC link connection (DCP, DCN) - Motor connection (U2, V2, W2) - PE connection	 mm² mm² mm²	 Busbar 2 x 95 2 x 95	 Busbar 2 x 95 2 x 95	 Busbar 2 x 240 2 x 240	 Busbar 2 x 240 2 x 240
Max. cable length	m	300 (shielded) / 450 (unshielded)			
Degree of protection		IP00	IP00	IP00	IP00
Dimensions - width - height - depth	 mm mm mm	 150 728 545	 150 728 545	 150 1172 545	 150 1172 545
Frame size		FXL	FXL	GXL	GXL
Weight	kg	41	41	80	80
Recommended fuse acc. to IEC - Number per phase (connected in parallel) - Rated current - Frame size acc. to IEC 60269	 A 	3NE3224 1 160 1	3NE3225 1 200 1	3NE3230-0B 1 315 1	3NE3233 1 450 2
Recommended fuse acc. to UL 5) Type 3NE3 - Number per phase (connected in parallel) - Rated current - Frame size acc. to IEC 60269	 A 	 3NE3224 1 160 1	 3NE3225 1 200 1	 3NE3230-0B 1 315 1	 3NE3233 1 450 2
Type 3NB1/3NB2 - rated current	 A	3NB1126- 4KK11 200	3NB1128- 4KK11 250	3NB1231- 4KK11 315	3NB1337- 4KK11 500

1) Rated power of a typical 6-pole standard induction motor based on I_L or I_H at 500 or 690 V 3 AC 50 Hz.

2) Rated power of a typical 6-pole standard induction motor based on I_L or I_H at 575 V 3 AC 60 Hz.

3) The specified power loss is the maximum value at 100% utilization level. The value in normal operation is lower.

4) This value applies to the water coolant option; for other coolant types, see Chapter "Cooling circuit and coolant properties".

5) To achieve a UL-approved system, it is absolutely essential to use the fuse types specified in the table.

Table 6- 14 Technical data for Motor Modules, DC 675 ... 1035 V (line voltage 3 AC 500 ... 690 V), Part 2

Article number	6SL3325–	1TG34-7AA7	1TG35-8AA7	1TG38–1AA7	1TG41–0AA7
Type rating					
- Based on I_L (50 Hz 690 V) [1)]	kW	450	560	800	1000
- Based on I_H (50 Hz 690 V) [1)]	kW	400	450	710	900
- Based on I_L (50 Hz 500 V) [1)]	kW	315	400	560	710
- Based on I_H (50 Hz 500 V) [1)]	kW	250	315	560	630
- Based on I_L (60 Hz 575 V) [2)]	HP	450	600	800	1000
- Based on I_H (60 Hz 575 V) [2)]	HP	450	500	700	900
Output current					
- Rated current $I_{N\,A}$	A	465	575	810	1025
- Base load current I_L	A	452	560	790	1000
- Base load current I_H	A	416	514	724	917
- Max. output current $I_{max\,A}$	A	678	840	1185	1500
DC link current					
- Rated current $I_{N\,DC}$ when fed via					
- Basic Line Module	A	558	702	990	1250
- Active Line Module	A	502	632	891	1125
- Base load current $I_{L\,DC}$ when fed via					
- Basic Line Module	A	544	683	963	1219
- Active Line Module	A	489	616	869	1100
- Base load current $I_{H\,DC}$ when fed via					
- Basic Line Module	A	496	627	883	1118
- Active Line Module	A	446	565	796	1009
Supply voltages					
- Electronics power supply	V_{DC}	24 (20.4 ... 28.8)			
- DC link voltage	V_{DC}	675 ... 1035			
- Output voltage	V_{ACrms}	0 to 0.72 x DC link voltage			
DC link capacitance	µF	9670	9670	14000	16000
Rated pulse frequency	kHz	1.25	1.25	1.25	1.25
- Max. pulse frequency without derating	kHz	1.25	1.25	1.25	1.25
- Max. pulse frequency with derating	kHz	7.5	7.5	7.5	7.5
Electronics current consumption (24 V DC)	A	1.6	1.6	1.46	1.46
Cooling method		Water cooling system with integrated heat exchanger manufactured out of a copper-nickel alloy			
Power loss, max. [3)]					
- At 50 Hz 690 V	kW	5.44	5.61	9.56	10.87
- At 60 Hz 575 V	kW	5.1	4.89	8.34	9.55
- Dissipated to the ambient air	kW	0.14	0.16	0.43	0.53
Max. coolant temperature					
- without derating	°C	45	45	45	45
- with derating	°C	50	50	50	50
Rated flow rate	l/min	16	16	27	27
Pressure drop, typical at the rated flow rate [4)]	Pa	70000	70000	70000	70000
Liquid volume of integrated heat exchanger	dm³	0.74	0.74	1.56	1.56
Sound pressure level L_{pA} (1 m) at 50/60 Hz	dB(A)	54	54	56	56

Article number	6SL3325–	1TG34-7AA7	1TG35-8AA7	1TG38–1AA7	1TG41–0AA7
DC link/motor connection		Flat connection for M12 screw			
Max. conductor cross-sections - DC link connection (DCP, DCN) - Motor connection (U2, V2, W2) - PE connection	 mm² mm² mm²	 Busbar 4 x 185 4 x 185	 Busbar 4 x 185 4 x 185	 Busbar Busbar Busbar	 Busbar Busbar Busbar
Max. cable length	m	300 (shielded) / 450 (unshielded)			
Degree of protection		IP00	IP00	IP00	IP00
Dimensions - Width - Height - Depth	 mm mm mm	 265 987 545	 265 987 545	 295 1510 545	 295 1510 545
Frame size		HXL	HXL	JXL	JXL
Weight	kg	125	125	230	230
Recommended fuse acc. to IEC - Number per phase (connected in parallel) - Rated current - Frame size acc. to IEC 60269	 A 	3NE3336 1 630 2	3NE3232-0B 2 [6)] 400 1	3NE3335 2 [6)] 560 2	3NE3337-8 2 [6)] 710 2
Recommended fuse acc. to UL [5)] Type 3NE3 Number per phase (connected in parallel) - Rated current - Frame size acc. to IEC 60269	 A 	 --	 3NE3232-0B 2 [6)] 400 1	 3NE3335 2 [6)] 560 2	 3NE3337-8 2 [6)] 710 2
Type 3NB1/3NB2 - rated current	 A	3NB1345- 4KK11 800	3NB2345- 4KK16 800	3NB2350- 4KK16 1000	3NB2357- 4KK16 1600

1) Rated power of a typical 6-pole standard induction motor based on I_L or I_H at 500 or 690 V 3 AC 50 Hz.

2) Rated power of a typical 6-pole standard induction motor based on I_L or I_H at 575 V 3 AC 60 Hz.

3) The specified power loss is the maximum value at 100% utilization level. The value in normal operation is lower.

4) This value applies to the water coolant option; for other coolant types, see Chapter "Cooling circuit and coolant properties".

5) To achieve a UL-approved system, it is absolutely essential to use the fuse types specified in the table.

6) When using fuses connected in parallel in each phase, if one fuse ruptures, then all of the fuses must be replaced.

Table 6- 15 Technical data for Motor Modules, DC 675 ... 1035 V (line voltage 3 AC 500 ... 690 V), Part 3

Article number	**6SL3325–**	**1TG41–3AA7** 7)	**1TG41-6AA7** 7)		
Type rating - Based on I_L (50 Hz 690 V) 1) - Based on I_H (50 Hz 690 V) 1) - Based on I_L (50 Hz 500 V) 1) - Based on I_H (50 Hz 500 V) 1) - Based on I_L (60 Hz 575 V) 2) - Based on I_H (60 Hz 575 V) 2)	 kW kW kW kW HP HP	 1200 1000 900 800 1250 1000	 1500 1260 1000 900 1500 1250		
Output current - Rated current $I_{N\ A}$ - Base load current I_L - Base load current I_H - Max. output current $I_{max\ A}$	 A A A A	 1270 1230 1136 1600	 1560 1500 1284 1950		
DC link current - Rated current $I_{N\ DC}$ when fed via - Basic Line Module - Active Line Module - Base load current $I_{L\ DC}$ when fed via - Basic Line Module - Active Line Module - Base load current $I_{H\ DC}$ when fed via - Basic Line Module - Active Line Module	 A A A A A A	 1550 1395 1500 1353 1384 1250	 1903 1714 1800 1650 1680 1550		
Supply voltages - Electronics power supply - DC link voltage - Output voltage	 V_{DC} V_{DC} V_{ACrms}	 24 (20.4 ... 28.8) 675 ... 1035 0 to 0.72 x DC link voltage			
DC link capacitance	μF	19330	21000		
Rated pulse frequency - Max. pulse frequency without derating - Max. pulse frequency with derating	kHz kHz kHz	1.25 1.25 7.5	1.25 1.25 7.5		
Electronics current consumption (24 V DC)	A	1.46	1.46		
Cooling method		Water cooling system with integrated heat exchanger manufactured out of a copper-nickel alloy			
Power loss, max. 3) - At 50 Hz 690 V - At 60 Hz 575 V - Dissipated to the ambient air	 kW kW kW	 13.49 11.84 0.57	 17.9 15.7 0.78		
Max. coolant temperature - without derating - with derating	 °C °C	 45 50	 45 50		
Rated flow rate	l/min	27	27		
Pressure drop, typical at the rated flow rate 4)	Pa	70000	70000		
Liquid volume of integrated heat exchanger	dm³	1.56	1.56		
Sound pressure level L_{pA} (1 m) at 50/60 Hz	 dB(A)	 56	 56		

Article number	6SL3325–	1TG41–3AA7 [7)]	1TG41-6AA7 [7)]		
DC link/motor connection		Flat connection for M12 screw			
Max. conductor cross-sections - DC link connection (DCP, DCN) - Motor connection (U2, V2, W2) - PE connection	 mm² mm² mm²	 Busbar Busbar Busbar	 Busbar Busbar Busbar		
Max. cable length	m	300 (shielded) / 450 (unshielded)			
Degree of protection		IP00	IP00		
Dimensions - Width - Height - Depth	 mm mm mm	 295 1510 545	 295 1510 545		
Frame size		JXL	JXL		
Weight	kg	230	240		
Recommended fuse acc. to IEC - Number per phase (connected in parallel) - Rated current - Frame size acc. to IEC 60269	 A 	3NE3340-8 2 [6)] 900 2	3NE3337-8 3 [6)] 710 2		
Recommended fuse acc. to UL [5)] Type 3NE3 Number per phase (connected in parallel) - Rated current - Frame size acc. to IEC 60269	 A 	 3NE3340-8 2 [6)] 900 2			
Type 3NB1/3NB2 - rated current	 A	3NB2364- 4KK17 2100	3NB2366- 4KK17 2400		

1) Rated power of a typical 6-pole standard induction motor based on I_L or I_H at 500 or 690 V 3 AC 50 Hz.

2) Rated power of a typical 6-pole standard induction motor based on I_L or I_H at 575 V 3 AC 60 Hz.

3) The specified power loss is the maximum value at 100% utilization level. The value in normal operation is lower.

4) This value applies to the water coolant option; for other coolant types, see Chapter "Cooling circuit and coolant properties".

5) To achieve a UL-approved system, it is absolutely essential to use the fuse types specified in the table.

6) When using fuses connected in parallel in each phase, if one fuse ruptures, then all of the fuses must be replaced.

7) The short-time current for low overload must be reduced from 150 % to 130 % for 10 s. The short-time current for high overload must be reduced from 160 % to 130 % for 10 s - and from 150 % to 130 % for 60 s. Otherwise, the duty cycle remains unchanged.

6.6.1 Overload capability

The Motor Modules have an overload reserve e.g. to handle breakaway torques.

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

The criterion for overload is that the Motor Module is operated with its base load current before and after the overload occurs (a load duration of 300 s is used as a basis here).

Another precondition is that the Motor Module is operated at its factory-set pulse frequency at output frequencies > 10 Hz.

Low overload

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

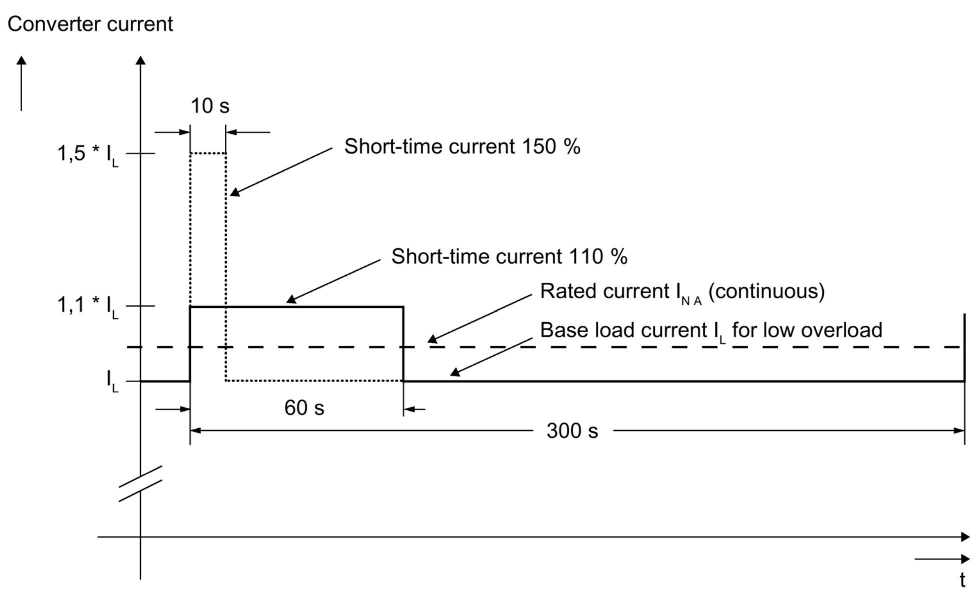


Figure 6-13 Low overload

High overload

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

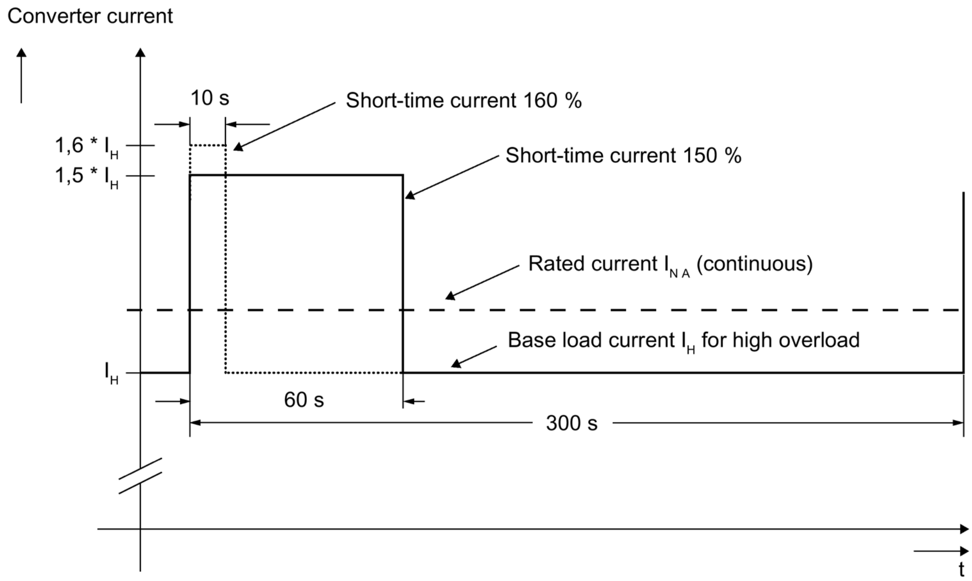


Figure 6-14 High overload

Low overload for 6SL3325–1TG41–3AA7 and 6SL3325–1TG41–6AA7 Motor Modules

The base load current for low overload (I_L) is based on a load duty cycle of 110 % for 60 s or 130 % for 10 s.

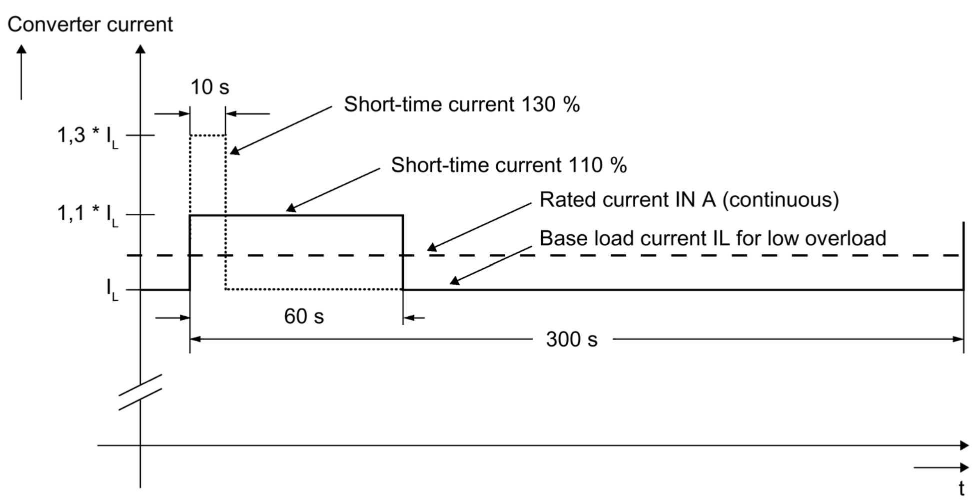


Figure 6-15 Low overload for 6SL3325–1TG41–3AA7 and 6SL3325–1TG41–6AA7 Motor Modules

High overload for 6SL3325–1TG41–3AA7 and 6SL3325–1TG41–6AA7 Motor Modules

The base load current for a high overload I_H is based on a duty cycle of 130 % for 60 s or 130 % for 10 s.

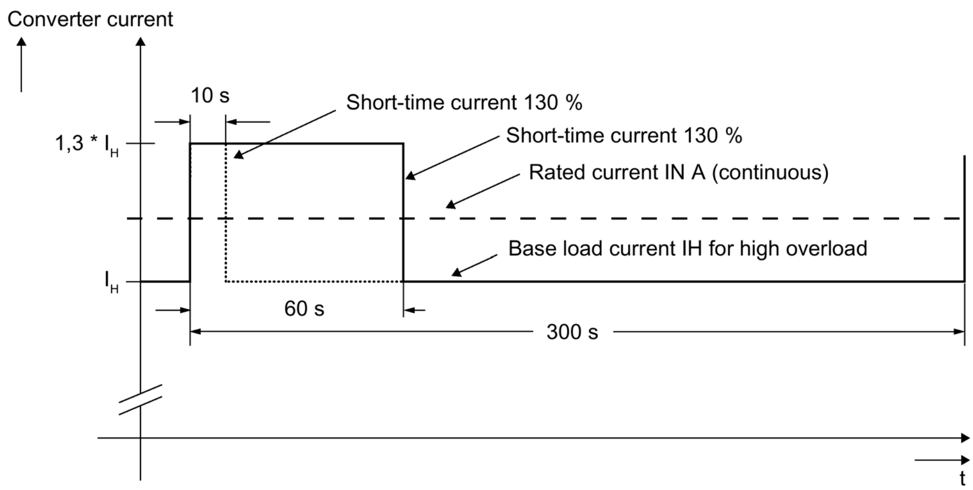


Figure 6-16 High overload for 6SL3325–1TG41–3AA7 and 6SL3325–1TG41–6AA7 Motor Modules

6.6.2 Derating factors

6.6.2.1 Derating factors as a function of coolant temperature

Water cooled SINAMICS S120 devices are suitable for water or a mixture of water and an antifreeze as coolant, corresponding to Section Antifreeze + biocide (Page 262).

When water is used as a coolant, the units can supply 100% output current at temperatures between 5 °C and 38 °C. The maximum output current decreases linearly to 90% at temperatures between 38 °C and 43 °C.

When water and an antifreeze mixture described above is used as a coolant, the units can supply 100% output current at temperatures between 0 °C and 38 °C. The maximum output current decreases linearly to 90% at temperatures between 38 °C and 43 °C.

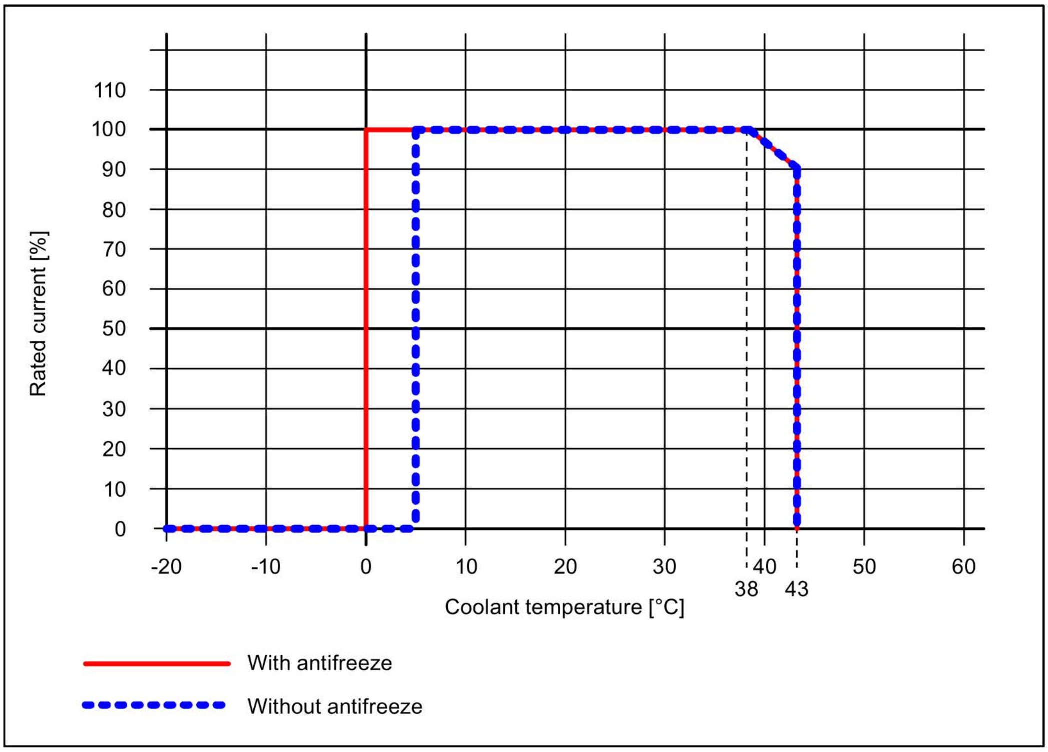


Figure 6-17 Maximum output current as a function of coolant temperature

6.6.2.2 Derating factors as a function of the ambient temperature

The units can supply 100 % output current at an ambient air temperature of between 0 °C and 45 °C. The maximum output current decreases linearly to 90 % at ambient air temperatures of between 45 °C and 50 °C.

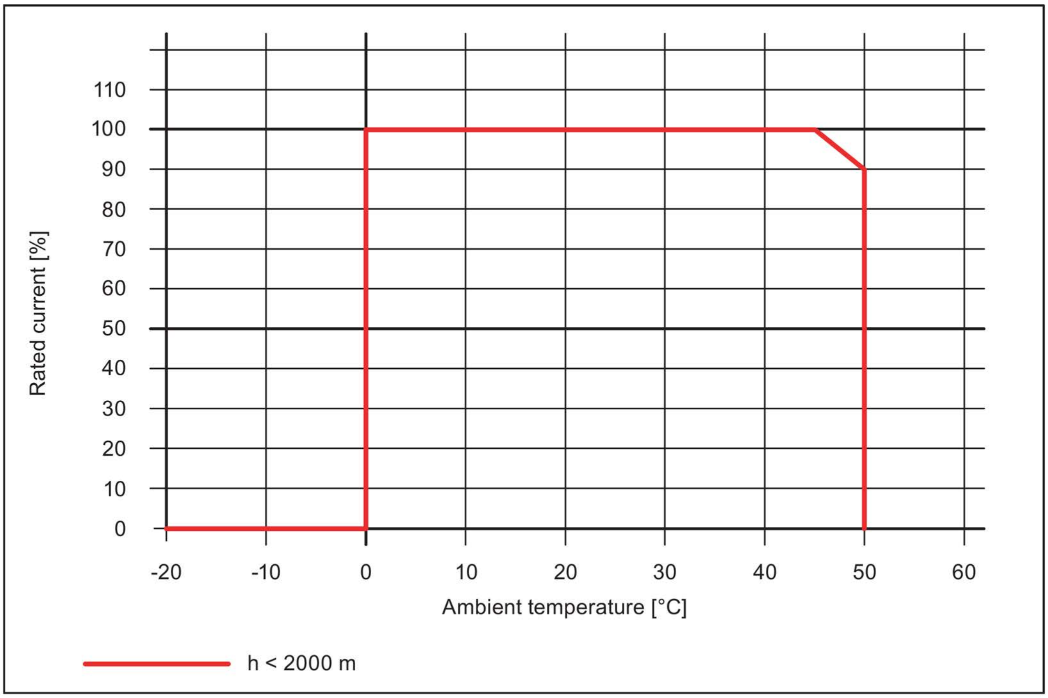


Figure 6-18 Maximum current as a function of ambient temperature

6.6.2.3 Derating factors as a function of installation altitude

When the units are operated at an installation altitude with reduced air pressure, the derating characteristic shown below applies to the output current or the ambient air temperature.

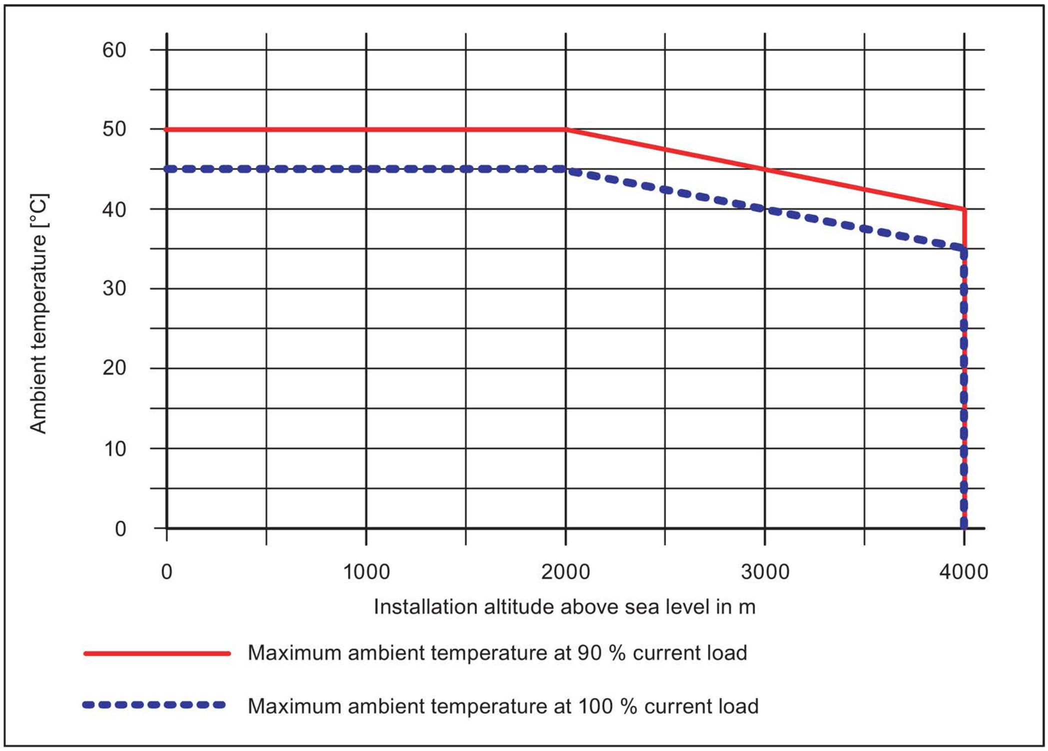


Figure 6-19 Maximum ambient temperature as a function of installation altitude

At installation altitudes above 2000 m (6562 ft), the line voltage must not exceed certain limits to ensure that surge voltages can be insulated in accordance with IEC 61800-5-1 for surge voltage category III. If the line voltage is higher than this limit at installation altitudes > 2000 m (6562 ft), measures must be taken to reduce transient category III surge voltages to category II values, e.g. equipment must be supplied via an isolating transformer.

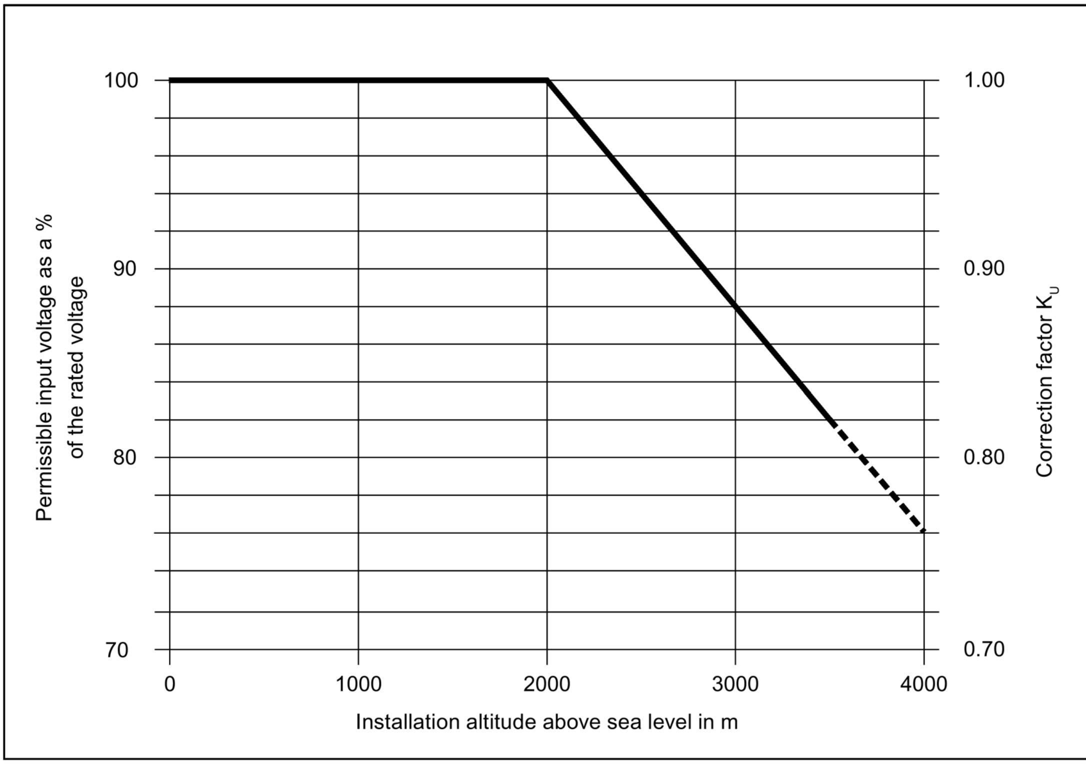


Figure 6-20 Voltage correction factor K_T as a function of the installation altitude

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Note

Rated voltage

Refer to the maximum line voltage under "Connection voltages" in the technical data for details of the rated voltage.

Note

Input voltage range that can be actually used

The dashed line represents a theoretical characteristic of the correction factor. The devices have an undervoltage threshold, which leads to shutdown when the voltage drops below it. Consequently, the input voltage range that is actually usable has a lower limit.

6.6.2.4 Current derating as a function of the pulse frequency

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

Table 6- 16 Derating factor of the output current as a function of the pulse frequency for devices with a rated pulse frequency of 2 kHz

Article No.	Type rating	Output current at 2 kHz	Derating factor at the pulse frequency				
6SL3325-...	[kW]	[A]	2.5 kHz	4 kHz	5 kHz	7.5 kHz	8 kHz
Supply voltage DC 510 ... 720 V (line voltage 3 AC 380 ... 480 V)							
1TE32-1AA3	110	210	95%	82%	74%	54%	50%
1TE32-6AA3	132	260	95%	83%	74%	54%	50%
1TE33-1AA3	160	310	97%	88%	78%	54%	50%
1TE35-0AA3	250	490	94%	78%	71%	53 %	50%

Table 6- 17 Derating factor of the output current as a function of the pulse frequency for units with a rated pulse frequency of 1.25 kHz

Article No.	Type rating	Output current at 1.25 kHz	Derating factor at the pulse frequency					
6SL3325-...	[kW]	[A]	2 kHz	2.5 kHz	4 kHz	5 kHz	7.5 kHz	8 kHz
Connection voltage DC 510 ... 720 V (line voltage 3 AC 380 ... 480 V)								
1TE37-5AA7	400	745	83%	72%	64%	60%	40%	--
1TE41-0AA7	560	985	92%	87%	70%	60%	50%	47 %
1TE41-2AA7	710	1260	92 %	87 %	70 %	60 %	50%	47 %
1TE41-4AA7	800	1405	97%	95%	74%	60 %	50%	47 %
Connection voltage DC 675 ... 1035 V (line voltage 3 AC 500 ... 690 V)								
1TG31-0AA3	90	100	92%	88%	71%	60%	40%	--
1TG31-5AA3	132	150	90%	84%	66%	55%	35%	--
1TG32-2AA3	200	215	92%	87%	70%	60%	40%	--
1TG33-3AA3	315	330	89%	82%	65%	55%	40%	--
1TG34-7AA7	450	465	92%	87%	67%	55%	35%	--
1TG35-8AA7	560	575	91%	85%	64%	50%	35%	--
1TG38-1AA7	800	810	97%	95%	71%	55%	35%	--
1TG41-0AA7	1000	1025	91%	86%	64%	50%	30%	--
1TG41-3AA7	1200	1270	87%	79%	55%	40%	25%	--
1TG41-6AA7	1500	1560	87%	79%	55%	40%	26%	--

Note

Derating factors for pulse frequencies in the range between fixed values

For pulse frequencies in the range between the specified fixed values, the relevant derating factors can be determined by linear interpolation.

Maximum output frequencies achieved by increasing the pulse frequency

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

Table 6- 18 Maximum output frequencies achieved by increasing the pulse frequency in VECTOR mode

Pulse frequency [kHz]	Maximum output frequency [Hz]
1.25	100
2	160
2.5	200
4	320
5	400

Table 6- 19 Maximum output frequencies achieved by increasing the pulse frequency in SERVO mode

Pulse frequency [kHz]	Maximum output frequency [Hz]
2	300
4	300 / 550 [1)]

[1)] Depending on the system configuration, higher frequencies are possible.

6.6.3 Parallel connection of Motor Modules

The following rules must be observed when connecting Motor Modules in parallel:

- Up to four identical Motor Modules can be connected in parallel.
- A common Control Unit is required whenever the modules are connected in parallel.
- The motor supply cables must be the same length (symmetrical design).
- Power must be supplied to the Motor Modules from a common DC link.
- For motors with a single winding system, supply cables with a minimum length or motor reactors must be used. The cable lengths are listed in the following tables.
- A derating factor of 5% must be taken into consideration, regardless of the number of Motor Modules connected in parallel.

Note

Mixed operation is not possible

It is only possible to connect identical power units in parallel if all power units have the same hardware version. Mixed operation between a power unit with Control Interface Module (Article No. 6SL33xx-xxxxx–xAA7 or 6SL33xx-xxxxx–xAA3) and a power unit with Control Interface Board (Article No. 6SL33xx-xxxxx–xAA0) is not possible.

Minimum cable lengths for parallel connection and connection to a motor with a single-winding system

Note

Minimum cable lengths

The minimum cable lengths specified in the tables below must be observed when two or more Motor Modules are connected in parallel and there is a connection to a motor with a single-winding system. If the cable length required for the application cannot be achieved, a motor reactor must be provided.

Table 6- 20 Motor Modules, DC 510 ... 720 V (line voltage 3 AC 380 ... 480 V)

Article number	Type rating [kW]	Output current [A]	Minimum cable length [m]
6SL3325-1TE32-1AA3	110	210	30
6SL3325-1TE32-6AA3	132	260	27
6SL3325-1TE33-1AA3	160	310	20
6SL3325-1TE35-0AA3	250	490	15
6SL3325-1TE37-5AA7	400	745	10
6SL3325-1TE41-0AA7	560	985	8
6SL3325-1TE41-2AA7	710	1260	8
6SL3325-1TE41-4AA7	800	1405	5

Table 6- 21 Motor Modules, DC 675 ... 1035 V (line voltage 3 AC 500 ... 690 V)

Article number	Type rating [kW]	Output current [A]	Minimum cable length [m]
6SL3325-1TG31-0AA3	90	100	90
6SL3325-1TG31-5AA3	132	150	70
6SL3325-1TG32-2AA3	200	215	50
6SL3325-1TG33-3AA3	315	330	30
6SL3325-1TG34-7AA7	450	465	25
6SL3325-1TG35-8AA7	560	575	20
6SL3325-1TG38-1AA7	800	810	15
6SL3325-1TG41-0AA7	1000	1025	10
6SL3325-1TG41-3AA7	1200	1270	8
6SL3325-1TG41-6AA7	1500	1560	7

Motor-side power components 7

7.1 Sine-wave filter

7.1.1 Description

If a sine-wave filter is connected to the output of the Power Modules or Motor Modules, the voltage between the motor terminals is virtually sinusoidal. This reduces the voltage load on the motor windings and prevents motor noise that would be induced by the pulse frequency.

Sine-wave filters are available up to a converter type power rating of 250 kW (without consideration for derating).

The pulse frequency of the Power Modules or Motor Modules must be set to 4 kHz for the sine-wave filters. This reduces the output current of the Power Modules or Motor Modules.

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

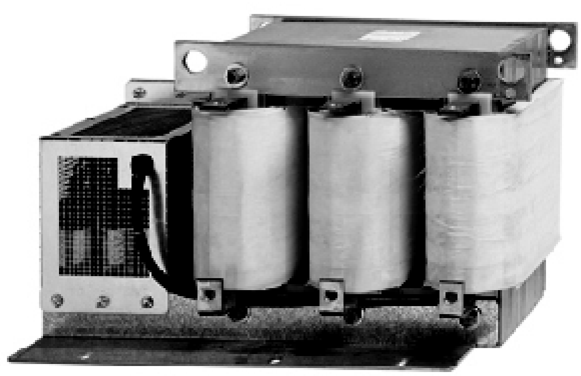


Figure 7-1 Sine-wave filter

7.1.2 Safety information

⚠ WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

The non-observance of the fundamental safety instructions and residual risks stated in Chapter 1 can result in accidents with severe injuries or death.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

⚠ WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

Inadequate ventilation clearances can cause overheating with a risk for personnel through smoke development and fire. Furthermore, an increased number of failures and shorter service life of the components can occur.

- Maintain 100 mm ventilation clearances above and to the side of the component.

⚠ CAUTION

Risk of burns resulting from high surface temperature of the sine-wave filter

The surface temperature of the sine-wave filters can exceed 80 °C. You can get seriously burnt when touching the surface.

- Mount the sine-wave filter so that it cannot be touched. If this is not possible, attach a clearly visible and understandable warning notice at hazardous positions.

NOTICE

Sine-wave filter damage due to interchanged connections

Interchanging the input and output connections will damage the sine-wave filter.

- Connect the incoming cable from the Power Modules or Motor Modules to 1U1, 1V1, 1W1.
- Connect the outgoing cable to the load at 1U2, 1V2, 1W2.

NOTICE

Damage to the Motor Module by using components that have not been released

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

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

NOTICE

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

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

- Operate the sine-wave filter with a maximum output frequency of 150 Hz.

NOTICE

Damage to the sine-wave filter if it is not activated during commissioning

The sine-wave filter may be damaged if it is not activated during commissioning.

- Activate the sine-wave filter during commissioning via parameter p0230 = 3.

NOTICE

Damage to the sine-wave filter if a motor is not connected

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

- Never operate a sine-wave filter on the Power Module or Motor Module without a connected motor.

Note

Cable lengths

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

7.1.3 Dimension drawing

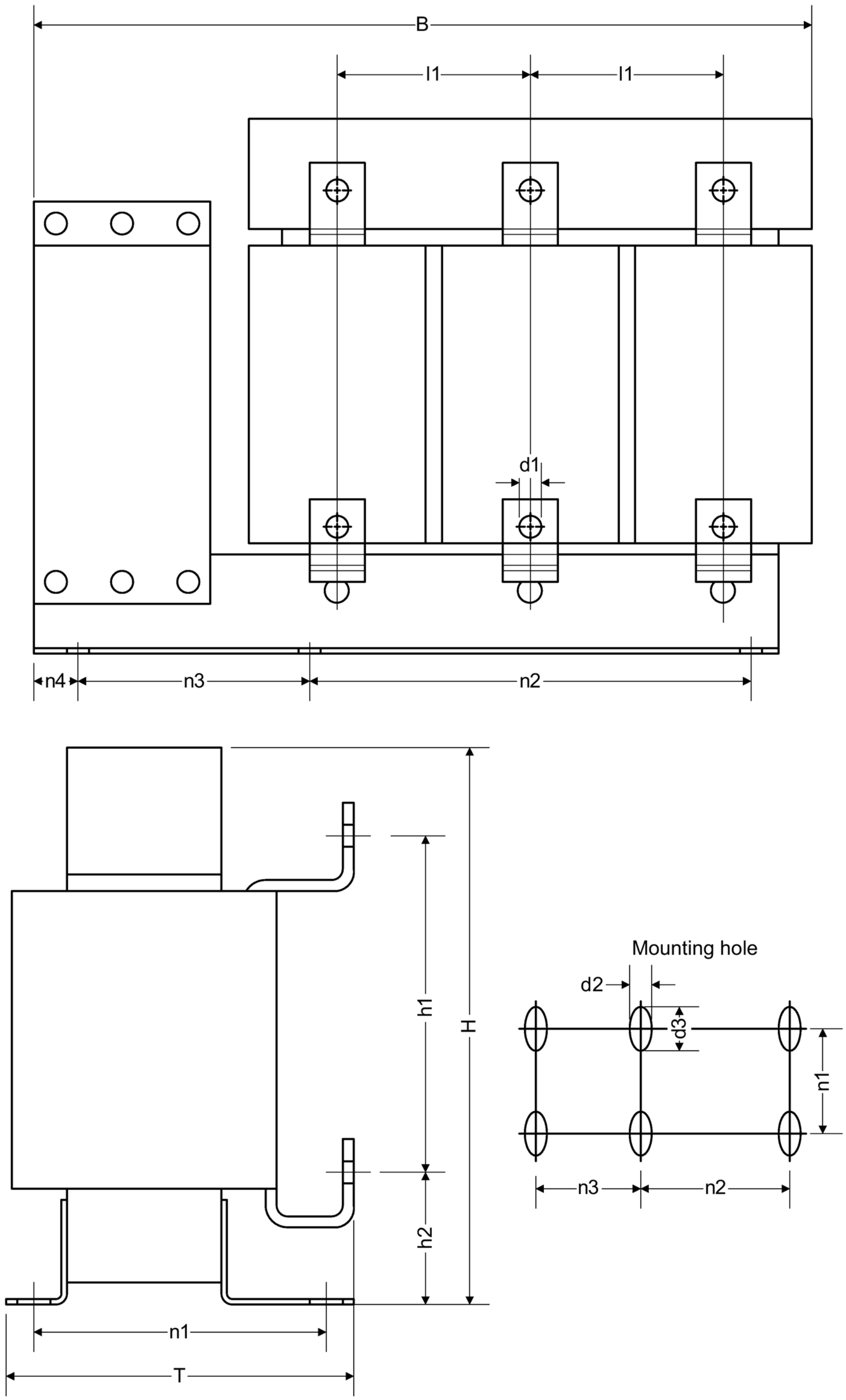


Figure 7-2 Dimension drawing, sine-wave filter

Table 7- 1 Dimensions of the sine-wave filter (all values in mm)

6SL3000-	2CE32-3AA0	2CE32-8AA0	2CE34-1AA0	
B	620	620	620	
H	300	300	370	
T	320	320	360	
l1	140	140	140	
h1	180	180	220	
h2	65	65	65	
n1 [1)]	280	280	320	
n2 [1)]	150	150	150	
n3 [1)]	225	225	225	
n4	105	105	105	
d1	12	12	12	
d2	11	11	11	
d3	22	22	22	

1) The lengths n1, n2 and n3 correspond to the drill hole spacing

7.1.4 Technical data

Table 7- 2 Technical data of sine-wave filters 380 V ... 480 V 3 AC

Article number	**6SL3000-**	**2CE32-3AA0**	**2CE32-3AA0**	**2CE32-8AA0**	**2CE34-1AA0**
Suitable for Power Module	6SL3315-	1TE32-1AAx	1TE32-6AAx	1TE33-1AAx	1TE35-0AAx
Suitable for Motor Module	6SL3325-	1TE32-1AAx	1TE32-6AAx	1TE33-1AAx	1TE35-0AAx
Rated current (unit rating) of the Power Modules or Motor Modules with sine-wave filter at pulse frequency of 4 kHz		170 A (90 kW)	215 A (110 kW)	270 A (132 kW)	380 A (200 kW)
Rated current	A	225	225	276	408
Maximum output frequency	Hz	150	150	150	150
Power loss - At 50 Hz - At 150 Hz	 kW kW	 0.35 0.6	 0.35 0.6	 0.4 0.69	 0.38 0.7
Connections - to the Power Module or Motor Module - load		M10 connecting lugs M10 connecting lugs			
Max. permissible cable length between sine-wave filter and motor	m	300 (shielded) 450 (unshielded)			
Degree of protection		IP00	IP00	IP00	IP00
Dimensions Width Height Depth	 mm mm mm	 620 300 320	 620 300 320	 620 300 320	 620 370 360
Weight	kg	124	124	127	198

7.2 Motor reactors

7.2.1 Description

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

7.2.2 Safety information

⚠ WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

The non-observance of the fundamental safety instructions and residual risks stated in Chapter 1 can result in accidents with severe injuries or death.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

⚠ WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

Inadequate ventilation clearances can cause overheating with a risk for personnel through smoke development and fire. Furthermore, an increased number of failures and shorter service life of the components can occur.

- Maintain 100 mm ventilation clearances above and to the side of the component.

⚠ CAUTION

Risk of burns resulting from high surface temperature of the motor reactor

The surface temperature of the motor reactors can exceed 80 °C. You can get seriously burnt when touching the surface.

- Mount the motor reactor so that it cannot be touched. If this is not possible, attach a clearly visible and understandable warning notice at hazardous positions.

NOTICE

Damage to the Motor Module by using components that have not been released

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

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

NOTICE

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

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

- Operate the motor reactor with a maximum output frequency of 150 Hz.

NOTICE

Damage to the motor reactor if the maximum pulse frequency is exceeded

The maximum permissible pulse frequency when a motor reactor is used is 2.5 kHz or 4 kHz. The motor reactor can be damaged if the pulse frequency is exceeded.

- When using the motor reactor, operate the Power Module or Motor Module with a maximum pulse frequency of 2.5 kHz or 4 kHz.

NOTICE

Damage to the motor reactor if it is not activated during commissioning

The motor reactor may be damaged if it is not activated during commissioning.

- Activate the motor reactor during commissioning via parameter p0230 = 1.

Note

Cable lengths

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

7.2.3 Dimension drawing

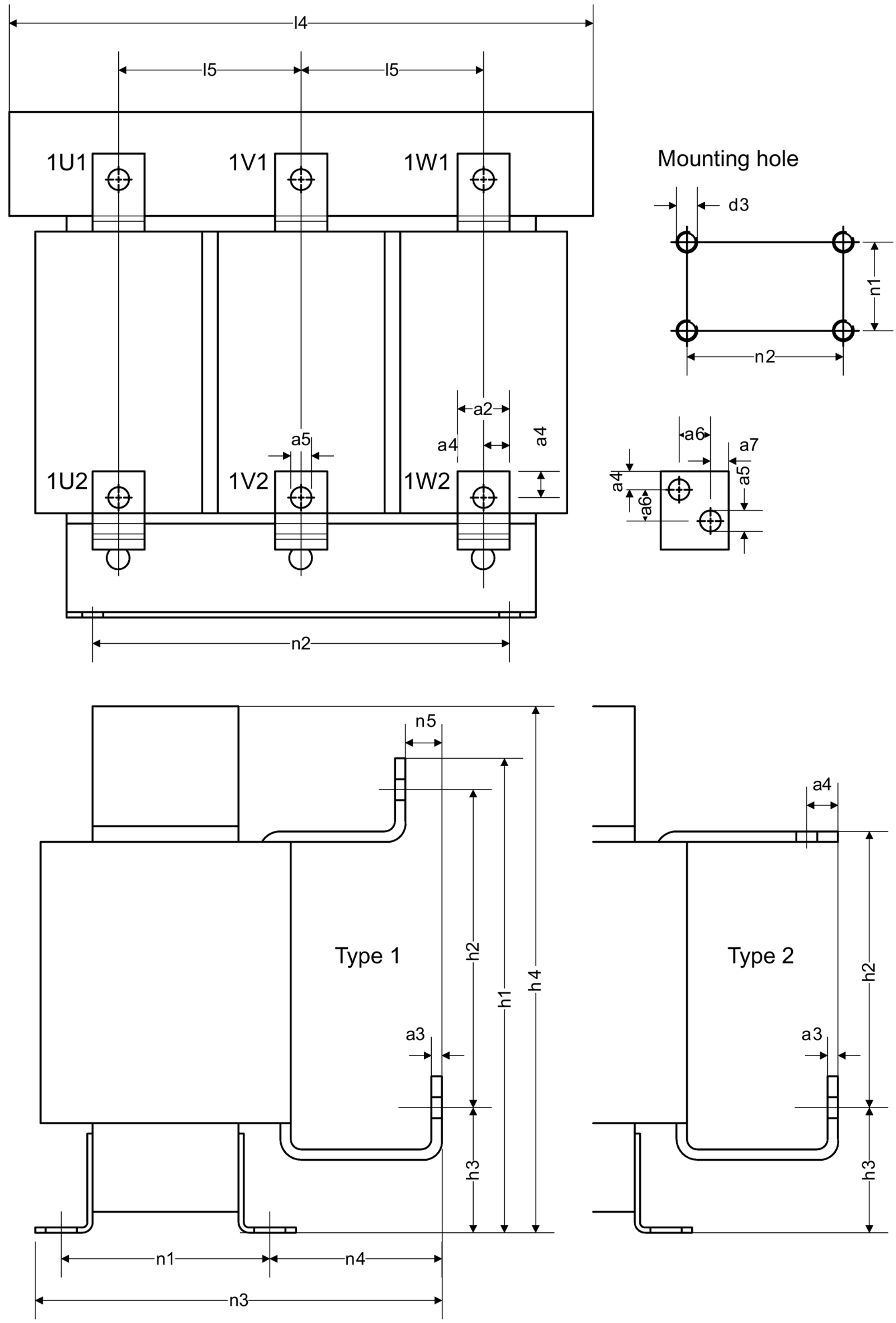


Figure 7-3 Dimension drawing, motor reactor

Table 7- 3 Dimensions of motor reactors, 3 AC 380 V ... 480 V, Part 1 (all specifications in mm)

6SL3000-	2BE32-1AA0	2BE32-6AA0	2BE33-2AA0	2BE35-0AA0
Connection type	Type 1	Type 1	Type 1	Type 2
a2	25	25	25	30
a3	5	5	5	6
a4	12.5	12.5	12.5	15
a5	11	11	11	14
l4	300	300	300	300
l5	100	100	100	100
h1	-	-	-	-
h2	194	227	194	245
h3	60	60	60	60
h4	285	315	285	365
n1 [1)]	163	183	163	183
n2 [1)]	224	224	224	224
n3	257	277	257	277
n4	79	79	79	79
d3	M8	M8	M8	M8

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

Table 7- 4 Dimensions of motor reactors, 3 AC 380 V ... 480 V, Part 2 (all specifications in mm)

6SL3000-	2AE38-4AA0	2AE41-0AA0	2AE41-4AA0	
Connection type	Type 1	Type 1	Type 1	
a2	40	40	60	
a3	8	8	11	
a4	20	20	17	
a5	14	14	14	
a6	-	-	22	
a7	-	-	19	
l4	410	410	460	
l5	140	140	160	
h1	392	392	392	
h2	252	252	255	
h3	120	120	120	
h4	385	385	385	
n1 [1)]	191	206	212	
n2 [1)]	316	316	356	
n3	292	302	326	
n4	84.5	79.5	94.5	
n5	30	-	-	
d3	M10	M10	M10	

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

Table 7- 5 Dimensions of motor reactors, 3 AC 500 V ... 690 V, Part 1 (all specifications in mm)

6SL3000-	2AH31-0AA0	2AH31-5AA0	2AH32-4AA0	2AH33-6AA0
Connection type	Type 1	Type 1	Type 1	Type 1
a2	25	25	25	25
a3	5	5	5	5
a4	12.5	12.5	12.5	12.5
a5	11	11	11	11
l4	270	270	300	300
l5	88	88	100	100
h1	-	-	-	-
h2	150	150	194	194
h3	60	60	60	60
h4	248	248	285	285
n1 1)	103	103	118	118
n2 1)	200	200	224	224
n3	200	200	212	212
n4	82	82	79	79
n5	-	-	-	-
d3	M8	M8	M8	M8

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

Table 7- 6 Dimensions of motor reactors, 3 AC 500 V ... 690 V, Part 2 (all specifications in mm)

6SL3000-	2AH34-7AA0	2AH35-8AA0	2AH38-1AA0	2AH41-1AA0	2AH41-3AA0
Connection type	Type 1	Type 1	Type 1	Type 1	Type 1
a2	40	40	40	50	60
a3	8	8	8	8	12
a4	20	20	20	14	17
a5	14	14	14	14	14
a6	-	-	-	22	22
a7	-	-	-	-	19
l4	410	410	410	410	460
l5	140	140	140	140	160
h1	392	392	392	392	392
h2	252	252	252	258	255
h3	120	120	120	120	120
h4	385	385	385	385	385
n1 1)	141	141	183	206	182
n2 1)	316	316	316	316	356
n3	292	292	279	317	296
n4	134.5	134.5	79.5	94.5	94.5
n5	30	30	-	-	-
d3	M10	M10	M10	M10	M10

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

7.2.4 Technical data

Table 7- 7 Technical data of motor reactors 380 V ... 480 V 3 AC, Part 1

Article number	**6SL3000-**	**2BE32-1AA0**	**2BE32-6AA0**	**2BE33-2AA0**	**2BE35-0AA0**
Suitable for Power Module	6SL3315-	1TE32-1AA3	1TE32-6AA3	1TE33-1AA3	1TE35-0AA3
Suitable for Motor Module	6SL3325-	1TE32-1AA3	1TE32-6AA3	1TE33-1AA3	1TE35-0AA3
Type rating of Power Module or Motor Module	kW	110	132	160	250
Rated current	A	210	260	310	490
Power loss - at 50 Hz - at 150 Hz	 kW kW	 0.436 0.486	 0.454 0.5	 0.422 0.47	 0.448 0.5
Connections - To the Power Module or Motor Module (1U1, 1V1, 1W1) - Load (1U2, 1V2, 1W2) - PE		 M10 M10 M8	 M10 M10 M8	 M10 M10 M8	 M12 M12 M8
Max. permissible cable length between the motor reactor and motor - without motor reactor - for 1 motor reactor - for 2 motor reactors in series	 m m m	 300 (shielded) / 450 (unshielded) 300 (shielded) / 450 (unshielded) 525 (shielded) / 787 (unshielded)			
Degree of protection		IP00	IP00	IP00	IP00
Dimensions Width Height Depth	 mm mm mm	 300 285 257	 300 315 277	 300 285 257	 300 365 277
Weight, approx.	kg	66	66	66	100

Table 7- 8 Technical data of motor reactors 380 V ... 480 V 3 AC, Part 2

Article number	6SL3000-	2AE38-4AA0	2AE41-0AA0	2AE41-4AA0	
Suitable for Motor Module	6SL3325-	1TE37-5AA7	1TE41-0AA7	1TE41-2AA7 1TE41-4AA7	
Type rating of the Motor Module	kW	400	560	710 / 800	
Rated current	A	840	985	1405	
Power loss - at 50 Hz - at 150 Hz	 kW kW	 0.834 0.943	 0.939 1.062	 0.946 1.054	
Connections - To the Motor Module (1U1, 1V1, 1W1) - Load (1U2, 1V2, 1W2) - PE		 M12 M12 M10	 M12 M12 M10	 2 x M12 2 x M12 M10	
Max. permissible cable length between the motor reactor and motor - without motor reactor - for 1 motor reactor - for 2 motor reactors in series	 m m m	 300 (shielded) / 450 (unshielded) 300 (shielded) / 450 (unshielded) 525 (shielded) / 787 (unshielded)			
Degree of protection		IP00	IP00	IP00	
Dimensions Width Height Depth	 mm mm mm	 410 392 292	 410 392 302	 460 392 326	
Weight, approx.	kg	140	146	179	

Table 7- 9 Technical data of motor reactors 500 V ... 690 V 3 AC, Part 1

Article number	**6SL3000-**	**2AH31-0AA0**	**2AH31-5AA0**	**2AH32-4AA0**	**2AH33-6AA0**
Suitable for Motor Module	6SL3325-	1TG31-0AA3	1TG31-5AA3	1TG32-2AA3	1TG33-3AA3
Type rating of the Motor Module	kW	90	132	200	315
Rated current	A	100	150	215	330
Power loss - at 50 Hz - at 150 Hz	 kW kW	 0.269 0.3	 0.296 0.332	 0.376 0.425	 0.4 0.454
Connections - To the Motor Module (1U1, 1V1, 1W1) - Load (1U2, 1V2, 1W2) - PE		 M10 M10 M6	 M10 M10 M6	 M10 M10 M6	 M10 M10 M6
Max. permissible cable length between the motor reactor and motor - without motor reactor - for 1 motor reactor - for 2 motor reactors in series	 m m m	 300 (shielded) / 450 (unshielded) 300 (shielded) / 450 (unshielded) 525 (shielded) / 787 (unshielded)			
Degree of protection		IP00	IP00	IP00	IP00
Dimensions Width Height Depth	 mm mm mm	 270 248 200	 270 248 200	 300 285 212	 300 285 212
Weight, approx.	kg	25	25.8	34	46

Table 7- 10 Technical data of motor reactors 500 V ... 690 V 3 AC, Part 2

Article number	**6SL3000-**	**2AH34-7AA0**	**2AH35-8AA0**	**2AH38-1AA0**	**2AH41-1AA0**	**2AH41-3AA0**
Suitable for Motor Module	6SL3325-	1TG34-7AA7	1TG35-8AA7	1TG38-1AA7	1TG41-0AA7	1TG41-3AA7
Type rating of the Motor Module	kW	450	560	800	1000	1200
Rated current	A	465	575	810	1025	1270
Power loss - at 50 Hz - at 150 Hz	 kW kW	 0.631 0.723	 0.705 0.801	 0.877 1.003	 0.927 1.052	 0.862 0.952
Connections - To the Motor Module (1U1, 1V1, 1W1) - Load (1U2, 1V2, 1W2) - PE		 M12 M12 M8	 M12 M12 M8	 M12 M12 M8	 M12 M12 M8	 M12 M12 M8
Max. permissible cable length between the motor reactor and motor - without motor reactor - for 1 motor reactor - for 2 motor reactors in series	 m m m	 300 (shielded) / 450 (unshielded) 300 (shielded) / 450 (unshielded) 525 (shielded) / 787 (unshielded)				
Degree of protection		IP00	IP00	IP00	IP00	IP00
Dimensions Width Height Depth	 mm mm mm	 410 392 292	 410 392 292	 410 392 279	 410 392 317	 460 392 296
Weight, approx.	kg	80	80	146	163	153

7.3 dv/dt filter with Voltage Peak Limiter

7.3.1 Description

The dv/dt filter plus voltage peak limiter comprises two components: the dv/dt reactor and the voltage-limiting network (voltage peak limiter), which cuts of the voltage peaks and returns energy to the DC link. The dv/dt filters plus voltage peak limiter must be used for motors for which the proof voltage of the insulation system is unknown or insufficient.

dv/dt filters plus voltage peak limiters limit the rate of voltage rise to values < 500 V/µs and the typical voltage peaks with rated line voltages to the values below:

< 1000 V at U_{line} < 575 V

< 1250 V at 660 V < U_{line} < 690 V.

Components

The article numbers of the individual components (dv/dt reactor and Voltage Peak Limiter) are listed in the following table:

Table 7- 11 dv/dt filter plus Voltage Peak Limiter, article numbers of the individual components

dv/dt filter plus voltage peak limiter	dv/dt reactor	Voltage peak limiter
Line voltage 3 AC 380 ... 480 V		
6SL3000-2DE32-6AA0	6SL3000-2DE32-6CA0	6SL3000-2DE32-6BA0
6SL3000-2DE35-0AA0	6SL3000-2DE35-0CA0	6SL3000-2DE35-0BA0
6SL3000-2DE38-4AA0	6SL3000-2DE38-4CA0	6SL3000-2DE38-4BA0
6SL3000-2DE41-4AA0	2 x 6SL3000-2DE41-4DA0	6SL3000-2DE41-4BA0
Line voltage 3 AC 500 ... 690 V		
6SL3000-2DH31-0AA0	6SL3000-2DH31-0CA0	6SL3000-2DH31-0BA0
6SL3000-2DH31-5AA0	6SL3000-2DH31-5CA0	6SL3000-2DH31-5BA0
6SL3000-2DH32-2AA0	6SL3000-2DH32-2CA0	6SL3000-2DH32-2BA0
6SL3000-2DH33-3AA0	6SL3000-2DH33-3CA0	6SL3000-2DH33-3BA0
6SL3000-2DH35-8AA0	6SL3000-2DH35-8CA0	6SL3000-2DH35-8BA0
6SL3000-2DH38-1AA0	2 x 6SL3000-2DH38-1DA0	6SL3000-2DH38-1BA0
6SL3000-2DH41-3AA0	2 x 6SL3000-2DH41-3DA0	6SL3000-2DH41-3BA0

Table 7- 12 Max. pulse frequency when a dv/dt filter is used with Power Modules and/or Motor Modules with a rated pulse frequency of 2 kHz

Article No.	Type rating [kW]	Output current for a pulse frequency of 2 kHz [A]	Max. pulse frequency when a dv/dt filter is used
Line voltage 3 AC 380 ... 480 V			
6SL3315-1TE32-1AA3 6SL3325-1TE32-1AA3	110	210	4 kHz
6SL3315-1TE32-6AA3 6SL3325-1TE32-6AA3	132	260	4 kHz
6SL3315-1TE33-1AA3 6SL3325-1TE33-1AA3	160	310	4 kHz
6SL3315-1TE35-0AA3 6SL3325-1TE35-0AA3	250	490	4 kHz

Table 7- 13 Max. pulse frequency when a dv/dt filter is used with Motor Modules with a rated pulse frequency of 1.25 kHz

Article No.	Type rating [kW]	Output current for a pulse frequency of 1.25 kHz [A]	Max. pulse frequency when a dv/dt filter is used
Line voltage 3 AC 380 ... 480 V			
6SL3325-1TE37-5AA7	400	745	2.5 kHz
6SL3325-1TE41-0AA7	560	985	2.5 kHz
6SL3325-1TE41-2AA7	710	1260	2.5 kHz
6SL3325-1TE41-4AA7	800	1405	2.5 kHz
Line voltage 3 AC 500 ... 690 V			
6SL3325-1TG31-0AA3	90	100	2.5 kHz
6SL3325-1TG31-5AA3	132	150	2.5 kHz
6SL3325-1TG32-2AA3	200	215	2.5 kHz
6SL3325-1TG33-3AA3	315	330	2.5 kHz
6SL3325-1TG34-7AA7	450	465	2.5 kHz
6SL3325-1TG35-8AA7	560	575	2.5 kHz
6SL3325-1TG38-1AA7	800	810	2.5 kHz
6SL3325-1TG41-0AA7	1000	1025	2.5 kHz
6SL3325-1TG41-3AA7	1200	1270	2.5 kHz

7.3.2 Safety information

WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

The non-observance of the fundamental safety instructions and residual risks stated in Chapter 1 can result in accidents with severe injuries or death.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

Inadequate ventilation clearances can cause overheating with a risk for personnel through smoke development and fire. Furthermore, an increased number of failures and shorter service life of the components can occur.

- Maintain 100 mm clearances above and below the components.

CAUTION

Risk of burns due to high surface temperature of the dv/dt reactor

The surface temperature of the dv/dt reactors may exceed 80 °C. You can get seriously burnt when touching the surface.

- Mount the dv/dt reactor so that it cannot be touched. If this is not possible, attach a clearly visible and understandable warning notice at hazardous positions.

NOTICE

Damage to the voltage peak limiter due to interchanged connections

The voltage peak limiter will be damaged if the input and output connections are interchanged.

- Connect the incoming cable from the DC link of the Motor Module to DCPS, DCNS.
- Connect the outgoing cable to the dv/dt reactor to 1U2, 1V2, 1W2.

NOTICE

Damage to the dv/dt filter by using components that have not been released

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

- Only use dv/dt filters that SIEMENS has approved for operation with SINAMICS.

NOTICE

Damage to the dv/dt filter by exceeding the maximum output frequency

The maximum permissible output frequency when using a dv/dt filter is 150 Hz. The dv/dt filter can be damaged if the output frequency is exceeded.

- Operate the dv/dt filter with a maximum output frequency of 150 Hz.

NOTICE

Damage to the dv/dt filter by exceeding the maximum pulse frequency

The maximum permissible pulse frequency when using a dv/dt filter is 2.5 kHz or 4 kHz. The dv/dt filter can be damaged if the pulse frequency is exceeded.

- When using the dv/dt filter, operate the Power Module or Motor Module with a maximum pulse frequency of 2.5 kHz or 4 kHz.

NOTICE

Damage to the dv/dt filter if it is not activated during commissioning

The dv/dt filter may be damaged if it is not activated during commissioning.

- Activate the dv/dt filter during commissioning via parameter p0230 = 2.

NOTICE

Damage to the dv/dt filter if a motor is not connected

dv/dt filters which are operated without a motor being connected can be damaged or destroyed.

- Never operate a dv/dt filter on the Power Module or Motor Module without a connected motor.

Note

Cable lengths

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

7.3.3 Interface description

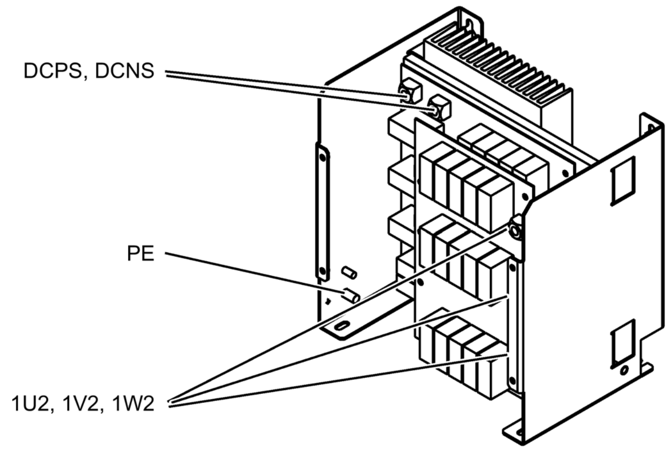


Figure 7-4 Interface overview, voltage peak limiter, type 1

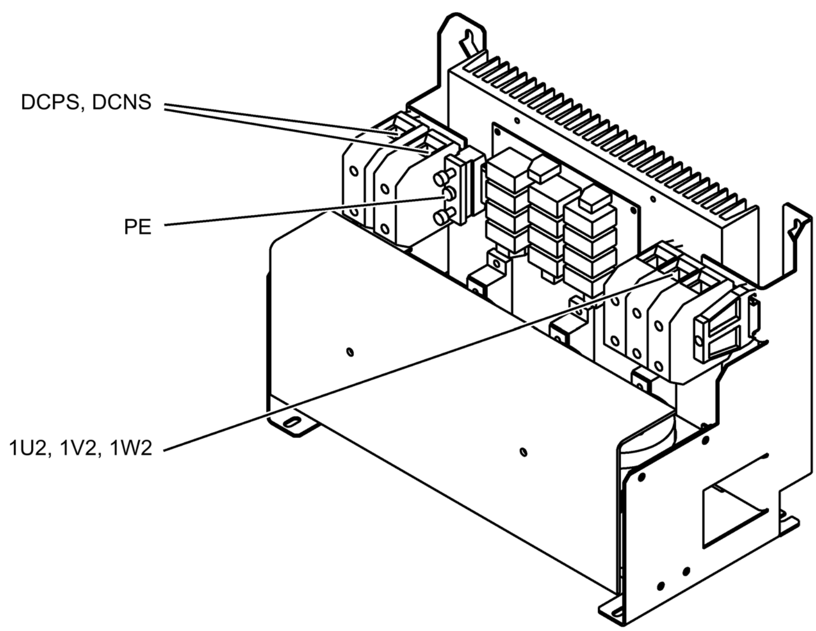


Figure 7-5 Interface overview, voltage peak limiter, type 2

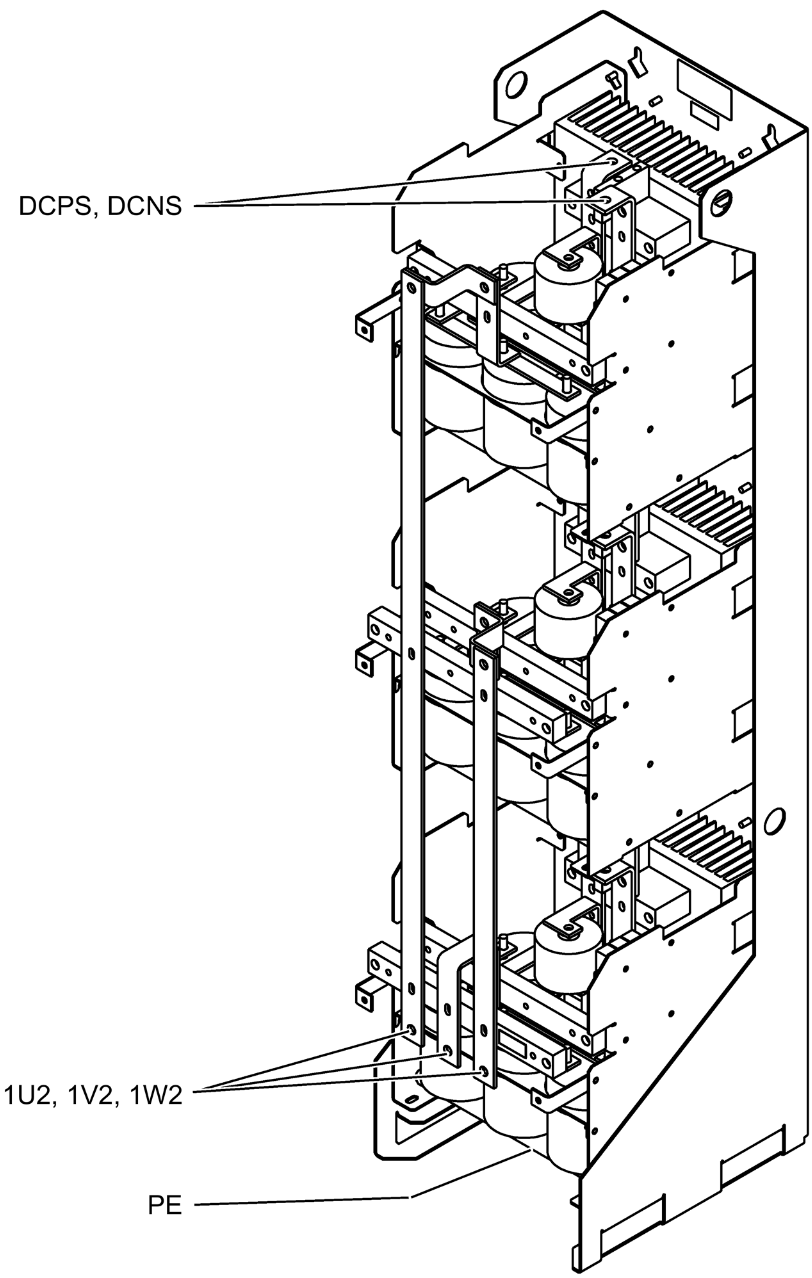


Figure 7-6 Interface overview, voltage peak limiter, type 3

7.3.4 Connecting the dv/dt filter plus Voltage Peak Limiter

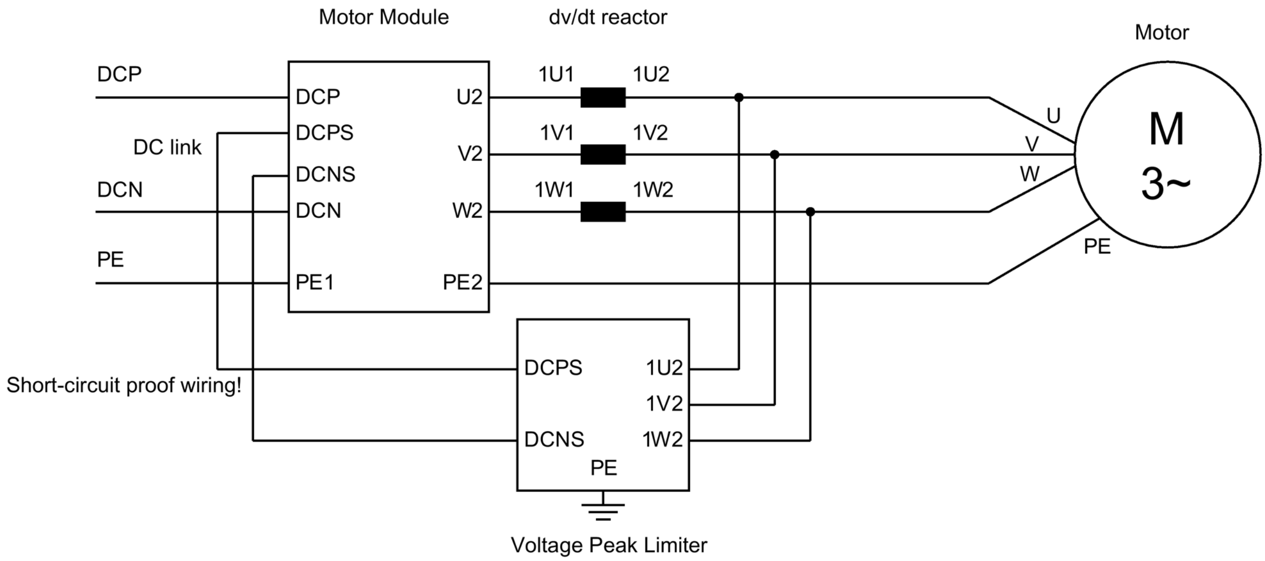


Figure 7-7 Connecting a dv/dt filter plus voltage peak limiter for versions with one dv/dt reactor

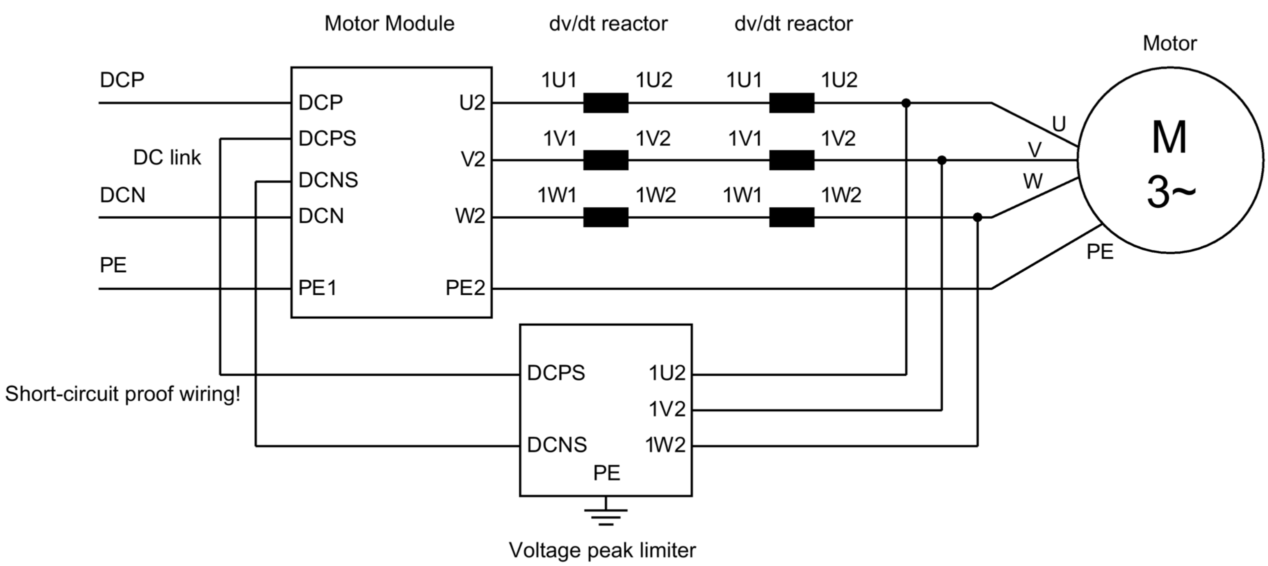


Figure 7-8 Connecting a dv/dt filter plus voltage peak limiter for versions with two dv/dt reactors

Cable cross-sections

Table 7- 14 Cable cross-sections for connections between the dv/dt filter plus voltage peak limiter and Power Module or Motor Module

dv/dt filter plus voltage peak limiter	Connection to the DC link (DCPS / DCNS) [mm²]	Connection between dv/dt reactor and voltage limiting network (1U2, 1V2, 1W2) [mm²]
Line voltage 3 AC 380 ... 480 V		
6SL3000-2DE32-6AA0	35	10
6SL3000-2DE35-0AA0	70	16
6SL3000-2DE38-4AA0	2 x 50	50
6SL3000-2DE41-4AA0	2 x 120	120
Line voltage 3 AC 500 ... 690 V		
6SL3000-2DH31-0AA0	16	6
6SL3000-2DH31-5AA0	16	6
6SL3000-2DH32-2AA0	70	16
6SL3000-2DH33-3AA0	70	16
6SL3000-2DH35-8AA0	120	35
6SL3000-2DH38-1AA0	2 x 70	70
6SL3000-2DH41-3AA0	2 x 120	120

⚠WARNING

Risk of fire due to ground fault / short-circuit

Inadequate installation of the cables to the Power Module or Motor Module DC link can result in a ground fault / short-circuit and place persons at risk as a result of the associated smoke and fire.

- Comply with local installation regulations that enable this fault to be ruled out.
- Protect the cables from mechanical damage.
- In addition, apply one of the following measures:
  - Use cables with double insulation.
  - Maintain adequate clearance, e.g. by using spacers.
  - Route the cables in separate cable ducts or pipes.

Note

Maximum cable lengths

The connections should be kept as short as possible.
The maximum cable length for the specified connections is 5 m in each case.

7.3.5 Dimension drawing, dv/dt reactor

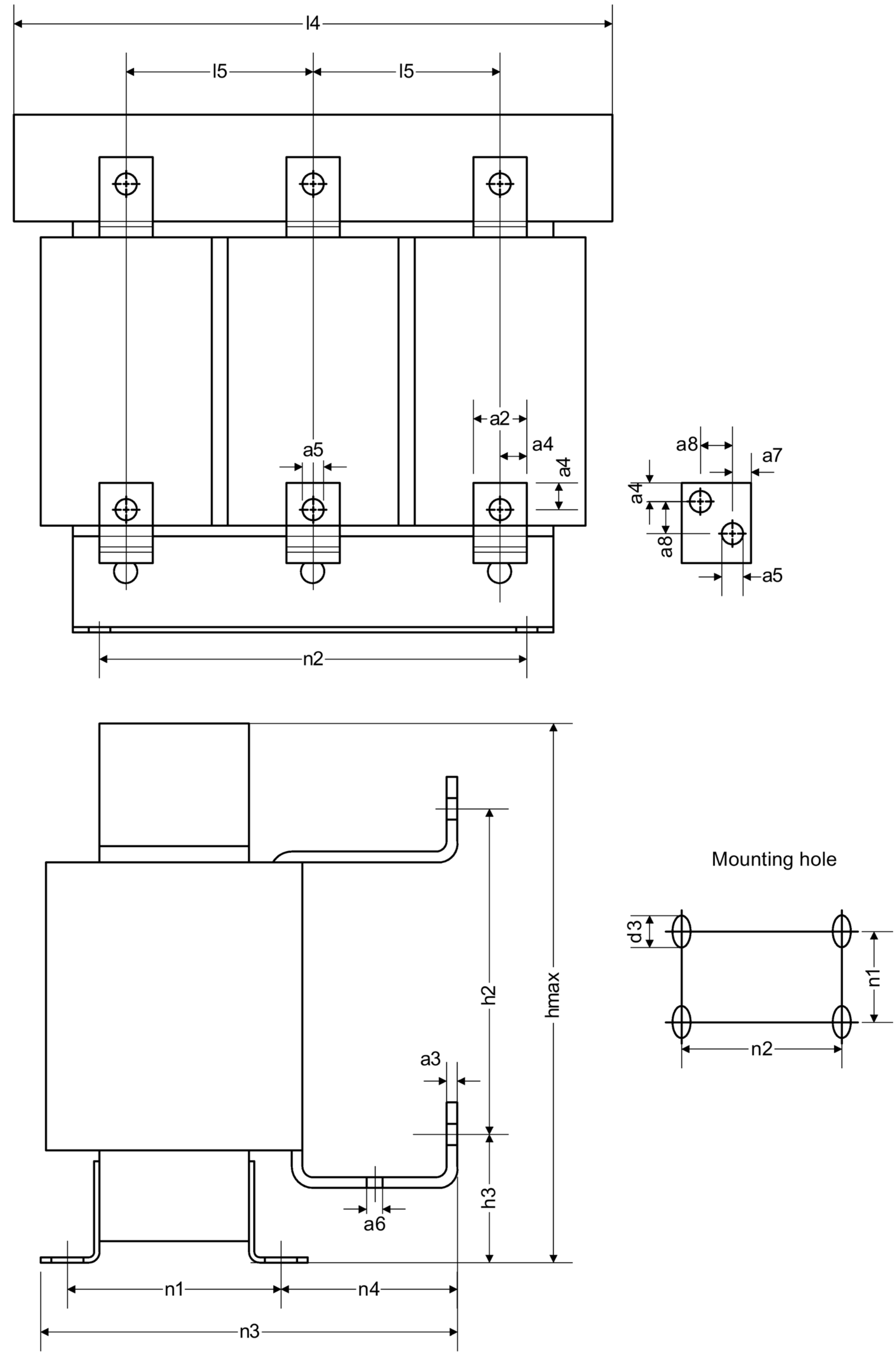


Figure 7-9 Dimension drawing, dv/dt reactor

Table 7- 15 Dimensions of dv/dt reactor, 380 V ... 480 V 3 AC (all dimensions in mm)

6SL3000-	2DE32-6CA0	2DE35-0CA0	2DE38-4CA0	2DE41-4CA0
a2	25	30	40	60
a3	5	6	8	10
a4	14	17	22	19
a5	10.5 x 14	14 x 18	14 x 18	14 x 18
a6	7	9	11	11
a7	-	-	-	17
a8	-	-	-	26
l4	410	460	460	445
l5	135	152.5	152.5	145
hmax	370	370	385	385
h2	258	240	280	250
h3	76	83	78	121
n1 [1)]	141	182	212	212
n2 [1)]	316	356	356	341
n3	229	275	312	312
n4	72	71	78	78
d3	M10 (12 x 18)	M12 (15 x 22)	M12 (15 x 22)	M12 (15 x 22)

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

Table 7- 16 Dimensions of dv/dt reactor, 500 V ... 690 V, Part 1 (all values in mm)

6SL3000-	2DH31-0CA0	2DH31-5CA0	2DH32-2CA0	2DH33-3CA0
a2	25	25	25	25
a3	6	6	5	5
a4	14	14	14	14
a5	10.5 x 14	10.5 x 14	10.5 x 14	10.5 x 14
a6	7	7	7	9
a7	-	-	-	-
a8	-	-	-	-
l4	350	350	460	460
l5	120	120	152.5	152.5
hmax	320	320	360	360
h2	215	215	240	240
h3	70	70	86	86
n1 [1)]	138	138	155	212
n2 [1)]	264	264	356	356
n3	227	227	275	275
n4	74	74	101	42
d3	M8	M8	M12 (15 x 22)	M12 (15 x 22)

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

Table 7- 17 Dimensions of dv/dt reactor, 500 V ... 690 V, Part 2 (all values in mm)

6SL3000-	2DH35-8CA0	2DH38-1DA0	2DH41-3DA0	
a2	40	50	60	
a3	8	8	10	
a4	22	16	19	
a5	14 x 18	14 x 18	14 x 18	
a6	11	11	11	
a7	-	14	17	
a8	-	22	26	
l4	460	445	445	
l5	152.5	145	145	
hmax	385	385	385	
h2	280	255	250	
h3	78	114	121	
n1 [1)]	212	212	212	
n2 [1)]	365	341	341	
n3	312	312	312	
n4	78	78	78	
d3	M12 (15 x 22)	M12 (15 x 22)	M12 (15 x 22)	

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

7.3.6 Dimension drawing of the voltage peak limiter

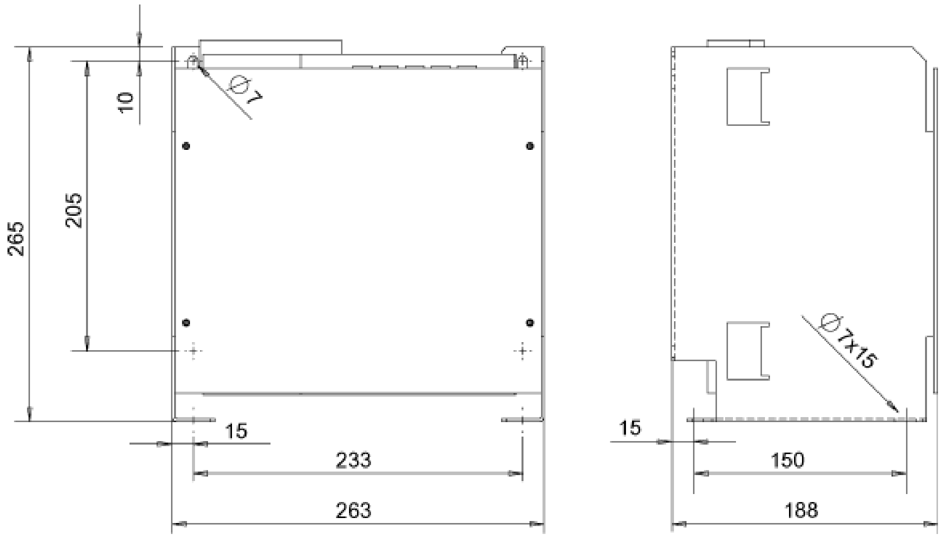


Figure 7-10 Dimension drawing of the voltage peak limiter, type 1

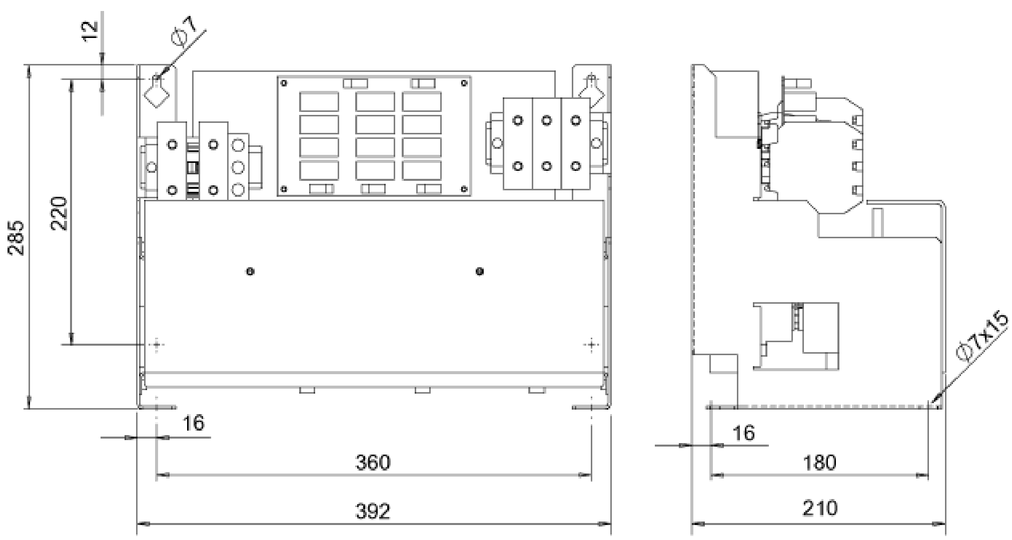


Figure 7-11 Dimension drawing of the voltage peak limiter, type 2

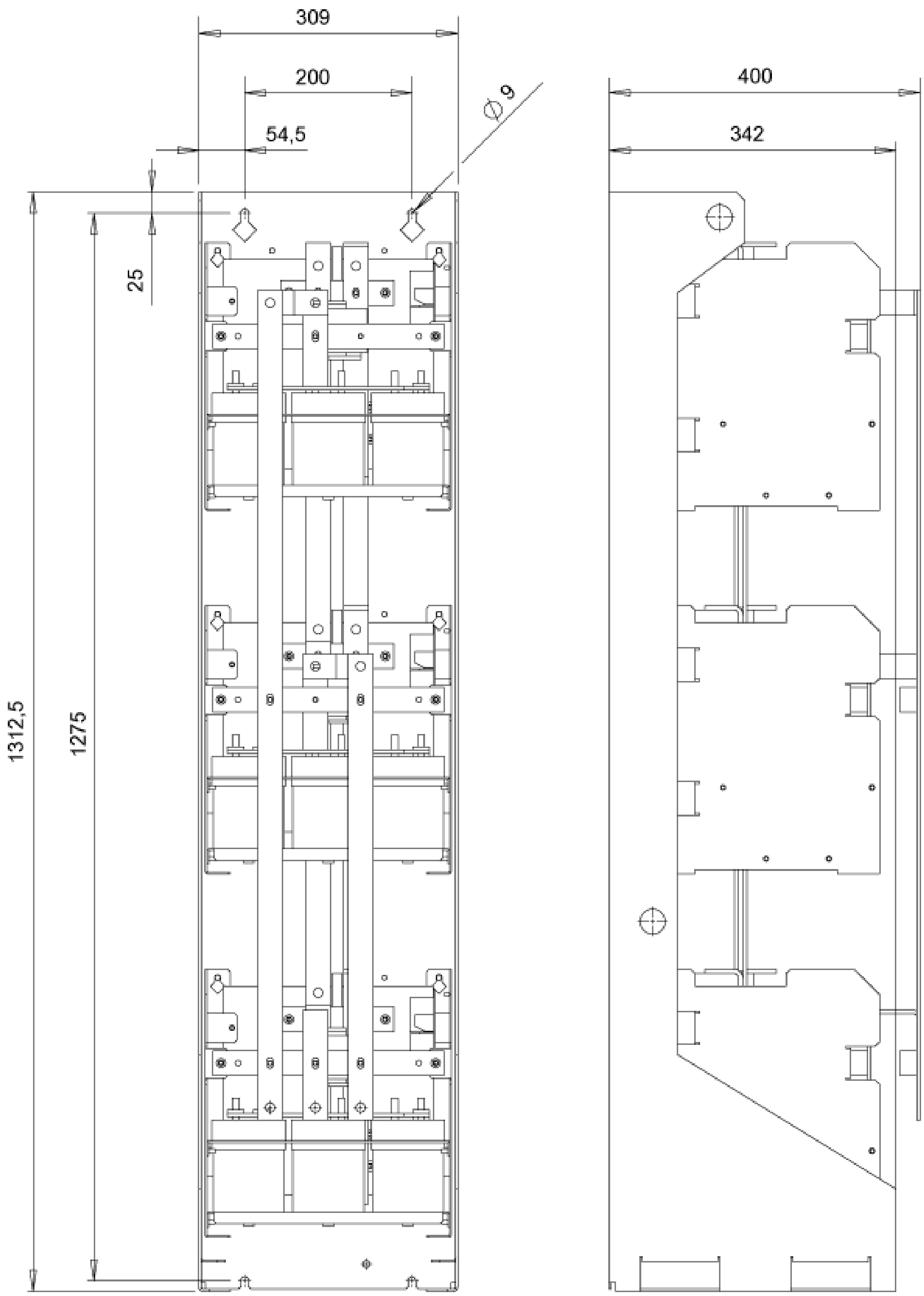


Figure 7-12 Dimension drawing of the voltage peak limiter, type 3

Table 7- 18 Assigning voltage peak limiters to dimension drawings

Voltage peak limiter	Dimension drawing type
Line voltage 3 AC 380 ... 480 V	
6SL3000-2DE32-6BA0	Type 1
6SL3000-2DE35-0BA0	Type 2
6SL3000-2DE38-4BA0	Type 3
6SL3000-2DE41-4BA0	Type 3
Line voltage 3 AC 500 ... 690 V	
6SL3000-2DH31-0BA0	Type 1
6SL3000-2DH31-5BA0	Type 1
6SL3000-2DH32-2BA0	Type 2
6SL3000-2DH33-3BA0	Type 2
6SL3000-2DH35-8BA0	Type 3
6SL3000-2DH38-1BA0	Type 3
6SL3000-2DH41-3BA0	Type 3

7.3.7 Technical data

Table 7- 19 Technical data of the dv/dt filter plus voltage peak limiter, 380 V ... 480 V 3 AC

Article number	**6SL3000-**	**2DE32-6AA0**	**2DE35-0AA0**	**2DE38-4AA0**	**2DE41-4AA0** [1)]
Suitable for Power Module	6SL3315-	1TE32-1AA3 1TE32-6AA3	1TE33-1AA3 1TE35-0AA3	--	--
Suitable for Motor Module	6SL3325-	1TE32-1AA3 1TE32-6AA3	1TE33-1AA3 1TE35-0AA3	1TE37-5AA7	1TE41-0AA7 1TE41-2AA7 1TE41-4AA7
Type rating of Power Module or Motor Module	kW	110 / 132	160 / 250	400	560 / 710 / 800
I_{thmax}	A	260	490	840	1405
Degree of protection		IP00	IP00	IP00	IP00
dv/dt reactor					
Power loss - at 50 Hz - at 60 Hz - at 150 Hz	 kW kW kW	 0.701 0.729 0.78	 0.874 0.904 0.963	 1.106 1.115 1.226	 1.111 1.154 1.23
Connections - To the Motor Module - Load - PE		 M10 M10 M6	 M12 M12 M6	 M12 M12 M6	 2 x M12 2 x M12 M6
Max. permissible cable length between dv/dt reactor and motor	m	300 (shielded) 450 (unshielded)			
Dimensions Width Height Depth	 mm mm mm	 410 370 229	 460 370 275	 460 385 312	 445 385 312
Weight, approx.	kg	66	122	149	158
Voltage peak limiter					
Power loss - at 50 Hz - at 60 Hz - at 150 Hz	 kW kW kW	 0.029 0.027 0.025	 0.042 0.039 0.036	 0.077 0.072 0.066	 0.134 0.125 0.114
Connections - To the dv/dt reactor - DC - PE		 M8 M8 M8	 Terminal 70 mm² Terminal 70 mm² Terminal 35 mm²	 M8 M8 M8	 M10 M10 M8
Dimensions Width Height Depth	 mm mm mm	 263 265 188	 392 285 210	 309 1312.5 400	 309 1312.5 400
Weight, approx.	kg	6	16	48	72

1) Two dv/dt reactors are required for these dv/dt filters. The technical data provided apply to one dv/dt reactor.

Note

Cable lengths for versions with two dv/dt reactors

For versions with two dv/dt reactors, the cable lengths specified in the table do not change.

Table 7- 20 Technical data of the dv/dt filter plus voltage peak limiter, 500 V ... 690 V 3 AC, Part 1

Article number	**6SL3000-**	**2DH31-0AA0**	**2DH31-5AA0**	**2DH32-2AA0**	**2DH33-3AA0**
Suitable for Motor Module	6SL3325-	1TG31-0AA3	1TG31-5AA3	1TG32-2AA3	1TG33-3AA3
Type rating of the Motor Module	kW	90	132	200	315
I_{thmax}	A	100	150	215	330
Degree of protection		IP00	IP00	IP00	IP00
dv/dt reactor					
Power loss - at 50 Hz - at 60 Hz - at 150 Hz	 kW kW kW	 0.49 0.508 0.541	 0.389 0.408 0.436	 0.578 0.604 0.645	 0.595 0.62 0.661
Connections - To the Motor Module - Load - PE		 M10 M10 M6	 M10 M10 M6	 M10 M10 M6	 M10 M10 M6
Max. permissible cable length between dv/dt reactor and motor	m	300 (shielded) 450 (unshielded)			
Dimensions Width Height Depth	 mm mm mm	 350 320 227	 350 320 227	 460 360 275	 460 360 275
Weight, approx.	kg	48	50	83	135
Voltage limiting network (Voltage Peak Limiter)					
Power loss - at 50 Hz - at 60 Hz - at 150 Hz	 kW kW kW	 0.016 0.015 0.013	 0.020 0.019 0.018	 0.032 0.03 0.027	 0.042 0.039 0.036
Connections - To the dv/dt reactor - DC - PE		 M8 M8 M8	 M8 M8 M8	 Terminal 70 mm² Terminal 70 mm² Terminal 35 mm²	 Terminal 70 mm² Terminal 70 mm² Terminal 35 mm²
Dimensions Width Height Depth	 mm mm mm	 263 265 188	 263 265 188	 392 285 210	 392 285 210
Weight, approx.	kg	6	6	16	16

Table 7- 21 Technical data of the dv/dt filter plus voltage peak limiter, 500 V ... 690 V 3 AC, Part 2

Article number	**6SL3000-**	**2DH35-8AA0**	**2DH38-1AA0** [1]	**2DH41-3AA0** [1]	
Suitable for Motor Module	6SL3325-	1TG34-7AA7 1TG35-8AA7	1TG38-1AA7	1TG41-0AA7 1TG41-3AA7	
Type rating of the Motor Module	kW	450 / 560	800	1000 / 1200	
I_{thmax}	A	575	810	1270	
Degree of protection		IP00	IP00	IP00	
dv/dt reactor					
Power loss - at 50 Hz - at 60 Hz - at 150 Hz	 kW kW kW	 0.862 0.902 0.964	 0.828 0.867 0.927	 0.865 0.904 0.966	
Connections - To the Motor Module - Load - PE		 M12 M12 M6	 2 x M12 2 x M12 M6	 2 x M12 2 x M12 M6	
Max. permissible cable length between dv/dt reactor and motor	m	300 (shielded) 450 (unshielded)			
Dimensions Width Height Depth	 mm mm mm	 460 385 312	 445 385 312	 445 385 312	
Weight, approx.	kg	172	160	164	
Voltage peak limiter					
Power loss - at 50 Hz - at 60 Hz - at 150 Hz	 kW kW kW	 0.063 0.059 0.054	 0.106 0.1 0.091	 0.15 0.14 0.128	
Connections - To the dv/dt reactor - DC - PE		 M8 M8 M8	 M10 M10 M8	 M10 M10 M8	
Dimensions Width Height Depth	 mm mm mm	 309 1312.5 400	 309 1312.5 400	 309 1312.5 400	
Weight, approx.	kg	48	72	72	

[1] Two dv/dt reactors are required for these dv/dt filters. The technical data provided apply to one dv/dt reactor.

Note

Cable lengths for versions with two dv/dt reactors

For versions with two dv/dt reactors, the cable lengths specified in the table do not change.

7.4 dv/dt filter compact plus voltage peak limiter

7.4.1 Description

The dv/dt filter compact plus voltage peak limiter comprises two components: the dv/dt reactor and the voltage-limiting network (voltage peak limiter), which cuts off the voltage peaks and feeds back the energy into the DC link. The dv/dt filter compact plus voltage peak limiter is designed for use with motors for which the voltage strength of the insulation system is unknown or insufficient.

dv/dt filters compact plus Voltage Peak Limiters limit the voltage rate of rise dv/dt to values < 1600 V/µs - and the typical voltage peaks to the following values according to limit value curve A acc. to IEC 60034-25:2007:

- < 1150 V at U_{line} < 575 V
- < 1400 V at 660 V < U_{line} < 690 V.

Note

Setting range for pulse frequencies

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

Note

Current derating at increased pulse frequency

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

Note

Components of the dv/dt filter

The dv/dt filters compact plus voltage peak limiter of Types 1 to 3 consist of one single component. Type 4 consists of two separate components, the dv/dt reactor and the voltage peak limiter.

Table 7- 22 Max. pulse frequency when a dv/dt filter compact plus voltage peak limiter is used in Power Modules or Motor Modules with a rated pulse frequency of 2 kHz

Article number of Power Module or Motor Module	Type rating [kW]	Output current for a pulse frequency of 2 kHz [A]	Max. pulse frequency when a dv/dt filter compact plus voltage peak limiter is used
Line voltage 3 AC 380 ... 480 V			
6SL3315-1TE32-1AA3 6SL3325-1TE32-1AA3	110	210	4 kHz
6SL3315-1TE32-6AA3 6SL3325-1TE32-6AA3	132	260	4 kHz
6SL3315-1TE33-1AA3 6SL3325-1TE33-1AA3	160	310	4 kHz
6SL3315-1TE35-0AA3 6SL3325-1TE35-0AA3	250	490	4 kHz

Table 7- 23 Max. pulse frequency when a dv/dt filter compact plus voltage peak limiter is used in Motor Modules with a rated pulse frequency of 1.25 kHz

Article No. of the Motor Module	Type rating [kW]	Output current for a pulse frequency of 1.25 kHz [A]	Max. pulse frequency when a dv/dt filter compact plus voltage peak limiter is used
Line voltage 3 AC 380 ... 480 V			
6SL3325-1TE37-5AA7	400	745	2.5 kHz
6SL3325-1TE41-0AA7	560	985	2.5 kHz
6SL3325-1TE41-2AA7	710	1260	2.5 kHz
6SL3325-1TE41-4AA7	800	1405	2.5 kHz
Line voltage 3 AC 500 ... 690 V			
6SL3325-1TG31-0AA3	90	100	2.5 kHz
6SL3325-1TG31-5AA3	132	150	2.5 kHz
6SL3325-1TG32-2AA3	200	215	2.5 kHz
6SL3325-1TG33-3AA3	315	330	2.5 kHz
6SL3325-1TG34-7AA7	450	465	2.5 kHz
6SL3325-1TG35-8AA7	560	575	2.5 kHz
6SL3325-1TG38-1AA7	800	810	2.5 kHz
6SL3325-1TG41-0AA7	1000	1025	2.5 kHz
6SL3325-1TG41-3AA7	1200	1270	2.5 kHz

7.4.2 Safety information

⚠ WARNING
Danger to life if the fundamental safety instructions and remaining risks are not carefully observed
The non-observance of the fundamental safety instructions and residual risks stated in Chapter 1 can result in accidents with severe injuries or death.
• Adhere to the fundamental safety instructions.
• When assessing the risk, take into account residual risks.

⚠ WARNING
Fire hazard due to overheating because of inadequate ventilation clearances
Inadequate ventilation clearances can cause overheating with a risk for personnel through smoke development and fire. Furthermore, an increased number of failures and shorter service life of the components can occur.
• Maintain 100 mm clearances above and below the components.
• Always mount the dv/dt filters compact plus voltage peak limiter in a vertical, upright position, to enable cooling air to flow through the heat sink on the voltage peak limiter from the bottom to the top.

⚠ CAUTION
Risk of burns due to high surface temperature of the dv/dt filter compact
The surface temperature of the dv/dt filters compact may exceed 80 °C. You can get seriously burnt when touching the surface.
• Mount the dv/dt filters compact so that they cannot be touched. If this is not possible, attach a clearly visible and understandable warning notice at hazardous positions.

NOTICE
Damage to the voltage peak limiter due to interchanged connections
The Voltage Peak Limiter will be damaged if the input and output connections are interchanged on devices with the article numbers 6SL3000-2DE41-4EA0, 6SL3000-2DG38-1EA0, and 6SL3000-2DG41-3EA0.
• Connect the incoming cable from the DC link of the Motor Module to DCPS, DCNS.
• Connect the outgoing cable to the dv/dt reactor to 1U2, 1V2, 1W2.

NOTICE

Damage to the dv/dt filter compact by using components that have not been released

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

- Only use a dv/dt filter compact that SIEMENS has approved for operation with SINAMICS.

NOTICE

Damage to the dv/dt filter by exceeding the maximum output frequency

The maximum permissible output frequency when a dv/dt filter compact is used is 150 Hz. The dv/dt filter compact can be damaged if the output frequency is exceeded.

- Operate the dv/dt filter compact with a maximum output frequency of 150 Hz.

NOTICE

Damage to the dv/dt filter compact during continuous operation with low output frequencies

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

- When using a dv/dt filter compact plus voltage peak limiter do not operate the drive continuously with an output frequency less than 10 Hz.
- You may operate the drive for a maximum load duration of 5 minutes at an output frequency less than 10 Hz, provided that you then select operation with an output frequency higher than 10 Hz for a period of 5 minutes.

NOTICE

Damage to the dv/dt filter compact by exceeding the maximum pulse frequency

The maximum permissible pulse frequency when a dv/dt filter compact is used is 2.5 kHz or 4 kHz. The dv/dt filter compact can be damaged if the pulse frequency is exceeded.

- When using the dv/dt filter compact, operate the Power Module or Motor Module with a maximum pulse frequency of 2.5 kHz or 4 kHz.

NOTICE

Damage to the dv/dt filter compact if it is not activated during commissioning

The dv/dt filter compact may be damaged if it is not activated during commissioning.

- Activate the dv/dt filter compact during commissioning using parameter p0230 = 2.

NOTICE

Damage to the dv/dt filter compact if a motor is not connected

dv/dt filters compact which are operated without a motor being connected can be damaged or destroyed.

- Never operate a dv/dt filter compact connected to the Power Module or Motor Module without a connected motor.

Note

Cable lengths

Keep the connecting cables to the Power Module or Motor Module as short as possible (max. 5 m). Use an equivalent cable type when replacing the cables supplied.

7.4.3 Interface description

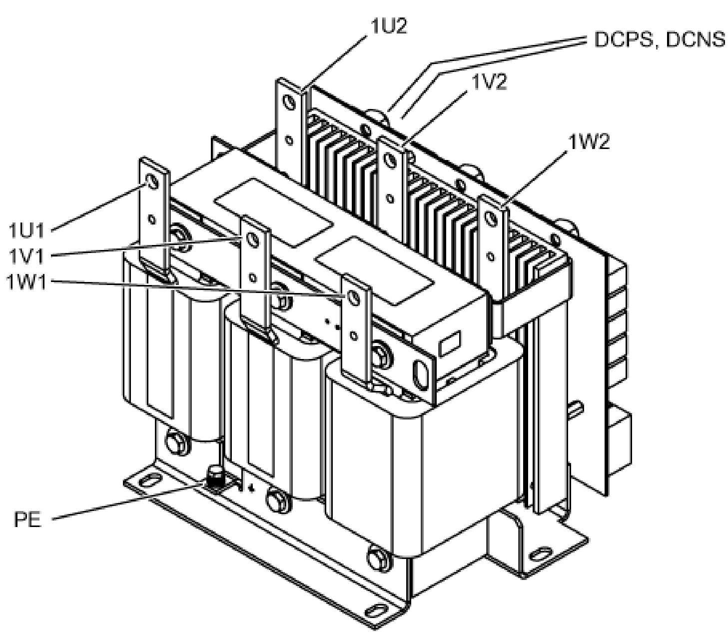


Figure 7-13 Interface overview, dv/dt filter compact plus voltage peak limiter, type 1

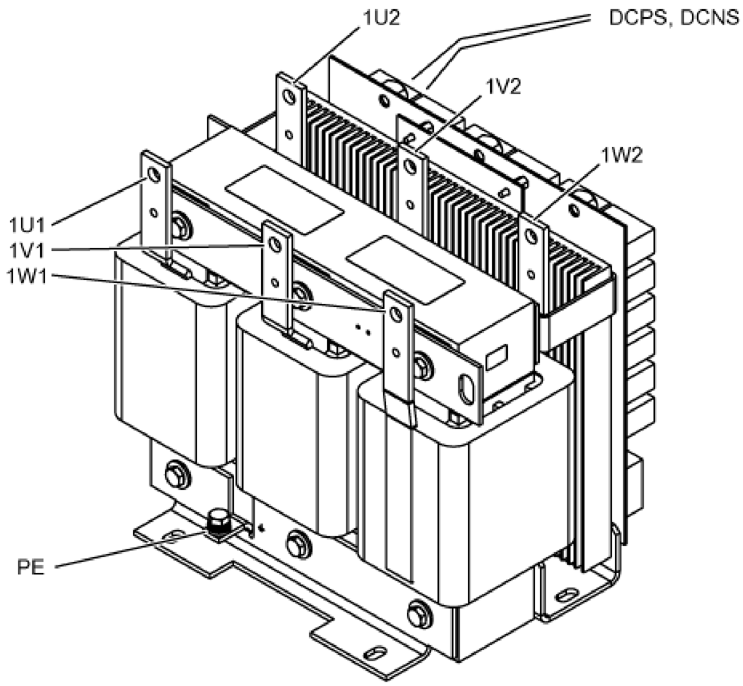


Figure 7-14 Interface overview, dv/dt filter compact plus Voltage Peak Limiter, type 2

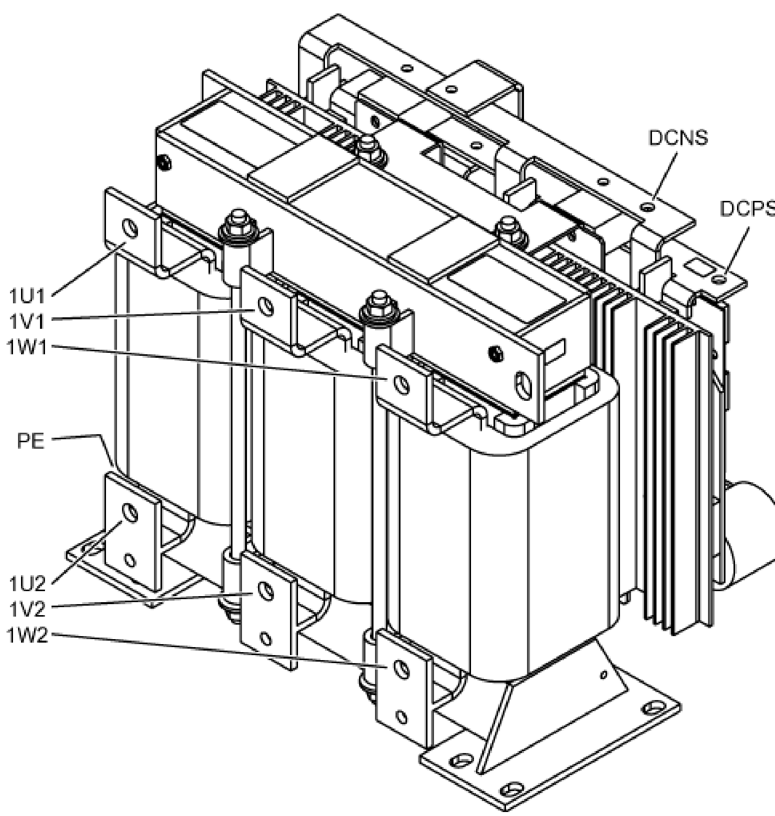


Figure 7-15 Interface overview, dv/dt filter compact plus voltage peak limiter, type 3

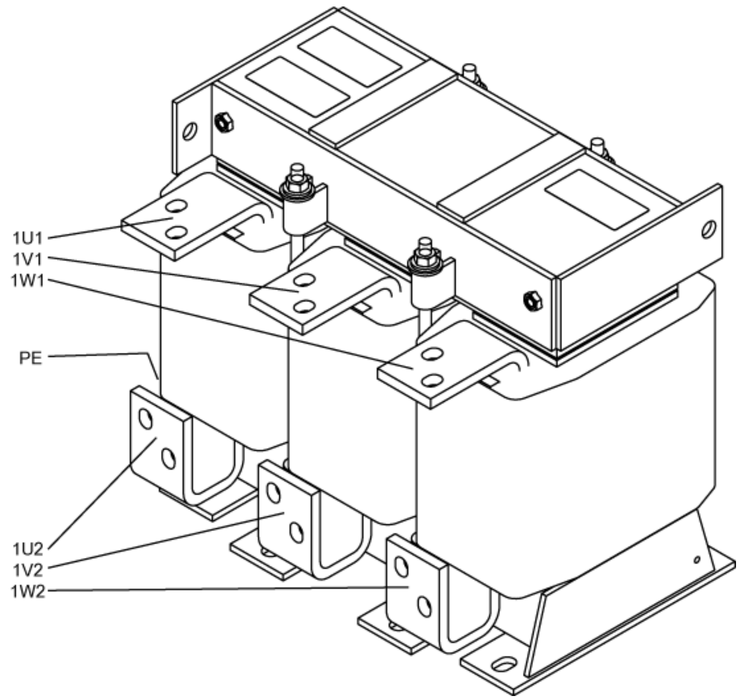


Figure 7-16 Interface overview for dv/dt filter compact plus Voltage Peak Limiter, Type 4 dv/dt reactor

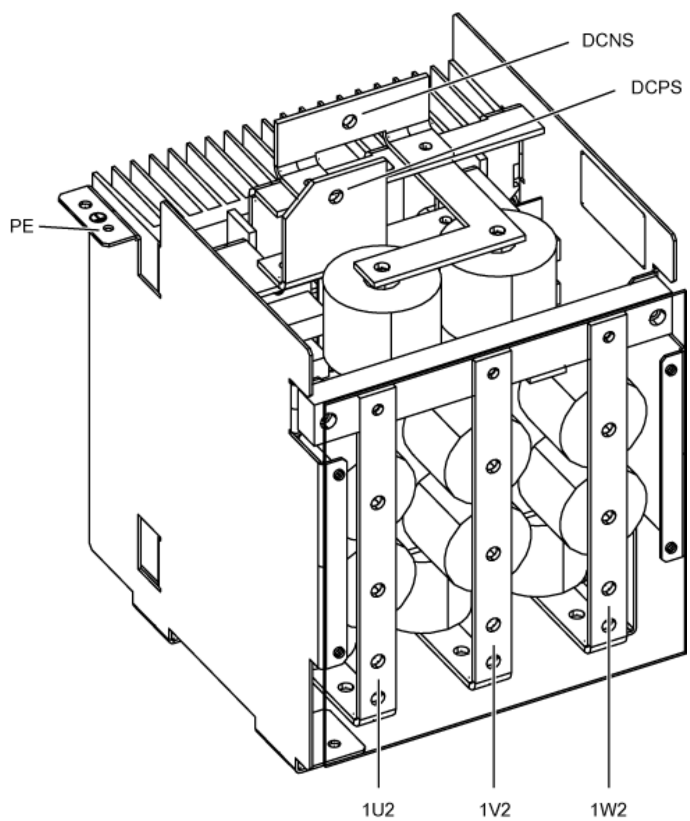


Figure 7-17 Interface overview for dv/dt filter compact plus Voltage Peak Limiter, Type 4 Voltage Peak Limiter

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

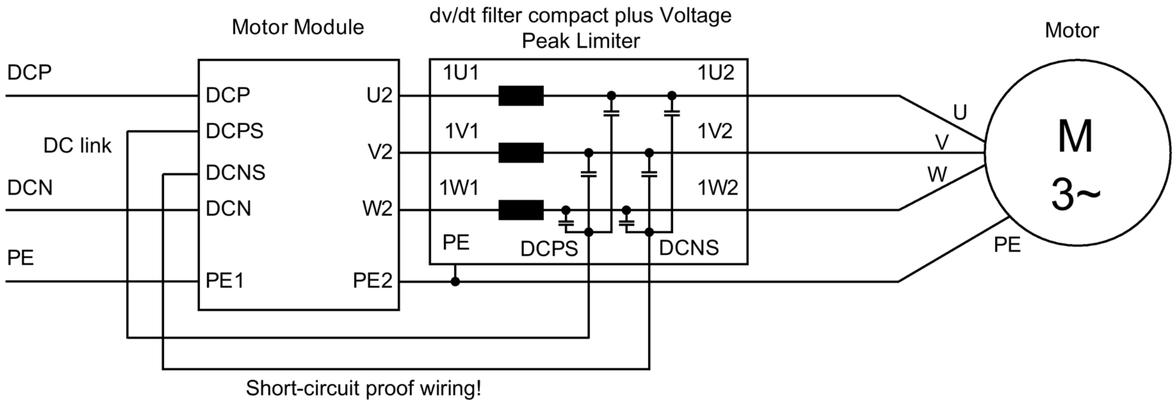


Figure 7-18 Connecting the dv/dt filter compact plus voltage peak limiter - integrated unit

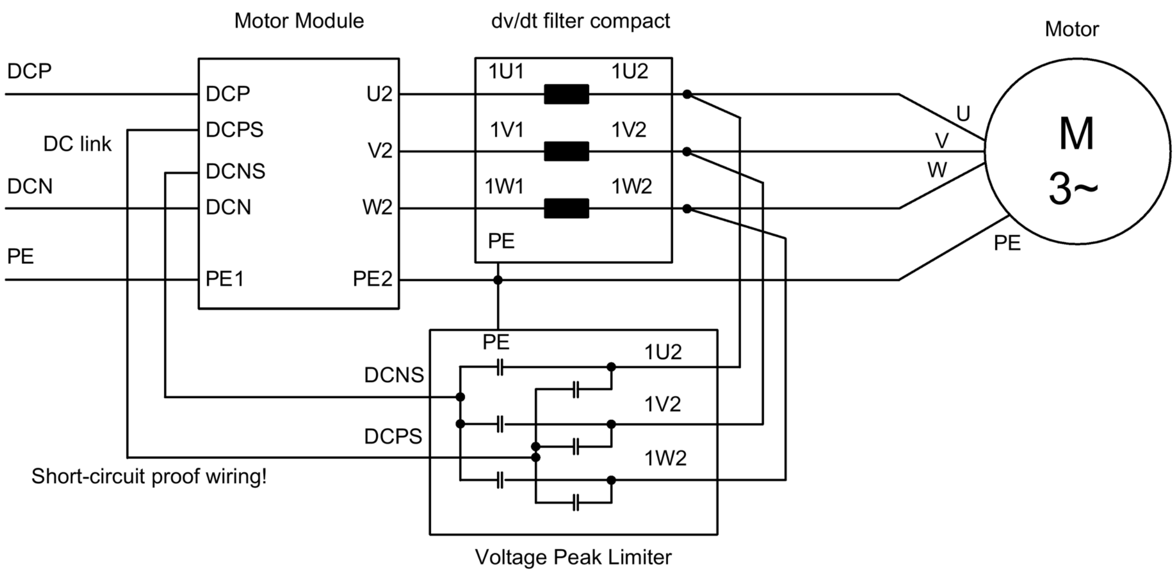


Figure 7-19 Connecting the dv/dt filter compact plus voltage peak limiter - separate components

Cable cross-sections

In a dv/dt filter with separate voltage peak limiter (Type 4), the connections between dv/dt reactor and voltage peak limiter are already installed on the voltage peak limiter.

Table 7- 24 Cable cross-sections for connections between a dv/dt filter and Motor Module

dv/dt filter compact plus voltage peak limiter	Cross-section [mm²]	Connection on dv/dt filter
Type 1	16	M8 screw/12 Nm
Type 2	25	M8 screw/12 Nm

dv/dt filter compact plus voltage peak limiter	Cross-section [mm²]	Connection on dv/dt filter
Type 3	50	Copper bar for M8 bolt / 12 Nm
Type 4	95	Copper bar for M8 bolt / 12 Nm

Table 7- 25 Connection cable enclosed for connecting dv/dt reactor and voltage peak limiter

Voltage peak limiter	Cross-section [mm²]	Lug for connecting 1U2 / 1V2 / 1W2 on the dv/dt reactor
Type 4	70	M12

Cable type: 600 V, UL style 3271, operating temperature 125° C

⚠WARNING

Risk of fire due to ground fault / short-circuit

Inadequate installation of the cables to the Motor Module DC link can result in a ground fault/short-circuit and place persons at risk as a result of the associated smoke and fire.

- Comply with local installation regulations that enable this fault to be ruled out.
- Protect the cables from mechanical damage.
- In addition, apply one of the following measures:
  - Use cables with double insulation.
  - Maintain adequate clearance, e.g. by using spacers.
  - Route the cables in separate cable ducts or pipes.

Note

Maximum cable lengths

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

An equivalent cable type must be used when replacing enclosed cables.

⚠WARNING

Damage to the dv/dt filter compact through mechanical load on the connections

The connections at the dv/dt filter compact are not designed for direct mechanical connection to the motor cables.

- Take measures on the installation to ensure that the connections cannot be deformed by the mechanical load exerted by the connected cables.

7.4.5 Dimension drawing for dv/dt filter compact plus Voltage Peak Limiter

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

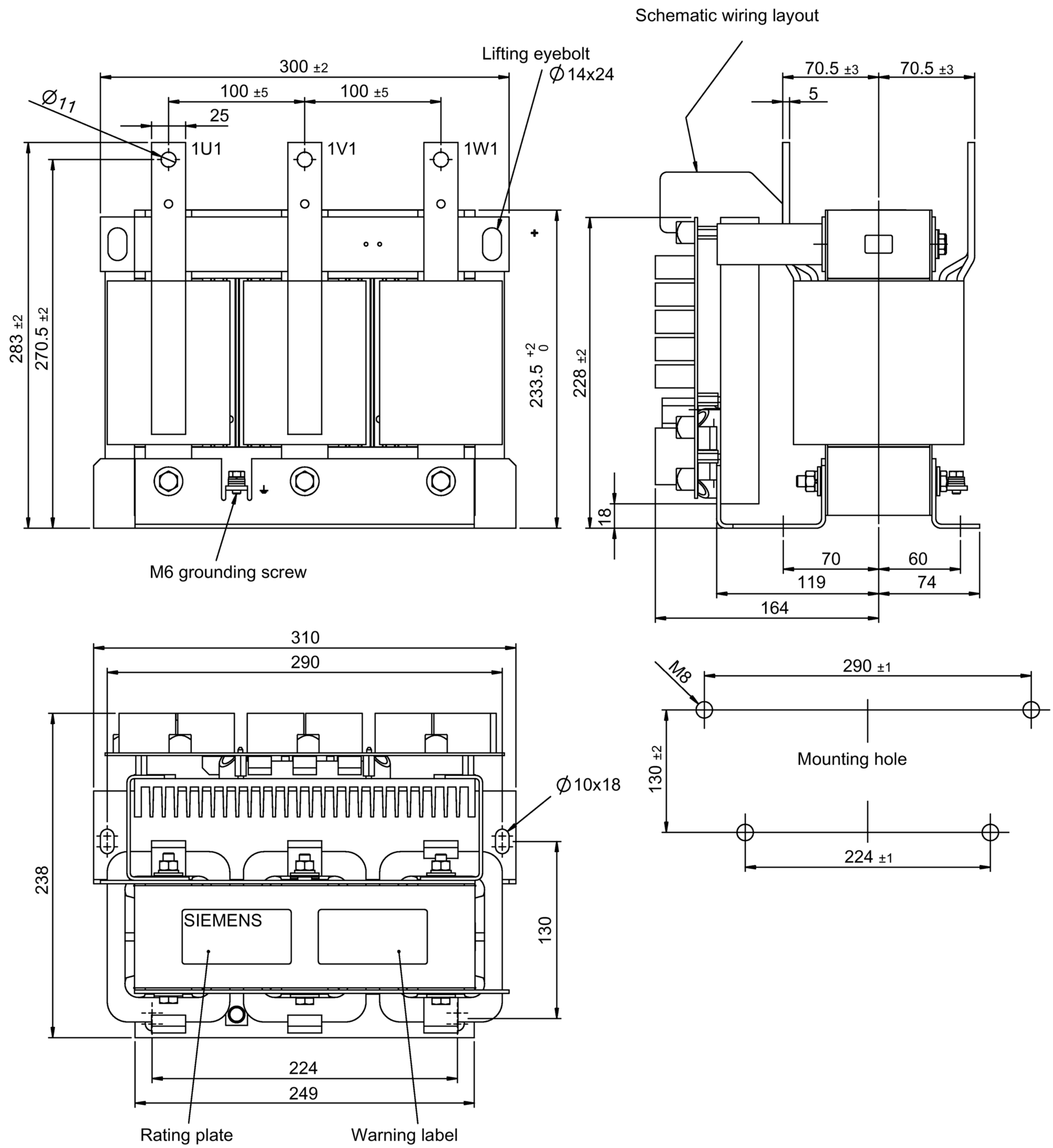


Figure 7-20 Dimension drawing for dv/dt filter compact plus Voltage Peak Limiter, type 1

dv/dt filter compact plus voltage peak limiter, type 2

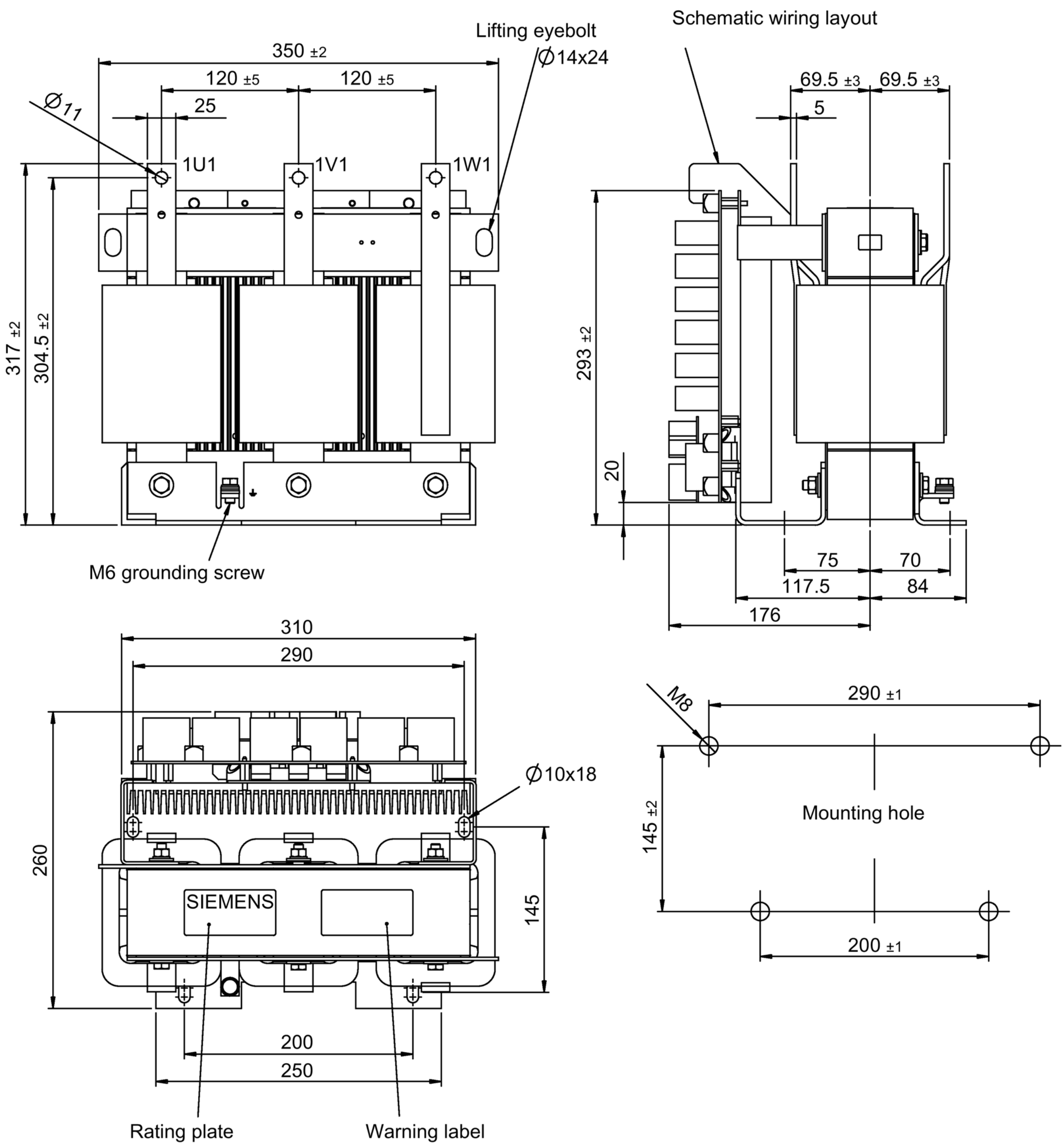


Figure 7-21 Dimension drawing for dv/dt filter compact plus Voltage Peak Limiter, type 2

dv/dt filter compact plus voltage peak limiter, type 3

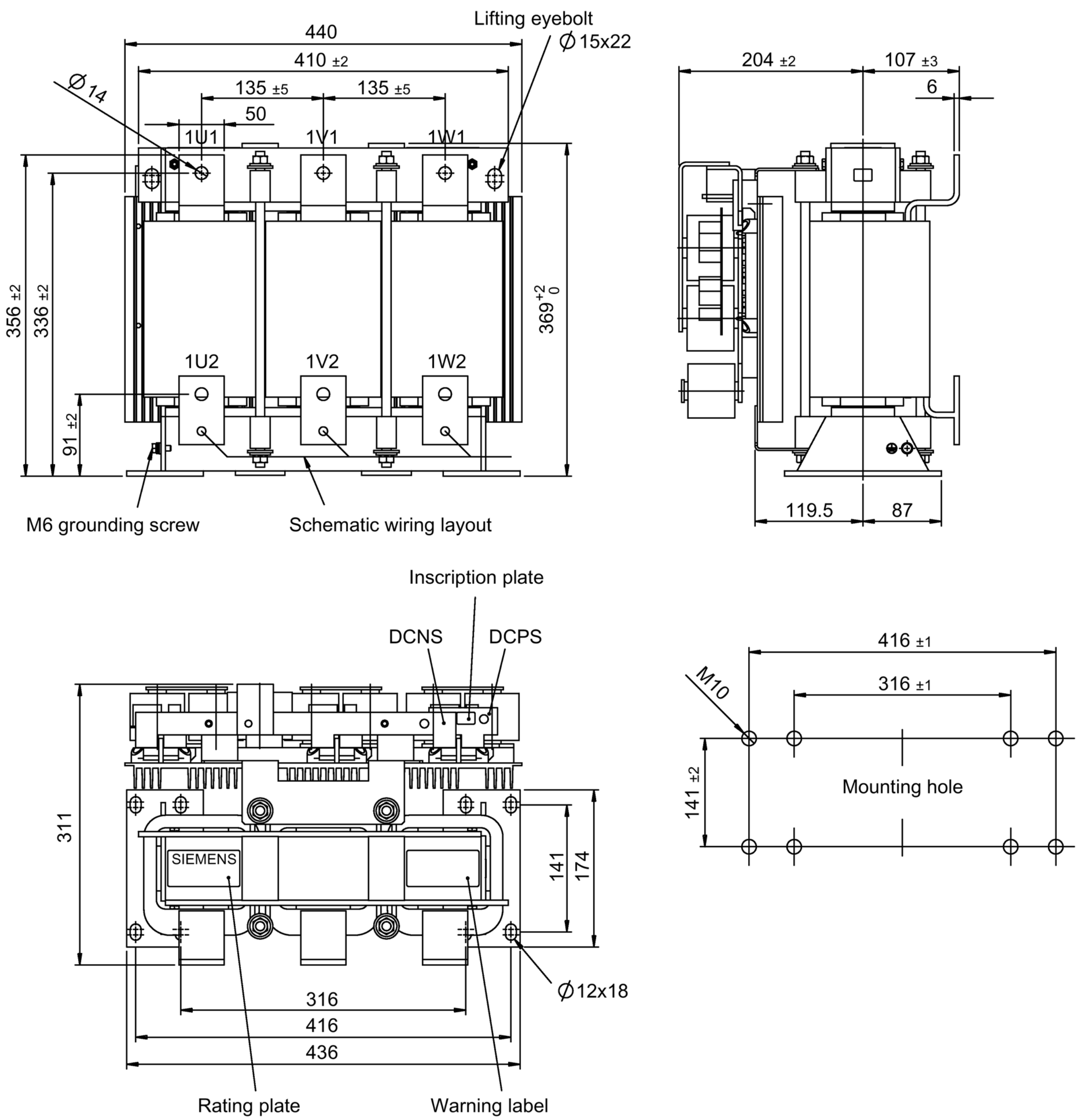


Figure 7-22 Dimension drawing for dv/dt filter compact plus voltage peak limiter, type 3

dv/dt filter compact plus voltage peak limiter, type 4

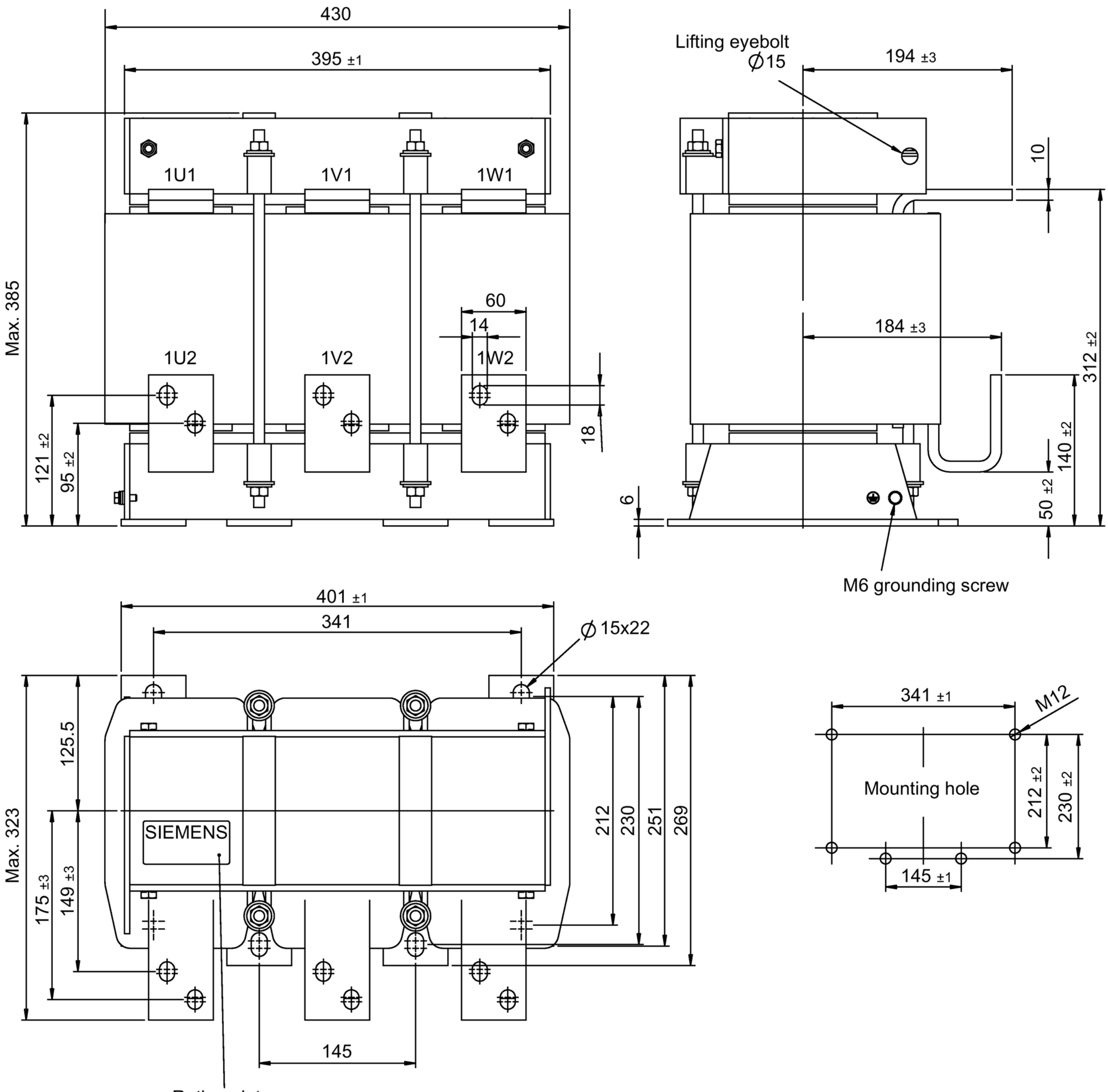


Figure 7-23 Dimension drawing for dv/dt filter compact plus voltage peak limiter, type 4 dv/dt reactor

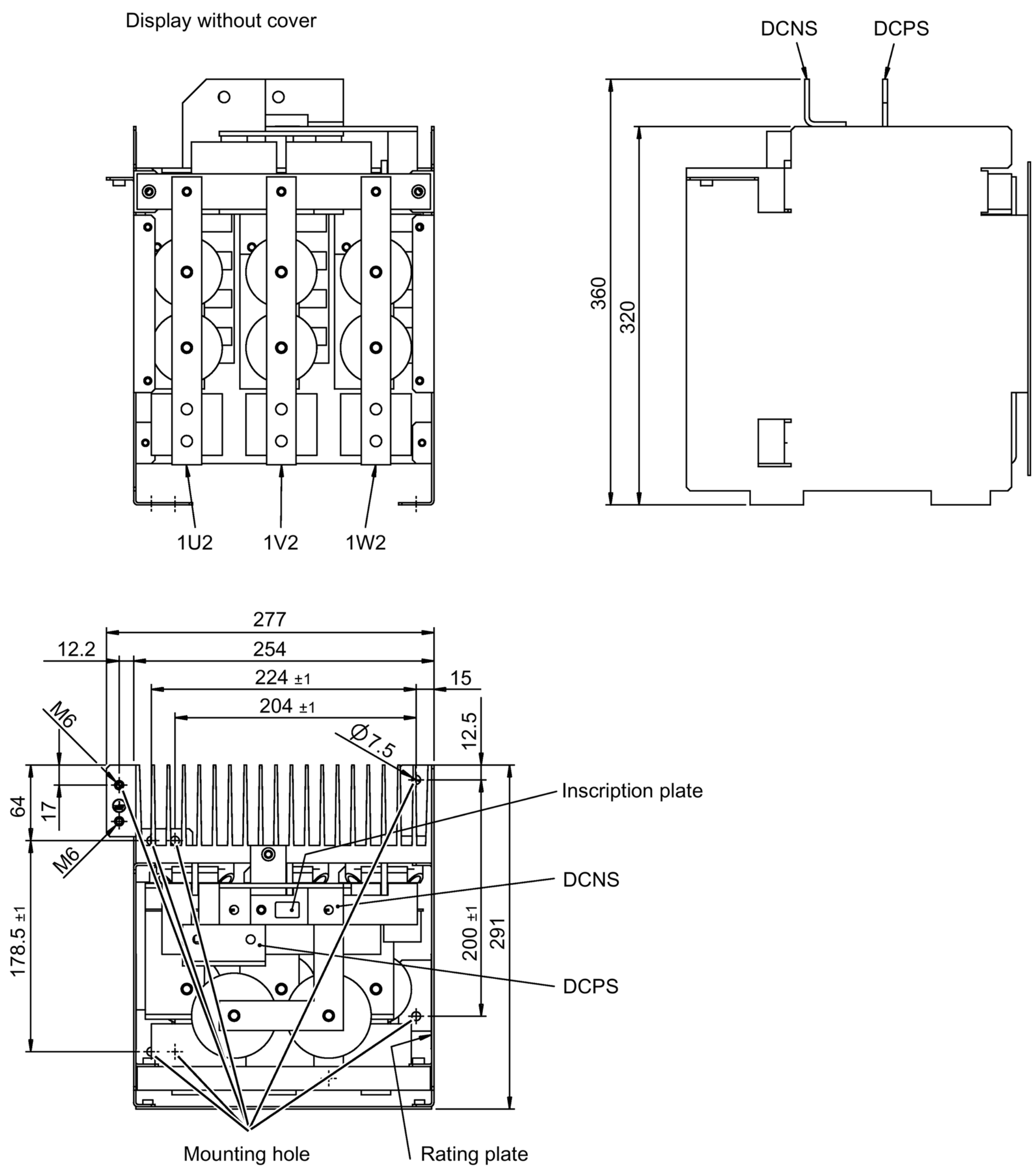


Figure 7-24 Dimension drawing for dv/dt filter compact plus voltage peak limiter, type 4 Voltage peak limiter

Table 7- 26 Assignment of dv/dt filters compact plus voltage peak limiter to the dimension drawings

dv/dt filter compact plus voltage peak limiter	Dimension drawing type
Line voltage 3 AC 380 ... 480 V	
6SL3000-2DE32-6EA0	Type 1
6SL3000-2DE35-0EA0	Type 2
6SL3000-2DE38-4EA0	Type 3
6SL3000-2DE41-4EA0	Type 4
Line voltage 3 AC 500 ... 690 V	
6SL3000-2DG31-0EA0	Type 1
6SL3000-2DG31-5EA0	Type 1
6SL3000-2DG32-2EA0	Type 2
6SL3000-2DG33-3EA0	Type 2
6SL3000-2DG35-8EA0	Type 3
6SL3000-2DG38-1EA0	Type 4
6SL3000-2DG41-3EA0	Type 4

7.4.6 Technical data

Table 7- 27 Technical data of the dv/dt filter compact plus voltage peak limiter, 380 V ... 480 V 3 AC, Part 1

Article number	6SL3000-	2DE32-6EA0	2DE35-0EA0	2DE38-4EA0
Suitable for Power Module (unit rating)	6SL3315-	1TE32-1AA3 (110 kW) 1TE32-6AA3 (132 kW)	1TE33-1AA3 (160 kW) 1TE35-0AA3 (250 kW)	--
Suitable for Motor Module (unit rating)	6SL3325-	1TE32-1AA3 (110 kW) 1TE32-6AA3 (132 kW)	1TE33-1AA3 (160 kW) 1TE35-0AA3 (250 kW)	1TE37-5AA7 (400 kW)
I_{thmax}	A	260	490	840
Degree of protection		IP00	IP00	IP00
Power loss - At 50 Hz - At 60 Hz - At 150 Hz	 kW kW kW	 0.210 0.215 0.255	 0.290 0.296 0.344	 0.518 0.529 0.609
Terminals - 1U1/1V1/1W1 - DCPS/DCNS - 1U2/1V2/1W2 - PE		 for M10 bolt for M8 screw for M10 bolt M6 screw	 for M10 bolt for M8 screw for M10 bolt M6 screw	 for M12 bolt for M8 bolt for M12 bolt M6 screw
Max. permissible cable length between dv/dt filter and motor	m	100 (shielded) 150 (unshielded)		
Dimensions Width Height Depth	 mm mm mm	 310 283 238	 350 317 260	 440 369 311
Weight, approx.	kg	41	61	103

Table 7- 28 Technical data of the dv/dt filter compact plus voltage peak limiter, 380 V ... 480 V 3 AC, Part 2

Article number	**6SL3000-**	**2DE41-4EA0**		
Suitable for Motor Module (unit rating)	6SL3325-	1TE41-0AA7 (560 kW) 1TE41-2AA7 (710 kW) 1TE41-4AA7 (800 kW)		
I_{thmax}	A	1405		
Degree of protection		IP00		
Power loss - At 50 Hz - At 60 Hz - At 150 Hz	 kW kW kW	 1.154 1.197 1.444		
Max. permissible cable length between dv/dt filter and motor	m	100 (shielded) 150 (unshielded)		
dv/dt reactor				
Terminals - 1U1/1V1/1W1 - 1U2/1V2/1W2 - PE		 for 2 x M12 bolts for 2 x M12 bolts M6 screw		
Dimensions Width Height Depth	 mm mm mm	 430 385 323		
Weight, approx.	kg	168.8		
Voltage peak limiter				
Terminals - DCPS/DCNS - 1U2/1V2/1W2 - PE		 for M8 bolt for M8 bolt for M6 screw		
Dimensions Width Height Depth	 mm mm mm	 277 360 291		
Weight, approx.	kg	19.2		

Table 7- 29 Technical data of the dv/dt filter compact plus voltage peak limiter, 500 V ... 690 V 3 AC, Part 1

Article number	6SL3000-	2DG31-0EA0	2DG31-5EA0	2DG32-2EA0
Suitable for Motor Module (unit rating)	6SL3325-	1TG31-0AA3 (90 kW)	1TG31-5AA3 (132 kW)	1TG32-2AA3 (200 kW)
I_{thmax}	A	100	150	215
Degree of protection		IP00	IP00	IP00
Power loss - At 50 Hz - At 60 Hz - At 150 Hz	 kW kW kW	 0.227 0.236 0.287	 0.270 0.279 0.335	 0.305 0.316 0.372
Terminals - 1U1/1V1/1W1 - DCPS/DCNS - 1U2/1V2/1W2 - PE		 for M10 bolt for M8 screw for M10 bolt M6 screw	 for M10 bolt for M8 screw for M10 bolt M6 screw	 for M10 bolt for M8 screw for M10 bolt M6 screw
Max. permissible cable length between dv/dt filter and motor	m	100 (shielded) 150 (unshielded)		
Dimensions Width Height Depth	 mm mm mm	 310 283 238	 310 283 238	 350 317 260
Weight, approx.	kg	34	36	51

Table 7- 30 Technical data of the dv/dt filter compact plus voltage peak limiter, 500 V ... 690 V 3 AC, Part 2

Article number	6SL3000-	2DG33-3EA0	2DG35-8EA0	
Suitable for Motor Module (unit rating)	6SL3325-	1TG33-3AA3 (315 kW)	1TG34-7AA7 (450 kW) 1TG35-8AA7 (560 kW)	
I_{thmax}	A	330	575	
Degree of protection		IP00	IP00	
Power loss - At 50 Hz - At 60 Hz - At 150 Hz	 kW kW kW	 0.385 0.399 0.480	 0.571 0.586 0.689	
Terminals - 1U1/1V1/1W1 - DCPS/DCNS - 1U2/1V2/1W2 - PE		 for M10 bolt for M8 screw for M10 bolt M6 screw	 for M12 bolt for M8 bolt for M12 bolt M6 screw	
Max. permissible cable length between dv/dt filter and motor	m	100 (shielded) 150 (unshielded)		
Dimensions Width Height Depth	 mm mm mm	 350 317 260	 440 369 311	
Weight, approx.	kg	60	100	

Table 7- 31 Technical data of the dv/dt filter compact plus voltage peak limiter, 500 V ... 690 V 3 AC, Part 3

Article number	**6SL3000-**	**2DG38-1EA0**	**2DG41-3EA0**	
Suitable for Motor Module (unit rating)	6SL3325-	1TG38-1AA7 (800 kW)	1TG41-0AA7 (1000 kW) 1TG41-3AA7 (1200 kW)	
I_{thmax}	A	810	1270	
Degree of protection		IP00	IP00	
Power loss - At 50 Hz - At 60 Hz - At 150 Hz	 kW kW kW	 0.964 0.998 1.196	 1.050 1.104 1.319	
Max. permissible cable length between dv/dt filter and motor	m	100 (shielded) 150 (unshielded)		
dv/dt reactor				
Terminals - 1U1/1V1/1W1 - 1U2/1V2/1W2 - PE		 for 2 x M12 bolts for 2 x M12 bolts M6 screw	 for 2 x M12 bolts for 2 x M12 bolts M6 screw	
Dimensions Width Height Depth	 mm mm mm	 430 385 323	 430 385 323	
Weight, approx.	kg	171.2	175.8	
Voltage peak limiter				
Terminals - DCPS/DCNS - 1U2/1V2/1W2 - PE		 for M8 bolt for M8 bolt for M6 screw	 for M8 bolt for M8 bolt for M6 screw	
Dimensions Width Height Depth	 mm mm mm	 277 360 291	 277 360 291	
Weight, approx.	kg	18.8	19.2	

Cabinet design and EMC 8

8.1 Notes

8.1.1 General

The modular concept of SINAMICS S120 chassis units allows a wide range of potential device combinations. For this reason, it is impossible to describe each individual combination. This section instead aims to provide some basic information and general rules on the basis of which special device combinations can be configured to ensure electromagnetic compatibility and adequate cooling – therefore ensuring reliable operation with the appropriate functionality.

SINAMICS S120 components are designed for installation in the appropriate enclosures, which can take the form of cabinet units or control boxes made of steel that provide protection against shock and other environmental effects. They are also part of the EMC concept.

8.1.2 Safety information

> ⚠ WARNING
>
> **Danger to life if the fundamental safety instructions and remaining risks are not carefully observed**
>
> The non-observance of the fundamental safety instructions and residual risks stated in Chapter 1 can result in accidents with severe injuries or death.
>
> - Adhere to the fundamental safety instructions.
> - When assessing the risk, take into account remaining risks.

> ⚠ WARNING
>
> **Danger of injury caused by foreign objects in the device**
>
> Parts (e.g. drilling chips, end sleeves) falling into the device can cause short-circuits and damage the insulation. This can lead to serious injuries (arcing, bangs, pieces flying out of the equipment).
>
> - Only perform installation and other work when the devices are current-free.
> - Cover the ventilation slits during the installation of the cabinet and remove the cover before switching on.

NOTICE

Limiting of overvoltages

On systems with a grounded phase conductor and a line voltage >600 VAC, line-side components should be installed to limit overvoltages to overvoltage category II according to IEC 61800-5-1.

Note

Protection against the spread of fire

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

Converters of the Open Type/IP20 degree of protection must be installed in a metal control cabinet or protected by another equivalent measure such that fire cannot spread and emissions outside of the control cabinet are prevented.

Note

Protection against condensation and electrically conductive contamination

To ensure the functional safety and safety functions of Safety Integrated, protect the converter, e.g. by installing it in a control cabinet with degree of protection IP54 according to IEC 60529 or Type 12 according to NEMA 250. Further measures may be necessary for particularly critical operating conditions.

A lower degree of cabinet protection is permissible, if condensation and conductive pollution can be excluded at the installation site.

Maximum cable lengths

Table 8- 1 Maximum cable lengths

Type	Maximum length [m]
24 VDC power cables [1)]	10
24 V signal cables [1)]	30
Power cable between the Motor Module and motor when using two motor reactors in series	300 (shielded) 450 (unshielded) 525 (shielded) 787 (unshielded)
DRIVE-CLiQ cables • Inside cabinet unit, e.g. connection between CU320 and the first Motor Module or between the Motor Modules • DRIVE-CLiQ MOTION-CONNECT connecting cables for external components	 70 100
Power cable between Braking Module and braking resistor	100

1) For longer lengths, suitable wiring must be provided by the user for overvoltage protection.

Table 8- 2 Recommendations for overvoltage protection

DC supply	24 V signal cables
Weidmüller Type: PU DS 24 V Order number: 8682100000	Weidmüller Type no.: MCZ OVP TAZ 24 V Order number: 8449160000
Weidmüller GmbH & Co. KG	

8.1.3 Directives

The control cabinet must satisfy the following EC Directives in the European Economic Area (EEA):

Table 8- 3 Directives

Directive	Description
2014/35/EU	Directive of the European Parliament and Council from February 26, 2014 on the approximation of the laws relating to the provision of electrical equipment designed for use within certain voltage limits (Low-Voltage Directive)
2014/30/EU	Directive of the European Parliament and Council of February 26, 2014 for the harmonization of the laws of the member states relating to electromagnetic compatibility (EMC directive)
2006/42/EC	Directive of the European Parliament and Council of May 17, 2006 on machinery and for changing Directive 95/16/EC (amendment) (machinery directive)

8.2 EMC-compliant design and control cabinet configuration

Detailed configuration instructions regarding the EMC-compliant design of drives and control cabinet configuration can be found in the "SINAMICS Low Voltage Configuration Manual", see Configuration Manual for SINAMICS G130, G150, S120 Built-in Units, S120 Cabinet Modules, S150 (https://support.industry.siemens.com/cs/ww/en/view/83180185).

8.3 Cabinet installation, vertical and horizontal installation

8.3.1 Mounting on mounting rails

The water-cooled SINAMICS S120 devices can be mounted in the control cabinet on mounting rails. For this purpose, mounting rails are provided on the lower side of the power units, which can be used to mount the device in the control cabinet.

The mounting rails simplify installing or removing the power unit (Active Interface Modules (filter module), Active Line Modules, Motor Modules).
For this purpose, the mounting equipment for the power units can be attached to the mounting rails (article number 6SL3766-1CA00-0AA0), in order to simplify mounting and installation work, see "Mounting equipment for power units (Page 282)".

By suitably designing the mounting rails in the control cabinet, the mechanical load of the power unit can be better distributed to the cabinet frame elements.

The mounting rails must be designed and manufactured on a system-for-system specific basis.

Bolting points for the mounting rails

In order that the mounting equipment for the power units can be correctly attached to the mounting rails, the mounting rails must be provided with the subsequently described bolting points at the front.

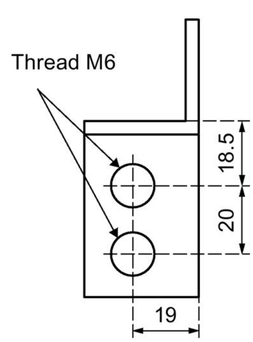


Figure 8-1 Bolting points for the mounting rails (dimensions in mm)

Rail profile at the power units

The dimensions of the rail profiles for the various power units are shown in the following drawings.

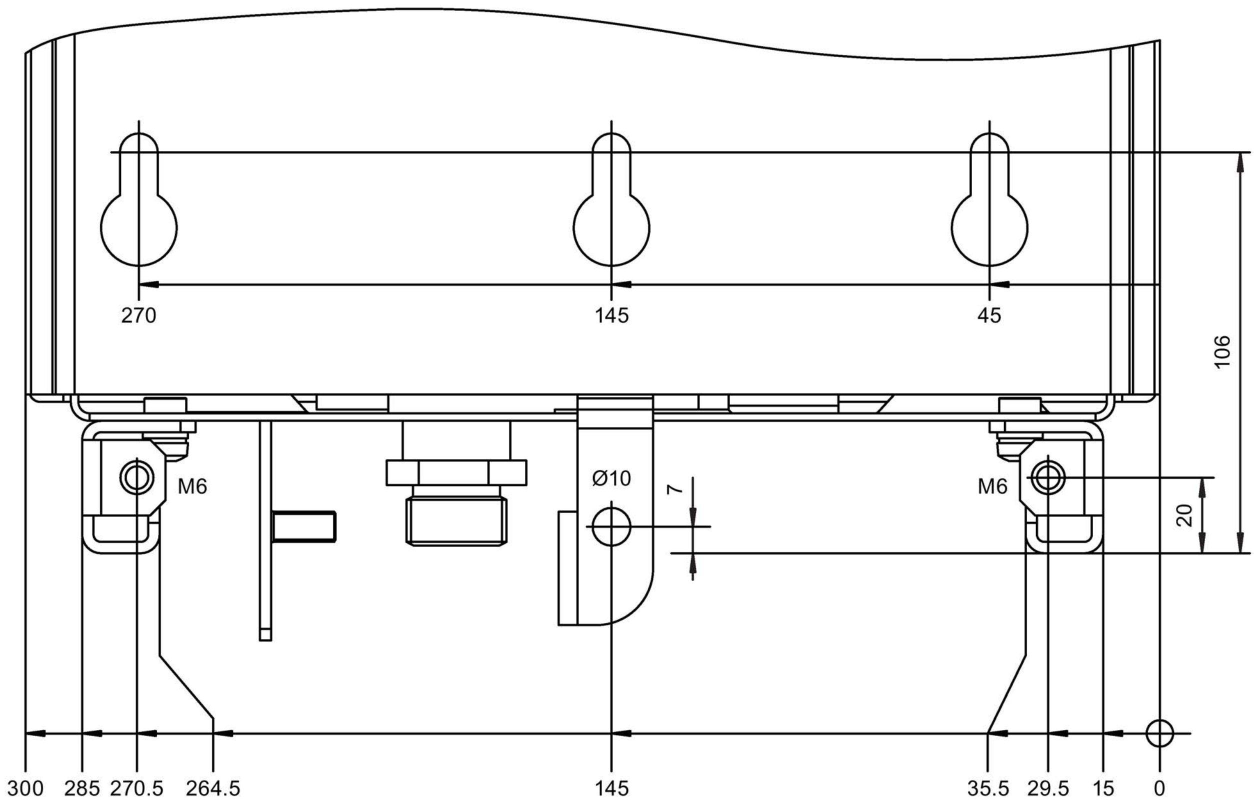


Figure 8-2 Rail profile, Active Interface Module (filter module), frame size JXL (dimensions in mm)

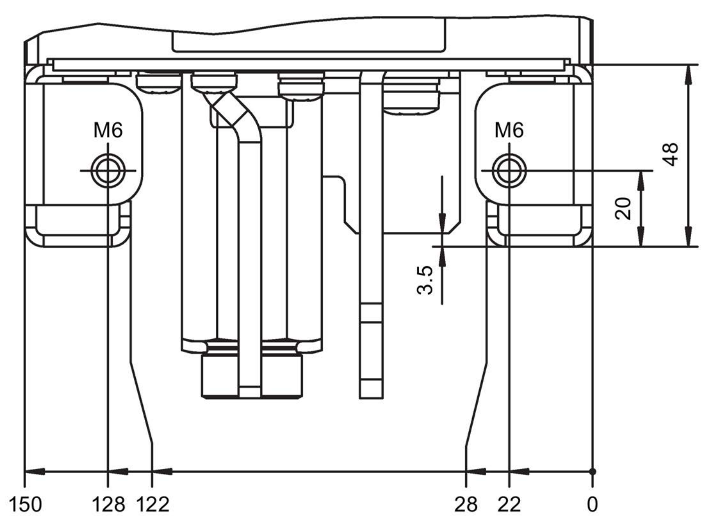


Figure 8-3 Rail profile, Motor Module, frame size FXL (dimensions in mm)

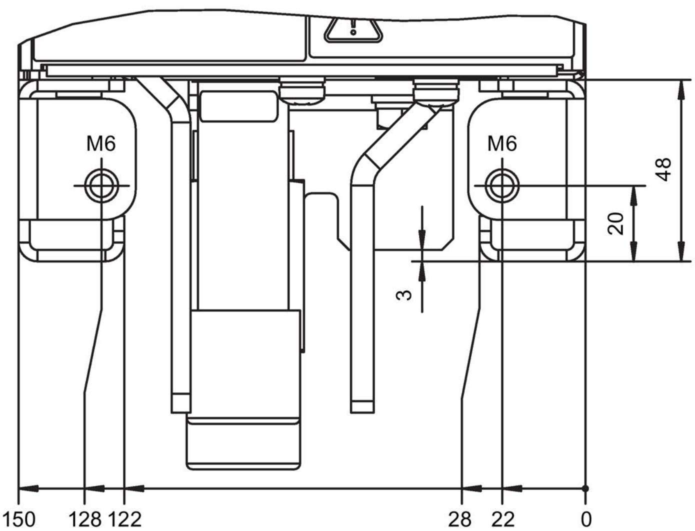


Figure 8-4 Rail profile, Motor Module, frame size GXL (dimensions in mm)

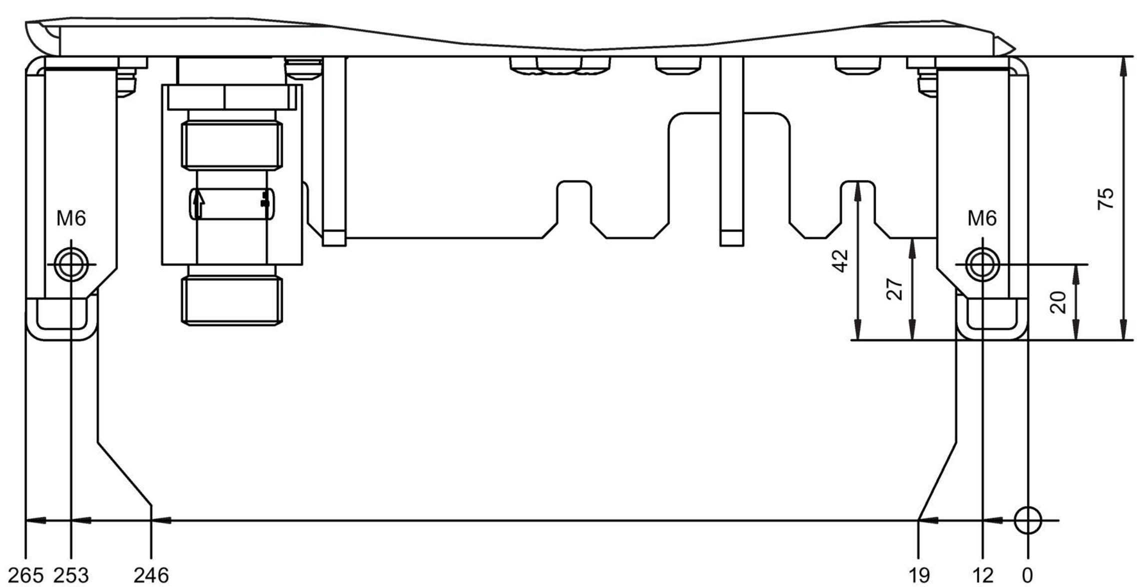


Figure 8-5 Rail profile, Active Line Module and Motor Module, frame size HXL (dimension data in mm)

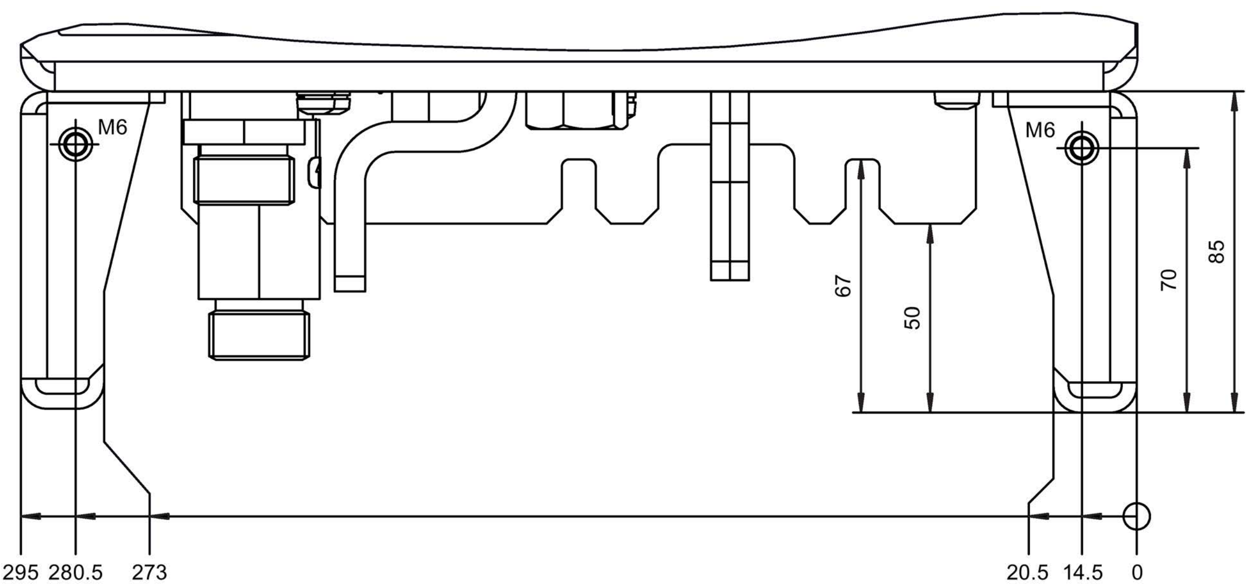


Figure 8-6 Rail profile, Active Line Module and Motor Module, frame size JXL, (dimensions in mm)

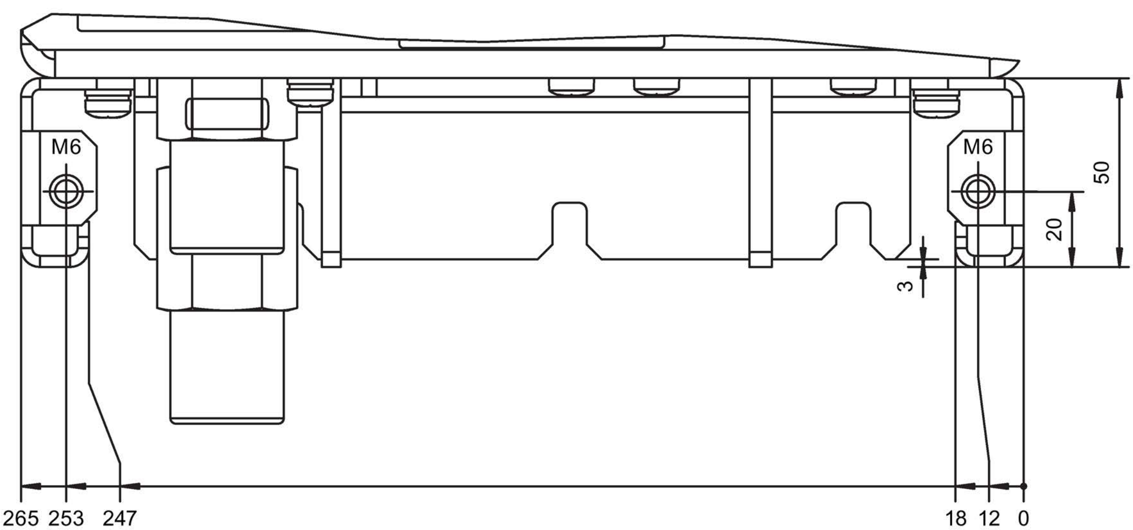


Figure 8-7 Rail profile, Power Modules, frame sizes FL, GL (dimensions in mm)

8.3.2 Horizontal installation

The water-cooled SINAMICS S120 devices can operate in a vertical position with the device resting on its rear panel.

To prevent concentrations of heat (hotspots) inside the devices in this mounting position, an external fan needs to be installed which is capable of removing heated air from the devices, see "Volumetric air flow and fans required (Page 238)".

A baffle (referred to below as air distribution baffle) must also be mounted above the device. This ensures that the air is sucked through the IP20 covers in an even distribution over the entire length of the device, thereby ensuring that even components at the bottom left of the device remain within the permissible tolerance range (see figure below).

The components required for a horizontal mounting position can be seen in the Figure below.

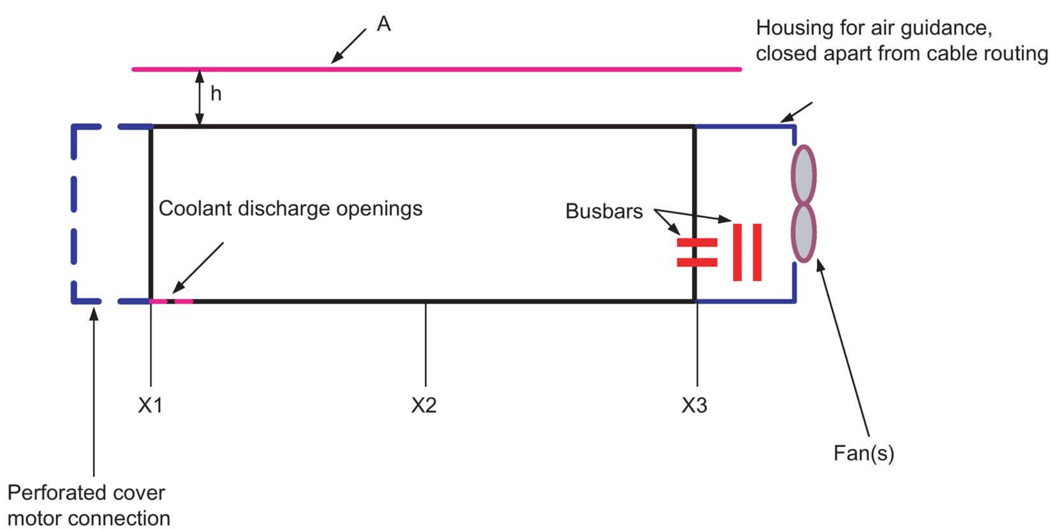


Figure 8-8 Basic layout for horizontal installation position

The height h (the distance between the device top edge (horizontal) and the air distribution baffle A) must be in the range 25 mm < h < 60 mm!

Requirement for air distribution baffle ("A")

In the case of a single device (Power Module, Active Line Module or Motor Module) or a Motor Module mounted adjacent to an Active Line Module: Air distribution baffle A is closed, the side openings ensure adequate distribution of air flow.

For configurations with several devices mounted adjacently, air distribution baffle A must be perforated. The perforation must be designed such that up to 60% of the opening area is in the lower device half (in the figure above, between X1 and X2).

8.3.3 Vertical installation

The water-cooled SINAMICS S120 devices are suitable for vertical installation in a cabinet with a minimum width of 400 mm.

A partition must be installed between the cabinets housing and the SINAMICS device to ensure that the device is adequately ventilated.

The dimensions for the installation heights of the partition are specified in the following table.

Table 8- 4 Installation height of the partition from the lower side of the device (from the lower edge of the device)

Type	Installation height of the partition [mm]
Power Module FL	140
Power Module GL	290
Motor Module FXL	150
Motor Module GXL	480
Active Line Module HXL, Motor Module HXL	340
Active Line Module JXL, Motor Module JXL	800

8.3.4 Housing for air guidance

The fan(s) can suck the air out of the device only if air cannot be sucked in between the device and the fan. A housing (enclosure/partition) must therefore be provided between the fan and the device.

8.3.5 Motor connection cover

The motor connection on a horizontally mounted module must be covered. This cover must be perforated. The perforations should have an opening area of 8 x 30 mm with a perforation spacing of 3 to 5 mm.

8.3.6 Volumetric air flow and fans required

Note

Notes for installation in control cabinets

The SINAMICS S120 water-cooled devices have IP20 degree of protection with the exception of the electrical connections (overall degree of protection IP00).

Depending on the degree of protection of the cabinet, it must be guaranteed that the thermal losses in the cabinet are extracted from the cabinet using a fan or an air/water heat exchanger.
the respective thermal losses can be found in the technical data of each individual device.

We recommend that a heat run is performed in order to be able to maintain the temperature ranges specified in the technical data also when installed in a cabinet.

Horizontal installation

The following table lists the fans required for different module types and also specifies the volumetric flow which must be provided through the SINAMICS device. These are minimum values, without taking into account additional components in the cabinet (e.g. fuses, busbars, etc.). The additional power losses must be taken into account.

If the specified fan is not available, an alternative fan can be used provided that its characteristic is higher than that of the fan recommended (fan with higher air flow rate). Data sheets for the recommended fan with characteristic (minimum requirement) are available on request from EBM-Papst.

Table 8- 5 Volumetric flow requirement and number of fans needed for horizontal mounting

Type	Required volumetric air flow [m³/s]	Number of fans Papst 4114NXH or Papst 4114NHH or Papst 4184NXH (120 x 120 mm) *)
Power Module, frame sizes FL, GL	0.015	1
Motor Module FXL, GXL	0.015	1
Active Line Module HXL, Motor Module HXL	0.025	1
Active Line Module JXL, Motor Module JXL	0.063	2

*) Available from info2@de.ebmpapst.com

Note

Note regarding horizontal installation

If the measures recommended above are not implemented, the equipment might malfunction during operation at air temperatures as low as approx. 30° C. This is because the current transformers would be overheated!

Vertical installation

Note

Notes for installation in control cabinets

No additional measures need to be taken if the modules are mounted in a cabinet with degree of protection up to IP21.

However, if they are mounted in a cabinet with a degree of protection higher than IP21, a fan must be installed above the modules to avoid the formation of hotspots.

The table below specifies the required volumetric flows and the average rates of flow within a canopy (400 mm high).

If a single module is installed in a cabinet with IP54 degree of protection, then the fan can be dispensed with if the required volumetric flow for the module is <0.01 m³/s.

If several modules are installed in the same cabinet, then the required volumetric flow corresponds to the total volumetric flows of the individual components.

In configurations where a number of cabinet canopies are interconnected, the total volumetric flow must also be calculated and a fan selected accordingly.

Table 8- 6 Required fan flow rate through the power unit for degree of protection > IP21

Type	Required volumetric flow dV/dt of roof-mounted fan [m³/s]	Average rate of flow [m/s]
Power Module FL, 210 A (400 V)	0.003	0.01
Power Module FL, 260 A (400 V)	0.003	0.02
Power Module GL, 310 A (400 V)	0.004	0.02
Power Module GL, 490 A (400 V)	0.006	0.03
Active Line Module JXL, 985 A (400 V)	0.020	0.10
Active Line Module JXL, 1405 A (400 V)	0.026	0.14
Active Line Module HXL, 810 A (690 V)	0.018	0.10
Active Line Module HXL, 1025 A (690 V)	0.021	0.11
Active Line Module JXL, 1270 A (690 V)	0.024	0.12
Active Line Module JXL, 1405 A (690 V)	0.038	0.21
Motor Module FXL, 210 A (400 V)	0.002	0.01
Motor Module FXL, 260 A (400 V)	0.003	0.02
Motor Module GXL, 310 A (400 V)	0.004	0.02
Motor Module GXL, 490 A (400 V)	0.006	0.03
Motor Module HXL, 745 A (400 V)	0.008	0.05
Motor Module JXL, 985 A (400 V)	0.020	0.10
Motor Module JXL, 1260 A (400 V)	0.022	0.12
Motor Module JXL, 1405 A (400 V)	0.026	0.14
Motor Module FXL, 100 A (690 V)	0.002	0.01

Type	Required volumetric flow dV/dt of roof-mounted fan [m³/s]	Average rate of flow [m/s]
Motor Module FXL, 150 A (690 V)	0.003	0.02
Motor Module FXL, 215 A (690 V)	0.004	0.02
Motor Module FXL, 330 A (690 V)	0.005	0.03
Motor Module HXL, 465 A (690 V)	0.006	0.03
Motor Module HXL, 575 A (690 V)	0.007	0.03
Motor Module JXL, 810 A (690 V)	0.019	0.10
Motor Module JXL, 1025 A (690 V)	0.021	0.11
Motor Module JXL, 1270 A (690 V)	0.024	0.12
Motor Module JXL, 1560 A (690 V)	0.038	0.21

Recommended fan: EBM-Papst, type W2E200-HH38-01

Note

Note regarding vertical installation

It must be ensured that the ambient temperature of the device in the cabinet does not exceed 45 °C at any location. From 45° C to 50° C, see derating data.

8.3.7 Coolant connection

The coolant connection must be designed to prevent any coolant leakage into the device.
It is advisable to empty the coolant hoses before connecting them and to close the heat sink before removing the coolant hoses.

9 Cooling circuit, coolant properties and protection against condensation

WARNING

Danger to life if the fundamental safety instructions and remaining risks are not carefully observed

The non-observance of the fundamental safety instructions and residual risks stated in Chapter 1 can result in accidents with severe injuries or death.

- Adhere to the fundamental safety instructions.
- When assessing the risk, take into account residual risks.

Note

Contact addresses

The contact addresses for companies named in this section are available on request from your local Siemens sales office.

9.1 Cooling circuits

General information

A copper-nickel alloy is used to guide the coolant into the cooling plates of the water-cooled SINAMICS S120 devices, providing the user with two options for the design of the cooling circuit.

A common cooling circuit is possible. This includes converter, motor and system. The heat is dissipated using a cooling system with water-water heat exchanger.

The electrochemical processes that take place in a cooling system must be minimized by choosing the right materials. For this reason, mixed installations, i.e. a combination of different materials, such as copper, brass, iron, or halogenated plastic (PVC hoses and seals), should not be used or limited to the absolutely essential minimum. The materials must be selected so that no electrical corrosion occurs (electro-chemical series of metals), see Chapter Materials (Page 264).

Please read the following definitions for clarification:

1. Closed common cooling circuit
   The pressure compensator is closed (no ingress of oxygen) and is fitted with a pressure-relief valve (< 6 bar); it is always connected on the suction side of the pump. A separate pressure-relief valve (<6 bar) must be connected to the discharge side of the pump. The coolant is guided only through the SINAMICS devices, the heat exchange components and possibly to a motor (for example, see Figure below). The materials used in the cooling circuit comply with the specifications provided in Chapter Materials (Page 264).
2. Semi-open, cooling circuit
   Oxygen and carbon dioxide can only enter the coolant via the pressure compensator, otherwise the same as for 1.

   The coolant is pumped through the SINAMICS devices and the heat exchanger components, as well as through third-party components. The materials used comply with the minimum requirements stipulated in Chapter Materials (Page 264).
   It is especially important to observe the water hardness for this configuration.

Table 9- 1 Cooling circuit for SINAMICS devices

SINAMICS devices	**Active Line Module, frame sizes HXL, JXL** **Motor Modules, frame sizes HXL, JXL** **Active Interface Module, frame size JIL**	**Power Modules, frame sizes FL, GL** **Motor Modules, frame sizes FXL, GXL**
Heat sink material	Copper-nickel alloy	Stainless steel
Closed cooling circuit	Permissible	Permissible
Semi-open cooling circuit	Permissible	Permissible

Pressure

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

Maximum permissible differential pressure for a heat sink: 150 kPa (is applicable for water as coolant).

The layout must be selected such that the total length of feed and discharge line is equal for each SINAMICS device or motor.

It is not permissible to use water cooling systems with devices or devices and motors connected in series as the increased volumetric flow increases the risk of cavitation and abrasion.

Coolant temperature

To prevent condensation, the coolant temperature should be controlled depending on the ambient temperature and the air humidity. Condensation on the device is not permissible.

Coolant temperature ranges:

- 0 ... 38 °C without derating
- >38 ... 43 °C see derating data

Operation with a coolant temperature between 0° C and 5° C is only permitted with antifreeze. Operation below 0° C is also not permitted with antifreeze.

Volume flow monitoring

The devices are equipped with volume flow monitoring. If the average output flow is less than the rated flow, then the volume flow may also be correspondingly lower. If occasionally overloads occur during operation with the average output flow that are higher than the average output flow, then the rated volume flow must also be provided.

It must be ensured that the volume flow is never zero.

Installation

The connection between the devices and cooling system should be designed with hoses for mechanical decoupling.

Recommendations for the hose type, seals and clamps are provided in Chapter Materials (Page 264).

The following information must be observed when installing the cooling circuit:

- Seals must be free of chloride, graphite and rust.
- As a result of negative experience with Teflon, Viton, AFM34 and EPDM are recommended instead.
- In order to prevent cavitation damage to the pump (but also in the heat sink), the pressure on the suction side of the pump must be a minimum of 30 kPa, or the geodesic height from the reservoir to the pump suction side must be >3 m (see the diagram in Chapter Preventing cavitation (Page 247)).
- To prevent blockages and corrosion, it is advisable also to install a flushback filter in the circuit (so that residues can be rinsed out when the system is running). It is not permissible that the flushback filter is bridged by a bypass circuit.
  In these types of applications, automatic flashback filters have clearly proven themselves.
- For circuits with an open pressure equalization tank, oxygen and CO_2 enter the cooling water. The system should be filled for the first time with desalinated water via an ion exchanger.

Note

Checking the hose lines

The inspection intervals depend on the prevailing ambient conditions.

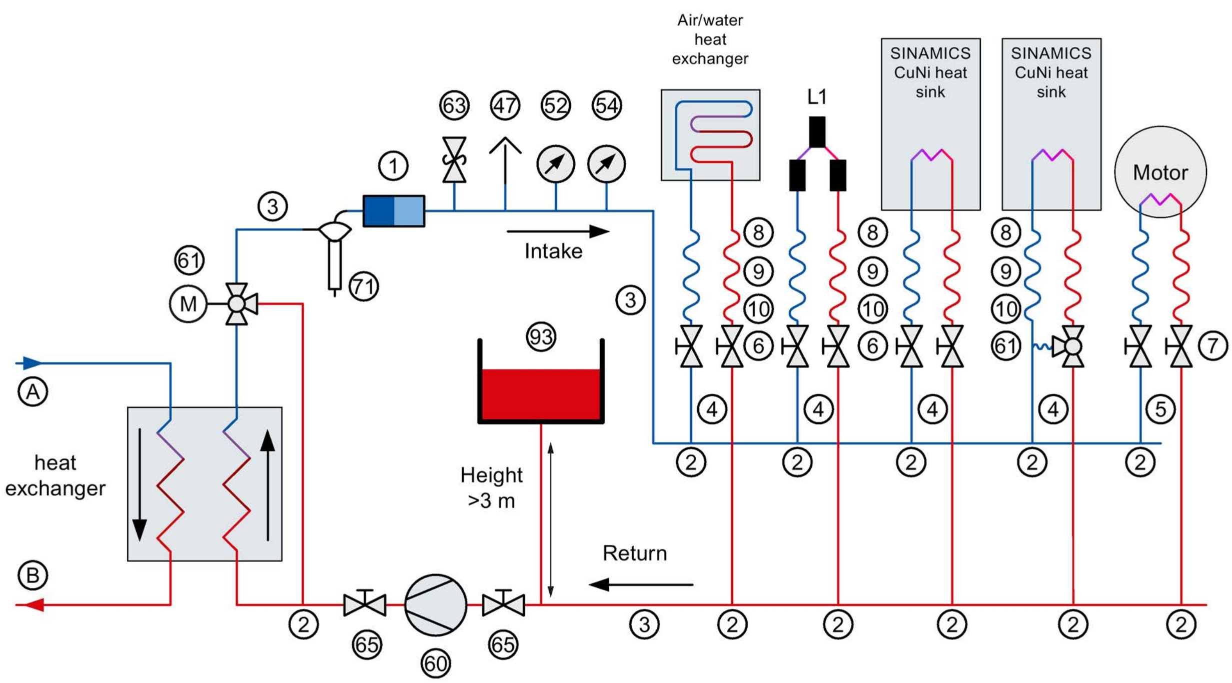
The following points should be noted for the coolant hoses:

- Damage through abrasion points
- Embrittlement (e.g. forming of cracks)
- Leaks
- The hose slipping out of the coupling
- Deformations that do not comply with the natural shape of the hose (e.g. separation of layers and blistering)
- Exceeding the storage and use times
  In accordance with the accepted rules and standards, we recommend a testing cycle of five years with the appropriate test pressure (twice the operating pressure).

9.1.1 Cooling circuit for heat sinks manufactured out of a copper-nickel alloy

To ensure an optimum heat sink service life, please note the following specifications for the copper-nickel alloy heat sinks (Active Line Modules and Motor Modules HXL and JXL):

- Common cooling circuit for converter, motor and system, which dissipates the heat to a cooling system via a water-water heat exchanger.
- Cooling circuit pipes, fittings made of stainless steel (Nirosta) or steel (ST37) with antifreeze in the coolant.



1	Sight glass	47	Vent
2	T piece	52	Temperature sensor
3	Line d1	54	Pressure sensor
4	Line d2	60	Pump
5	Line d3	61	Three-way bypass valve
6	Ball valve d2	63	Safety release valve
7	Ball valve d3	65	Ball valve d1
8	Hose connection at the device	71	Filter mit automatic backflushing or dirt trips, fine filter 100 µm
9	Hose, see Chapter "Materials (Page 264)"	93	Reservoir/expansion chamber
10	Hose connection at the ball valve		
A	Intake, cooling water primary circuit	B	Return, cooling water primary circuit

Figure 9-1 Recommendation for a common circuit to cool converter, motor and system

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Note

Requirements regarding the coolant reservoir

It must be guaranteed that the coolant is cooled down in the coolant reservoir.

Note

Arrangement of the devices in the cooling circuit

When arranging the devices in the cooling circuit, please note that the SINAMICS S120 devices must always be positioned upstream of the motors.

Dirt traps (strainer) with a mesh width ≤100 µm, at least one pressure measuring point and a sight glass are important for service.
For the dirt trap, the automatic backflushing version (Hydac company, Order No.: ATF-1-EPZ4-P-E-16-0-0/UKS1-100) or similar is recommended; this must always be connected on the pressure side of the pump.

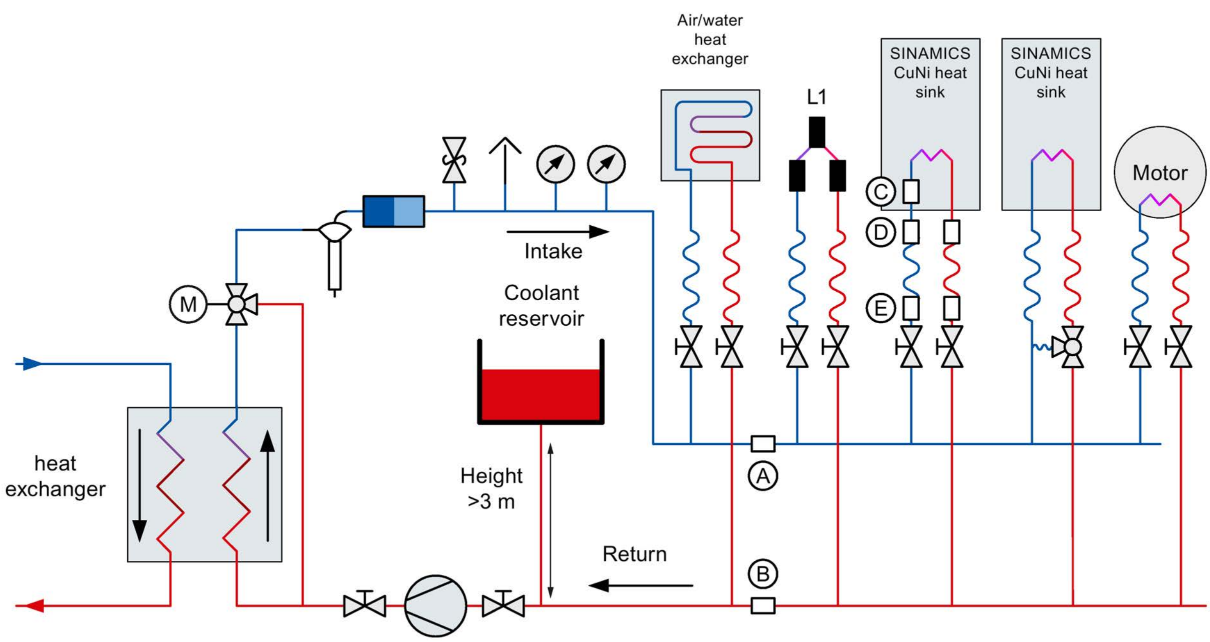
The customer must take measures (e.g. by monitoring the level) that the level in the coolant reservoir does not fall below a certain height.

Air bubbles in the coolant can cause the device to overheat. Permanently occurring air bubbles indicate a fault in the cooling arrangement.

9.1.2 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 and as close as possible to the pump (see Figure below).
- The minimum pressure on the suction side of the pump must be approximately 30 kPa (0.3 bar), 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 150 kPa (1.5 bar) in continuous operation, as the resultant increase in volumetric flow increases the risk of cavitation and/or abrasion.
- The guidelines given in Chapter Cooling circuit configuring information (Page 248) regarding series connections and maximum pressure must also be followed.



A Pressure drop, supply line
B Pressure drop, return line
C Pressure drop, SINAMICS with baffle plate
D Pressure drop, intake and return
E Pressure drop, hose

Figure 9-2 Arrangement of pressure compensator, component pressure drops

9.1.3 Cooling circuit configuring information

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 relevant devices. The devices are normalized to a rated pressure of 70 kPa (for water as coolant).

If a mixture of antifreeze and water is used as a coolant, the rated pressure must be calculated according to the ratio.

The maximum permissible pressure to atmosphere in the heat sink and thus in the cooling circuit must not exceed 6 bar. If the pump used can reach a maximum pressure in excess of this value, appropriate measures (safety valve p ≤ 6 bar, pressure control or similar) must be implemented by the customer to ensure that the maximum pressure limit is not exceeded.

The lowest possible differential pressure between the coolant in the supply and return lines should be selected to allow use of pumps with a flat characteristic.

The maximum differential pressure across a heat sink is 150 kPa (for water as coolant); higher differential pressures significantly increase the risk of cavitation and abrasion.

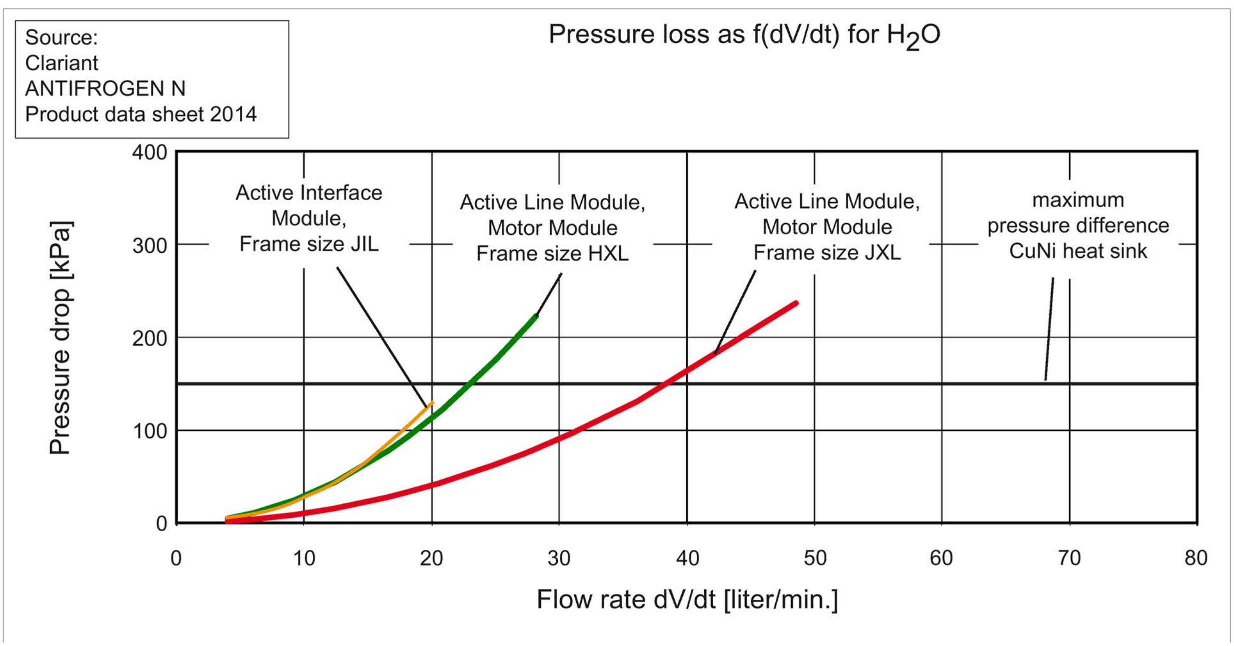


Figure 9-3 Pressure drop as a function of volumetric flow

Water cooling systems with series-connected SINAMICS devices should be avoided for the following reasons:

- The risk of cavitation and abrasion increases as a result of the high total volumetric flow. The material-dependent maximum velocity is exceeded.
- It is not possible to connect SINAMICS S120 in series because the total volumetric flow inherent to any series connection requires system pressures in the 600 kPa range or above.

The devices can be operated with a coolant based on filtered drinking water, which complies with the requirements specified in Chapter "Coolant properties (Page 260)".

For ambient temperatures below +5 °C, antifreeze must be added in order to prevent the coolant freezing in the cooling circuit.

The characteristic curves for the pressure drop across the heat sinks as a function of the volumetric flow vary depending on the temperature and the antifreeze and water coolant combination, as can be seen in the following figures.

Coolant mixture comprising Antifrogen N or Dowcal 100 and water

The following diagrams show the pressure drop as a function of the volumetric flow rates for the different SINAMICS S120 water-cooled components when using Antifrogen N or Dowcal 100.

Dowcal 100 has the same flow attribute as Antifrogen N.

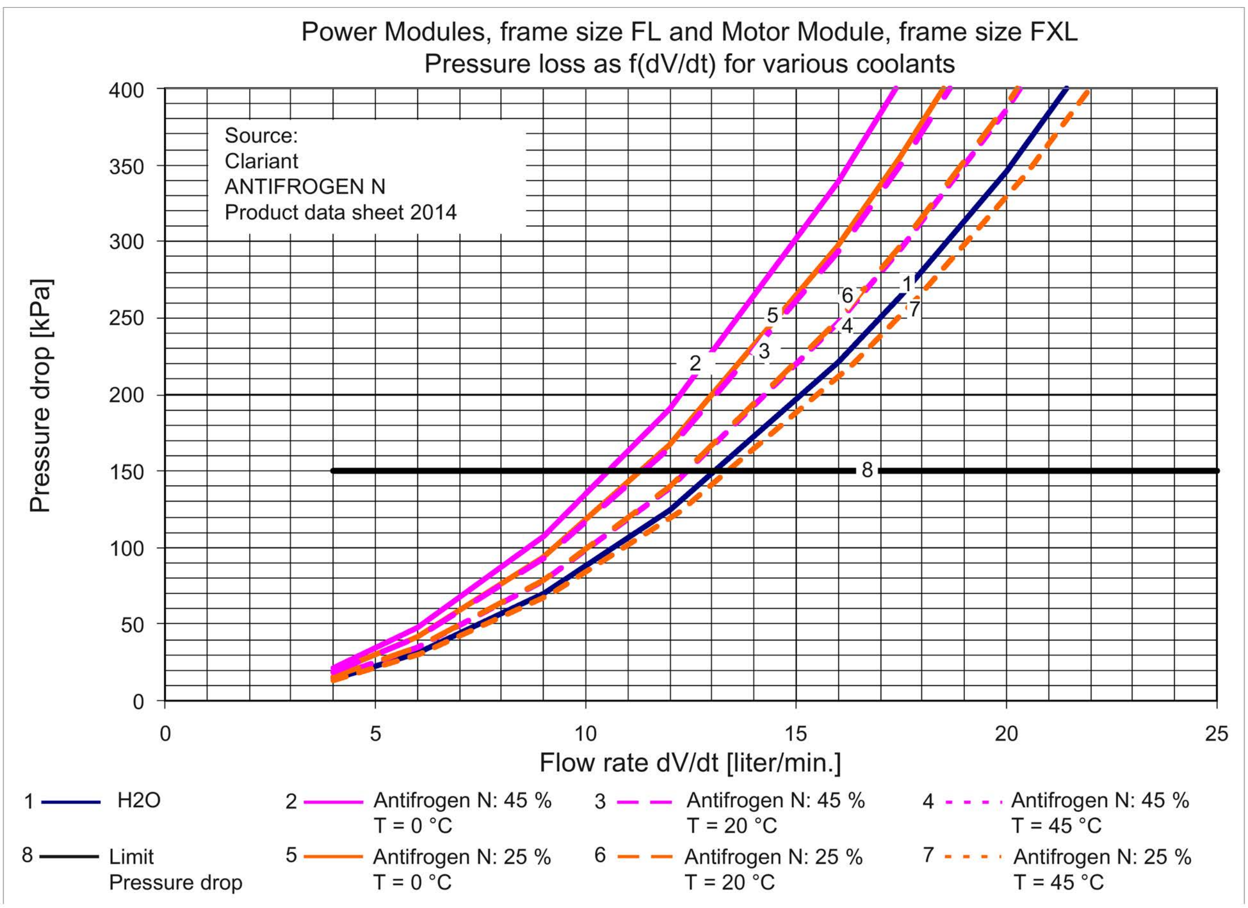


Figure 9-4 Pressure drop as a function of volumetric flow for Power Module frame size FL, and Motor Module frame size FXL

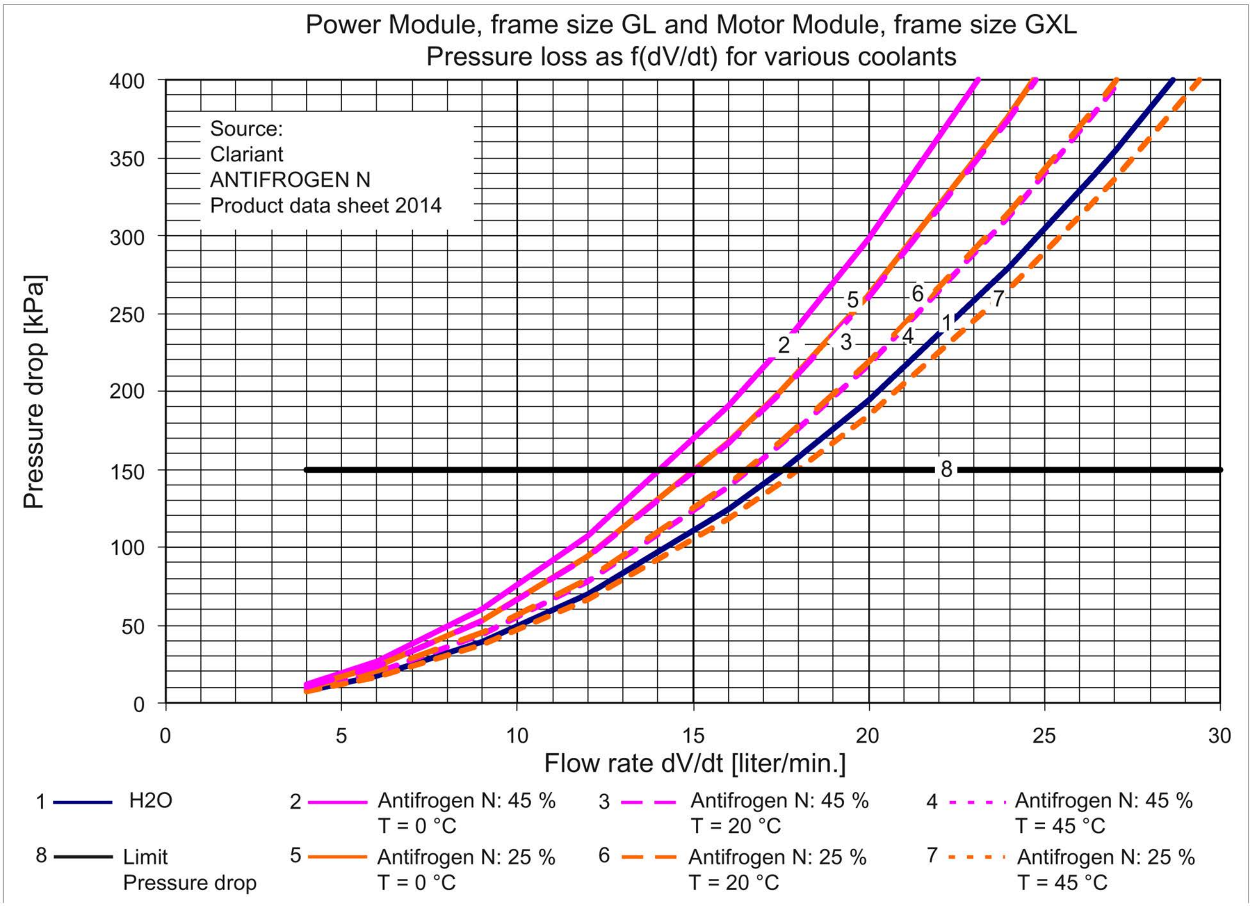


Figure 9-5 Pressure drop as a function of volumetric flow for Power Module frame size GL, and Motor Module frame size GXL

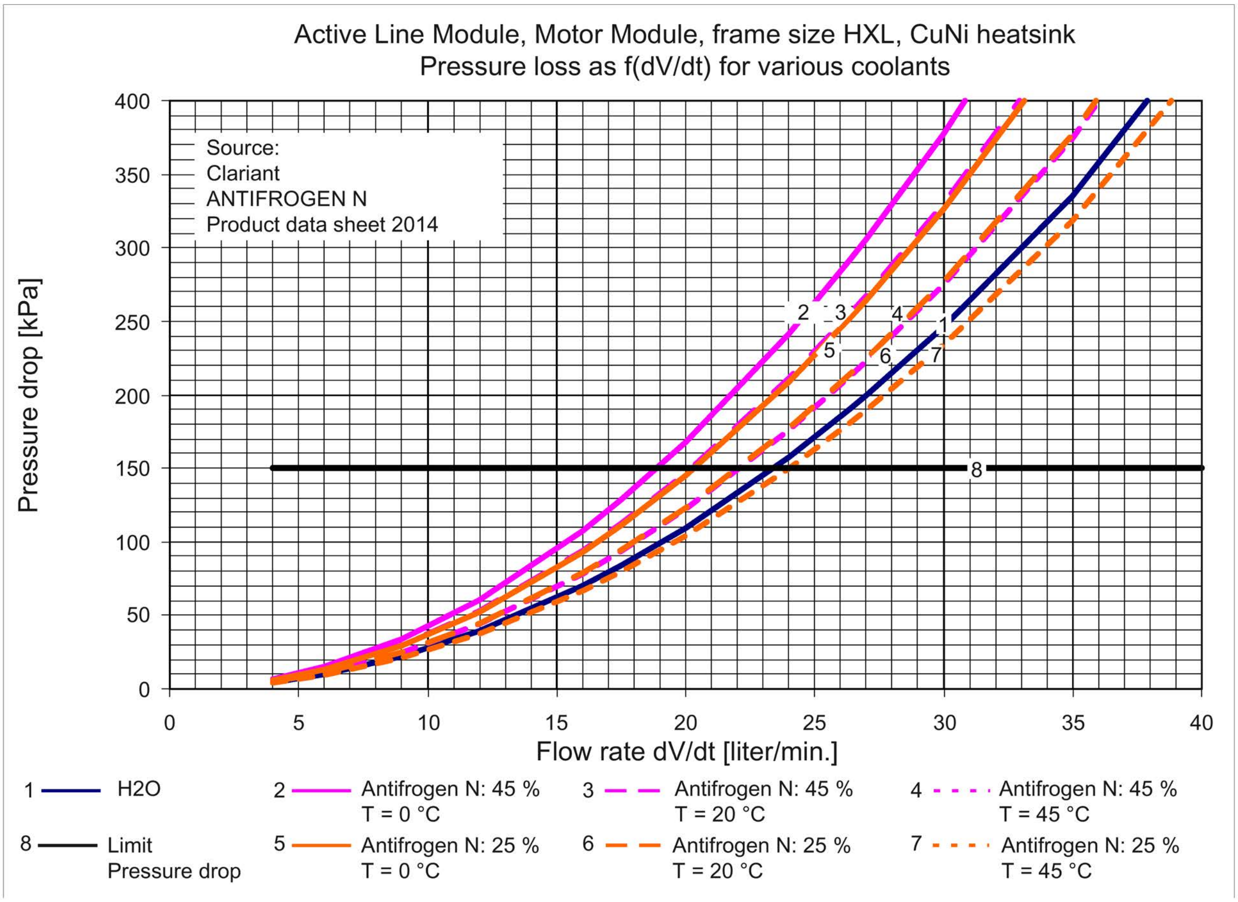


Figure 9-6 Pressure drop as a function of volumetric flow for Active Line Module and Motor Module, frame size HXL

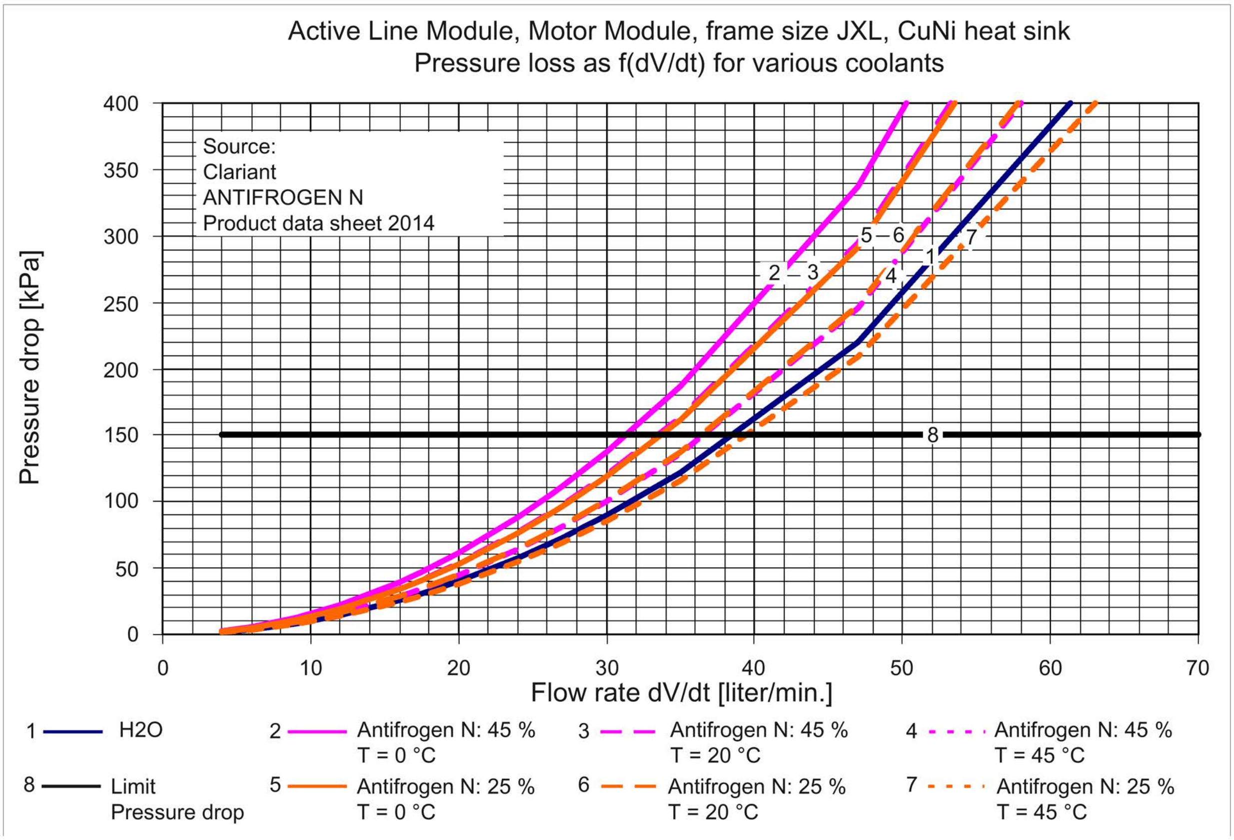


Figure 9-7 Pressure drop as a function of volumetric flow for Active Line Module and Motor Module, frame size JXL

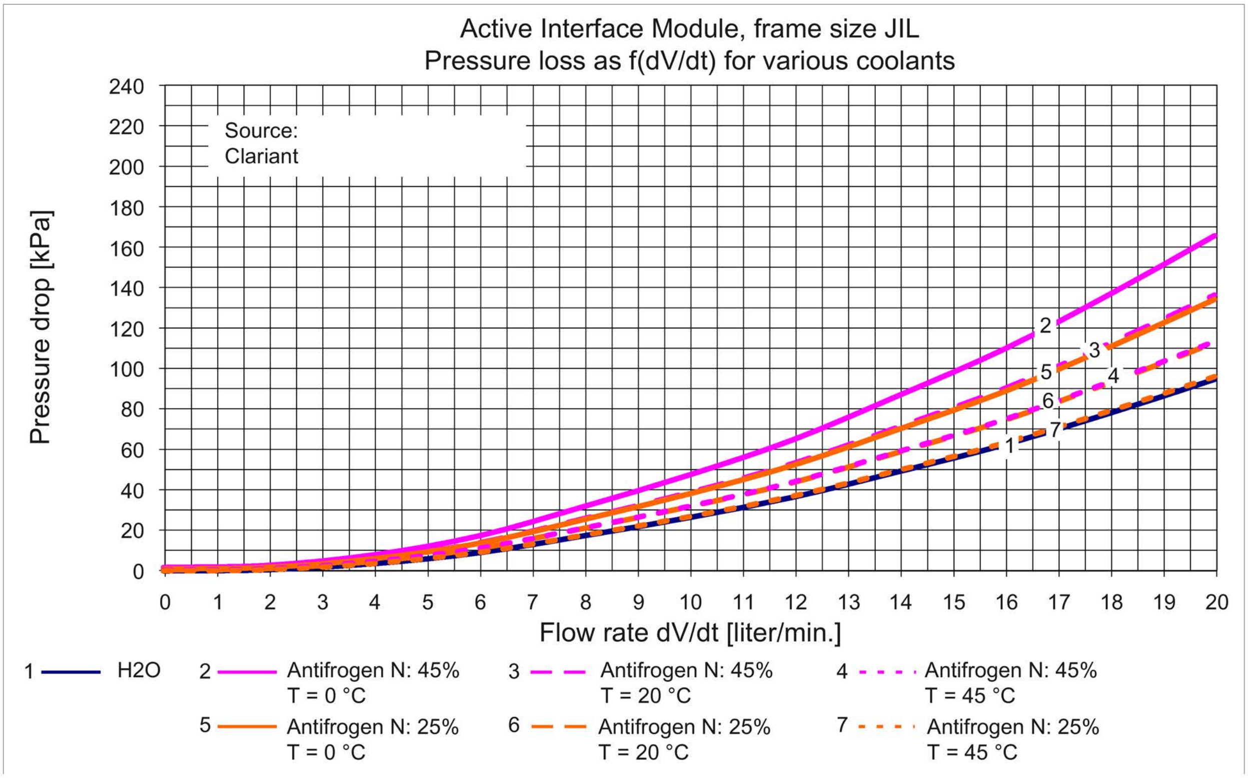


Figure 9-8 Pressure drop as a function of volumetric flow for Active Interface Module, frame size JIL

Coolant mixture comprising Antifrogen L and water

The following diagrams show the pressure drop as a function of the volumetric flow rates for the different SINAMICS S120 water-cooled components when using Antifrogen L.

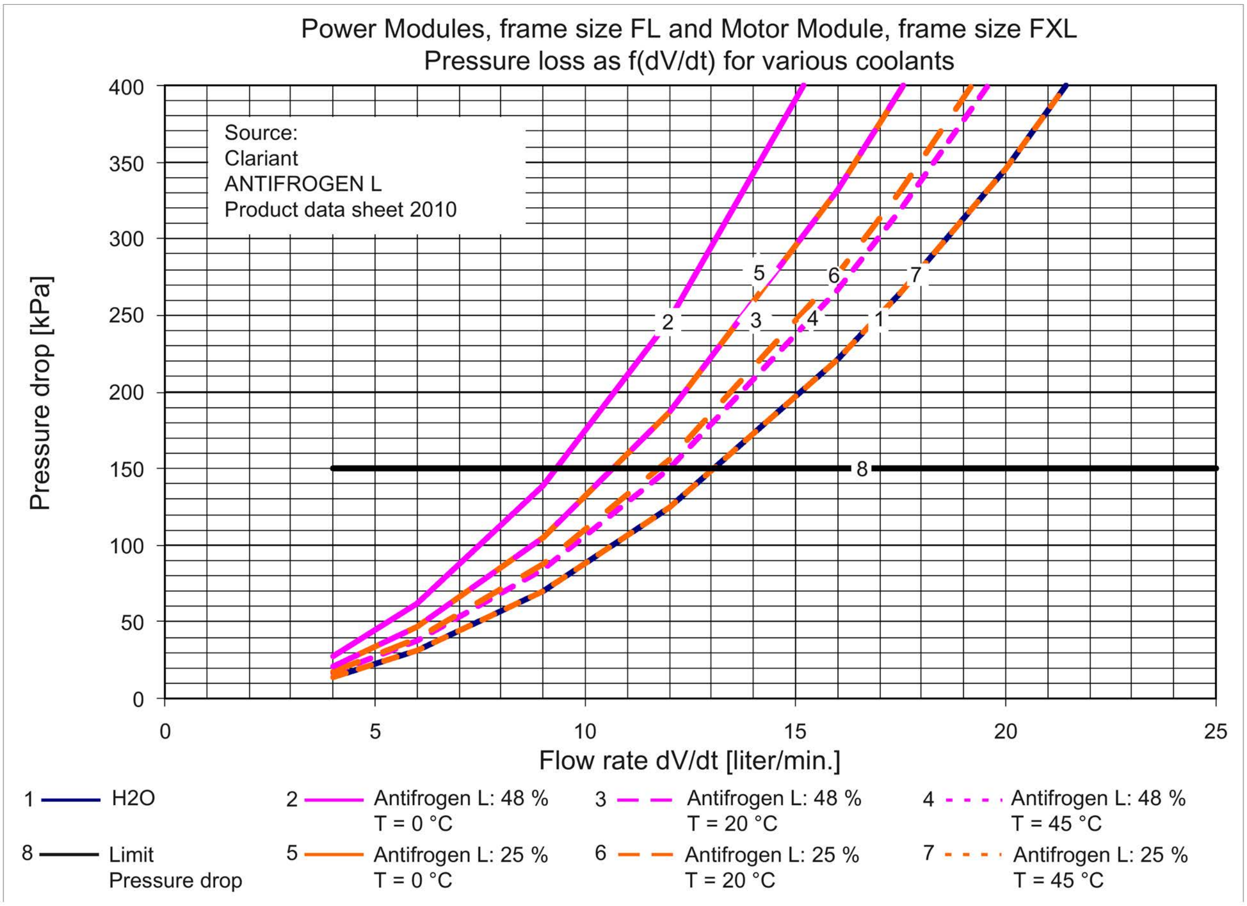


Figure 9-9 Pressure drop as a function of volumetric flow for Power Module frame size FL, and Motor Module frame size FXL

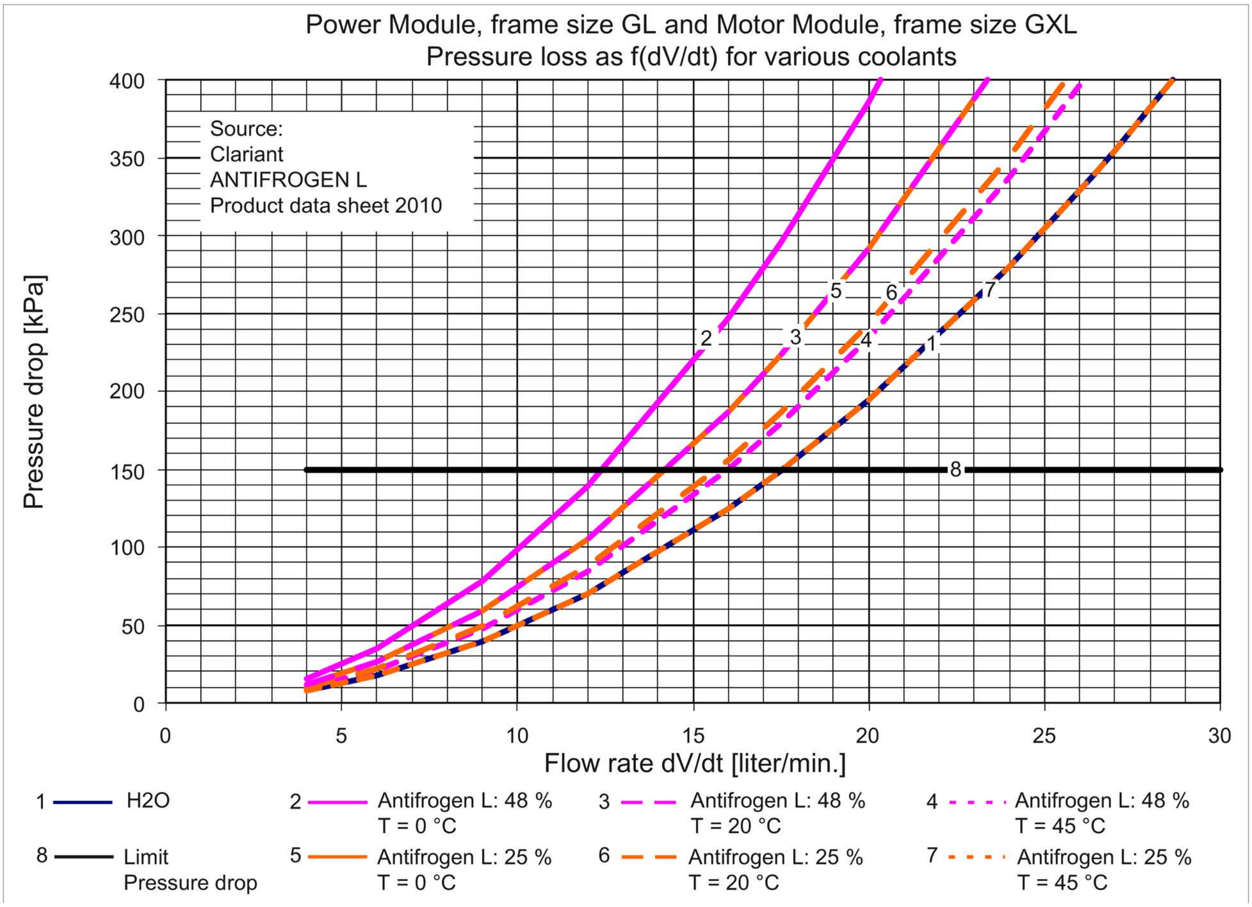


Figure 9-10 Pressure drop as a function of volumetric flow for Power Module frame size GL, and Motor Module frame size GXL

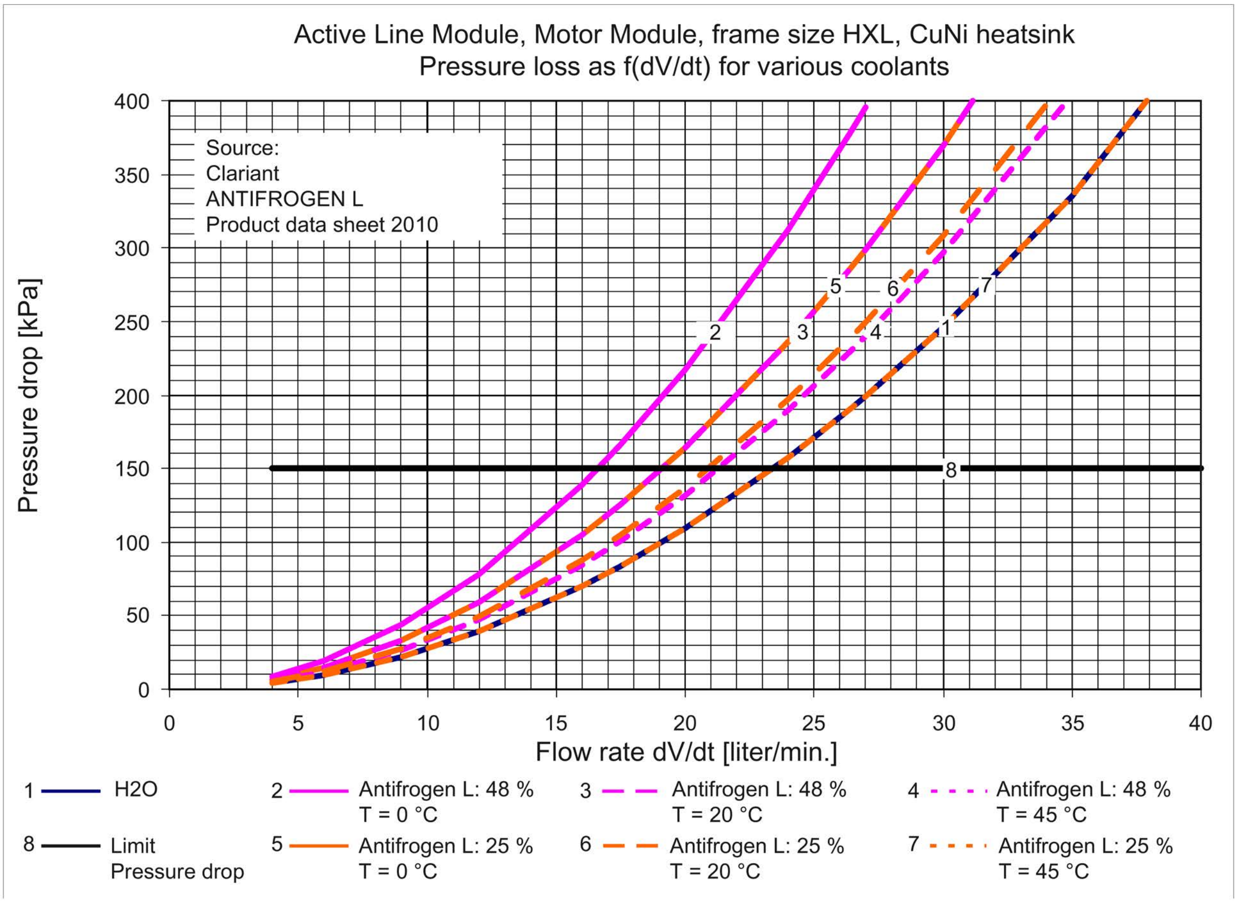


Figure 9-11 Pressure drop as a function of volumetric flow for Active Line Module and Motor Module, frame size HXL

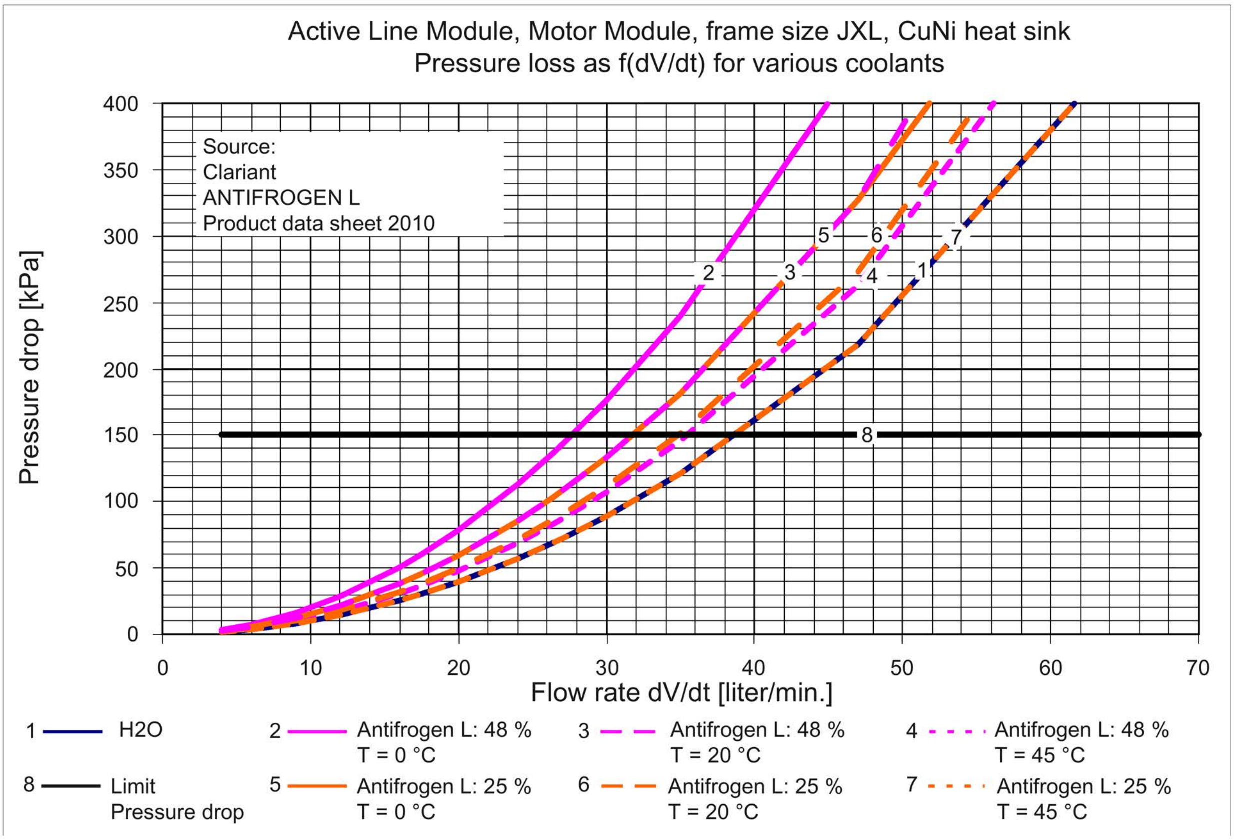


Figure 9-12 Pressure drop as a function of volumetric flow for Active Line Module and Motor Module, frame size JXL

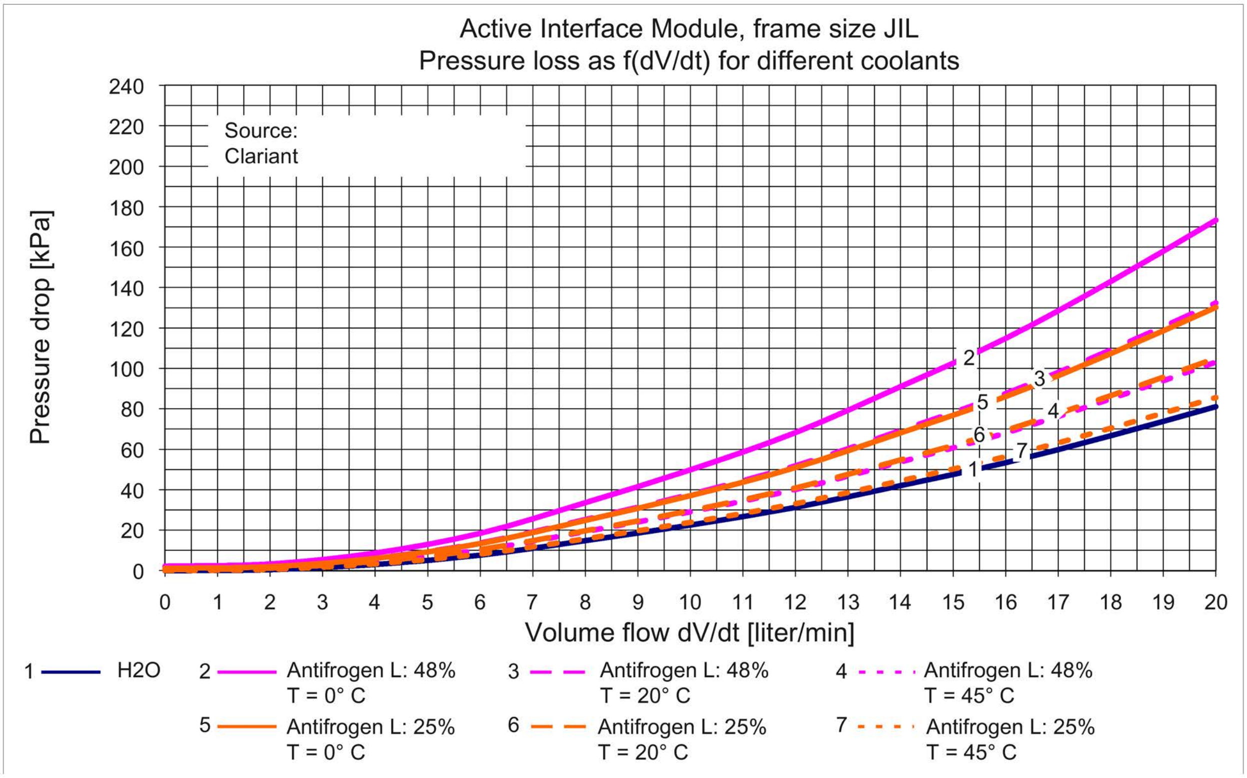


Figure 9-13 Pressure drop as a function of volumetric flow for Active Interface Module, frame size JIL

Dimensioning the cooling circuit

Recommendation for dimensioning the cooling circuit:

The differential pressure between the supply and return lines should be selected such that the following applies:

$$\sum dPi < dP_{System} < \sum dPi + 0.3 \text{ bar}$$

The individual pressure drops Pi represent the pressure drops of components (heat exchanger, piping, 70 kPa for the SINAMICS devices connected in parallel, valves, dirt traps, pipe bends, etc.).

⚠ WARNING

Danger to life as a result of electric shock due to incorrectly laid coolant lines

Incorrectly laid coolant lines can come into contact with live parts and components and can result in danger to life as a result of electric shock.

- Lay coolant lines so that they cannot come into contact with live components. Maintain an insulating clearance (clearances and creepage distances) of > 13 mm.
- Mechanically secure the coolant lines and check that they have no leaks.

9.1.4 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. This must be realized using a copper bar or stranded copper with the appropriate conductor cross-sections to prevent electrochemical processes from occurring.

If the installation comprises more than one control cabinet, they must be bolted together to establish a good electrical connection (e.g. bolt cabinet cross-beams together directly at several points to establish a good electrical connection). This eliminates potential differences and thus the risk of electrochemical corrosion. A PE bar must be installed in every cabinet (including the recooling system) and the individual bars then interconnected.

9.2 Coolant definition

9.2.1 Coolant properties

The coolant must fulfill the following requirements over the long term.

For ambient temperatures below +5 °C, antifreeze must be added to the coolant, see Antifreeze + biocide (Page 262).

Table 9- 2 Coolant requirements

	Heat sink manufactured out of a copper-nickel alloy	**Stainless steel heat sink**
Basis coolant	**Filtered drinking, process and cooling water with the following quality:**	**Filtered drinking, process and cooling water with the following quality:**
pH value	6.5 ... 9	6.5 ... 9
Electrical conductivity	< 2900 µS/cm	< 2500 µS/cm
Total salt content TDS	< 1800 mg/l	< 1550 mg/l
Chloride ions	< 500 mg/l	< 250 mg/l
Sodium	< 200 mg/l	< 200 mg/l
Sulfate ions	< 300 mg/l	< 240 mg/l
Sulfide ions	< 1 mg/l	< 1 mg/l
Nitrate ions	< 50 mg/l	< 50 mg/l
Iron	< 1 mg/l	< 1 mg/l
Silicate	< 10 mg/l	< 10 mg/l
Ammonia (NH_3), ammonium (NH_4^+)	< 1 mg/l	< 1 mg/l
Total hardness of which, maximum: - calcium hardness - magnesium hardness - carbonate hardness	< 1.78 mmol/l (corresponds to 10 °dH) < 1.25 mmol/l (corresponds to 7 °dH or 50 mg/l calcium) < 1.43 mmol/l (corresponds to 8 °dH or 35 mg/l magnesium) < 0.45 mmol/l earth alkali equivalent (corresponds to 2.5 °dH) That corresponds to < 0.9 mmol/l hydrogen carbonate (HCO_3^-) or < 0.45 mmol/l carbonate (CO_3^{2-}).	
Suspended solids / suspended substances: - solids - size of entrained particles	 < 340 mg/l < 100 µm	 < 340 mg/l < 100 µm

Note

Analyzing the liquid coolant

It is recommended that you contact the coolant manufacturer for analyzing the liquid coolant.

The coolant 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.

To better explain the coolant specifications in this document, a number of problems which can be encountered if these specifications are ignored are listed in the table below.

Table 9- 3 Substances which can cause irreparable heat sink damage

Problem	Possible causes/consequences Properties of the coolant or limit value exceeded	Countermeasure
Increase corrosion, deposits	Sea water	Do not use sea water!
	Water compliant with limit values	Use an appropriate concentration of antifreeze, cooling circuit must include a pressure-relief valve.
	Chloride	Use the specified coolant basis and the appropriate concentration of antifreeze.
	Sulfate	Use the specified coolant basis and the appropriate concentration of antifreeze.
Semi-open cooling circuit	Ingress of oxygen	Use a closed cooling circuit equipped with a pressure relief valve, the specified coolant basis and the appropriate concentration of antifreeze.
Erosion/particles	Suspended solids (e.g. sand)	Rinse cooling circuit without SINAMICS devices. Install dirt trap (e.g. strainer, 100 μm fine filter).
Whitish deposits	Excessively high total hardness	Use the specified coolant basis and the appropriate concentration of antifreeze.
Electro corrosion	Voltage potential can be identified Inadequate equipotential bonding	Connect all components to equipotential bonding system. Device connected using a high ohmic hose.
Deposits, residues, algae	Biological contamination	Use of biocides, dirt traps (e.g. strainers, fine filters).
	Oil residue	Use the appropriate concentration of antifreeze, flush cooling circuit without SINAMICS.
	Mechanical contamination	Rinse cooling circuit without SINAMICS devices. Install dirt trap (e.g. strainers, fine filters).

9.2.2 Antifreeze + biocide

Table 9- 4 Overview and application of coolant additives

	Used with SINAMICS S120 water cooled	Please note the following in particular
Antifreeze	Antifrogen N, 25 % < X ≤ 45 % Antifrogen L, 25 % < X ≤ 48 % Dowcal 100, 25 % < X ≤ 45 %	For Antifrogen L, for the same antifreeze protection, a higher concentration is required than for Antifrogen N
Biocide*	Yes Antifrogen N, minimum quantity 25% Antifrogen L, minimum quantity 25 % Dowcal 100, minimum quantity 25 % Biocide ACTIDE MBS (0.2 - 0.4 by vol %) is recommended as inhibitor.	Cooling circuit with open pressurizer
Antifreeze + biocide*	Antifreeze already has a biocidal effect in the minimum concentration specified above.	

* Effectiveness regarding the growth of microorganisms

Antifreeze

Only the following agents can be used as antifreeze:

- Antifrogen N (manufacturer: Clariant) with a percentage X of 25% < X ≤ 45% is the antifreeze used. Coolants containing 45% Antifrogen N provide protection down to -30° C.
- Antifrogen L (manufacturer: Clariant) with a percentage X of 25% < X ≤ 48% is the antifreeze used. Coolants containing 48% Antifrogen L provide protection down to -30° C.
- Dowcal 100 (manufacturer: DOW) used with a percentage X of 25 % < X ≤ 45 %. A Dowcal 100 percentage of 45 % provides frost protection down to -30 °C.

All agents contain anti-corrosion inhibitors which permanently protect the metal in the cooling system against corrosion.

It is particularly important to ensure that the percentage of antifreeze when topping up the cooling system always corresponds to the minimum quantity, otherwise the mixture becomes corrosive.

NOTICE
Material damage caused by incorrectly adding antifreeze
Incorrectly adding antifreeze to the cooling circuit can result in material damage caused by corrosion and cooling circuit leaks. • Always mix the coolant outside the cooling circuit before filling it. • Do not add the individual cooling components one after the other.

NOTICE

Damage caused by leaks if the appropriate concentration of antifreeze is not used

An insufficient concentration of antifreeze can result in material damage caused by corrosion and cooling circuit leaks.

- Regularly check the antifreeze concentration. Add the appropriate amount of antifreeze when required.

NOTICE

Material damage caused by mixing different antifreeze products

Incorrectly adding antifreeze to the cooling circuit can result in material damage caused by corrosion and cooling circuit leaks.

- Do not use different antifreeze products in a common cooling circuit.
- When changing the antifreeze, you must first empty the cooling circuit and flush it out before filling the new coolant. To do this, refer to the instructions provided by the manufacturer of the antifreeze.

Biocide

Cooling circuits with soft water (°DH>4) are susceptible to microbes. The risk of corrosion caused by microbes is virtually non-existent in chlorinated drinking water systems.

No strain of bacteria can survive when the appropriate quantity of antifreeze is added.

The following types of bacteria are encountered in practice:

- Slime-forming bacteria
- Corrosive bacteria
- Iron-depositing bacteria

The type of bacteria determines the suitability of a biocide. At least one water analysis per annum (to determine the number of bacterial colonies) is recommended. We recommend that a biocide is used depending on the ambient conditions – and that the compatibility with the components in the cooling circuit is carefully checked.

Note

Determining the appropriate biocide

The type of bacteria determines the biocide.

The concentration must be adapted to be in compliance with what the manufacturer recommends.

It is not permissible that biocides and antifreeze are mixed.

Antifreeze already has a biocidal effect in the minimum concentration specified above.

9.3 Materials

The following table lists a wide variety of materials and components which are permissible or not permissible for use in a cooling circuit.

Table 9- 5 Materials and components of a cooling circuit

Material	Used as	Used with SINAMICS S120 water cooled
Zinc	Pipes, valves and fittings	Do not use zinc!
Brass	Pipes, valves and fittings	Can be used in closed circuits with antifreeze.
Nickel	Nickel solder in the heat exchanger	Can be used in common cooling circuits.
Copper	Pipes, valves and fittings	Can be used in common cooling circuits with antifreeze in which the heat sink and copper component are galvanically isolated (e.g. hose connected to the devices). Copper should not be used or be restricted to the absolutely essential minimum.
Common steel (e.g. St37)	Pipes	Not permissible!
Cast steel, cast iron	Pipes, motors	Not permissible!
High-alloy steel (V4A) W1.4404, W4435 (AISI316L), W1.4571 (AISI316Ti)	Pipes, valves and fittings, heat exchang-ers	Can be used for drinking or tap water with a chloride content up to < 250 mg/l, suitable according to definition in Chapter Coolant properties (Page 260).
High-alloy steel W1.4539 (AISI904L) CuNi10Fe1.6	Pipe, valves and fit-tings, heat exchanger	Can be used for drinking or tap water with a chloride content up to < 500 mg/l, suitable according to definition in Chapter Coolant properties (Page 260). Preferred material for devices with heat exchanger manufactured out of a copper-nickel alloy.
Installation made of different materials (mixed installation)	Pipe, valves and fit-tings, heat exchanger	Do not use a mixed installation.
Plastic - PE (polyethylene) - PVC - NORYL PPE 10% filling or Ryton PPS 65% filling.	 Pipe Pipe, valve and fit-tings, hoses Connection manifold, molded part	 Do not use PE (polyethylene) for water pipes because they exces-sively expand. Do not use PVC. Can be used as connection manifold or molded part in the cooling circuit.
PE (polyethylene)	Pipes	Do not use PE (polyethylene) for water pipes because they are too long.
PVC	Pipes, valves and fittings, hoses	Do not use PVC!
Hoses		Reduce the use of hoses to a minimum (device connection). Must not be used as the main pipe for the whole system. The hose used must have the highest possible resistance! Recommendation: NBR hose from HANSA Flex TE 308 B (3TE) or Conti Goldschlange EPDM hoses with an electrical resistance 1 MΩ/m, (e.g. Semperflex FKD supplied by Semperit or DEMITTEL of PE/EPD supplied by the Telle company)

Material	Used as	Used with SINAMICS S120 water cooled
Gaskets	Pipes, valves and fittings	Use of Viton, AFM34, EPDM, NBR is recommended.
Hose connections	Pipe-hose transition	Secure with clips conforming to DIN2817, available, e.g. from the Telle company . Hose connectors manufactured out of a copper-nickel alloy are included in the accessories pack for devices with copper-nickel heat exchanger Installing the hose connectors using security clamp collars (Page 273).

Note

Checking the hose lines

The inspection intervals depend on the prevailing ambient conditions.

The following points should be noted for the coolant hoses:

- Damage through abrasion points
- Embrittlement (e.g. forming of cracks)
- Leaks
- The hose slipping out of the coupling
- Deformations that do not comply with the natural shape of the hose (e.g. separation of layers and blistering)
- Exceeding the storage and use times
  In accordance with the accepted rules and standards, we recommend a testing cycle of five years with the appropriate test pressure (twice the operating pressure).

9.4 Anti-condensation measures

The customer must take measures to protect the devices against condensation.

If condensation occurs in the device, it must be de-energized and dried before switching on again.

Condensation normally occurs at the intake connection of the devices.

Condensation occurs when the inlet temperature of the coolant is significantly lower than room temperature (ambient temperature). The permissible temperature difference between coolant and air varies as a function of the relative humidity ϕ of the ambient air. The air temperature at which the aqueous phase drops out is referred to as the "dew point".

The table below shows the dew points (in °C) for an atmospheric pressure of 1 bar (≈ installation altitude, 0 to 500 m). If the temperature of the coolant is below the specified value, condensation may occur, i.e. the coolant temperature must always be ≥ the dew point temperature.
The coolant temperature must be controlled according to the following table.

Table 9- 6 Dew point temperature as a function of relative air humidity ϕ and room temperature at an installation altitude of 0 m.

T room [° C]	φ=20%	φ=30%	φ=40%	φ=50%	φ=60%	φ=70%	φ=80%	φ=85%	φ=90%	φ=95%	φ=100%
10	<0	<0	<0	0.2	2.7	4.8	6.7	7.6	8.4	9.2	10
20	<0	2	6	9.3	12	14.3	16.4	17.4	18.3	19.1	20
25	0.6	6.3	10.5	13.8	16.7	19.1	21.2	22.2	23.2	24.1	24.9
30	4.7	10.5	14.9	18.4	21.3	23.8	26.1	27.1	28.1	29	29.9
35	8.7	14.8	19.3	22.9	26	28.6	30.9	32	33	34	34.9
38	11.1	17.4	22	25.7	28.8	31.5	33.8	34.9	36	36.9	37.9
40	12.8	19.1	23.7	27.5	30.6	33.4	35.8	36.9	37.9	38.9	39.9
45	16.8	23.3	28.2	32	35.3	38.1	40.6	41.8	42.9	43.9	44.9
50	20.8	27.5	32.6	36.6	40	42.9	45.5	46.6	47.8	48.9	49.9

The dew point also depends on the absolute pressure, i.e. the installation altitude.

The dew points for low atmospheric pressure are lower than those at an altitude of 0 m, i.e. it is always acceptable to calculate the coolant supply temperature for an altitude of 0 m.

9.5 Examples of coolant control

For water-cooled devices, warm ambient air can condense on the cold surfaces of heat sink. The resulting condensate can cause electrical damage such as leakage current bridges and flashovers. Condensation must be avoided by means of an appropriate temperature of the coolant by always maintaining the temperature of the heat sink above the dew point of the ambient air. This can be achieved either by a permanently set and correspondingly high coolant temperature, or by controlling the temperature of the coolant in accordance with the ambient air and the relative humidity.

A temperature control of the coolant adds a temperature difference T_L of approximately 3 K ... 5 K above the condensation temperature to the ambient temperature T_U and forms the setpoint T_{set} for the coolant temperature, see following figure. The control compares the temperature setpoint with the actual value at the coolant inlet T_{act}, which can be accessed via parameter r0037[19]. The coolant temperature control is performed by the three-step controller with the aid of the servo motor connected to the 3-way valve.

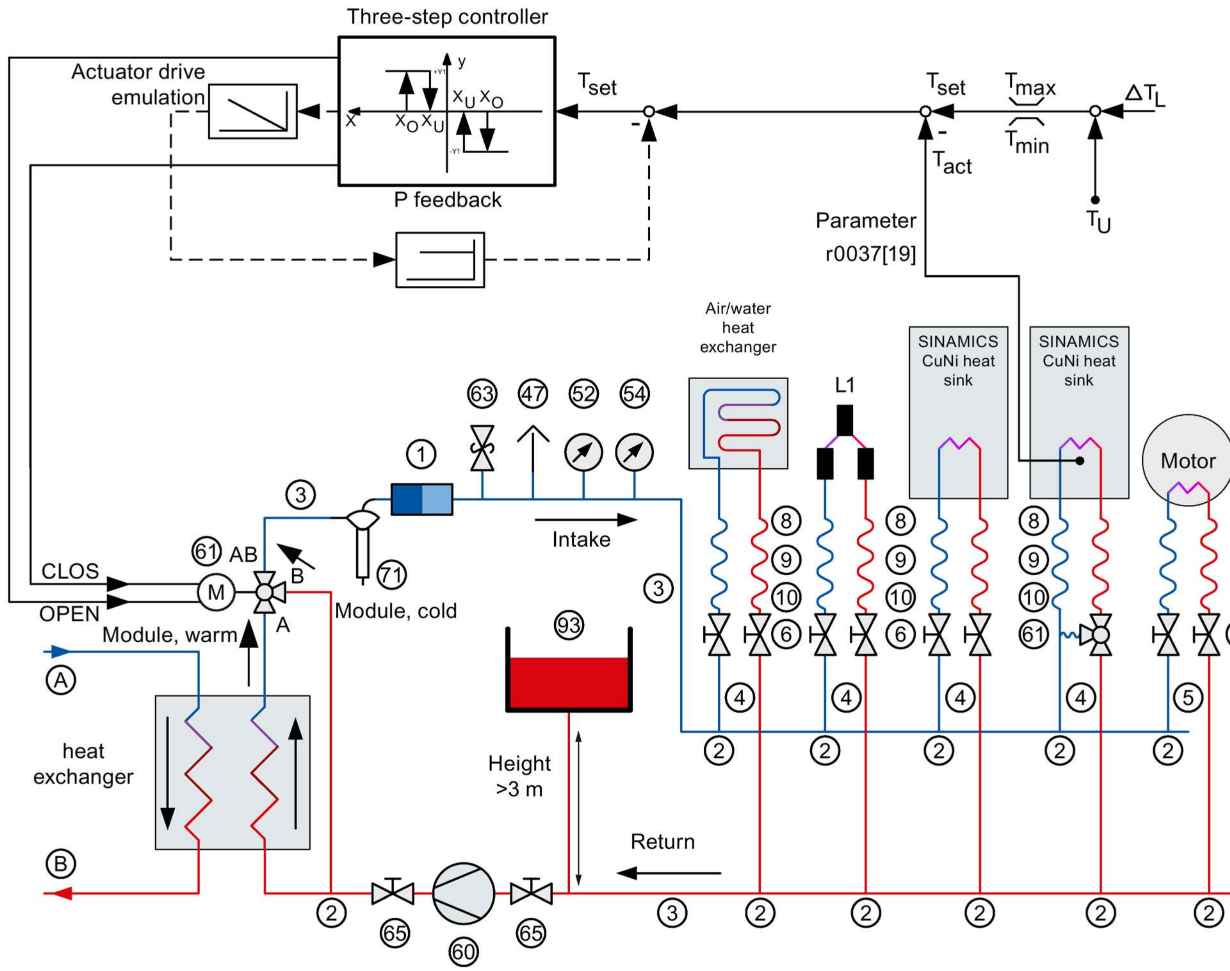
The three-step controller has three switch positions for control of the servo motor:

- +Y1 for forward motion
- 0 for standstill
- –Y1 for backward motion

When the control deviation x exceeds the upper switching hysteresis x_u, the servo motor is switched on, when the deviation falls below the lower switching hysteresis x_l, the servo motor is switched off. When the control deviation falls below the switching hysteresis in the negative direction, the servo motor runs in the opposite direction until the control deviation has been cleared and the servo motor is switched off.

From the control point of view, the servo motor on 3-way valve has an I behavior. The dashed feedback is recommended for a stable control with P behavior.

The 3-way valve is controlled so that the path B-AB is opened when the coolant is cold. The coolant is led past the heat exchanger and the heat sink is heated by the switching losses of the power semiconductors. When the coolant inlet temperature T_{act} reaches the setpoint, the three-step controller opens the 3-way valve and the path A-AB.



1	Sight glass	47	Vent
2	T piece	52	Temperature sensor
3	Line d1	54	Pressure sensor
4	Line d2	60	Pump
5	Line d3	61	Three-way bypass valve
6	Ball valve d2	63	Safety release valve
7	Ball valve d3	65	Ball valve d1
8	Hose connection at the device	71	Filter mit automatic backflushing or dirt trips, fine filter 100 µm
9	EPDM hose	93	Reservoir/expansion chamber
10	Hose connection at the ball valve		
A	Intake, cooling water primary circuit	B	Return, cooling water primary circuit

Figure 9-14 Principle of a flow control with 3-way valve as protection against condensation

Example of control of the coolant temperature depending on the relative humidity and the ambient temperature

The temperature correction value delta T_L (ΔT_L) is added to the ambient temperature to maintain the temperature setpoint (T_{set}) for the coolant. The value depends on the relative humidity plus 4° C above the dew point.

Coolant temperature setpoint = ambient temperature + Δ TL

Table 9- 7 ΔT_L depends on the humidity

Relative humidity [%]	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**85**	**90**	**95**	**100**
[° C] [1)]	25	18	15	12	9	7	4	3	2	1	0
Delta T_L [° C] [2)]	-21	-14	-11	-8	-5	-3	0	+1	+2	+3	+4

[1)] Temperature difference to the dew point

[2)] Dew point plus 4° C

If delta T_L (ΔT_L) is now added to the ambient temperature this provides the setpoint for the coolant temperature.

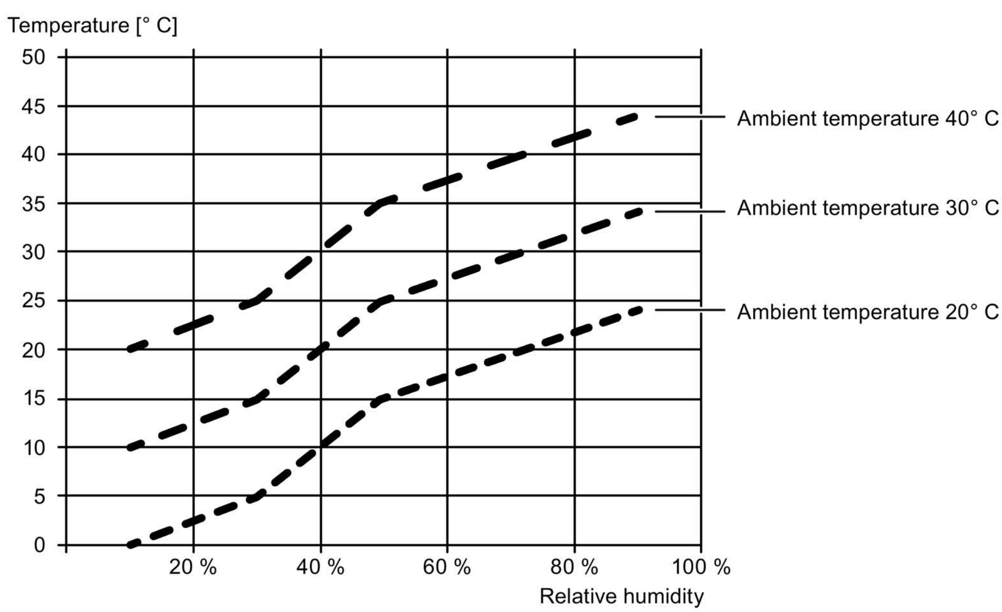


Figure 9-15 Examples of the minimum coolant temperature setpoint depending on the humidity of 20, 30 and 40° C ambient temperature (dew point plus 4° C)

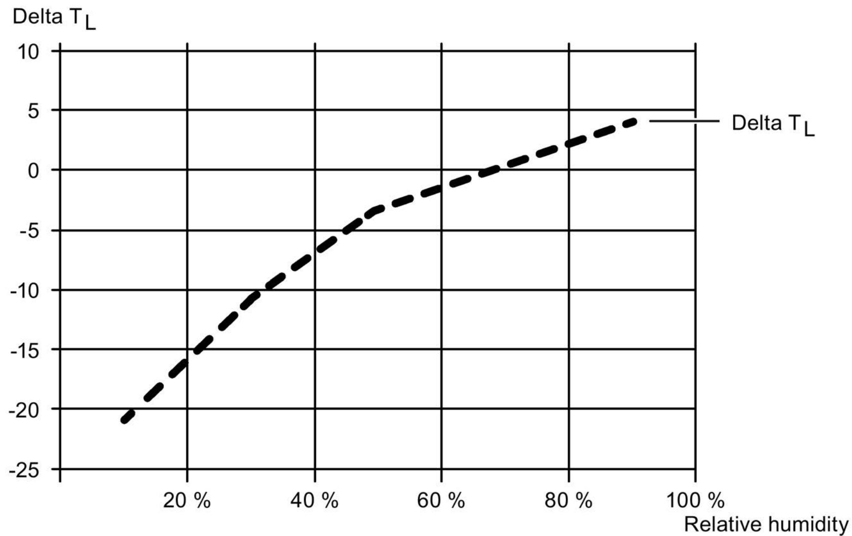
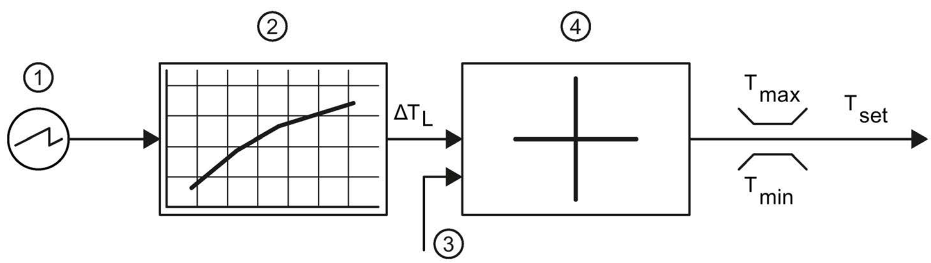


Figure 9-16 Curve to determine the temperature ΔT_L

The temperature ΔT_L can be determined according to the characteristic based on the measured humidity.

Example of the formation of the temperature setpoint of the coolant



① Actual humidity value
② Humidity characteristic – temperature difference
③ Actual ambient temperature value
④ Adder for temperatures

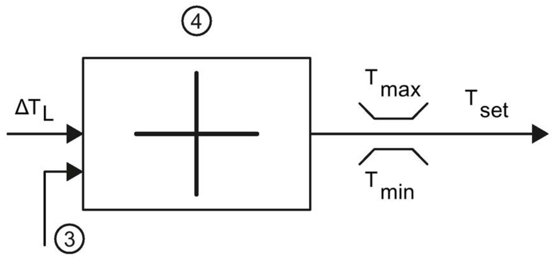
Figure 9-17 Formation of the coolant temperature setpoint

Tmin should be limited to plus 10° C. Tmax to 50° C.

Sensors for simultaneous measurement of the relative humidity and temperature can be supplied, for example, by JUMO.

Examples of the coolant temperature setpoint depending on the ambient temperature

This method is based on a high humidity (95%). The advantage is that only the ambient temperature and the coolant temperature are required as actual values for the coolant temperature control. A sensor for the humidity is not required.



③ Actual ambient temperature value
④ Adder for temperatures

Figure 9-18 Formation of the setpoint depending on the ambient temperature

The temperature difference ΔT_L should be 3° C. Condensation is therefore excluded for a humidity up to 95%.

SIEMENS cooling units

Cooling units with a cooling capacity of 32, 48, 72 and 120 kW can be ordered from SIEMENS.

Please contact your local Siemens office.

The cooling units in a Siemens control cabinet have a closed-control unit with a bypass valve as protection against condensation. The risk of condensation can be minimized by manually setting the coolant temperature using the Siemens control. Recognition of the danger of condensation due to too high an ambient temperature in relation to the coolant temperature is integrated as a warning to be issued.

9.6 Connection methods

9.6.1 Connections

The electrical connections on the SINAMICS S120 water-cooled devices must be made with cables having the cross-section specified in the technical data for the relevant device.

The coolant connection is made using 3/4" couplings.

The supply and return connections on the SINAMICS devices must be made with flexible, non-conductive hose (see Section "Materials") so as to eliminate the risk of electrochemical corrosion, to reduce transfer of vibration and to dampen pressure transients in the coolant. The hose should be about 1.5 m in length (total of supply and return lines).

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

Figure 9-19 Coolant connections

9.6.2 Installing the hose connectors using security clamp collars

Hose connectors manufactured out of a copper-nickel alloy are included in the accessories pack to attach the hoses to the connections for the liquid coolant. These hose connectors must be used in order to avoid corrosion.

The hose connectors with the associated clamp collars are suitable for hoses with a nominal diameter of 19 mm and an outer diameter of 30 mm - 33 mm.

Installation

	You require the following components for the installation: • Hose connectors • Clamp collars with nuts and bolts • Hose Tools required: • 5 mm Allen key • If necessary, a vice
	Cut the hoses so the ends are straight and insert the hose connectors into the hose until they are flush with the security flange.

	Position the clamp collars so that the retaining collars are located directly above the security flange of the hose connector.
	Place the nuts provided in the pockets in the clamp collar.
	Screw the two clamp collars together. Tighten the screws uniformly and alternating until a maximum gap height of 15 mm remains at both sides. The gap must run in parallel, and must be absolutely identical at both sides. You can carefully clamp the collars in a vice to make it easier to screw them together. The specified gap height can be used for the "HANSA Flex TE 308 B (3TE)" hose. When using other hoses, the gap height can deviate with reference to safe and reliable mounting and installation.

9.7 Commissioning

Commissioning the cooling circuit

Once the modules have been installed in the plant, the coolant circuit must be commissioned before the electrical systems.

Venting the heat sink

The heat sink does not have to be vented when filling the heatsink with integrated copper-nickel alloy or stainless steel heat exchanger.

After connecting the device to the power supply and before switching on for the first time, the cooling circuit should operate for approximately 30 min to ensure that coolant flows through the device.

9.8 Service

Service

Recommended service activities for the cooling circuit are described in Chapter "Maintenance (Page 278)".

Maintenance and service 10

10.1 Chapter content

This chapter provides information on the following:

- Maintenance and servicing procedures that have to be carried out on a regular basis to ensure the availability of the components.
- Exchanging device components when the device is serviced
- Forming the DC-link capacitors

> ⚠ WARNING
>
> **Danger to life if the fundamental safety instructions and remaining risks are not carefully observed**
>
> The non-observance of the fundamental safety instructions and residual risks stated in Chapter 1 can result in accidents with severe injuries or death.
>
> - Adhere to the fundamental safety instructions.
> - When assessing the risk, take into account residual risks.

> ⚠ DANGER
>
> **Danger to life through electric shock due to the residual charge of the DC-link capacitors**
>
> Because of the DC-link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off.
>
> Contact with live parts can result in death or serious injury.
>
> - Only open the device after five minutes have elapsed.
> - Measure the voltage before starting work on the DCP and DCN DC-link terminals.

> ⚠ DANGER
>
> **Danger to life due to electric shock from external supply voltages**
>
> When the external power supply or the external 230 VAC auxiliary supply is connected, dangerous voltages are still present in components even when the main circuit breaker is open.
>
> Contact with live parts can result in death or serious injury.
>
> - Switch off external supply voltages and external 230 V AC auxiliary supply before opening the device.

10.2 Maintenance

The devices comprise mostly electronic components. Apart from the electronic fan(s), therefore, they contain hardly any components that are subject to mechanical wear or that require maintenance or servicing. Maintenance is intended to ensure that the equipment remains in the specified condition. Inspections must be performed regularly, but at least once a year. Where necessary, contaminants must be removed and wearing parts replaced.

The following points must generally be observed.

Cleaning

Dust deposits

Dust deposits inside the device must be removed at regular intervals (or at least once a year) by qualified personnel in line with the relevant safety regulations. The unit must be cleaned using a brush and vacuum cleaner, and dry compressed air (max. 1 bar) for areas that cannot be easily reached.

Ventilation

The ventilation openings in the devices must never be obstructed. The electronic fans must be checked to make sure that they are functioning correctly.

Cable and screw terminals

Cable and screw terminals must be checked regularly to ensure that they are secure in position, and if necessary, retightened. Cabling must be checked for defects. Defective parts must be replaced immediately.

Checking for leaks

The cooling system should be checked for leaks whenever maintenance is carried out.

Note

Maintenance intervals

The actual intervals at which maintenance procedures are to be performed depend on the installation conditions (cabinet environment) and the operating conditions.

Siemens offers its customers support in the form of a service contract. For further details, contact your regional office or sales office.

Service for the cooling circuit

The following service is recommended for the cooling circuit:

- The coolant should be checked 3 months after the cooling circuit is filled for the first time and, subsequently, once a year.
  When analyzing the coolant, the concentration and the general conditions of the inhibitor/antifreeze should be checked.
- If the cooling water becomes cloudy, is colored, or becomes contaminated by mold spores, the cooling circuit must be cleaned and refilled.
- It is recommended that you contact the coolant manufacturer to analyze the liquid coolant.
- If the coolant level has dropped, the loss should be corrected for closed or semi-open circuits with a prepared mixture of coolant basis and antifreeze, see Chapters "Coolant properties (Page 260)" and "Antifreeze + biocide (Page 262)".

Maintaining coolant hoses

The coolant hoses must be inspected in regular intervals for cracks and leaks. If there are any leakages at the hose joints, the flat seal may need to be replaced.

EPDM hoses with cracks or that the leak should be replaced.

10.3 Servicing

Servicing involves activities and procedures for maintaining and restoring the specified condition of the devices.

Required tools

The following tools are required for replacing components:

- Standard set of tools with screwdrivers, screw wrenches, socket wrenches, etc.
- Torque wrenches 1.5 Nm up to 100 Nm
- 600 mm extension for socket wrenches

Tightening torques for screw connections

The following tightening torques apply when tightening current-conducting connections (DC link, motor connections, busbars, cable lugs) and other connections (ground connections, PE connections).

Table 10- 1 Tightening torques for screw connections

Thread	Ground connections, PE connections, steel threaded connections	Aluminum threaded connections, plastic, busbars, cable lugs
M3	1.3 Nm	0.8 Nm
M4	3 Nm	1.8 Nm
M5	6 Nm	3 Nm
M6	10 Nm	6 Nm
M8	25 Nm	13 Nm
M10	50 Nm	25 Nm
M12	88 Nm	50 Nm
M16	215 Nm	115 Nm

Note

Screw connections for protective covers

The threaded connections for the protective covers made of Makrolon may only be tightened with 2.5 Nm.

10.4 Replacing components

10.4.1 Safety information

WARNING

Danger to life due to improper transport and installation of devices and components

Serious injury or even death and substantial material damage can occur if the devices are not transported or installed properly.

- Transport, mount, and remove the devices and components only if you are qualified to do so.
- Take into account that the devices and components are in some cases heavy and top-heavy and take the necessary precautionary measures.

NOTICE

Material damage caused by mechanically stressed busbars and coolant connections

Mechanically stressed busbars and coolant connections can damage the device.

- Do not use the busbars and liquid coolant connections protruding from the device as handles or as support surfaces during transport.

10.4.2 Messages after replacement of DRIVE-CLiQ components

After DRIVE-CLiQ components are replaced (Control Interface Module, TM31, SMCxx) when service is required, generally no message is output after power-up, since an identical component is identified and accepted as component when the system boots.

The reason for this is that an identical component is detected and accepted as spare part when running-up. If, unexpectedly, a fault message of the "topology fault" category is displayed, then when replacing a component, one of the following faults/errors should have occurred:

- A Control Interface Module with different firmware data was installed.
- When connecting-up DRIVE-CLiQ cables, connections were interchanged.

Automatic firmware update

A firmware update for the replaced DRIVE-CLiQ component may run automatically after switching on the electronics.

- The following LEDs will flash slowly to indicate that an automatic firmware update is in progress: the "RDY" LED on the Control Unit (orange, 0.5 Hz) and an LED on the relevant DRIVE-CLiQ component (green/red, 0.5 Hz).

Note

Do not shut down the converter

For this action, the converter should not be shut down because otherwise the firmware update would need to be restarted.

- Once the automatic firmware update is complete, the "RDY" LED on the Control Unit will flash quickly (orange, 2 Hz) along with an LED on the relevant DRIVE-CLiQ component (green/red, 2 Hz).
- To complete the automatic firmware update process, a POWER ON is required (switch the device off and back on again).

10.4.3 Mounting equipment for power units

Mounting equipment

The mounting equipment is used to mount or remove water-cooled power units (Active Interface Modules (filter module) Active Line Modules, Motor Modules, Power Modules) in or out of a control cabinet.

The mounting equipment can be used if the power units are mounted on mounting rails, which at the front have two M6 threads at a vertical distance of 20 mm to attach the mounting equipment.

The mounting equipment is used to help mount the device; it is placed in front of the power unit, and attached to the mounting rails below the power unit.
Using the telescopic rails, the mounting equipment can be adapted to the actual mounting height and the power unit width. The power unit can be removed from the control cabinet after releasing the mechanical and electrical connections and the coolant connections. Whereby the power unit is guided and supported by the guide rails on the mounting equipment. To prevent it toppling over, the power unit must be secured to a crane, tripod or similar assembly using the lifting lugs or the lifting equipment. The device can then be lowered down from the mounting equipment.

Figure 10-1 Mounting aid

Article number of the mounting equipment

The article number for the mounting equipment is 6SL3766-1CA00-0AA0.

10.4.4 Replacing the Control Interface Module, Power Module, frame size FL

Replacing the Control Interface Module

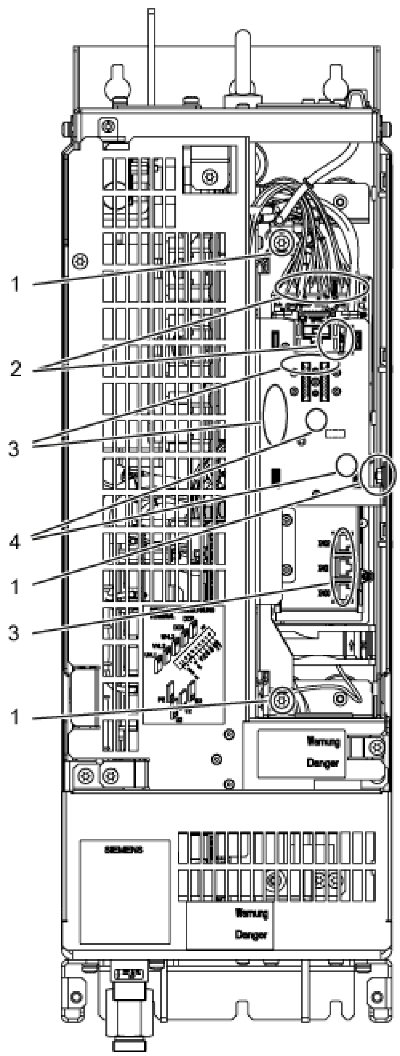


Figure 10-2 Replacing the Control Interface Module, Power Module, frame size FL

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access
- Remove the protective cover

Removal

The removal steps are numbered in accordance with the numbers in the diagram.

1. Undo the retaining screws for the control module holder and the plug-in electronics module (two screws and one nut) and remove the control module holder.
2. Disconnect the plug-in connections for the fiber-optic cables and signal cables (maximum five connectors).
3. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (maximum six connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
4. Take out the retaining screws for the IPD card (two screws) and remove the IPD card from connector -X45 on the Control Interface Module.

When removing the Control Interface Module, you have to disconnect a maximum of five additional connectors one after the other (two at the top, three below) and the PE connection (one screw below).

NOTICE
Damage to the device due to damaged signal cables during disassembly
Signal cables can be damaged when withdrawing the Control Interface Module, which can result in a device failure. • When withdrawing the Control Interface Module, ensure that you do not damage any signal cables.

Installation steps

Installing is the same as removing, however in the reverse order.

Tightening torque for the fastening screws of the plug-in electronics module (M6 x 16, item ①): 6 Nm

---

Note

Specifications for the installation

The tightening torques specified in the table "Tightening torques for screw connections" must be observed.

Carefully insert the plug connections and ensure that they are secure.

When using connectors with a locking mechanism, make sure that the locking lever is securely engaged once connected.

The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The DRIVE-CLiQ cable connectors should be labeled prior to disassembly and reinstalled at their original slot, since it is necessary to re-perform system identification after changing the DRIVE-CLiQ cables.

The screw connections for the protective covers may only be tightened by hand.

10.4.5 Replacing the Control Interface Module, Power Module, frame size GL

Replacing the Control Interface Module

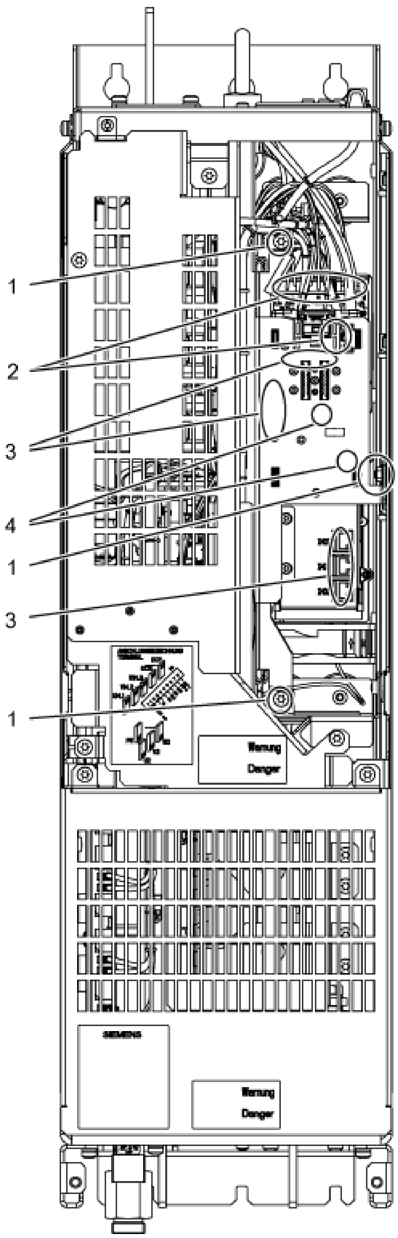


Figure 10-3 Replacing the Control Interface Module, Power Module, frame size GL

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access
- Remove the protective cover

Removal

The removal steps are numbered in accordance with the numbers in the diagram.

1. Undo the retaining screws for the control module holder and the plug-in electronics module (two screws and one nut) and remove the control module holder.
2. Disconnect the plug-in connections for the fiber-optic cables and signal cables (maximum five connectors).
3. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (maximum six connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
4. Take out the retaining screws for the IPD card (two screws) and remove the IPD card from connector -X45 on the Control Interface Module.

When removing the Control Interface Module, you have to disconnect a maximum of five additional connectors one after the other (two at the top, three below) and the PE connection (one screw below).

NOTICE
Damage to the device due to damaged signal cables during disassembly Signal cables can be damaged when withdrawing the Control Interface Module, which can result in a device failure. • When withdrawing the Control Interface Module, ensure that you do not damage any signal cables.

Installation steps

Installing is the same as removing, however in the reverse order.

Tightening torque for the fastening screws of the plug-in electronics module (M6 x 16, item ①): 6 Nm

Note

Specifications for the installation

The tightening torques specified in the table "Tightening torques for screw connections" must be observed.

Carefully insert the plug connections and ensure that they are secure.

When using connectors with a locking mechanism, make sure that the locking lever is securely engaged once connected.

The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The DRIVE-CLiQ cable connectors should be labeled prior to disassembly and reinstalled at their original slot, since it is necessary to re-perform system identification after changing the DRIVE-CLiQ cables.

The screw connections for the protective covers may only be tightened by hand.

10.4.6 Replacing the Control Interface Module, Motor Module, frame size FXL

Replacing the Control Interface Module

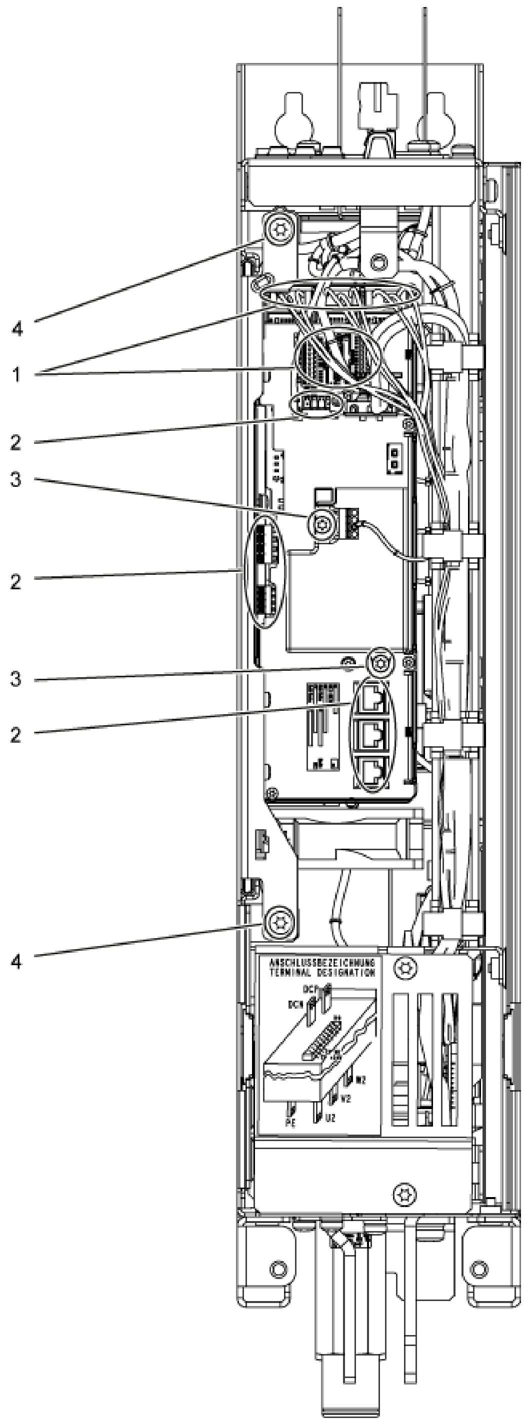


Figure 10-4 Replacing the Control Interface Module, Motor Module, frame size FXL

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access
- Remove the protective cover

Removal

The removal steps are numbered in accordance with the numbers in the diagram.

1. Disconnect the plug-in connections for the fiber-optic cables and signal cables (maximum five connectors).
2. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (maximum six connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
3. Take out the retaining screws for the IPD card (two screws) and remove the IPD card from connector -X45 on the Control Interface Module.
4. Remove the retaining screws for the Control Interface Module (two screws).

When removing the Control Interface Module, you have to disconnect a maximum of five additional connectors one after the other (two at the top, three below) and the PE connection (one screw below).

NOTICE
Damage to the device due to damaged signal cables during disassembly
Signal cables can be damaged when withdrawing the Control Interface Module, which can result in a device failure. • When withdrawing the Control Interface Module, ensure that you do not damage any signal cables.

Installation steps

Installing is the same as removing, however in the reverse order.

Tightening torque for the fastening screws of the Control Interface Module (M6 x 16, item ④): 6 Nm

---

Note

Specifications for the installation

The tightening torques specified in the table "Tightening torques for screw connections" must be observed.

Carefully insert the plug connections and ensure that they are secure.

When using connectors with a locking mechanism, make sure that the locking lever is securely engaged once connected.

The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The DRIVE-CLiQ cable connectors should be labeled prior to disassembly and reinstalled at their original slot, since it is necessary to re-perform system identification after changing the DRIVE-CLiQ cables.

The screw connections for the protective covers may only be tightened by hand.

10.4.7 Replacing the Control Interface Module, Motor Module, frame size GXL

Replacing the Control Interface Module

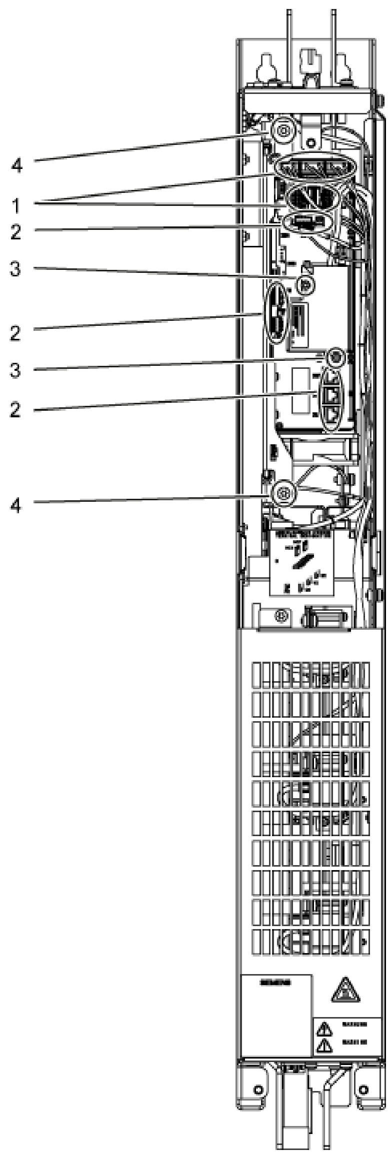


Figure 10-5 Replacing the control interface module, Motor Module, frame size GXL

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access
- Remove the protective cover

Removal

The removal steps are numbered in accordance with the numbers in the diagram.

1. Disconnect the plug-in connections for the fiber-optic cables and signal cables (maximum five connectors).
2. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (maximum six connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
3. Take out the retaining screws for the IPD card (two screws) and remove the IPD card from connector -X45 on the Control Interface Module.
4. Remove the retaining screws for the Control Interface Module (two screws).

When removing the Control Interface Module, you have to disconnect a maximum of five additional connectors one after the other (two at the top, three below) and the PE connection (one screw below).

NOTICE
Damage to the device due to damaged signal cables during disassembly
Signal cables can be damaged when withdrawing the Control Interface Module, which can result in a device failure.
• When withdrawing the Control Interface Module, ensure that you do not damage any signal cables.

Installation steps

Installing is the same as removing, however in the reverse order.

Tightening torque for the fastening screws of the Control Interface Module (M6 x 16, item ④): 6 Nm

---

Note

Specifications for the installation

The tightening torques specified in the table "Tightening torques for screw connections" must be observed.

Carefully insert the plug connections and ensure that they are secure.

When using connectors with a locking mechanism, make sure that the locking lever is securely engaged once connected.

The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The DRIVE-CLiQ cable connectors should be labeled prior to disassembly and reinstalled at their original slot, since it is necessary to re-perform system identification after changing the DRIVE-CLiQ cables.

The screw connections for the protective covers may only be tightened by hand.

10.4.8 Replacing the Control Interface Module, Active Line Module and Motor Module, frame size HXL

Replacing the Control Interface Module

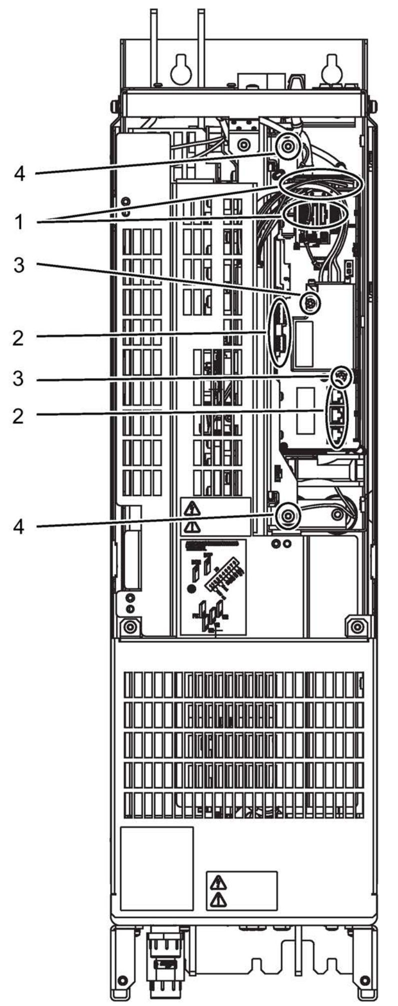


Figure 10-6 Replacing the Control Interface Module, Active Line Module and Motor Module, frame size HXL

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access
- Remove the protective cover

Removal

The removal steps are numbered in accordance with the numbers in the diagram.

1. Disconnect the plug-in connections for the fiber-optic cables and signal cables (maximum five connectors).
2. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (maximum six connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
3. Take out the retaining screws for the IPD card (two screws) and remove the IPD card from connector -X45 on the Control Interface Module.
4. Remove the retaining screws for the Control Interface Module (two screws).

When removing the Control Interface Module, you have to disconnect a maximum of five additional connectors one after the other (two at the top, three below) and the PE connection (one screw below).

NOTICE
Damage to the device due to damaged signal cables during disassembly
Signal cables can be damaged when withdrawing the Control Interface Module, which can result in a device failure.
• When withdrawing the Control Interface Module, ensure that you do not damage any signal cables.

Installation steps

Installing is the same as removing, however in the reverse order.

Tightening torque for the fastening screws of the Control Interface Module (M6 x 16, item ④): 6 Nm

---

Note

Specifications for the installation

The tightening torques specified in the table "Tightening torques for screw connections" must be observed.

Carefully insert the plug connections and ensure that they are secure.

When using connectors with a locking mechanism, make sure that the locking lever is securely engaged once connected.

The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The DRIVE-CLiQ cable connectors should be labeled prior to disassembly and reinstalled at their original slot, since it is necessary to re-perform system identification after changing the DRIVE-CLiQ cables.

The screw connections for the protective covers may only be tightened by hand.

10.4.9 Replacing the Control Interface Module, Active Line Module and Motor Module, frame size JXL

Replacing the Control Interface Module

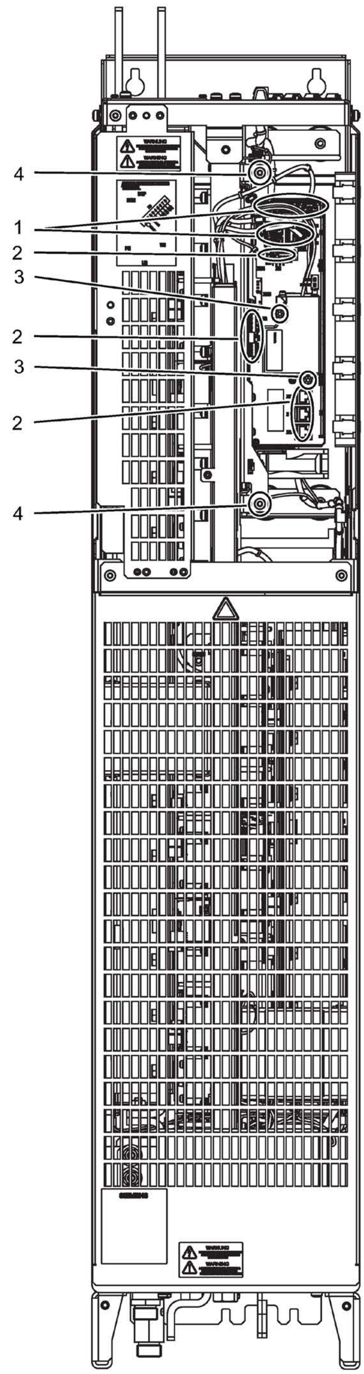


Figure 10-7 Replacing the Control Interface Module, Active Line Module and Motor Module, frame size JXL

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access
- Remove the protective cover

Removal

The removal steps are numbered in accordance with the numbers in the diagram.

1. Disconnect the plug-in connections for the fiber-optic cables and signal cables (maximum five connectors).
2. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (maximum six connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
3. Take out the retaining screws for the IPD card (two screws) and remove the IPD card from connector -X45 on the Control Interface Module.
4. Remove the retaining screws for the Control Interface Module (two screws).

When removing the Control Interface Module, you have to disconnect a maximum of five additional connectors one after the other (two at the top, three below) and the PE connection (one screw below).

NOTICE
Damage to the device due to damaged signal cables during disassembly Signal cables can be damaged when withdrawing the Control Interface Module, which can result in a device failure. • When withdrawing the Control Interface Module, ensure that you do not damage any signal cables.

Installation steps

Installing is the same as removing, however in the reverse order.

Tightening torque for the fastening screws of the Control Interface Module (M6 x 16, item ④): 6 Nm

---

Note

Specifications for the installation

The tightening torques specified in the table "Tightening torques for screw connections" must be observed.

Carefully insert the plug connections and ensure that they are secure.

When using connectors with a locking mechanism, make sure that the locking lever is securely engaged once connected.

The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The DRIVE-CLiQ cable connectors should be labeled prior to disassembly and reinstalled at their original slot, since it is necessary to re-perform system identification after changing the DRIVE-CLiQ cables.

The screw connections for the protective covers may only be tightened by hand.

10.4.10 Replacing the electronic fan, Power Module, frame size FL

Replacing the electronic fan

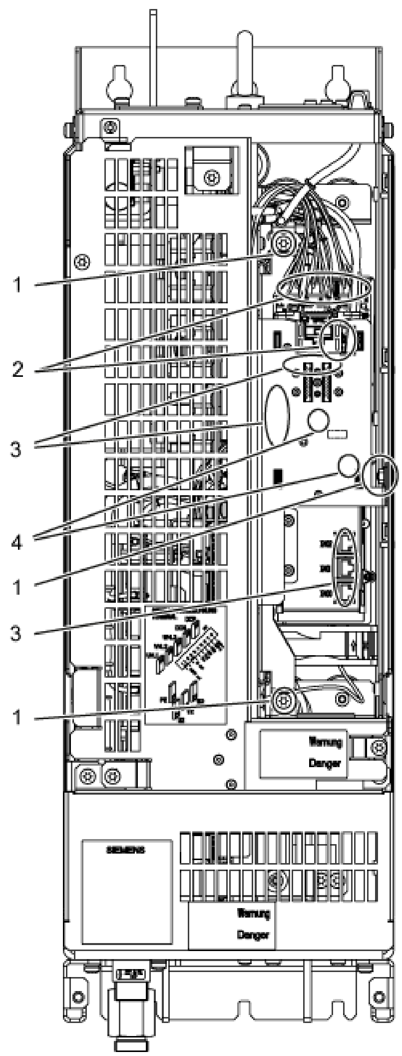


Figure 10-8 Replacing the electronic fan, Power Module, frame size FL

Description

The average service life of the electronic fans is 50,000 hours. In practice, however, the service life depends on other variables (e.g. ambient temperature, degree of cabinet protection, etc.) and, therefore, may deviate from this value.

The electronic fans must be replaced in good time to ensure that the device is available.

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access
- Remove the protective cover

Removal

The removal steps are numbered in accordance with the numbers in the diagram.

1. Undo the retaining screws for the control module holder and the plug-in electronics module (two screws and one nut) and remove the control module holder.
2. Disconnect the plug-in connections for the fiber-optic cables and signal cables (maximum five connectors).
3. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (maximum six connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
4. Take out the retaining screws for the IPD card (two screws) and remove the IPD card from connector -X45 on the Control Interface Module.

When removing the Control Interface Module, you have to disconnect a maximum of five additional connectors one after the other (two at the top, three below) and the PE connection (one screw below).

NOTICE
Damage to the device due to damaged signal cables during disassembly
Signal cables can be damaged when withdrawing the Control Interface Module, which can result in a device failure. • When withdrawing the Control Interface Module, ensure that you do not damage any signal cables.

Then, you can remove the plug for the electronic fan power supply from the Control Interface Module. Now you can remove the electronic fan for the Control Interface Module.

Installation steps

Installing is the same as removing, however in the reverse order.

Tightening torque for the fastening screws of the plug-in electronics module (M6 x 16, item ①): 6 Nm

---

Note

Specifications for the installation

The tightening torques specified in the table "Tightening torques for screw connections" must be observed.

Carefully insert the plug connections and ensure that they are secure.

When using connectors with a locking mechanism, make sure that the locking lever is securely engaged once connected.

The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The DRIVE-CLiQ cable connectors should be labeled prior to disassembly and reinstalled at their original slot, since it is necessary to re-perform system identification after changing the DRIVE-CLiQ cables.

The screw connections for the protective covers may only be tightened by hand.

10.4.11 Replacing the electronic fan, Power Module, frame size GL

Replacing the electronic fan

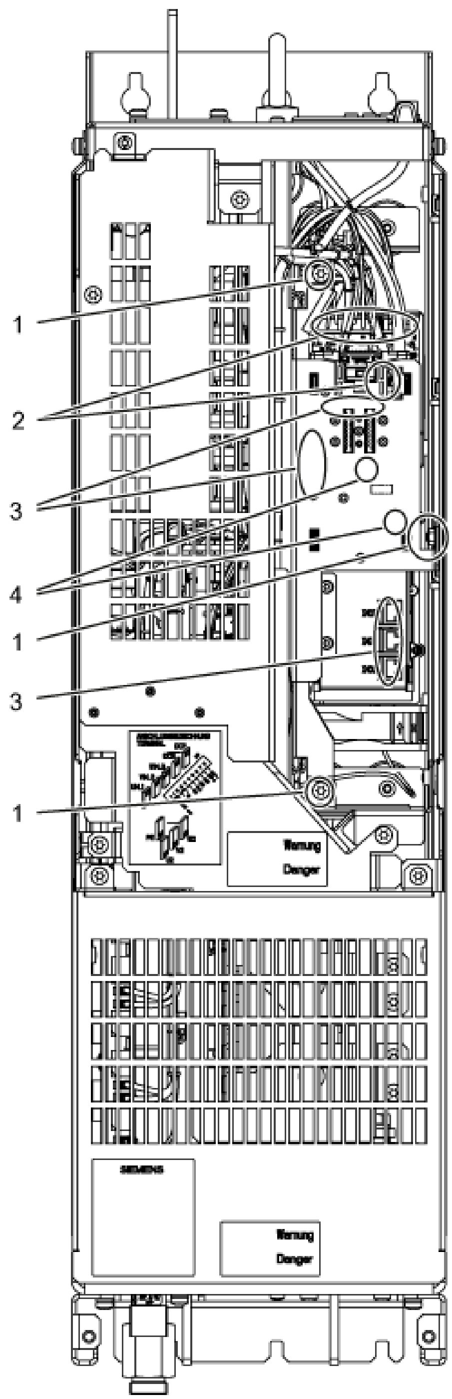


Figure 10-9 Replacing the electronic fan, Power Module, frame size GL

Description

The average service life of the electronic fans is 50,000 hours. In practice, however, the service life depends on other variables (e.g. ambient temperature, degree of cabinet protection, etc.) and, therefore, may deviate from this value.

The electronic fans must be replaced in good time to ensure that the device is available.

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access
- Remove the protective cover

Removal

The removal steps are numbered in accordance with the numbers in the diagram.

1. Undo the retaining screws for the control module holder and the plug-in electronics module (two screws and one nut) and remove the control module holder.
2. Disconnect the plug-in connections for the fiber-optic cables and signal cables (maximum five connectors).
3. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (maximum six connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
4. Take out the retaining screws for the IPD card (two screws) and remove the IPD card from connector -X45 on the Control Interface Module.

When removing the Control Interface Module, you have to disconnect a maximum of five additional connectors one after the other (two at the top, three below) and the PE connection (one screw below).

NOTICE
Damage to the device due to damaged signal cables during disassembly Signal cables can be damaged when withdrawing the Control Interface Module, which can result in a device failure. • When withdrawing the Control Interface Module, ensure that you do not damage any signal cables.

Then, you can remove the plug for the electronic fan power supply from the Control Interface Module. Now you can remove the electronic fan for the Control Interface Module.

Installation steps

Installing is the same as removing, however in the reverse order.

Tightening torque for the fastening screws of the plug-in electronics module (M6 x 16, item ①): 6 Nm

---

Note

Specifications for the installation

The tightening torques specified in the table "Tightening torques for screw connections" must be observed.

Carefully insert the plug connections and ensure that they are secure.

When using connectors with a locking mechanism, make sure that the locking lever is securely engaged once connected.

The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The DRIVE-CLiQ cable connectors should be labeled prior to disassembly and reinstalled at their original slot, since it is necessary to re-perform system identification after changing the DRIVE-CLiQ cables.

The screw connections for the protective covers may only be tightened by hand.

10.4.12 Replacing the electronic fan, Motor Module, frame size FXL

Replacing the electronic fan

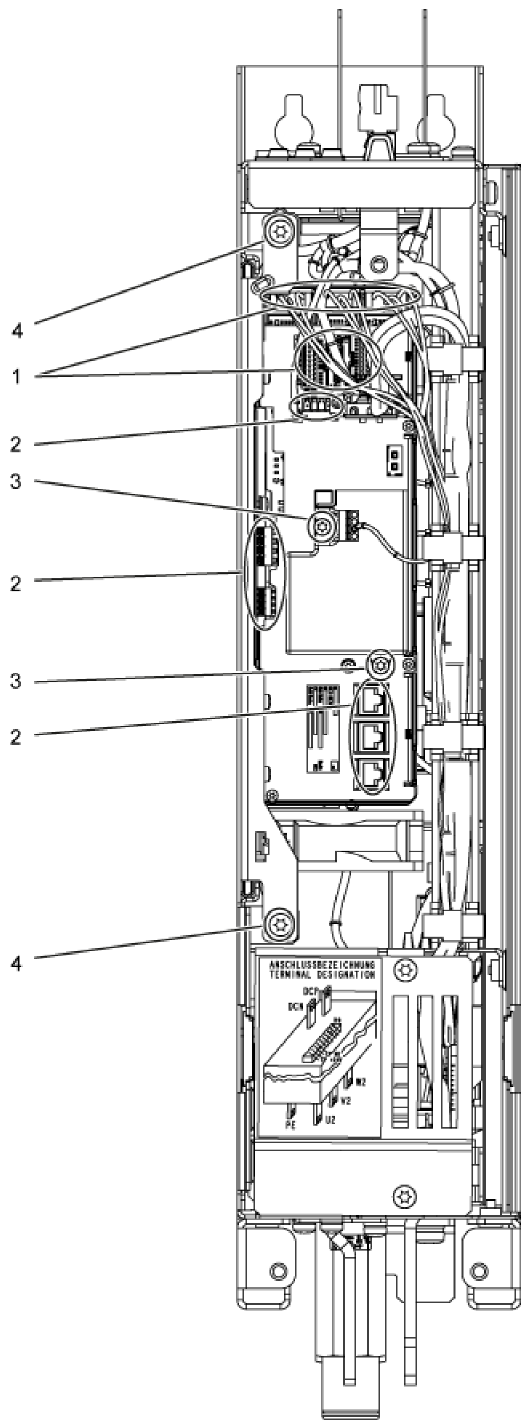


Figure 10-10 Replacing the electronic fan, Motor Module, frame size FXL

Description

The average service life of the electronic fans is 50,000 hours. In practice, however, the service life depends on other variables (e.g. ambient temperature, degree of cabinet protection, etc.) and, therefore, may deviate from this value.

The electronic fans must be replaced in good time to ensure that the device is available.

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access
- Remove the protective cover

Removal

The removal steps are numbered in accordance with the numbers in the diagram.

1. Disconnect the plug-in connections for the fiber-optic cables and signal cables (maximum five connectors).
2. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (maximum six connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
3. Take out the retaining screws for the IPD card (two screws) and remove the IPD card from connector -X45 on the Control Interface Module.
4. Remove the retaining screws for the Control Interface Module (two screws).

When removing the Control Interface Module, you have to disconnect a maximum of five additional connectors one after the other (two at the top, three below) and the PE connection (one screw below).

NOTICE
Damage to the device due to damaged signal cables during disassembly Signal cables can be damaged when withdrawing the Control Interface Module, which can result in a device failure. • When withdrawing the Control Interface Module, ensure that you do not damage any signal cables.

Then, you can remove the plug for the electronic fan power supply from the Control Interface Module. Now you can remove the electronic fan for the Control Interface Module.

Installation steps

Installing is the same as removing, however in the reverse order.

Tightening torque for the fastening screws of the Control Interface Module (M6 x 16, item ④): 6 Nm

---

Note

Specifications for the installation

The tightening torques specified in the table "Tightening torques for screw connections" must be observed.

Carefully insert the plug connections and ensure that they are secure.

When using connectors with a locking mechanism, make sure that the locking lever is securely engaged once connected.

The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The DRIVE-CLiQ cable connectors should be labeled prior to disassembly and reinstalled at their original slot, since it is necessary to re-perform system identification after changing the DRIVE-CLiQ cables.

The screw connections for the protective covers may only be tightened by hand.

10.4.13 Replacing the electronic fan, Motor Module, frame size GXL

Replacing the electronic fan

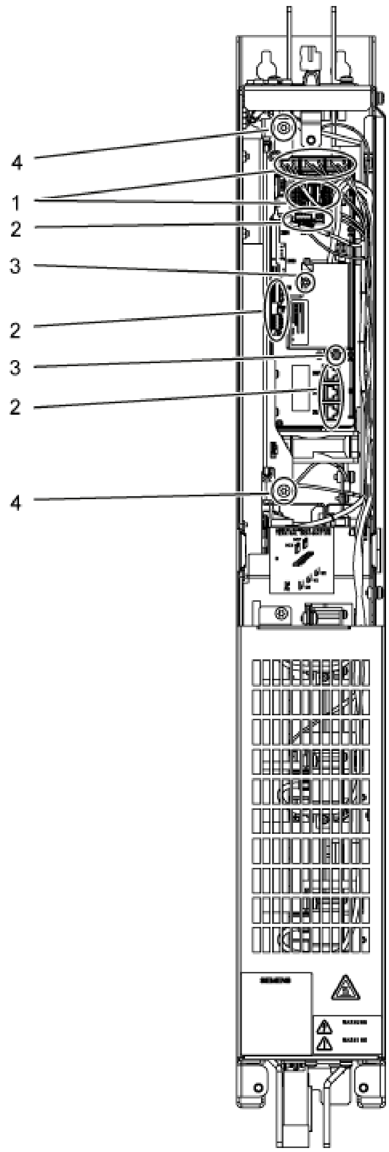


Figure 10-11 Replacing the electronic fan, Motor Module, frame size GXL

Description

The average service life of the electronic fans is 50,000 hours. In practice, however, the service life depends on other variables (e.g. ambient temperature, degree of cabinet protection, etc.) and, therefore, may deviate from this value.

The electronic fans must be replaced in good time to ensure that the device is available.

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access
- Remove the protective cover

Removal

The removal steps are numbered in accordance with the numbers in the diagram.

1. Disconnect the plug-in connections for the fiber-optic cables and signal cables (maximum five connectors).
2. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (maximum six connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
3. Take out the retaining screws for the IPD card (two screws) and remove the IPD card from connector -X45 on the Control Interface Module.
4. Remove the retaining screws for the Control Interface Module (two screws).

When removing the Control Interface Module, you have to disconnect a maximum of five additional connectors one after the other (two at the top, three below) and the PE connection (one screw below).

NOTICE

Damage to the device due to damaged signal cables during disassembly

Signal cables can be damaged when withdrawing the Control Interface Module, which can result in a device failure.

- When withdrawing the Control Interface Module, ensure that you do not damage any signal cables.

Then, you can remove the plug for the electronic fan power supply from the Control Interface Module. Now you can remove the electronic fan for the Control Interface Module.

Installation steps

Installing is the same as removing, however in the reverse order.

Tightening torque for the fastening screws of the Control Interface Module (M6 x 16, item ④): 6 Nm

---

Note

Specifications for the installation

The tightening torques specified in the table "Tightening torques for screw connections" must be observed.

Carefully insert the plug connections and ensure that they are secure.

When using connectors with a locking mechanism, make sure that the locking lever is securely engaged once connected.

The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The DRIVE-CLiQ cable connectors should be labeled prior to disassembly and reinstalled at their original slot, since it is necessary to re-perform system identification after changing the DRIVE-CLiQ cables.

The screw connections for the protective covers may only be tightened by hand.

10.4.14 Replacing the electronic fan, Active Line Module, and Motor Module, frame size HXL

Replacing the electronic fan

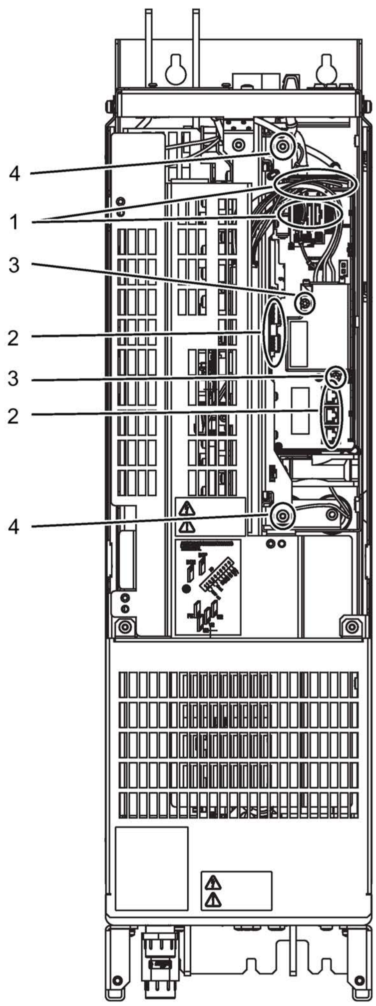


Figure 10-12 Replacing the electronic fan, Active Line Module, and Motor Module, frame size HXL

Description

The average service life of the electronic fans is 50,000 hours. In practice, however, the service life depends on other variables (e.g. ambient temperature, degree of cabinet protection, etc.) and, therefore, may deviate from this value.

The electronic fans must be replaced in good time to ensure that the device is available.

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access
- Remove the protective cover

Removal

The removal steps are numbered in accordance with the numbers in the diagram.

1. Disconnect the plug-in connections for the fiber-optic cables and signal cables (maximum five connectors).
2. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (maximum six connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
3. Take out the retaining screws for the IPD card (two screws) and remove the IPD card from connector -X45 on the Control Interface Module.
4. Remove the retaining screws for the Control Interface Module (two screws).

When removing the Control Interface Module, you have to disconnect a maximum of five additional connectors one after the other (two at the top, three below) and the PE connection (one screw below).

NOTICE
Damage to the device due to damaged signal cables during disassembly
Signal cables can be damaged when withdrawing the Control Interface Module, which can result in a device failure. • When withdrawing the Control Interface Module, ensure that you do not damage any signal cables.

Then, you can remove the plug for the electronic fan power supply from the Control Interface Module. Now you can remove the electronic fan for the Control Interface Module.

Installation steps

Installing is the same as removing, however in the reverse order.

Tightening torque for the fastening screws of the Control Interface Module (M6 x 16, item ④): 6 Nm

---

Note

Specifications for the installation

The tightening torques specified in the table "Tightening torques for screw connections" must be observed.

Carefully insert the plug connections and ensure that they are secure.

When using connectors with a locking mechanism, make sure that the locking lever is securely engaged once connected.

The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The DRIVE-CLiQ cable connectors should be labeled prior to disassembly and reinstalled at their original slot, since it is necessary to re-perform system identification after changing the DRIVE-CLiQ cables.

The screw connections for the protective covers may only be tightened by hand.

10.4.15 Replacing the electronic fan, Active Line Module, and Motor Module, frame size JXL

Replacing the electronic fan

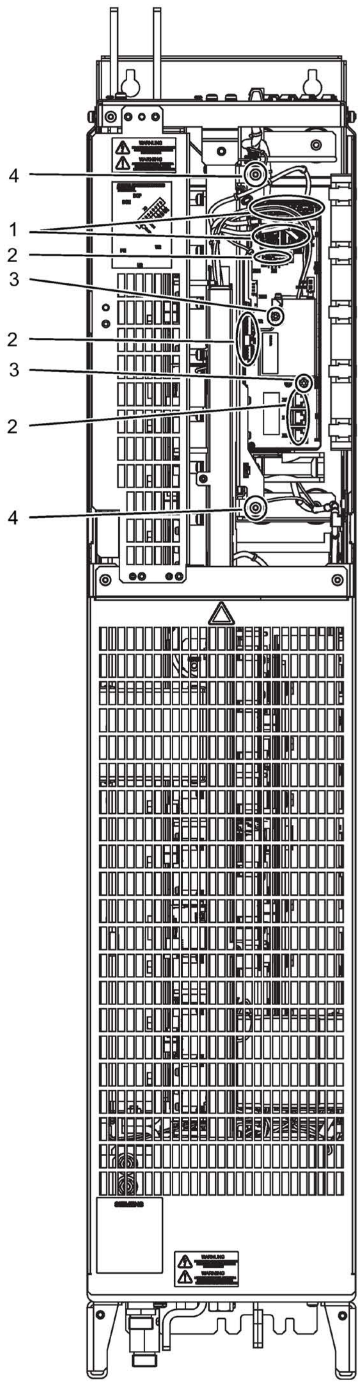


Figure 10-13 Replacing the electronic fan, Active Line Module, and Motor Module, frame size JXL

Description

The average service life of the electronic fans is 50,000 hours. In practice, however, the service life depends on other variables (e.g. ambient temperature, degree of cabinet protection, etc.) and, therefore, may deviate from this value.

The electronic fans must be replaced in good time to ensure that the device is available.

Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access
- Remove the protective cover

Removal

The removal steps are numbered in accordance with the numbers in the diagram.

1. Disconnect the plug-in connections for the fiber-optic cables and signal cables (maximum five connectors).
2. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (maximum six connectors).
   The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
3. Take out the retaining screws for the IPD card (two screws) and remove the IPD card from connector -X45 on the Control Interface Module.
4. Remove the retaining screws for the Control Interface Module (two screws).

When removing the Control Interface Module, you have to disconnect a maximum of five additional connectors one after the other (two at the top, three below) and the PE connection (one screw below).

NOTICE
Damage to the device due to damaged signal cables during disassembly Signal cables can be damaged when withdrawing the Control Interface Module, which can result in a device failure. • When withdrawing the Control Interface Module, ensure that you do not damage any signal cables.

Then, you can remove the plug for the electronic fan power supply from the Control Interface Module. Now you can remove the electronic fan for the Control Interface Module.

Installation steps

Installing is the same as removing, however in the reverse order.

Tightening torque for the fastening screws of the Control Interface Module (M6 x 16, item ④): 6 Nm

---

Note

Specifications for the installation

The tightening torques specified in the table "Tightening torques for screw connections" must be observed.

Carefully insert the plug connections and ensure that they are secure.

When using connectors with a locking mechanism, make sure that the locking lever is securely engaged once connected.

The fiber optic cable plugs must be remounted at their original slot. Fiber optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The DRIVE-CLiQ cable connectors should be labeled prior to disassembly and reinstalled at their original slot, since it is necessary to re-perform system identification after changing the DRIVE-CLiQ cables.

The screw connections for the protective covers may only be tightened by hand.

10.5 Forming the DC link capacitors

Description

If the Power Module, Active Line Module and Motor Module have not been used for more than two years, the DC link capacitors must be reformed. If this is not carried out, the units could be damaged when the DC link voltage is connected under load.

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

Storage period

It is important that the storage period is calculated from the date of manufacture and not from the date that the equipment was shipped.

Rating plate

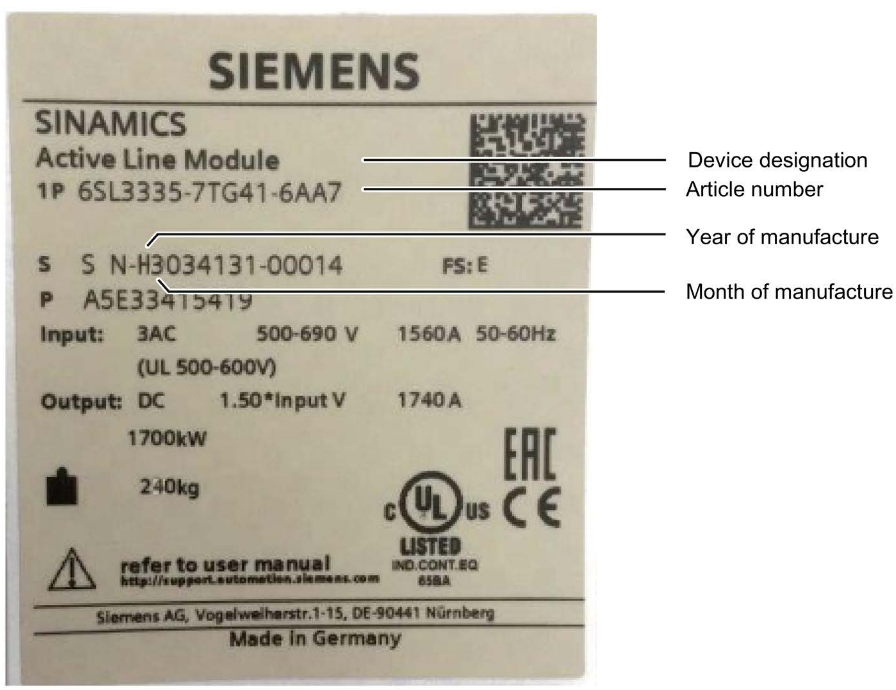


Figure 10-14 Nameplate using an Active Line Module as example

Date of manufacture

The date of manufacture can be determined as follows:

Table 10- 2 Production year and month

Character	Year of manufacture		Character	Month of manufacture
A	2010		1 ... 9	January to September
B	2011		O	October
C	2012		N	November
D	2013		D	December
E	2014			
F	2015			
H	2016			
J	2017			
K	2018			
L	2019			
M	2020			

Procedure in the event of repair or replacement

A replacement Line Module or Motor Module or the corresponding replacement power block has to be reformed after being in storage for a period of more than two years.

The DC link capacitors are reformed by applying the rated voltage without load for at least 30 minutes.
To do this, the DC link must be precharged (i.e. the Line Modules switched on), while the controller for the existing Motor Modules must not be enabled for the specified length of time.

Procedure for reforming outside the drive line-up

Replacement power units which have to be held ready for immediate use in the event of repair or replacement can also be reformed individually and outside the drive line-up.

For this, the equipment must be connected to the forming circuits described in the following.

Components for the forming circuit (recommendation)

- 1 fuse switch 3-phase 400 V / 10 A or 690 V / 10 A
- 3 incandescent lamps 230 V / 100 W for a line voltage of 380 to 480 V 3 AC.
  Alternatively, use 3 resistors of 1 kΩ / 100 W each (e.g. GWK150J1001KLX000 from Vishay) instead of the incandescent lamps.
- 6 incandescent lamps 230 V / 100 W for a line voltage of 500 to 690 V 3 AC, where 2 incandescent lamps must be connected in series in each supply phase.
  Alternatively, use 3 resistors of 1 kΩ / 160 W each (e.g. GWK200J1001KLX000 from Vishay) instead of the incandescent lamps.
- Various small components, such as lamp sockets, cable 1.5 mm^2, etc.

WARNING

Risk of death from electric shock when installation of lamp sockets is non-insulated

If two incandescent lamps connected in series are used, the insulation of the lamp sockets is not rated for the high voltage of 500 to 690 V 3 ph AC.

- For a line voltage of 500 to 690 V 3 ph AC, install the two lamp sockets connected in series with insulation and protect them from being touched.

Forming circuit for Line Modules

Note

Forming the Line Modules

Voltage must be supplied to Line Modules via a connected Motor Module and the associated DC link.

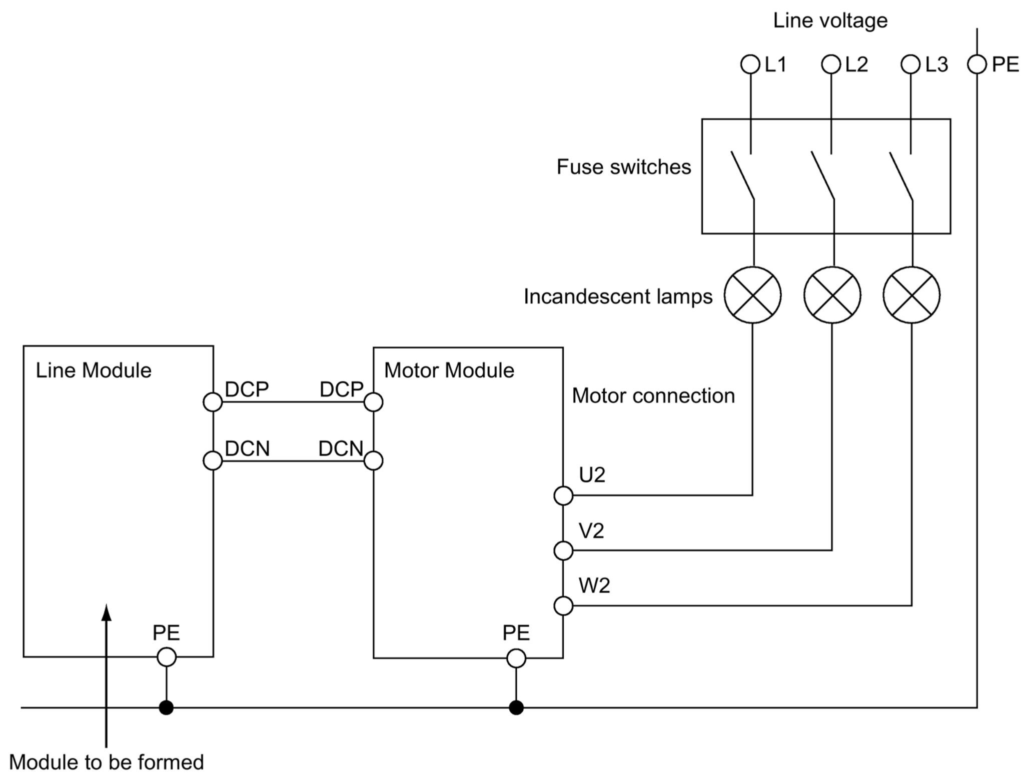


Figure 10-15 Forming circuit for Line Modules

Forming circuit for Motor Modules

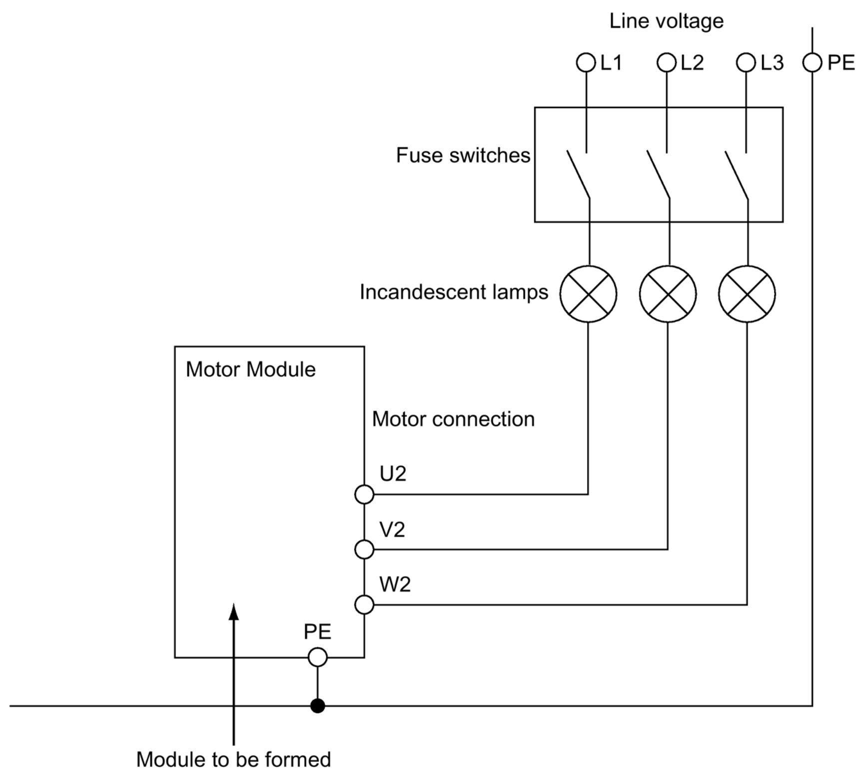


Figure 10-16 Forming circuit for Motor Modules

Procedure

- The device being formed must not receive a power-on command (e.g. from the keyboard, BOP20 or terminal block).
- Connect the appropriate forming circuit.
- Forming has been completed if the DC link voltage no longer rises.

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Further information

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