

SIEMENS

SINAMICS SM120

Basic Line Module

Type 6SL38751

Operating Instructions / Installation Instructions

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Answers for industry.

Basic Line Module

SINAMICS SM120 6SL38751

Operating Instructions
Installation Instructions

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

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Introduction

1.1 About these instructions

These instructions describe the drive and explain how to handle it, from initial delivery to final disposal of the equipment. Keep these instructions for later use.

Read these instructions before you handle the drive and follow the instructions. The instructions contain information about the safe handling of the drive as well as its components and modules. They provide information on assembling, installing, and maintaining the equipment properly.

If you have suggestions for improving the document, please contact our Service Center (Page 107).

Note

In these instructions, the term "Drive" is used, even if individual cabinet modules are involved.

Text format features

The warning notice system is explained on the rear of the inside front. Always follow the safety instructions and notices in these instructions.

In addition to the safety-related warning notices which you must read, you will find the text in these instructions is formatted in the following way:

1. Handling instructions are always formatted as a numbered list. Always perform the steps in the order given.
- Lists are formatted as bulleted lists.
 - Lists on the second level are hyphenated.

Note

A Note is an important item of information about the product, handling of the product or the relevant section of the document. Notes provide you with help or further suggestions/ideas.

1.2 Warning symbols on the device

Please observe the warning symbols attached to the device. The warning symbols have the following meaning:

Warning symbol	Meaning
	Warning: Voltage
	Warning: Hot surface
	General warning symbol: Observe the explanations about the hazard on the device labels.

For transportation, observe the "transportation markings (Page 43)" on the device packaging.

Safety instructions

In the individual chapters of this document, you will find safety instructions that must be obeyed absolutely, for your own safety, to protect other people and to avoid damage to property. Pay attention to the following safety instructions for all activities on the inverter.

2.1 Qualified personnel

The product/system described in this documentation may only be operated by **personnel qualified** for the specific task in accordance with the relevant documentation for the specific task, in particular its warning notices and safety instructions. Because of their training and experience, qualified personnel can recognize any risks involved with handling these products/systems and avoid any possible dangers.

2.2 The five safety rules

For your personal safety and to prevent material damage when carrying out any work, always observe the safety instructions and the following five safety rules, according to EN 50110-1 "Dead working". Apply the five safety rules in the sequence stated before starting work.

Five safety rules

1. Disconnect completely.
Disconnect the auxiliary circuits, for example anti-condensation heating.
2. Secure against reconnection.
3. Verify absence of operating voltage.
4. Carry out earthing and short-short-circuiting.
5. Provide protection against adjacent live parts.

To energize the system, apply the measures in reverse order.

2.3 Safe handling

WARNING

High voltages from external supplies

Even if the circuit breaker is open, parts of the drive can be under voltage (live) as a result of the auxiliary voltage at the premagnetization, precharging or demagnetization transformers. This danger is not limited to the drive, but can also occur with components that are electrically connected to the drive (e.g. circuit breakers or isolators). Touching live components can result in death, serious injury, or material damage.

Therefore, isolate all components that can feed voltage to the drive before commencing work.

WARNING

High voltages during operation

When operating this equipment very high voltages develop. Even after switching off the mains voltage, or while the connected machine is still turning, high voltages can remain for a prolonged length of time. High voltages can cause death or serious injury if the safety rules are not observed or if the equipment is handled incorrectly.

- Operate the drive properly.
- Always follow the "The five safety rules (Page 13)" when performing any work.
- Only remove the covers using the methods described by these operating instructions.
- Maintain the drive regularly and correctly.

WARNING

High voltages from machines still turning and connected

Rotating machinery can induce dangerous high voltages and synchronous motors that are not de-excited immediately can also pose a hazard. If the connection to the motor is not isolated or grounded, these voltages can also remain. If live parts are touched, this can result in death and serious physical injuries.

Before opening the doors, wait until the connected machine has come to a standstill.

WARNING

High voltages from DC-link capacitors

High voltages are still present at the DC-link capacitors even after shutdown. If live parts are touched, this can result in death or serious physical injury.

- Wait for the DC-link capacitor's discharge time specified on the device label. Do not touch the device during this time.
- Observe the five safety rules when performing any work.

**WARNING****High auxiliary voltages**

High auxiliary voltages are still present even after shutdown. If live parts are touched, this can result in death or serious physical injury.

Observe the five safety rules when performing any work.

**WARNING****Hazardous arcing**

Hazards caused by arcing can occur as result of the following factors, for example:

- The input currents are exceeded
- Incorrectly dimensioned circuit breaker or transformers
- Incorrectly connected cables or cables that have not been connected
- Excessive pollution

Arcing can result in death, serious injury or material damage.

- Make sure that the system is properly dimensioned and that the power cables are correctly connected. The maximum permissible input currents are listed in the "Technical specifications".
- Remove any excessive pollution.

**WARNING****Live, moving or rotating parts**

Contact with the parts mentioned can result in death, serious physical injury or damage to property.

- Observe the instructions regarding installation and operation.
- Always take protective measures before touching any components.
- Do not remove any necessary covers.

**WARNING****Hot component surfaces**

Certain components (e.g. heat sinks and reactors) can become very hot during operation. These components can remain hot for a long time after operation. Contact can result in serious injury, such as skin burns.

Do not touch hot components even after you have switched off the drive.



WARNING

Hot anti-condensation heating surface

When the temperature control limit value is reached the anti-condensation heating is switched on. Once activated, the anti-condensation heating can generate a great deal of heat. Contact can result in serious injury, such as skin burns.

Do not touch the anti-condensation heating.



CAUTION

Places that are difficult to access

If you do not use appropriate protective equipment when working in places that are difficult to access you are at risk of injury. For example, sharp edges and splinters can cause injuries to the head and skin. If you use unsuitable steps when working on the upper areas of the drive, you can fall and injure yourself.

- Use appropriate protective equipment, especially a hard hat and gloves.
- In the upper areas of the drive, use suitable steps.



CAUTION

Deionized water

Deionized water is harmful to eyes and skin and can damage surfaces.

Therefore, use appropriate protective clothing for all work on the drive. However, if your eyes or skin do come into contact with deionized water, rinse the affected area thoroughly with tap water as soon as possible. If deionized water leaks out, eliminate the source of the problem and remove the liquid from the surfaces affected.

NOTICE

Unsuitable residual current monitoring device

If you operate the drive together with a residual current monitoring device (RCD), it is possible the residual current monitoring device will trip in error (nuisance trip). The drive may be switched off as a result of the protection device tripping in error.

To minimize the risk of faulty trips, use a type-B RCD.

2.4 Electromagnetic fields in electrical power engineering installations

Electromagnetic fields are generated during operation of electrical power engineering installations. Electromagnetic fields can interfere with electronic devices. These devices can malfunction if electromagnetic fields are present.



WARNING

Interference with pacemakers

The functioning of cardiac pacemakers could be impaired by electromagnetic fields. Death or serious physical injury can result.

People with pacemakers are therefore not allowed to stay close to the drive.

NOTICE

Data loss

Electromagnetic fields can cause data loss to magnetic or electronic data storage media.

Therefore, do not carry magnetic or electronic data storage media with you.

For nominated persons in control of an electrical installation, you can find further information on electromagnetic fields under "Information for nominated persons in control of an electrical installation."

See also

Information for persons responsible for plants and systems (Page 19)

2.5 Components that can be destroyed by electrostatic discharge (ESD)

ESD guidelines

NOTICE

Electrostatic discharge

Electronic components can be destroyed in the event of improper handling, transporting, storage, and shipping.

Pack the electronic components in appropriate ESD packaging; e.g. ESD foam, ESD packaging bags and ESD transport containers.

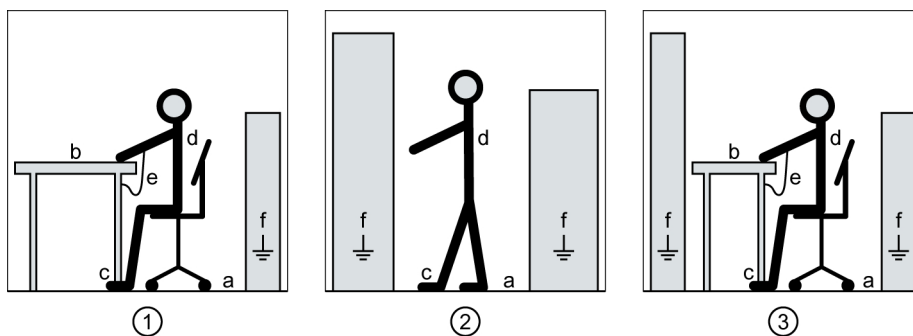
To protect your equipment against damage, follow the instructions given below.

2.5 Components that can be destroyed by electrostatic discharge (ESD)

- Avoid physical contact with electronic components. If it is essential that you perform work on these components, then you must wear one of the following pieces of protective gear:
 - Grounded ESD wrist strap
 - ESD shoes or ESD shoe grounding strips if there is also an ESD floor.
- Do not place electronic components close to data terminals, monitors or televisions. Maintain a minimum clearance to the screen (> 10 cm).
- Electronic components should not be brought into contact with electrically insulating materials such as plastic foil, plastic parts, insulating table supports or clothing made of synthetic fibers.
- Bring components into contact only with ESD-compliant materials, e.g. ESD tables, ESD surfaces, ESD packaging.
- Only carry out measurements on the components if one of the following conditions is met:
 - The measuring device is grounded with a protective conductor, for example.
 - The measuring head of a floating measuring device has been discharged directly before the measurement.

The necessary ESD protective measures for the entire working range for electrostatically sensitive devices are illustrated once again in the following drawings.

Precise instructions for ESD protective measures are specified in the standard DIN EN 61340-5-1.



- ① Sitting
- ② Standing
- ③ Standing/sitting

- a Conductive floor surface, is only effective in conjunction with ESD shoes or ESD shoe grounding strips
- b ESD furniture
- c ESD shoes or ESD shoe grounding strips are only effective in conjunction with conductive flooring
- d ESD clothing
- e ESD wrist strap
- f Cabinet ground connection

Figure 2-1 ESD protective measures

2.6 Information for persons responsible for plants and systems

2.6.1 Proper usage

The drives are intended to be used as a stationary installation in closed and dry rooms with a clean atmosphere. You can find the environmental and operating temperatures that are to be adhered to in the technical specifications. If the described environmental conditions are not complied with, then warranty claims and other claims may be rejected.



WARNING

Explosions

If you operate the drive in areas with a risk of explosion, explosions can occur which can cause death, serious injuries or material damage.

Only operate the converter in a non-explosive environment (no hazardous zones).



WARNING

Non-observance of proper usage

Improper use of the devices described can result in death, severe injury or material damage.

Therefore, please adhere to all instructions for proper usage.

The nominated person in control of an electrical installation must ensure that the following points are observed:

- Follow the local and industry-specific safety and setup regulations. Observe the requirements listed in the directives, specified in the "Technical specifications" in Section "Standards and regulations". Ensure that the specific safety and construction regulations and regulations for using personal protective equipment are adhered to during all work.
- The operating instructions and the complete product documentation are always available when carrying out any work.
- The technical specifications as well as the specifications relating to the permissible installation, connection, ambient and operating conditions are taken into account at all times.
- Only qualified personnel or personnel supervised by responsible, skilled specialists are allowed to carry out basic planning and all work on the drive.
- During shipping, specific transport conditions are adhered to.
- Assembly is performed according to assembly instructions. Separate cabinet units are connected properly (cables and busbars).
- All instructions for EMC-compatible installation, cabling, shielding, grounding, and for adequate auxiliary power supply are to be observed.
- Commissioning is only to be performed by qualified personnel trained for that purpose in accordance with the commissioning instructions.

2.6 Information for persons responsible for plants and systems

- System configuration is carried out by an experienced system integrator. Further system components such as the circuit-breaker, transformer, cables, and motor are adjusted for drive operation.
- The drive is only operated in conjunction with the engineered components.
- Different operating modes, overloads, load cycles, and differing environmental conditions are permitted only after special arrangement with the manufacturer.

Note

Make use of the support and services offered by the relevant service center for planning, installation, commissioning, and servicing work. You can find the relevant contact person under "Service & Support (Page 107)".

2.6.2 Industrial security concept

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, solutions, machines, devices, and/or networks. They are important components in a holistic industrial security concept. The products and solutions from Siemens are continuously developed with this aspect in mind. Siemens strongly recommends that you regularly check for product updates.

To ensure that Siemens products and solutions are operated securely, suitable preventive measures (e.g. cell protection concept) must be taken and each component must be integrated into a state-of-the-art holistic industrial security concept. Any third-party products used must also be taken into account. For more information about industrial security, visit <http://www.siemens.com/industrialsecurity> (<http://www.siemens.com/industrialsecurity>)

To receive information about product updates on a regular basis, subscribe to our product newsletter. For more information, visit <http://support.automation.siemens.com> (<http://support.automation.siemens.com>)

2.6.3 Grounding concept

Create a grounding concept and integrate the drive within it. The grounding concept must take into consideration national provisions and system specifics. Ensure that the following criteria are fulfilled:

- The drive sub-units must be screwed together with good conductivity on the construction site.
- If grounding bars are provided, these must be connected together.
- When the drive is supplied with power, the protective earth conductor must be connected to the system's grounding point. Select the cross-section of the protective ground conductor from one of the following variants:
 - According to local wiring regulations
 - Calculated according to IEC 60364-5-54, 543.1
 - Half a phase conductor cross-section

2.6.4 Installation site safety

 WARNING
Unsafe installation sites This drive is used in industrial high-voltage installations. Improper use, incorrect operation, insufficient maintenance, and access by unauthorized persons can lead to accidents. The results can be death, serious bodily injury or damage to property. • Install the drive in electrical rooms where only qualified personnel have access. If this is not possible, then ensure that a barrier prevents uncontrolled access. Use safety fences and appropriate signs, for example, to prevent unauthorized entry to the zone that has been fenced off. • Put up notices which indicate that only trained personnel are allowed to operate the drive and carry out maintenance and repair work.

Note

Installations that include drive drives need to be equipped with additional monitoring and protection equipment to fulfill the safety requirements, e.g. technical equipment regulations, accident prevention regulations, etc.

2.6.5 Instructions for inverters with no grounding switch

Note

The drive does not have a grounding breaker at the input/output. The system operator must, therefore, ensure that there is sufficient grounding.

2.6.6 Measures for operator protection in electromagnetic fields

The plant operator is responsible for taking the following appropriate measures (labels and hazard warnings) to adequately protect operating personnel against any possible risk.

- Observe the relevant nationally applicable health and safety regulations or the applicable national regulations in the country of installation. In Germany, "electromagnetic fields" are subject to regulations BGV B11 and BGR B11 stipulated by the German statutory industrial accident insurance institution.
- Display adequate hazard warning notices on the installation.



- Place barriers around hazardous areas.
- Take measures, e.g. using shields, to reduce electromagnetic fields at their source.
- Make sure that personnel are wearing the appropriate protective gear.

2.6.7 Requirements for the circuit breaker provided by the customer

The circuit breaker on the primary side of the input transformer on the plant side belongs to the safety system of the drive. If a fault occurs inside the drive, the energy that is effective at the fault location must be limited. This is realized as a result of the inductance of the incoming transformer, which limits the rate-of-rise and magnitude of the current and the circuit breaker that trips as quickly as possible.



WARNING

High voltages and arcs

Circuit breakers are safety components. Connecting or setting the circuit breaker incorrectly can result in death, serious injury, or material damage.

Connect the circuit breakers correctly. Select the system values that match the drive.

To ensure adequate drive protection, the circuit breaker provided by the customer must fulfill the following requirements:

- The total opening time of the circuit breaker – from the command to actually opening – must not be more than 80 ms. It is not permissible that the opening time, specified in the technical documentation of the circuit breaker manufacturer, exceeds 80 ms. The drive monitors the total opening time.
- The drive monitors the TRIP coils (shunt releases) for wire breakage and failure of the control voltage in the switchgear installation.
- The circuit breaker must be equipped with an undervoltage tripping function. The undervoltage trip unit (low-voltage coil) is controlled via the tripping circuit in which the "undervoltage trip unit" of the drive must also be integrated. The auxiliary voltage from the switchgear (this is a reliable supply) is used as the supply.
- Avoid additional delay times when controlling the circuit breaker. All commands from the drive to the circuit breaker must act directly without intervention of coupling relays.
- A feedback signal must be available for each of the circuit breaker states CLOSED and OPEN. The feedback signals must not be delayed. Do not use any coupling relays.
- An additional, independently operating overcurrent protection for the circuit breaker must be provided on the plant side (transformer and cable protection).
- The circuit breaker is activated and enabled by the drive closed-loop controller. Under no circumstances should you close the circuit breaker by external mechanical or electrical means. A mechanical interlock of the manual ON command at the circuit breaker prevents destruction of the drive as a result of an uncoordinated switch-on operation.

2.7 Residual risks

According to the EU machinery directive, machine manufacturers / plant operators must conduct a risk assessment of their machine. Plant operators must conduct a risk assessment of their plant. In particular, pay attention to Annex 1 "General Principles" of the EU machinery directive.

Pay attention to the following residual risks:

1. Unintentional movements of driven machine parts

Unintentional movements of driven machine parts can occur during commissioning, operation, maintenance, and repair, e.g. from the following causes:

- Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology
- Response times of the controller and drive
- Operating and/or environmental conditions outside of the specification
- Condensation/conductive contamination
- Parameterization, programming, cabling, and installation errors
- Use of radio devices/cellular phones in the immediate vicinity of the controller
- External influences/damage

2. High temperatures and emissions

A fault can occur as a result of the following, for example:

- Component malfunctions
- Software errors
- Operating and/or environmental conditions outside of the specification
- External influences/damage

A fault can, for example, have the following consequences both inside and outside the drive:

- Extraordinarily high temperatures, including open fires as a result of the fault
- Emissions of light, noise, particles or gases

Drives with open type / IP20 degree of protection must be installed in an electrical room or a comparable environment.

3. Hazardous shock voltages

Hazardous shock voltages can result from the following causes, for example:

- Component malfunctions
- Induction of voltages in moving motors
- Operating and/or environmental conditions outside of the specification
- Condensation/conductive contamination
- External influences/damage

4. The release of substances and emissions that are harmful to the environment

Improper operation or the improper disposal of components can harm the environment.

5. Damage from pressure build-up during electric arcs in the event of a fault
If the building has not been designed correctly for the drive in terms of how it has been dimensioned, damage can result from the pressure that can possibly build up inside.
6. Dangerous electric arcs during internal faults
The drives are designed according to the relevant IEC standards and have been tested in line with strict type-testing procedures. They were developed and manufactured so that there is a very low probability of internal faults occurring. However, internal faults cannot be completely ruled out.

**WARNING****Dangerous electric arcs during internal faults**

Defects such as damage to components, overvoltages, or loose parts, as well as exceptional operating statuses, can cause a failure within the enclosure. This can result in an internal electric arc. If an electric arc occurs and people are nearby, this could lead to death, serious physical injury, and damage to property.

- Ensure that only qualified personnel perform work on the drive.
- Observe the safety and operating instructions in this documentation and on labels at the drive for all work on the drive.

Note

There are no standards for medium-voltage drives stipulating requirements or inspections for electric arc resistance. There is therefore neither formal guidance provided nor formal certification available with regard to electric arc resistance.

Description

3.1 Safety concept

The drive and its components are subject to a comprehensive safety concept. When used properly, the security concept guarantees safe installation, safe operation as well as safe service and maintenance.

The safety concept encompasses safety components and functions to protect the device and operators. The drive is also equipped with monitoring functions to protect external components.

The drive operates safely when the interlock and protection systems are functioning properly. Nevertheless, there are areas on the drive that are hazardous for personnel and that cause material damage if the safety information of all the instructions and the label on the drive are not strictly observed.

3.1.1 Safety components and functions

The electromechanical door interlocking system prevents access to the power unit while operational. The following conditions must be fulfilled in order to open the doors: For additional information, see Chapter "Opening the unit (Page 85)".

3.1.2 External safety components

The drive has the following external safety components for the safety concept:

- Circuit breaker
More detailed information is provided in Chapter Requirements for the circuit breaker provided by the customer (Page 22).

3.1.3 Protection and monitoring functions of internal components

The internal components of the drive have the following protection and monitoring functions:

- Drive protection based on monitoring systems:
 - Current monitoring
 - DC link monitoring
 - Monitoring the output voltage
 - Thermal monitoring of the power unit
 - Precharging monitoring
 - Supply voltage monitoring
 - Insulation monitoring
 - Monitoring of the common power supply
 - Circuit breaker monitoring
 - Re-cooling unit monitoring
- Shutdown in the event of semiconductor failure
- Shutdown in the event of control component failure
- Internal protection functions for the control hardware
- Protection against communication failure between the closed-loop control and the power unit
- Anti-condensation heating

3.1.4 Protection and monitoring functions for external components

Transformer and motor can be monitored in the drive. A fast protective shutdown that you can activate for external problems, e.g. short-circuits, is present.

3.2 Basic Line Module

Basic Line Modules generate a DC voltage and thus provide the energy for the modules connected to the DC link. In this case, the line voltage fluctuations must remain within the permissible tolerance range. Depending on the design, the Basic Line Module consists of series-connected six-pulse rectifiers. In order to limit the short-circuit currents per unit, the Basic Line Modules are constructively divided into multiple cabinets. RC combinations are provided to protect the diodes.

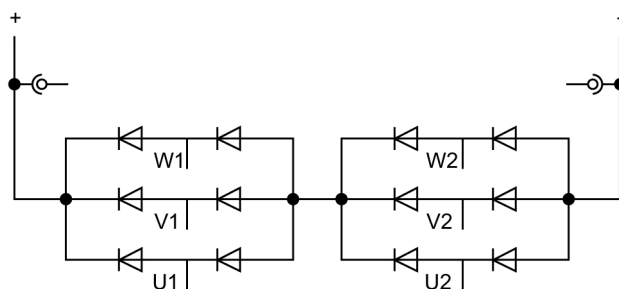


Figure 3-1 Block diagram: Basic Line Module with diodes

Note

Details on the design can be found in the layout diagram.

3.3 Re-cooling unit

3.3.1 Operating principle of the re-cooling unit

The re-cooling unit dissipates the heat loss from the drive. The deionized water in the internal water circuit absorbs the heat of the drive power unit which is to be dissipated, and is pumped to the heat exchanger by a maintenance-free circulating pump. The warm deionized water is cooled by the external raw water circuit and pumped back to the drive.

Two pipes are installed in the drive. The cold water of the re-cooling unit flows in one of the pipes, and is heated by the losses and flows back to the re-cooling unit through the other pipe.

For additional information, refer to the operating instructions of the re-cooling unit.

3.3.2 The internal deionized water circuit

The internal water circuit is filled with deionized water (deionized, fully-desalinated water). The conductivity of the cooling water must be $\leq 1 \mu\text{S/cm}$ in operation.

NOTICE

Inadmissible additives in the deionized water

Inadmissible additives in the deionized water can cause the cooling system to fail. This could damage the drive.

Use only deionized water that corresponds to the specifications. The specification of the deionized water can be found in the documentation for the re-cooling unit.

- The re-cooling unit monitors the level of the deionized water expansion tank and the motor circuit-breaker for the pump motors and checks for any water leakage.
- The pressure of the deionized water is displayed on a manometer.
- The flow, temperature, and conductivity are monitored.
- If one of the monitoring devices responds, a signal is output or the re-cooling unit and drive are switched off.

Deionized water requirements

Table 3-1 Deionized water requirements

	Value
Specific conductivity on filling	$< 10 \mu\text{S/cm}$
Evaporation residue	$< 20 \text{ mg/l}$
pH value	5 to 9
• Content of metals in the hydrogen sulfide group (lead, antimony, tin, bismuth, arsenic, copper, cadmium) • Content of metals from the ammonium sulfide group (iron, cobalt, nickel, chrome, manganese) • Content of sulfur chloride and nitrogen compounds	Not detectable
Content of oxidizable, organic substances	Max. a quantity equivalent to the usage of 30 mg/l potassium permanganate KMnO_4

Ion exchanger

An ion exchanger is installed in the re-cooling unit. The ion exchanger is connected in the deionized water circuit.

If the conductivity exceeds the permissible limits, then a message is output. In this case, replace the filling in the ion exchanger with an original filling. If the conductivity continues to rise, the re-cooling unit and drive are switched off. The ion exchanger is a consumable and is not covered by the warranty.

Dirt filters

The re-cooling unit is equipped with several dirt filters

- A dirt filter with a sieve (mesh width: 0.5 mm) is located in front of the drive intake.
- A fine filter (mesh width: 0.05 mm) is located at the ion filter outlet.
- An air filter is fitted on the expansion tank.

that filter out dirt and contamination from the water circuit, thereby preventing the drive from being damaged.

Pump pressure

A manometer displays the pump pressure. If the flow is excessively low, then the re-cooling unit automatically switches over the pumps.

3.3.3 The external raw water circuit

The raw water flows through the heat exchanger. The heat exchanger cools the deionized water.

If other raw water specifications apply, titanium heat exchanger plates or tube bundle heat exchangers are available (optional).

NOTICE

Deposits of suspended solids

If you reduce the flow rate to reduce the raw water usage, then deposits of suspended solids can build up in the heat exchanger as a result of the slow flow rate.

These suspended solids can then cause the cooling system to fail. The drive could be damaged.

Only reduce the raw water flow rate if the raw water does not have any suspended solids.

Raw water requirements

Table 3-2 Raw water requirements

	Value
Size of entrained particles	< 0.5 mm
pH value	6.5 to 8.0
Carbonate hardness	< 0.9 mMol/l (5 °dH)
Total hardness	< 1.7 mMol/l (9.5 °dH)
Chloride	60 mg/l

3.4 Components

	Value
Sulfate	80 mg/l
Nitrate	10 mg/l
Core	0.2 mg/l
Ammonia	10 mg/l
Dissolved solids	<3.4 mMol/l (340 ppm)

Where values deviate from the above stated, a water analysis should be carried out in order to ensure the long-term stability of the heat exchanger.

3.4 Components

3.4.1 Door limit switch

Door limit switches monitor the doors. The circuit breaker opens when a door is opened.

3.4.2 Electromechanical door interlocking system

The electromechanical door interlock system is designed to protect personnel, and is an integral part of the safety concept. During operation all the doors are interlocked (with the exception of the door for the Control Module).

The electromechanical door interlocking system prevents access to the power unit while operational. The following conditions must be fulfilled in order to open the doors. You can open the doors once released by the control.

For more information see section "Open device" in the "Maintenance" chapter.

The device cannot be switched on again until all the doors are closed. The doors remain interlocked if the auxiliary voltage fails. For more information on this topic, see section "Repair" in the "Maintenance" chapter.

See also

Opening the device (Page 85)

3.4.3 Actual value sensing

The actual value sensing is used to measure voltages and currents. The voltage are measured using AVT combination modules, whose measuring resistors are connected in series. The currents are measured using electronic LEM current transformers and AVT combination modules.

AVT combination modules are separated and isolated from circuits that can be touched using a transformer. The AVT combination module convert analog signals into digital signals. They transfer signals to the Power Stack Adapter (PSA) via fiber-optic cables.

Detailed information about interconnecting the actual value sensing modules is provided in the circuit manual. The component mounting locations are provided in the layout diagram.

See also

Replacing the AVT combination module (Page 96)

3.5 Options

3.5.1 Suitable for marine use with individual certificate from Germanischer Lloyd (GL) (option E11)

The design and implementation of the drive corresponds to the requirements of the Germanischer Lloyd classification society.

3.5.2 Suitable for marine use with individual certificate from Lloyds Register (LR) (option E21)

The design and implementation of the drive corresponds to the requirements of the Lloyds Register classification society.

3.5.3 Suitable for marine use with individual certificate from Bureau Veritas (BV) (option E31)

The design and implementation of the drive corresponds to the requirements of the Bureau Veritas classification society. This therefore allows an auxiliary voltage other than 3AC 400 V.

3.5.4 Suitable for marine use with individual certificate from Det Norske Veritas (DNV) (option E51)

The design and implementation of the drive corresponds to the requirements of the Det Norske classification society.

3.5.5 Suitable for marine use with individual certificate from American Bureau of Shipping (ABS) (option E61)

This drive version meets the requirements of the American Bureau of Shipping (ABS) classification society.

3.5.6 Suitable for marine use with individual certificate from Chinese Classification Society (CCS) (option E71)

This drive version meets the requirements of the Chinese Classification Society (CCS).

This option contains the following equipment/features:

- Strengthened mechanical cabinet design
- Handrail below the operator panel
- Mechanical cabinet door locking
- Cabinet design in an IP44 degree of protection
- Anti-condensation heating

The drive can be welded to the ship's hull structure.

See also

Anti-condensation heating (option L55) (Page 34)

3.5.7 Line-side grounding switch (option L48)

The motor-operated make-proof grounding switch is used to short-circuit and ground the line side. Pushbuttons installed in the closed-loop control section door are used to control the switch. Controlling this make-proof grounding switch is interlocked with the operating state and the switch-on control of the drive.

3.5.8 Anti-condensation heating (option L55)

The anti-condensation heating is used at low ambient temperatures and high levels of humidity to prevent condensation from forming. The heating is controlled via a thermostat.

The number of anti-condensation heaters is set in accordance with the number of cabinet panels.

The drive monitors the external auxiliary supply and outputs a message if it fails.

See also

Safety instructions for maintenance (Page 81)

3.5.9 Safety locking system (option M10)

The safety locking system is based on the key transfer system developed by Castell. It is a supplementary mechanism to the electromechanical door locking system integrated as standard. The medium-voltage breaker must be opened before access can be gained to the coded key of the key exchange unit. The opened medium-voltage breaker releases the key to the key exchange unit. This key is used in turn to release the keys for the cabinet doors of the power unit. This key interlocking system ensures that the drive is disconnected from the medium-voltage supply and that no cabinet components are connected to medium voltage. As long as the cabinet doors are not closed again and the keys to the power-unit cabinet are not inserted back in the key exchange unit, the key for the medium-voltage breaker will not be released. The medium-voltage breaker cannot be switched on again.

3.5.10 Dust protection (option M11)

The cabinet doors are equipped with additional filter mats. The filter mats prevent the entry of dangerous dust deposits on the power module components.

The filter mats are fitted to the exterior of the cabinet doors, which means that they can be replaced during operation.

3.5.11 Connection of auxiliary voltage and signal cable from above (option M34)

This option makes it possible to bring the cables for the auxiliary voltage and signal cables into the cabinet from the top.

3.5.12 Brass cable entry (option M36)

The cable entry is made of aluminum in the standard version. With option M36, the cable entry for the power cables is made of brass. The cable entry for signal cables is made of aluminum in both versions.

3.5.13 Degree of protection IP44 (option M44)

The degree of protection of the power section is increased from IP43 to IP44. The internal losses are dissipated by a closed cooling circuit with air-water heat exchanger into the water.

3.5.14 Redundant fan (option M61)

To increase the plant availability, the drive can be fitted with an additional, redundant fan. If a fan in the drive cabinet fails, this is detected immediately by the electronic monitoring of the fan. The redundant fan is connected by the drive controller without this causing the drive and, in turn, the drive system to fail. This prevents production failures or interruptions. The replacement of the defective fan can be postponed to the next planned stoppage.

3.5.15 Suitability for marine use (option M66)

The drive design corresponds to the requirements of the following classification societies.

- Lloyds Register
- American Bureau of Shipping
- Germanischer Lloyd
- Bureau Veritas
- Det Norske Veritas•
- Chinese Classification Society

The drive has the following supplementary equipment:

- Salt water resistant paint
- Strengthened mechanical cabinet design
- Handrail below the operator panel
- Mechanical cabinet door locking
- IP44 degree of protection
- Anti-condensation heating

The drive can be welded to the ship's hull plate

3.5.16 Grounding switch with disconnecter at the drive input (option N48)

The disconnecter is located in such a way that it isolates the drive from the supply system when it is switched off. The line side (A) or the converter side (B) of the disconnecter is short-circuited and grounded using the motor-operated grounding switch.

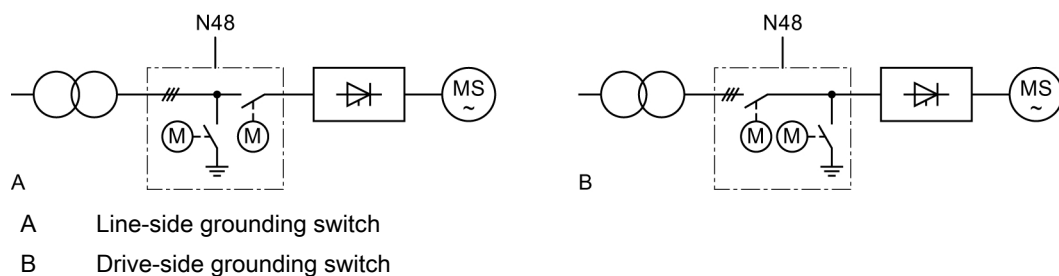


Figure 3-2 Option N48

Pushbuttons installed in the power unit door are used for actuation purposes. Controlling this disconnecter and grounding switch is interlocked with the operating state and the switch-on control of the drive.

3.5.17 Additional leakage water sensors in the power units (option W26)

Additional leakage water sensors are installed in the power units.

3.6 Interfaces

3.6.1 Hydraulic interfaces

The cooling circuit dissipates the semiconductor losses. The water flows into the cooling circuit through the inlet pipe. The water is heated by the waste in the semiconductors. The water flows out through the return pipe.

See also

Connecting the water circuits (Page 60)

3.6.2 Electrical interfaces

Auxiliary supply and signals

15-pin interfaces for the auxiliary power supply and signals are available at the input and output.

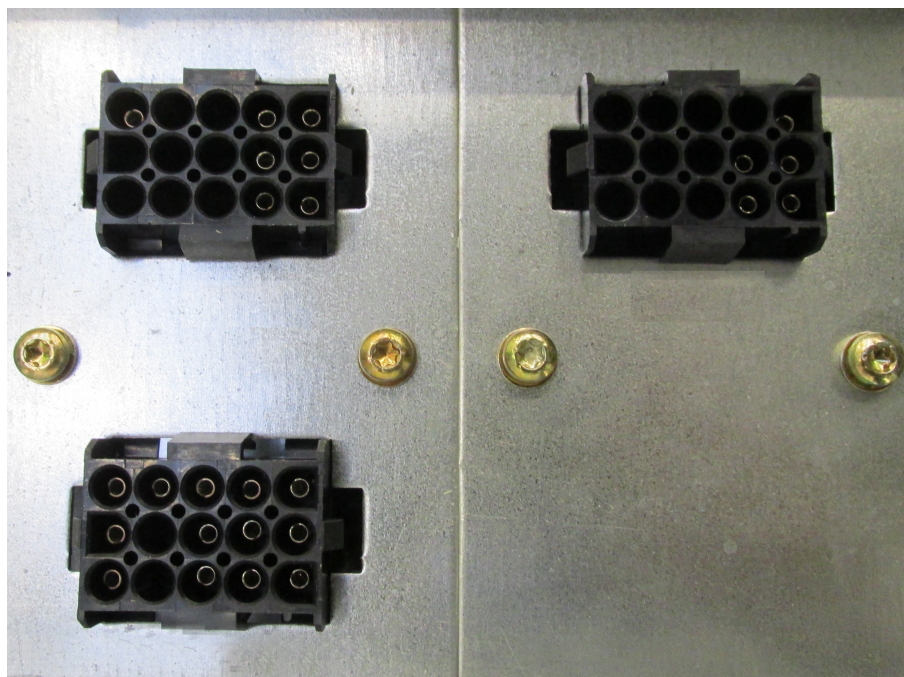


Figure 3-3 Auxiliary supply and signal interfaces

See also

Laying the signal lines (Page 69)

3.6.3 DRIVE-CLiQ interface

Table 3-3 DRIVE-CLiQ interface

Pin	Signal name	Technical data
1	TXP	Transmit data +
2	TXN	Transmit data -
3	RXP	Receive data +
4	Reserved, do not use	
5	Reserved, do not use	
6	RXN	Receive data -
7	Reserved, do not use	
8	Reserved, do not use	
A	+ (24 V)	Power supply
B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interface: Molex, order number: 85999-3255. The maximum DRIVE-CLiQ cable length is 50 m.		

Preparations for use

Observe Chapter, "Safety instructions" when carrying out any work at the converter.

4.1 Requirements for installation location

The cabinet units are suitable for installation in general operating areas (to DIN EN 60146-1-1 / VDE 558 T11 and DIN EN 50178 / VDE 0160 (IEC 62103), degree of contamination 2; without conducted contamination). For this reason, SINAMICS devices must be protected in such a way that they cannot be touched directly when they are being installed in general operating areas.

The operating areas must be dry and free of dust. The air supplied must not contain any electrically conductive gas, vapors, or dust which could impair operation.

For information about permissible ambient and installation conditions, see the "Technical specifications" section.

4.2 Inspections when the equipment is received

4.2.1 Checking the delivery

The components are assembled on an individual basis. When you take receipt of the delivery, please check immediately whether the scope of the delivery matches up with the accompanying documents. No claims relating to defects/items missing from the delivery will be accepted if they are submitted at a later date.

- Report any apparent transport damage to the delivery agent immediately.
- Immediately report any apparent defects/missing components to your contact partner.

These Operating Instructions are part of the scope of delivery; keep them in a location where they can be easily accessed.

4.2.2 Checking shock and tilt indicators

The purpose of shock and tilt indicators

The unit is equipped with shock and tilt indicators to monitor for damage during transit. It is essential that you check the shock and tilt indicators before commissioning the unit.



WARNING

Tripped shock and tilt indicators

Safe operation of the device is not guaranteed if the shock or tilt indicator has tripped (responded)

This can result in death, serious injury or material damage.

- If one of the indicators has tripped, do not perform any commissioning.
- Inform the Technical Support. Only specialist Siemens technicians can recommend appropriate measures.

See also

Siemens Industry Online Support (Page 107)

Location of the indicators

You can find the indicators at the following locations:

- The tilt indicators are located in the upper third of the cabinet.
- The shock indicators are located at the bottom of the cabinet.

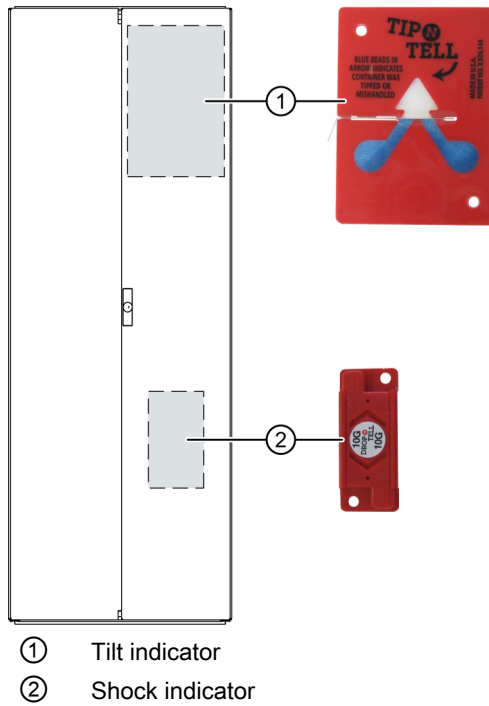
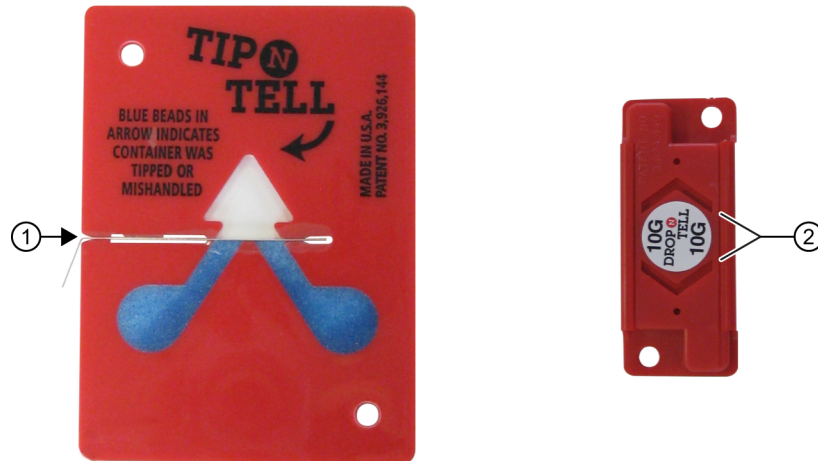


Figure 4-1 Example for attaching shock and tilt indicators

Diagram showing the indicators

Non-tripped indicator



- ① The arrow above the line is white. The tilt indicator has not tripped.
- ② All arrows are red. The shock indicator has not tripped.

Tripped indicator



- ① The arrow above the line is blue. The tilt indicator has tripped.
- ② One of the arrows has turned black. The shock indicator has tripped.

4.2.3 Checking the load handling attachments

Check the load suspension devices before lifting and transporting (such as lifting lugs and eyebolts) and the lifting gear:

- Inspect the load suspension devices attached to the equipment for possible damage. Replace load suspension devices if they are damaged.
- Before use, check that the load suspension devices are correctly attached.
- When lifting, use only approved and undamaged lifting gear of sufficient rated capacity. Check the lifting gear prior to its use.



WARNING

The device may fall

If the load suspension devices and lifting gear are damaged or not correctly secured, the equipment may be dropped during lifting and transportation. This can result in death, serious injury or material damage.

Inspect the load handling attachments and lifting gear before use.

4.3 Transport

The terms are defined as follows in the following part of the instructions:

- "Transportation unit" refers to the unit before it has been unpacked
- "Cabinet" refers to the unit after it has been unpacked

4.3.1 Transport markings

The packing differs depending on the transport type and size. If not otherwise contractually agreed, the packaging corresponds to the packing guidelines for International Standards for Phytosanitary Measures (ISPM).

Comply with the images shown on the packaging. Their meaning is as follows:



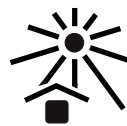
This
way up



Fragile goods



Keep dry



Keep cool



Center of
gravity



Do not use
hand hook



Attach here

4.3.2 Transport requirements

- Persons driving cranes and fork-lift trucks must hold appropriate licenses.
- You must observe the specifications to avoid transport damage to the enclosure and you must maintain the permissible climatic conditions during operation in accordance with IEC 60721-3-1/2/3. Please also observe the "Technical specifications" instructions.
- When lifting the drive, use only approved and undamaged sling guides and spreaders of sufficient rated capacity. Check these before using them. The weight of the drive is specified on the rating plate.
- When lifting, refer to the information on the lifting plate or in "Technical data and drawings." Comply with the specified spreading angles.

NOTICE

Vibrations

Significant vibration during transportation and shocks when setting down can damage the equipment.

Avoid vibrations and shocks.

4.3.3 Take the center of gravity into account



WARNING

Non-observance of center of gravity specifications

The cabinet is heavy. The center of gravity can be in the upper half of the cabinet. The unit can tip over if you transport it incorrectly – or if you use transport equipment that is not permitted for the purpose. This can result in death, serious injury or material damage.

- Ensure that only trained personnel transport the device with approved transport equipment and lifting tools.
- Observe the center of gravity specifications. A label or stamp is attached to each transportation unit and precisely shows the center of gravity of the cabinet.
- Do not tilt the device or allow it to fall.

The following figure shows the centers of gravity as an example: Carefully note the centers of gravity when performing any lifting or installation work.

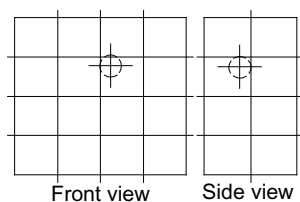


Figure 4-2 Example illustration of centers of gravity

4.3.4 Transport with a fork-lift truck

** WARNING****Use of non-approved fork-lift trucks**

If the forks are too short, this can cause the transport unit/cabinet to tip over resulting in death, serious injury, or damage to the cabinet.

The forks of the truck must protrude at the rear of the transport pallet. The floor panels of the transport units will not support a load.

Only use fork-lift trucks approved for this purpose to transport the units.

When the transport units are transported or moved with a fork-lift truck, the force is absorbed through the transport pallet.

Observe the following points for safe transport:

- Transport the transport unit/cabinet with the greatest care.
- Choose the lowest transport height possible. The pallet may not touch the ground. Always transport the cabinet in an upright position.
- Avoid driving over bumps.

4.3.5 Transport with a crane

** WARNING****Improper transport**

If the transport unit is not properly transported with a crane, the transport unit/cabinet could fall or tip over. This can result in death, serious injury or material damage.

Make sure that you read the safety information about transportation and the information provided on the transport unit (e.g. center of gravity specifications).

** WARNING****Use of inappropriate cross-arms**

If inappropriate cross-arms are used, the transport unit or cabinet can tip over. This can result in death, serious injury or material damage.

Observe the specifications provided in DIN EN 13155 on crossbars.



WARNING

Standing under suspended loads

If the lifting gear or load suspension devices were to fail, the transport unit/cabinet could fall. This can result in death, serious injury or material damage.

Do not stand underneath or near to a raised load.

Observe the following points for safe transport:

- When using a crane to transport the equipment, keep to the permissible lifting capacity. Carefully observe the center of gravity.
- If the cabinet center of gravity is off-center, use suitable and undamaged suspension equipment, e.g. a cross beam. The lifting beam reduces the pressure on the device and prevents damage.
- If the cabinet has eye hooks, use them. In such cases, do not use any lifting rods.

4.3.6 Using lifting rods

When transporting by crane, note that the force is applied via the transport rails attached to the bottom of the cabinet.



WARNING

Inadequately dimensioned lifting rods

Inadequately dimensioned lifting rods are liable to bend or break. The drive could drop off the crane. This can result in death, serious injury or material damage.

Use suitable lifting rods for transporting. The weight of the cabinet is indicated on the rating plate.

NOTICE

Improper lifting

If the transport unit is lifted incorrectly, this can damage the decorative trim, cabinet doors, or fans.

Protect the cabinet and protruding parts against damage.

Always lift the transport units with the appropriate spreading devices or hoisting tackle.

Procedure

1. If there are several holes, select which holes to use based on the center of gravity.
2. Push the lifting rods through the holes.

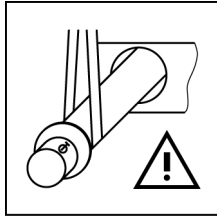


Figure 4-3 Lifting rod label

3. Place the sling ropes on the lifting rods so they are close to the cabinet. Secure the ends of the lifting rods using the splint.



Figure 4-4 Securing the lifting rods

4. To lift the transport unit, use single sling ropes or two ropes with a cross stitch. Attach the crane rope to the lifting rods so it is close to the cabinet.
5. Lift the cabinet. Avoid shifting the center of gravity or distorting or damaging the cabinet. When suspended, the cabinet must be parallel to the ground.

4.3.7 Transporting transportation units packed in boxes

Transportation with the fork-lift truck

When the transport units are transported with a fork-lift truck, the force is absorbed through the transport pallet. Observe the guidelines described in the section "Transport with a fork-lift truck".

Transportation with the crane

Observe the guidelines described in the section "Transport with a crane". To protect the boxes against pressure, use sufficiently long rope and a spreader beam. Please proceed as follows:

1. Attach the rope/cable to the pallet as shown in the following diagram.
2. Attach the rope/cable to the spreader beam ① and the crane hook.

4.3 Transport

3. Pay attention to the center of gravity imprinted on the box ② and the imprinted position of the ropes ③.
4. Carefully raise the transportation unit.

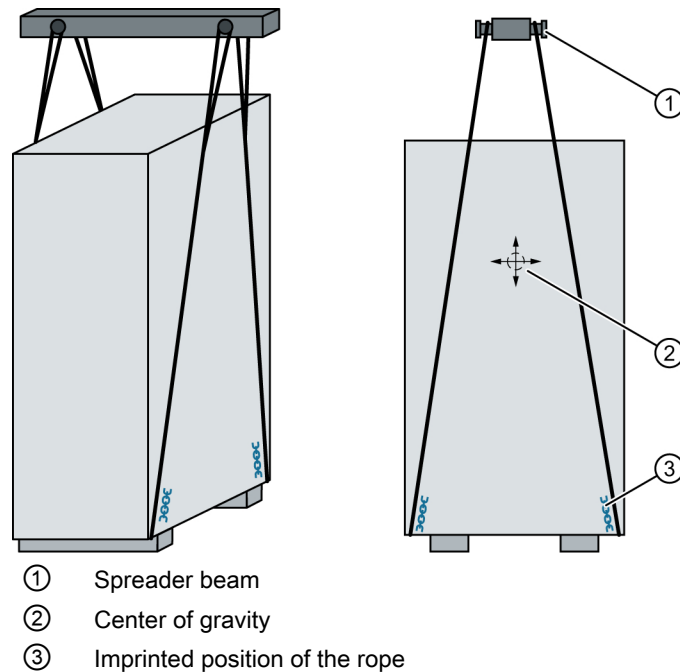


Figure 4-5 Transporting a transportation unit (still in packaging) with a crane

See also

Transport with a fork-lift truck (Page 45)

Transport with a crane (Page 45)

4.3.8 Transporting a re-cooling unit

NOTICE

Damage to the ion exchange cartridge

If the ion exchange cartridge is exposed to frost, it may be damaged.

Only transport and store the ion exchange cartridge in non-frosty conditions. More information is available in the re-cooling unit's operating instructions.

4.4 Unpacking the cabinets

4.4.1 Removing the packaging

NOTICE

Incorrect storage of unpacked devices

Proper packaging ensures that the equipment is protected. Unpackaged equipment may be damaged if it is stored or out of service over a long period.

Refer to the storage information under "Storage" and in the section "Technical specifications". Remove the packaging immediately prior to installation.

The devices are packaged by the manufacturers in accordance with the order and the climatic conditions of the transport route in the receiving country.

In order not to damage open mounting parts (e.g. pipes and busbars), take the following measures when removing the foil and the load securing devices:

- Remove the foil and load securing devices carefully.
- Remove the packaging immediately prior to installation. Protect the cabinets against dust until they have been commissioned. To do this, cover the ventilation openings and keep the doors closed.
- Do not remove the safety instructions and center of gravity specifications from the cabinet.

4.4.2 Removing load securing devices



WARNING

Fixing materials can come under tensile stress

If fixing materials are released suddenly during opening and people get in the way, this could result in bodily injury or death.

Release the retaining straps before opening. Stay out of the way of the impact direction of the retaining straps.

NOTICE

Improper removal of the load securing devices

The load securing device protects the cabinet from any damage. If you remove the load securing device improperly, the cabinet may sustain damage.

Correctly remove the load securing device.

4.4 Unpacking the cabinets

To extract the load securing device, proceed as follows:

1. Remove the retaining straps.
2. Remove the spacers such as wooden wedges, air cushions, etc.

4.4.3 Lifting the cabinet off the transport pallet

Use a crane to lower the transportation units from the transport pallets and transport them to the installation site. Observe the guidelines described in the section "Transport with a crane."

4.4.4 Opening doors in preparation for use

NOTICE
Incorrectly opening the doors If you incorrectly open the doors, then this can damage the locking mechanism. • When opening the doors, follow the steps described. • You must replace a damaged locking mechanism before commissioning, which will be charged for. Contact the service center in this regard. You can find the relevant contact person under "Service & Support".

The drive is supplied in a closed state.

A label showing the operating steps and a screw marked by a further label are located on the door. Under the screw you will find the opening for manually opening the doors.

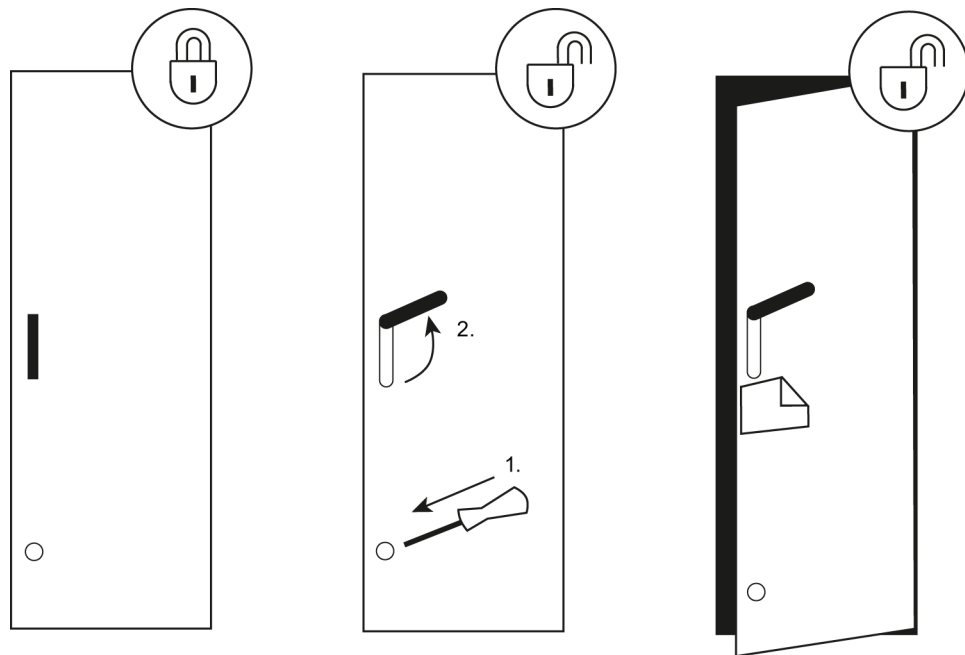


Figure 4-6 Labels



Figure 4-7 Example: Cover screw for manual door interlocking

To open the drive in a voltage-free state, proceed as follows:

1. Loosen the screw.
 2. Insert a screwdriver into this opening.
 3. Turn the door handle until you feel resistance.
 4. Remove the screwdriver from the opening.
 5. Open the doors.
- Also note the labels on the doors

4.5 Storage

4.4.5 Checking the shock and tilt indicators inside the cabinet.

Shock and tilt indicators are also located inside the cabinet. Check these as soon as you have unpacked and opened the device. To perform the check, proceed as described in "Check shock and tilt indicators"

See also

Checking shock and tilt indicators (Page 40)

4.5 Storage

4.5.1 Emptying the drive

NOTICE
Unemptied cooling system The coolant can corrode the components over the long term. Coolant can also freeze at temperatures of below 0° C causing damage to the drive. Make sure that the coolant has been completely removed from the system before the device is placed in storage. If the drive is stored for a longer period of time, then close and seal all water intakes and discharge points to protect against vermin and dirt.

If the drive was already connected to the cooling system and you want to store the drive away again, empty the drive completely prior to storing. To empty the drive proceed as follows:

1. Open the connection between the cabinet piping and the external piping.
2. Drain the coolant.
3. Then tighten the screws again.
4. At one of the flanges of the cabinet piping, connect oil-free compressed air or a nitrogen bottle. Use a suitable transition element. Blow out any residual water.

NOTICE
Blow-out pressure too high If the blow-out pressure used exceeds 6 bar, the piping and the heat sink can become damaged. Do not exceed the blowout pressure of 6 bar. Avoid pressure surges.

4.5.2 Storing a device

If you are not going to commission the device immediately after delivery, ensure that it is stored correctly.

Preconditions and preparations

- Store goods only in undamaged packaging. Unpack the goods if the packaging is damaged. Correctly store the goods corresponding to the type of goods.
- Repair any damage to the packaging before putting the equipment into storage insofar as this is necessary to ensure proper storage conditions.

General instructions for storage

Wherever possible, store the device in a storage room. The place of storage must satisfy the following general conditions:

- Select a sufficiently sized dry and horizontal place of storage that is above flood level and free of vibration ($v_{\text{eff}} \leq 0.2 \text{ mm/s}$).
- The place of storage must be well ventilated as well as free of dust and frost.
 - Provide protection against extreme weather conditions.
 - Optimum temperatures are between 10° C (50° F) to 50° C (120° F).
 - Room temperature should be approx. 10° C (50° F) above the outside temperature.
 - The temperature may not fall below -20 °C (-4 °F).
 - For lower temperatures, agree on suitable measures together with Siemens.
 - Relative humidity should be less than 60%.
 - The floor of the place of storage must be sufficiently strong. Do not exceed maximum permissible floor load levels or storage compartment load levels.
 - The ambient air must not contain any harmful gases.
- Protect the device against shocks and humidity.
- In order to ensure protection against ground moisture and water, place the equipment and crates on pallets, wooden beams or foundations.
- Ensure that the air circulation under the equipment is not impeded.
 - Place wooden spacer blocks between the covers and the device.
 - Do not place covers or tarpaulins completely around the equipment on the floor.

NOTICE

Improper storage

Incorrect or excessively long storage can damage the equipment.

- | |
|---|
| <ul style="list-style-type: none">• Do not store the device outdoors.• Observe the specified conditions for storing the device.• Ensure that it is not stored for longer than the permissible maximum of two years. |
|---|

Protection against humidity

- If a dry storage area is not available, then take the following precautions:
 - Wrap the device in humidity-absorbent material. Then wrap the device in film so that it is airtight.
 - Place a humidity meter that can be read from outside inside the film wrapping. Observe the values provided in the technical specifications on relative humidity. Check the values regularly using the humidity meter.
 - Inspect the device regularly.

4.5.3 Storing fans

NOTICE

Improper fan storage

Even if the fan is not used, the bearing grease ages. The utility of the fan can be impaired.

Rotate the fan at least once a year. Do not store the fan for longer than two years before commissioning.

4.5.4 Storing re-cooling units

NOTICE

Damage to the ion exchange cartridge

If the ion exchange cartridge is exposed to frost, it may be damaged.

Only transport and store the ion exchange cartridge in non-frosty conditions. More information is available in the re-cooling unit's operating instructions.
--

Observe Chapter, "Safety instructions" when carrying out any work at the converter.

5.1 Safety instructions for assembly

NOTICE

Improper installation

The devices can be damaged through improper installation.

Install the devices as described in the following sections. Take note of the ambient temperatures stated in the technical specifications. Protect the drive against excessive stress and loading.

WARNING

Danger as a result of defective seals

When working on the device, seals at the doors, roof panels as well as front, rear and side panels can be damaged. Operating the device with defective seals can result in death, serious injury or material damage.

Replace the defective seals before commissioning. Observe the environmental conditions stated in the technical specifications.

WARNING

Insufficient degree of protection from dust deposits

Dust gets deposited in the drive during installation work. Dust deposits can lead to the drive no longer fulfilling the requirements of the degree of protection indicated. If the drive is operated with an insufficient degree of protection, death, serious injury, and material damage can result.

Therefore, remove dust deposits after installation. Then keep the doors closed.

In the event of contamination from conductive dust particles (e.g. from welding work), professional cleaning will be required. Contact the service center in this regard.

NOTICE

Foreign bodies in the drive

If, after installation and maintenance work, foreign bodies are left in the drive, this can damage it when switching on.
--

Before switching on, check as to whether there are any foreign bodies in the drive. Remove any foreign bodies.
--

NOTICE

Incorrectly opening the doors

If you incorrectly open the doors, then this can damage the locking mechanism.
--

Open the doors as described in Chapter "".
--

5.2 Tools required

Installation of the connections requires the following tools:

- Wrench or socket wrench, width across the flats 10, 13, 16/17, 18/19
- Allen key, size 8
- Torque wrench up to 50 Nm
- Screwdriver, size 2
- Torx T20 and T30 screwdrivers

5.3 Attach the roof hood and fans

Note

If the fans and roof hood are not factory fitted, proceed as outlined below.

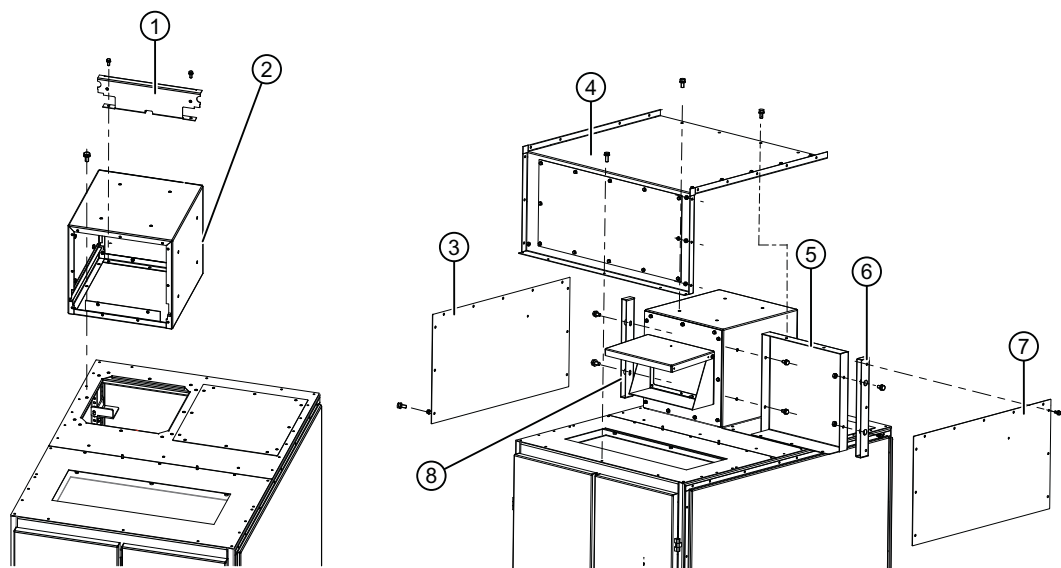


Figure 5-1 Attaching the roof hood

1. Fit the fan box ②. Tighten the fan box securely with ten M8 screws.
2. Insert the rear brackets ① to clamp the fan. Tighten the bracket securely with two M8 screws.
3. Clamp the fan cable to the terminal block beneath the roof panel.
4. Install the fan. For a detailed description, refer to section "Replacing a fan (Page 88)".
5. Screw the spacer plates ⑤ and ⑧ to the fan box, each with two M8 screws.
6. Screw spacer plate ⑥ to spacer plate ⑤ using two M8 screws and nuts.
7. Attach the upper roof hood ④. Screw the roof hood to the fan box, spacer plate ⑤, and the front crossbar of the cabinet using seven M8 screws.
8. Screw the two side parts ③ and ⑦ securely to the roof hood, each with eleven M6 screws and nuts.
9. Check the sealing guide on the components. Repair if necessary.

5.4 Screwing the transport units together

NOTICE

Mechanical damage

Stresses occurring during transport can exert mechanical pressure on the components.

Material damage can result.

- Line the cabinets up precisely with each other in order to avoid shearing forces when the base units are screwed together.
- Install the drive only on a level and horizontal surface.

Preparation

Ensure that access to the holes in the bottom of the cabinets is unobstructed. Remove the guard covers.

To screw the transport units together, you will need the following mounting hardware:

- Hexagon nuts ISO 4032-M8-8 A2L
- Contact washers SN70093-8-FSt-mechZn-f
- Threaded pin M8 x 15.5
- Self-adhesive sealing strips

Screwing the transport units together

To screw transport units together, proceed as follows:

1. Affix the self-adhesive sealing strips ①.
2. Align the transport units.
3. Insert the threaded bolts through the holes ②. Use the holes in the corners and then every 300 mm.

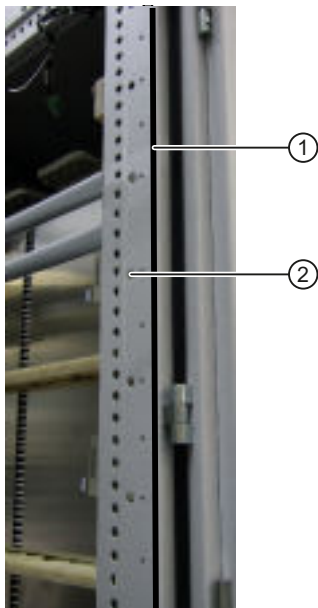


Figure 5-2 Screwing the cabinets together

4. Attach the contact washers to the threaded pins.
5. Screw the transport units together using the nuts with a torque of 32 Nm.

5.5 Connect to the foundation

Four holes for M12 screws are provided on each cabinet panel to secure the cabinet to the foundation. Information on mounting holes and their fixing dimensions are specified in the dimension drawing.

Install the transport units in accordance with the specifications provided in the accompanying dimension drawings. When doing this, maintain the specified distance between the top of the cabinet and the ceiling.

5.6 Connecting cabinets

DANGER

Insufficient grounding

The drive must be grounded to ensure that it operates safely and reliably. If the drive is operated with insufficient grounding, then the protection and monitoring functions can fail.

Death, serious injury, or material damage will result.

- Always apply all of the necessary protective measures.
- Always observe the five safety rules when working with the drive.
- Follow these steps when grounding the machine:
 - Establish the connections in a cabinet.
 - Ensure that the connections are also established over several cabinets.
 - Establish the ground connection for the whole plant immediately.

If several cabinets are set up as one unit, the grounding connections of the individual cabinets must be connected with each other. A grounding lug connection cable is supplied with each cabinet. To connect the ground connections for several cabinets, proceed as follows:

1. Insert the grounding cable ① through the side panel of the cabinet.

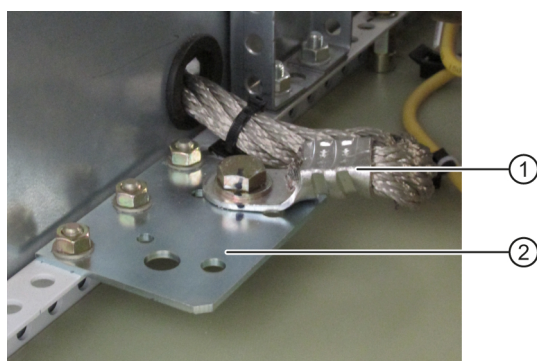


Figure 5-3 Connecting the grounding for the cabinet units

2. Secure the grounding cable on the grounding lug ② with an M12 screw.
3. Tighten the screw with a torque of 50 Nm.

5.7 Connecting the water circuits

CAUTION

Deionized water

Deionized water is harmful to eyes and skin and can damage surfaces.

Therefore, use appropriate protective clothing for all work on the drive. However, if your eyes or skin do come into contact with deionized water, rinse the affected area thoroughly with tap water as soon as possible. If deionized water leaks out, eliminate the source of the problem and remove the liquid from the surfaces affected.

NOTICE

Damage caused by foreign bodies in the cooling system

Foreign bodies in the cooling system can cause blockages in individual circuits. As a result, the water-cooled components overheat and the drive fails.

For this reason, make sure that no foreign bodies can enter the water circulation system. Only remove the protective cover immediately prior to connecting the water circuit.

Connect the re-cooling unit

Connect the deionized water circuit of the re-cooling unit to the deionized water piping of the drive. Refer to the associated information about the ionized-water connections in the dimension drawing.

The module has an inlet pipe and a return pipe. The pipes are marked accordingly. When connecting the re-cooling unit, ensure that the inlet pipe and return pipe are connected correctly. Only use the supplied connecting pipes.

Tighten the union nut ③ of the connecting pipe for the intake and discharge pipes.

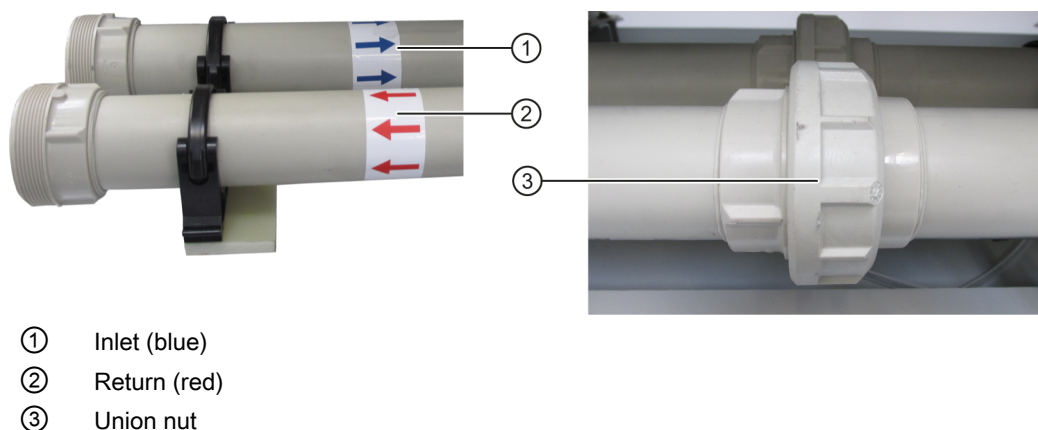


Figure 5-4 Water piping

To establish the connection of the raw water circuit, observe the details in the dimension drawing.

See also

Charging the deionized water circuit (Page 75)

Electrical connection

Observe Chapter, "Safety instructions" when carrying out any work at the converter.

See also

Safety instructions (Page 13)

6.1 Safety instructions for electrical connections



WARNING

Insufficient degree of protection as a result of inadequate sealing of the cable entry

If the cable entry is not correctly sealed, it is possible that the drive no longer complies with the requirements for the specified degree of protection.

If the drive is operated with an insufficient degree of protection, death, serious injury, and material damage can result.

To maintain the drive's degree of protection, after connecting the cable, seal the cable entries so they are air-tight immediately.



WARNING

Insufficient degree of protection as a result of modifying the floor/roof panel

If you make any changes to the floor panel or the roof panel in order to modify the cable entry, the changes may result in the drive no longer meeting the requirements for the degree of protection shown. If there are holes in the floor or roof panel, then animals and vermin, for example, can get into drive during operation.

If the drive is operated with an insufficient degree of protection, death, serious injury, and material damage can result.

To maintain the drive's degree of protection, seal the holes so they are air-tight immediately after installation.



WARNING

Danger as a result of defective seals

When working on the device, seals at the doors, roof panels as well as front, rear and side panels can be damaged. Operating the device with defective seals can result in death, serious injury or material damage.

Replace the defective seals before commissioning. Observe the environmental conditions stated in the technical specifications.



WARNING

Short-circuits

Damaged cables, or their improper routing, can cause damage to property and personal injury.

- Only use cables that are completely intact and not damaged. Correctly route the cables. Do not interchange input and output terminals.
- Make sure that a short-circuit cannot occur on the power cables due to failure of the insulation as a result of incorrect cable installation.
- Check the electrical connections after service work.

NOTICE

Using magnetic parts

The use of magnetic parts (e.g. magnetic cable clamps) is not permitted. Using magnetic parts can damage the drive.

Only use parts that consist of non-magnetic material.

NOTICE

Improper shrinking of cable terminations

If you are connecting the mains and motor-side power cables, when shrinking the cable terminations, other control lines and fiber-optic cables in the surrounding cable channels can become damaged.

When shrinking, ensure not to damage cables in the surrounding cable channels.

NOTICE

Incorrectly opening the doors

If you incorrectly open the doors, then this can damage the locking mechanism.

Open the doors as described in Chapter "".

Note

Control and signal lines must always be connected according to the circuit diagrams supplied with the unit. Detailed information about connecting the components is given in the interconnection diagram.

Note

We recommend using shielded cables. Unshielded cables can transfer disturbances to the control and signal lines and lead to malfunctions in the drive.

Note

To ensure trouble-free operation without interference or disturbances, route the power cables and signal lines separately. Interference, for example, will result in the device not behaving as expected.

When connecting and routing power and signal cables, observe the instructions contained in the "Electromagnetic compatibility" section.

See also

Electromagnetic compatibility (Page 65)

6.2 Electromagnetic compatibility

The following fundamental information and guidelines facilitate compliance with the EMC directives.

Note

We recommend that EMC is planned for the entire plant.

Cabinet installation

- Connect painted or anodized metal components using contact washers or remove the insulating layer.
- Use unpainted, de-oiled mounting plates.
- Establish a central connection between ground and the protective conductor system (PE protective conductor).

Cable installation

- Cables that are subject to or sensitive to interference should be laid as far apart from each other as possible.
- The distance between the electric power cable and signal cable should be > 20 cm. The drive-specific information applies to power cables. You can find further information on power cables under "Connecting power cables".
- When the cables are routed close to ground potential, the immunity to interference is increased. For this reason, you are advised to lay these cables along edges and at ground potential.
- Ground the reserve cores on at least one end.
- In order to avoid additional locations where interference can be coupled in, long cables should be shortened or routed where there is little interference.
- If conductors or cables conduct signals of different classes, then the conductors and cables must cross at a right angle. This especially involves sensitive and noisy signals.
 - Class 1:
Unshielded cables for ≤ 60 VDC
Unshielded cables for ≤ 25 VAC
Shielded analog signal cables
Shielded bus and data cables
Operator panel interfaces, incremental/absolute encoder cables
 - Class 2:
Unshielded cables for > 60 VDC and ≤ 230 VDC
Unshielded cables for > 25 VAC and ≤ 230 VAC
 - Class 3:
Unshielded cables for > 230 VAC/VDC and ≤ 1000 VAC/DC
 - Class 4:
Unshielded cables for > 1000 VAC/DC

Shield connection

- Do not use cable shields to conduct current. In other words, cable shields must not simultaneously act as neutral or PE conductors.
- Apply the cable shield so that it covers the greatest possible surface area. Use ground clamps, ground terminals or ground screw connections.
- Avoid extending the cable shield to the grounding point via a wire. This reduces the shield effectiveness by up to 90%.

- Attach the cable shield to a shield bar directly after the line inlet into the cabinet. Insulate the shielded cable without any interruptions. Route the cable shield up to the device connection.

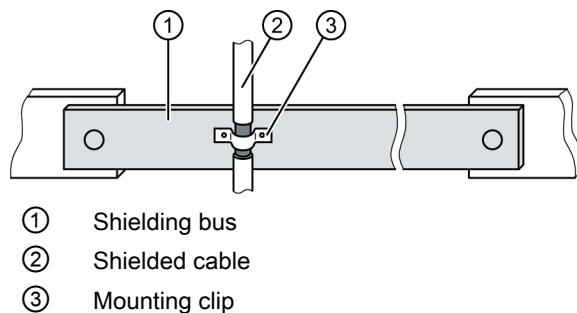


Figure 6-1 Shield connection using a clip

NOTICE**Damaged or incorrectly mounted cable shielding**

Incorrect connection or damaging of the cable shield can impair the function of the system.

- Handle the cable shield carefully.
- Ensure that the cable shield is correctly connected.

- Bridge shield gaps (at terminals, circuit-breakers, contactors, etc.) with minimum impedance and through the largest possible surface area.

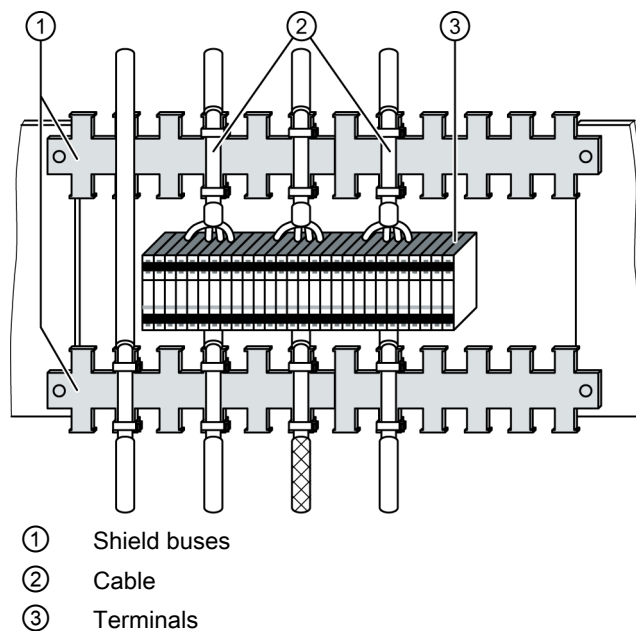


Figure 6-2 Bridging shield gaps

I/O interfacing

- Create a low-impedance ground connection for additional cabinets, system components, and distributed devices with the largest possible cross-section (at least 16 mm²).
- Ground unused lines at one end in the cabinet.
- Choose the greatest possible clearance between the power and signal cables (at least 20 cm). The greater the distance over which the cables are routed in parallel, the greater the clearance must be. You must install additional shields if sufficient clearance cannot be maintained.
- Avoid unnecessarily long cable loops.
- The operating coils for contactors and relays in the drive must be connected to overvoltage limiters (e.g. RC elements or varistors).
- In order to reduce noise/interference entering or exiting via the cable, filter auxiliary voltages in the control cabinet.

6.3 Potential concept

A noise-free connection between the internal and external supply voltage can be achieved by connecting the 0 V potentials to each other and grounding them. This also eliminates the need for the control circuit insulation monitor required by DIN EN 60204-1.

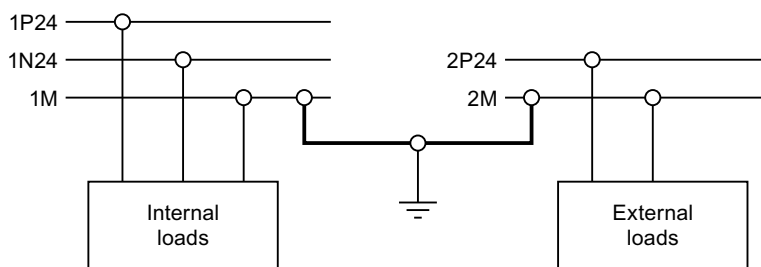


Figure 6-3 Potential concept

6.4 Cable cross-sections

Table 6-1 Cable cross-sections

Object	Cross-section	Remark
Power cable	Max. 240 mm ²	max. 4 per terminal
Cabinet protective conductor	Max. 120 mm ²	-

See also

Torques (Page 95)

6.5 Connecting ground

DANGER

Insufficient grounding

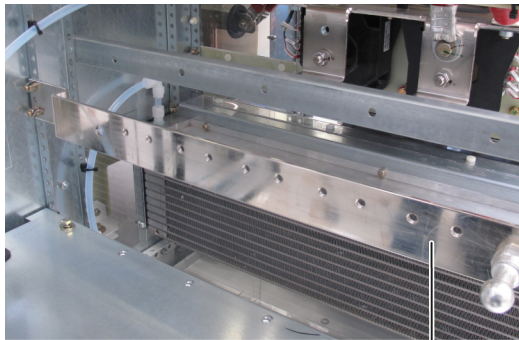
The drive must be grounded to ensure that it operates safely and reliably. If the drive is operated with insufficient grounding, then the protection and monitoring functions can fail.

Death, serious injury, or material damage will result.

To ensure the correct functioning of the protection and monitoring equipment, ground the device.

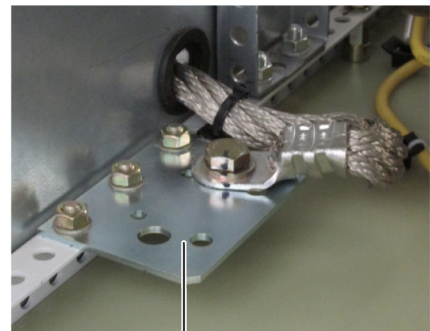
To ensure the drive operates safely, connect a protective grounding conductor.

A grounding bar and a grounding lug can be found in the lower area of the cabinets. Grounding bar and grounding lug are used for grounding the components installed in the cabinet.



①

① Grounding bar



②

② Grounding lug

Figure 6-4 Example: Grounding bar and grounding lug

6.6 Laying the signal lines

NOTICE

Malfunction due to common cable installation

Malfunctions can occur in the converter if cables with differing voltage levels are laid together with internal cables in one cable duct in the cabinet.

Do not run cables coming from the outside, for example to the terminal strips, together with internal cables in one cable duct.

6.7 Connecting power cables

All signal lines must be shielded. The cable shield should be braided, because cables shielded by tape or foil are five times less efficiently protected against interference. Always ground the cable shields at both ends. Contacting at one end is advantageous in exceptional cases only.

Clamp the shield of incoming analog and binary cables to the shield busbar at the entry point into the cabinet. Continue running the cable, still shielded, to the terminal strip or board. No shields are connected to the terminal strips or boards.

Serial connecting cables must be shielded. Place the shield on the metallic connector housing. Also connect the shield to the shield rail. Do not connect the cable shield to a ground pin of the connector.

The connector housing and front plate of the boards do not provide adequate cable shielding. Connect the cable shields at both ends to the shield rails in the cabinets. Always use shielded analog signal cables, regardless of whether they are installed inside or outside cabinets. In order to increase the effectiveness of the shielding, ground spare conductors at both ends.

You should only use the pre-assembled cable sets supplied. These cable sets are marked at both cable ends with the precise designation of the connection point at which you must connect or plug in the cable. Please proceed as follows:

1. Connect the signal and power supply cables. For further information, see the connection diagram in the circuit manual.
2. Seal the cable routing according to the degree of protection required.

6.7 Connecting power cables

6.7.1 Preparations

When connecting the cables, observe all the conditions regarding conductor protection. Do not exceed the permitted cable lengths between the drive output and motor. The distance between the motor cable and the signal cable should be at least 20 cm. Do not lay power cables and motor supply cables in parallel to each other.

The positions of the connections are shown in the layout diagrams. Detailed wiring notes for the drive are contained in the circuit manual of the drive.

Select the appropriate cable depending on the following conditions:

- Routing conditions
- Accumulation of cables
- Ambient temperature
- Bending radii
- Output voltage

Observe the connection capabilities on the drive and on the motor terminal box.

Detailed information about cabling of the drive is provided in the circuit diagrams supplied.

- Please ensure that the maximum cable lengths between the drive and motor are not exceeded.
- Make sure that the permissible cable capacitance is not exceeded.
- Use appropriate screws for the cable lugs provided.
- The tightening torque for the M12 screws is 50 Nm.
- Clean the contact surfaces before screwing the connections.
- Apply a thin layer of grease to the screws.

Table 6-2 Cleaning agents and grease

Materials required	
Cleaning agent	Ethyl alcohol
Grease	2G from Elektrolube

NOTICE

Thermal destruction

Cables that have not been properly secured at the connection point, represent a high electrical transition resistance, which can result in thermal destruction.

Tighten the screws with the specified torques. Tighten the M12 screws with a torque of 50 Nm.

Connecting power cables

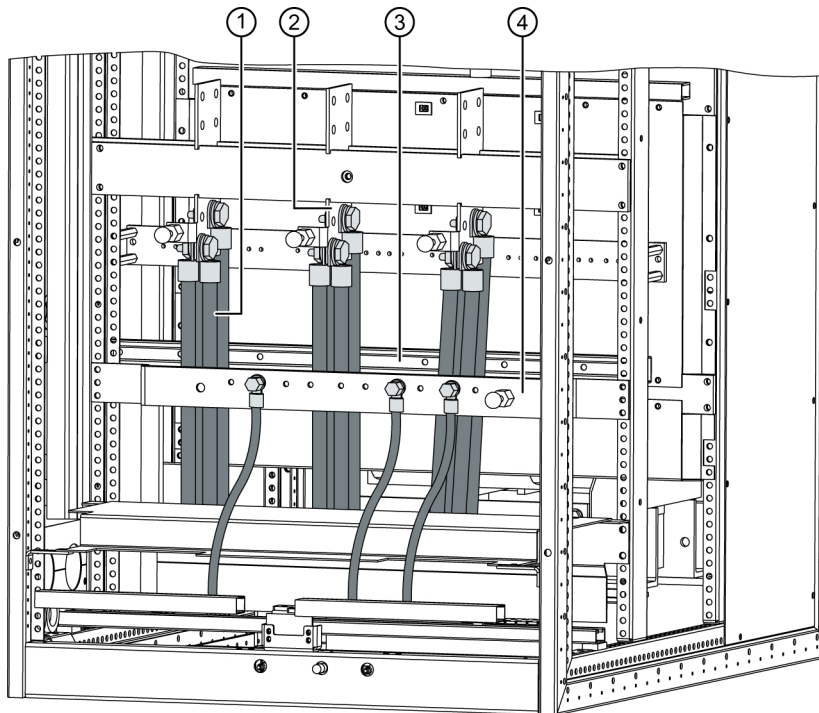


Figure 6-5 Schematic diagram: Connecting power cables

6.7.2 Procedure

To connect the power cables, proceed as follows:

1. Open the cabinet.
2. If there is a controller rack, swing it out of the way.
3. Remove or slide away the cover plate for the power cable entry.
4. Screw the PE protective conductor with an M12 screw at the locations ④ provided in the cabinet to the appropriate connection with the ground symbol. Observe the torque of 50 Nm. On this topic, take note of section "Connecting ground (Page 69)".
5. Screw the individual phases of the power cables ① with the connections in the lower area of the cabinet. To do this, follow the subsequent steps.
6. Insert the M12 screw into the corresponding connection bar ②.
7. Attach the cable lug.
8. Attach the nuts and, if necessary, the washers. Tighten the nuts with a torque of 50 Nm.
9. Expose the cable shield. Secure the cable on the cable clamping bar using cable clips ③.

6.8 Connecting the re-cooling unit to the drive

Connection cables for auxiliary power supplies and control signals are already connected to the drive. The remaining unconnected conductors are labeled. Connect these conductors to the corresponding terminals of the re-cooling unit.

Further details are contained in the circuit diagram of the drive and the re-cooling unit.

6.9 Interconnecting optional connections

Depending on the range of options installed, further connections have to be interconnected. Detailed information about interconnecting these options with the interfaces is provided in the circuit manual.

6.10 Fastening the cable ducts with cable ties

Fasten all cable ducts whose cover faces downward with cable ties. Wind the cable ties around the entire cable duct. The cable ties must be located at the same positions as in the delivered state.

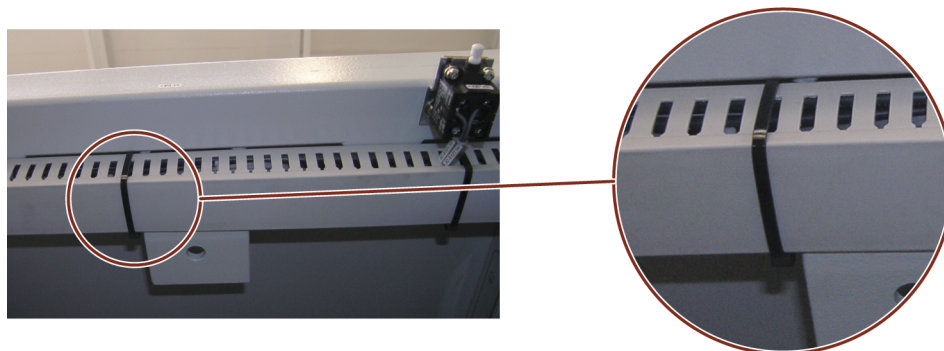


Figure 6-6 Fastening the cable ties

6.10 Fastening the cable ducts with cable ties

Commissioning

Make sure that all of the cable connections between the cabinet modules are prepared. Use the enclosed cable set.



WARNING

Incorrect commissioning

Malfunctions can occur as a result of incorrect commissioning and parameterization. This can result in premature failures and subsequent damage to the drive and the drive system components. This can result in death, serious injury or material damage. Incorrectly performed commissioning can result in the warranty becoming null and void.

This drive may only be commissioned by electrical technicians that have been adequately trained on this product, and have experience with commissioning this product and the associated plant and system components. The electrical technician commissioning the equipment must be trained on the specific product as a result of the differences between the individual products, e.g. regarding topology and closed-loop control.

Obtain information about the range of SITRAIN training courses available through your local contact person. Make use of the support and services offered by the responsible Siemens Service Center when commissioning this equipment. You can find the relevant contact person under "Service & Support".

7.1 Charging the deionized water circuit



CAUTION

Deionized water

Deionized water is harmful to eyes and skin and can damage surfaces.

Therefore, use appropriate protective clothing for all work on the drive. However, if your eyes or skin do come into contact with deionized water, rinse the affected area thoroughly with tap water as soon as possible. If deionized water leaks out, eliminate the source of the problem and remove the liquid from the surfaces affected.

NOTICE

Raw water in the deionized water circuit

Raw water in the deionized water circuit can damage the converter.

Observe the "Requirements placed on deionized water (Page 30)".

If you have filled the converter with raw water, you must switch on the converter. Drain the water. Free and dry all pipes, and heat sinks from raw water residues by purging with nitrogen gas.

NOTICE

Incorrect storage of deionized water

If you store deionized water incorrectly, it can become contaminated.

Consequently, store the deionized water only in closed containers made of glass or plastic.

Preparation

Check the connections of the water pipes for correct seating and absence of leaks.

Charging the deionized water circuit

When commissioning, start by charging the deionized water circuit. This is because it has to be vented repeatedly during the first 1-2 days.

Charge the deionized water circuit as follows:

1. Switch off the power supply of the electronics.
2. Check whether all other water valves are opened so that the water flows in everywhere.
3. Use an external pump to fill the converter and the re-cooling unit with deionized water (conductivity 1-2 μS) until the water discharges from the vent valves.
4. Switch off the external pump.
5. Close the water valves and the vent valves. Ventilate the deionized water circuit several times.
6. Check the location and the function of the leakage sensors and their alarms.
7. Fill sufficient water until both alarms (LSD and LA) of the expansion tank extinguish.

Observe Chapter, "Safety instructions" when carrying out any work at the converter.

8.1 Safety instructions for operation

 DANGER
Operation with the doors open High voltages are present in the drive and its components during operation and also after it has been switched off. When touched, these voltages can lead to death or severe injury. • Ensure that no voltage is present when the doors of the power unit are open. • Never operate the drive with doors open.

 WARNING
Faults Operating the drive when a fault has arisen can result in death, serious injury or substantial material damage. • Observe the fault and alarm messages. • Eliminate the source of the fault. Only put the drive back into operation once this is resolved. You can find further information on alarms and faults in the section "Fault indications and correction." • If it is not possible to correct a fault, inform the manufacturer's service personnel immediately. For additional information, see Chapter "Service & support".

 WARNING
Unpermitted operation with ground fault The type and location of the fault cannot be established just from a ground fault error message. For example, the glow discharge at the winding overhang of the machine may result in a fault signal. In the event of continued operation, serious aftereffects all the way to electric arcs are possible. This can result in death, serious injury or material damage. If a ground fault is experienced during drive operation, the drive must be switched off immediately. Then identify and eliminate the source of the ground fault. The plant operating company is responsible for the consequences, if the drive is still operated after a ground fault has been detected. Carry out a risk analysis.

**WARNING****Exceeding the permitted short-circuit currents**

Serious follow-on faults are possible, if the specified short-circuit current values are exceeded. This can result in death, serious injury or material damage.

Observe the maximum permitted short-circuit currents and maximum specified short-circuit times.

NOTICE**Incorrect parameterization**

The drive may malfunction if you change the parameters.

Do not change the parameters, e.g. for the motor circuit-breaker.

Note

To complement these operating instructions, the List Manual contains an overview of all parameters as well as a selection of function diagrams to describe the operating principle.

Only trained personnel may operate the drive.

8.2 Functions

Note**List manual**

References to functions, function plans, and parameters are found in the list manual for the drive.

8.2.1 Monitoring functions and protective functions

The drive features hardware and software functions that protect it against faults and damage caused by impermissible operating statuses or hardware malfunctions. The monitoring elements provide internal microprocessor-controlled monitoring and remote device monitoring.

8.2.1.1 Tripping of the circuit-breaker in case of undervoltage

If a serious fault occurs (e.g. overload in the DC link), the drive is immediately disconnected from the power supply by means of the safety shutdown function.



WARNING

Residual voltages

This function cannot ensure that the drive stops immediately, nor can it ensure that residual voltages do not still exist at the output terminals and within the unit.

High voltages can cause death or serious injury if the safety rules are not observed or if the equipment is handled incorrectly.

Always carefully observe the "five safety rules (Page 13)".

The shutdown of the circuit-breaker is triggered by a safety contactor combination.

The plant-side circuit-breaker must be equipped with an undervoltage trip to ensure the wire-break protection for the circuit-breaker OFF command. If a circuit-breaker OFF command is issued as a result of an overvoltage trip, the circuit-breaker is switched off so that it is fail-safe.

Maintenance

Observe Chapter, "Safety instructions" when carrying out any work at the converter.

9.1 Safety instructions for maintenance

 WARNING
Improper maintenance and repairs Improper repairs can result in death and serious physical injury. Only qualified maintenance and installation personnel may perform repairs.

 WARNING
Danger as a result of defective seals When working on the device, seals at the doors, roof panels as well as front, rear and side panels can be damaged. Operating the device with defective seals can result in death, serious injury or material damage. Replace the defective seals before commissioning. Observe the environmental conditions stated in the technical specifications.

 WARNING
High voltages from external supplies Magnetizing and demagnetizing equipment that is fed from an external voltage source can cause high voltages on the drive. This voltage can result in death or serious injury. Ensure that no voltage from external feeds exists before commencing maintenance and repair work.

 WARNING

High voltage when the anti-condensation heating is operational

The anti-condensation heating system is used when the drive is switched off due to production downtime or maintenance. For this reason, the heating is supplied with voltage from a separate line supply. When the supply voltage for the anti-condensation heating is connected, dangerous voltages are present in the cabinet unit, even with EMERGENCY OFF or when the main switch is open.

This voltage can cause serious injury.

The five safety rules must be observed.

 WARNING

Hot anti-condensation heating surface

When the temperature control limit value is reached the anti-condensation heating is switched on. Once activated, the anti-condensation heating can generate a great deal of heat. Contact can result in serious injury, such as skin burns.

Do not touch the anti-condensation heating.

 CAUTION

Risk of falling

When climbing onto the cover of the anti-condensation heating there is a risk of injury.

Therefore, do not use the anti-condensation heating system to help you get to the top of the cabinet.

NOTICE

Non-approved spare parts

Using non-approved spare parts can affect the function of the equipment and damage it. Third-party spare parts and unapproved spare parts may not meet the requirements.

Therefore, only use spare parts that have been approved by the manufacturer.

NOTICE

Foreign bodies in the drive

If, after installation and maintenance work, foreign bodies are left in the drive, this can damage it when switching on.

Before switching on, check as to whether there are any foreign bodies in the drive. Remove any foreign bodies.

NOTICE**Contamination**

Contamination and dirt can damage the device.

Visually inspect the equipment at least once per year. For more information, please refer to the section "Visual inspections".

Dust deposits inside the cabinet unit must be removed at regular intervals (or at least once a year) by qualified personnel in line with the relevant safety regulations.

Note

The actual intervals at which maintenance procedures are to be performed depend on the environmental and operating conditions. Define maintenance intervals for the drive which reflect your plant-specific environmental and operating conditions and meet your availability requirements. When doing so, take the prescribed maintenance intervals into consideration, as well as the instructions for repairing and replacing installed components.

Note

Siemens offers its customers support in the form of a service contract. For further details, contact your regional office or sales office.

Note

Inform the manufacturer about each maintenance job that has been carried out and about each spare part replacement for the purposes of a reliability analysis.

9.2 Grounding the system

 WARNING
High voltage after shutdown

High voltages are still present in the drive even after it has been shut down. Touching the drive can result in death or serious injury.

Only work on the power unit if it has been sufficiently grounded. Before touching the drive, ensure that the following parts of the power unit are de-energized:

- Internal busbars
- Input and output terminals
- Auxiliary power supply

Always observe the five safety rules (Page 13) when carrying out any work on the device.

9.2.1 Grounding using the grounding harness

Use a three-pole grounding harness for fixed ball points to ground the system.

Note

Ordering a grounding harness

You can order the grounding harness. Contact the Service Center.

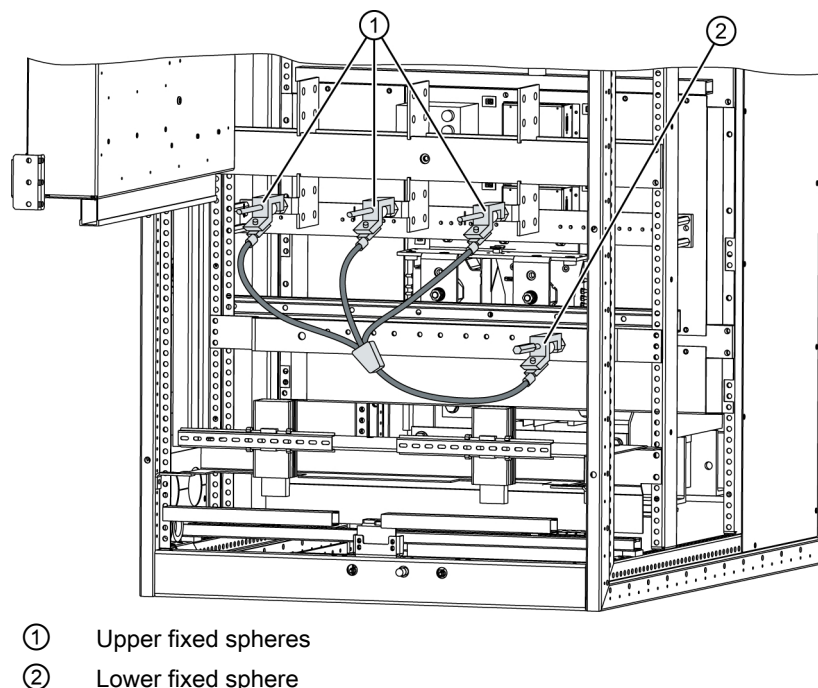
Note

Number of grounding harnesses

Depending on the configuration of the drive, use a sufficient number of grounding harnesses. A grounding harness is required for each three-phase system.

1. Secure the terminal of the grounding harness to the lower fixed sphere ②.
2. Secure the terminals of the grounding harness to the upper fixed spheres ①.

Attaching the grounding spider



- ① Upper fixed spheres
② Lower fixed sphere

Figure 9-1 Schematic diagram: Attaching the grounding spider

9.3 Opening the device

The drive is equipped with a door interlocking system. Depending on the design, this is an electromechanical door interlocking system or optionally a safety locking system.



WARNING

High voltages although the door interlocking has been released

Even when the door interlocking is released, high voltages can still be present at the auxiliary circuits (fans, anti-condensation heating, closed-loop control, etc.). Touching live components can result in death or serious injury.

- Ensure that work is only carried out by qualified personnel.
- The five safety rules must be observed.

The doors cannot be opened until the following conditions are fulfilled:

- The converter is ready to switch on, or in the "switching on inhibited" state, no ON command is active.
- The circuit breaker is open (feedback signal, "circuit-breaker OPEN").
- The "zero voltage criterion" in the DC link is fulfilled.
- The "zero voltage criterion" at the phase connection is fulfilled.



WARNING

High voltages after shutdown

After shutdown, high voltages are present at the converter and its components. Furthermore, if the connection to the machine or the line supply is not disconnected and grounded, these voltages can persist. Touching live components can result in death or serious injury.

- Never force the doors open during operation or while the DC link capacitors are being discharged.
- The five safety rules must be observed.

If the auxiliary voltage fails, you can only unlock the doors manually. To unlock the doors, proceed as described in the chapter titled "Preparation for use".

9.4 Preventive maintenance

9.4.1 Inspection

The purpose of an inspection is to ascertain and evaluate the current status of the equipment. An inspection mainly comprises visual checks. Inspections should be carried out based on a schedule that meets the needs of the special environmental conditions at the location of use. The following servicing and inspection instructions are used as the basis for regular inspection of the equipment.

9.4.2 Checklist for preventive maintenance work

Table 9-1 General checklist for preventive maintenance work

Maintenance	Carried out by:		Frequency	Comments
Clean the cabinet (exterior).	Owner		As required	Visual inspection, clean if required.
Clean the cabinet (interior).		Siemens service personnel	Annually	Visual inspection, clean if required.
Check the external connections.	Owner		After one year, and every four years thereafter	Inspecting the cable clamps and screw terminals.
Check the internal connections.		Siemens service personnel	After one year, and every four years thereafter	
Perform inspection and visual inspection.		Siemens service personnel	Annually	See the specifications in the Operating Instructions.
Check the cooling system.	Owner		After 30,000 operating hours	See the specifications in the Operating Instructions.
Check the spare parts.		Siemens service personnel	Annually	If necessary reorder spare parts.

9.4.3 Visual inspections

9.4.3.1 Equipment for visual inspections

You require the following basic equipment to carry out the visual checks and maintenance work:

- Mirror
- Torch
- Torque wrench for tightening screws

NOTICE

Contamination

Contamination and dirt can damage the device.

Visually inspect the equipment at least once per year. For more information, please refer to the section "Visual inspections".

Dust deposits inside the cabinet unit must be removed at regular intervals (or at least once a year) by qualified personnel in line with the relevant safety regulations.

Note

The actual intervals at which maintenance procedures are to be performed depend on the environmental and operating conditions. Define maintenance intervals for the drive which reflect your plant-specific environmental and operating conditions and meet your availability requirements. When doing so, take the prescribed maintenance intervals into consideration, as well as the instructions for repairing and replacing installed components.

9.4.3.2 Checking the isolating clearances

- Slight, dry, non-conducting contamination is permitted.
- Remove contamination caused by dust in conjunction with high humidity.

9.4.3.3 Checking hoisting solenoids and security bolts

- Check the hoisting solenoids and security bolts at regular intervals.
- Replace defective hoisting solenoids and security bolts before (re) commissioning.

9.4.3.4 Checking the plug connections.

Regularly check the plug connections to ensure they are seated correctly and the contacts are not corroded.

Note

The fiber-optic cables for the gating boards must be properly inserted in the connectors.

9.4.3.5 Checking the filter mats

- Check the air filters in the cabinet doors for pollution.
- Clean the filter mats or replace them if the air flow is obstructed.

See also

Cleaning (Page 92)

Replacing filter mats (Page 91)

9.4.3.6 Checking the cable and screw terminals

- Check the cable and screw terminals regularly to ensure that they are secure.
- Tighten the screws if necessary. When doing this, comply with the specified torques.
- Check the cabling for defects.
- Replace any defective parts immediately.

9.4.3.7 Checking the cooling circuit

- Check the entire cooling circuit for leaks. If you find a leak in a pipe coupling, tighten the nut by a ¼ turn
- Compare the measured conductivity value with the permissible conductivity value for the system ($\leq 0.6 \mu\text{S/cm}$). You must replace the ion exchanger if this value is close to $1 \mu\text{S/cm}$.
- Check the water level in the compensating chamber of the deionized water circuit. If the level is too low, add some more water. If the level is too high, drain some water until the level is correct.

See also

The external raw water circuit (Page 31)

9.5 Maintenance

9.5.1 Replacing a fan

The fans must also be fitted with a monitor to ensure that the drive operates reliably. The service life of the device fans is 30,000 hours. Replace the fan timely in order to maintain the reliable functioning of the cabinet unit.

Note

If a DC bus is available, the fan must be removed from the back.

9.5.1.1 Replacing fans, from the front

Removing the fan

The five safety rules must be observed.

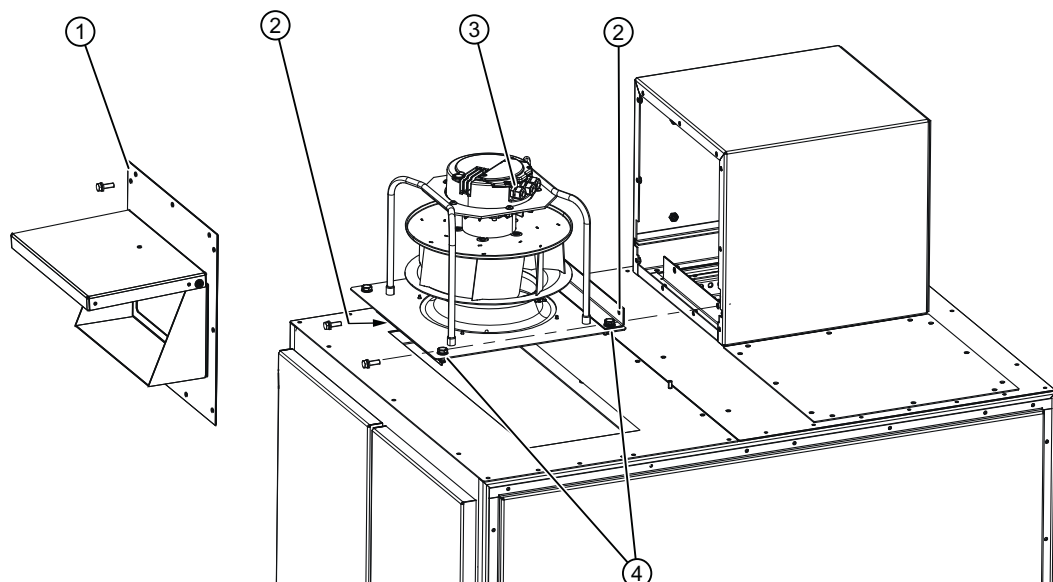


Figure 9-2 Replacing fans from the front

1. Remove the front cover including fan flap from the fan box. To do this, loosen the fastening screws ①.
2. Loosen the connector of the fan connector cable from the terminal in the fan box.
3. Loosen the fastening screws of fan ②.
4. Pull the fan out of the fan box.
5. Disconnect the connecting cable from the terminal box ③ of the fan.
6. Remove the two sheet metal brackets from the fan's base plate. To do this, loosen the screws ④.

CAUTION

The fan can fall

The fans are heavy. They can cause injury or material damage if handled improperly.
Please take special care when removing the fans from the drive.

Installing the fan

Install the fan in reverse order.

9.5.1.2 Replacing fans, from the back

Removing the fan

The five safety rules must be observed.

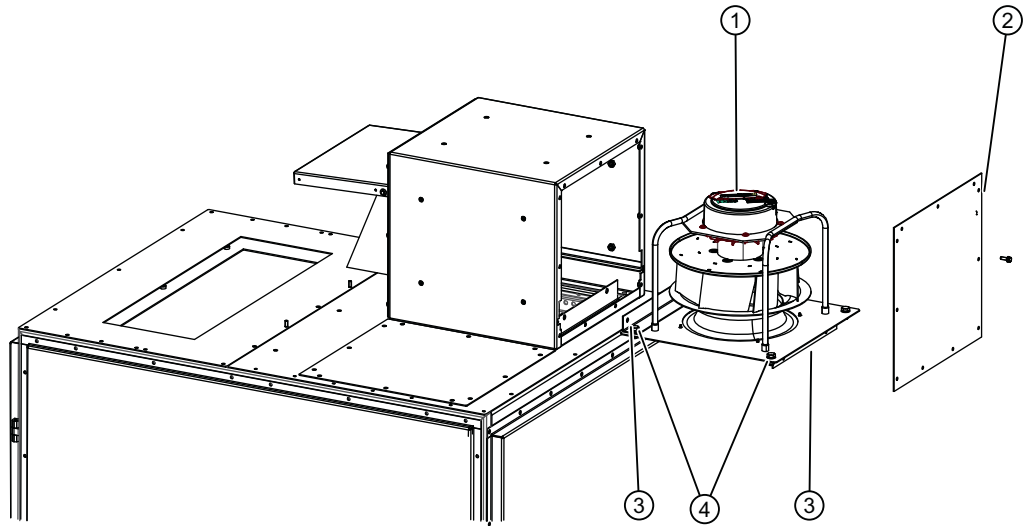


Figure 9-3 Replacing fans from the back

1. Remove the rear cover from the fan box. To do this, loosen the fastening screws ②.
2. Loosen the connector of the fan connector cable from the terminal in the fan box.
3. Loosen the fastening screws of fan ③.
4. Pull the fan out of the fan box.
5. Disconnect the connecting cable from the terminal box ① of the fan.
6. Remove the two sheet metal brackets from the fan's base plate. To do this, loosen the screws ④.



CAUTION

The fan can fall

The fans are very heavy. They can cause injury or material damage if handled improperly. Please take special care when removing the fans from the drive.

Installing the fan

Install the fan in reverse order.

9.5.2 Replacing filter mats

To prevent dangerous dust deposits from accumulating in the power unit components, additional filter mats are attached to the outside of the device.

The device must not be operated when the filter mats are dirty. Dirty filter mats can cause a premature thermal shutdown of the drive.

WARNING

Replacing the filter mats during operation

Replacing the filter mats while the drive is in operation can cause hazards for maintenance personnel due to arcing. This can result in death, serious injuries or material damage.

Do not replace filter mats while the drive is operational.

NOTICE

Suction of the running cabinet fans

Dust can enter the interior of the cabinet during filter mat replacement due to the suction of the running cabinet fans. Dust deposits can damage the device.

Ensure that no dust enters the cabinet when replacing the filter mats.

Procedure

1. Remove the screws for the louvered fan grid in the cabinet door.
2. Remove the filter mat.
3. If there is a slight amount of dirt, clean the filter mat at a suitable location. Otherwise, correctly dispose of the dirty filter mat. Use a new filter mat
4. Insert the filter mat in the frame of the fan opening.
5. Carefully place the louvered cover over the frame.
6. Retighten the cover screws.

9.6 Cleaning

9.6.1 Removing dust deposits

Remove dust deposits at least once per year. You can use an ESD brush or an ESD vacuum cleaner. The ventilation openings in the cabinet must never be obstructed.

NOTICE
Cleaning fiber-optic cables and electronic components with a damp rag
Fiber-optic cables, fiber-optic cable bundles and electronic components can be damaged if cleaned using a damp rag.
If the components are very dusty, remove the dust using a dry, lint-free cloth. In so doing, do not bend the fiber-optic cables.

Use a dry, clean, lint-free ESD cleaning cloth. Wipe all external parts of the rack with it. Make sure that the dirt is not distributed, but actually removed by constant changes of the wiping surface of the cloth. For severe pollution, use a cleaning cloth soaked in ethyl alcohol, but not to the extent that the alcohol drips.

9.6.2 Cleaning aluminum parts

The surface of untreated aluminum is always covered by a thin but dense oxide skin. The affinity of aluminum to oxygen is sufficiently strong that if the oxide skin is scratched, the metal reacts immediately with oxygen in the air. This forms a new oxide skin. This natural oxide layer acts as surface protection and is the reason for the good weathering resistance of aluminum materials. In most cases, this means that additional protective measures are superfluous.

Remove particularly greasy deposits with ethyl alcohol. If there are other heavily polluted areas, use ESD-compliant fiber or plastic brushes to clean them.

NOTICE
Unsuitable cleaning chemicals for aluminum
Any strongly alkaline chemicals such as caustic potash or soda as well as acids corrode the aluminum and roughen the surface. The agents often recommended for cleaning glass also exhibit this effect and must therefore not be used on aluminum.
Only use cleaning agents that are suitable for aluminum.

NOTICE**Unsuitable cleaning utensils for aluminum**

The use of unsuitable cleaning cloths and brushes may transfer metallic, corrosion-inducing impurities onto the aluminum. This can result in corrosion damage.

- Use ESD-compliant brushes and cloths.
- Do not use cleaning cloths and brushes that have been treated with copper, brass, bronze or other heavy metals.
- Use neither brass, bronze, or steel-wire brushes nor cloths or steel wool interwoven with copper wire.

9.7 Repair

9.7.1 Reference to the safety instructions section

Observe Chapter, "Safety instructions" when carrying out any work at the converter.

**WARNING****Insufficient cable insulation**

Improperly laid or damaged cables and incorrectly attached cable shieldings can heat up in places and cause fires or short-circuits wherever they make contact.

- Check whether all the cable shields are intact.
- Insulate damaged cable shields.
- Make sure that a short-circuit cannot occur on the power cables due to failure of the insulation as a result of incorrect cable installation.

NOTICE**Drive failure**

When the auxiliary power supply is switched off, data about error message statuses can be lost. Inadequate diagnostic and error rectification measures can result in damage to the drive.

We recommend using an uninterruptible power supply (UPS). If you are unsure of the measures necessary after the drive fails, or if a fault cannot be rectified, contact the Service Center.

Note**Fastening the cable ducts**

After performing repairs, refasten all cable ducts whose cover faces downward with a cable tie. The cable ties must be located at the same positions as in the delivered state. You will find more information in "Fastening the cable ducts with cable ties (Page 73)".

NOTICE**Re-commissioning a drive that has not been fully repaired**

When re-commissioning a drive that has not been fully repaired, consequential damage can occur.

Check whether secondary faults have occurred on components which have failed.

Measures in the event of an error

Return the faulty modules back to the manufacturing plant for repair, as only limited testing is possible when they are repaired on site.

Note

After replacing a thyristor controller component, return the defective part to the factory. The relevant address is available from your Siemens contact person.

Always enclose the following information:

- MLFB and serial number of the converter
- Time and date of the failure
- Description of the fault profile
Specify what happened when the component failed.
- Operating point, currents and voltages
- Log file with fault messages
- Copy of the CompactFlash card
- If possible, hard copies from the plotter or screenshots
- Mounting location
Specify the equipment identifier. You can find the item code on the component and close to the slot.

9.7.2 Components that can be replaced**WARNING****Components where it is not permissible to replace them**

Incorrect replacement of components can result in death, severe injury and material damage.

Only replace components where replacement is permissible. Contact the Service Center if other components are defective. You can find the relevant contact person under "Service & Support".

The following components may be replaced by qualified maintenance and installation personnel:

- Diode PowerCard
- AVT combination modules
- Precharging transformer
- Precharging rectifier
- Low-voltage components (e.g. anti-condensation heating, fans, contactors)

9.7.3 Torques

The following table contains the default values. If the replacement of a component requires different torques, they are specified in the associated sections.

Table 9-2 Tightening torques in Nm

Screw type	Soft materials S3 ¹	Hard materials S2 ²	Hard materials S1 ³
M3	0,8	1,8	1,3
M4	1,8	3,9	3,0
M5	3,0	7,8	6,0
M6	6,0	13,0	10,0
M8	13,0	32,0	25,0
M10	25,0	65,0	50,0
M12	50,0	115,0	88,0
M16	115,0	270,0	215,0

¹ Examples of soft materials are Cu, Al, CuZn cable entries, laminate materials, plastics, cast resin post insulators, press nuts, welding nuts, blind rivet nuts, and cage nuts.

² Hard materials S2 are materials with friction-enhancing washer components, e.g. a contact washer.

³ Hard S1 materials include steel, for example.

9.7.4 Replacing the AVT combination module

The AVT combination modules are part of the actual value acquisition module. The installation location is described in the layout diagram.



WARNING

High voltages

The AVT combination modules and measuring resistors are at hazardous voltage levels. Touching actual value acquisition components, particularly measuring resistors or LEM current transformers, can result in death, serious injury, or material damage.

- Do not touch AVT combination modules, LEM current transformers, or measuring resistors under any circumstances.
- Do not make any changes to the design of the actual value acquisition.

Removing the AVT combination module

1. Follow "the five safety rules (Page 13)".
2. Detach the cable connections ①.
3. Remove the four fixing screws ② of the AVT combination module.

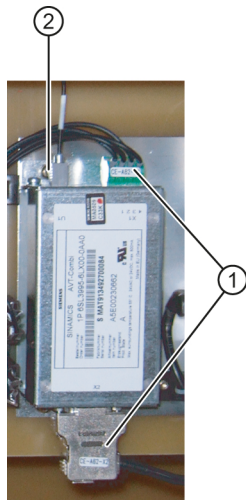


Figure 9-4 Example of an AVT combination module

Installing the AVT combination module

1. Use the screws ② to secure the AVT combination module.
2. Reconnect the control lines ①. Do not bend the fiber-optic conductors.

9.7.5 Replacing the precharging transformer

WARNING

Incorrect replacement of the precharging transformer

Replacing the precharging transformer incorrectly can result in death, serious injury, or material damage.

- Follow "the five safety rules (Page 13)".
- Before replacing the precharging transformer, switch off the safety transformer for the 400 V infeed.
- Lift the transformer carefully because it is heavy (approx. 45 kg).

Removing the precharging transformer

1. Detach the high-voltage cables ①.
2. Detach the 400 V connecting cables ②.
3. Detach the grounding cable ③.
4. Remove the fixing screws ④ at the front and rear on the base brackets.
5. Remove the transformer.

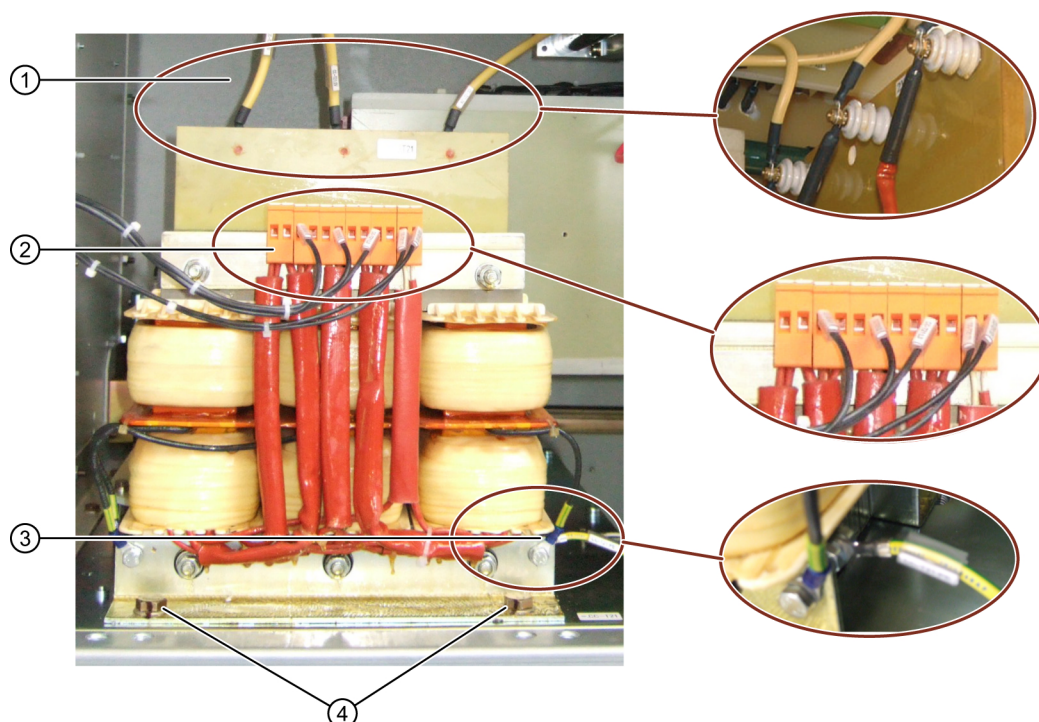


Figure 9-5 Replacing the precharging transformer

Installing the precharging transformer

1. Remove the paint from at least one screw position on the base brackets. This is where the transformer will be grounded.
2. Install the new transformer in the reverse order to when you removed it.
3. Check that the precharger is working correctly.

9.7.6 Replacing the precharging rectifier

Removing modules

To remove a pre-charging rectifier module, proceed as follows:

1. Loosen the five plastic screws ① on the cover.

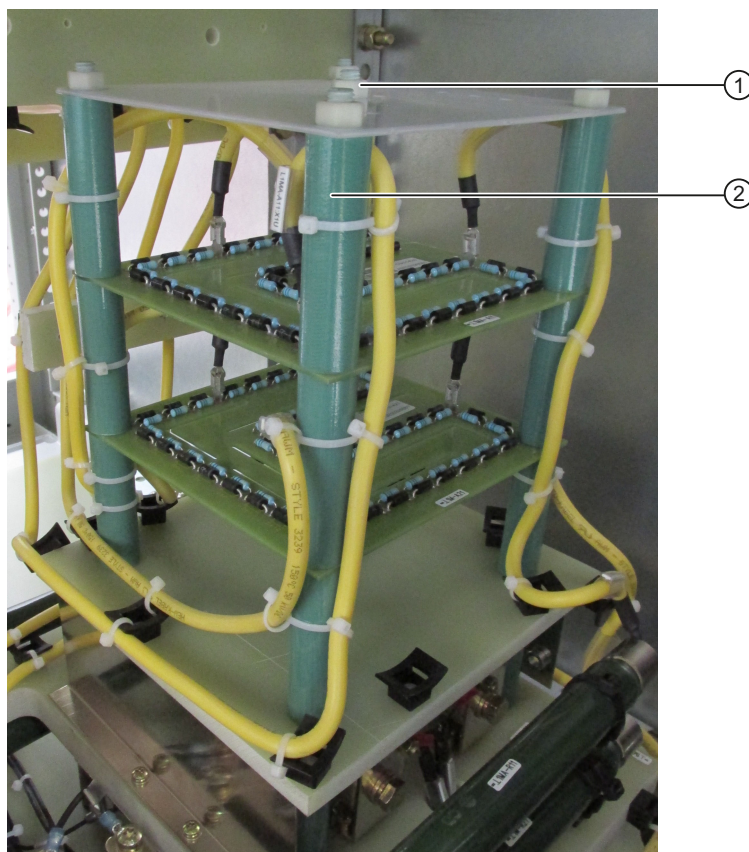


Figure 9-6 Replacing the pre-charging rectifier

2. Remove the five cylindrical spacing bolts ②.

3. Remove all connecting leads. If necessary, remove the cable ties.

Note**Noting the core markings**

The cables are equipped with Faston connectors. Make a note of the core markings. When installing the new module, note the core markings for the cables.

4. Remove the module.

Installing a module

Install the new module in the reverse order to when you removed it.

9.7.7 Replacing the diode PowerCard

The Basic Line Module comprises several diode modules. The diode module is a replaceable unit. A diode module weighs 13 kg. It takes experienced personnel 20 minutes to replace the diode rectifier.

Required tools

- 10 mm open-ended wrench or socket wrench
- 13 mm open-ended wrench or socket wrench
- Torque wrench

Removing a defective diode module

1. Remove the screwed connection ① between the power system connection busbar and the connection strap for the diode.
2. Release the screw connection ① of the PowerCard with the mounting bracket.

Note

The mounting bracket is not part of the diode module and must remain on the device.

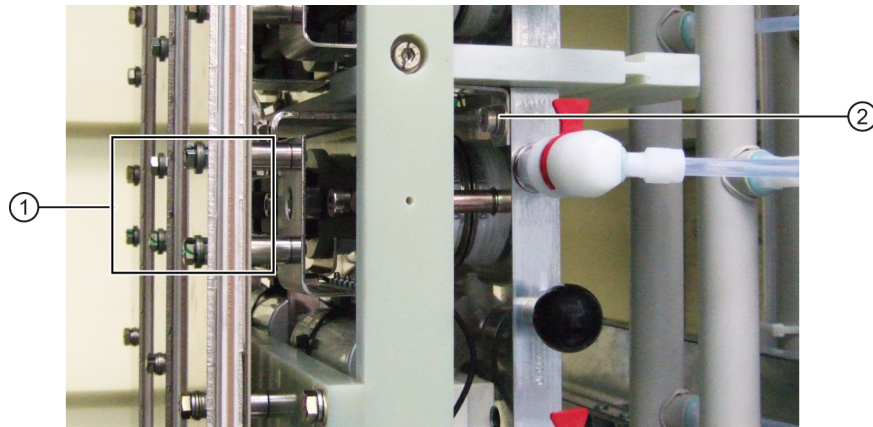


Figure 9-7 Loosening the screwed connection in the power system connection busbar

3. Remove the screwed connection ③ between the DC-link busbars and the heat sinks.

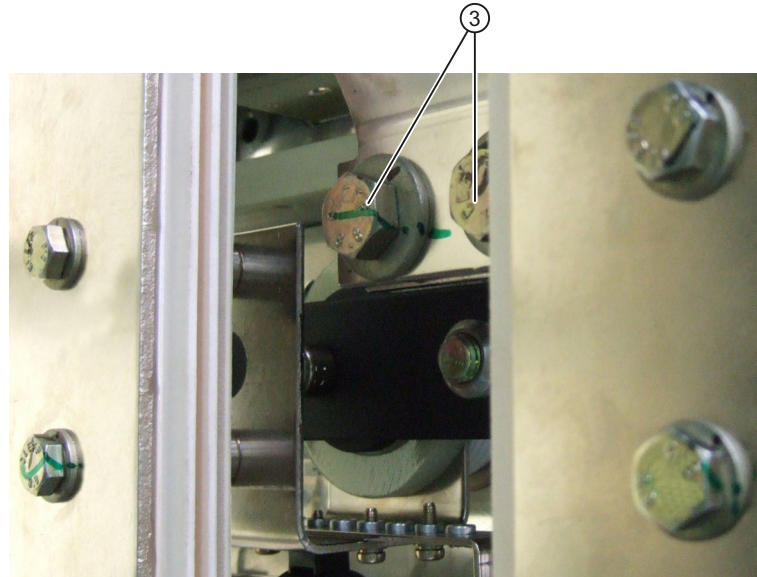


Figure 9-8 Undoing the screwed connection in the DC-link busbar

4. Remove the retainers ④ from the water hoses. Pull out the hoses.

 CAUTION

Deionized water

Deionized water is harmful to eyes and skin and can damage surfaces.

Therefore, use appropriate protective clothing for all work on the drive. However, if your eyes or skin do come into contact with deionized water, rinse the affected area thoroughly with tap water as soon as possible. If deionized water leaks out, eliminate the source of the problem and remove the liquid from the surfaces affected.

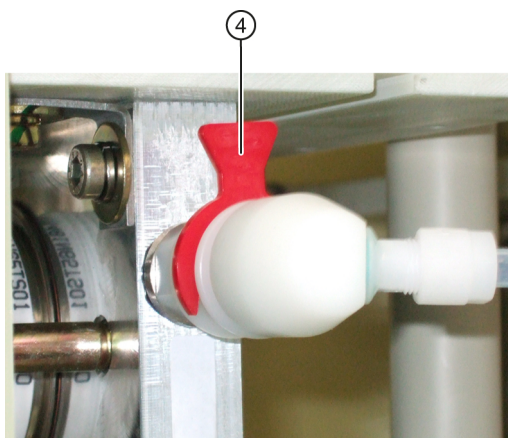


Figure 9-9 Removing the retainers for the water hoses

5. Remove the cable ties ⑤ and loosen the screws ⑥.

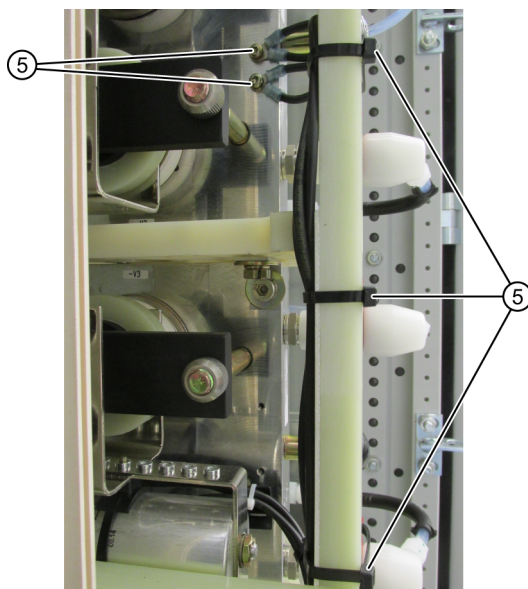


Figure 9-10 Diode power module cable ties

6. Pull the diode module out of the cabinet.

Installing the intact diode module

Install the intact diode module in the reverse order. Observe the circuit diagram when doing so.

Final checks

Make sure that all the screws have been tightened with the correct torques.

Table 9-3 Torques

Screw type	Torque
M8	13 Nm

Make sure that all the connections are secure.

Note

Ventilating the deionized water circuit

After replacing the diode PowerCard, the deionized water circuit must be ventilated.

NOTICE

Non-approved spare parts

Using non-approved spare parts can affect the function of the equipment and damage it. Third-party spare parts and unapproved spare parts may not meet the requirements.

Therefore, only use spare parts that have been approved by the manufacturer.

To request spare parts, please contact the Siemens sales office responsible for your region. You can find an overview of the Siemens contact partners in your region here (www.siemens.com/services/partner).

Note

Always indicate the part number and - if known - the order number (MLFB) of the spare part required. You can find the order number as follows:

The device label is attached to or next to each component. Find out which item code the required spare part has. The parts list supplied with the drive indicates the part number and, where appropriate, the order number corresponding to the item code. For inquiries by e-mail, if possible send a photograph of the product, spare part, rating plate.

Use Spares on Web ([https://b2b-extern.automation.siemens.com/spares_on_web\(bD1kZSZjPTA4MCZkPW1pbG==\)/default.htm](https://b2b-extern.automation.siemens.com/spares_on_web(bD1kZSZjPTA4MCZkPW1pbG==)/default.htm)) to obtain information about spare parts for your drive.

The spare parts list is contained in the separate document "Technical data and drawings".

Disposal

Observe Chapter, "Safety instructions" when carrying out any work at the converter.

11.1 Disposing of packaging material

The packing is designed in such a way as to pose the minimum risk to the environment. Some of the packaging can be recycled.

The disposal of packaging is controlled by country-specific laws. If in doubt, ask your local disposal specialists or contact the local authorities.

The packing material consists of the following components:

- Wooden frames
- Wooden pallets
- Polyethylene foil
- Plywood
- Plastic
- Silica gel

11.2 Removing device components and old devices

If you correctly dispose of the materials, none of the materials pollutes the environment. When disposing or reusing, comply with the local laws and regulations.



WARNING

Improper disassembly

In the event of an improper procedure during disassembly, material can slip, tilt, and fall down. This can result in death, serious injury or material damage.

- Only specialist personnel may disassemble and dispose of device components and old devices using appropriate protective clothing.
- Switch off the drive before you start to dismantle it. Ground the device
- With old devices, also follow the instructions in the section "Transport."

For the following components, pay special attention when disposing or reusing:

- Batteries
- Capacitors

11.2 Removing device components and old devices

- PCBs
- Electronic components

Service & Support

A.1 Siemens Industry Online Support

On-site service and spare parts

If you wish to request on-site service or if you require spare parts, please contact your local sales partner who establishes the contact to the responsible service center.

Technical queries or additional information

If you have any technical queries or you require additional information, please contact the Siemens Service Center.

Please have the following data ready:

- Order number
- Serial number

You can find this data on the rating plate of the device.

Answers to frequently asked questions and the possibility of sending your questions to the service department can be found here (<http://www.siemens.com/automation/support-request>).

You can find your local contact partner here ([Link: http://www.siemens.com/automation/support-request](http://www.siemens.com/automation/support-request)).

You can also call the following numbers directly during local working hours to reach a contact partner who speaks the corresponding national language.

Contact to central technical support

Europe and Africa

 +49 911 895 7222
 +49 911 895 7223
 support.automation@siemens.com

Americas

 +1 423 262 5710
 +1 423 262 2231
 support.america.automation@siemens.com

Asia/Australia/Pacific

 +86 10 6475 7575
 +86 10 6474 7474
 support.asia.automation@siemens.com

Technical data and drawings

B.1 Standards and regulations

Standards and regulations

Table B-1 Standards and regulations

Standards and regulations	
Standards	DIN EN 61800-5-1/VDE 0160 T105 (IEC 61800-5-1) DIN EN 61800-3/VDE 0160 T103 (IEC 61800-3) DIN EN 61800-4/VDE 0160 T104 (IEC 61800-4), however, only when referenced in the standards DIN EN 61800-3 or DIN EN 61800-5-1 DIN EN 60204-11/VDE 0113 T11 (IEC 60204-11)
EU Directives	2006/95/EC + amendments (Low Voltage Directive) 2004/108/EC + amendments (Electromagnetic Compatibility)
Insulation	According to DIN EN 50178/VDE 0160 (IEC 62103), IEC 61800-5-1: Pollution degree 2 (without conductive pollution), non-condensing
Protection class	Class 1 according to DIN EN 61800-5-1/VDE 0160 T105 (IEC 61800-5-1)
Touch protection	DIN EN 50274/VDE 0660 T514 and BGV A3 when used for the intended application
Emitted interference	This drive unit is part of a PDS, Category C4 according to DIN EN 61800-3/VDE 0160 T103 (IEC 61800-3). The drive unit has not been designed to be connected to the public line supply. The equipment can cause electromagnetic interference when it is connected to the public network. The essential requirements placed on EMC protection for the drive system should be secured using an EMC plan at the customer site.

B.2 Environmental conditions

Climatic environmental conditions

Table B-2 Climatic environmental conditions

	Storage with suitable packaging	Transport with suitable packaging	Operation (industrial)
Ambient temperature	-25° C to +70° C	-25° C to +70° C	5° C to +40° C
Relative humidity	5% to 95% (Only low condensation is permitted. The drive must be completely dry before commissioning.)	5% to 75%	5% to 85% (Condensation is not permitted)

	Storage with suitable packaging	Transport with suitable packaging	Operation (industrial)
Other climatic conditions according to class	1K3 according to DIN EN 60721-3-1 (IEC 60721-3-1)	2K2 according to DIN EN 60721-3-2 (IEC 60721-3-2)	3K3 according to DIN EN 60721-3-3 (IEC 60721-3-3)
Pollution degree	2 without conducting contamination according to DIN EN 61800-5-1 / VDE 0160 T105 (IEC 61800-5-1)	2 without conducting contamination according to DIN EN 61800-5-1 / VDE 0160 T105 (IEC 61800-5-1)	2 without conducting contamination according to DIN EN 61800-5-1 / VDE 0160 T105 (IEC 61800-5-1)

Mechanical ambient conditions

Table B-3 Mechanical ambient conditions

	Storage with suitable packaging	Transport with suitable packaging	Operation
Class	1M2 according to DIN EN 60721-3-1 (IEC 60721-3-1)	2M2 according to DIN EN 60721-3-2 (IEC 60721-3-2)	3M1 according to DIN EN 60721-3-3 (IEC 60721-3-3)

Other ambient conditions

Table B-4 Other ambient conditions

	Storage with suitable packaging	Transport with suitable packaging	Operation
Biological ambient conditions according to class	1B1 according to DIN EN 60721-3-1 (IEC 60721-3-1)	2B1 according to DIN EN 60721-3-2 (IEC 60721-3-2)	3B1 according to DIN EN 60721-3-3 (IEC 60721-3-3) (without harmful flora)
Chemically active substances according to class	1C1 according to DIN EN 60721-3-1 (IEC 60721-3-1)	2C1 according to DIN EN 60721-3-2 (IEC 60721-3-2)	3C1 according to DIN EN 60721-3-3 (IEC 60721-3-3)
Mechanically active substances according to class	1S1 according to DIN EN 60721-3-1 (IEC 60721-3-1)	2S1 according to DIN EN 60721-3-2 (IEC 60721-3-2)	3S1 according to DIN EN 60721-3-3 (IEC 60721-3-3)

B.3 Plant-specific information

You will find plant-specific information in the separate document "Technical data and drawings."

Additional documents

In addition to these operating instructions, further documents are provided that contain more information on commissioning and service.

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