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MANUAL

SINAMICS

S120 Combi

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SIEMENS

SINAMICS S120 Combi

Equipment Manual

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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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Trademarks

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Disclaimer of Liability

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

Preface

SINAMICS documentation

The SINAMICS documentation is organized in the following categories:

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

Additional information

You can find information on the following topics at the following address (<https://support.industry.siemens.com/cs/de/en/view/108993276>):

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

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

Siemens MySupport/Documentation

At the following address (<https://support.industry.siemens.com/My/ww/en/documentation>), you can find information on how to create your own individual documentation based on Siemens' content, and adapt it for your own machine documentation.

Training

At the following address (<http://www.siemens.com/sitrain>), you can find information about SITRAIN (Siemens training on products, systems and solutions for automation and drives).

FAQs

You can find Frequently Asked Questions in the Service&Support pages under Product Support (<https://support.industry.siemens.com/cs/de/en/ps/faq>).

SINAMICS

You can find information about SINAMICS at the following address (<http://www.siemens.com/sinamics>).

Target group

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

Benefits

This manual provides all of the information, procedures and operator actions required for the particular usage phase.

Standard scope

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

- Other functions not described in this documentation might be able to be executed in the drive system. However, no claim can be made regarding the availability of these functions when the equipment is first supplied or in the event of service.
- The documentation can also contain descriptions of functions that are not available in a particular product version of the drive system. The functionality of the supplied drive system should only be taken from the ordering documentation.
- Extensions or changes made by the machine manufacturer must be documented by the machine manufacturer.

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

Product-specific information via ID link

The QR code on your product and on the product packaging contains the ID link.

ID link is a globally unique identifier according to IEC 61406-1.

You can use the ID link to access product data, manuals, Declarations of Conformity, certificates and other information about your product.



The ID link is characterized by a frame with a black corner at the bottom right.

Technical Support

Country-specific telephone numbers for technical support are provided in the Internet at the following address (<https://support.industry.siemens.com/sc/ww/en/sc/2090>) in the "Contact" area.

Relevant directives and standards

You can obtain an up-to-date list of currently certified components on request from your local Siemens office. If you have any questions relating to certifications that have not yet been completed, please ask your Siemens contact person.

Certificates for download

The certificates can be downloaded from the Internet:

Certificates (<https://support.industry.siemens.com/cs/ww/en/ps/13206/cert>)



EC Declaration of Conformity

You can find the EC Declaration of Conformity for the relevant directives as well as the relevant certificates, prototype test certificates, manufacturers declarations and test certificates for functions relating to functional safety ("Safety Integrated") on the Internet at the following address (<https://support.industry.siemens.com/cs/ww/en/ps/13231/cert>).

The following directives and standards are relevant for SINAMICS S devices:

- **European Low Voltage Directive**

SINAMICS S devices fulfil the requirements stipulated in the Low-Voltage Directive 2014/35/EU, insofar as they are covered by the application area of this directive.

- **European Machinery Directive**

SINAMICS S devices fulfil the requirements stipulated in the European Machinery Directive 2006/42/EU, insofar as they are covered by the application area of this directive.

However, the use of the SINAMICS S devices in a typical machine application has been fully assessed for compliance with the main regulations in this directive concerning health and safety.

- **Directive 2011/65/EU**

SINAMICS S devices comply with the requirements of Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic devices (RoHS II).

- **European Directive on Waste Electrical and Electronic Equipment (WEEE)**

The SINAMICS converter series complies with the 2012/19/EU directive on taking back and recycling waste electrical and electronic equipment.

- **European EMC Directive**

SINAMICS S devices comply with the EMC Directive 2014/30/EU.

- **EMC requirements for South Korea**

SINAMICS S devices with the KC marking on the type plate satisfy the EMC requirements for South Korea.

- **Eurasian conformity**

SINAMICS S devices comply with the requirements of the Russia/Belarus/Kazakhstan customs union (EAC).





- **North American market**

SINAMICS S devices provided with one of the test symbols displayed fulfill the requirements stipulated for the North American market as a component of drive applications.

You can find the relevant certificates on the Internet pages of the certifier (<http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.html>).

- **Specification for semiconductor process equipment voltage drop immunity**

SINAMICS S devices meet the requirements of standard SEMI F47-0706.

- **Australia and New Zealand (RCM formerly C-Tick)**

SINAMICS S devices showing the test symbols fulfill the EMC requirements for Australia and New Zealand.

- **Quality systems**

Siemens AG employs a quality management system that meets the requirements of ISO 9001 and ISO 14001.

- **UK Declaration of Conformity**

The Power Modules complies with the requirements for the UK market (England, Wales and Scotland).



Not relevant standards



China Compulsory Certification

SINAMICS S devices do not fall in the area of validity of the China Compulsory Certification (CCC).

EMC limit values in South Korea

이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

For sellers or other users, please bear in mind that this device is an A-grade electromagnetic wave device. This device is intended to be used in areas other than at home.

The EMC limit values to be observed for Korea correspond to the limit values of the EMC product standard for variable-speed electric drives EN 61800-3 of category C2 or the limit value class A, Group 1 to KN11. By implementing appropriate additional measures, the limit values according to category C2 or limit value class A, Group 1, are observed. Further, additional measures may be required, such as using an additional radio interference suppression filter (EMC filter).

The measures for EMC-compliant design of the system are described in detail in this manual respectively in the EMC Installation Guideline Configuration Manual.

The final statement regarding compliance with the standard is given by the respective label attached to the individual unit.

Ensuring reliable operation

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

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

Spare parts

Spare parts are available on the Internet at the following address
(<https://www.automation.siemens.com/sow?sap-language=EN>).

Product maintenance

The components are subject to continuous further development within the scope of product maintenance (improvements to robustness, discontinuations of components, etc).

These further developments are "spare parts-compatible" and do not change the article number.

In the scope of such spare parts-compatible further developments, connector/connection positions are sometimes changed slightly. This does not cause any problems with proper use of the components. Please take this fact into consideration in special installation situations (e.g. allow sufficient clearance for the cable length).

Use of third-party products

This document contains recommendations relating to third-party products. Siemens accepts the fundamental suitability of these third-party products.

You can use equivalent products from other manufacturers.

Siemens does not accept any warranty for the properties of third-party products.

Ground symbols

Symbol	Meaning
	Connection for protective conductor
	Ground (e.g. M 24 V)
	Connection for function potential bonding

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Fundamental safety instructions

1.1 General safety instructions



WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

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

Generally, the following steps apply when establishing safety:

1. Prepare for disconnection. Notify all those who will be affected by the procedure.
2. Isolate the drive system from the power supply and take measures to prevent it being switched back on again.
3. Wait until the discharge time specified on the warning labels has elapsed.
4. Check that there is no voltage between any of the power connections, and between any of the power connections and the protective conductor connection.
5. Check whether the existing auxiliary supply circuits are de-energized.
6. Ensure that the motors cannot move.
7. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water. Switch the energy sources to a safe state.
8. Check that the correct drive system is completely locked.

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



WARNING

Risk of electric shock and fire from supply networks with an excessively high impedance

Excessively low short-circuit currents can lead to the protective devices not tripping or tripping too late, and thus causing electric shock or a fire.

- In the case of a conductor-conductor or conductor-ground short-circuit, ensure that the short-circuit current at the point where the converter is connected to the line supply at least meets the minimum requirements for the response of the protective device used.
- You must use an additional residual-current device (RCD) if a conductor-ground short circuit does not reach the short-circuit current required for the protective device to respond. The required short-circuit current can be too low, especially for TT supply systems.



! WARNING

Risk of electric shock and fire from supply networks with an excessively low impedance

Excessively high short-circuit currents can lead to the protective devices not being able to interrupt these short-circuit currents and being destroyed, and thus causing electric shock or a fire.

- Ensure that the prospective short-circuit current at the line terminal of the converter does not exceed the breaking capacity (SCCR or Icc) of the protective device used.



! WARNING

Electric shock if there is no ground connection

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

- Ground the device in compliance with the applicable regulations.



! WARNING

Electric shock due to connection to an unsuitable power supply

When equipment is connected to an unsuitable power supply, exposed components may carry a hazardous voltage. Contact with hazardous voltage can result in severe injury or death.

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



! WARNING

Electric shock due to equipment damage

Improper handling may cause damage to equipment. For damaged devices, hazardous voltages can be present at the enclosure or at exposed components; if touched, this can result in death or severe injury.

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

**! WARNING****Electric shock due to unconnected cable shield**

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

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

**! WARNING****Arcing when a plug connection is opened during operation**

Opening a plug connection when a system is in operation can result in arcing that may cause serious injury or death.

- Only open plug connections when the equipment is in a voltage-free state, unless it has been explicitly stated that they can be opened in operation.

**! WARNING****Electric shock due to residual charges in power components**

Because of the capacitors, a hazardous voltage is present for up to 5 minutes after the power supply has been switched off. Contact with live parts can result in death or serious injury.

- Wait for 5 minutes before you check that the unit really is in a no-voltage condition and start work.

NOTICE**Damage to equipment due to unsuitable tightening tools.**

Unsuitable tightening tools or fastening methods can damage the screws of the equipment.

- Only use screw inserts that exactly match the screw head.
- Tighten the screws with the torque specified in the technical documentation.
- Use a torque wrench or a mechanical precision nut runner with a dynamic torque sensor and speed limitation system.
- Adjust the tools used regularly.

NOTICE

Property damage due to loose power connections

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

- Tighten all power connections to the prescribed torque.
- Check all power connections at regular intervals, particularly after equipment has been transported.



WARNING

Electromagnetic interference due to inadequate shield support

A lack of adequate shield support for the power cables can cause malfunctions and impermissibly high levels of interference.

- Use the shield connection plates supplied or recommended.
- Use the shield connection clips recommended.



WARNING

Active implant malfunctions due to electromagnetic fields

Converters generate electromagnetic fields (EMF) in operation. Electromagnetic fields may interfere with active implants, e.g. pacemakers. People with active implants in the immediate vicinity of a converter are at risk.

- As the operator of an EMF-emitting installation, assess the individual risks of persons with active implants.
- Observe the data on EMF emission provided in the product documentation.



CAUTION

Symptomatic respiratory and skin reaction to chemicals

A newly purchased product might contain traces of substances that are identified as sensitizers.

Sensitizers are substances which can cause sensitization in the lungs and skin after exposure to them.

Once sensitized, individuals can have severe reactions to further exposure, even in small amounts. In the most extreme cases, individuals might develop asthma or dermatitis respectively.

- If the product has a strong smell, keep it in a well-ventilated area for 14 days.

 WARNING**Unexpected machine movement caused by radio devices or cellphones**

Using radio devices, cellphones, or mobile WLAN devices in the immediate vicinity of the components can result in equipment malfunction or faults and damage to the devices. Malfunctions may impair the functional safety of machines and can therefore put people in danger or lead to property damage.

- Avoid operating radio devices, cellphones and mobile WLAN devices in the direct vicinity of converters and operating units.
- Scan the machine readable code, e.g. a QR code, from a greater distance or switch off the converter power supply before scanning.
- Only operate built-in devices with the control cabinet doors closed.
- When control cabinet doors are open, only qualified electrical personnel are allowed to carry out service and maintenance work.

 CAUTION**Radio frequency interference in residential areas**

When you operate EMC category C2 devices in residential areas, the devices can cause radio frequency interference.

When you operate EMC category C3 or C4 devices in residential areas, it is to be expected that the devices will cause radio frequency interference.

- Do not operate EMC category C2 devices in residential areas.
- Do not operate EMC category C3 or C4 devices in public low-voltage networks supplying residential buildings.

NOTICE**Damage to motor insulation due to excessive voltages**

When operated on systems with grounded line conductors or in the event of a ground fault in the IT system, the motor insulation can be damaged by the higher voltage against ground. If you use motors that have insulation that is not designed for operation with grounded line conductors, you must perform the following measures:

- IT system: Use a ground fault monitor and eliminate the fault as quickly as possible.
- TN or TT systems with grounded line conductor: Use an isolating transformer on the line side.



! WARNING

Electric shock due to unsuitable motor temperature evaluation system

Voltage flashovers to the electronics of the converter can occur in motors without safe electrical separation of the temperature sensors in accordance with IEC 61800-5-1 when the motor develops a fault.

- Install a temperature monitoring relay 3RS1... or 3RS2...
- Evaluate the temperature monitoring relay output using a digital input of the converter, e.g. using the "External fault" function.

! WARNING

Fire due to inadequate ventilation clearances

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

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

NOTICE

Overheating due to inadmissible mounting position

The device may overheat and therefore be damaged if mounted in an inadmissible position.

- Only operate the device in admissible mounting positions.

! WARNING

Unrecognized dangers due to missing or illegible warning labels

Dangers might not be recognized if warning labels are missing or illegible. Unrecognized dangers may cause accidents resulting in serious injury or death.

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

NOTICE**Device damage caused by incorrect insulation resistance tests**

High test voltages can damage the device.

- Measure the insulation resistance of low voltage circuits of machines or systems only with ≤ 500 V DC.
- Measure the insulation resistance of SELV circuits of machines or systems only with ≤ 250 V DC.

NOTICE**Device damage caused by incorrect voltage tests**

High test voltages can damage the device. Capacitive leakage currents can distort the test results.

- Disconnect the components before carrying out a voltage test on the machine. ¹⁾

¹⁾ The components are voltage tested in accordance with the IEC 61800-5-1 product standard and must be disconnected during testing in accordance with IEC 60204-1:2021 Section 18.4.

**WARNING****Unexpected movement of machines caused by inactive safety functions**

Inactive or non-adapted safety functions can trigger unexpected machine movements that may result in serious injury or death.

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

Note**Important Safety instructions for Safety Integrated**

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

1.2 Equipment damage due to electric fields or electrostatic discharge

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



NOTICE

Equipment damage due to electric fields or electrostatic discharge

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

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

1.3 Warranty and liability for application examples

Application examples are not binding and do not claim to be complete regarding configuration, equipment, or any eventuality which may arise. Application examples do not represent customer-specific solutions, but merely serve to provide assistance with typical tasks.

As the user you yourself are responsible for ensuring that the products described are operated correctly. Application examples do not relieve you of your responsibility for safe handling when using, installing, operating and maintaining the equipment.

1.4 Cybersecurity information

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

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

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial cybersecurity measures that may be implemented, please visit
<https://www.siemens.com/cybersecurity-industry>.

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

To stay informed about product updates, subscribe to the Siemens Industrial Cybersecurity RSS Feed under
<https://new.siemens.com/cert>.

Further information is provided on the Internet:

Industrial Security Configuration Manual
(<https://support.industry.siemens.com/cs/ww/en/view/108862708>)

WARNING

Unsafe operating states resulting from software manipulation

Software manipulations, e.g. viruses, Trojans, or worms, can cause unsafe operating states in your system that may lead to death, serious injury, and property damage.

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

1.5 Residual risks of power drive systems

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

1. Unintentional movements of driven machine or system components during commissioning, operation, maintenance, and repairs caused by, for example,
 - Hardware faults and/or software errors in the sensors, control system, actuators, and connections
 - Response times of the control system and of the drive
 - Operation and/or environmental conditions outside the specification
 - Condensation/conductive contamination
 - Parameterization, programming, cabling, and installation errors
 - Use of wireless devices/mobile phones in the immediate vicinity of electronic components
 - External influences/damage
 - X-ray, ionizing radiation and cosmic radiation
2. Unusually high temperatures inside and outside the components, including open flames, as well as emissions of light, noise, particles, gases, etc. due to fault conditions, e.g.:
 - Component failure
 - Software errors
 - Operation and/or environmental conditions outside the specification
 - External influences/damage
 - Short circuits or ground faults in the intermediate DC circuit of the converter
3. Hazardous shock voltages caused by, for example:
 - Component failure
 - Influence during electrostatic charging
 - Induction of voltages in moving motors
 - Operation and/or environmental conditions outside the specification
 - Condensation/conductive contamination
 - External influences/damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc., if they are too close
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly
6. Influence of network-connected and wireless communications systems, e.g. ripple-control transmitters or data communication via the network or mobile radio, WLAN or Bluetooth.
7. Motors for use in potentially explosive areas:

When moving components such as bearings become worn, this can cause enclosure components to exhibit unexpectedly high temperatures during operation, creating a hazard in areas with a potentially explosive atmosphere.

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

System overview

2.1 SINAMICS S120 Combi drive system

System components

- Line-side power components such as fuses and contactors to switch the energy supply
- Reactors and filters to maintain EMC regulations
- S120 Combi Power Module
- Motor Modules for 1 - 2 expansion axes which function as inverters and provide the energy to the connected motors
- DC link components (Braking Module, Control Supply Module) used optionally for stabilizing the DC link voltage
- Additional system components and sensor modules to expand the functionality and to handle various interfaces for encoders and process signals.
 - Supported additional system components: Terminal Module TM54F, DRIVE-CLiQ Hub Module DMC20, DRIVE-CLiQ Hub Module External DME20
 - Supported sensor modules: Sensor Module Cabinet-Mounted SMC20, Sensor Module Cabinet-Mounted SMC30, Sensor Module Cabinet-Mounted SMC40, Sensor Module External SME20, Sensor Module External SME25, Sensor Module External SME125

Advantages

The SINAMICS S120 Combi is intended for installation in a control cabinet.

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

Application

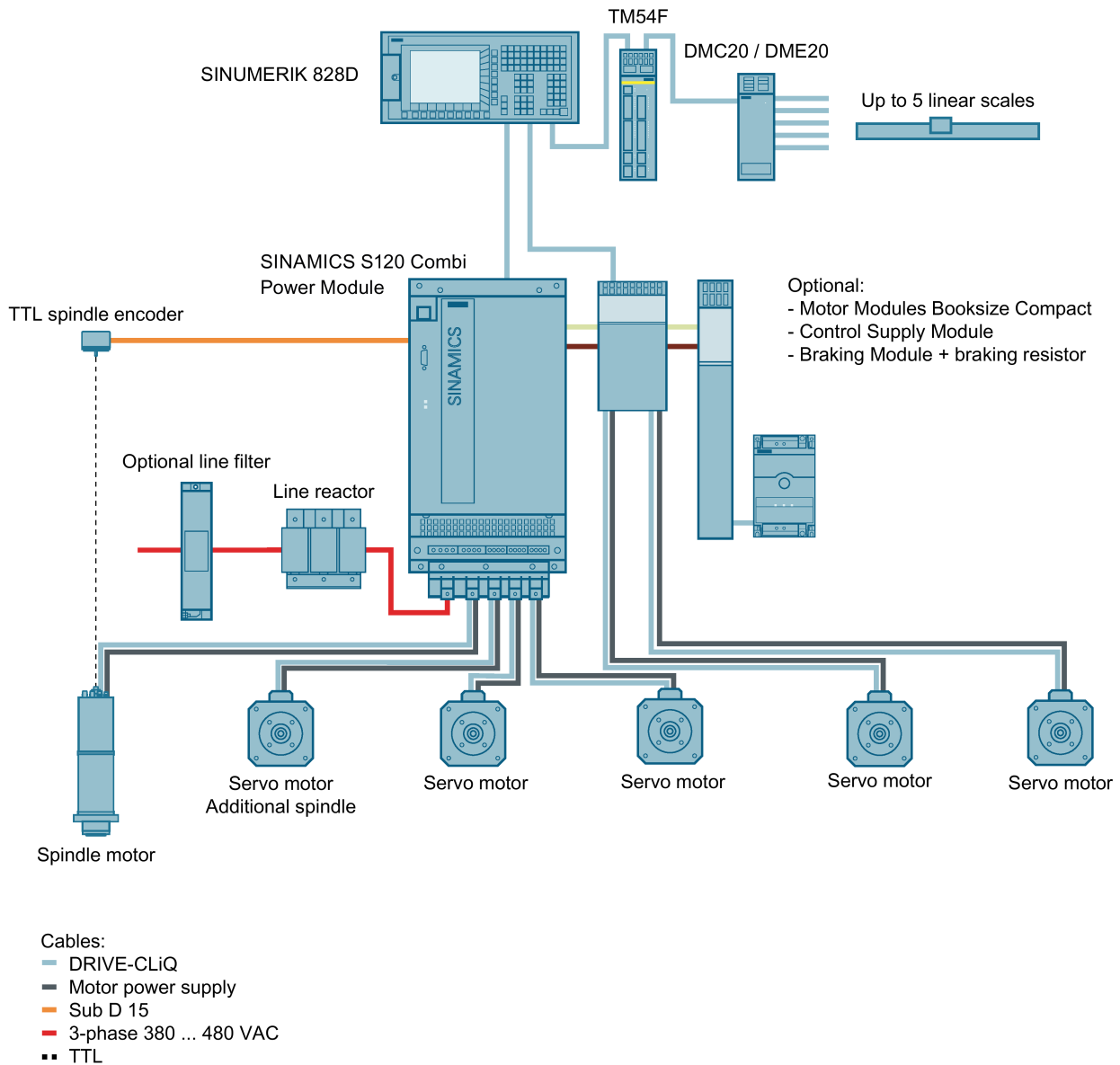
The S120 Combi Power Modules are optimized as a drive for processing machines with 3 to 6 axes. Motor Modules in booksize and booksize compact formats are used as expansion axes.

Note

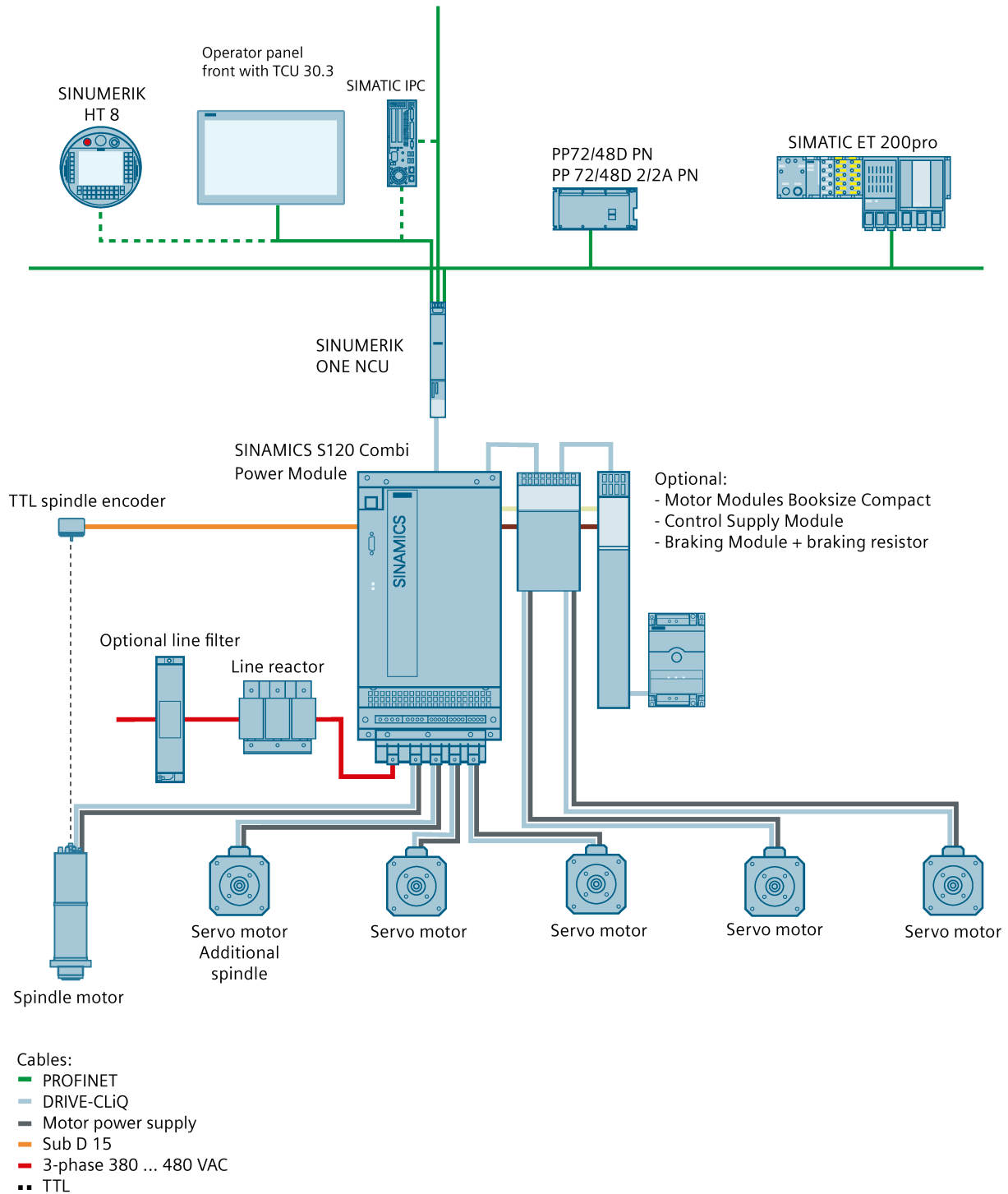
Motor Modules Booksize are for frame type B only. See Chapter "Expansion axes that can be connected (Page 31)" for more information on the software/firmware versions of the controller and the Control Unit that support Motor Modules Booksize.

2.2 System configuration examples

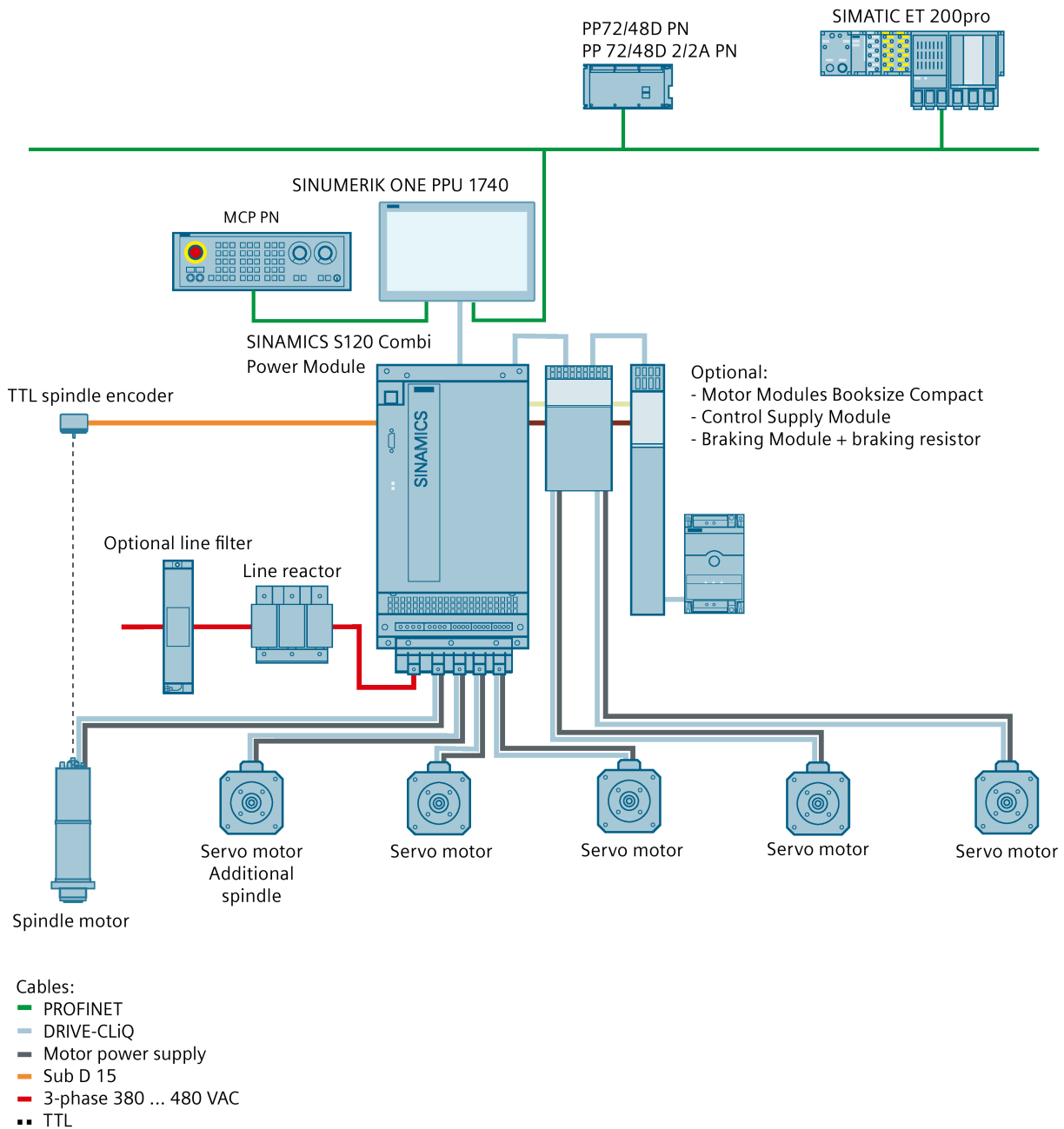
S120 Combi 4 axes Power Module with 2 expansion axes connected to SINUMERIK 828D



S120 Combi 4 axes Power Module with 2 expansion axes connected to SINUMERIK ONE NCU



S120 Combi 4 axes Power Module with 2 expansion axes connected to SINUMERIK ONE PPU



S120 Combi Power Modules

3.1 Introduction

3.1.1 Description

The SINAMICS S120 Combi

The S120 Combi is a Power Module with integrated infeed, Motor Modules (inverter) for 3 or 4 axes and a TTL encoder evaluation for the spindle, and is suitable for direct operation on TN, IT and TT line supplies.

The S120 Combi is capable of infeed/energy recovery. The infeed provides the integrated Motor Modules with an uncontrolled DC voltage.

In the infeed mode regarding the current and voltage waveforms, the infeed has a typical characteristic of a 6-pulse diode rectifier bridge. In the energy recovery mode, the current waveform is a square wave. The energy recovery is switched in depending on the power that is fed back. Energy recovery is deactivated when the infeed is operating under no-load conditions.

The S120 Combi is available in the following versions for various current ratings:

- 3 axes Power Module with infeed, spindle and 2 feed axes
- 4 axes Power Module with infeed, spindle and 3 feed axes

The S120 Combi is available in the following frame types for various mechanical properties:

- Frame type A: S120 Combi Axx, having a separated external fan and connecting DC link components via the DC link busbars
- Frame type B: S120 Combi Bxx, having an integrated external fan inside the heat sink and connecting DC link components via an optional DC link cable

Fault protection for the motor circuit

The electronic overcurrent trip complies with the requirements laid down in IEC 60364-3-2:2005/AMD1:- Section 411 for protection against electric shock.

- Observe the installation specifications provided in this manual.
- Observe the applicable installation standards.
- Ensure the continuity of the protective conductor.

The inverter provides short-circuit protection at the motor output terminals.

The manufacturer's declaration describes the conditions regarding protection against electric shock in the event of an insulation failure in the motor circuit.

You can find more information on the Internet: Manufacturer's declaration (<https://support.industry.siemens.com/cs/ww/en/view/109476638>)

Controlling the motor holding brake

The S120 Combi has an integrated brake control function for a motor holding brake. The motor holding brake is connected at terminal X11. Motor holding brakes up to 1 A are controlled.

The assignment of the motor holding brake to the feed axes of the S120 Combi can be freely parameterized using the software. The assignment of the motor holding brake to the spindle axis of the S120 Combi can also be parameterized if the software version of the SINUMERIK 828D is V4.7 or higher.

Temperature sensor connection

A temperature sensor can either be connected using terminal X22 or using the sub-D connector of the TTL encoder (X220). The interface used is selected using the software.

Encoder connection

The S120 Combi supports sin/cos encoders, TTL encoders and encoders with integrated DRIVE-CLiQ with a 5 V supply for motors. The TTL encoder is connected via the integrated X220 encoder interface and is permanently assigned to spindle output X2. The sin/cos encoder for spindle output X2 is connected to interface X205 via an SMxxx Sensor Module. In this particular case, encoder interface X220 is automatically inactive.

Fixed topology rules apply when connecting DRIVE-CLiQ encoders. Each feed axis is assigned exactly to one DRIVE-CLiQ interface (see Section Topology rules for DRIVE-CLiQ (Page 143)).

HTL encoders, SSI encoders and a 24 V encoder power supply are not supported by the integrated encoder interface on the S120 Combi.

Interface assignment

The assignment of the DRIVE-CLiQ interfaces on the S120 Combi is permanently defined and must not be changed.

The DRIVE-CLiQ connection of the expansion axes is always implemented via DRIVE-CLiQ interface X101 at the SINUMERIK control. You can find a detailed description in Sections Interface description (Page 36) of the S120 Combi and Topology rules for DRIVE-CLiQ (Page 143).

Measuring systems and additional encoders should always be connected via the DMC20 Hub Module.

Internal temperature sensing

The internal temperature of the S120 Combi is sensed. If the internal temperature becomes too high, the S120 Combi Power Module outputs an alarm. Customers need to take appropriate measures to cool down the module.

Cooling method

The S120 Combi Power Modules are available with the "external air cooling" cooling method.

For the following Power Modules, the fan is a separated part from the module.

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1
- 6SL3111-4VE21-0EA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1

For the following Power Modules, the fan is integrated to the heat sink of the module.

- 6SL3111-3VE21-6FC1
- 6SL3111-3VE21-6EC1
- 6SL3111-3VE22-0HC1
- 6SL3111-4VE21-6FC1
- 6SL3111-4VE22-0HC1
- 6SL3111-4VE21-6ED2
- 6SL3111-4VE21-6ED1
- 6SL3111-4VE21-6EC1

3.1.2 Module versions

Infeed Rated power S1/Max power P_{max} [kW]	Spindle Rated current I_n /Max current I_{max} [A _{rms}]	Feed 1 Rated current I_n /Max current I_{max} [A _{rms}]	Feed 2 Rated current I_n /Max current I_{max} [A _{rms}]	Feed 3 Rated current I_n /Max current I_{max} [A _{rms}]	Article number	Frame type
3 axes						
16/35	18/36	9/18	9/18	-	6SL3111-3VE21-6FA2	A01
16/35	24/48	9/18	9/18	-	6SL3111-3VE21-6EA1	A02
20/40	30/56	9/18	9/18	-	6SL3111-3VE22-0HA1	A03
16/35	18/36	9/18	9/18	-	6SL3111-3VE21-6FC1	B11
16/35	24/48	9/18	9/18	-	6SL3111-3VE21-6EC1	B12
20/40	30/56	9/18	9/18	-	6SL3111-3VE22-0HC1	B13

3.1 Introduction

Infeed Rated power S1/Max power P_{max} [kW]	Spindle Rated current I_n /Max current I_{max} [A _{rms}]	Feed 1 Rated current I_n /Max current I_{max} [A _{rms}]	Feed 2 Rated current I_n /Max current I_{max} [A _{rms}]	Feed 3 Rated current I_n /Max current I_{max} [A _{rms}]	Article number	Frame type
4 axes						
16/35	18/36	9/18	9/18	9/18	6SL3111-4VE21-6FA2	A04
16/35	24/48	9/18	9/18	9/18	6SL3111-4VE21-6EA1	A05
20/40	30/56	12/24	9/18	9/18	6SL3111-4VE22-0HA1	A06
10/35	24/60 ¹⁾	12/36	12/36	12/36	6SL3111-4VE21-0EA1	A07
16/35	18/36	9/18	9/18	9/18	6SL3111-4VE21-6FC1	B14
20/40	30/56	12/24	9/18	9/18	6SL3111-4VE22-0HC1	B16
16/35	24/72 ¹⁾	12/36	9/27	9/27	6SL3111-4VE21-6ED2	B17
16/35	24/48	12/24	9/18	9/18	6SL3111-4VE21-6EC1	B01
16/35	24/48	12/36	9/27	9/27	6SL3111-4VE21-6ED1	B02

¹⁾ Pulse frequency, 4 kHz/8 kHz

3.1.3 Supported controls

The S120 Combi is approved for operation with the following controls:

SINUMERIK 828D with PPU versions

PPU version	Keyboard	Article number (without CNC software)	Supported software version	Configurable S120 Combi Power Modules
271.4	Horizontal	6FC5370-5AA40-0AA0	V4.94 or later	6SL3111-xVE21-6FA2 6SL3111-xVE21-6EA1 6SL3111-xVE22-0HA1 6SL3111-4VE21-0EA1 6SL3111-4VE21-6Ex1
270.4	Vertical	6FC5370-6AA40-0AA0		
290.4	Vertical	6FC5370-8AA40-0BA0		
270.5	Horizontal	6FC5370-5AA50-0AA0	V5.24 SP1 or later	All frame types
271.5	Vertical	6FC5370-6AA50-0AA0		
290.5	Multi-touch, vertical	6FC5370-8AA50-0BA0		

Note

The SINUMERIK 828D (software version V4.94 or later) can control up to two S120 Combi modules. The Numerical Control Extension NX15.3 (article number: 6SL3040-1NB00-0AA0) is required to connect the second Combi module to the SINUMERIK 828D.

SINUMERIK ONE

NCU/PPU version	Article number (without CNC software)
PPU 1740 - 1500	6FC5317-4AA00-1CA0
PPU 1740 - 1900	6FC5317-4AA00-1DA0
NCU 1750	6FC5317-5AA00-0AA0
NCU 1760	6FC5317-6AA00-0AA0

Supported software version	Configurable S120 Combi Power Modules
V6.14 or later	6SL3111-xVE21-6FA2 6SL3111-xVE21-6EA1 6SL3111-xVE22-0HA1 6SL3111-4VE21-0EA1 6SL3111-4VE21-6Ex1
V6.24 SP1 or later	All frame types

3.1.4 Expansion axes that can be connected

The S120 Combi can be expanded with SINAMICS S120 Motor Modules Booksize (for frame type B only) and Booksize Compact (for frame types A and B) by 1 or 2 axes. The recommended modules list as follows:

Expansion axes	Width	Article number
Motor Module Booksize Compact (for frame types A and B)		
Single Motor Module 3 A	50 mm	6SL3420-1TE13-0AAx
Single Motor Module 5 A	50 mm	6SL3420-1TE15-0AAx
Single Motor Module 9 A	50 mm	6SL3420-1TE21-0AAx
Single Motor Module 18 A	75 mm	6SL3420-1TE21-8AAx
Double Motor Module 2 x 1.7 A	75 mm	6SL3420-2TE11-7AAx
Double Motor Module 2 x 3 A	75 mm	6SL3420-2TE13-0AAx
Double Motor Module 2 x 5 A	75 mm	6SL3420-2TE15-0AAx
Motor Module Booksize (for frame type B only)		
Single Motor Module 3 A (D type)	50 mm	6SL3120-1TE13-0ADx
Single Motor Module 5 A (D type)	50 mm	6SL3120-1TE15-0ADx
Single Motor Module 9 A (D type)	50 mm	6SL3120-1TE21-0ADx
Single Motor Module 18 A (D type)	50 mm	6SL3120-1TE21-8ADx
Single Motor Module 18 A (C type)	50 mm	6SL3120-1TE21-8ACx
Single Motor Module 24 A (D type)	50 mm	6SL3120-1TE22-4ADx
Single Motor Module 24 A (C type)	50 mm	6SL3120-1TE22-4ACx
Single Motor Module 30 A (D type)	100 mm	6SL3120-1TE23-0ADx
Single Motor Module 30 A (C type)	100 mm	6SL3120-1TE23-0ACx
Double Motor Module 2 x 3 A (D type)	50 mm	6SL3120-2TE13-0ADx
Double Motor Module 2 x 5 A (D type)	50 mm	6SL3120-2TE15-0ADx
Double Motor Module 2 x 9 A (D type)	50 mm	6SL3120-2TE21-0ADx
Double Motor Module 2 x 18 A (D type)	100 mm	6SL3120-2TE21-8ADx
Double Motor Module 2 x 18 A (C type)	100 mm	6SL3120-2TE21-8ACx

Note**Number of expansion axes**

A maximum of 2 expansion axes can be connected to an S120 Combi Power Module, i.e. two Single Motor Modules or one Double Motor Module.

The S120 Combi Power Module can be used with Motor Modules Booksize if the controller/Control Unit meets the following requirements:

Controller/Control Unit	Software/firmware version
SINUMERIK 828D	≥ V4.94
SINUMERIK ONE	≥ V6.14
CU320-2	≥ V5.2 SP3

You can visit the SIOS website

(<https://support.industry.siemens.com/cs/ww/en/ps/13231/man>) to find more information about these Motor Modules in the following user documentation:

- SINAMICS S120 Booksize Power Units Equipment Manual

3.2 Safety instructions for Combi Power Modules


! WARNING
Electric shock due to connection to the line supply

If the S120 Combi is not disconnected from the line supply system (e.g. via the line contactor or main switch), the DC link remains charged. Contact with live parts can result in death or serious injury.

- Before starting any maintenance work, disconnect the S120 Combi from the line supply using the line contactor or main switch.


! WARNING
Electric shock due to residual charge

A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off. Contact with live parts can result in death or serious injury.

- Remove the front plate only after 5 minutes have passed.
- When using expansion axes, check that the DC link connection is in a no-voltage condition (de-energized).
- Only operate the S120 Combi when the front plate is mounted.
- When operating without expansion axes, do not remove the factory-mounted DC link cover.
- Do not continue to operate damaged components.


! WARNING
Electric shock due to contact with unused terminals X1 and X2

If cables are not connected to the terminals X1 (line connection) and X2 (motor connection - spindle), contact can result in death or serious injury.

- Before starting any work on the connections, check for zero voltage.


! WARNING
Electric shock or fire due to overcurrent protective equipment that trips too late

Overcurrent protective devices that do not trip or trip too late can cause an electric shock or fire.

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


! WARNING
Electric shock due to high leakage currents caused by an interrupted external protective conductor

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

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

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


! WARNING
Electric shock due to incorrectly laid brake cables

If brake cables are laid without safe electrical separation, the insulation can fail with an electric shock.

- Close the holding brake with the specified MOTION-CONNECT cable.
- Only use third-party cables with safe electrically separated brake cores or lay the brake cores with safe electrical separation.



! WARNING

Electric shock in the event of voltage flashovers at the temperature sensor

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

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

! WARNING

Fire through overheating due to insufficient ventilation clearances

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

- It is absolutely essential that you maintain ventilation clearances according to the table Ventilation clearances above and below the component (Page 187).

! WARNING

Fire due to overheating when permissible cable lengths are exceeded

Excessively long cable lengths can cause components to overheat with the associated risk of fire and development of smoke.

- The total length of the power cables (motor feeder cables etc.) must not exceed 175 m.

! WARNING

Fire and damage to devices during operation without a line reactor

Operating a system without a line reactor can trigger a fire with smoke development.

- Do not operate the system without a line reactor.

! WARNING

Spread of fire

Devices with an open construction (built-in devices) can cause a fire or a pressure wave in the event of a fault, which can result in severe personal injury and damage to property. The higher the power rating of a converter, the more dangerous the effects of an arc or pressure wave.

- Install the devices in a robust metal control cabinet that is designed to prevent fire from escaping.
- Only operate the devices with the control cabinet doors closed.
- When control cabinet doors are open, only qualified electrical personnel are allowed to carry out service and maintenance work.
- Comply with the minimum control cabinet volume (Page 110).

NOTICE**Material damage due to loose power connections**

Insufficient tightening torques or vibrations can result in faulty electrical connections. This can cause fire damage or malfunctions.

- Tighten all the DC link busbar screws with the specified tightening torques (1.8 Nm, tolerance +30%).
- Check the tightening torques of all power connections at regular intervals and tighten them when required. This applies in particular after transport.

NOTICE**Damage through use of incorrect DRIVE-CLiQ cables**

Damage or malfunctions can occur on the devices or the system when incorrect or unreleased DRIVE-CLiQ cables are used.

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

Note**Operation on line supplies where energy recovery is not possible**

In line supply systems without energy recovery capability (e.g. a diesel generator), device faults can occur due to a lack of dissipation of braking energy.

- Deactivate the energy recovery capability of the Smart Line Modules using the corresponding parameter (see the SINAMICS S120/S150 List Manual).
- The braking energy must then be dissipated via an additional Braking Module with braking resistor in the drive line-up.

Note**Shutting down the device in the event of contaminated external heat sinks**

For components with external air cooling, the fan and the heat sinks can accumulate a lot of pollution. If the cooling air requirement is not provided by the filter fan, the components cannot output their specified power. This can cause the temperature monitoring function in the components to respond.

- Check the fans and heat sinks for pollution at regular intervals and clean them when necessary.

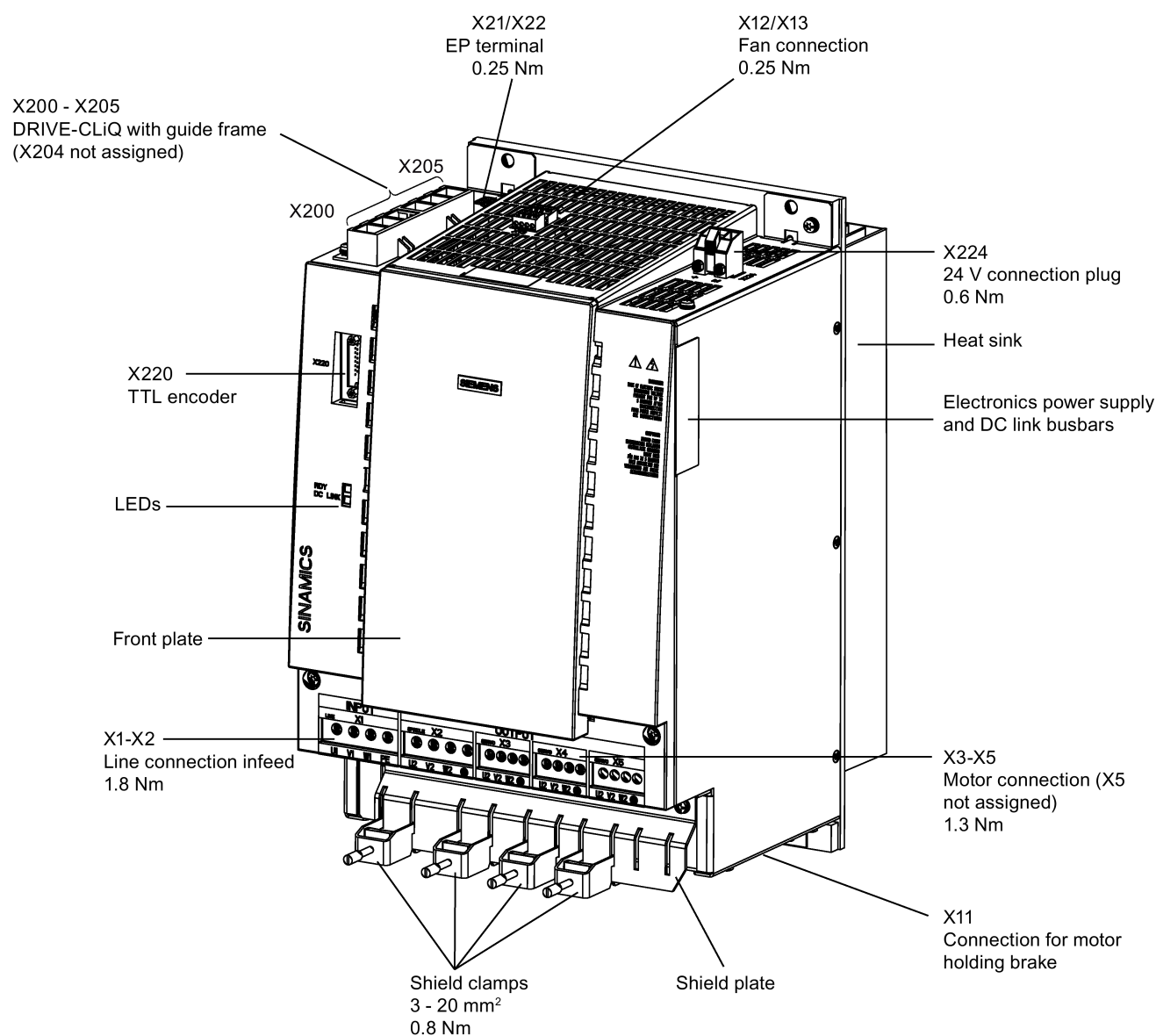
3.3 Interface description

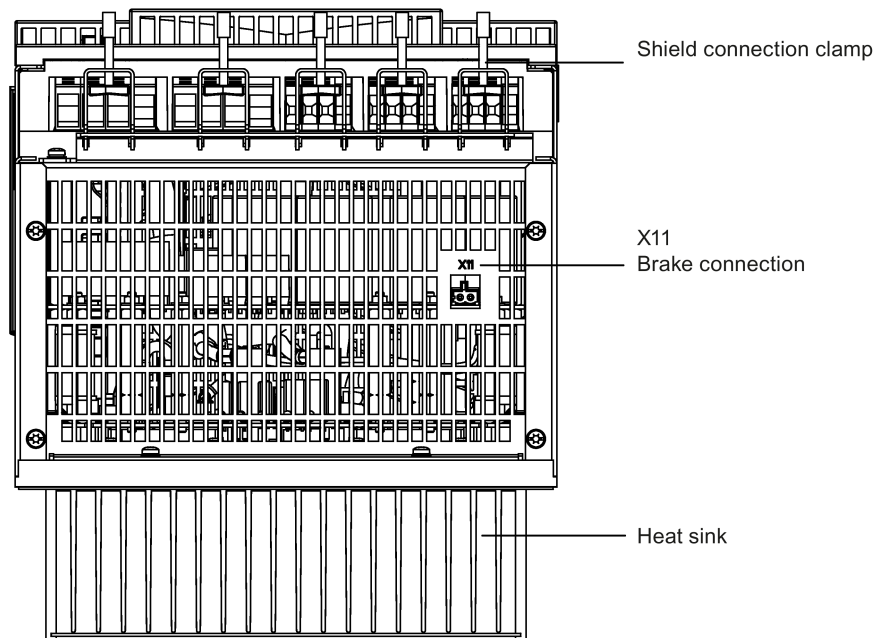
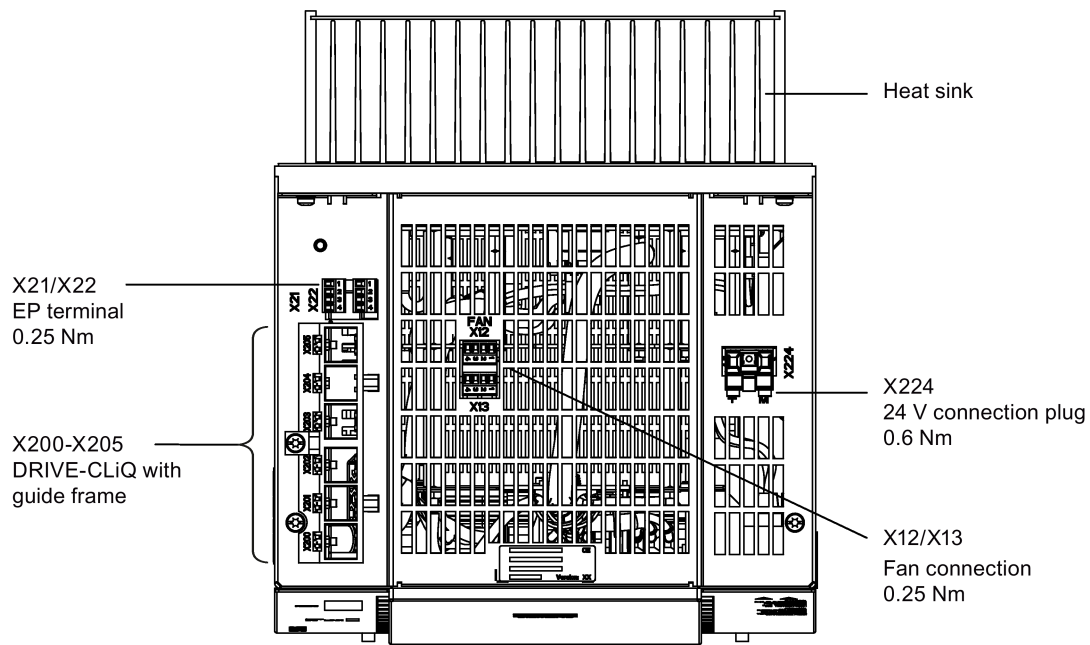
3.3.1 Overview diagrams

3.3.1.1 3 axes Power Modules

The following interface descriptions apply to Power Modules:

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1

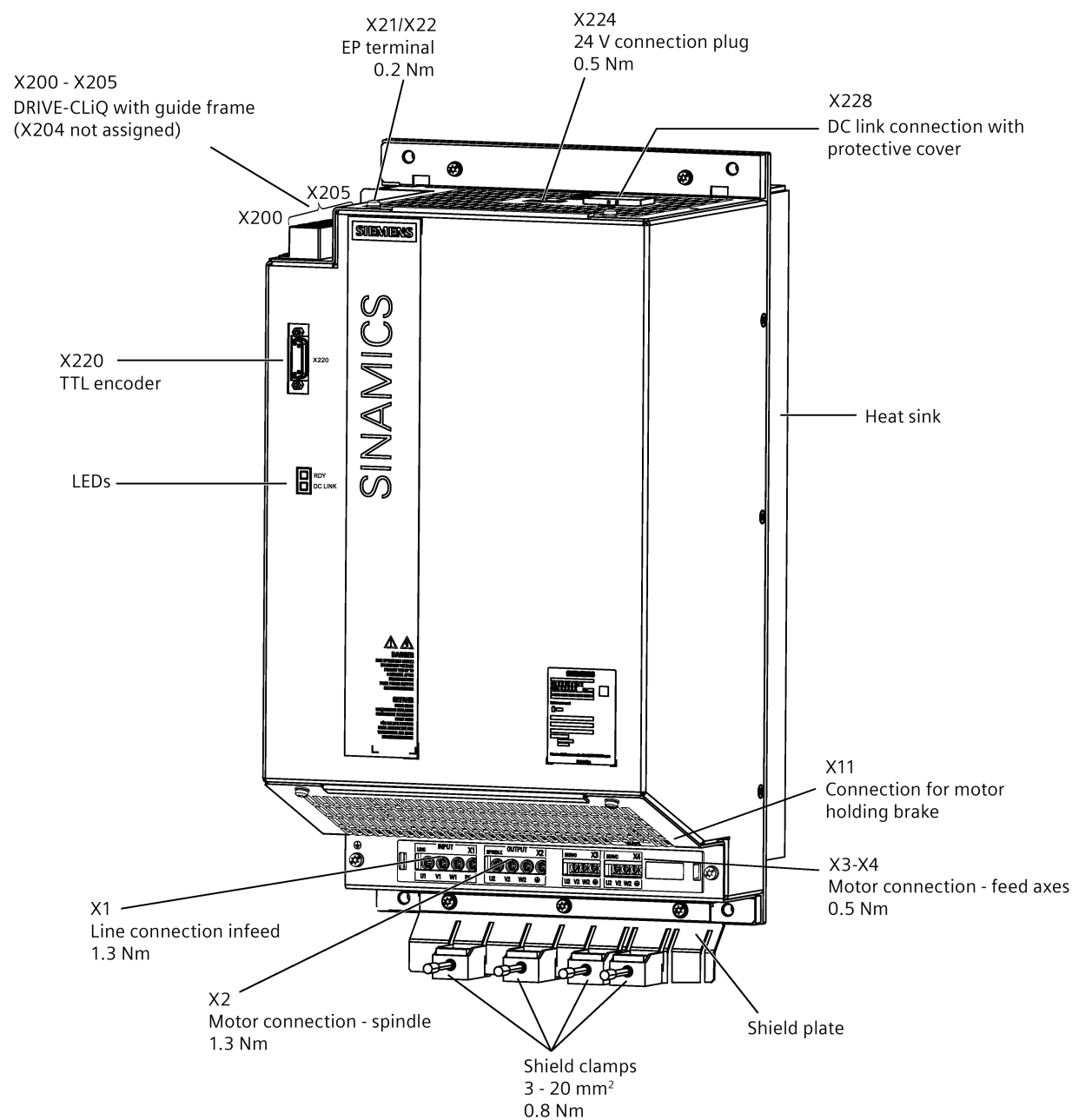


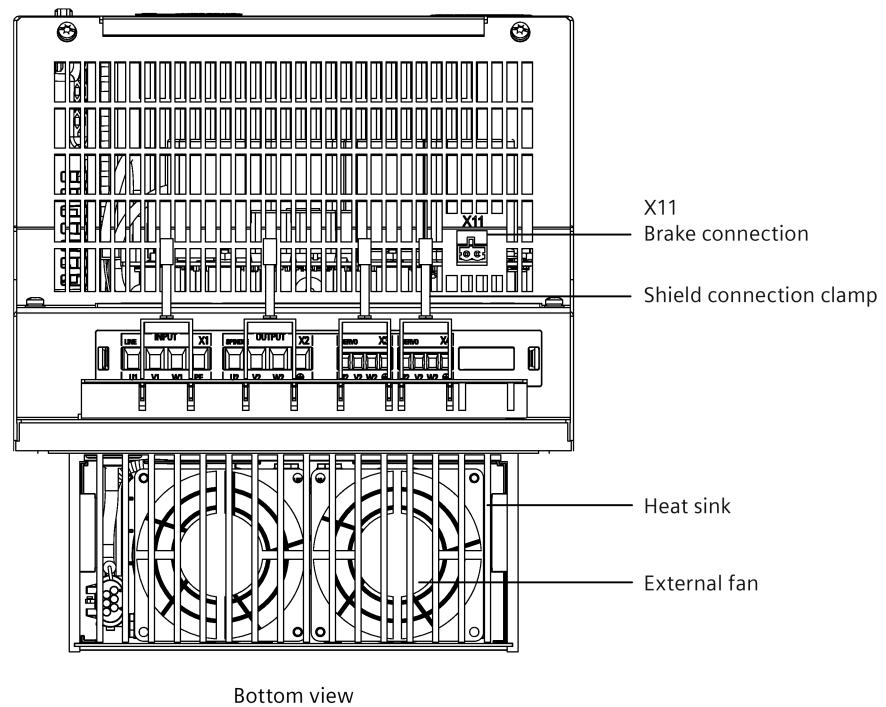
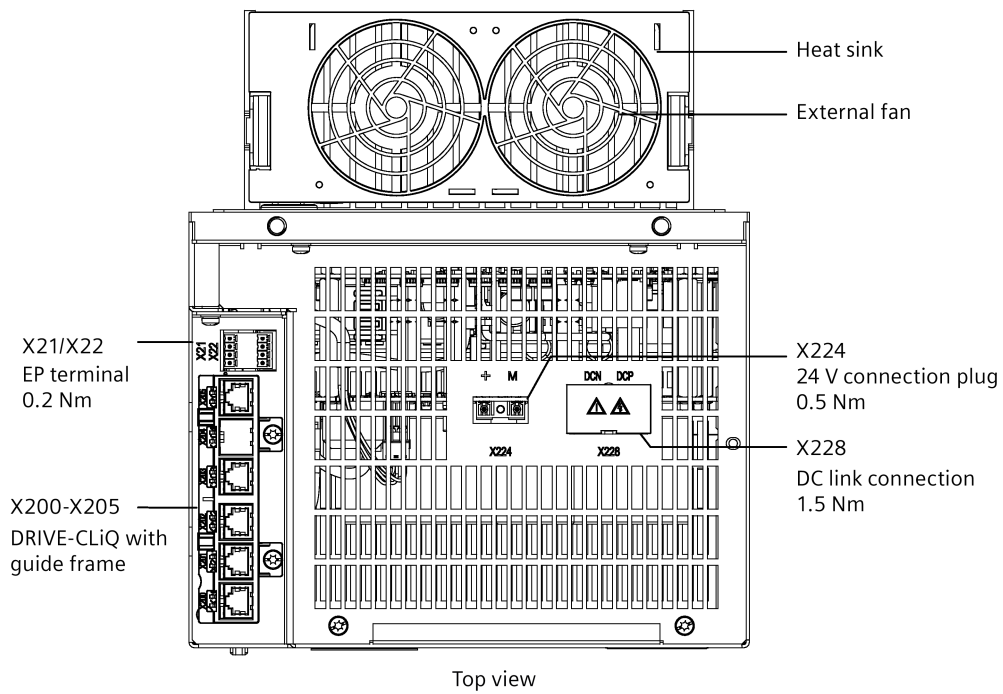


3.3 Interface description

The following interface descriptions apply to Power Modules:

- 6SL3111-3VE21-6FC1
- 6SL3111-3VE21-6EC1
- 6SL3111-3VE22-0HC1

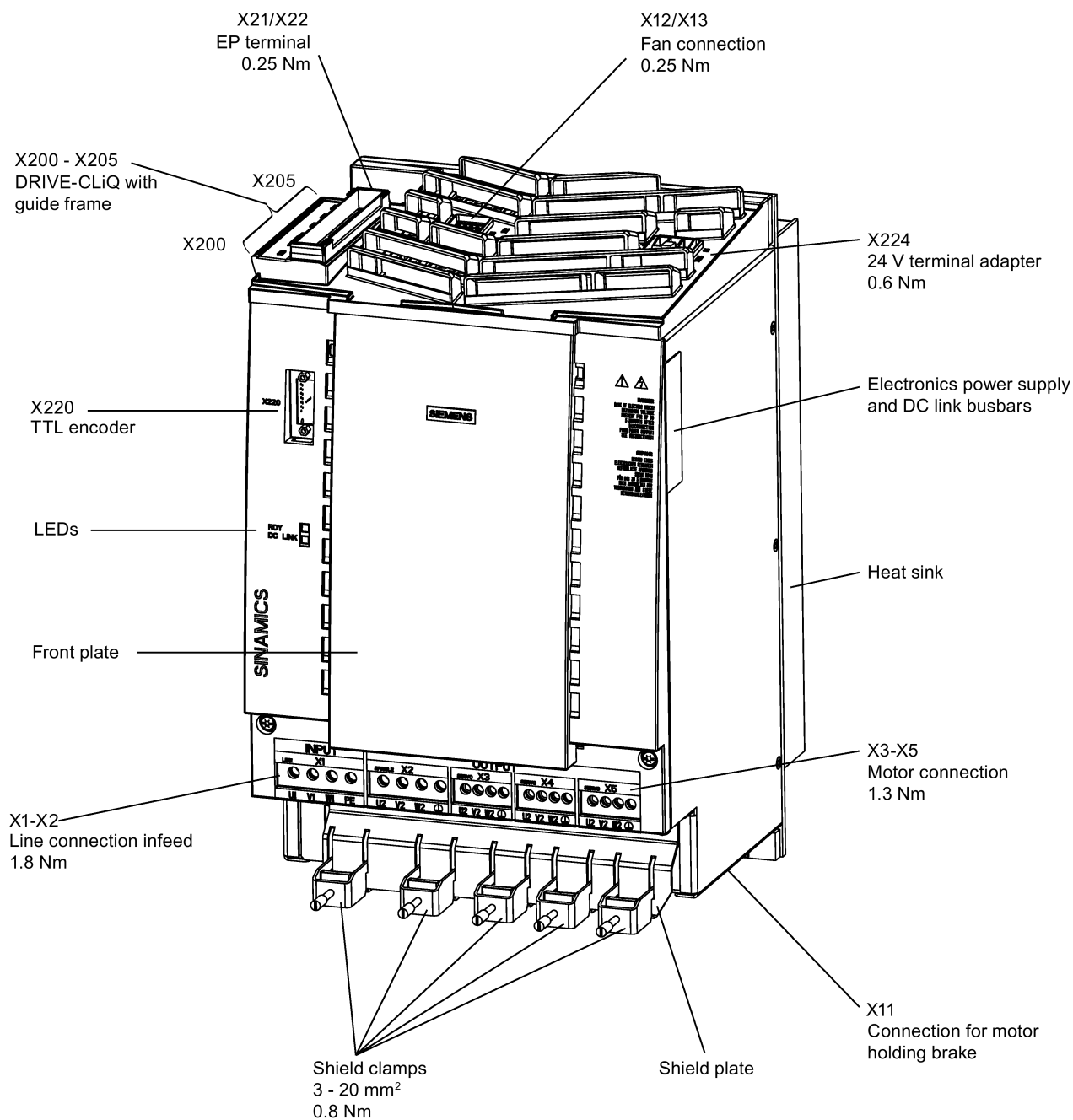


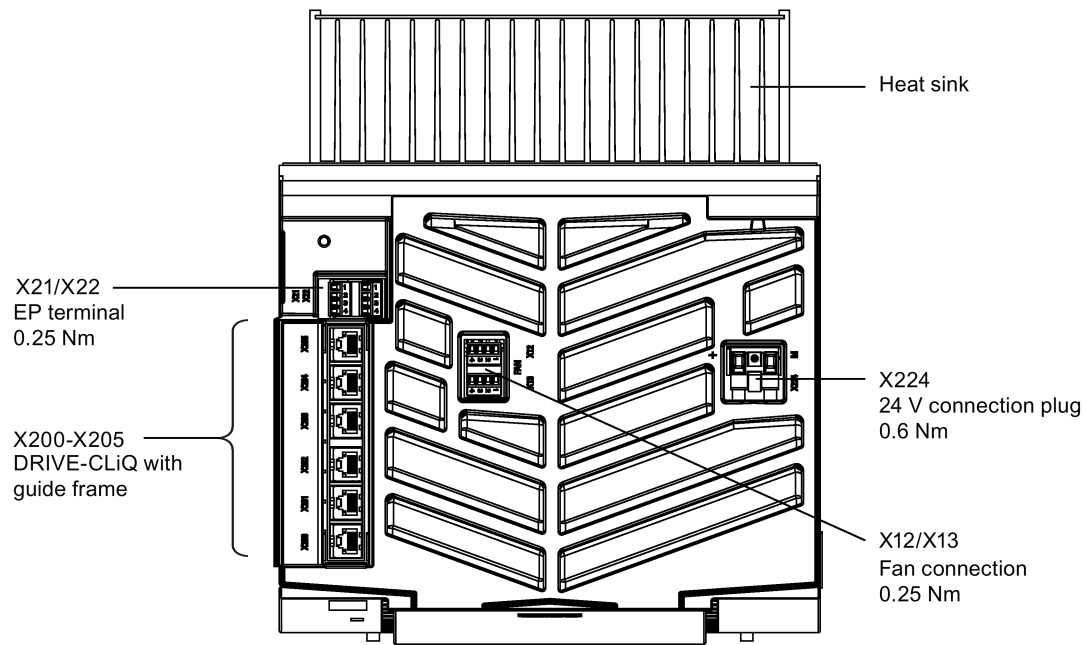


3.3.1.2 4 axes Power Modules

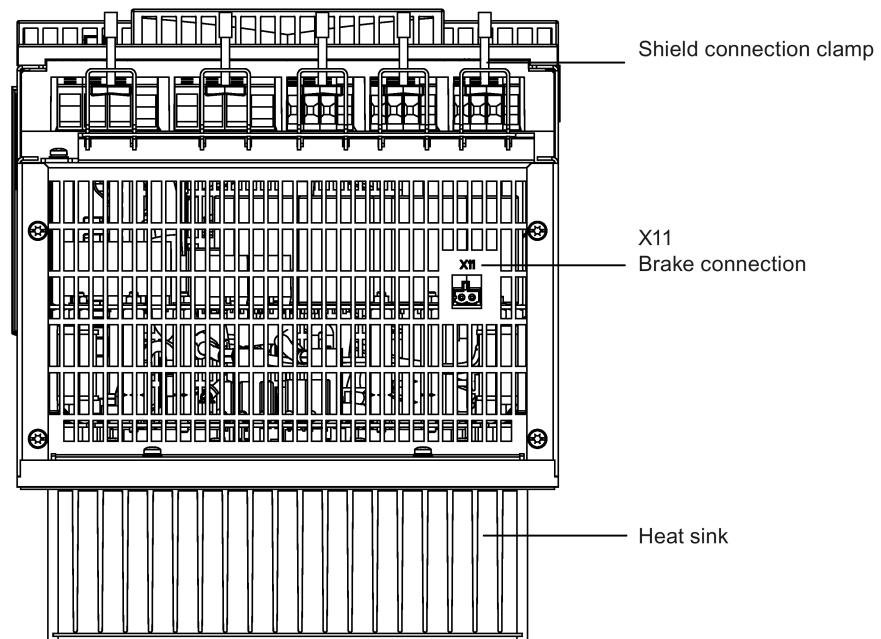
The following interface descriptions apply to Power Modules:

- 6SL3111-4VE21-0EA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1





Top view

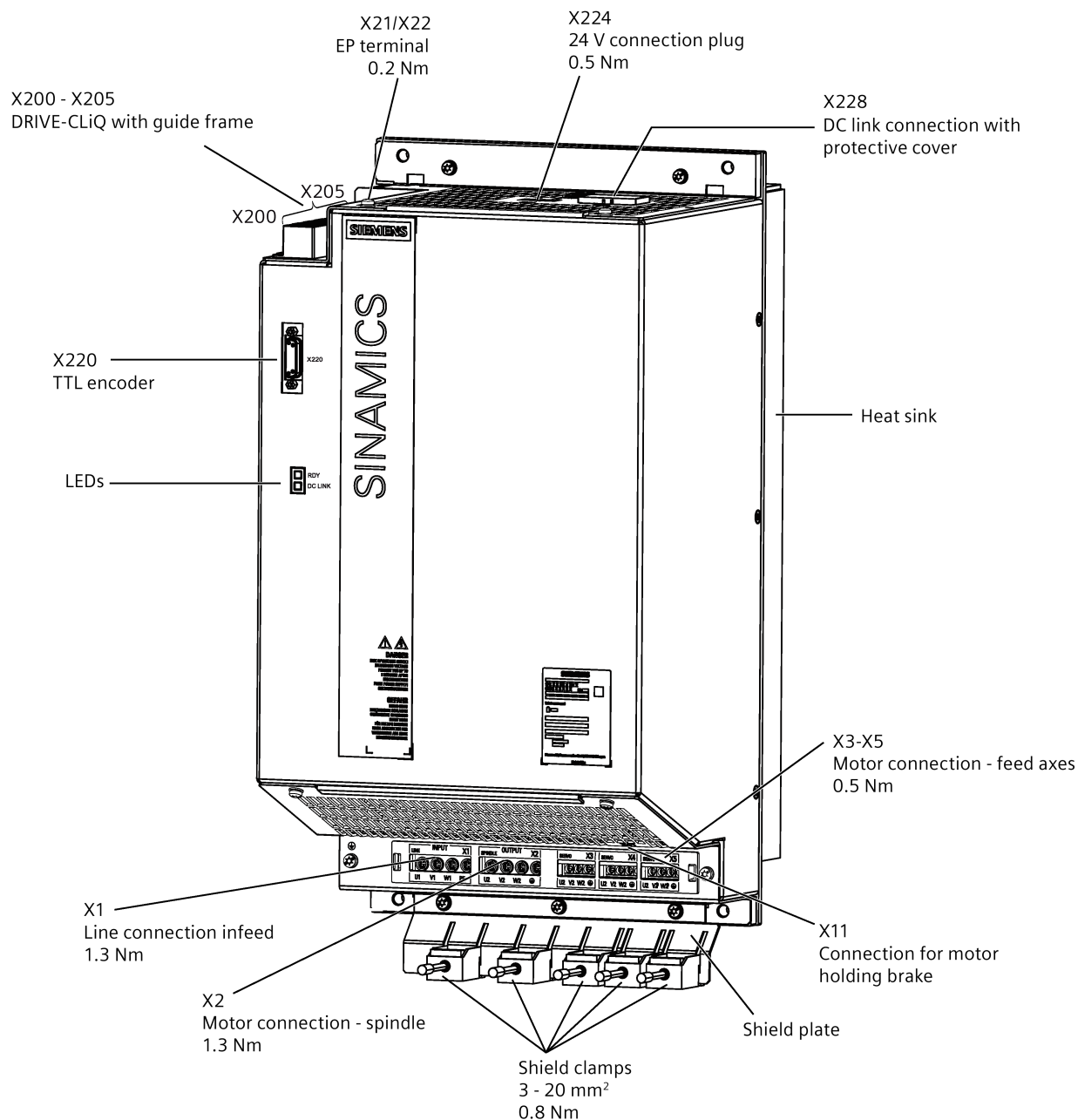


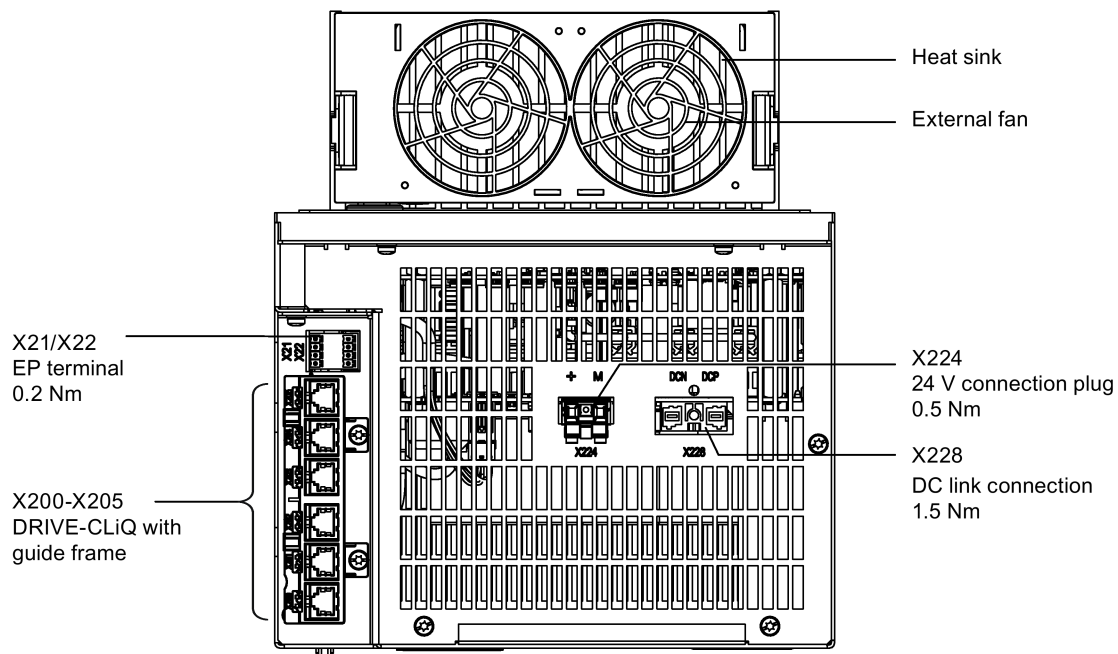
Bottom view

3.3 Interface description

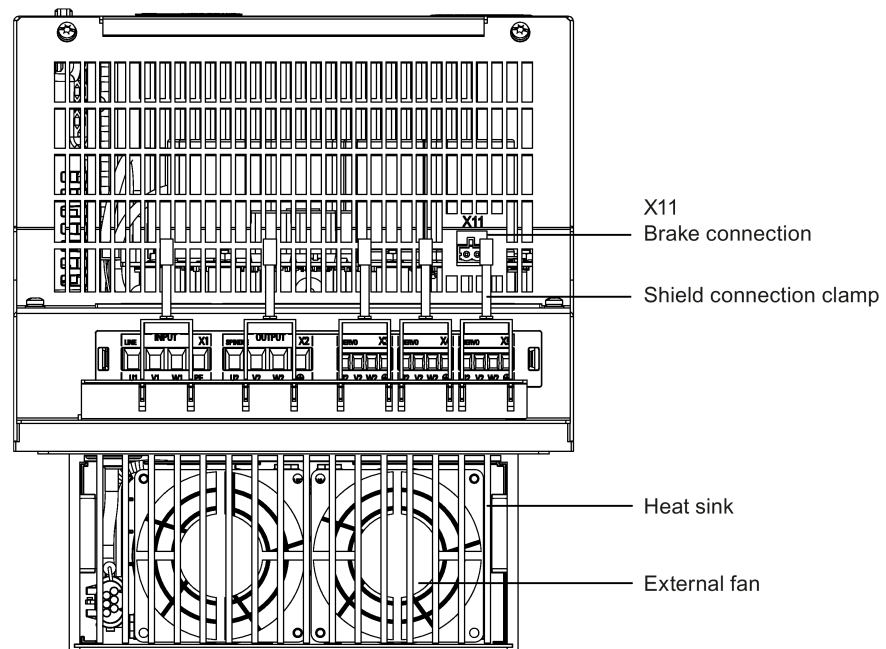
The following interface descriptions apply to Power Modules:

- 6SL3111-4VE21-6EC1
- 6SL3111-4VE21-6ED1
- 6SL3111-4VE21-6FC1
- 6SL3111-4VE22-0HC1
- 6SL3111-4VE21-6ED2



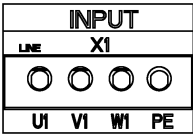


Top view

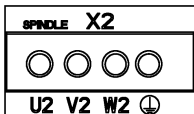
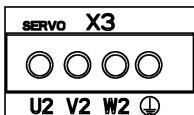


Bottom view

3.3.2 X1 line connection

Illustration	Terminal	Description
	U1	Line phase L1
	V1	Line phase L2
	W1	Line phase L3
	PE connection	Protective earthing
	Terminal type: For S120 Combi Power Modules frame type B: screw terminal 3 (Page 182) For S120 Combi Power Modules frame type A: screw terminal 7 (Page 182)	

3.3.3 X2 - X5 motor connection

Illustration	Terminal	Description
X2 - spindle		
	U2	Motor phase U
	V2	Motor phase V
	W2	Motor phase W
	PE connection	Protective earthing
	Terminal type: For S120 Combi Power Modules frame type B: screw terminal 3 (Page 182) For S120 Combi Power Modules frame type A: screw terminal 7 (Page 182)	
X3 to X5 - feed 1 to feed 3		
	U2	Motor phase U
	V2	Motor phase V
	W2	Motor phase W
	Protective conductor connection	Protective earthing
	Terminal type: For S120 Combi Power Modules frame type B: screw terminal 4 (Page 182) For S120 Combi Power Modules frame type A: screw terminal 5 (Page 182)	

Note

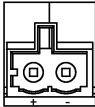
The interface X5 (feed 3) is available only on S120 Combi 4 axes Power Modules.

Note

Maximum cable length

The total length of the power cables must not exceed 175 m.

3.3.4 X11 brake connection

Illustration	Terminal	Description	Technical specifications
	BR +	Brake connection +	Voltage: 24 VDC
	BR -	Brake connection -	Max. load current: 1 A Min. load current: 0.1 A
	Terminal type: spring-loaded terminal 1 (Page 182)		



WARNING

Electric shock due to a terminal voltage that has not been adjusted

Contact with live terminals can cause death or severe injury.

- Only connect protective extra-low voltages (PELV or SELV) to all connections and terminals between 0 and 48 VDC.
- Observe the voltage tolerances of the motor holding brakes ($24\text{ V} \pm 10\%$).

Note

The motor brake must be connected via a connector. The connector is preassembled on the prefabricated cable. The BR- cable must not be connected directly to electronics ground (M).

3.3.5 X12/X13 fan connection

Illustration	Terminal	Description	Technical specifications
	1	Ground	Current-carrying capacity (24 V): 2 x 1 A or 1 x 2 A
	2	Fan monitoring	
	3	+24 V	
	4	Ground	
	Terminal type: screw terminal 1 (Page 182)		

Note

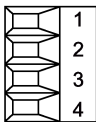
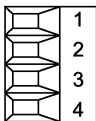
Customer-specific implementation of forced ventilation

If you implement the forced ventilation of the SINAMICS S120 Combi devices at the customer, terminals 1 and 2 must be jumpered at X12 and X13 in order to prevent the occurrence of a fan error message.

Note

The interfaces X12 and X13 are not available to S120 Combi Power Modules frame type B because they have an integrated fan on the modules.

3.3.6 X21/X22 EP terminals

Illustration	Terminal	Description	Technical specifications
X21 EP terminals - infeed			
	1	-	Reserved, do not use
	2	-	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 VDC (20.4 ... 28.8 V) Current consumption, typical: 4 mA at 24 V Isolated input
	4	EP M1 (Enable Pulses)	
Digital input: type 1 Terminal type: For S120 Combi Power Modules frame type B: screw terminal 2 (Page 182) For S120 Combi Power Modules frame type A: screw terminal 1 (Page 182)			
X22 EP terminal/temperature sensor - axes			
	1	Temp +	Temperature sensors ¹⁾ : KTY84– 1C130/Pt1000/PTC/bimetallic switch with NC contact
	2	Temp -	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 VDC (20.4 ... 28.8 V) Current consumption, typical: 4 mA at 24 V Isolated input The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (Enable Pulses)	
Digital input: type 1 Terminal type: For S120 Combi Power Modules frame type B: screw terminal 2 (Page 182) For S120 Combi Power Modules frame type A: screw terminal 1 (Page 182)			

¹⁾ The temperature sensor type can be selected by parameter (see the SINAMICS S120/S150 List Manual).



⚠ WARNING

Electric shock in the event of voltage flashovers at the temperature sensor

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

- Use temperature sensors that comply with the specifications relating to safe electrical separation.

NOTICE

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

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

- Connect the KTY temperature sensor with the correct polarity.

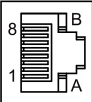
Note

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

Note

The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME).

3.3.7 X200 - X205 DRIVE-CLiQ interfaces

Illustration	Pin	Signal	Description
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	NC	
	5	NC	
	6	RXN	Receive data -
	7	NC	
	8	NC	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
	Connector type: DRIVE-CLiQ socket		

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

Blanking covers (50 pieces) Article number: 6SL3066-4CA00-0AA0

Note**DRIVE-CLiQ interface X204**

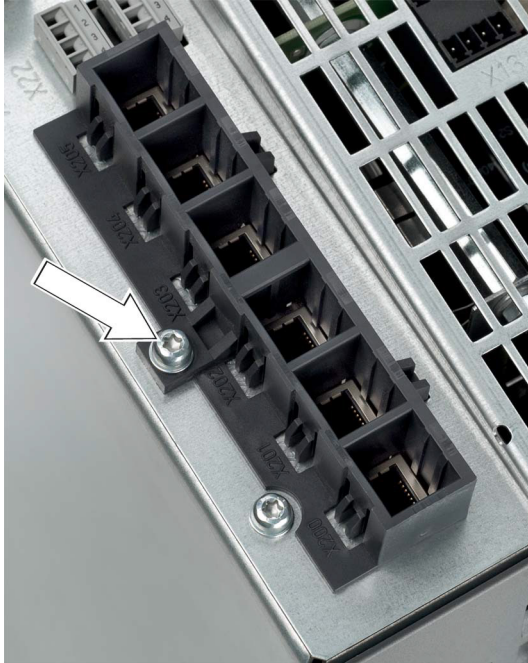
The DRIVE-CLiQ interface X204 is available only on S120 Combi 4 axes Power Modules.

Inserting and removing the DRIVE-CLiQ blanking covers

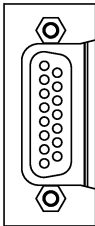
Blanking covers should be attached to the DRIVE-CLiQ interfaces that are not required.

To remove the blanking covers, we recommend that the guiding frame is dismantled. To do this, first remove all of the connections and the drip protection grid. Then remove the Torx slotted screw (see below).

As an alternative to dismantling the guiding frame, flat-nosed pliers can be used to remove the blanking covers.



3.3.8 X220 TTL encoder

Illustration	PIN	Signal	Technical specifications
	1	Temp +	Temperature sensor KTY84-1C130/Pt1000/PTC
	2	Clock	Clock
	3	Clock*	Inverse clock
	4	P encoder 5 V	Encoder power supply
	5	P encoder 5 V	
	6	P sense	Sense input of encoder power supply
	7	M encoder (M)	Ground for encoder power supply
	8	Temp -	Temperature sensor KTY84-1C130/Pt1000/PTC
	9	M sense	Ground sense input
	10	R	Reference signal R
	11	R*	Inverse reference signal R
	12	B*	Inverse incremental signal B
	13	B	Incremental signal B
	14	A*	Inverse incremental signal A
	15	A	Incremental signal A
Terminal type: Sub-D socket, 15-pin; TTL encoder; max. cable length 100 m			

Note

Only 5 V TTL encoders are supported.

**! WARNING****Electric shock in the event of voltage flashovers at the temperature sensor**

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

- Use temperature sensors that comply with the specifications relating to safe electrical separation.

Technical data of the encoder system supply

Encoder system supply	Unit	Value
Voltage	V _{bc}	5 (with or without remote sense) ¹⁾
Current	A _{bc}	0.35
Encoder frequency that can be evaluated (f _{encoder})	kHz	≤ 300

- ¹⁾ A controller compares the encoder system supply voltage - sensed via the remote sense cables - with the reference supply voltage of the encoder system, and adjusts the supply voltage for the encoder system at the output of the drive module until the required supply voltage is obtained directly at the encoder system.

Specification of TTL encoder systems that can be connected

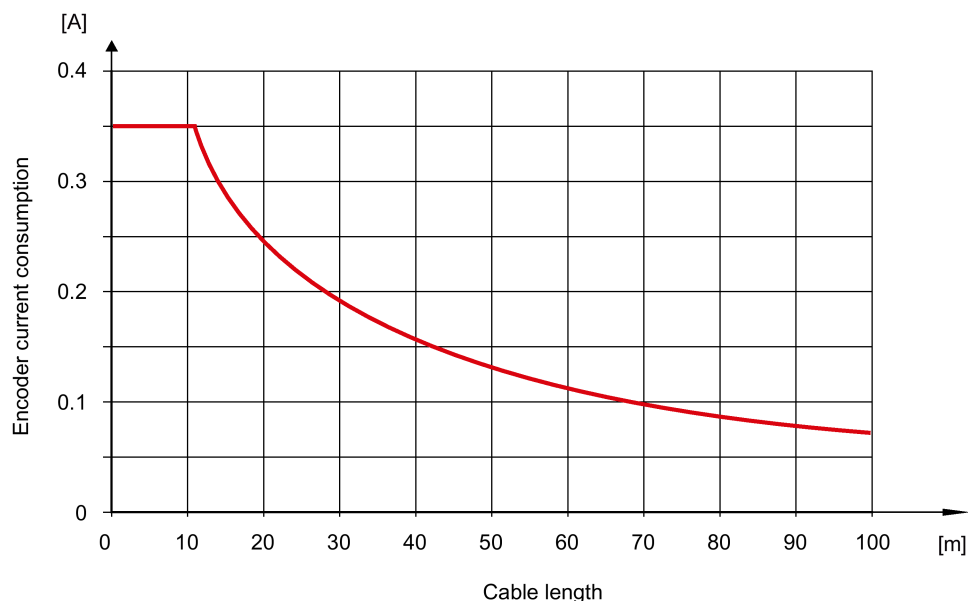
Parameter	Designation	Min.	Max.	Unit
Signal level, high ¹⁾	U_{Hdiff}	2	5	V
Signal level, low ¹⁾	U_{Ldiff}	-5	-2	V
Signal frequency	f_s	-	300	kHz
Edge clearance	t_{min}	100	-	ns
"Zero pulse inactive time" (before and after A = B = high)	t_{Lo}	640	$(t_{ALo-BHi} - t_{Hi})/2^{2)}$	ns
"Zero pulse active time" (while A = B = high and beyond) ³⁾	t_{Hi}	640	$t_{ALo-BHi} - 2 * t_{Lo}^{2)}$	ns

1) Other signal levels according to the RS422 standard.

2) $t_{ALo-BHi}$ is not a specified value, but is the time between the falling edge of track A and the next but one rising edge of track B.

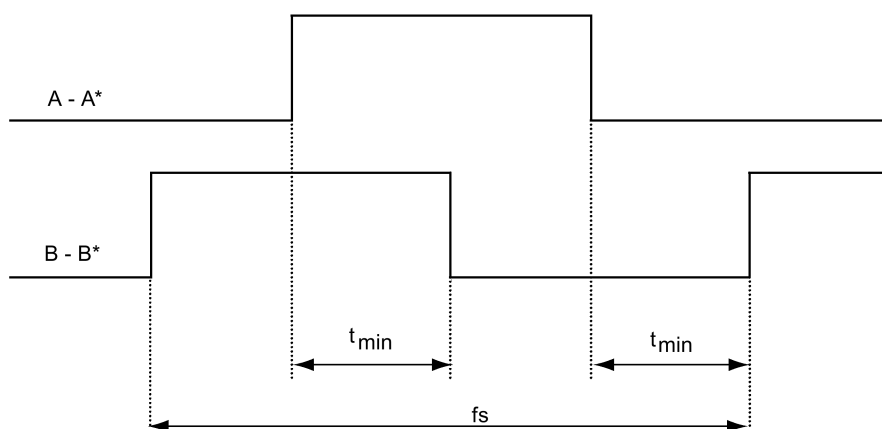
3) Further information on setting the "Zero pulse active time" can be found in SINAMICS S120 Drive Functions Function Manual, Section "Tolerant encoder monitoring".

Permissible current consumption of 5 V encoders without Remote Sense depending on the cable length (valid for cable cross-sections of 0.5 mm²)

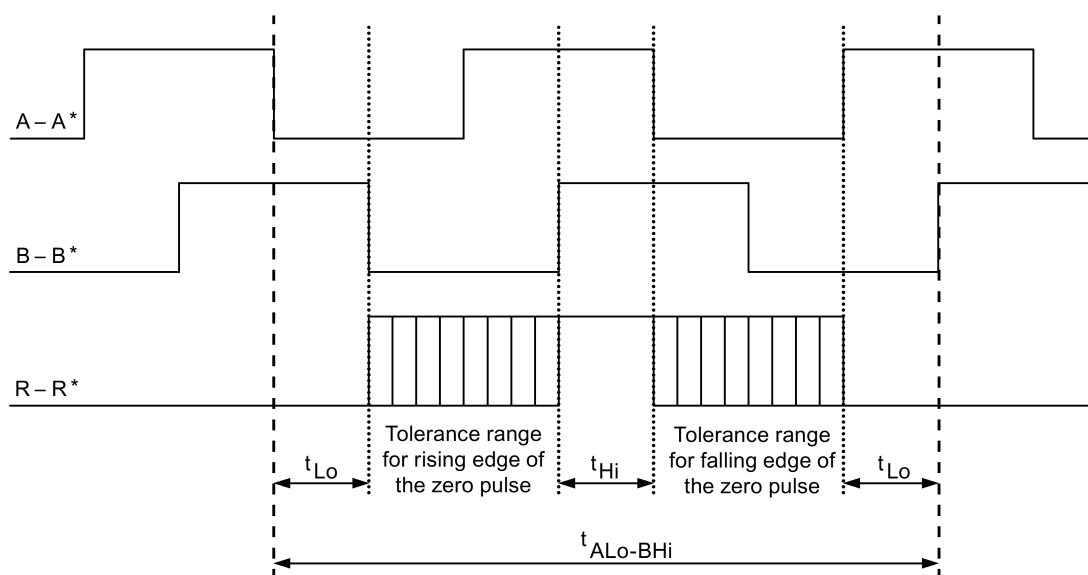


For encoders without remote sense the permissible cable length is restricted to 100 m (reason: the voltage drop depends on the cable length and the encoder current).

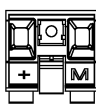
Signal characteristic of track A and track B between two edges (time between two edges with pulse encoders)



Position of the zero pulse to the track signals



3.3.9 X224 24 V connector

Illustration	Terminal	Description	Technical specifications
	+	24 V power supply	Supply voltage: 24 VDC
	M	Ground	Electronics ground
	Terminal type: For S120 Combi Power Modules frame type B: screw terminal 8 (Page 182) For S120 Combi Power Modules frame type A: screw terminal 10 (Page 182) The 24 V connector is included in the scope of supply.		

3.3.10 X228 DC link connection

Illustration	Terminal	Description	Technical specifications
	DCP	DC link voltage positive	Voltage: 460 V DC ... 720 V DC
	DCN	DC link voltage negative	Current: 40 A
	Terminal type: screw terminal 9 (Page 182) The DC link cable is not included in the scope of supply. It is provided in an expansion axis adapter (article number: 6SL3161-3XP00-0AA0), which you can order from Siemens. Before connecting the DC link cable, you need to open the DC link protective cover of X228 on the S120 Combi Power Module.		

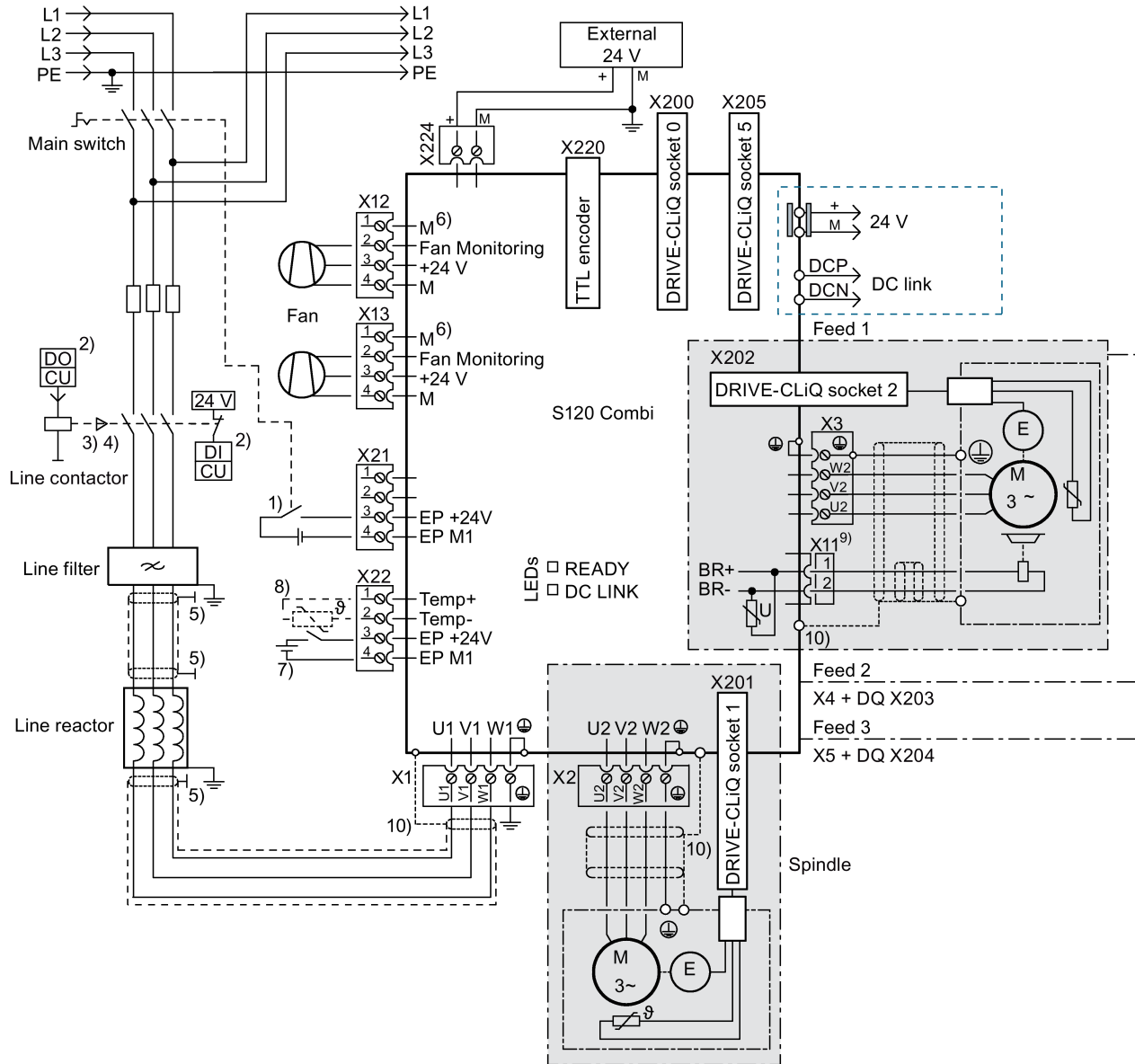
Note

The interface is available only on the S120 Combi Power Modules frame type B. If you do not need to connect the DC link cable, keep the DC link protective cover closed.

3.4 Connection examples

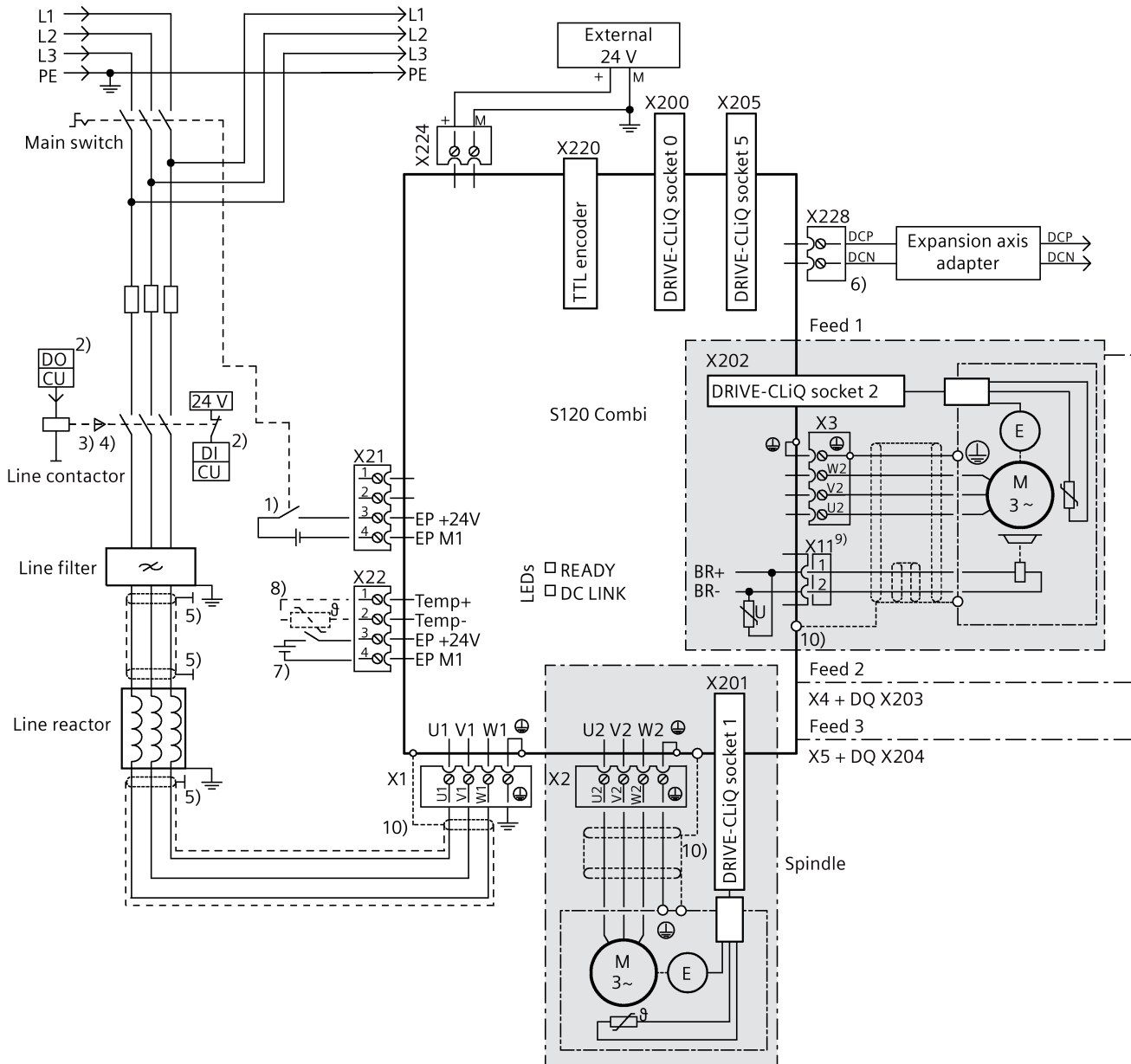
Overview

The system connection shown below is an example for the S120 Combi Power Modules frame type A:



- 1) Leading NC contact $t > 10$ ms
- 2) DI/DO controlled by the CU (PPU)
- 3) No additional loads permitted behind the line contactor
- 4) The current carrying capacity of the DO should be taken into account; it may be necessary to use an output interface relay
- 5) Contact established through the rear mounting panel or shield rails in accordance with the EMC installation guideline
- 6) Jumper between terminal 1 and 2 at connection of a customer fan subassembly
- 7) Required for safety
- 8) Optional, e.g. for encoderless motor
- 9) Integrated motor brake control via X11 can be freely assigned to an axis
- 10) Contact of the cable shield established through the shield connection clamp

The system connection shown below is an example for the S120 Combi Power Modules frame type B:



- 1) Leading NC contact $t > 10$ ms
- 2) DI/DO controlled by the CU (PPU)
- 3) No additional loads permitted behind the line contactor
- 4) The current carrying capacity of the DO should be taken into account; it may be necessary to use an output interface relay
- 5) Contact established through the rear mounting panel or shield rails in accordance with the EMC installation guideline
- 6) With protective cover
- 7) Required for safety
- 8) Optional, e.g. for encoderless motor
- 9) Integrated motor brake control via X11 can be freely assigned to an axis
- 10) Contact of the cable shield established through the shield connection clamp

Note

The feed 3 is available on 4 axes Power Module only.

Note

The interface X228 is available only on S120 Combi Power Modules frame type B.

Note

The interfaces X12 and X13 are not available to S120 Combi Power Modules frame type B because they have an integrated fan on the modules.

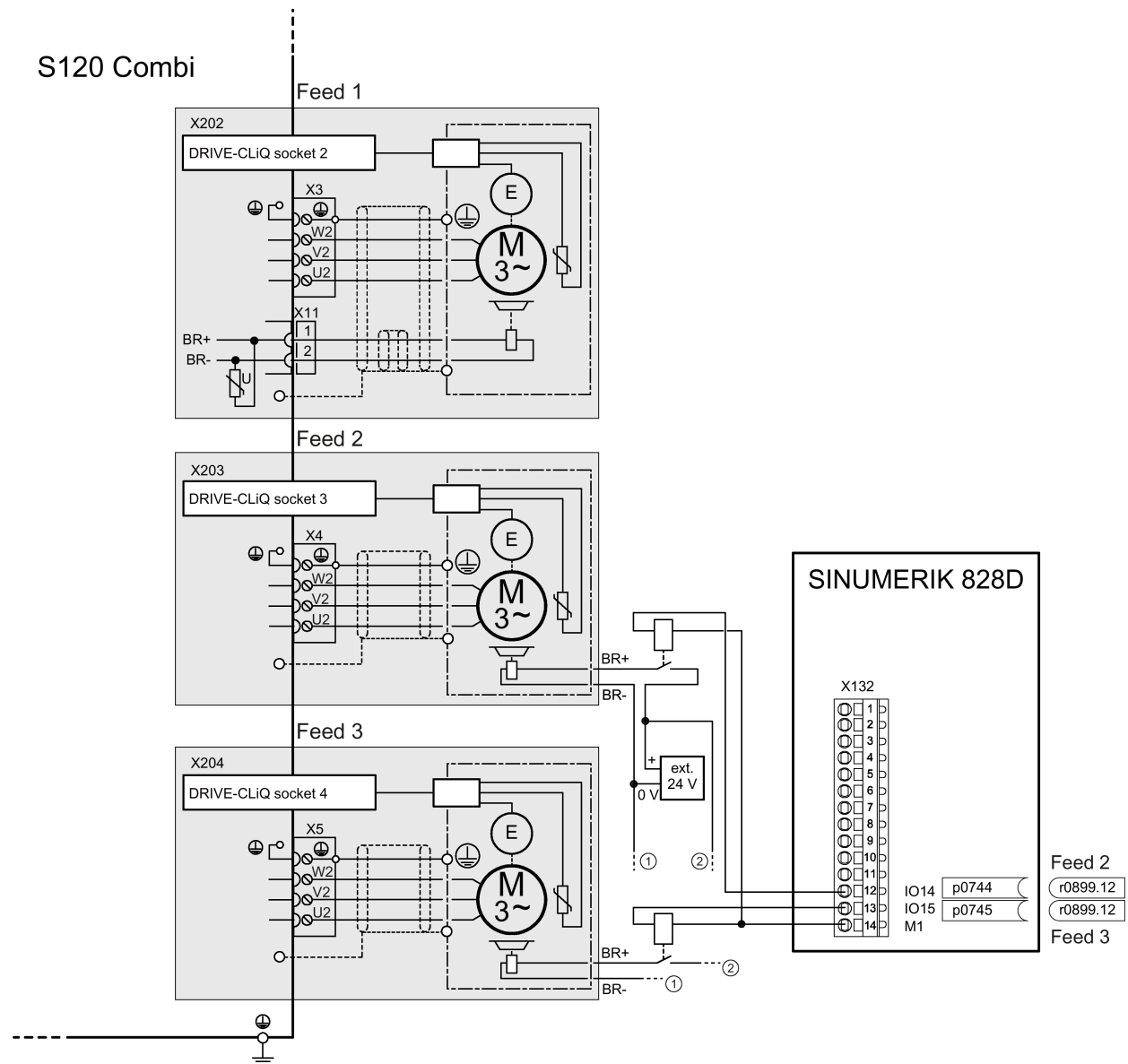
Note

The assignment of the motor holding brake see the description about "Controlling the motor holding brake" in Section "Description (Page 27)".

Note

The connections of the 24 V and the DC link to the additional modules see Section "Electrically connecting Motor Modules and DC link components (Page 131)".

Connecting the motor holding brake



Motor holding brake for feed 2 and feed 3 (parameterizable in the expert list)

- Settings in the Expert list
 - Feed 2 - p1215 = 3 and Feed 3 - p1215 = 3
(3: Motor holding brake as for the sequence control, connection via BICO, no SBC possible)
- BICO connections from the sequence control to digital outputs on the Control Unit
 - BICO interconnection to "open the holding brake"
 - BICO in CU_I - p0744: Feed 2 - r0899.12
 - BICO in CU_I - p0745: Feed 3 - r0899.12
 - Output definition in CU_I
 - CU_I - p0728.14 = 1
 - CU_I - p0728.15 = 1

Note

The circuit shown above is only an example.

A wiring diagram of the digital inputs/outputs on the PPU can be found in the SINUMERIK 828D Manual PPU.

3.5 Meaning of the LEDs on the S120 Combi

The SINAMICS S120 Combi has 2 LEDs to display the status. The LED statuses for the S120 Combi are described in the table below. The status display refers to the internal infeed, the spindle and the servo drives and the TTL encoder evaluation of the S120 Combi Power Module.

LEDs		Description	Remedy
RDY	DC LINK		
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.	Connect and check the electronic power supply
Green	Off	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	-
	Orange	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	-
	Red	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	-
Red	-	This component has at least one fault. Remark: The LED is activated irrespective of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/Red (0.5 Hz)	-	Firmware is being downloaded.	
Green/Red (2 Hz)	-	Firmware has been downloaded. Wait for POWER ON.	Carry out a POWER ON
Green/Orange or Red/Orange	-	Component recognition via LED is activated. This function can be parameterized (see SINAMICS S120/S150 List Manual) Comment: Both possibilities depend on the status of the LED when activating.	-



WARNING

Electric shock due to applied DC link voltage

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can always be present. Contact with live parts can result in death or serious injury.

- Observe the warning information on the component.

Cause and rectification of faults

The following reference material contains information about the cause of faults and how they are rectified:

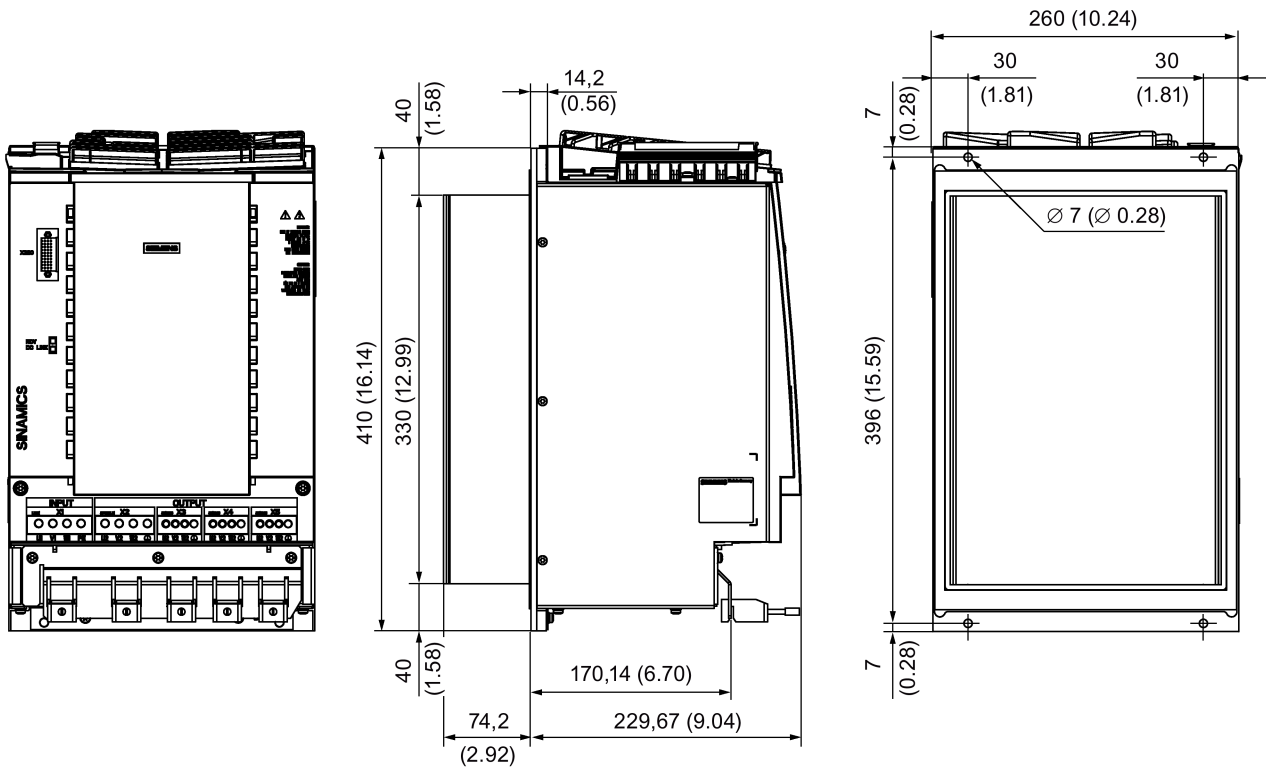
- SINAMICS S120 Function Manual, Drive Functions
- SINUMERIK 828D Turning and Milling Commissioning Manual
- SINUMERIK ONE NCU 1750 Equipment Manual
- SINUMERIK ONE NCU 1760 Equipment Manual
- SINUMERIK ONE PPU 1740 Equipment Manual
- Control Units and Additional System Components Equipment Manual

3.6 Dimension drawings

3 axes Power Modules

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1

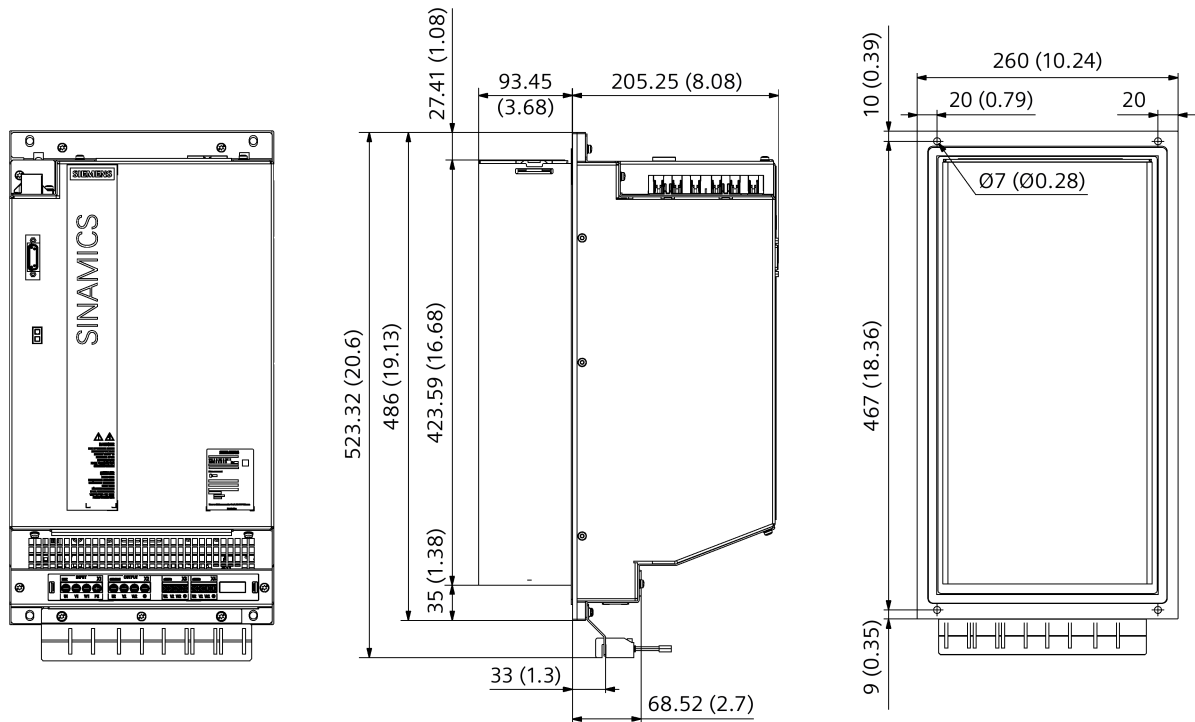
Unit: mm (in)



3.6 Dimension drawings

- 6SL3111-3VE21-6FC1
- 6SL3111-3VE21-6EC1
- 6SL3111-3VE22-0HC1

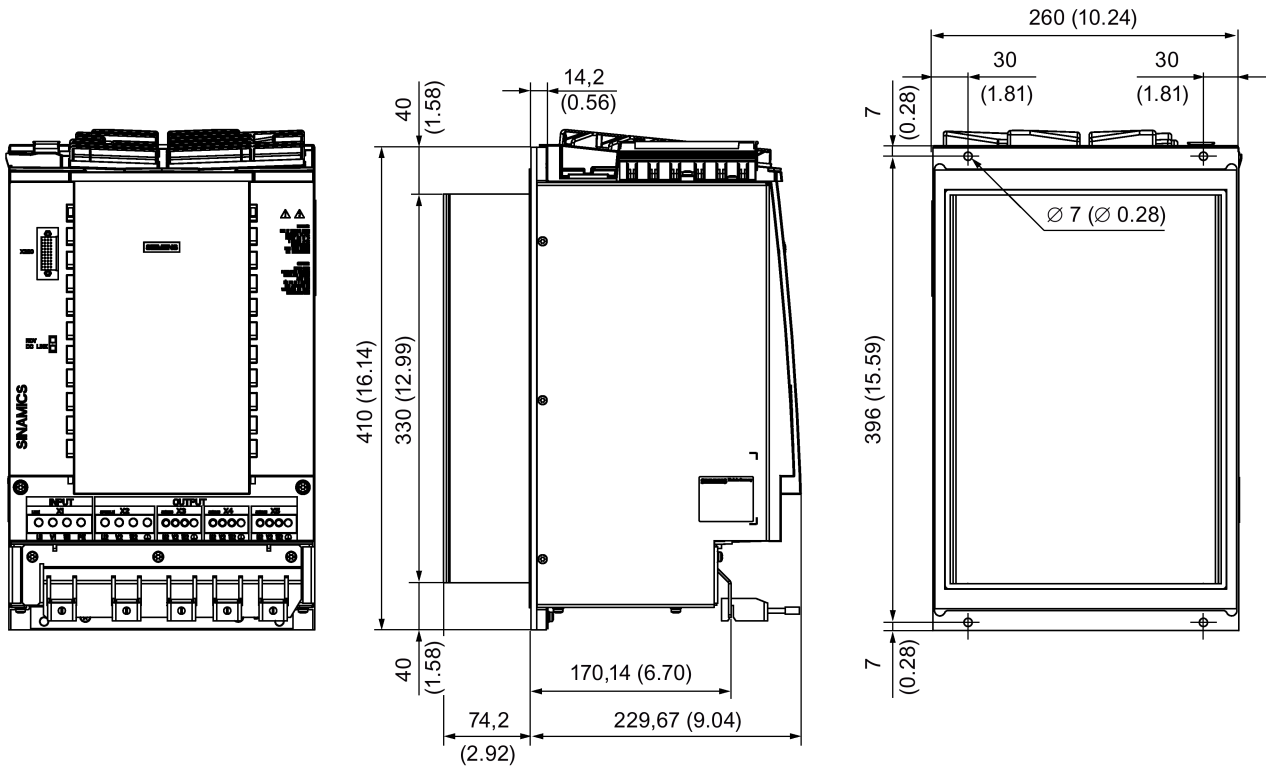
Unit: mm (in)



4 axes Power Modules

- 6SL3111-4VE21-0EA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1

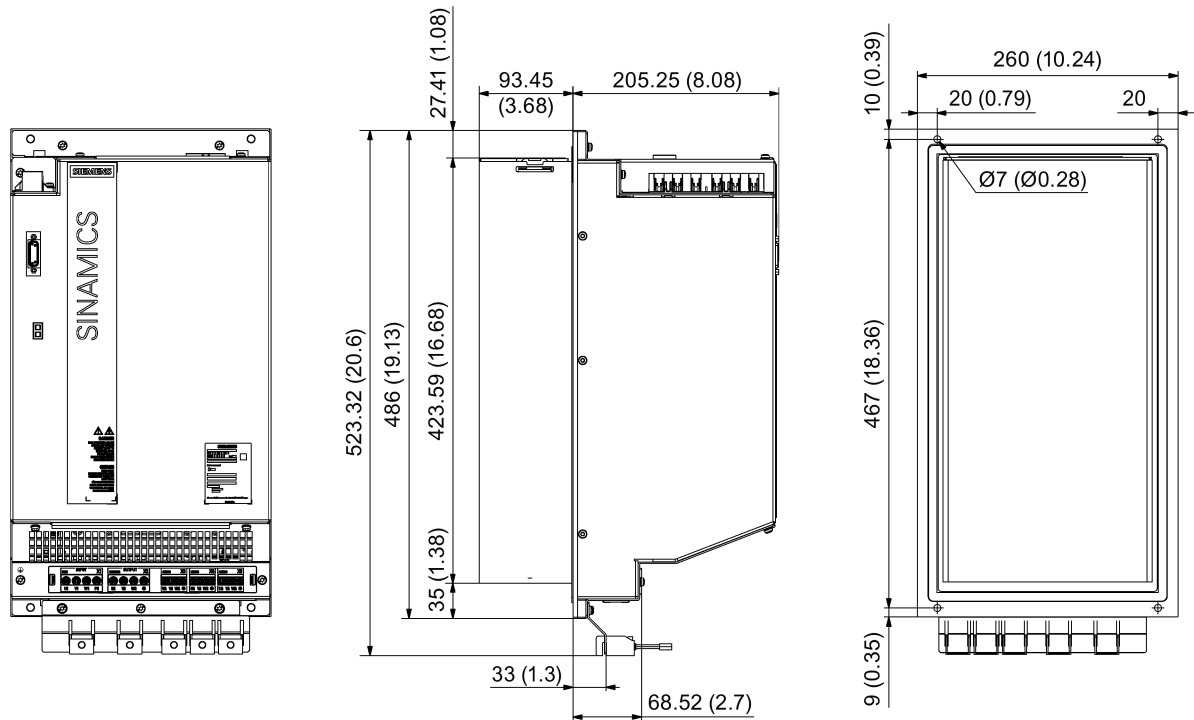
Unit: mm (in)



3.6 Dimension drawings

- 6SL3111-4VE21-6EC1
- 6SL3111-4VE21-6ED1
- 6SL3111-4VE21-6ED2
- 6SL3111-4VE21-6FC1
- 6SL3111-4VE22-0HC1

Unit: mm (in)



3.7 Unpacking the Power Module

Requirement

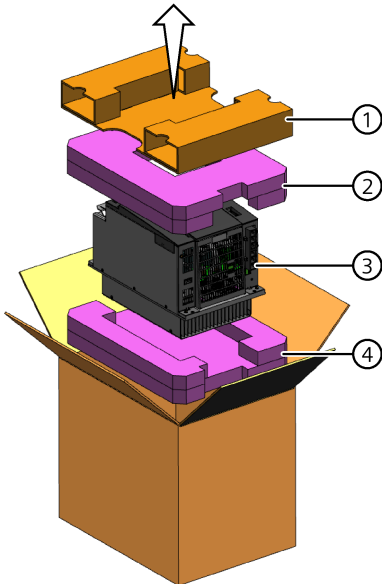
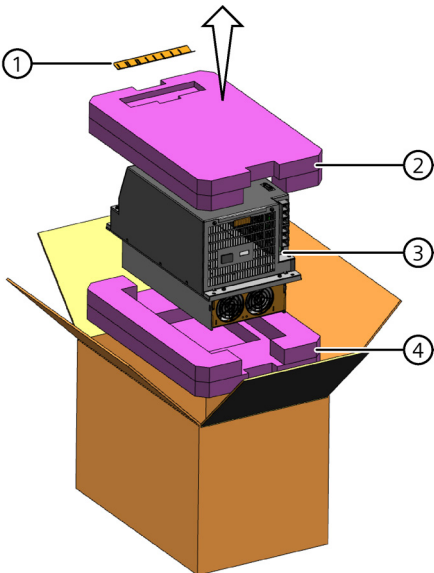
Tool required:

- A knife to open the packaging

Procedure

Proceed as follows to unpack the Power Module:

1. Place the packed Power Module on a stable surface with the underside facing downwards.
2. Open the packaging on the upper side.
3. Remove the packaging materials.
 - For frame type A, remove the folded inlay ① and the upper packaging cushion ②.
 - For frame type B, put aside the shielding plate ① and the upper packaging cushion ②.
4. Remove the Power Module from the packaging.

Frame type A	Frame type B
	
① Folded inlay ② Upper packaging cushion ③ Power Module frame type A ④ Lower packaging cushion	① Shielding plate ② Upper packaging cushion ③ Power Module frame type B ④ Lower packaging cushion

3.8 Installation

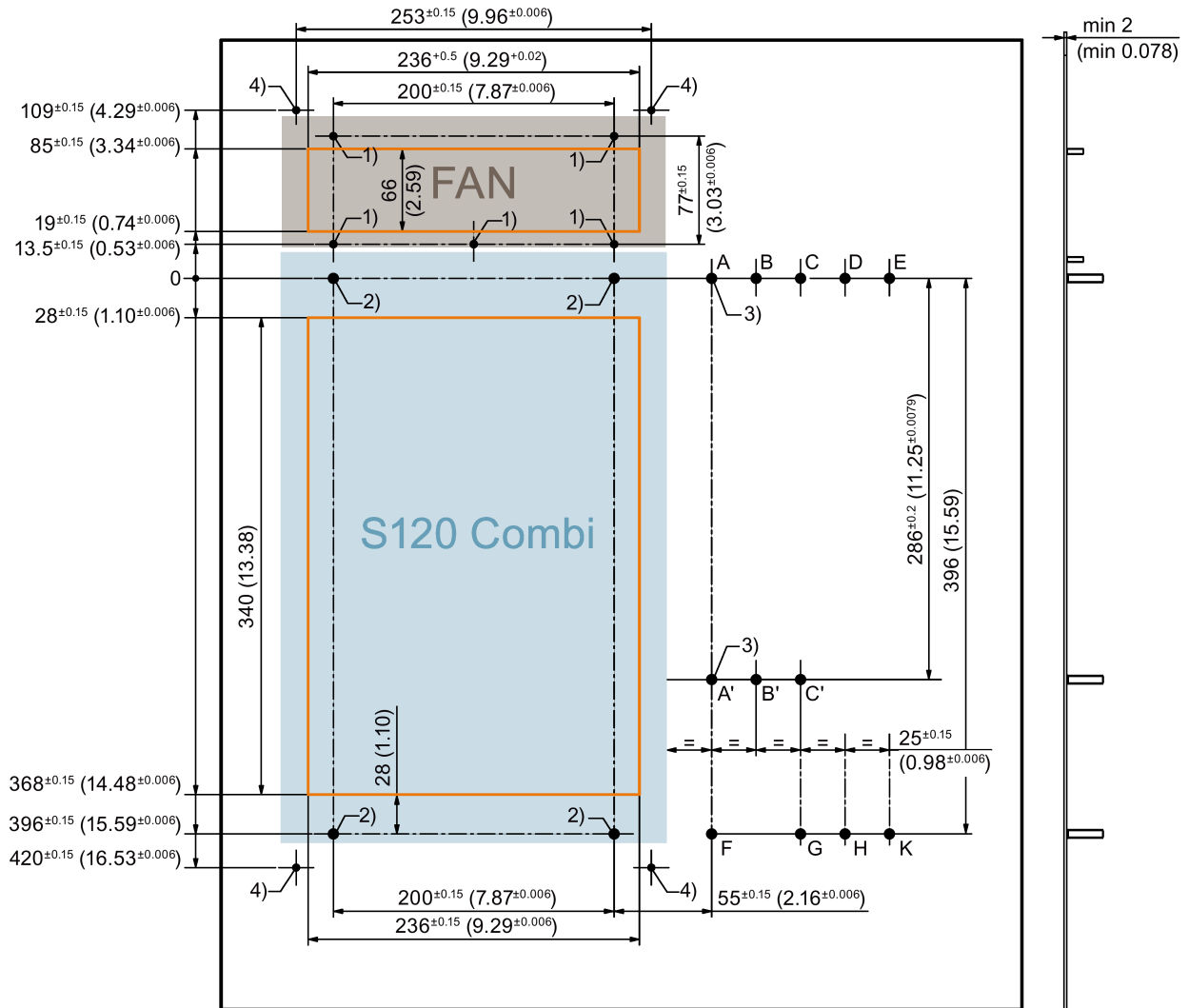
3.8.1 Drilling patterns and installation cut-outs

The drilling patterns differ by the number and width of the expansion axes. Select the appropriate drilling pattern corresponding to your individual design.

The installation cut-outs shown below are for the following Combi Power Modules and the separated external fan unit.

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1
- 6SL3111-4VE21-0EA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1

Unit: mm (in)



- 1) Holes for installing the external fan; M4 press-in threaded bolt
 - 2) Holes for installing the S120 Combi; M6 press-in threaded bolt
 - 3) Holes for installing the expansion modules; M6 press-in threaded bolt
 - 4) Holes for installing the reinforcement plate; M4 screws
- All chamfers without dimensions, 2 x 45°

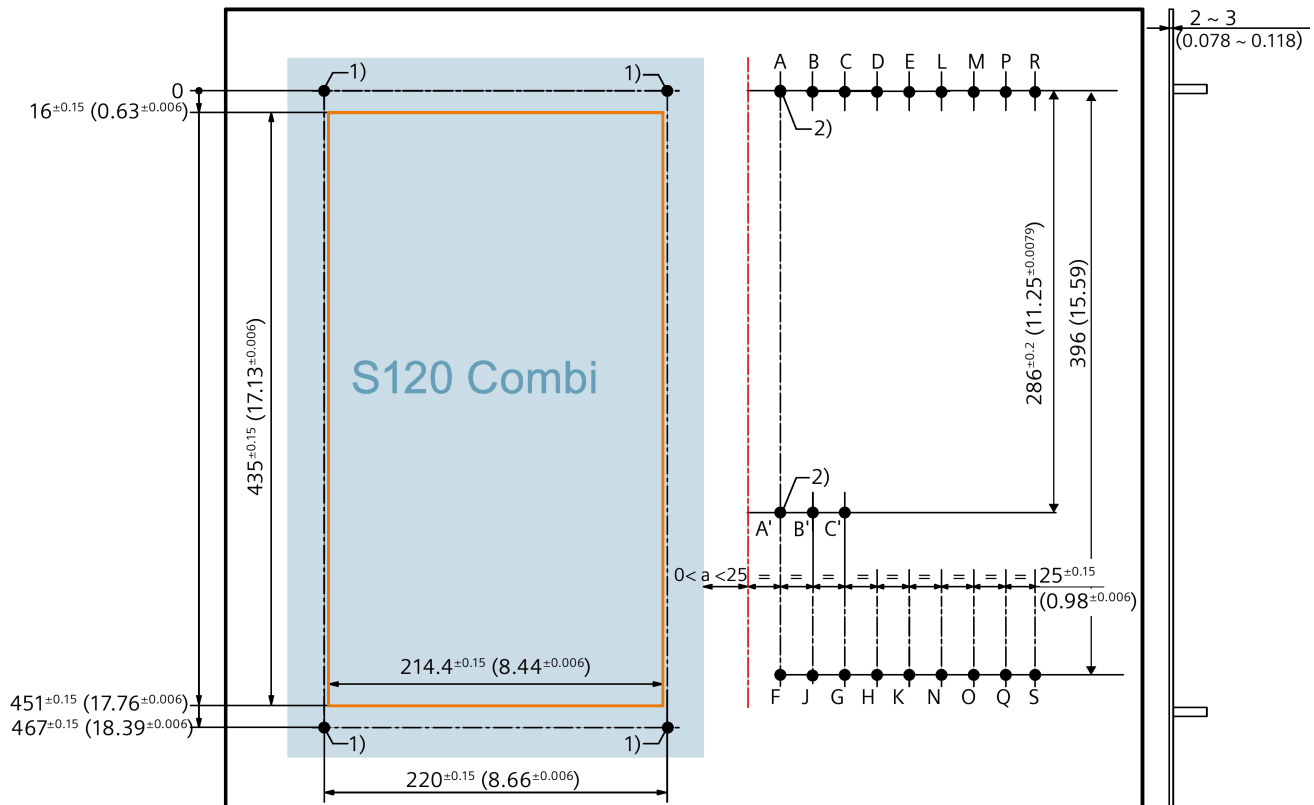
	A-A'	B-B'	C-C'	A-F*	C-G*	D-H*	E-K*
Combi	-	-	-	-	-	-	-
Combi + 50 mm	x	-	-	x	-	-	-
Combi + 50 mm + 50 mm	x	-	x	-	x	-	-
Combi + 50 mm + 50 mm + 50 mm	x	-	x	-	-	-	x
Combi + 75 mm	x	x	-	-	-	-	-
Combi + 75 mm + 50 mm	x	x	-	-	-	x	-

* Used only when you need to install a Control Supply Module

The installation cut-outs shown below are for the following Combi Power Modules.

- 6SL3111-3VE21-6FC1
- 6SL3111-3VE21-6EC1
- 6SL3111-3VE22-0HC1
- 6SL3111-4VE21-6FC1
- 6SL3111-4VE22-0HC1
- 6SL3111-4VE21-6ED2
- 6SL3111-4VE21-6ED1
- 6SL3111-4VE21-6EC1

Unit: mm (in)



1) Holes for installing the S120 Combi; M6 press-in threaded bolt

2) Holes for installing the expansion modules; M6 press-in threaded bolt

All chamfers without dimensions, 2 x 45°

Expansion modules		Drilling holes									
Module type	Width	A- A'	B -B'	C-C'	A-F	C-G	D-H	E-K	M-O	R-S	
Motor Module Booksize Compact	50 mm	x	—	—	—	—	—	—	—	—	
	50 mm + 50 mm	x	—	x	—	—	—	—	—	—	
	75 mm	x	x	—	—	—	—	—	—	—	
Motor Module Booksize Compact and Control Supply Module	50 mm + 50 mm	x	—	—	—	x	—	—	—	—	
	50 mm + 50 mm + 50 mm	x	—	x	—	—	—	x	—	—	
	75 mm + 50 mm	x	x	—	—	—	x	—	—	—	
Motor Module Booksize and/or Control Supply Module	50 mm	—	—	—	x	—	—	—	—	—	
	50 mm + 50 mm	—	—	—	x	x	—	—	—	—	
	50 mm + 50 mm + 50 mm	—	—	—	x	x	—	x	—	—	
	100 mm	—	—	—	x	x	—	—	—	—	
	100 mm + 50 mm	—	—	—	x	x	—	x	—	—	
	100 mm + 50 mm + 50 mm	—	—	—	x	x	—	x	x	—	
	100 mm + 100 mm	—	—	—	x	x	—	x	x	—	
	100 mm + 100 mm + 50 mm	—	—	—	x	x	—	x	x	x	

3.8.2 Installing the reinforcement plates

3.8.2.1 Description

For the following S120 Combi Power Modules, you must mount the reinforcement plates. The reinforcement plates must be installed at the rear of the mounting panel or the control cabinet **before** installing the S120 Combi Power Module and the external fan unit.

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1
- 6SL3111-4VE21-0EA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1

The reinforcement plates for the S120 Combi fulfill the following functions:

- Routing the air in a specific way to dissipate the heat of the external heat sink
- Stabilizing the mounting panel

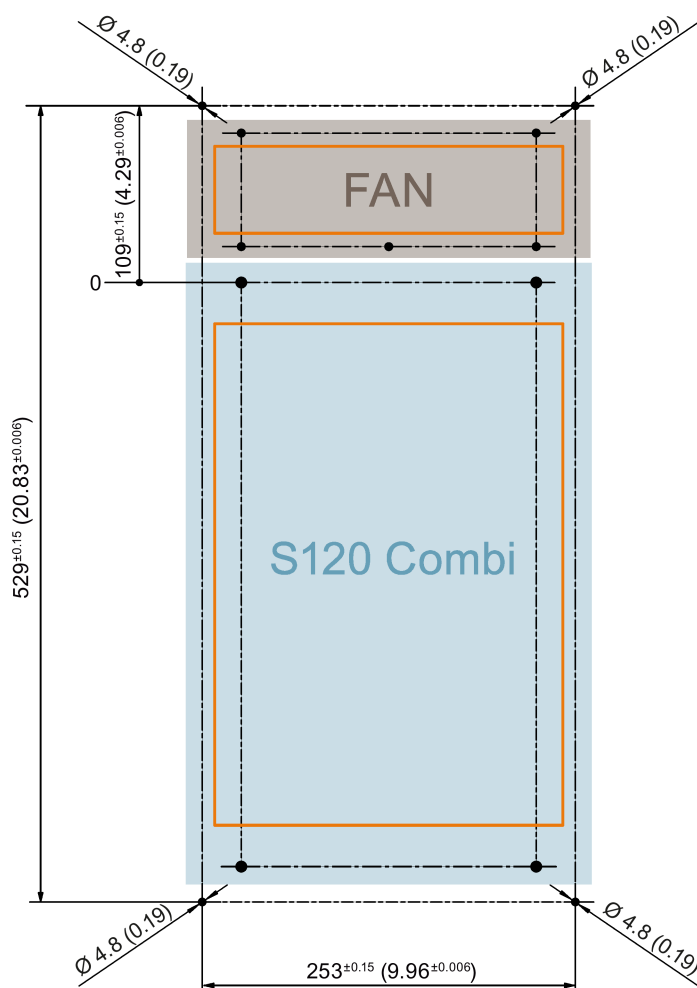
Note

The reinforcement plates are not included in the scope of delivery of the S120 Combi. They must be separately ordered (article number: 6SL3161-1LP00-0AA0).

3.8.2.2 Installation

The reinforcement plates for the S120 Combi must be mounted in each case. For mounting, holes that correspond to the drilling pattern below must be drilled in the mounting panel.

Unit: mm (in)



Holes:

4 x $\varnothing 4.8$ mm

Screws:

M4 x 10 (ISO 7045 (DIN 7965), ISO 7380, DIN EN ISO 1207, ISO 1580M4)

Tightening torques:

Initially tighten by hand (0.5 Nm), then tighten with 1.8 Nm

Installing the reinforcement plates



Insert the left reinforcement plate into the mounting cut-out.



Locate the reinforcement plate on the mounting panel.



Screw the reinforcement plate at the top and bottom.



Insert the right reinforcement plate into the mounting cut-out.

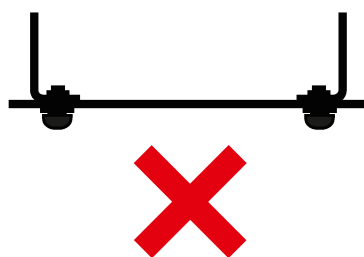
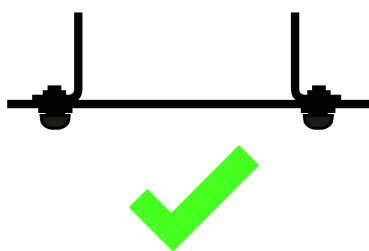


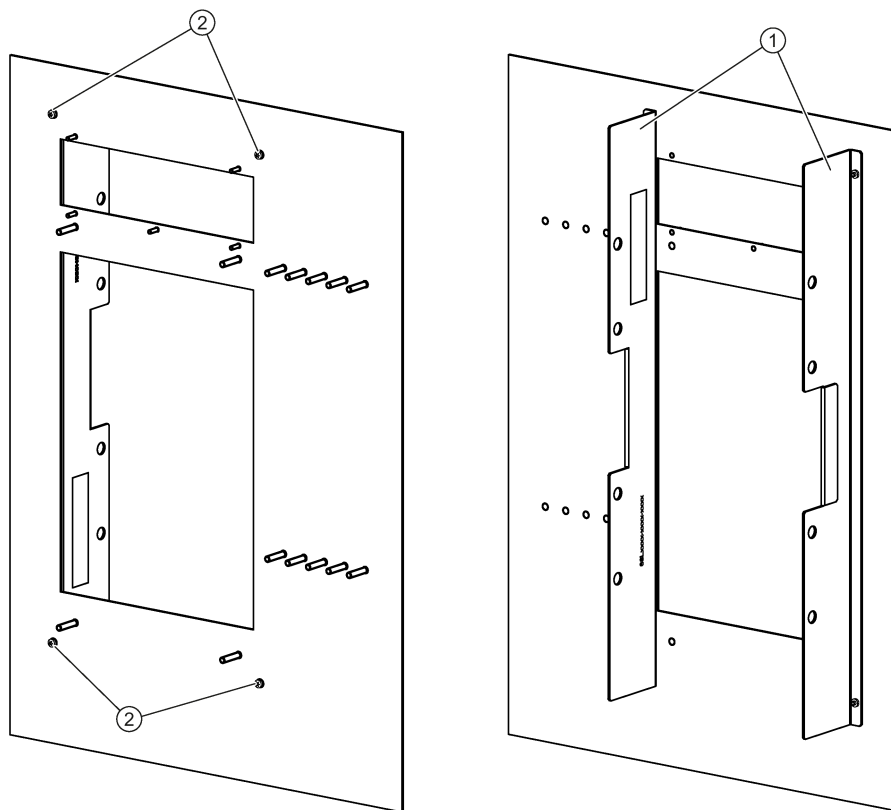
Locate the reinforcement plate on the mounting panel.



Screw the reinforcement plate at the top and bottom.

When installing the reinforcement plates, it is important to observe alignment.





- ① Reinforcement plates
② M4 x 10 screws



CAUTION

Burns due to incorrect mounting of the reinforcement plates

If the reinforcing plates are incorrectly mounted, this can result in an excessively high heat sink temperature and cause the S120 Combi Power Module to prematurely trip.

Contact with hot parts may cause you to suffer a burn injury.

- Follow the installation instructions when mounting the reinforcement plates.

3.8.2.3 Technical data

Reinforcement plates (6SL3161-1LP00-0AA0)	Unit	Value
Weight (2 units)	kg	1.5
Dimensions (W x H x D)	mm	15 x 575 x 75

3.8.3 Assembling a drip protection grid

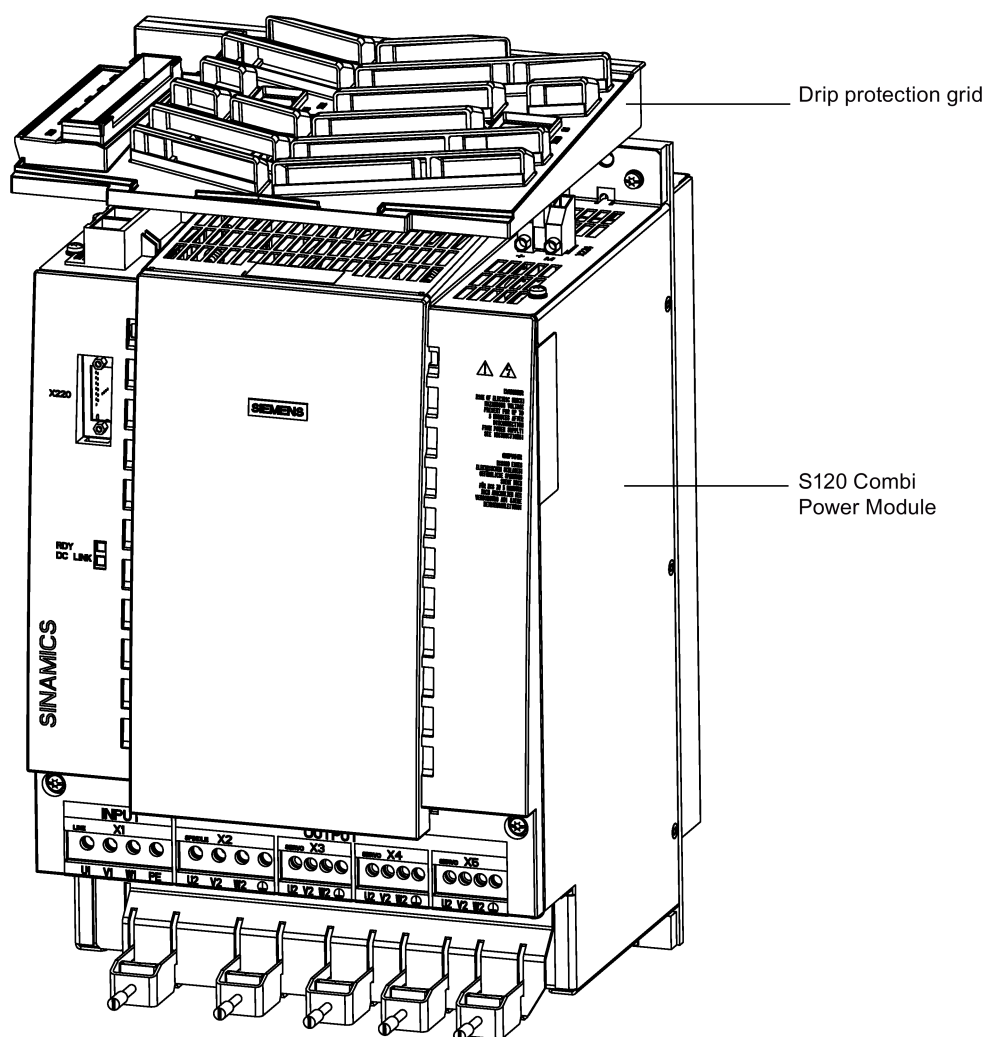
Drip protection grid 6SL3161-3DP00-0AA0 can be mounted on S120 Combi Power Modules in order to prevent liquids from dripping into the module. It is directly attached to the S120 Combi Power Modules.

You can order a drip protection grid for the following S120 Combi Power Modules:

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1

For the Power Module 6SL3111-4VE21-0EA1, a drip protection grid is provided when it is shipped from the factory.

The drip protection grid is not available to Power Modules frame type B.



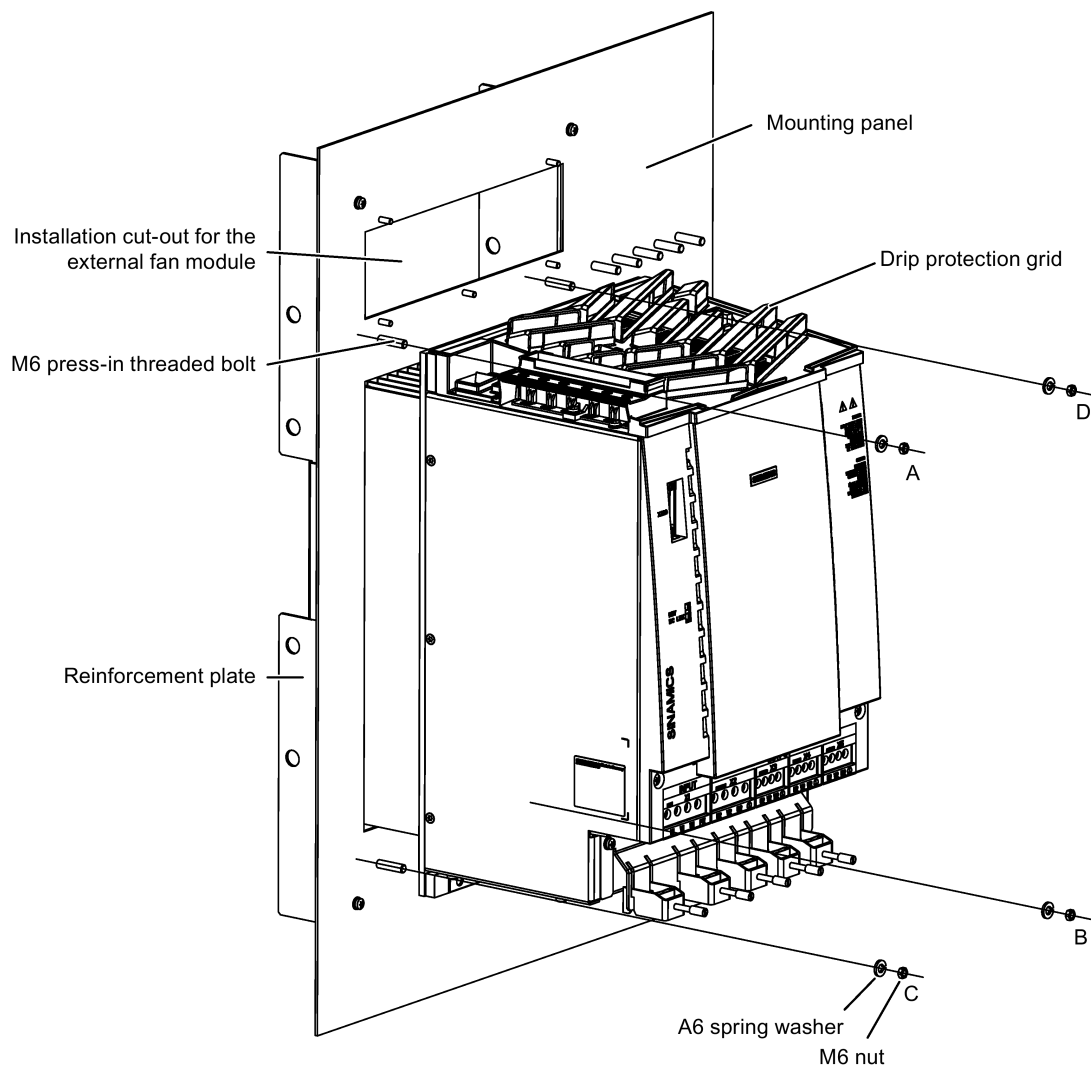
3.8.4 Installing an S120 Combi Power Module

To install the following S120 Power Modules, proceed steps below:

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1
- 6SL3111-4VE21-0EA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1

Steps:

1. Mount the M6 press-in threaded bolt to the mounting panel.
2. Push the S120 Combi Power Module through the installation cut-out.
3. Firstly tighten the M6 nuts by hand (0.5 Nm).
4. Then tighten the nuts in the specified sequence (A to D) with 10 Nm.
5. Install additional modules (for example, optional Motor Modules), if desired.



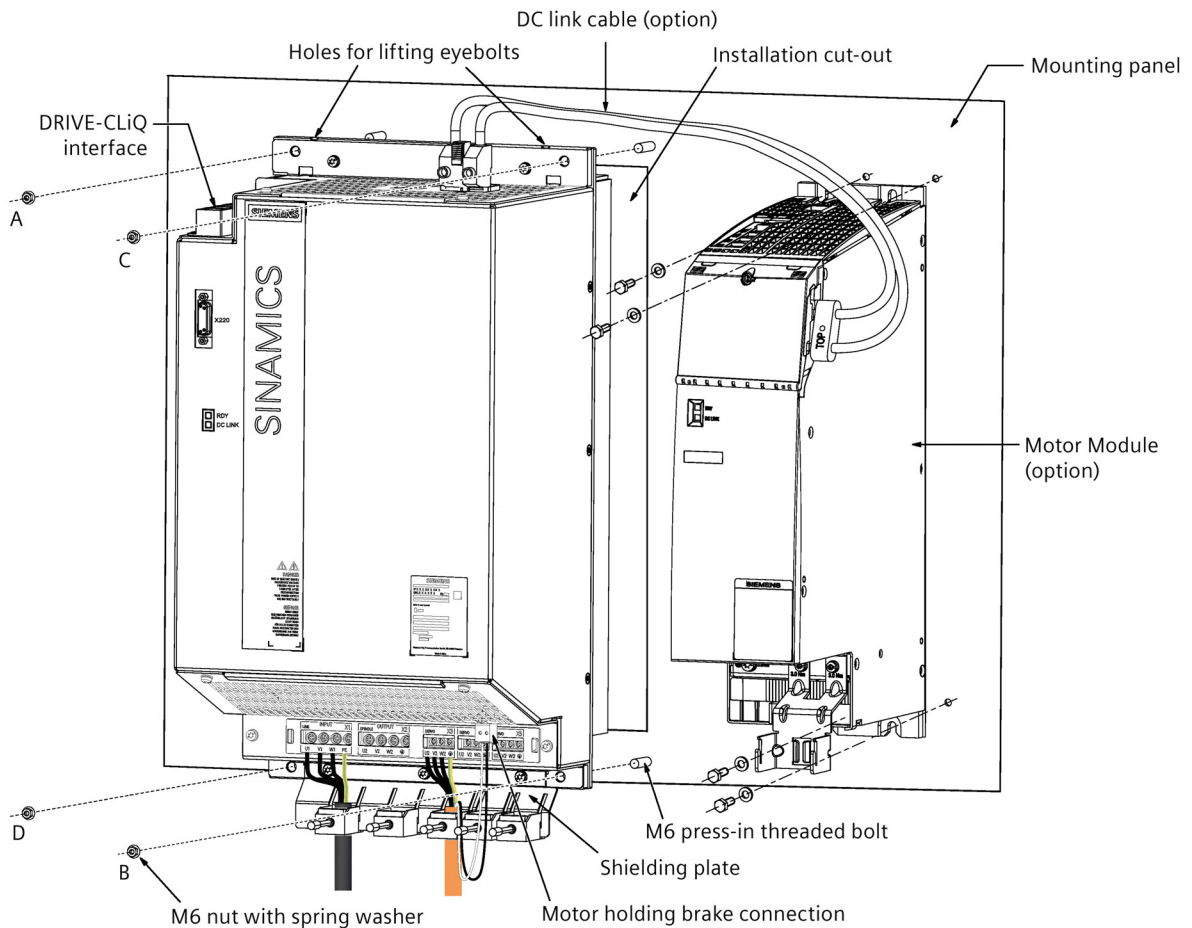
To install the following S120 Power Modules, proceed steps below:

- 6SL3111-3VE21-6FC1
- 6SL3111-3VE21-6EC1
- 6SL3111-3VE22-0HC1
- 6SL3111-4VE21-6FC1
- 6SL3111-4VE22-0HC1
- 6SL3111-4VE21-6ED2
- 6SL3111-4VE21-6ED1
- 6SL3111-4VE21-6EC1

Steps:

1. Mount the M6 press-in threaded bolt to the mounting panel.
2. Push the S120 Combi Power Module through the installation cut-out.
3. Firstly tighten the M6 nuts by hand (0.5 Nm).
4. Then tighten the nuts in the specified sequence (A to D) with 10 Nm.
5. Assemble the shielding plate to the S120 Combi Power Module with 1.8 Nm.
6. Install additional components (for example, optional Motor Modules), if desired.

Note: Before connecting the DC link cable, you need to open the DC link protective cover on the S120 Combi Power Module.



3.8.5 Installing the external fan modules

3.8.5.1 Overview

The S120 Combi provides an integrated fan control and supply for an external 24 V fan unit. The outputs are designed for a maximum total current of 2 A and are short-circuit and ground-fault proof.

Function

The following functions are available when using the external fan unit:

- Operating hours counter (see SINAMICS S120/S150 List Manual)
- Setting the maximum operating time (see SINAMICS S120/S150 List Manual)
- Evaluating fault signals

Installation type

For the following Power Modules, the fan is a separated part from the module. The fan unit is connected to the S120 Combi Power Module via the interface X12/X13.

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1
- 6SL3111-4VE21-0EA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1

For the following Power Modules, the fan is integrated to the heat sink of the S120 Combi Power Module; therefore, you do not need to mount it separately.

- 6SL3111-3VE21-6FC1
- 6SL3111-3VE21-6EC1
- 6SL3111-3VE22-0HC1
- 6SL3111-4VE21-6FC1
- 6SL3111-4VE22-0HC1
- 6SL3111-4VE21-6ED2
- 6SL3111-4VE21-6ED1
- 6SL3111-4VE21-6EC1

Note

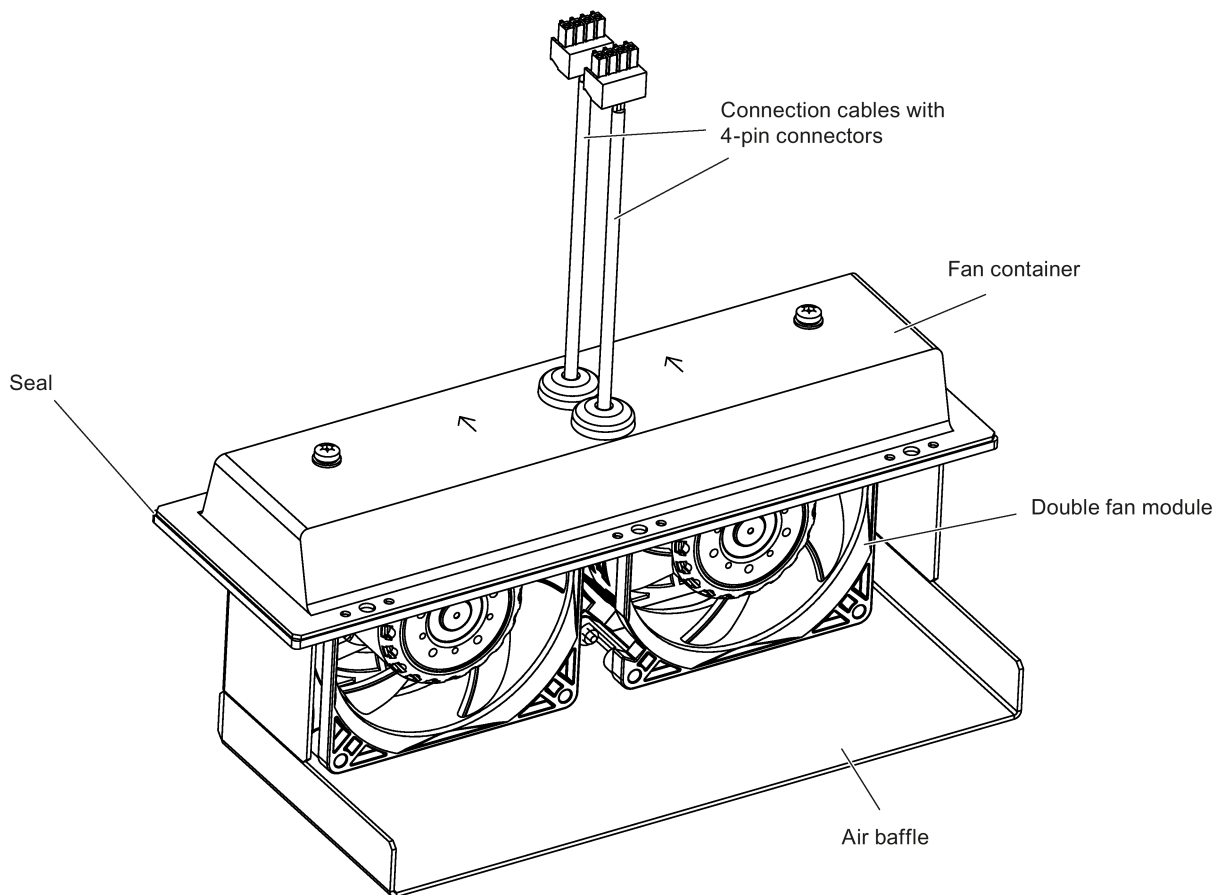
When a fan fails, the complete external fan unit must be replaced.

3.8.5.2 The separated external fan

Overview

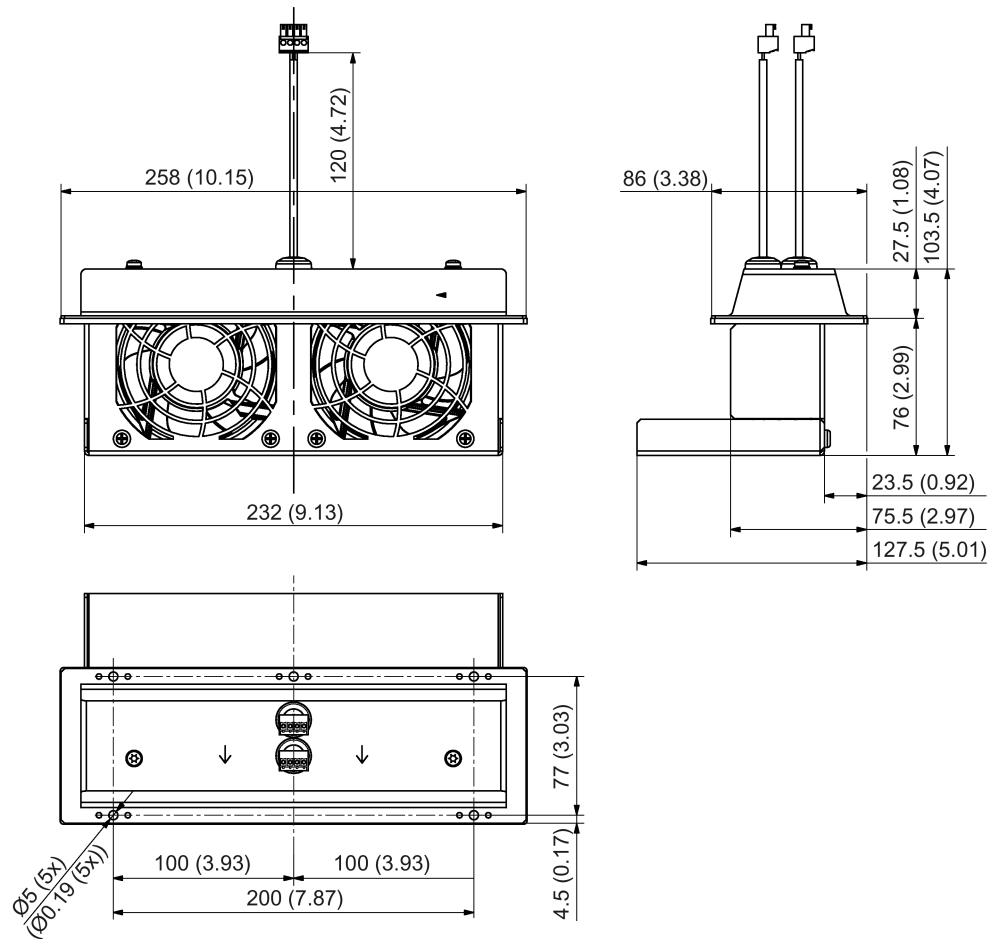
The separated external fan unit comprises the following components:

- Fan cradle with seal for installation in the control cabinet
- Connection cables with 4-pin connectors
- Double fan module
- Air baffle plate



Dimension drawing

Unit: mm (in)

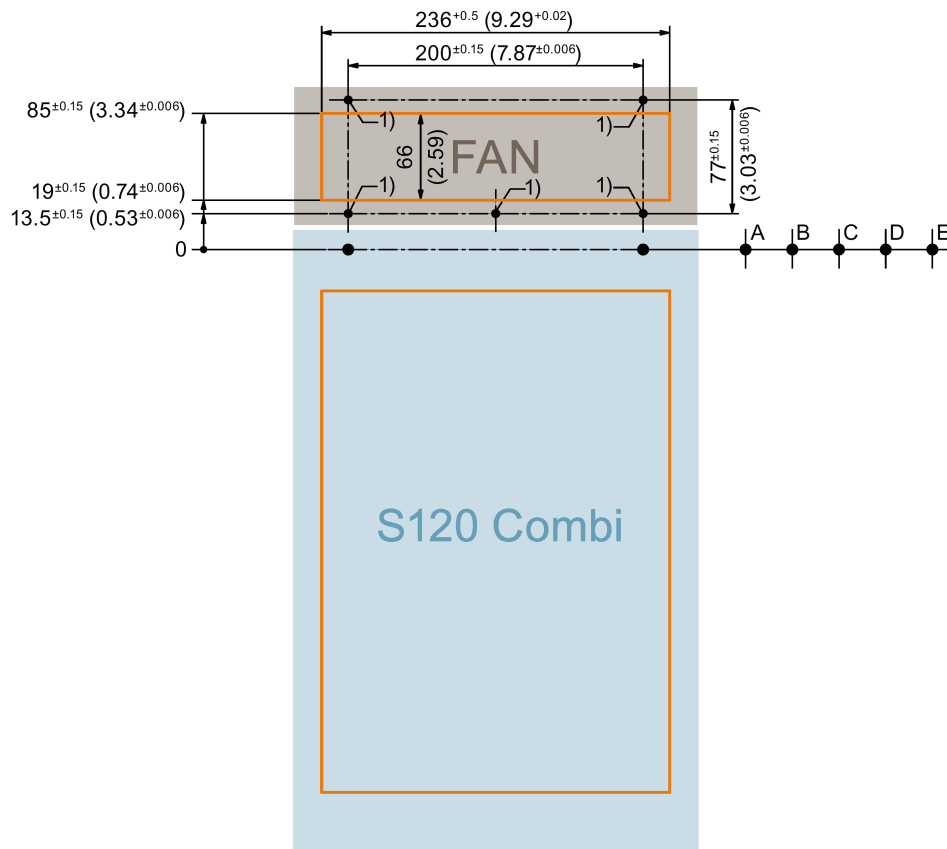


Installation

The external fan unit is always installed above the S120 Combi in the control cabinet.

Make an installation cut-out in the control cabinet panel. The position is dependent on the installation cut-out for the S120 Combi Power Module.

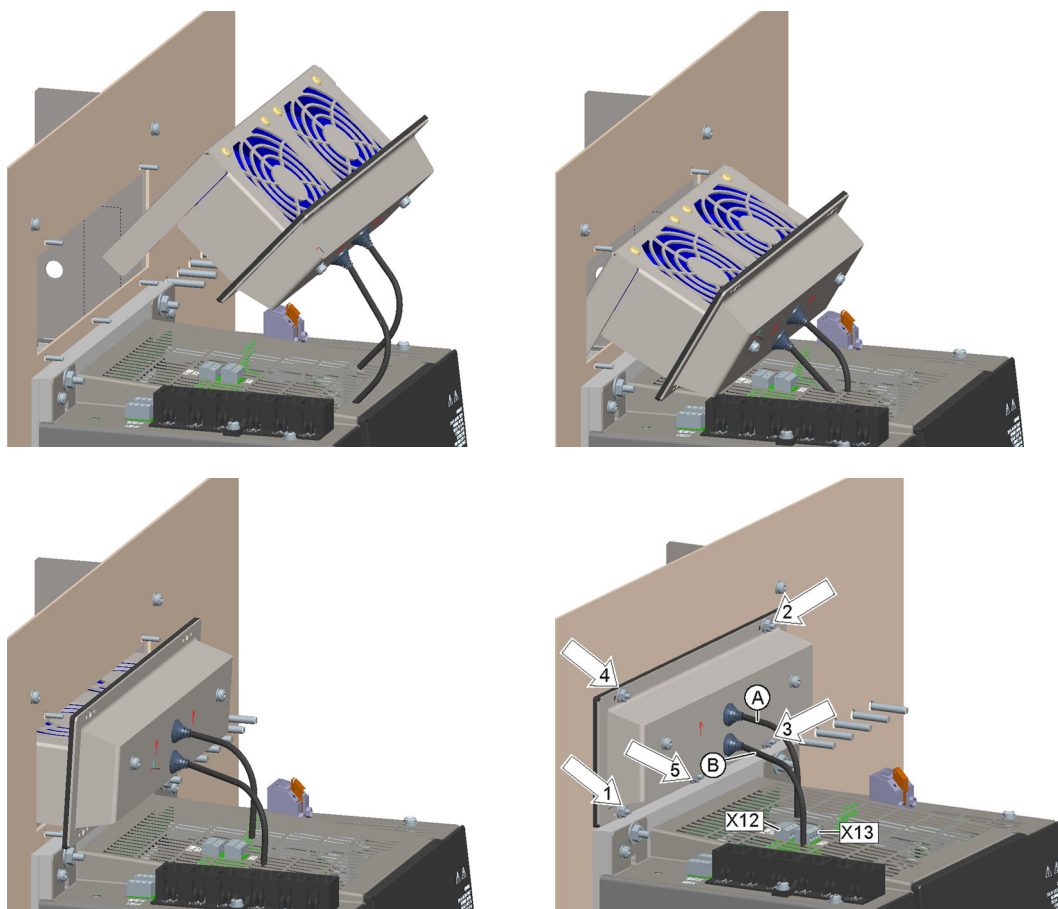
Unit: mm (in)



The zero line shown above runs at the height of the upper bolts used to mount the S120 Combi Power Module.

Procedure

1. Mount the self-clinching flush head studs to position 1) in the diagram above.
2. Mount the fan unit as shown below.
 - Install the fan to the installation cut-out
 - Tighten the nuts by hand with 0.5 Nm firstly and then tighten them in the specified mounting sequence 1 to 5 with a tightening torque of 1.8 Nm
3. Connect the power supply cables of the fan unit to the S120 Combi Power Module.
 - Cable A to terminal X12
 - Cable B to terminal X13



Mounting accessories

Designation	Number	Specification
Self-clinching flush head studs	5	M4, steel, strength class 8.8, zinc-plated, length: 15 mm
Nut	5	M4, steel, strength class 8, zinc-plated

Note

To remove the fan, proceed in reverse order.

The reinforcement plates must always be installed when operating the S120 Combi Power Modules with the external fan unit.



WRONG: S120 Combi and external fan unit without reinforcement plates



CORRECT: S120 Combi and external fan unit with installed reinforcement plates



CAUTION

Burning injury during operation without reinforcement plates

Operating without the reinforcement plates can result in an excessively high heat sink temperature and cause the S120 Combi Power Module to prematurely trip.

Contact with hot parts may cause you to suffer a burn injury.

- Only operate the S120 Combi with reinforcement plates.

Technical data

External fan (6SL3161-0EP00-0AA0)	Unit	Specification
Input voltage	V _{DC}	20.4 ... 28.8
Power consumption	W	18
Electronics current drawn at 24 V DC	A	0.8
Volumetric rate of air flow	m ³ /h	290
Service life	h	50000 at 55 °C
Dimensions (W x H x D)	mm	258 x 86 x 103.5
Weight	kg	1.5
Degree of protection	-	IP54

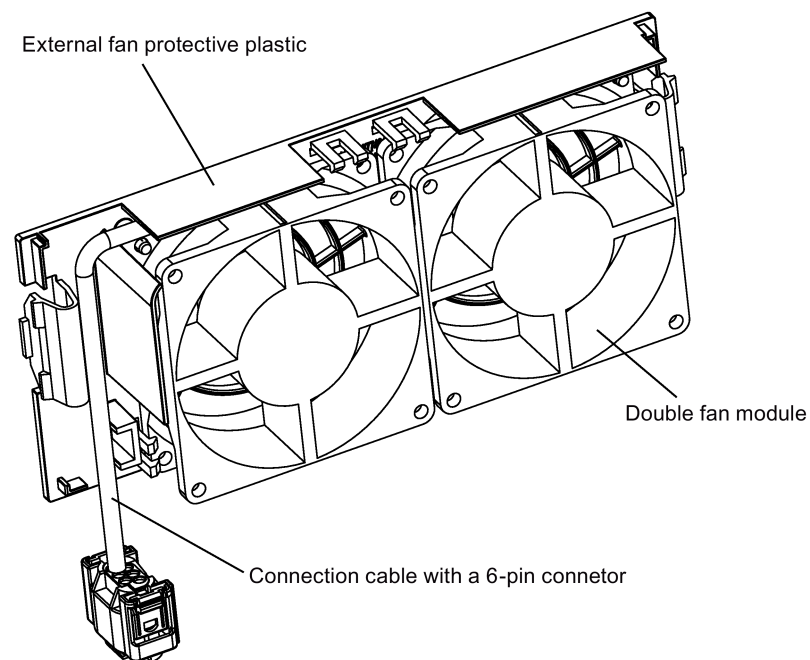
3.8.5.3 The integrated external fan

Overview

The integrated external fan is assembled on the heat sink of the S120 Combi Power Module at delivery. You can order it from Siemens as a spare part (article number: 6SL3161-0EQ00-0AA0) if the replacement is necessary. For the replacement process, see Section "Removing (Page 82)".

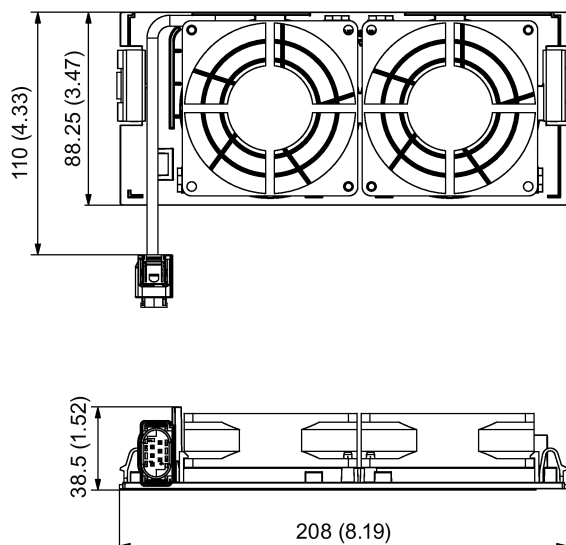
The integrated external fan unit comprises the following components:

- Connection cable with a 6-pin connector
- Double fan module
- External fan protective plastic



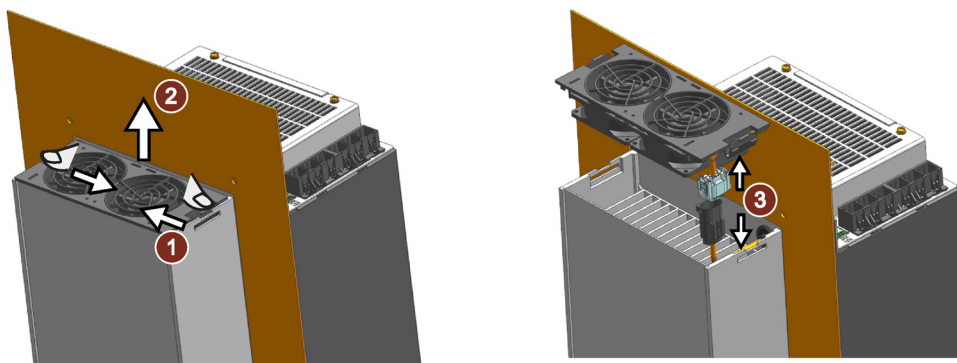
Dimension drawing

Unit: mm (in)



Removing

1. Press the clamp and lift the fan unit straight up to remove it from the heat sink.
2. Disconnect the cable connector.



CAUTION

Risk of injury due to removing the external fan

When removing the integrated external fan from the heat sink, your fingers may be cut by the edge of the heat sink.

- Use the appropriate personnel protection equipment, for example, gloves.

Note

To reinstall the fan, proceed in reverse order.

Technical data

External fan (6SL3161-0EQ00-0AA0)	Unit	Specification
Input voltage	V _{DC}	20.4 ... 28.8
Power consumption	W	16.8
Rated current	A	0.7
Volumetric rate of air flow	m ³ /h	246
Service life	h	70000 at 40 °C
Dimensions (W x H x D)	mm	208 × 88.25 × 38.5
Weight	kg	0.3
Degree of protection	-	IP54

3.9 Electrical connection

3.9.1 Stripped length for the line supply and power cables

Non-prefabricated MOTION-CONNECT power cables must be appropriately prepared before being connected to the S120 Combi.

Note

Special issue for UL applications

For UL applications, use 75 °C copper cables.

Cables without connection cables for the motor holding brake

1. Cut the cable jacket to dimension A from the table below
2. Strip the single cores U, V, W and protective conductor, and crimp on end sleeves with insulation support (according to DIN 46228-E)

Cables with connection cables for the motor holding brake

1. Cut the cable jacket to 250 ±5 mm
2. Cut the single cores U, V, W and protective conductor to dimension A from the table below, strip and crimp on end sleeves with insulation support (according to DIN 46228-E)
3. Strip the connection cables for the motor holding brake and screw to the brake connector



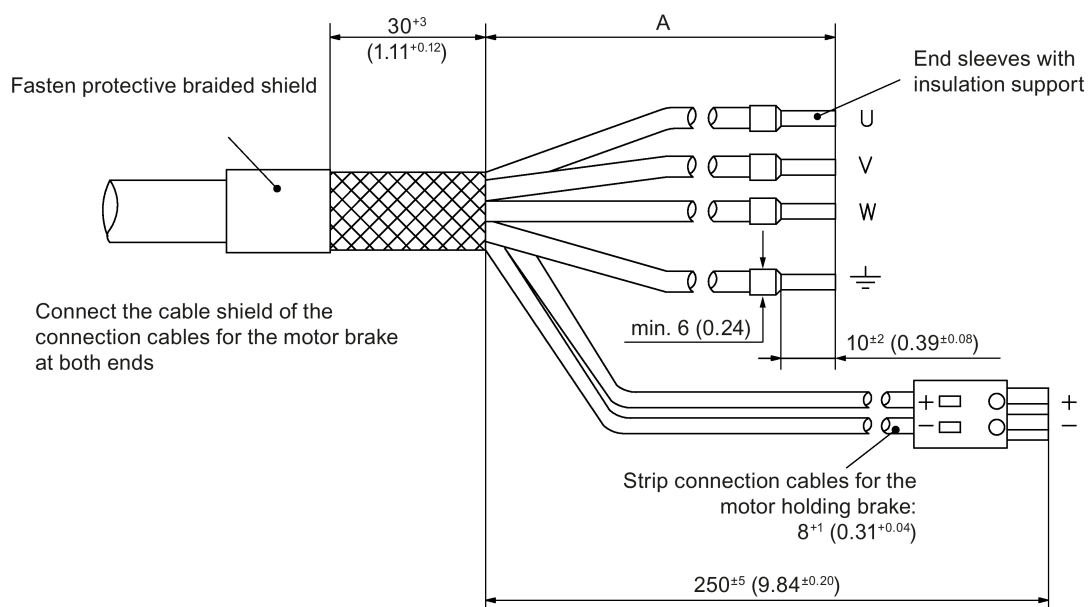
WARNING

Electric shock when using end sleeves without insulation support

If you use end sleeves without insulation support (according to DIN 46228-A), there is a danger of touching live parts with your fingers.

- Establish touch protection by using shrink tubing

Unit: mm (in)



Cable cross-section (unit: mm ²)	A (unit: mm (in))
4 x 1.5	55 $\pm$ 3 (2.17 $\pm$ 0.12)
4 x 2.5	55 $\pm$ 3 (2.17 $\pm$ 0.12)
4 x 4	55 $\pm$ 3 (2.17 $\pm$ 0.12)
4 x 6	55 $\pm$ 2 (2.17 $\pm$ 0.08)
4 x 10	55 $\pm$ 2 (2.17 $\pm$ 0.08)

3.9.2 Line supply cable

Shielded MOTION-CONNECT 500 and 800 line supply cables are recommended in order to maintain the EMC limit values. The line supply cable is connected at interface X1 (INPUT). The single cores of the cable are labeled with U, V, W and PE. Cables are connected at the S120 Combi corresponding to the terminal labeling.

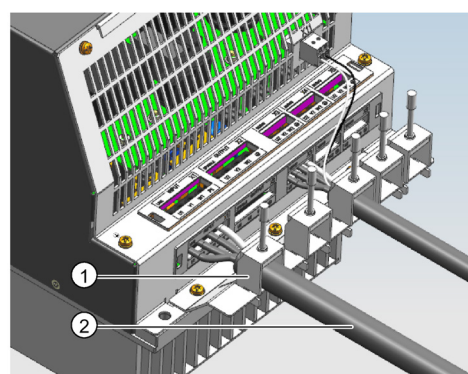
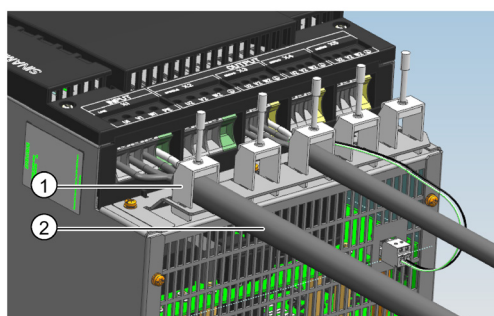
The cable shield should be connected and fixed using the shield clamp.

The left diagram shows the line supply cable connection of the following Power Modules:

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1
- 6SL3111-4VE21-0EA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1

The right diagram shows the line supply cable connection of the following Power Modules:

- 6SL3111-3VE21-6FC1
- 6SL3111-3VE21-6EC1
- 6SL3111-3VE22-0HC1
- 6SL3111-4VE21-6FC1
- 6SL3111-4VE22-0HC1
- 6SL3111-4VE21-6ED2
- 6SL3111-4VE21-6ED1
- 6SL3111-4VE21-6EC1



- ① Shield clamp
- ② Line supply cable

NOTICE

Damage to the shield clamp when strain relief is not used

The shield clamp does not provide strain relief. In the event that strain relief of the line supply cable is not carried out separately using appropriate measures, the shield clamp may be damaged.

- Install additional strain relief for the line supply cable.

NOTICE

Damage to unshielded line supply cables due to shield clamps

When fixing the unshielded line supply cables using shield clamps, the unshielded individual cores can be damaged by the shield clamp.

- Only use the shield clamp for shielded line supply cables.

3.9.3 Power cables for motors

The motor power cables are connected at interfaces X2 to X5. The single cores of the cable are labeled with U, V, W and $\perp$. The cables are connected corresponding to the terminal labels at the S120 Combi.

When using a power cable with connection cables for the motor holding brake, the cores for the motor holding brake are connected at interface X11 (see the diagram below). In this case, connect the cable shield of all cable cores. Fix the cable shield using the shield clamp.

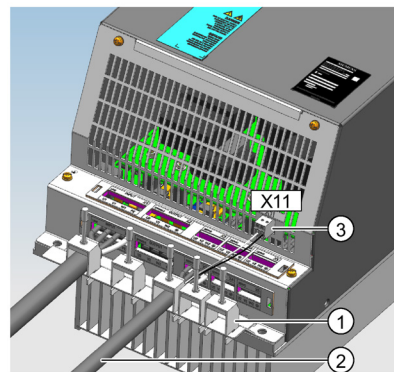
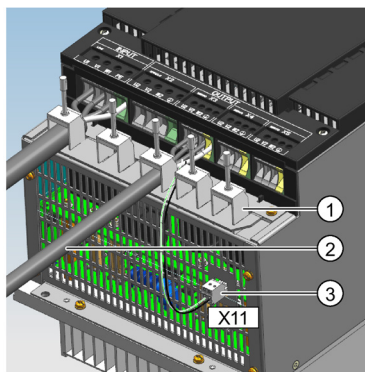
When using a separate cable for the motor holding brake, its cable shield should be connected to the associated shield support of the motor power cable.

The left diagram shows the power cable connection of the following Power Modules:

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1
- 6SL3111-4VE21-0EA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1

The right diagram shows the power cable connection of the following Power Modules:

- 6SL3111-3VE21-6FC1
- 6SL3111-3VE21-6EC1
- 6SL3111-3VE22-0HC1
- 6SL3111-4VE21-6FC1
- 6SL3111-4VE22-0HC1
- 6SL3111-4VE21-6ED2
- 6SL3111-4VE21-6ED1
- 6SL3111-4VE21-6EC1



- ① Shield clamp
- ② Power cables with connection cables for the motor holding brake
- ③ Connector for the motor holding brake

NOTICE**Damage to the shield clamp when strain relief is not used**

The shield clamp does not provide strain relief. In the event that strain relief of the power cable is not carried out separately using appropriate measures, the shield clamp may be damaged.

- Install additional strain relief for the power cable.

NOTICE**Damage to unshielded power cables due to shield clamps**

When fixing the unshielded power cables using shield clamps, the unshielded individual cores can be damaged by the shield clamp.

- Only use the shield clamp for shielded power cables.

3.10 Technical data

3.10.1 General technical data

3.10.1.1 System data

Electrical data

Line supply voltage	3 AC 380 V - 10% ... 3 AC 480 V + 10%
Line frequency	50/60 Hz (45 Hz ... 66 Hz)
Line supply types	TN, TT, and IT
Electronics power supply	24 VDC 15/20% ¹⁾ , safety extra-low voltage PELV or SELV (see Section 24 V DC supply (Page 168))
Rated short-circuit current SCCR according to UL61800-5-1	65 kA
Radio interference suppression	Category C2 according to EN 61800-3 For system versions in conformance with the documentation
Overvoltage category	III According to IEC 61800-5-1, EN 61800-5-1, UL 61800-5-1 and CSA C22.2 No 274
Pollution degree	2 ²⁾ According to IEC 61800-5-1, EN 61800-5-1, UL 61800-5-1 and CSA C22.2 No 274

¹⁾ If a motor holding brake is used, restricted voltage tolerances (24 V ± 10%) may have to be taken into account.

²⁾ The components must be protected against conductive pollution, e.g. by installing them in a control cabinet with degree of protection IP54 according to IEC 60529 or Type 12 according to NEMA 250. If conductive pollution can be excluded at the installation site, a lower degree of cabinet protection may be permitted.

Protection degree/protection class

Protection degree	IPXXB according to EN 60529, open type according to UL/CSA
Protection class Power circuits Electronic circuits	I (with protective conductor connection) Safety extra-low voltage PELV/SELV

Environmental conditions

Chemically active substances	
Long-term storage	Class 1C2 according to EN 60721-3-1, in product packaging ¹⁾
Transport	Class 2C2 according to EN 60721-3-2, in transport packaging ²⁾
Operation	Class 3C2 according to EN 60721-3-3
Biological environmental conditions	
Long-term storage	Class 1B1 according to EN 60721-3-1, in product packaging ¹⁾
Transport	Class 2B1 according to EN 60721-3-2, in transport packaging ²⁾
Operation	Class 3B1 according to EN 60721-3-3
Climatic environmental conditions	
Long-term storage	Class 1K4 according to EN 60721-3-1, in product packaging ¹⁾ Temperature: -25 °C ... +55 °C
Transport	Class 2K4 according to EN 60721-3-2, in transport packaging ²⁾ Temperature: -40 ... +70 °C
Operation	Class 3K3 according to EN 60721-3-3 with increased ruggedness with respect to relative humidity Temperature: 0° C ... + 45 °C: without derating + 45° C ... + 55 °C: with reduction of the output current by 4.0% per °C Relative humidity: 5% ... 95%: without condensation (better than Class 3K3) Oil mist, salt mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted
Mechanical environmental conditions	
Long-term storage	Class 1M2 according to EN 60721-3-1, in product packaging ¹⁾
Transport	Class 2M3 according to EN 60721-3-2, in transport packaging ²⁾
Operation Vibration test in operation Shock test in operation	Class 3M1 according to EN 60721-3-3 In accordance with IEC 60068-2-6 Test Fc (sinusoidal) 9 ... 29 Hz: 0.3 mm deflection amplitude 29 ... 200 Hz: 1 g acceleration amplitude 10 frequency cycles per axis In accordance with IEC 60068-2-27 Test Ea (half-sine) 5 g peak acceleration 30 ms duration 3 shocks in all three axes in both directions

Installation altitude	
Operation	0 m ... 1000 m above sea level: without derating 1000 m ... 4000 m above sea level: either of the following requirements need to be satisfied - Reducing the output current by 10% per 1000 meters - Reducing the ambient temperature by 5 °C per 1000 meters 2000 m ... 4000 m above sea level: either of the following requirements need to be satisfied - Connecting to line supply systems with grounded neutral point - Connecting to line supply systems via an isolating transformer with secondary grounded neutral

- 1) Product packaging (storage packaging) is individual packaging for storage - and does not satisfy the requirements for transport. As a consequence, product packaging is therefore not suitable for shipping.
- 2) Transport packaging is either packaging that is directly suitable for transport - or secondary packaging, which together with the product packaging, satisfies the requirements for transport.

Certificates

Approvals	CE, UL, RCM, KC, EAC, UKCA For the UL approval: - cURus for the following S120 Combi Power Modules: 6SL3111-3VE21-6FA2 6SL3111-3VE21-6EA1 6SL3111-3VE22-0HA1 6SL3111-4VE21-0EA1 6SL3111-4VE21-6FA2 6SL3111-4VE21-6EA1 6SL3111-4VE22-0HA1 - cULus for the following S120 Combi Power Modules: 6SL3111-3VE21-6FC1 6SL3111-3VE21-6EC1 6SL3111-3VE22-0HC1 6SL3111-4VE21-6FC1 6SL3111-4VE22-0HC1 6SL3111-4VE21-6ED2 6SL3111-4VE21-6ED1 6SL3111-4VE21-6EC1
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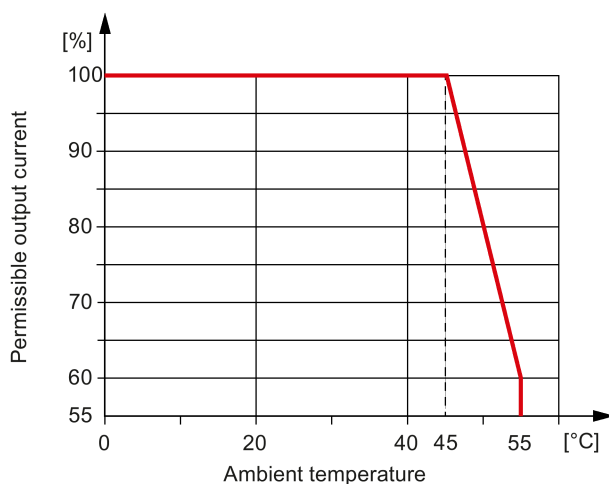
3.10.1.2 Derating as a function of the installation altitude and ambient temperature

The S120 Combi Power Modules are designed for operation at an ambient temperature of 45 °C, installation altitudes up to 1000 m above sea level and the specified pulse frequency.

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

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

The output current must be reduced if the Combi Power Modules are operated at ambient temperatures above 45 °C. Ambient temperatures above 55 °C are not permissible.



Further information about derating the output current of Combi Power Modules can be found in Section "System data (Page 87)".

3.10.2 Specific technical data

3.10.2.1 3 axes Power Modules

3 axes Power Modules (6SL3111-3VE2...)	Unit	1-6FA2	1-6EA1	2-0HA1	1-6FC1	1-6EC1	2-0HC1
Infeed							
Infeed							
Rated power (S1) ¹⁾	kW (P _n)	16	16	20	16	16	20
Infeed power for S6 duty P _{S6} (40 %) ¹⁾	kW (P _{S6})	21	21	26.5	21	21	26.5
Peak infeed power ¹⁾	kW (P _{max})	35	35	40	35	35	40
Regenerative feedback							
Rated power (S1)	kW (P _n)	16	16	20	16	16	20
Peak regenerative power	kW (P _{max})	35	35	40	35	35	40
Supply voltages							
Line voltage	V _{AC}	3 AC 380 – 10 % ... 3 AC 480 + 10 %					
Line frequency	Hz	50/60 (45 ... 66)					
Electronics power supply	V _{DC}	24 (20.4 ... 28.8)					
Rated input current							
at 400 V AC	A _{AC}	28	28	34	28	28	34
at 380 V AC / 480 V AC	A _{AC}	29/25	29/25	35/30	29/25	29/25	35/30
at 400 V; for S6 duty I _{S6} (40 %)	A _{AC}	35.5	35.5	44	35.5	35.5	44
at 400 V AC peak current	A _{AC}	56	56	63.5	56	56	63.5
Spindle - X2							
Output current							
Rated current (I _n)	A _{ACrms}	18	24	30	18	24	30
Intermittent duty current for S6 duty I _{S6} (40%)	A _{ACrms}	24	32	40	24	32	40
Peak current (I _{max})	A _{ACrms}	36	48	56	36	48	56
Rated power							
at 540 V DC link voltage	kW	8.7	11.7	14.4	8.7	11.7	14.4
at 600 V DC link voltage	kW	9.7	13	16	9.7	13	16
Pulse frequency spindle	kHz	4	4	4	4	4	4
Output voltage	V _{ACrms}	0 ... 0.7 x DC link voltage					
Feed 1 - X3							
Output current							
Rated current (I _n)	A _{ACrms}	9	9	9	9	9	9
Intermittent duty current for S6 duty I _{S6} (40%)	A _{ACrms}	12	12	12	12	12	12
Peak current (I _{max})	A _{ACrms}	18	18	18	18	18	18
Rated power							
at 540 V DC link voltage	kW	4.3	4.3	4.3	4.3	4.3	4.3
at 600 V DC link voltage	kW	4.8	4.8	4.8	4.8	4.8	4.8
Pulse frequency feed 1	kHz	4	4	4	4	4	4
Output voltage	V _{ACrms}	0 ... 0.7 x DC link voltage					
Feed 2 - X4							
Output current							
Rated current (I _n)	A _{ACrms}	9	9	9	9	9	9
Intermittent duty current for S6 duty I _{S6} (40%)	A _{ACrms}	12	12	12	12	12	12
Peak current (I _{max})	A _{ACrms}	18	18	18	18	18	18
Rated power							
at 540 V DC link voltage	kW	4.3	4.3	4.3	4.3	4.3	4.3
at 600 V DC link voltage	kW	4.8	4.8	4.8	4.8	4.8	4.8
Pulse frequency feed 2	kHz	4	4	4	4	4	4
Output voltage	V _{ACrms}	0 ... 0.7 x DC link voltage					

3.10 Technical data

3 axes Power Modules (6SL3111-3VE2...)	Unit	1-6FA2	1-6EA1	2-0HA1	1-6FC1	1-6EC1	2-0HC1
Output for expansion axis							
DC link voltage	V _{DC}	460 ... 720					
DC link output current (I _n)	A _{DC}	40					
Max. electronics output current for expansion axis	A _{24Vmax}	20					
General data							
Electronics current drawn at 24 V DC without external fan unit with external fan unit	A	1.5	1.5	1.5	1.5	1.5	1.5
	A	2.3	2.3	2.3	2.3	2.3	2.3
Total power loss (including losses from the electronics, see Power loss tables (Page 194)) internal external The external fan module is taken into account for the specified losses – also see Power loss calculation for partial load operation (Page 196).	W	470	537	634	470	537	634
	W	91	91	102	91	91	102
	W	379	446	532	379	446	532
Max. ambient temperature Without derating With derating	°C	45	45	45	45	45	45
	°C	55	55	55	55	55	55
DC link voltage	V _{DC}	460 ... 720					
Overvoltage tripping	V _{DC}	820 ± 2 %					
Undervoltage tripping	V _{DC}	380 ± 2 %					
Circuit breaker/fuse (IEC 60947 and UL)	-	See Chapter Line-side overcurrent protective devices (Page 110)					
Resulting rated short-circuit current SCCR at 480 V AC	kA	65	65	65	65	65	65
Cooling method	-	External air cooling					
Cooling air requirement	m³/h	160	160	160	160	160	160
Weight	kg	17.56	17.76	17.97	18.80	18.80	19.00

¹⁾ The specified power ratings apply to the line voltage range from 380 V to 480 V

3.10.2.2 4 axes Power Modules

4 axes Power Modules (6SL3111-4VE2...)		Unit	1-0EA1	1-6FA2	1-6EA1	1-6EC1	1-6ED1	2-0HA1	1-6FC1	2-0HC1	1-6ED2
Infeed											
Infeed											
Rated power P _n (S1) ¹⁾	kW	10	16	16	16	16	20	16	20	16	16
Infeed power for S6 duty P _{S6} (40%) ¹⁾	kW	13	21	21	21	21	26.5	21	26.5	21	21
Peak infeed power P _{max} ¹⁾	kW	35	35	35	35	35	40	35	40	35	35
Regenerative feedback											
Rated power P _n (S1)	kW	10	16	16	16	16	20	16	20	16	16
Peak regenerative power P _{max}	kW	35	35	35	35	35	40	35	40	35	35
Supply voltages											
Line voltage	V _{AC}	3 AC 380 - 10% ... 3 AC 480 + 10%									
Line frequency	Hz	50/60 (45 ... 66)									
Electronics power supply	V _{DC}	24 (20.4 ... 28.8)									

4 axes Power Modules (6SL3111-4VE2...)	Unit	1-0EA1	1-6FA2	1-6EA1	1-6EC1	1-6ED1	2-0HA1	1-6FC1	2-0HC1	1-6ED2
Rated input current at 400 VAC at 380 VAC / 480 VAC at 400 V; for S6 duty Is6 (40%) at 400 VAC peak current	AAC AAC AAC AAC	16.2 17/12.8 21.1 56.7	28 29/25 35.5 56	28 29/25 35.5 56	28 29/25 35.5 56	28 29/25 35.5 56	34 35/30 44 63.5	28 29/25 35.5 56	34 35/30 44 63.5	28 29/25 35.5 56
Spindle - X2										
Output current Rated current (In) Intermittent duty current for S6 duty Is6 (40%) ²⁾ Peak current (Imax)	AACrms AACrms AACrms	24 32 at 4 kHz 19.2 at 8 kHz 60	18 24 36	24 32 48	24 32 48	24 32 48	30 40 56	18 24 36	30 40 56	24 32 at 4 kHz 19.2 at 8 kHz 72
Rated power at 540 V DC link voltage at 600 V DC link voltage	kW kW	11.7 13	8.7 9.7	11.7 13	11.7 13	11.7 13	14.4 16	8.7 9.7	14.4 16	11.7 13
Pulse frequency spindle	kHz	4/8	4	4	4	4	4	4	4	4/8
Output voltage	VACrms	0 ... 0.7 x DC link voltage								
Feed 1 - X3										
Output current Rated current (In) Intermittent duty current for S6 duty Is6 (40%) Peak current (Imax)	AACrms AACrms AACrms	12 16 36	9 12 18	9 12 18	12 16 24	12 16 36	12 16 24	9 12 18	12 16 24	12 16 36
Rated power at 540 V DC link voltage at 600 V DC link voltage	kW kW	5.8 6.5	4.3 4.8	4.3 4.8	5.8 6.5	5.8 6.5	5.8 6.5	4.3 4.8	5.8 6.5	5.8 6.5
Pulse frequency feed 1	kHz	4	4	4	4	4	4	4	4	4
Output voltage	VACrms	0 ... 0.7 x DC link voltage								
Feed 2 - X4										
Output current Rated current (In) Intermittent duty current for S6 duty Is6 (40%) Peak current (Imax)	AACrms AACrms AACrms	12 16 36	9 12 18	9 12 18	9 12 18	9 12 27	9 12 18	9 12 18	9 12 18	9 12 27
Rated power at 540 V DC link voltage at 600 V DC link voltage	kW kW	5.8 6.5	4.3 4.8	4.3 4.8	4.3 4.8	4.3 4.8	4.3 4.8	4.3 4.8	4.3 4.8	4.3 4.8
Pulse frequency feed 2	kHz	4	4	4	4	4	4	4	4	4
Output voltage	VACrms	0 ... 0.7 x DC link voltage								
Feed 3 - X5										
Output current Rated current (In) Intermittent duty current for S6 duty Is6 (40%) Peak current (Imax)	AACrms AACrms AACrms	12 16 36	9 12 18	9 12 18	9 12 18	9 12 27	9 12 18	9 12 18	9 12 18	9 12 27
Rated power at 540 V DC link voltage at 600 V DC link voltage	kW kW	5.8 6.5	4.3 4.8	4.3 4.8	4.3 4.8	4.3 4.8	4.3 4.8	4.3 4.8	4.3 4.8	4.3 4.8
Pulse frequency feed 3	kHz	4	4	4	4	4	4	4	4	4
Output voltage	VACrms	0 ... 0.7 x DC link voltage								

3.10 Technical data

4 axes Power Modules (6SL3111-4VE2...)	Unit	1-0EA1	1-6FA2	1-6EA1	1-6EC1	1-6ED1	2-0HA1	1-6FC1	2-0HC1	1-6ED2
Output for expansion axis										
DC link voltage	V _{DC}	460 ... 720								
DC link output current (I _N)	A _{DC}	18.5	40	40	36	36	40	40	40	40
Max. electronics output current for expansion axis	A _{24Vmax}	20								
General data										
Electronics current consumption 24 VDC Without external fan unit With external fan unit	A A	1.6 2.4	1.6 2.4	1.6 2.4	1.6 2.3	1.6 2.3	1.6 2.4	1.6 2.4	1.6 2.4	1.6 2.4
Total power loss (including losses from the electronics, see Power loss tables (Page 95)) internal external The external fan module is taken into account for the specified losses – also see Power loss calculation for partial load operation (Page 196).	W	770	547	607	659	659	733	547	733	805
	W	115	100	100	100	100	113	100	113	116
	W	655	447	507	559	559	620	447	620	689
Max. ambient temperature Without derating With derating	°C °C	45 55	45 55	45 55	45 55	45 55	45 55	45 55	45 55	45 55
DC link voltage	V _{DC}	460 ... 720								
Overvoltage tripping	V _{DC}	820 ± 2%								
Undervoltage tripping	V _{DC}	380 ± 2%								
Circuit breaker/fuse (IEC 60947 and UL)	-	See Section Line-side overcurrent protective devices (Page 110)								
Resulting rated short-circuit current SCCR at 480 VAC	kA	65	65	65	65	65	65	65	65	65
Cooling method	-	External air cooling								
Cooling air requirement	m³/h	160	160	160	160	160	160	160	160	160
Weight	kg	18.43	18.01	18.11	19.64	19.64	18.33	19.30	19.30	19.30

- 1) The specified power ratings apply to the line voltage range from 380 V to 480 V
- 2) For operation with an 8 kHz pulse frequency, when using duty cycle S6 with a switch-on duration of 40%, a derating to 60% is required. Derating is required for S6 duty I_{s6} (40%), not for peak current I_{max}, also see characteristic "Rated duty cycles, spindle for a pulse frequency of 8 kHz".

3.10.3 Characteristic curves

3.10.3.1 Rated duty cycles

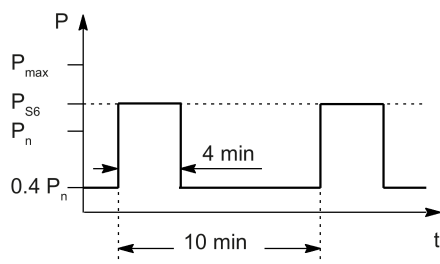
Note

For the S120 Combi Power Modules, the spindle and feed axes cannot work at their rated power at the same time because that they share the power of the infeed which is fixed for a Power Module.

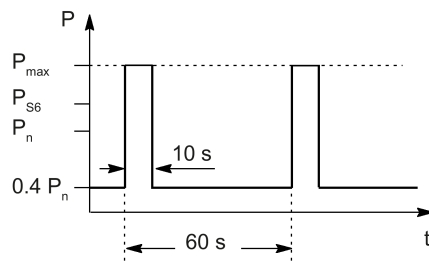
The following rated duty cycles apply to the Power Modules:

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1
- 6SL3111-3VE21-6FC1
- 6SL3111-3VE21-6EC1
- 6SL3111-3VE22-0HC1
- 6SL3111-4VE21-6FC1
- 6SL3111-4VE22-0HC1

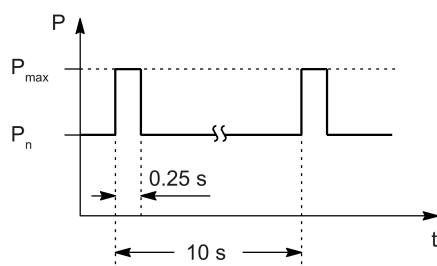
Rated duty cycles, infeed



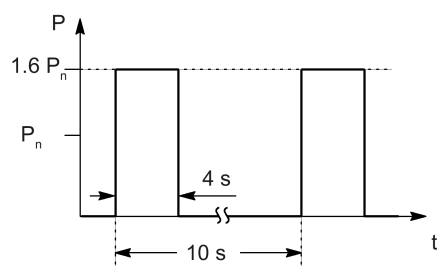
S6 duty cycle with initial load



S6 peak power load cycle with initial load

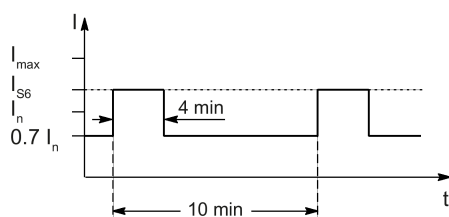


Peak power load cycle with initial load

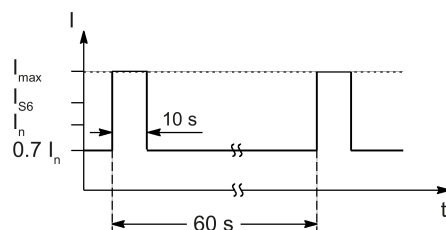


Peak power load duty cycle without initial load

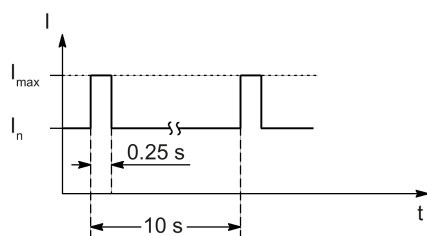
Rated duty cycles, spindle and feed (4 kHz pulse frequency)



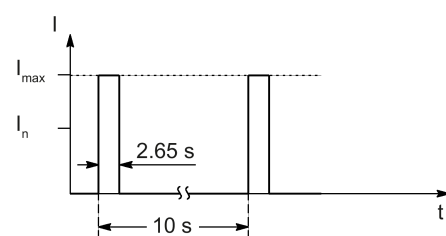
S6 duty cycle with initial load for a duty cycle duration of 600 s



S6 duty cycle with initial load for a duty cycle duration of 60 s



Peak current duty cycle with initial load

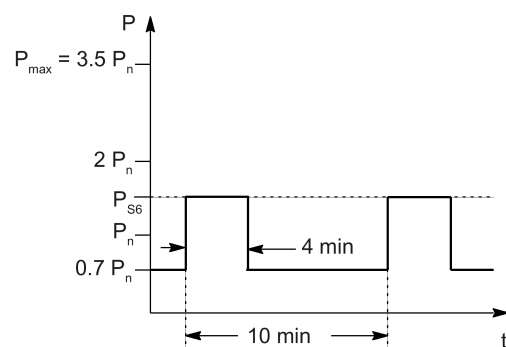


Peak current duty cycle without initial load

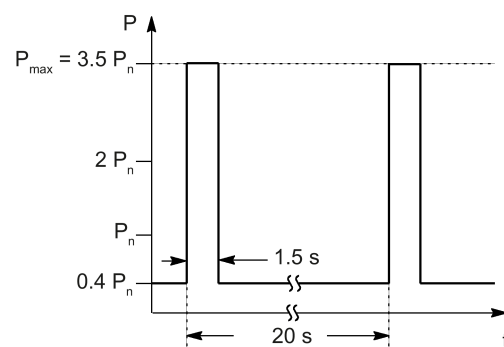
The following rated duty cycles apply to the Power Module:

- 6SL3111-4VE21-0EA1

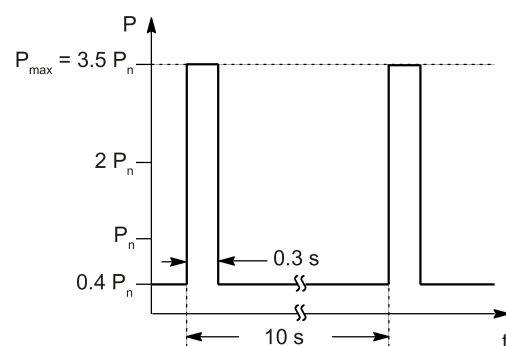
Rated duty cycles, infeed



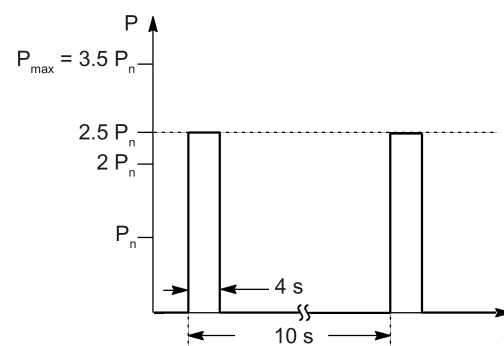
S6 duty cycle with initial load



Peak power load cycle with initial load

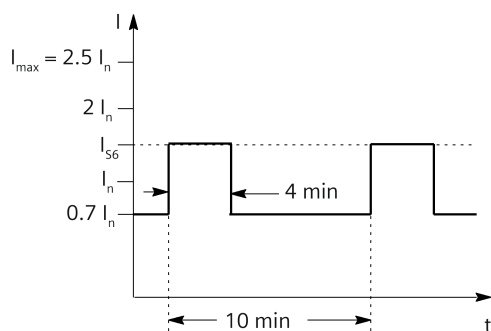


Peak power load cycle with initial load

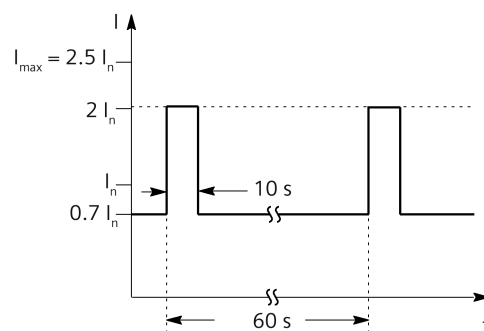


Peak power load duty cycle without initial load

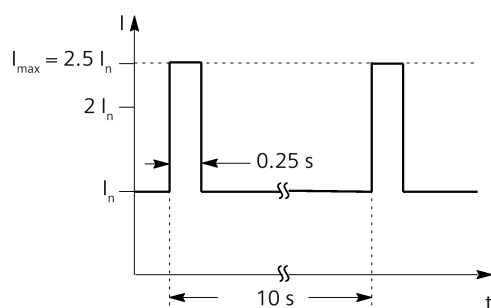
Rated duty cycles, spindle (4 kHz pulse frequency)



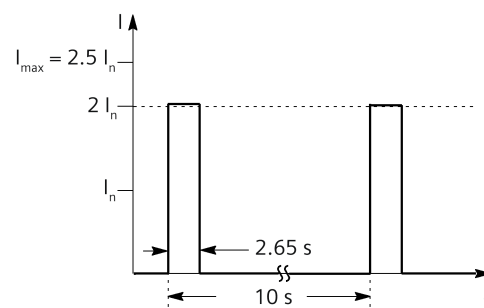
S6 current duty cycle with initial load



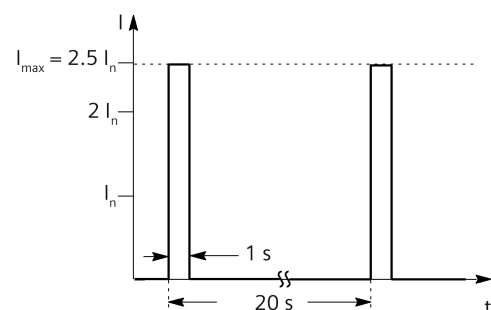
Peak power load duty cycle with initial load



Peak current duty cycle with initial load

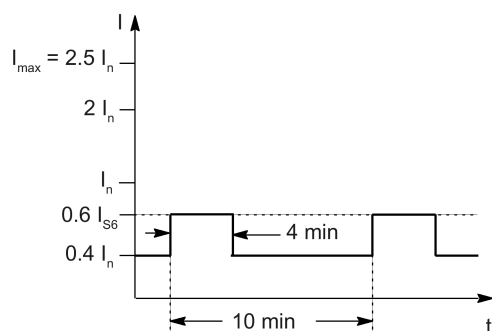


Peak current duty cycle without initial load

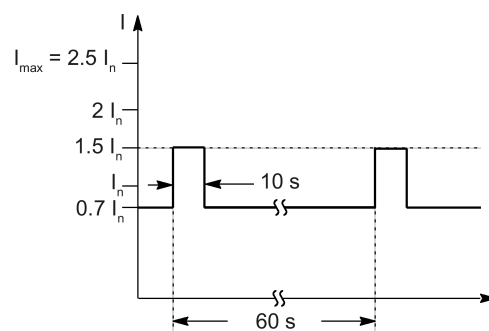


Peak current duty cycle without initial load

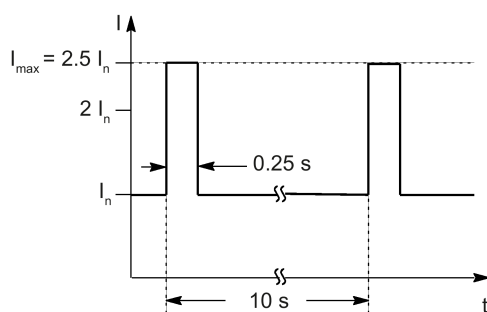
Rated duty cycles, spindle (8 kHz pulse frequency)



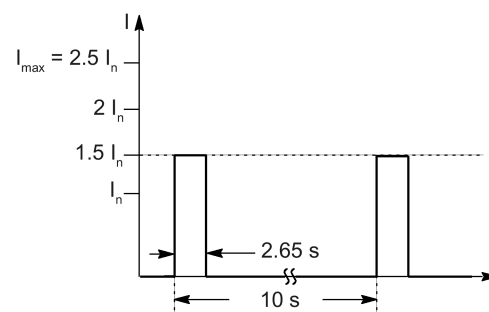
S6 duty cycle with initial load for a duty cycle duration of 600 s



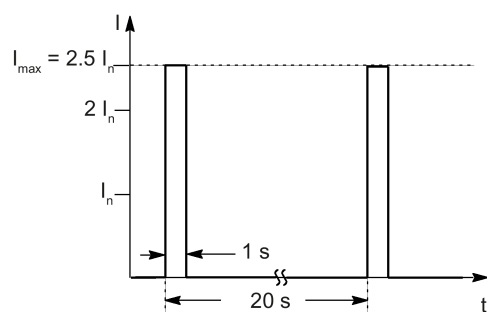
S6 duty cycle with initial load for a duty cycle duration of 60 s



Peak current duty cycle with initial load

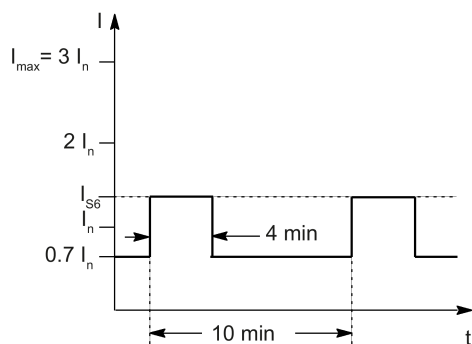


Duty cycle without initial load

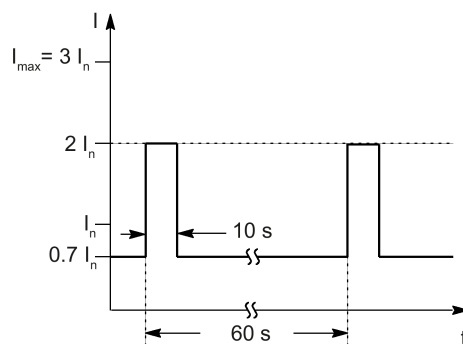


Peak current duty cycle without initial load

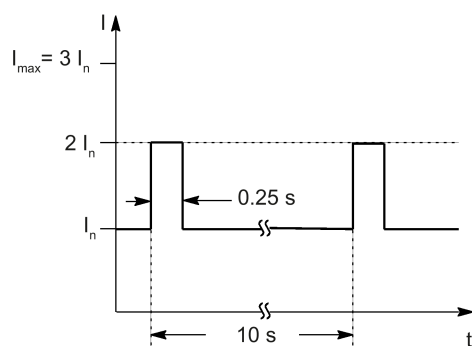
Rated duty cycles, feed (4 kHz pulse frequency)



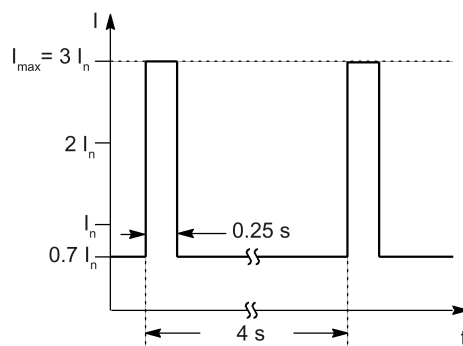
S6 duty cycle with initial load for a duty cycle duration of 600 s



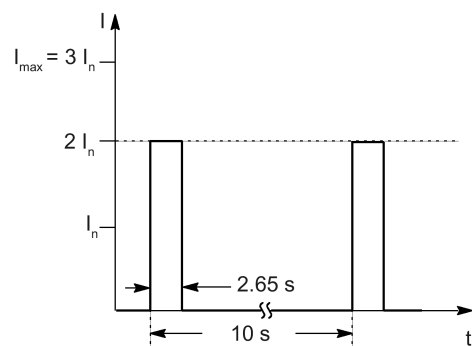
S6 duty cycle with initial load for a duty cycle duration of 60 s



Duty cycle with initial load



Peak current duty cycle with initial load

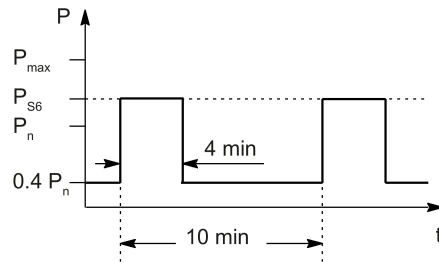


Duty cycle without initial load

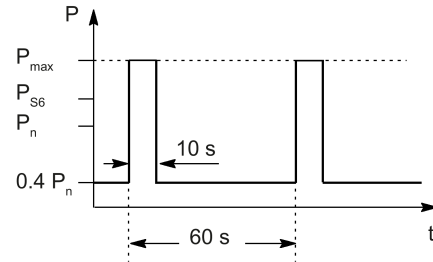
The following rated duty cycles apply to the Power Modules:

- 6SL3111-4VE21-6EC1

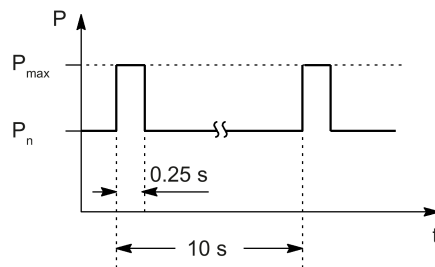
Rated duty cycles, infeed



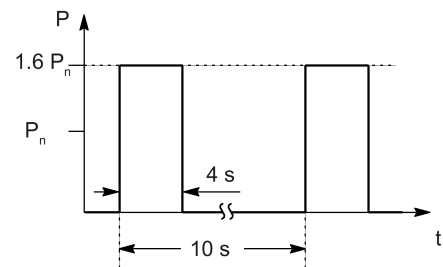
S6 duty cycle with initial load



S6 peak power load cycle with initial load

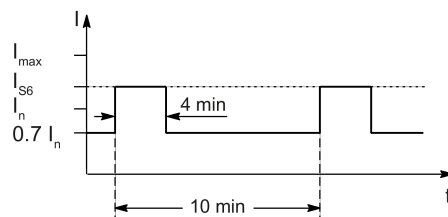


Peak power load cycle with initial load

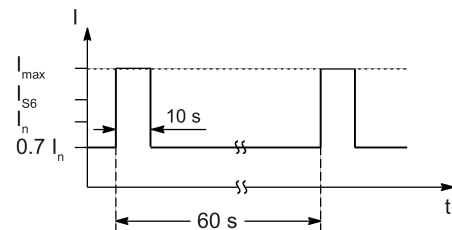


Peak power load duty cycle without initial load

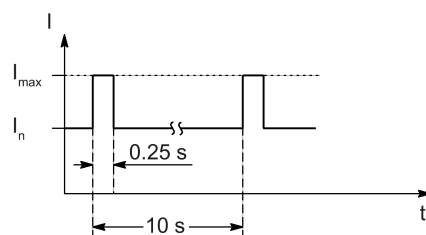
Rated duty cycles, spindle and feed (4 kHz pulse frequency)



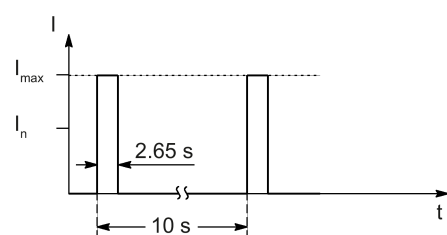
S6 duty cycle with initial load for a duty cycle duration of 600 s



S6 duty cycle with initial load for a duty cycle duration of 60 s



Peak current duty cycle with initial load

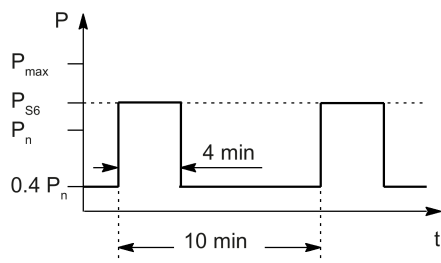


Peak current duty cycle without initial load

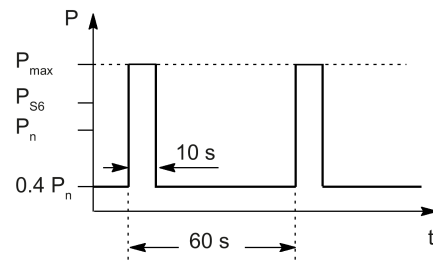
The following rated duty cycles apply to the Power Modules:

- 6SL3111-4VE21-6ED1

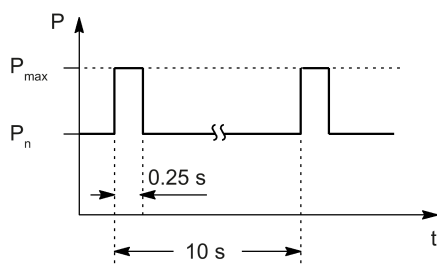
Rated duty cycles, infeed



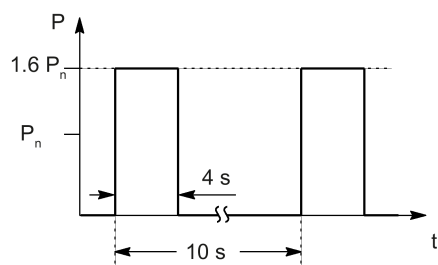
S6 duty cycle with initial load



S6 peak power load cycle with initial load

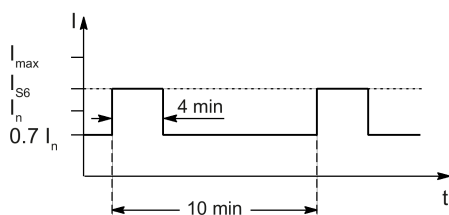


Peak power load cycle with initial load

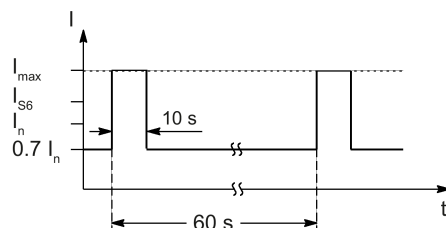


Peak power load duty cycle without initial load

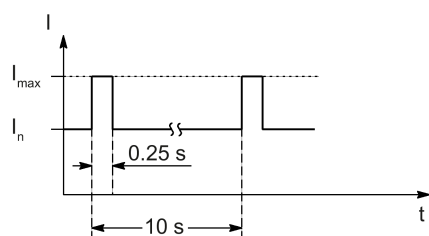
Rated duty cycles, spindle (4 kHz pulse frequency)



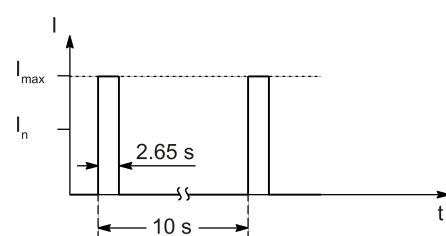
S6 duty cycle with initial load for a duty cycle duration of 600 s



S6 duty cycle with initial load for a duty cycle duration of 60 s

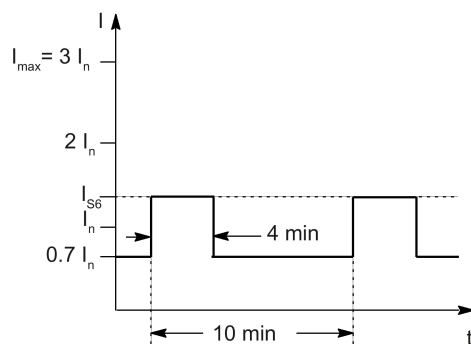


Peak current duty cycle with initial load

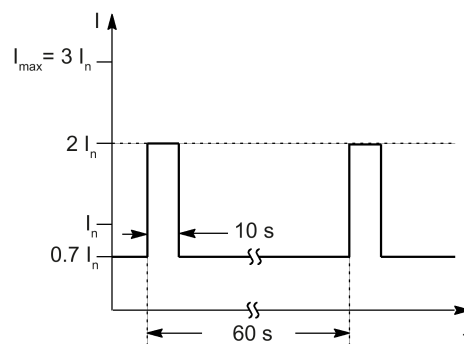


Peak current duty cycle without initial load

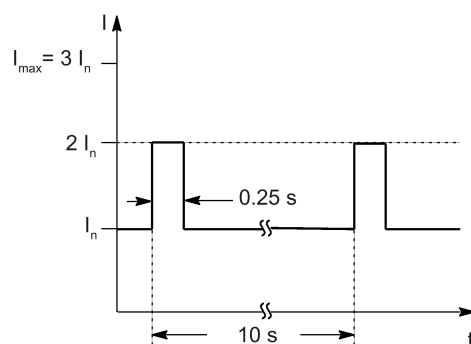
Rated duty cycles, feed (4 kHz pulse frequency)



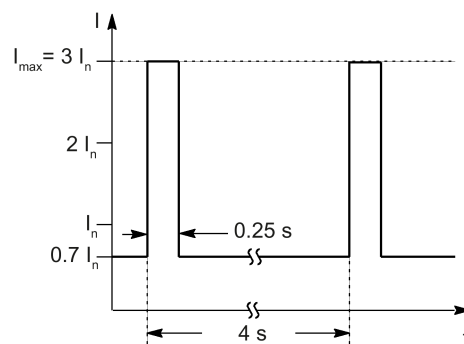
S6 duty cycle with initial load for a duty cycle duration of 600 s



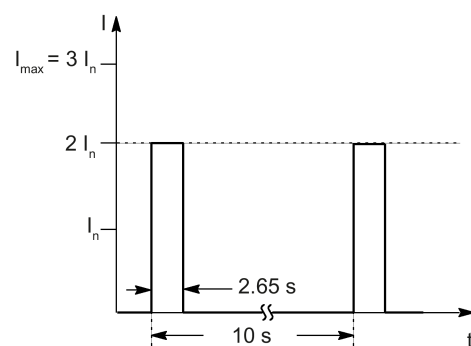
S6 duty cycle with initial load for a duty cycle duration of 60 s



Duty cycle with initial load



Peak current duty cycle with initial load

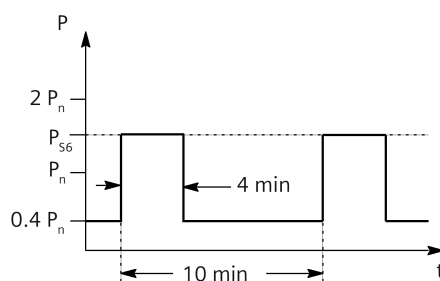


Duty cycle without initial load

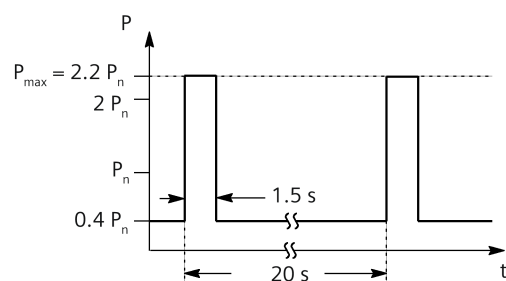
The following rated duty cycles apply to the Power Module:

- 6SL3111-4VE21-6ED2

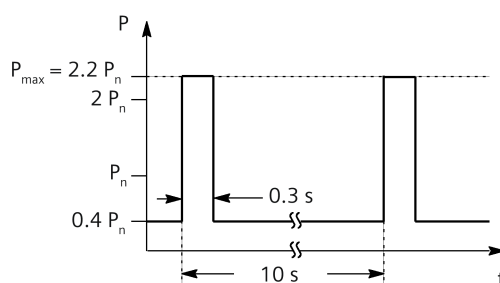
Rated duty cycles, infeed



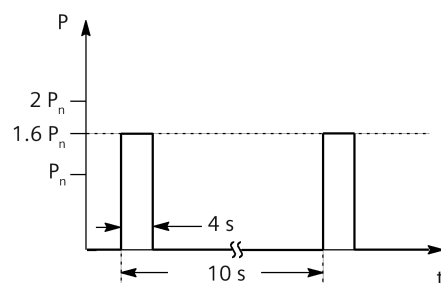
S6 duty cycle with initial load



Peak power load cycle with initial load

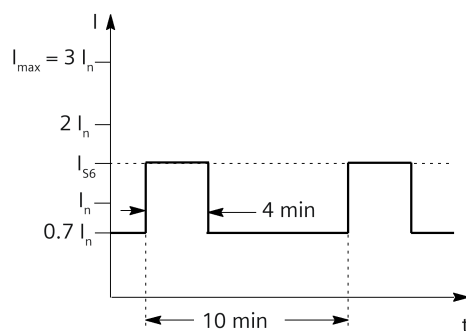


Peak power load cycle with initial load

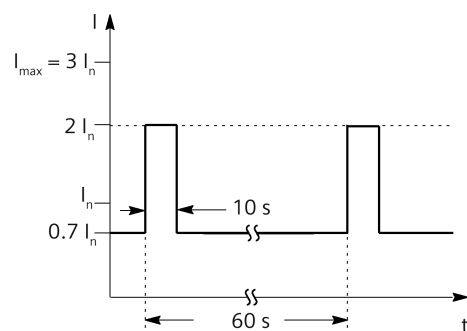


Peak power load duty cycle without initial load

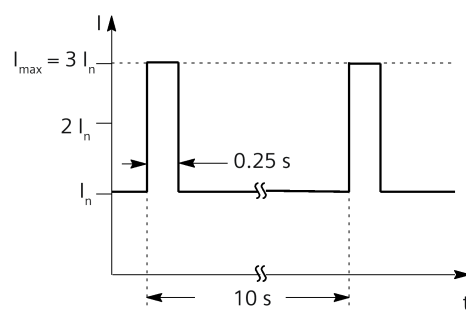
Rated duty cycles, spindle (4 kHz pulse frequency)



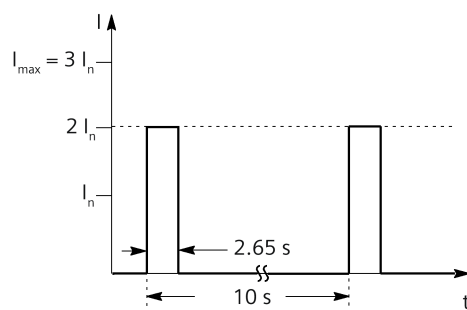
S6 current duty cycle with initial load



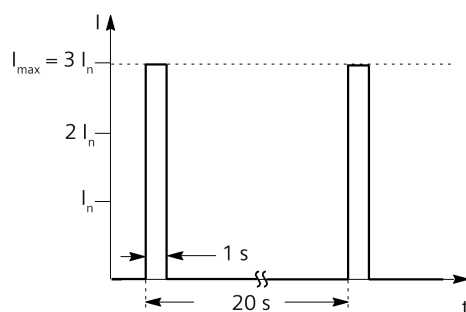
Peak power load duty cycle with initial load



Peak current duty cycle with initial load

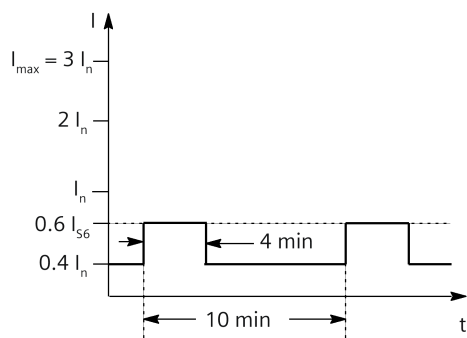


Peak current duty cycle without initial load

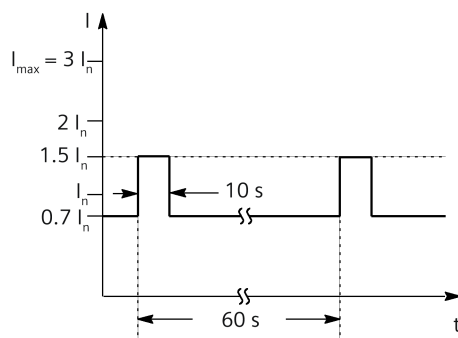


Peak current duty cycle without initial load

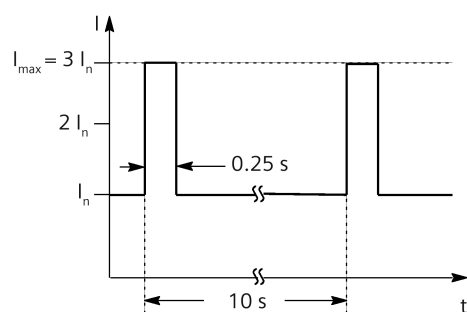
Rated duty cycles, spindle (8 kHz pulse frequency)



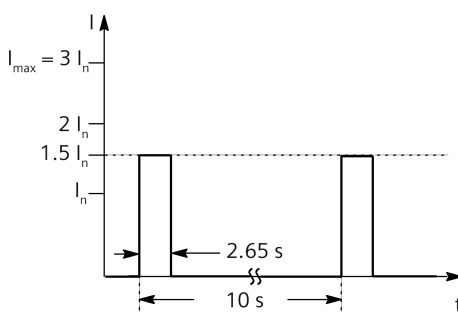
S6 duty cycle with initial load for a duty cycle duration of 600 s



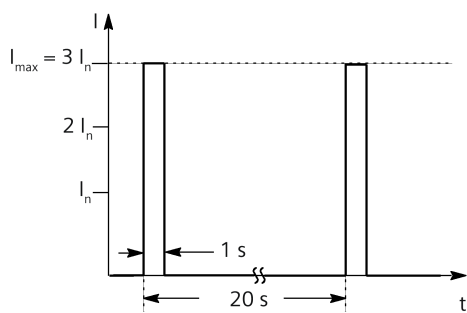
S6 duty cycle with initial load for a duty cycle duration of 60 s



Peak current duty cycle with initial load

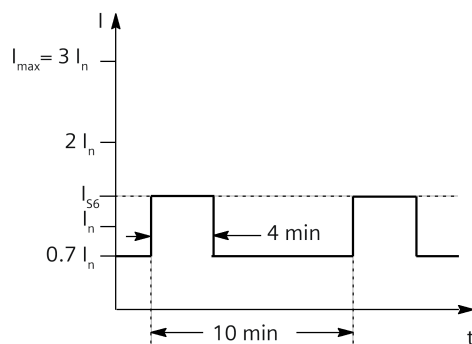


Duty cycle without initial load

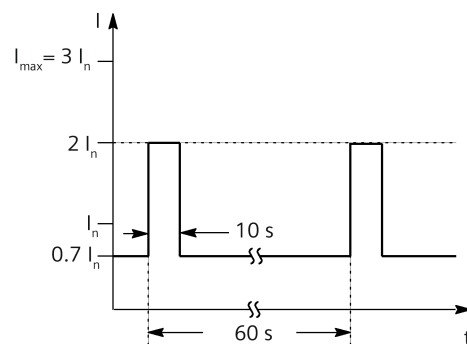


Peak current duty cycle without initial load

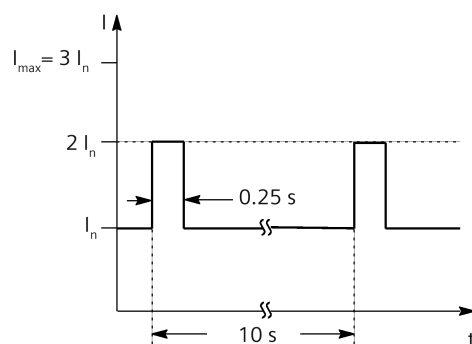
Rated duty cycles, feed (4 kHz pulse frequency)



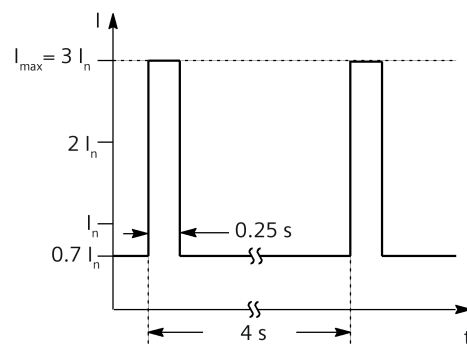
S6 duty cycle with initial load for a duty cycle duration of 600 s



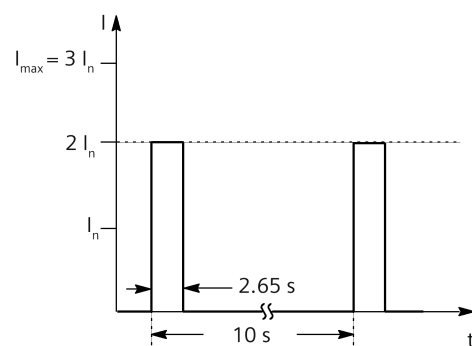
S6 duty cycle with initial load for a duty cycle duration of 60 s



Duty cycle with initial load

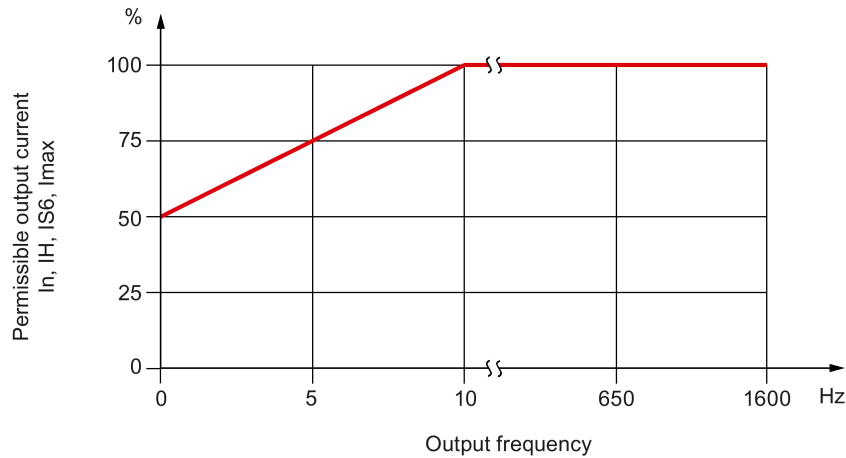


Peak current duty cycle with initial load



Duty cycle without initial load

3.10.3.2 Derating characteristics



Note

Information about derating the output current depending on the installation altitude and the temperature can be found in Sections "System data (Page 87)" and "Derating depending on the installation altitude and the ambient temperature (Page 90)":

3.10.4 Motor overload protection according to IEC/UL 61800-5-1

The Motor Module has integrated motor overload protection according to IEC/UL 61800-5-1. Ensure that the motor is protected from overload by observing the instructions below.

- The protection threshold is 115% of the rated motor current.
- Monitoring for motor overload protection is automatically activated during commissioning.
- Enter the motor data and protection function data when commissioning a Motor Module.
- Operation **without** motor temperature sensor

- Synchronous motors

To ensure motor overload protection, the minimum value of 40 °C for the ambient motor temperature must be entered in parameter p0613.

- Induction motors

To ensure motor overload protection, the minimum value of 40 °C for the ambient motor temperature must be entered in parameter p0625.

- **Additional information**

Additional information on parameter assignment for thermal motor models can be found in Chapter "Thermal motor protection" in the SINAMICS S120 Function Manual Drive Functions.

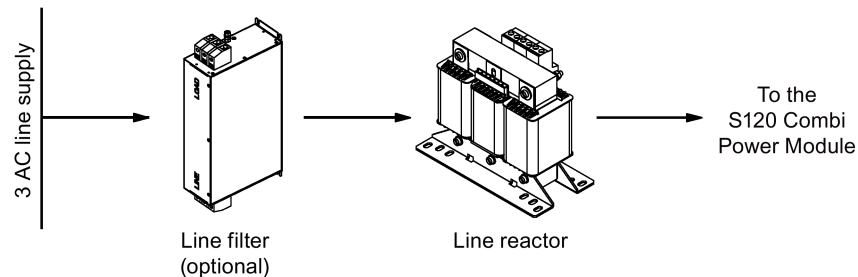
Line-side power components

4.1 Introduction

The following components should be used to connect the S120 Combi drive line-up to the line supply:

- Line disconnect
- Overcurrent protection device (line fuse or circuit breaker)
- Line contactor (this is required for electrical isolation)
- Line filter
- Line reactor (always required)

The line connection for a SINAMICS S120 Combi comprises in addition to the regionally required protective devices, an optional line filter and a line reactor:



4.2 Information on the disconnecter unit

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

NOTICE

Damage to loads connected in parallel caused by switching the line disconnecter while under load

When switching the line disconnecter under load, the voltage applied can damage external loads located parallel to the drive on the same switching component.

- Firstly, interrupt the voltage at the X21 interface, terminal 3 (EP +24 V) and 4 (EP M) on the S120 Combi. This can be achieved with a leading disconnecting auxiliary contact (≥ 10 ms), for example.

4.3 Line-side overcurrent protective devices

Recommended overcurrent protective devices for S120 Combi Power Modules

	10 kW	16 kW	20 kW
IEC-application			
In fuse	35 A	35 A	63 A
LV HRC line fuse	3NA3814	3NA3814	3NA3822
Motor starter protector (IEC 60947)	3RV2031-4UA..	3RV2031-4UA..	3RV2041-4JA..
Circuit breaker (IEC 60947)	3VA1140-6.... 3VA5150-4.... 3VA5150-5.... 3VA5150-6.... 3VA5250-5.... 3VA5250-6....	3VA1140-6.... 3VA5150-4.... 3VA5150-5.... 3VA5150-6.... 3VA5250-5.... 3VA5250-6....	3VA1163-6.... 3VA5160-4.... 3VA5160-5.... 3VA5160-6.... 3VA5260-5.... 3VA5260-6....
UL-application			
In fuse ¹⁾	35 A	35 A	60 A
Type E combination motor controller (NKKH)	3RV2031-4UA..	3RV2031-4UA..	3RV2041-4JA..
Circuit breaker (DIVQ)	3VA5150-4.... (SEAS) 3VA5150-5.... (MEAS) 3VA5150-6.... (HEAS) 3VA5250-5.... (MFAS) 3VA5250-6.... (HFAS)	3VA5150-4.... (SEAS) 3VA5150-5.... (MEAS) 3VA5150-6.... (HEAS) 3VA5250-5.... (MFAS) 3VA5250-6.... (HFAS)	3VA5160-4.... (SEAS) 3VA5160-5.... (MEAS) 3VA5160-6.... (HEAS) 3VA5260-5.... (MFAS) 3VA5260-6.... (HFAS)

¹⁾ Any UL/cUL-compliant listed (JDDZ/7) fuse rated Class J, T, CF, or CC from any manufacturer may be used.



WARNING

Risk of explosion or spread of fire from built-in devices

Short circuits in the Power Module or its components may cause explosion or fire in the unventilated control cabinet, which can result in serious personal injury or property damage.

- Install the S120 Combi Power Module in a suitable and robust metal cabinet. The minimum volume of the cabinet is 0.864 m³ (30.5 ft³).
- Take other appropriate protection measures, for example, using three safety cabinet locks additionally.

**WARNING****Electric shock or fire due to overcurrent protective equipment that trips too late or not at all**

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

- In the case of a conductor-conductor or conductor-ground short-circuit, ensure that the short-circuit current at the point where the converter is connected to the line supply corresponds as a minimum to the requirements of the protective equipment used.
- You must additionally use a residual-current protective device (RCD) (Page 111) if the required short-circuit current is not reached for a conductor-ground short-circuit. The required short-circuit current can be too low, especially for TT systems.
- The short-circuit current must not exceed the SCCR of the converter and the breaking capacity of the protective equipment.

**WARNING****Electric shock caused by oversized fuses**

Oversized fuses can result in significant levels of danger and also faults.

- Use an adapted fuse corresponding to the table "Recommended line fuses and circuit breakers for S120 Combi Power Modules".

4.4 Line supply connection via residual-current devices

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

Residual current circuit-breakers (RCCB)

**WARNING****Electric shock when a residual current protection device does not trip**

Overcurrent protective devices that do not trip or trip too late can cause an electric shock or fire.

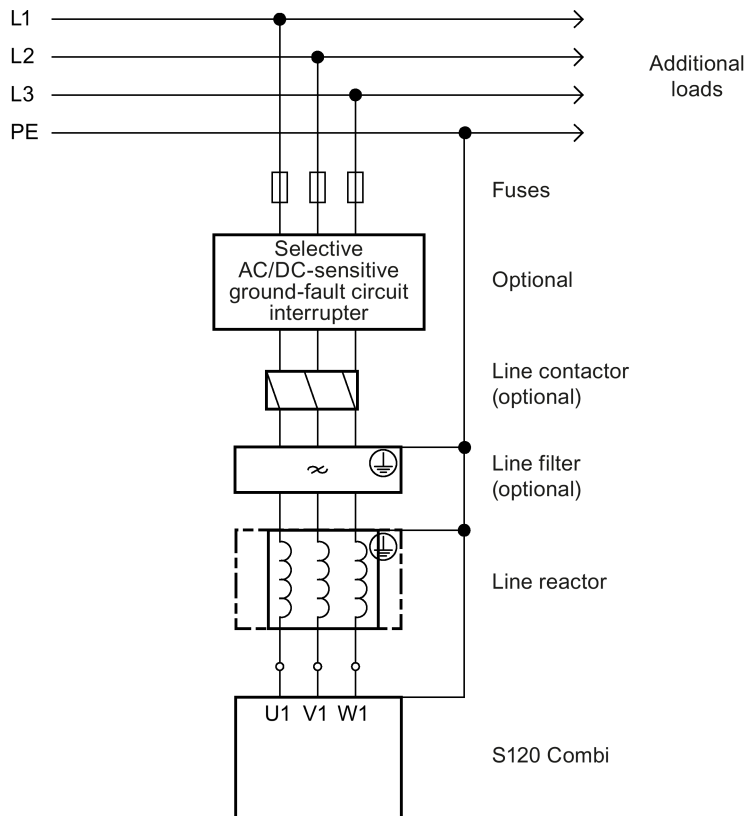
- Check or activate the residual current circuit breaker in regular cycles.

The following points must be observed when using a residual current circuit breaker:

- It is only permissible to use a type B delayed tripping, selective AC/DC-sensitive residual current circuit breaker.
- The loop impedance must comply with local installation regulations.
- The maximum total length of the shielded power cables in the drive line-up (motor cables incl. line supply cables from the line filter to the connecting terminals of the S120 Combi) may be no more than 175 m.

4.5 Overvoltage protection

- Only recommended line filters must be used in operation.
- Switching elements (disconnecter unit, contactors) for connecting and disconnecting the drive line-up have a maximum 35 ms delay time between closing/opening of the individual main contacts.



Recommendation

Siemens SIQUENCE RCCB, type B super resistant (short-time delayed) **K**, 300 mA rated residual current, type series 5SV364.-4.

Note

AC or pulse-sensitive RCCBs are not suitable.

4.5 Overvoltage protection

Overvoltage category III must be ensured. If required, install a surge arrester with a voltage protection level U_p of maximum 6 kV on the line side of the converter.

4.6 Line filters

4.6.1 Description

Line filters have the task to attenuate conducted interference emission in the frequency range according to the specifications of EMC legislation. They are mainly effective in the frequency range from 150 kHz to 30 MHz; this is the range relevant to ensure compliance with the appropriate standard.

In conjunction with a line filter and the associated line reactor, drive line-ups with S120 Combi 10 kW, 16 kW and 20 kW Power Modules and a maximum total cable length up to 175 m, fulfill Category C2 according to EN 61800-3. An EMC compliant design is always assumed.

Note

The line filter is only suitable for direct connection to line supplies with grounded neutral point. An isolating transformer with vector group "Dyn" and grounded neutral point must be used when connecting to other line supplies. The line filter and the control cabinet must be connected to the isolating transformer neutral point through a low inductance connection.

4.6.2 Safety instructions for line filters



WARNING
Electric shock due to residual charge
A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off. Contact with live parts can result in death or serious injury.
• Wait at least 5 minutes after switching off. • Measure the voltage before starting any work.


! WARNING
Electric shock due to high leakage currents caused by an interrupted external protective conductor

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

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

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

! WARNING
Fire hazard due to overheating because of inadequate ventilation clearances

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

- It is absolutely essential that you maintain ventilation clearances according to the table Ventilation clearances above and below the component (Page 161).

NOTICE
Damage to the line filter due to interchanging the input and output

The line filter can be damaged if the input and output connections are interchanged.

- Connect the incoming line supply cable to LINE L1, L2, L3.
- Connect the outgoing cable to line reactor at LOAD L1', L2', L3'.

NOTICE
Damage or fault to other loads when no line reactor is present

If the SINAMICS line filter is directly connected to the S120 Combi and not connected via the associated line reactor, other loads can be damaged or destroyed.

- Connect the line filter to the S120 Combi via the associated line reactor.
- Connect additional loads upstream of the SINAMICS line filter (if required, via a separate line filter).

NOTICE**Damage caused by third party filters**

According to product standard IEC 61800-3, RFI suppression commensurate with the relevant rated conditions is required. Line filters and line reactors are required for this purpose.

The use of filters of other makes can lead to limit value violations, resonances, overvoltages and irreparable damage to motors or other equipment.

- Only use line filters which are listed in this Manual.
- The machine manufacturer must provide verification that the machine equipped with the drive products and the installed suppression elements, e.g. line filters, is EMC-compliant before the machines are placed in the market.

NOTICE**Damage caused by line filters which are not approved for the SINAMICS S120 Combi**

The integrated infeed can be damaged or destroyed when using line filters that have not been approved by SIEMENS for the SINAMICS S120 Combi Power Modules. Furthermore, line harmonics can occur that damage or destroy loads connected to the same line supply.

It is not permissible to connect other loads after the line filter.

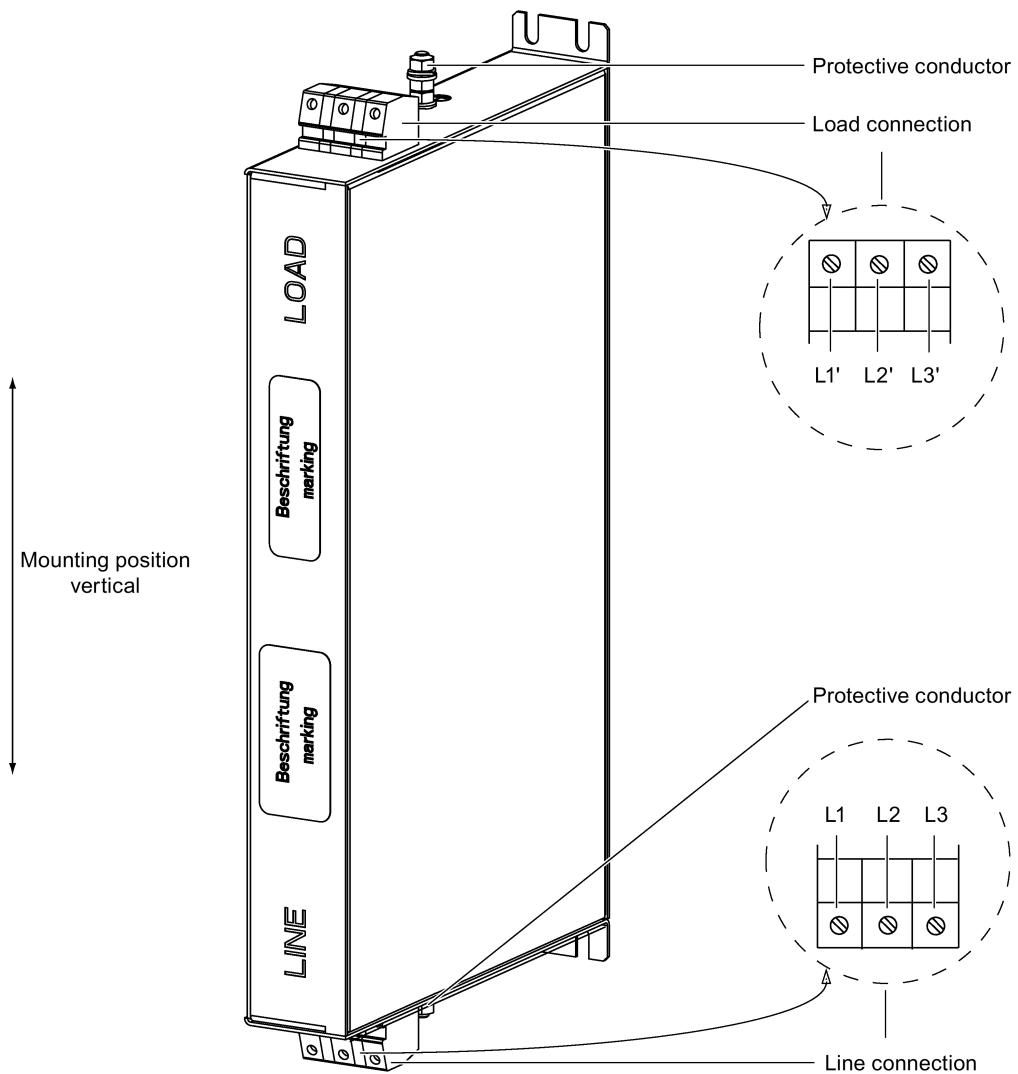
- Only use line filters which have been approved for the SINAMICS S120 Combi.

Note

When a high-voltage test is conducted with alternating voltage in the system, the existing line filters must be disconnected in order to obtain accurate measurements.

4.6.3 Interface description

4.6.3.1 Overview



Either the upper or lower protective conductor connection can be used for the connection. One of the connections remains unused. "Looping-through" the protective connection to the line reactor is not permissible.

4.6.3.2 Line/load connection

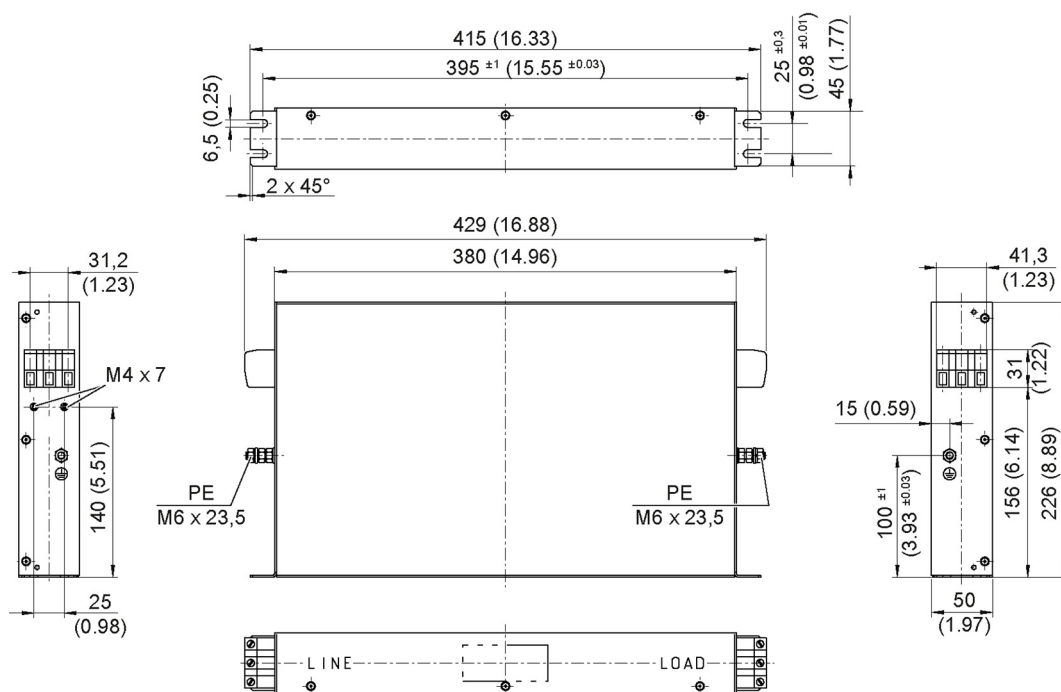
Article number	6SL3000-0BE21-6DA.
Rated infeed power	10 kW, 16 kW and 20 kW
Line connection L1, L2, L3	Terminal type: Screw terminal 6 (Page 182)
Load connection L1', L2', L3' (U, V, W)	Terminal type: Screw terminal 6 (Page 182)
Protective conductor connection	Terminal type: M6 bolt Tightening torque: 6 Nm

Note

The line filter 6SL3000-0BE21-6DAx can be used for all S120 Combi Power Modules.

4.6.4 Dimension drawing

Unit: mm (in)



4.6.5 Technical data

Line filter (6SL3000-0BE21-6DA0)	Unit	Specification
Rated power	kW	10, 16 and 20
Connection voltage: Line voltage Line frequency	V _{AC} Hz	3 AC 380 - 10% (- 15% < 1 min) ... 3 AC 480 +10% 50/60 (45 ... 66)
Rated current	A _{AC}	36
Power loss at 20 kW (see power loss tables (Page 194))	W	16
Dimensions (W x H x D)	mm	50 x 420 x 226
Weight, approx.	kg	5
Degree of protection	-	IP20

4.7 Line reactors

4.7.1 Description

Line reactors for the S120 Combi limit low-frequency line harmonics to permissible values. For this reason, line reactors should always be used.

4.7.2 Safety instructions for line reactors



WARNING

Electric shock in the event of missing touch protection

The line reactors are protected according to IPXXA against accidental contact of the back of the hand with live parts.

- Attach suitable covers if shock-hazard protection (IPXXB) is required.

NOTICE

Damage caused by line reactors which are not approved for the SINAMICS S120 Combi

The following can occur if line reactors are used that have not been approved for SINAMICS S120 Combi by SIEMENS:

- The infeed in the S120 Combi may be damaged or destroyed.
- Line harmonics may occur that damage or destroy loads connected to the same line supply.
- Only use line reactors which are listed in this Manual.

NOTICE**Damage due to high temperatures of line reactors**

The surface temperature of the line reactors may exceed 80° C. This can lead to temperature-related damage to adjacent components.

- It is absolutely essential that you maintain clearances according to the table Ventilation clearances above and below the component (Page 187) around the reactor.
- If this clearance cannot be observed, additional measures such as shielding plates or a cooling system must be provided.

NOTICE**Faults due to the magnetic fields of line reactors**

Reactors generate magnetic fields. Components and cables can be damaged or affected by this.

- Ensure there is sufficient clearance (at least 200 mm) from the reactors or shield them.

Note**Connecting cables**

The connecting cables between the line reactor and S120 Combi must be kept as short as possible.

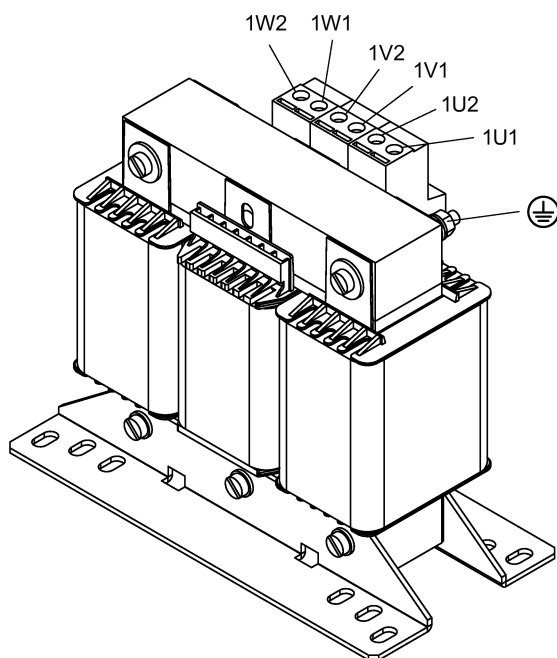
If at all possible, shielded connecting cables should be used.

When using unshielded connecting cables, the cores must be protected from rubbing against the shield connection clip.

4.7 Line reactors

4.7.3 Interface description

4.7.3.1 Overview



4.7.3.2 Line/load connection

Article number	6SL3100-0EE21-6AA0 ¹⁾	6SL3100-0EE21-6AB0 ²⁾	6SL3100-0EE22-0AA0
Power	16 kW	16 kW	20 kW
Line connection 1U1, 1V1, 1W1	Terminal type: Screw terminal 7 (Page 182)	Terminal type: Screw terminal 7 (Page 182)	Terminal type: Screw terminal 7 (Page 182)
Load connection 1U2, 1V2, 1W2	Terminal type: Screw terminal 7 (Page 182)	Terminal type: Screw terminal 7 (Page 182)	Terminal type: Screw terminal 7 (Page 182)
Protective conductor connection	Terminal type: M6 bolt Tightening torque: 6 Nm	Terminal type: M6 bolt Tightening torque: 6 Nm	Terminal type: M6 bolt Tightening torque: 6 Nm

¹⁾ For frame type A only.

²⁾ For frame type B only.

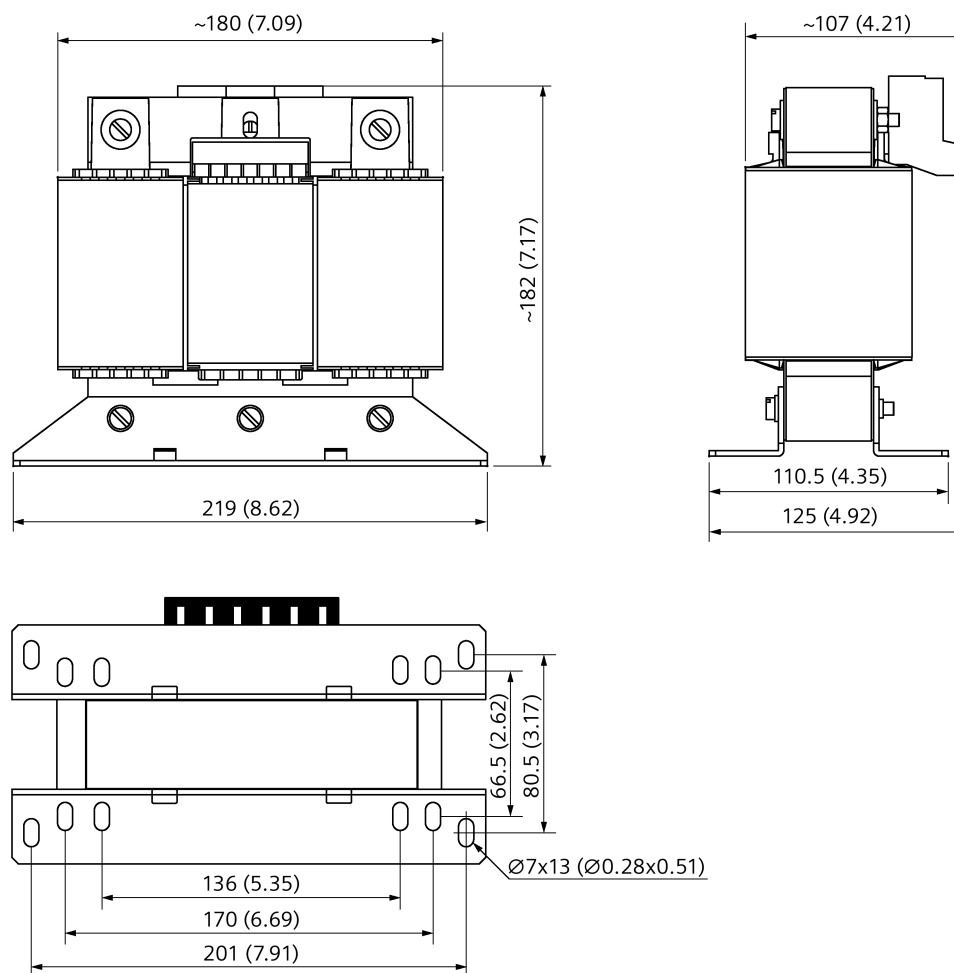
Note

A 6SL3111-4VE21-0EA1 Power Module (10 kW) must be combined with a 6SL3100-0EE21-6AA0 line reactor.

4.7.4 Dimension drawings

- Line reactor for the S120 Combi 16 kW infeed

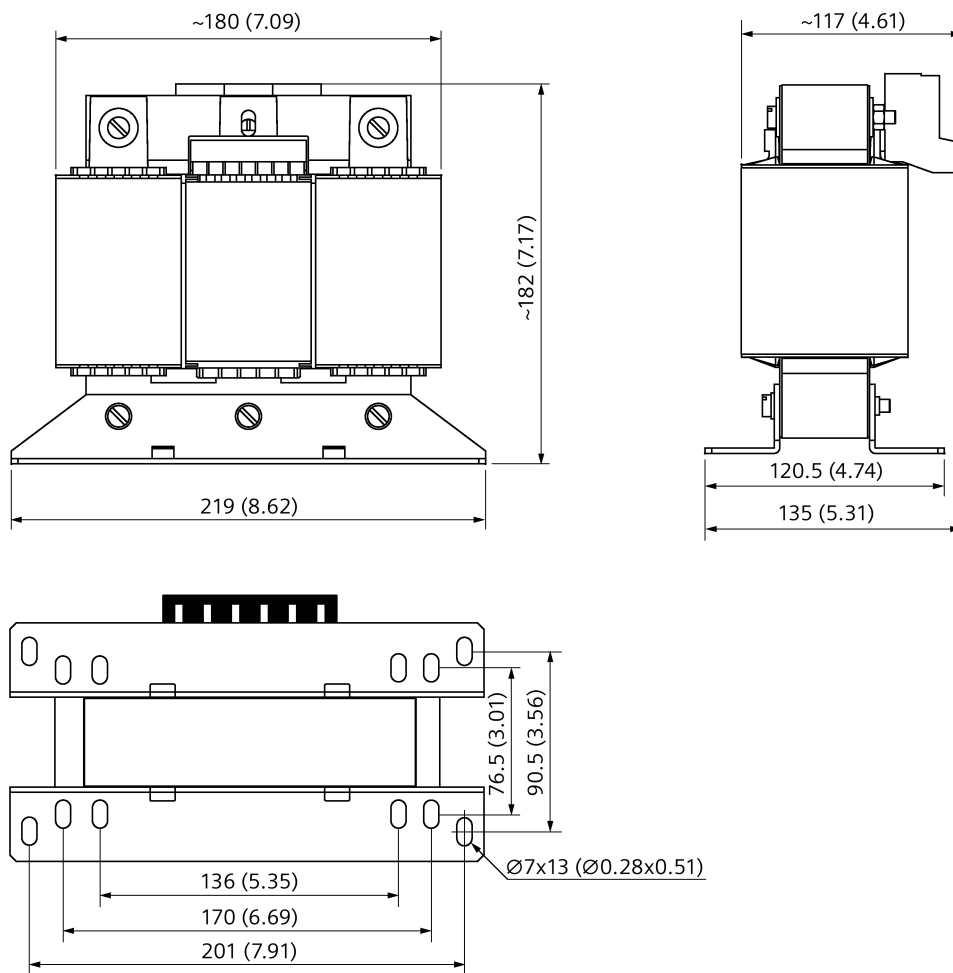
Unit: mm (in)



4.7 Line reactors

- Line reactor for the S120 Combi 20 kW infeed

Unit: mm (in)



4.7.5 Technical data

Line reactor	Unit	6SL3100-0EE21-6AA0 ¹⁾	6SL3100-0EE21-6AB0 ²⁾	6SL3100-0EE22-0AA0
Rated power	kW	16	16	20
Rated current	A _{rms}	28	28	33
Power loss (see power loss tables (Page 194))	W	75	75	98
Dimensions (W x H x D)	mm	219 x 182 x 125	219 x 182 x 125	219 x 182 x 135
Weight	kg	9.2	9.2	10.9
Degree of protection	-	IPXXA	IPXXA	IPXXA

¹⁾ For frame type A only.

²⁾ For frame type B only.

4.8 Combination options with line reactors and line filters

S120 Combi Power Module		Combined with		Features that can be achieved					
16 kW	20 kW	Filter	Reactor	DC link step up factor or rectified value B6	Total cable length for radio interference suppression according to EN 61800-3				Can be operated on an IT system (C4)
					Cat. C2 shielded [m]	Cat. C3 shielded [m]	No compliance with limit value category		
							Shielded [m]	Unshielded [m]	
●	●		x	1.35	-	-	175	175	Yes
●	●	x	x		175	175	175	175	No

4.9 Line connection versions

4.9.1 Ways of connecting the line supply

The following line connection versions are possible:

- Line connection components to be directly connected to the line supply
- Operation of the line connection components via an autotransformer
- Operation of the line connection components via an isolating transformer

Note

Line connection of motors

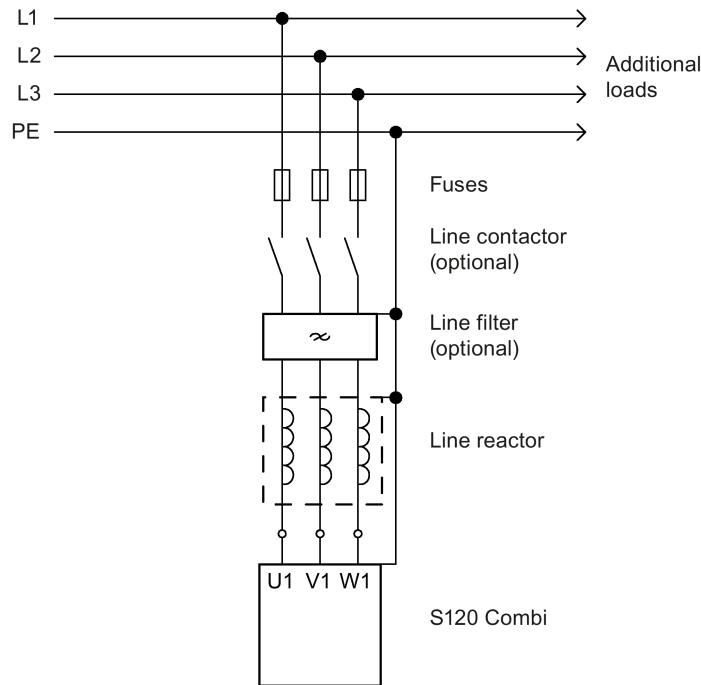
In combination with the drive system, the motors are generally approved for operation on TN and TT line supplies with grounded neutral point and on IT line supplies.

In operation on IT line supplies, the occurrence of a first fault between an active part and ground must be signaled by a monitoring device. The first fault must be removed as quickly as possible to minimize temporary overload of the motor insulation.

For all other line supplies, except TN and TT line supplies with grounded neutral point and IT line supplies, such as line supplies with a grounded phase conductor, an isolation transformer with grounded neutral point (secondary side) must be connected between the line supply and the drive system in order to protect the motor insulation from a continuous and inadmissibly high stress level.

4.9.2 Operating line connection components on the line supply

The SINAMICS S120 Combi drive system is designed to be directly connected to TN, TT, and IT line supplies with a rated voltage of 3-ph. 380 V to 3-ph. 480 V AC.



4.9.3 Operation of the line connection components via a transformer

Note

If the system fault level is too low, this can result in faults at the integrated infeed of the SINAMICS S120 Combi Power Modules. It can also cause faults and damage to other equipment and devices that are connected to the same line connection point as the S120 Combi Power Module.

Note

Using a transformer with the S120 Combi Power Module does not replace the external line reactor.

4.9.3.1 Line connection conditions

The S120 Combi is approved for operation on line supplies from $S_{K \text{ line}}/P_n \geq 70$.

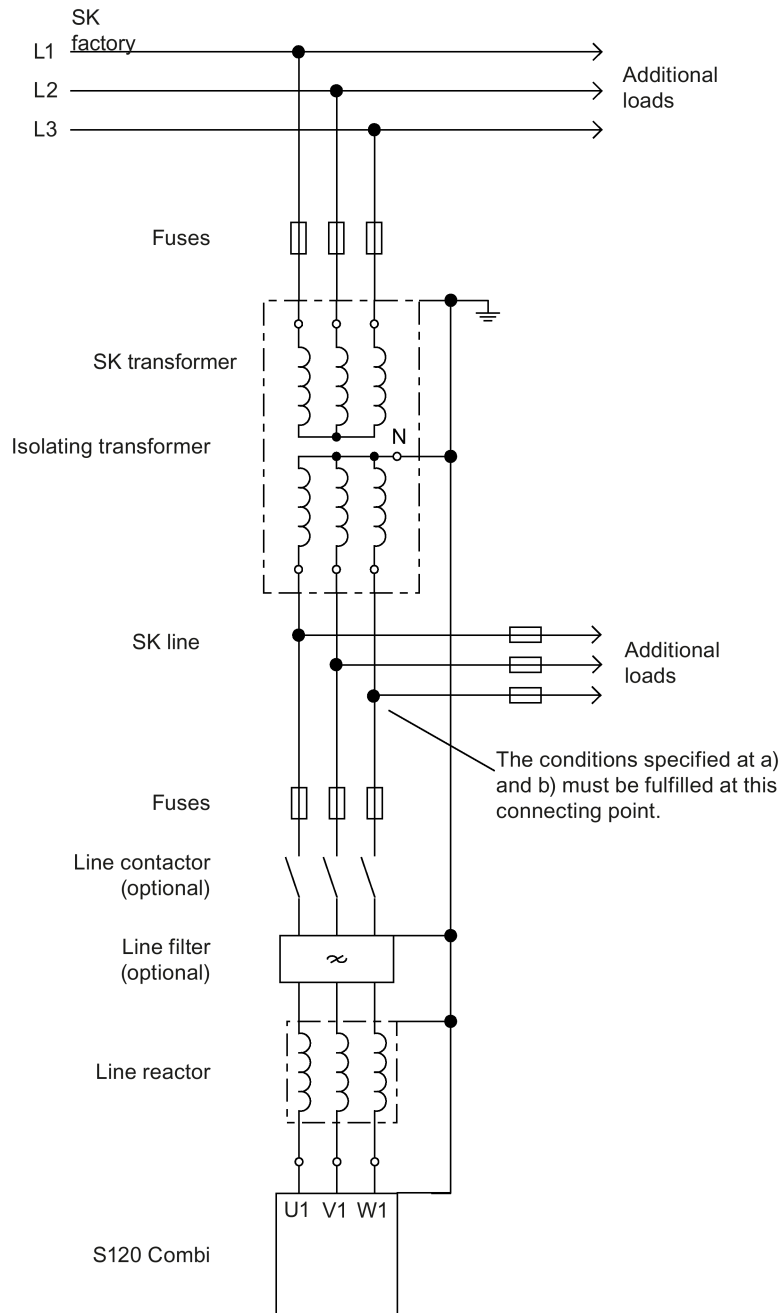
If a TN line supply is specified on the secondary side, a transformer with grounded neutral point must be used. On the other hand, to trigger the fuse within the specified time, the loop resistance must be low enough.

Vector group

Any vector group with the neutral point brought out on the secondary side

4.9.3.2 Dimensioning an isolating transformer / autotransformer for several loads

An S120 Combi Power Module with integrated infeed and other loads / machines should be connected to the line supply via an isolating/autotransformer (matching transformer). The following diagram shows the connection using an isolating transformer as an example.



An isolating transformer / autotransformer (matching transformer) must be dimensioned for the total of all loads connected to it. The apparent powers required must be determined and added as indicated in the table titled "Transformer configuration instructions". If the transformer is underdimensioned (S_n or S_k), this can lead to increased line voltage dips and faults in the line supply and in other loads at this connecting point.

If other loads are connected to the secondary side of the matching transformer, the boundary conditions indicated under a) and b) must be complied with when selecting the matching transformer.

S_{n1}, S_{n2} = calculated rated power of the transformer resulting from a) and b)

u_k = short-circuit voltage of the matching transformer in %
(must be between 1% ... 3% for the S120 Combi)

S_K = short-circuit power



! WARNING

Electric shock due to the connection of an unsuitable power supply

If the short-circuit power is not sufficiently high enough to trip the fuse in the event of a fault, there is a risk of electric shock or fire.

- Use a power supply which generates a sufficient system fault level.

Supplementary conditions

a) Rated power

The rated power of the matching transformer S_{n1} must always be a factor of 1.27 higher than the rated power P_n of the S120 Combi Power Module.

$$S_{n1} \geq 1.27 \cdot P_n$$

Example:

The minimum rated power of a matching transformer for a 16 kW S120 Combi Power Module is 21 kVA.

b) Short-circuit power

In order to avoid faults and disturbances at the other loads that are connected to the secondary side of the matching transformer, the total short-circuit power of the plant connection and that of the matching transformer at the connection point must reach the following values:

$$S_{K \text{ line}} \geq 70 \cdot P_n$$

Special case:

When operating with only one supply at a transformer, the values may be reduced by the factor 0.73.

$$S_{K \text{ line}} \geq 0.73 \cdot 70 \cdot P_n$$

For example $S_{K \text{ line}}$ for 16 kW S120 Combi Power Module: $S_{K \text{ line}} = 0.82 \text{ MVA} = 820 \text{ kVA}$

From $S_{K \text{ transformer}}$ the required rated power of the matching transformer can be calculated.

$$S_{n2} = \frac{S_{K \text{ factory [kVA]} \cdot S_{K \text{ line [kVA]} \cdot u_k [\%]}}{(S_{K \text{ factory [kVA]} - S_{K \text{ line [kVA]}}) \cdot 100 [\%]} \quad [\text{kVA}]$$

Remark:

The short-circuit power at the factory connection $S_{K \text{ factory}}$ plays a decisive role in dimensioning the matching transformer.

From the rated power (S_{n1} or S_{n2}) calculated under a) and b), the higher value must be used for the matching transformer.

S120 Combi Power Module P_n	Required rated power S_n of the isolating transformer/autotransformer	Required short-circuit voltage u_k	Required system fault level $S_{K \text{ line}}$
10 kW	$S_n \geq 13 \text{ kVA}$	$u_k \leq 3\%$	$S_{K \text{ line}} \geq 0.7 \text{ MVA}$
16 kW	$S_n \geq 21 \text{ kVA}$	$u_k \leq 3\%$	$S_{K \text{ line}} \geq 1.12 \text{ MVA}$
20 kW	$S_n \geq 26 \text{ kVA}$	$u_k \leq 3\%$	$S_{K \text{ line}} \geq 1.4 \text{ MVA}$

Note

Ask your local power utility company for the system fault level $S_{K \text{ line}}$.

Example 1

$u_k \text{ matching transformer} = 3 \%$

$S_{K \text{ factory}} = 50000 \text{ kVA}$

$S_{K \text{ line}} = 16 \text{ kW} \cdot 70 \cdot 0.73 = 820 \text{ kVA}$

according to a)

$S_{n1} = 1.27 \cdot 16 \text{ kW} = 21 \text{ kVA}$

According to b)

$$S_{n2} = \frac{50000 \text{ kVA} \cdot 820 \text{ kVA} \cdot 3\%}{(50000 \text{ kVA} - 820 \text{ kVA}) \cdot 100\%} = 25 \text{ kVA}$$

$S_{n2} > S_{n1} \Rightarrow S_{n2}$ is decisive.

The matching transformer requires a rated power S_n of 25 kVA for a short-circuit voltage u_k of 3%.

Example 2

$u_k \text{ matching transformer} = 1 \%$

$S_{K \text{ factory}} = 50000 \text{ kVA}$

$S_{K \text{ line}} = 16 \text{ kW} \cdot 70 \cdot 0.73 = 820 \text{ kVA}$

according to a)

$S_{n1} = 1.27 \cdot 16 \text{ kW} = 21 \text{ kVA}$

According to b)

$$S_{n2} = \frac{50000 \text{ kVA} \cdot 820 \text{ kVA} \cdot 1\%}{(50000 \text{ kVA} - 820 \text{ kVA}) \cdot 100\%} = 8.3 \text{ kVA}$$

$S_{n1} > S_{n2} \Rightarrow S_{n1}$ is decisive.

The matching transformer requires a rated power S_n of 21 kVA for a short-circuit voltage u_k of 1%.

Example 3

If $S_{K \text{ plant}}$ is lower, then a higher-rating transformer must be used.

u_k matching transformer = 3 %

$S_{K \text{ plant}} = 3000 \text{ kVA}$

$S_{K \text{ line}} = 16 \text{ kW} \cdot 70 \cdot 0.73 = 820 \text{ kVA}$

according to a)

$S_{n1} = 1.27 \cdot 16 \text{ kW} = 21 \text{ kVA}$

According to b)

$$S_{n2} = \frac{3000 \text{ kVA} \cdot 820 \text{ kVA} \cdot 3 \%}{(3000 \text{ kVA} - 820 \text{ kVA}) \cdot 100\%} = 33.9 \text{ kVA}$$

$S_{n2} > S_{n1} \Rightarrow S_{n2}$ is decisive

The matching transformer requires a rated power S_n of 34 kVA for a short-circuit voltage u_k of 3%.

Example 4

If $S_{K \text{ factory}}$ is lower, you can use, alternatively to example 3, a transformer with a lower u_k .

u_k matching transformer = 1%,

$S_{K \text{ factory}} = 3000 \text{ kVA}$

$S_{K \text{ line}} = 16 \text{ kW} \cdot 70 \cdot 0.73 = 820 \text{ kVA}$

according to a)

$S_{n1} = 1.27 \cdot 16 \text{ kW} = 21 \text{ kVA}$

According to b)

$$S_{n2} = \frac{3000 \text{ kVA} \cdot 820 \text{ kVA} \cdot 1 \%}{(3000 \text{ kVA} - 820 \text{ kVA}) \cdot 100\%} = 11.3 \text{ kVA}$$

$S_{n1} > S_{n2} \Rightarrow S_{n1}$ is decisive

The matching transformer requires a rated power S_n of 21 kVA for a short-circuit voltage u_k of 1%.

Note

S_{n2} for the matching transformer can be reduced by reducing u_k . In the examples listed above, the power drawn from other loads has not been taken into account.

4.9.3.3**Operation of the line connection components via an autotransformer**

An autotransformer can be used to adapt the voltage in the range up to 3-ph. 480 VAC + 10%.

**! WARNING****Electric shock caused by a high voltage**

If the voltage applied is too high for the existing insulation, there is a danger of electric shock.

- Use an isolating transformer for voltages as of 3-ph. 480 VAC + 10%.

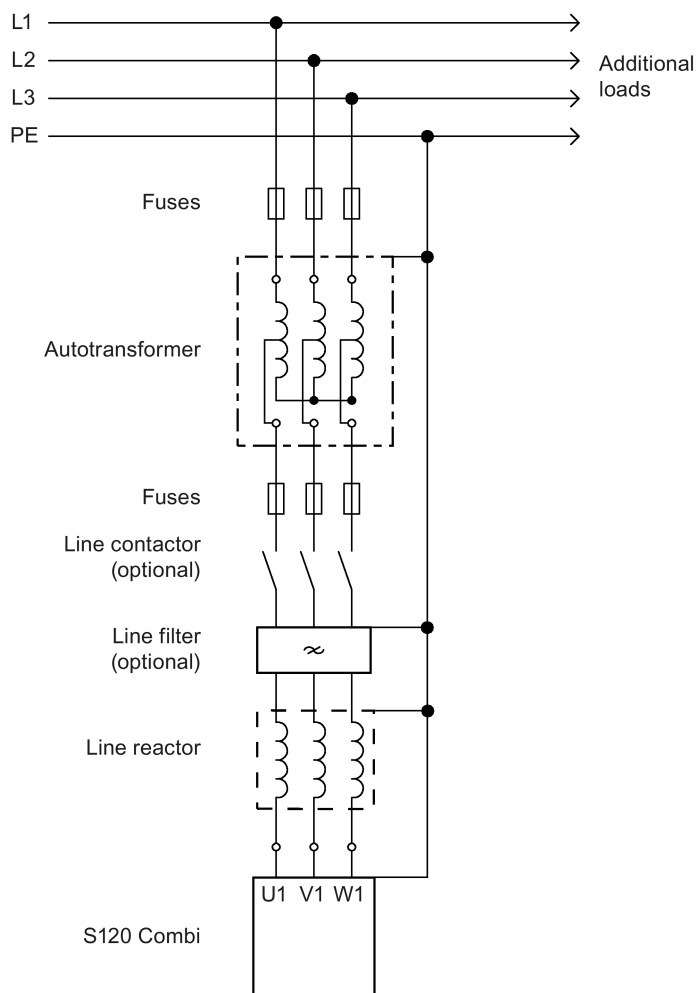
NOTICE**Damage to the device when using an autotransformer**

If an autotransformer is used, safe electrical separation is no longer possible for a line voltage higher than 480 V +10%. This can lead to damage or a fault in the device.

- In this particular case, use an isolating transformer

Application example:

- The motor insulation must be protected from excessive voltages.

**4.9.3.4****Operation of the line connection components via an isolating transformer**

An isolating transformer converts the line supply type of the plant or system (e.g. IT system) to a TN system. Additional voltage adaptation to the permissible voltage tolerance range is possible.

An isolating transformer must be used in the following cases:

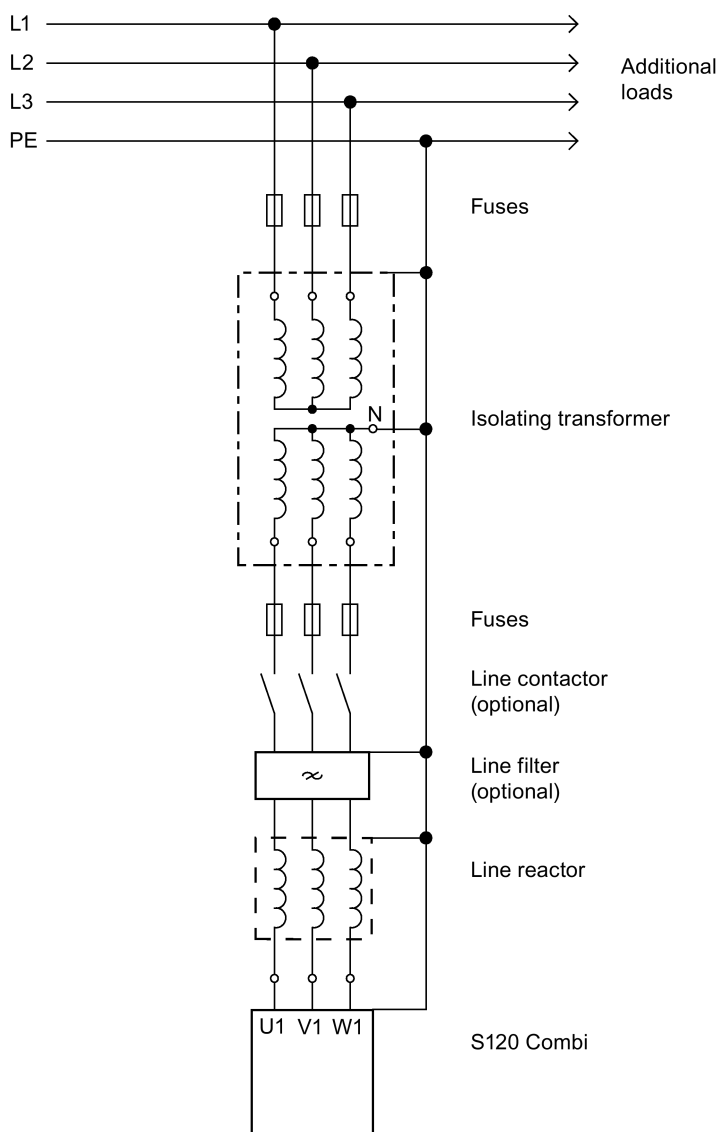
- The insulation of the Motor Module and/or the motor is not suitable for the voltages that occur.
- There is no compatibility with an existing residual-current protective device.

- The installation altitude is greater than 2000 m above sea level, and no TN or TT line system with grounded neutral point is used.
- A line filter should be used in a line supply system that is not a TN line supply system with grounded neutral conductor.

An isolating transformer must have the following properties:

- The transformer secondary must be in the star connection (a delta connection is not permissible!).
- The neutral conductor must be brought out. It must be connected with the PE of the line filter, line reactor and S120 Combi (infeed).

Comment: If the neutral conductor is not brought out and/or not connected, then all of the restrictions of an IT line supply apply!



Electrically connecting Motor Modules and DC link components

5

5.1 Introduction

The S120 Combi offers the possibility of connecting the following additional components (Motor Modules and DC link components) to the DC link and the 24 V electronics power supply:

- Motor Modules Booksize Compact
- Motor Modules Booksize (for frame type B only)
- Braking Module
- Control Supply Module

Connecting the DC link and 24 V power supply

For the following S120 Combi Power Modules, the DC link voltage and 24 V power supply for the additional components are provided by the S120 Combi via the integrated DC link busbars and 24 V busbars. The current-carrying capacity of the DC link busbars is 100 A.

To connect the DC link and the 24 V power supply to an additional component, remove the front cover and open the DC link cover on the S120 Combi Power Module.

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1
- 6SL3111-4VE21-0EA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1

For the following S120 Combi Power Modules, the DC link voltage for the additional components is provided by the S120 Combi while the 24 V power supply for the additional components is provided by an external 24 V power supply directly.

To connect the DC link and the 24 V power supply to an additional component, use a DC link cable and a 24 V terminal adapter. They are provided as an expansion axis adapter (article number: 6SL3161-3XP00-0AA0), which you can order from Siemens.

- 6SL3111-3VE21-6FC1
- 6SL3111-3VE21-6EC1
- 6SL3111-3VE22-0HC1
- 6SL3111-4VE21-6FC1
- 6SL3111-4VE22-0HC1
- 6SL3111-4VE21-6ED2
- 6SL3111-4VE21-6ED1
- 6SL3111-4VE21-6EC1

5.2 Connecting the DC link and 24 V power supply via the busbars

For the following S120 Combi Power Modules, the DC link voltage and the 24 V power supply for the additional components are provided by the S120 Combi Power Module via the busbars which are located under the DC link cover. To connect the DC link and the 24 V power supply for the additional components, remove the front plate of the S120 Combi firstly.

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1
- 6SL3111-4VE21-0EA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1

Removing the front plate and opening the DC link cover



WARNING

Electric shock due to residual charge

A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off. Contact with live parts can result in death or serious injury.

- Remove the front plate only after 5 minutes have passed.
- Check that it really is in a no-voltage condition, from phase conductor to phase conductor and phase conductor to protective conductor.
- Check that the DC link is in a no-voltage condition.

Proceed the following to remove the front plate and open the DC link cover of the S120 Combi.

Tool:

Torx T20 or slotted 1.2 x 6 screwdriver

Procedure:

1. If required, remove the drip protection grid.
2. Remove the two Torx-slotted screws at the front.



3. Release the front plate by slightly pressing upwards.



4. Remove the front plate.



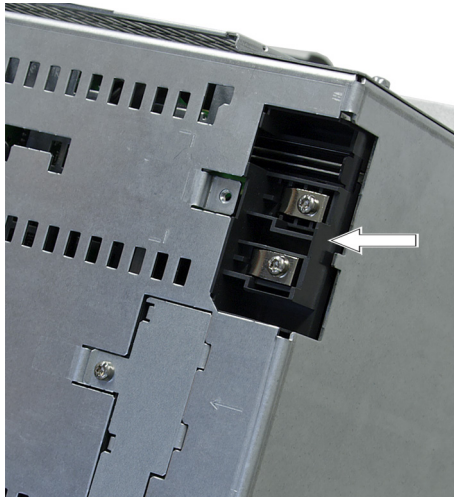
5. Remove the Torx-slotted screw of the DC link cover.



6. Remove the DC link cover.



7. Remove the DC link side cover and you can find the DC link busbars and 24 V power supply busbars.



Connecting the DC link and 24 V power supply



WARNING

Electric shock in the event of missing touch protection

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

- After removing the additional components, before recommissioning the system, you must reinstall the lateral DC link cover on the S120 Combi Power Module.



WARNING

Electric shock due to missing DC link side covers, protective cover or front plate

There is a danger of an electric shock through contact when the side covers, protective cover or front plate of the DC link are missing.

- Mount the supplied side covers on the first and last component in the drive line-up.
- Close the protective cover of the connected component.
- Mount the front plate on the S120 Combi.



WARNING

Electric shock when connecting and disconnecting 24 V connections during operation

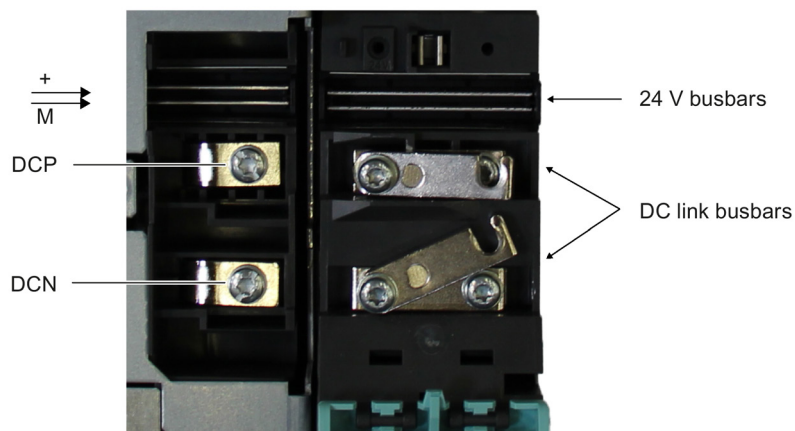
When opening plug connections in operation, arcs can result in severe injury or death.

- Only withdraw or insert the 24 V connectors in a no-voltage state.
- It is only permissible to withdraw or insert the 24 V connectors a maximum of 5 times.

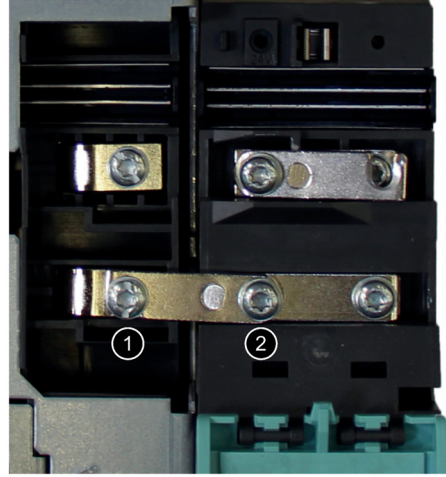
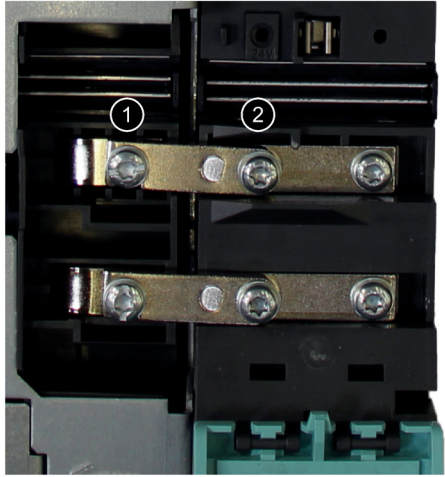
Proceed the following to connect the DC link and 24 V power supply to a Motor Module or a DC link component.

Procedure:

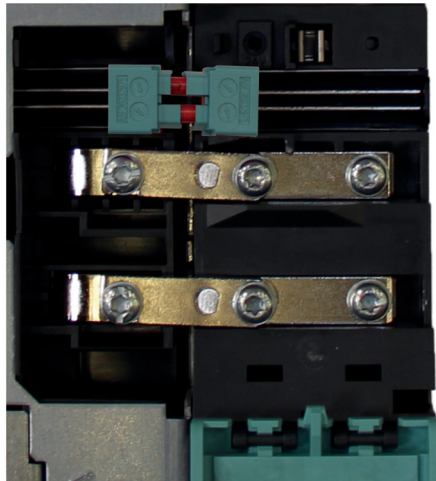
1. Use a suitable screwdriver to open the protective cover of the component which is to be connected.
2. Remove the DC link side cover at the connection location.



3. Install the lower and upper DC link busbars in the specified sequence (① to ②) respectively.

Install the lower DC link busbar		Install the upper DC link busbar	
			
• Release the screws. • Turn over the DC link bridge. • Observe the sequence when screwing into place.		• Release the screws. • Turn over the DC link bridge. • Observe the sequence when screwing into place.	
Screwdriver		Torx T20 or slotted 1.2 x 6	
Tightening torque		1.8 Nm	

4. Install the 24 V connector (accessories pack of the component to be connected).



5. Close the protective cover of the connected component.
6. Mount the front plate to the S120 Combi.

Note

Repeat Step 1 to Step 5 to connect another additional component.

Note

For more information about the 24 V power supply, see Section "24 V power supply and connection of components (Page 170)".

5.3 Connecting the DC link and 24 V power supply via the DC link cable and 24 V terminal adapter

For the following Power Modules, the DC link voltage for the additional components is provided by the S120 Combi while the 24 V power supply for the additional components (Control Supply Modules excluded) is provided by an external 24 V power supply directly.

To connect the DC link and the 24 V power supply for the additional components, you need to order an expansion axis adapter (article number: 6SL3161-3XP00-0AA0) which includes a DC link cable and a 24 V terminal adapter.

- 6SL3111-3VE21-6FC1
- 6SL3111-3VE21-6EC1
- 6SL3111-3VE22-0HC1
- 6SL3111-4VE21-6FC1
- 6SL3111-4VE22-0HC1
- 6SL3111-4VE21-6ED2
- 6SL3111-4VE21-6ED1
- 6SL3111-4VE21-6EC1



WARNING

Electric shock due to residual charges when connecting and disconnecting the expansion axis

A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off. Contact with live parts can result in death or serious injury.

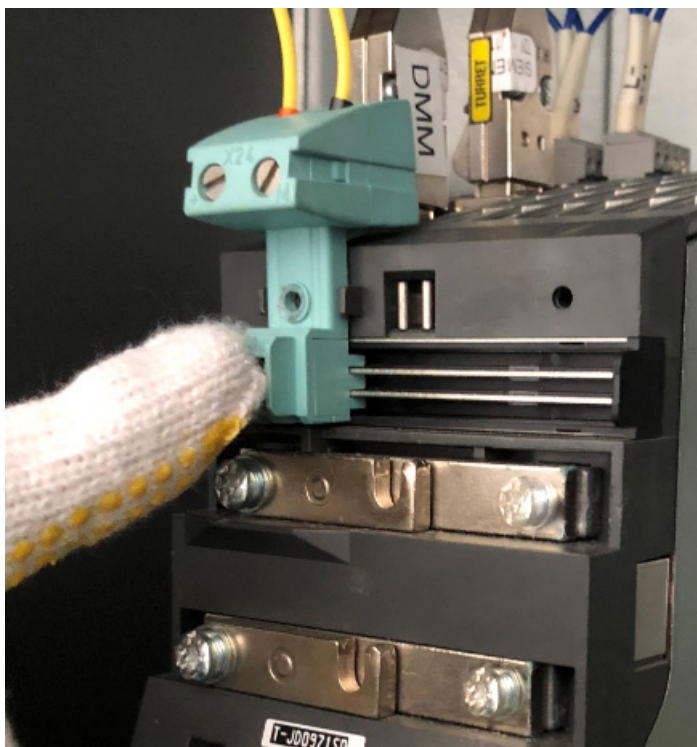
- Wait for 5 minutes before you check that the DC link really is in a no-voltage condition and start work.

Proceed the following to connect the DC link and 24 V power supply to the additional component.

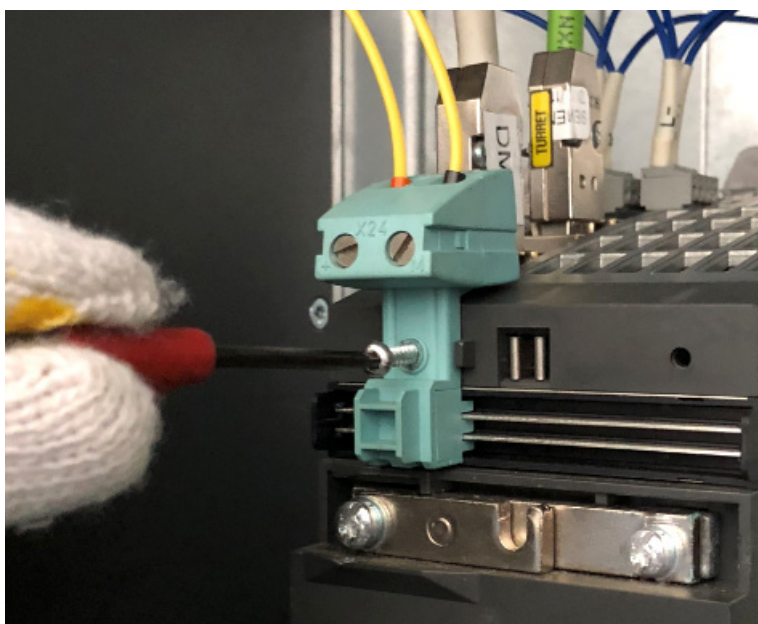
5.3 Connecting the DC link and 24 V power supply via the DC link cable and 24 V terminal adapter

Procedure:

1. Use a suitable screwdriver to open the protective cover of the component which is to be connected.
2. Install the 24 V terminal adapter to the 24 V busbars on the to-be-connected component.



3. Tighten the screw to fix the 24 V terminal adapter.



For more information about the 24 V power supply, see Section "24 V power supply and connection of components (Page 170)".

5.3 Connecting the DC link and 24 V power supply via the DC link cable and 24 V terminal adapter

4. Open the DC link protective cover of X228 on the S120 Combi Power Module with a slot head screwdriver (2.5 × 75 mm).



5. Plug the connector on the DC link cable to X228.



5.3 Connecting the DC link and 24 V power supply via the DC link cable and 24 V terminal adapter

6. Unscrew the screws on the right side of the to-be-connected component.

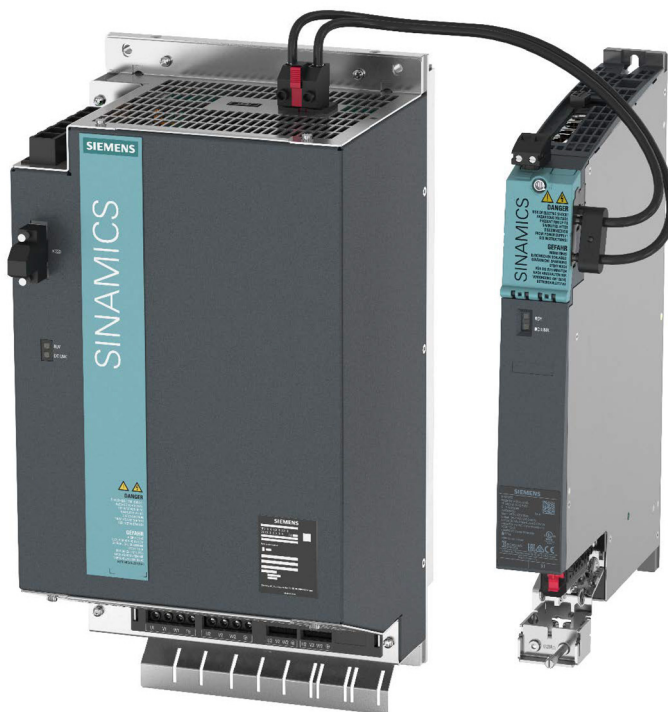


7. Install the ring terminal lugs to the DC link busbars on the component and tighten the screws.



Note: When connecting the DC link cable to the additional component, always install the ring terminal lugs to the screws on the right side of the additional component. Besides, you need to notice the poka yoke design on the terminal. When connecting the ring terminal lugs, always keep the poka yoke design on the top.

8. Close the protective cover of the connected component.



Note

If more than one additional components are connected, install the ring terminal lugs of the DC link cable to the screws on the right side of the rightmost additional component and install the 24 V terminal adapter to the 24 V busbars on the leftmost additional component.

The connections of the DC link and 24 V power supply between two additional components can still be realized by the busbars.

Topology rules for DRIVE-CLiQ

6.1 Introduction

If the S120 Combi is operated in conjunction with the SINUMERIK 828D, then fixed DRIVE-CLiQ topology rules apply. These rules must be observed. If violated, then a corresponding alarm is displayed.

Note

There are no fixed topology rules for the SINUMERIK ONE. The DRIVE-CLiQ interfaces X100 to X103 of SINUMERIK NCU can, for example, be connected with the DRIVE-CLiQ connections of the following devices:

- S120 Combi Power Modules
- Single Motor Module or Double Motor Module
- Hub Module (DMx20)
- Sensor Module (SM...)

The TM54F Terminal Module cannot be used with the SINUMERIK ONE.

Assigning the DRIVE-CLiQ interfaces on the S120 Combi

DRIVE-CLiQ interface	Connecting to
X200	X100 of the PPU X101 of the NX15.3 ¹⁾
X201	Motor encoder, spindle
X202	Motor encoder, feed 1
X203	Motor encoder, feed 2
X204	Motor encoder, feed 3 (only for 4 axes Power Modules)
X205	Optional: 2nd direct sin/cos encoder for spindle (via SM...) ²⁾ The interface remains empty when a direct TTL spindle encoder is connected via X220

¹⁾ For connecting the second Combi module to the SINUMERIK 828D

²⁾ In this case, the TTL encoder interface X220 remains free.

6.1 Introduction

Assigning the DRIVE-CLiQ interfaces on the SINUMERIK 828D (PPU)

DRIVE-CLiQ interface	Connecting to
X100	X200 of the S120 Combi
X101	X200 of a Single Motor Module or Double Motor Module
X102	X500 of the Terminal Module TM54F X500 of the Hub Module (DMx20) ¹⁾ X100 of the NX15.3 ²⁾

¹⁾ When using a TM54F, the DMx20 is connected in series at the TM54F via the DRIVE-CLiQ interface X501

²⁾ For connecting the second Combi module to the SINUMERIK 828D

Assigning the DRIVE-CLiQ interfaces on the expansion axes

DRIVE-CLiQ interface	Connecting to
First Single Motor Module	
X200	X101 of the PPU X102 of the NX15.3 ²⁾
X201 ¹⁾	X200 of the second Single Motor Module
X202	Motor encoder for the feed 1st expansion axis (via Sensor Module)
Second Single Motor Module	
X200	X201 of the first Single Motor Module
X201	Remains empty
X202	Motor encoder for the feed 2nd expansion axis (via Sensor Module)
Double Motor Module	
X200	X101 of the PPU X102 of the NX15.3 ²⁾
X201	Remains empty
X202	Motor encoder for the feed 1st expansion axis
X203	Motor encoder for the feed 2nd expansion axis

¹⁾ Remains empty if only one Single Motor Module is used

²⁾ For connecting the second Combi module to the SINUMERIK 828D

Assigning to DRIVE-CLiQ interfaces on the TM54F

DRIVE-CLiQ interface	Connecting to
X500	X102 of the control (PPU)
X501	X500 of the DMx20 If a DMx20 is not used, then this interface remains empty

For more information on possible connections, see Chapter "Connection examples (Page 146)".

Assigning the DRIVE-CLiQ interfaces on the DMx20

DRIVE-CLiQ interface	Feed axis
X500	X501 of the TM54F X102 of the PPU (when TM54F is not used) X100 ... X103 of the NCU
X501	Feed 1 on the S120 Combi
X502	Feed 2 on the S120 Combi
X503	Feed 3 on the S120 Combi (only for 4 axes Power Modules)
X504	Feed 1st expansion axis on the Motor Module
X505	Feed 2nd expansion axis on the Motor Module

For more information on possible connections, see Chapter "Connection examples (Page 146)".

Assigning the DRIVE-CLiQ interfaces on the NX15.3

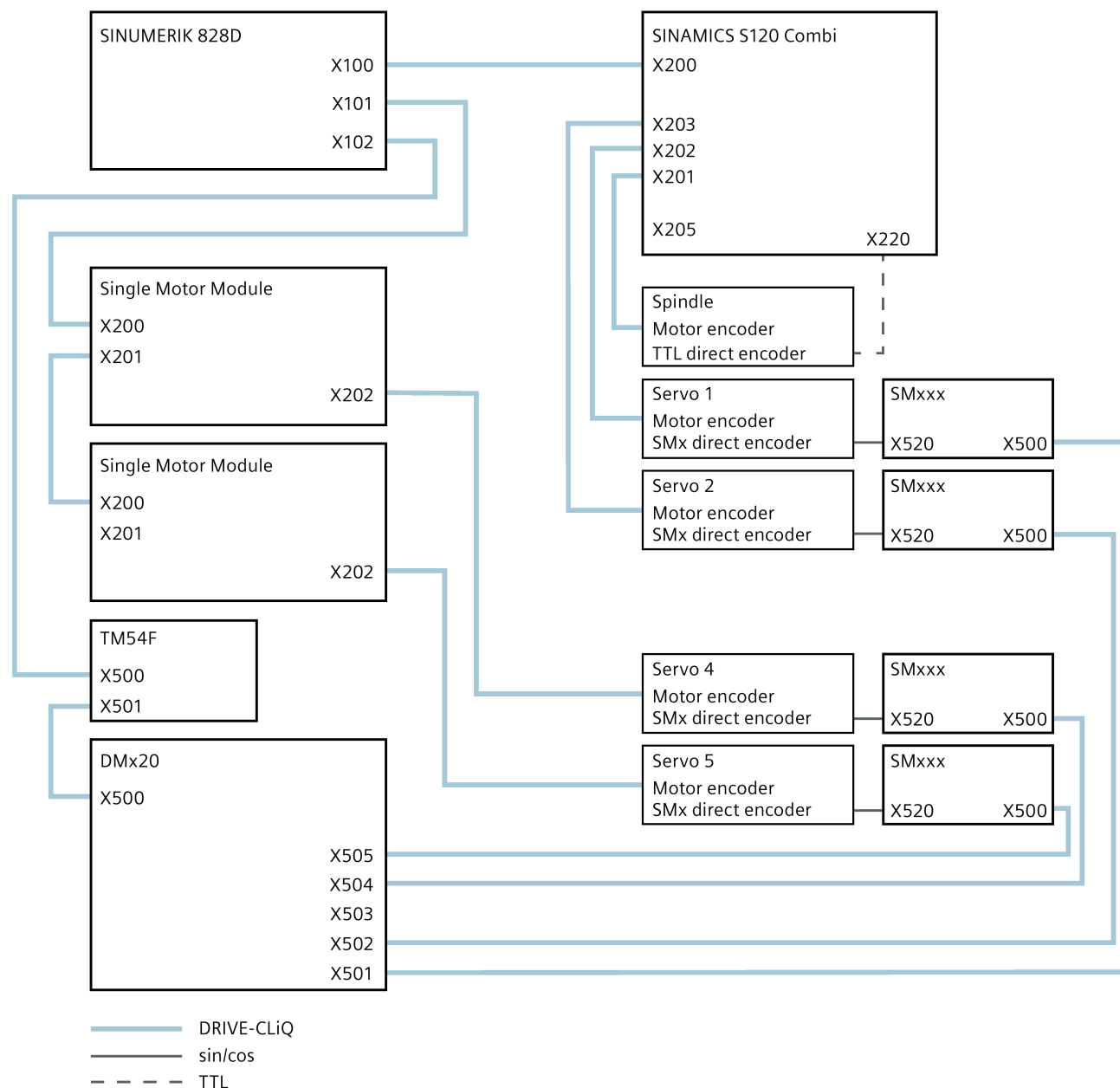
An NX15.3 module is required to connect the second Combi module to the SINUMERIK 828D.

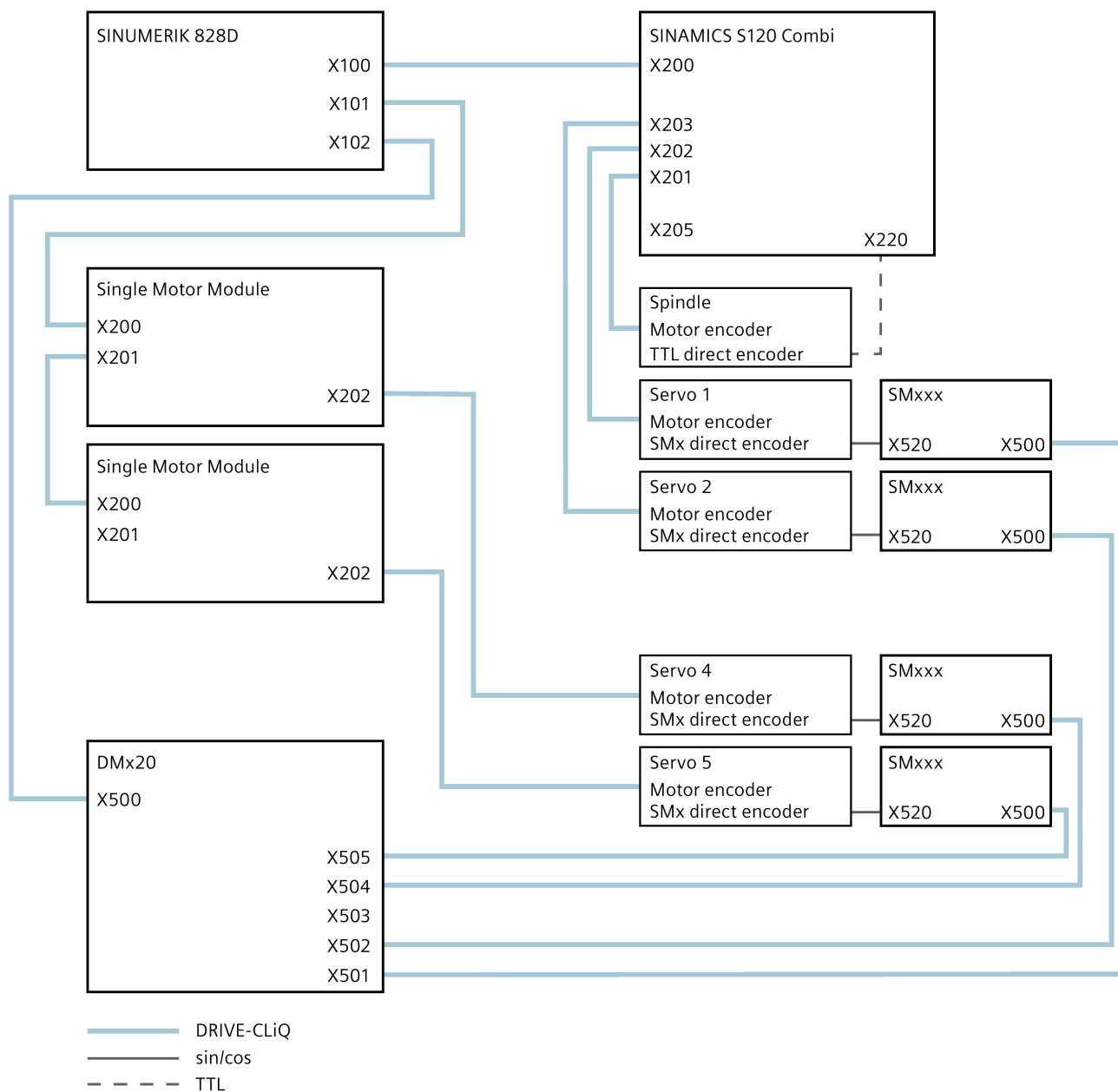
DRIVE-CLiQ interface	Connecting to
X100	X102 of the PPU
X101	X200 of the S120 Combi
X102	X200 of a Single Motor Module or Double Motor Module
X103	Remains empty

6.2 Connection examples

6.2.1 Operation with a 3 axes Power Module

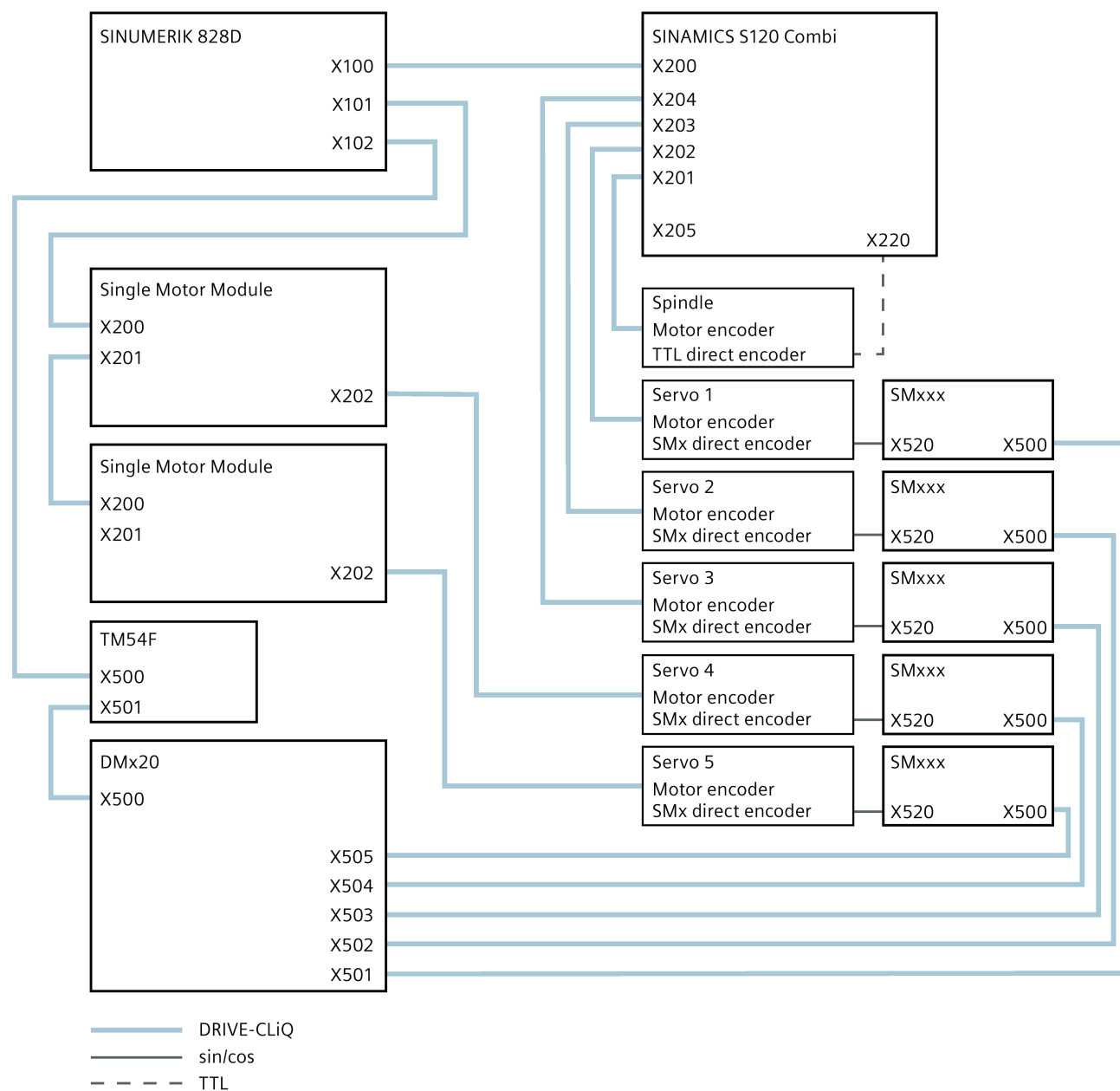
A Terminal Module TM54F is connected



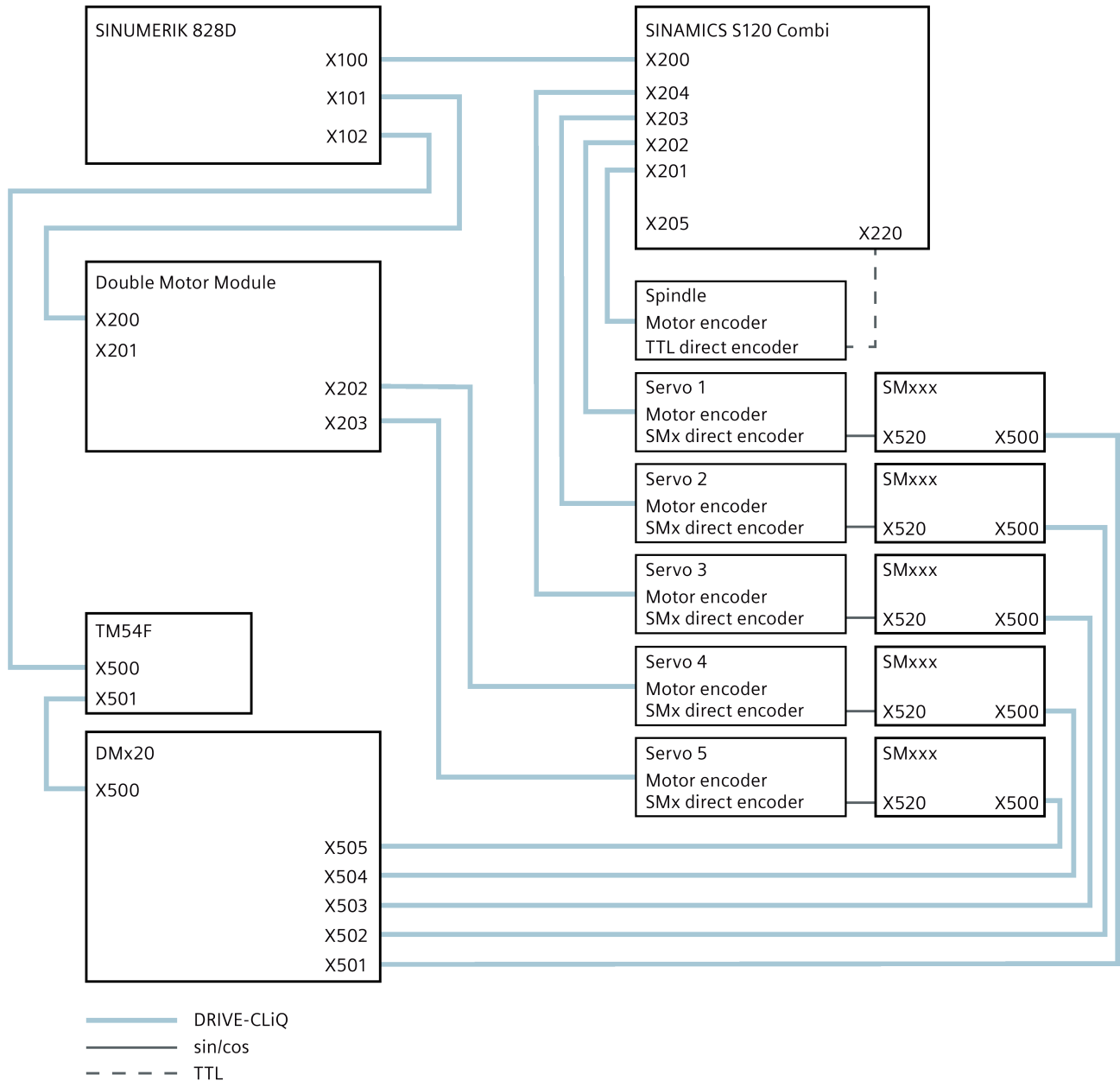
No Terminal Module TM54F is connected

6.2.2 Operation with a 4 axes Power Module

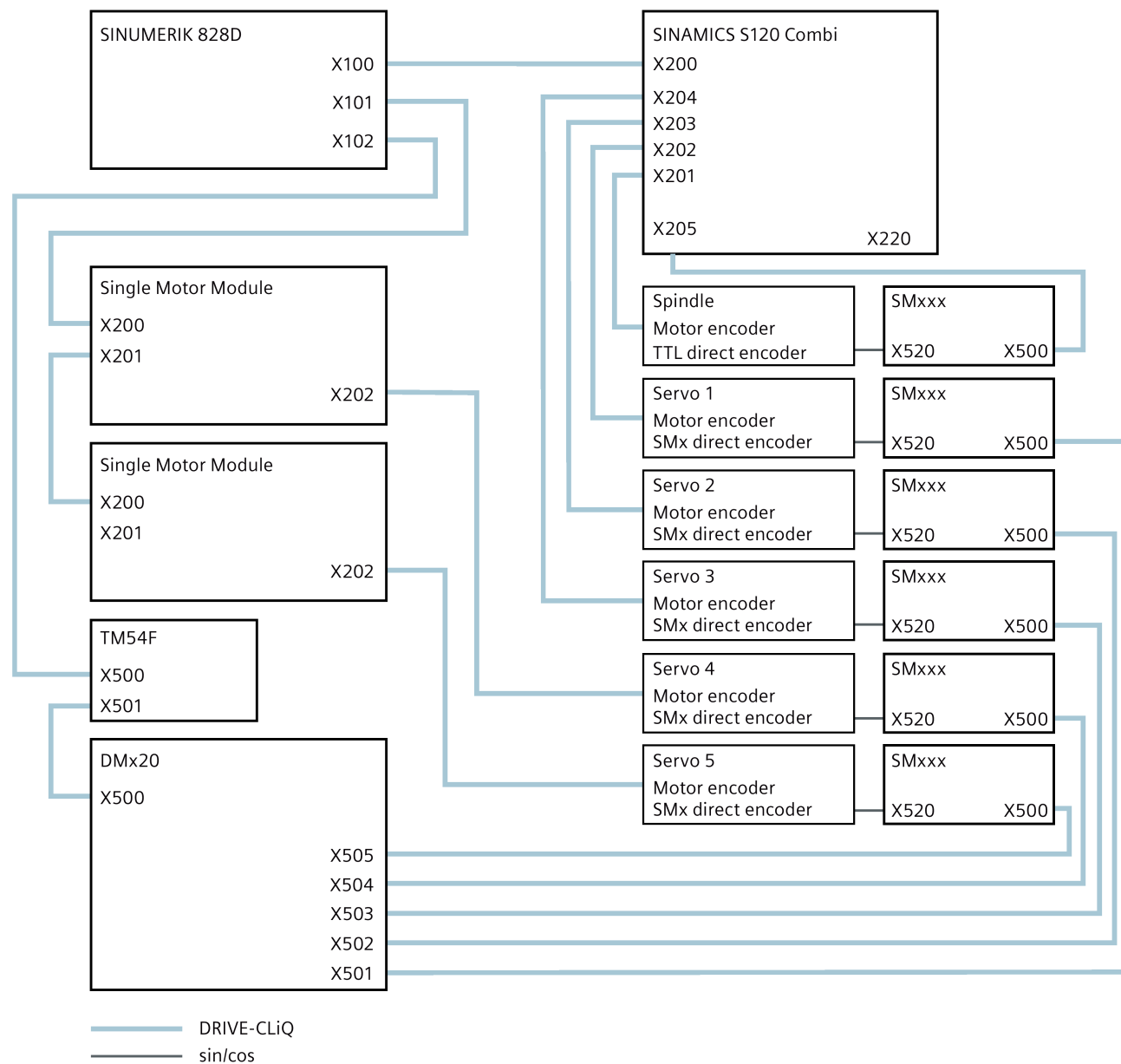
Two Single Motor Modules + a TTL encoder



A double Motor Module + a TTL encoder

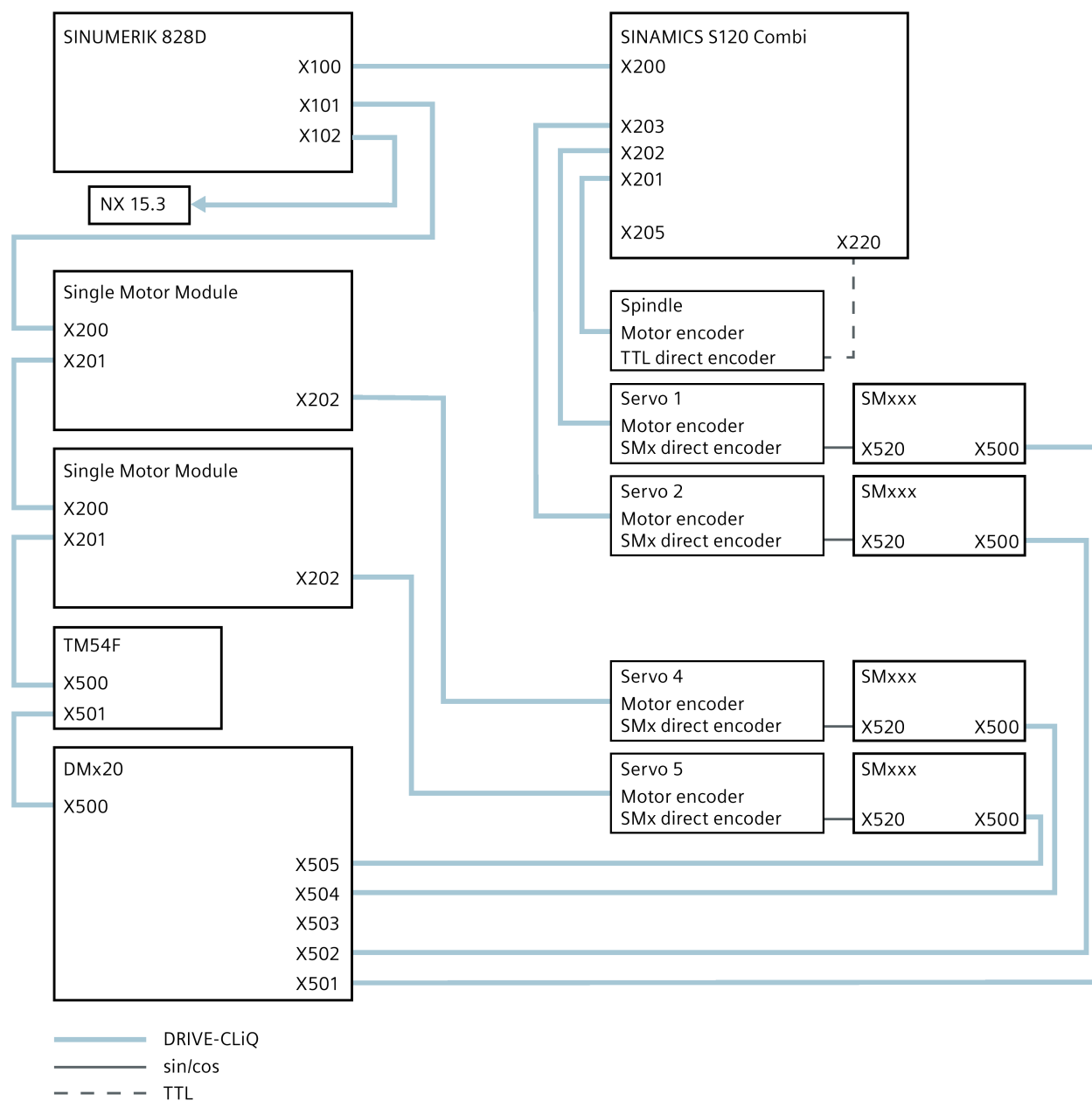


Two Single Motor Modules + an angular encoder

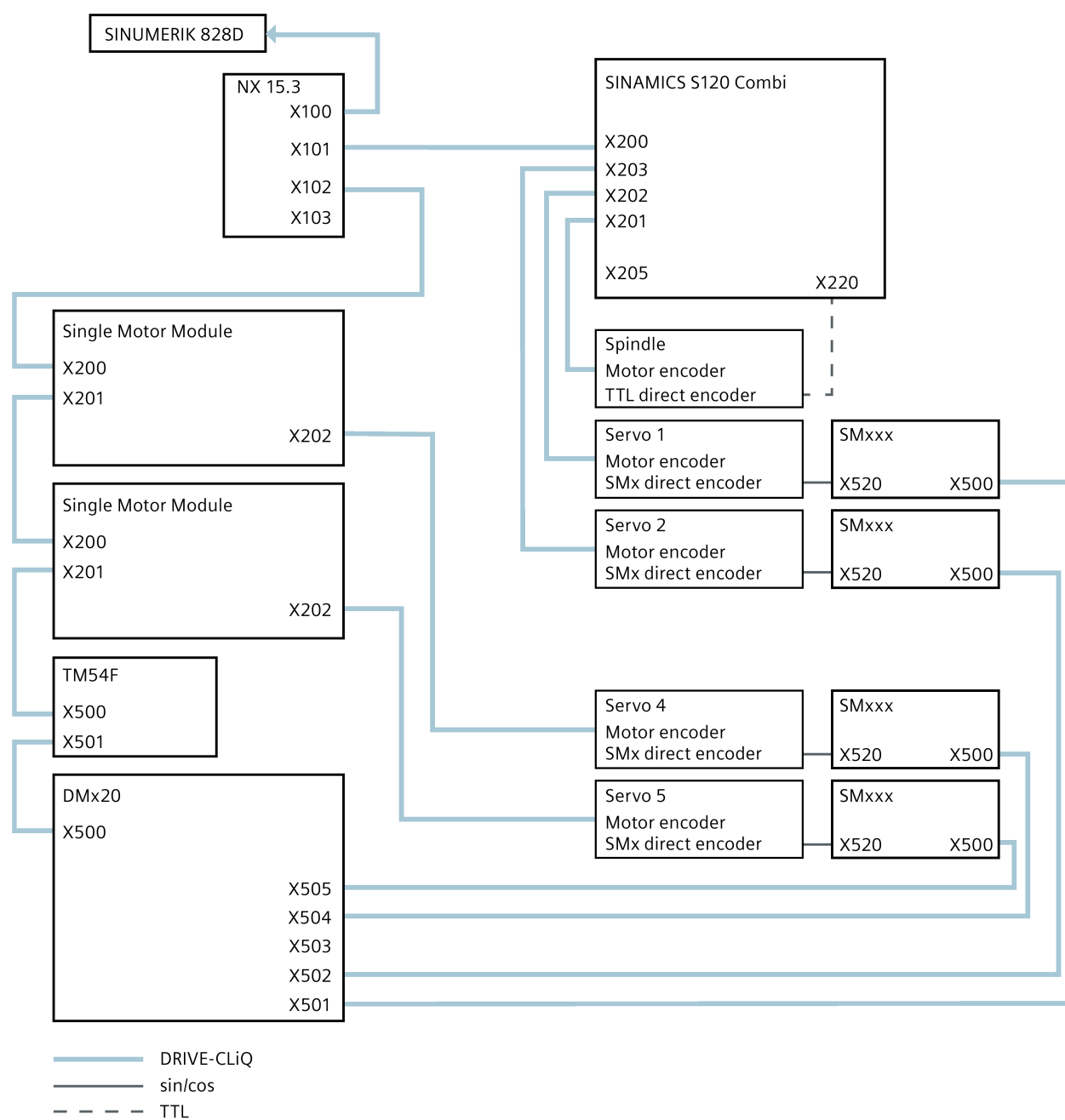


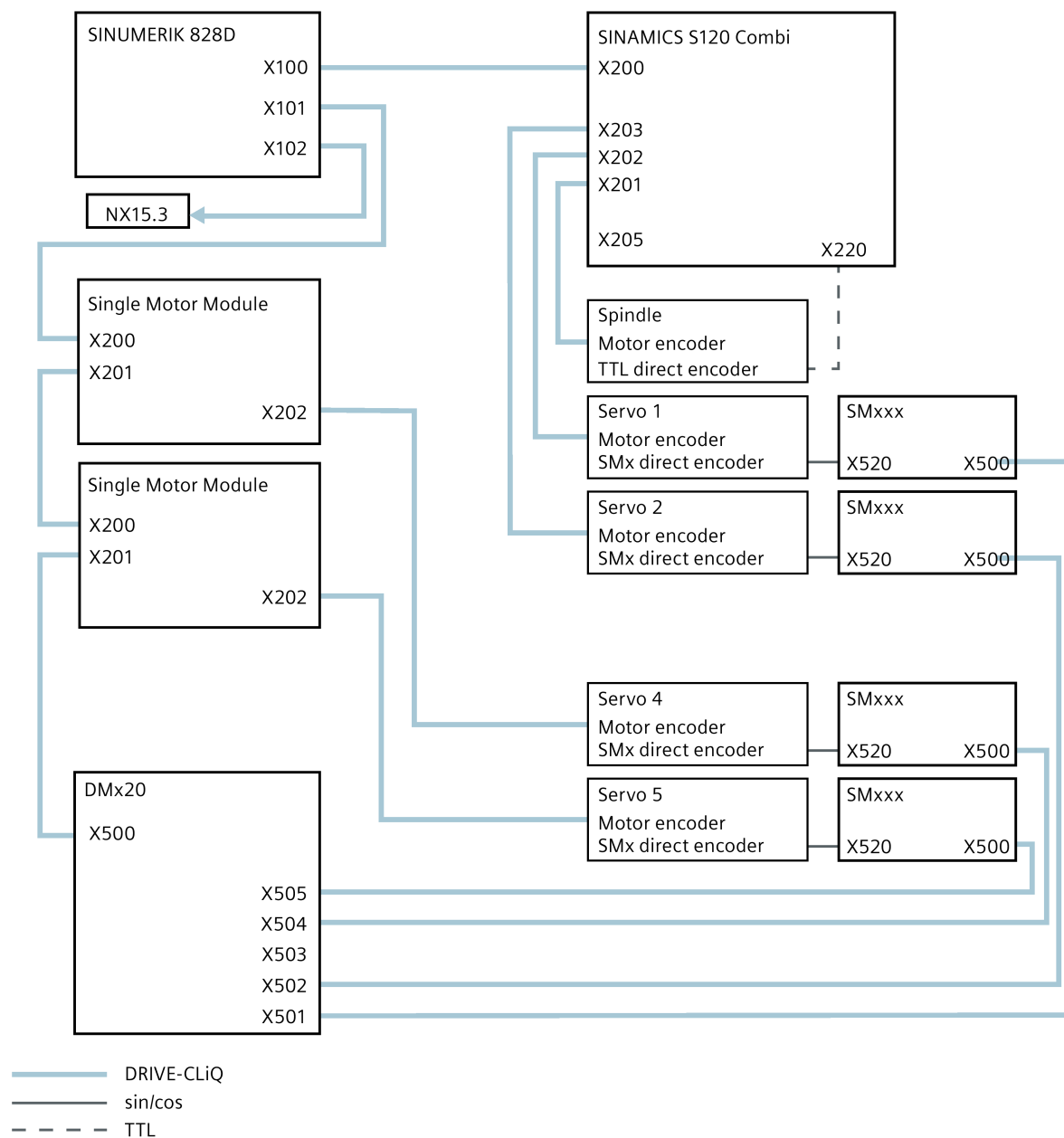
6.2.3 Operation with two 3 axes Power Modules

A Terminal Module TM54F is connected

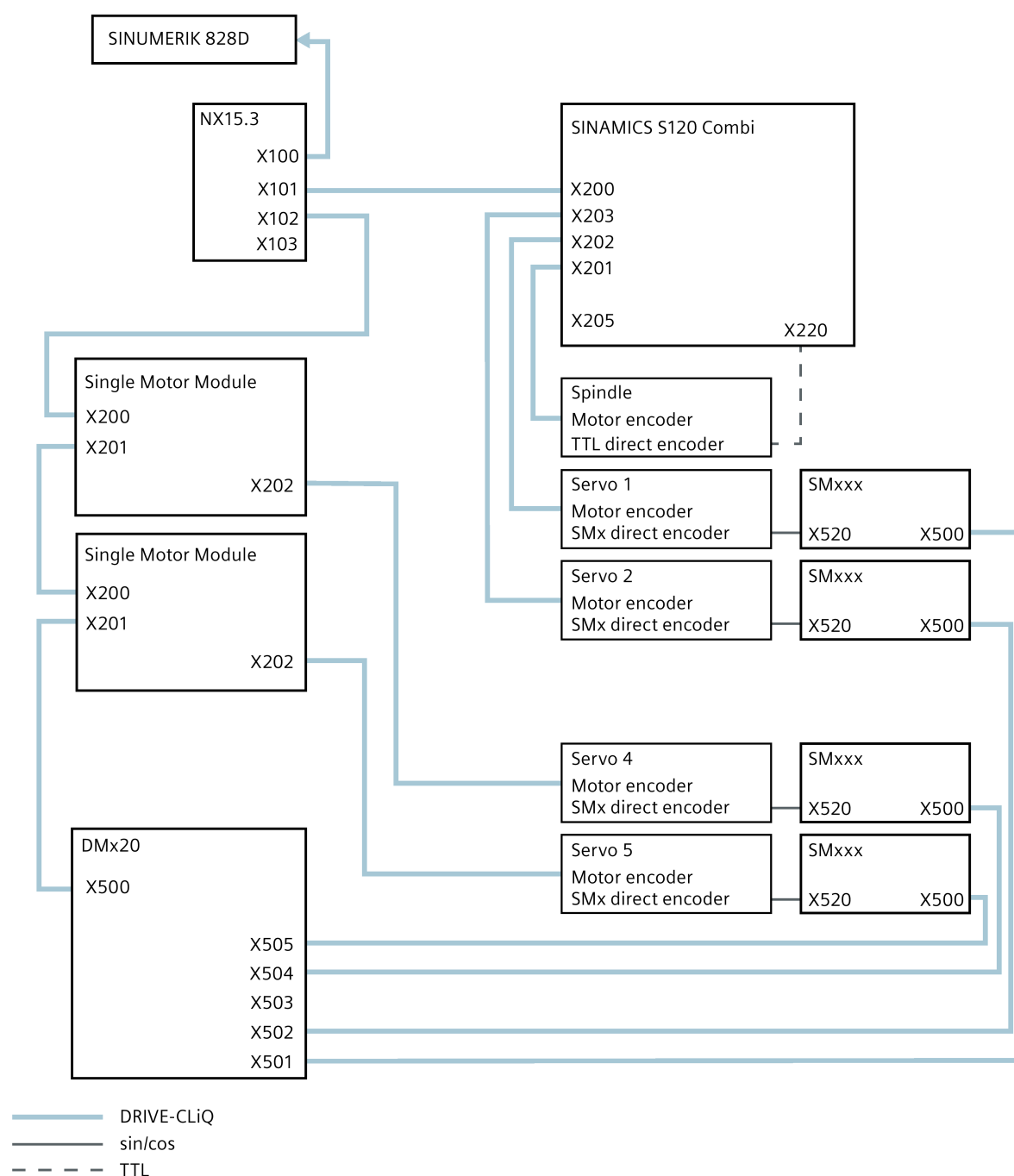


6.2 Connection examples



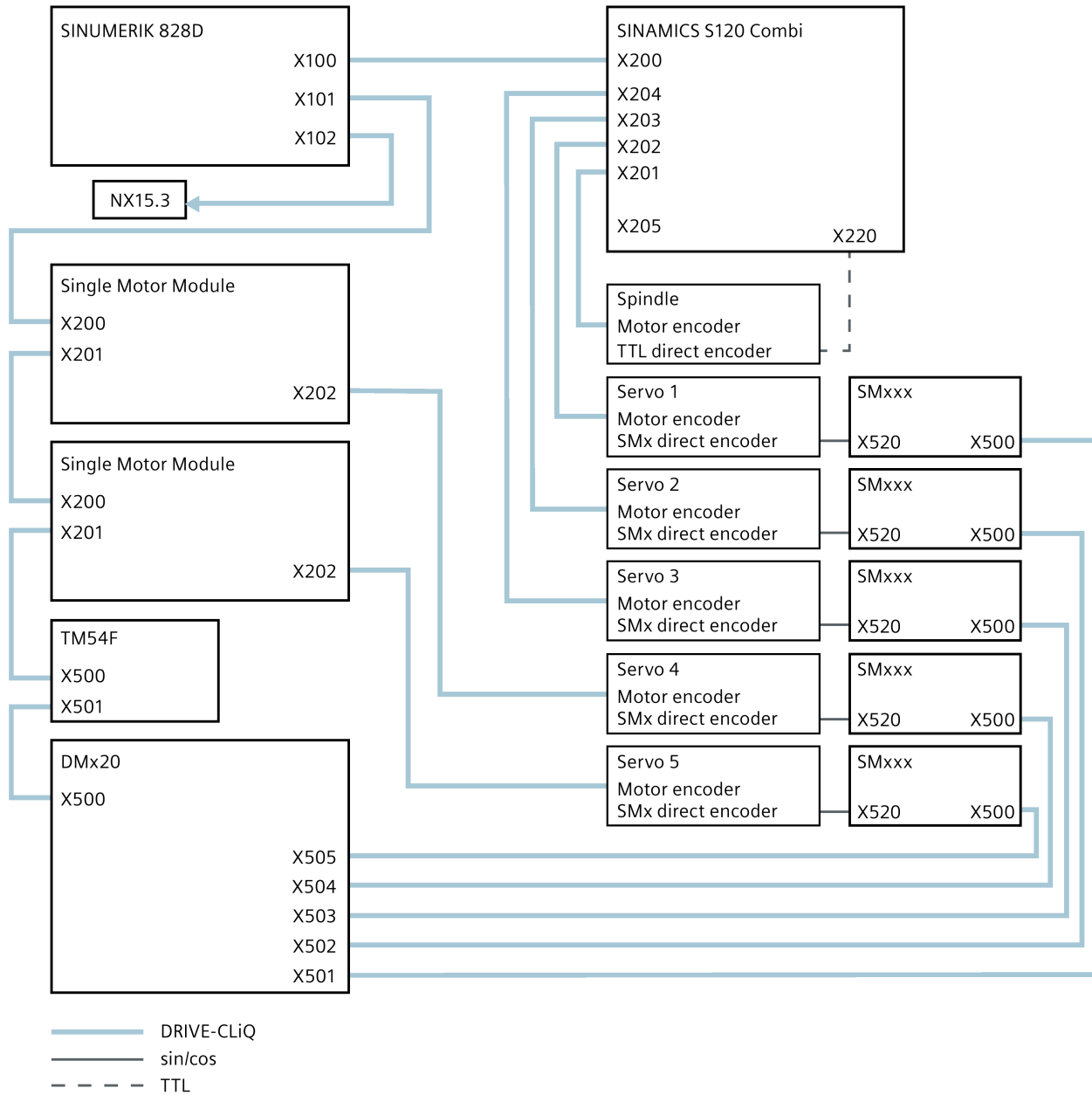
No Terminal Module TM54F is connected

6.2 Connection examples

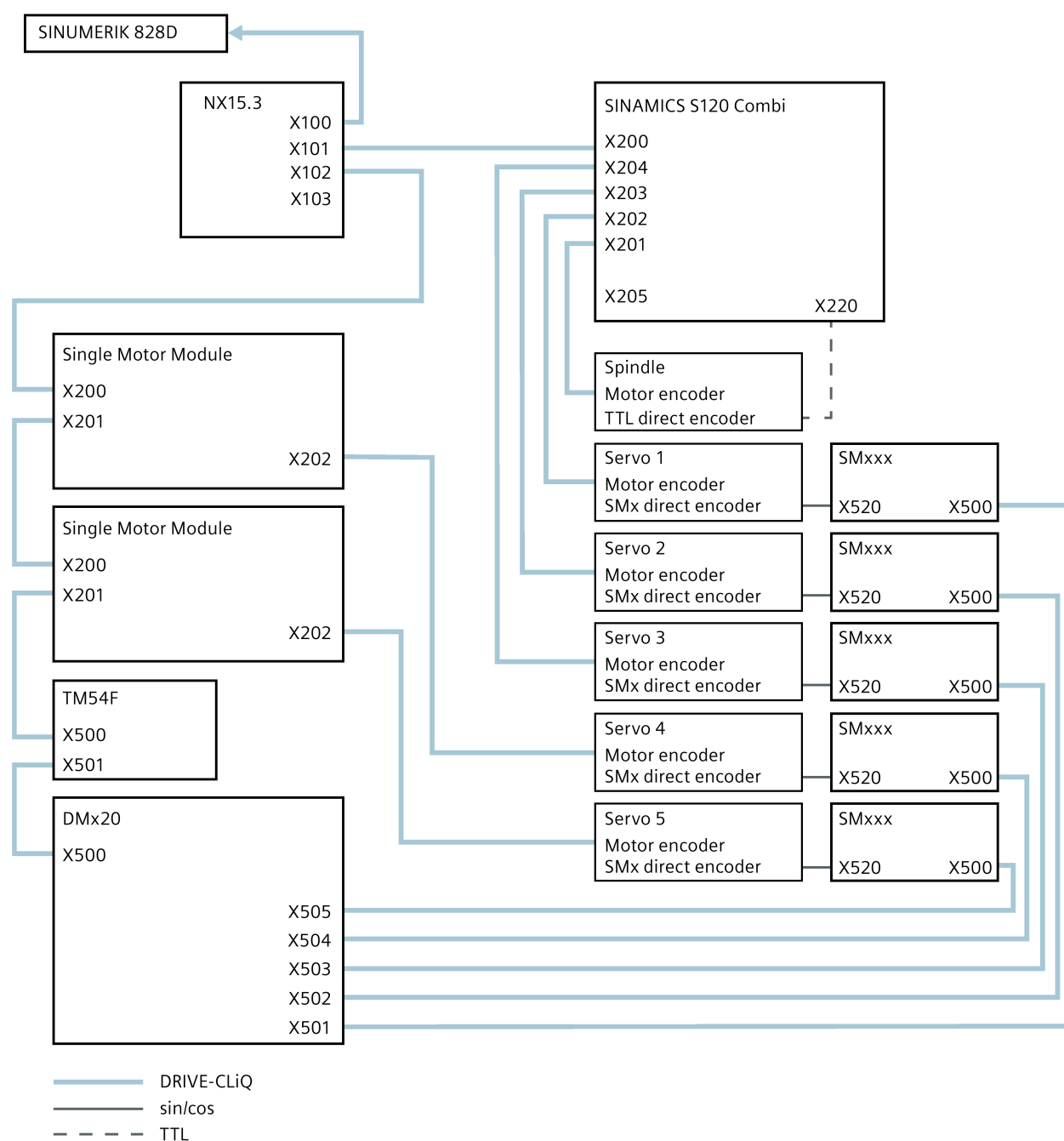


6.2.4 Operation with two 4 axes Power Modules

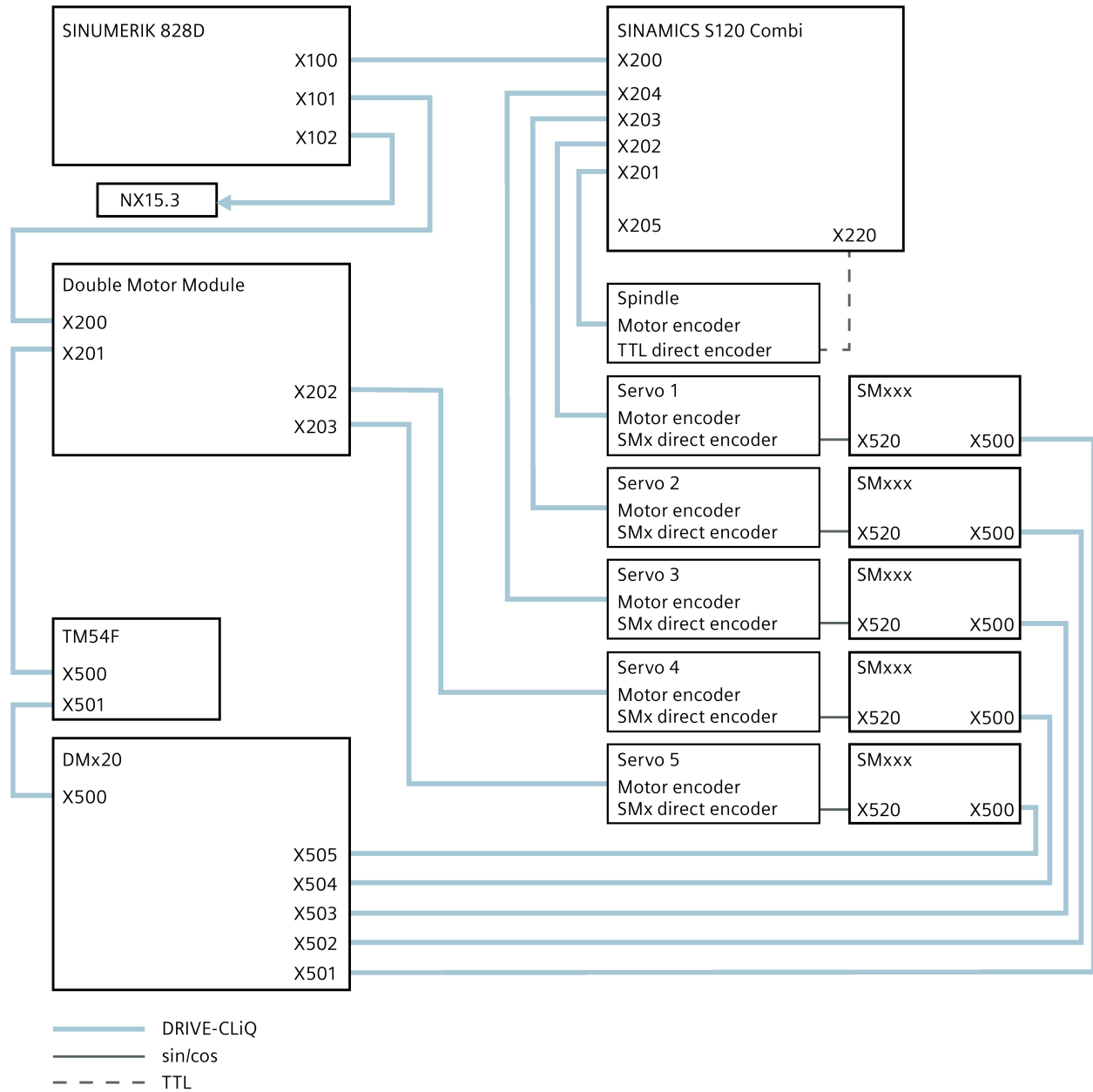
Two Single Motor Modules + a TTL encoder



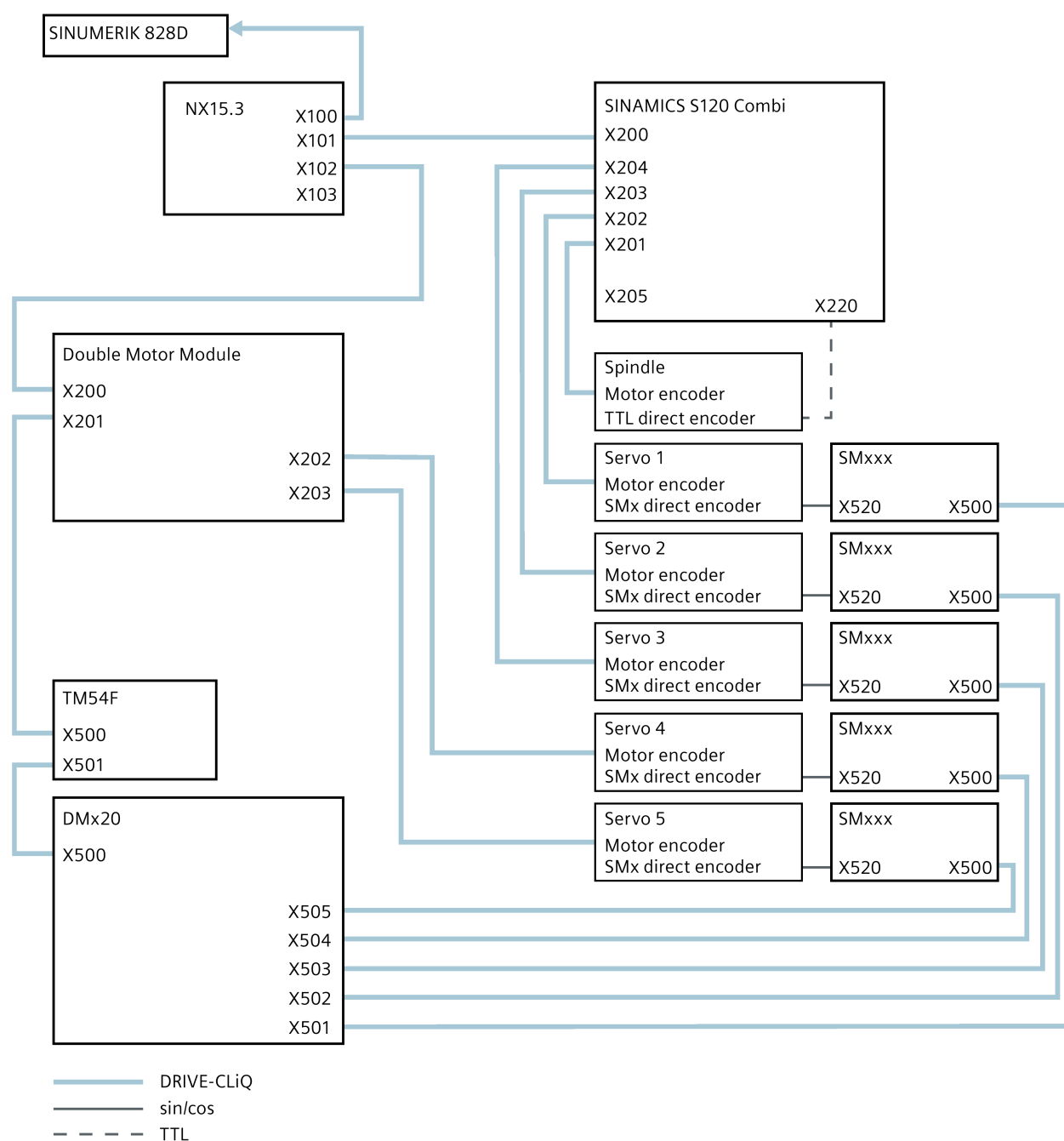
6.2 Connection examples



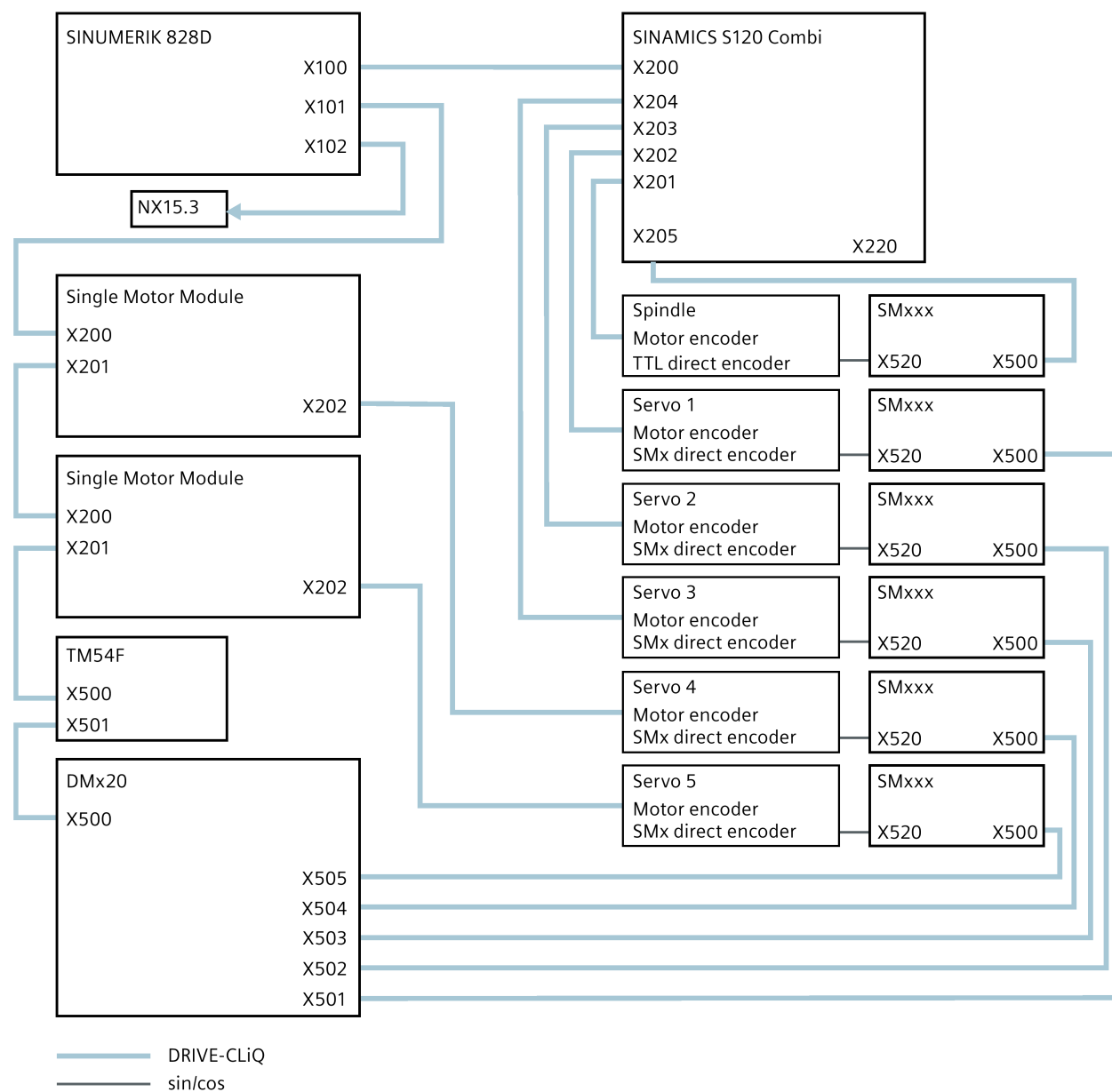
A double Motor Module + a TTL encoder



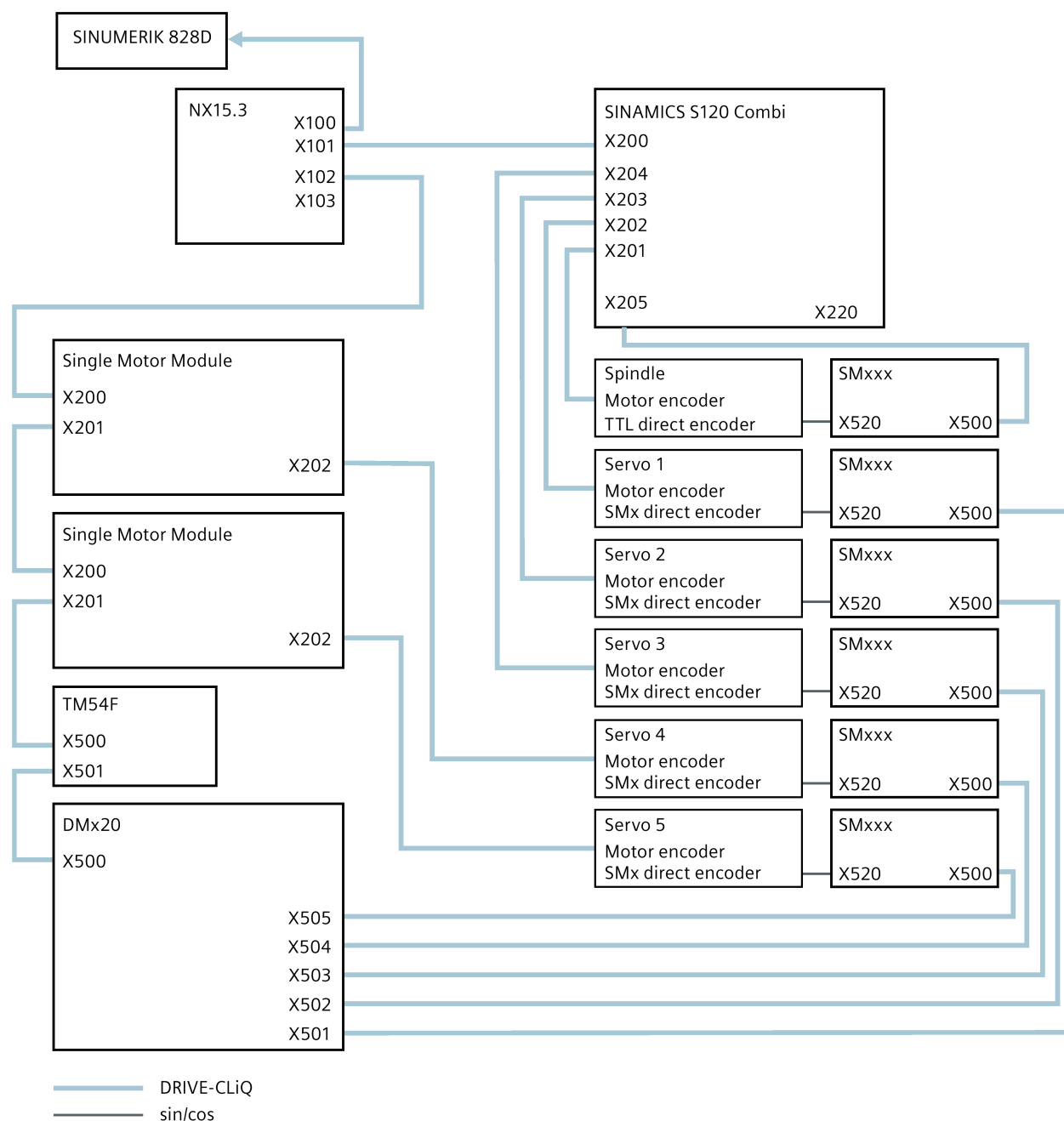
6.2 Connection examples



Two Single Motor Modules + an angular encoder



6.2 Connection examples



Cabinet design and EMC

7.1 General information

As built-in units, S120 Combi Power Modules comply with degree of protection IP20 or IPXXB according to IEC 60529, and open type devices according to UL 50. This therefore ensures that fingers cannot come into contact with any live parts.

To ensure also protection against mechanical stress and climatic conditions, the components must always be operated in housings, cabinets or enclosed electrical operating areas/rooms that fulfill at least degree of protection IP54 according to European enclosure specifications, or in compliance with US, Canadian and Mexican regulations as enclosure type 12, according to NEMA 250.

Note

Protection against the spread of fire

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

Converters of the open type / IPXXB degree of protection must be installed in a metal control cabinet or protected by another equivalent measure so that fire cannot spread and emissions cannot escape from the cabinet.

Note

Protection against condensation and electrically conductive contamination

To ensure the functional safety and safety functions of Safety Integrated, protect the converter, e.g. by installing it in a control cabinet with degree of protection IP54 according to IEC 60529 or Type 12 according to NEMA 250. Further measures may be necessary for particularly critical operating conditions.

If condensation and conductive pollution can be excluded at the installation site, a lower degree of cabinet protection is permissible.

Note

The minimum volume requirement of the cabinet

When you mount the S120 Combi Power Module to a cabinet, the minimum volume of the cabinet is 0.864 m³ (30.5 ft³).

Low-voltage switchgear and controlgear assemblies

If the S120 Combi is used for the electrical equipment of machines, the applicable requirements of EN 60204-1 must also be adhered to.

Safety of machinery - electrical equipment of machines

All information for device selection in this section applies to the following line supply systems:

- Operation on TN and TT line supply systems with grounded neutral point and grounded phase conductor
- Operation on IT line supply systems

7.2 Safety instructions with respect to control cabinet design

WARNING

Danger of injury caused by foreign objects in the device

Parts (e.g. drilling chips, end sleeves) falling into the device can cause short circuits and damage the insulation. This can lead to serious injuries (arcing, loud bang, pieces flying out of the equipment).

- Only perform installation and other work when the devices are safely isolated from the power supply.
- Cover the ventilation slits during installation of the cabinet and remove the cover before switching on.

NOTICE

Malfunctions and damage due to static discharge

If static discharge occurs on surfaces or interfaces that cannot be easily accessed, this can cause malfunctions and/or defects.

- Only touch components, modules and devices if you are first grounded by applying one of the following measures:
 - Wearing an ESD wrist strap
 - Wearing ESD shoes or ESD grounding straps in ESD areas with conductive flooring

7.3 Electromagnetic compatibility

7.3.1 Notes on electromagnetic compatibility (EMC)

Requirements to implement EMC are listed in EN 61800-3 and in the "EMC Installation Guideline" Configuration Manual (Article No. 6FC5297-0AD30-0.P.). Conformance with the EMC Directive of the EC can be ensured by following the measures described in the Configuration Manual, EMC installation guideline.

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

- Operation on TN and TT line supply systems with grounded neutral point
- Observance of information about cable shielding and equipotential bonding
- Use of the recommended power and signal cables from Siemens
- Only cables from Siemens may be used for DRIVE-CLiQ connections

NOTICE

Damage due to use of incorrect DRIVE-CLiQ couplings or cabinet glands

Damage or malfunctions can occur on the devices or system when incorrect or unreleased DRIVE-CLiQ couplings or cabinet glands are used.

- Only use suitable DRIVE-CLiQ couplings and cabinet glands that have been released by Siemens for the respective application.



! WARNING

Electric shock due to faulty shielding

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

- Ensure the correct shielding procedures are used.

! WARNING

Fire due to overheating when permissible cable lengths are exceeded

Excessively long cable lengths can cause components to overheat with the associated risk of fire and development of smoke.

- The cable lengths (e.g. motor cable, DC link cable) listed in the technical data must not be exceeded.

Note

Radio interference due to high-frequency interference in residential environments

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

This device is not designed for unrestricted operation in the first environment (residential environment) and may not be used in the first environment without suitable interference suppression measures.

- Have qualified personnel carry out the installation and commissioning with suitable interference suppression measures.

7.3.2 Classification of EMC behavior

The EMC environments and EMC categories are defined in the EMC product standard IEC 61800-3 as follows:

Environments

First environment (public systems)

An environment that includes domestic premises and establishments that are connected directly to a public low-voltage line supply without the use of an intermediate transformer.

Examples: houses, apartments, commercial premises or offices in residential buildings.

Second environment (industrial systems)

An environment that includes all other establishments that are not connected directly to a public low-voltage line supply.

Examples: industrial and technical areas of buildings fed from a dedicated transformer.

Categories

Category C1

Drive systems with a rated voltage < 1000 V that are intended for unrestricted use in the first environment.

Category C2

Stationary drive systems with a rated voltage < 1000 V for operation in the second environment.

Drive systems of Category C2 may only be used in the first environment if they are installed and commissioned by an expert and the limit values for harmonic currents are complied with.

Note

Disturbance of radio communication services due to radio-frequency interferences in residential environments

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

- Have the installation and commissioning performed with appropriate radio interference suppression measures by experts.
-

Category C3

Drive systems with a rated voltage < 1000 V that are solely intended for use in the second environment.

Note

Disturbance of radio communication services due to radio-frequency interferences in residential environments

In a residential environment, this product can cause radio-frequency interferences.

- Do not use this device in the first environment (residential area).
-

Category C4

Drive systems for IT line supplies for operation in complex systems in the second environment. An EMC plan must be drawn up.

7.3.3 Drive system applications

SINAMICS S120 Combi is designed for use in the second environment. It is to be used on a professional basis in trade, business and industry. This device is not designed for unrestricted operation in the first environment (residential environment) and may not be used in the first environment without suitable interference suppression measures.

In order to satisfy the EMC requirements, the drive system must be installed by appropriately qualified personnel in compliance with EMC regulations and the installation notes provided in the manual.

Note

Appropriately trained and qualified personnel

An appropriately trained and qualified person has the necessary experience for installing and/or commissioning drive systems (Power Drive Systems - PDS), including the associated EMC aspects.

Carefully observe the information in the "EMC installation guideline (<https://support.industry.siemens.com/cs/ww/en/view/60612658>)" Configuration Manual for EMC-compliant installation.

With regard to interference immunity, the drive system is suitable for operation in the second environment.

Category C2

To ensure that the drive system satisfies the requirements of Category C2, you have to

- Use RFI suppression filters
- Operate drive system in a network with grounded neutral point
- Use motor cables with shielding and observe the maximum total line lengths:
 - with the line reactor and line filter up to 175 m

Category C3

To ensure that the drive system satisfies the requirements of Category C3, you have to

- Use RFI suppression filters
- Operate drive system in a network with grounded neutral point
- Use motor cables with shielding and observe the maximum total line lengths:
 - with the line reactor and line filter up to 175 m

7.3.4 Emitted interference/interference immunity

Limiting interference emission

Radio interference suppression filters are required in order to limit interference emission. The filter is externally mounted.

- It is not permissible to use line filters in IT line systems.

Interference immunity

Note

Integrating SINAMICS S120 Combi in other plants/machines

When variable-speed drive systems are integrated in other plants/machines, additional measures may be required in order to comply with their product standards.

With respect to the compliance with limits for harmonic currents, the EMC product standard IEC 61800-3 for drive systems (PDS) refers to compliance with standards IEC 61000-3-2 and IEC 61000-3-12.

Converters are classified as equipment used on a professional basis, deployed in certain areas of business and industry - and are not operated in the general public domain.

The following constraints must be observed when used in the first environment:

- The drive system must be installed in compliance with EMC regulations by appropriately trained professionals.
- The converters must be equipped with a Category C2 line filter.
- The device-specific information and instructions for maintaining harmonic current limits must be complied with.

Note

Malfunctions when not using original Siemens accessories

Malfunctions can occur if accessories are used that are not original.

- For DRIVE-CLiQ connections, only use the genuine Siemens DRIVE-CLiQ wiring and DRIVE-CLiQ cabinet bushings.
-

Note

Faulty operation of the machine due to incorrect shielding or cables that are too long

The machine can malfunction if the shielding is incorrect or the cables are too long.

- Always follow the correct procedures for the shielding and the specified cable lengths.
-

7.4 Electromagnetic fields in the workplace

7.4.1 Preliminary remarks

Protection of workers from electromagnetic fields is specified in the European EMF Directive 2013/35/EU. This directive is implemented in national law in the European Economic Area (EEA). Employers are obligated to design workplaces in such a way that workers are protected from impermissibly strong electromagnetic fields. To this end, assessments and/or measurements must be performed for workplaces.

General conditions for correct assessment or measurement

1. The laws for protection from electromagnetic fields in force in individual EU member states can go beyond the minimum requirements of the EMF Directive 2013/35/EU and always take precedence.
2. The ICNIRP 2010 limits for the workplace are the basis for the assessment.
3. The 100 μT (RMS) mentioned below for assessment of active implants comes from the 26th BIMSChV (German Federal Emission Protection Regulation).
According to Directive 2013/35/EU, 500 μT (RMS) at 50 Hz is applicable here.
4. Compliance with the limit values was checked for the following frequencies:
 - Line frequency 45 ... 66 Hz (see system data)
 - Pulse frequency, for example 4/8 kHz and multiples thereof, assessed up to a maximum of 100 kHz (see system data or relevant technical specifications)
5. The routing of power cables has a significant impact on the electromagnetic fields that occur. You can find more detailed information in the "EMC installation guideline (<https://support.industry.siemens.com/cs/ww/en/view/60612658>)".

7.4.2 Measurements/assessments for SINAMICS S120 Combi Power Modules

Note

Validity

The following information regarding electromagnetic fields relates solely to products and components supplied by Siemens. A precondition is the installation and operation of components inside metallic cabinets in compliance with the documentation and the "EMC installation guideline (<https://support.industry.siemens.com/cs/ww/en/view/60612658>)" and the use of shielded motor cables.

7.5 24 V DC supply

The components of the SINAMICS S120 product family are normally used in machines. The assessment and testing is based on DIN EN 12198.

Frequency range	0 Hz ... 100 kHz	100 kHz ... 300 GHz
Electric field strength	Limits not exceeded	Limits not exceeded
Magnetic flux density	For assessment, see the following table	Limits not exceeded

Minimum distances from SINAMICS S120 Combi Power Module at 0 Hz ... 100 kHz in cm (inch)

Power Module	Generally		Individuals with active implants	
	Control cabinet closed	Control cabinet open	Control cabinet closed	Control cabinet open
$P \leq 36 \text{ kW}$	0 (0)	10 (4)	The limit of 100 μT (RMS) at 50 Hz is not exceeded. Must be separately assessed depending on the active implant.	Must be separately assessed depending on the active implant.

Note

The minimum distances indicated above apply to the head and complete torso of the human body. Shorter distances are possible for extremities.

7.4.3 Measurements/assessments for 24 V components

The 24 V components, e.g. Terminal Modules, Sensor Modules, Hub Modules and Voltage Sensing Modules, do not emit any significant electromagnetic fields.

No minimum clearance has to be maintained for 24 V components.

7.5 24 V DC supply

7.5.1 General information

The 24 V DC power supply is required to supply the voltage for the following components:

- Electronics of the S120 Combi and the expansion axes (Motor Modules)
- Electronics of the SINUMERIK 828D PPU, the SINUMERIK ONE, CU320-2, NX15.3, the Sensor Modules, the Terminal Module, the Braking Module, the DMx as well as the process voltage of its digital inputs
- Load voltage of the digital outputs
- Motor holding brake

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

Note

The electronics power supply has to be supplied by the user as described in Section System data (Page 87) of this documentation.

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



! WARNING

Electric shock due to a terminal voltage that has not been adjusted

Contact with live terminals can cause death or severe injury.

- Only connect protective extra-low voltages to all connections and terminals between 0 and 48 VDC.

NOTICE

Damage to other loads as a result of overvoltage

Overvoltages of switched inductances (contactors, relays) can damage connected loads.

- Install suitable overvoltage protection circuits and devices.

Note

Malfunction because 24 V supply voltage is too low

If the 24 V supply voltage falls short of the specified minimum value on a device in the assembly, a malfunction can occur.

- Select an input voltage that is high enough for there to be sufficient voltage on the last device. Do not exceed the maximum value for the supply voltage. If required, supply the voltage to the assembly at various locations.

Note

Motor holding brake connection

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V connections. The voltage tolerances of the motor holding brakes ($24\text{ V} \pm 10\%$) and the voltage drops of the connecting cables must be taken into account.

Set the DC power supply to 26 V. This ensures that the power supply for the brake remains within the permissible range when the following conditions are met:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- The max. motor cable length limits to 50 m (70 m for an 18 A supplementary axis)

7.5.2 24 V power supply and connection of components

The 24 V power supply can be supplied in two ways:

- Using an external 24 V power supply
- Using a Control Supply Module

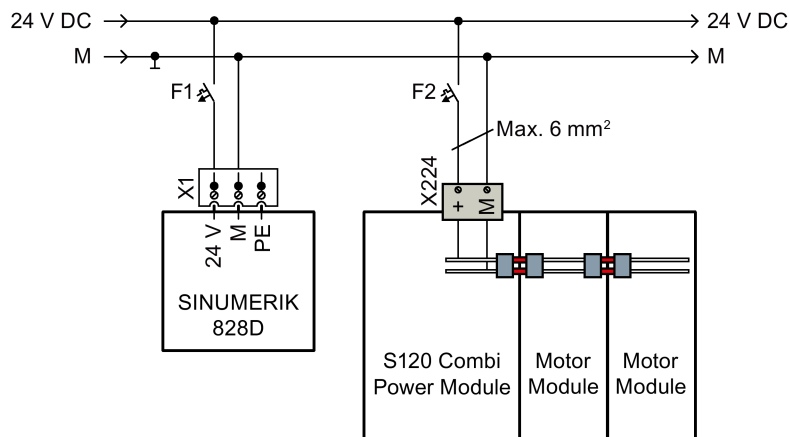
For different S120 Power Modules, the connection methods are different. Identify the article number of your Power Module before the connection.

Using an external 24 V power supply

When using an external 24 V power supply, e.g. SITOP, the external power supply should be located very close to the load (max. cable length 30 m). Miniature circuit breakers with tripping characteristic D are recommended as overcurrent. The ground potential M must be connected to the protective conductor system (DVC A).

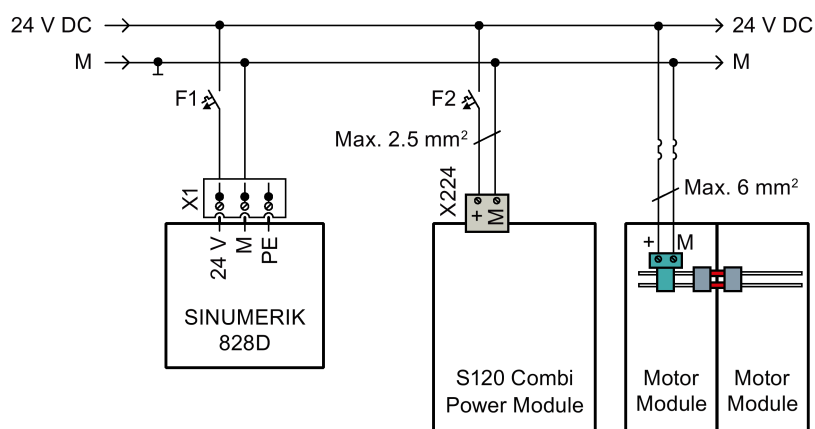
For the following S120 Combi Power Modules, the 24 V power supply for the expansion axes (Motor Modules) is provided by the S120 Combi via the integrated 24 V busbars. The current carrying capacity of these busbars is 20 A.

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1
- 6SL3111-4VE21-0EA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1



For the following S120 Combi Power Modules, the 24 V power supply for the expansion axes (Motor Modules) is provided by the external 24 V power supply directly. You need to connect the 24 V power supply to the 24 V busbar of the expansion axis via a 24 V terminal adapter. The terminal adapter is provided in an expansion axis adapter (article number: 6SL3161-3XP00-0AA0), which you can order from Siemens.

- 6SL3111-3VE21-6FC1
- 6SL3111-3VE21-6EC1
- 6SL3111-3VE22-0HC1
- 6SL3111-4VE21-6FC1
- 6SL3111-4VE22-0HC1
- 6SL3111-4VE21-6ED2
- 6SL3111-4VE21-6ED1
- 6SL3111-4VE21-6EC1

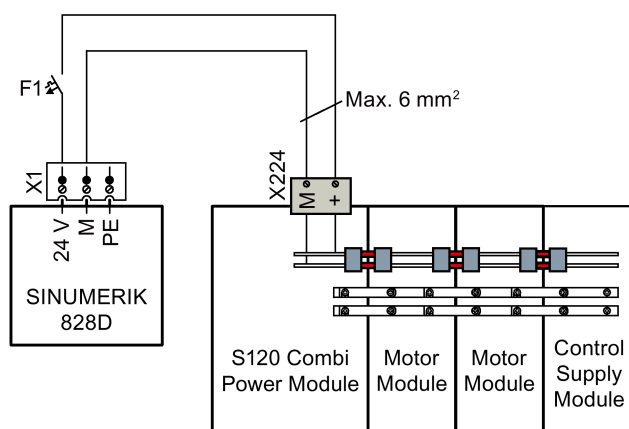


Using a Control Supply Module

When using a Control Supply Module, the 24 V supply can be directly established through the busbars. The electronic current limiting function integrated in the Control Supply Module protects the busbar system when a fault occurs. Additional loads can be connected via the 24 V connector.

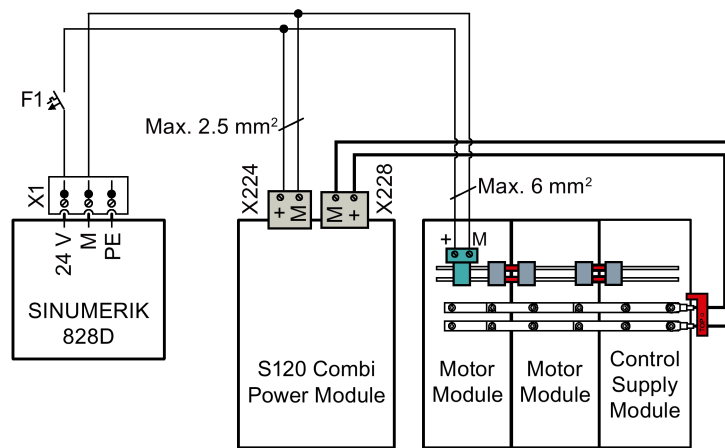
For the following S120 Combi Power Modules, you can connect the Control Supply Module with the DC link busbars.

- 6SL3111-3VE21-6FA2
- 6SL3111-3VE21-6EA1
- 6SL3111-3VE22-0HA1
- 6SL3111-4VE21-0EA1
- 6SL3111-4VE21-6FA2
- 6SL3111-4VE21-6EA1
- 6SL3111-4VE22-0HA1



For the following S120 Combi Power Modules, to connect the Control Supply Module, use a DC link cable. The cable is provided in an expansion axis adapter (article number: 6SL3161-3XP00-0AA0), which you can order from Siemens.

- 6SL3111-3VE21-6FC1
- 6SL3111-3VE21-6EC1
- 6SL3111-3VE22-0HC1
- 6SL3111-4VE21-6FC1
- 6SL3111-4VE22-0HC1
- 6SL3111-4VE21-6ED2
- 6SL3111-4VE21-6ED1
- 6SL3111-4VE21-6EC1



Note

If more than one additional components are connected, install the ring terminal lugs of the DC link cable to the screws on the right side of the rightmost additional component and install the 24 V terminal adapter to the 24 V busbars on the leftmost additional component.

The connections of the DC link and 24 V power supply between two additional components can still be realized by the busbars.

Note

When using cables with a cross-section of 2.5 mm², no additional protection is required on the 24 V side if a type XLPE or EPR cable, or a cable with a similar quality and with a thermal stability of up to 90 °C is used.

Note

When connecting the 24 V busbars, you need to observe the following requirements:

- A 24 V connector must be plugged onto the 24 V busbar between each S120 Combi, expansion axis and DC link component
- Insertion and withdrawal is only permissible in the no-voltage state
- Only 5 withdrawal and insertion cycles are permissible

7.5.3 Overcurrent protection in the 24 V solid-state circuit

The cables on the primary and secondary sides of the 24 V power supply unit must be protected against overcurrent.

The protection on the primary side depends on the instructions of the equipment manufacturer.

The protection on the secondary side depends on the actual conditions. Please note the following:

- Loading from loads, possibly the demand factor against the operation of the machine
- Current carrying capacity of the conductors used and cables in normal and short-circuit conditions
- Ambient temperature
- Cable bundling (laying cables in a common duct)
- Cable routing type

Overcurrent protective devices can be used in compliance with local installation regulations.

Circuit breakers as listed in the Siemens "NSK" catalog are recommended as overcurrent protection devices on the primary side.

Miniature circuit breakers or SITOP select (Article number 6EP1961-2BA00) are recommended as overcurrent protection devices on the secondary side. The MCBs can be selected according to Siemens catalog "BETA Modular Installation Devices - ET B1".

When selecting the miniature circuit breaker, local installation regulations must be carefully complied with.

Core cross-section	Max. value up to 40° C	Max. value up to 55° C
1.5 mm ²	10 A	6 A
2.5 mm ²	16 A	10 A
4 mm ²	25 A	16 A
6 mm ²	32 A	20 A
24 V busbar	20 A	20 A

The tripping characteristic of the miniature circuit breakers must be selected to match the loads to be protected and the maximum current provided by the supply unit in the event of a short circuit.

7.5.4 Typical 24 V current consumption of the components

A separate 24 V power supply must be used for the SINAMICS S120 drive group.

The following table can be used to calculate the 24 V DC power supply. The values for typical current consumption are used as a basis for configuration.

Component	Typical current consumption [A _{DC}]
Controller	
SINUMERIK 828D - PPU without load	1.2
SINUMERIK 828D - PPU with full load (USB, handwheel, ...)	2.5
SINUMERIK ONE NCU 1750 without load	1.865
SINUMERIK ONE NCU 1750 with load	14.89
SINUMERIK ONE NCU 1760 without load	1.865
SINUMERIK ONE NCU 1760 with load	14.89
SINUMERIK ONE PPU 1740 without load	2.4
SINUMERIK ONE PPU 1740 with load	8
Sensor Modules	
SMC20 without/with encoder system	0.20/0.355
SMC30 without/with encoder system	0.20/0.55
SME20 without/with encoder system	0.15/0.25
SME25 without/with encoder system	0.15/0.25
Terminal Modules	
TM54F (without digital outputs. without DRIVE-CLiQ)	0.2
Per digital output/DRIVE-CLiQ	0.5
Additional system components	
DMC20 (without DRIVE-CLiQ) per DRIVE-CLiQ	0.15 0.5
DME20 (without DRIVE-CLiQ) per DRIVE-CLiQ	0.15 0.5
S120 Combi 3 axes Power Module	
16 kW/18 A/9 A/9 A	1.5
16 kW/24 A/9 A/9 A	1.5
20 kW/30 A/9 A/9 A	1.5
S120 Combi 4 axes Power Module	
10 kW/24 A/12 A/12 A/12 A	1.6
16 kW/18 A/9 A/9 A/9 A	1.6
16 kW/24 A/9 A/9 A/9 A	1.6
16 kW/24 A/12 A/9 A/9 A	1.6
20 kW/30 A/12 A/9 A/9 A	1.6
DRIVE-CLiQ and brake	
DRIVE-CLiQ (e.g. motors with DRIVE-CLiQ interface)	0.19
Brake (e.g. motor holding brake)	Max. 1

Component	Typical current consumption [A _{DC}]
Single Motor Modules Booksize	
3 A	0.75
5 A	0.75
9 A	0.75
18 A	0.75
24 A	1.00
30 A	0.80
Double Motor Modules Booksize	
2 x 3 A	0.9
2 x 5 A	0.9
2 x 9 A	0.9
2 x 18 A	1.1
Single Motor Modules Booksize Compact	
3 A (+ 1 x DRIVE-CLiQ; + 1 x brake)	0.75
5 A (+ 1 x DRIVE-CLiQ; + 1 x brake)	0.75
9 A (+ 1 x DRIVE-CLiQ; + 1 x brake)	0.75
18 A (+ 1 x DRIVE-CLiQ; + 1 x brake)	0.75
Double Motor Modules Booksize Compact	
2 x 1.7 A (+ 2 x DRIVE-CLiQ; + 2 x brake)	1
2 x 3 A (+ 2 x DRIVE-CLiQ; + 2 x brake)	1
2 x 5 A (+ 2 x DRIVE-CLiQ; + 2 x brake)	1
External fan unit	0.8
Control Unit	
CU320-2 PN (without DRIVE-CLiQ, without digital output)	≤ 1.0
Numerical Control Extension	
NX15.3 (without DRIVE-CLiQ, without digital output)	0.3
Braking Module	0.5
Motor encoder	0.25

Example: calculating 24 V DC current requirements

Component	Number	Current consumption [A]	Total current consumption [A]
SINUMERIK 828D	1	2.5	2.5
S120 Combi 4 axes Power Module with external fan unit	1	2.4	2.4
Motor Module 9 A	1	0.75	0.75
Motor Module 18 A	1	0.75	0.75
Motor encoder	6	0.25	1.50
Brake	1	1	1
Total:			8.9

7.5.5 Selecting power supply units

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

Recommended SITOP Power Module

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

Note

When using an external 24 V power supply with a continuous current > 20 A, an overcurrent protection device must be used for the S120 Combi Power Module, the cables and the busbars. A circuit breaker is recommended as overcurrent protection device.

The tripping characteristic of the circuit breaker depends on the following:

- The loads to be protected
- The maximum current provided by the power supply unit in the case of a short-circuit.

Recommended Control Supply Module

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

7.6 Cable connection

7.6.1 DRIVE-CLiQ signal cables

Note

Only MOTION-CONNECT 500 and MOTION-CONNECT 800PLUS DRIVE-CLiQ cables are permitted for the connection. The maximum cable length for MOTION-CONNECT 500 cables is 100 m, for MOTION-CONNECT 800PLUS cables 75 m.

The maximum permissible cable length for the use of DRIVE-CLiQ couplings is calculated as follows:

$$\Sigma MC500 + 4/3 \times \Sigma MC800PLUS + n_c \times 5 \text{ m} \leq 100 \text{ m}$$

$\Sigma MC500$: Total length of all MC500 cable segments (fixed routing)

$\Sigma MC800PLUS$: Total length of all MC800PLUS cable segments (tow chain)

n_c : Number of DRIVE-CLiQ couplings (max. 0 ... 3)

Comparison of DRIVE-CLiQ signal cables

DRIVE-CLiQ signal cable	MOTION-CONNECT 500	MOTION-CONNECT 800PLUS
Approvals		
VDE cURus or UR/CSA UR-CSA File No. ¹⁾ in conformance with RoHS	Yes UL STYLE 2502/CSA-N.210.2-M90 Yes Yes	Yes UL STYLE 2502/CSA-N.210.2-M90 Yes Yes
Rated voltage U_0/U in accordance with EN 50395	30 V	30 V
Test voltage, rms	500 V	500 V
Operating temperature at the surface		
Permanently installed	-20 ... +80 °C	-20 ... +80 °C
Moveable	0 ... 60 °C	-20 ... +60 °C
Strain, max.		
Permanently installed	80 N/mm ²	50 N/mm ²
Moveable	30 N/mm ²	20 N/mm ²
Smallest bending radius		
Permanently installed	35 mm	35 mm
Moveable	125 mm	75 mm
Torsional stress	30°/m absolute	30°/m absolute
Bending operations	100000	10 million
Max. traversing speed	30 m/min	300 m/min
Max. acceleration	2 m/s ²	Up to 50 m/s ² (3 m)
insulation material	CFC/silicone-free	CFC/halogen-free/silicon-free
Oil resistance	EN 60811-2-1 (mineral oil only)	EN 60811-2-1
Protective jacket	PVC	PUR, HD22.10 S2 (VDE 0282, Part 10)
Flame retardant	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3

¹⁾ The file number is printed on the cable jacket.

7.6.2 MOTION-CONNECT power cables

Note

Only MOTION-CONNECT 500 and MOTION-CONNECT 800 power cables are permissible for the S120 Combi.

Motor	Article number 6FXx002- ¹⁾	Description	D _{max}	
			6FX5	6FX8
1PH3 with terminal box	5CE02	Power cable 1PH310 4 x 2.5	11	11
1PH3 with terminal box	5CE04	Power cable 1PH313 4 x 4	11.4	12.3
1PH3 with terminal box	5CE05	Power cable 1PH310 4 x 6	20	-
1PH3 with terminal box	5CE05	Power cable 1PH313 4 x 6	20	-
1PH8 with terminal box	5CE02	Power cable 1PH808 4 x 2.5	10.0	12.1
1PH8 with terminal box	5CE04	Power cable 1PH810 4 x 4	11.4	13.2
1PH8 with terminal box	5CE06	Power cable 1PH813 4 x 6	13.6	16.0
1FK2/1FT2/1FT7/1FK7 with quick release	5CF07	Power cable 4 x 1.5 SC GR0.5 (M17)	8.4	10.4
	5DF07	Power cable 4 x 1.5 + 2 x 1.5 SC GR0.5 (M17)	10.8	12.9
	5CF10	Power cable 4 x 1.5 SC GR.1 (M23)	8.4	10.4
	5DF10	Power cable 4 x 1.5 + 2 x 1.5 SC GR.1 (M23)	10.8	12.9
1PH8 with connector with fast release	5DF11	Power cable 4 x 2.5 SC GR.1.5 (M40)	10.0	12.1
1PH8 with connector with fast release	5CF12	Power cable 4 x 4 SC GR.1.5 (M40)	11.4	13.2
1PH8 with connector without fast release	5CF13	Power cable 4 x 10 SC GR.3 (M40)	20	19.4

¹⁾ x: 5 = MC500, 8 = MC800



WARNING

Missing emergency motor shutdown option

If the motor holding brake is not connected or is incorrectly connected, serious physical injuries can occur.

- Only connect motors with a safe electrically isolated holding brake. The brake cores must also be safely electrically isolated.
- If the motor power cable is connected to intermediate terminals, the power cables and brake cables must be laid separately (≥ 300 mm) from each other.

Note

If the connecting cables for a 24 V motor holding brake are included in the power cable, then only the specified cables must be used. These cables must have a separate shield for the 24 V and must be suitable for safe electrical separation.

The cable shield of the motor holding brake conductors must be connected at both ends.

Note

In order that the specified EMC limit values (EN 61800-3) are maintained, only shielded type MC500 and MC800 power cables must be used. The permissible cable length is 25 m for rated output currents I_n from 5 A to 30 A.

The total cable length for the complete drive line-up is 175 m.

Comparison of MOTION-CONNECT power cables

MOTION-CONNECT 500 power cables are mainly suitable for permanent routing. The MOTION-CONNECT 800PLUS power cables fulfill all high mechanical requirements for the use in tow chains. They are resistant to cutting oils.

Power cable	MOTION-CONNECT 500	MOTION-CONNECT 800PLUS
Approvals		
VDE ¹⁾ cURus or UR/CSA UR-CSA File No. ²⁾ in conformance with RoHS	Yes UL758-CSA-C22.2-N.210.2-M90 Yes Yes	Yes UL758-CSA-C22.2-N.210.2-M90 Yes Yes
Rated voltage U_0/U in accordance with EN 50395		
Supply conductors Signal conductors	600 V / 1000 V 24 V (EN) 1000 V (UL/CSA)	600 V / 1000 V 24 V (EN) 1000 V (UL/CSA)
Test voltage, rms		
Supply conductors Signal conductors	4 kV 2 kV	4 kV 2 kV
Operating temperature at the surface		
Permanently installed Moveable	-20 ... +80 °C 0 ... 60 °C	-20 ... +80 °C -20 ... +60 °C
Strain, max.		
Permanently installed Moveable	50 N/mm ² 20 N/mm ²	50 N/mm ² 20 N/mm ²
Smallest bending radius		
Permanently installed Moveable	5 x D_{max} Approx. 18 x D_{max}	4 x D_{max} Approx. 8 x D_{max}
Torsional stress	30°/m absolute	30°/m absolute
Bending operations	100000	10 million
Max. traversing speed	30 m/min	Up to 300 m/min
Max. acceleration	2 m/s ²	50 m/s ² (3 m)
insulation material	CFC/silicone-free	CFC/halogen/silicone-free IEC 60754-1 / DIN VDE 0472-815
Oil resistance	EN 60811-2-1 (mineral oil only)	EN 60811-2-1
Protective jacket	PVC	PUR, HD22.10 S2 (VDE 0282, Part 10)
Flame retardant	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3

¹⁾ The registration number is printed on the cable jacket.

²⁾ The file number is printed on the cable jacket.

7.6.3 Current-carrying capacity and derating factors for power cables and signal cables

Current-carrying capacity

The current-carrying capacity of PVC/PUR-insulated copper cables is specified for laying methods B1, B2 and C under continuous operating conditions in the table with reference to an ambient air temperature of 40° C. For other ambient temperatures, the values must be corrected by the factors listed in the "Derating factors for deviating conditions" table.

Cross-section	Effective current-carrying capacity; AC 50/60 Hz or DC for laying method		
mm ²	B1 A	B2 A	C A
Electronics			
0.20	–	4.3	4.4
0.50	–	7.5	7.5
0.75	–	9	9.5
Power			
0.75	8.6	8.5	9.8
1.00	10.3	10.1	11.7
1.50	13.5	13.1	15.2
2.50	18.3	17.4	21
4	24	23	28
6	31	30	36
10	44	40	50
16	59	54	66
DC link			
10	44	40	50

Laying methods

B1 cables in conduits or installation ducts

B2 multi-core cables in conduits or installation ducts

C cables along walls/panels without conduits and installation ducts

Derating factors

Ambient temperature [°C]	Derating factor according to EN 60204-1 Table D1
30	1.15
35	1.08
40	1.00
45	0.91
50	0.82
55	0.71
60	0.58

Example for dimensioning a power cable**Boundary conditions:**

Module: S120 Combi 4 axes Power Module with 20 kW infeed

Rated input current at 400 V_{AC}: 34 A (from the technical data)

Ambient temperature: 45 °C

Laying method: B2

Calculation/dimensioning:

With laying method B2 and a rated input current of 34 A_{AC}, from the table showing the current-carrying capacity, a cable cross-section of 10 mm² is obtained.

With a derating factor of 0.91 for 45 °C ambient temperature, the current-carrying capacity of the selected power cable decreases to 36.4 A.

Result:

Under the given boundary conditions, a power cable with a cross-section of 10 mm² can be used.

7.6.4 Connectable cable cross-sections for spring-loaded terminals

Type: Spring-loaded terminal			
1	Connectable cable cross-sections	Flexible	0.08 ... 3.3 mm ² /28 ... 12 AWG
	Stripped length	8 ... 9 mm	
	Tool	Slot head screwdriver: blade 0.4 x 2.0 mm	

7.6.5 Connectable cable cross-sections for screw terminals

The type of a screw terminal can be taken from the interface description of the particular module.

Note

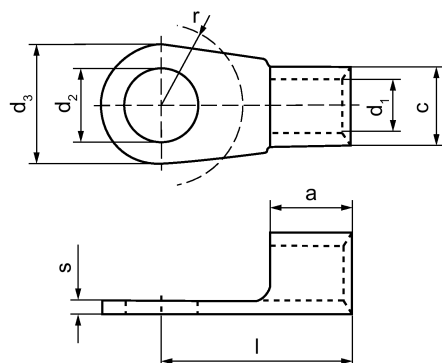
Siemens recommends you to select a connectable cable with end sleeves according to DIN 46228.

Type: Screw terminal			
1	Connectable cable cross-sections	Rigid, flexible	0.08 ... 2.1 mm ² /28 ... 14 AWG
	Stripped length	7 mm	
	Tool	Slot head screwdriver: blade 0.4 x 2.0 mm	
	Tightening torque	0.22 ... 0.25 Nm/1.95 ... 2.21 lbf.in	
2	Connectable cable cross-sections	Rigid, flexible	0.08 ... 2.1 mm ² /28 ... 14 AWG
	Stripped length	7 ... 8 mm	
	Tool	Slot head screwdriver: blade 0.4 x 2.0 mm	
	Tightening torque	0.2 Nm/1.77 lbf.in	

Type: Screw terminal			
3	Connectable cable cross-sections	For line connection: Flexible	8.4 ... 13.3 mm ² /8 ... 6 AWG
		For motor connection - spindle: Flexible	5.3 ... 13.3 mm ² /10 ... 6 AWG
	Stripped length	12 mm	
	Tool	Slot head screwdriver: blade 1.0 x 5.0 mm Cross head screwdriver: 2# x 100 mm	
	Tightening torque	1.2 ... 1.3 Nm/10.5 ... 11.5 lbf.in	
4	Connectable cable cross-sections	For motor connection - feed 1: Flexible	3.3 ... 5.3 mm ² /12 ... 10 AWG
		For motor connection - feed 2 to feed 3: Flexible	2.1 ... 5.3 mm ² /14 ... 10 AWG
	Stripped length	10 mm	
	Tool	Slot head screwdriver: blade 0.8 x 4.0 mm Cross head screwdriver: 1# x 80 mm	
	Tightening torque	0.5 ... 0.6 Nm/4.4 ... 5.3 lbf.in	
5	Connectable cable cross-sections	For motor connection - feed 1: Flexible	2.1 ... 8.4 mm ² /14 ... 8 AWG
		For motor connection - feed 2 to feed 3: Flexible	2.1 ... 8.4 mm ² /14 ... 8 AWG
	Stripped length	10 mm	
	Tool	Slot head screwdriver: blade 1.0 x 4.0 mm	
	Tightening torque	0.8 ... 1.3 Nm/7.08 ... 11.50 lbf.in	
6	Connectable cable cross-sections	Flexible	1 ... 10 mm ² /18 ... 6 AWG
	Stripped length	10 mm	
	Tool	Slot head screwdriver: blade 1.0 x 4.0 mm	
	Tightening torque	1.5 ... 1.8 Nm/13.27 ... 15.93 lbf.in	
7	Connectable cable cross-sections	For line connection: Flexible	8.4 ... 13.3 mm ² /8 ... 6 AWG
		For motor connection - spindle: Flexible	8.4 ... 13.3 mm ² /8 ... 6 AWG
	Stripped length	11 mm	
	Tool	Slot head screwdriver: blade 1.0 x 4.0 mm	
	Tightening torque	1.5 ... 1.8 Nm/13.27 ... 15.93 lbf.in	
8	Connectable cable cross-sections	Flexible	0.5 ... 3.3 mm ² /20 ... 12 AWG
	Stripped length	7 mm	
	Tool	Slot head screwdriver: blade 0.6 x 3.5 mm	
	Tightening torque	0.4 ... 0.5 Nm/3.54 ... 4.42 lbf.in	
9	Connectable cable cross-sections ¹⁾	-	
	Stripped length ¹⁾	-	
	Tool	Slot head screwdriver: blade 1.0 x 5.5 mm	
	Tightening torque	1.2 ... 1.5 Nm/10.62 ... 13.27 lbf.in	
10	Connectable cable cross-sections	Flexible	0.2 ... 8.4 mm ² /24 ... 8 AWG
	Stripped length	12 mm	
	Tool	Slot head screwdriver: blade 1.0 x 4.0 mm	
	Tightening torque	0.5 ... 0.6 Nm/4.42 ... 5.31 lbf.in	

¹⁾ The connectable cable can be obtained in the relevant option package as a prefabricated cable; therefore no information about terminal assembly is provided here.

7.6.6 Cable lugs



Screw/bolt	Cable cross-section [mm ²]	a [mm]	c [mm]	d ₁ [mm]	d ₂ [mm]	d ₃ [mm]	l [mm]	r [mm]	s [mm]
M5	6	6	6	3.6	5.3	10	15	6.5	1

7.7 Cable shielding and routing

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

- Line supply cables from the line filter via the line reactor to the S120 Combi Power Module
- All motor cables (if necessary, including cables for motor holding brake)
- Cables for analog direct voltage/current signals
- Signal cables for sensors
- Cables for temperature sensors

Supplementary conditions

- Alternative measures (e.g. laying behind mounting plates, suitable clearances) can also be used provided they have similar results. This excludes measures that relate to the design, installation, and laying of motor power cables and signal cables.
- If unshielded cables are used between the line supply connection point and the line filter, make sure that no interference-emitting cables are routed in parallel.
- Power and signal cables must always be routed separately. For this purpose, it is practical to arrange the various cables according to cable groups. Cables belonging to a group can be combined in a bundle. The various cable groups must be routed with the necessary clearance between them. A minimum clearance of 20 cm has proven itself in practice. As an alternative, shielding plates with the appropriate contacts at several locations can be used between the cable bundles.

- All cables inside the cabinet must be laid as closely as possible to parts connected with cabinet ground, such as a mounting plate or cabinet panel. Ducts made of sheet steel or cables laid between steel sheets (e.g. between the mounting plate and rear panel) should provide adequate shielding.
- All cables must be kept as short as possible, to minimize the antenna effect.
- Signal and power cables may cross each other (if absolutely necessary), but must never be routed closely to one and other in parallel over longer distances.
- Signal cables must be routed with a minimum clearance of 20 cm from strong magnetic fields (motors, transformers). Alternatively, shield plates with the appropriate contacts at several locations along their length can be used to provide the appropriate clearance.
- Cables for the 24 V supply should be treated just like signal cables.
- Avoid, where possible, routing unshielded cables, connected to the drive line-up, in the immediate vicinity of noise sources, e.g. transformers. Signal cables (shielded and unshielded) connected to the drive line-up must be laid at a great distance from strong external magnetic sources (e.g. transformers, line reactors). In both cases, a distance of ≥ 300 mm is usually sufficient.

Shield support

The cable shields must be connected as close to the conductor terminal connections as possible to ensure a low-impedance connection with cabinet ground. For power cables from Siemens in which the shield is connected to the connector shell (see relevant catalog), this is a sufficiently good shield support.

For components that do not have any special shield connection or where the shield connection is not sufficient, the cable shields can be connected to the metal mounting plate using hose clamps and toothed rails. The cable length between the shield contact point and the terminals for cable cores must be kept as short as possible.

Routing 24 V cables

When laying 24 V cables, the following must also be observed:

- No more than 1 conductor pair may be bundled together.
- 24 V conductors must be routed separately from other cables and conductors that could carry the operating current.
- 24 V cables must never be routed parallel to power cables.
- 24 V cables as well as power cables should be routed to the components so that they never cover ventilation slots.

Conditions of use for 24 V cables

- Ambient temperature: 55° C
- Conductor limit temperature: $\leq 70^\circ$ C for operation with the rated load current
Conductor limit temperature for UL applications: 60° C
- Maximum cable length: 30 m for 24 V power supply cables and for signal cables without additional circuitry
Surge voltage protection devices must be used for longer cable lengths.

7.8 Protective connection and equipotential bonding

Protective connections

The S120 Combi is designed for use in control cabinets with a protective conductor connection.

The protective conductor connection of the S120 Combi must be connected to the protective conductor connection of the control cabinet as follows:

Line supply cable	Copper protective connection (mm ²)
Up to 16 mm ²	The same as the line supply cable
From 16 mm ² to 35 mm ²	16 mm ²
From 35 mm ²	0.5 × line supply cable

For materials other than copper, the cross-section should be increased so that as a minimum, the same conductivity is attained.

All plant and machine parts must be incorporated in the protective concept.

The protective ground connection of the motors used must be established through the motor cable. For EMC reasons, these protective ground connections should be connected at the S120 Combi.

Installation regulations in the area of validity of IEC/EN

IEC 61800-5-1, Section 4.3.5.4, Table 5 (see also IEC 60364-5-54 Table 54.2) is the basic regulation, according to which the protective conductor must have the same minimum cross-section up to a line conductor cross-section of 16 mm².

Alternatively, the protective conductor can be dimensioned according to IEC 60364-5-54, Section 543.1.2. Taking the I^2t values of the specified protective equipment into account, the minimum conductor cross-section must be 6 mm² (copper).

Installation regulation in the area of validity of UL/CSA (NEC for USA / CEC for Canada)

The respective National Electrical Code applies in the USA and Canada. The minimum cross-section of the protective conductor should be dimensioned according to the rated current of the corresponding protective device. Taking the specified protective device up to 60 A into account, the minimum conductor cross-section for the protective conductor must be AWG 10 or 6 mm² (copper).

Equipotential bonding

A mounting plate serves simultaneously as an equipotential bonding surface. This means that no additional equipotential bonding is required within the drive line-up. The mounting plate must be connected to the protective conductor connection of the control cabinet through a low impedance.

If a common metallic bright mounting plate is not available, equally good equipotential bonding must be ensured using the cable cross-sections listed in the table above or with at least the same conductivity.

When mounting components on standard mounting rails, the equipotential bonding data listed in the table apply. If only smaller connection cross-sections are permissible at the

components, then the largest possible cross-section should be used, e.g. 6 mm² for SMC. These requirements also apply to distributed components located outside the control cabinet.

Note

For the S120 Combi Power Modules frame type B, if you want to set up an equipotential bonding connection additionally between the Power Module and the control cabinet, connect the copper protective conductor to the screw signed with a "⏚" symbol on the Power Module.

Note

Non-observance of the above guidelines on equipotential bonding can lead to faults on the fieldbus interfaces or to malfunction of the devices.

7.9 Note on control cabinet cooling

7.9.1 General information

The cabinet can be cooled, among others, by using:

- Filter fans
- Heat exchangers
- Refrigerators
- External air cooling

The decision in favor of one of these methods will depend on the prevailing ambient conditions and the cooling power required.

The air routing inside the control cabinet and the cooling clearances specified here, must be carefully observed. Other components or cables must not be installed/routed in these areas.

NOTICE

Reduced service life due to non-compliance with the installation guidelines
--

If you do not observe the guidelines for installing SINAMICS equipment in the cabinet, this can reduce the service life of the equipment and result in premature component failure.
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- | |
|--|
| <ul style="list-style-type: none"> • Always comply with the installation guidelines for SINAMICS devices. |
|--|

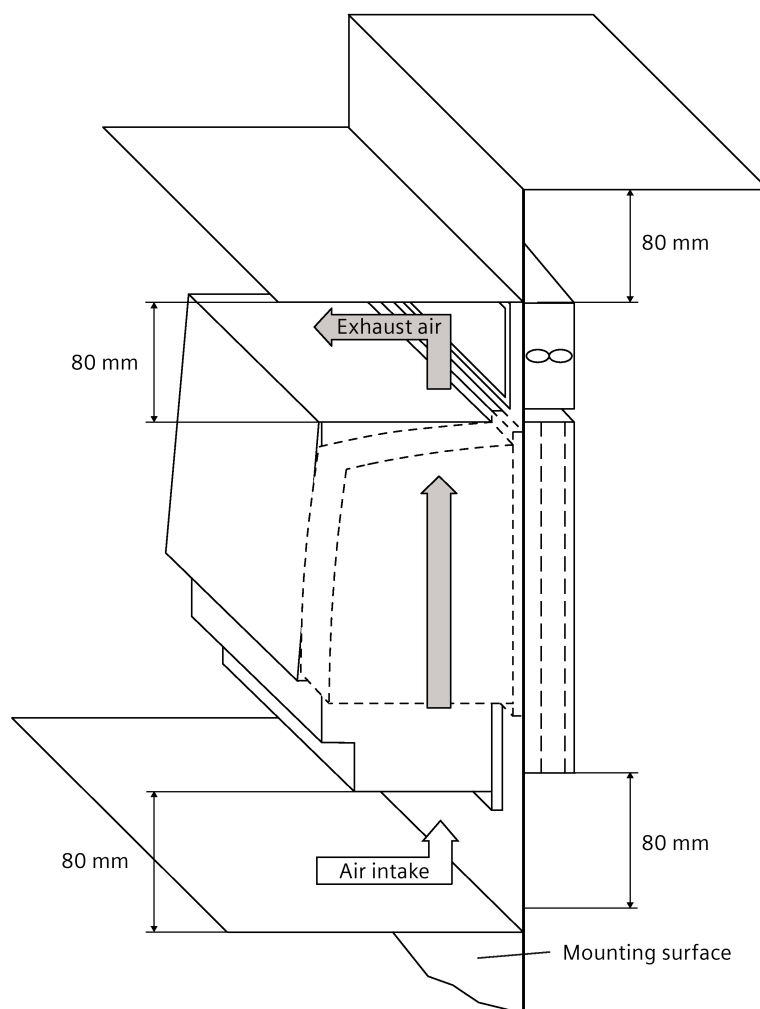
You must take into account the following specifications when installing a SINAMICS drive line-up:

- Ventilation clearance
- Wiring and cabling
- Air guidance, air-conditioner

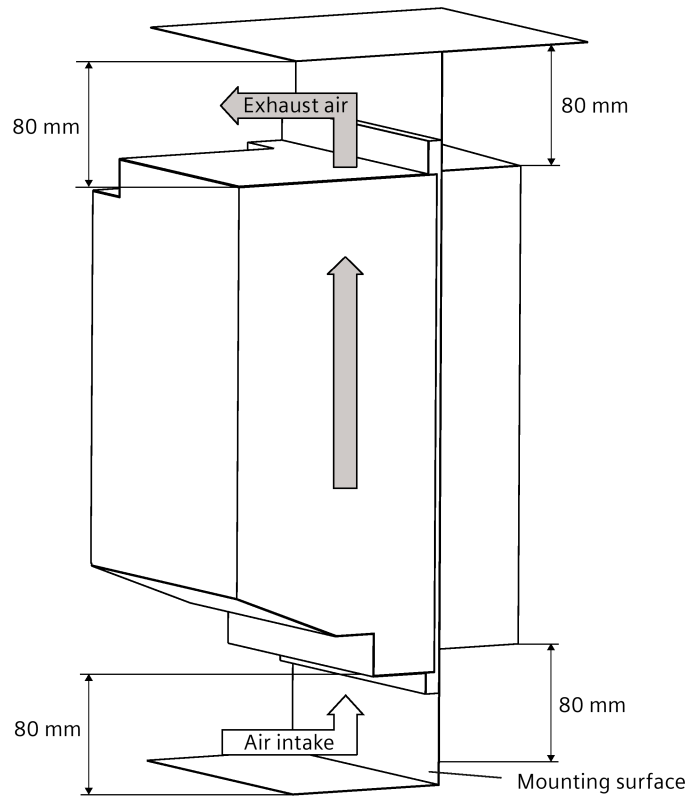
See the table below for ventilation clearances above and below the components:

Component	Article number	Clearance [mm]
S120 Combi 3 axes Power Module	6SL3111-3VE2x-xxxx	80
S120 Combi 4 axes Power Module	6SL3111-4VE2x-xxxx	80
Motor Modules Booksize Compact	6SL3420-xTExx-xAAx	80
Motor Modules Booksize	6SL3120-xTExx-xAxx	80
Line filter	6SL3000-0BE21-6DA1	100
Line reactors	6SL3100-0EE2x-xAx0	100
Braking Module	6SL3100-1AE31-0AAx	80
Control Supply Module	6SL3100-1DE22-0AAx	80
SMC20	6SL3055-0AA00-5EAx	50
SMC30	6SL3055-0AA00-5CAx	50
DMC20	6SL3055-0AA00-6AAx	50
Terminal Module TM54F	6SL3055-0AA00-3BAx	50
CU320-2	6SL3040-1MA01-0AA0	80
NX15.3	6SL3040-1NB00-0AA0	80

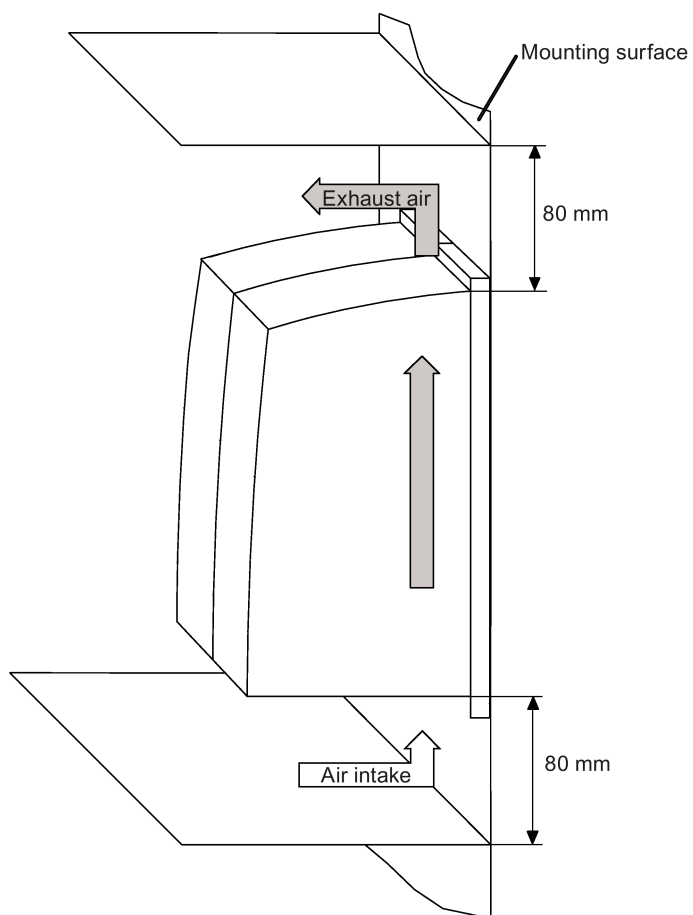
See figure below for cooling clearances for an S120 Combi Power Module frame type A with expansion axis.



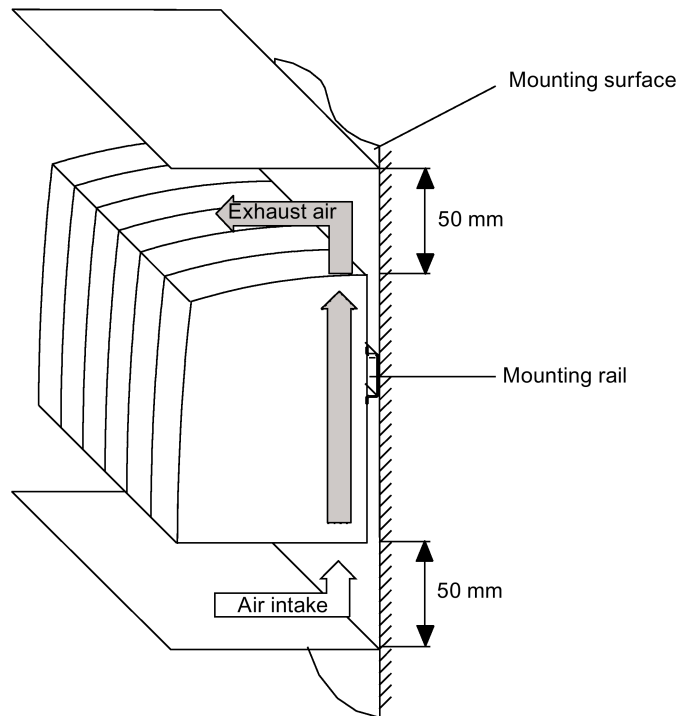
See figure below for cooling clearances for an S120 Combi Power Module frame type B.



See figure below for cooling clearances for Motor Modules Booksize Compact and Motor Modules Booksize.



See figure below for cooling clearances for modules mounted on standard rails (e.g. SMC, DMC).



7.9.2 Ventilation

The S120 Combi is equipped with an external fan to circulate the air inside the cabinet.

The cooling air must flow vertically through the external heat sink of the S120 Combi.

When using filter fans, heat exchangers, or air conditioners to cool the control cabinet, it must be ensured that the air is flowing in the correct direction. You must also ensure that the warm air can escape at the top. A ventilation clearance of at least 80 mm above and below must be observed.

NOTICE

Damage caused by cooling equipment

Damage to components can be caused by overheating or condensation.

- Route the connected signal and power cables to the components in such a way that they do not cover the ventilation slots.
- Select the air guidance and arrangement of the cooling equipment in such a way that cold air does not blow directly onto electronic equipment and as such no condensation can form on the components. If necessary, cabinet enclosure heating may have to be installed.

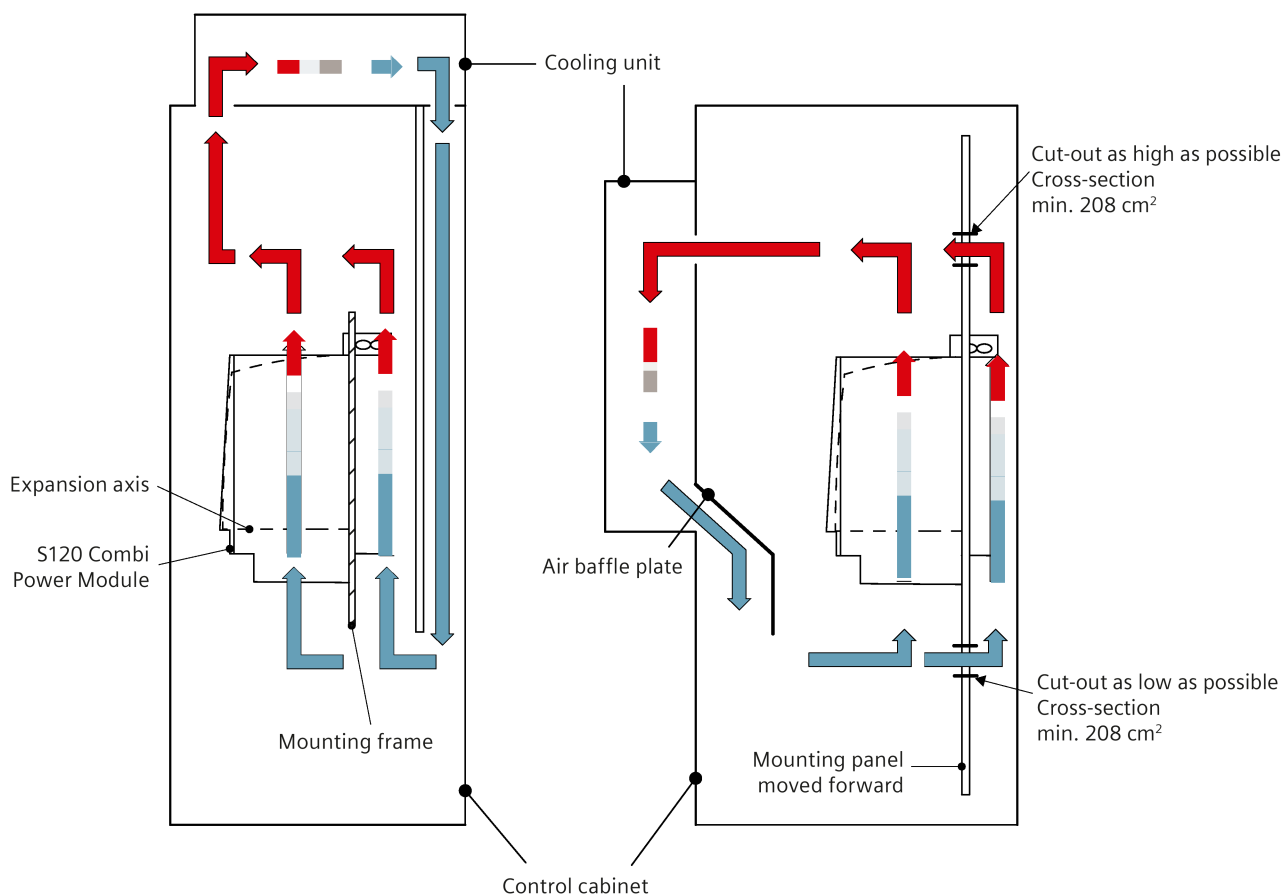
Note

The distance between the discharge opening of the air condition equipment and the electronic equipment must be at least 200 mm.

Note

If the components are installed in a sealed control cabinet, an internal air cooling system must be installed in the control cabinet to circulate the air and prevent hot spots. It is best to install the fan above the components to optimize the air flow (suction).

See figure below for examples of cabinet ventilation.



If air conditioners are used, the relative air humidity of the expelled air increases as the air in the air conditioner cools and may exceed the dew point. To avoid condensation, climate control equipment should be arranged so that cold discharged air is not directly blown onto SINAMICS components. Using air baffle plates, ensure that the air is adequately mixed with the air inside the cabinet. This reduces the relative air humidity to uncritical values.

7.9.3 Dimensioning Climate Control Equipment

Cabinet manufacturers provide calculation programs for selecting climate control equipment. It is always necessary to know the power loss of the components and equipment installed in the cabinet.

The physical relationship is shown in the following example.

Calculating the thermal power to be dissipated: $q = Q - k \cdot A \cdot \Delta T$

with

q = thermal power that has to be dissipated using a cooling unit [W]

Q = power loss [W]

ΔT = difference between the room temperature and the temperature inside the cabinet [K]

k = heat transfer coefficient, e.g. sheet-steel, painted 5.5 [W/(m² * K)]

A = free-standing cabinet surface area [m²]

See the following table for an example for calculating the power loss of a drive configuration.

Table 7- 1 Example, calculating the power loss of a drive configuration

Component	Number	Total power loss [W] (including electronic losses)	Total power loss [W]
SINUMERIK 828D	1	28	28
Line filter	1	16	16
Line reactor	1	98	98
S120 Combi 3 axes Power Module 20 kW	1	634	634
Motor Module 9 A	1	100.4	100.4
Motor Module 18 A	1	185.4	185.4
SMC	2	10	20
SITOP 20	1	53	53
Line contactor	1	12	12
Total:			1146.8

Assumption:

free-standing control cabinet surface $A = 5 \text{ m}^2$

difference between the room temperature and the temperature inside the control cabinet $\Delta T = 10 \text{ K}$

$$q = 1146.8 \text{ W} - 5.5 \text{ W} / (\text{m}^2 \text{ K}) \cdot 5 \text{ m}^2 \cdot 10 \text{ K} = 871.8 \text{ W}$$

7.9.4 Power loss of components in rated operation

7.9.4.1 General information

The tables below provide an overview of the power loss of all components during rated operation. The characteristic values apply for the following conditions:

- Line supply voltage 400 V
- Pulse frequency of the Motor Modules 4 kHz (clock frequency of the spindle 4 kHz or 8 kHz)
- Operating components at their rated power

The total losses of the relevant components (S120 Combi, Motor Module) are calculated from the power loss and the corresponding losses from the electronics.

7.9.4.2 Power losses for SINUMERIK control systems, DC link components and supplementary system components

See the following table for power losses at rated operation for SINUMERIK control systems, DC link components and supplementary system components.

	Unit	Power loss
SINUMERIK 828D	W	28
SINUMERIK ONE NCU 1750	W	44.76
SINUMERIK ONE NCU 1760	W	44.76
SINUMERIK ONE PPU 1740-1500	W	32
SINUMERIK ONE PPU 1740-1900	W	36
CU320-2 PN	W	≤ 24
NX15.3	W	15
SMC20/30	W	< 10
SME20/25	W	< 4
TM54F	W	4.5
Braking Module	W	20
Control Supply Module		
Line	W	70
DC link	W	65

7.9.4.3 Power losses for S120 Combi Power Modules

Power losses in rated operation

The following table provides the internal and external losses of the S120 Combi Power Modules for rated operation.

	Unit	Internal power loss	External power loss	Total power loss ¹⁾	Frame type
S120 Combi 3 axes Power Module					
16 kW / 18 A / 9 A / 9 A	W	91	379	470	A01/B11
16 kW / 24 A / 9 A / 9 A	W	91	446	537	A02/B12
20 kW / 30 A / 9 A / 9 A	W	102	532	634	A03/B13
S120 Combi 4 axes Power Module					
10 kW / 24 A / 12 A / 12 A / 12 A	W	115	655	770	A07
16 kW / 18 A / 9 A / 9 A / 9 A	W	100	447	547	A04/B14
16 kW / 24 A / 9 A / 9 A / 9 A	W	100	507	607	A05
16 kW / 24 A / 12 A / 9 A / 9 A	W	100	559	659	B01/B02
16 kW / 24 A / 12 A / 9 A / 9 A	W	116	689	805	B17
20 kW / 30 A / 12 A / 9 A / 9 A	W	113	620	733	A06/B16

¹⁾ The external fan unit has been taken into account in the specified power losses

7.9.4.4 Power loss for line filters and line reactors

See the following table for power loss during rated operation for line filters and line reactors.

	Unit	Power loss
Line filter		
10 kW	W	12
16 kW	W	15
20 kW	W	16
Line reactors		
10 kW	W	55
16 kW	W	75
20 kW	W	98

7.9.4.5 Electronics losses of power units

Electronics losses for S120 Combi Power Modules

Component		Power loss [W]
S120 Combi 3 axes Power Module ¹⁾	16 kW / 18 A / 9 A / 9 A	36.0
	16 kW / 24 A / 9 A / 9 A	36.0
	20 kW / 30 A / 9 A / 9 A	36.0
S120 Combi 4 axes Power Module ¹⁾	10 kW / 24 A / 12 A / 12 A / 12 A	38.4
	16 kW / 18 A / 9 A / 9 A / 9 A	38.4
	16 kW / 24 A / 9 A / 9 A / 9 A	38.4
	16 kW / 24 A / 12 A / 9 A / 9 A	38.4
	20 kW / 30 A / 12 A / 9 A / 9 A	38.4

¹⁾ Without power loss of the external fan

Electronics losses for Motor Modules

For more information about electronics losses for Motor Modules Booksize and Booksize Compact, see the SINAMICS S120 Booksize Power Units Equipment Manual.

7.9.4.6 Losses in partial-load operation

Losses in the partial-load range for the S120 Combi

The losses of the S120 Combi in partial-load operation can be calculated using the following formula:

$$P_v = a + b + IN1 \cdot P1 + S1 \cdot I1 + S2 \cdot I2 + S3 \cdot I3 + S4 \cdot I4$$

a: Electronics losses of the S120 Combi

b: Electronics losses of the external fan unit

IN1, S1 - S4: Coefficients to calculate the power loss

P1: Infeed power [kW] (LINE X1)

I1: Spindle current [A] (SPINDLE X2)

I2: Current of the 1st feed axis (servo X3)

I3: Current of the 2nd feed axis (servo X4)

I4: Current of the 3rd feed axis (servo X5)

See the following table for the coefficients to calculate the total power loss P_v in the partial-load range.

Power Module	a [W]	b [W]	IN1	S1 [W/A]	S2 [W/A]	S3 [W/A]	S4 [W/A]	Frame type
3 axes Power Module								
16 kW / 18 A / 9 A / 9 A	36	19.2	11.05	7.1	7.2	7.2	-	A01/B11
16 kW / 24 A / 9 A / 9 A	36	19.2	11.2	7.2	7.2	7.2	-	A02/B12
20 kW / 30 A / 9 A / 9 A	36	19.2	11.5	7.3	7.2	7.2	-	A03/B13
4 axes Power Module								
10 kW / 24 A / 12 A / 12 A / 12 A	38.4	19.2	9.1	14.3 / 7.2 ¹⁾	7.7	7.7	7.7	A07
16 kW / 18 A / 9 A / 9 A / 9 A	38.4	19.2	11.05	7.1	7.2	7.2	7.2	A04/B14
16 kW / 24 A / 9 A / 9 A / 9 A	38.4	19.2	11.4	7.2	7.2	7.2	7.2	A05
16 kW / 24 A / 12 A / 9 A / 9 A	38.4	19.2	11.4	7.1	7.7	7.2	7.2	B01/B02
16 kW / 24 A / 12 A / 9 A / 9 A	38.4	19.2	11.4	14.3 / 7.2 ¹⁾	7.7	7.2	7.2	B17
20 kW / 30 A / 12 A / 9 A / 9 A	38.4	19.2	11.7	7.3	7.7	7.2	7.2	A06/B16

¹⁾ For a pulse frequency of 8 kHz / 4 kHz

See the following table for the coefficients to calculate the power loss P_v in the control cabinet for external cooling.

Power Module	a [W]	b [W]	IN1	S1 [W/A]	S2 [W/A]	S3 [W/A]	S4 [W/A]	Frame type
3 axes Power Module								
16 kW / 18 A	36	0	1.95	0.6	0.4	0.4	-	A01/B11
16 kW / 24 A	36	0	2.1	0.6	0.4	0.4	-	A02/B12
20 kW / 30 A	36	0	2.03	0.6	0.4	0.4	-	A03/B13
4 axes Power Module								
10 kW / 24 A	38.4	0	3.3	1.2 / 0.6 ¹⁾	0.4	0.4	0.4	A07
16 kW / 18 A	38.4	0	1.95	0.6	0.4	0.4	0.4	A04/B14
16 kW / 24 A	38.4	0	2.3	0.6	0.4	0.4	0.4	A05/B01/B02
16 kW / 24 A	38.4	0	2.3	1.2 / 0.6 ¹⁾	0.4	0.4	0.4	B17
20 kW / 30 A	38.4	0	2.23	0.6	0.4	0.4	0.4	A06/B16

¹⁾ For a pulse frequency of 8 kHz / 4 kHz

Losses in the partial-load range for line reactors

The losses of the line reactors in partial-load operation can be calculated using the following formula:

$$P_v = D1 \cdot P1$$

D1: Coefficient to calculate the power loss

P1: Infeed power [kW]

See the following table for the coefficients to calculate the power loss P_v in the partial-load range.

Line reactor	D1
6SL3100-0EE21-6AA0 (10 kW)	5.5×10^{-3}
6SL3100-0EE21-6AA0 (16 kW)	4.7×10^{-3}
6SL3100-0EE21-6AB0 (16 kW)	5.1×10^{-3}
6SL3100-0EE22-0AA0 (20 kW)	4.9×10^{-3}

Service and maintenance

8.1 Required accessories and spare parts

Required accessories

Designation	Article number
S120 Combi line reactor	6SL3100-0EE21-6AA0 (16 kW) (for frame type A only) 6SL3100-0EE21-6AB0 (16 kW) (for frame type B only) 6SL3100-0EE22-0AA0 (20 kW)
S120 Combi reinforcement plate (for frame type A only)	6SL3161-1LP00-0AA0
S120 Combi external fan unit (separated variant, for frame type A only)	6SL3161-0EP00-0AA0

Spare parts

Designation	Article number
S120 Combi external fan unit (integrated variant)	6SL3161-0EQ00-0AA0
S120 Combi terminal kit (for frame type A) Contents: 1 24 V connector for X224 1 multi-language warning label 1 motor holding brake terminal for X11 3 DRIVE-CLiQ dust protection blanking plugs 2 EP terminals for X21/X22 5 shield clamps for the line supply cable and motor power cables 6 coding plugs	6SL3161-8AP00-0AA1
S120 Combi terminal kit (for frame type B) Contents: 1 24 V connector for X224 1 multi-language warning label 1 motor holding brake terminal for X11 3 DRIVE-CLiQ dust protection blanking plugs 2 EP terminals for X21/X22 5 shield clamps for the line supply cable and motor power cables 6 coding plugs	6SL3161-8AQ00-0AA0

Spare parts for additional components

You can find spare parts for all the other components and modules on the Internet
<https://support.industry.siemens.com/cs/ww/en/sc/2112>)

8.2 Replacing the fan

8.2.1 Safety instructions when replacing a fan



WARNING

Electric shock due to applied voltage or residual charge

Switch off the power supply (400 VAC) before replacing the fan.

A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off.

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

- Remove the device cover or the fan cover only after 5 minutes have elapsed.
- Check for zero voltage before removing the component.



WARNING

Electric shock when live parts are touched during fan replacement

Contact with live parts while the fan is being replaced can result in death or serious injury.

- When removing the fan, you must observe the ESD regulations.
- Assign qualified personnel to install spare parts.

8.2.2 Replacing the separated external fan for the S120 Combi Power Modules

For more information about how to replace a separated external fan for the S120 Combi Power Module, see Section "The separated external fan (Page 76)".

8.2.3 Replacing the integrated external fan for the S120 Combi Power Module

For more information about how to replace an integrated external fan for the S120 Combi Power Module, see Section "The integrated external fan (Page 81)".

8.3 Forming the DC link capacitors

NOTICE

Damage in the case of long storage periods

After being in storage for more than two years, the components may suffer damage when switched on.

- Reform the DC link capacitors on the S120 Combi Power Modules and the Motor Modules.

If the cabinet is commissioned within two years of its date of manufacture, the DC link capacitors do not need to be reformed. The date of manufacture can be taken from the serial number on the rating plate.

Note

The storage period is calculated from the date of manufacture and not from the date that the equipment was shipped.

A defined voltage and a limited current are applied to the DC link capacitors when forming them. As a consequence, the internal relationships required for the DC link capacitors to function correctly are re-established.

Date of manufacture

The date of manufacture can be determined from the following assignment to the serial number (e.g. T-**XN**2067000015 for 2009 or 2029, November):

Character	Year of manufacture	Character	Month of manufacture
X	2009, 2029	1 ... 9	January ... September
A	2010, 2030	0	October
B	2011, 2031	N	November
C	2012, 2032	D	December
D	2013, 2033		
E	2014, 2034		
F	2015, 2035		
H	2016, 2036		
J	2017, 2037		
K	2018, 2038		
L	2019, 2039		
M	2020, 2040		
N	2021, 2041		
P	2022, 2042		
R	2023, 2043		
S	2024, 2044		
T	2025, 2045		
U	2026, 2046		
V	2027, 2047		
W	2028, 2048		

The serial number is found on the rating plate.

Forming circuit

The S120 Combi Power Module has internal PTC resistors to pre-charge the DC link capacitors. The resistors can be used to form the DC link capacitors of the S120 Combi Module as well as the expansion axes (Motor Modules Booksize/Motor Modules Booksize Compact).

During the forming process, it is not permissible for the S120 Combi Power Module to receive a switch-on command. Therefore, disconnect the 24 V power supply to the S120 Combi Power Module.

Procedure

S120 Combi Power Module

1. Connect the S120 Combi Power Module with a line reactor to the line supply (see the connection example in Section Interface description (Page 36)).
2. Keep the module connected to the line supply for approx. 1 hour without issuing a switch-on command.

Expansion axis (Motor Module Booksize/Motor Module Booksize Compact)

1. Connect the expansion axis to be formed to the DC link of the S120 Combi Power Module.
2. Connect the S120 Combi Power Module with a line reactor to the line supply (see Section Connection examples (Page 53)).
3. Keep the S120 Combi Power Module and the expansion axis connected to the line supply for approx. 1 hour without issuing a switch-on command.



WARNING

Electric shock due to the residual charge of the DC link capacitors

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

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

- Do not open the protective cover of the DC link until five minutes have elapsed. Ensure that you press the release catch when opening the protective cover for the DC link. A suitable tool (e.g. screwdriver or supplied release tool) must be used for this purpose.
- Only operate the S120 Combi with the DC link protective cover closed.
- Do not continue to operate damaged components.

8.4 Recycling and disposal



For environmentally-friendly recycling and disposal of your old device, please contact a company certified for the disposal of waste electrical and electronic equipment, and dispose of the old device as prescribed in the respective country of use.

Optional system components and accessories

The S120 Combi Power Modules are available for the following optional system components and accessories:

Designation	Article number
S120 Combi expansion axis adapter (for frame type B only) Contents: 24 V terminal adapter DC link cable (length: 60 cm)	6SL3161-3XP00-0AA0
S120 Combi drip protection grid	6SL3161-3DP00-0AA0
S120 Combi line filter	6SL3000-0BE21-6DAx
Motor Modules Booksize Compact as expansion axes	6SL3420-1TE13-0AAx (Single Motor Module 3 A) 6SL3420-1TE15-0AAx (Single Motor Module 5 A) 6SL3420-1TE21-0AAx (Single Motor Module 9 A) 6SL3420-1TE21-8AAx (Single Motor Module 18 A) 6SL3420-2TE11-7AAx (Double Motor Module 2 x 1.7 A) 6SL3420-2TE13-0AAx (Double Motor Module 2 x 3 A) 6SL3420-2TE15-0AAx (Double Motor Module 2 x 5 A)
Motor Modules Booksize as expansion axes (for frame type B only)	6SL3120-1TE13-0ADx: Single Motor Module 3 A (D type) 6SL3120-1TE15-0ADx: Single Motor Module 5 A (D type) 6SL3120-1TE21-0ADx: Single Motor Module 9 A (D type) 6SL3120-1TE21-8ADx: Single Motor Module 18 A (D type) 6SL3120-1TE21-8ACx: Single Motor Module 18 A (C type) 6SL3120-1TE22-4ADx: Single Motor Module 24 A (D type) 6SL3120-1TE22-4ACx: Single Motor Module 24 A (C type) 6SL3120-1TE23-0ADx: Single Motor Module 30 A (D type) 6SL3120-1TE23-0ACx: Single Motor Module 30 A (C type) 6SL3120-2TE13-0ADx: Double Motor Module 2 x 3 A (D type) 6SL3120-2TE15-0ADx: Double Motor Module 2 x 5 A (D type) 6SL3120-2TE21-0ADx: Double Motor Module 2 x 9 A (D type) 6SL3120-2TE21-8ADx: Double Motor Module 2 x 18 A (D type) 6SL3120-2TE21-8ACx: Double Motor Module 2 x 18 A (C type)
Control Supply Module CSM	6SL3100-1DE22-0AA1
Braking Module Booksize	6SL3100-1AE31-0ABx
Braking resistors	6SN1113-1AA00-0DA0 (17 Ω) 6SL3100-01BE31-0AAx (5.7 Ω)
Terminal Module TM54F	6SL3055-0AA00-3BAx
DRIVE-CLiQ Hub Module DMC20	6SL3055-0AA00-6AA1
DRIVE-CLiQ Hub Module External DME20	6SL3055-0AA00-6ABx
Sensor Module Cabinet-Mounted SMC20	6SL3055-0AA00-5BAx
Sensor Module Cabinet-Mounted SMC30	6SL3055-0AA00-5CAx
Sensor Module External SME20	6SL3055-0AA00-5EA3
Sensor Module External SME25	6SL3055-0AA00-5HA3

Designation	Article number
Sensor Module External SME125	6SL3055-0AA00-5KA3
DRIVE-CLiQ cabinet bushing	6SL3066-2DA00-0AA0 (DRIVE-CLiQ) 6FX2003-0DT67 (M12)
DRIVE-CLiQ coupling	6SL3066-2DA00-0AB0

You can find more information about these components and accessories, for example, installation/assembly information, in the following user documentation collection:

- SINAMICS S120 Booksize Power Units Equipment Manual
- SINAMICS S120 Control Units and additional system components Equipment Manual

Appendix

A.1 List of abbreviations

Note

The following list of abbreviations includes all abbreviations and their meanings used in the entire SINAMICS family of drives.

Abbreviation	Source of abbreviation	Meaning
A		
A...	Alarm	Warning
AC	Alternating Current	Alternating current
ADC	Analog Digital Converter	Analog digital converter
AI	Analog Input	Analog input
AIM	Active Interface Module	Active Interface Module
ALM	Active Line Module	Active Line Module
AO	Analog Output	Analog output
AOP	Advanced Operator Panel	Advanced Operator Panel
APC	Advanced Positioning Control	Advanced Positioning Control
AR	Automatic Restart	Automatic restart
ASC	Armature Short-Circuit	Armature short-circuit
ASCII	American Standard Code for Information Interchange	American coding standard for the exchange of information
AS-i	AS-Interface (Actuator Sensor Interface)	AS-Interface (open bus system in automation technology)
ASM	Asynchronmotor	Induction motor
AVS	Active Vibration Suppression	Active load vibration damping
B		
BB	Betriebsbedingung	Operation condition
BERO	-	Contactless proximity switch
BI	Binector Input	Binector input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit	BG Institute for Occupational Safety and Health
BICO	Binector Connector Technology	Binector connector technology
BLM	Basic Line Module	Basic Line Module
BO	Binector Output	Binector output
BOP	Basic Operator Panel	Basic operator panel
C		
C	Capacitance	Capacitance
C...	-	Safety message
CAN	Controller Area Network	Serial bus system
CBC	Communication Board CAN	Communication Board CAN

Abbreviation	Source of abbreviation	Meaning
CBE	Communication Board Ethernet	PROFINET communication module (Ethernet)
CD	Compact Disc	Compact disc
CDS	Command Data Set	Command data set
CF Card	CompactFlash Card	CompactFlash card
CI	Connector Input	Connector input
CLC	Clearance Control	Clearance control
CNC	Computerized Numerical Control	Computer-supported numerical control
CO	Connector Output	Connector output
CO/BO	Connector Output/Binector Output	Connector/binector output
COB-ID	CAN Object-Identification	CAN Object Identification
CoL	Certificate of License	Certificate of License
COM	Common contact of a change-over relay	Center contact of a change-over contact
COMM	Commissioning	Startup
CP	Communication Processor	Communications processor
CPU	Central Processing Unit	Central processing unit
CRC	Cyclic Redundancy Check	Cyclic redundancy check
CSM	Control Supply Module	Control Supply Module
CU	Control Unit	Control Unit
CUA	Control Unit Adapter	Control Unit Adapter
CUD	Control Unit DC	Control Unit DC
D		
DAC	Digital Analog Converter	Digital analog converter
DC	Direct Current	Direct current
DCB	Drive Control Block	Drive Control Block
DCBRK	DC Brake	DC braking
DCC	Drive Control Chart	Drive Control Chart
DCN	Direct Current Negative	Direct current negative
DCP	Direct Current Positive	Direct current positive
DDC	Dynamic Drive Control	Dynamic Drive Control
DDS	Drive Data Set	Drive Data Set
DI	Digital Input	Digital input
DI/DO	Digital Input/Digital Output	Digital input/output, bidirectional
DMC	DRIVE-CLiQ Hub Module Cabinet	DRIVE-CLiQ Hub Module Cabinet
DME	DRIVE-CLiQ Hub Module External	DRIVE-CLiQ Hub Module External
DMM	Double Motor Module	Double Motor Module
DO	Digital Output	Digital output
DO	Drive Object	Drive object
DP	Decentralized Peripherals	Distributed I/O
DPRAM	Dual Ported Random Access Memory	Dual-Port Random Access Memory
DQ	DRIVE-CLiQ	DRIVE-CLiQ
DRAM	Dynamic Random Access Memory	Dynamic Random Access Memory
DRIVE-CLiQ	Drive Component Link with IQ	Drive Component Link with IQ
DSC	Dynamic Servo Control	Dynamic Servo Control
DSM	Doppelsubmodul	Double submodule
DTC	Digital Time Clock	Timer

Abbreviation	Source of abbreviation	Meaning
E		
EASC	External Armature Short-Circuit	External armature short-circuit
EDS	Encoder Data Set	Encoder data set
EEPROM	Electrically Erasable Programmable Read-Only Memory	Electrically Erasable Programmable Read-Only Memory
EGB	Elektrostatisch gefährdete Baugruppen	Electrostatic sensitive devices
ELCB	Earth Leakage Circuit Breaker	Residual current operated circuit breaker
ELP	Earth Leakage Protection	Ground-fault monitoring
EMC	Electromagnetic Compatibility	Electromagnetic compatibility
EMF	Electromotive Force	Electromotive force
EMK	Elektromotorische Kraft	Electromotive force
EMV	Elektromagnetische Verträglichkeit	Electromagnetic compatibility
EN	Europäische Norm	European standard
EnDat	Encoder-Data-Interface	Encoder interface
EP	Enable Pulses	Pulse enable
EPOS	Einfachpositionierer	Basic positioner
ES	Engineering System	Engineering system
ESB	Ersatzschaltbild	Equivalent circuit diagram
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ESM	Essential Service Mode	Essential service mode
ESR	Extended Stop and Retract	Extended stop and retract
F		
F...	Fault	Fault
FAQ	Frequently Asked Questions	Frequently Asked Questions
FBLOCKS	Free Blocks	Free function blocks
FCC	Function Control Chart	Function control chart
FCC	Flux Current Control	Flux current control
FD	Function Diagram	Function diagram
F-DI	Failsafe Digital Input	Fail-safe digital input
F-DO	Failsafe Digital Output	Fail-safe digital output
FEPRM	Flash-EPROM	Non-volatile write and read memory
FG	Function Generator	Function generator
FI	-	Fault current
FOC	Fiber-Optic Cable	Fiber-optic cable
FP	Funktionsplan	Function diagram
FPGA	Field Programmable Gate Array	Field Programmable Gate Array
FW	Firmware	Firmware
G		
GB	Gigabyte	Gigabyte
GC	Global Control	Global control telegram (broadcast telegram)
GND	Ground	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as M)
GSD	Gerätstammdatei	Generic Station Description: Describes the features of a PROFIBUS slave
GSV	Gate Supply Voltage	Gate supply voltage
GUID	Globally Unique Identifier	Globally Unique Identifier

A.1 List of abbreviations

Abbreviation	Source of abbreviation	Meaning
H		
HF	High frequency	High frequency
HFD	Hochfrequenzdrossel	Radio frequency reactor
HLA	Hydraulic Linear Actuator	Hydraulic linear actuator
HLG	Hochlaufgeber	Ramp-function generator
HM	Hydraulic Module	Hydraulic Module
HMI	Human Machine Interface	Human Machine Interface
HTL	High-Threshold Logic	Logic with high interference threshold
HW	Hardware	Hardware
I		
i. V.	In Vorbereitung	Under development: This property is currently not available
I/O	Input/Output	Input/output
I2C	Inter-Integrated Circuit	Internal serial data bus
IASC	Internal Armature Short-Circuit	Internal armature short-circuit
IBN	Inbetriebnahme	Startup
ID	Identifier	Identification
IE	Industrial Ethernet	Industrial Ethernet
IEC	International Electrotechnical Commission	International Electrotechnical Commission
IF	Interface	Interface
IGBT	Insulated Gate Bipolar Transistor	Insulated gate bipolar transistor
IGCT	Integrated Gate-Controlled Thyristor	Semiconductor power switch with integrated control electrode
IL	Impulslöschung	Pulse suppression
IP	Internet Protocol	Internet Protocol
IPO	Interpolator	Interpolator
IT	Isolé Terre	Non-grounded three-phase line supply
IVP	Internal Voltage Protection	Internal voltage protection
J		
JOG	Jogging	Jogging
K		
KDV	Kreuzweiser Datenvergleich	Data cross-check
KHP	Know-how protection	Know-how protection
KIP	Kinetische Pufferung	Kinetic buffering
Kp	-	Proportional gain
KTY84	-	Temperature sensor
L		
L	-	Symbol for inductance
LED	Light Emitting Diode	Light emitting diode
LIN	Linearmotor	Linear motor
LR	Lageregler	Position controller
LSB	Least Significant Bit	Least significant bit
LSC	Line-Side Converter	Line-side converter
LSS	Line-Side Switch	Line-side switch
LU	Length Unit	Length unit
LWL	Lichtwellenleiter	Fiber-optic cable

Abbreviation	Source of abbreviation	Meaning
M		
M	-	Symbol for torque
M	Masse	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as GND)
MB	Megabyte	Megabyte
MCC	Motion Control Chart	Motion Control Chart
MDI	Manual Data Input	Manual data input
MDS	Motor Data Set	Motor data set
MLFB	Maschinenlesbare Fabrikatebezeichnung	Machine-readable product code
MM	Motor Module	Motor Module
MMC	Man-Machine Communication	Man-machine communication
MMC	Micro Memory Card	Micro memory card
MSB	Most Significant Bit	Most significant bit
MSC	Motor-Side Converter	Motor-side converter
MSCY_C1	Master Slave Cycle Class 1	Cyclic communication between master (class 1) and slave
MSR	Motorstromrichter	Motor-side converter
MT	Messtaster	Probe
N		
N. C.	Not Connected	Not connected
N...	No Report	No report or internal message
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie	Standardization association for measurement and control in chemical industries
NC	Normally Closed (contact)	NC contact
NC	Numerical Control	Numerical control
NEMA	National Electrical Manufacturers Association	Standardization association in USA (United States of America)
NM	Nullmarke	Zero mark
NO	Normally Open (contact)	NO contact
NSR	Netzstromrichter	Line-side converter
NTP	Network Time Protocol	Standard for synchronization of the time of day
NVRAM	Non-Volatile Random Access Memory	Non-volatile read/write memory
O		
OA	Open Architecture	Software component which provides additional functions for the SINAMICS drive system
OAIF	Open Architecture Interface	Version of the SINAMICS firmware as of which the OA application can be used
OASP	Open Architecture Support Package	Expands the STARTER commissioning tool by the corresponding OA application
OC	Operating Condition	Operation condition
OCC	One Cable Connection	One-cable technology
OEM	Original Equipment Manufacturer	Original equipment manufacturer
OLP	Optical Link Plug	Bus connector for fiber-optic cable
OMI	Option Module Interface	Option Module Interface
P		
p...	-	Adjustable parameters
P1	Processor 1	CPU 1

A.1 List of abbreviations

Abbreviation	Source of abbreviation	Meaning
P2	Processor 2	CPU 2
PB	PROFIBUS	PROFIBUS
PcCtrl	PC Control	Master control
PD	PROFIdrive	PROFIdrive
PDC	Precision Drive Control	Precision Drive Control
PDS	Power unit Data Set	Power unit data set
PDS	Power Drive System	Drive system
PE	Protective Earth	Protective ground
PELV	Protective Extra Low Voltage	Safety extra-low voltage
PFH	Probability of dangerous failure per hour	Probability of dangerous failure per hour
PG	Programmiergerät	Programming device
PI	Proportional Integral	Proportional integral
PID	Proportional Integral Differential	Proportional integral differential
PLC	Programmable Logical Controller	Programmable logic controller
PLL	Phase-Locked Loop	Phase-locked loop
PM	Power Module	Power Module
PMSM	Permanent-magnet synchronous motor	Permanent-magnet synchronous motor
PN	PROFINET	PROFINET
PNO	PROFIBUS Nutzerorganisation	PROFIBUS user organization
PPI	Point to Point Interface	Point-to-point interface
PRBS	Pseudo Random Binary Signal	White noise
PROFIBUS	Process Field Bus	Serial data bus
PS	Power Supply	Power supply
PSA	Power Stack Adapter	Power Stack Adapter
Pt1000	-	Temperature sensor
PTC	Positive Temperature Coefficient	Positive temperature coefficient
PTP	Point To Point	Point-to-point
PWM	Pulse Width Modulation	Pulse width modulation
PZD	Prozessdaten	Process data
Q		
R		
r...	-	Display parameters (read-only)
RAM	Random Access Memory	Memory for reading and writing
RCCB	Residual Current Circuit Breaker	Residual current operated circuit breaker
RCD	Residual Current Device	Residual current device
RCM	Residual Current Monitor	Residual current monitor
REL	Reluctance motor textile	Reluctance motor textile
RESM	Reluctance synchronous motor	Synchronous reluctance motor
RFG	Ramp-Function Generator	Ramp-function generator
RJ45	Registered Jack 45	Term for an 8-pin socket system for data transmission with shielded or non-shielded multi-wire copper cables
RKA	Rückkühlanlage	Cooling unit
RLM	Renewable Line Module	Renewable Line Module
RO	Read Only	Read only
ROM	Read-Only Memory	Read-only memory
RPDO	Receive Process Data Object	Receive Process Data Object

Abbreviation	Source of abbreviation	Meaning
RS232	Recommended Standard 232	Interface standard for cable-connected serial data transmission between a sender and receiver (also known as EIA232)
RS485	Recommended Standard 485	Interface standard for a cable-connected differential, parallel, and/or serial bus system (data transmission between a number of senders and receivers, also known as EIA485)
RTC	Real Time Clock	Real-time clock
RZA	Raumzeigerapproximation	Space-vector approximation
S		
S1	-	Continuous operation
S3	-	Intermittent duty
SAM	Safe Acceleration Monitor	Safe acceleration monitoring
SBC	Safe Brake Control	Safe brake control
SBH	Sicherer Betriebshalt	Safe operating stop
SBR	Safe Brake Ramp	Safe brake ramp monitoring
SBT	Safe Brake Test	Safe brake test
SCA	Safe Cam	Safe cam
SCC	Safety Control Channel	Safety Control Channel
SCSE	Single Channel Safety Encoder	Single-channel safety encoder
SD Card	SecureDigital Card	Secure digital memory card
SDC	Standard Drive Control	Standard Drive Control
SDI	Safe Direction	Safe motion direction
SE	Sicherer Software-Endschalter	Safe software limit switch
SESM	Separately-excited synchronous motor	Separately excited synchronous motor
SG	Sicher reduzierte Geschwindigkeit	Safely limited speed
SGA	Sicherheitsgerichteter Ausgang	Safety-related output
SGE	Sicherheitsgerichteter Eingang	Safety-related input
SH	Sicherer Halt	Safe stop
SI	Safety Integrated	Safety Integrated
SIC	Safety Info Channel	Safety Info Channel
SIL	Safety Integrity Level	Safety Integrity Level
SITOP	-	Siemens power supply system
SLA	Safely-Limited Acceleration	Safety limited acceleration
SLM	Smart Line Module	Smart Line Module
SLP	Safely-Limited Position	Safely Limited Position
SLS	Safely-Limited Speed	Safely limited speed
SLVC	Sensorless Vector Control	Sensorless vector control
SM	Sensor Module	Sensor Module
SMC	Sensor Module Cabinet	Sensor Module Cabinet
SME	Sensor Module External	Sensor Module External
SMI	SINAMICS Sensor Module Integrated	SINAMICS Sensor Module Integrated
SMM	Single Motor Module	Single Motor Module
SN	Sicherer Software-Nocken	Safe software cam
SOS	Safe Operating Stop	Safe operating stop
SP	Service Pack	Service pack
SP	Safe Position	Safe position

Abbreviation	Source of abbreviation	Meaning
SPC	Setpoint Channel	Setpoint channel
SPI	Serial Peripheral Interface	Serial peripheral interface
SPS	Speicherprogrammierbare Steuerung	Programmable logic controller
SS1	Safe Stop 1	Safe Stop 1 (time-monitored, ramp-monitored)
SS1E	Safe Stop 1 External	Safe Stop 1 with external stop
SS2	Safe Stop 2	Safe Stop 2
SS2E	Safe Stop 2 External	Safe Stop 2 with external stop
SSI	Synchronous Serial Interface	Synchronous serial interface
SSL	Secure Sockets Layer	Encryption protocol for secure data transfer (new TLS)
SSM	Safe Speed Monitor	Safe feedback from speed monitor
SSP	SINAMICS Support Package	SINAMICS support package
STO	Safe Torque Off	Safe torque off
STW	Steuerwort	Control word
T		
TB	Terminal Board	Terminal Board
TEC	Technology Extension	Software component which is installed as an additional technology package and which expands the functionality of SINAMICS (previously OA application)
TIA	Totally Integrated Automation	Totally Integrated Automation
TLS	Transport Layer Security	Encryption protocol for secure data transfer (previously SSL)
TM	Terminal Module	Terminal Module
TN	Terre Neutre	Grounded three-phase line supply
Tn	-	Integral time
TPDO	Transmit Process Data Object	Transmit Process Data Object
TSN	Time-Sensitive Networking	Time-Sensitive Networking
TT	Terre Terre	Grounded three-phase line supply
TTL	Transistor-Transistor-Logic	Transistor-transistor logic
Tv	-	Rate time
U		
UL	Underwriters Laboratories Inc.	Underwriters Laboratories Inc.
UPS	Uninterruptible Power Supply	Uninterruptible power supply
USV	Unterbrechungsfreie Stromversorgung	Uninterruptible power supply
UTC	Universal Time Coordinated	Universal time coordinated
V		
VC	Vector Control	Vector control
Vdc	-	DC link voltage
VdcN	-	Partial DC link voltage negative
VdcP	-	Partial DC link voltage positive
VDE	Verband Deutscher Elektrotechniker	Verband Deutscher Elektrotechniker [Association of German Electrical Engineers]
VDI	Verein Deutscher Ingenieure	Verein Deutscher Ingenieure [Association of German Engineers]
VPM	Voltage Protection Module	Voltage Protection Module
Vpp	Volt peak to peak	Volt peak to peak
VSM	Voltage Sensing Module	Voltage Sensing Module

Abbreviation	Source of abbreviation	Meaning
W		
WEA	Wiedereinschaltautomatik	Automatic restart
WZM	Werkzeugmaschine	Machine tool
X		
XML	Extensible Markup Language	Extensible markup language (standard language for Web publishing and document management)
Y		
Z		
ZK	Zwischenkreis	DC link
ZM	Zero Mark	Zero mark
ZSW	Zustandswort	Status word

A.2 Documentation overview

Manuals with additional information that can be downloaded:

-  SINAMICS S120 Combi Equipment Manual
(<https://support.industry.siemens.com/cs/ww/en/ps/13231/man>)
Manual languages: German, English, Chinese (simplified), Chinese (traditional), Portuguese, Korean
-  SINAMICS S120 Combi Compact Installation Instructions
(<https://support.industry.siemens.com/cs/ww/en/ps/13231/man>)
Manual languages: English, Chinese (simplified)
-  SINAMICS S120 Control Units and Additional System Components Equipment Manual
(<https://support.industry.siemens.com/cs/ww/en/ps/13231/man>)
Manual languages: German, English, French, Italian, Spanish, Chinese (simplified)
-  SINAMICS S120/S150 List Manual
(<https://support.industry.siemens.com/cs/ww/en/ps/13231/man>)
Manual languages: German, English, French, Italian, Spanish, Chinese (simplified), Russian
-  SINAMICS S120 Function Manual for Drive Functions
(<https://support.industry.siemens.com/cs/ww/en/ps/13231/man>)
Manual languages: German, English, French, Italian, Spanish, Chinese (simplified), Russian, Portuguese
-  SINAMICS S120 Booksize C/D-type Power Units Equipment Manual
(<https://support.industry.siemens.com/cs/ww/en/ps/13231/man>)
Manual languages: German, English, French, Italian, Spanish, Chinese (simplified)

Get more information

SINAMICS:
www.siemens.com/sinamics

Industry Mall:
www.siemens.com/industrymall

Industry Online Support:
www.siemens.com/online-support