



## SINAMICS

### S120 SINAMICS S120M Distributed Drive Technology




Manual

<u>Fundamental safety instructions</u>	<b>1</b>
<u>System overview</u>	<b>2</b>
<u>Adapter Module 600</u>	<b>3</b>
<u>S120M</u>	<b>4</b>
<u>DRIVE-CLiQ Extension</u>	<b>5</b>
<u>Hybrid Cabinet Bushing</u>	<b>6</b>
<u>Cabinet design and EMC S120M</u>	<b>7</b>
<u>Service and maintenance</u>	<b>8</b>
<u>Appendix</u>	<b>A</b>

## Legal information

### Warning notice system

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

 <b>DANGER</b>
indicates that death or severe personal injury <b>will</b> result if proper precautions are not taken.
 <b>WARNING</b>
indicates that death or severe personal injury <b>may</b> result if proper precautions are not taken.
 <b>CAUTION</b>
indicates that minor personal injury can result if proper precautions are not taken.
<b>NOTICE</b>
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:

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

### Trademarks

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

### Disclaimer of Liability

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

# Foreword

## SINAMICS documentation

The SINAMICS documentation is organized in 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 (<http://www.siemens.com/motioncontrol/docu>):

- 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 (<mailto:docu.motioncontrol@siemens.com>).

## My Documentation Manager

At the following address (<http://www.siemens.com/mdm>), 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 (<http://support.automation.siemens.com/>).

## SINAMICS

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

## Usage phases and their documents/tools (as an example)

Table 1 Usage phases and the available documents/tools

Usage phase	Document/tool
Orientation	SINAMICS S Sales Documentation
Planning/configuration	<ul style="list-style-type: none"> <li>• SIZER Engineering Tool</li> <li>• Configuration Manuals, Motors</li> </ul>
Deciding/ordering	SINAMICS S120 catalogs <ul style="list-style-type: none"> <li>• SIMOTION, SINAMICS S120 and Motors for Production Machines (Catalog PM 21)</li> <li>• SINAMICS and Motors for Single-axis Drives (Catalog D 31)</li> <li>• SINUMERIK &amp; SINAMICS Equipment for Machine Tools (Catalog NC 61)</li> <li>• SINUMERIK 840D sl Type 1B Equipment for Machine Tools (Catalog NC 62)</li> </ul>
Installation/assembly	<ul style="list-style-type: none"> <li>• SINAMICS S120 Equipment Manual for Control Units and Additional System Components</li> <li>• SINAMICS S120 Equipment Manual for Booksize Power Units</li> <li>• SINAMICS S120 Equipment Manual for Chassis Power Units</li> <li>• SINAMICS S120 Equipment Manual for AC Drives</li> <li>• SINAMICS S120M Manual Distributed Drive Technology</li> <li>• SINAMICS S120 Manual Booksize C/D series</li> <li>• SINAMICS HLA System Manual Hydraulic Drive</li> </ul>
Commissioning	<ul style="list-style-type: none"> <li>• STARTER Commissioning Tool</li> <li>• SINAMICS S120 Getting Started</li> <li>• SINAMICS S120 Commissioning Manual</li> <li>• SINAMICS S120 CANopen Commissioning Manual</li> <li>• SINAMICS S120 Function Manual</li> <li>• SINAMICS S120 Safety Integrated Function Manual</li> <li>• SINAMICS S120/S150 List Manual</li> <li>• SINAMICS HLA System Manual Hydraulic Drive</li> </ul>
Usage/operation	<ul style="list-style-type: none"> <li>• SINAMICS S120 Commissioning Manual</li> <li>• SINAMICS S120/S150 List Manual</li> <li>• SINAMICS HLA System Manual Hydraulic Drive</li> </ul>
Maintenance/servicing	<ul style="list-style-type: none"> <li>• SINAMICS S120 Commissioning Manual</li> <li>• SINAMICS S120/S150 List Manual</li> </ul>
References	<ul style="list-style-type: none"> <li>• SINAMICS S120/S150 List Manual</li> </ul>

**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.

**Technical Support**

Country-specific telephone numbers for technical support are provided in the Internet at the following address

(<http://support.automation.siemens.com/WW/llisapi.dll?aktprim=99&lang=en&referer=%2fWW%2f&func=cslib.csinfo2&siteid=csius&extranet=standard&viewreg=WW&groupid=4000002>) in the "Contact" area.

**EC Declaration of Conformity, certificates, certifications, manufacturers declarations**

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") in the Internet at the following address

(<http://support.automation.siemens.com/WW/view/en/21901735/134200>).

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.

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**Note**

You can find certificates for the North American market on the Internet page of the certifier:

- For products with UL certificate (<http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.html>)
  - For products with TÜV SÜD certificate ([https://www.tuev-sued.de/industry\\_and\\_consumer\\_products/certificates](https://www.tuev-sued.de/industry_and_consumer_products/certificates))
  - For products with CSA certificate (<http://www.csagroup.org/de/en/services/testing-and-certification/certified-product-listing>)
- 

## Low-Voltage Directive

When operated in dry areas, SINAMICS S units conform to the Low-Voltage Directive 2006/95/EC.

## EMC directive

SINAMICS S devices fulfill EMC Directive 89/336/EEC or 2014/130/EEC in the configuration specified in the associated EC Declaration of Conformity for EMC and when the Configuration Manual EMC Installation Guideline, article number 6FC5297-0AD30-0□P□, is implemented.

## EMC limit values in South Korea

이 기기(는) 매우 높은 수준의 전자기적합성기기로서 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 CISPR11. 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 (<http://support.automation.siemens.com/WW/view/en/16612315>).

## Ground symbols

Table 2 Symbols

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





# Table of contents

	<b>Foreword</b> .....	<b>5</b>
<b>1</b>	<b>Fundamental safety instructions</b> .....	<b>15</b>
1.1	General safety instructions .....	15
1.2	Safety instructions for electromagnetic fields (EMF).....	19
1.3	Handling electrostatic sensitive devices (ESD).....	19
1.4	Industrial security .....	20
1.5	Residual risks of power drive systems .....	21
<b>2</b>	<b>System overview</b> .....	<b>23</b>
2.1	Field of application .....	23
2.2	Platform Concept and Totally Integrated Automation .....	24
2.3	Introduction .....	26
2.4	SINAMICS S120 components.....	29
2.4.1	SINAMICS S120M component overview.....	29
2.4.2	Component specification according to UL .....	31
2.4.3	Overview of Line Modules .....	37
2.4.4	Overview of Motor Modules .....	39
2.4.5	Overview of distributed S120M components .....	40
2.5	System Data.....	43
2.6	Derating as a function of the installation altitude .....	45
2.7	Recycling and disposal.....	45
<b>3</b>	<b>Adapter Module 600</b> .....	<b>47</b>
3.1	Description .....	47
3.2	Safety instructions for Adapter Modules.....	49
3.3	Interface description .....	51
3.3.1	Overview .....	51
3.3.2	X1 hybrid connector .....	52
3.3.3	X21 terminal strip for operating state .....	52
3.3.4	X201 DRIVE-CLiQ interface .....	53
3.4	Connection example.....	54
3.5	Meaning of the LEDs.....	56
3.6	Dimension drawing.....	57
3.7	Mounting .....	58
3.7.1	Mounting the AM600 (standard).....	58
3.7.2	Mounting an AM600 using spacing bolts.....	59
3.8	Electrical connection.....	62

3.9	Technical data.....	65
3.9.1	Characteristics .....	66
<b>4</b>	<b>S120M.....</b>	<b>69</b>
4.1	Description .....	69
4.2	Safety instructions for S120M.....	70
4.3	Mechanical properties .....	72
4.3.1	Shaft sealing ring .....	72
4.3.2	Radial force loading.....	73
4.3.3	Axial force stressing .....	75
4.4	Interface description.....	76
4.4.1	Overview.....	76
4.4.2	X1/X2 hybrid connector .....	78
4.4.3	X3/X4 signal interfaces.....	79
4.5	Connection example.....	81
4.6	Meaning of the LEDs.....	83
4.7	Dimension drawings .....	84
4.8	Mounting .....	85
4.9	Technical data.....	88
4.9.1	Characteristics .....	90
4.10	Motor holding brake.....	98
4.10.1	Connection at the S120M.....	99
<b>5</b>	<b>DRIVE-CLiQ Extension.....</b>	<b>101</b>
5.1	Description .....	101
5.2	Safety instructions for DRIVE-CLiQ Extensions .....	102
5.3	Interface description.....	102
5.3.1	Overview.....	102
5.3.2	Hybrid connector .....	103
5.3.3	DRIVE-CLiQ connector .....	104
5.4	Dimension drawing.....	105
5.5	Mounting .....	106
5.6	Technical data.....	106
5.6.1	Characteristics .....	107
<b>6</b>	<b>Hybrid Cabinet Bushing .....</b>	<b>109</b>
6.1	Description.....	109
6.2	Safety instructions for the Hybrid Cabinet Bushing.....	110
6.3	Interface description.....	111
6.4	Dimension drawing.....	112
6.5	Mounting .....	113
6.6	Technical data.....	114
6.6.1	Characteristics .....	114

<b>7</b>	<b>Cabinet design and EMC S120M</b> .....	<b>115</b>
7.1	General.....	115
7.2	24 V DC supply voltage.....	116
7.2.1	General.....	116
7.2.2	24 V power supply and connection of components.....	117
7.2.3	X24 24 V terminal adapter.....	120
7.2.4	Installing the 24 V terminal adapter.....	121
7.3	Connection system.....	123
7.3.1	Power/signal cables.....	123
7.3.2	Connection via Hybrid Cable: AM600 - S120M.....	129
7.3.3	Connection via Hybrid Cable: AM600 - Hybrid Cabinet Bushing.....	130
7.3.4	Connection via Hybrid Cable: Hybrid Cabinet Bushing - S120M.....	131
7.3.5	Hybrid Cable connection at the S120M.....	132
7.3.6	Hybrid Cable connection at DRIVE-CLiQ Extension.....	133
7.3.7	Maximum cable length for distributed S120M drive technology.....	134
7.3.8	Connectable conductor cross-sections for screw terminals.....	135
7.3.9	Routing cables in a damp environment.....	136
7.3.10	DRIVE-CLiQ signal cables.....	136
7.4	Potential equalization.....	139
7.5	Layout of the components.....	140
7.5.1	General.....	140
7.5.2	Current carrying capacity of the DC link busbar.....	140
7.5.3	Several Adapter Modules 600.....	141
7.5.4	Position of the S120M in the line.....	141
7.5.5	Line termination with the hybrid connector.....	142
7.5.6	Several Control Units and DRIVE-CLiQ Extension.....	144
7.5.7	Mixed configurations comprising central and distributed S120 versions.....	144
<b>8</b>	<b>Service and maintenance</b> .....	<b>145</b>
8.1	Spare parts.....	145
8.2	Replacing components.....	145
8.2.1	Safety instructions.....	145
8.2.2	Replacing an AM600.....	146
8.2.3	Replacing a S120M.....	149
8.2.4	Replacing a fuse in the Adapter Module 600.....	151
8.2.5	Replacing a fan in the Adapter Module 600.....	153
8.3	Forming the DC link capacitors.....	154
8.3.1	Central components (AM600).....	154
8.3.2	Distributed components.....	156
<b>A</b>	<b>Appendix</b> .....	<b>157</b>
A.1	List of abbreviations.....	157
A.2	Documentation overview.....	166
	<b>Index</b> .....	<b>167</b>



# Fundamental safety instructions

## 1.1 General safety instructions



### DANGER

#### **Danger to life due to live parts and other energy sources**

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

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

Generally, six steps apply when establishing safety:

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

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



### WARNING

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

Touching live components can result in death or severe injury.

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



**! WARNING**

**Danger to life when live parts are touched on damaged devices**

Improper handling of devices can cause damage.

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

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



**! WARNING**

**Danger to life through electric shock due to unconnected cable shields**

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

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



**! WARNING**

**Danger to life due to electric shock when not grounded**

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

- Ground the device in compliance with the applicable regulations.



**! WARNING**

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

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

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

**! WARNING**

**Danger to life due to fire spreading if housing is inadequate**

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

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

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

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

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

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

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

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

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

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

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

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

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

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



**NOTICE**

**Device damage caused by incorrect voltage/insulation tests**

Incorrect voltage/insulation tests can damage the device.

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

 **WARNING**

**Danger to life when safety functions are inactive**

Safety functions that are inactive or that have not been adjusted accordingly can cause operational faults on machines that could lead to 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 notices for Safety Integrated functions**

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

## 1.2 Safety instructions for electromagnetic fields (EMF)



### WARNING

#### Danger to life from electromagnetic fields

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

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

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

## 1.3 Handling electrostatic sensitive devices (ESD)

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



### NOTICE

#### Damage through electric fields or electrostatic discharge

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

- Only pack, store, transport and send electronic components, modules or devices in their original packaging or in other suitable materials, e.g. conductive foam rubber 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).

## 1.4 Industrial security

### Note

#### Industrial security

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, solutions, machines, equipment and/or networks. They are important components in a holistic industrial security concept. With this in mind, Siemens' products and solutions undergo continuous development. Siemens recommends strongly that you regularly check for product updates.

For the secure operation of Siemens products and solutions, it is necessary to take suitable preventive action (e.g. cell protection concept) and integrate each component into a holistic, state-of-the-art industrial security concept. Third-party products that may be in use should also be considered. For more information about industrial security, visit Hotspot-Text.

To stay informed about product updates as they occur, sign up for a product-specific newsletter. For more information, visit Hotspot-Text.

### WARNING

#### **Danger as a result of unsafe operating states resulting from software manipulation**

Software manipulation (e.g. by viruses, Trojan horses, malware, worms) can cause unsafe operating states to develop in your installation which can result in death, severe injuries and/or material damage.

- Keep the software up to date.  
You will find relevant information and newsletters at this address.
- Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine.  
You will find further information at this address.
- Make sure that you include all installed products into the holistic industrial security concept.

## 1.5 Residual risks of power drive systems

### Residual risks of power drive systems

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

The AM600 cabinet component may only be operated in closed housings or in higher-level control cabinets with protective covers that are closed, and when all of the protective devices are used.

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

When assessing the machine's risk in accordance with the respective local regulations (e.g., EC Machinery Directive), the machine manufacturer 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 components during commissioning, operation, maintenance, and repairs caused by, for example:
  - Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology
  - Response times of the controller and drive
  - Operating and/or ambient conditions outside of the specification
  - Condensation / conductive contamination
  - Parameterization, programming, cabling, and installation errors
  - Use of radio devices / cellular phones in the immediate vicinity of the controller
  - External influences / damage
2. In the event of a fault, exceptionally high temperatures, including an open fire, as well as emissions of light, noise, particles, gases, etc. can occur inside and outside the inverter, e.g.:
  - Component malfunctions
  - Software errors
  - Operating and/or ambient conditions outside of the specification
  - External influences / damage

Inverters of the Open Type / IP20 degree of protection must be installed in a metal control cabinet (or protected by another equivalent measure) such that the contact with fire inside and outside the inverter is not possible.

1.5 Residual risks of power drive systems

3. Hazardous shock voltages caused by, for example:
  - Component malfunctions
  - Influence of electrostatic charging
  - Induction of voltages in moving motors
  - Operating and/or ambient conditions outside of the specification
  - Condensation / conductive contamination
  - External influences / damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc. if they are too close.
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly.

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**Note**

The AM600 cabinet component must be protected against conductive contamination (e.g. by installing it in a control cabinet with degree of protection IP54 according to IEC 60529 or NEMA 12).

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

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

## System overview

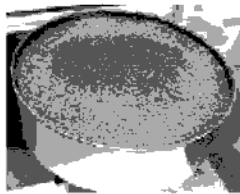
### 2.1 Field of application

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

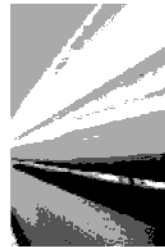
- Simple pump and fan applications in the process industry.
- Complex single drives in centrifuges, presses, extruders, elevators, as well as conveyor and transport systems
- Drive line-ups in textile, plastic film, and paper machines, as well as in rolling mill plants.
- High-precision servo drives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



Mixers/mills



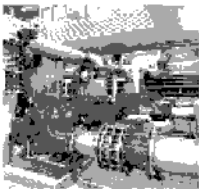
Plastic



Converting



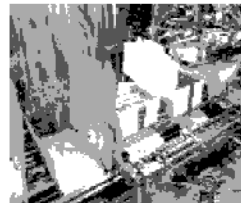
Machine tools



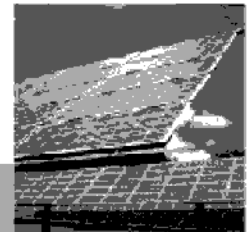
Pumps/fans/  
Compressors



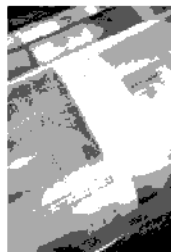
Textiles



Packaging



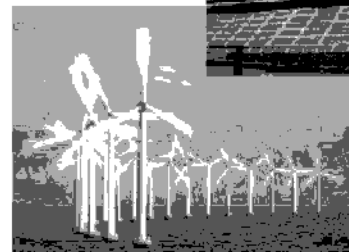
Conveyor systems



Printing machines



Woodworking



Renewable energy

Figure 2-1 SINAMICS applications

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

- SINAMICS S handles complex drive tasks with synchronous/induction motors and fulfills stringent requirements regarding
  - the dynamic performance and accuracy
  - the integration of extensive technological functions in the drive control system
- SINAMICS S120M for distributed servo drive technology S120M is a synchronous motor with integrated power unit, which is connected to a central Control Unit via DRIVE-CLiQ.
- SINAMICS G is designed for standard applications with induction motors. These applications have less stringent requirements regarding the dynamic performance of the motor speed.
- SINAMICS DC MASTER is the DC drive belonging to the SINAMICS family. As a result of its standard expandability, it addresses both basic as well as demanding drive applications and in complementary markets.

## 2.2 Platform Concept and Totally Integrated Automation

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

### Totally Integrated Automation (TIA) with SINAMICS S120

Apart from SIMATIC, SIMOTION and SINUMERIK, SINAMICS is one of the core components of TIA. The STARTER commissioning tool is an integral element of TIA. It is thus possible to seamlessly parameterize, program and commission all components in the automation system using a standardized engineering system. The system-wide data management functions ensure consistent data and simplify archiving of the entire plant project.

PROFIBUS, the standard fieldbus of TIA, is supported by all SINAMICS S120 versions. It provides a high-performance, system-wide communication network which links all automation components:

- HMI (operator control and monitoring)
- Open-loop control
- Drives
- I/O

SINAMICS S120 is also available with a PROFINET interface. This Ethernet-based bus enables control data to be exchanged at high speed via PROFINET IO with IRT or RT and makes SINAMICS S120 a suitable choice for integration in top-performance multi-axis applications. At the same time, PROFINET also uses standard IT mechanisms (TCP/IP) to transport information, e.g. operating and diagnostic data, to higher-level systems. This makes it easy to integrate into an IT corporate network.

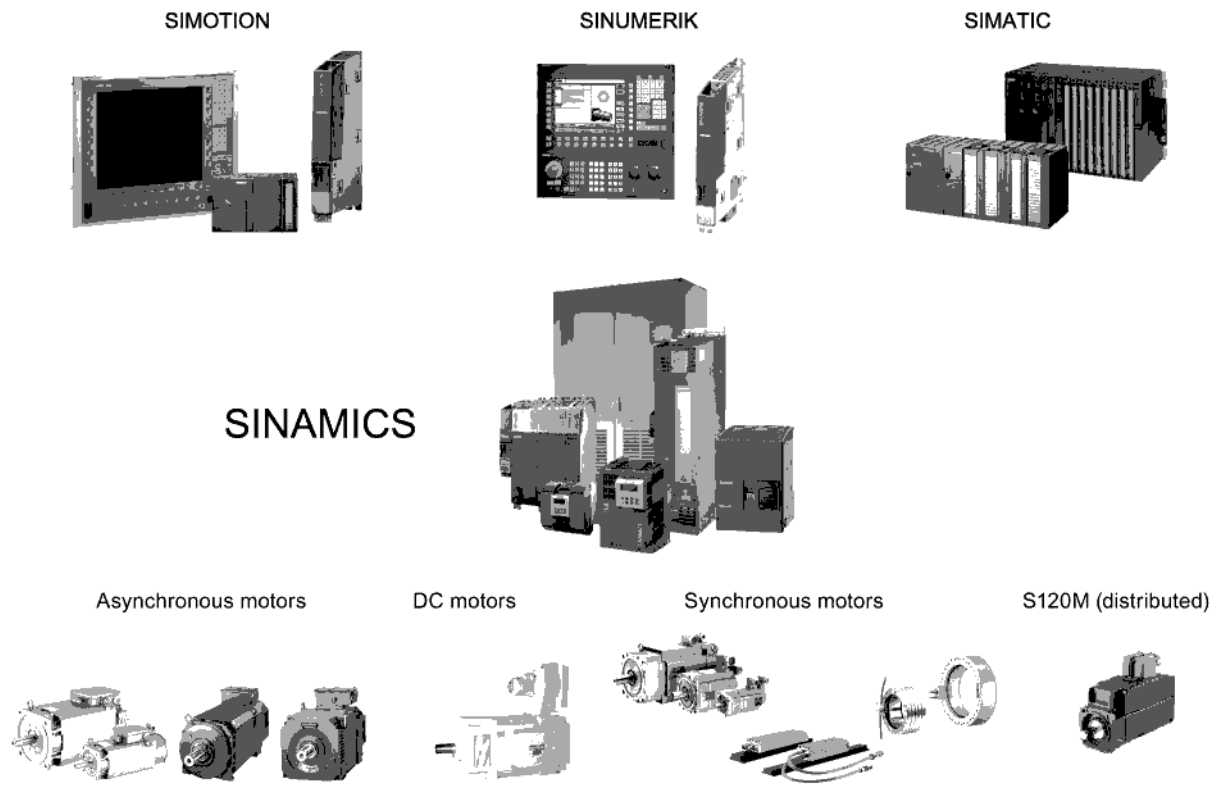


Figure 2-2 SINAMICS as part of the Siemens modular automation system



## 2.3 Introduction

### System overview

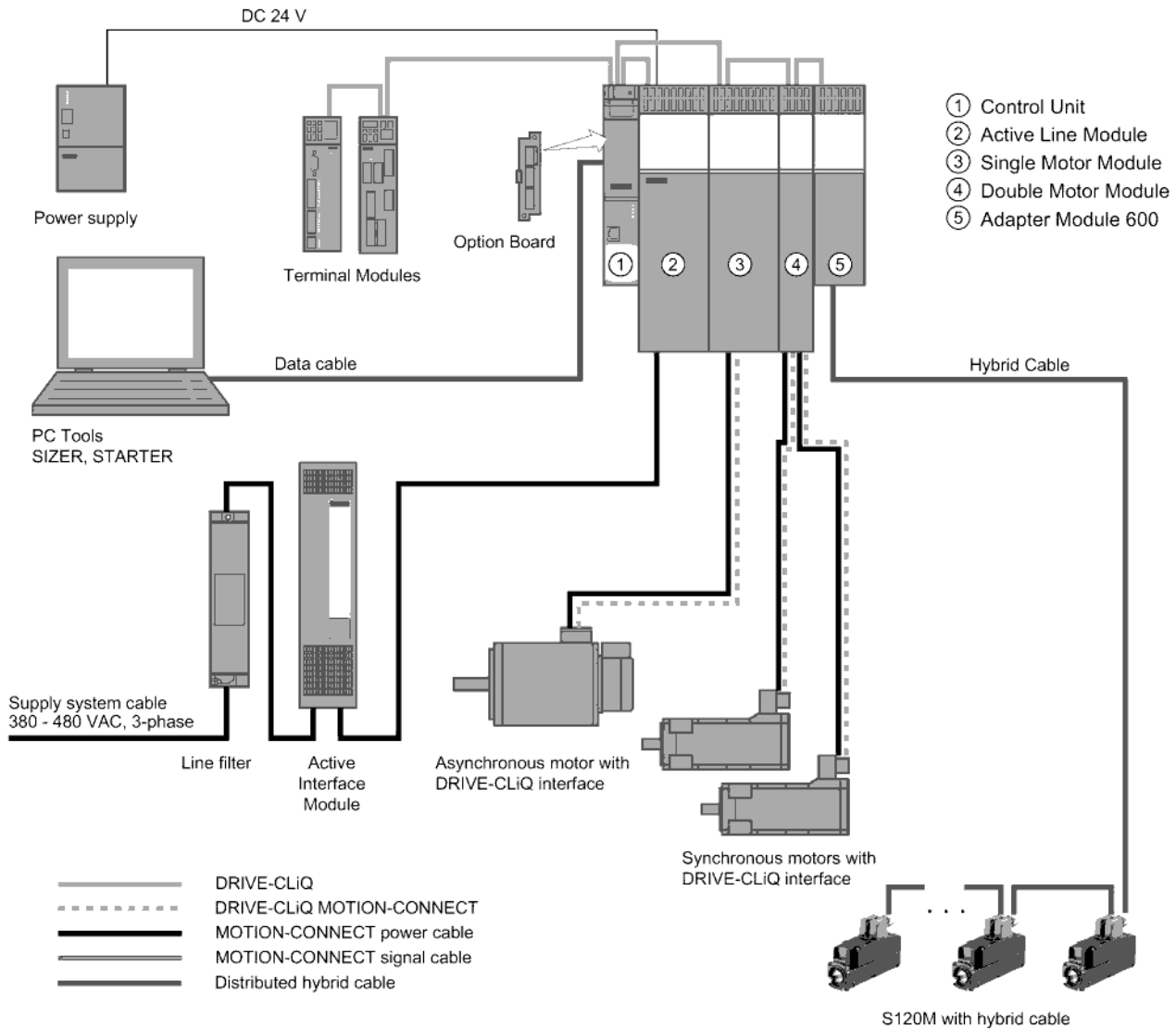


Figure 2-3 System overview, SINAMICS S120 with distributed servo drive technology S120M

## Modular system for sophisticated drive tasks

SINAMICS S120 solves complex drive tasks for a wide range of industrial applications and is, therefore, designed as a modular system. Users can choose from many different harmonized components and functions to create a solution that best meets their requirements. "SIZER for SIEMENS Drives", a powerful engineering tool, makes it easier to choose and determine the optimum drive configuration.

SINAMICS S120 optimally supports:

- Synchronous and induction motors
- Linear and torque motors
- SINAMICS S120M

## System architecture with a central Control Unit

On the SINAMICS S120, the drive intelligence is combined with closed-loop control functions into Control Units. These units are capable of controlling drives in the vector, servo and V/f modes. They also perform the speed and torque control functions plus other intelligent drive functions for all axes on the drive. Inter-axis connections can be established within a component and easily configured in the STARTER commissioning tool using a mouse.

## Functions for higher efficiency

- Basic functions: Speed control, torque control, positioning functions
- Intelligent starting functions for independent restart after power supply interruption
- BICO technology with interconnection of drive-related DI/DOs for easy adaptation of the drive system to its machine environment
- Integrated safety functions for rational implementation of safety concepts
- Regulated infeed/regenerative feedback functions for preventing undesirable reactions on the supply, allowing recovery of braking energy and ensuring greater stability against line fluctuations.

## DRIVE-CLiQ – the digital interface between SINAMICS components

The SINAMICS S120 components, including the motors and encoders, are interconnected via a joint serial interface called DRIVE-CLiQ. The standardized cables and connectors reduce the variety of different parts and cut storage costs. Encoder evaluations for converting standard encoder signals to DRIVE-CLiQ are available for third-party motors or retrofit applications.

## Electronic rating plates in all components

An important digital linkage element of the SINAMICS S120 drive system are the electronic type plates integrated in every component. They allow all drive components to be detected automatically via DRIVE-CLiQ wiring. As a result, data do not need to be entered manually during commissioning or component replacement – helping to ensure that drives are commissioned successfully!

The rating plate contains all the relevant technical data about that particular component. In the motors, for example, this data includes the parameters of the electric equivalent circuit diagram and characteristic values for the built-in motor encoder.

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

## 2.4 SINAMICS S120 components

### 2.4.1 SINAMICS S120M component overview

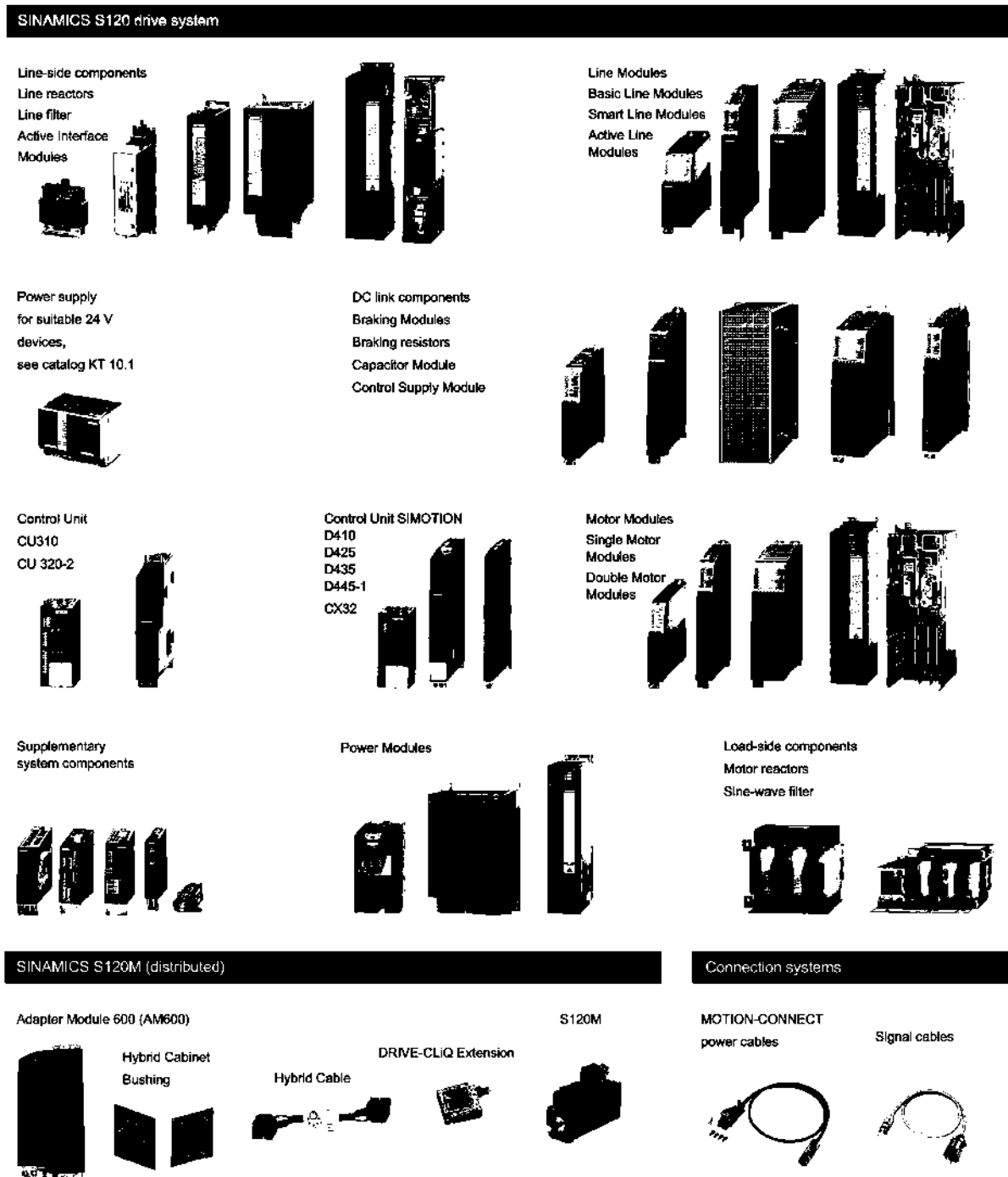


Figure 2-4 Overview of SINAMICS S120 with SINAMICS S120M distributed drive technology

### Central system components

- Line-side power components, such as fuses, contactors, reactors, and filters for switching the power supply and meeting EMC requirements.
- Line Modules, which supply power centrally to the DC link.
- DC link components (optional), which stabilize the DC link voltage.
- Adapter Modules 600 (AM600), which supply the distributed S120M with energy and data via a Hybrid Cable.

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

- Control Units that process the drive and technological functions across all axes.
- Supplementary system components that extend the functionality and offer different interfaces for encoders and process signals.

The central SINAMICS S120 system components are intended for installation in cabinets. They have the following features and characteristics:

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

### Booksize format

Booksize format units are optimized for multi-axis applications and are mounted adjacent to one another. The connection for the shared voltage-source DC link is an integral feature.

The booksize format offers various cooling options:

- Internal air cooling
- External air cooling
- Cold plate cooling
- Liquid Cooled

### Booksize compact format

The booksize compact format combines all benefits of the booksize format and provides the same performance with an even smaller overall height and an extended overload capability. The booksize compact format is thus particularly well suited for integration into machines with high dynamic requirements and confined installation conditions.

The booksize compact format offers the following cooling options:

- Internal air cooling
- Cold plate cooling

## Distributed system components

- S120M (1FK7 synchronous motor with integrated Power Module encoder)
- Hybrid cable (connection system)
- DRIVE-CLiQ extension (DQE)
- Hybrid Cabinet Bushing (HCB)

### 2.4.2 Component specification according to UL

The components of the SINAMICS S120M drive system are UL-certified. The certification is indicated on the products using the UL Listing Mark. You can find proof of the certification on the Internet at <http://www.ul.com> under "Tools / Online Certifications Directory" by entering the file number or the "Name".

The UL file number for the SINAMICS S120M drive system is E192450.

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#### Note

##### UL-Ratings

When using components in the area of validity of UL ("Underwriters Laboratories Inc.®"), observe the UL ratings below for the individual components. They deviate in some cases from the general parameters (see documentation for each of the components). The specifications for the rated currents/powers apply to a maximum ambient temperature of max. +40 °C. If the components are operating in the range between +40 °C and +55 °C, the linear reductions of the output currents or output powers to 60% should be used.

---

#### Note

##### Using the 24 V terminal adapter

When using the 24 V terminal adapter only use wires with a temperature rating of 60/75°C and a cross-section of AWG 10-20 (stranded wires). The maximum tightening torque is 16 lb-in (1.8 Nm). Alternatively, you can use the busbars to establish the connection.

---

Table 2- 1 Technical data of the Adapter Module 600 (AM600) according to UL

AM600	Unit	6SL3555-2BC10-0A..	
Max. ambient temperature	°C	40	55 (with derating)
Electronics power supply / (input)			
Electronics voltage	V <sub>DC</sub>	24	24
Electronics current	A <sub>DC</sub>	20	20
Line electronics supply/(output)			
Electronics power supply	V <sub>DC</sub>	48	48
Output current	A <sub>DC</sub>	10	10
DC-Bus Supply			
Input / Output Voltage	V <sub>DC</sub>	510 ... 700	510 ... 700
Input / Output Current	A <sub>DC</sub>	20	12
Enclosure type		open type	

Independent of the number of modules connected in the system, the above mentioned ratings for the Adapter Module AM600 should not be exceeded at any temperature. Under this precondition, up to a maximum of 40 S120 modules can be used on one line of the S120M drive system.

Table 2- 2 Technical data of the S120M according to UL up to a maximum Ambient Temperature of 40 °C

Technical data	Unit	6SL3532-6DF71-0R..	6SL3540-6DF71-0R..	6SL3542-6DF71-0R..	6SL3562-6DF71-0R..	6SL3563-6DF71-0R..
<b>S120M drive</b>						
Rated speed	rpm	3 000	3 000	3 000	3 000	3 000
Rated torque	Nm	0.8	1.05	1.8	2.7	2.2
Motor insulation system		Class F (155)				
Enclosure type		Type 1				
DC link voltage	V <sub>DC</sub>	510 ... 700				
DC-Bus Supply	A <sub>DC</sub>	20				
Max. Input / Output Current (Feedthrough current X1/X2)						
Max. input current (current consumption under normal operation)	A <sub>DC</sub>	1.13	1.7	1.6	1.5	1.7
Electronics power supply	V <sub>DC</sub>	48				
Electronics power supply	A <sub>DC</sub>	10				
Max. input/output current (Feedthrough current X1/X2)						
Max. input current 48 V electronics power supply	A <sub>DC</sub>	0.56	0.52	0.52	0.54	0.54
<b>Signal interface X3</b>						
Output voltage	V <sub>DC</sub>	24				
Max. output current terminal 1	A <sub>DC</sub>	0.1				
Max. output current terminal 2 (resistive)	A <sub>DC</sub>	0.1				

Technical data	Unit	6SL3532-6DF71-0R..	6SL3540-6DF71-0R..	6SL3542-6DF71-0R..	6SL3562-6DF71-0R..	6SL3563-6DF71-0R..
Max. output current terminal 3 (resistive)	A <sub>DC</sub>	0.1				
Max. total output current	A <sub>DC</sub>	0.2				

Table 2- 3 Technical data of the S120M according to UL up to a maximum ambient temperature of 55 °C (with derating)

Technical data	Unit	6SL3532-6DF71-0R..	6SL3540-6DF71-0R..	6SL3542-6DF71-0R..	6SL3562-6DF71-0R..	6SL3563-6DF71-0R..
<b>S120M drive</b>						
Rated speed	rpm	3 000	3 000	3 000	3 000	2 000
Rated torque	Nm	0.4	0.53	0.8	0.7	1.6
Motor insulation system		Class F (155)				
Enclosure type		Type 1				
DC link voltage	V <sub>DC</sub>	510 ... 700				
DC-Bus Supply Max. Input / Output Current (Feedthrough current X1/X2)	A <sub>DC</sub>	12				
Max. input current (current consumption under normal operation)	A <sub>DC</sub>	0.68	1.1	1.0	0.9	1.0
Electronics power supply	V <sub>DC</sub>	48				
Electronics power supply Max. input/output current (Feedthrough current X1/X2)	A <sub>DC</sub>	10				
Max. input current 48 V electronics power supply	A <sub>DC</sub>	0.56	0.52	0.52	0.54	0.54
<b>Signal interface X3</b>						
Output voltage	V <sub>DC</sub>	24				
Max. output current terminal 1	A <sub>DC</sub>	0.1				
Max. output current terminal 2 (resistive)	A <sub>DC</sub>	0.1				
Max. output current terminal 3 (resistive)	A <sub>DC</sub>	0.1				
Max. total output current	A <sub>DC</sub>	0.2				

The S120M modules provide motor overload protection at a level of 125 % of the nominal motor current.

For the brake release on connector X4 connect a power supply rated 24 Vdc, Class 2 only



Cable assemblies intended to be used for signal connectors X3/X4 shall comply with the requirements in the Standard for Cable Assemblies and Fittings for Industrial Control and Signal Distribution UL2238 (UL Category CYJV/CYJV2).

Table 2- 4 Technical data of the DRIVE-CLiQ Extension (DQE) according to UL

DQE	Unit	6SL3555-0AA00-6AB.	
Max. ambient temperature	°C	40	55 (with derating)
Electronics power supply (X1/X2)			
Input / Output Voltage	V <sub>DC</sub>	48	48
Input / Output Current	A <sub>DC</sub>	10	10
DC-Bus Supply (X1/X2)			
Input / Output Voltage	V <sub>DC</sub>	510 ... 700	510 ... 700
Input / Output Current	A <sub>DC</sub>	20	12
Enclosure type		Type 1	

Table 2- 5 Technical data of the Hybrid Cabinet Bushing (HCB) according to UL

HCB	Unit	6SL3555-2DA00-0AA.	
Max. ambient temperature	°C	40	55 (with derating)
Line Electronics / Control Power (output)			
Input / Output Voltage	V <sub>DC</sub>	48	48
Input / Output Current	A <sub>DC</sub>	10	10
DC-Bus Supply			
Input / Output Voltage	V <sub>DC</sub>	510 ... 700	510 ... 700
Input / Output Current	A <sub>DC</sub>	20	12
Enclosure type		Type 1 (exterior)	

Table 2- 6 Technical data of the Hybrid Cable according to UL

Hybrid Cable	Unit	6FX8002-7HY...-....	
Max. cable temperature	°C	80	
Electronics power supply			
Voltage	V <sub>DC</sub>	48	
Current	A <sub>DC</sub>	10	
Core cross-section	mm <sup>2</sup>	2.5	
DC link supply/grounding			
Voltage	V <sub>DC</sub>	720	
Current	A <sub>DC</sub>	20	
Core cross-section	mm <sup>2</sup>	4	
Signal cores			
Voltage	V <sub>DC</sub>	30	
Current	A <sub>DC</sub>	1	
Core cross-section	AWG	22	

To connect the distributed components HCB, DQE and S120M with one another and to the AM 600, it is only permissible to use the 6FX8002-7HY...-.... Hybrid Cable.

The dust covers on the power connectors X1 and X2 do not provide protection against Risk of Fire and/or Electrical shock and should be closed before installation by either

1. connecting hybrid cable 6FX8002-7HY...-....
2. or by using termination plug (Page 142).



**⚠ WARNING**

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

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

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

For applications in line with UL, only the following components are permitted to supply SINAMICS S120M components:

Table 2- 7 Active Line Modules booksize

Heat dissipation		16 kW	36 kW	55 kW	80 kW
Internal air cooling	6SL3130-	7TE21-6Axy <sup>1)</sup>	7TE23-6Axy <sup>1)</sup>	7TE25-5Axy <sup>1)</sup>	7TE28-0Axy <sup>1)</sup>
External air cooling	6SL3131-	7TE21-6Axy <sup>1)</sup>	7TE23-6Axy <sup>1)</sup>	7TE25-5Axy <sup>1)</sup>	7TE28-0Axy <sup>1)</sup>
Cold plate cooling	6SL3136-	7TE21-6Axy <sup>1)</sup>	7TE23-6Axy <sup>1)</sup>	7TE25-5Axy <sup>1)</sup>	7TE28-0Axy <sup>1)</sup>

<sup>1)</sup> x stands for any letter and y for any number

Operation of the components of the SINAMICS S120M system on Active Line Modules Booksize with 120 kW power is not certified.

Table 2- 8 Basic Line Modules booksize

Heat dissipation		20 kW	40 kW
Internal air cooling	6SL3130-	1TE22-0Axy <sup>1)</sup>	1TE24-0Axy <sup>1)</sup>
Cold plate cooling	6SL3136-	1TE22-0Axy <sup>1)</sup>	1TE24-0Axy <sup>1)</sup>

<sup>1)</sup> x stands for any letter and y for any number

Operation of the components of the SINAMICS S120M system on Basic Line Modules Booksize with 100 kW power is not certified.

Table 2- 9 Smart Line Modules booksize

Heat dissipation		5 kW	10 kW	16 kW	36 kW	55 kW
Internal air cooling	6SL3130-	6AE15-0Axy <sup>1)</sup>	6AE21-0Axy <sup>1)</sup>	6TE21-6Axy <sup>1)</sup>	6TE23-6Axy <sup>1)</sup>	6TE25-5Axy <sup>1)</sup>
External air cooling	6SL3131-	6AE15-0Axy <sup>1)</sup>	6AE21-0Axy <sup>1)</sup>	6TE21-6Axy <sup>1)</sup>	6TE23-6Axy <sup>1)</sup>	6TE25-5Axy <sup>1)</sup>
Cold plate cooling	6SL3136-	6AE15-0Axy <sup>1)</sup>	6AE21-0Axy <sup>1)</sup>	6TE21-6Axy <sup>1)</sup>	6TE23-6Axy <sup>1)</sup>	-

<sup>1)</sup> x stands for any letter and y for any number

Table 2- 10 Smart Line Modules Booksize Compact

<b>Heat dissipation</b>		<b>16 kW</b>
Internal air cooling	6SL3430-	6TE21-6Axy <sup>1)</sup>

<sup>1)</sup> x stands for any letter and y for any number

Operation is only permitted on line supplies with a maximum rated voltage of 480 V AC and a maximum short-circuit current of 65 kA (symmetrical) if Line Modules permitted in this manual are installed and used (see above tables). This applies to the complete S120M Modular Drive System, not for the individual modules.

---

**Note**

Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Manufacturer Instructions, National Electrical Code and any additional local codes.

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**Note**

Line fuses for the Line Modules must be installed in compliance with the requirements specified in the SINAMICS S120 Manual GH2 Booksize power units.

---

**Note**

The SINAMICS S120M Modular Drive System is intended for use only in industrial machinery NFPA 79 applications.

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### 2.4.3 Overview of Line Modules

Line Modules generate a DC voltage in the DC link from the three-phase line voltage that supplies the connected Motor Modules with power.

All Basic Line Modules and Active Line Modules as well as the 16 kW, 36 kW, and 55 kW Smart Line Modules are equipped with DRIVE-CLiQ interfaces for communicating with the Control Unit. The 5 kW and 10 kW Smart Line Modules must be connected with the Control Unit via terminals.

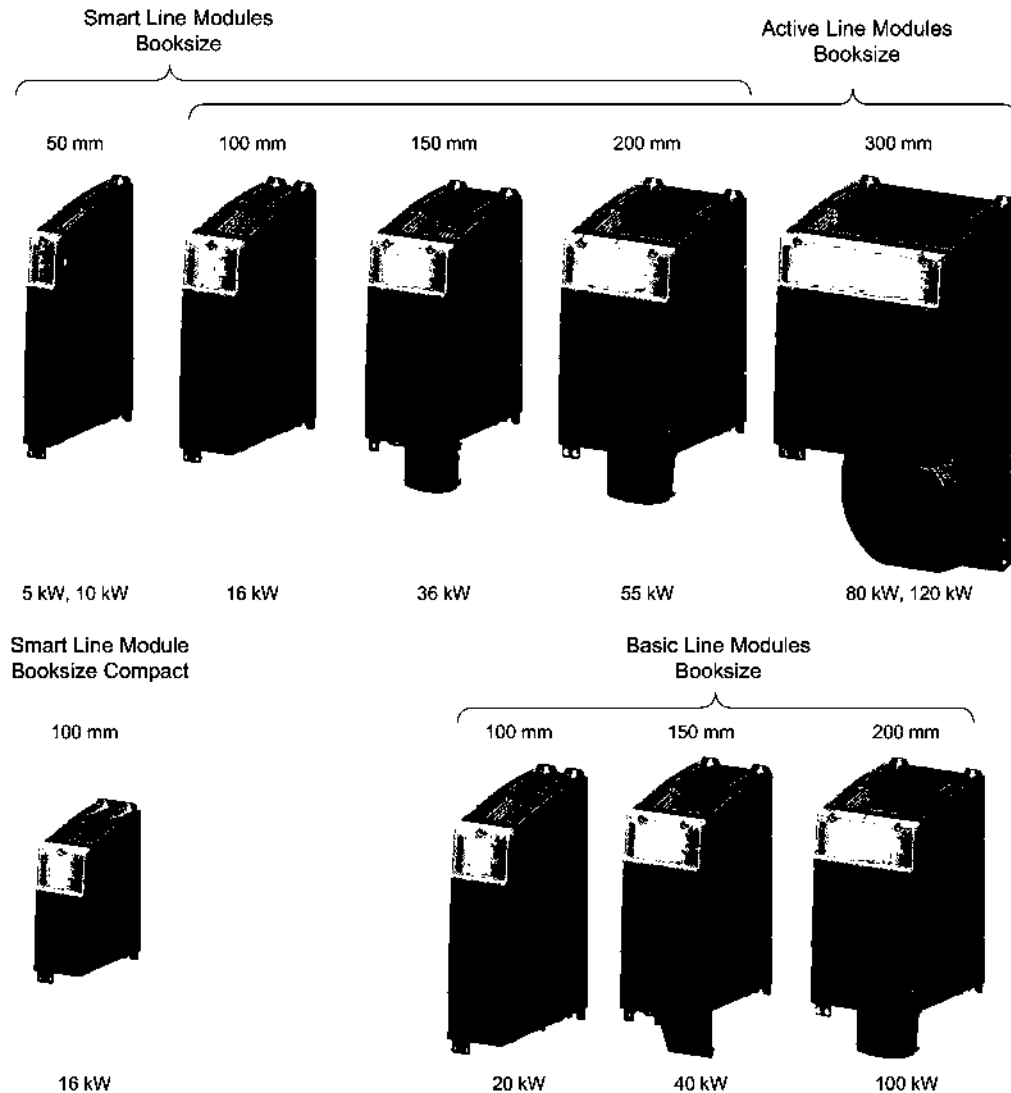


Figure 2-5 Overview of Line Modules

### General characteristics of the Line Modules

- Supply voltage 3 AC 380 V –10% (-15% <1 min) to 3 AC 480 V +10% (47 to 63 Hz)
- Suitable for TN, TT, and IT supply systems
- Internal/external air cooling
- Liquid cooling and cold plate cooling
- Short-circuit/ground-fault-proof during the precharge phase
- Integrated DC link and electronics current busbar connection
- LEDs for indicating statuses and for diagnostics

### Characteristics of the Active Line Modules

- Regulated DC link voltage
- Regenerative feedback capability
- Sinusoidal line currents
- Electronic rating plate
- DRIVE-CLiQ interface for communicating with the Control Unit and/or other components in the drive line-up.
  - Integration in system diagnostics
- For Active Line Modules as of 55 kW, an outgoing circuit for the DC link busbar is possible on both sides.
- For all Active Line Modules with article numbers ending in 3 (6SL□□□-□□□3): outgoing circuit for DC link busbar possible on both sides.

### Characteristics of the Smart Line Modules

- Unregulated DC link voltage
- Regenerative feedback capability
- Block-type network currents in feedback direction
- For 16 kW to 55 kW Smart Line Modules: outgoing circuit for DC link busbar possible on both sides.

### Characteristics of the Basic Line Modules

- Unregulated DC link voltage
- No regenerative feedback capability
- For all Basic Line Modules, an outgoing circuit for DC link busbar is possible on both sides.

## 2.4.4 Overview of Motor Modules

The Motor Modules in the SINAMICS S system in booksize format are implemented as inverters. They make the energy from the connected motors' DC link available at an adjusted voltage and with variable frequency. The control information is generated in the Control Unit and distributed to the individual Motor Modules via DRIVE-CLiQ.

Depending on the type (Single or Double), each Motor Module has one or two DRIVE-CLiQ interfaces for connecting the motor encoder evaluation (Sensor Modules).

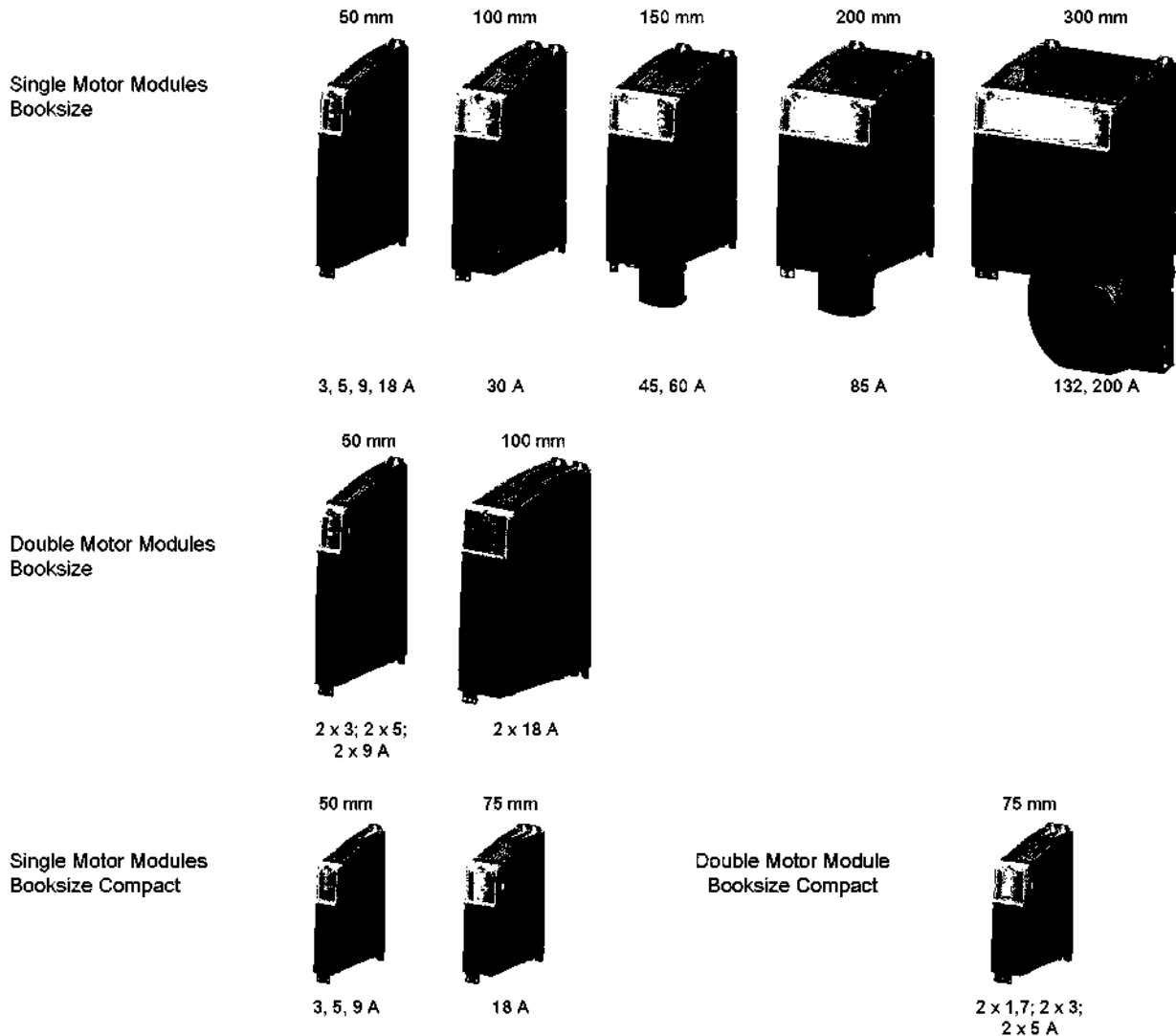


Figure 2-6 Overview of Motor Modules in booksize format

### Properties of the Motor Modules

- Single type from 3 A to 200 A
- Double type from 1.7 A to 18 A
- Internal/external air cooling
- Liquid cooling and cold plate cooling
- Short-circuit/ground-fault-proof
- Integrated DC link and electronics current busbar connection
- Integrated "safety motor braking control"
- Electronic rating plate
- Operating status and error status via LEDs
- DRIVE-CLiQ interface for communication with the Control Unit and/or other components in the drive line-up
- Integration in system diagnostics

### 2.4.5 Overview of distributed S120M components

SINAMICS S120M is the distributed version of the SINAMICS S120 booksize family.

#### Hardware

The SINAMICS S120M distributed system comprises the following units:

- S120M (1FK7 synchronous motor with integrated Power Module encoder)
- Adapter Modules 600 (AM600)
- Hybrid Cable (connection system)
- DRIVE-CLiQ extension (DQE)
- Hybrid Cabinet Bushing (HCB)

#### Functionality of distributed drive technology

- The 24 V electronic power supply is either provided from an external supply or from a Control Supply Module (CSM). The supply can also be taken from the central drive line-up using the 24 V terminal connector.
- Use of the Line Modules (ALM, BLM or SLM) from the SINAMICS S120 product family.
- The Adapter Module 600 opens a line of distributed S120M drives. It feeds the DC link, auxiliary voltage, and DRIVE-CLiQ in a Hybrid Cable.
- If several S120M drives are to be operated, then the possible number depends on the central Control Unit used. If an additional Control Unit is used, the closed-loop control signals are fed into the line via a DRIVE-CLiQ Extension.

- The AM600, DRIVE-CLiQ Extension, and Hybrid Cabinet Bushing are not "visible" DRIVE-CLiQ nodes in the topology. The number of DRIVE-CLiQ Extensions is not restricted.
- As Control Unit or control, all multi-axis CUs in the SINAMICS/SIMOTION/SINUMERIK range can be used (CU320-2, D4xx-2, CX32-2, NCUxx). The releases of the S120M on the corresponding systems are published via the Siemens Industry Online Support Portal (<http://support.automation.siemens.com>).
- Firmware and parameterization are updated via DRIVE-CLiQ.
- Replaceable storage media are not available for the S120M.

**Note**

**Functionality that deviates from SINAMICS S120**

- S120M has been released exclusively for servo control.
- The pulse frequency is permanently set to 4 kHz.

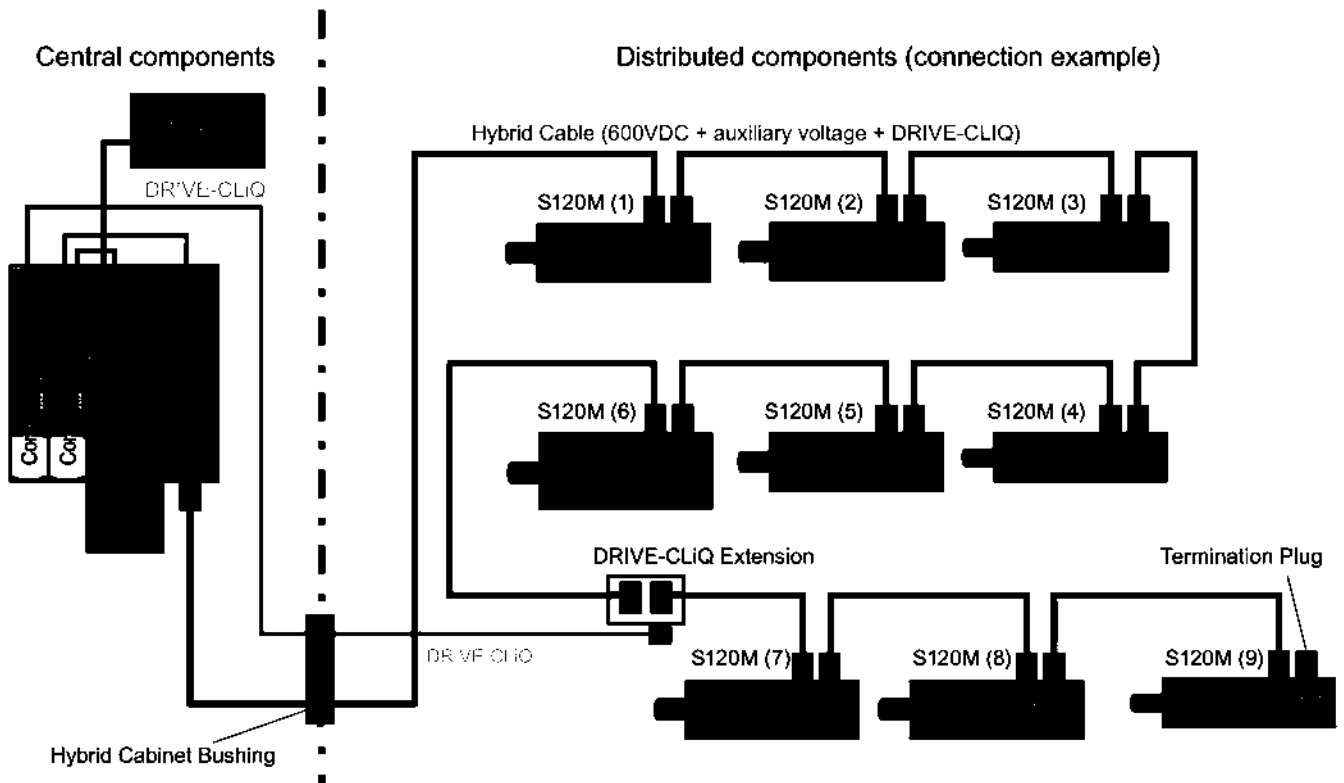


Figure 2-7 Principle of an S120M topology

**S120M Safety Integrated concept**

Safety Integrated functions can be controlled with PROFIsafe or TM54F.



## Interfaces

- Adapter Module 600
  - X1: Hybrid connector
  - X21: Terminal strip for operating states
  - X24: Terminal strip for 24 V ext.
  - X201: DRIVE-CLiQ interface
- S120M
  - X1/X2: Hybrid connector
  - X3: Connecting actuators and sensors to the S120M
  - X4: Connection to externally open a holding brake
  - LEDs: Display of operating states
- DRIVE-CLiQ Extension
  - X1 (IN): Hybrid connector
  - X2 (OUT): Hybrid connector
  - X200: DRIVE-CLiQ
- Hybrid Cabinet Bushing
  - X1 (IN): Hybrid connector
  - X2 (OUT): Hybrid connector
  - X201 (IN): DRIVE-CLiQ
  - X202 (OUT): DRIVE-CLiQ

## 2.5 System Data

### Technical data

The following technical data applies to components in the SINAMICS S120 booksize drive system and SINAMICS S120M distributed drive system.

Table 2- 11 Electrical data

<b>Electrical data</b>	
Line connection voltage	3-ph. 380 VAC ... 480 VAC $\pm 10\%$ (-15% < 1 min)
Line frequency	47 Hz to 63 Hz
Electronic power supply	24 V DC -15% / +20% PELV or SELV
Short-circuit current rating (SCCR) in accordance with UL 508C (up to 600 V)	<ul style="list-style-type: none"> <li>• 1.1 kW ... 447 kW: 65 kA</li> <li>• 448 kW ... 671 kW: 84 kA</li> <li>• 672 kW ... 1193 kW: 170 kA</li> <li>• <math>\geq 1194</math> kW: 200 kA</li> </ul>
Radio interference suppression acc. to EN 61800-3	<ul style="list-style-type: none"> <li>• Category C2 (optional) for system versions conformant with documentation</li> <li>• Category C3 only with additional measures</li> </ul>
Overvoltage category	III to EN 61800-5-1
Degree of contamination	2 acc. to EN 61800-5-1 for central S120 components 3 acc. to EN 61800-5-1 for distributed S120M components
Maximum permissible supply voltage	3-ph. 480 VAC

Table 2- 12 Environmental conditions

<b>Environmental conditions</b>	
Degree of protection <ul style="list-style-type: none"> <li>• The central components (SINAMICS S120 booksize and AM600)</li> <li>• Distributed components (S120M)</li> </ul>	IP20 or IPXXB acc. to IEC 60529, open type acc. to UL 508  IP65/IP67 optional on the shaft
Protection class for line circuits Protection class for electronic circuits	Protection class I (with protective conductor connection)
Chemically active substances <ul style="list-style-type: none"> <li>• Long-term storage in the transport packaging</li> <li>• Transport in the transport packaging</li> <li>• Operation</li> </ul>	Class 1C2 according to EN 60721-3-1 Class 2C2 according to EN 60721-3-2 Class 3C2 according to EN 60721-3-3
Biological environmental conditions <ul style="list-style-type: none"> <li>• Long-term storage in the transport packaging</li> <li>• Transport in the transport packaging</li> <li>• Operation</li> </ul>	Class 1B1 acc. to EN 60721-3-1 Class 2B1 acc. to EN 60721-3-2 Class 3B1 acc. to EN 60721-3-3

Environmental conditions	
Vibratory load <ul style="list-style-type: none"> <li>• Long-term storage in the transport packaging</li> <li>• Transport in the transport packaging</li> <li>• Operation (central components)</li> <li>• Operation (distributed components)</li> </ul>	Class 1M2 in accordance with EN 60721-3-1 Class 2M3 in accordance with EN 60721-3-2 Class 3M1 in accordance with EN 60721-3-3 Class 3M3 in accordance with EN 60721-3-3
Shock load <ul style="list-style-type: none"> <li>• Long-term storage in the transport packaging</li> <li>• Transport in the transport packaging</li> <li>• Operation (central components)</li> <li>• Operation (distributed components)</li> </ul>	Class 1M2 in accordance with EN 60721-3-1 Class 2M3 in accordance with EN 60721-3-2 Class 3M1 in accordance with EN 60721-3-3 Class 3M3 in accordance with EN 60721-3-3
Climatic environmental conditions <ul style="list-style-type: none"> <li>• Long-term storage in the transport packaging</li> <li>• Transport in the transport packaging</li> <li>• Operation</li> </ul>	Class 1K4 according to EN 60721-3-1 temperature: -25° C ... +55° C Class 2K4 according to EN 60721-3-2 temperature: -40° C ... +70° C Class 3K3 according to EN 60721-3-3 <ul style="list-style-type: none"> <li>• Temperature +0 °C ... +40 °C (central SINAMICS S120 components and AM600)</li> <li>• Temperature -15 °C ... +40 °C (distributed SINAMICS S120M components)</li> </ul> Relative humidity 5% ... 90% Oil mist, salt mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted Above 2,000 m installation altitude, refer to the characteristic for voltage derating
Permissible coolant temperature (air) and installation altitude during operation	<ul style="list-style-type: none"> <li>• Adapter Modules 600 0 °C ... +40 °C and up to 1,000 m installation altitude without derating</li> <li>• Other distributed components -15 °C ... +40 °C and up to 1,000 m installation altitude without derating</li> </ul> >40 °C ... +55 °C see characteristic for current derating. Installation altitude >1,000 m up to 4,000 m, see characteristic for current derating or reduction of the ambient temperature by 3.5 K per 500 m. Above 2,000 m installation altitude, see characteristic for voltage derating

Table 2- 13 Certificates

Certificates	
Declarations of Conformity	CE (Low-Voltage and EMC Directives)
Approvals	ULus

**Note****Radio service interference due to radio disturbances in residential environments**

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

## 2.6 Derating as a function of the installation altitude

Direct connection to line circuits up to 3-ph. 480 VAC is only allowed at altitudes between 2,000 m and 4,000 m if the neutral point of the line supply is grounded (TN or TT line supply). Otherwise, a suitable isolation transformer must be connected upstream. The secondary system of the isolation transformer can be grounded or insulated.

## 2.7 Recycling and disposal

The applicable national guidelines must be observed when disposing of the product.

The products described in this manual are extensively recyclable on account of the low-toxic composition of the materials used. For environmentally-compliant recycling and disposal of your electronic waste, please contact a company for the disposal of electronic waste.



## Adapter Module 600

### 3.1 Description

The Adapter Module 600 (AM600) is the interface between the central SINAMICS (booksize) components and the S120M integrated in the motor.

The AM600 is implemented in the Booksize Compact format with 75 mm module width and opens a line of distributed S120M drives. Correspondingly, the DC link connections, the 24 V electronic power supply, the status LEDs, the DQ sockets, and the terminal strips are identically arranged and labeled. The assignment of terminal X21 and the function of the status LEDs are different from SINAMICS Booksize Compact.

The AM600 feeds the DC link voltage, generated in a central infeed unit (Line Module), into the Hybrid Cable of the S120M.

The Hybrid Cable distributes it to the S120M devices connected in the drive line.

It is possible for several AM600 to be connected to a common infeed unit, and therefore several lines can be connected. The necessary infeed power must be adapted using the appropriate Line Modules.

#### NOTICE

##### Equipment damage due to overload of the 24 V busbar

At maximum load, the AM600 may only be mounted on the right-hand edge of the line-up. Otherwise, an overload of the 24 V busbar and equipment damage may occur.

- At maximum load, mount the AM600 on the right-hand edge of the line-up.
- Establish the 24 V power supply of the AM600 via an external power supply (e.g. SITOP).

#### AM600 functions

- Fusing for the Hybrid Cable conductor protection  
The DC link cables are protected against overload using fuses, which can be replaced (also refer to fuse replacement).
- Generating the 48 VDC electronic power supply for the distributive drive components.  
The 48 VDC cables are electronically protected against overload and short-circuit.
- Boosting the DRIVE-CLiQ signal using a repeater function (level and signal waveform) and feeding this into the Hybrid Cable.

### 3.1 Description

#### General conditions

- Maximum permissible line length per Adapter Module 600: 100 m.
- Segment length between an Adapter Module 600 and the first node:  $\geq 3 \text{ m} \dots \leq 75 \text{ m}$
- Segment length between two S120M: Maximum 75 m.
- The complete cable length, motor + Hybrid Cable, depends on the central power infeed (Line Modules).

#### Cooling methods

The AM600 has internal air cooling.

#### Identification at DRIVE-CLiQ


The AM600 is not an active DRIVE-CLiQ node. The AM600 only feeds into one DRIVE-CLiQ line in the Hybrid Cable.

#### See also


24 V power supply and connection of components (Page 117)


X24 24 V terminal adapter (Page 120)

## 3.2 Safety instructions for Adapter Modules


 <b>WARNING</b>
<p><b>Danger to life if the fundamental safety instructions and remaining risks are not carefully observed</b></p> <p>If the fundamental safety instructions and remaining risks in Chapter 1 are not observed, accidents involving severe injuries or death may occur.</p> <ul style="list-style-type: none"> <li>• Adhere to the fundamental safety instructions.</li> <li>• When assessing the risk, take into account remaining risks.</li> </ul>



 <b>DANGER</b>
<p><b>Danger to life through electric shock due to the residual charge of the DC link capacitors</b></p> <p>Because of the DC link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off.</p> <p>Contact with live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> <li>• Open the protective cover of the DC link and only remove/insert the Hybrid Cable after 5 minutes have elapsed.</li> <li>• Before starting any work, also check that the system is in a voltage-free state by measuring at the DC link terminals DCP and DCN.</li> </ul>

 <b>WARNING</b>
<p><b>Danger of an accident due to missing warning labels in the national language.</b></p> <p>Missing warning labels in the national language can result in death or serious injury.</p> <ul style="list-style-type: none"> <li>• Attach the component warning labels in the national language.</li> </ul>



 <b>WARNING</b>
<p><b>Danger to life in the event of interruption of the external protective conductor due to high leakage currents</b></p> <p>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.</p> <ul style="list-style-type: none"> <li>• Ensure that the external protective conductor satisfies at least one of the following conditions: <ul style="list-style-type: none"> <li>– It has been laid so that it is protected against mechanical damage.<sup>1)</sup></li> <li>– If it is a single cable, it has a cross-section of at least 10 mm<sup>2</sup> Cu.</li> <li>– If it is a conductor of a multi-conductor cable, it has a cross-section of at least 2.5 mm<sup>2</sup> Cu.</li> <li>– It has a second protective conductor in parallel with the same cross-section.</li> <li>– It complies with the local regulations for equipment with increased leakage current.</li> </ul> </li> </ul> <p><sup>1)</sup> Cables laid within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.</p>





**! WARNING**

**Danger to life through electric shock due to incorrect connection to the DC link**

Incorrectly established connections can result in overheating and therefore fire with associated smoke. There is also a risk of an electric shock. This can result in serious injury or death.

- Only use adapters (DC link adapters and DC link rectifier adapters) released by Siemens for the connection to the DC link.

**! WARNING**

**Fire hazard due to overheating because of inadequate ventilation clearances**

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

- Maintain minimum ventilation clearances of 80 mm above and below the components.

**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 power connections with the specified tightening torques, e.g.
  - DC link busbar screws 1.8 Nm, tolerance +30%
  - Fixing screw for the hybrid connector X1 3.0 Nm, tolerance +30%
- Check the tightening torques of all power connections at regular intervals when the system is disconnected from the power supply and the DC link is discharged, and tighten them as 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 system if incorrect or unreleased DRIVE-CLiQ cables or Hybrid Cables are used.

- Only use suitable DRIVE-CLiQ cables and Hybrid Cables that have been released by Siemens for the respective application.



**! WARNING**

**Danger to life through electric shock due to missing DC link side covers**

There is a danger of an electric shock through contact when the side covers of the DC link are missing.

- Mount the side covers on the first and last component in the drive line-up.

You can order missing side covers (article number: 6SL3162-5AA00-0AA0).

**Note**

**Mounting position in the control cabinet**

- Mount the Adapter Modules 600 vertically in the control cabinet.

### 3.3 Interface description

#### 3.3.1 Overview

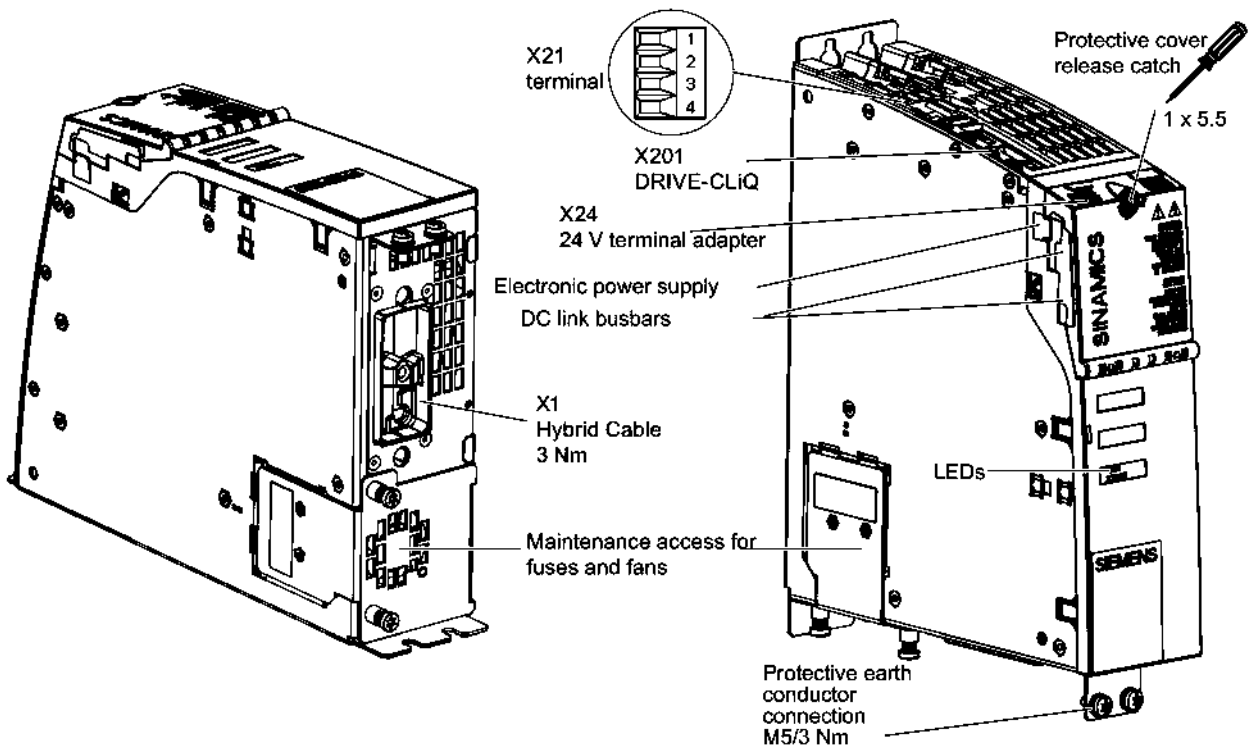
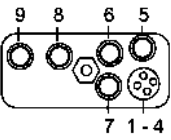


Figure 3-1 Adapter Module 600 (AM600)

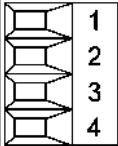
### 3.3.2 X1 hybrid connector

Table 3- 1 X1 hybrid connector

	Terminal	Signal name	Technical data
	1	1 (TXP)	Transmit data +
	2	2 (RXP)	Receive data +
	3	3 (TXN)	Transmit data -
	4	4 (RXN)	Receive data -
	5	PE	Potential equalization
	6	M	Electronics ground
	7	+	48 V power supply
	8	DCN	DC link voltage - (M600)
	9	DCP	DC link voltage + (P600)
	-	DQ_SHIELD	Shield

### 3.3.3 X21 terminal strip for operating state

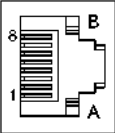
Table 3- 2 Terminal strip X21 operating state

	Terminal	Function	Technical data
	1	RDY	<p>Ready signal;                      Output referred to 24 V electronics ground                      Current carrying capacity: 100 mA (short-circuit proof)                      Meaning:                      The terminal has +24 V, if the electronic power supply is in the specified range.                      Brief voltage pulses of the 24 V supply outside of the specified voltage range are displayed via the RDY signal (not storing). The function of the drive train of the S120M system is not affected by this.                      If the supply voltage is permanently outside of the permitted range or if the supply voltage is exceeded by an impermissible amount, the drive train of the S120M system is shut down in a controlled way. The RDY signal displays the fault during shutdown.</p>
	2	DC LINK	<p>Notification: DC link voltage is present at the distributed line                      Output referred to 24 V electronics ground                      Current-carrying capacity: 100 mA (short-circuit proof)                      Meaning:                      The terminal has 0 V, if the DC link voltage is &gt; 50 V.                      Note:                      Hazardous DC link voltages may be present at any time regardless of the state of the system.</p>

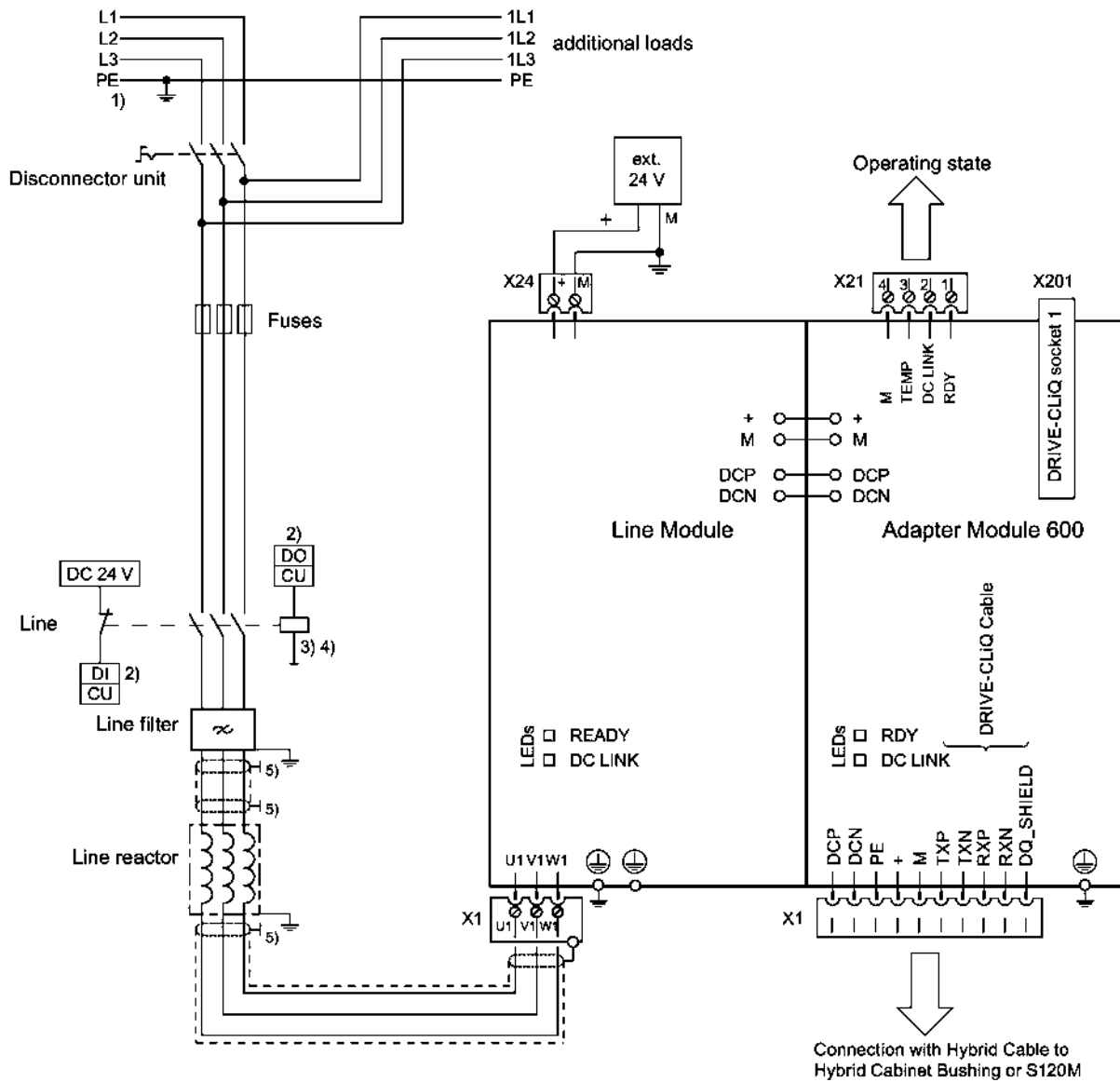
	Terminal	Function	Technical data
	3	TEMP	Alarm signal: AM600 overtemperature Meaning: Normally, 24 V is available at this terminal, and for an overtemperature condition, 0 V.
	4	M	Electronics ground
Maximum connectable cross-section: 1.5 mm <sup>2</sup> Type: Screw terminal 1 (see Chapter "Connectable conductor cross-sections for screw terminals" (Page 135))			

### 3.3.4 X201 DRIVE-CLiQ interface

Table 3- 3 DRIVE-CLiQ interfaces X201

	PIN	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	Reserved, do not use	
	B	Reserved, do not use	

### 3.4 Connection example



- 1) The line supply connection must always be available.
- 2) DI/DO, controlled by the Control Unit.
- 3) No additional load permitted downstream of line contactor
- 4) The current carrying capacity of the DO must be observed; an output interface may have to be used.
- 5) Contact established via rear mounting panel or shielding buses in accordance with the EMC installation guideline

Figure 3-2 Connection example, Adapter Module 600 (AM600)

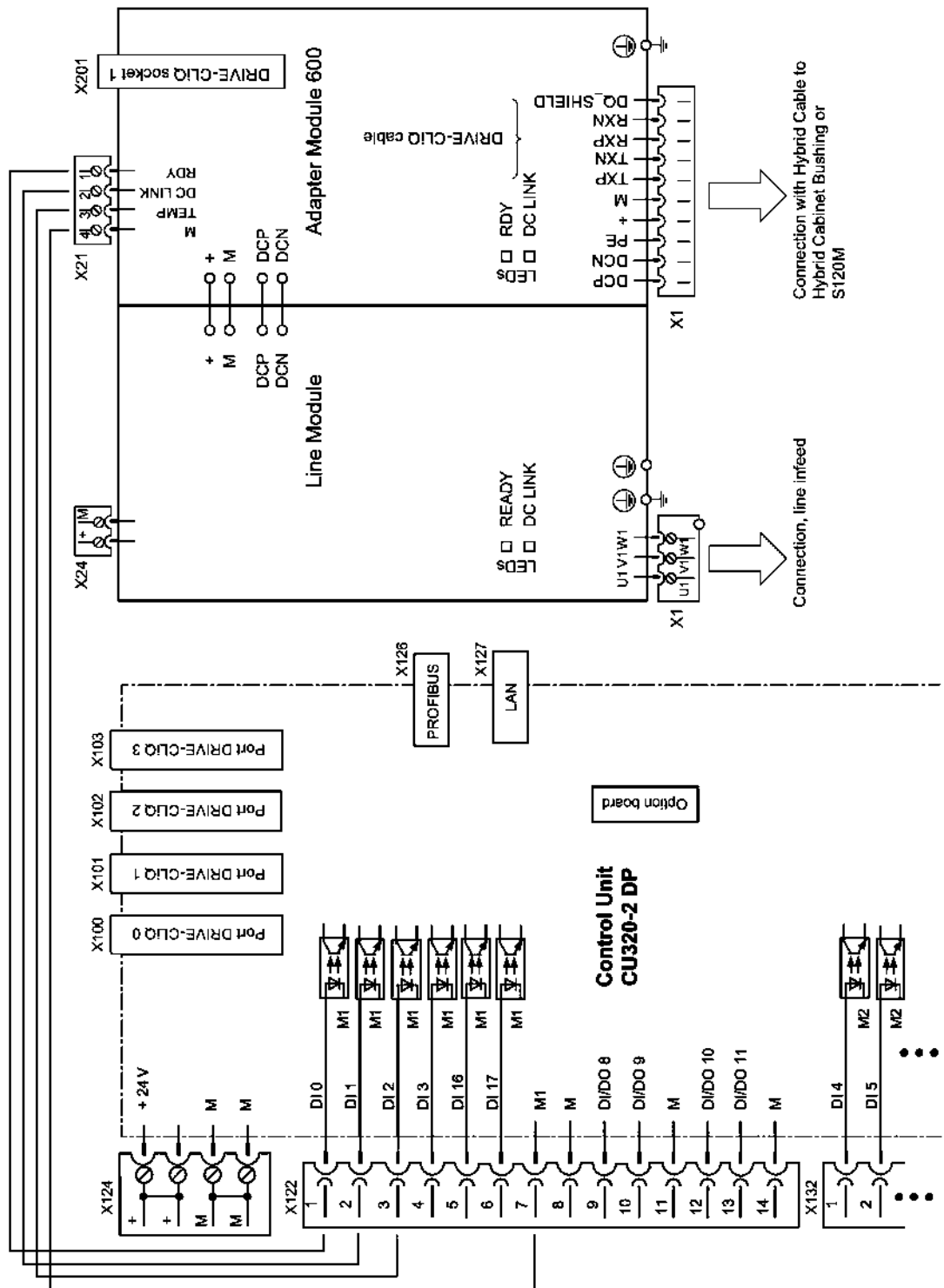


Figure 3-3 Connection example, AM600:X21 (operating states) at the Control Unit CU320-2 DP (schematic)

### 3.5 Meaning of the LEDs

Two LEDs (green/orange) are provided on the front panel to display the operating state; they are used to display the operating state or for fault diagnostics.

In addition to being visualized via the LED, the ready signal (RDY) is also available at terminal strip X21.

Table 3- 4 Significance of the LEDs at the Adapter Module 600 (AM600)

State		Description, cause
RDY	DC LINK	
Off	Off	The electronic power supply is missing or lies outside the permissible tolerance range.
Green	-	<ul style="list-style-type: none"> <li>Electronic power supply is present and in the specified range.</li> <li>Step-up controller to supply the electronics of the distributed drive line with 48 V DC is operating correctly (without fault).</li> <li>48 V DC is available at the line.</li> </ul>
	Orange	<ul style="list-style-type: none"> <li>The DC link voltage is available at the AM600 output.</li> </ul>
	Off	<ul style="list-style-type: none"> <li>Cable protection fuses have ruptured.</li> <li>DC link voltage can be present at the busbars of the AM600.</li> </ul>
Orange	-	<ul style="list-style-type: none"> <li>Overtemperature alarm or overtemperature fault with shutdown (saved after 5 K overtemperature alarm)</li> </ul>
Red	-	<ul style="list-style-type: none"> <li>Overcurrent trip or undefined DC link voltage</li> <li>24 V electronic power supply out of tolerance</li> </ul>



<p><b>! WARNING</b></p> <p><b>Danger to life through electric shock due to a high DC link voltage</b></p> <p>Independent of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means that when live components are touched this can result in death or serious injury.</p> <ul style="list-style-type: none"> <li>Observe the warning information on the component.</li> </ul>
---

### 3.6 Dimension drawing

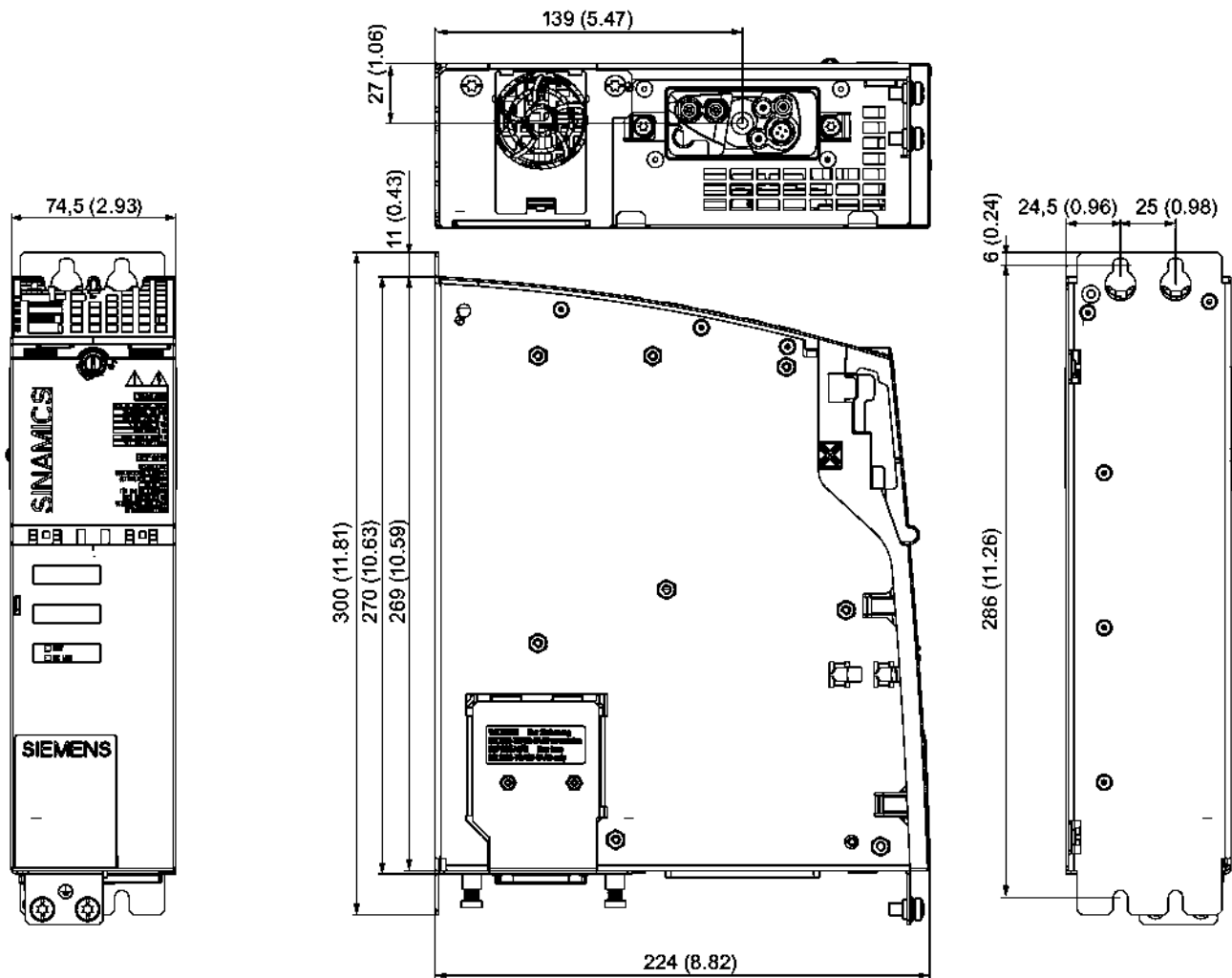


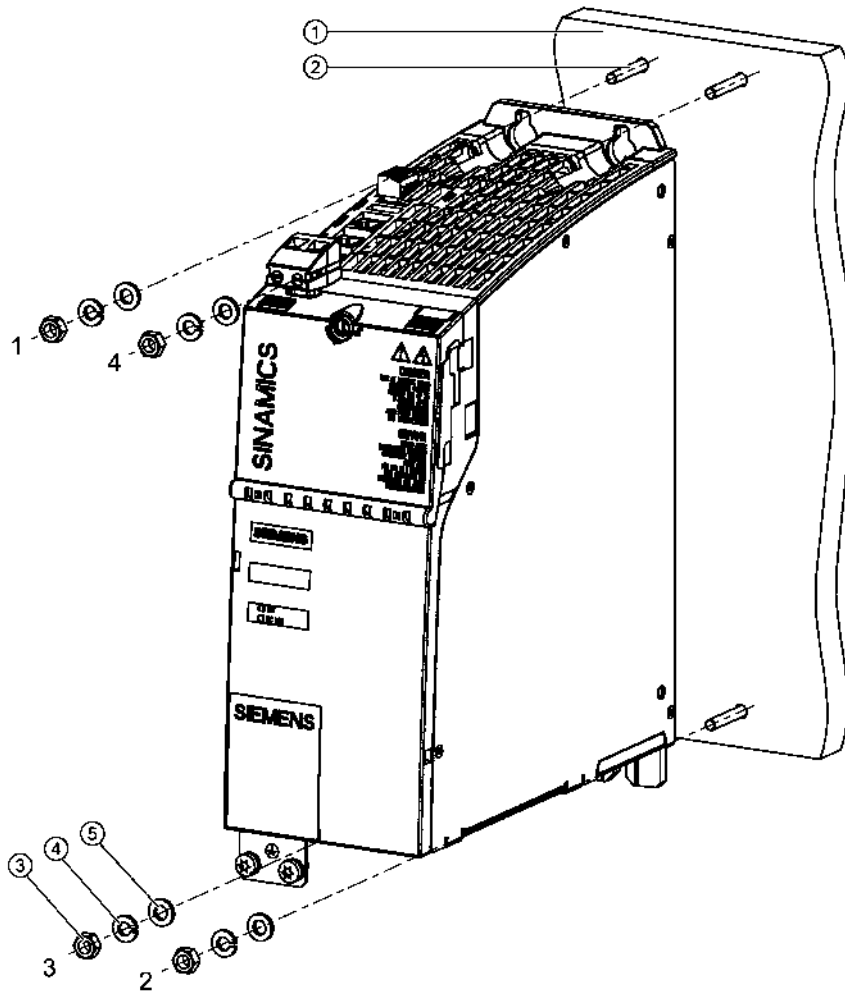
Figure 3-4 Dimension drawing, Adapter Module 600 (AM600), all data in mm or (inch)



### 3.7 Mounting

#### 3.7.1 Mounting the AM600 (standard)

Mounting an AM600 with internal air cooling



- ① Control cabinet panel/mounting panel
- ② M6 studs
- ③ M6 nut
- ④ Spring washer
- ⑤ Washer

Figure 3-5 Mounting an AM600 with internal cooling

**Tightening torques:**

- Initially, tighten the nuts by hand
- Then tighten with 6 Nm (tighten in the specific sequence 1 to 4, diagonally)

### 3.7.2 Mounting an AM600 using spacing bolts

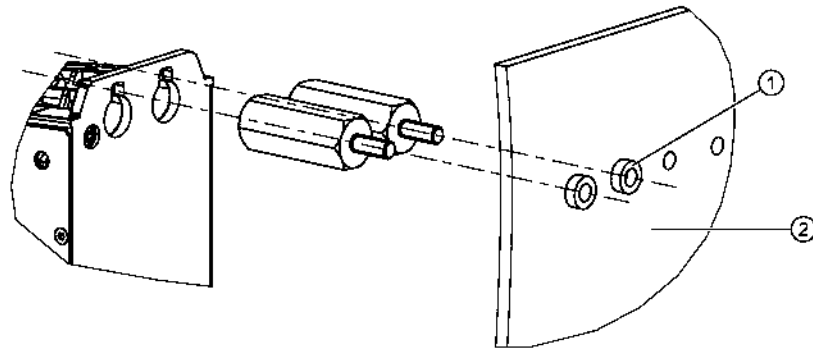
In order to increase the mounting depth of an AM600, spacing bolts are used (article number: 6SL3462-1CC00-0AA0). This means that the AM600 can be directly combined with SINAMICS components in the booksize format with internal air cooling.

Table 3- 5 Number of spacing bolts and holes for the AM600

Module width in [mm]	Number of spacing bolts	Number of holes/press-in nuts
75	4	4

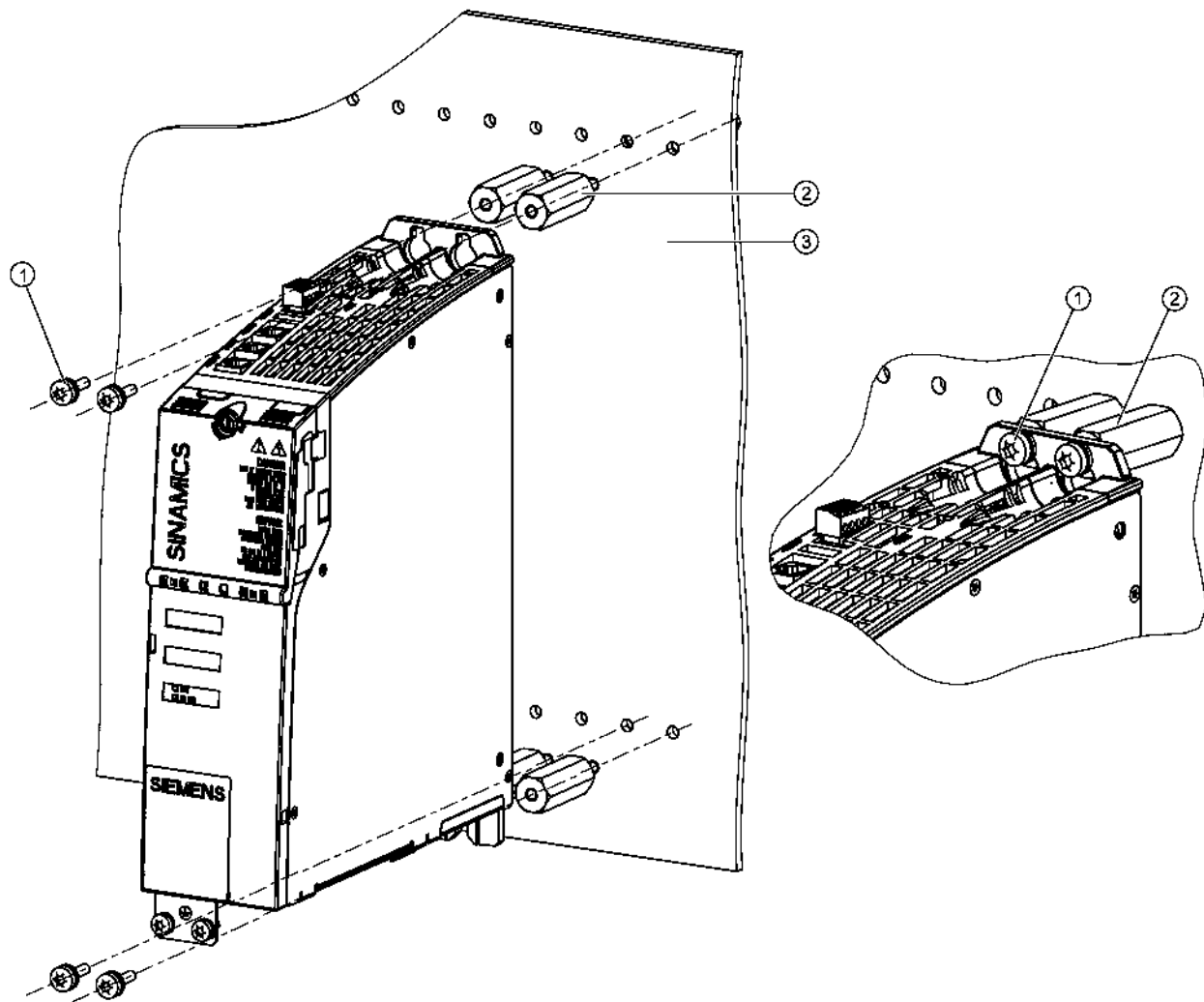
#### Preparing the mounting panel

- Inserting M6 press-in nuts into the mounting panel
- Distance 25 mm  $\pm$ 0.15 mm for module width 75 mm



- ① M6 press-in nuts
- ② Mounting panel

Figure 3-6 Installing the M6 press-in nuts on the rear of the mounting panel



- ① M6 x 20 screw, Torx T27
- ② Spacing bolts, SW 17 (6SL3462-1CC00-0AA0)
- ③ Mounting panel

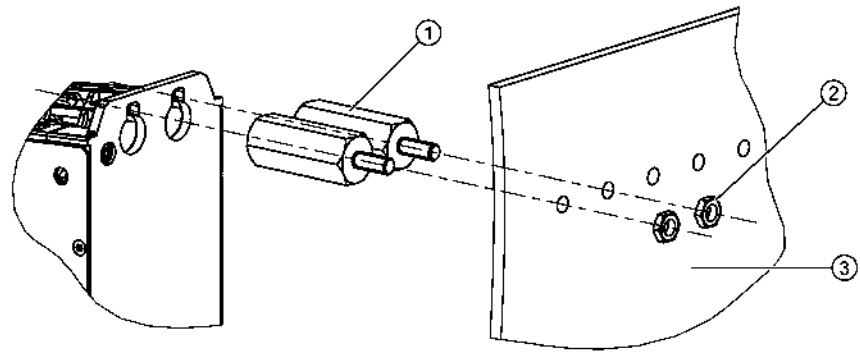
Figure 3-7 Mounting an Adapter Module 600 with spacing bolts

**Tightening torque:** 6 Nm

As an alternative to press-in nuts, you can secure spacing bolts with M6 nuts to the rear of the mounting panel.

### Preparing the mounting panel

- Drill  $\varnothing$  6.5 mm holes for spacing bolts
- Distance 25 mm  $\pm$ 0.15 mm for module width 75 mm



- ① Spacing bolt
- ② M6 nuts
- ③ Mounting panel

Figure 3-8 Installing the spacing bolts with M6 nuts on the rear of the mounting panel

**Tightening torque: 6 Nm**

### 3.8 Electrical connection

The DC link busbars and 24 V busbars of the components must be connected in a drive line-up before commissioning. Observe the notes on arranging the components and on the current-carrying capacity of the DC link busbars in the Equipment Manual for SINAMICS S120 booksize power units (GH2).



<b>⚠ WARNING</b>
<b>Danger to life through electric shock due to incorrectly installed DC link bridges</b>
Incorrectly installed DC link bridges <b>at the left-hand end of the drive line-up</b> can cause an electric shock.
<ul style="list-style-type: none"><li>• For all 50 mm wide modules (exception: Smart Line Module), remove the DC link bridge, including the screws. Do not tighten the screws without the DC link bridges.</li><li>• For all components that are 75 mm wide or wider, the DC link bridges must not be moved to the left or removed.</li></ul>

<b>NOTICE</b>
<b>Damage due to unsuitable screws</b>
The use of unsuitable screws for fastening the DC link busbars can cause damage.
<ul style="list-style-type: none"><li>• Only use the original M4x16 screws on the left-hand side.</li><li>• Only use the original M4x20 screws on the right-hand side.</li></ul>

The connection of a Line Module to a Motor Module is shown in the following.

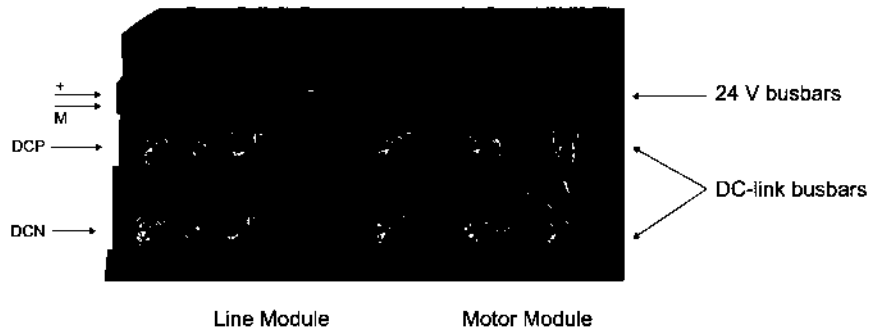


Figure 3-9 Line Module and Motor Module as delivered

## Connection of the DC link busbars

Always connect the lower DC link busbars first and then the upper DC link busbars.

**Tool:** Screwdriver Torx T20

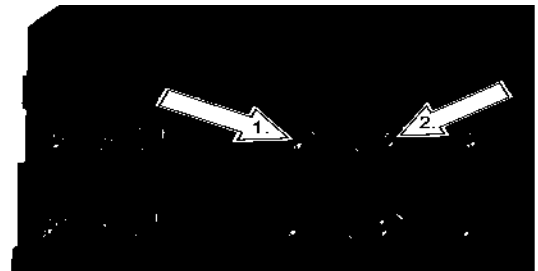
Working steps:

- Loosen the DC link busbar screws.
- Turn over the DC link bridge.
- Screw the DC link busbar screws tight. It is important that you follow the sequence shown below (1 and 2).

**Tightening torque:** 1.8 Nm



1. Connection of the lower DC link busbars



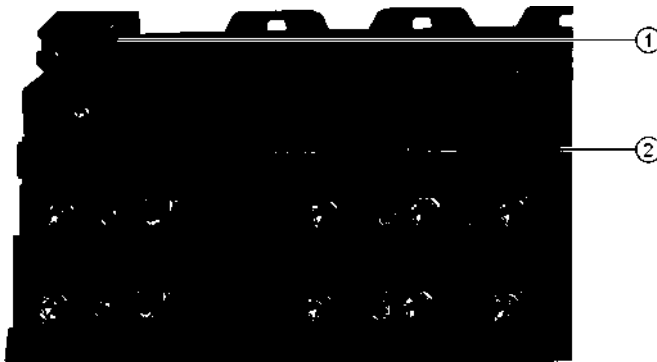
2. Connection of the upper DC link busbars

## Connection of the 24 V busbars


The 24 V busbars of the components are connected with the help of the red 24 V connectors in the accessories pack. A 24 V connector must be plugged onto the 24 V busbars between the Line Module, Motor Module and DC link component. The 24 V connectors must be attached before the drive line-up is commissioned!

Working steps:


- Place the 24 V connectors on to the 24 V busbars.
- Press the 24 V connectors down until they click into place.
- If required, mount the 24 V terminal adapter to supply the 24 VDC.



- ① Mounted 24 V terminal adapter (Torx T10, tightening torque 0.5 Nm)
- ② Mounted 24 V connector

 <b>WARNING</b>
<b>Fire hazard for 24 V connectors and unconnected DC link busbars</b>
The red 24 V connectors may only be used when the DC link busbars of the components are also connected. Otherwise the 24 V connectors may burn off.
<ul style="list-style-type: none"><li>• If the DC link busbars of the components are not connected, each component must be supplied with 24 V separately via a 24 V terminal adapter.</li></ul>



 <b>WARNING</b>
<b>Danger to life due to electric shock when connecting and disconnecting 24 V connections in operation</b>
When opening plug connections in operation, arcs can result in severe injury or death.
<ul style="list-style-type: none"><li>• Only connect or disconnect the connections in a no-voltage state.</li><li>• Only remove the 24 V terminal adapter vertically in relation to the front plate.</li><li>• Disconnect and connect the connections a maximum of 5 times in a row.</li></ul>

<b>NOTICE</b>
<b>Material damage due to loose power connections</b>
Insufficient tightening torques or vibrations can result in faulty electrical connections. This can cause fire damage or malfunctions.
<ul style="list-style-type: none"><li>• Tighten all power connections with the specified tightening torques, e.g. line supply connection, motor connection, DC link connections, Hybrid Cable.</li><li>• Check the tightening torques of all power connections at regular intervals and tighten them when required. This applies in particular after transport.</li></ul>

- DRIVE-CLiQ socket X201 on the upper side of the module: The connection to the Control Unit is established using a DRIVE-CLiQ cable.
- 4-pole terminal strip X21 on the upper side of the module: The status messages are output in the same way as the LEDs on the front side.
- Optional 24 V terminal adapter: When required, each AM600 can be individually supplied with 24 VDC. In this case, an external 24 V power supply, e.g. SITOP must be connected.

### 3.9 Technical data

The following technical data apply for the Adapter Module 600.

Table 3- 6 Technical data AM600

AM600	Unit	6SL3555-2BC10-0AA0
Line system configurations of the <b>infeed</b> Line voltage Line frequency Line system configuration	$V_{rms}$ Hz	380 ... 480 50 ... 60 TN/TT line systems with grounded neutral point or IT line systems
<b>Electronic power (input)</b> Electronics voltage Electronics current Current load capacity of the 24 V busbar	$V_{DC}$ $A_{DC}$ $A_{DC}$	24 (-15 % ... +20 %) 20 20
<b>Line electronics supply (output)</b> Electronic power supply Rated voltage ( $P_{out}$ ) <sup>1)</sup> Output current	$V_{DC}$ W $A_{DC}$	48 450 10
<b>DC link supply</b> DC link voltage Output current ( $I_n$ ) Base load current ( $I_{base}$ ) S6 current ( $I_{S6}$ 40 %) Peak current ( $I_{max}$ ) DC link capacitance Current carrying capacity of the DC link busbar	$V_{DC}$ $A_{rms}$ $A_{rms}$ $A_{rms}$ $A_{rms}$ $\mu F$ $A_{DC}$	510 ... 720 25.0 21.3 30.0 50.0 705 $\pm$ 20 % 100
Rated electrical power (for a DC link voltage 600 $V_{DC}$ )	kW	14.70
Total power loss (including electronic losses)	W	60
Minimum cable length to the 1st axis	m	$\geq 3$
Mounting position/type of construction		vertical, Booksize Compact
Maximum length of signal cables	m	30
Maximum cable lengths for 24 V power supply	m	10
Degree of protection (standard)		IP20
Weight	kg	3.2

<sup>1)</sup> Only applies for an electronics input voltage > 26.5 V



### 3.9.1 Characteristics

#### Derating characteristics

- For the 24 V busbar, the following characteristic applies, which limits the maximum output power:

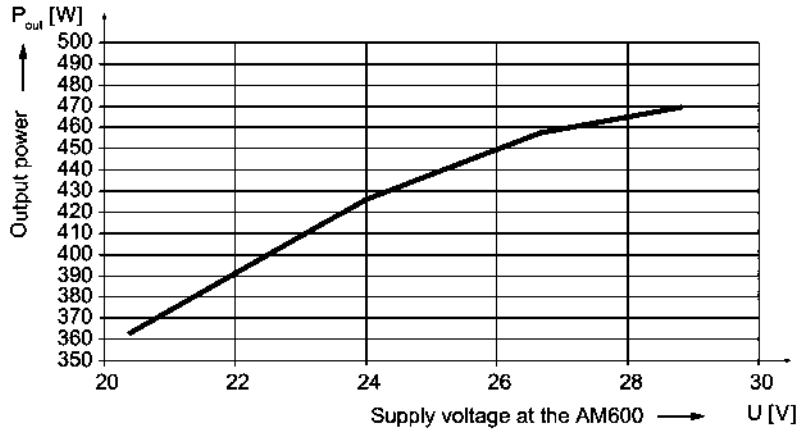


Figure 3-10 Output power as a function of the input voltage

**Note**

**24 V busbar**

Current carrying capacity of the 24 V busbar: max. 20 A

An additional 24 VDC feed is also possible via the 24 V terminal adapter.

- If the components are operated at increased ambient temperatures (40 to 55 °C) then the DC link current and the electronic power supply must be appropriately reduced.

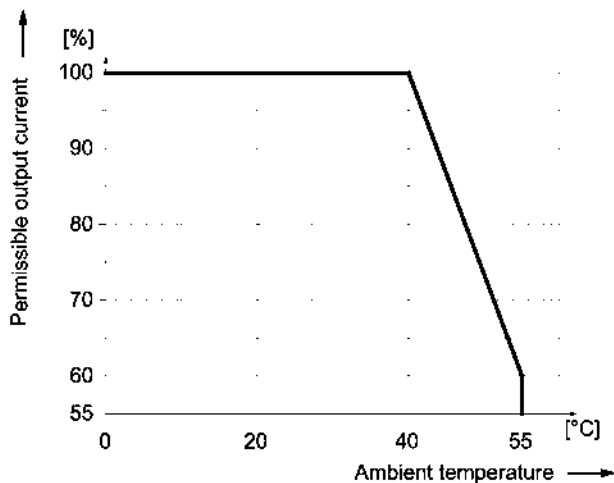


Figure 3-11 Output current as a function of the ambient temperature

## Dimensioning the power supply $U_{in} > 26.5$ VDC

If the maximum electronic power supply rating is to be utilized to supply large distributed drive lines, then the input voltage of the AM600 must be increased (to a minimum of 26.5 V).

If the input voltage is less, then the electronic power supply power available for the line decreases, as otherwise the maximum permissible current of the 24 V busbars would be exceeded.

The number of S120M which each AM600 can operate depends on the power data as specified above and the line length connected. It is determined using the SIZER for SIEMENS Drives engineering tool, or it can be taken from the following diagram.

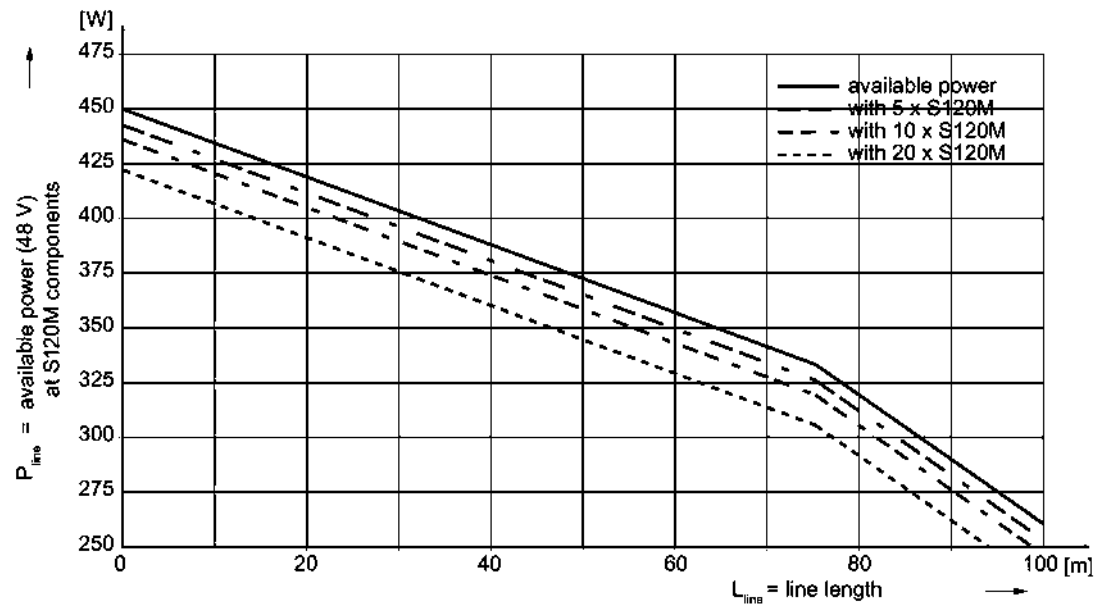


Figure 3-12 Dimensioning the power supply

Dimensioning using the diagram:

$$P_{line} = \sum(P_N)$$

$$L_{line} = \sum(L_{segment}), \text{ i.e. the sum of the segment lengths between the AM600 and the S120M drives}$$

$$P_N = \text{Power consumption 48 V + power consumption of brake an S120M according to the S120M technical data (Page 88)}$$

### Note

The power available (48 V; taken from the diagram) must exceed the calculated line power  $P_{line}$ .



# S120M

## 4.1 Description

The S120M component is a servomotor...

- With an integrated power unit
- With/without holding brake (15th position of the MLFB)
- With 20-bit absolute DQI encoder, multiturn

S120M is connected to the SINAMICS S120 central system via a Hybrid Cable with integrated DRIVE-CLiQ via the Adapter Module 600. A central Control Unit is used for the closed-loop control.

S120M is based on the 1FK7 synchronous motor and therefore has its most important properties.

These are:

- Radial eccentricity, concentricity, axial eccentricity
- Maximum mechanical speeds
- Torque ripple
- Balancing
- Shaft
- Flange

## 4.2 Safety instructions for S120M

### WARNING

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

If the fundamental safety instructions and remaining risks in Chapter 1 are not observed, accidents involving severe injuries or death may occur.

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



### DANGER

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

Because of the DC link capacitors, a hazardous voltage is still present for a while after the power supply has been switched off. In a drive line-up, this will be discharged within 5 minutes. If you disconnect the S120M from the drive line-up, the high voltage can remain for 30 minutes or longer.

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

- Only open the protective cover of the DC link and remove/insert the Hybrid Cable after this time has elapsed.
- Before starting any work, also check that the system is in a voltage-free state by measuring at the DC link terminals DCP and DCN.
- Do not remove the S120M from the drive line-up before the DC link is discharged.

### WARNING

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

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

- Attach the component warning labels in the national language.



### WARNING

**Danger to life in the event of interruption of the external protective conductor due to high leakage currents**

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 following protective conductor connection paths are available:
  - Via the Hybrid Cable.
  - Via the PE connection. In this case, the protective conductor cross-section must be  $\geq 4 \text{ mm}^2$ .

Each of these connections must be suitable as a protective connection.



**! WARNING**

**Danger to life due to electric shock when using an unsuitable Hybrid Cable**

The use of an unsuitable or unreleased Hybrid Cable for connecting to the Adapter Module can lead to death or serious injury.

- For connecting to the AM600 via interface X1, only use a suitable Hybrid Cable which has been released by Siemens for this application.

**! WARNING**

**Fire hazard due to overheating because of inadequate ventilation clearances**

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

- Maintain a minimum ventilation clearance of 100 mm on all sides of the component.

**! CAUTION**

**Fire hazard resulting from hot surface temperatures**

During operation and for a short while after the equipment has been switched off, the surface of the S120M is at a temperature which may cause burns if it is touched.

- Do not touch the S120M during operation.
- After switching off, you should also wait a few minutes until the S120M has cooled down.

**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 the fixing screw of the hybrid connector X1/X2 with the specified tightening torque (3.0 Nm, tolerance +30%).
- Check the tightening torques of all power connections at regular intervals when the system is disconnected from the power supply and the DC link is discharged, and tighten them as 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 system when incorrect or unreleased DRIVE-CLiQ cables are used.

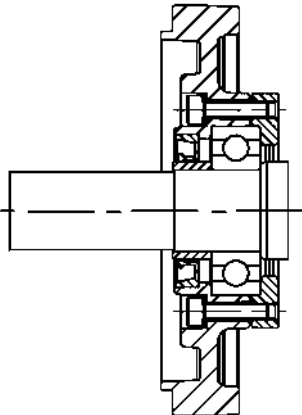
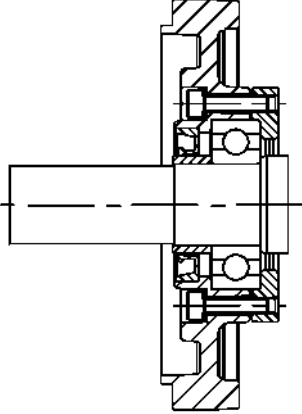
- Only use suitable Hybrid Cables which have been released by Siemens for connecting the S120M.

## 4.3 Mechanical properties

### 4.3.1 Shaft sealing ring

Protection against water alone is not adequate for cooling-lubricating mediums that contain oil, can creep and/or are aggressive. The S120M component must be protected by using suitable covers. Attention must be paid to providing suitable sealing of the motor shaft for the selected degree of protection for the motor.

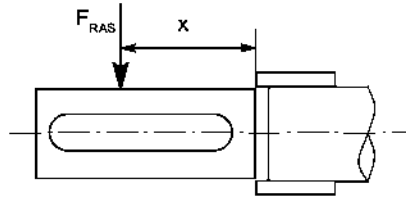
Table 4- 1 Sealing of the motor shaft

Degree of protection at shaft sealing ring acc. to EN 60034-5	Shaft sealing	Area of application
IP65	Radial shaft sealing ring without annular spring 	Shaft outlet seal to protect against spray water and cooling-lubricating medium. It is permissible that the radial shaft sealing ring runs dry. Service life: approx. 25000 h (nominal value). It is not permissible for liquid to collect in the flange.
IP67	Radial shaft sealing ring 	Version, shaft outlet + flange: IP67 (optional) For gearbox mounting (for gearboxes that are not sealed) to seal against oil. The sealing lip must be adequately cooled and lubricated by the gearbox oil in order to guarantee reliable function. Service life: approx. 10000 h (nominal value) If a radial shaft sealing ring runs dry, then this has a negative impact on its functionality and the lifetime.

### 4.3.2 Radial force loading

Point of application of radial forces  $F_{RAS}$  at the shaft extension for:

- average operating speeds
- nominal bearing service life ( $L_{10h}$ ) of 25 000 h



Dimension  $x$ : Distance between the point of application of force  $F_{RAS}$  and the shaft shoulder in mm

Figure 4-1 Force application point at the DE

#### Maximum permissible radial force on the S120M

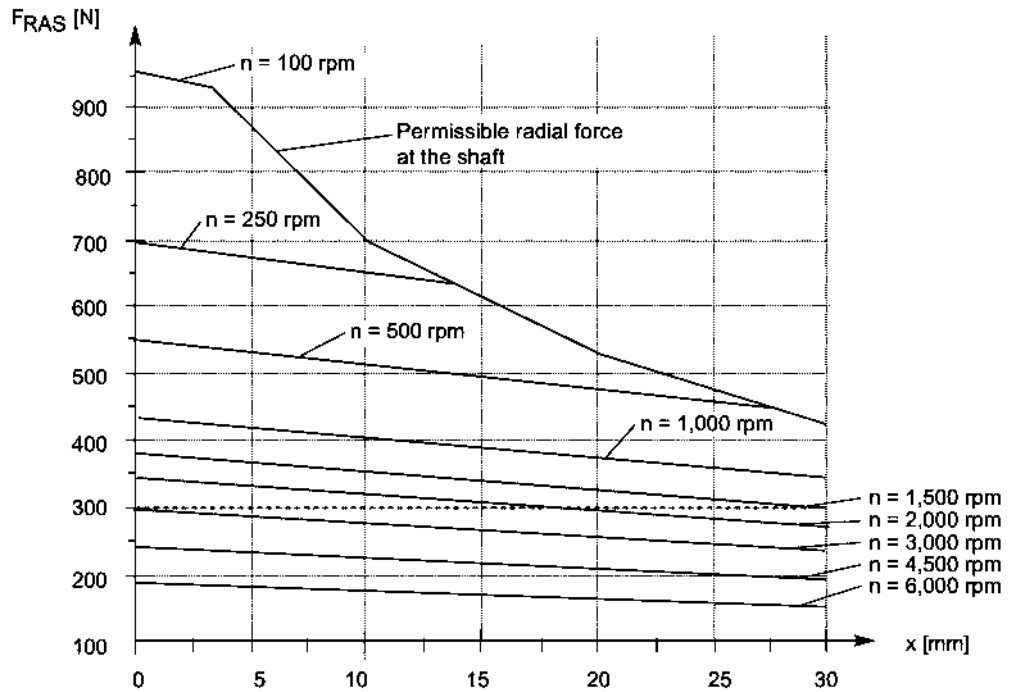


Figure 4-2 Maximum permissible radial force at S120M SH36 (article number: 6SL3532-6DF71)



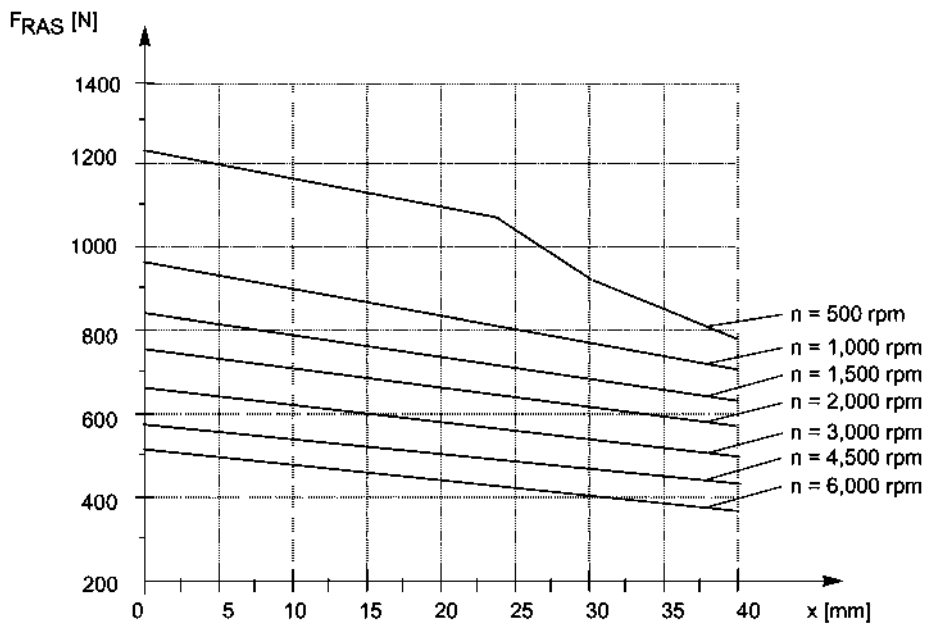


Figure 4-3 Maximum permissible radial force at S120M SH48 (article number: 6SL354□-6DF71)

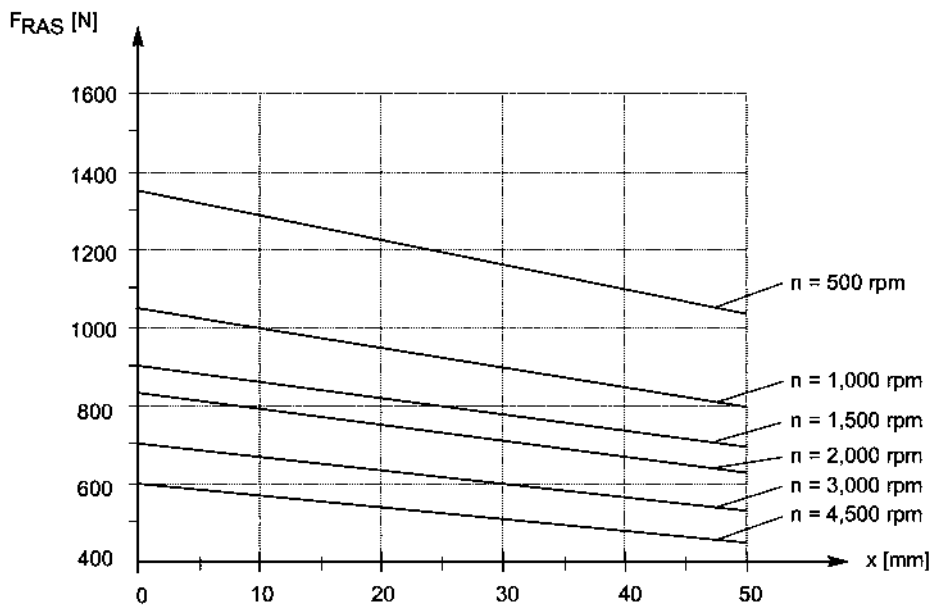


Figure 4-4 Maximum permissible radial force at S120M SH63 (article number: 6SL356□-6DF71)

### 4.3.3 Axial force stressing

When using, for example, helical toothed wheels as drive element, in addition to the radial force, there is also an axial force on the bearings of the S120M. For axial forces, the spring-loading of the bearings can be overcome so that the rotor is displaced corresponding to the axial bearing play present.

Shaft height	Displacement
36 and 48	approx. 0.2 mm
63	approx. 0.35 mm

An axial force as large as the spring-loading is not permitted (100 ... 500 N). Premature failure is the result when the bearing is not pre-tensioned.

Calculating the permissible axial force:  $F_A = F_{RAS} \cdot 0.35$

#### NOTICE

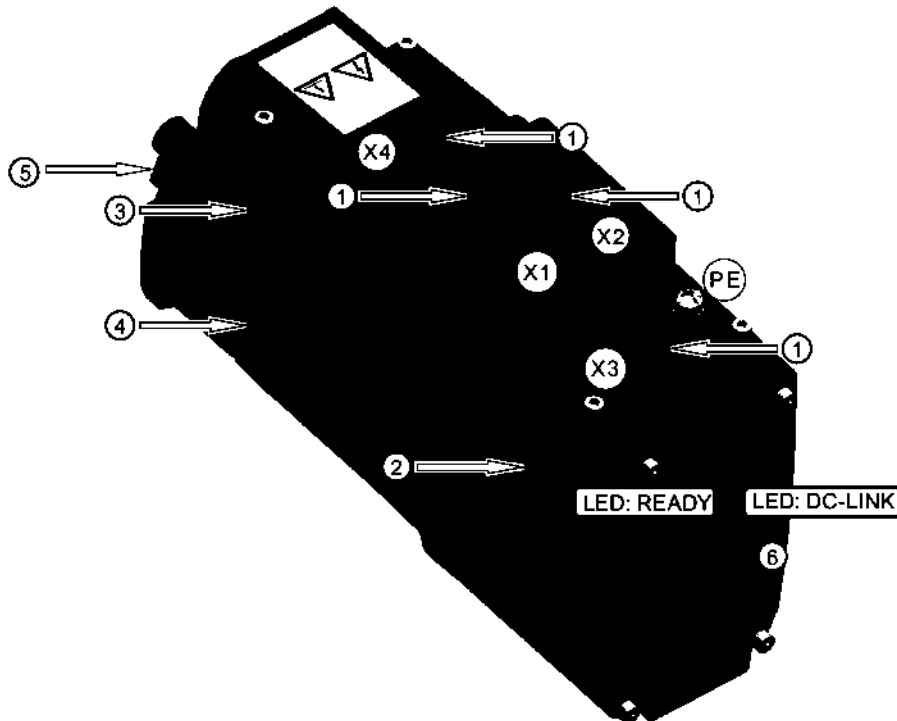
##### Damage due to axial forces on the S120M with holding brake

On an S120M with integrated permanent-magnet-excited holding brake, axial forces at the shaft extension can cause damage. This applies when installing the system and during operation.

- Lock the components connected to the shaft in place.

## 4.4 Interface description

### 4.4.1 Overview



- ① Protective covers
- ② Type plate
- ③ Converter housing
- ④ Motor 1FK7
- ⑤ 4 mounting points for the drive (flange)
- ⑥ Siemens logo
- PE PE connection (M5/3 Nm)

Figure 4-5 Design and interface overview S120M

### Shaft and flange

The specifications, particularly for the centering distance and hole circle, correspond to those of the 1FK7 motor series.

Just same as for the 1FK7 motor series, the shaft extension is available with or without keyway.

## Electrical connection system

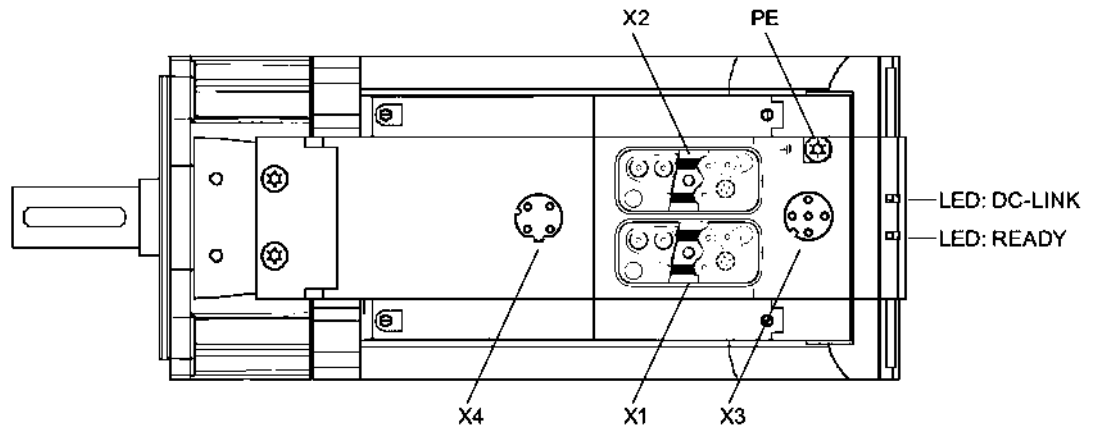


Figure 4-6 S120M interfaces

X1 and X2 Hybrid connector with connections for:

- centrally generated DC link voltage
- electronic power supply 48 V<sub>DC</sub>
- DRIVE-CLiQ
- PE

X3 M12 socket: Connection for sensors and actuators

X4 M12 socket: Connection is to externally release the holding brake (X4 has no function for motors without integrated holding brake)

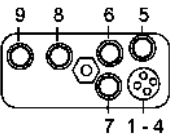
READY LEDs: Display of operating states and/or diagnostics

DC-LINK

PE M5 female thread: PE connection (3 Nm)

### 4.4.2 X1/X2 hybrid connector

Table 4-2 X1/X2 hybrid connector

	Terminal	Signal name	Technical data
	1	1 (TXP)	Transmit data +
	2	2 (RXP)	Receive data +
	3	3 (TXN)	Transmit data -
	4	4 (RXN)	Receive data -
	5	PE	Potential equalization
	6	M	Electronics ground
	7	+	48 V DC power supply
	8	DCN	DC link voltage - (M600)
	9	DCP	DC link voltage + (P600)
	-	DQ_SHIELD	Shield

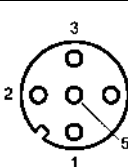
#### Note

##### Mounting the hybrid connector

The hybrid connector can be screwed on by hand. For operation, the hybrid connector should be tightened using an Allen key (3.0 Nm).

### 4.4.3 X3/X4 signal interfaces

Table 4- 3 X3: M12 socket, digital inputs/outputs and sensor supply, socket, A-coded

5-pole	Terminal	Designation <sup>1)</sup>	Technical data M12
	1	P24_SENSOR	<p>The DI/DO are protected against polarity reversal.</p> <p><b>Digital input:</b>            Voltage: -3 V ... +30 V DC            Current drain, typical: 10 mA at 24 V</p> <p>Level (including ripple)            High level: 15 V ... 30 V            Low level: -3 ... +5 V            DI/DO are "rapid inputs"<sup>2)</sup>            Input delay (typ)            For "0" → "1": 10 μs            For "1" → "0": 1 ms</p> <p><b>Digital output:</b>            Voltage: 24 V DC            Max. load current per output: 100 mA (in total, maximum 200 mA)            Continuously short-circuit proof            Overload proof            Output delay            For "0" → "1": 150 μs/400 μs (typ./max.)            For "1" → "0": 75 μs/100 μs (typ./max.)</p> <p><b>Note:</b> Three configurations can be parameterized in the software</p> <ul style="list-style-type: none"> <li>• 2 x DI → 100 mA sensor power supply</li> <li>• 2 x DO → 2 x 100 mA for the DOs, it is not permissible that the sensor supply is used</li> <li>• 1 x DI/1 x DO → 100 mA sensor power supply and 100 mA for DO</li> <li>• M_EXT is the ground at the DI. It is functionally isolated. To increase the interference resistance, we recommend connecting to PE (grounding).</li> </ul>
	2	DI/DO 0	
	3	M_EXT	
	4	DI/DO 1	
	5	PE	

1) P24\_SENSOR: 24 V external power supply;  
 DI/DO: bidirectional digital input/output;  
 M\_EXT: Electronics ground;  
 PE: Equipotential bonding

2) The fast inputs can be used as a probe input.

#### Note

##### Cables for digital inputs


- Use shielded cables when using digital inputs/outputs (interface X3).

**NOTICE****Damage to M12 threads through excessively high tightening torques**

M12 connectors are not standardized. In some instances, it is not possible to completely screw together connector and socket. An excessively high tightening torque can damage the thread.

- You must observe the tightening torques specified by the manufacturer.

Table 4- 4 X4: M12 socket, external brake, socket, D-coded

4-pole	Terminal	Designation	Technical data
	1	BR_RELEASE	Brake supply voltage, external: 24 V DC $\pm 10\%$
	2	nc	Reserved, not used
	3	M	Ground, brake supply voltage, external
	4	nc	Reserved, not used

**Note**

The X4 interface has no function on S120M motors without holding brakes.

**Note****Cable lengths at X3/X4**

Maximum cable length: 30 m each

**Note****Releasing the motor holding brake using X4**

For the function of interface X4, refer to the chapter Motor holding brake/Connection to S120M (Page 99).

# 4.5 Connection example

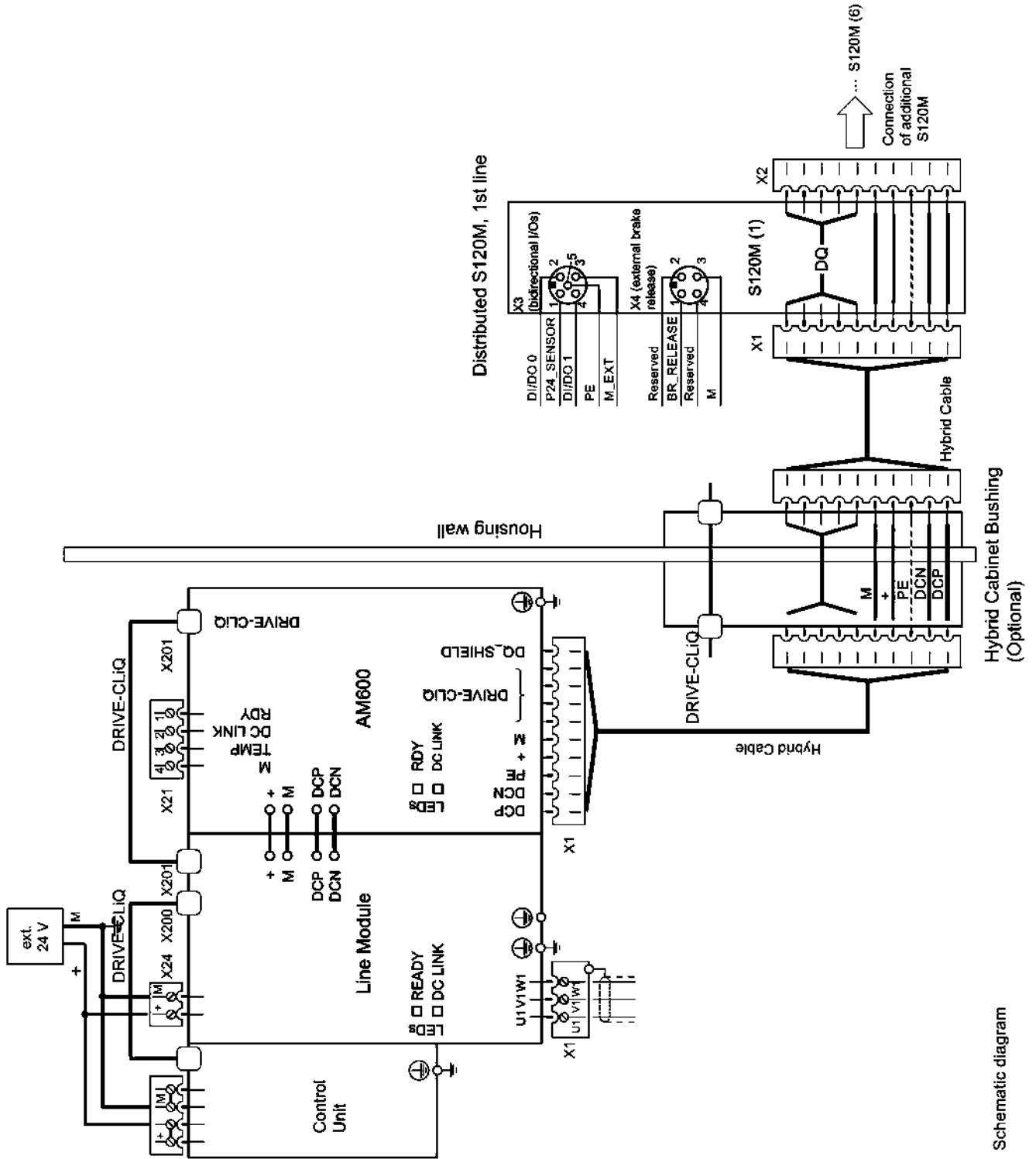


Figure 4-7 Connection example, S120M



4.5 Connection example

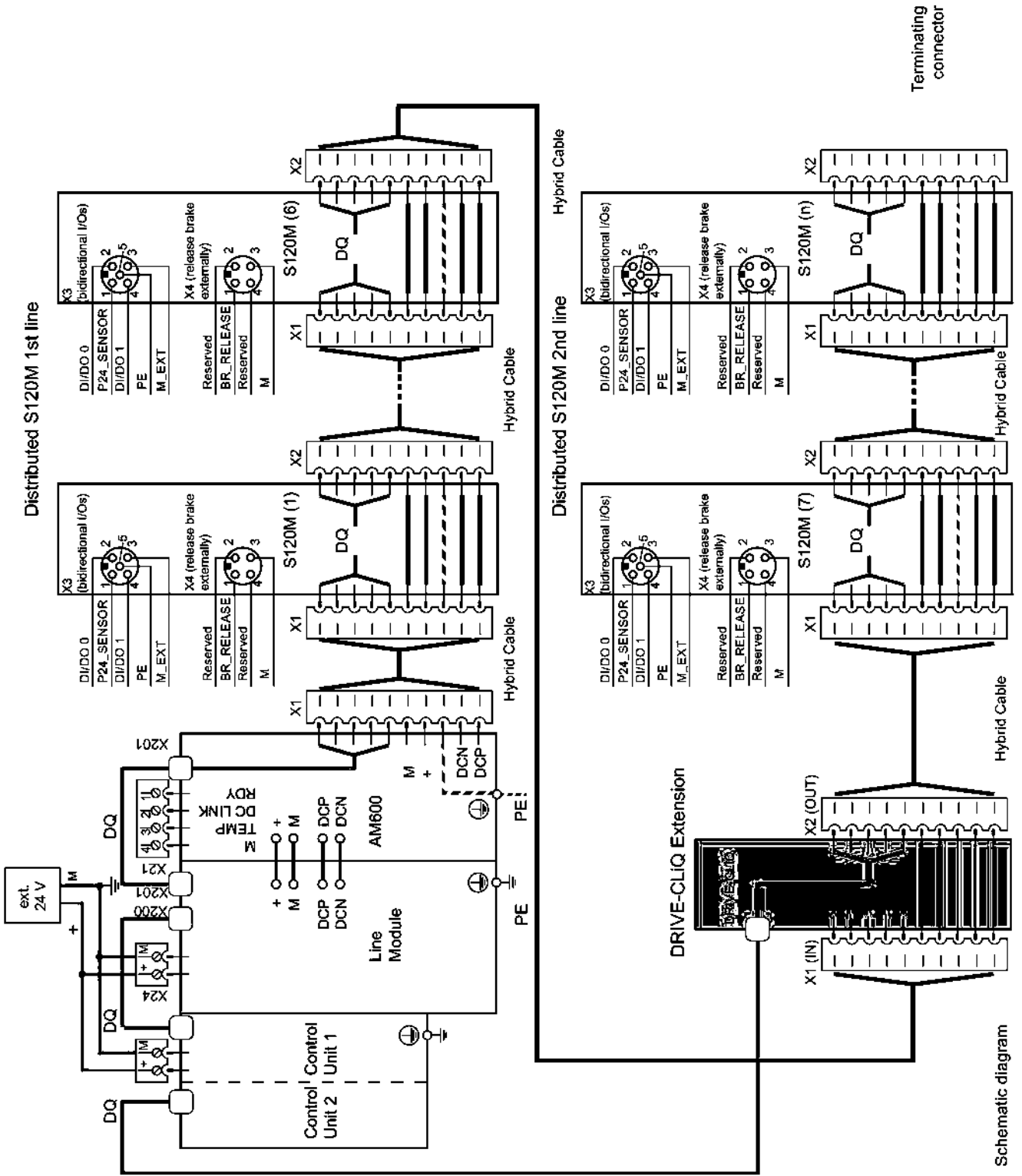


Figure 4-8 Connection example for S120M with DRIVE-CLiQ Extension (number of S120M > 6)

## 4.6 Meaning of the LEDs

Table 4- 5 S120M - description of the LEDs

State		Description, cause	Remedy
Ready	DC LINK		
Off	Off	The electronic power supply is missing or lies outside the permissible tolerance range.	–
Green	–	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check the line supply voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component (power unit + encoder). <b>Please observe:</b> The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	–	Firmware is being downloaded.	–
Green/red (2 Hz)	–	Firmware download is complete. Wait for POWER ON.	Execute POWER ON
Green/orange or Red/orange	–	Component recognition via LED is activated (p0124). <b>Please observe:</b> Both options depend on the LED state when component recognition is activated via p0124 = 1.	–



### WARNING

#### Danger to life through electric shock due to a high DC link voltage

Independent of the state of the LED "DC LINK", hazardous DC link voltages can be present. This means that when live components are touched this can result in death or serious injury.

- Observe the warning information on the component.

## 4.7 Dimension drawings

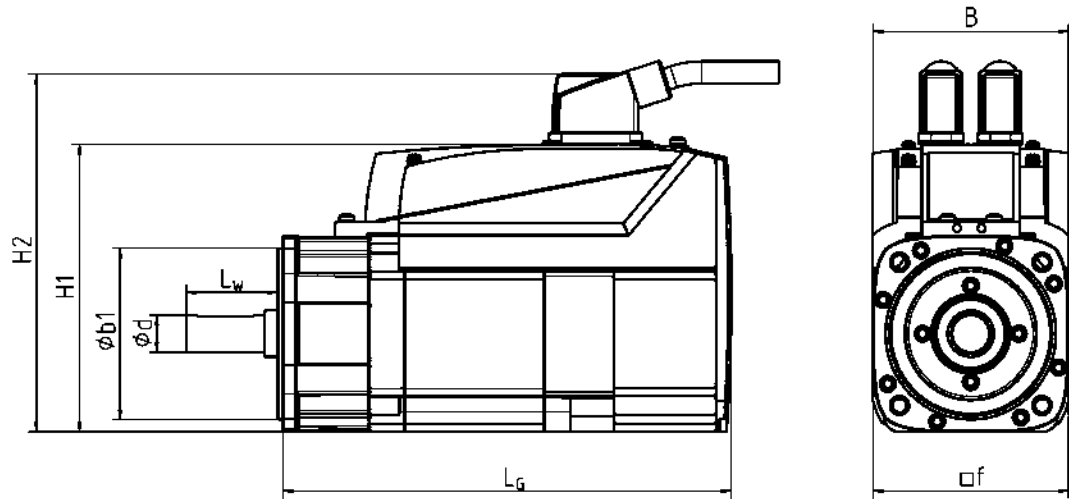


Figure 4-9 Dimension drawing of S120M

Table 4- 6 Table with dimension data in mm and (inch)

Article number	Length $L_G$	Width $B$	Height $H_1$	Height $H_2$	Flange $\phi f$	Centering edge $b_1$	Shaft $d \times L_w$
6SL3532-6DF71-0R□□	250 (9.84)	72 (2.83)	126 (4.96)	188 (7.4)	72 (2.83)	60 (2.36)	14 x 30 (0.55 x 1.18)
6SL3540-6DF71-0R□□	252 (9.92)	102 (4.02)	155 (6.1)	205 (8.07)	96 (3.78)	80 (3.15)	19 x 40 (0.75 x 1.57)
6SL3542-6DF71-0R□□	280 (11.02)	102 (4.02)	155 (6.1)	205 (8.07)	96 (3.78)	80 (3.15)	19 x 40 (0.75 x 1.57)
6SL3562-6DF71-0R□□	270 (10.63)	126 (4.96)	185 (7.28)	240 (9.45)	126 (4.96)	110 (4.33)	24 x 50 (0.94 x 1.97)
6SL3563-6DF71-0R□□	290 (11.42)	126 (4.96)	185 (7.28)	240 (9.45)	126 (4.96)	110 (4.33)	24 x 50 (0.94 x 1.97)

All dimensions are rounded off

### Note

#### Explanation of the dimensions

- Length  $L_G$  is measured from the flange locating surface (the length is identical with/without brake)
- Height  $H_1$  without connector
- Height  $H_2$  with connector, without space for cable outlet

## 4.8 Mounting

### Heat dissipation

S120M is cooled through the A flange and as a result of self convection. Hotspots occur when installed in a completely enclosed, thermally insulated space. This can cause the S120M to prematurely trip.

Please ensure that S120M components can be adequately cooled by not obstructing convection.




### Note

#### Distance from neighboring components

At a minimum of three sides of the S120M, maintain a clearance >100 mm to neighboring components.

### Mounting position

Table 4- 7 Designation according to IEC 60034-7

Designation	Graphic	Description
IM B5		Standard
IM V1		The S120M can also be used in mounting positions IM V1 and IM V3 without requiring a special order. Note: When configuring the IM V3 mounting position, attention must be paid to the permissible axial forces (force due to the weight of the transmission elements) and especially to the necessary degree of protection.
IM V3		

**NOTICE****Damage caused by liquid in the case of vertical installation with the shaft extension facing upwards**

If the shaft extension has been installed facing upwards (IM V3), it must be ensured that no liquid (water, drilling or cooling emulsion, etc.) can accumulate at the upper bearing, as this can damage the drive.

- If the drive is exposed to the influence of liquid, protect it in mounting position IM V3 using a cover.

Some of the motor power loss is dissipated through the flange when the S120M is connected to the mounting surface.

**Flange mounting**

- Ensure that the flange mounting is evenly distributed.
- When tightening the fixing screws avoid any uneven stressing.
- Use the hexagon socket head cap screws (with a minimum property class of 8.8)
- Note the tightening torques of the fixing screws for the motor flange (see the following table):

Table 4- 8 Tightening torques (for electrical connections)

Article number	Screw	Washer ISO 7092 (d2 = outer diameter) [mm]	Torque [Nm]
6SL3532-6DF71-0Rxx	M6	6 (d2 = 11)	8
6SL3540-6DF71-0Rxx 6SL3542-6DF71-0Rxx	M6	6 (d2 = 11)	8
6SL3562-6DF71-0Rxx 6SL3563-6DF71-0Rxx	M8	8 (d2 = 15)	20

**Non-thermally insulated mounting**

The following mounting conditions apply for the specified motor data:

Table 4- 9 Non-thermally insulated mounting conditions

Shaft height	Steel plate, width x height x thickness [mm]	Mounting surface[m <sup>2</sup> ]
Shaft heights 36 and 48	120 x 100 x 40	0.012
SH 63	450 x 370 x 30	0.17

For larger mounting surfaces, the heat dissipation conditions improve.

### Mounting with additional mounted components

- Holding brake (integrated in the S120M). No additional torque reduction required.

### Effect of thermally insulated/non-insulated mounting without and with gearbox

The heat dissipation of the motor via the flange is reduced by an insulated design or by mounting gearboxes on motors. The development of heat also changes depending on the gearbox type.

When designing the system, reduce the specified power data to avoid thermally overloading motors when using gearboxes (see schematic diagram "Effect of the mounting conditions on the S1 characteristic").

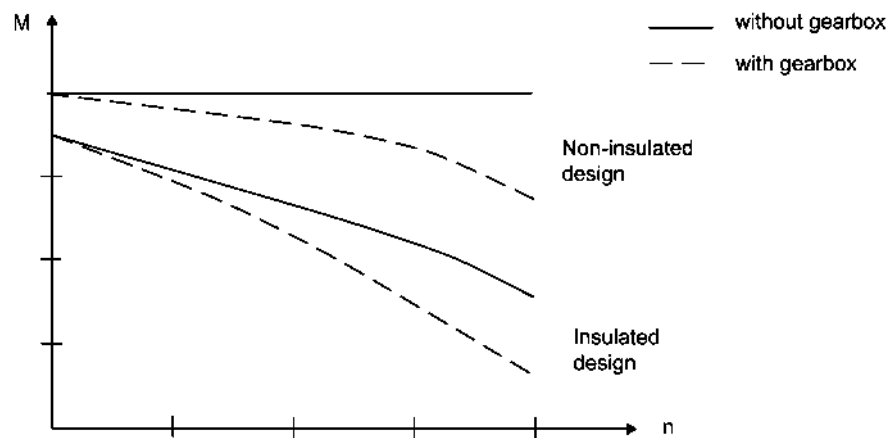


Figure 4-10 Effect of the mounting conditions on the S1 characteristic

## 4.9 Technical data

Table 4- 10 Technical data of the S120M

Technical data	Unit	6SL3532-6DF71-0R..	6SL3540-6DF71-0R..	6SL3542-6DF71-0R..	6SL3562-6DF71-0R..	6SL3563-6DF71-0R..
<b>Motor data</b>						
Rated speed	rpm	3 000	3 000	3 000	3 000	3 000
Max. speed	rpm	9 000	9 000	6 400	5 600	6 400
Rated torque	Nm	0.8	1.05	1.8	2.7	2.2
Moment of inertia						
• without brake	kgm <sup>2</sup>	$0.065 \cdot 10^{-3}$	$0.16 \cdot 10^{-3}$	$0.29 \cdot 10^{-3}$	$1.12 \cdot 10^{-3}$	$1.47 \cdot 10^{-3}$
• with brake	kgm <sup>2</sup>	$0.075 \cdot 10^{-3}$	$0.192 \cdot 10^{-3}$	$0.32 \cdot 10^{-3}$	$1.22 \cdot 10^{-3}$	$1.57 \cdot 10^{-3}$
Shaft torsional stiffness	Nm/rad	4 100	13 000	11 400	26 500	25 000
<b>Output current</b>						
Nominal current ( $I_{\text{nominal}}$ )	$A_{\text{rms}}$	1.2	1.7	1.4	1.9	2.0
Base load current (I)	$A_{\text{rms}}$	1.1	1.3	1.1	1.4	1.5
Intermittent duty current ( $I_{\text{Is6}}$ ) 40 %	$A_{\text{rms}}$	1.7	2.5	2.0	2.8	2.9
Peak current ( $I_{\text{max}}$ )	$A_{\text{rms}}$	4.5	7.7	7.6	14.0	21.0
Static torque	Nm	1.0	1.3	2.5	5.0	7.1
Stall current	A	1.4	1.9	1.8	3.15	5.0
Max. torque	Nm	3.0	4.9	10.0	19.3	27.0
<b>Converter data</b>						
Electronics power supply	$V_{\text{DC}}$	48				
Power consumption 48 V - electronics power supply	W	Max. 12				
Power drawn, brake	W	10	15	15	20	20
Rated DC link voltage	$V_{\text{DC}}$	600				
DC link voltage	$V_{\text{DC}}$	510 to 720				
Output voltage	$V_{\text{ACrms}}$	0 to $0.717 \cdot \text{DC link voltage}$				
Overvoltage trip	$V_{\text{DC}}$	$820 \pm 2 \%$				
Undervoltage trip	$V_{\text{DC}}$	$380 \pm 2 \%$				
Current carrying capacity of the DC link	$A_{\text{DC}}$	25.0				
DC link capacitance	$\mu\text{F}$	8	24	24	40	40
Pulse frequency	kHz	4				
Max. ambient temperature	$^{\circ}\text{C}$					
• Without derating		40				
• With derating		55				
Min. ambient temperature	$^{\circ}\text{C}$	-15				
Storage temperature	$^{\circ}\text{C}$	-25 to +55				
Transport temperature	$^{\circ}\text{C}$	-40 to +70				
Surface temperature	$^{\circ}\text{C}$	<100				

Technical data	Unit	6SL3532-6DF71-0R..	6SL3540-6DF71-0R..	6SL3542-6DF71-0R..	6SL3562-6DF71-0R..	6SL3563-6DF71-0R..
<b>Encoder (absolute encoder AM20DQI_dec)</b>						
Resolution within one revolution		20 bits				
Traversing range (multiturn)		4096				
Total angular error		±60"				
<ul style="list-style-type: none"> <li>In the range from -15 °C up to 40 °C</li> <li>In the range from 40 °C up to 115 °C</li> </ul>		±120"				
Pitch/subdivision angular error		±20"				
<ul style="list-style-type: none"> <li>In the range from -15 °C up to 40 °C</li> <li>In the range from 40 °C up to 115 °C</li> </ul>		±40"				
<b>Others</b>						
Mounting position/type of construction		<ul style="list-style-type: none"> <li>IM B5 (horizontal shaft),</li> <li>IM V1 (shaft vertically downwards),</li> <li>IM V3 (shaft vertically upwards),</li> </ul>				
Vibrational load in operation		With constant deflection: 1.5 With constant acceleration: 0.5 IEC 68-2-6, DIN EN 60721 Parts 3-0 and 3-3 Class 3M3				
<ul style="list-style-type: none"> <li>Frequency range 2...9 Hz</li> <li>Frequency range 10 ... 200 Hz</li> <li>Applicable standard</li> </ul>	mm g					
Shock load in operation		max. 7 22 DIN EN 60721 Part 3-0 and Part 3-3 Class 3M3				
<ul style="list-style-type: none"> <li>Peak acceleration</li> <li>Shock duration</li> <li>Applicable standard</li> </ul>	g ms					
Cooling method		via A flange and surface convection				
Installation altitude (without derating)	m	1000				
Sound pressure level acc. to DIN EN ISO 1680, max. tolerance +3 dB(A)	dB(A)	55	55	55	65	65
Non-thermally insulated mounting/insulated mounting		See Chapter "S120M mounting", diagram "Effect of the mounting conditions on the S1 characteristic" (Page 87)				
Degree of protection (standard)		IP65				
Degree of protection (optional)		DE shaft flange IP67				
Weight						
<ul style="list-style-type: none"> <li>without brake</li> <li>with brake</li> </ul>	kg kg	4.1 4.5	5.3 6.0	7.1 7.8	11.9 13.3	13.9 15.3



### 4.9.1 Characteristics

#### Torque characteristics

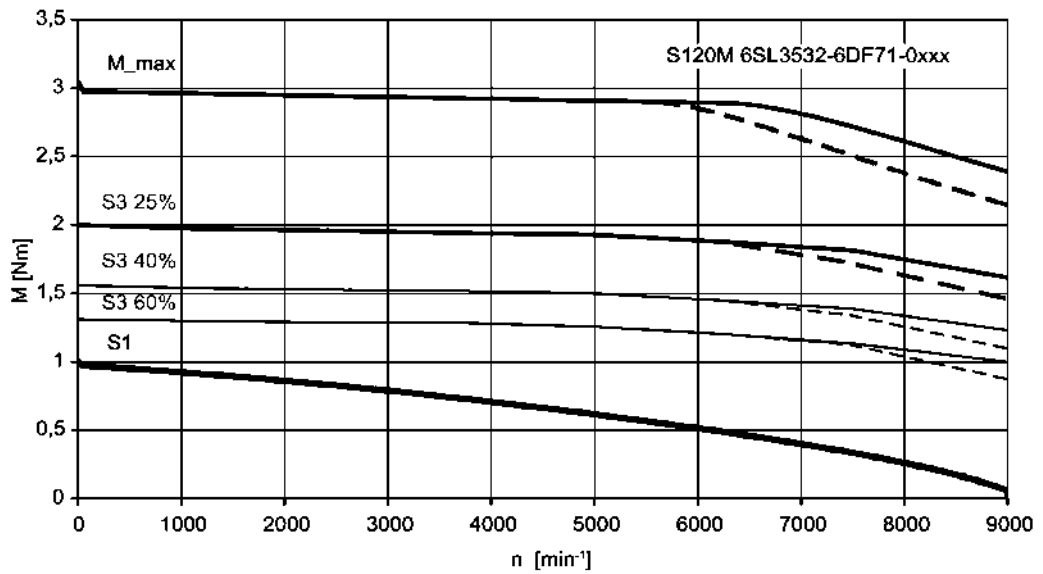


Figure 4-11 Torque characteristics S120M on 400 V network for AH36 (6SL3532-6DF71-0Rxx)

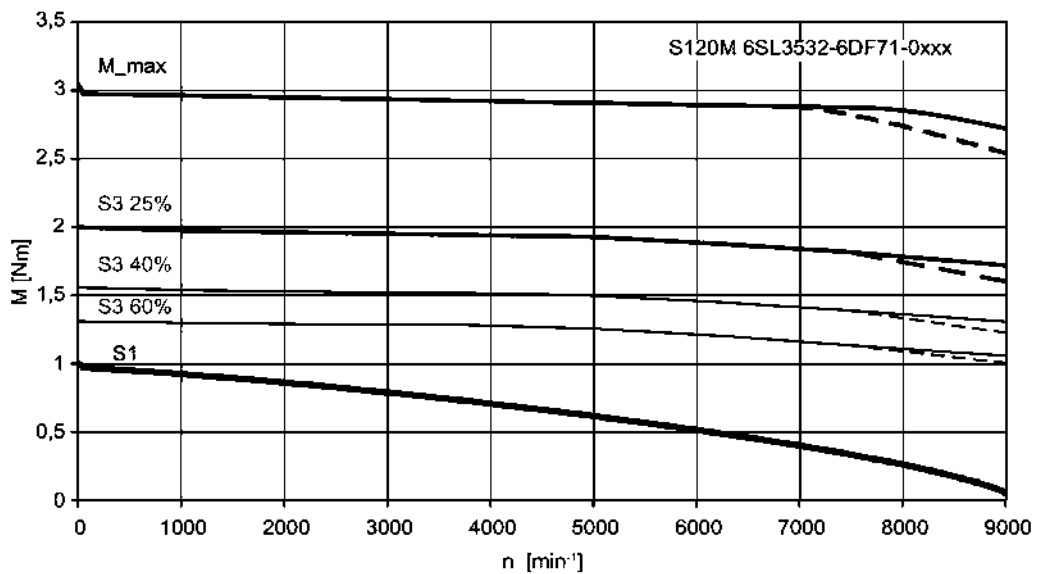


Figure 4-12 Torque characteristics S120M on 480 V network for AH36 (6SL3532-6DF71-0Rxx)

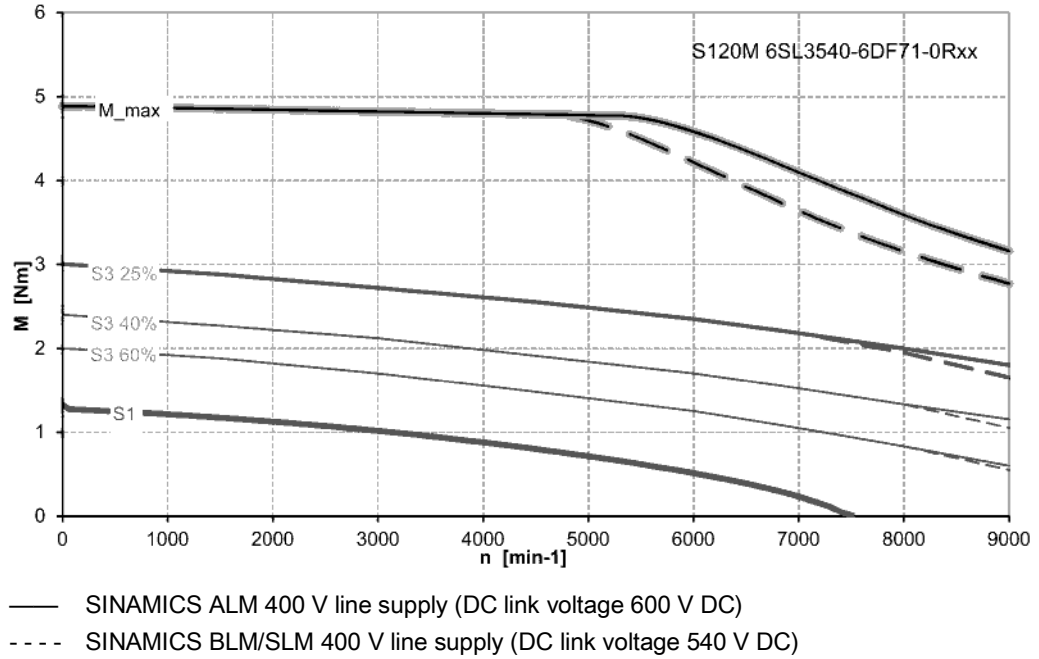


Figure 4-13 Torque characteristics S120M on 400 V line supply for SH48 (6SL3540-6DF71-0Rxx)

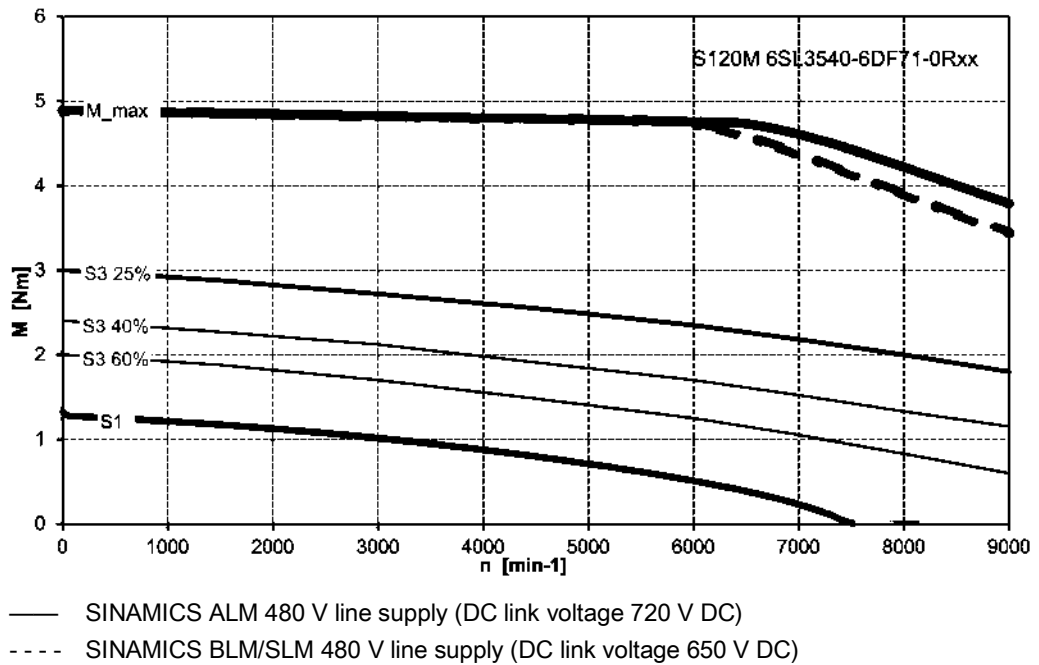


Figure 4-14 Torque characteristics S120M on 480 V line supply for AH48 (6SL3540-6DF71-0Rxx)

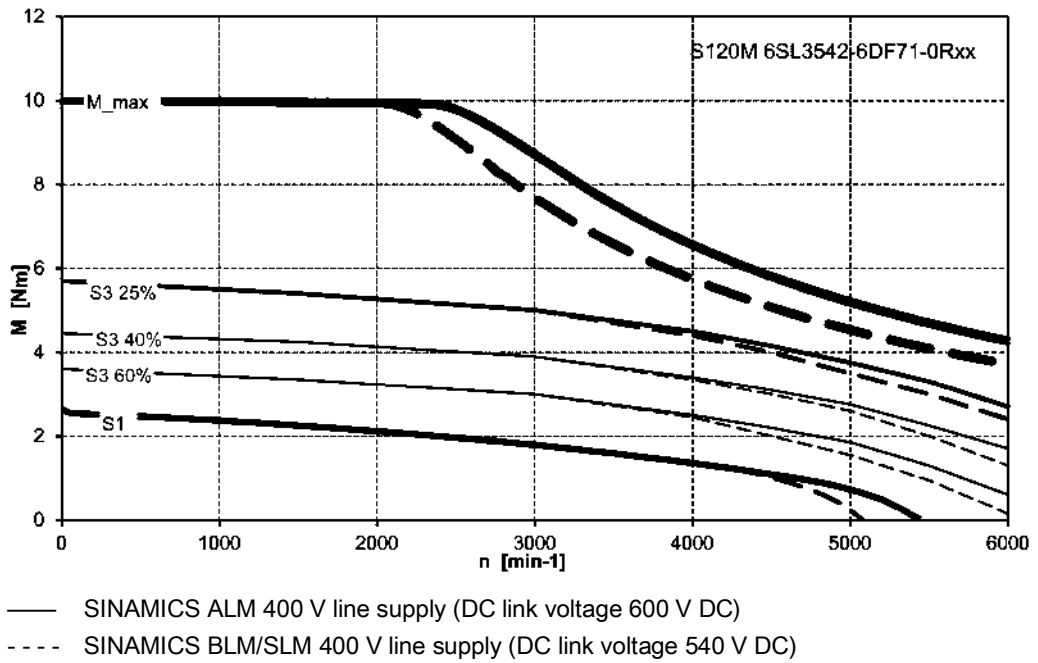


Figure 4-15 Torque characteristics S120M on 400 V line supply for AH48 (6SL3542-6DF71-0Rxx)

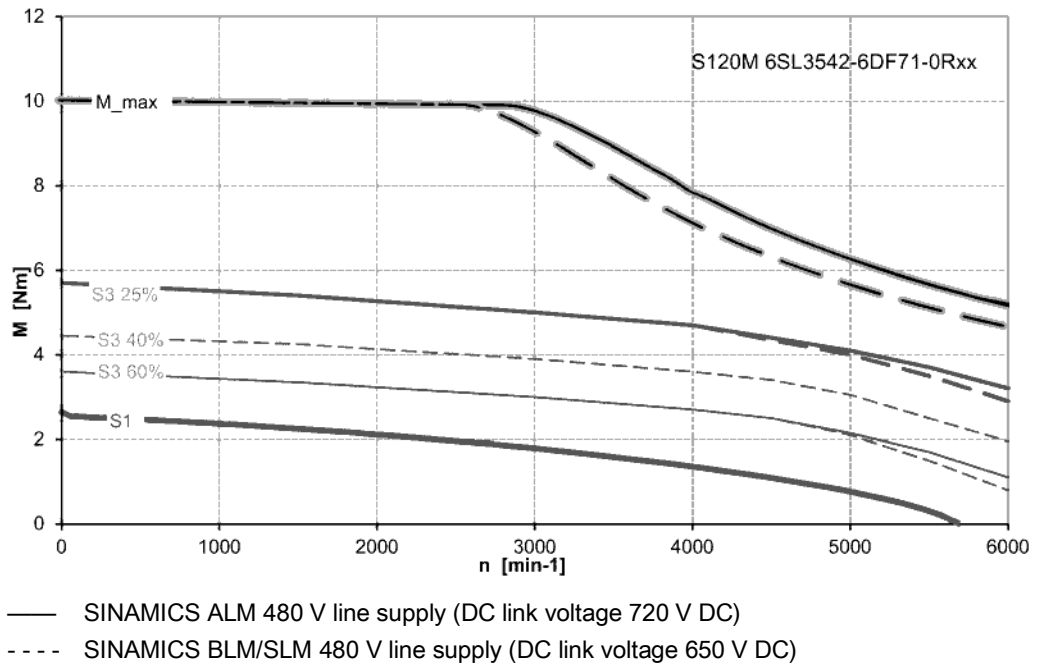
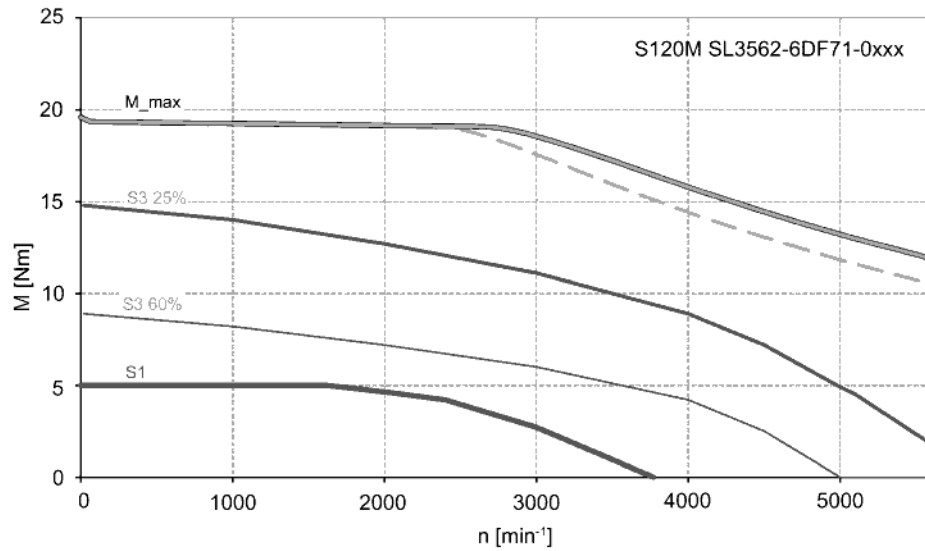
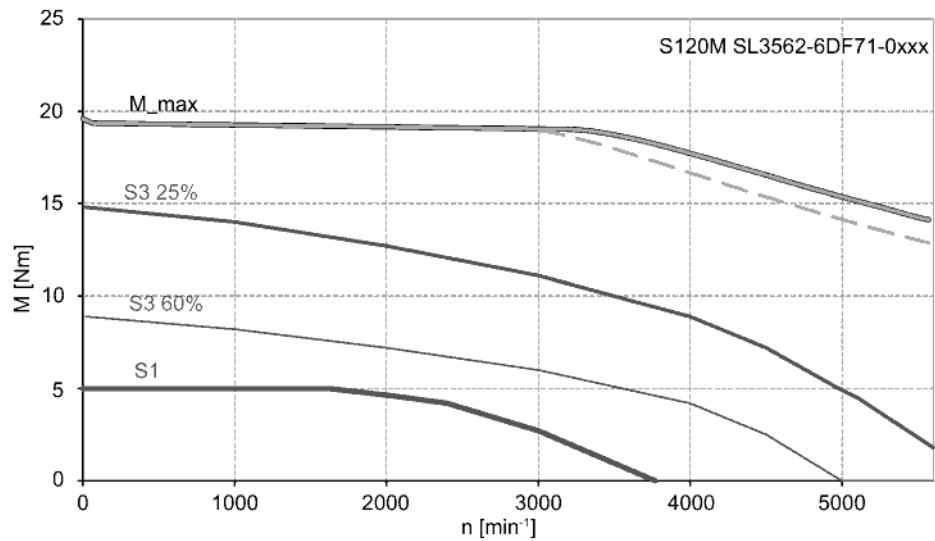


Figure 4-16 Torque characteristics S120M on 480 V line supply for AH48 (6SL3542-6DF71-0Rxx)



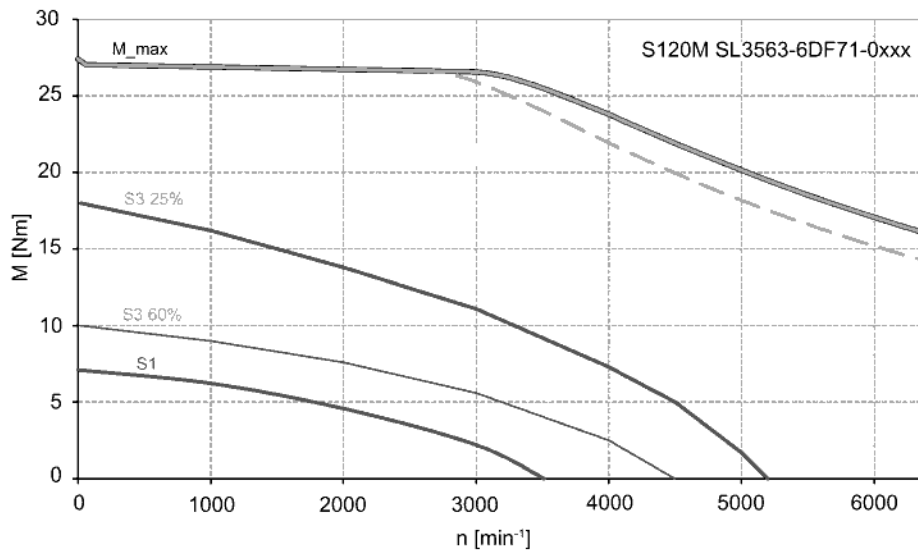
- SINAMICS ALM 400 V line supply (600 V DC link voltage)
- - - SINAMICS BLM/SLM 400 V line supply (DC link voltage 540 V DC)

Figure 4-17 Torque characteristics S120M on 400 V network for AH63 (6SL3562-6DF71-0Rxx)



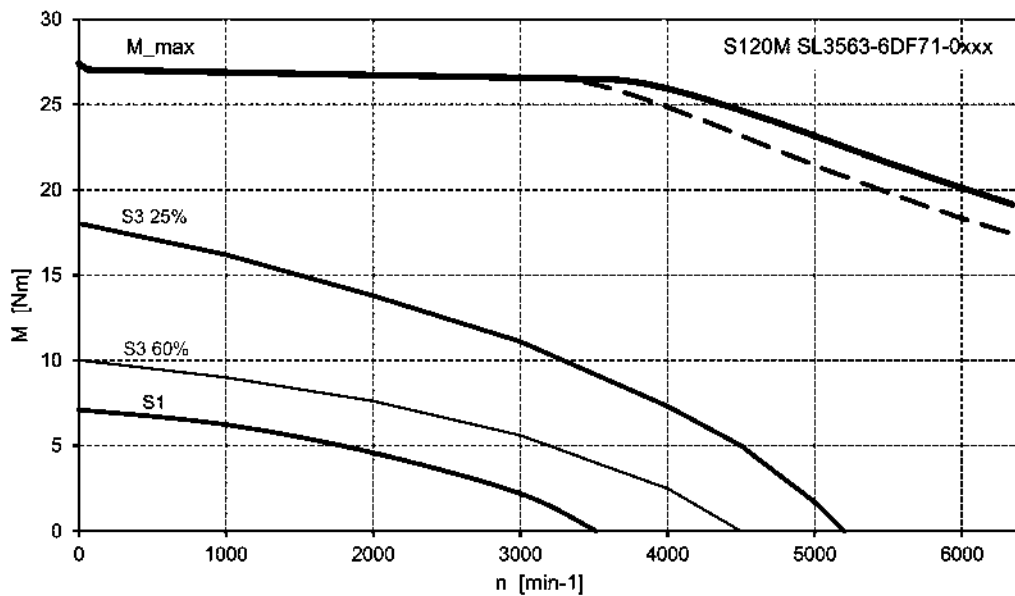
- SINAMICS ALM 480 V line supply (720 V DC link voltage)
- - - SINAMICS BLM/SLM 480 V line supply (DC link voltage 650 V DC)

Figure 4-18 Torque characteristics S120M on 480 V network for AH63 (6SL3562-6DF71-0Rxx)



— SINAMICS ALM 400 V line supply (600 V DC link voltage)  
 - - - SINAMICS BLM/SLM 400 V line supply (DC link voltage 540 V DC)

Figure 4-19 Torque characteristics S120M on 400 V network for AH63 (6SL3563-6DF71-0Rxx)



— SINAMICS ALM 480 V line supply (720 V DC link voltage)  
 - - - SINAMICS BLM/SLM 480 V line supply (DC link voltage 650 V DC)

Figure 4-20 Torque characteristics S120M on 480 V network for AH63 (6SL3563-6DF71-0Rxx)

**Note****S3 operation**

The duty cycle duration for S3 operation is 10 s.

**Overload capability**

The possible output (continuous) power of the S120M strongly depends, as is generally the case for motors, on the cooling power of the connection at the A flange. The minimum sizes of the motor flange must be maintained in order to be able to achieve the maximum output data.

We recommend the "SIZER" engineering software to select a suitable S120M.

See SIZER: <http://support.automation.siemens.com/WWW/view/de/10804987/130000>

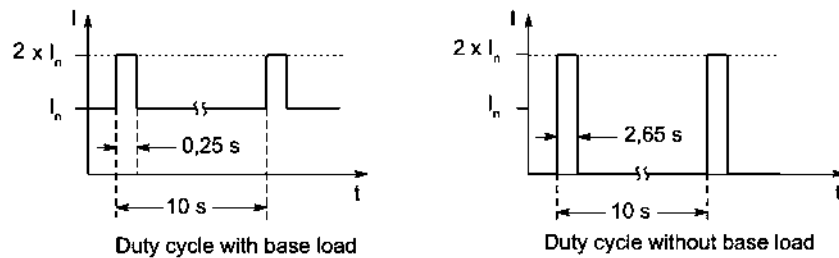


Figure 4-21 Duty cycle  $2 \times I_{\text{rated}}$  with/without base load (for servo drive)

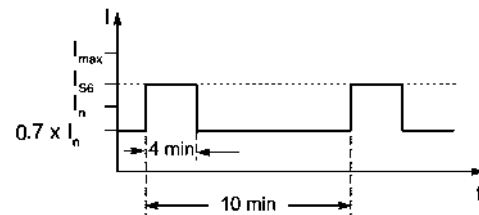


Figure 4-22 Duty cycle  $I_{s6}$  with base load

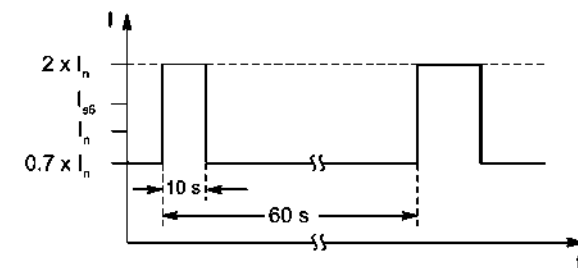


Figure 4-23 Duty cycle  $2 \times I_{\text{rated}}$  with base load (for servo drive)

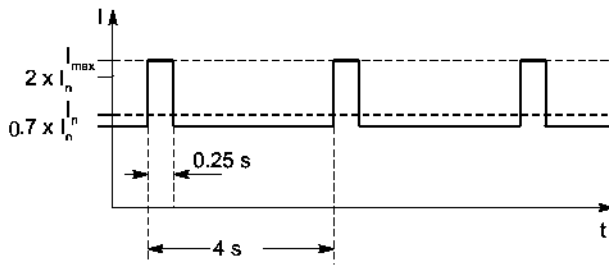


Figure 4-24 Duty cycle  $I_{max}$  with base load

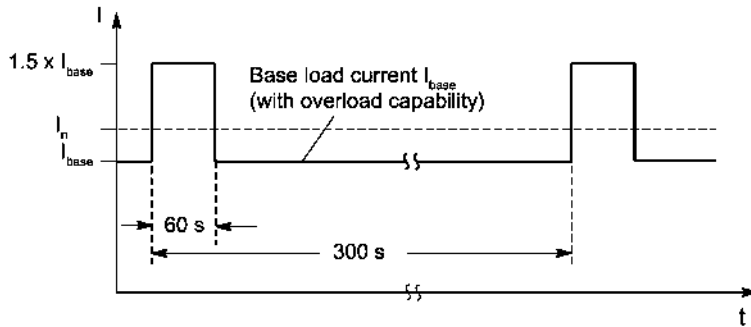


Figure 4-25 Duty cycle  $1.5 I_{base}$  with base load

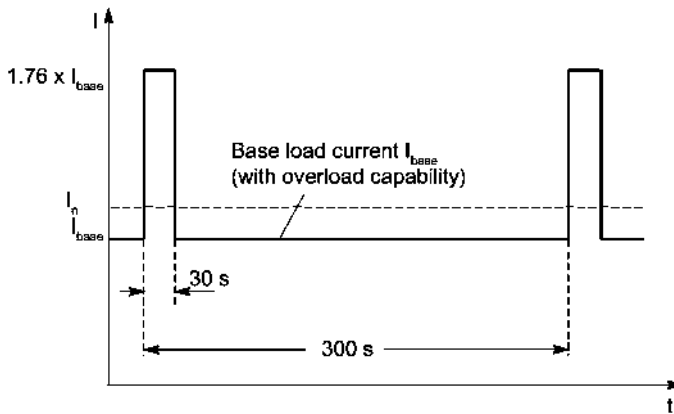


Figure 4-26 Duty cycle  $1.76 I_{base}$  with base load

## Derating characteristics

For SINAMICS, the rated data is only applicable for a specified range. Outside this range, certain performance data are restricted. For SINAMICS systems there are constraints regarding the ambient temperature, pulse frequency and installation altitude, for example.

The following derating characteristics apply for the S120M:

### Derating characteristics as a function of the ambient temperature

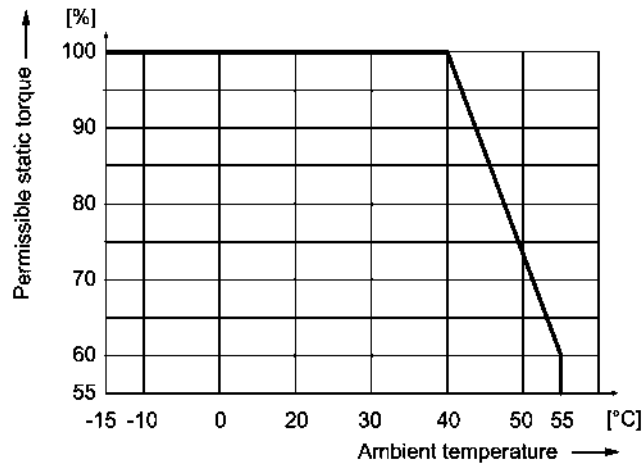


Figure 4-27 Derating as a function of the ambient temperature

The full torque is output in the range between -15 °C and +40 °C.

For temperatures between +40 °C and +55 °C, the static torque must be reduced according to the diagram above. Derating must be moved on the basis of the static torque in the form of a parallel movement of the torque characteristic (see the schematic diagram below).

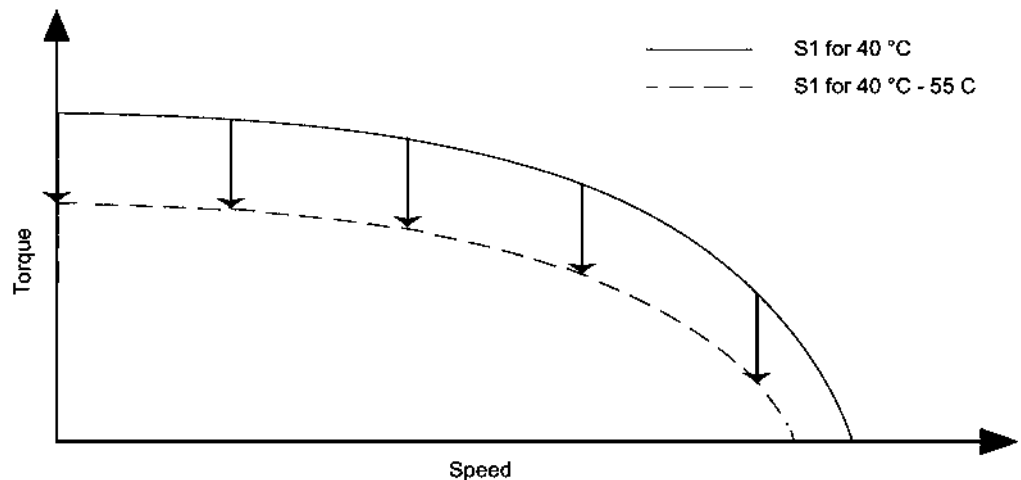


Figure 4-28 Schematic diagram for torque rating as a function of the ambient temperature



## 4.10 Motor holding brake

### Description

The holding brake is used to clamp the motor shaft when the motor is at a standstill. It is **not** a working brake that is used to brake a motor that is still rotating.

Restricted Emergency Stop operation is permissible. Up to 2000 braking operations can be executed with three times the rotor moment of inertia as external moment of inertia from a speed of 3000 rpm, without the brake being subject to an inadmissible amount of wear. The specific highest switching work for each emergency braking operation may not be exceeded.

#### NOTICE

##### **Wear to the brakes due to switching times which are too long or too frequent**

Excessive wear means that the braking function can no longer be guaranteed. Exceeding the emergency stop conditions specified above or briefly accelerating the motor repeatedly against a brake that is still closed leads to premature wear.

- Take into account the switching times of the brakes for drive control or release purposes.

#### Note

##### **Length of the S120M**

The length of the S120M does not depend on whether there is a holding brake.

The holding brake is a brake equipped with permanent magnets. The magnetic field of the permanent magnets results in a pulling force on the brake armature disk. This means that in the no-current condition, the brake is closed and the motor shaft is held.

When the rated voltage is connected to the brake, the solenoid – through which current flows – establishes an opposing field. As a result, the force of the permanent magnets is neutralized and the brake opens without residual torque on account of the spring return. The permanent magnet brake has a torsionally stiff connection to the motor rotor. This is the reason that this brake has no play.

#### NOTICE

##### **Damage due to axial forces on the S120M with holding brake**

On an S120M with integrated permanent-magnet-excited holding brake, axial forces at the shaft extension can cause damage. This applies when installing the system and during operation.

- Lock the components connected to the shaft in place.

### 4.10.1 Connection at the S120M

The motor holding brake is controlled, integrated in the S120M.

The S120M directly provides the current required by the motor holding brake. Contactors and protective circuits are not required.

The relevant times for holding operation of the motor holding brake can be taken from the technical data:

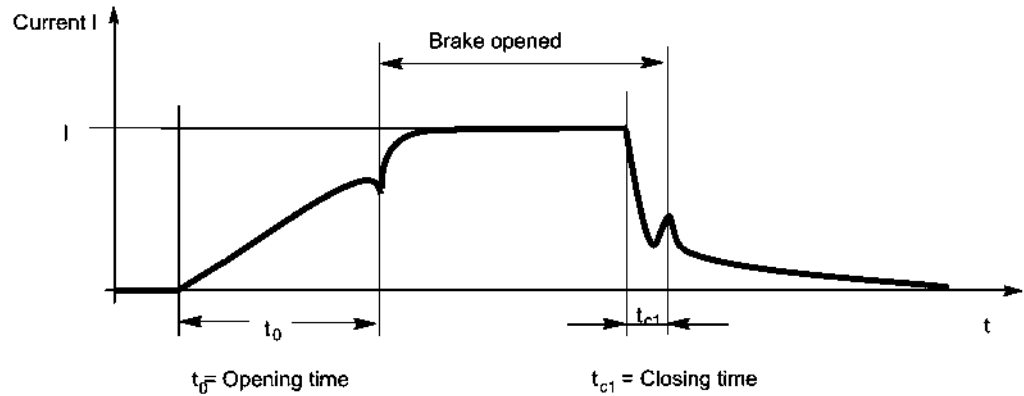


Figure 4-29 Diagram showing the various times applicable for motor holding operation

### Releasing the motor holding brake when mounting the motor

The motor holding brake can be released via the X4 interface. This means that the shaft of the S120M can be moved without connecting the supply voltage via the Hybrid Cable.

X4 is a commissioning interface; using it during operation is not permitted. Cover the X4 interface with the protective cap supplied.

Table 4- 11 X4: M12 socket, external brake, socket, D-coded

	Terminal	Signal name	Meaning
	1	BR_RELEASE	Brake supply voltage, external: 24 VDC $\pm$ 10%, protective class III
	2	nc	Reserved, not used
	3	M	Ground, brake supply voltage, external
	4	nc	Reserved, not used

#### WARNING

#### Danger to life due to incorrectly releasing the motor holding brake via X4

Releasing the motor holding brake via X4 with suspended loads can cause unexpected movements which could lead to severe personal injury or death.

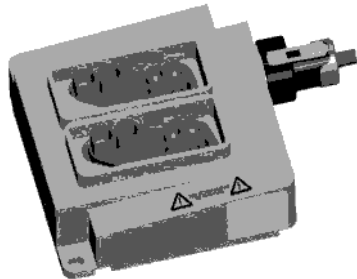
- Secure the suspended loads before wiring at X4.



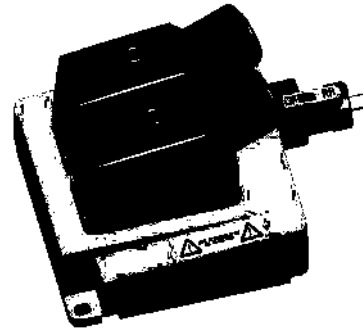
## DRIVE-CLiQ Extension

### 5.1 Description

A central Control Unit can only control a limited number of drives. If multiple S120M drives are operated on a common line, then an additional Control Unit is required. The closed-loop control signals are fed to the line using DRIVE-CLiQ, via a DRIVE-CLiQ Extension.



DRIVE-CLiQ Extension without hybrid connector



DRIVE-CLiQ Extension with hybrid connector

DRIVE-CLiQ Extension includes:

- One input socket for DRIVE-CLiQ
- One input socket for the connection with Hybrid Cable from the previous S120M
- One output socket for the connection with Hybrid Cable to the following S120M

## 5.2 Safety instructions for DRIVE-CLiQ Extensions

### WARNING

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

If the fundamental safety instructions and remaining risks in Chapter 1 are not observed, accidents involving severe injuries or death may occur.

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



### DANGER

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

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

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

- Do not remove/insert the hybrid connector until 5 minutes has elapsed.
- Before starting any work, also check that the system is in a voltage-free state by measuring at the DC link terminals DCP and DCN.

### NOTICE

**Damage through use of incorrect DRIVE-CLiQ cables or Hybrid Cables**

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

- Only use suitable DRIVE-CLiQ cables and Hybrid Cables that have been released by Siemens for the respective application.

### Note

#### Maintaining the degree of protection

The degree of protection is ensured when all of the connectors are inserted and interlocked/screwed.

## 5.3 Interface description

### 5.3.1 Overview

DRIVE-CLiQ Extension (DQE) has two connections for the S120M hybrid connector as well as a connection for DRIVE-CLiQ.

The DRIVE-CLiQ signals of the incoming hybrid line are terminated and the DRIVE-CLiQ signals of the DRIVE-CLiQ cable are fed into the new hybrid line. All other connections are only looped through from the inputs to the outputs.

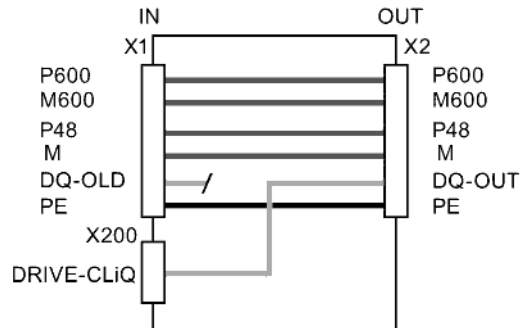


Figure 5-1 Block diagram of DRIVE-CLiQ Extension

#### Note

The X1 (input) and X2 (output) connections must not be interchanged.

### 5.3.2 Hybrid connector

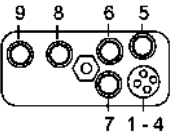
#### Connecting the Hybrid Cable from the S120M of the previous line

Table 5- 1 Terminal strip X1 (IN)

	Terminal	Signal name	Technical data
	1	1 (TXP)	Transmit data +
	2	2 (RXP)	Receive data +
	3	3 (TXN)	Transmit data -
	4	4 (RXN)	Receive data -
	5	PE	Potential equalization
	6	M	Electronics ground
	7	+	48 VDC power supply
	8	DCN	DC link voltage - (M600)
	9	DCP	DC link voltage + (P600)
	-	DQ_SHIELD	Shield

Connecting the Hybrid Cable at the S120M of the next line

Table 5-2 Terminal strip X2 (OUT)

	Terminal	Signal name	Technical data
	1	1 (TXP)	Transmit data +
	2	2 (RXP)	Receive data +
	3	3 (TXN)	Transmit data -
	4	4 (RXN)	Receive data -
	5	PE	Potential equalization
	6	M	Electronics ground
	7	+	48 VDC power supply
	8	DCN	DC link voltage - (M600)
	9	DCP	DC link voltage + (P600)
	-	DQ_SHIELD	Shield

**Note**

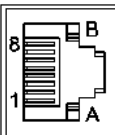
**Mounting the hybrid connector**

The hybrid connector can be screwed on by hand.

- For operation, tighten the hybrid connector with an Allen key (3.0 Nm).

**5.3.3 DRIVE-CLiQ connector**

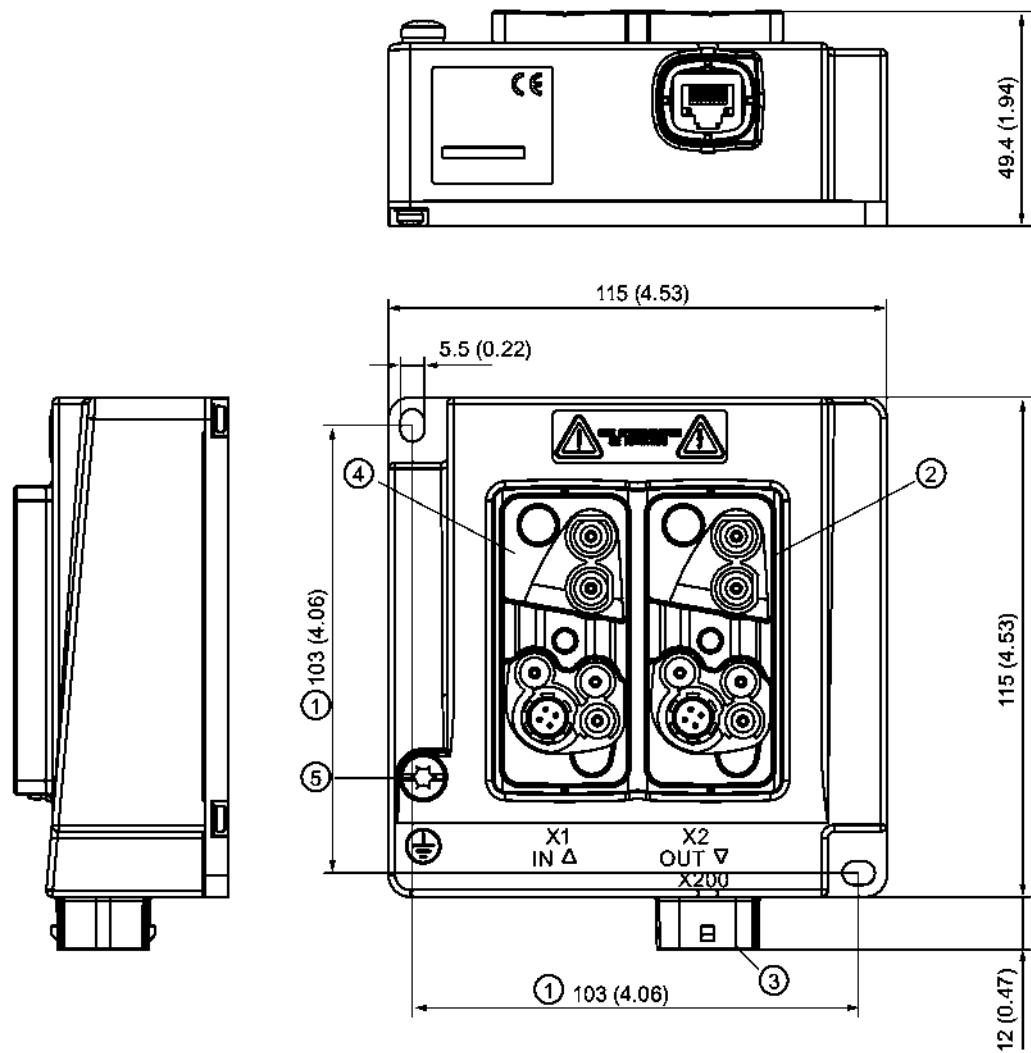
Table 5-3 DRIVE-CLiQ connector X200

	Terminal	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 VDC power supply
	B	GND (0 V)	Electronics ground

**See also**

Connection system (Page 123)

## 5.4 Dimension drawing



- ① Drilling pattern
- ② Output (to the next S120M)
- ③ DRIVE-CLiQ
- ④ Input (from the previous S120M)
- ⑤ PE connection (3 Nm)

Figure 5-2 Dimension drawing DRIVE-CLiQ Extension



## 5.5 Mounting

As a result of its IP65 degree of protection, DRIVE-CLiQ Extension can be mounted everywhere in the distributed I/O. Two M5 screw holes are provided for mounting it in the system.



**! WARNING**

**Danger to life in the event of interruption of the external protective conductor due to high leakage currents**

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 following protective conductor connection paths are available:
  - Via the Hybrid Cable.
  - Via the PE connection. In this case, the protective conductor cross-section must be  $\geq 4 \text{ mm}^2$ .

Each of these connections must be suitable as a protective connection.

## 5.6 Technical data

Table 5- 4 Technical data of DRIVE-CLiQ Extension

Technical data	Unit	6SL3555-0AA00-6AB0
DC link voltage	V <sub>DC</sub>	510 ... 720
Current-carrying capacity of the DC link (T <sub>ambient</sub> < 40 °C)	A <sub>DC</sub>	25
Current-carrying capacity of the electronics	A <sub>DC</sub>	10
Mounting position / type of construction		Any
Cooling method		Natural convection
Installation altitude	m	See Chapter "System data" (Page 43)
Current derating		See Chapter "System data" (Page 43)
Degree of protection		IP65
Maximum length between DRIVE-CLiQ Extension and the next axis	m	<10
Maximum length DRIVE-CLiQ cable at X200	m	50
Weight	kg	0.8

The DRIVE-CLiQ Extension fulfills the same thermal and mechanical requirements as for the S120M.

The derating characteristics of the S120M regarding the installation altitude and the temperature are also valid for the DRIVE-CLiQ extension.

### 5.6.1 Characteristics

- If the components are operated at increased ambient temperatures (40 to 55 °C) then the DC link current must be appropriately reduced.

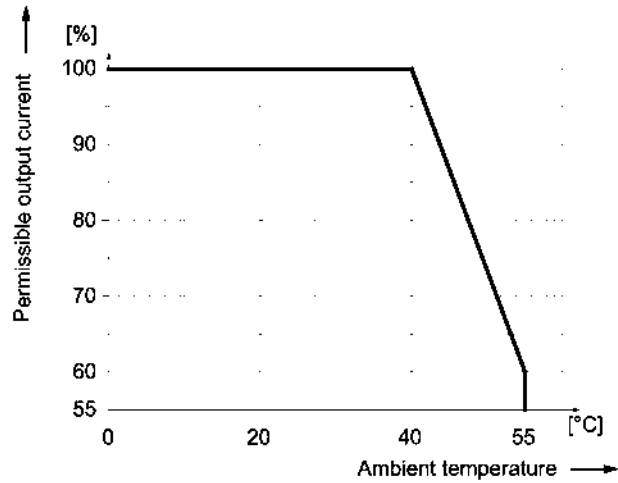


Figure 5-3 Output current as a function of the ambient temperature



# Hybrid Cabinet Bushing

## 6.1 Description

The Hybrid Cabinet Bushing (HCB) is used as a cabinet bushing for the Hybrid Cable and a DRIVE-CLiQ cable. An IP65 degree of protection is realized using the HCB. To achieve this, a DRIVE-CLiQ cable with degree of protection IP67 must be connected outside the cabinet. A DRIVE-CLiQ cable is connected in the cabinet, which as a minimum, corresponds to the degree of protection of the other components in the cabinet. Hybrid cables with degree of protection IP65 can be connected at both ends of the HCB.

Using the DRIVE-CLiQ cable, signals from the Control Unit are transferred via the DRIVE-CLiQ Extension for an additional drive line.

---

**Note****Transport cap**

If, on the outside of the cabinet, no DRIVE-CLiQ cable is connected to the HCB, a transport cap must be attached to this interface in order to ensure degree of protection IP65.

---

## 6.2 Safety instructions for the Hybrid Cabinet Bushing

 **WARNING**

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

If the fundamental safety instructions and remaining risks in Chapter 1 are not observed, accidents involving severe injuries or death may occur.

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



 **DANGER**

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

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

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

- Do not remove/insert the hybrid connector until 5 minutes has elapsed.
- Before starting any work, also check that the system is in a voltage-free state by measuring at the DC link terminals DCP and DCN.



 **WARNING**

**Danger to life in the event of interruption of the external protective conductor due to high leakage currents**

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 following protective conductor connection paths are available:
  - Via the Hybrid Cable.
  - Via the PE connection. In this case, the protective conductor cross-section must be  $\geq 4 \text{ mm}^2$ .

Each of these connections must be suitable as a protective connection.

**NOTICE**

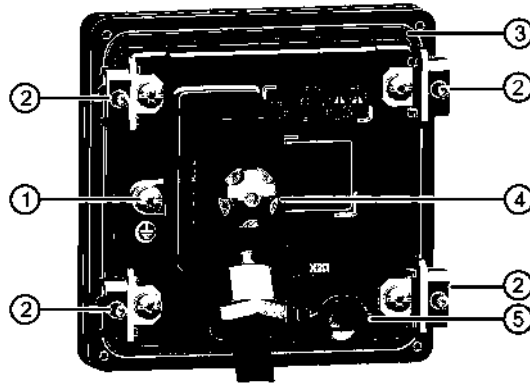
**Damage through use of incorrect DRIVE-CLiQ cables or Hybrid Cables**

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

- Only use suitable DRIVE-CLiQ cables and Hybrid Cables that have been released by Siemens for the respective application.

## 6.3 Interface description

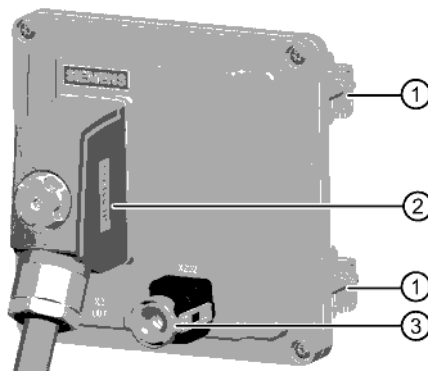
### Hybrid Cabinet Bushing, inner



- ① PE connection (3 Nm)
- ② Fastening clips with M5 Allen set screw (0.5 Nm) and M5 Torx screws (3 Nm)
- ③ Seal
- ④ Hybrid connector connection
- ⑤ DRIVE-CLiQ connection

Figure 6-1 Hybrid Cabinet Bushing, inner (IP65)

### Hybrid Cabinet Bushing, outer



- ① Fastening clips
- ② Hybrid connector connection
- ③ DRIVE-CLiQ connection

Figure 6-2 Hybrid Cabinet Bushing, outer (IP65)

**Note**

**Explanation of the interfaces**

A precise description of the interfaces can be found in the "Interface description" chapter relating to DRIVE-CLiQ Extension, under Hybrid connector (Page 103) or DRIVE-CLiQ connector (Page 104).

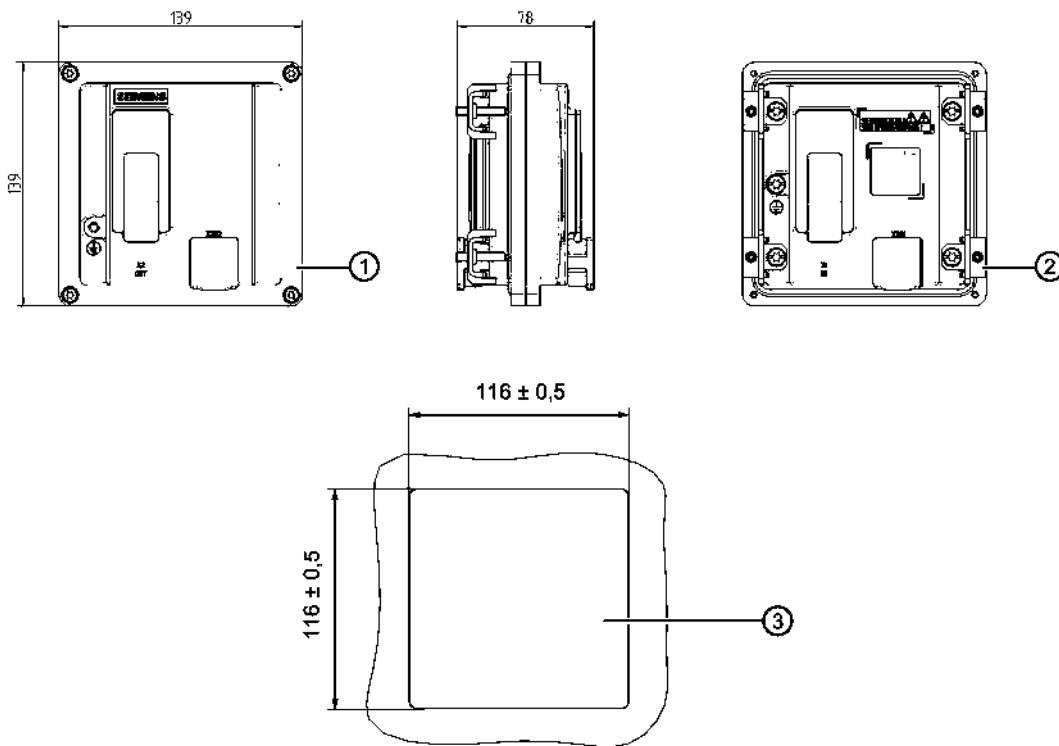
**Note**

**Malfunctions due to polluted DRIVE-CLiQ interfaces**

Malfunctions can occur in the system through the use of polluted DRIVE-CLiQ interfaces.

- Cover unused DRIVE-CLiQ interfaces with the supplied blanking covers.

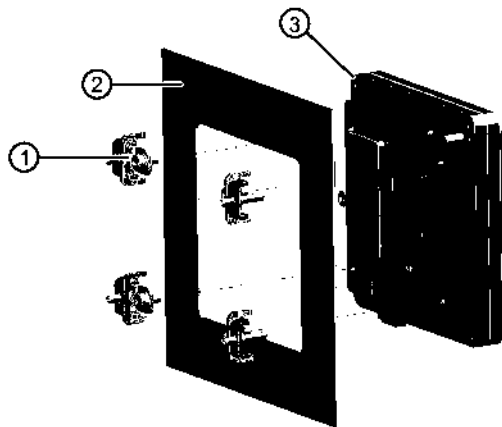
**6.4 Dimension drawing**



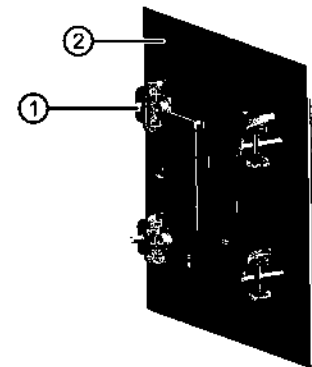
- ① Hybrid Cabinet Bushing, outer
- ② Hybrid Cabinet Bushing, inner
- ③ Cutout required in the control cabinet panel

Figure 6-3 Dimension drawing Hybrid Cabinet Bushing

## 6.5 Mounting



Connecting the HCB in the wall cutout



Complete mounting

1. Make a cutout for the Hybrid Cabinet Bushing in the control cabinet panel ② as shown in the dimension drawing (Page 112).
2. Connect the Hybrid Cabinet Bushing through the cutout from the outside.
3. Mount the fastening clips ① with M5 Torx screws (3 Nm) to the Hybrid Cabinet Bushing ③.
4. Attach the Hybrid Cabinet Bushing ③ to the inside of the control cabinet using the M5 Allen set screw (0.5 Nm) of the retaining clips ①.



## 6.6 Technical data

Table 6- 1 Technical data of the Hybrid Cabinet Bushing

Technical data	Unit	6SL3555-2DA00-0AA0
DC link voltage	V <sub>DC</sub>	510 ... 720
Current-carrying capacity of the DC link (T <sub>ambient</sub> < 40 °C)	A <sub>DC</sub>	25
Current-carrying capacity of the electronics	A <sub>DC</sub>	10
Mounting position / type of construction		Any
Cooling method		Natural convection
Installation altitude	m	See Chapter "System data" (Page 43)
Current derating		See Chapter "System data" (Page 43)
Dimensions (W x H x D; without connectors and caps)	mm	139 x 139 x 72
Weight	kg	0.85
Degree of protection		IP65

The Hybrid Cabinet Bushing fulfills the same thermal and mechanical specifications as the S120M.

The derating characteristic of the S120M regarding the installation altitude and the temperature also apply to the Hybrid Cabinet Bushing.

### 6.6.1 Characteristics

- If the components are operated at increased ambient temperatures (40 to 55 °C) then the DC link current must be appropriately reduced.

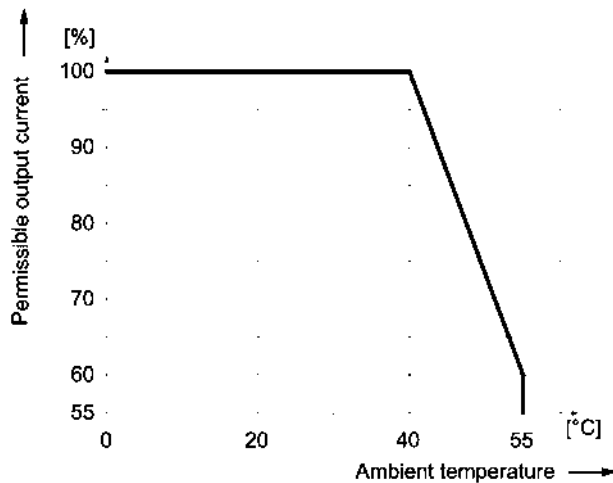


Figure 6-4 Output current as a function of the ambient temperature

## Cabinet design and EMC S120M

### 7.1 General

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**Note****Control cabinet design and electromagnetic compatibility (EMC)**

Information on control cabinet installation and electromagnetic compatibility (EMC), as well as on overcurrent and overvoltage protection, can be found in:

SINAMICS S120 Manual for Booksize Power Units (GH2)

Article number: 6SL3097-4AC00-0AP□

---

A prefabricated Hybrid Cable for transferring power, the auxiliary power and DRIVE-CLiQ can be ordered for the S120M.

The connection between the following components is established using the Hybrid Cable (with prefabricated, identical hybrid connectors at both ends of the cable):

- Adapter Module 600 - distributed drive line (S120M)
- Adapter Module 600 - Hybrid Cabinet Bushing
- Hybrid Cabinet Bushing - distributed drive line (S120M)
- Between S120M
- S120M - DRIVE-CLiQ Extension

** WARNING****Danger to life due to electric shock when connecting/disconnecting live cables**

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

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

- Open the protective cover of the DC link and only remove/insert the Hybrid Cable after 5 minutes have elapsed.
- Before starting any work, also check that the system is in a voltage-free state by measuring at the DC link terminals DCP and DCN.

<b>NOTICE</b>
<b>Damage caused by incorrect installation of the Hybrid Cable and terminating connector</b>
Incorrectly mounted Hybrid Cables or terminating connectors can cause damage or malfunctions.
<ul style="list-style-type: none"><li>• After connection, the Hybrid Cable and the terminating connector must be additionally tightened using the tool provided. Tool: Allen key; tightening torque, 3.0 Nm</li><li>• Observe the bending radii for Hybrid Cables<ul style="list-style-type: none"><li>– Static: 60 mm</li><li>– Dynamic: 112.5 mm</li><li>– <math>\geq 7.5 \cdot D</math> (<math>D = 14.6 \pm 0.4</math> mm)</li></ul></li></ul>

## 7.2 24 V DC supply voltage

### 7.2.1 General

The 24 VDC voltage is required for the power supply of

1. The electronics of the SINAMICS components via the integrated 24 V busbar
2. The electronics of the Control Units, Option Boards, Sensor Modules, and Terminal Modules, as well as the process voltage of their digital inputs
3. The load voltage of the digital outputs
4. The motor holding brakes

---

#### Note

##### Electronic power supply

For information on the electronic power supply, see the chapter titled "System data" in this documentation.

---

<b>NOTICE</b>
<b>Damage caused by missing overvoltage protection circuits</b>
Missing overvoltage protection circuits can cause equipment damage.
<ul style="list-style-type: none"><li>• When connecting other loads to the electronic power supply, fit connected inductance devices (contactors, relays) with suitable overvoltage protection circuits.</li></ul>

## 7.2.2 24 V power supply and connection of components

The Line Modules, Adapter Modules 600, and DC-link components are connected to the 24 VDC power supply via the integrated 24 VDC busbars. The current-carrying capacity of the 24 V busbars is 20 A.

---

### 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.
- 

The 24 V can be connected in two ways:

### Using a Control Supply Module

When a Control Supply Module is used, the 24 V supply can be directly established via 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 terminal adapter.

---

### Note

#### Cables with a cross-section of 2.5 mm<sup>2</sup>

If you use cables with a cross-section of 2.5 mm<sup>2</sup>, no additional protection is required on the 24 V side for the following cable types:

- Cables of the XLPE type
  - Cables of the EPR type
  - Cable with a similar quality and with a thermal stability of up to 90 °C
-

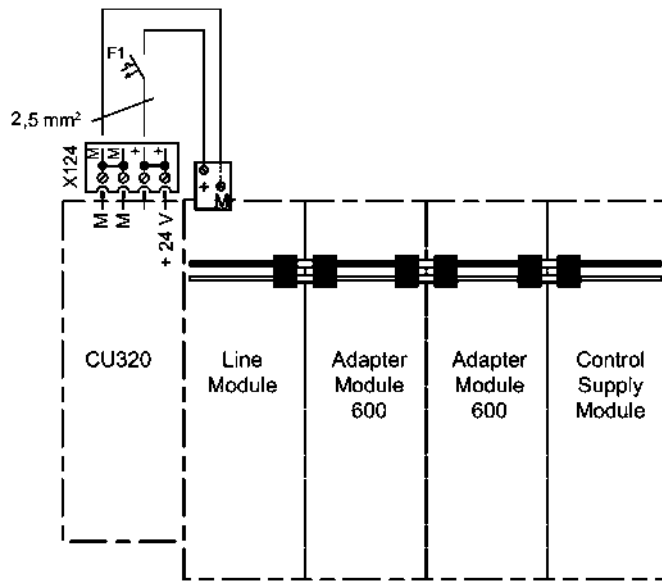


Figure 7-1 Example of a 24 V supply with Control Supply Module

When selecting the miniature circuit breakers, you must take into account the following standards:

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

In so doing, the following conditions for the cables must be taken into consideration:

- Ambient temperature 55 °C
- Limit conductor temperature, 75 °C for operation with the rated load current
- Cable lengths, max.:
  - 10 m for supply cables
  - 30 m for signal cables

Furthermore, the cables should be routed so that

- no more than one conductor pair is bundled and
- the 24 V cables are routed separately away from other cables and conductors that could carry the operating current.

### Using an external 24 V power supply

When using an external 24 V power supply, e.g. SITOP, the 24 V terminal adapter must be used. The external power supply should be located very close to the load (max. cable length 10 m). We recommend using miniature circuit breakers with tripping characteristic D as overcurrent protection devices for the cables and busbars. The ground potential M must be connected to the protective conductor system (DVC A).

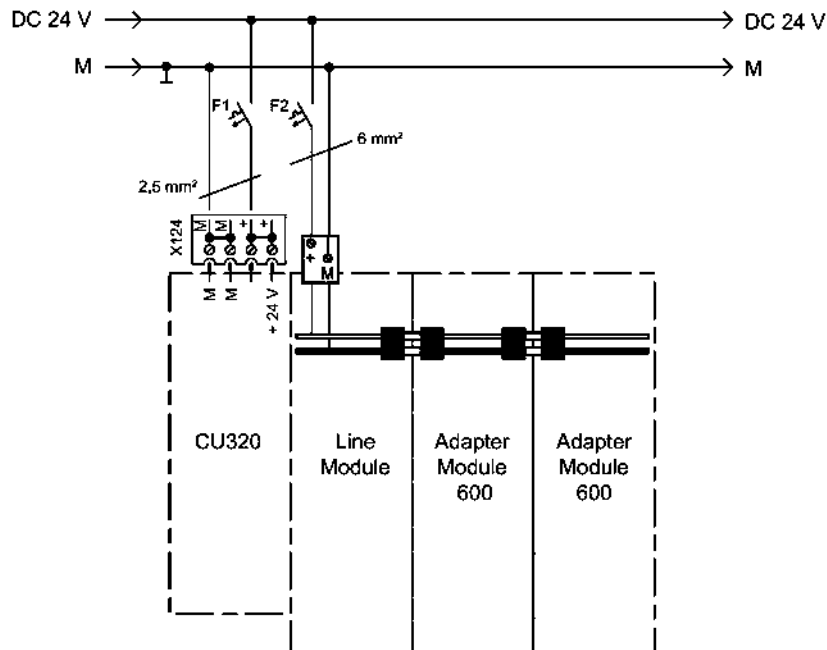



Figure 7-2 Example of an external 24 V power supply

### Using the red 24 V connectors

- A 24 V connector must be plugged onto the 24 V busbar between the Line Module, Adapter Module 600 and DC-link component.
- Attachment and removal are only permissible in a no-voltage state.
- A maximum of 5 attachment and removal cycles are permissible.

### 7.2.3 X24 24 V terminal adapter

Table 7- 1 Terminal strip X24

	Terminal	Designation	Technical data
	+	24 V power supply	24 VDC supply voltage
	M	Ground	Electronics ground

The 24 V terminal adapter is not included in the scope of delivery of the Adapter Module 600. It is included in the scope of delivery of the Line Modules and Control Supply Modules (article number: 6SL3162-2AA00-0AA0).

Maximum cross section that can be connected: 6 mm<sup>2</sup>

Type: Screw terminal 5 (see Chapter "Connectable conductor cross-sections for screw terminals (Page 135)")



<p><b>⚠ WARNING</b></p> <p><b>Danger to life due to electric shock when connecting and disconnecting 24 V terminal adapters and 24 V connections in operation</b></p> <p>When opening plug connections in operation, arcs can result in severe injury or death.</p> <ul style="list-style-type: none"> <li>• Only connect or disconnect the connections in a no-voltage state.</li> <li>• Only remove the 24 V terminal adapter vertically in relation to the front plate.</li> <li>• Disconnect and connect the connections a maximum of 5 times in a row.</li> </ul>
--

**Note**

You can find other versions of 24 V terminal adapters and 24 V connections in Chapter Adapter Module AM600/Electrical connection (Page 62).

## 7.2.4 Installing the 24 V terminal adapter

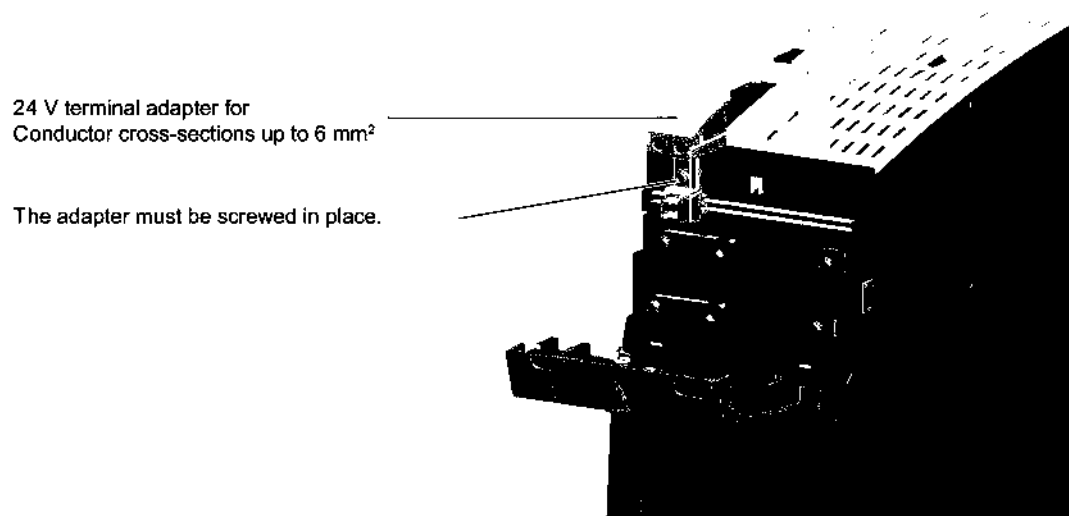


Figure 7-3 Mounted 24 V terminal adapter

The 24 V terminal adapter can be mounted on any Adapter Module 600. The corresponding cutout must be opened on the protective cover of the DC link using pliers. The 24 V terminal adapter is snapped on and is retained using the screw provided (tightening torque: 0.5 Nm).

Screw: SHR, PT-TORX K30-3, 0X16-ST-A2F WN1452 / company EJOT

The 24 V terminal adapter is suitable for connecting conductor cross-sections of 0.5 mm<sup>2</sup> up to 6 mm<sup>2</sup>. The 24 V terminal adapter and associated screw are included in the scope of delivery of the Line Modules and Control Supply Modules (article number 6SL3162-2AA00-0AA0).

### NOTICE

#### Damage caused by improper mounting of the 24 V terminal adapter

Improper mounting of the 24 V terminal adapter can cause it to be damaged.

- Do not connect or disconnect the 24 V terminal adapter when 24 V is applied.
- Only connect or disconnect the 24 V terminal adapter vertically in relation to the front panel.



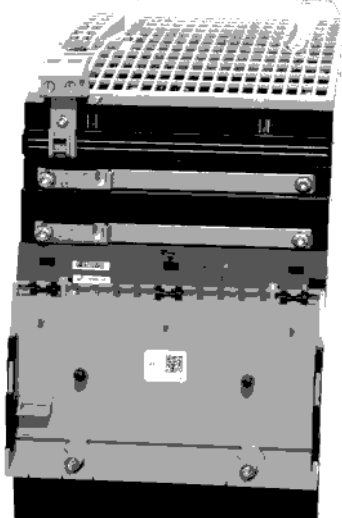
### Note

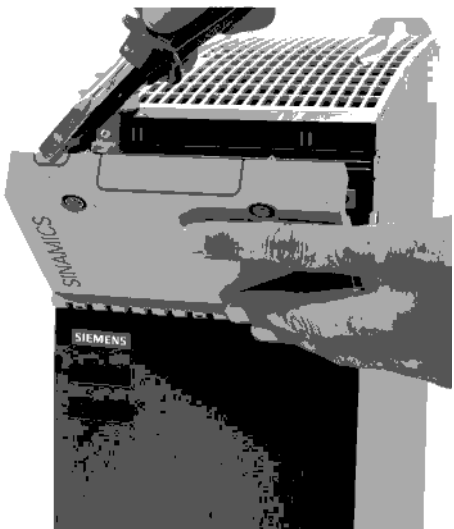
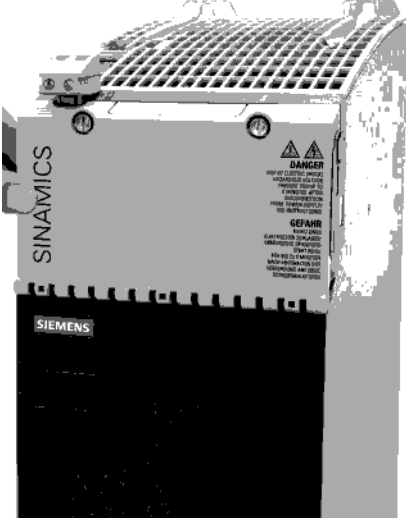
#### Fixing the 24 V terminal adapter

- Once attached, the 24 V terminal adapter must be screwed tight using the screw supplied.



Table 7-2 Mounting the 24 V terminal adapter using an Active Line Module (36 kW) as example

		
<p>Release the protective cover using a flat-bladed screwdriver 1 x 5.5</p>	<p>Open the protective cover</p>	<p>Attach and tighten the screws of the 24 V terminal adapter</p>

	
<p>Break out the cutout suitable pliers</p>	<p>Close the protective cover (the protective cover must audibly click into place)</p>

**Note****Mounting the 24 V terminal adapter on the component**

The 24 V terminal adapter should always be mounted to the left of the component located at the far left; if it is positioned anywhere else, there may not be enough space for the red 24 V jumpers.

If necessary, the 24 V terminal adapter can also be positioned on the right for 50 mm and 100 mm modules.

**Note****Replace the protective cover after removing the terminal adapter**

If the 24 V terminal adapter is removed, the protective cover whose cutout has been broken out must be replaced by a new one for safety reasons (article number: 6SL3162-3AC00-0AA1).

## 7.3 Connection system

### 7.3.1 Power/signal cables

#### Connection system S120M

The components of the S120M should be connected using DRIVE-CLiQ signal cables and Hybrid Cable.

Table 7- 3 Components of the S120M connection system

Designation	Article number
Hybrid Cable	6FX8002-7HYxx-xxxx
Hybrid Cabinet Bushing	6SL3555-2DA00-0AA0
DRIVE-CLiQ Extension	6SL3555-0AA00-6AB0
DRIVE-CLiQ cabinet bushing	6SL3066-2DA00-0AA0
DRIVE-CLiQ coupling	6SL3066-2DA00-0AB0

### Hybrid Cable

The Hybrid Cable (prefabricated hybrid cable) comprising DRIVE-CLiQ signal cable and signal/power cables.

Table 7- 4 Technical data of the Hybrid Cable 6FX8002-7HYxx-xxxx

Technical data	Unit	Value
Maximum permissible number of insertion cycles		50
Bending radii		
• Single bends	mm	≥60
• Multiple bends	mm	≥112.5
Tensile strength		
• Static	N/mm <sup>2</sup>	50
• Dynamic	N/mm <sup>2</sup>	20
Properties in the cable carrier		
• Minimum bending radius	mm	105
• Maximum permissible acceleration <sup>1)</sup>	m/s <sup>2</sup>	50
• Maximum traversing speed	m/min	300
• Bending cycles		5 000 000
• Permissible horizontal traversing path	m	50
• Angle of torsion	Grd	±30

1) depending on the traversing path (see the diagram below)

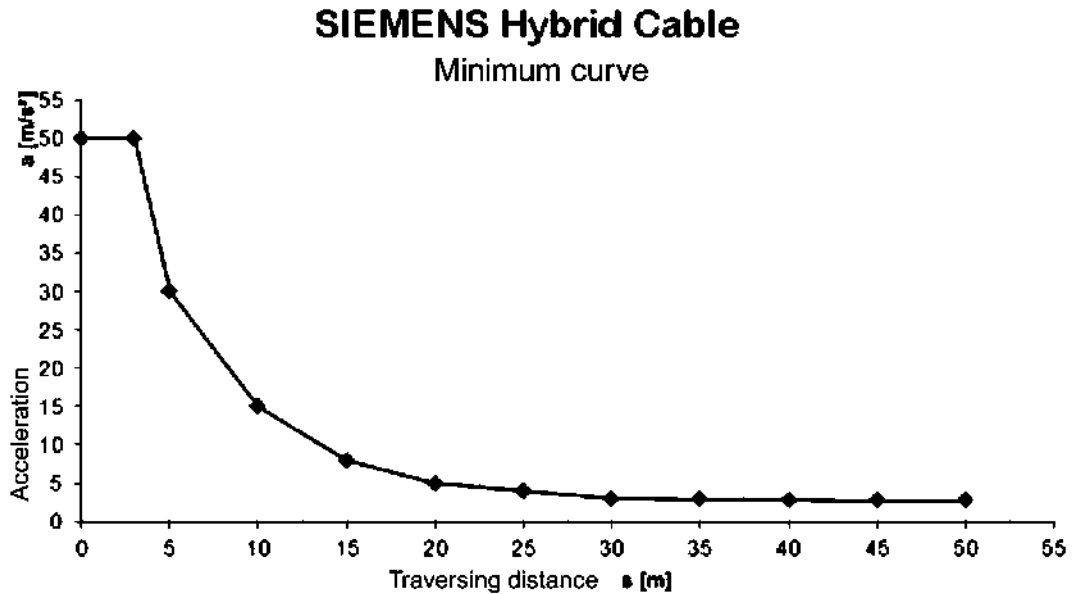


Figure 7-4 Hybrid Cable: acceleration as a function of the traversing path (minimum curve)

Table 7- 5 Core assignment

Designation/ Color	Meaning	Signal name	Cross-section [mm <sup>2</sup> ]	Load [A]
YE/PK/GN/BU	DRIVE-CLiQ signal cable (shielded)	DRIVE-CLiQ	(1x4xAWG22)/C	
RD	Electr. power supply	P48	2.5	10
BU	Ground (GND)	M	2.5	10
DCP	DC link voltage +	DCP	4	25
DCN	DC link voltage -	DCN	4	25
GN/YE	PE	PE	4	

### Derating characteristic

- If the cable is used at increased ambient temperatures (40 to 55 °C) then the DC link current must be appropriately reduced.

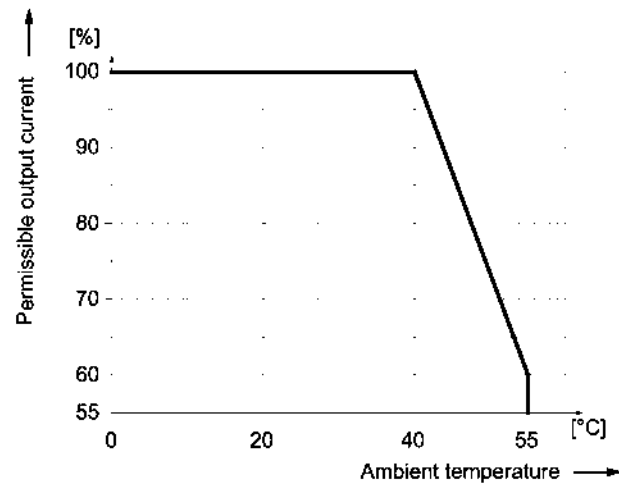


Figure 7-5 Output current as a function of the ambient temperature

The following prefabricated hybrid cables can be ordered to connect the components in the distributed drive line:

7.3 Connection system

MLFB position	6	F	X	8	0	0	2	-	7	H	Y	x	x	-	x	x	x	x
Cable outlet direction (hybrid connector):																		
NDE/NDE												0	0					
NDE/DE												1	1					
DE/DE												2	2					
Length code: (MLFB 13th position)																		
hundred meters	1 = 0 m	2 = 100 m														1, 2		
Length code: (MLFB 14th position)																		
ten meters	A = 0 m	B = 10 m ...	K = 90 m														A ...	K
Length code: (MLFB 15th position)																		
Meter	A = 0 m	B = 1 m ...	K = 9 m														A ...	K
Length code: (MLFB 16th position)																		
tenths of meters	0 = 0 m	1 = 0.1 m ...	8 = 0.8 m														0 ...	8

Figure 7-6 Hybrid Cable article number

Cable lengths for the prefabricated Hybrid Cable can be taken from the length code of the article number (MLFB).

The following Hybrid Cable MOTION-CONNECT can be used:

- Article number: 6FX8002-7HY00-□□□□ ⇒ cable outlet direction, NDE/NDE
- Article number: 6FX8002-7HY11-□□□□ ⇒ cable outlet direction, NDE/DE
- Article number: 6FX8002-7HY22-□□□□ ⇒ cable outlet direction, DE/DE

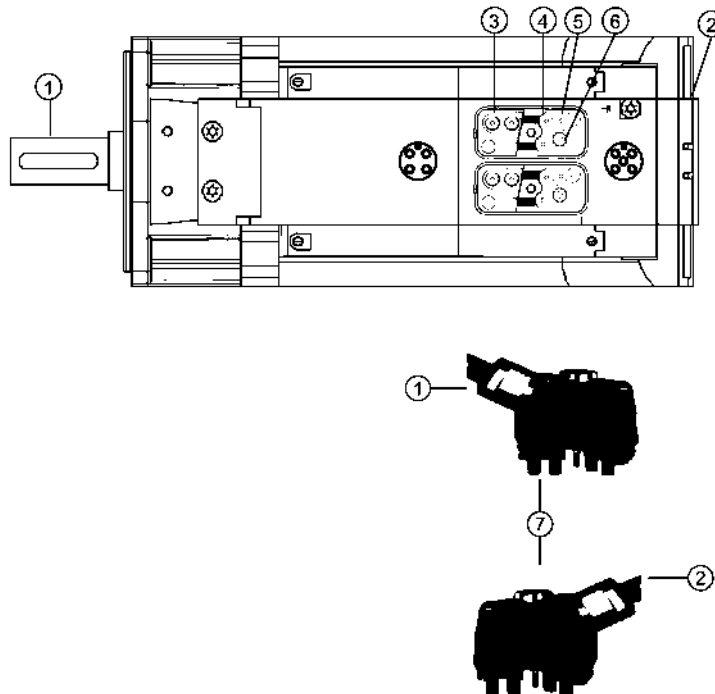
See also

Position of the S120M in the line (Page 141)

Several Control Units and DRIVE-CLiQ Extension (Page 144)

## Hybrid Cable, outlet versions

The following outlet versions of the hybrid connector at the Hybrid Cable are possible:



- ① DE of the S120M
- ② NDE of the S120M
- ③ Connection for the centrally generated DC link voltage
- ④ Connection for the electronic power supply 48 V DC
- ⑤ PE connection
- ⑥ DRIVE-CLiQ connection
- ⑦ Hybrid connector outlet direction, DE or NDE at the S120M

Figure 7-7 Definition of the outlet version for the hybrid connector

### Note

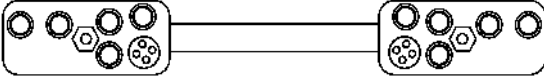
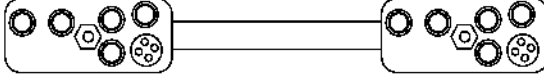
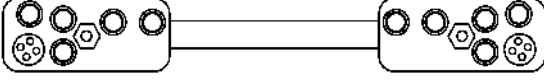
#### Hybrid cables with cable outlet at the B end at interface X3

If you use hybrid cables with cable outlet at the B end at the interface X3, then you must use M12 connectors with a maximum installation length of 50 mm or angled connectors.

### Hybrid Cable prefabricated

The following prefabricated Hybrid Cables can be used:

Table 7- 6 MOTION-CONNECT Hybrid Cable

Outlet directions	Article number
 <p>Hybrid Cable connector NDE/connector NDE</p>	6FX8002-7HY00-xxxx
 <p>Hybrid Cable connector NDE/connector DE</p>	6FX8002-7HY11-xxxx
 <p>Hybrid Cable connector DE/connector DE</p>	6FX8002-7HY22-xxxx

**⚠ WARNING**

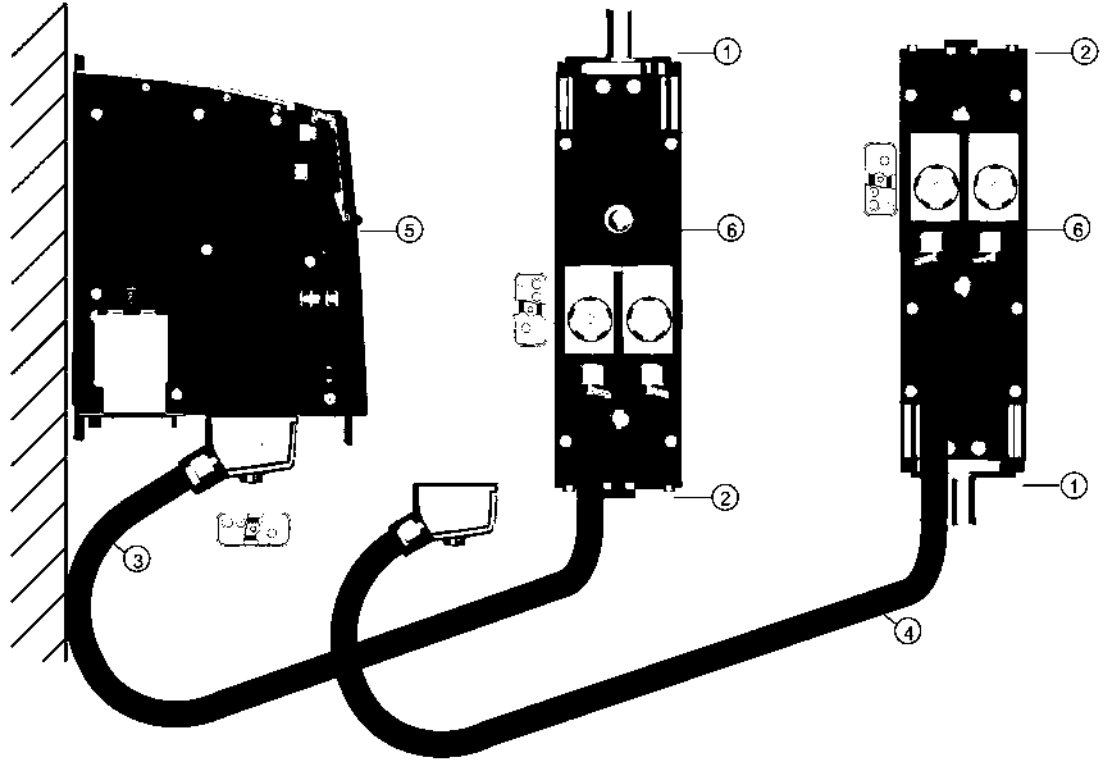
**Danger to life when changing over the plug inserts of prefabricated hybrid cables**

For prefabricated hybrid cables, it is not permissible to changeover the plug inserts. Hazardous touch voltages could occur, which could lead to severe injury or death.

- Always use prefabricated hybrid cables in the original state supplied from Siemens.

### 7.3.2 Connection via Hybrid Cable: AM600 - S120M

The following connection options are available from the Adapter Module 600 to the S120M using the Hybrid Cable:



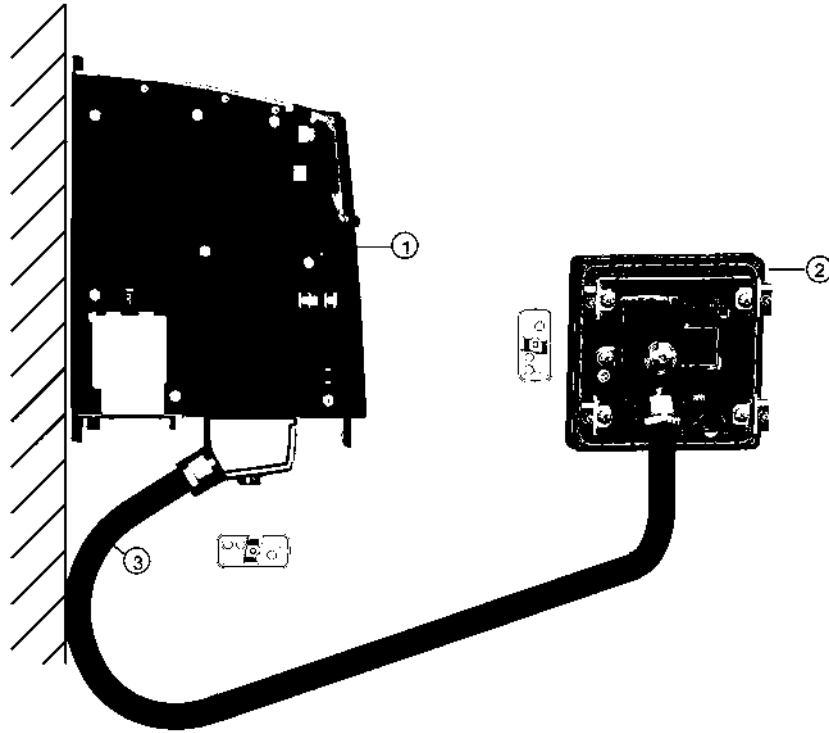
- ① DE of the S120M (DE S120M)
- ② NDE of the S120M (NDE S120M)
- ③ Hybrid Cable DE (AM600)/NDE (S120M) (6FX8002-7HY11-xxxx)
- ④ Hybrid Cable DE (AM600)/DE (S120M) (6FX8002-7HY22-xxxx)
- ⑤ Adapter Module 600 (AM600)
- ⑥ Mounting option, S120M

Figure 7-8 Hybrid Cable connection AM600 ↔ S120M



### 7.3.3 Connection via Hybrid Cable: AM600 - Hybrid Cabinet Bushing

The following connection option from the Adapter Module 600 (AM600) to the Hybrid Cabinet Bushing is possible using the Hybrid Cable (HCB):

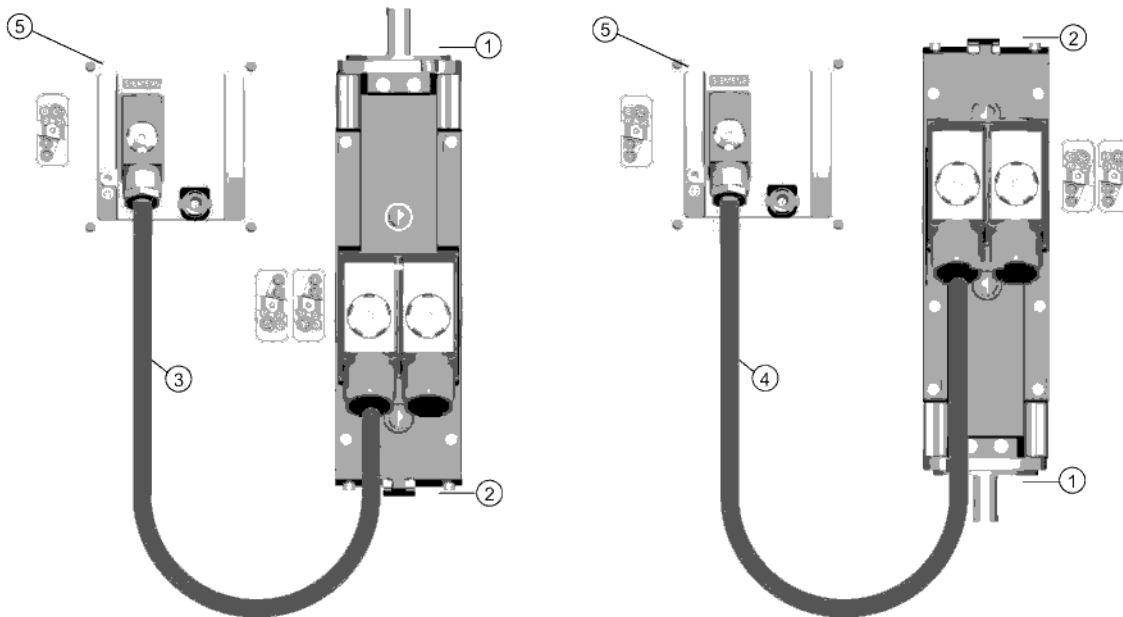


- ① Adapter Module 600
- ② Hybrid Cabinet Bushing, inner (control cabinet)
- ③ Hybrid Cable DE (AM600)/DE (HCB) (6FX8002-7HY22-xxxx)

Figure 7-9 Hybrid Cable connection AM600 ↔ HCB

### 7.3.4 Connection via Hybrid Cable: Hybrid Cabinet Bushing - S120M

The following connection options are possible from the Hybrid Cabinet Bushing (HCB) to the S120M using the Hybrid Cable:

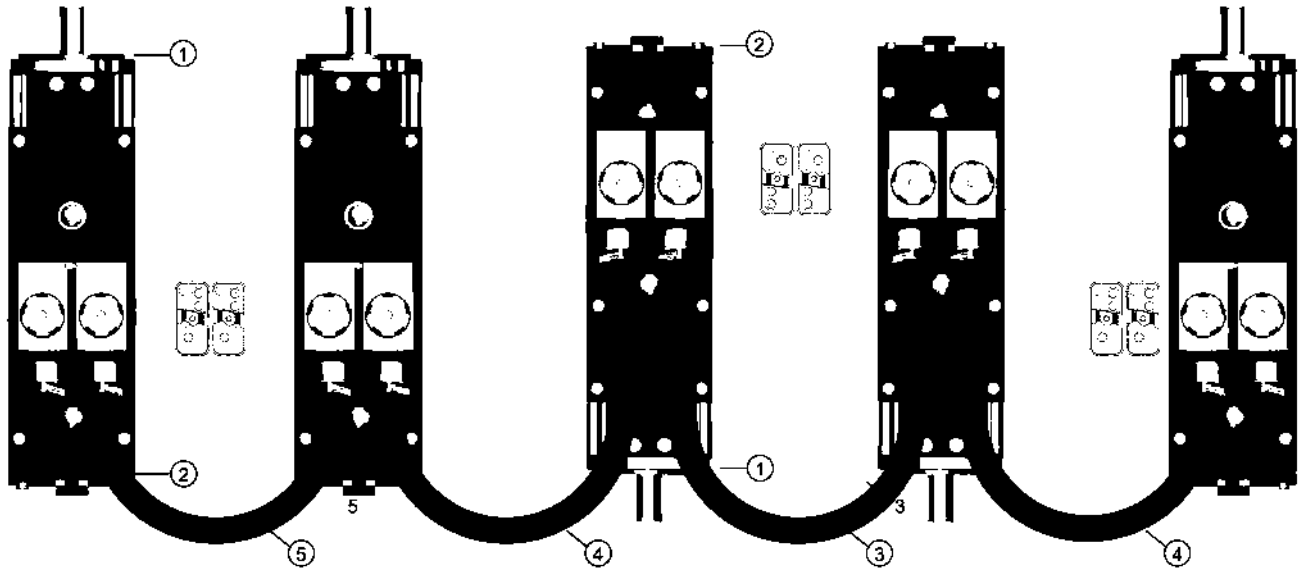


- ① DE of the S120M
- ② NDE of the S120M
- ③ Hybrid Cable DE (HCB)/NDE (S120M) (6FX8002-7HY11-xxxx)
- ④ Hybrid Cable DE (HCB)/DE (S120M) (6FX8002-7HY22-xxxx)
- ⑤ Hybrid Cabinet Bushing, outer (control cabinet)

Figure 7-10 Hybrid Cable connection HCB ⇔ S120M

### 7.3.5 Hybrid Cable connection at the S120M

The following connection options are possible at the S120M using the Hybrid Cable:

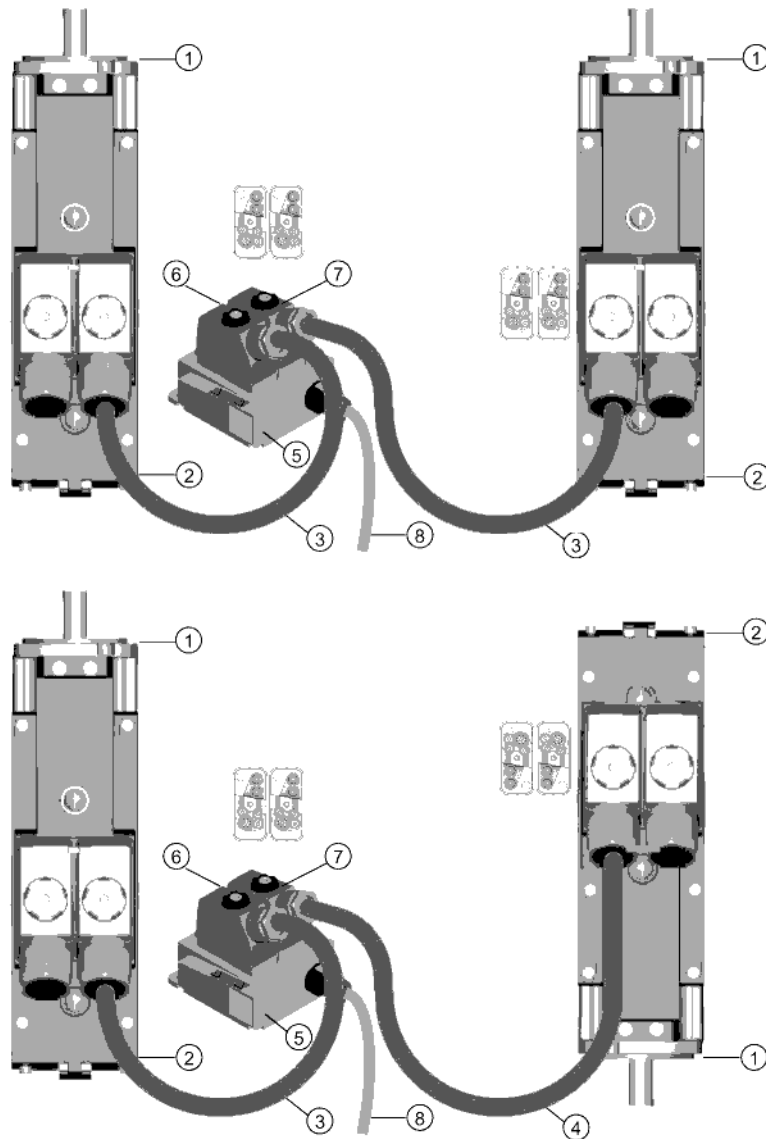


- ① DE of the S120M
- ② NDE of the S120M
- ③ Hybrid Cable DE (S120M)/DE (S120M) (6FX8002-7HY22-xxxx)
- ④ Hybrid Cable NDE (S120M)/DE (S120M) (6FX8002-7HY11-xxxx)
- ⑤ Hybrid Cable NDE (S120M)/NDE (S120M) (6FX8002-7HY00-xxxx)

Figure 7-11 Hybrid Cable motor outlets

### 7.3.6 Hybrid Cable connection at DRIVE-CLiQ Extension

The following connection options are possible from the S120M to DRIVE-CLiQ Extension using the Hybrid Cable:



- ① DE of the S120M
- ② NDE of the S120M
- ③ Hybrid Cable NDE/NDE (6FX8002-7HY00-xxxx)
- ④ Hybrid Cable NDE/NDE (6FX8002-7HY11-xxxx)
- ⑤ DRIVE-CLiQ Extension
- ⑥ Input (from the previous S120M)
- ⑦ Output (to the next S120M)
- ⑧ DRIVE-CLiQ cable connection

Figure 7-12 Examples, Hybrid Cable connection, DRIVE-CLiQ Extension ↔ S120M

### 7.3.7 Maximum cable length for distributed S120M drive technology

The table below provides an overview of the maximum permissible cable lengths for the distributed S120M drive technology.

Table 7- 7 Maximum cable lengths

Type	Maximum length [m]
DRIVE-CLiQ signal cables MC500	100
DRIVE-CLiQ signal cables MC800PLUS	75
Hybrid Cable between Adapter Module 600 and the first S120M	75 <sup>2)</sup>
Hybrid Cable connection two S120M	75
Hybrid Cable line length	Max. 100
24 VDC supply cables <sup>1)</sup>	10
24 V signal cables <sup>1)</sup>	30
Cables for digital input/outputs at the AM600 and S120M	30

- 1) For longer lengths, the user must connect a suitable protective circuit in order to provide overvoltage protection (refer to the chapter "Overvoltage protection" under "24 VDC supply")
- 2) First segment: Length, including the connection from the AM600 to the Hybrid Cabinet Bushing and the first S120M.

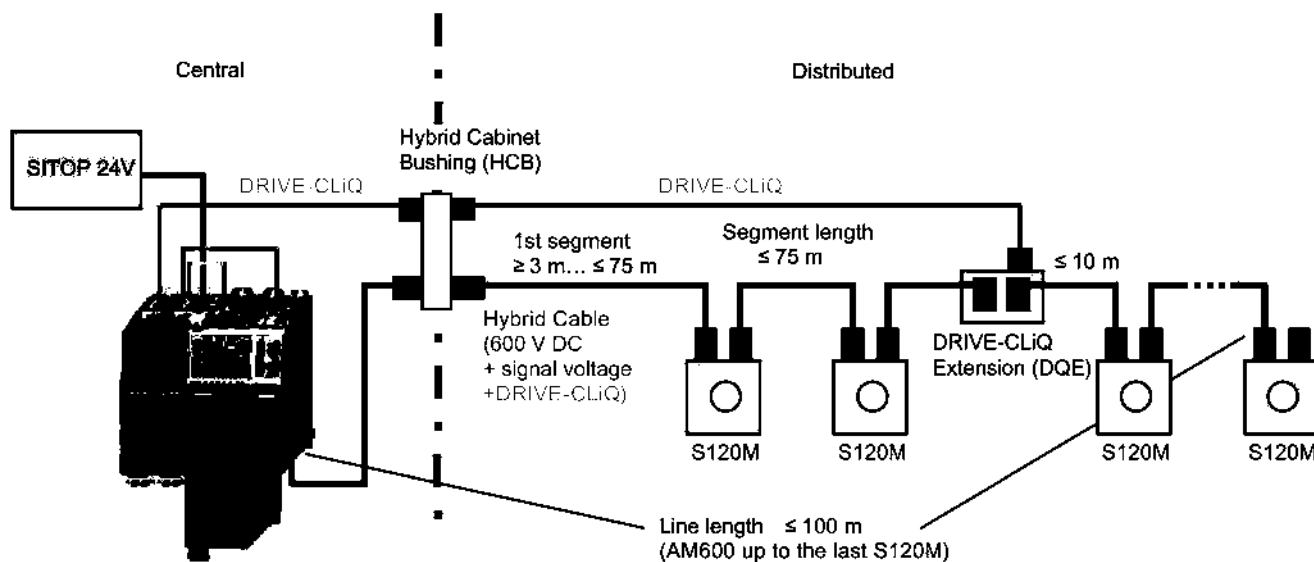


Figure 7-13 Cable lengths

If DRIVE-CLiQ Extension (DQE) and/or Hybrid Cabinet Bushing (HCB) are used, the permissible cable length can be calculated as follows:

$$\Sigma \text{ Hybrid} + n_c \cdot 5 \text{ m} \leq 100 \text{ m}$$

$\Sigma$  Hybrid: Total length of all Hybrid Cable sections

$$\Sigma \text{ MOTION-CONNECT 500} = \text{standard length} - \text{segment DQE to following S120M} - n_c \cdot 5 \text{ m}$$

$$\Sigma \text{ MOTION-CONNECT 800PLUS} = \text{standard length} - \text{segment DQE to following S120M} - n_c \cdot 5 \text{ m}$$

$n_c$ : Number of DQE (theoretically unrestricted) + number of HCB (0-3 max.)

Example of MOTION-CONNECT 500 (segment length 10 m, 1 DQE, 1 HCB):

$$100 \text{ m} - 10 \text{ m} - 5 \text{ m} \cdot 2 = <100 \text{ m}$$

### 7.3.8 Connectable conductor cross-sections for screw terminals

The type of screw terminal can be taken from the interface description of the particular component.

Table 7- 8 Screw terminals

Screw terminal type			
1 (X21 AM600)	Connectable conductor cross-sections	Rigid, flexible With wire end ferrule, without plastic sleeve	0.08 mm <sup>2</sup> to 1.5 mm <sup>2</sup> 0.25 mm <sup>2</sup> to 1.5 mm <sup>2</sup>
		With wire end ferrule, with plastic sleeve	0.25 mm <sup>2</sup> to 0.5 mm <sup>2</sup>
	Stripping length	7 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	
	Tightening torque	0.22 to 0.25 Nm	
5 (X24) (24 V terminal adapter)	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve	0.5 mm <sup>2</sup> to 6 mm <sup>2</sup> 0.5 mm <sup>2</sup> to 6 mm <sup>2</sup>
		With wire end ferrule, with plastic sleeve	0.5 mm <sup>2</sup> to 6 mm <sup>2</sup>
	Stripping length	12 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.2 to 1.5 Nm	

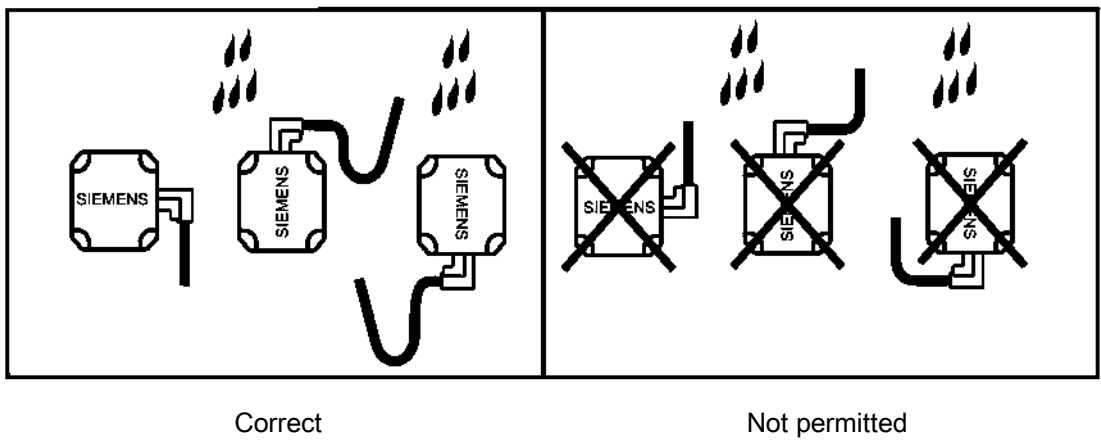
### 7.3.9 Routing cables in a damp environment

**NOTICE**

**Damage to the S120M due to incorrect cable routing in a humid environment**

Incorrect cable routing can allow moisture to enter the housing of the S120M, which can lead to failures and damage.

- In a humid environment, route the power and signal cables only as shown in the diagram below.



### 7.3.10 DRIVE-CLiQ signal cables

#### DRIVE-CLiQ signal cables in the central S120M drive area

The DRIVE-CLiQ signal cables specified in the SINAMICS S120 "Booksize Power Units" Equipment Manual (GH2) should be used to connect DRIVE-CLiQ to the Adapter Module 600 in the SINAMICS S120 control cabinet.

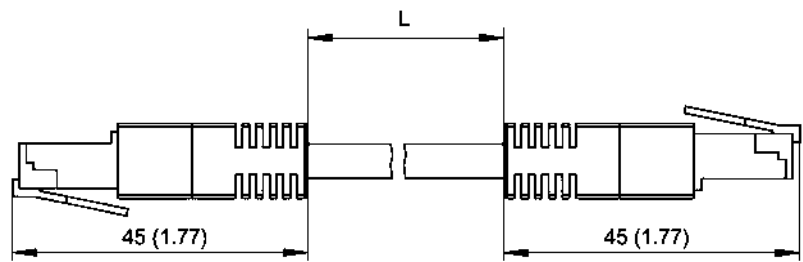


Figure 7-14 Drive-CLiQ signal cable

## DRIVE-CLiQ signal cables in the distributed S120M drive area

In the distributed drive area of the S120M, a DRIVE-CLiQ signal cable is required for the following connections:

- From the central Control Unit to the Hybrid Cabinet Bushing (degree of protection of the connectors, IP20 to IP20)
- From the central Control Unit to the DRIVE-CLiQ Extension (degree of protection of the connectors, IP20 to IP65)
- From the Hybrid Cable Bushing to the DRIVE-CLiQ Extension (degree of protection of the connectors, IP65 to IP65)

### Note

#### Connecting signal cables

Only MOTION-CONNECT DRIVE-CLiQ cables may be used for connections.

The maximum cable length is:

- MOTION-CONNECT 500 cables: 100 m
- MOTION-CONNECT 800PLUS cables: 75 m

## Using DRIVE-CLiQ signal cables

The following DRIVE-CLiQ signal cables MOTION-CONNECT can be used:

- Article number: 6FX5002-2DC□□ or 6FX8002-2DC□□  
⇒ cable quality MOTION-CONNECT 500 or MOTION-CONNECT 800PLUS
- Article number: 6FX□002-2DC10-□□□□  
Cable ends: Connector degree of protection IP20 ⇒ connector IP67
- Article number: 6FX□002-2DC20-□□□□  
Cable ends: Connector degree of protection IP67 ⇒ connector IP67

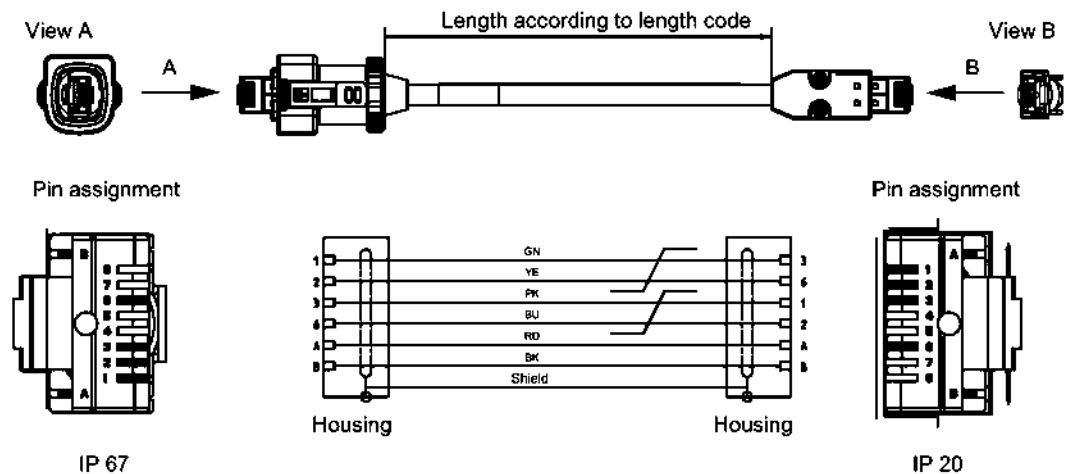
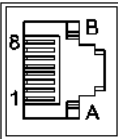


Figure 7-15 DRIVE-CLiQ signal cable for distributed connections (here: 6FX□002-2DC10-□□□□)



7.3 Connection system

Table 7-9 DRIVE-CLiQ connector (pin assignment)

	Terminal	Signal name	Technical data
 <p>DRIVE-CLiQ</p>	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 VDC power supply
	B	GND (0 V)	Electronics ground

## 7.4 Potential equalization

### Protective connections for a central components (AM600)

The SINAMICS S Booksize drive system and the Adapter Module 600 (AM600) are designed for use in cabinets with a PE conductor connection.

The protective conductor connection of the SINAMICS components must be connected to the protective conductor connection of the control cabinet as follows:

Table 7- 10 Conductor cross-section for copper protective connections

Line supply cable in mm <sup>2</sup>	Copper protective connection in mm <sup>2</sup>
Up to 16 mm <sup>2</sup>	The same as the line supply cable
From 16 mm <sup>2</sup> to 35 mm <sup>2</sup>	16 mm <sup>2</sup>
From 35 mm <sup>2</sup>	0.5 • line supply cable

For materials other than copper, the cross-section should be increased so that as a minimum, the same conductivity is attained.

All system components and machine parts must be incorporated in the protection concept.

The drive line-up must be arranged on a common bare metal mounting plate in order to comply with the EMC limit values. The mounting plate must be connected to the protective conductor connection of the control cabinet through a low impedance.

### Protective equalization for a central components (AM600)

A mounting plate serves simultaneously as potential equalization surface. This means that no additional equipotential equalization is required within the drive line-up.

If a common bare metal mounting plate is not available, then equally good potential equalization must be established using cable cross-sections as listed in the table above or, as a minimum, with the same conductivity.

### Protective connections/potential equalization for distributed components

- The distributed components are designed for use with a connected protective conductor.
- All system components and machine parts must be incorporated in the protection concept.
- Ensure that the following protective conductor connection paths are available:
  - Via the Hybrid Cable.
  - Via the PE connection. In this case, the protective conductor cross-section must be  $\geq 4 \text{ mm}^2$ .

Each of these connections must be suitable as a protective connection.

## 7.5 Layout of the components

### 7.5.1 General

The arrangement of the components and equipment takes account of

- Space requirements
- Cable routing
- Bending radii of connecting cables
  - For MOTION-CONNECT cables, refer to catalog PM21 and/or NC61
  - Hybrid Cable: static 60 mm, dynamic 112.5 mm
- Heat dissipation
- EMC

The central components of the drive line-up should preferably be installed on a conductive mounting surface to ensure a low impedance between the component and the mounting surface. Mounting plates with a galvanized surface are suitable.

Components are usually located centrally in a cabinet. The necessary mounting and installation clearances above and below the components can, under certain circumstances, exceed the minimum clearances specified in the product documentation.

The components can be arranged in one or more tiers. In a multiple-tier arrangement, vertical installation or, in a cabinet row, side-by-side installation in different cabinet sections is possible.

To determine the cross-section, use the DC link busbar current carrying capacity specified in the relevant technical data.

A ventilation clearance of 100 mm must be maintained around the line reactor (not including the mounting surface).

### 7.5.2 Current carrying capacity of the DC link busbar

The current carrying capacity of the DC link busbar must be observed for the configuration and arrangement of the drive line-up.

Table 7- 11 Maximum current carrying capacity of the DC link busbar

Current carrying capacity of the DC link busbar	Components
100 A	<ul style="list-style-type: none"> <li>• Motor Modules from 50 mm to 100 mm wide</li> <li>• DC link components</li> </ul>
150 A	<ul style="list-style-type: none"> <li>• Motor Modules from 50 mm to 100 mm wide with reinforced DC link busbars</li> </ul>
200 A	<ul style="list-style-type: none"> <li>• Motor Modules from 150 mm to 300 mm wide</li> </ul>

To calculate the load of the DC link busbar, the DC link currents  $I_d$  are added for:

- central and distributed, mixed operation
  - connected Motor Modules and Adapter Module 600
- Distributed servo drive technology
  - connected Adapter Module 600

If the current carrying capacity of the DC link busbar is exceeded for the planned configuration, two solutions are possible:

- Center infeed: arrangement of the drive line-up with infeed from left and right
- Another Line Module should be used

A center infeed with Motor Modules to the right and left of the Line Module can be configured for all Line Modules, taking into account the current carrying capacity.

Exception: Smart Line Modules 5 kW and 10 kW

---

**Note****Drive line-up structure**

For Smart Line Modules 5 kW and 10 kW, the drive line-up must be arranged to the right.

---

### 7.5.3 Several Adapter Modules 600

It is possible to use several Adapter Modules 600.

In this case, the AM600 should preferably be arranged to the far right in the module sequence.

### 7.5.4 Position of the S120M in the line

In a distributed drive line, the S120M can be installed as required.

Recommendation: Install the S120M with the highest power ratings at the beginning, and those with low power ratings at the end of the line.

Short cable lengths are advantageous.

**See also**

Overview of distributed S120M components (Page 40)

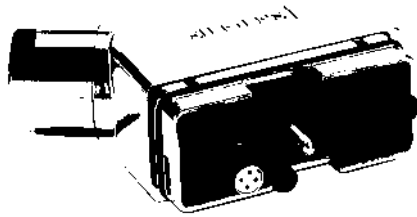
Power/signal cables (Page 123)

### 7.5.5 Line termination with the hybrid connector

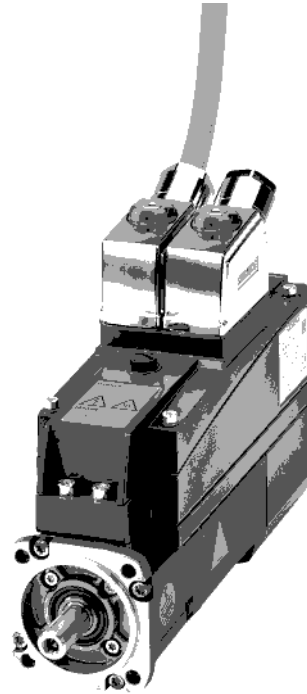
The line terminating connector (hybrid connector) is used to secure the degree of protection of the last node of a line.

It must be installed. Operation without line terminating connector is not permissible.

An alarm is output if a line with distributed drives is not terminated using a line terminating connector.



Line Termination Plug



S120M with Line Termination Plug

After inserting the line terminating connector, tighten it using the tool provided so that it cannot be released.


- Tool: Allen key
- Tightening torque: 3.0 Nm

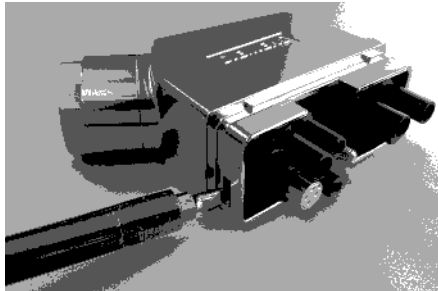
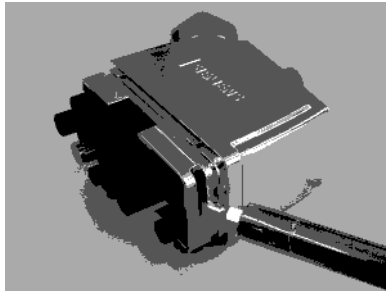
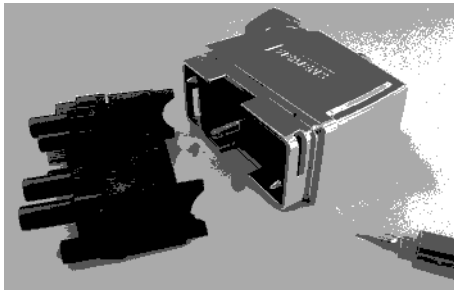
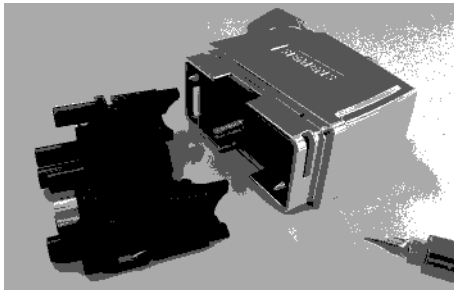
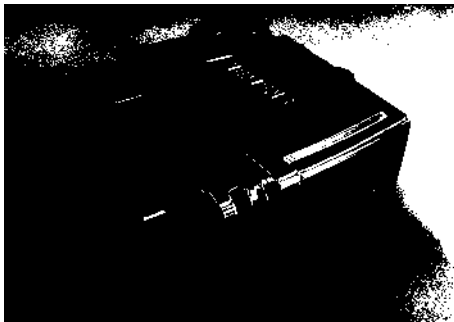
The line terminating connector is included in the package enclosed with the AM600.

Missing line terminating connectors can be reordered as spare parts using the following article number: 6SL3566-2DC00-0AA0.

**Changing over the outlet direction of the line terminating connector**

If you require a line terminating connector in the opposite outlet direction, then you can change this yourself by rotating the plug insert through 180°.

 <b>WARNING</b>
<p><b>Danger to life when changing over the plug inserts of prefabricated hybrid cables</b></p> <p>For prefabricated hybrid cables, it is not permissible to change over the plug inserts (see Hybrid Cable (Page 123)). Hazardous touch voltages could occur, which could lead to severe injury or death.</p> <ul style="list-style-type: none"> <li>• Only change over plug inserts for line terminating connectors.</li> </ul>

	
<p>Press the latch at one side using a slotted screwdriver or similar tool – and push out the plug insert by approx. 2 mm.</p>	<p>Repeat this operation for the second latch.</p>
	
<p>Remove the plug insert.</p>	<p>Rotate the plug insert through 180°.</p>
	
<p>Push the plug insert into the housing until it audibly snaps into place.</p>	

### 7.5.6 Several Control Units and DRIVE-CLiQ Extension

It is possible to use several Control Units and DRIVE-CLiQ Extensions. This should be configured if more than the maximum permissible number of S120Ms are operated on the same line.

In this case, the shortest possible Hybrid Cable downstream of the DQE (< 10 m) should be used for the first axis.

#### See also

Power/signal cables (Page 123)

Technical data (Page 106)

### 7.5.7 Mixed configurations comprising central and distributed S120 versions

It is possible to combine central and distributed S120 versions.

#### See also

Introduction (Page 26)

## Service and maintenance

### 8.1 Spare parts

Spare parts are available on the Internet at:

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

### 8.2 Replacing components

#### 8.2.1 Safety instructions

 **WARNING**

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

If the fundamental safety instructions and remaining risks in Chapter 1 are not observed, accidents involving severe injuries or death may occur.

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

 **WARNING**

**Danger to life when transporting devices and components**

Serious injury or even death and substantial material damage can occur if the devices are not lifted or transported properly.

- When transporting the devices and replacing components, observe the following:
  - Some of the devices and components are heavy (e.g. > 30 kg) and top-heavy.
  - Due to their weight, the devices must be handled with care by trained personnel.



## **8.2.2 Replacing an AM600**

### **Preparatory steps**

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Adapter Module 600.
- Wait 5 minutes
- Check that the device really is in a no voltage condition
- Open the DC link cover

## Replacing an Adapter Module 600

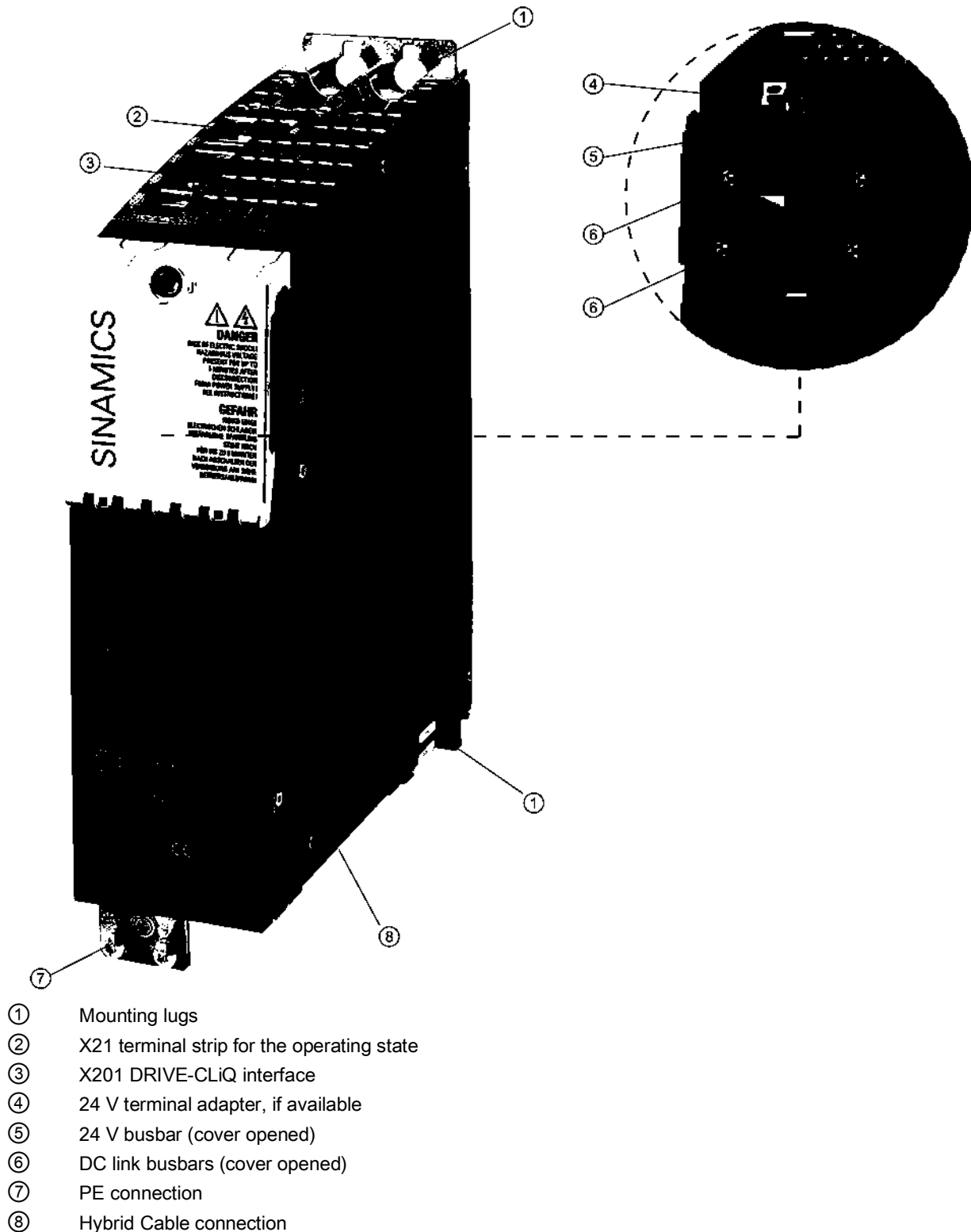


Figure 8-1 Replacing an Adapter Module 600

### Removal steps

1. Remove the Hybrid Cable from X1 ⑧ (1 connector).
2. Release the connection to the DC link (DC link clip) ⑥ (4 screws).
3. Remove the DRIVE-CLiQ from X201 ③ and connections at X21/X24 ②/④ (3 connectors).
4. Remove the 24 V connector ⑤ from the Adapter Module.
5. Remove the connection from PE ⑦.
6. Remove the bracket of the Adapter Module ① (2 nuts).

The Adapter Module 600 can then be carefully withdrawn.

#### NOTICE

##### Damage to the signal cables when replacing the AM600

Signal cables can be damaged if the Adapter Module 600 is withdrawn carelessly.

- When withdrawing the Adapter Module 600, ensure that you do not damage any signal cables.

### Installation steps

Installing follows the same steps as removing, but in reverse order.

#### NOTICE

##### Equipment damage due to unsuitable tightening torques

Unsuitable tightening torques can cause damage to components.

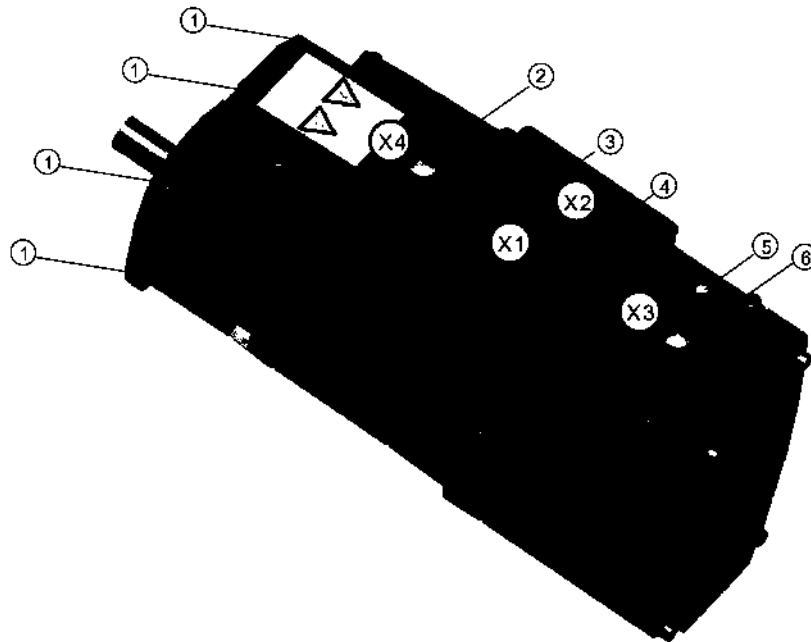
- The tightening torques specified in the table Screw terminal in Chapter "Connectable conductor cross-sections for screw terminals (Page 135)" must be observed.
- Carefully insert the plug connections and the 24 V connector and ensure that they are secure.
- Attach the Hybrid Cable using the appropriate tool (Allen key, tightening torque 3.0 Nm) and check that the connections are secure.

### 8.2.3 Replacing a S120M

#### Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the S120M.
- Check that the device is in a no-voltage condition

#### Replacing a S120M



- ① Mounting holes
- ② M12 socket to externally release the brake
- ③ Hybrid Cable connection
- ④ Hybrid Cable connection
- ⑤ PE connection
- ⑥ M12 socket to connect actuators and sensors

Figure 8-2 Replacing a S120M

**NOTICE**

**Damage to the S120M if opened**

The S120M can be seriously damaged and rendered inoperable if it is opened.

- Do not open the S120M.

As a consequence, it is not permissible for users to replace the encoder in the S120M.

**Removal steps**

1. Remove the Hybrid Cable from X1/X2 ③/④ and connections from X3/X4 ②/⑥ (4 connectors)
2. Remove the connection from PE ⑤
3. Remove the attachment of the S120M to the machine ① (4 screws)

The S120M can then be withdrawn.

**NOTICE**

**Damage to the signal cables when replacing the S120M**

Signal cables can be damaged when the S120M is disassembled.

- When withdrawing the S120M, ensure that you do not damage any signal cables.

**Installation steps**

Installing follows the same steps as removing, but in reverse order.

**NOTICE**

**Equipment damage due to unsuitable tightening torques**

Unsuitable tightening torques can cause damage to components.

- Carefully insert the plug connections and ensure that they are secure.
- Attach the Hybrid Cable using the appropriate tool (Allen key, tightening torque 3.0 Nm) and check that the connections are secure.

## 8.2.4 Replacing a fuse in the Adapter Module 600

### Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Adapter Module 600 (AM600).
- Check that the device is in a no-voltage condition

The fuses to protect the conductors of the Hybrid Cable are integrated in the Adapter Module 600.



#### DANGER

##### **Danger to life due to electric shock when replacing a fuse**

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

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

- Switch the power supply off before replacing the fuse.
- Wait at least 5 minutes after switching off.
- Before starting any work, also check that the system is in a voltage-free state by measuring at the DC link terminals DCP and DCN.
- Only use the following replacement fuses:
  - SIBA
  - Type URZ 14 x 51 mm, gR 800 VDC, 32 A
  - Part No. 5012006
  - Siemens article number: 6SL3566-7DA00-0AA0.

### Replacing a fuse in the AM600

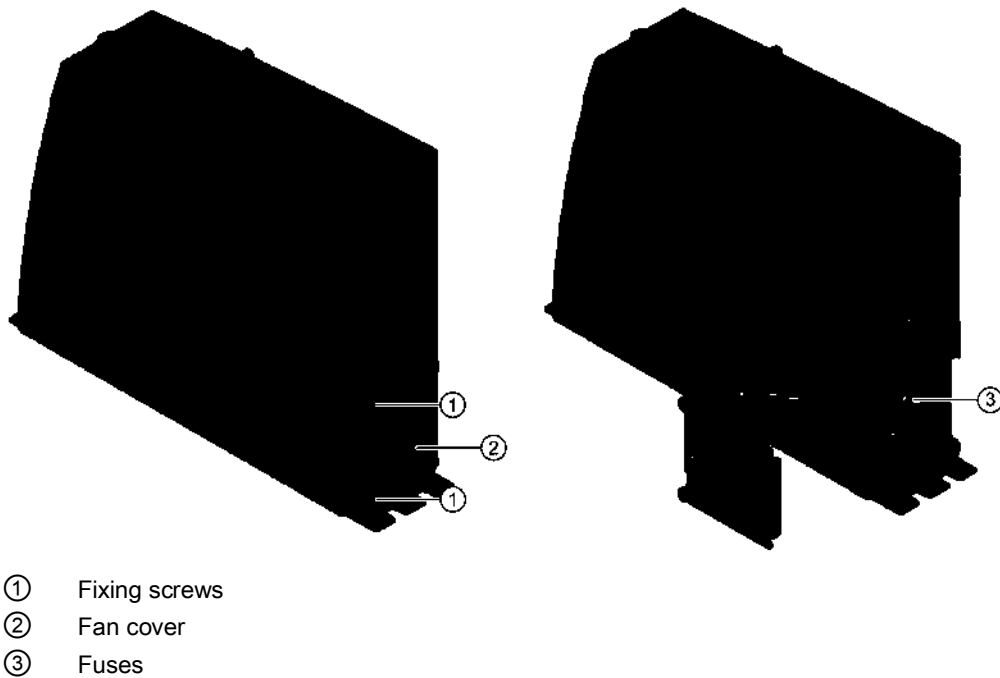


Figure 8-3 Replacing a fuse in the AM600

#### Removal steps

1. Open the fan cover using a tool ① (slotted screwdriver or Torx screwdriver).
2. Open the fan cover ②.
3. Remove the fuse ③ by hand. Both fuses must always be replaced together.

#### Installation steps

Installing follows the same steps as removing, but in reverse order.

---

#### Note

##### Checking the fastenings

Attach the fan cover using the appropriate tool (slotted screwdriver or Torx screwdriver), tightening to 1.8 Nm, and check that the connections are secure.

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## 8.2.5 Replacing a fan in the Adapter Module 600

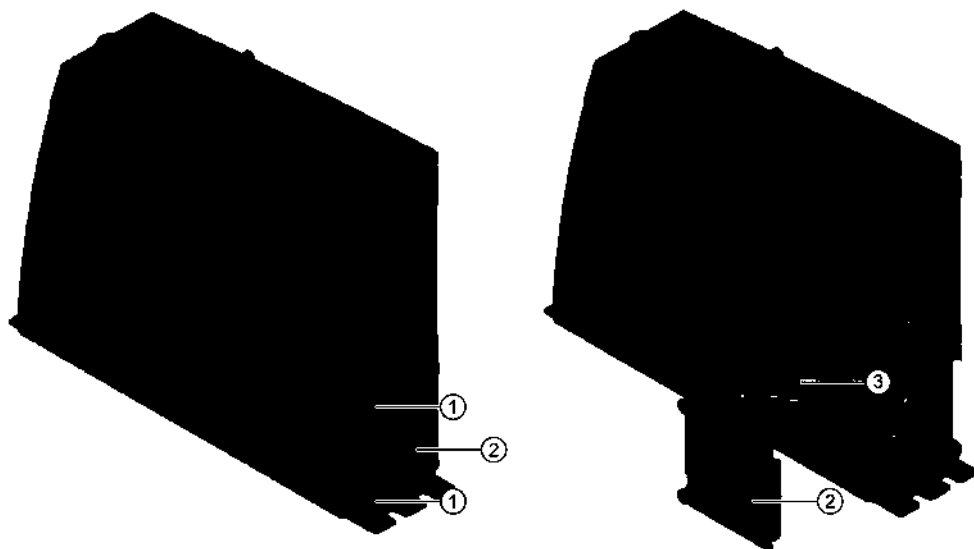
### Preparatory steps

- Disconnect the drive line-up from the power supply
- Allow unimpeded access to the Adapter Module 600 (AM600).
- Check that the device is in a no-voltage condition



<b>⚠ DANGER</b>
<b>Danger to life due to electric shock when replacing a fan</b>
Because of the DC link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off.
Contact with live parts can result in death or serious injury.
<ul style="list-style-type: none"><li>• Switch the power supply off before replacing the fan.</li><li>• Wait at least 5 minutes after switching off.</li><li>• Before starting any work, also check that the system is in a voltage-free state by measuring at the DC link terminals DCP and DCN.</li><li>• Only use the following fan module with fans:<ul style="list-style-type: none"><li>– Siemens article number: Fan module AM600 6SL3566-0AA00-0AA0</li></ul></li></ul>

### Replacing a fan in the AM600



- ① Fixing screws
- ② Fan cover
- ③ Fan connector

Figure 8-4 Replacing a fan in the AM600



### Removal steps

1. Open the fan cover using a tool ① (slotted screwdriver or Torx screwdriver).
2. Open the fan cover ②.
3. Withdraw the fan connector ③ (cable).
4. Remove the front cover with fan ② from the locating lugs

### Installation steps

1. Insert the new fan cover with fan ② in the locating lugs.
2. Insert the fan connector ③
3. Close the front cover ② and fix using the captive screws provided.

---

#### Note

#### Checking the fastenings

Attach the fan cover using the appropriate tool (slotted screwdriver or Torx screwdriver), tightening to 1.8 Nm, and check that the connections are secure.

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## 8.3 Forming the DC link capacitors

### 8.3.1 Central components (AM600)

#### Description

When DC link capacitors are formed, a defined voltage is connected to them and a defined current flows so that the appropriate capacitor characteristics are restored for them to be re-used as DC link capacitors.

<b>NOTICE</b>
<b>Damage to components when operating the AM600 after an extended period in storage</b>
If the AM600 is kept in storage for more than 2 years, the DC link capacitors must be re-formed. If this is not performed, the units could be damaged when they are switched on. <ul style="list-style-type: none"><li>• Form an AM600 after it has been in storage for more than two years.</li><li>• Make sure that the storage period is calculated from the date of manufacture and not from the date that the equipment was shipped.</li></ul>



If the device 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.

## Date of manufacture

The date of manufacture can be determined from the following assignment to the serial number (e.g. T-B92067000015 for 2011, September):

Table 8- 1 Production year and month

Character	Year of manufacture	Character	Month of manufacture
A	2010	1 to 9	January to September
B	2011	O	October
C	2012	N	November
D	2013	D	December
E	2014		
F	2015		
H	2016		
J	2017		
K	2018		
L	2019		
M	2020		
N	2021		
P	2022		
R	2023		
S	2024		
T	2025		
U	2026		
V	2027		
W	2028		
X	2029		
(Y and Z are not assigned)			

The serial number is found on the rating plate.

## Procedure

Contact Siemens Service.



### DANGER

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

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

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

- Do not open the protective cover of the DC link until five minutes have elapsed.
- Before starting any work, also check that the system is in a voltage-free state by measuring at the DC link terminals DCP and DCN.

## 8.3.2 Distributed components

Capacitors do not have to be formed for distributed components.

# Appendix

## A.1 List of abbreviations

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### Note

The following list of abbreviations includes all abbreviations and their meanings used in the entire SINAMICS family of drives.

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Abbreviation	Source of the abbreviation	Meaning
<b>A</b>		
A...	Alarm	Alarm
AC	Alternating Current	Alternating current
ADC	Analog Digital Converter	Analog-digital converter
AI	Analog Input	Analog input
AIM	Active Interface Module	Active Interface Module
ALM	Active Line Module	Active Line Module
AO	Analog Output	Analog output
AOP	Advanced Operator Panel	Advanced Operator Panel
APC	Advanced Positioning Control	Advanced Positioning Control
AR	Automatic Restart	Automatic restart
ASC	Armature Short-Circuit	Armature short-circuit
ASCII	American Standard Code for Information Interchange	American standard code for information interchange
AS-i	AS-Interface (Actuator Sensor Interface)	AS interface (open bus system in automation technology)
ASM	Asynchronmotor	Induction motor
<b>B</b>		
BB	Betriebsbedingung	Operating condition
BERO	-	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

<b>Abbreviation</b>	<b>Source of the abbreviation</b>	<b>Meaning</b>
BO	Binector Output	Binector output
BOP	Basic Operator Panel	Basic Operator Panel
<b>C</b>		
C	Capacitance	Capacitance
C...	-	Safety message
CAN	Controller Area Network	Serial bus system
CBC	Communication Board CAN	Communication Board CAN
CBE	Communication Board Ethernet	PROFINET communication module (Ethernet)
CD	Compact Disc	Compact disk
CDS	Command Data Set	Command data set
CF Card	CompactFlash Card	CompactFlash card
CI	Connector Input	Connector Input
CLC	Clearance Control	Clearance control
CNC	Computer Numerical Control	Computerized 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 on a changeover contact
COMM	Commissioning	Commissioning
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 MASTER	Control Unit DC MASTER
<b>D</b>		
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
DDS	Drive Data Set	Drive data set
DI	Digital Input	Digital input
DI/DO	Digital Input/Digital Output	Bidirectional digital input/output
DMC	DRIVE-CLiQ Hub Module Cabinet	DRIVE-CLiQ Hub Module Cabinet
DME	DRIVE-CLiQ Hub Module External	DRIVE-CLiQ Hub Module External

<b>Abbreviation</b>	<b>Source of the abbreviation</b>	<b>Meaning</b>
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
DTC	Digital Time Clock	Timer
<b>E</b>		
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
ESD	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	Enable pulses
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
<b>F</b>		
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

<b>Abbreviation</b>	<b>Source of the abbreviation</b>	<b>Meaning</b>
FEM	Fremderregter Synchronmotor	Separately excited synchronous motor
FEPROM	Flash-EPROM	Non-volatile write and read memory
FG	Function Generator	Function generator
FI	-	Residual current
FOC	Fiber-Optic Cable	Fiber-optic cable
FP	Funktionsplan	Function diagram
FPGA	Field Programmable Gate Array	Field programmable gate array
FW	Firmware	Firmware
<b>G</b>		
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
<b>H</b>		
HF	High frequency	High frequency
HFD	Hochfrequenzdrossel	High-frequency reactor
HLA	Hydraulic Linear Actuator	Hydraulic linear drive
HLG	Hochlaufgeber	Ramp-function generator
HM	Hydraulic Module	Hydraulic Module
HMI	Human Machine Interface	Human machine interface
HTL	High-Threshold Logic	Logic with high fault threshold
HW	Hardware	Hardware
<b>I</b>		
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	Commissioning
ID	Identifier	Identification
IE	Industrial Ethernet	Industrial Ethernet
IEC	International Electrotechnical Commission	International Electrotechnical Commission
IF	Interface	Interface
IGBT	Insulated Gate Bipolar Transistor	Bipolar transistor with insulated control electrode
IGCT	Integrated Gate-Controlled Thyristor	Semiconductor power switch with integrated control electrode

<b>Abbreviation</b>	<b>Source of the abbreviation</b>	<b>Meaning</b>
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
<b>J</b>		
JOG	Jogging	Jog
<b>K</b>		
KDV	Kreuzweiser Datenvergleich	Crosswise data comparison
KHP	Know-how protection	Know-how protection
KIP	Kinetische Pufferung	Kinetic buffering
Kp	-	Proportional gain
KTY	-	Special temperature sensor
<b>L</b>		
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
FO cable	Lichtwellenleiter	Fiber-optic cable
<b>M</b>		
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



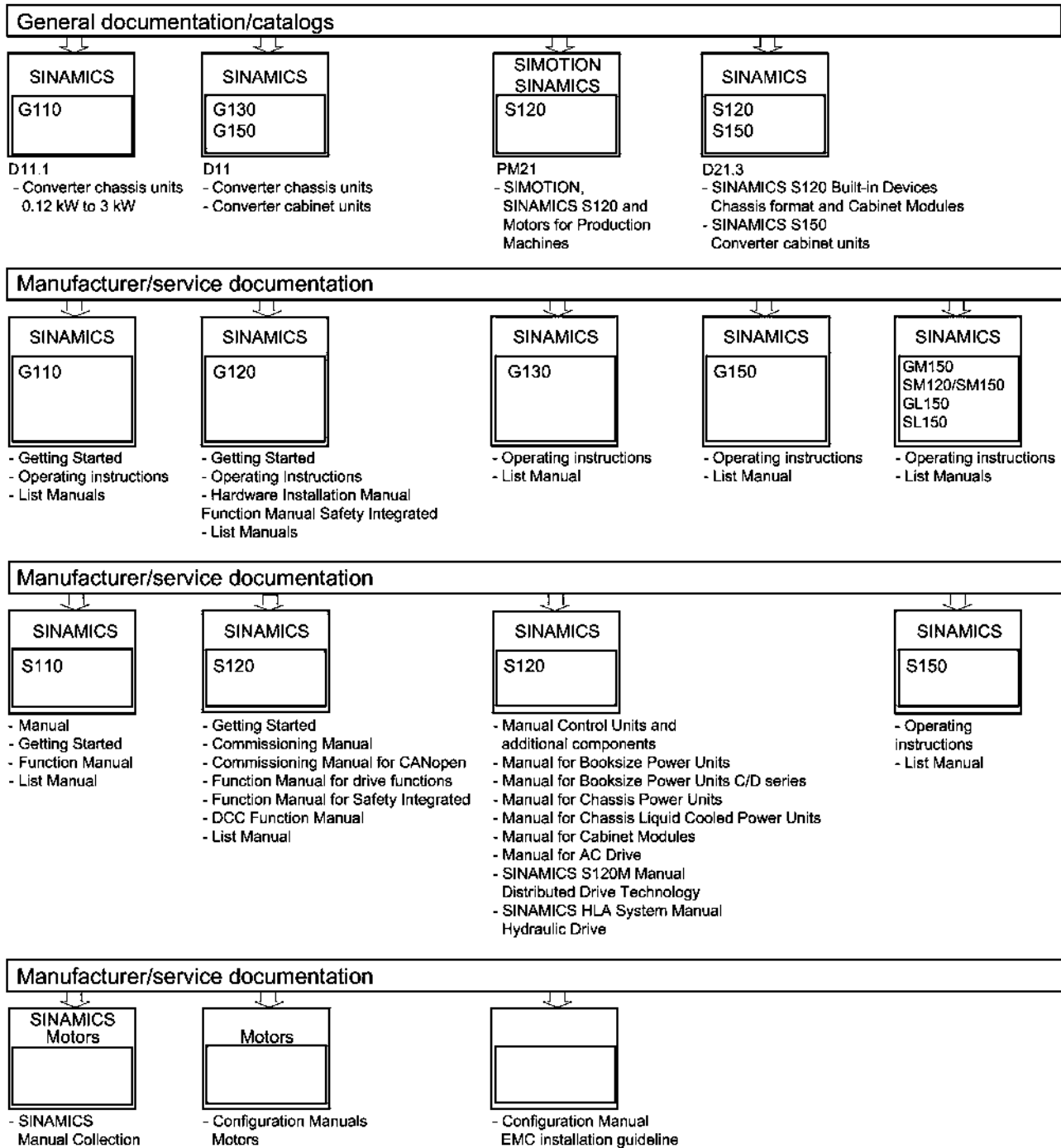
<b>Abbreviation</b>	<b>Source of the abbreviation</b>	<b>Meaning</b>
MSC	Motorstromrichter	Motor-side converter
MT	Messtaster	Probe
<b>N</b>		
N. C.	Not Connected	Not connected
N...	No Report	No report or internal message
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie	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 body in the US
NM	Nullmarke	Zero mark
NO	Normally Open (contact)	NO contacts
LSC	Netzstromrichter	Line-side converter
NVRAM	Non-Volatile Random Access Memory	Non-volatile read/write memory
<b>O</b>		
OA	Open Architecture	Software component (technology package) which provides additional functions for the SINAMICS drive system
OAIF	Open Architecture Interface	Version of the SINAMICS firmware from 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	Operating condition
OEM	Original Equipment Manufacturer	Original equipment manufacturer
OLP	Optical Link Plug	Bus connector for fiber-optic cable
OMI	Option Module Interface	Option Module Interface
<b>P</b>		
p...	-	Adjustable parameters
P1	Processor 1	CPU 1
P2	Processor 2	CPU 2
PB	PROFIBUS	PROFIBUS
PcCtrl	PC Control	Master control
PD	PROFIdrive	PROFIdrive
PDS	Power unit Data Set	Power unit data set
PE	Protective Earth	Protective ground
PELV	Protective Extra Low Voltage	Safety extra-low voltage
PEM	Permanenterregter Synchronmotor	Permanent-magnet synchronous motor
PG	Programmiergerät	Programming device
PI	Proportional Integral	Proportional integral
PID	Proportional Integral Differential	Proportional integral differential
PLC	Programmable Logical Controller	Programmable logic controller

<b>Abbreviation</b>	<b>Source of the abbreviation</b>	<b>Meaning</b>
PLL	Phase-Locked Loop	Phase-locked loop
PM	Power Module	Power Module
PN	PROFINET	PROFINET
PNO	PROFIBUS Nutzerorganisation	PROFIBUS user organization
PPI	Point to Point Interface	Point-to-point interface
PRBS	Pseudo Random Binary Signal	White noise
PROFIBUS	Process Field Bus	Serial data bus
PS	Power Supply	Power supply
PSA	Power Stack Adapter	Power Stack Adapter
PTC	Positive Temperature Coefficient	Positive temperature coefficient
PTP	Point To Point	Point-to-point
PWM	Pulse Width Modulation	Pulse width modulation
PZD	Prozessdaten	Process data
<b>Q</b>		
<b>R</b>		
r...	-	Display parameters (read only)
RAM	Random Access Memory	Read/write memory
RCCB	Residual Current Circuit Breaker	Residual current operated circuit breaker
RCD	Residual Current Device	Residual current operated circuit breaker
RCM	Residual Current Monitor	Residual current monitor
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
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	Realtime clock
RZA	Raumzeigerapproximation	Space vector approximation
<b>S</b>		
S1	-	Continuous duty
S3	-	Intermittent duty
SAM	Safe Acceleration Monitor	Safe acceleration monitoring

<b>Abbreviation</b>	<b>Source of the abbreviation</b>	<b>Meaning</b>
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
SD Card	SecureDigital Card	Secure digital memory card
SDI	Safe Direction	Safe motion direction
SE	Sicherer Software-Endschalter	Safe software limit switch
SG	Sicher reduzierte Geschwindigkeit	Safely-limited speed
SGA	Sicherheitsgerichteter Ausgang	Safety-related output
SGE	Sicherheitsgerichteter Eingang	Safety-related input
SH	Sicherer Halt	Safe standstill
SI	Safety Integrated	Safety Integrated
SIL	Safety Integrity Level	Safety Integrity Level
SLM	Smart Line Module	Smart Line Module
SLP	Safely-Limited Position	Safely-limited position
SLS	Safely-Limited Speed	Safely-limited speed
SLVC	Sensorless Vector Control	Vector control without encoder (sensorless)
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
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 (monitored for time and ramping up)
SS2	Safe Stop 2	Safe Stop 2
SSI	Synchronous Serial Interface	Synchronous serial interface
SSM	Safe Speed Monitor	Safe feedback from speed monitor
SSP	SINAMICS Support Package	SINAMICS support package
STO	Safe Torque Off	Safe torque off
STW	Steuerwort	Control word

<b>Abbreviation</b>	<b>Source of the abbreviation</b>	<b>Meaning</b>
<b>T</b>		
TB	Terminal Board	Terminal board
TIA	Totally Integrated Automation	Totally Integrated Automation
TM	Terminal Module	Terminal Module
TN	Terre Neutre	Grounded three-phase line supply
Tn	-	Integral time
TPDO	Transmit Process Data Object	Transmit process data object
TT	Terre Terre	Grounded three-phase line supply
TTL	Transistor-Transistor-Logic	Transistor-transistor logic
Tv	-	Rate time
<b>U</b>		
UL	Underwriters Laboratories Inc.	Underwriters Laboratories Inc.
UPS	Uninterruptible Power Supply	Uninterruptible power supply
UPS	Unterbrechungsfreie Stromversorgung	Uninterruptible power supply
UTC	Universal Time Coordinated	Universal time coordinated
<b>V</b>		
VC	Vector Control	Vector control
Vdc	-	DC-link voltage
VdcN	-	Partial DC link voltage, negative
VdcP	-	Partial DC link voltage, positive
VDE	Verband Deutscher Elektrotechniker	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
<b>W</b>		
WEA	Wiedereinschaltautomatik	Automatic restart
WZM	Werkzeugmaschine	Machine tool
<b>X</b>		
XML	Extensible Markup Language	Extensible markup language (standard language for web publishing and document management)
<b>Y</b>		
<b>Z</b>		
ZK	DC Link	DC Link
ZM	Zero Mark	Zero mark
ZSW	Status word	Status word

## A.2 Documentation overview



# Index

## 2

24 V connector, 119

## A

Adapter Module 600, 47

Adapter Module 600, replacing AM600, 147

Adapter Module 600, replacing fans, 153

Adapter Module 600, replacing fuses, 151

AM600, 47

AM600 interface

Overview, 51

X1 hybrid connector, 52

X201 DRIVE-CLiQ, 53

X21 operating state, 52

X24 24 V power supply, 120

Area of application, 23

## C

Connection example

S120M, 81

## D

DC link busbar

Connection, 62

Overload, 141

Degree of contamination, 43

Degree of protection, 43

Derating characteristics

AM600, 66

Diagnostics via AM600

DC LINK LED, 56

RDY LED, 56

X21, 52

Diagnostics via LEDs

S120M, 83

Digital inputs/outputs

X3, 79

DRIVE-CLiQ Extension

Safety instructions, 102

DRIVE-CLiQ interfaces X201, 53

DRIVE-CLiQ signal cable, 137

## E

Electrical connections

24 V busbars, 63

DC link busbars, 63

Electronic power supply, 43

## F

Forming DC link capacitors, 154

## H

Heat dissipation

Active Line Modules, 35

Basic Line Modules, 35

S120M, 85

Smart Line Modules, 35

Smart Line Modules Booksize Compact, 36

Holding brake, 98

Hybrid Cable, 124

## I

Introduction, 27

## L

LEDs

AM600, 56

S120M, 83

Line connection voltage, 43

Line frequency, 43

## M

Maximum permissible supply voltage, 43

Mounting

24 V terminal adapter, 121

AM600 with internal cooling, 58

Spacing bolts for the Adapter Module 600, 59

Mounting conditions, 86

## O

Overvoltage category, 43

## P

Platform Concept, 24  
Potential equalization, 139  
Protection class, 43

## R

Radial force loading, 73  
Radio interference suppression, 43  
Replacing  
    Adapter Module 600, 147  
    Fan in the Adapter Module 600, 153  
    Fuses in the Adapter Module 600, 151  
    S120M, 149  
Replacing components, 145  
Residual risks of drive systems, 21

## S

S120M  
    Connection, 77  
    Design, 76  
    Interfaces, 77  
S120M connection, 77  
S120M interface  
    X1, 78  
    X3, 79  
    X4, 80  
S120M, replacing, 149  
Safety instructions  
    Adapter Module AM600, 49  
    DRIVE-CLiQ Extension, 102  
    Hybrid Cabinet Bushing, 110  
    S120M, 70  
    Service work, 145  
Shock load, 44  
Short-circuit current rating, 43  
Spacing bolts for the Adapter Module 600, 59  
Spare parts, 145  
Storage, 43

## T

Technical data  
    AM600, 65  
    DRIVE-CLiQ Extension, 106

Hybrid Cabinet Bushing, 114  
S120M motor, 88  
Totally Integrated Automation, 24  
Transport, 43

## U

UL certification, 31

## V

Vibratory load, 44

## X

X1, 78  
X3, 79  
X4, 80





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