



Edition

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EQUIPMENT MANUAL

SINAMICS

S220

Control Unit and supplementary system components
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S220 Control Unit and additional SINAMICS S220 system components

Equipment Manual

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Legal information

Warning notice system

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

 DANGER
indicates that death or severe personal injury will result if proper precautions are not taken.
 WARNING
indicates that death or severe personal injury may result if proper precautions are not taken.
 CAUTION
indicates that minor personal injury can result if proper precautions are not taken.
NOTICE
indicates that property damage can result if proper precautions are not taken.

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

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified persons are those who, because of their training and experience, are familiar with the installation, assembly, commissioning, operation, decommissioning and disassembly of the product and can recognize risks and avoid possible hazards.

Proper use of Siemens products

Note the following:

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

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

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Introduction

1.1 About SINAMICS

Description

SINAMICS converters are the optimum solution for all drive applications extending from low voltage through to DC. All Siemens drive components, such as converters, motors, and controls, are matched to each other and can be integrated into your existing automation systems.

More information



You can find more information via the SINAMICS YouTube playlist:

YouTube playlist (<https://www.youtube.com/playlist?list=PLw7lLwXw4H53rtHeTeifKtVMr2aXTYt0X>)

1.2 About this manual

1.2.1 Content

Overview

The Equipment Manual describes hardware components, and provides the information, procedures and operator actions required for the particular usage phase.

The Equipment Manual provides information so that the target group is capable of installing, setting up, testing, operating and troubleshooting the devices safely and correctly.

To illustrate possible application areas for our products, typical use cases are listed in this product documentation and in the online help. These are purely exemplary and do not constitute a statement on the suitability of the respective product for applications in specific individual cases. Unless explicitly contractually agreed, Siemens assumes no liability for such suitability. Suitability for a particular application in specific individual cases must be assessed by the user, taking into account all technical, legal, and other requirements on a case-by-case basis. Always observe the descriptions of the technical properties and the applicable constraints of the respective product provided in the product documentation.

1.2.2 Target group

Overview

The Equipment Manual addresses the following target groups:

- Planning engineers
- Installation personnel
- Project engineers

1.2.3 Standard scope

The functions of the system as delivered can only be found in the order documents.

Further functions may be executable in the system, which are not explained in this documentation. However, there is no entitlement to these functions in the case of a new delivery or service.

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

The machine manufacturer must document any additions or modifications they make to the product themselves.

1.2.4 Use of third-party products in this documentation

This documentation contains recommendations relating to third-party products. Siemens accepts the fundamental suitability of these third-party products. You can use equivalent products from other manufacturers.

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

You can find details of our product partners here: website (<https://www.siemens.com/global/en/company/partners/product-partners-industry.html>).

1.2.5 Websites of third-party companies

This document may contain hyperlinks to third-party websites. Siemens is not responsible for and shall not be liable for these websites and their content. Siemens has no control over the information which appears on these websites and is not responsible for the content and information provided there. The user bears the risk for their use.

1.3 SINAMICS documentation

Description

Comprehensive documentation on the converter family can be found on the Internet:

Siemens Industry Online Support (<https://support.industry.siemens.com/cs/ww/en/view/109807358>)

You can display documents or download them in PDF and HTML5 format.

The product documentation for the converter family comprises the following documents:

Table 1-1 SINAMICS documentation

Information	Documentation class	Content
Information on the converter family	Original Instructions SINAMICS S220	Compact information and safety instructions for the converter family
	Function Manual SINAMICS S220	Description, commissioning, and optionally the application (programming or configuring) of the following: • Drive functions • Communication • Safety Integrated
	List Manual SINAMICS S220	Meaning, setting options and dependencies of the parameters and messages of the converter
	Configuration Manual SINAMICS S220 requirements placed on third-party motors	Information for the operation of third-party motors with the drive system
General information for SINAMICS	Configuration Manual industrial cybersecurity	Industrial Cybersecurity functions and safe operation of the converter
	Configuration Manual EMC - electromagnetic compatibility	Information on compliance with the following points: • Interference-free function of all devices • EMC standards and directives
Device information	Equipment Manual SINAMICS S220 Control Unit and additional system components	Compact description of module-specific information such as properties, connection diagrams, technical specifications
	Equipment Manual SINAMICS S220 Booksize power units	
	Equipment Manual SINAMICS S220 air-cooled Chassis power units	

Information	Documentation class	Content
Information about optional components	Operating instructions Smart Drive Interface SDI Pro 5.5"	Configuration, installation, wiring, commissioning and diagnostics of the converter with the Smart Drive Interface SDI Pro 5.5" operating unit
	Operating instructions SI-NAMICS Smart Adapter	Installing a local wireless network with the SI-NAMICS Smart Adapter to commission and diagnose the converter using an operating unit

1.4 Service and Support

1.4.1 ID link and Siemens Online Support

You can find additional information about the product:

- via ID link
- using the Siemens Industry Online Support
 - Website: SiePortal (<https://support.industry.siemens.com/cs/ww/en/>)
 - App Industry Online Support (for Apple iOS and Android)

Product-specific information via ID link

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

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

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



Figure 1-1 QR code with ID link included

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

Content of Siemens Online Support

- Product support
- Global forum for information and best practice sharing between users and specialists
- Local contact persons via the contact person database (→ Contact)
- Product information

- FAQs (frequently asked questions)
- Application examples
- Manuals
- Downloads
- Compatibility tool
- Newsletter with product selection
- Catalogs/brochures
- Certificates

1.4.2 Spare parts services

The online spare part service "Spares on Web (<https://www.sow.siemens.com>)" offers spare parts for the product.

1.5 Important product information

1.5.1 Names of drive technology terms

Overview

This manual contains simplified names of drive technology terms which have other names in normal usage or in a different context.

Description

Drive, frequency converter, AC/AC converter, servo converter or converter is the name for an electronic device for variable speed control of an electric motor. The electric motor is available in different versions as an induction motor, synchronous motor or synchronous reluctance motor.

In this document, Siemens uses the names "converter" and "drive" to mean the same thing and regardless of whether a converter or servo converter is meant.

A drive system means all of the components that are required to implement a drive task. For instance, a drive system comprises line-side switchgear, rectifier transformers, converters, output filters, motors, encoders, conductors, monitoring equipment, open-loop and closed-loop controlling systems.

In this document, Siemens uses the term "drive system" regardless of whether a converter or servo converter is meant in the context of a motor and cables.

A drive line-up is a system of converters that are supplied via a shared DC link or that communicate via DRIVE-CLiQ with a shared Control Unit.

Examples for converters that form a drive line-up:

- Several SINAMICS S210 with common DC link
- A SINAMICS S120 or SINAMICS S220 with a central Control Unit and components connected via DRIVE-CLiQ

In this document, Siemens uses the term "converter" regardless of whether a single converter or a drive line-up is meant.

1.5.2 Use for the intended purpose

Requirement

WARNING
Death or serious injury if not used for the intended purpose Not used for the intended purpose can result in hazardous states. • Carefully observe the description of intended use.

Note

It cannot be guaranteed that EMC emission limits are complied with if the products are connected to an isolated line supply grounded through a high ohmic connection or a line supply with grounded line conductor.

When operating a Smart Line Module without line filter connected to a TT or TN system, EMC emission limits are not complied with.

- Draw-up an EMC plan to comply with the EMC requirements of the intended application.
-

Description

The products described in this document, together with software, accessories and options, form an electric drive to supply low-voltage three-phase motors.

The products are professional devices for stationary indoor use in industrial, light-industrial and commercial applications and are intended for supply from a non-public (industrial) low-voltage network. The products are not intended for use in residential areas and are not intended for supply from a public low-voltage network.

The products must be correctly transported and stored and must be installed, commissioned and maintained by professionals who have adequate knowledge to implement the safety, cybersecurity and EMC measures in accordance with the specifications described in this manual and recognized state-of-the-art engineering practice.

You may only use the products when the following requirements are complied with:

- All regulations and directives that are applicable at the place of final use, especially with regard to electrical safety, functional safety and electromagnetic compatibility (EMC).
- All instructions, notes, technical specifications, safety information, and cybersecurity information contained in this document and other supporting documentation.

The products are part of a machine or system. They must guarantee the safety of persons and material assets as well as electromagnetic compatibility by applying suitable measures when designing the system.

A risk assessment of the complete application, including third-party products and implementation of adequate safety and cybersecurity measures must be performed before you use the product.

Products without protective enclosure (IP00 or IP20) are intended for installation in control panels or control cabinets that provide the required level of protection.

Any other use that is not expressly permitted can result in malfunctions and unpredictable hazards.

Fundamental safety instructions

2.1 General safety instructions



WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

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

Generally, the following steps apply when establishing safety:

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

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



WARNING

Electric shock due to connection to an unsuitable power supply

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

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



! WARNING

Electric shock due to unconnected cable shield

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

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

NOTICE

Damage to equipment due to unsuitable tightening tools.

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

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

NOTICE

Property damage due to loose power connections

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

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

! WARNING

Active implant malfunctions due to electromagnetic fields

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

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

 CAUTION**Symptomatic respiratory and skin reaction to chemicals**

A newly purchased product might contain traces of substances that are identified as sensitizers. Sensitizers are substances which can cause sensitization in the lungs and skin after exposure to them.

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

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

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

Radio devices, cell phones or mobile WLAN devices in the immediate vicinity of a component can impair the function of the component or damage the component. The malfunction may impair the functional safety of machines and can therefore endanger persons or result in material damage.

- Avoid operating radio devices, cellphones and mobile WLAN devices in the direct vicinity of converters and operating units.
- Scan the machine readable code, e.g. a QR code at least 0.4 m away from the component or switch off the converter power supply before scanning.
- Only operate built-in devices with the control cabinet doors closed.
- When the control cabinet doors are open, only qualified personnel may perform service and maintenance work.

 WARNING**Fire due to inadequate ventilation clearances**

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

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

NOTICE**Overheating due to inadmissible mounting position**

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

- Only operate the device in admissible mounting positions.



WARNING

Unexpected movement of machines caused by inactive safety functions

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

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

2.2 Equipment damage due to electric fields or electrostatic discharge

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



NOTICE

Equipment damage due to electric fields or electrostatic discharge

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

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

2.3 Warranty and liability for application examples

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

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

2.4 Cybersecurity information

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

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

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

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

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

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

Further information is provided on the Internet:

Configuration Manual Industrial Cybersecurity (<https://support.industry.siemens.com/cs/ww/en/view/109975311>)



WARNING

Unsafe operating states resulting from software manipulation

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

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

2.5 Residual risks of power drive systems

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

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

2.5 Residual risks of power drive systems

6. Influence of network-connected and wireless communications systems, e.g. ripple-control transmitters or data communication via the network or mobile radio, WLAN or Bluetooth.
7. Motors for use in potentially explosive areas:
When moving components such as bearings become worn, this can cause enclosure components to exhibit unexpectedly high temperatures during operation, creating a hazard in areas with a potentially explosive atmosphere.

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

System overview

3.1 Overview of the SINAMICS drive system

3.1.1 SINAMICS drive system

Overview

SINAMICS Booksize components are part of a modular system.

Description

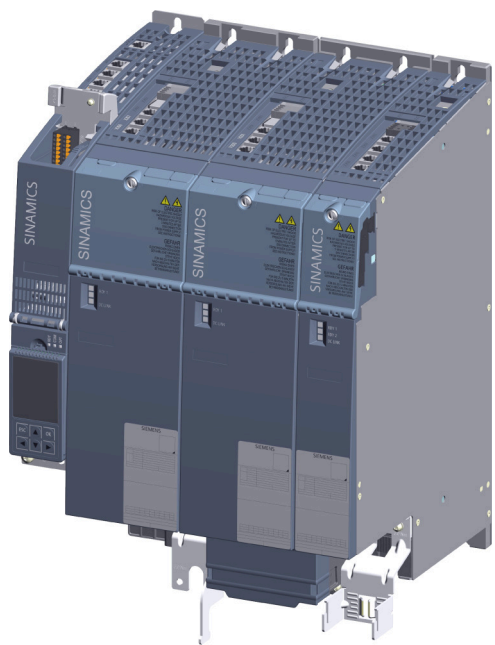


Figure 3-1 Example: CU320-3 Control Unit in a SINAMICS Booksize drive line-up

The components are arranged in the following groups:

Designation	Function, use	Components (examples)
Line-side power components	Switching the energy supply and to comply with EMC regulations	• Fuses • Contactors • Reactors • Filters
Line Modules	Central energy supply into the DC link	• Smart Line Modules

Designation	Function, use	Components (examples)
DC link components	Additional components for the DC link	- Braking Modules - Capacitor Module - Control Supply Modules
Motor Modules	Inverters, which draw energy from the DC link and supply the connected motors	Motor Modules
Motor-side power components	Additional components on the output side	Motor reactors
Control Units	Processing cross-axis drive and technological functions	Control Unit
Additional system components	Extend the functionality, provide various interfaces to encoders and process signals	- Option Board - Communication Board - Terminal Modules

3.1.2 Mixed operation of SINAMICS S120 and S220 components

Description

SINAMICS S220 Booksize and S120 Booksize components can be used in mixed operation in a common drive line-up. To achieve this, certain compatibility conditions must be complied with, e.g. with reference to hardware compatibility and firmware versions.

More information

More detailed information about mixed operation of SINAMICS S220 and SINAMICS S120 is provided in the SINAMICS S220-S120 compatibility list on the Internet:

SINAMICS S220/S120 booksize modules, compatibility list (<https://support.industry.siemens.com/cs/ww/en/view/109806050>)

3.2 Directives and standards

EC Declaration of Conformity



European Machinery Directive

The converters fulfill the requirements stipulated in the Machinery Directive 2006/42/EC, if they are covered by the application area of this directive.

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

European Low-Voltage Directive

The converter fulfills the requirements stipulated in the Low-Voltage Directive 2014/35/EU, insofar as they are covered by the application area of this directive.

Directive 2011/65/EU

The converters fulfill the requirements stipulated in Directive 2011/65/EU relating to the restriction of the use of certain hazardous substances in electrical and electronic devices (RoHS).

European EMC Directive

The compliance of the converter with the regulations of the Directive 2014/30/EU has been demonstrated by full compliance with IEC/EN 61800-3.

Ecodesign Directive 2009/125/EC

The converter meets the requirements of Ecodesign Directive 2009/125/EC.

UKCA Declaration of Conformity



The converter complies with the requirements for the British market (England, Wales and Scotland).

Underwriters Laboratories (North American market)



Converters provided with the test symbols displayed fulfil the requirements stipulated for the North American market as a component of drive applications.

Australia and New Zealand (RCM)



Converters with the symbols shown comply with requirements relating to electromagnetic compatibility for Australia and New Zealand.

EMC requirements for South Korea



Converters with the KC marking on the nameplate fulfill the EMC requirements relating to electromagnetic compatibility for South Korea.

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

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

China Compulsory Certification



The converters do not fall in the area of validity of the China Compulsory Certification (CCC).

Eurasian conformity



The converters fulfill the requirements of the Russia/Belarus/Kazakhstan customs union (EAC).

ISO 9001 and ISO 14001 quality systems

Siemens employs a quality management system that complies with the requirements of ISO 9001 and ISO 14001.

Taking back and recycling waste electrical and electronic equipment (WEEE)

The converters comply with the requirements laid down in Directive 2012/19/EU with regard to returning and recycling scrap electrical and electronic equipment.

Certificates for download

The certificates, manufacturer's declarations and prototype test certificates of the converter are available in the Internet:

Certificates, manufacturer's declarations, prototype test certificates (<https://support.industry.siemens.com/cs/ww/en/ps/29047/cert>)

Certificates for the North American market (<https://iq.ulprospector.com>)

3.3 System data

3.3.1 General technical data

Technical data

Table 3-1 Technical specifications of the drive system

Feature	Value
Electronics power supply	24 V DC -15 / +20% ¹⁾ , safety/protective extra-low voltage (SELV/PELV) ²⁾
Electromagnetic compatibility	According to IEC 61800-3: Used in the second environment (industrial line supplies). Category C2 or C3, depending on the drive components being used.
Overvoltage category	Line connection: III ³⁾ according to IEC 61800-5-1, UL 61800-5-1 and CSA C22.2 No 274 Electronics power supply: II (50 V rated voltage) acc. to IEC 61800-5-1 and UL 61800-5-1 (500 V impulse withstand voltage)
Pollution degree	2 according to IEC 61800-5-1, UL 61800-5-1 and CSA C22.2 No 274

¹⁾ In the event of a fault, the power supply voltage must not exceed 60 V DC (DVC A).

²⁾ Power supplies with safety extra-low voltage (SELV) can be used. The electric circuit must be implemented as a PELV circuit due to the internal grounding of the 24 V electronic power supply in the components.

³⁾ The components are designed for connection to circuits of overvoltage Category III. Ensure this through the installation itself or install an upstream surge protection device. Limit any overvoltages to 6 kV with respect to ground and 4 kV between phases. Use surge protection devices that are suitable for the line voltage and the prospective short-circuit current of the line.

3.3.2 Degree of protection / protection class

Technical data

Table 3-2 Degree of protection and protection class of the drive system

Feature	Value
Degree of protection (except SME20/25/120/125)	IPXXB according to IEC 60529, open type according to UL/CSA
Degree of protection for SME20/25/120/125	IP67, with mounted connection plugs or protective caps
Protection class	I (with protective conductor connection) according to IEC 61800-5-1

3.3.3 Environmental conditions

Technical data

Table 3-3 Protection against chemically active substances

Usage phase	Description
Long-term storage	Class 1C2 according to IEC 60721-3-1:1997, in product packaging ¹⁾
Transport	Class 2C2 according to IEC 60721-3-2:1997, in transport packaging ²⁾
Operation	Class 3C2 according to IEC 60721-3-3:2002 Class 3C2 according to IEC 60068-2-42 degree of severity G3 according to ANSI/ISA-S71.04.2013 Class 3C3 according to IEC 60721-3-3:2002 for H ₂ S and SO ₂

Table 3-4 Biological environmental conditions

Usage phase	Description
Long-term storage	Class 1B1 according to IEC 60721-3-1:1997, in product packaging ¹⁾
Transport	Class 2B1 according to IEC 60721-3-2:1997, in transport packaging ²⁾
Operation	Class 3B1 according to IEC 60721-3-3:2002

Table 3-5 Climatic conditions

Usage phase	Description
Long-term storage	Class 1K4 according to IEC 60721-3-1:1997, in product packaging ¹⁾ Temperature: -25 ... +55 °C
Transport	Class 2K4 according to IEC 60721-3-2:1997, in transport packaging ²⁾ Temperature: -40 ... +70 °C
Operation (except SME20/25(120/125))	Class 3K3 according to IEC 60721-3-3:2002 with increased ruggedness with respect to relative humidity Temperature: -10 ... +55 °C ³⁾ Relative humidity: 5 ... 95 % no condensation (better than Class 3K3) Oil mist, salt mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted
Operation for SME20/25/120/125	Class 3K3 according to IEC 60721-3-3:2002 with increased ruggedness with respect to relative humidity Temperature: -20 ... +55 °C Relative humidity: 5 ... 95 % no condensation (better than Class 3K3) Formation of ice and condensation not permissible

Table 3-6 Mechanical environmental conditions

Usage phase	Description
Long-term storage	Class 1M2 according to IEC 60721-3-1:1997, in product packaging ¹⁾
Transport	Class 2M3 according to IEC 60721-3-2:1997, in transport packaging ²⁾
Operation	Class 3M1 according to IEC 60721-3-3:2002
Vibration test in operation	According to IEC 60068-2-6 test Fc (sinusoidal) • 9 ... 29 Hz: 0.3 mm amplitude of deflection • 29 ... 200 Hz: 1 g acceleration amplitude • 10 frequency cycles per axis
Shock test in operation	According to IEC 60068-2-27 test Ea (half-sine) • 5 g peak acceleration • 30 ms duration • 3 shocks in all three axes in both directions

¹⁾ Product packaging (storage packaging) is single-unit packaging for storage - and does not satisfy the requirements for transport. As a consequence, product packaging is therefore not suitable for shipping.

²⁾ Transport packaging is either packaging that is directly suitable for transport, or secondary packaging which, together with the product packaging, satisfies the requirements for transport.

³⁾ The temperature must also be maintained at the air inlet on the underside of the components. The temperature corresponds to the surrounding air temperature for UL applications.

3.3.4 Installation altitude

Technical specifications

Table 3-7 Installation altitude for the drive system

Usage phase	Description
Operation	0 ... 1000 m above sea level without reducing the ambient temperature > 1000 ... 2000 m • Reduction in the ambient temperature by 5 °C per 1000 meters > 2000 ... 5000 m • Reduction in the ambient temperature by 5 °C per 1000 meters • When using the Safety Integrated Functions: Increase in PFH value. Information on the PFH values and on calculating the PFH value can be found on the Internet: PFH values (https://support.industry.siemens.com/cs/ww/en/view/76254308)

3.3.5 Safety Integrated

Technical data

Table 3-8 Functional safety

<i>Feature</i>	<i>Value</i>
Safety Integrity Level (SIL)	SIL 2 or 3 according to IEC 61800-5-2
Performance Level (PL)	PL d or e acc. to EN ISO 13849-1

Application planning

4.1 Information on application planning and installation

Description

Information on the topics of application planning and installation can be found in the following documentation:

- Equipment Manual "SINAMICS S220 Booksize power units"
- Equipment Manual "SINAMICS S220 air-cooled Chassis power units"

4.2 Electromagnetic compatibility (EMC)

Description

Interference suppression measures increase the electromagnetic compatibility (EMC).

EMC interference suppression measures allow the device to function correctly. As a consequence, the device is neither a source of interference for other devices nor an interference sink that can be disturbed by other devices.

More information

Fundamental information for EMC-compliant planning and EMC-compliant installation is provided in the Internet:

Configuration Manual EMC Installation Guideline (<https://support.industry.siemens.com/cs/ww/en/view/60612658>)

4.3 Usage time when using Safety Integrated Functions

Requirement

 WARNING
Unexpected motor response when the service life is exceeded If the service life is exceeded, the probability of failure of the Safety Integrated Functions increases. This can result in unexpected motor movement and as a consequence can cause accidents involving death or severe injury. • Take the converter out of service once the service life has been exceeded.

Description

The safety parameters of Safety Integrated Functions are applicable for a usage time of 20 years.

4.4 Installation in the control cabinet



WARNING

Spread of fire

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

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

4.4.1 Requirements for installation

Description

For installation, for the control cabinet panel and/or mounting panel, the following preconditions apply:

- Material: Sheet steel
- Panel thickness: min. 3 mm (0.12 in)
- Tensile strength: $\geq 270 \text{ N/mm}^2$ acc. to DX51 EN 10346

4.4.2 Mounting position

Requirement

NOTICE

Overheating due to inadmissible mounting position

Components can overheat and therefore be damaged if mounted in an impermissible position. Overheating can cause malfunctions.

- Only mount the components in a permissible mounting position in the control cabinet.

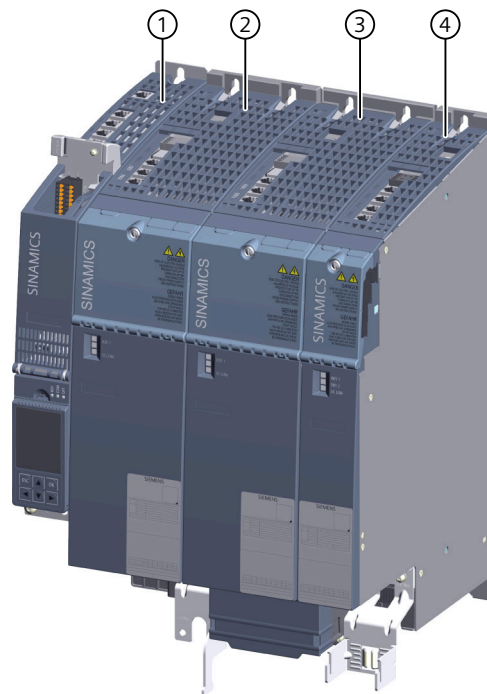
Description

The permissible mounting position for components in the control cabinet is vertical with the DRIVE-CLiQ connection at the top. Generally, all components are located directly next to one another at a central position in the control cabinet.

If another mounting position is permissible for a component, then this is separately described in the corresponding chapter (e.g. line filters, line reactors).

4.4.3 Configuration example

Overview diagram



- ① SINAMICS S220 Control Unit CU320-3
- ② SINAMICS S220 Booksize Smart Line Module
- ③ SINAMICS S220 Booksize Motor Module 60 A
- ④ SINAMICS S220 Booksize Motor Module 2x9 A

Figure 4-1 Example of a single-tier drive line-up with the infeed to the right

The Control Unit can be mounted on the right or left in a drive line-up. We recommend that it is installed to the left in the drive line-up.

4.4.4 Ventilation clearances

Overview

Ventilation clearances in the control cabinet protect components from overheating in operation. Inadequate ventilation clearances can result in malfunctions and can damage components.

Description

The ventilation clearances are defined by the minimum clearances of the components in the control cabinet that must be maintained. To ensure adequate ventilation in the control cabinet, the ventilation clearances as well as the ventilation slots of the components must be kept free and unobstructed. The air supply must not be significantly obstructed by the arrangement of neighboring components and the cable routing.

The ventilation clearances are required above and below the components. We recommend that the minimum clearance is maintained at the front.

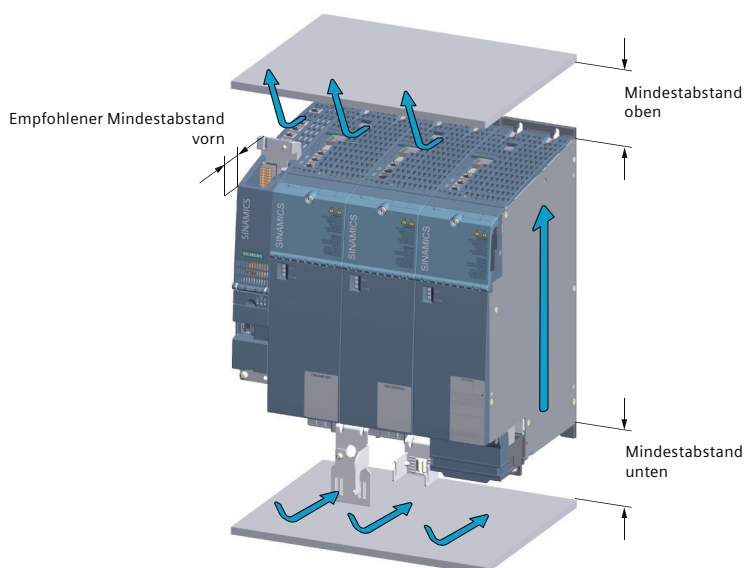


Figure 4-2 Minimum clearances

Table 4-1 Minimum clearances

Component	Unit	Minimum clearance at the top	Minimum clearance at the bottom	Recommended minimum clearance at the front
Control Unit	mm	80	80	10
Terminal Modules	mm	50	50	10
DRIVE-CLiQ Switch Modules	mm	50	50	10
Sensor Modules Cabinet-Mounted	mm	50	50	10

4.4.5 Air guidance

Overview

When installing in the control cabinet, take into account the support for the intended air guidance.

Description

Install the components so that the cooling air flows through them vertically from the bottom (cool region) to the top (warm region due to thermal component loss).

Also take into account the following notes:

- Ensure that the air flows in the right direction if you are using filter fans, heat exchangers or air-conditioning units.
- Ensure that warm air can escape at the top. Also ensure that no heat build-up or backflow can occur, e.g. due to the exhaust air from neighboring components.
- Maintain the ventilation clearances when installing components.
- The clearance between the discharge opening of the air-conditioning unit and the electronic equipment must be at least 200 mm.
- The components are cooled by free convection and/or fans. In both cases, ensure the direction of the cooling air in the drive line-up to be cooled is against gravity from bottom to top.
- When using filter fans, heat exchangers or air-conditioning units, make sure that the air flows do not compensate for each other, but add up.
- If the components are installed in a sealed control cabinet, you must use internal air cooling that ensures an unobstructed airflow to prevent local hotspots. It is advantageous to mount the fan above the components to optimize the air flow (air is drawn in).

Example

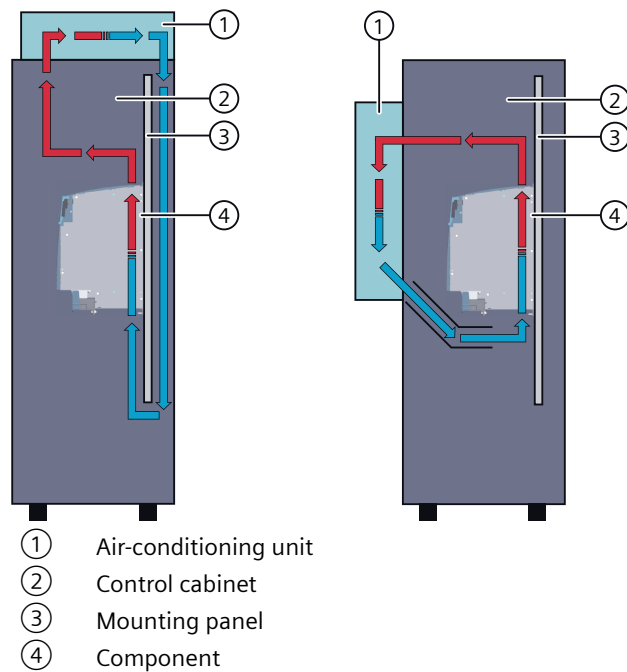


Figure 4-3 Cabinet with air-conditioning unit at the top (left) or at the front (right)

More information

Information about control cabinet cooling can be found on the internet:

SINAMICS control cabinet integration S120 Booksize/SIMODRIVE (<https://support.industry.siemens.com/cs/ww/en/view/29217967>)

4.5 24 V DC supply voltage

4.5.1 Selecting power supply

Overview

The following components require a 24 V DC voltage:

- Electronics of the components via the integrated 24 V busbar
- Electronics of the Control Units, Option Boards, Sensor Modules and Terminal Modules
- Digital outputs
- Holding brakes

Description

Use power supplies with safety extra-low voltage (SELV) or protective extra-low voltage (PELV) to supply the components. In the components, electronics ground M is permanently connected to the protective conductor potential. This is the reason that you must implement the circuit as PELV circuit.

Component	Input voltage
Drive line-up	24 V DC -15 / +20 %, safety/protective extra-low voltage (SELV/PELV) ¹⁾

¹⁾ In the event of a fault, the power supply voltage must not exceed 60 V DC (DVC A).

The following also applies:

- When connected to a "DC power supply" as specified in EN 60204-1:1997, Chapter 4.3.3, malfunctions may occur due to the voltage interruptions permitted for them.
- The 24 V supply voltage ripple must not exceed 2.5 %.
- When using a holding brake, take into consideration the restricted voltage tolerances (24 V $\pm$ 10%) that may apply.
- A malfunction can occur if the 24 V supply voltage falls below the specified minimum value at a component in the drive line-up.
 - Select an input voltage that is high enough for there to be sufficient voltage at the last component.
 - Do not exceed the maximum supply voltage value.
 - If required, supply the voltage to the assembly at various locations in the drive line-up.

Supplying other loads

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

4.5.2 Overvoltage protection

4.5.2.1 Using surge protection devices

Overview

To protect the 24 V supply and the digital inputs/outputs against overvoltages, a surge protection device is required for connection cables longer than 30 m.

Description

Every digital input/output as well as each associated reference potential requires its own dedicated surge protection device.

In addition, we recommend to set the sampling time to 5000 μ s for digital inputs (parameter p0799[0] for CU320-3 or p4099[0] for Terminal Boards/Terminal Modules). Unused digital inputs can otherwise supply the signal "1" rather than "0" due to EMC interference effects.

When selecting surge protection devices, the following technical requirements apply:

Table 4-2 Technical requirements relating to surge protection devices

Feature	Unit	24 V power supply	24 V digital input	24 V digital output
Highest continuous voltage	V	≥ 35	≥ 30	≥ 30
Rated current	A	$\geq 10^{1)}$	≥ 0.1	$\geq 0.1 / 0.5 / 2^{2)}$
Surge protection device class	-	Type 3 / 2 / 1 ³⁾	Type 3 / 2 / 1 ³⁾	Type 3 / 2 / 1 ³⁾
C1 rated discharge current	kA	-	≥ 0.5	≥ 0.5
C2 rated discharge current	kA	≥ 2	-	-
Protection level (L-N)	V	≤ 60	≤ 60	≤ 60
Protection level (L/N-PE)	V	≤ 500	≤ 60	≤ 60
Frequency limit	MHz	-	≥ 1	≥ 1
Example		Dehn company, Article No. 918422 - BVT AVD 24	Digital inputs/ outputs up to 0.1 A: Dehn company, Article Nos. 920364 - BXT ML4 BE C 24 and 926304 - BSP BAS 4	For digital inputs/ outputs up to 0.5 A: Dehn company, Article Nos. 927924 - BCO CL2 BE 24 and 927944 - BCO CL2 BD 24

¹⁾ Several devices of a drive line-up can share a common surge protection device as long as the total current of all connected current connections does not exceed the rated current of the protective device. Otherwise, several overcurrent protection devices are required in order to distribute the load.

²⁾ Dependent on the rated power of the digital output (0.1 A, 0.5 A or 2 A)

³⁾ Type 1 permissible for impulse category C1 or C2

4.5.2.2 Installing surge protection devices

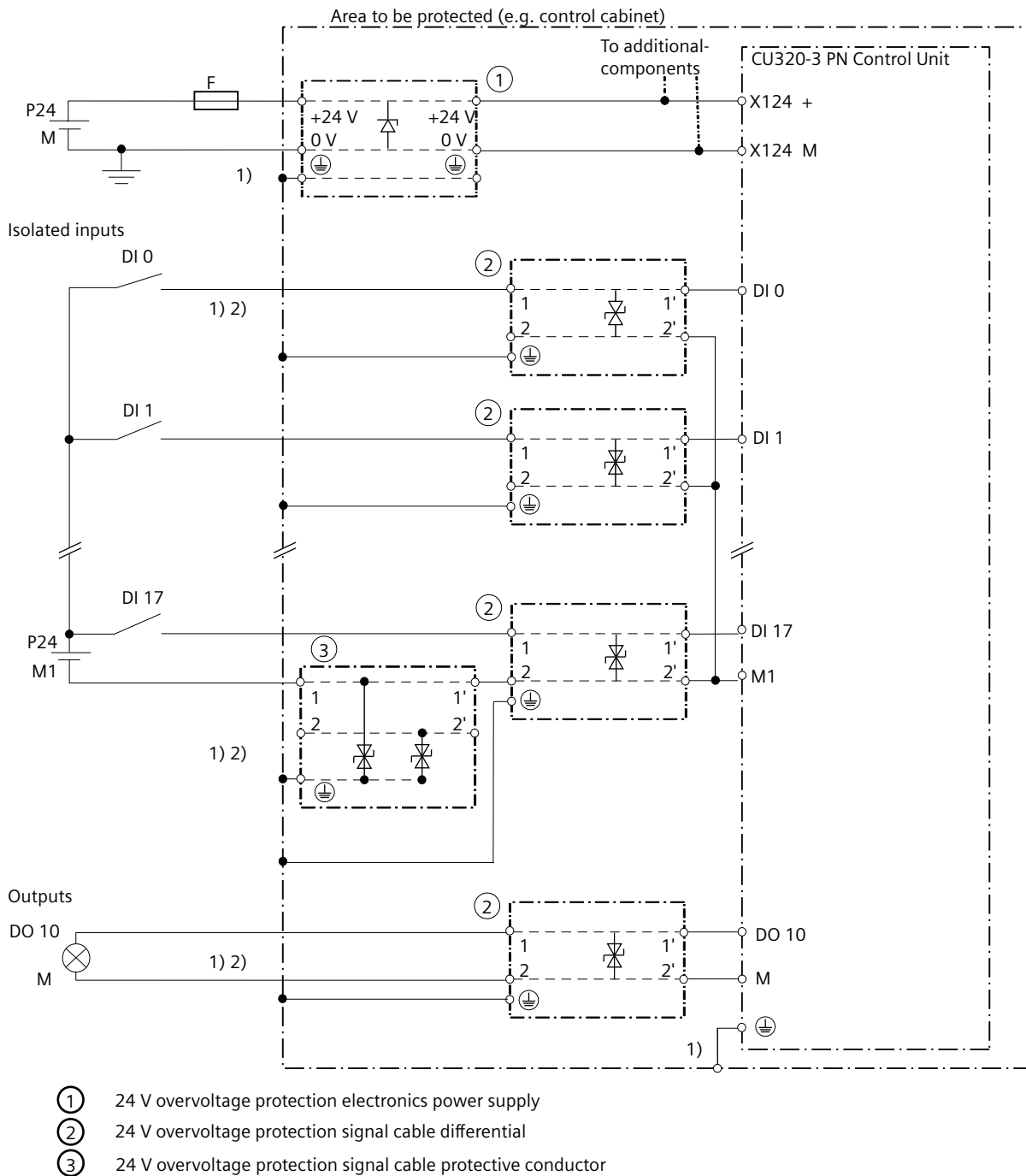
Description

Observe the following notes when installing surge protection devices:

- Always locate surge protection devices at the boundary of the area to be protected, e.g. at the entry point to the control cabinet.
- Install a surge protection device for all 24 V cables that exit the protected area.
- For equipotential bonding, the metal enclosure of the component and the protective conductor connection of the surge protection device must be conductively connected. You can achieve this, for example, by mounting the component on a metal mounting plate to establish a good electrically conductive connection. Then connect the protective conductor connections of the surge protection devices to the mounting plate through the shortest distance.
- The surge protection device is snapped onto a metal DIN rail for equipotential bonding of surge protection devices for signal cables. It is then sufficient to conductively connect the DIN rail to the metallic enclosure of the component. To establish this connection, mount the DIN rail and the component on a common metal mounting plate.

4.5.2.3 Connection example for surge protection devices

Connection example



- 1) Connection of the protective conductor connection of the surge protection device to the mounting plate
- 2) Mounting the DIN rail with surge protection device as well as the components on a common metal mounting plate

Figure 4-4 Connecting surge protection devices using a Control Unit as example

4.6 Cable selection and cable routing

Description

Comply with the following notes when installing power and signal cables to guarantee, safe, reliable, permanent and disturbance-free operation:

- Only use DRIVE-CLiQ signal cables from Siemens.
- Siemens cables are also recommended for all other power and signal cables.
- Always follow the correct procedures for the shielding and the specified cable lengths.

4.7 Cable requirements for UL applications

Description

For UL applications, only use copper cables with a minimum temperature rating of 75 °C for the following cables:

- Control Unit CU320-3 PN:
 - Signal cables for digital inputs/outputs
 - 24 V DC supply line
- Terminal Board TB30-3:
 - Signal cables for digital inputs/outputs

If cables with a higher minimum temperature rating are used, the conductor cross-section must not be smaller than for cables with a minimum temperature rating of 75 °C

4.8 Wiring rules for DRIVE-CLiQ and DRIVE-CLiQ Express

Description

Components are equipped with DRIVE-CLiQ and DRIVE-CLiQ Express interfaces. These support the following transfer rates:

Interface	Transfer rate
DRIVE-CLiQ Express	1 Gbps ¹⁾
DRIVE-CLiQ	100 Mbps

¹⁾ 100 Mbit/s when connecting to a component with DRIVE-CLiQ interface

There are binding rules for wiring components with DRIVE-CLiQ and DRIVE-CLiQ Express, which must be followed as well as recommended rules that should be complied with. Wiring rules for DRIVE-CLiQ are provided in Chapter "Rules for wiring DRIVE-CLiQ" in the SINAMICS S220 Function Manual.

4.9 Maximum permissible cable lengths

Technical specifications

An overview of the maximum permissible lengths of all signal and supply lines is provided in the following table.

Also comply with the following notes:

- Keep all cables as short as possible to minimize the antenna effect.
- Carefully observe the permissible cable lengths and the maximum total cable lengths for the various EMC categories.

Table 4-3 Maximum allowable cable lengths for signal and supply lines

Maximum length	Unit	Value
24 V DC supply lines	m	30 ¹⁾
Ethernet signal cable for interface X127 (100 Mbps)	m	30
Ethernet signal cable for interface X128 (1 Gbps)	m	100
Ethernet signal cable for PROFINET interfaces X150 P1 and X150 P2 (100 Mbps)	m	100
24 V signal cables for digital inputs/outputs	m	30 ¹⁾
Signal cables for analog inputs/outputs, shielded	m	30
DRIVE-CLiQ signal cables MC500 (100 Mbps)	m	100
DRIVE-CLiQ signal cables MC800PLUS (100 Mbps)	m	75
DRIVE-CLiQ Express signal cables MC500 (1 Gbps)	m	80
Encoder cable length for encoder interface X520 on Terminal Module TM41-3	m	30

¹⁾ For longer lengths up to a maximum of 100 meters, connect suitable surge protection devices.

4.10 High-frequency-compatible equipotential bonding for distributed DRIVE-CLiQ nodes

Description

Equipotential bonding suitable for high frequencies is required for all drive components to ensure the electromagnetic compatibility of the drive. High-frequency-compatible equipotential bonding is also required for the distributed DRIVE-CLiQ nodes, e.g. DME20, SME20, SME25, SME120 or SME125.

Measures:

- Installation on bare metal machine and system parts that are all conductively connected to each other
- Conductor laid parallel to the DRIVE-CLiQ cable ($\geq 6 \text{ mm}^2$)

More information

More information on protection against electric shock and high-frequency-compatible equipotential bonding can be found on the Internet:

Equipment Manual SINAMICS S220 Booksize power units (<https://support.industry.siemens.com/cs/ww/en/view/109803552>)

4.11 Connection system

4.11.1 Spring-loaded terminals

The type of spring-loaded terminal can be taken from the interface description of the particular component.

Table 4-4 Connectable conductor cross-sections for spring-loaded terminals

Spring-loaded terminal type			
1	Connectable cable cross-sections	Rigid, flexible Flexible with conductor end sleeve without plastic sleeve AWG / kcmil	0.14 ... 0.5 mm ² 0.25 ... 0.5 mm ² 26 ... 20
	Stripped length	8 mm (0.31 inch)	
2	Connectable cable cross-sections	Flexible Flexible with conductor end sleeve without plastic sleeve Flexible with conductor end sleeve with plastic sleeve AWG / kcmil	0.08 ... 2.5 mm ² 0.25 ... 2.5 mm ² 0.25 ... 1.5 mm ² 28 ... 12
	Stripped length	8 ... 9 mm (0.31 ... 0.35 inch)	
3	Connectable cable cross-sections	Rigid, flexible Flexible with conductor end sleeve without plastic sleeve Flexible with conductor end sleeve with plastic sleeve AWG / kcmil	0.2 ... 1.5 mm ² 0.25 ... 1.5 mm ² 0.25 ... 0.75 mm ² 24 ... 16
	Stripped length	10 mm (0.39 inch)	
4	Connectable cable cross-sections	AWG	25 ... 95 mm ² 4 ... 4/0
	Stripped length	35 mm (1.38 inch)	
5	Connectable cable cross-sections	Rigid Flexible Flexible with end sleeve without plastic sleeve Flexible with end sleeve with plastic sleeve AWG/kcmil	0.2 ... 10 mm ² 0.2 ... 6 mm ² 0.25 ... 6 mm ² 0.25 ... 4 mm ² 24 ... 8
	Stripped length	15 mm (0.59 inch)	

Spring-loaded terminal type			
6	Connectable cable cross-sections	Rigid, flexible Flexible with conductor end sleeve without plastic sleeve Flexible with conductor end sleeve with plastic sleeve AWG / kcmil	0.2 ... 2.5 mm ² 0.25 ... 2.5 mm ² 0.25 ... 1.5 mm ² 24 ... 12
	Stripped length	8 mm (0.31 inch)	
7	Connectable cable cross-sections	Rigid, flexible Flexible with conductor end sleeve without plastic sleeve Flexible with conductor end sleeve with plastic sleeve AWG / kcmil	0.25 ... 1.5 mm ² 0.25 ... 1.5 mm ² ¹⁾ 0.25 ... 0.75 mm ² 24 ... 16
	Stripped length	8 mm (0.31 inch)	

¹⁾ The maximum of 1.5 mm² is only possible for trapezoidal crimping. Otherwise, the maximum cable cross-sections reduced to 1.0 mm².

4.11.2 Screw terminals

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

Table 4-5 Connectable conductor cross-sections and tightening torques for screw terminals

Screw terminal type			
1	Connectable cable cross-sections	Rigid, flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve AWG / kcmil	0.08 ... 1.5 mm ² 0.25 ... 1.5 mm ² 0.25 ... 0.5 mm ² 28 ... 14
	Stripped length	7 mm (0.28 inch)	
	Tool	Screwdriver 0.4 x 2.0 mm	
	Tightening torque	0.22 ... 0.25 Nm (1.9 ... 2.2 lbf in)	
1_1	Connectable cable cross-sections	Rigid, flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve AWG / kcmil	0.14 ... 1.5 mm ² 0.25 ... 1.5 mm ² 0.25 ... 0.5 mm ² 26 ... 14
	Stripped length	7 mm (0.28 inch)	
	Tool	Screwdriver 0.4 x 2.5 mm	
	Tightening torque	0.22 ... 0.25 Nm (1.9 ... 2.2 lbf in)	
2	Connectable cable cross-sections	Rigid, flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve AWG / kcmil	0.2 ... 2.5 mm ² 0.2 ... 2.5 mm ² 0.2 ... 1.5 mm ² 22 ... 12
	Stripped length	6 ... 7 mm (0.24 ... 0.28 inch)	
	Tool	Screwdriver 0.5 x 3 mm	
	Tightening torque	0.4 ... 0.5 Nm (3.5 ... 4.4 lbf in)	

Screw terminal type			
3	Connectable cable cross-sections	Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve AWG / kcmil	0.2 ... 2.5 mm ² 0.25 ... 1 mm ² 0.25 ... 1 mm ² 22 ... 12
	Stripped length	9 mm (0.35 inch)	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 ... 0.6 Nm (4.4 ... 5.3 lbf in)	
4	Connectable cable cross-sections	Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve AWG / kcmil	0.2 ... 4 mm ² 0.25 ... 4 mm ² 0.25 ... 4 mm ² 22 ... 10
	Stripped length	7 mm (0.28 inch)	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 ... 0.6 Nm (4.4 ... 5.3 lbf in)	
5	Connectable cable cross-sections	Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve AWG / kcmil	0.5 ... 6 mm ² 0.5 ... 6 mm ² 0.5 ... 6 mm ² 20 ... 8
	Stripped length	12 mm (0.47 inch)	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.2 ... 1.5 Nm (10.6 ... 13.3 lbf in)	
6	Connectable cable cross-sections	Flexible With end sleeve, without plastic sleeve With end sleeve, with plastic sleeve AWG / kcmil	0.5 ... 10 mm ² 0.5 ... 10 mm ² 0.5 ... 10 mm ² 20 ... 6
	Stripped length	11 mm (0.43 inch)	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 ... 1.8 Nm (13.3 ... 15.9 lbf in)	
7	Connectable cable cross-sections	0.5 ... 16 mm ² (AWG 20 ... 4)	
	Stripped length	14 mm (0.55 inch)	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 ... 1.7 Nm (13.3 ... 15.0 lbf in)	

Control Unit CU320-3 PN

5.1 Description

Overview

The Control Unit CU320-3 PN is the central control unit of the SINAMICS S220 drive system.

Description

The communication, open-loop control and closed-loop control functions for a drive line-up are executed in the Control Unit. The control information is generated in it and distributed to the individual components (Motor Modules, Line Modules, Terminal Modules, Sensor Modules, etc.) via DRIVE-CLiQ. The firmware and the parameters set for the functions are stored on a memory card.

The Control Unit CU320-3 PN supports communication via PROFINET. It is used in the SINAMICS S220 drive system in drives of the Booksize, Chassis and Cabinet formats.

The following interfaces are available on the Control Unit CU320-3 PN for connecting additional functions:

Table 5-1 Overview of interfaces of the Control Unit CU320-3

Type	Quantity
Digital inputs	12
Bidirectional digital inputs/outputs	8
DRIVE-CLiQ Express interfaces	4
PROFINET interfaces	2
Ethernet interface 1 Gbps	1
Ethernet interface 100 Mbps	1
Option slot for Option Boards	1

Compatible firmware versions:

- Control Unit CU320-3 PN V6.6 or higher

5.2 Overview

Overview diagram

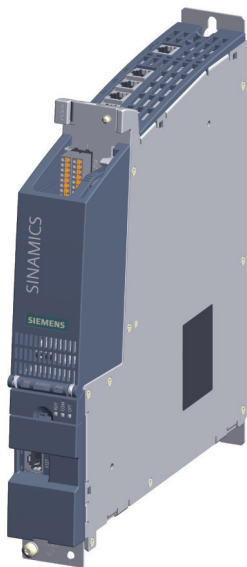


Figure 5-1 Control Unit CU320-3 PN

Table 5-2 Control Unit

Width	Description	Article number
50 mm	Control Unit CU320-3 PN	6SL5140-3MA00-0AA0

5.3 Safety information

NOTICE
Component destruction as a result of high leakage currents The Control Unit or other PROFINET nodes can be destroyed if significant leakage currents flow via the PROFINET cable. Connect remote plant systems for high-frequency-compatible equipotential bonding using a conductor ≥ 10 mm.

**NOTICE****Operational disturbances or plant downtimes due to electric fields or electrostatic discharge**

Electric fields or electrostatic discharge can lead to disruptions in operation or to plant downtime.

- For all connection and maintenance work on the Control Unit 320-3, especially when the front flap is open, always observe the ESD regulations in Chapter "Equipment damage due to electric fields or electrostatic discharge (Page 22)".

NOTICE**Damage or malfunctions of the Option Board by inserting and withdrawing during operation**

Withdrawing and inserting the option board in operation can damage it or cause it to malfunction.

- Only withdraw or insert the Option Board when the Control Unit is current-free.

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 DRIVE-CLiQ cables that have been released by Siemens for the particular application.

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

Dirty/polluted DRIVE-CLiQ interfaces can result in system malfunctions.

- Close and seal unused DRIVE-CLiQ interfaces using the blanking covers included in the scope of delivery. You can order missing blanking covers (article number: 6SL3066-4CA00-OAA0, 50 units).

Note**Malfunction in the switched-off state due to diagnostic currents**

Unlike mechanical switching contacts, e.g. emergency stop switches, diagnostic currents can also flow when the semiconductor is in the switched-off state (logical state "0" or "OFF"). If interconnection with digital inputs is faulty, the diagnostic currents can result in incorrect switching states. Incorrect signal states of digital inputs can cause unwanted motions of machine parts and trigger malfunctions.

- Observe the conditions of digital inputs and digital outputs specified in the relevant manufacturer documentation.
- Check the conditions of the digital inputs and digital outputs with regard to currents in the "OFF" state and, if necessary, connect the digital inputs to suitably dimensioned, external resistors against the reference potential of the digital inputs.

5.4 Interfaces and connections

5.4.1 Interfaces

Overview diagram

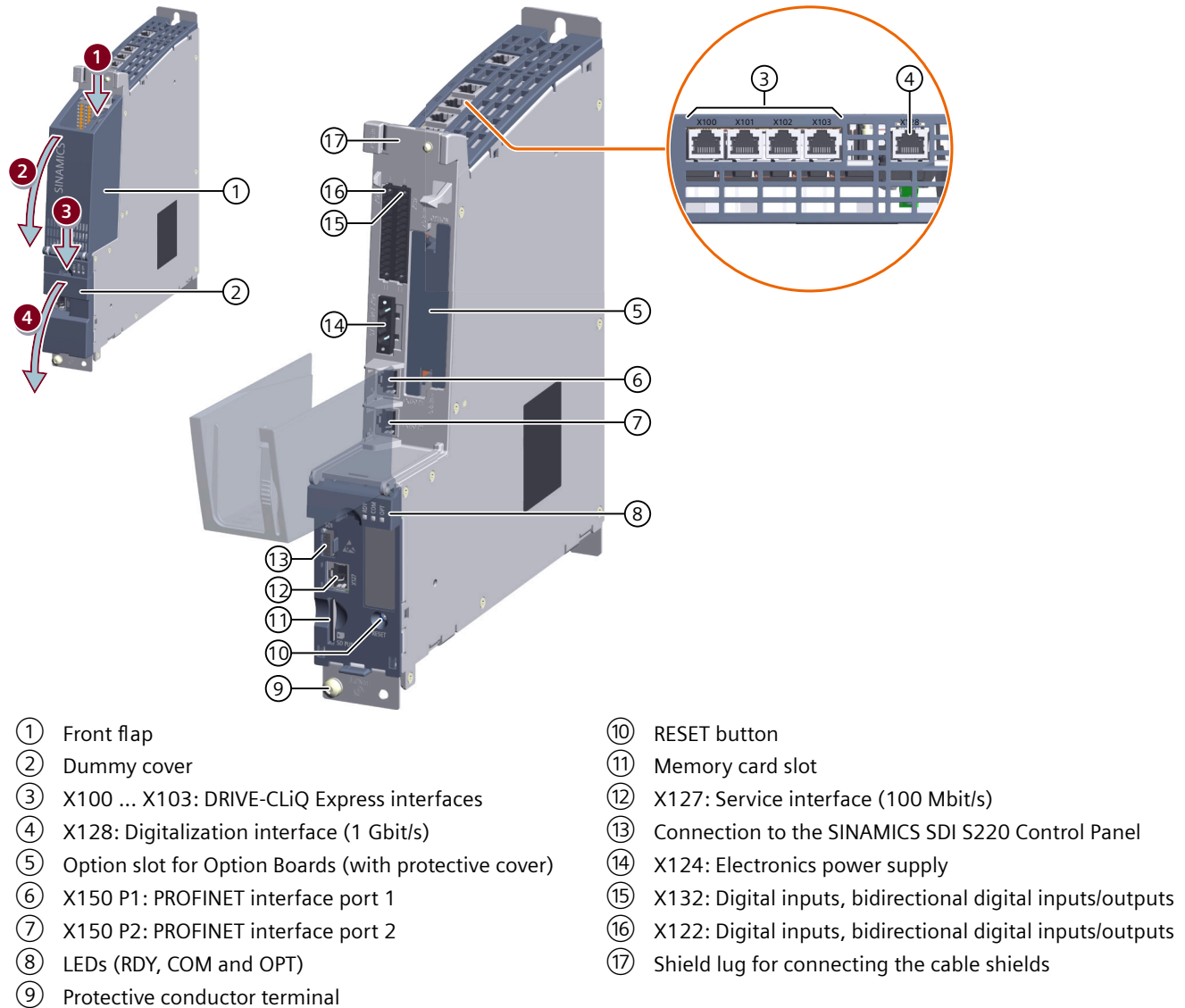


Figure 5-2 Interface overview Control Unit CU320-3 PN

5.4.2 X100 ... X103 DRIVE-CLiQ Express

Overview

The DRIVE-CLiQ Express interfaces X100 ... X103 are used to transfer the parameterization and control data between the drive components.

Requirement

Note

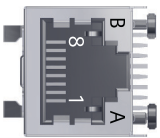
MOTION-CONNECT DRIVE-CLiQ cables are required

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

Description

A component with a DRIVE-CLiQ interface can also be connected to a DRIVE-CLiQ Express interface. The transfer rate in this case is 100 Mbps.

Table 5-3 X100 ... X103: DRIVE-CLiQ Express interfaces

Socket	Pin	Designation	Technical data
	1	TDA_P	Bidirectional data signal A +
	2	TDA_N	Bidirectional data signal A -
	3	TDB_P	Bidirectional data signal B +
	4	TDC_P	Bidirectional data signal C +
	5	TDC_N	Bidirectional data signal C -
	6	TDB_N	Bidirectional data signal B -
	7	TDD_P	Bidirectional data signal D +
	8	TDD_N	Bidirectional data signal D -
	A	+ (24 V)	Power supply ¹⁾
	B	M (0 V)	Electronics ground

¹⁾ The power supply is used to supply power to components with a DRIVE-CLiQ connection without their own electronic power supply, e.g. Sensor Modules External or DRIVE-CLiQ encoders.

5.4.3 X122, X132 digital inputs/outputs

Overview

External digital control elements can be connected via digital inputs and outputs at interfaces X122 and X132, for example sensors, buttons or switches.

The connectors for these interfaces are included in the terminal kit of the Control Unit.

Requirement

Note

Ensuring the function of digital inputs

Terminal M1 or M2 must be connected for the digital inputs (DI) to function correctly. Your achieve this by applying one of the following two measures:

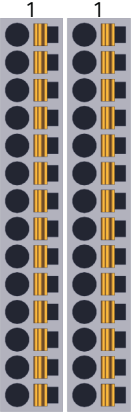
1. Connect the reference ground of the external signal source: Connect the reference ground of the external signal source, which you use for the digital inputs, directly at terminal M1 or M2.
2. Jumper to terminal M: Alternatively, you can insert a jumper between terminal M1 or M2 and terminal M.

Note the following: This removes the galvanic isolation for these digital inputs.

Description

If the 24 V supply is briefly interrupted, the digital outputs are deactivated during this time. Digital inputs that are not assigned are interpreted as "0".

Table 5-4 X122/X132: Digital inputs/outputs

Connector	Pin	Designation ¹⁾		Technical data
		X122	X132	
	1	DI 0	DI 4	Digital inputs
	2	DI 1	DI 5	
	3	DI 2	DI 6	
	4	DI 3	DI 7	
	5	DI 16	DI 20	
	6	DI 17	DI 21	
	7	M1	M2	Reference potential for terminals 1 ... 6
	8	M	M	Electronics ground
	9	DI/DO 8	DI/DO 12	Bidirectional digital inputs/outputs DI 8 ... DI 15: high-speed digital inputs ²⁾³⁾
	10	DI/DO 9	DI/DO 13	
	11	M	M	
	12	DI/DO 10	DI/DO 14	
	13	DI/DO 11	DI/DO 15	
	14	M	M	
Connectable cable cross-sections	Rigid, flexible			0.2 ... 1.5 mm ²
	Flexible, with end sleeve without protective collar			0.25 ... 1.5 mm ²
	Flexible, with end sleeve with protective collar			0.25 ... 0.75 mm ²
	AWG / kcmil			24 ... 16
Stripped length	10 mm (0.39 inch)			

¹⁾ DI: digital input, DI/DO: bidirectional digital input/output

²⁾ High-speed digital inputs must be shielded.

³⁾ High-speed digital inputs can be used as probe inputs or as inputs for the external zero mark.

Table 5-5 Technical specifications of the digital inputs DI 0 ... DI 7, DI 16, DI 17, DI 20 and DI 21¹⁾

Feature	Technical data
Voltage (incl. ripple)	-3 ... +30 V DC
Signal "0"	-3 ... +5 V
Signal "1"	15 ... 30 V
Galvanic isolation	Yes, max. 50 V potential difference
Reference potential	M1 or M2
Current consumption	
At 24 V DC (typ.)	3.5 mA
"0" signal reliably detected	< 1.5 mA
Delay time (hardware, without external cabling)	
"0" → "1" (typ. / max.)	10 µs / 20 µs
"1" → "0" (typ. / max.)	100 µs / 150 µs

¹⁾ The digital inputs correspond to the input characteristic acc. to IEC 61131-2, type 1 and type 3.

Table 5-6 Technical specifications of the bidirectional digital inputs/outputs DI/DO 8 ... DI/DO 15¹⁾

Feature	Technical data
As digital input	
Voltage (incl. ripple)	-3 ... +30 V DC
Signal "0"	-3 ... +5 V
Signal "1"	15 ... 30 V
Galvanic isolation	No
Reference potential	M
Current consumption	
At 24 V DC (typ.)	3.5 mA
"0" signal reliably detected	< 1.5 mA
Delay time (hardware, without external cabling)	
"0" → "1" (typ. / max.)	5 µs / 10 µs
"1" → "0" (typ. / max.)	50 µs / 120 µs
As digital output (continuous short-circuit-proof)²⁾	
Voltage	
Signal "1", loaded	-3 ... +30 V DC > X124. + -2 V
Galvanic isolation	No
Reference potential	M
Output current	
Per output	0.5 A
Total of all 8 outputs	4 A
Residual current with signal "0"	< 0.5 mA
Load types	ohmic, capacitive, inductive
Delay time	
"0" → "1" (ohmic load) (typ. / max.) ³⁾	50 µs / 100 µs
"1" → "0" (ohmic load) (typ. / max.) ³⁾	75 µs / 150 µs

Feature	Technical data
Switching frequency	
With ohmic load (max.)	100 Hz
With inductive load (max.)	0.5 Hz
With lamp load (max.)	10 Hz
Lamp load (max.)	5 W

¹⁾ The digital inputs correspond to the input characteristic acc. to IEC 61131-2, type 1 and type 3.

²⁾ Automatic restart after short-circuit

³⁾ Data for: $V_{cc} = 24 \text{ V}$; load 48Ω ; high ("1") = $90\% V_{out}$; low ("0") = $10\% V_{out}$

More information

The delay time of the digital inputs and outputs depends on the evaluation. More information is provided in Chapter "Function diagrams" in the SINAMICS S220 List Manual

5.4.4 X124 electronic power supply

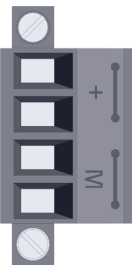
Overview

The electronic power supply for the Control Unit is connected to the X124 interface.

The connector for this interface is included in the terminal kit of the Control Unit.

Description

Table 5-7 X124: Electronics power supply¹⁾

Connector	Terminal	Designation	Technical data
	+	Electronics power supply	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: max. 5.7 A (including DRIVE-CLiQ, digital outputs, service interface X127 and Control Unit current) ²⁾ Max. current via jumper in connector: 20 A (15 A according to UL/CSA) The two "+" and "M" terminals are bridged in the connector. This ensures that the supply voltage is looped through.
	+	Electronics power supply	
	M	Electronics ground	
	M	Electronics ground	
Connectable cable cross-sections	Rigid, flexible		0.2 ... 2.5 mm ²
	Flexible, with end sleeve without protective collar		0.2 ... 2.5 mm ²
	Flexible, with end sleeve with protective collar		0.2 ... 1.5 mm ²
	AWG / kcmil		22 ... 12
Stripped length	6 ... 7 mm (0.24 ... 0.28 inch)		

Connector	Terminal	Designation	Technical data
Screwdriver	Slotted screwdriver 0.5 x 3 mm		
Tightening torque	0.4 ... 0.5 Nm (4.5 ... 5.0 lbf in)		

- 1) The electronic power supply is grounded internally. For this purpose, the electronic ground is connected internally to the Control Unit enclosure.
- 2) The total power consumption at the interface X124 must not exceed 5.7 A. If necessary, reduce the total load on the digital outputs.

5.4.5 X150 P1, P2 PROFINET

Overview

The Control Unit is connected to other components such as an operating unit or a higher-level controller via the PROFINET interfaces X150 P1 (= port 1) and X150 P2 (= port 2).

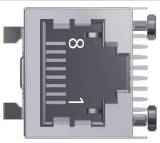
Requirement

Use plugs with a 145° cable outlet, e.g. the Industrial Ethernet Fast Connect RJ45 Plug 145 (article number for 1 plug: 6GK1901-1BB30-0AA0).

Description

The PROFINET interfaces can be operated isochronously. Each PROFINET interface features two LEDs. Information on this is provided in Chapter "LEDs (Page 61)".

Table 5-8 X150 P1/P2: PROFINET interfaces

Socket	Pin	Designation	Technical specifications
	1	RXP	Receive data +
	2	RXN	Receive data -
	3	TX	Send data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	TXN	Send data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
Connector type	RJ45 socket		

5.4.6 X127 service interface

Overview

Service interface X127 is intended for commissioning and diagnostics, which means that it must always be accessible. They are located on the front side of the Control Unit.

Requirement

Note

No compatibility of the power supply with Power over Ethernet (PoE)

The power supply of the interface is not compatible with Power over Ethernet (PoE) Mode A and Mode B. Therefore, only the SINAMICS Smart Adapter and the SINAMICS SDI Pro 5.5" are permitted for connection to the service interface X127, as no power supply is available for other devices.

The following restrictions apply to service interface X127:

- Only local access is permitted.
- Only local networking in a closed and locked electrical cabinet is permitted.
- When accessing the control cabinet remotely, you must take additional industrial cybersecurity measures to prevent misuse through sabotage, data manipulation by unqualified personnel, and the interception of confidential data.

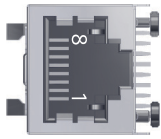
Description

Service interface X127 has a transfer rate of 100 Mbit/s. It can be used for the following functions:

- Access via Ethernet cable to an operating unit with Startdrive or web server, e.g. PC, notebook, SIMATIC HMI (IPC, Unified Comfort Panel)
- Access via WLAN using the SINAMICS Smart Adapter to an operating unit with Startdrive or web server, e.g. PC, notebook, tablet
- Access to the SINAMICS SDI Pro 5.5"

Service interface X127 is equipped with two LEDs. Information on this is provided in Chapter "LEDs (Page 61)".

Table 5-9 X127: Service interface

Socket	Pin	Designation	Technical data	
	1	TXP	Ethernet send data +	Power supply: Voltage: 24 V DC (taken from the 24 V input voltage at X124) Supply current: 300 mA
	2	TXN	Ethernet transmit data -	
	3	RXP	Ethernet receive data +	
	4	+ 24 V	Power supply	
	5	+ 24 V	Power supply	
	6	RXN	Ethernet receive data -	
	7	M	Ground	
	8	M	Ground	
Connector type	RJ45 socket			

5.4.7 X128 digitalization interface

Overview

Digitalization interface X128 is available for expanded applications, for example, a cloud connection.

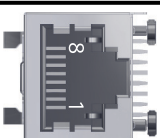
Description

Digitalization interface X128 has a transfer rate of 1 Gbit/s. It can be used for expanded applications that require a higher transfer rate, e.g.:

- Use of a SIMATIC HMI (IPC, Unified Comfort Panel)
- Cloud connection via an Edge Box

No direct Internet or cloud connection is possible via digitalization interface X128 and no power supply is provided at this interface. The interface is equipped with two LEDs. Information on this is provided in Chapter "LEDs (Page 61)".

Table 5-10 X128: Ethernet interface

Socket	Pin	Designation	Technical data
	1	TDA_P	Bidirectional data signal A +
	2	TDA_N	Bidirectional data signal A -
	3	TDB_P	Bidirectional data signal B +
	4	TDC_P	Bidirectional data signal C +
	5	TDC_N	Bidirectional data signal C -
	6	TDB_N	Bidirectional data signal B -
	7	TDD_P	Bidirectional data signal D +
	8	TDD_N	Bidirectional data signal D -

5.4.8 Memory card slot

Overview

The memory card is inserted into the slot on the front of the Control Unit. The memory card contains the firmware, set parameters, and any existing license keys.

The memory card is not included in the scope of supply of the Control Unit, but must be ordered separately.

Requirement



NOTICE
Damage to the memory card caused by electric fields or electrostatic discharge Electric fields or electrostatic discharge may result in the memory card being damaged. When removing and inserting the memory card, always observe the ESD regulations in Chapter "Equipment damage due to electric fields or electrostatic discharge (Page 22)".

Note
Plant standstill due to removal or insertion of the memory card during operation If the memory card is removed or inserted during operation, data may be lost and in some cases the plant may come to a standstill. Remove and insert the memory card only when the Control Unit is de-energized.

Operation of the Control Unit is not possible without a memory card. Only SIEMENS memory cards are permitted for operating the Control Unit. Only SIEMENS memory cards are suitable for use in the Control Unit, e.g. due to the temperature range.

Description

Table 5-11 Memory card slot

slot	Technical data
	The SD card slot is marked with an SD card symbol indicating the insertion direction of the SD card.

5.4.9 **RESET button**

Overview

A hardware reset of the Control Unit is initiated using the reset button; for example, to reinitialize the Control Unit when the system is down or for an unexpected malfunction.

Description

Table 5-12 RESET button

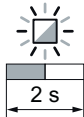
Button	Technical data
	Pressing the reset button initiates a hardware reset of the Control Unit. This operation results in the device restarting. The Control Unit is reset to its initial state. The button must be actuated using a sharp object, e.g. a pen. It is located behind the dummy cover or behind the SINAMICS SDI S220 Control Panel, if used.

5.5 **LEDs**

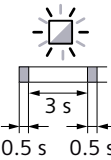
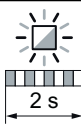
5.5.1 **Explanation of icons**

Response of the LEDs

The following tables explain the LED icons.

Icon	Description
	LED is bright
	LED is OFF
	LED flashes slowly
	LED flashes in alternating order 3 times quickly - 2 s pause - ...

5.5 LEDs

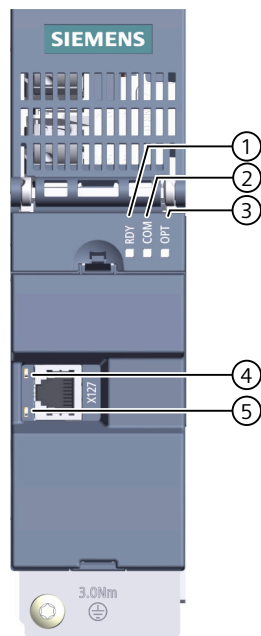
Icon	Description
	LED flashes briefly every 3 s
	LED flashes quickly
	LED flashes with variable frequency

5.5.2 LEDs on the Control Unit

Overview

The LEDs on the front of the Control Unit and the LEDs on the interfaces X150 P1, X150 P2, X127 and X128 provide information on the operating status of the Control Unit.

Description



- ① RDY (= READY)
- ② COM (= PROFIdrive cyclic operation)
- ③ OPT (= OPTION)
- ④ Link at interface X127¹⁾
- ⑤ Activity at interface X127¹⁾

Figure 5-3 LEDs on the Control Unit CU320-3 PN

¹⁾ Also applies to the interfaces X150 P1, X150 P2 and X128.

5.5.3 LED RDY and LED COM

Response of the LEDs

RDY	COM	Description	Remedy
 Green	Not relevant	Converter is ready for operation and is fault free.	
Not relevant	 Green	Cyclic communications running.	

5.5 LEDs

RDY	COM	Description	Remedy
 Green	 Green	Possible causes • Temporary state after the supply voltage is switched on. firmware being loaded and initialized. • Firmware is being updated. • All user-defined settings are reset to the factory setting.	
 Green	☐	Firmware update completed The converter is waiting.	Switch the converter supply voltage off and on.
 Green	☐	All user-defined settings are reset to the factory setting.	Switch the converter supply voltage off and on.
 Green	Not relevant	PROFenergy energy saving mode is active.	
 Orange	☐	Commission or restore factory settings using the commissioning tool	
 Orange	 Orange	Possible causes • Temporary state after the supply voltage is switched on • Restart	
 Orange	☐	The converter is identified, e.g. using the commissioning tool.	
 Red	☐	Possible causes • Converter signals a fault. • Firmware error • No license	Appropriate remedies: • Check message display, rectify cause of fault • Activate required license
☐	 Red	No fieldbus connection: • No data exchange or configuration error • Data exchange lost • Data is being exchanged, but there are no set-points (controller in the stop state)	Possible remedies: • Check message display and rectify cause of fault. • Check operating mode of controller (PLC)

RDY	COM	Description	Remedy
☐	 Red	Firmware update signals an error.	Possible remedies: - Switch the converter supply voltage off and on, and repeat the firmware update. - Firmware update via memory card: Replace memory card and repeat firmware update. - Contact Support/Hotline.
☐		Reset of all user-defined settings to the factory setting unsuccessful.	Possible remedies: - Check the memory card with the empty file called RESET.TXT - Switch off and switch on the converter supply voltage and reset all user-defined settings to the factory setting. - Contact Support/Hotline.
☐	 Red	Possible causes - BIOS error - General error - Loading error - File error: - Memory card is not available or is faulty. - File corrupt - CRC error	Possible remedies: - Switch the converter supply voltage off and on. - Check memory card if available - Reload firmware - Contact Hotline/Support.

5.5.4 LED OPT

Behavior of the LEDs

The OPT LED indicates signals when an option module (e.g. TB30-3) is used.

Table 5-13 Signal states of the LED OPT

OPT	Description	Remedy
☐	The electronic power supply is missing or outside the permissible tolerance.	Check power supply
 Green	The option module is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	
 Orange	DRIVE-CLiQ communication is being established.	

5.5 LEDs

OPT	Description	Remedy
 Red	The option module signals a fault. The LED is activated irrespective of the corresponding messages being reconfigured.	
 Green - red	Firmware update in progress	
 Green - red	Firmware update completed Waiting for the supply voltage to be switched off and on	Switch the converter supply voltage on and off
 Green - orange OR  Red - orange	Option module detection is activated. The color of the flashing LED depends on the LED state on activation with the commissioning tool.	

5.5.5 LED Link and LED Activity

Response of the LEDs in operation

The LED Link and the LED Activity indicate signals at PROFINET interfaces X150 P1 and X150 P2 as well as at interfaces X127 and X128.

Table 5-14 Signal states of the LED Link

Link ¹⁾	Description	Remedy
 Green	The Ethernet connection has been established successfully (100 Mbps).	
 Orange	The Ethernet connection has been established successfully (1 Gbps). ²⁾	
	The Ethernet connection has not been established.	- Establish the missing or interrupted Ethernet connection - Switch on connected and linked devices

¹⁾ All LEDs on the PROFINET interfaces X150 P1 and X150 P2 light up for approx. 5 s during start-up.

²⁾ Applies to digitalization interface X128

Table 5-15 Signal states of the LED Activity

Activity ¹⁾	Status	Remedy
 Orange	Sending or receiving	
	No activity	

¹⁾ All LEDs on the PROFINET interfaces X150 P1 and X150 P2 light up for approx. 5 s during start-up.

5.6 Connection example

Connection example

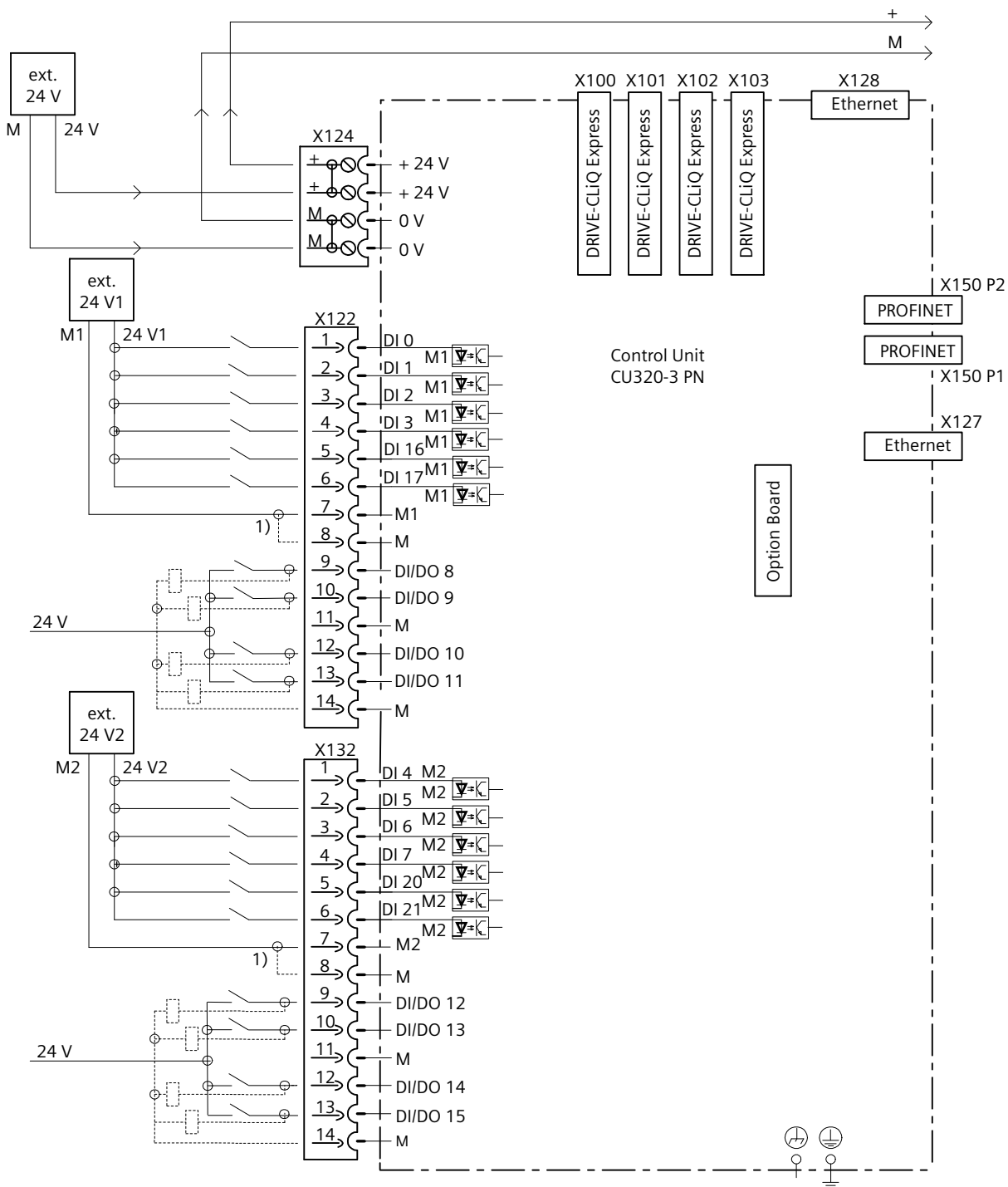


Figure 5-4 Connection example for the Control Unit CU320-3 PN

5.7 Dimension drawing

Dimension drawing

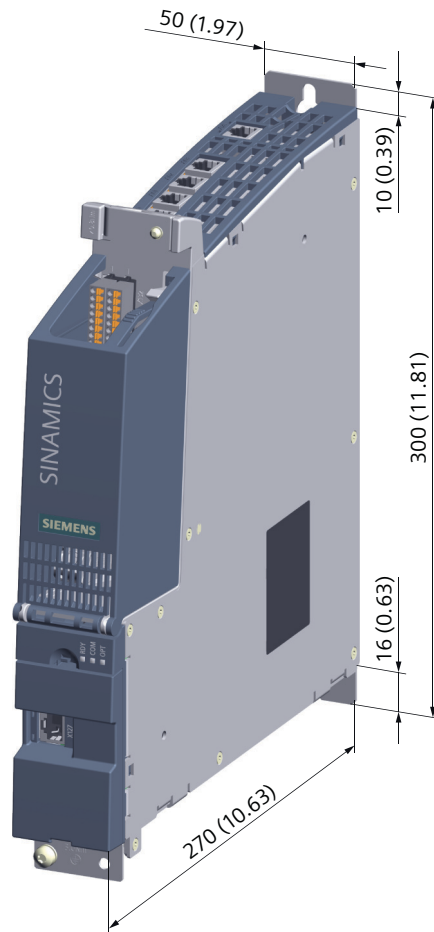


Figure 5-5 Dimension drawing Control Unit CU320-3 PN, all data in mm and (inches)

5.8 Installing the Control Unit

Overview

The Control Unit CU320-3 is designed for installation in the control cabinet. It is fixed to the control cabinet panel or a mounting panel.

Requirement



WARNING

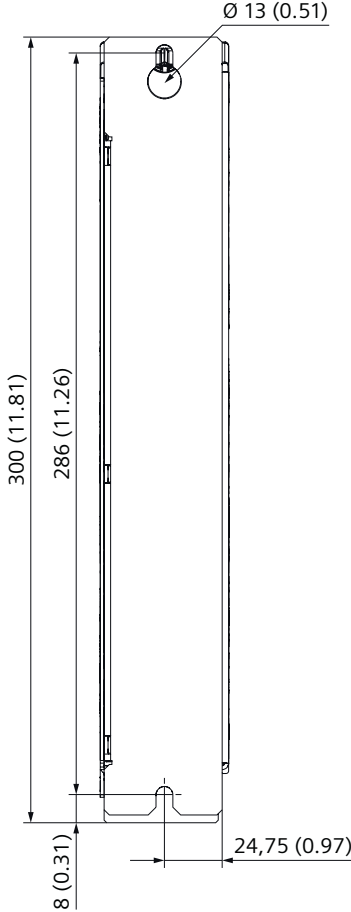
Risk of injury as a result of foreign bodies in the device

Parts (e.g.: drilling chips, protective collars) falling into the device can cause short-circuits and damage the insulation. This can result in severe injury (arcing, loud bang, parts that are flung out).

- Only perform installation and other work when the devices are current-free.
- Cover the ventilation slots when mounting and installing the control cabinet and remove the cover before switching on.

Procedure

Table 5-16 Drilling pattern of the Control Unit in mm and (inch)

Component	Control Unit CU320-3 PN
Rear view	 Ø 13 (0.51) 300 (11.81) 286 (11.26) 8 (0.31) 24,75 (0.97)
Mounting parts	2 x M6 screws 2 x M6 washers
Tightening torque	6 Nm (53.1 lbf in)

Proceed as follows to mount the Control Unit:

1. Prepare the mounting panel.
2. First, screw the 2 screws in far enough so that you can attach the component.
3. Attach the component.
4. Then tighten the screws fully. Tightening torque: 6 Nm (53.1 lbf in).

5.9 Connecting cables

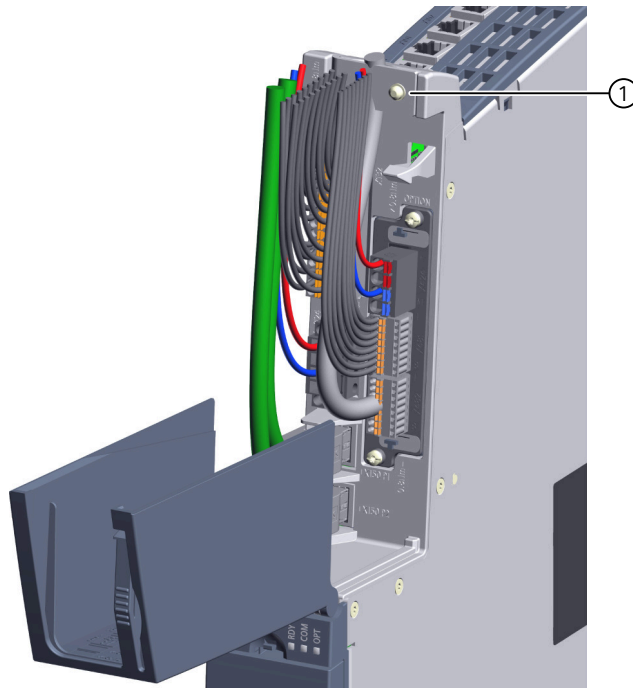
Overview

Connect cables to the Control Unit CU320-3 as specified, as this may otherwise lead to excessive heat generation and damage to the cables.

Description

When connecting the cables to the Control Unit CU320-3, the following applies:

- Lay cables loosely next to each other and avoid bundling.
- Only use the shield lug at the top of the Control Unit for shielded cables:
 - Signal cables for analog inputs/outputs
 - Signal cables for digital inputs/outputs if these are shielded



① Shield lug for connecting the cable shields

Figure 5-6 Cable connection on the Control Unit CU320-3

5.10 Connect the protective conductor

Requirement

The following requirement must be met:

- Use a ring or tubular cable lug M5 with a maximum width of 12 mm (0.47 in).

Required tools:

- Torx screwdriver TX 25

Procedure

Proceed as follows to connect the protective conductor to the protective conductor terminal of the Control Unit:

1. Prepare the cable with a ring/tubular cable lug.
2. Connect the protective conductor to the Control Unit with the protective conductor terminal screw M5.
3. Tighten the screw. Torx screwdriver TX 25. Tightening torque: 3 Nm (26.6 lbf in)

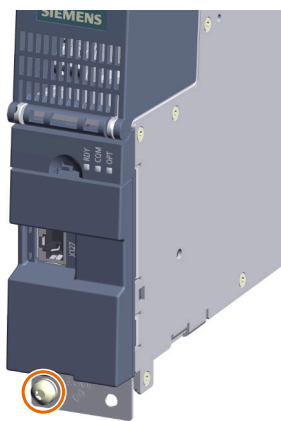


Figure 5-7 Protective conductor connection at Control Unit CU320-3 PN

4. Connect the protective conductor with the central PE rail in the electrical cabinet.

5.11 Pulling out the PROFINET cable

Overview

If it is necessary, for example, to pull the PROFINET cable(s) out of the Control Unit during maintenance work, various procedures are available depending on the position of the Control Unit in the drive line-up.

Requirement

The following requirements must be satisfied:

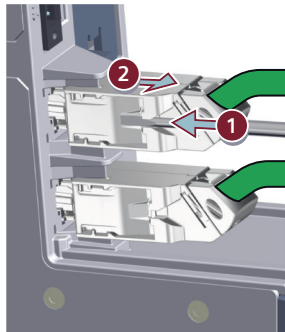
- You are using an Industrial Ethernet connector from SIEMENS.
- You are using a suitable screwdriver.

Description

If the Control Unit is mounted to the left of a Line Module or Motor Module, the PROFINET connector can be disconnected by hand.

If the Control Unit is mounted to the right of a Line Module or Motor Module, a special unlocking mechanism is available to pull out the PROFINET connector. Proceed as follows.

1. Unlatch the connector using a screwdriver.
 - When unlatching, make sure that the connector is not subjected to tension.
2. Unplug the connector.



5.12 Removing the front flap

Overview

The front flap of the Control Unit can be removed as required.

Procedure

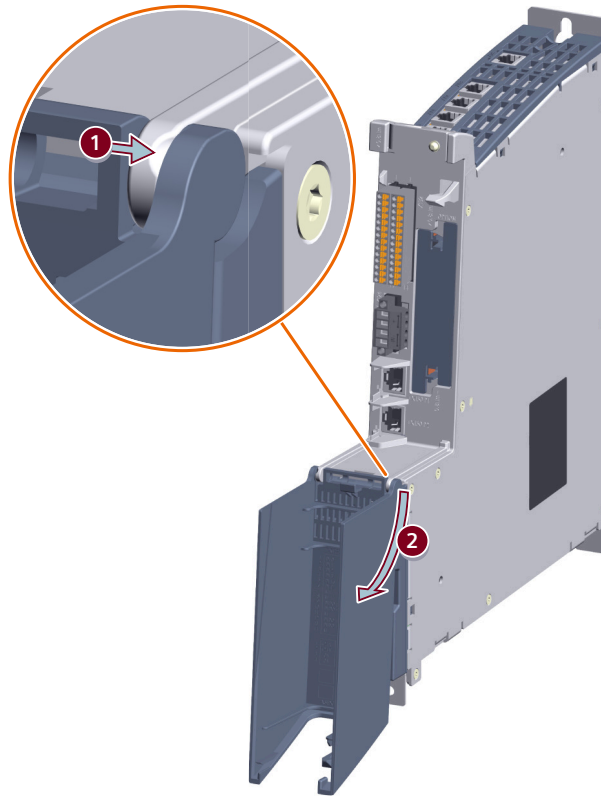


Figure 5-8 Removing the front flap

Remove the front flap of the Control Unit as follows:

1. Unlatch the front flap by gently applying lateral pressure at the joint.
2. To remove it, swivel the front flap downward.

5.13 Using multiple Control Units

Description

If your application requires more than one Control Unit, the number can be increased accordingly:

- The Control Units are then interconnected via PROFINET, for example.
- A Control Unit communicates with the associated components (Motor Modules, Line Modules, Sensor Modules, Terminal Modules, etc.) via the system-internal DRIVE-CLiQ interface.

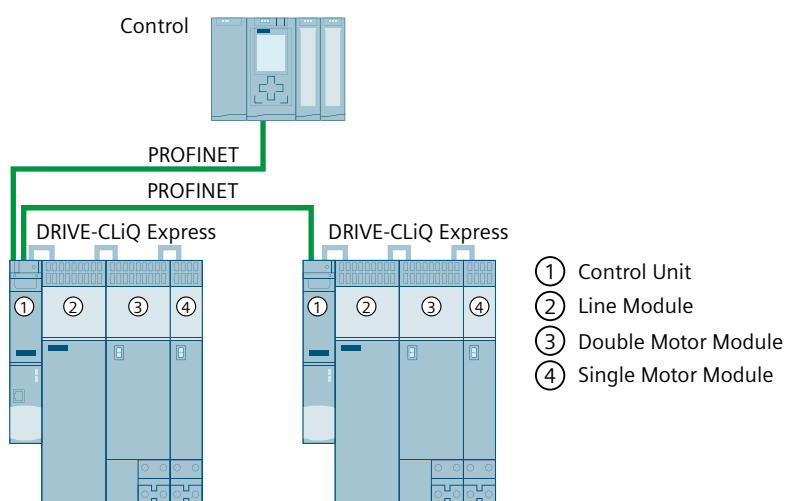


Figure 5-9 Example setup for several Control Units

5.14 Date and time

Description

The Control Unit has one hardware real-time clock. The hardware real-time clock bridges power supply interruptions of at least 10 days up to a maximum of 20 days. Date and time remain accurate in the event of interruptions of this duration.

5.15 Technical specifications

Technical specifications

Table 5-17 Technical specifications Control Unit CU320-3 PN

Feature	Unit	Value
Electronics power supply		
Voltage	V	20.4 ... 28.8
Current (typ.) ¹⁾	A	0.9
Power loss (typ.)	W	16
The sum of the maximum permissible output currents	A	4.8
Weight	kg	2.6
Cable lengths	m	See Chapter "Maximum permissible cable lengths (Page 45)"

¹⁾ Without DRIVE-CLiQ, digital outputs and service interface X127

Option Boards

6.1 Description

Description

Option Boards offer the possibility to expand a Control Unit with additional PROFINET and Ethernet interfaces as well as digital and analog inputs and outputs. Option Boards are separate components that are inserted into the option slot of the Control Unit.

6.2 Safety instructions

NOTICE
Damage to or malfunctioning of the Option Boards by inserting and withdrawing during operation
Withdrawing and inserting Option Boards during operation can damage them or cause the Option Boards to malfunction.
Only withdraw or insert Option Boards when the Control Unit is de-energized.

Note

Malfunction in the switched-off state due to diagnostic currents

Unlike mechanical switching contacts, e.g. emergency stop switches, diagnostic currents can also flow when the semiconductor is in the switched-off state (logical state "0" or "OFF"). If interconnection with digital inputs is faulty, the diagnostic currents can result in incorrect switching states. Incorrect signal states of digital inputs can cause unwanted motions of machine parts and trigger malfunctions.

- Observe the conditions of digital inputs and digital outputs specified in the relevant manufacturer documentation.
 - Check the conditions of the digital inputs and digital outputs with regard to currents in the "OFF" state and, if necessary, connect the digital inputs to suitably dimensioned, external resistors against the reference potential of the digital inputs.
-

6.3 Terminal Board TB30-3

6.3.1 Description

Description

The Terminal Board TB30-3 is an additional component that allows you to expand the Control Unit with additional digital inputs and outputs as well as analog inputs and outputs. This allows you to connect additional functions.

The Terminal Board TB30-3 has the following interfaces:

Table 6-1 Interface overview for the Terminal Board TB30-3

Type	Quantity
Digital inputs	4
Digital outputs	4
Analog inputs	2
Analog outputs	2

6.3.2 Overview

Overview diagram

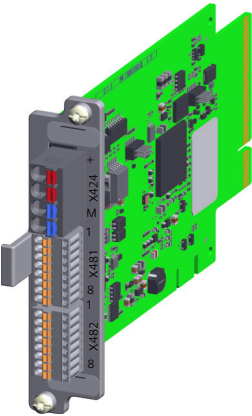


Figure 6-1 Terminal Board TB30-3

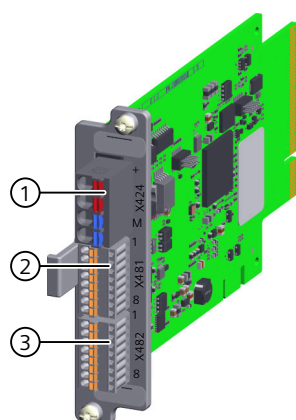
Table 6-2 Option Board

Designation	Article number
Terminal Board TB30-3	6SL5155-0TB03-0AA0

6.3.3 Interfaces and connections

6.3.3.1 Interfaces

Overview diagram



- ① X424: Power supply for the digital outputs
- ② X481: Digital inputs/outputs
- ③ X482: Analog inputs/outputs

Figure 6-2 Interface overview Terminal Board TB30-3

6.3.3.2 X424 power supply digital outputs

Overview

Power is supplied to the Terminal Board's digital outputs via the X424 interface.

The connector for this interface is included in the Terminal Kit of the Terminal Board.

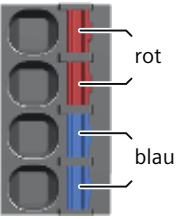
Description

The power supply is only required for the digital outputs. If no digital outputs used, it is not necessary to apply voltage at the X424.

6.3 Terminal Board TB30-3

The electronic power supply and the power supply for the analog inputs/outputs are provided via the option slot of the Control Unit.

Table 6-3 X424: Power supply for the digital outputs

Connector	Terminal	Designation ¹⁾	Technical specifications
	+	DO power supply (24 V)	Voltage: 24 V DC (20.4 ... 28.8 V)
	+	DO power supply (24 V)	Current consumption: max. 2 A (per digital output max. 0.5 A)
	M	DO ground (0 V)	Max. current via jumper in connector: 20 A (15 A according to UL/CSA)
	M	DO ground (0 V)	Galvanic isolation: Yes, max. 50 V potential difference The two "+" and "M" terminals are bridged in the connector. This ensures that the supply voltage is looped through.
Connectable cable cross-sections	Rigid, flexible		0.2 ... 2.5 mm ²
	Flexible, with end sleeve without protective collar		0.25 ... 2.5 mm ²
	Flexible, with end sleeve with protective collar		0.25 ... 1.5 mm ²
	AWG / kcmil		24 ... 12
Stripped length	8 mm (0.31 inch)		

¹⁾ DO: Digital output

6.3.3.3 X481 digital inputs/outputs

Overview

Digital inputs and outputs are available at the X481 interface of the TB30-3 Terminal Board for connecting additional functions.

The connector for this interface is included in the Terminal Kit of the Terminal Board. It is identical for the X481 and X482 interfaces and is encoded on terminal 1 for the X481 interface so that it can only be inserted one way.

Requirement

Note**Ensuring the function of digital inputs**

Terminal M1 or M2 must be connected for the digital inputs (DI) to function. This is achieved through one of the following measures:

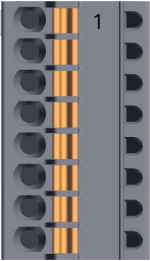
1. Providing the ground reference of the digital inputs
2. A jumper to terminal M

Note: This removes the galvanic isolation for these digital inputs.

Description

If the 24 V supply is briefly interrupted, the digital outputs are deactivated during this time. Open inputs are interpreted as "0".

Table 6-4 X481: Digital inputs and outputs

Connector	Pin	Designation ¹⁾	Technical data
	1	DI 0	Digital inputs
	2	DI 1	
	3	DI 2	
	4	DI 3	
	5	DO 0	Digital outputs
	6	DO 1	
	7	DO 2	
	8	DO 3	
Connectable cable cross-sections	Rigid, flexible		0.14 ... 0.5 mm ²
	Flexible, with end sleeve without protective collar		0.25 ... 0.5 mm ²
	AWG / kcmil		26 ... 20
Stripped length	8 mm (0.31 inch)		

¹⁾ DI: digital input, DO: Digital output

Table 6-5 Technical specifications of the digital inputs DI 0 ... DI 3¹⁾

Feature	Technical data
Voltage (incl. ripple)	-3 ... +30 V DC
Signal "0"	-3 ... +5 V
Signal "1"	15 ... 30 V
Galvanic isolation	Yes, max. 50 V potential difference
Reference potential	X424.M
Current consumption	
At 24 V DC (typ.)	3.5 mA
"0" signal reliably detected	< 1.5 mA
Delay time (hardware, without external cabling)	
"0" → "1" (typ. / max.)	25 / 50 μs (± 3.5 μs repeat accuracy)
"1" → "0" (typ. / max.)	25 / 50 μs (± 16 μs repeat accuracy)

¹⁾ The digital inputs correspond to the input characteristic acc. to IEC 61131-2, type 1 and type 3.

6.3 Terminal Board TB30-3

Table 6-6 Technical specifications of the digital outputs DO 0 ... DO 3 (continuous short-circuit-proof)¹⁾

Feature	Technical data
Voltage Signal "1", loaded	20.4 ... 28.8 V DC > X424.+ - 2 V
Galvanic isolation Reference potential	Yes, max. 50 V potential difference X424.M
Output current Per output Total of all 4 outputs Residual current with signal "0"	 ≤ 0.5 A ≤ 2 A < 0.5 mA
Load types	ohmic, capacitive, inductive
Delay time "0" → "1" (ohmic load) (typ. / max.) "1" → "0" (ohmic load) (typ.)	 150 μs / 500 μs 50 μs
Switching frequency With ohmic load (max.) With inductive load (max.) With lamp load (max.)	 100 Hz 0.5 Hz 10 Hz
Lamp load (max.)	5 W

¹⁾ Automatic restart after short-circuit

More information

The delay time of the digital inputs and outputs depends on the evaluation in the Control Unit. More information is provided in Chapter "Function diagrams" in the SINAMICS S220 List Manual

6.3.3.4 X482 analog inputs/outputs

Overview

Analog inputs and outputs are available at the X482 interface of the TB30-3 Terminal Board for connecting additional functions.

The connector for this interface is included in the Terminal Kit of the Terminal Board. It is identical for the X481 and X482 interfaces and is encoded on terminal 2 for the X482 interface so that it can only be inserted one way.

Requirement

Note

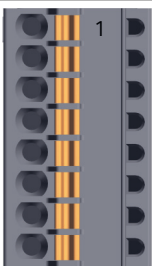
Permissible voltage values

In order to avoid incorrect results of the analog-digital conversion, the analog differential voltage signals can have a maximum offset voltage of ±30 V with respect to ground potential.

Description

The analog inputs and outputs are supplied with power via the option slot of the Control Unit. Open inputs are interpreted as approximately "0 V".

Table 6-7 X482: Analog inputs and outputs¹⁾

Connector	Pin	Designation ²⁾	Technical data
	1	AI 0+	Differential input voltage: Usable range: -10 ... +10 V Maximum control setting: -12.5 V ... +12.5 V Common mode range: ± 30 V Differential input resistance R_i : 80 k Ω Resolution: 15 bits + sign (related to maximum control setting)
	2	AI 0-	
	3	AI 1+	
	4	AI 1-	
	5	AO 0+	Output voltage: Usable range: -10 ... +10 V Maximum control setting: -11.5 V ... +11.5 V Load current: max. -3 ... +3 mA Short-circuit current: max. 37 mA Resolution: 11 bits + sign (related to maximum control setting) Continuous short-circuit-proof ³⁾
	6	AO 0-	
	7	AO 1+	
	8	AO 1-	
Connectable cable cross-sections	Rigid, flexible		0.14 ... 0.5 mm ²
	Flexible, with end sleeve without protective collar		0.25 ... 0.5 mm ²
	AWG / kcmil		26 ... 20
Stripped length	8 mm (0.31 inch)		

¹⁾ Analog inputs and outputs must be shielded.

²⁾ AI: analog input, AO: analog output

³⁾ Automatic restart after short-circuit

More information

The delay time of the analog inputs and outputs depends on the evaluation in the Control Unit. More information is provided in Chapter "Function diagrams" in the SINAMICS S220 List Manual

6.3.4 Connection example

Connection example

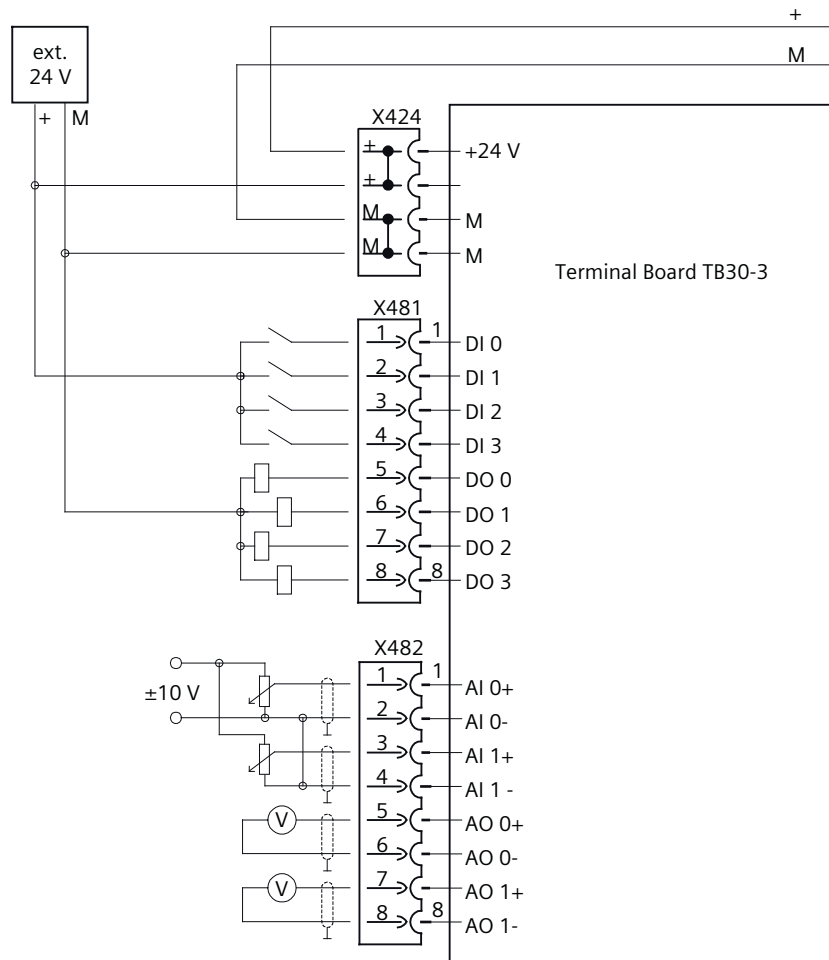


Figure 6-3 Connection example Terminal Board TB30-3

6.3.5 Mounting the Terminal Board

Overview

The Terminal Board is inserted into the option slot of the Control Unit. The protective conductor connection of the Terminal Board to the Control Unit is established by the two screws with which the Terminal Board is fastened in the option slot of the Control Unit.

Requirement

NOTICE

Damage to or malfunctioning of the Option Boards by inserting and withdrawing during operation

Withdrawing and inserting Option Boards during operation can damage them or cause the Option Boards to malfunction.

- Only withdraw or insert Option Boards when the Control Unit is de-energized.

Required tool:

Torx screwdriver TX 10

Procedure

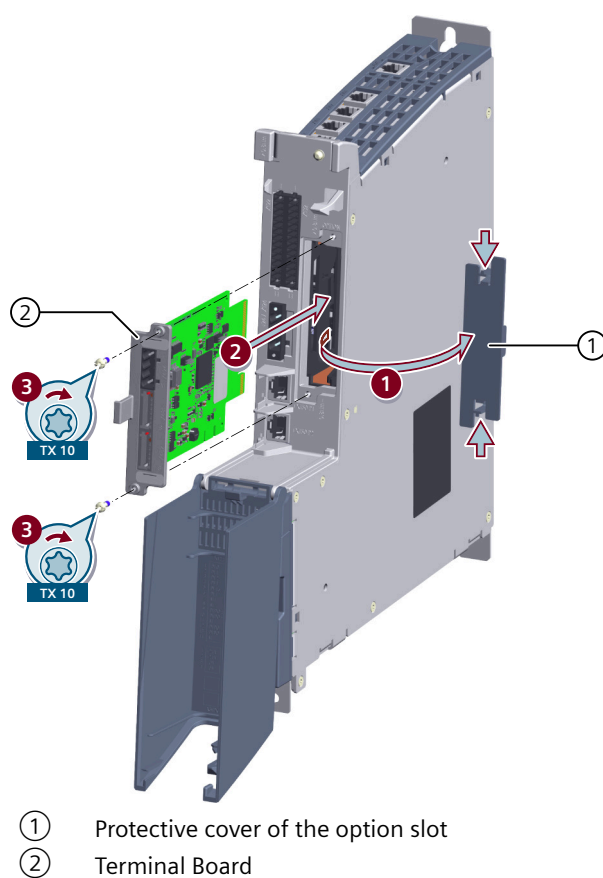


Figure 6-4 Mounting Terminal Board TB30-3

Proceed as follows to mount the Terminal Board:

1. Remove the protective cover of the option slot.
2. Insert the Terminal Board into the option slot.
3. Then screw the Terminal Board tight using the 2 screws. Tightening torque: 0.8 Nm (7.1 lbf in)

6.3.6 Attaching the cable shield

Overview

There is a shield support at the top front of the Control Unit for attaching cable shields. This is where you attach the cable shields of signal lines for analog inputs/outputs, for example.

Requirement

NOTICE
Damage or faulty operation due to incorrect shielding or inadmissible cable lengths If the correct shielding procedures or the permissible cable lengths are not observed, it can cause damage or the machine may malfunction. • Only use shielded cables. • Do not exceed the cable lengths specified in this documentation.

Required tool:

Torx screwdriver TX 10

Procedure

Proceed as follows to install cable shields:

1. Loosen the M3 screw at the top of the Control Unit.
2. Remove the plate for the shield support.
3. Insert the cable shields into the shield lug provided.
 - Observe the permissible bending radii when installing.
4. Then screw the shield support plate back on with the screw. Tightening torque: 0.8 Nm (7.08 lbf in)

Result

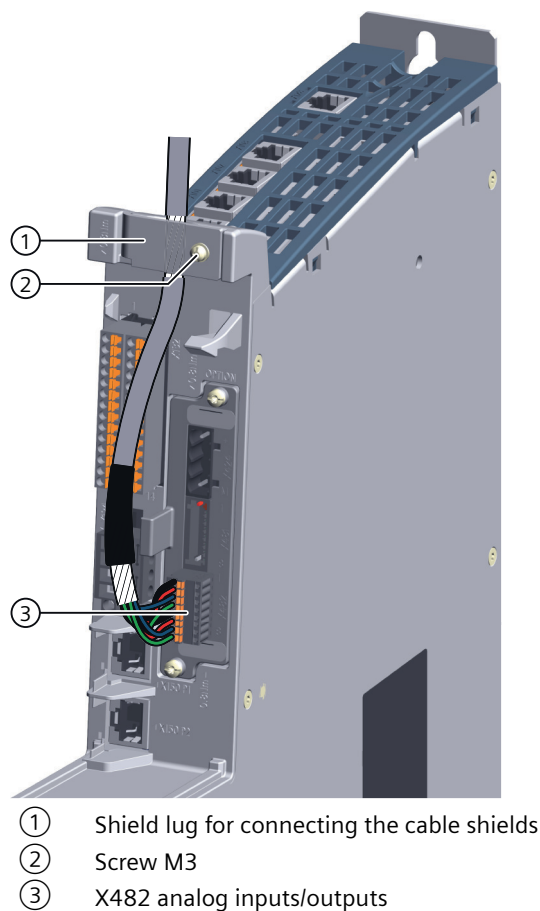


Figure 6-5 Shield support on the Control Unit

6.3.7 Technical specifications

Technical specifications

Table 6-8 Technical specifications Terminal Board TB30-3

Feature	Unit	Value
Current (at 24 V DC) at X124	A	0.1
Power loss	W	< 3
Weight	kg	0.1
Cable lengths	m	See Chapter "Maximum permissible cable lengths (Page 45)"

Terminal Modules

7.1 Safety information

NOTICE
Device failure as a result of unshielded or incorrectly routed cables to temperature sensors Unshielded or incorrectly laid cables to the temperature sensors can cause induced voltages from the power side to the signal-processing electronics. This can result in significant disturbance of all signals (fault messages) up to failure of individual components (destruction of the devices). • Only use shielded cables as temperature sensor cables. • If temperature sensor cables are routed together with the motor cable, use separately shielded cables twisted in pairs. • Connect the cable shield at both ends to ground potential through a large surface area. • Recommendation: Use suitable MOTION-CONNECT cables.

NOTICE
Damage through use of incorrect DRIVE-CLiQ cables The use of incorrect or unreleased DRIVE-CLiQ cables can cause damage or functional faults to devices or the system. • Only use suitable DRIVE-CLiQ cables that have been released by Siemens for the particular application.

Note

Malfunctions due to polluted DRIVE-CLiQ interfaces

Dirty/polluted DRIVE-CLiQ interfaces can result in system malfunctions.

- Close and seal unused DRIVE-CLiQ interfaces using the blanking covers included in the scope of delivery. You can order missing blanking covers (article number: 6SL3066-4CA00-0AA0, 50 units).
-

Note**Malfunction in the switched-off state due to diagnostic currents**

Unlike mechanical switching contacts, e.g. emergency stop switches, diagnostic currents can also flow when the semiconductor is in the switched-off state (logical state "0" or "OFF"). If interconnection with digital inputs is faulty, the diagnostic currents can result in incorrect switching states. Incorrect signal states of digital inputs can cause unwanted motions of machine parts and trigger malfunctions.

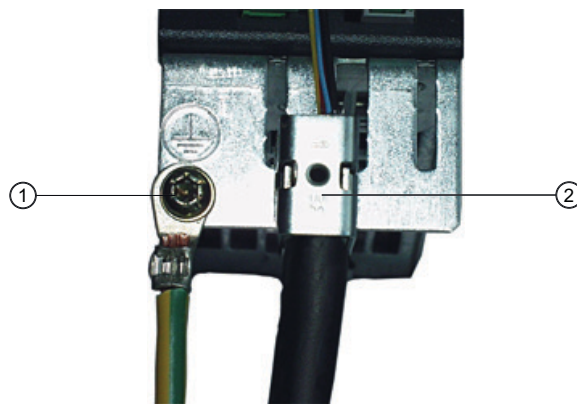
- Observe the conditions of digital inputs and digital outputs specified in the relevant manufacturer documentation.
 - Check the conditions of the digital inputs and digital outputs with regard to currents in the "OFF" state and, if necessary, connect the digital inputs to suitably dimensioned, external resistors against the reference potential of the digital inputs.
-

7.2 Terminal Module TM15

7.2.1 Protective conductor connection and shield support

It is always advisable to shield the digital input/output wiring.

The following diagram shows a typical Weidmüller shield connection clamp for the shield supports.



- ① Protective conductor connection M4 / 1.8 Nm (15.9 lbf in)
- ② Shield connection terminal, Weidmüller company, type: KLBUE CO1, Article number: 1753311001

Figure 7-1 Protective conductor connection and shield support

NOTICE

Damage or faulty operation due to incorrect shielding or inadmissible cable lengths

If the correct shielding procedures or the permissible cable lengths are not observed, it can cause damage or the machine may malfunction.

- Only use shielded cables.
- Do not exceed the cable lengths stated in the technical data.

The TM15 housing is connected to the ground terminal of the module supply (terminal X524). If the ground terminal is actually grounded, then the housing is also grounded. An additional ground connection using the M4 screw is especially necessary if high potential bonding currents can flow (e.g. through the cable shield).

7.2.2 Description

The Terminal Module TM15 is a terminal expansion for snapping on to an EN 60715 DIN rail. The TM15 can be used to increase the number of available digital inputs/outputs within a drive system.

Table 7-1 Interface overview of the TM15

Type	Quantity
DRIVE-CLiQ interfaces	2
Bidirectional digital inputs/outputs	24 (isolation in 3 groups each with 8 DI/DO)

7.2.3 Interface description

7.2.3.1 Overview

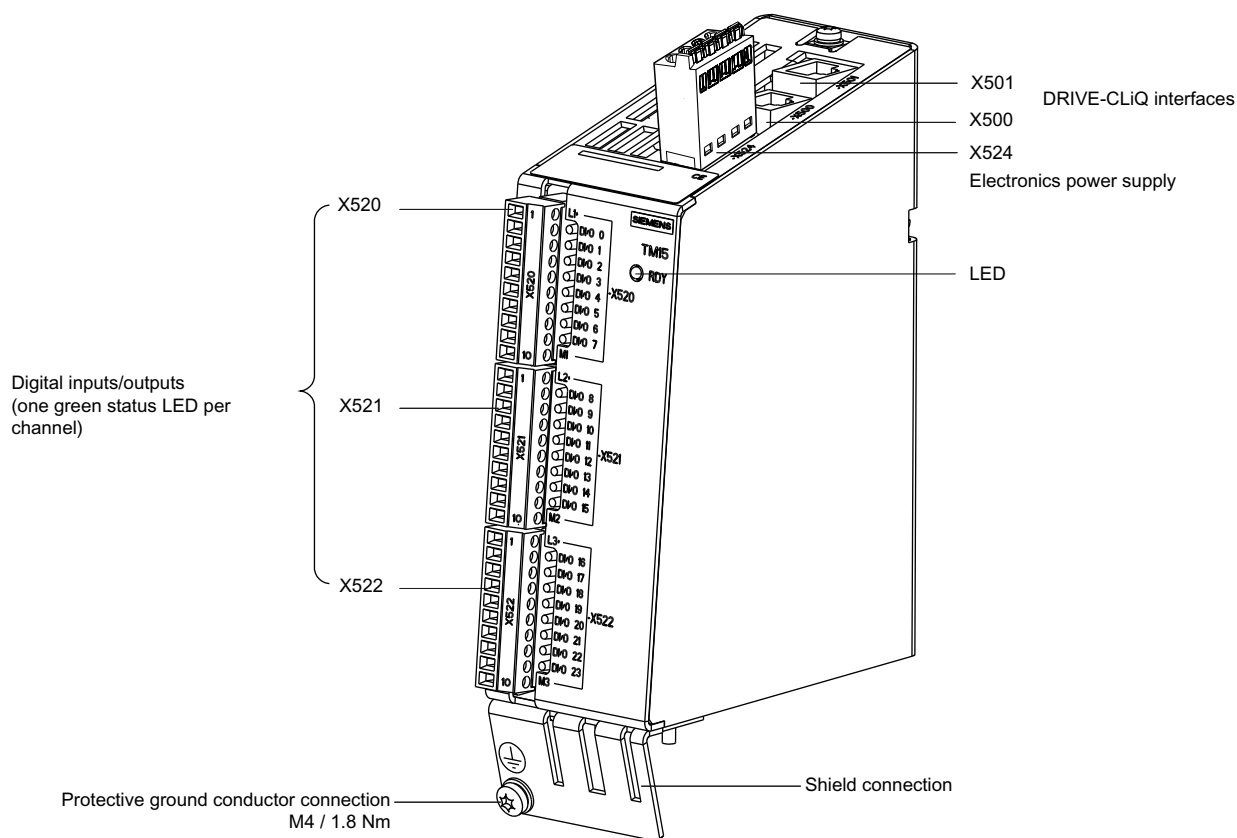
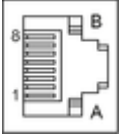


Figure 7-2 TM15 interface overview

7.2.3.2 X500/X501 DRIVE-CLiQ interfaces

Table 7-2 X500/X501 DRIVE-CLiQ interfaces

	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		

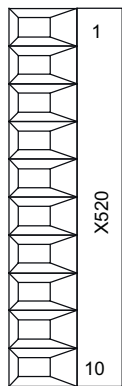
The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.
Blanking covers (50 x) Article No.: 6SL3066-4CA00-0AA0

Note

The maximum DRIVE-CLiQ cable length is 100 m.

7.2.3.3 X520 bidirectional digital inputs/outputs

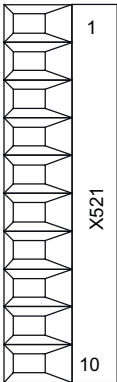
Table 7-3 X520 digital inputs/outputs

	Terminal	Designation ¹⁾	Technical data
	1	L1+	See Chapter "Technical data (Page 101)".
	2	DI/DO 0	
	3	DI/DO 1	
	4	DI/DO 2	
	5	DI/DO 3	
	6	DI/DO 4	
	7	DI/DO 5	
	8	DI/DO 6	
	9	DI/DO 7	
	10	M1 (GND)	
Type: Screw terminal 1 (Page 47)			

- ¹⁾ L1+: The 24 V DC infeed for DI/DO 0 to 7 (first potential group) must always be connected if at least one DI/DO of the potential group is used as an output.
M1: The ground reference for DI/DO 0 to 7 (first potential group) must always be connected if at least one DI/DO of the potential group is used as an input or output.
DI/DO: Bidirectional digital input/output

7.2.3.4 X521 bidirectional digital inputs/outputs

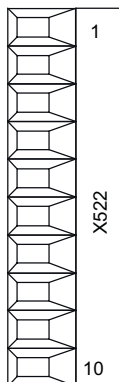
Table 7-4 X521 digital inputs/outputs

	Terminal	Designation ¹⁾	Technical data
	1	L2+	See Chapter "Technical data (Page 101)".
	2	DI/DO 8	
	3	DI/DO 9	
	4	DI/DO 10	
	5	DI/DO 11	
	6	DI/DO 12	
	7	DI/DO 13	
	8	DI/DO 14	
	9	DI/DO 15	
	10	M2 (GND)	
Type: Screw terminal 1 (Page 47)			

- ¹⁾ L2+: The 24 V DC infeed for DI/DO 8 to 15 (second potential group) must always be connected if at least one DI/DO of the potential group is used as an output.
M2: The ground reference for DI/DO 8 to 15 (second potential group) must always be connected if at least one DI/DO of the potential group is used as an input or output.
DI/DO: Bidirectional digital input/output

7.2.3.5 X522 bidirectional digital inputs/outputs

Table 7-5 X522 digital inputs/outputs

	Terminal	Designation ¹⁾	Technical data
	1	L3+	See Chapter "Technical data (Page 101)".
	2	DI/DO 16	
	3	DI/DO 17	
	4	DI/DO 18	
	5	DI/DO 19	
	6	DI/DO 20	
	7	DI/DO 21	
	8	DI/DO 22	
	9	DI/DO 23	
	10	M3 (GND)	
Type: Screw terminal 1 (Page 47)			

- ¹⁾ L3+: The 24 V DC infeed for DI/DO 16 to 23 (third potential group) must always be connected if at least one DI/DO of the potential group is used as an output.
M3: The ground reference for DI/DO 16 to 23 (third potential group) must always be connected if at least one DI/DO of the potential group is used as an input or output.
DI/DO: Bidirectional digital input/output

7.2.3.6 X524 Electronics power supply

Table 7-6 X524 electronics power supply

	Terminal	Designation	Technical data
 red blue	+	Electronics power supply (24 V)	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: max. 0.6 A (including DRIVE-CLiQ and control of digital outputs) Max. current via the jumper in the connector: 20 A (15 A according to UL/CSA)
	+	Electronics power supply (24 V)	
	M	Electronics ground (0 V)	
	M	Electronics ground (0 V)	
Type: Spring-loaded terminal 6 (Page 46)			

The maximum cable length is 30 m.

Note

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

The digital outputs are supplied via terminals X520, X521, and X522.

7.2.4 Connection example

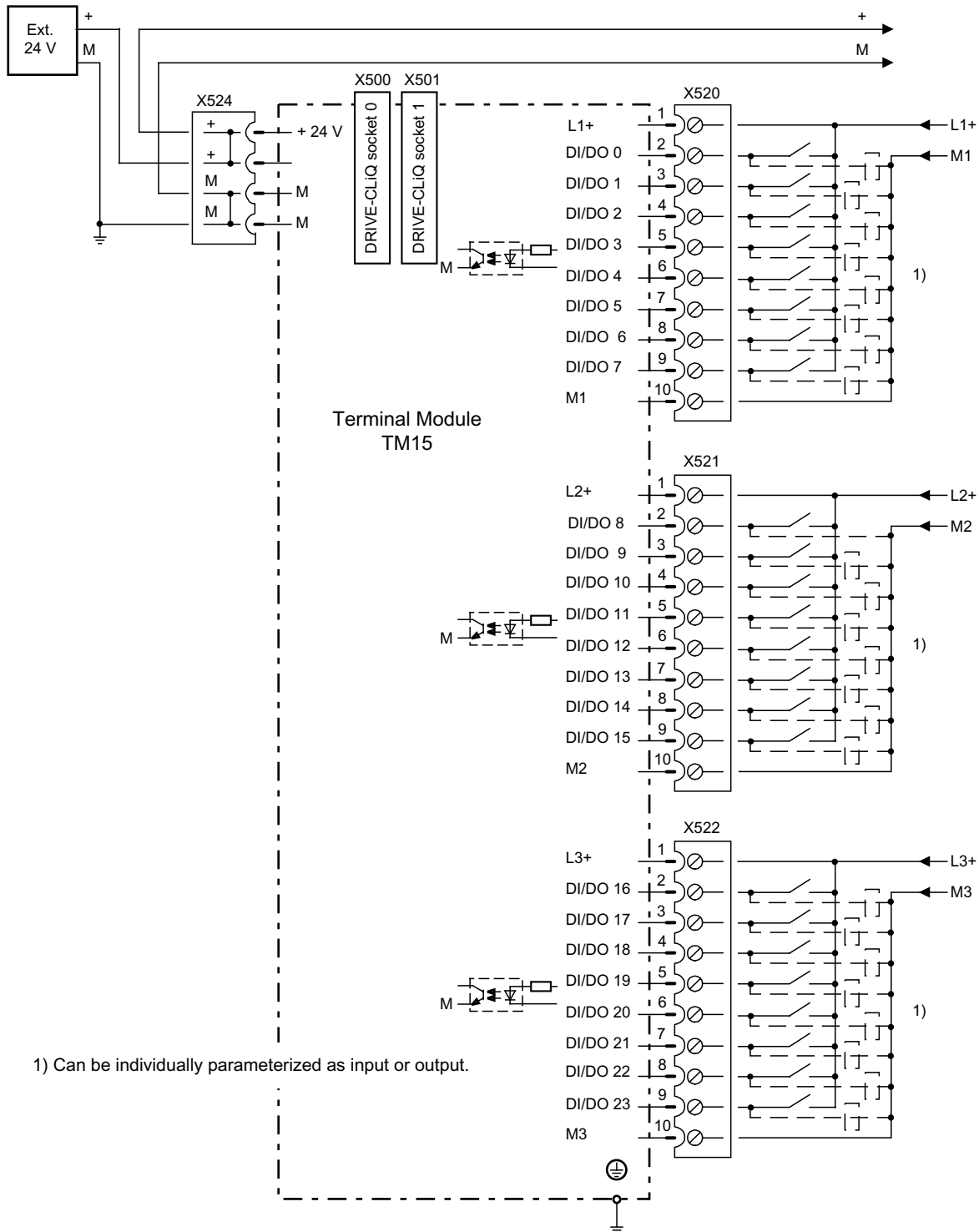


Figure 7-3 Example connection of TM15

7.2.5 Meaning of the LEDs

7.2.5.1 Terminal Module TM15

Table 7-7 Meanings of the LEDs on the Terminal Module TM15

LED	Color	Status	Description, cause	Remedy
READY	-	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	This component has at least one fault. Note: The LED is activated irrespective of whether the corresponding messages have been reconfigured.	Correct and acknowledge the fault.
	Green/red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
		Flashing light 2 Hz	Firmware download is complete. The system waits for POWER ON.	Carry out a POWER ON.
	Green/orange or Red/orange	Flashing light	Component recognition via LED is activated (parameter p0154=1). Note: Both options depend on the LED status when component recognition is activated.	–

7.2.6 Dimension drawing

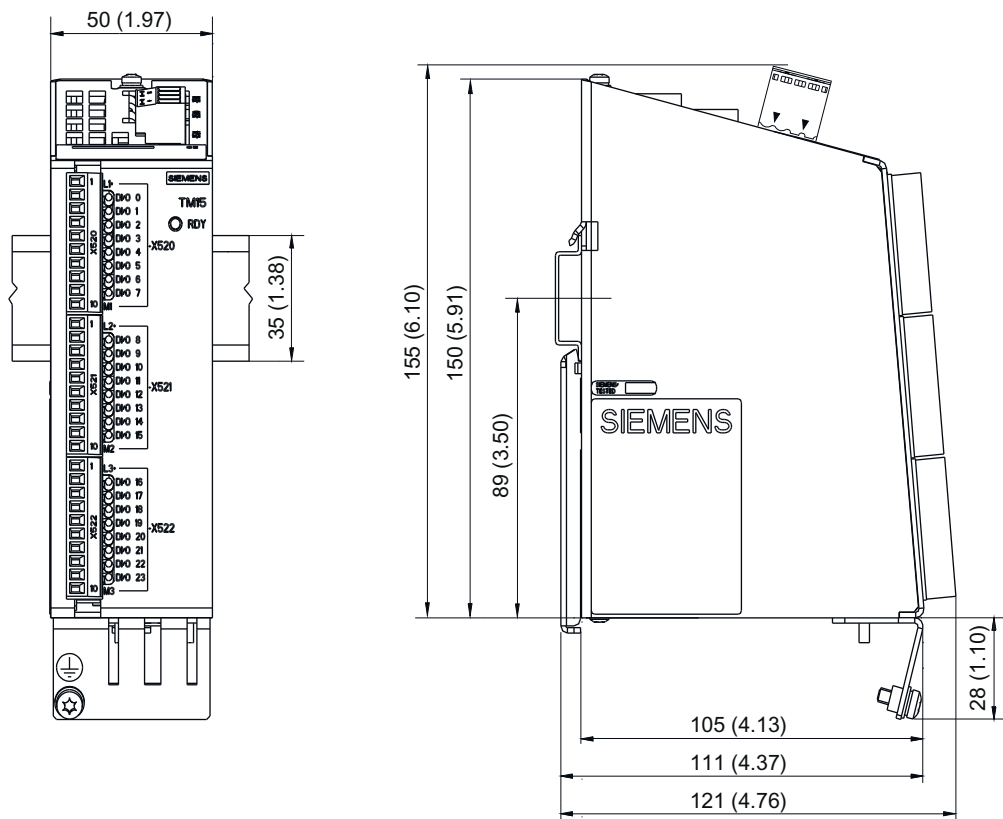


Figure 7-4 Dimension drawing of Terminal Module TM15, all data in mm and (inches)

7.2.7 Mounting

Mounting

1. Tilt the component backwards slightly and attach it to the DIN rail using the hooks.
2. Swivel the component onto the DIN rail until you hear the mounting slide at the rear latch into position.
3. Slide the component along the mounting rail to either the left or the right into its final position.

Removal

1. First shift the mounting slide downwards at the lug to release the interlocking with the mounting rail.
2. Swivel the component to the front and withdraw it upwards from the DIN rail.

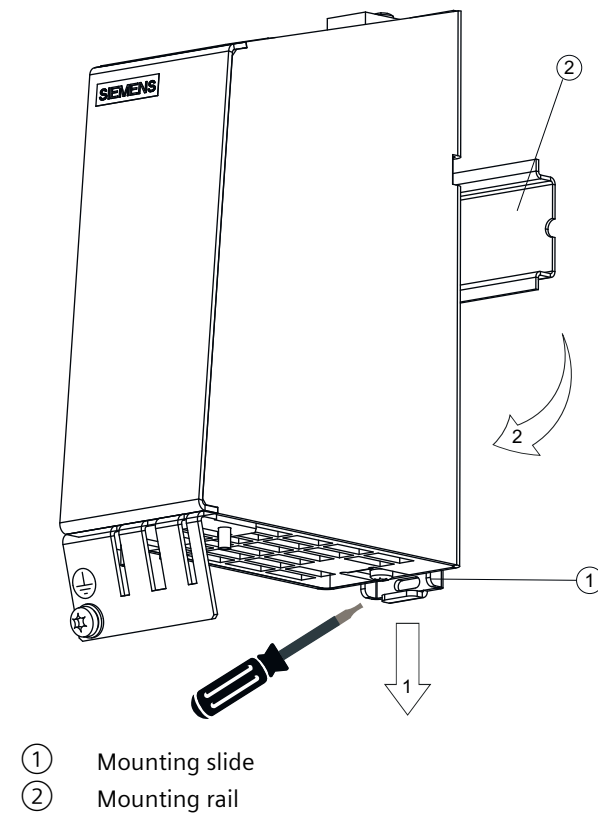


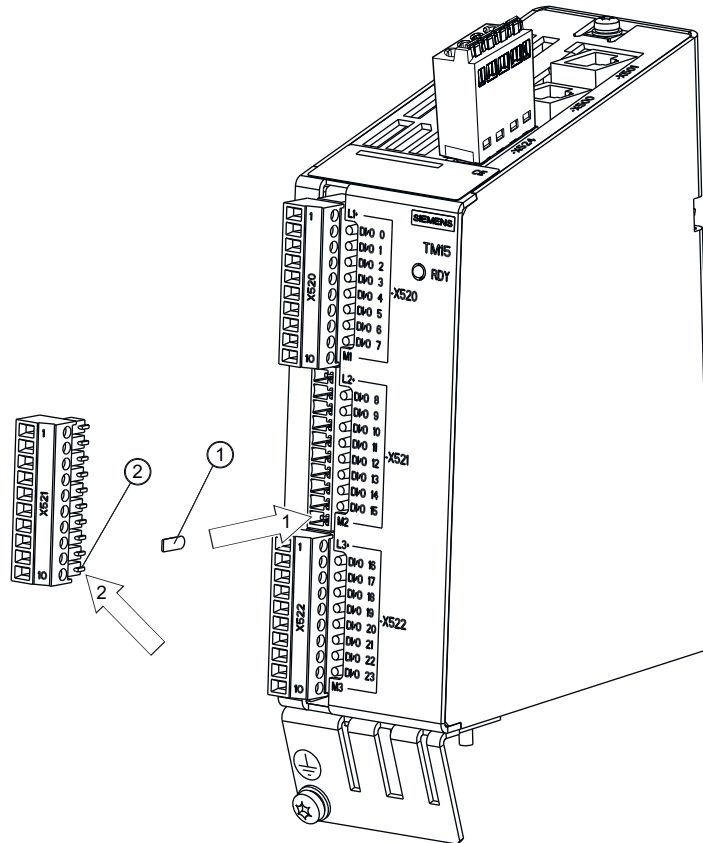
Figure 7-5 Removing from a DIN mounting rail

7.2.8 Connector coding

A series of coding elements ("coding sliders") are supplied with each Terminal Module TM15.

Connector coding

1. Insert at least one coding slider at the required position.
2. Remove the associated coding lug at the connector.



- ① Coding slider
② Coding lug at the connector to be removed

Figure 7-6 Connector coding using the example of interface X521

To avoid wiring errors, unique coding patterns must be defined for the connectors X520, X521 and X522.

Possible patterns:

- 3 connectors on one component are encoded differently (i.e. X520, X521 and X522).
- Different component types are encoded differently.
- Identical components on the same machine are encoded differently, e.g. several TM15-type components.

7.2.9 Technical data

Table 7-8 Technical data

6SL3055-0AA00-3FA.	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 (20.4 ... 28.8)
Current (without DRIVE-CLiQ or digital outputs)	A_{DC}	≤ 0.15
Power loss	W	≤ 3
Maximum cable length	m	30
I/O		
Digital inputs/outputs	Can either be parameterized as DI or DO	
Number of digital inputs/outputs	24	
Electrical isolation	Yes, in groups of 8	
Maximum cable length	m	30
Digital inputs		
Voltage	V_{DC}	-30 ... +30
Low-level (an open digital input is interpreted as "low")	V_{DC}	-30 ... +5
High level	V_{DC}	15 ... 30
Input Impedance	$k\Omega$	2.8
Input current, typical (at 24 V DC)	mA	9
Maximum in the off state	V_{DC}	5
Current in OFF state	mA	0.0 ... 1.0 (per channel)
Typical input delay of the digital inputs	μs	"0" → "1": 50 "1" → "0": 100
Digital outputs (continued-short-circuit-proof)		
Voltage	V_{DC}	24
Load current per digital output	A_{DC}	≤ 0.5
Output delay (resistive load)		
Typical	μs	"0" → "1": 50 "1" → "0": 150
Maximum	μs	"0" → "1": 100 "1" → "0": 225
Minimum output pulse (100 % amplitude, 0.5 A for a resistive load)	μs	125 (typical) 350 (maximum)
Switching frequency	Hz	≤ 100
For resistive load	Hz	≤ 0.5
For inductive load	Hz	≤ 10
For lamp load	W	5
Maximum lamp load	W	5
Maximum switching frequency (100 % amplitude, duty cycle 50 % / 50 %; for 0.5 A and resistive load)	kHz	1 (typical)
Voltage drop in ON state	V_{DC}	≤ 0.75 at maximum load in all circuits
Leakage current in OFF state	μA	≤ 10 per channel
Voltage drop, output (I/O power supply to the output)	V_{DC}	0.5

7.3 Terminal Module TM31

6SL3055-0AA00-3FA.	Unit	Value
Maximum total current of outputs (per group)		
up to 60°C	A _{DC}	2
up to 50° C	A _{DC}	3
up to 40 °C	A _{DC}	4
Response time	The response time of the digital inputs/outputs comprises the following: • Response time on the component itself (approx. 1/2 DRIVE-CLiQ cycle). • Transfer time via the DRIVE-CLiQ connection (approx. 1 DRIVE-CLiQ cycle). • Evaluation on the Control Unit (see function diagram) More information is provided in the following reference: Reference: SINAMICS S120/S150 List Manual, Chapter "Function diagrams/Terminal Module 15"	
Protective ground conductor connection	At the housing with M4 screw	
Ventilation clearances, above/below	mm	50
Weight	kg	1.0

7.3 Terminal Module TM31

7.3.1 Description

The Terminal Module TM31 is a terminal expansion that is snapped onto a EN 60715 standard mounting rail. Terminal Module TM31 can be used to increase the number of available digital inputs/digital outputs and also the number of analog inputs/analog outputs within a drive system.

The TM31 contains the following interfaces:

Table 7-9 Interface overview of the TM31

Type	Quantity
DRIVE-CLiQ interfaces	2
Digital inputs	8
Bidirectional digital inputs/outputs	4
Analog inputs	2
Analog outputs	2
Relay outputs	2
Temperature sensor input	1

7.3.2 Interface description

7.3.2.1 Overview

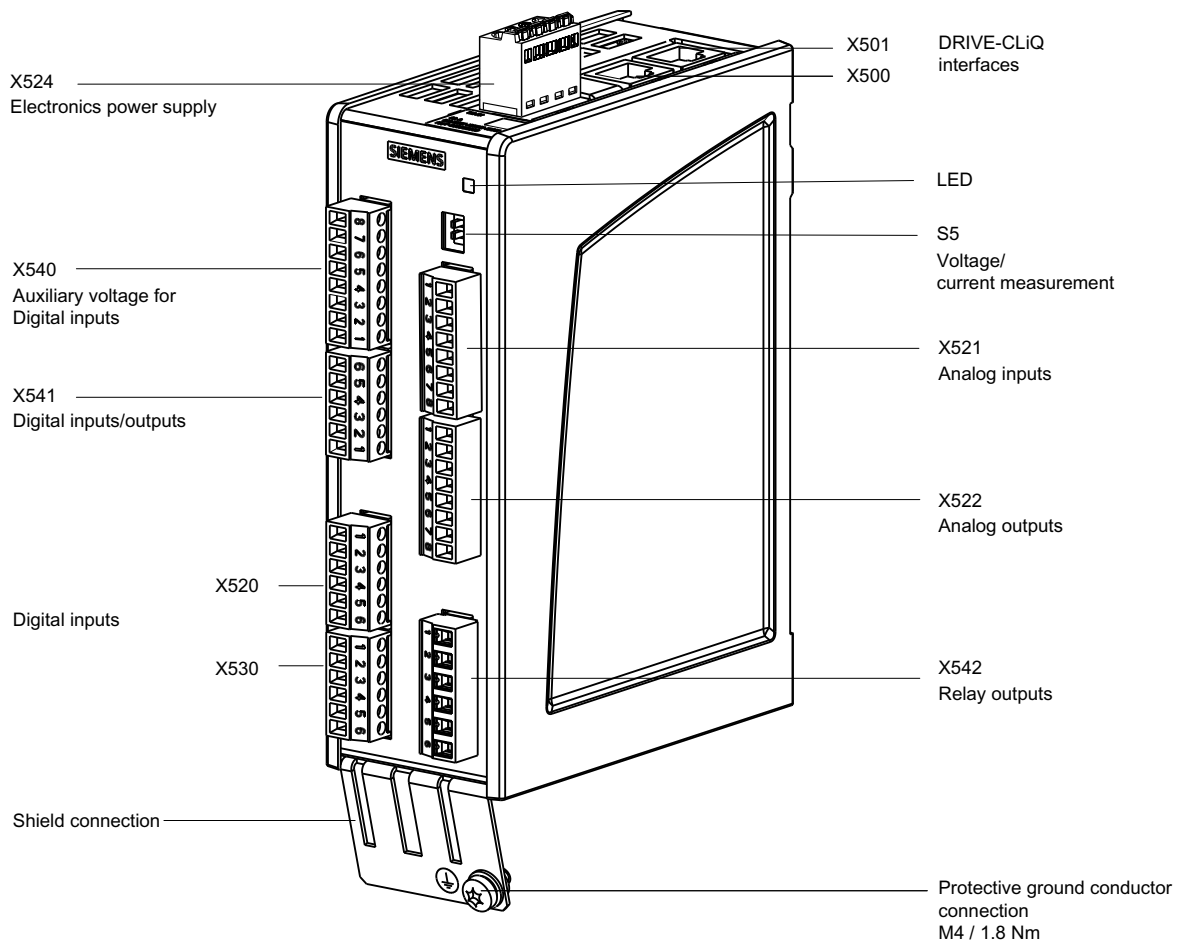
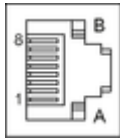


Figure 7-7 Interface overview TM31

7.3.2.2 X500/X501 DRIVE-CLiQ interfaces

Table 7-10 X500/X501 DRIVE-CLiQ interfaces

	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		

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

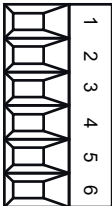
Blanking covers (50 x) Article No.: 6SL3066-4CA00-0AA0

Note

The maximum DRIVE-CLiQ cable length is 100 m.

7.3.2.3 X520 digital inputs

Table 7-11 X520: Digital inputs

	Terminal	Designation ¹⁾	Technical data
	1	DI 0	Voltage: -3 ... +30 V
	2	DI 1	Electrical isolation: Yes
	3	DI 2	Reference potential: M1
	4	DI 3	Input characteristic acc. to IEC 61131-2, type 1
	5	M1	Input voltage (including ripple) "1" signal: 15 ... 30 V "0" signal: -3 ... +5 V
	6	M	Input current at 24 V DC: typ. 9 mA at <0.5 mA: Signal "0" reliably detected Input delay for "0" → "1": typ. 50 µs max. 100 µs For "1" → "0": typ. 130 µs/max. 150 µs
Type: Screw terminal 1 (Page 47)			

¹⁾ DI: Digital input; M: Electronics ground; M1: reference potential

Note

Ensuring the function of digital inputs

An open input is interpreted as "low".

Terminal M1 must be connected so that the digital inputs (DI) can function.

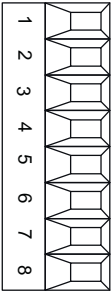
This is achieved by using one of the following measures:

1. Providing the ground reference of the digital inputs
2. A jumper to terminal M

Note: This removes isolation for these digital inputs.

7.3.2.4 X521 analog inputs

Table 7-12 X521: Analog inputs

	Terminal	Designation ¹⁾	Technical data
	1	AI 0+	The analog inputs can be toggled between current and voltage input using switches S5.0 and S5.1. As voltage input: -10 ... +10 V; R _i > 100 kΩ Resolution: 11 bits + sign As current input: -20 ... +20 mA; R _i = 250 Ω Resolution: 10 bits + sign
	2	AI 0-	
	3	AI 1+	
	4	AI 1-	
	5	P10	Auxiliary voltage: P10 = 10 V N10 = -10 V Current-carrying capacity: max. 3 mA Continuously short-circuit proof
	6	M	
	7	N10	
	8	M	

Type: Screw terminal 1 (Page 47)

¹⁾ AI: analog inputs; P10/N10: auxiliary voltage; M or GND: ground reference

NOTICE

Damage or malfunctions through impermissible voltage values

If a current exceeding $\pm 35\text{ mA}$ flows through the analog current input, the component could be destroyed.

The common mode range must not be violated in order to avoid incorrect analog-digital conversion results.

- The input voltage may only be in the range between -30 V and +30 V (destruction limit).
- The common mode voltage may only be in the range between -10 V and +10 V (error limit).
- The back EMF at the auxiliary voltage outputs may only be in the range between -15 V and +15 V.

Note

The power supply for the analog inputs can be taken internally or from an external power supply unit

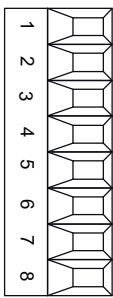
7.3.2.5 S5 current/voltage changeover switch for analog inputs

Table 7-13 Current/voltage selector S5

	Switch	Function
V  S5.0	S5.0	Selector voltage (V)/current (I) AI0
V  S5.1	S5.1	Selector voltage (V)/current (I) AI1

7.3.2.6 X522 analog outputs/temperature sensor

Table 7-14 X522: Analog outputs/temperature sensor

	Terminal	Designation ¹⁾	Technical data
	1	AO 0V+	You can set the following output signals using parameters: Voltage: -10 ... +10 V (max. 3 mA) Current 1: 4 ... 20 mA (max. load resistance ≤ 500 Ω) Current 2: -20 ... +20 mA (max. load resistance ≤ 500 Ω) Current 3: 0 ... 20 mA (max. load resistance ≤ 500 Ω) Resolution: 11 bits + sign Continuously short-circuit proof
	2	AO 0-	
	3	AO 0C+	
	4	AO 1V+	
	5	AO 1-	
	6	AO 1C+	
	7	+ Temp	Temperature sensor ²⁾ Pt1000 / PTC / KTY84-130 / bimetal NC contact Measuring current through temperature sensor connection: 2 mA
	8	- Temp	

Type: Screw terminal 1 (Page 47)

¹⁾ AO xV: analog output voltage; AO xC: analog output current

²⁾ Accuracy of temperature measurement (temperature sensor, including evaluation):

- Pt1000: ±5 °C (Pt1000 tolerance Class B acc. to EN 60751)
- PTC: ±5 °C
- KTY: ±7 °C

NOTICE**Damage or malfunctions through impermissible voltage values**

If the back EMF is impermissible then damage and malfunctions may occur on the components.

- The back EMF at the outputs may only be in the range between -15 V and +15 V.

NOTICE

Damage to the motor due to incorrectly connected KTY temperature sensor

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

- Connect a KTY temperature sensor with the correct polarity.



! WARNING

Electric shock when the motor temperature sensor insulation fails

When connecting temperature sensors, which have no safe protective separation with respect to the motor power circuit, then arcing to the signal electronics can occur.

- Use motors whose temperature sensors have safe electrical separation.
- Use only connecting cables and connectors with safe electrical separation between the wires of the temperature sensor and the wires of the power circuit.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

7.3.2.7 X524 Electronics power supply

Table 7-15 X524: Electronics power supply

	Terminal	Designation	Technical data
	+	Electronics power supply (24 V)	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: max. 1.7 A (including DRIVE-CLiQ, digital outputs and auxiliary voltages) Max. current via the jumper in the con- nector: 20 A (15 A according to UL/CSA)
	+	Electronics power supply (24 V)	
	M	Electronics ground (0 V)	
	M	Electronics ground (0 V)	
Type: Spring-loaded terminal 6 (Page 46)			

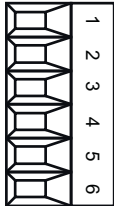
The maximum cable length is 30 m.

Note

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

7.3.2.8 X530 digital inputs

Table 7-16 X530: Digital inputs

	Terminal	Designation ¹⁾	Technical data
	1	DI 4	Voltage: -3 ... +30 V DC
	2	DI 5	Electrical isolation: Yes
	3	DI 6	Reference potential: M2
	4	DI 7	Input characteristic acc. to IEC 61131-2, type 1
	5	M2	Input voltage (including ripple)
	6	M	"1" signal: 15 ... 30 V "0" signal: -3 ... +5 V Input current at 24 V DC: typ. 9 mA at <0.5 mA: Signal "0" reliably detected Input delay for "0" → "1": typ. 50 µs/max. 100 µs for "1" → "0": typ. 130 µs/max. 150 µs
Type: Screw terminal 1 (Page 47)			

¹⁾ DI: digital input; M: electronics ground; M2: reference potential

Note

Ensuring the function of digital inputs

An open input is interpreted as "low".

To enable the digital inputs (DI) to function, terminal M2 must be connected.

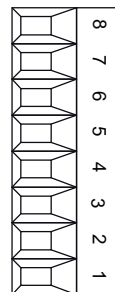
This is achieved by using one of the following measures:

1. Providing the ground reference of the digital inputs
2. A jumper to terminal M

Note: This removes isolation for these digital inputs.

7.3.2.9 X540 auxiliary voltage for the digital inputs

Table 7-17 X540: Auxiliary voltage for digital inputs

	Terminal	Designation	Technical data
	8	+24 V	Voltage: +24 V DC
	7	+24 V	Max. total load current of +24 V auxiliary voltage for terminals X540 and X541 combined: 150 mA
	6	+24 V	
	5	+24 V	
	4	+24 V	
	3	+24 V	
	2	+24 V	
	1	+24 V	
Type: Screw terminal 1 (Page 47)			

Note

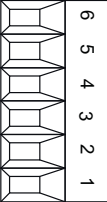
This voltage supply is only for powering the digital inputs.

Note

If the 24 V supply is briefly interrupted, the auxiliary voltage for the digital inputs is deactivated for this time.

7.3.2.10 X541 bidirectional digital inputs/outputs

Table 7-18 X541: Bidirectional digital inputs/outputs

	Terminal	Designation ¹⁾	Technical data
	6	M	As input: Voltage: -3 ... +30 V DC Electrical isolation: no Reference potential: M Input characteristic acc. to IEC 61131-2, type 1 Input voltage (including ripple) "1" signal: 15 ... 30 V "0" signal: -3 ... +5 V Input current at 24 V DC: typ. 9 mA at <0.5 mA: Signal "0" reliably detected Input delay: for "0" to "1": Typ. 50 µs for "1" to "0": typ. 100 µs As output: Voltage: 24 V DC Electrical isolation: no Reference potential: M Output voltage "1" signal, with load: > X524.+ -2 V Output current for each output: ≤ 0.5 A Sum of all 4 outputs: ≤ 0.1 A (when parameter p4046=0) ≤ 1.0 A (when parameter p4046=1) Residual current for "0" signal: < 0.5 mA Short-circuit protection, automatic restart after a short-circuit Load types: ohmic, capacitive, inductive Output delay for "0" → "1": typ. 150 µs / max. 500 µs (ohmic load) for "1" → "0": typ. 50 µs (ohmic load) Switching frequency for ohmic load: max. 100 Hz for inductive load: max. 0.5 Hz for lamp load: max. 10 Hz Lamp load: max. 5 W
	5	DI/DO 11	
	4	DI/DO 10	
	3	DI/DO 9	
	2	DI/DO 8	
	1	+24 V	Auxiliary voltage: Voltage: +24 V DC Max. Total load current of +24 V auxiliary voltage for terminals X540 and X541 combined: 150 mA
Type: Screw terminal 1 (Page 47)			

¹⁾ DI/DO: Bidirectional digital input/output; M: Electronics ground

Note

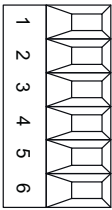
An open input is interpreted as "low".

Note

If the 24 V supply is briefly interrupted, then the digital outputs are deactivated during this time.

7.3.2.11 X542 relay outputs

Table 7-19 X542: Relay outputs

	Terminal	Designation ¹⁾	Technical data
	1	DO 0.NC	Contact type: Two-way contact max. load current: 8 A Max. switching voltage: 250 V _{AC} , 30 V _{DC} Max. switching capacity at 250 V _{AC} : 2000 VA (cos φ = 1) Max. switching capacity at 250 V _{AC} : 750 VA (cos φ = 0.4) Max. switching capacity at 30 V _{DC} : 240 W (resistive load) Required minimum current: 100 mA Output delay: ≤ 20 ms ²⁾ Overvoltage category: Class II according to IEC 61800-5-1
	2	DO 0.COM	
	3	DO 0.NO	
	4	DO 1.NC	
	5	DO 1.COM	
	6	DO 1.NO	
Type: Screw terminal 3 (Page 47) Maximum switching frequency at full load: 6 rpm			

¹⁾ DO: digital output, NO: normally-open contact, NC: normally-closed contact, COM: mid-position contact

²⁾ Depending on the parameterization and the supply voltage (P24) of the TM31

7.3.3 Connection example

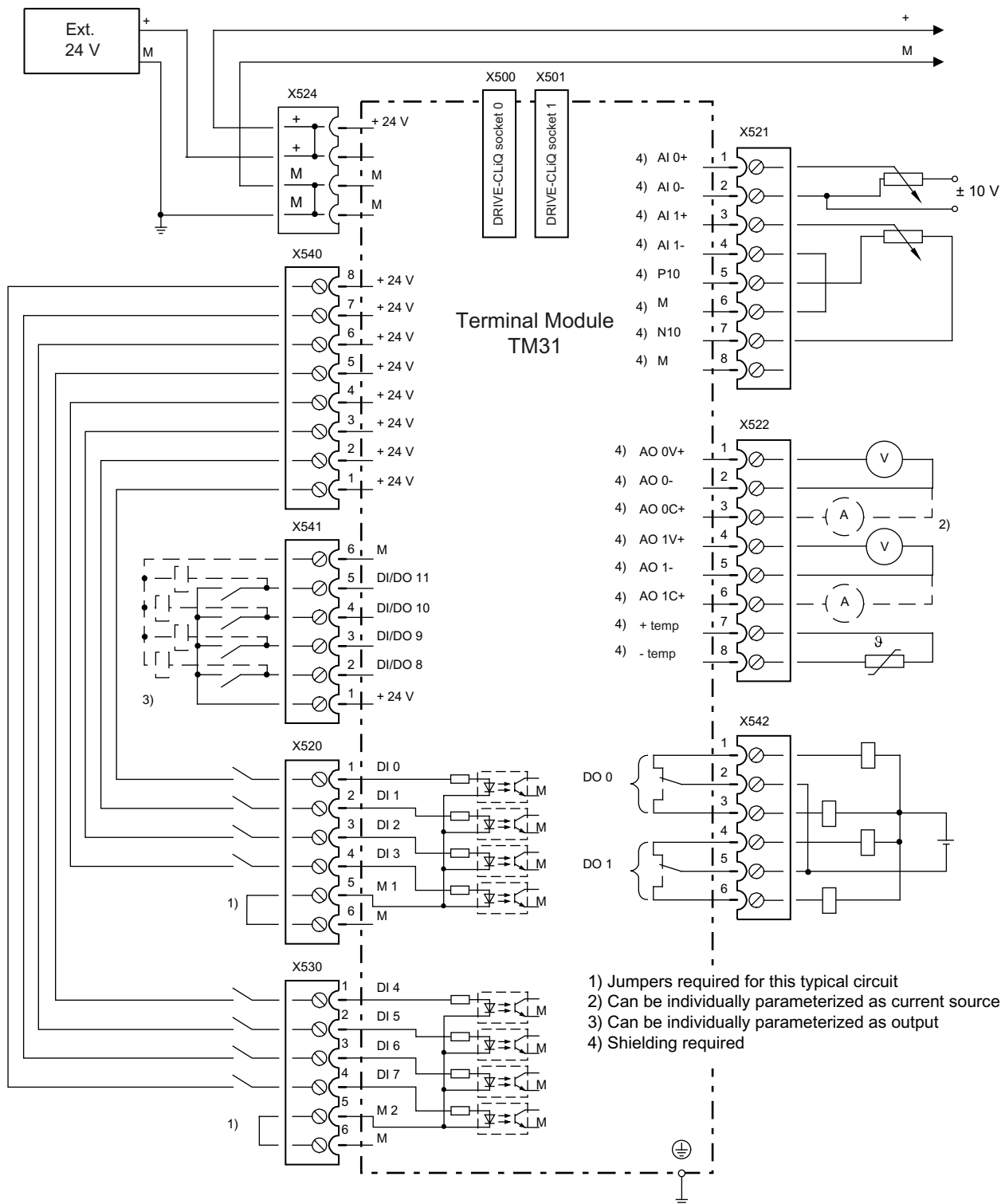


Figure 7-8 Connection example of TM31

7.3.4 Meaning of the LED

Table 7-20 Meanings of the LEDs on the Terminal Module TM31

LED	Color	Status	Description, cause	Remedy
READY	-	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	This component has at least one fault. Note: The LED is activated irrespective of whether the corresponding messages have been reconfigured.	Correct and acknowledge the fault.
	Green/red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
		Flashing light 2 Hz	Firmware download is complete. The system waits for POWER ON.	Carry out a POWER ON.
	Green/orange or Red/orange	Flashing light	Component recognition via LED is activated (parameter p0154=1). Note: Both options depend on the LED status when component recognition is activated.	–

7.3.5 Dimension drawing

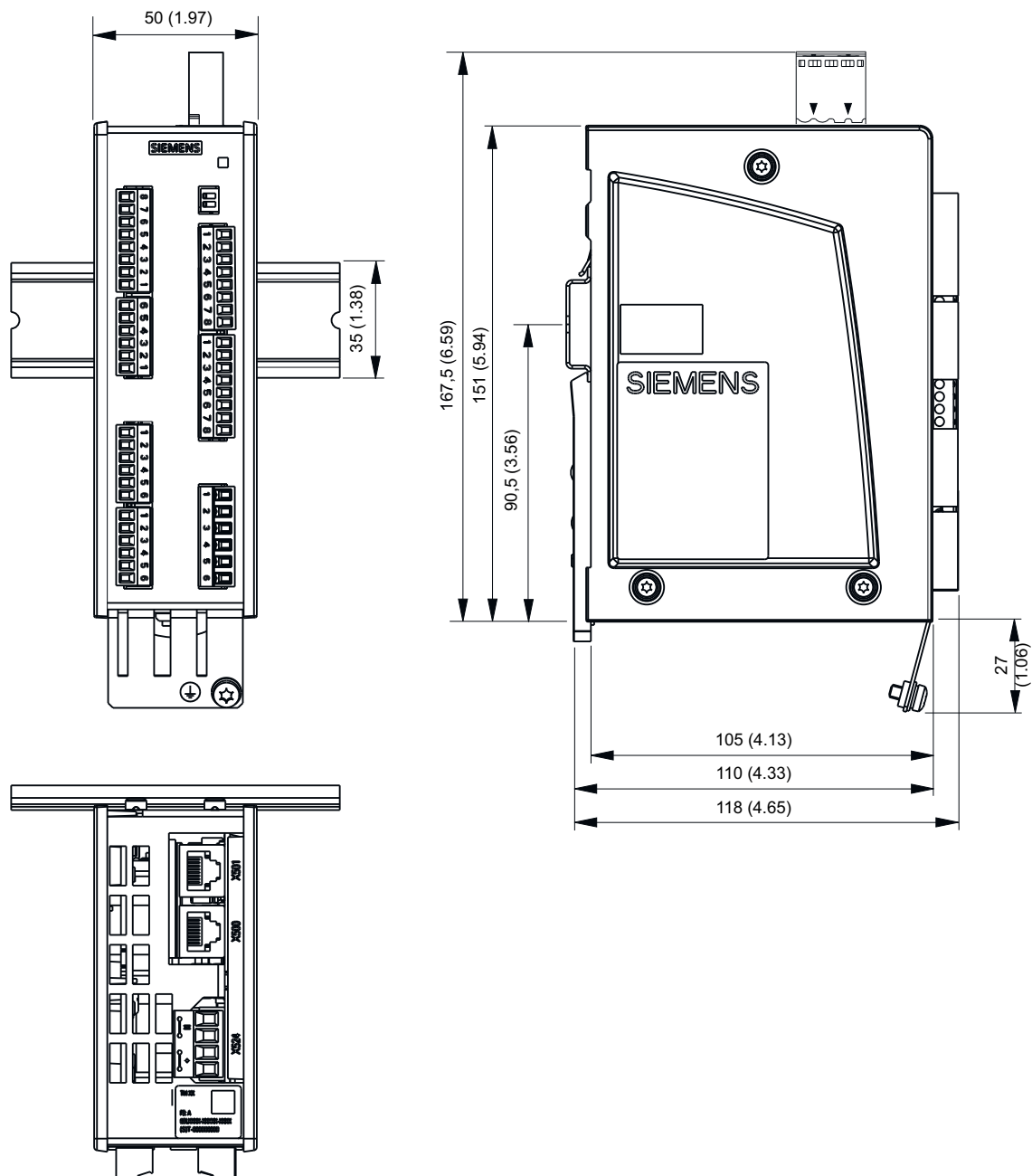


Figure 7-9 Dimension drawing of Terminal Module TM31, all data in mm and (inches)

7.3.6 Installation

Installation

1. Tilt the component backwards slightly and attach it to the DIN rail using the hooks.
2. Swivel the component onto the DIN rail until you hear the mounting slide at the rear latch into position.
3. Slide the component along the mounting rail to either the left or the right into its final position.

Removal

1. First shift the mounting slide downwards at the lug to release the interlocking with the mounting rail.
2. Swivel the component to the front and withdraw it upwards from the DIN rail.

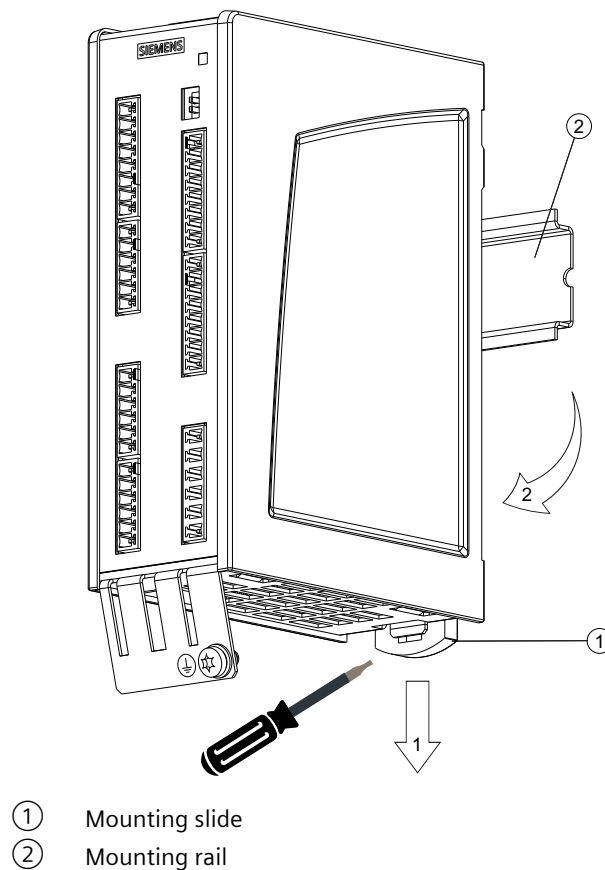
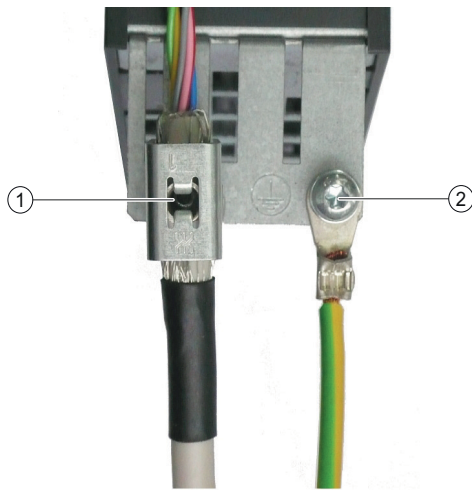


Figure 7-10 Removing from a DIN mounting rail

7.3.7 Protective conductor connection and shield support

It is always advisable to shield the digital input/output wiring.

The following diagram shows a typical Weidmüller shield connection clamp for the shield supports.



① Shield connection terminal, Weidmüller company, type: KLBUE CO1, Article number: 1753311001

② Protective conductor connection M4 / 1.8 Nm (15.9 lbf in)

Figure 7-11 Protective conductor connection and shield support

NOTICE

Damage or faulty operation due to incorrect shielding or inadmissible cable lengths

If the correct shielding procedures or the permissible cable lengths are not observed, it can cause damage or the machine may malfunction.

- Only use shielded cables.
- Do not exceed the cable lengths stated in the technical data.

7.3.8 Connector coding

To ensure that identical connectors are assigned correctly on the TM31, the connectors are encoded as shown in the following diagram.

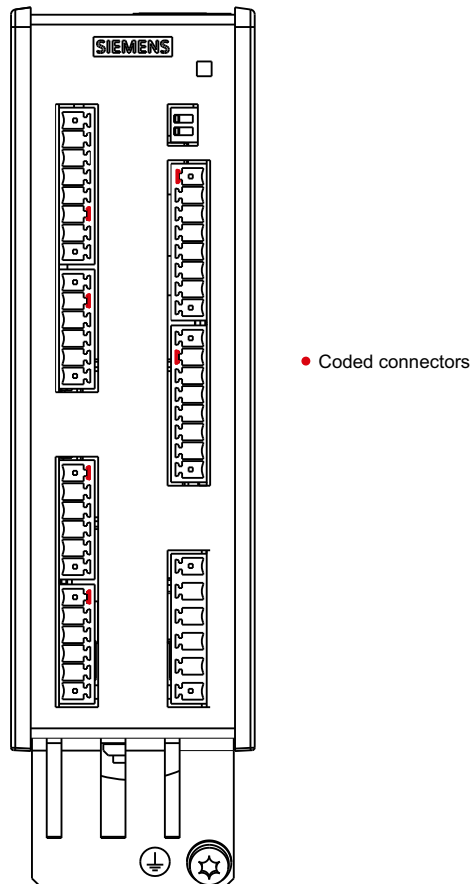


Figure 7-12 Example of connector coding at the TM31

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

7.3.9 Technical data

Table 7-21 Technical data

6SL3055-0AA00-3AA1	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 (20.4 ... 28.8)
Current (without DRIVE-CLiQ, digital outputs and auxiliary voltages)	A_{DC}	≤ 0.2
Power loss	W	≤ 5
Response time	The response time of the digital inputs/outputs and the analog inputs/outputs comprises the following: • Response time on the component itself (approx. 1/2 DRIVE-CLiQ cycle). • Transfer time via the DRIVE-CLiQ connection (approx. 1 DRIVE-CLiQ cycle). • Evaluation on the Control Unit (see function diagram). More information is provided in the following reference: Reference: SINAMICS S120/S150 List Manual, Chapter "Function diagrams/Terminal Module 31".	
Protective ground conductor connection	At the housing with M4 screw	
Maximum cable lengths:		
Electronics power supply	m	30
DRIVE-CLiQ cables	m	100
Inputs/outputs	m	30
Ventilation clearances, above/below	mm	50
Weight	kg	0.49

7.4 Terminal Module TM41-3

7.4.1 Description

Description

The Terminal Module TM41-3 is an additional component that can be used to expand the drive with additional interfaces for additional required functions. Among other things, it features an encoder interface that can be used to emulate an incremental encoder. The Terminal Module TM41-3 can also be used to connect analog controllers to the drive.

The Terminal Module TM41-3 has the following interfaces:

Table 7-22 Overview of interfaces of the Terminal Module TM41-3

Type	Quantity
DRIVE-CLiQ interfaces	2
Digital inputs	4
Bidirectional digital inputs/outputs	4
Analog inputs	1
Encoder interface	1

7.4.2 Overview

Overview diagram



Figure 7-13 Terminal Module TM41-3

Table 7-23 Terminal Module

Designation	Article number
TM41-3	6SL5155-0TM04-1AA0

7.4.3 Interfaces and connections

7.4.3.1 Interfaces

Overview diagram

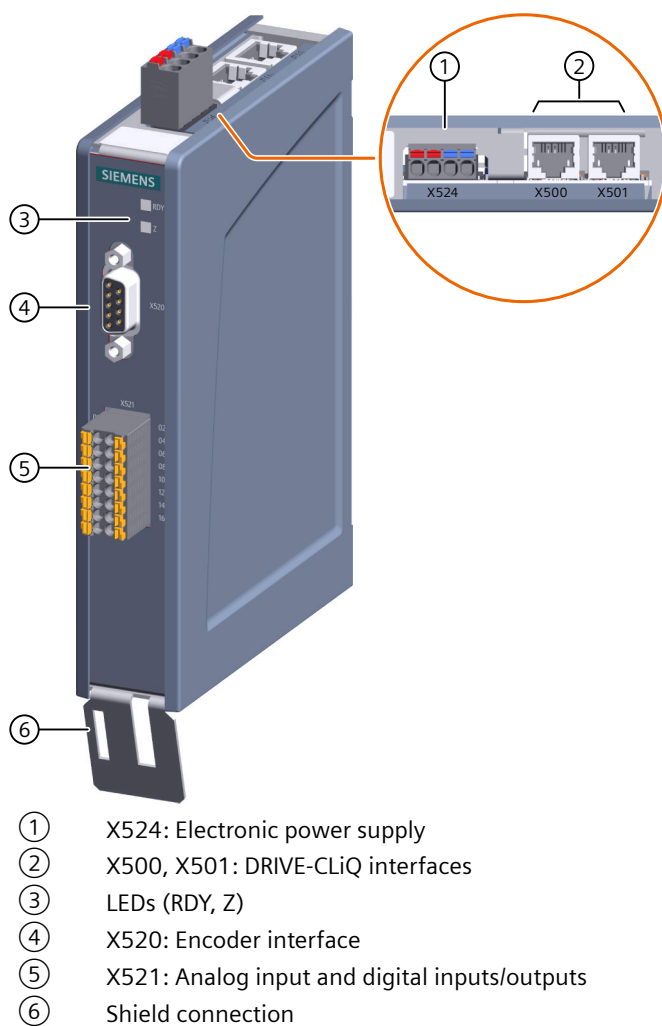


Figure 7-14 Interface overview Terminal Module TM41-3

7.4.3.2 X500, X501 DRIVE-CLiQ

Requirement

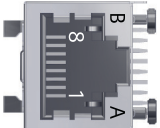
Note

MOTION-CONNECT DRIVE-CLiQ cables are required

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

Description

Table 7-24 X500 and X501: DRIVE-CLiQ interfaces

Socket	Pin	Designation	Technical data
	1	TXP	Send data +
	2	TXN	Send data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground

7.4.3.3 X524 electronic power supply

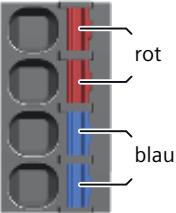
Overview

Power is supplied to the Terminal Module via the X524 interface.

The connector for this interface is included in the Terminal Kit of the Terminal Module.

Description

Table 7-25 X524: Electronics power supply of the Terminal Module

Connector	Terminal	Designation	Technical data
	+	Electronic power supply (24 V)	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: max. 3.1 A (including DRIVE-CLiQ and digital outputs) Max. current via jumper in connector: 20 A (15 A according to UL/CSA) The two "+" and "M" terminals are bridged in the connector. This ensures that the supply voltage is looped through.
	+	Electronic power supply (24 V)	
	M	Electronics ground (0 V)	
	M	Electronics ground (0 V)	
Connectable cable cross-sections	Rigid, flexible		0.2 ... 2.5 mm ²
	Flexible, with end sleeve without protective collar		0.25 ... 2.5 mm ²
	Flexible, with end sleeve with protective collar		0.25 ... 1.5 mm ²
	AWG / kcmil		24 ... 12
Stripped length	8 mm (0.31 inch)		

7.4.3.4 X520 encoder interface

Overview

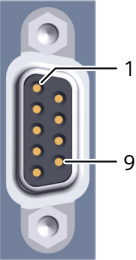
An incremental encoder can be emulated via the encoder interface X520.

Description

The encoder interface X520 provides signals according to the RS422 standard. RS422 is a technical standard for differential serial data transmission.

Differential signals A/A*, B/B*, and R/R* must not be operated "single-ended".

Table 7-26 X520: Encoder interface

Socket	Pin	Signal name	Technical specifications
	1	A	Incremental signal A
	2	R	Reference signal R
	3	B	Incremental signal B
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	A*	Inverse incremental signal A
	7	R*	Inverse reference signal R
	8	B*	Inverse incremental signal B
	9	M	Ground
Connector type	9-pin D-sub socket; TTL encoder (RS422)		

7.4.3.5 X521 analog input and digital inputs/outputs

Overview

A variety of functions can be connected to the X521 interfaces via the analog input and the digital inputs and outputs, e.g. various sensors, buttons or switches.

The connector for this interface is included in the Terminal Kit of the Terminal Module.

Requirement

Note

Ensuring the function of digital inputs

Terminal M1 must be connected for the digital inputs (DI) to function. This is achieved through one of the following measures:

1. Providing the ground reference of the digital inputs
2. A jumper to terminal M

Note: This removes the galvanic isolation for these digital inputs.

Note

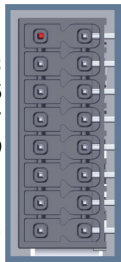
Permissible voltage values

In order to avoid incorrect results of the analog-digital conversion, the analog differential voltage signals can have a maximum offset voltage of ± 30 V with respect to ground potential.

Description

If the 24 V supply is briefly interrupted, the digital outputs are deactivated during this time. Open inputs are interpreted as "0".

Table 7-27 X521: Analog input and digital inputs/outputs

Socket	Pin	Designation ¹⁾	Technical data	Pin	Designation ¹⁾	Technical data
	01	AI 0+	Analog input	02	+24 V	Voltage: 24 V DC Max. total load current of the +24 V auxiliary voltage of terminals 02, 04, 06 and 08 together: 500 mA
	03	AI 0-		04	+24 V	
	05	M	Reference potential for terminals 02, 04, 06, 08, 10, 12, 14 and 16	06	+24 V	
	07	M1	Reference potential for terminals 09, 11, 13 and 15	08	+24 V	This power supply is only for supplying the digital inputs.
	09	DI 0	Digital inputs	10	DI/DO 0	Bidirectional digital inputs/outputs
	11	DI 1		12	DI/DO 1	
	13	DI 2		14	DI/DO 2	
	15	DI 3		16	DI/DO 3	

7.4 Terminal Module TM41-3

Socket	Pin	Designation ¹⁾	Technical data	Pin	Designation ¹⁾	Technical data
Connectable cable cross-sections		Rigid, flexible				0.2 ... 1.5 mm ²
		Flexible, with end sleeve without protective collar				0.25 ... 1.5 mm ²
		Flexible, with end sleeve with protective collar				0.25 ... 0.75 mm ²
		AWG / kcmil				24 ... 16
Stripped length		10 mm (0.39 inch)				

¹⁾ AI: analog input, DI: digital input, DI/DO: bidirectional digital input/output

Table 7-28 Technical specifications of the analog inputs AI 0+ and AI 0-¹⁾

Feature	Technical data
Differential input voltage	
Usable range	-10 ... +10 V
Maximum control setting	-12.5 ... +12.5 V
Common-mode range	±30 V
Differential input resistance R _i	80 kΩ
Resolution (related to maximum control setting)	15 bits + sign

¹⁾ Analog inputs must be shielded.

Table 7-29 Technical specifications of the digital inputs DI 0 ... DI 3¹⁾

Feature	Technical data
Voltage (incl. ripple)	-3 ... +30 V DC
Signal "0"	-3 ... +5 V
Signal "1"	15 ... 30 V
Galvanic isolation	Yes, max. 50 V potential difference
Reference potential	M1
Current consumption	
At 24 V DC (typ.)	3.5 mA
"0" signal reliably detected	< 1.5 mA
Delay time (hardware, without external cabling)	
"0" → "1" (typ. / max.)	25 / 50 μs (± 3.5 μs repeat accuracy)
"1" → "0" (typ. / max.)	25 / 50 μs (± 16.5 μs repeat accuracy)

¹⁾ The digital inputs correspond to the input characteristic acc. to IEC 61131-2, type 1 and type 3.

Table 7-30 Technical specifications of the bidirectional digital inputs/outputs DI/DO 0 ... DI/DO 3¹⁾

Feature	Technical data
As digital input	
Voltage (incl. ripple)	-3 ... +30 V DC
Signal "0"	-3 ... +5 V
Signal "1"	15 ... 30 V

Feature	Technical data
Galvanic isolation	No
Reference potential	M
Current consumption At 24 V DC (typ.) "0" signal reliably detected	3.5 mA < 1.5 mA
Delay time (hardware, without external cabling) "0" → "1" (max.) "1" → "0" (max.)	5 μs (± 1.5 μs repeat accuracy) 5 μs (± 1.5 μs repeat accuracy)
As digital output (continuous short-circuit-proof)²⁾	
Voltage Signal "1", loaded	24 V DC > X524 - 2 V
Galvanic isolation	No
Reference potential	M
Output current Per output Total of all 4 outputs Residual current with signal "0"	≤ 0.5 A ≤ 2 A < 0.5 mA
Load types	ohmic, capacitive, inductive
Delay time "0" → "1" (ohmic load) (typ. / max.) "1" → "0" (ohmic load) (typ.)	150 μs / 400 μs 50 μs
Switching frequency With ohmic load (max.) With inductive load (max.) With lamp load (max.) Lamp load (max.)	100 Hz 0.5 Hz 10 Hz 5 W

¹⁾ The digital inputs correspond to the input characteristic acc. to IEC 61131-2, type 1 and type 3.

²⁾ Automatic restart after short-circuit

More information

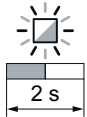
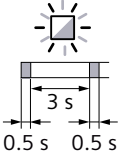
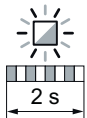
The delay time of the digital inputs and outputs and the analog input depends on various factors. More information is provided in Chapter "Function diagrams" in the SINAMICS S220 List Manual

7.4.4 LEDs

7.4.4.1 Explanation of icons

Response of the LEDs

The following tables explain the LED icons.

Icon	Description
	LED is bright
	LED is OFF
	LED flashes slowly
	LED flashes in alternating order 3 times quickly - 2 s pause - ...
	LED flashes briefly every 3 s
	LED flashes quickly
	LED flashes with variable frequency

7.4.4.2 LED RDY

Response of the LED in operation

Table 7-31 Signal states of the LED RDY

RDY	Description	Remedy
	The electronic power supply is missing or outside the permissible tolerance.	Check power supply
 Green	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	
 Orange	DRIVE-CLiQ communication is being established.	
 Red	The component signals a fault. The LED is activated irrespective of the corresponding messages being reconfigured.	
 Green - red	Firmware update in progress	
 Green - red	Firmware update completed Waiting for the supply voltage to be switched off and on	Switch the supply voltage of the component off and on
 Green - orange OR  Red - orange	Component recognition is activated. The color of the flashing LED depends on the LED state on activation with the commissioning tool.	

7.4.4.3 LED Z

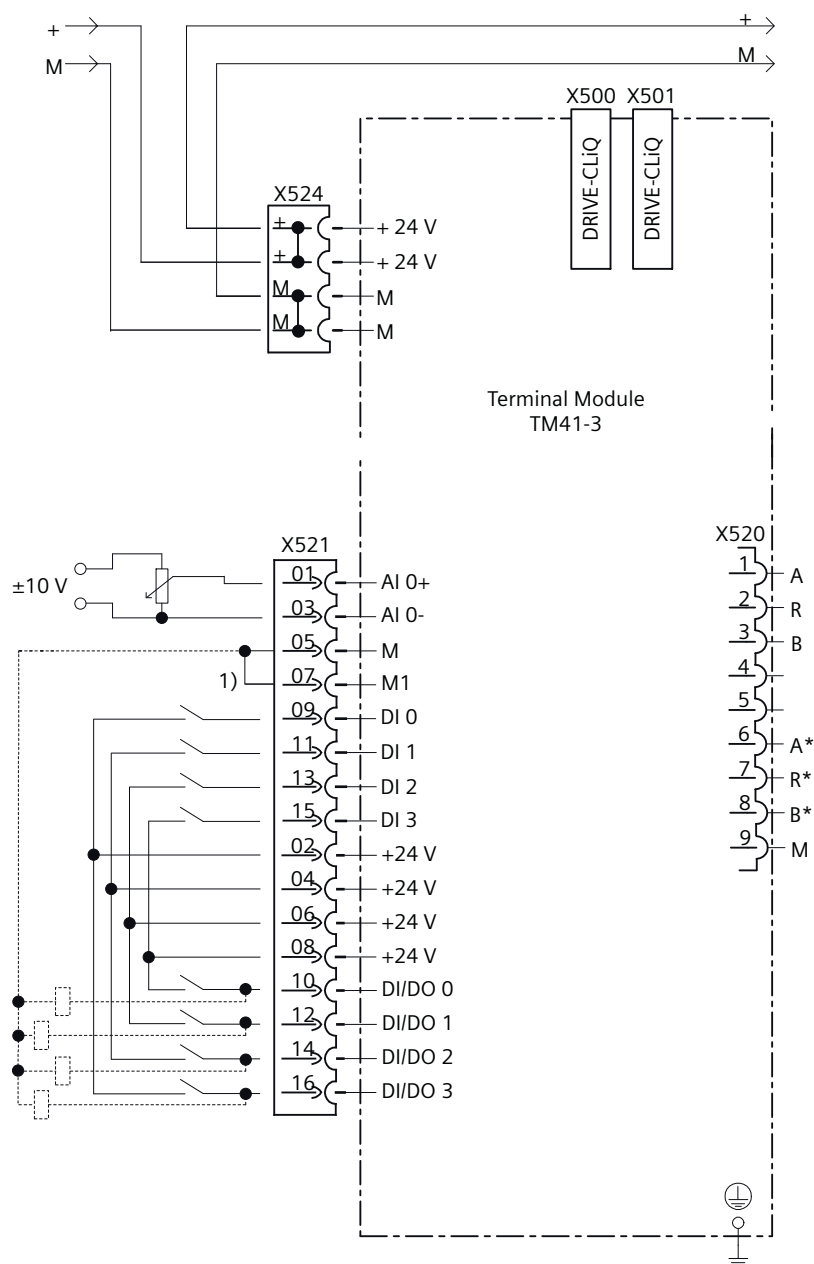
Response of the LED in operation

Table 7-32 Signal states of the LED Z (= Z pulse)

Z	Description	Remedy
	The zero mark was found and the system is waiting for the zero mark output. OR The component is switched off.	
 Green	The system stopped at the zero mark.	
 Green	The zero mark is output at each virtual revolution.	
 Red	The zero mark has not been released, or the zero mark search is running.	

7.4.5 Connection example

Connection example

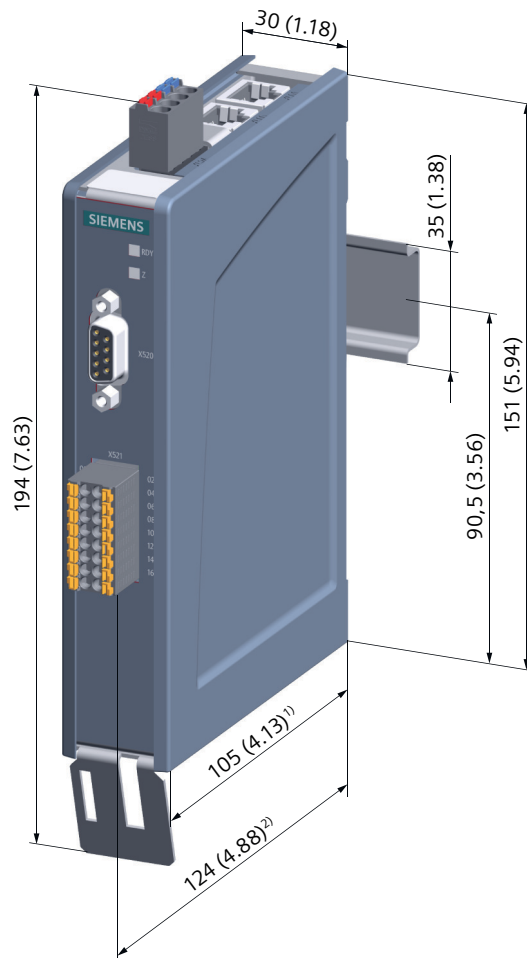


1) Bridges must be inserted for this circuit example.

Figure 7-15 Connection example Terminal Module TM41-3

7.4.6 Dimension drawing

Dimension drawing



1) Depth at the rear side without mounting slide

2) Depth at the rear side with mounting slide

Figure 7-16 Dimension drawing Terminal Module TM41-3, all data in mm and (inches)

7.4.7 Mounting Terminal Modules

Overview

Terminal Modules are designed for installation in the control cabinet. They are mounted in the control cabinet by snapping them onto a DIN rail.

Requirement

WARNING

Risk of injury as a result of foreign bodies in the device

Parts (e.g.: drilling chips, end sleeves) falling into the device can cause short-circuits and damage the insulation. This can result in severe injury (arcing, loud bang, parts that are flung out).

- Only perform installation and other work when the devices are current-free.
- Cover the ventilation slots when mounting and installing the control cabinet and remove the cover before switching on.

For the TM41-3 Terminal Module, the protection connection is established when it is mounted on a DIN rail. Ensure that the DIN rail is in contact with the correctly grounded control cabinet rear panel through a bare-metal connection.

Components required:

- DIN rail TH 35 according to EN 60715

Procedure

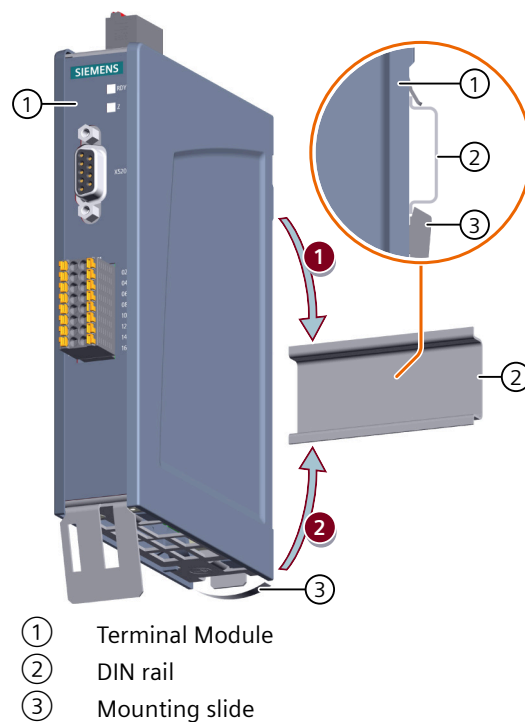


Figure 7-17 Mounting Terminal Module TM41-3

Proceed as follows to mount the Terminal Module:

1. Tilt the component backwards slightly and attach it to the DIN rail using the hooks.
2. Swivel the component onto the DIN rail until you hear the mounting slide at the rear latch into position.
3. Slide the component along the DIN rail to either the left or the right into its final position.

7.4.8 Removing Terminal Modules

Requirement



WARNING

Risk of injury as a result of foreign bodies in the device

Parts (e.g.: drilling chips, end sleeves) falling into the device can cause short-circuits and damage the insulation. This can result in severe injury (arcing, loud bang, parts that are flung out).

- Only perform installation and other work when the devices are current-free.
- Cover the ventilation slots when mounting and installing the control cabinet and remove the cover before switching on.

Procedure

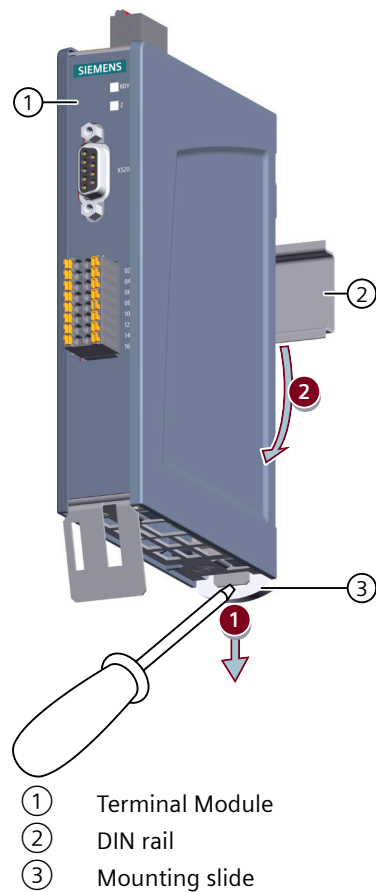


Figure 7-18 Removing Terminal Module TM41-3

Proceed as follows to dismantle a Terminal Module:

1. First shift the mounting slide downwards at the lug to release the interlocking with the DIN rail.
2. Swivel the component to the front and withdraw it upwards from the DIN rail.

7.4.9 Attaching the cable shield

Overview

There is a shield support at the front of a Terminal Module to attach cable shields. This is where you attach the cable shields of signal lines for analog inputs/outputs, for example.

Requirement

NOTICE**Damage or faulty operation due to incorrect shielding or inadmissible cable lengths**

If the correct shielding procedures or the permissible cable lengths are not observed, it can cause damage or the machine may malfunction.

- Only use shielded cables.
- Do not exceed the cable lengths specified in this documentation.

The following requirement must be met:

- Use a suitable shield connection clamp, e.g. type KLBUE CO1 (article number: 1753311001) from Weidmüller or type SK 8 from Phoenix Contact.

Procedure

Proceed as follows to install cable shields:

1. Remove the cable sheath.
2. Fasten the shield of the signal cable to the shield connection clamp on the shield connection plate of the Terminal Module.
 - Observe the permissible bending radii when installing.

Result

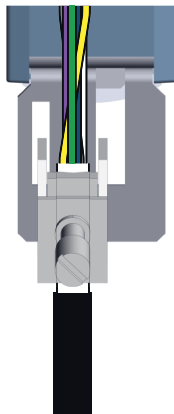


Figure 7-19 Shield support on a Terminal Module

More information

You can find more detailed instructions in the product information for the shield connection clamp you are using. Information on the shield connection clamp type KLBUE CO1 can be found, for example, in the instruction leaflet or in the online catalog of Weidmüller.

7.4.10 Technical specifications

Technical specifications

Table 7-33 Technical specifications Terminal Module TM41-3

Feature	Unit	Value
Electronic power supply		
Voltage	V	24 (20.4 ... 28.8)
Current ¹⁾	A	≤ 0.15
Power loss (typ.)	W	≤ 3
Weight	kg	0.32
Cable lengths	m	See Chapter "Maximum permissible cable lengths (Page 45)"

¹⁾ Without DRIVE-CLiQ, digital outputs and +24 V auxiliary voltage of the digital inputs

7.5 Terminal Module TM120

7.5.1 Description

The Terminal Module TM120 is a DRIVE-CLiQ component for safe electrically isolated temperature evaluation. It can be used for 1FN, 1FW6, and third-party motors in which the temperature sensors cannot be installed with safe electrical separation. The TM120 is installed in the control cabinet and can be snapped on to a DIN rail (EN 60715).

When a TM120 is being used, temperature evaluation and encoder evaluation functions are separated off from one another. The TM120 can detect the motor temperature via 4 channels with different temperature sensors. An encoder is evaluated using Sensor Modules (e.g. SMC., SME..). This means that when connected to a Sensor Module SMC, the TM120 represents a control cabinet alternative to the SME120/SME125.

The TM120 contains the following interfaces:

Table 7-34 Overview of the TM120 interfaces

Type	Quantity
DRIVE-CLiQ interfaces	2
Temperature sensor inputs	4

7.5.2 Interface description

7.5.2.1 Overview

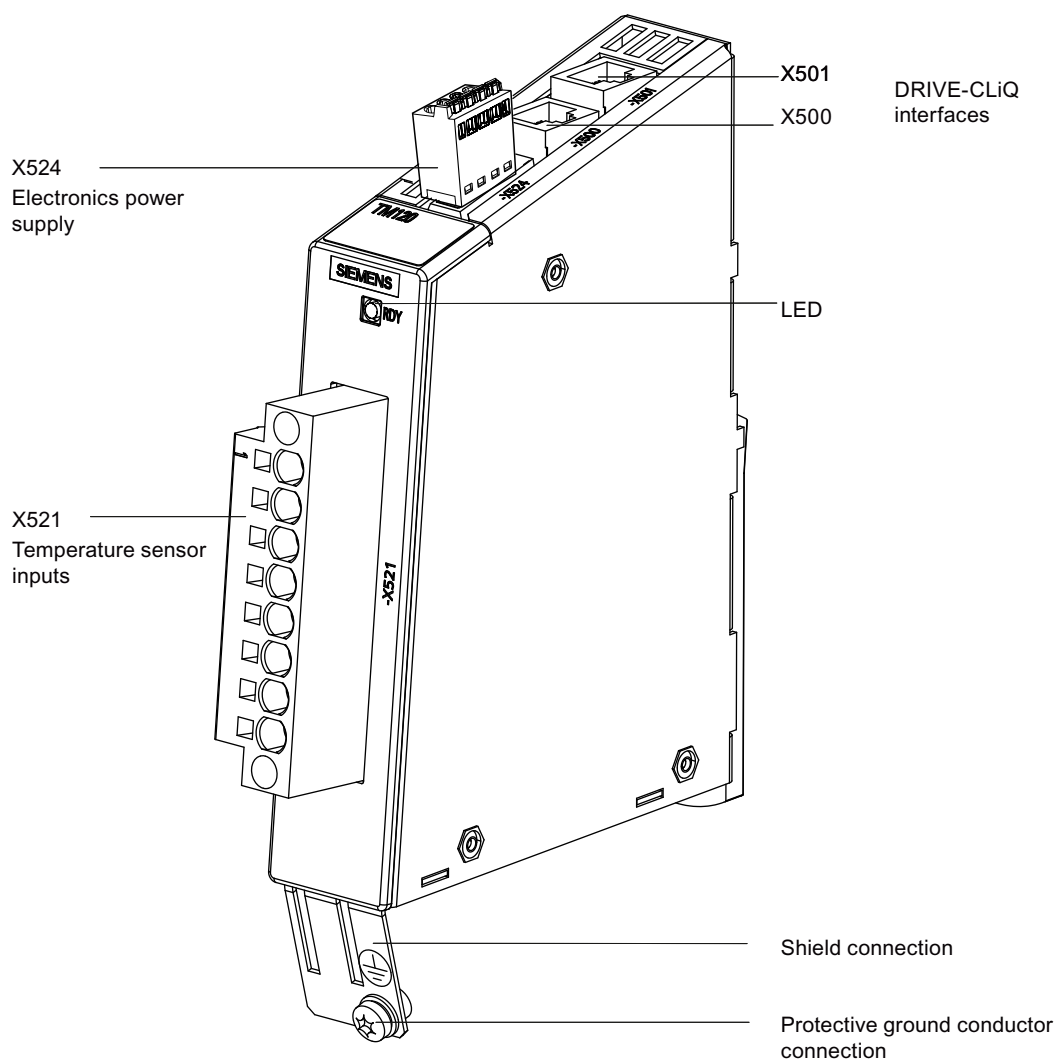
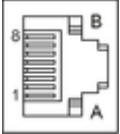


Figure 7-20 Interface overview TM120

7.5.2.2 X500/X501 DRIVE-CLiQ interfaces

Table 7-35 X500/X501: DRIVE-CLiQ interfaces

	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.
Blanking covers (50 x) Article No.: 6SL3066-4CA00-0AA0

Note

The maximum DRIVE-CLiQ cable length is 100 m.

7.5.2.3 X521 temperature sensor input

Table 7-36 X521: Temperature sensor input

	Terminal	Function	Technical data
	1	- Temp	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact for linear motor applications, connect the Pt1000 or KTY84-130 motor temperature sensor here
	2	+ Temp	
	3	- Temp	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact for linear motor applications, connect the PTC triplet 1 or bimetal NC contact here
	4	+ Temp	
	5	- Temp	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact for linear motor applications, connect the PTC triplet 2 here
	6	+ Temp	
	7	- Temp	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact for linear motor applications, connect the PTC triplet 3 here
	8	+ Temp	

Type: Spring-loaded terminal 5 (Page 46)

Measuring current via temperature sensor connection: 2 mA

Accuracy of the temperature measurement (temperature sensor, including evaluation):

- Pt1000: $\pm 5\text{ }^{\circ}\text{C}$ (Pt1000 tolerance class B acc. to EN 60751)
- KTY: $\pm 7\text{ }^{\circ}\text{C}$
- PTC: $\pm 5\text{ }^{\circ}\text{C}$

NOTICE**Damage when using a non-specified temperature sensor**

If sensors other than those specified are connected, this may result in incorrect measured values. Damage can result if overheating is not detected.

- Only connect temperature sensors that have been specified for operation with a TM120 Terminal Module.

NOTICE**Overheating of the motor through jumpering the temperature sensor connections**

Jumpering of the temperature sensor connections "+ temp" and "- temp" results in incorrect measurement results. Damage to the motor can result if the overheating is not detected.

- When using several temperature sensors, separately connect the individual sensors to "+ temp" and "- temp".

The table below shows the preferable assignment of the connecting terminal for the temperature sensor input:

Table 7-37 Preferable assignment, X521 temperature sensor input

Terminal	Signal name				Meaning
	1FW6	1FN3 (2x1FN3)	1FN1	Segment motor 4 segments	
1	Pt1000 ¹⁾	Pt1000 ¹⁾	Pt1000 ¹⁾	1 PTC 120 °C	Pt1000
2	Pt1000 ²⁾	Pt1000 ²⁾	Pt1000 ²⁾	1 PTC 120 °C	Pt1000
3	PTC 130 °C	PTC 120 °C	Bimetallic NC con- tact	2_PTC 120 °C	PTC triplet 1 or bimetal NC contact
4	PTC 130 °C	PTC 120 °C	Bimetallic NC con- tact	2_PTC 120 °C	
5	PTC 150 °C	(2_Pt1000) ¹⁾		3_PTC 120 °C	PTC triple element 2
6	PTC 150 °C	(2_Pt1000) ²⁾		3_PTC 120 °C	
7		(2 PTC 120 °C)		4 PTC 120 °C	PTC triple element 3
8		(2 PTC 120 °C)		4 PTC 120 °C	

¹⁾ Instead of a Pt1000 temperature sensor, a KTY temperature sensor can also be used (negative pole).

²⁾ Instead of a Pt1000 temperature sensor, a KTY temperature sensor can also be used (positive pole).

The interconnection provided is a suggestion (software default setting). Which temperature sensor is connected to which input can be freely configured.

NOTICE

Damage to the motor due to incorrectly connected KTY temperature sensor

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

- Connect a KTY temperature sensor with the correct polarity.

Note

A 6FX7008-1BC.1 power cable is recommended for connecting Pt1000 / KTY temperature sensors.

Note

The maximum length of the temperature sensor cable is 100 m. The cables must be shielded.

7.5.2.4 X524 Electronics power supply

Table 7-38 X524 electronics power supply

	Terminal	Designation	Technical data
	+	Electronics power supply (24 V)	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption (max.): 0.5 A (including DRIVE-CLiQ) Max. current via the jumper in the connector: 20 A (15 A according to UL/CSA)
	+	Electronics power supply (24 V)	
	M	Electronics ground (0 V)	
	M	Electronics ground (0 V)	
Type: Spring-loaded terminal 6 (Page 46)			

The maximum cable length is 30 m.

Note

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

7.5.3 Connection examples

Each TM120 is directly connected to an encoder evaluation unit (SMCxx or SMExx) by looping the corresponding DRIVE-CLiQ channel via the TM120. This ensures that encoders are automatically assigned to the temperature signals and, consequently, to the correct axis. The assignment can also be performed manually.

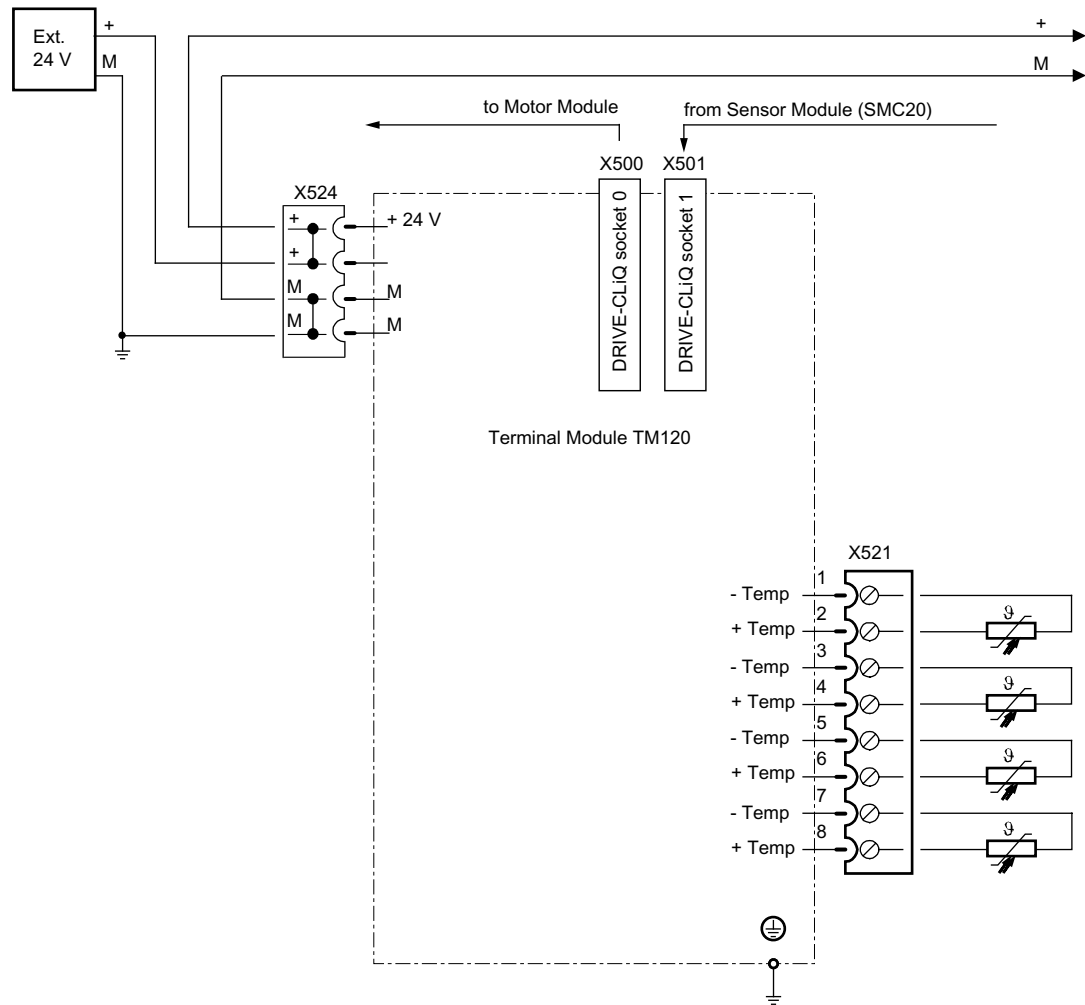


Figure 7-21 Connection example of TM120

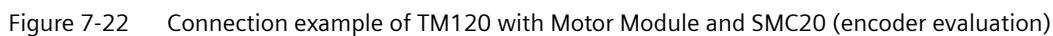


Table 7-39 Meaning of the LEDs on the Terminal Module TM120

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7.5.5 Dimension drawing

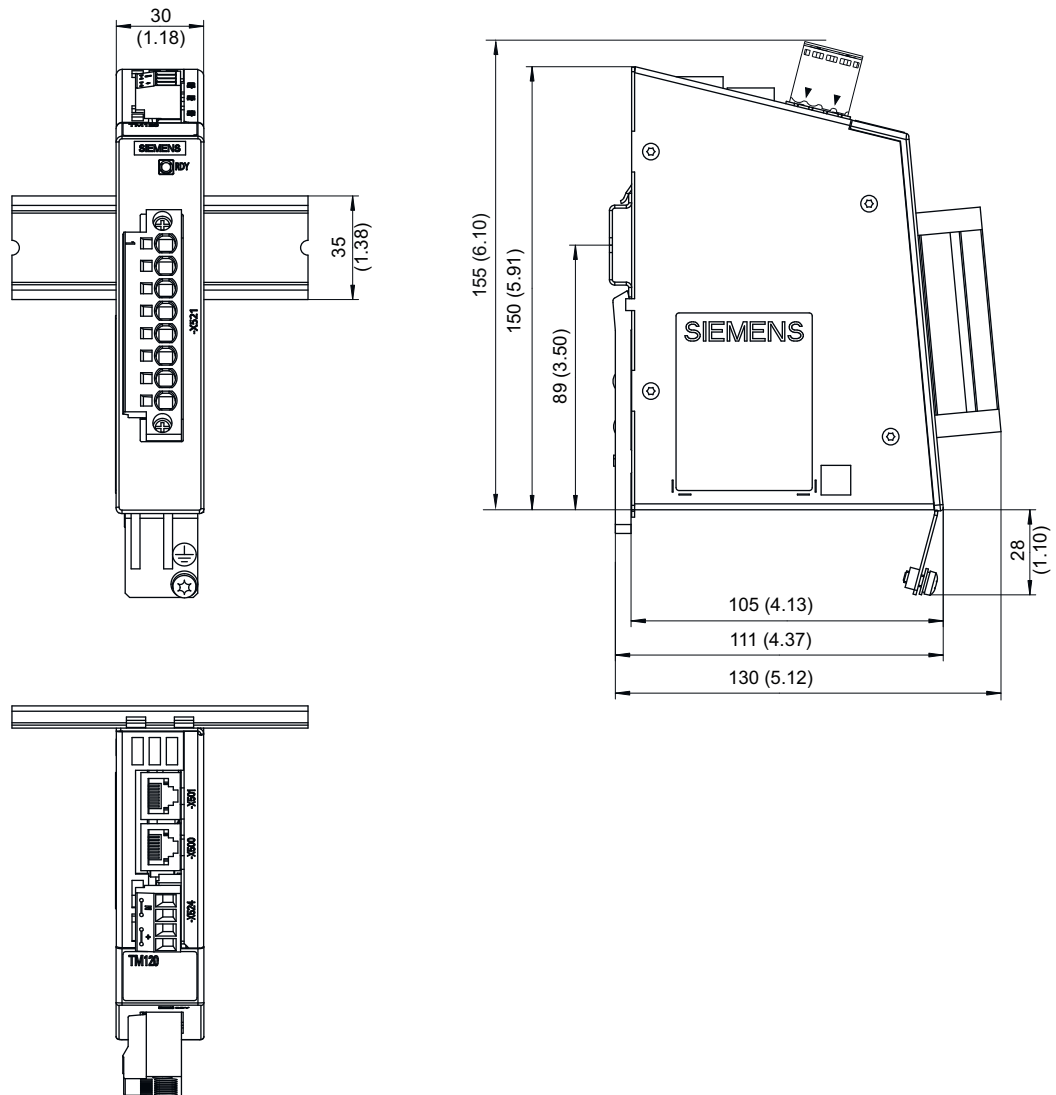


Figure 7-23 Dimension drawing of Terminal Module TM120, all data in mm and (inches)

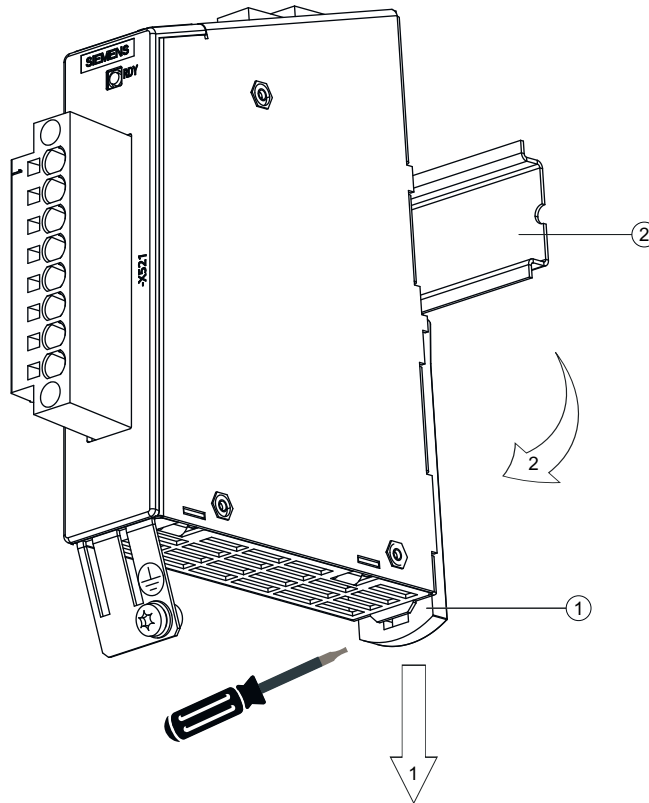
7.5.6 Installation

Installation

1. Tilt the component backwards slightly and attach it to the DIN rail using the hooks.
2. Swivel the component onto the DIN rail until you hear the mounting slide at the rear latch into position.
3. Slide the component along the mounting rail to either the left or the right into its final position.

Removal

1. First shift the mounting slide downwards at the lug to release the interlocking with the mounting rail.
2. Swivel the component to the front and withdraw it upwards from the DIN rail.

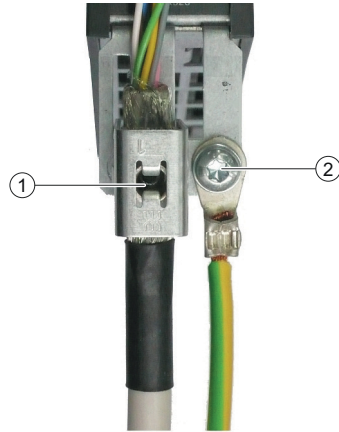


- ① Mounting slide
- ② Mounting rail

Figure 7-24 Removal of a TM120 from a DIN rail

7.5.7 Protective conductor connection and shield support

The following diagram shows a typical Weidmüller shield connection clamp for the shield supports.



- ① Shield connection terminal, Weidmüller company, type: KLBUE CO1, Article number: 1753311001
- ② Protective conductor connection M4 / 1.8 Nm (15.9 lbf in)

Figure 7-25 Protective conductor connection and shield support

NOTICE

Damage or faulty operation due to incorrect shielding or inadmissible cable lengths

If the correct shielding procedures or the permissible cable lengths are not observed, it can cause damage or the machine may malfunction.

- Only use shielded cables.
- Do not exceed the cable lengths stated in the technical data.

7.5.8 Technical data

Table 7-40 Technical data

6SL3055-0AA00-3KA.	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 (20.4 ... 28.8)
Current (without DRIVE-CLiQ)	A_{DC}	≤ 0.2
Power loss	W	≤ 4
Maximum cable length	m	30
Protective ground conductor connection	At the housing with M4 screw	
Ventilation clearances, above/below	mm	50
Weight	kg	0.41

7.6 Terminal Module TM150

7.6.1 Description

The terminal module TM150 is a DRIVE-CLiQ component for temperature evaluation. The temperature is measured in a temperature range from -99 °C to +250 °C for the following temperature sensors:

- Pt100 (with monitoring for wire break and short-circuit)
- Pt1000 (with monitoring for wire breakage and short-circuit)
- KTY84 (with monitoring for wire breakage and short-circuit)
- PTC (with short-circuit monitoring)
- Bimetallic NC contact (without monitoring)

For the temperature sensor inputs, for each terminal block the evaluation can be parameterized for 1x2-wire, 2x2-wire, 3-wire or 4-wire. There is no galvanic isolation in the TM150.

The TM150 is mounted in the control cabinet and can be snapped on to a standard mounting rail (EN 60715).

The TM150 contains the following interfaces:

Table 7-41 Overview of the TM150 interfaces

Type	Quantity
DRIVE-CLiQ interfaces	2
Temperature sensor inputs	12
Electronics power supply	1

7.6.2 Interface description

7.6.2.1 Overview

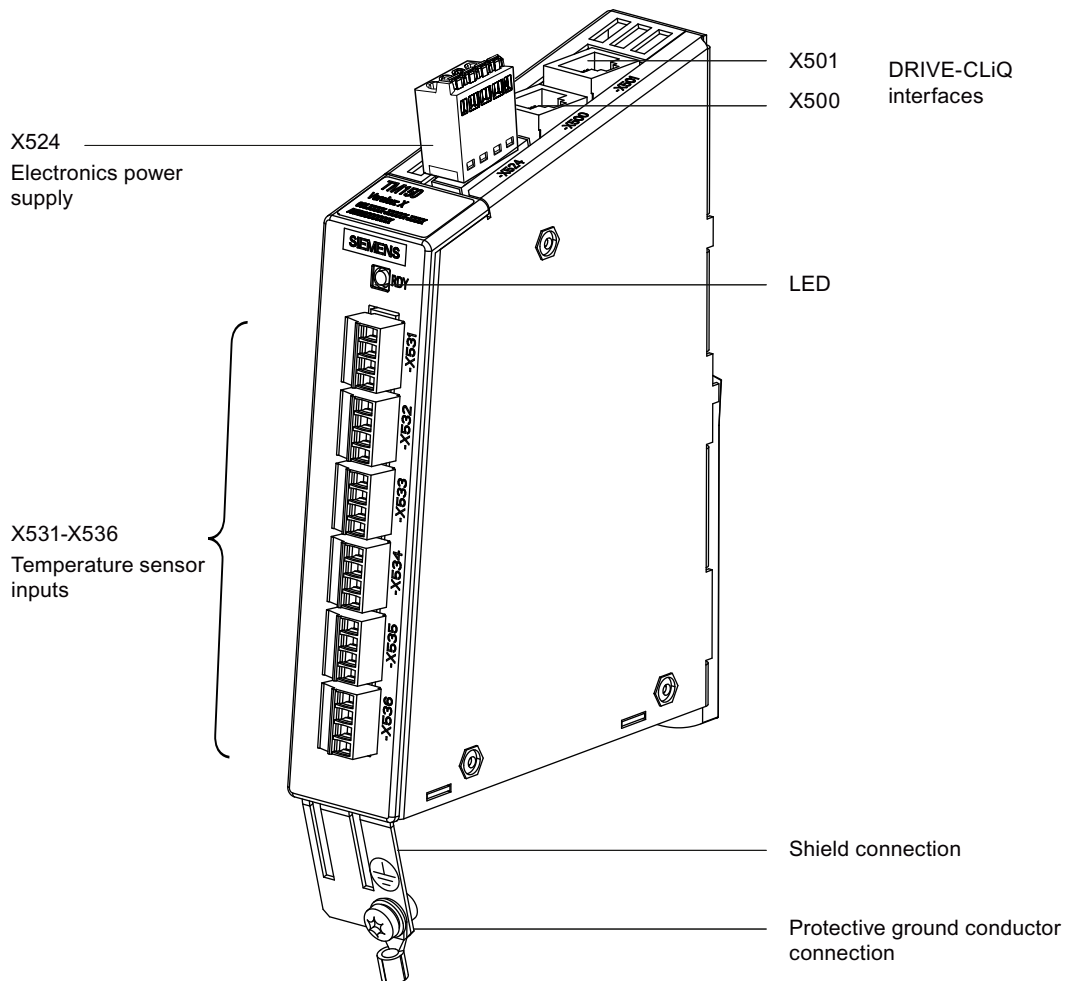
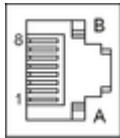


Figure 7-26 Interface overview of Terminal Module TM150

7.6.2.2 X500/X501 DRIVE-CLiQ interfaces

Table 7-42 X500/X501: DRIVE-CLiQ interfaces

	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply, max. 450 mA
	B	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		

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

Blanking covers (50 units), article number: 6SL3066-4CA00-0AA0

Note

The maximum DRIVE-CLiQ cable length is 100 m.

7.6.2.3 X524 Electronics power supply

Table 7-43 X524 electronics power supply

	Terminal	Designation	Technical data
 red blue	+	Electronics power supply (24 V)	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption (max.): 0.5 A (including DRIVE-CLiQ) Max. current via the jumper in the connector: 20 A (15 A according to UL/CSA)
	+	Electronics power supply (24 V)	
	M	Electronics ground (0 V)	
	M	Electronics ground (0 V)	
Type: Spring-loaded terminal 6 (Page 46)			

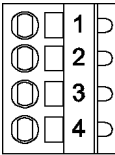
The maximum cable length is 30 m.

Note

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

7.6.2.4 X531-X536 temperature sensor inputs

Table 7-44 X531-X536: Temperature sensor inputs

	Terminal	Function 1x2- / 2x2-wire	Function 3 and 4-wire	Technical data
	1	+Temp (channel x)	+ (Channel x)	Temperature sensor connection for sensors with 1x2 wires Connection of the 1st measurement cable for sensors with 3 and 4 wires Temperature sensor Pt1000 / Pt100 / KTY84-130 / PTC / bimetal NC contact
	2	-Temp (channel x)	- (Channel x)	Temperature sensor connection for sensors with 1x2 wires Connection of the 2nd measurement cable for sensors with 4 wires Temperature sensor Pt1000 / Pt100 / KTY84-130 / PTC / bimetal NC contact
	3	+Temp (channel y)	+ I _c (constant current, positive channel x)	Temperature sensor connection for sensors with 2x2, 3 and 4-wires Temperature sensor Pt1000 / Pt100 / KTY84-130 / PTC / bimetal NC contact
	4	-Temp (channel y)	- I _c (constant current, negative channel x)	
Type: Spring-loaded terminal 3 (Page 46) Measuring current via temperature sensor connection: approx. 0.83 mA Accuracy of the temperature measurement (temperature sensor including evaluation): - Pt1000: ±3°C (Pt1000 tolerance class B according to EN 60751) - Pt100: ±3°C (Pt100 tolerance class B according to EN 60751) - KTY: ±7°C - PTC: ±5°C				

When connecting temperature sensors with 3 wires, a jumper must be inserted between X53□.2 and X53□.4 (□ = 1...6).

Table 7-45 Channel assignment

Terminal	Channel number [x] for 1x2, 3 and 4-wires	Channel number [y] for 2x2 wires
X531	0	6
X532	1	7
X533	2	8
X534	3	9
X535	4	10
X536	5	11

NOTICE**Damage to the motor due to incorrectly connected KTY temperature sensor**

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

- Connect a KTY temperature sensor with the correct polarity.

NOTICE**Overheating of the motor through jumpering the temperature sensor connections**

Jumpering temperature sensor connections "+Temp" and "-Temp" results in incorrect measurement results. Damage to the motor can result if the overheating is not detected.

- When using several temperature sensors, separately connect the individual sensors to "+Temp" and "-Temp".

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

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

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

Note**Incorrect temperature measured values as a result of cables with an excessively high resistance**

An excessively long cable length or an excessively small cable cross-section can falsify the temperature measurement (for a Pt100, a 10 Ω cable resistance can falsify the result of the measurement by 10%). As a consequence, excessively high measured values are output, which could lead to the motor being unnecessarily tripped prematurely.

- Use only cable lengths ≤ 300 m.
 - For cable lengths >100 m, use cables with a cross-section of ≥ 1 mm².
-



! WARNING

Electric shock when the motor temperature sensor insulation fails

When connecting temperature sensors, which have no safe protective separation with respect to the motor power circuit, then arcing to the signal electronics can occur.

- Use motors whose temperature sensors have safe electrical separation.
- Use only connecting cables and connectors with safe electrical separation between the wires of the temperature sensor and the wires of the power circuit.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

7.6.3 Connection examples

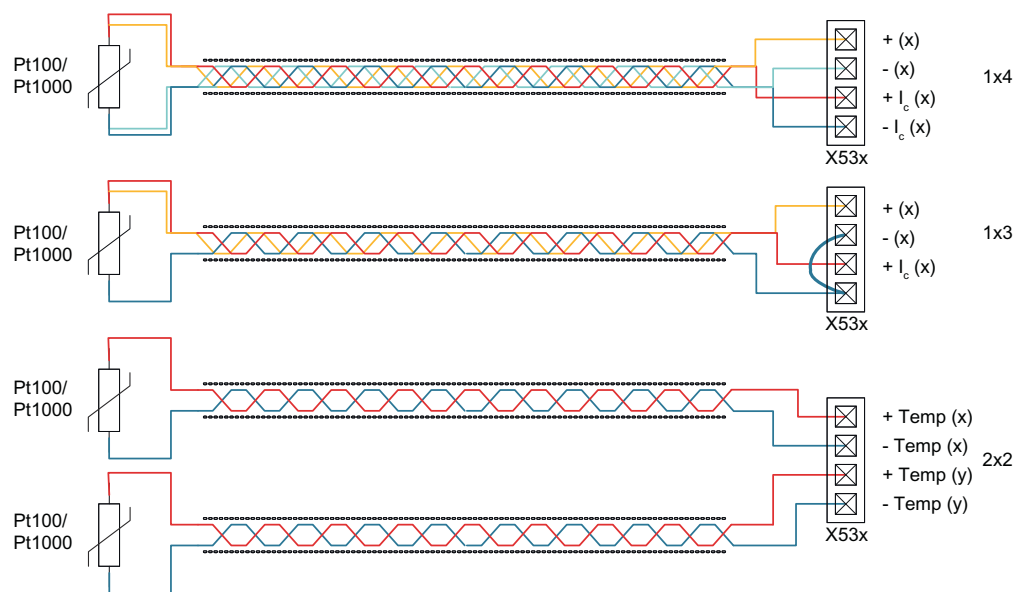


Figure 7-27 Connecting a Pt100/Pt1000 with 2x2, 3 and 4-wires to the temperature sensor inputs X53. of the TM150 Terminal Module

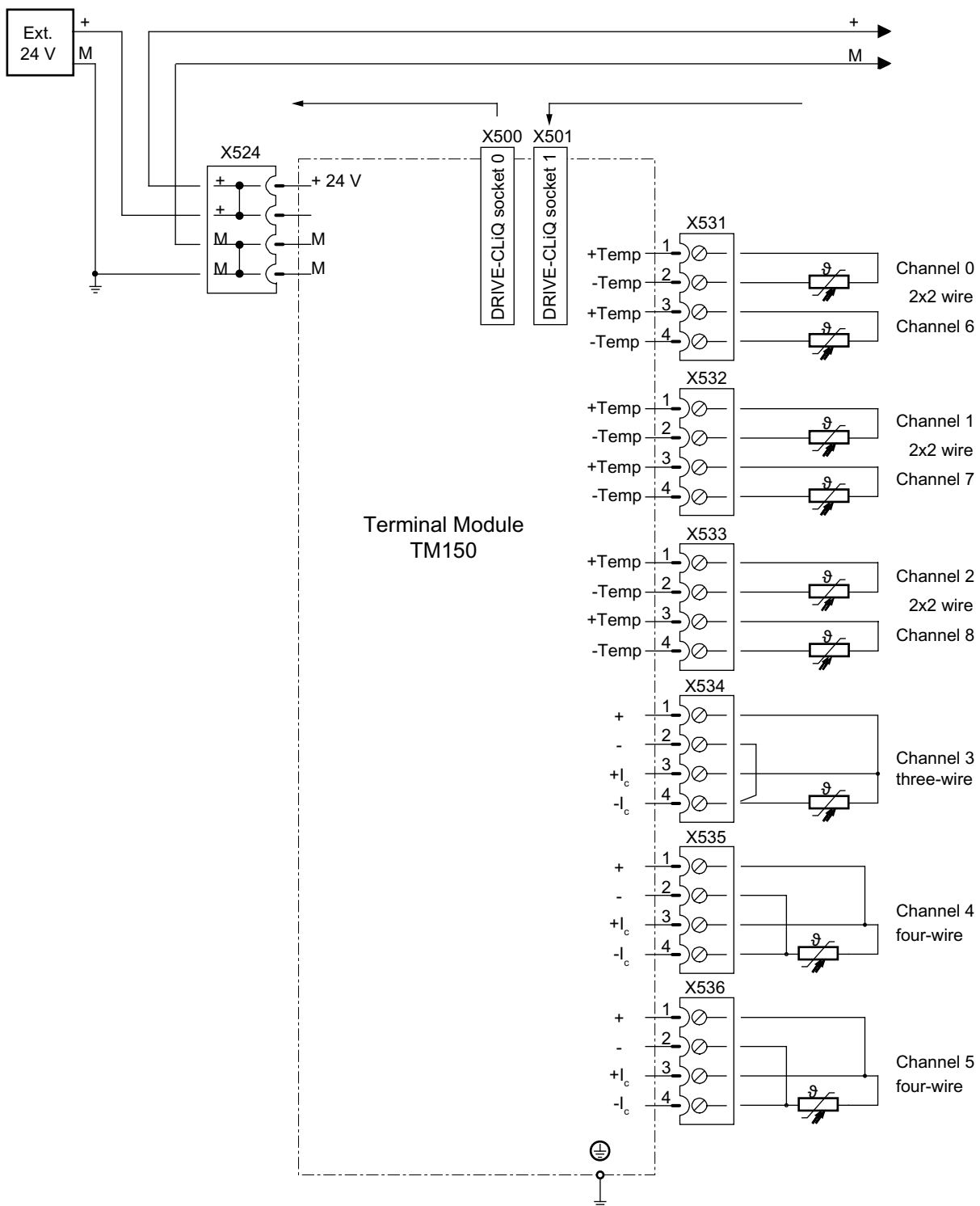


Figure 7-28 Connection example for a Terminal Module TM150

7.6.4 Meaning of the LED

Table 7-46 Meaning of the LEDs at the Terminal Module TM150

LED	Color	Status	Description, cause	Remedy
READY	–	Off	The electronics power supply is missing or outside the permissible tolerance range.	Check the power supply.
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	This component has at least one fault. Remark: LED is controlled irrespective of the corresponding messages being reconfigured.	Remove and acknowledge the fault.
	Green/ red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
		Flashing light 2 Hz	Firmware has been downloaded. The system waits for POWER ON.	Carry out a POWER ON.
	Green/ orange or red/ orange	Flashing light 2 Hz	Component recognition via LED is activated (parameter p0154=1). Remark: Both options depend on the LED status when component recognition is activated.	–

7.6.5 Dimension drawing

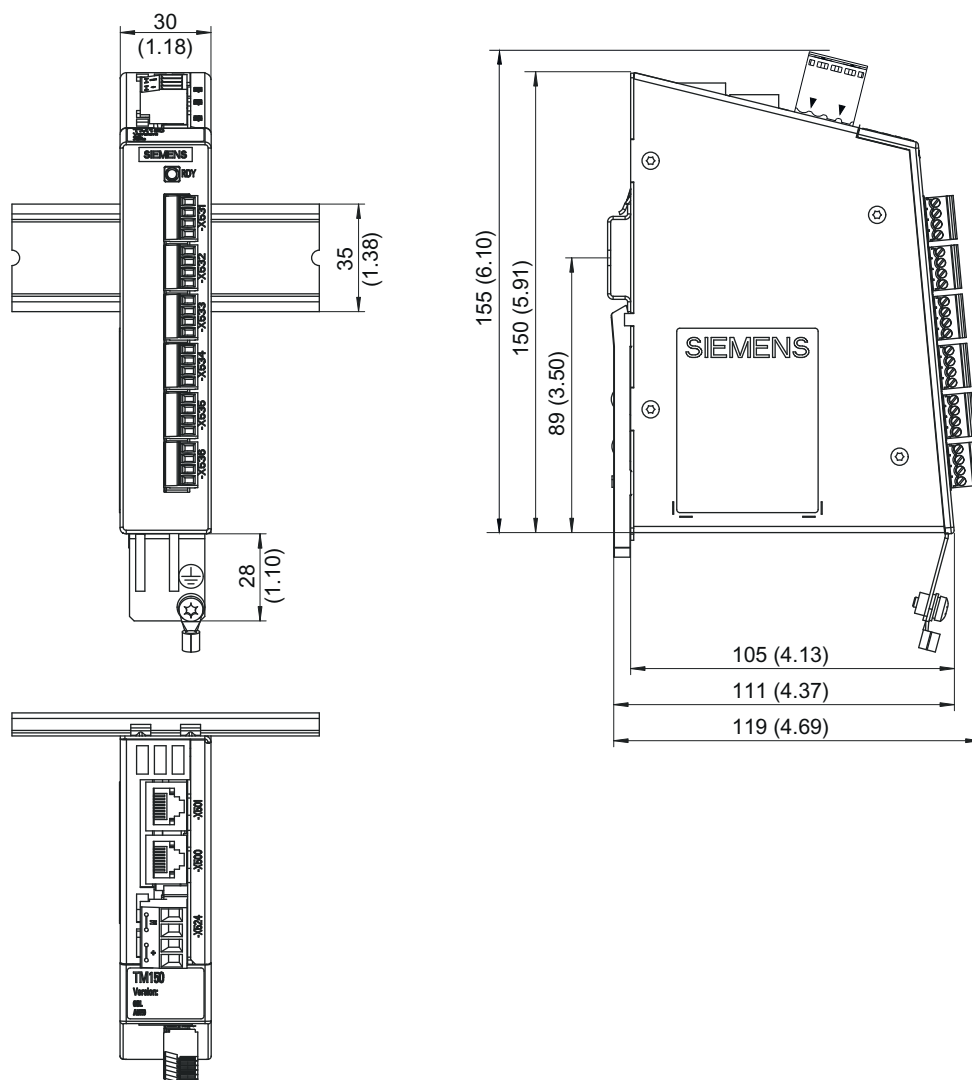


Figure 7-29 Dimension drawing of Terminal Module TM150, all data in mm and (inches)

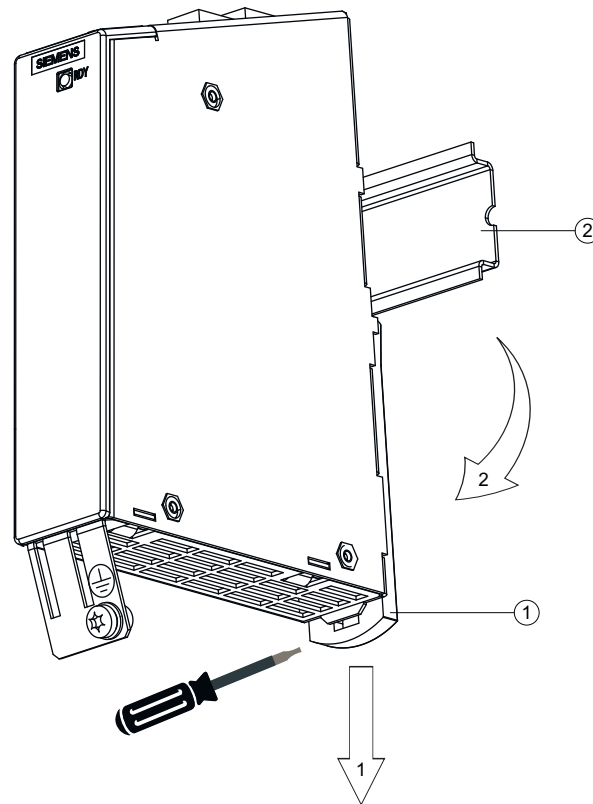
7.6.6 Installation

Installation

1. Tilt the component backwards slightly and attach it to the DIN rail using the hooks.
2. Swivel the component onto the DIN rail until you hear the mounting slide at the rear latch into position.
3. Slide the component along the mounting rail to either the left or the right into its final position.

Removal

1. First shift the mounting slide downwards at the lug to release the interlocking with the mounting rail.
2. Swivel the component to the front and withdraw it upwards from the DIN rail.

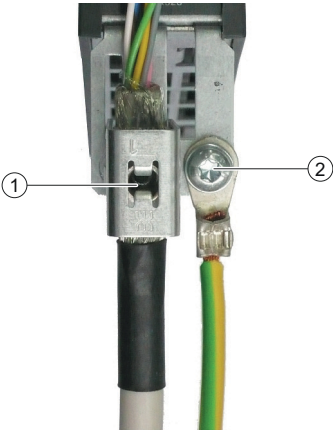


- ① Mounting slide
- ② Mounting rail

Figure 7-30 Removing a TM150 from a mounting rail

7.6.7 Protective conductor connection and shield support

The following diagram shows a typical Weidmüller shield connection clamp for the shield supports.



- ① Shield connection terminal, Weidmüller company, type: KLBUE CO1, Article number: 1753311001
- ② Protective conductor connection M4 / 1.8 Nm (15.9 lbf in)

Figure 7-31 Protective conductor connection and shield support

NOTICE
Damage or faulty operation due to incorrect shielding or inadmissible cable lengths If the correct shielding procedures or the permissible cable lengths are not observed, it can cause damage or the machine may malfunction. • Only use shielded cables. • Do not exceed the cable lengths stated in the technical data.

7.6.8 Technical data

Table 7-47 Technical data

6SL3055-0AA00-3LA0	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 (20.4 ... 28.8)
Current (without DRIVE-CLiQ)	A_{DC}	≤ 0.1
Power loss	W	≤ 2
Maximum cable length	m	30
Protective ground conductor connection	At the housing with M4 screw	
Ventilation clearances, above/below	mm	50
Weight	kg	0.4

DRIVE-CLiQ Switch Modules

8.1 Safety instructions

NOTICE
Damage through use of incorrect DRIVE-CLiQ cables The use of incorrect or unreleased DRIVE-CLiQ cables can cause damage or functional faults to devices or the system. Only use suitable DRIVE-CLiQ cables that have been released by Siemens for the particular application.

Note

Malfunctions due to polluted DRIVE-CLiQ interfaces

Dirty/polluted DRIVE-CLiQ interfaces can result in system malfunctions.

- Close and seal unused DRIVE-CLiQ interfaces using the blanking covers included in the scope of delivery. You can order missing blanking covers (article number: 6SL3066-4CA00-0AA0, 50 units).

8.2 DRIVE-CLiQ Switch Module DMC20-3

8.2.1 Description

Description

The DRIVE-CLiQ Switch Module DMC20-3 is an expansion unit and is used for the star-shaped distribution of a DRIVE-CLiQ line. This can be used to expand an axis line-up by 7 DRIVE-CLiQ interfaces for connecting further sub-axis systems. It is possible to connect DRIVE-CLiQ Switch Modules in series (cascading).

The component is particularly suitable for applications that require the ability to remove DRIVE-CLiQ nodes in groups without interrupting the DRIVE-CLiQ line and thus the data exchange.

The DMC20-3 is designed for installation in a control cabinet (degree of protection IP20).

It provides the following interfaces:

Table 8-1 Interface overview for the DRIVE-CLiQ Switch Module DMC20-3

Type	Quantity
DRIVE-CLiQ Express interfaces	2
DRIVE-CLiQ interfaces	6

8.2.2 Overview

Overview diagram

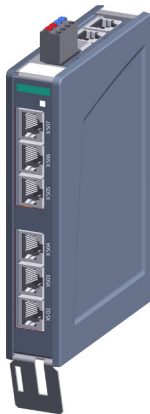


Figure 8-1 DRIVE-CLiQ Switch Module DMC20-3

Table 8-2 DRIVE-CLiQ Switch Module

Designation	Article number
DMC20-3	6SL5155-0DC02-0AA0

8.2.3 Interfaces and connections

8.2.3.1 Interfaces

Overview diagram

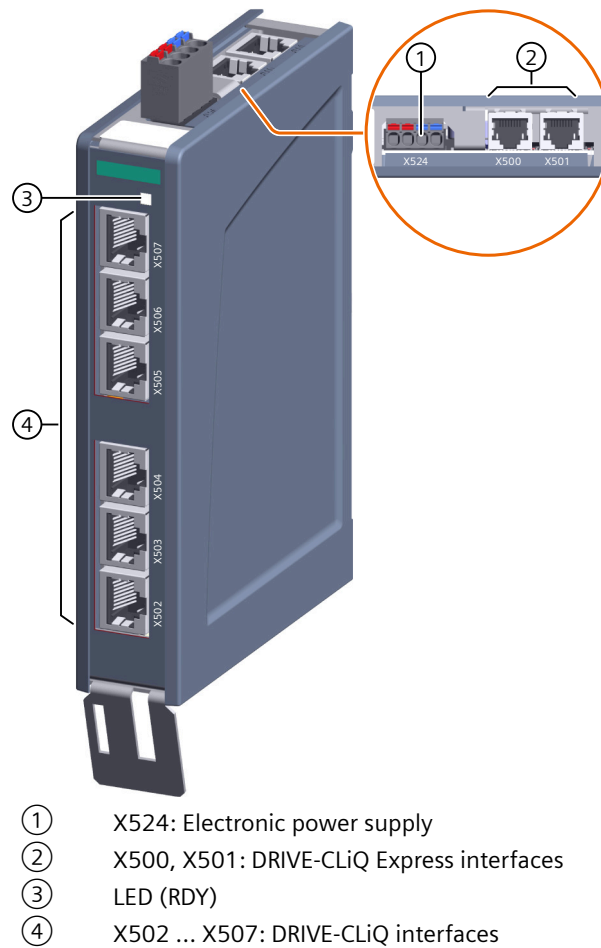


Figure 8-2 Interface overview DRIVE-CLiQ Switch Module DMC20-3

8.2.3.2 X500, X501 DRIVE-CLiQ Express

Requirement

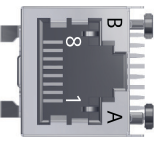
Note

MOTION-CONNECT DRIVE-CLiQ cables are required

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

Description

Table 8-3 X500/X501: DRIVE-CLiQ Express interfaces

Socket	Pin	Designation	Technical specifications
	1	TDA_P	Bidirectional data signal A +
	2	TDA_N	Bidirectional data signal A -
	3	TDB_P	Bidirectional data signal B +
	4	TDC_P	Bidirectional data signal C +
	5	TDC_N	Bidirectional data signal C -
	6	TDB_N	Bidirectional data signal B -
	7	TDD_P	Bidirectional data signal D +
	8	TDD_N	Bidirectional data signal D -
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground

8.2.3.3 X502 ... X507 DRIVE-CLiQ

Requirement

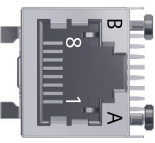
Note

MOTION-CONNECT DRIVE-CLiQ cables are required

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

Description

Table 8-4 X502 ... X507: DRIVE-CLiQ interfaces

Socket	Pin	Designation	Technical specifications
	1	TXP	Send data +
	2	TXN	Send data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground

8.2.3.4 X524 electronic power supply

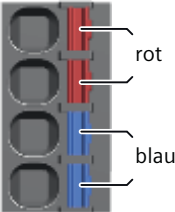
Overview

Power is supplied to the DMC20-3 via the X524 interface.

The connector for this interface is included in the Terminal Kit of the DRIVE-CLiQ Switch Module.

Description

Table 8-5 X524: Electronic power supply of the DMC20-3

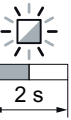
Connector	Terminal	Designation	Technical data
	+	Electronic power supply (24 V)	Voltage: 24 V DC (20.4 ... 28.8 V)
	+	Electronic power supply (24 V)	Current consumption: max. 3.3 A (including DRIVE-CLiQ)
	M	Electronics ground (0 V)	Max. current via jumper in connector: 20 A (15 A according to UL/CSA) The two "+" and "M" terminals are bridged in the connector. This ensures that the supply voltage is looped through.
	M	Electronics ground (0 V)	
Connectable cable cross-sections	Rigid, flexible		0.2 ... 2.5 mm ²
	Flexible, with end sleeve without protective collar		0.25 ... 2.5 mm ²
	Flexible, with end sleeve with protective collar		0.25 ... 1.5 mm ²
	AWG / kcmil		24 ... 12
Stripped length	8 mm (0.31 inch)		

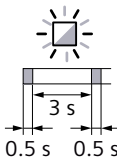
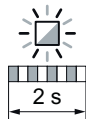
8.2.4 LED

8.2.4.1 Explanation of icons

Response of the LEDs

The following tables explain the LED icons.

Icon	Description
	LED is bright
	LED is OFF
	LED flashes slowly

Icon	Description
	LED flashes in alternating order 3 times quickly - 2 s pause - ...
	LED flashes briefly every 3 s
	LED flashes quickly
	LED flashes with variable frequency

8.2.4.2 LED RDY

Response of the LED in operation

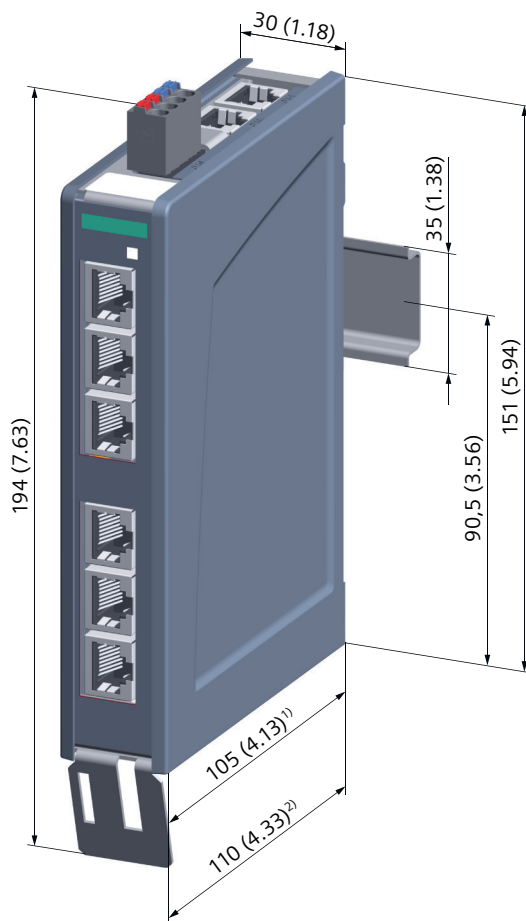
Table 8-6 Signal states of the LED RDY

RDY	Description	Remedy
	The electronic power supply is missing or outside the permissible tolerance.	Check power supply
 Green	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	
 Orange	DRIVE-CLiQ communication is being established.	
 Red	The component signals a fault. The LED is activated irrespective of the corresponding messages being reconfigured.	
 Green - red	Firmware update in progress	

RDY	Description	Remedy
 Green - red	Firmware update completed Waiting for the supply voltage to be switched off and on	Switch the supply voltage of the component off and on
 Green - orange OR  Red - orange	Component recognition is activated. The color of the flashing LED depends on the LED state on activation with the commissioning tool.	

8.2.5 Dimension drawing

Dimension drawing



1) Depth at rear edge without mounting slide

2) Depth at rear edge with mounting slide

Figure 8-3 Dimension drawing DRIVE-CLiQ Switch Module DMC20-3, all data in mm and (inches)

8.2.6 Mounting the DRIVE-CLiQ Switch Module

Overview

The DRIVE-CLiQ Switch Module DMC20-3 is designed for installation in the control cabinet. It is mounted in the control cabinet by snapping it onto a DIN rail.

Requirement

WARNING

Risk of injury as a result of foreign bodies in the device

Parts (e.g.: drilling chips, end sleeves) falling into the device can cause short-circuits and damage the insulation. This can result in severe injury (arcing, loud bang, parts that are flung out).

- Only perform installation and other work when the devices are current-free.
- Cover the ventilation slots when mounting and installing the control cabinet and remove the cover before switching on.

For DRIVE-CLiQ Switch Module DMC20-3, the protection connection is established when it is mounted on a DIN rail. Ensure that the DIN rail is in contact with the correctly grounded control cabinet rear panel through a bare-metal connection.

Components required:

- DIN rail TH 35 according to EN 60715

Procedure

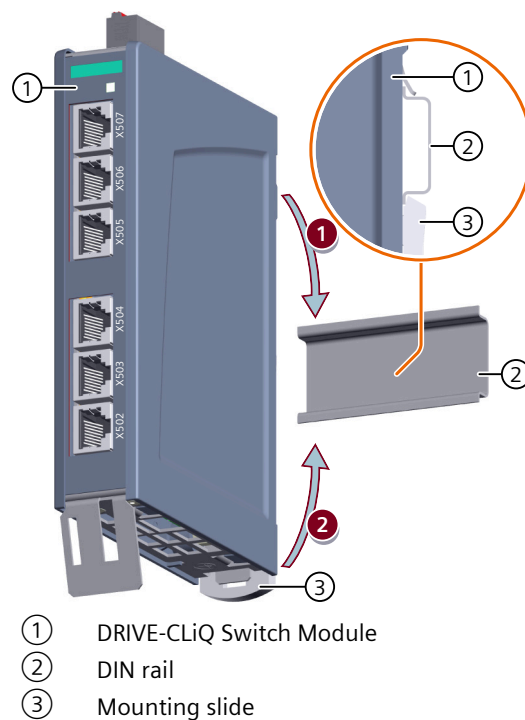


Figure 8-4 Mounting the DRIVE-CLiQ Switch Module DMC20-3

Proceed as follows to mount the DMC20-3:

1. Tilt the component backwards slightly and attach it to the DIN rail using the hooks.
2. Swivel the component onto the DIN rail until you hear the mounting slide at the rear latch into position.
3. Slide the component along the DIN rail to either the left or the right into its final position.

8.2.7 Removing the DRIVE-CLiQ Switch Module

Requirement



WARNING

Risk of injury as a result of foreign bodies in the device

Parts (e.g.: drilling chips, end sleeves) falling into the device can cause short-circuits and damage the insulation. This can result in severe injury (arcing, loud bang, parts that are flung out).

- Only perform installation and other work when the devices are current-free.
- Cover the ventilation slots when mounting and installing the control cabinet and remove the cover before switching on.

Procedure

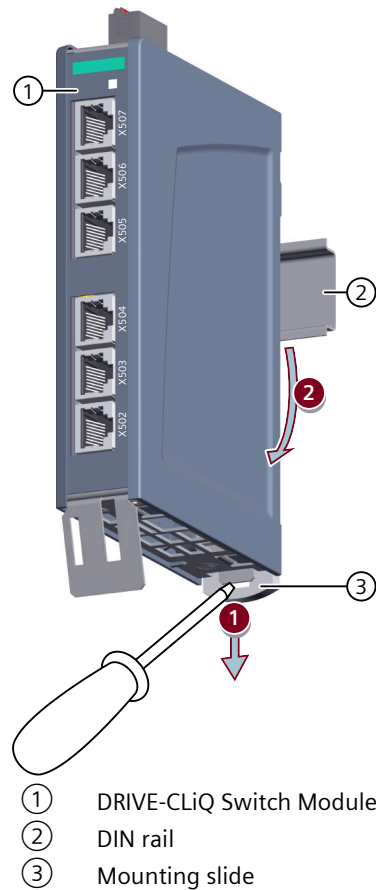


Figure 8-5 Removing the DRIVE-CLiQ Switch Module DMC20-3

Proceed as follows to dismantle the DMC20-3:

1. First shift the mounting slide downwards at the lug to release the interlocking with the DIN rail.
2. Swivel the component to the front and withdraw it upwards from the DIN rail.

8.2.8 Technical specifications

Technical specifications

Table 8-7 Technical specifications DRIVE-CLiQ Switch Module DMC20-3

Feature	Unit	Value
Electronic power supply		
Voltage	V	24 (20.4 ... 28.8)
Current ¹⁾	A	≤ 0.2
Power loss (typ.)	W	≤ 4.5

8.2 DRIVE-CLiQ Switch Module DMC20-3

Feature	Unit	Value
Weight	kg	0.36
Cable lengths	m	See Chapter "Maximum permissible cable lengths (Page 45)"

¹⁾ Without DRIVE-CLiQ

Voltage Sensing Module VSM10

9.1 Description

The Voltage Sensing Module VSM10 is an expansion module for snapping on to a standard mounting rail acc. to EN 60715. It is used to sense the actual value of a voltage. For example, it can be used to sense the three-phase line supply voltage, which is then provided to the closed-loop control. The phase differential voltage can be measured, either grounded (in the delivery state) or isolated.

The Voltage Sensing Module can be used for the following line types:

- Up to 600 V 3-ph. AC for all line types
- Up to 690 V 3-ph. AC for networks with grounded start point and IT networks

A 100 V 3-ph. AC input is available for transducer transformers. Do not use both voltage connections simultaneously.

For booksize units, these components can be optionally used to increase the degree of ruggedness against irregularities in the line supply.

A VSM is already integrated for Active Interface Modules Chassis and Smart Line Modules Chassis.

In addition to the voltage sensing, a temperature sensor can be connector to the VSM10 to thermally monitor the line reactor. Further, the functionality of the line filter can checked using two analog inputs. All data recorded are transferred to the higher-level system via DRIVE-CLiQ.

The Voltage Sensing Module achieves radio interference category C2 with limit classes A1 for interference voltage and A for emitted interference.

Table 9-1 Interface overview of the VSM10

Type	Quantity
Analog inputs	2
Voltage connection (690 V)	1 (3-phase)
Voltage connection (100 V)	1 (3-phase)
Temperature sensor input (KTY / Pt1000 / PTC) ¹⁾	1
Neutral point grounding	1
DRIVE-CLiQ interface	1

¹⁾ Pt1000 sensors cannot be evaluated by Voltage Sensing Modules with Article No. 6SL3053-0AA00-3AA0.

9.2 Safety instructions for the Voltage Sensing Module (VSM10)

NOTICE**Destruction of the VSM10 as a result of incorrectly performed voltage measurements**

If the voltage measurement is carried out incorrectly, the VSM10 can be destroyed as a result of the high voltage stress across the insulating clearance.

- When using long motor cables, it is not permissible that the output voltage of the Motor Module is directly measured at the motor.

NOTICE**Destruction of the VSM10 as a result of a terminal assignment which is not permissible**

The VSM10 has two terminal strips, X521 and X522, to sense the three-phase line supply voltage. A terminal assignment which is not permissible results in the module being destroyed.

- Use just one of the two terminal strips.
- Only connect voltages to terminal strip X521 up to a maximum 100 V (phase-to-phase) via a transformer.
- Only connect voltages to terminal strip X522 up to a maximum 690 V (phase-to-phase) directly.

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

The use of incorrect or unreleased DRIVE-CLiQ cables can cause damage or functional faults to devices or the system.

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

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.

Note**Malfunctions when using various generations of the VSM10 with parallel infeed**

When connecting infeeds in parallel, only Voltage Sensing Modules of the same generation may be used (either 6SL3053-0AA00-3AA0 or 6SL3053-0AA00-3AA1), as otherwise malfunctions can occur.

- Especially when replacing a VSM10 (Page 183) it is important that all of the other VSM10 connected in parallel are replaced.

9.3 Interface description

9.3.1 Overview

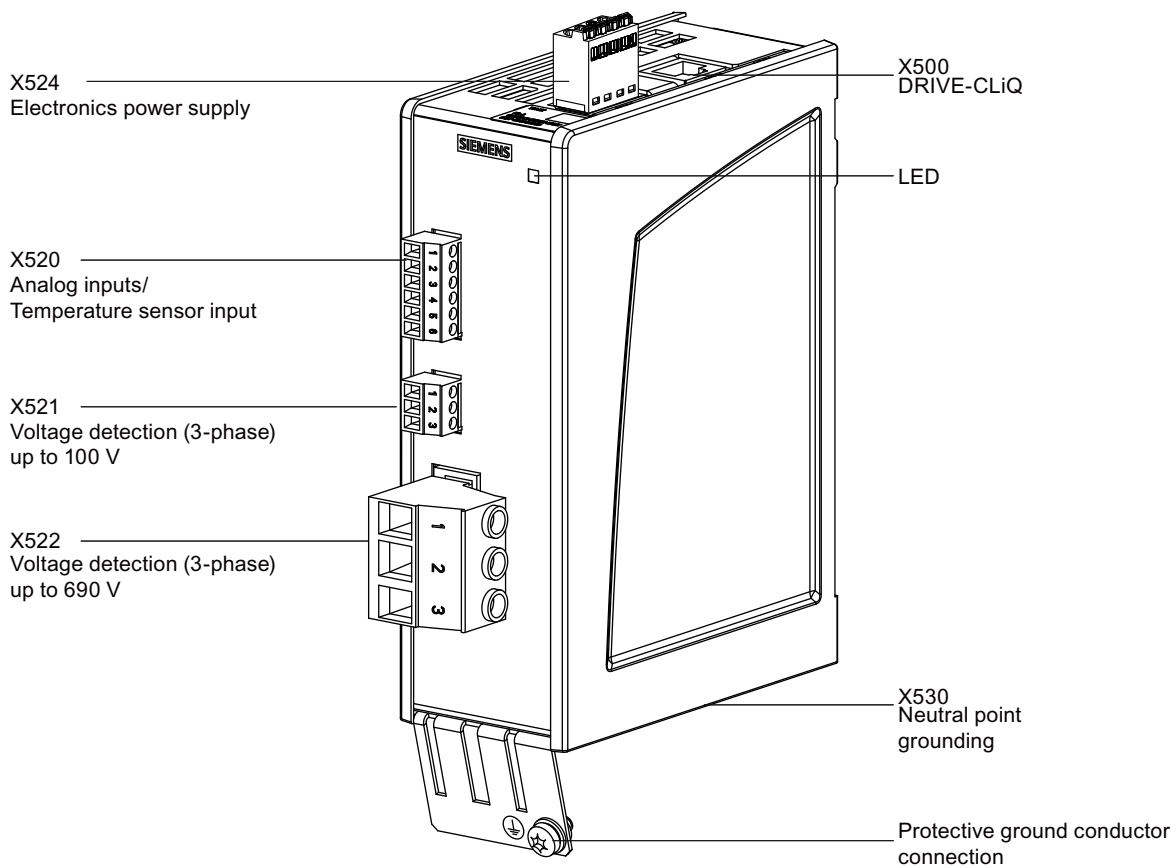


Figure 9-1 Interface overview of the VSM10

9.3 Interface description

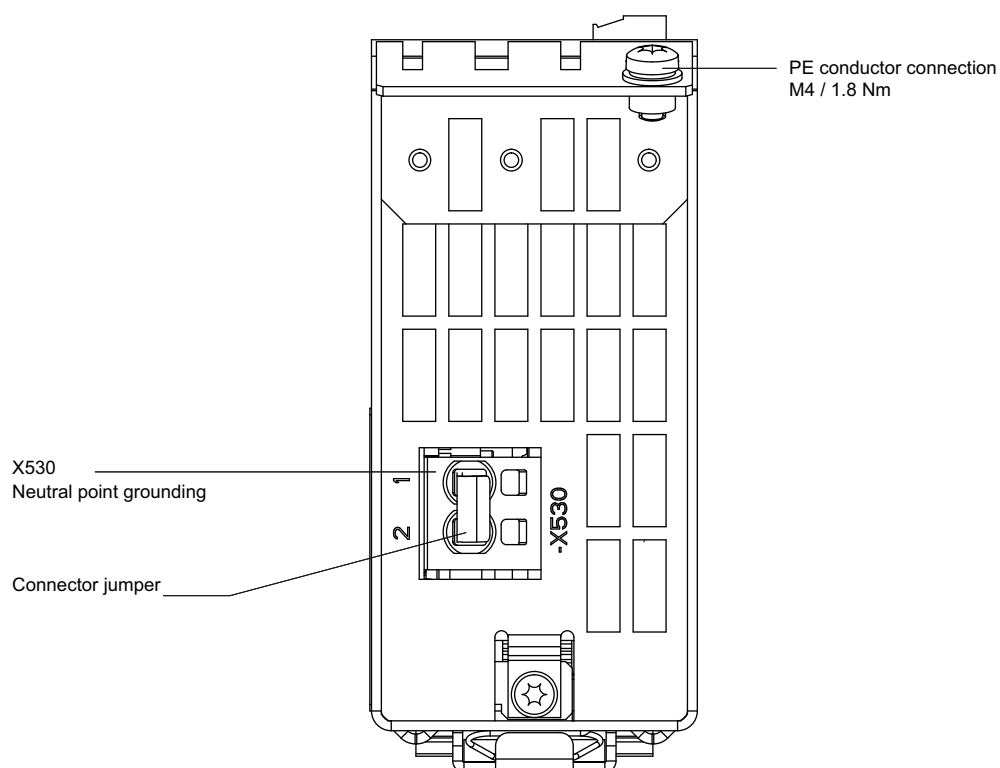
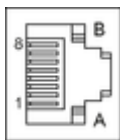


Figure 9-2 X530 interface at the VSM10 (view from below)

9.3.2 X500 DRIVE-CLiQ interface

Table 9-2 X500: DRIVE-CLiQ interface

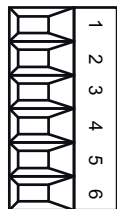
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		

The blanking cover for the DRIVE-CLiQ port is included in the scope of delivery.

Blanking covers (50 x) Article No.: 6SL3066-4CA00-0AA0

9.3.3 X520 analog inputs/temperature sensor

Table 9-3 X520: Analog inputs/temperature sensor

	Terminal	Designation	Technical data
	1	AI 0-	2 analog differential inputs Voltage: -10 ... +10 V; Ri > 100 kΩ Resolution: 12 bits + sign
	2	AI 0+	
	3	AI 1-	
	4	AI 1+	
	5	+ Temp ¹⁾	Pt1000 / KTY84-130 / PTC temperature sensor Measuring current via temperature sensor connection: 2 mA
	6	- Temp ¹⁾	
Type: Screw terminal 1 (Page 47)			

¹⁾ Accuracy of the temperature measurement (temperature sensor, including evaluation):

- Pt1000: $\pm 5\text{ }^\circ\text{C}$ (Pt1000 tolerance class B acc. to EN 60751)
- KTY: $\pm 7\text{ }^\circ\text{C}$
- PTC: $\pm 5\text{ }^\circ\text{C}$

Note

Permissible voltage values

The common mode range must not be violated in order to avoid incorrect analog-digital conversion results. The following voltages are permissible:

- Input voltage: $\pm 30\text{ V}$ (destruction limit)
- Common mode voltage: $\pm 10\text{ V}$ with respect to ground potential (increased errors when exceeded)

NOTICE

Damage to the motor due to incorrectly connected KTY temperature sensor

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

- Connect a KTY temperature sensor with the correct polarity.

Note

In order to minimize noise emission, shielded cables should be used.

Note

The maximum cable length for a shielded cable applied on both sides to the temperature sensor and to the analog inputs is 30 m.


! WARNING
Electric shock when the motor temperature sensor insulation fails

When connecting temperature sensors, which have no safe protective separation with respect to the motor power circuit, then arcing to the signal electronics can occur.

- Use motors whose temperature sensors have safe electrical separation.
- Use only connecting cables and connectors with safe electrical separation between the wires of the temperature sensor and the wires of the power circuit.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

9.3.4 X521 three-phase voltage sensing up to 100 V 3-ph. AC

Table 9-4 X521: Voltage sensing 100 V

	Terminal	Designation	Technical data
	1	Phase voltage U	Connection to the voltage sensing for medium-voltage networks via a safe electrically isolated transformer Resistance to neutral point: ~500 kΩ Insulation resistance, neutral point - ground when the jumper is not inserted: >10 MΩ
	2	Phase voltage V	
	3	Phase voltage W	
Type: Screw terminal 1 (Page 47)			

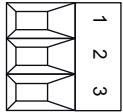
NOTICE
Damage to the VSM10 as a result of an impermissible terminal assignment

The VSM10 has two terminal strips, X521 and X522, to sense the three-phase line supply voltage. A terminal assignment which is not permissible results in the module being damaged.

- Use just one of the two terminal strips.
- Only connect voltages to terminal strip X521 up to a maximum 100 V (phase-to-phase) via a transformer.
- Only connect voltages to terminal strip X522 up to a maximum 690 V (phase-to-phase) directly.

9.3.5 X522 three-phase voltage sensing up to 690 V 3-ph. AC

Table 9-5 X522: Voltage sensing 690 V

	Terminal	Designation	Technical data
	1	Phase voltage U	Directly connected to the line voltage sensing
	2	Phase voltage V	Resistance to neutral point: ~3500 kΩ
	3	Phase voltage W	Insulation resistance, neutral point - ground when the jumper is not inserted: >10 MΩ
Type: Screw terminal 5 (Page 47)			

NOTICE

Damage to the VSM10 as a result of an impermissible terminal assignment

The VSM10 has two terminal strips, X521 and X522, to sense the three-phase line supply voltage. A terminal assignment which is not permissible results in the module being damaged.

- Use just one of the two terminal strips.
- Only connect voltages to terminal strip X521 up to a maximum 100 V (phase-to-phase) via a transformer.
- Only connect voltages to terminal strip X522 up to a maximum 690 V (phase-to-phase) directly.

NOTICE

Damage to the VSM10 through overcurrent with an incorrect connection sequence

Enabling the Line Module with an incorrect connection sequence results in overcurrents.

- Connect the line phases to the VSM10 in the same sequence as the one to the Line Module.

Note

Line voltage tap

If the configuration has a line filter, then the phase voltages for the VSM (X522) must be taken from in front of the line filter. If the configuration does not have a line filter, then X522 must be connected to the line side of the line reactor (voltages are taken from in front of the line reactor).

9.3.6 X524 Electronics power supply

Table 9-6 X524: Electronics power supply

	Terminal	Designation	Technical data
	+	Electronics power supply (24 V)	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: max. 0.2 A Max. current via the jumper in the connector: 20 A (15 A according to UL/CSA)
	+	Electronics power supply (24 V)	
	M	Electronics ground (0 V)	
	M	Electronics ground (0 V)	
Type: Spring-loaded terminal 6 (Page 46)			

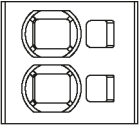
The maximum cable length is 30 m.

Note

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

9.3.7 X530 neutral point grounding

Table 9-7 X530: Neutral point grounding

	Terminal	Designation	Technical data
	1	Neutral point of the voltage sensing	Jumper inserted: Grounded measurement
	2	Ground potential	Jumper not inserted: isolated measurement
Type: Spring-loaded terminal 5 (Page 46)			

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

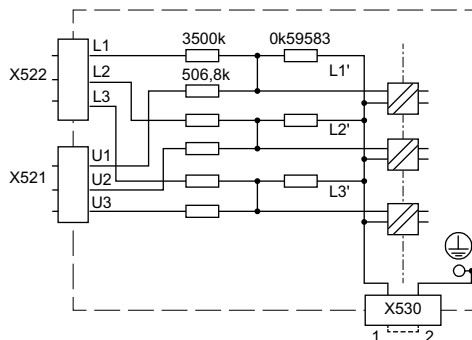
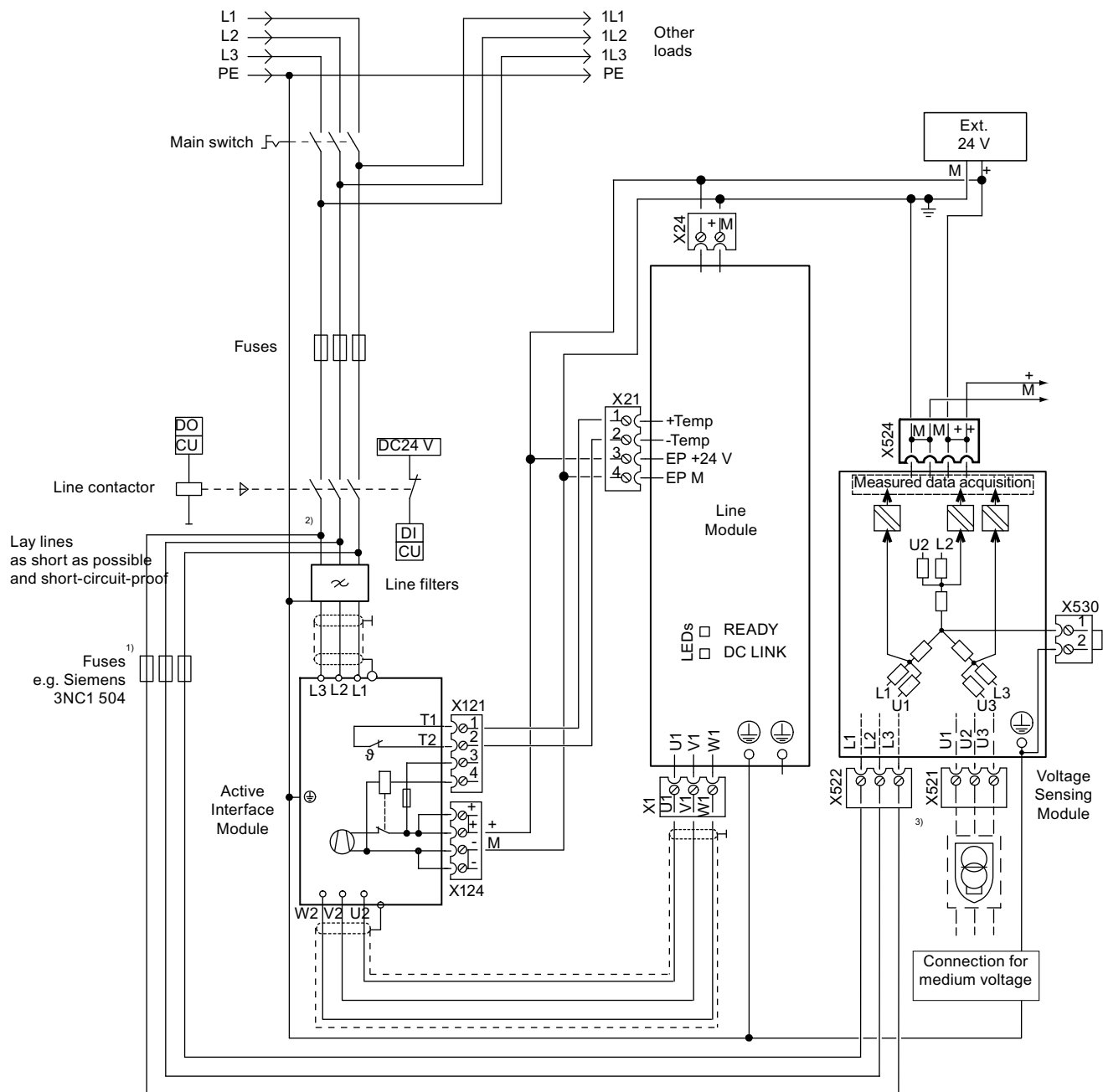


Figure 9-3 Internal circuit of the Voltage Sensing Module VSM10

9.4 Connection example



- ¹⁾ It is only possible to omit the fuses if the cables to the Voltage Sensing Module are routed so that no short-circuit or ground fault can be expected under normal operating conditions (short-circuit proof routing).
- ²⁾ Tap the line voltage as actual value for the Voltage Sensing Module VSM10 corresponding to the system design, for example refer to the table.
- ³⁾ Use either terminal X521 or terminal X522.

Figure 9-4 Connection example for the VSM10 to measure the line voltage

9.5 Meaning of the LED

Table 9-8 Suggestions for terminals and cable lugs which can be used for tapping line voltage for the VSM10

Conductor cross-section	Connection via	For components
Up to 6 mm ²	Direct connection possible	Smart Line Modules 5 kW and 10 kW
6 mm ² to 16 mm ²	ST16-TWIN terminal blocks, if required with a reducing jumper and ST4-TWIN or ST2.5-TWIN (Phoenix Contact company)	Active Line Modules 16 kW Smart Line Modules 16 kW Active Interface Module 16 kW
16 mm ² to 50 mm ²	AGK10 UKH tap-off terminals with UKH terminals (Phoenix Contact)	Active Line Modules 36 kW and 55 kW Smart Line Modules 36 kW and 55 kW Active Interface Module 36 kW and 55 kW
> 50 mm ²	Ring cable lug without insulation 8 mm/2.5 mm ²	Components with M8 connection bolts Active Line Modules 55 kW, 80 kW, and 120 kW Active Interface Module 80 kW and 120 kW
	Intermediate high-current connector, type UHV (Phoenix Contact) and ring cable lug without insulation 8 mm/2.5 mm ²	

9.5 Meaning of the LED

Table 9-9 Meanings of the LEDs on the Voltage Sensing Module VSM10

LED	Color	Status	Description, cause	Remedy
READY	–	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	This component has at least one fault. Note: LED is controlled irrespective of the corresponding messages being reconfigured.	Remove and acknowledge the fault.
	Green/red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
		Flashing light 2 Hz	Firmware download is complete. The system waits for POWER ON.	Carry out a POWER ON.
	Green/orange or Red/orange	Flashing light 2 Hz	Detection of the component via LED is activated (p0144 = 1). Note: Whether the LED flashes green/orange or red/orange depends on the status the LED had during activation (setting of parameter p0144 to "1").	–

Cause and rectification of faults

Further information about the cause and rectification of faults is available in the SINAMICS S120 Function Manual "Drive Functions".

9.6 Dimension drawing

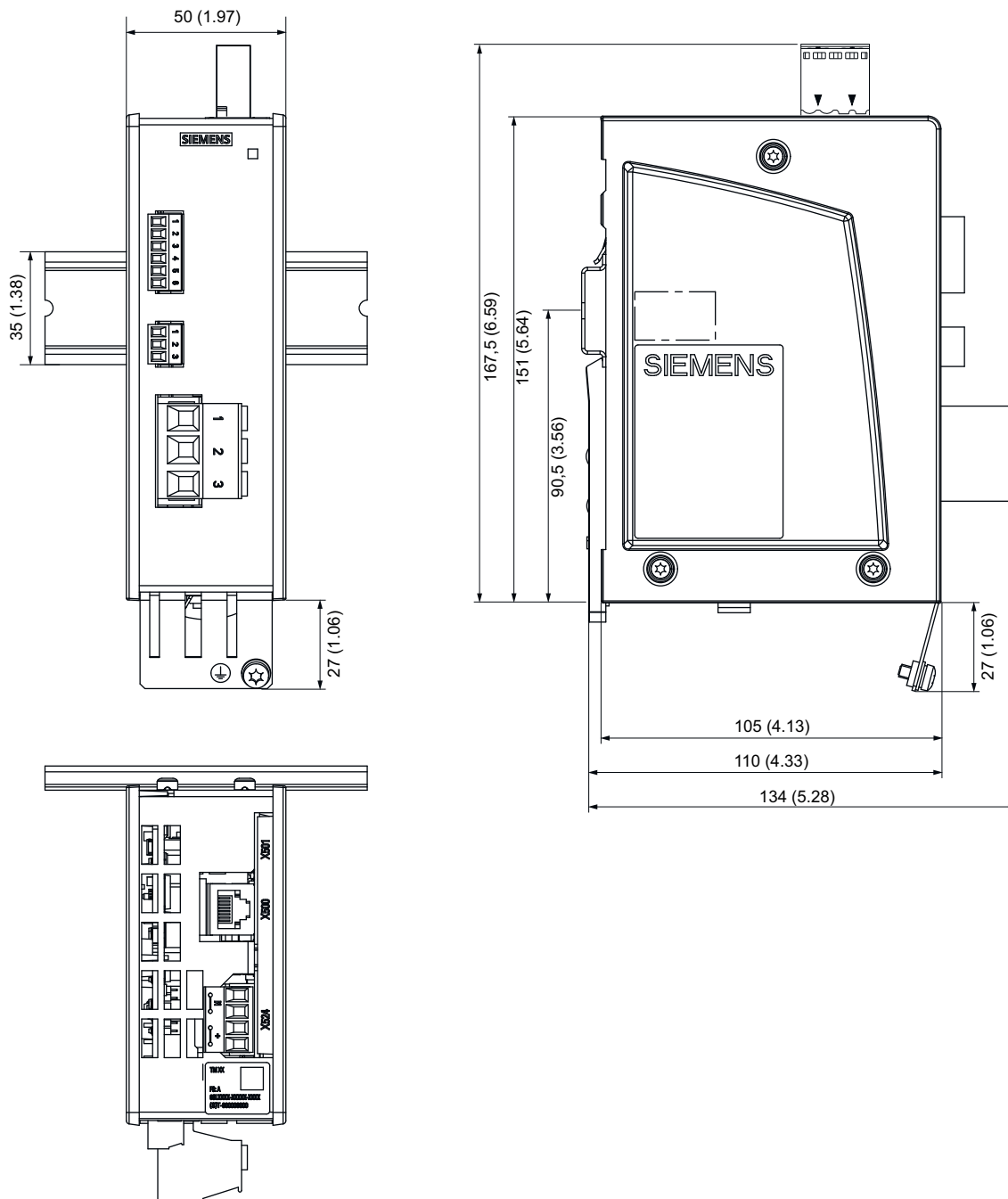


Figure 9-5 Dimension drawing of the Voltage Sensing Module VSM10, all data in mm and (inches)

9.7 Installation

Installation

1. Tilt the component backwards slightly and attach it to the DIN rail using the hooks.
2. Swivel the component onto the DIN rail until you hear the mounting slide at the rear latch into position.
3. Slide the component along the mounting rail to either the left or the right into its final position.

Removal

1. First shift the mounting slide downwards at the lug to release the interlocking with the mounting rail.
2. Swivel the component to the front and withdraw it upwards from the DIN rail.

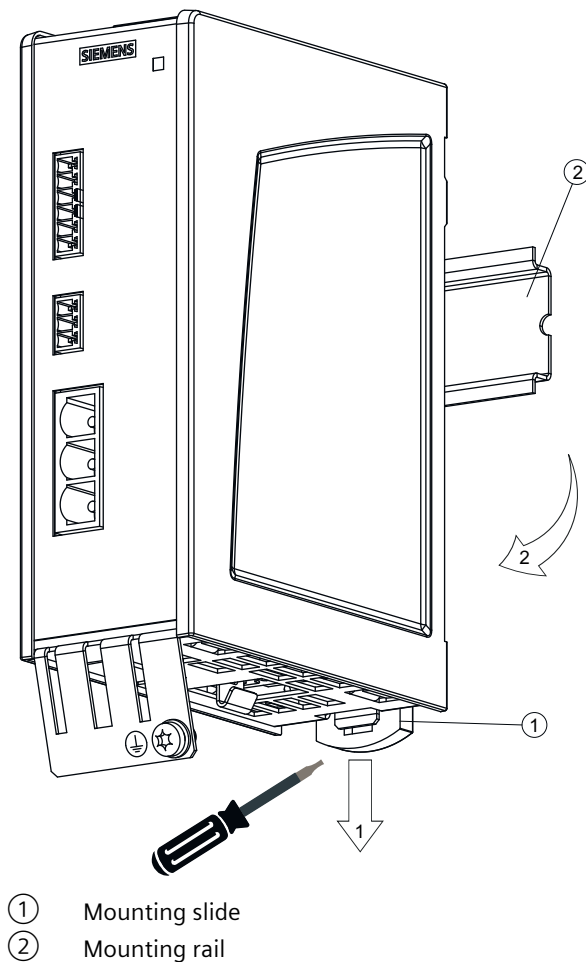


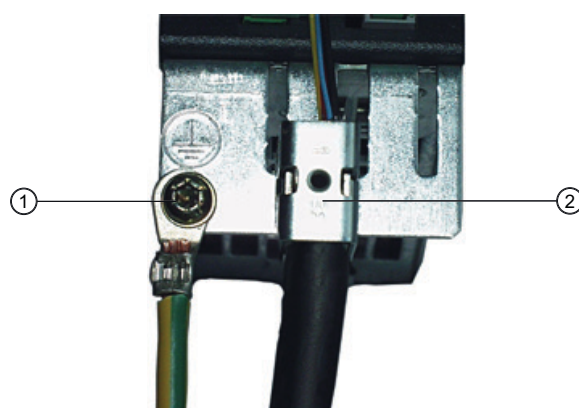
Figure 9-6 Removing from a DIN mounting rail

9.8 Protective conductor connection and shield support

The following shield connection clamps can be used on the bottom part of the component housing for shield connection of the analog inputs:

Shield connection clamp		Article No.
Phoenix Contact	SK8	3025163
Phoenix Contact	SK14	3025176
Phoenix Contact	SK20	3025189
Weidmüller	KLBUE CO1	1753311001

The following pictures show the shield contacts with a shield connection clamp from Weidmüller.



- ① Protective conductor connection M4 / 1.8 Nm (15.9 lbf in)
- ② Shield connection terminal, Weidmüller company, type: KLBUE CO1, Article number: 1753311001

Figure 9-7 Protective conductor connection and shield support at the VSM10

NOTICE

Damage or faulty operation due to incorrect shielding or inadmissible cable lengths

If the correct shielding procedures or the permissible cable lengths are not observed, it can cause damage or the machine may malfunction.

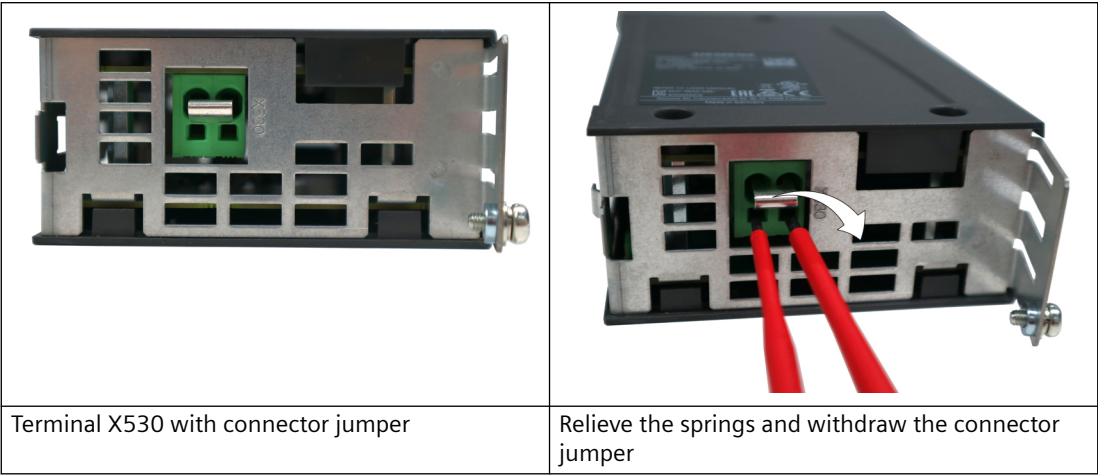
- Only use shielded cables.
- Do not exceed the cable lengths stated in the technical data.

9.9 Operation on an isolated-neutral system (IT system)

When using a Voltage Sensing Module on an insulated line supply (IT system), remove the connector jumper in terminal X530 from the under side of the component.

9.10 Technical data

Use 2 screwdrivers or another suitable tool in order to relieve the strain on the holding springs in the terminal, and then withdraw the connector jumper.



**WARNING**

Electric shock when the connector jumper is removed

As a result of the capacitors, a hazardous voltage is present at the X530 connector jumper for several minutes after the power supply has been switched off.

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

- Wait for the discharge time specified on the warning label of the component to elapse before you remove the connector jumper.

9.10 Technical data

Table 9-10 Technical data

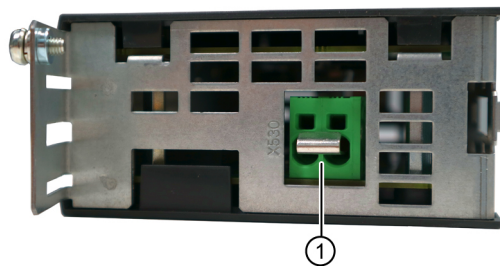
6SL3053-0AA00-3AA1	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 (20.4 ... 28.8)
Current (without DRIVE-CLiQ)	A_{DC}	≤ 0.2
Power loss	W	≤ 4
Maximum cable length	m	30
Protective ground conductor connection	On the housing with M4 screw	
Ventilation clearances, above/below	mm	50
Weight	kg	1

9.11 Service and maintenance

Replacing the Voltage Sensing Module VSM10 in Smart Line Modules Chassis and Active Interface Modules Chassis

When replacing a Voltage Sensing Module VSM10 in an Active Interface Module Chassis or Smart Line Module Chassis, observe the following application cases:

1. Replacing a VSM10 with article number 6SL3053-0AA00-3AA0 by a VSM10 with article number 6SL3053-0AA00-3AA1:
It is NOT permissible that the connector jumper ① at terminal X530 at the lower side of the VSM10 is removed!



2. Replacing a VSM10 with article number 6SL3053-0AA00-3AA1 by a VSM10 with article number 6SL3053-0AA00-3AA1:
Proceed with the connector jumper ① at terminal X530 of the new VSM10 (spare part) just the same as at the previously installed VSM10.



⚠ WARNING

Electric shock due to incorrect replacement of spare parts

If you remove the connector jumper at terminal X530 when replacing a VSM10 with article number 6SL3053-0AA00-3AA0 by a VSM10 with article number 6SL3053-0AA00-3AA1, then a hazardous voltage is present in the Active Interface Module Chassis or Smart Line Module Chassis. Touching live components can result in death or severe injury.

- When replacing the VSM10 proceed as specified above.

Encoder system connection

10.1 Introduction

The encoder system is preferably connected via DRIVE-CLiQ.

Motors with DRIVE-CLiQ interfaces (e.g. synchronous motors 1FK7 and 1FT7, and induction motors 1PH7 and 1PH8) are designed for this purpose. These motors simplify commissioning and diagnostics because the motor and encoder type are identified automatically.

Motors and external encoders without DRIVE-CLiQ interface

Motors without DRIVE-CLiQ interfaces, as well as external encoders without integrated DRIVE-CLiQ interface, must be connected via Sensor Modules to enable the encoder and temperature signals to be evaluated. Sensor Modules Cabinet-Mounted (SMC) are available for installation in control cabinets and Sensor Modules External (SME) for installation outside control cabinets.

If not otherwise specified, only one encoder system can be connected to each Sensor Module.

Motors and external encoders with DRIVE-CLiQ interface

Motors with DRIVE-CLiQ interfaces can be connected to the associated Motor Module directly via the MOTION-CONNECT DRIVE-CLiQ cables available. The connection of the MOTION-CONNECT DRIVE-CLiQ cable at the motor has degree of protection IP67.

The DRIVE-CLiQ interface supplies the motor encoder via the integrated 24 V DC supply and transfers the motor encoder and temperature signals and the electronic rating plate data, such as a unique identification number, rated data (voltage, current, torque) directly to the Control Unit. Different encoder cables are therefore no longer required for the various encoder types, e.g. resolvers or absolute encoders. Wiring can be effected throughout with a MOTION-CONNECT DRIVE-CLiQ cable.

DRIVE-CLiQ encoder

A DRIVE-CLiQ encoder is an absolute encoder with integrated DRIVE-CLiQ interface (see Chapter DRIVE-CLiQ encoder (Page 267)).

10.2 Overview of Sensor Modules

Sensor Modules Cabinet-Mounted (SMC)

Sensor Modules Cabinet-Mounted SMC10, SMC20, SMC30 and SMC40 can be ordered and configured separately. They are used when a motor with a DRIVE-CLiQ interface is not available or when external encoders in addition to the motor encoder are required. Only one encoder system may be connected to the Sensor Modules Cabinet-Mounted SMC10, SMC20 and SMC30. The SMC40 supports two encoder systems. The Sensor Modules Cabinet-Mounted evaluate these measuring systems and convert the calculated values to DRIVE-CLiQ. Motor or encoder data are not saved.

Note

The Sensor Module Cabinet-Mounted supplies the power to the encoder; however, the Sensor Module Cabinet-Mounted must be provided separately with 24 V DC.

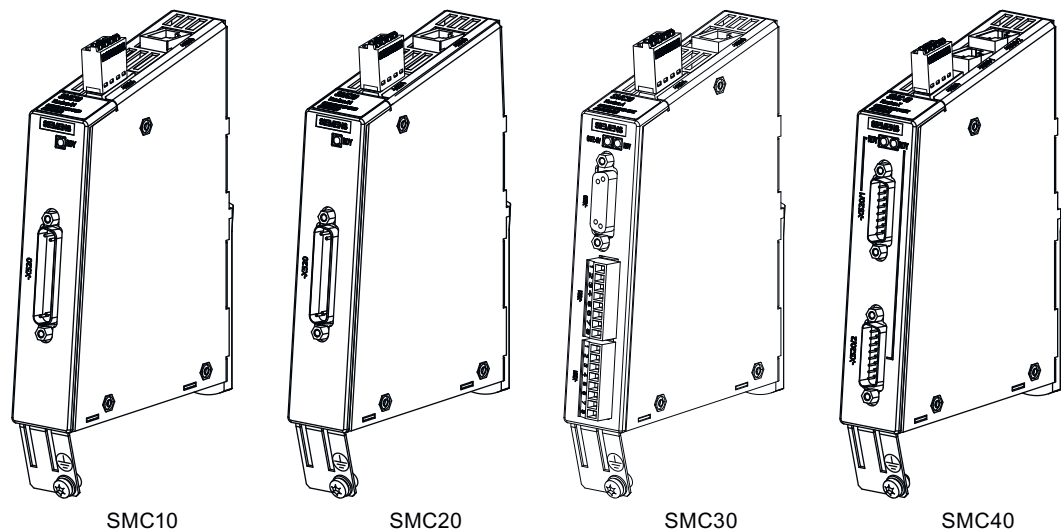


Figure 10-1 Overview of Sensor Modules Cabinet-Mounted (SMC)

Sensor Modules External (SME)

The Sensor Modules External SME20, SME25, SME120, and SME125 are only intended for use on machines (in North America, in accordance with the NFPA 79 "Electrical Standard for Industrial Machinery"). It is not permissible to connect DRIVE-CLiQ interfaces to other networks, e.g. Ethernet, but only to the DRIVE-CLiQ interfaces of the components.

Direct encoder systems outside the cabinet can be connected to the Sensor Modules External. The Sensor Modules External evaluate these encoder systems and convert the

calculated values to DRIVE-CLiQ. No motor or encoder data is stored in the Sensor Modules External.

Note

The Sensor Module External provides the encoder power supply. The power supply for the Sensor Module External is provided from the connected DRIVE-CLiQ cable. This fact must be taken into consideration when the DRIVE-CLiQ cable is selected.

The Sensor Modules External have a higher degree of protection (IP67) and are therefore suitable for installation outside the cabinet.

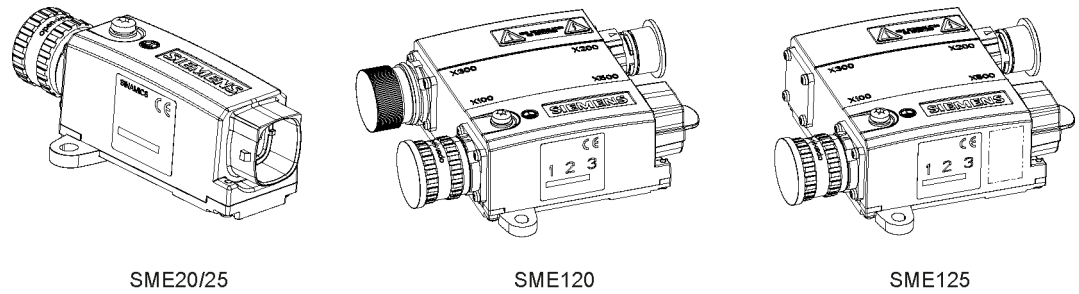


Figure 10-2 Overview of Sensor Modules External (SME)

Connectable encoder systems

Table 10-1 Overview of the connectable encoder systems

	SMC				SME			
Encoder systems	SMC10	SMC20	SMC30	SMC40	SME20	SME25	SME120	SME125
Resolver	Yes	-	-	-	-	-	-	-
Incremental encoder sin/cos (1 Vpp) with/without reference signal	-	Yes	-	-	Yes	-	Yes	-
Incremental encoder TTL / HTL	-	-	Yes	-	-	-	-	-
EnDat 2.1 absolute encoder	-	Yes	-	-	-	Yes	-	Yes
EnDat 2.2 absolute encoder with order designation EnDat01 or EnDat02	-	Yes	-	-	-	Yes	-	Yes
EnDat 2.2 absolute encoder with order designation EnDat22	-	-	-	Yes	-	-	-	-

10.3 Safety instructions for Sensor Modules and encoders

Encoder systems	SMC				SME			
	SMC10	SMC20	SMC30	SMC40	SME20	SME25	SME120	SME125
Absolute encoder SSI	-	Yes ¹⁾	Yes ²⁾	-	-	Yes ¹⁾	-	Yes ¹⁾
Temperature evaluation	Yes	Yes	Yes	-	Yes ³⁾	-	Yes (protective electrical separation)	Yes (protective electrical separation)

¹⁾ Only possible for SSI encoders with a 5 V supply

²⁾ Possible for SSI encoders with a 5 V or 24 V supply

³⁾ With specified 6FX8002-2CA88 adapter cable

10.3 Safety instructions for Sensor Modules and encoders

NOTICE

Devices damaged by disconnecting/connecting encoder lines during operation

Disconnecting or connecting plug-in connections during operation can damage devices or cause malfunctions.

- Only disconnect or connect the encoder cables to Siemens motors in a voltage-free state if hot-plugging has not been specifically released. When using direct measuring systems (third-party encoders), ask the manufacturer whether it is permissible to disconnect/connect under voltage.

NOTICE

Damage when connecting an impermissible number of encoder systems

If more than the maximum permissible number of encoder systems are connected to a Sensor Module, this will cause damage.

- At a Sensor Module only connect the maximum permissible number of encoder systems.
 - Sensor Modules SMC10, SMC20 and SMC30: Single-encoder system
 - Sensor Module SMC40: Two-encoder systems
 - Sensor Modules SMEx: Single-encoder system

Note

Encoder failures due to encoder signal disturbances

Unfavorable material combinations generate static electricity between the belt pulley and the belt. This electrostatic charge (several kV) can discharge via the motor shaft and the encoder, which results in disturbance of the encoder signals (encoder error).

- Use an antistatic version of the belt (special conductive polyurethane mixture).

Note**Diminished level of interference immunity due to equalizing currents via the electronics ground**

Ensure that there are no electrical connections between the encoder system housing and the signal cables, or the encoder system electronics.

If this is not carefully observed, under certain circumstances the system will not be able to reach the required interference immunity level (there is then a danger of equalization currents flowing through the electronics ground).

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

The use of incorrect or unreleased DRIVE-CLiQ cables can cause damage or functional faults to devices or the system.

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

Note**Function equipotential bonding for distributed DRIVE-CLiQ nodes**

Integrate all of the components that are connected via DRIVE-CLiQ in the functional equipotential bonding concept. You make the connection by mounting on bare metallic machine and plant units that are all connected to one another.

Alternatively, you can establish equipotential bonding with a conductor (min. 6 mm²), which is routed as far as possible in parallel to the DRIVE-CLiQ cable. This involves all distributed DRIVE-CLiQ nodes, e.g. DME20, SME20, SME25, SME120, SME125.

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.

10.4 Sensor Module Cabinet-Mounted SMC10

10.4.1 Description

The Sensor Module Cabinet-Mounted SMC10 is an expansion module for snapping on to a standard mounting rail acc. to EN 60715. It evaluates encoder signals and transmits the speed, actual position value, rotor position and, if necessary, the motor temperature via DRIVE-CLiQ to the Control Unit.

The SMC10 is used to evaluate sensor signals from resolvers.

10.4.2 Interface description

10.4.2.1 Overview

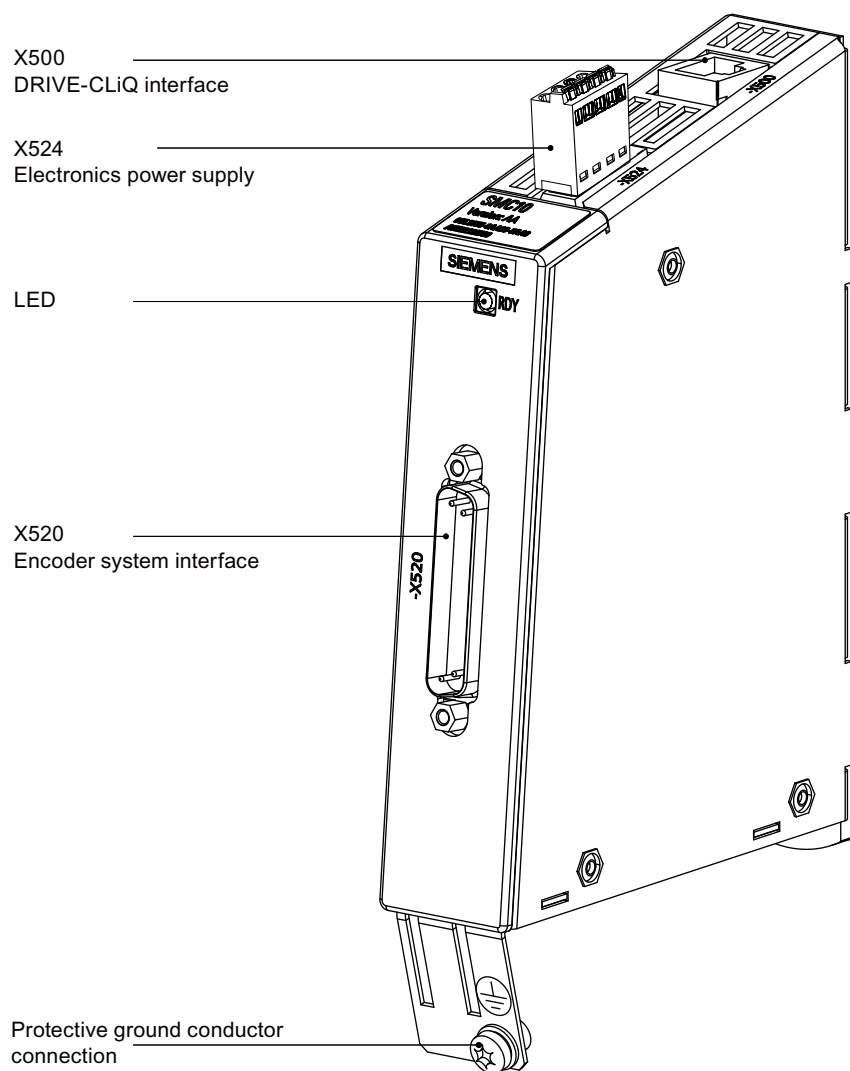
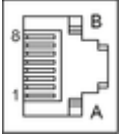


Figure 10-3 Interface overview for the SMC10

10.4.2.2 X500 DRIVE-CLiQ interface

Table 10-2 X500: DRIVE-CLiQ interface

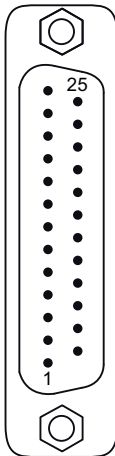
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	Reserved, do not use	-
	B	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		

The blanking cover for the DRIVE-CLiQ port is included in the scope of delivery.

Blanking covers (50 x) Article No.: 6SL3066-4CA00-0AA0

10.4.2.3 X520 encoder system interface

Table 10-3 X520: Encoder system interface

	Pin	Signal name	Technical data
	1	Reserved, do not use	-
	2	Reserved, do not use	-
	3	S2	Resolver signal A (sin+)
	4	S4	Inverted resolver signal A (sin-)
	5	Ground	Ground (for internal shield)
	6	S1	Resolver signal B (cos+)
	7	S3	Inverted resolver signal B (cos-)
	8	Ground	Ground (for internal shield)
	9	R1	Resolver excitation positive
	10	Reserved, do not use	-
	11	R2	Resolver excitation negative
	12	Reserved, do not use	-
	13	+ Temp ¹⁾	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact
	14	Reserved, do not use	-
	15	Reserved, do not use	-
	16	Reserved, do not use	-
	17	Reserved, do not use	-
	18	Reserved, do not use	-
	19	Reserved, do not use	-
	20	Reserved, do not use	-
	21	Reserved, do not use	-
	22	Reserved, do not use	-
	23	Reserved, do not use	-
	24	Ground	Ground (for internal shield)
	25	- Temp ¹⁾	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact
Connector type:	25-pin SUB D connector		
Measuring current via temperature sensor connection: 2 mA			

¹⁾ Accuracy of the temperature measurement (temperature sensor, including evaluation):

- Pt1000: ± 5 °C (Pt1000 tolerance class B acc. to EN 60751)
- KTY: ± 7 °C
- PTC: ± 5 °C

NOTICE**Damage to the motor due to incorrectly connected KTY temperature sensor**

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

- Connect a KTY temperature sensor with the correct polarity.

Information for assigning parameters to the KTY temperature sensor can be found in the SINAMICS S120 Function Manual "Drive Functions" in the Chapter "Monitoring and protection functions/thermal motor protection".



! WARNING

Electric shock when the motor temperature sensor insulation fails

When connecting temperature sensors, which have no safe protective separation with respect to the motor power circuit, then arcing to the signal electronics can occur.

- Use motors whose temperature sensors have safe electrical separation.
- Use only connecting cables and connectors with safe electrical separation between the wires of the temperature sensor and the wires of the power circuit.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

10.4.2.4 X524 Electronics power supply

Table 10-4 X524: Electronics power supply

	Terminal	Function	Technical data
	+	Electronics power supply (24 V)	Voltage: 24 V DC (20.4 ... 28.8 V)
	+	Electronics power supply (24 V)	Current consumption: max. 0.35 A (with encoder system)
	M	Electronics ground (0 V)	Max. current via jumper in connector: 20 A (15 A according to UL/CSA)
	M	Electronics ground (0 V)	

Type: Spring-loaded terminal 6 (Page 46)

The maximum cable length is 30 m.

Note

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

10.4.3 Connection example

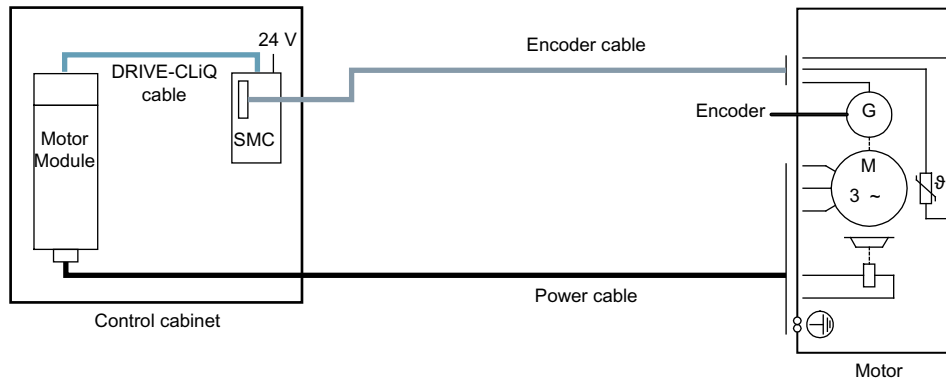


Figure 10-4 Connection of an encoder system via a Sensor Module Cabinet-Mounted (SMC) for a motor without a DRIVE-CLiQ interface

10.4.4 Meaning of the LED

Table 10-5 Meaning of the LEDs on the Sensor Module Cabinet-Mounted SMC10

LED	Color	Status	Description, cause	Remedy
RDY READY	-	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	This component has at least one fault. Note: The LED is activated irrespective of whether the corresponding messages have been reconfigured.	Remove and acknowledge the fault.
	Green/red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
		Flashing light 2 Hz	Firmware download is complete. The system waits for POWER ON.	Carry out a POWER ON.
	Green/orange or Red/orange	Flashing light 2 Hz	Component recognition via LED is activated (p0144=1). Note: Whether the LED flashes green/orange or red/orange depends on the status the LED had during activation (setting of parameter p0144 to "1").	–

10.4.5 Dimension drawing

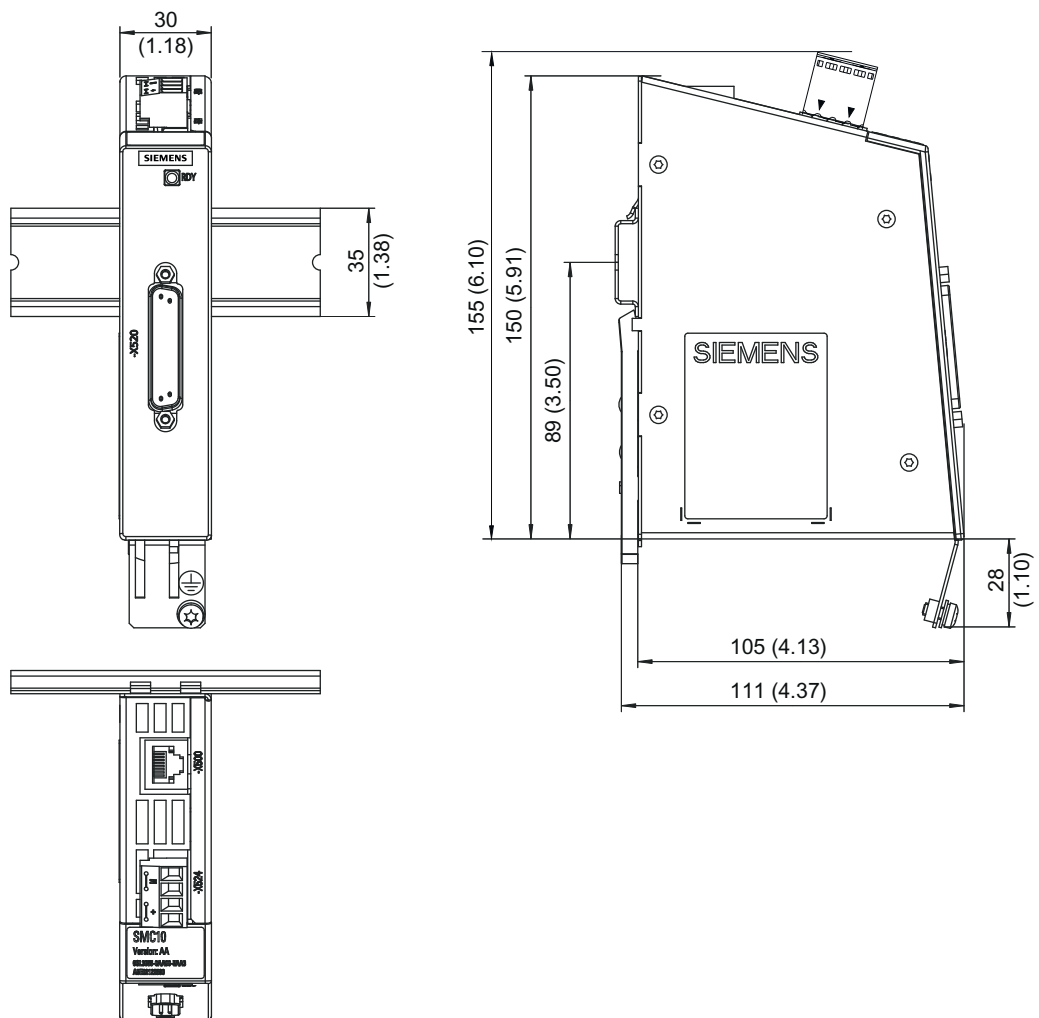


Figure 10-5 Dimension drawing of the Sensor Module Cabinet SMC10, all dimensions in mm and (inches)

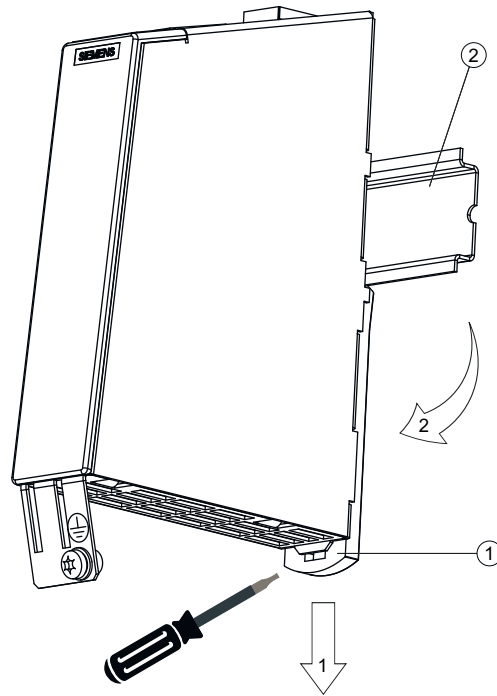
10.4.6 Mounting

Installation

1. Tilt the component backwards slightly and attach it to the DIN rail using the hooks.
2. Swivel the component onto the DIN rail until you hear the mounting slide at the rear latch into position.
3. Slide the components along the mounting rail to either the left or right up to their final position.

Removal

1. First shift the mounting slide downwards at the lug to release the interlocking with the mounting rail.
2. Swivel the component to the front and withdraw it upwards from the DIN rail.



① Mounting slide

② Mounting rail

Figure 10-6 Removing from a DIN mounting rail

10.4.7 Technical specifications

Table 10-6 Technical specifications

6SL3055-0AA00-5AA.	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 (20.4 ... 28.8)
Current (without encoder system)	A_{DC}	≤ 0.2
Power loss	W	≤ 4
Max. cable length	m	30
Specification		
Transformation ratio of the resolver ($\ddot{u}$)	V_{rms}	0.5
Excitation voltage on the SMC10 when $\ddot{u}=0.5$	V_{rms}	4.1
Amplitude monitoring threshold (secondary tracks) of the SMC10	V_{rms}	0.76
Excitation voltage (cannot be parameterized)	V_{rms}	4.1
Excitation frequency (synchronized to the current controller clock cycle)	kHz	5 to 16
Protective ground conductor connection	At the housing with M4 screw	
Max. encoder cable length	m	130
Ventilation clearances, above/below	mm	50
Weight	kg	0.41

Table 10-7 Max. frequency that can be evaluated (speed)

Resolver		Max. speed resolver / motor		
Number of poles	Number of pole pairs	8 kHz / 125 μs	4 kHz / 250 μs	2 kHz / 500 μs
2-pole	1	120000 rpm	60000 rpm	30000 rpm
4-pole	2	60000 rpm	30000 rpm	15000 rpm
6-pole	3	40000 rpm	20000 rpm	10000 rpm
8-pole	4	30000 rpm	15000 rpm	7500 rpm

The ratio between the ohmic resistance R and the inductance L (the primary winding of the resolver) determines whether the resolver can be evaluated with the SMC10. See the following diagram:

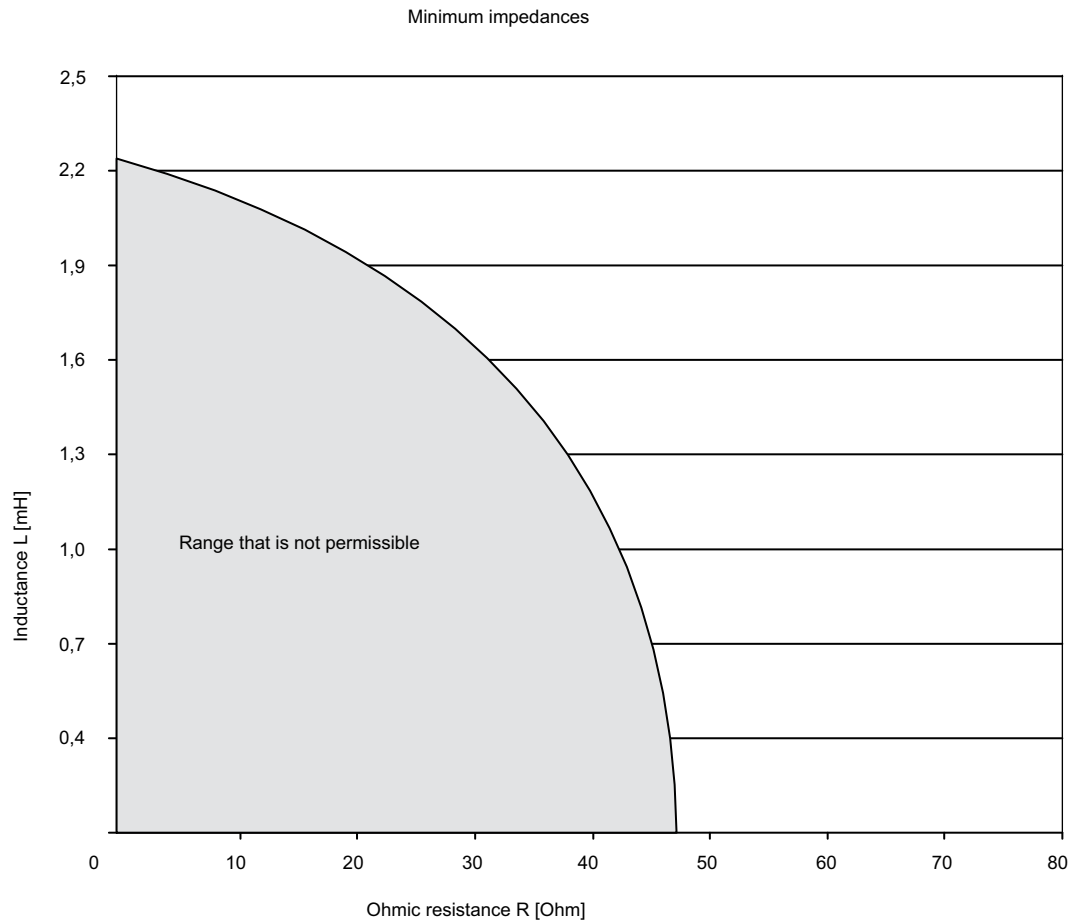


Figure 10-7 Rotor impedances that can be connected with excitation frequency $f = 5000$ Hz

To check as shown in the figure above, the impedances Z_{rs} or Z_{ro} (impedance between R1 and R2 with short-circuited or open outputs) from the encoder manufacturer's data sheet must be used.

10.5 Sensor Module Cabinet-Mounted SMC20

10.5.1 Description

The Sensor Module Cabinet-Mounted SMC20 is an expansion module for snapping on to a standard mounting rail acc. to EN 60715. It evaluates encoder signals and transmits the speed, actual position, rotor position and, if applicable, the motor temperature and reference point via DRIVE-CLiQ to the Control Unit.

Following encoder systems can be connected:

- Incremental encoder SIN/COS (1 Vpp) with and without reference signal
- Absolute encoder EnDat 2.1 (with SIN/COS incremental signals 1 Vpp)
- Absolute encoder EnDat 2.2 with order designation EnDat01 or EnDat02

- Absolute encoder SSI (with 5 V supply)
- Absolute encoder SSI (with 5 V supply) with SIN/COS incremental signals 1 Vpp

10.5.2 Interface description

10.5.2.1 Overview

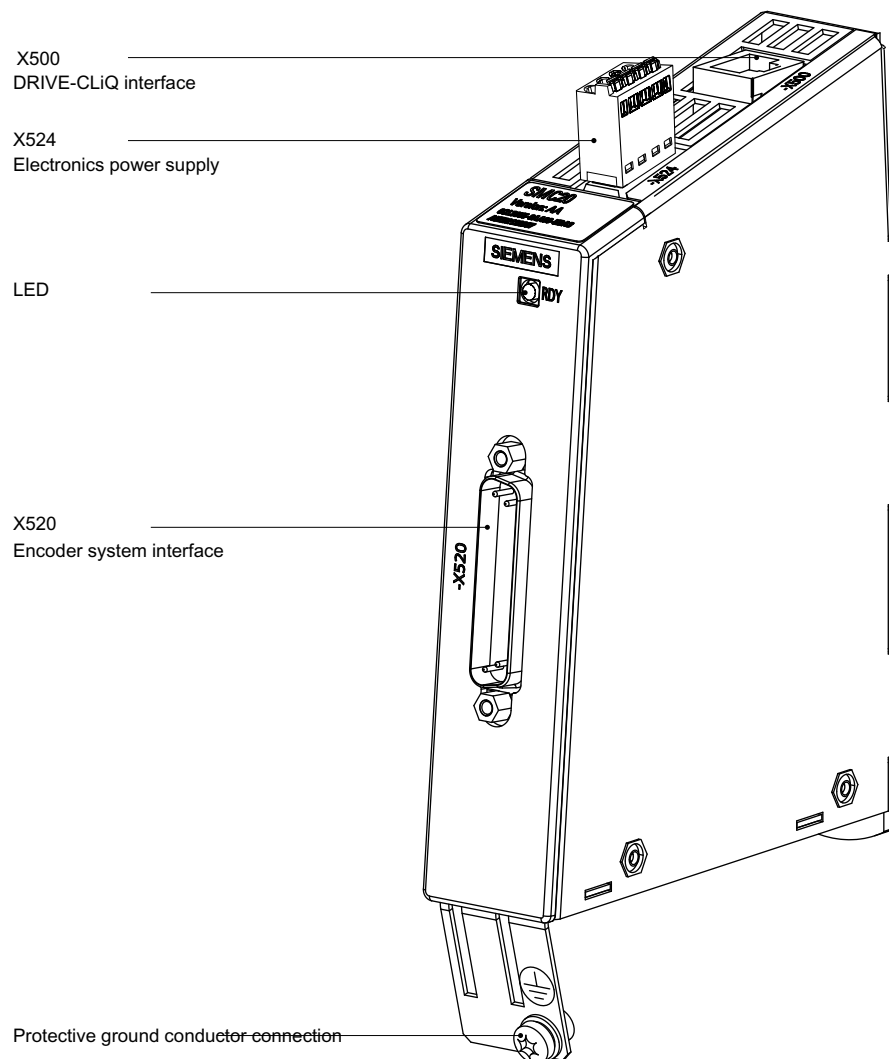
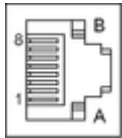


Figure 10-8 Interface description of the SMC20

10.5.2.2 X500 DRIVE-CLiQ interface

Table 10-8 X500: DRIVE-CLiQ interface

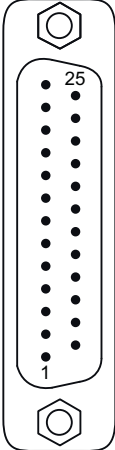
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	Reserved, do not use	-
	B	M (0 V)	Electronics ground
	Connector type	DRIVE-CLiQ socket	

The blanking cover for the DRIVE-CLiQ port is included in the scope of delivery.

Blanking covers (50 x) Article No.: 6SL3066-4CA00-0AA0

10.5.2.3 X520 encoder system interface

Table 10-9 X520: Encoder system interface

	Pin	Signal name	Technical data
	1	P encoder	Encoder power supply
	2	M encoder	Ground for encoder power supply
	3	A	Incremental signal A
	4	A*	Inverse incremental signal A
	5	Ground	Ground (for internal shield)
	6	B	Incremental signal B
	7	B*	Inverse incremental signal B
	8	Ground	Ground (for internal shield)
	9	Reserved, do not use	-
	10	Clock	Clock, EnDat interface, SSI clock
	11	Reserved, do not use	-
	12	Clock*	Inverted clock, EnDat interface, inverted SSI clock
	13	+Temp ¹⁾	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact
	14	P sense	Sense input encoder power supply
	15	Data	Data, EnDat interface, SSI data
	16	M sense	Ground sense input encoder power supply
	17	R	Reference signal R
	18	R*	Inverse reference signal R
	19	C	Absolute track signal C
	20	C*	Inverse absolute track signal C
	21	D	Absolute track signal D
	22	D*	Inverse absolute track signal D
	23	Data*	Inverse data, EnDat interface, Inverse SSI data
	24	Ground	Ground (for internal shield)
	25	-Temp ¹⁾	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact
Connector type:	25-pin SUB D connector		
Measuring current via temperature sensor connection: 2 mA			

¹⁾ Accuracy of the temperature measurement (temperature sensor, including evaluation):

- Pt1000: $\pm 5^\circ\text{C}$ (Pt1000 tolerance class B acc. to EN 60751)
- KTY: $\pm 7^\circ\text{C}$
- PTC: $\pm 5^\circ\text{C}$

NOTICE**Damage to the motor due to incorrectly connected KTY temperature sensor**

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

- Connect a KTY temperature sensor with the correct polarity.

Information for assigning parameters to the KTY temperature sensor can be found in the SINAMICS S120 Function Manual "Drive Functions" in the Chapter "Monitoring and protection functions/thermal motor protection".

**WARNING****Electric shock when the motor temperature sensor insulation fails**

When connecting temperature sensors, which have no safe protective separation with respect to the motor power circuit, then arcing to the signal electronics can occur.

- Use motors whose temperature sensors have safe electrical separation.
- Use only connecting cables and connectors with safe electrical separation between the wires of the temperature sensor and the wires of the power circuit.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

10.5.2.4 X524 Electronics power supply

Table 10-10 X524: Electronics power supply

	Terminal	Function	Technical data
 red blue	+	Electronics power supply (24 V)	Voltage: 24 V DC (20.4 ... 28.8 V)
	+	Electronics power supply (24 V)	Current consumption: max. 0.35 A (with encoder system)
	M	Electronics ground (0 V)	
	M	Electronics ground (0 V)	Max. current via jumper in connector: 20 A (15 A according to UL/CSA)
Type: Spring-loaded terminal 6 (Page 46)			

The maximum cable length is 30 m.

Note

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

10.5.3 Connection example

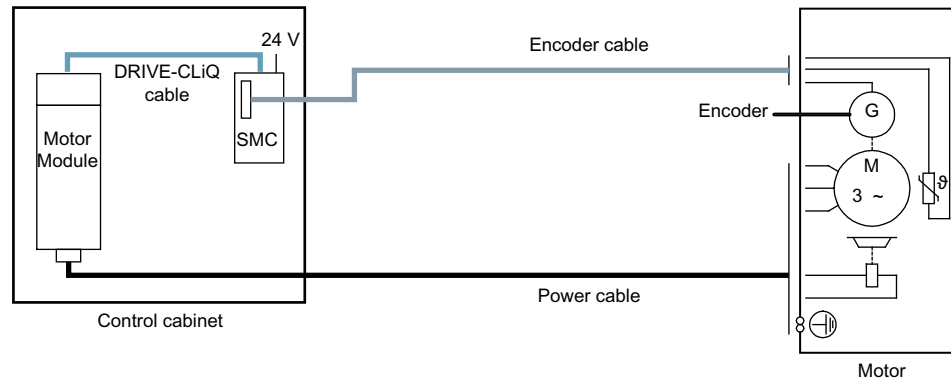


Figure 10-9 Connection of an encoder system via a Sensor Module Cabinet-Mounted (SMC) for a motor without a DRIVE-CLiQ interface

10.5.4 Meaning of the LED

Table 10-11 Meaning of the LEDs on the Sensor Module Cabinet-Mounted SMC20

LED	Color	Status	Description, cause	Remedy
RDY READY	-	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	This component has at least one fault. Note: The LED is activated irrespective of whether the corresponding messages have been reconfigured.	Remove and acknowledge the fault.
	Green / Red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
		Flashing light 2 Hz	Firmware download is complete. The system waits for POWER ON.	Carry out a POWER ON.
	Green / Orange or Red / Orange	Flashing light 2 Hz	Component recognition via LED is activated (p0144=1). Note: Whether the LED flashes green/orange or red/orange depends on the status the LED had during activation (setting of parameter p0144 to "1").	–

10.5.5 Dimension drawing

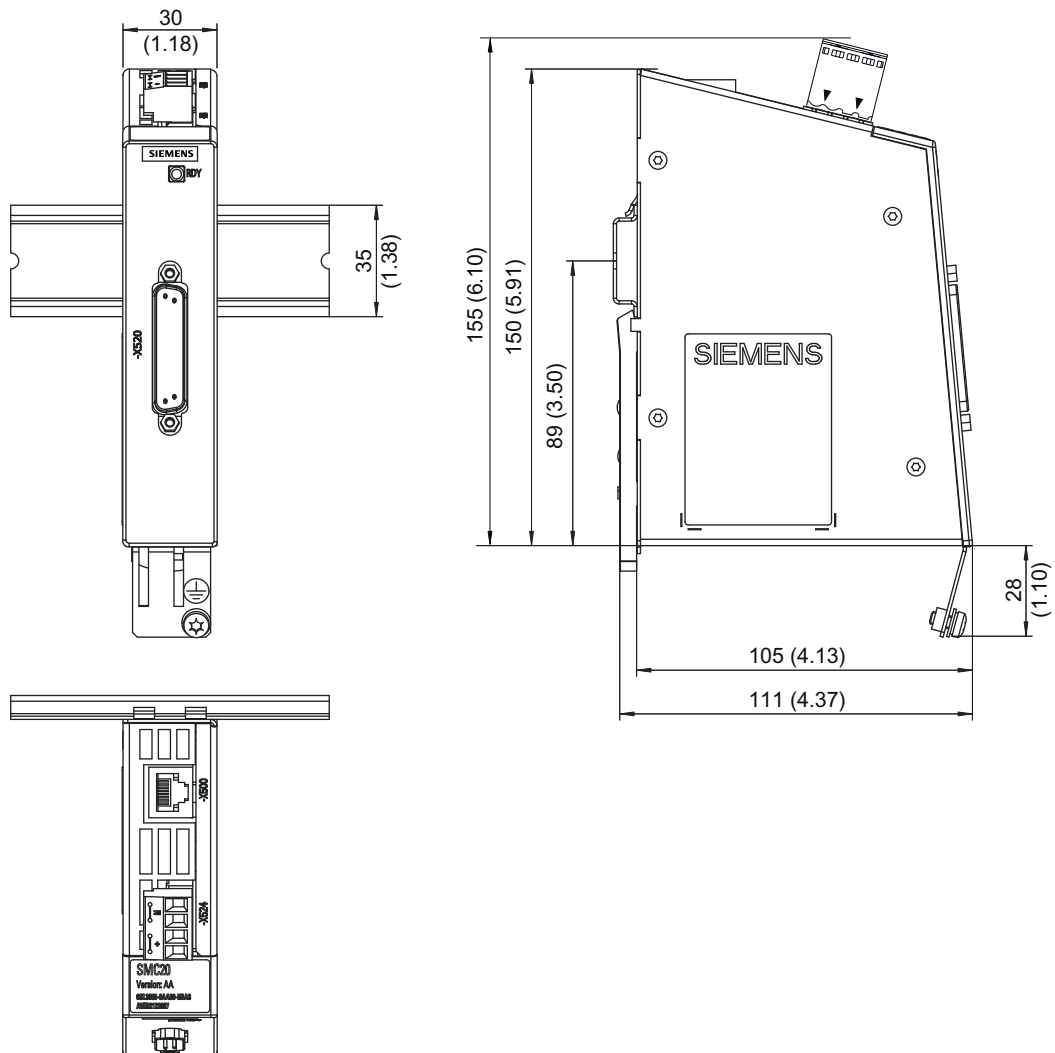


Figure 10-10 Dimension drawing of the Sensor Module Cabinet SMC20, all data in mm and (inches)

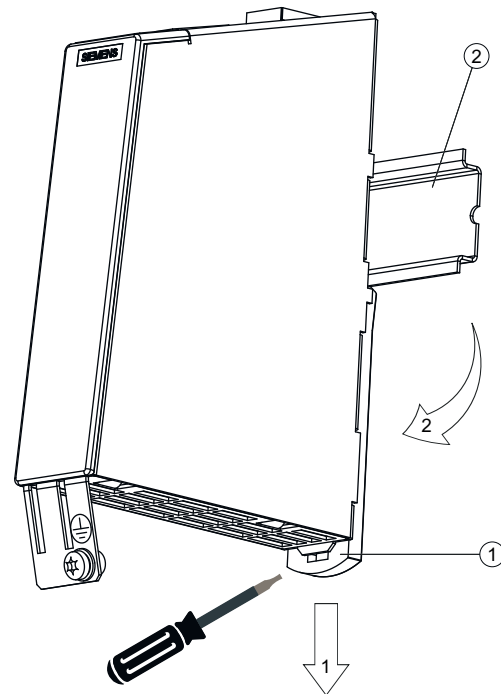
10.5.6 Mounting

Installation

1. Tilt the component backwards slightly and attach it to the DIN rail using the hooks.
2. Swivel the component onto the DIN rail until you hear the mounting slide at the rear latch into position.
3. Slide the components along the mounting rail to either the left or right up to their final position.

Removal

1. First shift the mounting slide downwards at the lug to release the interlocking with the mounting rail.
2. Swivel the component to the front and withdraw it upwards from the DIN rail.



① Mounting slide

② Mounting rail

Figure 10-11 Removing from a DIN mounting rail

10.5.7 Technical data

Table 10-12 Technical data

6SL3055-0AA00-5BA.	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 (20.4 ... 28.8)
Current (without encoder system)	A_{DC}	≤ 0.2
Power loss	W	≤ 4
Max. Cable length	m	30
Encoder system power supply		
Voltage	V_{DC}	5 V DC (with remote sense) ¹⁾
Current	A_{DC}	0.35
Encoder frequency that can be evaluated ($f_{encoder}$)	kHz	≤ 500
SSI baud rate ²⁾	kBd	100 - 1000 ³⁾
Max. encoder cable length	m	100

10.6 Sensor Module Cabinet-Mounted SMC30

6SL3055-0AA00-5BA.	Unit	Value
Protective conductor connection	At the housing with M4 screw	
Ventilation clearances, above/below	mm	50
Weight	kg	0.41

- ¹⁾ A controller compares the encoder system supply voltage - sensed via the Remote Sense cables - with the reference supply voltage of the encoder system, and adjusts the supply voltage for the encoder system at the output of the sensor module until the required supply voltage is obtained directly at the encoder system (only for 5 V encoder system power supply).
- ²⁾ Only possible for SSI encoders with 5 V supply.
- ³⁾ See the diagram "Maximum cable length depending on the SSI baud rate for SSI encoders"

Note**Current controller clock cycle**

For a current controller cycle clock of 31.25 μ s, use an SMC20 with Article No. 6SL3055-0AA00-5BA3.

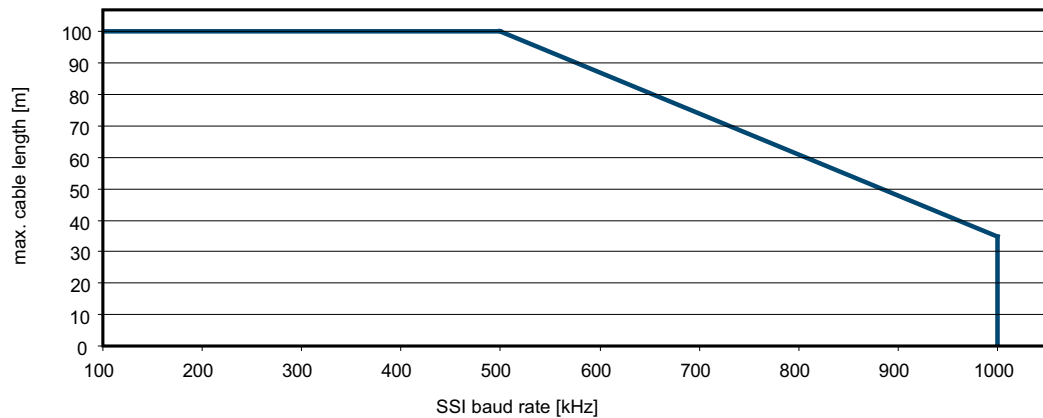


Figure 10-12 Maximum cable lengths depending on the SSI baud rate for SSI encoders

10.6 Sensor Module Cabinet-Mounted SMC30

10.6.1 Description

The Sensor Module Cabinet-Mounted SMC30 is an expansion module for snapping on to a standard mounting rail acc. to EN 60715. It evaluates encoder signals and transmits the speed, actual position, and, if applicable, the motor temperature and reference point via DRIVE-CLiQ to the Control Unit.

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

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

10.6.2 Interface description

10.6.2.1 Overview

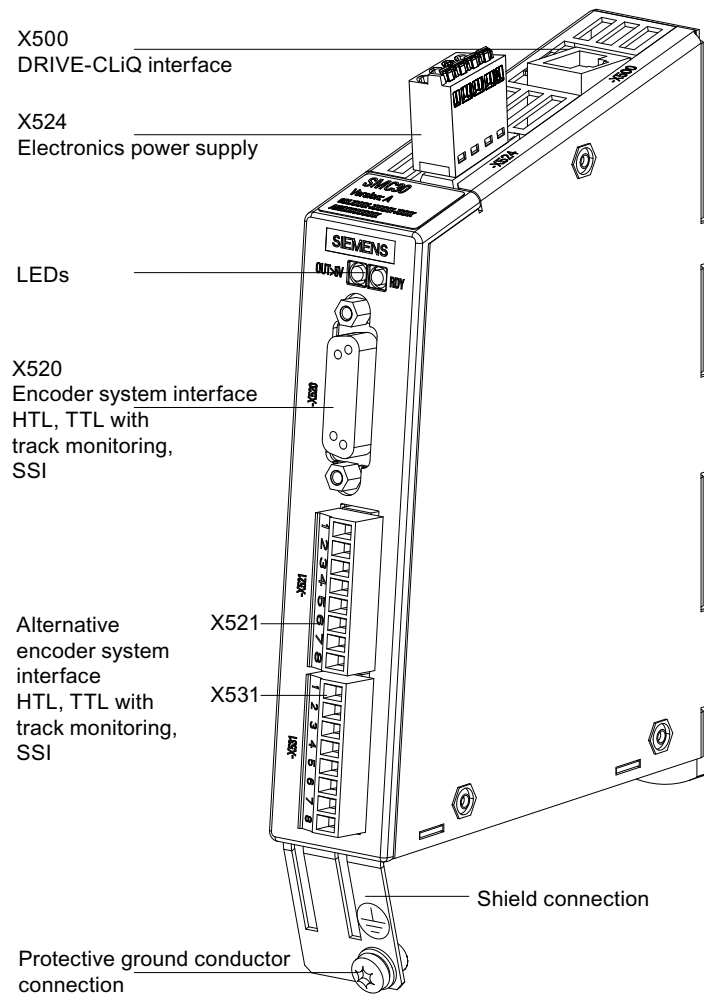
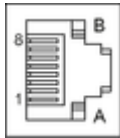


Figure 10-13 Interface description of the SMC30

10.6.2.2 X500 DRIVE-CLiQ interface

Table 10-13 X500: DRIVE-CLiQ interface

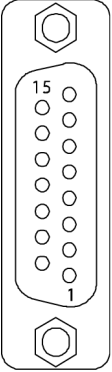
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	Reserved, do not use	-
	B	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		

The blanking cover for the DRIVE-CLiQ port is included in the scope of delivery.

Blanking covers (50 x) Article No.: 6SL3066-4CA00-0AA0

10.6.2.3 X520 encoder system interface

Table 10-14 X520: Encoder system interface

	Pin	Signal name	Technical data
	1	+Temp ¹⁾	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact
	2	Clock	SSI clock
	3	Clock*	Inverse SSI clock
	4	P encoder 5 V / 24 V	Encoder power supply
	5	P encoder 5 V / 24 V	
	6	P sense	Sense input encoder power supply
	7	M encoder (M)	Ground for encoder power supply
	8	- Temp ¹⁾	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact
	9	M sense	Ground sense input
	10	R	Reference signal R
	11	R*	Inverse reference signal R
	12	B*	Inverse incremental signal B
	13	B	Incremental signal B
	14	A* / data*	Inverted incremental signal A/inverted SSI data
	15	A / data	Incremental signal A/SSI data

	Pin	Signal name	Technical data
Connector type:	15-pin Sub-D socket		
Measuring current via temperature sensor connection: 2 mA			

- ¹⁾ Accuracy of the temperature measurement (temperature sensor, including evaluation):
- Pt1000: ± 5 °C (Pt1000 tolerance class B acc. to EN 60751)
 - KTY: ± 7 °C
 - PTC: ± 5 °C

NOTICE**Damage to the encoder due to incorrect supply voltage**

The encoder supply can be parameterized to 5 V or 24 V. Incorrect parameter assignment can cause damage to the encoder.

- Select the appropriate supply voltage.

NOTICE**Damage to the motor due to incorrectly connected KTY temperature sensor**

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

- Connect a KTY temperature sensor with the correct polarity.

Information for assigning parameters to the KTY temperature sensor can be found in the SINAMICS S120 Function Manual "Drive Functions" in the Chapter "Monitoring and protection functions/thermal motor protection".

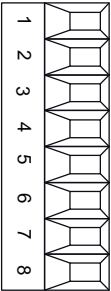
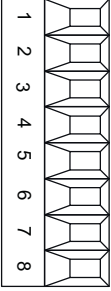
**! WARNING****Electric shock when the motor temperature sensor insulation fails**

When connecting temperature sensors, which have no safe protective separation with respect to the motor power circuit, then arcing to the signal electronics can occur.

- Use motors whose temperature sensors have safe electrical separation.
- Use only connecting cables and connectors with safe electrical separation between the wires of the temperature sensor and the wires of the power circuit.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

10.6.2.4 X521 / X531 alternative encoder system interface

Table 10-15 X521/X531: Alternative encoder system interface

	Pin	Designation	Technical data
X521 	1	A	Incremental signal A
	2	A*	Inverse incremental signal A
	3	B	Incremental signal B
	4	B*	Inverse incremental signal B
	5	R	Reference signal R
	6	R*	Inverse reference signal R
	7	CTRL	Control signal
	8	M	Ground
X531 	1	P_Encoder 5 V / 24 V	Encoder power supply
	2	M_Encoder	Ground for encoder power supply
	3	-Temp ¹⁾	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact
	4	+Temp ¹⁾	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact
	5	Clock	SSI clock
	6	Clock*	Inverse SSI clock
	7	Data	SSI data
	8	Data*	Inverse SSI data
Max. connectable cross-section: 1.5 mm ² (AWG 16) Measuring current via temperature sensor connection 2 mA When unipolar HTL encoders are used, A*, B*, and R* on the terminal block must be jumpered with M_Encoder (X531) ²⁾ .			

¹⁾ Accuracy of the temperature measurement (temperature sensor, including evaluation):

- Pt1000: ±5 °C (Pt1000 tolerance class B acc. to EN 60751)
- KTY: ±7 °C
- PTC: ±5 °C

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



WARNING

Electric shock due to unconnected cable shields

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

- Attach the cable shield to the component for the encoder system connection at the terminals.

Temperature sensor connection**NOTICE****Damage to the motor due to incorrectly connected KTY temperature sensor**

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

- Connect a KTY temperature sensor with the correct polarity.

Information for assigning parameters to the KTY temperature sensor can be found in the SINAMICS S120 Function Manual "Drive Functions" in the Chapter "Monitoring and protection functions/thermal motor protection".

Note

The maximum length of the temperature sensor cable is 100 m. The cables must be shielded.

**WARNING****Electric shock when the motor temperature sensor insulation fails**

When connecting temperature sensors which are not isolated from the motor power circuit according to safe electrical separation, arcing to the signal electronics may occur.

- Use motors whose temperature sensors have safe electrical separation.
- Use only connecting cables and connectors with safe electrical separation between the cores of the temperature sensor and the cores of the power circuit.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

10.6.2.5 X524 Electronics power supply

Table 10-16 X524: Electronics power supply

	Terminal	Function	Technical data
	+	Electronics power supply (24 V)	Voltage: 24 V DC (20.4 ... 28.8 V)
	+	Electronics power supply (24 V)	Current consumption: max. 0.55 A (with encoder system)
	M	Electronics ground (0 V)	
	M	Electronics ground (0 V)	Max. current via jumper in connector: 20 A (15 A according to UL/CSA)
Type: Spring-loaded terminal 6 (Page 46)			

The maximum cable length is 30 m.

Note

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

10.6.3 Connection examples

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

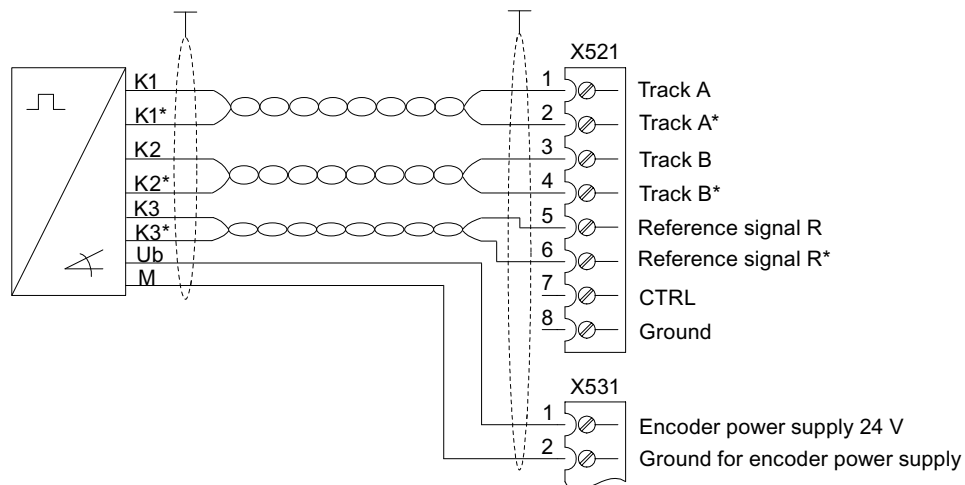


Figure 10-14 Connection example 1: HTL encoder, bipolar, with reference signal
Signal cables must be twisted in pairs to improve immunity to induced noise.

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

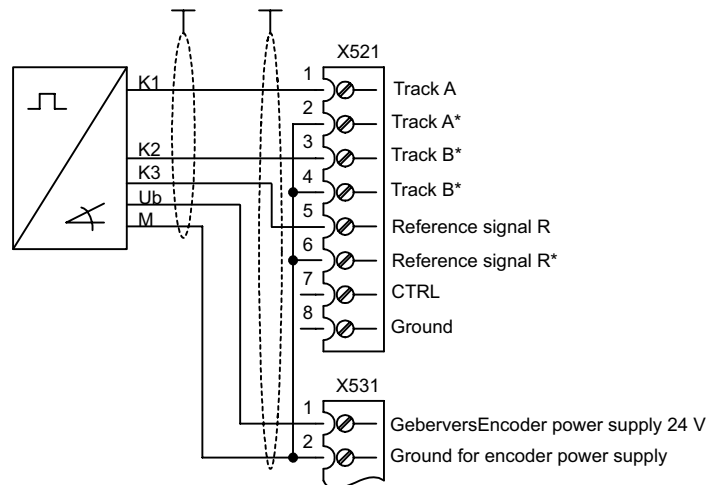


Figure 10-15 Connection example 2: HTL encoder, unipolar, with reference signal¹⁾

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

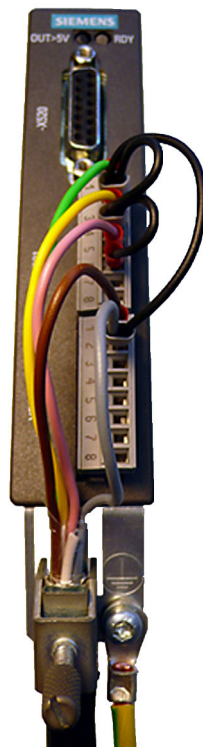


Figure 10-16 Photo of connection example 2: SMC30, 30 mm wide

The photo above shows the wire jumpers for connecting unipolar HTL encoders with a reference signal.

10.6.4 Meaning of the LEDs

Table 10-17 Meaning of LEDs on the Sensor Module Cabinet SMC30

LED	Color	Status	Description, cause	Remedy
RDY READY	–	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	This component has at least one fault. Note: LED is controlled irrespective of the corresponding messages being reconfigured.	Correct fault and acknowledge
	Green/red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
	Green/red	Flashing light 2 Hz	Firmware download is complete. The system waits for POWER ON.	Carry out a POWER ON
	Green/orange or Red/orange	Flashing light 2 Hz	Component recognition via LED is activated (p0144=1). Note: Whether the LED flashes green/orange or red/orange depends on the status the LED had during activation (setting of parameter p0144 to "1").	–
OUT > 5 V	–	Off	The electronics power supply is missing or outside permissible tolerance range. Power supply ≤ 5 V.	–
	Orange	Continuous light	The electronics power supply for the encoder system is available. Power supply > 5 V	–

10.6.5 Dimension drawing

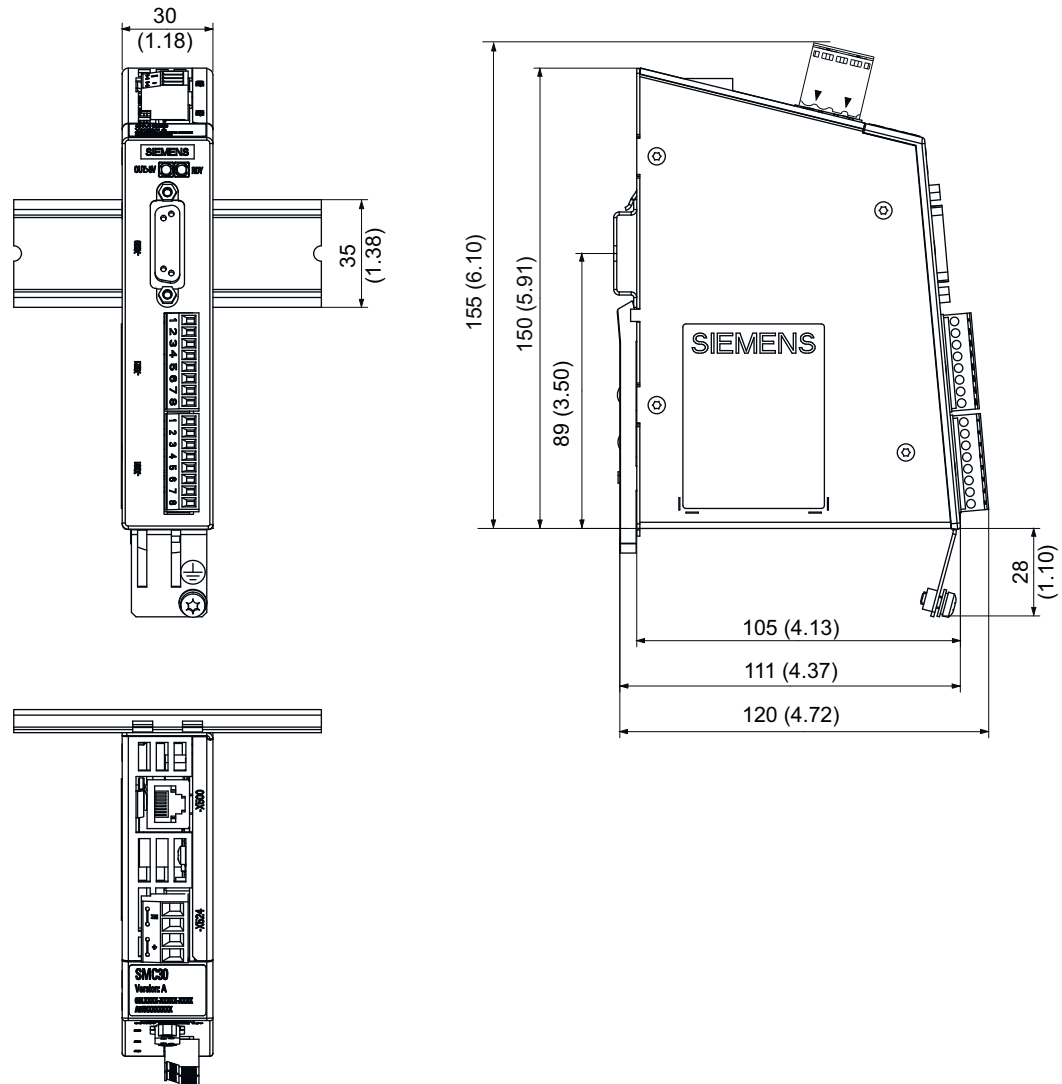


Figure 10-17 Dimension drawing of the Sensor Module Cabinet SMC30, all data in mm and (inches)

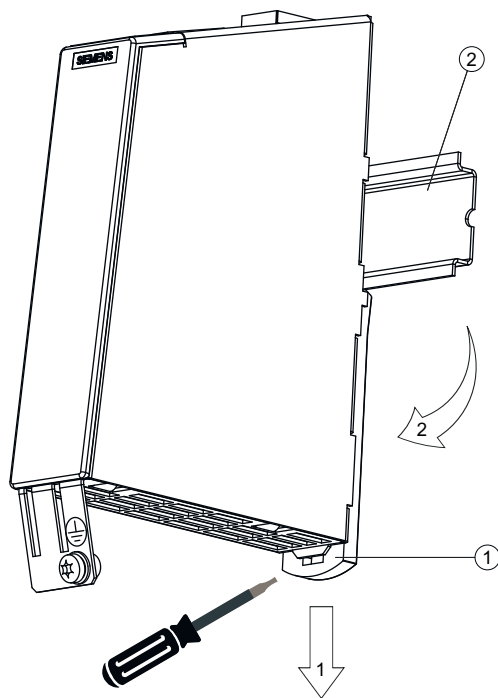
10.6.6 Mounting

Installation

1. Tilt the component backwards slightly and attach it to the DIN rail using the hooks.
2. Swivel the component onto the DIN rail until you hear the mounting slide at the rear latch into position.
3. Slide the components along the mounting rail to either the left or right up to their final position.

Removal

1. First shift the mounting slide downwards at the lug to release the interlocking with the mounting rail.
2. Swivel the component to the front and withdraw it upwards from the DIN rail.



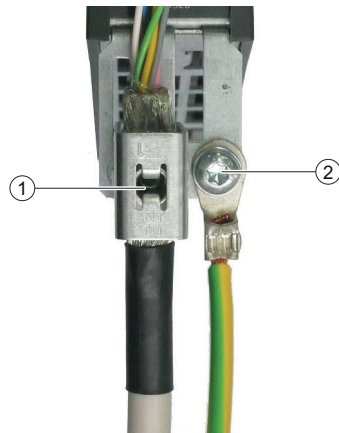
① Mounting slide

② Mounting rail

Figure 10-18 Removing from a DIN mounting rail

10.6.7 Protective conductor connection and shield support

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



① Shield connection terminal, Weidmüller company, type: KLBUE CO1, Article number: 1753311001

② Protective conductor connection M4 / 1.8 Nm (15.9 lbf in)

Figure 10-19 Protective conductor connection and shield support

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

NOTICE

Damage or faulty operation due to incorrect shielding or inadmissible cable lengths

If the correct shielding procedures or the permissible cable lengths are not observed, it can cause damage or the machine may malfunction.

- Only use shielded cables.
- Do not exceed the cable lengths stated in the technical data.

10.6.8 Technical specifications

Table 10-18 Technical data

6SL3055-0AA00-5CA2	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 (20.4 ... 28.8)
Current (without encoder system)	A_{DC}	≤ 0.2
Power loss	W	≤ 4
Max. cable length	m	30
Encoder system power supply		
Voltage	V_{DC}	5 (with or without remote sense) ¹⁾ or $V_{DC} - 1\text{ V}$
Current	A_{DC}	0.35
Encoder frequency that can be evaluated (f_{encoder})	kHz	≤ 500

10.6 Sensor Module Cabinet-Mounted SMC30

6SL3055-0AA00-5CA2	Unit	Value
SSI baud rate	kBd	100 - 1000 ²⁾
Protective conductor connection	At the housing with M4 screw	
Ventilation clearances, above/below	mm	50
Weight	kg	0.41

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

²⁾ See the diagram "Maximum cable length depending on the SSI baud rate for SSI encoders"

Connectable encoder systems

Table 10-19 Specification of encoder systems that can be connected

Parameter	Designation	Threshold	Min.	Max.	Unit
High signal level (TTL bipolar at X520 or X521/X531) ¹⁾	U_{Hdiff}	-	2	5	V
Low signal level (TTL bipolar at X520 or X521/X531) ¹⁾	U_{Ldiff}	-	-5	-2	V
High signal level (HTL unipolar)	U_H ³⁾	High	17	V_{CC}	V
		Low	10	V_{CC}	V
Low signal level (HTL unipolar)	U_L ³⁾	High	0	7	V
		Low	0	2	V
High signal level (HTL bipolar) ²⁾	U_{Hdiff}	-	3	V_{CC}	V
Low signal level (HTL bipolar) ²⁾	U_{Ldiff}	-	$-V_{CC}$	-3	V
High signal level (SSI bipolar at X520 or X521/X531) ¹⁾	U_{Hdiff}	-	2	5	V
Low signal level (SSI bipolar at X520 or X521/X531) ¹⁾	U_{Ldiff}	-	-5	-2	V
Signal frequency	f_s	-	-	500	kHz
Edge clearance	t_{min}	-	100	-	ns
"Zero pulse inactive time" (before and after A=B=high)	t_{Lo}	-	640	$(t_{ALo-BHi} - t_{Hi})/2$ ⁴⁾	ns
"Zero pulse active time" (while A=B=high and beyond) ⁵⁾	t_{Hi}	-	640	$t_{ALo-BHi} - 2 t_{Lo}$ ⁴⁾	ns

¹⁾ Other signal levels according to the RS 422 standard.

²⁾ The absolute level of the individual signals varies between 0 V and V_{CC} of the encoder system.

³⁾ Only with Article No. 6SL3055-0AA00-5CA2 and firmware version 2.5 SP1 or higher can this value be configured using software. For older firmware releases and Article Nos. less than 6SL3055-0AA00-5CA2, the "low" threshold applies.

⁴⁾ $t_{ALo-BHi}$ is not a specified value, but is the time between the falling edge of track A and the next but one rising edge of track B.

⁵⁾ Additional information on setting the "Zero pulse active time" can be found in the manual: SINAMICS S120, Function Manual, "Tolerant encoder monitoring for SMC30".

Table 10-20 Encoders that can be connected

	X520 (SUB-D)	X521 (terminal)	X531 (terminal)	Track monitoring	Remote Sense ²⁾
HTL bipolar 24 V	Yes	Yes		Yes	No
HTL unipolar 24 V ¹⁾	Yes	Yes ¹⁾		No	No
TTL bipolar 24 V	Yes	Yes		Yes	No
TTL bipolar 5 V	Yes	Yes		Yes	At X520
SSI 24 V/5 V	Yes	Yes		No	No
TTL unipolar	No				

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

²⁾ A controller compares the encoder system supply voltage – sensed via the Remote/Sense cables – with the reference supply voltage of the encoder system, and adjusts the supply voltage for the encoder system at the output of the sensor module until the required supply voltage is obtained directly at the encoder system (only for 5 V encoder system power supply).

Maximum encoder cable lengths

Note

The maximum cable lengths according to the following table must not be exceeded even when longer cable lengths can be calculated.

Table 10-21 Maximum encoder cable length

Encoder type	Maximum encoder cable length in m
TTL ¹⁾	100
HTL unipolar ²⁾	100
HTL bipolar	300
SSI	100 ³⁾

¹⁾ For TTL encoders at X520 → Remote Sense → 100 m

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

³⁾ See the diagram "Maximum cable length depending on the SSI baud rate for SSI encoders"

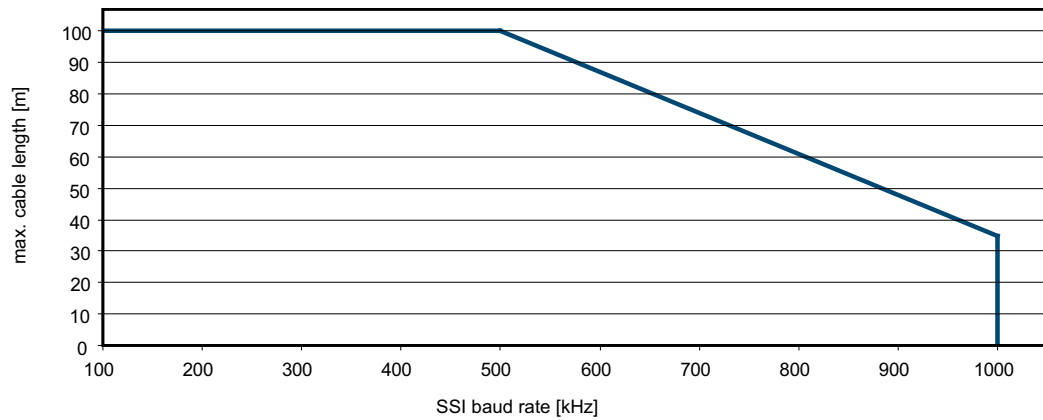
SSI encoder

Figure 10-20 Maximum cable lengths depending on the SSI baud rate for SSI encoders

Encoders with 5 V supply connected to X521/X531

For encoders with 5 V supply at X521/X531 (no Remote Sense available), the maximum cable length¹⁾ depends on the encoder current. The following diagram shows an example of a 0.5 mm² conductor cross section.

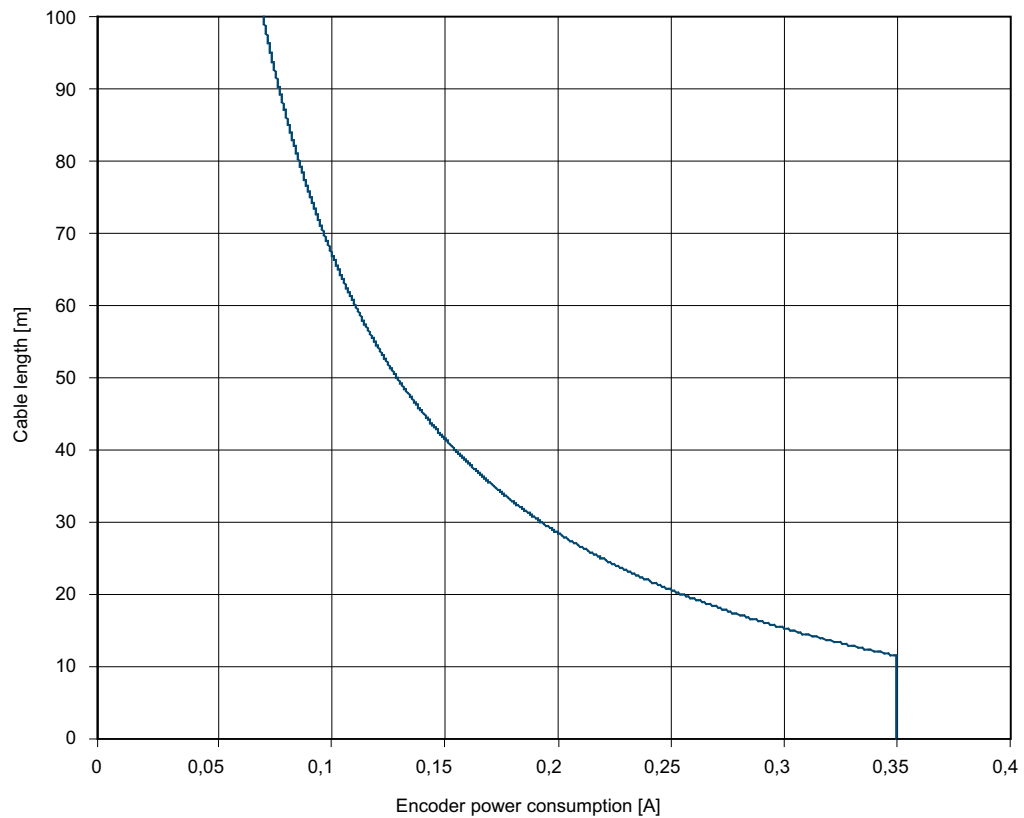


Figure 10-21 Max. cable length as a function of the encoder current drawn

¹⁾ When encoders without Remote Sense are used, the permissible cable length is limited to 100 m because the voltage drop depends on the cable length and the encoder current.

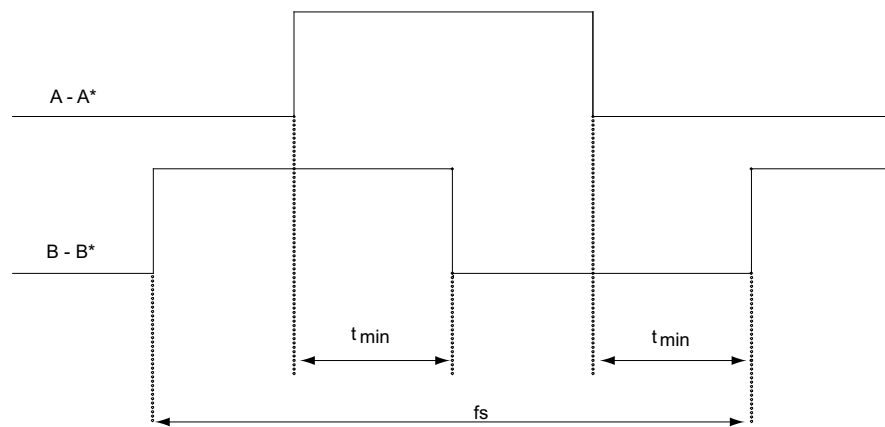


Figure 10-22 Signal characteristic of track A and track B between two edges: Time between two edges with pulse encoders

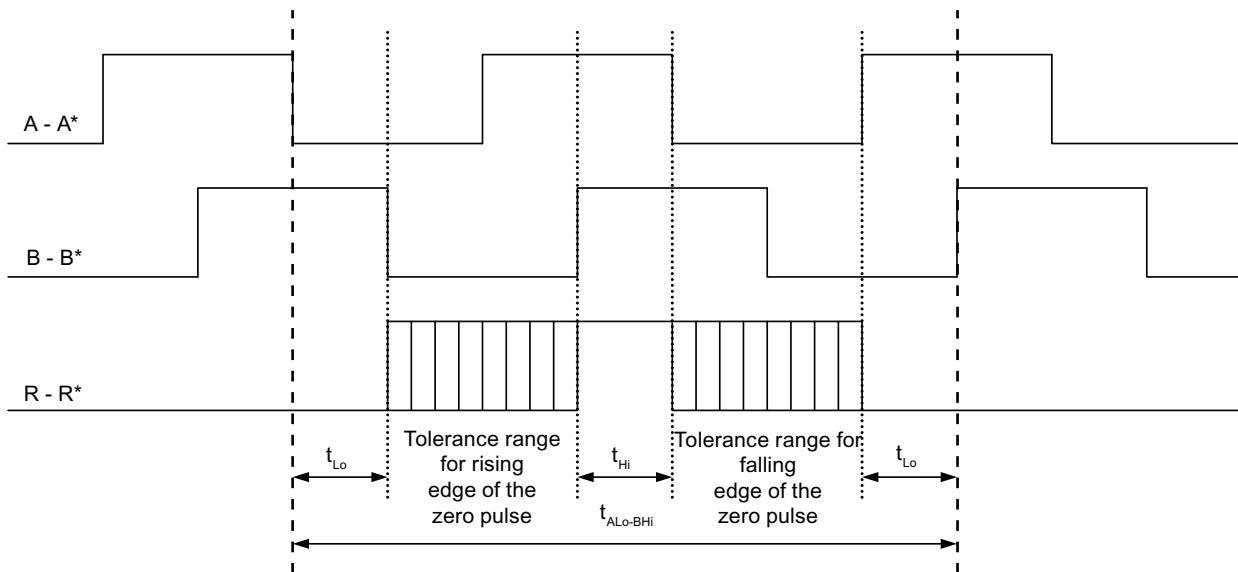


Figure 10-23 Position of the zero pulse to the track signals

10.7 Sensor Module Cabinet-Mounted SMC40

10.7.1 Description

The Sensor Module Cabinet-Mounted SMC40 is an expansion module for snapping on to a DIN rail acc. to EN 60715. It is used to convert encoder signals from absolute encoders with EnDat 2.2, order designation EnDat22, to DRIVE-CLiQ and transmit them to the Control Unit. Two encoder systems with EnDat 2.2 order designation EnDat22 can be connected to the SMC40, which are converted to two DRIVE-CLiQ encoder signals independently of each other.

Note**Permissible encoders**

- Only use absolute encoders EnDat 2.2 with order designation EnDat22. Do not connect an absolute encoder EnDat 2.2 with the order designation EnDat02.
 - Only use absolute encoders (not incremental encoders) with software versions 4.5 and 4.6.
 - Do not use battery buffered encoders.
-

Configuration and commissioning

To make sure that the Sensor Module Cabinet-Mounted SMC40 is integrated into the topology during first commissioning, observe the following connection conditions:

- Connect at least one of the DRIVE-CLiQ interfaces X500/1 or X500/2 on the SMC40 using DRIVE-CLiQ.
- Connect one EnDat encoder to the corresponding encoder interface X520/1 (to X500/1) or X520/2 (to X500/2).
- Operate the SMC40 only in a star topology. The DRIVE-CLiQ sockets X500/1 and X500/2 can **not** be used for a series connection.

Note

The SMC40 will only be subsequently integrated into the actual topology if the DRIVE-CLiQ interfaces X500/. and the corresponding encoder interfaces X520/. are assigned. Without a connected encoder, it is not possible to subsequently integrate the SMC40 into the topology.

Temperature signals

If the EnDat2.2 encoder already evaluates the temperature, the temperature signals can be transferred through the SMC40 via DRIVE-CLiQ.

10.7.2 Interface descriptions

10.7.2.1 Overview

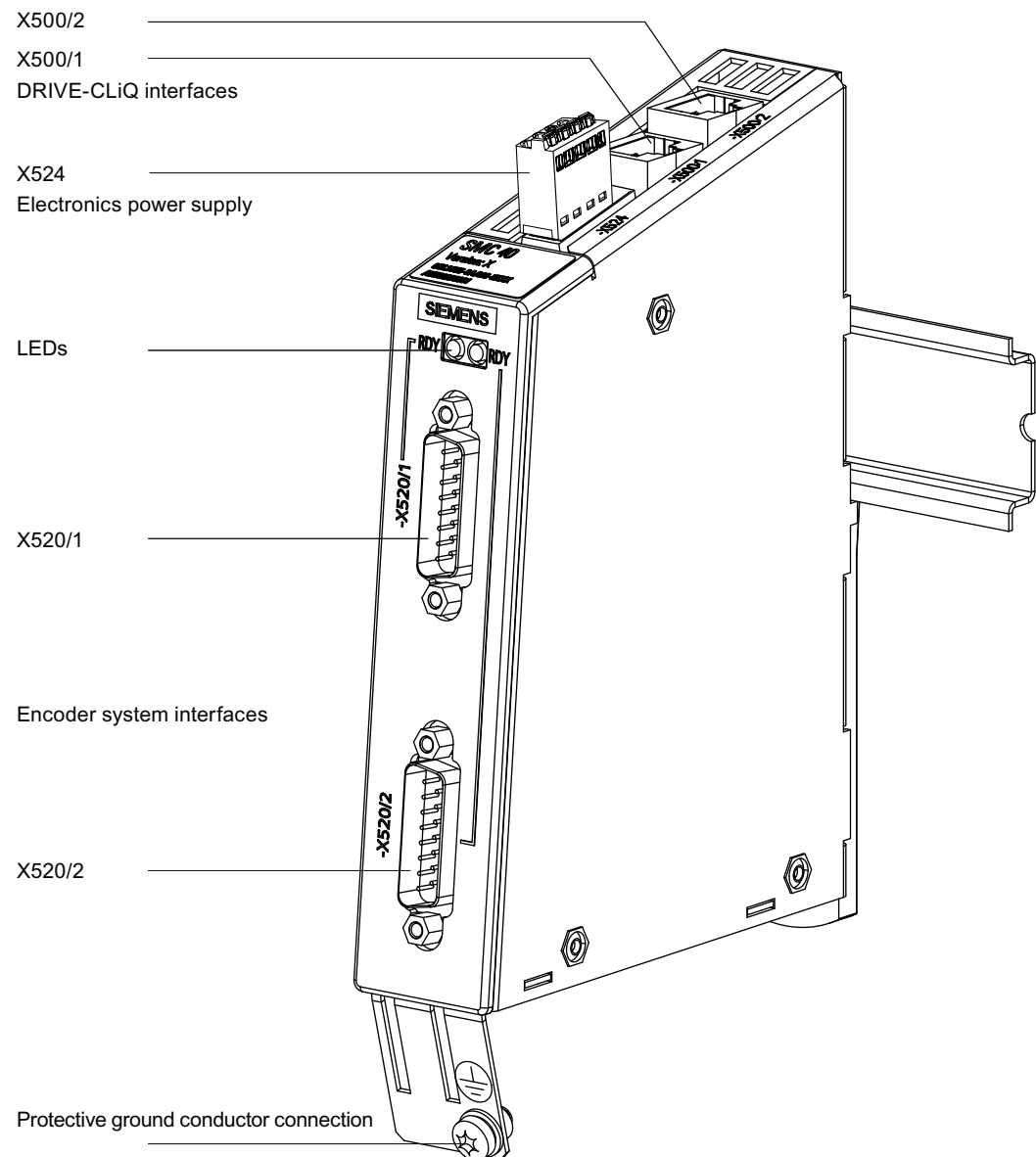


Figure 10-24 Interface overview for the SMC40

Interface assignment

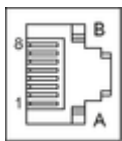
The DRIVE-CLiQ and encoder interfaces of channel 1 and channel 2 are logically completely independently of one another and permanently assigned.

		X500/1 DRIVE-CLiQ socket	X500/2 DRIVE-CLiQ socket	Left RDY LED	Right RDY LED
X520/1	EnDat 2.2 input	channel 1	---	channel 1	---
X520/2	EnDat 2.2 input	---	channel 2	---	channel 2

Connector X524 for the electronics power supply is used for both channels.

10.7.2.2 X500/1 and X500/2 DRIVE-CLiQ interfaces

Table 10-22 X500/1 and X500/2: DRIVE-CLiQ interfaces

	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	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		

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

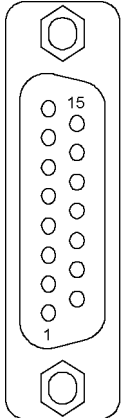
Blanking covers (50 x) Article No.: 6SL3066-4CA00-0AA0

Note

The maximum DRIVE-CLiQ cable length is 30 m.

10.7.2.3 X520/1 and X520/2 encoder system interfaces

Table 10-23 X520/1 and X520/2: Encoder system interfaces

	Pin	Signal name	Technical data
	1	P encoder	Encoder power supply
	2	M encoder	Ground, encoder power supply
	3	Reserved, do not use	-
	4	Reserved, do not use	-
	5	Data	Data, EnDat interface
	6	Reserved, do not use	-
	7	Reserved, do not use	-
	8	Data*	Inverse data EnDat interface
	9	P encoder	Encoder power supply
	10	Reserved, do not use	-
	11	M encoder	Ground, encoder power supply
	12	Reserved, do not use	-
	13	Reserved, do not use	-
	14	Clock	Clock, EnDat interface
	15	Clock*	Inverse clock EnDat interface
Connector type:	15-pin SUB D connector		

Note

The maximum cable length to encoder systems is 100 m. The specified supply voltage of the encoder must be observed.

Note

Pins 1/9 and 2/11 on the SMC40 side and on the encoder side (in the M12 connector, pin 8/2 and pin 5/1) are connected in parallel, and to increase the cable cross-section each must be wired with a separate conductor.



WARNING

Electric shock when the motor temperature sensor insulation fails

When connecting temperature sensors which are not isolated from the motor power circuit according to safe electrical separation, arcing to the signal electronics may occur.

- Use motors whose temperature sensors have safe electrical separation.
- Use only connecting cables and connectors with safe electrical separation between the wires of the temperature sensor and the wires of the power circuit.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

10.7.2.4 X524 Electronics power supply

Table 10-24 X524: Electronics power supply

	Terminal	Function	Technical data
 red blue	+	Electronics power supply (24 V)	Voltage: 24 V DC (20.4 ... 28.8 V)
	+	Electronics power supply (24 V)	Current consumption: max. 0.35 A (with encoder system)
	M	Electronics ground (0 V)	
	M	Electronics ground (0 V)	Maximum current via jumper in connector: 20 A (15 A according to UL/CSA)
Type: Spring-loaded terminal 6 (Page 46)			

The maximum cable length is 30 m.

Note

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

10.7.3 Connection example

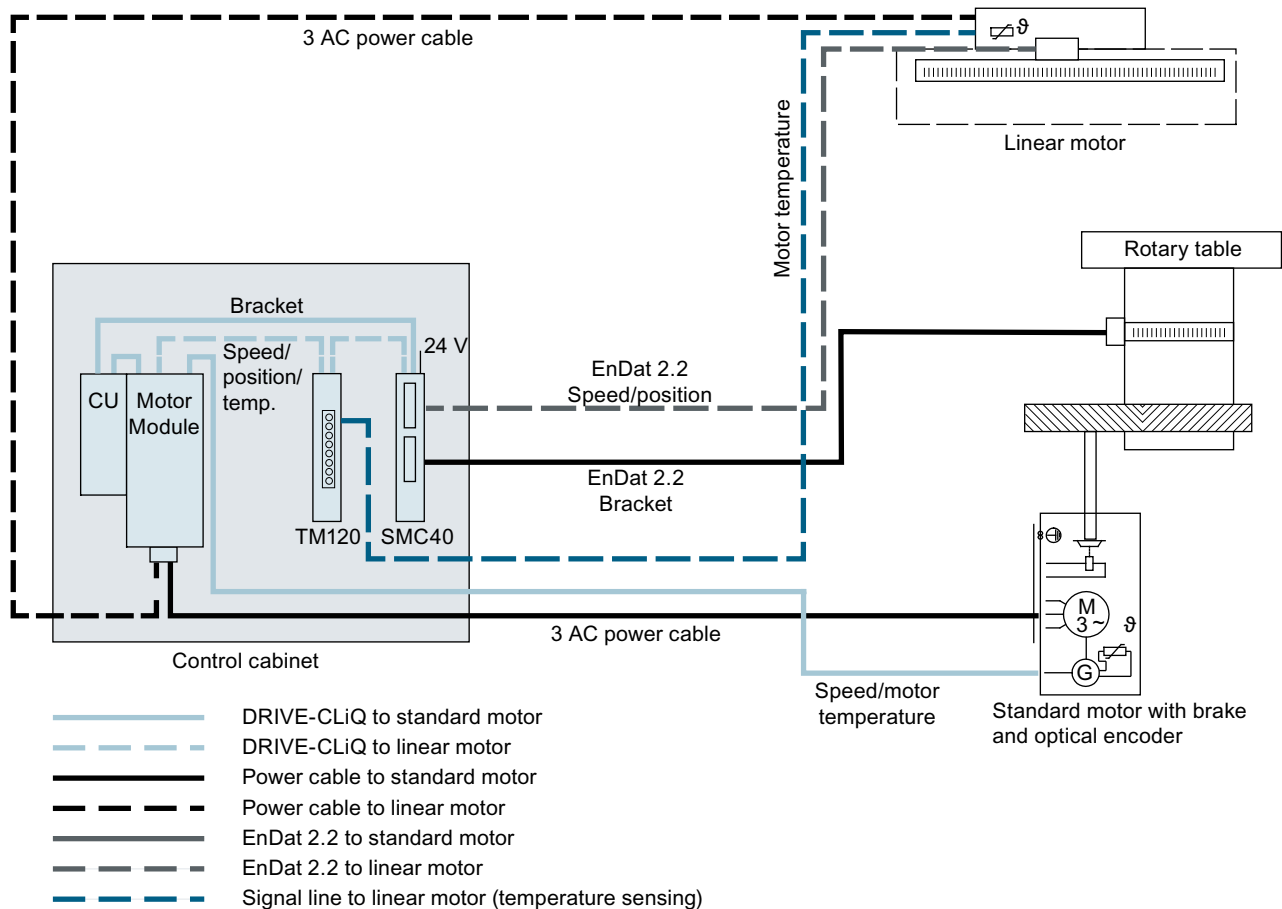


Figure 10-25 Encoder system connection via a Sensor Module Cabinet-Mounted SMC40

The wiring diagram shows two different applications of the SMC40. For each conversion of an EnDat 2.2 encoder signal into a DRIVE-CLiQ signal, a dedicated DRIVE-CLiQ cable must be used, as the electronics in the SMC40 is designed so that each channel is independent. The DRIVE-CLiQ cables cannot be interchanged.

Connecting a standard motor with brake and optical encoder

A standard motor with gearbox for a rotary indexing table drive is shown in the connection example. The rotary indexing table has an angular position measuring system with EnDat 2.2 interface. The measured angular data are transferred via EnDat 2.2 to the SMC40 and from there via DRIVE-CLiQ to the Control Unit.

The motor contains an integrated encoder and temperature evaluation, which transfers data via DRIVE-CLiQ directly to the Motor Module.

Connecting a linear motor without DRIVE-CLiQ interface

From a linear motor with linear scale, velocity and position are first transferred via the EnDat 2.2 connection to the SMC40 and from there, via DRIVE-CLiQ to a Terminal Module TM120.

10.7 Sensor Module Cabinet-Mounted SMC40

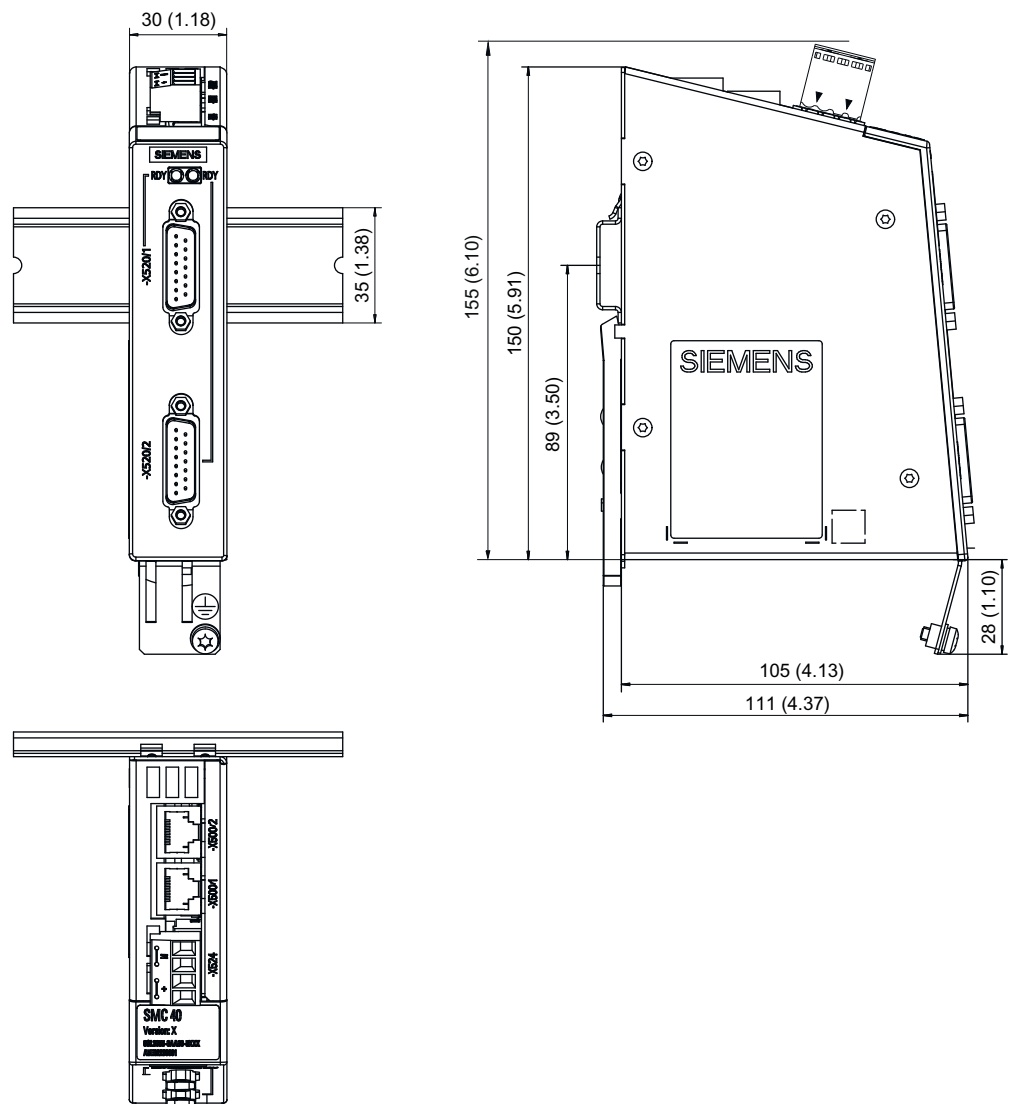
The temperature sensors of the linear motor supply their analog temperature values directly to the TM120, which guarantees the safe electrical separation of the temperature cable and which transfers the temperature data together with the velocity and position data in the DRIVE-CLiQ protocol to the Motor Module.

10.7.4 Meaning of the LEDs

Table 10-25 Meaning of the LEDs on the Sensor Module Cabinet-Mounted SMC40

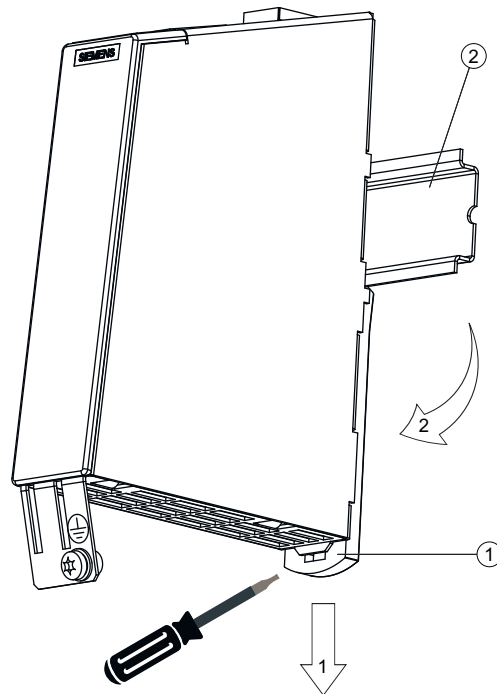
LED	Color	Status	Description, cause	Remedy
RDY READY	–	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	This component has at least one fault. Note: LED is controlled irrespective of the corresponding messages being reconfigured.	Correct and acknowledge the fault.
	Green/red	Flashing light 2 Hz	Firmware download is complete. The system waits for POWER ON.	Carry out a POWER ON.
	Green/ orange or Red/ orange	Flashing light 2 Hz	Component recognition via LED is activated (p0144=1). Note: Whether the LED flashes green/orange or red/orange depends on the status the LED had during activation (setting of parameter p0144 to "1").	–

Each channel has a multifunction LED.



Removal

1. First shift the mounting slide downwards at the lug to release the interlocking with the mounting rail.
2. Swivel the component to the front and withdraw it upwards from the DIN rail.



- ① Mounting slide
- ② Mounting rail

Figure 10-27 Removing from a DIN mounting rail

Mounting clearances

The SMC40 can be installed in the line-up together with other SMCs as required. When mounting next to heat sources, the following minimum lateral clearances must be observed:

- 50 mm for Line Modules and Motor Modules
- 100 mm for hotter components (e.g. pulsed resistor)

10.7.7 Technical data

Table 10-26 Technical data

6SL3055-0AA00-5DA0	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 (20.4 ... 28.8)
Current (without encoder system)	A_{DC}	≤ 0.1
Power loss	W	≤ 4
Max. cable length	m	30
Encoder system power supply		
Voltage	V_{DC}	5.1 (without Remote Sense)
Current	A_{DC}	0.5
Evaluable encoder protocol	EnDat 2.2 with order designation EnDat22	
Max. encoder cable length	m	100
Protective ground conductor connection	At the housing with M4 screw	
Ventilation clearances, above/below	mm	50
Weight	kg	0.45

10.8 Sensor Module External SME20

10.8.1 Description

Direct encoder systems outside the cabinet can be connected to the Sensor Module External SME20. The SME20 evaluates these encoder systems and converts the calculated values to DRIVE-CLiQ.

Incremental direct encoder systems with SIN/COS (1 Vpp) and reference signal can be connected.

It is possible to connect a motor with a 17-pin round connector for the encoder to the 12-pin round connector of the SME20 using adapter cable 6FX 8002-2CA88-xxxx

- Pt1000, KTY, PTC sensors and bimetal NC contact can be used to evaluate the motor temperature.
- The Sensor Module is only suitable for motors without absolute track signals (C/D track):
 - Induction motors (e.g. 1PH)
 - Synchronous motors with pole position identification (e.g. 1FN, 1FW, 1FE)

Neither motor nor encoder data are saved in the SME20.

10.8.2 Interface description

10.8.2.1 Overview

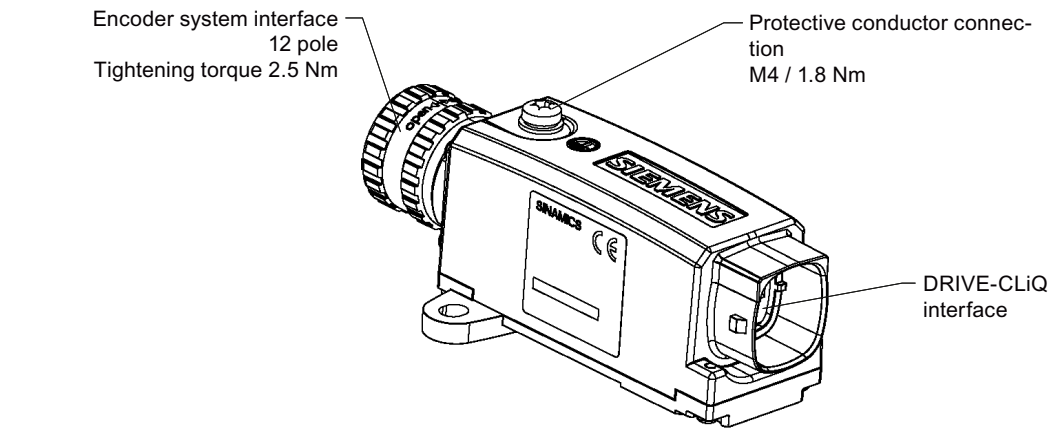
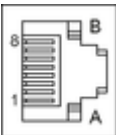


Figure 10-28 Interface description SME20

10.8.2.2 DRIVE-CLiQ interface

Table 10-27 DRIVE-CLiQ interface

	Pin	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		
Current consumption, maximum 0.25 A			

The blanking cover for the DRIVE-CLiQ port to secure the degree of protection IP 67 is not included in the scope of delivery.

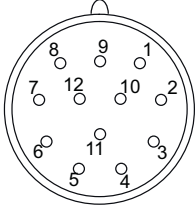
Blanking covers (6 units), article number: 6SL3066-4CA01-0AA0

Note

Only MOTION-CONNECT DRIVE-CLiQ cables may be used for connections. The maximum cable length is 100 m for MOTION-CONNECT 500, and 75 m for MOTION-CONNECT 800PLUS cables.

10.8.2.3 Encoder system interface

Table 10-28 Encoder system interface SME20

	Pin	Signal name	Technical data
	1	B*	Inverse incremental signal B
	2	P5	Encoder power supply
	3	R	Reference signal R
	4	R*	Inverse reference signal R
	5	A	Incremental signal A
	6	A*	Inverse incremental signal A
	7	-Temp ^{1) 2)}	Temperature sensor ³⁾ Pt1000 / KTY84-130 / PTC / bimetal NC contact
	8	B	Incremental signal B
	9	+Temp ^{1) 2)}	Temperature sensor ³⁾ Pt1000 / KTY84-130 / PTC / bimetal NC contact
	10	M	Ground for encoder power supply
	11	M	Ground for encoder power supply
	12	P5	Encoder power supply
Connector kit:	12 pole, article number: 6FX2003-0SA12		
Measuring current via temperature sensor connection: 2 mA Blanking cover for encoder system interface: Pöppelmann GmbH & Co. KG, Lohne, Article number: GPN 300 F211			

¹⁾ These connections do not have safe electrical separation!

²⁾ Accuracy of the temperature measurement (temperature sensor, including evaluation):

- Pt1000: ± 5 °C (Pt1000 tolerance class B acc. to EN 60751)
- KTY: ± 7 °C
- PTC: ± 5 °C

³⁾ Connecting cable: Article number 6FX8002-2CA88-....

NOTICE

Damage to the motor due to incorrectly connected KTY temperature sensor

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

- Connect a KTY temperature sensor with the correct polarity.



! WARNING

Electric shock when the motor temperature sensor insulation fails

When connecting temperature sensors, which have no safe protective separation with respect to the motor power circuit, then arcing to the signal electronics can occur.

- Use motors whose temperature sensors have safe electrical separation.
- Use only connecting cables and connectors with safe electrical separation between the wires of the temperature sensor and the wires of the power circuit.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

10.8.3 Connection example

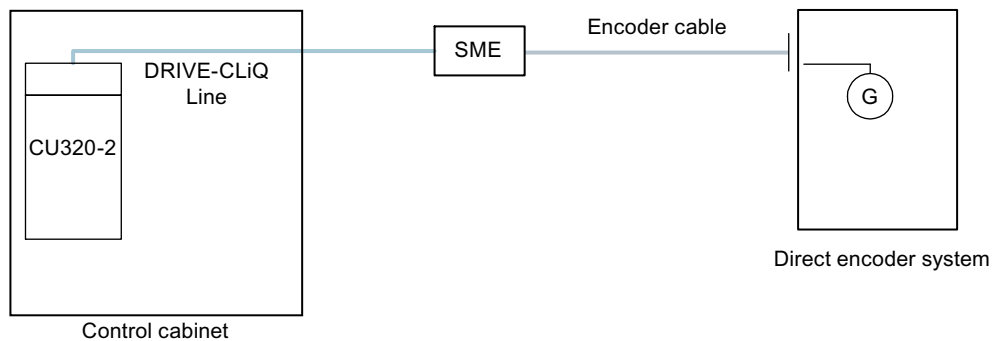


Figure 10-29 Connection of a direct encoder system via a Sensor Module External (SME)

10.8.4 Dimension drawing

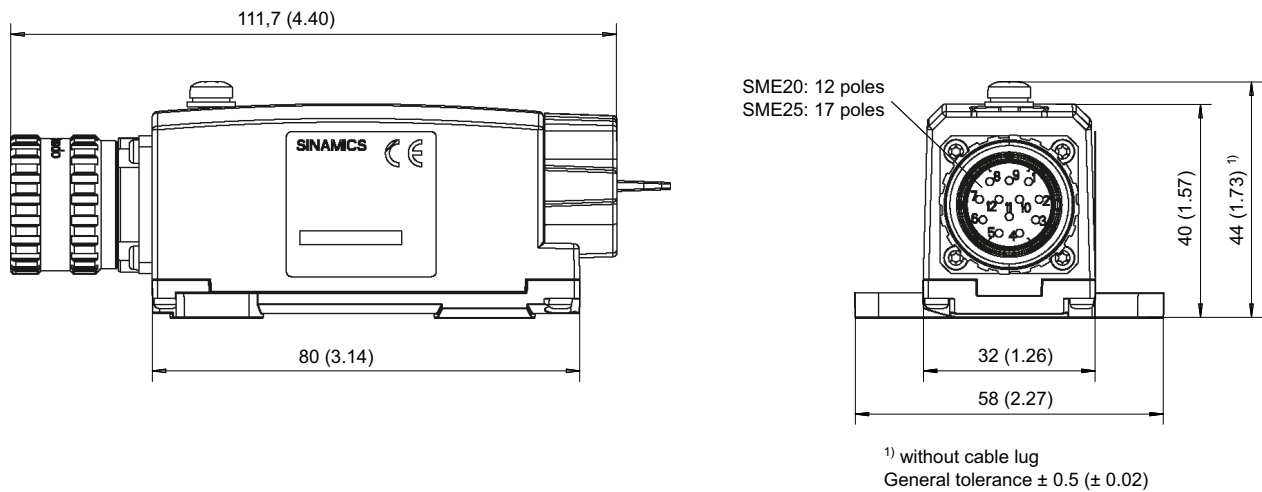


Figure 10-30 Dimension drawing of the Sensor Module External SME20, all data in mm and (inches)

10.8.5 Installation

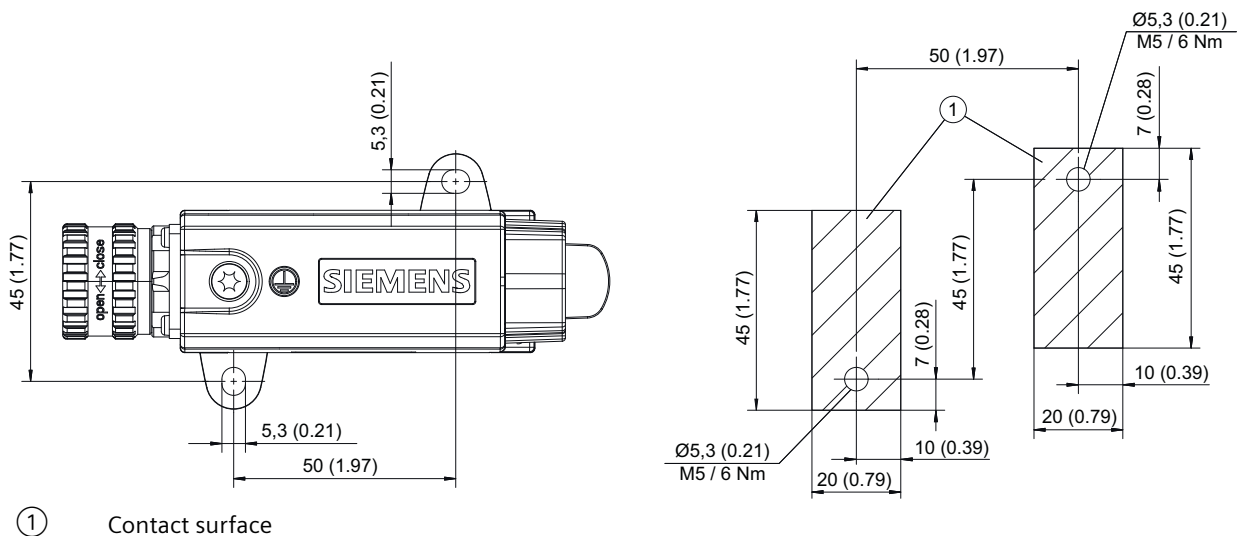


Figure 10-31 Drilling pattern for installing the SME20/SME25

Installation

1. Place the drilling pattern on the mounting surface. Make sure that the contact surface is bare, unpainted metal.
2. Drill two holes with $\varnothing 5.3$ or M5 threaded holes according to the drilling pattern.
3. Fix the Sensor Module to the mounting surface. The tightening torque is 6 Nm (53.1 lbf in).

10.8.6 Technical data

Table 10-29 Technical data

6SL3055-0AA00-5EA.	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 (20.4 ... 28.8)
Current (without encoder system)	A_{DC}	≤ 0.15
Current (with encoder system)	A_{DC}	≤ 0.25
Power loss	W	≤ 4
Max. cable length	m	30
Encoder system power supply		
Voltage	V_{DC}	5
Current	A_{DC}	0.35
Encoder frequency that can be evaluated (f_{encoder})	kHz	≤ 500
Protective ground conductor connection	At the housing with M4 screw	
Weight	kg	0.31

Note

Current controller clock cycle

For a current controller clock cycle of 31.25 μs , an SME20 with article number 6SL3055-0AA00-5EA3 must be used.

The maximum cable length for the encoder system interface depends on the current consumption of the encoder system and the cross-section of the wire in the cable. However, the maximum length is 30 m. The figure below applies to encoder systems that operate in the supply voltage range between 4.75 V and 5.25 V. The sample parameters shown are 0.28 mm² cross-section (0.14 mm² supply plus 0.14 mm² Remote Sense wires) and 0.64 mm² (0.5 mm² supply plus 0.14 mm² Remote Sense wires).

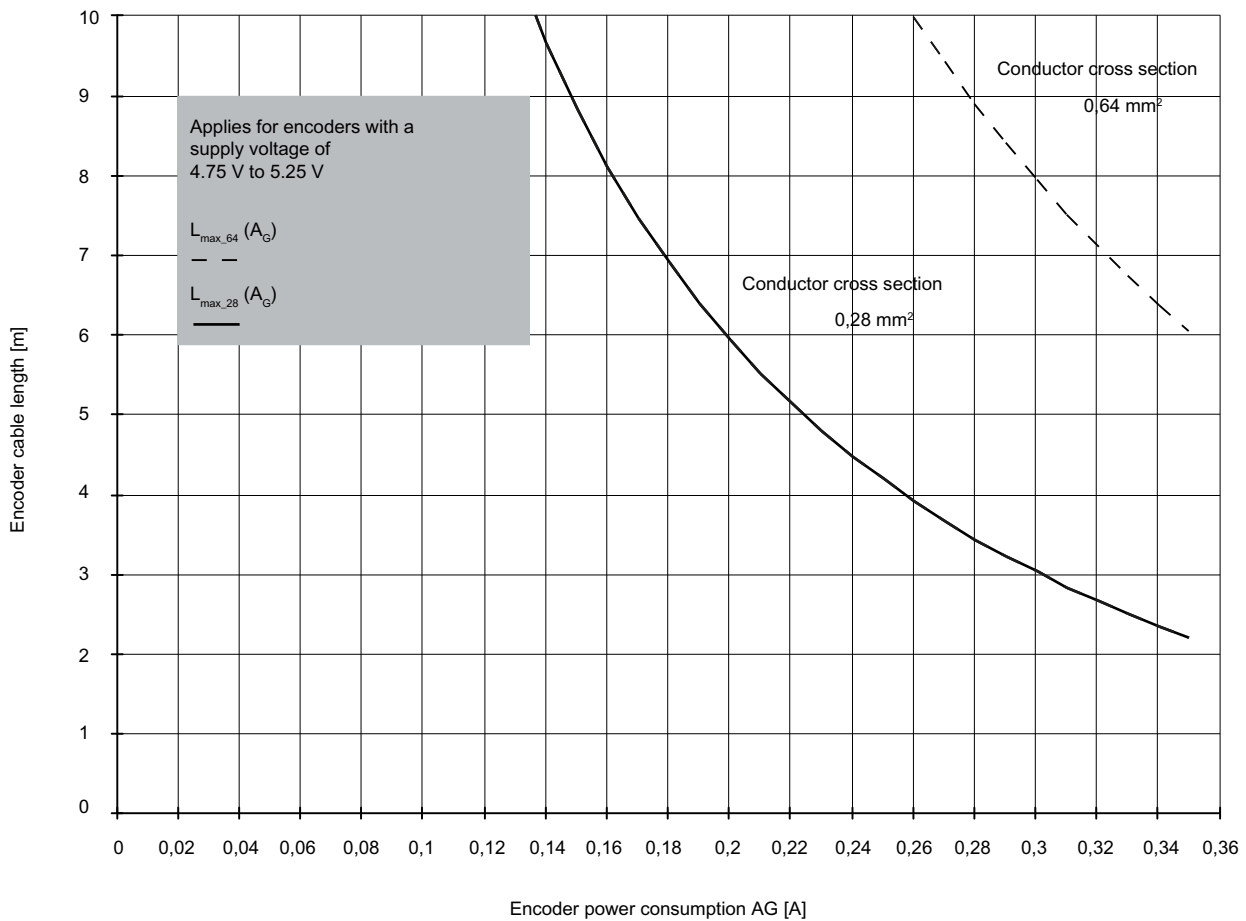


Figure 10-32 Max. cable length as a function of the current drawn by the encoder system

In addition to the encoder systems for the supply voltage range of 4.75 V to 5.25 V in the diagram above, encoder systems are also available for the extended range down to 3.6 V. These are generally operable using encoder system cables up to 30 m in length, provided that the total cross-section of the supply plus Remote Sense wires does not fall below 0.14 mm².

10.9 Sensor Module External SME25

10.9.1 Description

Direct encoder systems outside the cabinet can be connected to the Sensor Module External SME25. The SME25 evaluates these encoder systems and converts the calculated values to DRIVE-CLiQ.

Following encoder systems are connectable to absolute encoders:

- Absolute encoder EnDat 2.1 (with SIN/COS incremental signals 1 Vpp)
- Absolute encoder EnDat 2.2 with order designation EnDat01 or EnDat02

- Absolute encoder SSI (with 5 V supply)
- Absolute encoder SSI (with 5 V supply) with SIN/COS incremental signals 1 Vpp

Neither motor nor encoder data are saved in the SME25.

10.9.2 Interface description

10.9.2.1 Overview

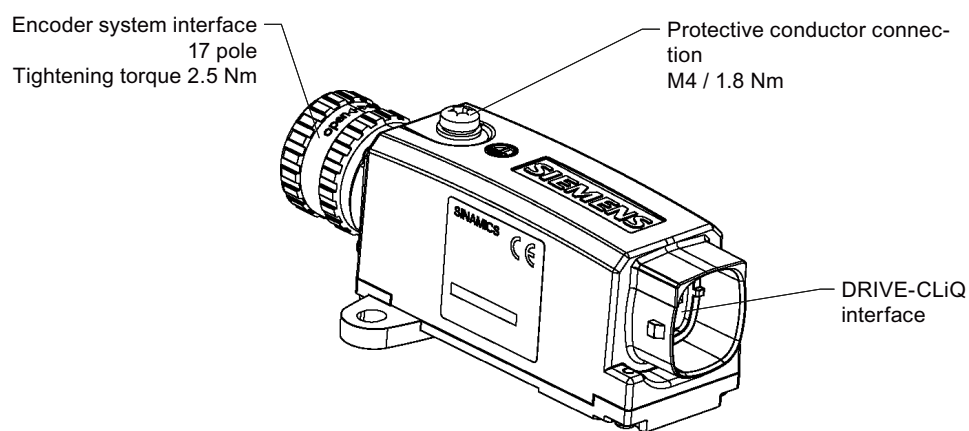
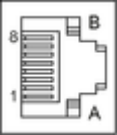


Figure 10-33 Interface description SME25

10.9.2.2 DRIVE-CLiQ interface

Table 10-30 DRIVE-CLiQ interface

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

	Pin	Signal name	Technical specifications
Connector type	DRIVE-CLiQ socket		
Current consumption, maximum 0.25 A			

The blanking cover for the DRIVE-CLiQ port to secure the degree of protection IP 67 is not included in the scope of delivery.

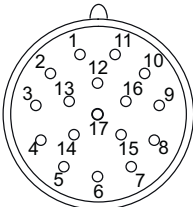
Blanking covers (6 units), article number: 6SL3066-4CA01-0AA0

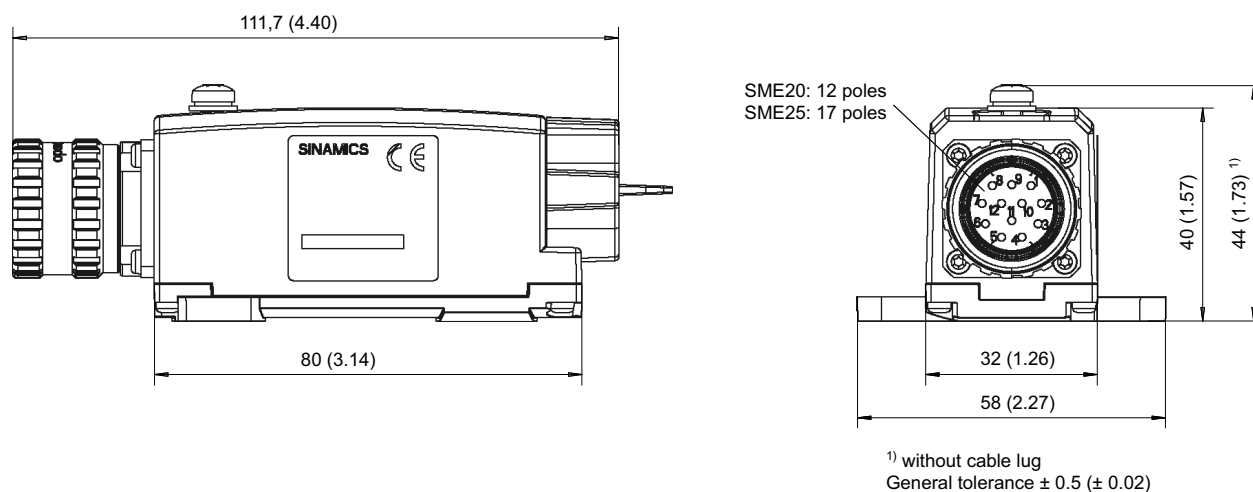
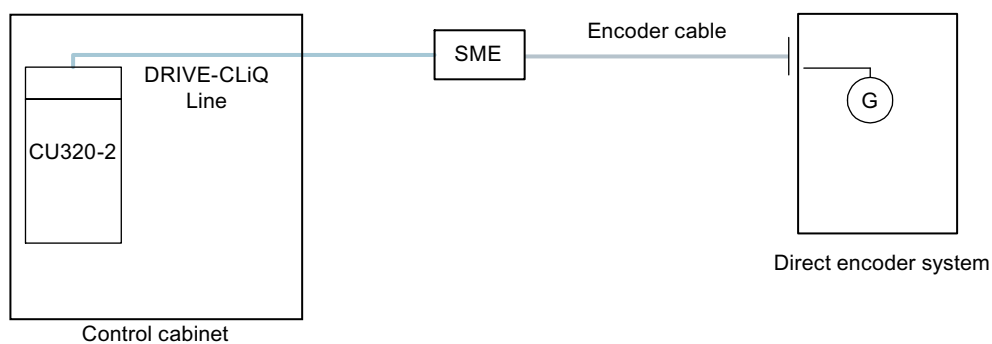
Note

Only MOTION-CONNECT DRIVE-CLiQ cables may be used for connections. The maximum cable length is 100 m for MOTION-CONNECT 500, and 75 m for MOTION-CONNECT 800PLUS cables.

10.9.2.3 Encoder system interface

Table 10-31 Encoder system interface SME25

	Pin	Signal name	Technical data
	1	P5	Encoder power supply
	2	Reserved, do not use	-
	3	Reserved, do not use	-
	4	M	Ground, encoder power supply
	5	Reserved, do not use	-
	6	Reserved, do not use	-
	7	P5	Encoder power supply
	8	Clock	Clock, EnDat interface, SSI clock
	9	Clock*	Inverted clock, EnDat interface, inverted SSI clock
	10	M	Ground, encoder power supply
	11	Housing potential	-
	12	B	Incremental signal B
	13	B*	Inverse incremental signal B
	14	Data	Data, EnDat interface, SSI data
	15	A	Incremental signal A
	16	A*	Inverse incremental signal A
	17	Data*	Inverse data, EnDat interface, Inverse SSI data
Connector kit:	17 pole, article number: 6FX2003-0SA17		
Blanking plate for encoder system interface: Pöppelmann GmbH & Co. KG, Lohne, Article number: GPN 300 F211			



10.9.5 Installation

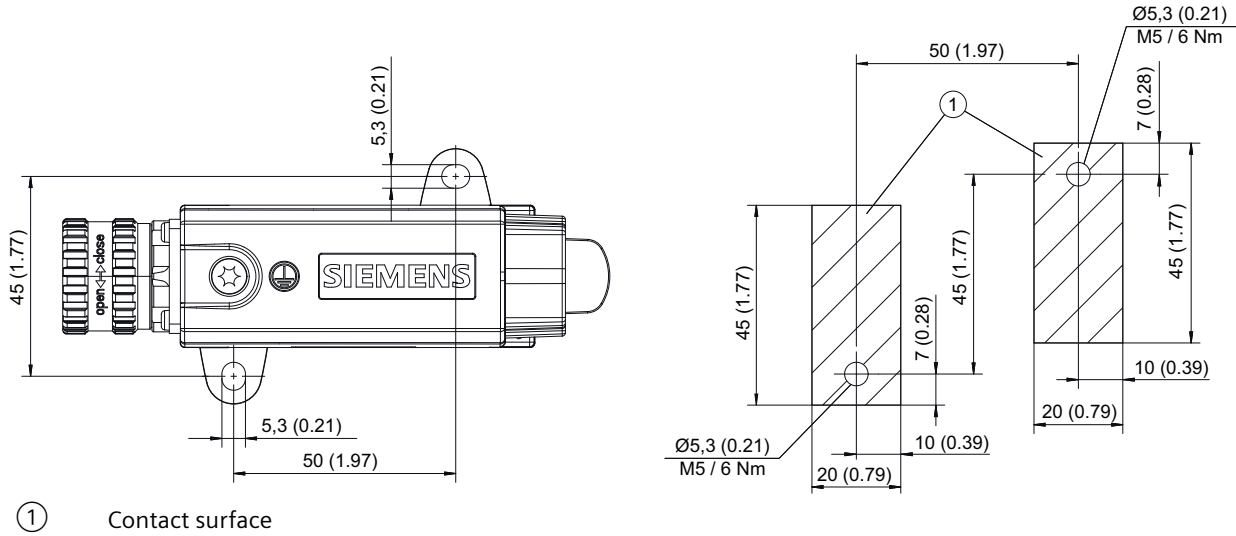


Figure 10-36 Drilling pattern for installing the SME20/SME25

Installation

1. Place the drilling pattern on the mounting surface. Make sure that the contact surface is bare, unpainted metal.
2. Drill two holes with Ø 5.3 or M5 threaded holes according to the drilling pattern.
3. Fix the Sensor Module to the mounting surface. The tightening torque is 6 Nm (53.1 lbf in).

10.9.6 Technical data

Table 10-32 Technical data

6SL3055-0AA00-5HA.	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 (20.4 ... 28.8)
Current (without encoder system)	A_{DC}	≤ 0.15
Current (with encoder system)	A_{DC}	≤ 0.25
Power loss	W	≤ 4
Max. cable length	m	30
Encoder system power supply		
Voltage	V_{DC}	5
Current	A_{DC}	0.35
Encoder frequency that can be evaluated ($f_{encoder}$)	kHz	≤ 500
SSI/EnDat baud rate	kBd	100
Protective ground conductor connection	At the housing with M4 screw	
Weight	kg	0.31

Note**Current controller clock cycle**

For a current controller clock cycle of $31.25 \mu\text{s}$, an SME25 with article number 6SL3055-0AA00-5HA3 must be used.

The maximum cable length for the encoder system interface depends on the current consumption of the encoder system and the cross-section of the wire in the cable. However, the maximum length is 30 m. The figure below applies to encoder systems that operate in the supply voltage range between 4.75 V and 5.25 V. The sample parameters shown are 0.28 mm^2 cross-section (0.14 mm^2 supply plus 0.14 mm^2 Remote Sense wires) and 0.64 mm^2 (0.5 mm^2 supply plus 0.14 mm^2 Remote Sense wires).

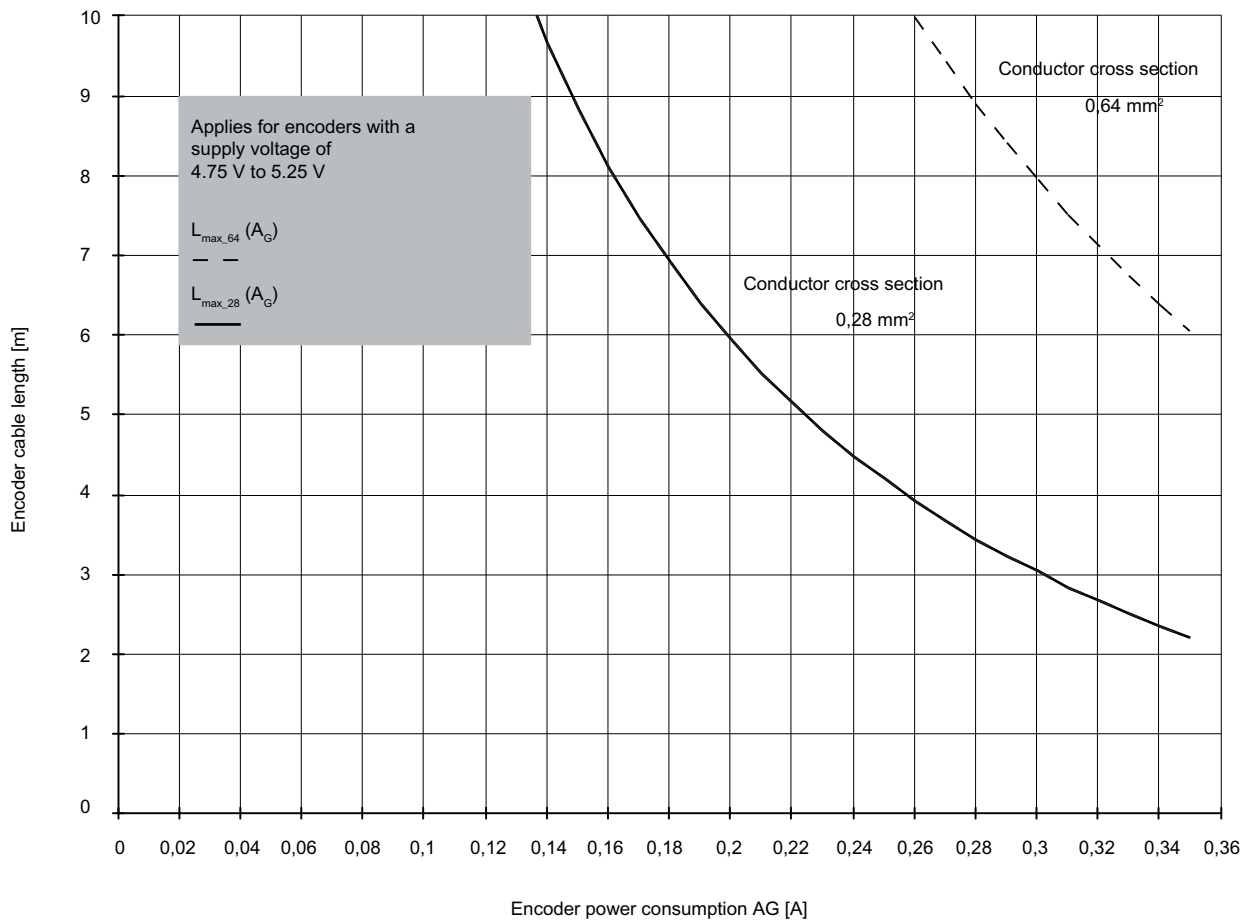


Figure 10-37 Max. cable length as a function of the current drawn by the encoder system

In addition to the encoder systems for the supply voltage range of 4.75 V to 5.25 V in the diagram above, encoder systems are also available for the extended range down to 3.6 V. These are generally operable using encoder system cables up to 30 m in length, provided that the total cross-section of the supply plus Remote Sense wires does not fall below 0.14 mm^2 .

10.10 Sensor Module External SME120

10.10.1 Description

Direct encoder systems outside the cabinet can be connected to the Sensor Module External SME120. The SME120 evaluates these encoder systems and converts the calculated values to DRIVE-CLiQ. Neither motor nor encoder data are saved in the SME120. Incremental direct encoder systems with SIN/COS (1 Vpp) and reference signal can be connected.

An SME120 is always used when the temperature signals of the motors do not have safe electrical separation or where this separation is not possible.

The SME120 is especially used for linear motor applications. A Hall sensor box can be connected to determine the commutation position of a linear motor.

10.10.2 Safety instructions for Sensor Modules External

The safety instructions listed here also apply to the "General safety instructions" and the "Safety instructions for Sensor Modules and encoders", especially for SME12□ Sensor Modules External (□ = 0 or 5).

A Sensor Module External SME12□ is a device belonging to safety class I.



WARNING

Improper handling of an SME12□

When an SME12□ is incorrectly used and handled, protective devices can be disabled, which means that death or severe injury can occur on touching.

- It is mandatory that you connect a protective conductor with a minimum cross-section of 2.5 mm² in order to guarantee safe electrical separation.
- In order to ensure degree of protection IP67, close all connections, even connections that are not used, with connectors or suitable sealing caps. You must observe the specified torques.
- Before commissioning, always replace the plastic covers of connections X100 to X500 using the corresponding connectors, as otherwise the Sensor Modules External SME12□ will not conform to degree of protection IP67.
- Under no circumstances open the Sensor Modules, as this can mean that they are no longer properly sealed! Only a certified SIEMENS service center should carry out repair and maintenance work.
- If it appears that the Sensor Module packaging has been damaged by water, do not commission the Sensor Module.

NOTICE

Damage caused by connecting a grounded encoder system power supply

The devices can be damaged by connecting encoder systems with grounded encoder system power supplies.

- Only connect those encoder systems where the power supply is **not** grounded.

10.10.3 Interface description

10.10.3.1 Overview

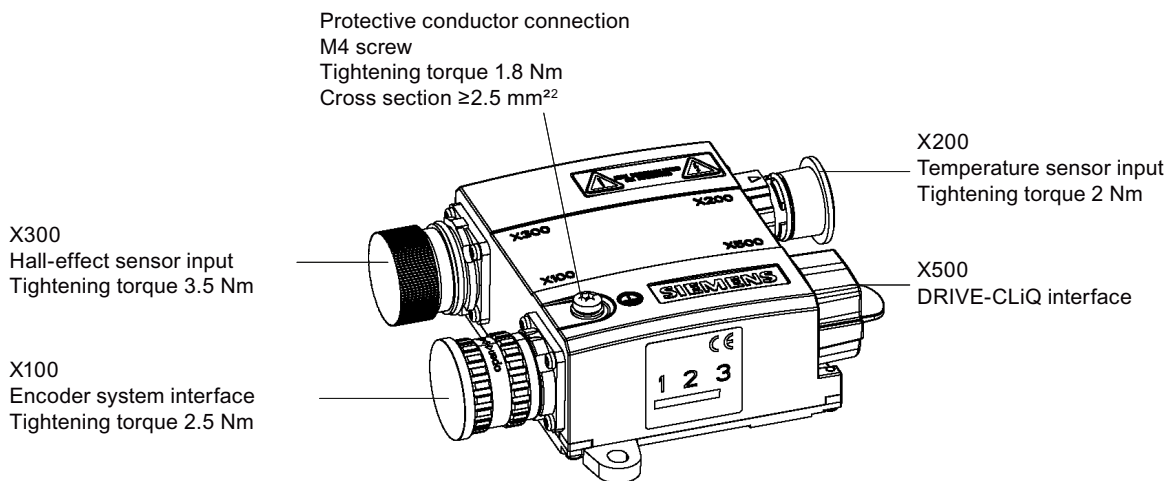
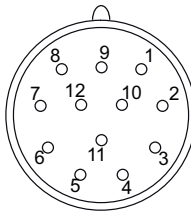


Figure 10-38 Interface description, SME120

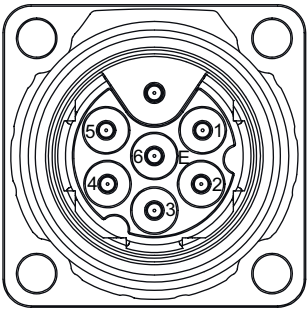
10.10.3.2 X100 encoder system interface

Table 10-33 X100: Encoder system interface

	Pin	Signal name	Technical data
	1	B*	Inverse incremental signal B
	2	P5	Encoder power supply
	3	R	Reference signal R
	4	R*	Inverse reference signal R
	5	A	Incremental signal A
	6	A*	Inverse incremental signal A
	7	Reserved, do not use	-
	8	B	Incremental signal B
	9	Reserved, do not use	-
	10	M	Ground, encoder power supply
	11	M	Ground, encoder power supply
	12	P5	Encoder power supply
Connector kit:	12 pole, article number: 6FX2003-0SA12		
Blanking plate for encoder system interface: Pöppelmann GmbH & Co. KG, Lohne, Article number: GPN 300 F211,			

10.10.3.3 X200 thermistor sensor input

Table 10-34 X200: Temperature sensor input

	Pin	Function	Technical data
	1	-Temp ¹⁾	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact for linear and torque motor applications, connect the KTY84-130 or Pt1000 motor temperature sensor here
	2	+Temp ¹⁾	
	3	+Temp ¹⁾	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact for linear and torque motor applications, connect the PTC triplet 1 or bimetal NC contact here
	4	-Temp ¹⁾	
	5	+Temp ¹⁾	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact for torque motor applications, connect the PTC triplet 2 here
	6	-Temp ¹⁾	
Connector kit:	6+1-pole, article number: 6FX2003-0SU07		
Measuring current via temperature sensor connection: 2 mA			

¹⁾ Accuracy of the temperature measurement (temperature sensor, including evaluation):

- Pt1000: ± 5 °C (Pt1000 tolerance class B acc. to EN 60751)
- KTY: ± 7 °C
- PTC: ± 5 °C

NOTICE**Damage to the motor due to incorrectly connected KTY temperature sensor**

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

- Connect a KTY temperature sensor with the correct polarity.

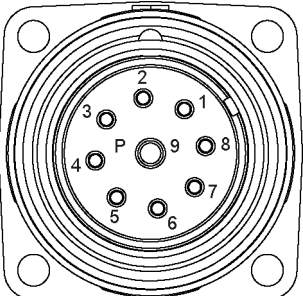
NOTICE**Overheating of the motor through jumpering the temperature sensor connections**

Jumpering temperature sensor connections "+Temp" and "-Temp" results in incorrect measurement results. Damage to the motor can result if overheating is not detected.

- When using several temperature sensors, separately connect the individual sensors to "+Temp" and "-Temp".

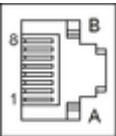
10.10.3.4 X300 hall sensor input

Table 10-35 X300: Hall sensor input

	Pin	Signal name	Technical data
	1	C	Absolute track signal C
	2	C*	Inverse absolute track signal C
	3	P5	Encoder power supply
	4	M	Ground, encoder power supply
	5	D	Absolute track signal D
	6	D*	Inverse absolute track signal D
	7	Not assigned	-
	8	Not assigned	-
	9	Ground	Ground (for internal shield)

10.10.3.5 X500 DRIVE-CLiQ interface

Table 10-36 X500: DRIVE-CLiQ interface

	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		
Power consumption max. 0.30 A			

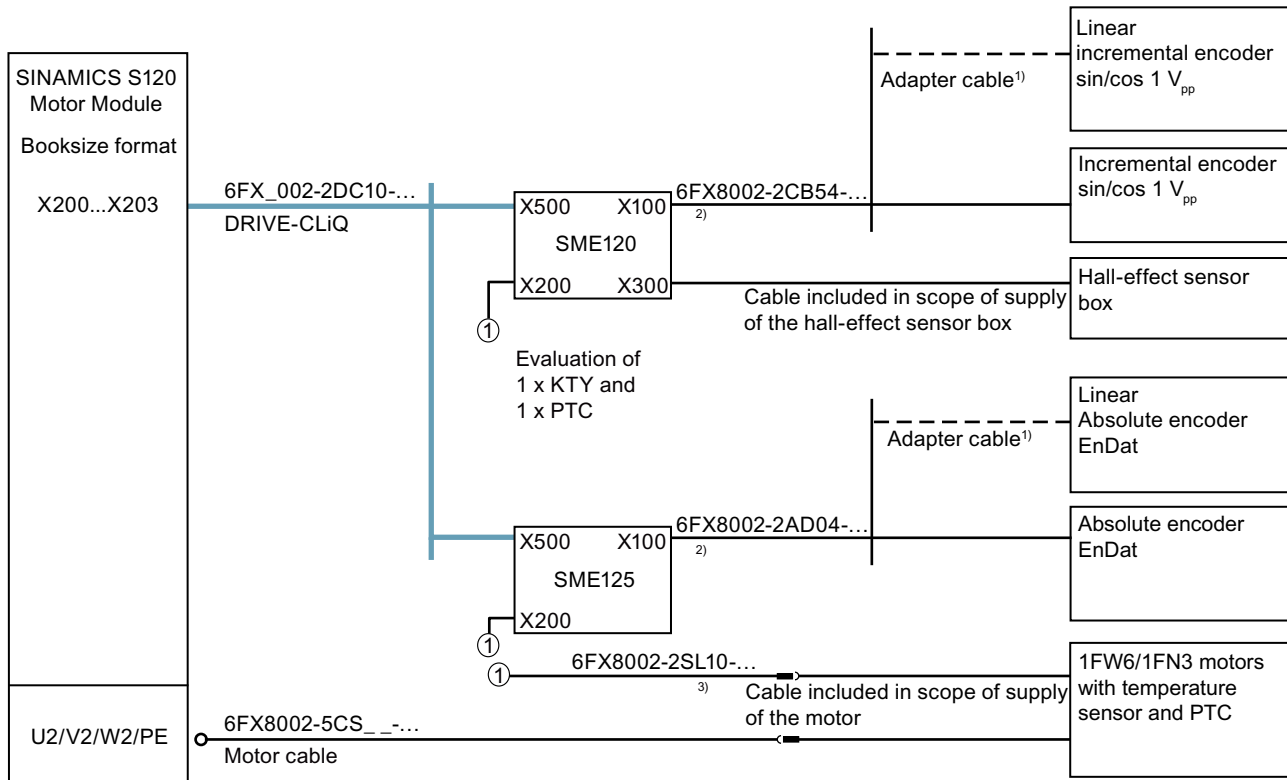
The blanking cover for the DRIVE-CLiQ port to secure the degree of protection IP 67 is not included in the scope of delivery.

Blanking covers (6 units), article number: 6SL3066-4CA01-0AA0

Note

Only MOTION-CONNECT DRIVE-CLiQ cables may be used for connections. The maximum cable length is 100 m for MOTION-CONNECT 500, and 75 m for MOTION-CONNECT 800PLUS cables.

10.10.4 Connection examples



¹⁾ Cable can be ordered from the manufacturer of the linear scale

²⁾ Maximum encoder cable length, see diagram in Chapter "Technical data"

³⁾ Maximum cable length between SME and motor connection: 10 m

Figure 10-39 Connecting motor encoders via SME for motors without a DRIVE-CLiQ interface and molded connecting cables with terminated cable ends

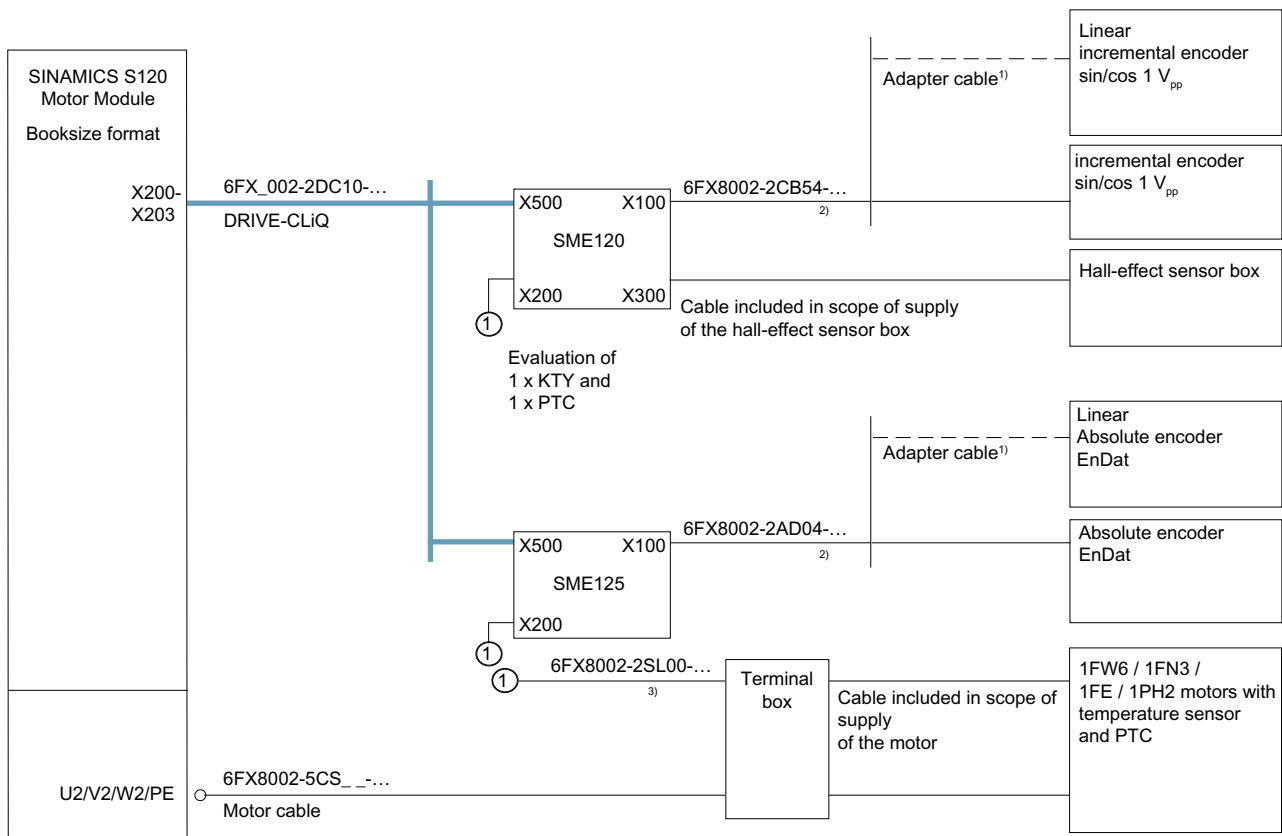
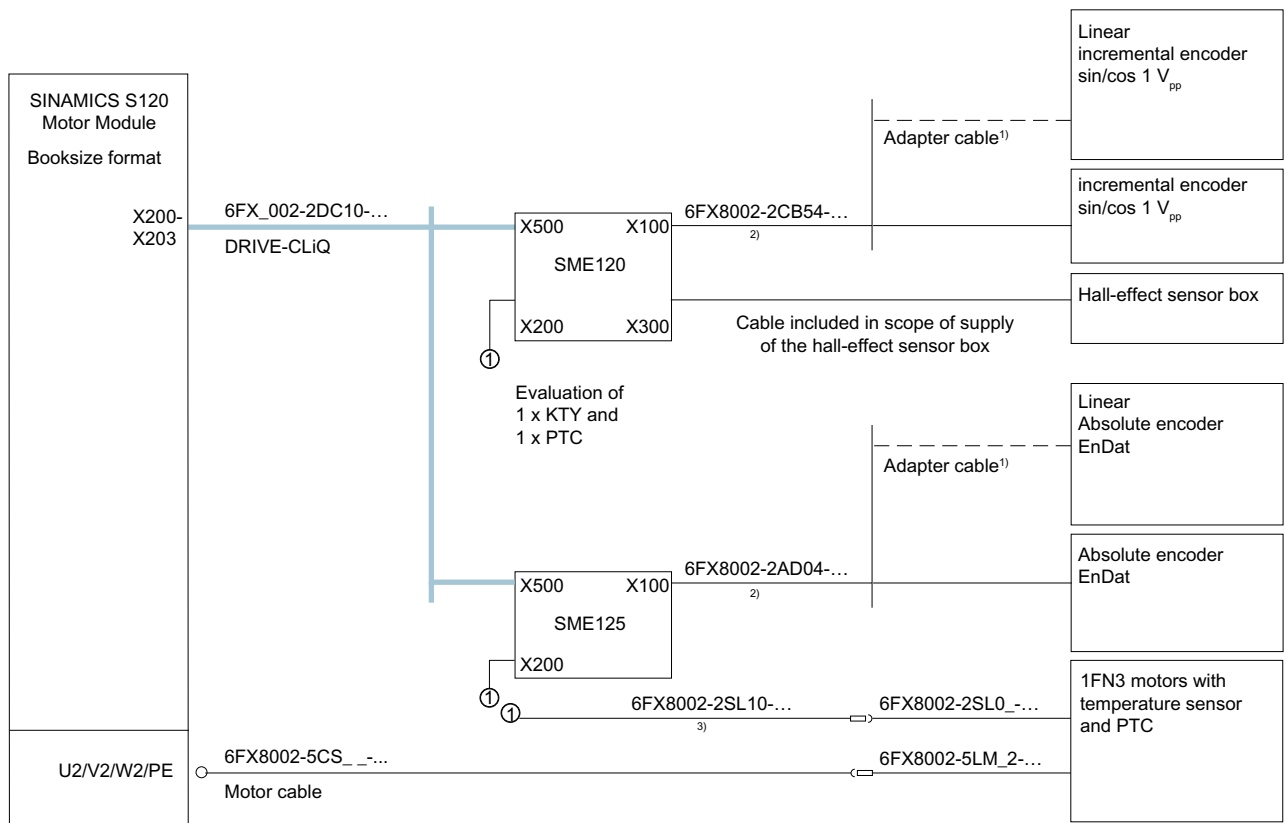


Figure 10-40 Connecting motor encoders via SME for motors without a DRIVE-CLiQ interface and molded connecting cables with open cable ends



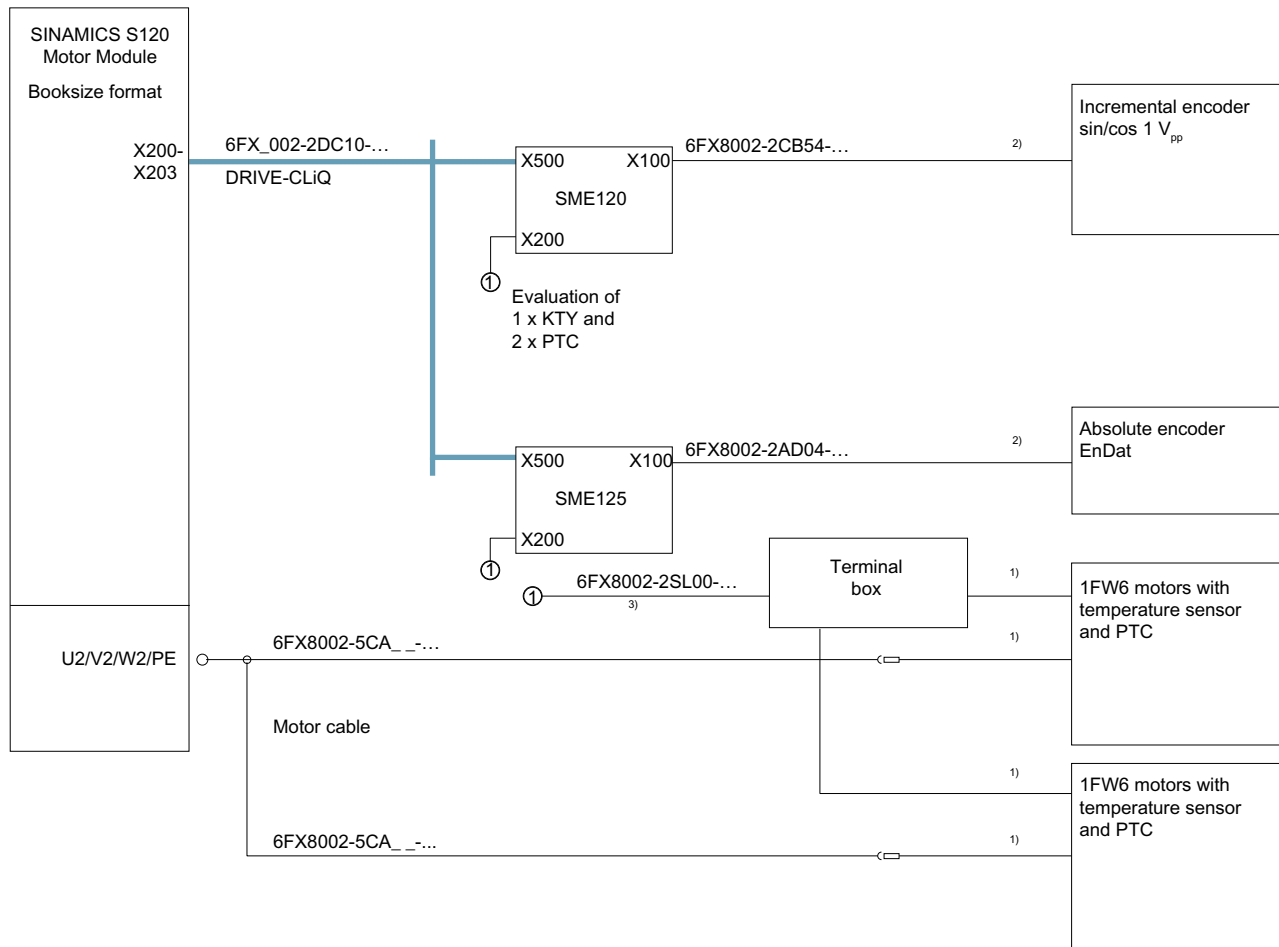
1) Cable can be ordered from the manufacturer of the linear scale

2) Maximum encoder cable length, see diagram in Chapter "Technical data"

3) Maximum cable length between SME and motor connection: 10 m

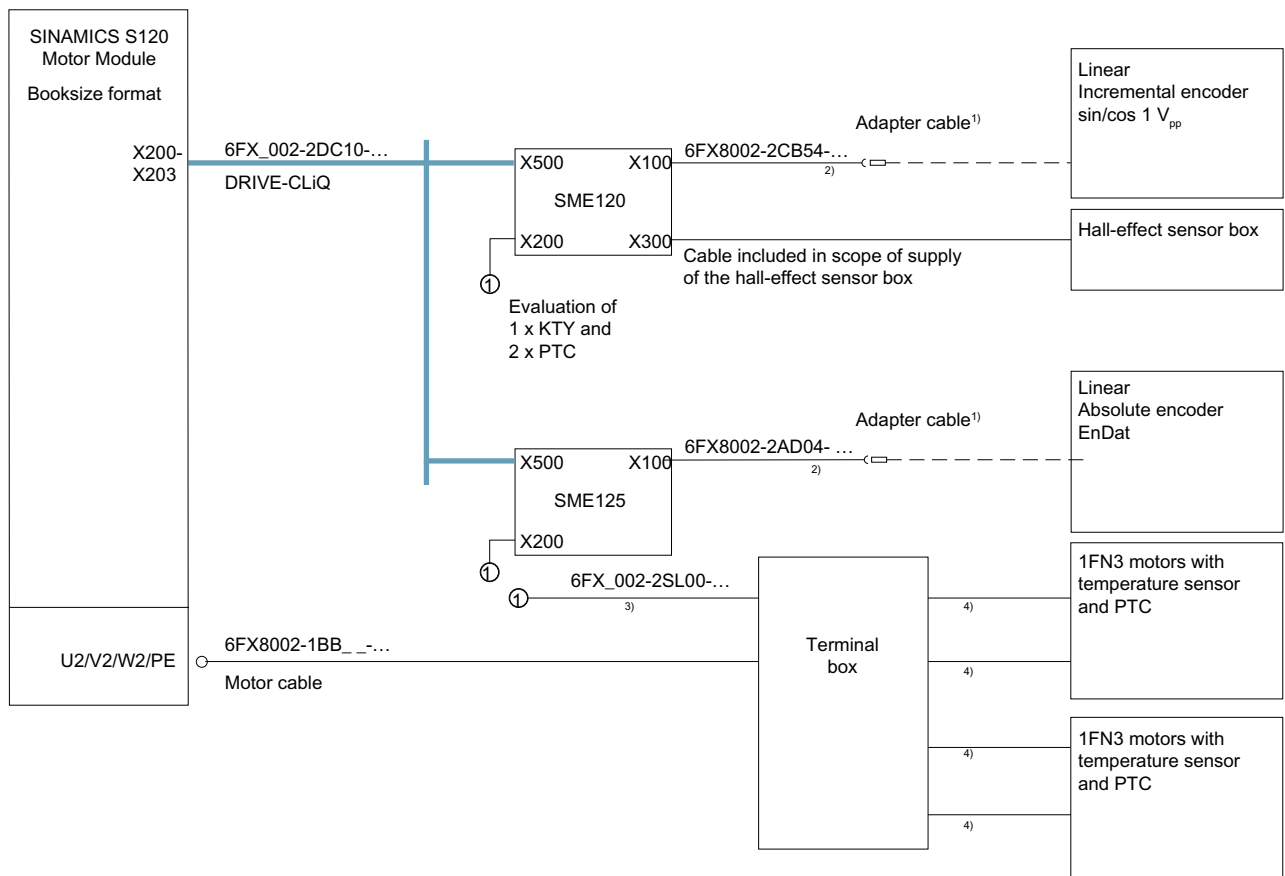
Figure 10-41 Connecting motor encoders via SME for motors without a DRIVE-CLiQ interface, with an integrated 2-hole terminal box

Connection examples for motors connected in parallel



- 1) Cable included in the scope of supply of the motor
- 2) Maximum encoder cable length, see diagram in Chapter "Technical data"
- 3) Maximum cable length between SME and motor connection: 10 m

Figure 10-42 Connecting motor encoders via SME for torque motors connected in parallel without a DRIVE-CLiQ interface



- 1) Cable can be ordered from the manufacturer of the linear scale
- 2) Maximum encoder cable length, see diagram in Chapter "Technical data"
- 3) Maximum cable length between SME and motor connection: 10 m
- 4) Cables are included in the scope of supply of motors without terminal boxes. 6FX8002-2SL0-... cables are to be used for motors with 2-hole terminal boxes.

Figure 10-43 Connecting motor encoders via SME for linear motors connected in parallel without a DRIVE-CLiQ interface

10.10.5 Dimension drawing

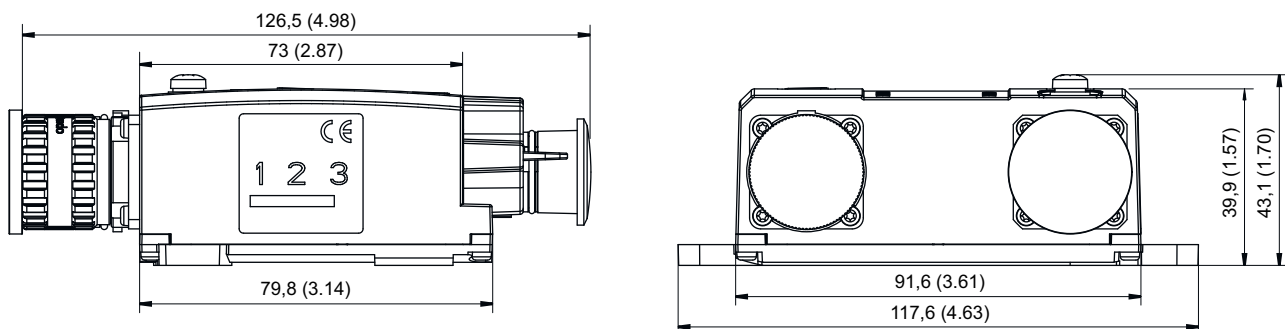
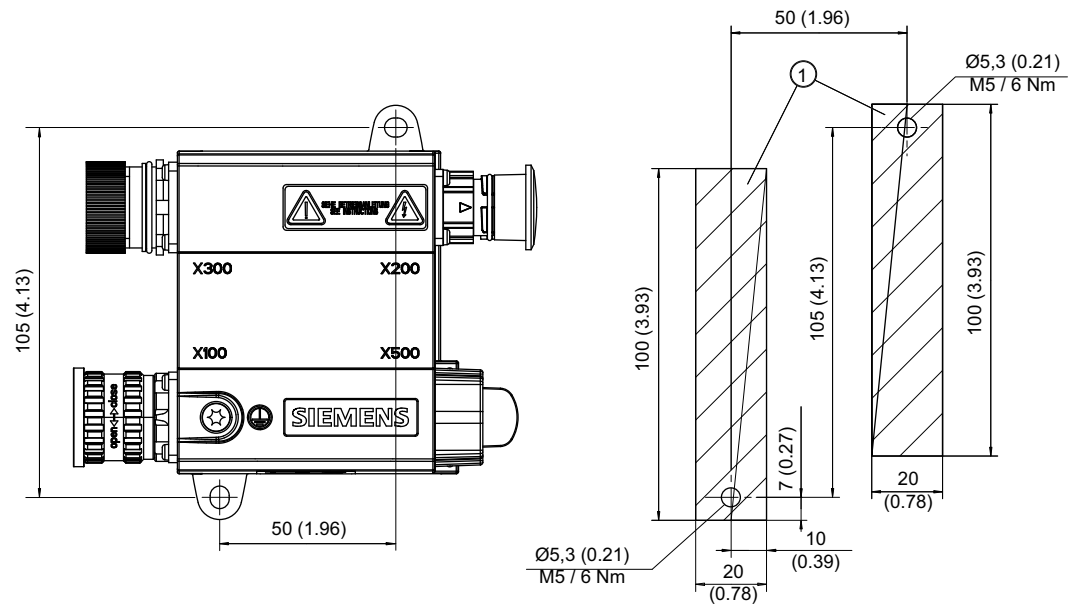


Figure 10-44 Dimension drawing of the Sensor Module External SME120, all data in mm and (inches)

10.10.6 Installation



① Contact surface

Figure 10-45 Hole drilling pattern for installation

Installation

1. Place the drilling pattern on the mounting surface. Make sure that the contact surface is bare, unpainted metal.
2. Drill two holes with Ø 5.3 or M5 threaded holes according to the drilling pattern.
3. Fix the Sensor Module to the mounting surface. The tightening torque is 6 Nm (53.1 lbf in).

10.10.7 Technical data

Table 10-37 Technical data

6SL3055-0AA00-5JA	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 (20.4 ... 28.8)
Current (without encoder system)	A_{DC}	≤ 0.20
Current (with encoder system)	A_{DC}	≤ 0.30
Power loss	W	≤ 4.5
Max. cable length	m	30
Encoder system power supply		
Voltage	V_{DC}	5
Current	A_{DC}	0.35
Encoder frequency that can be evaluated (f_{encoder})	kHz	≤ 500
Protective ground conductor connection	At the housing with M4 screw	
Weight	kg	0.7

Note

Current controller clock cycle

For a current controller clock cycle of 31.25 μs , an SME120 with article number 6SL3055-0AA00-5JA3 must be used.

Note

In order to guarantee the degree of protection, all of the plug connectors must be correctly screwed into place and appropriately locked.

The maximum cable length for the encoder system interface depends on the current consumption of the encoder system and the cross-section of the wire in the cable. However, the maximum length is 30 m. The figure below applies to encoder systems that operate in the supply voltage range between 4.75 V and 5.25 V. The sample parameters shown are 0.28 mm² cross-section (0.14 mm² supply plus 0.14 mm² Remote Sense wires) and 0.64 mm² (0.5 mm² supply plus 0.14 mm² Remote Sense wires).

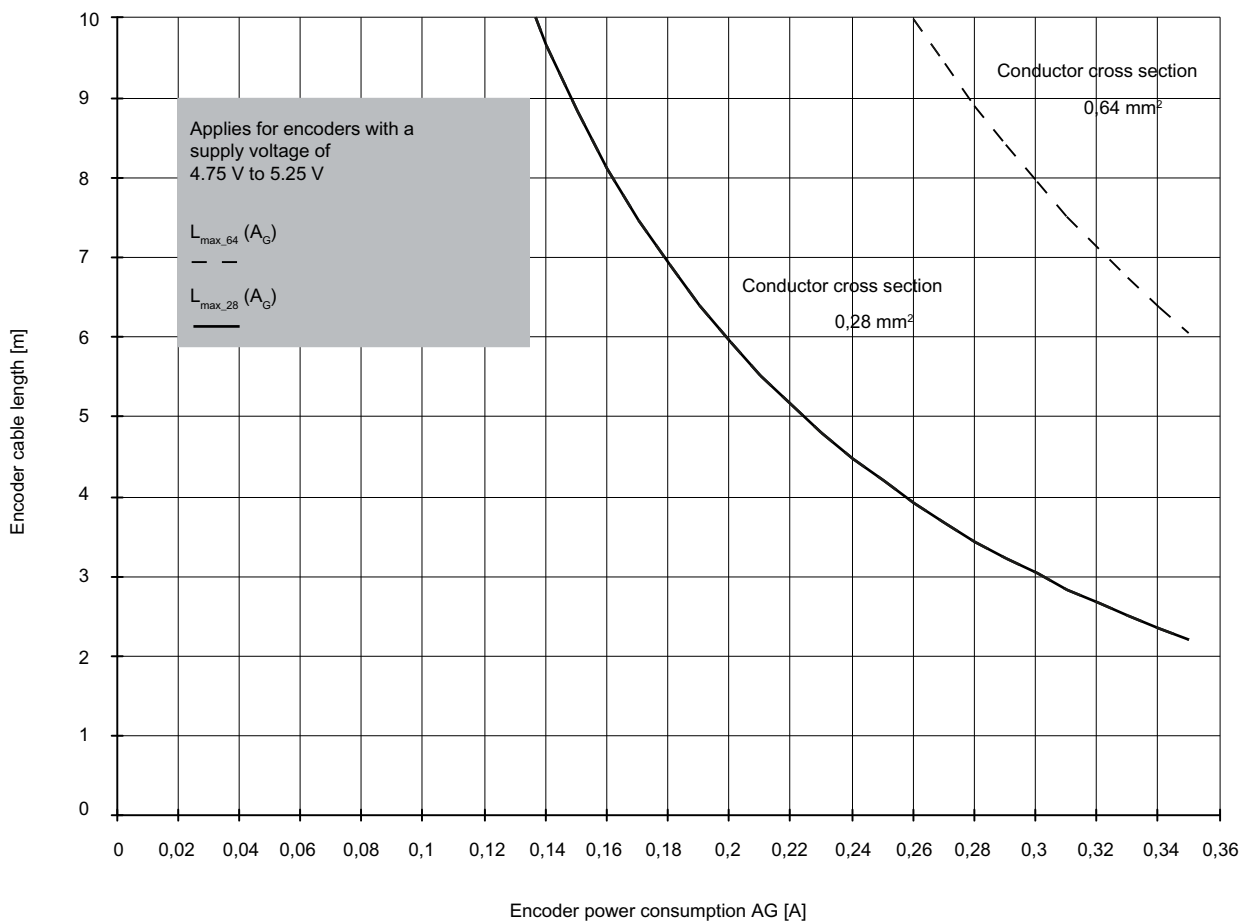


Figure 10-46 Max. cable length as a function of the current drawn by the encoder system

In addition to the encoder systems for the supply voltage range of 4.75 V to 5.25 V in the diagram above, encoder systems are also available for the extended range down to 3.6 V. These are generally operable using encoder system cables up to 30 m in length, provided that the total cross-section of the supply plus Remote Sense wires does not fall below 0.14 mm².

10.11 Sensor Module External SME125

10.11.1 Description

Direct encoder systems outside the cabinet can be connected to the Sensor Module External SME125. The SME125 evaluates these encoder systems and converts the calculated values to DRIVE-CLiQ.

This component is always used when the temperature signals of the motors do not have safe electrical separation or where this separation is not possible. SME125 is mainly used in linear motor applications.

Following encoder systems are connectable to absolute encoders:

- Absolute encoder EnDat 2.1 (with SIN/COS incremental signals 1 Vpp)
- Absolute encoder EnDat 2.2 with order designation EnDat01 or EnDat02
- Absolute encoder SSI (with 5 V supply)
- Absolute encoder SSI (with 5 V supply) with SIN/COS incremental signals 1 Vpp

Neither motor nor encoder data are saved in the SME125.

10.11.2 Safety instructions for Sensor Modules External

The safety instructions listed here also apply to the "General safety instructions" and the "Safety instructions for Sensor Modules and encoders", especially for SME12□ Sensor Modules External (□ = 0 or 5).

A Sensor Module External SME12□ is a device belonging to safety class I.



WARNING

Improper handling of an SME12□

When an SME12□ is incorrectly used and handled, protective devices can be disabled, which means that death or severe injury can occur on touching.

- It is mandatory that you connect a protective conductor with a minimum cross-section of 2.5 mm² in order to guarantee safe electrical separation.
- In order to ensure degree of protection IP67, close all connections, even connections that are not used, with connectors or suitable sealing caps. You must observe the specified torques.
- Before commissioning, always replace the plastic covers of connections X100 to X500 using the corresponding connectors, as otherwise the Sensor Modules External SME12□ will not conform to degree of protection IP67.
- Under no circumstances open the Sensor Modules, as this can mean that they are no longer properly sealed! Only a certified SIEMENS service center should carry out repair and maintenance work.
- If it appears that the Sensor Module packaging has been damaged by water, do not commission the Sensor Module.

NOTICE

Damage caused by connecting a grounded encoder system power supply

The devices can be damaged by connecting encoder systems with grounded encoder system power supplies.

- Only connect those encoder systems where the power supply is **not** grounded.

10.11.3 Interface description

10.11.3.1 Overview

Protective conductor connection
M4 screw
Tightening torque 1.8 Nm
Cross section $\geq 2.5 \text{ mm}^2$

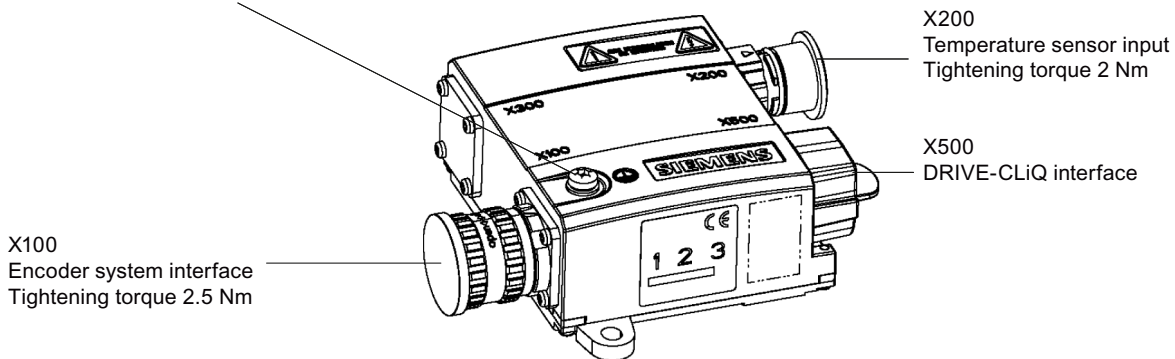
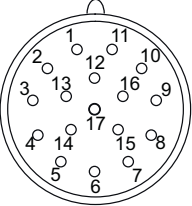


Figure 10-47 Interface description, SME125

10.11.3.2 X100 encoder system interface

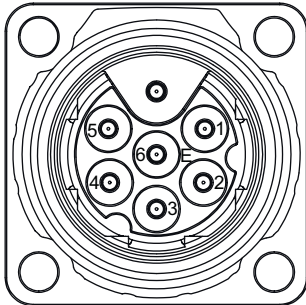
Table 10-38 X100: Encoder system interface

	Pin	Signal name	Technical data
	1	P5	Encoder power supply
	2	Reserved, do not use	-
	3	Reserved, do not use	-
	4	M	Ground, encoder power supply
	5	Reserved, do not use	-
	6	Reserved, do not use	-
	7	P5	Encoder power supply
	8	Clock	Clock, EnDat interface, SSI clock
	9	Clock*	Inverted clock, EnDat interface, inverted SSI clock
	10	M	Ground, encoder power supply
	11	Housing potential	-
	12	B	Incremental signal B
	13	B*	Inverse incremental signal B
	14	Data	Data, EnDat interface, SSI data
	15	A	Incremental signal A
	16	A*	Inverse incremental signal A
	17	Data*	Inverse data, EnDat interface, Inverse SSI data

	Pin	Signal name	Technical data
Connector kit:	17 pole, article number: 6FX2003-0SA17		
Blanking plate for encoder system interface: Pöppelmann GmbH & Co. KG, Lohne, Article number: GPN 300 F211			

10.11.3.3 X200 thermistor sensor input

Table 10-39 X200: Temperature sensor input

	Pin	Function	Technical data
	1	-Temp ¹⁾	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact for linear and torque motor applications, connect the KTY84-130 or Pt1000 motor temperature sensor here
	2	+Temp ¹⁾	
	3	+Temp ¹⁾	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact for linear and torque motor applications, connect the PTC triplet 1 or bimetal NC contact here
	4	-Temp ¹⁾	
	5	+Temp ¹⁾	Temperature sensor Pt1000 / KTY84-130 / PTC / bimetal NC contact for torque motor applications, connect the PTC triplet 2 here
	6	-Temp ¹⁾	
Connector kit:	6+1-pole, article number: 6FX2003-0SU07		
Measuring current via temperature sensor connection: 2 mA			

¹⁾ Accuracy of the temperature measurement (temperature sensor, including evaluation):

- Pt1000: ± 5 °C (Pt1000 tolerance class B acc. to EN 60751)
- KTY: ± 7 °C
- PTC: ± 5 °C

NOTICE

Damage to the motor due to incorrectly connected KTY temperature sensor

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

- Connect a KTY temperature sensor with the correct polarity.

NOTICE

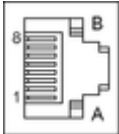
Overheating of the motor through jumpering the temperature sensor connections

Jumpering temperature sensor connections "+Temp" and "-Temp" results in incorrect measurement results. Damage to the motor can result if overheating is not detected.

- When using several temperature sensors, separately connect the individual sensors to "+Temp" and "-Temp".

10.11.3.4 X500 DRIVE-CLiQ interface

Table 10-40 X500: DRIVE-CLiQ interface

	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		
Power consumption max. 0.30 A			

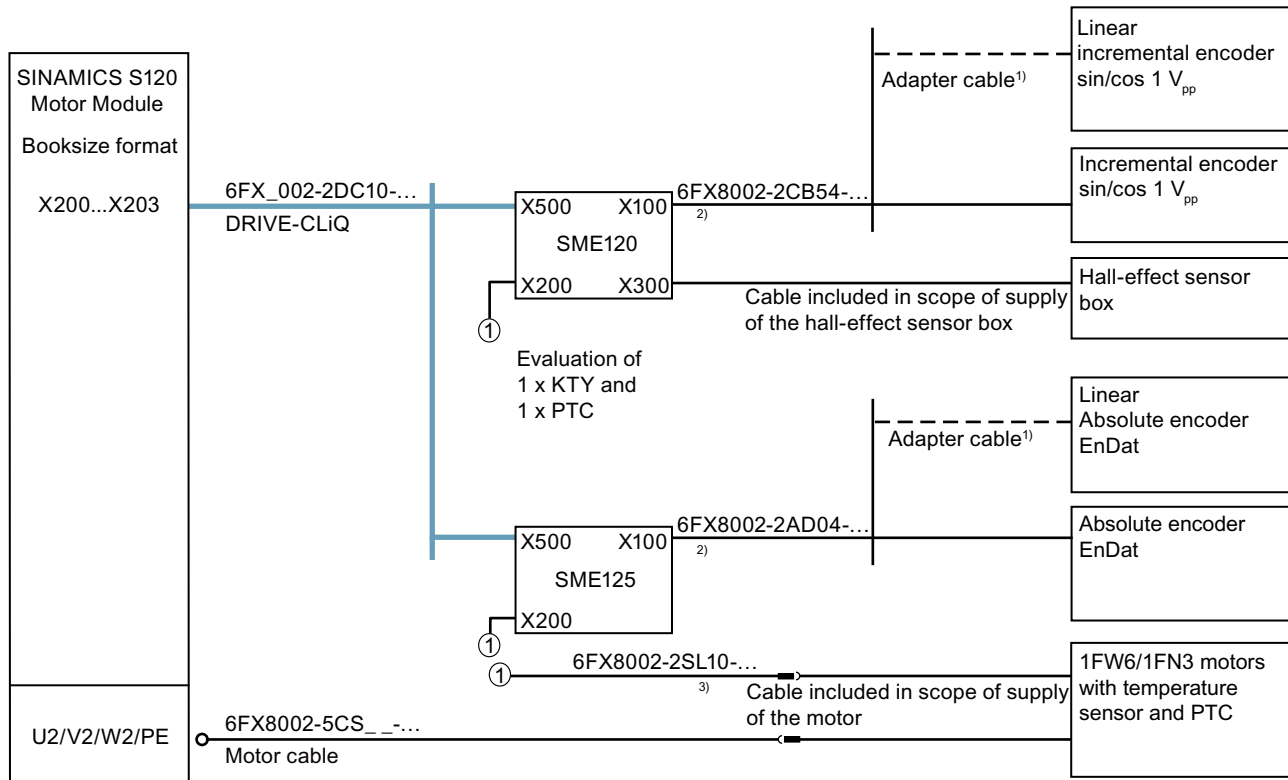
The blanking cover for the DRIVE-CLiQ port to secure the degree of protection IP 67 is not included in the scope of delivery.

Blanking covers (6 units), article number: 6SL3066-4CA01-0AA0

Note

Only MOTION-CONNECT DRIVE-CLiQ cables may be used for connections. The maximum cable length is 100 m for MOTION-CONNECT 500, and 75 m for MOTION-CONNECT 800PLUS cables.

10.11.4 Connection examples

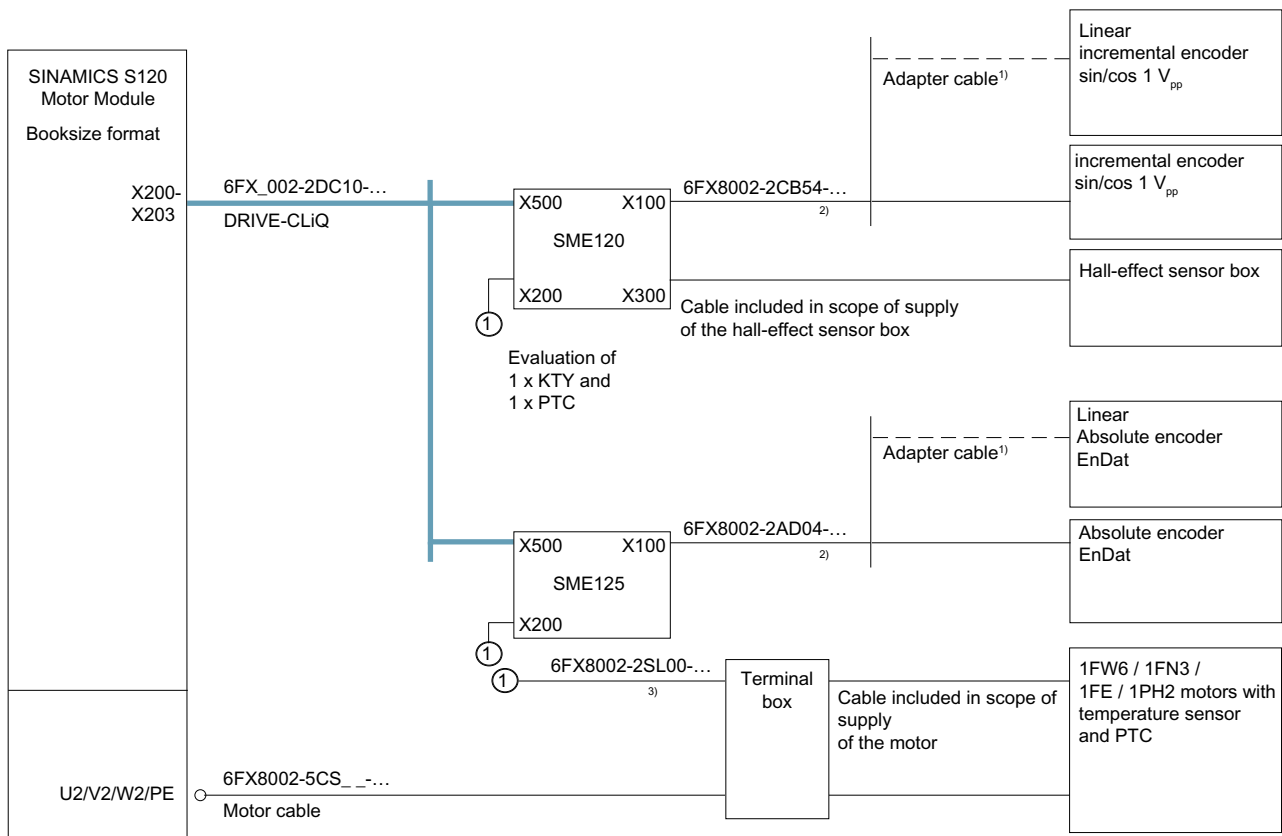


¹⁾ Cable can be ordered from the manufacturer of the linear scale

²⁾ Maximum encoder cable length, see diagram in Chapter "Technical data"

³⁾ Maximum cable length between SME and motor connection: 10 m

Figure 10-48 Connecting motor encoders via SME for motors without a DRIVE-CLiQ interface and molded connecting cables with terminated cable ends



- 1) Cable can be ordered from the manufacturer of the linear scale
- 2) Maximum encoder cable length, see diagram in Chapter "Technical data"
- 3) Maximum cable length between SME and motor connection: 10 m

Figure 10-49 Connecting motor encoders via SME for motors without a DRIVE-CLiQ interface and molded connecting cables with open cable ends

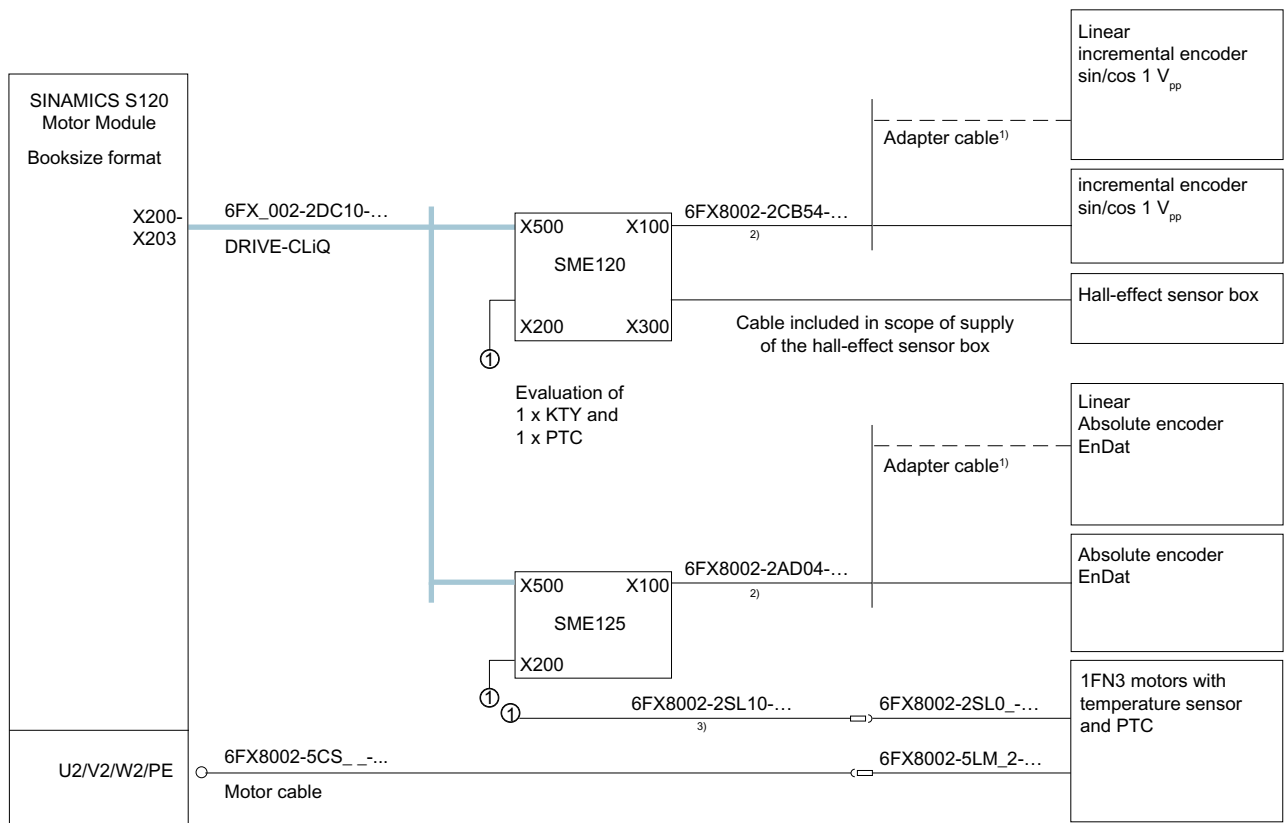
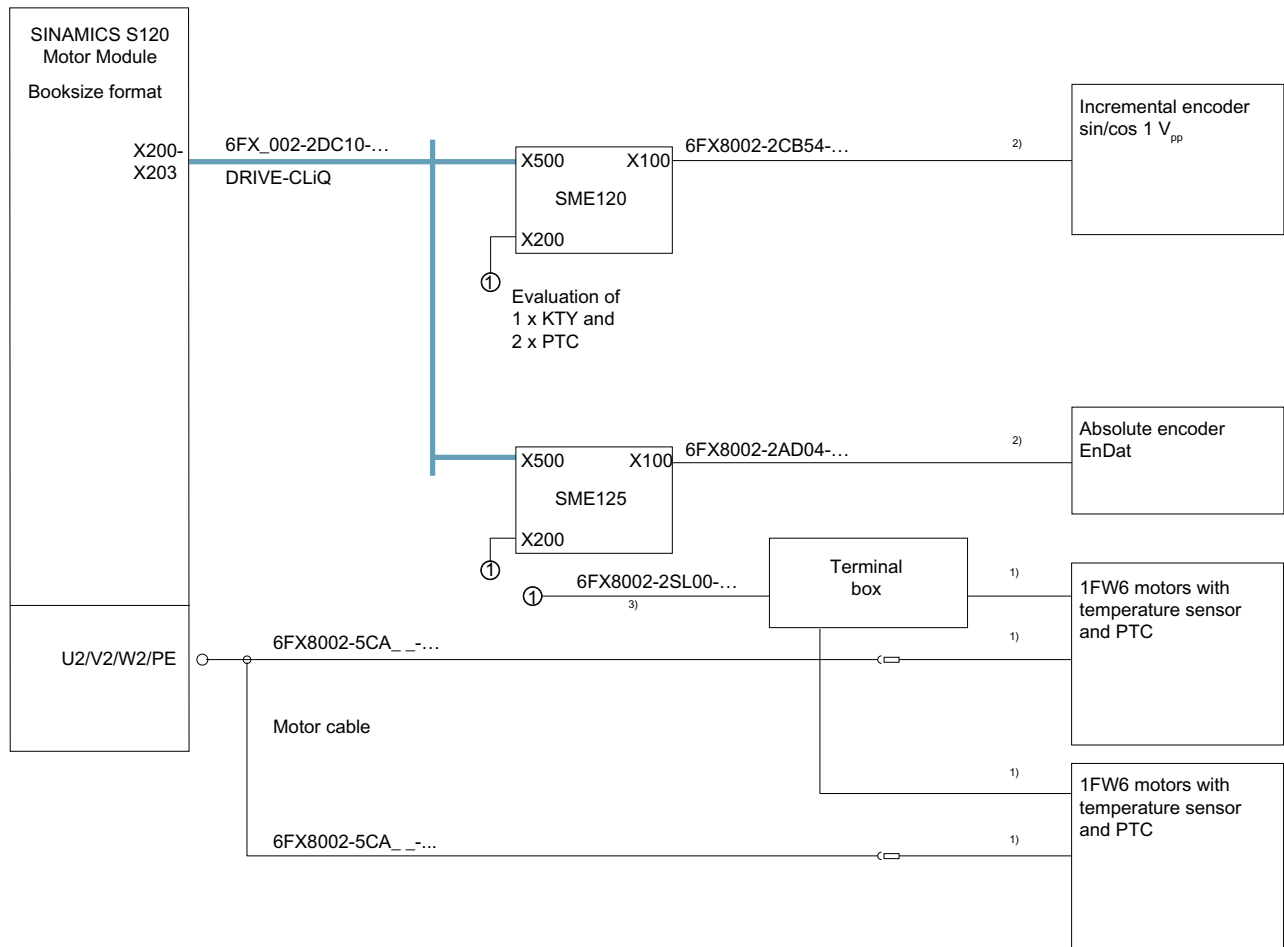


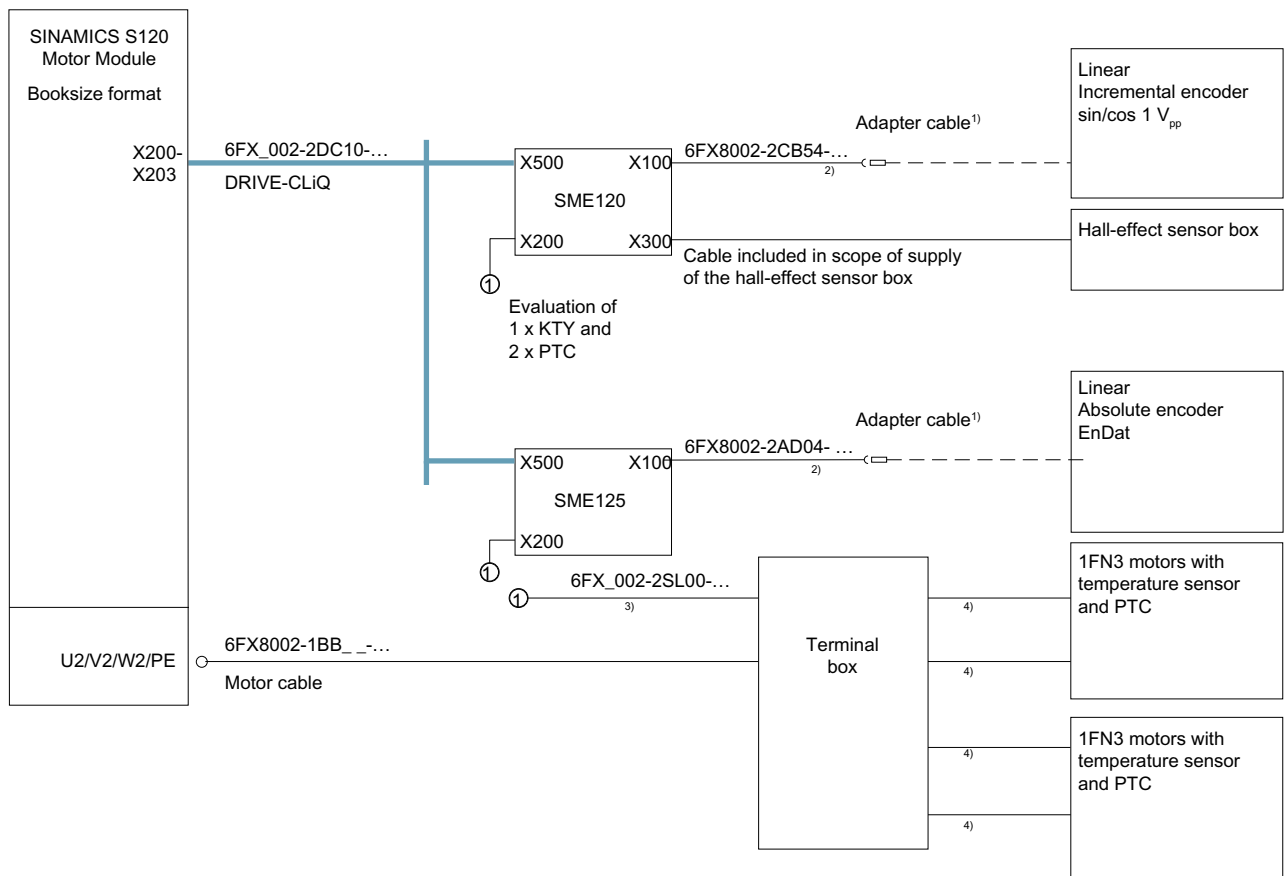
Figure 10-50 Connecting motor encoders via SME for motors without a DRIVE-CLiQ interface, with an integrated 2-hole terminal box

Connection examples for motors connected in parallel



- 1) Cable included in the scope of supply of the motor
- 2) Maximum encoder cable length, see diagram in Chapter "Technical data"
- 3) Maximum cable length between SME and motor connection: 10 m

Figure 10-51 Connecting motor encoders via SME for torque motors connected in parallel without a DRIVE-CLiQ interface



- 1) Cable can be ordered from the manufacturer of the linear scale
- 2) Maximum encoder cable length, see diagram in Chapter "Technical data"
- 3) Maximum cable length between SME and motor connection: 10 m
- 4) Cables are included in the scope of supply of motors without terminal boxes. 6FX8002-2SL0_... cables are to be used for motors with 2-hole terminal boxes.

Figure 10-52 Connecting motor encoders via SME for linear motors connected in parallel without a DRIVE-CLiQ interface

10.11.5 Dimension drawing

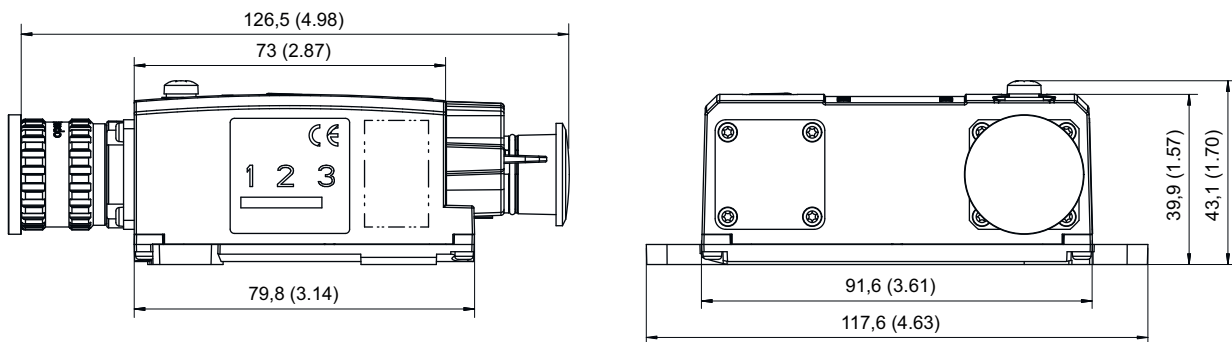
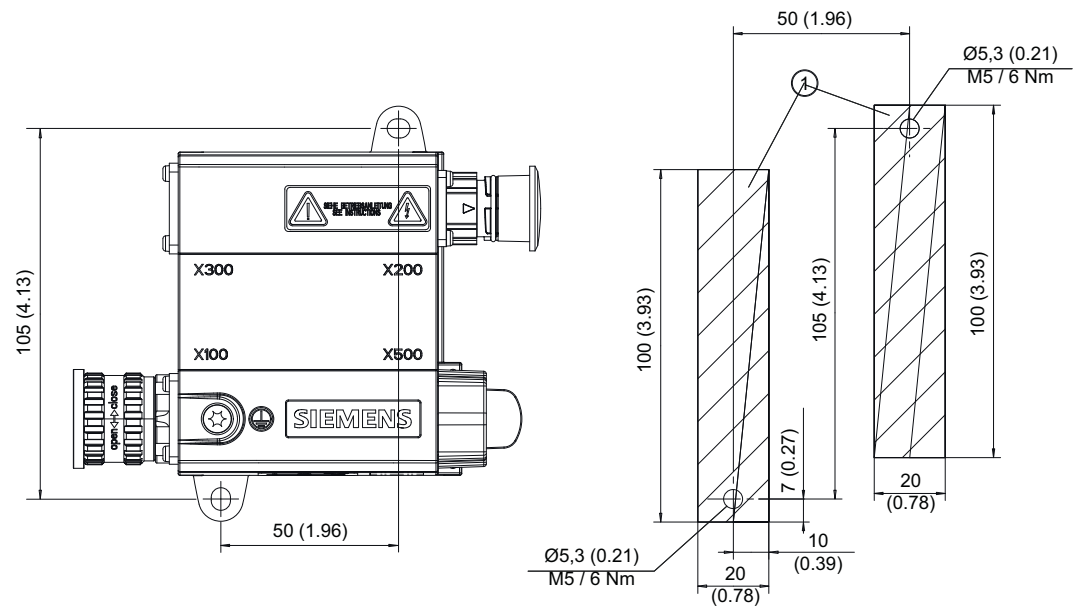


Figure 10-53 Dimension drawing of the Sensor Module External SME125, all data in mm and (inches)

10.11.6 Installation



① Contact surface

Figure 10-54 Hole drilling pattern for installation

Installation

1. Place the drilling pattern on the mounting surface. Make sure that the contact surface is bare, unpainted metal.
2. Drill two holes with Ø 5.3 or M5 threaded holes according to the drilling pattern.
3. Fix the Sensor Module to the mounting surface. The tightening torque is 6 Nm (53.1 lbf in).

10.11.7 Technical data

Table 10-41 Technical data

6SL3055-0AA00-5KA	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 (20.4 ... 28.8)
Current (without encoder system)	A_{DC}	≤ 0.20
Current (with encoder system)	A_{DC}	≤ 0.30
Power loss	W	≤ 4.5
Max. cable length	m	30
Encoder system power supply		
Voltage	V_{DC}	5
Current	A_{DC}	0.35
Encoder frequency that can be evaluated ($f_{encoder}$)	kHz	≤ 500

6SL3055-0AA00-5KA	Unit	Value
SSI/EnDat baud rate	kBd	100
Protective ground conductor connection	At the housing with M4 screw	
Weight	kg	0.7

Note**Current controller clock cycle**

For a current controller clock cycle of 31.25 μ s, an SME125 with article number 6SL3055-0AA00-5KA3 must be used.

Note

In order to guarantee the degree of protection, all of the plug connectors must be correctly screwed into place and appropriately locked.

The maximum cable length for the encoder system interface depends on the current consumption of the encoder system and the cross-section of the wire in the cable. However, the maximum length is 30 m. The figure below applies to encoder systems that operate in the supply voltage range between 4.75 V and 5.25 V. The sample parameters shown are 0.28 mm² cross-section (0.14 mm² supply plus 0.14 mm² Remote Sense wires) and 0.64 mm² (0.5 mm² supply plus 0.14 mm² Remote Sense wires).

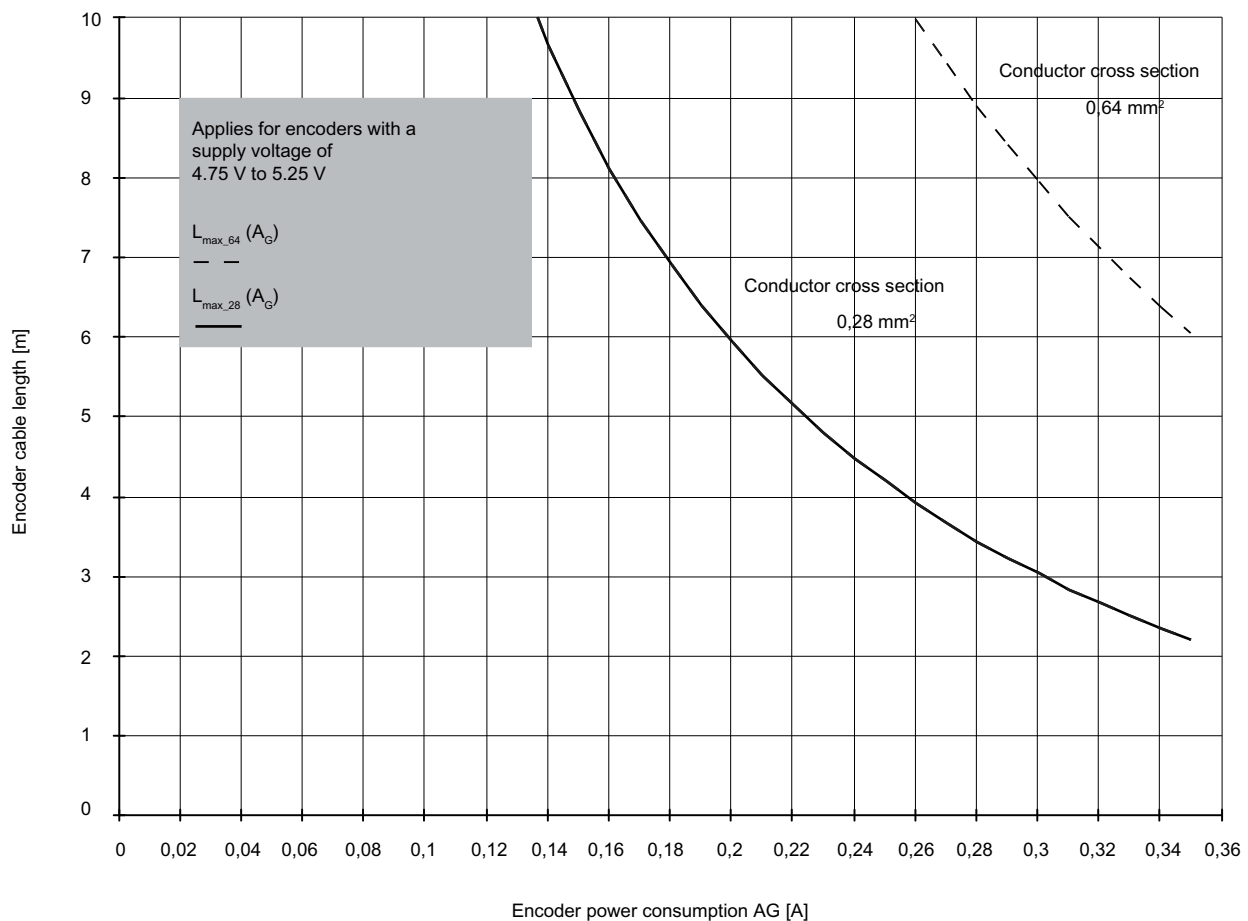


Figure 10-55 Max. cable length as a function of the current drawn by the encoder system

In addition to the encoder systems for the supply voltage range of 4.75 V to 5.25 V in the diagram above, encoder systems are also available for the extended range down to 3.6 V. These are generally operable using encoder system cables up to 30 m in length, provided that the total cross-section of the supply plus Remote Sense wires does not fall below 0.14 mm².

10.12 DRIVE-CLiQ encoder

10.12.1 Description

The DRIVE-CLiQ encoder is available as an absolute encoder with integrated DRIVE-CLiQ interface. The multiturn design of the encoder senses absolute position values extending over 4096 revolutions. The single-turn design senses the absolute position within a revolution.

The most important advantages are:

- Automatic commissioning via DRIVE-CLiQ
- High operating temperatures of 100 °C are possible

10.12 DRIVE-CLiQ encoder

- Integrated diagnostics concept
- Safety-related applications possible with Safety Integrated

Table 10-42 Encoder for mounting with DRIVE-CLiQ

Article No.	Description
6FX2001-5FD13-1AA0	Absolute encoder with DRIVE-CLiQ, single-turn, synchro flange VW 6 mm
6FX2001-5QD13-1AA0	Absolute encoder with DRIVE-CLiQ, single-turn, clamping flange VW 10 mm
6FX2001-5VD13-1AA0	Absolute encoder with DRIVE-CLiQ, single-turn, hollow shaft 10 mm
6FX2001-5WD13-1AA0	Absolute encoder with DRIVE-CLiQ, Single-turn, hollow shaft 12 mm
6FX2001-5FD25-1AA0	Absolute encoder with DRIVE-CLiQ, Multiturn, synchro flange VW 6 mm
6FX2001-5QD25-1AA0	Absolute encoder with DRIVE-CLiQ, Multiturn, clamping flange VW 10 mm
6FX2001-5VD25-1AA0	Absolute encoder with DRIVE-CLiQ, Multiturn, hollow shaft 10 mm
6FX2001-5WD25-1AA0	Absolute encoder with DRIVE-CLiQ, Multiturn, hollow shaft 12 mm

The rotary encoders for absolute position values with safe single-turn information of series 6FX2001-5.D.-1AA0 with serial DRIVE-CLiQ interface meet the basic requirements of the following standards:

- EN 61508: Part 1-4, SIL 2
- EN ISO 13849-1: 2008, Category 3 PL d
- IEC 61800-5-2 (if applicable)

10.12.2 Interface description

10.12.2.1 Overview

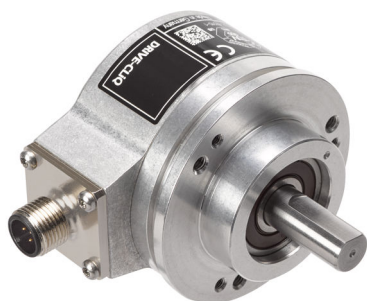
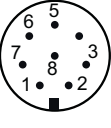


Figure 10-56 DRIVE-CLiQ encoder

10.12.2.2 DRIVE-CLiQ interface

Table 10-43 M12 DRIVE-CLiQ interface, 8-pole A-coded / 8-pin

	Pin	Signal name	Technical data
	1	+ (24 V)	Power supply
	2	Reserved, do not use	-
	3	RXP	Receive data +
	4	RXN	Receive data -
	5	M (0 V)	Electronics ground
	6	TXN	Transmit data -
	7	TXP	Transmit data +
	8	Reserved, do not use	-

10.12.3 Dimension drawings

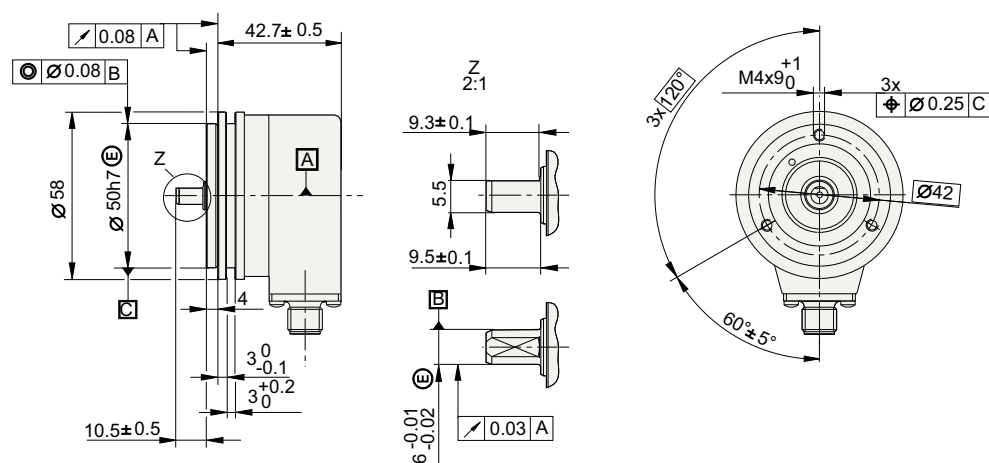


Figure 10-57 Dimension drawing of synchro flange, all data in mm

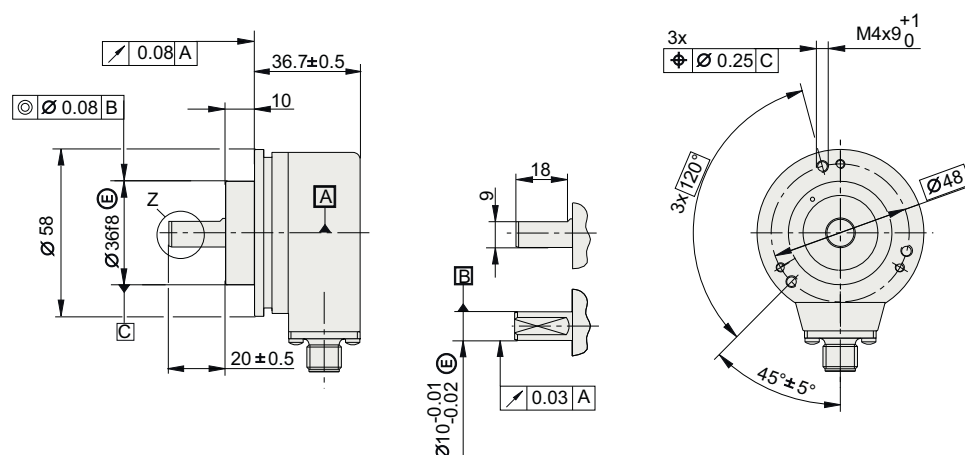


Figure 10-58 Dimension drawing of clamping flange, all data in mm

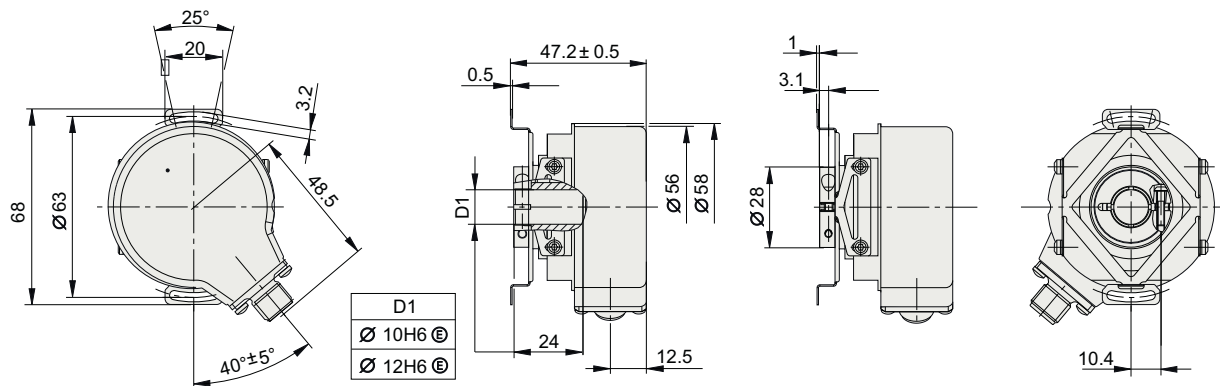


Figure 10-59 Dimension drawing of hollow shaft, all data in mm

10.12.4 Installation

The installation surfaces and screws must be clean and free of grease.

Screw M4 - 8.8 with threadlocker ($0.1 < \text{thread friction coefficient} < 0.16$). Minimum screw-in depth 6 mm. Please observe the hardening time for the threadlocker.

For a permitted surface pressure $P_G \leq 280 \text{ N/mm}^2$, use a washer.

For replacement, recut thread M4 and use new screws with threadlocker.

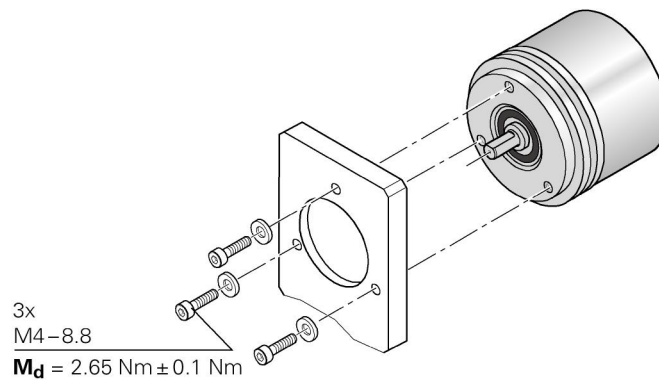


Figure 10-60 Installation: Synchro flange

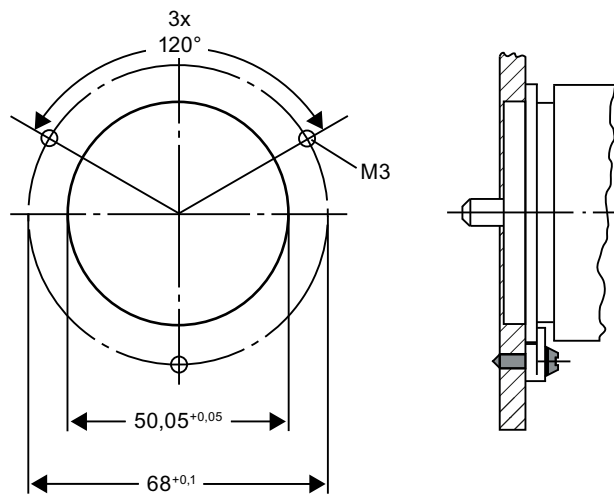


Figure 10-61 Installation with clamp straps

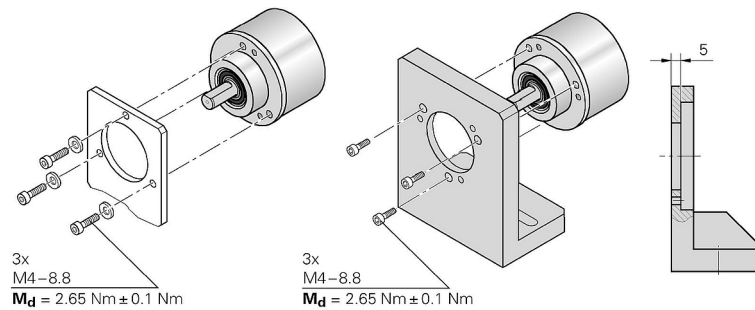


Figure 10-62 Installation: Clamp flange with axial screws

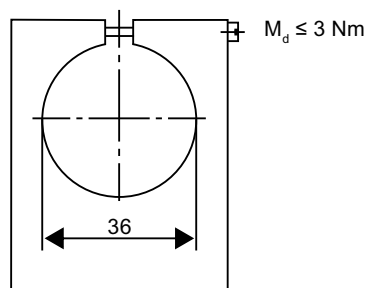


Figure 10-63 Installation: Clamp flange with slotted hole (not suitable for safety-related applications).

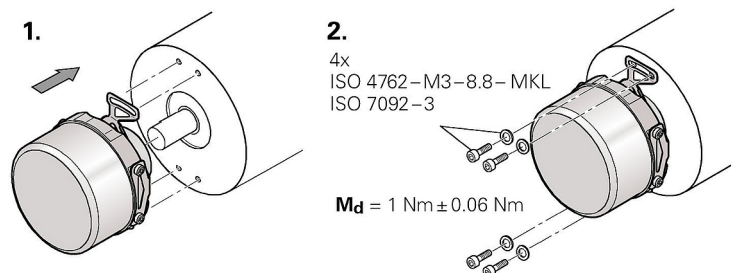


Figure 10-64 Installation: Hollow shaft

Note**Maximum of 4 reuses of screw fastenings**

To ensure functional safety, a screw fastening must not be reused more than 4 times.

10.12.4.1 Mounting accessories

Clamp straps and couplings can be supplied as mounting accessories. The clamp straps are used to fix the encoders with a synchronous flange.

Table 10-44 Selection and ordering data

Designation	Article No.
Clamp strap for encoder synchro flange (3 items are required)	6FX2001-7KP01
Spring disk coupling Shaft diameter: 6 mm / 6 mm 6 mm / 5 mm	6FX2001-7KF10 6FX2001-7KF06
Plug-in coupling Shaft diameter: 6 mm / 6 mm 10 mm / 10 mm	6FX2001-7KS06 6FX2001-7KS10

Table 10-45 Installation instructions

Product name	Unit	Spring disk coupling	Plug-in coupling
Transmission torque, max.	Nm (lbf in)	0.8 (7.1)	0.7 (6.2)
Shaft diameter	mm	6 (both ends) or $d_1 = 6, d_2 = 5$	6 (both ends) or 10 (both ends)
Center offset of shafts, max.	mm	0.4	0.5
Axial offset	mm	± 0.4	± 0.5
Angular displacement of shafts, max.	°	3	1
Torsional rigidity	Nm/rad	150	31
Lateral spring stiffness	N/mm	6	10
Moment of inertia	gcm ²	19	20
Max. speed	rpm	12,000	12,000
Operating temperature	°C	-20 to +150	-20 to +80
Weight, approx.	g	16	20

10.12.5 Technical specifications

Table 10-46 Technical data of DRIVE-CLiQ encoders

Design	Unit	Absolute encoder with DRIVE-CLiQ
Operating voltage at encoder	V	10 ... 28.8
Power consumption Single-turn Multiturn	mA mA	approx. 37 approx. 43
Interface		DRIVE-CLiQ
Transmission rate	Mbit	100
Speed electrically permissible mechanical, max. Single-turn Multiturn	rpm rpm rpm	14000 15000 12000
Cable length , max.	m	100
Connection		Radial flange outlet M12
Resolution Single-turn Multiturn	Bit Bit	24 36 (24-bit single-turn + 12-bit multiturn)
Incremental track	S/R	2048, 1 V _{pp} (encoder internal only)
Code type Transmission		DRIVE-CLiQ
Accuracy	arcsec	±20
Frictional torque	Nm	≤ 0.01 (at 20°C)
Starting torque	Nm	≤ 0.01 (at 20°C)
Shaft load capacity of solid shaft n > 6000 rpm n ≤ 6000 rpm		axial 10 N / radial 20 N at the shaft end axial 40 N / radial 60 N at the shaft end
Shaft diameter Synchro flange Clamp flange Torque arm hollow shaft	mm mm mm	6 with flat 10 with flat 10 or 12
Shaft length Synchro flange Clamp flange	mm mm	10 20
Angular acceleration , max.	rad/s ²	10 ⁵
Moment of inertia of the rotor Solid shaft Hollow shaft	kgm ² kgm ²	2.90 · 10 ⁻⁶ 4.60 · 10 ⁻⁶
Vibration load (55 ... 2000 Hz) Solid shaft Hollow shaft	m/s ² m/s ²	≤ 300 ≤ 150
Shock load (6 ms) Solid shaft Hollow shaft	m/s ² m/s ²	≤ 2000 ≤ 1000
Operating temperature	°C	-30 ... +100

Design	Unit	Absolute encoder with DRIVE-CLiQ
Degree of protection		IP67 at the frame IP64 at the shaft input
Weight		
Single-turn	kg	0.35
Multiturn	kg	0.35

Accessories

11.1 SINAMICS SDI S220

11.1.1 Description

Overview

The CU320-3 PN Control Unit can optionally be equipped with the SINAMICS SDI S220 Control Panel. The SINAMICS SDI S220 Control Panel, which has six keys and a color display, can be used to perform basic functions.

The SINAMICS SDI S220 is inserted in the Control Unit in the place of the blanking cover.

Description

The SINAMICS SDI S220 Control Panel supports the following functions:

- Input and changing of parameters
- Display of operating states and parameters
- Display and acknowledgment of alarms and faults
- QR code for connecting a mobile device (smartphone/tablet) to the web server of the drive

11.1.2 Overview

Overview diagram



Figure 11-1 SINAMICS SDI S220 Control Panel

Table 11-1 Control Panel

Designation	Article number
SINAMICS SDI S220	6SL5155-0SD22-0AA0

11.1.3 Arrangement

Overview

The SINAMICS SDI S220 enables Control Unit monitoring and diagnostics.

Description

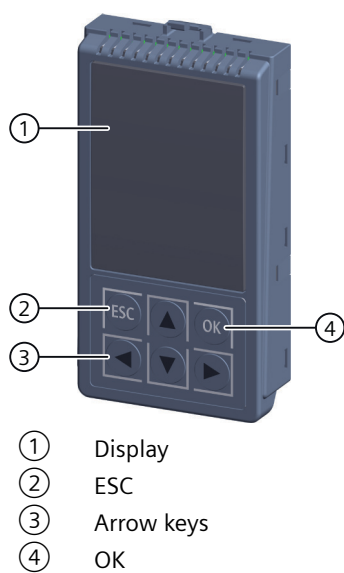


Figure 11-2 Arrangement of the SINAMICS SDI S220

Functions of the control keys:

- ESC
 - Navigation to the next level up
 - The navigation bar can be called from any level by pressing the ESC key for 2 seconds
 - Switch from content area to navigation bar
 - Switch from navigation bar to content area
- Arrow keys
 - Navigation within a level

- OK
 - Confirm selection
 - Switch to editing mode
 - Navigation to the next level down
- Display
 - Control Unit monitoring and diagnostics
 - Display of faults or alarms

As default setting, the display backlight dims after 60 s. In the event of a fault or alarm, backlighting becomes bright again. It remains active until a function is performed at the Control Panel.

11.1.4 Technical specifications

Technical specifications

Table 11-2 Technical specifications of the SINAMICS SDI S220 Control Panel

Feature	Unit	Value
Weight	kg	0.055
Degree of protection	-	IPXXB according to IEC 60529, open type according to UL/CSA

11.1.5 Installing the SINAMICS SDI S220

Overview

The SINAMICS SDI S220 is installed on the CU320-3 PN Control Unit by inserting it in place of the blanking cover on the front of the Control Unit.

Requirement

The following must be ensured when installing the SINAMICS SDI S220:

- The memory card is inserted in the CU320-3 PN Control Unit.
- The SINAMICS SDI S220 may be installed while the Control Unit is operating.

Procedure

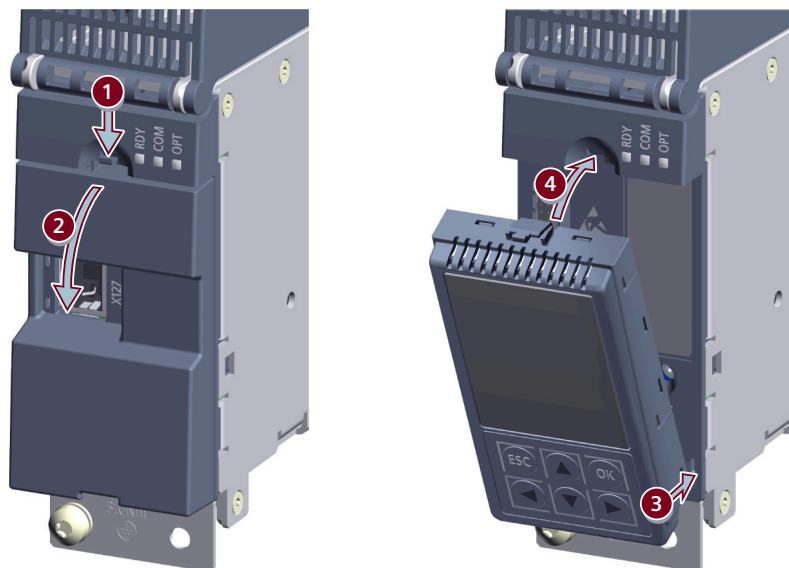


Figure 11-3 Installing the SINAMICS SDI S220 Control Panel

Install the SINAMICS SDI S220 Control Panel as follows:

1. Press the locking latch on the blanking cover down.
2. Fold the blanking cover out and remove it.
3. Insert the SINAMICS SDI S220 at an angle at the bottom of the Control Unit.
4. Press the SINAMICS SDI S220 forward into the Control Unit until it audibly latches in position.
 - Take care to ensure the SINAMICS SDI S220 is inserted into the SDI slot on the Control Unit.

Result

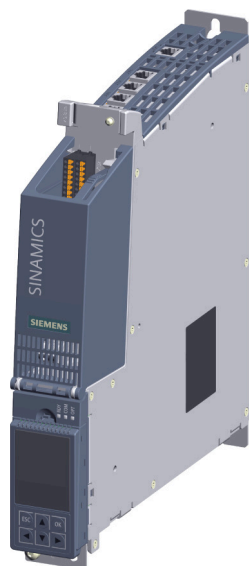


Figure 11-4 SINAMICS SDI S220 Control Panel on a Control Unit

11.1.6 Ordering data for the SINAMICS SDI S220

SINAMICS SDI S220	
Designation	Article number
SINAMICS SDI S220	6SL5155-0SD22-0AA0

11.2 SINAMICS Smart Adapter

11.2.1 Function of the SINAMICS Smart Adapter

Description

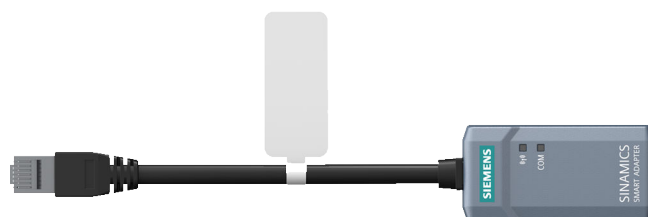


Figure 11-5 SINAMICS Smart Adapter

11.3 SINAMICS SDI Pro 5.5"

The SINAMICS Smart Adapter establishes a WLAN connection between the converter's X127 service interface and an operating unit, for example a tablet, smartphone, panel or PC.

Once plugged into the converter, the SINAMICS Smart Adapter is ready to use. No battery is required.

The SINAMICS Smart Adapter may only be installed temporarily for commissioning and service activities. It may not be used permanently with the converter.

The SINAMICS Smart Adapter supports WPA3 WLAN encryption.

11.2.2 SINAMICS Smart Adapter ordering data

SINAMICS Smart Adapter	
Designation	Article number
SINAMICS Smart Adapter	6SL4950-0AJ00-0AA0

11.3 SINAMICS SDI Pro 5.5"

11.3.1 Function of the SINAMICS SDI Pro 5.5"

Description

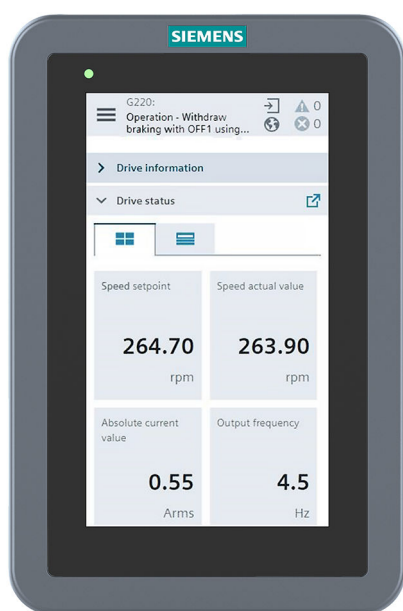


Figure 11-6 SINAMICS SDI Pro 5.5"

The SINAMICS SDI Pro 5.5" control panel can be used to commission and diagnose the drive.

11.3.2 SINAMICS SDI Pro 5.5" order data

SINAMICS SDI Pro 5.5"	
Designation	Article number
SINAMICS SDI Pro 5.5"	6SL4950-0AH35-2AA0

11.4 DRIVE-CLiQ signal cables

11.4.1 Overview

Description

To connect components with one another via DRIVE-CLiQ and DRIVE-CLiQ Express, depending on the application, various pre-assembled and unassembled DRIVE-CLiQ and DRIVE-CLiQ Express signal cables are available.

More information

More information on DRIVE-CLiQ and DRIVE-CLiQ Express signal cables is available on the Internet:

SiePortal MOTION-CONNECT connection systems (<https://sieportal.siemens.com/en-us/products-services/7519999?tree=CatalogTree>)

Wiring rules for DRIVE-CLiQ are provided in Chapter "Rules for wiring DRIVE-CLiQ" in the SINAMICS S220 Function Manual.

11.4.2 Connecting a direct measuring system

Overview

A direct measuring system can be connected via MOTION-CONNECT cables to a DRIVE-CLiQ component.

Description

There are various ways to connect a direct measuring system:

1. Direct connection via a basic cable
2. Connection via a basic cable and 1-3 extensions
3. Connection via a basic cable, cabinet bushing and a maximum of 2 extensions

11.4 DRIVE-CLiQ signal cables

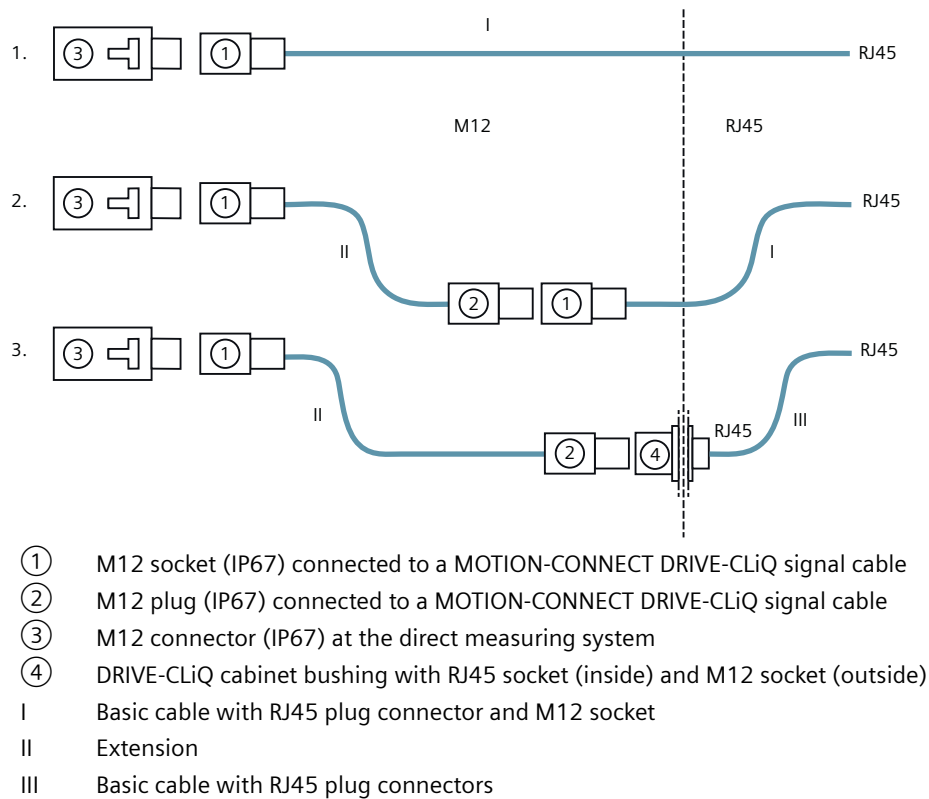


Figure 11-7 Example for connecting a direct measuring system with M12 plug to a DRIVE-CLiQ component with RJ45 socket (IP20)

11.4.3 Cable lengths when using DRIVE-CLiQ couplings

Overview

DRIVE-CLiQ signal cables MC500 and MC800PLUS can be mixed and used together. With this combination of these cable types using DRIVE-CLiQ couplings, the maximum permissible cable length must be calculated.

Description

You calculate the maximum permissible cable length as follows:

DRIVE-CLiQ signal cables with RJ45 plugs (100 Mbit/s) $\Sigma l_{MC500} + 4/3 \cdot \Sigma l_{MC800PLUS} + n_c \cdot 5 \text{ m} \leq 100 \text{ m}$

DRIVE-CLiQ signal cables with M12 plugs (100 Mbit/s) $\Sigma l_{MC500} + 4/3 \cdot \Sigma l_{MC800PLUS} \leq 100 \text{ m}$

Σl_{MC500} = Total length of all MC500 cable elements (fixed routing)

$\Sigma l_{MC800PLUS}$ = Total length of MC800PLUS cable elements (cable carrier)

n_c = Number of DRIVE-CLiQ disconnection locations (0 up to a maximum of 3)

With this combination, DRIVE-CLiQ cables with cable lengths exceeding 75 m can also be used in cable carriers.

Table 11-3 Examples of maximum cable lengths when using a DRIVE-CLiQ coupling

ΣI_{MC500} (fixed routing)	87 m	80 m	66 m	54 m	40 m	30 m	20 m	10 m	5 m
$\Sigma I_{MC800PLUS}$ (cable carrier)	5 m	10 m	20 m	30 m	40 m	48 m	55 m	63 m	66 m
$\Sigma I_{MC500} + \Sigma I_{MC800PLUS}$	92 m	90 m	86 m	84 m	80 m	78 m	75 m	73 m	71 m

11.4.4 Cable lengths when using DRIVE-CLiQ Switch Modules

Overview

By using the DRIVE-CLiQ Switch Module DMC20-3, the maximum permissible cable length of MOTION-CONNECT cables with RJ45 plugs can be doubled.

Description

The same length conditions apply both before as well as after the DRIVE-CLiQ Switch Module. You calculate the maximum permissible cable length as follows:

Table 11-4 DRIVE-CLiQ signal cables (100 Mbit/s)

Before the DRIVE-CLiQ Switch Module $\Sigma I_{MC500} + 4/3 \cdot \Sigma I_{MC800PLUS} + n_c \cdot 5 \text{ m} \leq 100 \text{ m}$

After the DRIVE-CLiQ Switch Module $\Sigma I_{MC500} + 4/3 \cdot \Sigma I_{MC800PLUS} + n_c \cdot 5 \text{ m} \leq 100 \text{ m}$

ΣI_{MC500} = Total length of all MOTION-CONNECT 500 cable elements (fixed routing)

$\Sigma I_{MC800PLUS}$ = Total length of all MOTION-CONNECT 800PLUS cable elements (cable carrier)

n_c = Number of DRIVE-CLiQ disconnection locations (0 up to a maximum of 3)

11.4.5 Order data, DRIVE-CLiQ and DRIVE-CLiQ Express signal cables

Pre-assembled DRIVE-CLiQ signal cables			
Name	Degree of protection	Connector type	Article number
DRIVE-CLiQ signal cables without 24 V DC cores (100 Mbit/s)	IP20 and IP67 available	with RJ45 plug	6SL3060-4A.. 6FX2002-1DC..
DRIVE-CLiQ signal cables MOTION-CONNECT with 24 V cores (100 Mbit/s)	IP20 and IP67 available	with RJ45 plug	6FX5002-2DC.. 6FX8002-2DC..

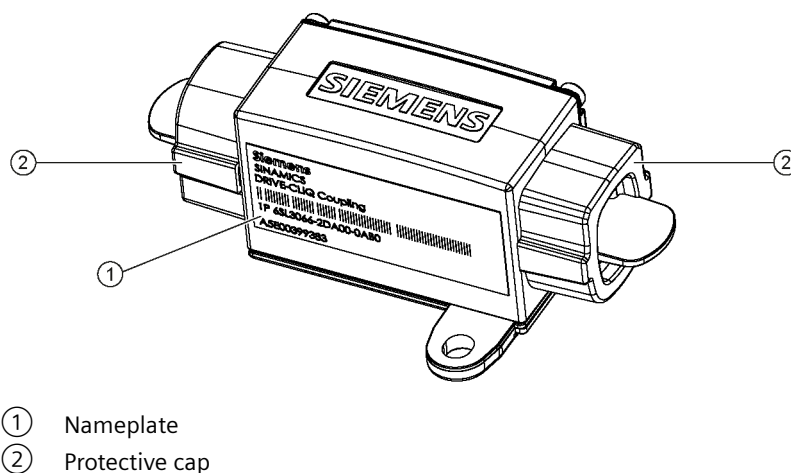
11.5 DRIVE-CLiQ coupling

Pre-assembled DRIVE-CLiQ signal cables			
Name	Degree of protection	Connector type	Article number
DRIVE-CLiQ signal cables MOTION-CONNECT with 24 V cores (100 Mbit/s)	Converting over from an RJ45 plug (IP20) to an M12 socket (IP67)		6FX5002-2DC30.. 6FX8002-2DC30..
DRIVE-CLiQ Express-CONNECT (1 Gbit/s)	IP20	with RJ45 plug	6SL5060-4A..
DRIVE-CLiQ Express signal cables MOTION-CONNECT (1 Gbit/s)	IP20	with RJ45 plug	6FX5002-1DG00..

11.5 DRIVE-CLiQ coupling

11.5.1 Description

Overview diagram



The DRIVE-CLiQ coupling (6SL3066-2DA00-0AB0) is used to connect 2 DRIVE-CLiQ cables in accordance with degree of protection IP67 acc. to IEC 60529.

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

11.5.2 Dimension drawing

Dimension drawing

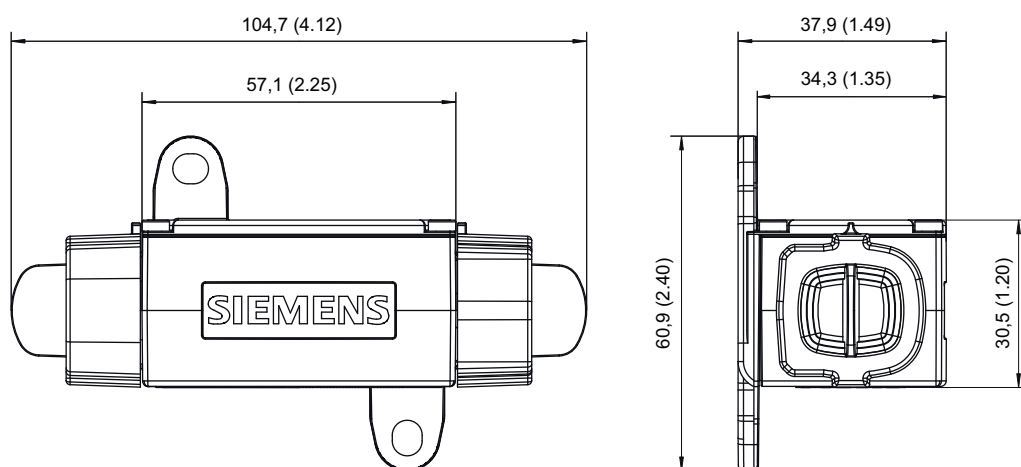
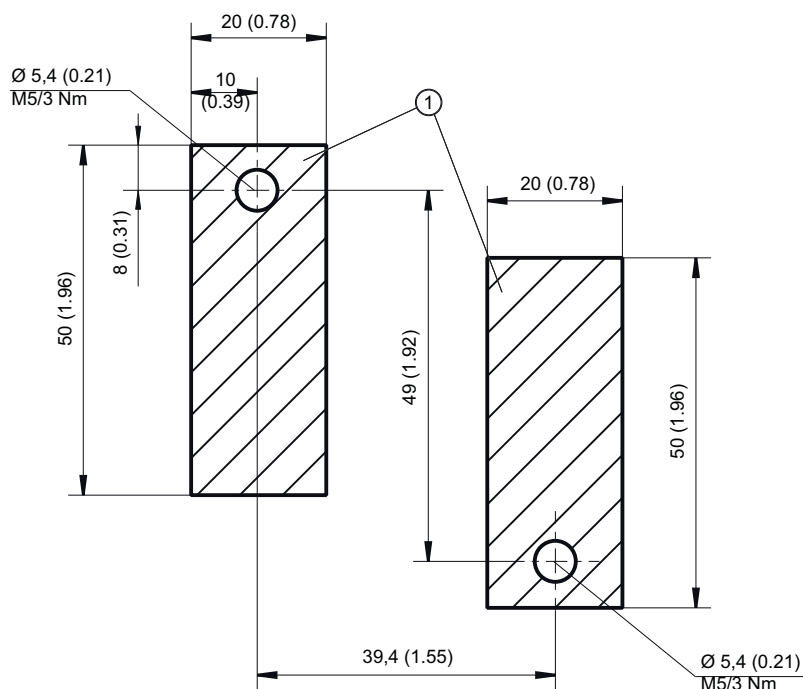


Figure 11-8 Dimension drawing of the DRIVE-CLiQ coupling, all dimensions in mm and (inches)

11.5.3 Mounting the DRIVE-CLiQ coupling

Procedure



① Contact surface

DRIVE-CLiQ coupling	Screw/tightening torque
6SL3066-2DA00-0AB0	M5 / 3 Nm (26.6 lbf in)

Proceed as follows to attach the DRIVE-CLiQ coupling to the control cabinet panel:

1. Prepare the mounting surface.
2. Mount the DRIVE-CLiQ coupling onto the mounting surface. Tightening torque: 3 Nm (26.6 lbf in)
3. Remove the protective caps of the DRIVE-CLiQ coupling.
4. Insert the DRIVE-CLiQ cable into both ends of the DRIVE-CLiQ coupling until they latch.

11.5.4 Technical data

Technical data

Table 11-5 DRIVE-CLiQ coupling (6SL3066-2DA00-0AB0)

Feature	Unit	Value
Weight	kg	0.272
Degree of protection	-	IP67 according to IEC 60529

11.5.5 Order data

Connecting DRIVE-CLiQ components	
Name	Article number
DRIVE-CLiQ coupling	6SL3066-2DA00-0AB0

11.5 DRIVE-CLiQ coupling

Service and maintenance

12.1 Date of manufacture

The date of manufacture of the device is coded in the serial number:

S Z V P 4 Y 7 M 0 0 0 1 4 1

Month of manufacture							
1	January	2	February	3	March	4	April
5	May	6	June	7	July	8	August
9	September	O	October	N	November	D	December

Year of manufacture							
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
A	2030	B	2031	C	2032	D	2033

Figure 12-1 Date of manufacture (example: April 2022)

12.2 Sending in the Control Unit

Overview

If it is ever necessary to send in a Control Unit, remove the memory card beforehand.

Description

When a defective Control Unit is returned, the data on the memory card (parameters, firmware, licenses, etc.) may be lost.

The memory card must not be sent in with the device, but must be kept for the replacement device and further operation of the system.

12.3 Device disposal

Description



For environmentally-friendly recycling and disposal of your old device, contact a company certified for the disposal of waste electrical and electronic equipment, and dispose of the old device as prescribed in the respective country of use.

12.4 Spare parts compatibility

Description

Converter components are being continuously developed within the scope of product maintenance.

Product maintenance includes, for example, measures to increase the ruggedness or hardware changes that become necessary as components are discontinued.

In the scope of such spare parts-compatible ongoing development, connectors or connection positions are sometimes slightly modified. This does not result in any problems when the component is used as intended. Please take this fact into consideration in special installation situations (e.g. allow sufficient reserve regarding the cable length).

More information

SINAMICS:

www.siemens.com/sinamics

Industry Mall:

www.siemens.com/industrymall

Industry Online Support:

www.siemens.com/online-support