SIEMENS

SINUMERIK 840D sl

NCU

Manual

Applicable to

controller
SINUMERIK 840D sl/840DE sl

04/2006 Edition
6FC5397-0AP10-1BA0

Safety Guidelines

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

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

Caution

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

Notice

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

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 device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

Warning

This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

Trademarks

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Disclaimer of Liability

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

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Preface

SINUMERIK Documentation

The SINUMERIK documentation is organized in 3 parts:

- General documentation
- User documentation
- Manufacturer/service documentation

An overview of publications, which is updated monthly and also provides information about the language versions available, can be found on the Internet at:
http://www.siemens.com/motioncontrol
Select "Support" → "Technical Documentation" → "Overview of Publications".

The Internet version of DOConCD (DOConWEB) is available at:
http://www.automation.siemens.com/doconweb

Information about training courses and FAQs (Frequently Asked Questions) can be found at the following website:
http://www.siemens.com/motioncontrol under menu item "Support".

Target group

This documentation is intended for manufacturers of machine tools, particularly:

- Project engineers, electricians and installers
- Service and operating personnel

Benefits

The information in this manual facilitates installation and connection of the SINUMERIK 840D numerical control in the control cabinet.

Standard version

This Equipment Manual describes the NCU 710/720/730 controller modules and all components associated with the construction and installation of a SINUMERIK 840D sl controller.

For the sake of simplicity, this documentation does not contain all detailed information about all types of the product and cannot cover every conceivable case of installation, operation, or maintenance.

Technical Support

If you have any questions, please contact our hotline:

	Europe/ Africa	Asia/ Australia	America
Phone	+49 180 5050 222	+86 1064 719 990	+1 423 262 2522
Fax	+49 180 5050 223	+86 1064 747 474	+1 423 262 2289
Internet	http://www.siemens.de/automation/support-request		
E-mail	mailto:adsupport@siemens.com		

Note

Country telephone numbers for technical support are provided under the following Internet address:

Enter http://www.siemens.com/automation/service&support

Questions about the Manual

If you have any queries (suggestions, corrections) in relation to this documentation, please fax or e-mail us:

Fax: +49 (0) 9131 / 98 - 63315
Email: mailto:motioncontrol.docu@siemens.com

Fax form: See the reply form at the end of this publication

SINUMERIK Internet address

http://www.siemens.com/sinumerik

EC declaration of conformity

The EC Declaration of Conformity for the EMC Directive can be found/obtained

- in the internet:

  http://www.ad.siemens.de/csinfo

  under product/order no. 15257461
- the relevant branch office of the A&D MC group of Siemens AG.

Conventions

Throughout this document, the term "control unit" is also used for product designations NCU 710/720/720, provided that the technical conditions described are applicable to both variants.

Table of contents

System overview

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1.1 Application

Features

Integrated into the SINAMICS S120 converter system and complemented by the SIMATIC S7-300 automation system, the SINUMERIK 840D sl is a complete digital system that is best suited for the mid to upper performance range.

- Maximum performance and flexibility, above all for complex multi-axis systems.
- Uniform openness from operation up to the NC core.
- Optimum integration into networks.
- Uniform structure in respect of operation, programming and visualization.
- Integral, certified safety functions for man and machine: SINUMERIK Safety Integrated
- Operating and programming software such as ShopMill or ShopTurn, as well as Motion Control Information System Products (MCIS-Products) can be used for the production sector.

Fields of application

The SINUMERIK 840D sl can be used worldwide in tool and mold making, for high-speed cutting applications, for wood and glass processing, for handling operations, in transfer lines and rotary indexing machines, for mass production and JobShop production.

The SINUMERIK 840DE sl is available as an export version for use in countries where approval is required.

1.2 System configuration

The heart of the SINUMERIK 840D sl is the Numerical Control Unit (NCU). It combines NCK, HMI, PLC, closed-loop control and communication tasks.

Components

With the TCU (Thin Client Unit), the operator panel can be installed as much as 100 meters away. Up to 2 distributed OPs can be operated on an NCU 710 and as many as 4 distributed OPs on an NCU 720/730 or PCU 50.3.

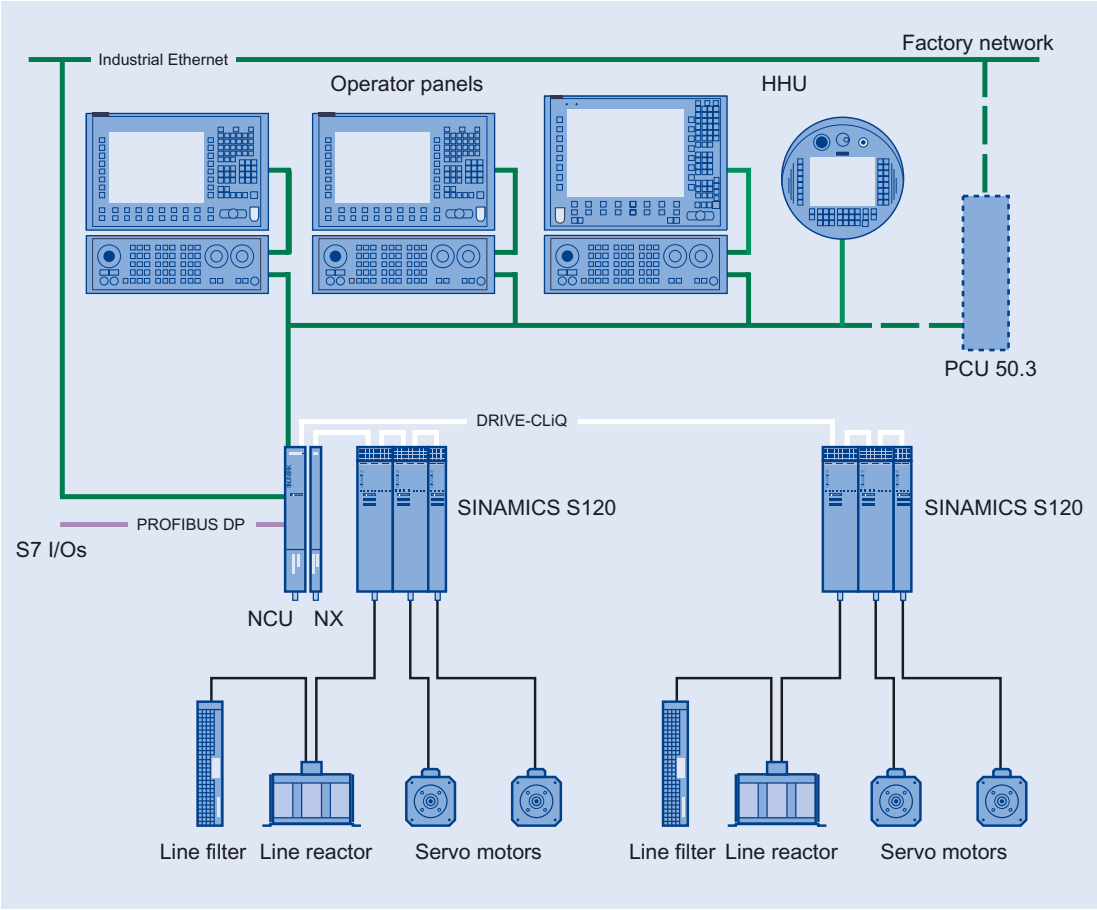


Figure 1-1 Typical topology of the SINUMERIK 840D sl compact system

The following components can be attached to the control unit:

- SINUMERIK operator panel front with TCU/PCU 50.3 and machine control panel/pushbutton panel
- SIMATIC CE panel
- Handheld units
- SIMATIC S7-300 I/O
- Distributed PLC I/O via PROFIBUS-DP connection
- Programming device
- SINAMICS 120 converter system
- 1FK/1FT/1FN/1FW6/1PH/1FE1/2SP1/1LA motors

1.3 Variants

The scalability of the hardware and software – both in the controller and control area – provides the prerequisites for use of the SINUMERIK 840D sl in many sectors. The possibilities range from simple positioning tasks up to complex multi-axis systems.

Application areas and performance

- As many as 6 axes can be implemented on an NCU 710. On the NCU 720/730, the number of axes and/or the performance of the drive controller can be increased to 31 axes. This is achieved by using the NX10/15 module. The NCU 720/730 can be expanded by up to 6 NX10/15 modules in performance for the drive controller and number of axes.
- If there is a high demand for axes and channels, e.g., when using rotary indexing or multi-spindle machines, the computing performance, configuration facilities and memory areas of the control units can be combined via the CBE 30 option module (available soon), thus becoming significantly extended.
- Use of an NCU 730 is recommended for maximum dynamics and accuracy in mold making or in the high speed cutting sector.

The following table shows the essential features of the various control units:

Table 1-1 Variants

Feature	NCU 710.1	NCU 720.1/730.1
DRIVE CLiQ ports	4	6
Axes	Up to 6	Up to 31
NX10/15	Up to 2	Up to 6

Application Planning

2

2.1 Secondary electrical conditions

2.1.1 Connection Conditions

Compliance with the connection conditions

The controller is tested for compliance with the ambient conditions specified below. Fault-free operation is only ensured if:

- These ambient conditions are maintained when storing, transporting and operating the equipment.
- Original components and spare parts are used. This applies in particular to the use of specified cables and plug connectors,
- the equipment is correctly installed and commissioned.

Danger

The equipment may not be commissioned until it has been clearly identified that the machine in which the controller is installed is in full conformance with the specifications in EC Machinery Directive 98/37/EC.

Assistance and support

The connection conditions must be carefully maintained while setting up the complete system. Please contact your sales representative for assistance and support.

2.1.2 Protective Separation as per EN 61800-5-1

Prerequisite

The complete system includes user interfaces (UIs) and interfaces for servicing, startup and maintenance.

User interfaces (UIs)

UIs are all the interfaces that are freely accessible to the machine operator without the need for tools or aids. These user interfaces are designed with safe isolation to EN 61800-5-1.

Interfaces for servicing, startup and maintenance

Danger

The interfaces for servicing/installation and start-up/maintenance purposes are provided **without** protective separation.

If necessary, these interfaces can be isolated safely using a supplementary adapter (insulation voltage 230 V AC). Although these adapters are not included in the Siemens scope of delivery, you can buy these parts from your local dealer, who will be happy to advise you.

Danger

Safe isolation can only be ensured if the system configuration specified below is strictly adhered to. When mounting additional components (e.g. S7-300 FM, IP) with an end user interface, please make sure that the end user interface has a basic insulation for at least 230 V AC.

The figure below shows the galvanic isolation of the 840D sl/SINAMICS S120/S7-300 system.

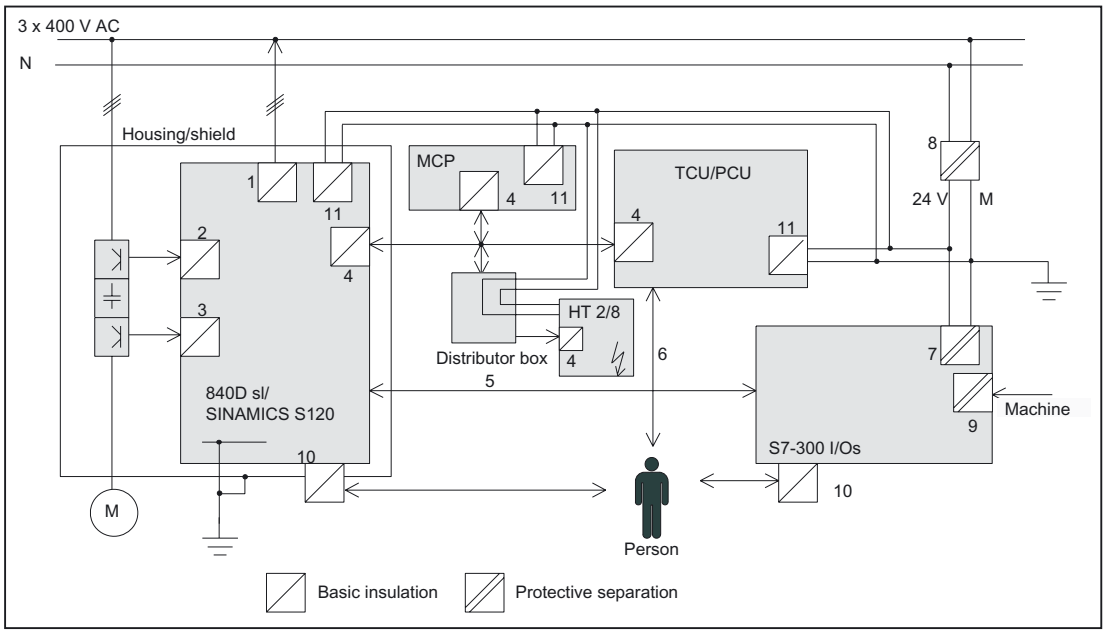


Figure 2-1 Safe isolation to EN 61800-5-1

(1) Floating power supply of the SINAMICS electronics unit with 230 V AC basic insulation.

(2) Floating transistor triggers for the three-phase rectifier bridge with 230 V AC basic insulation

(3) Floating transistor triggers for each axis of the three-phase inverter bridge with 230 V AC basic insulation

(4) Floating signal connection from the NCU to the TCU or HT with 230 V AC basic insulation.

(5) Non-isolated signal line between NC and I/O devices.

(6) Non-isolated user interface with safe isolation for 230 VAC through interfaces 1 to 4 and 7.

(7) Safely-isolated 5 V DC power supply, fed from a safely-isolated 24 V DC supply.

(8) 24 V DC power supply unit for external devices and for the machine adaptation control according to applicable standards in the form of a PELV (Protective Extra Low Voltage) circuit featuring safe isolation.

(9) Floating interfaces to the machine (not accessible to the end user).

(10) Floating signal interfaces directly accessible to the end user (e.g. V.24 etc.). For these interfaces, you must always make sure that there is either safe isolation with respect to the line supply voltage or that there are two basic insulation levels, for 230 V AC each.

(11) 5 V DC power supply with basic insulation, fed from a safely-isolated 24 V DC supply.

2.1.3 Grounding concept

Components

The SINUMERIK 840D sl system consists of a number of individual components which have been designed so that the system complies with the appropriate EMC and safety standards. The individual system components are:

- Numerical control unit (NCU)
- Machine control panel (MCP), pushbutton panel (MPP)
- Keyboard
- Operator panels (operator panel front + TCU/PCU)
- Distributor box and handheld unit
- S7-300 I/O with IM 153 interface module

Grounding measures

The individual modules are attached to a metal cabinet panel by means of screws. Make sure that low-impedance contact is possible between the control unit and the cabinet panel in the vicinity of the screws. Insulating paints at the contact point must be removed. The electronics unit grounds of the modules are connected to each other via DRIVE-CLiQ.

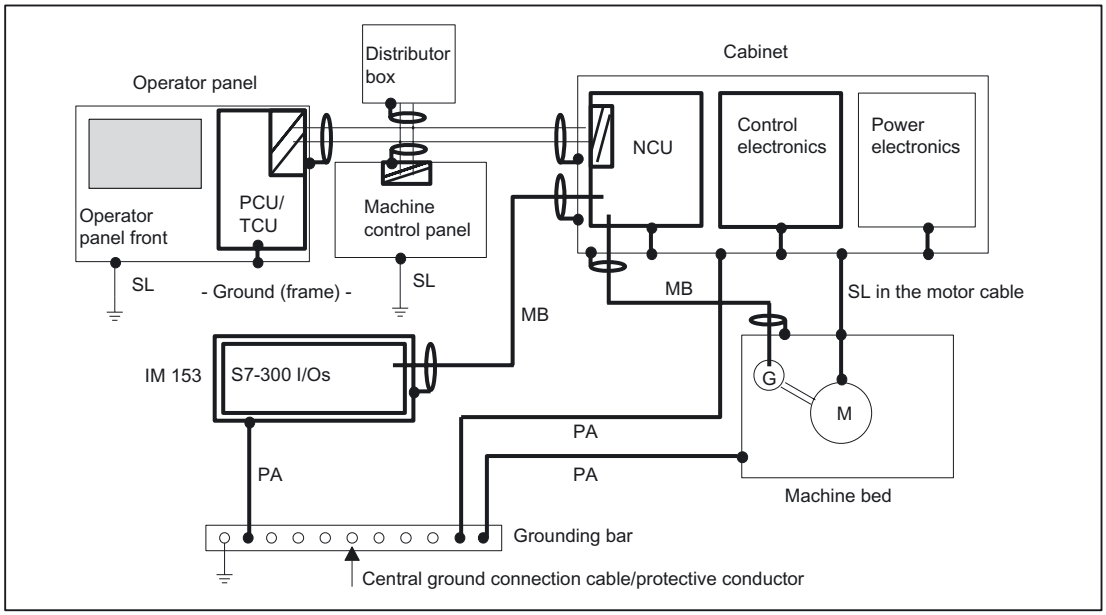


Figure 2-2 Grounding concept

MB	Shielded signal cable with reference ground
M	Motor
G	Encoder

PA	Equipotential bonding conductor
SL	Protective conductor

The following rules apply for external cable cross sections:

- Minimum PA cross section ≥ 10 mm^2
- The cable cross section of the central protective conductor is calculated from the cable cross section of the line connection as follows:

Line connection S (mm^2)	Protective conductor SL min. (mm^2)
S ≤ 16	S
16 ≤ S ≤ 35	16
S ≤ 35	S/2

Notice

If the PROFIBUS/ ethernet line is routed through several control cabinets, an equipotential bonding conductor is to be connected to the control unit's "potential connection". A finely stranded copper conductor with a 4 mm² cross-section must be used. The equipotential bonding conductor is to be routed together with the PROFIBUS/ ethernet lead.

Further reading

/EMC/EMC Installation Guide

2.1.4 RI suppression measures

In addition to the protective grounding of system components, special precautions must be taken to ensure safe, fault-free operation of the system. These measures include shielded signal cables, special equipotential bonding, isolation, and shielding measures.

Shielded signal lines

- To ensure safe, fault-free operation of the system, it is essential to use the cables specified in the individual diagrams.
- For digital signal transmission, the shielding must always be connected to the housings at both ends.
  Exception:
  If non-Siemens devices are connected (printers, programming devices, etc.), standard shielded cables grounded at one end can also be used. However, these devices must not be connected to the controller during normal operation. However, if the system cannot operate without them, then the cable shields must be connected at both ends. Furthermore, the non-Siemens device must be connected to the controller via an equipotential bonding cable.

Cable definitions

- Signal cables (example)
  - Data cables (Ethernet, PROFIBUS, sensor cables, etc.)
  - Binary inputs and outputs
  - EMERGENCY OFF lines
- Load cables (example)
  - Low-voltage supply lines (230 V AC, +24 V DC, etc.)
  - Supply cables to contactors (primary and secondary circuit)

Rules for routing cables

In order to maximize noise immunity for the complete system (controller, power section, machine) the following EMC measures must be observed:

- The distance between signal lines and load cables must be maximized.
- If necessary, signal and load cables may cross one another (if possible, at an angle of 90°), but must never be laid close or parallel to one another.
- Only cables provided by the manufacturer should be used as signal cables from and to the control unit.
- Signal cables may not be routed close to strong external magnetic fields (e.g., motors and transformers).
- Pulse-loaded HC/HV lines must always be laid completely separately from all other lines.
- If signal lines cannot be routed a sufficient distance away from other cables, they must be installed in grounded cable ducts (metal).
- The clearance (interference injection area) between the following lines must be kept to a minimum:
  - Signal line and electrical circuit signal line (twisted)
  - Signal line and associated equipotential bonding conductor
  - Equipotential bonding conductor and protective conductor (routed together)

Note

For more information about interference suppression measures and connection of shielded cables, see

References

/EMC/EMC Installation Guide

2.2 Ambient Climatic and Mechanical Conditions

2.2.1 Test and Requirements Standards

Test standards

Vibratory load	EN 60068-2-6
Shock load	EN 60068-2-27
Air-conditioning	EN 60068-2-1, EN 60068-2-2, EN 60068-2-14, EN 60068-2-30, EN 60068-2-31, EN 60068-2-32, EN 60068-2-33, EN 60068-2-34

Requirements standards

Long-term storage	EN 60721-3-1
Shipping	EN 60721-3-2
Stationary operation	EN 60721-3-3

2.2.2 Transport and Storage Conditions

Components in original packaging

The following specifications apply to components in transport packaging:

Table 2-1 Climatic environmental conditions according to EN 60721-3-1/-3-2, Class 1K3/2K4

	Transport	Storage	
Temperature range	-40 ... 70°C	-25 ... 55°C	
Temperature change	< 18 K	< 18 K	Within one hour
Relative humidity	10 ... 95 %	10 ... 95 %	Annual average
Permissible change in relative humidity	Max. 0.1%	Max. 0.1%	Within 1 minute

Table 2-2 Test limit values for mechanical environmental conditions during transport/storage

Vibration to EN 60068-2-6	Frequency range	5 ... 9 Hz
	Constant deflection	7.5 mm
	Acceleration amplitude	9 ... 200 Hz: 2 *g*
Shock resistance to EN 60068-2-27	Acceleration	30 *g*,
	Duration of nominal shock	6 ms
	Number of nominal shocks	18 shocks
	Shock form	Half-sine

g ≈ 9.81 m/s^2 (acceleration due to gravity)

Shipping backup batteries

Backup batteries may only be shipped in the original packaging. No special authorization is required to ship backup batteries. The lithium content is approximately 300 mg.

Note

The backup battery is classified as a hazardous substance, Class 9, in accordance with the relevant air-freight transportation regulations.

Danger

Incorrect handling of backup batteries can lead to a risk of ignition, explosion and combustion. The stipulations of DIN EN 60086-4, in particular regarding avoidance of mechanical or electrical tampering of any kind, must be complied with.

2.2.3 Operating Conditions

Climatic environmental conditions

If the specified values cannot be maintained, then a heat exchanger or air conditioner must be provided.

Table 2-3 Climatic environmental conditions to EN 60721-3-3, Class 3K5

Temperature range	0 ... 55°C	
Temperature change	Max. 0.5 K	Within 1 minute
Relative humidity	5 … 90 %	
Permissible change in relative humidity	Max. 0.1%	Within 1 minute
Moisture condensation and ice formation	Not permissible	
Dripping water, spray, splash water, water jets	Not permissible	
Supply air	Without aggressive gases, dusts and oils	
Air pressure	106 to 82 kPa	0 to 2000 meters above mean sea level
Derating	At altitudes of 2500 to 5000 m above mean sea level, the upper temperature limit must be reduced by 3.5°C/500 m.	

Table 2-4 Test limit values for mechanical environmental conditions during operation

Vibration to EN 60068-2-6	Frequency range	10 ... 58 Hz
	Constant deflection	0.075 mm
	Acceleration amplitude	58 ... 200 Hz: 1 *g*
Shock resistance to EN 60068-2-27	Acceleration	5 *g*
	Duration of nominal shock	30 ms
	Number of nominal shocks	18 shocks
	Shock form	Half-sine

g ≈ 9.81 m/s² (acceleration due to gravity)

Function-impairing gases

Degree of severity 3C2 according to EN60721-3-3

Function-impairing dust

When working in areas where gases, dust and oils may be hazardous to functionality, the controller must be operated in a control cabinet with a heat exchanger or with suitable supply air.

Table 2-5 Maximum permissible dust content in the air circulating in the control cabinet

Suspended component	0.2 mg/m^3
Deposits	1.5 $mg/m^2/h$

Note

Dust deposits must be removed at regular intervals.

Radio interference

Applicable standards: EN 61000-6-3 and -4

Table 2-6 Limit values for radio interference suppression in industrial environments

	Limit class as per EN 61000-6-4
Conducted radio interference	A (Industry)
Radio interference	A (Industry)

Note

The user must consider interference radiation for the complete system. Particular attention should be paid to cabling. Please contact your sales representative for assistance and support.

If compliance with limit value class B (residential areas) is required, please contact your local Siemens office or representative.

Notice

Please see the relevant SINAMICS documentation for EMC notes on how to deal with line filters and reactors.

Notice

The control unit is exclusively intended for installation in ESD-protected areas. The CE-associated ESD interference immunity limit values can only be achieved via installation in the control cabinet. Only make physical contact using appropriate ESD protective measures.

Safety Information

3

3.1 Danger notices

The following notices are intended firstly for your personal safety and secondly to prevent damage occurring to the product described or any connected devices and machines. Non-observance of the warnings can result in severe personal injury or property damage.

Danger

Only appropriately qualified personnel may commission/start-up SINUMERIK equipment.

The personnel must take into account the information provided in the technical customer documentation for the product, and be familiar with and observe the specified danger and warning notices.

When electrical equipment and motors are operated, the electrical circuits automatically conduct a dangerous voltage.

When the system is operating, dangerous axis movements may occur throughout the entire work area.

A potential fire hazard exists due to the energy being transferred in the equipment and the work materials used.

All work on the electrical system must be performed after the system has been switched off and disconnected from the power supply.

Danger

Proper transportation, expert storage, installation and mounting, as well as careful operation and maintenance are essential for this SINUMERIK device to operate correctly and reliably.

The details in the catalogs and proposals also apply to the design of special equipment versions.

In addition to the danger and warning information provided in the technical customer documentation, the applicable national, local, and system-specific regulations and requirements must be taken into account.

Only protective extra-low voltages (PELVs) that comply with EN 61800-5-1 can be connected to all connections and terminals between 0 and 48 V.

Should it be necessary to test or take measurements on live equipment, then the specifications and procedural instructions defined in Accident Prevention Regulation VBG A2 must be adhered to, in particular § 8 "Permissible deviations when working on live components". Suitable electric tools should be used.

Warning

Operating the equipment in the immediate vicinity (< 1.5 m) of mobile telephones with a transmitting power of > 1 W may lead to incorrect functioning of the devices.

Connecting cables and signal lines should be installed so that inductive and capacitive interference does not in any way impair the automation and safety functions.

SINAMICS equipment with three-phase motors conforms to EMC Directive 89/336/EEC in the configurations specified in the associated EC Certificate of Conformity.

Danger

Repairs to devices that have been supplied by our company may only be carried out by SIEMENS customer service or by repair centers authorized by SIEMENS.

When replacing parts or components, only use those parts that are included in the spare parts list.

EMERGENCY STOP devices EN 60204-1 (VDE 0113 Part 1) must remain active in all modes of the automation equipment. Resetting the EMERGENCY STOP device must not cause an uncontrolled or undefined restart.

Anywhere in the automation equipment where faults might cause physical injury or major material damage, in other words, where faults could be dangerous, additional external precautions must be taken, or facilities must be provided, that guarantee or enforce a safe operational state, even when there is a fault (e.g. using an independent limit value switch, mechanical locking mechanisms, EMERGENCY STOP devices)

3.2 ESD notices

Caution

The modules contain electrostatically sensitive devices. Discharge yourself of electrostatic energy before touching the components. The easiest way to do this is to touch a conductive, grounded object immediately beforehand (for example, bare metal parts of control cabinet or the protective ground contact of a socket outlet).

Notice

Handling ESD-modules:

- When handling electrostatically sensitive devices, make sure that operator, workplace and packing material are properly grounded.
- Generally, electronic modules must not be touched unless work has to be carried out on them. When handling PCBs make absolutely sure that you do not touch component pins or printed conductors.
- Touch components only if:
  - You are permanently grounded via an ESD armband
  - You are wearing ESD shoes or ESD shoe-grounding-strips, if ESD flooring is available
- Modules may only be placed on electrically conductive surfaces (table with ESD top, conductive ESD foam plastic, ESD packaging bags, ESD transport containers).
- Keep modules away from visual display units, monitors or TV sets (minimum distance from screen 10 cm).
- Do not bring ESD-sensitive modules into contact with chargeable and highly-insulating materials, such as plastic, insulating table tops or clothing made of synthetic materials.
- Measurements on modules are allowed only if:
  - The measuring instrument is properly earthed (e.g., protective conductor) or
  - Before measuring with a floating measuring instrument, the probe is briefly discharged (e.g., touch the bare metal parts of the control housing).

Description

4

4.1 Features

A control unit contains the following interfaces and modules:

- Battery-backed SRAM for persistent data storage
- Battery-backed real-time clock
- PROFIBUS interfaces
- Ethernet interfaces
- Slot for a CompactFlash Card
- Slot for option modules
- DRIVE-CLiQ interfaces
- Digital inputs/outputs (6 of which can be parameterized as inputs for probe and BERO)
- 3 analog test sockets

4.2 Illustration

Illustration of the device

The following figure shows an NCU 720/730 with its interfaces and control and display elements (fault LEDs and status indicators). Please note that the structure of the NCU 710 is almost identical, it simply has 4 DRIVE-CliQ interfaces instead of 6.

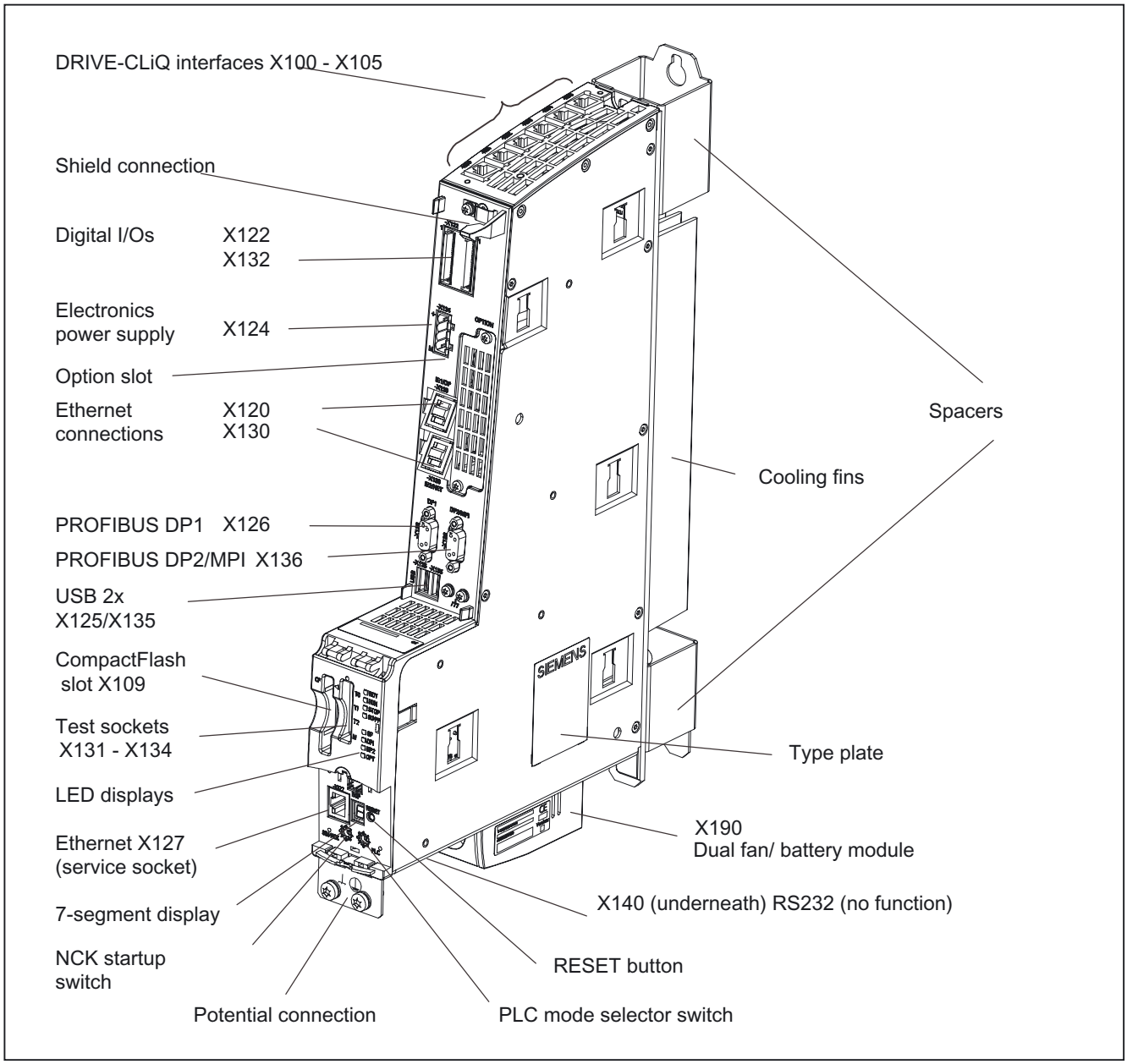


Figure 4-1 Illustration of the NCU 720/730

4.3 Type plate

Side-mounted type plate

The following figure shows you all the information included on the type plate located on the side of the unit.

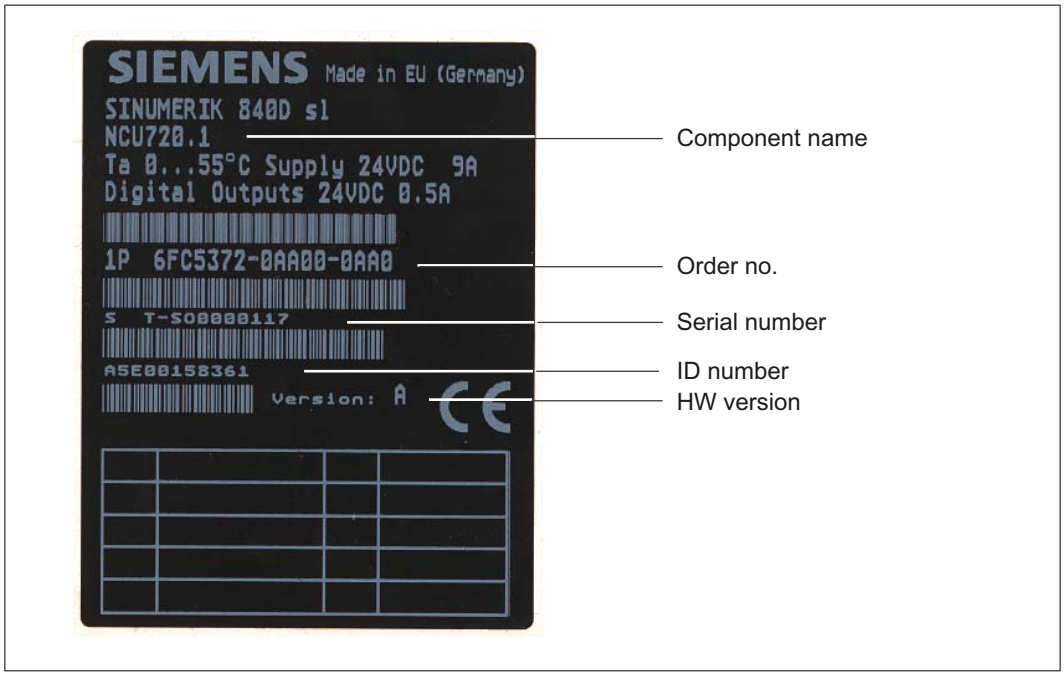


Figure 4-2 Type plate

You might need to access the information provided on the side-mounted type plate after the equipment has been mounted. Since the type plate is located on the right-hand side of the housing, which is the side typically used to connect to the SINAMICS S120 module, we recommend that you make a note of the serial number of the control unit prior to assembly.

Note

The information contained in each field of the type plate on the current control unit may differ from the information presented in this manual (for example, a later product version, approvals and marks that have not yet been issued, etc., may be shown).

4.4 Power supply

External 24 V power supply

Power is supplied to the control unit by an external 24 V power supply (e.g., SITOP). The following power consumption values for the control units provide a configuration basis for calculating the 24 V DC power supply.

Table 4-1 Input voltage specification

Parameters	Values
Typ. power consumption [1]	2.0 A
Max. power consumption [2]	9.0 A
[1] NCU only (processor, memory, etc.)	
[2] NCU with full load at all outputs (digital outputs, USB, DRIVE-CliQ, PROFIBUS-DP, etc.)	

Requirements of DC power supplies

Danger

The DC power supply is always referenced to ground and may not be generated by an autotransformer.

User interfaces must be powered via a DC power supply with safe isolation to EN 61800-5-1.

In the case of supply lines > 10 m, protectors must be installed at the device input in order to protect against lightning (surge).

The DC power supply must be connected to the ground/shield of the control unit for EMC and/or functional reasons. For EMC reasons, this connection should only be made at one point. As a rule, the connection is provided as standard in the S7-300 I/Os. In exceptional circumstances when this is not the case, the ground connection should be made on the grounding rail of the control cabinet; please also refer to /EMC/EMC Installation Guide.

Table 4-2 Requirements of the DC power supply

Rated voltage	According to EN 61131-2 Voltage range (mean value) Voltage ripple peak-to-peak Booting time at POWER ON	24 V DC 20.4 V DC to 28.8 V DC 5% (unfiltered 6-pulse rectification) Any
Non-periodic overvoltages	 Duration of overvoltage Recovery time Events per hour	≤ 35 V ≤ 500 ms ≥ 50 s ≤ 10
Transient voltage interruption**s**	Idle time Recovery time Events per hour	≤ 3 ms ≥ 10 s ≤ 10

Further reading

Recommended power supply units and tables for calculating power consumption for interconnection with SINAMICS S120 modules can be found in the chapter entitled **Control-Cabinet Construction and EMC Booksize** in the SINAMICS S120 Booksize Power Units Manual.

See also

Power supply X124 (Page 6-13)

Operating and display elements

5

5.1 Overview of operating and display elements

Overview of operating and display elements

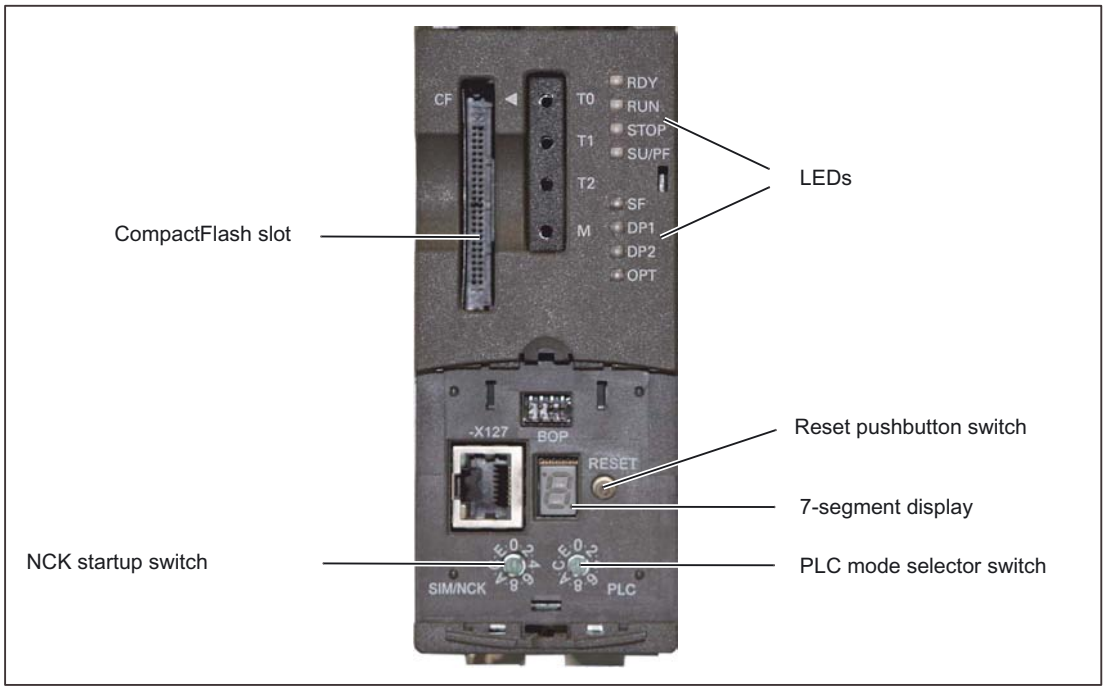


Figure 5-1 Overview of the operating and display elements behind the blanking plate

5.2 CompactFlash Card

5.2.1 Properties

Application

The CompactFlash Card is delivered bootable. It is not supplied with the control unit and must be ordered as a separate component.

The CompactFlash Card is inserted in the CF plug-in slot (X109 interface).

Caution

The CompactFlash Card may only be inserted or removed when the control unit is disconnected from the power supply.

Data

The CompactFlash Card is mandatory for operation of the control unit.

As well as the basic software for SINUMERIK and the firmware for SINAMICS, the CompactFlash Card also contains:

- User data (programs, configuration data, parameter settings)
- Version info (serial number, version, type designation)
- License key This means that the CompactFlash Card can be inserted into another control unit without requiring a license change.

5.2.2 Inserting the CompactFlash card

Procedure

Please proceed as follows:

1. Switch off the power supply.
2. Gently insert the new CompactFlash Card into the plug-in slot until it clicks into place. When properly installed, the card does not protrude beyond the housing.
3. Switch the power supply on again.

Figure 5-2 Inserting the CompactFlash Card

5.3 LED displays

Table 5-1 Meaning of LED states

Name	Function	Status	Meaning
RDY	Ready	Red	There is at least one fault (e.g., RESET, watchdog monitoring, etc.) or the control unit is booting up.
		Flashing red/yellow (0.5 Hz)	Error accessing CompactFlash Card
		Yellow	Accessing CompactFlash Card
RUN	PLC RUN	Off	
		Green	PLC ready to operate
STOP	PLC STOP		
		Yellow	PLC stopped
SU/PF	PLC FORCE	Off	
		Red	FORCE activated
SF	PLC SF	Off	
		Red	PLC group error
DP1	BUS1 F	Off	
		Red	PROFIBUS-DP1 group error
DP2	BUS2 F	Off	
		Red	PROFIBUS-DP2 group error
OPT	Option	Off	An option board is not inserted in the control unit.
		Red	At least one error is pending on the inserted option board, or the option board is not ready.
		Flashing green (0.5 Hz)	The meaning depends on the option (see respective description).
		Green	Option is ready to operate.

Notice

If all the LEDs are flashing, the PLC must be reset via the mode selector (move switch to position "3" to reboot).

Note

While the control unit is starting up, all LEDs are illuminated yellow for a brief time. You can carry out a detailed diagnosis using a PG/PC and the HMI software.

5.4 Reset button

Performing a reset operation

The RESET button is located behind the blanking plate.

A reset operation resets the entire system and requires a system restart. This is comparable to a "Power On reset" except that the 24 V power supply does not have to be switched off.

5.5 7-segment display

Displaying messages

The 7-segment display is located behind the blanking plate of the control unit. It serves as a status display during startup and performs the following tasks:

- Output of test and diagnostic messages.
- Output of status messages during booting

During normal operation, "6" appears here and the dot flashes.

Further reading

/IDsl/ Installation and Startup Manual CNC Part 1 (NCK, PLC, Drive)

5.6 Start-up and mode selector switch

Arrangement

The control unit has two coding switches in the lower section of the front panel.

- The left switch (labeled SIM/NCK) is the NCK startup switch.
  Setting during normal operation: "0"
- The right switch (labeled PLC) is the PLC mode selector switch.
  Setting during normal operation: "0"

The switch positions are marked with even numbers or letters; the uneven numbers are represented by dots due to space limitations.

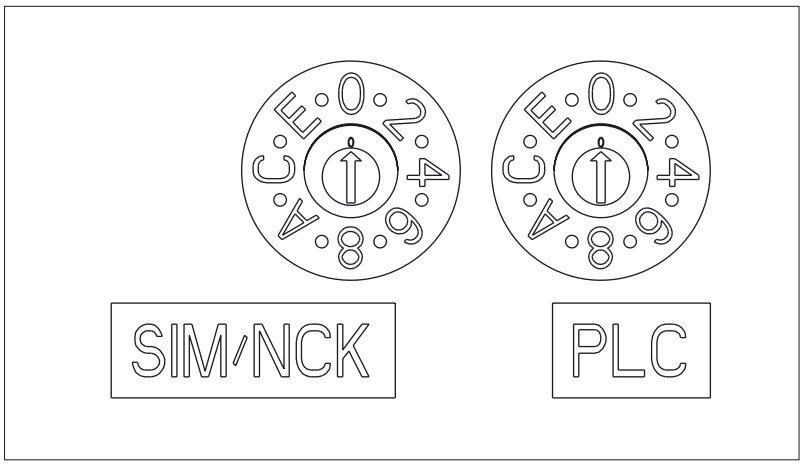


Figure 5-3 Startup and mode selector switch

Further reading

/IDsl/ Installation and Startup Manual CNC Part 1 (NCK, PLC, Drive)

Interfaces

6

6.1 Interface overview

Interface overview

Table 6-1 Overview of available external interfaces

Interface	Name	Plug-connector type
DRIVE-CLiQ (0)	X100	Spec. RJ45 socket
DRIVE-CLiQ (1)	X101	Spec. RJ45 socket
DRIVE-CLiQ (2)	X102	Spec. RJ45 socket
DRIVE-CLiQ (3)	X103	Spec. RJ45 socket
DRIVE-CLiQ (4)	X104 (only NCU 720/730)	Spec. RJ45 socket
DRIVE-CLiQ (5)	X105 (only NCU 720/730)	Spec. RJ45 socket
Ethernet (HMI) IE1/OP	X120	Standard RJ45 socket
Ethernet (HMI) IE2/NET	X130	Standard RJ45 socket
Ethernet (service socket)	X127	Standard RJ45 socket
Digital inputs/outputs	X122, X132	Micro Combicon 2x12-pin
24 V power supply	X124	Combicon 4-pin
USB interfaces	X125/X135	USB socket
PROFIBUS-DP1	X126	9-pin SUB D socket
PROFIBUS-DP2/MPI	X136	9-pin SUB D socket
RS232 interface	X140	9-pin SUB D plug connector
Test sockets (T0, T1, T2, and M)	X131 - X134	Sockets on the circuit board
CompactFlash Card	X109	50-pin socket
Dual fan/ battery module	X190	6-pin

6.2 DRIVE CLiQ Interfaces X100 - X105

Properties

- Automatic detection of components
- 24 V / 450 mA per DRIVE-CLiQ interface is provided for the connection of encoders and measuring systems

Features

Table 6-2 X100 - X103 or X100 – X105

Feature	Version
Plug-connector type	DRIVE-CLiQ plug
Cable type	DRIVE-CLiQ standard (inside the control cabinet)
Cable type	MOTION CONNECT (outside the control cabinet)
Maximum cable length	100 m

DRIVE-CliQ pin assignment

Table 6-3 DRIVE-CLiQ interface (X100 - X103 or X100 – X105)

PIN	Signal name	Signal type	Meaning
1	TXP	O	Transmit data +
2	TXN	O	Transmit data -
3	RXP	I	Receive data +
4			Reserved, do not use!
5			Reserved, do not use
6	RXN	I	Receive data -
7			Reserved, do not use
8			Reserved, do not use
A	+ (24 V)	VO	Voltage supply for DRIVE-CLiQ, 450 mA maximum
B	M (0 V)	VO	Ground to 24 V
Signal type: I = Input; O = Output; VO = Voltage Output			

Position of plug connectors

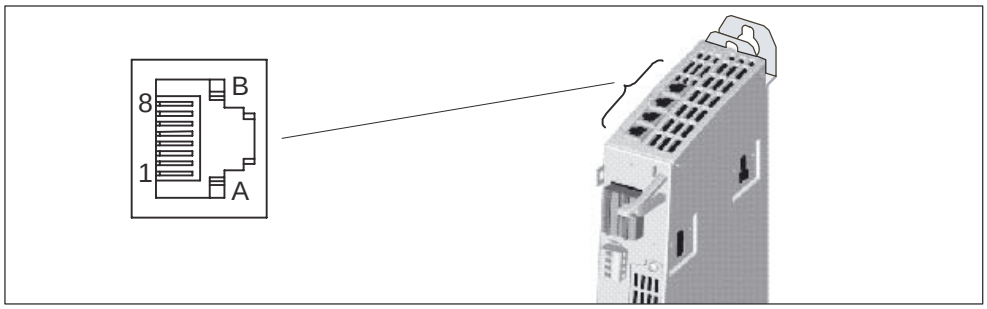


Figure 6-1 DRIVE-CLiQ interface

6.3 PROFIBUS-DP interfaces X126 and X136

6.3.1 Properties

Features

- Isolated RS–485 interface
- Max. data rate 12 Mbaud
- Supports master/slave mode
- Profibus address is set via configuration
- OLPs (6GK1502–1AA00) are not permitted

Note

In addition to the DP (Distributed Peripherals) log, X136 can also transmit the MPI (Multi Point Interface) log (software-controlled).

Table 6-4 Interfaces X126 and X136

Features	Version
Plug-connector type	9-pin Sub-D socket
Cable type	PROFIBUS cable
Maximum cable length	100 m for 12 Mbits

Interface assignment for X126, X136

Table 6-5 PROFIBUS-DP interface X126, X136

Pin	Signal name	Signal type	Meaning
1	Nc	-	-
2	M	VO	Ground to P24_SERV
3	2RS_DP	B	RS485 differential signal
4	2RTS_DP	O	Request to Send
5	1M	VO	Ground to 1P5
6	1P5	VO	5 V power supply for bus terminal, external, short-circuit proof
7	P24_SERV	VO	24 V for teleservice, short-circuit proof, 150 mA maximum
8	2XRS_DP	B	RS485 differential signal
9	Nc	-	-
The 1P5 voltage is provided exclusively to supply the bus terminal.			
Signal type: VO = Voltage output (power supply) O = Output B = Bidirectional			

Position of plug connectors

The following figure shows the mounting position and designation of the plug connectors on the control unit.

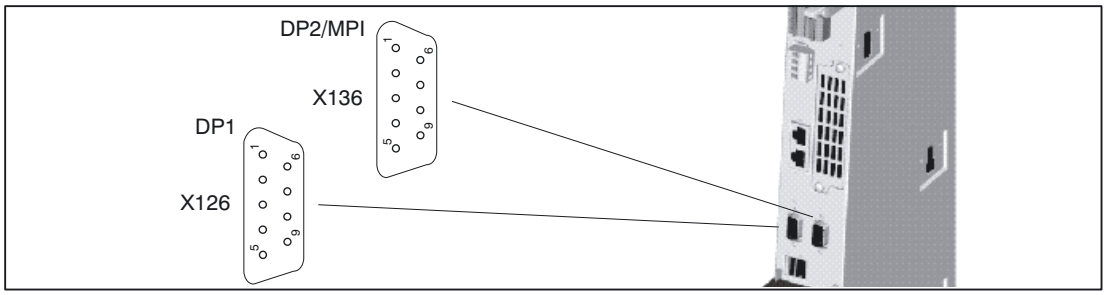


Figure 6-2 Interface X 126 / X 136: PROFIBUS–DP / MPI–Interfaces

6.3.2 Application

Connectable devices

The following devices can be connected to the PROFIBUS-DP interfaces:

- PG/PC
- S7 controllers with PROFIBUS-DP interface
- Distributed I/O
- Teleservice adapter
- Drive units with PROFIBUS-DP interface (standard slaves)

Note

A teleservice adapter can only be connected to one of the two interfaces.

6.4 Ethernet interfaces (X120, X130, X127)

6.4.1 Features

Features

The interfaces are full-duplex 10/100 Mbit Ethernet ports. Both ports are connected as an Ethernet terminal.

Note

A crossover cable is required for the direct link between the control unit and the TCU.

For diagnostic purposes, the RJ45 sockets are each equipped with a green and a yellow LED. This allows the following status information about the respective Ethernet port to be displayed:

Table 6-6 Ethernet port LED displays

LED	Status	Meaning
Green	On	10 or 100 Mbaud link available
	Off	Missing or faulty link
Yellow	On	Receive or transmit activity
	Off	No activity

Interface features

Table 6-7 X120, X130 and X127

Feature	Version
Plug-connector type	RJ45 socket
Cable type	Industrial Ethernet cable (CAT5)
Maximum cable length	100 m

Pin assignment

Table 6-8 Ethernet interfaces (X120, X130, X127)

Pin	Signal name	Signal type	Meaning
1	TXP	Output	Ethernet transmit difference signal
2	TXN	Output	Ethernet transmit difference signal
3	RXP	Input	Ethernet receive difference signal
4	NC		
5	NC		
6	RXN	Input	Ethernet receive difference signal
7	NC		
8	NC		

Position of plug connectors

The following figure shows the mounting position and name of the Ethernet plug connectors on the module.

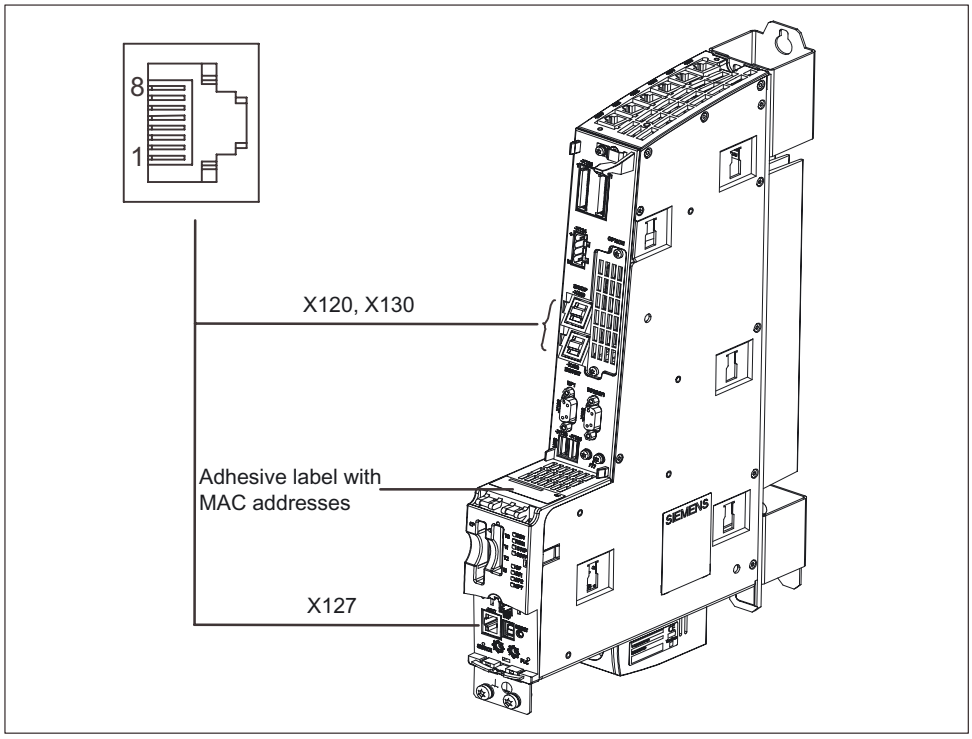


Figure 6-3 Position of the Ethernet interfaces

MAC addresses

A type plate for the MAC addresses of the Ethernet interfaces is attached to the front panel of the control unit:

Figure 6-4 MAC addresses of Ethernet interfaces X120, X130, X127

You can see this type plate when you open the front cover of the control unit.

6.4.2 Application

Ethernet connections

The following connections can be established via the Ethernet interfaces:

- X120 provides the link to the automation network (e.g., OPs).
- X130 connects the control unit to the plant network.
- X127 serves solely as a service socket.

6.5 Digital inputs/outputs X122 and X132

6.5.1 Properties

Interface features

Table 6-9 Interfaces X122 and X132

Features	Version
Plug-connector type	Micro Combicon
Connection option	up to 0.25 mm^2
Current carrying capacity	4 A, maximum

Position of plug connectors

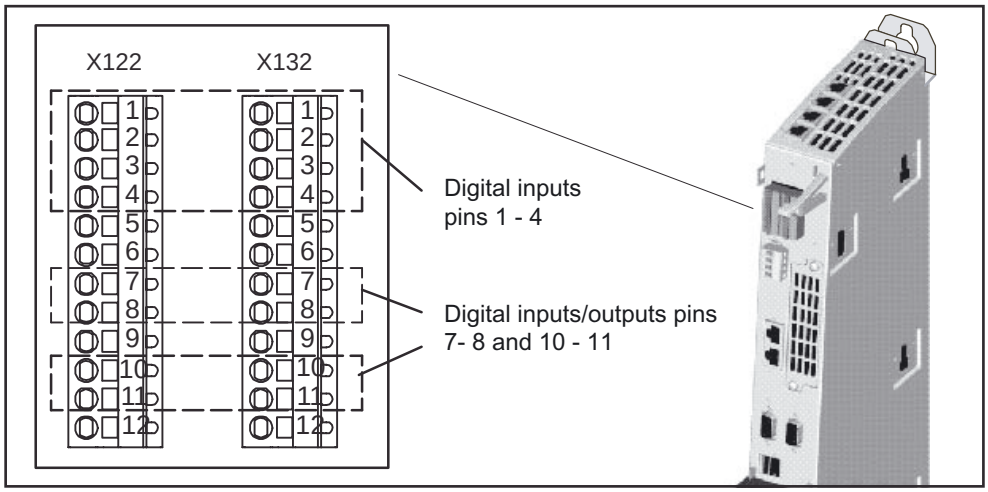


Figure 6-5 Digital inputs and digital inputs/outputs (interfaces X122 and X132)

Access to inputs/outputs

Note

The inputs/outputs are updated in the set PROFIBUS bus clock pulse for SINAMICS Integrated.

Wiring diagram and block diagram

The following figure shows the wiring diagram based on an example of the NCU 710 and the block diagram of the digital inputs and outputs.

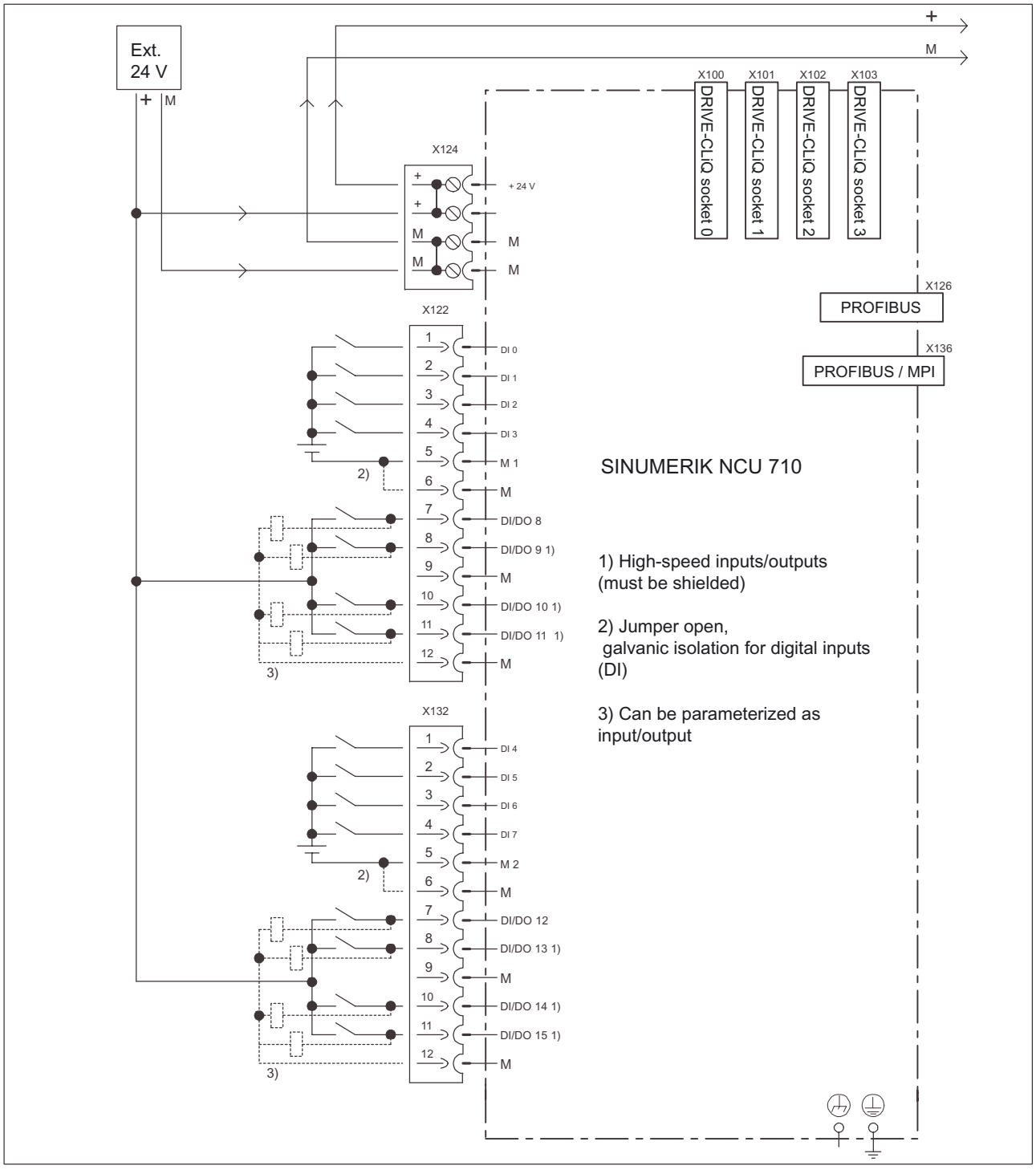


Figure 6-6 Wiring diagram and block diagram of the digital inputs/outputs

6.5.2 Assignment

Interface assignment of X122 and X132

Table 6-10 X122 digital inputs/outputs

Pin	Signal name	Signal type	Meaning
1	DI0	I	Digital input 0
2	DI1	I	Digital input 0
3	DI2	I	Digital input 0
4	DI3	I	Digital input 0
5	M1	GND	Ground for DI0 - DI3 (functionally-separated relative to M)
6	M	GND	Ground
7	DI/DO8	B	Digital input/output 8
8	DI/DO9	B	Digital input/output 9 (rapid input)
9	M	GND	Ground
10	DI/DO10	B	Digital input/output 10 (rapid input)
11	DI/DO11	B	Digital input/output 11 (rapid input)
12	M	GND	Ground
Signal type: B = Bidirectional; I = Input; GND = Reference potential (ground)			

Table 6-11 X132 digital inputs/outputs

Pin	Signal name	Signal type	Meaning
1	DI4	I	Digital input 4
2	DI5	I	Digital input 5
3	DI6	I	Digital input 6
4	DI7	I	Digital input 7
5	M2	GND	Ground for DI4 – DI7 (functionally-separated relative to M)
6	M	GND	Ground
7	DI/DO12	B	Digital input/output 12
8	DI/DO13	B	Digital input/output 13 (rapid input)
9	M	GND	Ground
10	DI/DO14	B	Digital input/output 14 (rapid input)
11	DI/DO15	B	Digital input/output 15 (rapid input)
12	M	GND	Ground

Note

The digital inputs/outputs are reserved by the system (terminal assignment).

6.5.3 Technical data

Digital inputs on X122/X132

Table 6-12 Technical data of digital inputs X122/X132

Parameter	Values
Voltage	-3 V to 30 V
Typical power consumption	10 mA at 24 V DC
Galvanic isolation	Reference potential is terminal M1 or M2
Signal level (including ripple)	High signal level: 15 V to 30 V
	Low signal level: -3 V to 5 V
Signal propagation delays	L → H: 50 µs
	H → L: 100 µs

Digital inputs/outputs on X122/X132

Table 6-13 Technical data of the digital inputs/outputs of X122/X132

Parameter	Values
As an input	
Voltage	-3 V to 30 V
Typical power consumption	10 mA at 24 V DC
Signal level (including ripple)	High signal level: 15 V to 30 V
	Low signal level: -3 V to 5 V
Pins 8, 10 and 11 are "rapid inputs"	
Signal propagation delays of inputs/"rapid inputs"	L → H: 50 µs/5 µs
	H → L: 100 µs/50 µs
As an output	
Voltage	24 V DC
Maximum load current per output	500 mA

Note

An open input is interpreted as "low".

Only "rapid inputs" can be used as inputs for BEROs and probes.

Terminals M1 or M2 must be connected for the digital inputs to work. This can be done as follows:

Connect the coupled-motion reference ground of the digital inputs, or provide a jumper to terminal M. (Notice! This removes the galvanic isolation for these digital inputs.)

6.5.4 Application

Connecting sensors and actuators

Digital inputs and outputs can be used to connect various sensors and actuators to the two 12-pin connectors (X122 and X132) on the front panel.

The following types of digital I/O are used:

- Digital inputs
- Bidirectional digital inputs/outputs

The assignment of I/Os to functions can be parameterized freely by the user. Special functions, such as probe input and cam output, can also be assigned to the I/Os.

The enables for the drive units and/or motors (Line Module, Motor Module) connected to the control unit can be switched using the digital inputs.

6.6 Power supply X124

Features of the interface

Table 6-14 Interface X124

Features	Type
Connector type	Combicon
Connection possibility:	up to 2.5 mm^2
Current carrying capacity	10 A, maximum
Maximum cable length	10 m

Interface assignments

Table 6-15 Power supply X124

Pin	Signal name	Signal type	Meaning
1	P24	VI	Power supply 24 V
2	P24	VI	
3	M	VO	
4	M	VO	Ground
Signal type: VI = Voltage input (power supply) VO = Voltage output (power supply)			

Note

The 24 V is looped through via the 24 V connector. In this case, pin 1 is jumpered with pin 2, and pin 3 is jumpered with pin 4.

Position of power supply interface

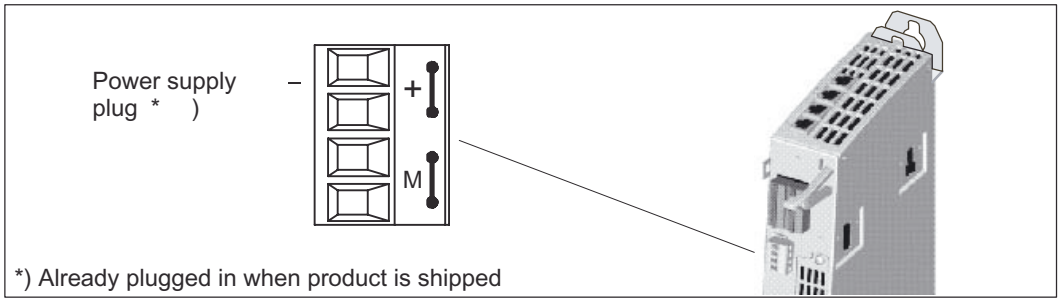


Figure 6-7 Power supply interface

Application of X124

This interface is provided exclusively for connection to the external power supply.

See also

Power supply (Page 4-4)

6.7 Test sockets X131 - X134

Application

The test sockets are used to output analog signals. Any interconnectable signal can be output to any test socket on the control unit.

- Max. output range of the test signal: 0 to 5 V
- Test sockets have to be parameterized before use, as there is no default setting on delivery.

Caution

The test sockets should be used exclusively for servicing purposes.

The measurements may only be carried out by appropriately trained specialists.

Test socket position

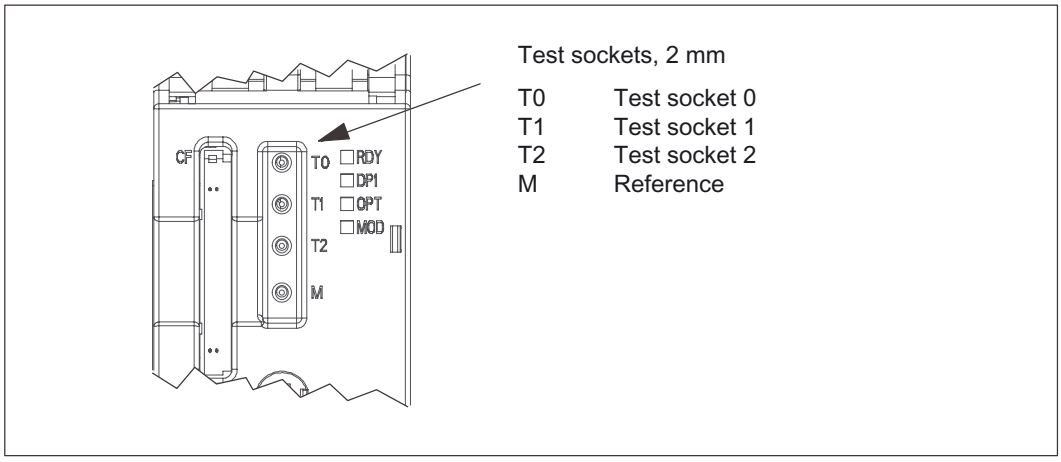


Figure 6-8 Test socket arrangement

6.8 USB–interfaces X125, X135

The USB interfaces are used exclusively for service purposes, correspond to the norm and are, therefore, not described in detail here.

Table 6-16 Interfaces X125 and X135

Features	Versions
Plug-connector type:	Double USB socket – type A
Version:	USB 2.0
Current carrying capacity:	0.5 A per channel

Note

The 5 V power supply is designed to be short-circuit proof.

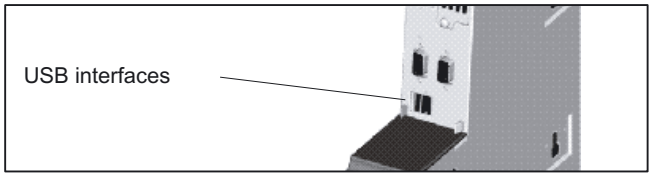


Figure 6-9 Position of USB interfaces

Dimension drawings

7

7.1 Dimension drawing

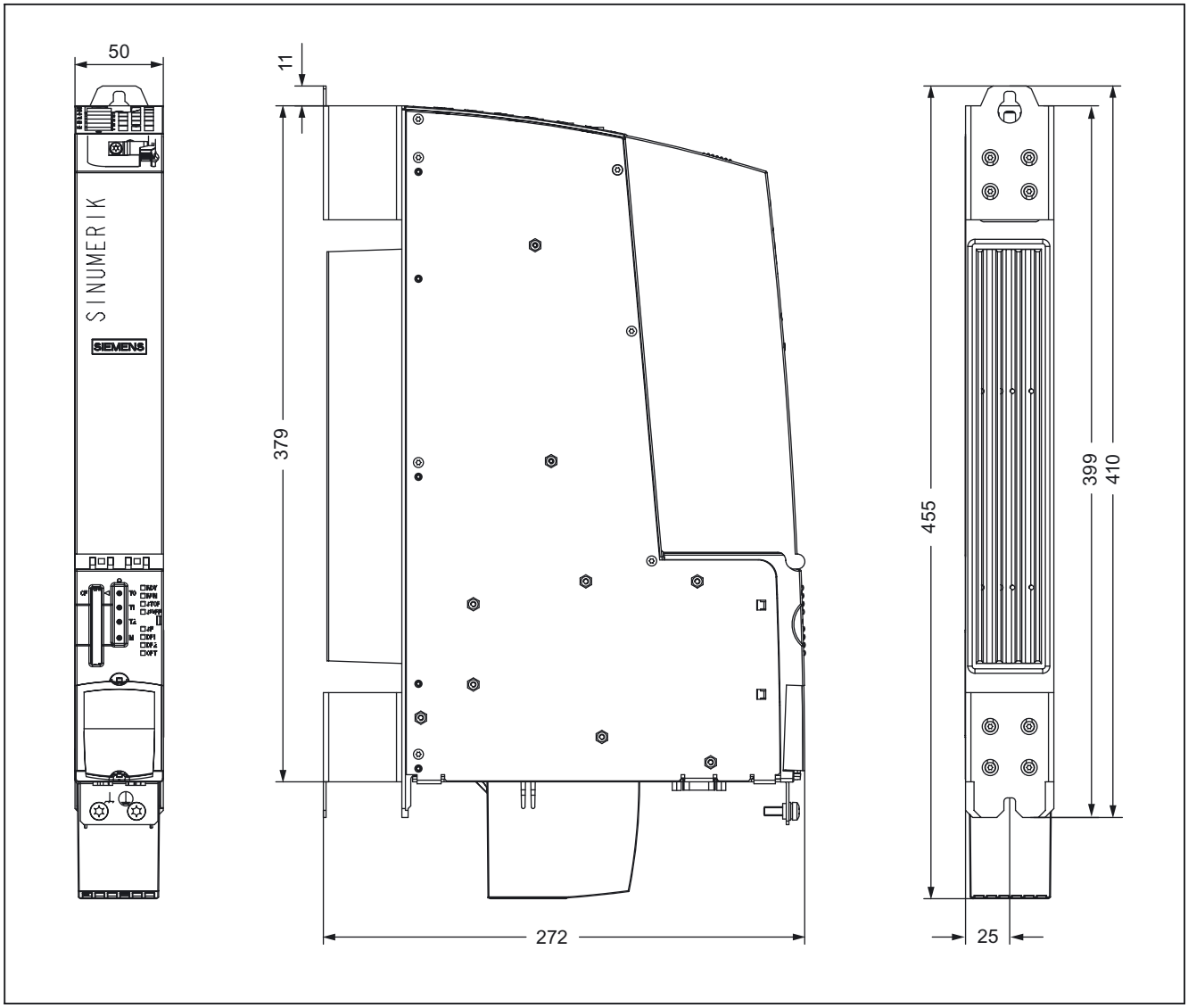


Figure 7-1 Dimension drawing of control unit

Mounting

8

8.1 Safety information

Open equipment

These modules are open equipment. This means they may only be installed in housings, cabinets or in electrical service rooms that can be entered or accessed exclusively by means of a key or tool. Housings, cabinets or electrical service rooms may only be accessed by trained or authorized personnel. An external fire protection housing is required.

Danger

The equipment must be deenergized when you mount the control unit.

Control cabinet manufacture

Please refer to the SINAMICS documentation for more details.

Notice

The 80 mm ventilation spaces above and below the control unit must be observed.

If you have any further questions or are looking for particular solutions, you can contact the Systems Engineering Plant Chemnitz directly.

8.2 Installation types

Prerequisite

The control unit is installed in a control cabinet along with the SINAMICS components.

The following prerequisites must be met to install a control unit:

- The control cabinet has been installed and wired.
- SINAMICS components should already have been installed and wired (for lateral mounting).
- Components and tools are available.

Note

The procedures described below for mounting the control unit refer to the delivery condition of the control unit: The upper clip is pulled in and the spacers are mounted (see figure below).

Designs

The control unit is compatible with the SINAMICS S120 booksize design. There are two possible mounting methods:

- Lateral mounting on the SINAMICS S120 Line Module

  In this type of mounting, the control unit is attached to the side wall of the Line Module in the control cabinet.
- Mounting on the rear wall of the control cabinet

As the design of the control unit is based on that of the SINAMICS S120 family, please observe these notes and the corresponding reference documents.

Mounting aids

The control unit is designed for mounting in a control cabinet (IP 20 degree of protection in accordance with general conditions).

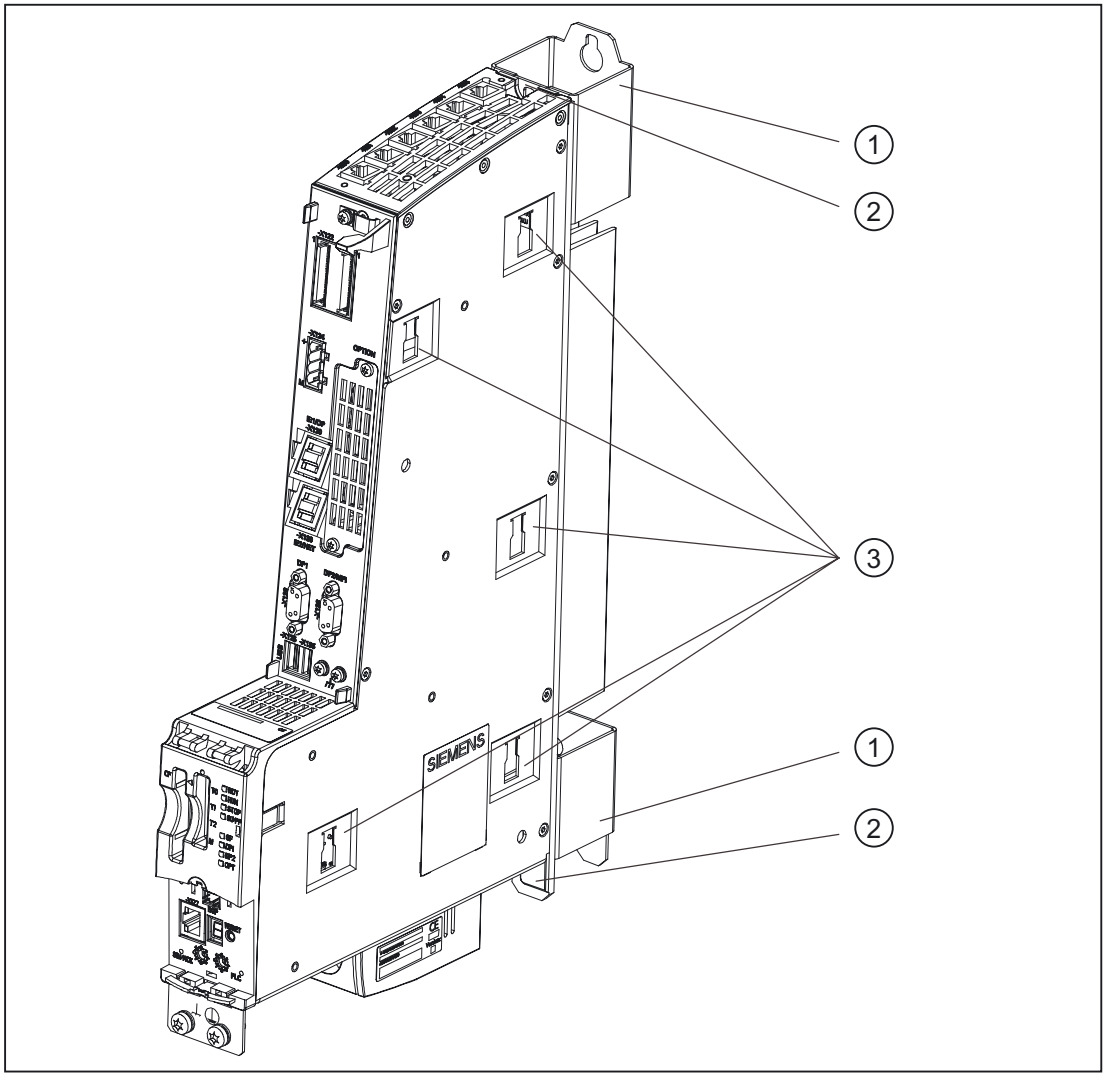


Figure 8-1 Mounting aids

(1) Spacers for mounting on the rear wall of the control cabinet
(2) Lugs for mounting directly on the rear wall of the control cabinet (external heat dissipation)
(3) Cutouts for lateral mounting on SINAMICS drive group

Mounting instructions

A seal can be provided for segregated heat removal on the control unit. This enables an air-tight connection to be made between the control unit and the rear wall of the control cabinet, i.e., the heat sink is located outside the control cabinet.

8.3 Side-mounting of control unit on SINAMICS group

Introduction

The control unit is normally mounted on the side wall of a SINAMICS S120 Line Module. The required mounting elements are supplied with the SINAMICS S120 Line Module.

Procedure

The SINAMICS S120 module has five mounting fixtures on the left-hand side. To mount the control unit, proceed as follows:

1. Remove the spacers from the control unit.
2. Position the control unit on the left-hand side of the SINAMICS S120 module. The mounting fixtures fit exactly in the five cutouts on the control unit.
3. Push the two units together.
4. Press down on the control unit until it engages and is securely connected to the SINAMICS S120 module.

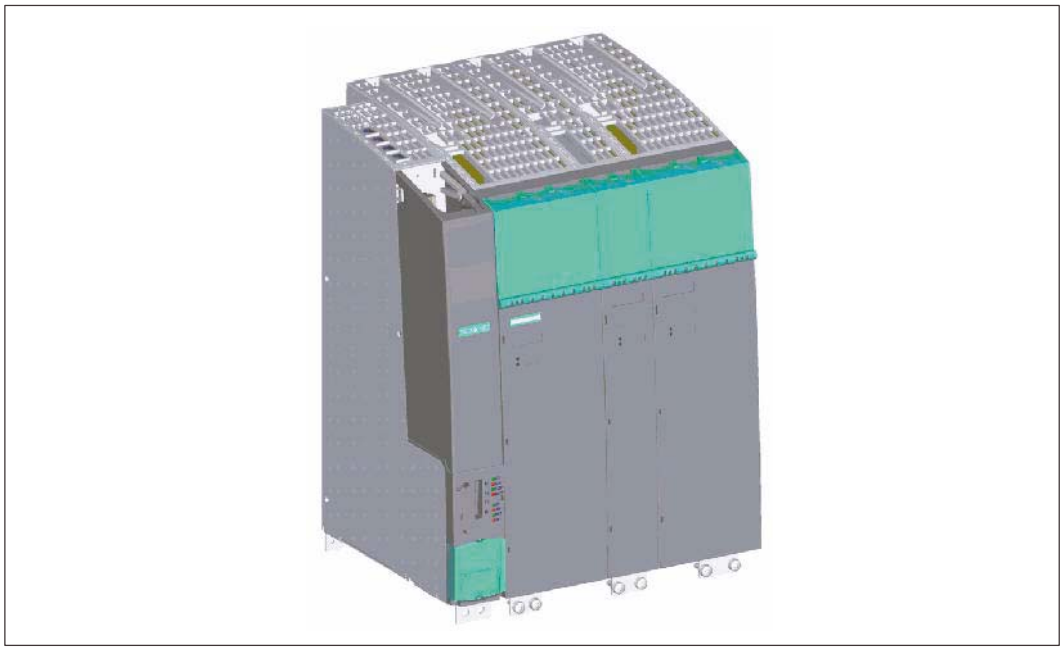


Figure 8-2 SINAMICS group with control unit

8.4 Mounting the control unit on the rear wall of the control cabinet

8.4.1 Mounting control unit using spacers

Introduction

Spacers can be used to mount the control unit on a bare-metal highly-conductive rear wall of a control cabinet. This mounting method should be used if a number of control units are required or if you wish to isolate the Line Module.

Procedure

Use two M5 (M6) screws in the spacers to mount the control unit to back rear wall of the control cabinet.

8.4.2 Mounting the control unit directly on the rear wall of the control cabinet

Introduction

If you wish to perform segregated heat removal on the control unit, the latter can be mounted directly on the rear wall of the control cabinet without spacers.

Prerequisite

The bushing for the heat sink has been fitted in the rear wall of the control cabinet.

Procedure

1. Remove the spacers.
2. Fit the seal around the control unit heat sink.
3. Loosen the three M3 screws (0.8 Nm) on the upper clip and push the clip up until the upper hole protrudes beyond the housing.
4. Tighten up the three screws on the clip again.
5. Mount the top and bottom of the control unit with heat sink directly on the rear wall of the control cabinet with two M6 screws (6 Nm).

Connections

9

9.1 Overview

Connection options

The control unit has a series of interfaces via which the power supply and the remaining system components are connected. The front cover on the control unit must be open to make the connections.

- The various SINAMICS components are connected with the control unit via DRIVE-CLiQ.
- Actuators and sensors can be connected to the digital inputs/outputs.
- For communication purposes, the control unit can be connected to PROFIBUS-DP, MPI and Ethernet.

The following overview shows an example of the various interfaces and their connection options.

Note

All devices in the SINUMERIK 840D sl and SINAMICS S120 product families appear in Catalog NC 61. SIMATIC products that can be connected to the control unit appear in Catalog PM 10.

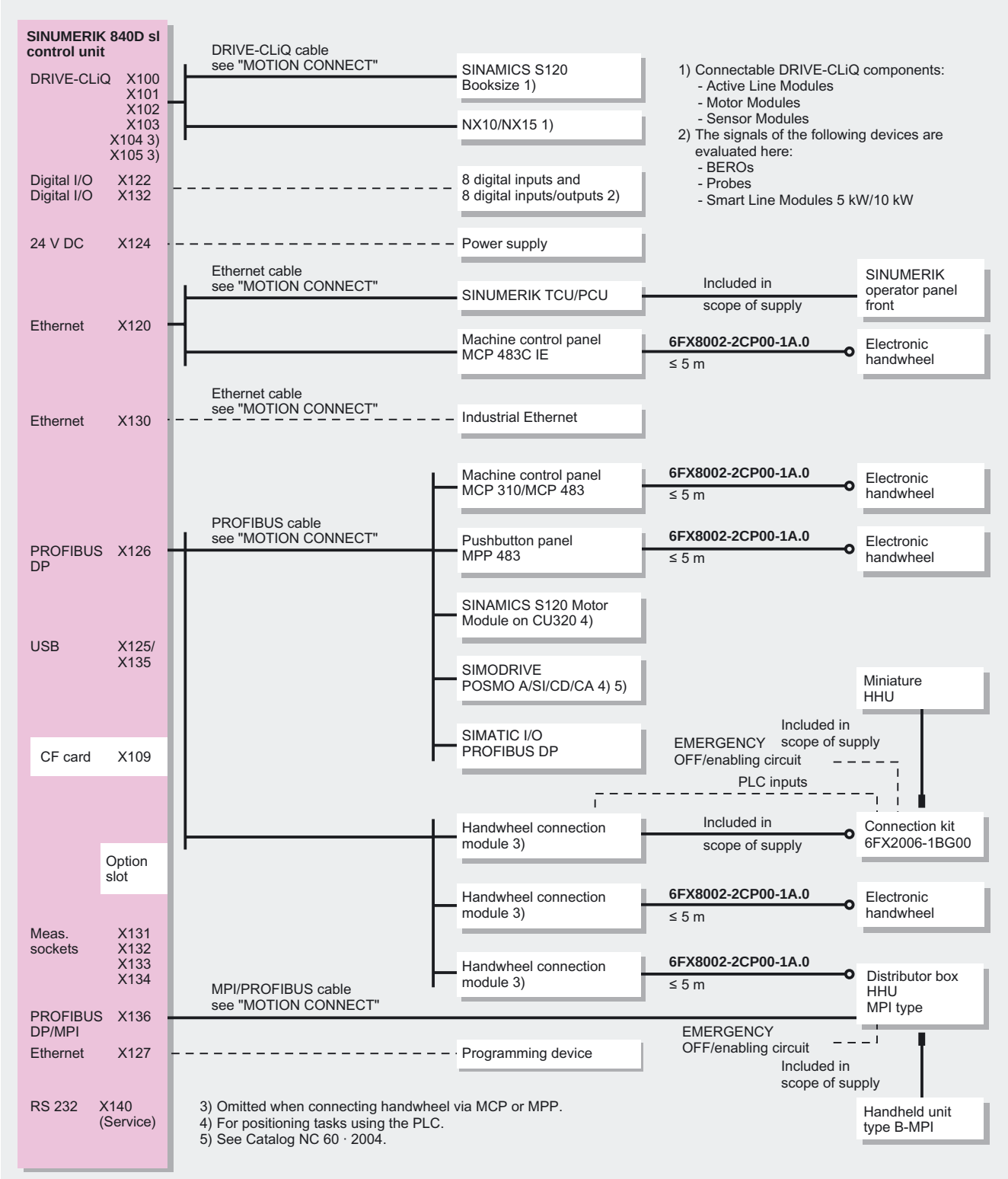


Figure 9-1 Connection options for a control unit

9.2 Safety information for wiring

Note the following:

Safety information

Danger

The system power supply must be disconnected when you wire the control unit.

Notice

If your axis grouping contains a Smart Line Module without DRIVE-CliQ (5 kW or 10 kW), you must assign the Smart Line Module enable signal to digital output X122.1 on the control unit.

9.3 Opening the front cover

Introduction

The interfaces are concealed behind a front cover. You must remove this cover before you can wire the interfaces.

A hinge connects the front cover to the front of the housing. Once opened, the cover can be completely removed. When the front cover is closed (folded up), it automatically locks into place by means of a hook on the connector panel.

Procedure

1. Disengage the release hook on the inside of the front cover (the front cover is open and in the up position).
2. Remove the front cover with a forward motion.

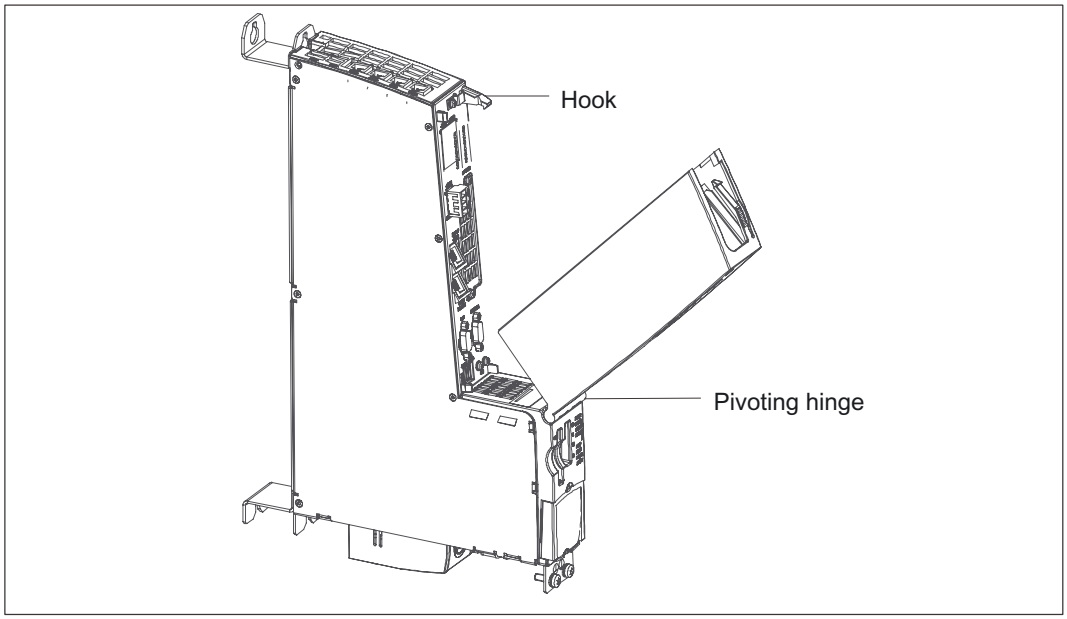


Figure 9-2 Removing the front cover

Note

All cables must be routed vertically upwards to the fullest extent possible so that the front cover can be closed. The front cover is open and in the up position.

9.4 Power supply

9.4.1 Safety regulations

Basic rules

Because of the wide range of possible applications, only the basic rules for electrical installation can be included in this section. At a minimum, you must comply with these basic rules to ensure fault;t-free operation.

Rules for safe operation

In order to ensure the safe operation of your equipment, implement the following measures, adapting them to suit your conditions:

- An EMERGENCY OFF concept in accordance with the generally accepted rules of current engineering practice (e.g., European Standards EN 60204, EN 418 and similar).
- Additional measures for end position limiting of axes (e.g., hardware limit switches).
- Equipment and measures for protection of motors and power electronics in accordance with the SINAMICS Installation Guidelines.

  In addition, in order to identify hazards, we recommend that a risk analysis be conducted on the complete system in accordance with the basic safety requirements set out in Appendix 1 of EU Machinery Directive 89/392/EEC.

Further reading

Please also note the information in the following sections of this manual:

- Guidelines on Handling Electrostatic Sensitive Devices (ESD)
- For the configuration of a system with SIMATIC ET 200 I/O (e.g., ET 200S, ET 200M, etc.), please refer to the manuals for the relevant ET 200 I/O system.
- For further information about EMC guidelines, we recommend the publication:

  /EMC/, EMC Installation Guide

9.4.2 Standards and Regulations

VDE guideline compliance

During wiring, you must observe the appropriate VDE guidelines, in particular VDE 0100 and VDE 0113 for tripping devices and short-circuit and overload protection.

System startup after certain events:

The following list identifies considerations required for startup of a system following certain events.

- If the system starts up again following a voltage drop or power failure, all hazardous operating states must be prevented from occurring. If necessary, force an EMERGENCY OFF.
- If the system starts up again after the EMERGENCY OFF apparatus is released, the startup must not be unchecked or undefined.

9.4.3 Mains voltage

Rules for the line voltage

The following list indicates what you must take into account for the line voltage:

- For stationary installations or systems that do not have all-pole line disconnect switches, the building installation must include a line disconnect switch or a fuse.
- For load power supplies and power supply modules, the rated voltage range set must correspond to the local line voltage.
- For all electrical circuits, the fluctuation/deviation of the line voltage from the rated value must be within the permissible tolerance (please refer to the technical specifications for the SINAMICS modules).

24 V DC supply

For...	Requirement	
Buildings	External lightning protection	Take lightning protection precautions (e.g., lightning conductors)
24 V DC supply lines, signal lines	Internal lightning protection	
24 V supply	Safe (electrical) isolation of low voltage	

Protection against external electrical phenomena

The table below shows how you must protect your system against electrical interference or faults.

Table 9-1 External electrical phenomena

For ...	Requirement
All plant or systems in which the component is installed	The plant or system is connected to a protective conductor for the discharge of electromagnetic interference.
Supply, signal, and bus lines	The wiring arrangement and installation complies with EMC regulations.
Signal and bus lines	A cable or wire break cannot lead to undefined states in the plant or system.

9.4.4 Connecting the power supply

Wiring the screw-type terminal block

The required 24 VDC load power supply is wired to the screw-type terminal block (X124).

Danger

The 24 VDC should be configured as functional extra-low voltage with safe isolation.

Supply system lines

Use flexible cables with a cross section of 0.25 to 2.5 mm^2 (or AWG 23 to AWG 13) for wiring the power supply.

If you only use one wire per connection, a ferrule is not required.

You can use ferrules without an insulating collar in accordance with DIN 46228, Form A long version.

9.5 DRIVE CLiQ components

9.5.1 DRIVE-CLiQ wiring

Introduction

The components of the SINAMICS S120 drive family and the control unit are interconnected using DRIVE-CLiQ. When connecting the components, please note the following rules.

Rules for wiring DRIVE-CLiQ

The following rules must be observed when wiring DRIVE-CLiQ:

- Ring wiring is not permitted.
- Components must not be double-wired.
- A maximum of 8 nodes can be connected in one row. A row is always regarded as starting at the control unit.
- Up to one Line Module, 6 Motor Modules (a Double Motor Module counts as 2 nodes) and 3 direct measuring systems may be connected to one control unit.

Rules for DRIVE-CLiQ sockets

The following rules must be observed when using DRIVE-CLiQ sockets:

- The control unit must be connected to X200 on the first booksize power section after it.
- The DRIVE-CLiQ lines between each of the power sections should be connected from interface X201 to X200 on the next component.
- The power line to the motor and the associated motor encoder must be connected to a Motor Module. The motor encoder is connected via terminal X202 or X208 on Double Motor Modules.

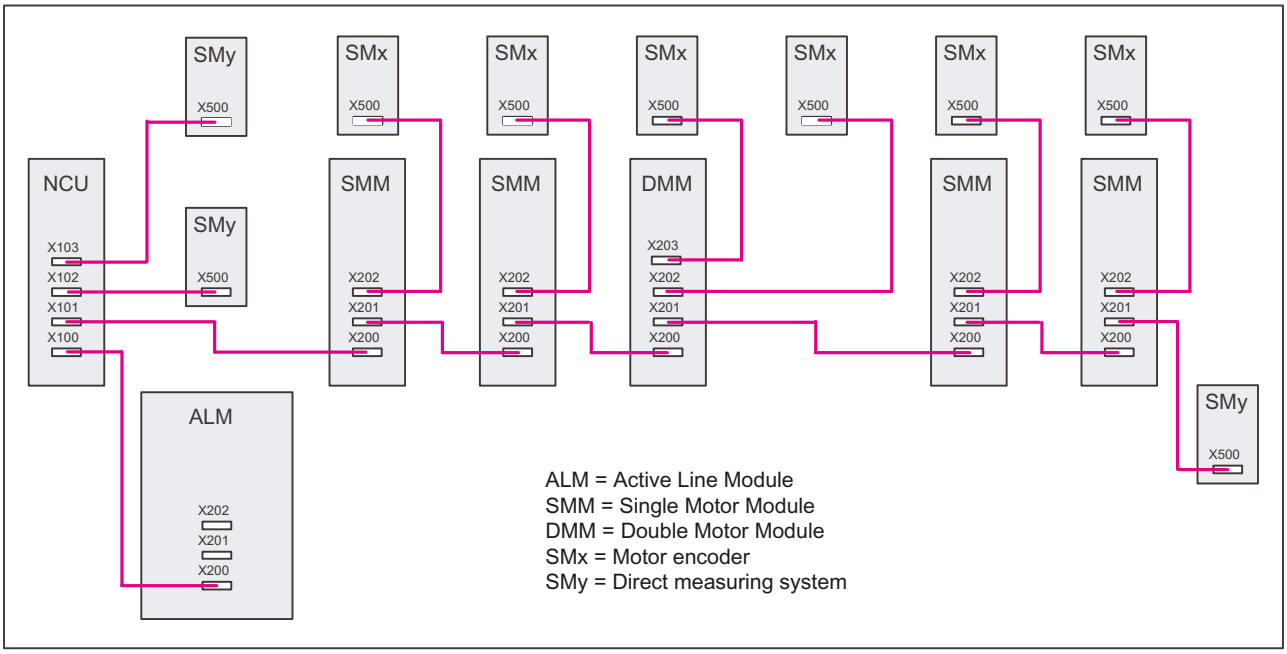


Figure 9-3 DRIVE-CLiQ wiring

Miscellaneous

- If an additional encoder is connected to a Motor Module, it is automatically assigned to this drive as encoder 2.
- The default sampling times must not be changed.

9.5.2 Connectable DRIVE-CLiQ components

Components

As a rule, all SINAMICS components approved for SINUMERIK can be connected using the DRIVE-CLiQ interface.

Table 9-2 Components with DRIVE-CLiQ

Component	Description
Active/Smart Line Module, Booksize	Line Modules provide the central power supply to the DC link.
Single/Double Motor Module, Booksize	Motor Modules draw their power from the DC link to supply the connected motors.
SMC10/20/30	Cabinet-Mounted Sensor Modules are needed when a motor with a DRIVE-CLiQ interface is not available and when external encoders are required in addition to the motor encoder.
SME20/25	Measuring systems outside the cabinet can be connected directly to the Sensor Module External.
NX10/15	Drive expansion module for up to 6 axes

Further reading

- You will find information about Line Modules and Motor Modules in the SINAMICS S120 Booksize Power Units Equipment Manual.
- You will find information about Sensor Modules in the SINAMICS S120 Control Units Equipment Manual.

9.6 Digital I/Os

9.6.1 Connecting cables for digital inputs/outputs

The following conditions apply to connecting cables:

- Flexible cable, cross section 0.25 mm^2
- Ferrules are not required.
- You can use ferrules without an insulating collar in accordance with DIN 46228, Form A long version.
- You can connect two cables each with a cross section of 0.25 mm^2 in one ferrule.

Note

To achieve optimum interference suppression, shielded cables must be used to connect measuring inputs or BEROs.

9.6.2 Wiring interfaces X122 and X132

Tools required

3.5-mm screwdriver or power screwdriver

Procedure

1. Strip off 6 mm of cable insulation and, if necessary, press on a ferrule.
2. Wire the digital inputs of the interface for connection of the sensors.
3. Wire the digital outputs of the interface for connection of the actuators.
4. Insert the cable into the corresponding spring-loaded terminal.

Pin assignment

For detailed information about the pin assignment of the X122/X132 interfaces, refer to the D4xx product manual under Interfaces.

Using shielded cables

If a shielded cable is used, the following additional actions are required:

1. Attach the cable shield to a grounded shielding bus immediately after the cable entry point in the cabinet (strip the insulation off the cable for this purpose).
2. Continue routing the shielded cable as far as the module but do not make a connection to the shield there.

9.6.3 Using a shield connection

Using a shield connection

1. Remove the fixing bracket.
2. Insert the cable and fasten the fixing bracket.

This figure shows where to attach the cables to the front panel connector and where to apply the cable interference suppression using the shield connecting element.

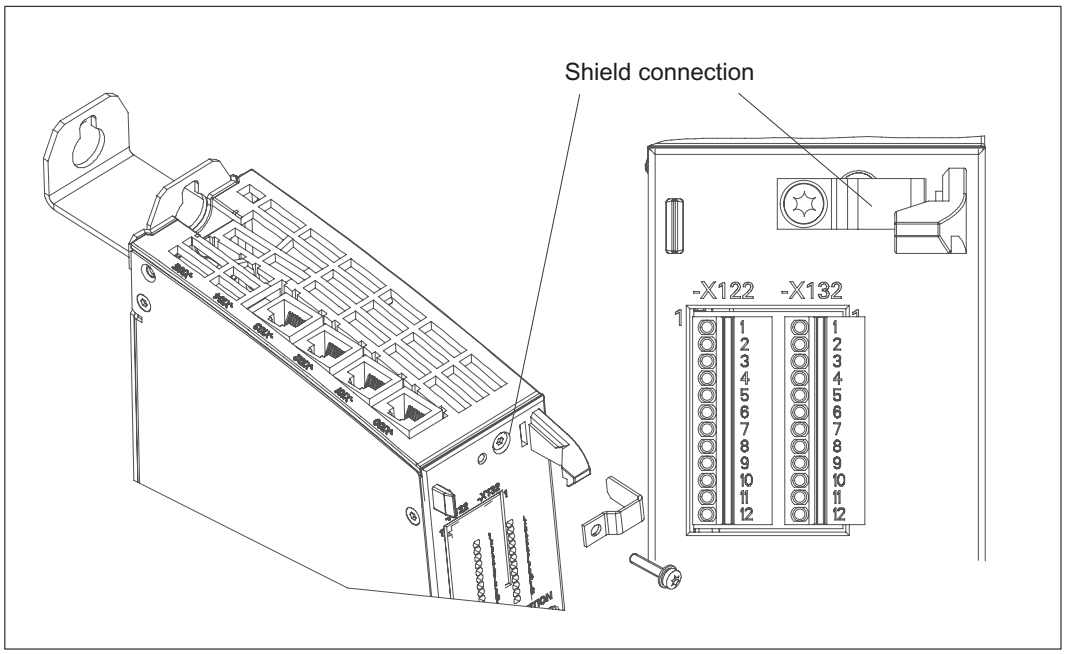


Figure 9-4 Using a shield connection

9.7 PROFIBUS / MPI

9.7.1 Connection components in PROFIBUS

Connection components

Individual nodes are connected by means of bus connectors and PROFIBUS cables. Remember to provide a bus connector with a programming port at either end of the subnet. This will give you the option of expanding the subnet if required, for example, for a programming device.

Use RS 485 repeaters to connect segments or extend cable lengths.

Segments

A segment is a bus line between two terminating resistors. A segment may contain up to 32 nodes. In addition, a segment is limited by the permissible cable length, which varies according to the transmission rate.

Terminating resistor

A cable must be terminated with its own surge impedance to prevent line disturbances caused by reflections. Activate the terminating resistor at the first and last node on a subnet or segment. The control unit must be either the first or the last node on the subnet.

Make sure that the stations to which the terminating resistor is connected are always supplied with voltage during power-up and operation.

9.7.2 PROFIBUS cables and connectors

Properties of PROFIBUS cables

The PROFIBUS cable is a two-stranded, twisted, and shielded cable with the following features:

Cable features

Table 9-3 Properties of PROFIBUS cables

Features	Values
Wave impedance	Approx. 135 to 160 Ω (f = 3 to 20 MHz)
Loop resistance	≤115 Ω/km
Effective capacitance	30 nF/km
Damping	0.9 dB/100 m (f = 200 kHz)
Permissible conductor cross section	0.3 mm^2 to 0.5 mm^2
Permissible cable diameter	8 mm + 0.5 mm

Connector features

The bus connector is used to connect the PROFIBUS cable to the PROFIBUS DP interfaces (X126, X136), thus establishing a connection to additional nodes.

Use of bus connectors with a 35° cable outlet is recommended so that the front cover of the control unit can be closed.

9.7.3 PROFIBUS cable lengths

Cable lengths and baud rate

The baud rate determines the cable length of a subnet segment.

Table 9-4 Permitted cable lengths of a subnet segment for specific baud rates

Baud rate	Max. segment cable length (in m)
19.6 to 187.5 Kbits/s	1000[1)]
500 Kbits/s	400
1.5 Mbits/s	200
3 to 12 Mbits/s	100
[1)] With isolated interface	

Greater cable lengths

If the cables lengths you require exceed the permitted length for a segment, you must use RS485 repeaters. The maximum possible cable length between two RS 485 repeaters corresponds to the cable length of a segment. With these maximum cable lengths, however, note that additional stations between the two RS 485 repeaters are not permitted. You can connect up to nine RS 485 repeaters in series.

Note that an RS 485 repeater must be counted as a subnet station when determining the total number of stations to be connected. This is true even if the RS 485 repeater is not assigned its own PROFIBUS address.

9.7.4 Rules for routing PROFIBUS cables

Routing bus cables

When routing the PROFIBUS cable, you must avoid:

- twisting
- stretching and
- squeezing

Constraints

In addition, when routing a bus cable for indoor use, you must take into account the following boundary conditions (dA = external cable diameter):

Table 9-5 General conditions for routing of PROFIBUS cables

Features	Constraints
Bend radius for a single bend	80 mm (10xdA)
Bending radius (multiple times)	160 mm (20xdA)
Permitted temperature range for cable routing	-5° C to +50° C
Shelf and static operating temperature range	-30° C to +65° C

References for further reading

Length codes for the preassembled cables are found in the following source:

Ordering information in Catalog NC 60.1

9.7.5 Connecting PROFIBUS-DP

Introduction

PROFIBUS cables are connected to the X126/X136 interface by means of a bus connector.

Wiring the bus connector

1. Proceed as follows to connect the bus connector:
2. Plug the bus connector into the corresponding interface on the control unit.
3. Screw the bus connector into place.

   As the control unit is located at the start or end of a segment, you must switch on the terminating resistor ("ON" switch setting).

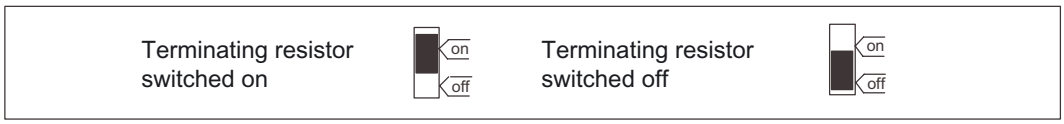


Figure 9-5 Terminating resistor switched on and off

Note

Make sure that the stations on which the terminating resistor is located are always supplied with voltage during booting and operation.

9.7.6 Disconnecting stations from the PROFIBUS

Removing the bus connector

You can remove the bus connector with a looped-through bus cable from the PROFIBUS DP interface at any time without interrupting data traffic on the bus.

Warning

Data exchange on the bus can be interrupted!

A bus segment must always be terminated with the terminating resistor at both ends. This is not the case, for example, if the last node with a bus connector is deenergized. Because the bus connector takes its voltage from the node, this terminating resistor is ineffective.

Make sure that the nodes at which the terminating resistor is connected are always energized.

9.7.7 Operating the X136 interface as MPI

Operated like PROFIBUS

The information on wiring the connector (terminating resistors) and the rules for routing of cables for PROFIBUS apply to this interface as well.

To do this, consult the relevant references.

Bus connector

This bus connector is used to connect the MPI bus cable to the MPI interface (X136), thus establishing a connection to an external programming device. You should only use plugs with a 35° cable outlet for the MPI connection.

MPI bus cable

The PROFIBUS cable specifications apply here as well; the only difference is that the cables can be longer due to a lower transmission rate.

To do this, consult the relevant references.

Technical Data

10

Table 10-1 General technical data

Safety	
Protection class	I (protective conductor) as per EN 61800-5-1
Degree of protection per EN 60529	IP20 or IPXXB
Approvals	CE, cULus
Degree of contamination	2
Cooling	Open circuit ventilation
Mounting position	Vertical
Mechanical ambient conditions	
Transportation (in transportation packaging)	2M2 according to EN 60721-3-2
Storage	1M2 according to EN 60721-3-1

Table 10-2 Electrical and mechanical data

	NCU 710.1	NCU 720.1	NCU 730.1
RAM	256 MB DRAM 0.5 MB SRAM	256 MB DRAM 0.5 MB SRAM	512 MB DRAM 1 MB SRAM
SIMATIC S7 - integrated	PLC 317-2 DP	PLC 317-2 DP	PLC 317-2 DP
Input voltage	DC 24 V	DC 24 V	24 V DC
Power consumption, max.	216 W	216 W	216 W
Power loss	55 W	55 W	55 W
Dimensions (WxHxD)	50 x 455 x 272 mm *)	50 x 455 x 272 mm *)	50 x 455 x 272 mm
Approx. weight	3.6 kg	3.6 kg	3.6 kg

*) With the fan/ battery module the height reduces to 418 mm

Spare Parts/Accessories 11

11.1 Dual fan/ battery module

11.1.1 Application

Functions of the dual fan/battery module

The dual fan/battery module can perform the following tasks:

- Cooling the CPU by means of two redundant fans.
- SRAM backup if the SuperCap is insufficient

The control unit monitors the temperature inside the module and the functioning of the fan. Fan faults are displayed and can be read out by means of the diagnostic buffer.

- Fan warning: When one of the two fans has ceased to turn.
- Fan fault: When none of the fans turn.
  If the software does not respond within approx. 1 minute the components are shutdown automatically and the status is indicated by means of the red SF LED.

Fans

If natural convection is not sufficient to cool the NCU 730.1, the fans integrated in the dual fan/ battery module will be activated when required.

- A temperature sensor on the NCU 730.1 will switch the fans on if the air intake temperature exceeds approx. 40°C.
- The fans will be switched off when the air intake temperature falls back below approx. 35°C.
- The fan is monitored during operation. In the event of a fault (stalled rotor or running too slowly) a message is output.

The fans in the NCU710.1 and NCU720.1 run constantly.

Notice

The control unit cannot be operated without fans, i.e. the control unit will not power up if the dual fan/battery module is not functioning.

Battery

A 3 V lithium battery can be inserted in the dual fan/battery module. The battery is preassembled with an approximately 4 cm long cable with plug connector. The appropriate mating connector is attached to a small circuit board for connection in the dual fan/battery module.

11.1.2 Mounting

Position of the dual fan/battery module

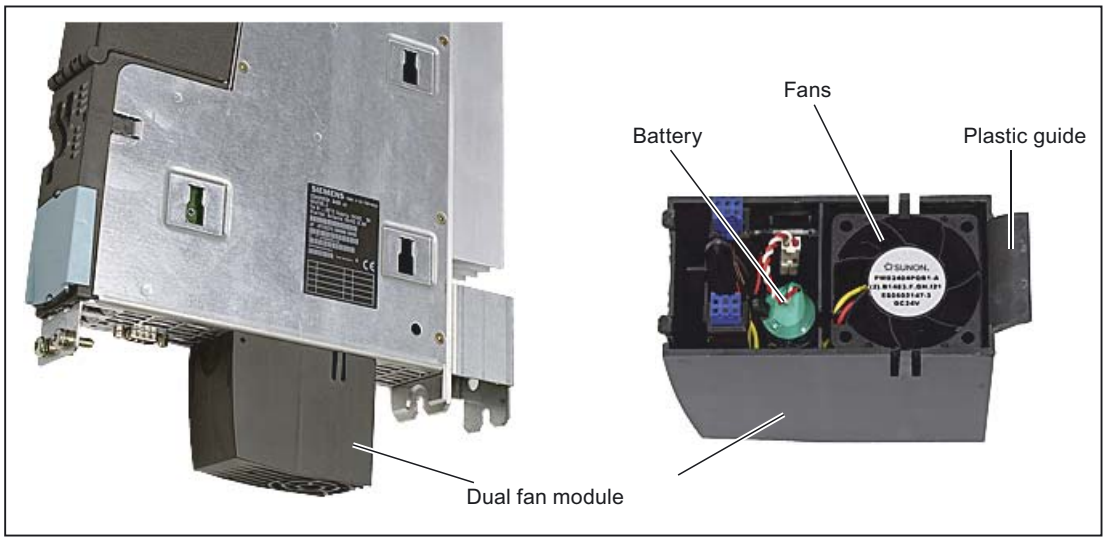


Figure 11-1 Replacing the dual fan/ battery module

Procedure

Proceed as follows to replace the dual fan/battery module but only observe points 3 and 4 if you want to replace the battery as well:

1. Gently press the dual fan/battery module backwards.

   This detaches the module from its front interlock.
2. Tilt the dual fan/battery module forwards at an angle and pull out the plastic guide from the control unit cutout.
3. Remove the battery by first removing the plug connector and then taking out the battery.
4. Connect the cable plug connector of the new battery to the mating connector in the dual fan/battery module and push the battery in.

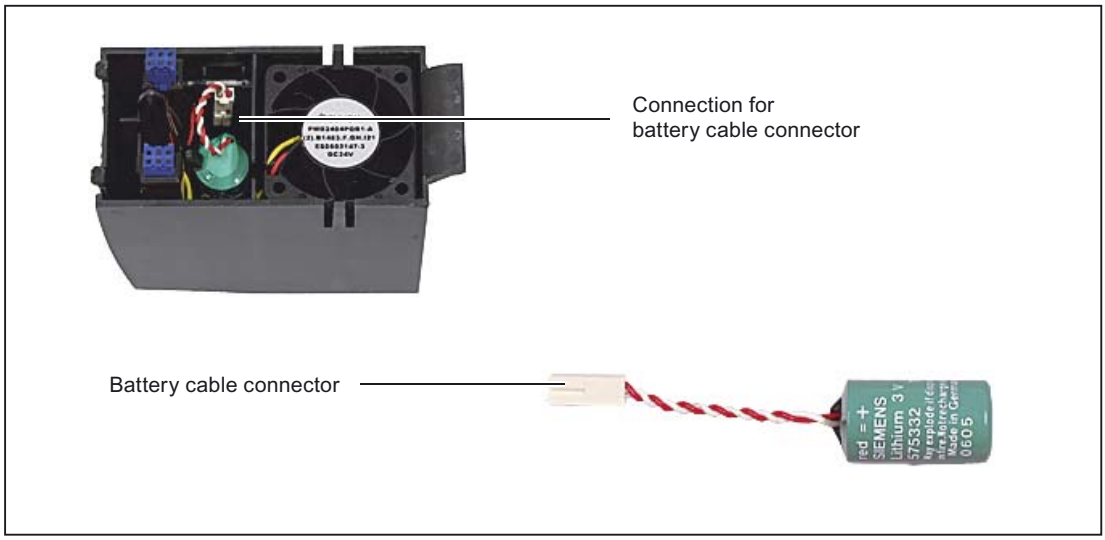


Figure 11-2 Battery replacement in the dual fan/battery module

5. Tilt the dual fan/battery module forwards at an angle with the open side facing up (battery visible).
6. Push the plastic guide into the cutouts on the underside of the control unit.
7. Tilt the dual fan/battery module up until the front interlock snaps into place.

   The electrical connection between the dual fan/battery module and the control unit is established automatically.

Note

The dual fan/battery module can be replaced during operation. When doing this, observe that the control unit can only be operated for a maximum of 1 minute without fans. If this time is exceeded, the control unit will shut itself down.

11.2 NX10/15

11.2.1 Description

Features

Using this module, you can expand the performance of an axis grouping of the SINUMERIK 840D sl CNC automation system. Each NX10 can control up to 3 additional axes and each NX15 can control up to 6 additional axes.

The NX10/15 has the following interfaces:

- 4 DRIVE-CLiQ (X100 – X103)
- 4 digital inputs and 4 digital inputs/outputs (X122)
- Power supply (X124)

Illustration

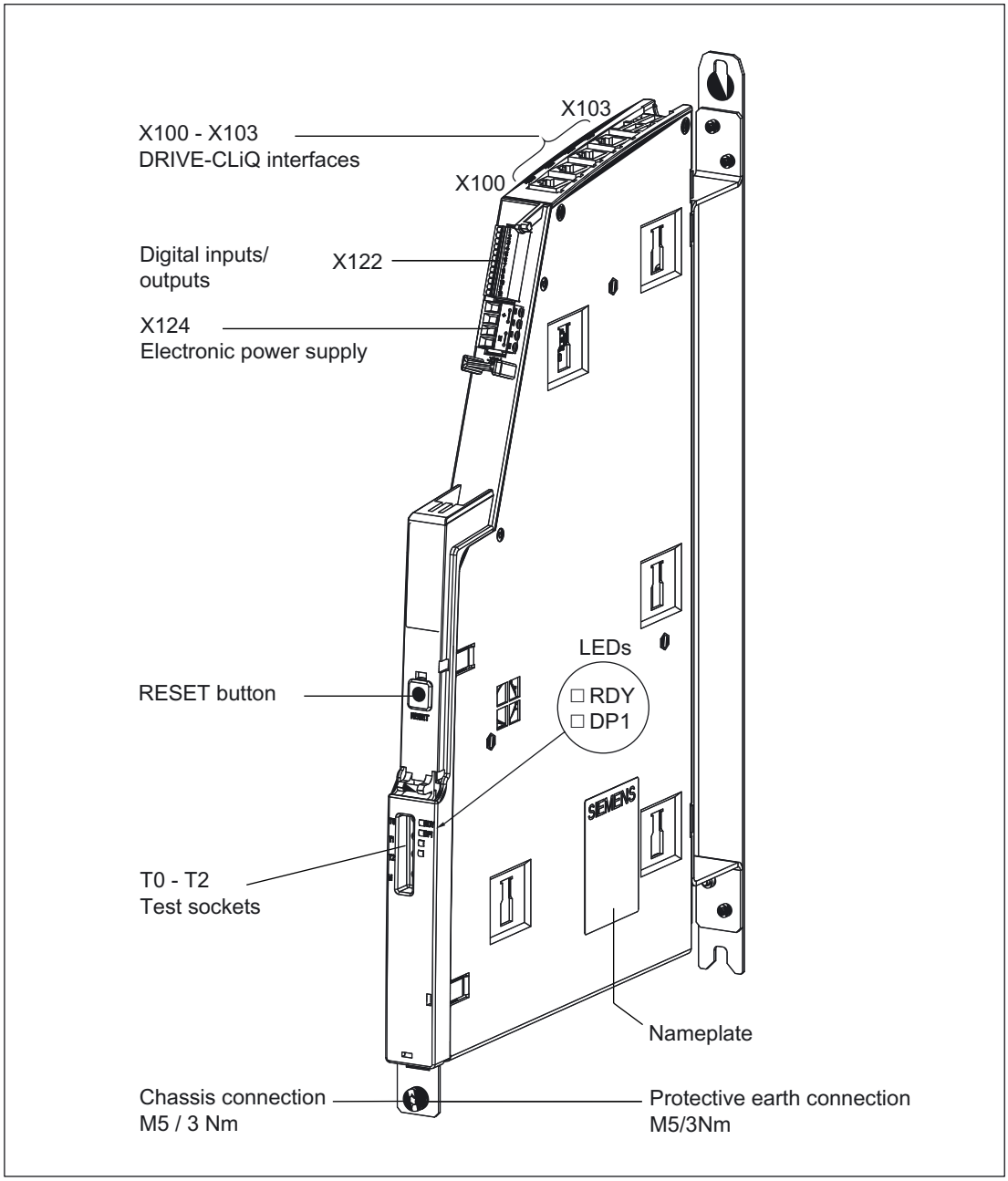


Figure 11-3 Representation of NX10/15 (without cover)

Type plate

The NX10/15 module type plate contains basically the same information as the control unit type plate (see Section 4.4).

11.2.2 Operating and display elements

LED displays

Table 11-1 Description of LEDs on the NX10/15

LED	Color	Status	Description
RDY, READY H1	Off		Electronic power supply outside permissible tolerance range
	Green	Steady-light signal	NX10/15 is ready for operation
		Blinklight 2 Hz	Writing to CompactFlash Card
	Red	Steady-light signal	At least one fault is pending (e.g., RESET, watchdog monitoring, basic system fault). NX10/15 is booting up.
		Blinklight 0.5 Hz	Boot fault (e.g., firmware cannot be loaded into the RAM)
	Yellow	Steady-light signal	Firmware loading into RAM
		Blinklight 0.5 Hz	Unable to load firmware into RAM
		Blinklight 2 Hz	Firmware CRC fault
DP1, CU_LINK H2	Off		Electronic power supply outside the permissible tolerance range, NX10/15 is not ready for operation.
	Green	Steady-light signal	CU_LINK is ready for communication and cyclic communication is running
		Blinklight 0.5 Hz	CU_LINK is ready for communication and no cyclic communication is running
	Red	Steady-light signal	At least one CU_LINK fault is present. CU_LINK not ready for operation (e.g., after POWER ON)

Cause and elimination of faults

Information on causes and on eliminating faults can be found in:

References: /IDsl/ Installation and Startup Manual CNC Part 1 (NCK, PLC, Drive)

RESET button

The RESET button is on the front of the module under the cover.

Function of the RESET button, see:

References: /IDsl/ Installation and Startup Manual CNC Part 1 (NCK, PLC, Drive)

11.2.3 Interfaces

Sample connection

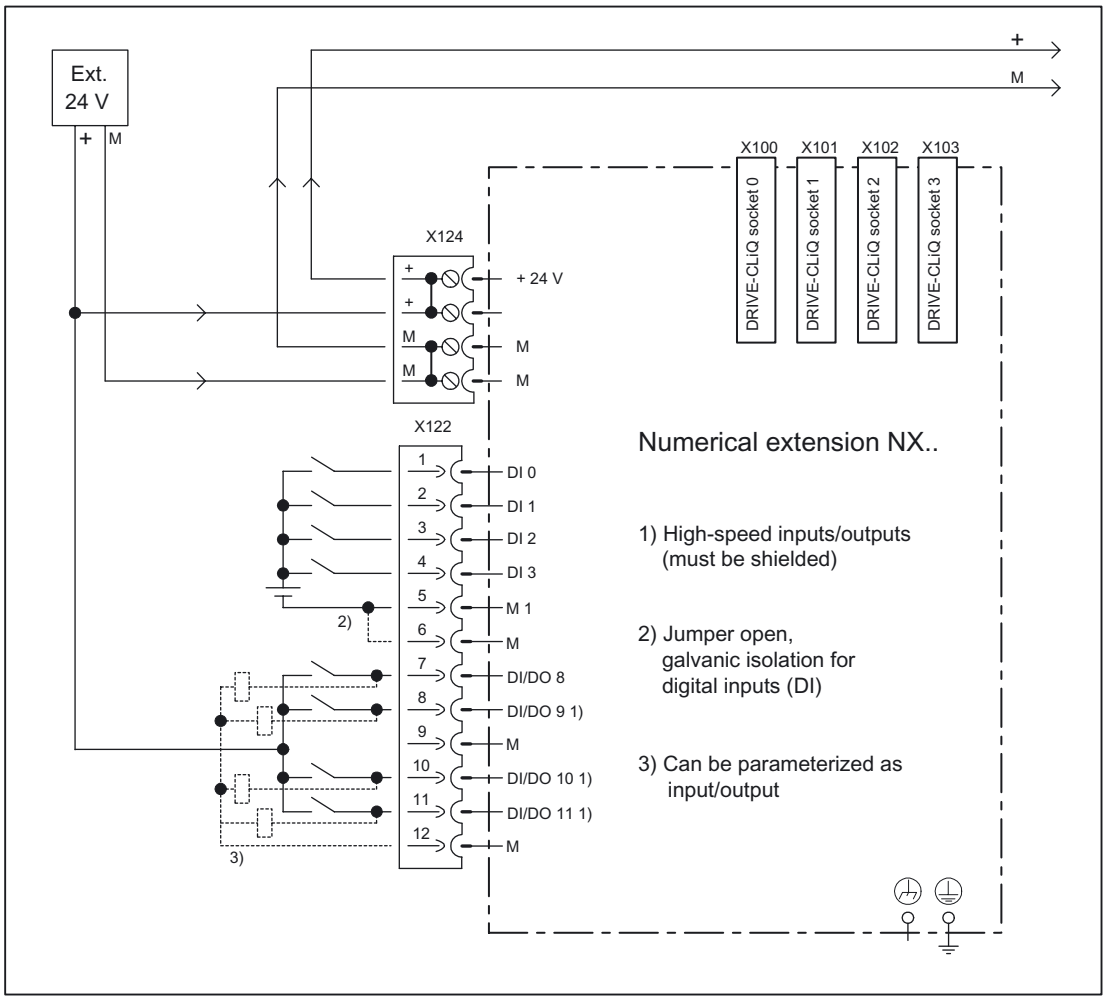


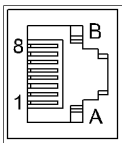
Figure 11-4 NX10/15 sample connection

Note

The digital inputs/outputs are reserved by the system (terminal assignment).

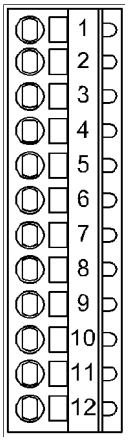
DRIVE-CLiQ interfaces X100 - X103

Table 11-2 DRIVE-CLiQ interface (X100-X103)

	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)	Electronic ground
Blanking plate for DRIVE-CLiQ interface: Tyco, order no.: 969556-5			

X122 digital inputs/outputs

Table 11-3 X122 terminal block

	Terminal	Name[1)]	Technical data
	1	DI 0	Voltage: -3 V to 30 V Typical current consumption: 10 mA at 24 V DC Galvanic isolation: reference potential is terminal M1 Signal level (incl. ripple) High signal level: 15 V to 30 V Low signal level: -3 V to 5 V Signal propagation times: L → H: approx. 50 µs H → L: approx. 100 µs
	2	DI 1	
	3	DI 2	
	4	DI 3	
	5	M1	
	6	M	
	7	DI/DO 8	As input: Voltage: -3 V to 30 V Typical current consumption: 10 mA at 24 V DC Signal level (incl. ripple) High signal level: 15 V to 30 V Low signal level: -3 V to 5 V Terminal numbers 8, 10 and 11 are "high-speed inputs" Signal propagation times for inputs/"high-speed inputs": L → H: approx. 50 µs/5 µs H → L: approx. 100 µs/50 µs As output: Voltage: 24 V DC Max. load current per output: 500 mA Continued-short-circuit-proof
	8	DI/DO 9	
	9	M	
	10	DI/DO 10	
	11	DI/DO 11	
	12	M	
Max. connectable cross-section: 0,5mm²Type: Spring-loaded terminal 1			

1) DI: digital input; DI/DO: Bidirectional digital input/output; M: Electronic ground M1: Reference ground

Note

An open input is interpreted as "low".

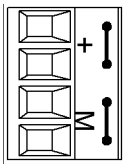
The "high-speed inputs" can be used for position detection.

To enable digital inputs (DI) 0 to 3 to function, terminal M1 must be connected. This can be done as follows:

Connect the coupled-motion reference ground of the digital inputs, or provide a jumper to terminal M. **(Notice! This removes galvanic isolation for these digital inputs.)**

Power supply X124

Table 11-4 Terminal block X124

	Terminal	Function	Technical data
	+	Electronic power supply	Voltage: 24 V DC (20.4 V - 28.8 V) Power consumption: max. 0.8 A (without load) Max. current via jumper in plug connector: 20 A at 55°C
	+	Electronic power supply	
	M	Electronic ground	
	M	Electronic ground	
Max. connectable cross-section: 2.5 mm^2 Type: Screw terminal 2			

Note

The two “+” and “M” terminals are jumpered in the plug connector and not in the device. This ensures the supply voltage is looped through.

The current consumption increases by the current consumption of DRIVE-CLiQ and the digital outputs.

11.2.4 Dimension drawing

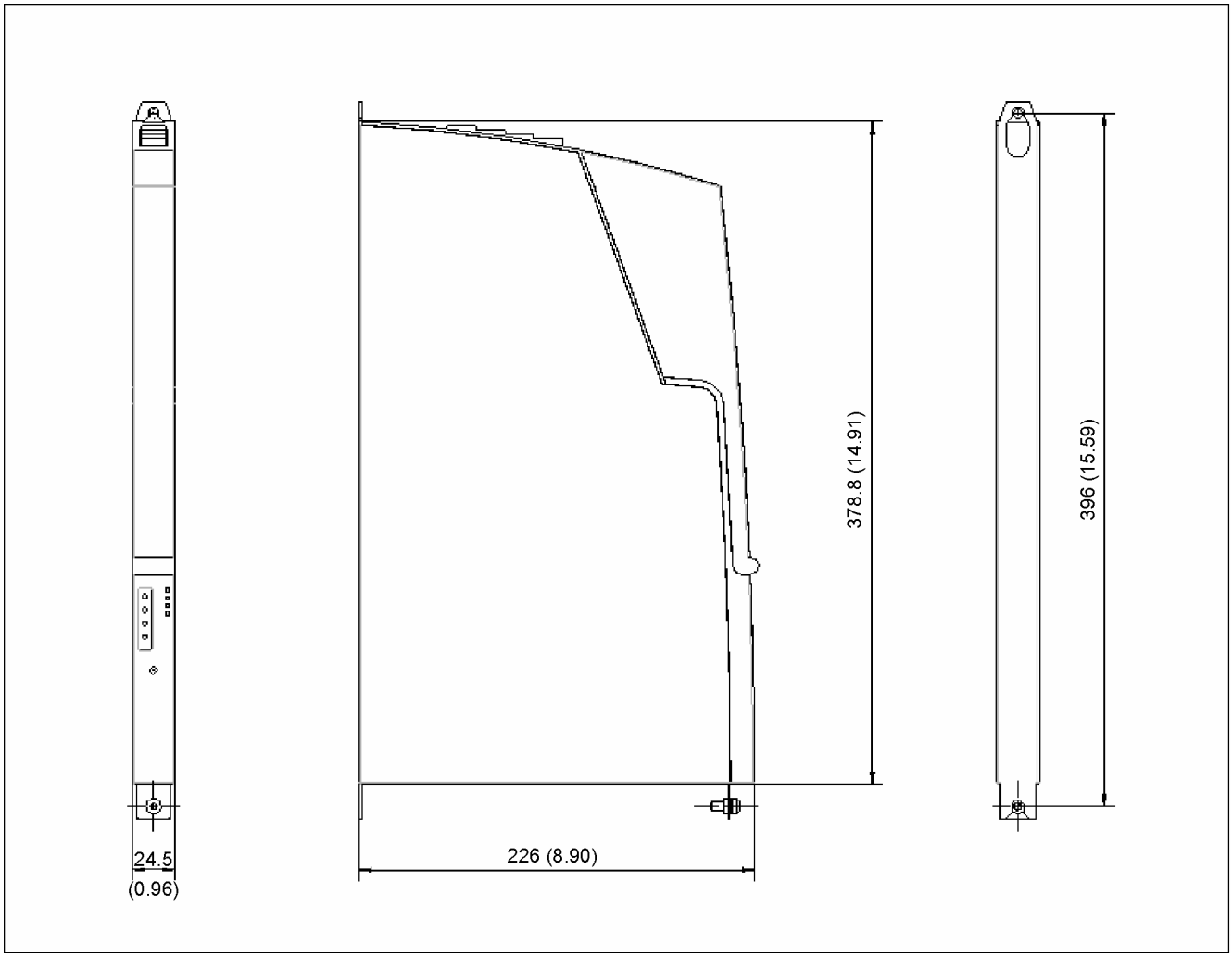


Figure 11-5 NX10/15 dimension drawing

11.2.5 Mounting

Mounting aids

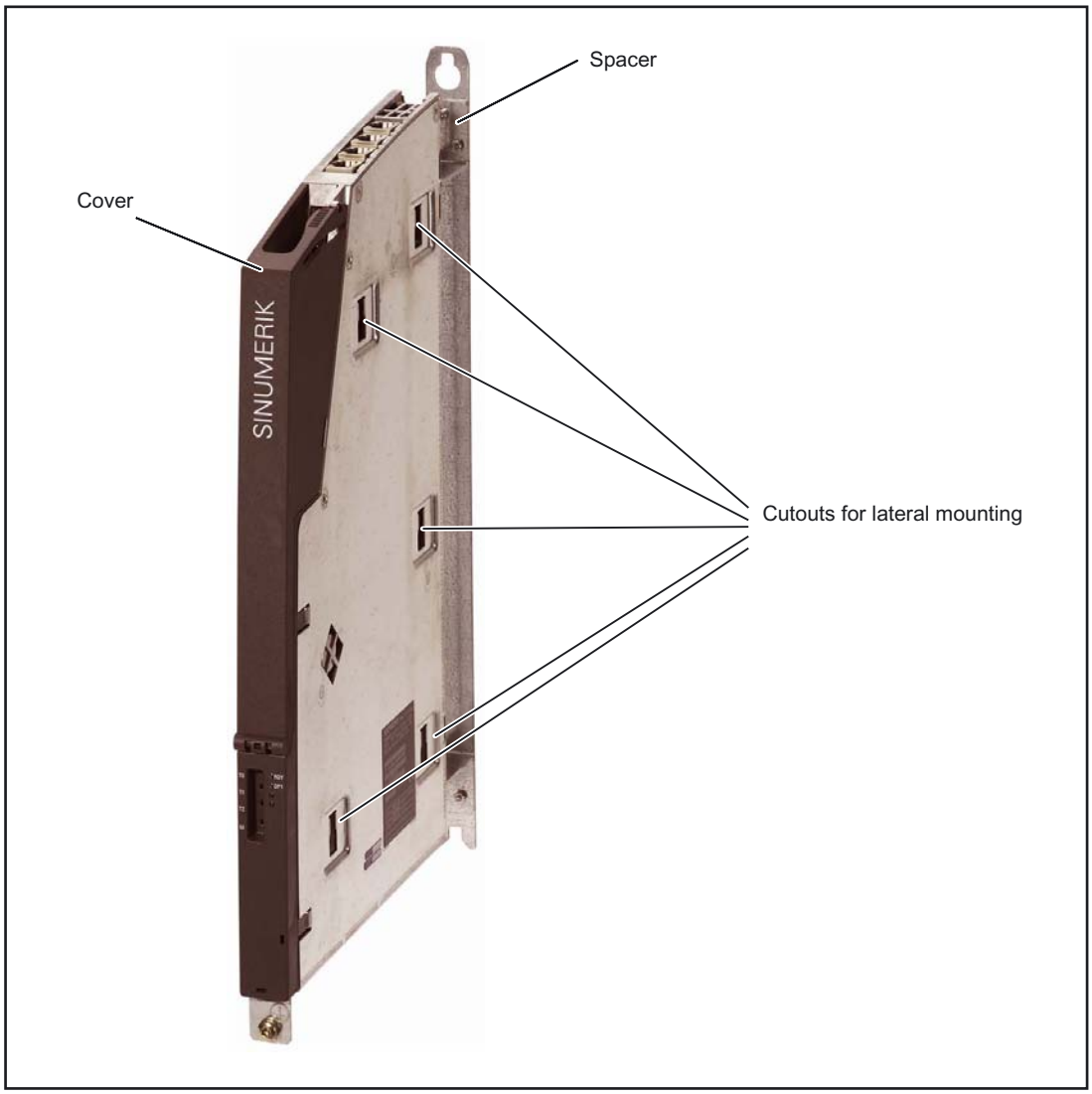


Figure 11-6 NX10/15 mounting aids

Installation types

Basically, the NX10/15 is integrated in the SINAMICS drive system exactly as the control unit is (see Chapter 8, Mounting).

Preferred call sequence: The NX modules should be inserted between the Line Module and the control unit.

Further reading

You can find further information on mounting the NX10/15 in the SINAMICS S120 Equipment Manual for Control Units and Supplementary System Components, Chapter CX32 (setting up the CX32 identically to the NX10/15).

Caution

The 80 mm ventilation spaces above and below the components must be observed.

11.2.6 Port

NX10/15 DRIVE-CLiQ topology

NX10/15 components can be connected to the control unit via DRIVE-CLiQ. The following rules apply to wiring of the NX10/15:

- Only one **star topology** is permitted between the NX10/15 and the control unit. This means that only one NX10/15 can be operated per DRIVE-CLiQ port on a control unit.
- DRIVE-CLiQ ports not assigned to NX10/15 can be wired to other DRIVE-CLiQ components.
- Once an NX10/15 has been connected and configured, you cannot simply insert it into a different DRIVE-CLiQ port, as the addresses of the integrated drives are set permanently from the point of view of the PLC. The following table illustrates this relation:

Table 11-5 NX10/15 PROFIBUS addresses

DRIVE-CLiQ port	Drive PROFIBUS addresses
X105	15
X104	14
X103	13
X102	12
X101	11
X100	10

The following figure shows a sample topology:

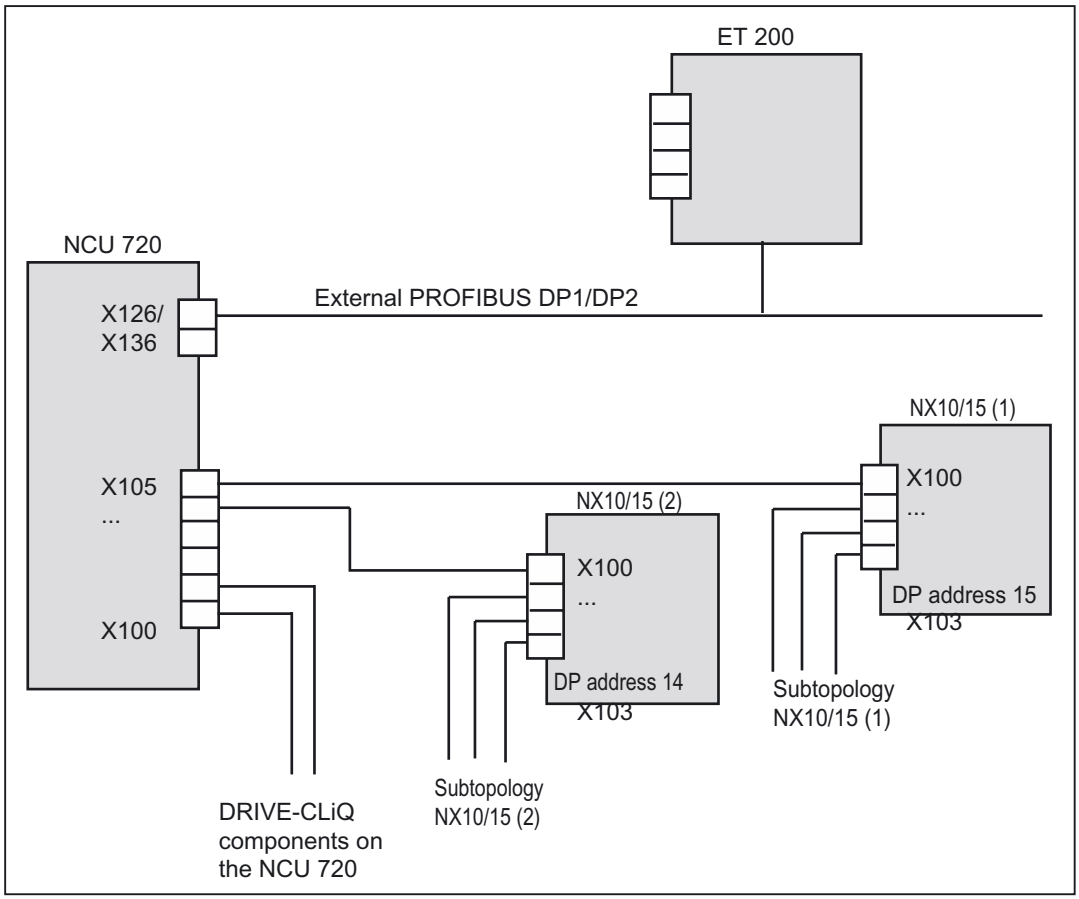


Figure 11-7 NX10/15 topology

11.2.7 Technical Data

Table 11-6 Technical data

Parameters	Values
Input voltage	24 V DC (20.4 – 28.8)
Current (without DRIVE-CLiQ or digital outputs)	0.8 A
PE/ground connection	On housing with M5/3 Nm screw
Dimensions (WxHxD)	24.5 x 396 x 226 mm
Weight	1.5 kg
Mounting position	Vertical

11.3 Ordering data

Table 11-7 Ordering data for spare parts

Spare parts	Order numbers
Dual fan/ battery module (for NCU 710.1 from version "B", NCU 720.1 from version "F", NCU 730.1)	6FC5348-0AA02-0AA0
Fan/ battery module (for NCU 710.1 version "A", NCU 720.1 up until version "E")	6FC5348-0AA01-0AA0
Battery	6FC5247-0AA18-0AA0
Seal for segregated heat removal	6FC5348-0AA07-0AA0
Spacer	6FC5348-0AA06-0AA0
Front cover	6FC5348-0AA00-0AA0
Blanking plate	6SL3064-3BB00-0AA0
Cover for optional guide frame	6SL3064-3CB00-0AA0
PROFIBUS/MPI plug connector with terminating resistor	6ES7972-0BB41-0XA0
CompactFlash Card 512 MB empty	6FC5313-4AG00-0AA1
CompactFlash Card 64 MB empty	6FC5313-2AG00-0AA1
CNC user memory expansion 2 MB	6FC5800-0AD00-0YB0
PLC user memory expansion 128 KB	6FC5800-0AD10-0YB0

List of abbreviations

A

AWG	American Wire Gauge
BERO	Proximity limit switch
B-MPI	Handheld unit with MPI connection
CNC	Computerized Numerical Control Computerized numerical control
CPU	Central Processing Unit
DIN	Deutsche Industrie Norm (German Industry Standard)
DIP	Dual In-line Package: Dual in-line arrangement
DP	Distributed I/O
DRAM	Dynamic Random Access Memory
DRIVE-CLiQ	Drive Component Link with IQ
EMC	ElectroMagnetic Compatibility
EN	European standard
ESD	Electrostatic Sensitive Device
HMI	Human Machine Interface: SINUMERIK operator interface for operating, programming and simulation
HSC	High-Speed Cutting
HT	Handheld Terminal
I/O bus	
LED	Light-Emitting Diode:
MAC	Media Access Control
MCP	Machine Control Panel
MLFB	Machine-readable product designation
MPI	Multi-Point Interface
NCK	Numerical Control Kernel: NC kernel with block preparation, traversing range, etc.
NCU	Numerical Control Unit: NCK hardware unit
NX	Numerical eXtension (axis extension module)
OLP	Optical Link Plug: Fibre-optic bus connector
OP	Operator Panel: Operator panel front
OPI	Operator Panel Interface
PCU	PC Unit: Computer unit
PG	Programming device
PLC	Programmable Logic Control (component of the CNC controller)
RAM	Random Access Memory: Program memory that can be read and written to
SIM	Single Inline Module
SRAM	Static RAM: Static memory (battery-backed)
TCU	Thin Client Unit (communication with operator panels)
UI	User Interface

VDE	Association of Electrical Engineering, Electronics and Information Technology (Germany)

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