SIEMENS

SINUMERIK

SINUMERIK 840D sl type 1B NCU 7x0.3 PN, NCU 7x0.3B PN

Manual

Valid for

SINUMERIK 840D sl / 840DE sl control

06/2014
6FC5397-1EP40-5BA1

Legal information

Warning notice system

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

⚠ DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
indicates that property damage can result if proper precautions are not taken.

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

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

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

Trademarks

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

Disclaimer of Liability

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

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Preface

SINUMERIK documentation

The SINUMERIK documentation is organized in the following categories:

- General documentation
- User documentation
- Manufacturer/service documentation

Additional information

You can find information on the following topics at http://www.siemens.com/motioncontrol/docu:

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

Please send any questions about the technical documentation (e.g. suggestions for improvement, corrections) to the following address:

mailto:docu.motioncontrol@siemens.com

My Documentation Manager (MDM)

Under the following link you will find information to individually compile OEM-specific machine documentation based on the Siemens content:

http://www.siemens.com/mdm

Training

For information about the range of training courses, refer to:

- http://www.siemens.com/sitrain
  SITRAIN - Siemens training for products, systems and solutions in automation technology
- http://www.siemens.com/sinutrain
  SinuTrain - training software for SINUMERIK

FAQs

You can find Frequently Asked Questions in the Service&Support pages under Product Support.

http://support.automation.siemens.com

SINUMERIK

You can find information on SINUMERIK under the following link:

http://www.siemens.com/sinumerik

Target group

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

- Project engineers, electricians and installers
- Maintenance and service personnel

Benefits

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

Standard scope

This documentation only describes the functionality of the standard version. Extensions or changes made by the machine tool manufacturer are documented by the machine tool manufacturer.

Other functions not described in this documentation might be executable in the controller. This does not, however, represent an obligation to supply such functions with a new controller or when servicing.

Further, 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

You will find telephone numbers for other countries for technical support in the Internet under http://www.siemens.com/automation/service&support

EC Declaration of Conformity

The EC Declaration of Conformity for the EMC Directive can be found on the Internet at:

http://support.automation.siemens.com/WW/view/de/10805517/134200

Table of contents

Fundamental safety instructions

1

1.1 General safety instructions

⚠ DANGER

Danger to life due to live parts and other energy sources

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

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

Generally, six steps apply when establishing safety:

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

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

⚠ WARNING

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

Touching live components can result in death or severe injury.

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

⚠ WARNING

Danger to life when live parts are touched on damaged devices

Improper handling of devices can cause damage.

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

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

⚠ WARNING

Danger to life through electric shock due to unconnected cable shields

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

- As a minimum, connect cable shields and the cores of cables that are not used at one end at the grounded housing potential.

⚠ WARNING

Danger to life due to electric shock when not grounded

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

- Ground the device in compliance with the applicable regulations.

⚠ WARNING

Danger to life due to fire spreading if housing is inadequate

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

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

⚠ WARNING

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

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

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

⚠ WARNING

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

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

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

⚠ WARNING

Danger to life when safety functions are inactive

Safety functions that are inactive or that have not been adjusted accordingly can cause operational faults on machines that could lead to serious injury or death.

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

Note

Important safety notices for Safety Integrated functions

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

1.2 Handling electrostatic sensitive devices (ESD)

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

NOTICE

Damage through electric fields or electrostatic discharge

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

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

1.3 Industrial security

Note

Industrial security

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

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

To stay informed about product updates as they occur, sign up for a product-specific newsletter. For more information, visit Hotspot-Text (http://support.automation.siemens.com).

⚠ WARNING

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

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

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

1.4 Residual risks of power drive systems

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

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

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

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

1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example,
   - Hardware and/or software errors in the sensors, control system, actuators, and cables 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 the control system
   - External influences/damage
2. In the event of a fault, exceptionally high temperatures, including an open fire, as well as emissions of light, noise, particles, gases, etc. can occur inside and outside the inverter, e.g.:
   - Component failure
   - Software errors
   - Operation and/or environmental conditions outside the specification
   - External influences/damage

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

Note

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

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

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

System overview 2

2.1 Application

Overview

SINUMERIK 840D sl offers modularity, openness, flexibility and uniform structures for operation, programming, and visualization. It provides a system platform with trend-setting functions for almost all technologies.

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

SINUMERIK 840D sl is characterized by:

- A high degree of flexibility
- Excellent dynamic response and precision
- Optimum integration into networks

Benefits

- Outstanding performance and flexibility for multi-axis systems of average to high complexity thanks to scalable hardware and software.
- Universal openness of the user interface, the PLC and the NC kernel to allow integration of your specialist know-how.
- Integrated safety functions for man and machine: SINUMERIK Safety Integrated.
- Comprehensive range of products for integrating machine tools into communication, engineering and production processes: SINUMERIK Integrate

Fields of application

The SINUMERIK 840D sl can be used worldwide for turning, drilling, milling, grinding, laser machining, nibbling, punching, 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 requiring an export authorization.

2.2 System configuration

SINUMERIK 840D sl combines CNC, HMI, PLC, closed-loop control, and communication tasks within a single NCU (Numerical Control Unit).

Components

For operation, programming, and visualization purposes, the corresponding operating software is already integrated into the CNC software for the NCU and therefore runs on the high-performance NCU multi-processor module. For increased performance in the operating area, the SINUMERIK PCU 50.5 can be used.

Up to 4 distributed OPs can be operated on one NCU / PCU. The operator panel can be installed as a Thin Client at a distance of up to 100 m.

The following components can be connected to the NCU:

- SINUMERIK operator panel front with TCU x0.2 / PCU 50.5 and Machine Control Panel/ Machine Push Button Panel
- SIMATIC Thin Client (from firmware V2.0.1)
- SIMATIC CE panel
- SINUMERIK handheld units
- Distributed PLC I/O
  - via PROFIBUS DP:
    e.g. SINUMERIK I/O modules PP 72/48D and Analog Drive Interface for 4 axes ADI 4
  - via PROFINET IO:
    SINUMERIK I/O modules PP 72/48D PN and PP 72/48D 2/2A PN
- SINAMICS 120 drive system
- Feed and main spindle motors
  - Synchronous motors 1FT / 1FK / 1FE1 / 2SP1
  - 1PH / 1PM induction motors
  - Linear / torque motors 1FN / 1FW6

PROFIBUS	
PROFIBUS I/O for the PLC/ NCK I/O (isochronous)	x
NCK / PLC isochronous drives (e.g. ADI 4, CU320)	x
PROFIsafe V2 at both interfaces	x
Second DP/MPI isochronous interface available for NCK	x

PROFINET	
PROFINET I/O for PLC peripherals	x
PROFINET I/O for NCK peripherals (isochronous)	x
PLC isochronous drives	x
NCK isochronous drives (also with Safety Integrated)	x [1)]

PROFINET	
PROFIsafe V2	x
PROFINET CBA	x 2)

Requirements: Step7 V5.5

1) Cannot be operated for NCU-Link

2) We recommend changing over from CBA to I-Device

Note

A specific software release is required. More detailed information is available in the corresponding ProdIS for the particular software release.

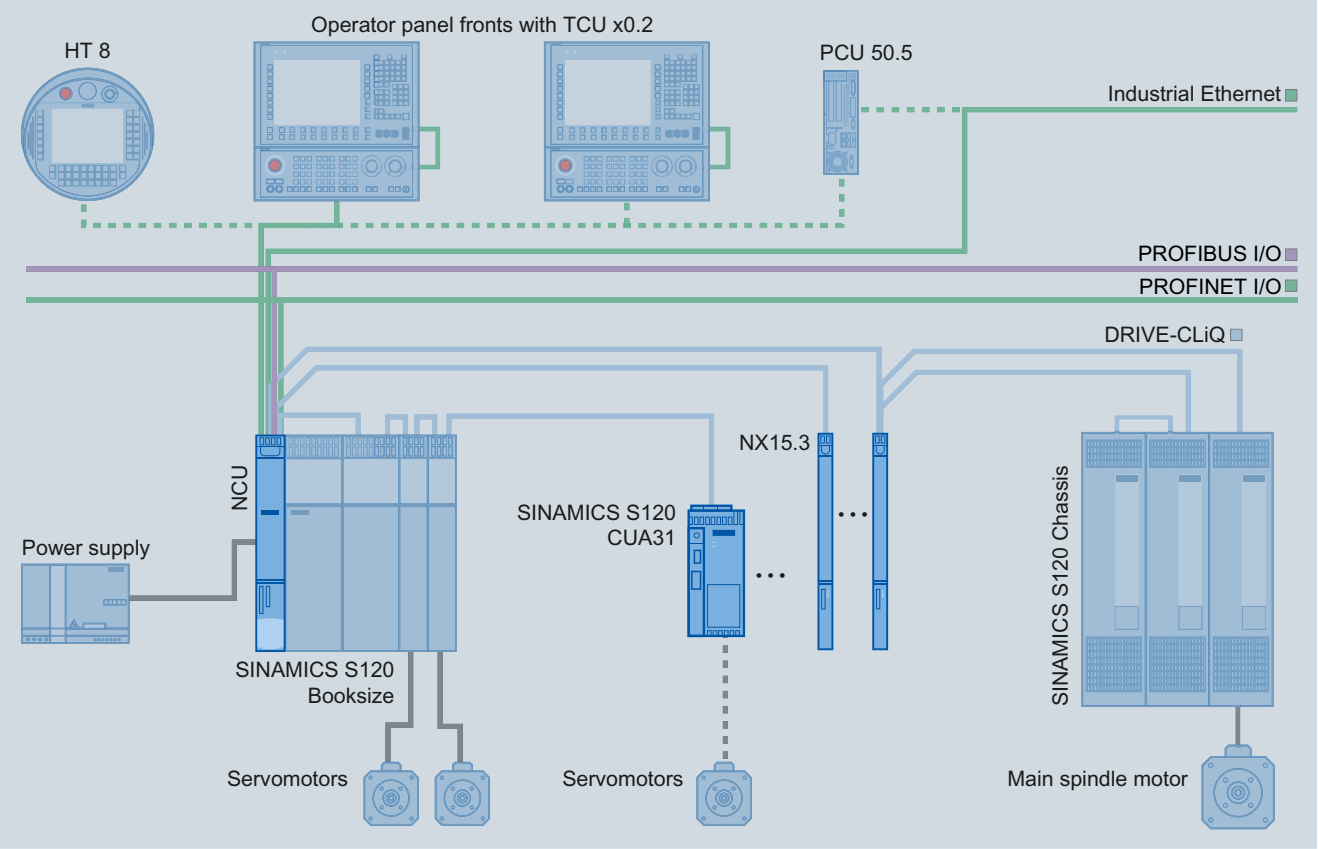


Figure 2-1 Typical topology of the SINUMERIK 840D sl complete system

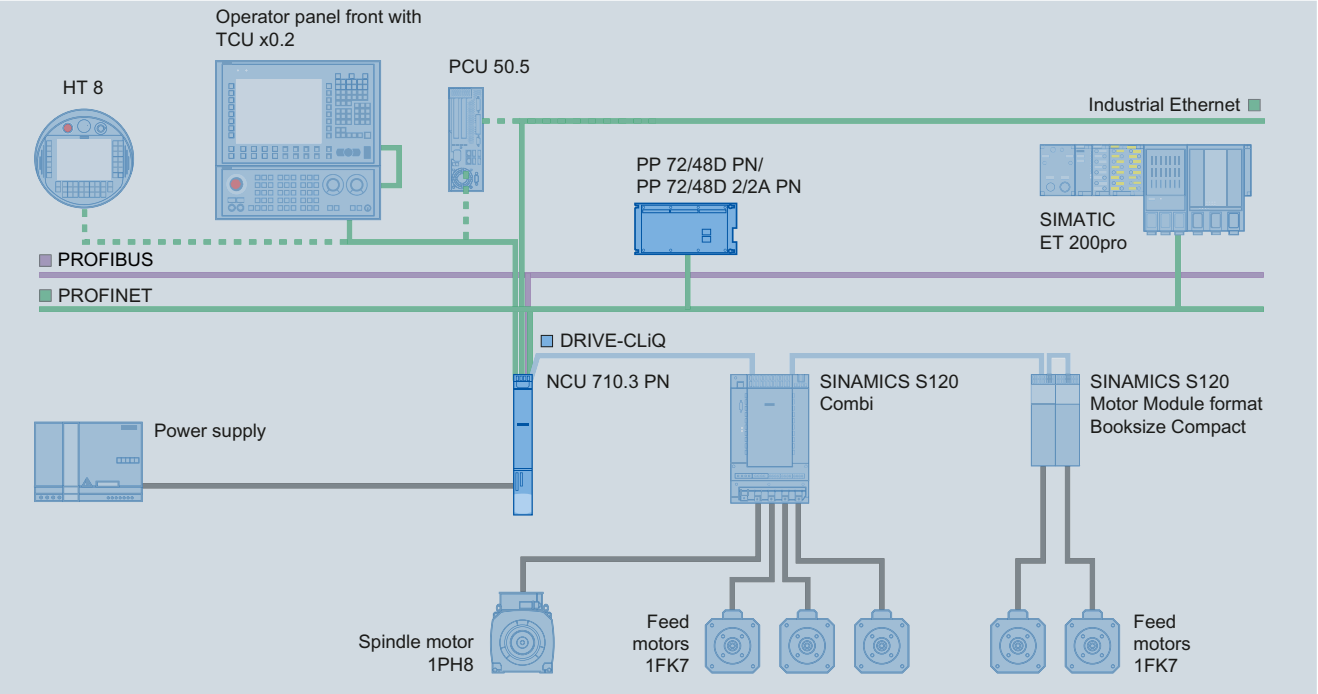


Figure 2-2 Sample topology which is only possible with an NCU 710.3 PN

Networking

The SINUMERIK 840D sl offers integrated PROFINET functionality. Supported:

- PROFINET CBA
  The CBA functionality integrated in the NCU allows users to modularize machinery and systems: Rapid real-time communication (up to 10 ms) between the controllers means that systems lend themselves better to standardization and can be reused or expanded more easily. Response to customer demands is faster and more flexible and startup is simplified and speeded up by pretesting at component level.
- PROFINET IO
  As part of PROFINET, PROFINET IO is a communication concept that is used to implement modular, distributed applications. PROFINET IO is based on Industrial Ethernet and allows distributed field and I/O equipment to be connected to the central processing unit.
  128 PROFINET IO devices can be operated on the NCU as an IO controller.

2.3 Variants

The scalability of the hardware and software – both from a CNC perspective and in terms of operation – means the SINUMERIK 840D sl can be used in many sectors. The possibilities range from simple positioning tasks up to complex multi-axis systems.

Application areas and performance

- Up to 8 axes may be implemented on an NCU 710. The NCU 710 can be expanded by up to 2 NX modules. One possible benefit would be increased drive control performance.
- 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 through the use of the NX modules. The NCU 720/730 can be expanded by up to 5 NX modules for increased performance of the drive control and number of axes.
- 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 key features of the various NCU versions:

Table 2-1 Versions of the NCU

	NCU 710.3 PN NCU 710.3B PN	NCU 720.3 PN NCU 730.3 PN	NCU 720.3B PN NCU 730.3B PN
Cooling ribs	No	Yes	No
DRIVE CLiQ ports	4	6	
Axes	Up to 8 *)	Up to 31	
NX10.3 / 15.3	Up to 2	Up to 5	
TCU	Up to 2	Up to 4	

*) With SINAMICS S120 Combi, up to 6 axes can be controlled.

2.4 Ordering data

Table 2-2 Order data for system components

System components	Order numbers
NCU 710.3 PN with PLC 317-3 DP/PN	6FC5371-0AA30-0AA1
NCU 710.3B PN with PLC 317-3 DP/PN	6FC5371-0AA30-0AB0
NCU 720.3 PN with PLC 317-3 DP/PN	6FC5372-0AA30-0AA1
NCU 720.3B PN with PLC 317-3 DP/PN	6FC5372-0AA30-0AB0
NCU 730.3 PN with PLC 317-3 DP/PN	6FC5373-0AA30-0AA1
NCU 730.3B PN with PLC 317-3 DP/PN	6FC5373-0AA30-0AB0
NCU 730.3B PN with PLC 319-3 DP/PN	6FC5373-0AA31-0AB0
Numeric Control Extension NX15.3 (High Extension)	6SL3040-1NB00-0AA0
Numeric Control Extension NX10.3 (Standard Extension)	6SL3040-1NC00-0AA0
COM01.3 RS232C(V.24) module for NCU 7x0.3 PN (cannot be used with NCU 730.3B PN with PLC 319 DP/PN)	6FC5312-0FA01-1AA0
CBE30-2 Link module (cannot be used with NCU 730.3B PN with PLC 319 DP/PN)	6FC5312-0FA00-2AA0
PP 72/48D 2/2A PN I/O module	6FC5311-0AA00-0AA0
Terminal Module Compact TMC 2040 PN	6AU1102-0AB00-0AA0
Strain relief/ shield connection for I/O cable	6AU1100-1AB00-0AA0

System components	Order numbers
5x connectors with screw connection (10 pin)	6AU1100-0AA00-0AA0
PP 72/48D 2/2A PN 2/2A PN I/O module	6FC5311-0AA00-1AA0
TS Adapter IE ISDN with integrated ISDN terminal adapter	6ES7972-0ED00-0XA0
TS Adapter IE Modem with integrated analog modem	6ES7972-0EM00-0XA0
USB FlashDrive 8 GB, USB 2.0	6ES7648-0DC50-0AA0

Table 2-3 Ordering data for spare parts / accessories

Spare parts / accessories	Order numbers
Dual fan/battery module	6FC5348-0AA02-0AA0
Battery	6FC5247-0AA18-0AA0
Seal for segregated heat removal	6FC5348-0AA07-0AA0
Spacer for NCU 720.3 PN and NCU 730.3 PN	6FC5348-0AA06-0AA0
Spacer for NCU 710.3 PN, NCU 7x0.3B PN	6SL3064-1BB00-0AA0
Front cover	6FC5348-0AA30-0AA0
Blanking plate for BOP	6SL3064-3BB00-0AA0
Cover for optional guide frame	6SL3064-3CB00-0AA0
Dust protection, blanking plug (50 pcs.) for DRIVE-CLiQ interfaces	6SL3066-4CA00-0AA0
PROFIBUS/MPI plug connector with terminating resistor	6ES7972-0BB42-0XA0
PROFIBUS adapter connector to raise the connector	6FX2003-0BB00
Terminal kit, consisting of connectors X122 / X124 / X132 / X142 and dust cover, blanking plugs for DRIVE-CLiQ interfaces	6SL3064-2CB00-0AA0

Table 2-4 Ordering data of the memory expansion options

Memory expansion options	Order numbers
CNC user memory expansion 2 MB	6FC5800-0AD00-0YB0
PLC user memory expansion 128 KB	6FC5800-0AD10-0YB0

Ordering options

The described products can be found in the following catalogs:

- You can find all of the devices that belong to the SINUMERIK 840D sl type 1B and SINAMICS S120 product families in Catalog NC 62.
- You can find SIMATIC products, which can be connected to the NCU, in Catalogs PM 10 and ST 80.

You can also order the products online:

- Industry Mall: http://www.siemens.com/industrymall
- Spares On Web: http://workplace.automation.siemens.de/sparesonweb

Description 3

3.1 Characteristics

The following elements designate an NCU:

- Battery-backed real-time clock
- Slot for a CompactFlash Card (behind the blanking cover)
- DRIVE-CLiQ interfaces for connecting to the drive
- Interfaces for operation behind a hinged front cover:
  - Ethernet ports
  - PROFINET interfaces
  - PROFIBUS interfaces
  - Digital inputs/outputs (6 of which can be parameterized as inputs for probe and BERO)
- Commissioning interfaces:
  - Ethernet interface
  - Measuring sockets

3.2 Illustration

The following diagram shows an NCU 730.3 PN with its interfaces and control and display elements (fault displays and status indicators). Please ensure that the structure of the NCUs is virtually identical. There are only a few discrepancies, as follows:

- NCU 710.3 PN and NCU 710.3B PN have 4 instead of 6 DRIVE-CliQ interfaces.
- NCU 710.3 PN and all .3B versions do not have any cooling ribs and therefore a different spacer.

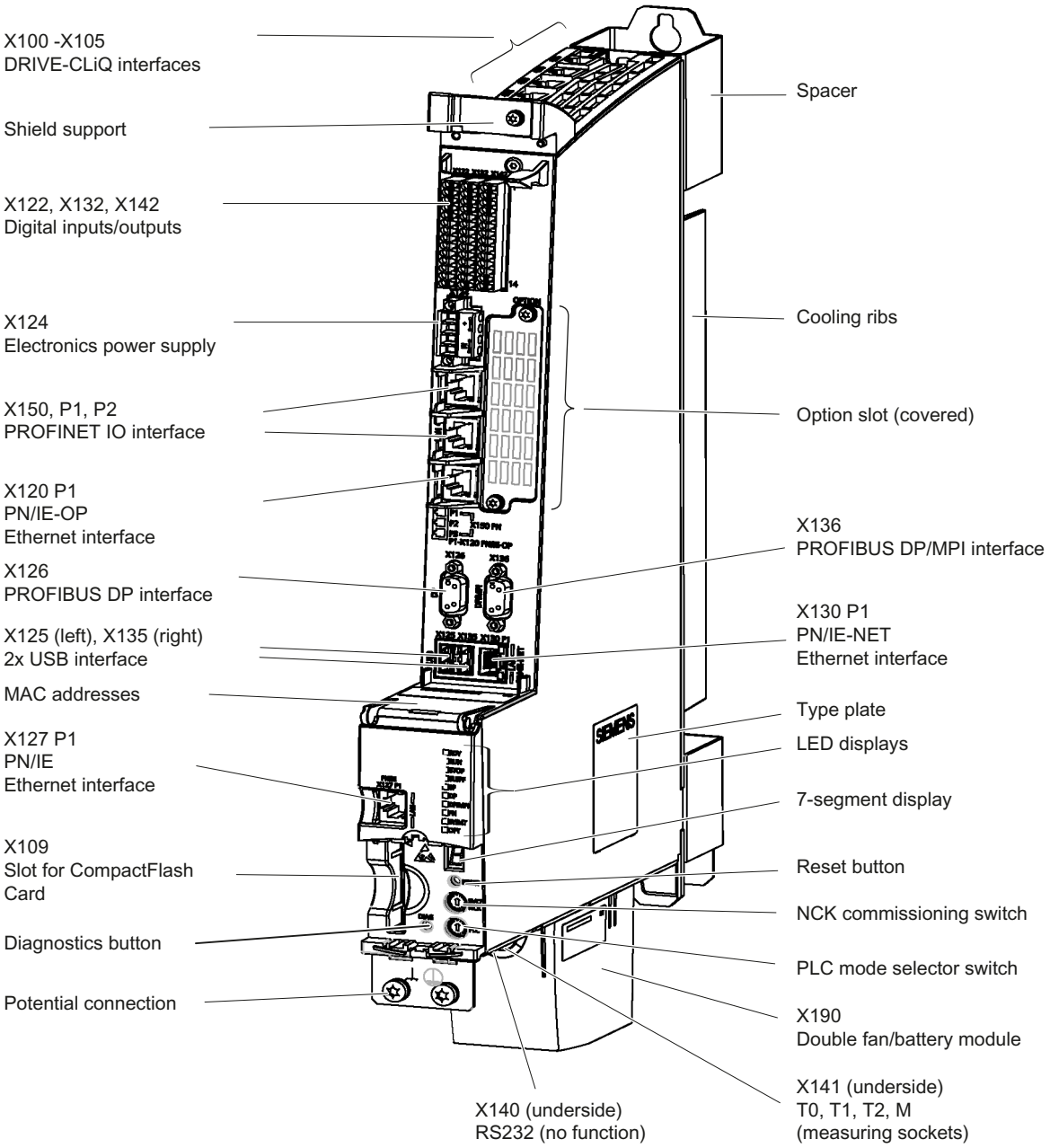


Figure 3-1 Illustration showing the NCU 730.3 PN

Note

For an NCU730.3B PN with PLC319, the option slot cannot be used.

3.3 Type plates

Side-mounted type plate

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

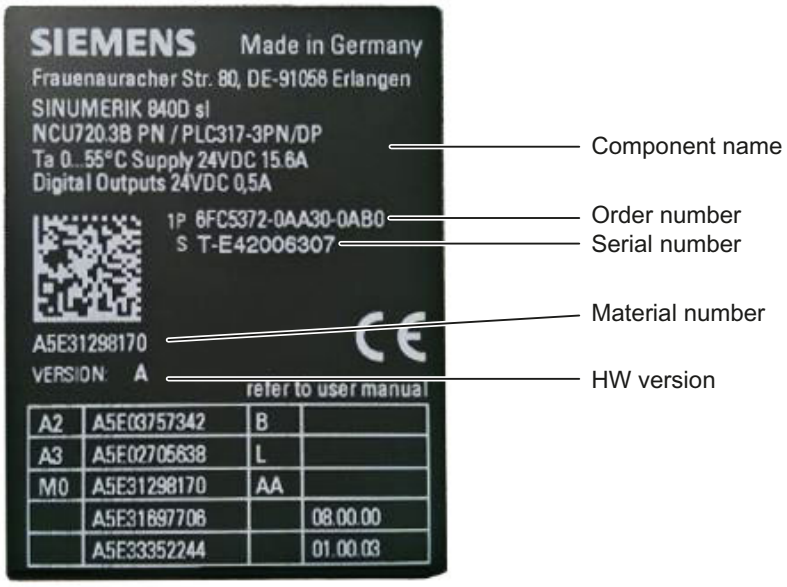


Figure 3-2 Type plate

MAC addresses

A type plate for the MAC addresses of the PROFINET and Ethernet interfaces is attached to the front panel of the NCU:

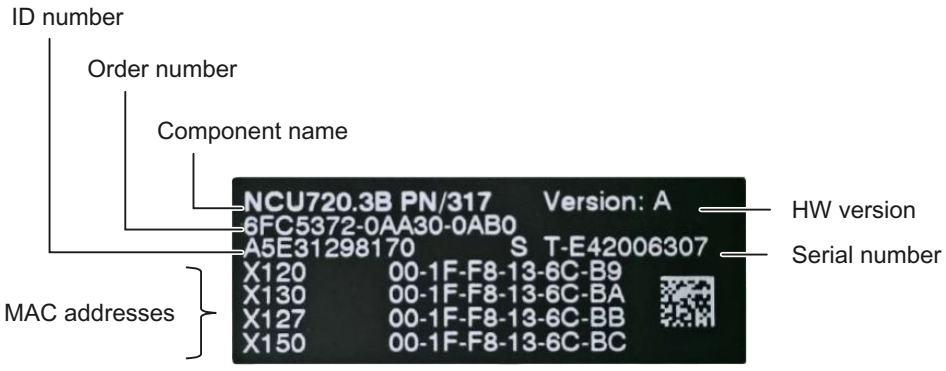


Figure 3-3 MAC addresses of the PROFINET/Ethernet interfaces

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

Note

The contents of the individual type plate fields on the actual NCU may differ from those described in this Manual (e.g. updated product status, approvals and identifications not yet issued, etc.).

3.4 Operator control and display elements

3.4.1 Overview of operating and display elements

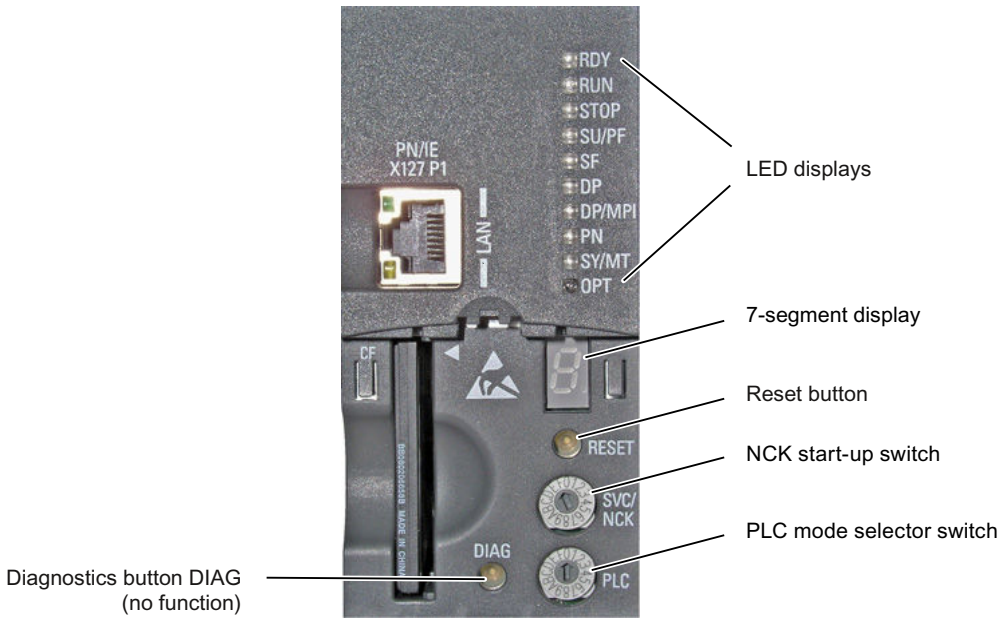


Figure 3-4 Position of operator control and display elements

3.4.2 LED displays

Table 3-1 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 NCU is booting up.
		Flashing red/orange (0.5 Hz)	Error accessing CompactFlash Card
		Orange	Accessing CompactFlash Card

Name	Function	Status	Meaning
		Flashing orange (0.5 Hz)	Updating the firmware of the connected DRIVE-CLiQ components
		Flashing orange (2 Hz)	Firmware update is complete for components. Wait for POWER ON for the components in question.
		Green	NC powered up and everything in cyclic mode
		Flashing green/orange or red/ orange (1 Hz)	LED-supported recognition of connected DRIVE-CLiQ component is activated: (p0124[0] = 1).
RUN	PLC RUN	Green	PLC ready to operate
STOP	PLC STOP	Orange	PLC stopped
SU/PF	PLC FORCE	Red	FORCE activated
SF	PLC SF	Red	PLC group error
DP	BUS1 F	Red	PROFIBUS group error X126
DP/MPI	BUS2 F	Red	PROFIBUS group error X136
PN	PN Fault	Red	PROFINET IO group error X150
SY/MT	MAINT	Orange	• Synchronization status (SY): No function • Maintenance status (MT) of the NCU: Maintenance request pending
OPT	-	-	No function

Important LED states

- If all the LEDs are flashing, the PLC must be reset via the mode selector (move switch to position "3" to reboot).
- While the NCU is powering up, all LEDs briefly light up orange. You can carry out a detailed diagnosis using a PG/PC and the operating software.

Additional references

- You can find a detailed description of LED states during power-up in the "NCU Operating System (IM7)" section of the Basesoftware and Operating Software Commissioning Manual.
- For information on drive faults and alarms, see also:
  SINAMICS S120/S150 List Manual (LH1)

3.4.3 7-segment display

Displaying messages

The 7-segment display is located behind the blanking plate of the NCU. 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

Critical messages

- During normal operation, "6" appears here and the dot flashes.
- An "8" indicates that the fan is defective or that the NCU is operating without a fan.

Additional references

Basic Software and Operating Software Commissioning Manual (IM7), Chapter "System startup displays".

3.4.4 RESET button

Arrangement

The RESET button is located behind the blanking cover.

Performing a reset operation

The reset operation resets the NCU and forces a new power-up. It is similar to a "Power On Reset" except that the 24 V power supply does not have to be switched off.

3.4.5 Start-up and mode selector switch

Layout

The NCU has two coding rotary switches in the lower section of the front panel:

- The upper switch (labeled SVC/NCK) is the NCK commissioning switch.
  Setting during normal operation: "0"
- The lower switch (labeled PLC) is the PLC mode selector switch.
  Setting during normal operation: "0"

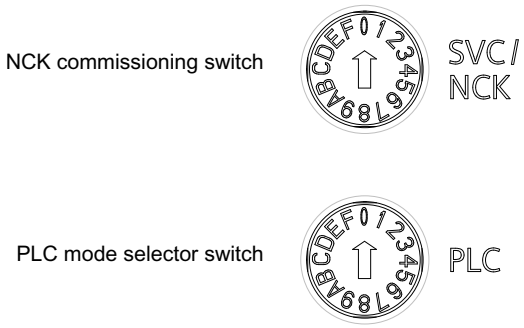


Figure 3-5 Startup and mode selector switch

Additional references

CNC Commissioning Manual Part 1 (NCK, PLC, drive)

3.5 Dual fan/battery module

Functions of the dual fan/battery module

The dual fan/battery module has the following tasks:

- Cooling the CPU by means of two redundant fans.
- Buffering of the real time clock.

The temperature inside the NCU and the correct functioning of the fan are monitored. Fan faults are displayed and can be read out by means of the diagnostic buffer.

- Fan alarm ⇒ alarm 2110 "NCK temperature alarm": if one of the two fans no longer rotates or the speed is out of tolerance.
- Fan fault ⇒ alarm 2120 "NCK fan alarm type %1": if none of the fans rotate.
  If the software does not respond within approx. 1 minute, the components are shut down automatically and the status is indicated by means of the red SF LED.

You can find more information on the alarms in the Diagnostics Manual.

Additional information on the diagnostics buffer is provided in the Function Manual Basic Functions, see PLC signal DB10 DBX109.6 (fan temperature alarm).

Fans

The temperature is sensed at several locations within the NCU. The fan is automatically switched in when the temperature thresholds set in the factory are exceeded. A hysteresis function prevents frequent fan start/stop operations.

If natural convection is not sufficient to ensure cooling of the NCU, the fans integrated in the dual fan/battery module are switched on when required (except for an NCU 730.3B PN with PLC 319-3 DP/PN, in this case, the fan runs continuously):

- After switching the NCU on, the fan is activated for a brief period of time (function test) before turning itself off again.
- The temperature is sensed at several locations within the NCU. The fan is automatically switched in when the temperature thresholds set in the factory are exceeded. A hysteresis function prevents frequent fan start/stop operations.

Note

The NCU cannot be operated without fans, i.e. it will not power up if the dual fan/battery module is not functioning. The RDY LED flashes red/orange with 0.5 Hz, all other LEDs light up orange. The state can only be exited by switching the NCU off.

Battery

A 3 V lithium battery is installed in the dual fan/battery module; this can be replaced when required. The battery is pre-assembled 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.

Note

Please dispose of used batteries in the specially provided collection points on site. This will ensure that the batteries are recycled in the correct manner or treated as special waste.

Note

The backup time of a used type of battery is at least 3 years. Exceeding this backup time risks loss of data.

Application planning 4

4.1 Secondary electrical conditions

4.1.1 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, Machine Push Button 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. Insulating paints on the mounting points must be removed.

It is permissible to have a cluster of operator components for ground connection/PA.
Example: The control panel on the swivel arm.
It is sufficient in this instance to connect the ground connections of, for example, the PCU, TCU, and operator panel front using a cable and to route a shared grounding conductor to the central ground connection in the control cabinet.

Additional references

Configuration Manual, EMC Guidelines

4.1.2 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 lines, special equipotential bonding connections, and isolation and shielding measures.

Shielded signal lines

- For safe and smooth operation of the system, the specified cables must be used. Please refer to the chapter titled Connection.
- For digital signal transmission, the shield must have a conductive connection at both sides of the housing.

Cable definitions

- Signal cables (example)
  - Data cables (Ethernet, PROFIBUS, PROFINET, sensor cables, etc.)
  - Digital inputs/outputs
  - EMERGENCY OFF lines
- Power cables (example)
  - Supply voltage 1 x 230 V AC or 3 x 400 V AC
  - Motor cables

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:

- A minimum distance of 200 mm is to be observed between the signal lines and power cables.
- 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 use cables approved by Siemens for the signal lines from and to the NCU.
- Signal cables may not be routed close to strong external magnetic fields (e.g., motors and transformers).
- If signal lines cannot be routed a sufficient distance away from other cables, they must be installed in grounded cable ducts (metal).

Note

For more specifications regarding interference suppression measures and connection of shielded cables, see

References

Configuration Manual, EMC Guidelines

EMC limit values in South Korea

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

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

The EMC limit values to be complied with for South Korea correspond to the limit values of the EMC product standard for variable-speed electric drives EN 61800-3, Category C2, or limit value class A, Group 1 according to EN 55011. By applying suitable supplementary measures, the limit values according to Category C2 or according to limit value class A, Group 1, are maintained. Further, additional measures may be required, for instance, using an additional radio interference suppression filter (EMC filter).

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

Please note that the final statement on compliance with the standard is given by the respective label attached to the individual unit.

4.2 Climatic and mechanical environmental conditions

4.2.1 Shipping and storage conditions

The components of the SINUMERIK 840D sl system exceed the requirements according to EN 61800-2 with regard to shipping and storage conditions.

The following data applies under the following conditions:

- Long-term storage in the transport and product packaging:
  At weather-protected locations that have continuous contact with outside air through openings.
- Transport in the transport packaging:
  - In unventilated containers under conditions not protected from weather effects.
  - In the “cold" in accordance with outside air.
  - Air transport in the air-conditioned cargo hold.

Table 4-1 Ambient conditions during storage and transport

Type of condition	Permissible range/class	
	Transport	Storage
Classification	EN 60721-3-2	EN 60721-3-1
Climate class	2K4	1K4
Ambient temperature	From -40° C to +70° C	From -25° C to +55° C

Type of condition	Permissible range/class		
Biological environmental conditions	2B1 [1]	1B1 [1]	
Chemically active environmental conditions	2C2 [2]	1C2 [2]	
Maximum permissible temperature change	Direct interaction in air/air: -40°/+30° C at 95% relative humidity	30 k/h	
Relative humidity	5 to 95 %		
Precipitation, rain	6 mm/min [1]	Not permitted	
Water other than rain	1 m/s and wet loading surfaces [3]	Not permissible [4]	1 m/s and wet loading surfaces [3]
Height	Max. 4,000 m above sea level		
Condensation, splash water, icing, salt spray	Permissible	Not permissible [4]	Permissible [3]

[1] Mold growth, slime, rodents, termites and other animal vermin are not permissible.

[2] In marine- and weather-resistant transport packaging (container).

[3] For storage in the transport packaging.

[4] For storage in the product packaging.

Note

Remove the transport protective foil and packaging material before installing the components.

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.

Storage of backup batteries

Always store backup batteries in a cool and dry place. The batteries have a maximum shelf life of 10 years.

Rules for handling backup batteries

⚠ WARNING

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.

- Do not open a battery. Replace a faulty battery only with the same type.
- Only purchase the batteries through Siemens (see Ordering data (Page 21)).
- Always try to return low batteries to the manufacturer or deliver these to a registered recycling company.

4.2.2 Operating conditions

The components of the SINUMERIK 840D sl system are intended for a weatherproof, fixed location. The documented environmental conditions apply to the climate in the immediate vicinity of the units and to the entry of the cooling air. They exceed the requirements according to EN 60204-1, EN 61800-2, EN 61131-2 and IEC 62477-1.

Table 4-2 Ambient conditions for operation

Ambient conditions	Application areas	Remarks
Climatic environmental conditions		
Climate class	3K3	According to EN 60721-3-3
Limit temperatures at 100% load	0 °C ... 55 °C	From an altitude of 2000 m, the max. ambient temperature decreases by 7° C for every 1000 m increase in altitude - derating.
Relative humidity	5% to 95% (60% when corrosive gases and/or dusts are present)	
Condensation, icing, drip, spray and splash water	Not permitted	
Max. installation altitude	1000 m above sea level	Without thermal derating
	2000 m above sea level	With insulation
	> 2000 m ... 5000 m above sea level	Clearances for an operating voltage of 50 V at 5000 m
Biological, chemical and mechanical influences, pollutants		
Biological environmental conditions		Class 3B1 according to EN 60 721-3-3: Mold, mold growth, slime, rodents, termite and other animal vermin are not permissible.
Mechanically active environmental conditions		Class 3S1 according to EN 60721-3-3: Conductive dust not permitted.
Classification of the mechanical environment		3M3 for components on the machine 3M1 / 3M2 for components in the control cabinet

Ambient conditions	Application areas	Remarks
Pollution degree		2
EMC conducted / radiation		Class C3 according to EN 61800-3

Note

The user must consider radio interference 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 C2 is required, please contact your local Siemens sales partner.

4.3 Recycling and disposal

Products should be disposed of corresponding to the relevant national regulations.
The products described in this manual can be mostly recycled due to the fact that they contain very few damaging substances. To recycle and dispose of your old device in an environmentally friendly way, please contact an appropriate disposal company.

Dimension drawings

5

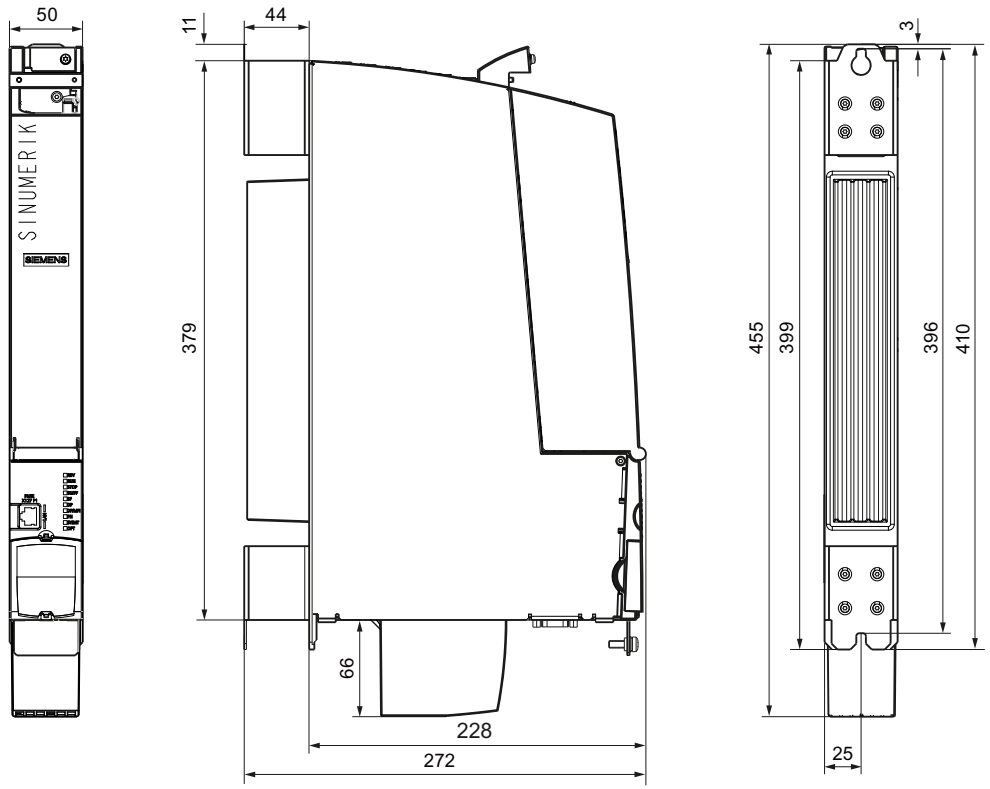


Figure 5-1 Dimension drawing NCU 720.3 PN and NCU 730.3 PN; dimensions in mm

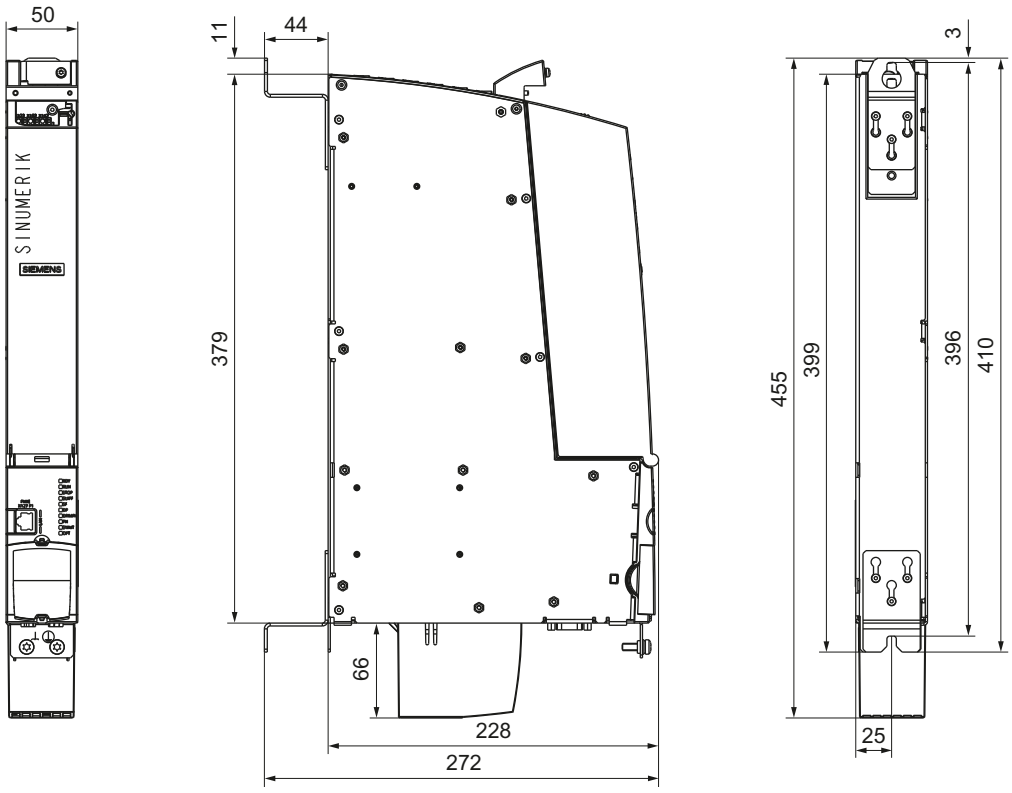


Figure 5-2 Dimension drawing NCU 710.3 PN, NCU 710.3B PN, NCU 720.3B PN and NCU 730.3B PN; dimensions in mm

Assembling 6

6.1 Safety information

Note

The NCU is exclusively intended for installation in ESD-protected zones. 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.

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 equipment rooms may only be accessed by trained or authorized personnel. An external fire protection casing is required.

NOTICE

The module can be damaged if power is connected to the NCU when installing/removing it

When installing the NCU, the system and the NCU must be disconnected (brought into a no voltage condition).

Control cabinet installation

Please refer to the SINAMICS documentation for more details.

⚠ WARNING

Risk of fire through overheating if there are insufficient ventilation clearances

Inadequate ventilation clearances cause overheating with a risk for personnel due to smoke and fire. Further, this can result in increased failures and a shorter service life of devices/ systems.

It is essential that you maintain 80 mm ventilation clearances above and below the NCU.

NOTICE

Risk of destroying components resulting from high discharge currents

The NCU or other PROFIBUS or PROFINET devices can be destroyed if significant discharge currents flow through the PROFIBUS or PROFINET cable.
Between parts of a plant or system, use a function equipotential bonding conductor with a minimum cross-section of 25 mm².

NOTICE
Cables not certified for the application can damage modules Only use Siemens cables for the DRIVE-CLiQ connections.

Note

Protecting unused DRIVE-CLiQ interfaces

Close any unused DRIVE-CLiQ interfaces using the blanking covers provided.

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. The connection should be preferably established by mounting on metallic bare machine and plant components that are connected with one another using an equipotential bonding conductor.
Alternatively, you can establish equipotential bonding using a conductor (min. 6 mm²), which as far as possible, is routed in parallel to the DRIVE-CLiQ cable. This applies to all distributed DRIVE-CLiQ nodes such as DM20, SME2x, SME12x, etc.

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

6.2 Designs

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

Designs

The NCU is preferably mounted vertically on the rear panel of the control cabinet. The following fixing options are available:

- Mounting using spacers.
- Mounting without spacers:
  - for NCU 710.3 PN, NCU 710.3B PN, NCU 720.3B PN and NCU 730.3B PN.
  - for external heat dissipation for NCU 720.3 PN and NCU 730.3 PN.

Note

The procedures described below for mounting the NCU refer to the delivery condition of the NCU: the upper clip is pulled in and the spacers are mounted.

6.3 Fix the NCU using spacers

Introduction

Spacers can be used to mount the NCU on a bare-metal highly-conductive rear panel of a control cabinet.

Note

The mechanical stability for horizontal mounting is only guaranteed with the help of supports or similar. These must be clarified depending on the specific application and are not part of this documentation.

Procedure

Mount the NCU using two M6 screws (6 Nm tightening torque) on the spacers on the rear of the control cabinet.

6.4 Mounting the NCU without spacers

Introduction

The NCU 710.3 PN and all of the .3B versions can be directly mounted onto the rear panel of the control cabinet without spacers.

Procedure

The NCU has a metal clip on the upper rear side that is pushed in and fixed using 3x M3 torx screws when supplied.

1. Remove the spacers with a T10 screwdriver .
2. Loosen the three M3 screws on the clip and push the clip up until the upper hole protrudes beyond the housing.
3. Retighten the 3x M3 screws (0.8 Nm) of the clip.
4. Attach the top and bottom of the NCU directly on the rear panel of the control cabinet using two M6 screws (6 Nm);
   Distance between the drilled holes, see Figure 6-1 Panel cutout (dimensions in mm) (Page 42)

6.5 Mounting the NCU for external cooling

Introduction

If the NCU must be externally cooled via the cooling ribs, then it can be directly mounted onto the rear of the control cabinet panel without using spacers.

Prerequisites

- You have an NCU 720.3 PN or NCU 730.3 PN.
- The bushing for the cooling ribs (external heat sink) has been fitted in the rear wall of the control cabinet.
- Please ensure that the surface around the seal is both clean and flat ② (please see the diagram "Panel cutout").

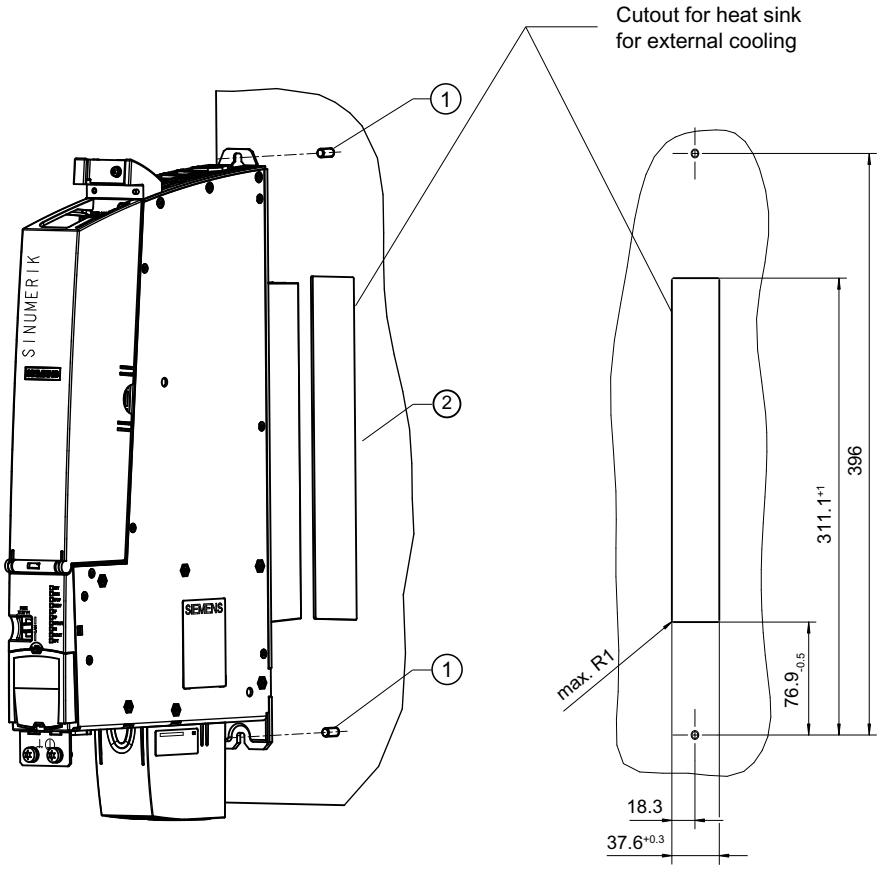


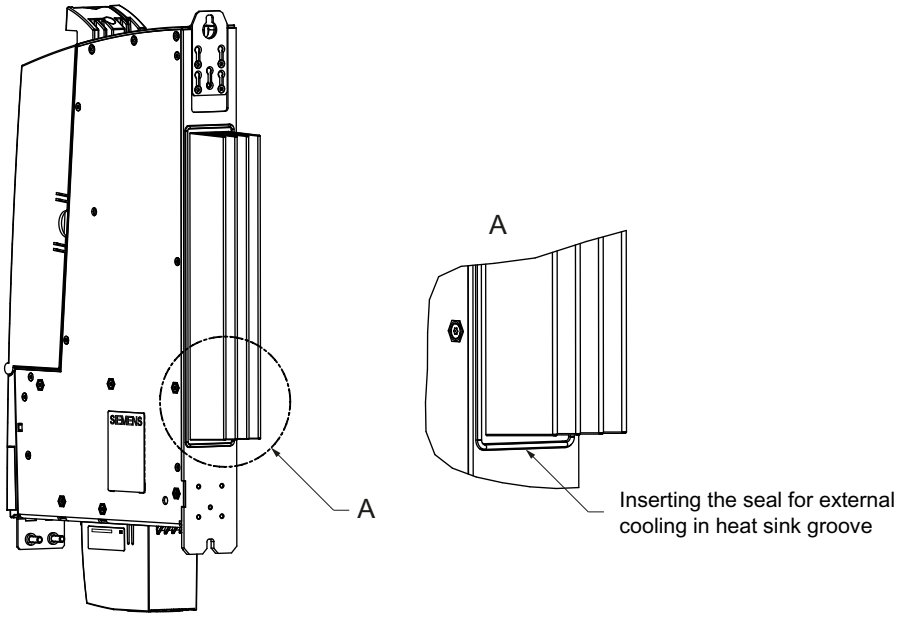
Figure 6-1 Panel cutout (dimensions in mm)

Procedure

1. Remove the spacers.
2. Fit the seal around the cooling ribs of the NCU.

Note

The seal is not included with the NCU. They must be additionally ordered, see Ordering data (Page 21).



3. Loosen the three M3 screws on the upper clip and push the clip up until the upper hole protrudes beyond the housing.
4. Retighten the 3x M3 screws (0.8 Nm) of the clip.
5. Mount the top and bottom of the NCU with heat sink directly on the rear panel of the control cabinet using two M6 screws (6 Nm) (① see figure titled "Panel cutout").

Connecting 7

7.1 Overview

Connection options

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

- The various SINAMICS components are connected with the NCU via DRIVE-CLiQ.
- Actuators and sensors can be connected to the digital inputs/outputs.
- The NCUs have the following communication options:
  - PROFIBUS DP, MPI, Ethernet
  - PROFINET

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

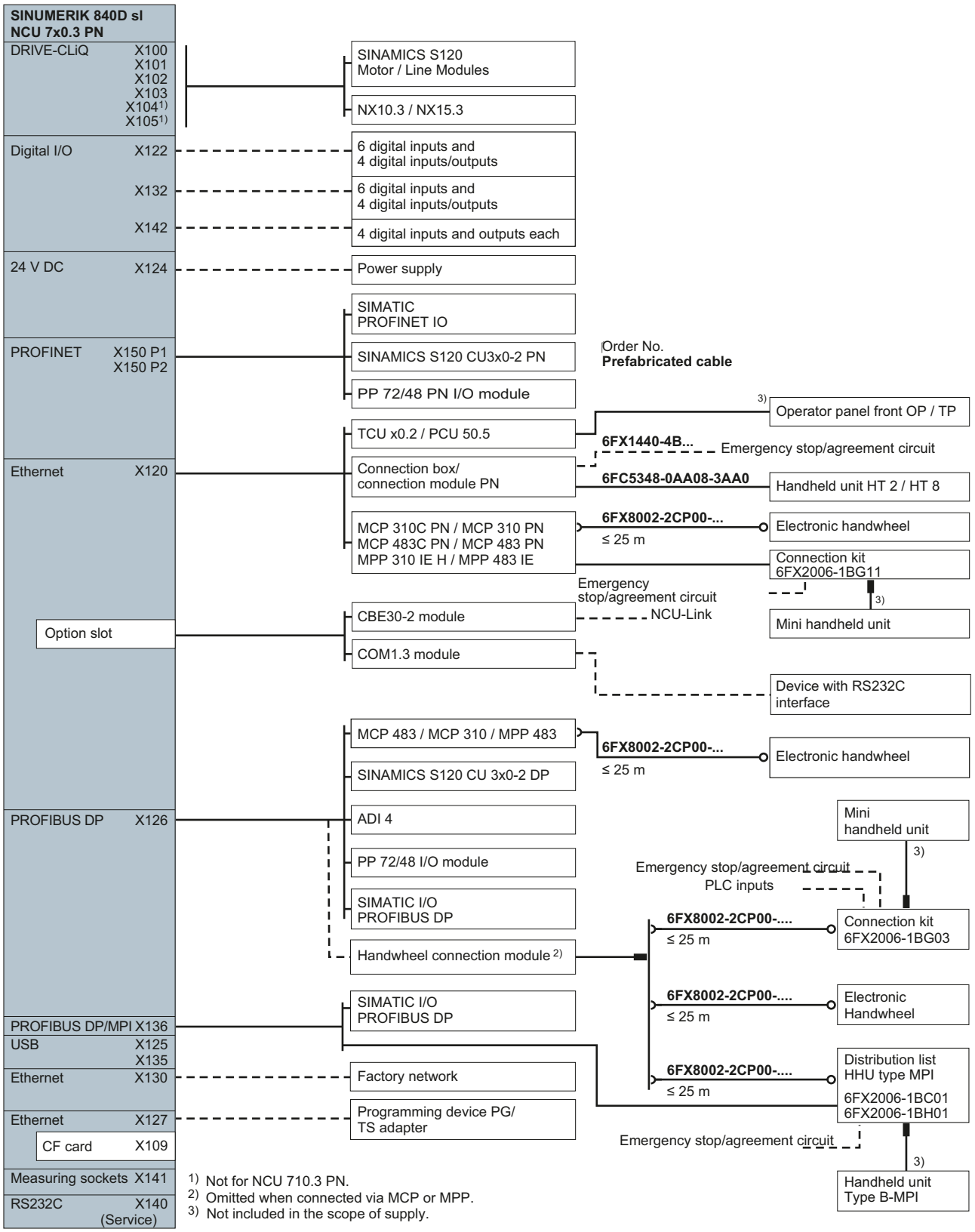


Figure 7-1 Options of connecting an NCU

Interface overview

Table 7-1 Overview of the interfaces that can be used

Interface	Designation	Connector type
DRIVE-CLiQ	X100 - X105	Spec. RJ45 socket
Ethernet IE1/OP	X120	Standard RJ45 socket
Ethernet IE2/NET	X130	Standard RJ45 socket
Ethernet (service socket)	X127	Standard RJ45 socket
PROFINET	X150; ports 1, 2	Standard RJ45 socket
Digital inputs/outputs	X122, X132, X142	Screw terminals, 3x14 pin
24 V power supply	X124	Screw terminals, 4-pin
USB	X125, X135	USB socket
PROFIBUS DP1	X126	9-pin SUB-D socket
PROFIBUS DP2/MPI	X136	9-pin SUB-D socket
RS232 (service socket)	X140	9-pin SUB D plug connector
Measuring sockets (T0, T1, T2, and M)	X141, X143	Sockets on the printed-circuit board
CompactFlash Card	X109	50-pin socket
Dual fan/battery module	X190	6-pin

7.2 Safety information for wiring

Note the following:

Safety information

NOTICE

The module can be damaged if power is connected when connecting up the NCU

When connecting the NCU, the system and the NCU must be disconnected (brought into a no voltage condition).

Note

If your axis grouping contains a Smart Line Module without DRIVE-CLiQ (5 kW or 10 kW), you must assign the Smart Line Module enabling signal to digital input X122.1 on the NCU.

7.3 Opening the front cover

Introduction

The interfaces are concealed behind a front cover. You must fold down this cover before you can wire up the interfaces. When the front cover is closed (flipped up), it automatically locks into place by means of a hook on the connector panel.

Note

Replacement of the front cover in the event of servicing

A hinge connects the front cover to the front of the housing. In order to replace them, it can easily be removed in the open state (45° angle) by pulling it slightly. It is installed in the same way, at a 45° angle, by slightly pressing on the hinge.

Procedure

1. Release the latch on the inside of the front cover (the front cover is open and in the up position) through slight pressure on it from the top.
2. Fold the front cover down to the front and bottom to give access to the interfaces.

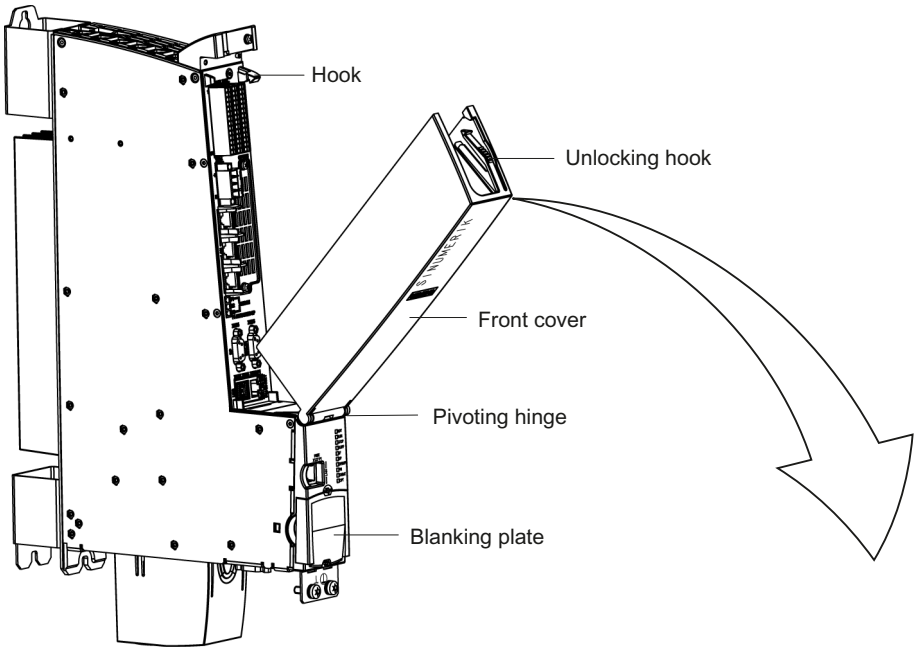


Figure 7-2 Removing the front cover

Note

All cables must be routed vertically upwards to the fullest extent possible so that the front cover can be closed.

7.4 Power supply

7.4.1 Application

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

Note

When using external power supplies (e.g. SITOP), the ground potential must be connected with the protective ground terminal (PELV).

Pin assignment

Table 7-2 Power supply X124

Pin	Signal name	Signal type	Meaning
+	P24	VI	Power supply 24 V
+	P24	VI	
M	M	VO	Ground
M	M	VO	
Signal type: VI = voltage input;VO = voltage output			

Note

The two "+" or "M" terminals are jumpered in the connector. This ensures the 24 V voltage is looped through.

Position of power supply interface

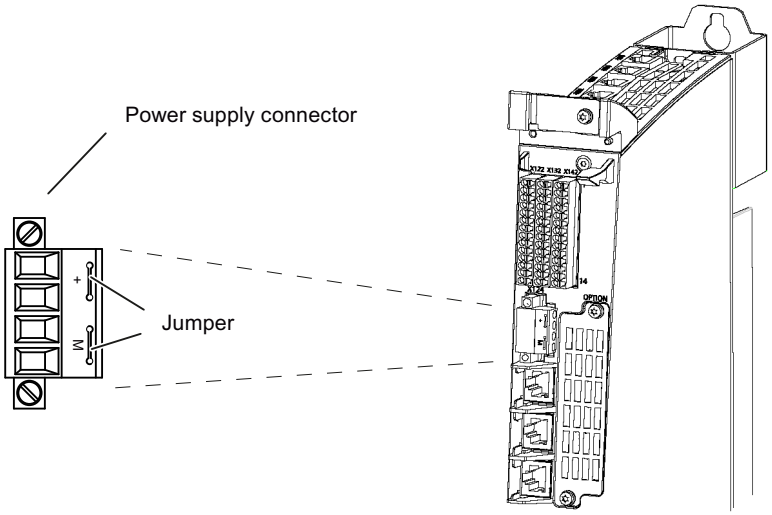


Figure 7-3 Power supply interface

7.4.2 Requirements for the power supply

External 24 V power supply

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

Table 7-3 Input voltage specification

	Typ. current consumption [1]	Max. power consumption [2]
NCU 710.3 PN / NCU 710.3B PN	0.9 A	11.7 A
NCU 720.3 PN / NCU 730.3 PN	1.9 A	15.6 A
NCU 720.3B PN	0.94 A	14.6 A
NCU 730.3B PN (PLC 317)	1 A	14.6 A
NCU 730.3B PN (PLC 319)	1.25 A	15 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

Danger of death caused by unsafe power supply

The DC power supply must be implemented as a circuit of Category PELV/DVC A according to EN 61800-5-1.

⚠ WARNING

Inadequately fused supply cables can be life-threatening

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 NCU 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 7-4 DC power supply requirements in accordance with EN 61131-2

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

Additional references

Recommended power supply units and tables for calculating the current drawn for SINAMICS S120 module lineups can be found in chapter "Control cabinet design and EMC Booksize" of the "SINAMICS S120 Booksize power units" manual.

7.4.3 Connecting the power supply

Wiring the screw-type terminal block

The required 24 V DC load current supply is wired to screw-type terminal block X124.

Power cables

Table 7-5 Cable specification for X124

Features	Version
Connector type	4-pin screw terminal
Connectable cable types and conductor cross-sections	
• Rigid	• 0.2 mm² to 2.5 mm²
• Flexible	• 0.2 mm² to 2.5 mm²
• Flexible, with end sleeve without plastic sleeve	• 0.2 mm² to 2.5 mm²
• Flexible, with end sleeve with plastic sleeve	• 0.2 mm² to 1.5 mm²
• AWG / kcmil	• 22 to 12
Stripped length	6-7 mm
Tool	Screwdriver 0.5 x 3 mm (M2.5)
Tightening torque	0.4 to 0.5 Nm
Max. current carrying capacity, incl. loop-through	20 A *) (15 A according to UL/CSA)
Max. cable length	10 m

*) This value must be taken into consideration for the current-carrying capacity of the power supply cable.

7.5 DRIVE-CLiQ components

7.5.1 Application

The components of the SINAMICS S120 drive family and the NCU are interconnected using DRIVE-CLiQ. When connecting the components, please follow the rules in the documentation below without exception:

The "Communication in the system" chapter of the "Machine configuration guidelines" System Manual.

Properties

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

DRIVE-CLiQ pin assignment

Table 7-6 DRIVE-CLiQ interface 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 the DRIVE-CLiQ interfaces

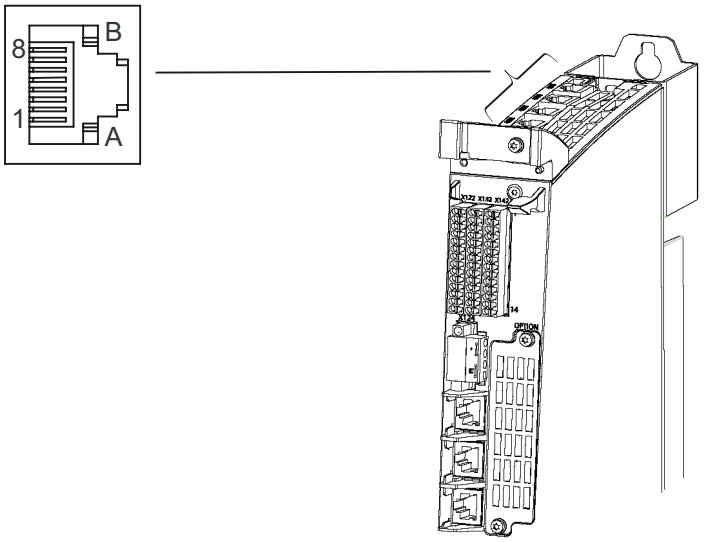


Figure 7-4 DRIVE-CLiQ interfaces

Cable specification

Table 7-7 Cable specification for X100 - X105

Characteristic	Version
Connector type	RJ45 socket
Cable type	DRIVE-CLiQ standard (inside the control cabinet)

Characteristic	Version
	MOTION CONNECT (outside the control cabinet)
Max. cable length	70 m

7.5.2 Connectable DRIVE-CLiQ components

Components

As a rule, all SINAMICS/SIMOTION components approved for SINUMERIK can be connected to an NCU using DRIVE-CLiQ.

Table 7-8 Components with DRIVE-CLiQ

Component	Description
NX10.3 / 15.3	Drive expansion module for up to 6 axes
SINAMICS S120, system components, booksize format	
Smart / Active / Basic Line Module	Line Modules provide the central power supply to the DC link.
Single / Double Motor Module	Motor Modules draw their power from the DC link to supply the connected motors.
HF Motor Module	Operates as inverter and provides the energy for the connected motor - High Frequency Drive.
SINAMICS S120, system components, chassis format	
Smart / Active / Basic Line Module	Line Modules provide the central power supply to the DC link.
Motor Module	Motor Modules draw their power from the DC link to supply the connected motors.
Power Module	Power Modules provide the energy for the connected motor.
CUA31	Adapter to connect a Power Module to the NCU.
SINAMICS S120 Combi (only in connection with NCU 710.3)	
Power Module	Integrated infeed, Motor Modules for 3 or 4 axs and TTL encoder evaluation for the spindle.
Motor Module Booksize Compact	Expansion axes for Power Modules.
SINAMICS S120, additional system components	
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 SME120 / 125	Measuring systems outside the cabinet can be connected directly to the Sensor Module External.
DMC20/DME20	DRIVE-CLiQ Hub Modules are used to implement star-shaped distribution of a DRIVE-CLiQ line.
TM15 / TM17	The number of available digital inputs and outputs within a drive system can be expanded using a Terminal Module.

Component	Description
TM41	The number of available digital inputs and outputs within a drive system can be expanded using a Terminal Module; an incremental encoder can also be emulated.
TM120	The TM120 Terminal Module is used for temperature evaluation with protective separation. It can be used for 1FN, 1FW6 and third-party motors.

Further references for SINAMICS S120 components

- You can find information about Line, Motor and Power Modules in:
  - Equipment Manual Booksize Power Units
  - Chassis Power Units Equipment Manual
  - AC DRIVE Manual
- You can find information on the Combi in the "SINAMICS S120 Combi" manual.
- You can find information on the HF Motor Modules and the associated components in the "High Frequency Drive System Manual".
- You can find information on all other modules in "Manual Control Units and supplementary system components".

7.6 Use of Ethernet interfaces

Application

The following connections can be established via the Ethernet interfaces:

- X120 provides the link to the system network (e.g. operator panels).
- X130 connects the NCU to the company network.
- X127 is used for commissioning and remote diagnostics via teleservice adapter IE.
  You can find further details in the following manuals:
  - SINUMERIK 840D sl Basesoftware and Operating Software Commissioning Manual
  - SIMATIC TS Adapter IE Manual

Properties

The interfaces are full duplex 10/100/1000 Mbit Ethernet ports. Both ports are connected as an Ethernet terminal.

Pin assignment

Table 7-9 Ethernet interfaces X120, X130, X127 in the 10/100 Mbit mode

Pin	Signal name	Signal type	Meaning
1	TXP	B	Transmit data +
2	TXN	B	Transmit data -
3	RXP	B	Receive data +
4	-	-	Reserved, do not use
5	-	-	Reserved, do not use
6	RXN	B	Receive data -
7	-	-	Reserved, do not use
8	-	-	Reserved, do not use
Signal type: B = bidirectional			

Table 7-10 Ethernet interfaces X120, X130, X127 in the 1 Gbit mode

Pin	Signal name	Signal type	Meaning
1	DA+	B	Bidirectional pair A+
2	DA-	B	Bidirectional pair A-
3	DB+	B	Bidirectional pair B+
4	DC+	B	Bidirectional pair C+
5	DC-	B	Bidirectional pair C-
6	DB-	B	Bidirectional pair B-
7	DD+	B	Bidirectional pair D+
8	DD-	B	Bidirectional pair D-
Signal type: B = bidirectional			

Note

The Ethernet interfaces have what is called autocrossing functionality, i.e. when required, send and receive lines are switched over.

LED displays

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

Table 7-11 LED displays of the Ethernet ports

Name	Color	Status	Meaning
Link	Green	Lights up green	Transfer rate 10 or 100 Mbit/s
		Lights up orange	Transfer rate 1000 Mbit/s
		off	No or faulty connection

Name	Color	Status	Meaning
Activity	Orange	lit	Data exchange
		off	No data exchange

Position of the Ethernet interfaces

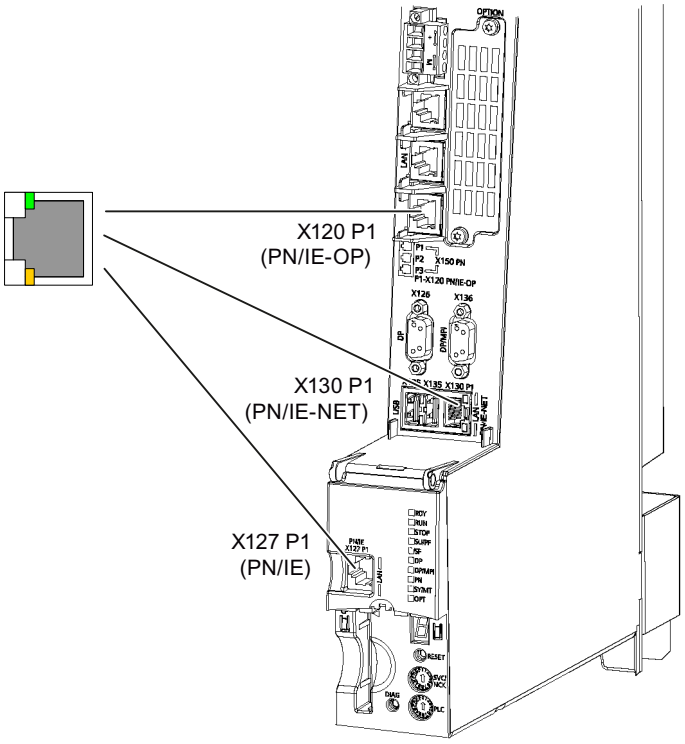


Figure 7-5 Ethernet ports

Cable specification

Table 7-12 Cable specification for X120, X130, and X127

Characteristic	Version
Connector type	RJ45 socket
Cable type	Industrial Ethernet cable (CAT5)
Max. cable length	100 m

7.7 PROFINET

7.7.1 Application

Application

The following communication networks can be established via the PROFINET interface:

- PROFINET CBA:
  Communication between controllers as components in distributed systems
- PROFINET IO
  Communication between the PLC controller and field devices

Properties

The PROFINET interface X150 is equipped with an integrated 2-port switch and a TCP/IP address for the 2 ports.

Pin assignment

Table 7-13 PROFINET interface, X150 ports 1, 2

Pin	Signal name	Signal type	Meaning
1	TXP	B	Transmit data +
2	TXN	B	Transmit data -
3	RXP	B	Receive data +
4	-	-	Reserved, do not use
5	-	-	Reserved, do not use
6	RXN	B	Receive data -
7	-	-	Reserved, do not use
8	-	-	Reserved, do not use
Signal type: B = bidirectional			

Note

The PROFINET interface has what is known as autocrossing functionality, i.e. when required, transmit and receive lines are switched over. Thus, no crossover cables are necessary.

LED displays

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

Table 7-14 PROFINET ports LED displays

Name	Color	Status	Meaning
Link	Green	lit	Transfer rate 100 Mbit/s
		off	No or faulty connection
Activity	Orange	lit	Data exchange
		off	No data exchange

Position of the PROFINET interface

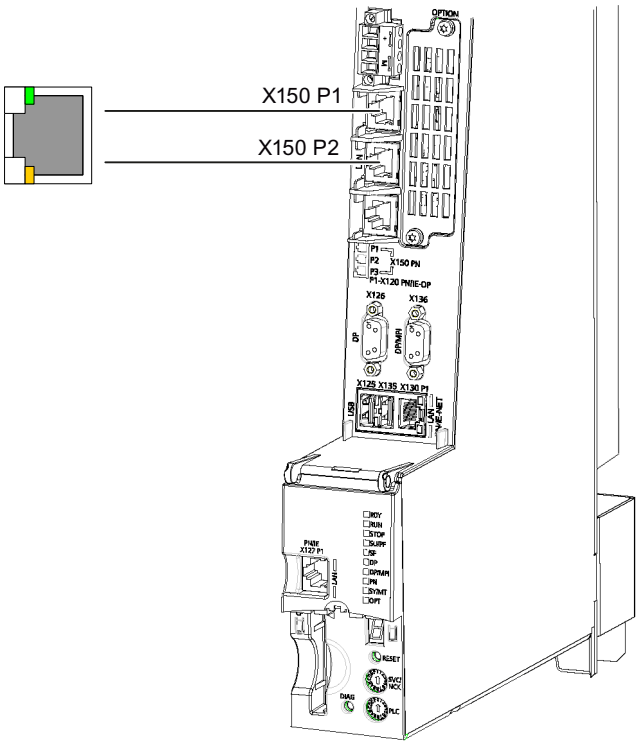


Figure 7-6 PROFINET interface

Cable specification

For PROFINET, you always require a data transmission rate of 100 Mbit/s (Fast Ethernet) in full duplex mode. For data transfer purposes, you can use twisted-pair copper cables (4-wire, 100Base-T).

Table 7-15 Cable specification for X150 ports 1, 2

Characteristic	Version
Connector type	RJ45 jack *)
Cable type	Industrial Ethernet cable (CAT5)
Max. cable length	100 m

*) Please use the Fast Connect connector as outlined in the chapter titled "PROFINET cables (Page 60)".

7.7.2 PROFINET cables

Cable and connector types

Note

For connecting PROFINET to the NCU we recommend using a connector with a 145° cable outlet (IE FC RJ45 plug 145).

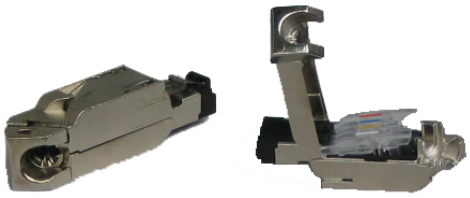


Figure 7-7 RJ45 PN connector with a 145°cable outlet

Table 7-16 Connector types for PROFINET

Connector	Designation	Order number
IE FC RJ45 plug 145	RJ45 PN connector with angled exit	6GK1 901-1BB30-0AA0/ 6GK1 901-1BB30-0AB0

Table 7-17 Cable types for PROFINET

Cable	Designation	Order number
IE FC Cable GP 2 (Type A)	4-wire, shielded TP installation cable for IE FC RJ45	6XV1 840-2AH10
IE FC Flexible Cable GP 2 (Type A)	4-wire, shielded flexible TP installation cable for IE FC RJ45	6XV1 870-2B

Cable	Designation	Order number
IE FC Trailing Cable GP 2x2 (Type C)	4-wire TP installation cable for ground cable use	6XV1 870-2D
IE FC Trailing Cable 2x2 (Type C)	4-wire shielded TP installation cable for connection to FC OUTLET RJ45, for ground cable use	6XV1 840-3AH10
IE FC Marine Cable 2x2	4-wire shielded marine-certified TP installation cable for connection to FC OUTLET RJ45	6XV1 840-4AH10

7.7.3 Preparing the twisted pair cables

Function

The IE FC RJ45 Plugs are used to install uncrossed 100 Mbit/s Ethernet connections up to 100 m without the use of patches. Crossed cables can also be installed by swapping the transmit and receive pair in a plug.

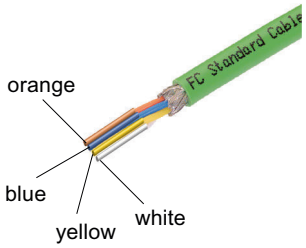
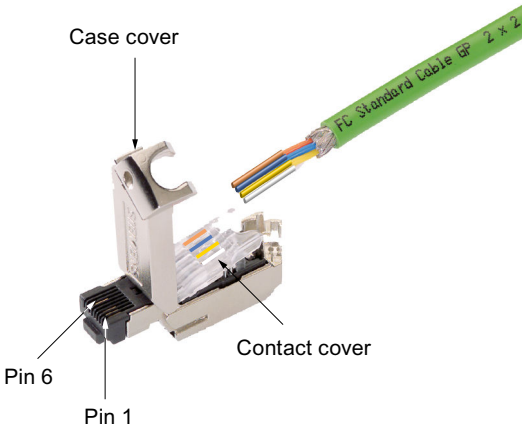
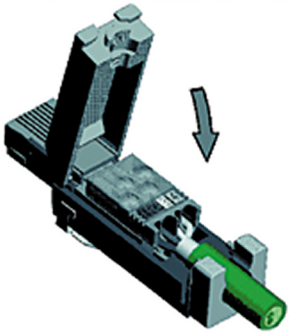
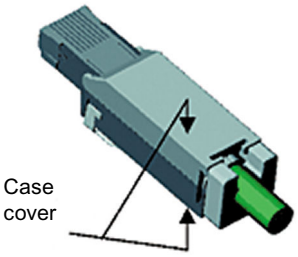
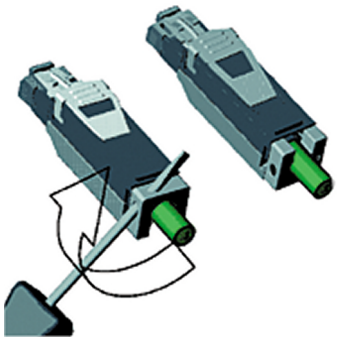
Prerequisite

When you set up your PROFINET system, you can cut the AWG 22 twisted pair cable on-site to the required length, strip it with the *Fast Connect Stripping Tool* (for Industrial Ethernet), and fit the *Industrial Ethernet FastConnect RJ-45 Plugs* using the cut-and-clamp technique.

Proceed as follows

Contacting of the FC cable versions is simple and reliable with the 4 integrated insulation displacement contacts.

- When the plug case is open, color markings on the contact cover make it easier to connect the cores to the insulation piercing connecting devices. The user can check that contact has been made correctly through the transparent plastic material of the contact cover.
- The stripped end of the cable is inserted in the raised insulation displacement terminals and the terminals are then pressed down to ensure reliable contacting of the conductors.

①  Strip the IE FC Cable 2x2 using a stripping tool and separate out the cores according to the color coding on the contact cover of the FC RJ45 plug.	②  Open the case cover of the FC RJ45 plug and insert the strands into their respective end positions according to the color coding.	
③  Lower the contact cover so that the strands are contacted.	④  Close the case cover and press down until it connects with the plug case below.	⑤  Use a screwdriver to turn the snap ring 90°. This will ensure tension and cable grip.

Assigning the installation cables to the pins on the IE FC RJ45 plug

Between the four individually colored wires of the IE FC RJ45 plug pins, the following assignments are made:

Pin no.	Wire color	Signal name	Meaning
1	yellow	TX+	Transmit data +
2	Orange	TX-	Transmit data -
3	white	RX+	Receive data +
6	blue	RX-	Receive data -

Additional references

For more information, please refer to:

- The Industry Mall
- The Catalog IK PI
- The manual titled "SIMATIC NET Twisted Pair and Fiber-Optic Networks" (entry ID: 8763736).

7.7.4 Example PROFINET CBA configuration

The following figure shows a typical system configuration with PROFINET CBA.

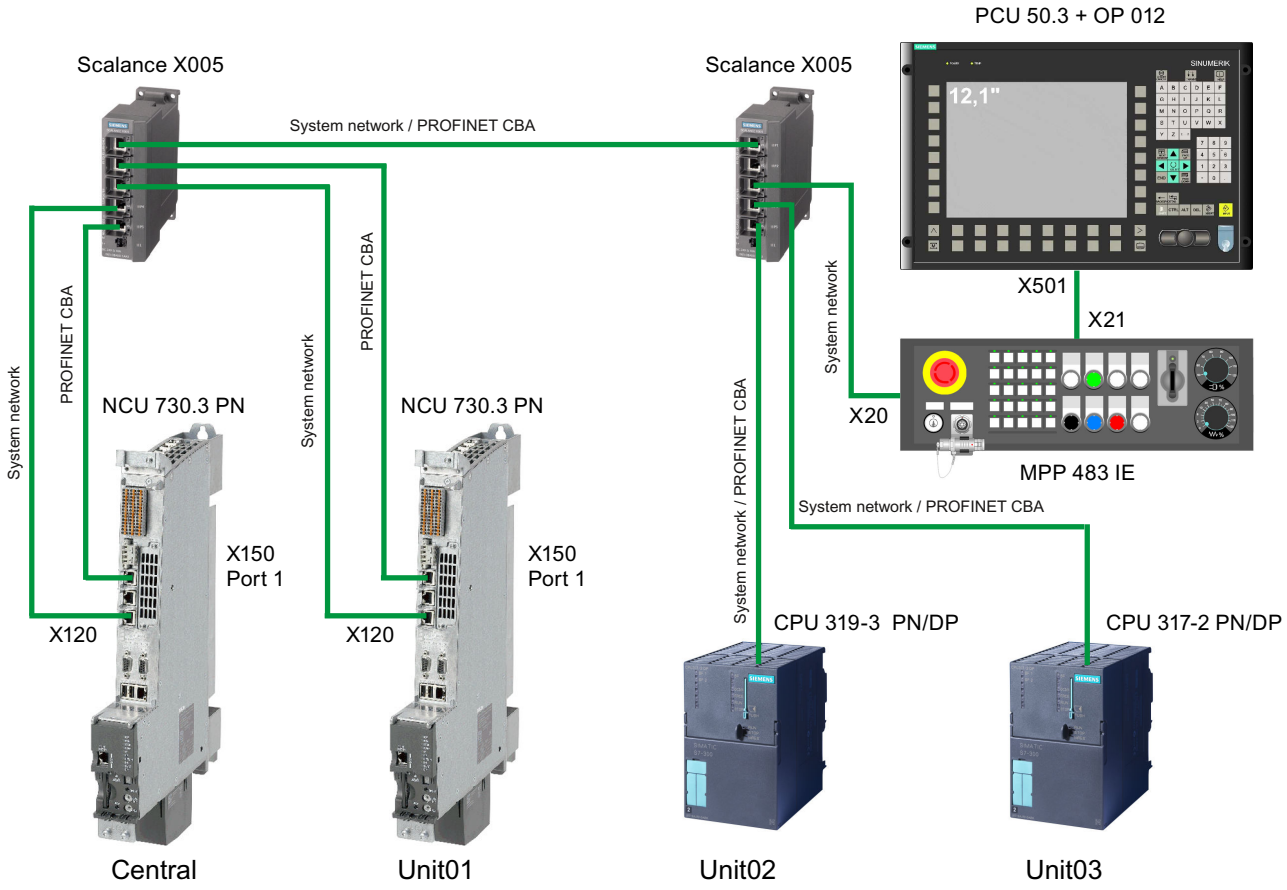


Figure 7-8 Example PROFINET CBA configuration

Station name	Module type	Interface	IP address
Central	NCU 730.3 PN	X120	192.168.200.1
		X150 port 1	192.168.200.2
	PCU 50.3	X501	192.168.200.5
	MPP 483 IE	X20 DHCP server	192.168.200.50

Station name	Module type	Interface	IP address
Unit01	NCU 730.3 PN	X120	192.168.200.11
		X150 port 1	192.168.200.12
Unit02	CPU 319-3 PN/DP	PN P1	192.168.200.22
Unit03	CPU 317-2 PN/DP	PN P1	192.168.200.32

7.8 PROFIBUS DP

7.8.1 Application

Connectable devices

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

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

Properties

- Isolated RS 485 interface
- Max. data rate 12 Mbits/s
- Supports master/slave operation
- PROFIBUS address is set via configuration

Note

In addition to the DP (distributed I/O) protocol, X136 can also transmit the MPI (multi point interface) protocol (software-controlled).

Pin assignment for X126, X136

Table 7-18 PROFIBUS DP interface X126

Pin	Signal name	Signal type	Meaning
1	-	-	Reserved, do not use
2	M	VO	Ground to P24_SERV
3	1RS_DP	B	RS-485 differential signal
4	1RTS_DP	O	Request to send
5	M5EXT	VO	Ground to P5EXT

Pin	Signal name	Signal type	Meaning
6	P5EXT	VO	5 V power supply for bus termination, external, short-circuit proof
7	P24_SERV	VO	24 V for teleservice, short-circuit proof, 150mA maximum
8	1XRS_DP	B	RS-485 differential signal
9	-	-	Reserved, do not use
The 1P5 voltage is provided exclusively to supply the bus termination.			
Signal type: VO = Voltage output (power supply) O = Output; B = Bidirectional			

Table 7-19 PROFIBUS DP/MPI interface X136

Pin	Signal name	Signal type	Meaning
1	-	-	Reserved, do not use
2	M	VO	Ground to P24_SERV
3	2RS_DP	B	RS-485 differential signal
4	2RTS_DP	O	Request to send
5	1M5EXT	VO	Ground to 1P5EXT
6	1P5EXT	VO	5 V power supply for bus termination, external, short-circuit proof
7	P24_SERV	VO	24 V for teleservice, short-circuit proof, 150mA maximum
8	2XRS_DP	B	RS-485 differential signal
9	-	-	Reserved, do not use
The 1P5 voltage is provided exclusively to supply the bus termination.			
Signal type: VO = Voltage output (power supply) O = Output; B = Bidirectional			

Position of connectors

The following figure shows the mounting position and the designation of the connector on the module.

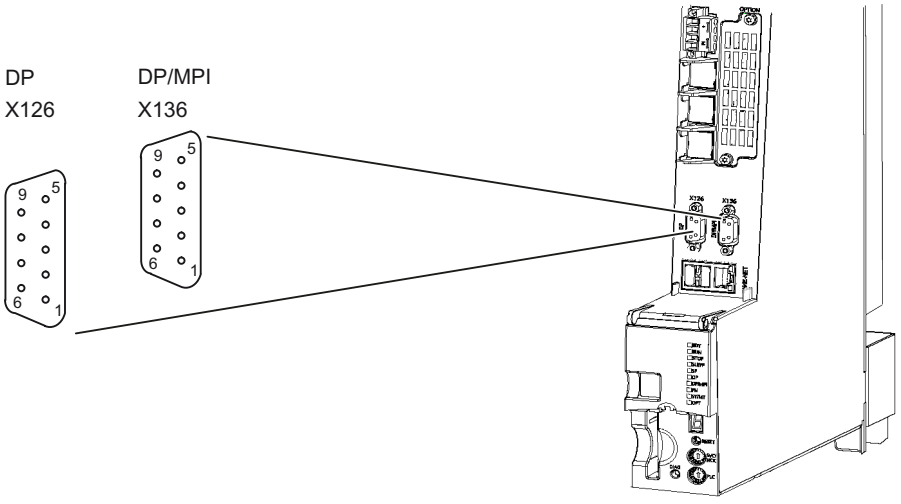


Figure 7-9 PROFIBUS DP/MPI interfaces

7.8.2 PROFIBUS cables and connectors

Cable specification

The PROFIBUS cable is 2-wire, twisted, and shielded with defined technical data.

Table 7-20 Cable specifications for X126 and X136

Characteristics	Version
Connector type	9-pin SUB D connector
Cable type	PROFIBUS cable
Max. cable length	100 m at 12 Mbit/s

Table 7-21 Technical data for PROFIBUS cables

Characteristics	Values
Wave impedance	Approximately 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

Cable lengths and data rate

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

Table 7-22 Permitted cable length of a subnet segment for specific data rates

Data rate	Max. cable length of a segment (in m)
19.6 to 187.5 kbit/s	1000[1)]
500 kbit/s	400
1.5 Mbit/s	200
3 to 12 Mbit/s	100

[1)] With isolated interface

Longer cable lengths:

If you must realize greater cable lengths than permitted in one segment, you must use RS 485 repeaters. The maximum possible cable lengths between two RS 485 repeaters correspond to the cable length of a segment. You can connect up to 9 RS 485 repeaters in series.

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

Connector features

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

Only bus connectors with a 35° cable outlet should be used in order to ensure that the front cover can be closed.

Note

Increased cabling space using PROFIBUS adapter connectors

The adapter connector is required if the bus cable is to be looped through at the left-hand PROFIBUS interface (X126) of the NCU (2 PROFIBUS cables are connected at the connector) and at the same time the Ethernet interface X120 is connected to a FastConnect connector. When using the adapter plug, the PROFIBUS connector is higher, which creates extra wiring space.

7.8.3 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 NCU 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.

7.8.4 Rules for the laying of PROFIBUS cables

Laying of bus cables

During laying of the PROFIBUS cable, you must avoid:

- twisting
- stretching and
- squeezing

Supplementary conditions

During laying of the indoor bus cable, you must also consider the following supplementary conditions (d_O = outer diameter of the cable):

Table 7-23 Supplementary conditions for the laying of PROFIBUS cables

Features	Supplementary conditions
Bending radius for a single bend	80 mm ($10xd_O$)
Bending radius (multiple times)	160 mm ($20xd_O$)
Permissible temperature range for cable routing	-5 °C to +50°C
Temperature range for storage and stationary operation	-30°C to +65°C

Additional references

For length codes of prefabricated cables and additional information on PROFIBUS cables, refer to "Electrical networks" in the PROFIBUS section of the IK PI catalog titled "Industrial Communication and Field Devices".

7.8.5 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 NCU.
3. Screw the bus connector into place.
   As the NCU is located at the start or end of a segment, you must switch on the terminating resistor ("ON" switch setting).

Figure 7-10 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.

7.8.6 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.

NOTICE

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 de-energized. 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.

7.8.7 Operating the X136 interface as MPI

Applications

The X136 interface can also be operated as an MPI interface instead of a PROFIBUS DP interface. 187.5 kbit/s is the typical (preset) data rate. A maximum data rate of 12 Mbit/s can be set to communicate with other CPUs. However, it should be noted that the maximum data rate is not supported by all CPUs (e.g. smaller SIMATIC S7 CPUs).

The following list provides examples of when using MPI (multi-point interface) may prove effective:

- If a PC/PG with an MPI is being used
- If an MPI-type handheld unit is being used

Operate MPI like PROFIBUS

The information on wiring the connector (terminating resistors) for PROFIBUS and the rules on the laying of cables for PROFIBUS apply to this interface as well. When carrying out this procedure, consult the relevant references.

Connector features

The bus connector is used to connect the MPI bus cable to the MPI (X136). This enables you to establish connections to additional nodes (e.g. PG or SIMATIC S7-CPU). Only bus connectors with a 35° cable outlet should be used in order to ensure that the front cover can be closed.

MPI bus cable

The PROFIBUS cable specifications apply here as well. Please note the relevant information on setting up an MPI network.

Setting up an MPI network

Keep in mind the following basic rules when setting up an MPI network:

- When using the interface as an MPI interface, it is not possible to arrange additional control for a drive in isochronous mode or to connect distributed I/Os to this interface.
- An MPI bus line must be terminated at both ends. This is achieved by activating the terminating resistor in the MPI connector in the first and last station and deactivating the other terminating resistors.
- At least one terminator must be supplied with 5 V.
  This means that an MPI connector with an activated terminating resistor must be connected to a device that is switched on.
- Spur lines (cables leading from the bus segment to the node) should be as short as possible, i.e. < 5 m in length. Unused spur lines should be removed wherever possible.
- Every MPI station must be connected to the bus first and then activated.
  To disconnect the station, it must first be deactivated. Then, the station can be removed from the bus.
- Maximum cable lengths:
  - 200 m per bus segment
  - 2000 m total length with RS 485 repeaters

7.9 Digital inputs/outputs

7.9.1 DIO application

Connecting sensors and actuators

Digital inputs and outputs can be used to connect various sensors and actuators to the 14-pin connectors X122 / X132 / X142 on the front panel. The interfaces are permanently assigned:

- X122 and X132: Drive
- X142: Control system

The following types of digital I/O are used:

- Digital inputs (isolated)
- Digital outputs
- Bidirectional digital inputs/outputs (only for drive terminals)

The assignment of I/Os to functions can be parameterized freely by the user. Special functions, such as probe inputs (rapid inputs only) and cam outputs, can also be assigned to the inputs/outputs.

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

Note

Terminal assignments

When commissioning the drive wizard, the digital inputs/outputs are correspondingly preassigned functions.

For more information about terminal assignment, see:

- Commissioning Manual "IBN CNC: NCK, PLC, drive", Chapter "Communication interfaces and terminal assignment"
- "Guidelines for machine configuration" System Manual, Chapter "Interfaces and their terminal assignment"

Access to digital inputs/outputs

Note

The digital inputs/outputs of the drive terminals are updated in accordance with the set PROFIBUS bus clock cycle of SINAMICS Integrated.

Pin assignment

Table 7-24 X122 digital inputs/outputs

Pin	Signal name	Signal type	Meaning
1	DI0	I	Digital input 0
2	DI1	I	Digital input 1
3	DI2	I	Digital input 2
4	DI3	I	Digital input 3
5	DI16	I	Digital input 16
6	DI17	I	Digital input 17
7	G1	GND	Ground for DI0 - DI3, DI16, DI17 (isolated with respect to M)
8	M	GND	Ground
9	DI/DO8	B	Digital input/output 8 (rapid input)
10	DI/DO9	B	Digital input/output 9 (rapid input)
11	M	GND	Ground
12	DI/DO10	B	Digital input/output 10 (rapid input)
13	DI/DO11	B	Digital input/output 11 (rapid input)
14	M	GND	Ground
Signal type: B = Bidirectional; I = Input; GND = Reference potential (ground)			

Table 7-25 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	DI20	I	Digital input 20
6	DI21	I	Digital input 21
7	G2	GND	Ground for DI4 – DI7 (functionally-separated relative to M)
8	M	GND	Ground
9	DI/DO12	B	Digital input/output 12 (rapid input)
10	DI/DO13	B	Digital input/output 13 (rapid input)
11	M	GND	Ground
12	DI/DO14	B	Digital input/output 14 (rapid input)
13	DI/DO15	B	Digital input/output 15 (rapid input)
14	M	GND	Ground
Signal type: B = Bidirectional; I = Input; GND = Reference potential (ground)			

Table 7-26 X142 digital inputs/outputs

Pin	Signal name	Signal type	Meaning
1	-	-	Reserved, do not use
2	-	-	Reserved, do not use

Pin	Signal name	Signal type	Meaning
3	IN/OUT0	B	Digital NC input 1
4	IN/OUT1	B	Digital NC input 2
5	M	GND	Ground
6	IN/OUT2	B	Digital NC input 3
7	IN/OUT3	B	Digital NC input 4
8	M	GND	Ground
9	IN/OUT4	B	Digital NC output 1
10	IN/OUT5	B	Digital NC output 2
11	M	GND	Ground
12	IN/OUT6	B	Digital NC output 3
13	IN/OUT7	B	Digital NC output 4
14	M	GND	Ground
Signal type: B = Bidirectional; GND = reference potential (ground)			

Position of connectors

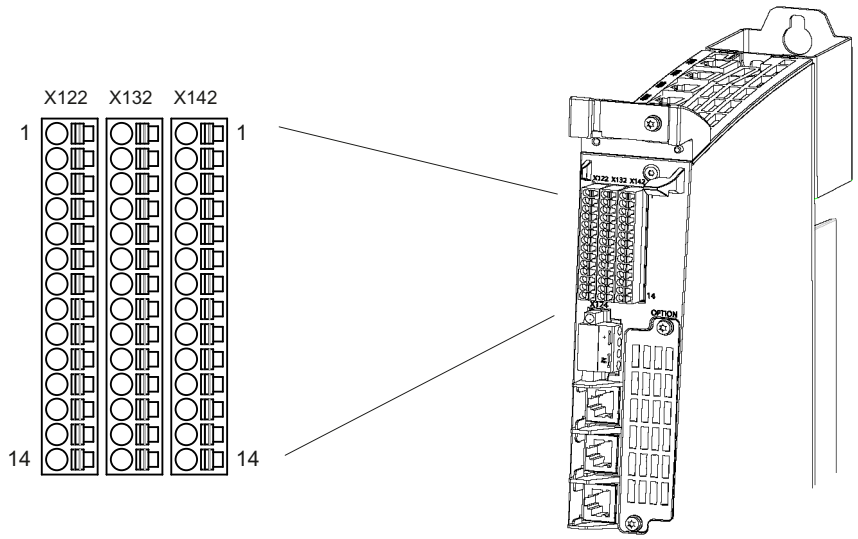
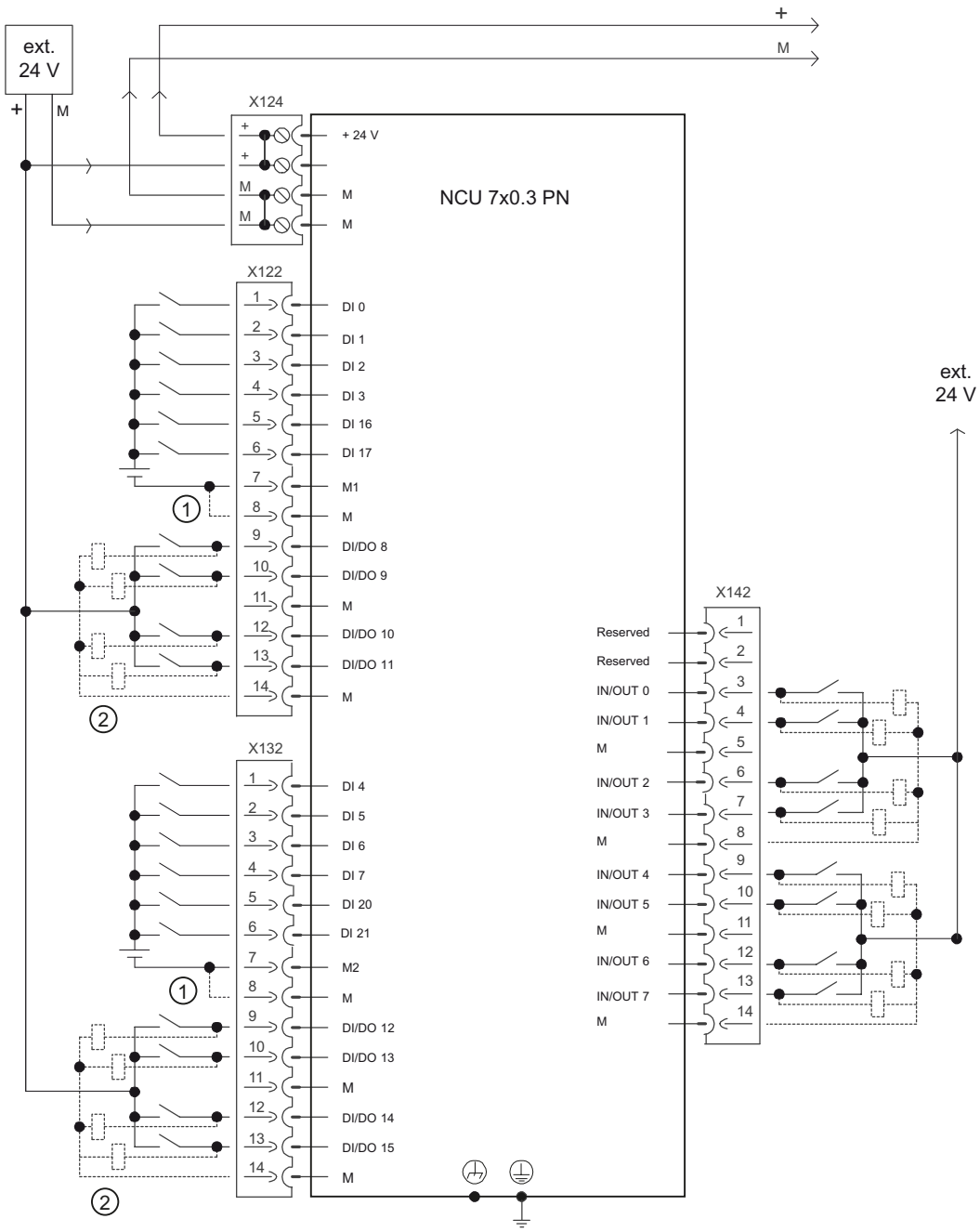


Figure 7-11 Digital inputs/outputs (interfaces X122, X132 and X142)

7.9.2 Block diagram

Block diagram

The following diagram shows the block diagram for the digital inputs/outputs of an NCU.



① Jumper open: Isolation for digital inputs

② can be parameterized as digital input/output

Figure 7-12 Block diagram for digital inputs/outputs

Note

The fast digital inputs/outputs must be shielded.

7.9.3 Connecting digital inputs/outputs

Cable specification

Table 7-27 Cable specification at X122 / X132 / X142

Features	Version
Connector type	14-pin spring-loaded terminals
Connection option	0.2 to 1.5 mm^2
Max. current carrying capacity	6 A
Max. cable length	30 m

Table 7-28 Connectable conductor cross-sections

Connectable conductor cross-sections	Rigid	0.2 to 1.5 mm^2
	Flexible	0.2 to 1.5 mm^2
	Flexible, with end sleeve without plastic sleeve	0.25 to 1.5 mm^2
	Flexible, with end sleeve with plastic sleeve	0.25 to 0.75 mm^2
	AWG / kcmil	24 to 16
Stripped length		10 mm
Tool	Screwdriver	0.4 x 2.0 mm

Note

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

Wiring digital inputs/outputs

1. Strip 10 mm of insulation from the wires.
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.

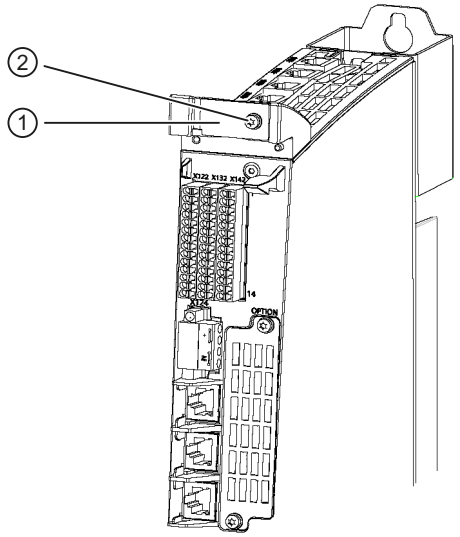
Using shielded cables

When using a shielded cable for the bidirectional inputs/outputs, the following options are available for the shield connection:

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.

Using a shield connection

1. Remove the fixing bracket of the shield connection.
2. Insert the cable and fasten the fixing bracket.



① Fixing bracket of the shield connection
② Torx screw M3/0.8 Nm

Figure 7-13 Shield support

7.9.4 Technical data

Digital inputs on X122/X132

Table 7-29 Technical data of digital inputs X122/X132

Parameters	Values
Voltage	-3 V to +30 V DC
Typical current consumption	9 mA at 24 V DC
Galvanic isolation	Reference potential is terminal G1 or G2
Signal level (including ripple)	High signal level: 15 V to 30 V

Parameters	Values
	Low signal level: -3 V to 5 V
Input delay (typ.)	L → H: 50 µs
	H → L: 100 µs

Digital inputs/outputs at X122 / X132 / X142

Table 7-30 Technical data of the digital inputs/outputs of X122 / X132 / X142

Parameters	Values
As an input	
Voltage	-3 V to +30 V DC
Typical current consumption	9 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
Input delay (typ.) 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 continuously short circuit-proof
Output delay (typ. / max.) [1]	L → H: 150 µs / 400 µs H → L: 75 µs / 100 µs
Switching frequency	for resistive load: max. 100 Hz for inductive load: max. 0.5 Hz for lamp load: max. 10 Hz
max. lamp load	5 W

[1] Data for: V_{cc} = 24 V; load 48 Ω; **H**igh = 90 % V_{out}; **L**ow = 10 % V_{out}

NOTICE

Ensuring the function of the digital inputs

An open input is interpreted as "low".

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

Terminals G1 or G2 must be connected for the digital inputs to work. This can be done as follows:

- Connect the ground reference of the digital inputs.
- A jumper to terminal M (note that these digital inputs are then no longer electrically isolated).

Note

For a transient (brief) voltage interruption of the 24 V supply, the digital outputs are switched inactive for this time.

7.10 USB

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

Table 7-31 Cable specification for X125 and X135

Characteristics	Versions
Connector type	Double USB socket – type A
Version	USB 2.0
Current carrying capacity	0.5 A per channel
Max. cable length	5 m

Note

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

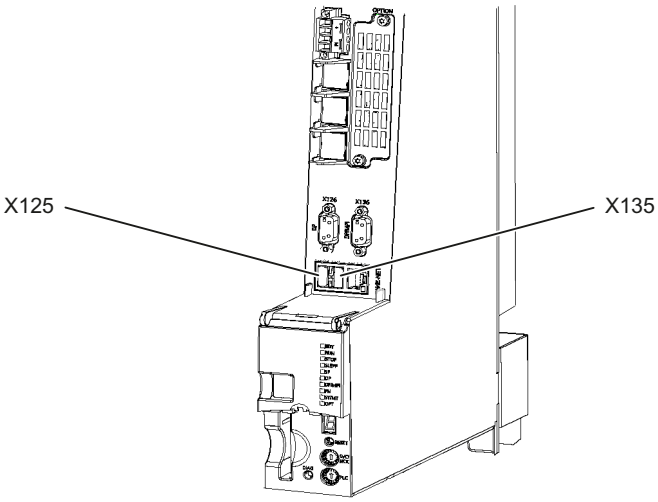


Figure 7-14 Position of USB interfaces

7.11 Measuring sockets

Application

The measuring sockets are used to output analog signals. Any interconnectable signal can be output on any measuring socket of the NCU.

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

Note

The measuring sockets should be used exclusively for servicing purposes.

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

Interface assignments

Table 7-32 Measuring sockets T0, T1, T2

Socket	Function	Technical data
T0	Test socket 1	Resolution: 8 bit.
T1	Measuring socket 2	Load current: max. 3 mA
T2	Measuring socket 3	continuous short-circuit-proof
M	Ground	The reference potential is terminal M
The measuring sockets are only suited for banana plugs with a diameter of 2 mm.		

Test socket position

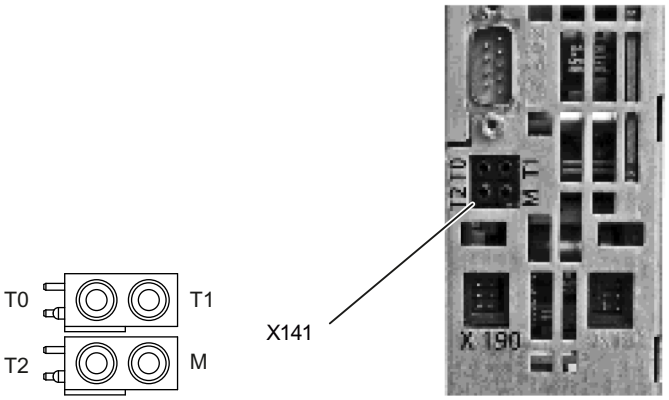


Figure 7-15 Arrangement of the measuring sockets on the lower side of the NCU

Technical data

8

Table 8-1 Safety-related data

Protection class	I (protective conductor) as per EN 61800-5-1
Degree of protection to EN 60529	IP20 or IPXXB with option slot cover or option board inserted
Approvals	CE, cULus
Declarations of conformity	Directive 2004/108/EC (EMC)
Pollution degree	2
Cooling	Open-circuit ventilation
Mounting position	Vertical

Note

Our products for industrial applications are presently not in the area of validity of Directive 2011/65/EC (RoHS).

However, to use our products in equipment, which today must already comply with Directive 2011/65/EC (RoHS), we can confirm that our products comply with the limit values laid down in directive 2011/65/EC (RoHS).

Table 8-2 Electrical and mechanical data

	NCU 710.3 PN NCU 710.3B PN	NCU 720.3 PN NCU 730.3 PN	NCU 720.3B PN NCU 730.3B PN	NCU 730.3B PN
Main memory	1 GB[1] / 2 GB[2] DRAM 1 MB NVM	1 GB DRAM 1 MB NVM	2 GB DRAM 1 MB NVM	2 GB DRAM 1 MB NVM
SIMATIC S7 - integrated	PLC 317-3 DP/PN	PLC 317-3 DP/PN	PLC 317-3 DP/PN	PLC 319-3 DP/PN
Input voltage	24 V DC	24 V DC	24 V DC	24 V DC
Power consumption, max.	281 W	374 W	352 W	367 W
Power loss, typ.	21 W	46 W	24 W	30 W
Dimensions W x H x D [3]	50 x 455 x 272 mm	50 x 455 x 272 mm	50 x 455 x 272 mm	50 x 455 x 272 mm
Weight (without packaging)	3.8 kg	4.4 kg	3.95 kg	3.95 kg

1) For NCU 710.3 PN

2) For NCU 710.3B PN

3) With dual fan/battery module and spacers

PLC data

The SIMATIC S7-PLC integrated in the SINUMERIK NCU is derived from a SIMATIC S7-CPU. In some cases, the technical data deviate. You can take these deviations from the following table:

	CPU317F-2 PN/DP	PLC 317-3 DP/PN	PLC 317-3 DP/PN
PLC firmware	v3.2	v3.2	v3.2+
PROFIBUS interfaces	1	2	2
Number of DP1/DP2 slaves	124 (only DP1)	124 (DP1 + DP2)	124 (DP1+DP2)
Retentive memory	256 KB	512 KB	512 KB
Load memory	max. 8 MB	2 MB (virtual)	2 MB (virtual)
PN I/O and CBA device ID	2	4	4
Number of PN I/O devices	256	128	128
I/O restrictions	8192 / 8192	5700 / 5700	10240 / 10240
Process image size	0 ... 8192	0 ... 4079 byte	0.. 12288 byte

	CPU319F-3 PN/DP	PLC 319-3 DP/PN
Load memory	max. 8 MB	8 MB (virtual)
PN I/O and CBA device ID	3	4
I/O restrictions	8192 / 8192	10240 / 10240 [4)]
Process image size	0 ... 8192	0.. 12288 byte

[4)] Can be manually expanded, drives > 10240, shift / adapt MD

You can find a detailed description of the PLC data online in the service & support portal of Siemens AG:

http://support.automation.siemens.com/WW/view/de/54058408

Connectable components

9

9.1 NX10.3 / NX15.3

9.1.1 Description

Properties

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

The NX module has the following interfaces:

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

Illustration

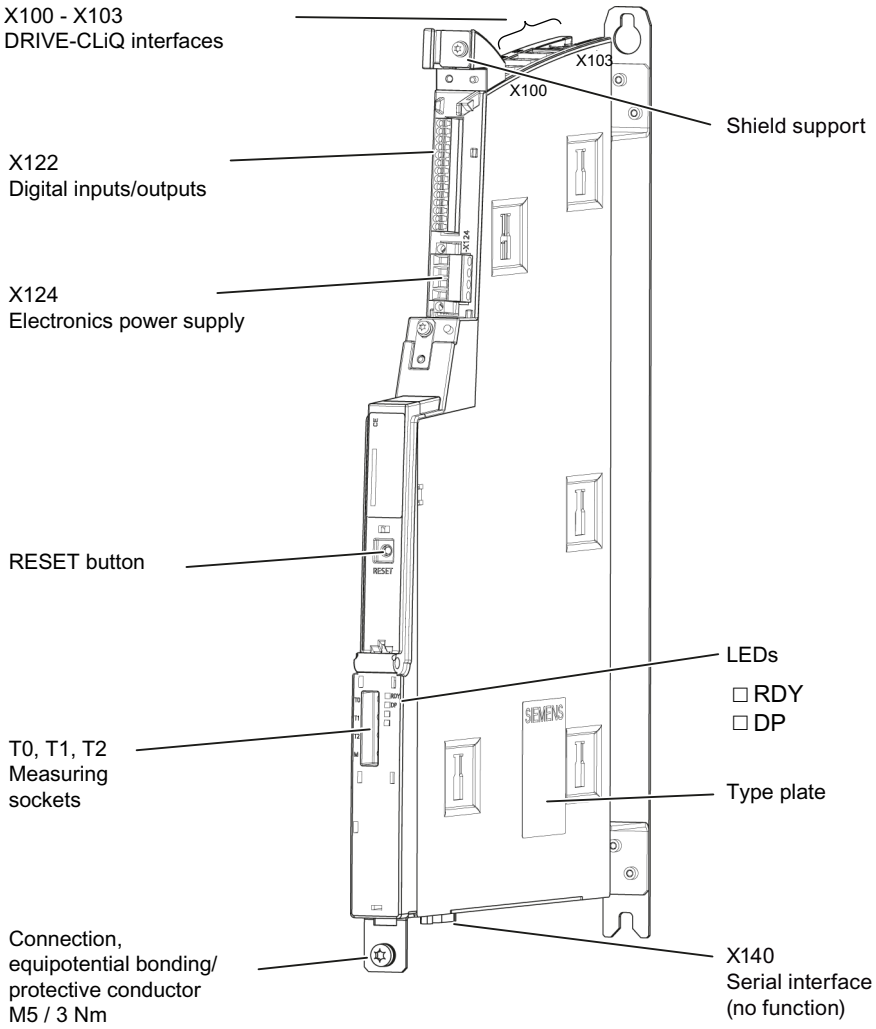


Figure 9-1 Illustration of the NX10.3 / 15.3 (without cover)

Type plate

The NX module type plate contains the following basic information:

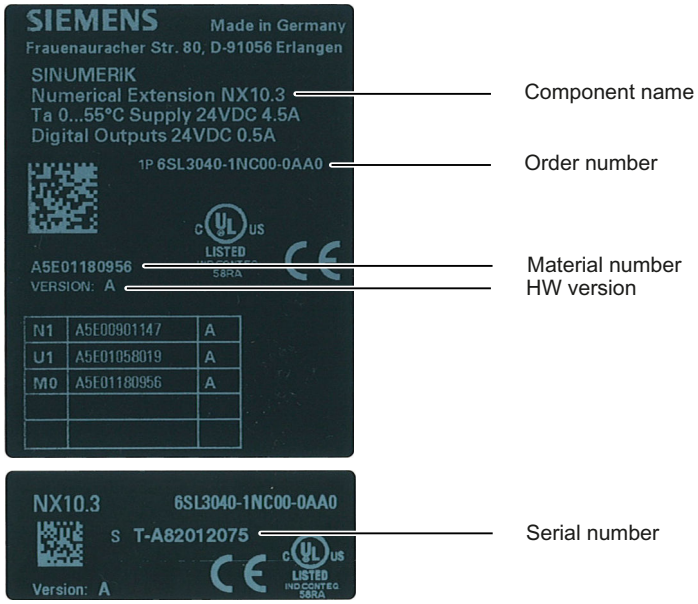


Figure 9-2 Type plate using the NX10.3 as example

Note

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 NX prior to assembly.

LED displays

Table 9-1 Description of LEDs on the NX10.3 / 15.3

LED	Color	Status	Description
RDY	Off		Electronic power supply outside permissible tolerance range
	Green	Continuous light	NX is ready for operation
		Flashing light 2 Hz	Writing to CompactFlash card of the connected NCU
	Red	Continuous light	NX is presently booting and at least one fault is present (e.g. RESET, watchdog monitoring, basic system fault).
		Flashing light 0.5 Hz	Boot error (e.g. firmware cannot be loaded into the RAM)
	Orange	Continuous light	Firmware loading into RAM
		Flashing light 0.5 Hz	Unable to load firmware into RAM
		Flashing light 2 Hz	Firmware CRC fault
DP	Off		Electronics power supply outside the permissible tolerance range, NX is not ready to run.

LED	Color	Status	Description
	Green	Continuous light	CU_LINK is ready for communication and cyclic communication is running.
		Flashing light 0.5 Hz	CU_LINK is ready for communication and no cyclic communication is running.
	Red	Continuous light	At least one CU_LINK fault is present. CU_LINK not ready for operation (e.g. after switching on)

RESET button

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

Note

When the pushbutton is actuated, the locally connected drive systems are brought to a standstill with no feedback to the control. In other words, the drive and controller run asynchronously once the drive has successfully booted up.

9.1.2 Dimension drawing

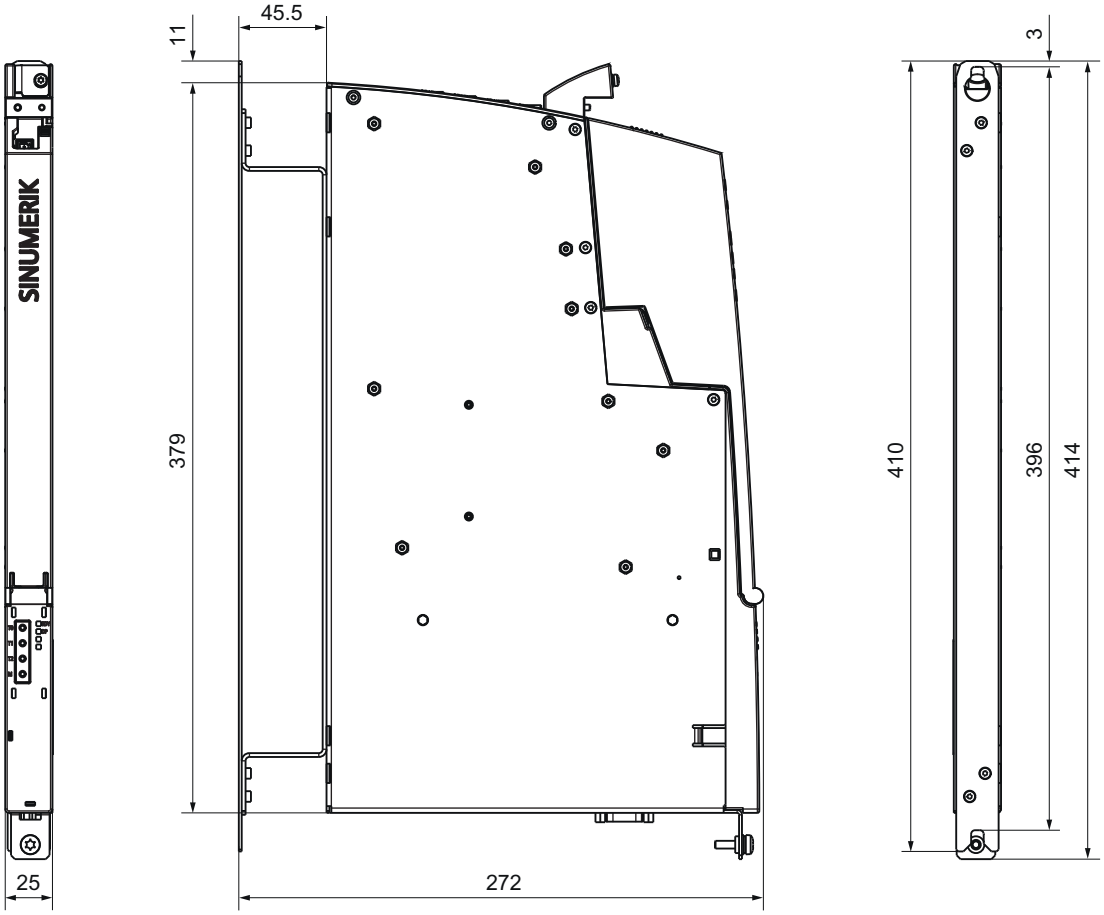


Figure 9-3 NX10.3 / 15.3 dimension drawing (dimensions in mm)

9.1.3 Mounting

Mounting aids

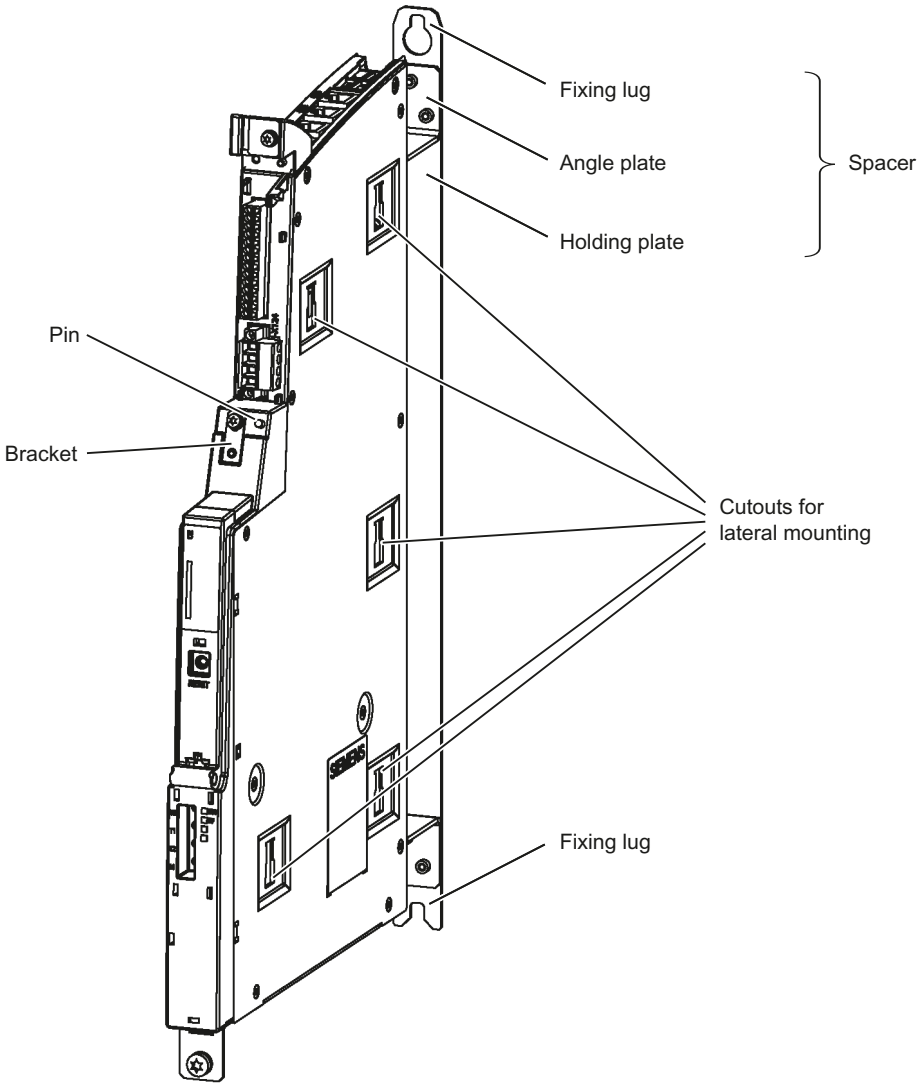


Figure 9-4 Mounting aids for the NX module

Designs

⚠ WARNING

Risk of fire through overheating if there are insufficient ventilation clearances

Inadequate ventilation clearances cause overheating with a risk for personnel due to smoke and fire. Further, increased failures and shorter service life of the devices/systems can occur. Under all circumstances, maintain a ventilation clearance of 80 mm above and below the NX module.

An NX can be mounted in the control cabinet in the following ways:

NX on the side of the SINAMICS drive line-up

First, you must insert the supports into the cutouts of the NX that are attached to the Line Module. Then the NX can be attached to the Line Module.

NX with spacer directly on the rear panel of the control cabinet - standard

The NX is secured with two M6 screws (6 Nm) to the mounting panel.

NX without spacer directly on the rear panel of the control cabinet

In addition, you can secure the NX directly on the rear panel of the control cabinet even without spacers. Using this method, you must remove the spacer attached as standard when originally supplied.

Note

The spacer is secured with M3 torx screws on the NX. You require a screwdriver T10 to attach/ remove the spacer.

1. Removing the holding plate.
2. Remove the angle plate.
3. Attach the holding plate to the NX using M3 screws (0.8 Nm).
4. Attach the NX with two M6 screws (6 Nm) to the mounting panel.

Mounting an NX to an additional NX

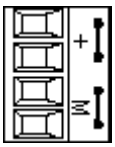
For stability reasons, you can connect the bracket of one NX to the clip of an adjacent NX:

1. Open the interface covers.
2. Release the screw fixing the bracket.
3. The bracket must be moved so that the pin is in the opening of the bracket. Tighten the screw.
4. Close the interface covers.

9.1.4 Connection

Power supply X124

Table 9-2 Pin assignment for X124

	Pin	Function
	+	24 V DC power supply (20.4 V - 28.8 V)
	+	
	M	Ground
	M	

Note

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

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

When using external power supplies (e.g. SITOP), the ground potential must be connected with the protective ground terminal (PELV).

Table 9-3 Cable specification for X124

Features	Version
Connector type	4-pin screw terminal
Connectable cable types and conductor cross-sections • Rigid • Flexible • Flexible, with end sleeve without plastic sleeve • Flexible, with end sleeve with plastic sleeve • AWG / kcmil	 • 0.2 mm² to 2.5 mm² • 0.2 mm² to 2.5 mm² • 0.2 mm² to 2.5 mm² • 0.2 mm² to 1.5 mm² • 22 to 12
Stripped length	6-7 mm
Tool	Screwdriver 0.5 x 3 mm (M2.5)
Tightening torque	0.4 to 0.5 Nm
Max. current carrying capacity, incl. loop-through	20 A (15 A according to UL/CSA)
Max. cable length	10 m

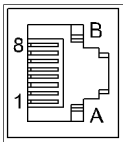
DRIVE-CLiQ interfaces X100 - X103

Table 9-4 Characteristics of X100 - X103

Characteristic	Version
Connector type	DRIVE-CLiQ plug
Cable type	DRIVE-CLiQ standard (inside the control cabinet)

Characteristic	Version
	MOTION CONNECT (outside the control cabinet)
Max. cable length	70 m

Table 9-5 Pin assignment, X100 - X103

	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)	Ground

DRIVE-CLiQ topology

NX components can be connected to the NCU via DRIVE-CLiQ. The following rules apply for the wiring:

- Only one **star topology** is permitted between the NX and the NCU. In this way, only one NX can be operated per DRIVE-CLiQ port of an NCU.
- DRIVE-CLiQ ports not assigned to NX can be wired to other DRIVE-CLiQ components.
- Once an NX 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 9-6 NX PROFIBUS addresses

DRIVE-CLiQ port on the NCU	Drive PROFIBUS addresses
X105	15
X104	14
X103	13
X102	12
X101	11

The following figure shows a sample topology:

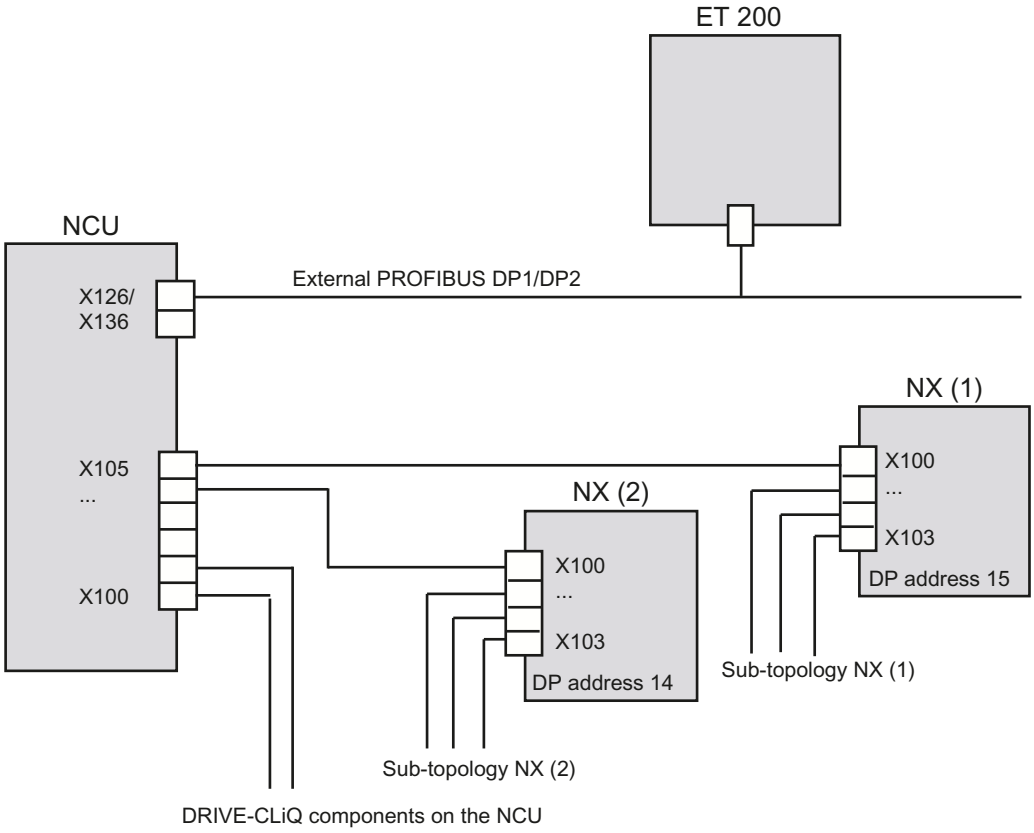


Figure 9-5 NX topology

X122 digital inputs/outputs

When commissioning the drive wizard, the digital inputs/outputs are correspondingly preassigned functions.

For more information about terminal assignment, see:

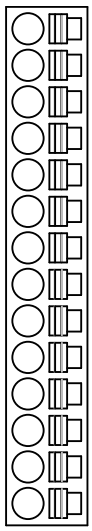
- "Guidelines for machine configuration" System Manual, Chapter "Interfaces and their terminal assignment"
- Commissioning Manual "IBN CNC: NCK, PLC, drive", Chapter "Communication interfaces and terminal assignment"

Table 9-7 Interface characteristics of X122

Features	Version
Connector type	14-pin spring-loaded terminal
Connection option	0.2 to 1.5 mm^2
Max. current carrying capacity	6 A
Max. cable length	30m

For details on the connection options, see Table 7-28 Connectable conductor cross-sections (Page 75).

Table 9-8 Pin assignment for X122

	Pin	Signal name	Signal type	Meaning
	1	DI 0	I	Digital input 0
	2	DI 1	I	Digital input 1
	3	DI 2	I	Digital input 2
	4	DI 3	I	Digital input 3
	5	DI 16	I	Digital input 16
	6	DI 17	I	Digital input 17
	7	G1	GND	Ground for DI0 - DI3, DI16, DI17 (isolated with respect to M)
	8	M	GND	Ground
	9	DI/DO 8	B	Digital input/output 8 (rapid input)
	10	DI/DO 9	B	Digital input/output 9 (rapid input)
	11	M	GND	Ground
	12	DI/DO 10	B	Digital input/output 10 (rapid input)
	13	DI/DO 11	B	Digital input/output 11 (rapid input)
	14	M	GND	Ground
	Signal type: B = Bidirectional; I = Input; GND = Reference potential (ground)			

DI: Digital input; DI/DO: Bidirectional digital input/output; M: Ground M1: Ground reference

Please take the technical data of the digital inputs/outputs from Chapter Technical data (Page 76).

NOTICE

Ensuring the function of the digital inputs

An open input is interpreted as "low".

The "rapid inputs" can be used for position detection and as inputs of measuring inputs depending on the terminal assignment used.

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

- Connect the ground reference of the digital inputs.
- A jumper to terminal M (note that these digital inputs are then no longer electrically isolated).

Note

For a transient (brief) voltage interruption of the 24 V supply, the digital outputs are switched inactive for this time.

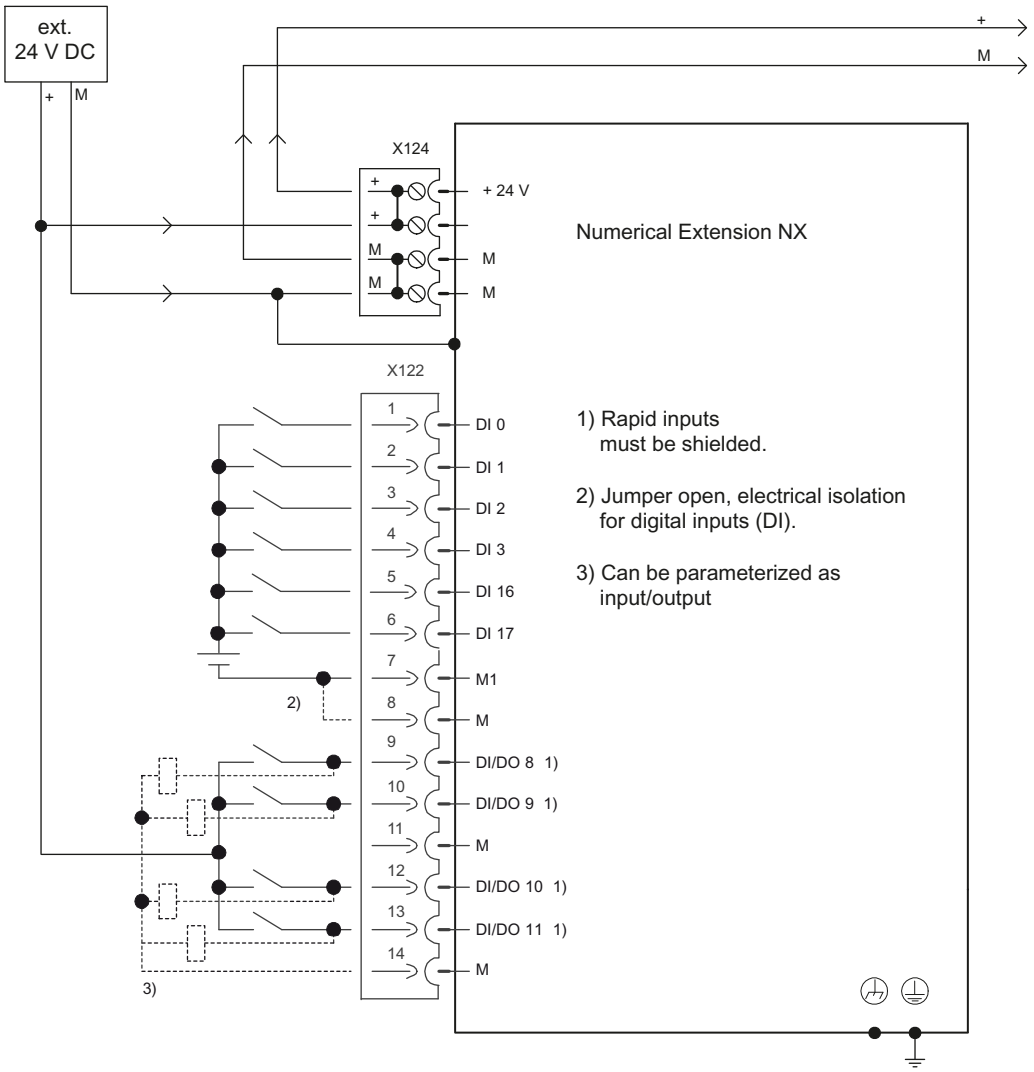


Figure 9-6 Block diagram for digital inputs/outputs

Additional references

For information on commissioning NX components, please refer to the "Commissioning Manual IBN CNC: NCK, PLC, drive".

9.1.5 Technical Data

Table 9-9 Safety-related data

Protection class according to EN 61800-5-1	Class I (with protective conductor system) and Class III (PELV)
Degree of protection to EN 60529	IP20
Approvals	CE, cULus

Pollution degree	2
Cooling	Open-circuit ventilation
Mounting position	Vertical
PE/ground connection	at the housing with M5 screw Torx / 3 Nm

Table 9-10 Electrical and mechanical data

Input voltage	24 V DC (20.4 – 28.8)
Current drain (without DRIVE-CLiQ and digital outputs)	0.3 A
Max. permitted output current	3.35 A
Power loss	15 W
Dimensions WxHxD (with spacers)	25 x 414 x 272 mm
Weight	2.58 kg

9.2 PP 72/48D PN

9.2.1 Description

Characteristics

I/O module PP 72/48D PN is a simple module (without a separate housing) for connecting digital input/outputs as part of an automation system based on PROFINET IO.

The module has the following important features:

- PROFINET IO connection (max. 100 Mbits/s)
- 72 digital inputs and 48 digital outputs
- On-board status display via 2 diagnostic LEDs
- The 3 plug-in connectors for the digital inputs and outputs are 50-pin terminal posts for connecting ribbon cables.
- Terminal strip converters can be used, or the direct connection of distribution boards, for example, is possible.

An external power supply unit (24 V DC) is required to supply the module and the digital outputs.

Illustration

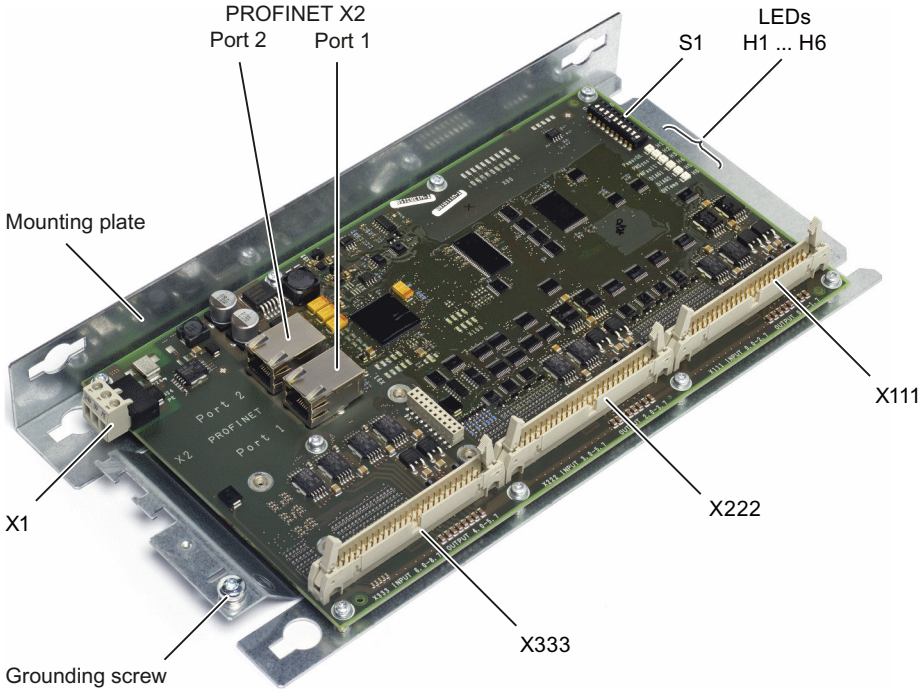


Figure 9-7 PP 72/48D PN I/O module

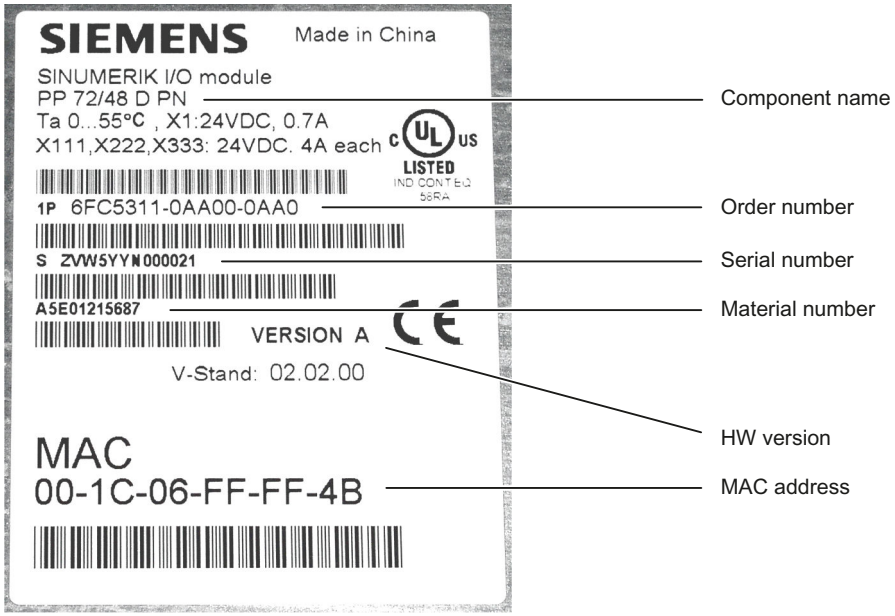


Figure 9-8 PP 72/48D PN type plate

Note

The type plate is located on the rear side of the mounting plate. It is advisable to make a note of relevant data as it is no longer visible after installation.

LED displays

Each PROFINET port has two integrated LEDs displaying the link status (green) and activity (orange); see chapter Application (Page 58).

The PP 72/48 D PN has the following additional LEDs, which provide information on the module status:

Table 9-11 LEDs: Status display

Name	Designation	Color	Description
H1	PowerOK	Green	Lit: Power supply ok
			Off: As soon as one of the generated logic voltages falls below its setpoint, a reset is triggered and the PowerOK LED goes out.
H2	PNSync	Green	Lit: Task system is synchronized to the bus cycle clock.
			Off: Task system is not synchronized to the bus cycle clock.
			Flashes 0.5 Hz: Task system has synchronized to the bus cycle clock and cyclic data exchange is running.
H3	PNFault	Red	Off: Module is operating without error.
			Lit: A system error has occurred (faulty module, incorrect parameterization by the PROFINET controller, etc.).
H4	DIAG1	Green	Reserved
H5	DIAG2	Green	Reserved
H6	OVTemp	Red	Overtemperature display

Note

When the system is booting, LEDs H1, H2 and H3 are lit.

9.2.2 Mounting

The I/O module can be fastened to the wall of the control cabinet using a mounting plate and M6 screws. The module must be installed according to EN 60204.

NOTICE

The I/O module can be damaged if there is no ground connection

A protective conductor must be connected using the grounding screw.

Note

The type plate is fitted to the rear side of the mounting plate. It is advisable to make a note of relevant data as it is no longer visible after installation.

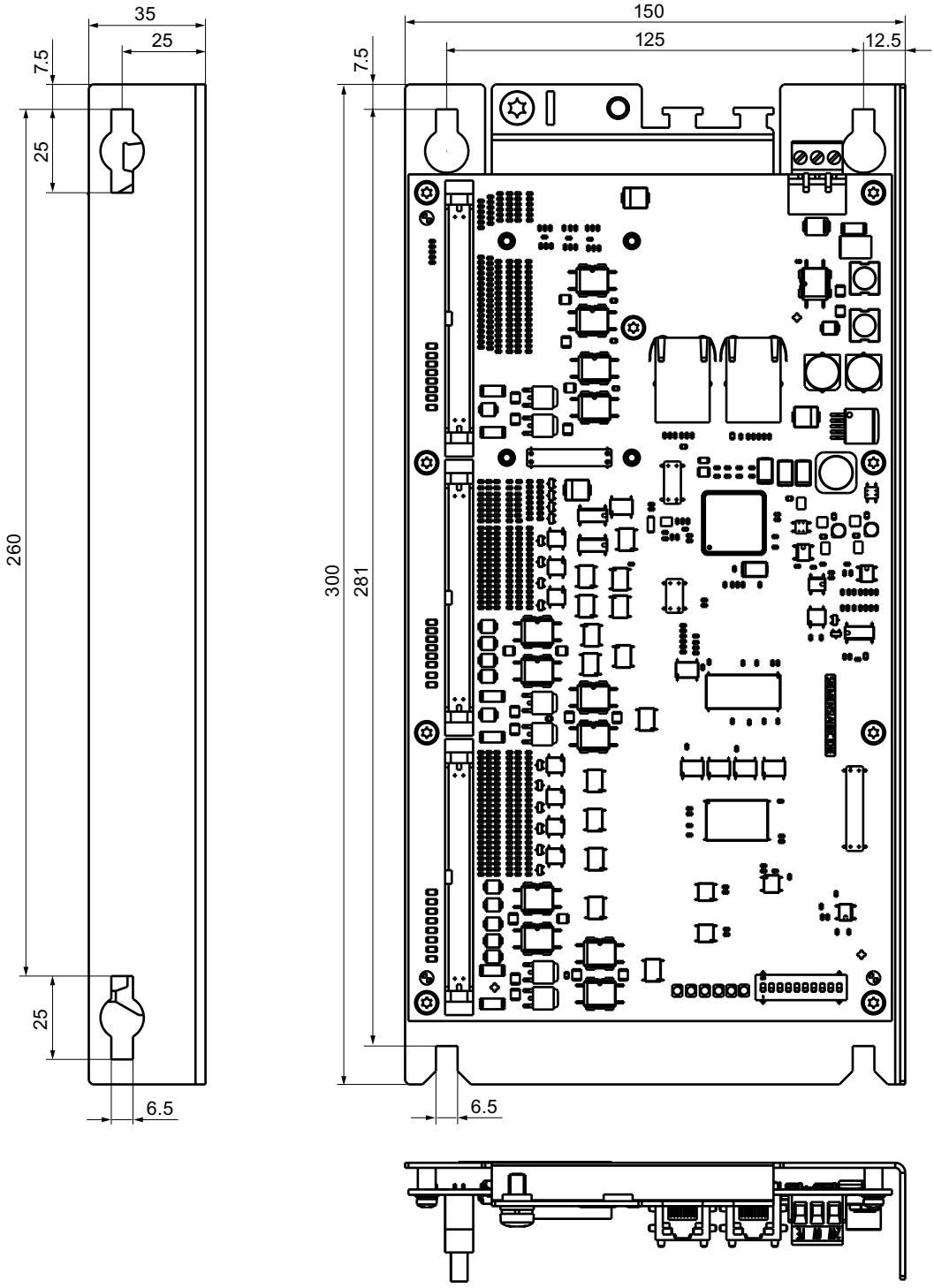


Figure 9-9 PP 72/48D PN dimension drawing

9.2.3 Connecting

9.2.3.1 Interface overview

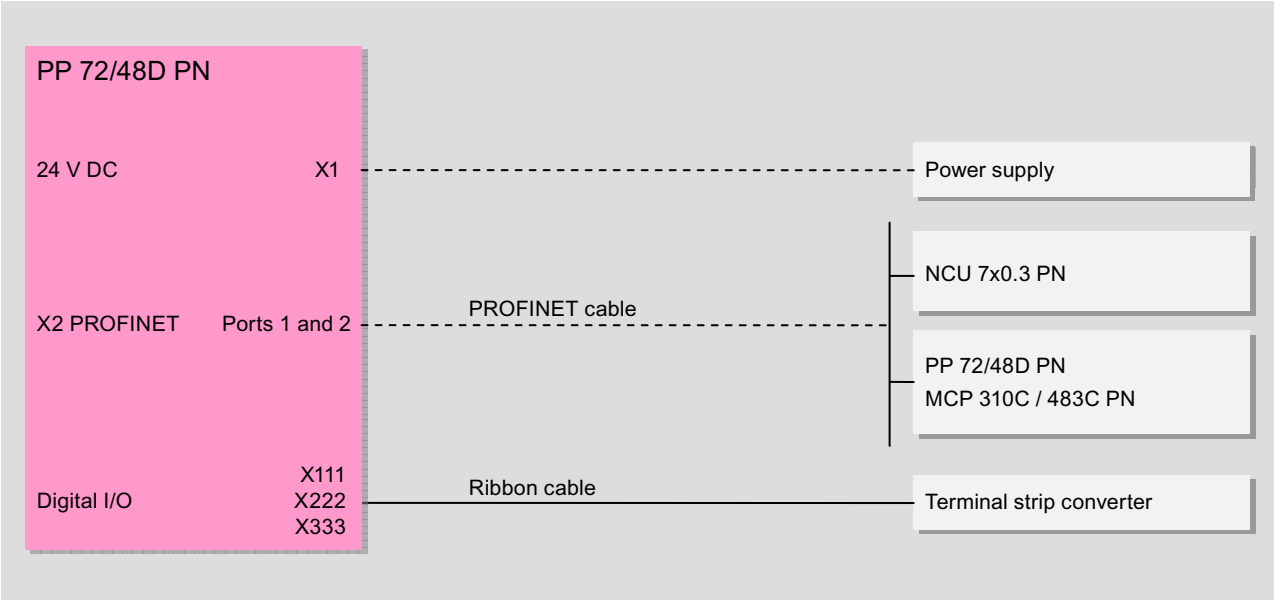


Figure 9-10 I/O module connection options

Table 9-12 PP 72/48D PN I/O module interfaces

Interface	Designation	Type
Power supply connection	X1	Screw-terminal block
PROFINET IO	X2 (ports 1 and 2)	Socket
PROFINET address	S1	DIP switch
Digital input/outputs 1	X111	Ribbon cable connector
Digital input/outputs 2	X222	Ribbon cable connector
Digital input/outputs 3	X333	Ribbon cable connector

9.2.3.2 X1 power supply

Properties

This interface is intended exclusively for the connection of the external 24 V power supply.

On the module side, the power supplies are protected against:

- Polarity reversal
- Short-circuit (elec. current limitation of the outputs)
- Overload (self-restoring PTC fuse - Multifuse)

Requirements placed on the DC power supply

⚠ WARNING

Inadequately fused supply cables can be life-threatening

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 I/O module for EMC and/or functional reasons. For EMC reasons, this connection should only be made at one point; see also EMC Installation Guide.

Table 9-13 Requirements of the DC power supply

Rated voltage	According to EN 61131-2	24 V DC
	Voltage range (average value)	20.4 V DC to 28.8 V DC
	Voltage range (dynamic)	18.5 to 30.2 V DC
	Voltage ripple peak-to-peak	5% (unfiltered 6-pulse rectification)
	Booting time at POWER ON	Any
Non-periodic overvoltages		≤ 35 V
	Duration of overvoltage	≤ 500 ms
	Recovery time	≥ 50 s
	Events per hour	≤ 10
Transient voltage interruptions	Outage time	≤ 3 ms
	Recovery time	≥ 10 s
	Events per hour	≤ 10

Digital inputs

The 24 V supplied at X1 are used to supply the 72 digital inputs.

If the internal supply voltage is not used to supply the digital inputs, this can optionally be replaced by an external power supply (24 V DC). The reference ground of the power supply source must each be connected with X111, X222, X333, pin 1 (GND). X111, X222, X333, pin 2 (P24OUT) then remains open.

Digital outputs

To supply (24 V DC) the digital outputs, an additional external power supply source is required. The power supply is connected to terminals X111, X222 and X333 via pins 47, 48, 49 and 50 (DOCOMx). Ground pins must be connected to a common chassis ground.

Maximum current consumption: 3 x 4 A if all outputs are used simultaneously.

Note

It is the user's responsibility to ensure that the max. current consumption per DOCOMx pin (X111, X222, X333: Pins 47, 48, 49, 50) does not exceed 1 A. The power supply (+24 V DC) for the digital outputs must therefore be connected to all 4 pins per DOCOMx (X111, X222, X333: pins 47, 48, 49, 50).

Wiring the power supply

Table 9-14 Pin assignment at X1 screw-type terminal block

Pin	Signal name	Signal type	Meaning
1	P24	VI	24 V DC power supply
2	M	GND	Ground
3	PE	GND	Protective ground

Current requirement

0.7 A (at 24 V DC) for PP 72/48D PN and digital inputs plus 3 x 4 A at X111, X222 and X333 for supplying digital outputs.

Wiring the screw-type terminal block

The required 24 V DC load power supply is wired to the screw-type terminal block (X1).

⚠ DANGER

Danger of death caused by unsafe power supply

The 24 V direct voltage is to be configured as an extra-low voltage with protective separation - DVC A or PELV according to EN 61800-5-1.

Power cables

Table 9-15 Cable specification at X1

Characteristics	Version
Connection option	Up to 2.5 mm^2
Current carrying capacity	max. 10 A
Max. cable length	10 m

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 according to the maximum current that flows.

If you only use one wire per connection, an end sleeve is not required.

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

9.2.3.3 X2 PROFINET

Data Transmission Rate and Cables

For PROFINET, you require a data transmission rate of 100 Mbit/s (Fast Ethernet). The interfaces are designed for full-duplex mode; in other words, the ports can both transmit and receive. For data transfer purposes you can use electrical twisted copper cables (twisted pair, 4-wire, 100Base-T):

- The transmission characteristics of these cables must meet the requirements of CAT5.
- The maximum length of the connections between the end device and network component or between two network components (e.g. switch ports) must not exceed 100 m.

Pin assignment

Table 9-16 PROFINET interfaces X2, ports 1, 2

Pin	Signal name	Signal type	Meaning
1	TX+	O	Transmit data +
2	TX-	O	Transmit data -
3	RX+	I	Receive data +
4	N.C.	-	Reserved, do not use
5	N.C.	-	Reserved, do not use
6	RX-	I	Receive data -
7	N.C.	-	Reserved, do not use
8	N.C.	-	Reserved, do not use

Cable specification

Table 9-17 Cable specification at X2, ports 1, 2

Characteristic	Version
Connector type	RJ45 socket
Cable type	Industrial Ethernet cable (CAT5)
Max. cable length	100 m

LED displays

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

Table 9-18 PROFINET ports LED displays

Name	Color	Status	Meaning
Link	Green	lit	Transfer rate 100 Mbit/s
		off	No or faulty connection

Name	Color	Status	Meaning
Activity	Orange	lit	Data exchange
		off	No data exchange

PROFINET address (S1)

A logical address can be assigned to the I/O module for communication with PROFINET using a 10-bit DIP switch S1.

Table 9-19 General settings with switch S1

1	2	3	4	5	6	7	8	9	10	Meaning
								on	**on**	PROFINET functionality
on	on	on	on	on	on	on	on			DCP mode

The switch positions 9 and 10 guarantee the PROFINET functionality of the module and must always be switched "on".

DCP mode

In this mode, there is no default device name.
The device name must be set using initialization and remains saved on the I/O module. It is first deleted when the factory setting is restored, e.g. using STEP7.

Default device names

The switch positions 1 to 8 define the default device name of the I/O module.
There are up to 128 default device names. If these default device names are used, there is no need for initialization.

Note

The default device names cannot be reconfigured using the STEP7 "device initialization" facility, for example.
If you are connecting the I/O module to a SINUMERIK controller as a PROFINET component, make sure that this functionality is supported by the controller concerned.

Table 9-20 Default device name with switch S1

1	2	3	4	5	6	7	8	9	10	Default device name
on	**on**	**on**	**on**	**on**	**on**	**on**	**off**			pp72x48pn127
off	**on**	**on**	**on**	**on**	**on**	**on**	**off**			pp72x48pn126
on	**off**	**on**	**on**	**on**	**on**	**on**	**off**			pp72x48pn125
off	**off**	**on**	**on**	**on**	**on**	**on**	**off**			pp72x48pn124
on	**on**	**off**	**on**	**on**	**on**	**on**	**off**			pp72x48pn123
off	**on**	**off**	**on**	**on**	**on**	**on**	**off**			pp72x48pn122
on	**off**	**off**	**on**	**on**	**on**	**on**	**off**			pp72x48pn121
off	**off**	**off**	**on**	**on**	**on**	**on**	**off**			pp72x48pn120

1	2	3	4	5	6	7	8	9	10	Default device name
on	on	on	off	on	on	on	off			pp72x48pn119
off	on	on	off	on	on	on	off			pp72x48pn118
on	off	on	off	on	on	on	off			pp72x48pn117
off	off	on	off	on	on	on	off			pp72x48pn116
on	on	off	off	on	on	on	off			pp72x48pn115
off	on	off	off	on	on	on	off			pp72x48pn114
on	off	off	off	on	on	on	off			pp72x48pn113
off	off	off	off	on	on	on	off			pp72x48pn112
x	x	x	x	x	x	x	x			"
on	on	on	on	off	off	off	off			pp72x48pn15
off	on	on	on	off	off	off	off			pp72x48pn14
on	off	on	on	off	off	off	off			pp72x48pn13
off	off	on	on	off	off	off	off			pp72x48pn12
on	on	off	on	off	off	off	off			pp72x48pn11
off	on	off	on	off	off	off	off			pp72x48pn10
on	off	off	on	off	off	off	off			pp72x48pn9
off	off	off	on	off	off	off	off			pp72x48pn8
on	on	on	off	off	off	off	off			pp72x48pn7
off	on	on	off	off	off	off	off			pp72x48pn6
on	off	on	off	off	off	off	off			pp72x48pn5
off	off	on	off	off	off	off	off			pp72x48pn4
on	on	off	off	off	off	off	off			pp72x48pn3
off	on	off	off	off	off	off	off			pp72x48pn2
on	off	off	off	off	off	off	off			pp72x48pn1
off	off	off	off	off	off	off	off			pp72x48pn

Note

A newly set PROFINET address will only come into effect after power OFF/ON.

9.2.3.4 X111, X222 and X333 digital inputs/outputs

Cable specification

- Connectors: 50-pin ribbon cable connectors
  50-pin insulation displacement connectors with cable grip, ribbon cables and terminal converters
  are required for connecting digital inputs and outputs.
- The required connecting cables (ribbon cables) must be provided by the user.
- Max. cable length: 30 m

Pin assignment

Table 9-21 Pin assignment X111

Pin	Signal name	Type	Pin	Signal name	Type
1	M	GND	2	P24OUT	VO
3	Input 0.0	I	4	Input 0.1	I
5	Input 0.2	I	6	Input 0.3	I
7	Input 0.4	I	8	Input 0.5	I
9	Input 0.6	I	10	Input 0.7	I
11	Input 1.0	I	12	Input 1.1	I
13	Input 1.2	I	14	Input 1.3	I
15	Input 1.4	I	16	Input 1.5	I
17	Input 1.6	I	18	Input 1.7	I
19	Input 2.0	I	20	Input 2.1	I
21	Input 2.2	I	22	Input 2.3	I
23	Input 2.4	I	24	Input 2.5	I
25	Input 2.6	I	26	Input 2.7	I
27	Not assigned	-	28	Not assigned	-
29	Not assigned	-	30	Not assigned	-
31	Output 0.0	O	32	Output 0.1	O
33	Output 0.2	O	34	Output 0.3	O
35	Output 0.4	O	36	Output 0.5	O
37	Output 0.6	O	38	Output 0.7	O
39	Output 1.0	O	40	Output 1.1	O
41	Output 1.2	O	42	Output 1.3	O
43	Output 1.4	O	44	Output 1.5	O
45	Output 1.6	O	46	Output 1.7	O
47	DOCOM1	VI	48	DOCOM1	VI
49	DOCOM1	VI	50	DOCOM1	VI
VI: Voltage input / VO: Voltage output I: Signal input / O: Signal output / GND: Reference potential (ground)					

Table 9-22 Pin assignment for X222

Pin	Signal name	Type	Pin	Signal name	Type
1	M	GND	2	P24OUT	VO
3	Input 3.0	I	4	Input 3.1	I
5	Input 3.2	I	6	Input 3.3	I
7	Input 3.4	I	8	Input 3.5	I
9	Input 3.6	I	10	Input 3.7	I
11	Input 4.0	I	12	Input 4.1	I
13	Input 4.2	I	14	Input 4.3	I
15	Input 4.4	I	16	Input 4.5	I
17	Input 4.6	I	18	Input 4.7	I

Pin	Signal name	Type	Pin	Signal name	Type
19	Input 5.0	I	20	Input 5.1	I
21	Input 5.2	I	22	Input 5.3	I
23	Input 5.4	I	24	Input 5.5	I
25	Input 5.6	I	26	Input 5.7	I
27	Not assigned	-	28	Not assigned	-
29	Not assigned	-	30	Not assigned	-
31	Output 2.0	O	32	Output 2.1	O
33	Output 2.2	O	34	Output 2.3	O
35	Output 2.4	O	36	Output 2.5	O
37	Output 2.6	O	38	Output 2.7	O
39	Output 3.0	O	40	Output 3.1	O
41	Output 3.2	O	42	Output 3.3	O
43	Output 3.4	O	44	Output 3.5	O
45	Output 3.6	O	46	Output 3.7	O
47	DOCOM2	VI	48	DOCOM2	VI
49	DOCOM2	VI	50	DOCOM2	VI
VI: Voltage input / VO: Voltage output I: Signal input / O: Signal output / GND: Reference potential (ground)					

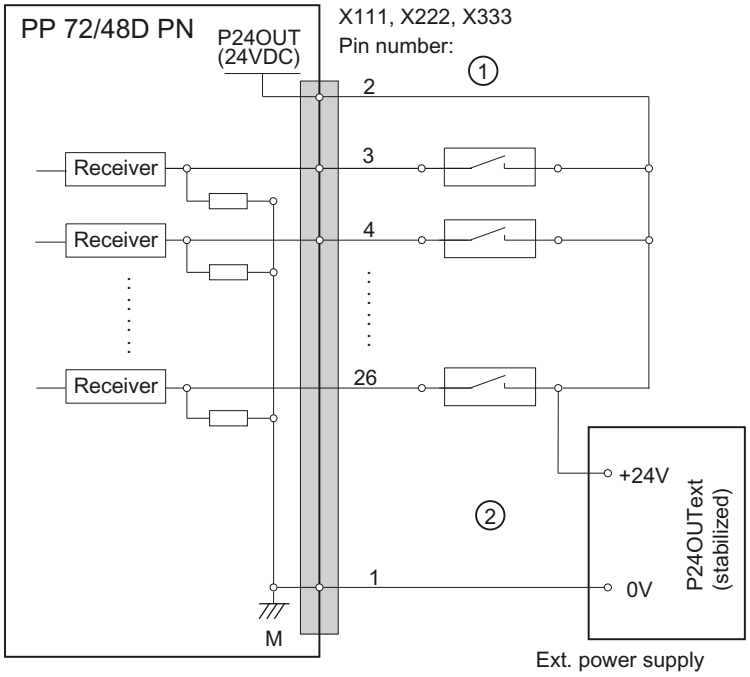
Table 9-23 Pin assignment for X333

Pin	Signal name	Type	Pin	Signal name	Type
1	M	GND	2	P24OUT	VO
3	Input 6.0	I	4	Input 6.1	I
5	Input 6.2	I	6	Input 6.3	I
7	Input 6.4	I	8	Input 6.5	I
9	Input 6.6	I	10	Input 6.7	I
11	Input 7.0	I	12	Input 7.1	I
13	Input 7.2	I	14	Input 7.3	I
15	Input 7.4	I	16	Input 7.5	I
17	Input 7.6	I	18	Input 7.7	I
19	Input 8.0	I	20	Input 8.1	I
21	Input 8.2	I	22	Input 8.3	I
23	Input 8.4	I	24	Input 8.5	I
25	Input 8.6	I	26	Input 8.7	I
27	Not assigned	-	28	Not assigned	-
29	Not assigned	-	30	Not assigned	-
31	Output 4.0	O	32	Output 4.1	O
33	Output 4.2	O	34	Output 4.3	O
35	Output 4.4	O	36	Output 4.5	O
37	Output 4.6	O	38	Output 4.7	O
39	Output 5.0	O	40	Output 5.1	O
41	Output 5.2	O	42	Output 5.3	O

Pin	Signal name	Type	Pin	Signal name	Type
43	Output 5.4	O	44	Output 5.5	O
45	Output 5.6	O	46	Output 5.7	O
47	DOCOM3	VI	48	DOCOM3	VI
49	DOCOM3	VI	50	DOCOM3	VI
VI: Voltage input / VO: Voltage output I: Signal input / O: Signal output / GND: Reference potential (ground)					

Digital inputs

- Characteristics:
  - X222: Inputs 3.0 to 3.7 are connected as rapid inputs; this means the input filter has a max. delay time of 600 µs.
  - The inputs have no signaling (status LEDs).
  - The inputs are not isolated.
  - It is not possible to connect 2-wire BEROs.
- Terminal assignment for the digital inputs:
  The following figure shows an example of the terminal assignment for the digital inputs on connector X111. Connectors X222 and X333 are assigned analogously.



① when using the internal power supply P24OUT

② when using an external power supply $P24OUT_{ext}$

Figure 9-11 Terminal assignment for the digital inputs

- Internal power supply (P24OUT):
  The internal power supply for the digital inputs (X111, X222, X333: Pin 2) is derived from the general power supply of module X1, pin 2 (P24).
- Technical data:

Table 9-24 Electrical specification of the digital inputs:

Digital inputs	min.	max.	Nominal
High-level voltage (U_H)	15 V	30 V	24 V
Input current I_{IN} at V_H	2 mA	15 mA	-
Low-level voltage (U_L)	-3 V	5 V	0 V
Signal delay time T_{PHL}	0.5 ms	3 ms	-

Digital outputs

- Characteristics
  - No galvanic isolation.
  - Protection against: Short-circuit, overtemperature, and loss of ground.
  - Automatic disconnection in case of undervoltage.
- Terminal assignment for the digital outputs:
  The following figure shows an example of the terminal assignment for the digital outputs on connector X111. Connectors X222 and X333 are assigned analogously.

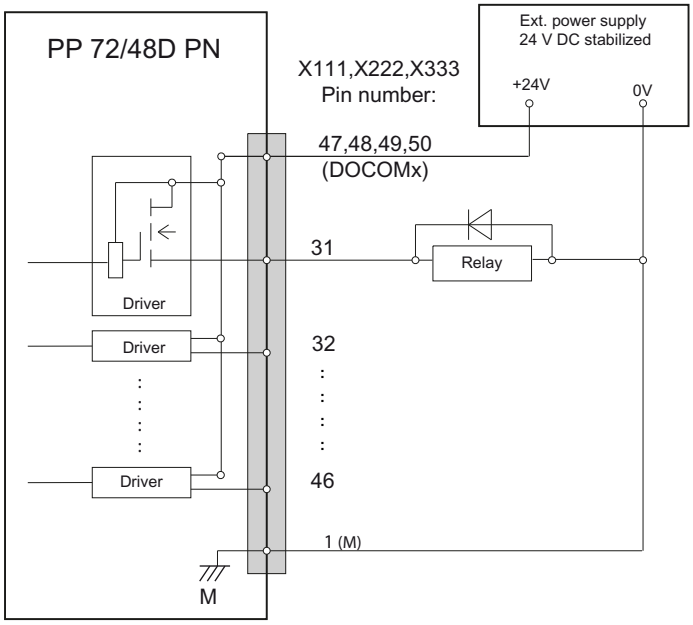


Figure 9-12 Terminal assignment for the digital outputs

NOTICE
Damage to the module If the outputs are overloaded, the heat can melt the contacts. Therefore, for a demand factor of 100%, a max. current of I_{out} = 0.25 A at X111, X222, X333: Pin 2, must not be exceeded.

- Technical data:

Table 9-25 Electrical specification of the digital outputs

Digital outputs	min.	Standard	max.	Nominal
High-level voltage (U_H)	V_{CC} - 3 V	1)	V_{CC}	24 V
Output current I_{OUT}	-	-	250 mA 2)	-
Voltage with low level (U_L)	-	-	-	Output open
Leakage current at low level	-	50 µA	400 µA	-

Digital outputs	min.	Standard	max.	Nominal
Signal delay time T_{PHL}	-	0.5 ms	-	-
Maximum switching frequency				
Resistive load	-	-	100 Hz	-
Inductive load	-	-	2 Hz	-
Lamp	-	-	11 Hz	-

- [1] $U_{H\_typical} = V_{CC} - I_{OUT} \times R_{ON}$
  V_{CC}: Current operating voltage
  I_{OUT}: Output current
  Maximum short-circuit current: 4 A (max. 100 µs, V_{CC} = 24 V)
  R_{ON}: Maximum internal resistance = 0.4 Ω
- [2] Where demand factor is 100% (all outputs active)
- Incorrect connection causes neither high level nor destruction of the outputs.

9.2.4 Parameter assignment

9.2.4.1 Input / output images

Input image

The image comprises 2 slots (n, d ≙ start address):

- Slot 1: Digital inputs (DI)
  - n+0 … n+8 (9 byte)
  - X222.P3 - .P10 are rapid inputs
- Slot 2: Diagnostics: d+0 .. d+1

Table 9-26 Input image of digital inputs for the 1st I/O module (n=0)

Terminal	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
X111	n+0	Pin10 DI 0.7	Pin9 DI 0.6	Pin8 DI 0.5	Pin7 DI 0.4	Pin6 DI 0.3	Pin5 DI 0.2	Pin4 DI 0.1	Pin3 DI 0.0
	n+1	Pin18 DI 1.7	Pin17 DI 1.6	Pin16 DI 1.5	Pin15 DI 1.4	Pin14 DI 1.3	Pin13 DI 1.2	Pin12 DI 1.1	Pin11 DI 1.0
	n+2	Pin26 DI 2.7	Pin25 DI 2.6	Pin24 DI 2.5	Pin23 DI 2.4	Pin22 DI 2.3	Pin21 DI 2.2	Pin20 DI 2.1	Pin19 DI 2.0
X222	n+3	Pin10 DI 3.7	Pin9 DI 3.6	Pin8 DI 3.5	Pin7 DI 3.4	Pin6 DI 3.3	Pin5 DI 3.2	Pin4 DI 3.1	Pin3 DI 3.0
	n+4	Pin18 DI 4.7	Pin17 DI 4.6	Pin16 DI 4.5	Pin15 DI 4.4	Pin14 DI 4.3	Pin13 DI 4.2	Pin12 DI 4.1	Pin11 DI 4.0
	n+5	Pin26 DI 5.7	Pin25 DI 5.6	Pin24 DI 5.5	Pin23 DI 5.4	Pin22 DI 5.3	Pin21 DI 5.2	Pin20 DI 5.1	Pin19 DI 5.0
X333	n+6	Pin10 DI 6.7	Pin9 DI 6.6	Pin8 DI 6.5	Pin7 DI 6.4	Pin6 DI 6.3	Pin5 DI 6.2	Pin4 DI 6.1	Pin3 DI 6.0

Terminal	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	n+7	Pin18 DI 7.7	Pin17 DI 7.6	Pin16 DI 7.5	Pin15 DI 7.4	Pin14 DI 7.3	Pin13 DI 7.2	Pin12 DI 7.1	Pin11 DI 7.0
	n+8	Pin26 DI 8.7	Pin25 DI 8.6	Pin24 DI 8.5	Pin23 DI 8.4	Pin22 DI 8.3	Pin21 DI 8.2	Pin20 DI 8.1	Pin19 DI 8.0

Output image

The image comprises one slot (n ≙ start address):

Digital outputs (DO): n+0 … n+5 (6 byte)

Table 9-27 Output image of digital outputs for the 1st I/O module (n=0)

Terminal	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
X111	n+0	Pin38 DO 0.7	Pin37 DO 0.6	Pin36 DO 0.5	Pin35 DO 0.4	Pin34 DO 0.3	Pin33 DO 0.2	Pin32 DO 0.1	Pin31 DO 0.0
	n+1	Pin46 DO 1.7	Pin45 DO 1.6	Pin44 DO 1.5	Pin43 DO 1.4	Pin42 DO 1.3	Pin41 DO 1.2	Pin40 DO 1.1	Pin39 DO 1.0
X222	n+2	Pin38 DO 2.7	Pin37 DO 2.6	Pin36 DO 2.5	Pin35 DO 2.4	Pin34 DO 2.3	Pin33 DO 2.2	Pin32 DO 2.1	Pin31 DO 2.0
	n+3	Pin46 DO 3.7	Pin45 DO 3.6	Pin44 DO 3.5	Pin43 DO 3.4	Pin42 DO 3.3	Pin41 DO 3.2	Pin40 DO 3.1	Pin39 DO 3.0
X333	n+4	Pin38 DO 4.7	Pin37 DO 4.6	Pin36 DO 4.5	Pin35 DO 4.4	Pin34 DO 4.3	Pin33 DO 4.2	Pin32 DO 4.1	Pin31 DO 4.0
	n+5	Pin46 DO 5.7	Pin45 DO 5.6	Pin44 DO 5.5	Pin43 DO 5.4	Pin42 DO 5.3	Pin41 DO 5.2	Pin40 DO 5.1	Pin39 DO 5.0

9.2.4.2 Diagnostics via input image

Table 9-28 Diagnostics input image

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit3	Bit1	Bit0
d+0	count_2	count_1	count_0	T_Alarm_2	T_Alarm_1	Diag_2	Diag_1	Diag_0
d+1	Status_1							

Table 9-29 Messages in byte 0

Bit	Signal name	Message
7	count_2	alive and well 2
6	count_1	alive and well 1
5	count_0	alive and well 0
4	T_Alarm_2	Temperature not within the operating temperature range defined for the module
3	T_Alarm_1	Critical temperature exceeded
2	Diag_2	Overload DO byte 5/4

Bit	Signal name	Message
1	Diag_1	Overload DO byte 3/2
0	Diag_0	Overload DO byte 1/0

Note

The "alive and well" counter is a 3 bit modulo counter at the PP application level. The PP application can be monitored using this counter. Failure of the application software does not generally result in a communication failure, as this is developed in a hardware-supported manner. The watch dog switches off the digital outputs, while the inputs remain at their last set values.

Table 9-30 Messages in byte 1, depending on the "alive and well" counter

"alive and well" counter	Value byte 1	Message
0	0	Reserved
1		Temperature value
2	5	Internal error, system error Effect: The "PNFault" LED is activated. The outputs are disabled. The value 0x80 is stored in status byte 1. Remedy: Switch the module off and on again.
3 ... 7	0	Reserved

9.2.5 Technical data

Table 9-31 Technical data of the I/O module

Safety	
Degree of protection	IP 00 according to EN 60529
Protection class	III; DVC A, (PELV) acc. to EN 61800-5-1
Approvals	cULus, CE
Power consumption at rated load (without digital outputs)	
PP 72/48D PN	17 W
PP 72/48D 2/2A PN	19 W
Mechanical data	
Dimensions WxHxD	150 x 300 x 35 mm
Weight, approx.	0.9 kg

9.3 PP 72/48D 2/2A PN

9.3.1 Description

Characteristics

The I/O module is a simple module (without a separate enclosure) for connecting digital and analog input/outputs as part of an automation system based on PROFINET IO.

The module has the following important features:

- 72 digital inputs and 48 digital outputs
- 2 analog inputs and 2 analog outputs
  Analog process signals such as for detecting temperatures or controlling hydraulic workholders can be implemented via analog inputs/outputs.
- PROFINET IO connection (max. 100 Mbits/s)
- On-board status display via 6 LEDs
- The 3 plug-in connectors for the digital inputs and outputs are 50-pin terminal posts for connecting ribbon cables.
- Terminal strip converters can be used, or the direct connection of distribution boards, for example, is possible.
- Analog signal cables can be connected directly to terminal contacts on the module.

An external power supply unit (24 V DC) is required to supply the module and the digital outputs.

Illustration

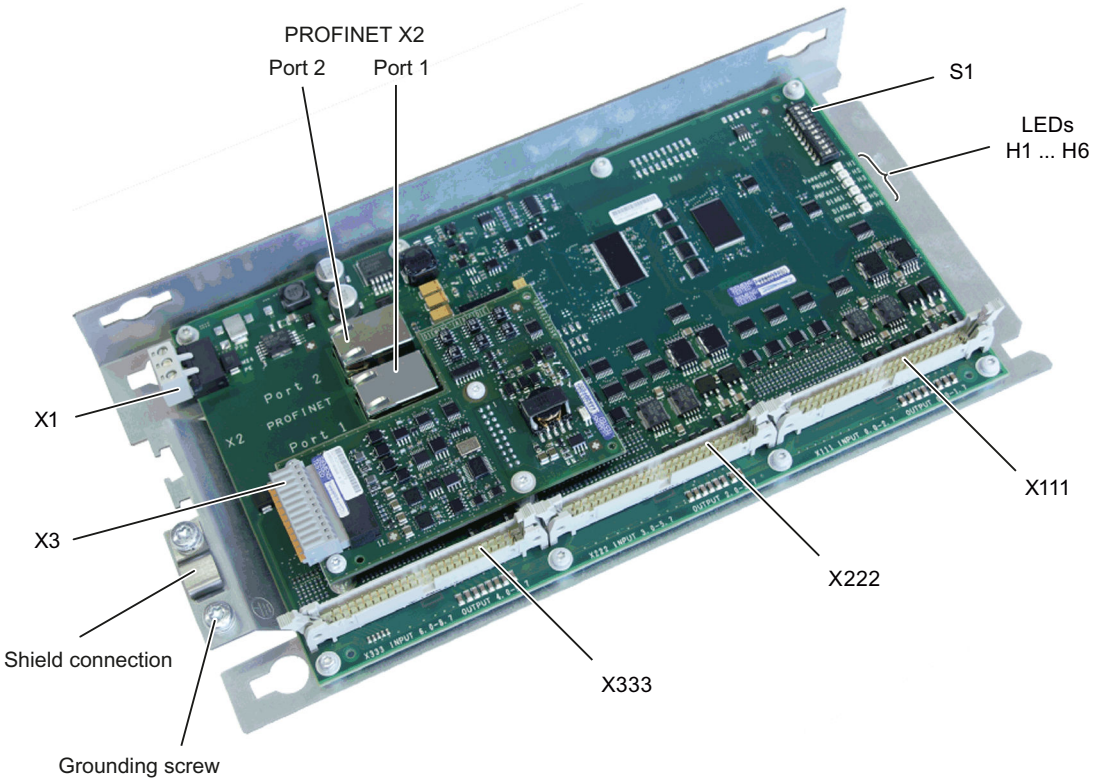


Figure 9-13 PP 72/48D 2/2A PN I/O module

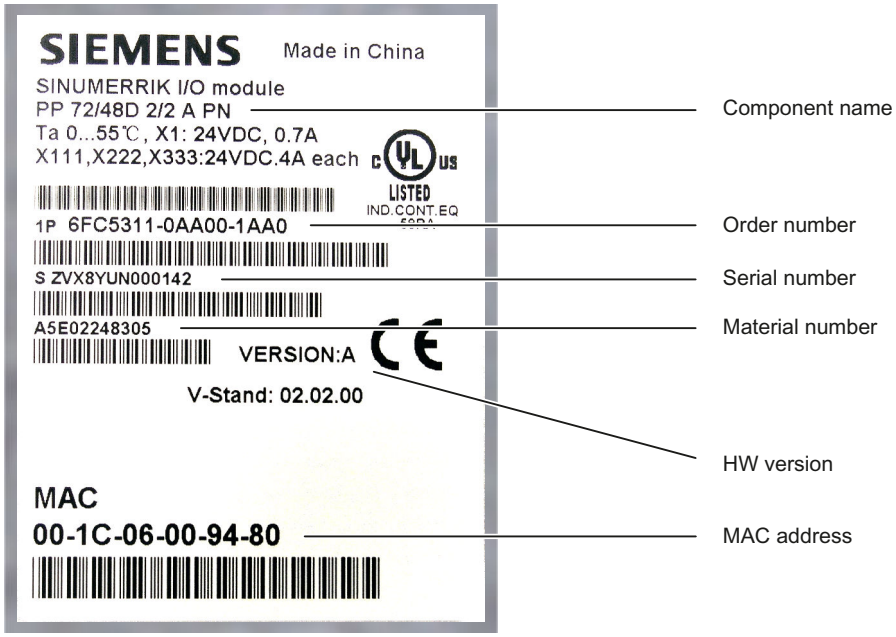


Figure 9-14 PP 72/48D 2/2A PN type plate

Note

The type plate is located on the rear side of the mounting plate. It is advisable to make a note of relevant data as it is no longer visible after installation.

LED displays

Each PROFINET port has two integrated LEDs displaying the link status (green) and activity (orange); see chapter Application (Page 58).

The PP 72/48D 2/2A PN has the following LEDs, which provide information on the module status.

Table 9-32 LEDs: Status display

Name	Designation	Color	Description
H1	PowerOK	Green	Lit: Power supply ok
			Not lit: As soon as one of the generated logic voltages falls below its setpoint, a reset is triggered and the PowerOK LED goes out.
H2	PNSync	Green	Lit: Task system is synchronized to the bus cycle clock.
			Not lit: Task system is not synchronized to the bus cycle clock.
			Flashes 0.5 Hz: Task system has synchronized to the bus cycle clock and cyclic data exchange is running.
H3	PNFault	Red	Not lit: Module is operating without error.
			Lit: A system error has occurred (faulty module, incorrect parameterization by the PROFINET controller, etc.).
H4	DIAG1	Green	Reserved
H5	DIAG2	Green	Reserved
H6	OVTemp	Red	Overtemperature display

Note

When the system is booting, LEDs H1, H2 and H3 are lit.

9.3.2 Dimension drawing

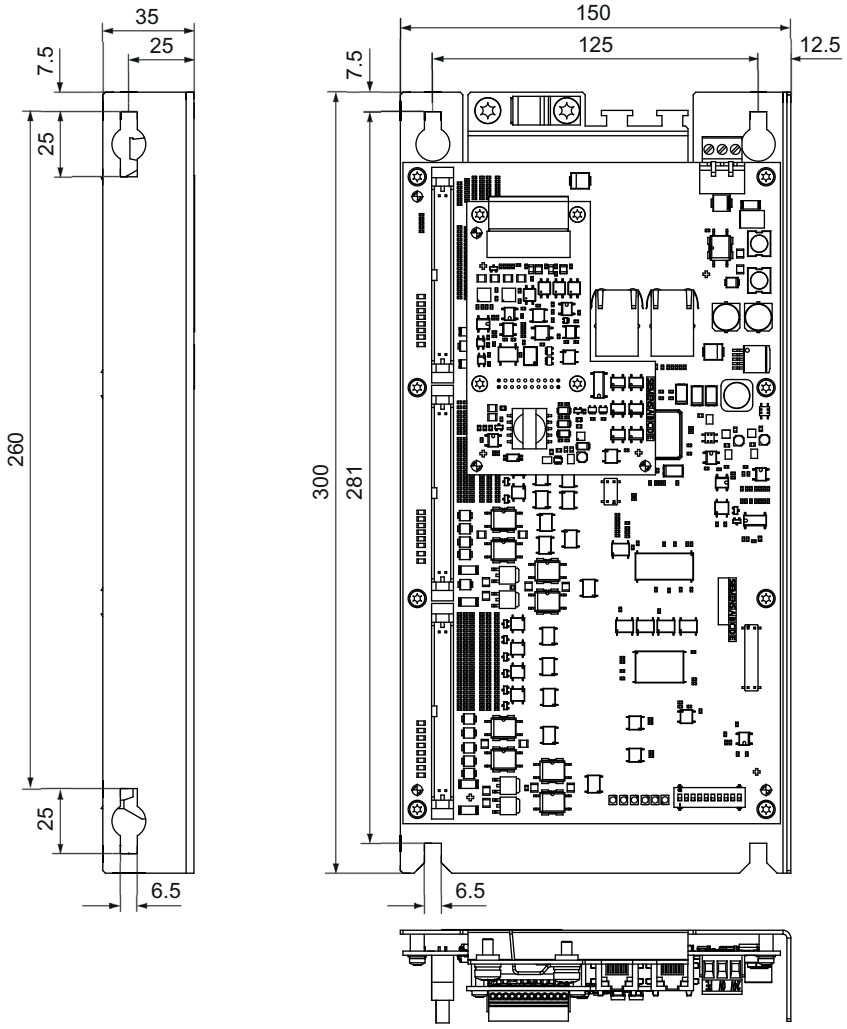


Figure 9-15 PP 72/48D 2/2A PN dimension drawing

9.3.3 Mounting

The PP 72/48D 2/2A PN I/O module is mounted just the same as the PP 72/48D PN, see Mounting (Page 97).

9.3.4 Connection

9.3.4.1 Interface overview

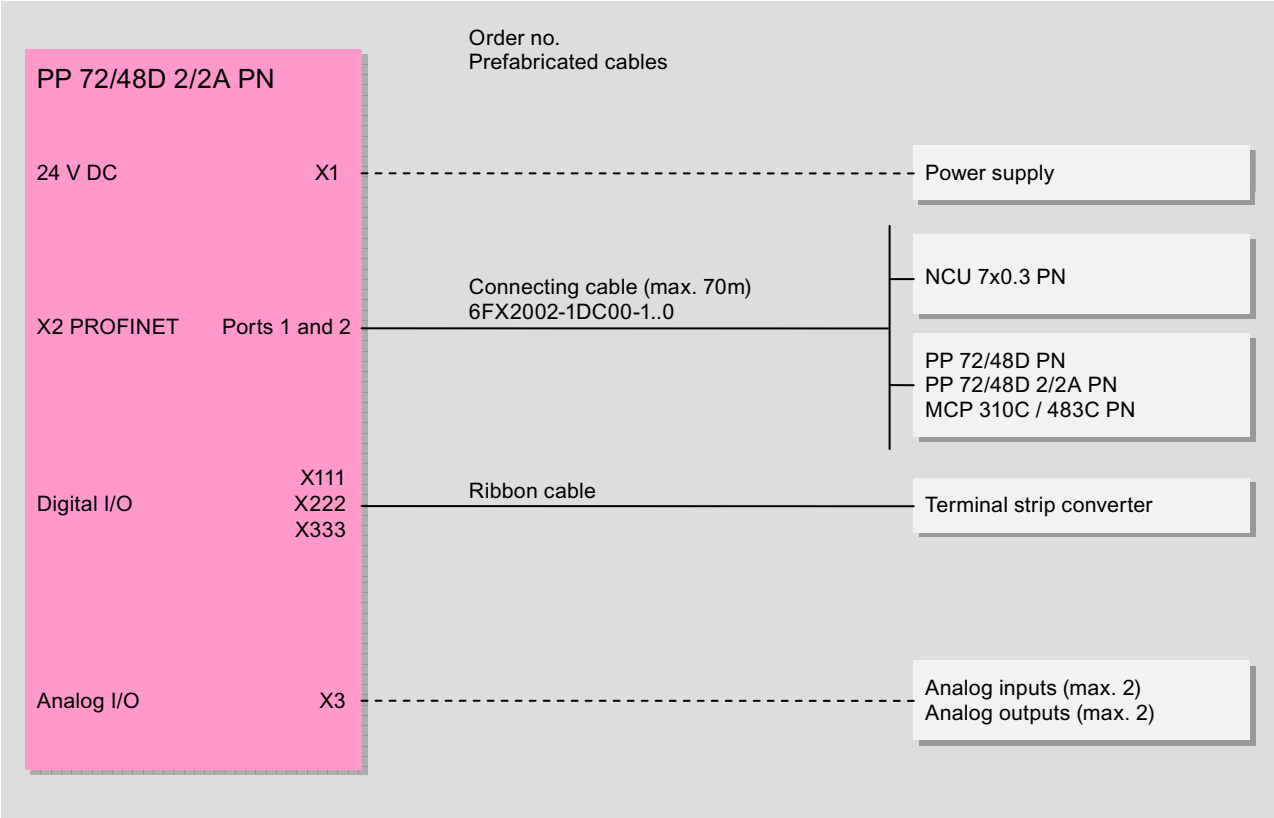


Figure 9-16 Connection options of the PP 72/48D 2/2A PN I/O module

Interface overview

Table 9-33 Interfaces of the PP 72/48D 2/2A PN I/O module

Interface	Designation	Type
Power supply connection	X1	Screw-terminal block
PROFINET IO	X2 (ports 1 and 2)	Socket
Analog inputs/outputs	X3	Terminal block
PROFINET address	S1	DIP switch
Digital input/outputs 1	X111	Ribbon cable connector
Digital input/outputs 2	X222	Ribbon cable connector
Digital input/outputs 3	X333	Ribbon cable connector

The following abbreviations are used:

Signal type	Meaning
I	Input
O	Output
B	Bidirectional
V	Supply voltage
GND	Protective ground (reference potential)

Note

Digital and analog signals must not be laid together within a cable.

9.3.4.2 X1 power supply

Properties

This interface is intended exclusively for the connection of the external 24 V power supply.

On the module side, the power supplies are protected against:

- Polarity reversal
- Short-circuit (elec. current limitation of the outputs)
- Overload (self-restoring PTC fuse - Multifuse)

Requirements placed on the DC power supply

⚠ WARNING

Inadequately fused supply cables can be life-threatening

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 I/O module for EMC and/or functional reasons. For EMC reasons, this connection should only be made at one point; see also EMC Installation Guide.

Table 9-34 Requirements of the DC power supply

Rated voltage	According to EN 61131-2	24 V DC
	Voltage range (average value)	20.4 V DC to 28.8 V DC
	Voltage range (dynamic)	18.5 to 30.2 V DC
	Voltage ripple peak-to-peak	5% (unfiltered 6-pulse rectification)
	Booting time at POWER ON	Any
Non-periodic overvoltages		≤ 35 V
	Duration of overvoltage	≤ 500 ms

	Recovery time	≥ 50 s
	Events per hour	≤ 10
Transient voltage interruptions	Outage time	≤ 3 ms
	Recovery time	≥ 10 s
	Events per hour	≤ 10

Digital inputs

The 24 V supplied at X1 are used to supply the 72 digital inputs.

If the internal supply voltage is not used to supply the digital inputs, this can optionally be replaced by an external power supply (24 V DC). The reference ground of the power supply source must each be connected with X111, X222, X333, pin 1 (GND). X111, X222, X333, pin 2 (P24OUT) then remains open.

Digital outputs

To supply (24 V DC) the digital outputs, an additional external power supply source is required. The power supply is connected to terminals X111, X222 and X333 via pins 47, 48, 49 and 50 (DOCOMx). Ground pins must be connected to a common chassis ground.

Maximum current consumption: 3 x 4 A if all outputs are used simultaneously.

Note

It is the user's responsibility to ensure that the max. current consumption per DOCOMx pin (X111, X222, X333: Pins 47, 48, 49, 50) does not exceed 1 A. The power supply (+24 V DC) for the digital outputs must therefore be connected to all 4 pins per DOCOMx (X111, X222, X333: pins 47, 48, 49, 50).

Analog inputs/outputs

The inputs and outputs are supplied with power on-board, i.e. no further external power supply units are required.

Wiring the power supply

Table 9-35 Pin assignment at X1 screw-type terminal block

Pin	Signal name	Signal type	Meaning
1	P24	VI	24 V DC power supply
2	M	GND	Ground
3	PE	GND	Protective ground

Current requirement

0.7 A (at 24 V DC) for PP 72/48D 2/2A PN and digital inputs plus 3 x 4 A at X111, X222 and X333 for supplying digital outputs.

Wiring the screw-type terminal block

The required 24 V DC load power supply is wired to the screw-type terminal block (X1).

⚠ DANGER
Danger of death caused by unsafe power supply The 24 V direct voltage is to be configured as an extra-low voltage with protective separation - DVC A or PELV according to EN 61800-5-1.

Power cables

Table 9-36 Cable specification at X1

Characteristics	Version
Connection option	Up to 2.5 mm^2
Current carrying capacity	max. 10 A
Max. cable length	10 m

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 according to the maximum current that flows.

If you only use one wire per connection, an end sleeve is not required.

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

9.3.4.3 X2 PROFINET

Data Transmission Rate and Cables

For PROFINET, you require a data transmission rate of 100 Mbit/s (Fast Ethernet). The interfaces are designed for full-duplex mode; in other words, the ports can both transmit and receive. For data transfer purposes you can use electrical twisted copper cables (twisted pair, 4-wire, 100Base-T):

- The transmission characteristics of these cables must meet the requirements of CAT5.
- The maximum length of the connections between the end device and network component or between two network components (e.g. switch ports) must not exceed 100 m.

Pin assignment

Table 9-37 PROFINET interfaces X2, ports 1, 2

Pin	Signal name	Signal type	Meaning
1	TX+	O	Transmit data +
2	TX-	O	Transmit data -
3	RX+	I	Receive data +
4	N.C.	-	Reserved, do not use

Pin	Signal name	Signal type	Meaning
5	N.C.	-	Reserved, do not use
6	RX-	I	Receive data -
7	N.C.	-	Reserved, do not use
8	N.C.	-	Reserved, do not use

Cable specification

Table 9-38 Cable specification at X2, ports 1, 2

Characteristic	Version
Connector type	RJ45 socket
Cable type	Industrial Ethernet cable (CAT5)
Max. cable length	100 m

LED displays

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

Table 9-39 PROFINET ports LED displays

Name	Color	Status	Meaning
Link	Green	lit	Transfer rate 100 Mbit/s
		off	No or faulty connection
Activity	Orange	lit	Data exchange
		off	No data exchange

PROFINET address (S1)

A logical address can be assigned to the I/O module for communication with PROFINET using a 10-bit DIP switch S1.

Table 9-40 General settings with switch S1

1	2	3	4	5	6	7	8	9	10	Meaning
								on	on	PROFINET functionality
on	on	on	on	on	on	on	on			DCP mode

The switch positions 9 and 10 guarantee the PROFINET functionality of the module and must always be switched "on".

DCP mode

In this mode, there is no default device name.
The device name must be set using initialization and remains saved on the I/O module. It is first deleted when the factory setting is restored, e.g. using STEP7.

Default device names

The switch positions 1 to 8 define the default device name of the I/O module.
There are up to 128 default device names. If these default device names are used, there is no need for initialization.

Note

The default device names cannot be reconfigured using the STEP7 "device initialization" facility, for example.
If you are connecting the I/O module to a SINUMERIK controller as a PROFINET component, make sure that this functionality is supported by the controller concerned.

Table 9-41 Default device name with switch S1

1	2	3	4	5	6	7	8	9	10	Default device name
on	on	on	on	on	on	on	off			pp72x48pn127
off	on	on	on	on	on	on	off			pp72x48pn126
on	off	on	on	on	on	on	off			pp72x48pn125
off	off	on	on	on	on	on	off			pp72x48pn124
on	on	off	on	on	on	on	off			pp72x48pn123
off	on	off	on	on	on	on	off			pp72x48pn122
on	off	off	on	on	on	on	off			pp72x48pn121
off	off	off	on	on	on	on	off			pp72x48pn120
on	on	on	off	on	on	on	off			pp72x48pn119
off	on	on	off	on	on	on	off			pp72x48pn118
on	off	on	off	on	on	on	off			pp72x48pn117
off	off	on	off	on	on	on	off			pp72x48pn116
on	on	off	off	on	on	on	off			pp72x48pn115
off	on	off	off	on	on	on	off			pp72x48pn114
on	off	off	off	on	on	on	off			pp72x48pn113
off	off	off	off	on	on	on	off			pp72x48pn112
x	x	x	x	x	x	x	x			"
on	on	on	on	off	off	off	off			pp72x48pn15
off	on	on	on	off	off	off	off			pp72x48pn14
on	off	on	on	off	off	off	off			pp72x48pn13
off	off	on	on	off	off	off	off			pp72x48pn12
on	on	off	on	off	off	off	off			pp72x48pn11
off	on	off	on	off	off	off	off			pp72x48pn10
on	off	off	on	off	off	off	off			pp72x48pn9
off	off	off	on	off	off	off	off			pp72x48pn8
on	on	on	off	off	off	off	off			pp72x48pn7
off	on	on	off	off	off	off	off			pp72x48pn6

1	2	3	4	5	6	7	8	9	10	Default device name
on	off	on	off	off	off	off	off			pp72x48pn5
off	off	on	off	off	off	off	off			pp72x48pn4
on	on	off	off	off	off	off	off			pp72x48pn3
off	on	off	off	off	off	off	off			pp72x48pn2
on	off	off	off	off	off	off	off			pp72x48pn1
off	off	off	off	off	off	off	off			pp72x48pn

Note

A newly set PROFINET address will only come into effect after power OFF/ON.

9.3.4.4 X111, X222 and X333 digital inputs/outputs

Cable specification

- Connectors: 50-pin ribbon cable connectors
  50-pin insulation displacement connectors with cable grip, ribbon cables and terminal converters
  are required for connecting digital inputs and outputs.
- The required connecting cables (ribbon cables) must be provided by the user.
- Max. cable length: 30 m

Pin assignment

Table 9-42 Pin assignment X111

Pin	Signal name	Type	Pin	Signal name	Type
1	M	GND	2	P24OUT	VO
3	DI 0.0	I	4	DI 0.1	I
5	DI 0.2	I	6	DI 0.3	I
7	DI 0.4	I	8	DI 0.5	I
9	DI 0.6	I	10	DI 0.7	I
11	DI 1.0	I	12	DI 1.1	I
13	DI 1.2	I	14	DI 1.3	I
15	DI 1.4	I	16	DI 1.5	I
17	DI 1.6	I	18	DI 1.7	I
19	DI 2.0	I	20	DI 2.1	I
21	DI 2.2	I	22	DI 2.3	I
23	DI 2.4	I	24	DI 2.5	I
25	DI 2.6	I	26	DI 2.7	I
27	Not assigned	-	28	Not assigned	-
29	Not assigned	-	30	Not assigned	-

Pin	Signal name	Type	Pin	Signal name	Type
31	DO 0.0	O	32	DO 0.1	O
33	DO 0.2	O	34	DO 0.3	O
35	DO 0.4	O	36	DO 0.5	O
37	DO 0.6	O	38	DO 0.7	O
39	DO 1.0	O	40	DO 1.1	O
41	DO 1.2	O	42	DO 1.3	O
43	DO 1.4	O	44	DO 1.5	O
45	DO 1.6	O	46	DO 1.7	O
47	DOCOM1	VI	48	DOCOM1	VI
49	DOCOM1	VI	50	DOCOM1	VI
VI: Voltage Input / VO: Voltage Output I: Signal Input / O: Signal Output / GND: Reference potential (ground)					

Table 9-43 Pin assignment for X222

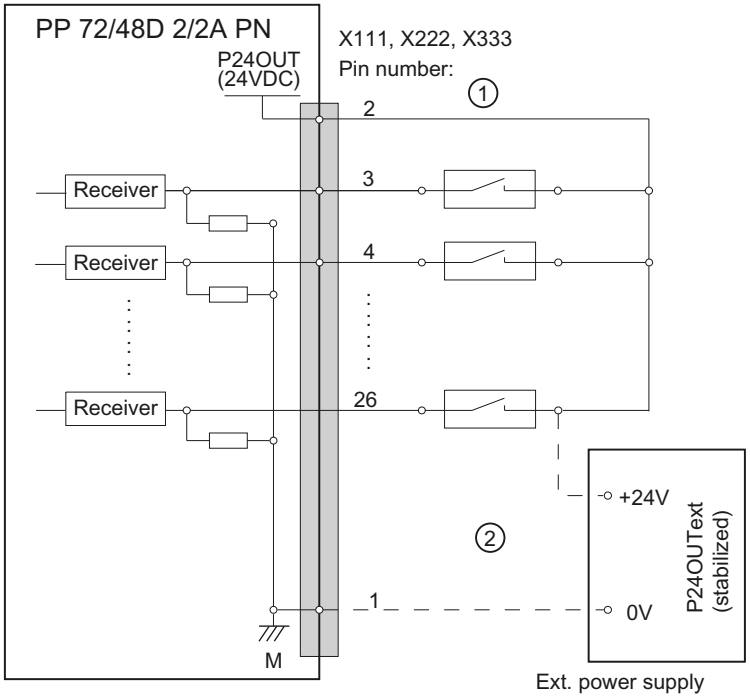
Pin	Signal name	Type	Pin	Signal name	Type
1	M	GND	2	P24OUT	VO
3	DI 3.0	I	4	DI 3.1	I
5	DI 3.2	I	6	DI 3.3	I
7	DI 3.4	I	8	DI 3.5	I
9	DI 3.6	I	10	DI 3.7	I
11	DI 4.0	I	12	DI 4.1	I
13	DI 4.2	I	14	DI 4.3	I
15	DI 4.4	I	16	DI 4.5	I
17	DI 4.6	I	18	DI 4.7	I
19	DI 5.0	I	20	DI 5.1	I
21	DI 5.2	I	22	DI 5.3	I
23	DI 5.4	I	24	DI 5.5	I
25	DI 5.6	I	26	DI 5.7	I
27	Not assigned	-	28	Not assigned	-
29	Not assigned	-	30	Not assigned	-
31	DO 2.0	O	32	DO 2.1	O
33	DO 2.2	O	34	DO 2.3	O
35	DO 2.4	O	36	DO 2.5	O
37	DO 2.6	O	38	DO 2.7	O
39	DO 3.0	O	40	DO 3.1	O
41	DO 3.2	O	42	DO 3.3	O
43	DO 3.4	O	44	DO 3.5	O
45	DO 3.6	O	46	DO 3.7	O
47	DOCOM2	VI	48	DOCOM2	VI
49	DOCOM2	VI	50	DOCOM2	VI
VI: Voltage Input / VO: Voltage Output I: Signal Input / O: Signal Output / GND: Reference potential (ground)					

Table 9-44 Pin assignment for X333

Pin	Signal name	Type	Pin	Signal name	Type
1	M	GND	2	P24OUT	VO
3	DI 6.0	I	4	DI 6.1	I
5	DI 6.2	I	6	DI 6.3	I
7	DI 6.4	I	8	DI 6.5	I
9	DI 6.6	I	10	DI 6.7	I
11	DI 7.0	I	12	DI 7.1	I
13	DI 7.2	I	14	DI 7.3	I
15	DI 7.4	I	16	DI 7.5	I
17	DI 7.6	I	18	DI 7.7	I
19	DI 8.0	I	20	DI 8.1	I
21	DI 8.2	I	22	DI 8.3	I
23	DI 8.4	I	24	DI 8.5	I
25	DI 8.6	I	26	DI 8.7	I
27	Not assigned	-	28	Not assigned	-
29	Not assigned	-	30	Not assigned	-
31	DO 4.0	O	32	DO 4.1	O
33	DO 4.2	O	34	DO 4.3	O
35	DO 4.4	O	36	DO 4.5	O
37	DO 4.6	O	38	DO 4.7	O
39	DO 5.0	O	40	DO 5.1	O
41	DO 5.2	O	42	DO 5.3	O
43	DO 5.4	O	44	DO 5.5	O
45	DO 5.6	O	46	DO 5.7	O
47	DOCOM3	VI	48	DOCOM3	VI
49	DOCOM3	VI	50	DOCOM3	VI
VI: Voltage Input / VO: Voltage Output I: Signal Input / O: Signal Output / GND: Reference potential (ground)					

Digital inputs

- Characteristics:
  - X222: DI 3.0 to 3.7 are connected as rapid inputs.
  - The inputs have no signaling (status LEDs).
  - The inputs are not isolated.
  - It is not possible to connect 2-wire BEROs.
- Terminal assignment for the digital inputs:
  The following figure shows an example of the terminal assignment for the digital inputs on connector X111. Connectors X222 and X333 are assigned analogously.



① when using the internal power supply P24OUT

② when using the external power supply $P24OUT_{ext}$

Figure 9-17 Terminal assignment for the digital inputs

- Power supply for digital inputs (X111, X222, X333: Pin 2)
  - The internal power supply (P24OUT) is taken from the general power supply of module X1, pin 2 (P24).
  - Alternatively, an external power supply can be connected if the load at the digital outputs becomes too high.
- Technical data:

Table 9-45 Electrical specification of the digital inputs:

Digital inputs	min.	max.	Nominal
High-level voltage (U_H)	15 V	30 V	24 V
Input current I_{IN} at V_H	2 mA	15 mA	-
Low-level voltage (U_L)	-3 V	5 V	0 V
Signal delay time T_{PHL}	0.5 ms	3 ms	-
Signal delay time T_{PHL} rapid inputs (X222: DI 3.0 to 3.7)	-	-	600 µs

Digital outputs

- Characteristics
  - No galvanic isolation.
  - Protection against: Short-circuit, overtemperature, and loss of ground.
  - Automatic disconnection in case of undervoltage.
- Terminal assignment for the digital outputs:
  The following figure shows an example of the terminal assignment for the digital outputs on connector X111. Connectors X222 and X333 are assigned analogously.

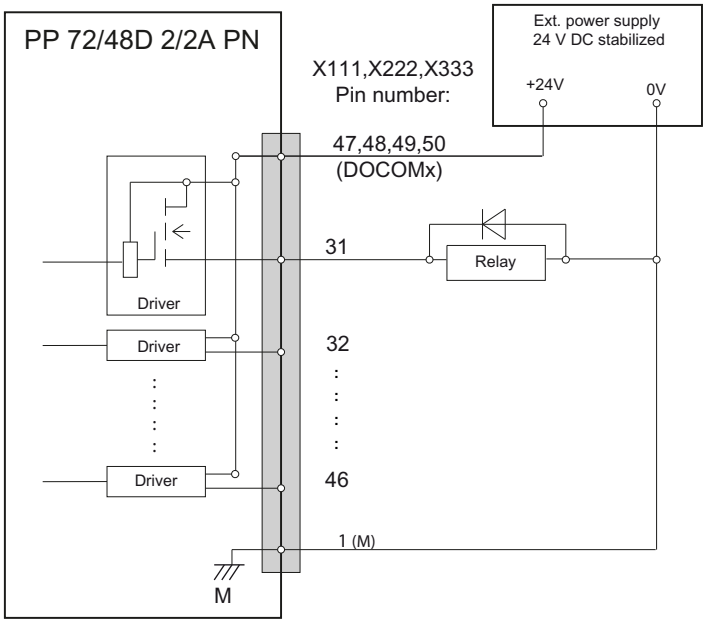


Figure 9-18 Terminal assignment for the digital outputs

NOTICE

Damage to the module

If the outputs are overloaded, the heat can melt the contacts.

Therefore, for a demand factor of 100%, a max. current of I_{out} = 0.25 A at X111, X222, X333: Pin 2, must not be exceeded.

- Technical data:

Table 9-46 Electrical specification of the digital outputs

Digital outputs	min.	Standard	max.	nominal
High-level voltage (U_H)	V_{CC} - 3 V	1)	V_{CC}	24 V
Output current I_{OUT}	-	-	250 mA 2)	-
Voltage with low level (U_L)	-	-	-	Output open
Leakage current at low level	-	50 µA	400 µA	-
Signal delay time T_{PHL}	-	0.5 ms	-	-

Digital outputs	min.	Standard	max.	nominal
Maximum switching frequency				
Resistive load	-	-	100 Hz	-
Inductive load	-	-	2 Hz	-
Lamp	-	-	11 Hz	-

- [1] $U_{H\_typical} = V_{CC} - I_{OUT} \times R_{ON}$
  V_{CC}: Current operating voltage
  I_{OUT}: Output current
  Maximum short-circuit current: 4 A (max. 100 µs, V_{CC} = 24 V)
  R_{ON}: Maximum internal resistance = 0.4 Ω
- [2] Where demand factor is 100% (all outputs active)
- Incorrect connection causes neither high level nor destruction of the outputs.

9.3.4.5 Analog X3 inputs/outputs

Cable specification

- Connectors: 12-pin socket/plug combination
- Cable: shielded
  - max. cable length: 30 m
  - max. connectable core cross-section: 0.5 mm²

Wiring analog inputs/outputs

NOTICE

Shield support

If the analog inputs/outputs are wired, a shielded lead must be used. The shield must be supported.

Procedure:

1. Strip cable for analog signals.
2. Secure the stripped connection piece of the cable with the shield connection clamp.

X3 pin assignment

Table 9-47 Pin assignment (standard)

Pin	Signal name	Signal type	Meaning
1	CO1	O	Channel 1 current output for PT100
2	CI1	I	Channel 1 current input for PT100
3	AI1+	I	Channel 1 analog input +
4	AI1-	I	Channel 1 analog input -

Pin	Signal name	Signal type	Meaning
5	CO2	O	Channel 2 current output for PT10
6	CI2	I	Channel 2 current input for PT100
7	AI2+	I	Channel 2 analog input +
8	AI2-	I	Channel 2 analog input -
9	AO3+	O	Channel 3 current and voltage output +
10	AO3-	O	Channel 3 current and voltage output -
11	AO4+	O	Channel 4 current and voltage output +
12	AO4-	O	Channel 4 current and voltage output -

The analog signal to be measured is connected to the terminals AI 1+/- and AI 2+/-. AI stands for "Analog Input". The CO "Current Output" and CI "Current Input" terminals supply the constant current for the 4-wire measurement of PT100 elements.

Analog inputs

The module has two analog inputs. These can optionally be assigned parameters as voltage, current or PT100 input.

Note

The analog inputs are only enabled following the parameter assignment.

Cycle time of the analog value accumulation: 20 ms per channel

Table 9-48 Technical specifications in the "voltage input" operating mode

Parameter	Value
Input range (rated value)	- 10 V to + 10 V
permitted overrange	- 11.75 V to + 11.75 V
Resolution	16 bits (including sign)
Accuracy	+/- 0,5 %
Internal resistance Ri	100 KOhm

Table 9-49 Technical specifications in the "current input" operating mode

Parameter	Value
Input range (rated value)	- 20 mA to + 20 mA
Permitted overrange	- 23.5 mA to + 23.5 mA
Resolution	16 bits (including sign)
Accuracy	+/- 0,5 %
Internal resistance Ri	133 ohm

Table 9-50 Technical data in the "PT100" operating mode

Parameter	Value
Input range (rated value)	- 200 °C to + 259 °C
Standard	EN60751
Resolution	16 bits (including sign)
Accuracy	+/- 2 °C
Internal resistance Ri	>> 10 kOhm

Note

If the PT100 operating mode is selected, the hardware is protected against overvoltage.

In the event of an error the following occurs:

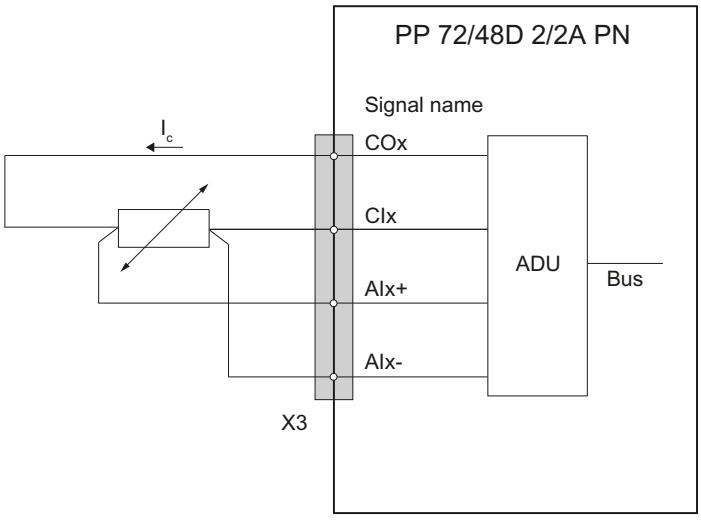
1. An error bit is set which is then communicated to the PLC.
2. The module is shut down.

Measurement using a 4-wire connection system

Notes regarding the connection and operation of PT100 resistors:

This enables the module to supply X3 with a constant current via the CO1, CI1, CO2 and CI2 terminals. The constant current is fed to the resistor to be measured where it is then measured as the voltage drop. It is imperative to wire the connected constant current cables directly to the resistor.

Measurements with 4-wire connections compensate for line resistances and return a considerably higher degree of precision in comparison with 2-wire connections.



x 1, 2

ADU Analog Digital Unit

I_c Constant current

Figure 9-19 PT100 pin assignment

Measurement using a 3-wire connection system

The following pins must be jumpered at connector X3 in order to perform the measurement in the PT100 using a 3-wire connection system:

- Temperature measurement with channel 1:
  Short-circuit pin 2 (CI 1) and pin 4 (AI 1-) and connect the jumper at connector X3
- Temperature measurement with channel 2:
  Short-circuit pin 6 (CI 2) and pin 8 (AI 2-) and connect the jumper at connector X3.

Note

Measuring accuracy

The accuracy of the temperature input becomes poorer: The resistance of the connecting cable of the jumpered connecting cable falsifies the measurement.

Analog outputs

The module has two analog outputs. These can optionally be assigned parameters as voltage or current output.

Note

The analog outputs are only enabled following the parameter assignment.

From the switch-on of the I/O module to when it is enabled, the analog outputs do not read 0 V, but are defined by a voltage pulse at -0.2 V. This value must be taken into consideration when specifying the setpoint value.

The cycle time of the analog value accumulation is limited by the PLC cycle.

Table 9-51 Technical specifications in the "voltage output" operating mode

Parameter	Value
Output range (rated value)	- 10 V to + 10 V
Permitted overrange	- 10.5 V to + 10.5 V
Resolution	16 bits (including sign)
Accuracy	+/- 0,5 %
Max. load current	-3 mA to +3 mA

Table 9-52 Technical specifications in the "current output" operating mode

Parameter	Value
Output range (rated value)	- 20 mA to + 20 mA
Permitted overrange	- 20.2 mA to + 20.2 mA
Resolution	16 bits (including sign)
Accuracy	+/- 0,5 %
Load impedance	≤ 600 ohm

9.3.5 Parameter assignment

9.3.5.1 Input / output images

Input image

The image comprises 3 slots (n, m, d ≙ start address):

- Slot 1: Digital inputs (DI)
  - n+0 … n+8 (9 byte)
  - X222.P3 - .P10 are rapid inputs
- Slot 2: 2 analog inputs (AI): m+0 … m+7 (8 byte)
- Slot 3: Diagnostics: d+0 .. d+1

Table 9-53 Input image of digital inputs for the 1st I/O module (n=0)

Terminal	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
X111	n+0	Pin10 DI 0.7	Pin9 DI 0.6	Pin8 DI 0.5	Pin7 DI 0.4	Pin6 DI 0.3	Pin5 DI 0.2	Pin4 DI 0.1	Pin3 DI 0.0
	n+1	Pin18 DI 1.7	Pin17 DI 1.6	Pin16 DI 1.5	Pin15 DI 1.4	Pin14 DI 1.3	Pin13 DI 1.2	Pin12 DI 1.1	Pin11 DI 1.0
	n+2	Pin26 DI 2.7	Pin25 DI 2.6	Pin24 DI 2.5	Pin23 DI 2.4	Pin22 DI 2.3	Pin21 DI 2.2	Pin20 DI 2.1	Pin19 DI 2.0
X222	n+3	Pin10 DI 3.7	Pin9 DI 3.6	Pin8 DI 3.5	Pin7 DI 3.4	Pin6 DI 3.3	Pin5 DI 3.2	Pin4 DI 3.1	Pin3 DI 3.0
	n+4	Pin18 DI 4.7	Pin17 DI 4.6	Pin16 DI 4.5	Pin15 DI 4.4	Pin14 DI 4.3	Pin13 DI 4.2	Pin12 DI 4.1	Pin11 DI 4.0
	n+5	Pin26 DI 5.7	Pin25 DI 5.6	Pin24 DI 5.5	Pin23 DI 5.4	Pin22 DI 5.3	Pin21 DI 5.2	Pin20 DI 5.1	Pin19 DI 5.0
X333	n+6	Pin10 DI 6.7	Pin9 DI 6.6	Pin8 DI 6.5	Pin7 DI 6.4	Pin6 DI 6.3	Pin5 DI 6.2	Pin4 DI 6.1	Pin3 DI 6.0
	n+7	Pin18 DI 7.7	Pin17 DI 7.6	Pin16 DI 7.5	Pin15 DI 7.4	Pin14 DI 7.3	Pin13 DI 7.2	Pin12 DI 7.1	Pin11 DI 7.0
	n+8	Pin26 DI 8.7	Pin25 DI 8.6	Pin24 DI 8.5	Pin23 DI 8.4	Pin22 DI 8.3	Pin21 DI 8.2	Pin20 DI 8.1	Pin19 DI 8.0

Table 9-54 Input image of analog inputs for the 1st I/O module (m=56)

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit3	Bit1	Bit0
m+0	Analog Status Byte 0							
m+1	Analog Status Byte 1							
m+2	Analog Status Byte 2							
m+3	Analog Status Byte 3							
m+4	AI 0.15	AI 0.14	AI 0.13	AI 0.12	AI 0.11	AI 0.10	AI 0.9	AI 0.8
m+5	AI 0.7	AI 0.6	AI 0.5	AI 0.4	AI 0.3	AI 0.2	AI 0.1	AI 0.0

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit3	Bit1	Bit0
m+6	AI 1.15	AI 1.14	AI 1.13	AI 1.12	AI 1.11	AI 1.10	AI 1.9	AI 1.8
m+7	AI 1.7	AI 1.6	AI 1.5	AI 1.4	AI 1.3	AI 1.2	AI 1.1	AI 1.0

Output image

The image comprises 2 slots (n, m, ≙ start address):

- Slot 1: Digital outputs (DO): n+0 … n+5 (6 byte)
- Slot 2: 2 analog outputs (AO): m+0 … m+7 (8 byte)

Table 9-55 Output image of digital outputs for the 1st I/O module (n=0)

Terminal	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
X111	n+0	Pin38 DO 0.7	Pin37 DO 0.6	Pin36 DO 0.5	Pin35 DO 0.4	Pin34 DO 0.3	Pin33 DO 0.2	Pin32 DO 0.1	Pin31 DO 0.0
	n+1	Pin46 DO 1.7	Pin45 DO 1.6	Pin44 DO 1.5	Pin43 DO 1.4	Pin42 DO 1.3	Pin41 DO 1.2	Pin40 DO 1.1	Pin39 DO 1.0
X222	n+2	Pin38 DO 2.7	Pin37 DO 2.6	Pin36 DO 2.5	Pin35 DO 2.4	Pin34 DO 2.3	Pin33 DO 2.2	Pin32 DO 2.1	Pin31 DO 2.0
	n+3	Pin46 DO 3.7	Pin45 DO 3.6	Pin44 DO 3.5	Pin43 DO 3.4	Pin42 DO 3.3	Pin41 DO 3.2	Pin40 DO 3.1	Pin39 DO 3.0
X333	n+4	Pin38 DO 4.7	Pin37 DO 4.6	Pin36 DO 4.5	Pin35 DO 4.4	Pin34 DO 4.3	Pin33 DO 4.2	Pin32 DO 4.1	Pin31 DO 4.0
	n+5	Pin46 DO 5.7	Pin45 DO 5.6	Pin44 DO 5.5	Pin43 DO 5.4	Pin42 DO 5.3	Pin41 DO 5.2	Pin40 DO 5.1	Pin39 DO 5.0

Table 9-56 Output image of analog outputs for the 1st I/O module (m=56)

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit3	Bit1	Bit0
m+0	Analog Control Byte 0							
m+1	Analog Control Byte 1							
m+2	Analog Control Byte 2							
m+3	Analog Control Byte 3							
m+4	AO 0.15	AO 0.14	AO 0.13	AO 0.12	AO 0.11	AO 0.10	AO 0.9	AO 0.8
m+5	AO 0.7	AO 0.6	AO 0.5	AO 0.4	AO 0.3	AO 0.2	AO 0.1	AO 0.0
m+6	AO 1.15	AO 1.14	AO 1.13	AO 1.12	AO 1.11	AO 1.10	AO 1.9	AO 1.8
m+7	AO 1.7	AO 1.6	AO 1.5	AO 1.4	AO 1.3	AO 1.2	AO 1.1	AO 1.0

9.3.5.2 Assigning parameters to the analog inputs / outputs

Operating mode

Parameters are assigned to the operating mode via the m+0 byte (Analog Control Byte 0) of the output image of the analog outputs:

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit3	Bit1	Bit0
m+0	AO (channel 4)	AO (channel 4)	AO (channel 3)	AO (channel 3)	AI (channel 2)	AI (channel 2)	AI (channel 1)	AI (channel 1)
m+1	Reserved							Data format
m+2	Reserved							
m+3	Reserved							

The reserved bits must be preassigned with the value "0".

The operating mode is set to "no operating mode" during power-up, as soon as a valid setting is made this will be applied and will subsequently no longer be reset. If a reset is initiated by the user, this is interpreted as an error.

Type of control

The control type must be specified in the Analog Control Byte m+1 (bit 0), so that the 16 bit input and output values from and for the analog module are correctly interpreted by the control. In the SINUMERIK 840D sl control, the value "1" must be entered here.

Note

The control type must be set prior to the operating mode so that the first set of user data is not misinterpreted. In addition to this, the Analog Control Byte m+0 / m+1 must only be accessed byte by byte.

Assigning parameters to the analog inputs

The analog inputs (AI) can be operated in the following operating modes:

Operating mode 1st channel	Bit 1	Bit 0
No operating mode	0	0
Voltage measurement	0	1
Current measurement	1	0
Temperature measurement (Pt100)	1	1

Operating mode 2nd channel	Bit 3	Bit 2
No operating mode	0	0
Voltage measurement	0	1

Operating mode 2nd channel	Bit 3	Bit 2
Current measurement	1	0
Temperature measurement (Pt100)	1	1

Assigning parameters to the analog outputs

The analog outputs (AO) can be operated in the following operating modes:

Operating mode 3rd channel	Bit 5	Bit 4
No operating mode	0	0
Voltage output	0	1
Current output	1	0
Impermissible operating mode	1	1

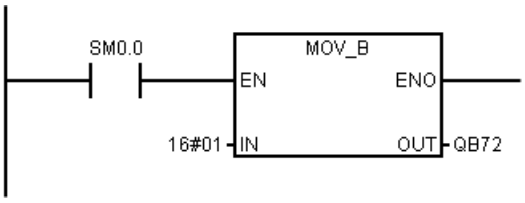
Operating mode 4th channel	Bit 7	Bit 6
No operating mode	0	0
Voltage output	0	1
Current output	1	0
Impermissible operating mode	1	1

Checkback signal of the operating modes

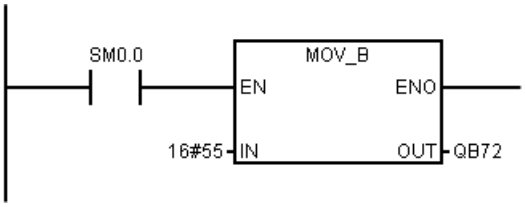
The set operating modes are saved in the input image in Status Byte 0. This value must be compared with Control Byte 0 in the output image. If these are different, an error has occurred, e. g. in the case of overvoltage in the "Temperature measurement" operating mode, see Diagnostics via input image (Page 142).

Examples of programming

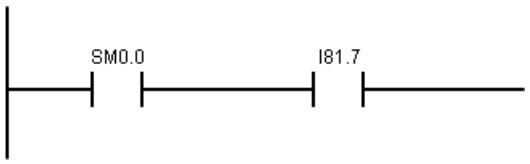
1. Determine control type:



2. Set the operating mode:



3. Query the error status bit in cyclic operation:



9.3.5.3 Analog value representation

Note

The analog values of the inputs and outputs are written or read in 16 bit data format i.e. they must be accessed word by word.

The analog values are provided as 16 bit integer values. Depending on the operating mode, the measured values must be converted using the following factors in order to achieve the corresponding physical value.

	Voltage [V]	Current [mA]	Temperature [°C]
Factor (AI):	0.00152	0.00305	0.1
Factor (AO):	0.00038	0.00076	-

Calculation: 16 bit value (hex. or dec.) * factor = measured value

Analog inputs

Table 9-57 Measured values in the voltage measurement operating mode

16 bit value (hex.)	16 bit value (dec.)	Factor	Voltage value [V]
Overflow		-	Deactivation
Overrange		-	Up to 11.75 V
0x19B5	6581	0.00152	10 V
0x0CDA	3291		5 V
0x066D	1645		2.5 V
0x0000	0		0 V
0xF993	-1645		-2.5 V
0xF326	-3291		-5 V
0xE64B	-6581		-10 V
Underrange		-	Up to -11.75 V
Underflow		-	Deactivation

Table 9-58 Measured values in the current measurement operating mode

16 bit value (hex.)	16 bit value (dec.)	Factor	Current value [V]
Overflow		-	Deactivation
Overrange		-	Up to 23.5 mA
0x1999	6553	0.00305	20 mA
0x0CCC	3277		10 mA
0x0000	0		0 mA
0xF333	-3277		-10 mA
0xE666	-6553		-20 mA
Underrange		-	Up to -23.5 mA
Underflow		-	Deactivation

Table 9-59 Measured values in the "temperature measurement" operating mode

16 bit value (hex.)	16 bit value (dec.)	Factor	Temperature value [V]
Overflow			
0x0A28	2590	0.1	259 °C
0x03E8	1000		100 °C
0x01F4	500		50 °C
0x0000	0.0		0 °C
0xFE0C	-500		-50 °C
0xFC18	-1000		-100 °C
0xF830	-2000		-200 °C
Underflow			

Note

If a Pt100 element is accidentally not connected in this operating mode and an input voltage higher than 0.25 V is output, the analog module automatically switches to the "no operating mode" operating mode and resets the gain factor to "1". This is signalized in Status Word 0 (channel-specific) in the input image. In addition, a corresponding error code is output in the diagnostics slot at a counter value of "2".

In the case of operation without a Pt100 element, a slightly negative voltage may be applied, which results in an error status for the module. Here, the "PNFault" LED and the status byte 1 are to be observed.

Analog outputs

Table 9-60 Measured values in the "voltage output" operating mode

16 bit value (hex.)	16 bit value (dec.)	Factor	Voltage value [V]
Overflow		-	Deactivation
Overrange		-	Up to 10.5 V
0x6666	26214	0.00038	10 V
0x4CD1	19665		7.5 V
0x199B	6555		2.5 V
0x0000	0		0 V
0xE665	-6555		-2.5 V
0xB32F	-19665		-7.5 V
0x999A	-26214		-10 V
Underrange		-	Up to -10.5 V
Underflow		-	Deactivation

Table 9-61 Measured values in the "current output" operating mode

16 bit value (hex.)	16 bit value (dec.)	Factor	Current value [V]
Overflow		-	Deactivation
Overrange		-	20.2 mA
0x6666	26214	0.00076	20 mA
0x4CD1	19665		15 mA
0x199B	6555		5 mA
0x0000	0		0 mA
0xE665	-6555		-5 mA
0xB32F	-19665		-15 mA
0x999A	-26214		-20 mA
Underrange		-	-20.2 mA
Underflow		-	Deactivation

9.3.5.4 Examples

The following examples for assigning parameters to analog inputs / outputs are provided for the I/O module with device number "7".

Table 9-62 Measured values and responses in the voltage measurement operating mode

	Address	Voltage ±10 V			
		0 V	2.5 V	10 V	12 V
Operating mode	QB72	16#55	16#55	16#55	16#55
Format	QB73	16#1	16#1	16#1	16#1
Value	QW76	16#0	16#199B	16#6666	16#7AE1
Value	QW78	16#0	16#199B	16#6666	16#7AE1
Operating mode	IB72	16#55	16#55	16#55	16#55
Format	IB73	16#1	16#1	16#1	16#1
Value	IW76	16#0	16#66D	16#19B5	16#0
Value	IW78	16#0	16#66D	16#19B5	16#0
Diagnostics	IB50	-	-	-	16#2
	IB51	16#0	16#0	16#0	16#7
PNFault LED		off	off	off	on
Troubleshooting					Deactivating/ activating

Table 9-63 Measured values and responses in the current measurement operating mode

	Address	Current 20 mA			
		0 mA	5 mA	20 mA	22 mA
Operating mode	QB72	16#AA	16#AA	16#AA	16#AA
Format	QB73	16#1	16#1	16#1	16#1
Value	QW76	16#0	16#199B	16#6666	16#70A5
Value	QW78	16#0	16#199B	16#6666	16#70A5
Operating mode	IB72	16#AA	16#AA	16#AA	16#AA
Format	IB73	16#1	16#1	16#1	16#81
Value	IW76	16#0	16#665	16#1996	16#0
Value	IW78	16#0	16#665	16#1996	16#0
Diagnostics	IB50	-	-	-	16#2
	IB51	16#0	16#0	16#0	16#7
PNFault LED		off	off	off	on
Troubleshooting					Deactivating/ activating

Table 9-64 Measured values and responses in the temperature measurement operating mode

	Address	Pt100	
		Incorrect operating mode	Resistor is not connected
Operating mode	QB72	16#AA	16#0F
Format	QB73	16#1	16#1
Value	QW76	-	-
Value	QW78	-	-
Operating mode	IB72	16#AA	16#0F
Format	IB73	16#81	16#81
Value	IW76	-	-
Value	IW78	-	-
Diagnostics	IB50	16#2	16#2
	IB51	16#3	16#6
PNFault LED		on	on
Troubleshooting		Deactivating/activating	Deactivating/activating

9.3.5.5 Diagnostics via input image

Table 9-65 Diagnostics input image

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit3	Bit1	Bit0
d+0	count_2	count_1	count_0	T_Alarm_2	T_Alarm_1	Diag_2	Diag_1	Diag_0
d+1	Status_1							

Table 9-66 Messages in byte 0

Bit	Signal name	Message
7	count_2	alive and well 2
6	count_1	alive and well 1
5	count_0	alive and well 0
4	T_Alarm_2	Temperature not within the operating temperature range defined for the module
3	T_Alarm_1	Critical temperature exceeded
2	Diag_2	Overload DO byte 5/4
1	Diag_1	Overload DO byte 3/2
0	Diag_0	Overload DO byte 1/0

Note

The "alive and well" counter is a 3 bit modulo counter at the PP application level. The PP application can be monitored using this counter. Failure of the application software does not generally result in a communication failure, as this is developed in a hardware-supported manner. The watch dog switches off the digital outputs, while the inputs remain at their last set values.

Table 9-67 Overview of the messages in byte 1, depending on the "alive and well" counter

"alive and well" counter	Value byte 1	Message
0	0	Reserved
1		Temperature value
2	0	No error
	1	Impermissible input voltage in the temperature measurement mode
	2	Reserved
	3	Overload at the outputs
	4	Incorrect operating mode selection
	5	Internal error, system error
	6	Range exceeded at the inputs
	7	Range exceeded at the outputs
3 ... 7	0	Reserved

Table 9-68 Elimination of error for "alive and well" counter status "2"

Value byte 1	Cause	Effect	Remedy
1	In the temperature measurement operating mode, an input voltage is too high. The hardware may become damaged/ destroyed as a result.	The "PNFault" LED is activated. The outputs are disabled. [1)] The value 0x80 is stored in status byte 1.	It is essential that a Pt100 element is connected to terminals 3.4 or 7.8. The module must be restarted with Power ON after the error has been eliminated.
2	Reserved	-	-
3	Overload at the outputs	The "PNFault" LED is activated. The outputs are disabled. [1)] The value 0x80 is stored in status byte 1.	Check the loads at the analog output. The module must be restarted with Power ON after the error has been eliminated.
4	Incorrect operating mode selection, e.g. temperature measurement at the analog outputs.	Selection of operating mode is rejected,	If selected correctly, the module switches to cyclic operation.
5	Internal error, system error	The "PNFault" LED is activated. The outputs are disabled. [1)] The value 0x80 is stored in status byte 1.	The firmware has detected a system error, this status can only be exited by means of a switch-on / switch-off.

Value byte 1	Cause	Effect	Remedy
6	Range exceeded at the inputs		Check input circuit and adjust, if required.
7	Range exceeded at the outputs		Correct the values in the user program.

1) The analog outputs retain their last specified value.

Diagnostics via status bytes 0/1

In status byte 0, the set operating modes are reflected e.g. "0x55" if control byte 0 = 0x55 has been specified (voltage on all channels).

In the event of an error, the error bit is set in status byte 1 (bit 7). In the event of an error in one channel, **all** channels are deactivated.

Table 9-69 Input image of analog inputs (excerpt)

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit3	Bit1	Bit0
m+0	0	0	0	0	0	0	0	0
m+1	Error bit	0	0	0	0	0	0	0

9.3.6 Technical data

Table 9-70 Technical data of the I/O module

Safety	
Degree of protection	IP 00 according to EN 60529
Protection class	III; DVC A, (PELV) acc. to EN 61800-5-1
Approvals	cULus, CE
Electrical data	
Rated voltage	24 V DC
Rated current	0.7 A
Power consumption at rated load	19 W (without digital outputs)
Power loss	18 W
Mechanical data	
Dimensions WxHxD	150 x 300 x 35 mm
Weight, approx.	0.9 kg

For detailed technical data relating to the inputs and outputs, see the "Connecting" chapter.

X111, X222 and X333 digital inputs/outputs (Page 124)

Analog X3 inputs/outputs (Page 130)

9.4 COM01.3 RS 232C (V.24) module

9.4.1 Description

The COM01.3 RS 232C (V. 24) option board can be inserted into the option slot of the NCU.

An NCU can be connected to a master computer or modem via COM port X491. The COM port has been designed in accordance with the "ANSI/EIA/TIA-232-F-1997" standard.

Note

The option board COM01.3 RS 232C (V.24) module cannot be used for the NCU730.3B PN with PLC 319 DP/PN.

Illustration

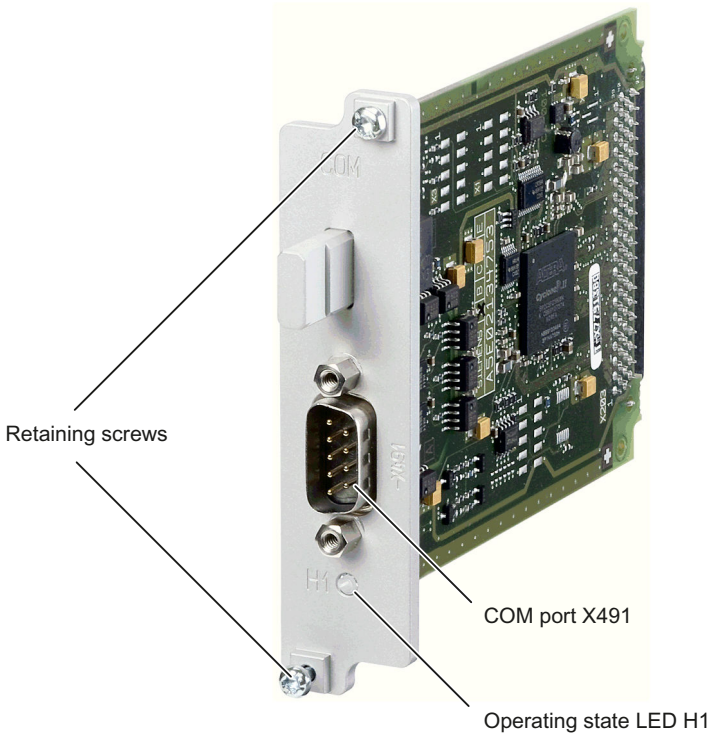


Figure 9-20 COM01.3 RS 232C (V.24) module

Type plate

Note

You might need to access the information provided on the type plate after mounting. Since the type plates after mounting the option board can no longer be read, we recommend that you at least note down the serial number before mounting.

The following diagram shows you all of the information provided on the type plate.

Figure 9-21 COM01.3 RS 232C (V.24) module type plate

This plate is only visible, when the option board has been removed; it is attached to the underside of the option board.

Note

The contents of the individual type plate fields on the actual option board may differ from those described in this manual (e.g. updated product status, approvals and markings not yet issued, etc.).

LED displays

LED H1 is located under the COM port. This can display the following operating states:

Table 9-71 LED displays, H1

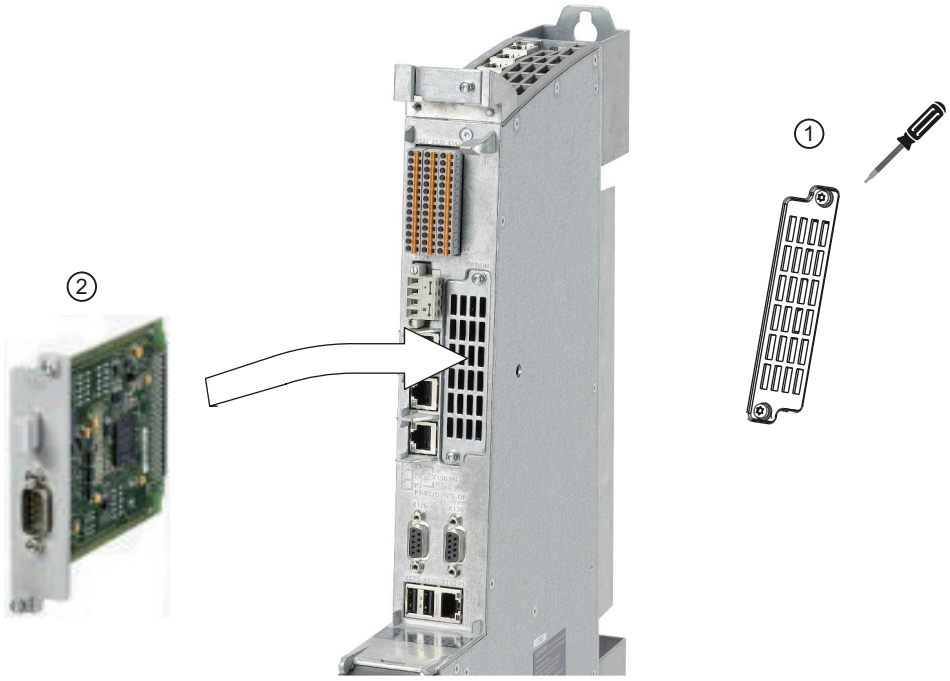
Color	Status	Meaning
Orange	lit	COM01.3 is ready; after reset.
Green	lit	COM01.3 is active.
Red	lit	Operating error

9.4.2 Installation/Mounting

NOTICE
Damage to the option board by inserting and withdrawing in operation • Option boards should only be inserted and removed when the NCU and option board are in a no-current condition. • Option boards may only be operated by qualified personnel. The ESD notices must be observed.

Installing the COM01.3 RS 232C (V.24) module

A COM01.3 option board is installed in the option slot of the NCU.



① Release the M3 fixing screws and remove the protective cover.
② Insert and secure the option board.
Tightening torque of the M3 fixing screws: 0.8 Nm.

Figure 9-22 Installing COM01.3

The cable outlet is at the top.

9.4.3 Connection

The RS 232C (V.24) module has a standardized serial interface.

Properties

COM port X491 is opto-uncoupled.

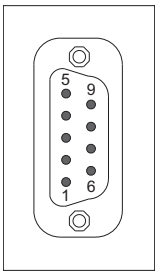
Cable specification

Table 9-72 Cable specification for COM port X491

Characteristic	Version
Connector type	9-pin SUB-D socket; pin
Cable type	Prefabricated signal line RS 232C/V.24 (9-pin - 9-pin)
Order number	6FX8002-1AA01
Max. cable length	15 m

Pin assignment

Table 9-73 COM port X491

	Pin	Signal name	Signal type	Meaning
	1	DCD	Input	Receiver signal level
	2	RXD	Input	Serial receive data
	3	TXD	Output	Serial transmit data
	4	DTR	Output	Data terminal equipment ready
	5	GND	-	Ground (reference potential)
	6	DSR	Input	Readiness for operation
	7	RTS	Output	Request To Send
	8	CTS	Input	Clear To Send
	9	RI	Input	Incoming call

9.5 CBE30-2

9.5.1 Description

With the CBE30-2 Ethernet communication board, based on the generally released standard configuration, an NCU link communication with a maximum of three NCUs can be configured. Additional NCUs can be integrated into the link communication on a project-for-project basis when regional Siemens partners are contacted.

When using a CBE30-2, the NCU is assigned an additional interface X1400, comprising 4 PROFINET ports. The NCU-Link is permanently wired via port 1 (in) and port 2 (out).

Note

The Communication Board Ethernet CBE30-2 cannot be used for the NCU730.3B PN with PLC 319 DP/PN.

Additional references

For further information, please refer to the Function Manual Extended Functions, B3, Chapter "Link communication".

Illustration

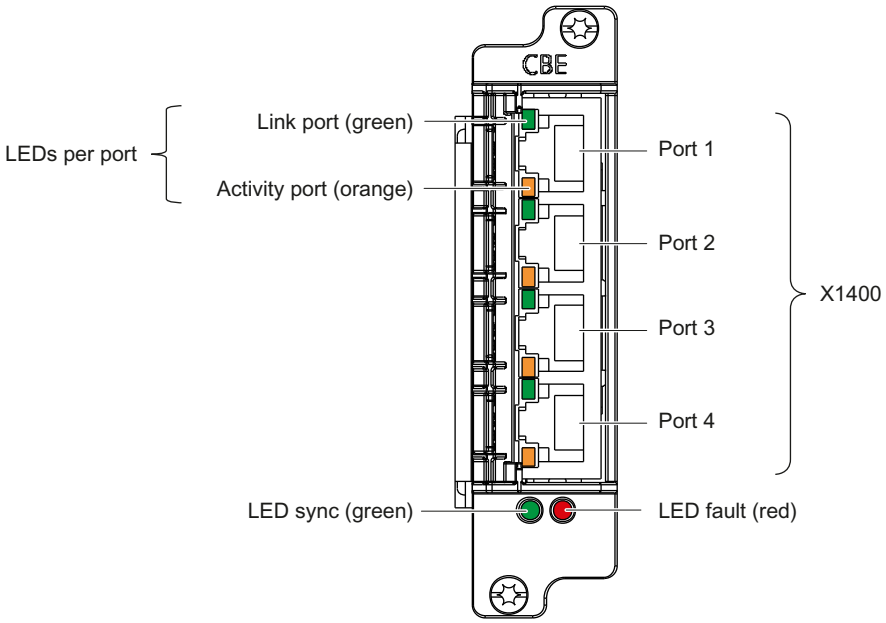


Figure 9-23 CBE30-2 Ethernet communication board

Note

The NCU link communication is exclusively operated using ports 1 and 2. Ports 3 and 4 cannot be used and are not freely available.

Type plate

Note

You might need to access the information provided on the type plate after mounting. Since the type plate after mounting the option board can no longer be read, we recommend that you at least note down the serial number before mounting.

The following diagram shows you all of the information provided on the type plate.

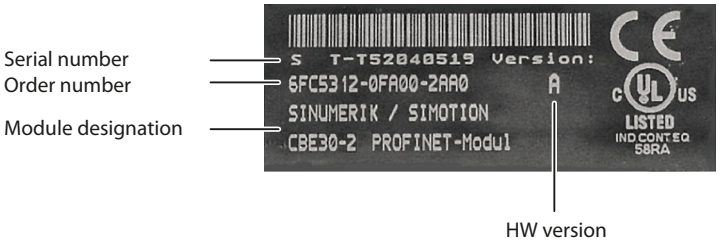


Figure 9-24 CBE30-2 type plate

This plate is only visible, when the option board has been removed; it is attached to the underside of the option board.

Note

The contents of the individual type plate fields on the actual option board may differ from those described in this manual (e.g. updated product status, approvals and markings not yet issued, etc.).

LED displays

The four ports of the X1400 interface provide integrated LEDs for displaying the link and the activity. The front panel of the CBE30-2 is also fitted with two LEDs (Fault and Sync), which indicate the bus status.

Table 9-74 LED displays

Name	Color	Status	Meaning
Link port	Green	lit	The physical connection exists.
Activity port	Yellow	lit	Data is being received or transmitted.
Fault	Red	off	CBE runs without errors, data is being exchanged.
		lit	Bus fault: • No physical connection to a subnet/switch • Incorrect transmission rate • Full duplex transmission is not activated.

Name	Color	Status	Meaning
		flashing (2 Hz)	• Failure of a connected NCU • At least one of the assigned NCUs cannot be addressed • Incorrect or no configuration.
Sync	Green	off	Clock cycle system of the NCU is not synchronized to the send cycle. An internal substitute clock of the same size as the send clock is generated.
		lit	Clock cycle system of the NCU has synchronized to the send cycle and data exchange is running.
		flashing (0.5 Hz)	Clock cycle system of the NCU has synchronized to the send cycle and cyclic data exchange is running.

9.5.2 Installation/Mounting

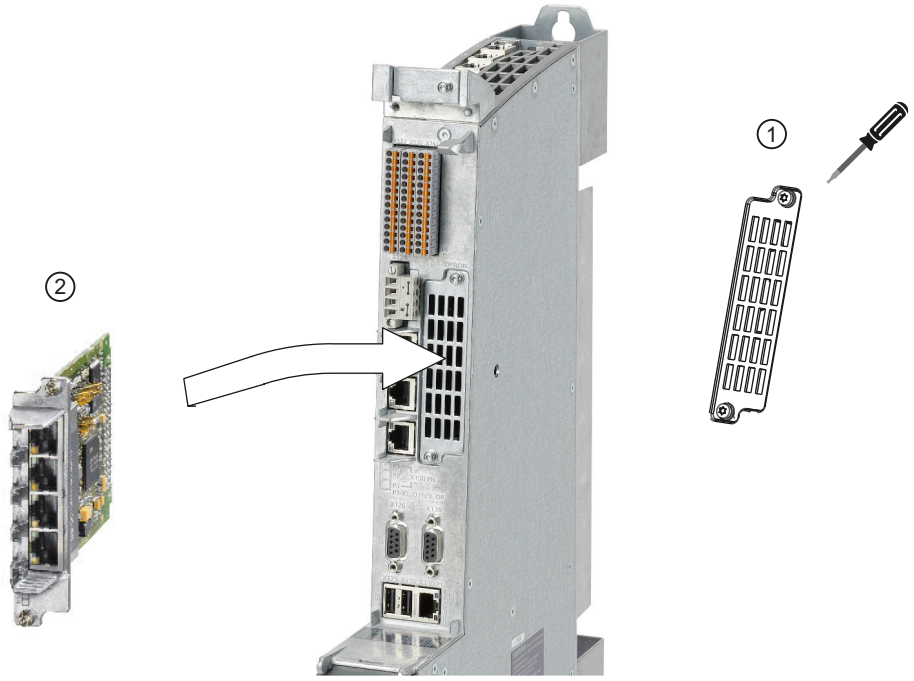
NOTICE

Damage to the option board by inserting and withdrawing in operation

- Option boards should only be inserted and removed when the NCU and option board are in a no-current condition.
- Option boards may only be operated by qualified personnel. The ESD notices must be observed.

Installing the CBE30-2

A CBE30-2 is installed in the option slot of the NCU.



① Release the M3 fixing screws and remove the protective cover.

② Insert and secure the option board.
Tightening torque of the M3 fixing screws: 0.8 Nm.

Figure 9-25 Installing the CBE30-2

9.5.3 Connection

Properties

The X1400 interface has full-duplex 10/100-Mbit Ethernet ports with autocrossing. The module has an integrated 4-port switch.

Interface characteristics

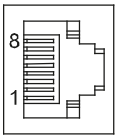
Table 9-75 X1400

Characteristic	Version
Connector type	RJ45 socket*)
Cable type	Industrial Ethernet cable (CAT5)
Max. cable length	100 m

*) Please use the Fast Connect connector as described in Chapter "PROFINET cables (Page 60)".

Pin assignment

Table 9-76 X1400 interface, ports 1 - 4

	Pin	Signal name	Signal type	Meaning
	1	TX+	Output	Transmit data +
	2	TX-	Output	Transmit data -
	3	RX+	Input	Receive data +
	4	NC		
	5	NC		
	6	RX-	Input	Receive data -
	7	NC		
	8	NC		

Spare Parts/Accessories

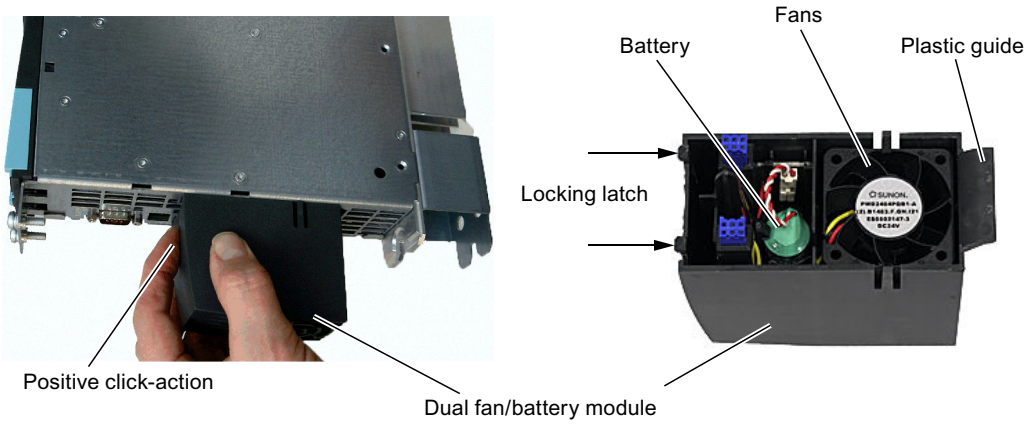
10

10.1 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 push the dual fan/battery module backwards (by pressing on the pressure point) to release the module from its front interlock (snap-in hooks).



NOTICE
Forcibly withdrawing the module can permanently damage it Never pull the dual fan/battery module out abruptly without having released the interlock. This would break the snap-in hooks and you would not be able to reinsert the module.

2. Tilt the dual fan/battery module forward at an angle and pull out the plastic guide from the NCU 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.

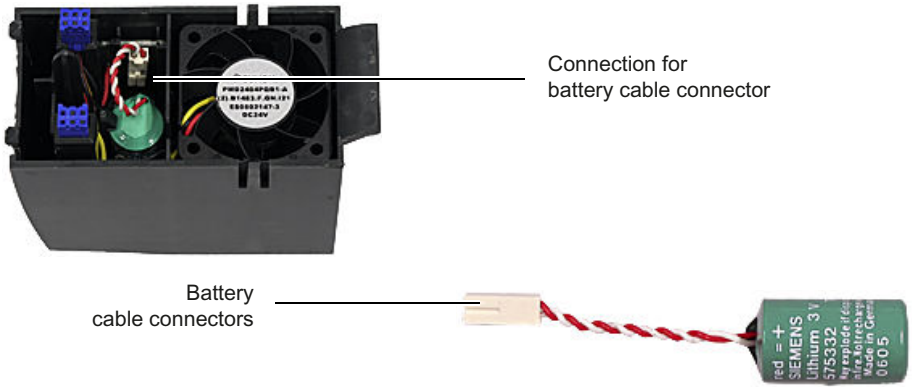
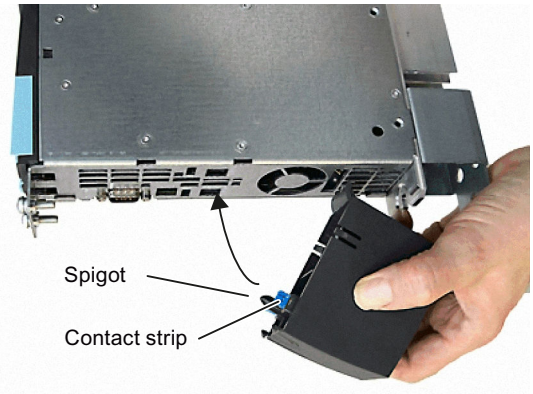


Figure 10-1 Battery replacement in the dual fan/battery module

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 NCU.
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 NCU is established automatically.



Note

The dual fan/battery module can be replaced during operation. If you choose to do this, remember that the NCU can only be operated for a maximum of 1 minute without fans. If this time is exceeded, it will shut itself down.

10.2 CompactFlash Card

10.2.1 Properties of the CompactFlash card

Application

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

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

NOTICE
Inserting or withdrawing with the power connected can destroy the CF card 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 NCU.

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 NCU without having to change the license.

10.2.2 Inserting the CompactFlash card

Procedure

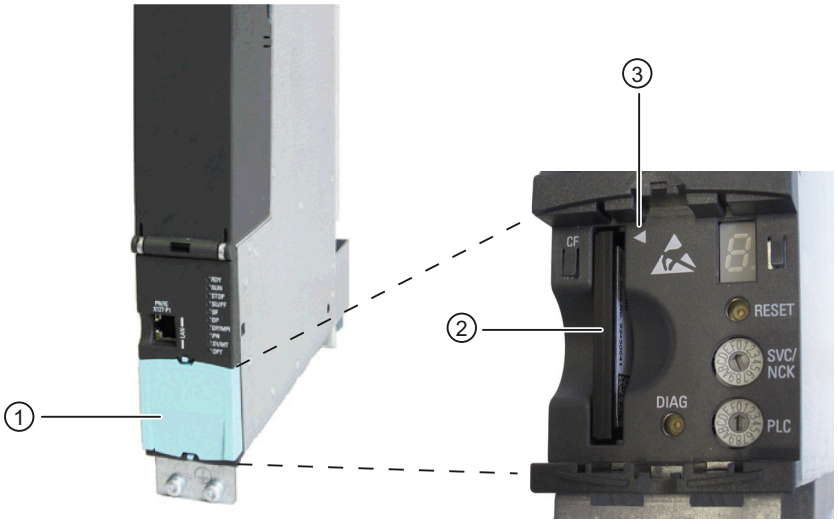
Note

ESD: you must discharge yourself at the cabinet or ground terminal before touching the CompactFlash Card.

Please proceed as follows:

1. Switch off the power supply.
2. Remove the blanking cover ①.

3. Carefully insert the new CompactFlash Card ② into the slot until it clicks into place. The marking ③ provided on the CompactFlash Card is used as orientation: the two arrow heads point to one another. When properly installed, the card does not extend beyond the housing.
4. Switch the power supply on again.



① Blanking plate
② CompactFlash Card
③ Marking for insertion direction

Figure 10-2 Inserting the CompactFlash card

Appendix

A

A.1 Abbreviations

AWG	American Wire Gauge
B-MPI	Handheld unit with MPI connection
BERO	Proximity limit switch
CAT5	Quality class (category) for shielded twisted-pair cables. Class 5 states that these cables have a particularly low damping factor, making them suitable for 100 Mbit/s-FastEthernet networks.
CBA	Component Based Automation: Component Based Automation
CNC	Computerized Numerical Control Computerized numerical control
CPU	Central Processing Unit Central processing unit
CRC	Cyclic redundancy check: Checksummenprüfung
DCP	Discovery and basic Configuration Protocol (standard for assigning IP addresses)
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
EGB	Electrostatic Sensitive Devices
EMC	Electromagnetic compatibility
EN	European standard
ESD	Electrostatic discharge: elektrostatische Entladung
HMI	Human Machine Interface: SINUMERIK operator interface for operating, programming and simulation
HSC	High-Speed Cutting
HT	Handheld Terminal
LED	Light-emitting diode light-emitting-diode display
MAC	Media Access Control
MCP	Machine Control Panel
MPI	Multi-Point Interface Multi-point interface
MPP	Machine Push Button Panel
NCK	Numerical Control Kernel: NC kernel with block preparation, traversing range, etc.
NCU	Numerical Control Unit: NCK hardware unit
NVM	Non-Volatile Memory: non-volatile memory
NX	Numerical eXtension (axis extension module)
OP	Operator Panel : Operator panel front
PCU	PC Unit: Computer unit
PG	Programming device
PLC	Programmable Logic Control: Programmable logic control (component of the CNC controller)
PN	PROFINET
RAM	Random Access Memory: Program memory which can be read and written into

TCU	Thin Client Unit (communication with operator panels)
TS	Teleservice
VDE	Association of Electrical Engineering, Electronics and Information Technology (Germany)
Full duplex	An Ethernet/PROFINET port can simultaneously transmit and receive data.

A.2 Documentation overview

SINUMERIK 840D sl documentation overview

General documentation

Sales brochure

Catalog NC 62

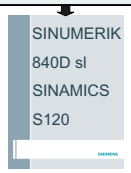
Catalog PM 21 SIMOTION, SINAMICS S120 and motors for production machines

User documentation

Operating Manual
– Universal
– Turning
– Milling

Programming manual
– Fundamentals
– Job planning
– Measuring cycles

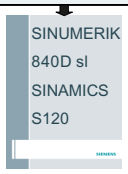
Programming manual
– ISO turning
– ISO milling



Diagnostics manual

Manufacturer/service documentation

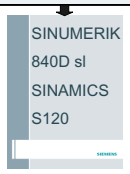
Device manual
– NCU
– operator components and networking



System manual
Guidelines for the machine configuration

System manual
Ctrl Energy

Commissioning manual
– CNC: NCK, PLC, Drive
– Base software and operating software

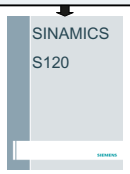


List manual
– Machine data
– Interface signals
– Variables

Manufacturer/service documentation

Function manual
– Basic functions
– Extended functions
– Special functions
– Synchronous actions
– ISO dialects

Function manual
Tool management



Function manual
Drive functions

Function manual
Safety Integrated

Configuration manual
EMC Design Guidelines

Info/training

Training documents
– Simple milling with ShopMill
– Simple turning with ShopTurn

Manuals
Tool and mold making

Electronic documentation

DOConCD

My Documentation Manager

Industry Mall

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