SIEMENS

SINUMERIK

SINUMERIK ONE NCU 1750

Equipment Manual

Valid for

Control SINUMERIK ONE 6FC5317-5AA00-0AA0

Introduction	1
Fundamental safety instructions	2
System overview	3
Description	4
Application planning	5
Dimension drawings	6
Installation	7
Connecting	8
Diagnostics	9
Service and maintenance	10
Technical data	11
Connectable components	12
Spare parts/accessories	13
Safety symbols	14
Appendix	Α

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.

Table of contents

1	Introduction	ntroduction7			
	1.1	About SINUMERIK	7		
	1.2	About this documentation	7		
	1.3 1.3.1 1.3.2	Documentation on the internet	8		
	1.4	Feedback on the technical documentation	9		
	1.5	mySupport documentation	9		
	1.6	Service and Support	10		
	1.7	Important product information	12		
2	Fundamen	tal safety instructions	15		
	2.1	General safety instructions	15		
	2.2	Equipment damage due to electric fields or electrostatic discharge	19		
	2.3	Warranty and liability for application examples	19		
	2.4	Security information	19		
	2.5	Residual risks of power drive systems	21		
3	System ove	erview	23		
	3.1	Application	23		
	3.2	System configuration	24		
	3.3	Versions	27		
	3.4	Ordering data	28		
4	Description	1	29		
	4.1	Characteristics	29		
	4.2	Illustration	30		
	4.3	Type plates	31		
	4.4 4.4.1 4.4.2 4.4.3 4.4.4 4.4.5 4.4.6	Operator control and display elements Overview of operating and display elements LED displays 7-segment display Start-up and mode selector switch RESET button DIAG button	34 35 39 41 42		
	4.5	Dual fan module	42		

5	Application	planning	45
	5.1 5.1.1 5.1.2 5.1.3 5.1.4	Supplementary electrical conditions Grounding concept	45 46 47
	5.2 5.2.1 5.2.2	Climatic and mechanical environmental conditions Shipping and storage conditions Operating conditions	47
6	Dimension	drawingsdrawings	51
7	Installation		53
	7.1	Safety instructions	53
	7.2	Designs	54
	7.3	Fix the NCU using spacers	55
	7.4	Mounting the NCU without spacers	55
8	Connecting		57
	8.1	Overview	57
	8.2	Communication services and used port numbers	59
	8.3	Safety information for wiring	62
	8.4	Opening the front cover	62
	8.5 8.5.1 8.5.2	Power supply	64
	8.6 8.6.1 8.6.2	DRIVE-CLiQ components	69
	8.7	Use of Ethernet interfaces	72
	8.8	PROFINET	75
	8.9 8.9.1 8.9.2 8.9.3 8.9.4 8.9.5 8.9.6	PROFIBUS DP	77 78 79 80 81
	8.10 8.10.1 8.10.2 8.10.3 8.10.4	Digital inputs/outputs	82 87 88
	0.11	U.U.D	フィ

9	Diagnosti	cs	93
	9.1	Error messages	93
10	Service an	nd maintenance	95
	10.1	Service and maintenance	95
11	Technical	data	97
	11.1	Standards and approvals	98
	11.2	Recycling and disposal	98
12	Connectal	ble components	99
	12.1	NX10.3/NX15.3	99
	12.1.1	Description	
	12.1.2	Dimension drawing	
	12.1.3	Mounting	
	12.1.4	Connection	
	12.1.5	Technical Data	
	12.2	PP 72/48D PN and PP 72/48D 2/2A PN	111
	12.2.1	Description	
	12.2.1.1	LED status display	
	12.2.2	Installation	
	12.2.2.1	Mounting	
	12.2.2.2	PP 72/48D PN dimension drawing	
	12.2.2.3	PP 72/48D 2/2A PN dimension drawing	
	12.2.3	Connecting	
	12.2.3.1	Interface overview	
	12.2.3.2	Power supply	
	12.2.3.3	X2 PROFINET	
	12.2.3.4	X111, X222 and X333 digital inputs/outputs	
	12.2.3.5	X3 analog inputs/outputs	
	12.2.4	Parameterization	
	12.2.4.1	Parameterization of the digital input/output images	138
	12.2.4.2	Assigning parameters to the analog inputs / outputs	
	12.2.4.3	Diagnostics via input image	
	12.2.5	Technical data	142
13	Spare part	ts/accessories	145
	13.1	Replacing the dual fan module	145
	13.2	SD card	146
	13.2.1	Properties of the SD card	
	13.2.2	Inserting the SD card	
14	Safety syn	mbols	149
Α	Appendix		151
	A.1	Abbreviations	151
	Indov		152

Introduction

1.1 About SINUMERIK

From simple, standardized CNC machines to premium modular machine designs – the SINUMERIK CNCs offer the right solution for all machine concepts. Whether for individual parts or mass production, simple or complex workpieces – SINUMERIK is the highly dynamic automation solution, integrated for all areas of production. From prototype construction and tool design to mold making, all the way to large-scale series production.

Visit our website for more information SINUMERIK (https://www.siemens.com/sinumerik).

1.2 About this documentation

Validity

This Equipment Manual deals with the SINUMERIK NCU 1750 control. This documentation is valid for SINUMERIK ONE systems.

Target group

This Equipment Manual addresses planners, installers and configuration engineers in the field of automation technology. The Equipment Manual enables the target group to install, assemble, test, and operate the device professionally and safely.

Structure

The documentation provides information about the components and functions of the NCU 1750.

- Chapter "System overview" provides general information on the system, system configuration, versions and order data.
- Chapter "Description" contains general information about the device, such as appearance, features, operating and display elements as well as interfaces.
- Chapter "Application planning" includes information on electrical constraints as well as climatic/mechanical ambient conditions.
- Chapter "Connecting" describes the pin assignment and the connection of the interfaces.
- Chapter "Diagnostics" includes a selection of fault messages as well as information on fault rectification.
- In addition to the technical specifications of the device, chapter "Technical data" contains information on disposal, as well as on the relevant standards and approvals.
- Chapter "Components that can be connected" contains detailed information on components "NX10.3/NX15.3". "PP 72/48D PN" as well as "PP 72/48D PN 2/2A PN".

1.3 Documentation on the internet

Standard scope

This documentation only describes the functionality of the standard version. This may differ from the scope of the functionality of the system that is actually supplied. Please refer to the ordering documentation only for the functionality of the supplied drive system.

It may be possible to execute other functions in the system which are not described in this documentation. This does not, however, represent an obligation to supply such functions with a new control or when servicing.

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

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

Websites of third-party companies

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

1.3 Documentation on the internet

1.3.1 Documentation overview SINUMERIK ONE

Comprehensive documentation about the functions provided in SINUMERIK ONE Version 6.13 and higher is provided in the Documentation overview SINUMERIK ONE (https://example.com/cs/ww/en/view/109768483).



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

The documentation is divided into the following categories:

User: OperatingUser: Programming

Manufacturer/Service: FunctionsManufacturer/Service: Hardware

Manufacturer/Service: Configuration/SetupManufacturer/Service: Safety Integrated

· Information and training

Manufacturer/Service: SINAMICS

1.3.2 Documentation overview SINUMERIK operator components

Comprehensive documentation about the SINUMERIK operator components is provided in the Documentation overview SINUMERIK operator components (https://support.industry.siemens.com/cs/document/109783841/technische-dokumentation-zusinumerik-bedienkomponenten?dti=0&lc=en-WW).

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

The documentation is divided into the following categories:

- Operator Panels
- Machine control panels
- Machine Pushbutton Panel
- Handheld Unit/Mini handheld devices
- Further operator components

An overview of the most important documents, entries and links to SINUMERIK is provided at SINUMERIK Overview - Topic Page (https://support.industry.siemens.com/cs/document/109766201/sinumerik-an-overview-of-the-most-important-documents-and-links? dti=0&lc=en-WW).

1.4 Feedback on the technical documentation

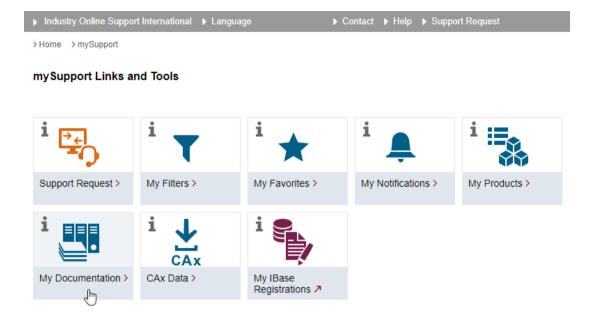
If you have any questions, suggestions or corrections regarding the technical documentation which is published in the Siemens Industry Online Support, use the link "Send feedback" link which appears at the end of the entry.

1.5 mySupport documentation

With the "mySupport documentation" web-based system you can compile your own individual documentation based on Siemens content, and adapt it for your own machine documentation.

1.6 Service and Support

To start the application, click on the "My Documentation" tile on the mySupport homepage (https://support.industry.siemens.com/cs/ww/en/my):



The configured manual can be exported in RTF, PDF or XML format.

Note

Siemens content that supports the mySupport documentation application can be identified by the presence of the "Configure" link.

1.6 Service and Support

Product support

You can find more information about products on the internet:

Product support (https://support.industry.siemens.com/cs/ww/en/)

The following is provided at this address:

- Up-to-date product information (product announcements)
- FAQs (frequently asked questions)
- Manuals
- Downloads
- Newsletters with the latest information about your products
- Global forum for information and best practice sharing between users and specialists

- Local contact persons via our Contacts at Siemens database (→ "Contact")
- Information about field services, repairs, spare parts, and much more (→ "Field Service")

Technical support

Country-specific telephone numbers for technical support are provided on the internet at address (https://support.industry.siemens.com/cs/ww/en/sc/4868) in the "Contact" area.

If you have any technical questions, please use the online form in the "Support Request" area.

Training

You can find information on SITRAIN at the following address (https://www.siemens.com/sitrain).

SITRAIN offers training courses for automation and drives products, systems and solutions from Siemens.

Siemens support on the go





With the award-winning "Siemens Industry Online Support" app, you can access more than 300,000 documents for Siemens Industry products – any time and from anywhere. The app can support you in areas including:

- · Resolving problems when implementing a project
- Troubleshooting when faults develop
- Expanding a system or planning a new system

Furthermore, you have access to the Technical Forum and other articles from our experts:

- FAQs
- Application examples
- Manuals
- Certificates
- Product announcements and much more

The "Siemens Industry Online Support" app is available for Apple iOS and Android.

1.7 Important product information

Data matrix code on the nameplate

The data matrix code on the nameplate contains the specific device data. This code can be read with a smartphone and technical information about the device displayed via the "Industry Online Support" mobile app.

1.7 Important product information

Using OpenSSL

This product can contain the following software:

- Software developed by the OpenSSL project for use in the OpenSSL toolkit
- Cryptographic software created by Eric Young.
- Software developed by Eric Young

You can find more information on the internet:

- OpenSSL (https://www.openssl.org)
- Cryptsoft (https://www.cryptsoft.com)

Compliance with the General Data Protection Regulation

Siemens observes standard data protection principles, in particular the data minimization rules (privacy by design).

For this product, this means:

The product does not process or store any personal data, only technical function data (e.g. time stamps). If the user links this data with other data (e.g. shift plans) or if he/she stores person-related data on the same data medium (e.g. hard disk), thus personalizing this data, he/she must ensure compliance with the applicable data protection stipulations.

Intended use

The products described in this manual, together with software, accessories and options, form a Numerical Control Unit intended for use in machine tool systems. The products are intended for use in industrial, light industrial and commercial applications. The products must be installed and maintained by professionals with sufficient knowledge to implement the safety and EMC measures in accordance with the specifications described in this manual and the recognized state of the art.

You may only use the products in compliance with the following requirements:

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

1.7 Important product information

Before using the products, you must perform a risk assessment of the entire application and implement appropriate system design measures to ensure the safety of persons, property and electromagnetic compatibility.

Open-type products (IP20) are intended for installation in operator panels or cabinets which provide the necessary protection.

Any use other than that expressly permitted is prohibited, and can result in unforeseen dangers.

1.7 Important product information

Fundamental safety instructions

2.1 General safety instructions



M WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

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

Generally, the following steps apply when establishing safety:

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

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



/ WARNING

Electric shock due to connection to an unsuitable power supply

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

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

2.1 General safety instructions



№ WARNING

Electric shock due to equipment damage

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

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





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.





Electric shock if there is no ground connection

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

• Ground the device in compliance with the applicable regulations.

NOTICE

Damage to equipment due to unsuitable tightening tools.

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

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

MARNING

Spread of fire from built-in devices

Built-in devices can cause a fire and a pressure wave in the event of a fault. Fire and smoke can escape from the control cabinet and cause serious personal injury and property damage.

- Install built-in appliances in a robust metal control cabinet that is suitable for protecting people from fire and smoke.
- Only operate built-in devices with the control cabinet doors closed.
- Ensure that smoke can only escape via controlled and monitored paths.

A CAUTION

Symptomatic respiratory and skin reaction to chemicals

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

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

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

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

MARNING

Unexpected machine movement caused by radio devices or mobile phones

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

- Therefore, if you move closer than 20 cm to the components, be sure to switch off radio devices, cellphones or WLAN devices.
- Use the "SIEMENS Industry Online Support app" only on equipment that has already been switched off.

MARNING

Fire due to inadequate ventilation clearances

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

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

2.1 General safety instructions

NOTICE

Overheating due to inadmissible mounting position

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

• Only operate the device in admissible mounting positions.

№ WARNING

Unexpected movement of machines caused by inactive safety functions

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

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

Note

Important Safety instructions for Safety Integrated

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

2.2 Equipment damage due to electric fields or electrostatic discharge

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



NOTICE

Equipment damage due to electric fields or electrostatic discharge

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

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

2.3 Warranty and liability for application examples

Application examples are not binding and do not claim to be complete regarding configuration, equipment or any eventuality which may arise. Application examples do not represent specific customer solutions, but are only intended to provide support for typical tasks.

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

2.4 Security information

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

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

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

For additional information on industrial security measures that may be implemented, please visit

https://www.siemens.com/industrialsecurity (https://www.siemens.com/industrialsecurity).

2.4 Security information

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

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under

https://www.siemens.com/cert (https://www.siemens.com/cert).

Further information is provided on the Internet:

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



Unsafe operating states resulting from software manipulation

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

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

2.5 Residual risks of power drive systems

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

- 1. Unintentional movements of driven machine or system components during commissioning, operation, maintenance, and repairs caused by, for example,
 - Hardware 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 electronic components
 - External influences/damage
 - X-ray, ionizing radiation and cosmic radiation
- 2. Unusually high temperatures, including open flames, as well as emissions of light, noise, particles, gases, etc., can occur inside and outside the components under fault conditions caused by, for example:
 - Component failure
 - Software errors
 - Operation and/or environmental conditions outside the specification
 - External influences/damage
- 3. Hazardous shock voltages caused by, for example:
 - Component failure
 - Influence during electrostatic charging
 - Induction of voltages in moving motors
 - Operation and/or environmental conditions outside the specification
 - Condensation/conductive contamination
 - External influences/damage
- 4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc., if they are too close
- 5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly
- 6. Influence of network-connected communication systems, e.g. ripple-control transmitters or data communication via the network

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

2.5 Residual risks of power drive systems

System overview

3.1 Application

Overview

SINUMERIK ONE 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.

SINUMERIK ONE with the integrated SINAMICS S120 drive system and the SIMATIC S7-1500 automation system constitutes a complete digital system that is best-suited for medium and high performance ranges.

SINUMERIK ONE sets itself apart as a result of:

- · 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 Plus.
- Comprehensive range of products for integrating machine tools into communication, engineering and production processes.
- Universal engineering in all configuring phases of a plant by integration in the Totally Integrated Automation Portal (TIA Portal).

Fields of application

SINUMERIK ONE 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 Job Shop production.

The SINUMERIK ONE E is available as export version for use in countries where approval is required.

3.2 System configuration

3.2 System configuration

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

Connectable 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. A SIMATIC IPC für SINUMERIK can be used for increased performance in the operating area.

Up to 4 distributed Panels can be operated on one NCU/IPC. 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:

- SIMATIC IPC for SINUMERIK and Machine Control Panel / Machine Push Button Panel
- SIMATIC Industrial Thin Client V3 (from firmware V3.1.2.0)
- SIMATIC CE panel
- SINUMERIK handheld units
- Distributed PLC I/O
 - SIMATIC e.g. ET200SP and ET200MP
 - SINUMERIK via PROFIBUS DP:
 e.g. SINUMERIK I/O module PP 72/48D
 - SINUMERIK via PROFINET IO:
 SINUMERIK I/O modules PP 72/48D PN and PP 72/48D 2/2A PN
- SINAMICS S120 drive system

• Feed motors, main spindle motors and direct-drive motors in synchronous and asynchronous design:

- Feed motors: 1FT, 1FK

Main spindle motors: 1PH, 1FE, 2SP1

Direct-drive motors: 1FN3, 1FW6

Limited operation of I/O devices and NCK drives
 The I/O connection options that are supported are listed in the table.
 More information is also provided in the Commissioning Manual "SINUMERIK ONE Steps when Configuring and Commissioning".

	DP1 (X126) Interface	DP Integrated Interface	PN1 (X150) Interface	PN2 (X160) Interface
PLC	Х		X	Х
I/O (e.g. ET200)				
NCK	X ¹		X	
I/O (e.g. ET200)				
Isochronous PLC	X		X	
I/O (e.g. ET200)				
Isochronous NCK	X ^{1 2}		X	
I/O (e.g. ET200)				
Isochronous PLC + NCK	X ^{1 2}		X	
I/O at the same interface				
Isochronous NCK drives		Х	Х	
Isochronous NCK drives + isochro- nous PLC I/O at the same interface			Х	
Isochronous PLC Drives (S7-Mo- tion)	X		X	

^{1:} from NCU-SW 6.14

Note

A specific software release is required. More detailed information can be found in the corresponding SIOS article for the associated software release.

^{2:} I/O devices isochronous to DP1, but NCK and DP1 not isochronous.

3.2 System configuration

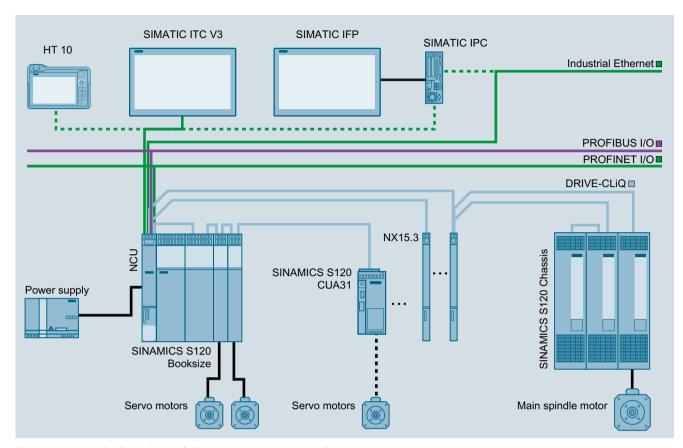


Figure 3-1 Typical topology of the SINUMERIK ONE complete system

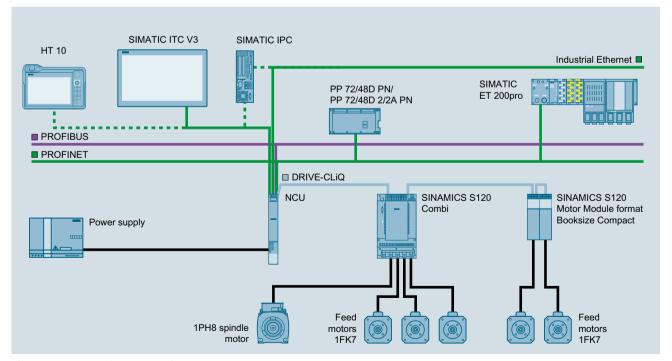


Figure 3-2 Topology example

Networking

SINUMERIK ONE offers integrated PROFINET functionality.

PROFINET IO is supported:

- 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.
- The NCU has 2 separate PROFINET interfaces:
 - up to 255 PROFINET devices can be connected to X150
 - up to 128 PROFINET devices can be connected to X160

The SINUMERIK NCK only supports PROFINET devices that are connected to port X150

3.3 Versions

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

Application areas and performance

- On the NCU, the number of axes and/or the performance of the drive control can be increased to 31 axes. This is achieved through the use of the NX modules. The NCU can be expanded by up to 5 NX modules for increased performance of the drive control and number of axes.
- An NCU 1750 is recommended for maximum dynamic performance and accuracy in mold making or in the High Speed cutting sector.

The following table shows the key characteristics of the various NCU versions:

Table 3-1 Versions of the NCU 1750

DRIVE-CLiQ ports	6
Axes	31 CNC axes (max. 40 axes, incl. PLC axes)
NX10.3 / 15.3	Up to 5
ITC	Up to 4
Channels	10
Mode groups (BAG)	10
Maximum resolution with SINUMERIK Operate for NCU	1920 x 1080px

3.4 Ordering data

Table 3-2 Order data for system components

System component	Article number
NCU 1750	6FC5317-5AA00-0AA0
Numeric Control Extension NX15.3 (High Extension)	6SL3040-1NB00-0AA0
Numeric Control Extension NX10.3 (Standard Extension)	6SL3040-1NC00-0AA0
PP 72/48D PN I/O module	6FC5311-0AA00-0AA0
PP 72/48D 2/2A PN I/O module	6FC5311-0AA00-1AA0
USB flash drive 32 GB, USB 3.0	6AV6881-0AS42-0AA1

Table 3-3 Ordering data for spare parts / accessories

Spare parts / accessories	Article number
Dual fan module	6FC5348-0AA30-3AA0
Spacer for NCU 17x0	6SL3064-1BB00-0AA0
Front cover	6FC5348-0AA30-1AA0
Service area cover	6FC5348-0AA30-2AA0
Cover for optional guide frame	6SL3064-3CB00-0AA0
Dust-protection blanking plug (50 pcs.) for DRIVE-CLiQ interfaces	6SL3066-4CA00-0AA0
PROFIBUS connector with terminating resistor	6ES7972-0BB42-0XA0
Terminal kit, consisting of connectors X122 / X124 / X132 / X142 and dust cover, blanking plugs for DRIVE-CLiQ interfaces	6SL3064-2CB00-0AA0

Table 3-4 Ordering data of the memory expansion options

Memory expansion options	Article number
CNC user memory expansion	6FC5800-0BD00-0YB0
PLC main memory each expanded with 1.5 MB program and 5 MB data	6FC5800-0BD10-0YB0

Ordering options

The described products can be found in the following catalogs:

• All devices that belong to the SINUMERIK ONE and SINAMICS S120 product families can be found in Catalog NC 63. This catalog makes references to all other related catalogs.

You can also order the products online:

- Industry Mall (http://www.siemens.com/industrymall)
- Spares On Web (https://www.sow.siemens.com/)

Description

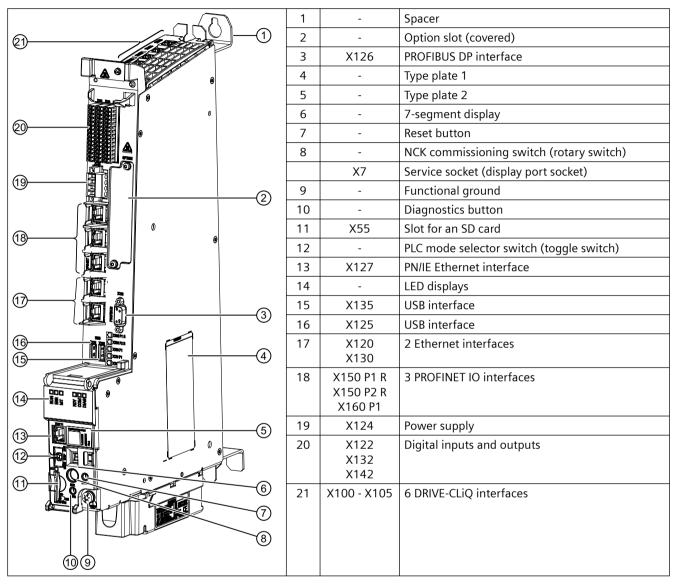
4.1 Characteristics

The following elements designate an NCU:

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

4.2 Illustration

The following diagram shows an NCU with its interfaces, operating control and display elements (fault and status displays).



Representation of the NCU

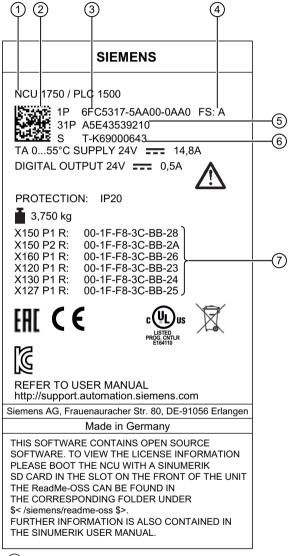
Note

Interface X7 is only designed for service purposes, and cannot be used to connect a display.

4.3 Type plates

Side-mounted nameplate

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



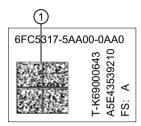
- (1) Component name
- (2) Product code
- 3 Article number
- 4 Version (functional state)
- (5) Material number
- 6 Serial number with production date (here K6 = 2018, June)
- (7) MAC addresses

Figure 4-1 Nameplate (on the side)

4.3 Type plates

Nameplate on the front

You can find this nameplate below the service flap for the operating and display elements.



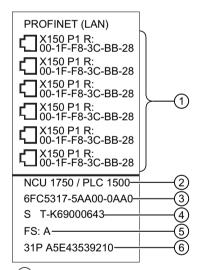
(1) Data matrix code

Figure 4-2 Nameplate (on the front)

The data matrix code contains information about the MLFB, FID, FS, product name and the MAC addresses of X150, X160, X120, X130 and X127.

MAC addresses

A nameplate for the MAC addresses of the PROFINET and Ethernet interfaces is fastened inside the service cover of the NCU:



- 1 MAC addresses
- 2 Component name
- Serial number
- (4) Article number
- 5 Version (functional state)
- 6 Material number

Figure 4-3 MAC addresses of the PROFINET/Ethernet interfaces

Note

Product code scanning

The product code contains the article number of the device. Scan the product code with the aid of the Siemens Industry Online Support App to be taken directly to the Internet Webpage for the product, including all of the technical information and graphical data.

The app is available for iPhone, iPad, Android and Windows Phone.

Note

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

Production date

The production date can be derived from the following assignment:

Table 4-1 Production year and month

Character	Production year	Character	Production month
Α	2010	1 9	January to September
В	2011	0	October
С	2012	N	November
D	2013	D	December
Е	2014		
F	2015		
Н	2016		
J	2017		
K	2018		
L	2019		
М	2020		
N	2021		
Р	2022		
R	2023		

The serial number is stamped on the nameplate.

Information about third-party software used

This product contains open source software ("OSS") components that are subject to the GPL/LGPL licenses and other OSS licenses. The associated OSS component and license information as well as information about the OSS source code (together "OSS Information") are stored on the product and can be fetched as follows:

4.4 Operator control and display elements

Export on an SD Card

- 1. Insert an SD Card formatted with the FAT or ext2/3 file system in the card slot provided at the front of the device.
- 2. Boot the NCU.
- 3. After booting, open the "/siemens/readme-oss" directory. The OSS information is contained in the "ReadMe OSS.txt" file.
- 4. To display the file content, open the file with a text editor, e.g. the Windows "Editor" application.

4.4 Operator control and display elements

4.4.1 Overview of operating and display elements

Open the service flap by pressing on the area labeled with "Push".

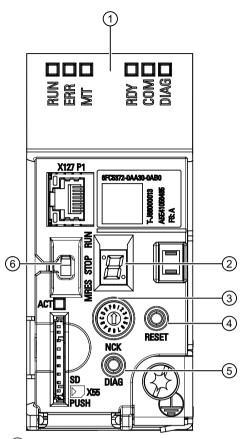
Only appropriately trained personnel may use the operating elements provided in the service area.

NOTICE

Electrostatic discharge if there is no ground connection

If there is no ground connection or a faulty ground connection, then the electronic components in the devices can be damaged as a result of electrostatic discharge (ESD).

Before you open the service flap, discharge yourself at the cabinet or at the ground terminal.



- 1 LED display
- 2 7-segment display
- 3 NCK commissioning switch (rotary switch)
- 4 Reset button
- 5 Diagnostics button
- 6 PLC mode selector switch (toggle switch)

Figure 4-4 Position of operator control and display elements

4.4.2 LED displays

Meaning of the RUN/STOP, ERROR and MAINT PLC-LEDs

RUN/STOP LED	ERROR LED	MAINT LED	Meaning
B			Supply voltage at the PLC not present or too low.
LED off	LED off	LED off	
B	柒		An error has occurred.
LED off	LED flashes red	LED off	

4.4 Operator control and display elements

RUN/STOP LED	ERROR LED	MAINT LED	Meaning
•			The PLC is in the RUN operating state.
LED lights up green	LED off	LED off	
			Diagnostic event pending.
LED lights up green	LED flashes red	LED off	
•			A plant maintenance request is pending.
LED lights up green	LED off	LED lights up yellow	The affected hardware must be validated/replaced within a short interval.
			Active force job
			PROFlenergy pause
•		洪	A plant maintenance requirement is pending.
LED lights up green	LED off	LED flashes yellow	The affected hardware must be validated/replaced within a foreseeable interval.
			Configuration faulty
•		崇	Firmware update completed successfully.
LED lights up yellow	LED off	LED flashes yellow	
_			The PLC is in the STOP operating state.
LED lights up yellow	LED off	LED off	
-	崇	洪	The program from the internal PLC memory causes an error.
LED lights up yellow	LED flashes red	LED flashes yellow	PLC defective
茶			The PLC performs internal activities during STOP, e.g. ramp-up after STOP.
LED flashes yellow	LED off	LED off	Loading the user program from the internal PLC memory.
===			Startup (transition from RUN → STOP)
LED flashes yellow/green	LED off	LED off	
		崇	Startup (booting the PLC)
	LED flashes red	LED flashes yellow	Test the LEDs during startup, insert a module.
LED flashes yellow/green	LED Hasties led	LLD liasties yellow	LED flash test

Meaning of the RDY, COM, DIAG and SD Activity NCU LEDs

Name	Function	Status	Meaning
RDY	Ready	■ LED lights up red	There is at least one fault (e.g. RESET, watchdog monitoring etc.) or the NCU is ramping up.
			SINAMICS communication error
		LED flashes red (2 Hz)	
		•	Ramping up the NCU.
		LED lights up yellow	
		洪	Firmware update of the connected DRIVE-CLiQ components
		LED flashes yellow (0.5 Hz)	
		LED flashes yellow (2 Hz)	Firmware update is complete for components. Wait for POWER ON for the components in question.
		LED liasiles yellow (2 Hz)	NC ramped up and everything in cyclic mode
		LED lights up green	, , , , ,
		業/業	LED-supported detection of connected DRIVE-CLiQ component is activated: $(p0124[0] = 1)$.
		LED flashes green/orange or red/orange (1 Hz)	
СОМ	Communi-		CP not ramped up / started
	cation	LED off	
		•	Communication via CP possible (RUN operating state)
		LED lights up green	
		-	Communication possible (no configuration)
		LED flashes green	
		-	CP was stopped via PLC/TIA. No communication.
		LED lights up yellow	
		汶	Configuration received and transition to the RUN operating state.
		LED flashes yellow	
		崇	Error status (FATAL error)
		LED flashes red	

4.4 Operator control and display elements

Name	Function	Status	Meaning
DIAG	Diagnostics		Everything OK.
		LED lights up green	
		-	Software-related fault is pending, e.g. at PLC, HMI, Linux. Generate
		LED lights up yellow	the diagnostic data wit the Diag button and so contact the Hotline.
		洪	The data backup operation initiated with the Diag button is running.
		LED flashes yellow (0.5 Hz)	
		•	HW-related tests fail, e.g. memory test during switch on.
		LED lights up red	If no change occurs after multiple switch off/on, replace the device.
SD Activity			No SD card inserted.
LED (directly on		LED off	
the card slot)		洪	Active access to SD card
		LED flashes yellow	

Important LED states

- If all the LEDs are flashing, the PLC must be reset (general reset) via the mode selector switch (ramp-up with the switch in the "MRES" position).
- While the NCU is ramping up, all LEDs briefly light up orange. You can carry out a detailed diagnosis using a PG/PC and the operating software.

More information

You can find more information about the drive faults and alarms here:

• Parameter Manual (LH1) SINAMICS S120/S150

4.4.3 7-segment display

Displaying messages

It serves to output status information during commissioning, run-up and cyclical operation. The display is visible only for opened service cover.

Load BIOS

7-segment display	Meaning	
00	Before loading the Master Boot Record (MBR)	
01	Before starting the Master Boot Record (MBR) code	
02	Master Boot Record (MBR) code started	
03	Second stage of the boot loader started, before reading the configuration file	

7-segment display	Meaning	
04	Before loading the kernel	
05	Before starting the kernel	

Basic system run-up

7-segment display	Meaning	
1	Basic initializations	
2	Cleaning up and preparing the file system	
3	The name is set and the loopback interface configured.	
4	Starting the system logging	
	Starting the CFS class 1, provide the network interfaces.	
5	Initializing the network interfaces and the firewall	
6	Starting the time server (ntpd)	
7	Starting the SSH server (generate a host key if one is still not available).	
8	Starting the FTP server	
9	Starting the TCU services (TFTP, VNC)	
Р	Partitioned: The system performs a partitioning operation.	

NRK/NCK run-up

7-segment display	Meaning	
1	Not applicable.	
2	Not applicable.	
3	Debugger was initialized.	
4	NRK operating system was successfully activated.	
5	NRK operating system has booted, init task is being processed (\rightarrow application run-up).	
1 or 2	SD Card and NVRAM data do not match. To resolve this problem, a general reset is required by booting with switch position 1 or 2.	

Operation

7-segment display	Meaning
6.	With flashing dot: The control is in cyclic operation and the cycles are active.

4.4.4 Start-up and mode selector switch

The NCU is equipped with an NCK rotary coding switch and a PLC mode switch in the form of a toggle switch with three different settings:

4.4 Operator control and display elements

NCK commissioning switch



Figure 4-5 NCK commissioning switch

Switch position	NC operating mode
0	NCK normal run-up, setting in normal operation
1	General reset (NCK run-up with default values)
2	NCK runs up with the data that was saved at the last shutdown.
7	Debug mode (NCK is not started); the SSH port tcp/22 is open at X130
8	IP address for X130 of the NCU appears on the 7-segment display; the NCK is not started; the PLC remains at STOP
9	SSH port tcp/22 is open at X130 (without any entry in basesys.ini file)
All others	Not relevant

Note

Switch position when booting the service system

When booting the service system, it is not permissible that the rotary switch is in the "0" position, as in the "0" position, the NCU always boots from the integrated memory and from the SD Card.

PLC mode switch



RUN Places the PLC in the RUN operating state. Setting in normal operation.

STOP Places the PLC in the STOP operating state.

MRE Triggers a general reset of the PLC.

S

Figure 4-6 PLC mode switch

Restoration of the factory settings when the PLC powers up

While the control system powers up, you can delete the user program of the PLC via the toggle switch position MRES. When doing this, the PLC SD Card is cleared and the remanent data initialized. The PLC IP addresses of the X150/X160 interfaces assigned via the TIA Portal are also deleted.

The procedure is divided into requesting and acknowledging the deletion request. The controller can then no longer be set to RUN as long as no project has been loaded.

- 1. Switch on the NCU or press the RESET button if the NCU has already been switched on. The NCU restarts, all PLC LEDs light up orange.
- 2. Wait until the ERR_LED starts flashing alternately green/orange.
- 3. Request: At this moment at the latest, set the PLC mode switch to the MRES position and hold the PLC mode switch in this position until the ERR_LED goes out.

 The PLC recognizes the deletion request.
- 4. Acknowledgment:
 - Now release the PLC mode switch.
 The PLC mode switch automatically jumps back to the STOP position.
 - Briefly press the PLC mode switch to the MRES position and release it again.
 The PLC mode switch automatically jumps back to the STOP position.

Note

As soon as the ERR_LED goes out, perform the acknowledgement steps within max. 3 seconds.

5. When the request has been correctly acknowledged, the RUN LED flashes orange approx. 5 times.

Once the PLC has rebooted, it is deleted.

If the RUN LED does not flash approx. 5 times, the request did not function. Repeat steps 1-5.

4.4.5 RESET button

Arrangement

The RESET button is located behind the service cover.

Performing a reset operation

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

4 5 Dual fan module

4.4.6 DIAG button

Pressing the DIAG has various functions depending on when it is pressed.

Requirements

• Version (functional state) = FS: J

Diagnostic data of the system bootloader

- 1. Insert a USB stick with FAT file system and directory "beiboot.log" into the NCU (X125/X135).
- 2. After switching on and while executing the "Beiboot", press the DIAG button on the NCU.
- 3. The DIAG-LED flashes yellow slowly.
- 4. If directory "beiboot-log" was found, file "YYYYMMDD-HHMMSS-CCC.txt" is created, which contains the content of the usual detailed screen and the syslog from "Beiboot".
- 5. Once the operation has been completed, the DIAG-LED flashes green quickly

Diagnostic data of Operate (Didac)

Once the NCU has run-up, during operation, you can press the DIAG button at any time. This generates file "out 20xx-xx-xxTxx xx xx.7z" in directory/card/user/sinumerik/didac.

This file contains all the relevant NCU diagnostic data.

4.5 Dual fan module

Functions of the dual fan module

The dual fan module cools the CPU with two redundant fans.

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": When none of the fans turn.
 If the software does not respond within approx. 1 minute, the components are shut down automatically.

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

Additional information on the diagnostics buffer can be found in the Basic Functions Function Manual, see PLC signal LBP_NC.E_ATempAlarm (fan temperature alarm).

Fans

The temperature is sensed at several locations within the NCU.

4.5 Dual fan module

If natural convection is not sufficient to ensure cooling of the NCU, the two fans in the dual fan module are switched on automatically. The speed is controlled so that permissible temperature limit values are maintained at the measuring points.

After switching the NCU on, the fan is activated for a brief period of time (function test) before turning itself off again.

Note

The NCU can be operated only with an operational dual fan module.

4.5 Dual fan module

Application planning

5.1 Supplementary electrical conditions

5.1.1 Grounding concept

Components

The SINUMERIK ONE system consists of several individual components that 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 (SIMATIC ITC, SIMATIC IPC for SINUMERIK + SIMATIC IFP)
- · Distributor box and handheld unit
- S7-1500 I/O devices

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 / equipotential bonding.

Example: The control panel on the swivel arm.

It is sufficient in this instance to connect the ground connections of, for example, the SIMATIC IPC for SINUMERIK or ITC using a cable and to route a shared grounding conductor to the central ground connection in the control cabinet.

More information

More information about EMC installation guidelines can be found under:

Configuration Instructions, EMC installation guideline (https://support.industry.siemens.com/cs/document/60612658/emc-design-guidelines-configuration-manual-01-2012?dti=0&lc=en-WW)

5.1 Supplementary electrical conditions

5.1.2 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 cables

- 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 Stop cables
- Power cables (example)
 - Supply voltage 1 x 230 VAC or 3 x 400 VAC
 - Motor cables

Rules for routing cables

In order to maximize noise immunity for the complete system (control, power unit, 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).

More information

You can find more information on interference suppression measures and the connection of shielded cables here:

Configuration Instructions, EMC installation guideline (https://support.industry.siemens.com/cs/document/60612658/emc-design-guidelines-configuration-manual-01-2012?dti=0&lc=en-WW)

5.1.3 EMC limit values in South Korea

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

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

The EMC limit values to be observed for Korea correspond to the limit values of the EMC product standard for variable-speed electric drives EN 61800-3 of category C2 or the limit value class A, Group 1 according to EN 55011. By implementing appropriate additional measures, the limit values according to category C2 or limit value class A, Group 1, are observed. Further, additional measures may be required, 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.

5.1.4 EMF assessments for 24 V components

The 24 V components, e.g. control systems (NCU, MCU, PPU), IPCs, ITCs, IFPs, handheld units and machine control panels do not generate any appreciable electromagnetic fields.

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

The EC Declaration of Conformity for the EMC Directive can be found on the Internet at the following address (https://support.industry.siemens.com/cs/https://support.industry.siemens.com/cs/ww/de/ps/14604/certww/en/ps/13231/cert).

5.2 Climatic and mechanical environmental conditions

5.2.1 Shipping and storage conditions

The components of the SINUMERIK ONE 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.

5.2 Climatic and mechanical environmental conditions

Table 5-1 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
Biological environmental conditions	2B1 ¹⁾	1B1 ¹⁾	
Chemically active environ- mental conditions	2C2 ²⁾	1C2 ²⁾	
Maximum permissible tem- perature 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 permissi- ble ⁴⁾	1 m/s and wet load- ing surfaces 3)
Condensation, splash water, icing, salt spray	Permissible	Not permissi- ble ⁴⁾	Permissible 3)

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

Note

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

5.2.2 Operating conditions

The components of the SINUMERIK ONE system are intended for a weatherproof, fixed location. The documented ambient conditions apply to the climate in the immediate vicinity of the units and to the entry of the cooling air. The following standards are complied with: EN 60204-1, EN 61800-2, EN 61131-2 and IEC 62477-1.

Table 5-2 Ambient conditions for operation

Ambient conditions		Remarks			
Climatic ambient cond	Climatic ambient conditions				
Climate class	Better than 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 1 000 m increase in altitude - derating.			
Relative humidity (without condensa- tion)	5% to 95% (60% when corrosive gases and/or dusts are present)				

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

For storage in the transport packaging.

⁴⁾ For storage in the product packaging.

Ambient conditions	Application areas	Remarks	
Condensation, icing, drip, spray and splash water	Not permitted		
Max. installation altitude	1 000 m above sea level	Without thermal derating	
	2000 m above sea level	With insulation	
	> 2000 m 4000 m above sea level	Clearances for an operating voltage of 50 V at 5000 m	
Air pressure	620 1060 hPa		
Biological, chemical ar	nd mechanical influence	ces, 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		3M1	
Vibratory load		Frequency range: 10 – 200 Hz	
		Deflection at 10 – 58 Hz: 0.075 mm	
		Acceleration at 58 – 200 Hz: 1 g	
Shock load with shock-sensitive components		Acceleration: 5 g	
		Shock duration: 30 ms	
		Load: 3 x in each direction	
Pollution degree		2 (for indoor use only)	
Type of enclosure		Open type	
Overvoltage category		OVC 2	
EMC conducted / radiation		Class C2 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.

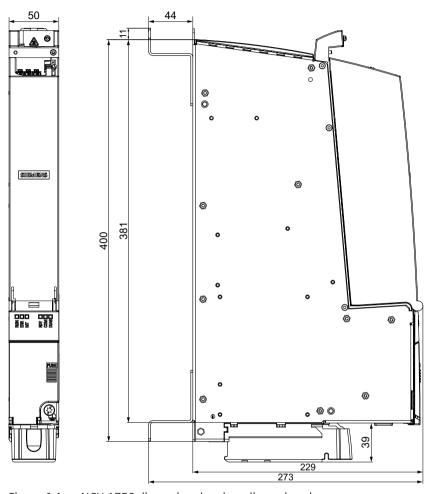
NOTICE

This device is designed for operation in the second environment (industrial areas) and must not be used in the first environment (residential areas) without appropriate interference suppress measures.

5.2 Climatic and mechanical environmental conditions

Dimension drawings

6



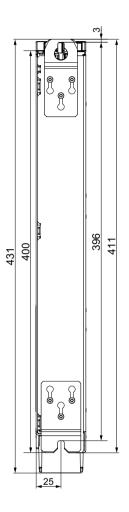


Figure 6-1 NCU 1750 dimension drawing; dimensions in mm

Installation

7.1 Safety instructions

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.



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.

7.2 Designs

NOTICE

Risk of destroying components resulting from high discharge currents

The NCU or other PROFIBUS or PROFINET nodes can be destroyed if significant discharge currents flow through the PROFIBUS or PROFINET cable.

Between parts of a plant or system, use an 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

Equipotential bonding for distributed DRIVE-CLiQ nodes

Integrate all of the components that are connected via DRIVE-CLiQ into the 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 DME20, SME2x, SME12x, etc.

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

7.2 Designs

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

Designs

The NCU is mounted vertically on the rear panel of the control cabinet. It can be mounted with or without a spacer.

Note

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

7.3 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.

7.4 Mounting the NCU without spacers

Procedure

The NCU has spacers on the upper and lower rear side, each fixed with three Torx M3 screws as delivered.

- 1. Remove the spacers with a T10 screwdriver.
- 2. At the top and bottom, fasten the metal lugs of the NCU directly to the rear panel of the control cabinet using two M6 screws (6 Nm).

7.4 Mounting the NCU without spacers

Connecting

8.1 Overview

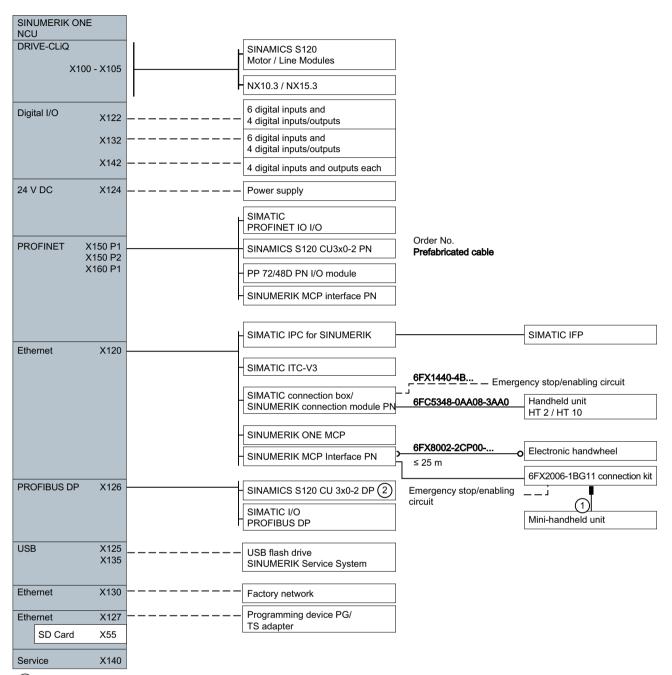
Connection options

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, Ethernet
 - PROFINET

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

8.1 Overview



- (1) Cable included in scope of delivery.
- Cannot be used as an NC axis.

Figure 8-1 Options of connecting an NCU

Interface overview

Table 8-1 Overview of the interfaces that can be used

Interface	Designation	Connector type
DRIVE-CLiQ	X100 - X105	Spec. RJ45 socket
Digital inputs/outputs	X122, X132, X142	3x14-pole spring-loaded terminals
24 VDC power supply	X124	Screw-type terminals, 4-pin
PROFINET	X150; port 1, 2 X160; port 1	Standard RJ45 socket
Ethernet IE1/OP	X120	Standard RJ45 socket, not suitable for PoE
Ethernet IE2/NET	X130	Standard RJ45 socket, not suitable for PoE
PROFIBUS DP1	X126	9-pin SUB-D socket
USB	X125, X135	Double SuperSpeed, type A socket
Ethernet (service socket)	X127	Standard RJ45 socket, not suitable for PoE
SD Card	X55	SD standard slot
Service socket	X140	DisplayPort socket
Dual fan module	X190	10-pin

Note

Interface X140 is only designed for service purposes, and cannot be used to connect a display.

8.2 Communication services and used port numbers

SINUMERIK supports the protocols listed in the following tables. The address parameters, the relevant communication layer as well as the communication role and the communication direction are specified for each protocol.

This information allows you to match the security measures for the protection of the automation system to the used protocols (e.g. firewall).

The following table shows a section of the various layers and protocols that are used.

8.2 Communication services and used port numbers

Layers and protocols

Basically a distinction is made between three port areas:

- System ports / standardized ports
 Ports 0 to 1023 (0_{hex} to 3FF_{hex})
 These ports are reserved for services, if they have not already been assigned as "reserved ports" of the IANA itself (e.g. for future expansions).
- Registered ports
 1024 to 49151 (400_{hex} to BFFF_{hex})
 These ports are intended for registered services, but can also be used for client programs.
- Dynamic ports
 Ports 49152 to 65535 (C000_{hex} to FFFF_{hex})
 These ports are assigned dynamically from the operating system to client programs.

NCU communication services and port numbers

Device	Interface	Port	Protocol	Function	Description
NCU17x0	X120 ¹⁾	22	TCP/UDP	SSH NCU Linux	Secure Shell or SSH refers to both a network protocol and the associated programs, which can be used to safely establish an encrypted network connection with a remote device.
	X120 ¹⁾	102	TCP	S7 communication	ISO on TCP (according to RFC 1006), SIMATIC S7-1500 PLC communication
	X120 ¹⁾	3843	TCP	Diagnostics server	Proprietary protocol, diagnostic data
	X120 ¹⁾	5848	ТСР	SIUpdateService	Proprietary protocol, SINUMERIK Operate update service
	X120 ¹⁾	5849	TCP	tcu_hwsd	Proprietary protocol, registration of USB devices of TCUs on NCUs
	X120 ¹⁾	5850	TCP	tcu_hwsd	Proprietary protocol, TCU hardware service, management of various TCU functions (resolution switchover, focus, light/dark switching, etc.)
	X120 ¹⁾	5900	TCP/UDP	VNC	Virtual Network Computing (VNC) is a software that displays the screen content of a remote computer (server) on a local computer (client), and in return sends keyboard and mouse movements of the local computer to the remote computer.
	X120 ¹⁾	5904	TCP	VNC	VNC according to RFC 6143, NCU service shell
	X120 ¹⁾	5905	TCP	VNC	VNC according to RFC 6143, display of local NCU log files
	X130 ²⁾	22	TCP/UDP	SSH NCU Linux	Secure Shell or SSH refers to both a network protocol and the associated programs, which can be used to safely establish an encrypted network connection with a remote device.
	X130 ²⁾	102	TCP	S7 communication	ISO on TCP (according to RFC 1006), SIMATIC S7-1500 PLC communication
	X130 ²⁾	4840	TCP/UDP	OPC UA Protocol	OPC UA (Unified Architecture) is a standardized, industrial communication protocol for access to control data, e.g. by higher-level control systems.
	X130 ²⁾	5900	TCP/UDP	VNC	Virtual Network Computing (VNC) is a software that displays the screen content of a remote computer (server) on a local computer (client), and in return sends keyboard and mouse movements of the local computer to the remote computer.

¹⁾ Internal HMI network

Note: Note that the firewall X130 is closed as delivered.

²⁾ Company network

8.4 Opening the front cover

8.3 Safety information for wiring

NOTICE

The module can be damaged if power is connected when wiring 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.

8.4 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.

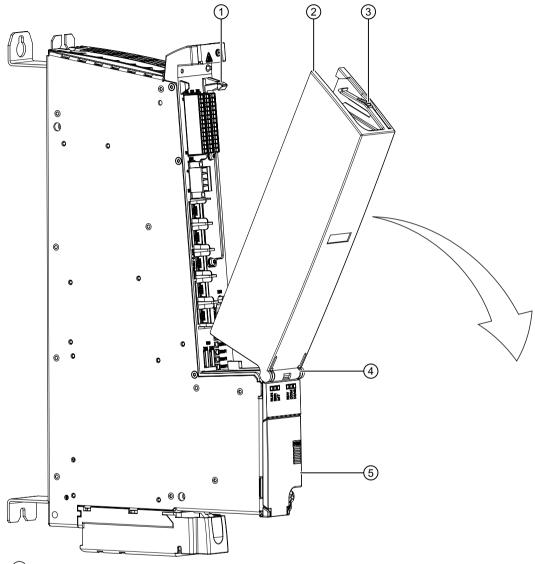
Note

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 it, 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.



- 1 Hooks
- 2 Front cover
- 3 Release hooks
- 4 Hinge, can be opened and closed
- 5 Service cover

Figure 8-2 Removing the front cover

8.5 Power supply

Note

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

8.5 Power supply

8.5.1 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 of the power supply must be connected with the protective ground connection of the system (PELV).

Note

Ground potential and housing (PE) are connected internally with low impedance.

Interface characteristics

The following special requirements apply to the connecting cables:

- The 24 V DC cable must be approved for temperatures up to 70 °C.
- Select the permitted conductor cross-section in accordance with national regulations (NEC, VDE,...) from the "X124 interface" table below. The basis for this can be the output current of the 24 V DC power supply or the overcurrent protection device used in the 24 V circuit. If the 24 V power supply unit that is used has a short-circuit current greater than 50 A, a corresponding overcurrent protection device, which limits to this value, must be used upstream of the product.
- The PE connection must have a minimum conductor cross-section according to EN 60204-1 and a maximum length of 10 m.
- Strip 7 mm of the insulation from the cables for connection to the 24 V DC connector.
- Observe the permissible bending radius of the cables.
- Route all of the cables so that they cannot be crushed or pinched.
- Route all of the cables so that they cannot come into contact with chafing edges.

Les câbles de raccordement doivent répondre aux conditions suivantes :

- Le câble 24 V CC doit être autorisé pour des températures jusqu'à 70 °C.
- Choisir la section de conducteur conformément aux prescriptions nationales (NEC, VDE,...) dans le tableau ci-dessous "Interface X124". Le courant de sortie de l'alimentation 24 V CC ou le dispositif de protection contre les surintensités du circuit de commande 24 V peuvent servir de base. Si le courant de court-circuit de l'alimentation 24 V CC utilisée est supérieur à 50 A, placer un dispositif de protection contre les surintensité en amont du produit qui limite le courant à cette valeur.
- Le raccordement PE doit être dimensionné avec une longueur maximale de 10 m et une section minimale correspondant à EN 60204-1.
- Dénuder les conducteurs de raccordement au connecteur 24 V CC sur 7 mm.
- Tenir compte du rayon de courbure admissible des câbles.
- Pose les câbles de manière à ce qu'ils ne pincent pas les câbles.
- Pose les câbles en évitant tout contact avec des arrêtes abrasives.

Note

When connecting an external 24 V DC power supply to the interfaces, this must satisfy the requirements of a protective extra low voltage (PELV) according to UL 61010. A series fuse must also be used which reliably trips within 120 seconds at an ambient temperature of 0 °C when a short-circuit occurs.

For a primary supply of the power supply used from OVC III circuits up to 600 V AC (line to neutral voltage), it must be ensured that the contact gap of the fuse – or the individual fault-proof circuit – is 3.0 mm according to UL 61010.

When using an external power supply, ensure that the fuse used has a trip rating that corresponds to the maximum possible short-term short-circuit current of the power supply unit being used.

Table 8-2 X124 interface

Chara	acteristics	Version
Conn	ector type	4-pin screw-type terminal
Numl	per of cables that can be connected	1
Conn tions	ectable cable types and conductor cross-sec-	
	Rigid	1.3 mm² 2.5 mm²
	Flexible	1.3 mm² 2.5 mm²
	Flexible, with end sleeve without plastic sleeve	1.3 mm ² 2.5 mm ²
Flexible, with end sleeve with plastic sleeve		1.3 mm² 2.5 mm²
	AWG/kcmil	16 14
Stripp	ped length	6 7 mm
Tool		Screwdriver 0.5 x 3 mm (M2.5)

8.5 Power supply

Characteristics	Version
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.

The following cable lugs may be used:

- Crimped cable lug to DIN 46234
- Pressed cable lug to DIN 46235
- Tube-type cable lug to SN 71322
- Tube-type cable lug "Klauke R Series", UL Category ZMVV

Pin assignment

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

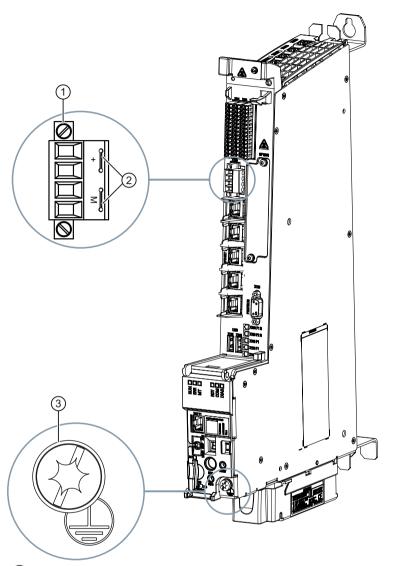
Note

The two "+" or "M" terminals are jumpered in the connector. This ensures the 24 V voltage is looped through. The maximum current can be limited through the current carrying capacity of the cable. The current carrying capacity of the cable depends, for example, on the type of cable installation (cable duct, laying on a cable rack, etc.).

Wiring the screw terminal block

The 24 V DC load power supply required is wired to screw terminal block X124.

Position of the power supply interface



- 1 Power supply connectors
- (2) Jumpe
- 3 Functional grounding, at the housing with M5 screw Torx / 3 Nm

Note

Tighten the power supply terminal strip using a slot screwdriver.

8.5 Power supply

8.5.2 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 VDC power supply.

Table 8-3 Input voltage specification

Typ. current consumption 1)	Max. power consumption 2)	
1.865 A	14.89 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



WARNING

Electric shock as a result of an unsafe DC power supply

If an unsafe DC power supply is connected, exposed components may be at a hazardous voltage level, which can result in serious injury or death.

Use a PELV/DVC A category circuit according to EN 61010-1 as the DC power supply.



WARNING

Electric shock due to inadequately protected power supply cables

If power supply cables are inadequately protected, then lightning strikes can result in a surge voltage. This can result in death, serious injury and material damage.

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. This connection is normally provided as standard in the S7-1500 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 8-4 DC power supply requirements according to EN 61131-2

Rat	ted voltage	24 V DC
	Voltage range (average value)	20.4 VDC to 28.8 VDC
	Voltage ripple peak-to-peak	5% (unfiltered 6-pulse rectification)
	Ramp-up time when switched on	Any
No	n-periodic overvoltages	≤ 35 V

	Duration of overvoltage	≤ 500 ms
	Recovery time	≥ 50 s
	Events per hour	≤ 10
Tra	nsient voltage interruptions	
	Outage time	≤ 3 ms
	Recovery time	≥ 10 s
	Events per hour	≤ 10

Additional information

More information about recommended power supply units and tables for calculating the current drawn for SINAMICS S120 module lineups can be found in the:

• SINAMICS S120 Booksize Power Units Manual

8.6 DRIVE-CLiQ components

8.6.1 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:

• SINAMICS S120 "Drive Functions" Function Manual, Chapter "System control, sampling times and DRIVE-CLiQ wiring".

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 8-5 DRIVE-CLiQ interface X100 - X105

PIN	Signal name	Signal type	Meaning
1	TXP	0	Transmit data +
2	TXN	0	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

8.6 DRIVE-CLiQ components

PIN	Signal name	Signal type	Meaning
8	-	-	Reserved, do not use
Α	+ (24 V)	VO	Voltage supply for DRIVE-CLiQ, 450 mA maximum
В	M (0 V)	VO	Ground to 24 V
Signal type: I = Input; O = Output; VO = Voltage Output			

Position of the DRIVE-CLiQ interfaces

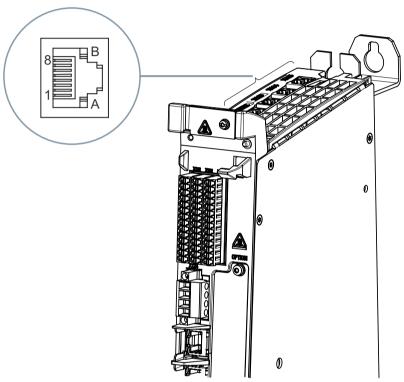


Figure 8-3 DRIVE-CLiQ interfaces

Cable specification

Table 8-6 Cable specification for X100 - X105

Characteristic	Version	
Connector type RJ45 socket		
Cable type	DRIVE-CLiQ standard (inside the control cabinet)	
	MOTION-CONNECT (outside the control cabinet)	
Max. cable length	70 m	

8.6.2 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 8-7 Components with DRIVE-CLiQ

Component	Description
NX10.3 / 15.3	Drive expansion module for up to 6 axes
SINAMICS S120, system com	ponents, 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.
S120 Combi	Compact and robust multi-axis Power Module for the machine tool.
Power Modules	Power Modules provide the energy for the connected motor.
SINAMICS S120, system com	ponents, 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.
SINAMICS S120, additional s	ystem components
SMC10 / 20 / 30 / 40	Cabinet-mounted Sensor Modules are used 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 control 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.
TM15-2/TM31	The number of available digital inputs and outputs within a drive system can be expanded using a Terminal Module.
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.
CUA31	Adapter to connect a Power Module to the NCU.
VSM10	The VSM10 Voltage Sensing Module is capable of measuring the line voltage waveform precisely and helps Line Modules to continue functioning properly under difficult supply conditions, for example, in the case of extreme voltage fluctuations or brief supply interruptions.

8.7 Use of Ethernet interfaces

Component	Description
HLA	Controls (open-loop and closed-loop) electrohydraulic control valves in hydraulic linear axes in conjunction with SINUMERIK ONE
S120M	This is the distributed version of the modular SINAMICS S120 drive system.

Additional information

Additional information about Line, Motor and Power Modules is provided in:

- Booksize Power Units Equipment Manual
- Chassis Power Units Equipment Manual
- AC DRIVE Equipment Manual
- HLA System Manual
- S120M Equipment Manual

Additional information about the Combi is provided in:

• SINAMICS S120 Combi Equipment Manual

Additional information about HF Motor Modules and the associated components is available in:

• High Frequency Drive System Manual

You can find additional information on all of the other modules in:

• Control Units and Additional System Components Equipment Manual

8.7 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 ONE Commissioning Manual Basic Software and Operating Software
 - SIMATIC TS Adapter IE Manual

Properties

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

Pin assignment

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 8-8 Assignment of the Ethernet interfaces X120, X130 and X127 in 10/100 Mbit/s mode

Connector	Pin	Name	Туре	Remark
LED 8	1	TxD+		
	2	TxD-	0	Transmit data
	3	RxD+	I	Receive data
LED 1	4/5	GND	-	(terminated internally with 75 Ω ; not required for data transmission)
	6	RD-	I	Receive data
	7/8	GND	-	(terminated internally with 75 Ω ; not required for data transmission)
	Shield	-	-	On connector housing
	-	LED green	-	Lit: 10 or 100 Mbit/s
		(Link)		Off: No or faulty connection
	-	LED orange	-	Flashes: Data exchange
		(Activity)		Off: No data exchange

Signal type: O = Output; I = Input

Table 8-9 Assignment of the Ethernet interfaces X120, X130 and X127 in 1 Gbit/s mode

Connector	Pin	Name	Туре	Remark
LED 8	1	DA+	В	Bidirectional pair A+
	2	DA-		Bidirectional pair A-
	3	DB+		Bidirectional pair B+
LED 1	4	DC+		Bidirectional pair C+
	5	DC-		Bidirectional pair C-
	6	DB-		Bidirectional pair B-
	7	DD+		Bidirectional pair D+
	8	DD-		Bidirectional pair D-
	Shield	-	-	On connector housing
	-	LED green	-	Lights up orange: 1000 Mbit/s
		(Link)		Off: No or faulty connection
	-	LED orange (Activity)	-	Flashes: Data exchange Off: No data exchange

Signal type: B = Bidirectional

Note

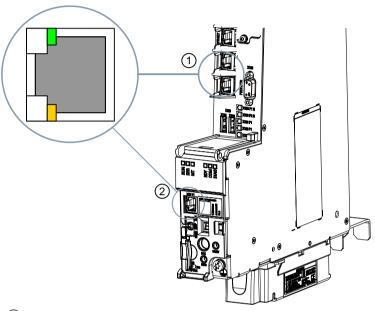
Connection only on LAN, not on telecommunication networks!

8.7 Use of Ethernet interfaces

Note

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

Position of the Ethernet interfaces



- 1 X120 P1 (PN/IE-OP) X130 P1 (PN/IE-NET)
- 2 X127 P1 (PN/IE)

Figure 8-4 Ethernet ports

Cable specification

Table 8-10 Cable specification for X120, X130, and X127

Characteristic	Version	
Connector type	RJ45 socket	
Cable type	Industrial Ethernet cable (as of CAT5)	
Max. data transmission rate:	10/100/1000 Mbit/s	
Max. cable length	100 m	

8.8 PROFINET

Application

Via the PROFINET interface, you can establish PROFINET IO communications networks between the PLC of the control and the field devices.

- X150 supports RT and IRT
- X160 supports RT

Properties

The PROFINET interfaces X150 and X160 are separate interfaces.

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

Pin assignment

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 8-11 Assignment of PROFINET interfaces X150, ports 1, 2 in the 10/100 MBit/s mode

Connector Pin		Name	Туре	Remark
LED 8	1	TxD+		
	2	TxD-	0	Transmit data
	3	RxD+	I	Receive data
LED 1	4/5	GND	-	(terminated internally with 75 Ω ; not required for data transmission)
	6	RD-	I	Receive data
	7/8	GND	-	(terminated internally with 75 Ω ; not required for data transmission)
	Shield	-	-	On connector housing
	-	LED green	-	Lit: 10 or 100 Mbit/s
		(Link)		Off: No or faulty connection
	-	LED orange (Activity)	-	Flashes: Data exchange Off: No data exchange

Signal type: O = Output; I = Input

Remark Connector Pin Name Туре LED 1 DA+ Bidirectional pair A+ 2 DA-Bidirectional pair A-3 DB+ Bidirectional pair B+ 4 DC+ Bidirectional pair C+ LED 5 DC-Bidirectional pair C-6 DB-Bidirectional pair B-7 Bidirectional pair D+ DD+ 8 DD-Bidirectional pair D-Shield On connector housing LED green Lights up orange: 1000 Mbit/s

Off: No or faulty connection

Flashes: Data exchange

Off: No data exchange

Table 8-12 Assignment of PROFINET interface X160 in the 10/100 MBit/s mode

(Link)

LED orange

(Activity)

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.

Position of the PROFINET interface

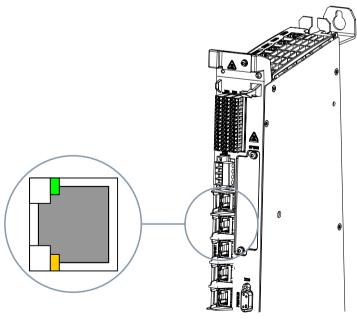


Figure 8-5 PROFINET interface

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 8-13 Cable specification for X150 ports 1, 2

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

8.9 PROFIBUS DP

8.9.1 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 controls with PROFIBUS DP interface
- PG/PC for diagnostics/troubleshooting

Properties

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

X126 pin assignment

Pin	Signal name	Signal type	Meaning
1	-	-	Reserved, do not use
2	М	VO	Ground to P24_SERV
3	1RS_DP	В	RS-485 differential signal
4	1RTS_DP	0	Request to send
5	M5EXT	VO	Ground to P5EXT

8.9 PROFIBUS DP

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, 150 mA maximum			
8	1XRS_DP	В	RS-485 differential signal			
9	9 - Reserved, do not use					
The P	The P5EXT voltage is provided exclusively to supply the bus termination.					
Signa	Signal type: VO = Voltage output (power supply); O = Output, B = Bidirectional					

Position of the connector

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

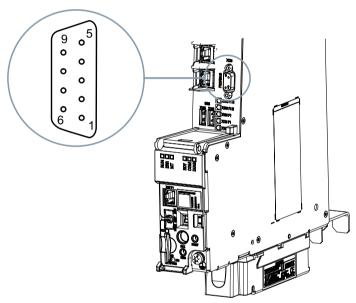


Figure 8-6 PROFIBUS DP interface

8.9.2 PROFIBUS cables and connectors

Cable specification

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

Table 8-14 Cable specification for X126

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

Table 8-15 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 8-16 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	10001)
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 longer 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 connects the PROFIBUS cables to the PROFIBUS DP interface X126, 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.

8.9.3 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.

8 9 PROFIBLIS DP

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.

8.9.4 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_0 = outer diameter of the cable):

Table 8-17 Supplementary conditions for the laying of PROFIBUS cables

Characteristics	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

8.9.5 Connecting PROFIBUS DP

Introduction

PROFIBUS cables are connected to the X126 interface via 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 8-7 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 ramp-up and operation.

8.9.6 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.

8.10 Digital inputs/outputs

8.10 Digital inputs/outputs

8.10.1 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.

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:

• System Manual Guidelines for the Machine Configuration

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.

Note

If the DI/DQ interfaces X122, X132 and X142 are operated partially as DI and partially as DQ (mixed operation), then the DI must be operated with the same power supply as the NCU module power supply X124. This applies to hardware versions frame size A to E

Pin assignment

Table 8-18 X122 digital inputs/outputs

Pin	Signal name	Signal type	Meaning		Default set- ting
1	DIO	I	Digital input 0 Input ON/OFF1 infeed (if one infeed with a DRIVE-CLiQ connection is operated at the NCU)		х
2	DI1	I	"OFF3 – rapid stop" Braking with a configurable p1137); thereafter, pulse s	Input 2. Operating condition OFF3 drives "OFF3 – rapid stop" Braking with a configurable OFF3 ramp (p1135, p1136, p1137); thereafter, pulse suppression and switching on inhibited. The drive stops controlled. The braking re-	
3	DI2	I	Digital input 2 Selection safe standstill gr SH/SBC - Group 1 SINAMIC p9601 release)	oup 1	
4	DI3	I	Digital input 3 Selection safe standstill group 2 SH/SBC - Group 2 SINAMICS Safety Integrated (SH = p9601 release)		
5	DI16	I	Digital input 16 Freely available		
6	DI17	I	Digital input 17 Freely available		
7	G1	GND	Ground for DIO - DI3, DI16, DI17 (isolated with respect to M)		
8	M	GND	Ground for DI8 - DI11		
9	DI/DO8	В	Digital input/output 8 (rapid input) Status safe standstill group 1 SH/SBC - Group 1 SINAMICS Safety Integrated		
10	DI/DO9	В	Digital input/output 9 (rapid input) Status safe standstill group 2 SH/SBC - Group 2 SINAMICS Safety Integrated		
11	М	GND	Ground for DI8 - DI11		
12	DI/DO10	В	Digital input/output 10 (rapid input) Input, external zero mark - BERO 1		
13	DI/DO11	В	Digital input/output 11 (rapid input)	Input, probe 1 - central measuring (check that MD13210 = 0)	x
				Input, probe 1 - distributed measurement (check that MD13210 = 1)	

8.10 Digital inputs/outputs

Pin	Signal name	Signal type	Meaning	Default set- ting
14	М	GND	Ground for DI8 - DI11	
Signal	Signal type: B = Bidirectional; I = Input; GND = Reference potential (ground)			

In the "Default setting" column, the signals for which the associated SINAMICS parameters are set when configuring a SINAMICS device are marked with "x".

Table 8-19 X132 digital inputs/outputs

Pin	Signal name	Signal type	Meaning		Default set- ting
1	DI4	1	Digital input 4		
			Freely available		
2	DI5	1	Digital input 5		
			Freely available		
3	DI6	1	Digital input 6		
			Freely available		
4	DI7	1	Digital input 7		
			Infeed line contactor feedb with a DRIVE-CLiQ connec	eack (if one infeed is operated tion at the NCU)	
5	DI20	1	Digital input 20		
			Freely available		
6	DI21	1	Digital input 21		
			Freely available		
7	G2	GND	Ground for DI4 – DI7 (functionally-separated relative to M)		
8	М	GND	Ground for DI12 - DI15		
9	DI/DO12	В	Digital input/output 12 (rapid input)	Output: Infeed operation (if one infeed is operated with a DRIVE-CLIQ connec- tion at the NCU)	Х
				Input 2. Operating condition OFF2 drives	
10	DI/DO13	В	Digital input/output 13 (rapid input)	Output: Status, infeed ready to start (if one infeed is operated at the NCU with a DRIVE-CLiQ connection)	х
				Input 2. Operating condition OFF2 drives	
				Input, external zero mark 2	
				Input probe 2 - central measurement	
				Input probe 2 - distributed measurement	
11	М	GND	Ground for DI12 - DI15		

Pin	Signal name	Signal type	Meaning		Default set- ting
12	DI/DO14	В	Digital input/output 14 (rapid input)	Input 2. Operating condition OFF2 drives	
				Input, external zero mark 3	
				Input probe 2 - central measurement	
				Input probe 2 - distributed measurement	
				Infeed, control line contactor	
13	DI/DO15	В	Digital input/output 15 (rapid input)	Input 2. Operating condition OFF2 drives	
				Input, external zero mark 4	
				Input probe 2 - central measurement	
				Input probe 2 - distributed measurement	
14	М	GND	Ground for DI12 - DI15		
Signa	Signal type: B = Bidirectional; I = Input; GND = Reference potential (ground)				

In the "Default setting" column, the signals for which the associated SINAMICS parameters are set when configuring a SINAMICS device are marked with "x".

Table 8-20 X142 digital inputs/outputs

Pin	Signal name	Signal type	Meaning	Meaning	
1	-	-	Reserved, do not use		
2	-	-	Reserved, do not use		
3	IN/OUT0	В	Digital NC input 1	\$A_IN[1]	fixed
4	IN/OUT1	В	Digital NC input 2	\$A_IN[2]	fixed
5	М	GND	Ground for IO - I7	•	
6	IN/OUT2	В	Digital NC input 3	\$A_IN[3]	fixed
7	IN/OUT3	В	Digital NC input 4	\$A_IN[4]	fixed
8	М	GND	Ground for IO - I7	Ground for IO - I7	
9	IN/OUT4	В	Digital NC output 1	\$A_OUT[1]	fixed
10	IN/OUT5	В	Digital NC output 2	\$A_OUT[2]	fixed
11	М	GND	Ground for IO - I7		
12	IN/OUT6	В	Digital NC output 3	\$A_OUT[3]	fixed
13	IN/OUT7	В	Digital NC output 4	\$A_OUT[4]	fixed
14	М	GND	Ground for I0 - I7		
Signa	Signal type: B = Bidirectional; GND = reference potential (ground)				

8.10 Digital inputs/outputs

Position of connectors

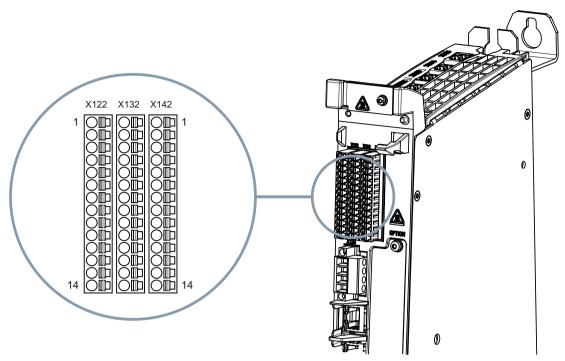
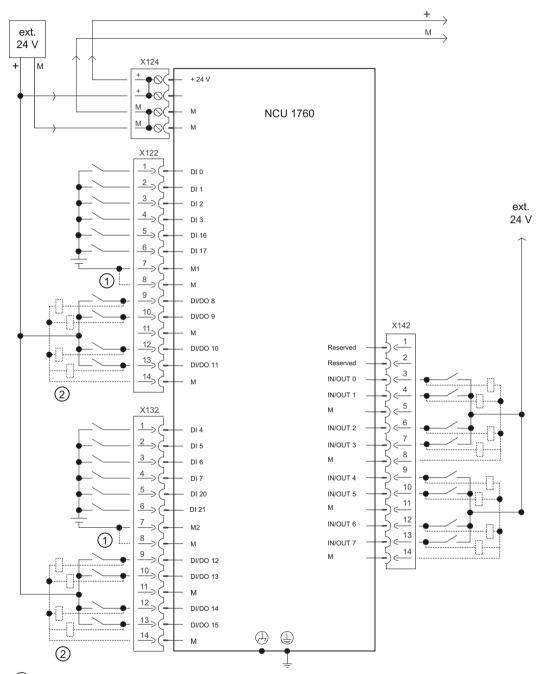


Figure 8-8 Digital inputs/outputs (interfaces X122, X132 and X142)

8.10.2 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 8-9 Block diagram for digital inputs/outputs

8.10 Digital inputs/outputs

Note

The fast digital inputs/outputs must be shielded.

8.10.3 Connecting digital inputs/outputs

Cable specification

Table 8-21 Cable specification at X122 / X132 / X142

Features	Version
Connector type	14-pin spring-loaded terminals
Number of cables that can be connected	1
Connection option	0.2 to 1.5 mm ²
Max. current carrying capacity	6 A
Max. cable length	30 m

Table 8-22 Connectable conductor cross-sections

Connectable conduc-	Rigid	0.2 to 1.5 mm ²
tor cross-sections	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.

The following cable lugs may be used:

- Crimped cable lug to DIN 46234
- Pressed cable lug to DIN 46235
- Tube-type cable lug to SN 71322
- Tube-type cable lug "Klauke R Series", UL Category ZMVV

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.

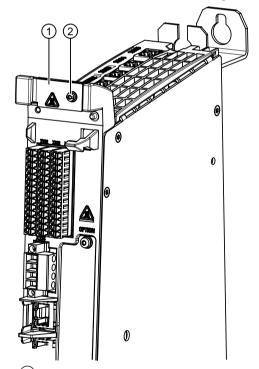
Using shielded cables

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 8-10 Shield support

8.10 Digital inputs/outputs

8.10.4 Technical data

Digital inputs on X122/X132

Table 8-23 Technical data of digital inputs X122/X132

Parameters	Values	
Voltage	-3 VDC to +30 VDC	
Typical current consumption	2.5 mA at 24 VDC	
Galvanic isolation	Reference potential is terminal M1 or M2	
Signal level (including ripple)	High signal level: 15 V to 30 V	
	Low level: -3 V to 5 V	
Input delay (typ.)	L → H: 50 µs	
	H → L: 150 μs	

Digital inputs/outputs at X122 / X132 / X142

Table 8-24 Technical data of the digital inputs/outputs of X122 / X132 / X142

Parameters	Values			
As an	As an input			
Voltage -3 VDC to +30 VDC				
Typical current consumption	2.5 mA at 24 VDC			
Signal level (including ripple)	High signal level: 15 V to 30 V			
	Low level: -3 V to 5 V			
Input delay (typ.) of inputs / "rapid inputs"	L → H: 10 µs / 5 µs			
	H → L: 30 μs / 5 μs			
As an	output			
Voltage	24 VDC			
Maximum load current per output	500 mA continuously short-circuit proof			
Output delay (typ./max.) 1)	L → H: 100 µs H → L: 150 µs			
Switching frequency	for resistive load: max. 100 Hz for inductive load: max. 2 Hz for lamp load: max. 11 Hz			
max. lamp load	5 W			

¹⁾ Data for: V_{cc} = 24 V; load 48 Ω ; High = 90% V_{out} ; Low = 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 M1 or M2 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.

8.11 USB

Table 8-25 Cable specification for X125 and X135

Characteristics	Versions	
Connector type	Double USB socket – type A	
Version	USB 3.0	
Current carrying capacity	0.9 A per channel	
Max. cable length	3 m	

Note

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

8.11 USB

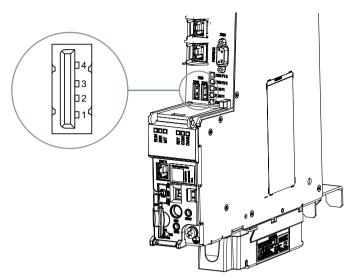


Figure 8-11 Position of the USB interfaces

Diagnostics

9.1 Error messages

These error messages are shown on the 7-segment display (Page 38) as continuously running text ("ticker").

Note

When submitting a query to SIEMENS Technical Support: In addition to the message shown on the 7-segment display, additional information regarding the status LEDs and the operating state (continuous operation, switch-on phase, restart, etc) can provide important information on resolving your problem.

7-segment display	Meaning	Troubleshooting
С	"Crash" or kernel panic: The Linux system no longer responds	Restart the NCU. Execute the "DIDAC" diagnostics option.
Copy FAIL	Firmware installation failed.	This function saves all the diagnostic data
F	"Failure"	to a ZIP file.
F.	The point is continuously lit and no longer flashes: NCK crash	3. Contact SIEMENS Technical Support and transfer the zipped diagnostics data.
Lxx=yyy	Internal error when starting NCK, "xx" is the line number in the mcsystem.ini, "yyy" is a unique error code for the code position.	
Merr	"System Restore Error": A system restore point installation failed.	Check the log file under "/var/log/initn- cu.log".
		Contact SIEMENS Technical Support.
NO ARC	The CNC software package is missing or cannot be found on the SD Card.	Boot the NCU using the SINUMERIK service system, and check the partition using the "Check storage integrity" diagnostics option.
		Replace the SD Card if it is shown to be defective.
		Contact SIEMENS Technical Support if the SD Card is not defective.
NO SD	The operating system cannot detect an SD Card.	Insert the SD Card.
		Check that the SD Card is correctly inserted.
		Check whether the SD Card is defective.
NO SSD	The internal storage medium was not detected.	Contact SIEMENS Technical Support.
PART FAIL	Error when repartitioning	Boot the NCU using the SINUMERIK service system, and check the partition using the "Check storage integrity" diagnostics option.

9.1 Error messages

7-segment display	Meaning	Troubleshooting
SD Error <n></n>	 <n> = single-digit code:</n> SD Error 1: System card reader is not present in HW info SD Error 2: Card reader not responding; HW problem SD Error 3: SD Card missing, or does not contain an ext4 partition SD Error 4: fsck (file system check) failed with incorrigible errors SD Error 5: File system linking failed A write or read error has occurred on the SD Card. 	 Check whether the mechanical write protection (lock) of the SD Card has been activated. It is possible that the SD Card is defective and must be replaced. Check the SD Card using the "Check storage integrity" diagnostics option.
SIGErr= <nn></nn>	<nn> = double-digit code:</nn>	
	SIGErr=08: signature file error No SIEMENS signature was found for a software component.	Check whether the original CNC software package is installed and has not been modified. Install the original CNC software package.
	SIGErr=09: Device certificate period of validity error	Occurs the first time the device is switched on if the system time has not yet been set.
	The system time has not been correctly set.	Check the settings if the error is permanent.
	SIGErr=11: signature file invalid Software was installed with an unassociated signature file.	Check whether the original CNC software package is installed and has not been modified. Install the original CNC software package.
	All others SIGErr	The hardware may be defective. • Contact SIEMENS Technical Support.
unPAC FAIL	A problem has occurred when reading, unzipping or writing the data.	Boot the NCU using the SINUMERIK service system, and check the partition using the "Check storage integrity" diagnostics option. Contact SIEMENS Technical Support if the diagnostics check is unsuccessful.
	The archive with the CNC software is possibly corrupt or unreadable.	Reinstall the CNC software if the SD Card is OK.
6	Dot not flashing: Operating system has crashed where the NCK is no longer clocking	Restart the NCU.
8	"8" and all LEDs are lit yellow: Fan module is not detected.	Check whether the fan module is inserted or is defective.

Please contact SIEMENS Technical Support if it was not possible to resolve the error.

Service and maintenance 10

10.1 Service and maintenance

Cleaning the device

The device is designed for low-maintenance operation. Nevertheless, you must regularly clean the device.

Note

Switch the device off for cleaning

Clean the device only when it is switched off.

For cleaning, use a soft cloth moistened either with water or a mild cleaning agent. Use only dishwashing detergent or foaming detergent.

Procedure

Spray the cleaning agent on to a cleaning cloth. Never use caustic solvents or abrasive cleaners.

Note

Avoid damage

Do not clean the device using compressed air or steam jets because they can damage it.

Checking the device

In order to prevent foreign bodies or liquids entering the device, regularly check the device for the following:

- Ensure that all the housing screws are in place and tight
- For damage to the housing
- For damage to the cable cover or cable entry

Protect the device from environmental effects

Protect the device against the following environmental factors:

- Direct sunshine and heat sources
- Mechanical vibration and shock
- Dust
- Humidity
- Strong magnetic fields

10.1 Service and maintenance

Suspected malfunction

If you suspect a malfunction due to unusual product reactions, isolate the device from power. Immediately inform qualified personnel to check the function and ensure that the product functions correctly.

The following signs can indicate a malfunction:

- Unusual or no functioning
- · Unusual heat generation
- Smoke development

Repair

Send the device back to the manufacturer for repair, with details of the malfunction. The device must only be repaired there.

Technical data

Table 11-1 Safety-related data

Protection class	III
Degree of protection	Open type (open equipment) 1)
Approvals	CE, cULus, RCM, KC, EAC
Declarations of conformity	Directive 2004/108/EC (EMC)
	Directive 2006/42/EC (machinery directive)
	Directive 2011/65/EU (RoHS)
	Directive 2011/65/EU (RoHS), supplemented by: Delegated Directive (EU) 2015/8/63 (document 32015L0863)
Pollution degree	2
Cooling	Open-circuit ventilation
Mounting position	Vertical

¹⁾ Open equipment according to UL 61010

Note

Customers must ensure that the product, with the external fire protection enclosure to be attached by customers, meets the requirements for fire protection of the material according to UL 94 V-1 and the mechanical stability / fire protection requirements / touch protection according to UL 61010.

Table 11-2 Electrical and mechanical data

SIMATIC S7 - integrated	PLC 1500	
Overvoltage category	Secondary circuit supplied from primary circuits up to Cat. II, 300 VAC ²⁾	
Input voltage 3)	24 V DC	
Power consumption, max.	357.5 W	
Power loss, typ.	44.76 W	
Dimensions W x H x D 4)	50 x 432 x 272 mm	
Weight (without packaging)	3.75 kg	

²⁾ If power supply units with primary-side supplies up to 600 V AC (line-to-neutral voltage) are to be used, the transient voltages on the primary side of the power supply unit must be limited to 4000 V.

³⁾ Connect the device only to a 24 V DC power supply that is compliant with protective extra-low voltage (PELV) requirements according to UL 61010.

⁴⁾ With dual fan module and spacers

11.2 Recycling and disposal

11.1 Standards and approvals

CE approval



Figure 11-1 CE marking

The operator panels and the safety-relevant accessories satisfy the requirements and protection objectives of the following EC directives. The operator panels and the safety-relevant accessories comply with the harmonized European standards (EN), promulgated in the Official Journals of the European Community:

More information can be found in the Internet at the following link: SIOS (https://support.industry.siemens.com/cs/document/59843164/)

China RoHs

The products comply with the China RoHs regulation.

More information can be found on the Internet at the following link: SIOS (https://support.industry.siemens.com/cs/products?
dtpsecom/cs/products?
dtpsecom/cs/products/
dtpsecom/cs/products/
dtpsecom/cs/products/
https://dtpsecom/cs/products/
dtpsecom/cs/products/
https://dtpsecom/cs/products/
https://dtpsecom/cs/products/
dtpsecom/cs/products/
https://dtpsecom/cs/products/
https://dtpsecom/cs/prod

11.2 Recycling and disposal



For environmentally friendly recycling and disposal of your old equipment, please contact a company certified for the disposal of waste electrical and electronic equipment and dispose of the equipment in accordance with the regulations in your country.

Connectable components 12

12.1 NX10.3/NX15.3

12.1.1 Description

Properties

Using this module, you can expand the performance of an axis grouping of the SINUMERIK ONE 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)

12.1 NX10.3/NX15.3

Illustration

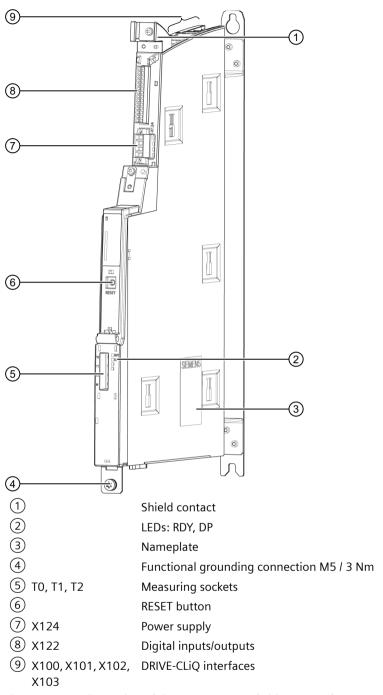


Figure 12-1 Illustration of the NX10.3 / 15.3 (without cover)

Nameplate

The NX module type plate contains the following basic information:

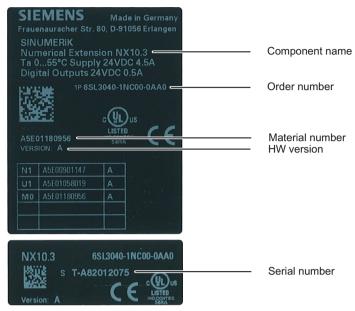


Figure 12-2 Type plate using the NX10.3 as example

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 12-1 Description of LEDs on the NX10.3 / 15.3

LED	Color	Status	Description
RDY	Off		Electronic power supply outside permissible tolerance range
		Continuous light	NX is ready for operation
	Green	Flashing light 2 Hz	Writing to SD card of the connected NCU
	Red	Continuous light	NX is presently ramping up 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

12.1 NX10.3/NX15.3

LED	Color	Status	Description
DP	Off		Electronics power supply outside the permissible tolerance range, NX is not ready to run.
	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

The RESET button of the NX1x.3 only affects the devices connected to the NX. To get the NX ready for operation again after a reset with the NCU, a Reset (po) via the Sinumerik Operate is required.

12.1.2 Dimension drawing

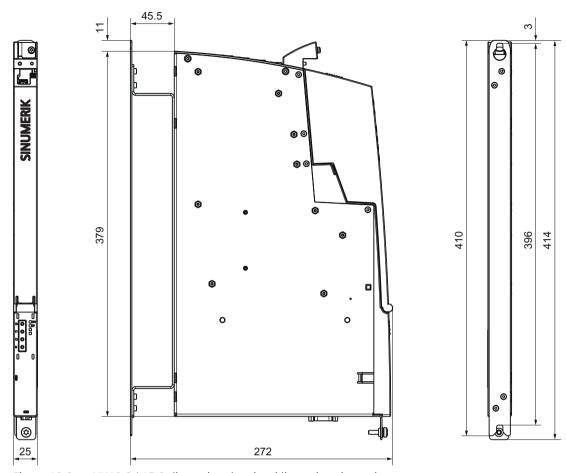
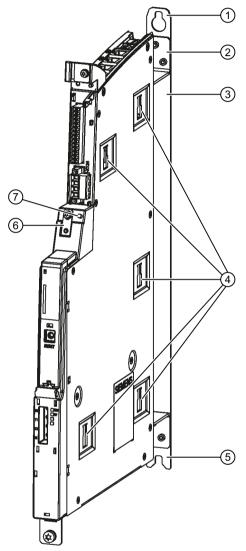


Figure 12-3 NX10.3 / 15.3 dimension drawing (dimensions in mm)

12.1.3 Mounting

Mounting aids



- 1 Fixing lug
- 2 Angle plate
- 3 Holding plate
- 4 Cutouts for side mounting
- 5 Fixing lug
- 6 Bracket
- 7 Pin

Figure 12-4 Mounting aids for the NX module

Designs



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 as delivered.

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 pin 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.

12.1.4 Connection

Power supply X124

Table 12-2 Pin assignment for X124

	Pin	Function
	+/-	24 VDC power supply (20.4 V - 28.8 V)
== +4	+/-	
⊒ _≤ †	М	Ground
	М	

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 of the power supply must be connected with the protective ground connection of the system (PELV).

Table 12-3 Cable specification for X124

Characteristics	Version
Connector type	4-pin screw-type 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	• 16 to 14
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 12-4 Characteristics of X100 - X103

Characteristic	Version	
Connector type	DRIVE-CLiQ connector	
Cable type	DRIVE-CLiQ standard (inside the control cabinet)	
	MOTION-CONNECT (outside the control cabinet)	
Max. cable length	70 m	

Table 12-5 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
8 B	5	-	Reserved, do not use
	6	RXN	Receive data -
THA	7	-	Reserved, do not use
	8	-	Reserved, do not use
	Α	+ (24 V)	Power supply
	В	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 12-6 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:

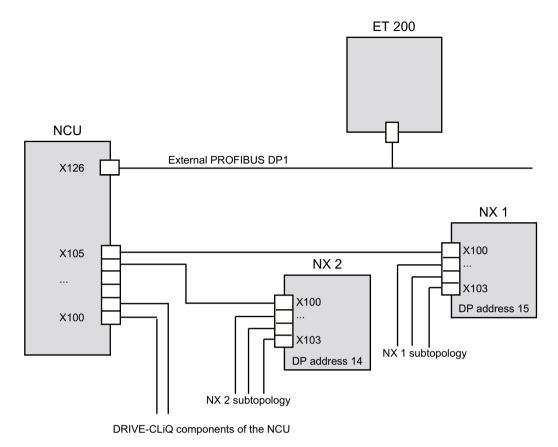


Figure 12-5 NX topology

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 12-7 Interface characteristics of X122

Characteristics	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 8-22 Connectable conductor cross-sections (Page 88).

Table 12-8 Pin assignment for X122

	Pin	Signal name	Signal type	Meaning
	1	DI 0	I	Digital input 0
	2	DI 1	1	Digital input 1
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 DIO - DI3, DI16, DI17 (isolated with respect to M)
	8	М	GND	Ground
	9	DI/DO 8	В	Digital input/output 8 (rapid input)
	10	DI/DO 9	В	Digital input/output 9 (rapid input)
	11	М	GND	Ground
	12	DI/DO 10	В	Digital input/output 10 (rapid input)
	13	DI/DO 11	В	Digital input/output 11 (rapid input)
	14	М	GND	Ground
14	Signal type: B = Bidirectional; I = Input; GND = Reference potential (ground)			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 90).

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 probes depending on the associated terminal assignment.

To enable digital inputs 0 to 3 to function, terminal G1 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.

12.1 NX10.3/NX15.3

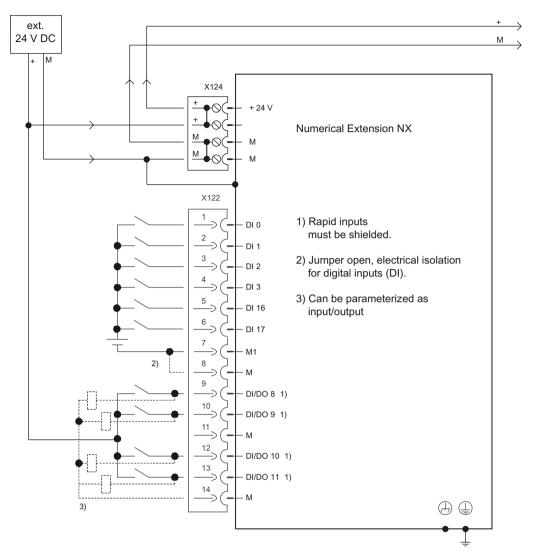


Figure 12-6 Block diagram for digital inputs/outputs

Measuring sockets

Purpose

The TO, T1 and T2 measuring sockets output analog signals. Any signal interconnectable via SINAMICS can be output on any measuring socket of the NX.

Note

The measuring sockets should be used exclusively for servicing purposes.

The measurements may be performed only by appropriately trained skilled personnel.

The measuring sockets are suitable only for multiple-spring wire plugs with a diameter of 2 mm.

Additional information

Additional information on how to commission an NX component is provided in:

• Commissioning Manual IBN CNC: NCK, PLC, Drive

See also

Connecting digital inputs/outputs (Page 88)

12.1.5 Technical Data

Table 12-9 Safety-related data

Protection class	III
Degree of protection to EN 60529	IPXXB
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 12-10 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

12.2 PP 72/48D PN and PP 72/48D 2/2A PN

12.2.1 Description

Characteristics

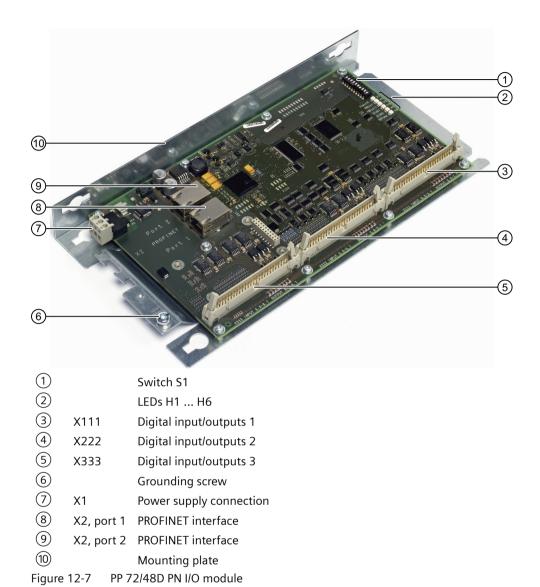
The PP 72/48D PN and PP 72/48D 2/2A PN I/O modules are simple modules (without a separate housing) for connecting digital and analog input/outputs as part of an automation system based on PROFINET IO.

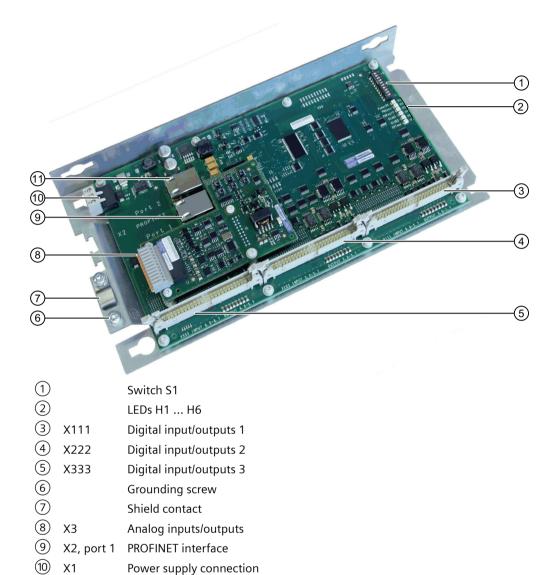
The modules have the following features:

- 72 digital inputs and 48 digital outputs
- PROFINET IO connection (max. 100 MBaud)
- Integrated 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.
- The use of terminal strip converters or the direct connection of distribution boards is possible.
- The PP 72/48D 2/2A PN I/O module also has 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.
- Analog signal cables can be connected directly to terminal contacts on the module.

An external power source (24 VDC) is required for supplying power to the module and digital outputs.

Illustration





11) X2, port 1 PROFINET interface

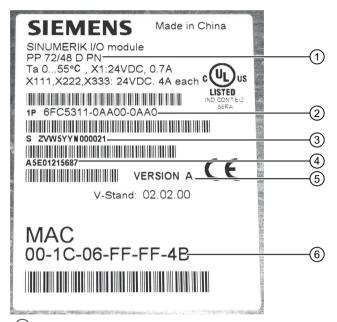
Figure 12-8 PP 72/48D 2/2A PN I/O module

Note

The type plate is located on the rear side of the mounting plate. Note the relevant data because the type plate is no longer visible after installation.

Example: Nameplate

The type plate and the MAC address label are on the rear of the mounting plate. It is advisable to make a note of relevant data as it is no longer visible after installation.



- (1) Component name
- 2 Article number
- (3) Serial number
- (4) Material number
- (5) Hardware revision level
- (6) MAC address

Figure 12-9 PP 72/48D PN type plate

See also

PROFINET (Page 75)

12.2.1.1 LED status display

The I/O module has the following status displays that provide information on the module status:

Name	Designation	Color	Description	
H1	PowerOK	Green	en 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 has 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 the cyclic data exchange is running.	

Name	Designation	Color	Description	
Н3	PNFault	Red	Not lit: Module is operating without errors; the data exchange with all configured I/O modules is running.	
			Lit: Severe bus error	
			One of the following errors is present at port 1/port 2:	
			No physical connection to a subnet/switch	
			Incorrect transmission rate	
			Full duplex transmission is not activated	
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.

12.2.2 Installation

12.2.2.1 **Mounting**

The I/O module is 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. Note the relevant data because it is no longer visible after installation.

Table 12-11 Mounting versions:

Portrait mounting at the lateral strap of the mounting plate	(2x screw M6).
Flat mounting at the rear wall of the mounting plate	(4x screw M6).
Only use copper conductors as ground wire.	AWG10 (2.5 mm2), the torque is 3 Nm.

12.2.2.2 PP 72/48D PN dimension drawing

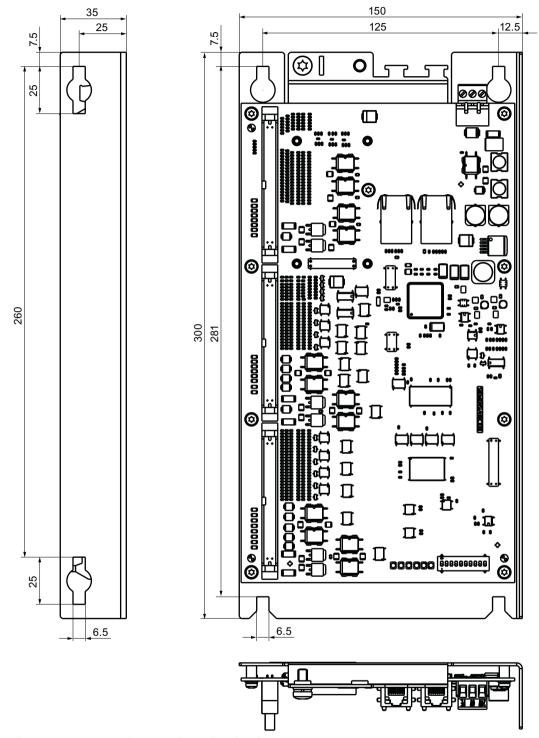


Figure 12-10 PP 72/48D PN dimension drawing

12.2.2.3 PP 72/48D 2/2A PN dimension drawing

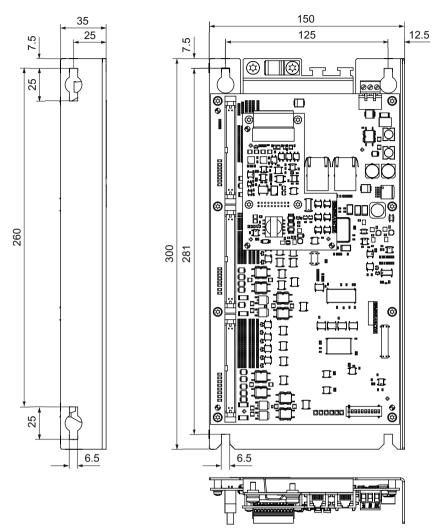


Figure 12-11 PP 72/48D 2/2A PN dimension drawing

12.2.3 Connecting

12.2.3.1 Interface overview

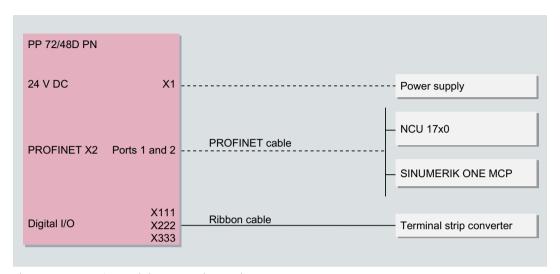


Figure 12-12 I/O module connection options

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

Interface	Designation	Туре
Power supply connection	X1	Screw-type 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

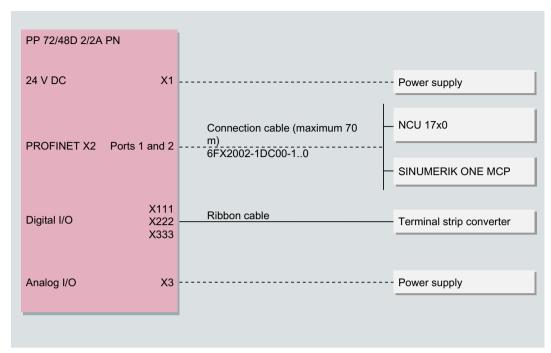


Figure 12-13 Connection options of the PP 72/48D 2/2A PN I/O module

Table 12-13 Interfaces of the PP 72/48D 2/2A PN I/O module

Interface	Designation	Туре
Power supply connection	X1	Screw-type 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	
0	Output	
В	Bidirectional	
V	Supply voltage	
GND	Protective ground (reference potential)	

Note

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

12.2.3.2 Power supply

Requirements for the power supply



DANGER

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/shielding of the Control Unit for EMC 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 PLC I/Os. If this is not the case in exceptional circumstances, the ground connection should be made on the grounding rail of the control cabinet.

See also: "EMC Installation Guideline" Configuration Manual

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 VDC to 30.2 V DC
	Voltage ripple peak-to-peak	5% (unfiltered 6-pulse rectification)
	Ramp-up 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 interrup-	Outage time	≤ 3 ms
tions	Recovery time	≥ 10 s
	Events per hour	≤ 10
X1 terminal	Wiring area	AWG 28 to AWG 12
	Torque	0.51 Nm
\triangle	Conductor material	Only use copper conductors

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.

The required 24 V DC load power supply is wired to the screw-type terminal block (X1). Use flexible cables with a cross-section of 0.25 to 2.5 mm² (or AWG 30 to AWG 12) for wiring the power supply according to the maximum current that flows.

Note

If you only use one wire per connection, a ferrule is not required. You can use ferrules without an insulating collar according to DIN 46228, Form A long version.

Table 12-14 Requirements for digital inputs

Characteristics	Value
Connection option	Up to 2.5 mm2
Current carrying capacity	Max. 10 A
Maximum cable length	10 m

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.

NOTICE

Protection against short-circuit

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

An additional external power supply is not required for the analog inputs and outputs.

Wiring the power supply

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

Table 12-15 Pin assignment at X1 screw-type terminal block

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

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

- Polarity reversal
- Short-circuit (electrical current limiting of outputs)
- Overload (self-restoring PTC fuse)

Wiring the screw-type terminal block

The required 24 VDC load current supply is wired to the screw-type terminal block X1.



Protective separation

The 24 V direct voltage must be configured as an extra-low-voltage with protective separation - DVC A or PELV.

Use flexible cables with a cross-section of 0.25 to 2.5 mm² (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, a ferrule is not required.

You can use ferrules without an insulating collar according to DIN 46228, Form A long version.

Table 12-16 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				

12.2.3.3 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 12-17 PROFINET interfaces X2, ports 1, 2

Pin	Signal name	Signal type	Meaning
1	TX+	0	Transmit data +
2	TX-	0	Transmit data -
3	RX+	1	Receive data +
4	N.C.	-	Reserved, do not use
5	N.C.	-	Reserved, do not use
6	RX-	1	Receive data -
7	N.C.	-	Reserved, do not use
8	N.C.	-	Reserved, do not use

Cable specification

Table 12-18 Cable specification at X2, ports 1, 2

Characteristic	Version
Connector type	RJ45 socket
Cable type	Industrial Ethernet cable (as of 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 12-19 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 12-20 General settings with switch S1

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

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 STEP 7 (TIA Portal).

Table 12-21 General settings with switch S1

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

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.

These device names are required for the SINUMERIK 828D. If you want to operate the I/O module at another controller, e.g. SINUMERIK ONE, then use the DCP mode.

Note

The default device names cannot be reconfigured, for example with the TIA Portal "Assign device name" function.

If you are connecting the I/O module to a SINUMERIK control as a PROFINET component, make sure that this functionality is supported by the associated control.

Table 12-22 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

1	2	3	4	5	6	7	8	9	10	Default device name
off	off	off	off	on	on	on	off			pp72x48pn112
Х	х	Х	Х	Х	х	х	х			п
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			pp72x48pn1						
off			pp72x48pn							

Note

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

12.2.3.4 X111, X222 and X333 digital inputs/outputs

X111, X222 and X333 pin assignment

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 12-23 Pin assignment X111

Pin	Signal name	Туре	Pin	Signal name	Type
1	М	GND	2	P24OUT	VO
3	Input 0.0	1	4	Input 0.1	I
5	Input 0.2	1	6	Input 0.3	I
7	Input 0.4	I	8	Input 0.5	I
9	Input 0.6	1	10	Input 0.7	1
11	Input 1.0	1	12	Input 1.1	1
13	Input 1.2	1	14	Input 1.3	1
15	Input 1.4	I	16	Input 1.5	I
17	Input 1.6	1	18	Input 1.7	I
19	Input 2.0	1	20	Input 2.1	1
21	Input 2.2	1	22	Input 2.3	1
23	Input 2.4	I	24	Input 2.5	I
25	Input 2.6	1	26	Input 2.7	1
27	Not assigned	-	28	Not assigned	-
29	Not assigned	-	30	Not assigned	-
31	Output 0.0	0	32	Output 0.1	0
33	Output 0.2	0	34	Output 0.3	0
35	Output 0.4	0	36	Output 0.5	0
37	Output 0.6	0	38	Output 0.7	0
39	Output 1.0	0	40	Output 1.1	0
41	Output 1.2	0	42	Output 1.3	0
43	Output 1.4	0	44	Output 1.5	0
45	Output 1.6	0	46	Output 1.7	0
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 12-24 Pin assignment for X222

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

Pin	Signal name	Туре	Pin	Signal name	Туре
17	Input 4.6	I	18	Input 4.7	1
19	Input 5.0	I	20	Input 5.1	1
21	Input 5.2	I	22	Input 5.3	1
23	Input 5.4	1	24	Input 5.5	1
25	Input 5.6	1	26	Input 5.7	1
27	Not assigned	-	28	Not assigned	-
29	Not assigned	-	30	Not assigned	-
31	Output 2.0	0	32	Output 2.1	0
33	Output 2.2	0	34	Output 2.3	0
35	Output 2.4	0	36	Output 2.5	0
37	Output 2.6	0	38	Output 2.7	0
39	Output 3.0	0	40	Output 3.1	0
41	Output 3.2	0	42	Output 3.3	0
43	Output 3.4	0	44	Output 3.5	0
45	Output 3.6	0	46	Output 3.7	0
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 12-25 Pin assignment for X333

Pin	Signal name	Туре	Pin	Signal name	Туре
1	M	GND	2	P24OUT	VO
3	Input 6.0	1	4	Input 6.1	1
5	Input 6.2	1	6	Input 6.3	1
7	Input 6.4	I	8	Input 6.5	1
9	Input 6.6	1	10	Input 6.7	1
11	Input 7.0	1	12	Input 7.1	1
13	Input 7.2	1	14	Input 7.3	1
15	Input 7.4	1	16	Input 7.5	1
17	Input 7.6	1	18	Input 7.7	1
19	Input 8.0	I	20	Input 8.1	I
21	Input 8.2	1	22	Input 8.3	1
23	Input 8.4	1	24	Input 8.5	1
25	Input 8.6	1	26	Input 8.7	1
27	Not assigned	-	28	Not assigned	-
29	Not assigned	-	30	Not assigned	-
31	Output 4.0	0	32	Output 4.1	0
33	Output 4.2	0	34	Output 4.3	0
35	Output 4.4	0	36	Output 4.5	0
37	Output 4.6	0	38	Output 4.7	0

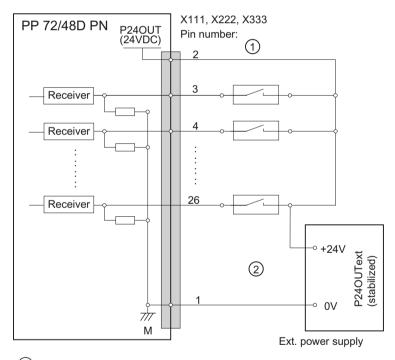
Pin	Signal name	Туре	Pin	Signal name	Туре
39	Output 5.0	0	40	Output 5.1	0
41	Output 5.2	0	42	Output 5.3	0
43	Output 5.4	0	44	Output 5.5	0
45	Output 5.6	0	46	Output 5.7	0
47	DOCOM3	VI	48	DOCOM3	VI
49	DOCOM3	VI	50	DOCOM3	VI

VI: Voltage input / VO: Voltage output

Specification of the digital inputs

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}

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.

I: Signal input / O: Signal output / GND: Reference potential (ground)

- It is not possible to connect a 2-wire BERO.
- 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.

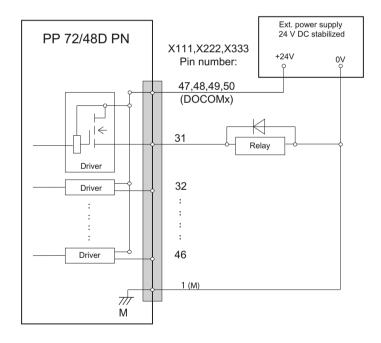
Table 12-26	Electrical	specification	of the	digital	inputs:

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} at X222: DI 3.0 to 3.7			600 μs

Specification of the digital outputs

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.



Characteristics

- No galvanic isolation.
- Protection against: Short-circuit, overtemperature, and loss of ground.
- Automatic disconnection in case of undervoltage.

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.

Table 12-27 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 μΑ	400 μΑ	-
Signal delay time T _{PHL}	-	0.5 ms	-	-
Internal resistance R _I		7 kΩ/kOhm		
Maximum switching frequency				
Resistive load	-	-	100 Hz	-
Inductive load	-	-	2 Hz	-
Lamp	-	-	11 Hz	-

¹⁾ $U_{H \text{ typical}} = V_{CC} - I_{OUT} \times R_{ON}$

V_{CC}: Current operating voltage

I_{OUT}: Output current

Maximum short-circuit current: 4 A (max. 100 μ s, V_{CC} = 24 V)

 R_{ON} : Maximum internal resistance = 0.4 Ω

2) For a simultaneity factor of 100% (all outputs active)

Incorrect connection causes neither high level nor destruction of the outputs.

12.2.3.5 X3 analog inputs/outputs

Analog X3 inputs/outputs

X3 pin assignment

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

Table 12-28 Pin assignment (standard)

Pin	Signal name	Signal type	Meaning
1	CO1	0	Channel 1 current output for PT100
2	CI1	1	Channel 1 current input for PT100
3	AI1+	I	Channel 1 analog input +

Pin	Signal name	Signal type	Meaning
4	AI1-	1	Channel 1 analog input -
5	CO2	0	Channel 2 current output for PT10
6	CI2	I	Channel 2 current input for PT100
7	Al2+	1	Channel 2 analog input +
8	Al2-	I	Channel 2 analog input -
9	AO3+	0	Channel 3 current and voltage output +
10	AO3-	0	Channel 3 current and voltage output -
11	AO4+	0	Channel 4 current and voltage output +
12	AO4-	0	Channel 4 current and voltage output -

Al: Analog input - AO: Analog output Cl: Current input - CO: Current output

Table 12-29 Cable specification:

Plug	12-pin socket/plug combination
Cable	shielded
Max. cable length:	30 m
Max. connectable core cross-section:	0.5 mm ²
Material for the cable	Only use copper conductors. AWG 28 ~ AWG 24 (0.32 mm² ~ 0.5 mm²).
A	

Wiring analog inputs/outputs

Procedure:

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

NOTICE

Shielded signal cables for analog signals

To ensure safe, fault-free operation of the system, shielded cables with shield connection should be used for the wiring of the analog outputs.

Analog inputs

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

• "Voltage input" operating mode:

Parameter	Value
Input range (rated value)	- 10 V to + 10 V
Permissible range overstepping	- 11.75 V to + 11.75 V
Resolution	16-bit (incl. sign)
Accuracy	+/-0.5%
Internal resistance Ri	100 KOhm

"Current input" operating mode:

Parameter	Value
Input range (rated value)	- 20 mA to + 20 mA
Permissible range overstepping	- 23.5 mA to + 23.5 mA
Resolution	16-bit (incl. sign)
Accuracy	+/-0.5%
Internal resistance Ri	133 ohm

• "PT100" operating mode

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

Note

The analog inputs are only enabled following the parameter assignment.

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

NOTICE

Protection from overvoltage

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

In the event of an error the following occurs:

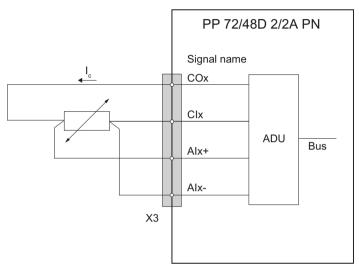
- 1. An error bit is set which is then communicated to the PLC.
- 2. The module is shut down.

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 12-14 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 (Cl 1) and pin 4 (Al 1-) and connect the jumper at connector X3
- Temperature measurement with channel 2: Short-circuit pin 6 (Cl 2) and pin 8 (Al 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.

• "Voltage output" operating mode:

Parameter	Value
Output range (rated value)	- 10 V to + 10 V
Permissible range overstepping	- 10.5 V to + 10.5 V
Resolution	16-bit (incl. sign)
Accuracy	+/-0.5%
Max. load current	-3 mA to +3 mA

• "Current output" operating mode:

Parameter	Value
Output range (rated value)	- 20 mA to + 20 mA
Permissible range overstepping	- 20.2 mA to + 20.2 mA
Resolution	16-bit (incl. sign)
Accuracy	+/-0.5%
Load impedance	≤ 600 ohm

Note

The analog outputs are only enabled after 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.

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

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 12-30 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		10 V
0x0CDA	3291		5 V
0x066D	1645		2.5 V
0x0000	0	0.00152	0 V
0xF993	-1645		-2.5 V
0xF326	-3291		-5 V
0xE64B	-6581		-10 V
Underrange		-	Up to -11.75 V
Underflow		-	Deactivation

Table 12-31 Measured values in the current measurement operating mode

16-bit value (hex.)	16-bit value (dec.)	Factor	Current value [mA]	
Overflow		-	Deactivation	
Overrange		-	up to 23.5 mA	
0x1999	6553		20 mA	
0x0CCC	3277		10 mA	
0x0000	0	0.00305	0 mA	
0xF333	-3277		-10 mA	
0xE666	66 -6553		-20 mA	
Underrange		-	up to -23.5 mA	
Underflow		-	Deactivation	

Table 12-32 Measured values in the "temperature measurement" operating mode

16-bit value (hex.)	16-bit value (dec.)	Factor	Temperature value [°C]
Overflow			
0x0A28	2590		259 °C
0x03E8	1000		100 °C
0x01F4	500		50 °C
0x0000	0.0	0.1	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 connected, 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 for the diagnostics at a counter value of "2" (Page 140).

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

Analog outputs

Table 12-33 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		10 V
0x4CD1	19665		7.5 V
0x199B	6555		2.5 V
0x0000	0	0.00038	0 V
0xE665	-6555		-2.5 V
0xB32F	-19665		-7.5 V
0x999A	x999A -26214		-10 V
Underrange		-	Up to -10.5 V
Underflow		-	Deactivation

Table 12-34 Measured values in the "current output" operating mode

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

12.2.4 Parameterization

12.2.4.1 Parameterization of the digital input/output images

Input image of the digital inputs

The input image for the 1st I/O module (n=0) contains the following digital inputs (DI): $n+0 \dots n+8$ (9 byte)

X222.P3 ... X222.P10 are rapid inputs

Terminal	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	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
X111	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
	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
X222	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
	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
X333	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 of the digital outputs

The output image for the 1st I/O module (n=0) contains the following digital outputs (DO): n+0 ... n+5 (6 byte)

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

Terminal	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
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

12.2.4.2 Assigning parameters to the analog inputs / outputs

Operating mode of the analog outputs

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)	Al (channel 2)	Al (channel 2)	Al (channel 1)	Al (channel 1)							
m+1	Reserved														
m+2		Reserved													
m+3				Rese	rved			Reserved							

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

The operating mode is set to "no operating mode" during ramp-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.

Control type

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 to the analog module are correctly interpreted by the control. In the SINUMERIK ONE control, the value "0" must be entered.

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

Operating mode 1st channel	Bit 1	Bit 0
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
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

Feedback 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 AUTOHOTSPOT.

12.2.4.3 Diagnostics via input image

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				Stat	us_1			

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

Messages in byte 1, depending on the "alive and well" counter

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.

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

Correcting errors at counter value "2"

Value of byte 1	Cause	Effect	Remedy
1	In the temperature measure- ment operating mode, an in- put voltage is too high. The hardware may become dam- aged/destroyed as a result.	The "PNFault" LED is activated. The outputs are switched off. 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 following elimination of the error.
2	Reserved	-	-
3	Overload at the outputs	The "PNFault" LED is activated. The outputs are switched off. 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 following elimination of the error.
4	Incorrect operating mode se- lection, e.g. temperature measurement at the analog outputs.	Selection of the operating mode is rejected.	If selected correctly, the mod- ule switches to cyclic opera- tion.
5	Internal error, system error	The "PNFault" LED is activated. The outputs are switched off. 1) The value 0x80 is stored in	The firmware has detected a system error, this status can only be exited by means of a switch-on / switch-off.
6	Overrange at the inputs	status byte 1.	Check input circuit and adjust, if required.
7	Overrange at the outputs		Correct the values in the user program.

¹⁾ The analog outputs retain their last output value.

12.2.5 Technical data

Table 12-35 Technical data of the I/O module

	PP 72/48D PN	PP 72/48D 2/2A PN
Safety		
Degree of protection	IP 00 accordin	g to EN 60529
Overvoltage category	OV	C II
Protection class	III; DVC A, (PELV) ac	cc. to EN 61800-5-1
Approvals	CE, cULus, KCC, EAC	
Electrical data		
Input voltage	24 V DC + 20%/- 15%	
Rated current	0.7 A	0.8 A
Power consumption at rated load (without digital outputs)	17 W	19 W

Power loss	18 W
Output power X111, X222, X333:	
Resistor	24 V DC; 0.25 A/channel; 4 A/terminal
Pilot duty	24 V DC; 0.25 A/channel; 4 A/terminal
Tungsten	24 V; 5 W
Mechanical data	
Dimensions WxHxD	150 x 300 x 35 mm
Weight, approx.	0.9 kg
Pollution degree	2
Heat dissipation/cooling	Open-circuit ventilation
Condensation	Not permitted
Limitation of relative air humidity at	5 to 95% (without condensation)
25 °C	5 to 90% (with condensation)
Air pressure	106 to 92 kPa or
	0 to 1000 m above mean sea level
Derating	At installation altitudes of more than 1000 to 4000 m above mean sea level, the upper temperature limit must be reduced by 3.5°C / 500m .
Ambient temperature:	
Storage	-40 to 70 ℃
Transport	-40 to 70 ℃
Operation	0 to 55 ℃
Storage	1M2 (in product package); 1.5 mm; 0.5 g
Shock load during transport (in transport packaging)	Free-fall ≤ 1 m

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

X111, X222 and X333 pin assignment (Page 126)

Analog X3 inputs/outputs (Page 131)

Spare parts/accessories 13

13.1 Replacing the dual fan module

Removing the dual fan module

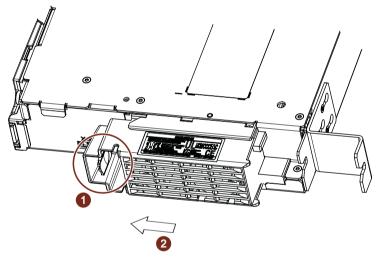
NOTICE

Damage to the module caused by forced removal

The abrupt removal of the locked dual fan module can break the snap-in hooks. The module can no longer be reinserted.

• Release the locking before removing the dual fan module.

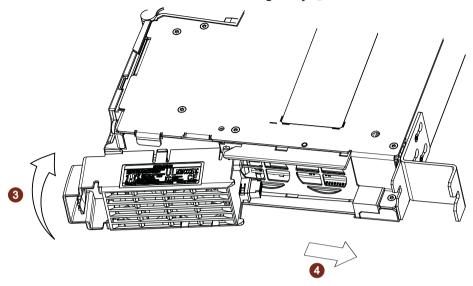
1. Press the release lug 1 to release the module.



2. Withdraw ② the dual fan module straight out toward the front (do not skew).

Inserting the dual fan module

1. Hold the dual fan module tilted forwards diagonally ③.



2. Insert 4 it again into the fan guide on the lower side of the NCU until the locking mechanism engages. The electrical connection between the dual fan module and the NCU is established automatically.

Note

The dual fan 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.

13.2 SD card

13.2.1 Properties of the SD card

Application

The SD card is not supplied with the NCU and must be ordered as a separate component. The SD card is inserted in the plug-in slot with designation SD (X55 interface).

NOTICE

Inserting or withdrawing with the power connected can destroy the SD card

The SD card may be inserted or removed only when the system is de-energized.

Data

The SD card is required for operation of the NCU.

As well as the base software for SINUMERIK and the firmware for SINAMICS, the SD card also contains:

- User data (programs, configuration data, parameter settings)
- Version info (serial number, version, type designation)
- License key This means that the SD card can be inserted into another NCU without having to change the licenses.

13.2.2 Inserting the SD card

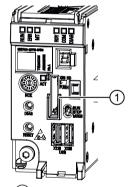
Procedure

Note

ESD: You must discharge yourself at the cabinet or ground terminal before touching the SD card.

Please proceed as follows:

- 1. Switch off the power supply.
- 2. Open the service cover.



(1) Slot for the SD card

Figure 13-1 Inserting the SD card

- 3. Gently insert the SD card into the slot until it clicks into place.
- 4. Switch the power supply on again.

13.2 SD card

Safety symbols 14

lcon	Explanation
Direct current	The equipment is only suitable for direct current. Used for marking corresponding terminals.
	For marking the connection for an external protective conductor for protecting against electrical shock in the event of an error or for a connecting terminal of the external protective conductor.
Protective conductor connection	
<i>,</i>	To identify the functional grounding.
Ground	
	The documentation must be consulted in any scenario where the symbol is affixed in order to find out the type of potential hazard and the actions required to avoid the risk.
General warning symbol	

Appendix

A.1 Abbreviations

AC	Alternating Current
AWG	American Wire Gauge
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.
CCC	China Compulsory Certification
CE	Conformité Européenne: European Conformity
CNC	Computerized Numerical Control: computerized numerical control
CPU	Central Processing Unit: central processing unit
CRC	Cyclic Redundancy Check: checksum validation
CSA	Canadian Standards Association
cULus	UL (Underwriters Laboratories) tested for Canada and USA
DC	Direct Current
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
DMC	DRIVE-CLiQ Module Cabinet (Hub)
DME	DRIVE-CLiQ Module External (Hub)
DP	Distributed I/O
DRAM	Dynamic Random Access Memory
DRIVE-CLiQ	Drive Component Link with IQ
DVC A	Decisive Voltage Category A
EAC	Eurasian Conformity
EC	European Conformity
EGB	Electrostatic Sensitive Devices
EMC	Electromagnetic compatibility
EN	European standard
ESD	Electrostatic discharge: electrostatic discharge
GPL	General Public License
HLA	Hydraulic Linear Actor
НМІ	Human Machine Interface: SINUMERIK operator interface for operating, programming and simulation
HT	Handheld Terminal
IE	Industrial Ethernet
IO or I/O	Input/output
IPC	Industrial PC
IRT	Isochronous Realtime: data exchange with isochronous mode
ISO	International Standards Organization

A.1 Abbreviations

KC	Korean Certification
LAN	Local Area Network
LED	Light-Emitting Diode: light-emitting-diode display
LGPL	Lesser General Public License
MAC	Media Access Control
MCP	Machine Control Panel
MPP	Machine Pushbutton Panel
NCK	Numerical Control Kernel: NC kernel with block preparation, traversing range, etc.
NCU	Numerical Control Unit: NCK hardware unit
NVRAM	Non-Volatile Memory: non-volatile memory
NX	Numerical eXtension (axis extension module)
OP	Operator Panel: operator panel front
OPC UA	Open Platform Communications Unified Architecture: industrial communication protocol
OSS	Open source software
PCU	PC Unit: computer unit
PELV	Protective Extra Low Voltage
PG	Programming device
PLC	Programmable Logic Control: programmable logic control (component of the CNC)
PN	PROFINET
PP	I/O modules
PTC	Positive Temperature Coefficient
RAM	Random Access Memory: program memory that can be read and written into
RCM	Regulatory Compliance Mark
RFC	Request for Comments
RSS	Really Simple Syndication
RT	Realtime: data exchange without isochronous mode
SD	Secure Digital: secure digital memory card
SELV	Safe Extra Low Voltage
SIOS	Siemens Industry Online Support
SME	Sensor Module External
SSH	Secure Shell
TCU	Thin Client Unit (communication with operator panels)
TCP	Transmission Control Protocol
TS	Teleservice
UDP	User Datagram Protocol
UL	Underwriters Laboratories
USB	Universal Serial Bus
VDE	Association of Electrical Engineering, Electronics and Information Technology (Germany)
VNC	Virtual Network Computing
Full duplex	An Ethernet/PROFINET port can simultaneously transmit and receive data.

Index

Pin assignment, 69 Dual fan module, 145
Insert, 146 Properties, 42
E
equipment, 53 Equipotential bonding, 46 Ethernet
Cable specification, 74 Pin assignment, 73
J
F
Front cover, 62
G
General Data Protection Regulation, 12 Grounding measures, 45
I
Initialization, 125 Interface Digital inputs/outputs, 88 DRIVE-CLiQ, 69 Ethernet, 72 Power supply, 64 PROFIBUS DP, 77 PROFINET, 75
USB, 91
L
LED displays Ethernet, 73 I/O module, 115
PROFINET, 75 License key, 147 Line Module, 71 Load operating system, 38

DRIVE-CLiQ

S M MAC address label, 115 Scope of maintenance, 95 MAC addresses, 32 Send feedback, 9 Maintenance, 95 Sensor Module, 71 Messages, 38 Sensors, 57 Motor Module, 71 Shielding, 46 Siemens Industry Online Support Mounting With spacers, 55 App, 11 Without spacers, 55 SINUMERIK, 7 mySupport documentation, 9 Standard scope, 8 Status information, 38 Subnet Ν Connection components, 79 Segment, 80 Nameplate Terminating resistor, 80 I/O module, 115 System error, 93 NCU, 31 NX1x.3, 101 NCK commissioning switch, 40 Т Noise immunity, 46 Technical support, 11 Teleservice, 72 0 Terminating resistor, 80 Training, 11 OpenSSL, 12 Operator control and display elements, 35 Operator panel, 24 W Websites of third-party companies, 8 Ρ PLC mode switch, 40 Power supply, 68 Product support, 10 **PROFIBUS** cables Cable length, 79 Connection, 81 Data rate, 79 Properties, 78 removing, 81 Rules for cabling, 80 PROFIBUS DP interface, 77 PROFINET, 27 Pin assignment, 75 PROFINET address, 124 PT100, pin assignment, 134

R

Remove, 145 RESET button, 41