

SIEMENS

SINUMERIK

SINUMERIK 828D PPU

Manual

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Valid for: SINUMERIK 828D PPU 24x.3 BASIC PPU
26x.3 PPU 28x.3


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Legal information

Warning notice system

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

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

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

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

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


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

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified 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.

Preface

SINUMERIK documentation

The SINUMERIK documentation is organized into the following categories:

- General documentation
- User documentation
- Manufacturer/service documentation

Additional information

You can find information on the following topics under the link (www.siemens.com/motioncontrol/docu):

- Ordering documentation / current documentation overview
- Additional links to download documents
- Using documentation online (finding and searching in manuals/information)

Please send any questions about the technical documentation (e.g. suggestions for improvement, corrections) to the following address:
(<mailto:docu.motioncontrol@siemens.com>)

My Documentation Manager (MDM)

Under the following link you will find information to individually compile OEM-specific machine documentation based on the Siemens content: MDM (www.siemens.com/mdm)

Training

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

- SITRAIN (www.siemens.com/sitrain) - training courses from Siemens for automation products, systems and solutions
- SinuTrain (www.siemens.com/sinutrain) - training software for SINUMERIK

FAQs

You can find Frequently Asked Questions in the Service&Support pages under Product Support (www.siemens.com/automation/service&support).

SINUMERIK

You can find information on SINUMERIK under the following link: (www.siemens.com/sinumerik)

Target group

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

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

Benefits

The information in this manual facilitates installation and connection of the SINUMERIK 828D numerical control.

Standard version

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

Other functions not described in this documentation might be executable in the control. However, no claim can be made regarding the availability of these functions when the equipment is first supplied or in the event of servicing.

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

Technical support

Country-specific telephone numbers for technical support are provided in the Internet under "Contact" (www.siemens.com/automation/service&support).

EC Declaration of Conformity

The EC declaration of conformity for the EMC directive can be found in the Internet (<http://support.automation.siemens.com/WW/view/de/10805517/134200>).

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1.1 Danger notices

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

 DANGER
Qualified personnel Only appropriately qualified personnel may commission/start-up SINUMERIK equipment. The personnel must take into account the information provided in the technical customer documentation for the product, and be familiar with and observe the specified danger and warning notices. When electrical equipment and motors are operated, the electrical circuits automatically conduct a dangerous voltage. When the system is operating, dangerous axis movements may occur throughout the entire work area. A potential fire hazard exists due to the energy being transferred in the equipment and the work materials used. All work on the electrical system must be performed after the system has been switched off and disconnected from the power supply.

 DANGER
Supply voltage External power supply units for supplying components of the drive control must have safety isolation from circuits with dangerous voltages (DVC A according to EN 61800-5-1; SELV/PELV). In addition only power units with control circuits that have safety isolation from circuits with dangerous voltages may be connected.

 DANGER
Commissioning and operation of the devices <p>Proper transportation, expert storage, installation and mounting, as well as careful operation and maintenance are essential for this SINUMERIK device to operate correctly and reliably.</p> <p>The details in the catalogs and proposals also apply to the design of special equipment versions.</p> <p>In addition to the danger and warning information provided in the technical customer documentation, the applicable national, local, and system-specific regulations and requirements must be taken into account.</p> <p>Only class DVC A protective extra-low voltages (PELVs) may be connected to connections and terminals up to 60 V DC in accordance with EN 61800-5-1.</p> <p>Should it be necessary to test or take measurements on live equipment, then the specifications and procedural instructions defined in Accident Prevention Regulation BGV A2 must be adhered to, in particular § 8 "Permissible deviations when working on live components". Suitable electric tools should be used.</p>

 DANGER
Carrying out of repairs <p>Repairs to devices that we have supplied may only be carried out by Siemens Customer Service or by repair centers authorized by Siemens.</p> <p>When replacing parts or components, only use those parts that are included in the spare parts list.</p> <p>EMERGENCY STOP/EMERGENCY OFF devices according to EN 60204-1 (VDE 0113 Part 1) must remain active in all modes of the automation equipment. Resetting the EMERGENCY STOP/EMERGENCY OFF device must not cause an uncontrolled or undefined restart.</p> <p>Anywhere in the automation equipment where faults might cause physical injury or major material damage, in other words, where faults could be dangerous, additional external precautions must be taken, or facilities must be provided, that guarantee or enforce a safe operational state, even when there is a fault (e.g. using an independent limit value switch, mechanical locking mechanisms, EMERGENCY STOP/EMERGENCY OFF devices).</p>

1.2 ESD notices

NOTICE

Handling ESD modules:

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

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

System description

2.1 Controller features

Features

The SINUMERIK 828D is a tailor-made CNC solution for milling and turning machines in the medium performance range.

SINUMERIK 828D is a panel-based CNC (panel processing unit). A CNC, PLC, operator panel and axis control for six drives (standard) are combined in a single unit. This design provides a high degree of robustness by eliminating the need for hardware interfaces between the CNC electronics board and the operator panel. In order to guarantee that operation is as low-maintenance as possible, there are no wearing parts such as fans or back-up batteries.

- CNC operator panel with tailor-made system software versions for turning and milling technologies. PPU 28x, PPU 26x and PPU 24x BASIC
- Two operator panel versions for horizontal and vertical operator panel housings.
- Integrated full QWERTY CNC keyboard with mechanical short-stroke keys. This enables the user to enter text for part-program names or tool identifiers and plain-text language commands directly, without using the keys of the second input level (shift key). The keys have IP65 degree of protection.
- USB, CompactFlash card and Ethernet interface on the operator panel front.
- Additional Ethernet interface on the rear of the CNC for a permanent factory network.
- PLC I/O Interface based on PROFINET for the connection of PLC I/O devices and a machine control panel.
- PP 72/48D PN and PP 72/48D 2/2A PN as PLC I/O module.
- Three handwheels can be connected.
- Optional GSM modem connection possible.
- Up to six axes/spindles for milling applications and up to eight axes/spindles for turning applications.
- One machining channel / mode group.
- Integrated PLC based on the SIMATIC S7-200 command set with ladder logic programming.
- Standardized 3/8" threads are embedded in the upper edges of the operator panel. These threads can be used for attaching commercially available additional components such as holders for diagrams or similar.

Control system versions

The SINUMERIK 828D is available in different versions (horizontal or vertical; turning or milling).

The SINUMERIK 828D is available in the following versions:

2.1 Controller features

- PPU 240.3 BASIC (vertical operator panel)
- PPU 241.3 BASIC (horizontal operator panel)
- PPU 260.3 (vertical operator panel)
- PPU 261.3 (horizontal operator panel)
- PPU 280.3 (vertical operator panel)
- PPU 281.3 (horizontal operator panel)

Quantity structure

The following table shows the quantity structures for the different control versions:

Function	PPU 240.3 / 241.3 BASIC		PPU 260.3 / 261.3		PPU 280.3 / 281.3	
	Turning	Milling	Turning	Milling	Turning	Milling
Non-volatile memory (NVRAM): • For OEM data • For user data	512 KB 3 MB	512 KB 3 MB	512 KB 5 MB	512 KB 5 MB	512 kB 8 MB	512 kB 8 MB
Number of axes/spindles	3	4	3	4	3	4
Maximum number of axes/spindles	5	5	6	6	6 / 8 *	6
Maximum number of axes with drive-based Safety Integrated	5	5	6	6	6 / 8 *	6
Axis expansion with NX10.3	--	--	--	1	1	1
Number of DRIVE-CLiQ interfaces	3	3	3	3	3	3
Maximum number of I/O modules (digital/analog)	3	3	4	4	5	5

Note

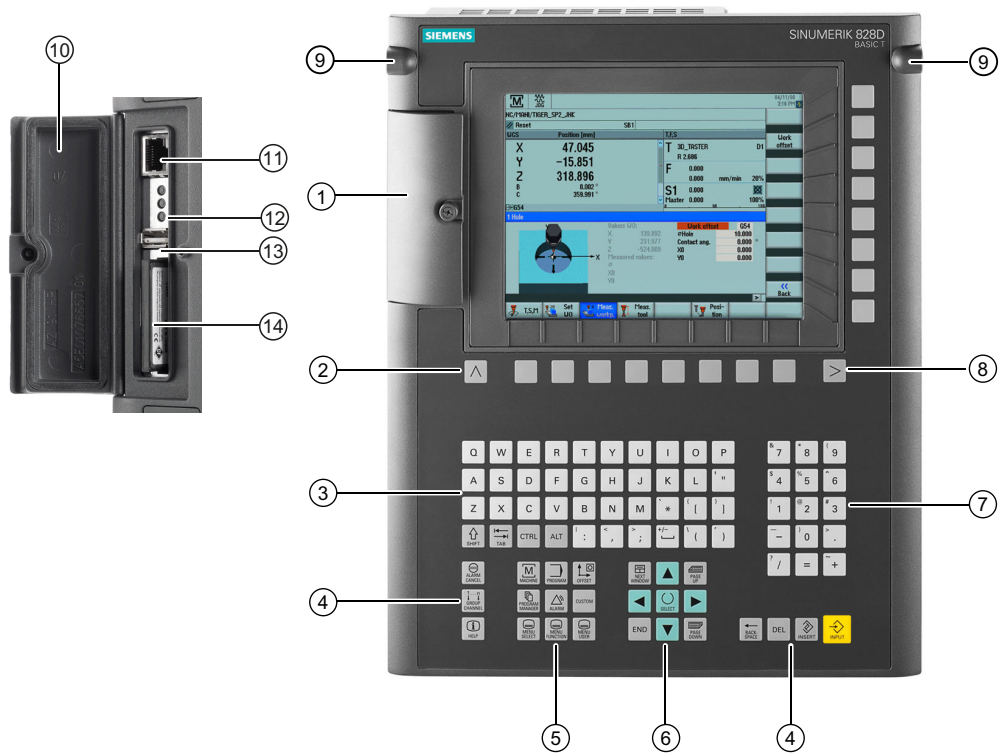
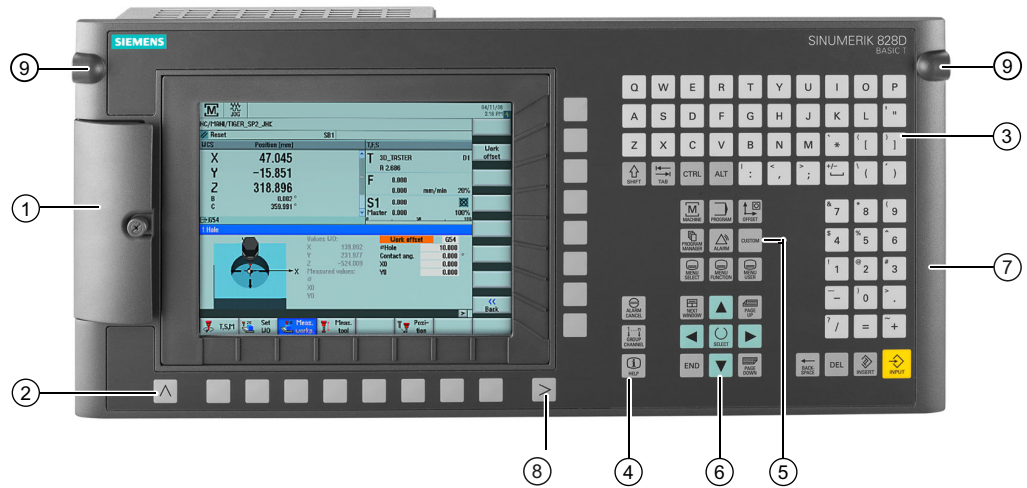
Axis extensions for PPU 28x.3

With the help of a NX10.3, the following extensions can be connected:

- The maximum number of axes can be increased to eight, six of which can be connected to the PPU and two to the NX10.3.
- One high-speed spindle (e.g. 24,000 rpm with four pole pairs) can be connected to the NX10.3 and five axes to the PPU.

2.2 PPU version 24x.3 BASIC

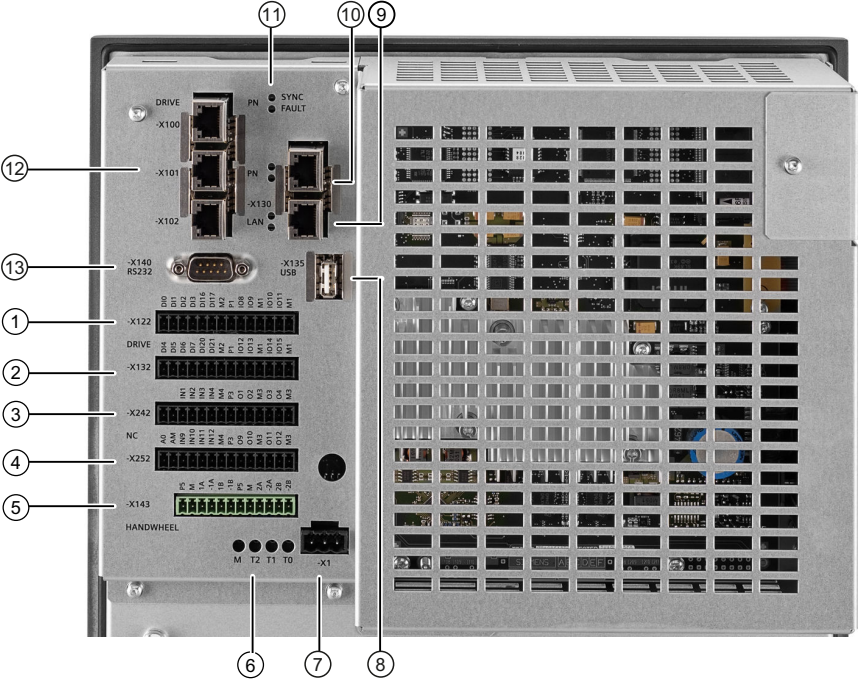
Front side of the PPU 24x.3 BASIC



- ① ⑩ Front cover
- ② Menu back key
- ③ Alphabetic key group
- ④ Control key group
- ⑤ Hotkey group
- ⑥ Cursor key group
- ⑦ Numerical block
- ⑧ Menu forward key
- ⑨ 3/8" threads for additional components
- ⑪ X127 Ethernet (service socket)
- ⑫ Status LED: RDY, NC, CF
- ⑬ X125 USB interface
- ⑭ Slot for CompactFlash card with user data

Figure 2-1 System versions

Rear side of the PPU 24x.3 BASIC

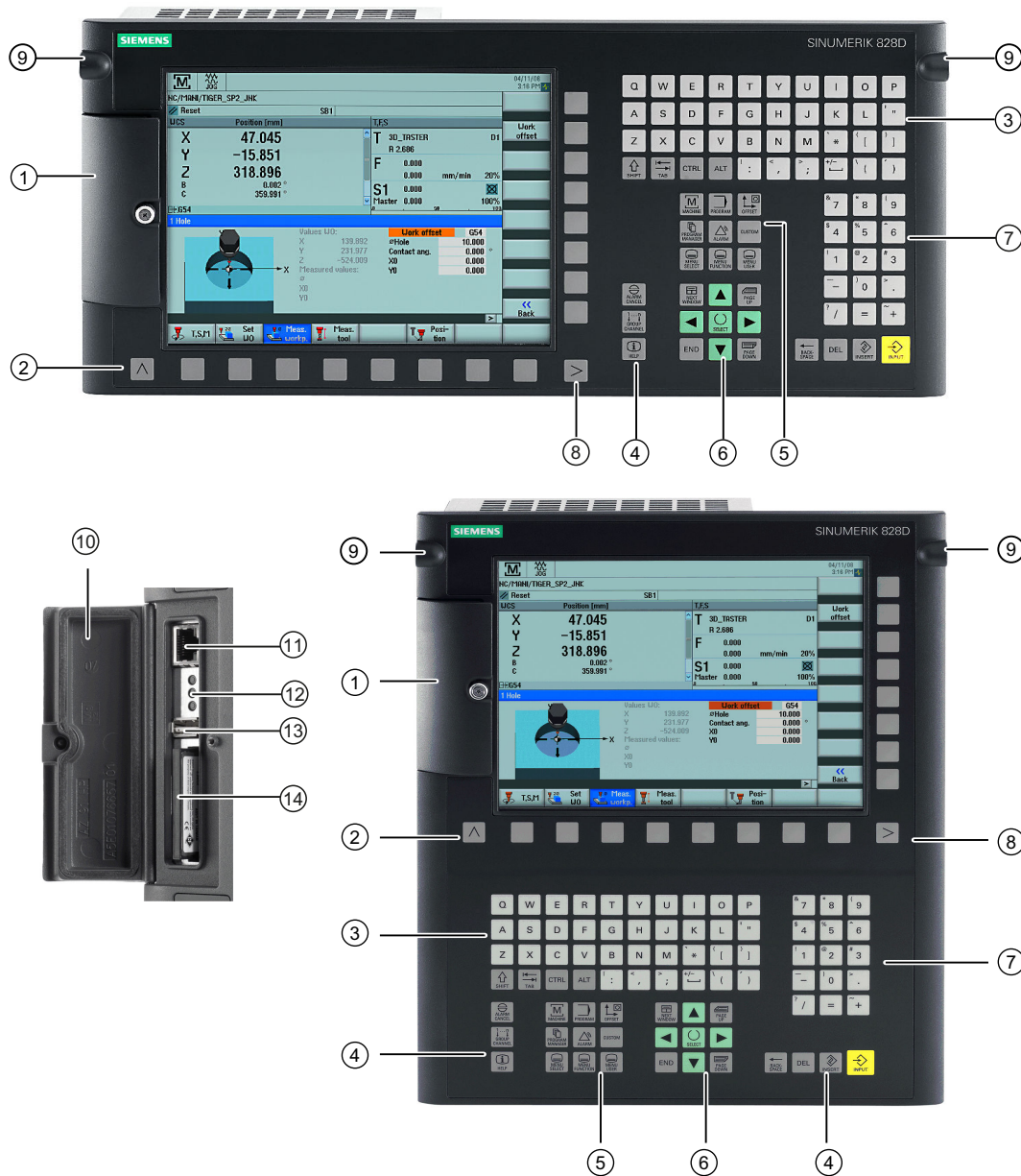


- ① ② X122, X132 Digital inputs/outputs, drive
- ③ ④ X242, X252 Digital inputs/outputs for NC; controller of the analog spindle (X252)
- ⑤ X143 Handwheels
- ⑥ M, T2, T1, T0 Measuring sockets
- ⑦ X1 Power supply
- ⑧ X135 USB interface: For service purposes only
- ⑨ X130 Ethernet LAN
- ⑩ PN PLC I/O Interface
- ⑪ SYNC, FAULT Status LEDs
- ⑫ X100, X101, X102 DRIVE-CLiQ interfaces
- ⑬ X140 Serial interface RS232

Figure 2-2 Interfaces at the rear

2.3 PPU versions 26x.3 and 28x.3

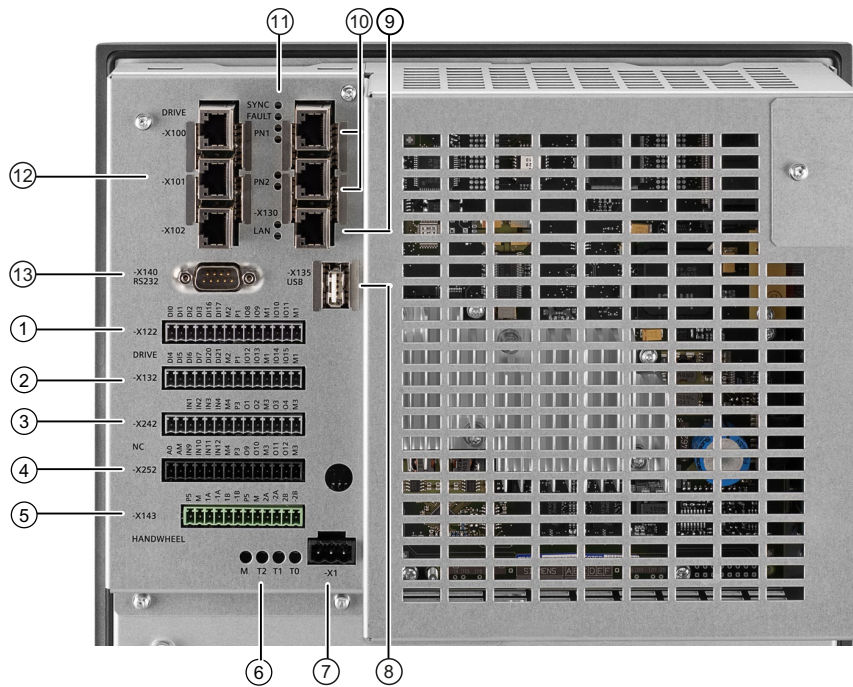
Front of the PPU versions 26x.3 and 28x.3



①		Front cover
②		Menu back key
③		Alphabetic key group
④		Control key group
⑤		Hotkey group
⑥		Cursor key group
⑦		Numerical block
⑧		Menu forward key
⑨		3/8" threads for additional components
⑩		Front cover
⑪	X127	Ethernet (service socket)
⑫		Status LED: RDY, NC, CF
⑬	X125	USB interface
⑭		Slot for CompactFlash card with user data

Figure 2-3 System versions

Rear of the PPU versions 26x.3 and 28x.3



- | | | |
|-----|------------------|--|
| ① ② | X122, X132 | Digital inputs/outputs, drive |
| ③ ④ | X242, X252 | Digital inputs/outputs for NC; controller of the analog spindle (X252) |
| ⑤ | X143 | Handwheels |
| ⑥ | M, T2, T1, T0 | Measuring sockets |
| ⑦ | X1 | Power supply |
| ⑧ | X135 | USB interface: For service purposes only |
| ⑨ | X130 | Ethernet LAN |
| ⑩ | PN 1, PN 2 | PLC I/O Interface |
| ⑪ | SYNC, FAULT | Status LEDs |
| ⑫ | X100, X101, X102 | DRIVE-CLiQ interfaces |
| ⑬ | X140 | Serial interface RS232 |

Figure 2-4 Interfaces at the rear of the PPU

2.4 Operator controls and display elements

TFT color display

The TFT color display has a diagonal size of 10.4" (PPU 26x.3/28x.3) or 8.4" (PPU 24x.3). The resolution is 800 x 600 pixels. The softkeys are arranged in an 8 + 8 layout; this makes the CNC easy to operate using only a very small number of menu levels.

Note









Pixel error acc. to DIN EN ISO 13406-2 Class II.

Keyboard


















Several keys and key pads are installed on the operator panel front:

- The alphabetic key group contains the letters A ... Z and the space character for entering text.
- The numeric key group contains the digits 0 - 9, arithmetic/special characters and the decimal point for entering numeric characters and operators.
- The cursor key group is used to navigate on the screen.
- The control key group includes special functions.
- The area changeover displays the operating areas.
- The menu forward key allows the horizontal softkey bar to be extended in the same menu.
- The softkeys call up functions that are available on screen via a menu bar.
- The machine area key switches directly into the "Machine" operating area.
- The menu back key returns to the superordinate menu, one window is closed.

The keys used on the operator panel front along with the corresponding function keys on the PC keyboard are shown in the following overview:

Key	Function corresponds to PC key function	Key	Function corresponds to PC key function
	Esc		End
	F11		Backspace
	F12		Tabulator
	Spaces		(only for internal keyboard changeover)

2.5 Type plate

Key	Function corresponds to PC key function	Key	Function corresponds to PC key function
	Home		CTRL key
	Page up		ALT key
	Page down		Delete
	Cursor up		Insert
	Cursor left		Enter
	Cursor right		F9
	Cursor down		F10
	5 (in numeric key group)	A ... Z	A ... Z
	<Shift> F9		<Shift> F10

2.5 Type plate

Type plates

The PPU type plate is located on the rear side.

Note

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

The following images display all the information required to uniquely identify a PPU.

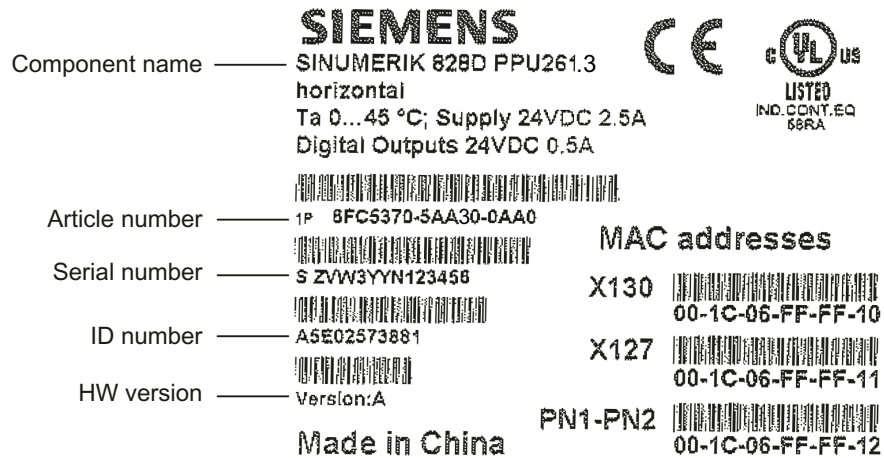


Figure 2-5 Horizontal PPU type plate

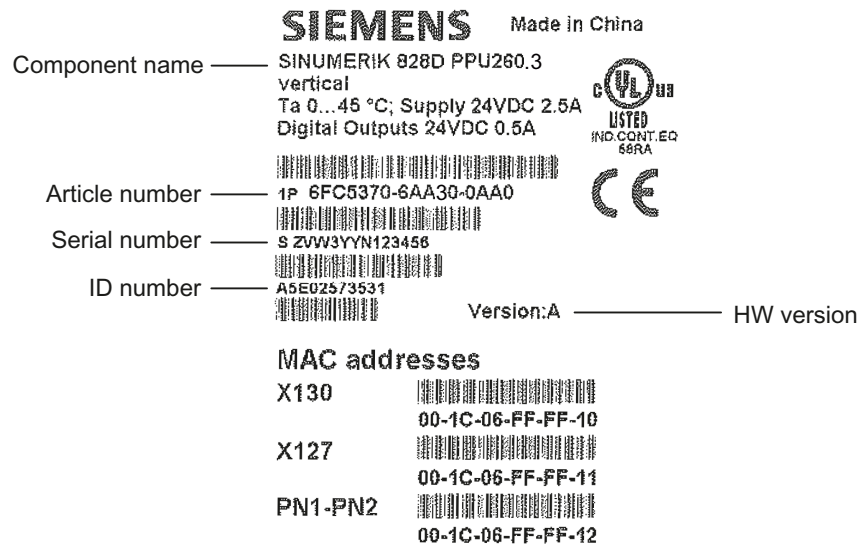


Figure 2-6 Vertical PPU type plate

Note**MAC addresses**

The MAC addresses printed on the type plate of the PPU are required for configuring the PLC I/O Interface communications networks based on PROFINET and Industrial Ethernet.

There is a similar situation for the machine control panels and the I/O modules.

2.6 System overview

Configuration with four axes (basic configuration)

The following configuration shows a typical example with SINAMICS S120 booksize:

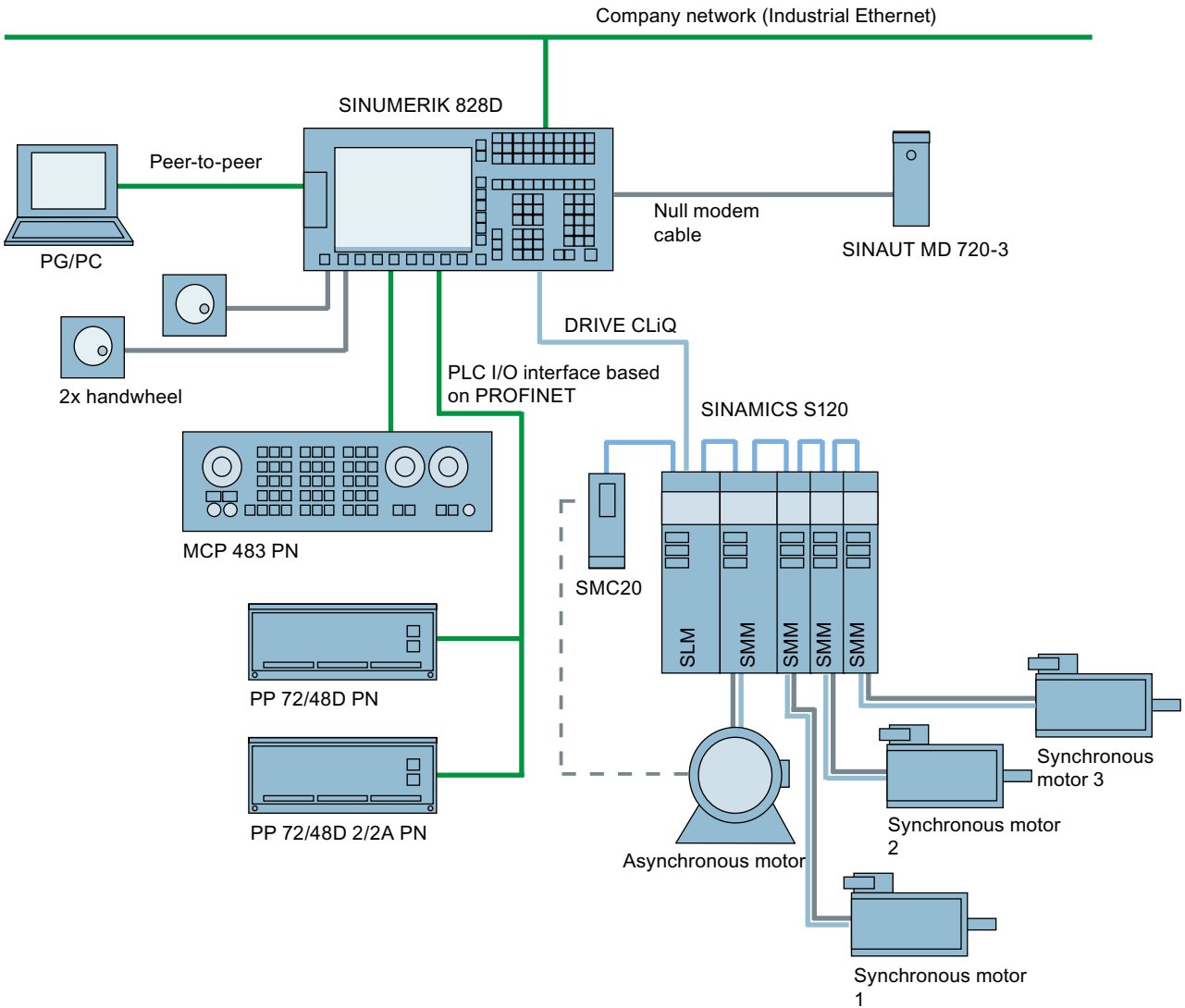


Figure 2-7 Configuration example 1: Basic configuration with four axes

Configuration with S120 Combi and six axes

The following configuration shows the maximum expansion stage with SINAMICS S120 Combi:

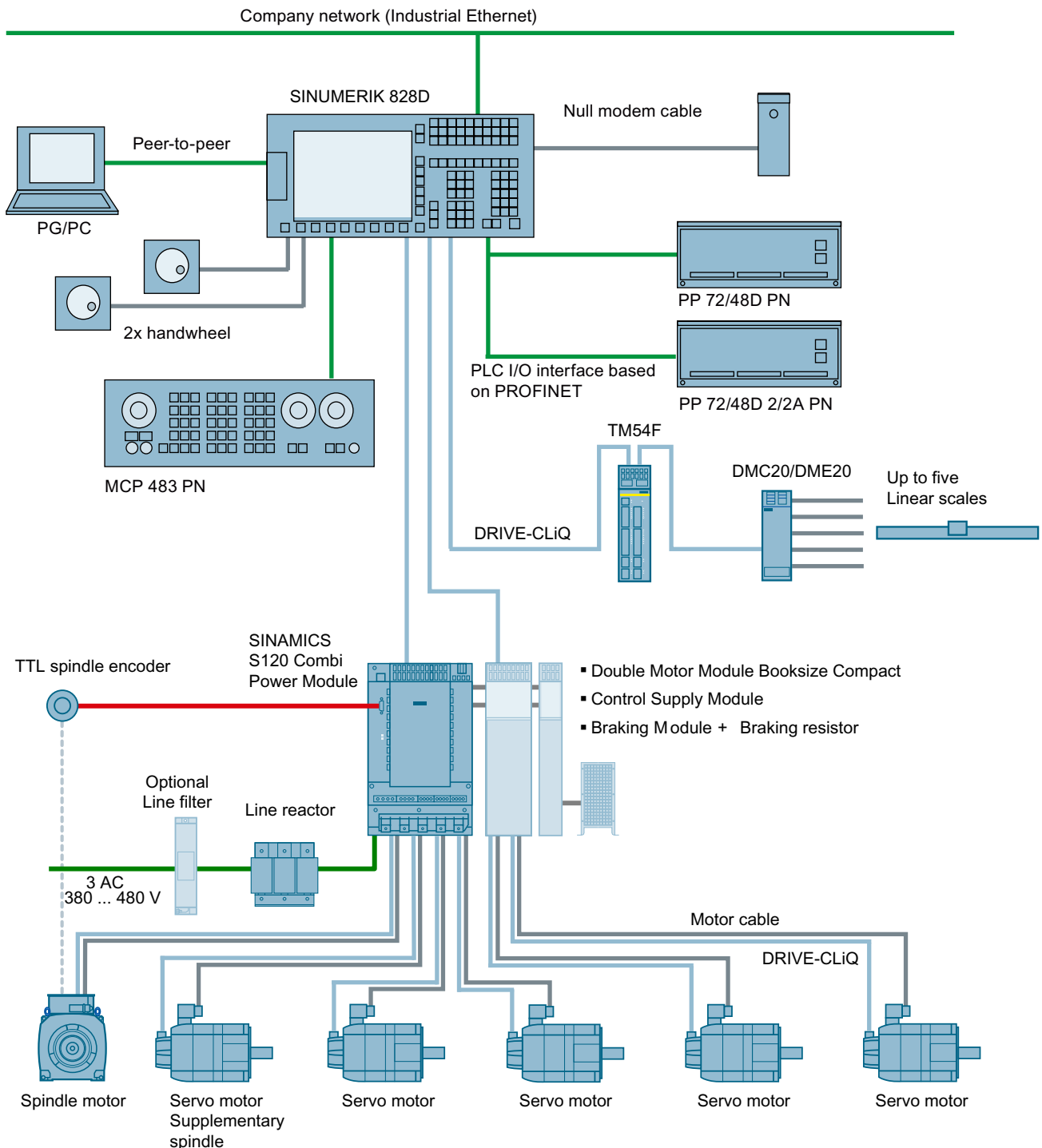


Figure 2-8 Configuration example 2: Maximum expansion stage with six axes and with Safety Integrated

2.7 Connectable components

Component overview

The following components can be connected to the PPU:

- **Machine Control Panel MCP 310C PN, MCP 483C PN**
Contains the keys and switches required for the operation of a machine (turning or milling machine).
- **Interface module MCP Interface PN**
The MCP Interface PN module enables customer-specific machine control panels to be connected. Further, a 3rd handwheel can be connected via the module.
- **Handwheels**
A maximum of three handwheels can be connected.
- **Mini handheld unit**
A mini HHU can be integrated into the SINUMERIK 828D system using a connection kit.
- **I/O modules PP 72/48D PN / PP 72/48D 2/2A PN**
The modules are used to connect digital as well as analog inputs and outputs. To supply the module and the outputs, an external power supply unit (24 VDC) is required, which provides safety isolation from dangerous voltages.
- **GSM modem**
Connection of a SINAUT MD720-3 GSM modem for sending and receiving SMS messages (Easy Message) via the serial RS232 interface.
- **PN/PN coupler**
A PN/PN coupler can be connected in order to link a SINUMERIK 828D to PROFINET networks.
- **SETRON PAC 3200/PAC 4200**
The connection of a SETRON PAC 3200 / PAC 4200 makes available functions for increasing the energy efficiency of machine tools.

SINAMICS S120 drive system

Only the SINAMICS S120 Line Modules and Motor Modules are used for drive control. Motor Modules can be used to connect **servo motors** as type 1FK7, 1FT7, and 1PH8 feed and main spindle motors. Type 1FW6 **torque motors** can also be connected.

See also

Connectable components (Page 93)

SINAMICS components (Page 86)

- Rules for permitted topologies (Page 53)
- Interface description (Page 67)

2.8 Ordering data

Ordering data of the components

SINUMERIK 828D is generally marketed in sales packages with drives, motors and accessories. For orders, please contact your local Siemens sales representative.

Table 2-1 Components

Designation	Article number
Panel Processing Unit without system software	
• PPU 241.3 BASIC horizontal	6FC5370-3AA30-0AA0
• PPU 240.3 BASIC vertical	6FC5370-4AA30-0AA0
• PPU 261.3 horizontal	6FC5370-5AA30-0AA0
• PPU 260.3 vertical	6FC5370-6AA30-0AA0
• PPU 281.3 horizontal	6FC5370-7AA30-0AA0
• PPU 280.3 vertical	6FC5370-8AA30-0AA0
CompactFlash card with system software and license	
• For PPU 241.3 / PPU 240.3: Turning	6FC5835-1GY40- □ YA0
• For PPU 241.3 / PPU 240.3: Milling	6FC5835-2GY40- □ YA0
• For PPU 261.3 / PPU 260.3: Turning	6FC5834-1GY40- □ YA0
• For PPU 261.3 / PPU 260.3: Milling	6FC5834-2GY40- □ YA0
• For PPU 281.3 / PPU 280.3: Turning	6FC5833-1GY40- □ YA0
• For PPU 281.3 / PPU 280.3: Milling	6FC5833-2GY40- □ YA0
Axis extension:	
• Numeric Control Extension NX10.3	6SL3040-1NC00-0AA0
Machine control panels:	
• MCP 483C PN	6FC5303-0AF22-0AA1
• MCP 310C PN	6FC5303-0AF23-0AA1
Interface module	
• MCP Interface PN	6FC5303-0AF03-0AA0
Mini handheld unit:	
• With spiral connection cable	6FX2007-1AD03
• With straight cable	6FX2007-1AD13
I/O modules:	
• PP 72/48D PN (digital)	6FC5311-0AA00-0AA0
• PP 72/48D 2/2A PN (analog)	6FC5311-0AA00-1AA0

Spare parts

Table 2-2 Spare parts

Designation	Article number
Set of tensioners (9 units)	6FC5248-0AF14-0AA0
CompactFlash card (empty), 2 GB	6FC5313-5AG00-0AA2
Front flap with fastening	6FC5348-2AA00-0AA0

Accessories

Table 2-3 Accessories

Designation	Article number
SETRON PAC3200 Power Monitoring Device	7KM2112-0BA00-3AA0
SETRON PAC4200 Power Monitoring Device	7KM4212-0BA00-3AA0
PROFINET Switched Ethernet expansion module	7KM9300-0AE00-0AA0
SINAUT MD720-3 GSM/GPRS MODEM	6NH9720-3AA00
SINAUT ANT 794-4MR ANTENNA	6NH9860-1AA00
RS232 modem cable	6NH7701-5AN
SIMATIC DP PN/PN coupler	6ES7158-3AD00-0XA0
Terminal strip converter, 50-pin	6EP5406-5AA00
Cable set comprising: <ul style="list-style-type: none"> • 6 m ribbon cable, 50-pin • 8 insulation displacement connectors, 50-pin 	6EP5306-5BG00
IP20 PLC I/O interface connecting cable (corresponds to DRIVE-CLiQ signal cable)	6FX2002-1DC00-...
Blanking plates for the DRIVE-CLiQ interface	6SL3066-4CA00-0AA0
USB flash drive, 8 GB	6ES7648-0DC50-0AA0
CompactFlash card (empty as user memory), 8 GB	6FC5313-6AG00-0AA0
Stabilized power supply SITOP lite 10 A 24 VDC, 1-phase	6EP1334-1LB00
Stabilized power supply SITOP smart 10 A 24 VDC, 1-phase	6EP1334-2BA01
Stabilized power supply PSU100S 20 A 24 VDC, 1-phase	6EP1336-2BA10
Stabilized power supply PSU300S 10 A 24 VDC, 3-phase	6EP1434-2BA10
Stabilized power supply PSU300S 20 A 24 VDC, 3-phase	6EP1436-2BA10

2.9 CompactFlash Cards

2.9.1 CompactFlash card system

Overview

The PPU has two slots for CompactFlash cards:

- The slot for the user CompactFlash card is located at the front behind the front flap.
- The slot for the system CompactFlash card with the system software is at the rear.

CompactFlash card with system software

The system CompactFlash card is shipped in a bootable condition. It is not supplied with the PPU and must be ordered as a separate component.

The system CompactFlash card is essential for the operation of the PPU.

In addition to the technology-specific system software for SINUMERIK 828D and the firmware for SINAMICS, the system CompactFlash card also contains:

- Version information (serial number, version, type designation)
- License key: Allows the CompactFlash card to be inserted into another PPU without having to change the licenses.

Note the following when using a system CompactFlash card:

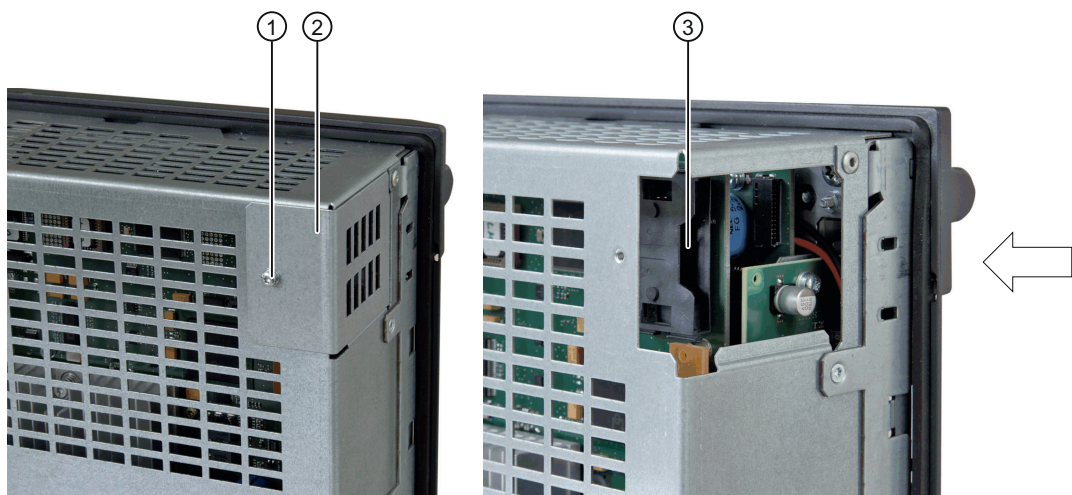
- SINUMERIK CNC supports the file systems FAT16 and FAT32 for CompactFlash cards. You may need to format the memory card if you want to use a memory card from another device or if you want to ensure the compatibility of the memory card with the SINUMERIK. However, formatting the memory card will permanently delete all data on it.
- Do not remove the memory card while it is being accessed. This can lead to damage of the memory card and the SINUMERIK as well as the data on the memory card.
- If you cannot use a memory card with the SINUMERIK, it is probably because the memory card is not formatted for the control system (e.g. Ext3 Linux file system), the memory card file system is faulty or it is the wrong type of memory card.
- Insert the memory card carefully and the right way round into the memory card slot (observe indicators such as arrow or similar). This way you avoid mechanical damage to the memory card or the device.

- Only use memory cards that have been approved by Siemens for use with SINUMERIK. Even though SINUMERIK follows general industry standards for memory cards, it is possible that memory cards from some manufacturers will not function perfectly in this device or are not completely compatible with it (you can obtain information on compatibility from the memory card manufacturer or supplier).
- For SINUMERIK 828D, only the memory card (2 GB) with order number 6FC5313-5AG00-0AA2 is permitted.

NOTICE
CompactFlash card system
<ul style="list-style-type: none">• The CompactFlash card always comes formatted! You must not reformat it under any circumstances!• To ensure that the system CompactFlash card functions properly, the card must not be repartitioned.• In the event of a defect, the system software card must be replaced. For information about restoring your system using an empty CompactFlash card, refer to the Service Manual.

2.9.2 Inserting the system CompactFlash Card

Slot and mounting position



- ① M3 screw
- ② Metal cover
- ③ Slot

The CompactFlash card has an edge on the opposite side to the pins. This edge must always be on the right when inserting the card.



Figure 2-9 Mounting position

Replacing the system CompactFlash card

 **CAUTION**

Electrostatic Device (ESD)

Before you touch a CompactFlash card, discharge yourself at the cabinet or at the ground terminal.

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

Procedure:

1. Switch off the power supply.
2. Loosen the screw ①.
3. Swing the metal cover ② to the side and remove.



4. Pull out the CompactFlash card sideways.



5. Gently insert the new CompactFlash card into slot ③ until it clicks into place.
6. Re-attach the metal cover ② by first guiding it in backward, then tilting into the end position and finally screwing in the screw ① (max. tightening torque, 0.8 Nm).

NOTICE
Plugging in the CompactFlash card
Please ensure that the CompactFlash card is inserted with care. Otherwise, the card may be damaged.

7. Switch the power supply on again.

2.9.3 CompactFlash card for user data

CompactFlash card for user data

You can write to the user CompactFlash card as follows:

- The user CompactFlash card is inserted in the front slot of the PPU and is written to via the operating software.
- The user CompactFlash card can be written to using a suitable memory card adapter directly via the PG/PC.

Note

A permanently inserted CompactFlash card can also be used as an extension of the CNC user memory, e.g. for oversized mold making programs, which exceed the storage capacity integrated in the CNC user memory.

Inserting the CompactFlash card

To correctly insert the CompactFlash card in the slot, note the position the edge (arrow) in the figure below:



Figure 2-10 Direction to insert the user CompactFlash card

Application planning

3.1 Secondary electrical conditions

3.1.1 Protective Separation as per EN 61800-5-1

Protective separation of the interfaces

Note

By using an extra-low voltage, all interfaces have protective separation according to Class DVC A (SELV/PELV).

3.1.2 Grounding concept

Components

The SINUMERIK 828D system consists of a number of individual components which have been designed so that the system complies with the appropriate EMC and safety standards. The individual system components are:

- Panel Processing Unit PPU
- Machine Control Panel
- PLC I/O modules

Grounding measures

The PPU and MCP are attached with tensioners to a metal panel on the operator panel. Both have a protective conductor connection for grounding (grounding screw) at the rear of the device, which must be connected to the grounding bar of the control cabinet.

The SINAMICS S120 drive system is installed in the control cabinet. The electronics unit grounds of the modules are connected to each other via DRIVE-CLiQ. The modules are grounded either via the galvanized mounting plate or via the grounding lugs on the front of the modules.

The PLC I/O device modules are installed in the control cabinet and grounded via a grounding screw.

3.1 Secondary electrical conditions

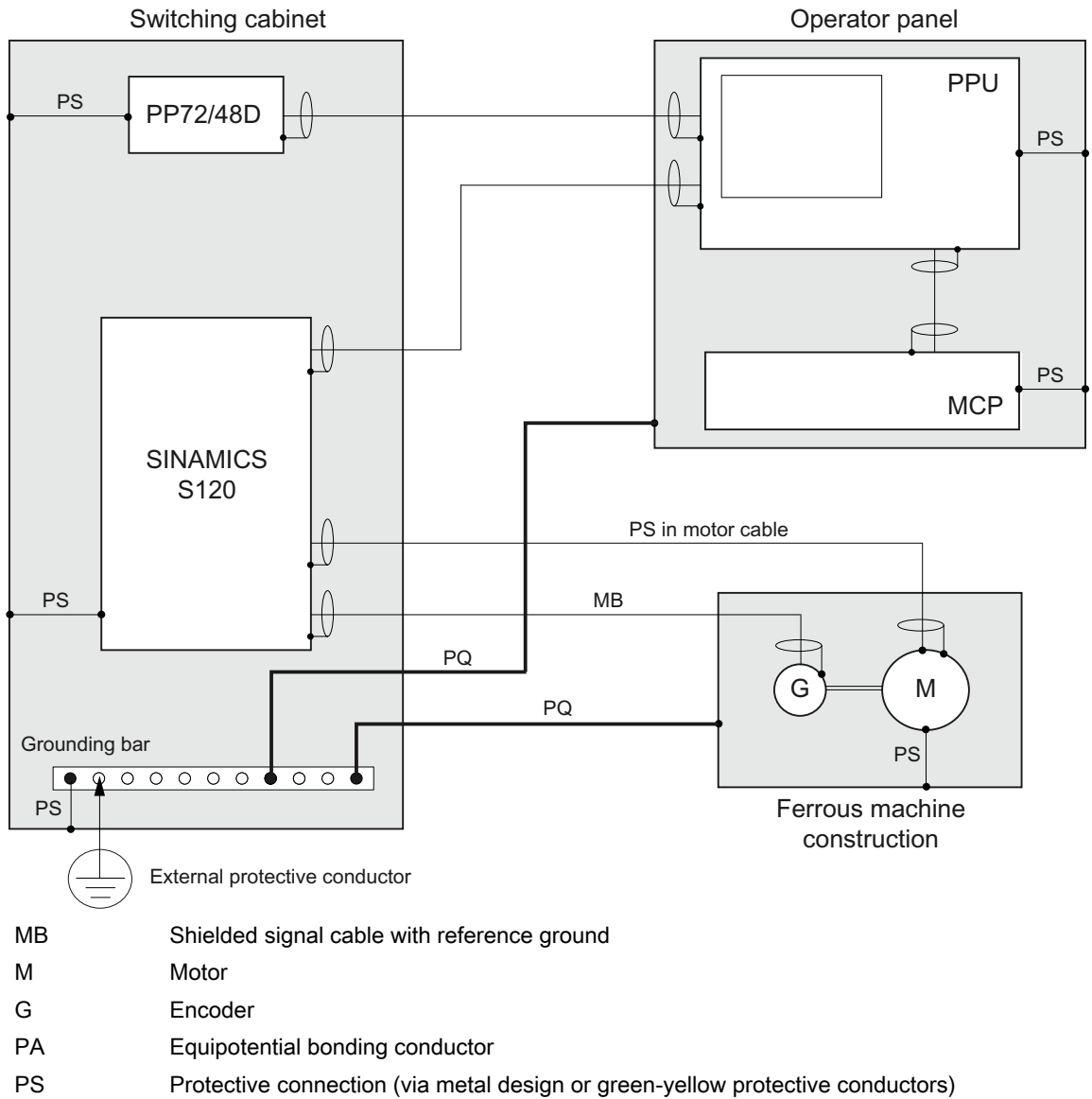


Figure 3-1 Grounding concept

The following rules apply for external cable cross sections:

- PA cross-section $\geq 10 \text{ mm}^2$
- The conductor cross-section of the external protective conductor is calculated from the conductor cross-section of the line connection as follows:

Line connection S (mm ²)	External protective conductor min. (mm ²)
$S \leq 16$	S
$16 \leq S \leq 35$	16
$S \geq 35$	S/2

3.1.3 RI suppression measures

Shielded signal cables

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

- For safe and fault-free operation of the system, the specified cables must be used.
- For digital signal transmission, the shield must have a conductive connection at both sides of the housing.

Exception:

Standard shielded cables grounded on only one side can be used for devices from other manufacturers (printers, programming devices, etc.). However, these devices must not be connected to the controller during normal operation. However, if the system cannot operate without them, then the cable shields must be connected at both ends. Furthermore, the non-Siemens device must be connected to the controller via an equipotential bonding cable.

Cable definitions

The following cables are permissible:

- Signal cables:
 - Data cables (Ethernet, PROFINET, DRIVE-CLiQ, sensor cables, etc.)
 - Ribbon cables for digital inputs/outputs
 - Emergency Stop cables
- Power cables:
 - Low-voltage supply cables (230 VAC, 24 VDC, etc.)
 - Supply cables to contactors (primary and secondary circuit)

Rules for routing cables

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

- Signal cables and power cables must be routed at the greatest possible distance from one another.
- If necessary, signal and power cables may cross one another (if possible at an angle of 90°), but must never be laid close or parallel to one another.
- Signal cables may not be routed close to strong external magnetic fields (e.g. motors and transformers).
- Pulse-loaded HC/HV lines must always be laid completely separately from all other lines.

3.1 Secondary electrical conditions

- If signal lines cannot be routed a sufficient distance away from other cables, they must be installed in grounded cable ducts (metal).
- The clearance (interference injection area) between the following lines must be kept to a minimum:
 - Signal line and electrical circuit signal line (twisted)
 - Signal line and associated equipotential bonding conductor
 - Equipotential bonding conductor and protective conductor (routed together)

References

For more information about interference suppression measures and connection of shielded cables and specified cables:

- EMC Installation Guideline Configuration Manual/Basic system requirements
- SINAMICS S120 Combi Manual

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

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

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

3.2 Climatic and mechanical environmental conditions

3.2.1 Ambient conditions

Observing the ambient conditions

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

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

Standard requirements

The SINUMERIK 828D system components meet the following standard requirements:

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

Assistance and support

Compliance with environmental requirements must be ensured during installation of the complete system. Please contact your sales representative for assistance and support.

3.2.2 Transport and Storage Conditions

Components in original packaging

The following specifications apply to components in transport packaging:

Table 3-1 Climatic environmental conditions

	Transport	Storage
Standard / class	EN 60721-3-2 / 2K4	EN 60721-3-1 / 1K4
Temperature range	-20 ... + 60 °C	-25 ... + 55 °C
Temperature change	-40 °C / +30 °C and +70 °C / +15 °C **)	< 0.5 K / min (Δ 30 K / h) ¹⁾

3.2 Climatic and mechanical environmental conditions

Relative humidity	5 ... 95%	10 ... 100%
Permissible change in relative humidity	max. 0.1% / min (\pm 6% / h)	

*) Averaged over 5 min

**) Assuming a direct change in the specified air temperatures

3.2.3 Operating Conditions

Note

Before commissioning components with display, remove the foil which is used to protect the components during transport.

Climatic environmental conditions

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

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

Temperature range	Front side: 0 ... 45 °C	Rear side: 0 ... 55 °C	
Temperature change	< 0.5 K / min (\pm 30 K / h) averaged over 5 min		
Humidity	Relative: 5 ... 90% at 25 °C	Absolute: \leq 25 g / m ³	
Permissible change in relative humidity	max. 0.1% / min (\pm 6% / h)		
Moisture condensation and ice formation	Not permissible		
Dripping water, spray, splash water, water jets	Permissible		
Supply air	Without aggressive gases, dusts and oils		
Air pressure	106 to 92 kPa or 0 to 1000 m above sea level		
Derating	At altitudes over 1,000 to 4,000 m above sea level, the upper temperature limit must be reduced by 3.5 °C / 500 m.		
Active environmental conditions	Chemical: Class 3C2	Mechanical: Class 3S2	Biological: Class 3B1

Function-impairing dust

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

Table 3-3 Maximum permissible dust content in the air

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

Note

Dust deposits must be removed at regular intervals.

Radio interference

Applicable standards: EN 61800-3

Table 3-4 Limit values for radio interference suppression in industrial environments

	Limit class according to EN 61800-3
Conducted radio interference	C3
Radio interference	C3

Note

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

If compliance with limit value class C2 is required, please contact your local Siemens sales partner.

Note


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

3.3 Recycling and disposal

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

Installation notes

PPU modules may only be installed in housings, cabinets or in isolated electrical business establishments. Housings, cabinets, or isolated electrical business establishments may only be accessed by trained or authorized personnel.

 DANGER
Risk of electric shock
The entire system must be voltage-free when mounting or wiring the SINUMERIK 828D.

Components in the control cabinet

The SINAMICS components and the axis expansion modules are installed in a control cabinet.

References

Notes for mounting components of the SINAMICS S120 product family are contained in the following manuals:

- SINAMICS S120 Booksize Power Units Manual
- SINAMICS S120 Combi Manual

For further details on the control cabinet installation, refer to:

- "Control Cabinet Integration, SINAMICS S120 Booksize / SIMODRIVE" System Manual

4.1 Mounting positions

Permitted mounting positions

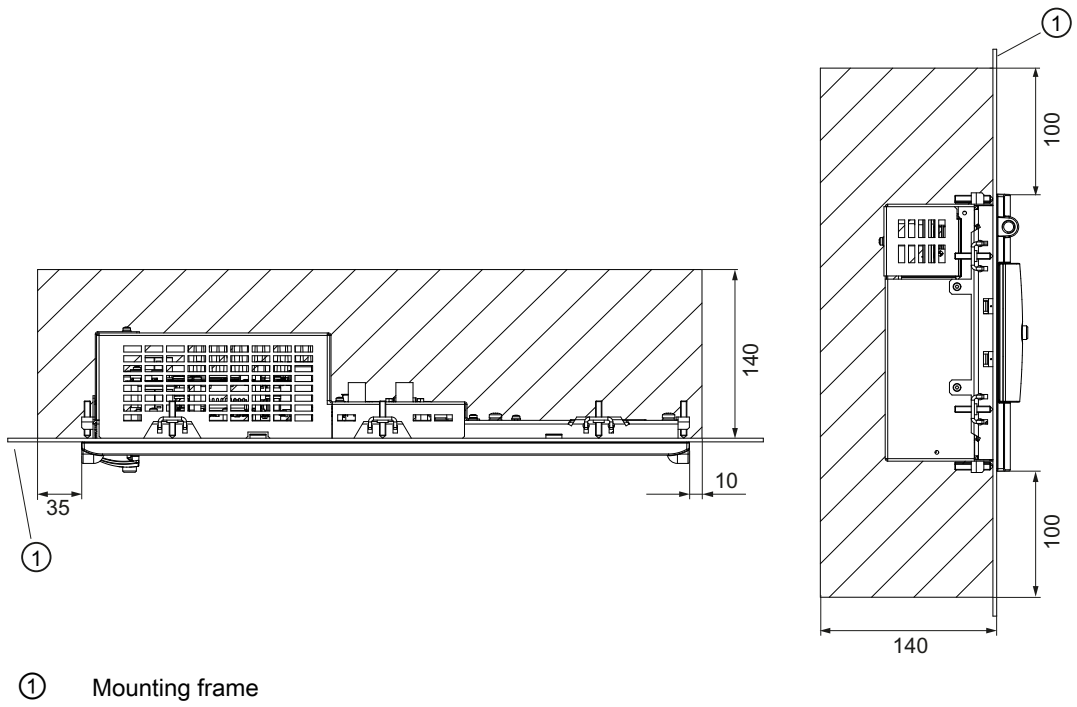
The PPU is secured with special tensioning elements and tensioners in the operator panel housing. The tensioners are included in the scope of delivery.

Note

Installing the PPU

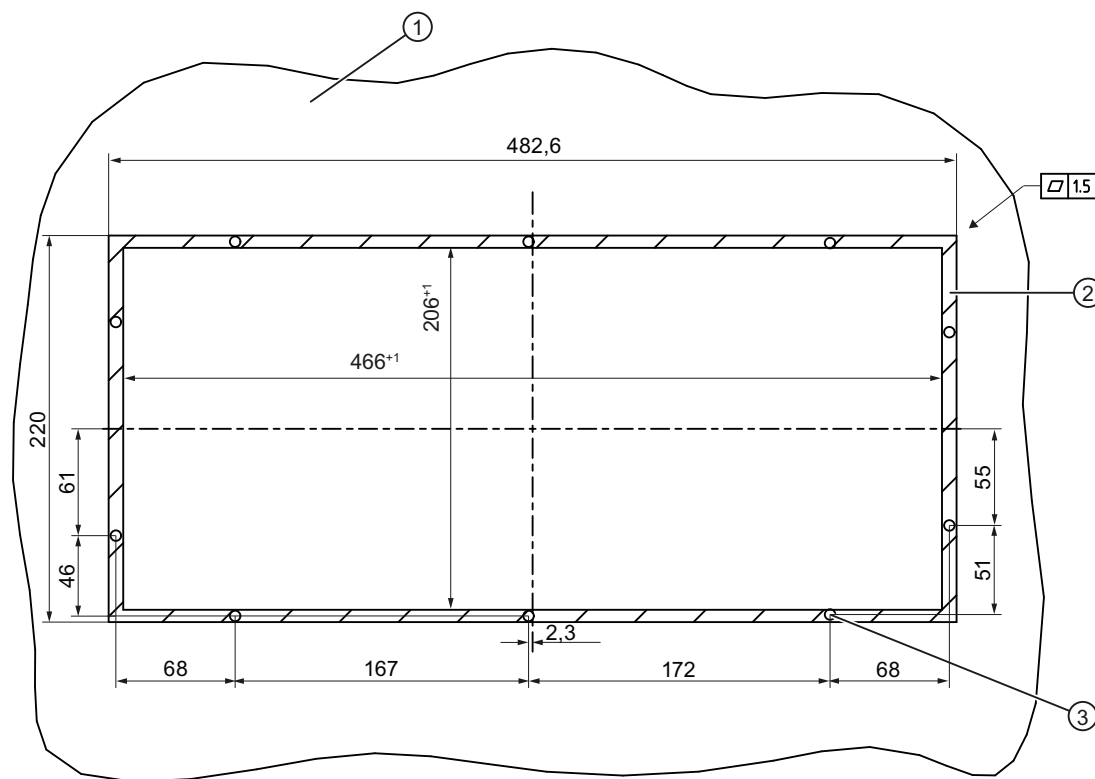
The maximum permissible tightening torque for the tensioning screws is 0.5 Nm and this value must not be exceeded.

Installation of the horizontal PPU variant



① Mounting frame
Figure 4-1 Clearance for ventilation and cables in the horizontal PPU

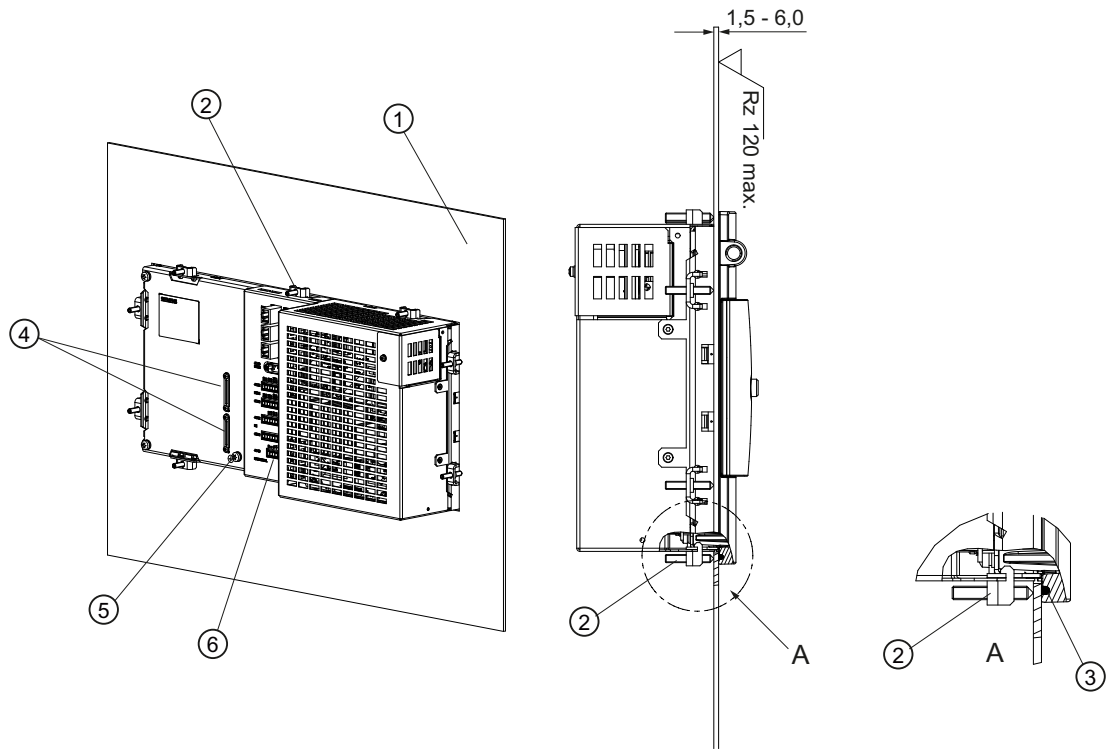
Panel cutout of the horizontal PPU variant



- ① Mounting frame
- ② Seal area
- ③ Pressure point for tensioners

Figure 4-2 Horizontal PPU panel cutout

4.1 Mounting positions



- ① Mounting frame
- ② Tensioner (10 parts)
- ③ Seal
- ④ Shield contact
- ⑤ Grounding screw M5
- ⑥ Interfaces

Figure 4-3 Horizontal PPU mounting

Installation of the vertical PPU variant

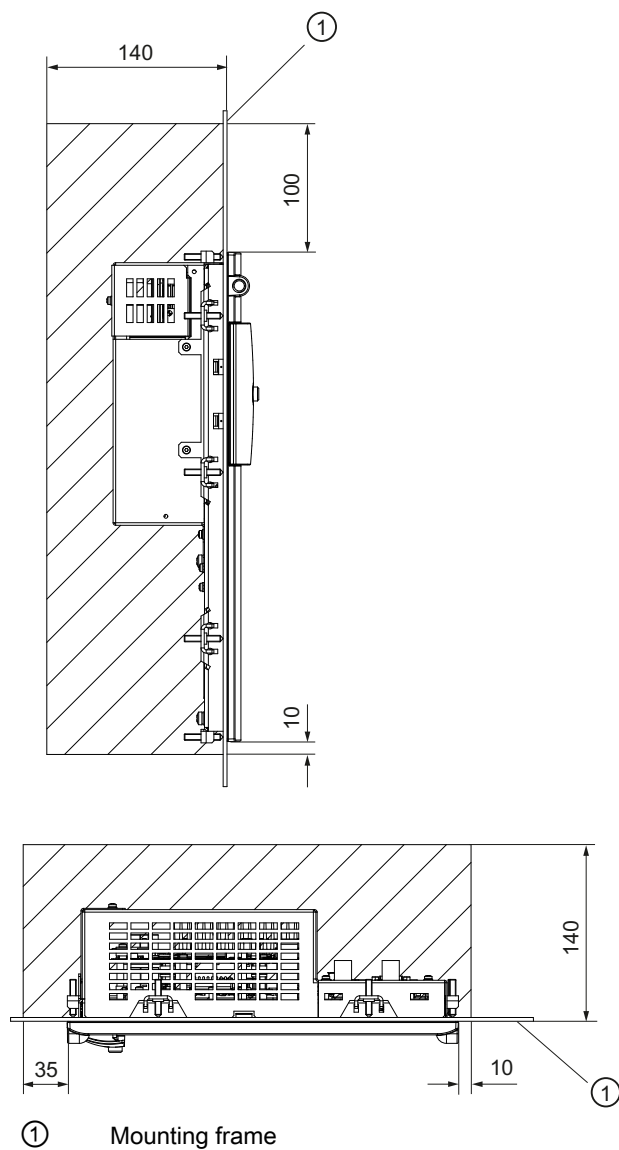


Figure 4-4 Clearance for ventilation and cables in the vertical PPU

Panel cutout of the vertical PPU variant

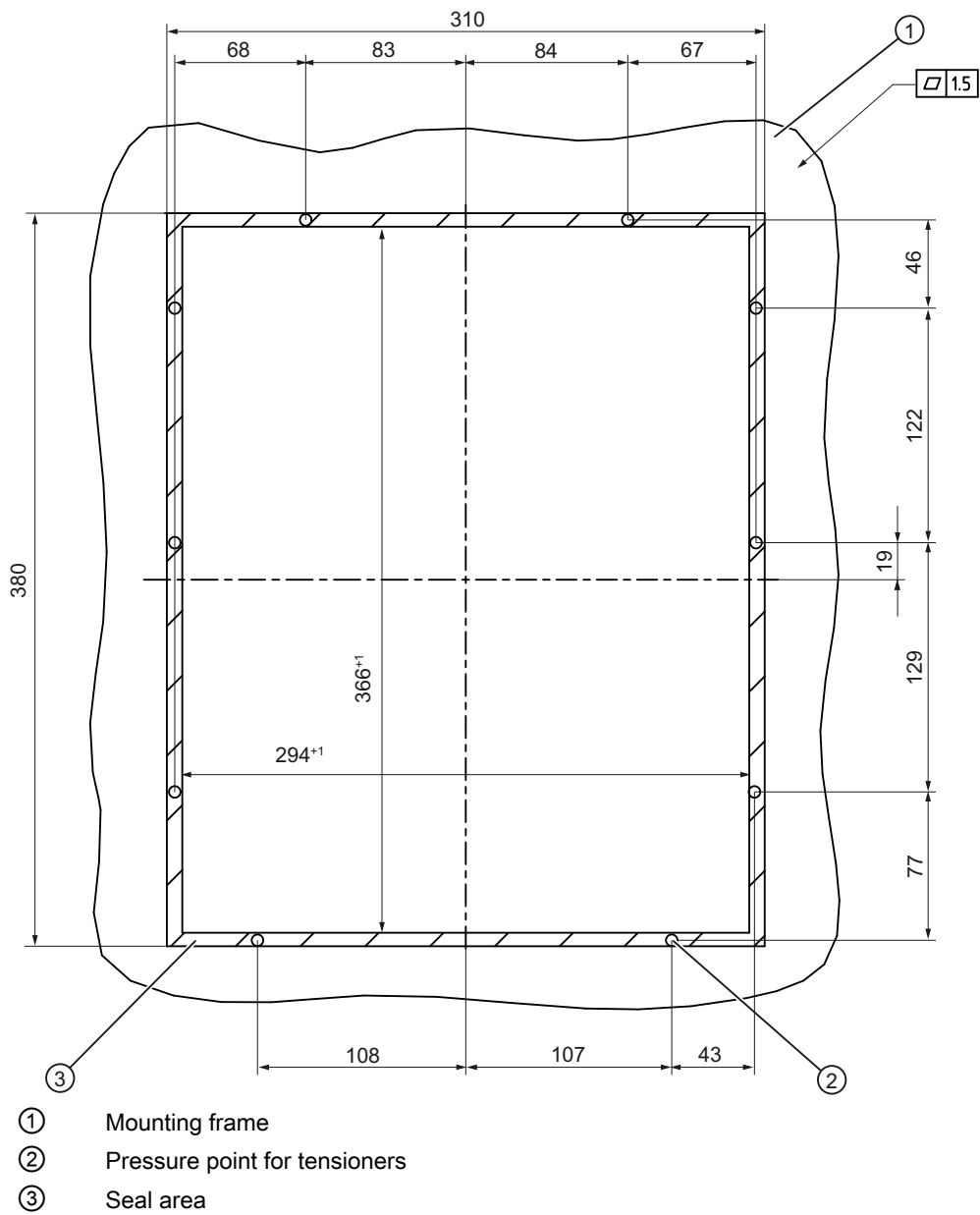


Figure 4-5 Vertical PPU panel cutout

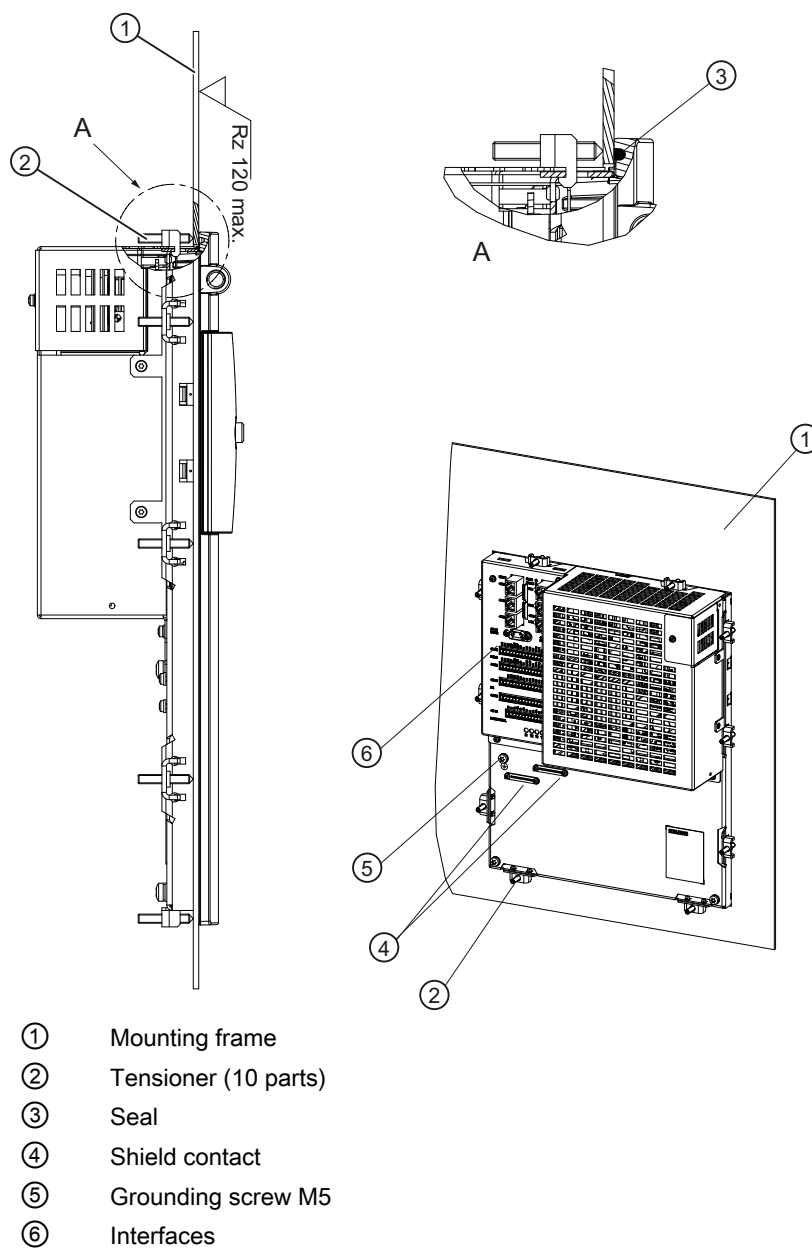


Figure 4-6 Installation of the vertical PPU variant

4.2 Dimension drawings

PPU horizontal

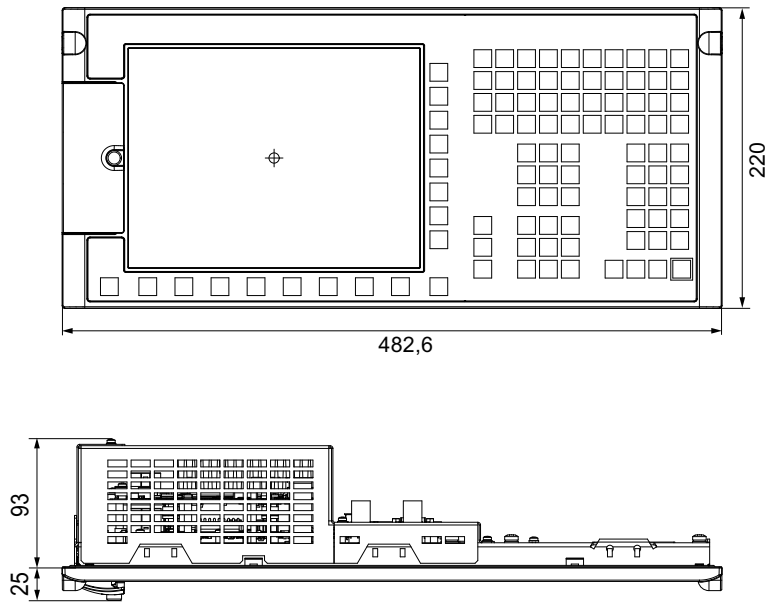


Figure 4-7 Horizontal PPU dimensioning

PPU vertical

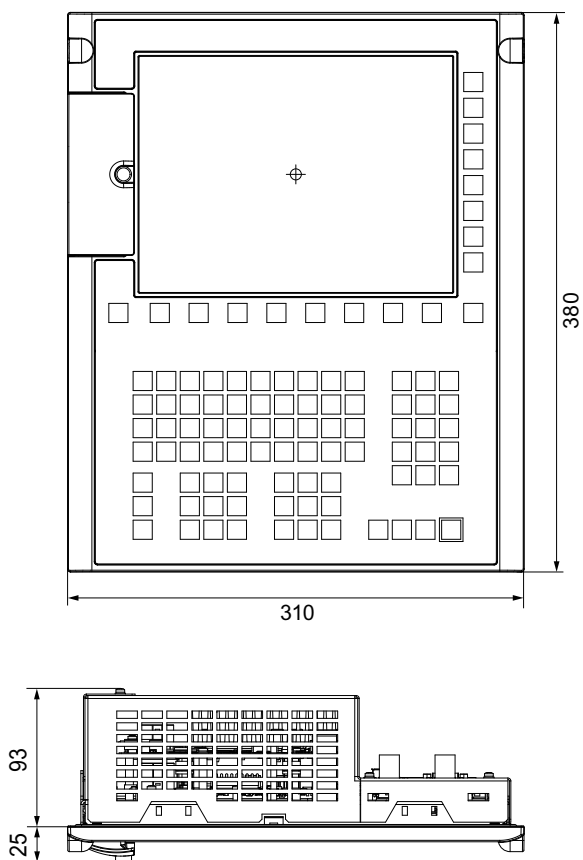


Figure 4-8 Vertical PPU dimensioning

Rules for permitted topologies

5.1 Topology rules for S120 Combi

Topology rules for DRIVE-CLiQ

There are fixed DRIVE-CLiQ topology rules for the S120 Combi. These rules must be observed. If these rules are violated, then a corresponding alarm is displayed.

Assigning the DRIVE-CLiQ interfaces

Table 5-1 Assigning the DRIVE-CLiQ interfaces on the S120 Combi

DRIVE-CLiQ interface	Connection with
X200	X100 of the PPU
X201	Motor encoder, spindle
X202	Motor encoder, feedrate 1
X203	Motor encoder, feedrate 2
X204	Motor encoder feed 3 → only for 4-axis S120 Combi Remains empty for 3-axis S120 Combi
X205	Optional: 2. direct sin/cos encoder for spindle (via SMx20) ¹⁾ Remains empty when connecting a direct TTL spindle encoder via X220

¹⁾ In this case, the TTL encoder interface X220 remains free

Table 5-2 Assigning the DRIVE-CLiQ interfaces to the SINUMERIK 828D (PPU)

DRIVE-CLiQ interface	Connection with
X100	X200 of the S120 Combi
X101	X200 of a Single Motor Module or Double Motor Module
X102	X500 of the Terminal Module TM54F X500 of the Hub Modules (DMx20) ¹⁾

¹⁾ When using a TM54F, the DMx20 is connected in series at the TM54F via the DRIVE-CLiQ interface X501

Table 5-3 Assigning the DRIVE-CLiQ interfaces of the expansion axes

DRIVE-CLiQ interface	Connection with
First Single Motor Module	
X200	X101 of the PPU
X201 ¹⁾	X200 of the second Single Motor Module
X202	Motor encoder for feedrate 1st expansion axis (via Sensor Module)
Second Single Motor Module	
X200	X201 of the first Single Motor Module

5.2 Topology rules for S120 Booksize

DRIVE-CLiQ interface	Connection with
X201	Remains empty
X202	Motor encoder for feedrate 2nd expansion axis (via Sensor Module)
Double Motor Module	
X200	X101 of the PPU
X201	Remains empty
X202	Motor encoder for feedrate 1st expansion axis
X203	Motor encoder for feedrate 2nd expansion axis

1) Remains empty if only one Single Motor Module is used

Table 5-4 Assigning the DRIVE-CLiQ interfaces at the DMx20 to assign a direct measuring system to the feed axes.

DRIVE-CLiQ interface	Feed axis
X500	X501 of the TM54F X102 of the PPU (if a TM54F is not being used)
X501	Direct encoder, feedrate 1 at the S120 Combi
X502	Direct encoder, feedrate 2 at the S120 Combi
X503	Direct encoder, feedrate 3 at the S120 Combi → only for 4-axis S120 Combi Remains empty for 3-axis S120 Combi
X504	Feedrate 1st expansion axis at the Motor Module
X505	Feedrate 2nd expansion axis at the Motor Module

Table 5-5 Assigning the DRIVE-CLiQ interfaces at the TM54F

DRIVE-CLiQ interface	
X500	X102 of the control (PPU)
X501	X500 of the DMx20 If a DMx20 is not being used, then this interface remains empty.

5.2 Topology rules for S120 Booksize

Introduction

The following rules apply for wiring components with DRIVE-CLiQ. A distinction is made between **DRIVE-CLiQ rules**, which must always be observed, and **recommended rules**, which, when observed, do not require any subsequent changes to the topology when expansions are made.

The maximum number of DRIVE-CLiQ components and the possible wiring form depend on the following points:

- The binding DRIVE-CLiQ wiring rules
- The number and type of activated drives and functions on the respective Control Unit

- The computing power of the respective Control Unit
- The set processing and communication cycles

In addition to the binding wiring rules that must be observed, some additional recommendations as well as topology examples for DRIVE-CLiQ wiring are provided in the PPU manual.

The components used in these examples can be removed, replaced with others or supplemented. If components are replaced by another type or additional components are added, the SIZER tool should be used to check the topology.

Note

Every topology that SIZER permits can also run and is therefore correct (SINAMICS S120 D Function Manual /FH1/).

DRIVE-CLiQ rules

The wiring rules below apply to standard cycle times (servo 125 μ s). For cycle times that are shorter than the corresponding standard cycle times, additional restrictions apply due to the computing power of the Control Unit.

The rules below apply on a general basis, unless limited, as a function of the firmware version.

- A maximum of eight DRIVE-CLiQ nodes can be connected in one row. A row is always seen from the perspective of the Control Unit.
This number reduces to a maximum of four DRIVE-CLiQ nodes in one row when the extended functions of drive-based Safety Integrated are configured.
- A maximum of 14 nodes can be connected to one DRIVE-CLiQ line on a Control Unit.
- Ring wiring is not permitted.
- Components must not be double-wired.

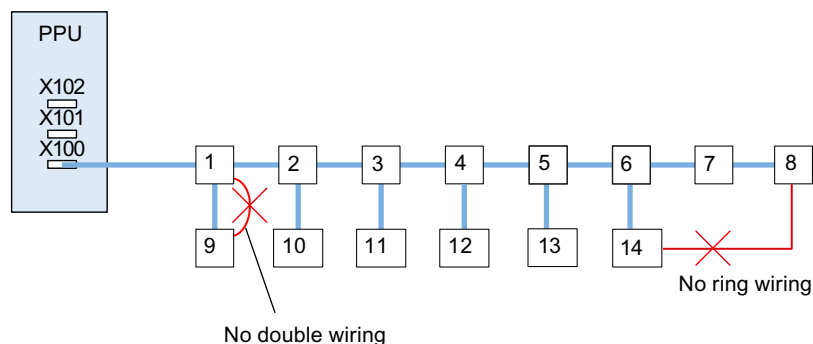


Figure 5-1 Example: DRIVE-CLiQ line at the X100 terminal (without Safety Integrated)

- The following applies to the booksize format:
 - In the servo control and vector U/f control operating modes, only one Line Module may be connected to the Control Unit. In the vector control operating mode, a maximum of three further Line Modules may be connected in parallel (i.e. a total of four Line Modules).
 - It is permissible that one Line Module and Motor Modules are connected together to one DRIVE-CLiQ line in the servo control mode.
 - One Line Module and Motor Modules must be connected to separate DRIVE-CLiQ lines in the vector control mode.
 - For booksize format, a parallel connection of Infeed Modules or Motor Modules is not possible.
- The following applies to the chassis format: Line Modules (Active Line, Basic Line, Smart Line) and Motor Modules must be connected to separate DRIVE-CLiQ lines.
- The default sampling times may be changed.
- A maximum of 16 measuring systems can be connected to a PPU with NX10.3:
Example 1: PPU with 6 axes with 6 motor measuring systems and 6 direct measuring systems as well as NX10.3 with 2 motor measuring systems and 2 direct measuring systems.
Example 2: PPU with five axes with five motor measuring systems and five direct measuring systems as well as NX10.3 with three motor measuring systems and three direct measuring systems.
- Only one TM54F is permitted for each PPU and for each NX10.3.
- The Active Line Module Booksize and the Motor Modules Booksize can be connected to one DRIVE-CLiQ line.
- Chassis Line Module and Motor Module are connected in series.
- To allow the following modules to be assigned automatically during the commissioning (device identification), they should be connected to a free DRIVE-CLiQ port on the associated Active Line Module/Motor Module:
 - Voltage Sensing Module (VSM)
 - Terminal Module TM120

Note

If the TM120 is connected without observing this rule, the commissioning engineer must use BICO technology to assign the temperature channels to the drive.

- The sampling times (p0115[0] and p4099) of all components that are connected to a DRIVE-CLiQ line must be divisible by one another with an integer result. If the current controller sampling time on a DO has to be changed to another pattern that does not match the other DOs on the DRIVE-CLiQ line, the following options are available:
 - Reconnect the DO to a separate DRIVE-CLiQ line.
 - Also change the current controller sampling time and the sampling time of the inputs/ outputs of the DO not involved so that they again fit into the time grid.

Note

A Double Motor Module, a DMC20, and a TM54F each correspond to two DRIVE-CLiQ nodes. This also applies to Double Motor Modules, of which just one drive is configured.

To enable the function "Automatic configuration" to assign the encoders to the drives, the recommended rules below must be observed.

Recommended rules

- The DRIVE-CLiQ cable from the Control Unit must be connected as follows:
 - To X200 of the first booksize power unit
 - To X400 of the first chassis power unit
- The DRIVE-CLiQ connections between the power units must each be connected from interface X201 to X200 or from X401 to X400 on the follow-on component.

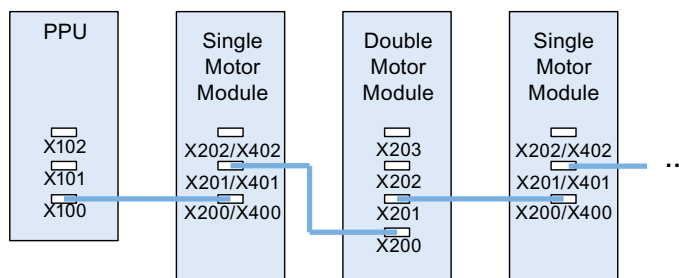


Figure 5-2 Example: DRIVE-CLiQ line

- The motor encoder must be connected to the associated power unit.

Component	Connecting the motor encoder via DRIVE-CLiQ
Single Motor Module booksize	X202
Double Motor Module booksize	<ul style="list-style-type: none"> • Motor connection X1: Encoder at X202 • Motor connection X2: Encoder at X203
Single Motor Module chassis	X402
Power Module chassis	X402

5.3 Topology rules for Safety Integrated functions

Note

If an additional encoder is connected to a Motor Module, it is assigned to this drive as encoder 2 in the automatic configuration. At a Double Motor Module, an encoder at X201 is assigned to the 2nd feedrate as 2nd measuring system.

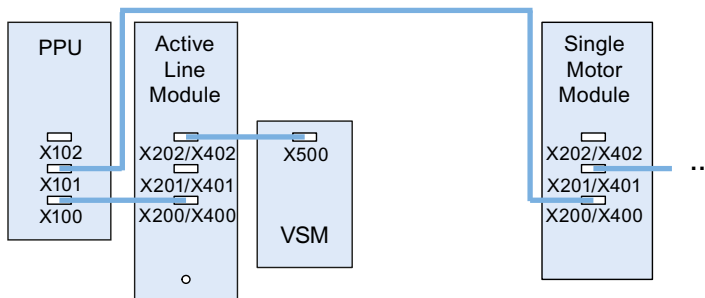


Figure 5-3 Example: Topology with VSM for booksized and chassis components

Component	VSM connection
Active Line Module booksized	X202
Active Line Module (chassis)	X402
Power Modules	The VSM is not supported.

5.3 Topology rules for Safety Integrated functions

Number of axes	Port 1 at the PPU X100	Port 2 at the PPU X101	Port 3 at the PPU X102	Example in the figure:
<i>SINAMICS S120 booksized</i>				
5	1 x LM 4 x MoMo 1 x SMY at the 4th MoMo	1 x TM54F 1x MoMo 1 x Hub DMx 4 x SMY at the Hub DMx	not used	---
6	1 x LM 4 x MoMo 1 x SMY at the 4th MoMo	1 x TM54F 2x MoMo 1 x Hub DMx 5 x SMY at the Hub DMx	not used	---
7	1 x LM 4 x MoMo 1 x SMY at the 4th MoMo	1 x TM54F 2x MoMo 1 x Hub DMx 5 x SMY at the Hub DMx	1 x NX10.3 1 x TM54F 1 x MoMo 1 x SMY at the MoMo	---

5.4 Topology example without Safety Integrated functions

Number of axes	Port 1 at the PPU X100	Port 2 at the PPU X101	Port 3 at the PPU X102	Example in the figure:
8	1 x LM 4 x MoMo 1 x SMY at the 4th MoMo	1 x TM54F 1x MoMo 1 x Hub DMx 4 x SMY at the Hub DMx	1 x NX10.3 1 x TM54F 3 x MoMo 1 x SMY at NX10.3 1 x SMY at TM54F 1 x SMY at the 3rd MoMo	Topology with SINAMICS S120 Booksize 5+3 axes (Page 63)
8	1 x LM 4 x MoMo 1 x SMY at the 4th MoMo	1 x TM54F 2x MoMo 1 x Hub DMx 5 x SMY at the Hub DMx	1 x NX10.3 1 x TM54F 2 x MoMo 1 x SMY at NX10.3 1 x SMY at the 2nd MoMo	Topology with SINAMICS S120 Booksize and 6+2 axes (Page 63)
<i>SINAMICS S120 Combi</i>				
3	3x Combi 1xSMY at the Combi	not used	1 x TM54F 1 x Hub DMx 2 x SMY at the Hub DMx	---
4	3x Combi 1xSMY at the Combi	1 x booksize compact	1 x TM54F 1 x Hub DMx 3 x SMY at the Hub DMx	---
4	4x Combi 1xSMY at the Combi	not used	1 x TM54F 1 x Hub DMx 3 x SMY at the Hub DMx	---
5	4x Combi 1xSMY at the Combi	1 x booksize compact	1 x TM54F 1 x Hub DMx 4 x SMY at the Hub DMx	---
6	4x Combi 1xSMY at the Combi	2 x booksize compact	1 x TM54F 1 x Hub DMx 5 x SMY at the Hub DMx	---

5.4 Topology example without Safety Integrated functions

Note

These wiring examples are valid using the standard clock cycle setting and do not take into account any Safety Integrated functions.

For further notes on Safety Integrated functions, see the SINAMICS S120 Safety Integrated Function Manual.

Topology for the maximum configuration with SINAMICS S120 booksize and six axes

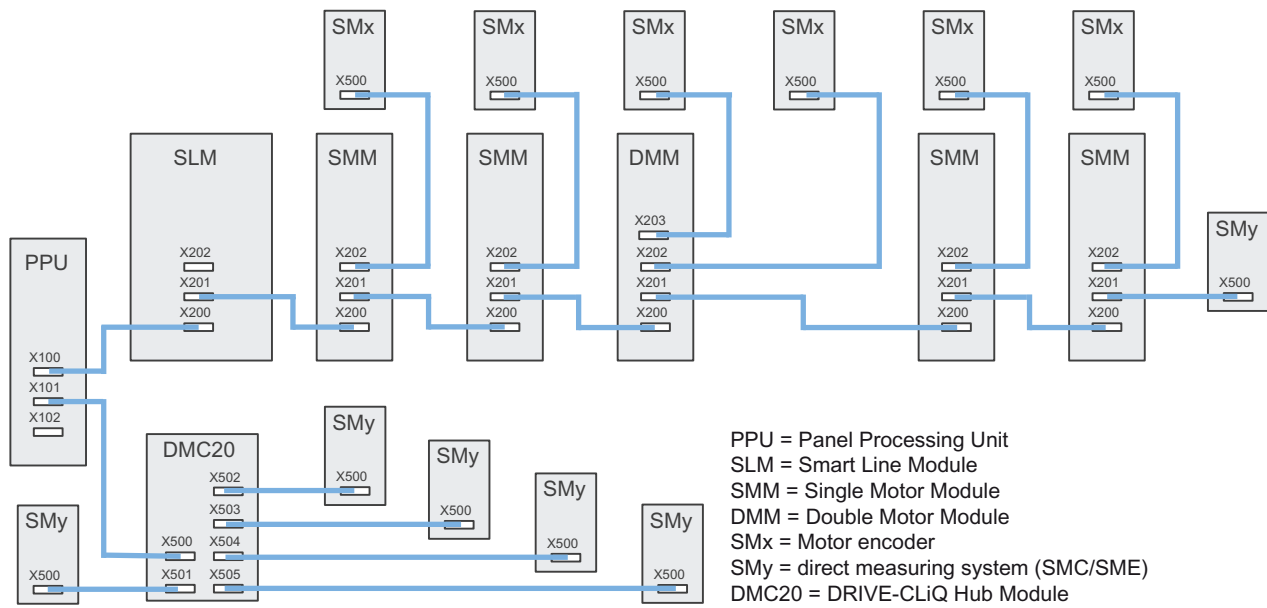


Figure 5-4 DRIVE-CLiQ wiring without NX

Topology for the maximum configuration with SINAMICS S120 booksize and eight axes

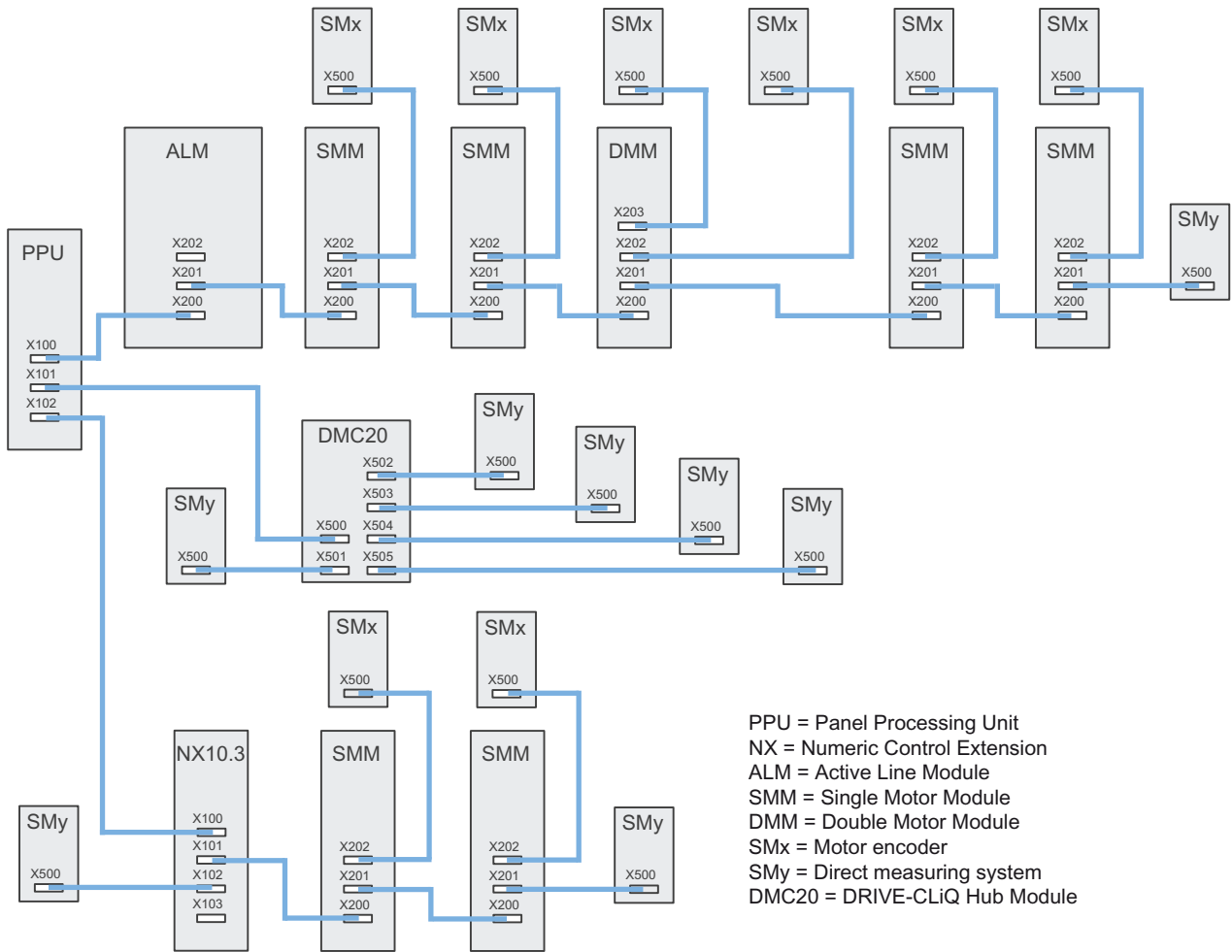


Figure 5-5 DRIVE-CLiQ wiring with NX

Topology with SINAMICS S120 chassis and SINAMICS S120 booksize and eight axes

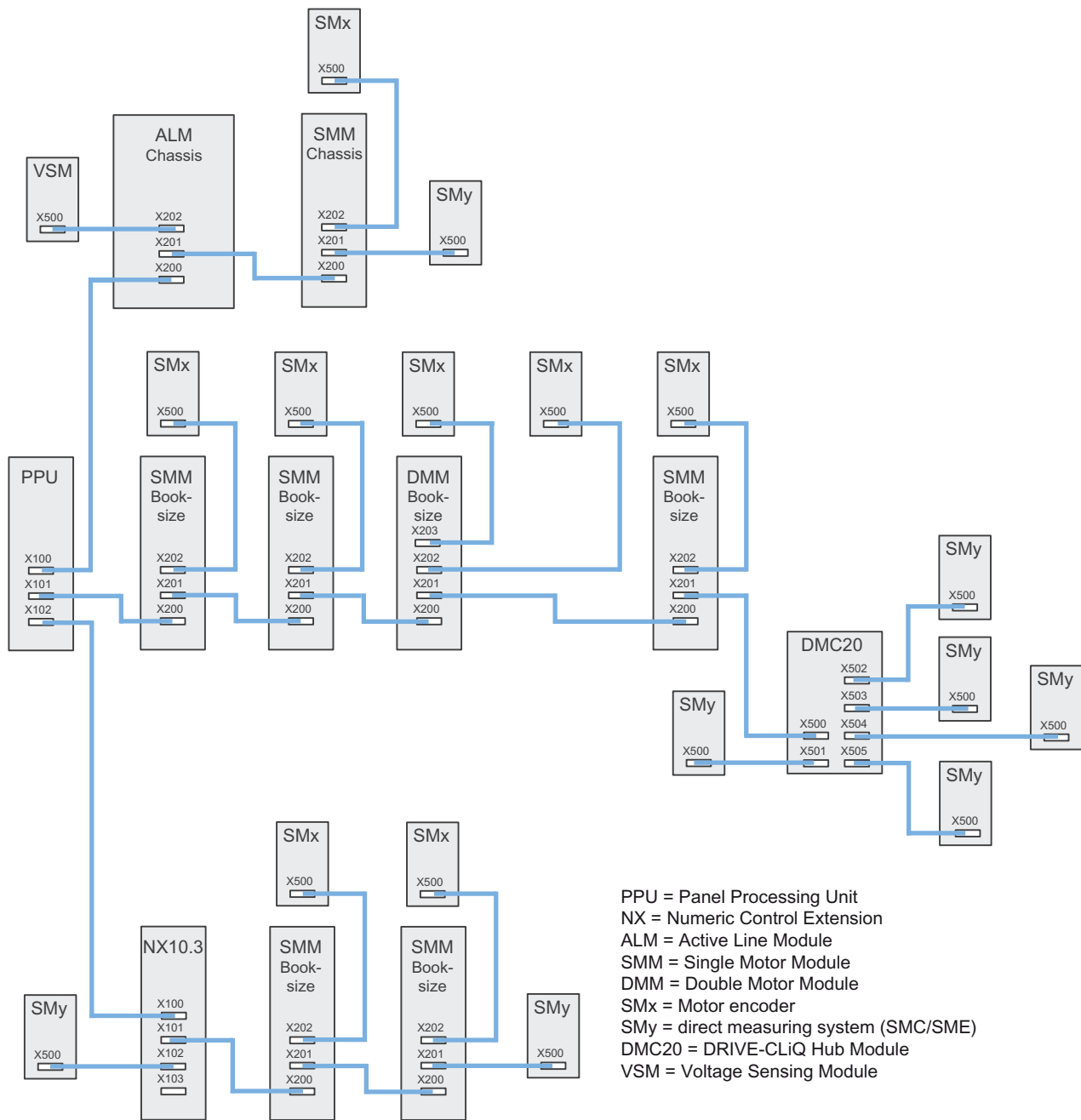


Figure 5-6 DRIVE-CLiQ wiring with NX

5.5 Topology example with Safety Integrated functions

Note

Additional notes on Safety Integrated functions are available under:
SINAMICS S120 Safety Integrated Function Manual.

Topology with SINAMICS S120 booksize and six plus two axes

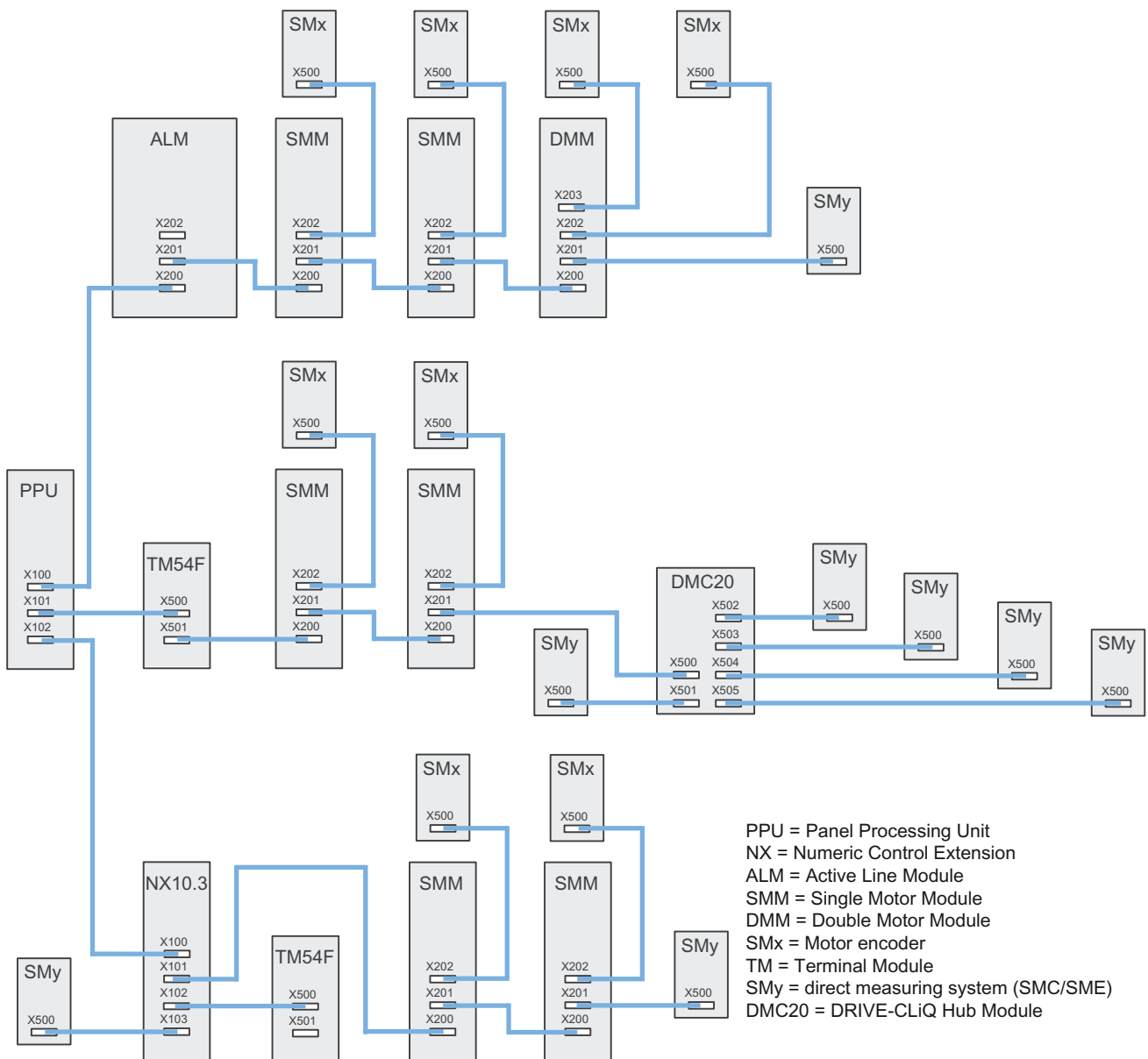


Figure 5-7 DRIVE-CLiQ wiring with Safety Integrated functions and NX

Topology with SINAMICS S120 booksize and five plus three axes

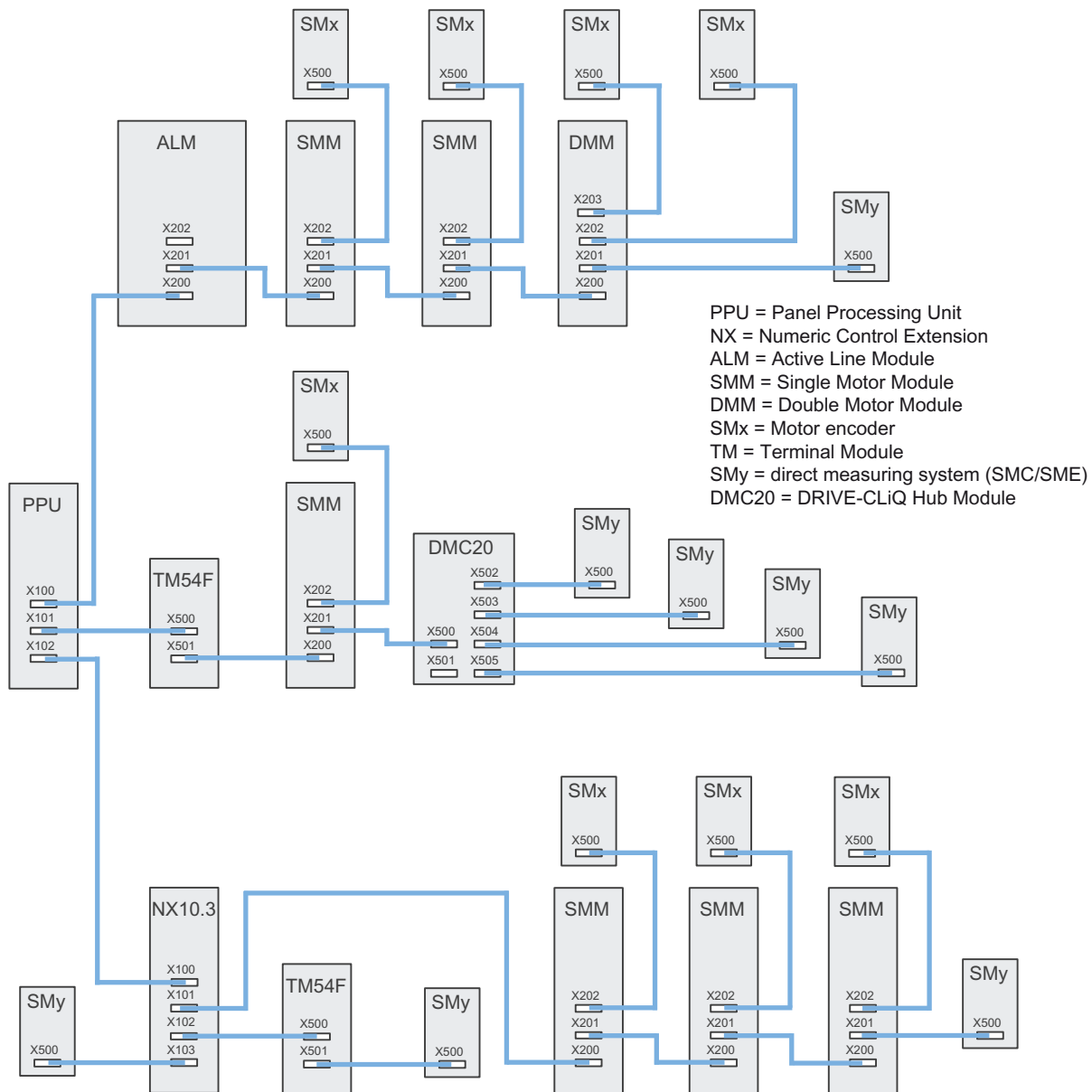


Figure 5-8 DRIVE-CLiQ wiring with Safety Integrated functions and NX

Note

Please note the following conditions for the examples below:

1. Chassis Line Modules must be based on a DAC-ASIC
2. With Safety Integrated functions
3. Standard cycles: T_{ireg}/T_{nreg} = 125 μs, LM = 250 μs, monitoring cycle = 12 ms, T_{dp} = 1.5 ms

Topology with SINAMICS S120 chassis and SINAMICS S120 booksize and six axes

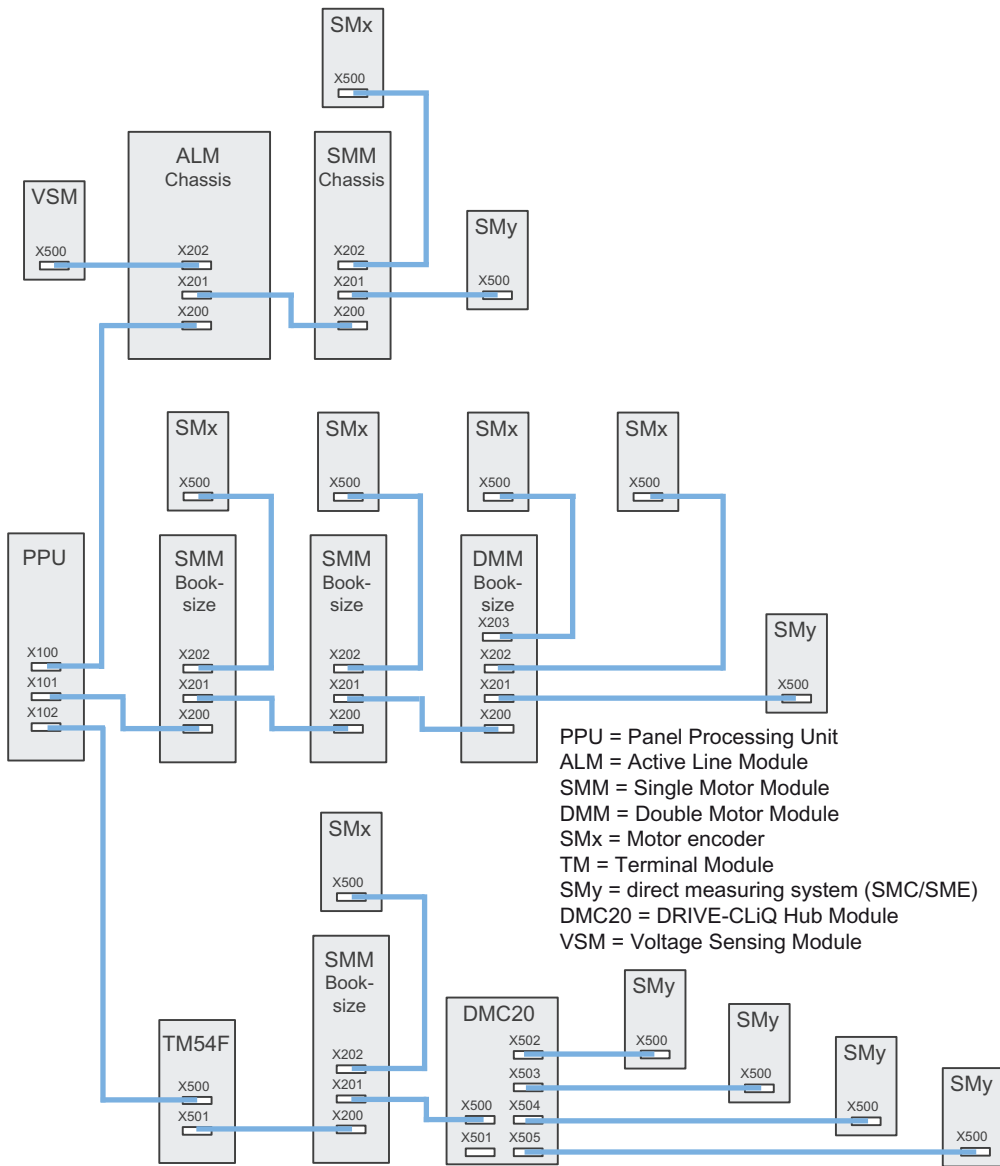


Figure 5-9 DRIVE-CLiQ wiring with Safety Integrated functions and without NX

Topology with SINAMICS S120 chassis and SINAMICS S120 booksize and eight axes

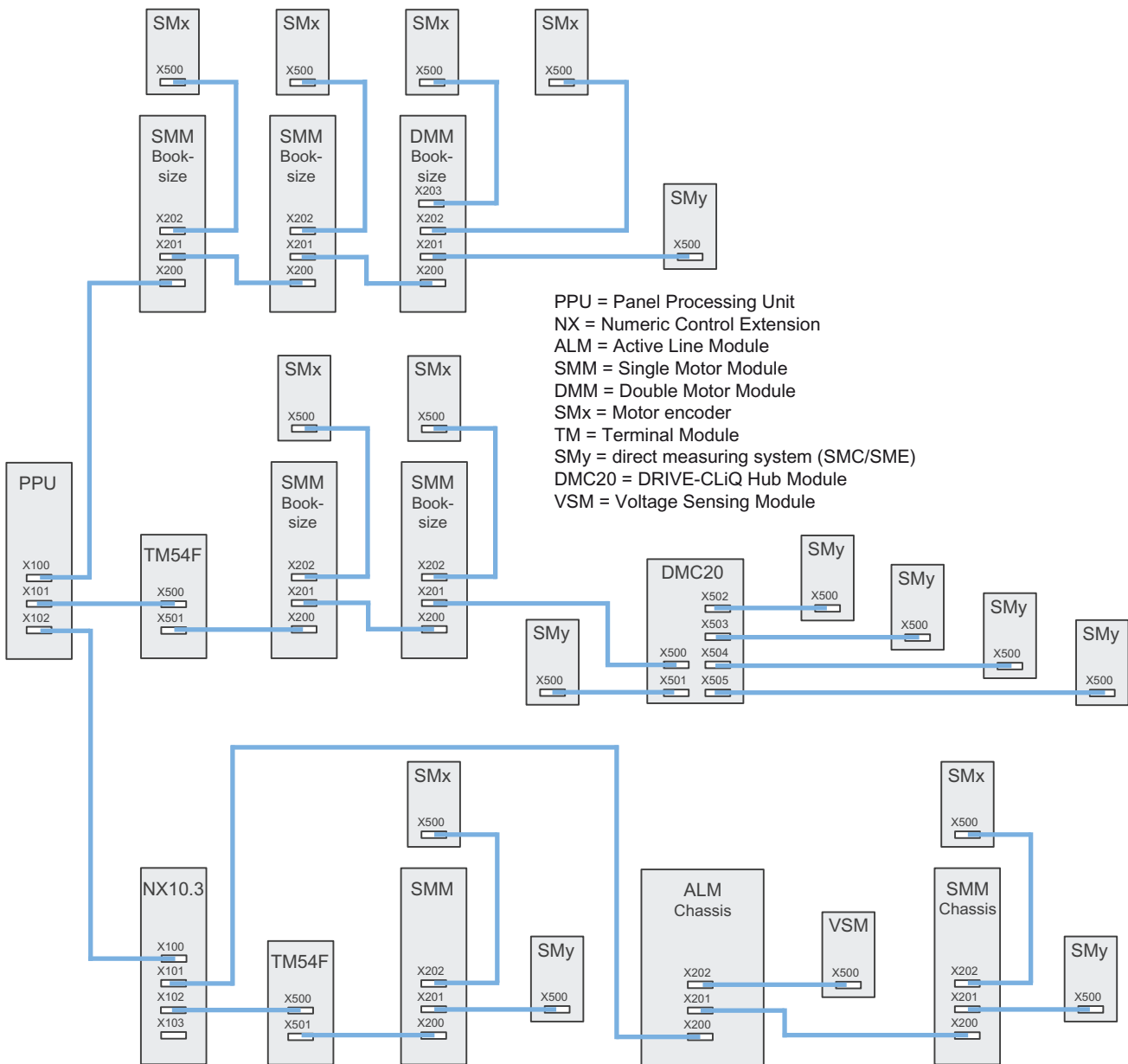


Figure 5-10 Example with Safety Integrated functions and with NX


Note

You can find an example with SINAMICS S120 Combi and Safety Integrated functions under Controller features (Page 13) or in the SINAMICS S120 Combi Manual.

Interface description

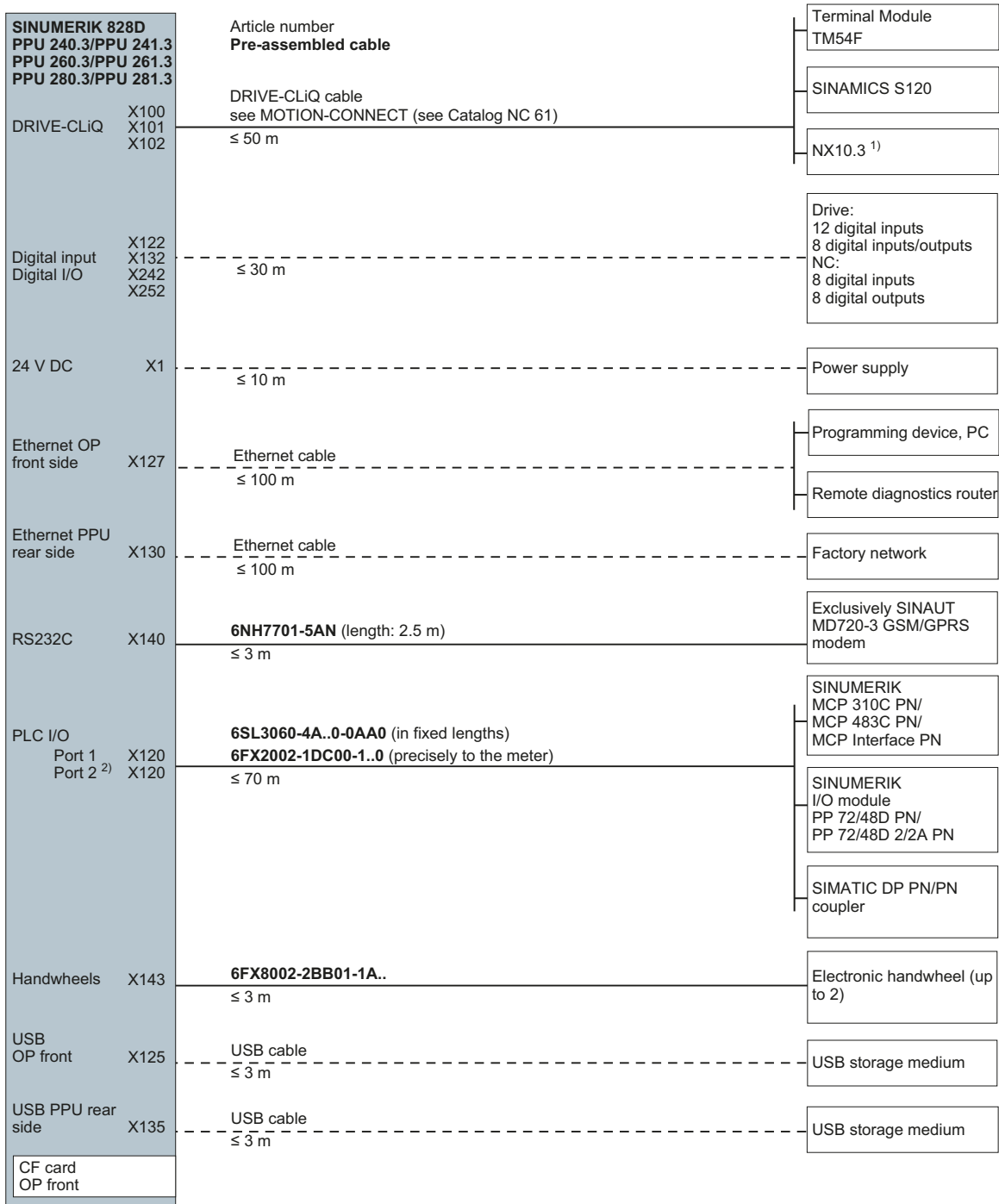
6.1 Interface overview

Requirement

 DANGER
Risk of electric shock
The entire system must be voltage-free when mounting or wiring the SINUMERIK 828D.

Connection options

The overview below shows the interfaces and their connection possibilities:



¹⁾ Only for PPU 280.3/PPU 281.3

²⁾ Not for PPU 240.3/PPU 241.3

Figure 6-1 Connection options of the PPU

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 the X122.1 digital input on the PPU.

Definition

The abbreviations used in "Signal type" column in the tables showing the pin assignment have the following meaning:

B	Bidirectional
GND	Grounding
I	Input
O	Output
VI	Voltage input (supply voltage)
VO	Voltage output (supply voltage)

6.2 Power supply connection

6.2.1 Requirements for the power supply

Pin assignment at X1 screw-type terminal block

Table 6-1 Pin assignment

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

Requirements of DC power supplies

Interface X1 is intended exclusively for the connection of the external 24 V power supply, e.g.

- SITOP (stabilized 24 V power supplies)
- CSM (Control Supply Module)

The following power consumption values for the PPU provide a configuration basis for calculating the 24 VDC power supply.

6.2 Power supply connection

Table 6-2 Input voltage specification

Parameter	Values
Typ. power consumption ¹⁾	1.2 A
Max. power consumption ²⁾	2.5 A
Max. starting current	4.4 A

1) PPU only (processor, memory, etc.)

2) PPU with full load (USB, handwheels)



 DANGER
<p>Risk of lightning strike</p> <p>In the case of supply lines > 10 m, protectors must be installed at the device input in order to protect against lightning (surge).</p> <p>The DC power supply must be connected to the ground/shield of the control unit for EMC and/or functional reasons. For EMC reasons, this connection should only be made at one point. As a rule, the connection is provided as standard in the 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.</p> <p>See also: "EMC Installation Guideline" Configuration Manual</p>

Table 6-3 Technical data of the DC power supply

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

6.2.2 Connecting the power supply

Cable specification

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

The required 24 VDC 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 23 to AWG 13) for wiring the power supply according to the maximum occurring current.

If you only use one wire per connection, a ferrule is not required. The following wire-end ferrules are permissible: Without an insulating collar in accordance with DIN 46228, Form A, long version

Table 6-4 Cable specification for X1

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

6.3 Ethernet

X130, X127 pin assignment

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

6.3 Ethernet

Use

The interfaces are designed for operation in full-duplex mode; in other words, the ports can be used for the sending as well as for the receiving of data packets. The ports are connected as an Ethernet terminal with 10/100 Mbit:

- X130 connects the PPU to the plant network.
 - The IP address can be freely selected.
 - MAC address, see also: Type plate (Page 22).
- X127 is used to connect the following components:
 - PG/PC via peer-to-peer with permanently assigned IP address 192,168,215 .1, for example, for the commissioning software, RCS Commander
 - Modem for remote diagnostics

LED status displays

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

Table 6-5 LED status displays

LEDs	Status	Meaning
Green	Lit	10 or 100 Mbit link available
	Off	Missing or faulty link
Yellow	Lit	Receive or transmit activity
	Off	No activity

Cable specification for X130 and X127

Feature	Version
Connector type	RJ45 socket with 180° cable outlet
Cable type	Industrial Ethernet cable (CAT5)
Max. cable length	100 m

Note

The X127 interface does not support auto crossing. If the Ethernet port of the connected PC or modem does not support auto-crossing, a crossed Ethernet cable must be used.

6.4 PLC I/O Interface based on PROFINET

Pin assignment PN1, PN2

Pin	Signal name	Signal type	Meaning
1	TX+	O	Transmit data +
2	TX-	O	Transmit data -
3	RX+	I	Receive data +
4	N.C.	-	Not assigned
5	N.C.	-	Not assigned
6	RX-	I	Receive data -
7	N.C.	-	Not assigned
8	N.C.	-	Not assigned

The interfaces have the following properties:

- The interfaces are designed for full-duplex mode; in other words, the ports can both transmit and receive.
- The two 100 Mbit Ethernet ports and the internal Ethernet controller are connected to an integrated 3-port switch. The MAC address of the Ethernet controller is stamped on the type plate.

Wiring the PLC I/O Interface

Interfaces PN1 and PN2 can be used to establish the PLC I/O Interface communication network, which is based on PROFINET IO:

- To connect a machine control panel (MCP 310C PN, MCP 483C PN or MCP Interface PN)
- To connect to the PLC I/Os

Note

The PPU has one MAC address for both PLC I/O Interface ports that is the printed on the type plate of the PPU, see section "Type plate (Page 22)". The same applies for the MAC addresses of the operator components.

When connecting I/O devices (I/O modules, machine control panel) to the I/O Controller (PPU), please use the pre-assembled SINAMICS S120 DRIVE-CLiQ signal cables; from a technical point of view, these are also suitable for use with PLC I/O Interface.

- Article number: 6FX2002-1DC00-1□□0
- Max. cable length: 70 m

LED displays on the rear

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

Name	Color	Status	Meaning
Link	Green	Lit	100 Mbit link available
		Off	Missing or faulty link
Activity	Yellow	Lit	Sending or receiving
		Off	No activity

Next to the PN1 port there are two status LEDs (Fault, Sync) that apply to both ports:

Name	Color	Status	Meaning
Fault	Red	Off	For the 828D, all possible I/O modules, machine control panels and PN/PN couplers are connected. This is the reason why this status is not relevant for diagnostics.
		Red	Bus fault: <ul style="list-style-type: none"> • No physical connection to a subnet/switch • Incorrect transmission rate • Full duplex transmission is not activated
		Flashing red (2 Hz)	For the 828D, this is a normal state and does not represent incorrect behavior.
Sync	Green	Off	The SINUMERIK 828D task system is not synchronized to the send cycle of PLC I/O Interface. An internal substitute clock of the same size as the send clock is generated.
		Green	The SINUMERIK 828D task system has been synchronized to the cycle for PLC I/O Interface, and data exchange is running.
		Flashing green (0.5 Hz)	The SINUMERIK 828D task system has been synchronized to the cycle for PLC I/O Interface, and cyclic data exchange is running.

LED displays on the front

The three LEDs located behind the front flap at the front of the PPU have the following significance:

Name	Color	Status	Meaning
RDY	Green	Lights up	NC Ready and PLC in run mode.
	Yellow	Lights up	PLC in stop mode
		Flashing	Power-up

Name	Color	Status	Meaning
	Red	Lights up	NC in stop mode: <ul style="list-style-type: none"> • When booting, if NC Ready is not yet available • Critical fault (power off/on necessary)
NC	Yellow	Cyclic flashing	NC operation
CF	Yellow	Lights up	Accessing the CompactFlash card.

NOTICE**CompactFlash card**

If the LED is lit, the CompactFlash card must not be removed!

Non-compliance can result in damage to the CompactFlash card.

6.4.1 Addressing the I/O modules

IP addresses of the I/O modules

You can find the DIP switch S1 for the IP address of the appropriate I/O module in the following table. In this case, the maximum configuration with I/O modules, bus coupler and machine control panel via the PLC I/O Interface based on PROFINET is taken into consideration.

I/O module	Bus	Device name	IP address	Input addresses	Output addresses
			192.168.214.	(active with MD12986[x] = -1)	
				Index n:	
1. Digital PP module	PN	pp72x48pn9	9	0 ... 8	0 ... 5
2. Digital PP module	PN	pp72x48pn8	8	9 ... 17	6 ... 11
3. Digital PP module	PN	pp72x48pn7	7	18 ... 26	12 ... 17
4th PP module digital	PN	pp72x48pn6	6	27 ... 35	18 ... 23
5. Digital PP module	PN	pp72x48pn5	5	36 ... 44	24 ... 29
Unassigned				45	30 ... 55
				Index d:	
1. PP module diagnostics	PN	pp72x48pn9	9	46 ... 47	--
2. PP module diagnostics	PN	pp72x48pn8	8	48 ... 49	--
3. PP module diagnostics	PN	pp72x48pn7	7	50 ... 51	--
4. PP module diagnostics	PN	pp72x48pn6	6	52 ... 53	--
5. PP module diagnostics	PN	pp72x48pn5	5	54 ... 55	--
				Index m:	
1. Analog PP module	PN	pp72x48pn9	9	56 ... 63	56 ... 63
2. Analog PP module	PN	pp72x48pn8	8	64 ... 71	64 ... 71
3. Analog PP module	PN	pp72x48pn7	7	72 ... 79	72 ... 79
4. Analog PP module	PN	pp72x48pn6	6	80 ... 87	80 ... 87
5. Analog PP module	PN	pp72x48pn5	5	88 ... 95	88 ... 95

Interface description

6.5 Digital inputs/outputs

I/O module	Bus	Device name	IP address	Input addresses	Output addresses
PN/PN coupler *	PN	pn-pn-coupler20	20	96 ... 111	96 ... 111
External machine control panel	PN	mcp-pn64	64	112 ... 125	112 ... 121
Reserved		--	--	126 ... 131	122 ... 123
Sentron PAC 4200 *	PN	pac4200-pn21	21	132 ... 143	132 ... 143
Sentron PAC 3200 *	PN	pac3200-pn22	22	144 ... 155	144 ... 155

The Index n, m, d is always the start address of the address range.

*) The IP address of these components is not set using a switch but rather configured appropriately.

6.5 Digital inputs/outputs

Pin assignment for X122

Pin	Signal name	Meaning	
1	DI0	DI0	Digital input 0
2	DI1	DI1	Digital input 1
3	DI2	DI2	Digital input 2
4	DI3	DI3	Digital input 3
5	DI16	DI16	Digital input 16
6	DI17	DI17	Digital input 17
7	M2	MEXT2	Ground for pins 1...6
8	P1	P24EXT1	+24 V power supply
9	IO8	DI/DO8	Digital input/output 8
10	IO9	DI/DO9	Digital input/output 9
11	M1	MEXT1	Ground for pins 9, 10, 12, 13
12	IO10	DI/DO10	Digital input/output 10
13	IO11	DI/DO11	Digital input/output 11
14	M1	MEXT1	Ground for pins 9, 10, 12, 13

X132 pin assignment

Pin	Signal name	Meaning	
1	DI4	DI4	Digital input 4
2	DI5	DI5	Digital input 5
3	DI6	DI6	Digital input 6
4	DI7	DI7	Digital input 7
5	DI20	DI20	Digital input 20
6	DI21	DI21	Digital input 21

Pin		Signal name	Meaning
7	M2	MEXT2	Ground for pins 1...6
8	P1	P24EXT1	+24 V power supply
9	IO12	DI/DO12	Digital input/output 12
10	IO13	DI/DO13	Digital input/output 13
11	M1	MEXT1	Ground for pins 9, 10, 12, 13
12	IO14	DI/DO14	Digital input/output 14
13	IO15	DI/DO15	Digital input/output 15
14	M1	MEXT1	Ground for pins 9, 10, 12, 13

Connection notes

1. Recommended connection:

If both inputs and outputs are operated on a digital inputs/outputs group, it is recommended that both the inputs and the outputs are fed with the same 24 VDC supply:

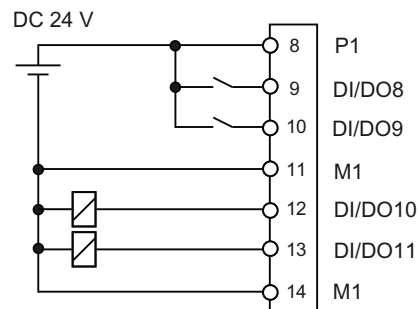


Figure 6-2 Inputs and outputs on the same supply

2. Not recommended connection:

If the inputs and outputs supplied separately with power, the input current can exceed the permissible value of 15 mA according to EN61131-2. This may possibly cause the signal source to be overloaded:

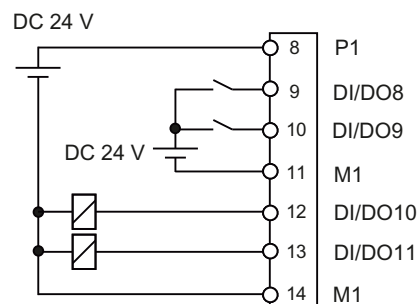


Figure 6-3 Inputs and outputs on different supplies

X242 pin assignment

Pin	Signal name	NC variable	Meaning	
1	Not connected			
2	Not connected			
3	IN1	DIN1	\$A_IN[1]	Digital NC input 1
4	IN2	DIN2	\$A_IN[2]	Digital NC input 2
5	IN3	DIN3	\$A_IN[3]	Digital NC input 3
6	IN4	DIN4	\$A_IN[4]	Digital NC input 4
7	M4	MEXT4		Ground for pins 3...6
8	P3	P24EXT3		+24 V power supply
9	O1	DOUT1	\$A_OUT[1]	Digital NC output 1
10	O2	DOUT2	\$A_OUT[2]	Digital NC output 2
11	M3	MEXT3		Ground for pins 9, 10, 12, 13
12	O3	DOUT3	\$A_OUT[3]	Digital NC output 3
13	O4	DOUT4	\$A_OUT[4]	Digital NC output 4
14	M3	MEXT3		Ground for pins 9, 10, 12, 13

X252 pin assignment

Pin	Signal name	NC variable	Meaning	
1	AO	AOUT		Analog output (voltage for analog spindle)
2	AM	AGND		Analog ground
3	IN9	DIN9	\$A_IN[9]	Digital NC input 9
4	IN10	DIN10	\$A_IN[10]	Digital NC input 10
5	IN11	DIN11	\$A_IN[11]	Digital NC input 11
6	IN12	DIN12	\$A_IN[12]	Digital NC input 12
7	M4	MEXT4		Ground for pins 3...6
8	P3	P24EXT3		+24 V power supply
9	O9	DOUT9	\$A_OUT[9]	Digital NC output 9
10	O10	DOUT10	\$A_OUT[10]	Digital NC output 10
11	M3	MEXT3		Ground for pins 9, 10, 12, 13
12	O11	DOUT11	--	<ul style="list-style-type: none"> Without analog spindle: Digital NC output 11 With analog spindle: Controller release for analog spindle (in accordance with MD30134 \$MA_IS_UNIPOLAR_OUT PUT)

Pin		Signal name	NC variable	Meaning
13	O12	DOUT12	--	<ul style="list-style-type: none"> Without analog spindle: Digital NC output 12 With analog spindle: Travel direction of the analog spindle (in accordance with MD30134 \$MA_IS_UNIPOLAR_OUTPUT)
14	M3	MEXT3		Ground for pins 9, 10, 12, 13

Use

The following assignment applies to the terminals:

- Ten signals can each be assigned to connectors X122 and X132:
 - Six digital inputs
 - Four bidirectional digital inputs/outputs

These twelve inputs and eight inputs/outputs are used for drive control.

- For the X242 connector, four inputs and four outputs are available for the NC.
- For the X252 connector, four inputs and two outputs are available for the NC.

Cable specification at X122, X132, X242 and X252

Please note the following:

- Use flexible cables with a cable cross-section of at least 0.25 mm²
- Ferrules are not required.
- You can use ferrules without an insulating collar in accordance with DIN 46228, Form A long version.
- You can connect two cables each with a cross section of 0.25 mm² in one ferrule.

Features	Version
Connection option	Up to 0.5 mm ²
Current carrying capacity	4 A max. 4 A
Max. cable length	30 m

Wiring the digital inputs/outputs

Tools required: 3.5-mm screwdriver or power screwdriver

Procedure:

1. Strip off 6 mm of cable insulation and, if necessary, press on a ferrule.
2. Wire the digital inputs of the interface for connection of the sensors.

6.5 Digital inputs/outputs

3. Wire the digital outputs of the interface for connection of the actuators.
4. Insert the cable into the corresponding screw terminal.

References

More information about digital inputs/outputs can be found in:
Basic Functions Function Manual, "PLC for SINUMERIK 828D" (P4)

6.5.1 Terminal connection diagram

The following figure shows the terminal connection diagram for the digital inputs/outputs of a PPU.

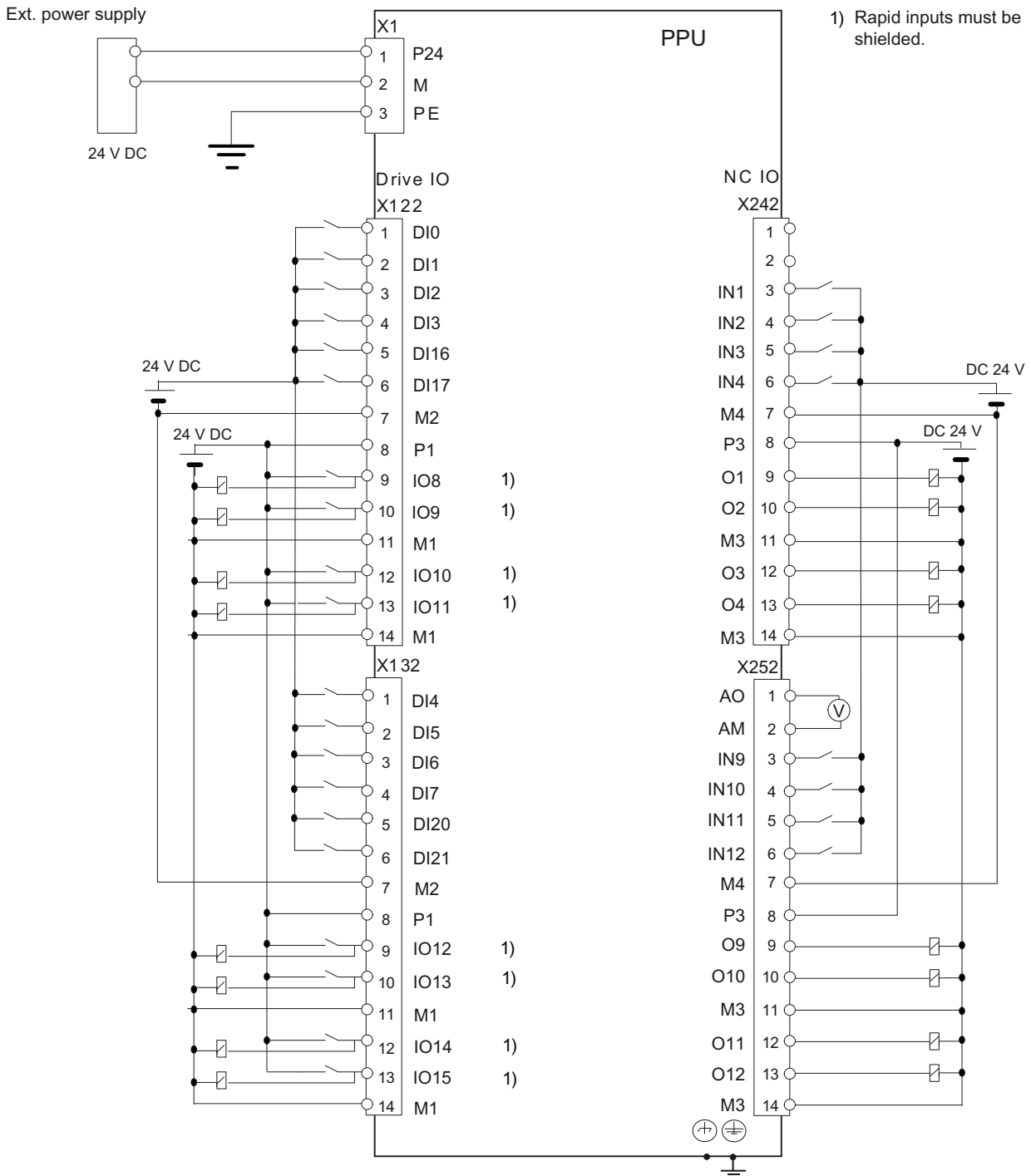


Figure 6-4 Terminal connection diagram for digital inputs/outputs

6.5.2 Example: Connecting an inductive proximity switch (BEROs)

Boundary conditions

When connecting a BERO the following rules must be observed:

- BEROs can always be connected to each input.
- Because both the DI input terminals as well as the parameterizable DI/DO terminals are isolated, the ground of the supply must be connected to the associated M terminal.
- When a connection is made to one of the parameterizable terminals, the positive pole of the power supply must also be connected to the associated P connection terminal.
- Each group can be supplied with its own supply that is independent of the device supply. In the simplest case can, however, everything can be fed from a single supply. Nevertheless, all M and P terminals must be connected.

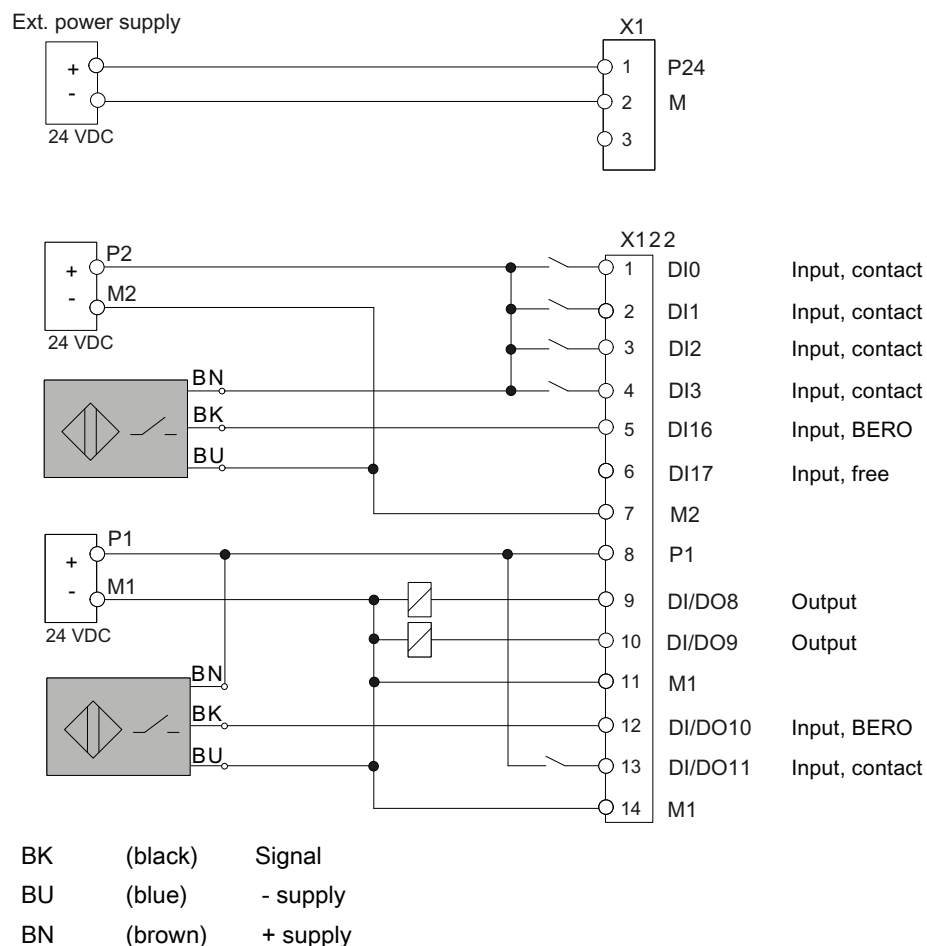


Figure 6-5 Connection to X122

6.5.3 Technical data

Note

An open input is interpreted as "low".

Note

Terminals MEXT1 ... MEXT4 must be connected for the digital inputs/outputs to function. This can be done as follows:

- Connect the ground reference of the digital inputs.
- A jumper to terminal M on plug connector X1.

P24EXT (P1, P3) must also be connected so that the outputs function. An external supply can also be connected here, or a jumper can be inserted to terminal P at X1.

This removes the galvanic isolation for these digital inputs.

Digital inputs

Table 6-6 Technical data of the digital inputs at X122/X132 and X242/X252

Parameter	Value
Voltage	-3 V to 30 V
Typical power consumption	10 mA at 24 V DC
Signal level (including ripple)	High: 15 V to 30 V Low: -3 V to 5 V
Signal propagation times	L → H: 50 μs H → L: 150 μs
Galvanic isolation	Yes: The reference potential is terminal 2M at X122/X132. The reference potential is terminal 4M at X242/X252.

Digital inputs/outputs

Table 6-7 Technical data of the digital inputs/outputs at X122/X132

Parameter	Value
As input:	
Voltage	-3 V to 30 V
Typical power consumption	10 mA at 24 V DC
Signal level (including ripple)	High: 15 V to 30 V Low: -3 V to 5 V
Signal propagation (rapid inputs)	L → H: 10 μs H → L: 150 μs
Galvanic isolation	Yes: The reference potential is terminal 1M.

6.6 DRIVE-CLiQ

Parameter	Value
As output:	
Voltage	18 V to 30 V
Load current per output, maximum	0.5 A
Load current per connector, maximum	1 A
Signal propagation times	L → H: 50 μs H → L: 200 μs
Galvanic isolation	Yes: The reference potential is terminal 1M/1P24 (24 V DC)

Digital outputs

Table 6-8 Technical data of the digital outputs at X242/X252

Parameter	Value
Voltage	18 V to 30 V
Load current per output, maximum	0.5 A
Load current per connector, maximum	1 A
Signal propagation times	L → H: 50 μs H → L: 200 μs
Galvanic isolation	Yes: The reference potential is terminal 3M/3P24 (24 V DC).

6.6 DRIVE-CLiQ

6.6.1 DRIVE-CLiQ interface

Pin assignment at X100 - X102

PIN	Signal name	Signal type	Meaning
1	TXP	O	Transmit data +
2	TXN	O	Transmit data -
3	RXP	I	Receive data +
4	--	--	Reserved
5	--	--	Reserved
6	RXN	I	Receive data -
7	--	--	Reserved
8	--	--	Reserved
A	--	--	Reserved
B	--	--	Reserved

Use

DRIVE-CLiQ interfaces are used to connect SINAMICS S120 components to the PPU.

The following rules apply:

- Topology rules for S120 Combi (Page 53)
- Topology rules for S120 Booksize (Page 54)
- Topology rules for Safety Integrated functions (Page 58)
- Topology example without Safety Integrated functions (Page 59)
- Topology example with Safety Integrated functions (Page 63)

DRIVE-CLiQ has the following properties:

- Components can be independently expanded
- Automatic detection of components by the PPU
- Standardized interfaces to all components
- Uniform diagnostics down to the components
- Complete service down to the components

Cable specification for X100 - X102

Feature	Version
Connector type	RJ45 socket with 180° cable outlet
Cable type	MOTION-CONNECT
Article number	6FX2002-1DC00-1□□0
Max. cable length	70 m

Blanking cover for DRIVE-CLiQ interface: Tyco company, article number: 969556-5

Note

Interfaces X100 to X102

The interfaces X100 to X102 of the PPU do not provide any 24 V supply voltage. Consequently, no components, such as SME, can be connected here that must be supplied with 24 V via DRIVE-CLiQ.

Additional references

Further information on the components in this section:

- SINAMICS S120 Control Units and Additional System Components Manual
- SINAMICS S120 Booksize Power Units Manual
- SINAMICS S120 Booksize Power Units with Cold Plate Manual
- SINAMICS S120 Combi Manual

6.6.2 SINAMICS components

Components with DRIVE-CLiQ

As a rule, all SINAMICS components approved for SINUMERIK 828D can be connected using DRIVE-CLiQ.

Component	Description
NX10.3	Axis expansion module
Active / Basic / Smart Line Modules Booksize / Chassis	Line Modules provide the central power supply to the DC link.
Single / Double Motor Modules Booksize / Chassis	Motor Modules draw their power from the DC link to supply the connected motors.
SINAMICS S120 Combi	The S120 Combi is a compact unit in the Booksize format with integrated infeed.
Single/Double Motor Modules Booksize Compact	The Booksize Compact format is the expansion module for the S120 Combi.
SMC10 / 20 / 30	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.
SMC40	This Sensor Module is used to convert encoder signals from absolute encoders with EnDat 2.2 to DRIVE-CLiQ.
DMC20 / DME20	DRIVE-CLiQ Hub Modules are used to implement the star-shaped distribution of a DRIVE-CLiQ line.
TM54F	The TM54F Terminal Module is a terminal expansion module for Safety Integrated functions.
TM120	The Terminal Module TM120 is a DRIVE-CLiQ component for safe electrically isolated temperature evaluation.

Note

Connection of Sensor Modules

In principle, SMx encoder modules can be connected to Line Modules provided standard cycles are used for current and speed controllers in the related Motor Module.

If the standard cycle is reduced, it is then **not** possible to connect an SMx to a Line Module.

NOTICE

Connection of the SMC40

The SMC40 can only be integrated in the actual topology if the DRIVE-CLiQ X500/x interfaces and the corresponding X520/x encoder interfaces are assigned.

Without a connected encoder, it is also not possible to subsequently integrate the SMC40 in the topology.

6.7 Handwheel

Pin assignment

Table 6-9 X143 pin assignment

Pin		Signal name	Meaning
1	P5	P5	5 VDC power supply
2	M	M	Ground
3	1A	1A	Handwheel pulses track A, channel 1
4	-1A	1/A	Handwheel pulses track A (negated), channel 1
5	1B	1B	Handwheel pulses track B, channel 1
6	-1B	1/B	Handwheel pulses track B (negated), channel 1
7	P5	P5	5 VDC power supply
8	M	M	Ground
9	2A	2A	Handwheel pulses track A, channel 2
10	-2A	2/A	Handwheel pulses track A (negated), channel 2
11	2B	2B	Handwheel pulses track B, channel 2
12	-2B	2/B	Handwheel pulses track B (negated), channel 2

Connection diagram

Possible connection types for handwheels are shown in the following diagram.

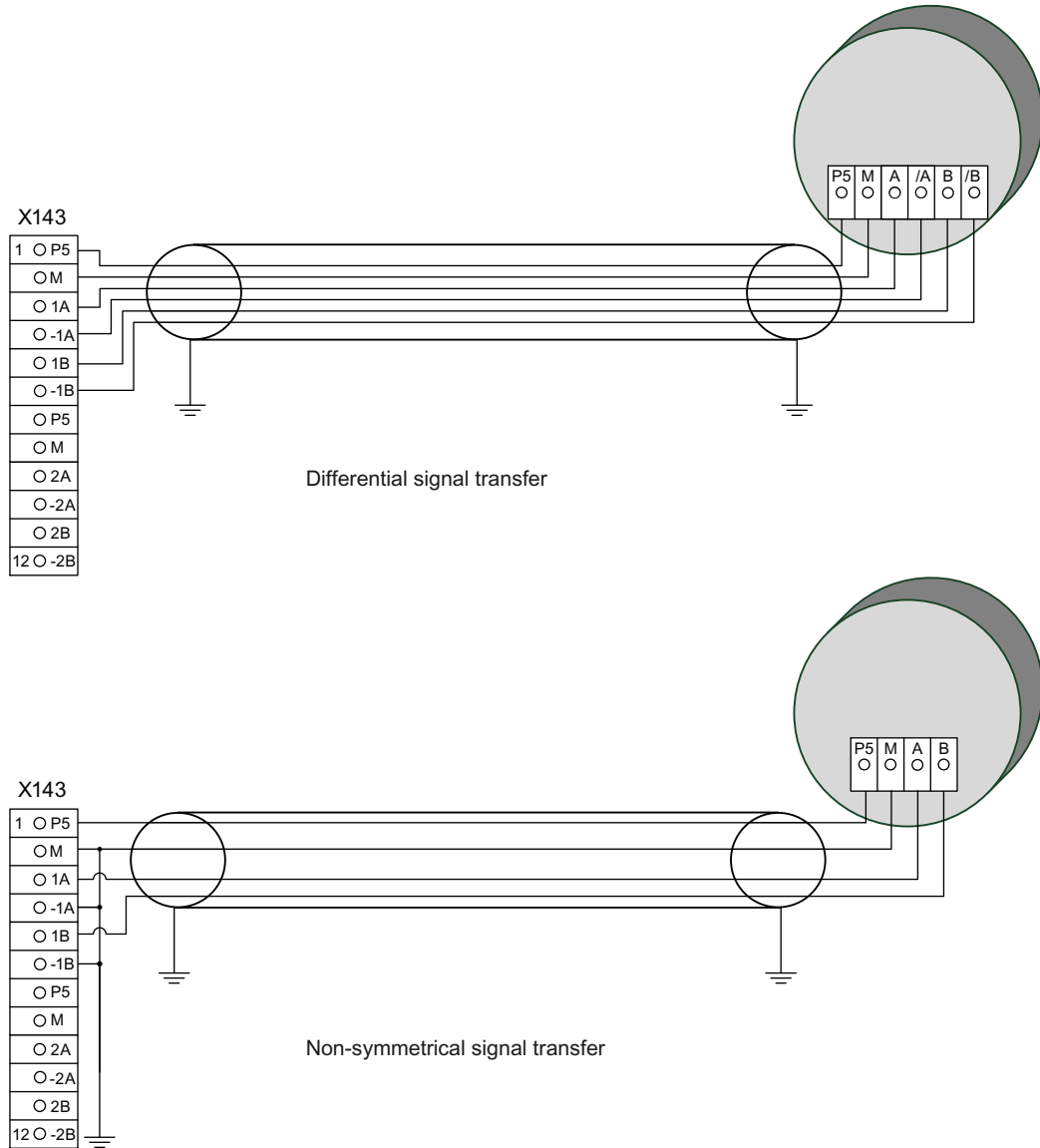


Figure 6-6 Connecting a handwheel with different data transfer types

Use

Max. two electronic handwheels can be connected to connector X143 on the rear of the PPU. The handwheel must meet the following requirements:

- Transmission procedure: Differential or non-symmetrical signal transfer
- Signals:
 - Differential signal transfer (RS422):
For each track a signal and a negated signal
 - Non-symmetrical signal transfer:
For each track, a 5 V TTL signal
- Max. output frequency: 500 kHz
- Phase shift of Track A to Track B: $90^\circ \pm 30^\circ$
- Supply: 5 V, max. 250 mA

Differential signal transfer is the preferred technique, as it is insensitive to electromagnetic disturbances.

Note

The SINUMERIK 828D software can process up to three handwheels. You can connect two handwheels to the PPU. You can connect an additional handwheel to the machine control panel, see Connectable components (Page 93).

Cable specification

Table 6-10 Cable specification for X143

Feature	Version
Connector type:	12-pin screw terminal
Cable type:	Twisted pair, shielded
Article number	6FX8002-2BB01-1A□□
Max. cable length	3 m

6.8 USB

Use

The USB interfaces correspond to the norm and are, therefore, not described in detail here.

- The **X125 USB interface** (at the front behind a flap) can be used to connect a USB-FlashDrive for transferring user and commissioning data.
- The X135 USB interface (at the rear) is available only for service purposes.

Cable specification

Features	Variants
Connector type:	USB socket - type A
Version:	USB 2.0
Current carrying capacity:	0.5 A per connector
Max. data transmission rate	12 Mbit/s
Max. cable length	3 m

Note

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

6.9 RS 232 serial interface

Pin assignment

Table 6-11 X140 pin assignment

Pin	Signal name	Signal type	Meaning
1	Not connected		
2	RxD	I	Serial receive data
3	TxD	O	Serial transmit data
4	DTR	O	Data terminal ready
5	M	-	Ground (reference potential)
6	DSR	I	Ready for operation
7	RTS	O	Switch-on transmit section
8	CTS	I	Clear to send
9	Reserved		

Use

For connecting the SINAUT MD720-3 GSM modem.

Cable specification

Table 6-12 Cable specification for X140

Feature	Version
Connector type	9-pin SUB-D connector
Cable type	RS232

Feature	Version
Article number	6FX8002-1AA11-1□□0
Max. cable length	3 m

Connectable components

7.1 MCP 483C PN

Description

The MCP 483C PN machine control panel enables user-friendly operation of the machine functions. It can be used with a SINUMERIK 828D control for machine-level operation of milling and turning machines.

All keys are designed with replaceable caps for machine-specific adaptations. The key caps can be freely inscribed using laser. Clear key caps can be used as an alternative.

The machine control panel is mounted from the rear with special tension jacks supplied with the panel.

Operator controls

- Operating mode and function keys:
 - 50 keys with assigned LEDs
 - Direction keys for milling machines with rapid traverse override (The key covers for the direction keys for lathes are supplied.)
 - Key type: Mechanical short-stroke keys
- Spindle control with override spindle (rotary switch with 16 positions)
- Feed control with override feed/rapid traverse (rotary switch with 23 positions)
- Key-operated switch (four positions and three different keys)
- Emergency-Stop button, two contact pairs (1 NO + 1 NC)

Interfaces

- PLC I/O Interface (data transmission rate: 100 Mbit/s)
- Nine customer-specific inputs (e.g. for illuminated pushbuttons)
- Six customer-specific outputs
- Handwheel connection

Expansion slots

Two slots for control devices (d = 16 mm)

An additional cable set required for control devices: Spare parts and accessories (Page 108)

7.1.1 Operator controls and display elements

Operator controls (front)

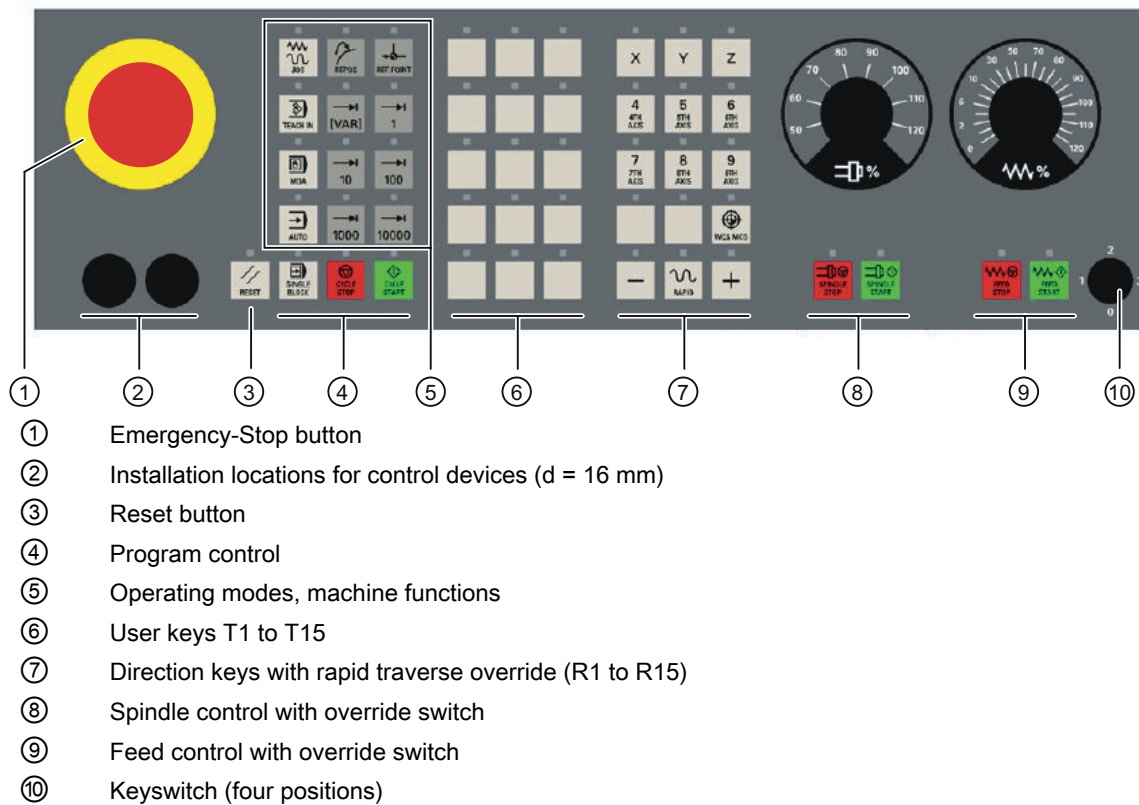



Figure 7-1 Position of control elements on MCP 483C PN

 WARNING
Mounting slots for control devices
The openings for installing control devices ② in "Position of control elements of MCP483C PN" Fig. must not be broken out (risk of damage) but carefully drilled to the required width.

Emergency Stop circuit

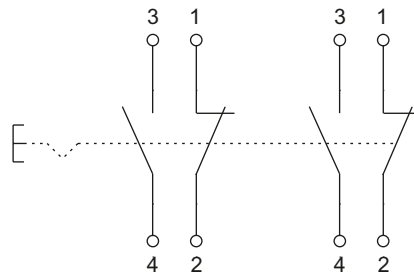
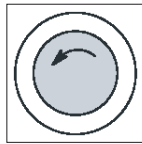


Figure 7-2 Emergency Stop circuit

EMERGENCY STOP



Press the red Emergency-Stop button in emergencies when

- people are at risk.
- there is the danger of a machine or workpiece being damaged.

As a rule, when operating the Emergency-Stop button, all drives are brought to a standstill with max. braking torque.

Turn the emergency-stop counterclockwise to unlatch it.










Machine manufacturer



For details of other or additional reactions to an Emergency-Stop: Please note information provided by machine tool manufacturer.

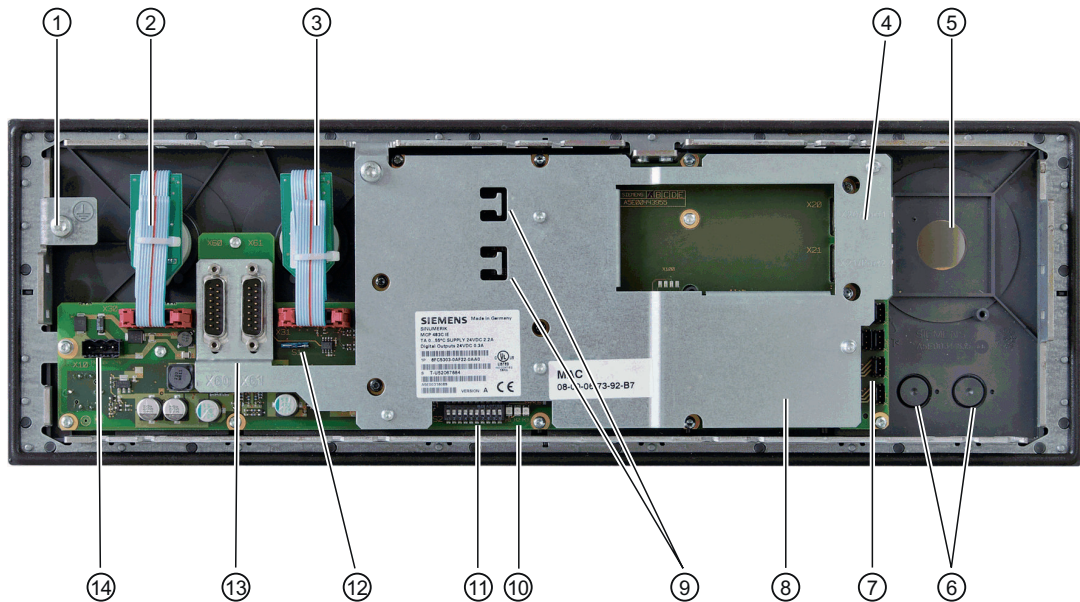
Key caps

All keys of the MCP 483C PN come with changeable key caps. Refer to the following table for the additional replacement key caps provided for lathes in the accessories pack:

Key cap	Symbol number	Key cap	Symbol number
	7027		7129
	7125		7130
	7126		7131
	7127		7132
	7128		

You will find article numbers for the key caps in Chapter Spare parts and accessories (Page 108).

Display elements (rear)



- ① Ground terminal
- ② Feed override X30
- ③ Spindle override X31
- ④ PLC I/O Interface X20/X21 connections
- ⑤ Slot for emergency stop
- ⑥ Installation locations for additional control devices (d = 16 mm)
- ⑦ Customer-specific inputs and outputs
- ⑧ Cover plate
- ⑨ Ethernet cable strain relief
- ⑩ LEDs
- ⑪ Switch for setting the MCP address
- ⑫ Switch for setting the handwheel signal type
- ⑬ X60 connection for handwheel, X61 reserved
- ⑭ Power supply interface X10

Detail for ④:

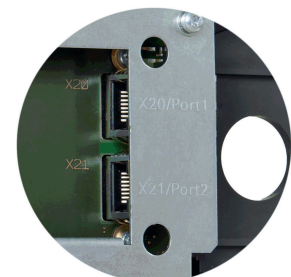


Figure 7-3 Rear panel of MCP 483C PN

LEDs for status display

When the system is booting, all three LEDs are lit.

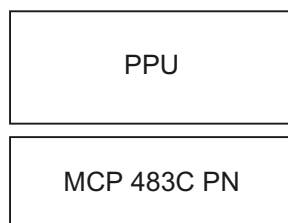
Name	Designation	Color	Description
H1	PowerOK	Green	Lit: Power supply OK
H2	PNSync	Green	Lit: System software running, STOP state

Name	Designation	Color	Description
			Flashes 0.5 Hz: System software running, RUN state
H3	PNFault	Red	<p>Not lit: Module is operating without errors; data exchange with all configured IO devices is running.</p> <p>Lit: Serious bus fault; only output when one of the following errors is detected for the ports:</p> <ul style="list-style-type: none"> • No physical connection to a subnet/switch • Incorrect transmission rate • Full duplex transmission is not activated

7.1.2 Mounting

Call sequence

The recommended installation of the MCP 483C PN machine control panel is shown in the following figure:



Mounting positions

The permitted mounting position is max. 60° to the vertical.

Note

For mounting positions greater than 60°, a fan must also be installed to keep the ambient temperature of the machine control panel constantly below 55 °C.

Tension jacks

The machine control panel is mounted from the front in a rectangular cut-out and attached by means of nine supplied tension jacks (0.5 Nm tightening torque).

Tension jacks are also available as a spare part (see Section: "Spare parts and accessories (Page 108)").

7.1 MCP 483C PN

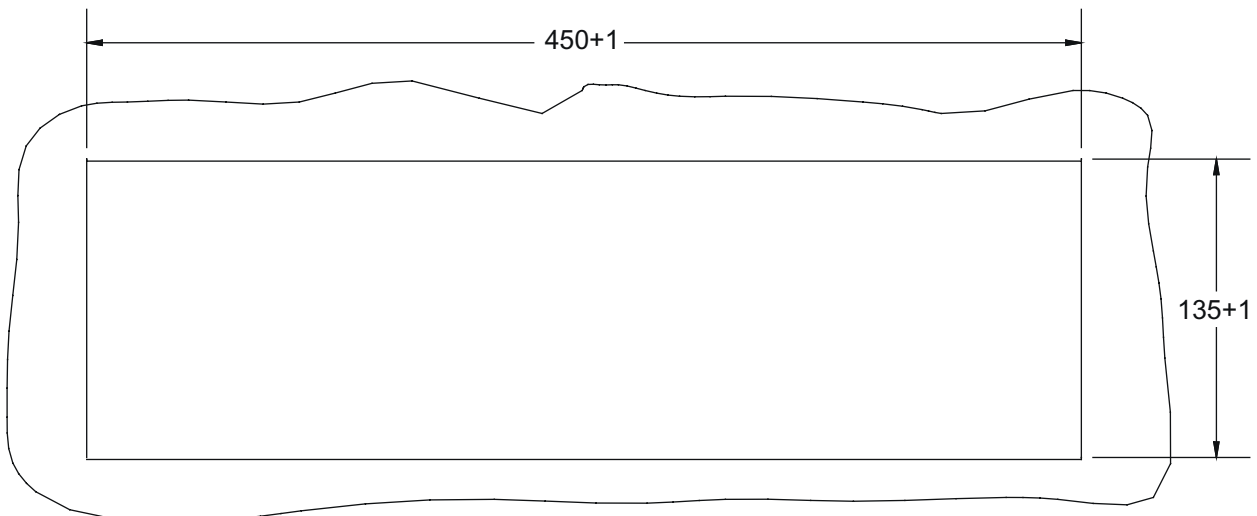


Figure 7-4 Panel cutout of MCP 483C PN

MCP 483C PN dimension drawing

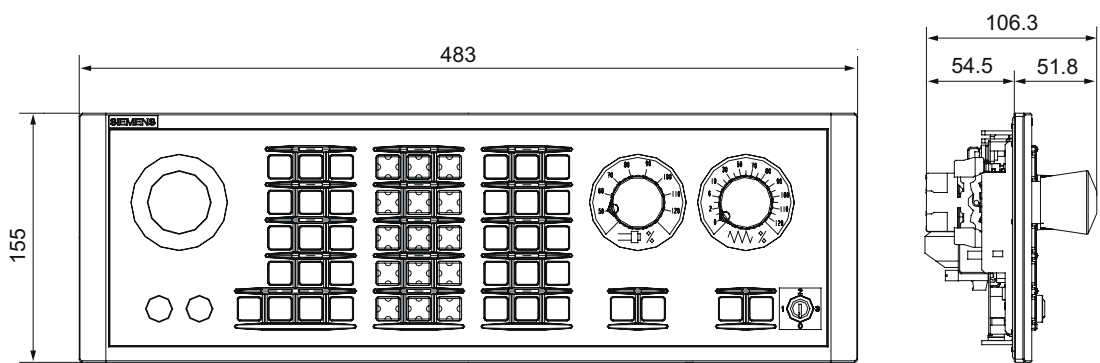


Figure 7-5 MCP 483C PN dimensions

7.1.3 Connecting

Securing the cables

Two equivalent connections (Fast Ethernet) are available for establishing the PLC I/O Interface communication network based on PROFINET.

Two cable ties are included in the scope of delivery. You use these to secure the Ethernet cables on the cover plate at the rear of the machine control panel.

The Ethernet cables are not included in the scope of delivery. When connecting the machine control panel to the SINUMERIK 828D, please use the preassembled SINAMICS DRIVE-CLiQ signal cables; from a technical point of view, these are also suitable for use with PROFINET.

NOTICE

Damage to cables

Make sure that all cables are routed so that they do not come into contact with chafing edges.

See also

Ordering data (Page 27)

Interface overview

X10	Power supply interface
X20	PLC I/O Interface port 1
X21	PLC I/O Interface port 2
X30	Interface for rotary switch feed override
X31	Interface for rotary switch spindle override/EMERGENCY STOP (optional)
X51 / X52 / X55	Interfaces for customer-specific inputs
X53 / X54	Interfaces for customer-specific outputs
X60	Interface for handwheel
X61	Reserved
S1	Switch for setting the handwheel signal type
S2	Switch for setting the MCP address

X10 power supply pin assignment

Connector designation: **X10**

Connector type: Terminal block, 3-pin plug connector

Pin	Signal name	Signal type	Meaning
1	P24	V	24 V potential
2	M24	V	24 V ground
3	SHIELD	V	Shield connection

PLC I/O Interface pin assignment

Connector designation: **X20, X21**

Connector type: RJ45 socket

Table 7-1 Assignment of connectors X20, X21

Pin	Signal name	Signal type	Meaning
1	TX+	I	Transmit +
2	TX-	I	Transmit -
3	RX+	O	Receive +
4	N.C.	-	Not assigned
5	N.C.	-	Not assigned
6	RX-	O	Receive -
7	N.C.	-	Not assigned
8	N.C.	-	Not assigned

Rotary switch: Feed override X30 / spindle override X31

Connector designation: **X30/X31**

Connector type: 2 x 5-pin plug connector, according to EN 60603-13 with coding

Table 7-2 Assignment of connector X30

Pin	Signal name	Signal type	Meaning
1	N.C.	-	Not assigned
2	N.C.	-	Not assigned
3	M	V	Ground
4	N.C.	-	Not assigned
5	P5	V	5 V supply
6	OV16	I	Rotary override switch, position/value 16
7	OV8		Rotary override switch, position/value 8
8	OV4		Rotary override switch, position/value 4
9	OV2		Rotary override switch, position/value 2
10	OV1		Rotary override switch, position/value 1

Optional customer buttons IN (X51 / X52 / X55)

Only switches (passive inputs) may be connected via the X51, X52 and X55 connectors. X51 and X52 are typically used for connecting illuminated pushbuttons. The lamps in the buttons are activated via X53 and X54. X55 has no corresponding outputs.

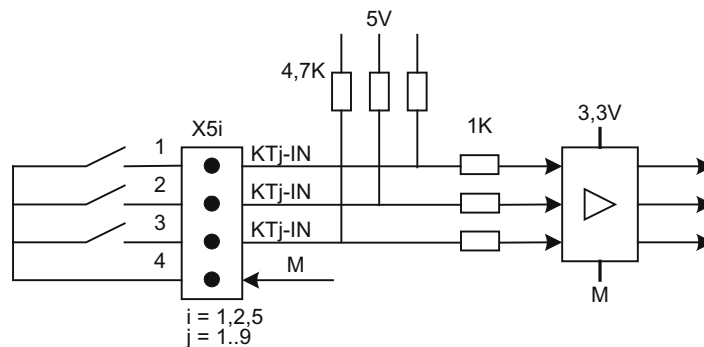


Figure 7-6 Main circuit diagram for input circuit for X51, X52 and X55

Connector designation: **X51, X52, X55**

Connector type: 4-pin plug connector

Table 7-3 Assignment of connector X51

Pin	Signal name	Signal type	Meaning
1	KT-IN1	I	Customer key 1
2	KT-IN2		Customer key 2
3	KT-IN3		Customer key 3
4	M	V	Ground

Table 7-4 Assignment of connector X52

Pin	Signal name	Signal type	Meaning
1	KT-IN4	I	Customer key 4
2	KT-IN5		Customer key 5
3	KT-IN6		Customer key 6
4	M	V	Ground

Table 7-5 Assignment of connector X55

Pin	Signal name	Signal type	Meaning
1	KT-IN7	I	Customer key 7
2	KT-IN8		Customer key 8
3	KT-IN9		Customer key 9
4	M	V	Ground

Optional customer buttons OUT (X53 / X54)

The short-circuit-proof outputs X53/X54 are provided to control lamps in the buttons. Lamps with 24 V and 1.2 W per output are recommended.

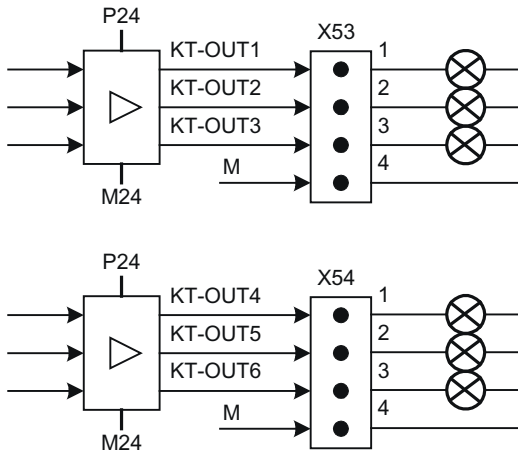


Figure 7-7 Main circuit diagram for input circuit for X53 and X54

	CAUTION
Do not connect any relays, valves or other inductive loads.	

Connector designation: **X53, X54**

Connector type: 4-pin plug connector

Table 7-6 Assignment of connector X53

Pin	Signal name	Signal type	Meaning
1	KT-OUT1	O	Output 1 lamp
2	KT- OUT2		Output 2 lamp
3	KT- OUT3		Output 3 lamp
4	M	V	Ground

Table 7-7 Assignment of connector X54

Pin	Signal name	Signal type	Meaning
1	KT-OUT4	O	Output 4 lamp
2	KT- OUT5		Output 5 lamp
3	KT- OUT6		Output 6 lamp
4	M	V	Ground

X60 handwheel

Via X60, you can connect 1 handwheel either with TTL or difference signals.

Note

The handwheel is supplied by the MCP module with 5 V / 100 mA. An external power supply is not permitted.

NOTICE

Handwheel connections

The SINUMERIK 828D software can process up to three handwheels. You can connect two handwheels to the PPU. You can connect an additional handwheel to the machine control panel.

Connector designation: **X60**
 Connector type: 15-pin Sub-D socket

Table 7-8 Assignment of connector X60

Pin	Name	Type	Meaning
1	P5V	V	5 V power supply
2	M	V	Ground
3	HW1_A	I	Handwheel pulses track A
4	HW1_XA	I	Handwheel pulses track A (negated)
5	N.C.	-	Not assigned
6	HW1_B	I	Handwheel pulses track B
7	HW1_XB	I	Handwheel pulses track B (negated)
8	N.C.	-	Not assigned
9	P5V	V	5 V power supply
10	N.C.	-	Handwheel 2 pulses track A (negated)
11	M	V	Ground
12	N.C.	-	Not assigned
13	N.C.	-	Not assigned
14	N.C.	-	Not assigned
15	N.C.	-	Not assigned

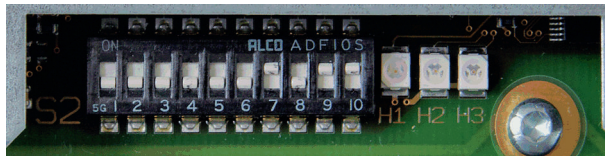
Switch S1

The handwheel signal type is set with switch S1.

Closed	differential interface
Open	TTL interface

Switch S1 is closed when supplied ex works.

Switch S2



Schalter S2

Switch position: "ON" is at the top.

Table 7-9 Switch S2 is set as delivered

1	2	3	4	5	6	7	8	9	10	Meaning
								ON	ON	PLC I/O Interface
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF			PROFINET address "0"

The two switches S2-9 and S2-10 must remain set to "ON".

The switches S2-1 to S2-8 define the PROFINET address. For a SINUMERIK 828D, the address "64" must always be assigned to the MCP.

Table 7-10 Settings of switch S2

1	2	3	4	5	6	7	8	9	10	Meaning
						ON		ON	ON	
OFF	OFF	OFF	OFF	OFF	OFF		OFF			PROFINET address "64"

7.1.4 Parameterization

The specifications for assigning input and output bytes listed in the tables are set as standard addresses in the PLC by setting the following machine data:
 MD12986 PLC_DEACT_IMAGE_LADDR_IN[6] = -1

Standard input image

Table 7-11 Input image MCP 483C PN

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	Spindle override				Operating mode			
EB112	D (2 ³)	C (2 ²)	B (2 ¹)	A (2 ⁰)	JOG	TEACH IN	MDA	AUTO
	Machine function							
EB113	REPOS	REF.	var. INC	10000 INC	1000 INC	100 INC	10 INC	1 INC
EB114	Keyswitch position 0	Keyswitch position 2	Spindle Start	*Spindle Stop	Feed Start	*Feed Stop	NC start	*NC Stop

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
EB115	RESET	Keyswitch position 1	Single block	Feedrate override				
				E (2 ⁴)	D (2 ³)	C (2 ²)	B (2 ¹)	A (2 ⁰)
EB116	Direction keys			Keyswitch position 3	Axis selection			
	+ R15	- R13	Rapid traverse R14		X R1	4. axis R4	7. axis R7	R10
EB117	Axis selection							
	Y R2	Z R3	5. axis R5	Drive command in MCS/WCS	R11	9. axis R9	8. axis R8	6. axis R6
EB118	Unassigned customer keys							
	T9	T10	T11	T12	T13	T14	T15	-
EB119	Unassigned customer keys							
	T1	T2	T3	T4	T5	T6	T7	T8
EB120	-	-	-	-	-	-	-	-
EB121	-	-	-	-	-	-	-	-
EB122	KT-IN8	KT-IN7	KT-IN6	KT-IN5	KT-IN4	KT-IN3	KT-IN2	KT-IN1
EB123	-	-	-	-	-	-	-	KT-IN9
EB124	-	-	-	-	-	-	-	-
EB125	-	-	-	X31 pin 6 ¹⁾	X31 pin 7 ¹⁾	X31 pin 8 ¹⁾	X31 pin 9 ¹⁾	X31 pin 10 ¹⁾

Signals marked with * are inverse signals.

1) If the 4-stage spindle override rotary switch on X31 is replaced by a 5-stage rotary switch, the information here can be measured in 5 stages.

Input image of the handwheel

Table 7-12 Input image for handwheel data

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
EB m + 0	Handwheel 1 counter status (16-bit signed, low-order byte equals byte m + 0)							
EB m + 1								
EB m + 2	Handwheel 2 counter status (16-bit signed, low-order byte equals byte m + 2)							
EB m + 3								

Note

Within the SINUMERIK control, the handwheel data is processed directly by the NC and is not available to the PLC.

Output image

Table 7-13 Output image MCP 483C PN

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
AB112	Machine function				Operating mode			
	1000 INC	100 INC	10 INC	1 INC	JOG	TEACH IN	MDA	AUTO
AB113	Feed Start	*Feed Stop	NC start	*NC Stop	Machine function			
					REPOS	REF.	var. INC	10000 INC
AB114	Direction key - R13	Axis selection			R10	Single block	Spindle Start	*Spindle Stop
		X R1	4. axis R4	7. axis R7				
AB115	Axis selection							Direction key + R15
	Z R3	5. axis R5	Drive command in MCS/WCS	R11	9. axis R9	8. axis R8	6. axis R6	
AB116	Unassigned customer keys							
	T9	T10	T11	T12	T13	T14	T15	Y R2
AB117	Unassigned customer keys							
	T1	T2	T3	T4	T5	T6	T7	T8
AB118	-	-	-	-	-	-	RESET	R14
AB119	-	-	KT-OUT 6	KT-OUT 5	KT-OUT 4	KT-OUT 3	KT-OUT 2	KT-OUT 1

Signals marked with * are inverse signals

Default key assignment

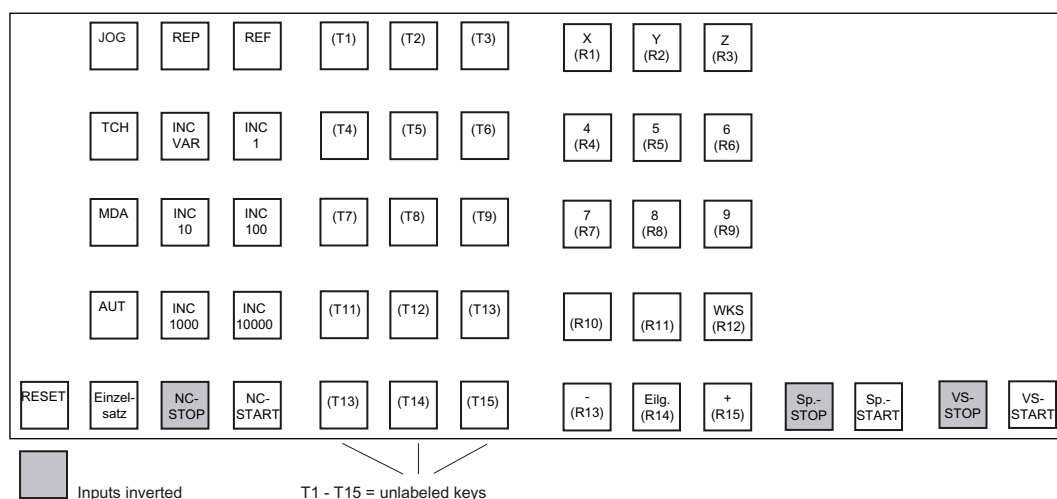


Figure 7-8 Default key assignment of MCP 483C PN

Assignment of the inputs (I) and outputs (O) to the keys and LEDs

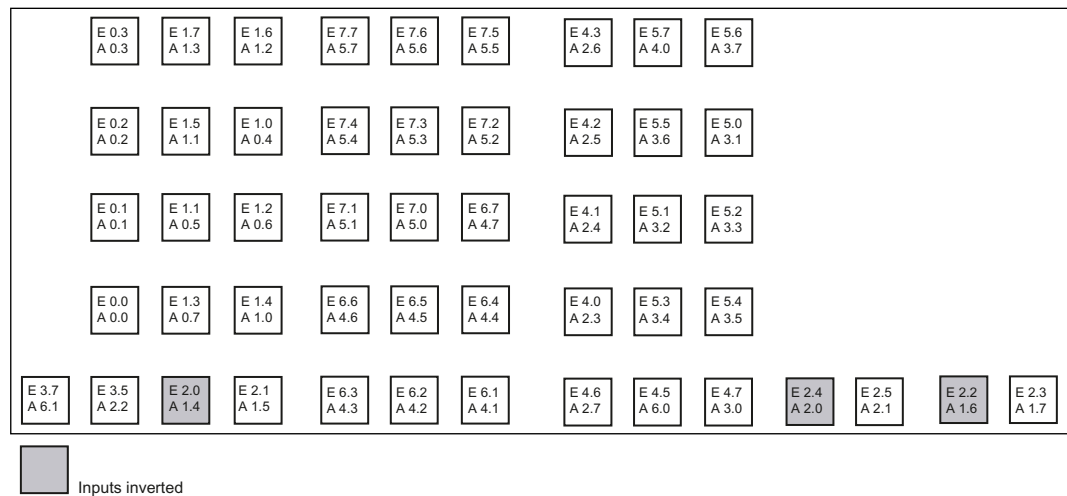


Figure 7-9 Inputs and outputs of the MCP 483C PN keyboard

7.1.5 Technical data

MCP 483C PN

Parameter	Value
Input voltage	24 V DC
Power consumption, max.	
• Board	5 W
• Illumination	43.2 W (6 x 7.2 W *)
• Handwheels	2 x 0.9 W
• Total	50 W
Vibratory load:	
• Operation	10 – 58 Hz: 0.15 mm/58 - 200 Hz: 2g
• Transportation (in transportation packaging)	(3M6 in acc. with EN 60721-3-3) 5 – 9 Hz: 6.2 mm/9 - 200 Hz: 2g (2M3 in acc. with EN 60721-3-2)
Shock load:	
• Operation	15g, 11 ms, 18 shocks (in acc. with EN 60721-3-3)
• Transportation (in transportation packaging)	15g, 6 ms, 18 shocks (in acc. with EN 60721-3-2)
Protection class in acc. with EN 61800-5-1	III (DVC A, PELV)
Degree of protection in acc. with DIN IEC 529	IP54 (front) IP00 (rear)

Parameter	Value
Temperature limits:	
• Storage in acc. with EN 60721-3-1	-25 °C ... 55 °C
• Transportation (in transportation packaging) in acc. with EN 60721-3-2	-25 °C ... 55 °C 0 ... 45 °C (front)
• Operation in acc. with EN 60721-3-3	0 to 55 °C (rear)
Cooling	By natural convection
Climate class	
• Storage	1K3 in acc. with EN 60721-3-1
• Transportation	2K4 in acc. with EN 60721-3-2
• Operation	3K5 in acc. with EN 60721-3-3
Condensation, spraying water, and icing	Not permitted
Supply air	Without aggressive gases, dusts and oils
Approvals	CE, cULus
Dimensions:	
• Width	483 mm
• Height	155 mm
• Depth	55 mm
Weight, approx.	2 kg

*) If the outputs for the illuminated pushbuttons (X53/X54) are loaded with the max. permissible current of 0.3 A, this results in additional power consumption of 36 W. The total power consumption is then 50 W.

See also

Other values/standards: Application planning (Page 35)

7.1.6 Spare parts and accessories

Table 7-14 Spare part kits for machine control panel MCP 483C PN

Name	Description	Quantity	Article number
Emergency Stop button	22 mm actuating element, 40 mm mushroom pushbutton, snap action with tamper protection, latching, red, with holder, non-illuminated	1	3SB3000-1HA20
Contact block	with 2 contact pairs (1 NO + 1 NC), 2-pin, screw terminal (3rd contact pair can be additionally connected)	1	3SB3400-0A
Set of keys	Set of keys for machine control panel	10	6FC5148-0AA03-0AA0
Rapid traverse dial	for 16-stage rotary switch	20	6FC5248-0AF30-0AA0
Rotary switch for spindle	Spindle/rapid traverse override, electronic rotary switch 1x16G, T=24, cap, knob, pointer, spindle and rapid-traverse dials	1	6FC5247-0AF12-1AA0

Name	Description	Quantity	Article number
Rotary switch for feed	Override feedrate / rapid traverse electronic rotary switch 1x23G, T=32, cap, knob, pointer, feedrate and rapid-traverse dials	1	6FC5247-0AF13-1AA0
Set of tensioners	Set of tensioners for supplementary operator components with 2.5 mm profile, 20mm length	9	6FC5248-0AF14-0AA0

Table 7-15 Accessories pack (for delivery ex works)

Component	Description	Amount
Keyset	Key caps for turning (labeled)	9
	Ergo gray key caps (can be labeled)	30
	Clear key caps (can be labeled)	30
Yellow backing plate	for emergency stop	1

Table 7-16 Accessories available for order

Component	Description	Amount	Article number
Square key cap, can be laser-labeled	1 set of 90, ergo-gray and 20 each of red / green / yellow / medium gray	1	6FC5248-0AF12-0AA0
Square key cap, for inscription plates	1 set of 90, clear	1	6FC5248-0AF21-0AA0
Cable set	For additional MCP control devices, length 500 mm	60	6FC5247-0AA35-0AA0

Removing the rotary switch

Note

For the machine control panel, use only electronic rotary switches.

Procedure:

1. Lever the cover ③ off the rotary knob ② (snap-on connection).
2. Remove the nut of collet ① with a wrench (width 10).
3. Remove the entire rotary knob ②.
4. Remove the lock nut ⑤ on the axis of the rotary switch ④ with a wrench (width 14).

5. Remove the connector at the end of the rotary switch cable from the socket.
6. Remove the rotary switch.

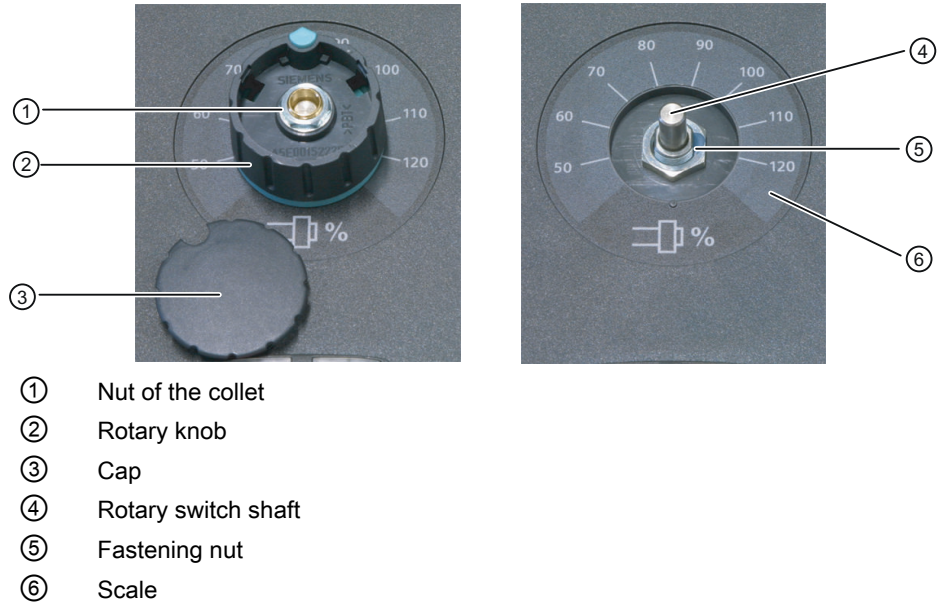


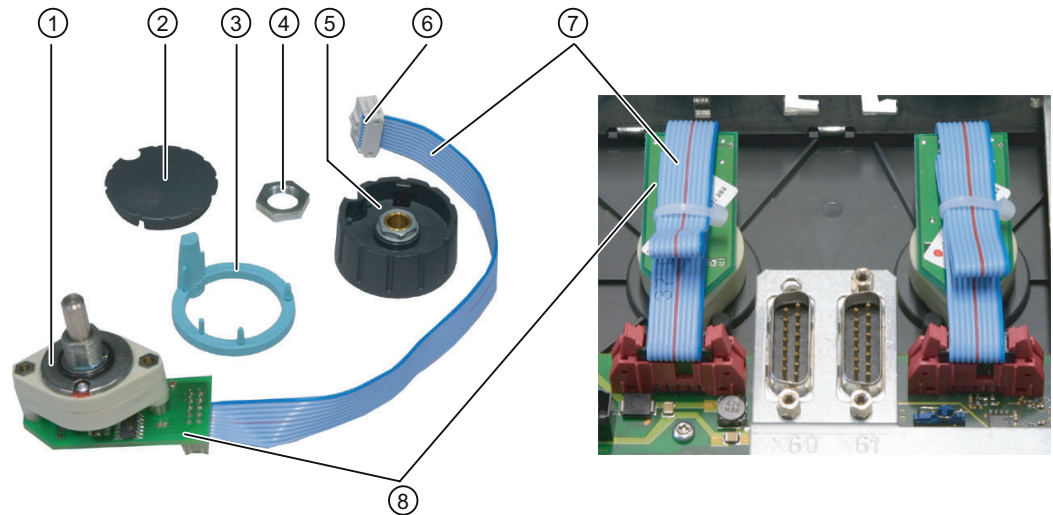
Figure 7-10 Removal of rotary switch

Installing the rotary switch

Procedure:

1. Push the O-ring ① onto the axis of the new rotary switch as a seal.
2. Insert the rotary switch into the front cutout so that pressure is applied to the O-ring.
3. Screw the lock nut ④ on the axis of the rotary switch from the front with a wrench (width 14) (tightening torque: 3 Nm).
4. Connect the arrow ring ③ and rotary knob ⑤.
5. Slide both parts onto the shaft of the rotary switch.
6. Align the arrow point on the ring with position "0" on the scale.
7. Tighten the collet nut of the rotary knob by hand and using a torque spanner with 2 Nm torque.

8. Place the cover ② on the rotary knob and snap it into position.
9. Fold and fasten the connecting cable ⑦ as shown in the figure on the right.



- ① O-ring
- ② Cap
- ③ Arrow ring
- ④ Fastening nut
- ⑤ Rotary knob
- ⑥ Connection plug
- ⑦ Connecting cable
- ⑧ Terminal board

Detail diagram of the connector

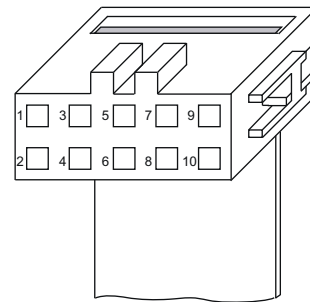


Figure 7-11 Installation of rotary switch

Proceed in the same way to install the second rotary switch.

Note

It is essential to use the correct tightening torques.

7.2 MCP 310C PN

Description

The 310C PN machine control panel enables user-friendly operation of the machine functions. It can be used in the SINUMERIK 828D system for machine-level operation of milling and turning machines.

All keys are designed with replaceable caps for machine-specific adaptations. The key caps can be freely inscribed using laser. Clear key caps can be used as an alternative.

The machine control panel is mounted from the rear with special tension jacks supplied with the panel.

Operator controls

- Operating mode and function keys:
 - 49 keys with assigned LEDs
 - Direction keys for milling machines with rapid traverse override (key covers for direction keys for turning machines are supplied)
 - Key type: Mechanical short-stroke keys
- Feed control with override feed/rapid traverse (rotary switch with 23 positions)
- Key-operated switch (four positions and three different keys)

Interfaces

- PLC I/O Interface (data transmission rate: 100 Mbit/s)
- Nine customer-specific inputs (e.g. for illuminated pushbuttons)
- Six customer-specific outputs
- Handwheel connection

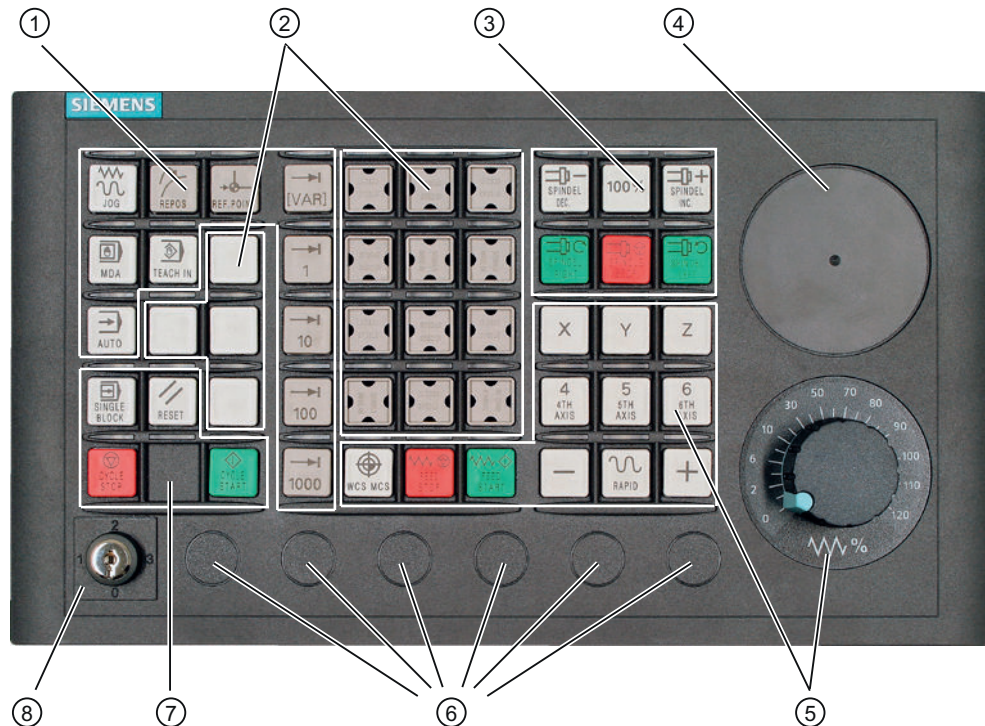
Expansion slots

Six slots for control devices (d = 16 mm)

Additional cable set required for control devices: Spare parts and accessories (Page 127)

7.2.1 Operator controls and display elements

Operator controls




- ① Operating modes and machine functions
- ② 16 customer keys
- ③ Spindle control
- ④ Slot for EMERGENCY STOP button or override switch for the spindle control
- ⑤ Feed control with override switch
- ⑥ Slots for control devices 16 mm
- ⑦ Program control
- ⑧ Key-operated switch

Figure 7-12 Arrangement of the MCP 310C PN control elements

Emergency Stop button


If an EMERGENCY STOP button is to be retrofitted, refer to Chapter Operator controls and display elements (Page 94) of the MCP 483C PN.

Mounting slots for control devices

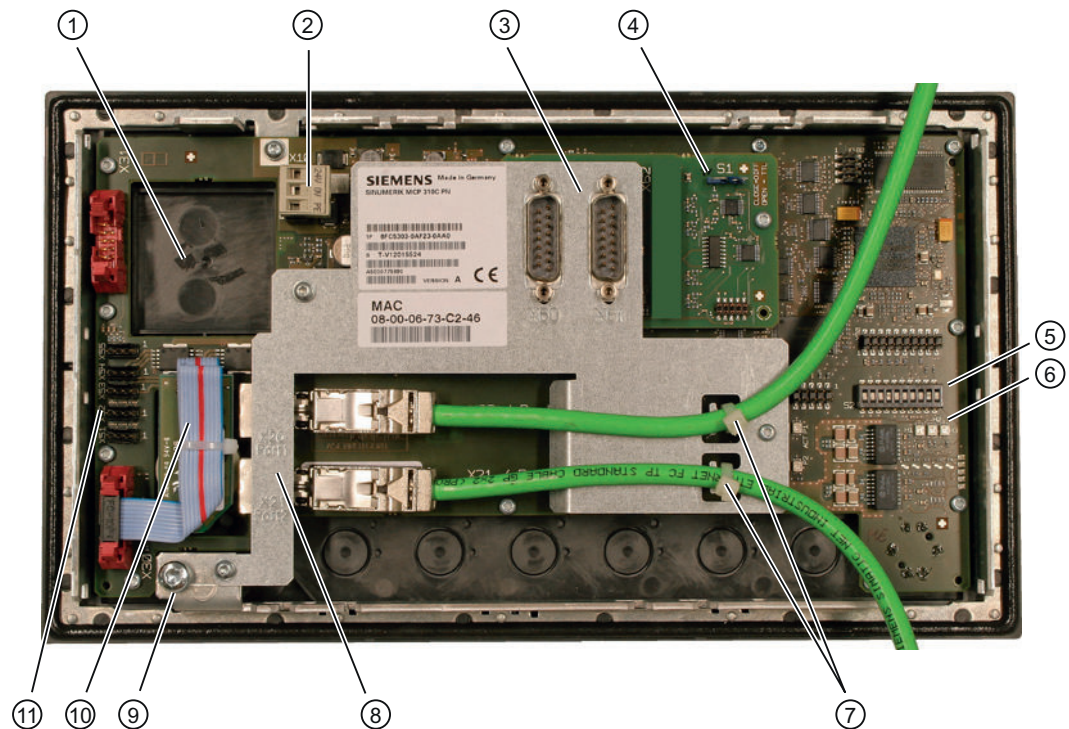
 WARNING
Warning of damage
Do not chip out the openings for mounting control devices ⑥; drill them to the required width.

Key caps

All keys of the MCP 310C PN come with changeable key caps. Refer to the following table for the additional replacement key caps provided for lathes in the accessories pack:

Key cap	Symbol number	Key cap	Symbol number
 RAPID	7027	-X	7129
+C	7125	-Y	7130
+X	7126	-Z	7131
+Y	7127	-C	7132
+Z	7128		

You will find article numbers for the key caps in Chapter Spare parts and accessories (Page 127).



- ① Slot for Emergency-Stop button or spindle override
- ② Power supply interface X10
- ③ X60 connection for handwheel, X61 reserved
- ④ Switch for setting the handwheel signal type
- ⑤ Switch S2
- ⑥ LEDs
- ⑦ Ethernet cable strain relief
- ⑧ PLC I/O Interface connections X20 (port 1), X21 (port 2) behind cover plate
- ⑨ Equipotential bonding
- ⑩ Feed override
- ⑪ Customer-specific inputs and outputs

Figure 7-13 Rear of the MCP 310C PN with Ethernet connecting cables

Equipotential bonding

The equipotential bonding conductor is attached by means of an M5 screw.

LEDs for status display

Table 7-17 LEDs

Name	Designation	Color	Description
H1	PowerOK	Green	Lit: Power supply ok
H2	PNSync	Green	Lit: System software running, STOP state Flashes 0.5 Hz: System software running, RUN state
H3	PNFault	Red	Not lit: Module is operating without errors; data exchange with all configured I/O devices is running. Lit: Serious bus fault; only output when one of the following errors is detected for the ports: <ul style="list-style-type: none">• No physical connection to a subnet/switch• Incorrect transmission rate• Full duplex transmission is not activated

Note

When the system is booting, all three LEDs are lit.

7.2.2 Mounting

Mounting position

The permitted mounting position is max. 60° to the vertical.

Note

For mounting position greater than 60°, a fan must also be installed to keep the ambient temperature of the machine control panel constantly below 55 °C.

Tension jacks

The machine control panel is attached using 6 tension jacks (tightening torque, 0.5 Nm).

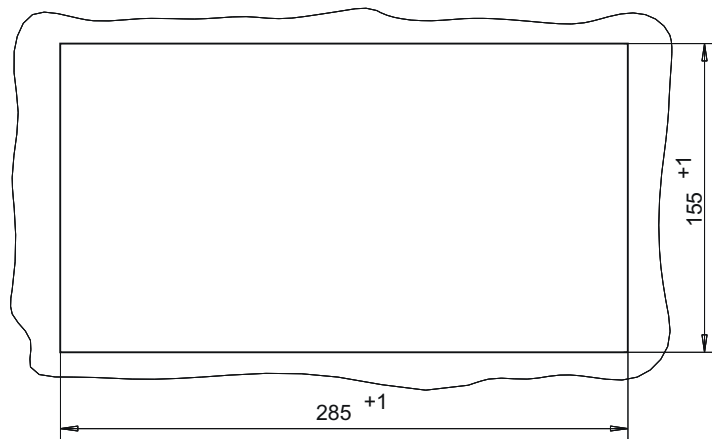
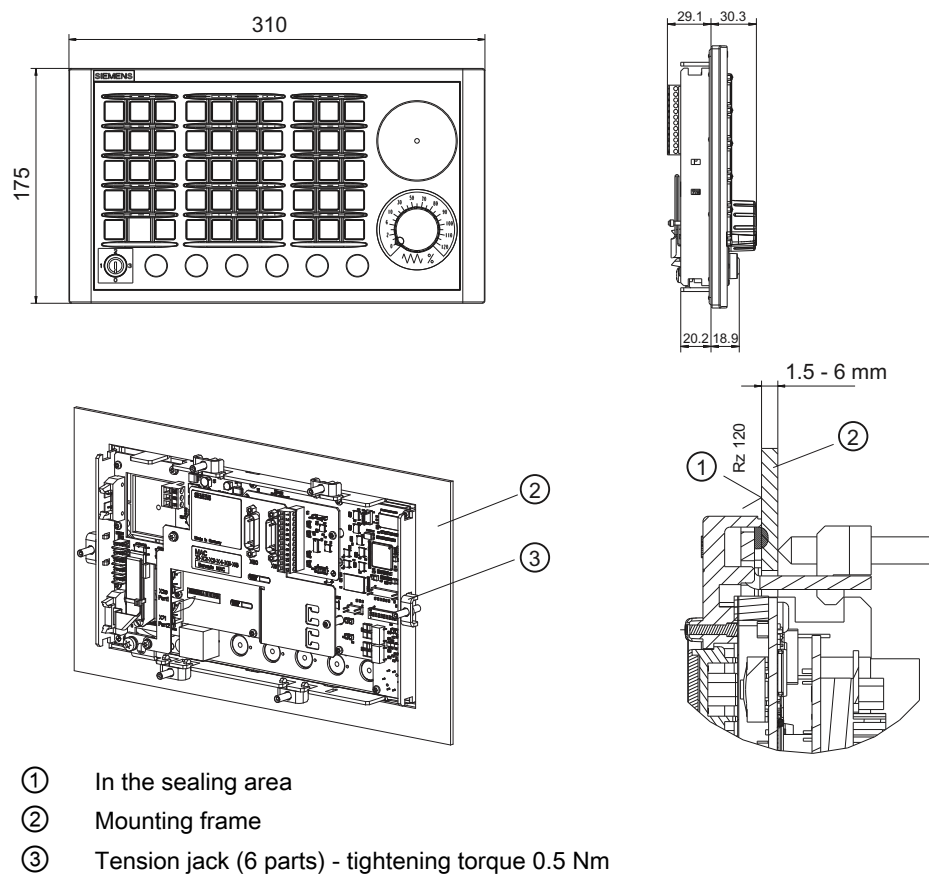


Figure 7-14 Panel cut-out for the machine control panel MCP 310C PN

Dimension drawing



- ① In the sealing area
- ② Mounting frame
- ③ Tension jack (6 parts) - tightening torque 0.5 Nm

Figure 7-15 MCP 310C PN dimensions

7.2.3 Connecting

Securing the cables

Two equivalent connections (Fast Ethernet) are available for establishing the PLC I/O Interface communication network based on PROFINET.

Two cable ties are included in the scope of delivery. You use these to secure the Ethernet cables on the cover plate at the rear of the machine control panel.

The Ethernet cables are not included in the scope of delivery. When connecting the machine control panel to the SINUMERIK 828D, please use the preassembled SINAMICS DRIVE-CLiQ signal cables; from a technical point of view, these are also suitable for use with PROFINET.

NOTICE

Damage to cables

Make sure that all cables are routed so that they do not come into contact with chafing edges.

See also

Ordering data (Page 27)

Interface overview

X10	Power supply interface
X20	PLC I/O Interface port 1
X21	PLC I/O Interface port 2
X30	Interface for rotary switch feed override
X31	Interface for rotary switch spindle override/EMERGENCY STOP (optional)
X51 / X52 / X55	Interfaces for customer-specific inputs
X53 / X54	Interfaces for customer-specific outputs
X60	Interface for handwheel
X61	Reserved
S1	Switch for setting the handwheel signal type
S2	Switch for setting the MCP address

X10 power supply pin assignment

Connector designation: **X10**

Connector type: Terminal block, 3-pin plug connector

Pin	Signal name	Signal type	Meaning
1	P24	V	24 V potential
2	M24	V	24 V ground
3	SHIELD	V	Shield connection

PLC I/O Interface pin assignment

Connector designation: **X20, X21**

Connector type: RJ45 socket

Table 7-18 Assignment of connectors X20, X21

Pin	Signal name	Signal type	Meaning
1	TX+	I	Transmit +
2	TX-	I	Transmit -
3	RX+	O	Receive +
4	N.C.	-	Not assigned
5	N.C.	-	Not assigned
6	RX-	O	Receive -
7	N.C.	-	Not assigned
8	N.C.	-	Not assigned

Rotary switch: Feed override X30 / spindle override X31

Connector designation: **X30/X31**

Connector type: 2 x 5-pin plug connector, according to EN 60603-13 with coding

Table 7-19 Assignment of connector X30

Pin	Signal name	Signal type	Meaning
1	N.C.	-	Not assigned
2	N.C.	-	Not assigned
3	M	V	Ground
4	N.C.	-	Not assigned
5	P5	V	5 V supply
6	OV16	I	Rotary override switch, position/value 16
7	OV8		Rotary override switch, position/value 8
8	OV4		Rotary override switch, position/value 4
9	OV2		Rotary override switch, position/value 2
10	OV1		Rotary override switch, position/value 1

Optional customer buttons IN (X51 / X52 / X55)

Only switches (passive inputs) may be connected via the X51, X52 and X55 connectors. X51 and X52 are typically used for connecting illuminated pushbuttons. The lamps in the buttons are activated via X53 and X54. X55 has no corresponding outputs.

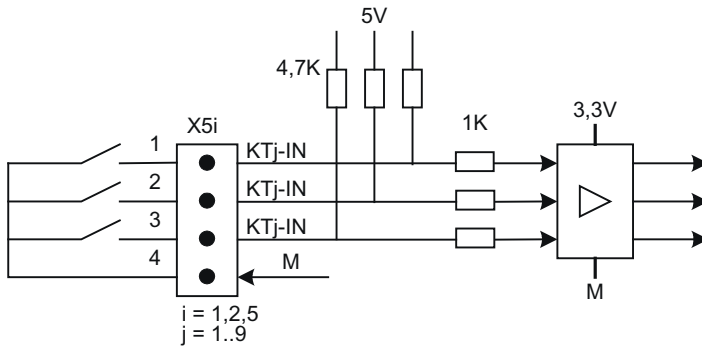


Figure 7-16 Main circuit diagram for input circuit for X51, X52 and X55

Connector designation: **X51, X52, X55**

Connector type: 4-pin plug connector

Table 7-20 Assignment of connector X51

Pin	Signal name	Signal type	Meaning
1	KT-IN1	I	Customer key 1
2	KT-IN2		Customer key 2
3	KT-IN3		Customer key 3
4	M	V	Ground

Table 7-21 Assignment of connector X52

Pin	Signal name	Signal type	Meaning
1	KT-IN4	I	Customer key 4
2	KT-IN5		Customer key 5
3	KT-IN6		Customer key 6
4	M	V	Ground

Table 7-22 Assignment of connector X55

Pin	Signal name	Signal type	Meaning
1	KT-IN7	I	Customer key 7
2	KT-IN8		Customer key 8
3	KT-IN9		Customer key 9
4	M	V	Ground

Optional customer buttons OUT (X53 / X54)

The short-circuit-proof outputs X53/X54 are provided to control lamps in the buttons. Lamps with 24 V and 1.2 W per output are recommended.

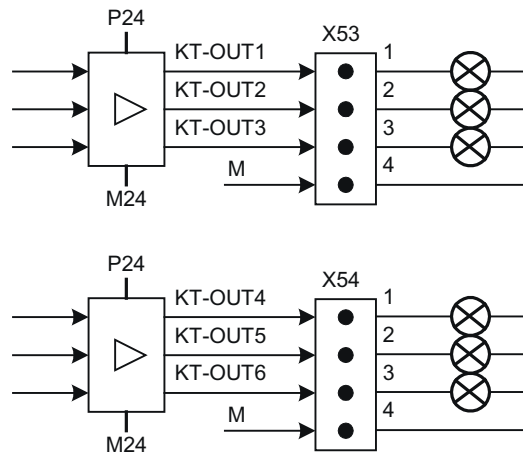


Figure 7-17 Main circuit diagram for input circuit for X53 and X54

CAUTION

Do not connect any relays, valves or other inductive loads.

Connector designation: **X53, X54**

Connector type: 4-pin plug connector

Table 7-23 Assignment of connector X53

Pin	Signal name	Signal type	Meaning
1	KT-OUT1	O	Output 1 lamp
2	KT- OUT2		Output 2 lamp
3	KT- OUT3		Output 3 lamp
4	M	V	Ground

Table 7-24 Assignment of connector X54

Pin	Signal name	Signal type	Meaning
1	KT-OUT4	O	Output 4 lamp
2	KT- OUT5		Output 5 lamp
3	KT- OUT6		Output 6 lamp
4	M	V	Ground

X60 handwheel

Via X60, you can connect 1 handwheel either with TTL or difference signals.

Note

The handwheel is supplied by the MCP module with 5 V / 100 mA. An external power supply is not permitted.

NOTICE

Handwheel connections

The SINUMERIK 828D software can process up to three handwheels. You can connect two handwheels to the PPU. You can connect an additional handwheel to the machine control panel.

Connector designation: **X60**
 Connector type: 15-pin Sub-D socket

Table 7-25 Assignment of connector X60

Pin	Name	Type	Meaning
1	P5V	V	5 V power supply
2	M	V	Ground
3	HW1_A	I	Handwheel pulses track A
4	HW1_XA	I	Handwheel pulses track A (negated)
5	N.C.	-	Not assigned
6	HW1_B	I	Handwheel pulses track B
7	HW1_XB	I	Handwheel pulses track B (negated)
8	N.C.	-	Not assigned
9	P5V	V	5 V power supply
10	N.C.	-	Handwheel 2 pulses track A (negated)
11	M	V	Ground
12	N.C.	-	Not assigned
13	N.C.	-	Not assigned
14	N.C.	-	Not assigned
15	N.C.	-	Not assigned

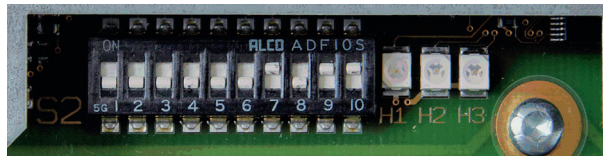
Switch S1

The handwheel signal type is set with switch S1.

Closed	differential interface
Open	TTL interface

Switch S1 is closed when supplied ex works.

Switch S2



Schalter S2

Switch position: "ON" is at the top.

Table 7-26 Switch S2 is set as delivered

1	2	3	4	5	6	7	8	9	10	Meaning
								ON	ON	PLC I/O Interface
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF			PROFINET address "0"

The two switches S2-9 and S2-10 must remain set to "ON".

The switches S2-1 to S2-8 define the PROFINET address. For a SINUMERIK 828D, the address "64" must always be assigned to the MCP.

Table 7-27 Settings of switch S2

1	2	3	4	5	6	7	8	9	10	Meaning
						ON		ON	ON	
OFF	OFF	OFF	OFF	OFF	OFF		OFF			PROFINET address "64"

7.2.4 Parameterization

The specifications for assigning input and output bytes listed in the tables are set as standard addresses in the PLC by setting the following machine data:

MD12986 PLC_DEACT_IMAGE_LADDR_IN[6] = -1

Standard input image

Table 7-28 Input image MCP 310C PN

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
EB112	* NC Stop	Spindle -	Spindle 100%	Spindle +	Single block	JOG	MDA	AUTO
EB113	NC Start	Spindle right	* Spindle stop	Spindle left	Keyswitch position 3	REF	REP	Teach IN
EB114	Feed Start	* Feed Stop	INC VAR	Keyswitch position 0	INC 1000	INC 100	INC 10	INC 1

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
EB115	RESET	Keyswitch	Keyswitch	Feedrate override				
		position 2	position 1	E (2 ⁴)	D (2 ³)	C (2 ²)	B (2 ¹)	A (2 ⁰)
EB116	Direction keys			KT5	KT4	KT3	KT2	KT1
	+	-	Rapid traverse					
EB117	T16	KT6	6	5	4	Z	Y	X
EB118	Unassigned customer keys				Unassigned customer keys			
	T9	T10	T11	T12	WCS MCS	T13	T14	T15
EB119	Unassigned customer keys							
	T1	T2	T3	T4	T5	T6	T7	T8
EB120	-	-	-	-	-	-	-	-
EB121	-	-	-	-	-	-	-	-
EB122	KT-IN8	KT-IN7	KT-IN6	KT-IN5	KT-IN4	KT-IN3	KT-IN2	KT-IN1
EB123	-	-	-	-	-	-	-	KT-IN9
EB124	-	-	-	-	-	-	-	-
EB125	-	-	-	X31 pin 6 ¹⁾	X31 pin 7 ¹⁾	X31 pin 8 ¹⁾	X31 pin 9 ¹⁾	X31 pin 10 ¹⁾

Signals marked with * are inverse signals.

1) If the 4-stage rotary spindle override switch on X31 is replaced by a 5-stage rotary switch, the input information here can be measured in 5 stages.

Input image of the handwheel

Table 7-29 Input image for handwheel data

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
EB m + 0	Handwheel 1 counter status (16-bit signed, low-order byte equals byte m + 0)							
EB m + 1								
EB m + 2	Handwheel 2 counter status (16-bit signed, low-order byte equals byte m + 2)							
EB m + 3								

Note

Within the SINUMERIK control, the handwheel data is processed directly by the NC and is not available to the PLC.

Output image

Table 7-30 Output image MCP 310C PN

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
AB112	* NC Stop	Spindle -	Spindle 100%	Spindle +	Single block	JOG	MDA	AUTO
AB113	NC Start	Spindle right	* Spindle stop	Spindle left	RESET	REF	REP	Teach IN
AB114	Feed Start	* Feed Stop	INC VAR	-	INC 1000	INC 100	INC 10	INC 1
AB115	-	-	-	-	-	-	-	-
AB116	+	-	Rapid traverse	KT-OUT5	KT-OUT4	KT-OUT3	KT-OUT2	KT-OUT1
AB117	T16	KT-OUT6	6	5	4	Z	Y	X
AB118	Unassigned customer keys							
	T9	T10	T11	T12	WCS MCS	T13	T14	T15
AB119	Unassigned customer keys							
	T1	T2	T3	T4	T5	T6	T7	T8

Signals marked with * are inverse signals

Default key assignment

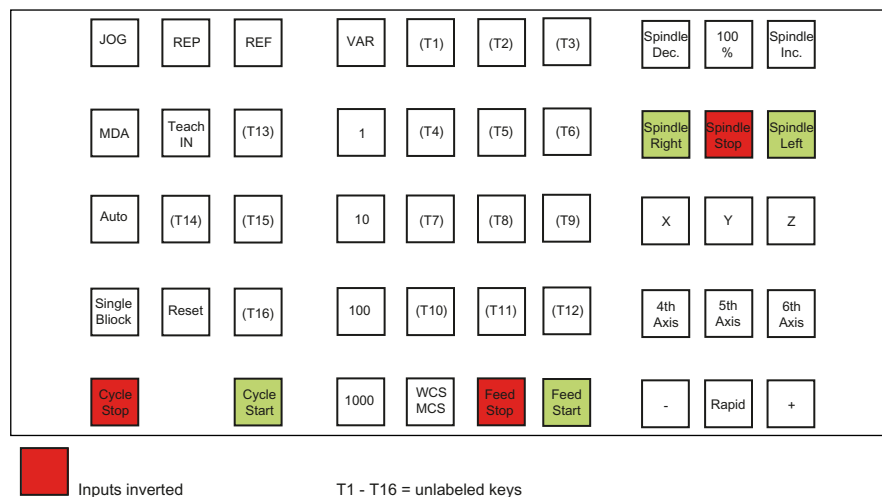


Figure 7-18 Default key assignment of MCP 310C PN

Assignment of the inputs (I) and outputs (O) to the keys and LEDs



Figure 7-19 Inputs and outputs of the MCP 310C PN keyboard

7.2.5 Technical data

MCP 310C PN

Parameter	Value
Input voltage	24 V DC
Power consumption, max.	
• Board	5 W
• Illumination	43.2 W (6 x 7.2 W) *
• Handwheels	2 x 0.9 W
• Total	50 W
Vibratory load:	
• Operation	10 – 58 Hz: 0.15 mm
• Transportation (in transportation packaging)	58 – 200 Hz: 2g (in acc. with EN 60068-2-6 test Fc) 5 – 9 Hz: 3.5 mm 9 - 200 Hz: 1g (in acc. with EN 60068-2-6)
Shock load:	
• Operation	15g, 11 ms, 18 shocks (3 in each direction in acc. with EN 60068-1)
• Transportation (in transportation packaging)	15g, 11 ms, 18 shocks (3 in each direction in acc. with EN 60068-2-27)
Protection class in acc. with EN 61800-5-1	III (DVC A, PELV)
Degree of protection in acc. with DIN IEC 529	IP54 (front) IP00 (rear)

Parameter	Value
Temperature limits:	
• Operation in acc. with EN 60721-3-3	0 ... 45 °C (front)
• Storage in acc. with EN 60721-3-1	0 to 55 °C (rear)
• Transportation (in transportation packaging) in acc. with EN 60721-3-2	-25 °C ... 55 °C -40 °C ... 70 °C
Cooling	By natural convection
Climate class	3K3
Condensation, spraying water, and icing	Not permitted
Supply air	Without aggressive gases, dusts, and oils
Approvals	CE, cULus
Dimensions:	
• Width	310 mm
• Height	175 mm
• Depth	54 mm with cable 29 mm without cable
Weight, approx.	1.2 kg

*) If the outputs for the illuminated pushbuttons (X53/X54) are loaded with the max. permissible current of 0.3 A, this results in additional power consumption of 36 W. The total power consumption is then 50 W.

See also

Other values/standards: Chapter "Application planning (Page 35)"

7.2.6 Spare parts and accessories

Accessories and spare parts for MCP 310C PN

Name	Description	Amount	Article number
Emergency-Stop button	22 mm actuating element, 40 mm mushroom pushbutton, snap action with tamper protection, latching, red, with holder, non-illuminated	1	3SB3000-1HA20
Contact block	with 2 contact pairs (1 NO + 1 NC), 2-pin, screw terminal (3rd contact pair can be additionally connected)	1	3SB3400-0A
Sets of keys	Set of keys (10 sets) for machine control panel	1 set	6FC5148-0AA03-0AA0
Set of tensioners	Tensioner set (9 items) for supplementary components with 2.5 mm profile, length 20 mm	1 set	6FC5248-0AF14-0AA0

Name	Description	Amount	Article number
Override Spindle rotary switch	Spindle/rapid traverse override, electronic rotary switch 1x16G, T=24, cap, knob, pointer, spindle and rapid-traverse dials	1	6FC5247-0AF12-1AA0
Override Feed rotary switch	Override feedrate / rapid traverse electronic rotary switch 1x23G, T=32, cap, knob, pointer, feedrate and rapid-traverse dials	1	6FC5247-0AF13-1AA0
Key cap	Square, can be labeled by laser, 1 set of 90, ergo-gray and 20 each of red / green / yellow / medium gray	1	6FC5248-0AF12-0AA0
Key cap	Square, for inscription plates, 1 set of 90, clear	1	6FC5248-0AF21-0AA0
Cable set	For additional MCP control devices, length 500 mm	60	6FC5247-0AA35-0AA0

Accessories pack (for delivery ex works):

Component	Description	Amount
Keyset	Key caps for turning (labeled)	9
	Ergo gray key caps (can be labeled)	30
	Clear key caps (can be labeled)	30
Yellow backing plate	for emergency stop	1

Removing the rotary switch

Note

For the machine control panel, use only electronic rotary switches.

Procedure:

1. Lever the cover ③ off the rotary knob ② (snap-on connection).
2. Remove the nut of collet ① with a wrench (width 10).
3. Remove the entire rotary knob ②.
4. Remove the lock nut ⑤ on the axis of the rotary switch ④ with a wrench (width 14).

5. Remove the connector at the end of the rotary switch cable from the socket.
6. Remove the rotary switch.

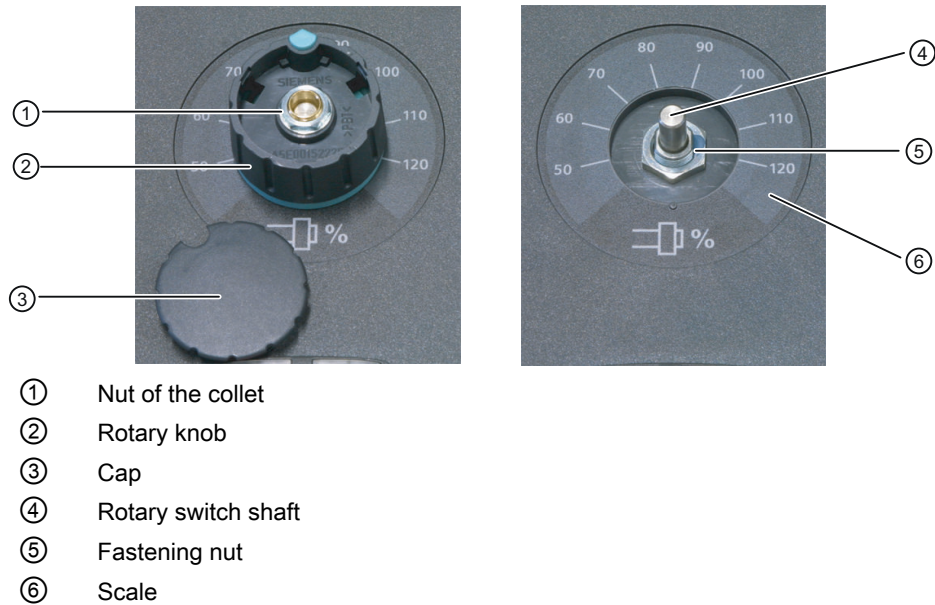


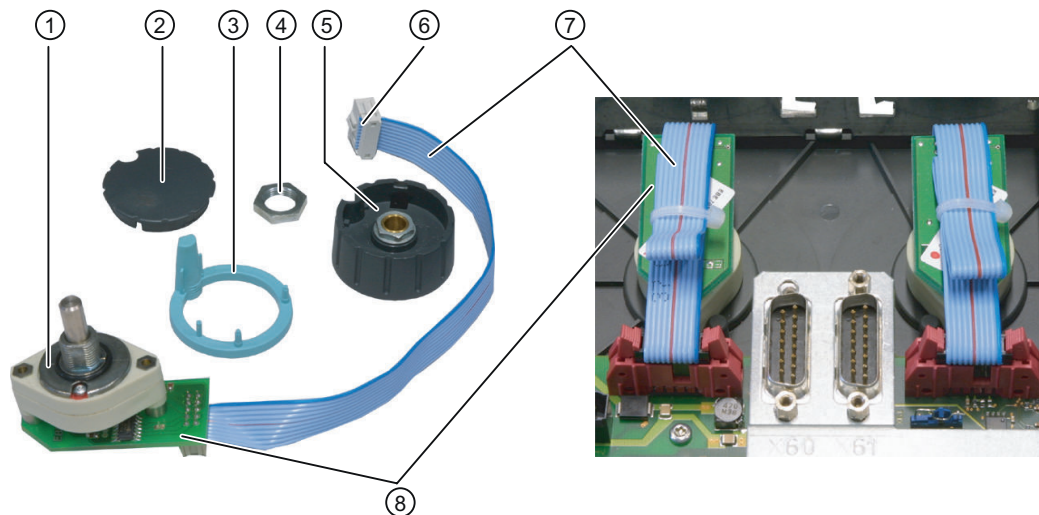
Figure 7-20 Removal of rotary switch

Installing the rotary switch

Procedure:

1. Push the O-ring ① onto the axis of the new rotary switch as a seal.
2. Insert the rotary switch into the front cutout so that pressure is applied to the O-ring.
3. Screw the lock nut ④ on the axis of the rotary switch from the front with a wrench (width 14) (tightening torque: 3 Nm).
4. Connect the arrow ring ③ and rotary knob ⑤.
5. Slide both parts onto the shaft of the rotary switch.
6. Align the arrow point on the ring with position "0" on the scale.
7. Tighten the collet nut of the rotary knob by hand and using a torque spanner with 2 Nm torque.

8. Place the cover ② on the rotary knob and snap it into position.
9. Fold and fasten the connecting cable ⑦ as shown in the figure on the right.



- ① O-ring
- ② Cap
- ③ Arrow ring
- ④ Fastening nut
- ⑤ Rotary knob
- ⑥ Connection plug
- ⑦ Connecting cable
- ⑧ Terminal board

Detail diagram of the connector

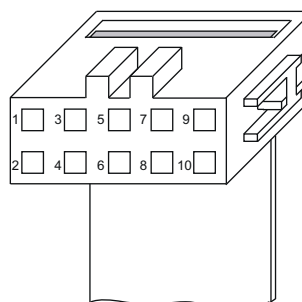


Figure 7-21 Installation of rotary switch

Proceed in the same way to install the second rotary switch.

Note

It is essential to use the correct tightening torques.

7.3 MCP Interface PN

Description

In the SINUMERIK solution line control family, communication with the operator panels is via PROFINET (Industrial Ethernet).

The MCP Interface PN module enables customer-specific machine control panels to be connected to a machine tool. Communication is handled via PROFINET RT or Industrial Ethernet.

You can connect the following operator controls to the interface:

- 80 single keys
- 64 LEDs
- Handwheel
- 2 override switches

The following inputs/outputs are also available:

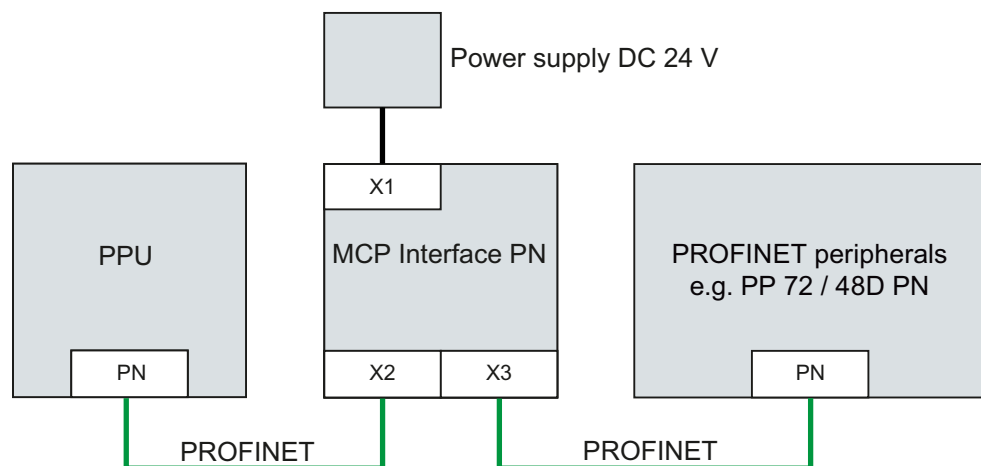
- 9 digital inputs (5 V)
- 6 digital inputs (24 V)
- 15 digital inputs (24 V / each 0.15 A)

Validity

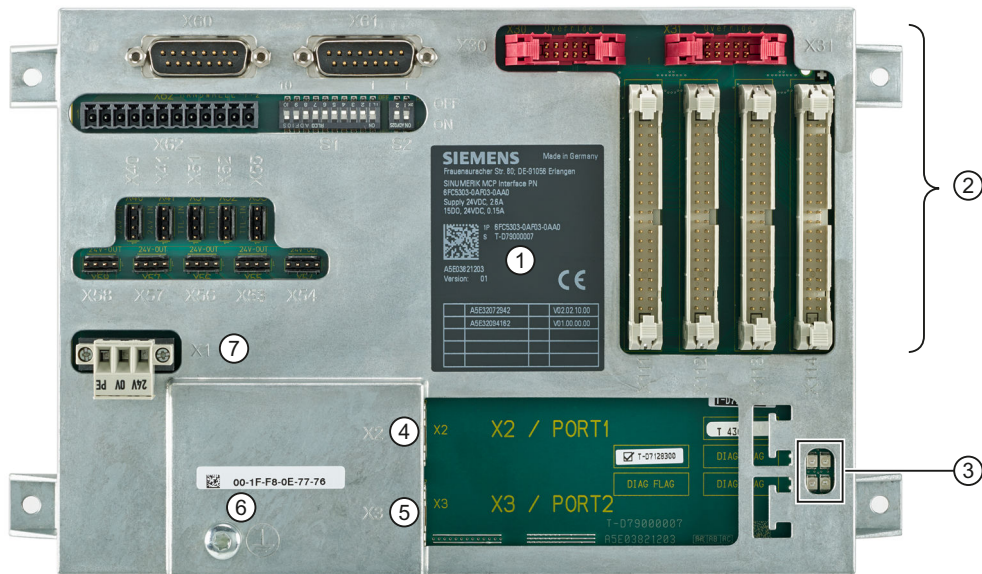
The following description applies to the MCP Interface PN.

Article number: 6FC5303-0AF03-0AA0

System configuration



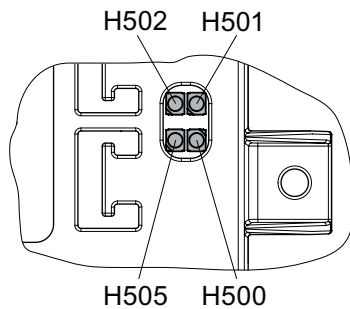
Display



- ① Type plate
- ② Terminal strips / connectors for operator controls
- ③ Diagnostic LEDs
- ④ PROFINET interface X2 (Industrial Ethernet 100 Mbit/s)
- ⑤ PROFINET interface X3 (Industrial Ethernet 100 Mbit/s)
- ⑥ Grounding screw M5 for potential equalization connection
- ⑦ 24 VDC power supply X1 (with screw connection)

Figure 7-22 View of MCP Interface PN

LED displays



Name	Function	Status	Meaning
H500	POWER OK (green)	Lights up	All internal voltages are in the setpoint range.
		Does not light up	At least one of the generated voltages has exceeded its setpoint; a reset will be initiated.

Name	Function	Status	Meaning
H501	BUS_SYNC	Does not light up	No PROFINET communication.
		Lights up	PROFINET is synchronized (STOP state).
		Flashes (0.5 Hz)	PROFINET is synchronized (RUN state).
H502	BUS_FAULT	Lights up	PROFINET group fault.
H505	Temperature alarm (red)	Lights up	At least one temperature limit is being exceeded.

7.3.1 Mounting

Installation

The module can be attached at a suitable position via the four mounting holes (e.g. behind the machine control panel or in the control cabinet). The selection of the appropriate mounting position depends on the interfaces used and the associated maximum cable lengths.

Four standard torx-slotted screws T20/M4 are used to attach the module.

MCP Interface PN dimension drawing

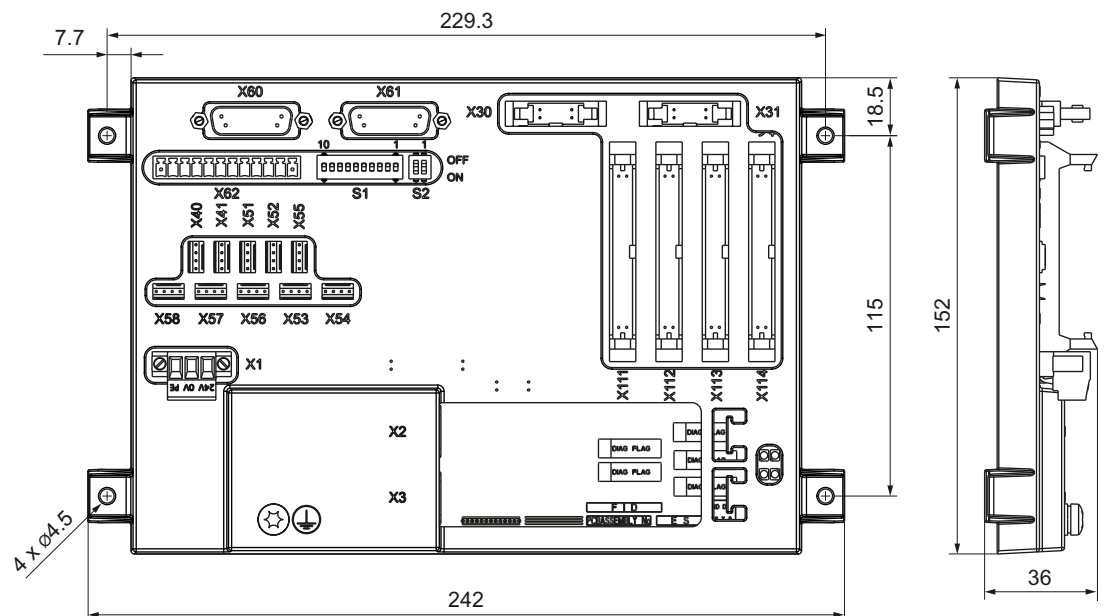


Figure 7-23 MCP Interface PN dimension drawing

7.3.2 Connection

Position of the interfaces

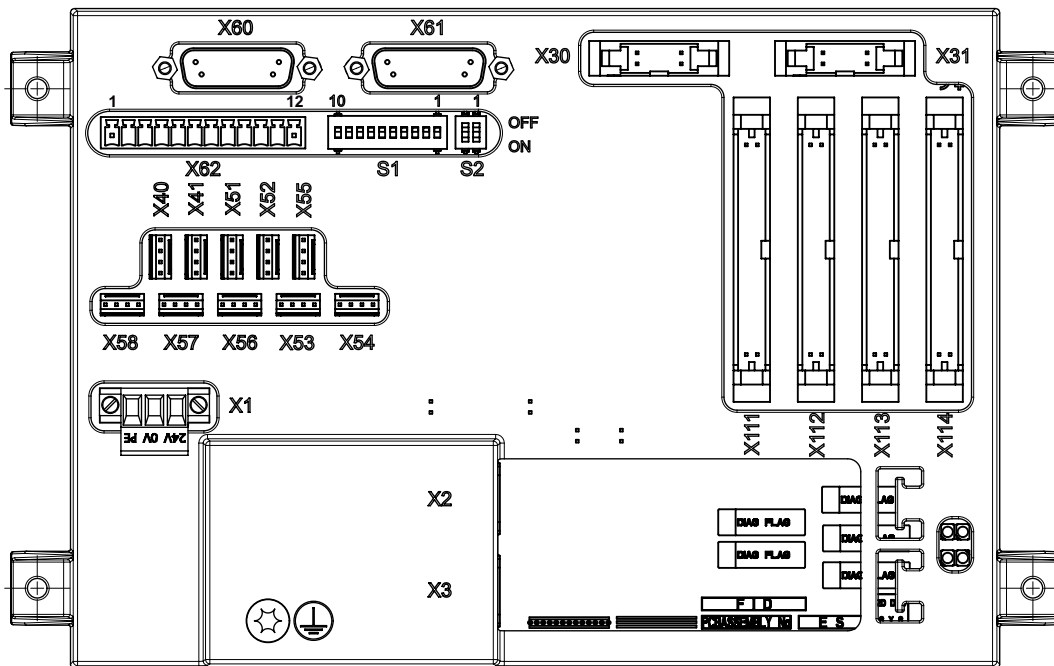


Figure 7-24 MCP Interface PN interfaces

Interface overview

X1	24 VDC power supply
X2	PROFINET interface
X3	PROFINET interface
X30	Interface for rotary switch feed override
X31	Interface for rotary switch spindle override
X40/X41	Digital inputs (24 V)
X51 / X52 / X55	Digital inputs (TTL)
X53 / X54 / X56 / X57 / X58	Digital outputs (24 V)
X60 / X62	Handwheel
X61	Reserved
X111/X112/X113/X114	Keys and LED interface
S1	DIP switch for setting the MCP address
S2	DIP switch for setting the handwheel signal type

Rotary switch: Feed override X30 / spindle override X31Connector designation: **X30/X31**

Connector type: 2 x 5-pin plug connector, according to EN 60603-13 with coding

Table 7-31 Assignment of connector X30 / X31

Pin	Signal name	Signal type	Meaning
1	N.C.	-	Not assigned
2	N.C.	-	Not assigned
3	M	V	Ground
4	N.C.	-	Not assigned
5	P5	V	5 V supply
6	DI122.4 / DI123.4	I	Rotary override switch, position/value 16
7	DI122.3 / DI123.3		Rotary override switch, position/value 8
8	DI122.2 / DI123.2		Rotary override switch, position/value 4
9	DI122.1 / DI123.1		Rotary override switch, position/value 2
10	DI122.0 / DI123.0		Rotary override switch, position/value 1

Digital inputs X40, X41

A total of six 24 V signals can be evaluated via the X40 and X41 connectors.

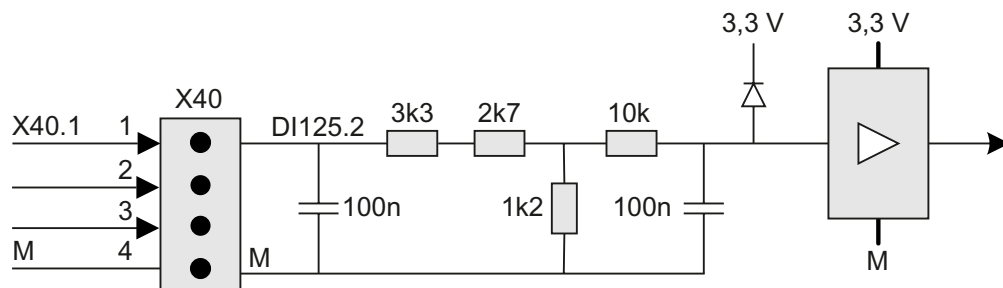


Figure 7-25 Schematic circuit diagram X40, X41

Connector designation: **X40, X41**

Connector type: 4-pin plug connector

Special feature: No galvanic isolation, short-circuit proof

Max. cable length: 0.6 m

Table 7-32 X40 pin assignments

Pin	Signal name	Type	Meaning
1	DI125.2	I	24 V input 0
2	DI125.3		24 V input 1

Pin	Signal name	Type	Meaning
3	DI125.4		24 V input 2
4	M	V	Ground

Table 7-33 X41 pin assignments

Pin	Signal name	Type	Meaning
1	DI125.5	I	24 V input 3
2	DI125.6		24 V input 4
3	DI125.7		24 V input 5
4	M	V	Ground

Table 7-34 Technical data for X40, X41

Parameter	Value
Voltage:	-3 V to 30 V
Typical current consumption:	6 mA at 24 VDC
Signal level (including ripple):	High signal level: 15 V to 30 V
	Low signal level: -3 V to 5 V

Digital inputs X51, X52, X55

Only switches (passive inputs) may be connected via the X51, X52 and X55 connectors. Typically, illuminated pushbuttons are connected here. The lamps in the buttons are activated via X53, X54 and X56 to X58.

Note

Connection miniature handheld unit

Alternatively, at the inputs X51, X52 and X55, one miniature handheld unit may be operated. For details, please refer to the corresponding section.

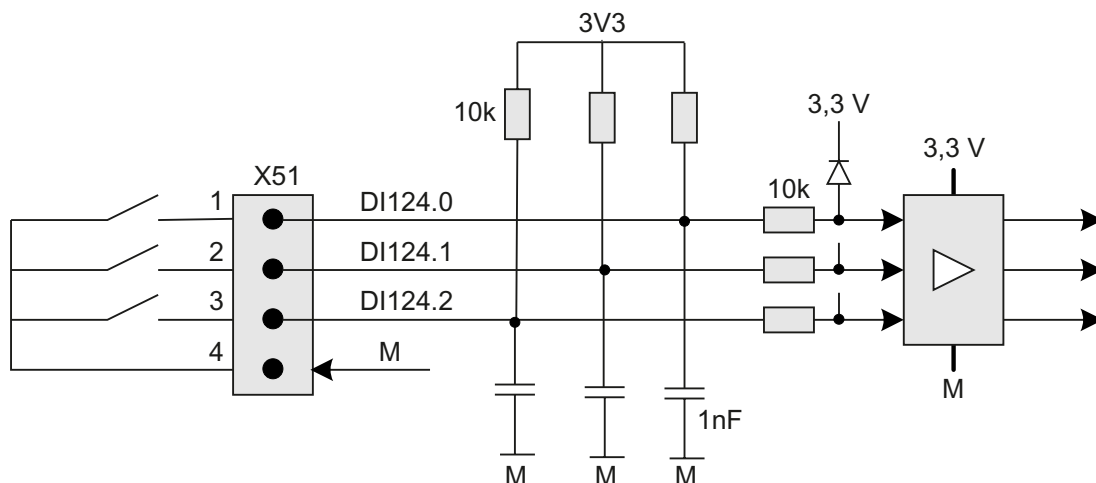


Figure 7-26 Block diagram X51, X52, X55

Connector designation: **X51, X52, X55**
 Connector type: 4-pin plug connector
 Special feature: No galvanic isolation
 Max. cable length: 0.6 m

Table 7-35 Assignment of connector X51

Pin	Signal name	Type	Meaning
1	DI124.0	I	Customer key 0
2	DI124.1		Customer key 1
3	DI124.2		Customer key 2
4	M	V	Ground

Table 7-36 Assignment of connector X52

Pin	Signal name	Type	Meaning
1	DI124.3	I	Customer key 3
2	DI124.4		Customer key 4
3	DI124.5		Customer key 5
4	M	V	Ground

Table 7-37 Assignment of connector X55

Pin	Signal name	Type	Meaning
1	DI124.6	I	Customer key 6
2	DI124.7		Customer key 7
3	DI125.0		Customer key 8
4	M	V	Ground

Table 7-38 Technical data for X51, X52, X55

Parameter	Value
Voltage:	Nominal: 0 V to 5 V
	Permissible: -3 V to 30 V
Typical current consumption:	0.2 mA at 5 VDC
	-0.3 mA at 0 VDC
Signal level (including ripple):	High signal level: 2.3 V to 5 V
	Low signal level: 0 V to 1 V

Digital outputs X53, X54, X56, X57, X58

The 15 outputs are provided to control lamps in the illuminated pushbuttons. Recommended are lamps with 1.2 W (50 mA).

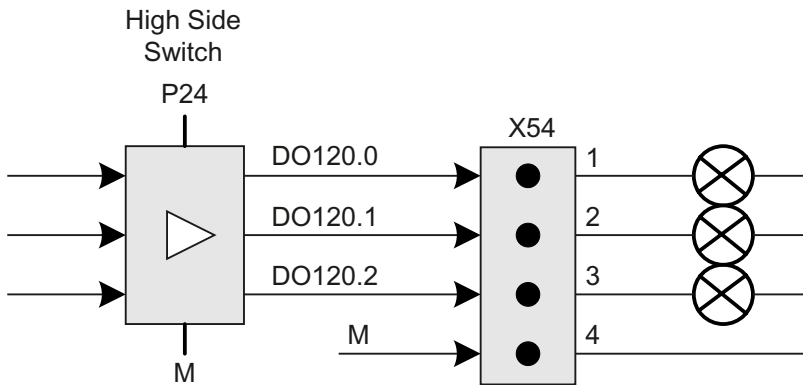


Figure 7-27 Block diagram X53, X54 and X56 to X58

Note

Observe the utilization of the power supply

The fifteen 24 V outputs are divided into 2 groups with 8 or 7 outputs each.

- Group 1 comprises the output signals DO120.x
- Group 2 comprises the output signals DO121.x

For each group, the 24 V supply may be loaded with max. 1.2 A.

Connector designation:	X53, X54, X56, X57, X58
Connector type:	4-pin plug connector
Special feature:	No galvanic isolation, short-circuit proof
Max. cable length:	0.6 m

Table 7-39 Assignment of connector X53

Pin	Signal name	Type	Meaning
1	DO120.3	O	24 V output 3 (group 1)
2	DO120.4		24 V output 4 (group 1)
3	DO120.5		24 V output 5 (group 1)
4	M	V	Ground

Table 7-40 Assignment of connector X54

Pin	Signal name	Type	Meaning
1	DO120.0	O	24 V output 0 (group 1)
2	DO120.1		24 V output 1 (group 1)
3	DO120.2		24 V output 2 (group 1)
4	M	V	Ground

Table 7-41 Assignment of connector X56

Pin	Signal name	Type	Meaning
1	DO120.6	O	24 V output 6 (group 1)
2	DO120.7		24 V output 7 (group 1)
3	DO121.0		24 V output 8 (group 2)
4	M	V	Ground

Table 7-42 Assignment of connector X57

Pin	Signal name	Type	Meaning
1	DO121.1	O	24 V output 9 (group 2)
2	DO121.2		24 V output 10 (group 2)
3	DO121.3		24 V output 11 (group 2)
4	M	V	Ground

Table 7-43 Assignment of connector X58

Pin	Signal name	Type	Meaning
1	DO121.4	O	24 V output 12 (group 2)
2	DO121.5		24 V output 13 (group 2)
3	DO121.6		24 V output 14 (group 2)
4	M	V	Ground

Table 7-44 Technical data for X53, X54 and X56 to X58

Parameter	Value
Voltage:	Nominal: 24 V
	Permissible: 18 V to 30 V
Max. load current:	Per output: 0.7 A
	Per connector: 1 A

Parameter	Value
	Per output at 100% simultaneity of all 15 outputs: 0.15 A
UL certified rating	Each output: 24 V / 0.15 A general, resistive load 24 V / 3.6 W lamp load 24 V / 0.15 A coil load

Handwheel X60 / X62

Via X60, you can connect 1 handwheel either with TTL or difference signals. Alternatively, you can connect the handwheel via X62. You can connect only 1 handwheel to the module because the signals from X60 are fed parallel to X62.

Use switch S2 to switch between TTL and difference signals.

Note

The handwheel is supplied by the MCP module with 5 V / 100 mA. An external power supply is not permitted.

NOTICE

Handwheel connections

The SINUMERIK 828D software can process up to three handwheels. You can connect two handwheels to the PPU. You can connect an additional handwheel to the machine control panel.

Connector designation: **X60**
 Connector type: 15-pin Sub-D socket

Table 7-45 Assignment of connector X60

Pin	Signal name	Type	Meaning
1	P5V	V	5 V power supply
2	M	V	Ground
3	HW1_A	I	Handwheel pulses track A
4	HW1_XA	I	Handwheel pulses track A (negated)
5	N.C.	-	Not assigned
6	HW1_B	I	Handwheel pulses track B
7	HW1_XB	I	Handwheel pulses track B (negated)
8	N.C.	-	Not assigned
9	P5V	V	5 V power supply
10	N.C.	-	Handwheel 2 pulses track A (negated)
11	M	V	Ground
12	N.C.	-	Not assigned
13	N.C.	-	Not assigned

Pin	Signal name	Type	Meaning
14	N.C.	-	Not assigned
15	N.C.	-	Not assigned

Connector designation: **X62**
 Connector type: 12-pin plug connector
 Special feature: No galvanic isolation
 Max. cable length: 5 m

Table 7-46 Assignment of connector X62

Pin	Signal name	Type	Meaning
1	P5HW	V	5 V power supply
2	M	V	Ground
3	HW1_A	I	Handwheel 1 pulses track A
4	HW1_XA	I	Handwheel 1 pulses track A (negated)
5	HW1_B	I	Handwheel 1 pulses track B
6	HW1_XB	I	Handwheel 1 pulses track B (negated)
7	P5HW	V	5 V power supply
8	M	V	Ground
9	HW2_A	I	Handwheel 2 pulses track A
10	HW2_XA	I	Handwheel 2 pulses track A (negated)
11	HW2_B	I	Handwheel 2 pulses track B
12	HW2_XB	I	Handwheel 2 pulses track B (negated)

Digital inputs and outputs X111, X112, X113, X114

You can connect up to 80 keys and 64 LEDs. The connectors are connected to the machine control panel with ribbon cables.

All keys signal "high" in the idle state (= open). When actuated, the state changes to "low". Short-stroke keyboards and membrane keyboards can be connected. 5 V signals can also be applied to the inputs. The inputs are TTL-compatible, but not 24 V-tolerant.

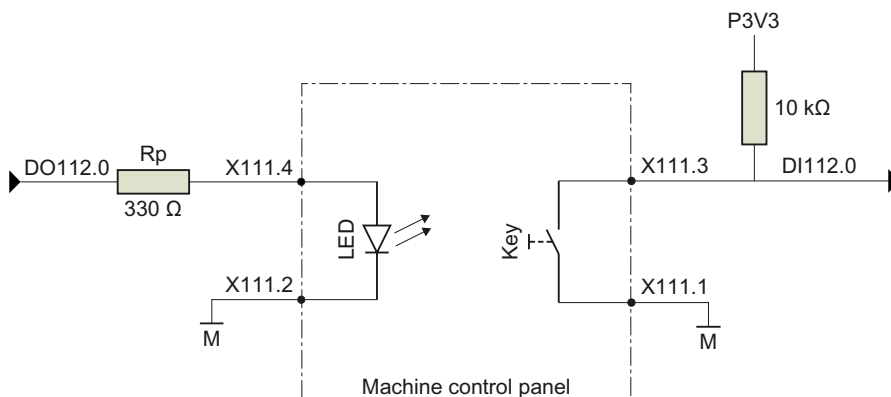


Figure 7-28 Schematic circuit diagram X111

Note

LED brightness

The setting of the LED brightness can be implemented by an additional external resistor connected in series.

- Connector designation: **X111, X112, X113, X114**
- Connector type: 40-pin plug connector
- Special feature: No galvanic isolation, with interlock
- Max. cable length: 2 m

Table 7-47 Assignment of connector X111

Pin	Signal name	Type	Pin	Signal name	Type
1	Ground	V	2	Ground	V
3	DI112.0	I	4	DO112.0	O
5	DI112.1		6	DO112.1	
7	DI112.2		8	DO112.2	
9	DI112.3		10	DO112.3	
11	DI112.4		12	DO112.4	
13	DI112.5		14	DO112.5	
15	DI112.6		16	DO112.6	
17	DI112.7		18	DO112.7	
19	DI113.0		20	DO113.0	
21	DI113.1		22	DO113.1	
23	DI113.2		24	DO113.2	
25	DI113.3		26	DO113.3	
27	DI113.4		28	DO113.4	
29	DI113.5		30	DO113.5	
31	DI113.6		32	DO113.6	

Pin	Signal name	Type	Pin	Signal name	Type
33	DI113.7		34	DO113.7	
35	DI120.0		36	DI120.1	I
37	DI120.2		38	DI120.3	I
39	Reserved		40	Reserved	

Table 7-48 Assignment of connector X112

Pin	Signal name	Type	Pin	Signal name	Type		
1	Ground	V	2	Ground	V		
3	DI114.0	I	4	DO114.0	O		
5	DI114.1		6	DO114.1			
7	DI114.2		8	DO114.2			
9	DI114.3		10	DO114.3			
11	DI114.4		12	DO114.4			
13	DI114.5		14	DO114.5			
15	DI114.6		16	DO114.6			
17	DI114.7		18	DO114.7			
19	DI115.0		20	DO115.0			
21	DI115.1		22	DO115.1			
23	DI115.2		24	DO115.2			
25	DI115.3		26	DO115.3			
27	DI115.4		28	DO115.4			
29	DI115.5		30	DO115.5			
31	DI115.6		32	DO115.6			
33	DI115.7		34	DO115.7			
35	DI120.4		36	DI120.5		I	
37	DI120.6		38	DI120.7		I	
39	Reserved			40		Reserved	

Table 7-49 Assignment of connector X113

Pin	Signal name	Type	Pin	Signal name	Type
1	Ground	V	2	Ground	V
3	DI116.0	I	4	DO116.0	O
5	DI116.1		6	DO116.1	
7	DI116.2		8	DO116.2	
9	DI116.3		10	DO116.3	
11	DI116.4		12	DO116.4	
13	DI116.5		14	DO116.5	
15	DI116.6		16	DO116.6	
17	DI116.7		18	DO116.7	
19	DI117.0		20	DO117.0	
21	DI117.1		22	DO117.1	
23	DI117.2		24	DO117.2	

7.3 MCP Interface PN

Pin	Signal name	Type	Pin	Signal name	Type	
25	DI117.3		26	DO117.3		
27	DI117.4		28	DO117.4		
29	DI117.5		30	DO117.5		
31	DI117.6		32	DO117.6		
33	DI117.7		34	DO117.7		
35	DI121.0		36	DI121.1		I
37	DI121.2		38	DI121.3		I
39	Reserved		40	Reserved		

Table 7-50 Assignment of connector X114

Pin	Signal name	Type	Pin	Signal name	Type	
1	Ground	V	2	Ground	V	
3	DI118.0	I	4	DO118.0	O	
5	DI118.1		6	DO118.1		
7	DI118.2		8	DO118.2		
9	DI118.3		10	DO118.3		
11	DI118.4		12	DO118.4		
13	DI118.5		14	DO118.5		
15	DI118.6		16	DO118.6		
17	DI118.7		18	DO118.7		
19	DI119.0		20	DO119.0		
21	DI119.1		22	DO119.1		
23	DI119.2		24	DO119.2		
25	DI119.3		26	DO119.3		
27	DI119.4		28	DO119.4		
29	DI119.5		30	DO119.5		
31	DI119.6		32	DO119.6		
33	DI119.7		34	DO119.7		
35	DI121.4		36	DI121.5		I
37	DI121.6		38	DI121.7		I
39	Reserved		40	Reserved		

Table 7-51 Technical data of the inputs of X111 to X114

Parameter	Value
Voltage:	0 V to 5 V
Typical current consumption:	0.2 mA at 5 VDC
	-0.3 mA at 0 VDC
Signal level (including ripple):	High signal level: 2.3 V to 5 V
	Low signal level: 0 V to 1 V

Table 7-52 Technical data of the outputs of X111 to X114

Parameter	Value
Voltage:	0 V to 5 V (depending on the load)
Typical load current (without external series resistor):	8 mA at LED flow voltage = 2.3 V
	15 mA at short-circuit

Switch S1, S2

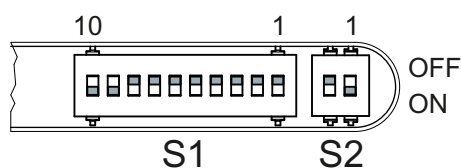


Table 7-53 Setting of switch S1 as delivered

1	2	3	4	5	6	7	8	9	10	Meaning
								ON	ON	PLC I/O Interface
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF			PROFINET address "0"

The two switches S1-9 and S1-10 must remain set to "ON".

The switches S1-1 to S1-8 define the PROFINET address. For a SINUMERIK 828D, the address "64" must always be assigned to the MCP.

Table 7-54 Switch S1 settings

1	2	3	4	5	6	7	8	9	10	Meaning
						ON		ON	ON	
OFF	OFF	OFF	OFF	OFF	OFF		OFF			PROFINET address "64"

The handwheel signal type is set with switch S2-1.

Table 7-55 Switch S2 settings

1	Meaning
ON	differential interface
OFF	TTL interface

Note

Switch S2-2 is reserved for test purposes.

7.3.3 Parameter assignment

The specifications for assigning input and output bytes listed in the tables are set as standard addresses in the PLC by setting the following machine data:

MD12986 PLC_DEACT_IMAGE_LADDR_IN[6] = -1

Standard input image

Table 7-56 MCP Interface PN input image

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
EB112	X111.17	X111.15	X111.13	X111.11	X111.9	X111.7	X111.5	X111.3
EB113	X111.33	X111.31	X111.29	X111.27	X111.25	X111.23	X111.21	X111.19
EB114	X112.17	X112.15	X112.13	X112.11	X112.9	X112.7	X112.5	X112.3
EB115	X112.33	X112.31	X112.29	X112.27	X112.25	X112.23	X112.21	X112.19
EB116	X113.17	X113.15	X113.13	X113.11	X113.9	X113.7	X113.5	X113.3
EB117	X113.33	X113.31	X113.29	X113.27	X113.25	X113.23	X113.21	X113.19
EB118	X114.17	X114.15	X114.13	X114.11	X114.9	X114.7	X114.5	X114.3
EB119	X114.33	X114.31	X114.29	X114.27	X114.25	X114.23	X114.21	X114.19
EB120	X112.38	X112.37	X112.36	X112.35	X111.38	X111.37	X111.36	X111.35
EB121	X114.38	X114.37	X114.36	X114.35	X113.38	X113.37	X113.36	X113.35
EB122	T_Critical ^{*)}	T_High ^{*)}	T_Low ^{*)}	X30.6	X30.7	X30.8	X30.9	X30.10
EB123	-	-	-	X31.6	X31.7	X31.8	X31.9	X31.10
EB124	X55.2	X55.1	X52.3	X52.2	X52.1	X51.3	X51.2	X51.1
EB125	X41.3	X41.2	X41.1	X40.3	X40.2	X40.1	-	X55.3
EB126	The current temperature value of the LM77 temperature sensor in degrees Celsius, further information see below							
EB127	Identifier for the 'MCP Interface PN' module is 0x8D							

^{*)} A logical 1 in the appropriate bit means that the associated temperature alarm is present.

Note

Bytes EB126 and EB127

The EB126 and EB127 bytes have significance only when the MCP Interface PN module is configured as universal component.

The LM77 temperature sensor measures the temperature on the MCP Interface PN module. The temperature is represented as integer value.

Range of values: -25° C to 100° C

Table 7-57 Temperature representation examples

Temperature in °C	Representation in byte EB126
65	0x41
36	0x20
0	0x00

Temperature in °C	Representation in byte EB126
-1	0xFF
-5	0xFB

Input image of the handwheels

Table 7-58 Input image for handwheel data

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
EB m + 0	Handwheel 1 counter status (16-bit signed, low-order byte equals byte m + 0)							
EB m + 1								
EB m + 2	Handwheel 2 counter status (16-bit signed, low-order byte equals byte m + 2)							
EB m + 3								

Note

Within the SINUMERIK control, the handwheel data is processed directly by the NC and is not available to the PLC.

Output image

Table 7-59 MCP Interface PN output image

Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
AB112	X111.18	X111.16	X111.14	X111.12	X111.10	X111.8	X111.6	X111.4
AB113	X111.34	X111.32	X111.30	X111.28	X111.26	X111.24	X111.22	X111.20
AB114	X112.18	X112.16	X112.14	X112.12	X112.10	X112.8	X112.6	X112.4
AB115	X112.34	X112.32	X112.30	X112.28	X112.26	X112.24	X112.22	X112.20
AB116	X113.18	X113.16	X113.14	X113.12	X113.10	X113.8	X113.6	X113.4
AB117	X113.34	X113.32	X113.30	X113.28	X113.26	X113.24	X113.22	X113.20
AB118	X114.18	X114.16	X114.14	X114.12	X114.10	X114.8	X114.6	X114.4
AB119	X114.34	X114.32	X114.30	X114.28	X114.26	X114.24	X114.22	X114.20
AB120	X56.2	X56.1	X53.3	X53.2	X53.1	X54.3	X54.2	X54.1
AB121	-	X58.3	X58.2	X58.1	X57.3	X57.2	X57.1	X56.3

Note

An appropriate bit set to "High" switches the associated output to "High" or the corresponding LED on. This means that inversion by the operating software is not required.

7.3.4 Technical data

MCP Interface PN

Parameter	Value
Input voltage	24 VDC
Power consumption, max.	
• Board	2.4 W
• Handwheels	2 x 0.9 W
• Lamps	54 W (15 x 3.6 W)
• LEDs	4 W (80 x 0.05 W)
• Total	62.4 W
Dimensions	
• Width	242 mm
• Height	152 mm
• Depth	36 mm
Weight	557 g
Safety class according to EN60204-1	III
Degree of protection according to EN 60529	IP00
Approvals	CE, cULus

See also

Other values/standards: Application planning (Page 35)

7.4 Electronic handwheel

7.4.1 Description

Validity

The description applies to the following electronic handwheel:

Designation	Interface	Article number
Handheld electronic handwheel	DC 5 V, RS 422	6FC9320-5DE02

The portable electronic handwheel is intended for use in conjunction with machines. A magnetic bracket and spiral connection cable can be found on its enclosure. The magnetic bracket (retaining magnet) enables the handwheel to be attached to metallic surfaces.

The portable electronic handwheel is an incremental encoder that generates signals according to how the manually operated wheel is rotated. The handwheel's magnetic latching facility

makes for an extremely precise incremental process. The axis selected via the control can be positioned so that the axes are parallel. The portable handwheel offers a PPR count of 100 S/R.



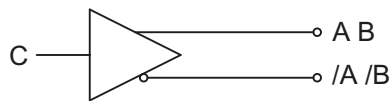
- ① Handwheel
- ② Spiral connection cable
- ③ 9-pin connector

Figure 7-29 View of electronic portable handwheel

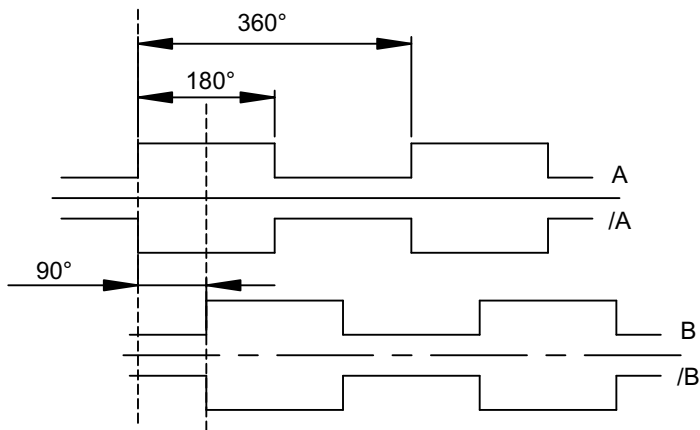
For safe storage on non-magnetic surfaces, a holder (Page 154) is available.

Output circuitry

RS 422 A: Load current ≤ 20 mA



Pulse diagram:



7.4.2 Mounting

Dimensions of the electronic handheld handwheel

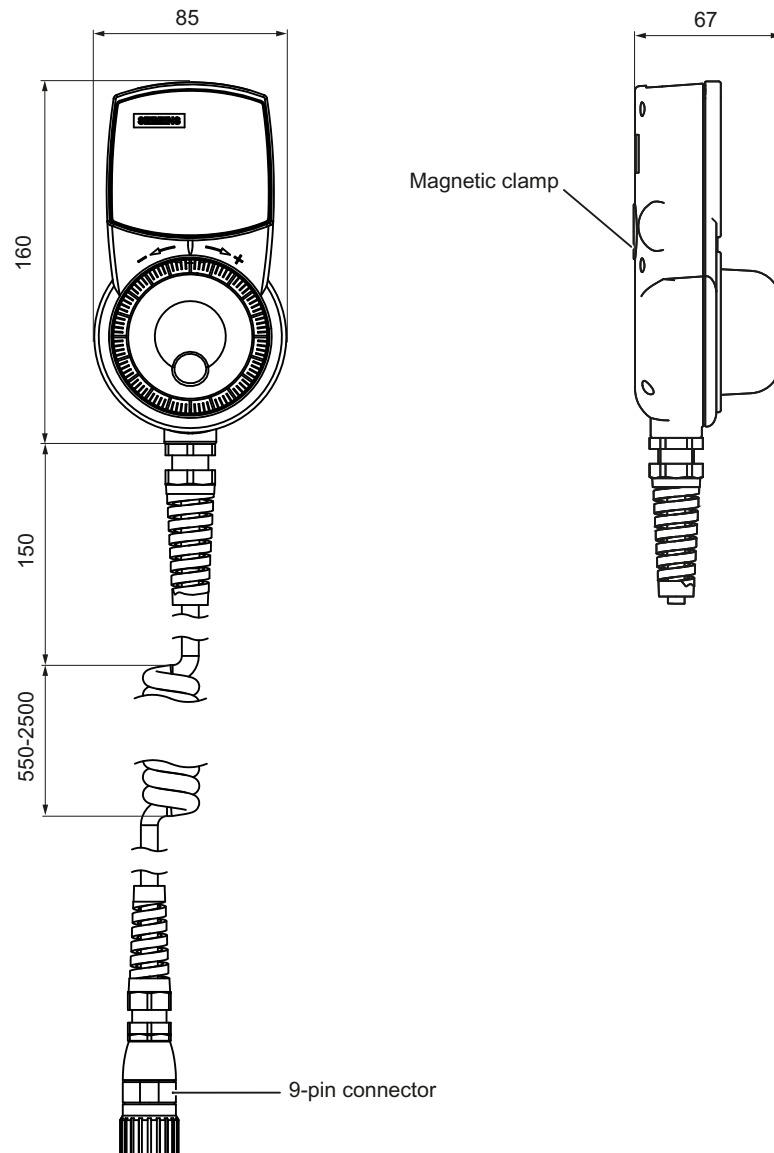


Figure 7-30 Front view and side view

Additional options

Optionally, the handheld electronic handwheel can be stored in a screw-on holder. The holder is mounted using three M4 screws (included in the scope of delivery).

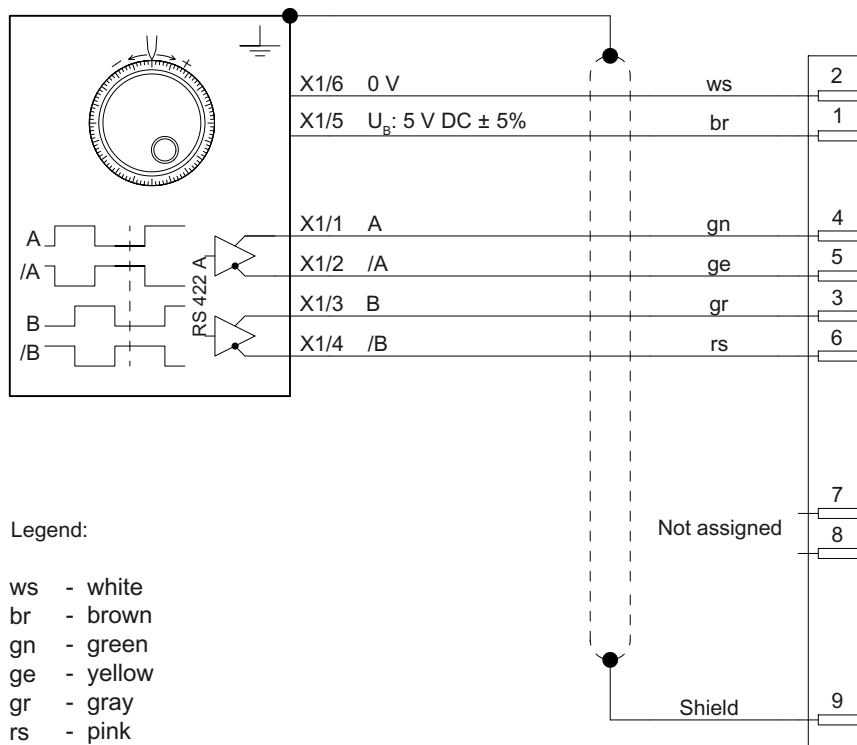
See also: Mini handheld unit, Chapter "Mounting (Page 157)"

7.4.3 Connection

Electrical connection diagram

The handheld handwheel is connected via a flange socket using the spiral connection cable.

You will find article numbers for the recommended flange socket in Chapter Spare parts and accessories (Page 154).



Note

If a connected handwheel triggers pulses while in the idle position or when there is only minimal contact, connect it the opposite way round to what is stated on the label.

Swap:

- The wires of terminal A with those of terminal /A
- The wires of terminal B with those of terminal /B

7.4.4 Technical specifications

Handheld electronic handwheel

Parameter	Value
Operating voltage	5 VDC \pm 5%
Current consumption	Max. 80 mA
Limit frequency	10 kHz
Number of pulses	100 S/R
Displacement of phase A to B, typical	90° electrical
Interface	RS 422
Cable length	Max. 25 m
Actuating force	4 Ncm
Speed	Max. 1,000 rpm
Protection class	I
Degree of protection in acc. with DIN EN 60529/ IEC 60529	IP65
Vibratory load	
• Operation	58 – 200 Hz: 10 m/s ²
• Transportation (in transportation packaging)	9 - 200 Hz: 20 m/s ²
Shock load in acc. with IEC 68-2-27	
• Operation	100 m/s ² , 11 ms, 6 shocks
• Transportation (in transportation packaging)	300 m/s ² , 6 ms, 6 shocks
Condensation, splash water, and icing	Not permitted
Supply air	Without aggressive gases, dusts, and oils
Operation:	
• Applicable standard	EN 60721-3-3
• Temperature range	0 ... 50 °C
• Limits for relative humidity	5 ... 80 %
Storage:	
• Applicable standard	EN 60721-3-2
• Temperature range	-20 ... 50 °C
• Limits for relative humidity	10 ... 95 %
Enclosure material	Thermoplastic
Dimensions:	
• Width	160 mm
• Height	85 mm
• Depth	67 mm
Weight	0.3 kg (without spiral connection cable)

7.4.5 Spare parts and accessories

Accessories

The following components are available as accessories for the handheld electronic handwheel:

Component	Description	Article number
Flange socket	9-pin flange socket	6FC9341-1AQ
Holder	including three M4 screws	6FX2006-1BG70

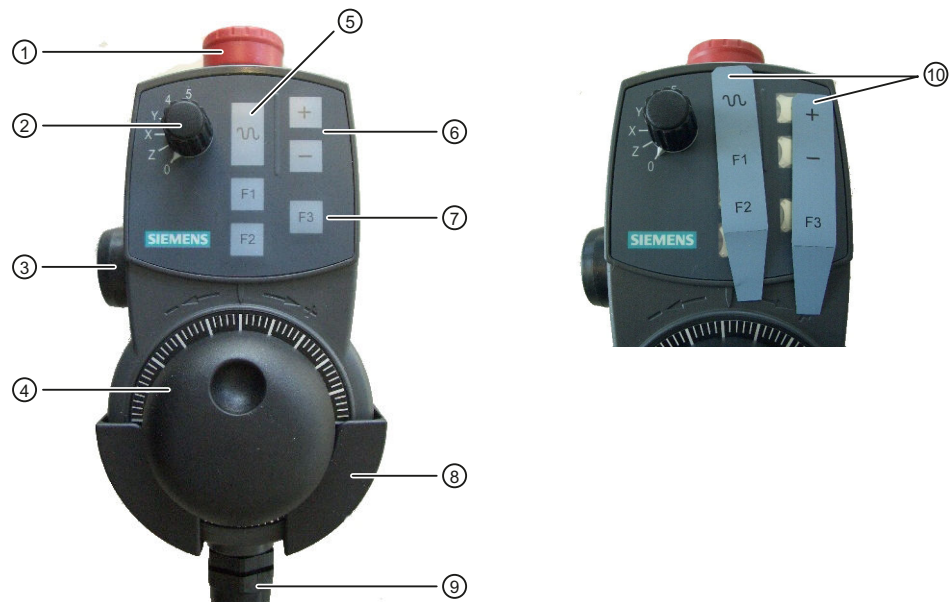
7.5 Mini handheld unit

7.5.1 Description

Features

The mini handheld unit (mini HHU) is a small easy-to-handle unit for setting up and operating simple machines in the JobShop area. Special attention has been paid in the design to ergonomics and logical layout of the control elements.

- The mini HHU is connected to the control with a connection kit.
- The mini HHU can be fixed on metal surfaces by means of the integrated magnetic clamp.
- Key labeling can be customized using slide-in labels.



- ① EMERGENCY STOP button
- ② Selection switch for five axes and neutral position
- ③ Enabling button, two channels, three positions
- ④ Handwheel
- ⑤ Rapid traverse key for high-speed travel with traversing keys or handwheel
- ⑥ Traversing key direction + / direction -
- ⑦ Function keys F1, F2, F3
- ⑧ Holder (optional)
- ⑨ Connecting cable
- ⑩ Slide-in labels

Figure 7-31 Control elements of the mini handheld unit

Control elements of the mini handheld unit

Features of the operator controls:

- **EMERGENCY STOP button**
The EMERGENCY STOP button must be pressed in the following emergency situations:
 - When a person is at risk.
 - When there is a danger of the machine or workpiece being damaged.
- **Axis selection switch**
The axis selection switch can be used to select up to five axes. The coding is carried out in Gray Code.

Table 7-60 Coding of axis selection switch

Connector X1			Switch position	Function
Pin 8	Pin 9	Pin 10		
0	0	0	-	Mini HHU not connected
1	1	0	0	No axis selected
0	1	0	Z	Z axis selected
0	1	1	X	X axis selected
1	1	1	Y	Y axis selected
1	0	1	4	Axis 4 selected
0	0	1	5	Axis 5 selected

- Enabling button**
The enabling button is designed as a 3-way switch. This must be held in its central position for movements to be triggered.
- Handwheel**
The handwheel can be used to initiate movements at the selected axis using the axis selection switch.
- Rapid traverse key**
The rapid traverse key increases the traversing speed of the selected axis with the axis selector switch. The rapid traverse button is active both for traversing commands issued via the +/- keys and for handwheel signals.
- Traversing keys**
The + and - traversing keys can be used to trigger traversing movements on the axis selected via the axis selection switch.
- Function keys**
The function keys can be used to trigger machine-specific functions.

7.5.2 Mounting

Dimensions of the mini handheld unit

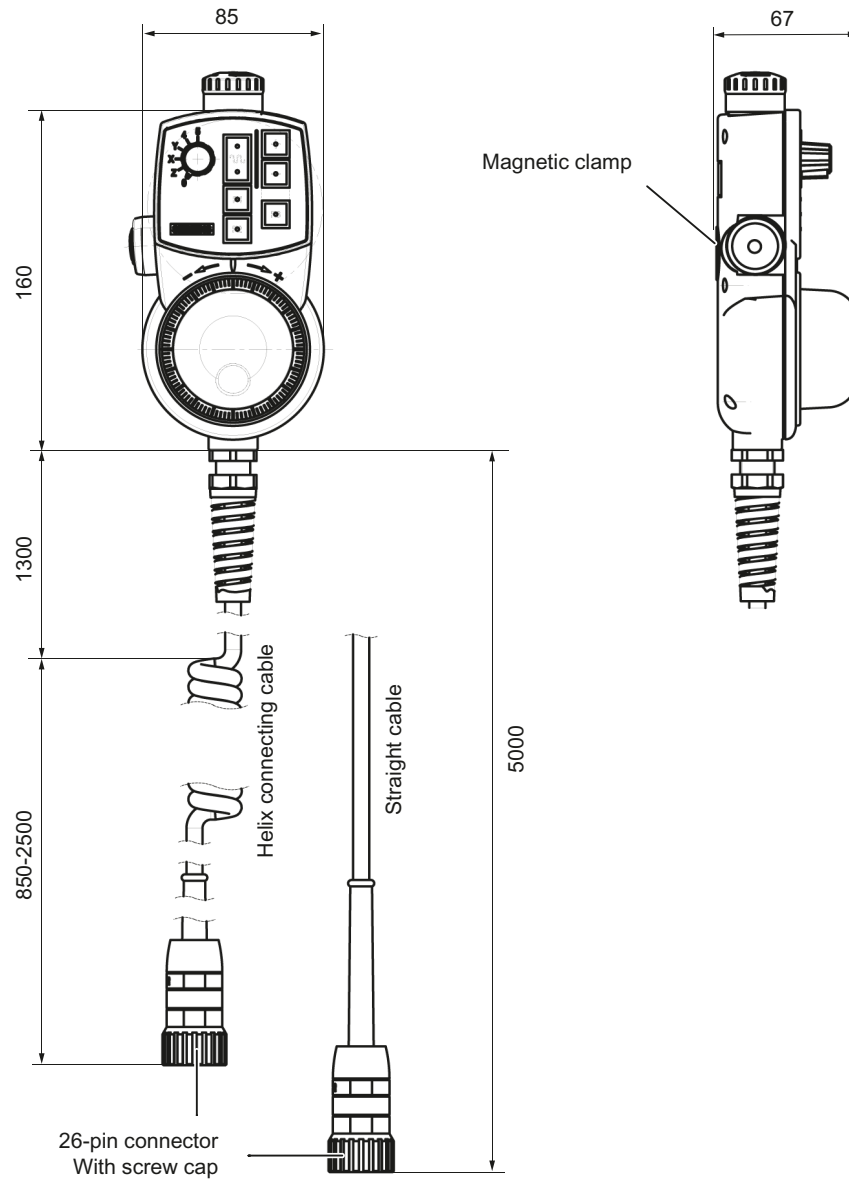


Figure 7-32 Dimension drawing of the mini HHU

Installing the connection kit

Procedure:

1. Transfer the hole pattern to the wall of the controller housing.

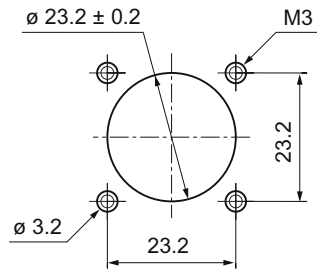


Figure 7-33 Hole pattern for mounting

2. Insert the connection wires through the large drill hole into the controller housing.
3. Mount the flange socket (with seal) onto the controller housing.
4. Connect the connecting cables according to the circuit diagram.

Additional options

Optionally, you can use the following brackets for connection of the mini HHU:

- **Angle box**

An angle box is available as an option, which permits the cable outlet direction to be rotated through 90°.

Note

The angular socket can only be used in conjunction with the non-assembled connection kit.

- **Adapter plate**

To install the metal flange socket in the location for plastic flange sockets, an adapter plate is available.

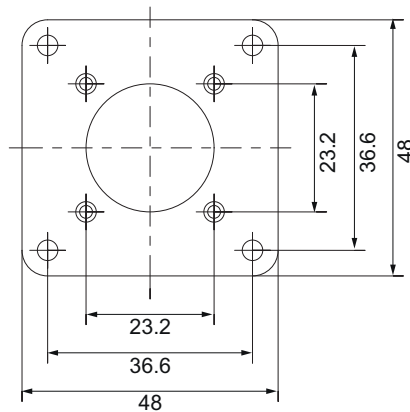


Figure 7-34 Dimension drawing of the adapter plate

- **Holder**

The mini HHU can be stored in a screw-on holder; this enables safe storage even on non-magnetic surfaces. The holder is secured with three M4 screws.

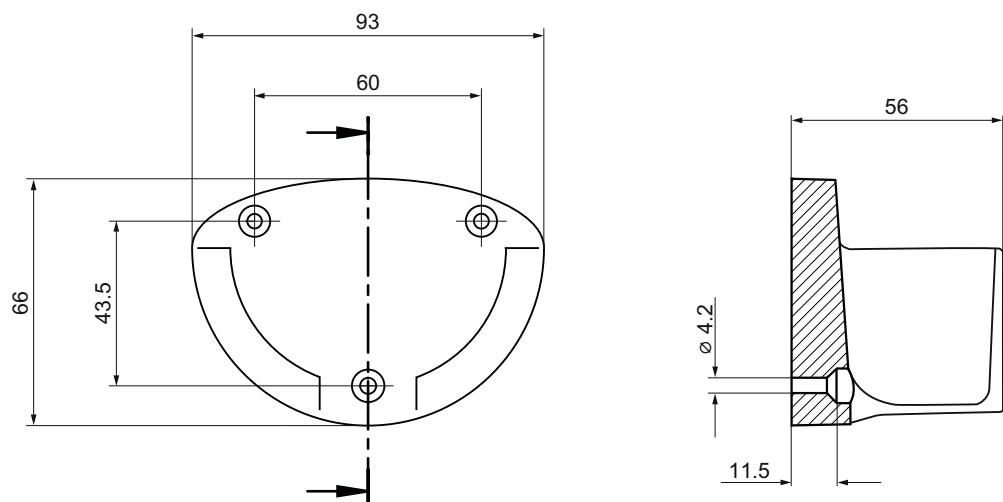


Figure 7-35 Dimension drawing of the holder

7.5.3 Connecting

Connection diagram overview

A connection kit that must be ordered separately is required for connection of the mini HHU. This connection kit contains a flange socket made of metal for installation in the control housing on the machine and a terminating connector for overriding the EMERGENCY STOP circuit when the handheld unit is not connected.

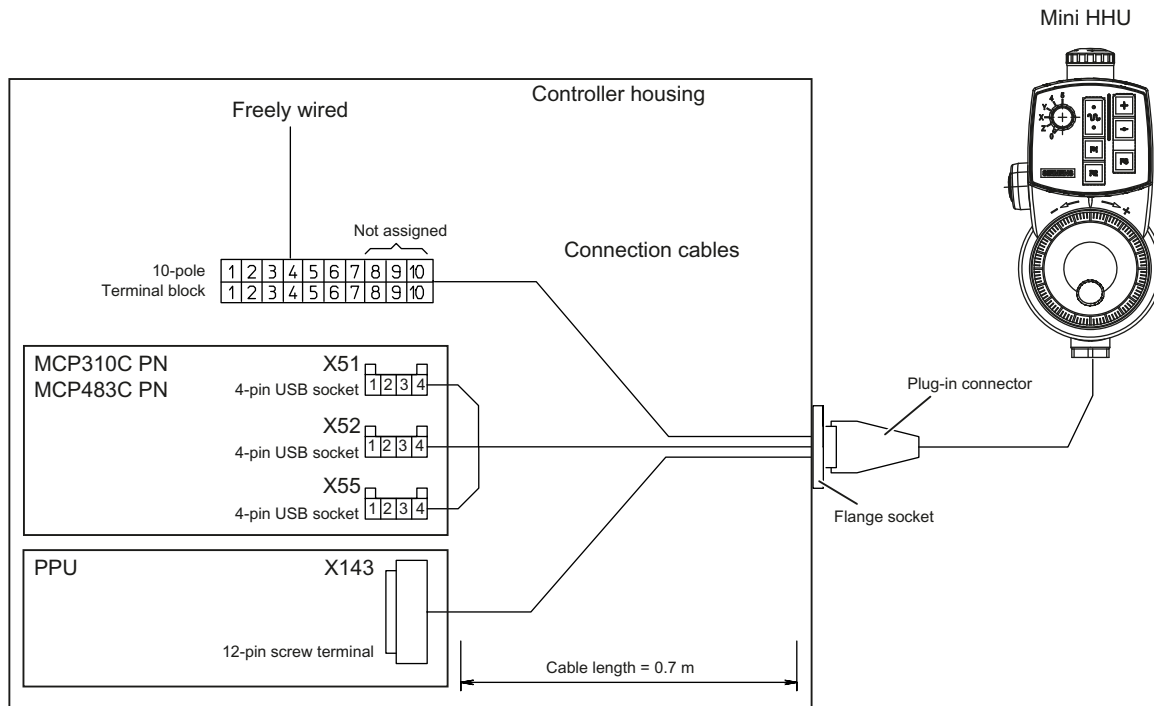


Figure 7-36 Connection diagram

Note

Mini HHU on the MCP Interface PN

You can also connect the mini HHU to the MCP Interface PN module:

- The selection switch at X51
- The function keys at X52 and X55
- The handwheel at X60 / X62

Note that the SINUMERIK 828D software can process up to three handwheels.

Circuit diagram

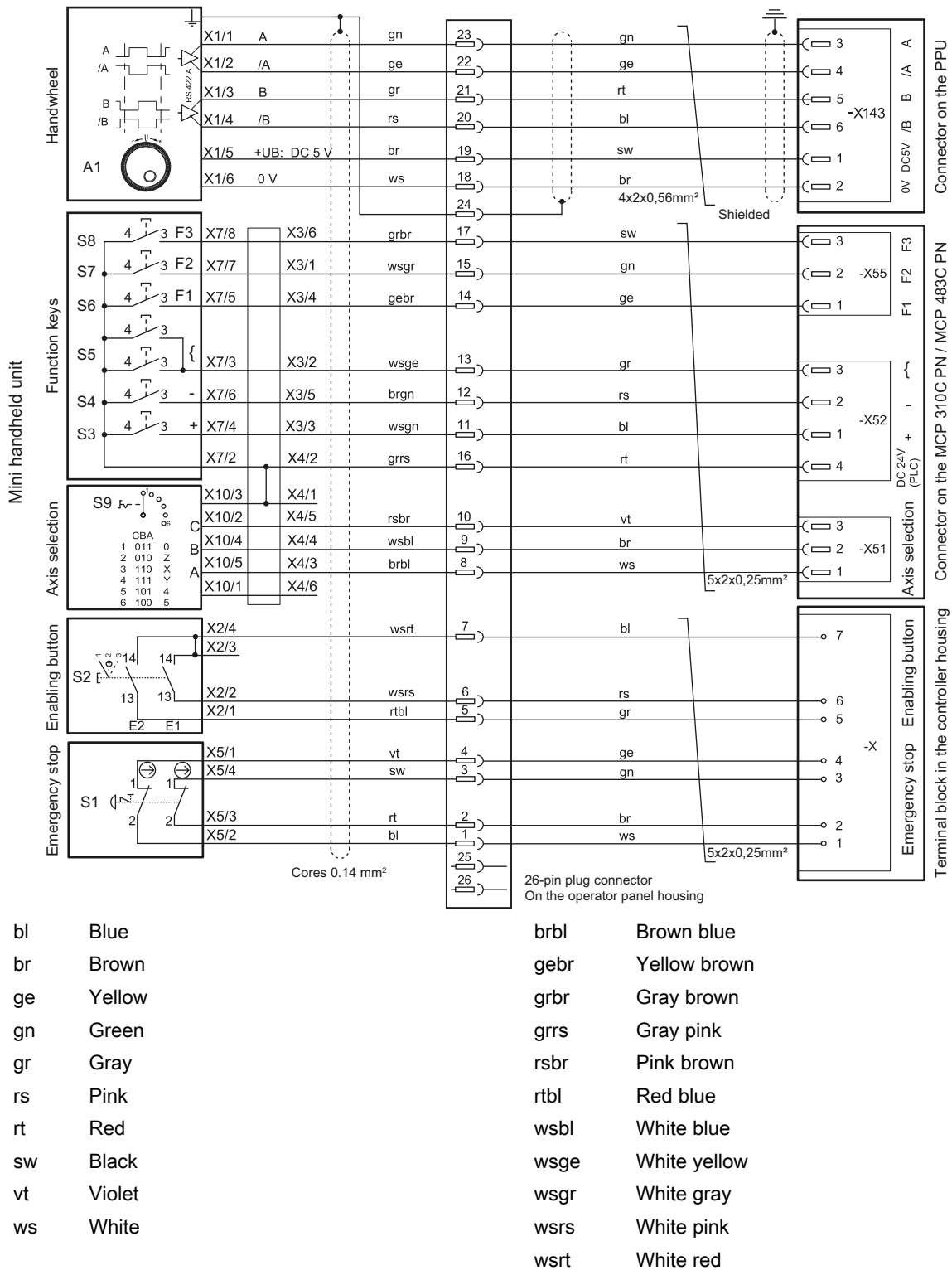


Figure 7-37 Mini HHU circuit diagram

Connection of the flange socket

Procedure:

1. Use the flange-mounted socket to connect the mini HHU to the PLC via the handwheel interface. The signals are sent to the NC in parallel. There is no need for an additional distributor.

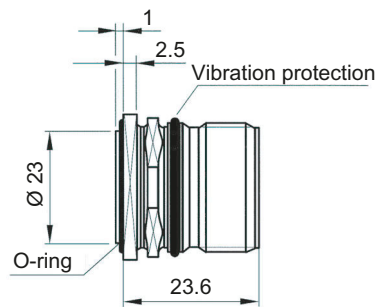


Figure 7-38 Flange socket

2. Insert the connector for the mini HHU connection cable in the detent lugs / guideways of the flange socket.
3. Tighten the screw cap.

Note

If the connector is connected incorrectly, the pins may be damaged.

7.5.4 Parameterization

Note

The mini HHU can only be operated with a Siemens machine control panel.

To address the mini HHU using standard addresses, set the following machine data:
MD12986 PLC_DEACT_IMAGE_LADDR_IN[6] = -1

If a mini HHU is connected, the functional assignment listed in the table below is valid for customer keys KT1 to KT9. On machine control panels MCP 310C PN and MCP 483C PN, the customer keys are assigned to input bytes IB122 and IB123. On the MC Interface PN module, the customer keys are assigned to input bytes IB124 and IB125.

When the mini HHU is connected, the customer keys (inputs) are not available for other applications.

Table 7-61 Input image for MCP 310C PN and MCP 483C PN







Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
EB122						Axis selection switch		
	KT8	KT7	KT6	KT5	KT4	KT3	KT2	KT1
	F2	F1				2 ³	2 ²	2 ¹
	X55.2	X55.1	X52.3	X52.2	X52.1	X51.3	X51.2	X51.1
EB123	-	-	-	-	-	-	-	KT9 F3 X55.3

Table 7-62 Input image for MCP Interface PN


Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
EB124						Axis selection switch		
	KT8	KT7	KT6	KT5	KT4	KT3	KT2	KT1
	F2	F1				2 ³	2 ²	2 ¹
	X55.2	X55.1	X52.3	X52.2	X52.1	X51.3	X51.2	X51.1
EB125	-	-	-	-	-	-	-	KT9 F3 X55.3



Note

Within the SINUMERIK control, the handwheel data is processed directly by the NC and is not available to the PLC.

7.5.5 Technical data

Mini handheld unit

Parameter	Value
Enabling button	isolated, two-channel NO contact, 3-positions
Emergency Stop button	isolated, two-channel NC contact, locked by twisting
Selection switch	5 axes: X, Y, Z, 4th axis, 5th axis, and neutral position
	Jog key: Positive traverse direction

Parameter	Value	
	Jog key: Negative traverse direction	
	Jog key: Rapid traverse for jog keys and handwheel	
Function keys	3 x: F1, F2, F3	
Handwheel	100 S/R	
Rated voltage for switching signals	24 V	
Rated voltage for handwheel	5 V	
5 V current consumption	Approx. 90 mA	
Handwheel signals	RS 422	
EMERGENCY STOP button	24 V, 2 A	NC contact
Enabling buttons	24 V, 2 A	NO contact
Safety class	IP65 (in acc. with EN 60529)	
Approvals	CE	
Temperature ranges		
• Operation	0 ... 55 °C	
• Storage/transport	-20 ... 60° C	
Temperature change	Within 1 minute max. 0.2 K	
Permissible change in relative atmospheric humidity in acc. with EN 60721-3-3, Class 3K5	Within 1 minute max. 0.1%	
Dimensions:		
• Width	180 mm	
• Height	90 mm	
• Depth	67 mm	
Approx. weight	0.5 kg without connecting cable	
Max. cable length	25 m	

7.5.6 Spare parts and accessories

List of the spare parts

The following spare parts are available:

Item name	Article number	Can be used with 6FX2007-	
		-1AD03	-1AD13
6-pos. load-tap-changer with accessories	104899	X	X
Emergency-Stop button	104900	X	X
ZXE-104833 (3-position enabling button)	104901	X	X
Protective cover and nut for ZXE	104902	X	X

Item name	Article number	Can be used with 6FX2007-	
		-1AD03	-1AD13
Spiral cable 3.5 m	104903	X	----
Cable 5 m	104904	---	X
Extension cable 5 m	103832	X	X
Extension cable 10 m	103833	X	X
Extension cable 15 m	103834	X	X
Connection adapter	103835	X	X
Dismantling tool for plug connector	105037	X	X

Ordering address:

Euchner GmbH + Co
 Vertrieb Technik
 Kohlhammerstr. 16
 70771 Leinfelden-Echterdingen
 Germany

Phone +49 (0) 711 7597-0
 Fax +49 (0) 711 7597-303

Accessories

The following components are available as accessories for the mini handheld unit:

Component	Description	Article number
Connection kit	With terminating connector	6FX2006-1BG20
Connection kit	Without terminating connector	6FX2006-1BG25
Angle box	Non-assembled, metal version	6FX2006-1BG56
Adapter plate	Non-assembled, plastic on metal version	6FX2006-1BG45
Holder	including three M4 screws	6FX2006-1BG70

7.6 PP 72/48D PN

7.6.1 Description

Features

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

The module has the following important features:

- 72 digital inputs and 48 digital outputs
- PLC I/O Interface connection (max. 100 MBaud)
- On-board status display via two diagnostic LEDs
- The three 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.
- Analog signal cables can be connected directly to screw contacts on the module.

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

Illustration

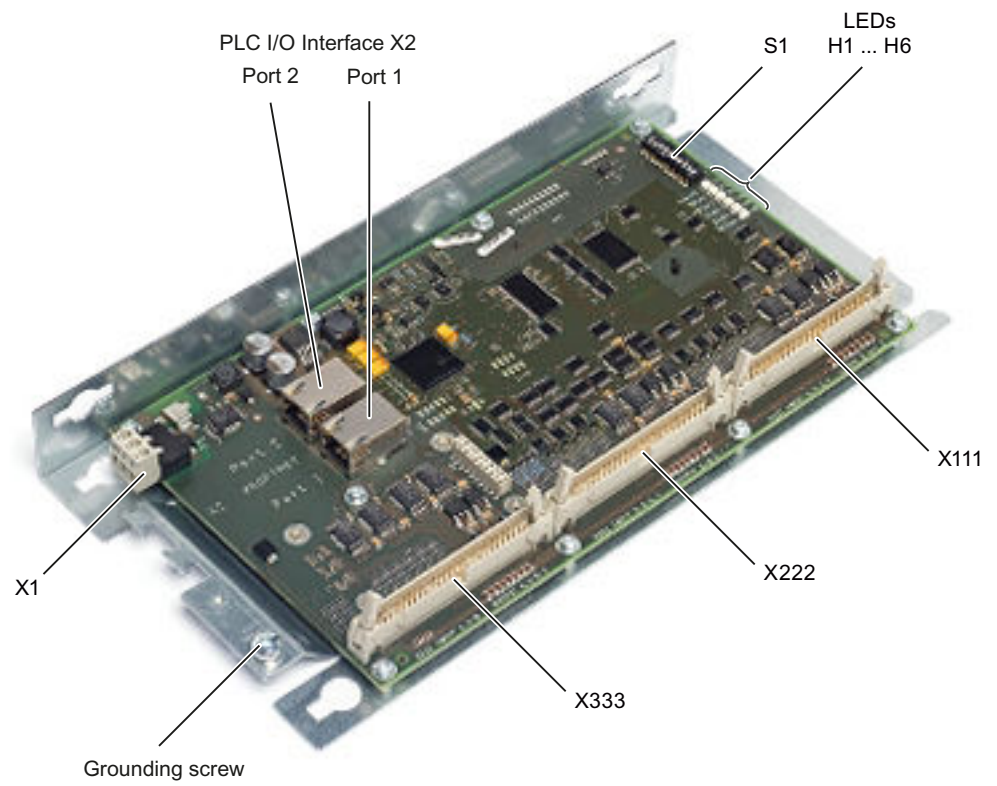


Figure 7-39 PP 72/48D PN I/O module

Type plate

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

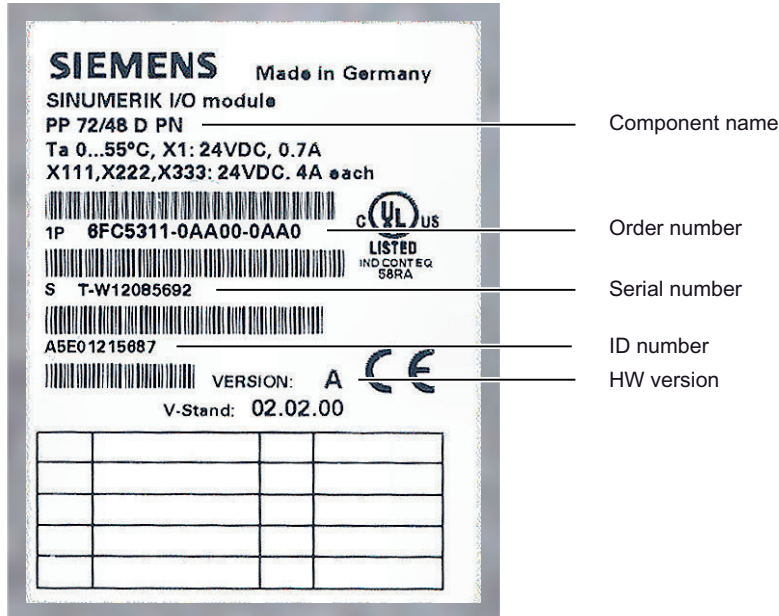


Figure 7-40 PP 72/48D PN type plate

LED for status displays

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

Name	Designation	Color	Description
H1	PowerOK	Green	Lit: Power supply ok
			Not lit: As soon as one of the generated logic voltages falls below its setpoint, a reset is triggered and the PowerOK LED goes out.
H2	PNSync	Green	Lit: Task system is synchronized to the bus cycle clock.
			Not lit: Task system is not synchronized to bus cycle clock.
			Flashes 0.5 Hz: Task system is synchronized to the bus cycle clock and cyclic data exchange is running.
H3	PNFault	Red	Not lit: Module is operating without errors; data exchange with all configured I/O devices is running.
			Lit: Serious bus fault; only output when one of the following errors is detected for the ports: <ul style="list-style-type: none"> No physical connection to a subnet/switch Incorrect transmission rate Full duplex transmission is not activated
H4	DIAG1	Green	Reserved

Name	Designation	Color	Description
H5	DIAG2	Green	Reserved
H6	OVTemp	Red	Overtemperature indication


Note

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

7.6.2 Mounting

Mounting

The I/O module is screwed with a mounting plate to the control cabinet wall in the control cabinet. The module must be installed according to EN 60204.

 WARNING
Protection against electric shock
A protective conductor must be connected using the grounding screw.

Mounting versions:

- Portrait mounting at the lateral strap of the mounting plate (2x M5 or M6 screws).
- Flat mounting at the rear wall of the mounting plate (4x M5 or M6 screws).

Dimension drawing

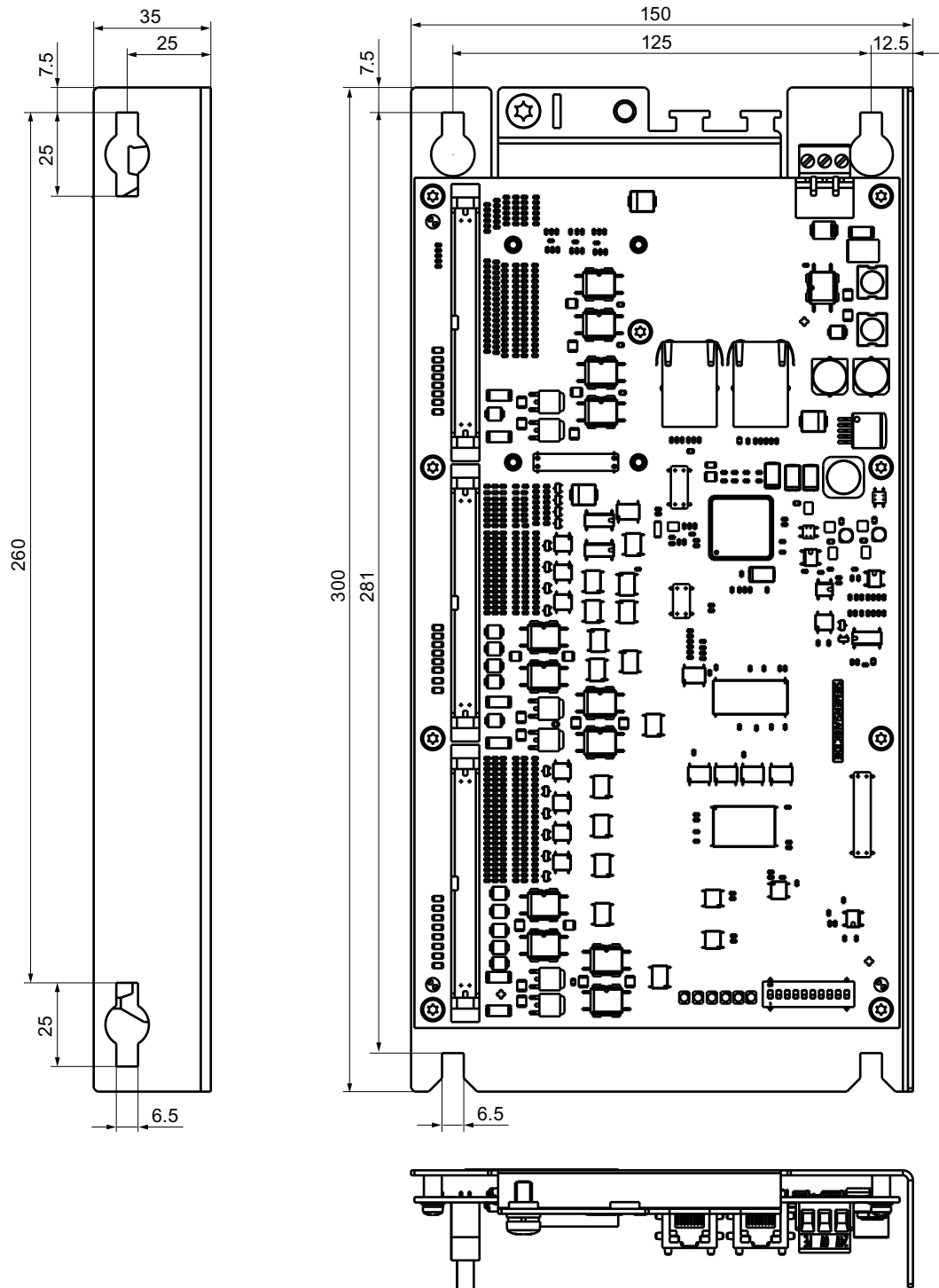


Figure 7-41 PP 72/48D PN dimensions

7.6.3 Connecting

Connection options

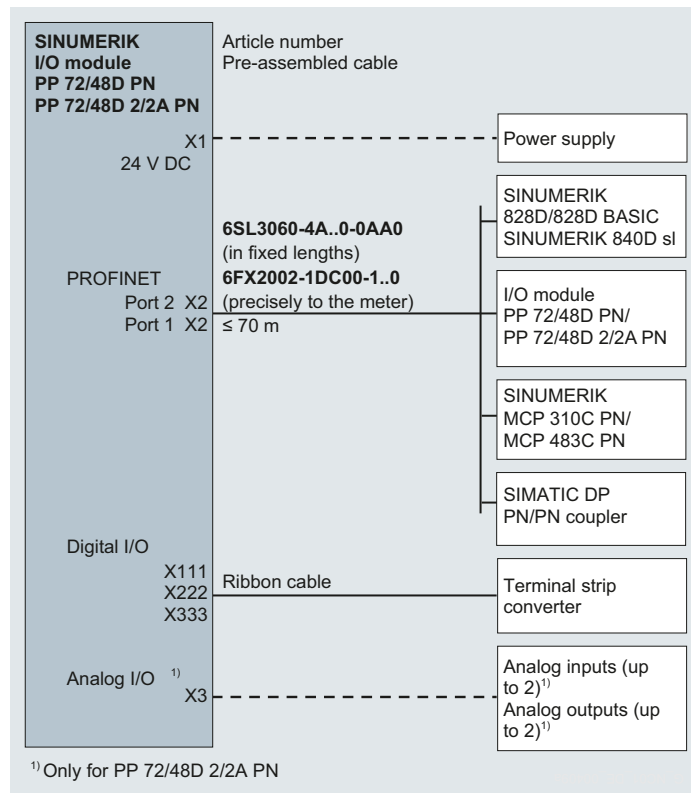


Figure 7-42 Connections of the PP 72/48D PN

Interfaces

Table 7-63 PP 72/48D PN I/O module interfaces

Interface	Designation	Type
Power supply connection	X1	Screw-terminal block
PLC I/O Interface	X2 (ports 1 and 2)	Socket
PLC I/O Interface 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

See also

Addressing the I/O modules (Page 75)

7.6.3.1 X1 power supply

Features and use

A description of the interfaces for the external power supply X1 can be found in Chapter "Power supply connection (Page 69)" of the PPU description.

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

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

Power requirement

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

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 VDC). The reference ground of the power supply source must each be connected with X111, X222, X333, pin 1 (GND). X111, X222, X333, pin 2 (P24OUT) then remains open.

Digital outputs

To supply (24 VDC) 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
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 VDC) for the digital outputs must therefore be connected to all four pins per DOCOMx (X111, X222, X333: pins 47, 48, 49, 50).

7.6.3.2 X2 PROFINET

Requirement

The I/O module has certified PROFINET interfaces, however their functionality cannot be fully utilized within the scope of the SINUMERIK 828D control system. Networking within SINUMERIK 828D is performed via a PLC I/O interface, which is based on PROFINET.

Data Transmission Rate and Cables

The interfaces are designed for full-duplex mode; in other words, the ports can both transmit and receive. When connecting I/O modules to the SINUMERIK 828D, please use the preassembled SINAMICS DRIVE-CLiQ signal cables; from a technical point of view, these are also suitable for use with PROFINET:

- Article number: 6FX2002-1DC00-...
- The transmission characteristics of these cables meet the requirements of CAT5.
- Data transmission speed: 100 Mbps (fast Ethernet).
- 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 70 m.

Pin assignment

Table 7-64 Pin assignment - PROFINET X2, Port 1 and Port 2

Pin	Signal name	Signal type	Meaning
1	TX+	O	Transmit data +
2	TX-	O	Transmit data -
3	RX+	I	Receive data +
4	N.C.	-	Not assigned
5	N.C.	-	Not assigned
6	RX-	I	Receive data -
7	N.C.	-	Not assigned
8	N.C.	-	Not assigned

LED displays

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

Table 7-65 PROFINET ports LED displays

Name	Color	Status	Meaning
Link	Green	Lit	100 Mbit link available
		Off	Missing or faulty link

Name	Color	Status	Meaning
Activity	Yellow	Lit	Sending or receiving
		Off	No activity

PROFINET address (S1)

The right logical address must be assigned to the I/O module for communication with PLC I/O interface using the 10 bit DIP switch S1.

Table 7-66 Switch S1 settings

1	2	3	4	5	6	7	8	9	10	Device name	Meaning
								on	on		
on	off	off	on	off	off	off	off			pp72x48pn9	1. PP module
off	off	off	on	off	off	off	off			pp72x48pn8	2. PP module
on	on	on	off	off	off	off	off			pp72x48pn7	3. PP module
off	on	on	off	off	off	off	off			pp72x48pn6	4. PP module
on	off	on	off	off	off	off	off			pp72x48pn5	5. PP module

The device name consists of the PROFINET name and the device number: in the case of I/O modules, the 1st module is device number 9.

Note

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

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

7.6.3.3 X111, X222 and X333 pin assignment

Pin assignment

Table 7-67 Pin assignment X111

Pin	Signal name	Type	Pin	Signal name	Type
1	M	GND	2	P24OUT	VO
3	DI 0.0	I	4	DI 0.1	I
5	DI 0.2	I	6	DI 0.3	I
7	DI 0.4	I	8	DI 0.5	I
9	DI 0.6	I	10	DI 0.7	I
11	DI 1.0	I	12	DI 1.1	I
13	DI 1.2	I	14	DI 1.3	I
15	DI 1.4	I	16	DI 1.5	I
17	DI 1.6	I	18	DI 1.7	I
19	DI 2.0	I	20	DI 2.1	I

Pin	Signal name	Type	Pin	Signal name	Type
21	DI 2.2	I	22	DI 2.3	I
23	DI 2.4	I	24	DI 2.5	I
25	DI 2.6	I	26	DI 2.7	I
27	Not assigned	-	28	Not assigned	-
29	Not assigned	-	30	Not assigned	-
31	DO 0.0	O	32	DO 0.1	O
33	DO 0.2	O	34	DO 0.3	O
35	DO 0.4	O	36	DO 0.5	O
37	DO 0.6	O	38	DO 0.7	O
39	DO 1.0	O	40	DO 1.1	O
41	DO 1.2	O	42	DO 1.3	O
43	DO 1.4	O	44	DO 1.5	O
45	DO 1.6	O	46	DO 1.7	O
47	DOCOM1	VI	48	DOCOM1	VI
49	DOCOM1	VI	50	DOCOM1	VI

VI: Voltage input/VO: Voltage Output
I: Signal input/O: Signal output/GND: Reference potential (ground)

Table 7-68 Pin assignment for X222

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

Pin	Signal name	Type	Pin	Signal name	Type
45	DO 3.6	O	46	DO 3.7	O
47	DOCOM2	VI	48	DOCOM2	VI
49	DOCOM2	VI	50	DOCOM2	VI

VI: Voltage input/VO: Voltage Output
I: Signal input/O: Signal output/GND: Reference potential (ground)

Table 7-69 Pin assignment for X333

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

VI: Voltage input/VO: Voltage Output
I: Signal input/O: Signal output/GND: Reference potential (ground)

Cable specification:

- 50-pin ribbon cable connector: 50-pin insulation piercing connecting device with strain relief, ribbon cables and terminal converter are required to connect the digital inputs and outputs.
- The required connecting cables (ribbon cables) must be provided by the user. Maximum cable length: 30 m

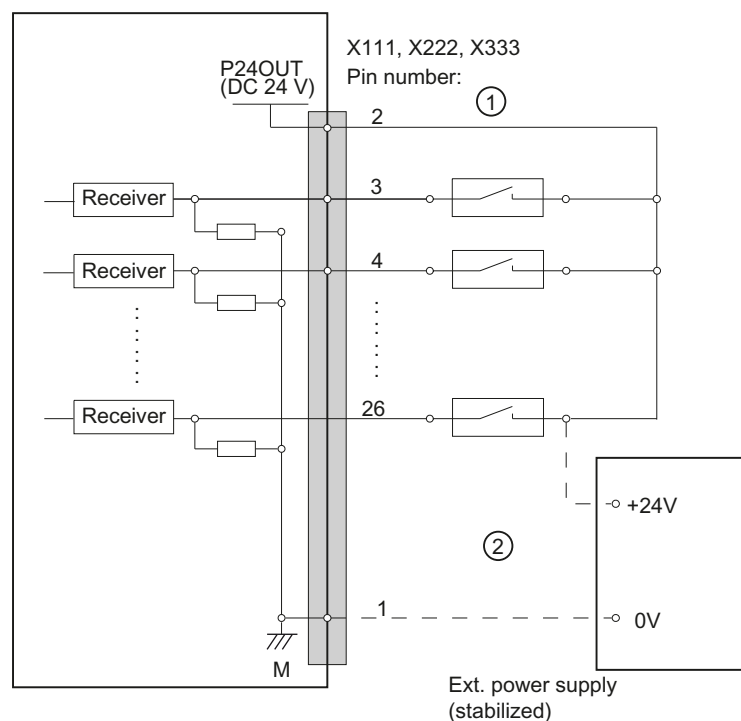
7.6.3.4 Specification of the digital inputs

Terminal assignment for the digital inputs

Characteristics:

- X222: DI 3.0 to 3.7 are connected as rapid inputs.
- The inputs have no signaling (status LEDs).
- The inputs are not isolated.
- It is not possible to connect a 2-wire BERO.

The following figure shows an example of the terminal assignment for the digital inputs on connector X111. Connectors X222 and X333 are assigned analogously.



- ① When using the internal power supply P24OUT
- ② When using the external power supply P24OUT_{ext}

Figure 7-43 Terminal assignment for the digital inputs

Power supply for digital inputs (X111, X222, X333: Pin 2):

The internal power supply (P24OUT) is taken from the general power supply of module X1, pin 2 (P24). Alternatively, an external power supply can be connected if the load at the digital outputs becomes too high.

Technical data

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} for X222: DI 3.0 to 3.7	--	--	600 μ s

7.6.3.5 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.

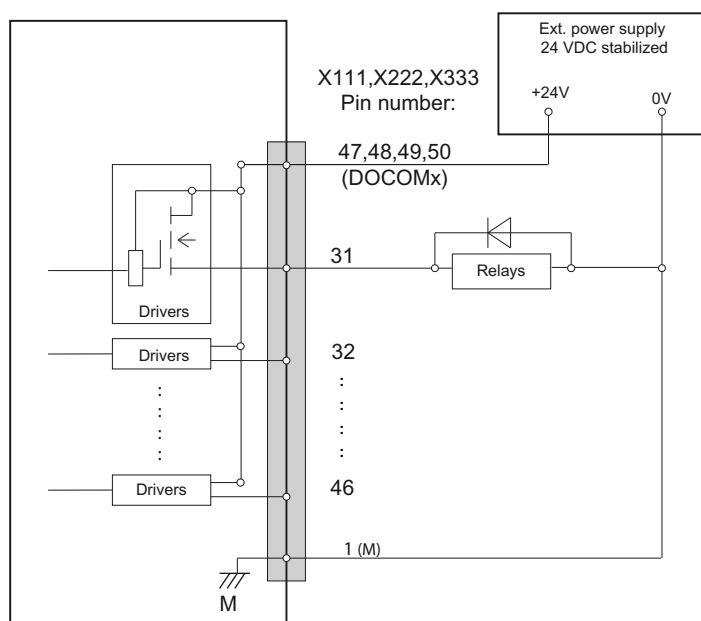


Figure 7-44 Terminal assignment for the digital outputs

NOTICE

Protection against short circuit

A max. current of $I_{out} = 0.25$ A at X111, X222, X333 where the demand factor is 100%: Pin 2 must not be exceeded.

Characteristics:

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

Technical data:

Table 7-70 Electrical specification of the digital outputs

Digital outputs	min.	Typical	max.	Nominal
High-level voltage (U_H)	$V_{CC} - 3\text{ V}$	¹⁾	V_{CC}	24 V
Output current I_{OUT}	--	--	250 mA ²⁾	--
Voltage with low level (U_L)	--	--	--	Output open
Leakage current at low level	--	50 μA	400 μA	--
Signal delay time T_{PHL}	--	0.5 ms	--	--
Maximum switching frequency				
Resistive load	--	--	100 Hz	--
Inductive load	--	--	2 Hz	--
Lamp	--	--	11 Hz	--
¹⁾ $U_{H_typical} = V_{CC} - I_{OUT} \times R_{ON}$ V_{CC} : Current operating voltage I_{OUT} : Output current Maximum short-circuit current: 4 A (max. 100 μs , $V_{CC} = 24\text{ V}$) R_{ON} : Maximum internal resistance = 0.4 Ω ²⁾ Where demand factor is 100% (all outputs active) Incorrect connection causes neither high level nor destruction of the outputs.				

7.6.4 Parameter assignment

7.6.4.1 Input / output images

Input image

The image comprises 3 slots (n, m, d \triangleq start address, see Addressing the I/O modules (Page 75)):

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

Table 7-71 Input image of digital inputs for the 1st I/O module (n=0)

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

Table 7-72 Input image of analog inputs for the 1st I/O module (m=56)

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

Output image

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

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

Table 7-73 Output image of digital outputs for the 1st I/O module (n=0)

Terminal	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
X111	n+0	Pin38 DO 0.7	Pin37 DO 0.6	Pin36 DO 0.5	Pin35 DO 0.4	Pin34 DO 0.3	Pin33 DO 0.2	Pin32 DO 0.1	Pin31 DO 0.0
	n+1	Pin46 DO 1.7	Pin45 DO 1.6	Pin44 DO 1.5	Pin43 DO 1.4	Pin42 DO 1.3	Pin41 DO 1.2	Pin40 DO 1.1	Pin39 DO 1.0

Terminal	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
X222	n+2	Pin38 DO 2.7	Pin37 DO 2.6	Pin36 DO 2.5	Pin35 DO 2.4	Pin34 DO 2.3	Pin33 DO 2.2	Pin32 DO 2.1	Pin31 DO 2.0
	n+3	Pin46 DO 3.7	Pin45 DO 3.6	Pin44 DO 3.5	Pin43 DO 3.4	Pin42 DO 3.3	Pin41 DO 3.2	Pin40 DO 3.1	Pin39 DO 3.0
X333	n+4	Pin38 DO 4.7	Pin37 DO 4.6	Pin36 DO 4.5	Pin35 DO 4.4	Pin34 DO 4.3	Pin33 DO 4.2	Pin32 DO 4.1	Pin31 DO 4.0
	n+5	Pin46 DO 5.7	Pin45 DO 5.6	Pin44 DO 5.5	Pin43 DO 5.4	Pin42 DO 5.3	Pin41 DO 5.2	Pin40 DO 5.1	Pin39 DO 5.0

Table 7-74 Output image of analog outputs for the 1st I/O module (m=56)

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

7.6.4.2 Diagnostics via input image

Table 7-75 Diagnostics input image

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

Table 7-76 Messages in byte 0

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

Note

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

Table 7-77 Overview of messages as a function of the "alive and well" counter

"alive and well" counter	Value byte 1	Message
0	0	Reserved
1		Temperature value
2	0	No error
	1	Impermissible input voltage in 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

Table 7-78 Elimination of error at "alive and well" counter status "2"

Value byte 1	Cause	Effect	Remedy
1	In the temperature measurement operating mode, an input voltage is too high. The hardware may become damaged/ destroyed as a result.	The "PNFault" LED is activated. The outputs are disabled. ¹⁾ The value 0x80 is stored in Status Byte 1.	It is essential that a Pt100 element is connected to terminals 3-4 or 7-8. The module must be restarted with Power ON following elimination of the error.
2	Reserved	-	-
3	Overload at the outputs	The "PNFault" LED is activated. The outputs are disabled. ¹⁾ The value 0x80 is stored in Status Byte 1.	Check the loads at the analog output. The module must be restarted with Power ON following elimination of the error.
4	Incorrect operating mode selection, e.g. temperature measurement at the analog outputs.	Selection of operating mode is rejected,	If selected correctly, the module switches to cyclic operation.
5	Internal error, system error	The "PNFault" LED is activated. The outputs are disabled. ¹⁾ The value 0x80 is stored in Status Byte 1.	The firmware has detected a system error, this status can only be exited by means of a switch-on / switch-off.

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

¹⁾ The analog outputs retain their last specified value.

Diagnostics via Status Bytes 0/1

In Status Byte 0, the set operating modes are reflected e.g. "0x55" if Control Byte 0 = 0x55 has been specified.

In the event of an error, the error bit is set in Status Byte 1 (bit 7). In the event of an error in one channel, **all** channels are disabled.

Table 7-79 Input image of analog inputs (excerpt)

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

7.6.5 Technical data

PP 72/48D PN I/O module

Parameter	Value
Input voltage	24 V DC + 20% / - 15%
Power consumption at rated load (without digital outputs)	17 W
Degree of protection in acc. with EN 60529	IP00
Protection class in acc. with EN 61800-5-1	III; DVC A (PELV)
Shock load during transportation (in transportation packaging)	Free-fall \leq 1 m
Approvals	CE, cULus
Cooling	Open-circuit ventilation
Condensation	Not permitted
Limits for relative humidity at 25 °C:	
• Storage	5 ... 95% without condensation
• Transportation	5 ... 95% without condensation
• Operation	5 ... 90% without condensation
Temperature limits:	
• Storage	-40 ... 70 °C
• Transportation	-40 ... 70 °C
• Operation	0 ... 55 °C

Parameter	Value
Dimensions:	
• Width	300 mm
• Height	150 mm
• Depth	35 mm
Weight, approx.	0.9 kg

7.7 PP 72/48D 2/2A PN

7.7.1 Description

Features

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

The module has the following important features:

- 72 digital inputs and 48 digital outputs
- Two analog inputs and two analog outputs
Analog process signals such as for detecting temperatures or controlling hydraulic workholders can be implemented via analog inputs/outputs.
- PROFINET IO connection (max. 100 MBaud)
- On-board status display via six LEDs
- The three 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.
- Analog signal cables can be connected directly to terminal contacts on the module.

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

Illustration

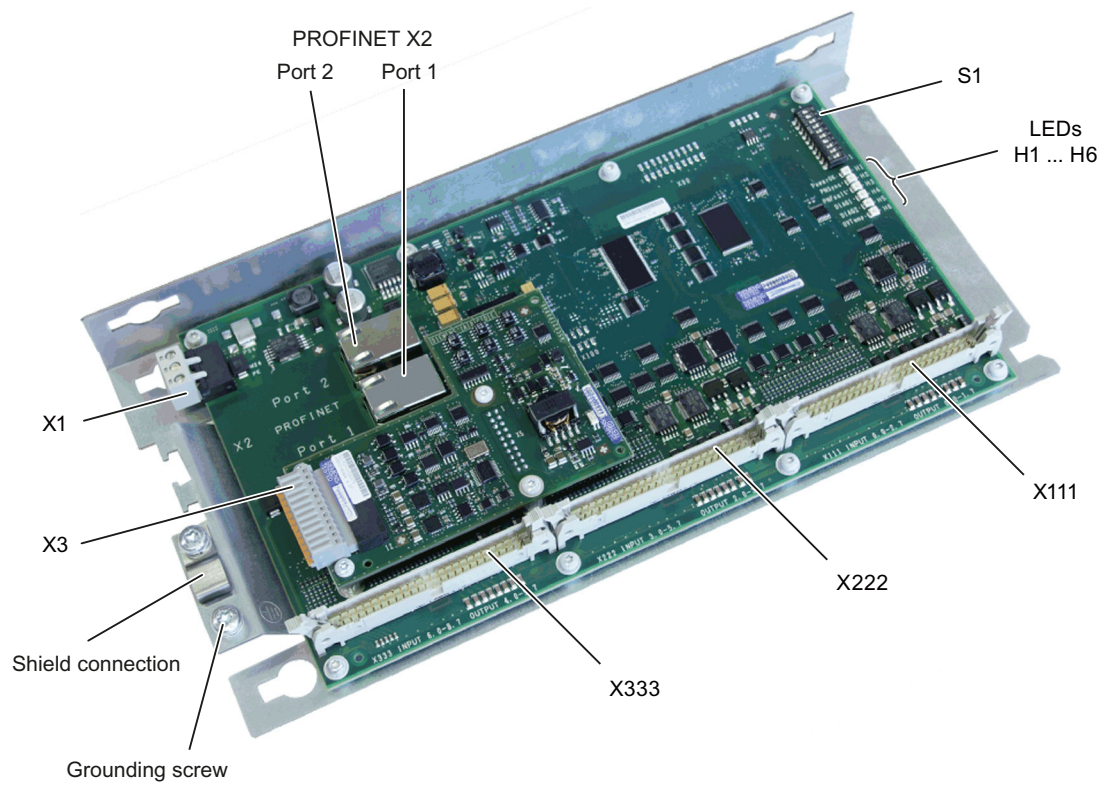


Figure 7-45 PP 72/48D 2/2A PN I/O module

Type plate

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

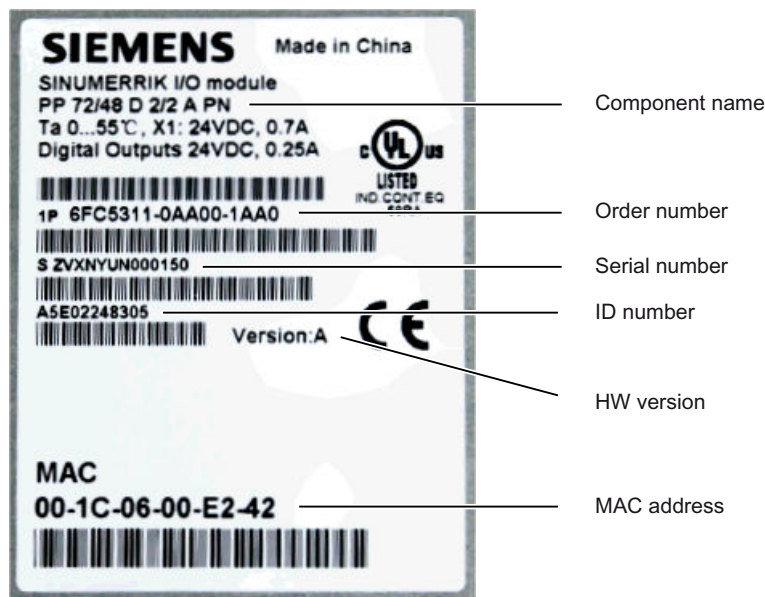


Figure 7-46 PP 72/48D 2/2A PN type plate

LEDs for status display

The PP 72/48D 2/2A PN has the following status displays that provide information on the module status:

Table 7-80 LEDs

Name	Designation	Color	Description
H1	PowerOK	Green	Lit: Power supply ok
			Not lit: As soon as one of the generated logic voltages falls below its setpoint, a reset is triggered and the PowerOK LED goes out.
H2	PNSync	Green	Lit: Task system is synchronized to the bus cycle clock.
			Not lit: Task system is not synchronized to bus cycle clock.
			Flashes 0.5 Hz: Task system is synchronized to the bus cycle clock and cyclic data exchange is running.
H3	PNFault	Red	Not lit: Module is operating without errors; data exchange with all configured I/O devices is running.
			Lit: Serious bus fault; only output when one of the following errors is detected for the ports: <ul style="list-style-type: none"> • No physical connection to a subnet/switch • Incorrect transmission rate • Full duplex transmission is not activated
H4	DIAG1	Green	Reserved

Name	Designation	Color	Description
H5	DIAG2	Green	Reserved
H6	OVTemp	Red	Overttemperature indication


Note

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

7.7.2 Assembling

Mounting

The I/O module is screwed with a mounting plate to the control cabinet wall in the control cabinet. The module must be installed according to EN 60204.

 WARNING
Protection against electric shock
A protective conductor must be connected using the grounding screw.

Mounting versions:

- Portrait mounting at the lateral strap of the mounting plate (2x M5 or M6 screws).
- Flat mounting at the rear wall of the mounting plate (4x M5 or M6 screws).

Dimension drawing

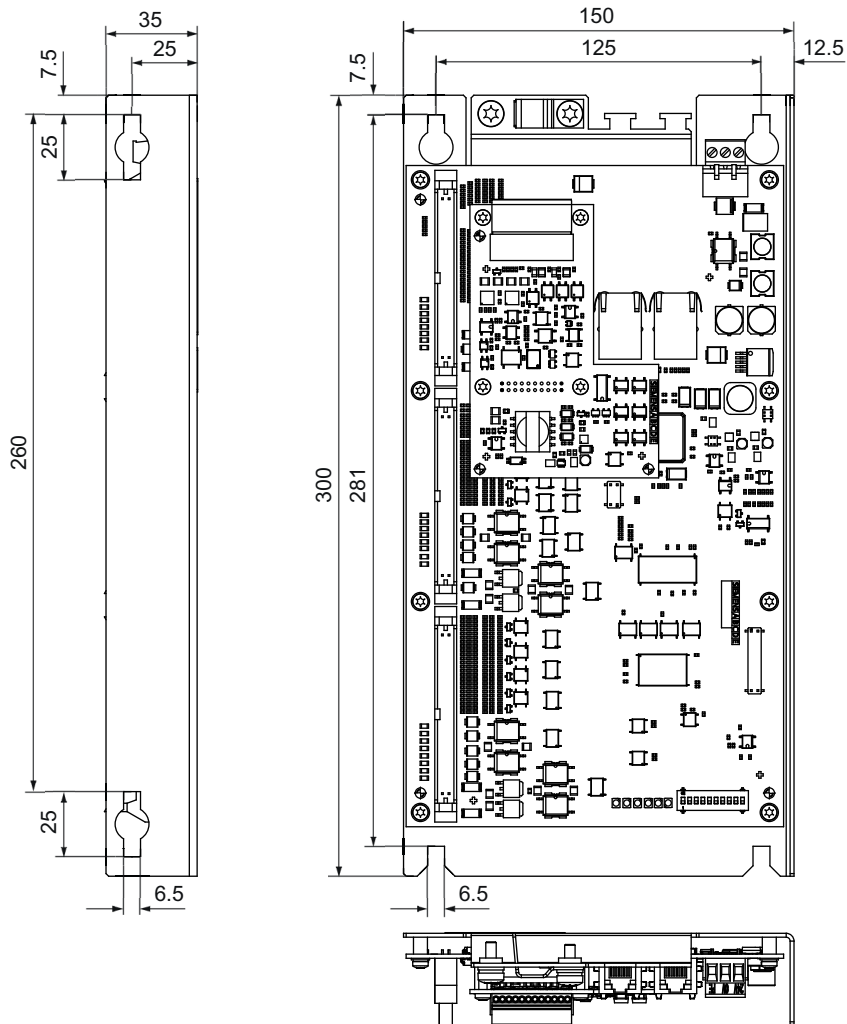


Figure 7-47 PP 72/48D 2/2A PN dimension drawing

7.7.3 Connection

Connection options

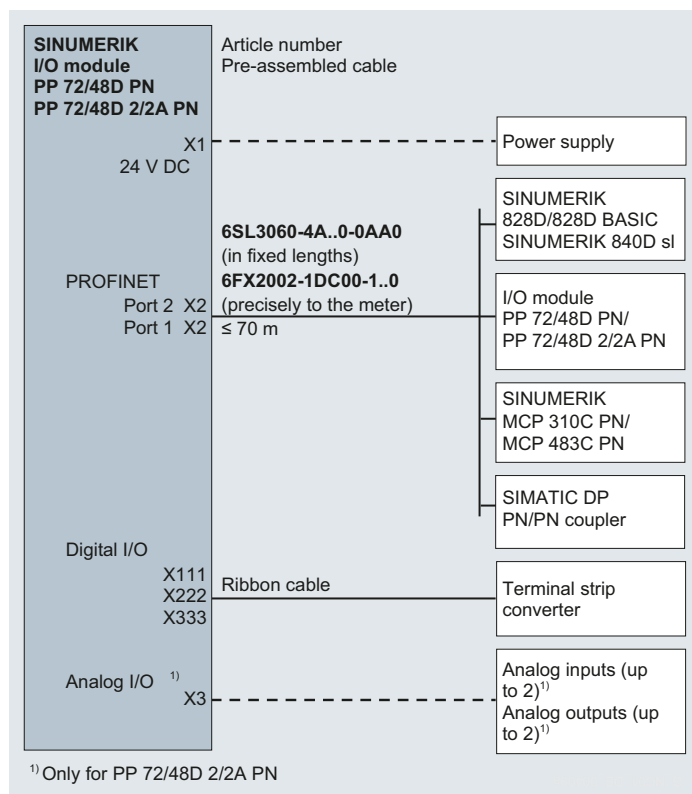


Figure 7-48 PP 72/48D 2/2A PN connections

Interface overview

Table 7-81 Interfaces of the PP 72/48D 2/2A PN I/O module

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

Note

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

See also

Addressing the I/O modules (Page 75)

7.7.3.1 X1 power supply

Requirements for the power supply


 DANGER
<p>Risk of lightning strike</p> <p>In the case of supply lines > 10 m, protectors must be installed at the device input in order to protect against lightning (surge).</p> <p>The DC power supply must be connected to the ground/shield 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.</p> <p>See also: "EMC Installation Guideline" Configuration Manual.</p>

Table 7-82 Requirements of the DC power supply

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

Digital inputs

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

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

Digital outputs

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

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

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

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

Wiring the power supply

Properties

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

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

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

Pin assignment

Table 7-83 Pin assignment at X1 screw-type terminal block


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

Power requirement

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

Wiring the screw terminal block

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

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

Power cables

Table 7-84 Cable specification for X1

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

Use flexible cables with a cross-section of 0.25 to 2.5 mm² (or AWG 23 to AWG 13) for wiring the power supply according to the maximum occurring current.

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

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

7.7.3.2 X2 PROFINET

Requirement

The I/O module has certified PROFINET interfaces, however their functionality cannot be fully utilized within the scope of the SINUMERIK 828D control system. Networking within SINUMERIK 828D is performed via a PLC I/O interface, which is based on PROFINET.

Data Transmission Rate and Cables

The interfaces are designed for full-duplex mode; in other words, the ports can both transmit and receive. When connecting I/O modules to the SINUMERIK 828D, please use the preassembled SINAMICS DRIVE-CLiQ signal cables; from a technical point of view, these are also suitable for use with PROFINET:

- Article number: 6FX2002-1DC00-...
- The transmission characteristics of these cables meet the requirements of CAT5.
- Data transmission speed: 100 Mbps (fast Ethernet).
- 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 70 m.

Pin assignment

Table 7-85 Pin assignment - PROFINET X2, Port 1 and Port 2

Pin	Signal name	Signal type	Meaning
1	TX+	O	Transmit data +
2	TX-	O	Transmit data -
3	RX+	I	Receive data +
4	N.C.	-	Not assigned
5	N.C.	-	Not assigned
6	RX-	I	Receive data -
7	N.C.	-	Not assigned
8	N.C.	-	Not assigned

LED displays

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

Table 7-86 PROFINET ports LED displays

Name	Color	Status	Meaning
Link	Green	Lit	100 Mbit link available
		Off	Missing or faulty link

Name	Color	Status	Meaning
Activity	Yellow	Lit	Sending or receiving
		Off	No activity

PROFINET address (S1)

The right logical address must be assigned to the I/O module for communication with PLC I/O interface using the 10 bit DIP switch S1.

Table 7-87 Switch S1 settings

1	2	3	4	5	6	7	8	9	10	Device name	Meaning
								on	on		
on	off	off	on	off	off	off	off			pp72x48pn9	1. PP module
off	off	off	on	off	off	off	off			pp72x48pn8	2. PP module
on	on	on	off	off	off	off	off			pp72x48pn7	3. PP module
off	on	on	off	off	off	off	off			pp72x48pn6	4. PP module
on	off	on	off	off	off	off	off			pp72x48pn5	5. PP module

The device name consists of the PROFINET name and the device number: in the case of I/O modules, the 1st module is device number 9.

Note

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

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

7.7.3.3 X111, X222 and X333 pin assignment

Pin assignment

Table 7-88 Pin assignment X111

Pin	Signal name	Type	Pin	Signal name	Type
1	M	GND	2	P24OUT	VO
3	DI 0.0	I	4	DI 0.1	I
5	DI 0.2	I	6	DI 0.3	I
7	DI 0.4	I	8	DI 0.5	I
9	DI 0.6	I	10	DI 0.7	I
11	DI 1.0	I	12	DI 1.1	I
13	DI 1.2	I	14	DI 1.3	I
15	DI 1.4	I	16	DI 1.5	I
17	DI 1.6	I	18	DI 1.7	I
19	DI 2.0	I	20	DI 2.1	I

Pin	Signal name	Type	Pin	Signal name	Type
21	DI 2.2	I	22	DI 2.3	I
23	DI 2.4	I	24	DI 2.5	I
25	DI 2.6	I	26	DI 2.7	I
27	Not assigned	-	28	Not assigned	-
29	Not assigned	-	30	Not assigned	-
31	DO 0.0	O	32	DO 0.1	O
33	DO 0.2	O	34	DO 0.3	O
35	DO 0.4	O	36	DO 0.5	O
37	DO 0.6	O	38	DO 0.7	O
39	DO 1.0	O	40	DO 1.1	O
41	DO 1.2	O	42	DO 1.3	O
43	DO 1.4	O	44	DO 1.5	O
45	DO 1.6	O	46	DO 1.7	O
47	DOCOM1	VI	48	DOCOM1	VI
49	DOCOM1	VI	50	DOCOM1	VI

VI: Voltage input/VO: Voltage Output
I: Signal input/O: Signal output/GND: Reference potential (ground)

Table 7-89 Pin assignment for X222

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

Pin	Signal name	Type	Pin	Signal name	Type
45	DO 3.6	O	46	DO 3.7	O
47	DOCOM2	VI	48	DOCOM2	VI
49	DOCOM2	VI	50	DOCOM2	VI

VI: Voltage input/VO: Voltage Output
I: Signal input/O: Signal output/GND: Reference potential (ground)

Table 7-90 Pin assignment for X333

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

VI: Voltage input/VO: Voltage Output
I: Signal input/O: Signal output/GND: Reference potential (ground)

Cable specification:

- 50-pin ribbon cable connector: 50-pin insulation piercing connecting device with strain relief, ribbon cables and terminal converter are required to connect the digital inputs and outputs.
- The required connecting cables (ribbon cables) must be provided by the user. Maximum cable length: 30 m

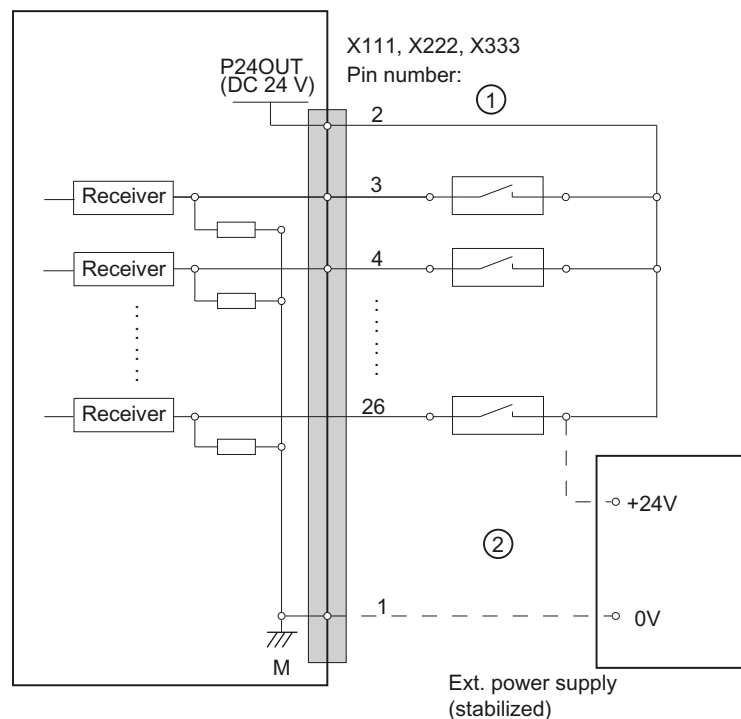
7.7.3.4 Specification of the digital inputs

Terminal assignment for the digital inputs

Characteristics:

- X222: DI 3.0 to 3.7 are connected as rapid inputs.
- The inputs have no signaling (status LEDs).
- The inputs are not isolated.
- It is not possible to connect a 2-wire BERO.

The following figure shows an example of the terminal assignment for the digital inputs on connector X111. Connectors X222 and X333 are assigned analogously.



- ① When using the internal power supply P24OUT
 ② When using the external power supply P24OUT_{ext}

Figure 7-49 Terminal assignment for the digital inputs

Power supply for digital inputs (X111, X222, X333: Pin 2):

The internal power supply (P24OUT) is taken from the general power supply of module X1, pin 2 (P24). Alternatively, an external power supply can be connected if the load at the digital outputs becomes too high.

Technical data

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} for X222: DI 3.0 to 3.7	--	--	600 μ s

7.7.3.5 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.

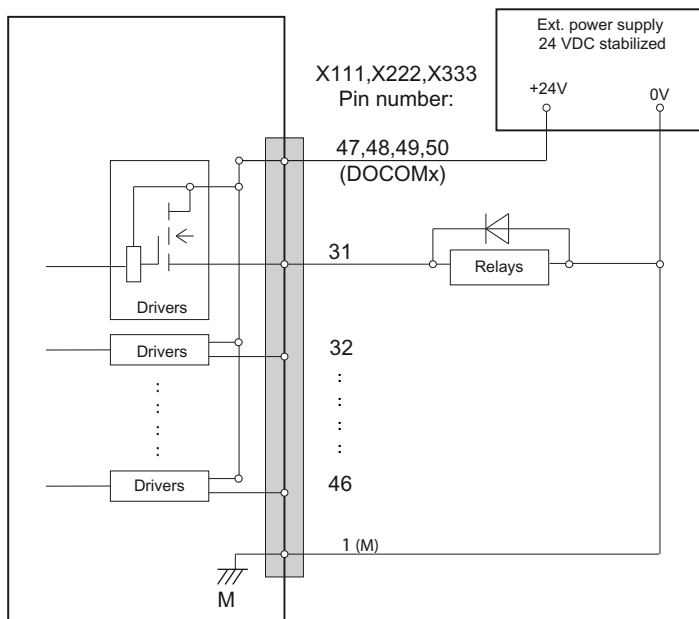


Figure 7-50 Terminal assignment for the digital outputs

NOTICE

Protection against short circuit

A max. current of $I_{out} = 0.25$ A at X111, X222, X333 where the demand factor is 100%: Pin 2 must not be exceeded.

Characteristics:

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

Technical data:

Table 7-91 Electrical specification of the digital outputs

Digital outputs	min.	Typical	max.	Nominal
High-level voltage (U_H)	$V_{CC} - 3 V$	¹⁾	V_{CC}	24 V
Output current I_{OUT}	--	--	250 mA ²⁾	--
Voltage with low level (U_L)	--	--	--	Output open
Leakage current at low level	--	50 μA	400 μA	--
Signal delay time T_{PHL}	--	0.5 ms	--	--
Maximum switching frequency				
Resistive load	--	--	100 Hz	--
Inductive load	--	--	2 Hz	--
Lamp	--	--	11 Hz	--
¹⁾ $U_{H_typical} = V_{CC} - I_{OUT} \times R_{ON}$ V_{CC} : Current operating voltage I_{OUT} : Output current Maximum short-circuit current: 4 A (max. 100 μs , $V_{CC} = 24 V$) R_{ON} : Maximum internal resistance = 0.4 Ω ²⁾ Where demand factor is 100% (all outputs active) Incorrect connection causes neither high level nor destruction of the outputs.				

7.7.3.6 Analog X3 inputs/outputs

Cable specification

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

Wiring analog inputs/outputs

Procedure:

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

NOTICE
<p>Shield contact</p> <p>If the analog inputs/outputs are wired, a shielded lead must be used. The shield must be supported.</p>

X3 pin assignment

Table 7-92 Pin assignment (standard)

Pin	Signal name	Signal type	Meaning
1	CO1	O	Channel 1 current output for PT100
2	CI1	I	Channel 1 current input for PT100
3	AI1+	I	Channel 1 analog input +
4	AI1-	I	Channel 1 analog input -
5	CO2	O	Channel 2 current output for PT100
6	CI2	I	Channel 2 current input for PT100
7	AI2+	I	Channel 2 analog input +
8	AI2-	I	Channel 2 analog input -
9	AO3+	O	Channel 3 current and voltage output +
10	AO3-	O	Channel 3 current and voltage output -
11	AO4+	O	Channel 4 current and voltage output +
12	AO4-	O	Channel 4 current and voltage output -

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

Analog inputs

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

Note

The analog inputs are only enabled following the parameter assignment.

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

Table 7-93 Technical specifications in the "voltage input" operating mode

Parameter	Value
Input range (rated value)	- 10 V to + 10 V
permitted overrange	- 11.75 V to + 11.75 V
Resolution	16 bits (including sign)
Accuracy	+/- 0.5%
Internal resistance Ri	100 KOhm

Table 7-94 Technical specifications in the "current input" operating mode

Parameter	Value
Input range (rated value)	- 20 mA to + 20 mA
Permitted overrange	- 23.5 mA to + 23.5 mA
Resolution	16 bits (including sign)
Accuracy	+/- 0.5%
Internal resistance Ri	133 ohm

Table 7-95 Technical data in the "PT100" operating mode

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

NOTICE**Protection from overvoltage**

If the PT100 operating mode is selected, the hardware is protected against overvoltage. The following mechanisms are triggered in the event of an error:

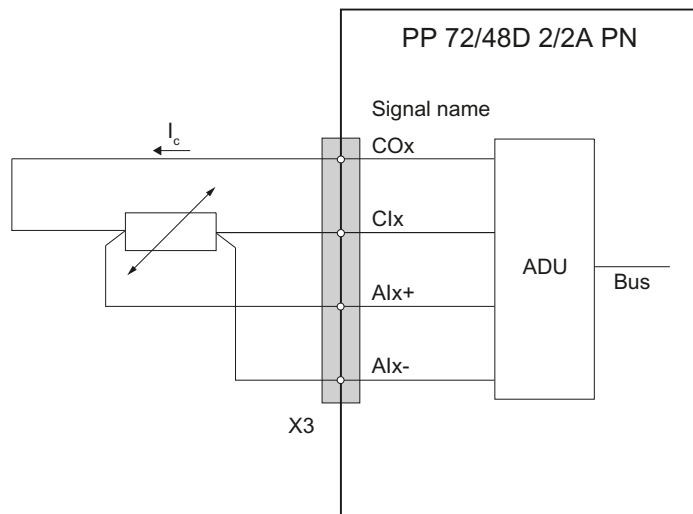
1. An error bit is set which is then communicated to the PLC.
2. The module is shut down.

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 7-51 PT100 pin assignment

Measurement using a 3-wire connection system

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

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

Note

Measuring accuracy

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

Analog outputs

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

Note

The analog outputs are only enabled following the parameter assignment.

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

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

Table 7-96 Technical specifications in the "voltage output" operating mode

Parameter	Value
Output range (rated value)	- 10 V to + 10 V
Permitted overrange	- 10.5 V to + 10.5 V
Resolution	16 bits (including sign)
Accuracy	+/- 0.5%
Max. load current	-3 mA to +3 mA

Table 7-97 Technical specifications in the "current output" operating mode

Parameter	Value
Output range (rated value)	- 20 mA to + 20 mA
Permitted overrange	- 20.2 mA to + 20.2 mA
Resolution	16 bits (including sign)
Accuracy	+/- 0.5%
Load impedance	≤ 600 ohm

7.7.4 Assigning parameters

7.7.4.1 Input / output images

Input image

The image comprises 3 slots (n, m, d $\hat{=}$ start address, see Addressing the I/O modules (Page 75)):

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

Table 7-98 Input image of digital inputs for the 1st I/O module (n=0)

Terminal	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
X111	n+0	Pin10 DI 0.7	Pin9 DI 0.6	Pin8 DI 0.5	Pin7 DI 0.4	Pin6 DI 0.3	Pin5 DI 0.2	Pin4 DI 0.1	Pin3 DI 0.0
	n+1	Pin18 DI 1.7	Pin17 DI 1.6	Pin16 DI 1.5	Pin15 DI 1.4	Pin14 DI 1.3	Pin13 DI 1.2	Pin12 DI 1.1	Pin11 DI 1.0

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

Table 7-99 Input image of analog inputs for the 1st I/O module (m=56)

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

Output image

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

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

Table 7-100 Output image of digital outputs for the 1st I/O module (n=0)

Terminal	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
X111	n+0	Pin38 DO 0.7	Pin37 DO 0.6	Pin36 DO 0.5	Pin35 DO 0.4	Pin34 DO 0.3	Pin33 DO 0.2	Pin32 DO 0.1	Pin31 DO 0.0
	n+1	Pin46 DO 1.7	Pin45 DO 1.6	Pin44 DO 1.5	Pin43 DO 1.4	Pin42 DO 1.3	Pin41 DO 1.2	Pin40 DO 1.1	Pin39 DO 1.0
X222	n+2	Pin38 DO 2.7	Pin37 DO 2.6	Pin36 DO 2.5	Pin35 DO 2.4	Pin34 DO 2.3	Pin33 DO 2.2	Pin32 DO 2.1	Pin31 DO 2.0
	n+3	Pin46 DO 3.7	Pin45 DO 3.6	Pin44 DO 3.5	Pin43 DO 3.4	Pin42 DO 3.3	Pin41 DO 3.2	Pin40 DO 3.1	Pin39 DO 3.0

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

Table 7-101 Output image of analog outputs for the 1st I/O module (m=56)

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

7.7.4.2 Diagnostics via input image

Table 7-102 Diagnostics input image

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

Table 7-103 Messages in byte 0

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

Note

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

Table 7-104 Overview of messages as a function of the "alive and well" counter

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

Table 7-105 Elimination of error at "alive and well" counter status "2"

Value byte 1	Cause	Effect	Remedy
1	In the temperature measurement operating mode, an input voltage is too high. The hardware may become damaged/ destroyed as a result.	The "PNFault" LED is activated. The outputs are disabled. ¹⁾ The value 0x80 is stored in Status Byte 1.	It is essential that a Pt100 element is connected to terminals 3-4 or 7-8. The module must be restarted with Power ON following elimination of the error.
2	Reserved	-	-
3	Overload at the outputs	The "PNFault" LED is activated. The outputs are disabled. ¹⁾ The value 0x80 is stored in Status Byte 1.	Check the loads at the analog output. The module must be restarted with Power ON following elimination of the error.
4	Incorrect operating mode selection, e.g. temperature measurement at the analog outputs.	Selection of operating mode is rejected,	If selected correctly, the module switches to cyclic operation.
5	Internal error, system error	The "PNFault" LED is activated. The outputs are disabled. ¹⁾ The value 0x80 is stored in Status Byte 1.	The firmware has detected a system error, this status can only be exited by means of a switch-on / switch-off.
6	Ovrange at the inputs		Check input circuit and adjust, if required.
7	Ovrange at the outputs		Correct values in the user program.

¹⁾ The analog outputs retain their last specified value.

Diagnostics via Status Bytes 0/1

In Status Byte 0, the set operating modes are reflected e.g. "0x55" if Control Byte 0 = 0x55 has been specified.

In the event of an error, the error bit is set in Status Byte 1 (bit 7). In the event of an error in one channel, **all** channels are disabled.

Table 7-106 Input image of analog inputs (excerpt)

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

7.7.4.3 Assigning parameters to the analog inputs / outputs

Operating mode

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

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

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

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

Type of control

The control type must be specified in the Analog Control Byte m+1 (bit 0), so that the 16 bit input and output values from and for the analog module are correctly interpreted by the control. In the SINUMERIK 828D control, the value "1" 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

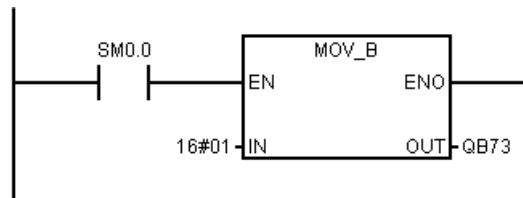
Operating mode 4th channel	Bit 7	Bit 6
No operating mode	0	0
Voltage output	0	1
Current output	1	0
Impermissible operating mode	1	1

Checkback signal of the operating modes

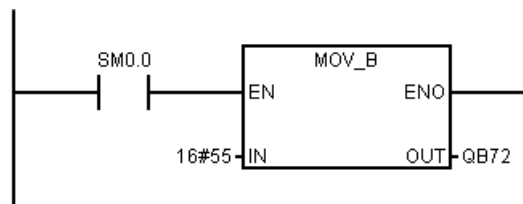
The set operating modes are saved in the input image in Status Byte 0. This value must be compared with Control Byte 0 in the output image. If these are different, an error has occurred, e. g. in the case of overvoltage in the "Temperature measurement" operating mode, see Diagnostics via input image (Page 205).

Examples of programming

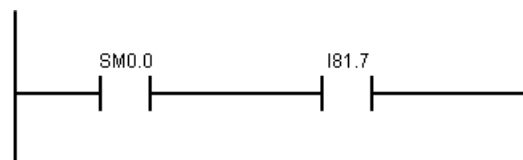
1. Determine control type:



2. Set the operating mode:



3. Query the error status bit in cyclic operation:



7.7.4.4 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):	0.00151947	0.003051758	0.1
Factor (AO):	0.000381469	0.0007629	-

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

Analog inputs

Table 7-107 Measured values in the voltage measurement operating mode

16 bit value (hex.)	16 bit value (dec.)	Factor	Voltage value [V]
Overflow		-	Deactivation
Overrange		-	Up to 11.75 V
0x19B5	6581	0.00151947	10 V
0x0CDA	3291		5 V
0x066D	1645		2.5 V
0x0000	0		0 V
0xF993	-1645		-2.5 V
0xF326	-3291		-5 V
0xE64B	-6581		-10 V
Underrange		-	Up to -11.75 V
Underflow		-	Deactivation

Table 7-108 Measured values in the current measurement operating mode

16 bit value (hex.)	16 bit value (dec.)	Factor	Current value [V]
Overflow		-	Deactivation
Overrange		-	Up to 23.5 mA
0x1999	6553	0.003051758	20 mA
0x0CCC	3277		10 mA
0x0000	0		0 mA
0xF333	-3277		-10 mA
0xE666	-6553		-20 mA
Underrange			-
Underflow		-	Deactivation

Table 7-109 Measured values in the "temperature measurement" operating mode

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

Note

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

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

Analog outputs

Table 7-110 Measured values in the "voltage output" operating mode

16 bit value (hex.)	16 bit value (dec.)	Factor	Voltage value [V]
Overflow		-	Deactivation
Overrange		-	Up to 10.5 V
0x6666	26214	0.000381469	10 V
0x4CD1	19665		7.5 V
0x199B	6555		2.5 V
0x0000	0		0 V
0xE665	-6555		-2.5 V
0xB32F	-19665		-7.5 V
0x999A	-26214		-10 V
Underrange			-
Underflow		-	Deactivation

Table 7-111 Measured values in the "current output" operating mode

16 bit value (hex.)	16 bit value (dec.)	Factor	Current value [V]
Overflow		-	Deactivation
Overrange		-	20.2 mA
0x6666	26214	0.0007629	20 mA
0x4CD1	19665		15 mA
0x199B	6555		5 mA
0x0000	0		0 mA
0xE665	-6555		-5 mA
0xB32F	-19665		-15 mA
0x999A	-26214		-20 mA
Underrange			-
Underflow		-	Deactivation

7.7.4.5 Examples

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

Table 7-112 Measured values and responses in the voltage measurement operating mode

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

Table 7-113 Measured values and responses in the current measurement operating mode

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

Table 7-114 Measured values and responses in the temperature measurement operating mode

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

7.7.5 Technical data

PP 72/48D 2/2A PN I/O module

Parameter	Value
Input voltage	24 V DC + 20% / - 15%
Power consumption at rated load (without digital outputs)	19 W
Power loss	18 W
Rated current	0.7 A
Shock load during transportation (in transportation packaging)	Free-fall \leq 1 m
Degree of protection in acc. with EN 60529	IP00
Protection class in acc. with EN 61800-5-1	III; DVC A (PELV)
Approvals	CE, cULus
Heat dissipation	Open-circuit ventilation
Condensation	Not permitted
Limits for relative humidity at 25 °C:	
• Storage	5 ... 95% without condensation
• Transportation	5 ... 95% without condensation
• Operation	5 ... 90% without condensation

7.8 NX10.3

Parameter	Value
Temperature limits:	
• Storage	-40 ... 70 °C
• Transportation	-40 ... 70 °C
• Operation	0 ... 55 °C
Dimensions:	
• Width	300 mm
• Height	150 mm
• Depth	35 mm
Weight, approx.	0.9 kg

7.8 NX10.3

7.8.1 Description

Properties

Using this module, you can expand the performance of an axis grouping of the SINUMERIK 828D CNC automation system. With an NX10.3 Numeric Control Extension, the PPU is able to control up to 8 axes.

Type plate

The NX10.3 module type plate contains the following basic information:

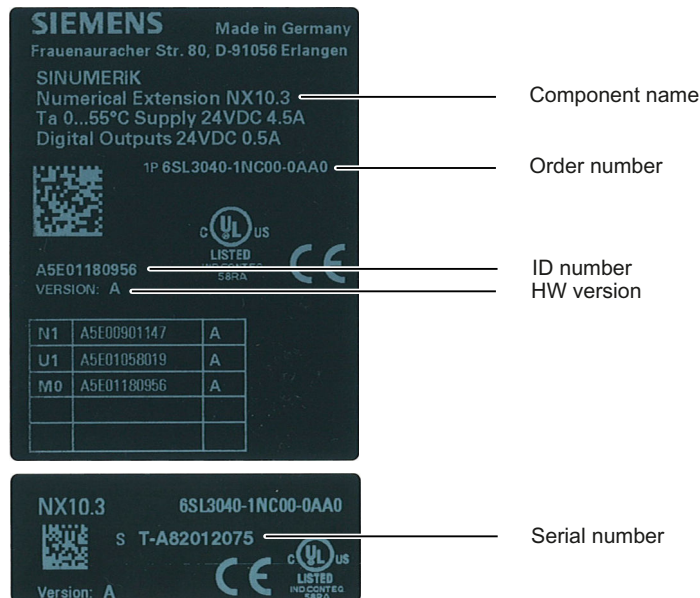


Figure 7-52 NX10.3 type plate

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 NX10.3 prior to assembly.

Illustration

The NX10.3 has the following interfaces:

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

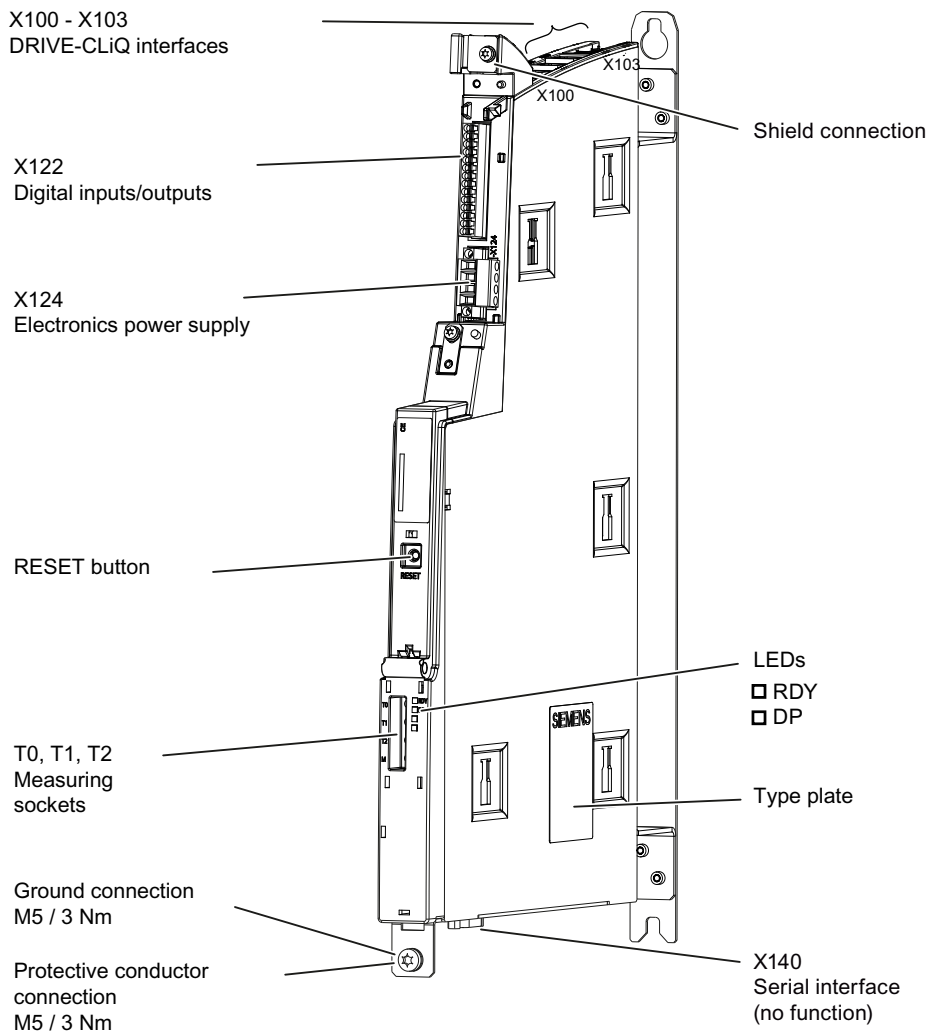


Figure 7-53 Illustration of the NX10.3 (without cover)

LEDs for status display

The following status displays on the NX10.3 provide information about the module state:

LEDs	Color	Status	Description
RDY	Off		Electronic power supply outside permissible tolerance range
	Green	Continuous light	NX10.3 is ready for operation.

LEDs	Color	Status	Description
	Red	Flashing 2 Hz	Writing to CompactFlash card
		Continuous light	NX10.3 is presently booting and at least one fault is pending (e.g. RESET, watchdog monitoring, basic system fault).
		Flashing 0.5 Hz	Boot error (e.g. firmware cannot be loaded into the RAM)
	Yellow	Continuous light	Firmware is being loaded into the RAM.
		Flashing 0.5 Hz	Firmware cannot be loaded into the RAM.
		Flashing 2 Hz	Firmware CRC fault
DP	Off		Electronics power supply outside permissible tolerance range: NX10.3 is not ready for operation.
	Green	Continuous light	CU_LINK is ready for communication and cyclic communication is running.
		Flashing 0.5 Hz	CU_LINK is ready for communication and cyclic communication is not running.
	Red	Continuous light	At least one CU_LINK fault is present. CU_LINK is not ready for operation (e.g. after switching on).

RESET button

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

Note

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

7.8.2 Mounting

Designs

The NX10.3 is integrated into the SINAMICS drive line-up. For the preferred installation sequence, the NX module should be mounted at the side of the Line Module.

NOTICE

Protection against overheating

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

Mounting aids

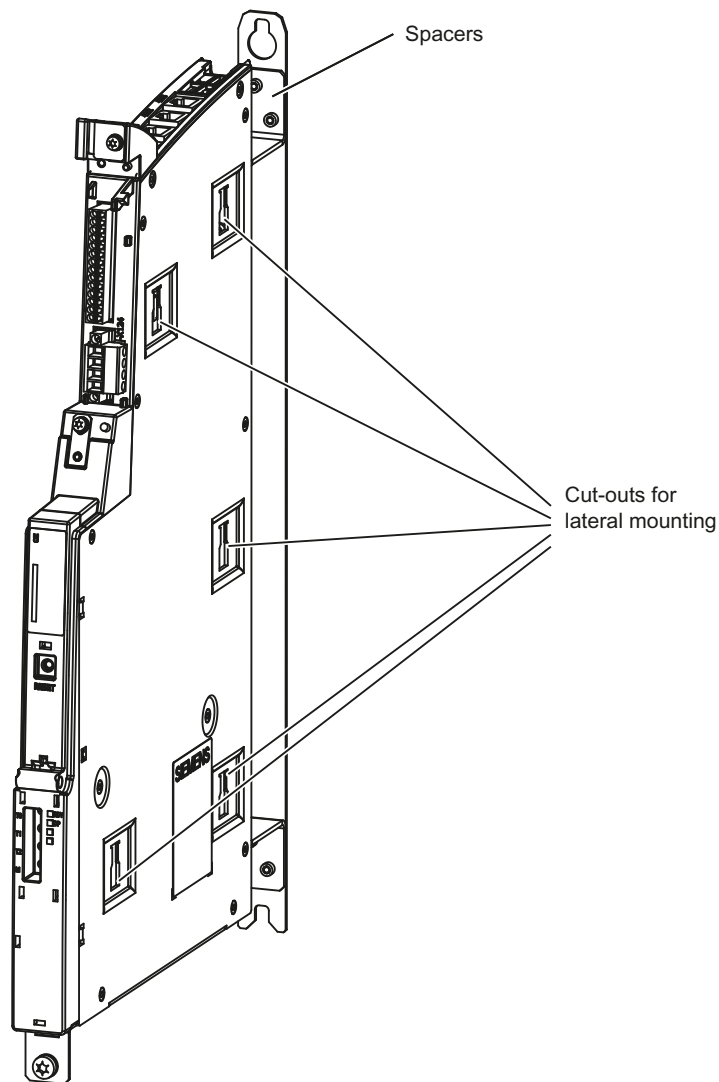


Figure 7-54 NX10.3 mounting aids

Mounting an NX10.3 on an Active Line Module

Procedure:

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

Dimension drawing

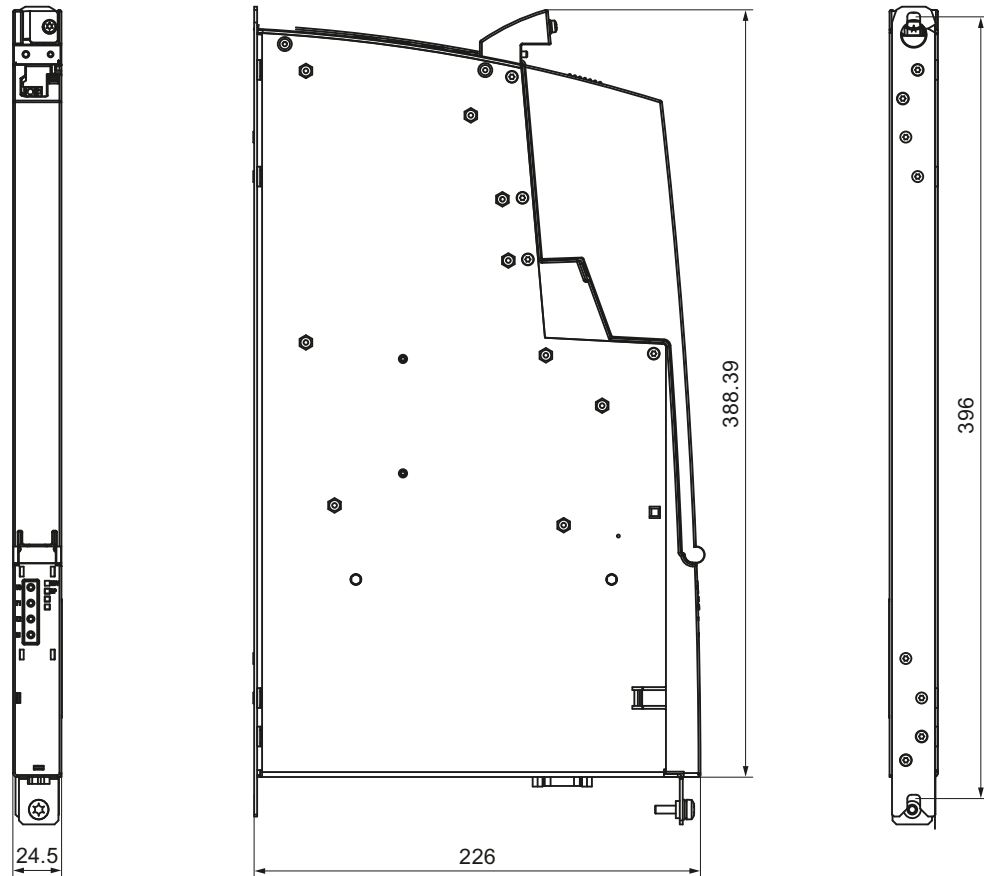


Figure 7-55 NX10.3 dimensions

7.8.3 Connecting

Power supply X124

Connector designation:	X124
Connector type:	Screw terminal 2
Max. connectable cross-section:	2.5 mm ²

Table 7-115 Pin assignment for X124

Pin	Signal name	Meaning
1	+	(Voltage input) Electronics power supply
2	+	(Voltage input) Electronics power supply
3	M	(Voltage output) Ground
4	M	(Voltage output) Ground

Note

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

Table 7-116 Technical data for X124

Parameter	Value
Voltage	24 V DC (20.4 V - 28.8 V)
Current consumption	max. 0.8 A (without load)
Max. current via the bridges in the connector	20 A at 55 °C

Note**Current consumption**

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

X122 digital inputs/outputs

Connector designation:	X122
Connector type:	Spring-loaded terminal 1
Max. connectable cross-section:	0.5 mm ²

Table 7-117 Pin assignment for X122

Pin	Signal name	Meaning
1	DI0	Digital input 0
2	DI1	Digital input 1
3	DI2	Digital input 2
4	DI3	Digital input 3
5	DI16	Digital input 16
6	DI17	Digital input 17
7	M1	Reference potential for terminals 1 to 6
8	M	Ground
9	DI/DO8	Digital input/output 8 (rapid input)

Pin	Signal name	Meaning
10	DI/DO9	Digital input/output 9 (rapid input)
11	M	Ground
12	DI/DO10	Digital input/output 10 (rapid input)
13	DI/DO11	Digital input/output 11 (rapid input)
14	M	Ground

An open input is interpreted as "low".

Note

Terminal M1 must be connected for the digital inputs (DI) 0 to 3 and 16/17 to function. This can be done as follows:

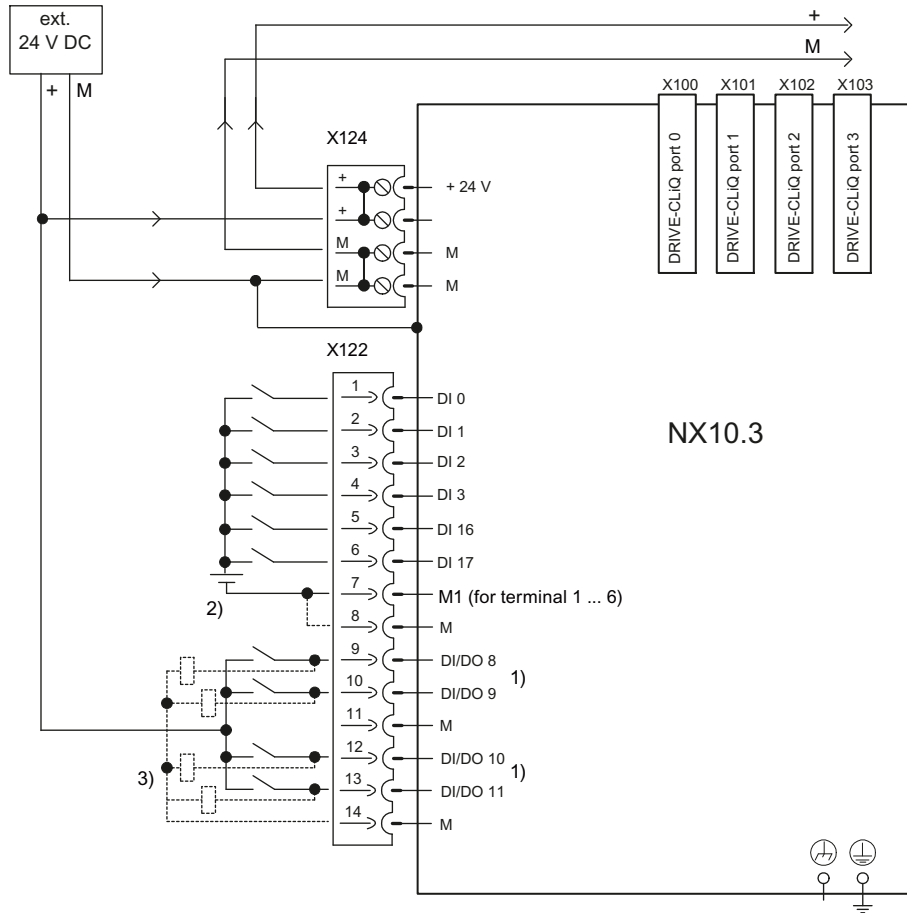
- Connect the ground reference of the digital inputs.
- Jumper to terminal M: This removes the electrical isolation for these digital inputs.

Table 7-118 Technical data for X122

Parameter	Value
Current consumption	Typical: 10 mA at 24 V DC
Galvanic isolation	The reference potential is terminal M1
As an input	
Voltage	-3 V to 30 V
Current consumption	Typical: 10 mA at 24 V DC
Signal level (including ripple)	High signal level: 15 V to 30 V Low signal level: -3 V to 5 V
Signal propagation times	Inputs / "fast inputs": L → H: approx. 50 µs/5 µs H → L: approx. 100 µs/50 µs
As an output	
Voltage	24 V DC
Max. load current	Per output: 500 mA continuous short circuit-proof

Connection example

When commissioning the system for the first time, the digital inputs/outputs are correspondingly preassigned.



- 1) Rapid inputs must be shielded.
- 2) Jumper open, electrical isolation for digital inputs (DI)
- 3) can be parameterized as either input or output

Figure 7-56 Connection example NX10.3

See also

For the pin assignment of the DRIVE-CLiQ interfaces X100 - X103, please refer to Chapter "DRIVE-CLiQ (Page 84)".

For further information on DC voltage and standards, please see Chapter "Power supply connection (Page 69)".

7.8.4 Technical Data

Technical specifications NX10.3

Parameter	Value
Input voltage	24 VDC
• permissible range:	DC 20.4 V - 28.8 V
Current (without DRIVE-CLiQ and digital outputs)	0.8 A
Digital inputs	6
Digital inputs/outputs	4 (parameterizable)
Inrush current	1.6 A
PE/ground connection	On housing with M5/3 Nm screw
Heat dissipation	Open-circuit ventilation
Pollution degree in acc. with EN 61800-5-1	2
Protection class in acc. with EN 61800-5-1	III (DVC A, PELV)
Degree of protection in acc. with EN 60529	IP20
Approvals	cULus
Mounting position	Vertical
Dimensions:	
• Width	25 mm
• Height	414 mm
• Depth	272 mm
Weight, approx.	2.58 kg

Technical data

PPU

Parameter	Value
Input voltage	24 VDC + 20% / - 15%
Power consumption, max.	60 W
Power loss	28 W
Heat dissipation	Open-circuit ventilation
Degree of protection in acc. with EN 60529	IP65 (with closed front cover) IP20 (rear)
Protection class in acc. with EN 61800-5-1	III (DVC A, PELV)
Pollution degree in acc. with EN 61800-5-1	2
Approvals	CE / cULus
Classification:	
• Operation	3M1 in acc. with EN 60721-3-3
• Transportation (in transportation packaging)	2M3 in acc. with EN 60721-3-2 1M2 in acc. with EN 60721-3-1
• Storage (in transport packaging)	
Mounting position	Vertical
Dimensions:	PPU vertical: PPU horizontal:
• Width	• 310 mm • 483 mm
• Height	• 380 mm • 220 mm
• Depth	• 105 mm • 105 mm
Weight, approx.	4.5 kg

See also

Further technical data for the PPU can be found in the following sections:

- Transport and Storage Conditions (Page 39)
- Operating Conditions (Page 40)
- Requirements for the power supply (Page 69)

Digital inputs/outputs:

- Technical data (Page 83)

Spare parts and accessories

9.1 SINAUT modem

Description

The SINUMERIK 828D can be equipped with a SINAUT MD720-3 GSM modem. This optional hardware module makes it possible to exchange SMS messages with a cell phone on the basis of the GSM standard.

In addition to error messages, it is also possible to transmit operating states such as the machining processing level, tool wear limits or measuring process results. Using operating screens, it is very easy to assign specific information to specific cell phones.

Please ensure that the antenna required for data transmission (supplied by the manufacturer) is suitably located on the machine to achieve the best transmission/receiving conditions. Connection to the SINUMERIK 828D uses an RS232 modem cable. Please note that optimum transmission quality can only be guaranteed if the cable is no more than 3 m long.

A SIM card is not included in the GSM modem scope of delivery. The users have to choose their own cell phone contract.

Note

The SINAUT MD720-3 has two different operating modes. Only the terminal mode is used with the SINUMERIK 828D.

Mounting

The SINAUT MD720-3 is intended for installation on DIN rails complying with DIN EN 50022. There is a suitable fastener on the rear of the device.

Interfaces

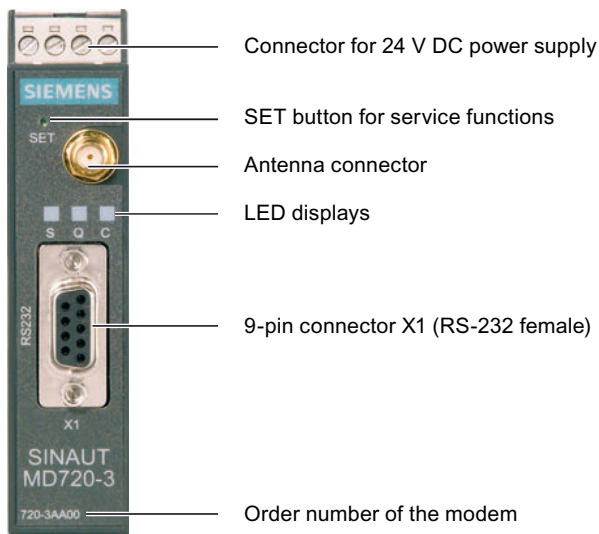


Figure 9-1 SINAUT MD720-3 interfaces

The following figure shows the standard way in which the GSM modem is connected to a PPU.

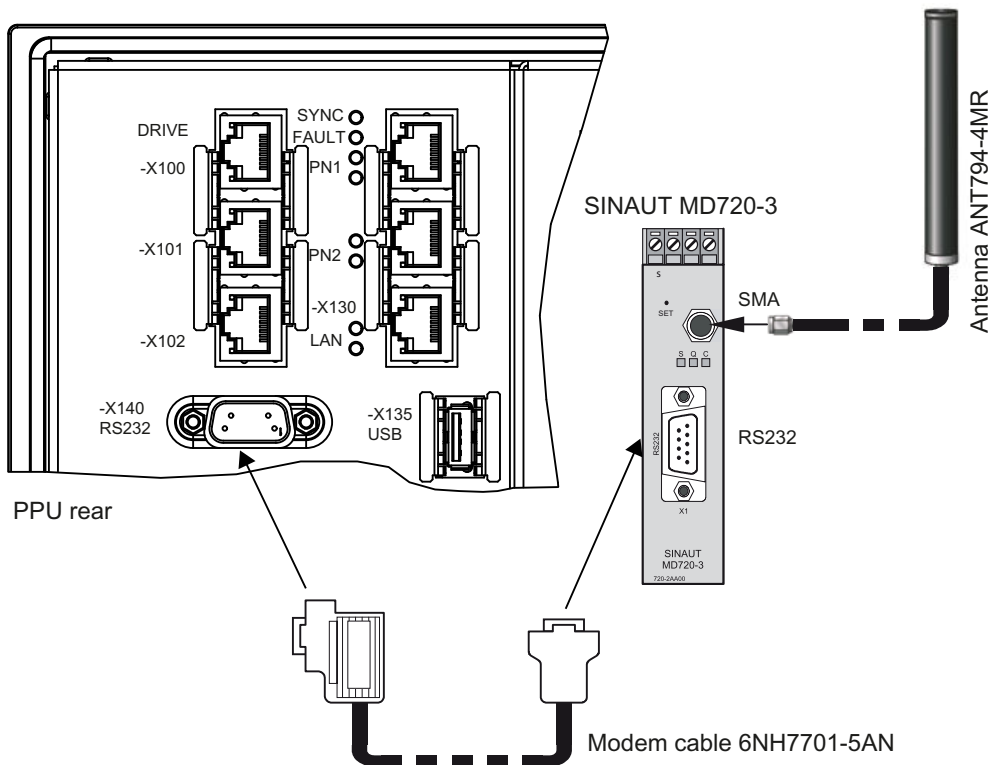


Figure 9-2 Connecting SINAUT MD720-3 to the PPU

Additional references

Further information on the GSM modem can be found in the following books included on the enclosed product CD:

- "SIMATIC NET GPRS/GSM modem SINAUT MD720-3" system manual:
 - Inserting the SIM card
 - Connecting the device and starting up
 - Service functions
- "SIMATIC NET Quad-Band GSM Antenna SINAUT 794-4MR" Operating Instructions: Mounting the antenna

9.2 PN/PN coupler

9.2.1 Principle of operation

Application

The PN/PN coupler is used to link two Ethernet subnets with one another and to exchange data. The maximum size of the data that can be transferred is 16-byte input data and 16-byte output data.

As a device, the PN/PN coupler has two PROFINET interfaces, each of which is linked to a subnet. During configuring, two I/O devices are made from this one PN/PN coupler; this means that there is one I/O device for each station with its own subnet. The other part of PN/PN coupler is called the coupling partner. Once configuring has been completed, the two parts are merged.

Example

The following example shows that the two networks are independent of one another. This means that for each PROFINET IO network you assign dedicated device names.

In the following diagram, these are the device names "Subnet1" in network 1 and "Subnet2" in network 2.

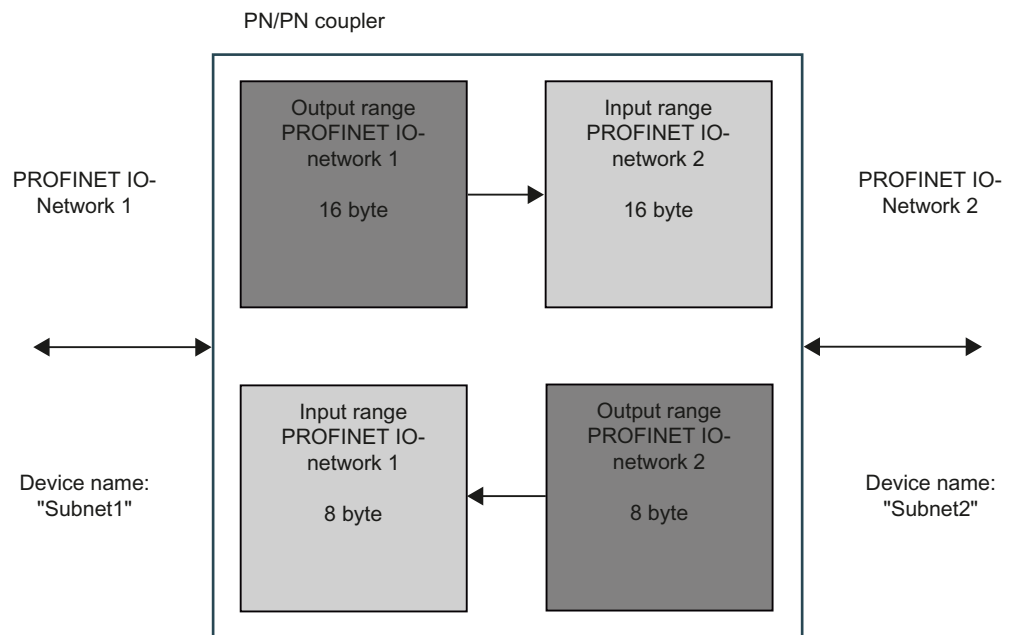


Figure 9-3 Principal mode of operation of the PN/PN coupler (example)

References

SIMATIC bus couplings PN/PN coupler Hardware Installation and Operating Manual

9.2.2 Configuration

Requirements

Please observe the following preconditions when configuring:

- For SINUMERIK 828D, the "PN-PN-Coupler20" name is already permanently defined; as a consequence, the name must be exactly the same in the connected subnet.
- The PN/PN coupler has the IP address 192.168.214.20 (permanently set).
- The I/O address area is 16 bytes from 96 ...111 (index m).
- SINUMERIK 828D must be connected to the PROFINET interface X1.

Note**Tools for configuring and analyzing PROFINET components**

To configure and analyze PROFINET components, Siemens Automation and Drives Service & Support provides the following tools at no cost:

- Primary Setup Tool (PST)
Using the Primary Setup Tool (PST), you can configure PROFINET components, e.g. you can allocate the PN/PN coupler a device name.
You can find this tool in the Internet at the following address: (<http://support.automation.siemens.com/WW/view/en/19440762>)
- PRONETA
PRONETA (PROFINET network analysis) is a PC tool to analyze PROFINET networks.
You can find this tool in the Internet under the following address: (<http://support.automation.siemens.com/WW/view/en/67460624>)

Configuration

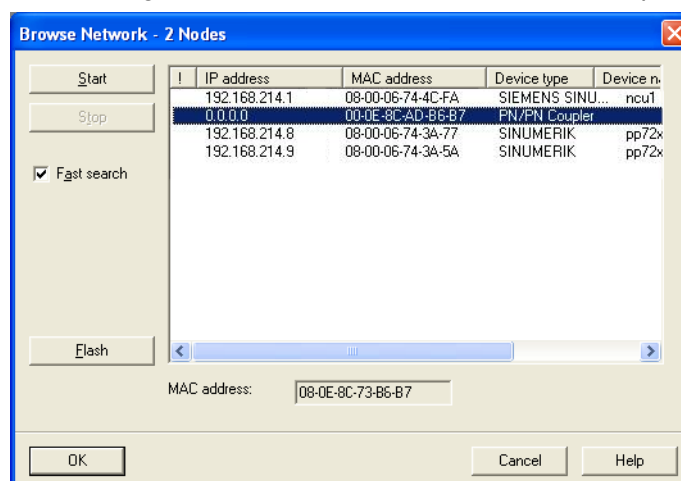
The device name must be defined in the following cases:

- When commissioning for the first time
- When a device is replaced

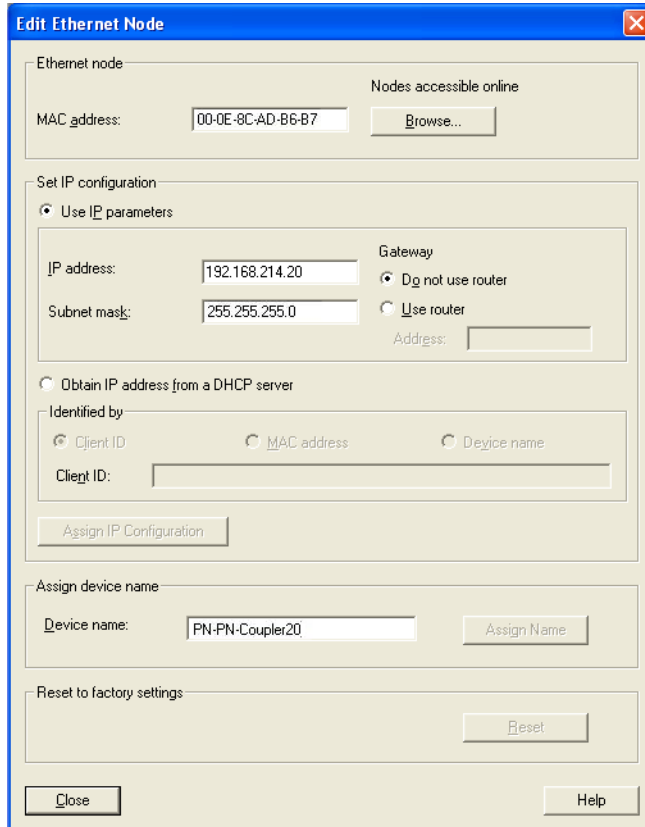
The PC must be connected using a crossover cable with, e.g. X2 at the PN/PN coupler.

Procedure:

1. Under "Tools" select → "Set PG/PC interface" → "TCP/IP" → "Intel(R) PRO/100 VM".
2. Under "Target system" select → "Edit Ethernet nodes ...".
3. In the dialog window "Edit Ethernet Nodes", press the "Search..." button under "Nodes that can be accessed online".
4. In the dialog window "Search Network" select the coupler and press "OK".



5. Enter the IP address in the "Edit Ethernet Node" dialog.
6. Enter "PN-PN Coupler20" as a device name: This designation is mandatory so that the device will be detected.



See also

Addressing the I/O modules (Page 75)

9.3 SENTRON PAC3200/PAC4200

Description



Figure 9-4 SENTRON PAC3200

The SENTRON PAC measuring devices ensure precise, reproducible and reliable measurement of energy values for infeed, outgoing feeders or individual loads. They not only supply comprehensive information about your electrical installation and power distribution system, but also provide important measured values to help you assess the status of your system and the power quality. For further processing of the measurement data, the devices are equipped with a wide range of communication options for easy integration into higher-level automation and power management systems.

They can be used for both single-phase and multi-phase measurements in 3- and 4-conductor power supply systems (TN, TT, IT).

You require a PAC PROFINET expansion module, article number 7KM 9300-0AE00-0AA0, for the communication between the PPU and the SENTRON PAC.

Further information concerning the operation and the commissioning of the SENTRON PAC is available in the Ctrl-Energy system manual.

Article numbers

- SENTRON PAC3200: 7KM2112-0BA00-3AA0
- SENTRON PAC4200: 7KM4212-0BA00-3AA0

Technical data

Parameter	Value	
	SENTRON PAC3200	SENTRON PAC4200
Suitable for TN, TT and IT systems	✓	✓
Continuous signal acquisition	✓	✓

9.3 SENTRON PAC3200/PAC4200

Parameter	Value	
	SENTRON PAC3200	SENTRON PAC4200
Measuring inputs for voltage 3 AC; UL-L/UL-N; CAT III	Max. 690 V / 400 V	
• Wide-range power supply	95 to 240 VAC 50/60 Hz ±10% 110 to 340 VDC ±10%	
Measuring inputs for voltage 3 AC; UL-L/UL-N; CAT III	Max. 500 V / 289 V	
• Low-voltage power supply	22 to 65 VDC; ±10%	
Measurement at voltage transformers for voltages > 500 V / 690 V	✓	✓
Measuring inputs for current 3 AC; CAT III	x/1 A or x/5 A	
Current direction programmable	✓	✓ per phase
Measurement using current transformers	✓	✓
Dimensions (W x H x D)	96 x 96 x 56 mm	96 x 96 x 82 mm
Overall depth		
• Without module	51 mm	77 mm
• With module	73 mm	99 mm
Protection class	II	
Degree of protection at front	IP65	
Slots for expansion modules	1	2
Operating temperature	-10 to +55° C	
Relative humidity in operation at 25° C without condensation	95 %	
Degree of contamination	2	
Approvals	CE, cULus, C-Tick, GOST	CE, cULus, GOST

Further information

You can find additional information on the Internet at:

- SENTRON PAC3200 (<http://support.automation.siemens.com/WW/view/de/25240652>)
- SENTRON PAC4200 (<http://support.automation.siemens.com/WW/view/de/31675630>)

9.4 SITOP power supply

Description



Figure 9-5 SITOP PSU100S

The 24 V power supply units from the SITOP range are optimized for industrial use and operate on the switched-mode principle. Due to the precisely regulated output voltage, the devices are even suitable for the connection of sensitive sensors. Different versions are available depending on the output current and field of application. Some versions are listed in the table below.

SITOP lite/smart does not require much space on the standard mounting rail. With its tolerant overload response, even loads with a high inrush current can be smoothly switched on. If required, 50% extra power is made available for 5 seconds.

Selection and ordering data

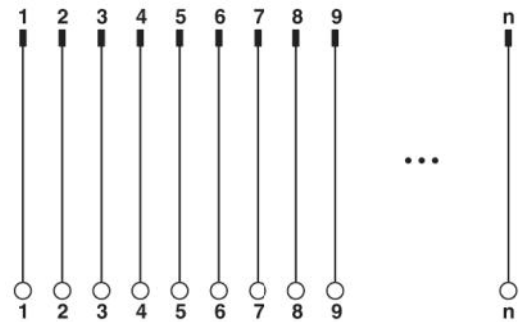
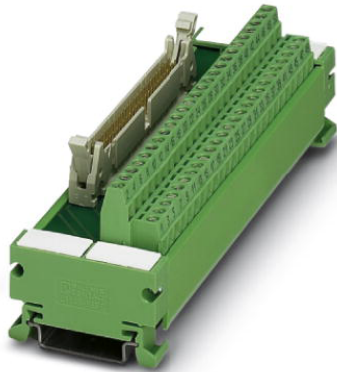
Description	Article number
Stabilized power supply SITOP lite 10 A 24 VDC, 1-phase	6EP1334-1LB00
Stabilized power supply SITOP smart 10 A 24 VDC, 1-phase	6EP1334-2BA01
Stabilized power supply PSU100S 20 A 24 VDC, 1-phase	6EP1336-2BA10
Stabilized power supply PSU300S 10 A 24 VDC, 3-phase	6EP1434-2BA10
Stabilized power supply PSU300S 20 A 24 VDC, 3-phase	6EP1436-2BA10

Further information

You can find additional information on the Internet at SITOP power supply (<http://support.automation.siemens.com/WW/view/de/10807212>)

9.5 Terminal strip converter

Terminal strip converter



Article number: 6EP5406-5AA00

1: 1 interconnection

Technical data

Parameter	Values
Rated voltage V_N	24 V AC
	60 V DC
Max. current carrying capacity per branch	1 A
Number of poles	50
Pollution degree in acc. with EN 61800-5-1	2
Protection class in acc. with EN 61800-5-1	II
Applicable standards	IEC 60664
	DIN VDE 0110
Ambient temperature:	
• Operation	-20 ... 55°C
• Storage/transport	-40 ... 70°C
Mounting position	Any
Dimensions:	
• Width	151 mm
• Height	50 mm
• Depth	40 mm
Weight, approx.	0.15 kg

Appendix

A.1 Abbreviations

ALM	Active Line Module
ASIC	Application Specific Integrated Circuit
AWG	American Wire Gauge
BERO	Proximity limit switch
CAT5	Quality class (category) for shielded twisted pair network cables. Class 5 states that these cables have a particularly low damping factor, making them suitable for 100 Mbit/s-FastEthernet networks.
CE	The CE marking (Conformité Européenne, which means "compliance with EU directives") for products is a marking according to EU law in relation to product safety.
CNC	Computerized Numerical Control Computerized numerical control
CRC	Cyclic redundancy check: Checksummenprüfung
cULus	Approval (see CE) for Canada and USA (UL = Underwriters Laboratories)
DIN	Deutsche Industrie Norm (German Industry Standard)
DIP	Dual In-Line Package: Dual in-line arrangement
DMC	DRIVE-CLiQ Hub Module
DP	Distributed I/O
DRAM	Dynamic Random Access Memory
DRIVE-CLiQ	Drive Component Link with IQ
EMC	Electromagnetic compatibility
EN	European standard
ESD	Electro-Static Discharge: elektrostatische Entladung
GSM	Global System for Mobile Communications: Worldwide standard for wireless transmission of voice, data, fax and text messages (SMS).
LEDs	Light-emitting diode light-emitting-diode display
MAC	Media Access Control
MCP	Machine control panel: Machine control panel
MLFB	Machine-Readable Product Code
MPI	Multi-Point Interface Multi-point interface
N.C.	Not connected: Connection unassigned
NCK	Numerical Control Kernel: NC kernel with block preparation, traversing range, etc.
NX	Numerical eXtension (axis extension module)
OLP	Optical Link Plug: Fiber-optic bus connector
OP	Operator Panel : Operator panel front
PCU	PC Unit: Computer unit
PG	Programming device
PLC	Programmable Logic Control: Programmable logic control (component of the CNC controller)
PN	PROFINET

Appendix

A.1 Abbreviations

QWERTY	keyboard assignment: American keyboard layout, the first six letters in the top row of letters, read from left to right.
RAM	Random Access Memory: Program memory which can be read and written into
SI	Safety Integrated
SLM	Smart Line Module
SMC	Cabinet-mounted sensor modules
SME	Sensor Module External
S/R	Steps per revolution: Pulses per revolution
SRAM	Static Random Access Memory: Static memory (battery-backed)
NV SRAM	Non-Volatile Static Random Access Memory: Non-volatile memory
USB	Universal Serial Bus: Bus system for connecting additional devices to a computer
VDE	Association of Electrical Engineering, Electronics and Information Technology (Germany)

A.2 Documentation overview SINUMERIK 828D

General Documentation



Catalog NC 82



Sales Brochure
SINUMERIK 828D



Sales Brochure
SINUMERIK 828D BASIC T
SINUMERIK 828D BASIC M

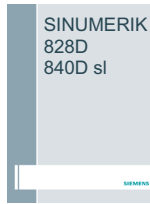


Sales Brochure
SINUMERIK 828D

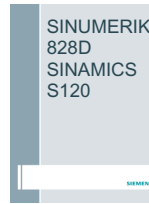
User documentation



Operating Manual
Technology-specific



Programming Manual
- Fundamentals
- Job planning
- Measuring cycles
- ISO Rotate
- ISO Milling



Diagnostics Manual

Manufacturer/service documentation



Manual
Commissioning Manual
Service Manual



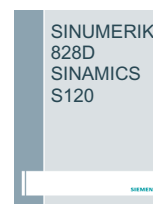
Function Manual
- Safety Integrated



Function Manual
- Basic functions
- Expansion functions
- Special functions
- Synchronized actions
- ISO dialects



List Manual
- Machine data
- Interface signals
- Variables



List Manual
- Parameters

Manufacturer/service documentation



System Manual
- Ctrl-Energy



Configuration Manual
- EMC Installation Guideline

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