

SIEMENS

SINUMERIK

SINUMERIK 828D PPU

Manual

Valid for:
SINUMERIK 828D
PPU 24x.2 BASIC T
PPU 24x.2 BASIC M
PPU 26x.2
PPU 28x.2

02/2012

6FC5397-2DP40-3BA0

Preface

Safety notes

1

System description

2

Application planning

3

Installing

4

Rules for permitted
topologies

5

Interface description

6

Connectable components

7

Technical data

8

Appendix

A

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
--

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

CAUTION

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

NOTICE

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

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

Qualified Personnel

The 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 (www.siemens.com/automation/service&support).

Enter as search term the number **15257461** or contact your local Siemens office.

Table of contents

	Preface	3
1	Safety notes.....	9
1.1	Danger notices	9
1.2	ESD notices	11
2	System description	13
2.1	Controller features	13
2.2	System versions, BASIC T and BASIC M.....	16
2.3	System versions horizontal and vertical	18
2.4	Operator controls and display elements	20
2.5	Type plate	22
2.6	System overview	24
2.7	Connectable components	26
2.8	Ordering data	27
2.9	CompactFlash Cards	29
2.9.1	CompactFlash card system	29
2.9.2	Inserting the system CompactFlash Card.....	30
2.9.3	CompactFlash card for user data.....	32
3	Application planning.....	35
3.1	Secondary electrical conditions	35
3.1.1	Protective Separation as per EN 61800-5-1	35
3.1.2	Grounding concept.....	35
3.1.3	RI suppression measures	37
3.2	Climatic and mechanical environmental conditions	39
3.2.1	Ambient conditions.....	39
3.2.2	Transport and Storage Conditions	39
3.2.3	Operating Conditions	40
3.3	Recycling and disposal	42
4	Installing	43
4.1	Mounting positions	44
4.2	Dimension drawings.....	50
5	Rules for permitted topologies	53
5.1	Topology rules for S120 Combi	53
5.2	Topology rules for S120 Booksize	55
5.3	Topology rules for Safety Integrated functions	59

5.4	Topology example without Safety Integrated functions	60
5.5	Topology example with Safety Integrated functions	63
6	Interface description	67
6.1	Interface overview	67
6.2	Power supply connection	69
6.2.1	Requirements for the power supply	69
6.2.2	Connecting the power supply	71
6.3	Ethernet.....	72
6.4	PLC I/O Interface based on PROFINET	74
6.4.1	Addressing the I/O modules.....	77
6.5	Digital inputs/outputs.....	78
6.5.1	Terminal connection diagram.....	82
6.5.2	Example: Connecting an inductive proximity switch (BEROs).....	83
6.5.3	Technical data.....	84
6.6	DRIVE-CLiQ.....	86
6.6.1	DRIVE-CLiQ interface.....	86
6.6.2	SINAMICS components	88
6.7	Handwheel	89
6.8	USB.....	90
6.9	RS 232 serial interface.....	91
7	Connectable components	93
7.1	MCP 483C PN.....	93
7.1.1	Operator controls and display elements	94
7.1.2	Mounting.....	97
7.1.3	Connecting	98
7.1.3.1	Connection	98
7.1.3.2	Description	99
7.1.4	Parameterization	104
7.1.5	Technical data.....	107
7.1.6	Spare parts and accessories	108
7.2	MCP 310C PN.....	111
7.2.1	Operator controls and display elements	112
7.2.2	Mounting.....	115
7.2.3	Connecting	117
7.2.3.1	Description	118
7.2.4	Parameterization	122
7.2.5	Technical data.....	124
7.2.6	Spare parts and accessories	125
7.3	Mini handheld unit.....	129
7.3.1	Operator controls	130
7.3.2	Mounting.....	132
7.3.3	Connecting	133
7.3.4	Parameterization	137
7.3.5	Technical data.....	138
7.3.6	Spare parts and accessories	139

7.4	PP 72/48D PN.....	140
7.4.1	Description	140
7.4.2	Mounting	143
7.4.3	Connecting	145
7.4.3.1	X1 power supply	146
7.4.3.2	X2 PROFINET.....	147
7.4.3.3	X111, X222 and X333 pin assignment	149
7.4.3.4	Specification of the digital inputs.....	152
7.4.3.5	Specification of the digital outputs	153
7.4.4	Parameter assignment.....	155
7.4.4.1	Input / output images	155
7.4.4.2	Diagnostics via input image	157
7.4.5	Technical data.....	159
7.5	PP 72/48D 2/2A PN	160
7.5.1	Description	160
7.5.2	Assembling.....	163
7.5.3	Connection	165
7.5.3.1	X1 power supply	166
7.5.3.2	X2 PROFINET.....	168
7.5.3.3	X111, X222 and X333 pin assignment	170
7.5.3.4	Specification of the digital inputs.....	173
7.5.3.5	Specification of the digital outputs	174
7.5.3.6	Analog X3 inputs/outputs	175
7.5.4	Assigning parameters	180
7.5.4.1	Input / output images	180
7.5.4.2	Diagnostics via input image	182
7.5.4.3	Assigning parameters to the analog inputs / outputs.....	184
7.5.4.4	Analog value representation	186
7.5.4.5	Examples	189
7.5.5	Technical data.....	190
7.6	NX10.3	192
7.6.1	Description	192
7.6.2	Mounting	194
7.6.3	Connecting	197
7.6.4	Technical Data	200
7.7	PN/PN coupler	201
7.7.1	Principle of operation	201
7.7.2	Configuration.....	202
7.8	GSM modem	204
7.9	Terminal strip converter	207
8	Technical data	209
A	Appendix.....	211
A.1	Abbreviations	211
A.2	Overview	213
	Index.....	215

Safety notes

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

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

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

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

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

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

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

DANGER

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

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

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

Only 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.

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.

 DANGER

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

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

EMERGENCY STOP/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.

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).

 DANGER

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.

1.2 ESD notices

CAUTION

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

NOTICE

Handling ESD modules:

- When handling electrostatically sensitive devices, make sure that operator, workplace and packing material are properly grounded.
- Generally, electronic modules must not be touched unless work has to be carried out on them. When handling 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 one 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 and PPU 26x as well as PPU 24x in the versions: BASIC T and BASIC M.
- 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 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.
- Two connectable handwheels.
- 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 Steps 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.

Controller versions

The SINUMERIK 828D is available in different versions (horizontal or vertical; turning or milling) as well as with different performance levels.

For the PPU 24x.2 a distinction is made between the turning and milling versions. When booting, the preconfigured technology-specific system software automatically scales itself as a result of the hardware that is found. As a consequence, e.g. a PPU 24x.2 BASIC T cannot be used for milling.

The SINUMERIK 828D is available in the following versions:

- PPU 240.2 BASIC T (vertical operator panel)
- PPU 240.2 BASIC M (vertical operator panel)
- PPU 241.2 BASIC T (horizontal operator panel)
- PPU 241.2 BASIC M (horizontal operator panel)
- PPU 260.2 (vertical operator panel)
- PPU 261.2 (horizontal operator panel)
- PPU 280.2 (vertical operator panel)
- PPU 281.2 (horizontal operator panel)

Performance

The following table shows the difference between the different versions based on characteristic technical data/features:

Function	PPU 240.2 / 241.2		PPU 260.2 / 261.2		PPU 280.2 / 281.2	
	BASIC T	BASIC M	Turning	Milling	Turning	Milling
Non-volatile memory (NVRAM):						
• For OEM data	512 KB	512 KB	512 KB	512 KB	512 KB	512 KB
• For user data	1 MB	1 MB	3 MB	3 MB	5 MB	5 MB
Number of DRIVE-CLiQ interfaces	3	3	3	3	3	3
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
Maximum number of I/O modules (digital/analog)	3	3	4	4	5	5
IPO cycle for maximum configuration	9 ms	9 ms	6 ms	6 ms	6 ms	3 ms
Minimum block change time	~9 ms	~9 ms	~6 ms	~6 ms	~6 ms	~3 ms
Position-control cycle	3 ms	3 ms	3 ms	3 ms	1.5 ms	3 ms
PLC cycle time	9 ms	9 ms	6 ms	6 ms	6 ms	3 ms
Reaction time to process interrupts (terminal to terminal)	7.5 ms	7.5 ms	7.5 ms	7.5 ms	7.5 ms	7.5 ms
Speed/current controller cycle	125 µs	125 µs	125 µs	125 µs	125 µs	125 µs
Reduced speed/current controller cycle (see note)	--	--	--	62.5 µs	--	62.5 µs

Note

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

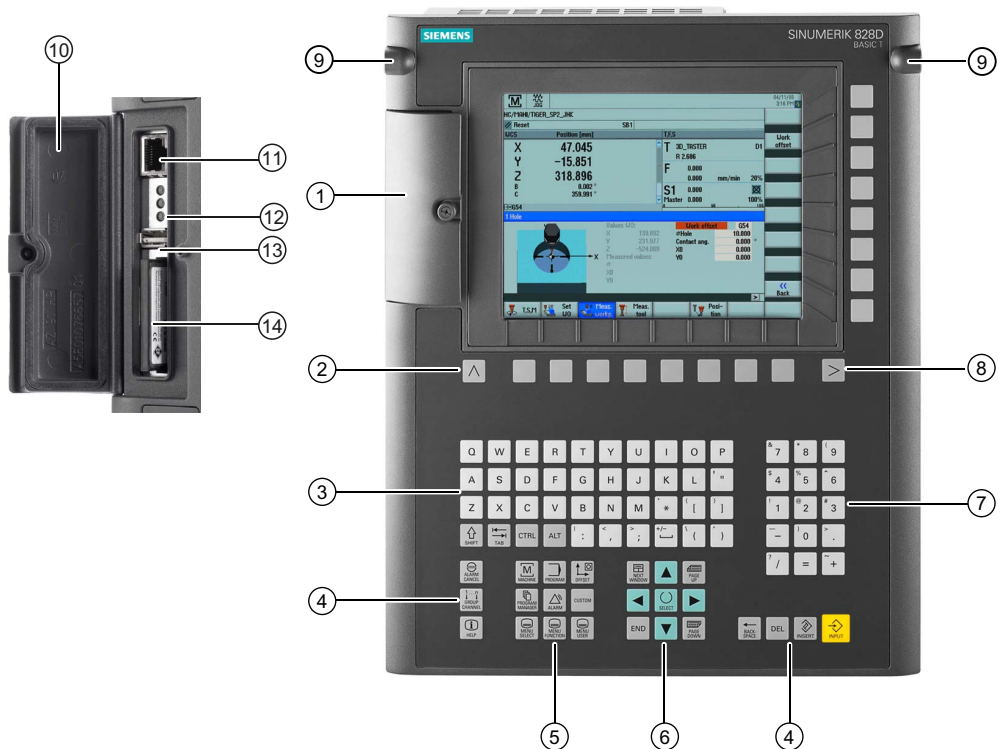
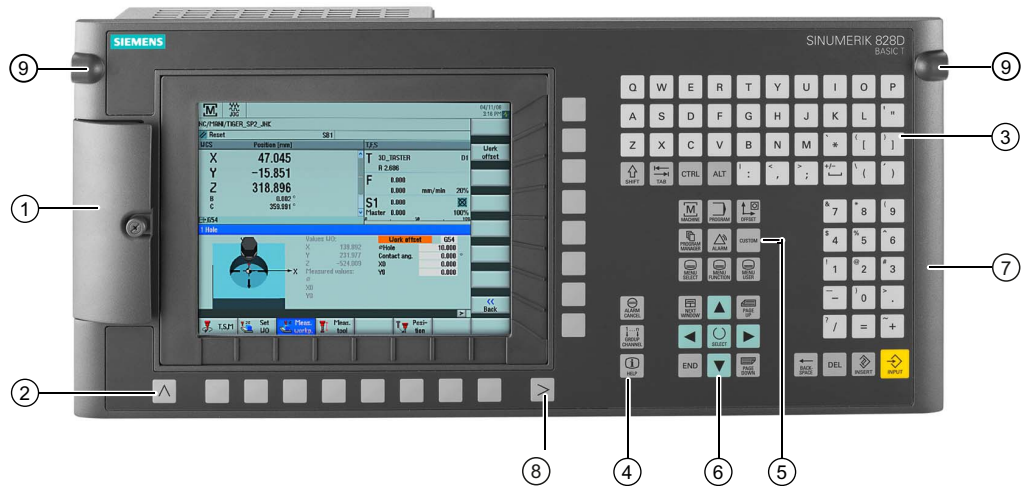
- The maximum number of axes can be increased to eight, six of which can be connected to the PPU and two to the NX10.3.
- A high-speed spindle (e.g. 24,000 rpm with four pole pairs) can be connected to the NX10.3 (62.5 µs) and five axes to the PPU (125 µs).

For the reduced speed/current controller cycle, in accordance with Topology Rules (Page 63), the following apply:

- Max. number of axes = 5 for mixed operation 4 x 125 µs and 1 x 62.5 µs
- Max. number of axes = 6 with NX10.3

2.2 System versions, BASIC T and BASIC M

Front panel of the SINUMERIK 828D BASIC T with interfaces

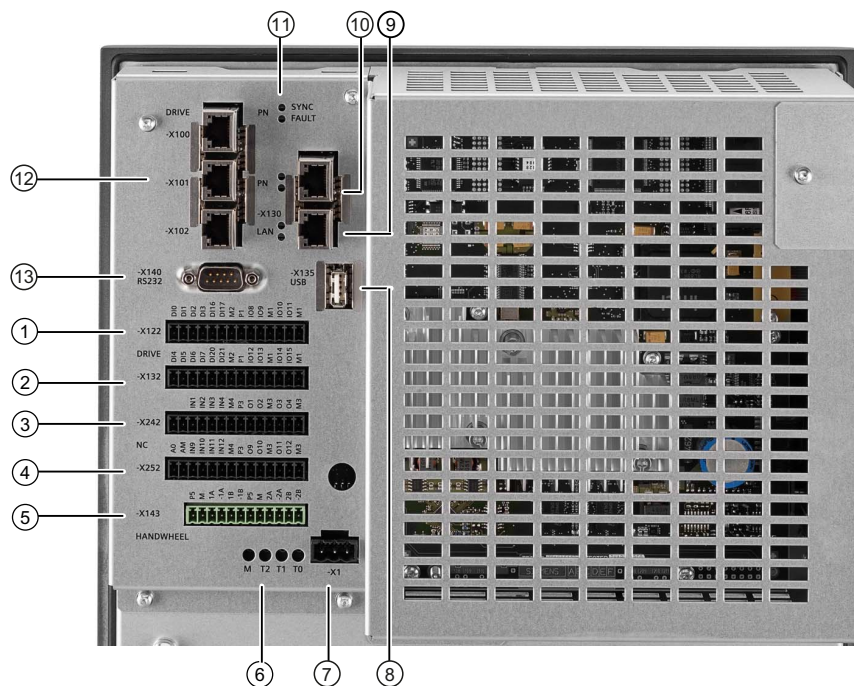


- ① ⑩ Protective cover for user interfaces
- ② Menu back key
- ③ Alphabetic key group
- ④ Control key group
- ⑤ Hotkey group
- ⑥ Cursor key group

- 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 of the PPU 24x.2

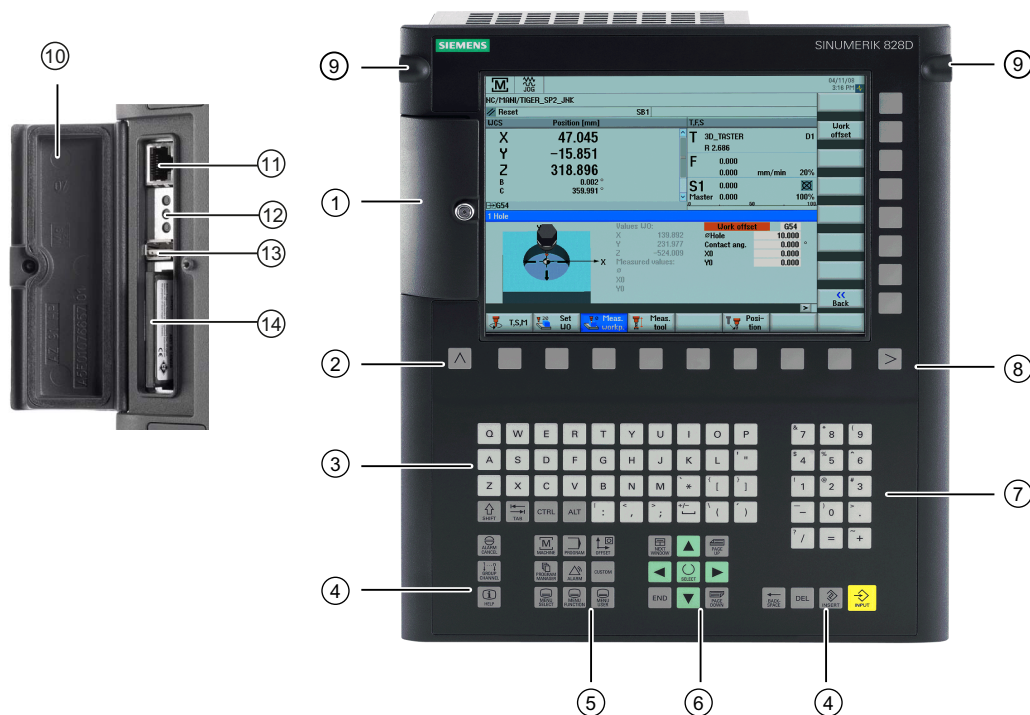


- ① ② X122, X132 Digital inputs/outputs, drive
- ③ ④ X242, X252 Digital inputs/outputs for NCK; controller of the analog spindle (X252)
- ⑤ X143 Handwheels
- ⑥ M, T2, T1, T0 Measuring sockets
- ⑦ X1 Power supply
- ⑧ X135 USB interface: For service purposes only
- ⑨ X130 Ethernet LAN
- ⑩ PN PLC I/O Interface
- 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 System versions horizontal and vertical

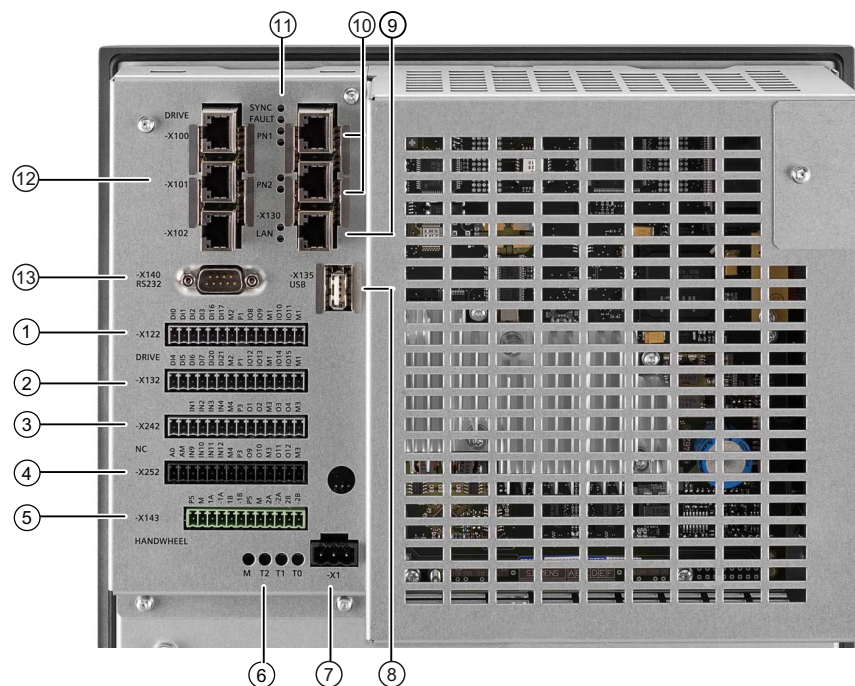
Front of the PPU versions 26x.2 and 28x.2



- ① Protective cover for user interfaces
- 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 Protective cover for user interfaces
- 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 26x.2 and 28x.2

- ① ② X122, X132 Digital inputs/outputs, drive
- ③ ④ X242, X252 Digital inputs/outputs for NCK; 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 on the rear side 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.2/28x.2) or 8.4" (PPU 24x.2). 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)
	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.

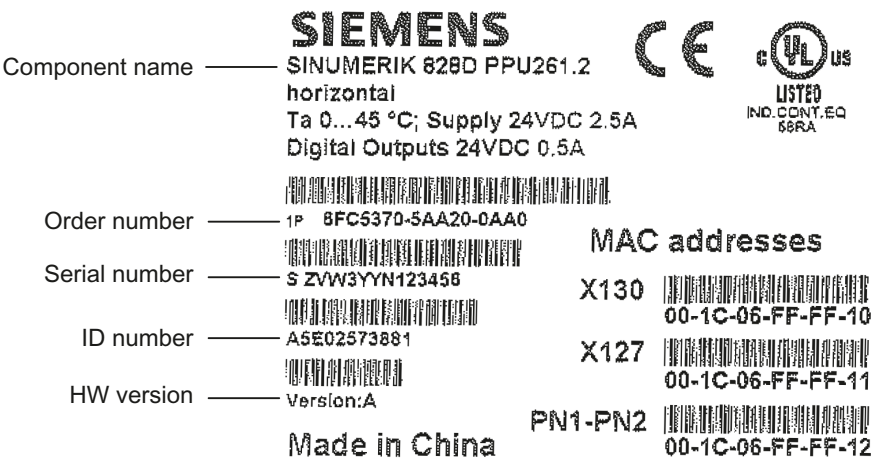


Figure 2-5 Horizontal PPU type plate

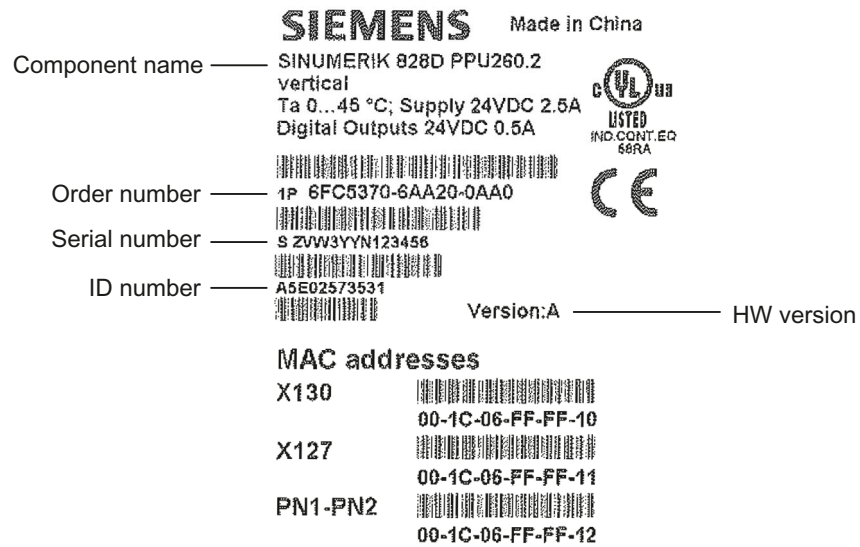


Figure 2-6 Vertical PPU type plate

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:

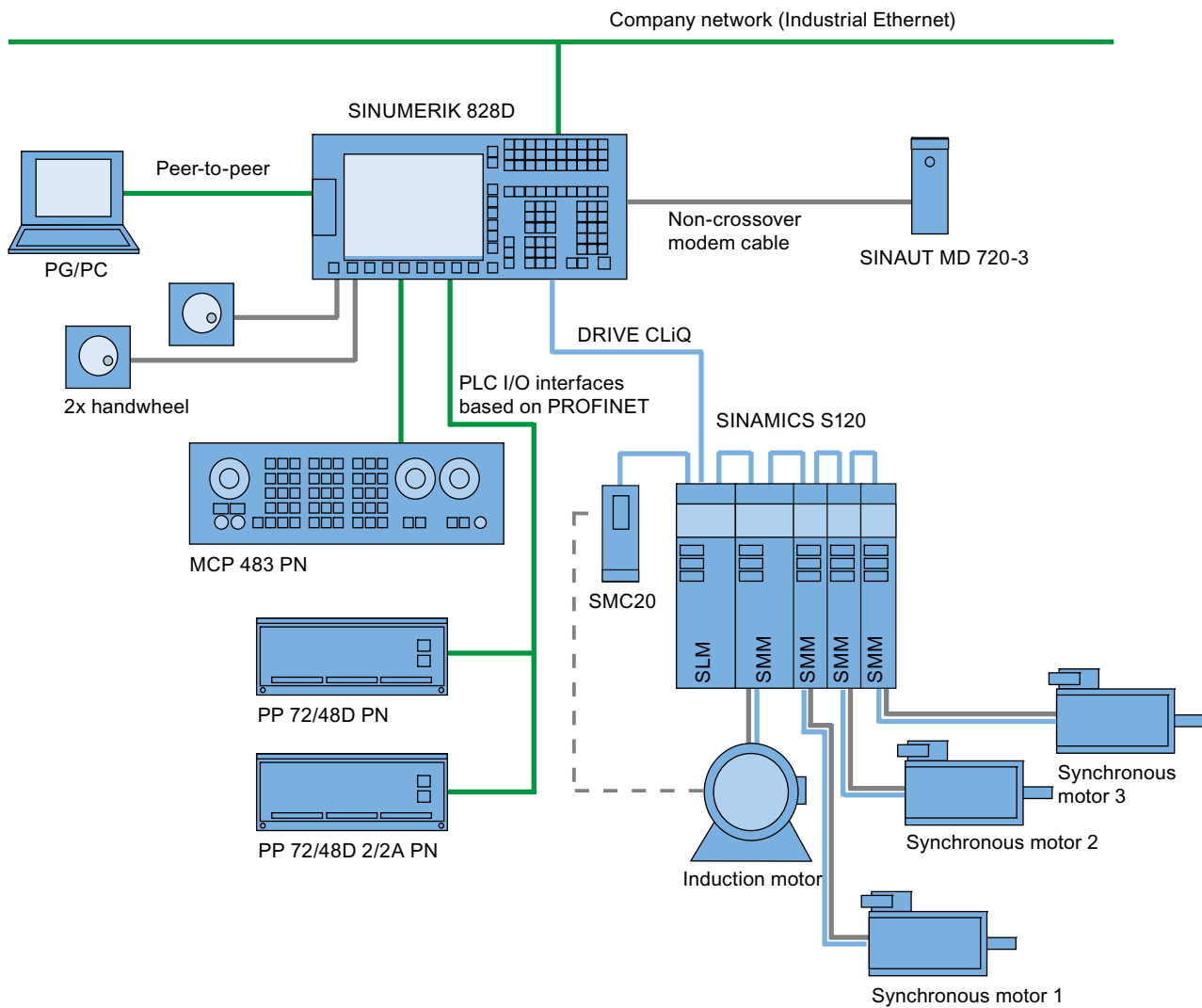


Figure 2-7 Configuration example 1: Basic configuration with four axes

Configuration with S120 Combi and six axes

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

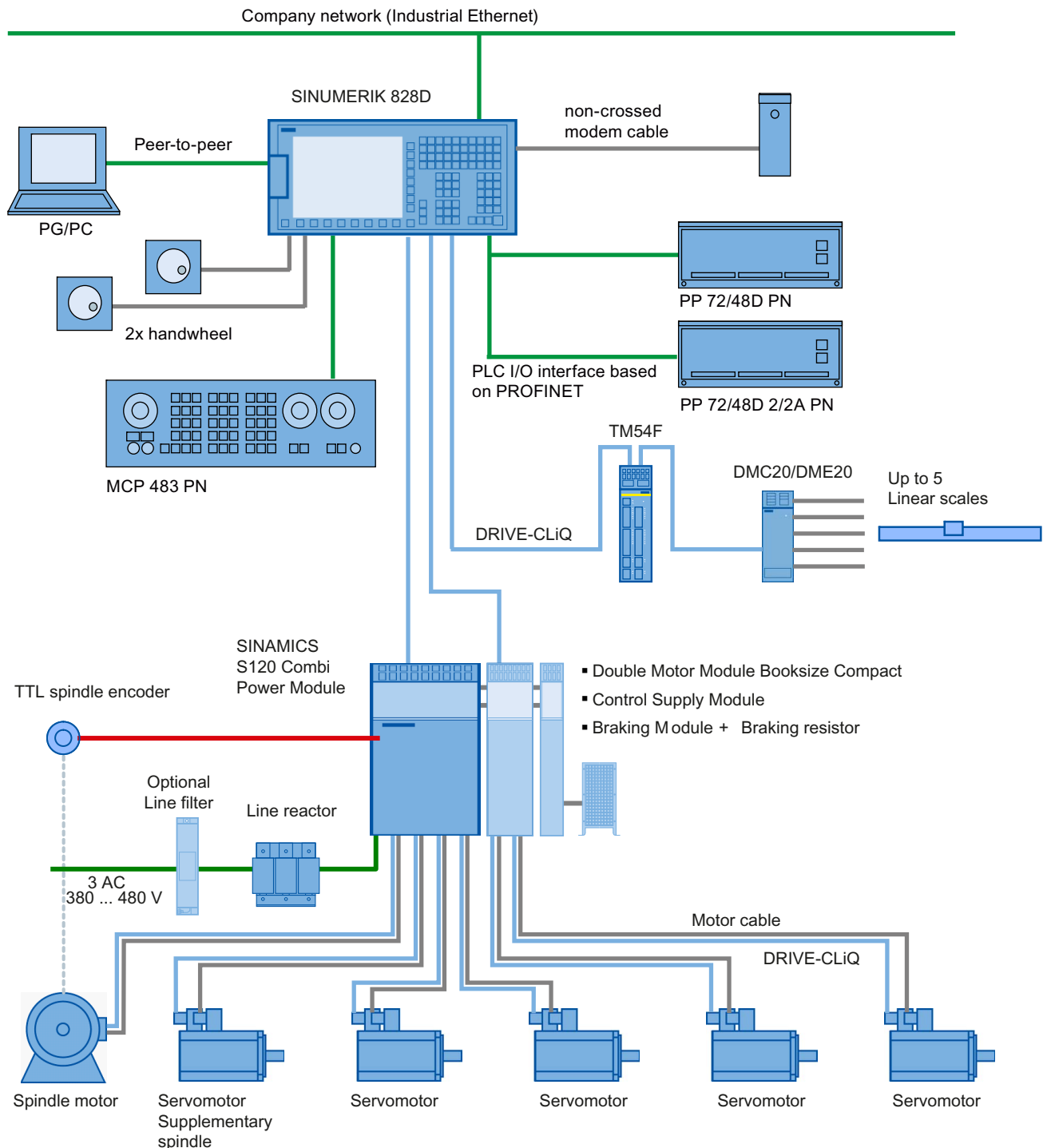


Figure 2-8 Configuration example 2: Maximum expansion stage with six axes and with Safety Integrated

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).

- **Handwheels**

A maximum of two handwheels can be connected to the X143.

- **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 **feed and main spindle motors** of the 1FT7 and 1PH8 type.

See also

Connectable components (Page 93)

SINAMICS components (Page 88)

- 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	Order number (MLFB)
Panel Processing Unit without system software	
• PPU 240.2: BASIC T	6FC5370-4AT20-0AA0
• PPU 240.2: BASIC M	6FC5370-4AM20-0AA0
• PPU 241.2: BASIC T	6FC5370-3AT20-0AA0
• PPU 241.2: BASIC M	6FC5370-3AM20-0AA0
• PPU 261.2 horizontal	6FC5370-5AA20-0AA0
• PPU 260.2 vertical	6FC5370-6AA20-0AA0
• PPU 281.2 horizontal	6FC5370-7AA20-0AA0
• PPU 280.2 vertical	6FC5370-8AA20-0AA0
CompactFlash card with system software and license	
• for PPU 241.2 / PPU 240.2: Turning	6FC5835-1GY40- □ YA0
• for PPU 241.2 / PPU 240.2: Milling	6FC5835-2GY40- □ YA0
• for PPU 261.2 / PPU 260.2: Turning	6FC5834-1GY40- □ YA0
• for PPU 261.2 / PPU 260.2: Milling	6FC5834-2GY40- □ YA0
• for PPU 281.2 / PPU 280.2: Turning	6FC5833-1GY40- □ YA0
• for PPU 281.2 / PPU 280.2: 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
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	Order number (MLFB)
Set of tensioners (9 units)	6FC5248-0AF14-0AA0
CompactFlash card (empty), 1 GB	6FC5313-5AG00-0AA1

Accessories

Table 2- 3 Accessories

Designation	Order number (MLFB)
SETRON PAC3200 multifunction measuring device	7KM2111-1BA00-3AA0 7KM2112-...
SETRON PAC4200 multifunction measuring device	7KM4211-... 7KM4212-0BA00-...
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: • 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-...
USB-FlashDrive, 8 GB	6ES7648-0DC50-0AA0
CompactFlash card (empty as user memory), 8 GB	6FC5313-6AG00-0AA0

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 protective 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.

As well as the technology-specific system software for SINUMERIK 828D and the firmware for SINAMICS, the system CompactFlash card also contains:

- Version info (serial number, version, type designation)
- License key: This means that the CompactFlash card can 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 the SINUMERIK keeps to the 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 (1 GB) with order number 6FC5313-5AG00-0AA1 is permitted.

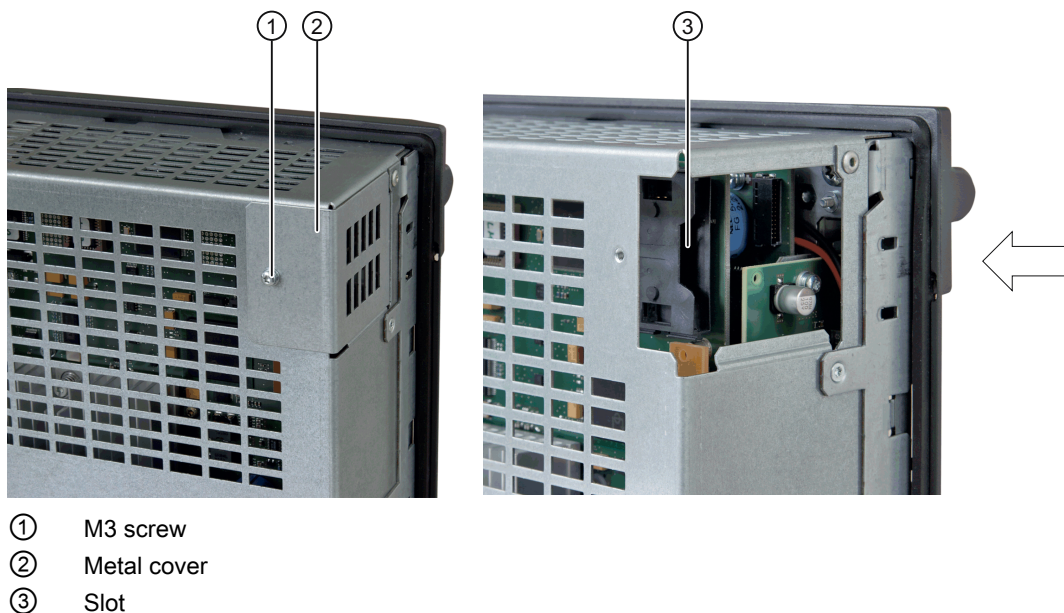
CAUTION

CompactFlash card system

- 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



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
Damage to 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.



- 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 (mm²)	External protective conductor min. (mm²)
$S \leq 16$	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)

EMC limit values in South Korea

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

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

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

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

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

References

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

- EMC Installation Guideline
- SINAMICS S120 Combi Manual

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) *)

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

NOTICE

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.

NOTICE

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.

Installing

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

The system must be voltage-free when mounting 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.

NOTICE

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

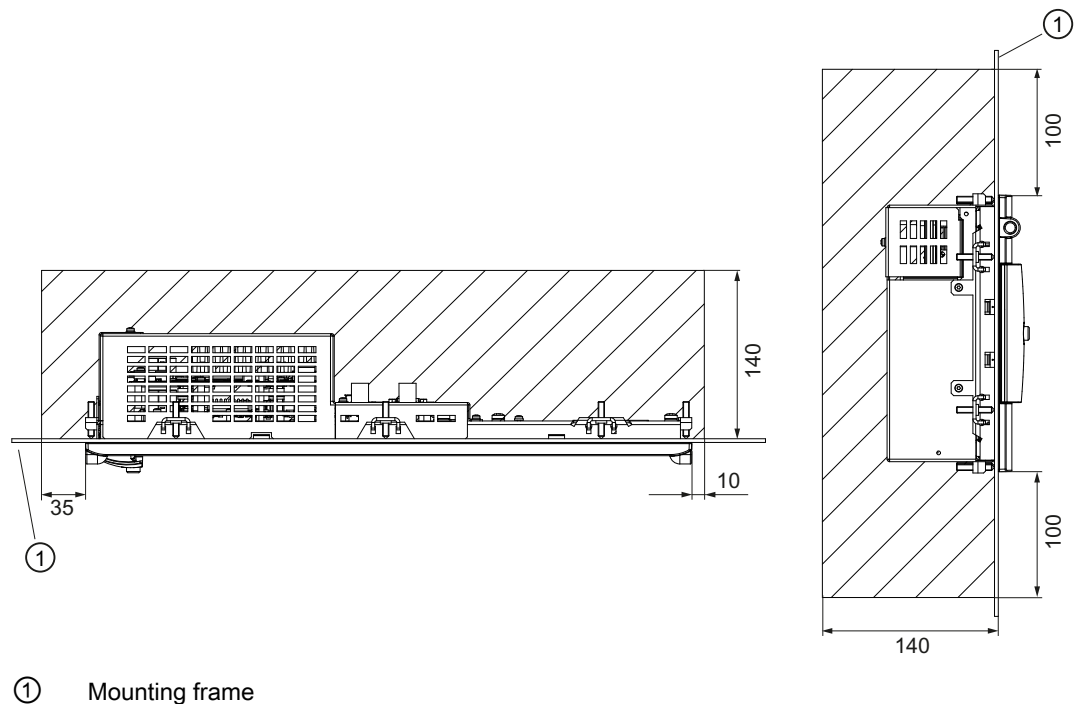


Figure 4-1 Clearance for ventilation and cables in the horizontal PPU

Panel cutout of the horizontal PPU variant

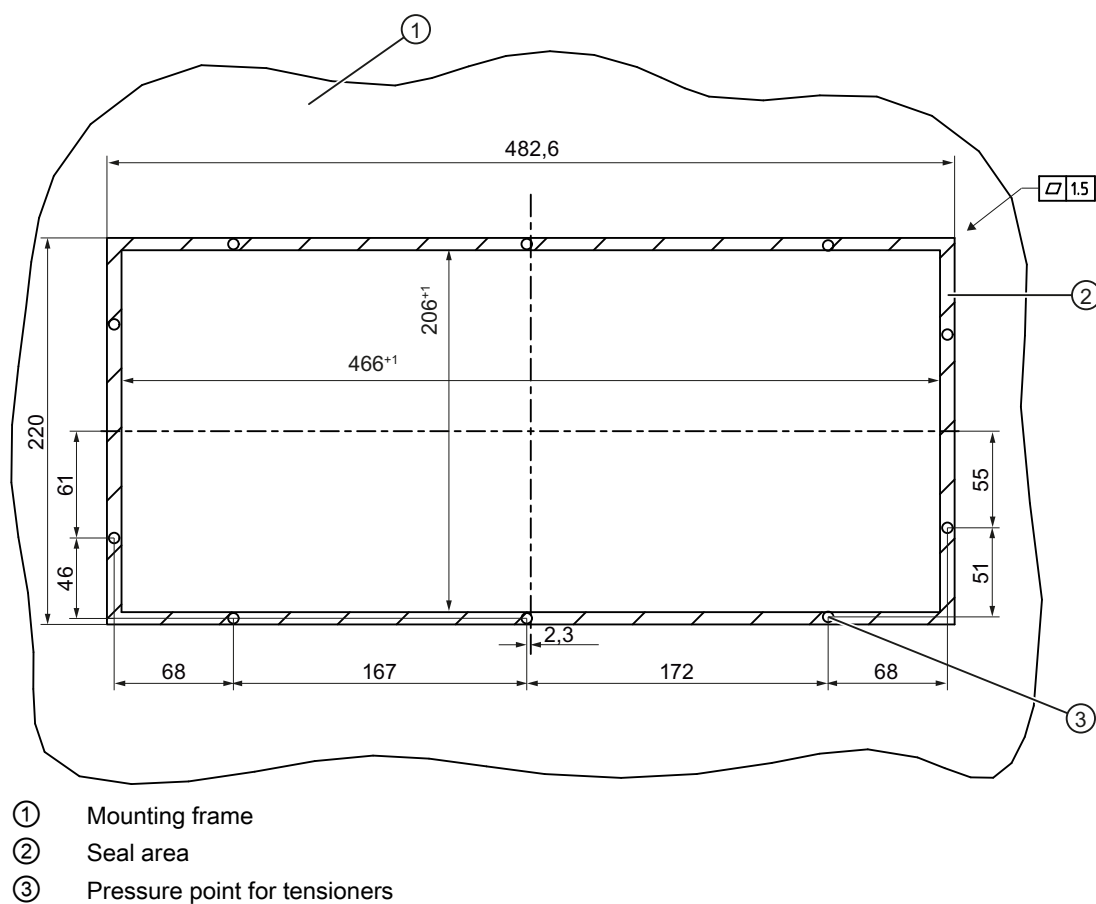
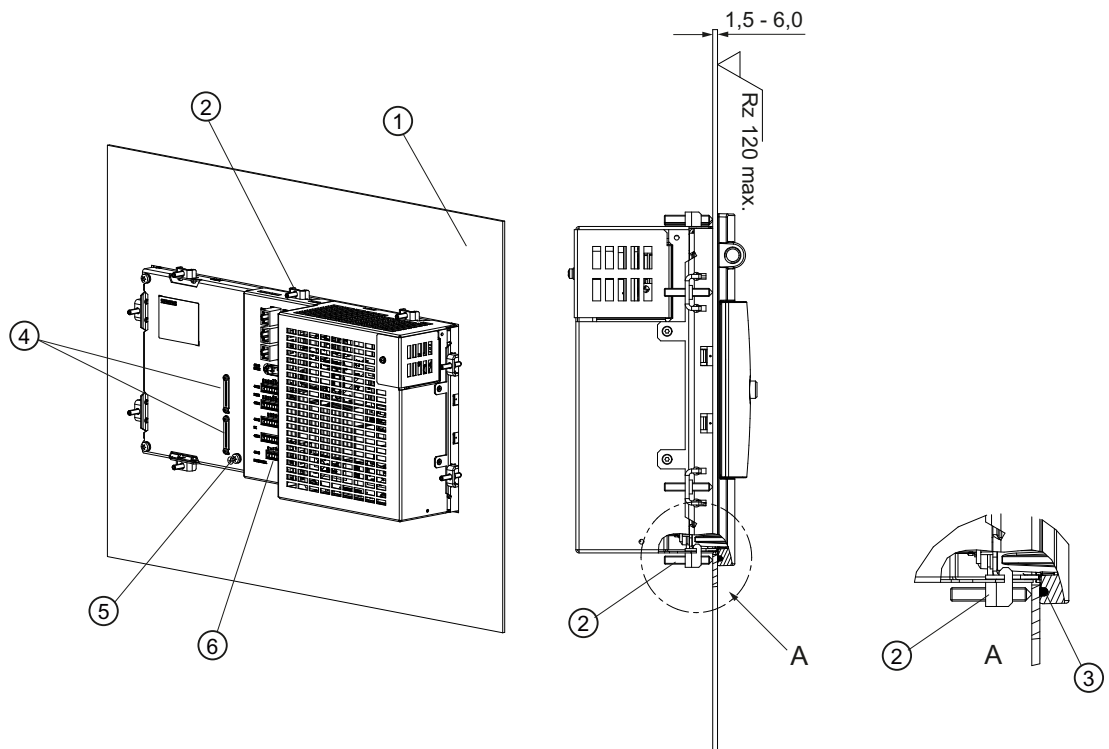


Figure 4-2 Horizontal PPU panel cutout



- 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

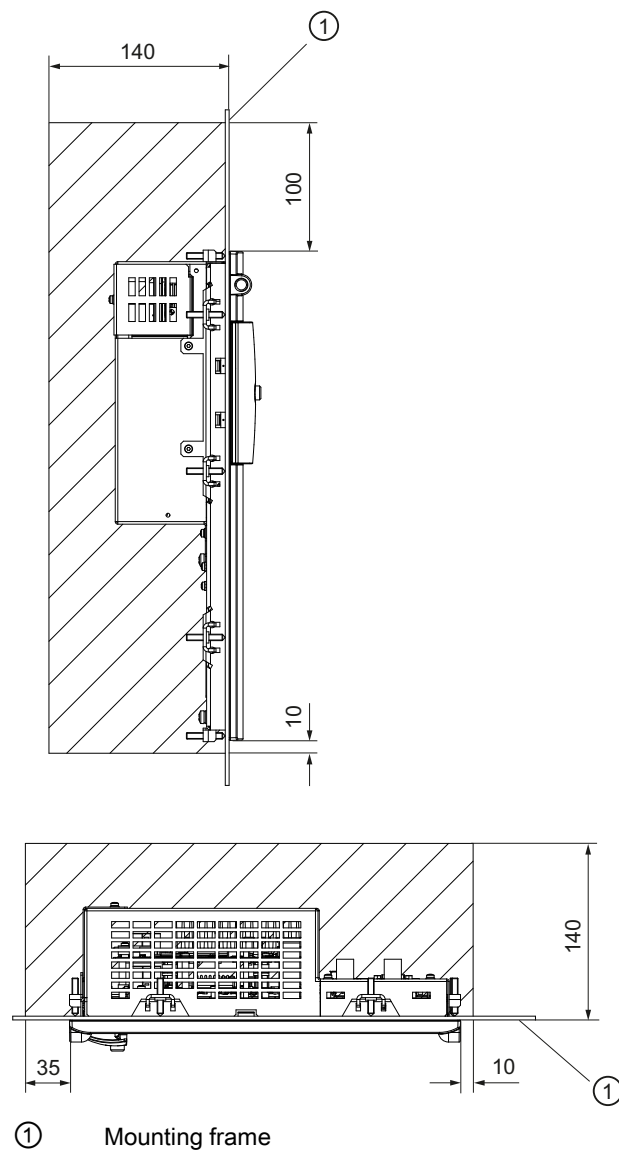


Figure 4-4 Clearance for ventilation and cables in the vertical PPU

Panel cutout of the vertical PPU variant

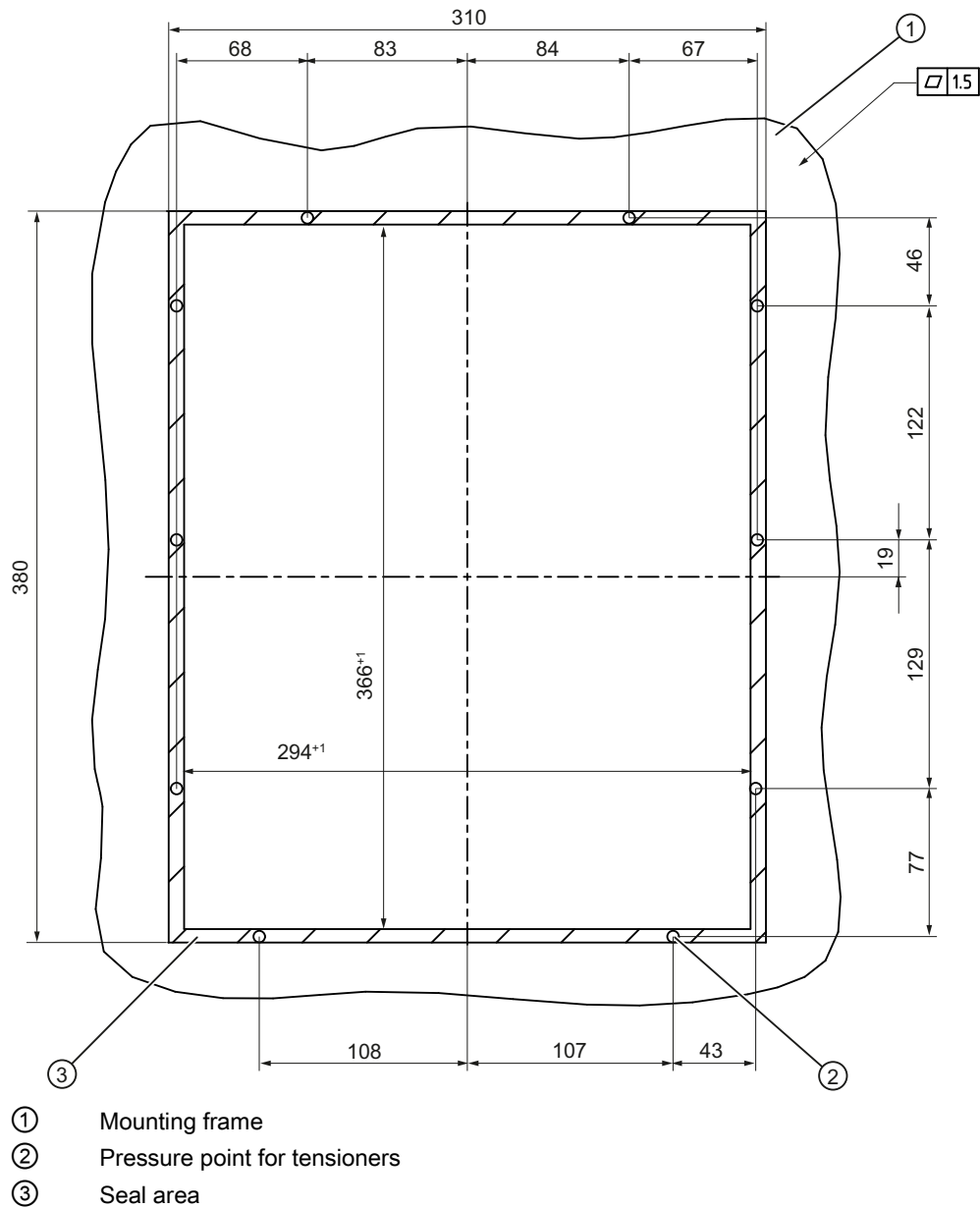


Figure 4-5 Vertical PPU panel cutout

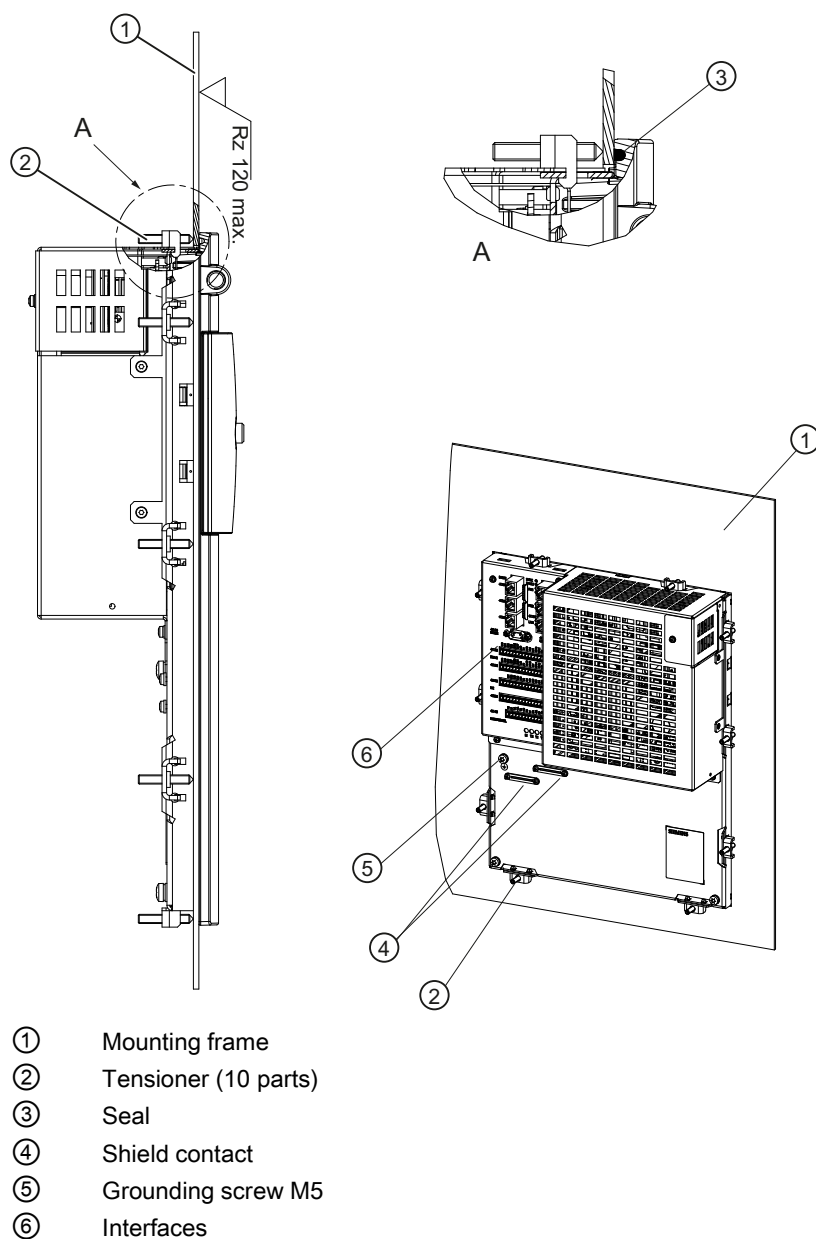


Figure 4-6 Installation of the vertical PPU variant

4.2 Dimension drawings

PPU horizontal

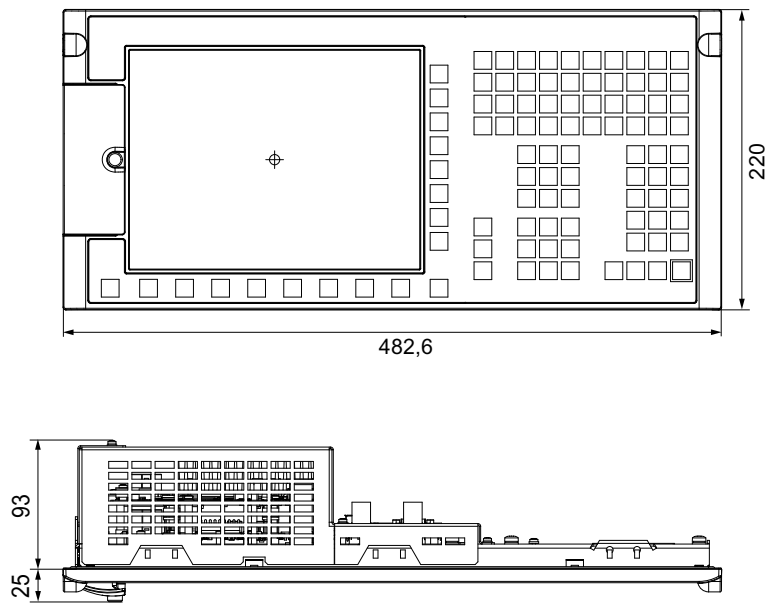


Figure 4-7 Horizontal PPU dimensioning

PPU vertical

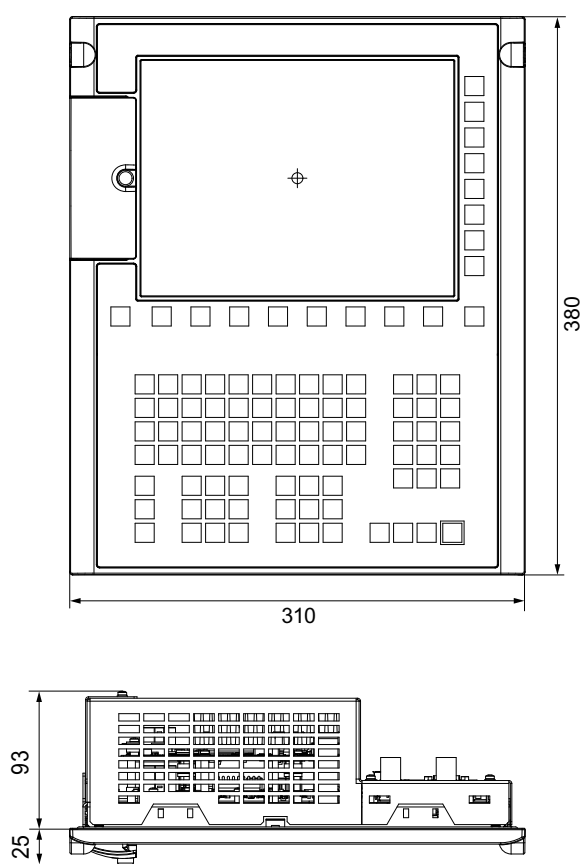


Figure 4-8 Vertical PPU dimensioning

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

5.1 Topology rules for S120 Combi

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
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.

NOTICE
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 µs). 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.

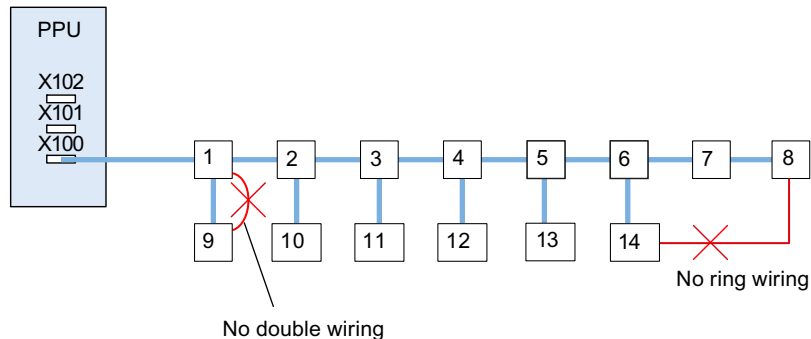


Figure 5-1 Example: DRIVE-CLiQ line at the X100 terminal (without Safety Integrated)

- 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. at 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 the PPU and a maximum of six measuring systems can be connected to the NX10.3.
- 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

NOTICE

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.

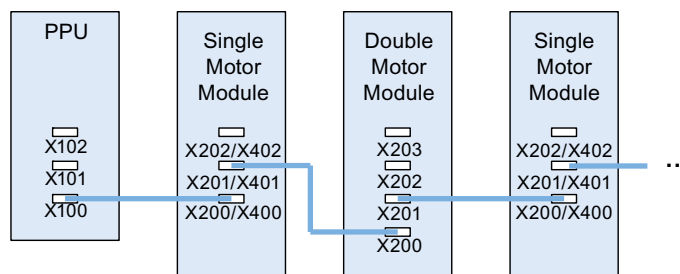


Figure 5-2 Example: DRIVE-CLiQ line

- 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	- Motor connection X1: Encoder at X202 - Motor connection X2: Encoder at X203
Single Motor Module chassis	X402
Power Module chassis	X402

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.

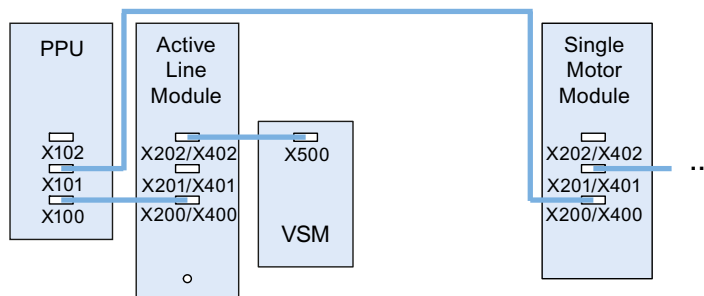


Figure 5-3 Example: Topology with VSM for booksize and chassis components

Component	VSM connection
Active Line Module booksize	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 booksize</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	---
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

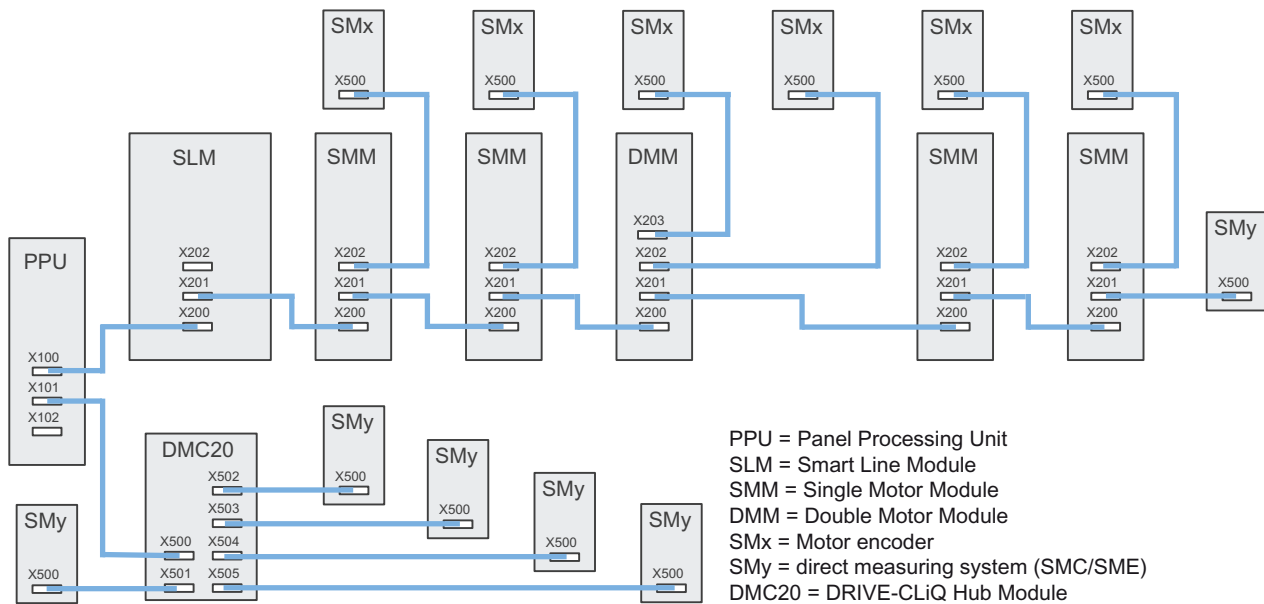


Figure 5-4 DRIVE-CLiQ wiring without NX

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

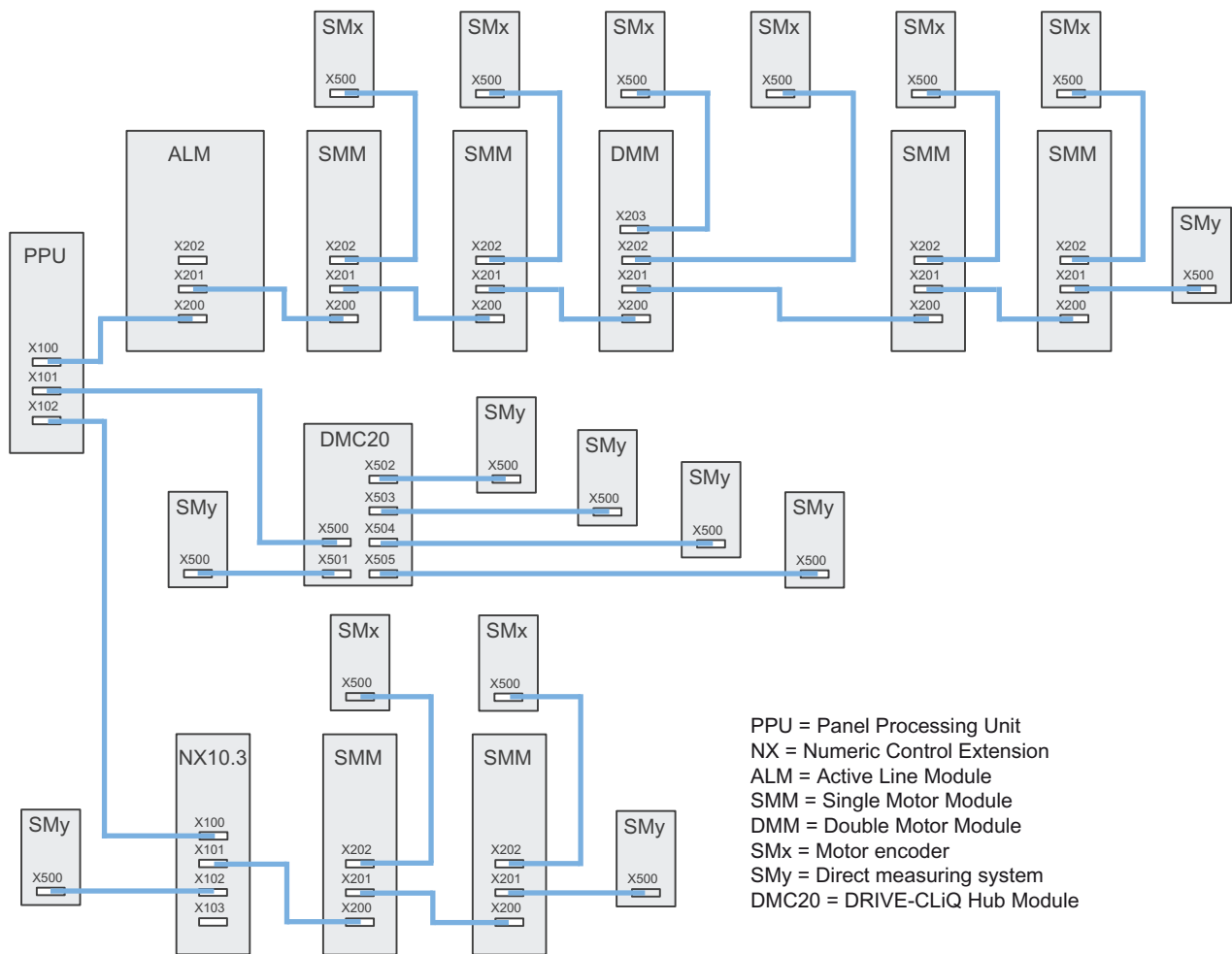


Figure 5-5 DRIVE-CLiQ wiring with NX

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

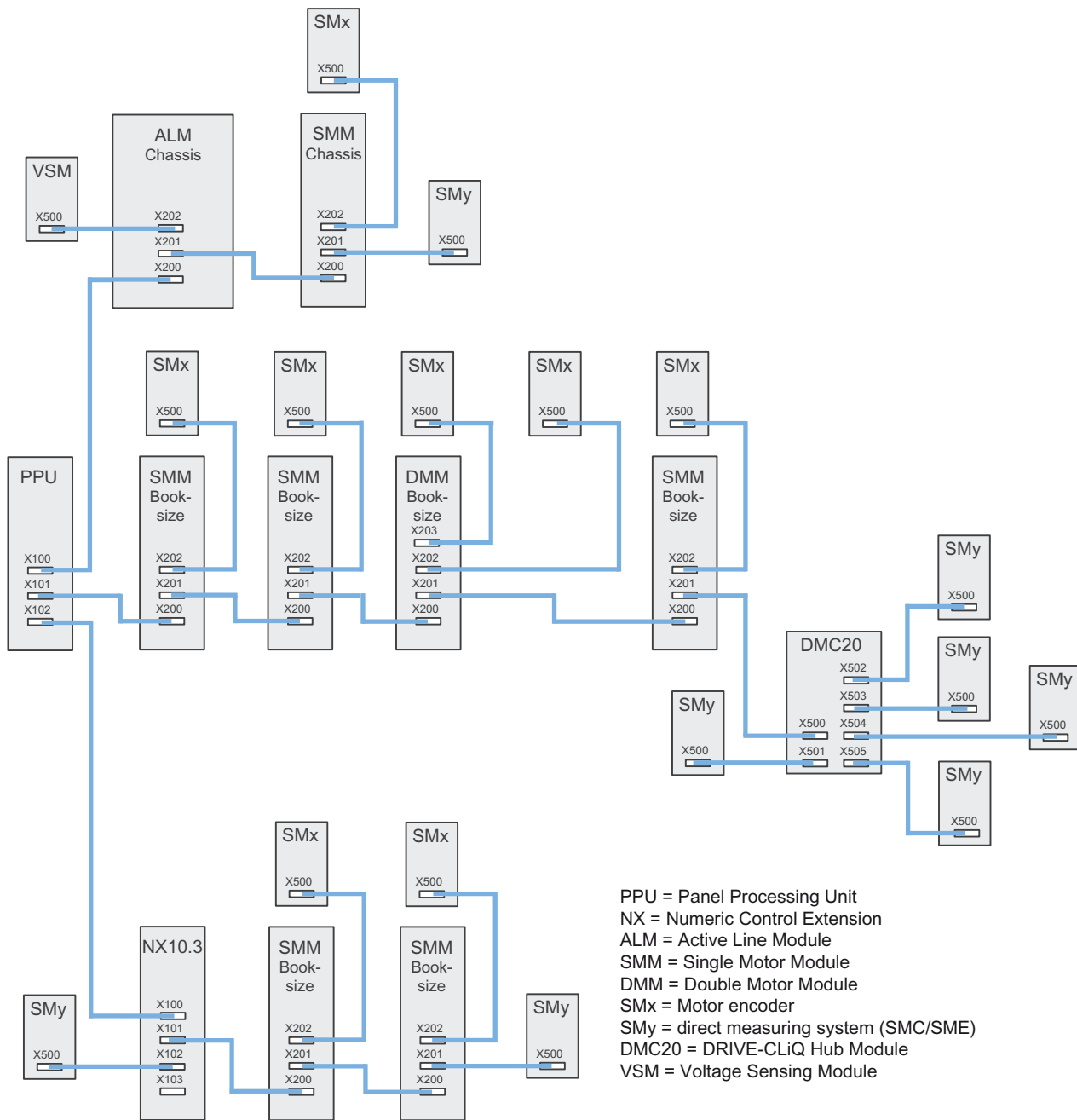


Figure 5-6 DRIVE-CLiQ wiring with NX

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

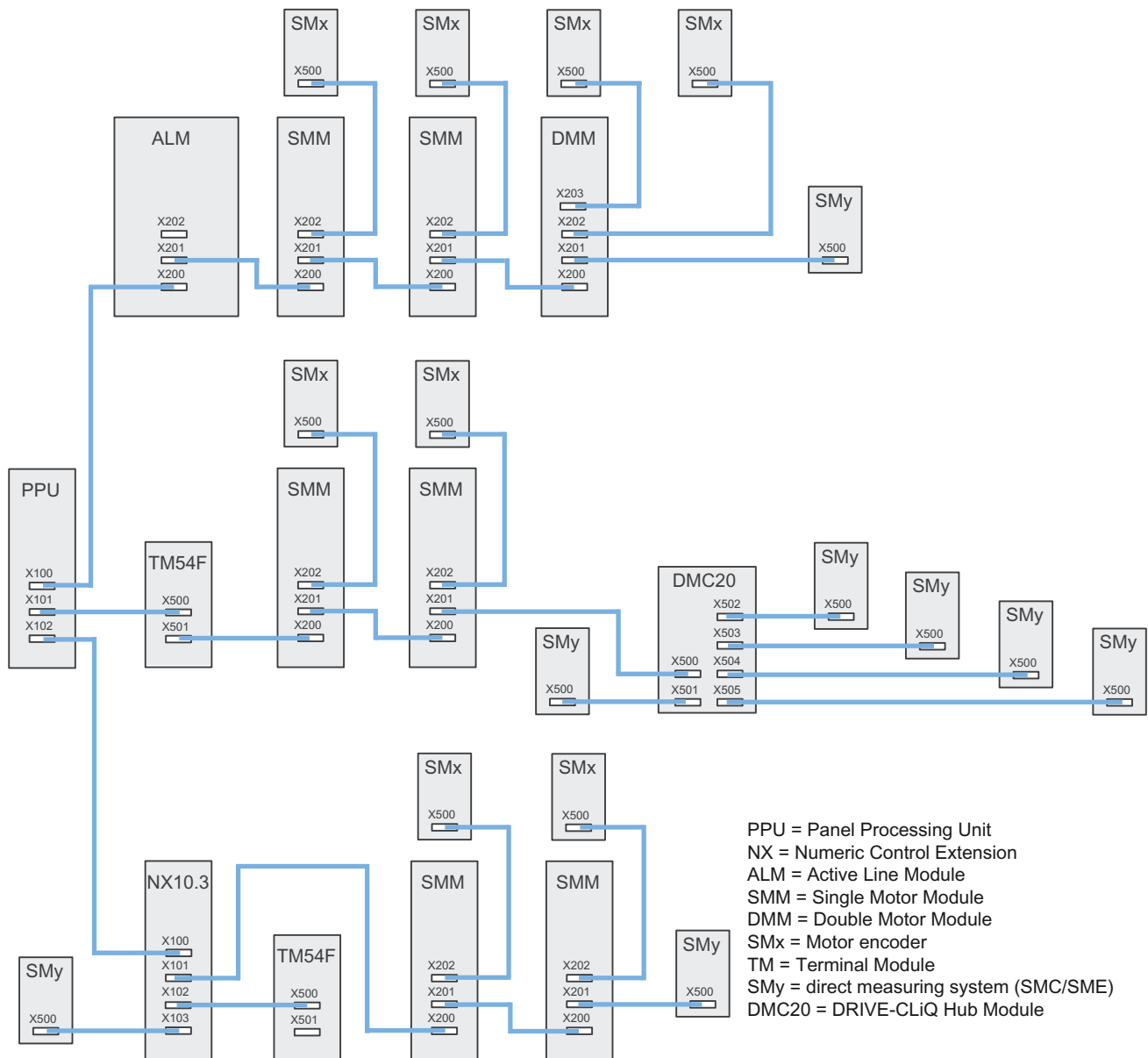


Figure 5-7 DRIVE-CLiQ wiring with Safety Integrated functions and NX

Diagram illustrating a Drive-CLiQ network topology. The network is organized into three main sections: Top, Middle, and Bottom.

Top Section:

- PPU (Panel Processing Unit):** Contains X100, X101, and X102.
- ALM (Active Line Module):** Contains X202, X201, and X200.
- SMM (Single Motor Module):** Contains X202, X201, and X200.
- DMM (Double Motor Module):** Contains X203, X202, X201, and X200.
- SMx (Motor encoder):** Contains X500.
- SMy (direct measuring system (SMC/SME)):** Contains X500.

Middle Section:

- PPU:** Same as above.
- TM54F (Terminal Module):** Contains X500 and X501.
- SMM:** Same as above.
- DMC20 (DRIVE-CLiQ Hub Module):** Contains X502, X503, X504, X505, X500, and X501.
- SMy:** Same as above.

Bottom Section:

- SMx:** Same as above.
- SMM:** Same as above.
- NX10.3 (Numeric Control Extension):** Contains X100, X101, X102, and X103.
- TM54F:** Same as above.
- SMy:** Same as above.
- SMM:** Same as above.
- SMy:** Same as above.

Legend:

- PPU = Panel Processing Unit
- NX = Numeric Control Extension
- ALM = Active Line Module
- SMM = Single Motor Module
- DMM = Double Motor Module
- SMx = Motor encoder
- TM = Terminal Module
- SMy = direct measuring system (SMC/SME)
- DMC20 = DRIVE-CLiQ Hub Module

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

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:
Tireg/Tnreg = 125 μ s, LM = 250 μ s, monitoring cycle = 12 ms, Tdp = 1.5 ms

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

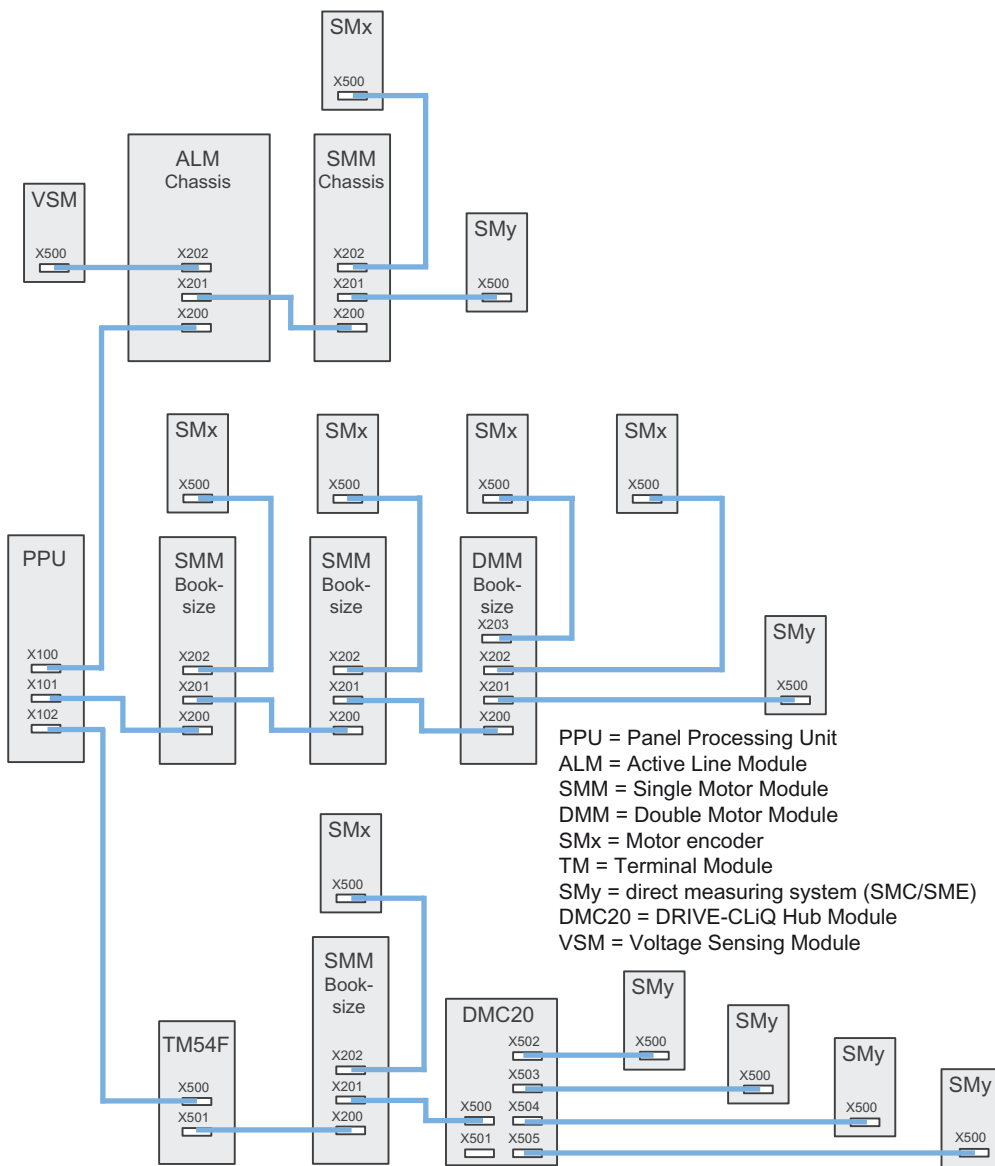


Figure 5-9 DRIVE-CLiQ wiring with Safety Integrated functions and without NX

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

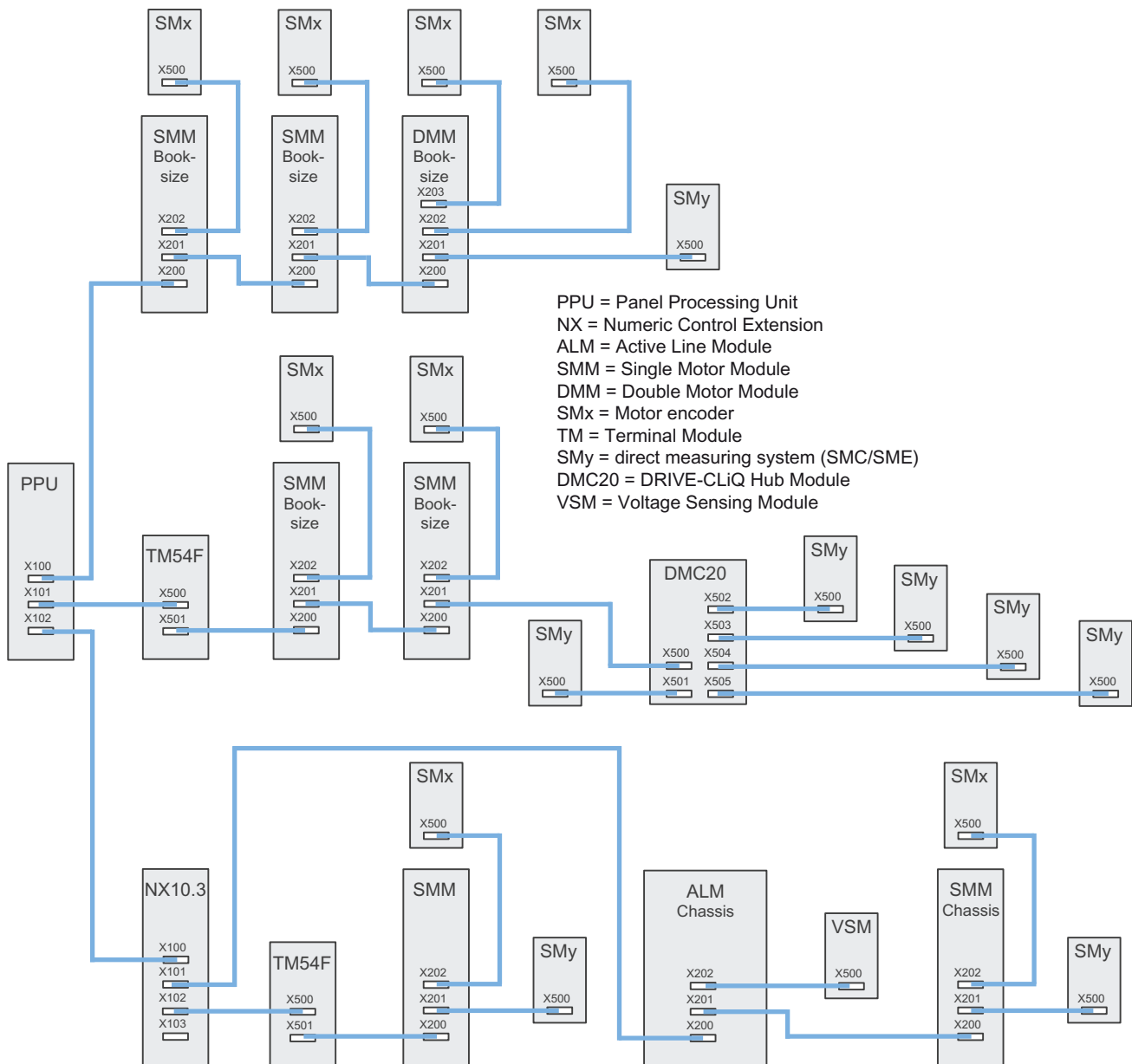


Figure 5-10 Example with Safety Integrated functions and with NX

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

Requirements

 DANGER
The system must be voltage-free when wiring the SINUMERIK 828D.
NOTICE
If your axis grouping contains a Smart Line Module without DRIVE-CLiQ (5 kW or 10 kW), you must assign the Smart Line Module enabling signal to the X122.1 digital input on the PPU.

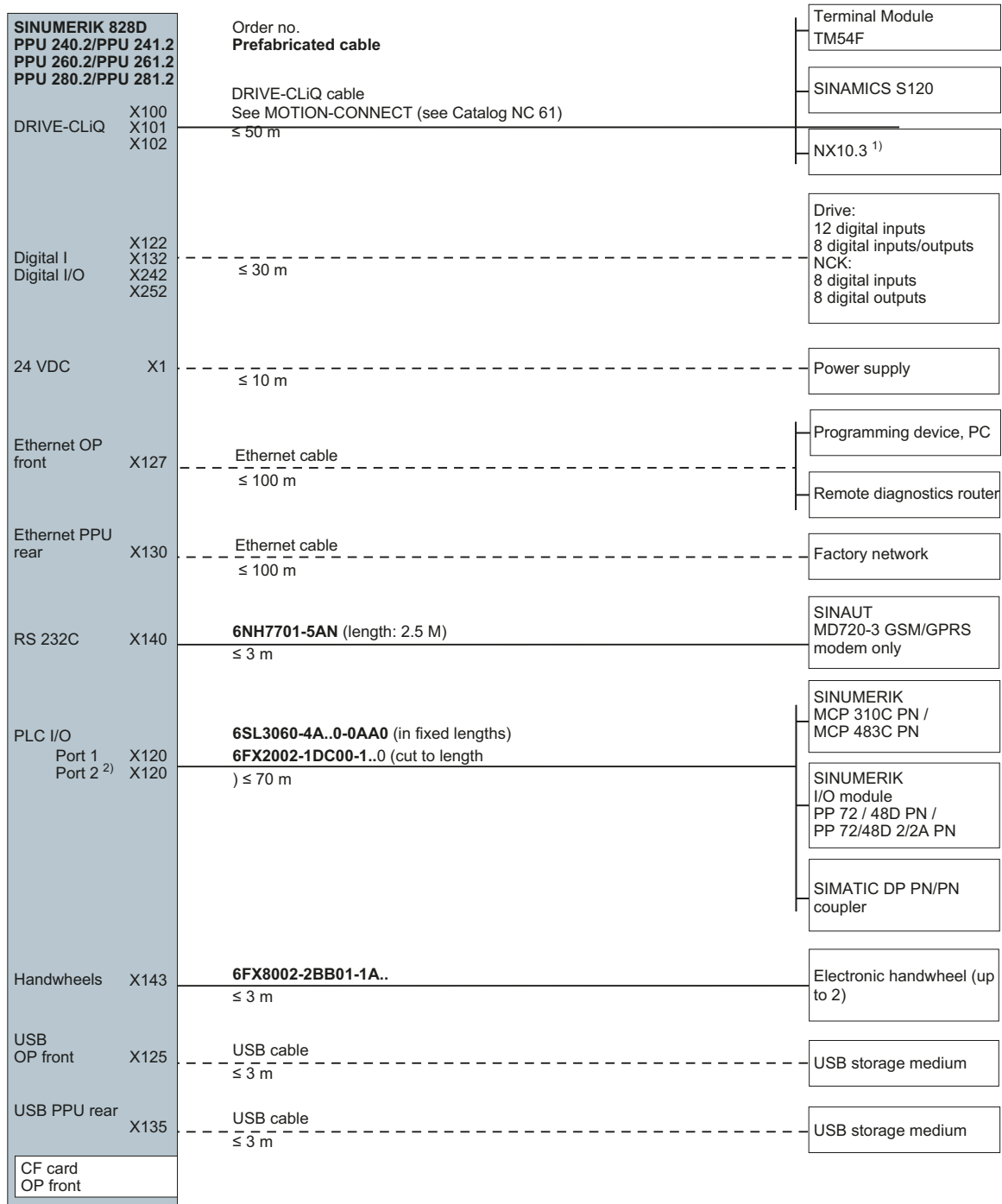
Definition

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)

Connection options

The overview below shows the interfaces and their connection possibilities:



¹⁾ Only for PPU 280.2 / PPU 281.2

²⁾ Not for PPU 240.2 / PPU 241.2

Figure 6-1 Connection options of the PPU

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.

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

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

The DC power supply must be connected to the ground/shield of the control unit for EMC and/or functional reasons. For EMC reasons, this connection should only be made at one point. As a rule, the connection is provided as standard in the PLC I/Os. If this is not the case in exceptional circumstances, the ground connection should be made on the grounding rail of the control cabinet.

See also: EMC Installation Guideline.

Table 6- 3 Technical data of the DC power supply

Rated voltage	According to EN 61131-2	24 VDC
	Voltage range (mean value)	20.4 VDC to 28.8 VDC
	Voltage range (dynamic)	18.5 to 30.2 VDC
	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
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	-	

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 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:

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

Note

The PPU has one MAC address for both PLC I/O Interface ports that is 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.

- Order no.: 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: • 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 protective flap on the front side of the PPU have the following significance:

Name	Color	Status	Meaning
RDY	Green	Is lit	NC Ready and PLC in run mode.
	Yellow	Is lit	PLC in stop mode
		Flashing	Power-up
	Red	Is lit	NC in stop mode: • When booting, if NC Ready is not yet available • Critical fault (power off/on necessary)
NC	Yellow	Cyclic flashing	NC operation
CF	Yellow	Is lit	Accessing the CompactFlash card.

CAUTION

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
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
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:

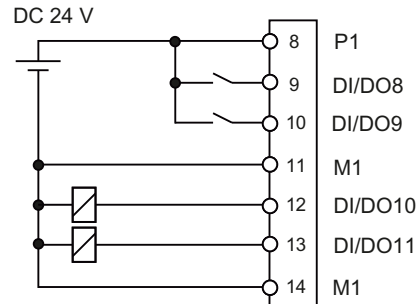


Figure 6-2 Inputs and outputs on the same supply

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:

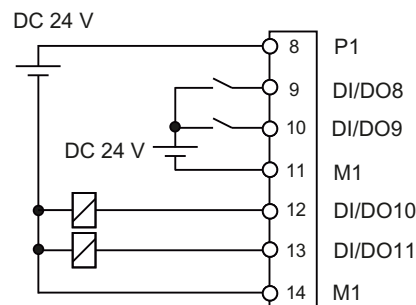


Figure 6-3 Inputs and outputs on different supplies

X242 pin assignment

Pin		Signal name	NC variable	Meaning
1		Not connected		
2		Not connected		
3	IN1	DIN1	\$A_IN[1]	Digital NCK input 1
4	IN2	DIN2	\$A_IN[2]	Digital NCK input 2
5	IN3	DIN3	\$A_IN[3]	Digital NCK input 3
6	IN4	DIN4	\$A_IN[4]	Digital NCK input 4
7	M4	MEXT4		Ground for pins 3...6
8	P3	P24EXT3		+24 V power supply
9	O1	DOUT1	\$A_OUT[1]	Digital NCK output 1
10	O2	DOUT2	\$A_OUT[2]	Digital NCK output 2
11	M3	MEXT3		Ground for pins 9, 10, 12, 13
12	O3	DOUT3	\$A_OUT[3]	Digital NCK output 3
13	O4	DOUT4	\$A_OUT[4]	Digital NCK 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 NCK input 9
4	IN10	DIN10	\$A_IN[10]	Digital NCK input 10
5	IN11	DIN11	\$A_IN[11]	Digital NCK input 11
6	IN12	DIN12	\$A_IN[12]	Digital NCK input 12
7	M4	MEXT4		Ground for pins 3...6
8	P3	P24EXT3		+24 V power supply
9	O9	DOUT9	\$A_OUT[9]	Digital NCK output 9
10	O10	DOUT10	\$A_OUT[10]	Digital 10
11	M3	MEXT3		Ground for pins 9, 10, 12, 13
12	O11	DOUT11 *)	--	Controller enable for analog spindle
13	O12	DOUT12 *)	--	Direction of travel for analog spindle
14	M3	MEXT3		Ground for pins 9, 10, 12, 13

*) These terminals are pre-assigned for the analog spindle.

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

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.
Max. cable length	30 m

Tools required

3.5-mm screwdriver or power screwdriver

Wire digital inputs/outputs

Procedure:

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

References

Further information on the programming the NCK inputs/outputs can be found in: "Turning and Milling" Commissioning Manual, Commissioning the PLC (part 2)

6.5.1 Terminal connection diagram

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

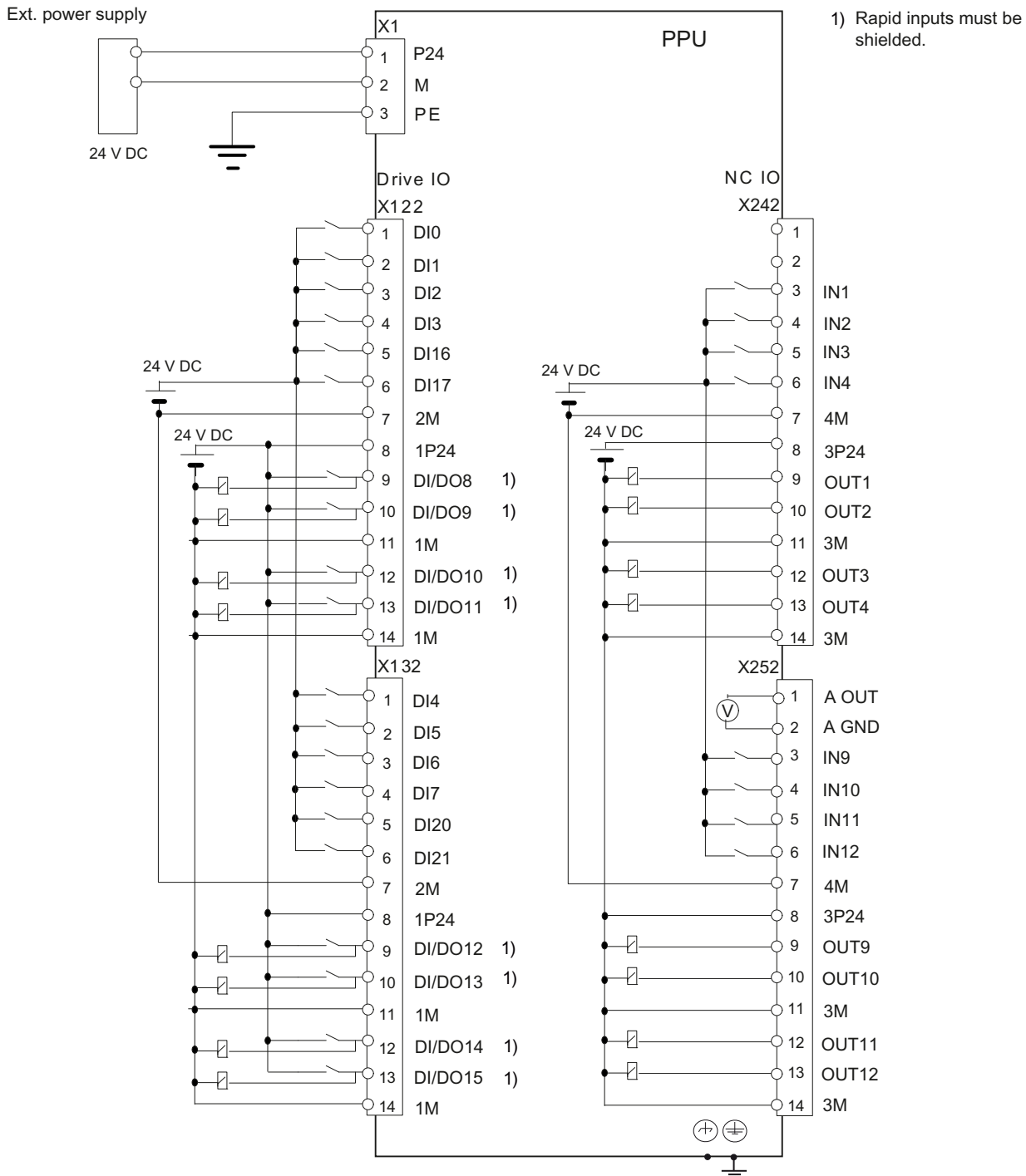


Figure 6-4 Terminal connection diagram for digital inputs/outputs

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.

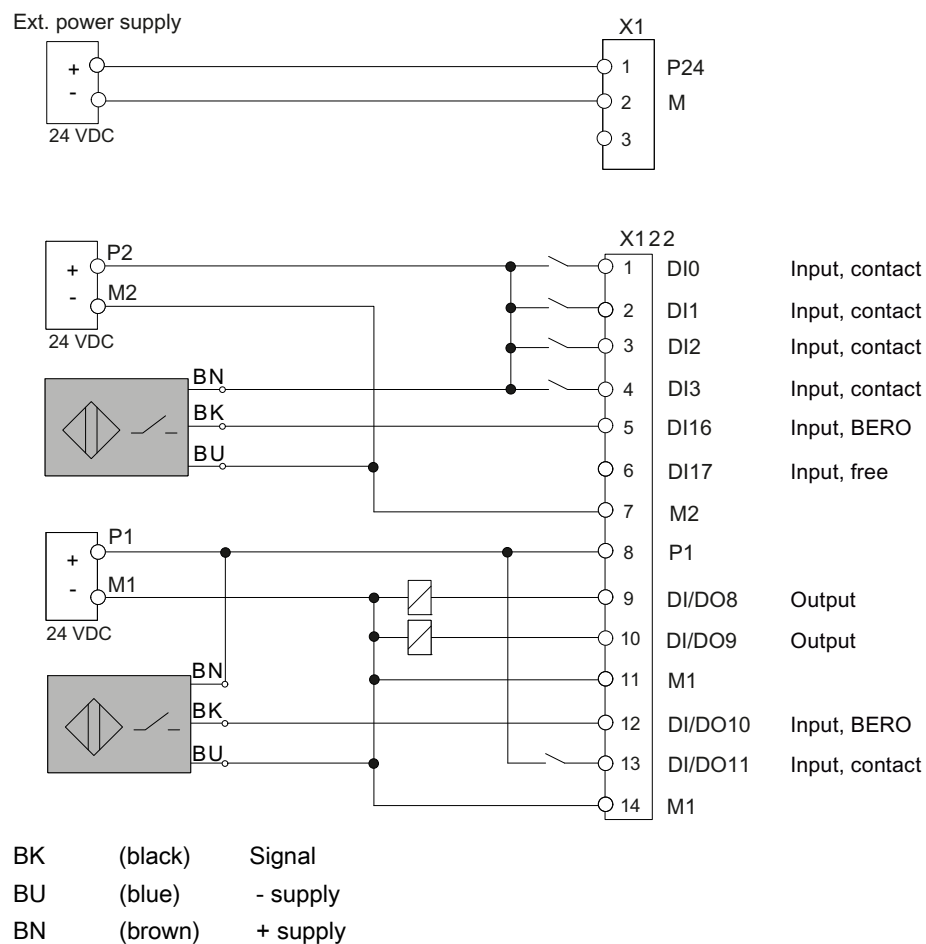


Figure 6-5 Connection to X122

6.5.3 Technical data

Note

An open input is interpreted as "low".

NOTICE

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, reference potential is terminal 2M at X122/X132 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, reference potential is terminal 1M
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, 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, 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 55)
- Topology rules for Safety Integrated functions (Page 59)
- Topology example without Safety Integrated functions (Page 60)
- 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
Order number	6FX2002-1DC00-1□□0
Max. cable length	70 m

Blanking cover for DRIVE-CLiQ interface: Tyco, order no.: 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.
SME20 / 25 / 120 / 125	Measuring systems outside the cabinet can be connected directly to the Sensor Module External.
DMC20 / DME20	DRIVE-CLiQ Hub Modules are used to implement 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.

6.7 Handwheel

Pin assignment

Table 6- 9 X143 pin assignment

Pin		Signal name	Meaning
1	P5	P5	5 V DC power supply
2	M	M	Ground
3	1A	1A	Handwheel pulses track A, channel 1
4	-1A	X1A	Handwheel pulses track A (negated), channel 1
5	1B	1B	Handwheel pulses track B, channel 1
6	-1B	X1B	Handwheel pulses track B (negated), channel 1
7	P5	P5	5 V DC power supply
8	M	M	Ground
9	2A	2A	Handwheel pulses track A, channel 2
10	-2A	X2A	Handwheel pulses track A (negated), channel 2
11	2B	2B	Handwheel pulses track B, channel 2
12	-2B	X2B	Handwheel pulses track B (negated), channel 2

Use

Max. 2 electronic handwheels can be connected to connector X143 on the rear of the PPU.

The handwheel must meet the following requirements:

- Transmission procedure: 5 V TTL or differential signal
- Signals:
 - Track A as a true and inverted signal
 - Track B as a true and inverted 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

Cable specification

Table 6- 10 Cable specification for X143

Feature	Version
Connector type	12-pin screw terminal
Cable type	Twisted pair, shielded
Order 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 protective 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
Order 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 controller 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 (transfer rate: 100 Mbit/s)
- Nine customer-specific inputs (e.g. for illuminated pushbuttons)
- Six customer-specific outputs

NOTICE
Handwheel connections A maximum of two handwheels can be connected to the SINUMERIK 828D. They must be wired directly with terminal X143 of the PPU.

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)

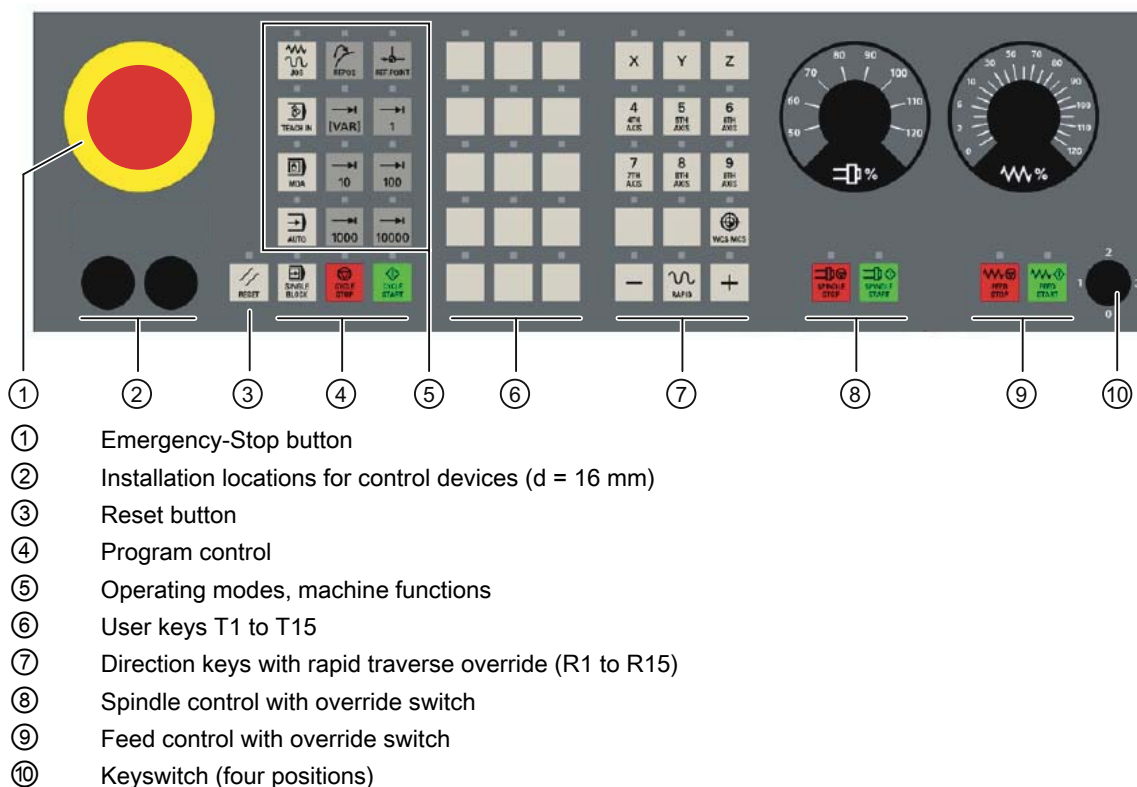


Figure 7-1 Position of control elements on MCP 483C PN

! 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

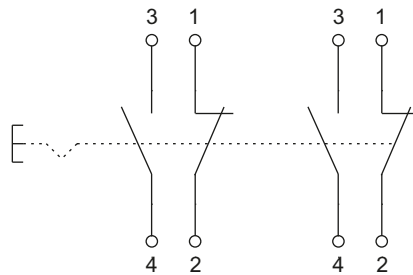
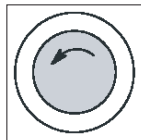


Figure 7-2 Emergency-stop circuit

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.

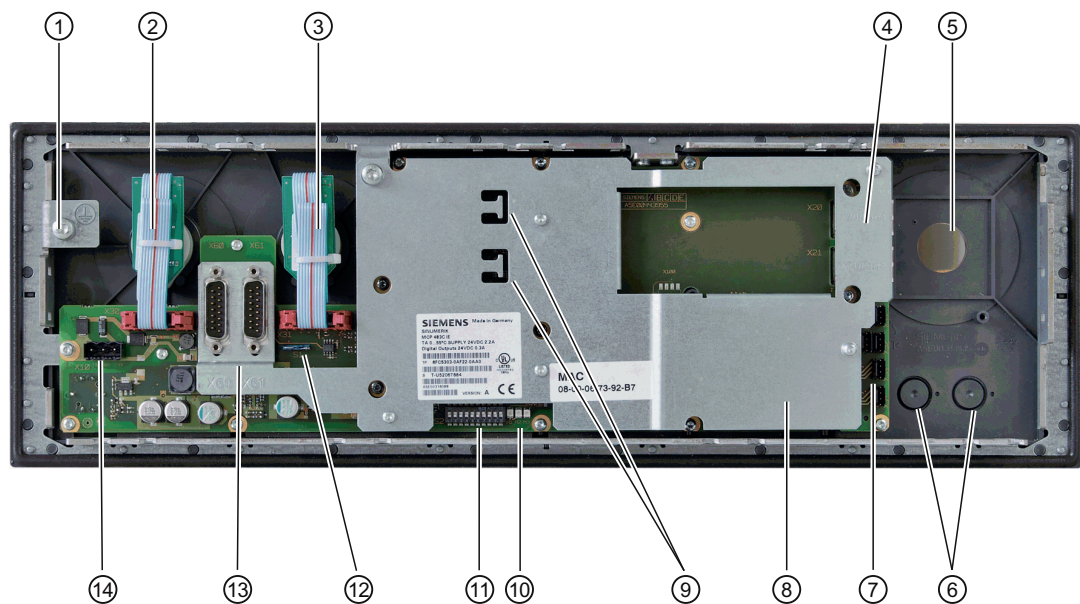
Key caps

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 order numbers for the key caps in Chapter Spare parts and accessories (Page 108).

Display elements (rear)



Detail for ④:



- 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 S2
- ⑫ Reserved
- ⑬ Reserved
- ⑭ Power supply interface X10

Figure 7-3 Rear panel of MCP 483C PN

LED for status display

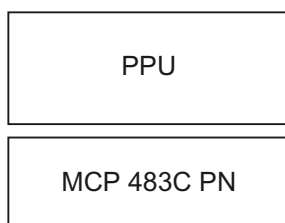
When the system is booting, all three LEDs are lit.

Name	Designation	Color	Description
H1	PowerOK	Green	Lit: Power supply OK
H2	PNSync	Green	Lit: System software running, STOP state Flashes 0.5 Hz: System software running, RUN state
H3	PNFault	Red	Not lit: Module is operating without errors; data exchange with all configured IO Devices is running. Lit: Serious bus fault; only output when one of the following errors is detected for the ports: • 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)").

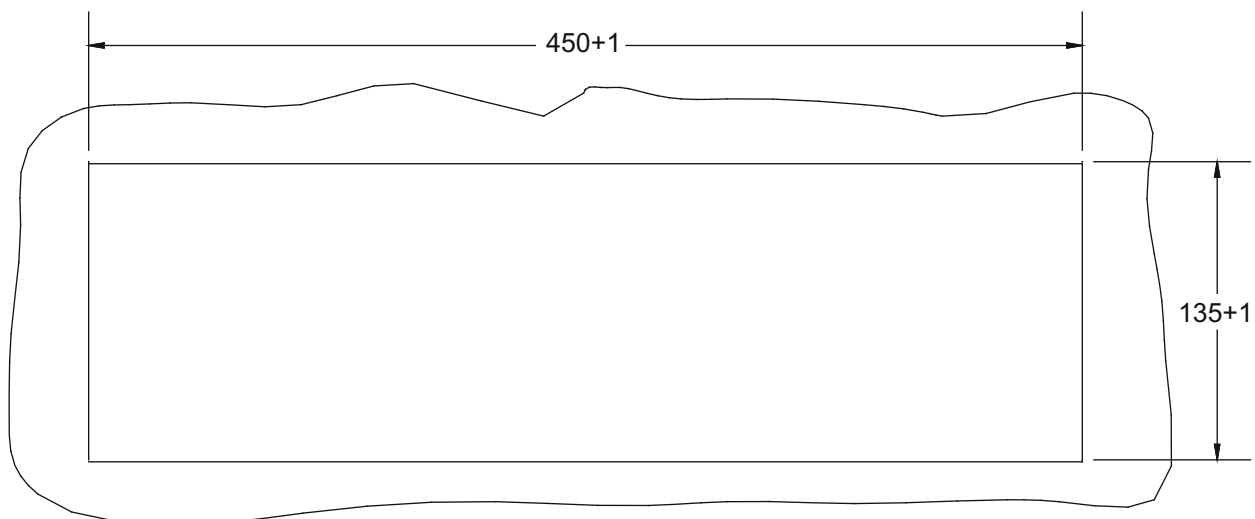


Figure 7-4 Panel cutout of MCP 483C PN

MCP 483C PN dimension drawing

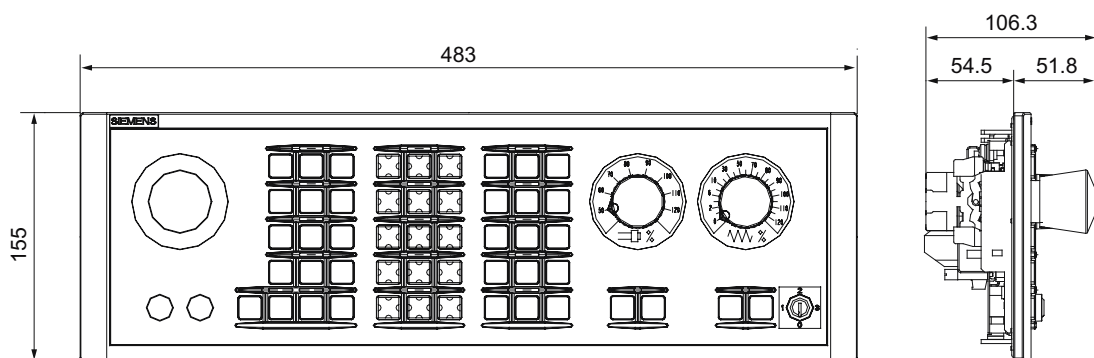


Figure 7-5 MCP 483C PN dimensions

7.1.3 Connecting

7.1.3.1 Connection

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.

See also

Ordering data (Page 27)

NOTICE

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

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 / X61	Reserved
S1	Reserved
S2	Switch for setting the MCP address

7.1.3.2 Description

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 assignmentConnector 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 X31Connector designation: **X30/X31**

Connector type: 2 x 5-pin plug connector, acc. 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.

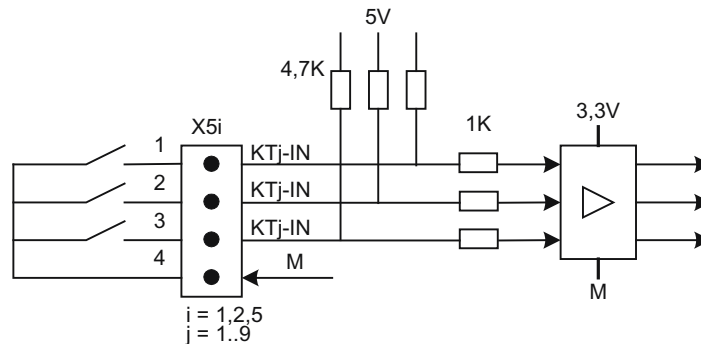


Figure 7-6 Main circuit diagram for input circuit for X51, X52 and X55

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.

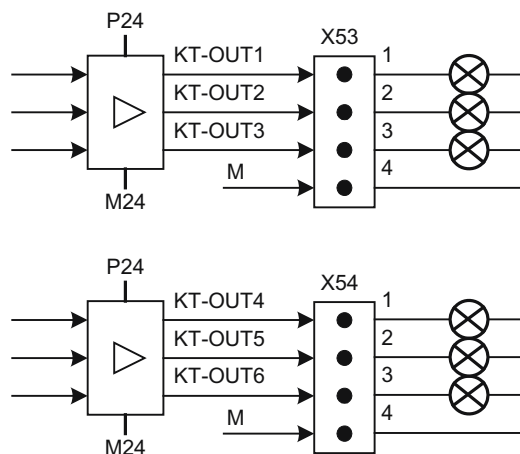


Figure 7-7 Main circuit diagram for input circuit for X53 and X54

⚠ CAUTION

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

Connector designation: **X53, X54**

Connector type: 4-pin plug connector

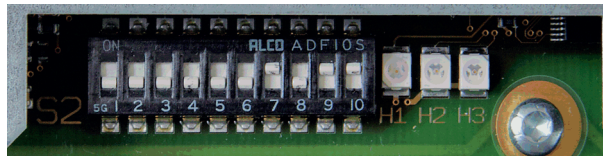
Table 7- 6 Assignment of connector X53

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

Switch S2



Schalter S2

Switch position: "ON" is at the top.

Table 7- 8 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- 9 Settings of switch S2

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

7.1.4 Parameterization

Input image

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

Table 7- 10 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
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	Axis selection			
	+ R15	- R13	Rapid traverse R14	position 3	X R1	4. axis R4	7. axis R7	R10
EB117	Axis selection							
	Y R2	Z R3	5. axis R5	Motion 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.

Output image

Table 7- 11 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			Single block	Spindle Start	*Spindle Stop	
		X R1	4. axis R4	7. axis R7				R10
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

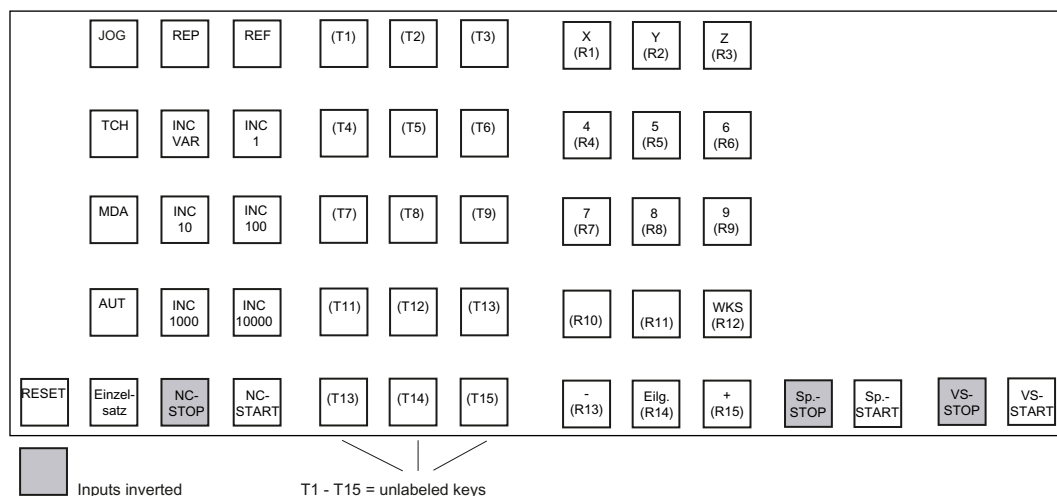


Figure 7-8 Default key assignment of MCP 483C PN

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

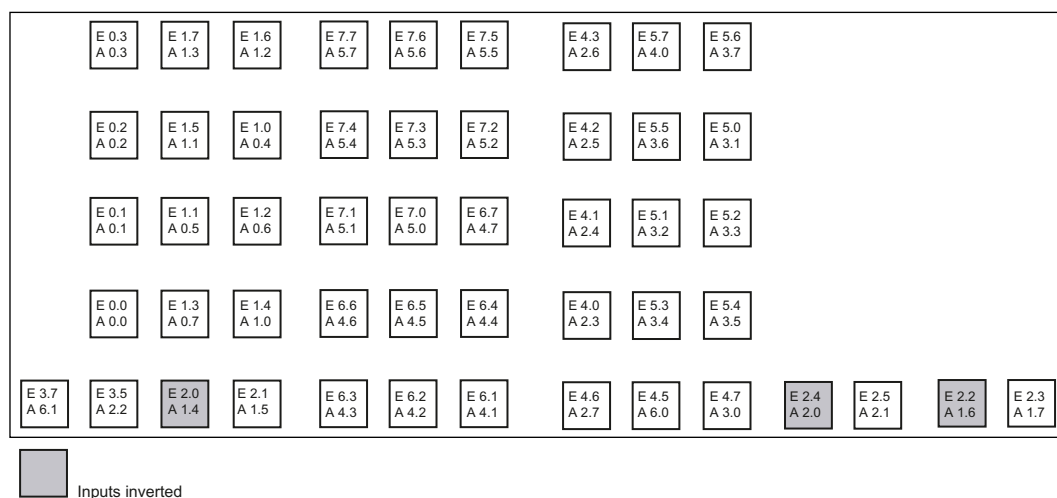


Figure 7-9 Inputs and outputs of the MCP 483C PN keyboard

7.1.5 Technical data

Safety				
Protection class	III (DVC A, PELV) acc. to EN 61800-5-1			
Degree of protection according to EN 60529	Front side: IP54		Mounting frame: IP65	Rear side: IP00
Approvals	CE / cULus			
Electrical data				
Input voltage	24 VDC			
Power consumption, max.	Board	Handwheels	Lamps	Total
	5 W	2 x 0.9 W	43.2 W (6x 7.2 W) *)	50 W
Mechanical data				
Dimensions	Width: 483 mm Height: 155 mm		Depth: 106 mm Mounting depth: 54.5 mm	
Weight	Approx. 2 kg			
Mechanical environmental conditions	Operation		Transport (in transport packaging)	
Vibratory load	10 –58 Hz: 0.15 mm 58 –200 Hz: 2g3M6 according to EN 60721-3-3		5 -9 Hz: 6.2 mm 9 –200 Hz: 2g2M3 according to EN 60721-3-2	
Shock stressing	15 g, 11 ms 18 shocks 3M4 per EN 60721-3-3		15 g, 6 ms 18 shocks 2M2 according to EN 60721-3-2	
Climatic environmental conditions				
Cooling	By natural convection			
Condensation, splashwater and icing	Not permissible			
Supply air	Without aggressive gases, dusts and oils			
	Operation		Storage / shipping (in transport packaging)	
Applicable standards	EN 60721-3-3		EN 60721-3-1 / -3-2	
Climate class	3K5		1K3 / 2K4	
Temperature limits	0 ... 45 °C (at front) 0 ... 55 °C (at rear)		-25 ... 55 °C	

*) 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- 12 Spare part kits for machine control panel MCP 483C PN

Name	Description	Quantity	Order 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
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- 13 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- 14 Accessories available for order

Component	Description	Amount	Order 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

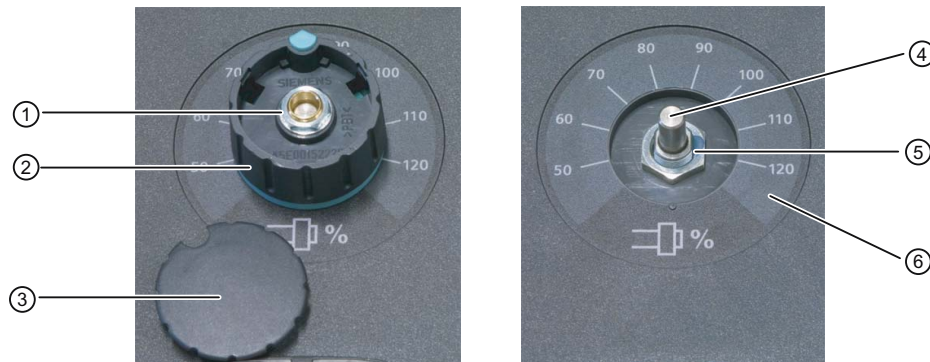
Removing the rotary switch

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.



- ① Nut of the collet
- ② Rotary knob
- ③ Cap
- ④ Rotary switch shaft
- ⑤ Fastening nut
- ⑥ Scale

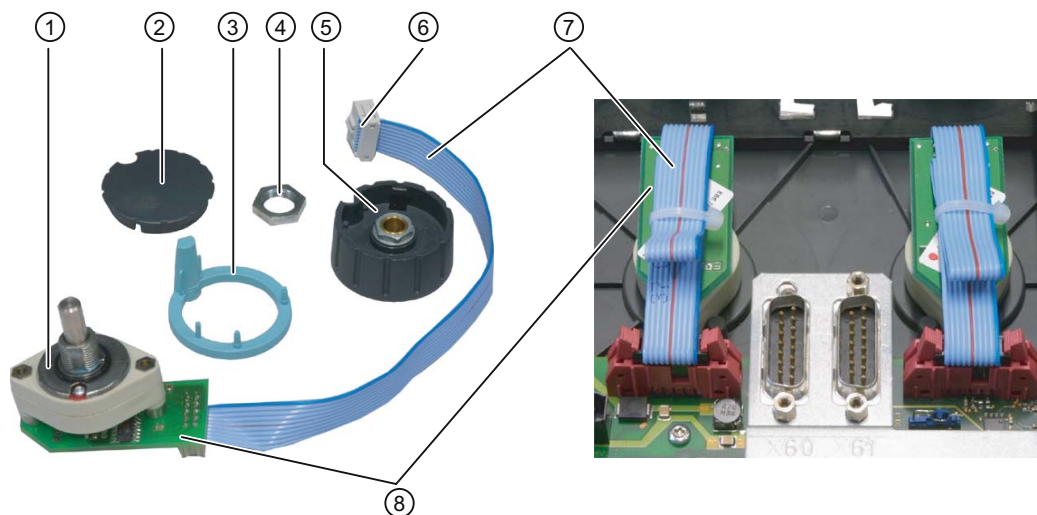
Figure 7-10 Removal of rotary switch

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

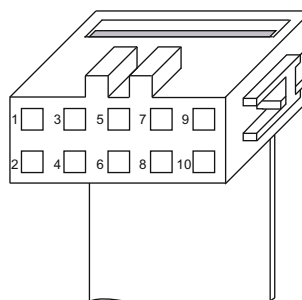


Figure 7-11 Installation of rotary switch

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

NOTICE

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 (transfer rate: 100 Mbit/s)
- Nine customer-specific inputs (e.g. for illuminated pushbuttons)
- Six customer-specific outputs

NOTICE
Handwheel connections A maximum of two handwheels can be connected to the SINUMERIK 828D. They must be wired directly with terminal X143 of the PPU.

Expansion slots

Six slots for control devices (d = 16 mm)

Additional cable set required for control devices: Spare parts and accessories (Page 125)

7.2.1 Operator controls and display elements

Operator controls

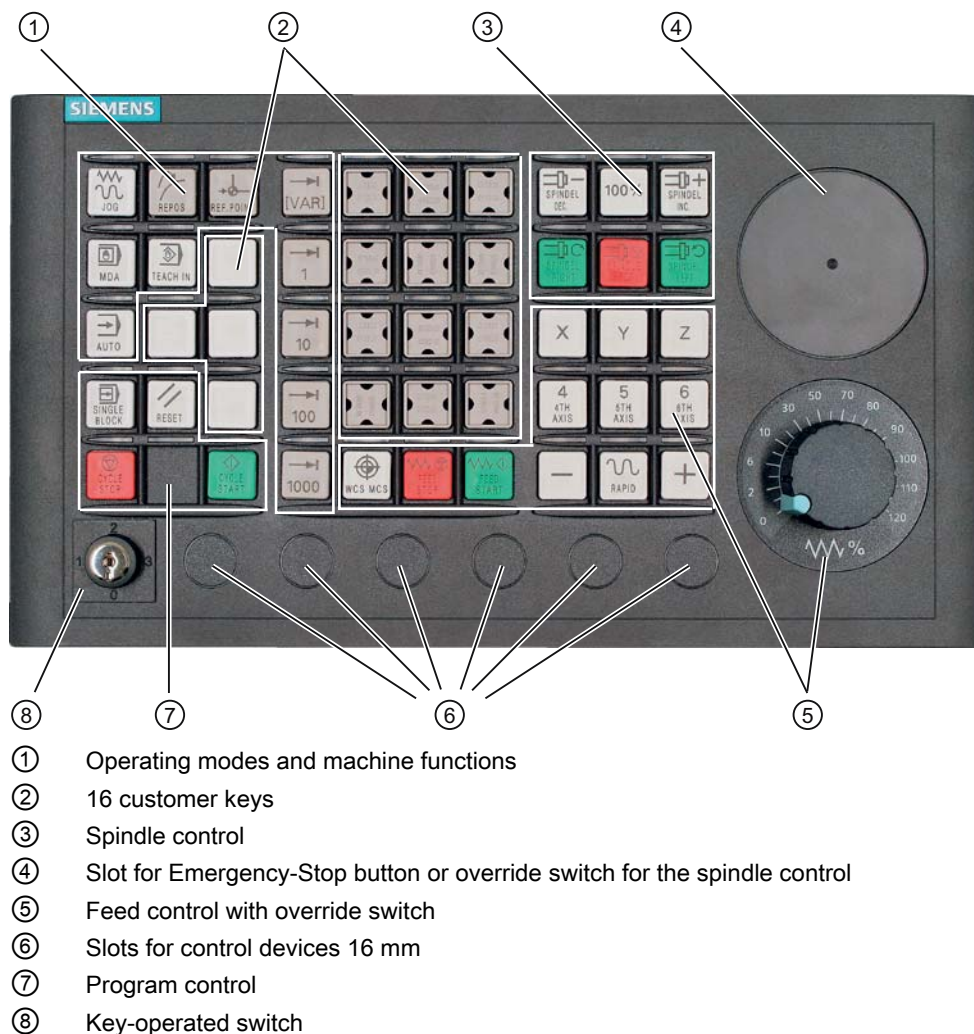


Figure 7-12 Arrangement of the MCP 310C PN control elements

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

Do not chip out the openings for mounting control devices ⑥ (risk of damage), but 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 order numbers for the key caps in Chapter Spare parts and accessories (Page 125).

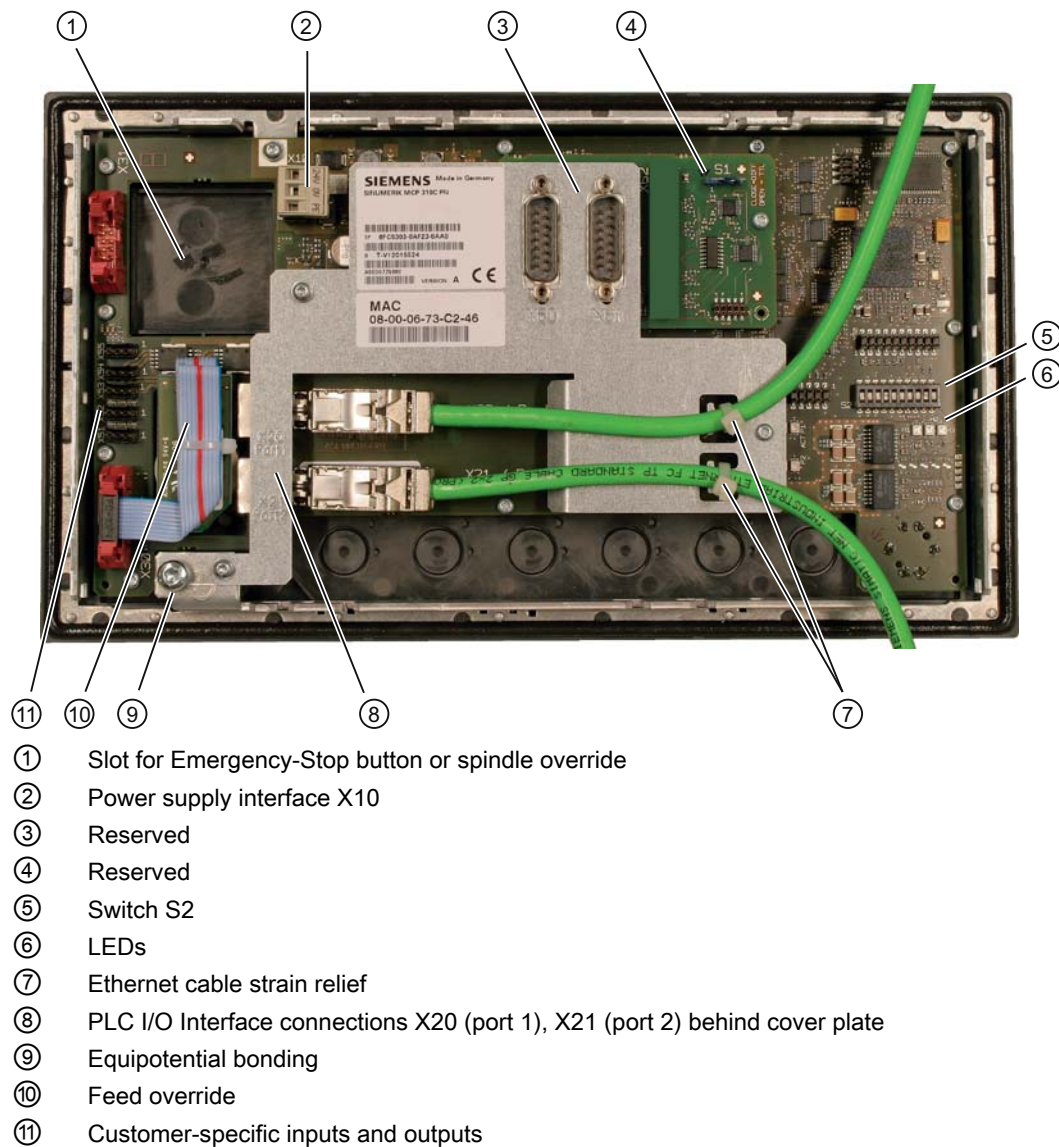


Figure 7-13 Rear of the MCP 310C PN with Ethernet connecting cables

Equipotential bonding

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

LEDs for status display

Table 7- 15 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: • 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).

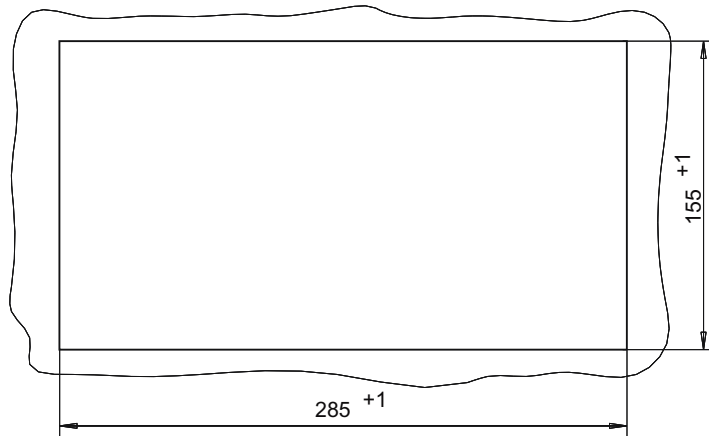


Figure 7-14 Panel cut-out for the machine control panel MCP 310C PN

Dimension drawing

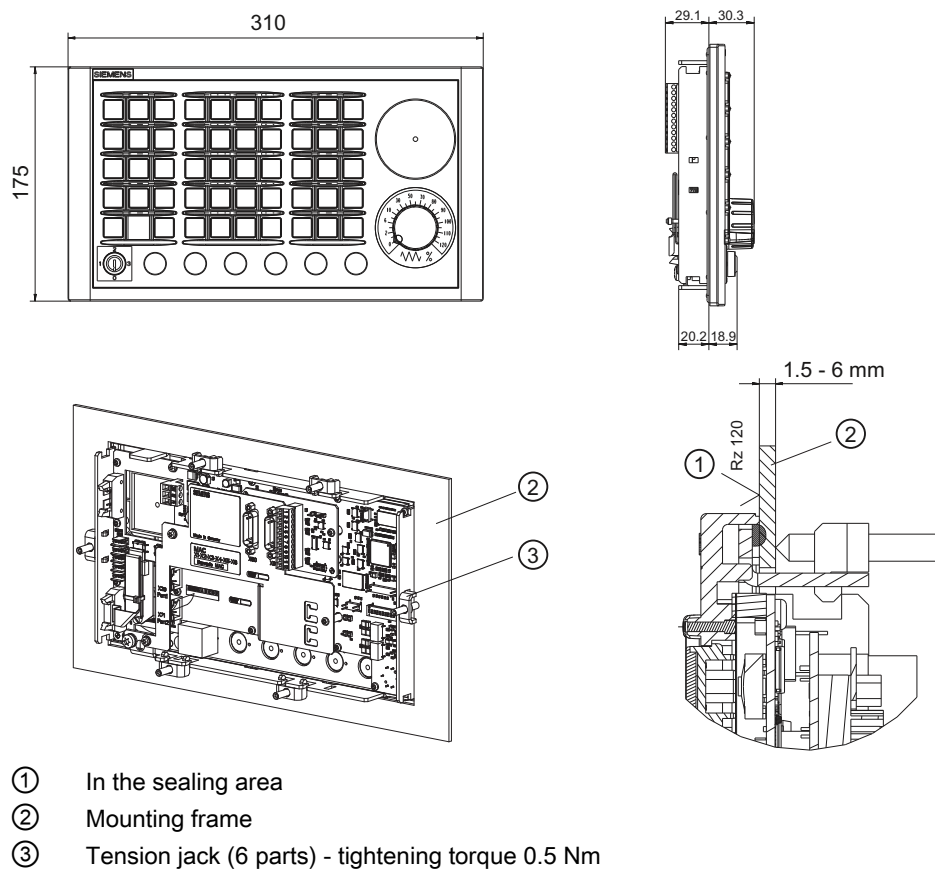


Figure 7-15 MCP 310C PN dimensions

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.

See also

Ordering data (Page 27)

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

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 / X61	Reserved
S1	Reserved
S2	Switch for setting the MCP address

7.2.3.1 Description

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- 16 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, acc. to EN 60603-13 with coding

Table 7- 17 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

Pin	Signal name	Signal type	Meaning
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.

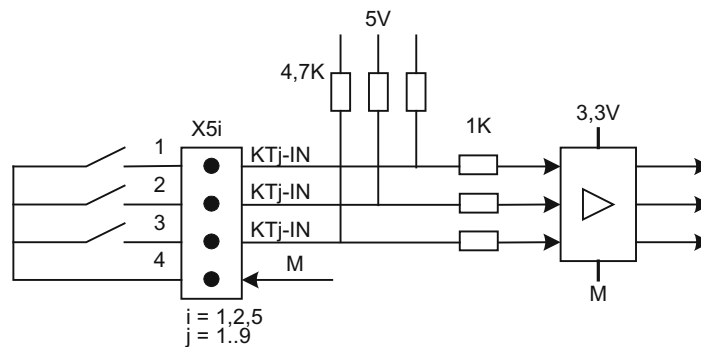


Figure 7-16 Main circuit diagram for input circuit for X51, X52 and X55

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

Connector type: 4-pin plug connector

Table 7- 18 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- 19 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- 20 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.

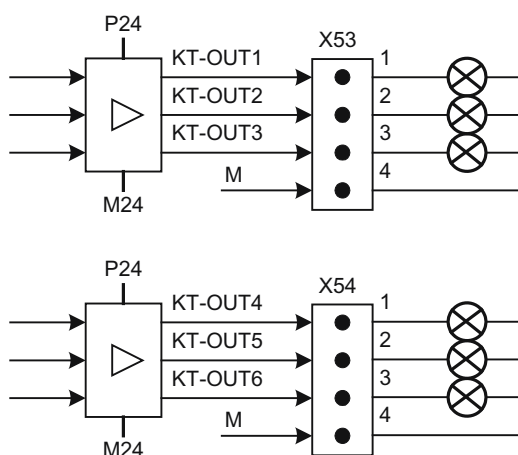


Figure 7-17 Main circuit diagram for input circuit for X53 and X54



CAUTION

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

Connector designation: **X53, X54**

Connector type: 4-pin plug connector

Table 7- 21 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- 22 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

Switch S2



Schalter S2

Switch position: "ON" is at the top.

Table 7- 23 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- 24 Settings of switch S2

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

7.2.4 Parameterization

Input image

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

Table 7- 25 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
EB115	RESET	Keyswitch position 2	Keyswitch position 1	Feedrate override				
				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				WCS MCS	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 rotary spindle override switch on X31 is replaced by a 5-stage rotary switch, the input information here can be measured in 5 stages.							

Output image

Table 7- 26 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

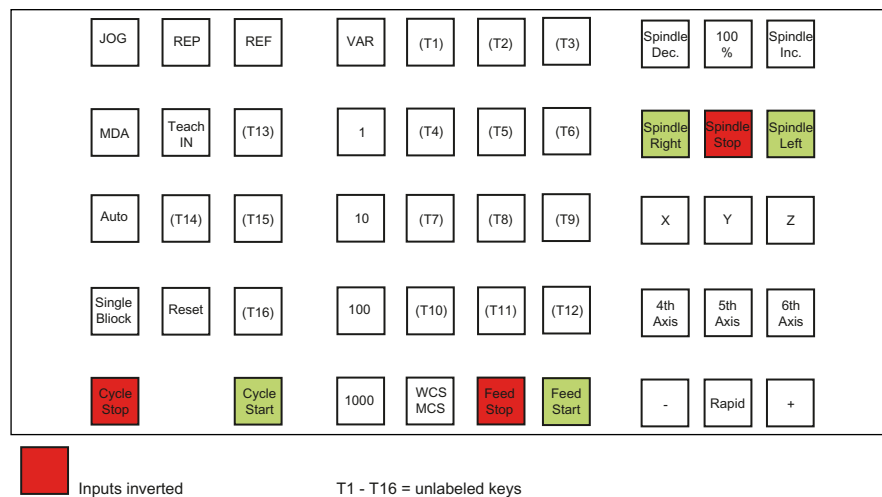


Figure 7-18 Default key assignment of MCP 310C PN

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

Safety				
Protection class	III (DVC A, PELV) acc. to EN 61800-5-1			
Degree of protection acc. to DIN IEC 529	Front side: IP54		Rear side: IP00	
Approvals	CE / cULus			
Electrical data				
Input voltage	24 VDC			
Power consumption, max.	Board 5 W	Lamps 43.2 W (6 x 7.2 W) *)	Handwheels 2 x 0.9 W	Total 50 W
Mechanical data				
Dimensions	Width: 310 mm Height: 175 mm		Depth: 85.2 mm Mounting depth (with cables): 53.9 mm Mounting depth (without cables): 29.1 mm	
Weight	Approx. 1.2 kg			
Mechanical environmental conditions	Operation		Transport (in product packaging)	
Vibratory load	10 – 58 Hz: 0.15 mm 58 – 200 Hz: 2g acc. to EN 60068-2-6 (test Fc)		5 – 9 Hz: 3.5 mm 9 - 200 Hz: 1 g according to EN 60068-2-6	
Shock stressing	15g, 11 ms 18 shocks (3 in each direction) acc. to EN 60068-1		15g, 11 ms 18 shocks (3 in each direction) acc. to EN 60068-2-27	

Climatic environmental conditions			
Cooling	By natural convection		
Condensation, splashwater and icing	Not permissible		
Supply air	Without aggressive gases, dusts and oils		
	Operation	Storage	Transport (in transport packing)
Applicable standards	DIN EN 60721-3-3	DIN EN 60721-3-1	DIN EN 60721-3-1 / -3-2
Climate class	3K3		
Temperature limits	0 ... 45 °C (at the front) 0 ... 55 °C (at the rear)	-25 °C ... 55 °C	-40 ... 70 °C

*) 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: Section "Application planning (Page 35)"

7.2.6 Spare parts and accessories

Accessories and spare parts for MCP 310C PN

Name	Description	Amount	Order 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
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

Name	Description	Amount	Order number
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.

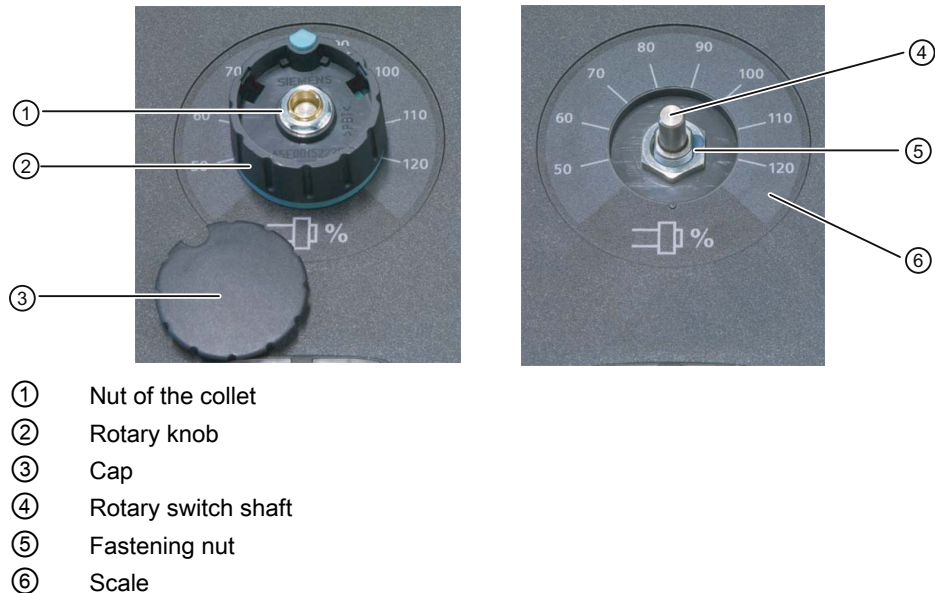


Figure 7-20 Removal of rotary switch

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.

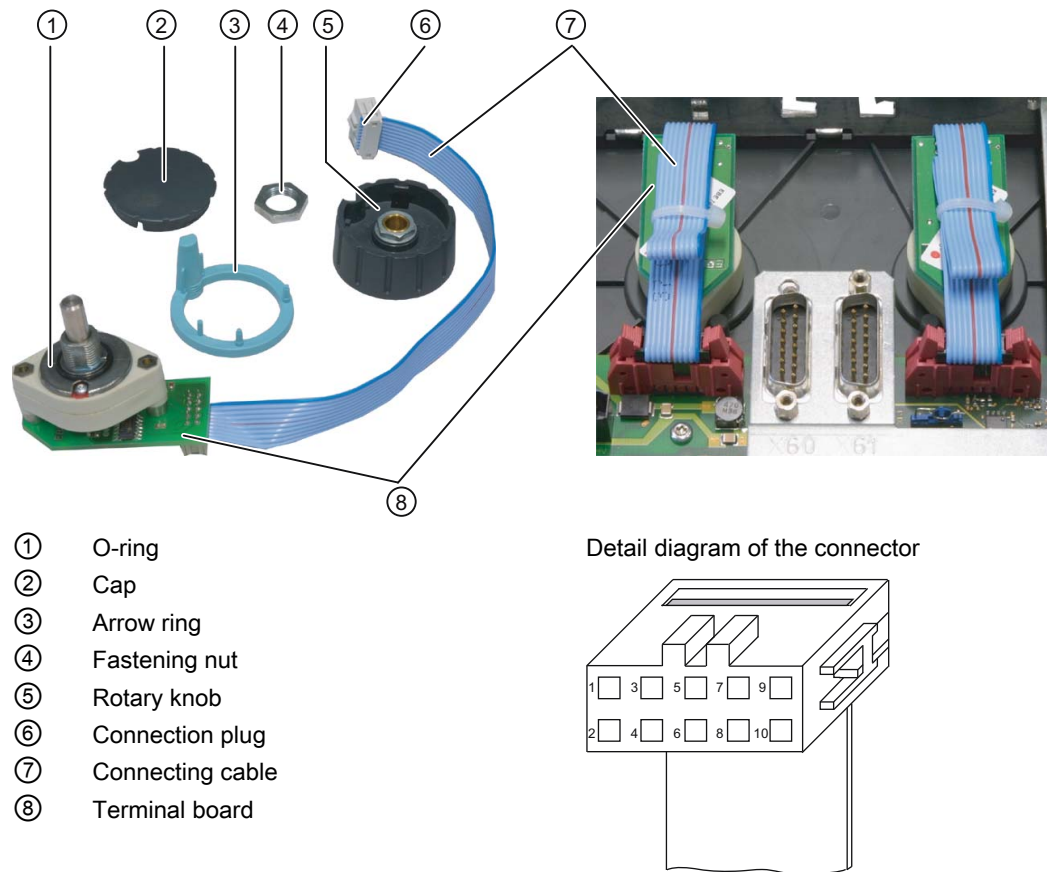


Figure 7-21 Installation of rotary switch

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

NOTICE
It is essential to use the correct tightening torques.

7.3 Mini handheld unit

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 to ergonomics and logical operating in the design of the housing and the arrangement of the control elements.

- The mini HHU can be connected to the SINUMERIK 828D control system using a connection kit.
- Key labeling can be customized using slide-in labels.
- The mini handheld unit can be fixed on metal surfaces by means of the integrated magnetic clamp.

7.3.1 Operator controls

Control elements of the mini handheld unit

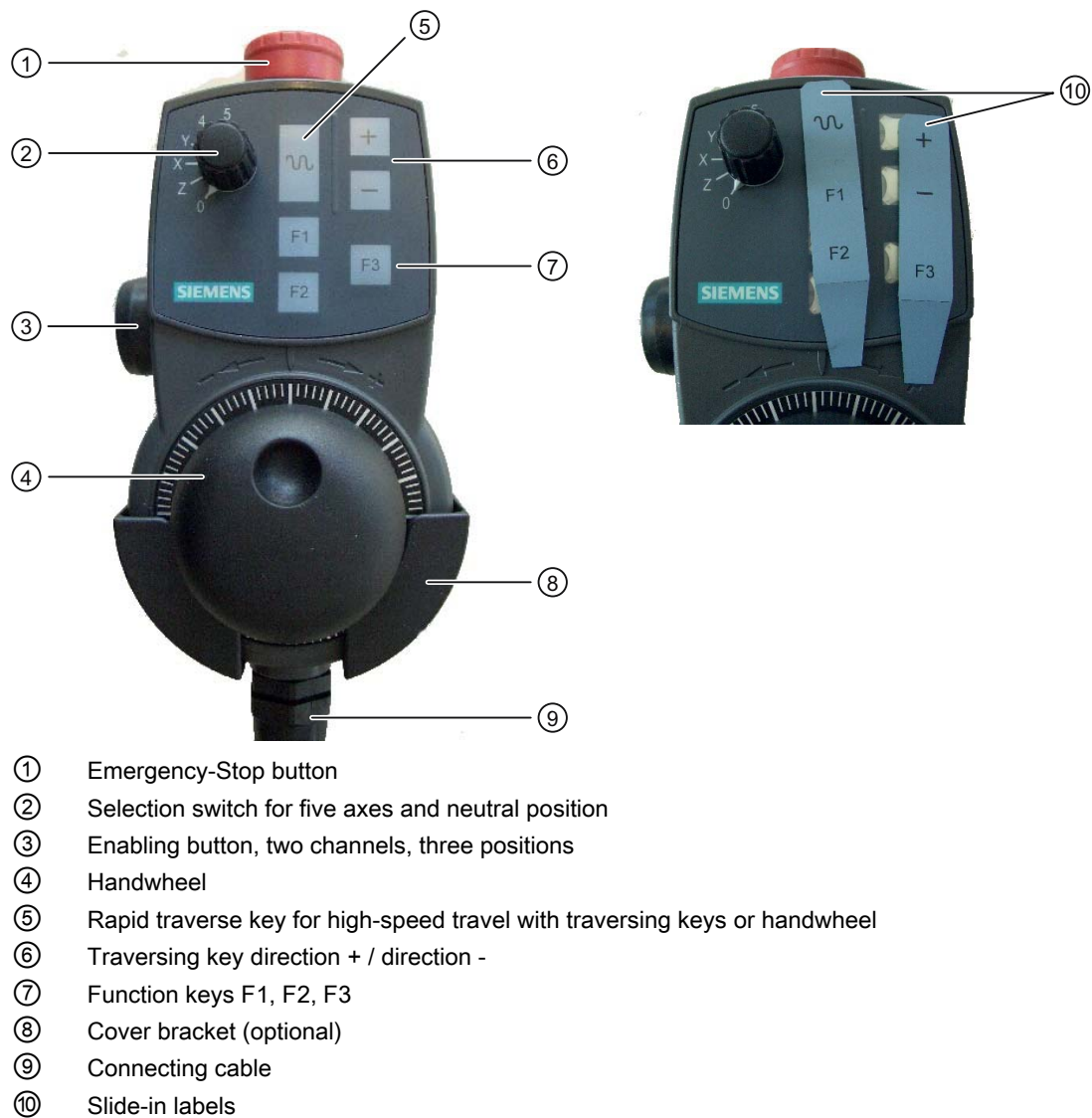


Figure 7-22 Control elements of the mini handheld unit

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- 27 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.

7.3.2 Mounting

Dimension drawing

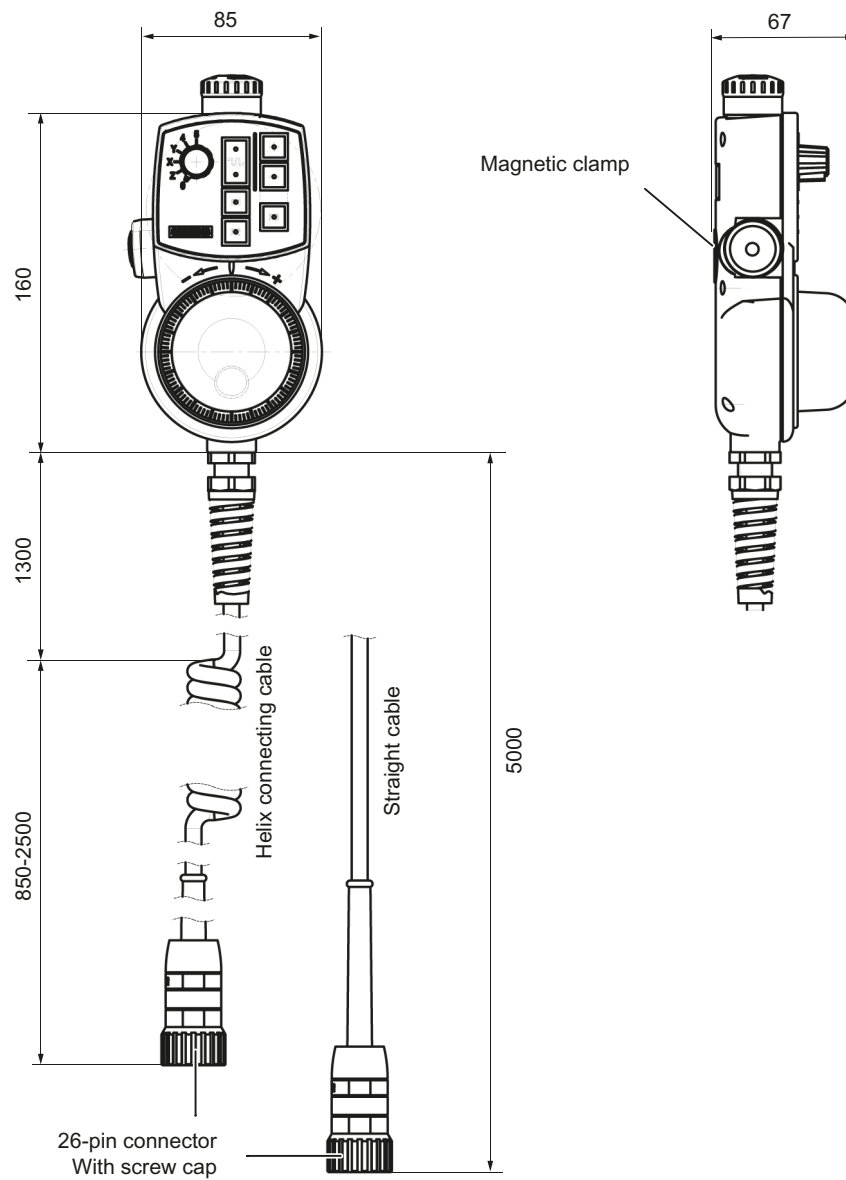


Figure 7-23 Dimensions of the mini handheld unit

7.3.3 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.

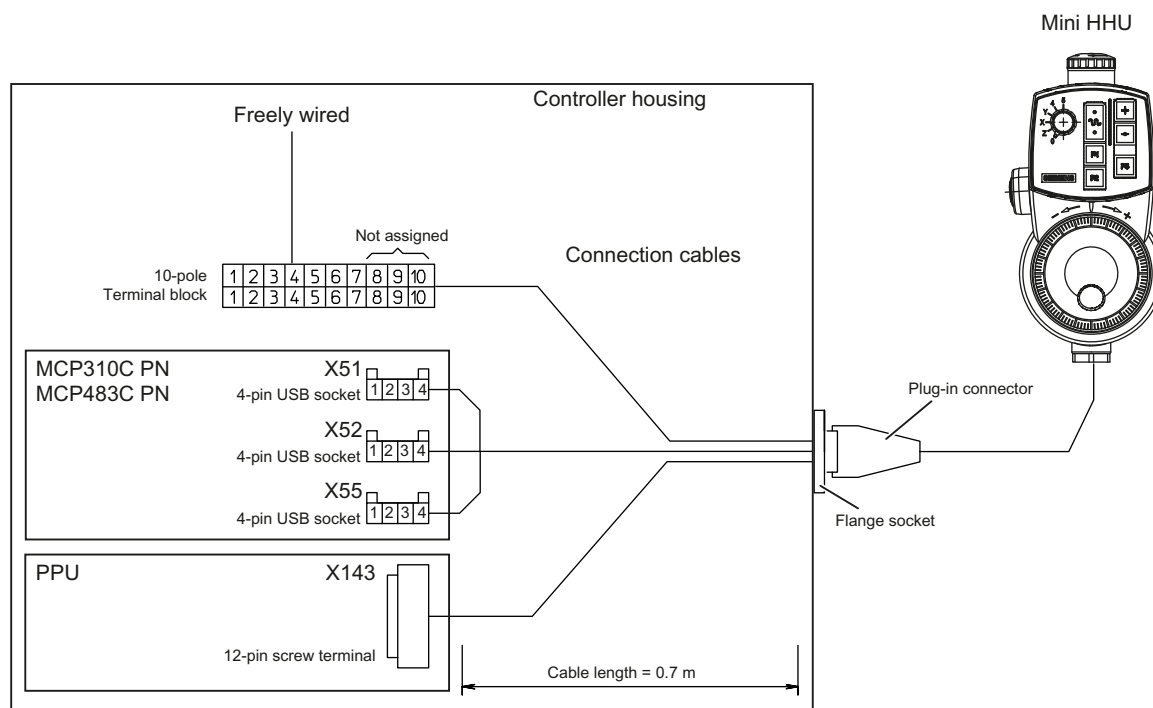


Figure 7-24 Connection diagram

Connection kit with flange socket

Procedure:

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

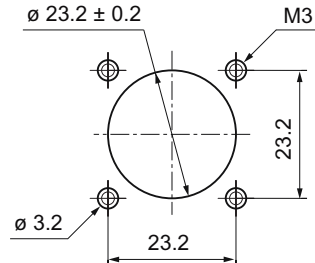
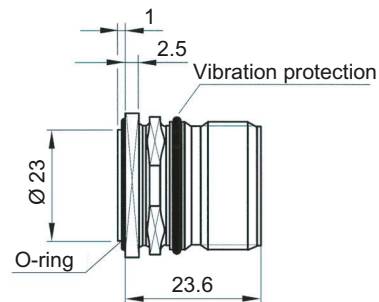


Figure 7-25 Hole pattern for mounting

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 (see below).
5. 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 7-26 Flange socket



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

Note

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

Handwheel

A1	X1/1	A	gn	23	gn	3	A
	X1/2	/A	ge	22	ge	4	/A
	X1/3	B	gr	21	rt	5	B
	X1/4	/B	rs	20	bl	6	/B
	X1/5	+UB: DC 5 V	br	19	sw	1	DC5V
	X1/6	0 V	ws	18	br	2	0V

Function keys

S8	4	3	F3	X7/8	X3/6	grbr	17	sw	3	F3
S7	4	3	F2	X7/7	X3/1	wsgr	15	gn	2	F2
S6	4	3	F1	X7/5	X3/4	gebr	14	ge	1	F1
S5	4	3		X7/3	X3/2	wsge	13	gr	3	
S4	4	3	-	X7/6	X3/5	brgn	12	rs	2	-
S3	4	3	+	X7/4	X3/3	wsgr	11	bl	1	+
				X7/2	X4/2	grrs	16	rt	4	

Axis selection

S9	1	011	Z	X10/3	X4/1	rsbr	10	vt	3	Z
	2	010	X	X10/2	X4/5	wsbl	9	br	2	X
	3	110	Y	X10/4	X4/4	brbl	8	ws	1	Y
	4	111		X10/5	X4/3					
	5	101	4	X10/1	X4/6					4
	6	100	5							5

Enabling button

S2	14	14	X2/4	wsrt	7	bl	7
	13	13	X2/2	wsrs	6	rs	6
			X2/1	rtbl	5	gr	5

Emergency stop

S1	1	1	X5/1	vt	4	ge	4
	2	2	X5/4	sw	3	gn	3
			X5/3	rt	2	br	2
			X5/2	bl	1	ws	1

Legend:

bl	Blue	brbl	Brown blue
br	Brown	gebr	Yellow brown
ge	Yellow	grbr	Gray brown
gn	Green	grrs	Gray pink
gr	Gray	rsbr	Pink brown
rs	Pink	rtbl	Red blue
rt	Red	wsbl	White blue
sw	Black	wsge	White yellow
vt	Violet	wsgr	White gray
ws	White	wsrs	White pink
		wsrt	White red

Notes:

- 26-pin plug connector On the operator panel housing
- Coors 0.14 mm²
- 5x2x0,25mm²
- 4x2x0,56mm²
- Shielded

Figure 7-27 Mini HHU circuit diagram

Additional options

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

- **Adapter plate**

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

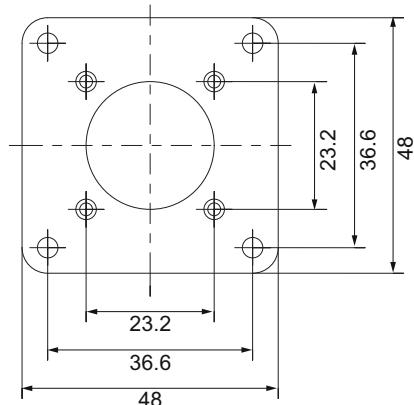


Figure 7-28 Dimension drawing of the adapter plate

- **Angle box**

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

Note

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

- **Retaining plate**

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

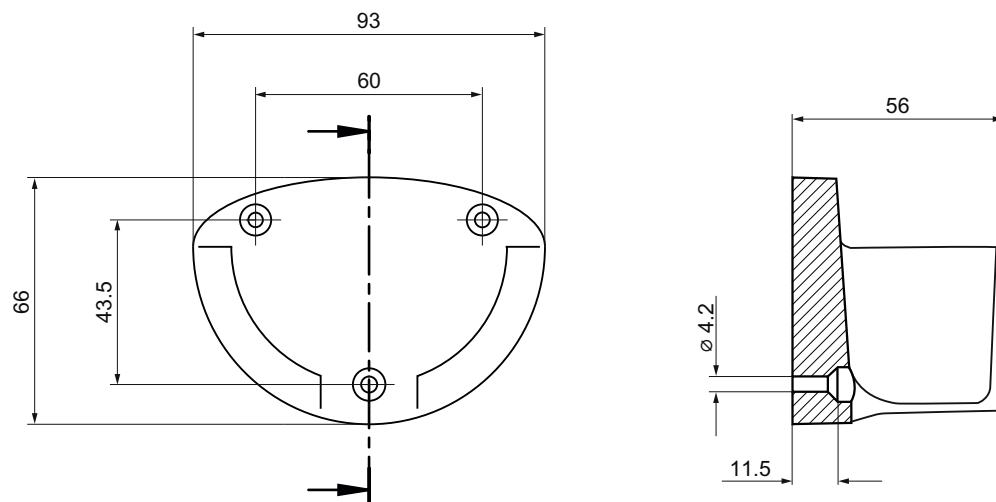


Figure 7-29 Dimension drawing of the retaining plate

7.3.4 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 (byte 122 and byte 123). The customer keys (inputs) are then not available for other applications.

Input image for MCP with standard addresses:

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

Note

Within the SINUMERIK controller, the handwheel data are processed directly by the NCK and are not available to the PLC.

7.3.5 Technical data

Table 7- 28 Technical specifications of the mini HHU

Operator controls				
Enabling button		floating	Two channels	NO contact, 3-positions
Emergency Stop button		floating	Two channels	NC contact, locked by twisting
Selection switch		5 axes: X, Y, Z. 4. 5 and neutral position		
	Jog key	Positive traverse direction		
	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		
Electrical data				
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				
Protection class		IP65 (to EN 60529)		
Approvals		CE		
Mechanical data				
Dimensions approx.		Height: 180 mm	Width: 90 mm	Depth: 67 mm
Approx. weight		0.5 kg without connecting cable		
Max. cable length		25 m		
Ambient conditions				
		Application/operation		Storage/transport
Temperature ranges		0 ... 55 °C		-20 ... 60° C
Temperature change		Within 1 minute max. 0.2 K		
Permissible change in relative humidity EN 60721-3-3, Class 3K5				
Within 1 minute		Max. 0.1%		

7.3.6 Spare parts and accessories

List of the spare parts

The following spare parts are available:

Item name	Order 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
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	Order number	Remarks
Connection kit	6FX2006-1BG20	With terminating connector
Connection kit	6FX2006-1BG25	Without terminating connector
Angle box	6FX2006-1BG56	Non-assembled, metal version
Adapter plate	6FX2006-1BG45	Non-assembled, plastic on metal version
Retaining plate	6FX2006-1BG70	Including three M4 screws

7.4 PP 72/48D PN

7.4.1 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

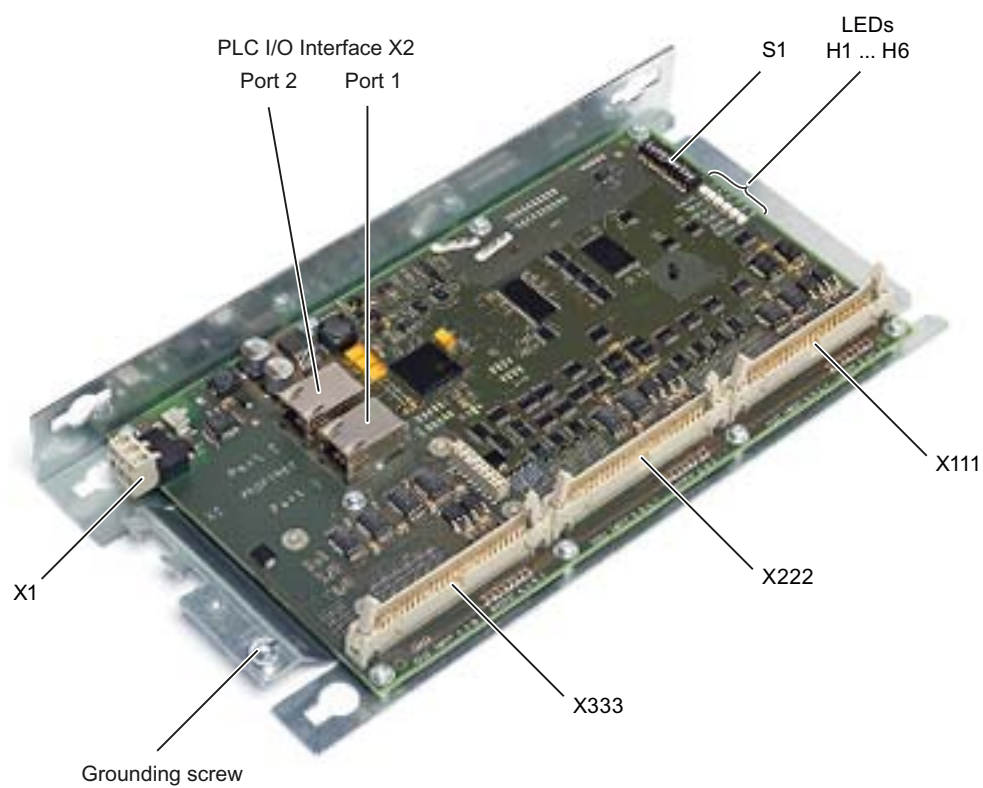


Figure 7-30 PP 72/48D PN I/O module

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.

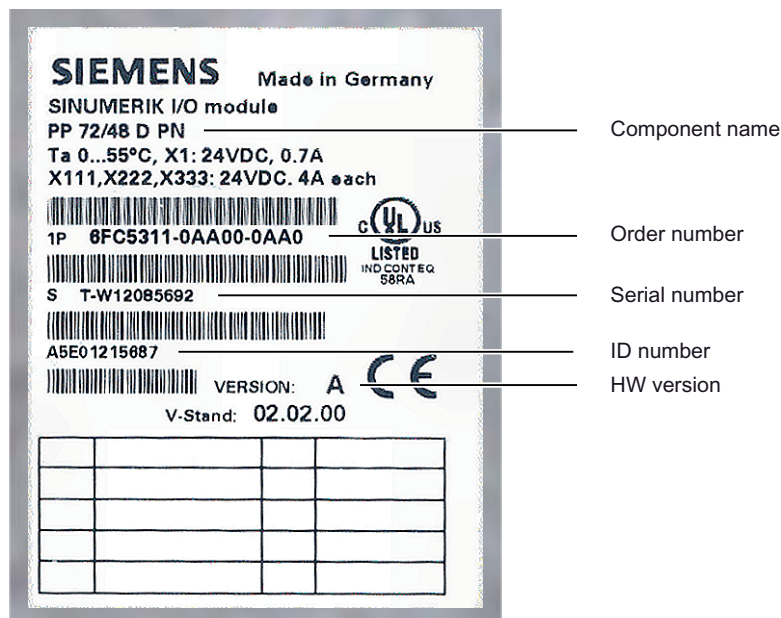


Figure 7-31 PP 72/48D PN type plate

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: - No physical connection to a subnet/switch - Incorrect transmission rate - Full duplex transmission is not activated

Name	Designation	Color	Description
H4	DIAG1	Green	Reserved
H5	DIAG2	Green	Reserved
H6	OVTemp	Red	Overtemperature indication

Note

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

7.4.2 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**

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

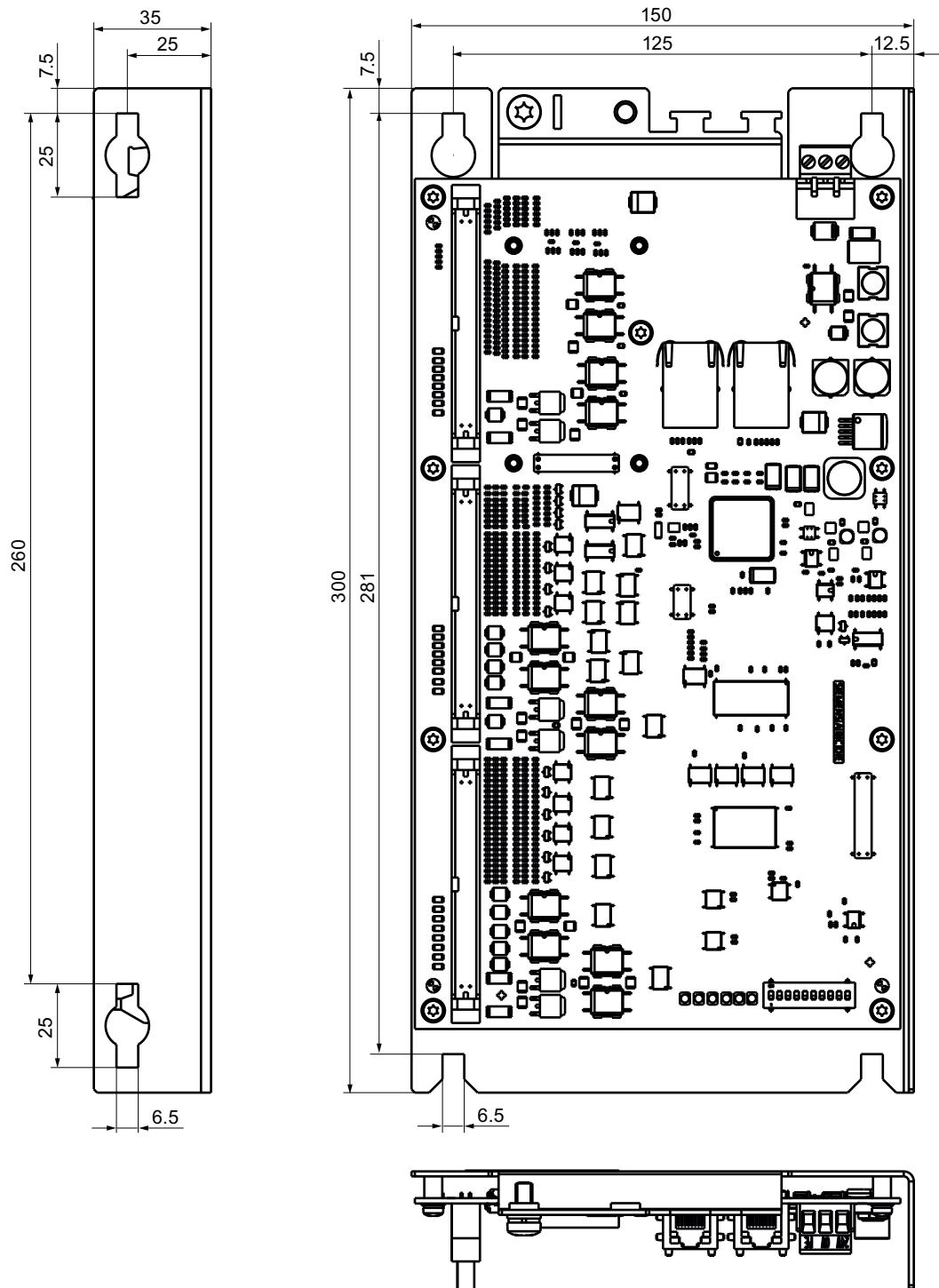


Figure 7-32 PP 72/48D PN dimensions

7.4.3 Connecting

Connection options

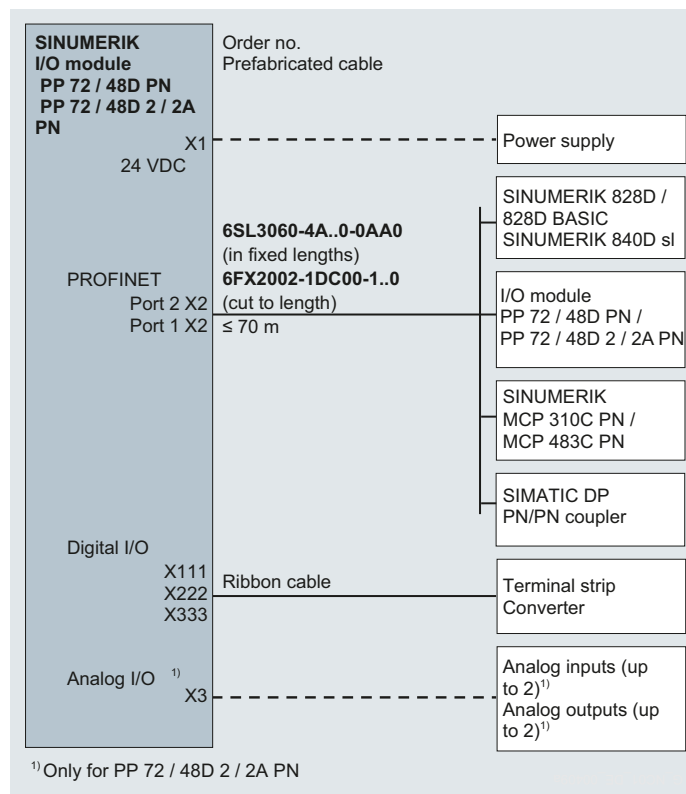


Figure 7-33 Connections of the PP 72/48D PN

Interfaces

Table 7- 29 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 77)

7.4.3.1 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.

CAUTION
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).

7.4.3.2 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:

- Order No.: 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- 30 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- 31 PROFINET ports LED displays

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

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- 32 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.

NOTICE

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".

7.4.3.3 X111, X222 and X333 pin assignment

Pin assignment

Table 7- 33 Pin assignment X111

Pin	Signal name	Type	Pin	Signal name	Type
1	M	GND	2	P24OUT	VO
3	DI 0.0	I	4	DI 0.1	I
5	DI 0.2	I	6	DI 0.3	I
7	DI 0.4	I	8	DI 0.5	I
9	DI 0.6	I	10	DI 0.7	I
11	DI 1.0	I	12	DI 1.1	I
13	DI 1.2	I	14	DI 1.3	I
15	DI 1.4	I	16	DI 1.5	I
17	DI 1.6	I	18	DI 1.7	I
19	DI 2.0	I	20	DI 2.1	I
21	DI 2.2	I	22	DI 2.3	I
23	DI 2.4	I	24	DI 2.5	I
25	DI 2.6	I	26	DI 2.7	I
27	Not assigned	-	28	Not assigned	-
29	Not assigned	-	30	Not assigned	-
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- 34 Pin assignment for X222

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

Table 7- 35 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)					

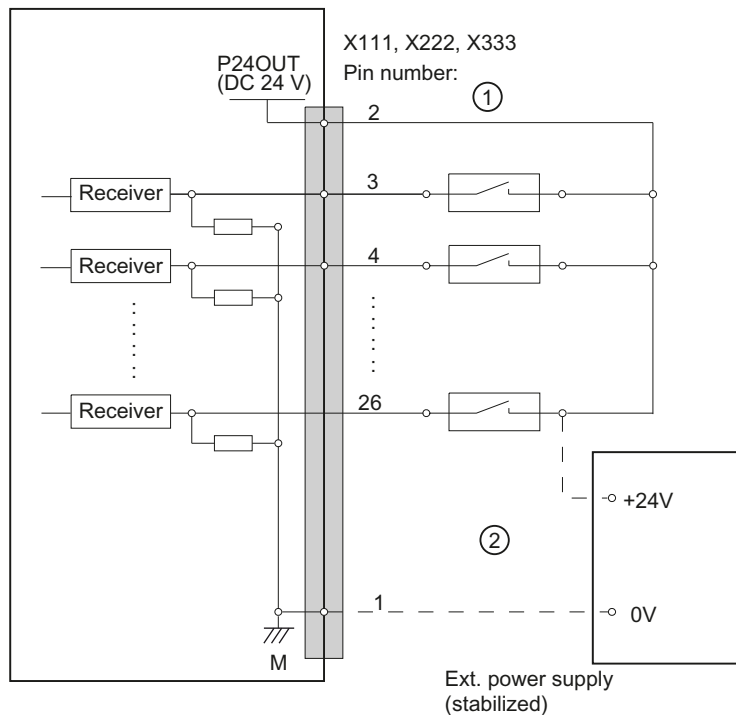
Cable specification:

- 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

7.4.3.4 Specification of the digital inputs

Terminal assignment for the digital inputs

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



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

Figure 7-34 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.

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

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

Technical data:

Table 7- 36 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)	-30 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

7.4.3.5 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.

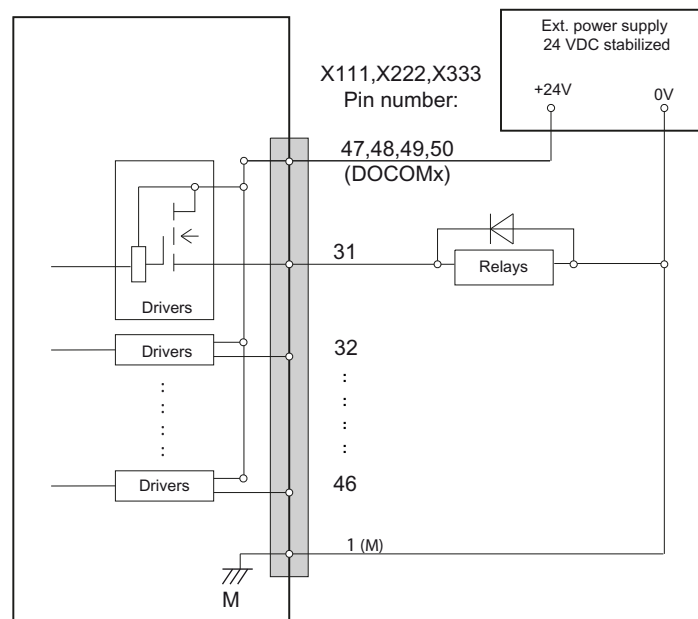


Figure 7-35 Terminal assignment for the digital outputs

CAUTION

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- 37 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.				

7.4.4 Parameter assignment

7.4.4.1 Input / output images

Input image

The image comprises 3 slots (n, m, d $\triangleq$ start address, see Addressing the I/O modules (Page 77)):

- 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- 38 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- 39 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- 40 Output image of digital outputs for the 1st I/O module (n=0)

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

Table 7- 41 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

7.4.4.2 Diagnostics via input image

Table 7- 42 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- 43 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- 44 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- 45 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	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- 46 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

7.4.5 Technical data

Table 7- 47 Technical data of the I/O module

Safety		
Degree of protection	IP 00 according to EN 60529	
Protection class	III; DVC A, (PELV) acc. to EN 61800-5-1	
Approvals	cULus, CE	
Power consumption at rated load (without digital outputs)		
PP 72/48D PN	17 W	
Mechanical data		
Dimensions (WxHxD)	(150 x 300 x 35) mm	
Weight, approx.	0.9 kg	
Climatic environmental conditions		
Cooling	Open-circuit ventilation	
	Operation	Storage/transport
Temperature limits	0 ... 55 °C	-40 ... 70 °C
Limits for relative humidity	5 ... 90%	5 ... 95%
At 25 °C	Without condensation	Without condensation
Condensation	Not permissible	
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.	
Shock stress during transportation		
Free fall	≤ 1 m (in transport packaging)	

7.5 PP 72/48D 2/2A PN

7.5.1 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

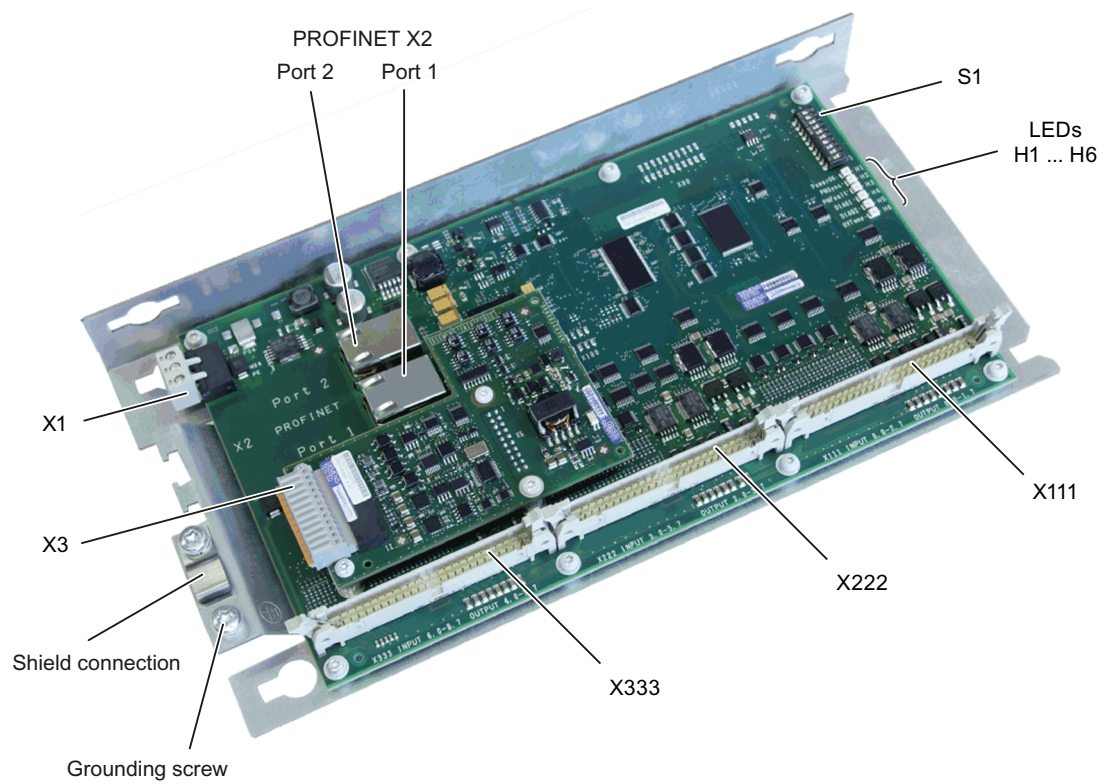


Figure 7-36 PP 72/48D 2/2A PN I/O module

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.

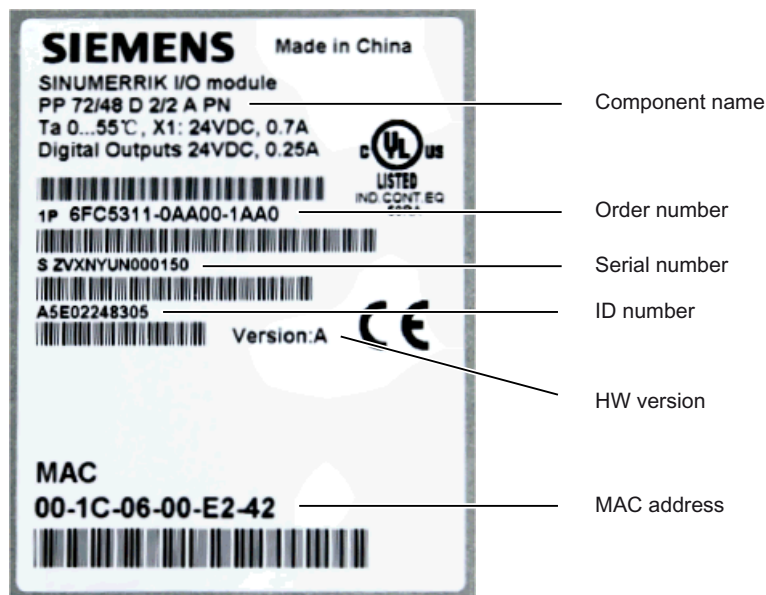


Figure 7-37 PP 72/48D 2/2A PN type plate

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- 48 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: - No physical connection to a subnet/switch - Incorrect transmission rate - Full duplex transmission is not activated

Name	Designation	Color	Description
H4	DIAG1	Green	Reserved
H5	DIAG2	Green	Reserved
H6	OVTemp	Red	Overtemperature indication

Note

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

7.5.2 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

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

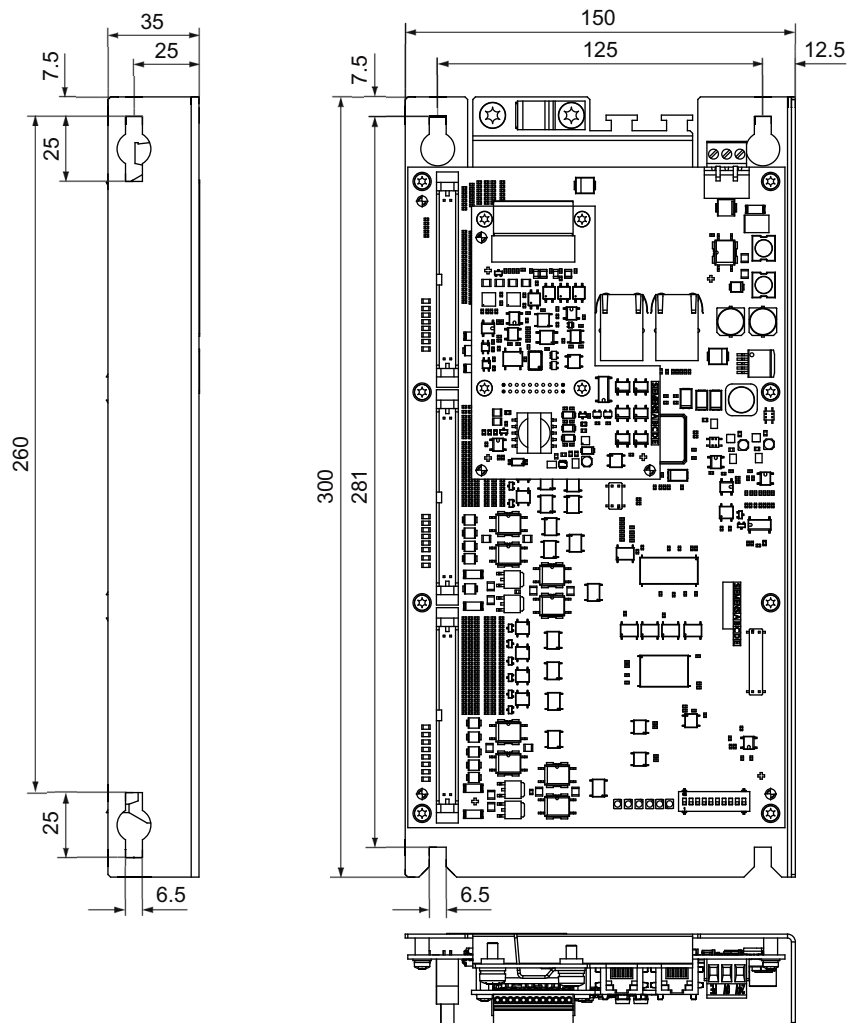


Figure 7-38 PP 72/48D 2/2A PN dimension drawing

7.5.3 Connection

Connection options

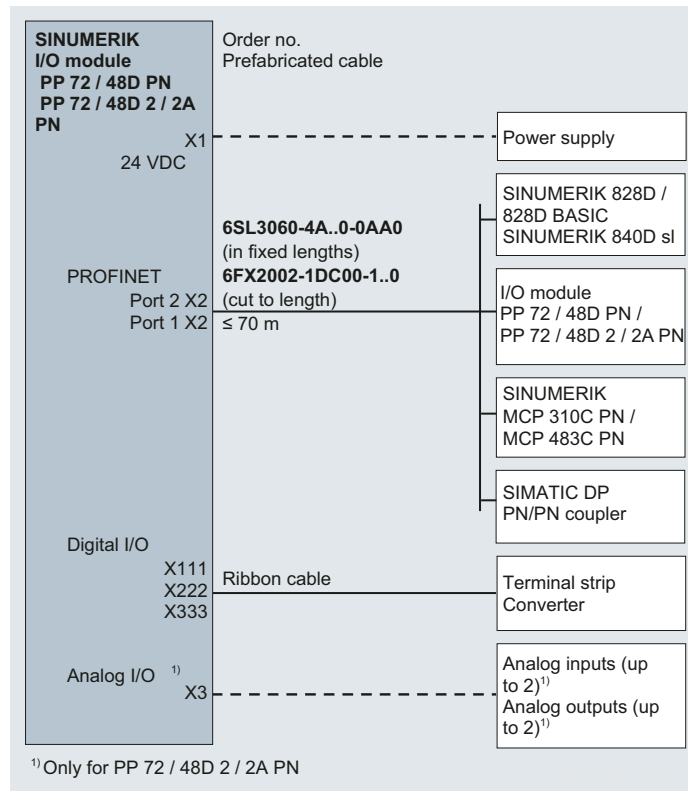


Figure 7-39 PP 72/48D 2/2A PN connections

Interface overview

Table 7- 49 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

NOTICE

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

See also

Addressing the I/O modules (Page 77)

7.5.3.1 X1 power supply**Requirements for the power supply****DANGER**

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

The DC power supply must be connected to the ground/shield of the I/O module for EMC and/or functional reasons. For EMC reasons, this connection should only be made at one point; see also EMC Installation Guide.

Table 7- 50 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.

CAUTION

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- 51 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

The 24 V direct voltage is to be configured as an extra-low voltage with safe isolation - DVC A or PELV.

Power cables

Table 7- 52 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.

7.5.3.2 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:

- Order No.: 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- 53 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- 54 PROFINET ports LED displays

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

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- 55 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.

NOTICE

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".

7.5.3.3 X111, X222 and X333 pin assignment

Pin assignment

Table 7- 56 Pin assignment X111

Pin	Signal name	Type	Pin	Signal name	Type
1	M	GND	2	P24OUT	VO
3	DI 0.0	I	4	DI 0.1	I
5	DI 0.2	I	6	DI 0.3	I
7	DI 0.4	I	8	DI 0.5	I
9	DI 0.6	I	10	DI 0.7	I
11	DI 1.0	I	12	DI 1.1	I
13	DI 1.2	I	14	DI 1.3	I
15	DI 1.4	I	16	DI 1.5	I
17	DI 1.6	I	18	DI 1.7	I
19	DI 2.0	I	20	DI 2.1	I
21	DI 2.2	I	22	DI 2.3	I
23	DI 2.4	I	24	DI 2.5	I
25	DI 2.6	I	26	DI 2.7	I
27	Not assigned	-	28	Not assigned	-
29	Not assigned	-	30	Not assigned	-
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- 57 Pin assignment for X222

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

Table 7- 58 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)					

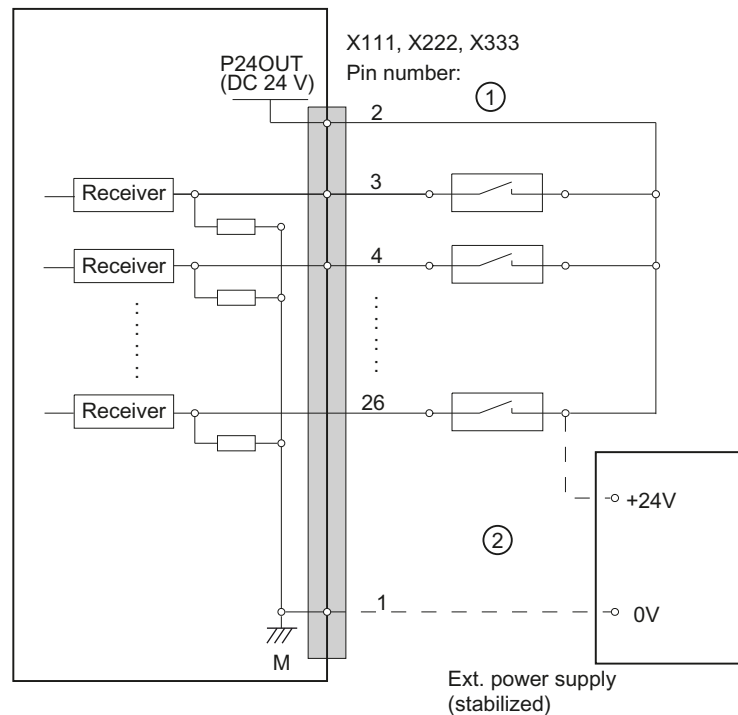
Cable specification:

- 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

7.5.3.4 Specification of the digital inputs

Terminal assignment for the digital inputs

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



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

Figure 7-40 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.

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

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

Technical data:

Table 7- 59 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)	-30 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

7.5.3.5 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.

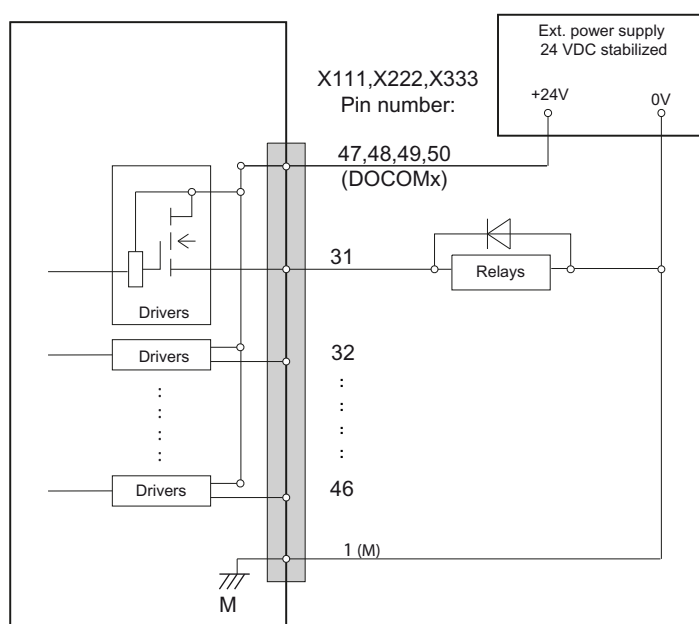


Figure 7-41 Terminal assignment for the digital outputs

CAUTION

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- 60 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.				

7.5.3.6 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.

CAUTION**Shield contact**

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

X3 pin assignment

Table 7- 61 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.

NOTICE

The analog inputs are only enabled following the parameter assignment.

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

Table 7- 62 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)

Parameter	Value
Accuracy	+/- 0.5%
Internal resistance Ri	100 kOhm

Table 7- 63 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- 64 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

CAUTION

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

In the event of an error the following occurs:

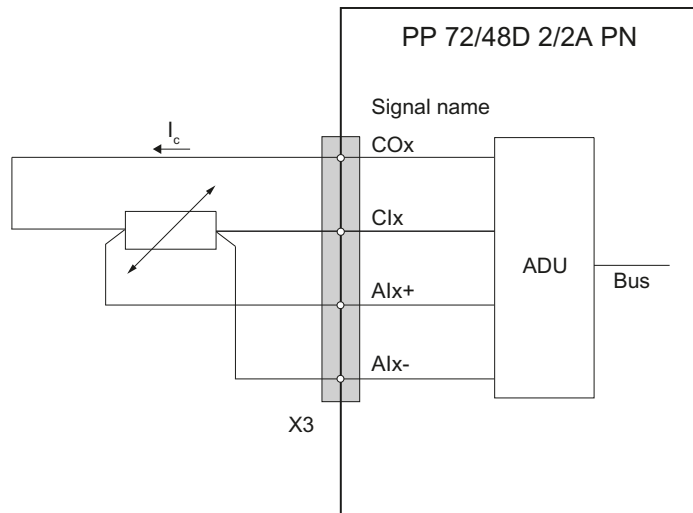
1. An error bit is set which is then communicated to the PLC.
2. The module is shut down.

Measurement using a 4-wire connection system

Notes regarding the connection and operation of PT100 resistors:

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

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



x 1, 2

ADU Analog Digital Unit

I_c Constant current

Figure 7-42 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.

NOTICE

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- 65 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- 66 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

7.5.4 Assigning parameters

7.5.4.1 Input / output images

Input image

The image comprises 3 slots (n, m, d $\triangleq$ start address, see Addressing the I/O modules (Page 77)):

- 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- 67 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- 68 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, $\triangle$ 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- 69 Output image of digital outputs for the 1st I/O module (n=0)

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

Table 7- 70 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

7.5.4.2 Diagnostics via input image

Table 7- 71 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- 72 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- 73 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- 74 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	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- 75 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

7.5.4.3 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.

NOTICE

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

Assigning parameters to the analog inputs

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

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

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

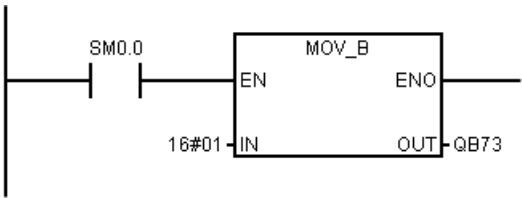
Operating mode 4th channel	Bit 7	Bit 6
No operating mode	0	0
Voltage output	0	1
Current output	1	0
Impermissible operating mode	1	1

Checkback signal of the operating modes

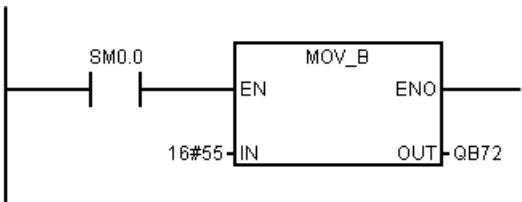
The set operating modes are saved in the input image in Status Byte 0. This value must be compared with Control Byte 0 in the output image. If these are different, an error has occurred, e. g. in the case of overvoltage in the "Temperature measurement" operating mode, see Diagnostics via input image (Page 182).

Examples of programming

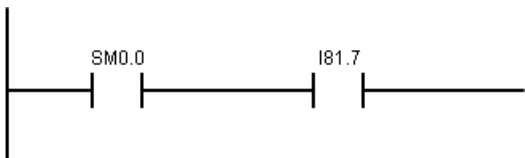
1. Determine control type:



2. Set the operating mode:



3. Query the error status bit in cyclic operation:



7.5.4.4 Analog value representation

NOTICE

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- 76 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- 77 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		-	Up to -23.5 mA
Underflow		-	Deactivation

Table 7- 78 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- 79 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		-	Up to -10.5 V
Underflow		-	Deactivation

Table 7- 80 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		-	-20.2 mA
Underflow		-	Deactivation

7.5.4.5 Examples

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

Table 7- 81 Measured values and responses in the voltage measurement operating mode

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

Table 7- 82 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
Diagnostics	IB50	-	-	-	16#2
	IB51	16#0	16#0	16#0	16#7
PNFault LED		off	off	off	on
Troubleshooting					Deactivating/ activating

Table 7- 83 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

7.5.5 Technical data

Table 7- 84 Technical data of the I/O module

Safety		
Degree of protection	IP 00 according to EN 60529	
Protection class	III; DVC A, (PELV) acc. to EN 61800-5-1	
Approvals	cULus, CE	
Electrical data		
Rated voltage	24 VDC	
Rated current	0.7 A	
Power consumption at rated load	19 W (without digital outputs)	
Power loss	18 W	
Mechanical data		
Dimensions WxHxD	150 x 300 x 35 mm	
Weight, approx.	0.9 kg	
Climatic environmental conditions		
Cooling	Open-circuit ventilation	
	Operation	Storage/transport
Temperature limits	0 ... 55 °C	-40 ... 70 °C
Limits for relative humidity	5 ... 90%	5 ... 95%
At 25 °C	Without condensation	Without condensation
Condensation	Not permissible	
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.
Shock stress during transportation	
Free fall	≤ 1 m (in transport packaging)

7.6 NX10.3

7.6.1 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:

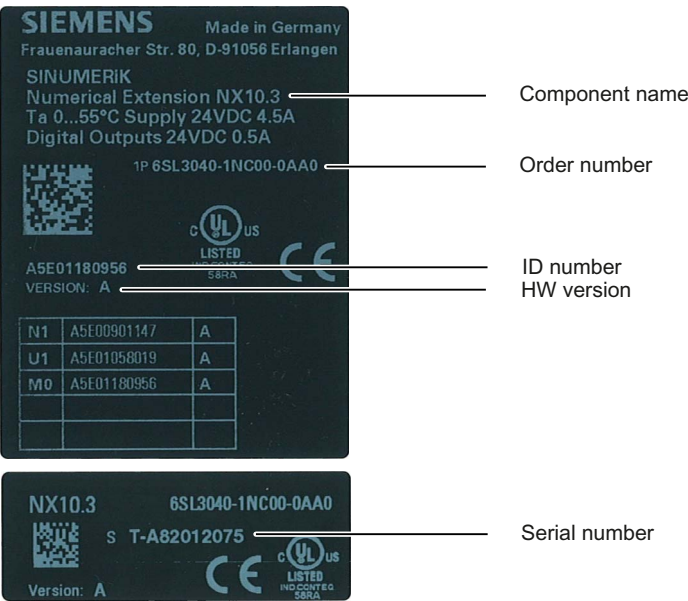


Figure 7-43 NX10.3 type plate

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)

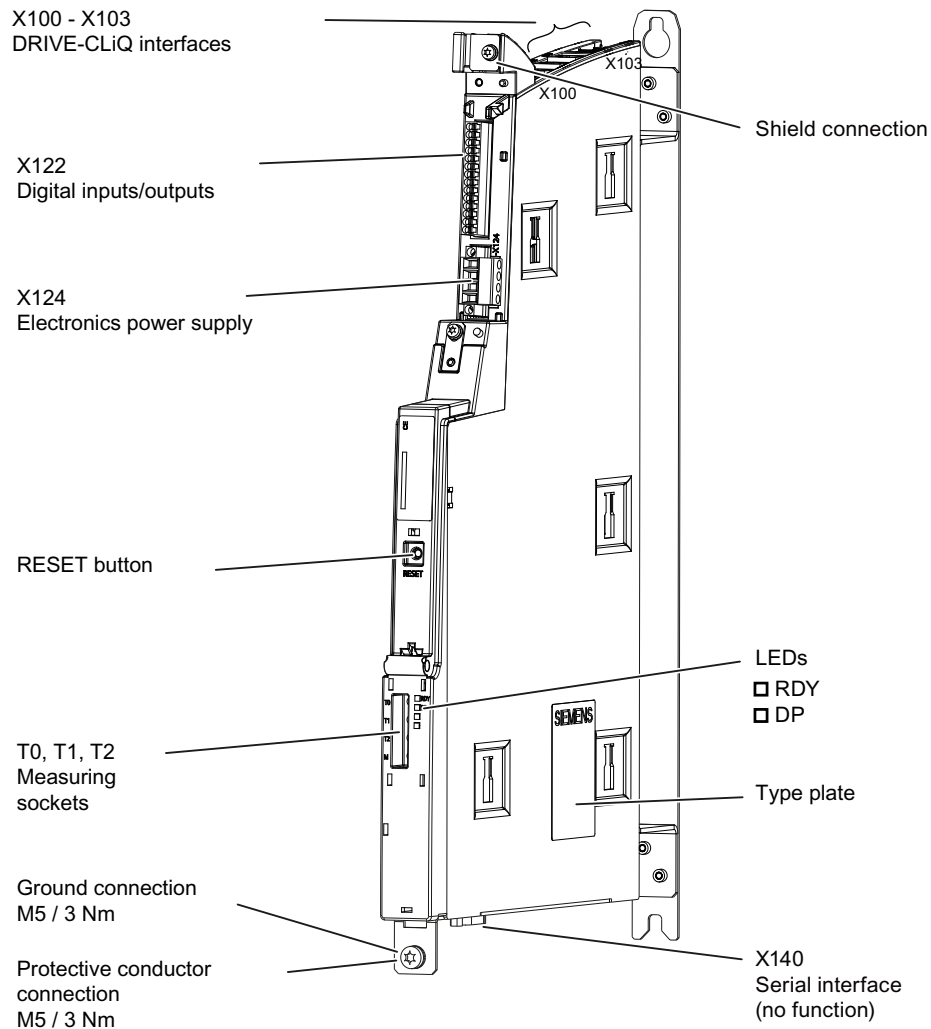


Figure 7-44 Illustration of the NX10.3 (without cover)

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.
		Flashing 2 Hz	Writing to CompactFlash card
	Red	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.

NOTICE

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.

7.6.2 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.

CAUTION

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

Mounting aids

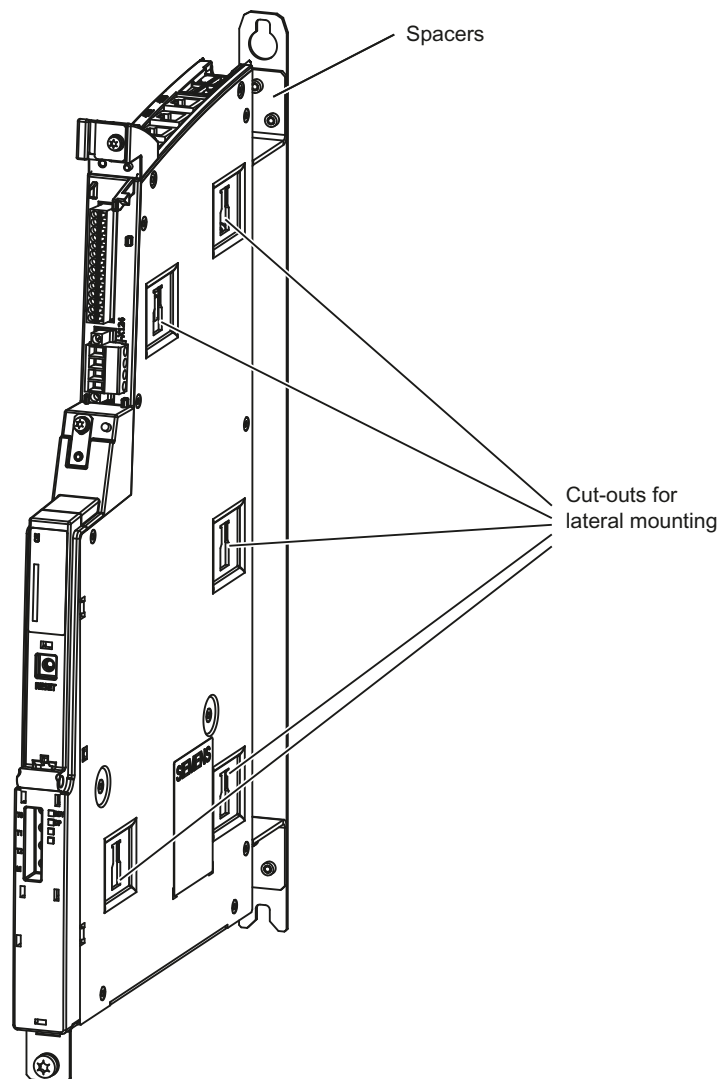


Figure 7-45 NX10.3 mounting aids

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

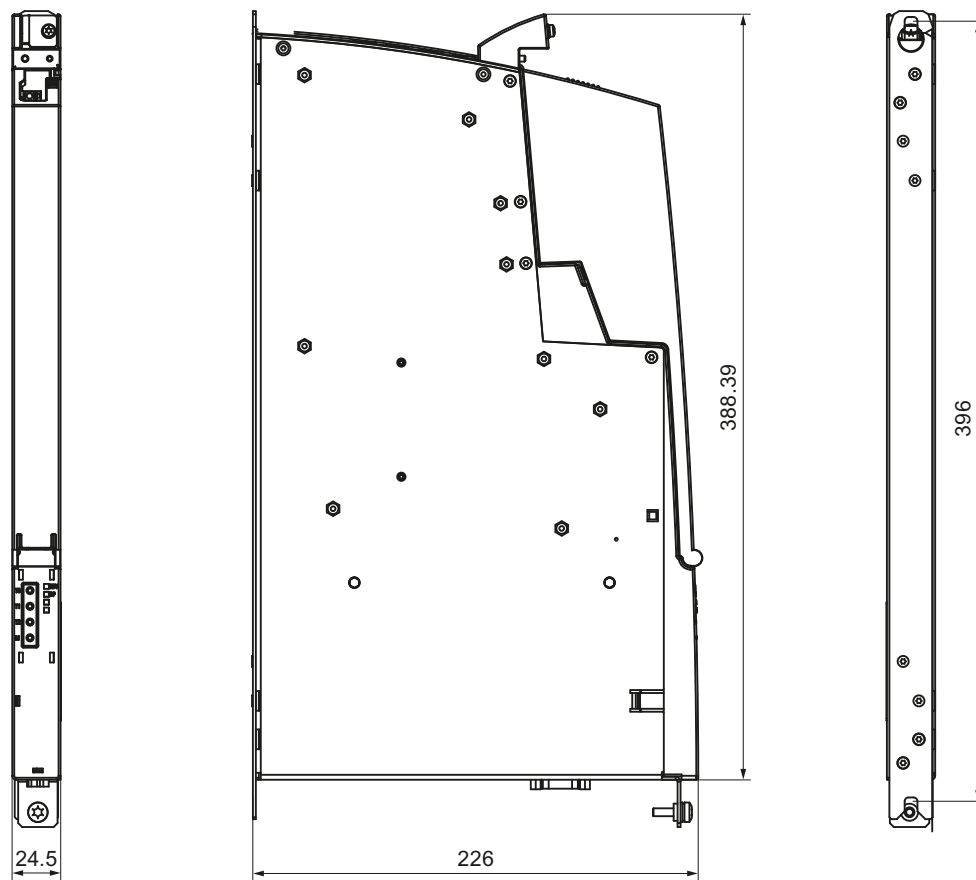


Figure 7-46 NX10.3 dimensions

7.6.3 Connecting

Power supply X124

Connector designation: **X124**
 Connector type: Screw terminal 2
 Max. connectable cross-section: 2.5 mm²

Table 7- 85 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- 86 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- 87 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)
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".

NOTICE

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.

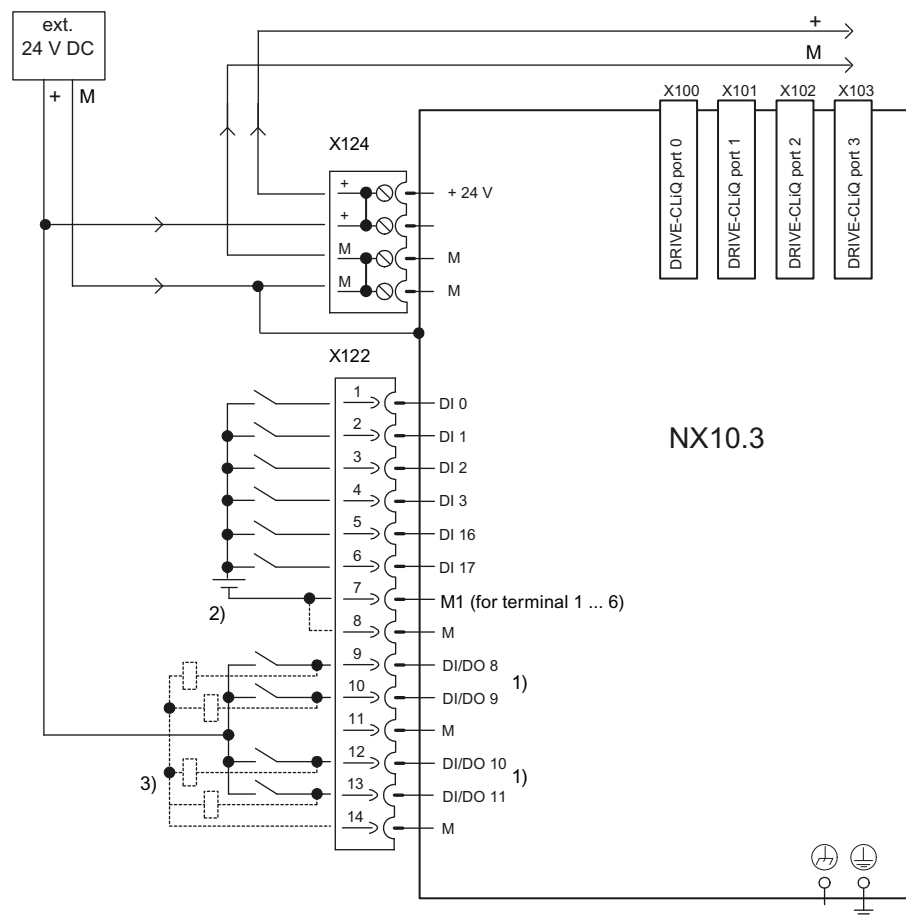
Table 7- 88 Technical data for X122

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

Parameter	Value
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 7-47 Connection example NX10.3

See also

For the pin assignment of the DRIVE-CLiQ interfaces X100 - X103, please refer to Chapter "DRIVE-CLiQ (Page 86)".

For further information on DC voltage and standards, please see Chapter "Power supply connection (Page 69)".

7.6.4 Technical Data

Table 7- 89 Technical data

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

7.7 PN/PN coupler

7.7.1 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.

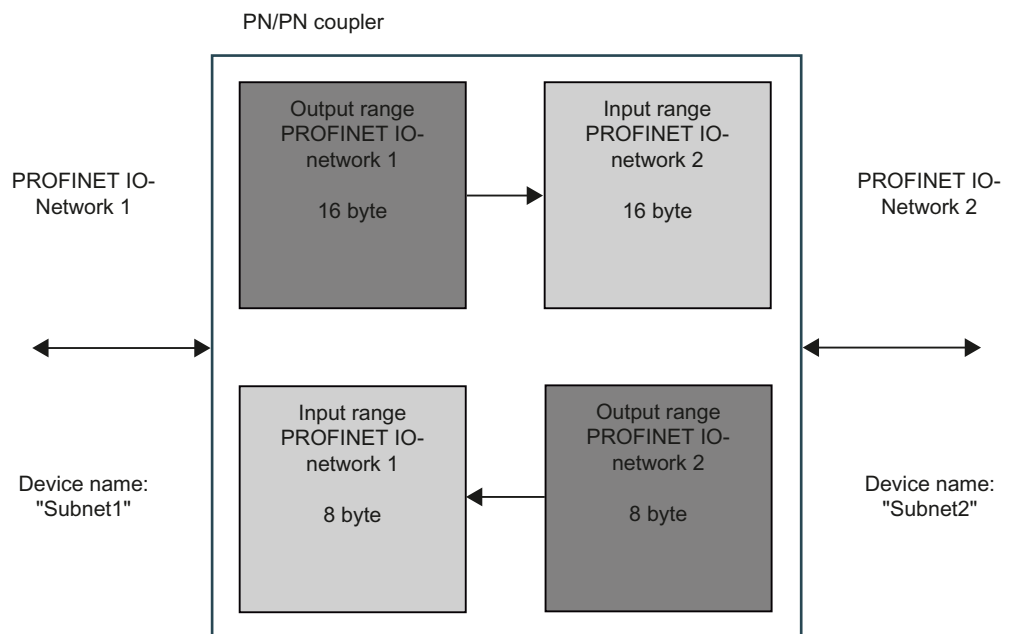


Figure 7-48 Principal mode of operation of the PN/PN coupler (example)

References

SIMATIC bus couplings PN/PN coupler Hardware Installation and Operating Manual

7.7.2 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.
- A coupling between two SINUMERIK 828D systems is not possible as standard.

Configuration

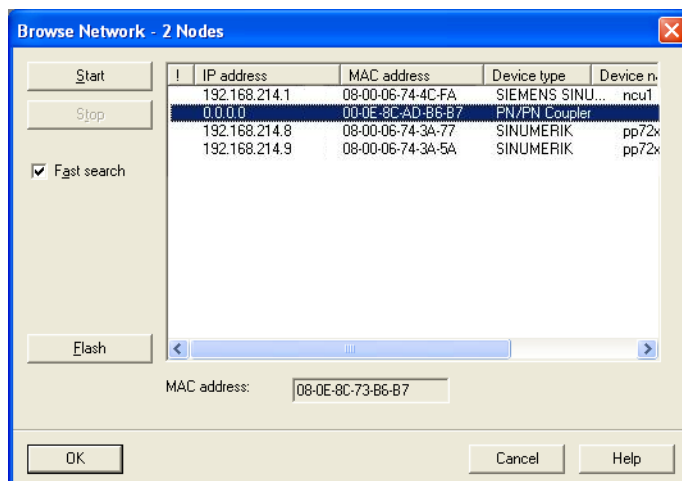
The device name must be defined in the following cases:

- 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.

Edit Ethernet Node

Ethernet node

MAC address: 00-0E-8C-AD-B6-B7 [Browse...](#)

Nodes accessible online

Set IP configuration

☒ Use IP parameters

IP address: 192.168.214.20

Subnet mask: 255.255.255.0

Gateway

☒ Dg not use router

☐ Use router

Address:

☐ Obtain IP address from a DHCP server

Identified by

☒ Client ID ☐ MAC address ☐ Device name

Client ID:

[Assign IP Configuration](#)

Assign device name

Device name: PN-PN-Coupler20 [Assign Name](#)

Reset to factory settings

[Reset](#)

[Close](#) [Help](#)

See also

Addressing the I/O modules (Page 77)

7.8 GSM 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

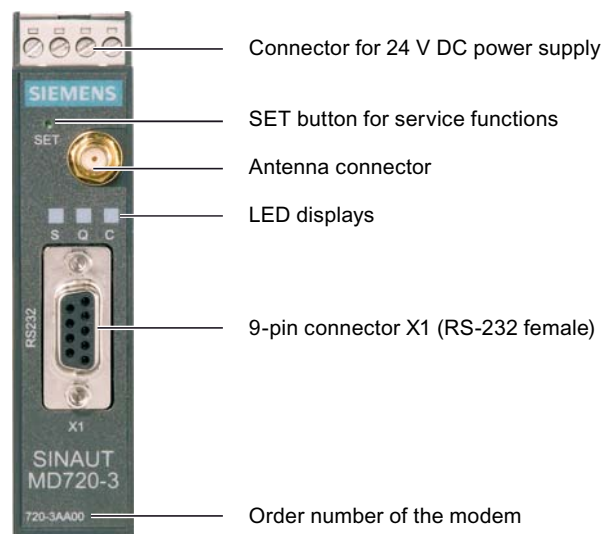


Figure 7-49 SINAUT MD720-3 interfaces

The following figure shows the standard way in which the GSM modem is connected to a PPU.

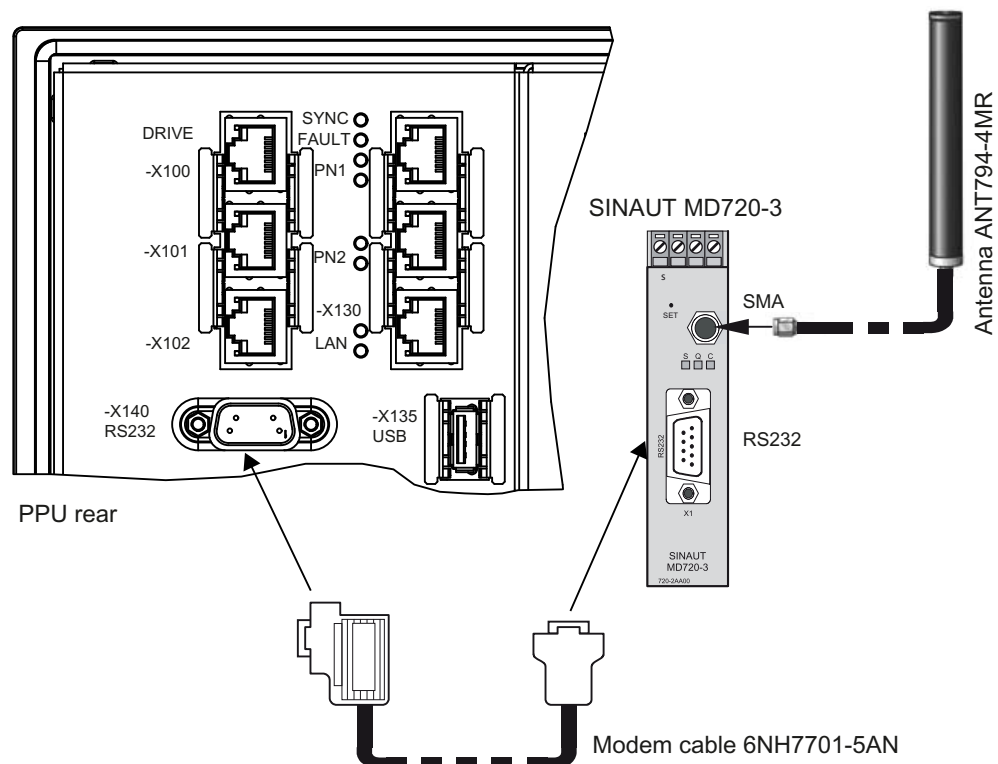


Figure 7-50 Connecting SINAUT MD720-3 to the PPU

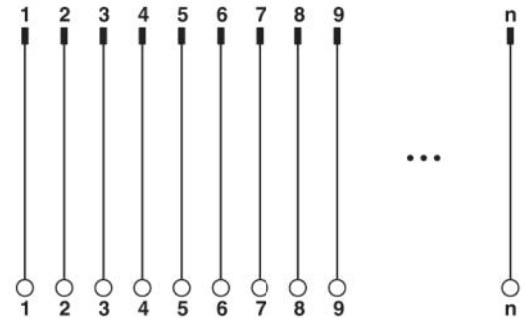
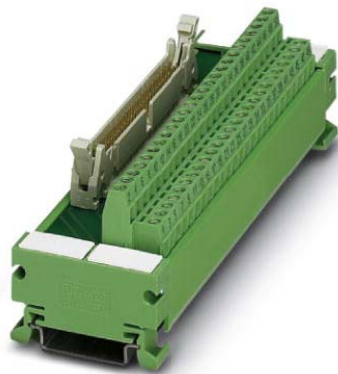
Additional references

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

7.9 Terminal strip converter

Terminal strip converter



MLFB: 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
Dimensions WxHxD	151 x 50 x 40 mm
Weight, approx.	0.15 kg
Ambient temperature (in operation)	-20 ... 55°C
Ambient temperature during (storage/transportation)	-40 ... 70°C
Mounting position	Any
Degree of pollution	2 according to 61800-5-1
Protection class	II acc. to EN 61800-5-1
Applicable standards	IEC 60664 DIN VDE 0110

Technical data

General technical data

Safety	
Protection class	III (DVC A, PELV) acc. to EN 61800-5-1
Degree of protection according to EN 60529	IP65 (front) ^{*)} , IP20 (rear)
Approvals	CE / cULus
Degree of pollution	2 according to 61800-5-1
Cooling	Open-circuit ventilation
Mounting position	Vertical
Mechanical stress	
Operation	3M1 according to EN 60721-3-3
Transportation (in transportation packaging)	2M3 according to EN 60721-3-2
Storage (in transport packaging)	1M2 according to EN 60721-3-1

^{*)} with closed protective flap

Electrical and mechanical data

Data	
Input voltage	24 VDC
Power consumption, max.	60 W
Power loss	28 W
Dimensions WxHxD	310 x 380 x 118 mm (PPU vertical) 482.6 x 220 x 118 mm (PPU horizontal)
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 84)

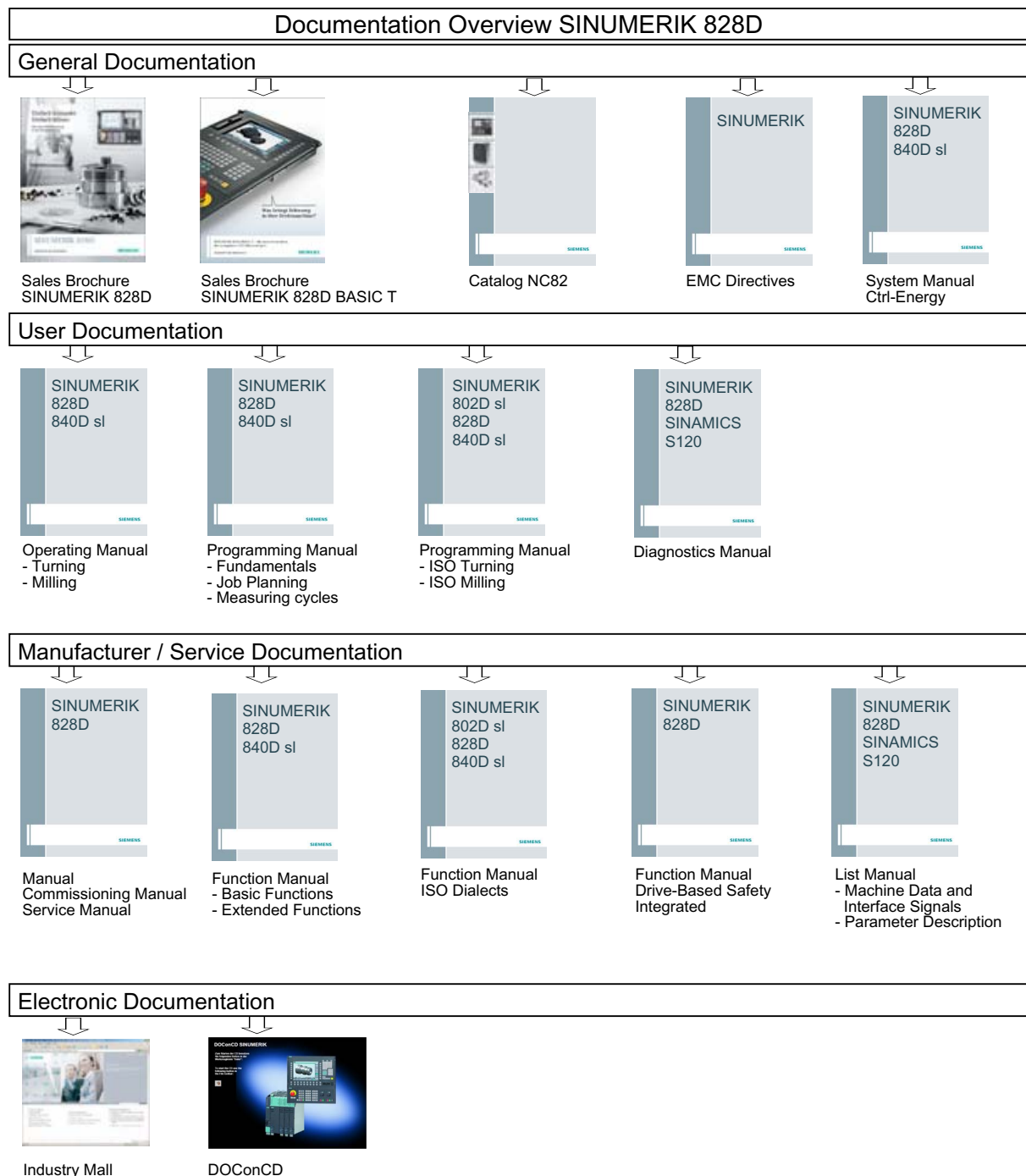
Appendix

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

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 Overview



Index

A

- Air-conditioning
 - Operation, 40
 - Storage and transport, 39
- Ambient conditions, 39
- Axis expansion, 192, 194

B

- BERO, 83

C

- Cables
 - Digital inputs/outputs, 81
 - Ethernet, 73
 - Handwheel, 89
 - Power supply, 71
 - PROFINET, 74
 - RS232, 91
- CompactFlash card, 29
- Connect digital I/Os, 81
- Connection options, 68

D

- Diagnostics
 - Ethernet, 72
 - PROFINET, 75
- Digital I/O interface
 - Technical data, 84
- Dimension drawing
 - MCP 310C PN, 116
 - MCP 483C PN, 98
- DRIVE-CLiQ
 - Connectable components, 88
 - Interface, 86
 - Wiring rules, 55
- DRIVE-CLiQ Hub Module, 88
- DRIVE-CLiQ wiring
 - Safety Integrated functions, 63, 64, 65, 66
 - with NX, 61, 62, 63, 64, 66
 - without NX, 60, 65

E

- Emergency-stop circuit
 - MCP 310C PN, 112
 - MCP 483C PN, 95
- Equipotential bonding, 37

F

- Function-impairing dust, 41

G

- Grounding connections, 37
- Grounding measures, 35
- Grounding screw, 143, 163

I

- I/O module DIP switch, 77
- Installing the PPU, 44
- Interfaces
 - PROFINET, 74
- IP address, 77

K

- Key assignment
 - MCP 310C PN, 123
 - MCP 483C PN, 106
- Key caps
 - MCP 310C PN, 126
 - MCP 483C PN, 108

L

- LED displays
 - Front side of the PPU, 76
 - I/O module, 162
 - PROFINET, 75, 148, 169
 - Rear of the PPU, 75
- LED status displays
 - Ethernet, 72
 - PP 72/48D PN, 142

Line connection, 36
Line Module, 88

M

MAC address label, 142, 162
MCP
 Customer keys, 101, 119
 PROFINET address, 103, 121
 Replacing the rotary switch, 109, 126
Memory card adapter, 32
Mini handheld unit
 Connection kit, 134
 Dimensions, 138
Motor Module, 88
Mounting position
 MCP 310C PN, 115
 MCP 483C PN, 97

N

Noise immunity, 37
NX10.3
 Call sequence, 194
 Connection example, 199
 Mounting, 195

O

OP key symbols, 20
Order numbers, 27

P

Panel cutout, 45, 48
Pin assignment
 Digital inputs/outputs, 78, 80
 DRIVE-CLiQ, 86
 Ethernet, 72
 Handwheels, 89
 Power supply, 69
 PROFINET, 74
 RS232, 91
PN/PN coupler
 Device name, 202
 PROFINET IO network, 201
Power cables, 37, 168
Power supply
 24 VDC, 69
 I/O module, 146

PP 72/48D PN
 External power supply, 146
 Status indicator, 142
PT100
 Terminal assignment, 178

R

Radio interference, 41

S

Sensor Module, 88
Sensor Module External, 88
Shield contact, 176
Shielded signal cables, 37
Signal cables, 37
SINAMICS S120 Booksize Compact, 88
SINAMICS S120 Combi, 88
SINAUT MD720-3
 Connecting, 205
 Description, 204
SINUMERIK 828D
 Features, 13
 MAC addresses, 23
 Performance, 15
Smart Line Module
 Enabling signal, 67
Standard
 Long-term storage, 39
 Stationary operation, 39
 Transport, 39

T

Technical data
 Analog inputs, 176
 Analog outputs, 179
 Digital I/O NX10.3, 198
 Digital inputs, 153, 174
 digital inputs of the PPU, 84
 Digital outputs, 154, 175
 digital outputs of the PPU, 85
 Digital PPU inputs/outputs, 85
 I/O module, 190
 MCP 310C PN, 125
 MCP 483C PN, 107
 Mini HHU, 138
 NX10.3, 200
 Power supply NX10.3, 197
 PP 72/48D PN, 159

PPU, 209

Terminal strip converter, 207

Terminal Module, 88

Topology

SINAMICS S120 booksize, 60, 61, 64

SINAMICS S120 booksize, 60, 61, 64

SINAMICS S120 chassis, 62

SINAMICS S120 chassis, 62

SINAMICS S120 chassis, 62

Type plates

I/O module, 142, 162

NX10.3, 192

PPU, 22

W

Wiring rules DRIVE-CLiQ, 55

