

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

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Legal information

Warning notice system

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

 DANGER
indicates that death or severe personal injury will result if proper precautions are not taken.
 WARNING
indicates that death or severe personal injury may result if proper precautions are not taken.
 CAUTION
indicates that minor personal injury can result if proper precautions are not taken.
NOTICE
indicates that property damage can result if proper precautions are not taken.

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

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

Trademarks

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

Disclaimer of Liability

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

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

Function	PPU 240.2 / 241.2		PPU 260.2 / 261.2		PPU 280.2 / 281.2	
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:

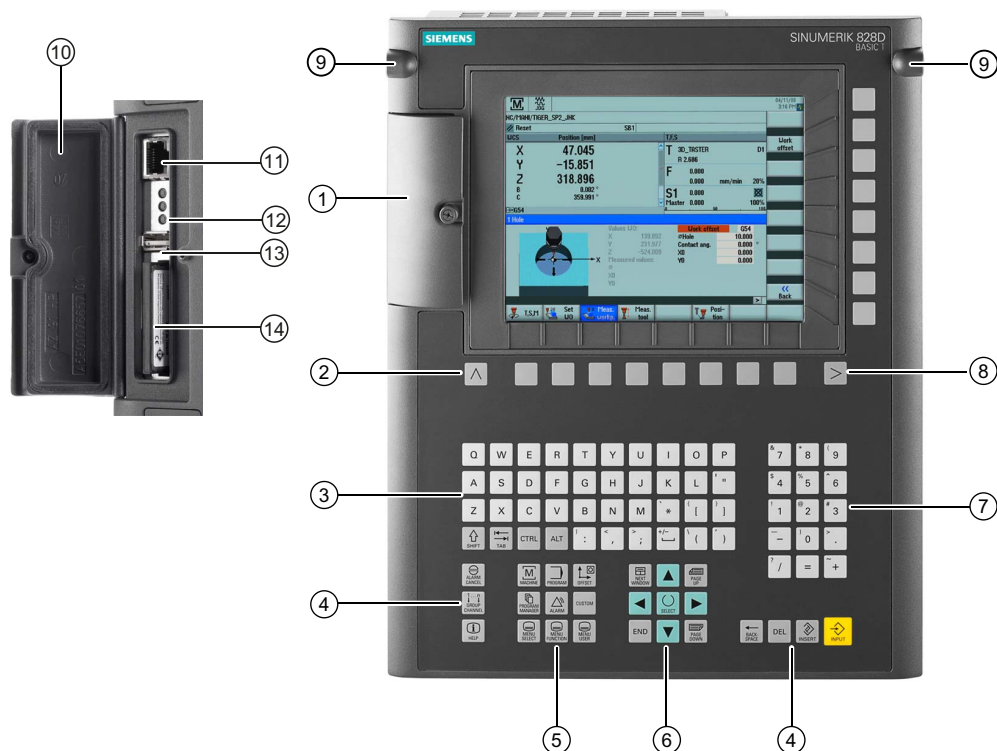
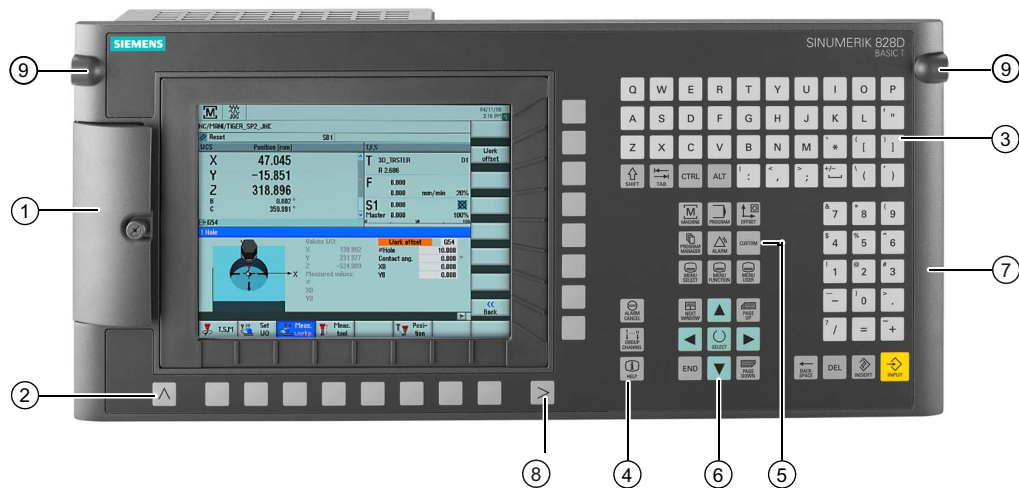
- The maximum number of axes can be increased to eight, six of which can be connected to the PPU and two to the NX10.3.
- A high-speed spindle (e.g. 24,000 rpm with four pole pairs) can be connected to the NX10.3 (62.5 µs) and five axes to the PPU (125 µs).

For the reduced speed/current controller cycle, in accordance with Topology Rules (Page 65), 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

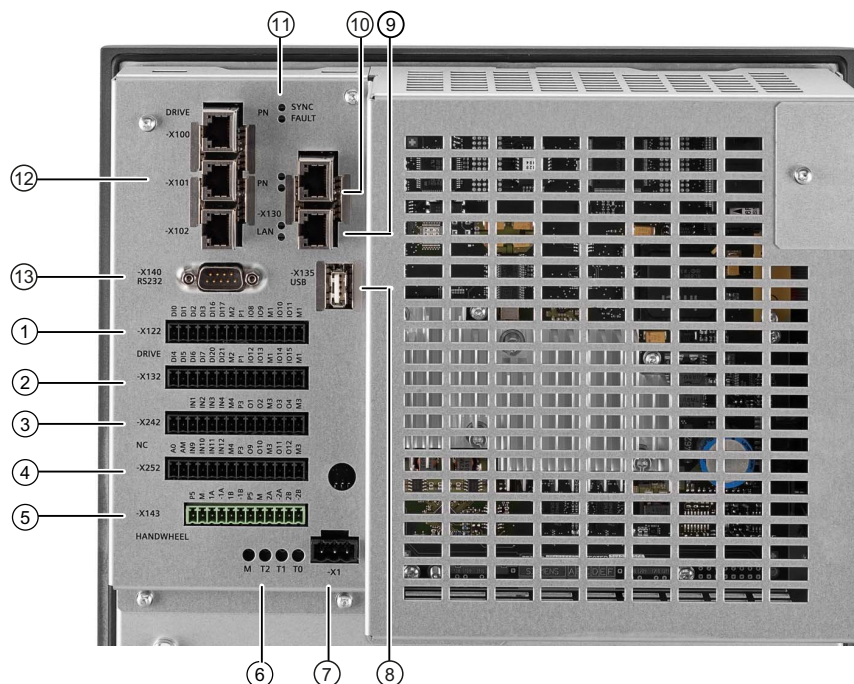


- ① ⑩ Protective cover for user interfaces
- ② Menu back key
- ③ Alphabetic key group
- ④ Control key group
- ⑤ Hotkey group
- ⑥ Cursor key group

- 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

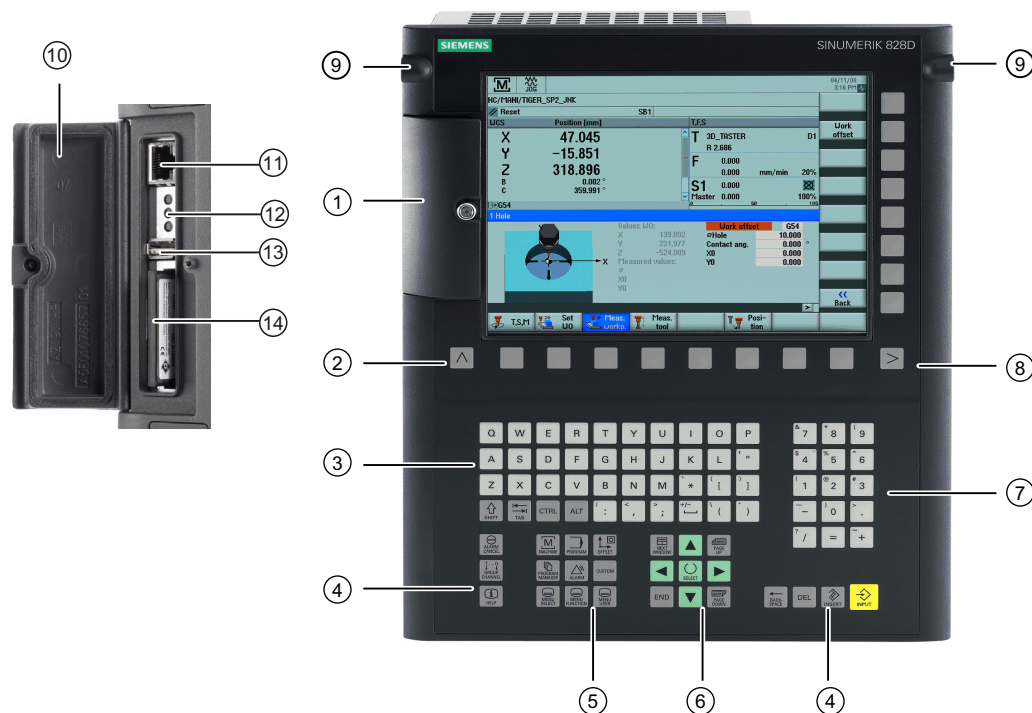


- ① ② X122, X132 Digital inputs/outputs, drive
- ③ ④ X242, X252 Digital inputs/outputs for NCK; controller of the analog spindle (X252)
- ⑤ X143 Handwheels
- ⑥ M, T2, T1, T0 Measuring sockets
- ⑦ X1 Power supply
- ⑧ X135 USB interface: For service purposes only
- ⑨ X130 Ethernet LAN
- ⑩ PN PLC I/O Interface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

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

Key	Function corresponds to PC key function	Key	Function corresponds to PC key function
	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.

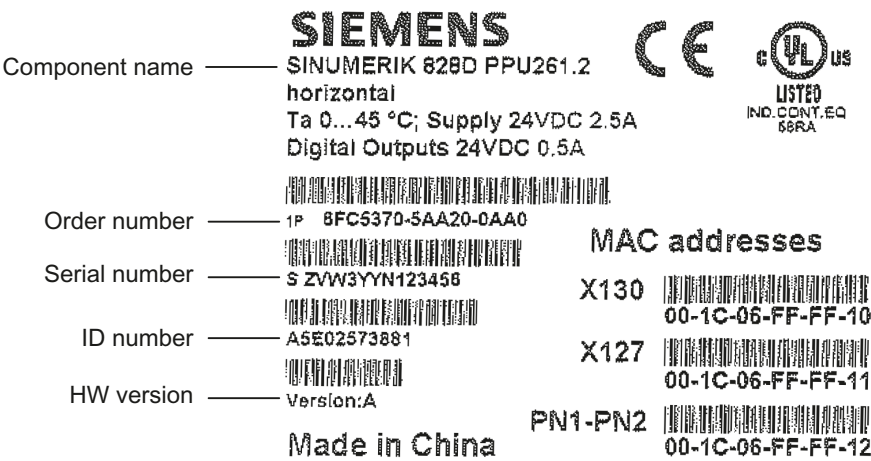


Figure 2-5 Horizontal PPU type plate

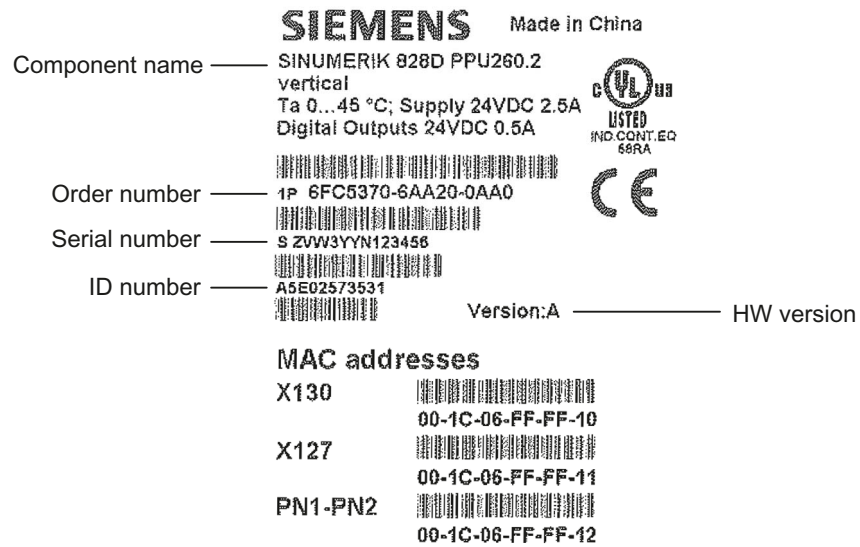


Figure 2-6 Vertical PPU type plate

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:

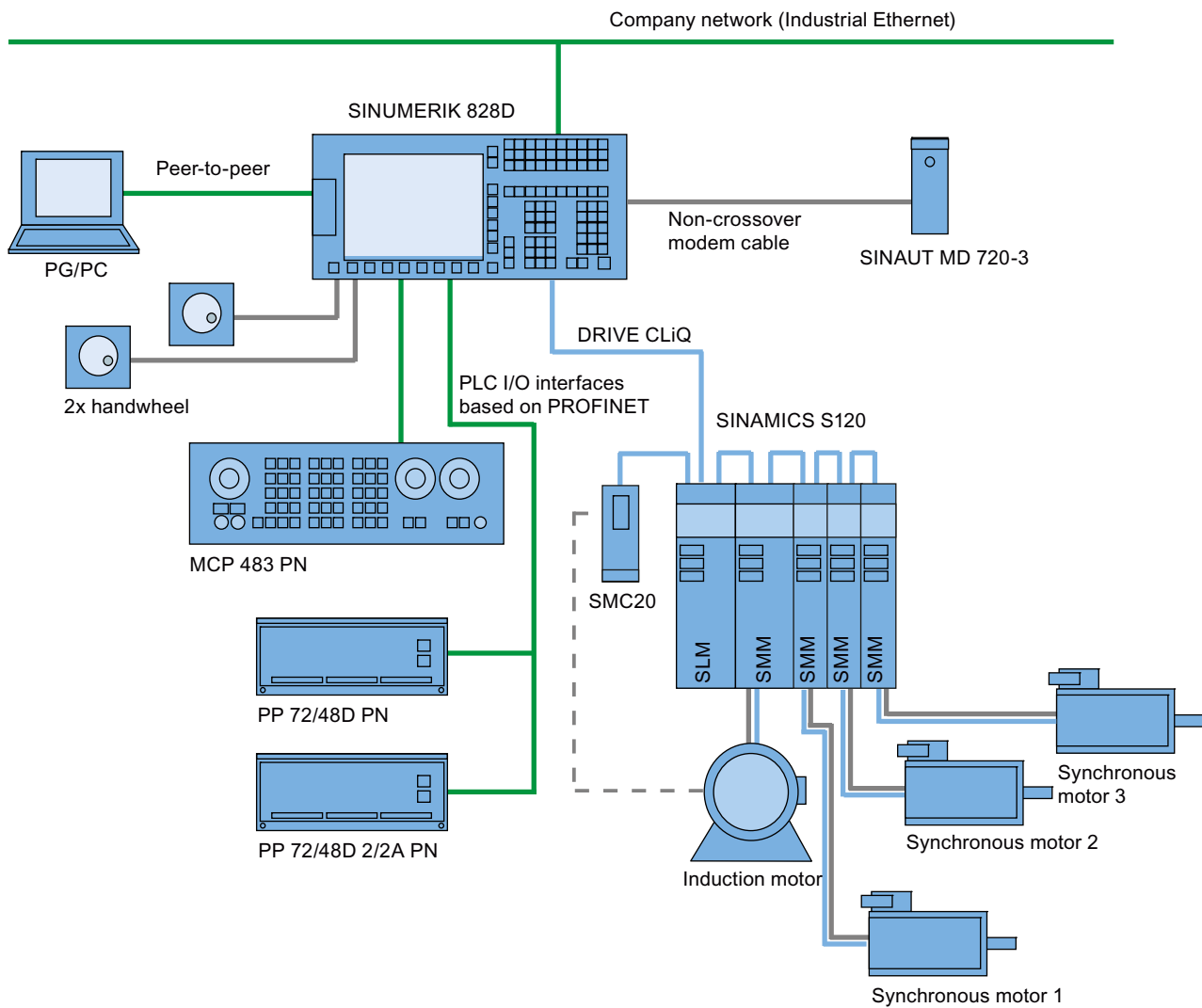


Figure 2-7 Configuration example 1: Basic configuration with four axes

Configuration with S120 Combi and six axes

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

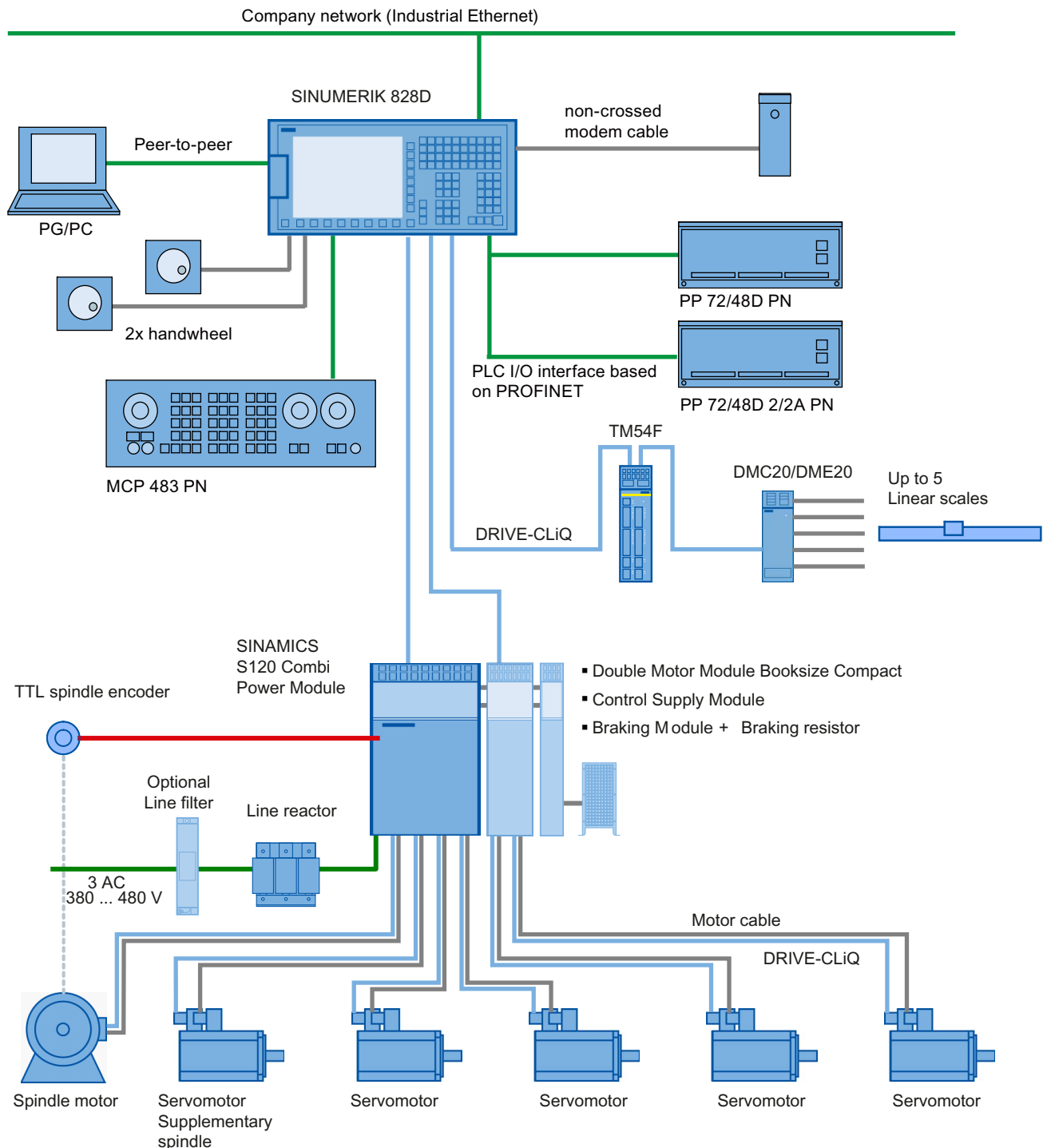


Figure 2-8 Configuration example 2: Maximum expansion stage with six axes and with Safety Integrated

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 **servo motors** as type 1FK7, 1FT7, and 1PH8 feed and main spindle motors. Type 1FW6 **torque motors** can also be connected.

See also

Connectable components (Page 97)

SINAMICS components (Page 91)

- Rules for permitted topologies (Page 55)
- Interface description (Page 69)

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

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 ($\cong$ 30 K / h) *)
Relative humidity	5 ... 95%	10 ... 100%
Permissible change in relative humidity	max. 0.1% / min ($\cong$ 6% / h)	

*) Averaged over 5 min

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

3.2.3 Operating Conditions

Note

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

Climatic environmental conditions

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

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

Temperature range	Front side: 0 ... 45 °C	Rear side: 0 ... 55 °C	
Temperature change	< 0.5 K / min (≅ 30 K / h) averaged over 5 min		
Humidity	Relative: 5 ... 90% at 25 °C	Absolute: ≤ 25 g / m³	
Permissible change in relative humidity	max. 0.1% / min (≅ 6% / h)		
Moisture condensation and ice formation	Not permissible		
Dripping water, spray, splash water, water jets	Permissible		
Supply air	Without aggressive gases, dusts and oils		
Air pressure	106 to 92 kPa or 0 to 1000 m above sea level		
Derating	At altitudes over 1,000 to 4,000 m above sea level, the upper temperature limit must be reduced by 3.5 °C / 500 m.		
Active environmental conditions	Chemical: Class 3C2	Mechanical: Class 3S2	Biological: Class 3B1

Function-impairing dust

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

Table 3- 3 Maximum permissible dust content in the air

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

Note

Dust deposits must be removed at regular intervals.

Radio interference

Applicable standards: EN 61800-3

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

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

Note

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

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

Note

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

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

Risk of electric shock

The entire system must be voltage-free when mounting or wiring the SINUMERIK 828D.

Components in the control cabinet

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

References

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

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

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

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

4.1 Mounting positions

Permitted mounting positions

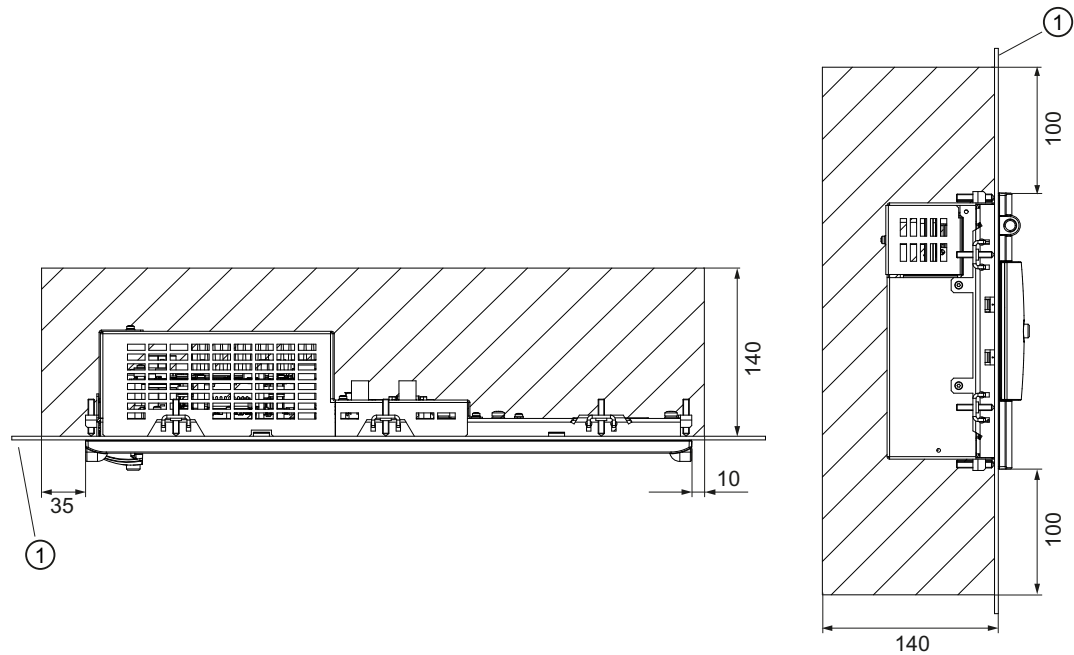
The PPU is secured with special tensioning elements and tensioners in the operator panel housing. The tensioners are included in the scope of delivery.

Note

Installing the PPU

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

Installation of the horizontal PPU variant



① Mounting frame

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

Panel cutout of the horizontal PPU variant

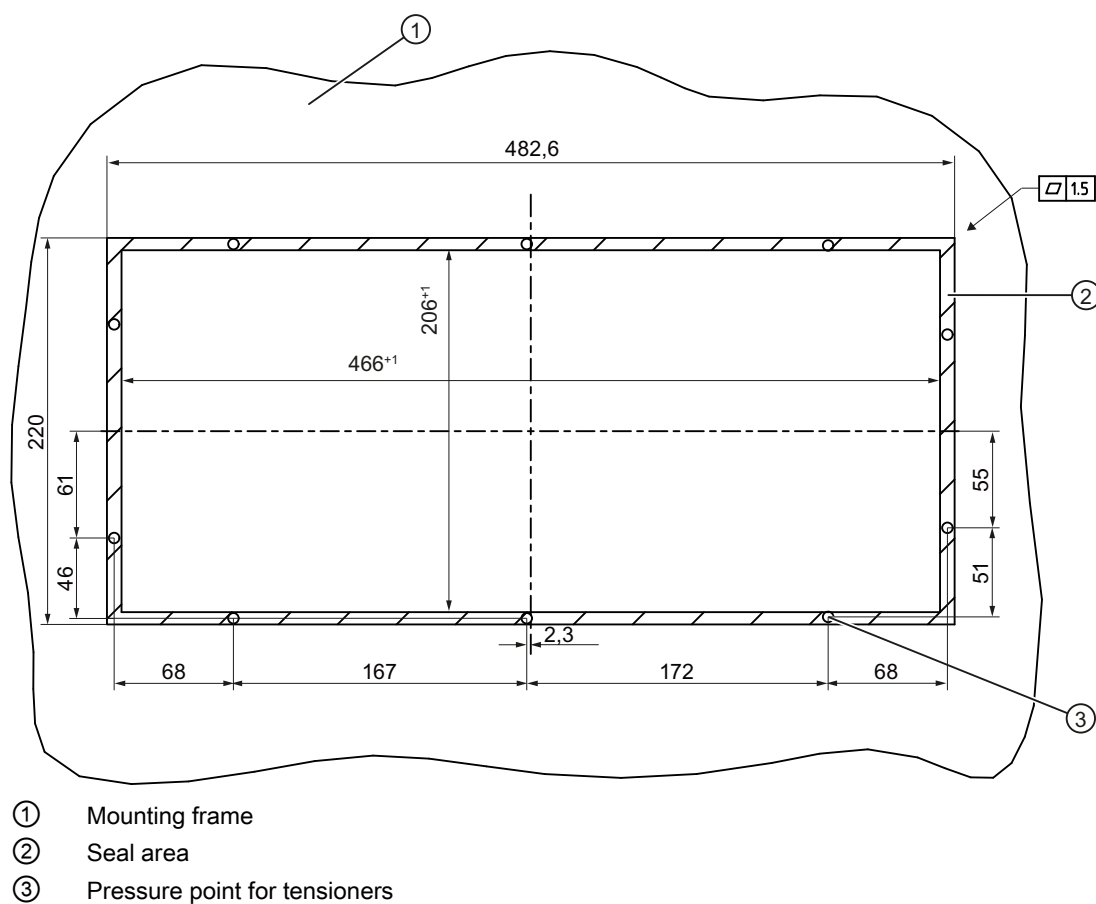
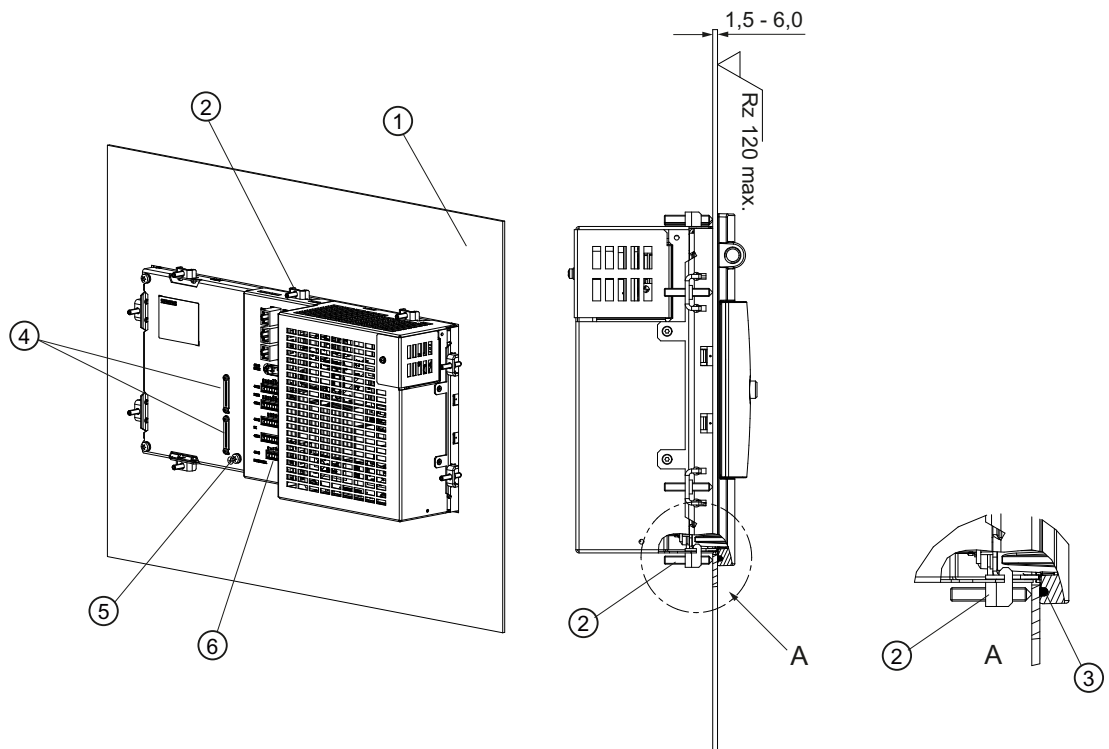


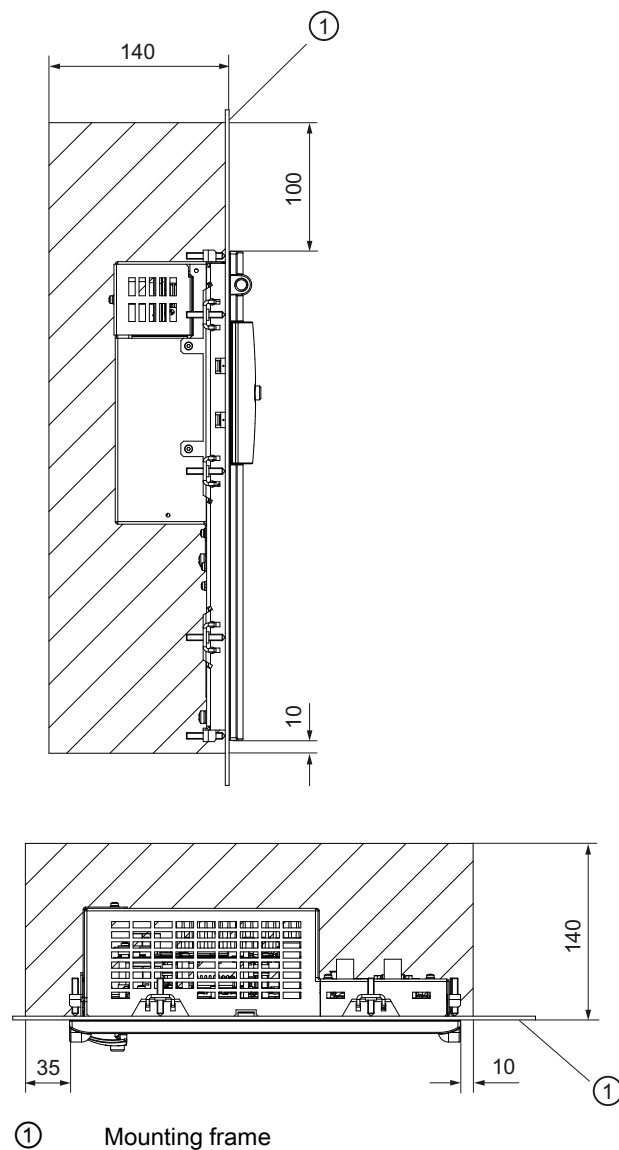
Figure 4-2 Horizontal PPU panel cutout



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

Figure 4-3 Horizontal PPU mounting

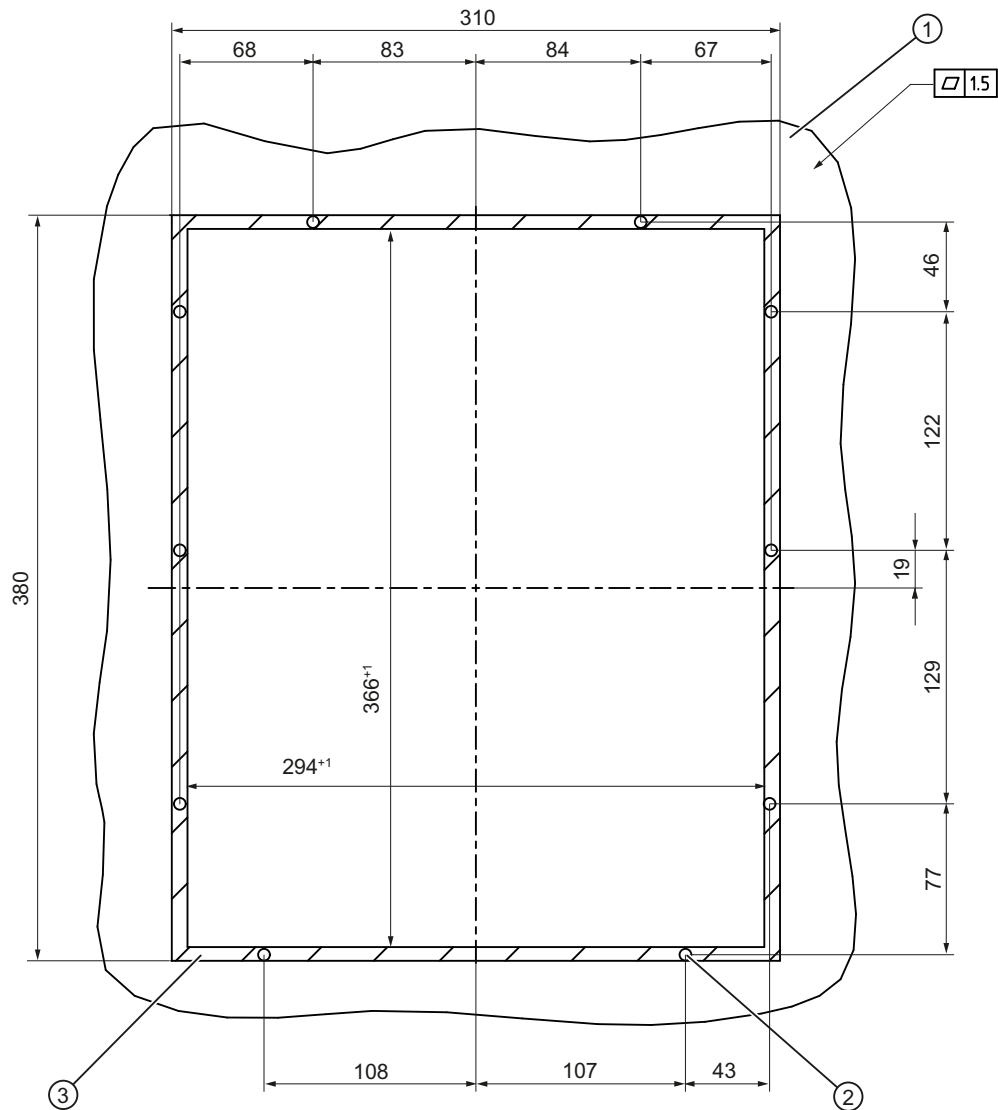
Installation of the vertical PPU variant



① Mounting frame

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

Panel cutout of the vertical PPU variant



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

Figure 4-5 Vertical PPU panel cutout

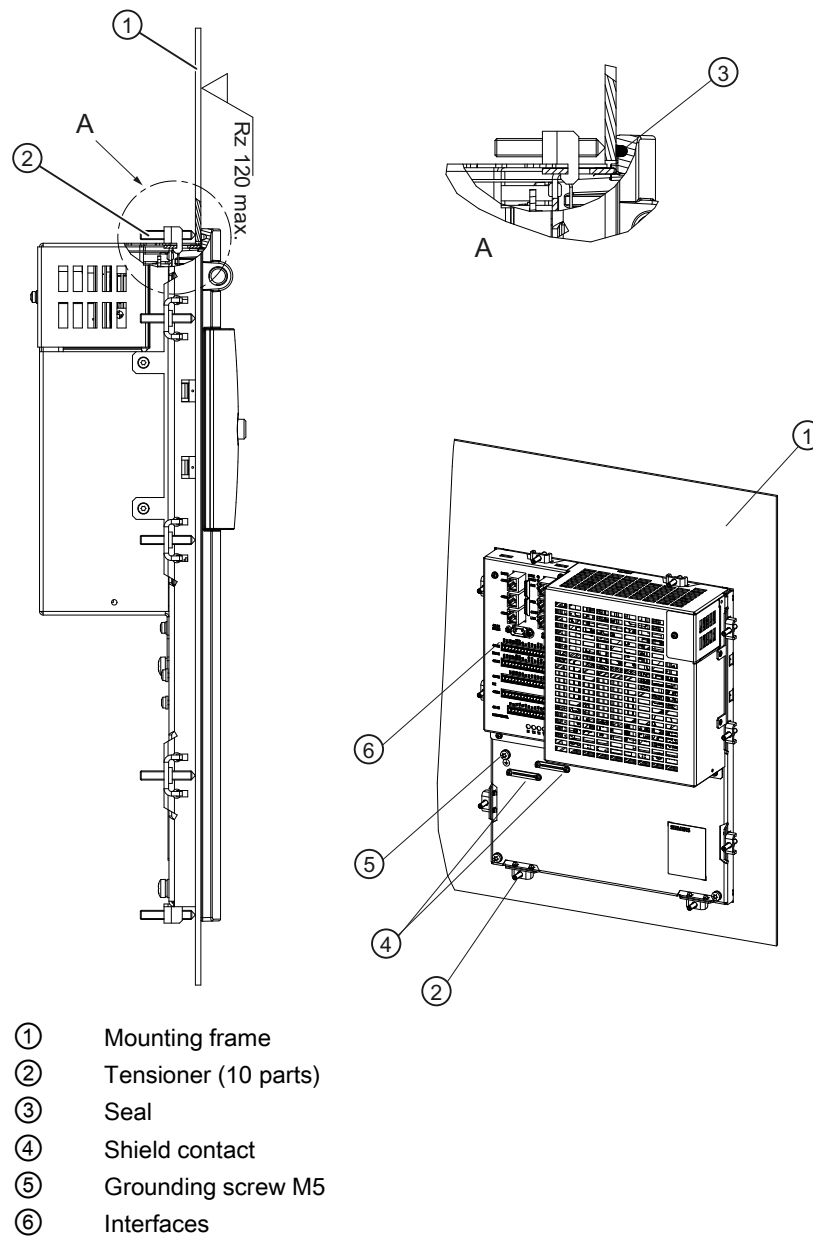


Figure 4-6 Installation of the vertical PPU variant

4.2 Dimension drawings

PPU horizontal

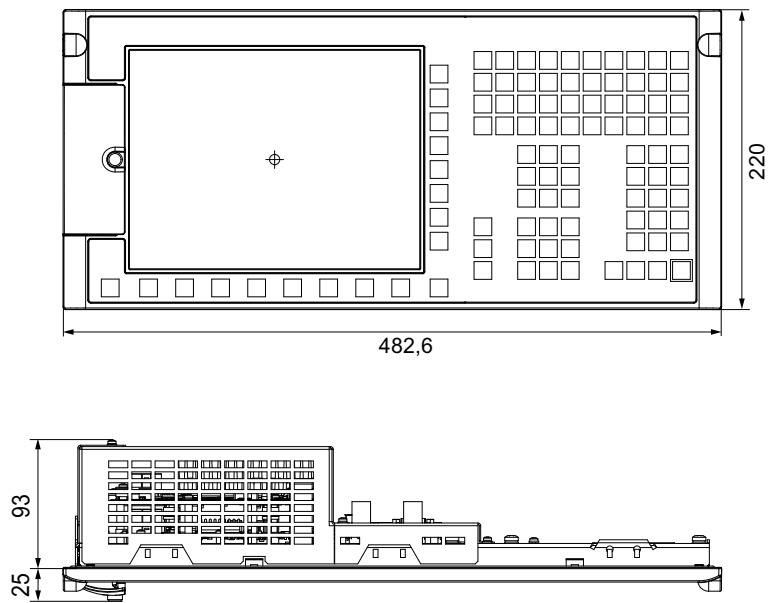


Figure 4-7 Horizontal PPU dimensioning

Interface description

6.1 Interface overview

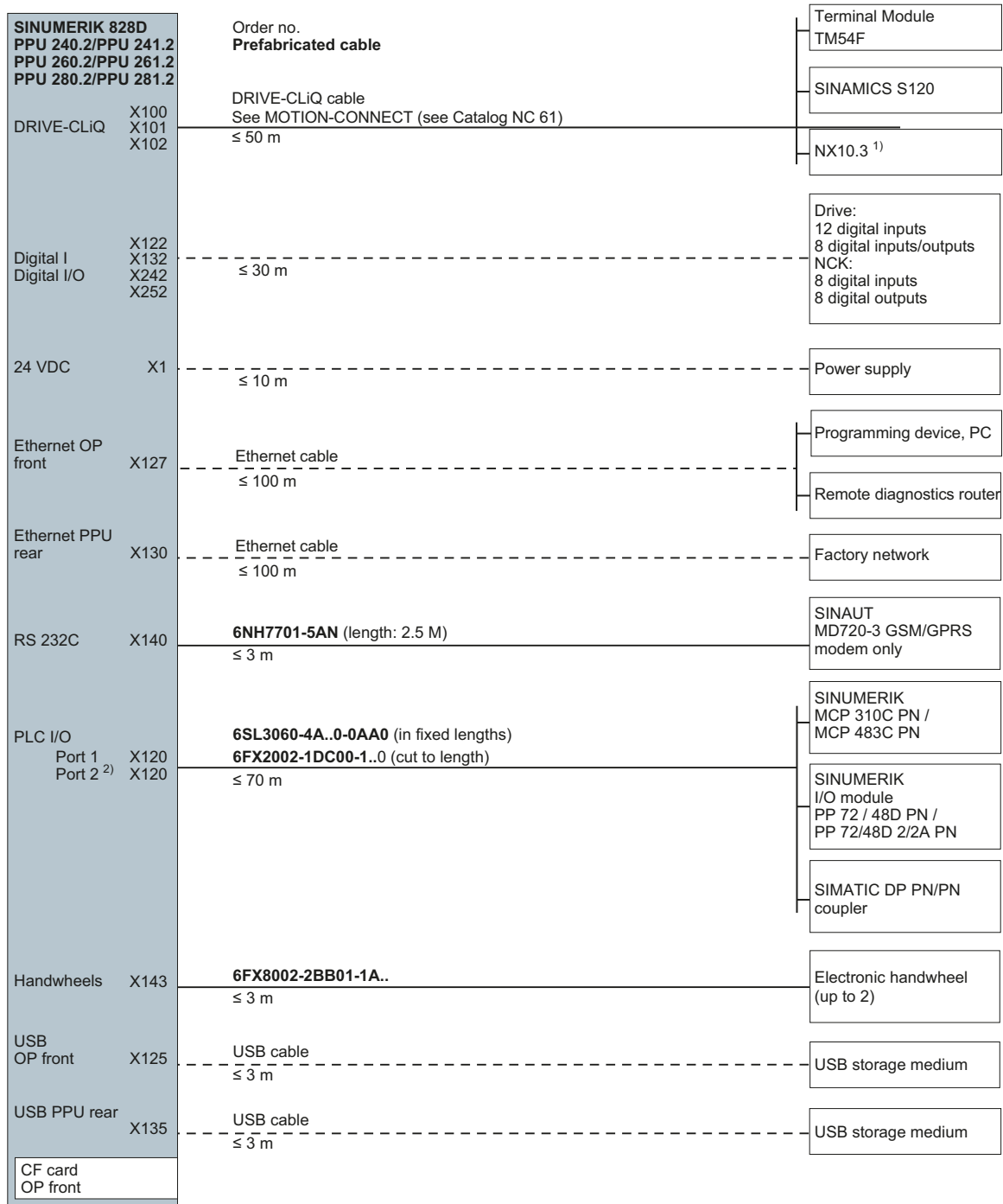
Requirement

**DANGER****Risk of electric shock**

The entire system must be voltage-free when mounting or wiring the SINUMERIK 828D.

Connection options

The overview below shows the interfaces and their connection possibilities:



¹⁾ Only for PPU 280.2 / PPU 281.2

²⁾ Not for PPU 240.2 / PPU 241.2

Figure 6-1 Connection options of the PPU

Note

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

Definition

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

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

6.2 Power supply connection

6.2.1 Requirements for the power supply

Pin assignment at X1 screw-type terminal block

Table 6- 1 Pin assignment

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

Requirements of DC power supplies

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

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

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

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
Risk of lightning strike 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" Configuration Manual

Table 6- 3 Technical data of the DC power supply

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

6.2.2 Connecting the power supply

Cable specification

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

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

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

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

Table 6- 4 Cable specification for X1

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

6.3 Ethernet

X130, X127 pin assignment

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

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.

NOTICE

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:	
1st digital PP module	PN	pp72x48pn9	9	0 ... 8	0 ... 5
2nd digital PP module	PN	pp72x48pn8	8	9 ... 17	6 ... 11
3rd digital PP module	PN	pp72x48pn7	7	18 ... 26	12 ... 17
4th PP module digital	PN	pp72x48pn6	6	27 ... 35	18 ... 23
5th digital PP module	PN	pp72x48pn5	5	36 ... 44	24 ... 29
Unassigned				45	30 ... 55
				Index d:	
1st PP module diagnostics	PN	pp72x48pn9	9	46 ... 47	--
2nd PP module diagnostics	PN	pp72x48pn8	8	48 ... 49	--
3rd PP module diagnostics	PN	pp72x48pn7	7	50 ... 51	--
4th PP module diagnostics	PN	pp72x48pn6	6	52 ... 53	--
5th PP module diagnostics	PN	pp72x48pn5	5	54 ... 55	--
				Index m:	
1st analog PP module	PN	pp72x48pn9	9	56 ... 63	56 ... 63
2nd analog PP module	PN	pp72x48pn8	8	64 ... 71	64 ... 71
3rd analog PP module	PN	pp72x48pn7	7	72 ... 79	72 ... 79
4th analog PP module	PN	pp72x48pn6	6	80 ... 87	80 ... 87
5th 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:

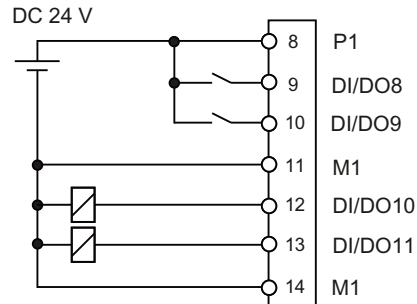


Figure 6-2 Inputs and outputs on the same supply

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:

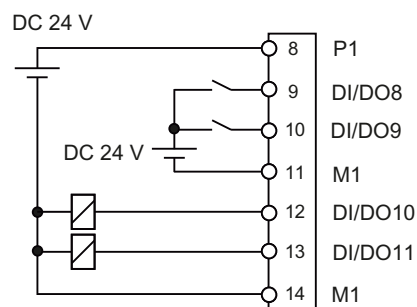


Figure 6-3 Inputs and outputs on different supplies

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

Pin		Signal name	NC variable	Meaning
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 NCK output 10
11	M3	MEXT3		Ground for pins 9, 10, 12, 13
12	O11	DOUT11	--	- Without analog spindle: Digital NCK output 11 - With analog spindle: Controller release for analog spindle (in accordance with MD30134 \$MA_IS_UNIPOLAR_OUT PUT)
13	O12	DOUT12	--	- Without analog spindle: Digital NCK output 12 - With analog spindle: Travel direction of the analog spindle (in accordance with MD30134 \$MA_IS_UNIPOLAR_OUT PUT)
14	M3	MEXT3		Ground for pins 9, 10, 12, 13

Use

The following assignment applies to the terminals:

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

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

- For the X242 connector, four inputs and four outputs are available for the 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. 4 A
Max. cable length	30 m

Wire digital inputs/outputs

Tools required: 3.5-mm screwdriver or power screwdriver

Procedure:

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

References

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

6.5.1 Terminal connection diagram

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

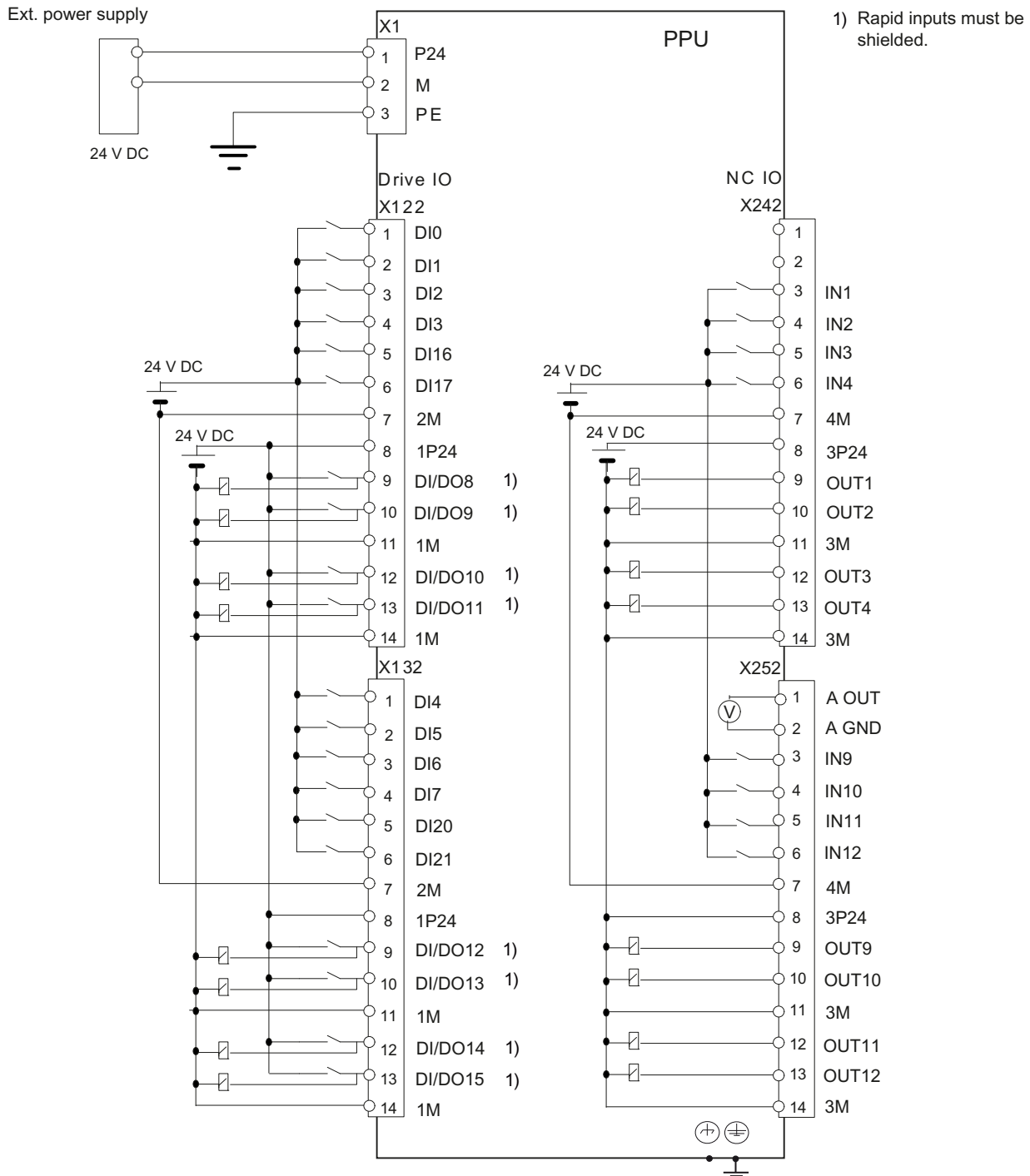


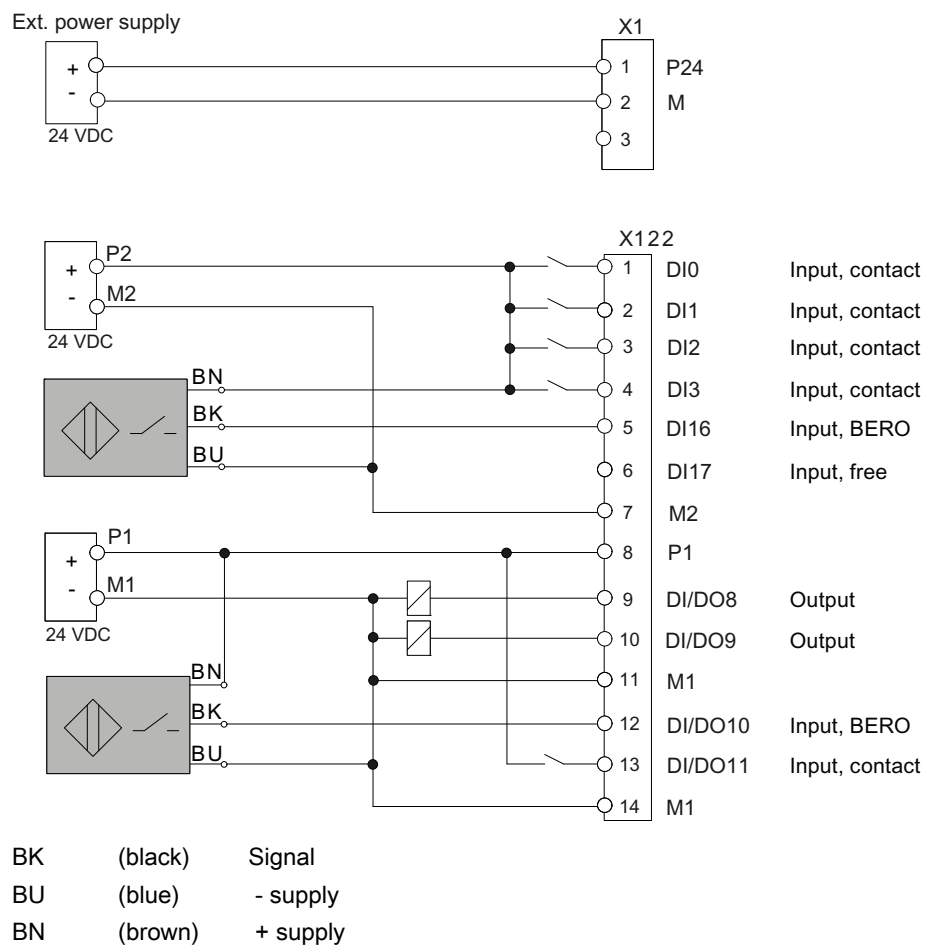
Figure 6-4 Terminal connection diagram for digital inputs/outputs

6.5.2 Example: Connecting an inductive proximity switch (BEROs)

Boundary conditions

When connecting a BERO the following rules must be observed:

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



6.5.3 Technical data

Note

An open input is interpreted as "low".

Note

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

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

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

This removes the galvanic isolation for these digital inputs.

Digital inputs

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

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

Digital inputs/outputs

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

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

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

Digital outputs

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

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

6.6 DRIVE-CLiQ

6.6.1 DRIVE-CLiQ interface

Pin assignment at X100 - X102

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

Use

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

The following rules apply:

- Topology rules for S120 Combi (Page 55)
- Topology rules for S120 Booksize (Page 57)
- Topology rules for Safety Integrated functions (Page 61)
- Topology example without Safety Integrated functions (Page 62)
- Topology example with Safety Integrated functions (Page 65)

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.
SMC40	This Sensor Module is used to convert encoder signals from absolute encoders with EnDat 2.2 to DRIVE-CLiQ.
DMC20 / DME20	DRIVE-CLiQ Hub Modules are used to implement the star-shaped distribution of a DRIVE-CLiQ line.
TM54F	The TM54F Terminal Module is a terminal expansion module for Safety Integrated functions.
TM120	The Terminal Module TM120 is a DRIVE-CLiQ component for safe electrically isolated temperature evaluation.

Note

Connection of Sensor Modules

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

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

NOTICE

Connection of the SMC40

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

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

6.7 Handwheel

Pin assignment

Table 6- 9 X143 pin assignment

Pin		Signal name	Meaning
1	P5	P5	5 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

Technical data

PPU

Parameter	Value	
Input voltage	24 V DC + 20% / - 15%	
Power consumption, max.	60 W	
Power loss	28 W	
Heat dissipation	Open-circuit ventilation	
Degree of protection in acc. with EN 60529	IP65 (front) ^{*)} IP20 (rear)	
Protection class in acc. with EN 61800-5-1	III (DVC A, PELV)	
Pollution degree in acc. with EN 61800-5-1	2	
Approvals	CE / cULus	
Classification:		
• Operation	3M1 in acc. with EN 60721-3-3	
• Transportation (in transportation packaging)	2M3 in acc. with EN 60721-3-2 1M2 in acc. with EN 60721-3-1	
• Storage (in transport packaging)		
Mounting position	Vertical	
Dimensions:	PPU vertical:	PPU horizontal:
• Width	• 310 mm	• 483 mm
• Height	• 220 mm	• 220 mm
• Depth	• 105 mm	• 105 mm
Weight, approx.	4.5 kg	

^{*)} with closed protective flap

See also

Further technical data for the PPU can be found in the following sections:

- Transport and Storage Conditions (Page 40)
- Operating Conditions (Page 41)
- Requirements for the power supply (Page 72)

Digital inputs/outputs:

- Technical data (Page 87)

