SIEMENS

SINUMERIK

SINUMERIK 828D
PP 72/48D 2/2A PN I/O module

Manual

Valid for SINUMERIK 828D control

03/2010

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 corresponding 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 for the specific task, 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 adhered to. The information in the relevant documentation must be observed.

Trademarks

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Disclaimer of Liability

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

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Safety notes

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1.1 Danger notices

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

⚠ DANGER

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.

⚠ WARNING

Operating the equipment in the immediate vicinity (< 1.5 m) of mobile telephones with a transmitting power of > 1 W may lead to incorrect functioning of the devices.

Connecting cables and signal lines should be installed in such a way that inductive and capacitive interference does not in any way impair the automation and safety functions.

⚠ 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).

1.3 Protective Separation as per EN 61800-5-1

Prerequisite

The complete system includes user interfaces (UIs) and interfaces for servicing, startup and maintenance.

User interfaces (UIs)

UIs are all the interfaces that are freely accessible to the machine operator without the need for tools or aids. These user interfaces provide safe isolation up to 230 V AC according to EN 61800-5-1.

Interfaces for servicing, startup and maintenance

⚠ DANGER

The interfaces for servicing/installation and start-up/maintenance purposes are provided **without** protective separation.

If necessary, these interfaces can be isolated safely using a supplementary adapter (insulation voltage 230 V AC). Although these adapters are not included in the Siemens scope of delivery, you can buy these parts from your local dealer, who will be happy to advise you.

⚠ DANGER

Safe isolation can only be ensured if the system configuration specified below is strictly adhered to. When installing additional components with EUIs, please make sure that the EUIs have safe isolation for at least 230 V AC.

Note

The components of the drive control comply with EN 61800-5-1 and contain only circuits and customer terminals with class DVC A voltages and safety isolation from circuits with dangerous voltages (PELV circuits).

1.4 RI suppression measures

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

Shielded signal lines

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

  Exception:
  Standard shielded cables grounded on 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

- Signal cables (example)
  - Data cables (Ethernet, PROFINET, DRIVE-CLiQ, sensor cables, etc.)
  - Ribbon cables for digital inputs/outputs
  - EMERGENCY OFF lines
- Power cables (example)
  - Low-voltage supply cables (230 V AC, 24 V DC, 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.

- 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)

Note

For more information about interference suppression measures and connection of shielded cables, see

References

/EMC/EMC Installation Guide

Description

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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
- 2 analog inputs and 2 analog outputs

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

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

Illustration

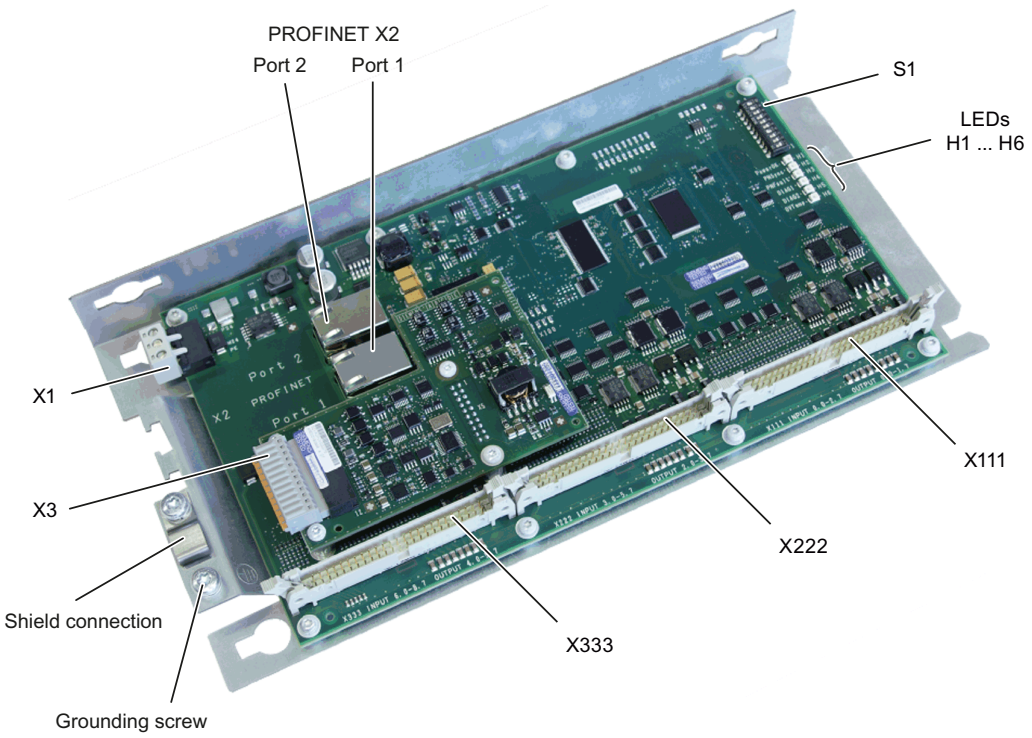

Figure 2-1 PP 72/48D 2/2A PN I/O module

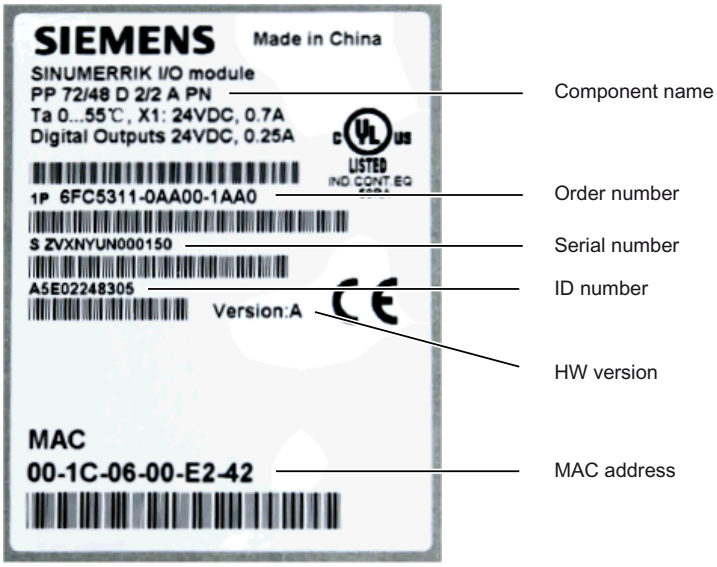

Figure 2-2 PP 72/48D 2/2A PN type plate

Note

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.

Dimension drawings

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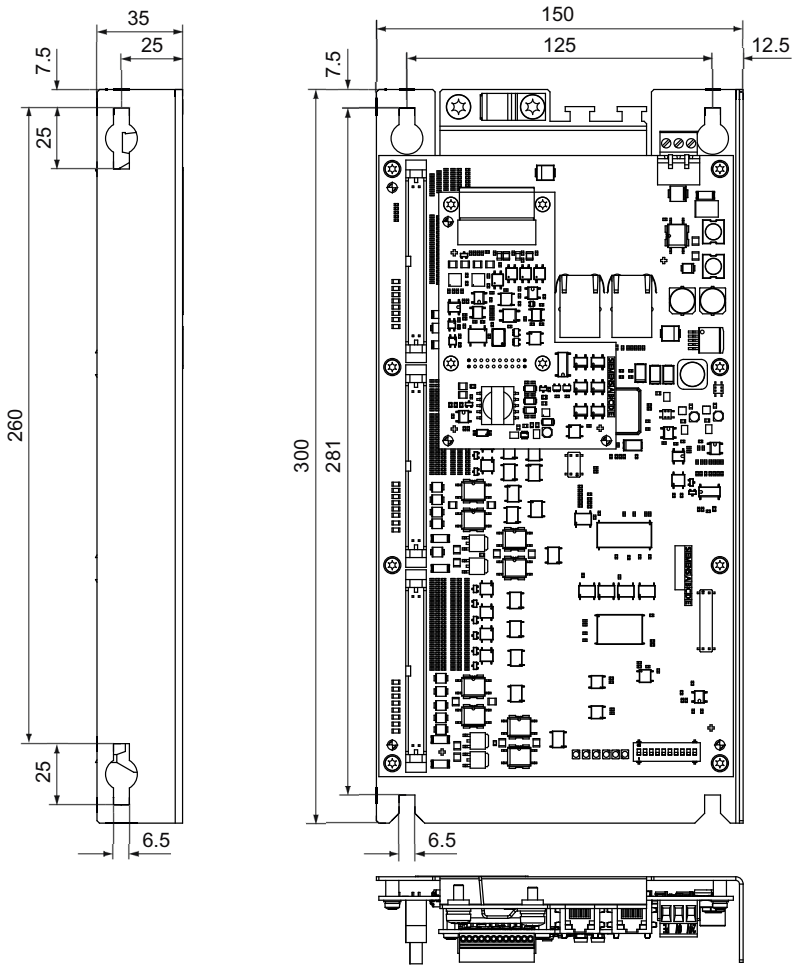

Figure 3-1 PP 72/48D 2/2A PN dimension drawing

Assembling

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

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).

⚠ WARNING
A protective conductor must be connected using the grounding screw.

Connection 5

5.1 Interface overview

Interface overview

Table 5- 1 Interfaces of the PP 72/48D 2/2A PN I/O module

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

The following abbreviations are used:

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

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

5.2 I/O module

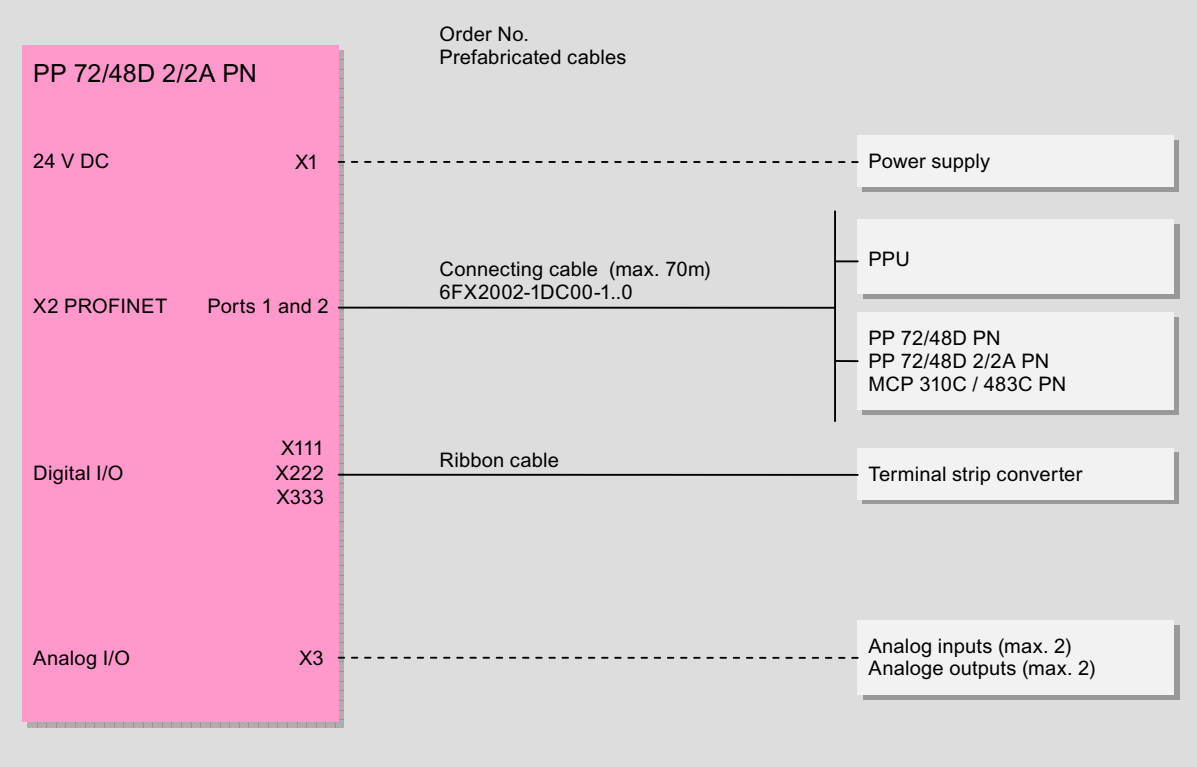


Figure 5-1 Connection options of the PP 72/48D 2/2A PN I/O module

NOTICE
With PPU 28x a maximum of five and with PPU 26x a maximum of four I/O modules can be operated within a SINUMERIK 828D control.

5.3 X1 power supply

5.3.1 Requirements for the power supply

⚠DANGER

The DC power supply is always referenced to ground and may not be generated by an autotransformer.

User interfaces must be powered via a DC power supply with safe isolation to EN 61800-5-1.

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 5- 2 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.

5.3.2 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 5- 3 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 5- 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

Use flexible cables with a cross-section of 0.25 to 2.5 mm^2 (or AWG 23 to AWG 13) for wiring the power supply according to the maximum 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.

5.4 X2 PROFINET

Prerequisite

The PP 72/48D 2/2A PN I/O module has certified PROFINET interfaces, however their functionality cannot be fully exhausted 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 5- 5 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 5- 6 PROFINET ports LED displays

Name	Color	Status	Meaning
Link	Green	On	100 Mbit link available
		Off	Missing or faulty link
Activity	Yellow	On	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 5- 7 Switch S1 settings

1	2	3	4	5	6	7	8	9	10	Device name	Meaning
2^0	2^1	2^2	2^3	2^4	2^5	2^6	2^7				
								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
off	off	on	off	on	off	off	off			pn-pn-coupler20	PN bus coupler

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".

5.5 X111, X222 and X333 digital inputs/outputs

Cable specification

- Connectors: 50-pin ribbon cable connectors

  50-pin insulation displacement connectors with cable grip, ribbon cables and terminal converters

  are required for connecting digital inputs and outputs.
- The required connecting cables (ribbon cables) must be provided by the user.
- Max. cable length: 30 m

Pin assignment

Table 5- 8 Pin assignment X111

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

Table 5- 9 Pin assignment for X222

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

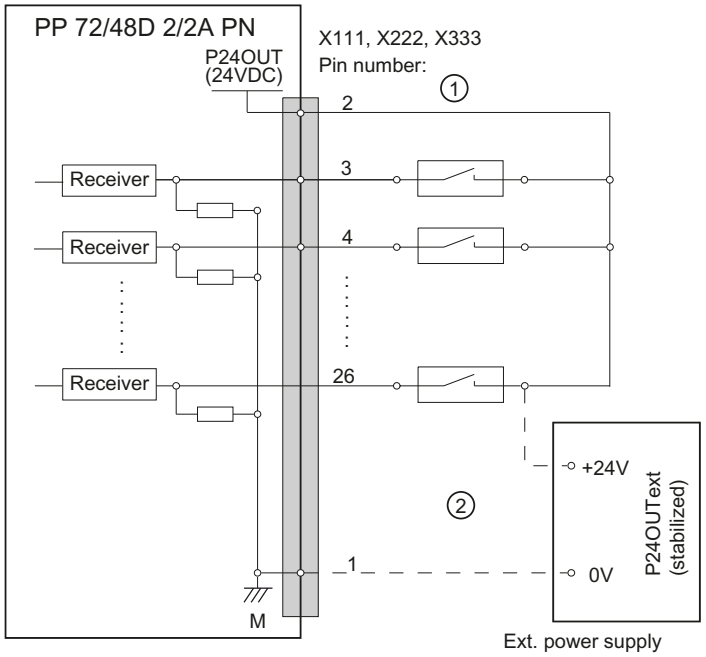
Table 5- 10 Pin assignment for X333

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

Digital inputs

- Features:
  - X222: Inputs 3.0 to 3.7 are connected as rapid inputs.
  - The inputs have no signaling (status LEDs).
  - The inputs are not isolated.
  - It is not possible to connect 2-wire BEROs.
- Terminal assignment for the digital inputs:

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



① when using the internal power supply P24OUT

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

Figure 5-2 Terminal assignment for the digital inputs

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

- Technical specifications:

Table 5- 11 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} rapid inputs (X222: Input 3.0 to 3.7)	-	-	600 µs

Digital outputs

- Features
  - No galvanic isolation.
  - Protection against: Short-circuit, overtemperature, and loss of ground.
  - Automatic disconnection in case of undervoltage.
- Terminal assignment for the digital outputs:

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

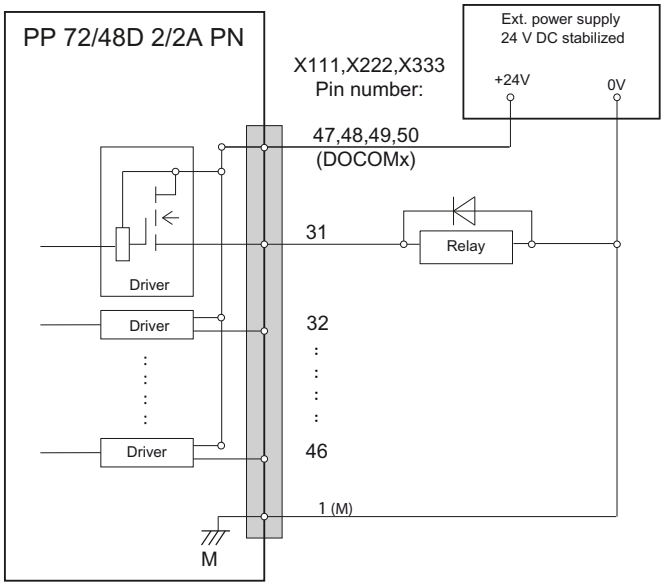


Figure 5-3 Terminal assignment for the digital outputs

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.

- Technical specifications:

Table 5- 12 Electrical specification of the digital outputs

Digital outputs	min.	Standard	max.	nominal
High-level voltage (U_H)	V_{CC} - 3 V	1)	V_{CC}	24 V
Output current I_{OUT}	-	-	250 mA 2)	-
Voltage with low level (U_L)	-	-	-	Output open
Leakage current at low level	-	50 µA	400 µA	-
Signal delay time T_{PHL}	-	0.5 ms	-	-
Maximum switching frequency				
Resistive load	-	-	100 Hz	-
Inductive load	-	-	2 Hz	-
Lamp	-	-	11 Hz	-

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

5.6 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

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

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

Pin assignment

Table 5- 13 X3 pin assignment

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

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

Analog inputs

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

NOTICE
The analog inputs are only enabled following the parameter assignment.

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

Table 5- 14 Technical specifications in the "voltage input" operating mode

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

Table 5- 15 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 5- 16 Technical specifications 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

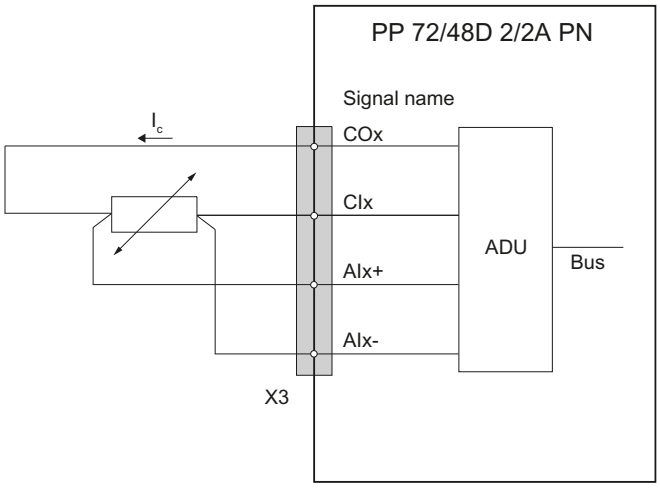
CAUTION
If the Pt100 operating mode is selected, the hardware is protected against overvoltage. In the event of an error: 1. an error bit is set which is then communicated to the PLC. 2. the module is brought to a standstill.

Notes regarding the connection and operation of Pt100 resistors:

The measurement is performed using a 4-wire connection system.

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 5-4 Pt100 pin assignment

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 5- 17 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 5- 18 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

Assigning parameters

6

6.1 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 5 I/O modules for PPU 28x (4 I/O modules for PPU 26x), bus coupler and Machine Control Panel with PLC I/O interface (based on PROFINET) is taken into consideration.

Example: Setting for I/O module with device number "8"

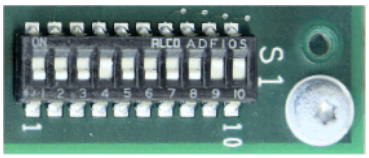


Figure 6-1 DIP Switch S1

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

I/O module	Bus	Device name	IP address	Input addresses	Output addresses
PN bus 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

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

6.2 Input / output images

Input image

The image comprises 3 slots (n, m, d ≙ start address, see Addressing the I/O modules (Page 37)):

- 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; see Diagnostics via input image (Page 48)

Table 6- 1 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 6- 2 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, ≙ 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 6- 3 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 6- 4 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

6.3 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

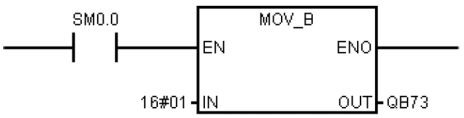
Operating mode 4th channel	Bit 7	Bit 6
No operating mode	0	0
Voltage output	0	1
Current output	1	0
Impermissible operating mode	1	1

Checkback signal of the operating modes

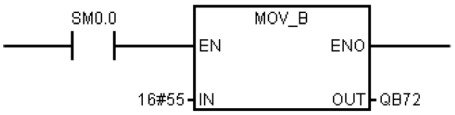
The set operating modes are saved in the input image in Status Byte 0. This value must be compared with Control Byte 0 in the output image. If these are different, an error has occurred, e. g. in the case of overvoltage in the "Temperature measurement" operating mode, see Diagnostics via input image (Page 48).

Examples of programming

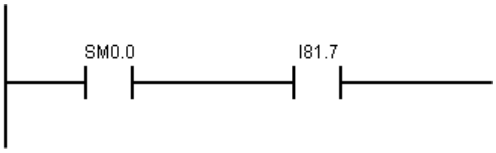
1. Determine control type:



2. Set the operating mode:



3. Query the error status bit in cyclic operation:



6.4 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 6- 5 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 6- 6 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 6- 7 Measured values in the "temperature measurement" operating mode

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

Note

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

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

Analog outputs

Table 6- 8 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 6- 9 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

6.5 Examples

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

Table 6- 10 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 6- 11 Measured values and responses in the current measurement operating mode

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

Table 6- 12 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

Error and system messages 7

7.1 LED displays

LED displays

Each PROFINET port has two integrated LEDs displaying the link status (green) and activity (yellow); see the chapter titled X2 PROFINET (Page 23).

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

Table 7- 1 LEDs: Status indicator

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 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.
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.

7.2 Diagnostics via input image

Table 7- 2 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- 3 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- 4 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- 5 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- 6 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

Technical data

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Table 8- 1 Technical specifications 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 specifications		
Rated voltage	24 V DC	
Rated current	0.7 A	
Power consumption at rated load	19 W (without digital outputs)	
Power loss	18 W	
Mechanical data		
Dimensions (WxHxD)	150 x 300 x 35 mm	
Weight, approx.	0.9 kg	
Climatic environmental conditions		
Cooling	Open-circuit ventilation	
	Operation	Storage/transport
Temperature limits	0 ... 55 °C	-40 ... 70 °C
Limits for relative humidity At 25 °C	5 ... 90 % Without condensation	5 ... 95 % 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)	

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

X111, X222 and X333 digital inputs/outputs (Page 25)
Analog X3 inputs/outputs (Page 31)

List of abbreviations

A

ALM	Active Line Module
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
EUI	User Interface
EGB	Electrostatic Sensitive Devices
EMC	Electromagnetic compatibility
EN	European standard
ESD	Electrostatic discharge: elektrostatische Entladung
GSM	Global System for Mobile Communications: Worldwide standard for wireless transmission of voice, data, fax and text messages (SMS).
HMI	Human Machine Interface: SINUMERIK operator interface for operating, programming and simulation
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
S/R	Steps per rotation
SLM	Smart Line Module
SMC	Cabinet-mounted sensor modules
SME	Sensor Module External
SRAM	Static RAM: Static memory (battery-backed)
USB	Universal Serial Bus: Bus system for connecting additional devices to a computer
VDE	Association of Electrical Engineering, Electronics and Information Technology (Germany)

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