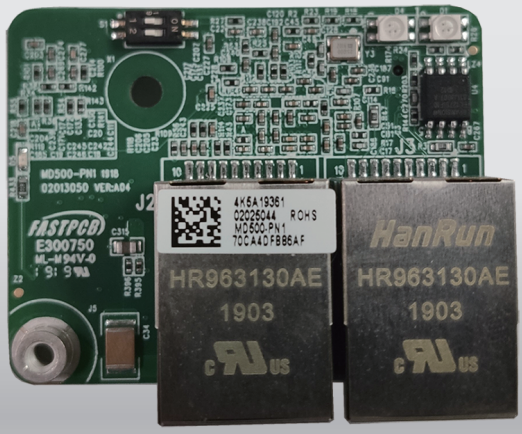
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MD500-PN1 PROFINET Communication Expansion Card

User Guide

Industrial Automation | New Energy Vehicle | Intelligent Elevator | Intelligent Robot | Digital Energy | Rail Transit

Data code 19012211C06

Legal Information

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The contents are subject to change without notice due to product upgrade.

Waste Disposal

The storage, use, and disposal of this product (including optional accessories) must comply with local laws and regulations.

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 can identify the risks of the product/system and prevent possible dangers.

Proper Use of the Product

Proper transportation, storage, assembly, installation, commissioning, operation, and maintenance are required to ensure the safe operation of the product without any problems. The required ambient conditions must be met. All operations must follow the guidelines provided in this documentation.

Preface

Introduction

This user guide describes the specifications, dimensions, installation, wiring, communication protocol, communication parameters, and communication instances of the MD500-PN1 expansion card.



- The software version of the MD500-PN1 card must be 1.00 or later. You can view the version through U0-67 on the MD500 after the card is installed and the drive is powered on. The corresponding GSDML file name is "GSDML-V2.33-Inovance-MD500PN1-20200619.xml".
- This guide describes use of the MD500-PN1 card in MD500 series AC drives. For use of the card in other drives, contact Inovance technical support to check whether the card is available and obtain corresponding technical documentation.

Revision history

Date	Document version	Software version	Revision
April 2026	C06	Firmware code: 0302CT37 Version: A00 Version label: U0-67= 000112	• Changed the function description of J1 to "Used for connection to the drive" in *"2.5 Terminal descriptions" on page 17*. • Added a ring connection topology diagram in *"3.2.1 PROFINET Topology" on page 21*. • Changed GSDML and XML files to GSD files in *" Troubleshooting" on page 49*.
November 2025	C05	Firmware code: 0302CT37 Version: A00 Version label: U0-67= 000112	• Updated *" Cover" on page 1* and *" Preface" on page 2*. *" Back Cover" on page 55* • Updated the pin description of J2/J3 in *"2.5 Terminal descriptions" on page 17*. • Added *" Legal Information" on page 1*. • Added "Industrial Information Security" and "Fundamental Safety Instructions" sections, and placed "Safety Precautions" and "Industrial Information Security" sections under "Fundamental Safety Instructions" section.
December 2024	C04	Firmware code: 0302CT37 Version: A00 Version label: U0-67= 000112	• Updated *" Cover" on page 1*, *" Preface" on page 2*, and *" Back Cover" on page 55*. • Updated the description for F0-28 in *"4.2 Communication-related Parameters" on page 27*. • Configured watchdog time in *"4.3.2 MRP Function of the MD500-PN1 Card" on page 44*.

Date	Document version	Software version	Revision
August 2024	C03	Firmware code: 0302CT37 Version: A00 Version label: U0-67= 000112	• Updated *" Cover" on page 1*, *" Preface" on page 2*, *"1.1 General Safety Instructions" on page 7*, and *" Back Cover" on page 55*. • Added new fault descriptions and solutions in *" Troubleshooting" on page 49*. • Updated the functional description for J2/J3 terminals in *"2.5 Terminal descriptions" on page 17*. • Standardized the expression and formatting throughout the document.
October 2023	C02	Firmware code: 0302CT37 Version: A00 Version label: U0-67= 000112	• Updated the range of drives compatible with the MD500-PN1 card in *"2.2 Applicable AC Drive" on page 15*. • Section updated. Changed FD-28 to F0-28, and modified the setting range for U3-16 and the decimal addresses for communication monitoring-related parameters in *"4.2 Communication-related Parameters" on page 27*. • Updated *" Cover" on page 1*, *" Preface" on page 2*, *"1.1 General Safety Instructions" on page 7*, and *" Back Cover" on page 55*.
November 2021	C01	Firmware code: 0302CT37 Version: A00 Version label: U0-67= 000112	• Updated the dimension drawing in *"2.4 Overall Dimensions" on page 17*.
September 2021	C00	-	• Added "1.2 Applicable AC Drives", dimensions in section 1.3, and "2.2.2 EMC Cabling Instructions". • Adjusted the manual structure.

Access to the guide

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- Visit https://www.inovance.com/global, and choose Service&Support > Support > Documentation Download.

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1 Fundamental Safety Instructions

1.1 General Safety Instructions

Safety Disclaimer

- This chapter provides essential safety instructions for proper use of the product. Before using this product, read through the guide and comprehend all the safety instructions. Failure to comply with the safety instructions may result in death, severe injury, or equipment damage.
- "DANGER", "WARNING", and "CAUTION" signs in this guide are only supplements to the safety instructions, and do not reflect all safety instructions to be followed.
- Use this product according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
- Inovance shall take no responsibility for any personal injury or property damage caused by improper use.

Safety Levels and Definitions



Indicates that failure to comply with the notice can result in death or severe personal injury.



Indicates that failure to comply with the notice may result in severe personal injuries or even death.



Indicates that failure to comply with the notice may result in minor or moderate injury or equipment damage.

General Safety Instructions

- Drawings in the guide are sometimes shown without covers or protective guards. Install the covers or protective guards as specified first, and then perform operations in accordance with the instructions.
- The drawings in the guide are shown for illustration only and may be different from the product you purchased.
- Operators must take mechanical protection measures to protect their safety. For example, they must wear safety shoes, safety clothing, safety glasses, protective gloves and sleeves, or other protective equipment.

Unpacking
 • Do not install the product in the case of any damage, rust, or signs of use on the product or accessories upon unpacking. • Do not install the product in the case of water seepage into the product or missing or damaged components upon unpacking. • Do not install the product in the case of any discrepancy between the product you received and the product name on the packing list.
 • Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking. • Unpack the package by following the unpacking sequence. Do not strike the package violently. • Check for damage, rust, or dents on the surfaces of the product and accessories upon unpacking. • Check the number of the product, accessories, and paper materials against the packing list carefully upon unpacking.

Storage and Transportation



- Large or heavy equipment must be handled by qualified professionals using specialized hoisting equipment. Failure to comply could result in personal injury or equipment damage.
- Before hoisting the equipment, ensure that components such as the front cover and terminal blocks are secured firmly with screws. Loosely connected components may fall off and result in personal injury or equipment damage.
- Never stand or stay under the equipment while it is being hoisted.
- When hoisting the equipment with a steel rope, ensure the equipment is hoisted at a constant speed without suffering from vibration or shock. Do not turn the equipment over or let the equipment stay hanging in the air. Failure to comply could result in personal injury or equipment damage.



- Handle the equipment with care and mind your steps during transportation to prevent personal injury or equipment damage.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply could result in personal injury.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply could result in equipment damage.
- Do not store or transport the equipment in locations where the equipment may be exposed to splashing water or rain, direct sunlight, strong electric field, strong magnetic field, or strong vibration.
- Store the equipment for up to three months. Take stricter protective measures and carry out the necessary inspections for a longer storage time.
- Pack the equipment securely and properly before transportation. Use a fully enclosed container for long-distance transportation.
- Never transport the equipment with other devices or items that could impact or cause harm to the equipment.

Installation



- This equipment must be operated only by trained and qualified electrical personnel. Non-professionals must not operate this equipment.



- Read through the guide and safety instructions before installation.
- Do not install this equipment in places with strong electric or magnetic field.
- Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply may result in mechanical hazards.
- Do not wear loose clothes or accessories during installation. Failure to comply may result in an electric shock.
- When installing the equipment in an enclosed environment (such as a cabinet or case), use cooling devices (such as fans or air conditioners) to cool the space and meet the installation environment requirements. Failure to do so could result in equipment overheating or fire.
- Do not modify this equipment.
- Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
- When the equipment is installed in a cabinet or terminal device, appropriate guard devices (guards for fire, electrical, and mechanical protection) meeting applicable IEC standards and local laws and regulations must be provided.
- Before installing devices with strong electromagnetic interference, such as a transformer, install a shielding device for the equipment to prevent malfunction.
- Install the equipment onto an incombustible object such as a metal. Keep the equipment away from combustible objects. Failure to comply may result in a fire.



- Cover the top of the product with a piece of cloth or paper during installation. This is to prevent unwanted objects such as metal chippings, oil, and water from falling into the product and causing faults. After installation, remove the cloth or paper on top of the product to prevent over-temperature caused by poor ventilation due to blocked ventilation holes.
- Resonance may occur when the equipment operating at a constant speed executes variable speed operations. In this case, install the vibration-proof rubber under the motor frame or use the vibration suppression function to reduce resonance.

Wiring



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Before wiring, switch off all the power supplies of the equipment. Wait for at least the time designated on the warning label before further operations because residual voltage still exists after power-off. After waiting for the designated time, measure the DC voltage in the main circuit to ensure the DC voltage is within the safe voltage range. Failure to comply could result in electric shock.
- Do not perform wiring, remove the equipment cover, or touch the circuit board with power ON. Failure to comply could result in electric shock.
- Make sure that the equipment and product are grounded properly. Failure to comply can result in the risk of electric shock.



- Never connect the power cable to output terminals of the equipment or product. Failure to comply may damage the equipment or even cause a fire.
- When connecting a drive with the motor, make sure that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Cables used must comply with corresponding cross-sectional area and shielding requirements. The shield of the shielded cable must be grounded at one end properly.
- Tighten the terminal screws with the torque specified in the user guide. Insufficient or excessive torque may cause overheating and damage to the joint, which could result in fire.
- After wiring is done, ensure that all cables are connected properly and no screws, washers or exposed cables are left inside the equipment. Failure to comply could result in electric shock or equipment damage.



- Follow the proper electrostatic discharge (ESD) procedure, and wear an antistatic wrist strap to perform wiring. Failure to comply may damage the equipment or its internal circuits.
- Use shielded twisted pair cables for the control circuit. Connect the shield to the grounding terminal of the equipment. Failure to comply may result in equipment malfunction.

Power-on



- Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Before power-on, make sure that the power supply meets equipment requirements to prevent equipment damage or even a fire.
- After power-on, do not open the cabinet door or protective cover of the equipment. Do not touch any terminals, or remove any part of the equipment at power-on. Failure to comply will result in an electric shock.



- Perform a trial run after wiring and parameter setting to ensure that the equipment operates safely. Failure to comply may result in personal injuries or equipment damage.
- Before power-on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in a fire. If the power supply voltage is used incorrectly, it will result in a fire.
- Before power-on, check that no one is near the equipment, motor, or other mechanical parts. Failure to comply may result in personal injuries or even death.

Operation



- The equipment must be operated only by professionals. Failure to comply can result in injury or death.
- Do not touch any connecting terminals or disassemble any unit or component of the equipment during operation. Failure to comply could result in electric shock.



- Never touch the enclosure, fan, or resistor with a bare hand. Failure to comply may result in burns.
- Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in a fire or equipment damage.

Maintenance



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Never maintain the equipment with power-on. Failure to comply may result in an electric shock.
- Before maintenance, disconnect all the power supplies of the equipment and wait for at least the time specified on the warning label.
- In case of a permanent magnet motor, do not touch the motor terminals even after power-off because there is still induced voltage generated during rotation. Failure to comply will result in an electric shock.



- Perform routine and periodic inspection and maintenance on the equipment according to maintenance requirements and keep a maintenance record.

Repair



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Never repair the equipment with power-on. Failure to comply may result in electric shock.
- Before inspection or repair, disconnect all the power supplies of the equipment and wait for at least the time specified on the warning label.



- Submit a request for repair based on the warranty agreement.
- When the fuse is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait for at least the time specified on the warning label before power-on or other operations. Failure to comply may result in personal injury or death and equipment damage.
- Troubleshooting and repair of a faulty or damaged equipment must be performed by professionals based on the repair instructions, with the repair records kept properly.
- Replace quick-wear parts of the equipment according to the replacement instructions.
- Do not use damaged equipment. Failure to comply could result in death, personal injury, or severe equipment damage.
- Recheck the wiring and reset the parameters after equipment replacement.

Disposal

• Dispose of the retired equipment in accordance with applicable national regulations and standards. Failure to comply could result in property damage, personal injury, or death. • Recycle retired equipment in accordance with industry waste disposal standards to avoid environmental pollution.

1.2 Industrial Information Security

The product provides interfaces for network connection and data transmission. To protect factories, systems, machines, and networks from cyberattacks, it is essential to implement proper protection mechanism for industrial security.

Customers are responsible for providing and maintaining a secure connection between the product and their network or any other network to protect their factories, systems, machines, and networks from unauthorized access. Such systems or machines can be connected to an enterprise network or the Internet only when a secure connection is established and appropriate security measures (such as using antivirus software or installing firewalls) are in place.

Inovance continuously develops and improves its products and solutions to enhance safety. It is strongly recommended that you update the product promptly and always use the latest version.



Tampering with software (such as viruses, Trojans, and Worms) can lead to unsafe drive state, which can put the device in an unsafe operation state. This may result in death, serious injury, and property damage. Observe the following strictly.

- Always use the latest software version. If the product version is no longer supported or the latest version of the program is not applied, customers are at increased risk of cyber-attacks.
- Take proper protection measures (including but not limited to deploying antivirus software, firewall, WAF, IPS/IDS, situational awareness system, ID verification, and data encryption) to prevent files in the mobile storage device from being damaged by malware and protect products, networks, systems, and interfaces from unauthorized access, disturbance, intrusion, data disclosure, or information theft.
- Check all safety-related interfaces and settings after commissioning.

2 Product Information

2.1 Introduction

The MD500-PN1 card is a PROFINET field bus adapter card complying with the international PROFINET standard and IEC 61158-6-10 and IEC 61158-6-10 application standard. It is installed in the MD series AC drive to improve the communication efficiency and implement the AC drive networking function, which enables the AC drive to be a slave controlled by the field bus master station.

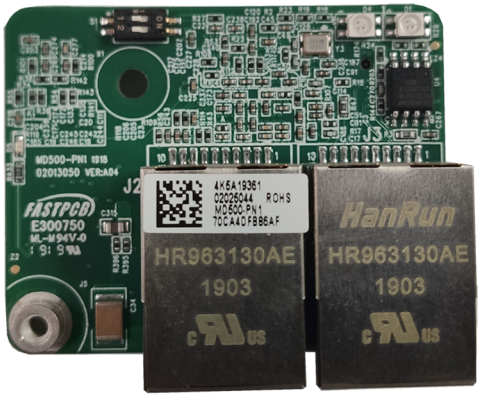


Figure 2-1 Appearance of MD500-PN1 card

2.2 Applicable AC Drive

Expansion Card	Applicable AC Drive
MD500-PN1	MD290
	MD480 (T2 and higher models)
	MD480-PLUS
	MD500
	MD500-PLUS
	MD510
	MD520
	CS290
	CS710
	IS580
	ES590
	ES680



This guide describes use of the MD500-PN1 card in MD500 series AC drives. For use of the card in other drives, contact Inovance technical support to check whether the card is available and obtain corresponding technical documentation.

2.3 Technical Specifications

Item	Technical specification
Real-time class	RT
Minimum data update cycle	1 ms
Number of nodes	At most 65535 (determined by PLC performance)
Baud rate	100 Mbps, full duplex
Transmission medium	Cat 5e or better Ethernet cable
Transmission distance	Maximum 100 m between two nodes
Topology	Bus, star, tree, ring
Ring network (MRP)	Supported
Startup with priority (fast startup)	Supported
Non-periodic read/ write	Supported
Periodic data	Up to 12 parameters can be read and written.

2.4 Overall Dimensions

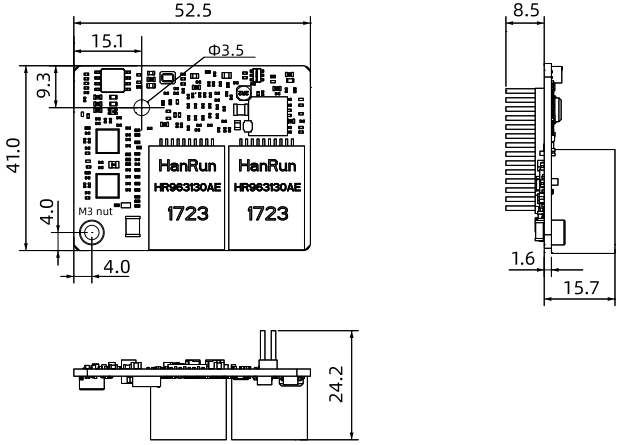


Figure 2-2 Dimensions of MD500-PN1 card (mm)

2.5 Terminal descriptions

Terminal layout

The following figure describes terminals and indicators of the MD500-PN1 card. The pin header J1 on the back of the MD500-PN1 card is used to connect the AC drive. The MD500-PN1 card provides two network ports J2 and J3 for communication with the PROFINET card (PLC).

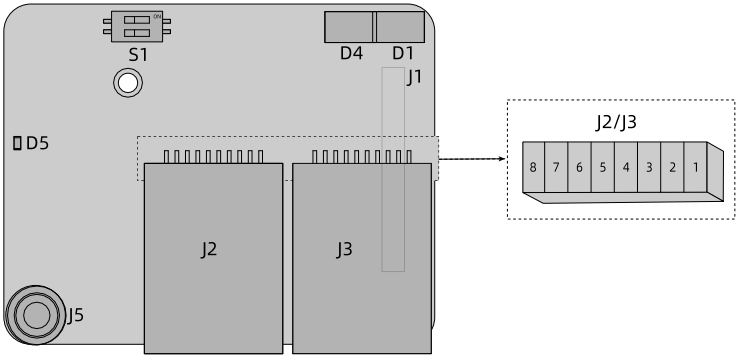


Figure 2-3 Interface layout of the MD500-PN1 card

Terminal Description

Table 2–1 Descriptions of network port communication terminals (J2 and J3) on the MD500-PN1 card

Pin No.	Name	Description
1	TD+	Data transmission+
2	TD-	Data transmission-
3	RD+	Data reception+
4	-	-
5	-	-
6	RD-	Data reception-
7	-	-
8	-	-

Terminal descriptions

Table 2–2 Descriptions of MD500-PN1 card terminals

Mark	Name	Function description
J1	Pin header	Used to connect the drive.
J2	Network port	Standard Ethernet RJ45 ports used for communication between the PN card and PN master/slave devices
J3		
D5	Power supply indicator	Used to indicate the status of the power supply. ON: Normal; OFF: Abnormal. Check whether the card is installed properly.
D1	PLC communication status indicator (PLCLink)	See *"Table 2-3 " on page 19*.
D4	Drive communication status indicator (DSPLink)	
S1	2-bit DIP switch	Used for upgrade only by the manufacturer.

Descriptions of status indicators

Table 2–3 Status indicators of the MD500-PN1 card

Indicator		State	Solution
DSPLink	Steady green	Normal	None
	Steady yellow	MAC address abnormal	Replace the PN card.
	Flashing yellow	Drive fault	Rectify the drive fault.
	Steady red	Abnormal communication with the AC drive	Set F0-28 to 1 and check whether the AC drive supports the MD500-PN1 card.
	Flashing red	Drive communication timeout	Check whether the AC drive software version supports the MD500-PN1 card. Restore the AC drive software to default settings.
PLCLink	Steady green	Communication normal	None
	Flashing green	Master not found	Check whether a device name is assigned to the slave. Check whether the corresponding PLC is connected.
	Steady yellow	Configuration error	Check whether the GSD is correct.
	Steady red	Communication with the master lost	Check the wiring, and check whether the network cable shield is connected properly.
D1 and D4	Both in red	PN card software error	Power off and on the drive again. Replace the PN card.
		DIP switch error	Check that the DIP switch S1 is OFF and power off and on the drive again.

3 Installation and Wiring

3.1 Installation

The MD500-PN1 card is installed inside the MD500 series AC drive. Before installation, de-energize the AC drive and wait about 10 minutes until the charging indicator on the AC drive becomes off. Then, insert the MD500-PN1 card into the AC drive and fasten the screws to prevent the signal socket between boards from being damaged by the pulling force of the external signal cable. *"Figure 3-1 " on page 20* shows the installation.

After installing the MD500-PN1 card to the drive, connect the grounding terminals of the MD500-PN1 card and the drive properly, as shown in *"Figure 3-2 " on page 20* .

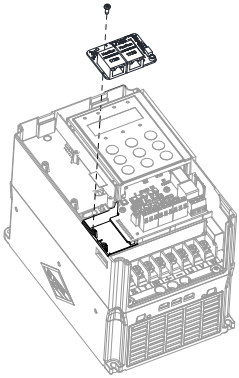


Figure 3-1 MD500-PN1 card installation

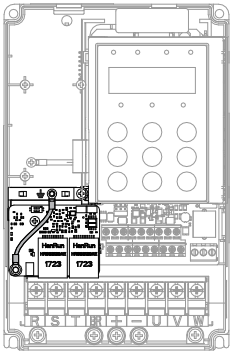


Figure 3-2 Connecting ground terminals of the MD500-PN1 card and AC drive

CAUTION

Do not install or disassemble the expansion card with power on.

3.2 Wiring

3.2.1 PROFINET Topology

The PROFINET protocol supports a variety of topologies, including bus, star, and tree topologies. Diversified networking modes can be implemented by using switches.

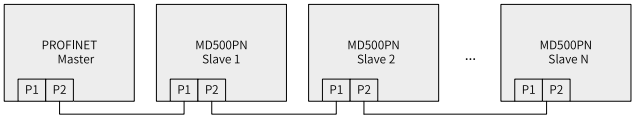


Figure 3-3 Bus topology

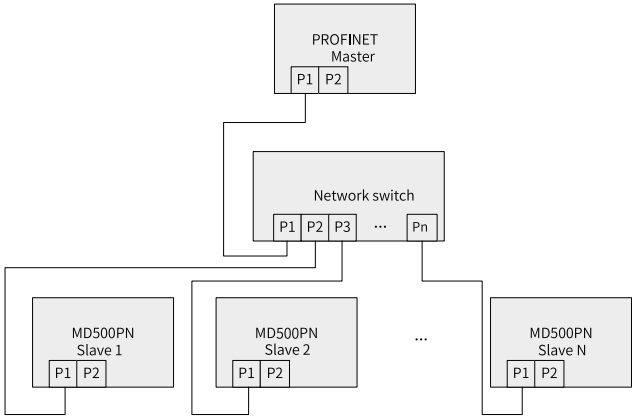


Figure 3-4 Star topology

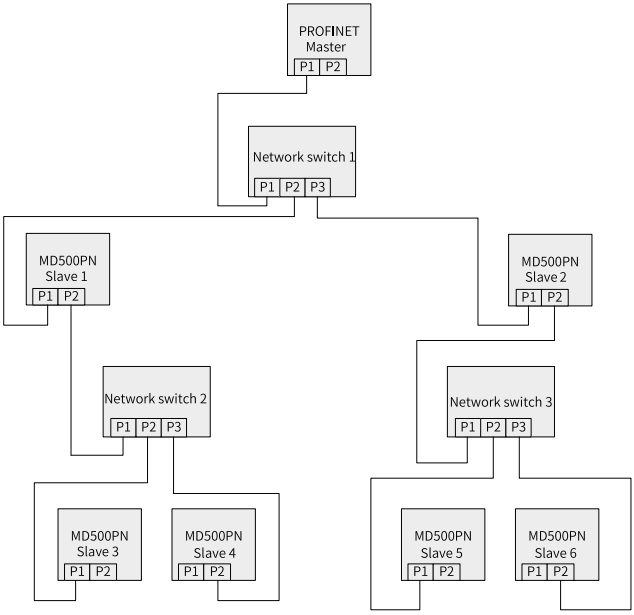


Figure 3-5 Tree topology

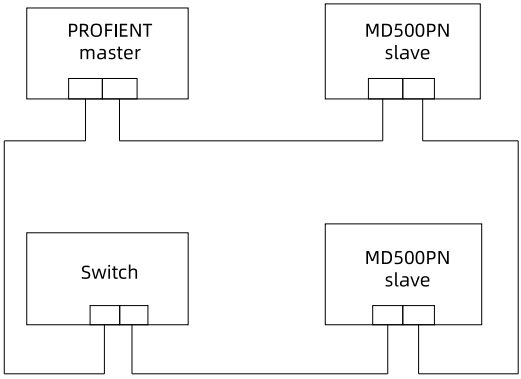


Figure 3-6 Ring topology

3.2.2 EMC Cabling Instructions

- During installation and commissioning on site, route communication signal cables and power cables through different routes. Failure to comply will result in communication interference.

- Connect the motor casing to the ground terminal (PE terminal) of the AC drive, and connect the ground cable of the motor casing properly. Failure to comply will result in poor grounding performance.
- It is recommended to use shielded cable. Connect the shield to the grounding terminal (PE) of the drive.
- Read the communication state through the status indicator on the card. See *"Table 2-3 " on page 19* for details.

4 Communication Descriptions

4.1 Descriptions of PROFINET Communication Protocol

Data transmission format

The MD500-PN1 card transmits data using PZD formats with different lengths as required. You can set the PZD functions during configuration.

The following table lists the functions supported by each data format.

Data type	Data length	Functions available
Standard telegram 1	PZD-2/2	AC drive command and frequency setting Reading of AC drive state and operating frequency
Standard telegram 2	PZD-4/4	AC drive command and frequency setting Periodic writing of two function parameters Reading of AC drive state and operating frequency Periodic reading of two function parameters
Standard telegram 3	PZD-6/6	AC drive command and frequency setting Periodic writing of four function parameters Reading of AC drive state and operating frequency Periodic reading of four function parameters
Standard telegram 4	PZD-8/8	AC drive command and frequency setting Periodic writing of six function parameters Reading of AC drive state and operating frequency Periodic reading of six function parameters
Standard telegram 5	PZD-10/10	AC drive command and frequency setting Periodic writing of eight function parameters Reading of AC drive state and operating frequency Periodic reading of eight function parameters

Data type	Data length	Functions available
Standard telegram 6	PZD-12/12	AC drive command and frequency setting Cyclic writing of 10 function parameters Reading of AC drive state and operating frequency Cyclic reading of 10 function parameters
Supplementary telegram	PZD-2/6	AC drive command and frequency setting Reading of AC drive state and operating frequency Periodic reading of four function parameters

Description of data in PZD area

The PZD data is used for the master station to modify and read AC drive data in real time and perform periodic data exchange. The data communication addresses are directly configured by the drive. The specific functions are as follows:

- Setting AC drive control command and target frequency in real time
- Real-time reading of AC drive current state and running frequency
- Real-time exchange of function parameters and monitoring data between the AC drive and the PROFINET master

The PZD is used for periodic data exchange between the master station and AC drive, as described in the following table.

Master-to-Drive PZD area		
AC drive command	Target frequency of the drive	Real-time change of function parameter
PZD1	PZD2	PZD3 to PZD12
Drive-to-Master PZD area		
AC drive state	AC drive operating frequency	Real-time reading of function parameters
PZD1	PZD2	PZD3 to PZD12

Description of master-to-drive data

The data sent by the master to different AC drives varies slightly.

- MD500, MD500-PLUS, MD290, and MD480 series AC drives

Description of master-to-drive PZD		
PZD1	AC drive command word (command source set to "communication")	
	01: Forward run 02: Reverse run 03: Forward jog 04: Reverse jog	05: Coast to stop 06: Stop according to F6-10 (Stop mode) 07: Reset fault
PZD2	It indicates the AC drive target frequency (frequency source set to communication), which ranges from the reverse frequency upper limit (negative value) to forward frequency upper limit (decimal places included, for example, 2000 corresponds to 20.00 Hz on the AC drive). When the given target frequency exceeds this range, the AC drive runs at the frequency upper limit.	
PZD3 to PZD12	The data is used to change the function parameter values (groups F and A) in real time without writing the values into the EEPROM. FE-02 to FE-11 correspond to PZD3 to PZD12. The mapping set manually in group FE is invalid.	

- CS710 and CS290 series AC drives

Description of master-to-drive PZD	
PZD1	bit0: Decelerate to stop; bit1: Coast to stop bit2: Forward run; bit3: Reverse run bit4: Quick stop; bit5: Torque control bit6: Fault reset; bit7: Command valid bit8 to bit15: Reserved
PZD2	It is used to set the target frequency of the AC drive. (The frequency reference source must be set to communication.) The frequency can be set in two different ways by bd.06. • If the lowest bit of bd.06 is 0, the frequency ranges from 0 to 10000, which corresponds to 0.00% to 100.00% of the maximum frequency (negative or positive). • If the lowest bit of bd.06 is 0, the frequency ranges from 0 Hz to the maximum frequency (negative or positive).
PZD3 to PZD12	The corresponding value is written to the RAM area of a function parameter address. The writing address of the function parameter is set in bd.11 to bd.20. For example, if bd.11 is set to B5.00 and 500 is written to PZD3, the value of B5.00 is changed to 5.00. The address of the written function parameter can also be configured in the slave station properties (device-specific parameters) of the PLC. Once configured in the slave station properties, the address of the parameter specified by bd.11 to bd.20 will automatically be changed to that configured by the device-specific parameters.

Description of drive-to-master data

The data responded by different AC drives varies slightly.

- MD500, MD500-PLUS, MD290, and MD480 series AC drives

Description of drive-to-master PZD	
PZD1	It indicates the AC drive running state, as defined by the following bits: bit0: 0: Stopped; 1: Running bit1: 0: Forward running; 1: Reverse running bit2: 0: No fault; 1: Faulty bit3: 0: Running frequency not reached; 1: Running frequency reached bit4 to bit7: Reserved bit8 to bit15: AC drive fault code
PZD2	It indicates the AC drive running frequency (unit: 0.01 Hz). The current AC drive running frequency, which is the 16-bit signed data, is returned.
PZD3 to PZD12	It is used for real-time reading of function parameters (groups F and A) and monitoring parameters (group U). FE-22 to FE-31 correspond to PZD3 to PZD12. The mapping set manually in group FE is invalid.

- CS710 and CS290 series AC drives

Description of drive-to-master PZD	
PZD1	bit0: AC drive operating; bit1: Forward run bit2: Reverse run; bit3: No fault bit4: Coast to stop; bit5: No communication with the AC drive bit6: Frequency reached; bit7: Torque control valid bit8 to bit15: Reserved
PZD2	It indicates the AC drive running frequency. For example, if 2500 is returned, the AC drive running frequency is 25.00 Hz.
PZD3 to PZD12	PZD3 to PZD12 are used to return the current value of the corresponding parameter address. The parameter address is specified by bd.21 to bd.30. For example, if bd.21 is set to B5.01 and the value of B5.01 is 25.00, the value returned by PZD3 is 2500. The address of the function parameter can also be configured in the slave station properties (device-specific parameters) of the PLC. Once configured in the slave station properties, the address of the parameter specified by bd.21 to bd.30 will automatically be changed to that configured by the device-specific parameters.

4.2 Communication-related Parameters

Communication card settings

The communication configuration varies with the drives, as shown below.

- Communication card settings for MD500, MD290, and MD480

After powering on the AC drive, set F0-28 to 1 to enable communication between the MD500-PN1 card and the AC drive.

Parameter code	Parameter name	Value range	Setpoint	Description
F0-28	Communication protocol selection	0: Modbus 1: Expansion communication protocol	1	This parameter is used to select a communication protocol. 0: Modbus The Modbus protocol is used. 1: Expansion communication protocol PROFIBUS DP, PROFINET, EtherCAT, Modbus TCP, and EtherNet/IP protocols can be used. No setting is required for CANlink because it is always valid.

- Communication card settings for MD500-PLUS and MD480-PLUS
  After powering on the AC drive, set FD-00 (baud rate) to 9 (115200 bps) and FD-01 (Modbus data format) to 3 (No check 8-N-1) to enable communication between the MD500-PN1 card and the AC drive.



F0-28 does not need to be set for the MD500-PLUS and MD480-PLUS series AC drive.

- Communication card settings for CS710 and CS290
  After the AC drive is powered on, the MD500-PN1 card can communicate with the AC drive properly only after bd.07 is set to 2.

Parameter code	Parameter name	Value range	Setpoint	Description
bd.07	Expansion card selection	0: Modbus 1: DP 2: CANopen/PN	2	PROFINET communication expansion card

Parameters related to communication control

Parameter code	Parameter name	Value range		Decimal address
U3-16	Frequency setting	-327.68 Hz to +327.67 Hz		29456
U3-17	Control command	0001: Forward run 0002: Reverse run 0003: Forward jog 0004: Reverse jog	0005: Coast to stop 0006: Decelerate to stop 0007: Fault reset	29457
U3-18	DO control	bit0: DO1 output control bit1: DO2 output control bit2: Relay 1 output control bit3: Relay 2 output control bit4: FMR output control	bit5: VDO1 bit6: VDO2 bit7: VDO3 bit8: VDO4 bit9: VDO5	29458
U3-19	AO1 control	0 to 7FFF indicates 0% to 100%.		29459
U3-20	AO2 control	0 to 7FFF indicates 0% to 100%.		29460
U3-21	FMP control	0 to 7FFF indicates 0% to 100%.		29461
U3-22	Reserved	Reserved		-
U3-23	Speed control	Signed data, 1 rpm		29463

By default, when the MD500-PN1 card is used, the written PZD1 and PZD2 are mapped to U3-17 and U3-16, respectively. If any command or frequency cannot be written into the AC drive correctly but PZD3 to PZD12 can be written and F0-02 and F0-03 are set to 2 and 9 respectively, check whether FE-00 and FE-01 are set to U3-17 and U3-16 respectively. If not, manually correct the values of FE-00 and FE-01.

Parameters Related to Communication Monitoring

Parameter code	Parameter name	Unit	Decimal address
U0-00	Running frequency (Hz)	0.01 Hz	28672
U0-01	Set frequency (Hz)	0.01 Hz	28673
U0-02	Bus voltage (V)	0.1 V	28674
U0-03	Output voltage (V)	1 V	28675
U0-04	Output current (A)	0.01 A	28676
U0-05	Output power (kW)	0.1 kW	28677
U0-06	Output torque (%)	0.10%	28678
U0-07	DI state	1	28679
U0-08	DO state	1	28680
U0-09	AI1 voltage (V)	0.01 V	28681

Parameter code	Parameter name	Unit	Decimal address
U0-10	AI2 voltage (V)	0.01 V	28682
U0-11	AI3 voltage (V)	0.01 V	28683
U0-12	Count value	1	28684
U0-13	Length value	1	28685
U0-14	Load speed display	100.00 %	28686
U0-15	PID setting	1	28687
U0-16	PID feedback	1	28688
U0-17	PLC phase	1	28689
U0-18	Pulse input frequency (kHz)	0.01 kHz	28690
U0-19	Feedback speed (Hz)	0.01 Hz	28691
U0-20	Remaining operating time	0.1 min.	28692
U0-21	AI1 voltage before correction	0.001 V	28693
U0-22	AI2 voltage before calibration	0.001 V	28694
U0-23	AI3 voltage before correction	0.001 V	28695
U0-24	Linear speed	1 m/min.	28696
U0-25	Current power-on time	1 min.	28697
U0-26	Current operating time	0.1 min.	28698
U0-27	Pulse input frequency	1 Hz	28699
U0-28	Communication setpoint	0.01%	28700
U0-29	Encoder feedback speed	0.01 Hz	28701
U0-30	Display of main frequency X	0.01 Hz	28702
U0-31	Display of auxiliary frequency Y	0.01 Hz	28703
U0-32	Memory address view	1	28704
U0-33	Synchronous motor rotor position	0.1°	28705
U0-34	Motor temperature	1℃	28706
U0-35	Target torque	0.10%	28707
U0-36	Resolver position	1	28708
U0-37	Power factor angle	0.1°	28709
U0-38	ABZ position	1	28710
U0-39	Target voltage upon V/f separation	1 V	28711
U0-40	Output voltage upon V/f separation	1 V	28712
U0-41	DI input state display	1	28713
U0-42	DO output state display	1	28714
U0-43	DI input state display 1	1	28715
U0-44	DI input state display 2	1	28716

Parameter code	Parameter name	Unit	Decimal address
U0-45	Fault information	1	28717
U0-58	Z signal counting	1	28730
U0-59	Rated frequency (%)	0.01%	28731
U0-60	Running frequency (%)	0.01%	28732
U0-61	AC drive state	1	28733
U0-62	Current fault code	1	28734
U0-63	Operating frequency after drooping control	0.01 Hz	38375
U0-64	Current back EMF	0.1 V	28736
U0-65	Reserved	-	-
U0-66	Expansion card model	100: CANopen 200: PROFIBUS DP 300: CANlink 400: PROFINET 500: EtherCAT	28738
U0-67	Expansion card version number	0.01	28739
U0-68	AC drive state	1	28740
U0-69	Running frequency (Hz)	0.01 Hz	28741
U0-70	Motor speed	1 rpm	28742
U0-71	Output current	0.1 A	28743

When MD500-PN1 is used, the read PZD1 and PZD2 are mapped to U0-68 and U0-69 respectively by default. If any state or the running frequency fails to be read while PZD3 to PZD12 can be read, check whether FE-20 and FE-21 are U0-68 and U0-69 respectively. If not, manually correct the parameter values.

Note

For CS710 series AC drives, the address to read U0.00 (frequency reference) is 16#D000 (53248 in the decimal format) and the address to read U0.10 (DI status) is 16#D00A (53258 in the decimal format).

For details about the PDZ definitions of other AC drives, see the corresponding AC drive user guides.

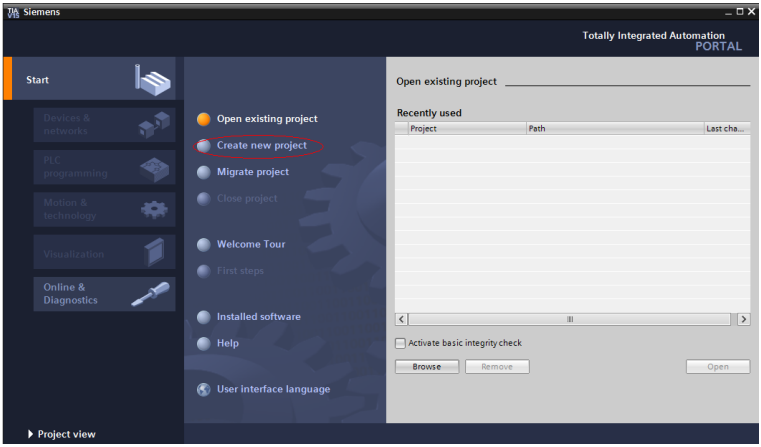
4.3 Communication Instances

4.3.1 Configuring Slaves on the S7-1200 Master

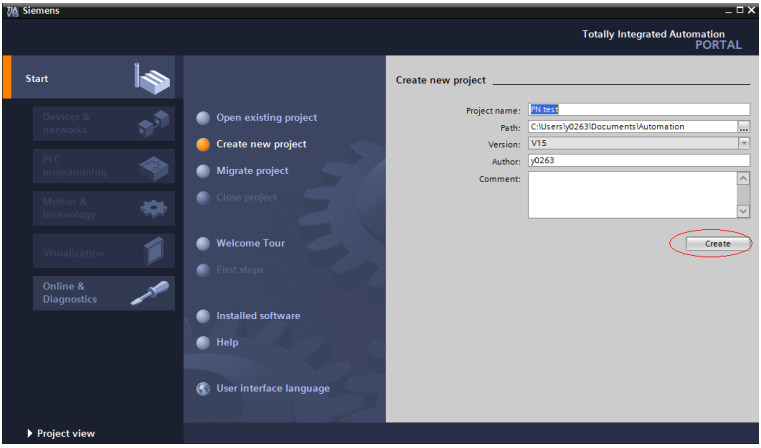
Before using the PROFINET master, you need to configure the GSDML file of the slave to add the corresponding slave stations to the master. If the file exists, skip step 2. You can obtain the GSDML file from the Inovance agent or the manufacturer.

To configure the slave, do as follows:

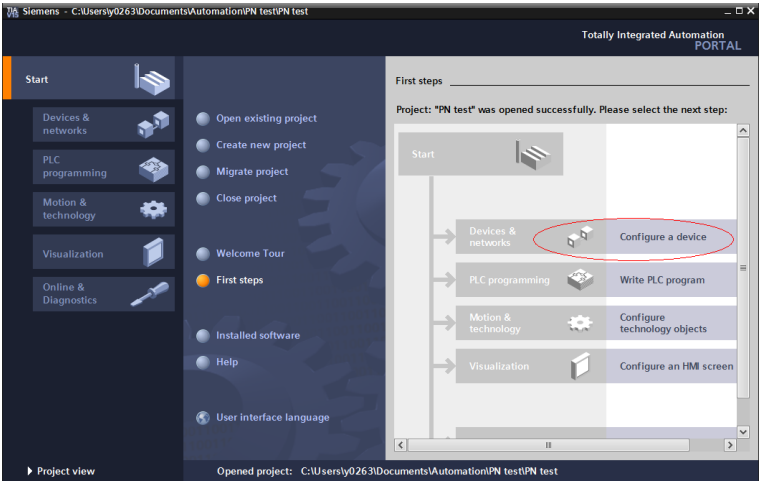
1. Create a project and add the S7-1200 master to the project in PORTAL. To be specific, open PORTAL first. The interface as shown in the following figure is displayed.



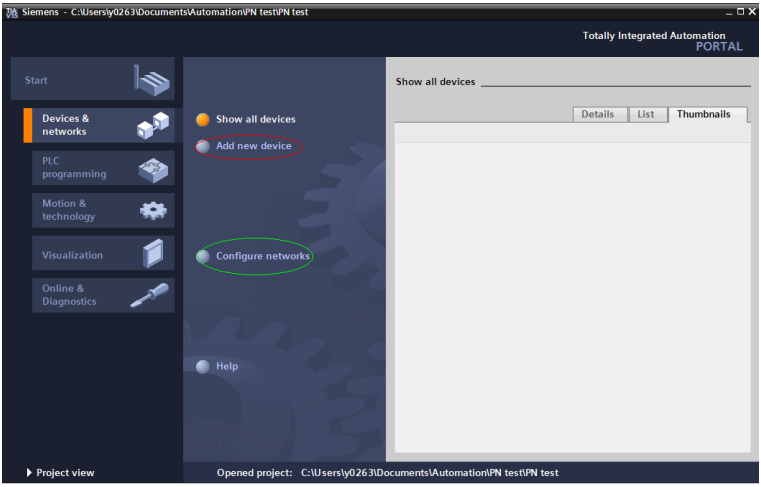
Click **Create new project**, enter a project name and storage path, and click **Create**.



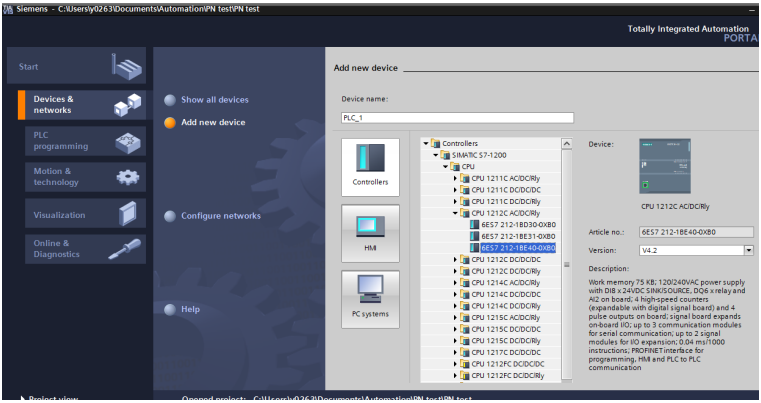
Click **Configure a device**.



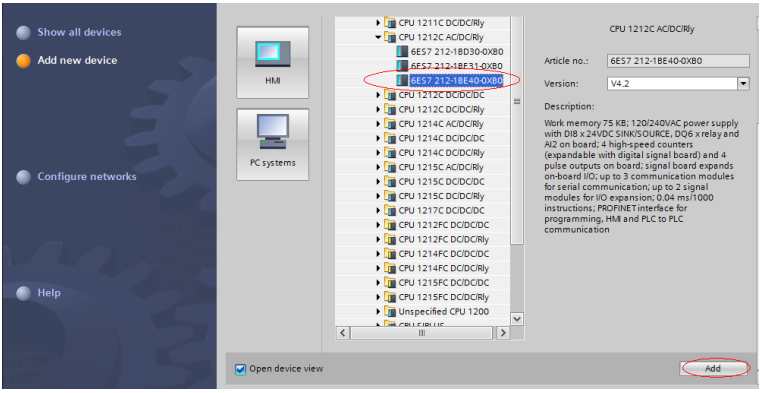
For a new project, click **Add new device** (marked with a red circle in the following figure). For an existing project, click **Configure networks** (marked with a green circle in the following figure).



Select a PLC on the displayed interface. Ensure that the article number and firmware version of the PLC are correct to avoid a download failure.

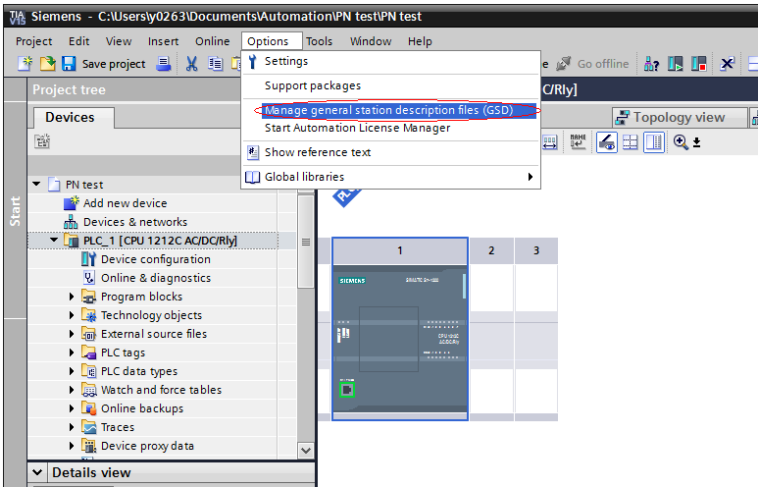


Click **Add** or double-click the selected master station.

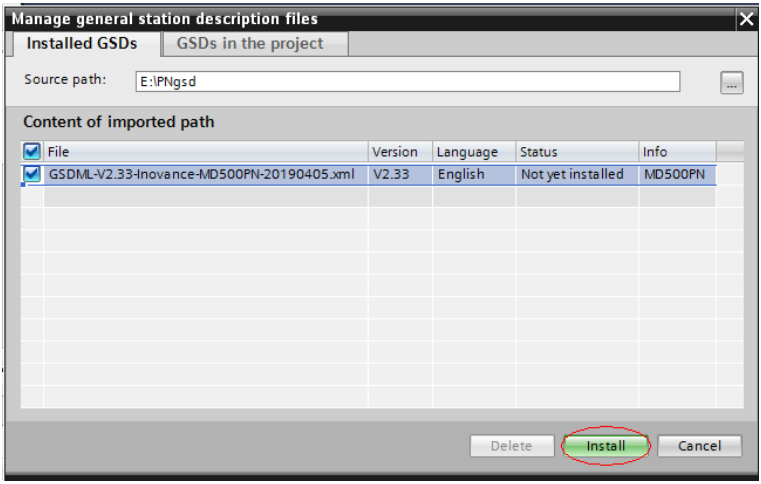


The master is added.

2. (Optional) To install the GSDML file, choose **Options** > **Manage general description files (GSD)**.



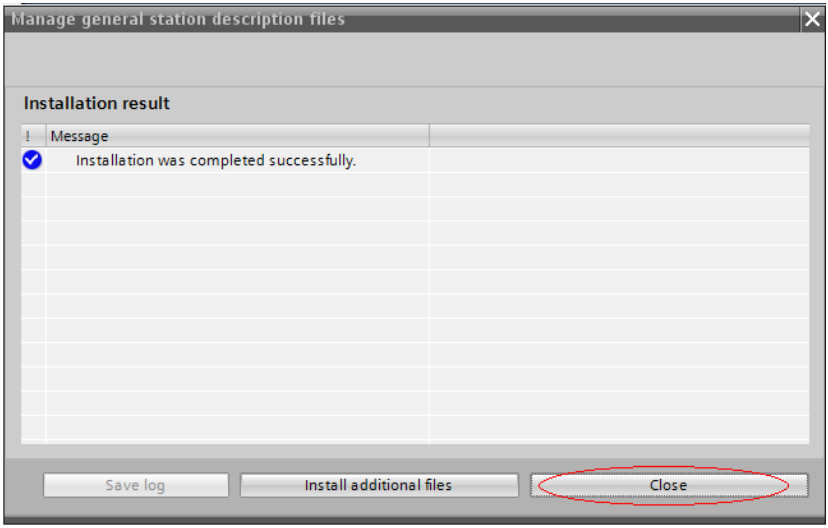
Select the storage path that does not contain any Chinese characters for the GSDML file, select the GSDML file to be installed, and click **Install**.



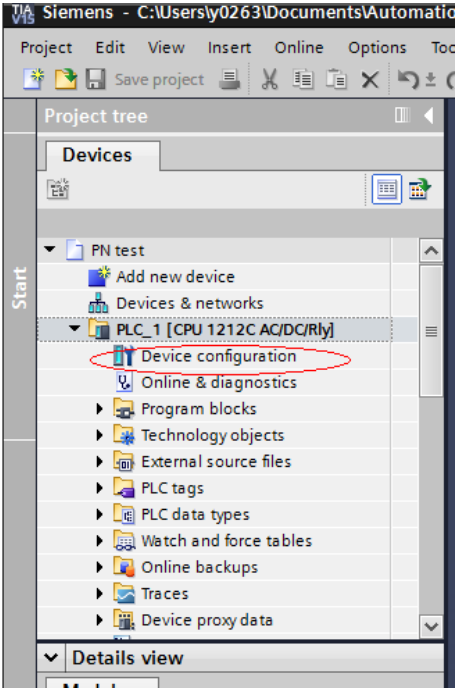
CAUTION

The GSDML file name varies with the AC drive series. For details, see the corresponding user guide.

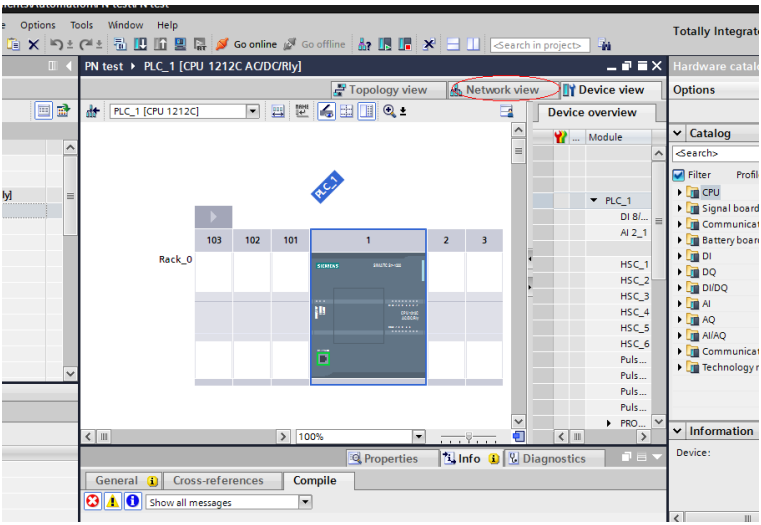
After installation is done, click **Close**.



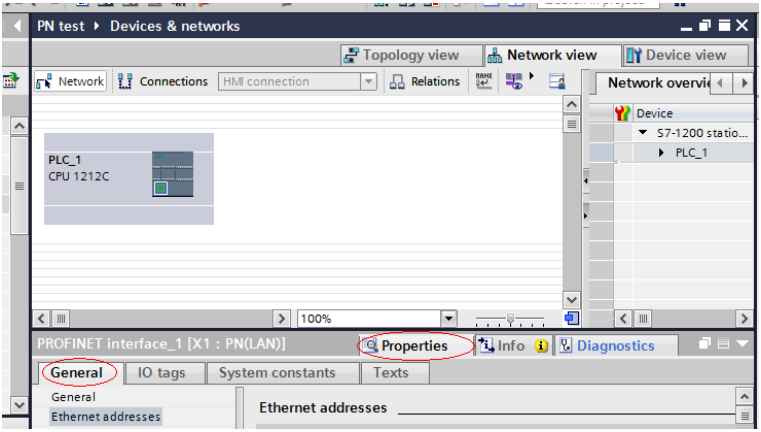
3. Configure a slave.
   Click **Device configuration**.



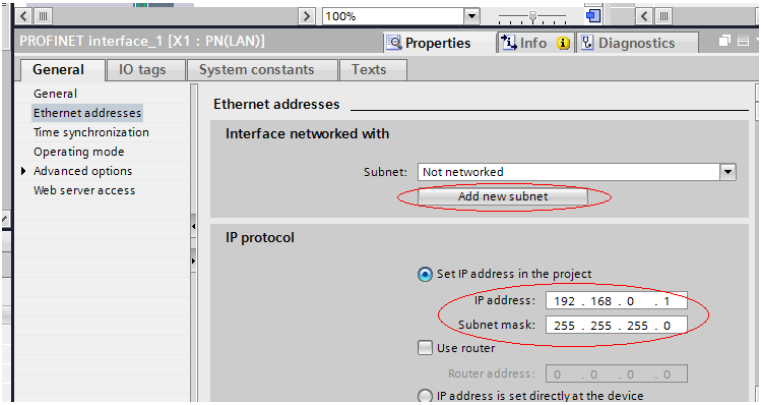
   Switch to **Network View**.



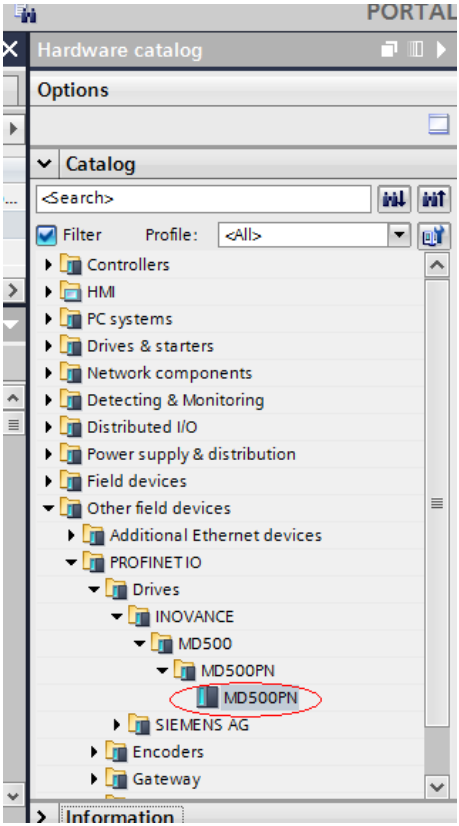
Select the Ethernet interface of the PLC, and choose **Properties** > **General**.



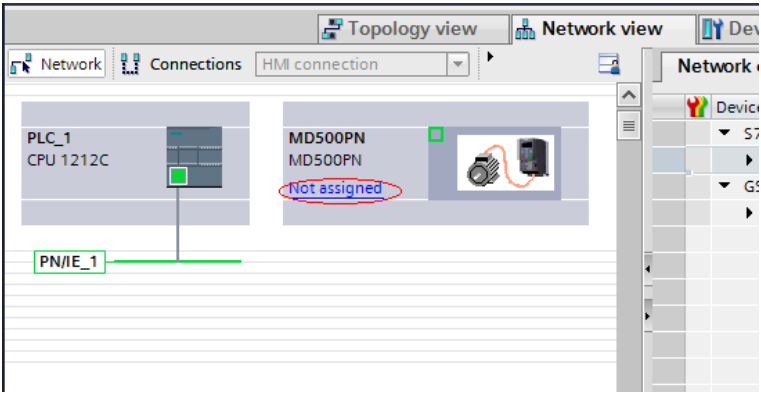
Set the IP address and subnet mask of the PLC, and click **Add new subnet**.



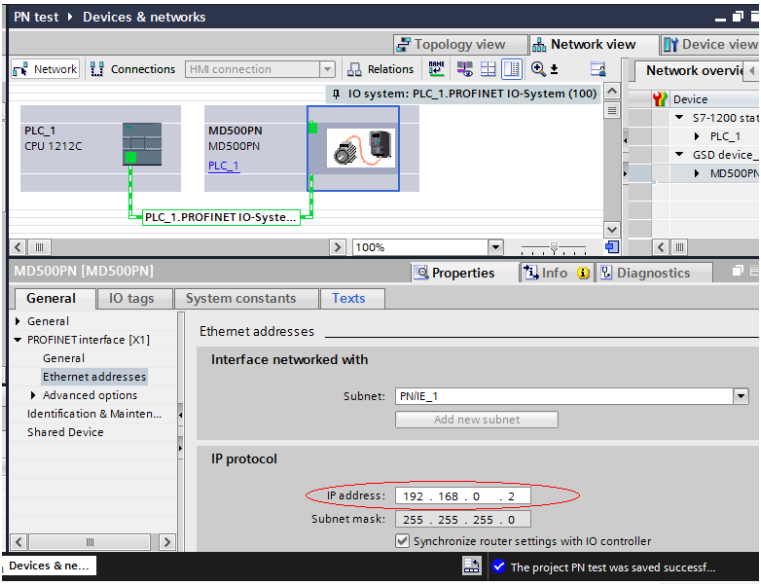
Locate MD500PN under **Hardware catalog** on the right, and double-click **MD500PN**.



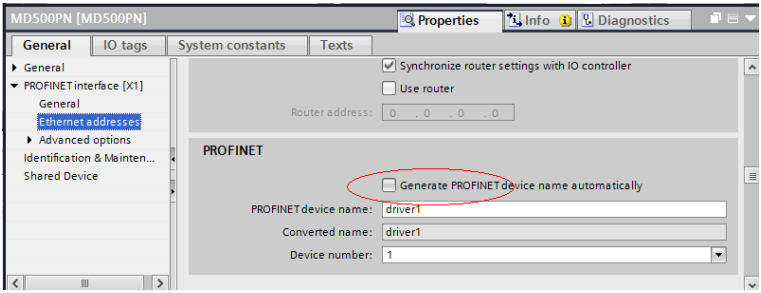
Click **Not assigned** to select the master system for the slave.



Select the slave, and choose **Properties** > **General** > **PROFINET interface [X1]** > **Ethernet addresses** and set the IP address.

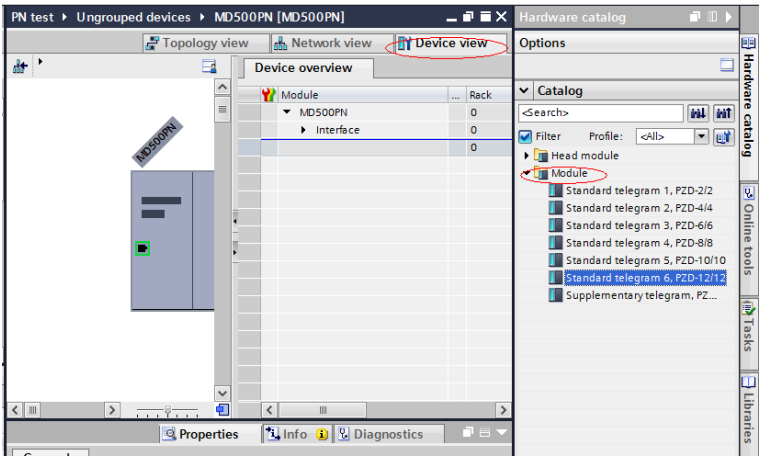


Scroll down the interface to locate the **PROFINET** area. Clear **Generate PROFINET device name automatically**, and name the slave device in the **PROFINET device name** text box. Alternatively, select **Generate PROFINET device name automatically** to enable the system to generate a device name automatically.



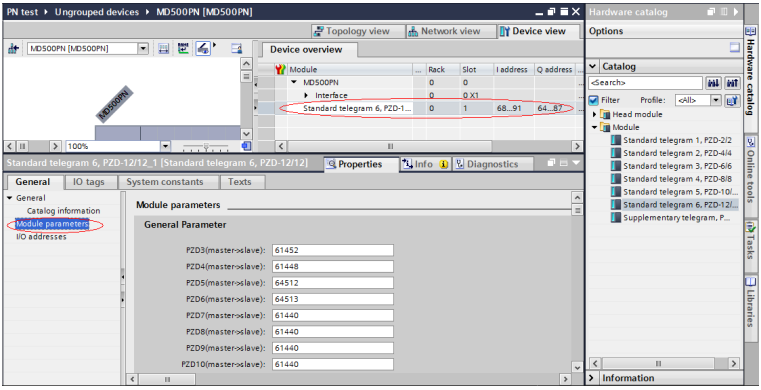
4. Configure data features of the slave.

   Select the slave station and click the **Device view** tab. In the **Hardware catalog** pane, click **Module**, and double-click the data length configured to the slave station.



5. Configure the PZD.

   The PZD1 and PZD2 configurations are fixed and cannot be modified by users. PZD3 to PZD12 are intended for exchange of user-defined cyclic data. They can be set in hardware configuration.

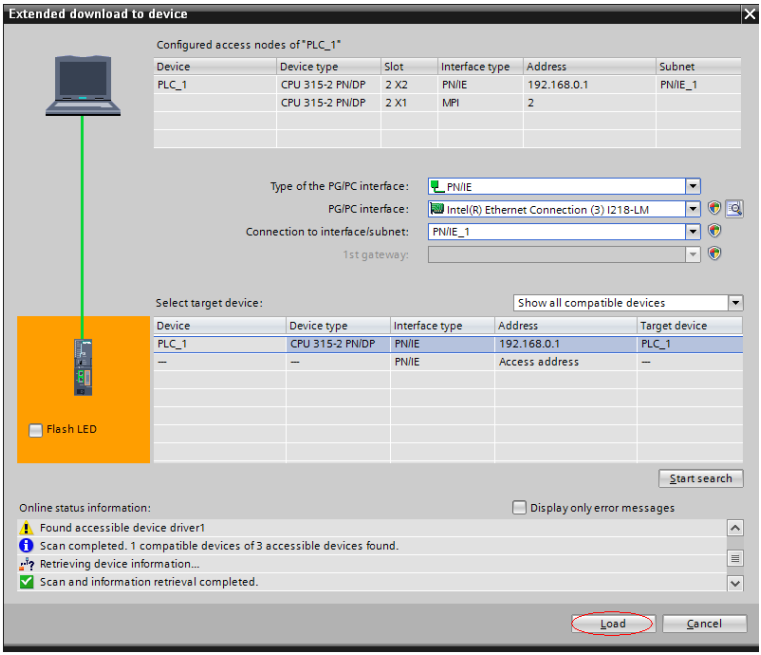


PZDx(master->slave) indicates the address of the slave used by the master to write data to the slave, and PZDx(slave->master) indicates the address of the slave used by the master to read data from the slave. PZD3 to PZD12 (determined by the selected message type) are displayed in decimal and can be modified. For example, to set PZD3(master->slaver) to F0-12, enter **61452**.

By default, all PZDs of the MD520 are set to F0-00 (61440 in decimal). For unused PZDs, modification is not required and default values can be retained. PZD mapping must be set independently for each slave as required. If mapping relationships of various slaves are the same, you can select one configured slave, press Ctrl+C, select the PROFINET bus in the configuration, press Ctrl+V, and modify the device name and IP address.

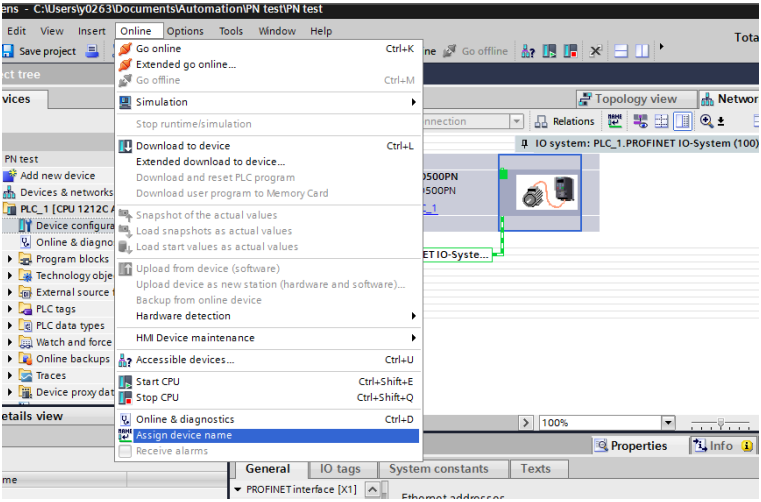
Switch to **Network view**. To add more stations, repeat the preceding steps. If the configuration is the same, select and copy a configured slave and modify the IP address and device name (note that the device name must be unique).

6. Download the configuration.
   Save the network configuration. Set the IP address of the PC to the same network segment as that of the PLC. (Note that the IP address of the PC must be different from that of the slave station in the configuration. You can also enable the function of automatic IP address distribution for the PC.) Start compiling, click **Load**, select the interface, and click **Start search**.

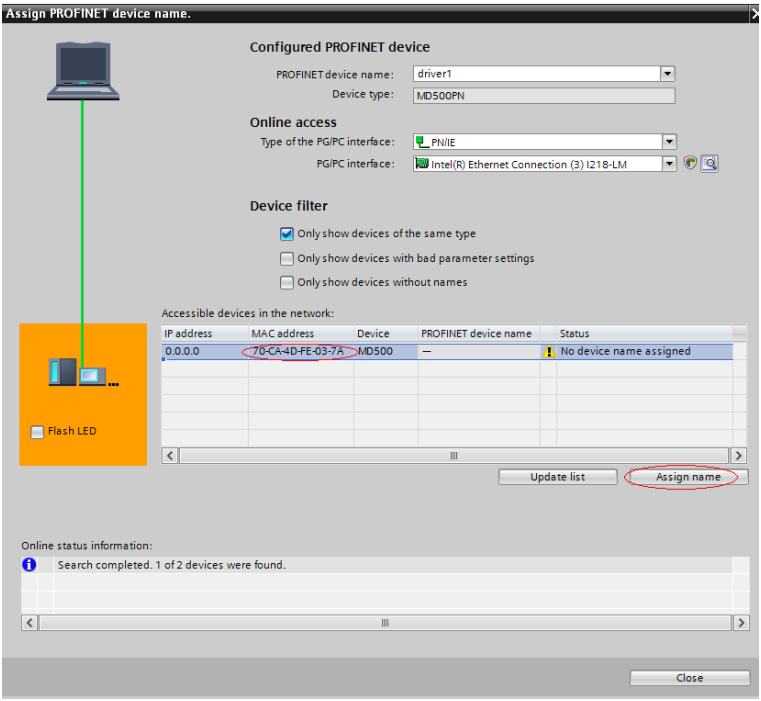


7. Assign a device name.

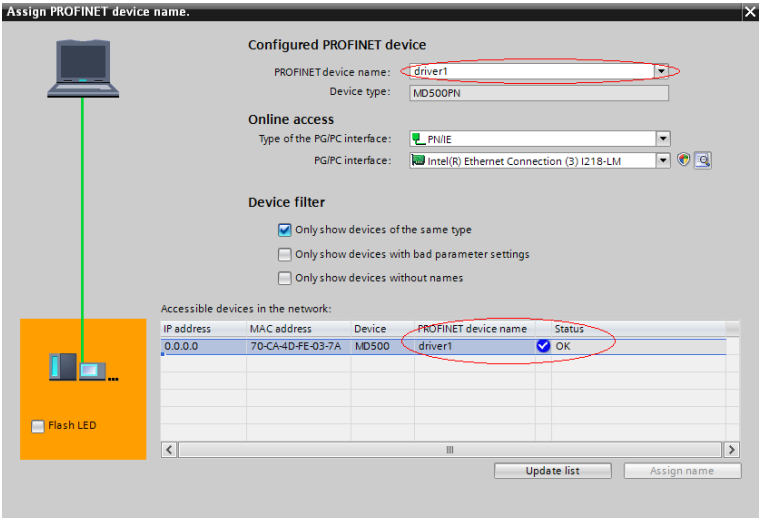
   After downloading is complete, assign device names for slave stations without names. Select a slave, and choose **Online** > **Assign device name**, or right-click the slave and select **Assign device name**.



Devices of the same type will be displayed in the popped-out interface. Select the slave to be assigned with the device name. The MAC address for each slave is unique. When multiple devices of the same type exist in a network, differentiate such devices with their MAC addresses. The MAC address of the MD500-PN1 card is on the product enclosure. Click **Assign name**.



If information similar to the following figure is displayed, the device name is assigned successfully. The displayed **PROFINET device name** in the following figure must be consistent with that displayed in the preceding figure. After assigning the device name, close the interface or select another device from the **PROFINET device name** drop-down list to assign device names for other stations.



The slave will save the assigned name, and the master identifies each slave based on the device name. (The MAC address is not intuitive in use. The device name assigned is bound to the MAC address of a device for identification.)

CAUTION

- Each device name can be assigned to only one slave station on the network.
- After the device name of a station in the configuration is changed, the device must be assigned with a name again. (For any exception, see "Troubleshooting".)
- After modifying the IP address, you only need to download the modified configuration to the PLC. Name assignment is not required.

After the preceding steps, the PROFINET slave is configured. You can compile programs in the PLC to control the AC drive. Reading and writing operations on PROFINET slaves through the PLC are similar to those on PROFIBUS DP slaves through the PLC.

To ensure normal operation of the PLC, function blocks such as OB82, 83, 86, and 122 need to be added during programming. The content of the function blocks can be compiled according to actual needs or left blank.

4.3.2 MRP Function of the MD500-PN1 Card

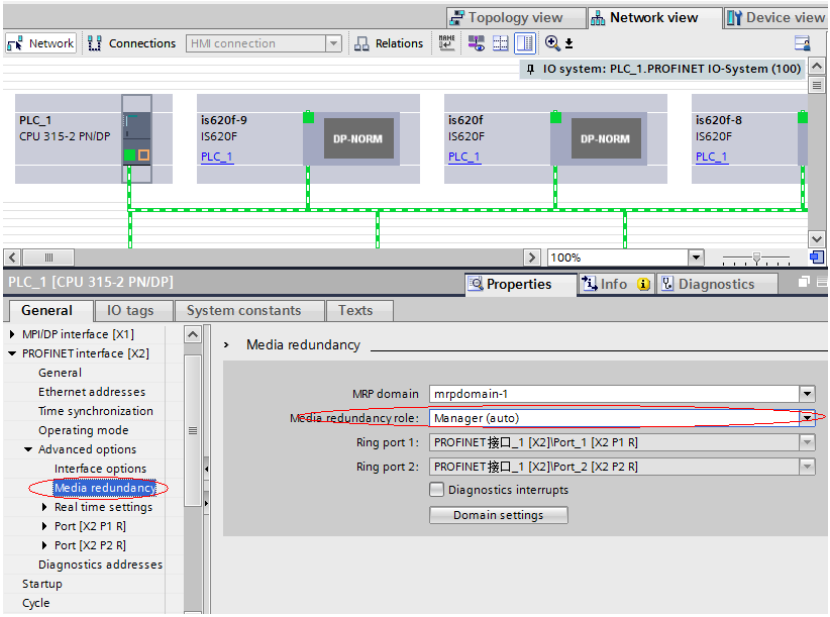
MRP indicates Media Redundancy Protocol. The MRP ring network is used in PROFINET to enable the MRP function. Only one MRP ring network is allowed in one PROFINET network.

The MD500-PN1 card whose software version is 1.04 or above supports the MRP function. (Check U0-67 on the AC drive to see the version.) To use the MRP function, the corresponding configuration is required.

Configuring the MRP function in PORTAL

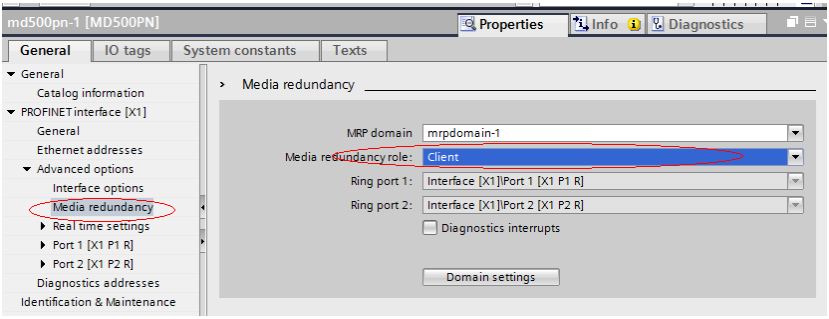
1. Configure the MRP manager.

   An MRP manager is required in the MRP ring network. The MD500-PN1 card cannot be used as the manager. Generally, the PLC is used as the manager. Select the station to be used as the manager, and select **Manager (auto)** for **Media redundancy role**, as shown in the following figure.



2. Configure the MRP client.

   Select the slave station, and select **Client** for **Media redundancy role**, as shown in the following figure. Note that the manager must be configured before the client is configured.



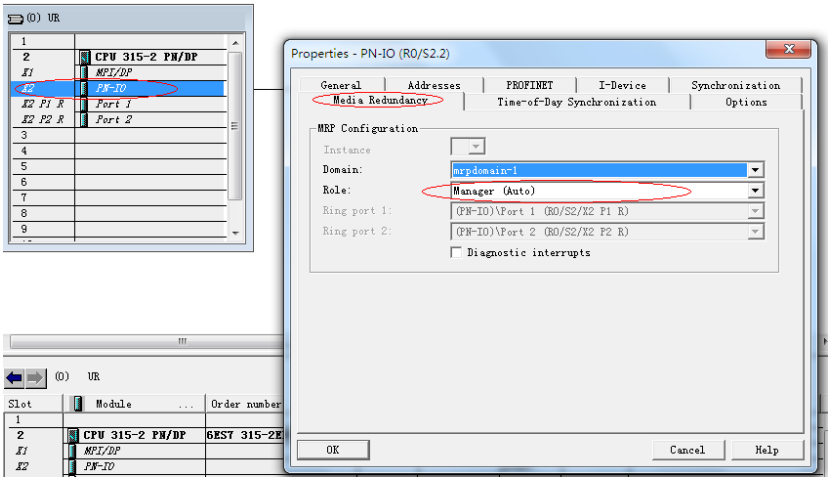
3. Configure the watchdog time.
   The MRP function requires that the watchdog time cannot be shorter than 200 ms. Therefore, you need to modify the watchdog time, as shown in the following figure. Go to **IO cycle** > **Watchdog time**, and modify **Accepted update cycles without IO data** to a value not less than 200 ms.

   Note: If the watchdog time is shorter than 200 ms, and the ring network circuit is interrupted, the node in the network reports a communication interruption fault and then resumes normal connection.

4. Download the configuration.
   After configuring all devices in the MRP ring network, start compiling and download the configuration to the PLC.

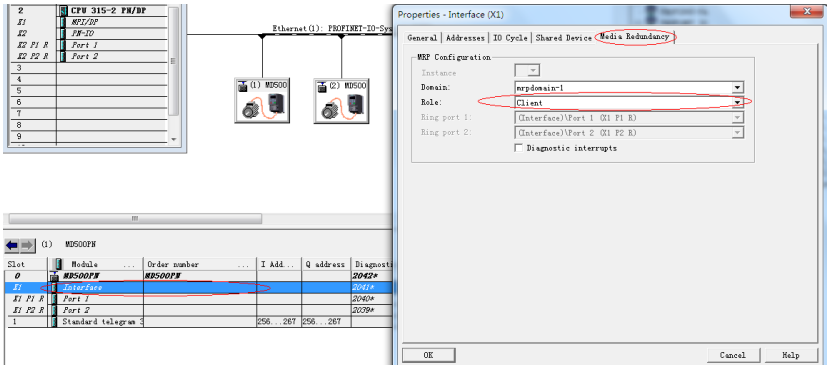
Configuring the MRP function in STEP 7

1. Configure the MRP manager.
   An MRP manager is required in the MRP ring network. The MD500-PN1 card cannot be used as the manager. Generally, the PLC is used as the manager. Double-click **PN-IO** of the PLC, and select **Manager (auto)** for **Role** in the **Media Redundancy** tab, as shown in the following figure.



2. Configure the MRP client.

   Select the slave station, double-click Interface, and select **Client** for **Role** in the **Media Redundancy** tab, as shown in the following figure. Note that the manager must be configured before the client is configured.



3. Configure the watchdog time.

   The MRP function requires that the watchdog time cannot be shorter than 200 ms. Therefore, you need to modify the watchdog time.

   Go to **IO cycle** > **Watchdog time**, and modify **Accepted update cycles without IO data** to a value not less than 200 ms.

   Click OK.

CAUTION

If the watchdog time is shorter than 200 ms, and the ring network circuit is interrupted, the node in the network reports a communication interruption fault and then resumes normal connection.

4. Download the configuration.

   After configuring all devices in the MRP ring network, start compiling and download the configuration to the PLC.

CAUTION

- Each device in the ring network must be configured as an MRP manager or client.
- Configuration of the topological structure is not required during MRP configuration. You can configure the topological structure after the MRP configuration is complete if needed.
- Do not connect devices without the MRP function configured to the ring network. Otherwise, connection failure or frequent disconnections will occur.
- In a PROFINET network configured with MRP, when a disconnection occurs in the ring network, handshaking will be performed again. If the watchdog time is shorter than 200 ms, the AC drive slave reports ERR16, which is cleared automatically (if the automatic clearing function is supported) after the handshaking is complete. You can also manually clear the fault. The preceding action is also performed after the disconnected circuit is restored. To avoid equipment faults caused by the interruption of the ring network circuit, configure the watchdog time to not shorter than 200 ms.
- Even if the MRP is configured, when two disconnections occur in the network, all nodes between the two disconnected points cannot be connected normally. To avoid such problems, the star topology is recommended.

5 Troubleshooting

The following table describes the faults that may occur during the usage of the MD500-PN1 card and AC drive.

Description		Solution
After the AC drive is powered on, only the power supply indicator (D4) is on, which indicates that communication between the MD500-PN1 card and AC drive has not been established.		1. Check whether F0-28 is set to 1. 2. Check the AC drive model. This user guide describes the usage of the PN card only on the MD500. For the usage of the card on other types of AC drives, contact the technical engineers to obtain the corresponding user guides. 3. Check whether the AC drive software supports the MD500-PN1 card.
After the AC drive is powered on, the power supply indicator (D5) is on and the communication indicator (D4) is solid yellow.		An MAC error occurs. Replace the MD500-PN1 card.
Connection fails after the configuration is downloaded.	After the configuration is downloaded, D5 and D4 indicators on the PN card are solid green, and D1 indicator blinks green.	1. Check whether the cable is correctly connected. 2. Check whether the upstream PN node operates properly. 3. Check whether a device name is assigned to this node through the PLC. 4. Check whether the GSD used for configurations is correct.
	After the configuration is downloaded, D5 and D4 indicators on the PN card are solid on, and D1 indicator blinks yellow.	1. Check whether the GSD used is correct. 2. Check whether the PZD mapping relations are set correctly. Device-specific parameters in STEP 7 and TIA PORTAL must be set in the decimal format. Therefore, the parameters must be converted to decimal values. For example, the decimal value of FC-11 is 64523 (0xFC0B in hexadecimal format). If a parameter in the hexadecimal format instead of the decimal format is entered, the connection fails. Note that addresses using Modbus (such as H2000 and H8000) are unavailable for PZD mapping.

Description		Solution
After the connection is successful, all indicators on the PLC are ON in green, but data cannot be written into or read from the AC drive.	No data can be written/read.	Check whether the operated address is correct. For example, if the I address and Q address of the station are both 520 to 531 (note that the I and Q addresses may start from different numbers), the PZD1 and PZD2 data written into the AC drive are stored in QW520 and QW522, respectively. (If the PLC is S7-300 or S7-400, PQW is required.) If SFC15 is used, check whether RET_VAL of SFC15 block is 0. If not, an invocation error occurs. In this case, rectify the error first and then invoke the function block.
	PZD3 or subsequent data can be written, while PZD1 or PZD2 cannot be written/ read.	Check whether F0-02 and F0-03 are set to 2 and 9, respectively. Check whether the command reference is in the range of 1 to 7 (not bit) or frequency reference is in the range of -F0-10 to +F0-10. If not, the write operation fails. Check whether FE-00 and FE-01 are U3-17 and U3-16, respectively. If not, manually correct the parameter values or restore to factory settings.
	PZD1 and PZD2 can be written/read, while PZD3 or subsequent data cannot be written/read.	Check whether the message type supports this PZD. Check whether device-specific parameters are set properly (View corresponding parameters in group FE to check whether they are written to the mapping correctly.).
	-	Check the logic relations. Check whether the same PZD is assigned for multiple times in a certain logic relation (by checking whether the value given by the PLC is correct under the logic relation in the monitoring table of the PLC).
After the communication is connected, the AC drive reports Err16, which cannot be cleared. However, the D1 indicator on the PN card and the BF indicator on the PLC are normal.		Check whether the eight higher bits of the PZD1 data (QW data) written into the AC drive are 0 in the PLC program. If not, change them to 0. The PZD1 command in this user guide refers to values instead of bits. Note: This solution applies only to the MD500. For other AC drives, consult the technical engineers.
After the MD500-PN1 communication card is powered on, all PZD data reported by the drive is 4369 (that is, 0x1111).		1. Download the latest GSD file. 2. Check the software version through U0-67. The software version must be later than 111. 3. Check whether the parameter settings are correct through F0-00 for troubleshooting. 4. Check whether the communication between the communication card and the AC drive is interfered. Check that the communication card and AC drive share common ground.

CAUTION

When the status word returned by the MD500-PN1 card and the drive fails to display the fault status, you can use OB82 for monitoring or perform write/read operations on an address of the drive for diagnosis.

The MD500-PN1 card can be replaced directly without reconfigurations only when the MD500-PN1 card of a slave node is faulty.

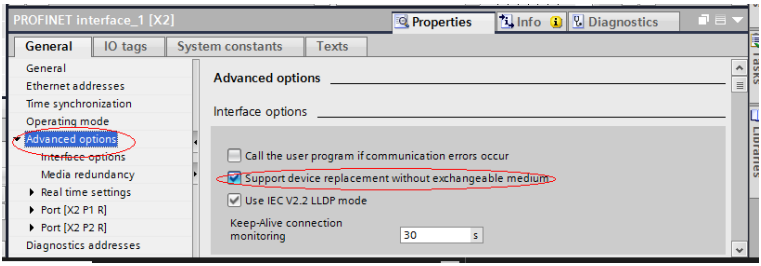
Prerequisites for directly replacing the MD500-PN1 card:

- The alternative component and the component to be replaced are both the MD500-PN1 cards.
- The alternative MD500-PN1 card has not been assigned with a device name before.
- The topology has been configured during PLC network configurations.
- During PLC configuration, "Support device replacement without exchangeable medium" is enabled.

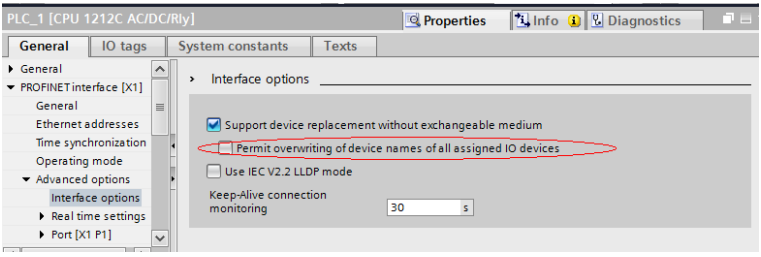
To directly replace the MD500-PN1 card, the corresponding configuration is required. The configuration varies in STEP 7 and PORTAL.

Enabling the "Support device replacement without exchangeable medium option" and setting topology in PORTAL

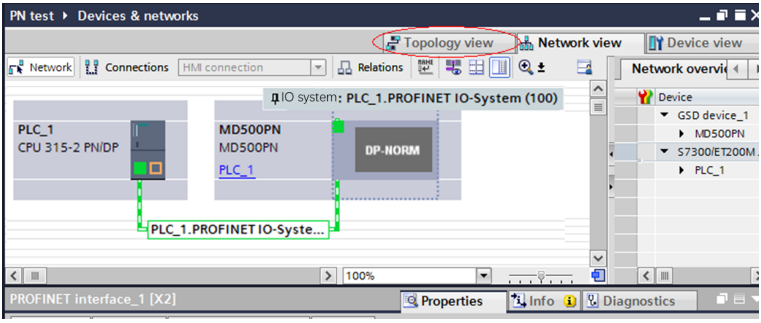
Open PORTAL, and select the PROFINET interface of the master station in the hardware configuration. In the Properties > General tab, choose Advanced options > Interface options, and select Support device replacement without exchangeable medium, as shown in the following figure.



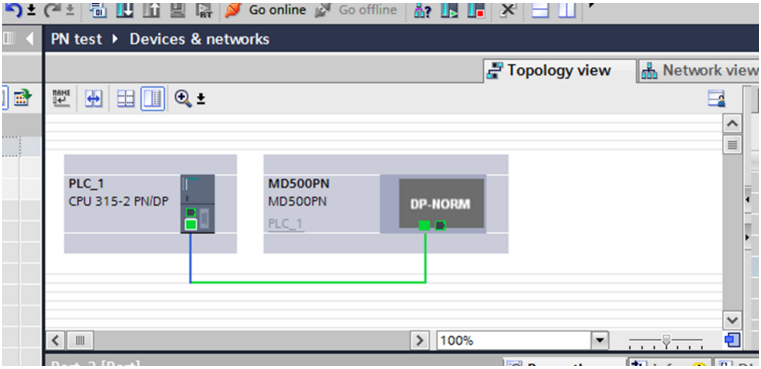
For the S7-1200 or S7-1500 PLC, the suboption Permit overwriting of device names of all assigned IO devices is provided. If this suboption is selected, the second prerequisite for directly replacing the MD500-PN1 card is not required.



Click the Topology view tab.



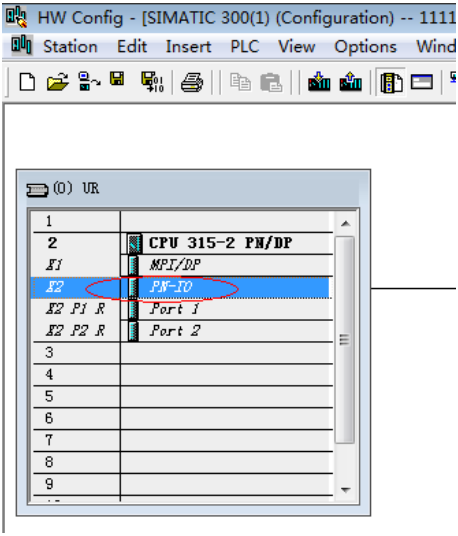
In the topology view, click and drag an interface to the interface of another device which is directly connected with the first interface, and release the mouse button. Note that the preceding connection must be consistent with the actual network connection of devices. For example, if P1 of the PLC is connected to P2 of slave station 1, and P1 of slave station 1 is connected to another slave station, the connections must be consistent in the topology. An incorrect topology will cause function failures after replacement and even communication errors. After the MD500-PN1 card is installed, P1 is on the left and P2 is on the right when you face the RJ45 interface.



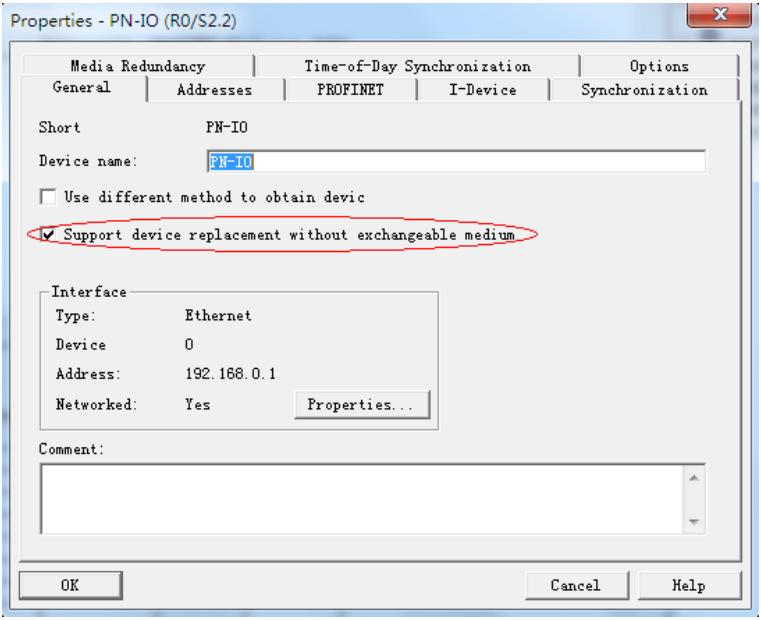
After completing the topology, start compiling and download it to the PLC.

Enabling the "Support device replacement without exchangeable medium" option and setting topology in STEP 7

In hardware configuration, double-click PN-IO, as shown in the following figure.

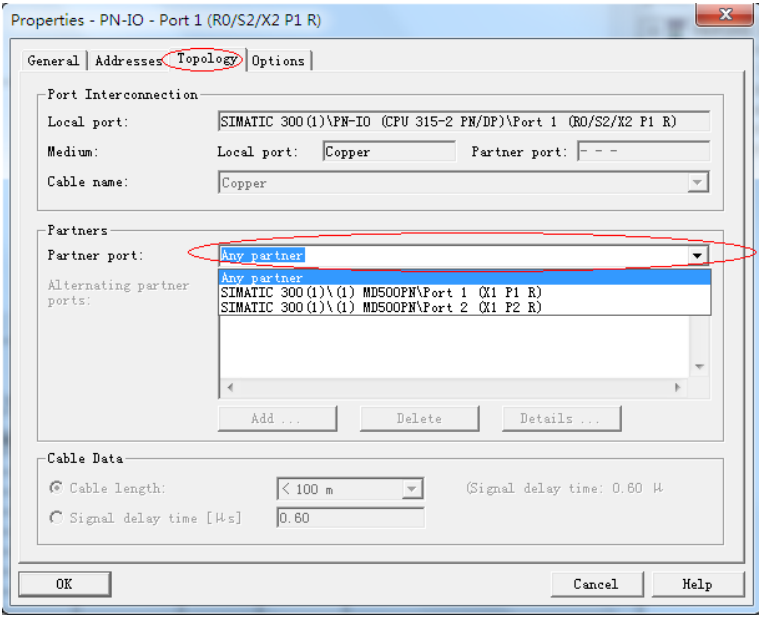


In the "General" tab, select "Support device replacement without exchangeable medium", and click "OK", as shown in the following figure.



According to the actual network connections, double-click Port 1 or Port 2 of the PLC, and switch to the Topology tab. Select the port of the slave station connected to the PLC for

Partner port (the default option is Any partner, which must be changed to the actual connected port), and click OK.



Then, click the corresponding ports of the slave station to set the topology. The operations are similar to the preceding steps. After setting all connected ports, start compiling and download the configuration to the PLC.

After completing the preceding configuration, perform the following operations when any slave station needs to be replaced: 1) Disconnect the device from the network. 2) Install a new device to which no device name is assigned before at the same position. (For S7-1200 or S7-1500, if Permit overwriting of device names of all assigned IO devices has been selected, devices which have been assigned names to can be used.) 3) Connect the new device to the network using the original wiring mode. (Note that the network cable connection must be consistent with the original connection and the connection in the topology.) 4) Power on the slave station to enable the PLC to assign a device name to the newly connected device automatically.

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