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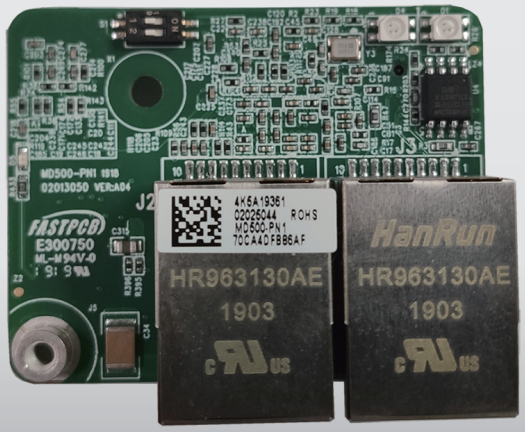

MD500-PN1
Communication Expansion Card

User Guide

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

Data code 19012211 C01

Preface

About This Guide

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

- The MD500-PN1 card software version required in this user guide is 1.00 or later. After installing the card and powering on the AC drive, check the version by U0-67 on the MD500. The corresponding GSDML file of the card is named GSDML-V2.31-inovance-md500-20180705.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 of Revision	Version	Revision
November 2021	C01	• Updated 1.3 Appearance and Dimensions.
September 2021	C00	• Added 1.2 Applicable AC Drives, dimensions in 1.3, and 2.2.2 EMC Cabling Instructions. • Adjusted the guide structure.

How to Obtain

This guide is not delivered with the product. You can obtain the PDF version by the following method:

Visit *www.inovance.com*, go to Services and Support > Download, search by keyword, and then download the PDF file.

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Safety Precautions

Safety Disclaimer

1. This chapter presents essential safety instructions for proper use of the AC drive. Before using the product, please read the guide and make sure you understand the safety instructions correctly. Failure to comply with the safety instructions may result in death, serious injury, or equipment damage.
2. "CAUTION", "WARNING", and "DANGER" items in the guide are just supplementary and do not cover all safety instructions.
3. Use this product in an environment that complies with the design specifications. Malfunction or component damage caused by improper usage is not covered by warranty.
4. Inovance shall take no responsibility for any personal injuries or property loss caused by noncompliance with this guide or improper use of this product.

Safety Levels and Definitions

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

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 personal injury or damage to the equipment.

Safety Precautions

- The drawings in this guide sometimes show the product without covers or protective guards to display more details. When using this product, be sure to install the casing or cover according to the regulations, and operate in accordance with the guide.
- The product drawings in this guide are for reference only and may be slightly different from the product you ordered.

Unpacking and Acceptance
 • Do not install the product if any damage, rust, or sign of use is found on the product and accessories. • Do not install the product in case of water seepage in the product, part missing or part damage. • Do not install the product if you find the packing list does not conform to the product you received.

CAUTION

- Before unpacking, check whether the packing is intact without damage, water seepage, damp, and deformation.
- Unpack the package in sequence. Do not hit the package with force.
- Check the surface of the equipment and accessories for any damage or rust.
- Check the equipment, accessories, and materials in the package against the packing list to ensure that no item is missing.

Storage and Transportation

WARNING

- Use professional hoisting equipment operated by qualified professionals to carry large-scale or heavy products. Failure to comply may result in personal injury or product damage.
- Before hoisting the product vertically, confirm that the front cover, terminal block, and other parts of the product have been firmly fixed with screws. Failure to comply may cause the parts to fall off and result in personal injury or product damage.
- Never stand or stay below the product that is lifted by hoisting equipment.
- Lift the product with a steel rope steadily at a constant speed to protect the product against vibration, impact, or turnover. Do not keep the product lifted for a long time. Failure to comply may result in personal injury or product damage.

CAUTION

- Handle the product with care and mind your steps. Failure to comply may result in personal injury or product damage.
- When carrying the product with bare hands, hold the product casing firmly with care to prevent parts from falling. Failure to comply may result in personal injury or product damage.
- Store and transport the product as required. Failure to comply may result in product damage.
- Avoid storage and transportation in environments subject to water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Avoid storing the product for more than 3 months. Long-term storage shall require stricter protection and necessary inspections.
- Pack the product strictly before transportation. Use a sealed box for long-distance transportation.
- Never transport this product with equipment or materials that may damage or have negative impacts on this product.

Installation

DANGER

- Only professional personnel with electrical expertise can operate this product. Operations by non-professionals are strictly prohibited.

- Read through the user guide and safety precautions before installation.
- Do not install this product in places subject to strong electric field or strong electromagnetic wave interference.
- Before installation, make sure that the installation position is mechanically strong enough to 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 product in a closed environment (such as a cabinet or a chassis), cool the environment with a fan or an air conditioner to prevent overheat or fire.
- Do not modify this product.
- Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
- When installing this product in a cabinet or terminal equipment, equip the cabinet or terminal equipment with protective devices such as fireproof enclosures, electrical protective enclosures, and mechanical protective enclosures with the protection level that meets requirements of relevant IEC standards and local laws and regulations.
- Before installing equipment with strong electromagnetic interference, such as a transformer, install an electromagnetic shielding device to prevent malfunctions of this product.
- Install the product on incombustible objects such as metal and keep it away from combustible materials. Failure to comply may result in a fire.

- Cover the top of the product with a piece of cloth or paper during installation to prevent unwanted objects such as metal chippings, oil, and water from falling into the equipment and causing faults. After installation, remove the cloth or paper to prevent overtemperature 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 anti-vibration rubber under the motor frame or use the vibration suppression function to reduce the resonance.

Wiring

- Do not allow non-professionals to perform equipment installation, wiring, maintenance, inspection, or parts replacement.
- Cut off all power supplies before wiring. Wait for at least the time specified on the product warning label after power-off so that residual voltage can discharge safely. Measure the DC voltage on the main circuit to ensure that it is within the safe voltage range. Failure to comply may result in an electric shock.
- Do not perform wiring, remove the product cover, or touch the circuit board with power ON. Failure to comply may result in an electric shock.
- Ensure that the product is well grounded. Failure to comply may result in an electric shock.

WARNING

- Never connect the power cable to an output terminal. Failure to comply may result in product damage or even fire.
- When connecting a drive with the motor, ensure that the phase sequences of the drive and motor are consistent to prevent motor reverse rotation.
- Ensure that the diameter and shielding of the cables used meet corresponding requirements, and that the shielding layer of the shielded cables is grounded reliably at one end.
- Tighten terminal screws with tightening torque specified in this guide. Failure to comply may result in overheat and damage to the connection parts or even fire.
- After wiring, check that each cable is connected properly, no screws or gaskets fall into the product, and no cables are exposed. Failure to comply may result in an electric shock or product damage.

CAUTION

- Follow the proper electrostatic discharge (ESD) procedures, and wear an anti-static wrist strap during wiring. Failure to comply may result in damage to the product or the circuit of the product.
- Use shielded twisted pair cables for the control circuit. Connect the shielding layer to the product grounding terminal. Failure to comply may result in product malfunction.

Power-on

DANGER

- Before power-on, ensure that the product is properly installed, all cables are securely connected, and the motor can be restarted.
- Before power-on, ensure that the power supply meets requirements. Failure to comply may result in product damage or even fire.
- Do not open the cabinet or protective cover, touch any terminal, or dismantle any device or component when the product is powered on. Failure to comply may result in an electric shock.

WARNING

- After wiring and parameter setting, perform a trial run to check whether the device can run properly. Failure to comply may result in personal injury or device damage.
- Before power-on, check that the rated voltage of the product is consistent with that of the power supply. Failure to comply may result in fire.
- Before power-on, check that no one is near the equipment, motor, or machine. Failure to comply may result in personal injury or even death.

Operation

DANGER

- Do not allow non-professionals to operate the product. Failure to comply may result in personal injury or even death.
- Do not touch any wiring terminals or disassemble any unit or component of the equipment during operation. Failure to comply may result in an electric shock.

WARNING

- Never touch the product shell, fan, or resistor to check the temperature. Failure to comply may result in burn.
- Prevent metal or other objects from falling into the product during operation. Failure to comply may result in product damage or fire.

Maintenance

DANGER

- Do not allow non-professionals to perform equipment installation, wiring, maintenance, inspection, or parts replacement.
- Never perform maintenance during power-on. Failure to comply may result in an electric shock.
- Before maintenance, cut off all equipment power supplies and wait for at least the time specified on the product warning label.
- In case of a permanent magnet motor, do not touch the motor terminals immediately after power-off because the motor terminals will generate induced voltage during rotation even after the equipment power supply is off. Failure to comply may result in an electric shock.

WARNING

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

Repair

DANGER

- Do not allow non-professionals to perform equipment installation, wiring, maintenance, inspection, or parts replacement.
- Never perform any inspection or maintenance operations during power-on. Failure to comply may result in an electric shock.
- Before inspection or maintenance, cut off all equipment power supplies and wait for at least the time specified on the product warning label.

WARNING

- Require repair services according to the product 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 product warning label before power-on or further operations. Failure to comply may result in equipment damage, personal injury, or even death.
- When the equipment fails or is damaged, designate qualified technicians to troubleshoot and repair the equipment in accordance with the maintenance instructions and keep a maintenance record.
- Replace quick-wear parts of the equipment according to the replacement guide.
- Do not use a damaged machine. Failure to comply may result in worse damages, personal injury, or even death.
- Make sure to re-check the wiring and parameter setting after device replacement.

Disposal
WARNING • Scrap the equipment or product in accordance with relevant national regulations and standards. Failure to comply may result in property damage, personal injury, or even death. • Recycle retired equipment by observing industry waste disposal standards to avoid environmental pollution.

Safety Signs

For safety operations, follow the safety signs on the equipment. Do not stain or remove the safety signs. The safety signs are described as follows:

Safety Signs	Description
	• Read through the safety instructions before operating the equipment. Failure to comply may result in equipment damage, personal injury, or even death. • Do not touch terminals or remove the cover during power-on or within 10 minutes after power-off. Failure to comply may result in an electric shock.

1 Product Information

1.1 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.

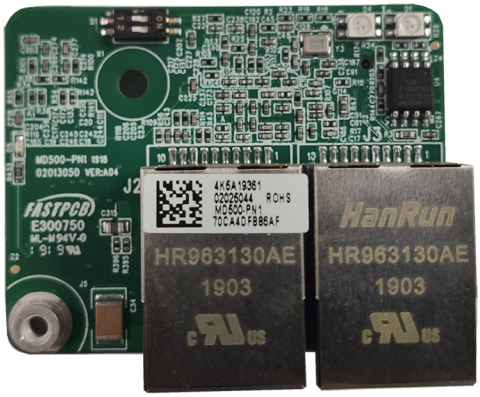


Figure 1-1 MD500-PN1 card appearance

1.2 Applicable AC Drives

Expansion Card	Applicable AC Drive
MD500–PN1	MD290
	MD380 (3.7 kW and above)
	MD480 (3.7 kW and above)
	MD480
	MD500
	MD500–PLUS
	MD510
	CS290
	CS710

Caution

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.

1.3 Dimensions

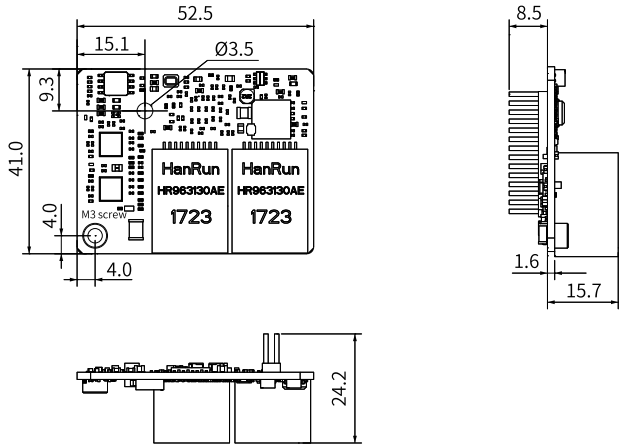


Figure 1-2 Dimensions (mm) of the MD500-PN1 card

1.4 Terminals and Indicators

Terminal and indicator 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).

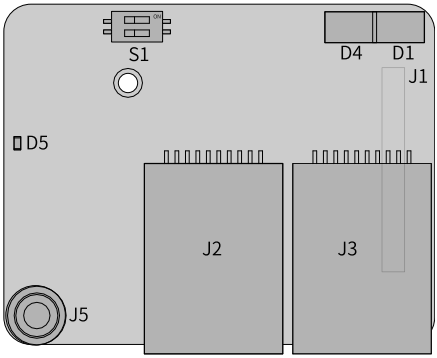


Figure 1-3 Terminal and indicator layout of the MD500-PN1 card

Terminals and indicators

Table 1–1 Terminals and indicators of the MD500-PN1 card

Terminal Mark	Terminal Name	Description
J1	Pin header	Check that FD-00 is set to 9 and FD-01 is set to 3.
J2	Network port	J2 and J3 are standard Ethernet RJ45 sockets that are direction-insensitive. J3 is used for communication between the PN card of the AC drive and that of other devices (such as the PLC).
J3		
D5	Power supply indicator	It is 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 1–2 " on page 12*.
D4	AC drive communication status indicator (DSPLINK)	
S1	Two-position DIP switch	It is used only for upgrade by the manufacturer.

Status indicators

Table 1–2 Descriptions of MD500-PN1 status indicators

Indicator		Description	Solution
DSPLINK	Steady green	Normal	N/A
	Steady yellow	The MAC address is abnormal.	Replace the MD500-PN1 card.
	Flashing yellow	The AC drive encounters a fault.	Clear the AC drive fault.
	Steady red	The communication between the PN card and the AC drive is abnormal.	Set F0-28 to 1 and check whether the AC drive supports the MD500-PN1 card.
	Flashing red	Communication with the AC drive times out.	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	N/A
	Flashing green	The master station is 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 station is interrupted.	Check the wiring and check whether the network cable shield is connected properly.
D1 and D4	Steady red	The MD500-PN1 card software is abnormal.	Power on the AC drive again. Replace the MD500-PN1 card.
		DIP switch abnormal	Check that the DIP switch S1 is OFF and power on the AC drive again.

2 Installation and Wiring

2.1 Installation

The MD500-PN1 expansion card is installed in the MD500 series AC drive. Before installation, de-energize the AC drive and wait at least 10 minutes until the charging indicator on the AC drive becomes off. Then, insert the MD500-PN1 expansion card into the AC drive and fasten the screws to prevent the signal socket between boards from being damaged by external signal cable tension. *"Figure 2–1 " on page 13* describes the installation of the expansion card.

Note that the ground terminals of both the MD500-PN1 card and AC drive must be connected properly, as shown in *"Figure 2–2 " on page 13* .

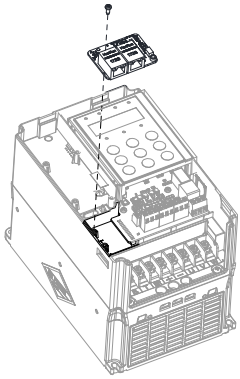


Figure 2-1 MD500-PN1 card installation

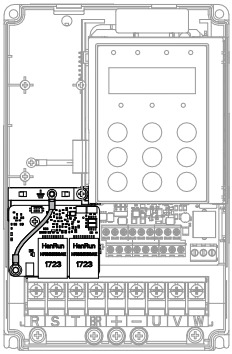


Figure 2-2 Ground terminal connection between the MD500-PN1 card and AC drive

Caution

Do not remove or install the card with power ON.

2.2 Wiring

2.2.1 Topology

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

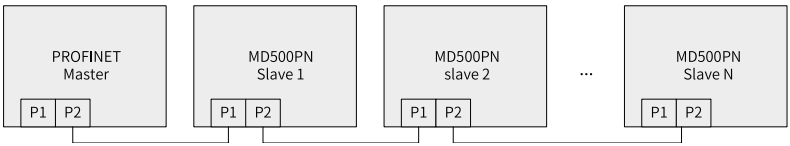


Figure 2-3 Bus topology

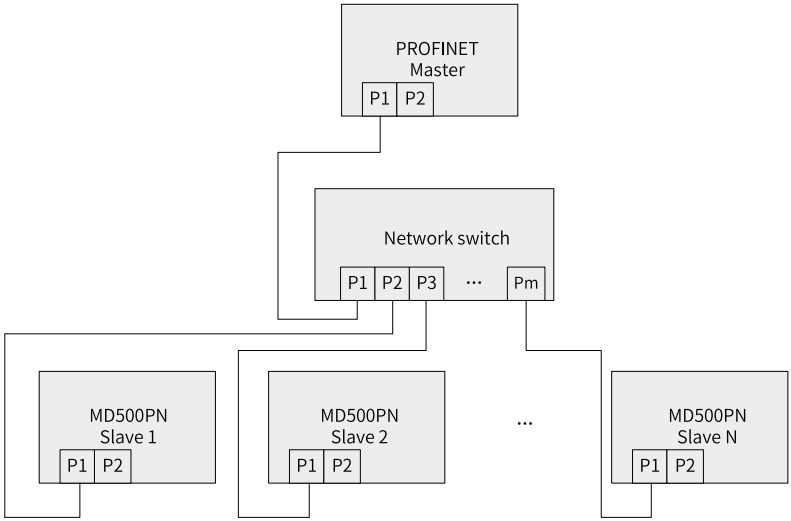


Figure 2-4 Star topology

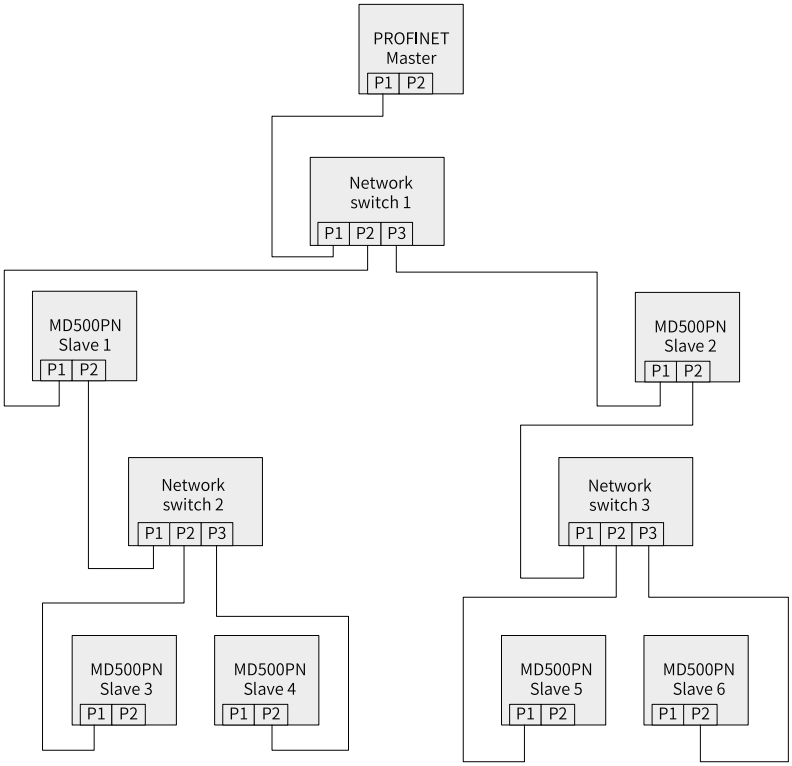


Figure 2-5 Tree topology

2.2.2 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 1–2 " on page 12* for details.

3 Communication

3.1 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	Supported Function
Standard telegram 1	PZD-2/2	AC drive command and frequency settings AC drive state and running frequency reading
Standard telegram 2	PZD-4/4	AC drive command and frequency settings Periodic writing of two function parameters AC drive state and running frequency reading Periodic reading of two function parameters
Standard telegram 3	PZD-6/6	AC drive command and frequency settings Periodic writing of four function parameters AC drive state and running frequency reading Periodic reading of four function parameters
Standard telegram 4	PZD-8/8	AC drive command and frequency settings Periodic writing of six function parameters AC drive state and running frequency reading Periodic reading of six function parameters
Standard telegram 5	PZD-10/10	AC drive command and frequency settings Periodic writing of eight function parameters AC drive state and running frequency reading Periodic reading of eight function parameters

Data Type	Data Length	Supported Function
Standard telegram 6	PZD-12/12	AC drive command and frequency settings Periodic writing of 10 function parameters AC drive state and running frequency reading Periodic reading of 10 function parameters
Supplementary telegram	PZD-2/6	AC drive command and frequency settings AC drive state and running frequency reading Periodic reading of four function parameters

PZD data description

The master can modify and read AC drive data in real time and exchanges data cyclically through the PZD data. Data communication addresses are directly configured by the AC drive. The specific functions are as follows:

- Real-time settings of AC drive control command and target frequency
- Real-time reading of AC drive current state and running frequency
- Real-time exchange of function parameter and monitoring data between the AC drive and PROFINET master station

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

PZD Sent by the Master		
AC drive command	AC drive target frequency	Modifying function parameters of AC drive in real time
PZD1	PZD2	PZD3–PZD12
PZD Responded by the AC drive		
AC drive status	AC drive running frequency	Reading function parameters of AC drive in real time
PZD1	PZD2	PZD3–PZD12

Data sent by the master station

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

- MD500, MD500-PLUS, MD290, MD480, and MD380 series AC drives

PZD Sent by the Master		
PZD1	AC drive command word (with the command source set to communication)	
	01: Forward running 02: Reverse running 03: Forward jogging 04: Reverse jogging	05: Coast to stop 06: Stop according to F6-10 (Stop mode) 07: Fault reset
PZD2	AC drive target frequency (with the frequency source set to communication) in the range of 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

PZD Sent by the Master	
PZD1	Bit 0: Decelerate to stop Bit 1: Coast to stop Bit 2: Forward running Bit 3: Reverse running Bit 4: Fast stop Bit 5: Torque control Bit 6: Fault reset Bit 7: Command valid Bit 8 to Bit 15: Reserved
PZD2	It is fixed to set the target frequency of the drive. The frequency source of the drive 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.

Data responded by the AC drive

The data responded by different AC drives varies slightly.

- MD500, MD500-PLUS, MD290, MD480, and MD380 series AC drives

PZD Responded by the AC Drive	
PZD1	It indicates the AC drive running state, as defined by the following bits: Bit 0 • 0: AC drive stop • 1: AC drive running Bit 1 • 0: Forward running • 1: Reverse running Bit 2 • 0: No fault • 1: AC drive fault Bit 3 • 0: Running frequency not reached • 1: Running frequency reached Bit 4 to bit 7: Reserved Bit 8 to Bit 15: 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

PZD Responded by the AC Drive	
PZD1	Bit 0: AC drive running Bit 1: Forward running Bit 2: Reverse running Bit 3: No fault Bit 4: Coast to stop Bit 5: No communication with the drive Bit 6: Frequency reach Bit 7: Torque control valid Bit 8 to Bit 15: 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	The PZD is fixed to return the address of the function parameter. The address of the function parameter is set in 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.

3.2 Communication-related Parameters

Communication card settings

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

- Communication card settings for MD500, MD290, MD480, and MD380 series AC drives
  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	Set Value	Description
FD-28	Serial port communication protocol	0: Modbus Protocol 1: Communication card network bridge protocol	1	Select this parameter to 1.

- Communication card settings for MD500-PLUS series AC drives
  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.

- Communication card settings for CS710 and CS290 series AC drives
  After powering on the AC drive, set bd.07 to 2 to enable communication between the MD500-PN1 card and the AC drive.

Parameter Code	Parameter Name	Value Range	Set Value	Description
bd.07	Expansion card selection	0: Modbus 1: DP 2: CANopen/PN	2	PROFINET communication expansion card

Communication-related parameters

Parameter Code	Parameter Name	Value Range		Decimal Address
U3-16	Frequency reference	Negative maximum frequency to position maximum frequency in the unit of 0.01 Hz		29456
U3-17	Control command	0001: Forward running 0002: Reverse running 0003: Forward jogging 0004: Reverse jogging	0005: Coast to stop 0006: Decelerate to stop 0007: Fault reset	29457

Parameter Code	Parameter Name	Value Range		Decimal Address
U3-18	DO control	Bit 0: DO1 output control Bit 1: DO2 output control Bit 2: Relay 1 output control Bit 3: Relay 2 output control Bit 4: FMR output control	Bit 5: VDO1 Bit 6: VDO2 Bit 7: VDO3 Bit 8: VDO4 Bit 9: VDO5	29458
U3-19	AO1 control	0 to 7FFF indicate 0% to 100%.		29459
U3-20	AO2 control	0 to 7FFF indicate 0% to 100%.		29460
U3-21	FMP control	0 to 7FFF indicate 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 2 and 9 respectively, check whether FE-00 and FE-01 are set to U3-17 and U3-16 respectively on the AC drive. If not, manually correct the values of FE-00 and FE-01.

Parameters related to communication monitoring

Table 3–1

Parameter Code	Parameter Name	Unit	Decimal Address
U0-00	Running frequency (Hz)	0.01 Hz	28672
U0-01	Frequency reference (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
U0-10	AI2 voltage (V)	0.01 V	28682
U0-11	AI3 voltage (V)	0.01 V	28683
U0-12	Count value	1	28684

Parameter Code	Parameter Name	Unit	Decimal Address
U0-13	Length value	1	28685
U0-14	Load speed display	100.00%	2868600.00%
U0-15	PID reference	1	28687
U0-16	PID feedback	1	28688
U0-17	PLC stage	1	28689
U0-18	Pulse input reference (Hz)	0.01 kHz	28690
U0-19	Feedback speed (Hz)	0.01 Hz	28691
U0-20	Remaining running time	0.1 min	28692
U0-21	Uncalibrated AI1 voltage	0.001 V	2869300.00%
U0-22	Uncalibrated AI2 voltage	0.001 V	28694
U0-23	Uncalibrated AI3 voltage	0.001 V	28695
U0-24	Linear speed	1 m/min	28696
U0-25	Current power-on time	1 min	28697
U0-26	Current running time	0.1 min	28698
U0-27	Pulse input frequency	1 Hz	28699
U0-28	Reference set through communication	0.01%	28700
U0-29	Encoder feedback speed	0.01 Hz	28701
U0-30	Main frequency X display	0.01 Hz	28702
U0-31	Auxiliary frequency Y display	0.01 Hz	28703
U0-32	Memory address view	1	28704
U0-33	Synchronous motor rotor position	0.1°	2870500.00%
U0-34	Motor temperature	1°C	2870600.00%
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

Parameter Code	Parameter Name	Unit	Decimal Address
U0-40	Output voltage upon V/f separation	1 V	28712
U0-41	DI state display	1	28713
U0-42	DO state display	1	28714
U0-43	DI state display 1	1	28715
U0-44	DI state display 2	1	28716
U0-45	Failure information	1	28717
U0-58	Z signal counting	1	28730
U0-59	Frequency reference (%)	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	0.01	28739
U0-68	AC drive state read by expansion card	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.

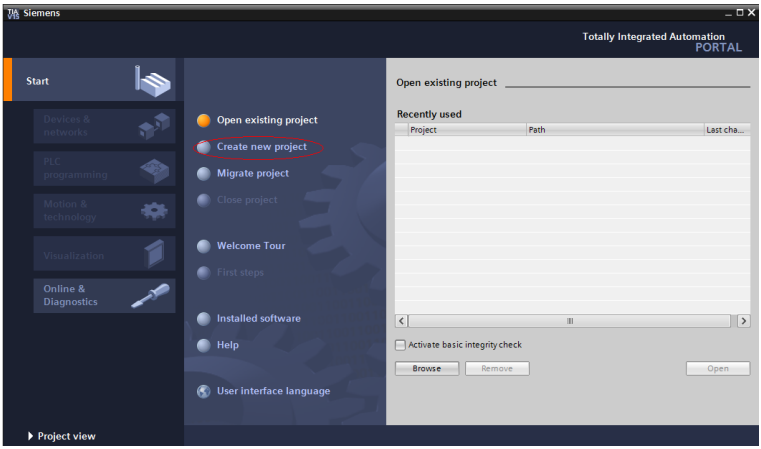
3.3 Communication Instances

3.3.1 Configuring Slaves on the S7-1200 Master

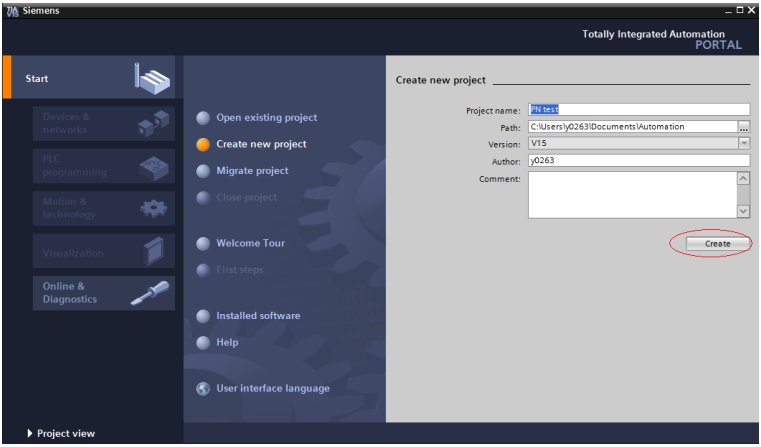
Before using the PROFINET master, you need to configure the GSDML file of the slave to add the corresponding slave device to the system of the master. If the file exists, skip step 2. You can obtain the GSDML file from Inovance or its agent.

The configuration procedure is as follows:

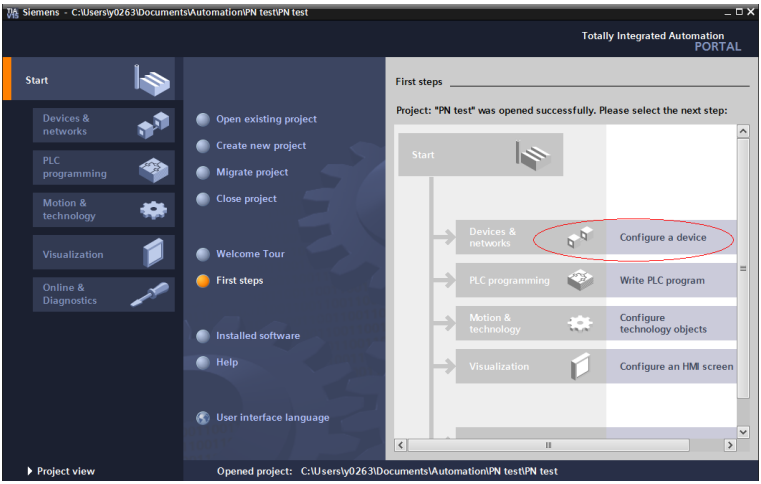
1. Create a project and add the S7-1200 master to the project in PORTAL. To be specific, open PORTAL first. The interface as shown in the following figure is displayed.



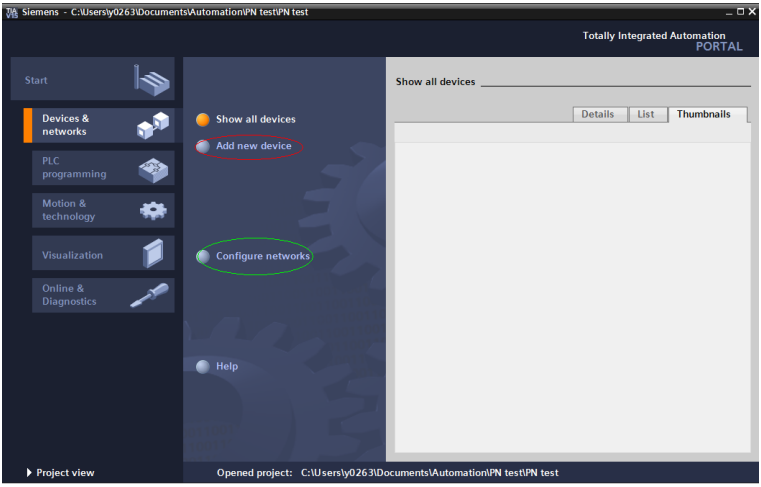
Click **Create new project**, enter a project name and storage path, and click **Create**.



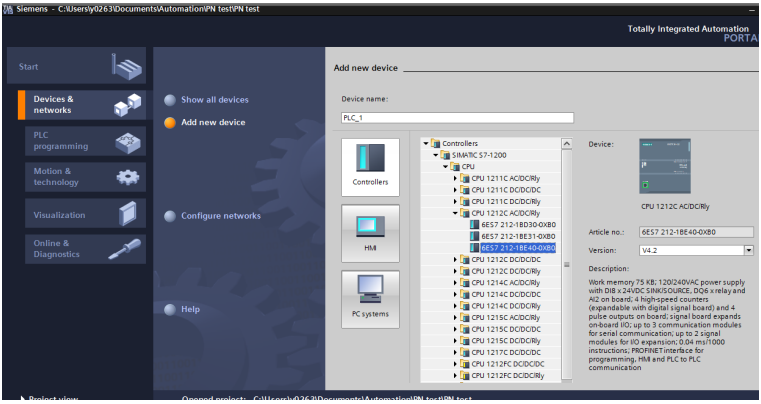
Click **Configure a device**, as shown in the following figure.



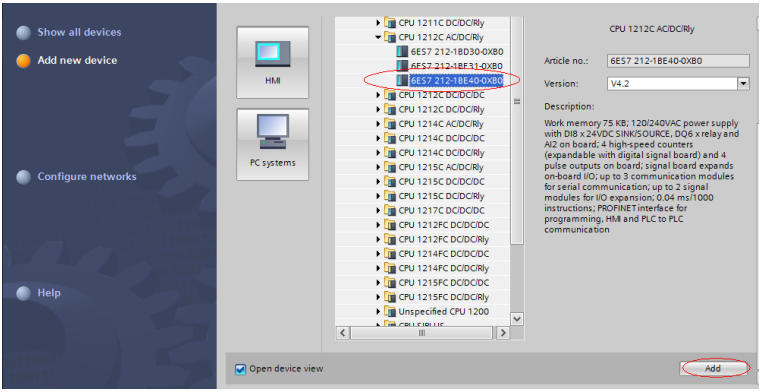
For a new project, click **Add new device** (marked with a red circle in the following figure). For an existing project, click **Configure networks** (marked with a green circle in the following figure).



Select a PLC on the displayed page. Set the article number and firmware version of the PLC correctly to avoid download failure.

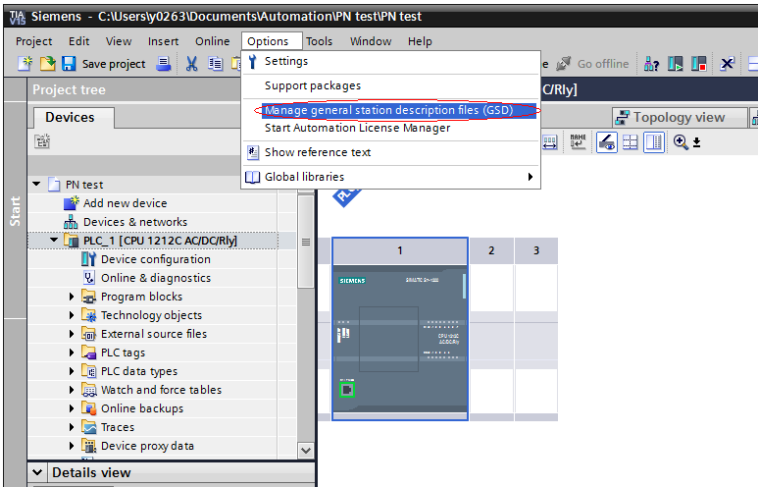


Click **Add** or double-click the selected master, as shown in the following figure.

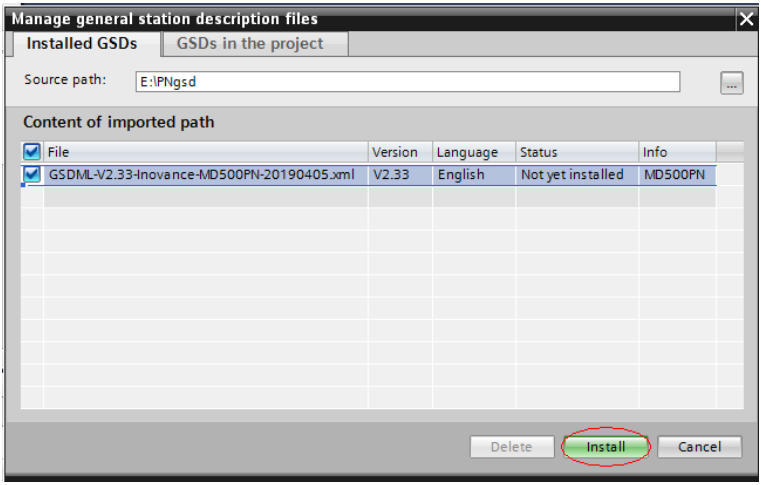


Now the master is established.

2. Install the GSDML file. (Skip this step if the GSDML file has been installed.) Choose **Options** > **Manage general station description files (GSD)**.



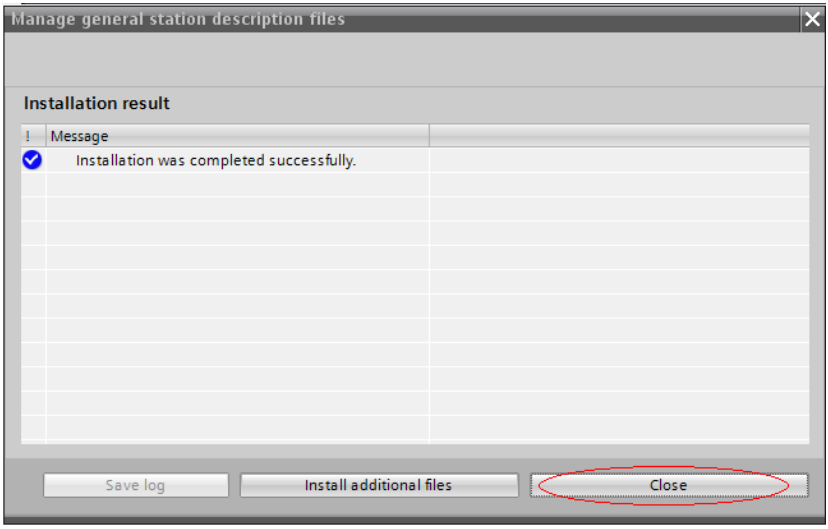
Select the path (English path required) for storing the GSDML file, select the GSDML file to be installed, and click **Install**.



Caution

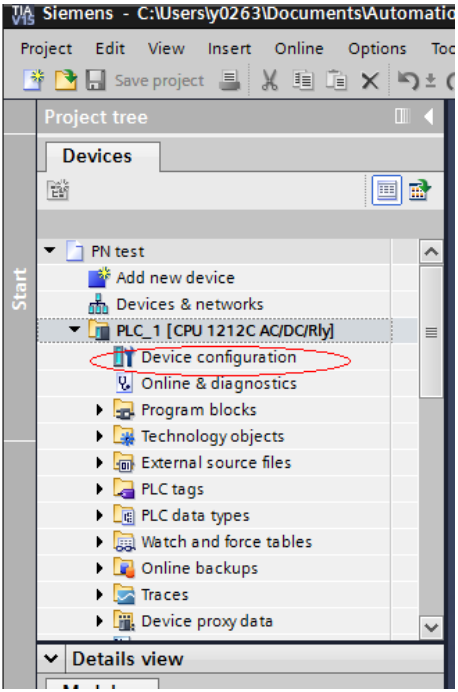
The GSDML file name varies with the AC drive series. For details, see the corresponding user guide.

After the installation is successful, click **Close**.

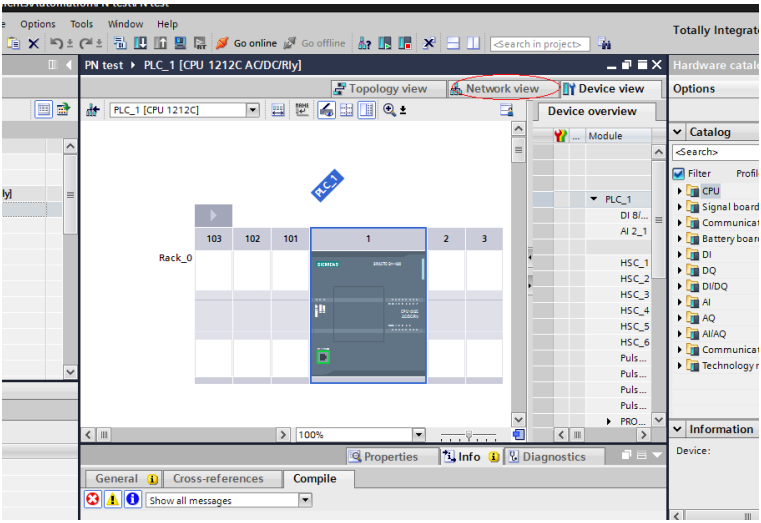


3. Configure a slave.

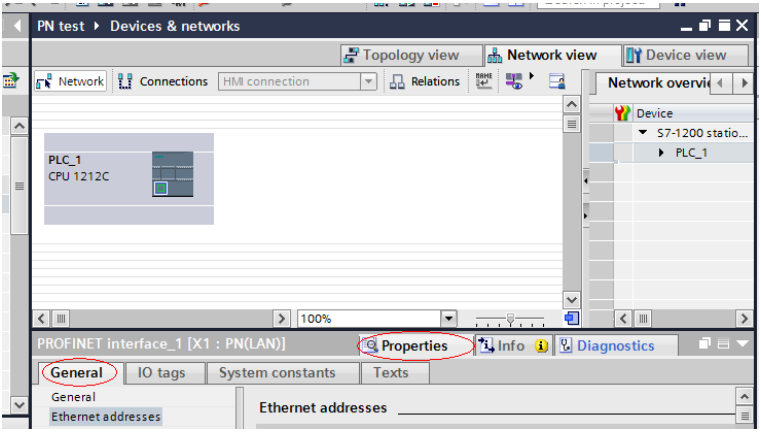
Click **Device configuration** on the interface.



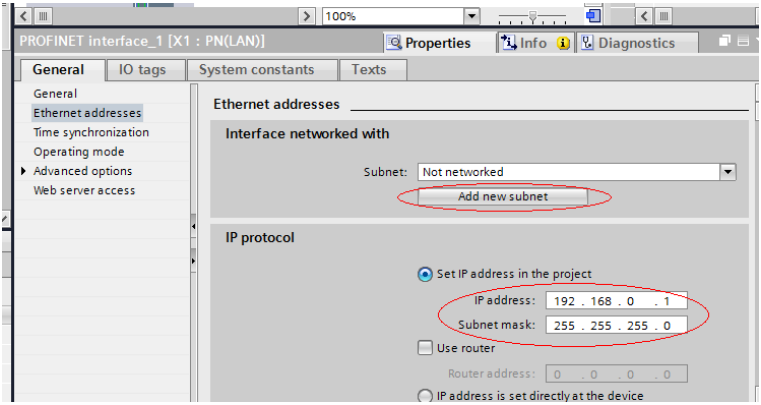
Click **Network view**.



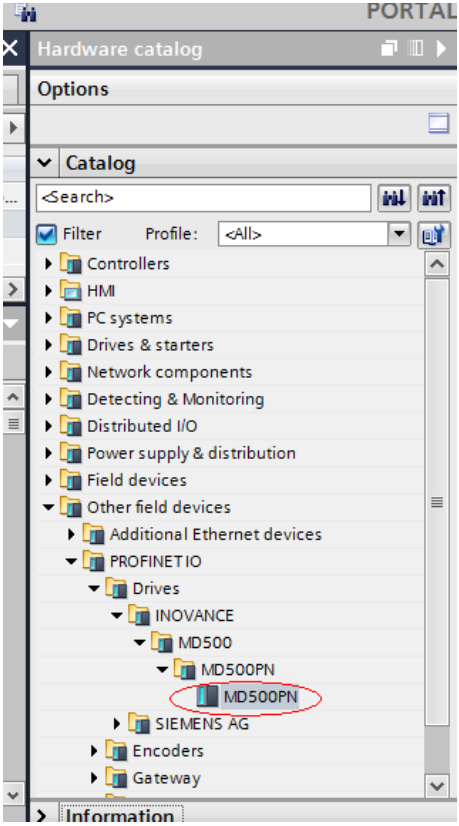
Select the Ethernet interface of the PLC, and choose **Properties** > **General**.



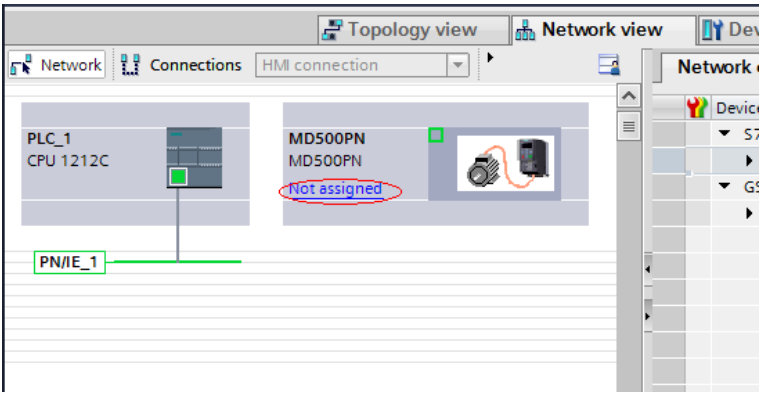
Set the IP address and subnet mask of the PLC master, and click **Add new subnet**.



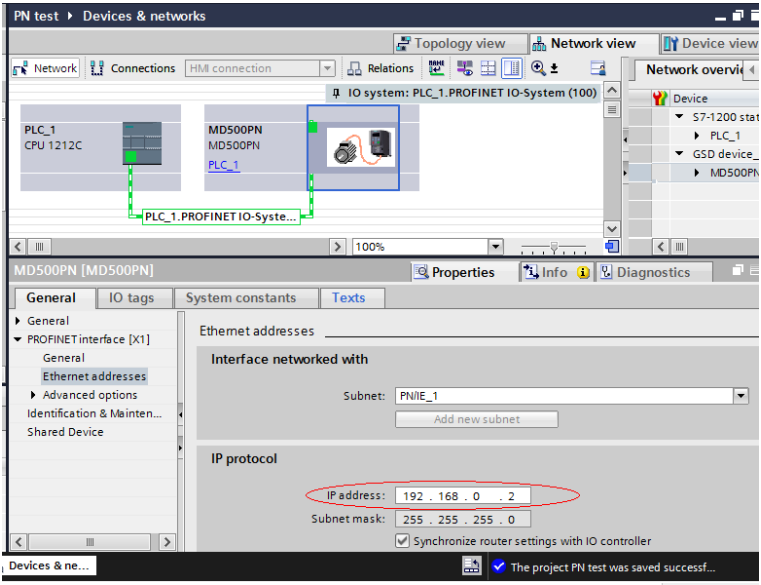
Locate MD500 under **Hardware catalog** on the right, and double-click **MD500PN**.



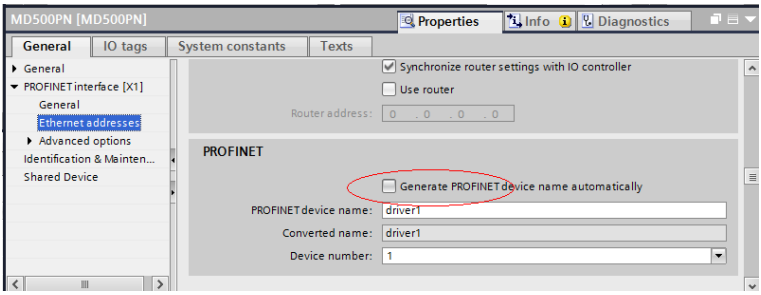
Click **Not assigned** to select the master system for the slave.



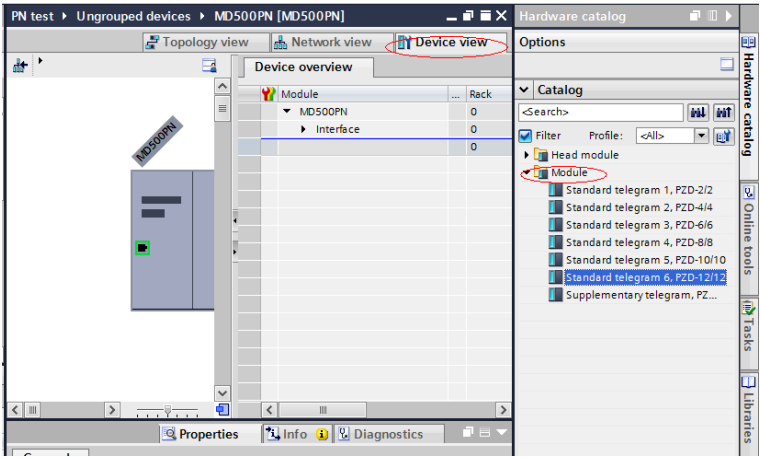
Select the slave, and choose **Properties** > **General**. Then, choose **PROFINET interface [X1]** > **Ethernet addresses** and set the IP address.



Scroll down the screen to locate **PROFINET**. Deselect **Generate PROFINET device name automatically** and enter a name in **PROFINET device name**. (Or you can keep the option selected to allow the system to generate a device name automatically.)

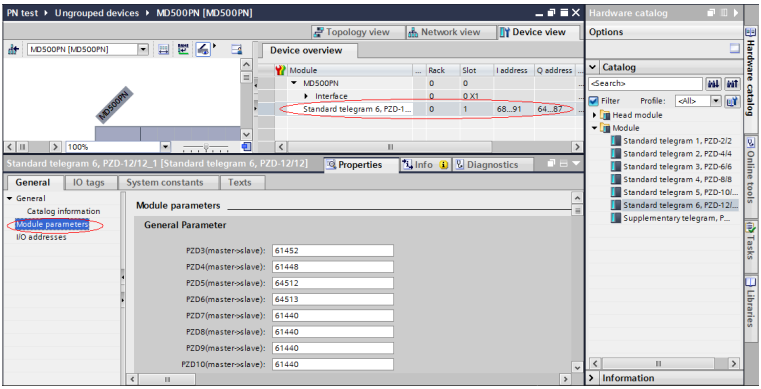


4. Configure data features of the slave.
   Select the slave and switch to the **Device view** page. Locate **Module** under **Hardware catalog**, and double-click the data length for the slave as required.



5. Configure PZDs.

   The PZD1 and PZD2 configurations are fixed and cannot be modified by users. PZD3 to PZD12 are for customized periodic data exchange. They can be set in hardware configuration.

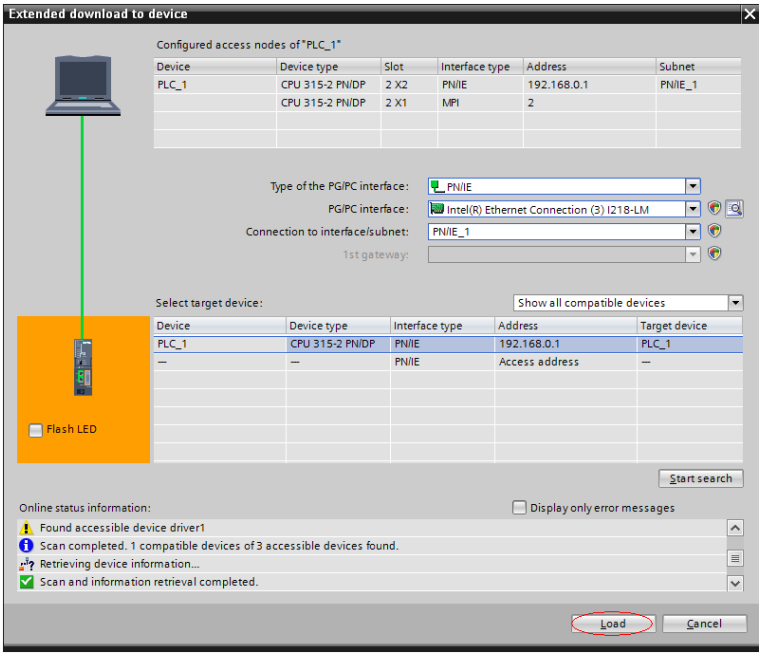


PZDx(master->slave) indicates the address used by the master to write to the slave, and PZDx(slave->master) indicates the address used by the master to read the slave. PZD3 to PZD12 (determined by the selected message type) are displayed in decimal and can be modified. For example, to set **PZD3(master->slaver)**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

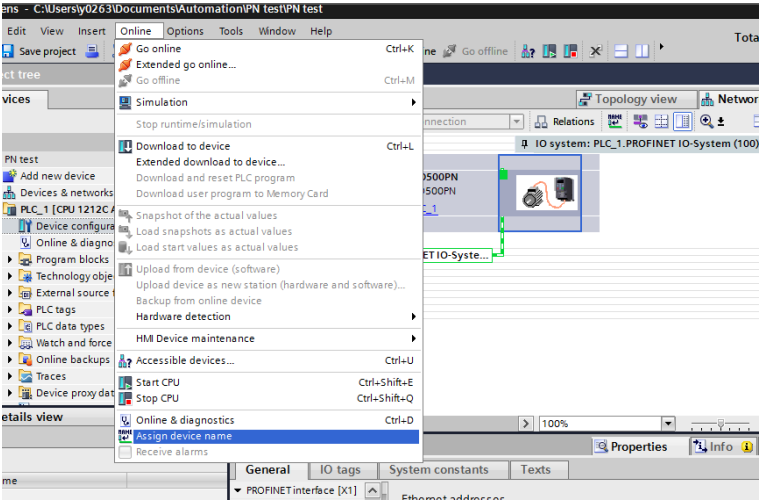
By default, all PZDs of MD500 are set to F0-00 (61440 in decimal). For unused PZDs, modification is not required and default values can be retained. PZD mapping must be set independently for each slave as required (if the mappings of various slaves are the same, you can select a configured slave, press **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 cannot be duplicate).

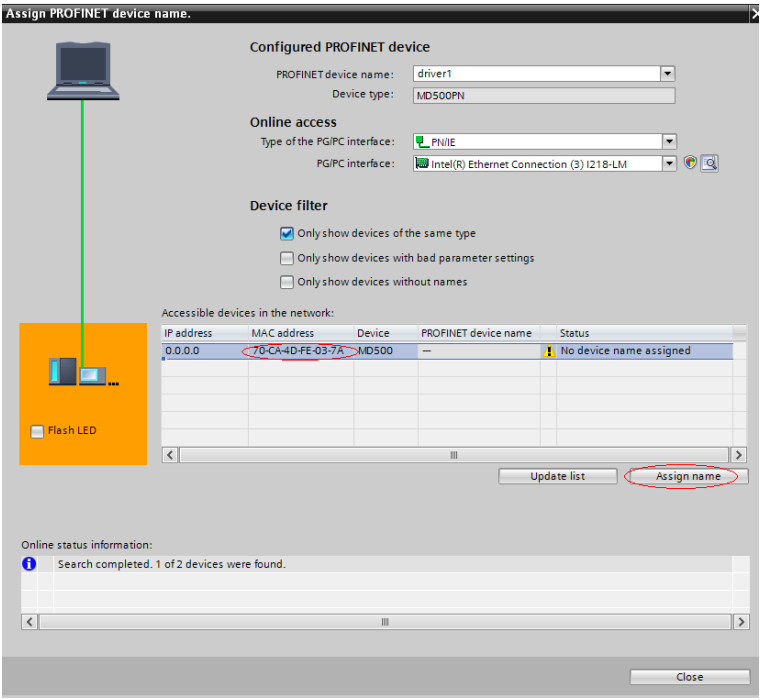
6. Download the configuration.
   Save the network configuration. Set the IP address of the PC to an address in the same network segment with the PLC. (Note that the IP address of the PC must be different from the IP addresses of the slaves in the configuration. You can also allow automatic IP address allocation for the PC.) Then, start compiling, click **Load**, select the interface, and click **Start search**.



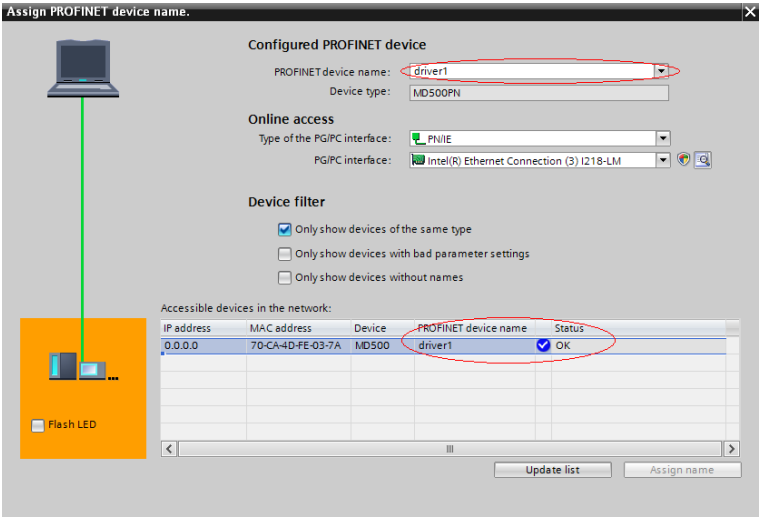
7. Assign device names.
   Assign device names for slaves without names. Select a slave, and choose **Online** > **Assign device name** (or right-click the slave and choose **Assign device name** in the shortcut menu).



On the displayed page, devices of the same type are listed. Select the slave to be assigned with a device name based on its unique MAC address. The MAC address of the MD500-PN1 card can be found on its housing. Then, click **Assign name**.



If information similar to that shown in the following figure is displayed, the device name is assigned successfully. The displayed **PROFINET device name** must be consistent with that displayed in the preceding figure. After assigning the device name, close the window 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 process of assigning the device name is actually binding the device name with the MAC address.)

Caution

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

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

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.

3.3.2 MRP Function of the MD500-PN1 Card

The Media Redundancy Protocol (MRP) function is implemented by the MRP ring network in PROFINET. Only one MRP ring network is allowed in one PROFINET network.

The MD500-PN1 card with the software version of 1.04 or later 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, a PLC is used as the manager. Select the station to be used as the manager, and select **Manager (auto)** from the **Media redundancy role** drop-down list, as shown in the following figure.

2. Configure the MRP client.
   Select the slave, and select **Client** from the **Media redundancy role** drop-down list, as shown in the following figure. Configure the manager before the client; otherwise, an error will be reported.

3. Download the configuration.
   After configuring all devices in the MRP ring network, compile 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, a PLC is used as the manager. Double-click **PN-IO** of the PLC, click the **Media Redundancy** tab, and select **Manager (auto)** from the **Role** drop-down list, as shown in the following figure.

2. Configure the MRP client.
   Select the slave, double-click **Interface**, click the **Media Redundancy** tab, and select **Client** from the **Role** drop-down list, as shown in the following figure. Configure the manager before the client; otherwise, an error will be reported.

3. Download the configuration.
   After configuring all devices in the MRP ring network, compile and download the configuration to the PLC.

- 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. In this case, the AC drive slave reports ERR164, which is cleared automatically (if the automatic clearing function is supported) after the handshaking is complete. You can also manually clear the fault. After the network recovers from the disconnection, the preceding operations are repeated.
- 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.

4 Troubleshooting

4.1 Troubleshooting

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

Fault Description		Solution
After the AC drive is powered on, only the power indicator (D4) is on, which indicates that the communication connection 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 MD500-PN1 card only on the MD500. For the usage of the card on other AC drive models, 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 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 configurations are downloaded, indicators D5 and D4 are solid green, and indicator D1 blinks in 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 GSDML used for configurations is correct.
	After configurations are downloaded, indicators D5 and D4 are steady on, and indicator D1 blinks in 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.

Fault 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 or read.	Check whether the operation address is correct. If the I address of this station is 520 to 531, Q address is 520 to 531 (Note that I and Q addresses may not start from the same number), then the PZD1 data written to the drive is saved in QW520, and PZD2 is saved in QW522. If the PLC is S7-300 and S7-400, use PQW. If SFC15 is used, check whether RET_VAL of the SFC15 block is 0. If not, an invocation error exists. Eliminate this error first and invoke the block again.
	PZD3 or subsequent data can be written, while PZD1 or PZD2 cannot be written or 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 and read, while PZD3 or subsequent data cannot be written or read.	Check whether the message type supports this PZD. Check whether parameters in FE group (namely, device-specific parameters) 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.		View the PLC user program to check whether the eight high-order bits of the PZD1 data (QW data) written to the drive is 0. If not, modify it. The PZD1 command in this guide refers to the value instead of the bit, which is applicable only to the MD500. For remarks on other AC drives, contact technical support engineers.

When the status word returned by the MD500–PN1 card and the drive fails to display the fault status, OB82 needs to be used for monitoring the status or writing a changed value to an address of the drive and then reading the value are used to determine the status.

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

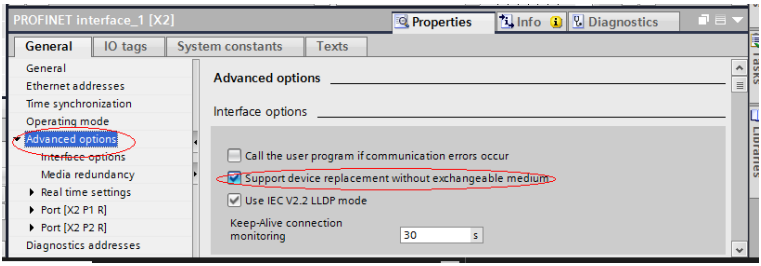
Prerequisites for directly replacing the MD500-PN1 card are as follows:

- 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.
- The Support device replacement without exchangeable medium option is enabled during PLC configuration.

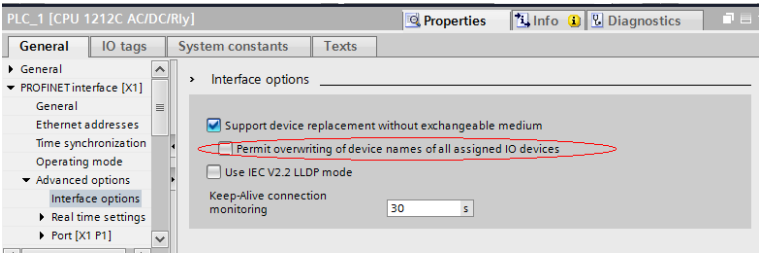
To directly replace the MD500-PN1 card, the corresponding configuration is required. The configuration varies with STEP 7 and PORTAL.

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

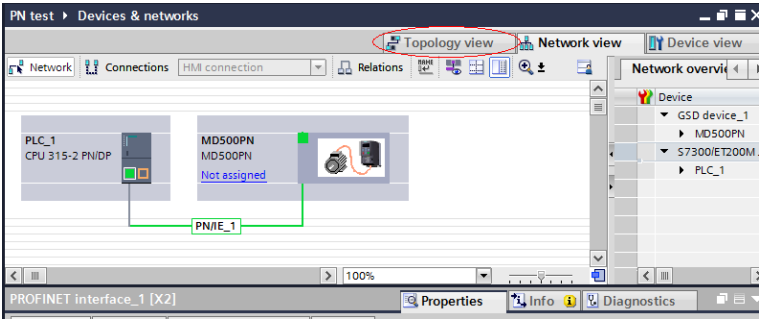
Open PORTAL, and select the PROFINET interface of the master station in the hardware configuration. Go to **Properties** > **General** > **Advanced options**, and select **Support device replacement without exchangeable medium**, as shown in the following figure.



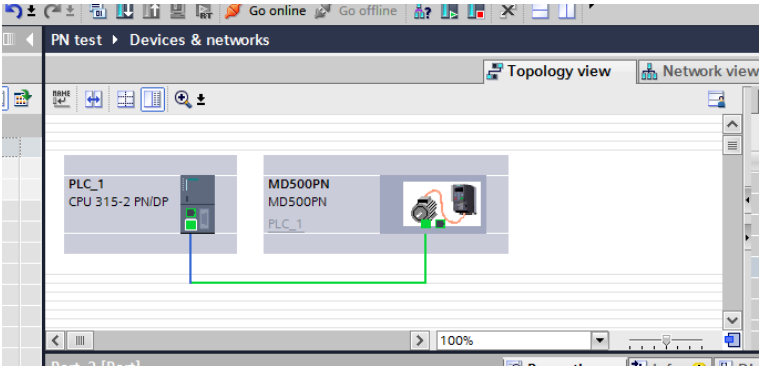
For the S7-1200 or S7-1500 PLC, the check box **Permit overwriting of device names of all assigned IO devices** is provided. If this check box is selected, the second prerequisite for directly replacing the device is not required.



Click the **Topology view** tab.



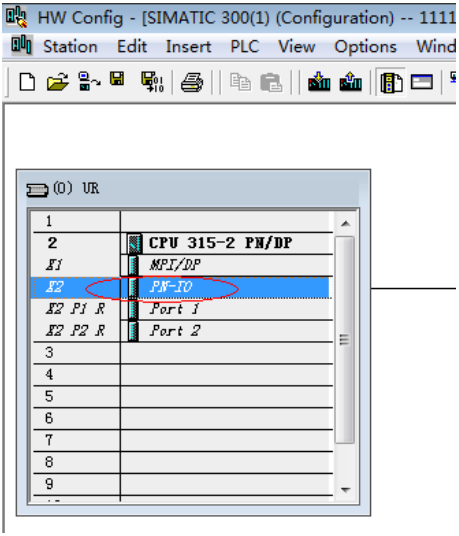
In the topology view, click and drag an interface to the interface of another device which is directly connected with the first interface, and release the mouse button. Note that the preceding connection must be consistent with the actual network connection of devices. For example, if P1 of the PLC is connected to P2 of slave station 1, and P1 of slave station 1 is connected to another slave station, the topology must be consistent with the actual connection. 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.



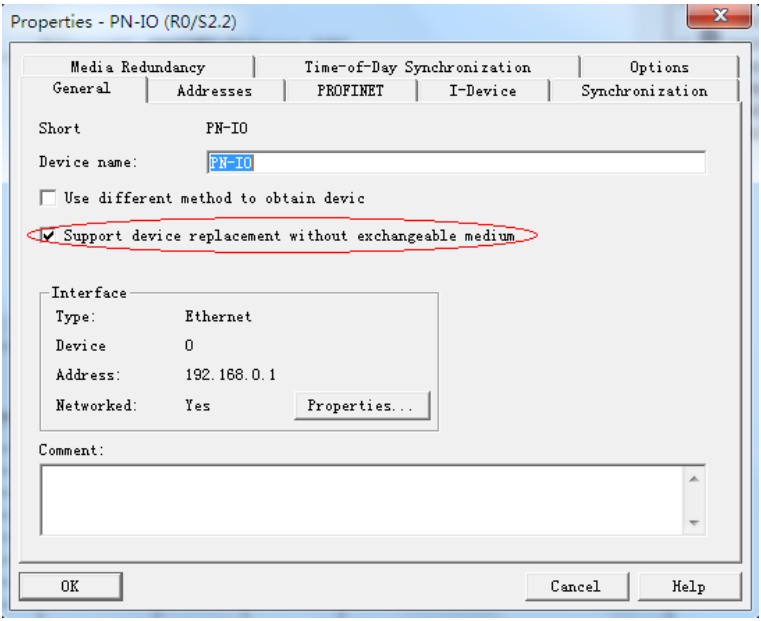
After completing the topology, start compiling and download it to the PLC.

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

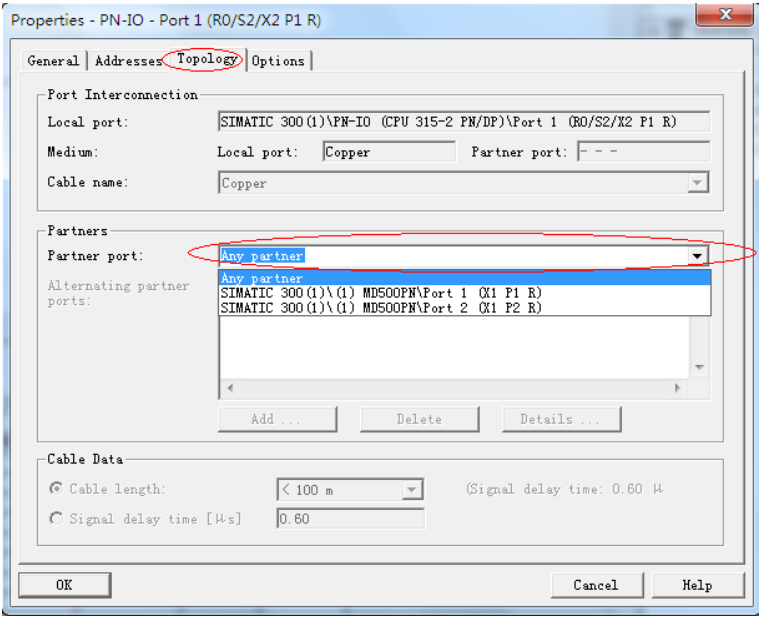
In the hardware configuration, double-click **PN-IO**.



In the **General** tab, select **Support device replacement without exchangeable medium**, and click **OK**.



According to the actual network connections, double-click **Port 1** or **Port 2** of the PLC. Click the **Topology** tab, select the port of the slave station connected to the PLC (**Any partner** by default) from the **Partner port** drop-down list box, and click **OK**.



Click the port 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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