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MD800 Series AC Drive (Multidrive System)

Communication Guide

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

Data code 19011496B03

Preface

Introduction

The MD800 series is a new generation of standard AC drive (multidrive system) designed for low-power multidrive applications in the traditional original equipment manufacturer (OEM) industry. It is widely applied in industries such as printing and packaging, woodworking machine tools, food and beverage, logistics and storage, textile printing and dyeing, fans, and water pumps.

This guide describes the communication method, networking, and communication settings of the AC drive.

More Documents

Name	Data code	Description
MD800 Series AC Drive (Multidrive System) Quick Installation and Commissioning Guide	19011494	This guide describes the installation, wiring, quick commissioning, commissioning parameters, and commissioning troubleshooting of the product.
MD800 Series AC Drive (Multidrive System) Design and Model Selection Guide	19011492	This guide describes the system composition, technical specifications, dimensions, detailed specifications and selection of options (installation accessories, cables, and peripheral electrical components), common EMC problems and solutions, and compliant certifications and standards.
MD800 Series AC Drive (Multidrive System) Maintenance and Repair Guide	19011495	It covers maintenance, part replacement , troubleshooting and so on.
MD800 Series AC Drive (Multidrive System) Function Guide	19011493	This guide describes the commissioning tools, system commissioning procedures, parameters, fault codes, and product functions and applications.
MD800 Series AC Drive (Multidrive System) Communication Guide	19011496	This guide describes the communication mode, communication networking, and communication configuration of the product.
MD800 Series AC Drive (Multidrive System) User Guide	PS00009036	This guide describes model selection, installation, wiring, commissioning, function description, fault handling, maintenance, and so on.

Revision History

Date	Version	Description
September 2024	B03	• Updated *" Front Cover" on page 1*, *" Preface" on page 1*, *" Safety Instructions" on page 8*, and *" Back Cover" on page 194*. • Correct minor errors. • Updated part of the parameters. • Corrected the V/F to V/f. • Updated *"3.4.1 Operations of AC Drive Parameters" on page 57* to change the high-order and low-order 16 bits to the high-order and low-order eight bits. • Updated *"5.7 Parameters" on page 106* to change the decimal address to the index address in Table 5–10 Communication monitoring parameters of drive unit. • Updated *"3.4.3 Operation Example (PDO)" on page 61* to add a note to Table 3–23 Mapping example of group AF: Parameter group number offset shall be converted into the hexadecimal format. • Deleted the contents about the FVC mode.
January 2024	B02	**Modified the following content:** • Updated *"1.3 Modbus-Specific Parameter Communication Addresses" on page 17*. • Updated *"1.4.1 Setting the Station No." on page 20*. • Updated *"2.5 Parameters" on page 32*. • Updated *"2.6.2 Configuration for RS485 Communication Between AC Drive and AM600" on page 39*. • Updated *"3.5.1 Configuration for CANlink Communication Between AC Drive and H5U" on page 63*. • Updated *"4.1 Introduction" on page 75*. • Updated *"4.5 PZD Data" on page 78*. • Updated *"4.7.1 Configuration" on page 81*. • Updated *"5.5 PDO Data" on page 102*. • Updated *"5.8.1 Configuration for EtherCAT Communication Between AC Drive and H5U" on page 117*.
July 2023	B01	• Added description about CN5 termination resistor setting in 3.2 Networking and Interfaces. • Added the note that PDO data will not be retained upon a power failure in 3.4.3 Operation Example (PDO). • Updated table 5-11 in 5.8.1 Configuration for EtherCAT Communication Between AC Drive and H5U. • Added the contents about the explicit message configuration in Section 6.7 Parameters and Section 6.8 Communication Instances. • Updated the front cover, back cover, and fundamental safety instructions.

Date	Version	Description
March 2023	B00	• Added EtherNet/IP communication information in Chapter 6 EtherNet/IP Communication. • Added 6000H group object dictionary in Section 3.3 Parameters, Section 5.7 Parameters, and the Appendix. • Updated fault codes in Emergency Message and AC Drive Faults, Section 1.3 Modbus-Specific Parameter Communication Addresses, Section 4.8.1 PN Card Communication Error, and Table 5–12 ECAT card communication fault codes. • Correct minor errors in Section 2.5 Parameters, Section 2.6.2 Configuration of RS485 Communication Between AC Drive and AM600, Section 3.5.1 Configuration for CANlink Communication Between AC Drive and H5U, Section 4.5, and Section 5.7 Parameters.
January 2023	A05	Updated the preface, front cover, and back cover.
November 2022	A04	Corrected some minor errors.
September 2022	A03	• Update the section of Emergency Message and AC Drive Fault. • Update 1.3 Modbus-Specific Parameter Communication Addresses. • Updated the preface, front cover, and back cover.
April 2022	A02	• Updated parameters of A0 to AF groups in 1.2 Parameter Communication Address. • Updated the functions of automatic station number allocation and manual settings of account algorithms in 1.4.1 Station Number Settings. • Deleted FD-95 to FD-99 parameters in 1.4.2 Parameters. • Updated configurations and figures related to the PLC in 2.6.2 Configuration for RS485 Communication Between AC Drive and AM600.
September 2021	A01	• Updated the communication networking diagrams in the following sections: 2.2 Networking and Interfaces, 3.2 Networking and Interfaces, 4.4 Network Typology, 5.4 Network Typology. • Added Table 3-7 CN3 terminal pins and Table 3-8 CN4 terminal pins in 3.2 Networking and Interfaces. • Updated the algorithms for manually setting the station number in 1.4.1 Station Number Settings. • Added 3.6 Communication Error. • Deleted ECAT card communication error code E16.11 and E16.12 from ECAT Communication Error.
March 2021	A00	Initial release.

Access to the Guide

This guide is not in the scope of delivery. If necessary, you can download the PDF file in three ways:

- Do keyword search under Service and Support at http://www.inovance.com.
- Scan the QR code on the product with your smart phone.
- Scan the QR code below to install the app, where you can search for and download manuals.



Warranty Disclaimer

If your product becomes defective under normal use conditions, we will offer guaranteed repair services within the warranty period. You need to pay charges beyond the warranty listed in the purchase order.

The warranty does not cover any defect caused by:

- Your failure to operate the product in accordance with the user guide
- Events beyond our reasonable control, such as fire, flood and abnormal voltage
- Damage caused by unintended use of the product
- Damage caused by use beyond the specified scope of application of the product
- Damage or secondary damage caused by force majeure (natural disaster, earthquake, and lightning strike)

The maintenance is charged according to the latest Price List of Inovance. If otherwise agreed upon, the terms and conditions in the agreement shall prevail.

For details, see Product Warranty Card.

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Safety Instructions

Safety Disclaimer

- This section describes the safety precautions that help you use this product correctly. Before using this product, read the user guide thoroughly and correctly understand the related safety precautions. Failure to comply may result in severe personal injuries or even death or equipment damage.
- "DANGER", "WARNING", and "DANGER" items in the user guide do not indicate all safety precautions that need to be followed; instead, they just supplement the safety precautions.
- Use this equipment according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
- Inovance shall take no responsibility for any personal injuries or property damage caused by improper usage.

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 or moderate personal injuries or equipment damage.

Safety Instructions

- Product illustrations in the user guide are sometimes shown without covers or protective guards. Remember to install the covers or protective guards as specified first, and then perform operations in accordance with the instructions.
- Product illustrations in this guide are for reference only. Actual products may vary.
- Operators must take mechanical precautions to protect personal safety and wear protective equipment, such as anti-smashing shoes, safety clothing, safety glasses, protective gloves, and protective sleeves.

Unpacking
 • Do not install the equipment if you find damage, rust, or signs of use on the equipment or accessories upon unpacking. • Do not install the equipment if you find water seepage or missing or damaged components upon unpacking. • Do not install the equipment if you find the packing list does not conform to the equipment you received.



- 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 whether there is damage, rust, or injuries on the surface of the equipment and equipment accessories before unpacking.
- Check whether the number of packing materials is consistent with the packing list.

Storage and Transportation



- Large-scale or heavy equipment must be transported by qualified professionals using specialized hoisting equipment. Failure to comply may result in personal injury or equipment damage.
- Before hoisting the equipment, ensure the equipment components such as the front cover and terminal blocks are secured firmly with screws. Loosely-connected components may fall off and result in personal injuries or equipment damage.
- Never stand or stay below the equipment when the equipment is being hoisted by the hoisting equipment.
- 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 may result in personal injuries or equipment damage.



- Handle the equipment with care during transportation and mind your steps to prevent personal injuries 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 may result in personal injuries.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply will result in equipment damage.
- Avoid transporting the equipment in environments such as water splashing, 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 equipment strictly before transportation. Use a sealed box for long-distance transportation.
- Never transport the equipment with other equipment or materials that may harm or have negative impacts on this equipment.

Installation



- The equipment must be operated only by professionals with electrical knowledge. Non-professionals are not allowed.



- Read through the guide and safety instructions before installation.
- Do not install this equipment in places with strong electric or magnetic fields.
- Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply will 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 a closed environment (such as a cabinet or casing), use a cooling device (such as a fan or air conditioner) to cool the environment down to the required temperature. Failure to comply may result in equipment over-temperature or a fire.
- Do not retrofit the 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 final assembly, a fireproof enclosure providing both electrical and mechanical protections must be provided. The IP rating must meet IEC standards and local laws and regulations.
- Before installing devices with strong electromagnetic interference, such as a transformer, install a shielding device for the equipment to prevent malfunction.
- Install the product on an incombustible object such as metal and do not touch or attach the product to combustible objects. Failure to comply can result in fire accident.



- Cover the top of the equipment 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 equipment and causing faults. After installation, remove the cloth or paper on top of the equipment 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 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, cut off all the power supplies of the equipment, Wait as specified on the product warning sign before further operations because residual voltage exists after power-off. Measure the DC voltage of the main circuit and make sure that it is below the safety voltage. Failure to comply will result in an electric shock.
- Never perform wiring at power-on. Failure to comply will result in an electric shock.
- Make sure that the equipment is well grounded. Failure to comply will result in an electric shock.



- Do not connect the input power supply to the output end of the equipment. Failure to comply will result in equipment damage or even a fire.
- When connecting a drive to the motor, check that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Cables used for wiring must meet cross sectional area and shielding requirements. The shield of the cable must be reliably grounded at one end.
- Fix the terminal screws with the tightening torque specified in the user guide. Improper tightening torque may overheat or damage the connecting part, resulting in a fire.
- After wiring is done, check that all cables are connected properly and no screws, washers or exposed cables are left inside the equipment. Failure to comply may result in electric shock or equipment damage.



- Follow the proper electrostatic discharge (ESD) procedure and wear an anti-static wrist strap to perform wiring. Failure to comply may result in damage to the equipment or to the internal circuit of the product.
- Use shielded twisted pairs for the control circuit. Connect the shield to the grounding terminal of the equipment for grounding purpose. Failure to comply can 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.
- Check that the power supply meets equipment requirements before power-on to prevent equipment damage or 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 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.
- Before power-on, check that no one is near the equipment, motor, or machine. Failure to comply may result in death or personal injuries.

Operation



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



- Do not touch the equipment casing, fan, or resistor with bare hands to feel the temperature. Failure to comply may result in personal injuries.
- 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.
- Do not maintain the equipment with power ON. Failure to comply will result in an electric shock.
- Before maintenance, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment 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 can 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.
- Do not repair the equipment with power ON. Failure to comply can result in an electric shock.
- Before inspection and repair, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.



- Submit the repair request according to the warranty agreement.
- When the fuse is blown or the circuit breaker or earth leakage circuit breaker (ELCB) trips, wait as specified on the product warning sign before power-on or further operations. Failure to comply may result in personal injuries, equipment damage or even death.
- When the equipment is faulty or damaged, the troubleshooting and repair work must be performed by professionals that follow the repair instructions, with repair records kept properly.
- Replace quick-wear parts of the equipment according to the replacement instructions.
- Do not operate on damaged equipment. Failure to comply may result in death, personal injury, or severe equipment damage.
- After the equipment is replaced, perform wiring inspection and parameter settings again.

Disposal
 • Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in property damage, personal injuries, or even death. • Recycle retired equipment by observing industry waste disposal standards to avoid environmental pollution.

Safety Labels

For safe operation and maintenance, comply with the safety labels on the equipment. Do not damage or remove the safety labels. The following table describes the safety signs.

Safety Sign	Description
	• Read through the safety instructions before operating the equipment. Failure to comply may result in death, personal injuries, or equipment damage. • Do not touch the terminals or remove the cover with power ON or within 10 min after power-off. Failure to comply will result in an electric shock.

Emergency Message and AC Drive Faults

Emergency Message Data

The following table describes the seven bytes in an emergency message.

Table –1 Emergency message data

Emergency Error Code	Error Register	Predefined Error Code
0 to 1	2	3 to 7

Note

- Emergency error code: See related sections in the DS301 document. 0x8100 indicates a communication error and 0xFF00 indicates a vendor defined error.
- Error register: See the data value of the object dictionary 1001H in related sections of the DS301 document. Bit0 indicates the error generation flag, bit4 indicates the communication error flag, and bit7 indicates a vendor defined error.
- Vendor defined error code: The fault code of the AC drive.

Error Code

The following table lists standard fault codes of the MD800. For details about the fault codes, see MD800 Series AC Drive (Multidrive System) User Guide

Table –2 Fault code of the power supply unit

Fault code of the power supply unit (decimal)	Fault code of the drive unit (decimal)	
0: No fault 12: Grid voltage abnormal 14: Drive overheat 16: Communication fault 21: EEPROM read/write fault 61: Braking unit fault 80: Fan fault 98: Internal communication fault 99: I/O expansion card mapping resource loss	0: No fault 1: Hardware fault 2: Overcurrent during acceleration 3: Overcurrent during deceleration 4: Overcurrent during operation at constant speed 5: Overvoltage during acceleration 6: Overvoltage during deceleration 7: Overvoltage at constant speed 9: Undervoltage 10: Drive overload 11: Motor overload 13: Output phase loss 14: Drive overheat 15: External device fault 16: Communication fault 18: Current detection circuit fault 19: Motor parameter auto-tuning fault 21: EEPROM read/write fault 22: Motor parameter auto-tuning warning 23: Output short-circuited to ground 25: Power supply unit fault	26: Accumulative running time reached fault 27: User-defined fault 1 28: User-defined fault 2 29: Accumulative power-on time reached 30: Load lost 31: PID feedback loss during running 36: Torque limit timeout 37: Frequency direction fault 38: Frequency following fault 42: Excessive speed deviation 45: Motor temperature fault 47. STO fault 80: Fan fault 90: Braking feedback fault 91: Brake release timeout 93: Command direction conflict 99: I/O expansion card mapping resource loss

1 Parameter Communication Addresses

1.1 Parameter Data

Parameters of the AC drive include basic function parameters and monitoring function parameters, which are categorized in different parameter groups. Basic function parameters are included in groups F and A, as shown in the following table.

Parameter Data	Group F (Read/ Write)	F0, F1, F2, F3, F4, F5, F6, F7, F8, F9, FA, FB, FC, FD, FE, and FF
	Group A (Read/ Write)	A0, A1, A5, A6, A9, AD, and AF

The following table shows the addresses used by the monitoring function parameters, including running command, running status, running parameters, and alarm information.

Monitoring Function Parameter	Status data (Read-only)	U0 and 8000H[Note 1]
	Control Parameters (Write-only)	U3 and 1000H[Note 1]

Note 1: 1000H and 8000H are communication addresses specific to Modbus.

1.2 Parameter Communication Addresses

There are multiple function parameters in each of the parameter groups F0 to FF and A0 to AF. For example, F0-16 indicates parameter number 16 in group F0. High-order 16 bits in the communication address of a function parameter are the parameter group number. Low-order 16 bits are the hexadecimal format of the parameter serial number in the parameter group. For example, the communication address of F0-16 is 0xF010.

Writing basic function parameters and saving them upon power failure indicate frequent operations on the EEPROM, which reduces its service life. Therefore, you can modify some basic function parameters in the RAM through communication without saving them.

For parameters in group F, to obtain the RAM address, change the high-order bit F of the parameter address to 0. For example, the communication RAM address of F3-12 is 0x030C.

For parameters in group A, to obtain the RAM address, change the high-order bit A of the parameter address to 4. For example, the communication RAM address of A0-05 is 0x4005.

Group No.	Communication Address	Parameter Address in RAM Changed Through Communication
Groups F0 to FE	0xF000 to 0xFEFF	0x0000 to 0x0EFF
A0 to AF	0xA000 to 0xAFFF	0x4000 to 0x4FFF
Group U0	0x7000 to 0x70FF	/
Group U3	0x7300 to 0x73FF	/
Group U4	0x7400 to 0x74FF	/
Group U5	0x7500 to 0x75FF	/

Note the following:

- Group FF: The parameters can neither be read or written.
- Groups U0, U4, and U5 are read only. Group U3 can be read and written.
- 1000H and 8000H are Modbus-specific communication addresses.
- Only the write operation can be performed on communication RAM addresses. They are invalid addresses during the read operation.

1.3 Modbus-Specific Parameter Communication Addresses

Table 1–1 Modbus-specific parameter communication addresses

Parameter Address		Description
Frequency reference 1 set through communication	1000H	Communication setting value (decimal) -10000 to +10000 The reference set through communication is a relative percentage. The value +10000 corresponds to 100.00%, and -10000 corresponds to -100.00%. For frequency dimension data, the frequency reference is the percentage of the maximum frequency (F0-10). For torque dimension data, the percentage is F2-10 (Digital setting of torque limit in speed control).
Frequency reference 2 set through communication	7310H	Set F8-64 to choose Hz or rpm as the unit. When F8-64 is set to 0, the unit is Hz. The decimal place is determined by F0-22. For example, when F0-22 is set to 2, the decimal number 1000 means that the frequency reference is 10.00 Hz. When F8-64 is set to 1, the unit is rpm. For example, the decimal number 1000 means that the speed reference is 1000 rpm.

Parameter Address		Description
Control command input to the drive (write-only) 1	7311H	0: Stop according to the stop mode specified by F6-10 1: Forward run 2: Reverse run 3: Forward jog 4: Reverse jog 5: Coast to stop 6: Decelerate to stop 7: Reset upon fault
Control command input to the drive (write-only) 2	2000H	0: Stop mode set by F6-10 1: Forward run 2: Reverse run 3: Forward jog 4: Reverse jog 5: Coast to stop 6: Decelerate to stop 7: Reset upon fault
DO control (write-only)	2001H	Bit 0: DO1 output control Bit 1: DO2 output control Bit 2: DO3 output control Bit 3: DO4 output control Bit 4: DO5 output control Bit 5 to Bit 15: Reserved
Read AC drive state 1	703DH	1: Forward run 2: Reverse run 3: Stop Motor auto-tuning 5: Fault
Read AC drive state 2	7044H	Bit 0: Running status Bit 1: Running direction (forward/reverse) Bit 2: Whether a fault occurs Bit 3: Whether output frequency reaches the frequency reference Bit 4: Normal communication flag Bit 5 to Bit 7: Reserved Bits 8 to Bit 15: Fault codes
Password verification upon parameter lock	1F00H	If the value returned is the actual password, it indicates the password passes the verification. If password protection is not applied (FP-00 = 0), the returned value is 0000H.

Parameter Address		Description		
DO control	7312H	Bit 0: DO1/ DO1 output control Bit 1: DO2/ DO2 output control Bit 2: DO3 output control Bit 3: DO4 output control Bit 4: DO5 output control Bit 5 to Bit 15: Reserved		
AC drive fault description	8000H	Power supply unit fault (decimal): 12: Grid voltage abnormal 14: Drive overheat 16: Communication fault 21: EEPROM read/ write fault 61: Braking unit fault 80: Fan fault 98: Internal communication fault 99: I/O expansion card mapping resource loss	Drive unit fault (decimal): 1: Hardware fault 2: Overcurrent during acceleration 3: Overcurrent during deceleration 4: Overcurrent during operation at constant speed 5: Overvoltage during acceleration 6: Overvoltage during deceleration 7: Overvoltage at constant speed 9: Undervoltage 10: Drive overload 11: Motor overload 13: Output phase loss 14: Drive overheat 15: External device fault 16: Communication fault 18: Current detection circuit fault 19: Motor parameter auto-tuning fault 21: EEPROM read/ write fault 22: Motor parameter auto-tuning warning 23: Output short-circuited to ground 25: Rectifier fault	26: Accumulative running time reached fault 27: User-defined fault 1 28: User-defined fault 2 29: Accumulative power-on time reached fault 30: Load lost 31: PID feedback loss during running 36: Torque limit timeout 37: Frequency direction fault 38: Frequency following fault 42: Excessive speed deviation 45: Motor temperature fault 47. STO fault 80: Fan fault 90: Braking feedback fault 91: Brake release timeout 93: Command direction conflict 99: I/O expansion card mapping resource loss

1.4 Station Number Allocation

1.4.1 Setting the Station No.

Note

The contents allocated only apply to Modbus, CANopen, and CANlink communication.

Set FD-18 properly when multiple drives need to be cascaded.

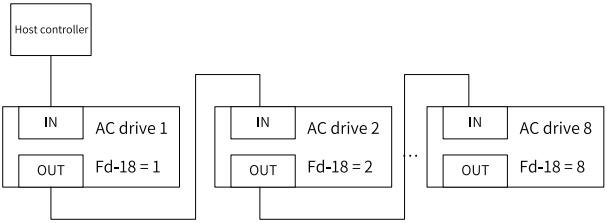


Figure 1-1 Topology for cascade connection

Automatic assignment of station numbers

1. Set F-18 and FD-39 for each power supply unit.
   FD-18 = Current AC drive number

   FD-39 = 0 (station number assigned automatically)

2. Restart the device after setting the preceding parameters.
3. The algorithms and diagrams of station numbers after automatic assignment are as follows.
   Algorithms:

   Station number of the power supply unit = FD-18 x 16

   Station number of the drive unit = Current slot number + (FD-18 - 1) x 16

   Example:

   When FD-18 is 1, the station number of drive unit 1 is 1 (formula: 1 + (1 - 1) x 16 = 1).

   Station number of card slot 1 = 14 + (FD-18 - 1) x 16

   Station number of card slot 2 = 15 + (FD-18 - 1) x 16

   The station number of the card slot device can be viewed in FD-93 and FD-94.

   The station numbers of devices 1 and 2 are shown in the following figure.

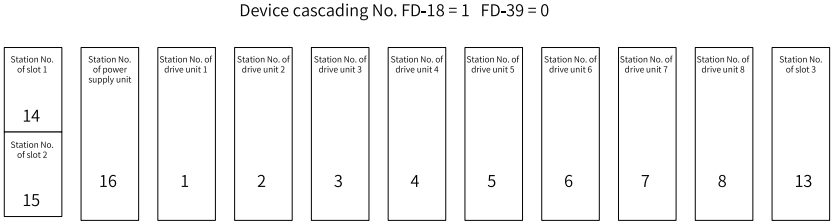


Figure 1-2 Station number of device 1

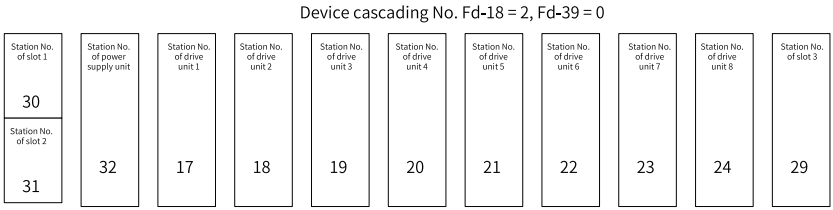


Figure 1-3 Station number of device 2

Setting the station number manually

1. Set FD-18 and FD-39 for each power supply unit.
   FD-18 = Power supply unit number (set based on actual conditions)

   FD-39 = 1 (manual setting mode, in which the station numbers are set based on FD-40... FD-48)

2. Set FD-40...FD-48. Set station numbers based on actual needs.
3. Restart the device to activate the settings.
4. The algorithms and diagrams of station numbers after automatic assignment are as follows.
   Algorithms:

   Station number of the power supply unit = FD-40

   Station numbers of drive units 1 to 8 = FD-41 to FD-48

   Station number of card slot 1 = (FD-18 - 1) x 7 + 133

   Station number of card slot 2 = (FD-18 - 1) x 7 + 134

   The station number of the card slot device can be viewed in FD-93 and FD-94.

   Example: If two sets of drives are cascaded, the parameter values are shown in the following table.

Parameter Code	Parameter Name	Value of Drive 1	Value of Drive 2
FD-18	Power supply unit No.	1	2
FD-39	Function enabling bit configuration of AC drive station number	1	1
FD-40	Station number of the power supply unit that is manually set	1	10
FD-41	Station number of the drive unit 1 that is manually set	2	11
FD-42	Station number of the drive unit 2 that is manually set	3	12
FD-43	Station number of the drive unit 3 that is manually set	4	13
FD-44	Station number of the drive unit 4 that is manually set	5	14
FD-45	Station number of the drive unit 5 that is manually set	6	15
FD-46	Station number of the drive unit 6 that is manually set	7	16
FD-47	Station number of the drive unit 7 that is manually set	8	17
FD-48	Station number of the drive unit 8 that is manually set	9	18

The station numbers of devices 1 and 2 are shown in the following figure.

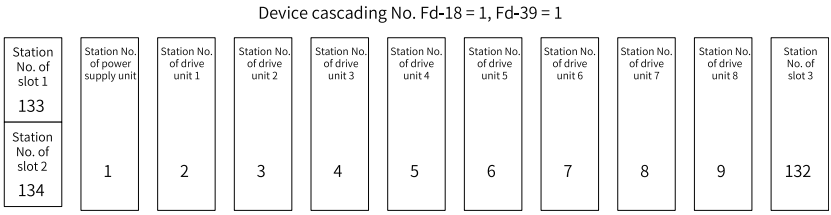


Figure 1-4 Station number of device 1

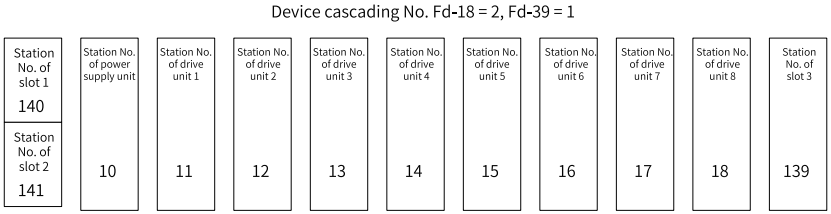


Figure 1-5 Station number of device 2

Detection on station number conflict

- Automatic assignment mode of station numbers
  No conflict can occur on station numbers assigned automatically. Such detection is unavailable for multiple groups of cascaded drives.
- Manual assignment mode of station numbers
  Alarms can be reported for station numbers set repeatedly within one group of drives. Such detection is unavailable for multiple groups of cascaded drives.

1.4.2 Parameters

The following parameters are set in the power supply unit. There is no need to set any parameter in the drive unit.

Table 1–2 Related parameters

Parameter	Parameter Name	Value Range	Description	Property	Description
FD-18	Power supply unit No.	1–15	/	RW	Set the number of the power supply unit. This parameter is used to assign the station number to the power supply unit and the drive unit after the automatic assignment of station numbers is enabled. See the following rules: Station number of the power supply unit = FD-18 x 16 Station number of the drive unit = Current slot number +（FD-18 - 1）x 16
FD-39	Function enabling bit configuration of AC drive station number	0 to 1	0: Disable 1: Enable	RW	It specifies the mode of station number assignment. 0: Disable Station number of the AC drive cannot be manually set. 1: Enable Station number of the AC drive can be manually set.

Parameter	Parameter Name	Value Range	Description	Property	Description
FD-40	Station number of the power supply unit that is manually set	0 to 127	/	RW	Set the station number of the power supply unit. Set the station number of the power supply unit through FD-40.
FD-41	Station number of the drive unit 1 that is manually set	0 to 127	/	RW	Set the station number of drive unit 1 manually.
FD-42	Station number of the drive unit 2 that is manually set	0 to 127	/	RW	Set the station number of drive unit 2 manually.
FD-43	Station number of the drive unit 3 that is manually set	0 to 127	/	RW	Set the station number of drive unit 3 manually.
FD-44	Station number of the drive unit 4 that is manually set	0 to 127	/	RW	Set the station number of drive unit 4 manually.
FD-45	Station number of the drive unit 5 that is manually set	0 to 127	/	RW	Set the station number of drive unit 5 manually.
FD-46	Station number of the drive unit 6 that is manually set	0 to 127	/	RW	Set the station number of drive unit 6 manually.
FD-47	Station number of the drive unit 7 that is manually set	0 to 127	/	RW	Set the station number of drive unit 7 manually.
FD-48	Station number of the drive unit 8 that is manually set	0 to 127	/	RW	Set the station number of drive unit 8 manually.
Note: When FD-39 is set to 1, FD-40 to FD-48 are active.					
FD-93	Station number of the device connected to expansion card slot 1	0 to 65535	Indicates the station number of current card slot.	R	Displays the station number of the device connected to the current slot. This station number is used for extension device commissioning or programming.
FD-94	Station number of the device connected to expansion card slot 2	0 to 65535	Indicates the station number of current card slot.	R	

2 Modbus Communication

2.1 Introduction

The AC drive connects to the PC/PLC control network that includes one master and multiple slaves as the slave through the RS485 communication port. You can carry out centralized control by using a PC or PLC. Through the communication protocol, you can also set the running commands, modify or read parameters, and read the operating status and fault information of the drive.

The AC drive supports the Modbus-RTU slave communication protocol. This protocol defines content and format of transmitted messages during serial communication, If an error occurs when the slave receives a message, or the slave cannot complete the action required by the master, the slave responds with a fault message to the master.

2.2 Networking and Interfaces

In a network with a single master and multiple slaves, one of the devices works as the communication master (typically a host controller, PLC, or HMI), and the other devices work as communication slaves. The master establishes communication with the slave to perform read or write operations on slave parameters, whereas the slave responds to queries or operations from the master. At the same moment, only one device can transmit data and the other can only receive data.

Each communication slave has a unique slave address, The address range of the slaves is from 1 to 247, and 0 is the broadcast address.

Networking

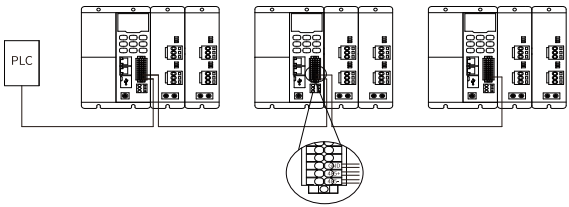


Figure 2-1 Modbus communication networking

Communication Port

Modbus communication connection is implemented through the CN1 interfaces on the power supply unit that include one pair of RJ485 terminals, as shown below.

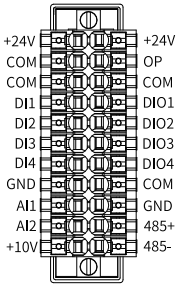


Figure 2-2 Modbus communication interface

Transmission Distance

The following table lists the maximum number of nodes and transmission distance supported by the standard RS485 circuit at different transmission rates.

Table 2–1 Maximum number of nodes and transmission distance

Transmission Distance (m)	Rate (kbps)	Number of Nodes	Cable Specification
100	115.2	128	AWG26
1000	19.2	128	AWG26

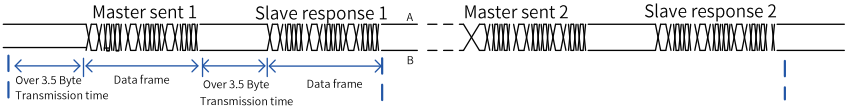
Termination Resistor Settings

Table 2–2 Termination resistor settings

Terminal Assignment		Pin Description
Pin No.	DIP Switch	
1	DIP switch for enabling/ disabling RS485 termination resistor	By default, the RS485 termination resistor is disabled. To enable the RS485 termination resistor, set pins 1 and 2 to ON.
2		

2.3 Communication Transmission Mode

In an RS485 communication network, data is transmitted in the asynchronous serial and half-duplex transmission mode. Data is sent frame by frame in the message format specified by the Modbus RTU protocol. The idle time longer than 3.5-byte transmission time marks the start of a new communication frame.

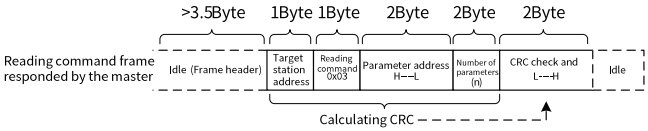


The built-in communication protocol of the AC drive is the Modbus RTU slave communication protocol, which allows the AC drive to respond to the query command from the master or execute the action according to query command from the master and respond with communication data.

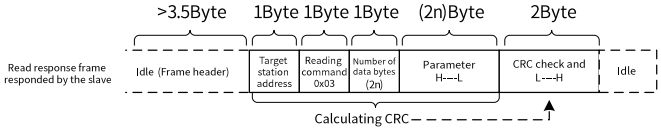
The master can be a PC, an industrial control device, or a PLC, etc. The master can separately communicate with a slave or issue broadcast information to all slaves. When the master sends a query command to a single slave, the slave needs to return a response frame. For a broadcast message sent by the master, the slaves do not need to return a response to the master.

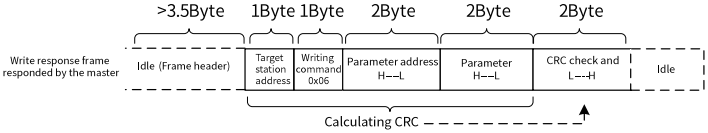
2.4 Communication Data Frame Structure

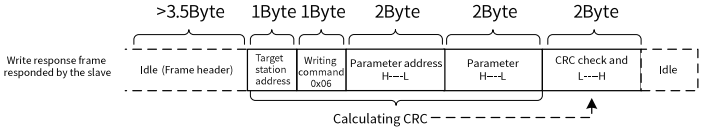
The following figure shows the communication data format of the Modbus RTU protocol. The AC drive supports reading or writing only of word type parameters, and does not support reading or writing of bytes or bits. The read operation command is 0x03, the write operation command is 0x06, and the multi-data write operation command is 0x10.

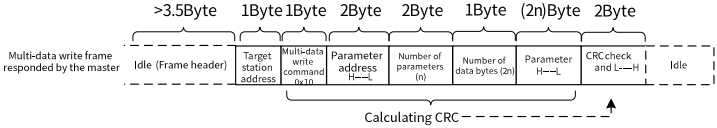


In theory, the host controller can read or write a maximum of 12 consecutive parameters. However, these parameters must be in the same group. Otherwise, a response error occurs.

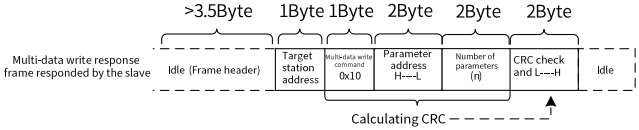








A maximum of 12 consecutive parameters can be read or written.



If the slave detects a communication frame error or reading/writing failure caused by other reasons, an error frame will be returned.

Note

CRC check errors will not be responded to.

Modbus is the standard protocol version.

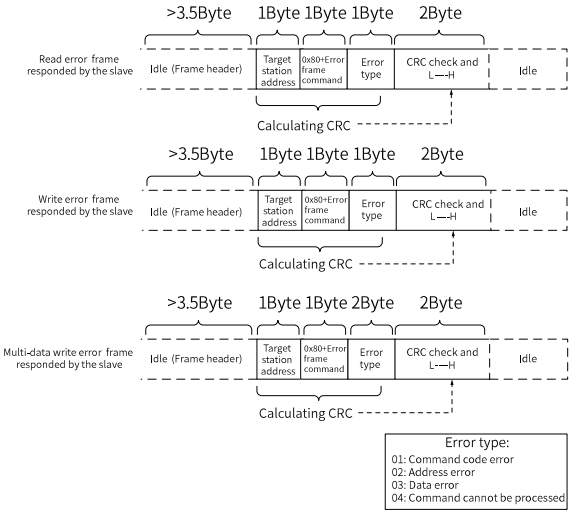


Table 2–3 Data frame fields

Data frame field	Description
Frame header (START)	Longer than the time for transmitting 3.5 bytes
Slave address (ADR)	Communication address range: 1 to 247; 0: Broadcast address
Command code (CMD)	03: Read a slave parameter; 06: Write a slave parameter; 10: Write multiple slave parameters
Parameter address (H)	AC drive internal parameter address in hexadecimal format; parameter type and non-parameter type (such as running status parameters and running commands). See the address definition for details. Low-order bytes follow high-order bytes during transmission.
Parameter address (L)	
Number of parameters (H)	Number of parameters read in this frame. 1 indicates that one parameter is read. During transmission, low-order bytes follow the high-order bytes. Only one parameter can be modified at a time.
Number of parameters (L)	
Number of data bytes	Data length, which is twice the number of parameters
Data (H)	Response data or data to be written. Low-order bytes follow high-order bytes during transmission.
Data (L)	
CRC low-order bits	Detection value: CRC16 check value. High-order bytes follow low-order bytes during transmission. For the calculation method, see the following descriptions of CRC.
CRC high-order bits	
END	Time for transmitting 3.5 bytes

CRC check:

The cyclical redundancy check (CRC) adopts the RTU frame format. A Modbus message includes a CRC-based error check field. The CRC field checks content of the entire message. The CRC field is two bytes, containing a 16-bit binary value. It is added to the message after being calculated by the transmission device. The receiving device recalculates a CRC value in the message, and compares the calculated value with the CRC value in the received CRC field. If the two CRC values are different, transmission errors occur.

The CRC is first stored to 0xFFFF. Then a procedure is invoked to process the consecutive 8-bit byte in the message and the value in the register. Only the 8-bit data in each character is valid for the CRC. The start bit, stop bit and the parity bit do not apply to the CRC.

During CRC, each eight-bit byte is in exclusive or (XOR) with the content in the register. The result is shifted to the least significant bit (LSB), and 0 is filled in the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB is 1, the register then performs XOR with a preset value. If the LSB is 0, no XOR is performed. This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next eight-bit byte is in XOR with the register's current value, and the process repeats for eight more shifts as described above. The final value of the register is the CRC value after all the bytes in the message have been applied.

The CRC is added to a message from the low-order byte to the high-order byte. The CRC simple function is as follows:

```
unsigned int crc_chk_value（unsigned char *data_value, unsigned char length）
{
unsigned int crc_value=0xFFFF;
int i;
while (length–)
{
crc_value^=*data_value++;
for (i=0;i<8;i++)
{
if (crc_value&0x0001)
{
crc_value= (crc_value>>1) ^0xa001;
}
else
{
crc_value=crc_value>>1;
}
}
```

```
}
return (crc_value);
 }
```

Definition of communication parameter addresses:

The parameters can be read and written (except those which cannot be changed because they are only for factory use or monitoring).

2.5 Parameters

Table 2–4 Modbus communication parameters of the power supply module

Parameter	Parameter Name	Default	Value Range	Descriptions
FD-00	RS485 baud rate	5	0: 300 bps 1: 600 bps 2: 1200 bps 3: 2400 bps 4: 4800 bps 5: 9600 bps 6: 19200 bps 7: 38400 bps 8: 57600 bps 9: 115200 bps	This parameter defines the speed of data transmitted between the host controller and the AC drive. The higher the baud rate, the faster the communication speed. Note that the baud rate of the host controller must be the same as that of the AC drive. Otherwise, communication will fail.
FD-01	RS485 communication data format	0	0: No check (8-N-2) 1: Even parity check (8-E-1) 2: Odd parity check (8-O-1) 3: No check (8-N-1) 4: No check (7-N-2) 5: Even parity check (7-E-1) 6: Odd parity check (7-O-1) 7: No check (7-N-1)	This parameter defines the format of Modbus data transmitted between the host controller and the AC drive. 0: No check (8-N-2) The data format is 8-bit data, no check, and 2-bit stop bit. 1: Even parity check (8-E-1) The data format is 8-bit data, even parity check, and 1-bit stop bit. 2: Odd parity check (8-O-1) The data format is 7-bit data, odd parity check, and 1-bit stop bit. 3: No check (8-N-1) The data format is 8-bit data, no check, and 1-bit stop bit. 4: No check (7-N-2) The data format is 7-bit data, no check, and 2-bit stop bit. 5: Even parity check (7-E-1) The data format is 7-bit data, no check, and 2-bit stop bit. 6: Odd parity check (7-O-1) The data format is 7-bit data, odd parity check, and 1-bit stop bit. 7: No check (7-N-1) The data format is 7-bit data, no check, and 1-bit stop bit. Note that the data format of the host controller must be the same as that of the AC drive. Otherwise, communication fails.

Parameter	Parameter Name	Default	Value Range	Descriptions
FD-02	RS485 local address	16	1 to 127	Local address when communicating through RS485 Read-only. The actual local address is set by FD-40. When the local address is set to 0 (broadcast address), the host controller broadcast is enabled. The local address must be unique in the range of 1 to 127, which is the basis for point-point communication between the AC drive and the host controller.
FD-03	RS485 response delay	0	0 ms to 20 ms	Used to set the interval between the AC drive completing data receiving and host controller completing data sending. If the response delay is shorter than the drive processing time, the drive processing time prevails. That is, after the drive finishes data processing, it sends data to the host controller. If the response delay is longer than the system processing time, the AC drive will send data to the host controller only after the system finishes data processing and the response delay expires.
FD-04	RS485 communication timeout time	0	0.0s to 60.0s	Used to set the maximum interval between the two consecutive successful RS485 communications. When this parameter is set to 0.0s, the drive does not detect communication timeout. In general cases, this parameter is set to 0.0s. It is used to monitor communication status in a system with continuous communication. When it is set to an effective value, if the time interval between the current communication and the next communication exceeds FD-04 value, the system reports a communication fault (E16.01).
FD-92	Communication version	0.00	0.00-655.35	The parameter indicates the communication software version.

Table 2–5 Modbus communication parameters of the drive unit

Parameter	Parameter name	Default	Value Range	Descriptions
FD-02	Local address	1	0 to 247	Local address When the local address is set to 0 (broadcast address), the host controller broadcast is enabled. The local address must be unique in the range of 1 to 247, which is the basis for point-point communication between the AC drive and the host controller.
FD-03	RS485 communication response delay	2 ms	0 ms to 20 ms	Used to set the interval between the AC drive completing data receiving and host controller completing data sending. If the response delay is shorter than the drive processing time, the drive processing time prevails. That is, after the drive finishes data processing, it sends data to the host controller. If the response delay is longer than the system processing time, the AC drive will send data to the host controller only after the system finishes data processing and the response delay expires.
FD-04	RS485 communication timeout time	0s	0.0s to 60.0s	Used to set the maximum interval between the two consecutive successful RS485 communications. When this parameter is set to 0.0s, the drive does not detect communication timeout. In general cases, this parameter is set to 0.0s. It is to monitor communication status in a system with continuous communication. When it is set to an effective value, if the time interval between the current communication and the next communication exceeds FD-04 value, the system reports a communication fault (E16.01).
FD-92	Communication version	0.00	0.00-655.35	This parameter shows the communication software version of the AC drive.

2.6 Communication Configuration

2.6.1 Configuration for RS485 Communication Between AC Drive and H5U

Software Acquisition and Hardware Wiring

1. Log in to Inovance website http://www.inovance.com/support/download.html to download the H5U programming software.
2. Connect RS485+ and RS485– on the H5U to RS485+ and RS485– on the AC drive, as shown in the following figure.

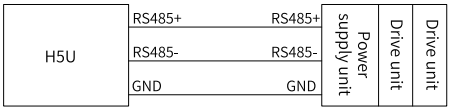


Figure 2-3 Connecting communication interfaces

Master and Slave Configuration

1. Run AutoShop. On the page displayed, click **New Project**, confirm that the value in the **Series and models** field is H5U, and then click **OK**.
2. Click COM in the left pane to go to the PLC configuration interface, select the protocol and data format, and click **OK**.



3. Click COM , then click Add Modbus Config and OK. COM0 Modbus Config is displayed. Double-click COM0 Modbus Config , and click Add on the displayed interface.
   Each time you click **Add**, you can add and edit an AC drive variable.

4. Write operation: Click **Add**, select the target **Slave NO.** and **Trigger Mode** (Cycle by default).

NO.	Name	Slave NO.	Trigger Mode	Trigger Conditions	Function Code	Slave addr...	Quantity	Mapped Addr.	Repeat Num
1	slave	1	Cycle(ms)	1000	Write Register(16)	1000	1	D0	1

As shown in the preceding figure, Slave NO. is 1, indicating that the operation will be performed on slave 1. Set Trigger Mode to Cycle and Function Code to Write Register; otherwise, the write operation will fail. The internal variables of the AC drive are all 16-bit data. Therefore, set Quantity to 1. If Quantity is set to 2, the write operation will fail.

5. Read operation: Click **Add**, select the target **Slave NO.** and **Trigger Mode** (Cycle by default).

NO.	Name	Slave NO.	Trigger Mode	Trigger Conditions	Function Code	Slave addr...	Quantity	Mapped Addr.	Repeat Num
1	slave	1	Cycle(ms)	.. 1000	Write Register(16)	1000	1	.. D0	1
2	slave	1	Cycle(ms)	.. 1000	Write Register(16)	2000	1	.. D2	1
3	slave	1	Cycle(ms)	.. 1000	Read Register(03)	7002	1	.. D300	1
4	slave	1	Cycle(ms)	.. 1000	Read Register(03)	7003	1	.. D302	1

As shown in the preceding figure, Slave NO. is 1, indicating that the operation will be performed on slave 1. Set Trigger Mode to Cycle and Function Code to Read Register; otherwise, the read operation will fail. The internal variables of the AC drive are all 16-bit data. Therefore, set Quantity to 1. If Quantity is set to 2, the read operation will fail.

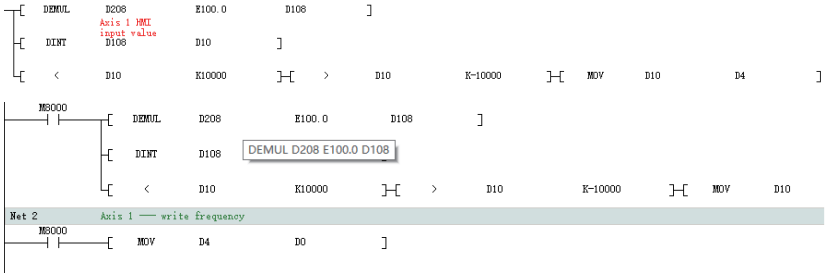
After finishing all write and read configurations, click **OK** to go back to the programming page.

Instances

1. Write the frequency (F0-03 is set to 9).
   Data conversion: Multiply the required frequency (a) by 100 to obtain an integer, and then write the integer to 1000H.

   The following figure shows the configuration and the program.

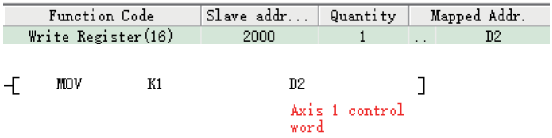
Function Code	Slave addr...	Quantity	Mapped Addr.	Repeat Num
Write Register(16)	1000	1	.. D0	1



2. Start or stop the AC drive (F0-02 is set to 2).
   Assign a value to the D component corresponding to the station address 2000H to control forward running, reverse running, and stop of the AC drive through communication. Definitions of 2000H are as follows: 1

   1: Run in forward direction; 2: Run in reverse direction; 3: Jog in forward direction; 4: Jog in reverse direction; 5: Coast to stop; 6: Decelerate to stop; 7: Reset upon fault

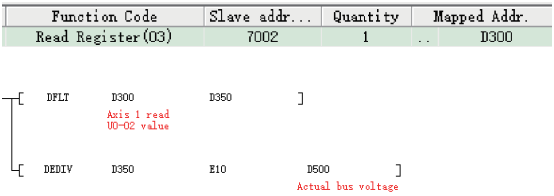
The following figure shows the configuration and the program.



The PLC soft component address corresponding to 2000H is D2. Therefore, to control the AC drive to run in forward direction through communication, write 1 to D2. Similarly, to control the AC drive to decelerate to stop, set D2 to 6.

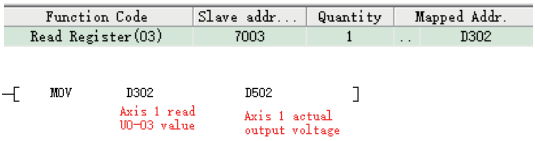
3. Read the bus voltage.
   Based on the conversion rule, convert the bus voltage U0-02 to 7002 (convert U in the high-order 2 bits to 7, and convert the low-order 2 bits to a hexadecimal equivalent). The actual bus voltage is the read bus voltage (a) divided by 10. According to the communication configuration, the D component address of the bus voltage is D300. Convert D300 to a floating-point number and then divide this value by 10.

   The following figure shows the configuration and the program.



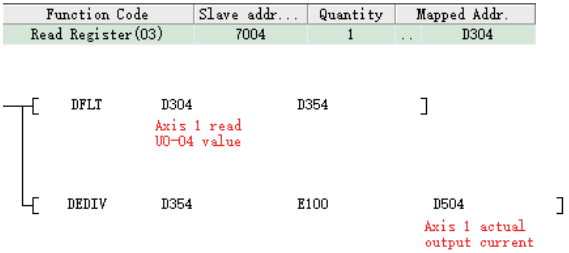
4. Read the output voltage.
   Convert the output voltage U0-03 to 7003 based on the conversion rule. The read value is the actual output voltage. According to the communication configuration, you only need to move the value of D302 to another D component (or not).

   The following figure shows the configuration and the program.



5. Read the output current.
   Convert the output current address U0-04 to 7004 based on the conversion rule. The actual output current is the read output current divided by 100.

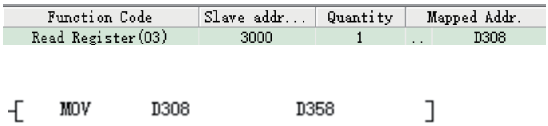
   The following figure shows the configuration and the program.



6. Read the AC drive state.

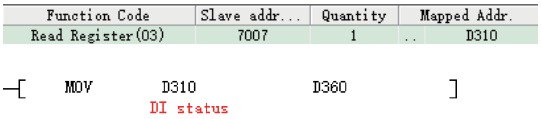
   Read 3000H to directly obtain the current state of the AC drive (1: Running in forward direction; 2: Running in reverse direction; 3: Stopped).

   The following figure shows the configuration and the program.



7. Read the DI state.

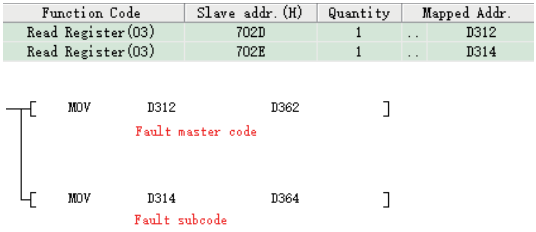
   According to the conversion rule, convert the DI state U0-07 to 7007. Convert the read value into a binary value. The LSB indicates DI1, the second bit indicates DI2, and so on.



8. Read the fault code.

   Convert the fault code U0-45 to 702D and convert the fault subcode U0-46 to 702E based on the conversion rule.

   The following figure shows the configuration and the program.



Common problems and solutions

Items must be checked:

1. Check whether other pins instead of 485+ and 485– are connected.
2. Check whether the communication speed of the power supply unit (set through FD-00) is the same as that of the host controller.
3. Check whether the data format of the power supply unit (set through FD-01) is the same as that of the host controller.
4. Check whether the communication address defined by FD-02 (local address) of each device is unique to avoid conflicts caused by duplicated local addresses.

Table 2–6 Common problems and solutions

FAQ	Solution
Failure to write frequency	1. Check F0-03 to confirm that the address in the configuration table is correct. When F0-03 is 0, the address is the address of F0-08; when F0-03 is 9, the address is 1000H or 7310H. 2. Check whether the termination resistor is connected. If not, switch on the termination resistor and then power on the AC drive again.
Failure to start the AC drive	1. Check that F0-02 is set to 2 (0: Operating panel; 1: Terminal; 2: Communication). 2. Check whether the termination resistor is connected. If not, switch on the termination resistor and then power on the AC drive again.
Unstable connection	1. Ensure stable connection on PLC side. 2. Check that wiring on the AC drive end is reliable. 3. Check and ensure that the signal cables are far away from the power cable.
Incorrect reading	1. Ensure that the address configured is correct. 2. Ensure that data conversion is performed. 3. Ensure that the D element is not occupied.

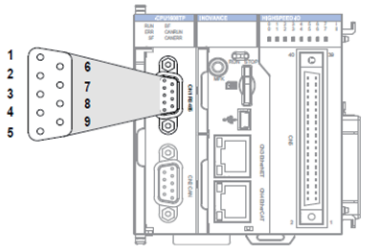
2.6.2 Configuration for RS485 Communication Between AC Drive and AM600

The following section describes how to configure the AM600 series PLC to control the AC drive to run forward or reversely.

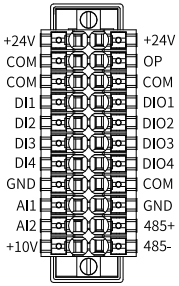
Hardware Wiring

Interfaces:

- The AM600 provides two RS485 ports. The two RS485 channels share the same DB9 interface. For details, see the following figure.

RS485 port on CPU module	Pin	Channel	Assignment	Function
	1	COM0 (RS485)	RS485-	Negative signal of the RS485 differential pair of COM0
	2		RS485+	Positive signal of the RS485 differential pair of COM0
	5		GND0	Power ground of COM0
	6	COM1 (RS485)	RS485-	Negative signal of the RS485 differential pair of COM1
	9		RS485+	Positive signal of the RS485 differential pair of COM1
	3		GND1	Power ground of COM1

- The AC drive is provided with one set of RS485 port, which is on the CN1 connector of the power supply unit.



Hardware connection procedure:

1. Take COM1 as an example. Connect one end of the network cable to CN1 of the AM600 through the DB9 terminal. Strip the other end of the cable, connect the RS485+, RS485–, and GND0 wires to the 485+, 485–, and GND terminals of the AC drive, respectively, as shown in the following figure.



Connection on AM600 side



Connection on AC drive side

2. Switch the termination resistor of the AC drive to the ON position (to the left).



Configuration on the drive side

1. Press the **AXIS** button on the AC drive and select the power supply unit from the commissioning station number. After the green characters **00** are displayed in the upper left corner of the AC drive display, press **PRG** to enter the parameter menu and set the parameters as follows:
   FD-00 = 5

   FD-01 = 0

   FD-03 = 2

   FD-04 = 0.0

   Record the address displayed in FD-02. The address is the station number of the AC drive power supply unit.

2. Press the **AXIS** button on the AC drive and select station 1 of the drive unit from the commissioning station number. After the green characters **01** are displayed in the upper left corner of the AC drive display, press **PRG** to enter the parameter menu and set the parameters as follows:
   F0-02 = 2 (set the command source to communication)

   F0-03 = 9 (set the frequency source to communication)

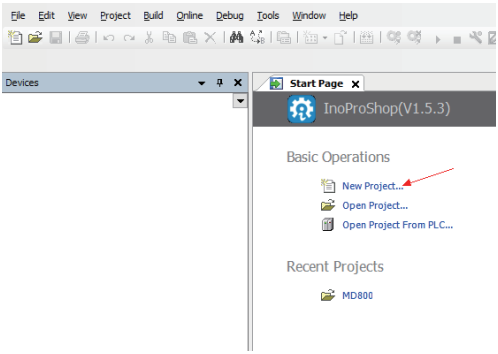
   FD-03 = 2

   Record the address displayed in FD-02. The address is the station number of station 1 of the drive unit.

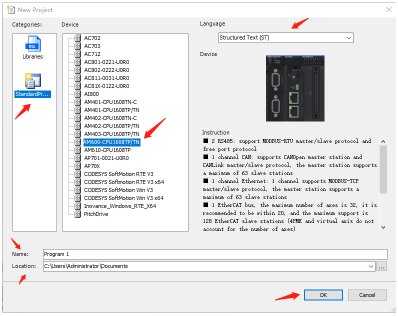
3. If the AC drive have multiple drive units, repeat the above steps, set parameters and record the station number for each drive unit. If you need to manually set the station numbers of the power supply unit and the drive unit, configure the function codes FD-39 to FD-40 on the power supply unit.

Configuration on the PLC side

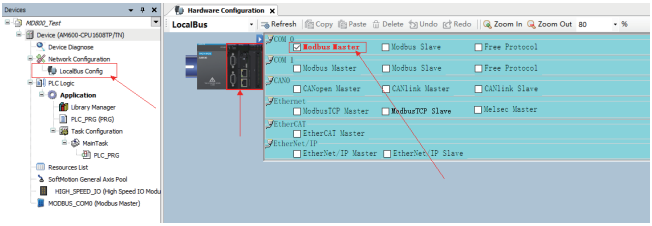
1. Connect the PC and PLC by using a network cable or USB, run the InoProShop, and click **New Project**.



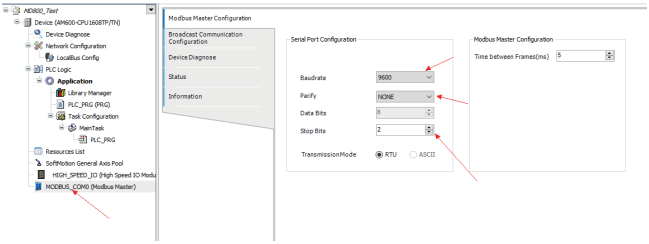
2. In the menu bar, go to **File > New Project**. In the displayed **New Project** dialog box, click **StandardProjects**. In the **Device** pane, click **AM600-CPU1608TP/TN**. Select **Structured Text (ST)** from the **Language** drop-down list box, enter the project name in the **Name** field, select a storage path in the **Location** field, and click **OK**.



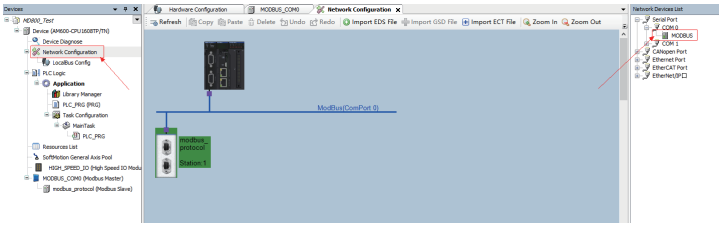
3. Click **LocalBus Config** and then click to select a CPU module. In hardware connection, COM0 is connected to MD800 through the RS485 cable. Therefore, select the Modbus master station of the serial port 0.



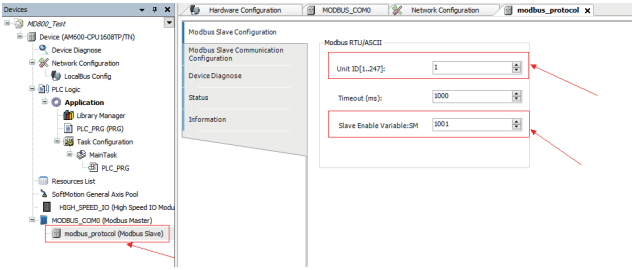
4. Select **Modbus_COM0** on the left, and set **Baudrate**, **Parity**, and **Stop Bits**. These three parameters must be set the same as FD-00 and FD-01 settings of the power supply unit of the AC drive.



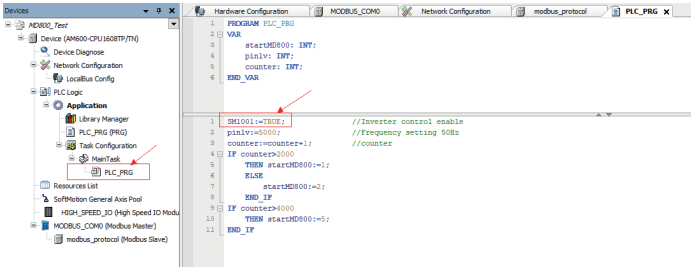
5. Double-click **Network Configuration** on the left pane. Double-click the **MODBUS** option in the menu of **Serial Port > COM 0** on the right pane. A new slave is displayed on the Modbus bus in the center of the interface. If there are multiple slaves, click **MODBUS** multiple times to generate multiple slaves.



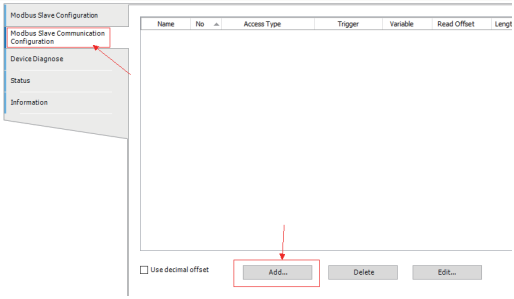
6. Double-click the new Modbus slave station and set its number, which must be same as the station number of the AC drive set by FD-02. Record the value of **Slave Enable Variable**.



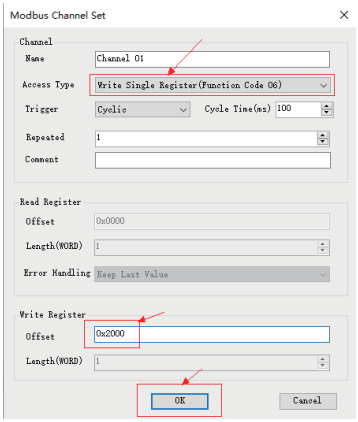
7. Compile the PLC program as follows: Enable the slave enable variable. Set the frequency of the AC drive to 50 Hz. Make the PLC run for 4000 scanning cycles. During the first 2000 scanning cycles, make the PLC control the AC drive to run in the forward direction, and during the last 2000 scanning cycles, make the PLC control the AC drive to run in the reverse direction. Make the PLC control the AC drive to decelerate to stop. Note that the slave enable variable must be enabled.

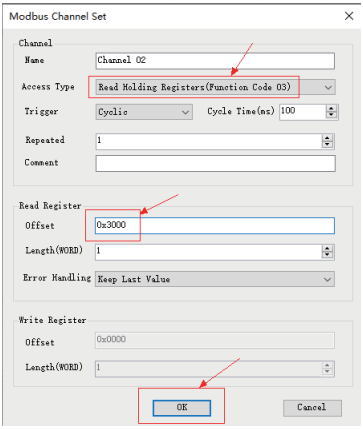


8. Click **Modbus Slave Communication Configuration** and then click **Add**.

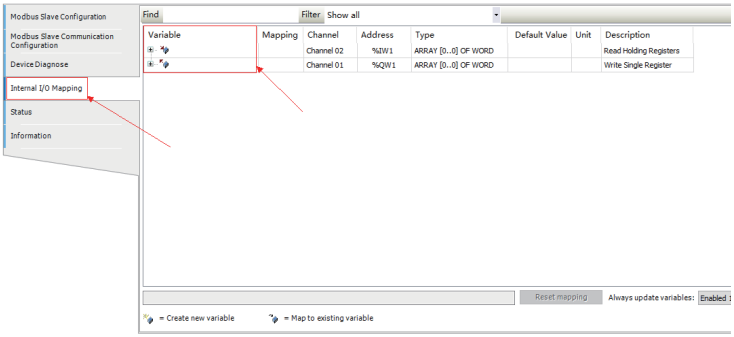


9. Configure the register in the displayed dialog box. The control word reading address of the AC drive is 3000H, the writing address is 2000H, and the frequency address is 1000H. For details about address configuration, see *Write Single Register (Function Code 06)*.

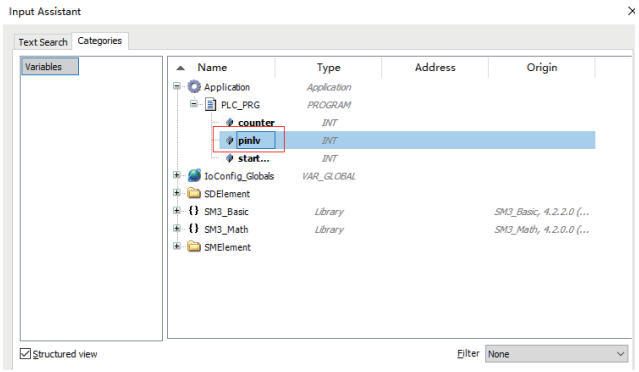




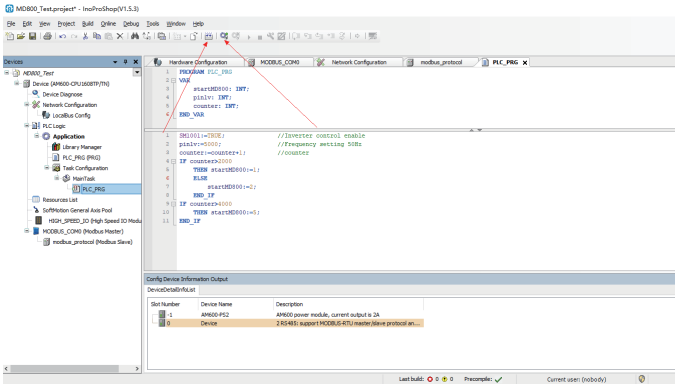
10. On the **Internal I/O Mapping** tab, map the variable of the PLC to the address of the AC drive.



11. Select the variable to be mapped.



12. Compile the program to check whether there are errors. If no error is found, log in to the PLC, download the program, and click the **Execute** button to execute the program.


MD800_Test.project* - InoProShop(V1.5.3)
File Edit View Project Build Online Debug Tools Window Help
Devices
MD800_Test
Device (AM600-CPU1608TP/TN)
Device Diagnose
Network Configuration
LocalBus Config
PLC Logic
Application
Library Manager
PLC_PRG (PRG)
Task Configuration
MainTask
PLC_PRG
Resources List
SoftMotion General Axis Pool
HIGH_SPEED_IO (High Speed IO Modu
MODBUS_COM0 (Modbus Master)
modbus_protocol (Modbus Slave)
Hardware Configuration
MODBUS_COM0
Network Configuration
modbus_protocol
PLC_PRG
PROGRAM PLC_PRG
VAR
startMD800: INT;
pinlv: INT;
counter: INT;
END_VAR
SM1001:=TRUE; //Inverter control enable
pinlv:=5000; //Frequency setting 50Hz
counter:=counter+1; //counter
IF counter>2000
THEN startMD800:=1;
ELSE
startMD800:=2;
END_IF
IF counter>4000
THEN startMD800:=5;
END_IF
Config Device Information Output
DeviceDetailInfoList
Slot Number
Device Name
Description
1
AM600-PS2
AM600 power module, current output is 2A
0
Device
2 RS485: support MODBUS-RTU master /slave protocol an...
Last build: 0 0
Precompile:
Current user: (nobody)

3 CANopen and CANlink Communication

3.1 Protocol Description

The CANopen communication protocol is an international general standard protocol. The CANlink communication protocol is a special protocol independently developed by Inovance based on CAN bus applications. This protocol can be used to communicate with only Inovance PLCs such as H2U, H3U, and H5U.

Communication Model

CANopen is an application layer protocol of the network transmission system based on the CAN serial bus. The CAN bus follows an ISO/OSI standard model. This protocol defines the data link layer and some physical layers in the OSI model. It can adopt multi-master mode, in which any node in the network can send a message to other nodes. Network nodes are assigned with different priorities based on the system real-time requirements, reducing the bus arbitration time in case of transmission conflicts. The CAN network cancels the traditional address coding that is replaced with communication data block coding. With data block coding, the number of nodes in the network is not limited theoretically, and different nodes can receive the same data at the same time. This coding mode also features short transmission byte, fast speed, good fault tolerance, and reliable data transmission, making it suitable for industrial control and distributed real-time control. The following figure shows a CANopen communication model.

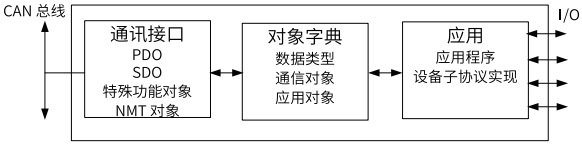


Figure 3-1 CANopen communication model

The following describes the object dictionary, common communication objects, and CANopen packet format in the CANopen communication model.

Protocol Features

CANopen supports six protocols and is described as follows:

- With the Node Guard protocol supported, the master can query the equipment status.
- The heartbeat protocol allows the slave to report its current state to the master regularly.
- The Service Data Object (SDO) supports only the accelerated transmission mechanism. One parameter or one object dictionary is transmitted at a time.
- Four TPDOs and four RPDOs are supported.
- The emergency object is supported.
- The synchronous mode is supported.

Object Dictionary

The object dictionary is an ordered set of parameters and variables that are accessed through the network in an ordered and predefined manner. It contains all parameters of device descriptions and device network status.

The CANopen protocol uses object dictionaries with 16-bit index and 8-bit sub-index. One master node or configuration tool can access all values in a slave node object dictionary. The following figure shows the structure of the object dictionary.

索引	对象
000	未使用
0001~001F	静态数据类型（标准数据类型，如Boolean，Integer16）
0020~003F	复杂数据类型（预定义由简单类型组合成的结构如PDOCommPar, SDOParmeter）
0040~005F	制造商规定的复杂数据类型
0060~007F	设备子协议规定的静态数据类型
0080~009F	设备子协议规定的复杂数据类型
00A0~0FFF	保留
1000~1FFF	通信子协议区域（如设备类型，错误寄存器，支持的PDO数量）
2000~5FFF	制造商特定子协议区域
6000~9FFF	标准的设备子协议区域（例如“DSP-401 I/O模块设备子协议”： Read State 8 Input Lines等）
A000~FFFF	保留

Figure 3-2 Structure of the object dictionary

Common Communication Object

CANopen provides multiple communication objects. Every communication object has different features. You can select a communication object according to different applications. The predefined COB-ID is used. Specific rules are as follows:

- NMT object: 0x000
- SYNC object: 0x080
- SDO object:
  Transmitted SDO— 0x600+Node- ID

  Received SDO — 0x580+Node- ID
- PDO object:
  RPDO1 — 0x200+Node-Id

  RPDO2 — 0x300+Node-Id

  RPDO3 — 0x400+Node-Id

  RPDO4 — 0x500+Node-Id

  TPDO1 — 0x180+Node-Id

  TPDO2 — 0x280+Node-Id

TPDO3 — 0x380+Node-Id

TPDO4 — 0x480+Node-Id

- EMCY object: 0x80+Node- ID
  Node- ID Equipment ID (station address) set in FD-13.

Communication objects are defined as follows:

- NMT
  The NMT object includes Boot-up messages, Heartbeat protocol, and NMT messages. Based on the master/slave communication mode, the NMT is used to manage and monitor all nodes in the network, implementing node state control, error control, and node startup.

- SDO
  By using indexes and sub-indexes, SDOs enable clients to access entries in the object dictionary of devices. An SDO is achieved through a CMS object of the multi-element domain in CAL and transmitting data in any length is allowed. When the data exceeds four bytes, the data is divided into several packets. The SDO protocol produces a response for every message. The SDO request and response packets always contain eight bytes.

- PDO
  A PDO is used to transmit real-time data from one creator to one or multiple receivers. The length of transmitted data ranges from one to eight bytes. Each CANopen device has eight default PDO channels, that is, four PDO channels for transmitting and four for receiving. The PDO supports synchronous and asynchronous transmission modes, which are determined by the communication parameter corresponding to the PDO. The content of a PDO message is pre-defined and is determined by the mapping parameter corresponding to the PDO.

- SYNC object
  A SYNC object is a message periodically broadcast by the CANopen master to the CAN bus. It is used to provide basic network clock signals. Each device determines whether to perform synchronous communication with other network devices using the event based on its configuration.

CANopen Packet Format

- NMT module control packet
  Only an NMT master node can send an NMTModuleControlNMT packet. *"Table 3–1 NMT message format" on page 50* shows the packet format. COB-ID is fixed at 0x000. Data0 is the command word, which occupies one byte. See *"Table 3–2 NMT packet command format" on page 50*. Data1 is a CANopen network device address occupying one byte. When it is 0, it indicates a broadcast message that is valid for all slave devices in the network.

For example, the command to set a device with device address "6" to the operable state is "0x0000x010x06".

Table 3–1 NMT message format

COB-ID	RTR	Data0	Data1
0x000	0	Command word	Node ID

Table 3–2 NMT packet command format

Command	Description
0x01	Start the remote node.
0x02	StopRemoteNode
0x80	Enter the pre-operation state.
0x81	ResetNode
0x82	ResetCommunication

- NodeGuarding packet
  By using the node protection service, the MNT master node can check the current state of every node. Especially, this service is significant when these nodes have no data to be transmitted.

  The standard protocol object 0x100C is used to set GuardTime and 0x100D is used to set the multiplication factor of GuardTime. The GuardTime and its multiplication factor jointly determine the node protection time period.

  "Table 3–3 NodeGuarding packet sent by the master node" on page 50 describes the remote frame sent by the NMT master node.

  Table 3–3 NodeGuarding packet sent by the master node

COB-ID	RTR
0x700+Node-ID	1

  "Table 3–4 NodeGuarding response packet returned from a slave node" on page 50 is the response message returned by the NMT slave node. *"Table 3–5 Status word returned by the NodeGuarding slave node" on page 51* describes the status word in the one-byte format.

  Table 3–4 NodeGuarding response packet returned from a slave node

COB-ID	RTR	Data0
0x700+Node-ID	0	Status word

Table 3–5 Status word returned by the NodeGuarding slave node

Data Bit	Description
Bit 7	"0" or "1" must be alternatively set every time.
Bit 0 to Bit 6	State: 4: Stopped 5 : Operational 127: Pre-operational

- Heartbeat packet
  A node can be configured to produce periodic heartbeat messages, in which Bit 7 is 0, and Bit 0 to Bit 6 are the same as those of the NodeGuarding message. See *"Table 3–6 Heartbeat packet" on page 51* for details. The heartbeat time is defined by the standard protocol object 0x1017. A node can support either the NodeGuarding protocol or the Heartbeat protocol.

Table 3–6 Heartbeat packet

COB-ID	RTR	Data0
0x700+Node-ID	0	Status word

3.2 Networking and Interfaces

Networking

The CAN bus topology is shown below. Use shielded twisted cables as the CAN bus, connect a 120 Ω termination resistor to both ends of the bus to prevent signal reflection, and ground the shield in the single point grounding mode.

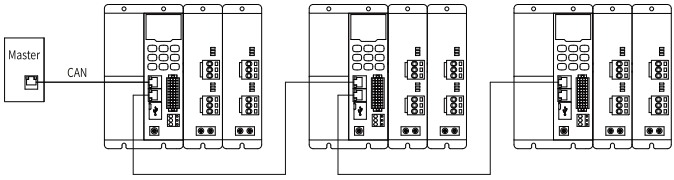


Figure 3-3 CAN bus topology

Note

- Ensure that termination resistors are located at both ends of the CAN bus.
- A computer or commissioning tool can be connected at the end of the CAN network.

Communication Port

The RJ45 ports on the power supply unit are used for CANopen/CANlink communication, as shown below.

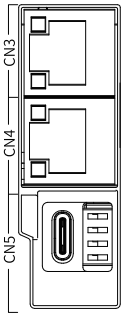


Figure 3-4 CANopen/CANlink communication port

Table 3–7 CN3 terminal pins

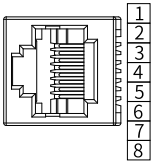
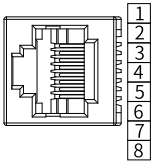
Pin No.	Pin Assignment	Pin Name	Pin Layout
1	CANH	CAN_H signal of CAN communication	
2	CANL	CAN_L signal of CAN communication	
3	CGND	CAN communication signal ground	
4	Reserved	Reserved	
5	Reserved	Reserved	
6	Reserved	Reserved	
7	Reserved	Reserved	
8	Reserved	Reserved	

Table 3–8 CN4 terminal pins

Pin No.	Pin Assignment	Pin Name	Pin Layout
1	CANH	CAN_H signal of CAN communication	
2	CANL	CAN_L signal of CAN communication	
3	CGND	CAN communication signal ground	
4	Reserved	Reserved	
5	Reserved	Reserved	
6	Reserved	Reserved	
7	Reserved	Reserved	
8	Reserved	Reserved	

Caution

Do not insert the Ethernet bus cable to the CAN bus network port.

Table 3–9 Signal definitions of the DIP switch

Appearance	Terminal Name	Function	Position
CN5 	DIP switch for connecting the RS485 termination resistor	Toggle positions 1 and 2 to ON: Termination resistor connected	
		Toggle positions 1 and 2 to OFF: Termination resistor not connected	
	DIP switch for connecting the CAN termination resistor	Toggle positions 3 and 4 to ON: Termination resistor connected	
		Toggle positions 3 and 4 to OFF: Termination resistor not connected	

Transmission Distance

The transmission distance of the CANopen/CANlink bus is directly related to the baud rate and communication cable. The following table describes the relationship between the bus length and the baud rate.

Table 3–10 Relationship between the bus length and the baud rate

Baud Rate (bps)	Length (m)
1M	25
500k	100
250k	250
125k	500
100k	500
50k	1000
20k	1000

3.3 Parameters

Table 3–11 Related parameters

Parameter	Parameter Name	Default	Value Range	Descriptions
FD-09	CANopen/ CANlink communication state	0	Ones position (CANopen) 0: Stop 1: Initialized 2: Pre-operational 8: In operation Tens position (CANlink) 0: Stop 1: Initialized 2: Pre-operational 8: In operation	Indicates the CANopen/CANlink communication state. 0 (ones position): Disabled CANopen communication is in the stop state. 1 (ones position): Initialized CANopen communication is in the initialized state. 2 (ones position): Pre-operational CANopen communication is in the pre-operational state. 8 (ones position): Running CANopen communication is in the running state. 0 (tens position): Disabled CANlink communication is in the stop state. 1(tens position): Initialized CANlink communication is in the initialized state. 2 (tens position): Pre-operational CANlink communication is in the pre-operational state. 8 (tens position): Running CANlink communication is in the running state. This read-only parameter is used to monitor the communication status.
FD-10	Communication type	1	1: CANopen/ Modbus 2: CANlink 3: Communication card mode	Set the current communication type 1: CANopen/Modbus Set the communication type to CANopen/Modbus. 2: CANlink Set the communication type to CANlink. 3: Communication card mode Set the communication type to communication card, including EtherCAT, PN, or EtherNet/IP. You just need to set FD-10 of the power supply unit. When the drive unit is running, FD-10 of the power supply unit cannot be modified.

Parameter	Parameter Name	Default	Value Range	Descriptions
FD-11	CANopen402 enable	0	0: Disable 1: Enable	It is used to select the CANopen mode. When it is set to 0, the ordinary mode is used. When it is set to 1, the CIA402 mode is used. For details on the 6000H object dictionary, see *" Appendix 6000H Group Object Dictionary of CiA402 Protocol " on page 181*
FD-12	CAN baud rate	5	0: 20 kbps 1: 50 kbps 2: 100 kbps 3: 125 kbps 4: 250 kbps 5: 500 kbps 6: 1 Mbps	This parameter is used to set the baud rate of the CANlink and CANopen communication. In the same network, baud rates of all stations must be consistent. Otherwise, communication fails.
FD-13	CAN station number	16	1 to 127	Set CAN station number, including CANlink and CANopen. On the same network, all station numbers must be different. Otherwise, communication fails.
FD-14	Number of CAN frames received per unit time (real time)	0	0 to 65535	Number of CAN frames received within a period. This parameter is used to monitor the bus load. It shows the number of CAN frames received by the station per second.
FD-15	Maximum number of error frames received by node (real time)	0	0 to 65535	Number of error frames received by node from the CAN network. This parameter indicates maximum number of error frames received by the node, and is used to monitor bus errors.
FD-16	Maximum value of error frames sent by node (real time)	0	0 to 65535	Number of error frames transmitted by node from the CAN network. This parameter indicates maximum number of error frames transmitted by the node, and is used to monitor bus errors.
FD-17	Number of bus disconnection times per unit of time	0	0 to 65535	Number of CAN bus disconnection events per unit time. This parameter indicates the number of CAN bus disconnection events which is used to monitor bus errors.

Parameter	Parameter Name	Default	Value Range	Descriptions
FD-18	Power supply unit No.	1	1 to 15	Set the number of power supply unit. This parameter is used to assign the station number to the power supply unit and the drive unit after the automatic assignment of station numbers is enabled. See the following rules: Station number of the power supply unit = FD-18 x 16 Station number of the drive unit = Current slot number +(FD-18 - 1) x 16
FD-19	CAN communication disconnection coefficient.	5	1 to 15	This parameter defines the CAN communication disconnection coefficient.
FD-34	CANopen mode	0	0: Standard mode 1: Expert mode	Used to set the operating mode of CANopen. 0: Standard mode Set the operating mode of CANopen to the standard mode. 1: Expert mode Set the operating mode of CANopen to the expert mode.
FD-35	CANopen prohibition time	0	0 to 65535	This parameter defines the CANopen inhibit time.
FD-36	CANopen event time	0	0 to 65535	CANopen event time.
FD-92	Communication version	0.00	0.00 to 655.35	The parameter indicates the communication software version.

3.4 Application

3.4.1 Operations of AC Drive Parameters

You can determine the corresponding relationship between AC drive parameters and object dictionaries based on their corresponding method, which facilitates operations on parameters.

The following section describes the corresponding method and corresponding relationship of AC drive parameters and CANopen object dictionary indexes.

- Corresponding method
  The parameter groups of the AC drive correspond to indexes 0x2000 to 0x20FF of the CANopen object dictionary. The corresponding method is as follows: An object dictionary index is the high-order eight bits of a parameter address plus 0x2000; an object dictionary sub-index is the low-order eight bits of the parameter address plus 1.

  For example, the communication address of F0-03 is 0xF003. The corresponding object dictionary index and sub-index are 0x20F0 and 0x04, respectively.

- Corresponding parameter groups
  The parameter groups of the AC drive include groups F0 to FF, A0 to AF, and U0 to UF.

  For parameter read/write operations, the mapping between parameter groups and object dictionary indexes is as follows.

  Table 3–12 Mapping between the parameter groups and the object dictionary indexes

Parameter Group	CANopen Object Dictionary Sub-index
F0 to FF	0x20F0 to 0x20FF
A0 to AF	0x20A0 to 0x20AF
U0 to UF	0x2070 to 0x207F

  A sub-index is the low-order 16 bits of a parameter address plus 1, so the mapping between parameter indexes in parameter groups and object dictionary sub-indexes is as follows.

Table 3–13 Mapping between parameter indexes in parameter groups and object dictionary sub-indexes

Parameter Index	CANopen Object Dictionary Sub-index
0x0 to 0xFE	0x1 to 0xFF

3.4.2 Operation Example (SDO)

Take F0-17 as an example. When the value of F0-17 is read, the parameter address is 0xF011. The object dictionary index and sub-index are 0x20F0 and 0x12 respectively.

1. The communication master station uses a CANopen SDO to read data from the AC drive. The following table shows the format of data sent by the master.
   Take F0-02 as an example. According to the correspondence described in the preceding section, the index and sub-index for F0-02 are 0x20F0 and 0x03, respectively.

Table 3–14 SDO object sent during the read operation

CAN Frame		CANopen Data	Description
COB-ID	11-bit ID	0x600 + Node-ID	DIP switch setting of Node-ID equipment address
RTR	RTR	0	Remote frame sign "0"

CAN Frame		CANopen Data	Description
8-byte frame data	DATA0	Command code (0x40)	0x40 read command
	DATA1	Low-order byte of index	Parameter group (0xF0 for group F0)
	DATA2	High-order byte of index	0x20
	DATA3	Sub-index	Parameter No. + 1 ("0x03")
	DATA4	Data 1	0 reserved
	DATA5	Data 2	0 reserved
	DATA6	Data 3	0 reserved
	DATA7	Data 4	0 reserved

2. The following table shows the SDO responded by the slave to the read operation.
   If the operation is successful, the command code returns "0x4B". The index remains unchanged. DATA4 and DATA5 return the read data, and DATA6 and DATA7 return "0".

   If the operation fails, the command code returns "0x80". The index remains unchanged. DATA4, DATA5, DATA6, and DATA7 return an SDO failure error code.

Table 3–15 SDOs returned for the read operation

CAN Frame		CANopen Data	Description
COB-ID	11-bit ID	0x580+Node-ID	DIP switch setting of Node-ID equipment address
RTR	RTR	0	Remote frame sign "0"
8-byte frame data	DATA0	Returned value of the command code	Success: "0x4B" Failure: "0x80"
	DATA1	Low-order byte of index	Parameter group (0xF0 for group F0)
	DATA2	High-order byte of index	0x20
	DATA3	Sub-index	Parameter No. + 1 ("0x03")
	DATA4	Data 1	Low-order byte of data
	DATA5	Data 2	High-order byte of data
	DATA6	Data 3	Success: "0" Failure: SDO operation failure error code
	DATA7	Data 4	

3. SDO for the write operation
   The CANopen SDO is used to perform the write operation on the AC drive. The following table describes the data format of the SDO sent by the master.

Table 3–16 SDO sent for the write operation

CAN Frame		CANopen Data	Description
COB-ID	11-bit ID	0x600 + Node-ID	DIP switch setting of Node-ID equipment address
RTR	RTR	0	Remote frame sign "0"
8-byte frame data	DATA0	Command code	0x2B
	DATA1	Low-order byte of index	Parameter group (0xF0 for group F0)
	DATA2	High-order byte of index	0x20
	DATA3	Sub-index	Parameter No. + 1 ("0x03")
	DATA4	Data 1	Low-order byte of data
	DATA5	Data 2	High-order byte of data
	DATA6	Data 3	0 reserved
	DATA7	Data 4	0 reserved

4. The following table shows the SDO responded by the slave for the write operation.
   If the operation is successful, the command code returns "0x60". The index remains unchanged. DATA4, DATA5, DATA6, and DATA7 return "0".

   If the operation fails, the command code returns "0x80". The index remains unchanged. DATA4, DATA5, DATA6, and DATA7 return an SDO failure error code.

Table 3–17 SDO returned during the write operation

CAN Frame		CANopen Data	Description
COB-ID	11-bit ID	0x580+Node-ID	DIP switch setting of Node-ID equipment address
RTR	RTR	0	Remote frame sign "0"
8-byte frame data	DATA0	Returned value of the command code	Success: "0x60"; Failure: "0x80"
	DATA1	Low-order byte of index	Parameter group (0xF0 for group F0)
	DATA2	High-order byte of index	0x20
	DATA3	Sub-index	Parameter No. + 1 ("0x03")
	DATA4	Data 1	Success: 0 Failure: SDO operation failure error code 0 reserved
	DATA5	Data 2	
	DATA6	Data 3	
	DATA7	Data 4	

5. Read and write operations on the AC drive

Take read and write operations on the F0-02 as examples. The CANopen address of the AC drive is set to "0x06".

Read the AC drive command source (F0-02).

To read the value of F0-02 (Command source selection), the master sends the following CANopen message.

Table 3–18 Message sent by the master to read F0-02

Message ID (Hex)	RTR	Data (Hex)
0x606	0	40F0200300000000

6. The following table describes a CANopen message returned by the AC drive.
   The current value of F0-02 is "0x0002", indicating that the current command source of the AC drive is communication.

Table 3–19 Message returned by the AC drive for the read operation of F0-02

Message ID (Hex)	RTR	Data (Hex)
0x586	0	4BF0200302000000

7. Set the command source (F0-02) to the operation panel.
   To set the command source to the operation panel, the master can send the following CANopen command to write 0 to F0-02.

Table 3–20 Message sent by the master to write F0-02

Message ID (Hex)	RTR	Data (Hex)
0x606	0	2BF0200300000000

8. The following table describes the CANopen message returned by the AC drive. Write 0 to F0-02 to set the current command source to the operating panel.

Table 3–21 Message returned by the AC drive for the write operation of F0-02

Message ID (Hex)	RTR	Data (Hex)
0x586	0	60F0200300000000

3.4.3 Operation Example (PDO)

The AC drive supports four RPDOs (RPOD1, RPDO2, RPDO3 and RPDO4) and four TPDOs (TPOD1, TPDO2, TPDO3 and TPDO4), which can be configured as needed.

You can configure the PDO mapping of the slave on the operating panel. It is recommended to use the CANopen master to configure mappings. You can also manually change parameters in group AF to configure PDO mappings. The following table shows the mapping relation of every PDO.

Table 3–22 PDO mapping

RPDO	Group AF Address		TPDO	Group AF Address	
RPDO1	Sub-index 1	AF-00	TPDO1	Sub-index 1	AF-32
		AF-01			AF-33
	Sub-index 2	AF-02		Sub-index 2	AF-34
		AF-03			AF-35
	Sub-index 3	AF-04		Sub-index 3	AF-36
		AF-05			AF-37
	Sub-index 4	AF-06		Sub-index 4	AF-38
		AF-07			AF-39
RPDO2	Sub-index 1	AF-08	TPDO2	Sub-index 1	AF-40
		AF-09			AF-41
	Sub-index 2	AF-10		Sub-index 2	AF-42
		AF-11			AF-43
	Sub-index 3	AF-12		Sub-index 3	AF-44
		AF-13			AF-45
	Sub-index 4	AF-14		Sub-index 4	AF-46
		AF-15			AF-47
RPDO3	Sub-index 1	AF-16	TPDO3	Sub-index 1	AF-48
		AF-17			AF-49
	Sub-index 2	AF-18		Sub-index 2	AF-50
		AF-19			AF-51
	Sub-index 3	AF-20		Sub-index 3	AF-52
		AF-21			AF-53
	Sub-index 4	AF-22		Sub-index 4	AF-54
		AF-23			AF-55
RPDO4	Sub-index 1	AF-24	TPDO4	Sub-index 1	AF-56
		AF-25			AF-57
	Sub-index 2	AF-26		Sub-index 2	AF-58
		AF-27			AF-59
	Sub-index 3	AF-28		Sub-index 3	AF-60
		AF-29			AF-61
	Sub-index 4	AF-30		Sub-index 4	AF-62
		AF-31			AF-63

Each PDO can be configured with four mappings. To configure one mapping, you need to operate two parameters in group AF to implement 32-bit data, of which the high-order 16 bits (with a smaller parameter No.) are the object dictionary index, and the low-order 16 bits (with a larger parameter No.) are the object dictionary sub-index and object length. The object length is calculated in bits. The format of mapping objects is as follows:

Index	Sub-index	Object Length
High-order bits of the parameter in group AF	Low-order bits of the parameter in group AF	/

According to the preceding relation between the parameters and the object dictionary, when a parameter needs to be mapped to a PDO, you only need to write the object dictionary index and sub-index and data length corresponding to the parameter into group AF according to the preceding rules.

Take configurations of two mappings to RPDO1 as examples. One mapping directs at F0-01 and the other mapping is an object dictionary object 0x6060-00. The operation is as follows:

Table 3–23 Mapping example of group AF

Assumed Address	Group AF Address	Contents	Remarks
F0-01	AF-00	0x20F0	Parameter address index Equal to group No. F0 + 0x2000
	AF-01	0x0210	High-order bit 02: Parameter group No. offset + 1 Low-order bit 10: 16-bit parameter length
0x6060-00	AF-02	0x6060	Object dictionary index
	AF-03	0x0008	High-order bit 00: Object dictionary sub-index Low-order bit 08: 8-bit object length

Note

- Any write operation via the software or operating panel must be finished before a CANopen remote node is started.
- PDO data will not be retained upon a power failure.
- Parameter group number offset shall be converted into the hexadecimal format.

3.5 Communication Configuration

3.5.1 Configuration for CANlink Communication Between AC Drive and H5U

Software Acquisition and Hardware Wiring

1. Log in to Inovance website http://www.inovance.com/support/download.html to download the H5U programming software.
2. Connect one registered jack of a standard LAN cable to the CN3/4 port of the power supply unit of the AC drive and connect the other end to H5U.

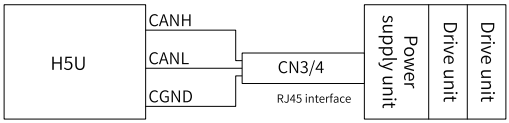


Figure 3-5 Connecting communication interfaces

Master and Slave Configuration

1. Open AutoShop, click **New Project**, check that **Series and models** is H5U, and click **OK** to enter the programming interface.
2. On the left of the page displayed, click CAN(CANLink) to enter the CANlink communication settings page of PLC, set the parameters as follows, and then click **OK**.
   Protocol: CANlink

   Communicate Param: Select Upper computer setting. Note that the CANlink station number of the PLC must be different from that of the AC drive.

   Baud Rate: Select Upper computer setting. (The communication baud rate must be consistent with the baud rate of the AC drive.)
3. Click CAN(CANLink), and click **AddCAN Config**. CAN(CANLink) CANlink Config is displayed. Double-click **CANlink Config**, click **Next** on the displayed interface, and then set parameter as follows.

   a. Set the slave type to MD (AC drive).
   b. Set the slave number according to that defined by FD-13 of the AC drive.
   c. Set the state register and start/stop component to 7000 and 6000.
   d. Click **Add** and then **Finish**.

   In this way, a slave is added. If the AC drive has multiple axes, click **Add** and then repeat the preceding steps.
4. Write operation: After a slave is added, select the PLC to set the configuration to be written to the D element of the AC drive.

Station number	Device type
63	Host(H5U Series)
1	MD (Frequency Converter)
2	MD (Frequency Converter)

Host (63) Config

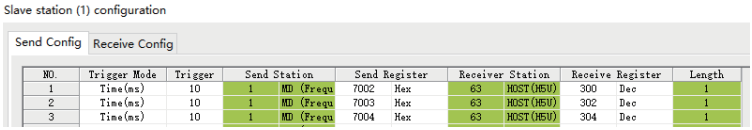
Send Config | Receive Config | Synchronous Write

NO.	Trigger Mode	Trigger	Send Station		Send Register		Receiver Station		Receive Register		Length
1	Time(ms)	10	63	HOST(H5U)	0	Dec	1	MD (Frequency	1000	Hex	1
2	Time(ms)	10	63	HOST(H5U)	2	Dec	1	MD (Frequency	2000	Hex	1
3	Time(ms)	10	63	HOST(H5U)	100	Dec	2	MD (Frequency	1000	Hex	1
4	Time(ms)	10	63	HOST(H5U)	102	Dec	2	MD (Frequency	2000	Hex	1

As shown in the preceding figure, assign the value of D2 to the control word address of the AC drive with the station number 1, and assign the value of D102 to the control word

address of the AC drive with the station number 2. Write the corresponding register address as required, and make sure that the receiving register address is correct and writable; otherwise, the write operation will fail.

5. Read operation: Select the station (AC drive) to be read and enter the configuration interface for reading the D component of the AC drive.
   To read station 1, click 1 to configure. To read station 2, click 2. If the station number is incorrect, the required value cannot be read.

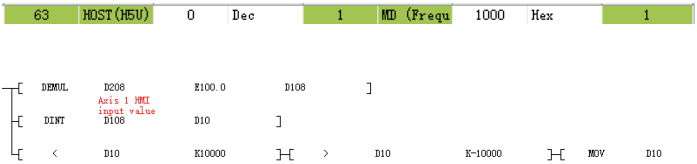


   As shown in the preceding figure, the bus voltage, output voltage, and output frequency of the AC drive are sent to D300, D302, and D304 of the PLC. Configure the transmission register address and D component correctly as needed. After finishing all write and read configurations, click **"OK"** continuously to go back to the programming page.

Instances

1. Write the frequency (F0-03 is set to 9).
   Data conversion: Multiply the required frequency (a) by 100 to obtain an integer, and then write the integer to 1000H.

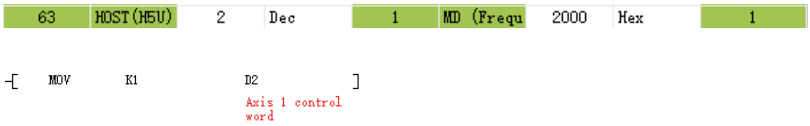
   The following figure shows the configuration and the program.



2. Start or stop the AC drive (F0-02 is set to 2).
   Assign a value to the D component corresponding to the station address 2000H to control forward running, reverse running, and stop of the AC drive through communication. Definitions of 2000H are as follows:

   1: Run in forward direction; 2: Run in reverse direction; 3: Jog in forward direction; 4: Jog in reverse direction; 5: Coast to stop; 6: Decelerate to stop; 7: Reset upon fault

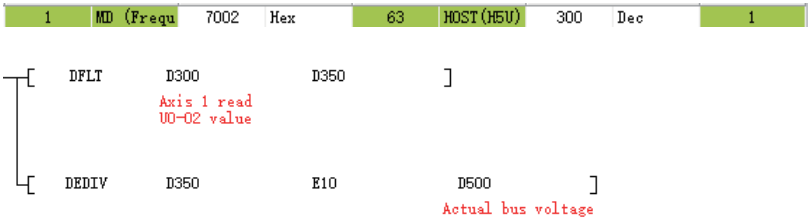
   The following figure shows the configuration and the program.



The PLC soft component address corresponding to 2000H is D2. Therefore, to control the AC drive to run in the forward direction through communication, write 1 to D2. Similarly, to control the AC drive to decelerate to stop, set D2 to 6.

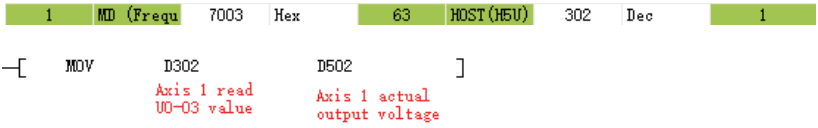
3. Read the bus voltage.
   Convert the bus voltage U0-02 to 7002 based on the conversion rule (convert U in the high-order two bits to 7, and convert the low-order two bits to a hexadecimal equivalent). The actual bus voltage is the read bus voltage (a) divided by 10. According to the communication configuration, the D component address of the bus voltage is D300. Convert D300 to a floating-point number and then divide this value by 10.

   The following figure shows the configuration and the program.



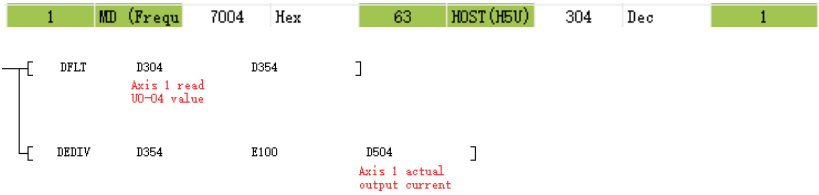
4. Read the output voltage.
   Based on the conversion rule, convert the output voltage U0-03 to 7003 and then the reading is the actual output voltage. According to the communication configuration, you only need to move the value of D302 to another D component (or not).

   The following figure shows the configuration and the program.



5. Read the output current.
   Based on the conversion rule, convert the output current U0-04 to 7004 and divide the reading by 100 to get the actual output current.

   The following figure shows the configuration and the program.



6. Read the AC drive state.

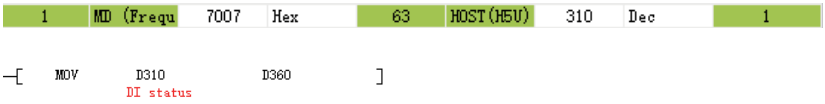
Read 3000H to directly obtain the current state of the AC drive (1: Running in forward direction; 2: Running in reverse direction; 3: Stopped).

The following figure shows the configuration and the program.



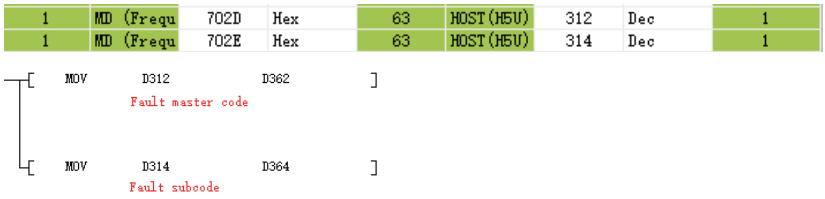
7. Read the DI state.
   Based on the conversion rule, convert the DI state U0-07 to 7007 and then convert the reading to a binary number, in which the least significant bit indicates DI1 status, the second least significant bit indicates DI2 status, and so on.

   The following figure shows the configuration and the program.



8. Read the fault code.
   Convert the fault code U0-45 to 702D and convert the fault subcode U0-46 to 702E based on the conversion rule.

   The following figure shows the configuration and the program.



Common problems and solutions

Items must be checked:

1. Check the wiring. Check whether other pins instead of CANH and CANL are connected to the PLC.
2. Check FD-10 for all stations. The value 1 indicates CANopen and 2 indicates CANlink.
3. Check whether the CAN communication baud rate of the power supply unit (set through Fd-12) is the same as that of the PLC.
4. Check whether the CAN station number defined by FD-13 is unique to avoid conflicts with other AC drives.

Table 3–24 Common problems and solutions

FAQ	Solution
Failure to write frequency	1. Check F0-03 to confirm that the address in the configuration table is correct. When F0-03 is 0, the address is the address of F0-08; when F0-03 is 9, the address is 1000H or 7310H. 2. Check whether the termination resistor is connected. If not, switch on the termination resistor and then power on the AC drive again.
Failure to start the AC drive	1. Check that F0-02 is set to 2 (0: Operating panel; 1: Terminal; 2: Communication). 2. Check whether the termination resistor is connected. If not, switch on the termination resistor and then power on the AC drive again.
Unstable connection	1. Touch the connection cables on the PLC end to check for poor contact. Ensure that wiring on the PLC end is reliable. 2. Check that wiring on the AC drive end is reliable, and make sure that network cables are inserted tightly. 3. Check and ensure that the signal cables are far away from the power cable.
Incorrect reading	1. Ensure that the address configured is correct. 2. Ensure that data conversion is performed. 3. Ensure that the D element is not occupied.

3.5.2 Configuration for CANopen Communication Between AC Drive and H5U

Software Acquisition and Hardware Wiring

1. Log in to Inovance website http://www.inovance.com/support/download.html to download the H5U programming software and the latest EDS file.
2. Connect one registered jack of a standard LAN cable to the CN3/4 port of the power supply unit of the AC drive and connect the other end to H5U.

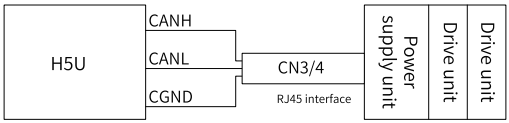


Figure 3-6 Connecting communication interfaces

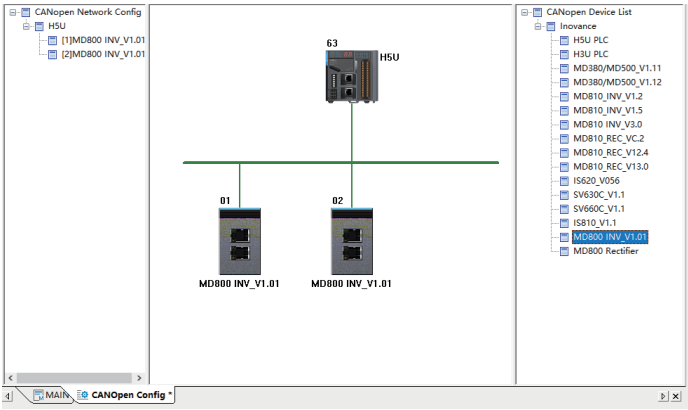
Master and slave configuration

1. Open AutoShop, click **New Project**, check that **Series and models** is H5U, and click **OK** to enter the programming interface.
2. Click CAN(CANopen) in the left pane, set parameters as follows, and click **OK**.
   Protocol: CANopen

   Communication Param: Select Upper computer setting. (Note that the CANopen station number of the PLC must be different from that of the AC drive.)

   Baud Rate: Select Upper computer setting. (The communication baud rate must be consistent with the baud rate of the AC drive.)

3. Configure the master and slave stations: Click CAN(CANopen). Click **Add CAN Config**, and CAN(CANopen) / CANOpen Config is displayed. Double-click **CANopen Config**. In the **CANopen Device List** on the right of the page displayed, double-click the drive unit slave station of the AC drive and add it to the configuration.



4. Configure the RPDOs and TPDOs of the slave. Double-click the slave to configure.
   RPDO: The PDOs for writing the running frequency and control commands are added by default.

   TPDO: Click Send PDO, and configure the PDOs according to the following conversion rule:

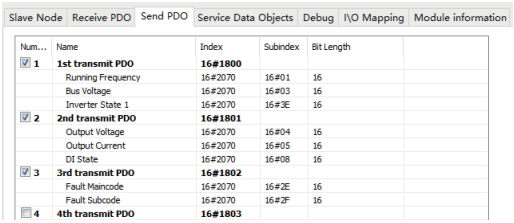
   Index: Groups F0 to FF: Convert the high bit F to 0 and then add 0x2000.

   For groups A0 to AF, convert A in the high-order bit to 4 and then add 0x2000.

   For groups U0 to UF, convert A in the high-order bit to 7 and then add 0x2000.

   Sub-index: For the low-order 16 bits, convert the decimal serial number into a hexadecimal equivalent and then add 1.

According to the conversion rule, the index of the bus voltage U0-02 is 0x2070, and the sub-index is 03.



Slave Node | Receive PDO | Send PDO | Service Data Objects | Debug | I\O Mapping | Module information

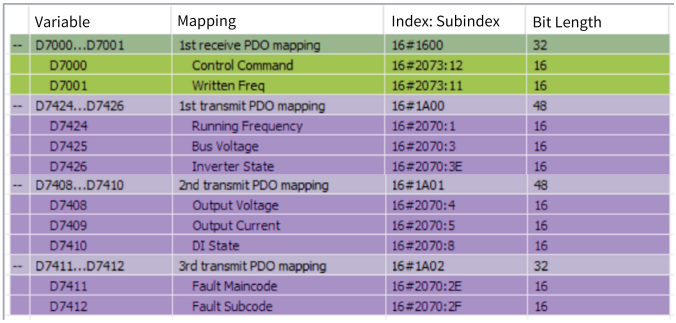
Num...	Name	Index	Subindex	Bit Length
☑ 1	**1st transmit PDO**	**16#1800**		
	Running Frequency	16#2070	16#01	16
	Bus Voltage	16#2070	16#03	16
	Inverter State 1	16#2070	16#3E	16
☑ 2	**2nd transmit PDO**	**16#1801**		
	Output Voltage	16#2070	16#04	16
	Output Current	16#2070	16#05	16
	DI State	16#2070	16#08	16
☑ 3	**3rd transmit PDO**	**16#1802**		
	Fault Maincode	16#2070	16#2E	16
	Fault Subcode	16#2070	16#2F	16
☐ 4	**4th transmit PDO**	**16#1803**		

Caution

Only four PDOs can be added to each group. As the annotation of the EDS file used during configuring the PDO may be wrong, it is recommended to check the PDOs again based on parameters after all the PDOs are added.

5. Perform I/O mapping.

   This step is to map data (that is, the value to be read or written) in the PDO. The D component is used as a bridge to implement data exchange between the PLC and the AC drive. The H5U high-performance small PLC of Inovance automatically performs I/O mapping based on the configured PDOs. Therefore, you only need to click the I/O mapping to determine the D component to perform the read and write operations.



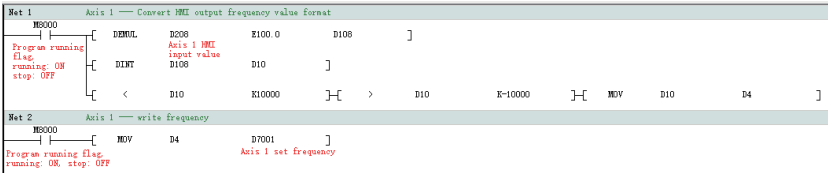
	Variable	Mapping	Index: Subindex	Bit Length
--	D7000...D7001	1st receive PDO mapping	16#1600	32
	D7000	Control Command	16#2073:12	16
	D7001	Written Freq	16#2073:11	16
--	D7424...D7426	1st transmit PDO mapping	16#1A00	48
	D7424	Running Frequency	16#2070:1	16
	D7425	Bus Voltage	16#2070:3	16
	D7426	Inverter State	16#2070:3E	16
--	D7408...D7410	2nd transmit PDO mapping	16#1A01	48
	D7408	Output Voltage	16#2070:4	16
	D7409	Output Current	16#2070:5	16
	D7410	DI State	16#2070:8	16
--	D7411...D7412	3rd transmit PDO mapping	16#1A02	32
	D7411	Fault Maincode	16#2070:2E	16
	D7412	Fault Subcode	16#2070:2F	16

Instances

1. Write the frequency (F0-03 is set to 9).

   Data conversion: Multiply the required frequency (a) by 100 to obtain an integer, and then write the integer to D7001.

   The program is as follows:



2. Start or stop the AC drive (F0-02 is set to 2).
   Assign a value to the D component corresponding to the control word of the desired station to control forward running, reverse running, and stop of the AC drive through communication. The control word is defined as follows:

   1: Run in forward direction; 2: Run in reverse direction; 3: Jog in forward direction; 4: Jog in reverse direction; 5: Coast to stop; 6: Decelerate to stop; 7: Reset upon fault

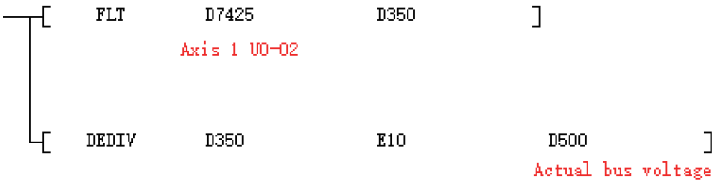
   The program is as follows:



   The PLC soft component address corresponding to the control word is D7000. Therefore, to control the AC drive to run in forward direction through communication, write 1 to D7000. Similarly, to control the AC drive to decelerate to stop, set D7000 to 6.

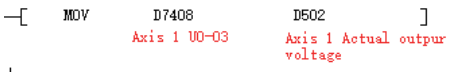
3. Read the bus voltage.
   The actual bus voltage is the read bus voltage (a) divided by 10. According to the communication configuration, the D component address of the bus voltage is D7425. Convert D7425 to a floating-point number and then divide this value by 10.

   The program is as follows:



4. Read the output voltage.
   According to the communication configuration, you only need to move the value of D7408 to another D component (or not).

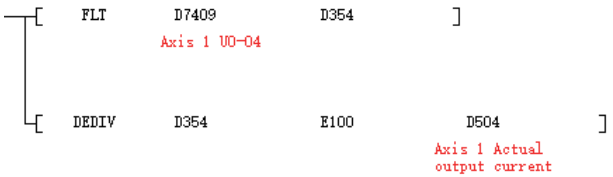
   The program is as follows:



5. Read the output current.

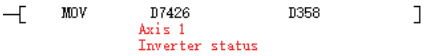
According to the conversion rule, the actual output current is the read output current divided by 100.

The program is as follows:



6. Read the AC drive state.
   Based on the I/O mapping, read D7426 to directly obtain the current state of the AC drive (1: Running in forward direction; 2: Running in reverse direction; 3: Stopped).

   The program is as follows:



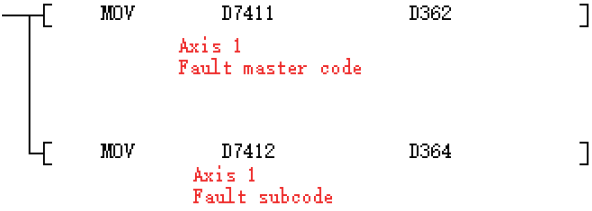
7. Read the DI state.
   According to the conversion rule and the I/O mapping, the DI state maps to D7410. Convert the read value into a binary value. The LSB indicates DI1, the second bit indicates DI2, and so on.

   The program is as follows:



8. Read the fault code.
   According to the conversion rule and the I/O mapping, the fault code maps to 7411, and the fault subcode maps to 7412.

   The program is as follows:



Common problems and solutions

Items must be checked:

1. Check the wiring. Check whether other pins instead of CANH and CANL are connected to the PLC.
2. Check FD-10 for all stations. The value 1 indicates CANopen and 2 indicates CANlink.
3. Check whether the CAN communication baud rate of the power supply unit (set through Fd-12) is the same as that of the PLC.
4. Check whether the CAN station number defined by FD-13 is unique to avoid conflicts with other drives.

Table 3–25 Common problems and solutions

FAQ	Solution
Failure to write frequency	1. Check F0-03 to confirm that the D component and the address in the configuration table are correct. When F0-03 is 0, the I/O mapping is 2000sub8; when F0-03 is 9, the I/O mapping is 2073sub11. 2. Check whether the termination resistor is connected. If not, switch on the termination resistor and then power on the AC drive again.
Failure to start the AC drive	1. Check that F0-02 is set to 2 (0: Operating panel; 1: Terminal; 2: Communication). 2. Check whether the termination resistor is connected. If not, switch on the termination resistor and then power on the AC drive again.
Unstable connection	1. Touch the connection cables on the PLC end to check for poor contact. Ensure that wiring on the PLC end is reliable. 2. Check that wiring on the AC drive end is reliable, and make sure that network cables are inserted tightly. 3. Check and ensure that the signal cables are far away from the power cable.
Incorrect reading	1. Ensure that the address configured is correct. 2. Ensure that data conversion is performed. 3. Ensure that the D element is not occupied. 4. Check the D element for I/O mapping.

3.6 Communication Fault

3.6.1 Simple Diagnosis

Description

The AC drive parameter FD-33 provides the simple diagnosis function. This parameter shows the number of times that the CAN bus is off due to strong interference after power-on.

Diagnosis

If the value is greater than 0 but does not continue to increase, the network has suffered strong interference for a long time. If the value is greater than 0 and increases within 5 minutes, the network is suffering interference or the configuration is incorrect, which requires troubleshooting.

Solution

Check whether the baud rates of all the nodes are the same or whether the addresses conflict. Check whether the dial is set properly and whether the baud rate and address of the main controller are correct.

Check whether the termination resistor is connected only to both ends of the bus. Power off all devices and check whether the resistance between CANH and CANL of the bus is between 50 Ω and 60 Ω by using a multimeter.

Check whether CANH and CANL of a node are reversely connected and whether CGND of the bus is connected (typically CGND terminals of all devices are connected together and not grounded).

4 PROFINET Communication

4.1 Introduction

The PROFINET communication card (hereinafter referred to as the SI-EN card) supports data exchange among up to nine PROFINET nodes, including one power supply unit and eight drive units.

In this guide, the SI-PN card software version must be 33.01 or later. After the PN card is installed and the AC drive is powered on, query the parameter FD-91 of the power supply unit. The GSDML file is GSDML-Vn.nn-inovance-MD800PNGATE-20xxxxxx.xml , where n.nn refers to the version number and 20xxxxxx indiactes the date. Use V2.31 and 20201229 and later.)

4.2 Installation

Power off the AC drive, wait for about 10 minutes until the charging indicator of the AC drive is completely turned off, and then install the PN card.

Check whether the PN card is firmly inserted to the AC drive and prevent the signal socket between boards from being damaged by the pulling force of external signal cable.

Do not hot-swap the PN card.

4.3 Hardware Layout

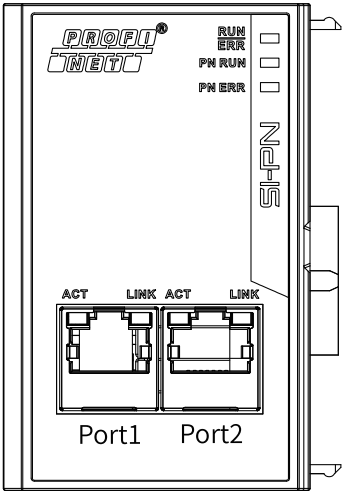


Figure 4-1 Arrangement of SI-PN card terminals

The PN card is connected to the PROFINET master station by using the standard Ethernet RJ45 socket. Its pin signal definitions are the same as those of the standard Ethernet pins. They can be connected using crossover cables or straight-through cables.

Table 4–1 Description of SI-PN card terminals

Terminal	Terminal Name	Description
Port1	Network port 1	When the topology is not configured, any terminal can be connected to the PLC. When the topology is configured, port 1 and port 2 must be distinguished. After installation, Port1 is on the left and Port2 is on the right from the front view of the card. It is recommended to use shielded Cat 5e cables to ensure stable operation.
Port2	Network port 1	

Table 4–2 Description of SI-PN card indicator

Indicator		Description	Solution
RUN/ERR	Steady green	Communication normal	/
	Steady red	Communication between the PN communication expansion card and the node times out.	1. Restart the PN card. 2. Eliminate field interference.
	Flashing red once per 500 ms	Communication between the PN communication expansion card and the power supply unit times out.	
	Flashing red once per 1s	The communication inside the PN card times out.	
PN RUN	Steady on	The PN card communication is normal.	/
PN ERR	Steady on	The PN card lost communication with the master station.	Check the wiring.
	Blinking	The master station sends the flashing request.	/

4.4 Network Topology

After communication between the PN card and the AC drive is implemented, you can connect the AC drive to the PROFINET master station and configure related parameters to implement communication between the PN card and the PROFINET master station, thereby implementing AC drive networking.

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

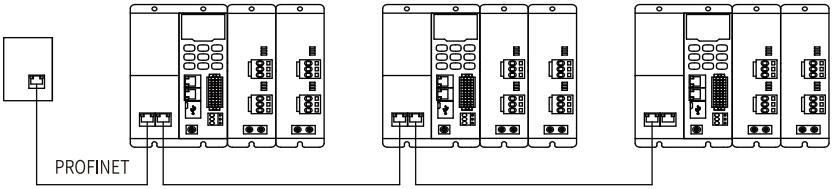


Figure 4-2 Bus topology

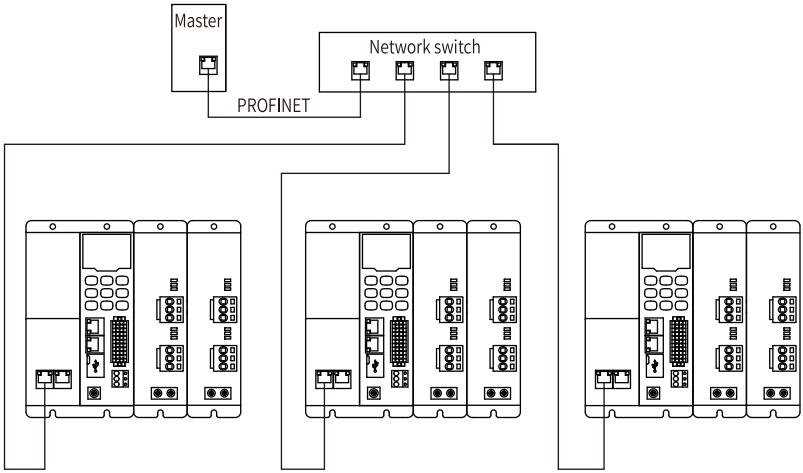


Figure 4-3 Star topology

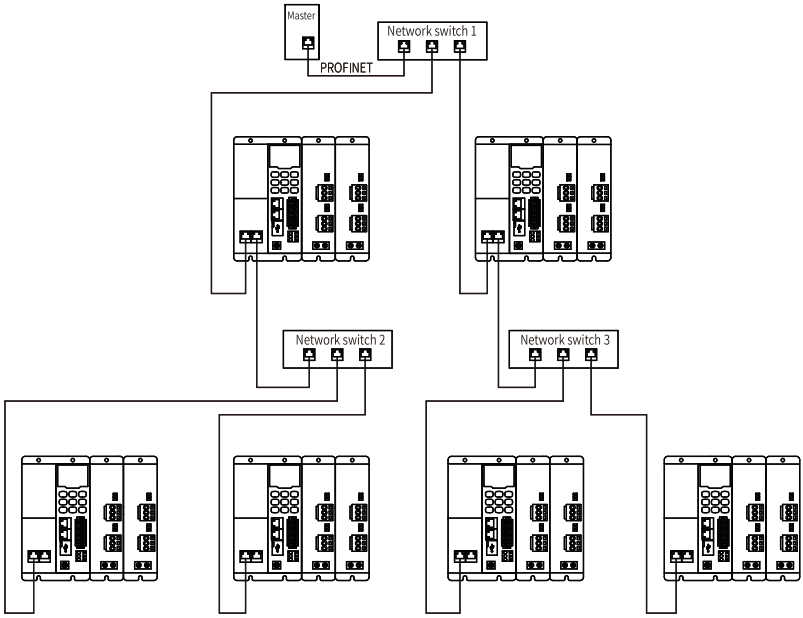


Figure 4-4 Tree topology

4.5 PZD Data

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 mainly includes the following:

1. Real-time settings of AC drive control commands and target frequencies
2. Real-time reading of AC drive current state and running frequency
3. Exchange function parameters and monitor data between the AC drive and the PROFINET master station in real time.

By default, the written PZD1 is mapped to the control word and PZD2 is mapped to the frequency reference; the read PZD1 is mapped to the status word and PZD2 is mapped to the operation frequency. You can manually modify the default value. The following table lists the interactive data.

Table 4–3 Interaction data

PZD Data Sent by Master			PZD Data Responded by AC Drive		
PZD1	PZD2	PZD3 to PZD16	PZD1	PZD2	PZD3 to PZD16
Control Word (U3–17)	Frequency reference (U3-16)	Real-Time Modification of AC Drive Parameters	Status Word (U0–68)	Operation frequency (U0-00)	Real-Time Reading of AC Drive Parameters

Table 4–4 Data description

PZD data sent by master		PZD Responded by the AC Drive	
PZD1	AC drive command word (command source , F0-02 set to 2 (communication)) 0: Stop by a stop method set in F6-10 (Stop mode) 1: Forward run 2: Reverse run 3: Forward jog 4: Reverse jog 5: Coast to stop 6: Decelerate to stop 7: Reset upon fault	PZD1	It indicates the AC drive state. Bit 0: Running status. 0: Stopped; 1: Running Bit 1: Running direction (forward/reverse). 0: Forward; 1: Reverse Bit 2: faulty status of the AC drive. 0: No fault; 1: Faulty Bit 3: Whether output frequency reaches the frequency reference. 0: Reached; 1: Not reached. Bit 4: Normal communication status. 0: abnormal communication;1: normal communication. (Fixed to 1 under normal conditions) Bit 5 to Bit 7: Reserved Bit 8 to Bit 15: Fault code
PZD2	AC drive target frequency (frequency source F0-03 set to 9 (communication)) Set F8-64 to choose Hz or rpm as the unit. When F8-64 is set to 0, the unit is Hz. The decimal place is determined by F0-22. For example, when F0-22 is set to 2, the decimal number 1000 means that the frequency reference is 10.00 Hz. When F8-64 is set to 1, the unit is rpm. For example, the decimal number 1000 means that the speed reference is 1000 rpm.	PZD2	It indicates the AC drive running frequency (unit: 0.01 Hz). The current AC drive running frequency is returned as 16-bit signed data.
PZD3 to PZD16	Modifying function parameters in real time but not writing to EEPROM	PZD3 to PZD16	Function parameters are read in real time.

4.6 Parameters

PN Card Configuration of the AC Drive

After the PN extension card is inserted to the AC drive, you must set FD–10 to 3 and restart the AC drive before enabling the PN communication card mode.

Parameter	Parameter Name	Value Range	Setpoint	Description
FD-10	Communication type	1: CANopen/ 2: CANlink 3: Communication card mode	3	Set the communication type. When it is set to 1, CANopen communication is used. When it is set to 2, CANlink communication is used. When it is set to 3, the communication card mode is used.

Communication Monitoring Parameters

You can monitor the online status and other parameters of the slave station by using the parameters of the power supply unit.

Parameter	Description
FD-51	Used to set the slave communication disable time.
FD-52	Indicates the number of online slave stations.
FD-53	Indicates the online state of slave 1 to 15. Bit 1 indicates slave 1, and so on.
FD-54	Indicates the online state of slave 16 to 31. Bit 0 indicates slave 16, and so on.
FD-61	Indicates the highest two bytes of the MAC address.
FD-62	Indicates the middle two bytes of the MAC address.
FD-63	Indicates the lowest two bytes of the MAC address.
FD-91	Indicates the software version of the communication expansion card.

Communication Auxiliary Parameters

- Start with station lost
  This function is applicable to scenarios where you want to start the network without modifying the PLC configuration and program when a slave station fails to go online. In this case, set FD-50 to 1.

Parameter	Description
FD-50	This function is applicable to scenarios where you want to start the network without modifying the PLC configuration and program when a slave station fails to go online. 0: Disable The communication error E16.74 is returned when the number of slave stations configured for the PLC is different from the actual number. 1: Enable No communication error is returned when the number of slave stations configured for the PLC is different from the actual number.

The setting takes effect after power-on again.



This function is an auxiliary function which cannot be used to rectify faults (such as E16.74). Enable this function only after commissioning is done. Do not commission the network when this function is enabled.

- Communication timeout
  You can use this parameter to set the PN communication timeout period. After the setting takes effect, the communication network stops running when the timeout period expires.

Parameter	Description
FD-55	This parameter defines the PN timeout time in ms. After the setting takes effect, the communication network stops running when the timeout period expires.

The setting takes effect after power-on again.

4.7 Communication Configuration

4.7.1 Configuration

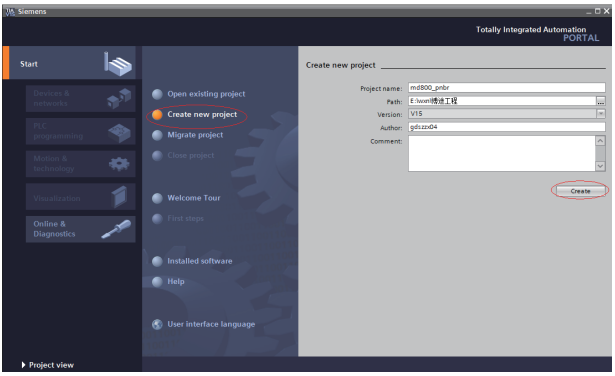
To use a PROFINET master station, you must configure the GSDML file of the slave station first to add the slave station devices to the master station system. If the slave station devices have been added to the master station system, skip this step. You can obtain the GSDML file from the Inovance agent or the manufacturer.

If the 200 SMART ST&SR series master station is used, the PLC firmware version must be 2.05 or later.

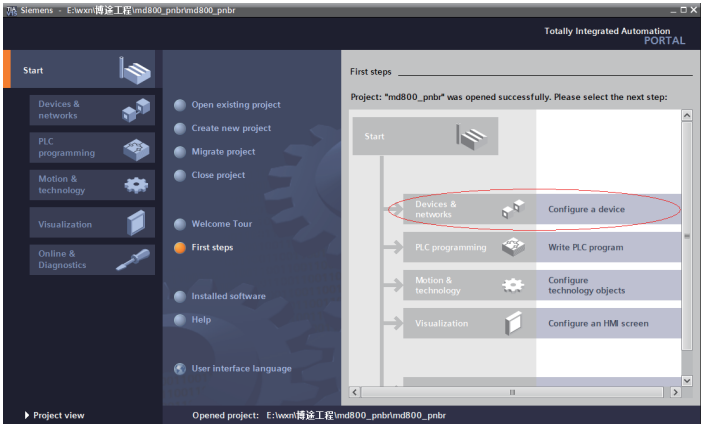
The configuration procedure is as follows:

1. Creating a project

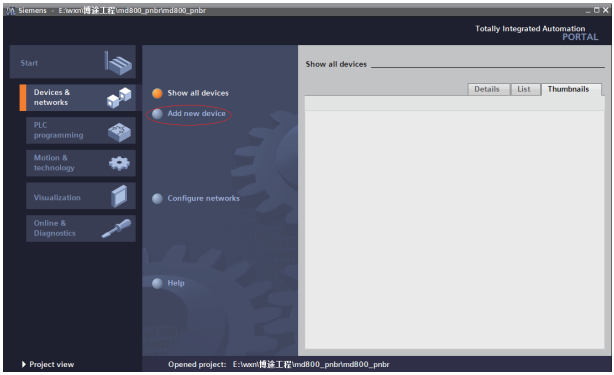
   a. Select **Create new project**, set a project name and storage path in the **Project name** and **Path** fields, and then click **Create**.



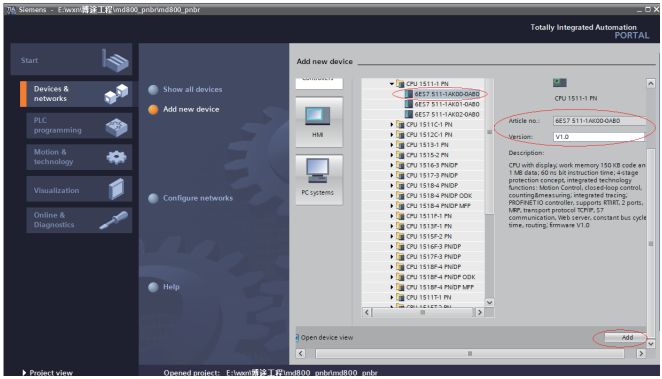
   b. Click **Configure a device**, as shown in the following figure.



   c. Click **Add new device**.

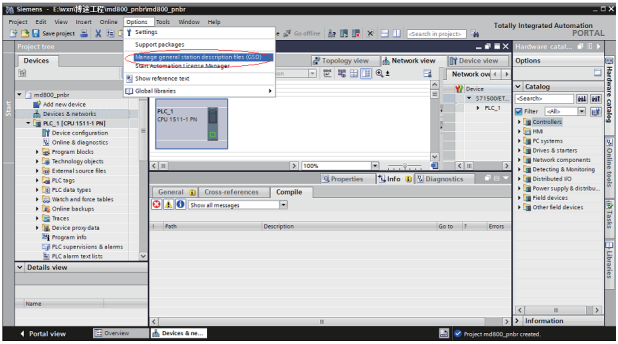


d. On the page displayed, select the PLC and its firmware version based on the article No. Click **Add** or double-click the master station. The master station is created.
Note: The selected PLC must match the article No. Otherwise, the PLC cannot be downloaded.

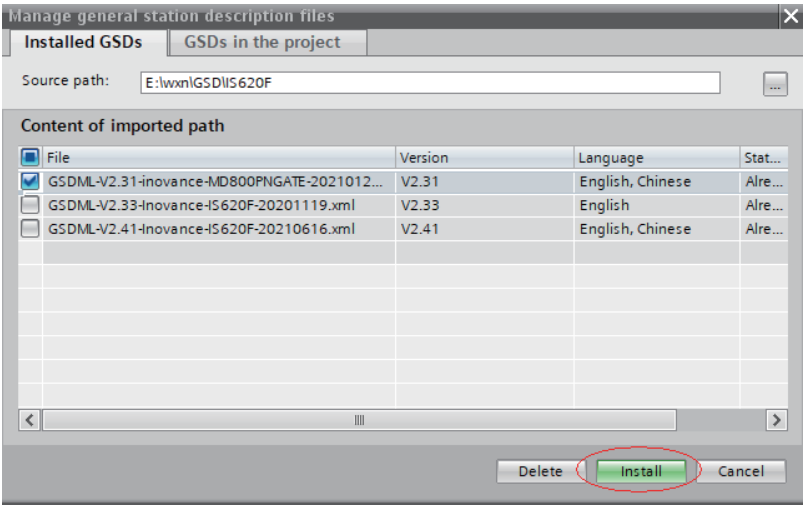


2. Install the GSD file (if you never install GSDML, perform this step).

a. In the **Options** drop-down list, select **Manage general station description files (GSD)**.



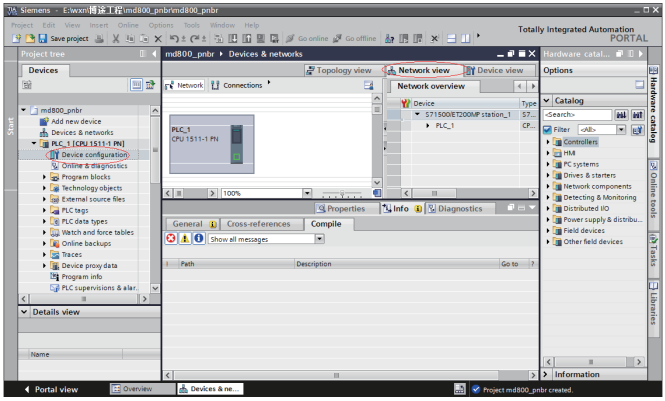
b. Select the storage path for the GSDML file (must be stored in an English path), select the GSDML file to be installed, and click **Install**.



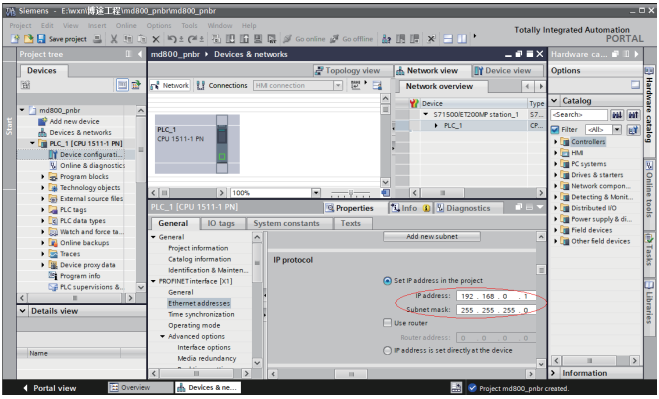
After the successful installation message is displayed, click **Close**.

3. Create a network

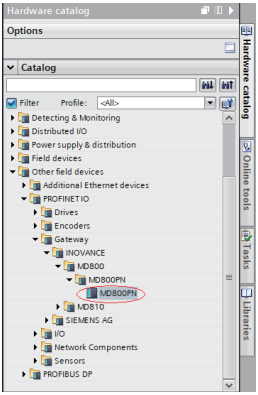
a. Click **Device configuration** on the page and then switch to the **Network view**.



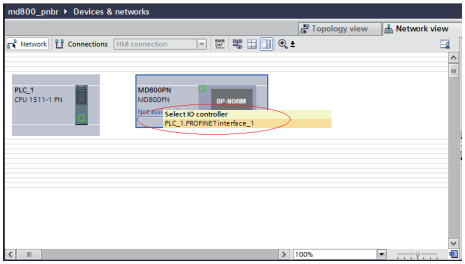
b. Select the EtherNet port of the PLC, choose **Properties > General**, and set the IP address and subnet mask of the PLC master station.



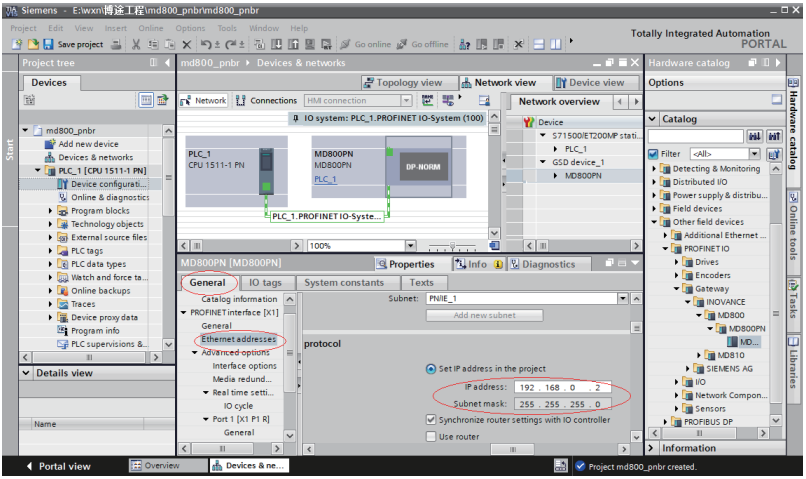
c. In the **Hardware catalog** section on the right, locate MD800 and then double-click MD800PN.



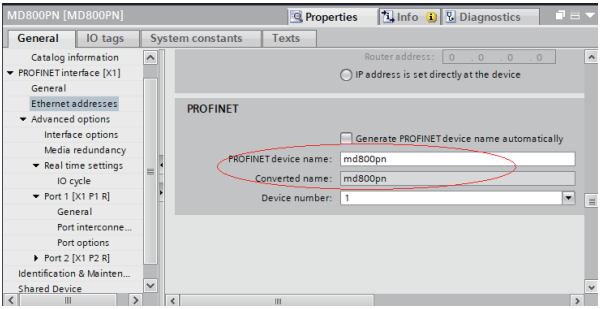
d. Click **Not assigned** to select the master station to which the slave is to be connected.



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



f. 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 the Modbus slave

Note

The PN card can be configured as follows:

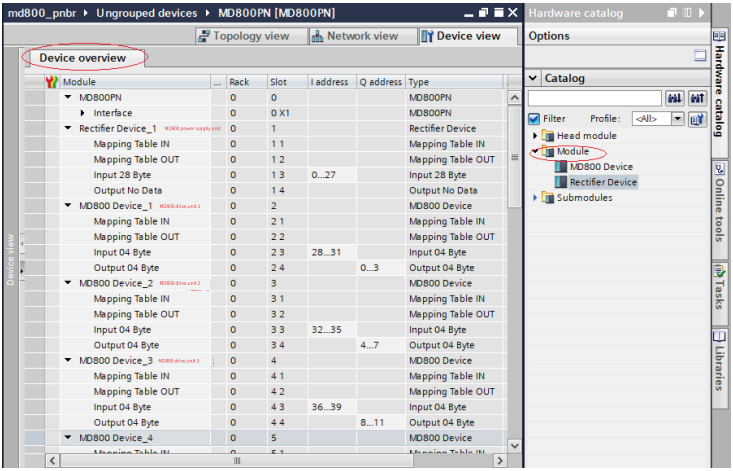
1. Add a station by double-clicking or dragging and dropping a power supply unit or drive unit in the module list.
2. Configure the mapping of the slave station.
3. Configure the process data of the slave station.

To apply the configuration of a drive unit to other drive units, select the drive unit and copy its configuration instead of repeating the preceding steps.

---

a. Add a slave station

Select the slave station and switch to **Device view**. In the **Module** list under **Catalog**, two modules are available: Rectifier Device and MD800 Device. Double-click a module to add the module to the **Device overview** list.

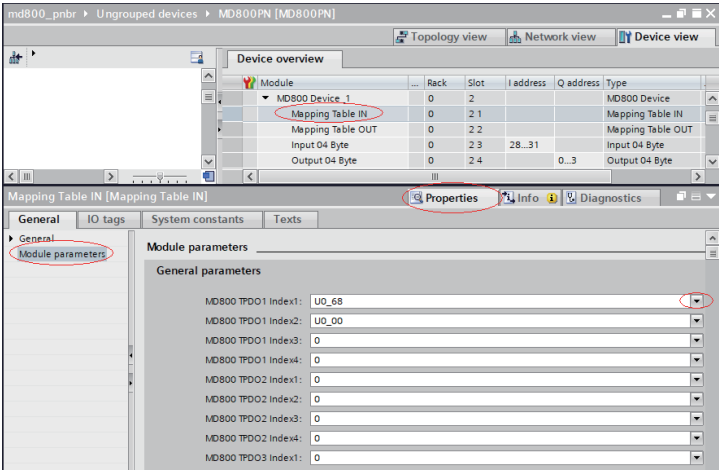


Note

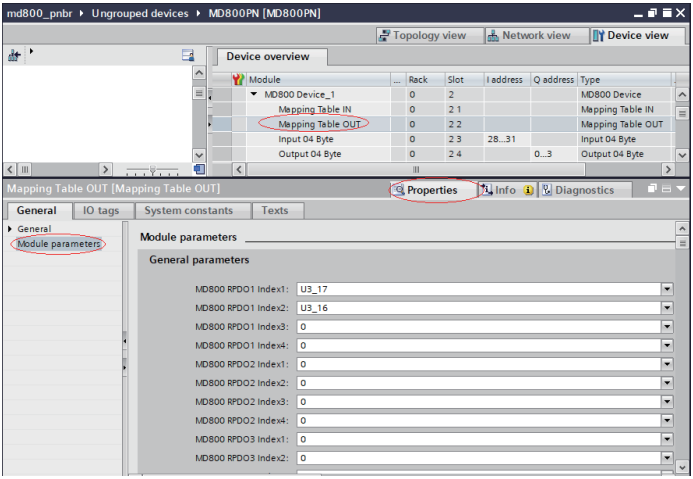
- The type of quantity of the modules configured must be consistent with the devices in the actual network.
- The power supply unit is "Rectifier Device". The "Rectifier Device" must be added no matter whether the process data of the power supply unit is present.
- The drive unit is "MD800 Device". "MD800 Device_1" corresponds to the No. 1 drive unit station. "MD800 Device_2" corresponding to the No. 2 drive unit station, and so on.

b. Configure the mapping

1). Select **Mapping Table IN**. Choose **Properties > General > Module parameters**, select a mapping from the drop-down list for the slave station TPDO data.



2). Select **Mapping Table OUT**. Choose **Properties > General > Module parameters**, select a mapping from the drop-down list for the slave station RPDO data.

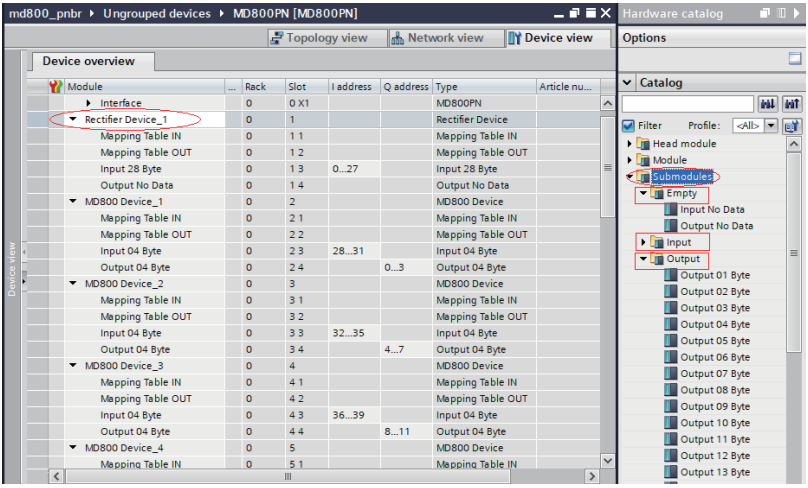


Note

- The mapping relation between sub-slot 1 (Mapping Table IN) and RPDO is the data of slave -> master. The mapping relation between sub-slot 2 (Mapping Table OUT) and RPDO is the data of master -> slave.
- Each slave supports a maximum of four TPDOs and four RPDOs, with the mapping relation of the same PDO being successive.
- The mapping relation for unused PDO is 0 by default.
- Each mapping relation corresponds to the 16-bit parameter, which represents 2-byte data.

c. Configure the process data

Select a module from the **Device overview** list. In the list of **Submodules** under **Catalog**, three catalogs are available: Empty, Input, and Output, which are used to configure the process data length for the module. In the **Output** catalog, set the length of the master-to-slave process data. In the **Input** catalog, set the length of the slave-to-master process data. If the process data is not needed, make configuration under the **Empty** catalog.

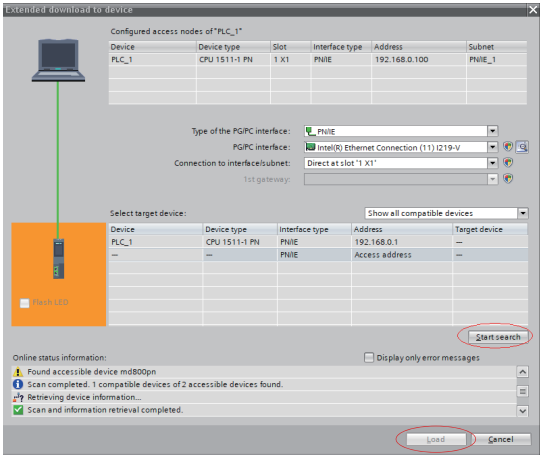


Note

- Sub-slot 3 corresponds to Input data. The length of Input data must be consistent with the mapping relation length configured by sub-slot 1 (Mapping Table IN). Sub-slot 4 corresponds to Output data. The length of Output data must be consistent with the mapping relation length configured by sub-slot 2 (Mapping Table OUT).For example, if five mapping relations is configured in Mapping Table IN, insert Input 10 Byte into sub-slot 3. If seven mapping relations is configured in Mapping Table OUT, insert Output 14 Byte in sub-slot 4.
- If there is no Input or Output data for a certain station, insert Input No Data or Output No Data in the corresponding sub-slot.

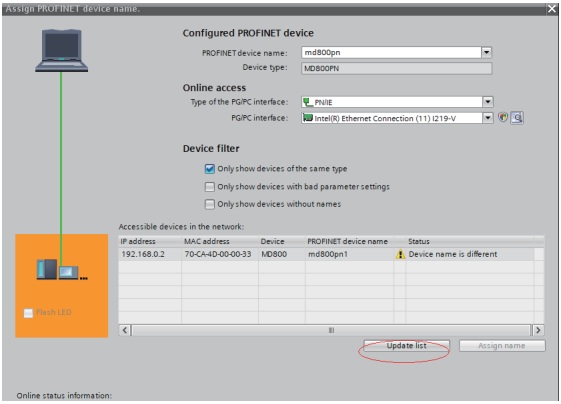
d. Download the project

After configuration, save the project, set the PC IP address to be in the same segment of the PLC IP address (note that this IP address cannot be the same as that of the slave station. You can choose to automatically assign the PC IP address), compile the project, click **Download** to download the generated file, select an interface, and then click **Start search**.

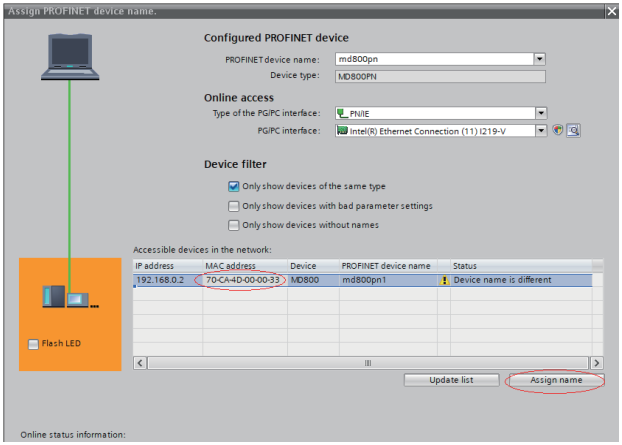


e. Assign a device name.

1). 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**.

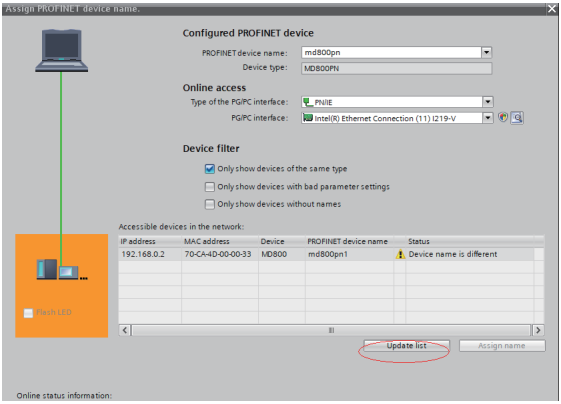


2). Among the accessible nodes in the network, select the slave station for which you want to assign a name (nodes are distinguished by MAC addresses) and then click **Assign name**.



When information in the following figure is displayed, the device name is written and consistent with that in the **Configured PROFINET device** section 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 station saves the assigned name. The master station distinguishes slave stations by their names (the MAC addresses are not intuitive enough to distinguish slave stations. The device name is bound to its MAC address).



Note

One device name can be allocated to one slave in the network only.

Re-allocate the name after modifying the station device name in the configuration.

After modifying the IP address, download the modified configuration to PLC to activate the modification, without the need to allocate the name again.

After all the preceding operations are done, write corresponding program in the PLC to control the AC drive.

4.7.2 MRP Function and Configuration

MRP overview

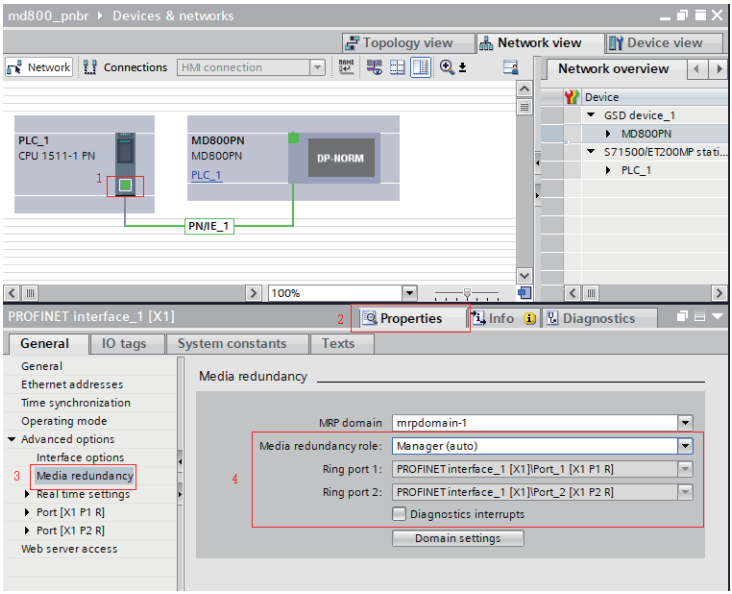
The AC drive adopts the standard Media Redundancy Protocol (MRP) that meets the IEC62439-2 standard. It provides a typical reconstruction time of 200 ms and supports up to 50 devices in each ring network.

MRP basic rules:

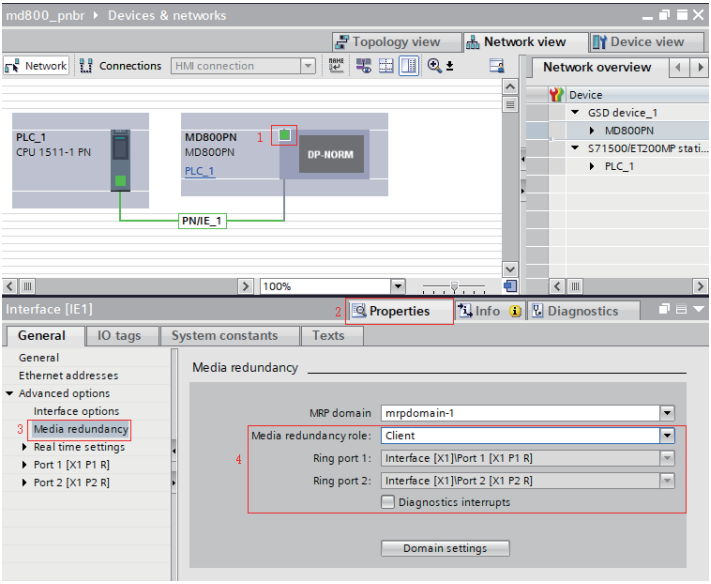
1. All nodes in the ring network must support and be enabled with MRP.
2. All devices are interconnected through ports on the ring network.
3. All devices in the ring network are in the same redundancy domain.
4. A maximum of 50 devices can be connected in a ring network. More devices will prolong the reconstruction time.
5. Only one device in the ring network can serve as the ring network manager, and other devices are all ring network clients.

MRP settings

1. Select a PLC port, choose "Properties" > "Media redundancy". In the drop-down list of "Media redundancy role", select "Manager". Check the parameters of "Ring port 1" and "Ring port 2".

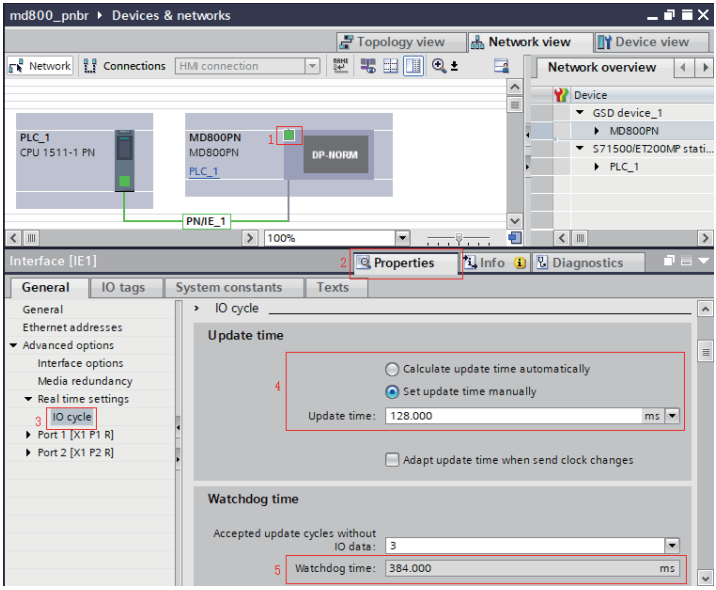


2. Select an I/O device port, choose "Properties" > "Media redundancy". In the drop-down list of "Media redundancy role", select "Client". Check the parameters of "Ring port 1" and "Ring port 2".



3. MRP provides a typical reconstruction time of 200 ms and supports up to 50 devices in each ring network. To avoid interference to PROFINET communication during ring network reconstruction, set the PROFINET watchdog time of the I/O device to be greater than 200 ms.

   Select an I/O device port, choose "Properties" > "IO cycle", and adjust the "Update time" to an appropriate value so that the "Watchdog time" is greater than 200 ms.



4.8 Fault Diagnosis

4.8.1 PN Card Communication Error

When the communication function is configured incorrectly, both the PLC and power supply unit will report a fault. You can troubleshoot the fault based on diagnosis information on the power supply unit operating panel and PLC.

The following table describes the fault code of the power supply unit.

Table 4–5 Fault code of the power supply unit

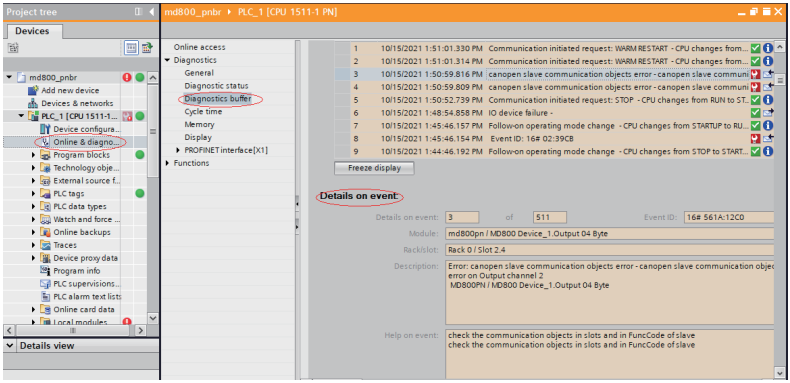
Fault Code	Fault Cause	Solution	Reset Mode
E16.71	Master station offline during operation of the communication card	Check and ensure that the connection between the communication card and PLC is normal. Check whether the network cable in use is the shielded Cat 5e cable. Check and ensure the proper grounding and no EMC interference issues. Check whether the master station is abnormal.	When Fd-06 is set to 1, auto reset is performed. When Fd-06 is set to 0, you need to manually reset the fault.
E16.72	Internal slave station offline during operation of the communication card	Check and ensure that both the connection between the communication card and the power supply unit, as well as the connection between the power supply unit and the drive unit, are normal.	
/	The slave station has an application alarm.	Check the alarm source and eliminate the AC drive fault. (The alarm is generated only on the PLC.)	
E16.74	Communication card configuration fault	Check whether the configured slave station exists and whether startup with slave loss is disabled (FD-50 of the power supply unit = 0).	
E16.75	Configurations of drive unit mappings on the communication card faulty	Check and ensure that the number of pieces of process data configured for the drive unit is consistent with the number of mapping relations.	
E16.76	Configurations of power supply unit mappings on the communication card faulty	Check and ensure that the number of pieces of process data configured for the power supply unit is consistent with the number of mapping relations.	

4.8.2 PLC Diagnosis Information

The following table lists mapping between the PLC diagnosis information and fault codes.

Fault Code	Diagnostic Information
E16.72	Slave station lost error
E16.74	Lack of matched slave
E16.75	CANopen slave communication objects error
E16.76	Communication objects error of PN to CANopen bridge

You can locate and view the current error messages through the diagnostic function of the PLC background. Choose **"Online & diagnostics>Diagnostics buffer"** and then view the detailed diagnosis information. As shown in the figure below, slot 5.4 (corresponding to drive unit 4) has an error indicating that the process data of drive unit 4 does not match the mapping.


Project tree
Devices
md800_pnbr
Add new device
Devices & networks
PLC_1 [CPU 1511-1...
Device configura...
Online & diagno...
Program blocks
Technology obje...
External source f...
PLC tags
PLC data types
Watch and force ...
Online backups
Traces
Device proxy data
Program info
PLC supervisions...
PLC alarm text lists
Online card data
Local modules
Details view
md800_pnbr ▸ PLC_1 [CPU 1511-1 PN]
Online access
Diagnostics
General
Diagnostic status
Diagnostics buffer
Cycle time
Memory
Display
PROFINET interface[X1]
Functions
1 10/15/2021 1:51:01.330 PM Communication initiated request: WARM RESTART - CPU changes from...
2 10/15/2021 1:51:01.314 PM Communication initiated request: WARM RESTART - CPU changes from...
3 10/15/2021 1:50:59.816 PM canopen slave communication objects error - canopen slave communi
4 10/15/2021 1:50:59.809 PM canopen slave communication objects error - canopen slave communi
5 10/15/2021 1:50:52.739 PM Communication initiated request: STOP - CPU changes from RUN to ST...
6 10/15/2021 1:48:54.858 PM IO device failure -
7 10/15/2021 1:45:46.157 PM Follow-on operating mode change - CPU changes from STARTUP to RU...
8 10/15/2021 1:45:46.154 PM Event ID: 16# 02:39CB
9 10/15/2021 1:44:46.192 PM Follow-on operating mode change - CPU changes from STOP to START...
Freeze display
Details on event:
Details on event: 3 of 511
Event ID: 16# 561A:12C0
Module: md800pn / MD800 Device_1.Output 04 Byte
Rack/slot: Rack 0 / Slot 2.4
Description: Error: canopen slave communication objects error - canopen slave communication objec
error on Output channel 2
MD800PN / MD800 Device_1.Output 04 Byte
Help on event: check the communication objects in slots and in FuncCode of slave
check the communication objects in slots and in FuncCode of slave

5 EtherCAT Communication

5.1 Introduction

The EtherCAT communication card (hereinafter referred to as the ECAT card) supports the super-high-speed I/O network for industrial field application. The protocol can be used to directly process data at the I/O layer. It features high efficiency, flexible topology, and ease-to-use.

It is installed on the MD520 series AC drive to improve the communication efficiency and implement AC drive networking, enabling the AC drive to be a slave controlled by the fieldbus master. The minimum synchronization cycle supported by the ECAT card is 500 us.

In this guide, the ECAT card software version must be 1.08 or later. After the ECAT card is installed and the AC drive is powered on, query the parameter Fd-91 of the power supply unit. The device description XML file is MD800_9Axis_Vn.nn.xml, wherein n.nn indicates the version which must be 0.16 or later.

5.2 Installation

The ECAT card is a built-in extension card of the AC drive. Power off the AC drive, wait for about 10 minutes until the charging indicator of the AC drive is completely turned off, and then install the ECAT card.

Check whether the ECAT card is firmly inserted to the AC drive and prevent the signal socket between boards from being damaged by the pulling force of external signal cable.

5.3 Hardware Layout

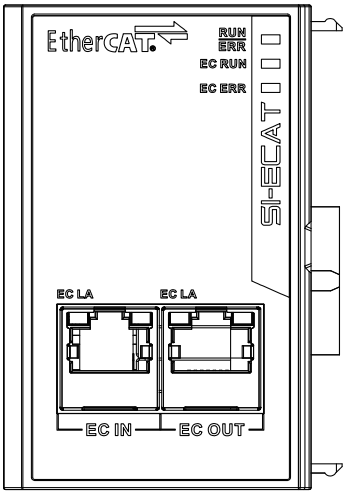


Figure 5-1 Arrangement of ECAT card terminals

The ECAT card is connected to the EtherCAT master station by using the standard Ethernet RJ45 socket. Its pin signal definitions are the same as those of the standard Ethernet pins. They can be connected using crossover cables or straight-through cables.

Table 5–1 Description of ECAT card terminals

Terminal	Terminal Name	Description
EC IN	Input terminal	After installation, EC IN is on the left and EC OUT is on the right from the front view of the card. The two terminals must be connected correctly. The Cat 5e shielded twisted pair (STP) network cable must be used to ensure stability.
EC OUT	Output terminal	

Table 5–2 Description of ECAT card indicator

Indicator		Description	Solution
RUN/ERR	Steady green	Communication normal	/
	Steady red	Communication between the EtherCAT communication expansion card and the node times out.	Check the connector for interference.
	Red indicator flashing slowly	Communication between the EtherCAT communication expansion card and the power supply unit times out.	1. Check that the communication expansion card is installed correctly. 2. Check whether the power supply unit is normal.
	Red indicator flashing quickly	The EtherCAT communication expansion card is faulty.	Troubleshoot the fault according to the fault code displayed on the operating panel of the power supply unit.
EC RUN	Green indicator OFF	EtherCAT state machine status: INIT (initializing)	/
	Green indicator flashing quickly	EtherCAT state machine status: PREOP (pre-operational)	/
	Green indicator flashing slowly	EtherCAT state machine status: SAFEOP (safe operation)	/
	Steady green	EtherCAT state machine status: OP (operating)	/
EC ERR	Red indicator OFF	The EtherCAT communication is normal.	/
	Steady red	The EtherCAT communication is faulty.	Check the fault code on the operating panel of the power supply unit.
EC LA	Yellow indicator OFF	No connection with the previous EtherCAT device	/
	Steady yellow	Connected with the previous EtherCAT device	/
	Green indicator OFF	No data exchange with the network interface	/
	Flashing in green	Data exchange with the network interface	/

5.4 Network Topology

After communication between the ECAT card and the AC drive is implemented, you can connect the AC drive to the ECAT master station and configure related parameters to implement communication between the ECAT card and the ECAT master station, thereby implementing AC drive networking.

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

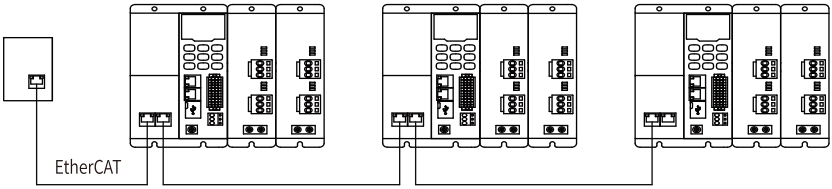


Figure 5-2 Bus topology

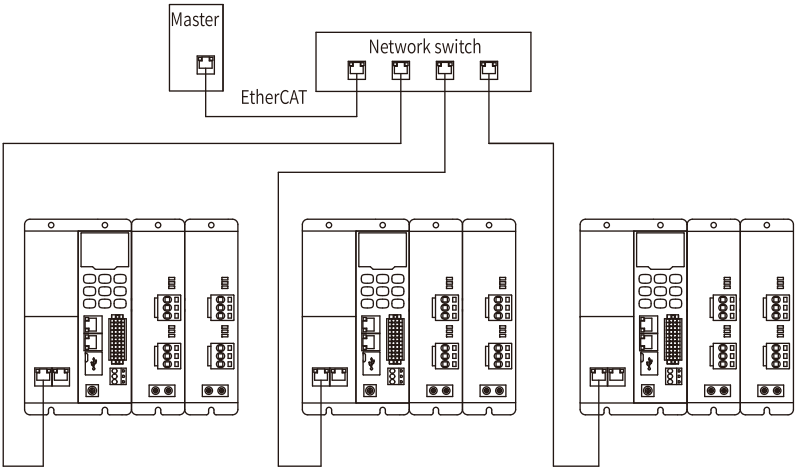


Figure 5-3 Star topology

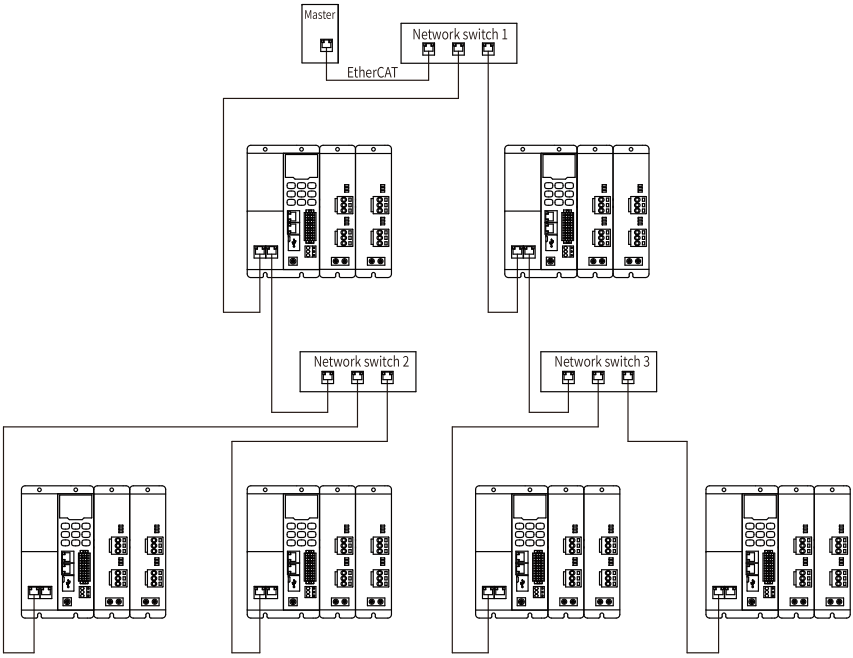


Figure 5-4 Tree topology

5.5 PDO Data

PDO Data Description

The PDO data enables the master to modify and read AC drive data in real time and perform periodic data exchange with the AC drive. The data communication addresses are directly configured by the AC drive. The data mainly includes the following:

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

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

Caution

The RPDO process data must be configured. Otherwise, EtherCAT communication may fail.

PDO Sent from Master to AC Drive Axis 1 (1601h)			PDO Responded by AC Drive Axis 1 to Master (1A01h)		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive frequency reference	Real-time modification of AC drive parameters	AC drive state	AC drive running frequency	Real-time reading of AC drive parameters
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

PDO Sent from Master to AC Drive Axis 2 (1602h)			PDO Responded by AC Drive Axis 2 to Master (1A02h)		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive frequency reference	Real-time modification of AC drive parameters	AC drive state	AC drive running frequency	Real-time reading of AC drive parameters
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

PDO Sent from Master to AC Drive Axis 3 (1603h)			PDO Responded by AC Drive Axis 3 to Master (1A03h)		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive frequency reference	Real-time modification of AC drive parameters	AC drive state	AC drive running frequency	Real-time reading of AC drive parameters
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

PDO Sent from Master to AC Drive Axis 4 (1604h)			PDO Responded by AC Drive Axis 4 to Master (1A04h)		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive frequency reference	Real-time modification of AC drive parameters	AC drive state	AC drive running frequency	Real-time reading of AC drive parameters
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

PDO Sent from Master to AC Drive Axis 5 (1605h)			PDO Responded by AC Drive Axis 5 to Master (1A05h)		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive frequency reference	Real-time modification of AC drive parameters	AC drive state	AC drive running frequency	Real-time reading of AC drive parameters
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

PDO Sent from Master to AC Drive Axis 6 (1606h)			PDO Responded by AC Drive Axis 6 to Master (1A06h)		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive frequency reference	Real-time modification of AC drive parameters	AC drive state	AC drive running frequency	Real-time reading of AC drive parameters
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

PDO Sent from Master to AC Drive Axis 7 (1607h)			PDO Responded by AC Drive Axis 7 to Master (1A07h)		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive frequency reference	Real-time modification of AC drive parameters	AC drive state	AC drive running frequency	Real-time reading of AC drive parameters
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

PDO Sent from Master to AC Drive Axis 8 (1608h)			PDO Responded by AC Drive Axis 8 to Master (1A08h)		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive frequency reference	Real-time modification of AC drive parameters	AC drive state	AC drive running frequency	Real-time reading of AC drive parameters
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

Corresponding Data PDO (1A10h) of AC Drive Power Supply Unit		
Bus voltage	IGBT temperature	Reading function parameters of AC drive power supply unit in real time
TPDO1	TPDO2	TPDO3 to TPDO16

PDO (1610h) Sent by the Master Station	
Communication control	Communication control DO/RO
RPDO1	RPDO2

Data Sent by the Master

Table 5–3 Descriptions of RPDO sent by the master

RPDO	Description
RPDO1	AC drive command word (command source set to communication, that is, F0-02 = 2) 0: Stop according to F6-10 (Stop mode) 1: Forward run 2: Reverse run 3: Forward jog 4: Reverse jog 5: Coast to stop 6: Decelerate to stop 7: Reset upon fault
RPDO2	AC drive target frequency (frequency source F0-03 set to 9 (communication)) Set F8-64 to choose Hz or RPM as the unit. When F8-64 is set to 0, the unit is Hz. The decimal place is determined by F0-22. For example, when F0-22 is set to 2, the decimal number 1000 means that the frequency reference is 10.00 Hz. When F8-64 is set to 1, the unit is RPM. For example, the decimal number 1000 means that the speed reference is 1000 RPM.
RPDO3 to RPDO16	Modifying function parameters in real time, but not writing to EEPROM. For the configuration method, see PDO data configuration.

Data Responded by the AC Drive

Table 5–4 TPDO Responded by the AC Drive

RPDO	Description
TPDO1	It indicates the AC drive state. AC drive running states are determined by the bits as follows: bit0: 0: AC drive stop; 1: AC drive running bit1: 0: Forward running; 1: Reverse running bit2: 0: No fault; 1: AC drive fault bit3: 0: Running frequency not reached; 1: Running frequency reached
TPDO2	It indicates the AC drive running frequency (unit: 0.01 Hz). The current AC drive running frequency is returned as 16-bit signed data.
TPDO3 to TPDO16	Reading function parameter values (groups F and A) and monitoring parameter values (group U) in real time. For the configuration method, see PDO data configuration.

5.6 SDO Mailbox Data

EtherCAT service data object (SDO) is used to transfer non-cyclic data, such as communication parameter configurations and drive running parameter configurations.

The CANopen over EtherCAT (CoE) service types include emergency messages, SDO requests, SDO responses, TxPDO, RxPDO, remote TxPDO transmitting requests, remote RxPDO transmitting request, and SDO information.

The MD800 supports the SDO request and SDO response.

5.7 Parameters

ECAT card configuration of the AC drive

After installing the ECAT card to the AC drive, set FD-10 as follows to enable the ECAT card to communicate with the AC drive. FD-50 and subsequent parameters are optional.

Table 5–5 Parameters of power supply unit

Parameter	Parameter Name	Range	Setpoint	Description
FD-10	Communication type	1: CANopen/ 2: CANlink 3: Communication card mode	3	Set current communication type 1: CANopen/ Set current communication type to CANopen/Modbus. 2: CANlink Set current communication type to CANlink. 3: Communication card mode Set current communication type to communication card, including EtherCAT, PN, and EtherNet/IP. You just need to set FD-10 of the power supply unit. When the drive unit is running, FD-10 of the power supply unit cannot be modified.
FD-50	Startup with slave loss	0: Disable 1: Enable	0	This function is applicable to scenarios where you want to start the network without modifying the PLC configuration and program when a slave station fails to go online. 0: Disable The communication error E16.74 is returned when the number of slave stations configured for the PLC is different from the actual number. 1: Enable No communication error is returned when the number of slave stations configured for the PLC is different from the actual number.
FD-70	EtherCAT station name	0 to 65535	0	EtherCAT station name
FD-71	EtherCAT station alias	0 to 65535	0	EtherCAT station alias

Parameter	Parameter Name	Range	Setpoint	Description
FD-72	Number of times for synchronization interruption signal loss allowed by the EtherCAT module	0–30	10	Number of sync interrupts allowed by EtherCAT
FD-73	CRC check error of EtherCAT port 0	0 to 65535	0	Maximum number of error frames and invalid frames of EtherCAT port 0 per unit time
FD-74	CRC check error of EtherCAT port 1	0 to 65535	0	Maximum number of error frames and invalid frames of EtherCAT port 1 per unit time
FD-75	Data transfer error of EtherCAT port 0 and port 1	0 to 65535	0	Maximum number of error frames forwarded by EtherCAT port per unit time
FD-76	EtherCAT processing unit and PDI error	0 to 65535	0	Max. EtherCAT data frame processing unit error per unit time
FD-77	Link loss of EtherCAT port 0 and port 1	0 to 65535	0	Maximum number of lost links over the EtherCAT port per unit time
FD-78	EtherCAT master type selection	0 to 65535	0	Determined by the host controller type. Reserved for non-standard models.
FD-79	EtherCAT synchronization error monitoring mode	0 to 1	0	Used to set the detection mode of failure (synchronization loss).
FD-80	EtherCAT synchronization frame loss count	0 to 65535	0	Number of synchronization loss events
FD-81	EtherCAT state machine and PHYLink state	0 to 65535	0	State machine and PHYLink status
FD-82	EtherCAT - AL fault code	0: No error 1 to 0xFFFF: Error state code	0	AL fault code
FD-83	EtherCAT - XML file version	0.00 to 655.35	0.00	XML file version No.
FD-84	EtherCAT - FPGA firmware version	0 to 65535	0	FPGA software version
FD-86	EtherCAT - EEPROM read time	0 to 65535	0	EtherCAT EEPROM reading time

Parameter	Parameter Name	Range	Setpoint	Description
FD-87	EtherCAT - DC gain parameter	0 to 65535	0	EtherCAT DC gain
FD-88	EtherCAT - DC acceleration limit	0 to 65535	0	EtherCAT DC acceleration limit
FD-89	EtherCAT - DC speed limit	0 to 65535	0	EtherCAT DC speed limit
FD-90	EtherCAT - DC integral coefficient	0 to 65535	0	EtherCAT DC integral coefficient
FD-91	Communication card version	0.00 to 655.35	0.00	Indicates the communication extension card software version.

Table 5–6 Parameters of drive unit

Parameter	Parameter Name	Value Range	Setpoint	Description
F0-02	Command source selection	0: Operation panel 1: Terminal 2: Communication	2	For the drive unit, set this parameter to 2. Control commands are input through remote communication. The AC drive can communicate with the host controller through RS485, CAN communication, or communication card. This mode is suitable for remote control or centralized control on multiple equipment.
F0-03	Main frequency X source	0: Digital setting (preset frequency F0-08 that can be changed by UP or DOWN key, non-retentive upon power failure) 1: Digital setting (preset frequency F0-08 that can be changed by UP or DOWN key, retentive upon power failure) 2: AI1 3: AI2 4: AI3 5: Reserved 6: Multi-reference 7: Simple PLC 8: PID 9: Communication reference 10: Reserved	9	For the drive unit, set this parameter to 9. The main frequency value is set by communication. The frequency can be input through remote communication. The AC drive can communicate with the host controller through RS485, CAN communication, or communication card. This mode is suitable for remote control or centralized control on multiple equipment.

Parameter	Parameter Name	Value Range	Setpoint	Description
FD-10	Switchover between CANopen and CANlink	1: CANopen 2: CANlink	1	Displays the CAN communication protocol. Displays the set for the power supply unit. If the value is 1, CANopen communication or other CANopen network bridge is used. If the value is 2, CANlink communication is used.
FD-11	CANopen402 enable	0: Disable 1: Enable	0	CANopen mode selection. When it is set to 0, the common mode is used. When it is set to 1, the CIA402 mode is used. For details on the 6000H object dictionary, see *" Appendix 6000H Group Object Dictionary of CiA402 Protocol " on page 181* Set this parameter when you need to control the motor by using the CANopen402 protocol.

Communication control parameters

Table 5–7 Communication control parameters

Parameter		Description	Index	Sub-index
Communication and control word parameters of the drive unit	U3-16	Frequency set through communication	16#2073	16#11
	U3-17	Communication control command	16#2073	16#12
	U3-18	Communication control DO/RO	16#2073	16#13
Common parameters of the drive unit	U0-06	Output torque	16#2070	16#07
	U0-07	DI input state	16#2070	16#08
	U0-08	RO/DO output state	16#2070	16#09
	U0-45	Fault code	16#2070	16#2E
	U0-46	Fault subcode	16#2070	16#2F
	U0-61	AC drive operation status word 1	16#2070	16#3E
	U0-68	AC drive operation status word 2	16#2070	16#45
Common parameters of the power supply unit	U0-00	Bus voltage	16#2170	16#01
	U0-01	Heatsink temperature	16#2170	16#02
	U0-03	Fan speed	16#2170	16#04
	U0-04	Input voltage Usr	16#2170	16#05
	U0-05	Input voltage Ust	16#2170	16#06
	U0-06	Input voltage Utr	16#2170	16#07
	U0-07	Three-phase unbalance factor (%)	16#2170	16#08

The position of the object dictionary in the parameter list is specified by the "Index" and "Sub-index".

Index: This field (in hexadecimal) specifies the position of the same type of objects in the object dictionary.

"Sub-index": This field specifies the offset of each object under the same index.

The following table lists the mapping between the AC drive parameters and the object dictionary.

Table 5–8 Mapping between the AC drive parameters and object dictionary

Device type	Mapping
Power supply unit	Object dictionary index = 0x2100 + Parameter group number Object dictionary sub-index = Hexadecimal offset within the parameter group + 1
Inverter	Object dictionary index = 0x2000 + ((Axis number – 1) x 0x800) + Parameter group number Object dictionary sub-index = Hexadecimal offset within the parameter group + 1

The following table lists the object dictionary mapping.

Table 5–9 Object dictionary mapping

Device type	Object Dictionary Index Range of I/O Device	Object Dictionary Index Range of CANopen402 Protocol
Power supply unit	0x2100 to 0x2200	Not supported
Drive unit axis 1	0x2000 to 0x20FF	0x6000 to 0x67FF
Drive unit axis 2	0x2800 to 0x28FF	0x6800 to 0x6FFF
Drive unit axis 3	0x3000 to 0x30FF	0x7000 to 0x77FF
Drive unit axis 4	0x3800 to 0x38FF	0x7800 to 0x7FFF
Drive unit axis 5	0x4000 to 0x40FF	0x8000 to 0x87FF
Drive unit axis 6	0x4800 to 0x48FF	0x8800 to 0x8FFF
Drive unit axis 7	0x5000 to 0x50FF	0x9000 to 0x97FF
Drive unit axis 8	0x5800 to 0x58FF	0x9800 to 0x9FFF

When an SI-ECAT card is used, the written PDO1 and PDO2 are mapped to U3-17 and U3-16 respectively by default. Note that the first two items of TxPDO configured on the master station must be U3-17 and U3-16 in sequence.

For multi-axis AC drives, the mapping must be configured as described above.

Communication monitoring parameters of drive unit

Table 5–10 Communication monitoring parameters of drive unit

Parameter	Parameter Name	Unit	Index	Sub-index
U0-00	Operating frequency	0.01 Hz	16#2070	16#01
U0-01	Frequency reference	0.01 Hz	16#2070	16#02
U0-02	Bus voltage	0.1 V	16#2070	16#03
U0-03	Output voltage	1V	16#2070	16#04
U0-04	Output current	0.01 A	16#2070	16#05

Parameter	Parameter Name	Unit	Index	Sub-index
U0-05	Output power	0.1 kW	16#2070	16#06
U0-06	Output torque	0.1%	16#2070	16#07
U0-07	DI input state	1	16#2070	16#08
U0-08	RO/DO output state	1	16#2070	16#09
U0-09	AI1 voltage	0.01 V	16#2070	16#10
U0-10	AI2 voltage	0.01 V	16#2070	16#0B
U0-11	AI3 voltage	0.01 V	16#2070	16#0C
U0-12	Counting value	1	16#2070	16#0D
U0-13	Length value	1	16#2070	16#0E
U0-14	Load speed display	1	16#2070	16#0F
U0-15	PID reference	1	16#2070	16#10
U0-16	PID feedback	1	16#2070	16#11
U0-17	PLC stage	1	16#2070	16#12
U0-19	Feedback speed	0.01 Hz	16#2070	16#14
U0-20	Remaining running time	0.1 min	16#2070	16#15
U0-21	AI1 gain and voltage after offset	0.001 V	16#2070	16#16
U0-22	AI2 gain and voltage after offset	0.001 V	16#2070	16#17
U0-23	AI3 gain and voltage after offset	0.001V	16#2070	16#18
U0-24	Linear speed	1 m/min	16#2070	16#19
U0-25	Current power-on time	1 min	16#2070	16#1A
U0-26	Current operating time	0.1 min	16#2070	16#1B
U0-28	Communication setpoint	0.01%	16#2070	16#1D
U0-30	Display of main frequency X	0.01 Hz	16#2070	16#1F
U0-31	Display of auxiliary frequency Y	0.01 Hz	16#2070	16#20

Parameter	Parameter Name	Unit	Index	Sub-index
U0-33	Synchronous motor rotor position	0.1°	16#2070	16#22
U0-34	Reserved	1	16#2070	16#23
U0-35	Target torque	0.1%	16#2070	16#24
U0-37	Power factor angle	0.1°	16#2070	16#26
U0-39	Target voltage upon V/f separation	1V	16#2070	16#28
U0-40	Output voltage upon V/f separation	1V	16#2070	16#29
U0-41	DI input state display	1	16#2070	16#2A
U0-42	DO/RO output state display	1	16#2070	16#2B
U0-43	DI function state display 1	1	16#2070	16#2C
U0-44	DI function state display 2	1	16#2070	16#2D
U0-45	Fault code	1	16#2070	16#2E
U0-46	Fault subcode	1	16#2070	16#2F
U0-47	Drive unit temperature	1°C	16#2070	16#30
U0-48	Voltage received by PTC channel 1	0.001 V	16#2070	16#31
U0-49	Voltage received by PTC channel 2	0.001 V	16#2070	16#32
U0-50	Voltage received by PTC channel 3	0.001 V	16#2070	16#33
U0-51	PTC1 temperature	1°C	16#2070	16#34
U0-52	PTC2 temperature	1°C	16#2070	16#35
U0-53	PTC3 temperature	1°C	16#2070	16#36
U0-54	Motor speed	1 rpm	16#2070	16#37

Parameter	Parameter Name	Unit	Index	Sub-index
U0-55	Automatically-allocated station number	1	16#2070	16#38
U0-56	Auto-tuned axis type	1	16#2070	16#39
U0-57	Fan speed	1 rpm	16#2070	16#3A
U0-61	AC drive operation status word 1	1	16#2070	16#3E
U0-64	Special protocol status word	1	16#2070	16#41
U0-68	AC drive operation status word 2	1	16#2070	16#45
U0-78	AC drive rated current	0.1A	16#2070	16#4F
U0-79	AC drive power	0.1 kW	16#2070	16#50
U0-81	Local LED state	1	16#2070	16#52
U0-88	Alarm code	1	16#2070	16#59
U0-89	Alarm subcode	1	16#2070	16# 5A
U0-90	Percentage of preset fan speed	1%	16#2070	16
U0-91	PTC1 mode	1	16#2070	16#5C
U0-92	PTC2 mode	1	16#2070	16#5D
U0-93	PTC3 mode	1	16#2070	16#5E
U0-95	STO initialization flag	1	16#2070	16#60
U0-96	STO status word monitoring	1	16#2070	16#61
U0-97	STO model	1	16#2070	16#62
U0-98	STO AD sampling value	1	16#2070	16#63
U0-99	STO internal execution flag	1	16#2070	16#64

Note

The default axis number of the index is 1 in the above table.

When an SI-ECAT card is used, the PDO1 and PDO2 read by axes 1 to 8 of the drive unit are mapped to U0-68 and U0-00, respectively by default.

The PDO1 and PDO2 read by axis 16 of the power supply unit are mapped to U0-00 and U0-01, respectively by default.

5.8 Communication Configuration

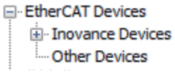
5.8.1 Configuration for EtherCAT Communication Between AC Drive and H5U

Software acquisition and hardware connection

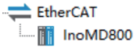
1. Log in to Inovance website http://www.inovance.com/support/download.html to download the H5U programming software and the latest XML file.
2. Use a standard network cable to connect the EtherCAT RJ45 interface of H5U to the EC IN port on the EtherCAT card of the AC drive.

Master and slave configuration

1. Run AutoShop. On the page displayed, click **New Project**, confirm that the value in the **Series and models** field is H5U, and then click **OK**.
2. Click **Inovance** on the right of

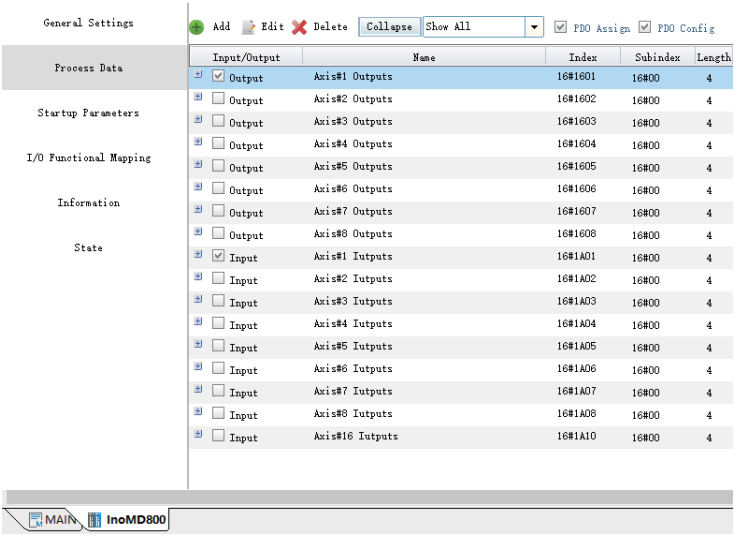


and then click the target AC drive, and



is displayed for EtherCAT configuration. Click **InoMD800** and configure the process parameters.

3. Click **Process Data** and select the slave station to be configured.



As shown in the preceding figure, Output is the process that PLC writes data to the AC drive. Input is the process that the PLC reads data from the AC drive.

4. Set PDOs of input frequency and control word to their defaults.
   The parameter of the output PDO must be converted according to the following rules.

   Index:

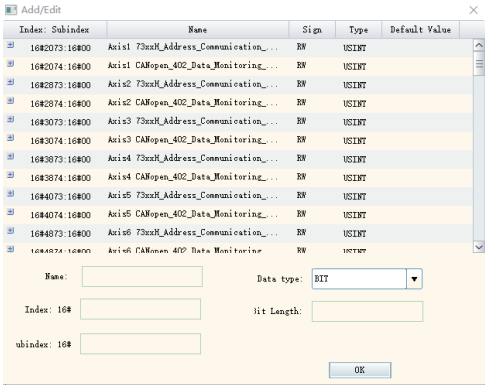
   Groups F0 to FF: Convert the high bit F to 0 and then add 0x2000.

   For groups A0 to AF, convert A in the high-order bit to 4 and then add 0x2000.

   For groups U0 to UF, convert A in the high-order bit to 7 and then add 0x2000.

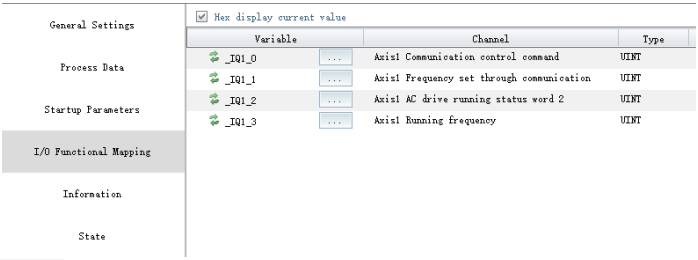
   Sub-index: Convert the decimal number of the lower 16 bits to a hexadecimal value and then add 1 to the conversion result.

   For example, the index of the bus voltage U002 is 0x2070 and the sub-index is 03. Click the corresponding slave station, and then click Add in the upper left corner. The following page is displayed.



You can customize a name but must fill in the **Index**, **Subindex**, and **Data type** fields with the values converted according to the conversion rule. All data of the AC drive is of the INT type. Then, click **OK**. To add another PDO, repeat this step.

5. Perform I/O mapping.
   In this step, you need to map the PDO data (the read or written data) to exchange the data between the PLC and the AC drive through the D element. Click **I/O Functional Mapping**. The following page is displayed.

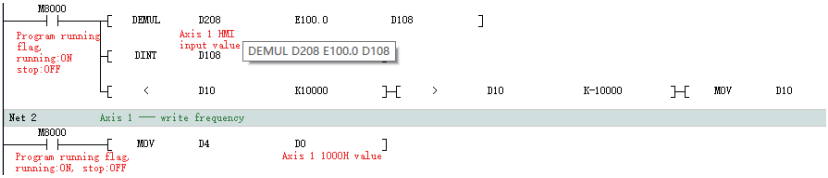


Click  to a variable to select the D element or other elements. After configuring the I/O mapping, you can perform programming based on the configured soft element.

Instances

1. Write the frequency (F0-03 is set to 9).
   Based on the I/O mapping, you need to assign a value for DO.

   The procedure is as follows (equivalent to writing a data to the address 1000H in RS485 communication mode):



2. Start or stop the AC drive (F0-02 is set to 2).
   Based on the I/O mapping, assign a value for D2, assign a value for the D element corresponding to the control word of the required station number to enable the AC drive to run forward or backward or stop. The control word is defined as follows:

   1: Run in forward direction; 2: Run in reverse direction; 3: Jog in forward direction; 4: Jog in reverse direction; 5: Coast to stop; 6: Decelerate to stop; 7: Reset upon fault

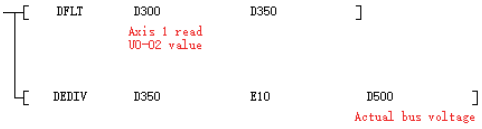
   The procedure of making the AC drive run forward is as follows:



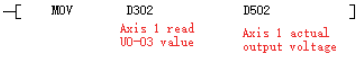
   The PLC soft component address corresponding to 2000H is D2. Therefore, to control the AC drive to run in the forward direction through communication, write 1 to D2. To decelerate to stop, set D2 to 6.

3. Read the bus voltage.
   Based on the conversion rule, convert the high bit U of the bus voltage address U002 to 7, convert the address to a hexadecimal number and then add 1 to the conversion result. Then, the index is 2070 and the sub-index is 03. Based on the communication configuration, the D element address of the bus voltage is D300. Therefore, convert D300 to a floating-point number and then divide the conversion result by 10.

   The program is as follows:



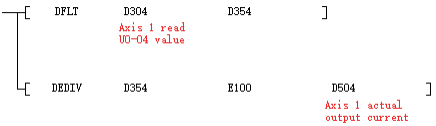
4. Read the output voltage.
   Based on the conversion rule, convert the output voltage U0-03 to 2070sub4 and then the reading is the actual output voltage. According to the communication configuration, you only need to move the value of D302 to another D component (or not).



5. Read the output current.

Based on the conversion rule, convert the output current U0-04 to 2070sub5 and then divide the reading by 100 to obtain the actual output current. Based on the I/O mapping, read D304.

The program is as follows:



6. Read the AC drive state.
   Read U0-61 to get the current state of the AC drive and convert it to 2070sub3E according to the conversion rule. Based on the I/O mapping, read D304.

   1: Forward running; 2: Reverse running; 3: Stop

   The program is as follows:



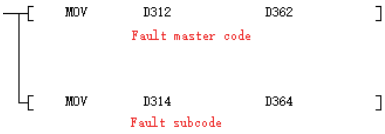
7. Read the DI state.
   Based on the conversion rule, convert the DI state U0-07 to 2070sub8 and then convert the reading to a binary number, in which the least significant bit indicates DI1 status, the second least significant bit indicates DI2 status, and so on. Based on the I/O mapping, read D304.

   The program is as follows:



8. Read the fault code.
   Convert the fault code U0-45 to 2070sub2E and convert the fault subcode U0-46 to 2070sub2E based on the conversion rule. Based on the I/O mapping, read D312 and D314.

   The program is as follows:



Common problems and solutions

Items must be checked: Check whether FD-10 is set to 3 for the power supply unit and to 1 for the drive unit.

Table 5–11 Common problems and solutions

FAQ	Solution
Failure to write frequency	Check the address in the configuration table based on F0-03.
Failure to start the AC drive	Check that F0-02 is set to 2 (0: Operating panel; 1: Terminal; 2: Communication).
Unstable connection	1. Ensure stable connection on PLC side. 2. Ensure stable connection on AC drive side. 3. Check and ensure that the signal cables are far away from the power cable.
Incorrect reading	1. Ensure that the address configured is correct. 2. Ensure that data conversion is performed. 3. Ensure that the D element is not occupied.

5.8.2 Example of Configuration on Beckhoff Controller Using ECAT Card

This section describes how to configure the MD500-ECAT card on the TwinCAT master station of Beckhoff.

Note

Use Intel chip or FE (Fast Ethernet) card as the network card. If other brands of network cards are used, the EtherCAT operation may fail.

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1. Install TwinCAT.
   Windows XP: tcat_2110_2230 is recommended.

   Windows 7 (32-bit): tcat_2110_2248 is recommended.

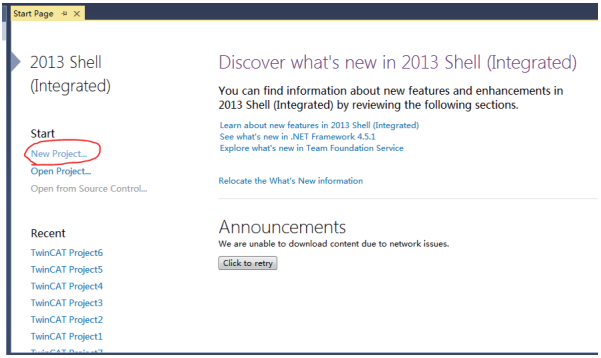
2. Copy the EtherCAT configuration file (MD800_9Axis_V0.16.xml) of the AC drive to the TwinCAT installation directory.
   TwinCAT2 directory: TwinCAT\IO\EtherCAT

   TwinCAT3 directory: TwinCAT\3.1\config\IO\EtherCAT

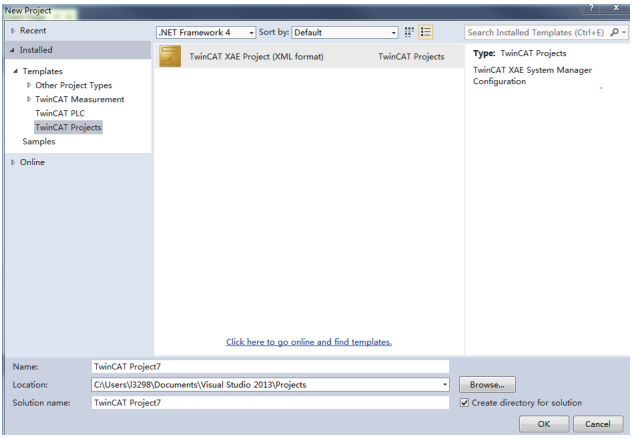
   TwinCAT3 is used as an example in the following section. The operation steps for TwinCAT2 are similar to those for TwinCAT3.

3. Run TwinCAT.

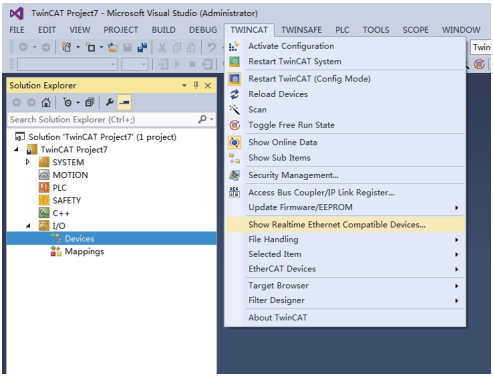
   a. Click **New Project**



b. Click **OK**. A new project is created.

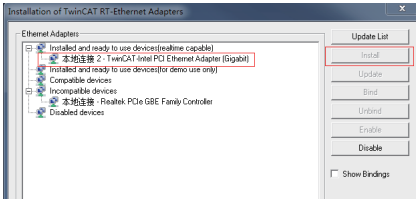


4. Install the TwinCAT network card drive.



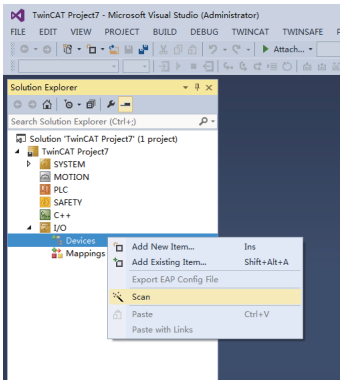
Access the menu **Show Real Time Ethernet Compatible Devices...** in the preceding figure. In the dialog box displayed, select the local device from the **Incompatible**

devices field, and then click **Install**. After installation, the installed network adapter is displayed in Installed and ready to use devices.

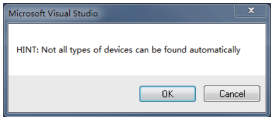


5. Search for the device.

   a. Create a project. On the page displayed, right-click **Devices**, and select **Scan** to scan devices, as shown below.



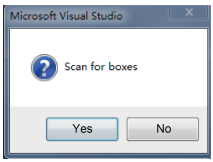
   b. Click **OK**.



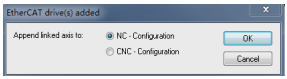
   c. Click **OK**.



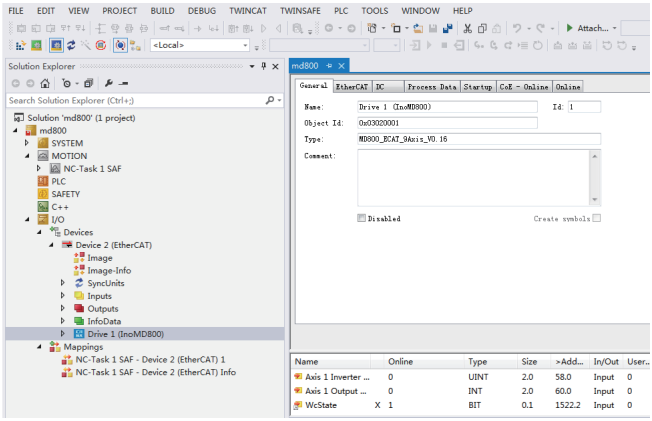
   d. Click **Yes**.



e. Click **OK**.



f. Click **No**. Then, the device searching is completed.

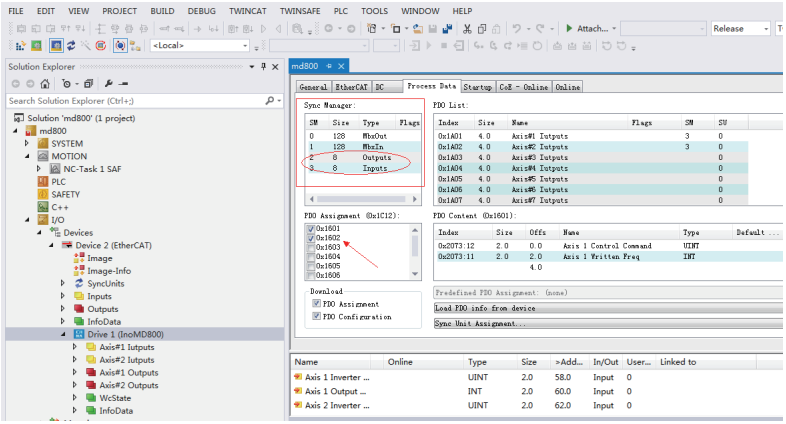


6. Configure PDO parameters..

This AC drive has multiple axes. When configuring the PDO parameters, match each TPDO and RPDO with the corresponding axis.

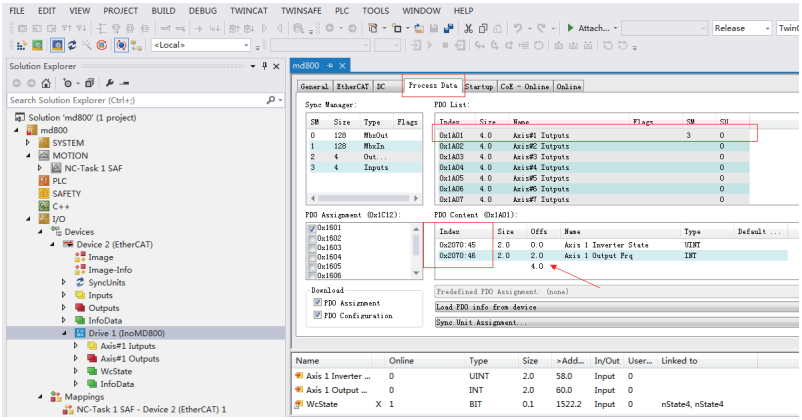
a. Configure the axis PDO.

Select the PDO to be configured according to the number of axes of the AC drive. In **Sync Manager**, click **SM2** or **SM3** to switch the corresponding TPDO and RPDO under **PDO Assignment**. Then, select the axis to be configured.



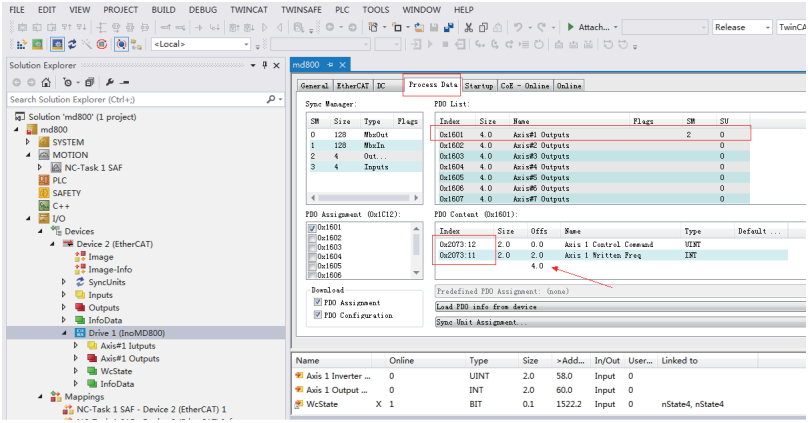
b. Configure the TPDO.

When you configure TPDO, 0x1A01 (Axis 1) is selected by default. The first two items are the default TPDOs, which can be modified as needed. Add the TPDO mapping as required in the following figure.



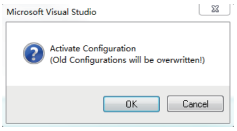
c. Configure the RPDO.

When you configure RPDO, 0x1601 (Axis 1) is selected by default. The first two items are the default RPDOs, which can be modified as needed. Add the RPDO mapping as required in the following figure.

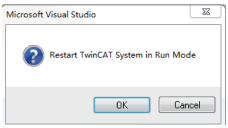


7. Configure the SDO list (not supported now).
8. Activate the configuration and switch to the running mode.

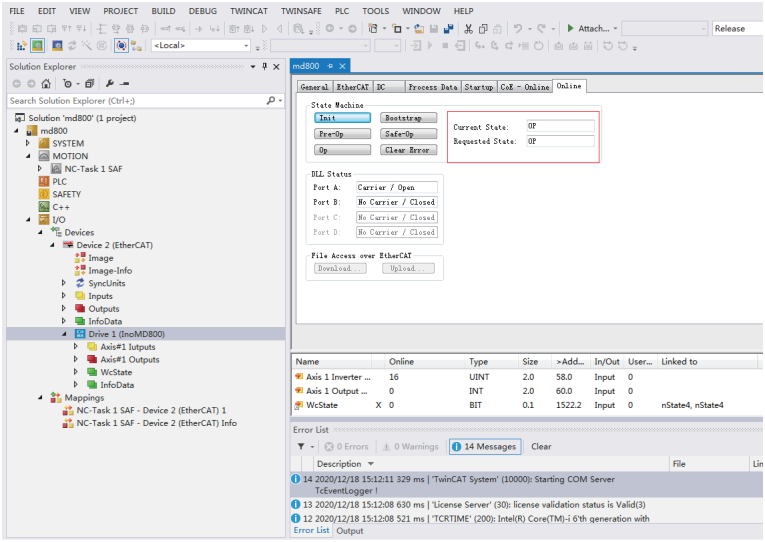
a. Click . The following page is displayed.



b. Click **OK**.

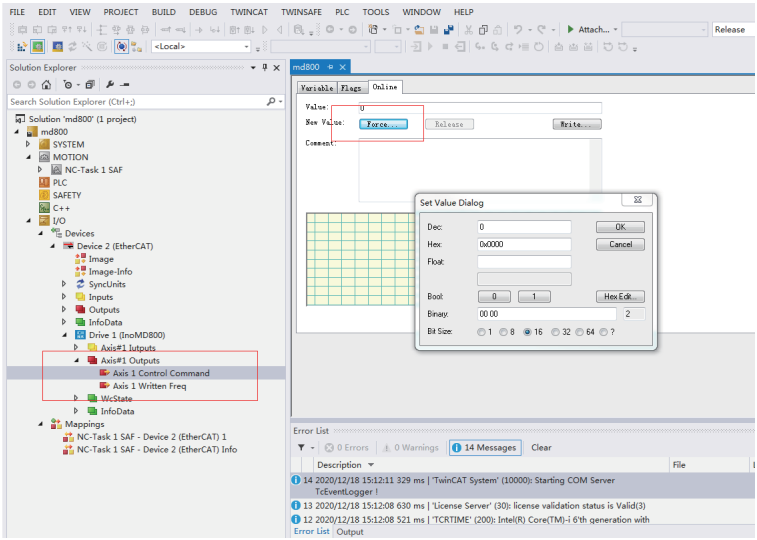


c. Click **OK** to enter the OP state.



9. Control the AC drive through the PDO.

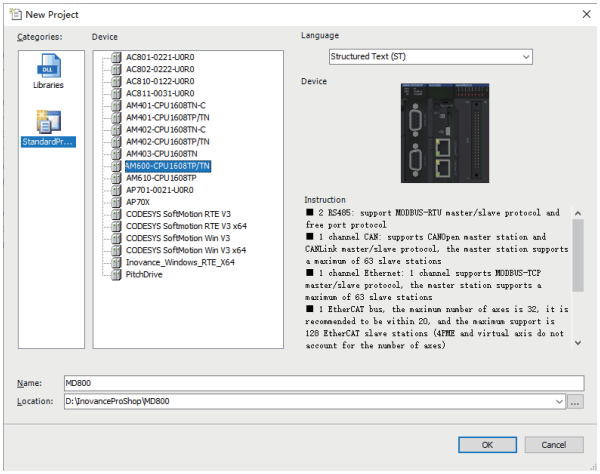
   Write corresponding values through the configured RPDO to control the AC drive.



5.8.3 Example of Configuration on AM600 Master Station Using ECAT Card

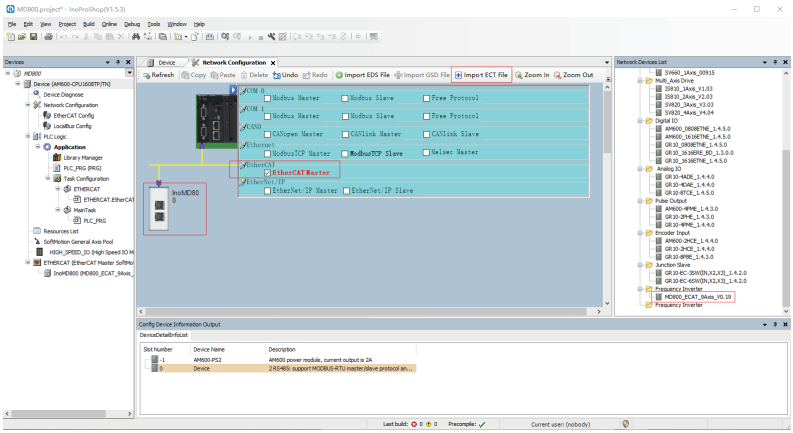
The following takes the AM600 master station as an example to describe how to configure the AC drive to work with the master station.

1. Open the software, and create an AM600 project.
   Select **AM600-CPU1608TP/TN** from the device list. The following screen is displayed.



2. Add this device as an AC drive slave station.

a. Access the **Network Configuration** page and import the EtherCAT configuration file of this product. If configuration files of other versions exist, delete them first.

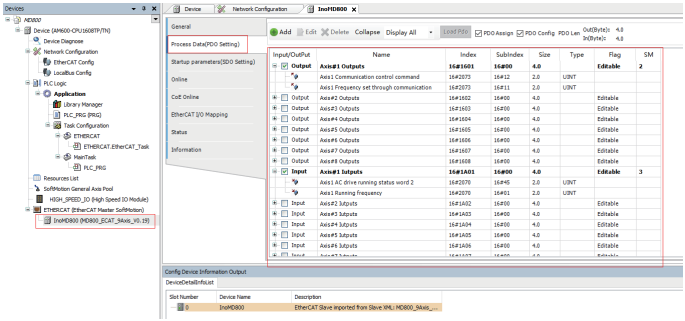


b. Drag the device in the network device list to add the AC drive slave station,



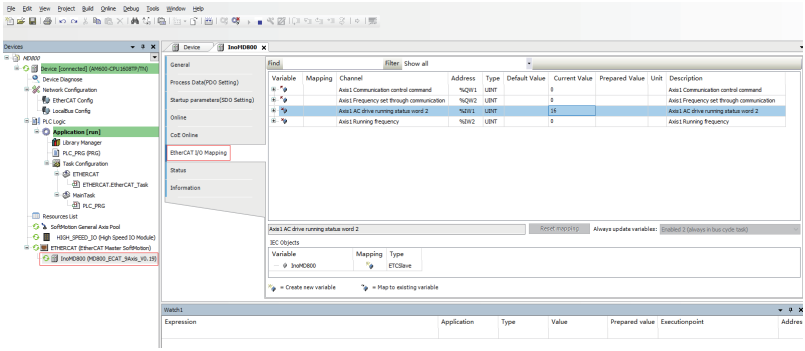
3. Configure the PDO parameters.

a. Add the TPDO mapping as required in the following figure.
The control command of RPDO and inverter state of TPDO can be modified. RPDO must be configured; otherwise, an error may occur during operation. Axis#1 Outputs means the control data received by axis 1 from the master station. Axis#1 Inputs means the state data sent by the axis 1 to the master station. MD800 can configure up to eight axes. You can select Axis#16 Inputs to enable the power supply unit to send the state data to the master station.



b. Download the project to the PLC.

You can view TPDO data and write RPDO data in real time through EtherCAT I/O mappings.



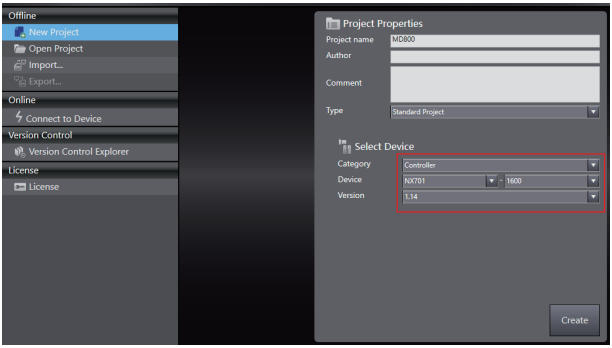
5.8.4 Example of Configuration on Omron Master Station Using ECAT Card

The following takes the Omron NX701-1600 master station as an example to describe how to configure the AC drive to work with the master station.

1. Copy the XML file of this product to the installation directory "E:\OMRON\Sysmac Studio \IODeviceProfiles\EsiFiles\UserEsiFiles" of Sysmac Studio, run the software, and import the XML file.
2. Create a project.

   Device: Select the actual controller model.

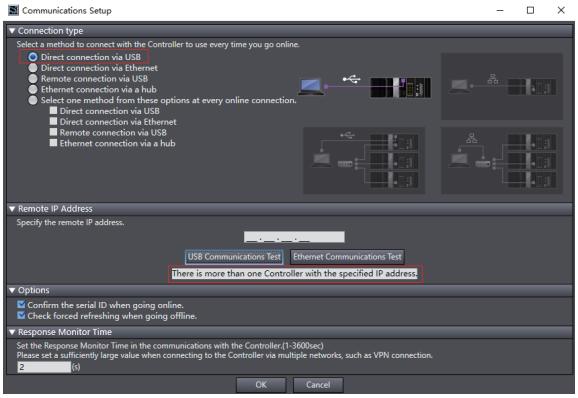
   Version: Select the device version.



3. Configure communication parameters.

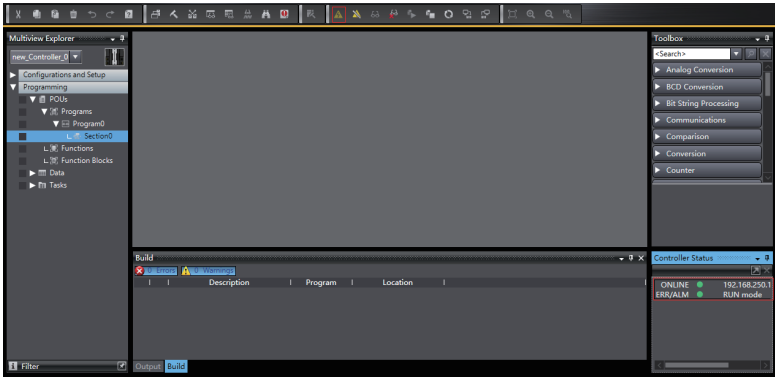
   a. Enter the main interface and choose **Controller** > **Communications Setup** to set the connection mode for the computer and controller.

   b. Select **Direct connection via USB**. If the test is successful, proceed to the next step.



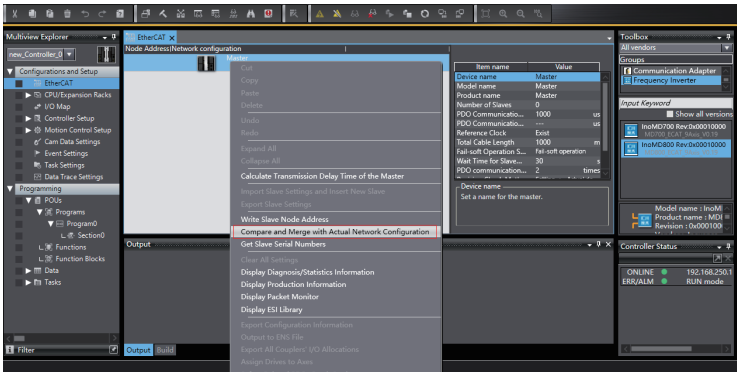
4. Scan the devices.

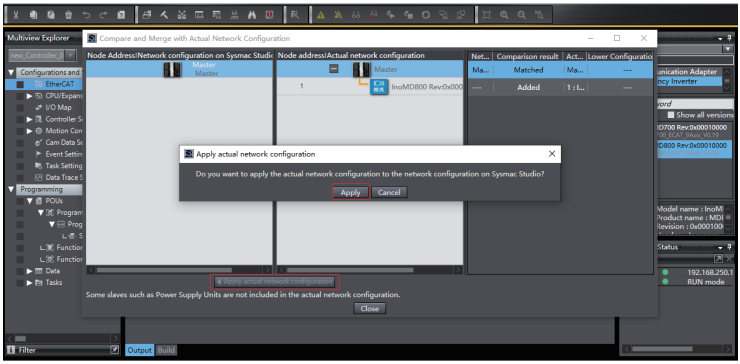
   a. Switch the controller to the online and running mode.
   The controller status is displayed in the lower right corner.

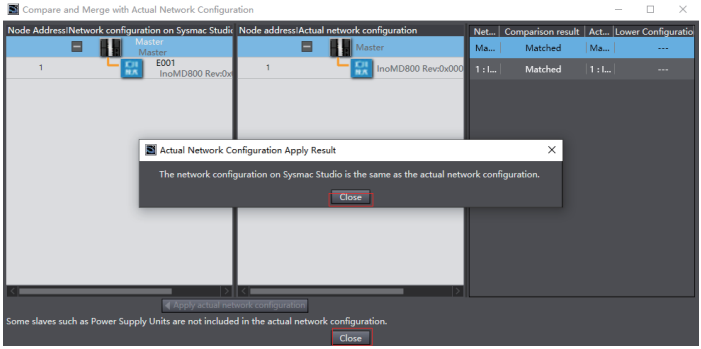


b. Scan the device and add the slave station.

Choose **Configurations and Setup > EtherCAT**. Right-click Master and select **Compare and Merge with Actual Network Configuration**. The controller automatically scans all slave stations in the network (an error is reported when the number of a station is 0). In the **Apply actual network configuration** dialog box, click **Apply**, and the slave station is added. You can view the added slave station on the main interface.

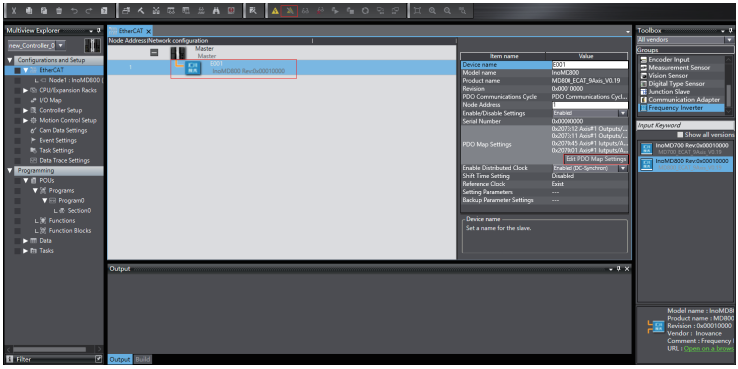




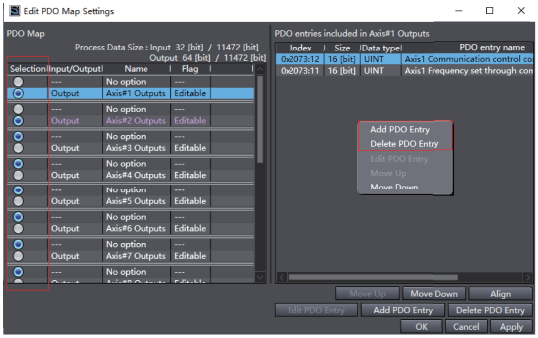


5. Configure the parameters.

   a. Change the controller status to OFFLINE, select this device, and click **Edit PDO Map Setting**s.

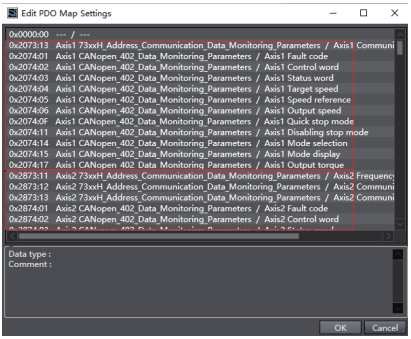


   b. On the **Edit PDO Map Settings** page displayed, select the axis number to be configured and right-click in the blank area on the right, and then click **Add PDO Entry** or **Delete PDO Entry** to add or delete a PDO entry.

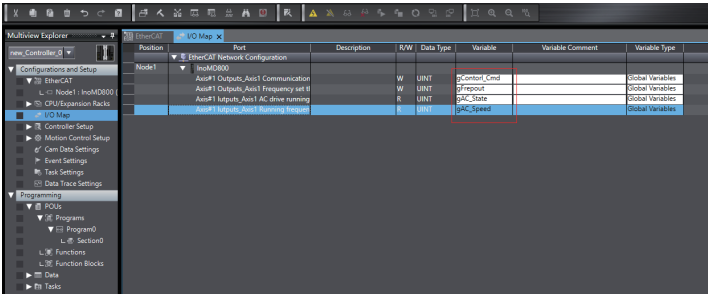


Caution

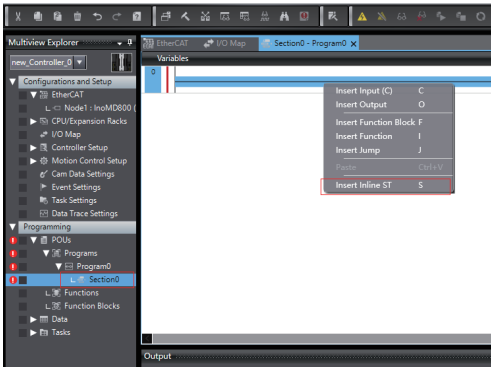
When adding a PDO entry, you must select the entry corresponding to the specific axis. Otherwise, an error is reported and the AC drive cannot run.

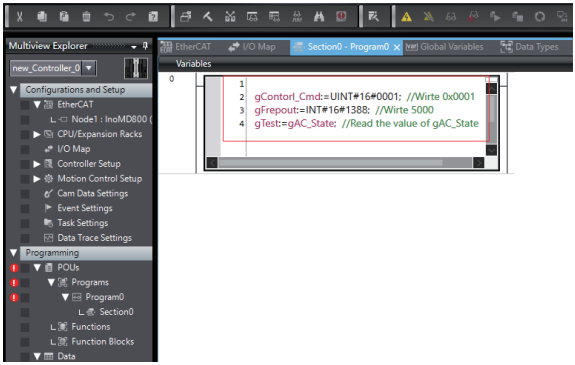


c. Set the PDO mapping (I/O mapping distribution).



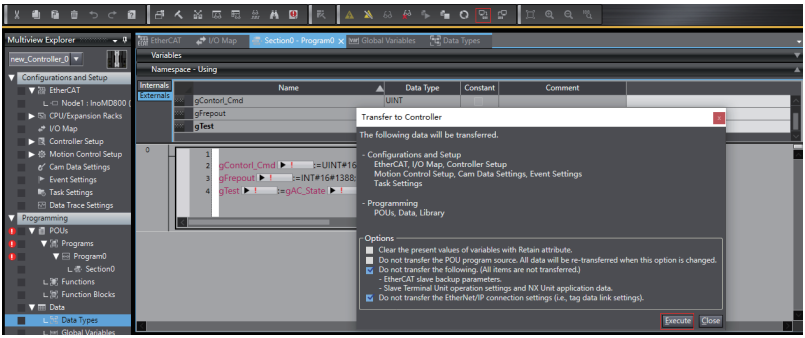
6. Edit the PLC program.



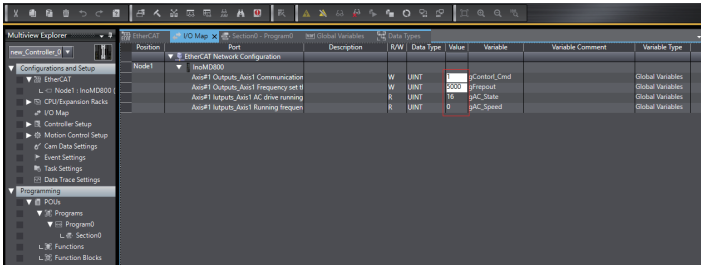


7. Download the PLC program to the controller.

   a. After settings and programming are complete, switch to the online state, and download the program to the controller.



   b. After the PLC program is run, access **I/O Map**, and the real-time data is displayed.



5.9 Fault Diagnosis

All communication fault codes are displayed on the power supply unit operating panel.

Table 5–12 ECAT card communication fault codes

Fault Code	Fault Cause	Solution	Reset Method
E16.52	EtherCAT communication card EEPROM fault	1. If the programming or upgrading of the communication card fails, program the communication card again. 2. If this fault occurs during normal use, replace the communication card.	When FD-06 is set to 1, auto reset is performed. When FD-06 is set to 0, you need to manually reset the fault.
E16.53	Slave control chip of the EtherCAT communication card faulty	1. If the programming or upgrading of the communication card fails, program the communication card again. 2. If this fault occurs during normal use, replace the communication card.	
E16.55	Incorrect EtherCAT parameter setting	When the master station goes wrong, check whether it sends synchronous frame (FD-78). If not, make sure that TPDO and RPDO have been configured for the master PDO. If the master PDO is configured correctly, check the network port status (FD-72 to FD-77) and make sure that the communication cable is connected properly.	
E16.71	Master station offline during operation of the communication card	Check and ensure that the connection between the communication card and PLC is normal. Check whether the network cable in use is the shielded Cat 5e cable. Check and ensure the proper grounding and no EMC interference issues. Check whether the master station is abnormal.	
E16.72	Internal slave station offline during operation of the communication card	Check and ensure that both the connection between the communication card and the power supply unit, as well as the connection between the power supply unit and the drive unit, are normal.	
E16.74	Communication card configuration fault	Check whether the configured slave station exists and whether startup with station lost is disabled (FD-50 of the power supply unit = 0).	
E16.75	Configurations of drive unit mappings on the communication card faulty	Check and ensure that the number of pieces of process data configured for the drive unit is consistent with the number of mapping relations.	
E16.76	Configurations of power supply unit mappings on the communication card faulty	Check and ensure that the number of pieces of process data configured for the power supply unit is consistent with the number of mapping relations.	

6 EtherNet IP Communication

6.1 Introduction

As an EtherNet/IP fieldbus adapter that complies with international EtherNet/IP bus standards, the EtherNet/IP communication expansion card (SI-EN card) features high efficiency, flexible topology, and easy operation. It is installed on an MD800 series AC drive to improve the communication efficiency and implement the AC drive networking function. This enables the AC drive to be a slave controlled by the fieldbus master.

In this guide, the SI- EN card software version must be V6.00 or later. After the SI-EN card is installed and the AC drive is powered on, query the parameter FD-91 of the AC drive. The device EDS file is MD800-EN1_Vn.nn.eds, wherein n.nn indicates the version which must be 1.00 or later.

6.2 Installation

The SI-EN card is a built-in expansion card of the AC drive. Power off the AC drive, wait for about 10 minutes until the charging indicator of the AC drive is completely turned off, and then install the SI-EN card.

6.3 Hardware Layout

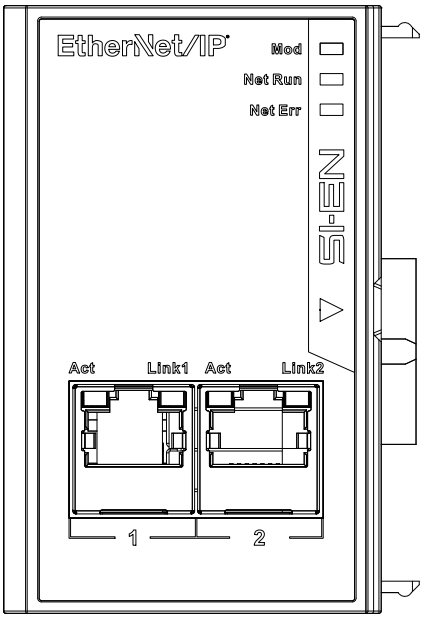


Figure 6-1 Terminal layout of the SI-EN card

The EtherNet/IP communication expansion card (SI-EN) provides the standard Ethernet RJ45 port to connect to the EtherNet/IP master station using crossover cables or straight-through cables. Definitions of the pin signals are the same as those of the standard Ethernet pin signals.

Table 6–1 Description of SI-EN card terminals

Terminal	Terminal Name	Description
1	Network port 1	Use any of the two ports to connect to the PLC. After installation, network port 1 is on the left and network port 2 is on the right from the front view of the expansion card. The Cat 5e shielded twisted pair (STP) network cable must be used for ensuring stability. To improve the anti-interference capability of communication, it is recommended to install the card in the expansion card slot 2.
2	Network port 2	

Table 6–2 Description of SI-EN card indicator

Indicator		Description	Solution
Mod	Steady green	Communication is normal.	/
	Steady red	Communication between the SI-EN card and the node times out.	Check the connector for interference.
	Red indicator flashing slowly	Communication between the SI-EN card and the power supply unit times out.	1. Check that the communication card is installed correctly. 2. Check whether the power supply unit is normal.
	Red indicator flashing quickly	The SI-EN card is faulty.	Troubleshoot the fault according to the fault code displayed on the operating panel of the power supply unit.
Net Run Net Err	Steady green Red indicator Off	The SI-EN card is connected.	/
	Flashing in green Red indicator OFF	Wait for connection to the SI-EN card.	1. Check whether the network cable is connected properly and whether the master station is running. 2. The expansion card is in the static mode or DHCP mode. Assign an IP address to the expansion card using the parameter on the operating panel or DHCP.
	Flashing in green Flashing in red	The SI-EN card is disconnected or the connection times out.	1. Check whether the network cable is connected properly and whether the master station is online. 2. Check whether a fault code is displayed on the operating panel of the power supply unit. If yes, refer to *"6.9 Fault Diagnosis" on page 179* for troubleshooting.
	Green indicator OFF Steady red	System fault	Check whether a fault code is displayed on the operating panel of the power supply unit. If yes, refer to *"6.9 Fault Diagnosis" on page 179* for troubleshooting.

6.4 Network Topology

After the SI-EN card communicates with the AC drive, connect the SI-EN card to the SI-EN master correctly and complete communication configurations. This can enable the SI-EN card to communicate with the SI-EN master and can implement the AC drive networking function.

SI-EN card supports multiple types of topologies including the bus type, star type, tree type, and ring type. Multiple types of networking can be achieved through the switch.

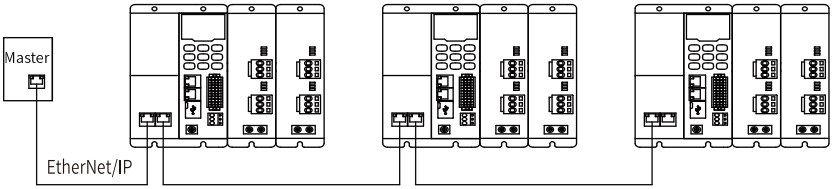


Figure 6-2 Bus topology

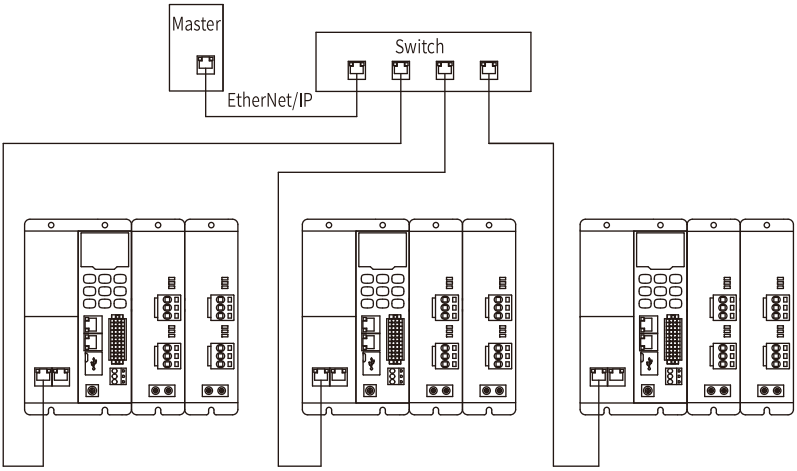


Figure 6-3 Star topology

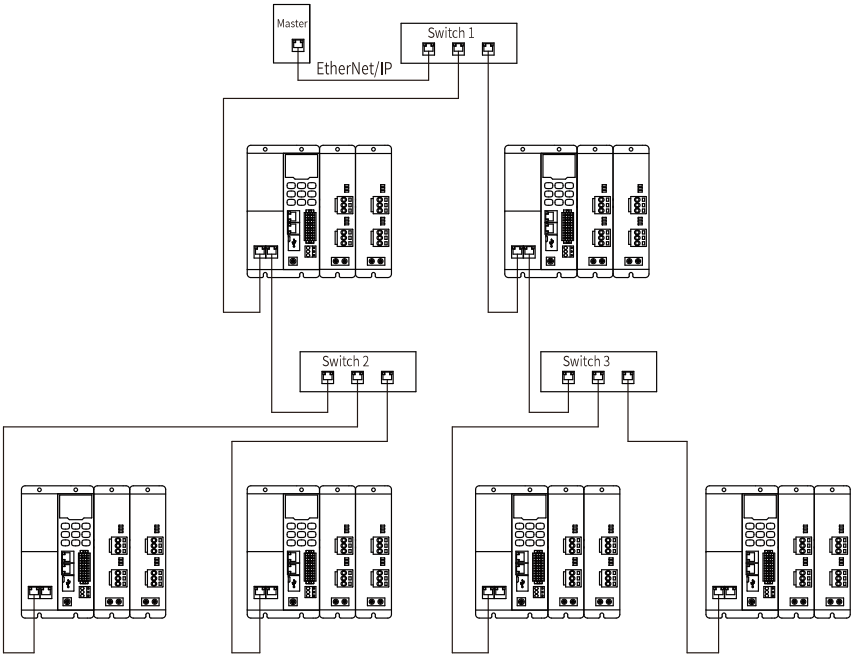


Figure 6-4 Tree topology

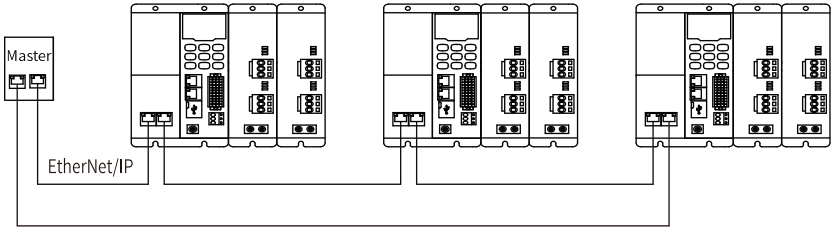


Figure 6-5 Ring topology

6.5 Device Level Ring

Device level ring (DLR), a second-layer protocol within the OSI model, is applicable to the EtherNet/IP devices with multiple Ethernet ports and embedded switch technology. This protocol provides a means for fault detection and re-configuration in a network. It also provides configuration and diagnosis interfaces (DLR Object) for EtherNet/IP devices. In addition, the DLR network includes at least one node configured to be a ring supervisor.

The SI-EN card acts as the node of the DLR-based beacon frame in the ring network. When the SI-EN card detects a ring network topology fault or recovery from faults, the switchover between the ring network and the linear network can be completed within 1 ms.

To use this function, do as follows:

1. Connect the SI-EN card and the EtherNet/IP master in a linear topology.
2. Enable the ring supervisor function of the EtherNet/IP master.
3. Connect the SI-EN card and the EtherNet/IP master in a ring topology.

The following precautions shall be taken:

1. To enable the SI-EN card to support the DLR network, ensure the software version of the SI-EN card is V6.00 or later.
2. The ring supervisor function shall be enabled before the devices are connected to the ring network. Otherwise, the network link may be full-load and communication faults may occur.
3. When the SI-EN card is used for ring networking, non-DLR devices that meet the following requirements can also be integrated into the network:
   - Non-DLR devices that disable unicast MAC address learning or do not use MAC address learning.
   - Non-DLR devices that disable the multi-cast MAC address filtering function on the ports connected to the network.
   - Non-DLR devices that receive an 802.1 Q Ethernet frame and retain the field of the VLAN.
   - Non-DLR devices that forward the VLAN field according to its priority to prevent ring network performance degradation.
4. When the switch is involved in networking, the DLR switch is preferred. Using a non-DLR switch may result in the loss of a unicast frame after a ring network topology fault or after recovery from faults. The loss occurs until the MAC learning table of the switch is re-established. To avoid this situation, you can take the following measures:
   - Configure the static unicast MAC address.
   - Disable unicast MAC address learning of the switch.
   - Connect the non-DLR switch to a multi-port DLR device (such as a 3-port DLR switch) which then is connected to the ring network.

6.6 IO Data

The SI-EN expansion card supports 23 I/O messages for data transmission, of which 11 messages are sent from the master to slave and 12 messages are sent from the slave to master. The master can read and modify AC drive data in real time and exchange data cyclically with the AC drive through the I/O. The specific functions are as follows:

- Real-time settings of drive unit control command and target frequency
- Real-time reading of the current state and running frequency of the drive unit
- Real-time reading of the bus voltage and temperature of the power supply unit (also referred to as rectifier)
- Function parameter and monitor data exchange between AC drive and EtherNet/IP master station

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

Table 6–3 Data exchange between master and the power supply unit

I/O data (O->T) sent by the master			
Real-time modification of power supply unit parameters			
Output Data to Rectifier [1-11]			
I/O data (T->O) returned by the power supply unit			
Active state of the AC drive power supply unit data	Bus voltage of the AC drive power supply unit	Temperature of the AC drive power supply unit	Real-time reading of AC drive power supply unit parameters
Rectifier Device Status	Input Data from Rectifier[1]	Input Data from Rectifier[2]	Input Data from Rectifier[3-11]

Table 6–4 Data exchange between master and Axis *i* (*i* = 1 to 8)

I/O data (O->T) sent by the master			
AC drive (Axis *i*) command	AC drive (Axis *i*) frequency reference	Real-time modification of AC drive Axis *i* parameters	
Output Data to Axis *i* [1]	Output Data to Axis *i* [2]	Output Data to Axis *i* [3-11]	
I/O data (T->O) returned by the AC drive unit			
Active state of the AC drive Axis *i* data	Running state of the AC drive Axis *i*	Running frequency of the AC drive Axis *i*	Real-time reading of AC drive Axis *i* parameters
Axis *i* Device Status	Input Data from Axis *i* [1]	Input Data from Axis *i* [2]	Input Data from Axis *i* [3-11]

Data Sent by the Master

Table 6–5 Data sent by the master

I/O data (O->T) sent by the master	
Output Data to Axis *i*[1]	Communication command word (command source set to communication, that is, F0-02 = 2) 0: Stop according to F6-10 (Stop mode) 1: Forward run 2: Reverse run 3: Forward jog 4: Reverse jog 5: Coast to stop 6: Decelerate to stop 7: Reset upon fault
Output Data to Axis *i*[2]	AC drive target frequency (frequency source F0-03 set to 9 (communication)) Set F8-64 to choose Hz or rpm as the unit. When F8-64 is set to 0, the unit is Hz. The decimal place is determined by F0-22. For example, when F0-22 is set to 2, the decimal number 1000 means that the frequency reference is 10.00 Hz. When F8-64 is set to 1, the unit is rpm. For example, the decimal number 1000 means that the speed reference is 1000 rpm.
Output Data to Axis *i*[3] to Output Data to Axis *i*[11]	The data is used to modify the parameters of the AC drive in real time.
Output Data to Rectifier[1] to Output Data to Rectifier[11]	The data is used to modify the parameters of the AC drive in real time.

Descriptions of Data Returned by the AC Drive

Table 6–6 Descriptions of data returned by the AC drive

I/O data returned by the AC drive	
Device Status	Data active state of the slave device of the AC drive
Input Data from Axis *i* [1]	Running state of the AC drive AC drive running states are determined by the bits as follows: Bit 0: 0: Stopped; 1: Running Bit 1: 0: Running in forward direction; 1: Running in reverse direction Bit 2: 0: Not faulty; 1: Faulty Bit 3: 0: Running frequency not reached; 1: Running frequency reached Bit 4 to Bit 7: Reserved Bit 8 to Bit 15: The AC drive is faulty.

I/O data returned by the AC drive	
Input Data from Axis *i* [2]	AC drive running frequency (unit: 0.01 Hz). The current AC drive running frequency is returned as 16-bit signed data.
Input Data from Axis *i* [3] to Input Data from Axis *i* [11]	The data is used to read the parameters of the AC drive in real time.
Input Data from Rectifier [1]	The bus voltage of the AC drive power supply unit is returned as 16-bit unsigned data.
Input Data from Rectifier [2]	The current heatsink temperature is returned as 16-bit signed data.
Input Data from Rectifier [3] to Input Data from Rectifier [11]	The data is used to read the parameters of the AC drive in real time.

6.7 Parameters

SI- EN Card Configuration

After installing the SI- EN card to the AC drive, configure the following parameters to enable the SI-EN card to communicate with the AC drive. Other parameters are optional.

Table 6–7 Parameters of power supply unit

Parameter	Parameter Name	Value Range	Setpoint	Parameter Description
FD-10	Communication type	1: CANopen/ Modbus 2: CANlink 3: Communication card mode	3: Communication card mode	Set the communication type 1: CANopen/ Set the communication type is CANopen or Modbus. 2: CANlink Set the communication type is CANlink. 3: Communication card mode Set the communication type is communication card, including EtherCAT, PN, EtherNet or IP. You just need to set FD-10 of the power supply unit. When the drive unit is running, FD-10 of the power supply unit cannot be modified.
F0-01	Product code	800	800	This parameter indicates the product code of the AC drive.
F0-02	Software version	0.00-655.35	05.04	This parameter indicates the software version of the power supply unit.

Parameter	Parameter Name	Value Range	Setpoint	Parameter Description
FD-18	Power supply unit number	1–15	1	Set the number of the power supply unit. This parameter assigns the station number of the power supply and drive units after the automatic assignment of station numbers is enabled. The assignment shall follow the rules: Station number of the power supply unit = FD-18 x 16 Station number of the drive unit = Current slot number +(FD-18 - 1) x 16
FD-39	Function enabling bit configuration of AC drive station number	0: Disable 1: Enable	0	Used to set whether the station number of the AC drive can be set manually. 0: Disable The station number of the AC drive cannot be set manually. It can only be assigned automatically. 1: Enable The station number of the AC drive can be set manually.
FD-50	Startup with slave loss	0: Disable 1: Enable	0	This function is applicable to scenarios where you want to start the network without modifying the PLC configuration and program when a slave station fails to go online. 0: Disable The communication error E16.74 is returned when the number of slave stations configured for the PLC is different from the actual number. 1: Enable No communication error is returned when the number of slave stations configured for the PLC is different from the actual number.
FD-91	Communication card version	0.00-655.35	18.00	This parameter indicates the communication expansion card software version.

Caution

- The SI-EN card is supported only when the value of F0-02 is L05.04 or later. If the value of F0-02 is smaller than or equal to L05.03, the MOD and NET ERR indicators glow red and an alarm is reported.
- After FD-50 (start with station lost) is set to 1 (Enable), the function takes effect after a restart.

IP Address Setting of SI- EN Card

Table 6–8 Parameters related to IP address setting

Parameter	Parameter Name	Value Range	Descriptions
AD-00	DHCP/BOOTP function	0: Disable 1: Enable	It is used to set the Dynamic Host Configuration Protocol (DHCP) function. If the DHCP function is enabled, settings of AD01 to AD12 do not take effect.
AD-01	Highest order byte of the IP address	1–254	Set the highest order byte of the IP address, ranging from 1 to 254 (displayed in decimal format, equivalent to 0x01 to 0xFE in hexadecimal).
AD-02	Second highest order byte of the IP address	0 to 254	Set the second highest order byte of the IP address, ranging from 0 to 254 (displayed in decimal format, equivalent to 0x00 to 0xFE in hexadecimal).
AD-03	Third highest order byte of the IP address	0 to 254	Set the third highest order byte of the IP address, ranging from 0 to 254 (displayed in decimal format, equivalent to 0x00 to 0xFE in hexadecimal).
AD-04	Lowest order byte of the IP address	1–253	Set the lowest order byte of the IP address, ranging from 1 to 253 (displayed in decimal format, equivalent to 0x01 to 0xFD in hexadecimal).

Parameter	Parameter Name	Value Range	Descriptions
AD-05	Highest order byte of the subnet mask	0 to 255	Set the highest order byte of the subnet mask, ranging from 0 to 255 (displayed in decimal format, equivalent to 0x00 to 0xFF in hexadecimal).
AD-06	Second highest order byte of the subnet mask		
AD-07	Third highest order byte of the subnet mask		
AD-08	Lowest order byte of the subnet mask		
AD-09	Highest order byte of the gateway IP address	1–254	Set the highest order byte of the gateway IP address, ranging from 1 to 254 (displayed in decimal format, equivalent to 0x01 to 0xFE in hexadecimal).
AD-10	Second highest order byte of the gateway IP address	0 to 254	Set the second highest order byte of the gateway IP address, ranging from 0 to 254 (displayed in decimal format, equivalent to 0x00 to 0xFE in hexadecimal).
AD-11	Third highest order byte of the gateway IP address	0 to 254	Set the third highest order byte of the gateway IP address, ranging from 0 to 254 (displayed in decimal format, equivalent to 0x00 to 0xFE in hexadecimal).
AD-12	Lowest order byte of the gateway IP address	0 to 254	Set the lowest order byte of the gateway IP address, ranging from 0 to 254 (displayed in decimal format, equivalent to 0x00 to 0xFE in hexadecimal).

The IP address can be a static one or dynamic one assigned by DHCP function, which is set through AD-00. You can set the static IP using parameters AD-00 to AD-12. For example, if the static IP address is 192.168.0.4, the subnet mask is 255.255.255.0, and the gateway IP address is 192.168.0.1, set parameters as following.

Parameter	Parameter Name	Value
AD-00	DHCP/BOOTP function	0
AD-01	Highest order byte of the IP address	192
AD-02	Second highest order byte of the IP address	168

Parameter	Parameter Name	Value
AD-03	Third highest order byte of the IP address	0
AD-04	Lowest order byte of the IP address	4
AD-05	Highest order byte of the subnet mask	255
AD-06	Second highest order byte of the subnet mask	255
AD-07	Third highest order byte of the subnet mask	255
AD-08	Lowest order byte of the subnet mask	0
AD-09	Highest order byte of the gateway IP address	192
AD-10	Second highest order byte of the gateway IP address	168
AD-11	Third highest order byte of the gateway IP address	0
AD-12	Lowest order byte of the gateway IP address	1

When using the DHCP function, you can check the MAC address of the SI-EN card by the following ways:

1. Viewing the sticker on the SI-EN card.
2. Viewing corresponding parameters of the AC drive (FD-61 to FD-63).

The SI-EN card also supports the IP address conflict detection function. When the IP address of this card is the same as that of another device in the network, the NET ERR indicator becomes steady red.

There are three IP address conflict situations, as described in the following table.

No.	Situation	Symptom	Solution
1	Both devices support IP detection. The two devices are powered on or connected to the network in sequence.	1. If two devices are adjacent to each other, both devices can detect IP address conflict. 2. If two devices are not adjacent to each other, the device that is powered on or connected to the network later can detect IP address conflict.	Check the IP address conflict and modify the duplicate IP address.
2	Both devices support IP detection. The two devices are powered on or connected to the network at the same time.	Both devices enter the IP address conflict mode.	
3	One device supports IP conflict detection, whereas the other device does not.	The device that does not support IP address conflict detection obtains the IP address no matter whether it is powered on first. The device that supports IP address conflict detection enters the conflict mode.	

Note

- If the DHCP is to be used to assign IP addresses and IP address conflicts occur, IP address assignment will fail.
- IP conflicts will be detected upon power-on of the SI-EN card and upon IP address assignment through DHCP, and then passive detection will be performed. If the same dynamic/static IP address that is used by another device in the network is assigned to the drive, both the device and the drive will report IP address conflicts after the drive is connected to the network.

Explicit Message Configuration

The SI-EN card supports explicit message exchange. The master station can read and change the AC drive data through the explicit messaging function. To enable the master station to exchange data with the power supply unit or the drive unit aperiodically, you can configure the following parameters on the master station:

- Class ID: 0x93, the class ID of the parameter for reading/writing an explicit message.
- Instance ID: The instance ID is the station number of the power supply unit or drive unit. (The station number of the power supply unit is 16, and the station number of the drive unit is 1, 2, n, ..., 8.)
- Attribute ID: The attribute ID is the address of the parameter to be read and written.
- Requested service (read/write parameter): 0x0E is used to obtain an attribute, that is, to read a parameter; 0x10 is used to set an attribute, that is, to set a parameter.

Parameters Related to SI-EN Card

Table 6–9 Parameters of power supply unit

Parameter	Parameter Name	Value Range	Descriptions
FD-61	MAC address 1	0 to 65535	Indicates the highest two bytes of the MAC address
FD-62	MAC address 2	0 to 65535	Indicates the middle two bytes of the MAC address
FD-63	MAC address 3	0 to 65535	Indicates the lowest two bytes of the MAC address

Table 6–10 Parameters of drive unit

Parameter	Parameter Name	Value Range	Set point	Descriptions
F0-02	Command source selection	0: Operation panel 1: Terminal 2: Communication	2	2: For the drive unit, set this parameter to 2.
F0-03	Main frequency X source	0: Digital setting (preset frequency F0-08 that can be changed by UP or DOWN key, non-retentive upon power failure) 1: Digital setting (preset frequency F0-08 that can be changed by UP or DOWN key, retentive upon power failure) 2: AI1 3: AI2 4: AI3 5: Reserved 6: Multi-reference 7: Simple PLC 8: PID 9: Communication 10: Reserved	9	9: For the drive unit, set this parameter to 9.

Communication Control Parameters

Parameter		Value Range	Decimal Address	Parameter Description
Communication and control word parameters of the drive unit	U3-16	0 to 65535	29456	Frequency set through communication
	U3-17	0 to 65535	29457	Communication control command
Common parameters of the drive unit	U0-06	-3276.8% to -3276.7%	28678	Output torque
	U0-07	0–0xFFFF	28679	DI input state
	U0-08	0–0xFFFF	28680	RO/DO output state
	U0-45	0 to 65535	28717	Fault code
	U0-46	0 to 65535	28718	Fault subcode
	U0-61	0 to 65535	28733	AC drive operation status word 1
	U0-68	0 to 65535	28740	AC drive operation status word 2
Common parameters of the power supply unit	U0-00	0 V to 6553.5 V	28672	Bus voltage
	U0-01	-50°C to 150°C	28673	Heatsink temperature
	U0-04	0 V to 1000 V	28676	Input voltage Usr
	U0-05	0 V to 1000 V	28677	Input voltage Ust
	U0-06	0 V to 1000 V	28678	Input voltage Utr
	U0-07	0.0% to 100.0%	28679	Degree of three-phase input voltage unbalance (%)

Communication Monitoring Parameters

Table 6–11 Monitoring parameters of drive unit

Parameter	Parameter Name	Unit	Decimal Address
U0-00	Operating frequency	0.01 Hz	28672
U0-01	Frequency reference	0.01 Hz	28673
U0-02	Bus voltage	0.1 V	28674
U0-03	Output voltage	1 V	28675
U0-04	Output current	0.01 A	28676
U0-05	Output power	0.1 kW	28677

Parameter	Parameter Name	Unit	Decimal Address
U0-06	Output torque	0.1%	28678
U0-07	DI input state	1	28679
U0-08	RO/DO output state	1	28680
U0-09	AI1 voltage	0.01 V	28681
U0-10	AI2 voltage	0.01 V	28682
U0-11	AI3 voltage	0.01 V	28683
U0-12	Counting value	1	28684
U0-13	Length value	1	28685
U0-14	Load speed display	1	28686
U0-15	PID reference	1	28687
U0-16	PID feedback	1	28688
U0-17	PLC stage	1	28689
U0-19	Feedback speed	0.01 Hz	28691
U0-20	Remaining running time	0.1 min	28692
U0-21	AI1 gain and voltage after offset	0.001V	28693
U0-22	AI2 gain and voltage after offset	0.001 V	28694
U0-23	AI3 gain and voltage after offset	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
U0-28	Communication setpoint	0.01%	28700
U0-30	Display of main frequency X	0.01 Hz	28702
U0-31	Display of auxiliary frequency Y	0.01 Hz	28703
U0-33	Synchronous motor rotor position	0.1°	28705
U0-34	Reserved	1	28706
U0-35	Target torque	0.1%	28707
U0-37	Power factor angle	0.1°	28709
U0-39	Target voltage upon V/f separation	1 V	28711
U0-40	Output voltage upon V/f separation	1 V	28712

Parameter	Parameter Name	Unit	Decimal Address
U0-41	DI input state display	1	28713
U0-42	DO/RO output state display	1	28714
U0-43	DI function state display 1	1	28715
U0-44	DI function state display 2	1	28716
U0-45	Fault code	1	28717
U0-46	Fault subcode	1	28718
U0-47	Drive unit temperature	1°C	28719
U0-48	Voltage received by PTC channel 1	0.001 V	28720
U0-49	Voltage received by PTC channel 2	0.001 V	28721
U0-50	Voltage received by PTC channel 3	0.001 V	28722
U0-51	PTC1 temperature	1°C	28723
U0-52	PTC2 temperature	1°C	28724
U0-53	PTC3 temperature	1°C	28725
U0-54	Motor speed	1 rpm	28726
U0-55	Automatically-allocated station number	1	28727
U0-56	Auto-tuned axis type	1	28728
U0-57	Fan speed	1 rpm	28729
U0-61	AC drive operation status word 1	1	28733
U0-64	Special protocol status word	1	28736
U0-68	AC drive operation status word 2	1	28740
U0-78	AC drive rated current	0.1 A	28750
U0-79	AC drive power	0.1 kW	28751
U0-81	Local LED state	1	28753
U0-88	Alarm code	1	28760
U0-89	Alarm subcode	1	28761
U0-90	Percentage of preset fan speed	1%	28762
U0-91	PTC1 mode	1	28763
U0-92	PTC2 mode	1	28764
U0-93	PTC3 mode	1	28765

Parameter	Parameter Name	Unit	Decimal Address
U0-95	STO initialization flag	1	28767
U0-96	STO status word monitoring	1	28768
U0-97	STO model	1	28769
U0-98	STO AD sampling value	1	28770
U0-99	STO internal execution flag	1	28771

6.8 Communication Configuration

6.8.1 Configuration for EtherNet/IP Communication Between AC Drive and AC810

Software Acquisition and Hardware Wiring

1. Visit the official website of Inovance at http://www.inovance.com/support/download.html to obtain Inovance programming software InoProShop and the latest EDS file of the SI-EN card. The EDS file is named "MD800-EN1_Vn.nn.eds" and n.nn is the version number. Use V1.00 or later.
2. Use a standard network cable to connect the LAN A or B interface of AC810 to the network port 1 or 2 on the SI-EN card of the AC drive.

Instances

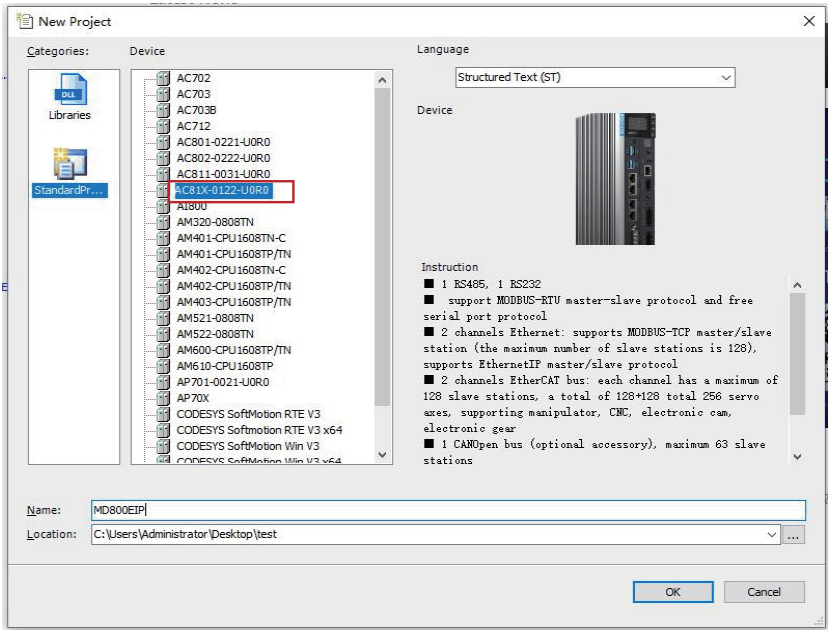
Take the InoProShop v1.7.3 and AC810 as an example. Before the communication configuration, set the following items:

- Set the IP address of the SI-EN card via the parameters AD-00 to AD-12. See IP Address Setting of SI- EN Card in *"6.7 Parameters" on page 145*.
- Set the AC drive parameters as the following table.

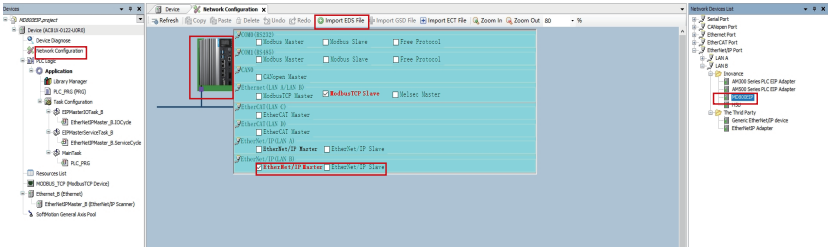
Type	Parameter	Value
Rectifier unit	FD-10	3
Rectifier unit	FD-01	800
Rectifier unit	F0-02	⩾ L05.04
Rectifier unit	FD-18	1
Rectifier unit	FD-39	0
Inverter unit	F0-02	2
Inverter unit	F0-03	9

Configure the communication as follows.

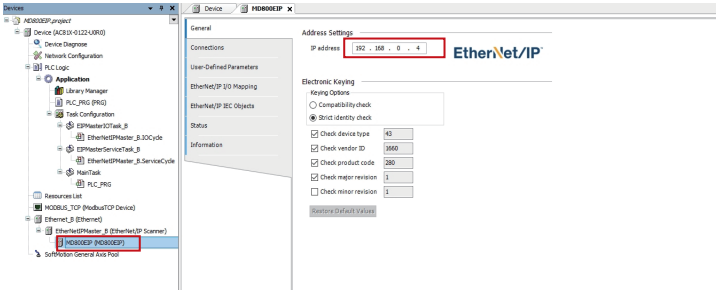
1. Create a project.
   Open InoProShop, and select **AC81X-0122-U0R0**.



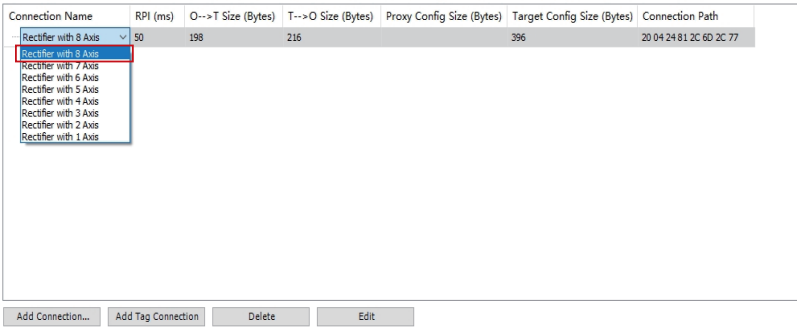
2. Import the EDS file and add a slave.
   Open the **Network Configuration** interface and click the PLC to select the current communication protocol as **EtherNet/IP Master**. Then Click **Import EDS File** above to import the EDS file of the SI-EN card. And import the device in the **Network Device List** on the right pane.



3. Configure the slave parameters.
   a. Click **MD800 (MD800)** and set the slave **IP Address**.



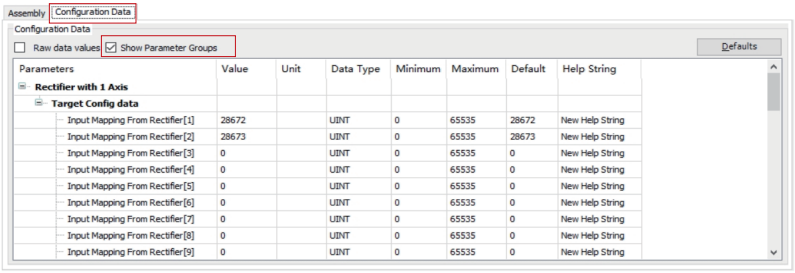
b. Select **Rectifier with 8 Axis**.



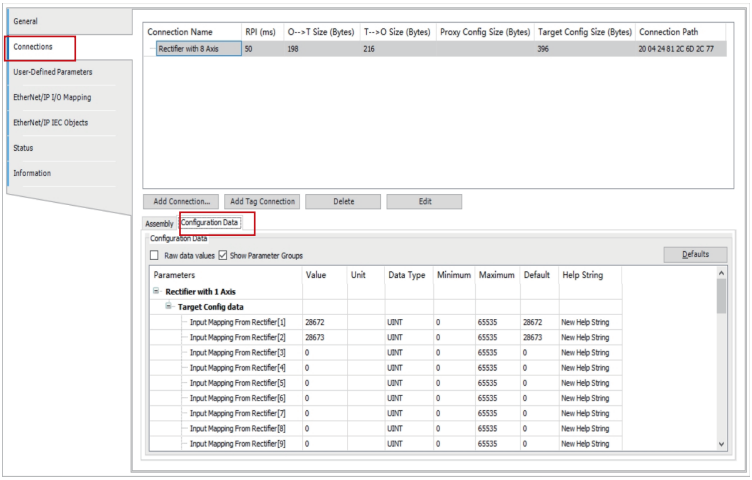
c. Check **Show Parameter Groups** to ensure that the parameter update is complete.

Caution

If **Show Parameter Groups** is not checked, check it. If it is checked, uncheck it first, and then check it again.



d. Click **Connections>Configuration Data** to configure the implicit message mapping relationship.



As shown in the above figure, in Input Mapping From Rectifier [x]/Axis *i* (*i* =1 to 8) [x], [x] is the data mapping sent from the slave to the master; in Output Mapping to Rectifier [x]/Axis i (i = 1 to 8) [x], [x] is the data mapping sent from the master to the slave, with a maximum of 11 mappings per item.

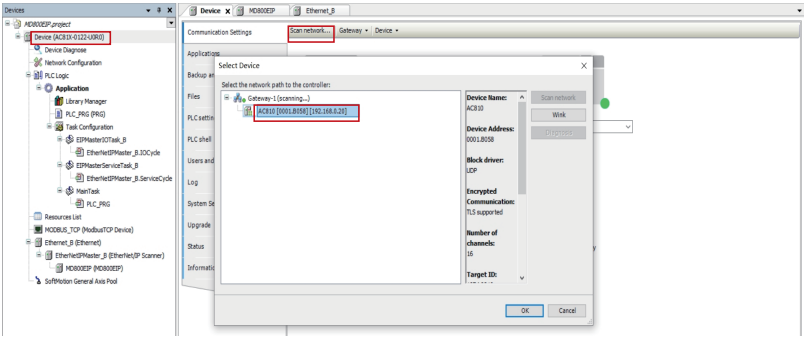
The default mapping of some target configuration data is shown in the following table. The mapping of the remaining target configuration data is 0 by default. You can configure it to other values.

Table 6–12

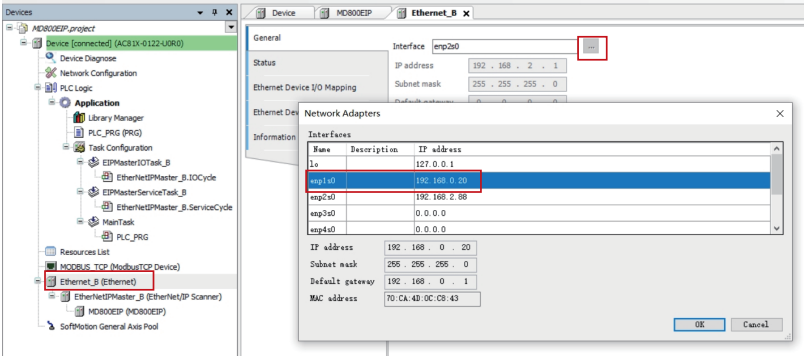
Target Configuration Data	Default Mapping	
	Parameter	Communication Address (In the Decimal Format)
Input Mapping From Axis *i* (*i* =1 to 8) [1]	U0-68	28740
Input Mapping From Axis *i* (*i* =1 to 8) [2]	U0-00	28672
Input Mapping From Rectifier [1]	U0-00	28672
Input Mapping From Rectifier [2]	U0-01	28673
Output Mapping to Axis *i* (*i* =1 to 8) [1]	U3-17	29457
Output Mapping to Axis *i* (*i* =1 to 8) [2]	U3-16	29456

4. Configure the IP address for the master.

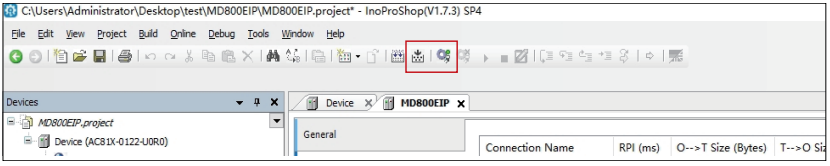
   a. Click **Scan network** and choose the master that needs to be configured, such as AC810.



b. Select the IP address assigned by the network port of the master according to the scanned IP address of the master.



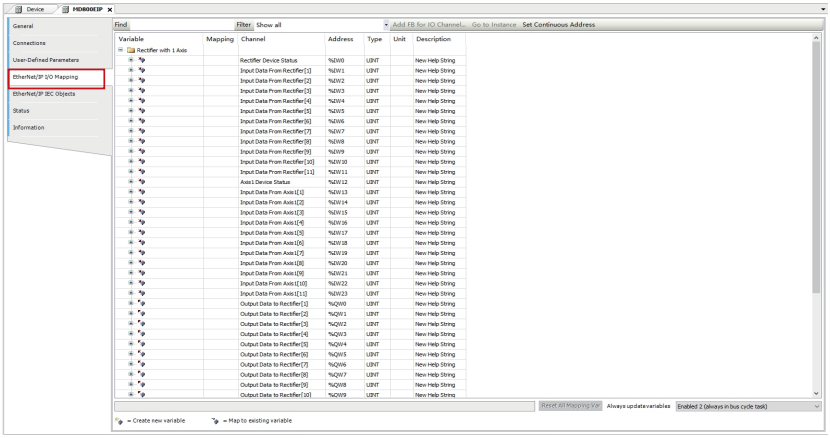
5. Compile and download the project to the PLC.



After downloading, click **EtherNet/IP I/O Mapping** to see the **Output Data and Input Data**.

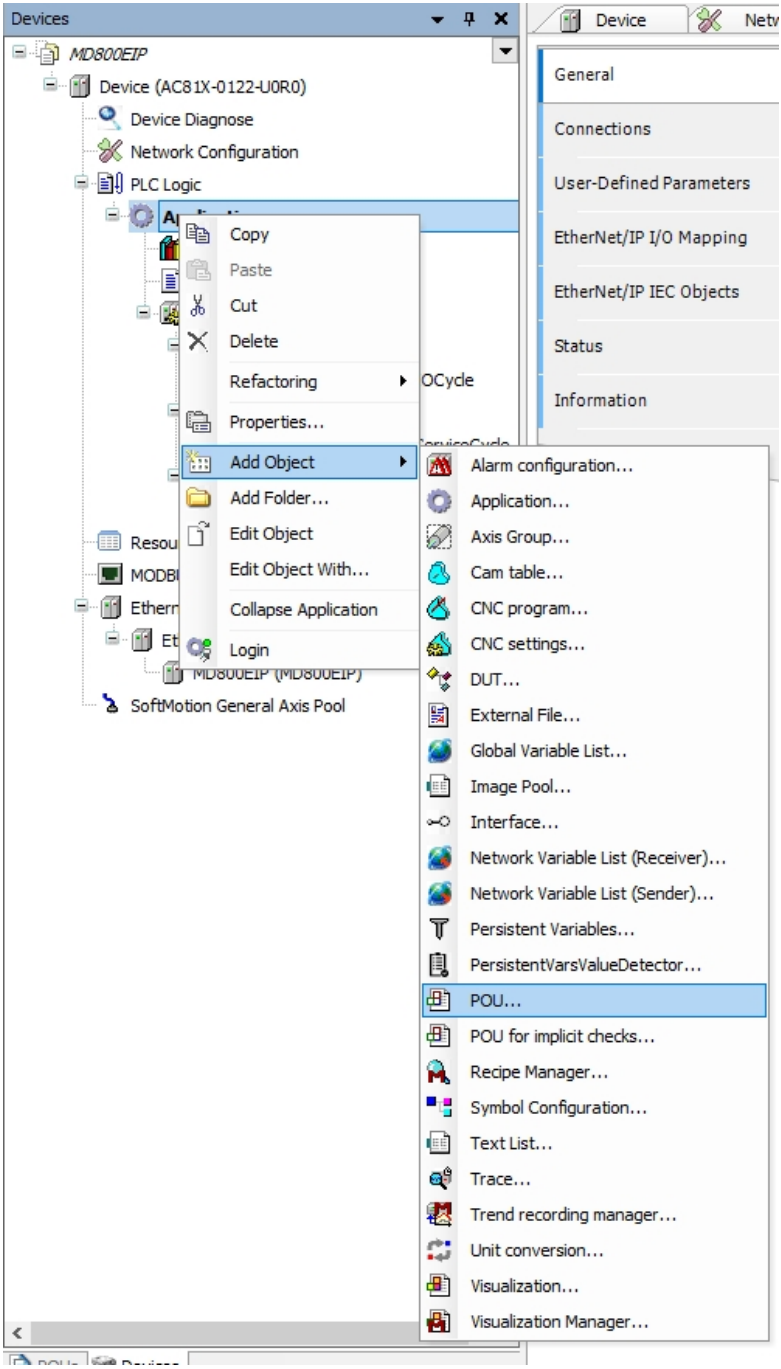
Note

There is one I/O in both rectifier and Axis *i* (*i* = 1 to 8) to indicate the slave state.

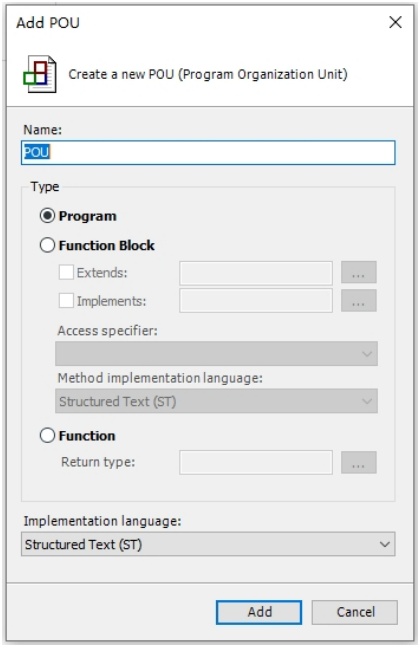


6. Transmit data through explicit messaging.

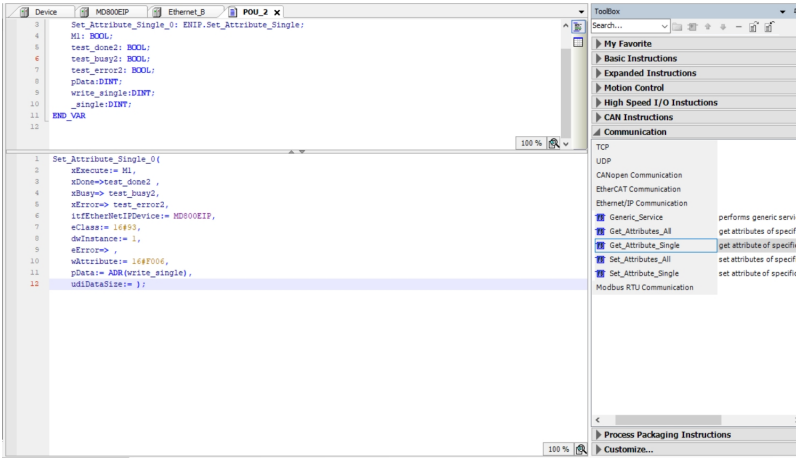
   a. Right-click **Application** and go to **Add Object > POU**.


Devices
MD800EIP
Device (AC81X-0122-U0R0)
Device Diagnose
Network Configuration
PLC Logic
Copy
Paste
Cut
Delete
Refactoring
Properties...
Add Object
Add Folder...
Edit Object
Edit Object With...
Collapse Application
Login
SoftMotion General Axis Pool
Device
General
Connections
User-Defined Parameters
EtherNet/IP I/O Mapping
EtherNet/IP IEC Objects
Status
Information
Alarm configuration...
Application...
Axis Group...
Cam table...
CNC program...
CNC settings...
DUT...
External File...
Global Variable List...
Image Pool...
Interface...
Network Variable List (Receiver)...
Network Variable List (Sender)...
Persistent Variables...
PersistentVarsValueDetector...
POU...
POU for implicit checks...
Recipe Manager...
Symbol Configuration...
Text List...
Trace...
Trend recording manager...
Unit conversion...
Visualization...
Visualization Manager...

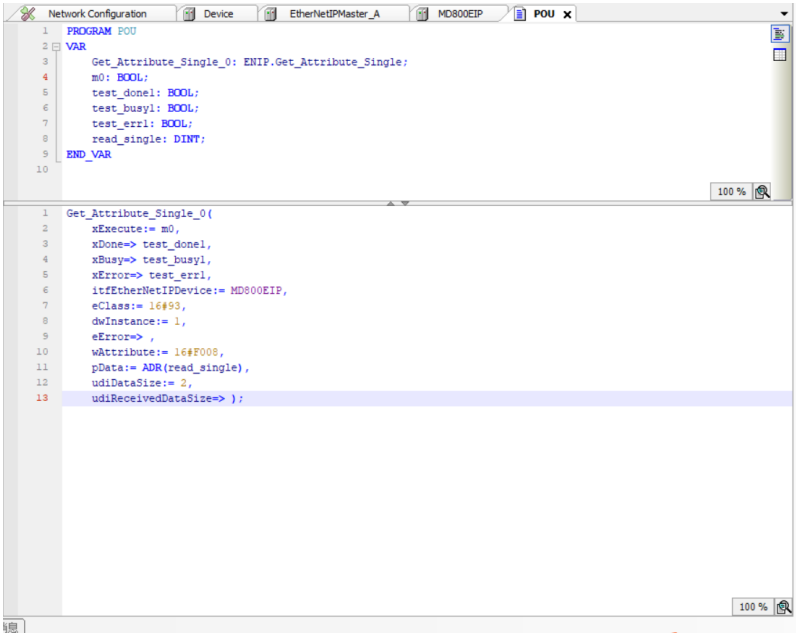
b. In the pop-up dialog box, select **Structured Text (ST)** from the **Implementation language** drop-down box.



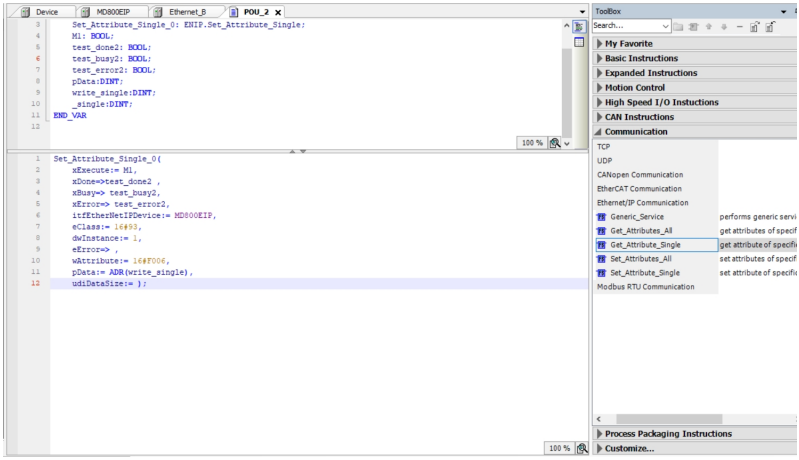
c. Select **EtherNet/IP Communication** in the toolbox on the right pane. Select **Get_Attribute_Single** to read a parameter. Select **Set_Attribute_Single** to write a parameter.



d. The PLC program for reading the parameter is as follows.

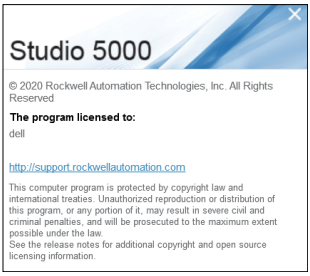


e. Read the parameter through Get_Attribute_Single. eClass is fixed to 0x93 in hexadecimal; dwInstance is the station number 1 of the drive unit (see Explicit Message Configuration in *"6.7 Parameters" on page 145*), and WAttribute is the parameter address (For example, the hexadecimal equivalent of F0-08 is F008). pData is the data that has been read, and udiDataSize is the size of that data. The PLC program for writing the parameter is as follows.



6.8.2 Configuration for EtherNet/IP Communication Between AC Drive and AB L1756-L71

Take the Studio5000 and 1756-L71 as an example.



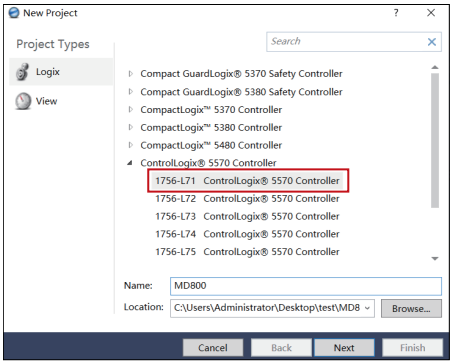
Before the communication configuration, set the following items:

- Set the IP address of the SI-EN card via the parameters AD-00 to AD-12. See IP Address Setting of SI- EN Card in *"6.7 Parameters" on page 145*.
- Set the AC drive parameters as the following table.

Type	Parameter	Value
Rectifier unit	FD-10	3
Rectifier unit	FD-01	800
Rectifier unit	F0-02	L05.04
Rectifier unit	FD-18	1
Rectifier unit	FD-39	0
Inverter unit	F0-02	2
Inverter unit	F0-03	9

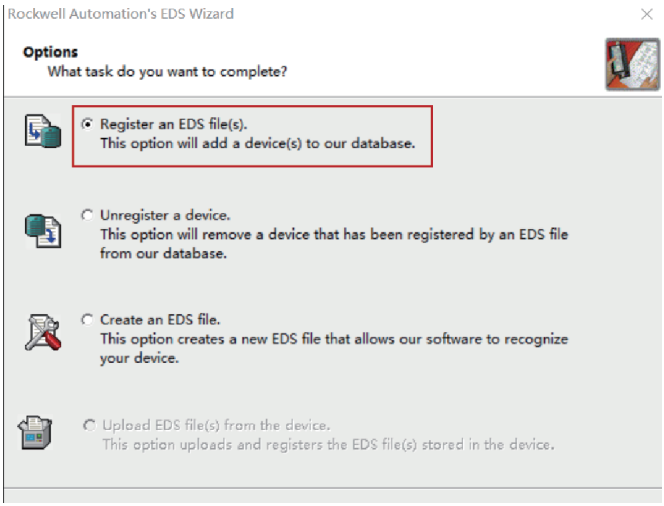
To configure the communication, do as follows:

1. Open Studio 5000 and create a project. Select **1756-L71 ControlLogix® 5570 Controller** under **ControlLogix® 5570 Controller** as the controller model.

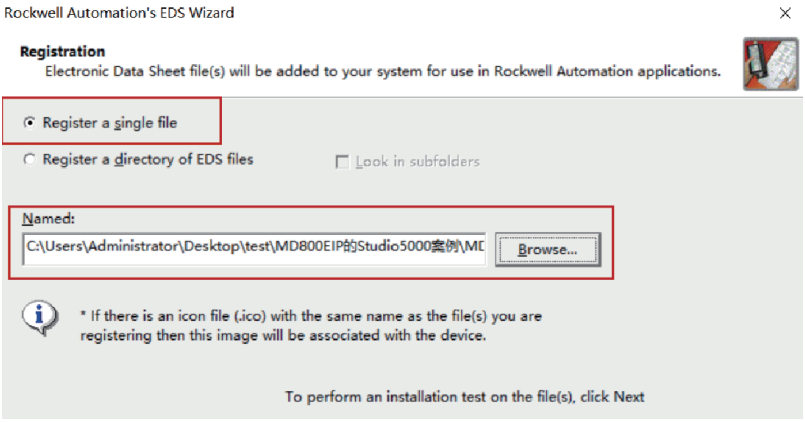


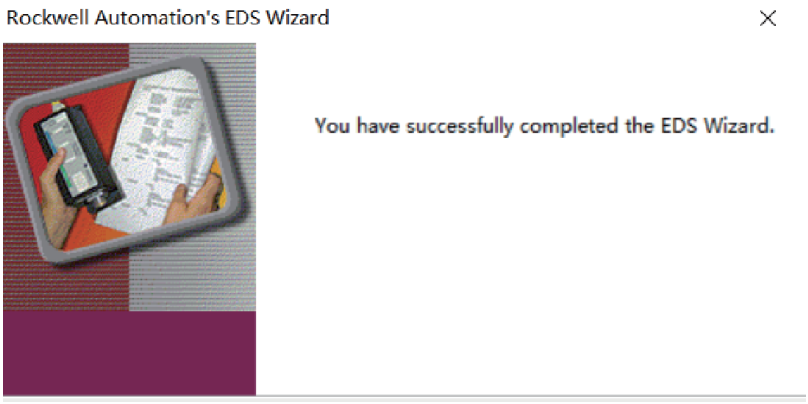
2. Import the EDS file.

a. Click **Tools > EDS Hardware Installation Tool** and click **Next** to choose **Register an EDS file(s)**.



b. After the EDS file is registered, click **Next** until the task is completed.

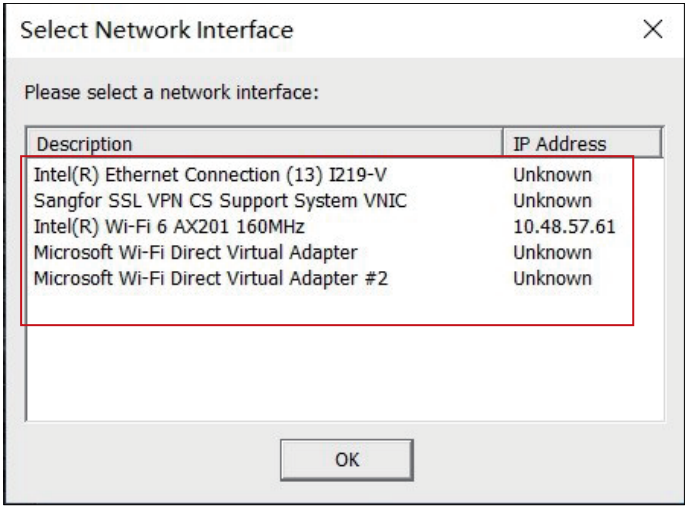




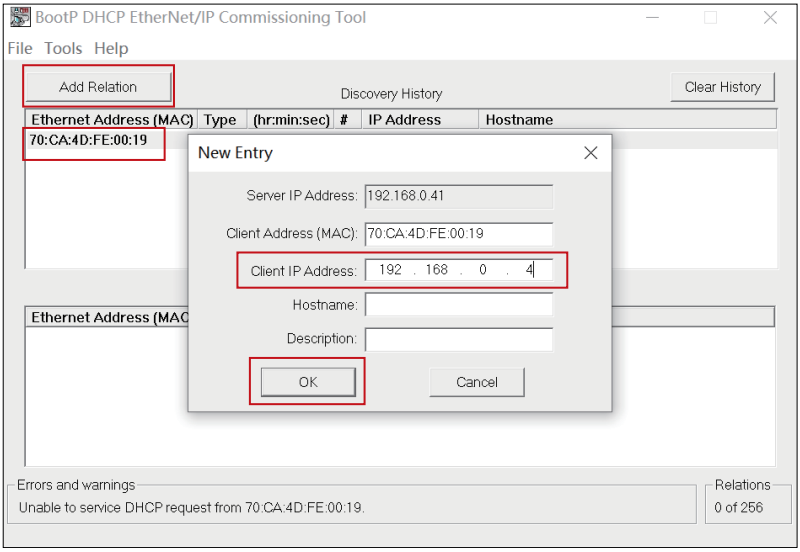
3. Set the IP address of the SI-EN card. Use either static IP or DHCP to set the IP address. To use the static IP address, set AD-00 to AD-12. To use DHCP, do as follows:

   a. Set AD-00 to 1 to enable DHCP mode and restart the AC drive.

   b. Ensure the PC and AC drive are on the same network. Open the BootP DHCP EtherNet/IP Commissioning Tool and select the corresponding network interface in the dialog box displayed. After power-on, the software sends an IP request message.

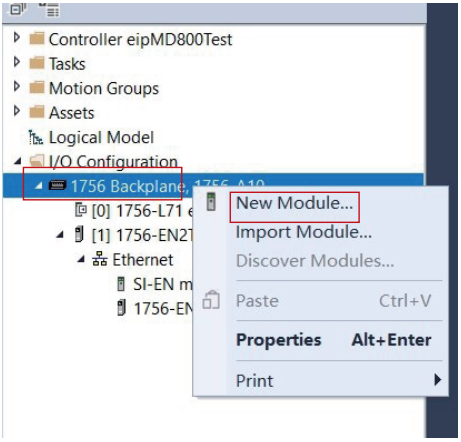


   c. Select the software MAC address and click **Add Relation**. Change the **Client IP Address** and click **OK** in the pop-up dialog box. Then the IP address is set.

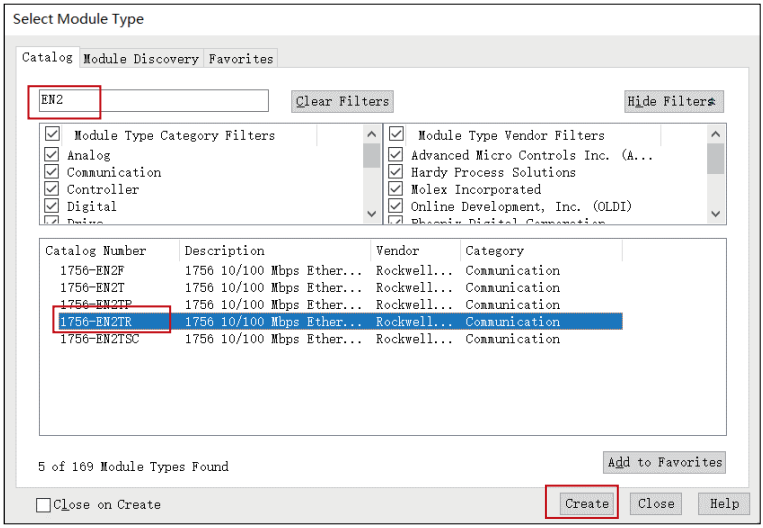


4. Configure the Studio 5000 project.

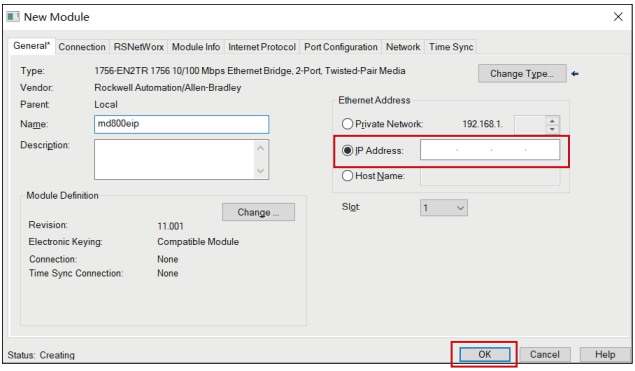
   a. In the left pane of the software, right click **1756Backplane**, and select **New Module**.



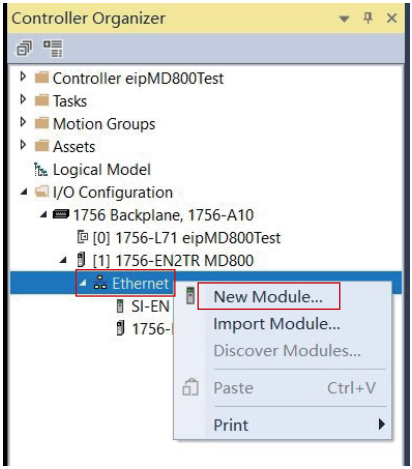
   b. Enter **EN2** to perform search, and select **1756-EN2TR** in the result list. Click **Create**.



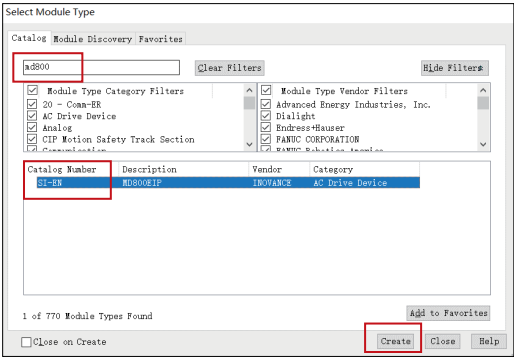
c. Set the **Name** and **IP Address** and click **OK**.



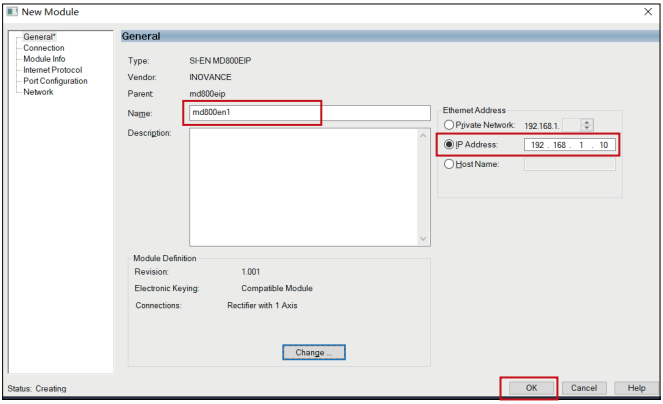
5. On the added device list, right-click **Ethernet** and select **New Module**.



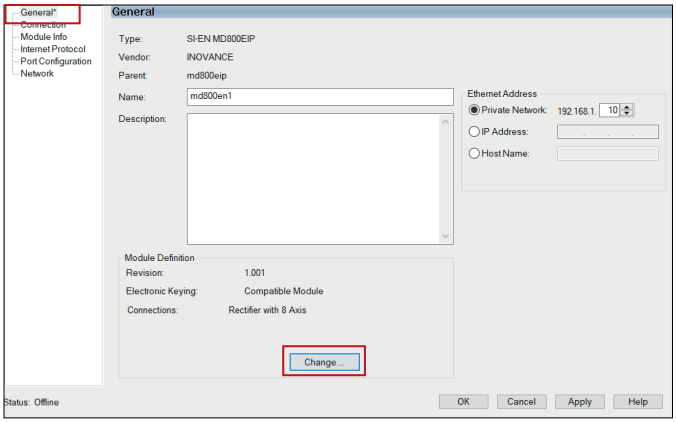
Enter **MD800** to perform search and select SI-EN and click **Create**.



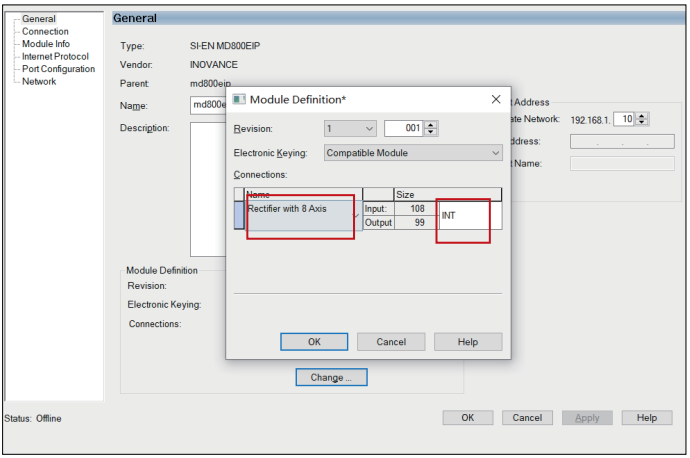
Set the **Name** and **IP Address** and click **OK**.



Double-click the added **md800en1**. In the displayed interface, click **General**, and then click **Change**.

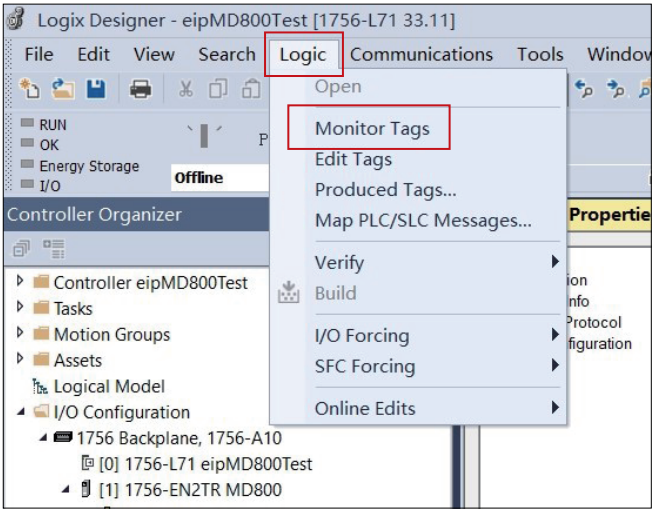


Select **Rectifier with 8 Axis** in the Name list. Select **INT** as the unit, and then click **OK**. If a warning is displayed, select **Yes** to ignore the warning.

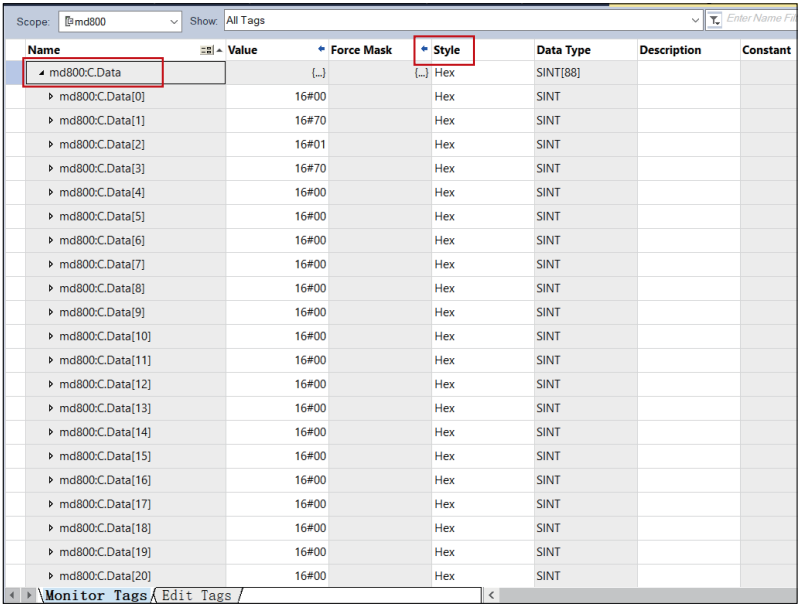


6. Configuration the data mapping

   a. Choose **Logic** > **Monitor Tags**.



b. Unfold **MD800:C.Data**, and select **Hex** in the **Style** column.



c. Configure mapping parameters

Every two parameters are combined to form a parameter mapping group. For example, C.Data[0] = 44 and C.Data[1] = 70 together map to the parameter U0-68, representing **Input Mapping from Rectifier[1]**.

The mapping parameter description for each PDO is as follows:

- C.Data[0] to [21]: Input Mapping from Rectifier
- C.Data[22] to [43]: Output Mapping to Rectifier
- C.Data[X1]: Input Mapping from Axis *i,* X1=(0 to 21)+44 x *i*, *i* =1 to 8.
- C.Data[X2]: Output Mapping to Axis *i,* X2= (22 to 43)+44 x *i*, *i* =1 to 8.

The default mapping of some target configuration data is shown in the following table. The mapping of the remaining target configuration data is 0 by default. You can configure it to other values.

Target Configuration Data		Default Mapping	
		Parameter	Communication Address Mapping Parameter
C:Data[0 + 44 × i], *i* =1 to 8 C:Data[1 + 44 × i], *i* =1 to 8	Input Mapping From Axis *i* (*i* =1 to 8) [1]	U0-68	C:Data[0 + 44 × i] = 44, i = 1 to 8 C:Data[1 + 44 × i] =70, i =1 to 8
C:Data[2 + 44 × i], *i* =1 to 8 C:Data[3 + 44 × i], *i* =1 to 8	Input Mapping From Axis *i* (*i* =1 to 8) [2]	U0-00	C:Data[2 + 44 × i] =0, i =1 to 8 C:Data[3 + 44 × i] =70, i = 1 to 8
C:Data[0] C:Data[1]	Input Mapping From Rectifier [1]	U0-00	C:Data[0] = 0 C:Data[1] = 70
C:Data[2] C:Data[3]	Input Mapping From Rectifier [2]	U0-01	C:Data[2] = 1 C:Data[3] = 70
C:Data[22 + 44 × i], *i* =1 to 8 C:Data[23 + 44 × i], *i* =1 to 8	Output Mapping to Axis *i* (*i* =1 to 8) [1]	U3-17	C:Data[22 + 44 × i] =11, *i* =1 to 8 C:Data[23 + 44 × i] = 73, *i* =1 to 8
C:Data[24 + 44 × i], *i* =1 to 8 C:Data[25 + 44 × i], *i* =1 to 8	Output Mapping to Axis *i* (*i* =1 to 8) [2]	U3-16	C:Data[24 + 44 × i] = 10, *i* =1 to 8 C:Data[25 + 44 × i] = 73, *i* =1 to 8

Note

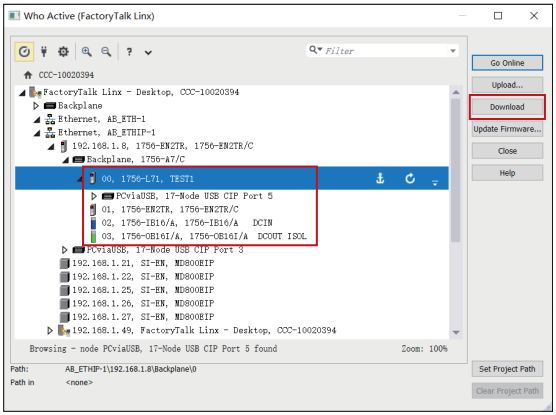
- md800_eip:I.Data and md800_eip:O.Data are IO data during transmission. The value written into the md800_eip:O.Data is written into the parameter configured through mapping, and the received data is uploaded to the md800_eip:I.Data.
- In the md800_eip:I.Data, I.Data[X] indicates the online state of the drive and X equals to 0 +12 x i (i = 0 to 8).

7. Compile and download the project to the PLC.

   a. Click  to perform device searching.

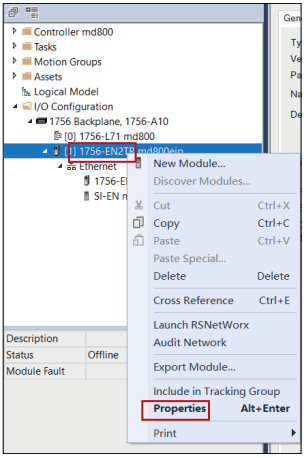


b. Select the MD800 device and then click **Download** to download the program to the PLC.

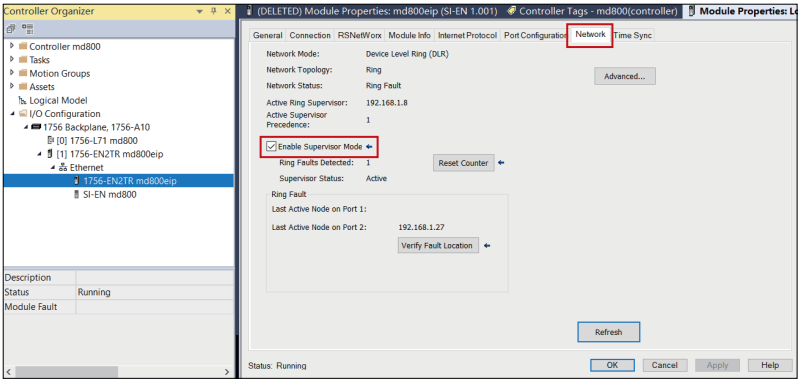


8. If the topology is ring type, connect the ring network and configure the controller.

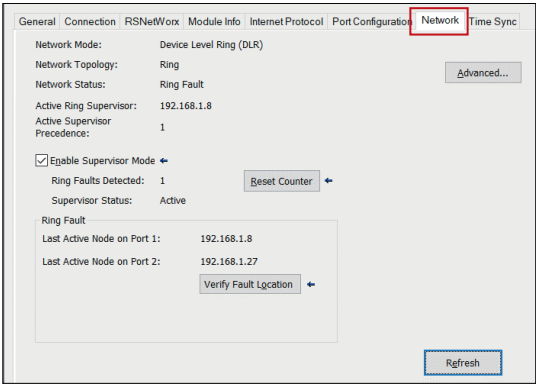
a. In the left pane, right-click the corresponding controller and select **Properties.**



b. Switch to the **Network** tab on the **Module Properties** interface. Select **Enable Supervisor Mode** and click **OK** to enable the controller network supervisor function.

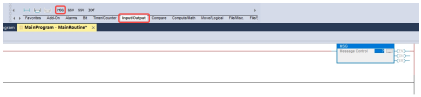


c. Connect the master station and the SI-EN card to form a ring typology, and open the interface again. You can see the current network mode and the network status,etc.

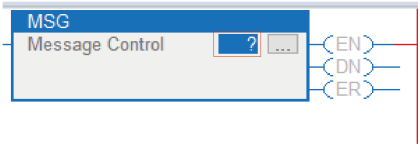


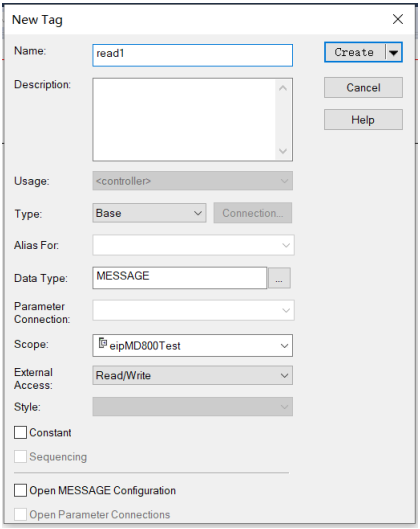
9. Transmit data through explicit messaging.

a. Open the PLC programming section and click **MSG** of **Input/Output** .

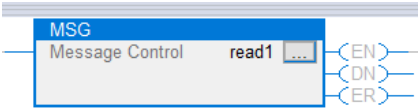


b. Right-click the question mark and select **New Tag**. Then fill in **Name** on the pop-up dialog box, and click **Create**.

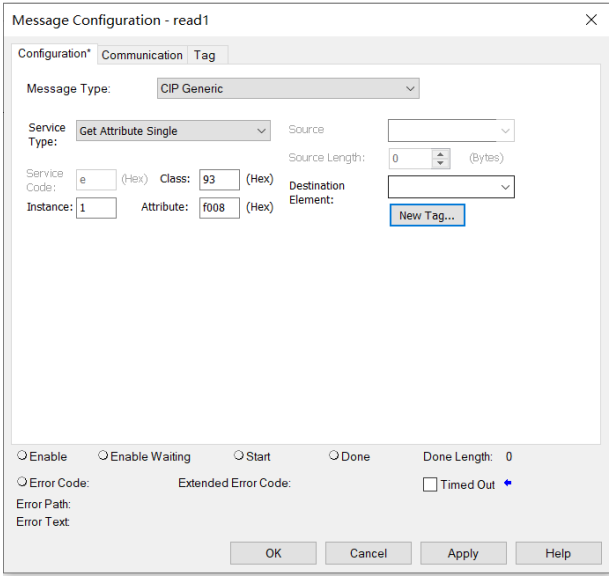




c. Click the "..." button.

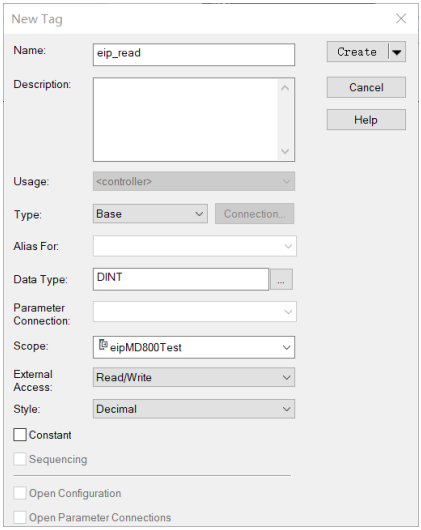


d. Configure as the following figures to read the parameter.

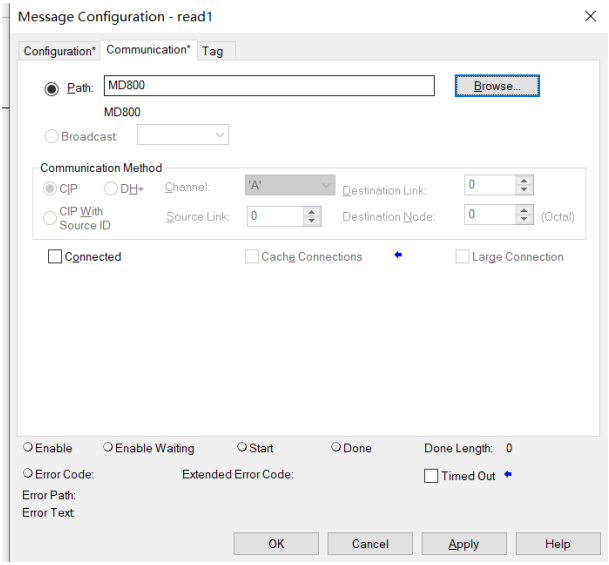


Select **Set Attribute Single** from the **Service Type** drop-down list. **Class** is fixed to 0x93 in hexadecimal; **Instance** is the station number 1 of the drive unit (see Explicit Message Configuration in *"6.7 Parameters" on page 145*), and **Attribute** is the parameter address (For example, the hexadecimal equivalent of F0-08 is F008 and the decimal value is 61448). The **Destination Element** on the right pane is used to select where to save the parameter. You can also use **New Tag** to create a tag.

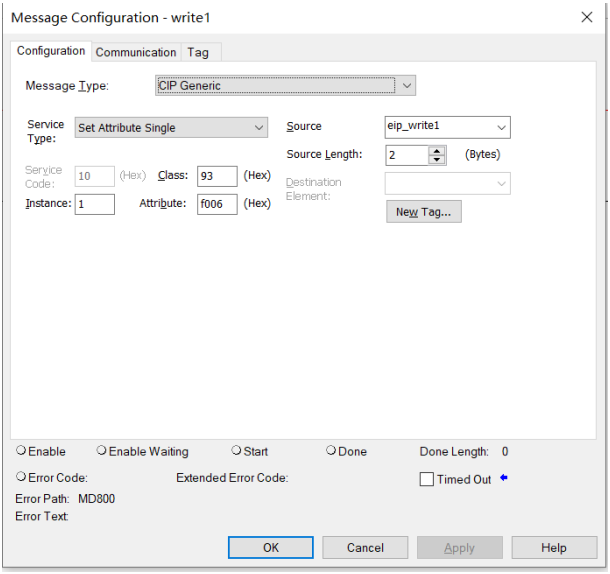
a. Click **New Tag** to create a tag, fill in **Name**, and click **Create.**



b. Click the **Communication** tab, select the corresponding AC drive using **Browse**, and click **OK**. The master station reads the parameter and saves the data to the selected tag. You can see the value of this tag in **Monitor Tags**.



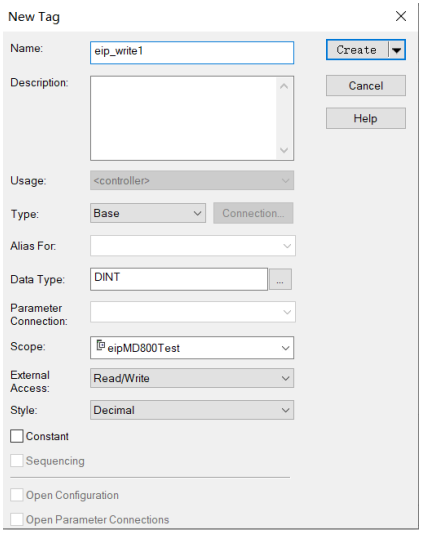
c. Configure as the following figures to write the parameter.



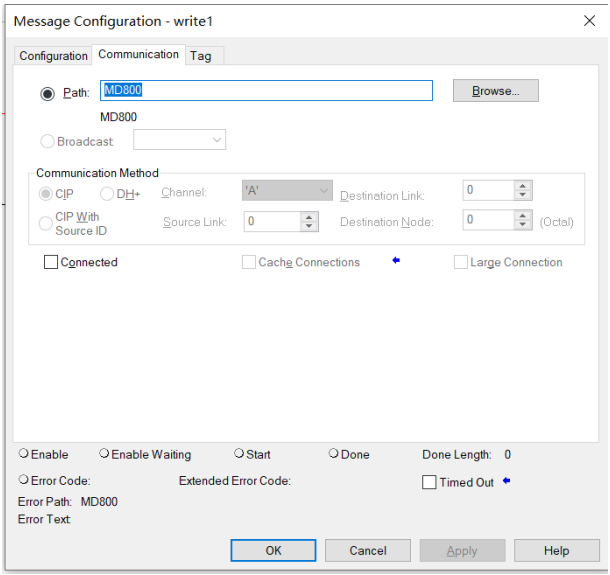
Select **Set Attribute Single** from the **Service Type** drop-down list. **Class** is fixed to 0x93 in hexadecimal; **Instance** is the station number 1 of the drive unit (see Explicit Message Configuration in *"6.7 Parameters" on page 145*), and **Attribute** is the parameter address (For example, the hexadecimal equivalent of F0-06 is F006 and the decimal value is

61446). The **Destination Element** on the right pane is used to select where to save the parameter. You can also use **New Tag** to create a tag.

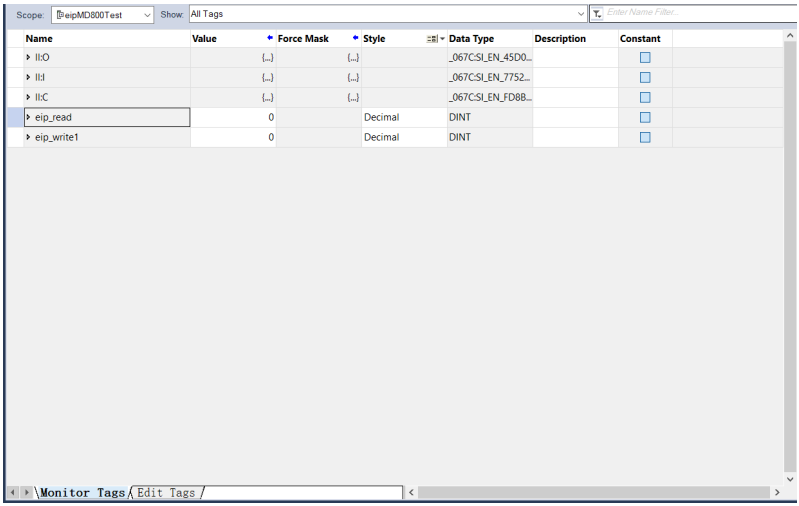
a. Click **New Tag** to create a tag, fill in **Name**, and click **Create.**



b. Click the **Communication** tab, select the corresponding AC drive using **Browse**, and click **OK**. The master station reads the parameter and saves the data to the selected tag. You can see the value of this tag in **Monitor Tags**.



c. See the tags to read/write parameters on the **Monitor Tags** window as shown below.



6.9 Fault Diagnosis

The following table describes the faults that may occur during use of the SI-EN card and the AC drive.

Fault code	Fault cause	Solution	Reset method
E16.71	Master station offline during operation of the communication card	Check and ensure that the connection between the communication card and PLC is normal. Check whether the network cable in use is the shielded Cat 5e cable. Check and ensure the proper grounding and no EMC interference issues. Check whether the master station is normal.	When FD-06 is set to 1, auto reset is performed. When FD-06 is set to 0, you need to manually reset the fault.
E16.72	Internal slave station offline during operation of the communication card	Check and ensure that both the connection between the communication card and the power supply unit, as well as the connection between the power supply unit and the drive unit, are normal.	
E16.74	Communication card configuration fault	Check whether the configured slave station exists and whether startup with slave loss is disabled. (Check whether FD-50 is set to 0.)	
E16.75	Configurations of drive unit mappings on the communication card faulty	Check and ensure that the number of pieces of process data configured for the drive unit is consistent with the number of mapping relations.	
E16.76	Configurations of power supply unit mappings on the communication card faulty	Check and ensure that the number of pieces of process data configured for the power supply unit is consistent with the number of mapping relations.	
E16.81	Communication card connection failure	Check and ensure that the communication link is normal and the master station is running properly.	
E16.82	Ethernet hardware error	Contact the agent or Inovance.	
E16.83	MAC address not configured	Contact the agent or Inovance.	
E16.84	IP address conflict	Ensure that the IP of the AC drive is different from that of other devices.	

Appendix 6000H Group Object Dictionary of CiA402 Protocol

Protocol

Index 603Fh	Name	Error code			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Uint16
	Access	RO	Mapping	TPDO	Mode	ALL	Data Range	0 to 65535	Default Setting	/
The read error code is internally-defined error code and does not comply with the DS402 profile. The high-order eight bits are the fault code and the high-order eight bits are the fault subcode.										

Index 6040h	Name	Control word			Setting Condition & Effective Time	During operation	Data structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Mode	ALL	Data Range	0 to 65535	Default	0
For details on control commands, see *"Table –13 " on page 181*.										

Table –13 Control command descriptions

Bit	Name	Description
0	Switch on	1: Active; 0: Inactive
1	Enable voltage	1: Active; 0: Inactive
2	Quick stop	0: Active; 1: Inactive
3	Enable operation	1: Active; 0: Inactive
4-6	Operation mode specific	Related to the operation mode
7	Fault reset	The rising edge of bit 7 is used to reset a fault. If the value is always 1, the fault reset is disabled.
8	Reserved	Not defined

Bit	Name	Description
9	Operation mode specific	Related to the operation mode
10	Reserved	Not defined
11-15	Manufacturer-specific	Manufacturer-defined
Bits 11 to Bit 15 are manufacturer-defined.		

Index 6041h	Name	Status word			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Uint16
	Access	RO	Mapping	TPDO	Mode	ALL	Data Range	0 to 65535	Default	0
For details on the drive unit state, see *"Table –15 " on page 182*.										

Table –14 Descriptions of the drive unit state

Bit	Name	Description
0	Ready to switch on	1: Active; 0: Inactive
1	Switch on	1: Active; 0: Inactive
2	Operation enabled	1: Active; 0: Inactive
3	Fault	1: Active; 0: Inactive
4	Voltage enabled	1: Active; 0: Inactive
5	Quick stop	0: Active; 1: Inactive
6	Switch on disabled	1: Active; 0: Inactive
7	Not defined	
8	Manufacturer-specific	
9	Remote	1: Active; 0: Inactive
10	Target reach	1: Active; 0: Inactive
11-15	Not defined	

Table –15 Examples of the drive unit state

Value (Binary)	Description
Xxxx xxxx x0xx 0000	Not ready to switch on
Xxxx xxxx x1xx 0000	Switch on disabled
Xxxx xxxx x01x 0001	Ready to switch on
Xxxx xxxx x01x 0011	Switch on
Xxxx xxxx x01x 0111	Operation enabled

Value (Binary)	Description
Xxxx xxxx x00x 0111	Quick stop active
Xxxx xxxx x0xx 1111	Fault reaction active
Xxxx xxxx x0xx 1000	Fault

Index 6042h	Name	vl target velocity			Setting Condition & Effective Time	During operation	Data structure	VAR	Data Type	int16
	Access	RO	Mapping	RPDO	Mode	vl	Data Range	-32768 -32767	Default	0

1. The unit of the target velocity is determined by F8-64. The value 0 indicates Hz and 1 indicates rpm.
2. When the unit is Hz, set the corresponding parameters according to the unit. Assume that F0-22 is set to 2 and the frequency resolution is 0.01 Hz. To set the target frequency to 10.00 Hz, write 1000 through communication. Assume that F0-22 is set to 1 and the frequency resolution is 0.1 Hz. To set the target frequency to 10.0 Hz, write 100 through communication.
3. When the unit is rpm, the supported speed ranges from -32768 to 32767. If the speed exceeds this range, use the unit of Hz to support a higher speed.

Index 6043h	Name	vl velocity demand			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	int16
	Access	RO	Mapping	RPDO	Mode	vl	Data Range	-32768 -32767	Default	0

1. The vl velocity demand is the instantaneous velocity provided by the ramp function.
2. The unit is the same as the unit of the target velocity 6042h.

Index 6044h	Name	vl velocity actual value			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	int16
	Access	RO	Mapping	TPDO	Mode	vl	Data Range	-32768 -32767	Default	0
1. The actual running velocity of the drive unit. It indicates the synchronous frequency in the case of V/f control and represents the velocity estimated according to the motor mode in the case of SVC control. 2. The unit is the same as the unit of the target velocity 6042h.										

Index 6046h	Name	vl velocity min max amount			Setting Condition & Effective Time	/	Data Structure	ARR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Mode	vl	Data Range	OD data range	Default	OD default value
It indicates the minimum or maximum running velocity.										

Sub-index 0h	Name	Number of entries of min/max velocity			Setting Condition & Effective Time	/	Data Structure	/	Data Type	Uint8
	Access	RO	Mapping	NO	Mode	vl	Data Range	/	Default	2

Sub-index 1h	Name	vl velocity min amount			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Mode	vl	Data Range	0 to 65535	Default	0
It indicates the minimum velocity (unit: Hz) at which the drive unit is allowed to run. The value is limited by the maximum frequency (F0-10) and sub-index 2. You can view the actual value by querying F0-14 (unit: Hz).										

Sub-index 2h	Name	vl velocity max amount			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Mode	vl	Data Range	0 to 65535	Default	1500
It indicates the maximum velocity (unit: rpm) at which the drive unit is allowed to run. The value is limited by the maximum frequency (F0-10).										

Index 6048h	Name	vl velocity acceleration			Setting Condition & Effective Time	/	Data Structure	ARR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Mode	vl	Data Range	OD data range	Default	OD default value
It is used to set the acceleration time of the drive unit.										

Sub-index 0h	Name	Number of entires of velocity acceleration			Setting Condition & Effective Time	/	Data Structure	/	Data Type	Uint8
	Access	RO	Mapping	NO	Mode	vl	Data Range	/	Default	2

Sub-index 1h	Name	Delta speed			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Mode	vl	Data Range	1 to 65535 (unit: rpm)	Default	1500
Set F0-25 to 0. If F0-25 is set to other values, the acceleration time will be inaccurate.										

Sub-index 2h	Name	Delta time			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Mode	vl	Data Range	0 to 65536 (unit: s)	Default	20
Set F0-19 to 1 or 2. If F0-19 is set to 0, the acceleration/deceleration time will be inaccurate due to calculation error.										

Index 6049h	Name	vl velocity deceleration			Setting Condition & Effective Time	/	Data Structure	ARR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Mode	vl	Data Range	OD data range	Default	OD default value

Sub-index 0h	Name	Number of entires of velocity deceleration			Setting Condition & Effective Time	/	Data Structure	/	Data Type	Uint8
	Access	RO	Mapping	NO	Mode	vl	Data Range	/	Default	2

Sub-index 1h	Name	Delta speed			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Uint32
	Access	RW	Mapping	RPDO	Mode	vl	Data Range	1–65535	Default	1500
Set F0-25 to 0. If F0-25 is set to other values, the deceleration time will be inaccurate.										

Sub-index 2h	Name	Delta time			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Mode	vl	Data Range	0 to 65535	Default	20
Set F0-19 to 1 or 2. If F0-19 is set to 0, the acceleration/deceleration time will be inaccurate due to calculation error.										

Index 605Ah	Name	Quick stop option code			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Int16
	Access	RW	Mapping	NO	Mode	ALL	Data Range	0 to 2	Default	1
Value descriptions 0: Coast to stop 1: Decelerate to stop. The deceleration time is set by F0-18, namely, the time set by 6049h in vl mode. 2: Emergency stop. The deceleration time is set by F8-60.										

Index 605Bh	Name	Shutdown option code			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Int16
	Access	RW	Mapping	NO	Mode	ALL	Data Range	0 to 1	Default	1
Value descriptions 0: Coast to stop 1: Decelerate to stop. The deceleration time is set by F0-18, namely, the time set by 6049h in vl mode.										

Index 605Ch	Name	Disable operation option code			Setting Condition & Effective Time		Data Structure	VAR	Data Type	Int16
	Access	RW	Mapping	NO	Mode	ALL	Data Range	0 to 1	Default	1
Value descriptions 0: Coast to stop 1: Decelerate to stop. The deceleration time is set by F0-18, namely, the time set by 6049h in vl mode.										

Index 605Eh	Name	Disable operation option code			Setting Condition & Effective Time		Data Structure	VAR	Data Type	Int16
	Access	RW	Mapping	NO	Mode	ALL	Data Range	0	Default	0
0 (available): Coast to stop										

Index 6060h	Name	Modes of operation Modes of operation			Setting Condition & Effective Time		Data Structure	VAR	Data Type	Int8
	Access	RW	Mapping	RPDO	Mode	ALL	Data Range	0 to 9	Default	2
Value descriptions 0: NA 1: NA 2: vl (velocity mode) 3: NA 4: NA 5: NA 6: NA 7: NA 8: NA 9: Cyclic Synchronous Velocity (CSV) Mode										

Index 6061h	Name	Mode of operation display			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Int8
	Access	RO	Mapping	RPDO	Mode	ALL	Data Range	0 to 9	Default	9
Value descriptions 0: NA 1: NA 2: vl (velocity mode) 3: NA 4: NA 5: NA 6: NA 7: NA 8: NA 9: Cyclic Synchronous Velocity (CSV) Mode										

Index 606Ch	Name	Velocity actual value			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Int32
	Access	RO	Mapping	TPDO	Mode	CSV	Data Range	-2^{31} to $+(2^{31}-1)$	Default	/
It indicates the actual running speed of the drive unit.										

Index 6077h	Name	Torque actual value			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Int16
	Access	RO	Mapping	TPDO	Mode	ALL	Data Range	Unit: 0.1%	Default	/
The unit uses the rated motor torque as the base value.										

Index 607Eh	Name	Polarity			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Uint8
	Access	RO	Mapping	TPDO	Mode	CSV	Data Range	0 to 255	Default	0
Set the target velocity limit through Bit 6. If Bit 6 is set to 0, the target velocity is 60FF+60B1. If bit 6 is set to 1, the target velocity is -(60FF+60B1).										

Index 60B1h	Name	Velocity offset Velocity offset			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Int32
	Access	RO	Mapping	TPDO	Mode	CSV	Data Range	$-2^{31}$to (2^{31}-1) unit: rpm	Default	0

Index 60FDh	Name	Digital inputs Digital Inputs			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Uint32
	Access	RO	Mapping	YES	Mode	ALL	Data Range	0 to (2^{31}-1) Unit: /	Default	0
0 to 26: Reserved 27: STO1 28: STO2 29: EDM 30 to 31: Reserved										

Index 60FFh	Name	Target velocity			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Int32
	Access	RW	Mapping	YES	Mode	CSV	Data Range	$-2^{31}$to (2^{31}-1) unit: rpm	Default	0

Index 6502h	Name	Supported drive modes Supported drive modes			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Uint32
	Access	RO	Mapping	RO	Mode	ALL	Data Range	0 to 2^{32}	Default	0x00000102
0: NA 1: Vl supported 2: NA 3: NA 4: NA 5: NA 6: NA 7: NA 8: CSV supported 9 to 31: Reserved										

Index 20FDh	Name	Communication parameters			Setting Condition & Effective Time	/	Data Structure	ARR	Data Type	Uint16
	Access	RW	Mapping	NO	Mode	ALL	Data Range		Default	0

Sub-index 8h	Name	Object dictionary Retained upon power failure			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Mode	ALL	Data Range	0 to 1	Default	0
The FD-07 parameter decides whether the object dictionary can be saved at power failure by modifying the SDO. Set FD-07 to 0 to save without power failure, and set FD-07 to 1 to save at power failure. Part of the object dictionary entries can be saved at power failure by modifying the SDO and some of them do not support. See the following table.										
• 603F: Not supported • 6040: Not supported • 6041: Not supported • 6042: Not supported • 6043: Not supported • 6044: Not supported • 6046-0: Not supported • 6046-1: Supported • 6046-2: Supported • 6048-0: Not supported • 6048-1: Supported • 6048-2: Supported • 6049-0: Not supported					• 6049-1: Supported • 6049-2: Supported • 605A: Supported • 605B: Supported • 605C: Supported • 605E: Supported • 6060: Supported • 6061: Not supported • 606C: Not supported • 6077: Not supported • 607E: Supported • 60B1: Not supported • 60FF: Not supported					

Sub-index Ch	Name	402 mode supported			Setting Condition & Effective Time	/	Data Structure	VAR	Data Type	Uint16
	Access	RW	Mapping	RPDO	Mode	ALL	Data Range	0 to 1	Default	0
0: Operate in non-402 mode; 1: Operate in 402 mode.										

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