



MD800 Series AC Drive (Multidrive System) Communication Guide



Industrial
Automation



Intelligent
Elevator



New Energy
Vehicle



Industrial
Robot



Rail
Transit



Data code 19011496 A01

Preface

Introduction

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

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

More Documents

Document Name	Description
MD800 Series AC Drive (Multidrive System) Quick Installation and Commissioning Guide	Describes the installation, wiring, quick commissioning, commissioning parameters, and troubleshooting during commissioning.
MD800 Series AC Drive (Multidrive System) Design and Selection Guide	Describes the system composition, technical specifications, and dimensions of the AC drive, specific specifications and selection of options (including installation accessories, cables, and peripheral electrical components), common EMC problems and solutions, and certifications and standards.
MD800 Series AC Drive (Multidrive System) Maintenance Guide	Describes the routine maintenance, component replacement, and troubleshooting of the product.
MD800 Series AC Drive (Multidrive System) Function Guide	Describes the software tools, system commissioning procedures, parameters, fault codes, and product functions and applications.

Revision History

Date	Version	Description
September 2021	A01	Updated the communication networking diagrams in the following sections: 2.2 Networking and Interfaces (2 Modbus) 3.2 Networking and Interfaces (3 CANopen and CANlink Communication) 4.4 Networking Topology (4 PROFINET Communication) 5.4 Networking Topology (5 EtherCAT Communication) Added "Table 3-7 CN3 terminal pins" and "Table 3-8 CN4 terminal pins" in the description of CANopen (CN3)/CANlink (CN4) communication terminals in the section "3.2 Networking and Interfaces". Updated the algorithm formula for manually setting the station number in the section "1.4.1 Station Number Settings". Added the section "3.6 Communication Error". Deleted the ECAT card communication fault codes E16.11 and E16.12 from the section "ECAT Card Communication Error".
March 2021	A00	First release

Document Acquisition

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

Log in to Inovance's website (<http://en.inovance.cn/>), choose Support > Download, perform keyword search, and download the PDF file.

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	Vendor Defined 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.
-

Fault Code

The following table lists standard fault codes of the MD800 AC drive. For details about the fault codes, see the MD800 Series Multidrive AC Drive Maintenance Guide.

Table –2 Fault code of the drive unit

AC Drive Fault Information	AC Drive Fault Information
0000: No fault 0001: Hardware fault 0002: Overcurrent during acceleration 0003: Overcurrent during deceleration 0004: Overcurrent during operation at constant speed 0005: Overvoltage during acceleration 0006: Overvoltage during deceleration 0007: Overvoltage during operation at constant speed 0008: Reserved 0009: Undervoltage fault 000A: AC drive overload 000B: Motor overload 000C: Reserved 000D: Output phase loss 000E: Heatsink overheat 000F: External fault 0010: Communication error 0011: Contactor fault 0012: Current detection fault 0013: Motor auto-tuning fault 0014: Reserved	0015: EEPROM read-write fault 0016: Motor auto-tuning error 0017: Motor shorted to the ground 0018: Motor inter-phase short circuit 0019: Power supply unit fault 001A: Running time reach 001B: User-defined fault 1 001C: User-defined fault 2 001D: Power-on time reach 001E: Load lost 001F: PID feedback loss during operation 002A: Excessive speed deviation 002B: Motor overspeed 002D: Motor overtemperature 002F: STO fault 0037: Reserved 0050: Fan fault 0063: I/O mapping resource lost

Table –3 Fault code of the power supply unit

AC Drive Fault Information	AC Drive Fault Information
0000: No fault 000C: Grid voltage abnormal 000E: IGBT overtemperature 0010: Communication error 0015: EEPROM fault	003D: Braking unit fault 0050: Fan unit abnormal 0062: Internal communication error 0063: Extension card fault

Table of Contents

Preface	1
Emergency Message and AC Drive Faults.	3
1 Parameter Communication Address.	7
1.1 Parameter Data	7
1.2 Parameter Communication Address.	7
1.3 Modbus-Specific Parameter Communication Addresses.	8
1.4 Station Number Allocation	12
1.4.1 Station Number Settings	12
1.4.2 Parameters	15
2 Modbus Communication.	17
2.1 Communication Overview.	17
2.2 Networking and Interfaces	17
2.3 Communication Transmission Mode	18
2.4 Communication Data Frame Structure	19
2.5 Parameters	23
2.6 Communication Configuration.	24
2.6.1 Configuration for RS485 Communication Between AC Drive and H5U.	24
2.6.2 Configuration for RS485 Communication Between AC Drive and AM600.	29
3 CANopen and CANlink Communication.	37
3.1 Protocol Description.	37
3.2 Networking and Interfaces	41
3.3 Parameters	43
3.4 Application	45
3.4.1 Communication Data Frame Structure	45
3.4.2 Operation Example (SDO)	46
3.4.3 Operation Example (PDO)	49
3.5 Communication Configuration.	51
3.5.1 Configuration for CANlink Communication Between AC Drive and H5U	51
3.5.2 Configuration for CANopen Communication Between AC Drive and H5U	56
3.6 Communication Error.	61
3.6.1 Simple Diagnosis.	61
4 PROFINET Communication.	63
4.1 Overview	63
4.2 Installing	63
4.3 Hardware Layout.	63

4.4	Networking Topology	65
4.5	PZD Data	66
4.6	Parameters	68
4.7	Communication Configuration.	69
4.7.1	Configuration.	69
4.7.2	MRP Function and Configuration	79
4.8	Troubleshooting	81
4.8.1	Communication Fault Code.	81
4.8.2	PLC Diagnosis Information	82
5	EtherCAT Communication.	84
5.1	Overview	84
5.2	Installing	84
5.3	Hardware Layout.	85
5.4	Networking Topology	87
5.5	PDO Data	88
5.6	SDO Data	91
5.7	Parameters	91
5.8	Communication Configuration.	99
5.8.1	Configuration for EtherCAT Communication Between AC Drive and H5U.	99
5.8.2	Example of Configuration on Beckhoff Controller Using ECAT Card	104
5.8.3	Example of Configuration on AM600 Master Station Using ECAT Card	111
5.8.4	Example of Configuration on Omron Master Station Using ECAT Card	113
5.9	Troubleshooting	119
5.9.1	ECAT Card Communication Error	119

1 Parameter Communication Address

1.1 Parameter Data

Parameters of the AC drive include basic function parameters and monitoring function parameters. They are stored in corresponding parameter groups. Basic function parameters are stored 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 for the monitoring function parameters including operation commands, running status, running parameters, and alarm information.

Monitoring Function Parameter	Status data (read-only)	U0 and 8000H ^{Note 1}
	Control parameter (write-only)	U3 and 1000H ^{Note 1}

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

1.2 Parameter Communication Address

Groups F0 to FF and A0 to AF each include multiple function parameters. For example, F0-16 indicates the 16th parameter in group F0. In the communication address of a function parameter, the high 16 bits indicate the number of the parameter group, whereas the low 16 bits are the hexadecimal data format of the serial number of the parameter in the group. For example, the communication address of F0-16 is 0xF010. In addition, writing basic function parameters and performing power-off save cause frequent operations on EEPROM, reducing the service life of EEPROM. Therefore, some basic function parameters are modified by changing the values in RAM through communication without being stored.

For parameters in group F, corresponding RAM addresses are obtained by replacing F with 0 in the higher bit of the address. For example, the communication RAM address of F3-12 is 0x030C.

For parameters in group A, corresponding RAM addresses are obtained by replacing A with 4 in the higher bit of the address. For example, the communication RAM address of A0-05 is 0x4005.

Parameter Group No.	Communication Access Address	Modified RAM Parameter Address Through Communication
F0 to FE	0xF000 to 0xFEFF	0x0000 to 0x0EFF
A0 to AF	0xA000 to 0xACFF	0x4000 to 0x4CFF
U0	0x7000 to 0x70FF	-
U3	0x7300 to 0x73ff	-
U4	0x7400 to 0x74ff	-
U5	0x7500 to 0x75ff	-

Parameter groups have the following restrictions:

- Group FF: Parameters cannot be read or changed.
- Groups U0, U4, and U5: Parameters can be read, but cannot be changed. Group U3: Parameters can be read and changed.
- 1000H and 8000H are communication addresses specific to Modbus.
- 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

Para. Address		Description
Communication frequency reference 1	1000H	Communication setting value (decimal) –10000 to +10000 Communication setting values correspond to percentages. +10000 and –10000 correspond to +100.00% and –100.00% respectively. For frequency data, this percentage is relative to the maximum frequency (F0-10). For torque data, this percentage is F2-10 (Digital setting of torque upper limit).
Communication frequency reference 2	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.

Para. Address		Description
Control command input to AC drive (write-only)	7311H	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: Fault reset
Read AC drive state 1	703DH	1: Forward run 2: Reverse run 3: Stop 4: Auto-tuning 5: Fault
Read AC drive state 2	7044H	Bit0: Running status Bit1: Forward/Reverse state Bit2: Whether a fault occurs Bit3: Whether the output frequency reaches the frequency reference Bit4: Communication normal flag Bit5 to Bit7: Reserved Bit8 to Bit15: Fault code
Parameter locking password check	1F00H	Parameter locking password check: If the actual password value is returned, password check succeeds. (If no password is set, namely, the password is 0, 0000H is returned.)

Para. Address		Description
DO control	7312H	Bit0: DO1/RO1 output control Bit1: DO2/RO2 output control Bit2: DO3/RO3 output control Bit3: DO4/RO4 output control Bit4: DO5/RO5 output control Bit5 to bit15: Reserved

Para. Address		Description
AC drive fault description	8000H	Power supply unit fault: 12: Grid voltage abnormal 14: IGBT overtemperature 16: Communication error 21: EEPROM fault 61: Braking unit fault 80: Fan unit abnormal 98: Internal communication error 99: Extension card fault Drive unit 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 during operation at constant speed 9: Undervoltage fault 10: AC drive overload 11: Motor overload 13: Output phase loss 14: Heatsink overheat 15: External fault 16: Communication error 17: Contactor fault 18: Current detection fault 19: Motor auto-tuning abnormal 21: EEPROM read-write fault 22: Motor auto-tuning error 23: Motor shorted to the ground 24: Motor inter-phase short circuit 25: Power supply unit fault 26: Running time reach 27: User-defined fault 1 28: User-defined fault 2 29: Power-on time reach 30: Load lost 31: PID feedback loss during PID operation 42: Excessive speed deviation 43: Motor overspeed 45: Motor overtemperature 47: STO fault 61: Braking unit fault 80: Fan fault 99: I/O mapping resource lost

1.4 Station Number Allocation

1.4.1 Station Number Settings

When AC drives are cascaded, Fd-18 must be set.

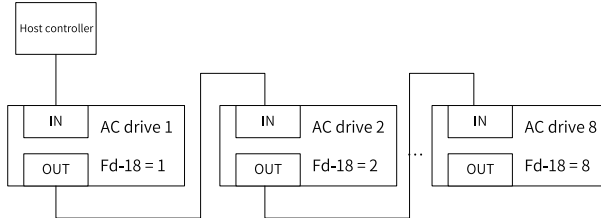


Figure 1-1 System cascading topology

Automatically Assigning Station Number

1. Set parameters Fd-18 and Fd-39 of each power supply unit as appropriate. By default, Fd-18 is set to 1 and Fd-39 is set to 0 (auto mode).
Set Fd-18 to the number of the current AC drive.

Set Fd-39 to 0 to enable auto assignment of station numbers.

2. After the above setting, restart the AC drive.
3. Formula and diagram of algorithm for auto station number assignment:
Algorithm:

Station number of power supply unit = $Fd-18 \times 16$

Station number of drive unit = Number of current slot + $(Fd-18 - 1) \times 16$

Example:

If Fd-18 is set to 1, the station number of drive unit 1 is $1 + (1 - 1) \times 16$, that is, 1.

Station number of slot 1 = $14 + (Fd-18 - 1) \times 16$

Station number of slot 2 = $15 + (Fd-18 - 1) \times 16$

Station number of slot 3 = $13 + (Fd-18 - 1) \times 16$

You can refer to Fd-93...Fd-99 to view the station number of the device connected to a slot.

The following figures show the current station numbers of devices 1 and 2.

Device cascading No. FD-18 = 1 FD-39 = 0

Station No. of slot 1	Station No. of power supply unit	Station No. of drive unit 1	Station No. of drive unit 2	Station No. of drive unit 3	Station No. of drive unit 4	Station No. of drive unit 5	Station No. of drive unit 6	Station No. of drive unit 7	Station No. of drive unit 8	Station No. of slot 3
14										
Station No. of slot 2	16	1	2	3	4	5	6	7	8	13
15										

Figure 1-2 Current station number of device 1

Device cascading No. Fd-18 = 2, Fd-39 = 0

Station No. of slot 1	Station No. of power supply unit	Station No. of drive unit 1	Station No. of drive unit 2	Station No. of drive unit 3	Station No. of drive unit 4	Station No. of drive unit 5	Station No. of drive unit 6	Station No. of drive unit 7	Station No. of drive unit 8	Station No. of slot 3
30										
Station No. of slot 2	32	17	18	19	20	21	22	23	24	29
31										

Figure 1-3 Current station number of device 2

Manually Setting Station Number

- Set parameters Fd-18 and Fd-39 of each power supply unit as appropriate. By default, Fd-18 is set to 1 and Fd-39 is set to 0 (auto mode).
Set Fd-18 to the number of the power supply unit.

Set Fd-39 to 1 (manual mode). In this mode, the station number is determined by Fd-40 to Fd-48.
- Set Fd-40...Fd-48 to assign station numbers as needed.
- Restart the AC drive to make the settings take effect.
- Formula and diagram of algorithm for auto station number assignment:
Algorithm:

Station number of power supply unit = Fd-40

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

Station number of slot 1 = $(Fd-18 - 1) \times 7 + 133$

Station number of slot 2 = $(Fd-18 - 1) \times 7 + 134$

Station number of slot 3 = $(Fd-18 - 1) \times 7 + 132$

You can refer to Fd-93...Fd-99 to view the station number of the device connected to a slot.

Example: The following table lists the parameter value when two AC drives are cascaded.

Para.	Name	Value of AC Drive 1	Value of AC Drive 2
Fd-18	Number of the power supply unit	1	2
Fd-39	Station number setting mode	1	1
Fd-40	Manual setting of power supply unit station number	1	10
Fd-41	Manual setting of drive unit 1 station number	2	11
Fd-42	Manual setting of drive unit 2 station number	3	12
Fd-43	Manual setting of drive unit 3 station number	4	13
Fd-44	Manual setting of drive unit 4 station number	5	14
Fd-45	Manual setting of drive unit 5 station number	6	15
Fd-46	Manual setting of drive unit 6 station number	7	16
Fd-47	Manual setting of drive unit 7 station number	8	17
Fd-48	Manual setting of drive unit 8 station number	9	18

The following figures show the current station numbers of devices 1 and 2.

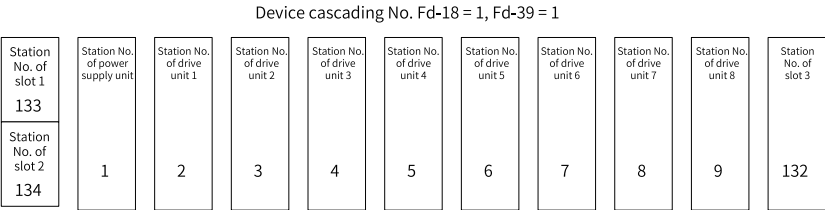


Figure 1-4 Current station number of device 1

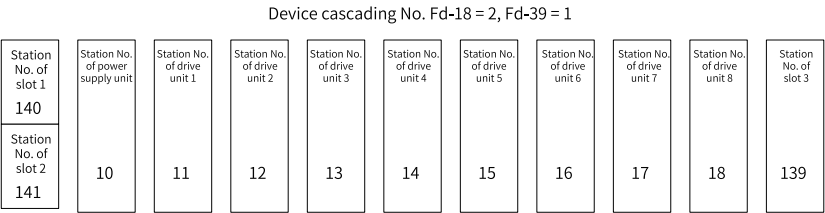


Figure 1-5 Current station number of device 2

Station Number Conflict Detection

- Auto assign mode

No station number conflict will occur in this mode. Station number conflicts between cascaded AC drives cannot be detected.

- Manual assign mode

An alarm is triggered in the case of duplicate station numbers in one group. Station number conflicts between cascaded AC drives cannot be detected.

1.4.2 Parameters

The following parameters are all set in the power supply unit. You do not need to set any parameters in the drive unit.

Table 1-2 Parameters

Para.	Name	Value Range	Meaning	Attribute	Description
Fd-18	Number of the power supply unit	1 to 15		RW	The number of each group of AC drive. The system can automatically assign station numbers for a maximum of 15 groups. $15 \times 16 = 240$. The value cannot exceed 255.
Fd-39	Station number setting mode	0 to 1	0: Auto 1: Manual	RW	Specifies the mode of station number assignment.
Fd-40	Manual setting of power supply unit station number	0 and 1 to 127		RW	The station number of the power supply unit that is manually set.
Fd-41	Manual setting of drive unit 1 station number	0 and 1 to 127		RW	
Fd-42	Manual setting of drive unit 2 station number	0 and 1 to 127		RW	
Fd-43	Manual setting of drive unit 3 station number	0 and 1 to 127		RW	
Fd-44	Manual setting of drive unit 4 station number	0 and 1 to 127		RW	
Fd-45	Manual setting of drive unit 5 station number	0 and 1 to 127		RW	
Fd-46	Manual setting of drive unit 6 station number	0 and 1 to 127		RW	
Fd-47	Manual setting of drive unit 7 station number	0 and 1 to 127		RW	
Fd-48	Manual setting of drive unit 8 station number	0 and 1 to 127		RW	

Note: When Fd-39 is set to 1, Fd-40 to Fd-48 are valid.

Para.	Name	Value Range	Meaning	Attribute	Description
Fd-93	Station number of device connected to extension card slot 1		The station number of the current 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 device connected to extension card slot 2		The station number of the current slot	R	
Fd-95	Station number of device connected to extension card slot 3		The station number of the current slot	R	
Fd-96	Station number of device connected to extension card slot 4		The station number of the current slot	R	
Fd-97	Station number of device connected to extension card slot 5		The station number of the current slot	R	
Fd-98	Station number of device connected to extension card slot 6		The station number of the current slot	R	
Fd-99	Station number of device connected to extension card slot 7		The station number of the current slot	R	

2 Modbus Communication

2.1 Communication Overview

The AC drive is provided with RS485 communication interfaces and can serve as a communication slave in a PC/PLC control network that includes one master and multiple slaves. You can use a computer or PLC to implement centralized control, such as setting operation commands, modifying or reading parameters, and reading running state and fault information of the AC drive.

The AC drive supports the Modbus-RTU slave communication protocol. This protocol defines the content and format of messages transmitted 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 returns a fault message as a response to the master.

2.2 Networking and Interfaces

In a network consisting of one master and multiple slaves, one device is the master (a PC, PLC, or HMI) and initiates communication to perform parameter read or write operations on slaves, whereas other devices (slaves) respond to queries or operations from the master. Only one device is allowed to transmit data at a time, whereas other devices should be in data receiving status.

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

Communication Networking

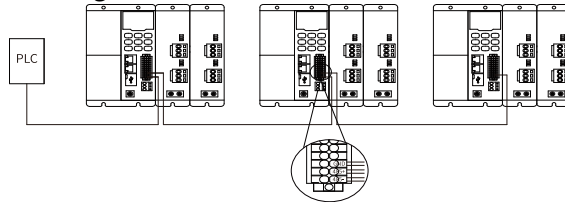


Figure 2-1 Modbus communication networking

Communication Interface

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

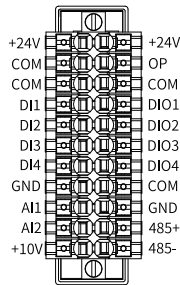


Figure 2-2 Modbus communication interface

Transmission Distance

The maximum allowable number of nodes and transmission distance of a standard RS485 circuit vary with transmission rates, as listed in the following table.

Table 2-1 Maximum number of nodes and transmission distance

Transmission Distance (m)	Rate (kbps)	Number of Nodes	Cable Diameter
100	115.2	128	AWG 26
1000	19.2	128	AWG 26

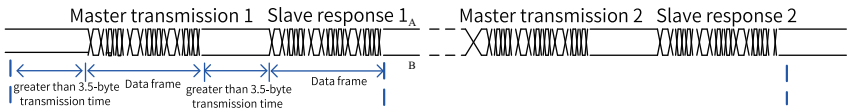
Settings of Termination Resistor

Table 2-2 Settings of termination resistor

Port Definition		Pin Description
Pin	Network Name	
1	DIP switch for enabling/ disabling RS485 termination resistor	When pins 1 and 2 are switched to ON, the RS485 termination resistor is enabled. This RS485 termination resistor is disabled by default.
2		

2.3 Communication Transmission Mode

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

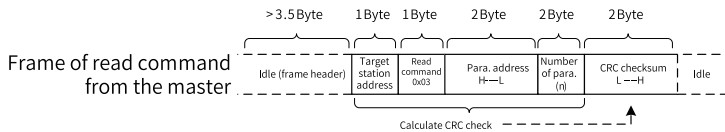


The AC drive adopts the Modbus-RTU slave communication protocol, which allows the AC drive to provide data to respond to query commands from the master or execute actions according to query/commands from the master.

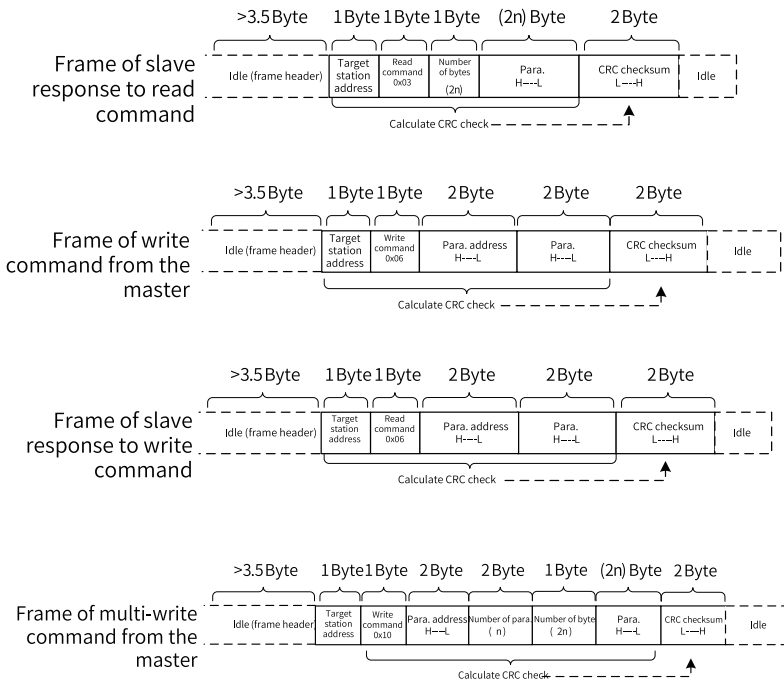
The master can be a PC, an industrial control device, or a PLC. The master can communicate with a single slave or send broadcast messages to all slaves. When the master communicates with a single slave, the slave needs to return a message (response) to the query command from the master. For a broadcast message sent by the master, the slaves do not need to return a response.

2.4 Communication Data Frame Structure

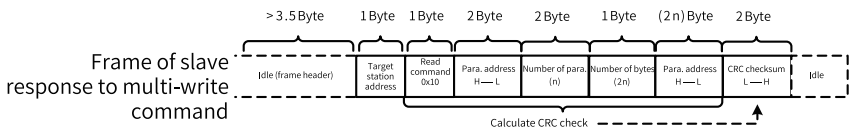
The following figure shows the Modbus-RTU communication date. The AC drive supports read and write of word-type parameters only. The read command is 0x03, the write command is 0x06, and the multi-write command is 0x10. The AC drive does not support read and write of bytes or bits.



Theoretically, the host controller can read multiple continuous parameters at a time (that is, n is up to 12). Do not stride over the last parameter in this parameter group; otherwise, an error will be returned.



Multi-write is the same as multi-read and up to 12 parameters can be continuously written.



If the slave detects a communication frame error or read/write failure due to other causes, the slave returns a frame of error.

Note

No response is returned for CRC check error.

A read error returned from the slave is 0x83. A write error returned from the slave is 0x86. A multi-write error returned from the slave is 0x90.

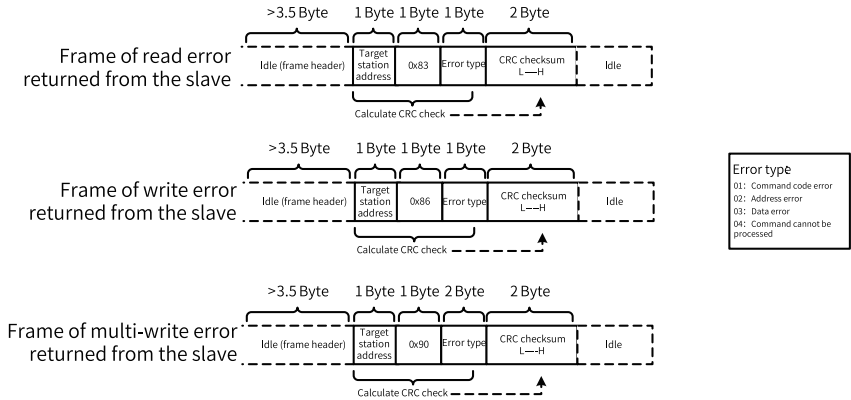


Table 2-3 Data frame fields

Frame header (START)	Idle time greater than 3.5-byte transmission time
Slave address (ADR)	Communication address range: 1 to 247; 0 = Broadcast
Command code (CMD)	03: Read slave parameters; 06: Write slave parameters; 10: Multi-write slave parameters
Parameter address (H)	Internal parameter address of the AC drive, expressed in hexadecimal. Parameters are divided into parameter type and non-parameter type (for example, operation status parameters and operation commands). See the definition of addresses. Low-order bytes follow high-order bytes during transmission.
Parameter address (L)	
Parameter count (H)	Number of parameters read in this frame. The value 1 indicates reading one parameter. Low-order bytes follow high-order bytes during transmission. According to this protocol, only one parameter can be rewritten at a time without this field.
Parameter count (L)	
Data bytes	The 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 bit	Detection value: CRC16 check value. High-order bytes follow low-order bytes during transmission. For details of the calculation method, see the description of CRC in this section.
CRC high bit	
END	3.5-byte transmission time

CRC check:

Cyclical Redundancy Check (CRC) uses the RTU frame format. A Modbus message includes a CRC-based error check field. The CRC field is used to check content of the entire message. The CRC field contains two bytes, making up a 16-bit binary value. The CRC field is calculated by the transmitting device, and then added to the

message. The receiving device recalculates a CRC value after receiving the message, and compares the calculated value with the CRC value in the received CRC field. If the two CRC values are unequal, a transmission error occurs.

The CRC is first stored to 0xFFFF. Then a procedure is invoked to process the successive 8-bit bytes in the message and the value in the register. Only the eight bits in each character are used for the CRC. The start bit, stop bit, and the parity bit do not apply to the CRC.

During generation of the CRC, each eight-bit character is in exclusive-OR (XOR) with the content in the register. Then, the result is shifted in the direction of the least significant bit (LSB), with a zero filled into 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 another eight shifts as described above. The final value of the register, after all the bytes of the message have been applied, is the CRC value.

When CRC is added in a message, high-order bytes follow low-order bytes. 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:

R/W parameter (some parameters cannot be modified as they are manufacturer-specific parameters or for monitoring purpose only.)

2.5 Parameters

Modbus communication parameters are set on the power supply unit.

Table 2-4 Modbus communication parameters

Para. No.	Name	Default	Value Range	Description
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 is used to set a data transmission rate between the host controller and the AC drive. A higher baud rate indicates faster communication. 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 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)	Note that the data format set in the host controller must be the same as that set in the AC drive. Otherwise, communication will fail.
Fd-02	RS485 local address	1	1 to 247 0: Broadcast address	This value is read-only. The station number can be automatically assigned or manually set. When the local address is set to 0 (broadcast address), the broadcasting function of the host controller is implemented. The local address is unique (except the broadcast address) and is used to implement point-to-point communication between the host controller and the AC drive.

Para. No.	Name	Default	Value Range	Description
Fd-03	RS485 response delay	2	0 ms to 20 ms	This parameter indicates the interval from the end of data receiving by the AC drive to the start of data transmission to the host controller. If the response delay is less than the system processing time, the former is subject to the latter. Otherwise, after the system finishes data processing, the system waits until the response delay time expires before sending the data to the host controller.
Fd-04	RS485 communication timeout time	0	0.0 (invalid) 0.1s to 60.0s	When this parameter is set to 0.0s, the communication timeout time is invalid. It is set to 0.0s under normal circumstances. This parameter is used to monitor communication status in a system with continuous communication. When it is set to a valid value, if the communication interval between current communication and the next communication exceeds the value of Fd-04 (communication timeout time), the system reports a communication fault (E16).
Fd-92	Communication version	0.00	0.00 to 655.35	This parameter shows the communication software version.

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 the terminals RS485+ and RS485- of H5U to those of the AC drive, as shown below.

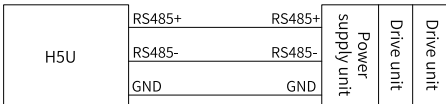
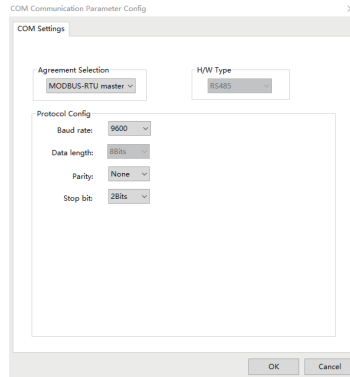


Figure 2-3 Connection of communication interfaces

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. On the left of the page displayed, click  **COM**. On the PLC configuration page displayed, select the protocol and data format and then click **"OK"**.



3. Click  **COM**. Click **"Add Modbus Config"** and **"OK"**, and  **COM0 Modbus Config** is displayed. Double-click  **COM0 Modbus Config**. On the page displayed, click **"Add"**.
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, when you select the slave number 1, you can operate on station 1. You must set Trigger Mode to Cycle and Function Code to Write Register. Otherwise, the write operation cannot be performed. Quantity must be set to 1 and all AC drive variables must be 16-bit data. 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, when you select the slave number 1, you can operate on station 1. You must set Trigger Mode to Cycle and Function Code to Read Register. Otherwise, the read operation cannot be performed. Quantity must be set to 1 and all AC drive variables must be 16-bit data. If Quantity is set to 2, the read operation will fail.

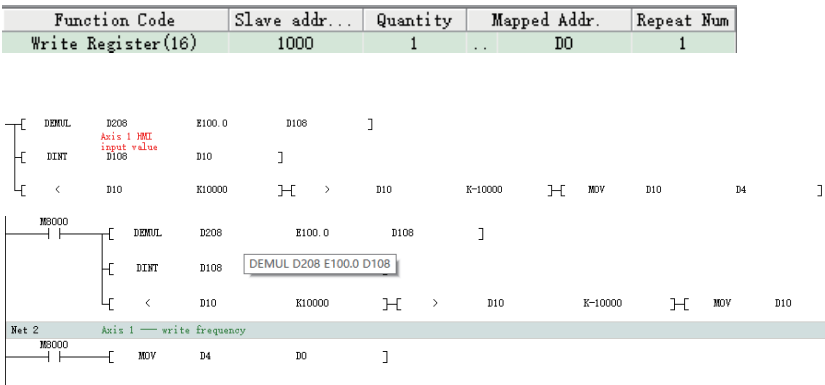
After finishing all write and read configurations, click "OK" to go back to the programming page.

Example

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

Data conversion: Multiply the required frequency value (a) by 100, convert the result into an integer, and then write the integer in 1000H.

The configuration and procedure are as follows:

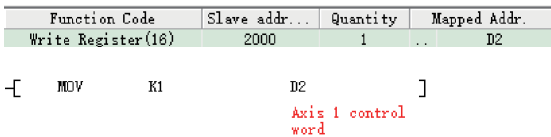


2. Start/stop control over the AC drive (F0-02 set to 2)

Assign a value for the D element corresponding to 2000H of the required station number to enable the AC drive to run forward or backward or stop. 2000H is defined as follows: 1

1: Forward run 2: Reverse run 3: Forward jog 4: Reverse jog 5: Coast to stop 6: Decelerate to stop 7: Fault reset

The configuration and procedure are as follows:



2000H corresponds to the PLC soft element address D2. When the D2 value is set to 1, the AC drive runs forward. To decelerate to stop, set D2 to 6.

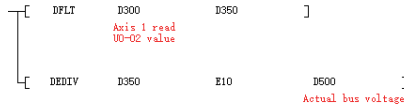
3. Read bus voltage

Based on the conversion rule, convert the bus voltage address U002 to 7002 (convert the higher two bits U to 7 and the lower two bits to a hexadecimal value). Divide the read bus voltage value (a) by 10 to obtain the actual bus voltage. 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 configuration and procedure are as follows:

Function Code	Slave addr...	Quantity	Mapped Addr.
Read Register(03)	7002	1	.. D300



4. Read output voltage

Based on the conversion rule, convert the output voltage U003 to 7003 and then the reading is the actual output voltage. Based on the communication configuration, you can move or not move the D302 value to another D element.

The configuration and procedure are as follows:

Function Code	Slave addr...	Quantity	Mapped Addr.
Read Register(03)	7003	1	.. D302

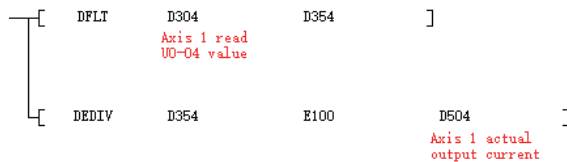


5. Read output current

Based on the conversion rule, convert the output current U004 to 7004. Then, divide the reading by 100 to obtain the actual output current.

The configuration and procedure are as follows:

Function Code	Slave addr...	Quantity	Mapped Addr.
Read Register(03)	7004	1	.. D304



6. Read AC drive state

Read 3000H to directly obtain the current state of the AC drive. (1: Forward running; 2: Reverse running; 3: Stop)

The configuration and procedure are as follows:

Function Code	Slave addr. . .	Quantity	Mapped Addr.
Read Register(03)	3000	1	.. D308

—[MOV D308 D358]

7. Read DI state

Based on the conversion rule, convert the DI state U007 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.

Function Code	Slave addr. . .	Quantity	Mapped Addr.
Read Register(03)	7007	1	.. D310

—[MOV D310 D360]
 DI status

8. Read fault code

Based on the conversion rule, convert the fault code U045 to 702D and fault sub-code U046 to 702E.

The configuration and procedure are as follows:

Function Code	Slave addr. (H)	Quantity	Mapped Addr.
Read Register(03)	702D	1	.. D312
Read Register(03)	702E	1	.. D314

[MOV D312 D362]
 Fault master code
[MOV D314 D364]
 Fault subcode

FAQ and Solutions

Items must be checked:

1. Check whether other pins instead of RS485+ and RS485– 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 Fd-02 (local address) setting of the AC drives is unique from that of other AC drives. Avoid duplication to prevent conflicts.

Table 2-5 FAQ and Solutions

FAQ	Solution
Failure to write frequency	1. Check the address in the configuration table based on F0-03. When F0-03 is set to 0, the address should correspond to the value of F0-08. When F0-03 is set to 9, the address should be 1000H or 7310H. 2. Check whether the termination resistor is connected. If not, connect the termination resistor and then power on the AC drive again.
Failure to start the AC drive	1. Ensure that F0-02 is set to 2 (communication). 0 means operating panel and 1 means terminal. 2. Check whether the termination resistor is connected. If not, connect the termination resistor and then power on the AC drive again.
Unstable connection	1. Ensure stable connection on PLC side. 2. Ensure stable connection on AC drive side. 3. Check whether the signal cable is close to the power cable. Keep the signal cable 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.

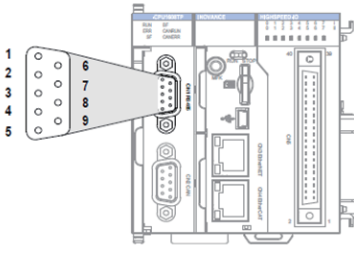
2.6.2 Configuration for RS485 Communication Between AC Drive and AM600

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

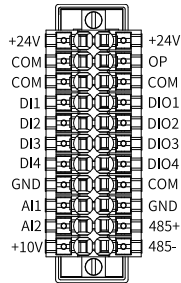
Hardware Wiring

Port definition:

- AM600 provides two sets of RS485 ports that share one DB9 connector. The following figure shows the ports.

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. Taking COM1 as an example, connect one end of the LAN cable to CN1 of AM600 through DB9 and connect the RS485+, RS485-, and GND0 terminals of the other end to the RS485+, RS485-, and GND pins of the AC drive, as shown below.



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 AC 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 to 5

Fd-01 to 0

Fd-03 to 2

Fd-04 to 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 to 2 (set the command source to communication)

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

Fd-00 to 5

Fd-01 to 0

Fd-03 to 2

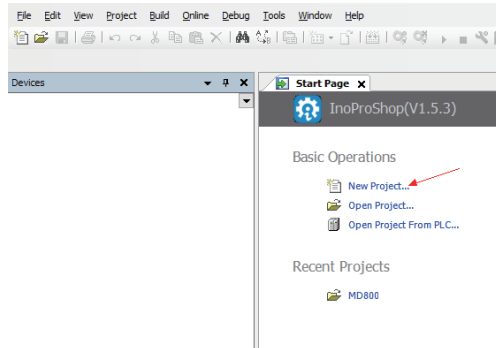
Fd-04 to 0.0

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

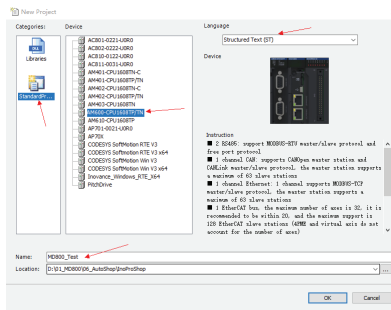
3. If the AC drive have multiple drive units, repeat the above steps, set parameters in group Fd and the station number for each drive unit.

Configuration on PLC Side

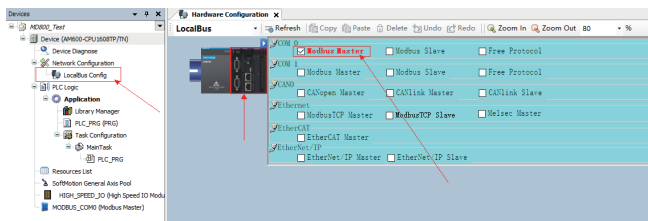
1. Connect the PC to the PLC through a LAN cable or USB cable, run InoProShop, and click "New Project".



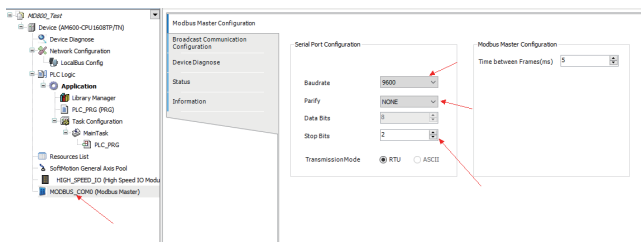
2. Select StandardProjects under Categories, select AM600-CPU1608TP/TN from the Devices section, select Structured Text (ST) from Language, set the project name and storage path, and then click "OK".



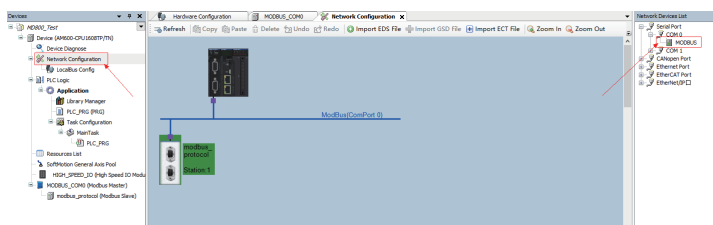
3. Click "LocalBus Config" and then click to select a CPU module. In hardware connection, COM0 is connected to MD800 through the RS485 cable. Therefore, select the Modbus master station of the serial port 0.



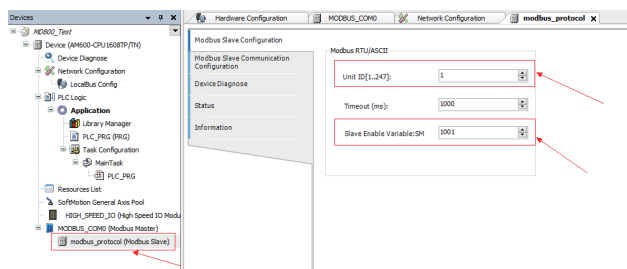
4. Select "MODBUS_COM0" on the left, and set the baud rate, parity check, and stop bit. These three parameters must be set the same as Fd-01 settings of the drive unit of the AC drive.



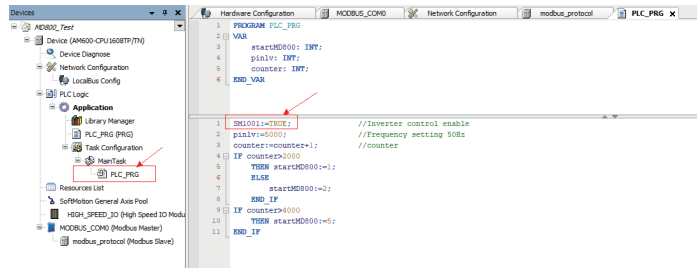
5. Double-click **"Network Configuration"** on the left. Double-click the MODBUS option in the menu of Serial Port > COM 0 on the right. A slave station is added to the Modbus area in the screen center. If there are multiple slave stations, click MODBUS multiple times to add multiple slave stations.



6. Double-click the new Modbus slave station and set its number (this station number must be same as the station number of the AC drive (set by Fd-02)). Record the value of Slave Enable Variable:SM.

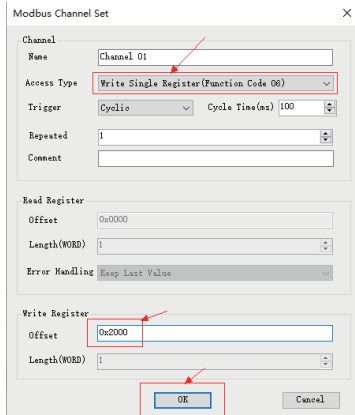


7. Compile the PLC program as follows: Enable the slave station, set the AC drive frequency to 50 Hz, and set the PLC to run 4000 scan cycles, during which the AC drive runs forward in the first 2000 scan cycles, runs reversely in the last 2000 scan cycles, and then decelerates to stop. The slave station must be enabled when you compile the PLC program.



8. Add the configuration on the "Modbus Slave Communication Configuration" page.

9. In the window displayed, configure the register information. Set the read address, write address, and frequency address of the control word of the AC drive to 3000H, 2000H, and 1000H, respectively. For details about address configuration, see *Write Single Register (Function Code 06)*.



Modbus Channel Set

Channel Name: Channel 02

Access Type: Read Holding Registers(Function Code 03)

Trigger: Cyclic Cycle Time(ms): 100

Repeated: 1

Comment:

Read Register

Offset: 0x3000

Length(WORD): 1

Error Handling: Keep Last Value

Write Register

Offset: 0x0000

Length(WORD): 1

OK Cancel

10. On the Internal I/O Mapping page, map the PLC variables to the AC drive address.

Modbus Slave Configuration

Modbus Slave Communication Configuration

Device Diagnose

Internal I/O Mapping

Status

Information

Find: Filter: Show all

Variable	Mapping	Channel	Address	Type	Default Value	Unit	Description
* *		Channel 02	%QW1	ARRAY [0...0] OF WORD			Read Holding Registers
* *		Channel 01	%QW1	ARRAY [0...0] OF WORD			Write Single Register

Create new variable Map to existing variable

Reset mapping Always update variables: Enabled

11. Select the variable to be mapped.

Input Assistant

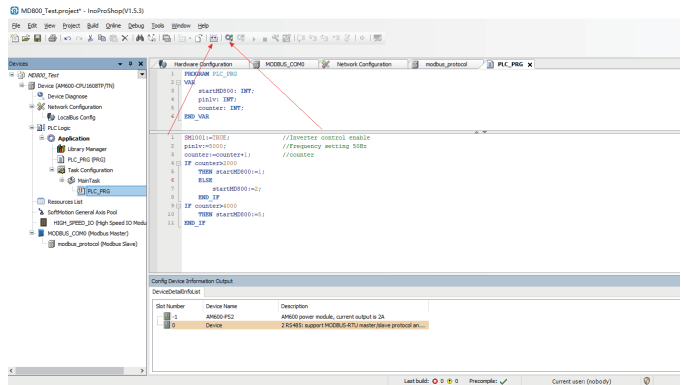
Text Search Categories

Variables

Name	Type	Address	Origin
Application	Application		
PLC_PRG	PROGRAM		
counter	INT		
pinlv	INT		
start...	INT		
toConfig_Globals	VAR_GLOBAL		
SDElement	Library		SM3_Basic, 4.2.2.0 (...)
SM3_Basic	Library		SM3_Math, 4.2.2.0 (...)
SM3_Math	Library		
SMEElement	Library		

Structured view Filter: None

12. Check whether the compiled program has an error. If not, log in to the PLC and download the program, and then click to run the program.



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 based on the CAN bus application and independently developed by Inovance. This protocol can be only used for communication with Inovance's PLCs such as H2U, H3U, and H5U.

Communication Model

CANopen is an application layer protocol of 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 a part of the physical layer in the OSI model. CANopen supports the multi-master mode, in which any node in the network can send a message to other nodes. Network nodes are classified with different priorities based on the system real-time requirements, reducing the bus arbitration time in case of a transmission collision. In a CAN network, the traditional address coding is replaced by communication data block coding. Theoretically, with data block coding, the number of nodes in the network is unlimited, and different nodes can receive the same data at the same time. This coding mode also features few transmission bytes, 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 device model.

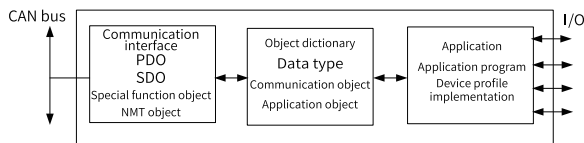


Figure 3-1 CANopen communication model

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

Protocol Feature

CANopen supports six protocols as follows:

- Supports the NodeGuard protocol. The master uses this function to query device status.
- Supports the Heartbeat protocol. The slave regularly reports the current status to the master.
- For SDO, CANopen supports only the acceleration transmission mechanism. One parameter or one object dictionary is transmitted a time.
- Supports four TPDOs and four RPDOs.

- Supports emergency objects.
- Supports the synchronous mode.

Object Dictionary

An object dictionary is an ordered set of parameters and variables, and includes all parameters of the device profile and device network state. A set of objects can be accessed by using the ordered pre-defined method.

The CANopen protocol uses an object dictionary with 16-bit indexes and 8-bit sub-indexes. 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.

Index	Object
000	Unused
0001—001F	Static data type (standard data type such as Boolean and Integer 16)
0020—003F	Complex data type (predefined structure consisting of simple types, such as PDOCommPar and SDOParmeter)
0040—005F	Complex data type specified by the manufacturer
0060—007F	Static data type specified by the device profile
0080—009F	Complex data type specified by the device profile
00A0—00FF	Reserved
1000—1FFF	Communication profile area (such as device type, error register, and supported PDO quantity)
2000—5FFF	Manufacturer-specific profile area
6000—9FFF	Standard device profile area (such as "DSP-401 I/O module device profile": Read State 8 Input Lines)
A000—FFFF	Reserved

Figure 3-2 Object dictionary structure

Common Communication Objects

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

- NMT object: 0x000
- SYNC object: 0x080
- SDO object:
 - SDO sending — 0x600+Node-ID
 - SDO receiving — 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: Device ID (station address) set by Fd-13.

Communication objects are defined as follows:

- NMT
A network management object (NMT) includes Boot-up messages, Heartbeat protocol, and NMT messages. Based on the master-slave mode, an NMT is used to manage and monitor nodes in the network and implements three functions: node status control, error control, and node activation.
- SDO
A service data object (SDO) enables you to access items in the device object dictionary by using an index and sub-index. An SDO is achieved through a CMS object of the multi-element domain in CAL and allows transmitting data in any length. When exceeding four bytes, data is split into several packets. The SDO protocol produces a response for every request. SDO request and response packets always contain eight bytes.
- PDO
A process data object (PDO) is used to transmit real-time data from one node to one or multiple nodes. The data length ranges from one to eight bytes. Each CANopen device contains eight default PDO channels, four TPDO channels, and four RPDO channels. A PDO supports synchronous and asynchronous transmission modes, depending the corresponding communication parameter of the PDO. The content of a PDO message is pre-defined and depends on the corresponding mapping parameter of the PDO.
- SYNC object
A synchronization (SYNC) object is a packet that is broadcast to the CAN bus periodically by the CANopen master. It is used to achieve basic network clock signals. Each device determines whether to perform synchronous communication with other network devices using this event according to its own configuration.

CANopen Packet Format

- NMT module control packet
Only an NMT-Master node can send an NMTModuleControlNMT packet. ["Table 3-1 NMT packet format" on page 40](#) shows the packet format. COB-ID is "0x000". Data0

is a command word occupying one byte, as shown in ["Table 3-2 NMT packet command format" on page 40](#). Data1 is a CANopen network device address occupying one byte. When it is "0", it indicates a broadcast message that is sent to all slave devices in the network

For example, to set a device with device address "6" to an operable state, you need to use the command "0x0000x010x06"

Table 3-1 NMT packet format

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

Table 3-2 NMT packet command format

Command	Description
0x01	StartRemoteNode
0x02	StopRemoteNode
0x80	EnterPre-operationalState
0x81	ResetNode
0x82	ResetCommunication

- NodeGuarding packet

The current state of each node can be checked by an NMT master node using the node protection service NodeGuarding. Especially, this service is relevant when these nodes have no data to be transmitted.

The standard protocol object 0x100C sets Guard Time and 0x100D sets a product factor of Guard Time. Both jointly determine the node protection time period

["Table 3-3 NodeGuarding packet sent from the master node" on page 40](#) shows a remote frame sent from the NMT master node.

Table 3-3 NodeGuarding packet sent from the master node

COB-ID	RTR
0x700+Node-ID	1

["Table 3-4 NodeGuarding response packet returned from a slave node" on page 40](#) shows a response packet returned from an NMT slave node. A status word occupies one byte. ["Table 3-5 NodeGuarding return status" on page 41](#) shows the 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 NodeGuarding return status

Data Bit	Description
Bit7	"0" or "1" must be alternatively set every time.
Bit6 to bit0	State: 4: Stopped 5: Operational 127: Pre-operational

- Heartbeat packet**
 The nodes can be configured to periodically generate Heartbeat packets. The status word bit7 is "0" and bit6 to bit0 are the same as those described in ["Table 3-6 Heartbeat packet" on page 41](#) for NodeGuarding. The Heartbeat time is set in the standard protocol object 0x1017. One node cannot support both NodeGuarding and Heartbeat mechanisms.

Table 3-6 Heartbeat packet

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

3.2 Networking and Interfaces

Communication Networking

The following figure shows the CAN bus topology. Use shielded twisted pair as the CAN bus. Two 120 Ω termination resistors must be connected at each end of the bus to avoid signal reflection. Reliable single-point grounding is often used for shields.

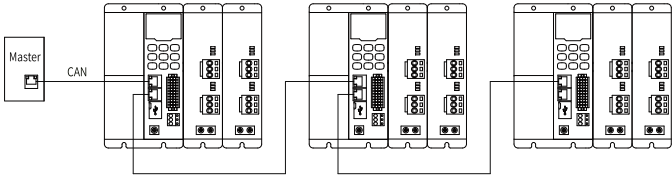


Figure 3-3 CAN bus topology

Communication Interface

The CANopen/CANlink communication ports are on the power supply unit and use dual RJ45 terminals, as shown below.

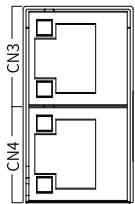


Figure 3-4 CANopen/CANlink communication terminals

Table 3-7 CN3 terminal pins

No.	Code	Name	Arrangement
1	CANH	H terminal for CAN communication	 1 2 3 4 5 6 7 8
2	CANL	L terminal for CAN communication	
3	CGND	Grounding terminal for CAN communication	
4	Reserved	Reserved	
5	Reserved	Reserved	
6	Reserved	Reserved	
7	Reserved	Reserved	
8	Reserved	Reserved	

Table 3-8 CN4 terminal pins

No.	Code	Name	Arrangement
1	CANH	H terminal for CAN communication	 1 2 3 4 5 6 7 8
2	CANL	L terminal for CAN communication	
3	CGND	Grounding terminal for CAN communication	
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.

Transmission Distance

The transmission distance of CANopen/CANlink bus is directly dependent on the baud rate and communication cable. The mapping between the maximum transmission distance of the bus and the baud rate is described in the following table.

Table 3–9 Baud rate and bus length

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

3.3 Parameters

Table 3–10 Parameters

Para. No.	Name	Default	Value Range	Description
Fd-09	CANopen/CANlink communication state	0	Ones (CANopen) 0: Stop 1: Initializing 2: Pre-running 8: Running Tens (CANlink) 0: Stop 1: Initializing 2: Pre-running 8: Running	This read-only parameter is used to monitor the communication status.
Fd-10	Communication protocol selection	1	1: CANopen 2: CANlink 3: Communication card mode	This parameter defines the CAN communication protocol. If it is set to 1, CANopen communication is selected. If it is set to 2, CANlink communication is selected. If it is set to 3, communication card mode is selected. 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.

Para. No.	Name	Default	Value Range	Description
Fd-11	CANopen402 selection	0	0: Disabled 1: Enabled	This parameter defines whether to enable the CANopen mode. When it is set to 0, ordinary mode is selected. When it is set to 1, CIA402 mode is selected.
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 defines the baud rate for CAN communication, including CANlink and CANopen communication. In the same network, baud rates of all stations must be consistent. Otherwise, communication will fail. This parameter can be set only in the power supply unit.
Fd-13	CAN station number	1	1 to 247	This value is read-only. The station number can be automatically assigned or manually set. This parameter shows the CAN station number, including station numbers for CANlink and CANopen communication. In the same network, all station numbers must be unique. Otherwise, communication will fail.
Fd-14	Number of CAN frames received per unit of time	0	0 to 65535	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 value of node reception error counter	0	0 to 65535	This parameter is used to monitor bus errors. It shows the maximum value of the CAN reception error counter of the node.
Fd-16	Maximum value of node transmission error counter	0	0 to 65535	This parameter is used to monitor bus errors. This parameter shows the maximum value of the CAN transmission error counter of the node.
Fd-17	Bus disconnection times per unit of time	0	0 to 65535	This parameter is used to monitor bus errors. This parameter shows the CAN bus-off count of the node.
Fd-18	Power supply unit number	1	1 to 15	This parameter defines the common bus network group number. It is used for networking of multiple common bus network groups. Networks within a group that share a common bus must share one number. The number of each common bus network group must be unique.
Fd-19	CAN communication failure coefficient	1	1 to 15	This parameter defines the CAN communication disconnection coefficient.

Para. No.	Name	Default	Value Range	Description
Fd-34	CANopen mode	0	0: Standard mode 1: Expert mode	This parameter defines the CANopen mode.
Fd-35	CANopen inhibit time	0	0 to 65535	This parameter defines the CANopen inhibit time.
Fd-36	CANopen event time	0	0 to 65535	This parameter defines the CANopen event time.
Fd-92	Communication version	0.00	0.00 to 655.35	This parameter shows the communication software version.

3.4 Application

3.4.1 Communication Data Frame Structure

There is a correspondence between the parameters of the drive and the object dictionary. You can easily and directly determine the object dictionary index corresponding to a parameter based on a calculation method. This facilitates operations on parameters.

Correspondence between the drive parameters and CANopen object dictionary indexes

- Calculation method

The parameter groups correspond to the indexes 0x2000 to 0x20FF in the CANopen object dictionary. The calculation method is as follows: An object dictionary index is the upper 16 bits of the parameter address plus 0x2000; an object dictionary sub-index is the lower 16 bits plus 1.

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

- Correspondence list

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

According to the preceding calculation method, for parameter read/write operations, the correspondence between the parameter group numbers and the object dictionary indexes is as follows:

Table 3-11 Correspondence between the parameter group numbers and the object dictionary indexes

Parameter Group	CANopen Object Dictionary Index
F0 to FF	0x20F0 to 0x20FF
A0 to AF	0x20A0 to 0x20AF
U0 to AF	0x2070 to 0x207F

The sub-index is the lower 16 bits of a parameter address plus 1, so the correspondence between the parameter group numbers and the object dictionary sub-indices is as follows:

Table 3-12 Correspondence between the parameter group numbers and the object dictionary sub-indices

Parameter Index	CANopen Object Dictionary Index
0x0 to 0xFE	0x1 to 0xFF

3.4.2 Operation Example (SDO)

For example, when the F0-17 parameter value is read, the parameter address is 0xF011. Therefore, its object dictionary index number and sub-index number are 0x20F0 and 0x12, respectively.

1. The communication master station uses a CANopen data service object (SDO) to read data from the AC drive. The following table shows the format of data sent from the master.

The following takes 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 3-13 SDO object sent for read operation

CAN Frame		CANopen Data	Description
COB-ID	11-bit ID	0x600+Node-ID	Node-ID is determined by dial switch setting..
RTR	RTR	0	Remote frame flag "0"
8-byte frame data	DATA0	Command code (0x40)	0x40 read command
	DATA1	Lower byte of index	Parameter group (group F0 "0xF0")
	DATA2	Higher byte of index	0x20
	DATA3	Sub-index	Parameter No. + 1 ("0x03")
	DATA4	Data 1	Reserved "0"
	DATA5	Data 2	Reserved "0"
	DATA6	Data 3	Reserved "0"
	DATA7	Data 4	Reserved "0"

2. The following table shows the slave's SDO response to the read operation.

If the operation is successful, the command code return value is "0x4B"; the index remains unchanged; the read data is returned in DATA4 and DATA5; "0" is returned in DATA6 and DATA7.

If the operation fails, the command code return value is "0x80"; the index remains unchanged; SDO failure error codes are returned in DATA4, DATA5, DATA6, and DATA7.

Table 3-14 SDO object returned for read operation

CAN Frame		CANopen Data	Description
COB-ID	11-bit ID	0x580+Node-ID	Node-ID is determined by dial switch setting..
RTR	RTR	0	Remote frame flag "0"
8-byte frame data	DATA0	Command code return	Success: "0x4B" Failure: "0x80"
	DATA1	Lower byte of index	Parameter group (group F0 "0xF0")
	DATA2	Higher byte of index	0x20
	DATA3	Sub-index	Parameter No. + 1 ("0x03")
	DATA4	Data 1	Lower byte of data
	DATA5	Data 2	Higher byte of data
	DATA6	Data 3	Success: "0"
	DATA7	Data 4	Failure: SDO operation failure error code

3. SDO write operation

A CANopen data service object (SDO) is used to write data to the AC drive. The following table shows the format of data sent from the master.

Table 3-15 SDO object sent for write operation

CAN Frame		CANopen Data	Description
COB-ID	11-bit ID	0x600+Node-ID	Node-ID is determined by dial switch setting..
RTR	RTR	0	Remote frame flag "0"
8-byte frame data	DATA0	Command code	0x2B
	DATA1	Lower byte of index	Parameter group (group F0 "0xF0")
	DATA2	Higher byte of index	0x20
	DATA3	Sub-index	Parameter No. + 1 ("0x03")
	DATA4	Data 1	Lower byte of data
	DATA5	Data 2	Higher byte of data
	DATA6	Data 3	Reserved "0"
	DATA7	Data 4	Reserved "0"

4. The following table shows the slave's SDO response to the write operation.

If the operation is successful, the command code return value is "0x60"; the index remains unchanged; "0" is returned in DATA4, DATA5, DATA6, and DATA7.

If the operation fails, the command code return value is "0x80"; the index remains unchanged; SDO failure error codes are returned in DATA4, DATA5, DATA6, and DATA7.

Table 3-16 SDO object returned for write operation

CAN Frame		CANopen Data	Description
COB-ID	11-bit ID	0x580+Node-ID	Node-ID is determined by dial switch setting..
RTR	RTR	0	Remote frame flag "0"
8-byte frame data	DATA0	Command code return	Success: "0x60" Failure: "0x80"
	DATA1	Lower byte of index	Parameter group (group F0 "0xF0")
	DATA2	Higher byte of index	0x20
	DATA3	Sub-index	Parameter No. + 1 ("0x03")
	DATA4	Data 1	Success: "0"
	DATA5	Data 2	Failure: SDO operation failure error code
	DATA6	Data 3	
	DATA7	Data 4	Reserved "0"

5. Read and write operations on the AC drive

The following takes the F0-02 read and write operations as an example. The CANopen address of the AC drive is set to "0x06".

Read the AC drive command source (F0-02)

Read the AC drive parameter F0-02 (Command source selection). The following table shows a CANopen packet sent from the master.

Table 3-17 Packet sent from the master for reading F0-02

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

6. The following table shows a CANopen response packet from the AC drive.

The current value of F0-02 is "0x0002", indicating that the current command source of the AC drive is a communication command channel.

Table 3-18 AC drive response to the request of reading F0-02

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

7. Set the command source (F0-02) to the operating panel.

To set the command source to the operating panel, write F0-02 (Command source selection) as "0" by sending a CANopen packet from the master, as shown in the following table.

Table 3–19 Packet sent from the master for writing F0-02

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

8. The following table shows the CANopen response packet from the AC drive. F0-02 is rewritten as "0", that is, the current command source is set to the operating panel.

Table 3–20 AC drive response to the request of writing F0-02

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

3.4.3 Operation Example (PDO)

The AC drive supports four RPDOs (RPDO1, RPDO2, RPDO3, and RPDO4) and four TPDOs (TPDO1, TPDO2, TPDO3, and TPDO4). You can configure them as required.

You can configure the PDO mapping of the slave station on the operating panel. Generally, use the CANopen master to configure a mapping. The AC drive also supports any manual modification to parameters in group AF to configure a PDO mapping. The following table shows the mapping relation of every PDO.

Table 3–21 PDO mapping table

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

RPDO	Group AF Address		TPDO	Group AF Address	
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

One PDO can be configured with four mappings. Configuring one mapping requires operating two parameters in group AF to achieve 32-bit data whose upper 16 bits are an object dictionary index and lower 16 bits (parameter No.) are the object dictionary sub-index and object length. The object length is calculated in bits. Mapping object format must meet the following requirements: 311615870.

Index	Sub-index	Object Length
Group AF upper bits	Group AF lower bits	-

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

For example, to configure two mappings in RPDO1, where one directs at F0-01 and the other is an object dictionary object 0x6060-00, perform the following operation:

Table 3-22 Example of group AF mapping

Assumed Address	Group AF Address	Content	Remarks
F0-01	AF-00	0x20F0	Parameter address index Equal to group number F0 + 0x2000
	AF-01	0x0210	Higher bit 02: Parameter group number offset + 1 Lower bit 10: 16-bit parameter length
0x6060-00	AF-02	0x6060	Object dictionary index
	AF-03	0x0008	Higher bit 00: Object dictionary sub-index Lower bit 08: 8-bit parameter length

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.

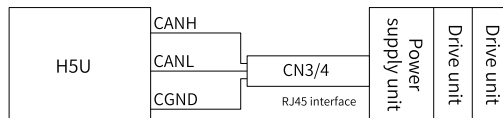


Figure 3-5 Connection of communication interfaces

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. 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: Upon computer setting (the CANlink station number of PLC must not be the same as that of the AC drive)

Baud Rate: Upon computer setting (the baud rate of CAN communication for PLC initialization must be the same as that of the AC drive)

3. Click  **CAN(CANLink)** and then click **"Add CAN Config"**. Next, double-click **"CANlink Config"** and click **"Next"** on the page displayed, and then set the parameters as follows on the page displayed next.
 - a. Set the slave type to MD (AC drive).
 - b. Set the slave station number to the value of Fd-02 of the AC drive.
 - c. Set 7000 and 6000 for the status register and start/stop element.
 - 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 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 (HEV)	0 Dec	1 MD (Frequency	1000 Hex	1	
2	Time(ms)	10	63 HOST (HEV)	2 Dec	1 MD (Frequency	2000 Hex	1	
3	Time(ms)	10	63 HOST (HEV)	100 Dec	2 MD (Frequency	1000 Hex	1	
4	Time(ms)	10	63 HOST (HEV)	102 Dec	2 MD (Frequency	2000 Hex	1	

As shown in the preceding figure, assign the D2 value to the control word address of the AC drive whose station number is 1, and assign the D102 value to the control word address of the AC drive whose station number is 2. Write the register address as needed. Ensure that the address of the receiving register is correct and writable.

5. Read operation: Select the station (AC drive) to read and enter the page of configuration for reading AC drive D element.

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.

Slave station (1) configuration

Send Config Receive Config								
NO.	Trigger Mode	Trigger	Send Station	Send Register	Receiver Station	Receive Register	Length	
1	Time(ms)	10	1 MD (Frequ	7002 Hex	63 HOST (HEV)	300 Dec	1	
2	Time(ms)	10	1 MD (Frequ	7003 Hex	63 HOST (HEV)	302 Dec	1	
3	Time(ms)	10	1 MD (Frequ	7004 Hex	63 HOST (HEV)	304 Dec	1	

As shown in the preceding figure, send the bus voltage, output voltage, and output frequency of the AC drive to D300, D302, and D304 of the PLC. Correctly configure the sending register address and D element as needed. After finishing all write and read configurations, click **"OK"** continuously to go back to the programming page.

Example

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

Data conversion: Multiply the required frequency value (a) by 100, convert the result into an integer, and then write the integer in 1000H.

The configuration and procedure are as follows:

63	HOST (HEU)	0	Dec	1	MD (Frequ	1000	Hex	1
----	------------	---	-----	---	-----------	------	-----	---

[	DEMWL	D208	E100.0	D108	]							
[	DMT	Axis 1 MVI input value D108	D10	]								
[	<	D10	K10000	]	>	D10	K-10000	]	MOV	D10	D4	]

2. Start/stop control over the AC drive (F0-02 set to 2)

Assign a value for the D element corresponding to 2000H of the required station number to enable the AC drive to run forward or backward or stop. 2000H is defined as follows:

1: Forward run 2: Reverse run 3: Forward jog 4: Reverse jog 5: Coast to stop 6: Decelerate to stop 7: Fault reset

The configuration and procedure are as follows:

63	HOST (H5U)	2	Dec	1	MD (Frequ	2000	Hex	1
----	------------	---	-----	---	-----------	------	-----	---

[	MOV	K1	D2	]
			Axis 1 control word	

2000H corresponds to the PLC soft element address D2. When the D2 value is set to 1, the AC drive runs forward. To decelerate to stop, set D2 to 6.

3. Read bus voltage

Based on the conversion rule, convert the bus voltage address U002 to 7002 (convert the higher two bits U to 7 and the lower two bits to a hexadecimal value). Divide the read bus voltage value (a) by 10 to obtain the actual bus voltage. 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 configuration and procedure are as follows:

1	MD (Frequ	7002	Hex	63	HOST (H5U)	300	Dec	1
[DFLT D300 D350]								
Axis 1 read U0-02 value								
[DEDIV D350 E10 D500]								
Actual bus voltage								

4. Read output voltage

Based on the conversion rule, convert the output voltage U003 to 7003 and then the reading is the actual output voltage. Based on the communication configuration, you can move or not move the D302 value to another D element.

The configuration and procedure are as follows:

1	MD (Frequ	7003	Hex	63	HOST (H5U)	302	Dec	1
- [MOV D302 D502]								
Axis 1 read U0-03 value								
Axis 1 actual output voltage								

5. Read output current

Based on the conversion rule, convert the output current U004 to 7004 and divide the reading by 100 to get the actual output current.

The configuration and procedure are as follows:

1	MD (Frequ	7004	Hex	63	HOST (H5U)	304	Dec	1
[DFLT D304 D354]								
Axis 1 read U0-04 value								
[DEDIV D354 E100 D504]								
Axis 1 actual output current								

6. Read AC drive state

Read 3000H to directly obtain the current state of the AC drive. (1: Forward running; 2: Reverse running; 3: Stop)

The configuration and procedure are as follows:

1	MD (Frequ	3000	Hex	63	HOST (H5U)	308	Dec	1
- [MOV D308 D358]								

7. Read DI state

Based on the conversion rule, convert the DI state U007 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 configuration and procedure are as follows:

1	MD (Frequ	7007	Hex	63	HOST (HEV)	310	Dec	1
---	-----------	------	-----	----	------------	-----	-----	---

```

-[ MOV      D310      D360      ]
  DI status

```

8. Read fault code

Based on the conversion rule, convert the fault code U045 to 702D and fault sub-code U046 to 702E.

The configuration and procedure are as follows:

1	MD (Frequ	702D	Hex	63	HOST (HEV)	312	Dec	1
1	MD (Frequ	702E	Hex	63	HOST (HEV)	314	Dec	1

```

-[ MOV      D312      D362      ]
  Fault master code
[
  MOV      D314      D364      ]
  Fault subcode

```

FAQ and Solutions

Items must be checked:

1. Check whether other pins instead of CANH and CANL are connected to the PLC.
2. Check Fd-10 of all stations. 1: CANopen; 2: 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 Fd-13 (CAN station number) setting of the current AC drive is unique from that of other AC drives. Avoid duplication to prevent conflicts.

Table 3-23 FAQ and Solutions

FAQ	Solution
Failure to write frequency	1. Check the address in the configuration table based on F0-03. When F0-03 is set to 0, the address should correspond to the value of F0-08. When F0-03 is set to 9, the address should be 1000H or 7310H. 2. Check whether the termination resistor is connected. If not, connect the termination resistor and then power on the AC drive again.
Failure to start the AC drive	1. Ensure that F0-02 is set to 2 (communication). 0 means operating panel and 1 means terminal. 2. Check whether the termination resistor is connected. If not, connect the termination resistor and then power on the AC drive again.
Unstable connection	1. Ensure stable connection on PLC side. 2. Ensure stable connection on AC drive side and firm contact between the LAN cable and the LAN port. 3. Check whether the signal cable is close to the power cable. Keep the signal cable 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.

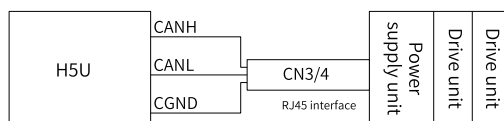


Figure 3-6 Connection of communication interfaces

Master and Slave Configuration

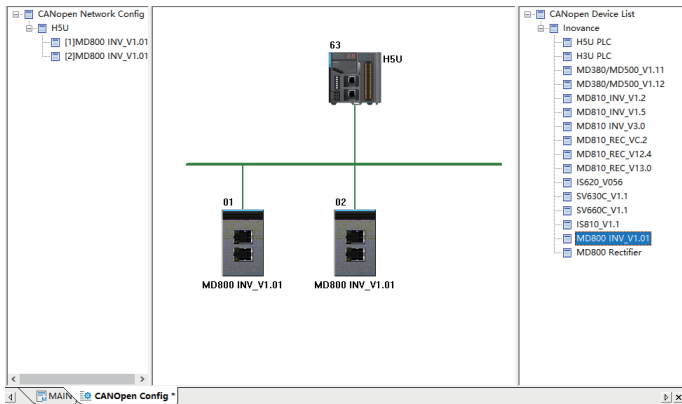
1. Run AutoShop. On the page displayed, click **"New Project"**, confirm that the value in the **"Series and models"** field is H5U, and then click **"OK"**.
2. On the left of the page displayed, click  **CAN(CANopen)** to enter the CANopen communication settings page of PLC, set the parameters as follows, and then click **"OK"**.

Protocol: CANopen

Communicate Param: Upon computer setting (the CANopen station number of PLC must not be the same as that of the AC drive)

Baud Rate: Upon computer setting (the baud rate of CAN communication for PLC initialization must be the same as that of the AC drive)

3. Configure the master and slave stations: Click  **CAN(CANopen)**. Click **"Add CAN Config"**, and  **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 TPDO and RPDO of the slave station. Double-click the slave station to be configured.

RPDO: The PDO used to write the operation frequency and control command is added by default.

TPDO: The default mapping is displayed after you click Send PDO.

Index: Groups F0 to FF: Convert the high bit F to 0 and then add 0X2000.

Groups A0 to AF: Convert the high bit A to 4 and then add 0X2000.

Groups U0 to UF: Convert the high bit U 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.

Based on the conversion rule, the index of the bus voltage U002 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				

5. 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. Inovance H5U is a high-performance compact PLC that automatically performs I/O mapping based on the configured PDO. To read from or write to a D element, you only need to click I/O Mapping and select the D element.

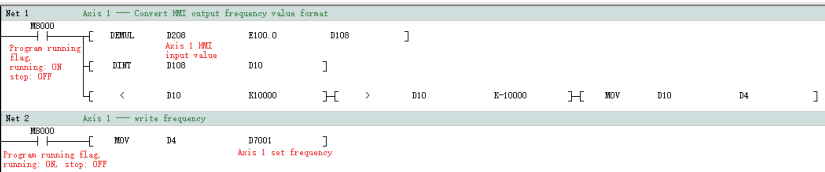
Variable	Mapping	Index: Subindex	Bit Length
-- D7000...D7001	1st receive PDO mapping	16#1600	32
D7000	Control Command	16#2073:12	16
D7001	Written Freq	16#2073:11	16
-- D7424...D7426	1st transmit PDO mapping	16#1A00	48
D7424	Running Frequency	16#2070:1	16
D7425	Bus Voltage	16#2070:3	16
D7426	Inverter 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

Example

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

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

The procedure is as follows:



2. Start/stop control over the AC drive (F0-02 set to 2)

```
—[      MOV      K1      D7000      ]
                                Axis 1 control word
```

Read the bus voltage (a) and then divide (a) by 10 to get the actual bus voltage

```

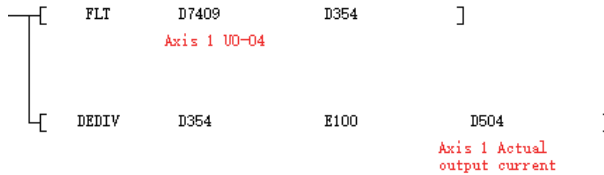
[      FLT      D7425      D350      ]
      Axis 1 U0-02
[      DEDIV    D350      E10      D500      ]
      Actual bus voltage

```

Based on the communication configuration, you can move or not move the D7408

—[	MOV	D7408	D502	]
		Axis 1 UO-03	Axis 1 Actual output voltage	

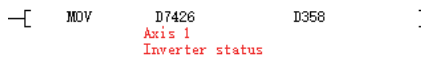
Based on the conversion rule, divide the reading by 100 to get the actual output



6. Read AC drive state

Based on the I/O mapping, read D7426 to get the current state of the AC drive (1: Forward running; 2: Reverse running; 3: Stop).

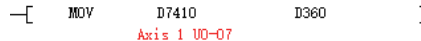
The procedure is as follows:



7. Read DI state

Based on the conversion rule, convert the DI state to D7410 according to the I/O mapping 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.

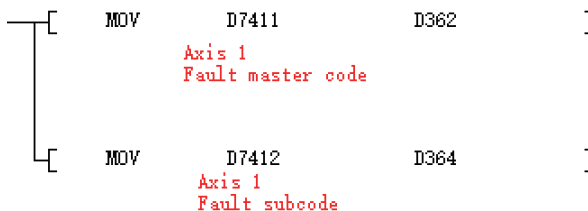
The procedure is as follows:



8. Read fault code

Based on the conversion rule, convert the fault code to 7411 and fault sub-code to 7412 according to I/O mapping.

The procedure is as follows:



FAQ and Solutions

Items must be checked:

1. Check whether other pins instead of CANH and CANL are connected to the PLC.
2. Check Fd-10 of all stations. 1: CANopen; 2: 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 Fd-13 (CAN station number) setting of the current AC drive is unique from that of other AC drives are the same. Avoid duplication to prevent conflicts.

Table 3-24 FAQ and Solutions

FAQ	Solution
Failure to write frequency	1. Check the address and D element in the configuration table based on F0-03. When F0-03 is set to 0, the I/O mapping should be 2000sub8. When F0-03 is set to 9, the I/O mapping should be 2073sub11. 2. Check whether the termination resistor is connected. If not, connect the termination resistor and then power on the AC drive again.
Failure to start the AC drive	1. Ensure that F0-02 is set to 2 (communication). 0 means operating panel and 1 means terminal. 2. Check whether the termination resistor is connected. If not, connect the termination resistor and then power on the AC drive again.
Unstable connection	1. Ensure stable connection on PLC side. 2. Ensure stable connection on AC drive side and firm contact between the LAN cable and the LAN port. 3. Check whether the signal cable is close to the power cable. Keep the signal cable 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 Error

3.6.1 Simple Diagnosis

Description

The parameter Fd-33 provides a simple diagnostic function that displays the number of CAN bus shutdown times due to strong interference after the AC drive is powered on.

Diagnostic

If the displayed value is greater than 0 and does not increase, it is indicated that the network once suffered strong interference for a long time. If the displayed value is greater than 0 and increases within 5 minutes, it is indicated that the network is suffering interference or the configuration is inappropriate. Find the specific cause and eliminate the problem.

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 termination resistors are provided at both ends of the bus. Power off all devices and use a multimeter to measure whether the resistance between CANH and CANL of the bus is within the range of 50 Ω to 60 Ω .

Check whether the nodes CANH and CANL are connected reversely and whether the CGND terminal of the bus is connected. Generally, you just need to connect all CGND terminals of all devices together and do not need to ground them.

4 PROFINET Communication

4.1 Overview

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

In this guide, the 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-V2.31-inovance-MD800PNGATE-20201229.xml.

4.2 Installing

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

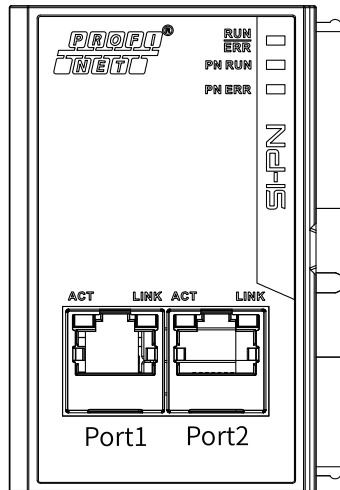


Figure 4-1 Arrangement of PN card terminals

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 PN card terminals

Terminal Code	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 the PN card is installed, face the RJ45 socket, the port on your left is port 1 and that on your right is port 2. For operation stability, use Cat 5e shielded twisted pair LAN cables.
Port2	Network port 2	

Table 4–2 Description of PN card indicator

Indicator		Status Description	Solution
RUN/ERR	Steady ON in green	The communication is normal.	None
	Steady ON in red	The communication between the PN card and a node times out.	1. Restart the PN card. 2. Remove field interference.
	Flicker quickly in red (flicker once every 500 ms)	The communication between the PN card and the power supply unit times out.	
	Flicker slowly in red (flicker once every 1s)	The communication inside the PN card times out.	
PN RUN	Steady ON	The PN card communication is normal.	None
PN ERR	Steady ON	The PN card lost communication with the master station.	Check the cable connection.
	Flicker	The master station sends a flicker request.	None

4.4 Networking 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.

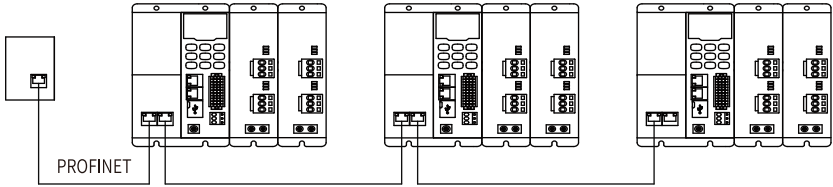


Figure 4-2 Bus topology

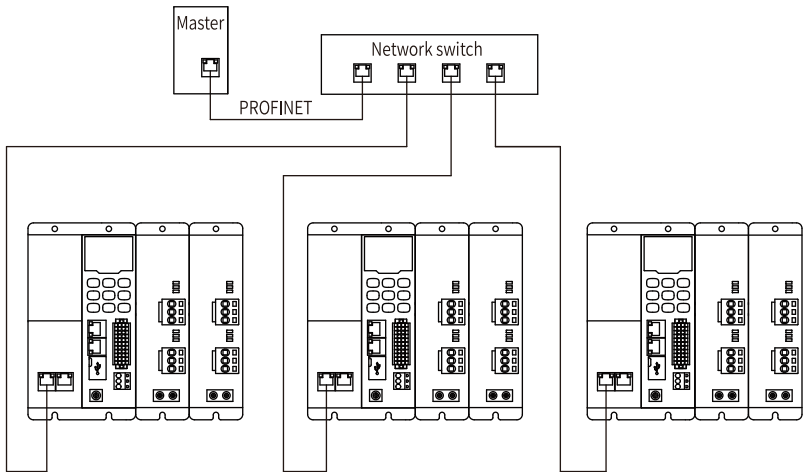


Figure 4-3 Star topology

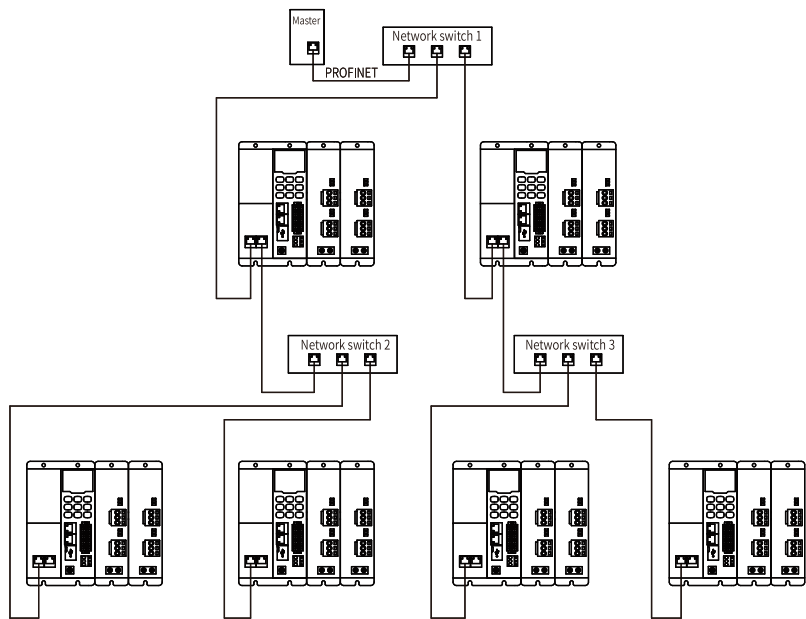


Figure 4-4 Tree topology

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. It is mainly used to:

1. Set AC drive control command and target frequency in real time.
2. Read AC drive state and operation frequency in real time.
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 interaction data.

Table 4-3 Interaction data

PZD of Data Sent by the Master Station			PZD of AC Drive Response		
PZD1	PZD2	PZD3 to PZD16	PZD1	PZD2	PZD3 to PZD16
Control word (U3-17)	Frequency reference (U3-16)	Modifying function parameters of AC drive in real time	Status word (U0-68)	Operation frequency (U0-00)	Reading function parameters of AC drive in real time

Table 4-4 Data description

PZD of Data Sent by the Master Station		PZD of AC Drive Response	
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: Fault reset	PZD1	AC drive running state 0: Running state 1: Forward/Reverse state 2: Whether a fault occurs 3: Whether the output frequency reaches the frequency reference 4: Communication normal flag 5 to 7: Reserved 8 to 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	AC drive operation frequency (unit: 0.01 Hz) The current AC drive operation 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	Reading function parameters in real time

4.6 Parameters

PN Card Setting of 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.

Para. No.	Name	Value Range	Setpoint	Description
Fd-10	Communication protocol selection	1: CANopen 2: CANlink 3: Communication card mode	3	If it is set to 1, CANopen communication is selected. If it is set to 2, CANlink communication is selected. If it is set to 3, the communication card mode is selected.

Function Parameters for Communication Monitoring

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

Para. No.	Description
Fd-51	This parameter shows the slave station communication inhibit time.
Fd-52	This parameter shows the number of online slave stations.
Fd-53	This parameter shows the online status of stations 1 to 15. Bit1 indicates station 1 status, and so on.
Fd-54	This parameter shows the online status of stations 16 to 31. Bit0 indicates station 16 status, and so on.
Fd-61	This parameter shows the highest two bytes of the MAC address.
Fd-62	This parameter shows the middle two bytes of the MAC address.
Fd-63	This parameter shows the lowest two bytes of the MAC address.
Fd-91	This parameter shows the PN card version.

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.

Para. No.	Description
Fd-50	0: The communication error E16.74 is reported when the number of slave stations configured for the PLC is inconsistent with the actual number of slave stations in the network. 1: No communication error is reported when the number of slave stations configured for the PLC is inconsistent with the actual number of slave stations in the network.

The setting takes effect after power-on again.

- **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.

Para. No.	Description
Fd-55	This parameter defines the PN communication timeout time in ms.

The setting takes effect after power-on again.

4.7 Communication Configuration

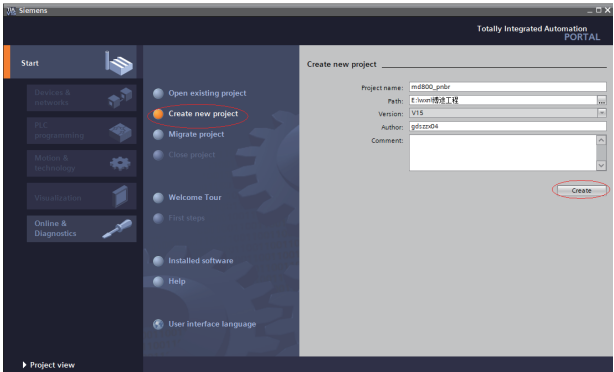
4.7.1 Configuration

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. Contact Inovance agents or vendors to get the GSDML file.

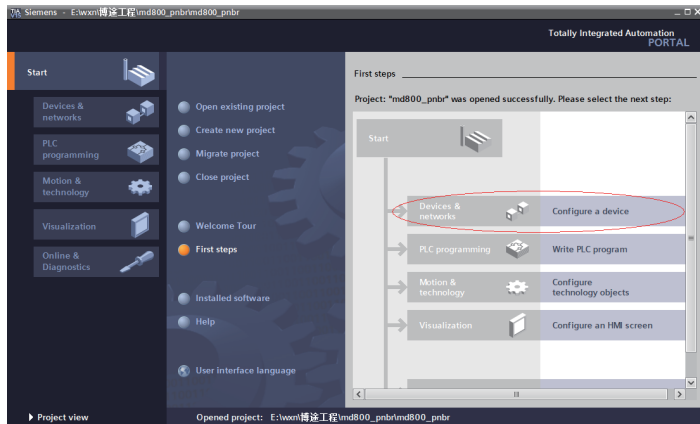
If the 200 SMART ST&SR series master station is used, the PLC firmware version must be 2.05 or later.

The configuration procedure is as follows:

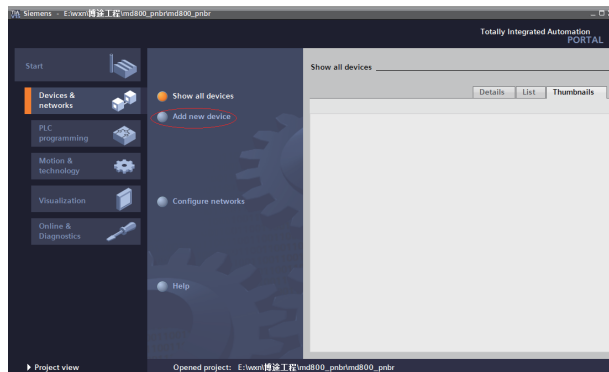
1. Create a project
 - a. Select "Create new project", set a project name and storage path in the "Project name" and "Path" fields, and then click "Create".



- b. Select "Configure a device", as shown below.

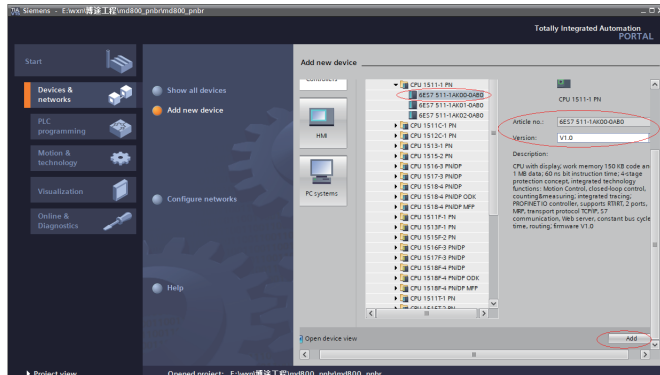


c. Click "Add new device".



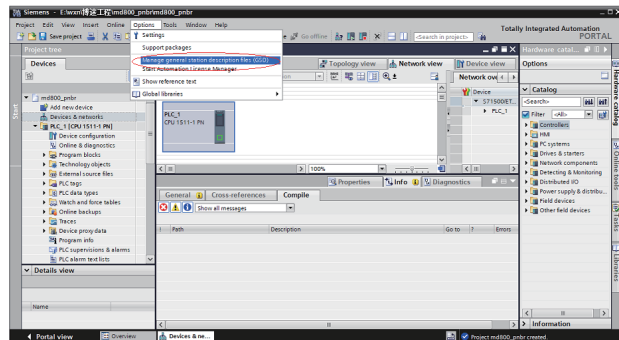
d. On the page displayed, select the PLC and its firmware version based on the article No. Click "Add" or double-click the master station. The master station is created.

Note: The selected PLC must match the article No. Otherwise, the PLC cannot be downloaded.

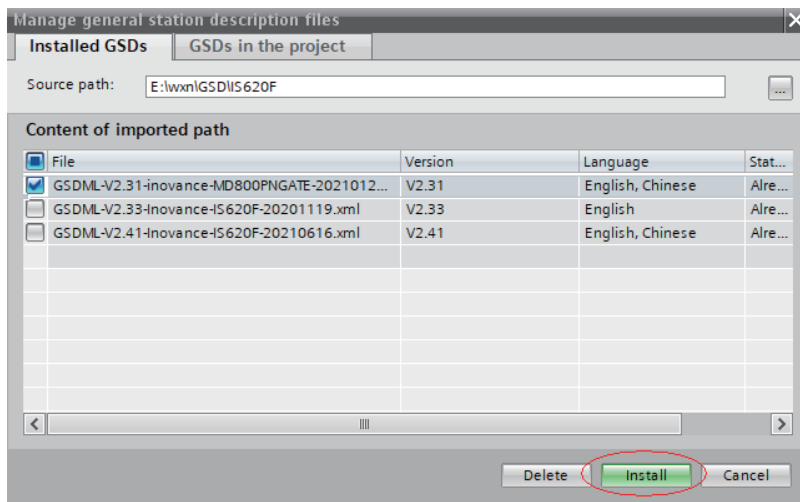


2. Install the GSD file (if you never install GSDML, perform this step).

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



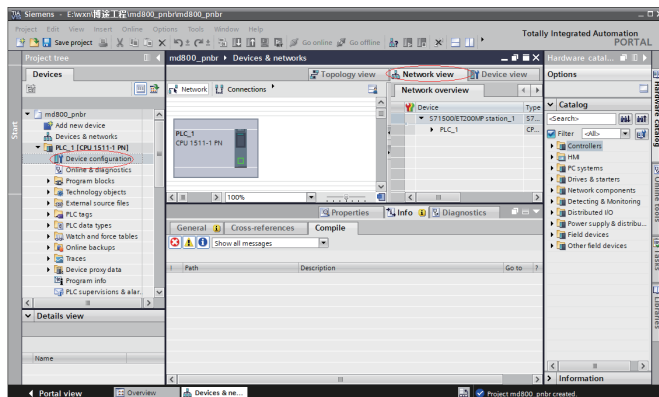
- b. Select the GSDML storage path (Note: The GSDML file cannot be stored in a path containing Chinese characters. Otherwise, an error is reported). Select the GSDML to be installed and then click "Install".



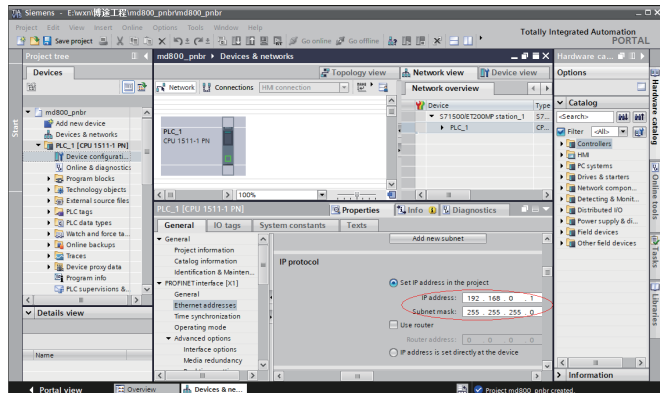
In the dialog box prompting that the GSDML is installed, click "Close".

3. Create a network

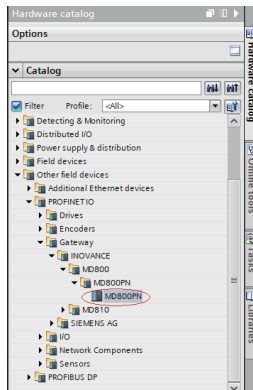
- a. Click "Device configuration" on the page and then switch to the "Network view".



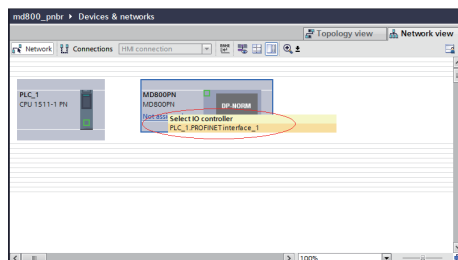
- b. Select the Ethernet port of the PLC, choose "Properties" > "General", and set the IP address and subnet mask of the PLC master station.



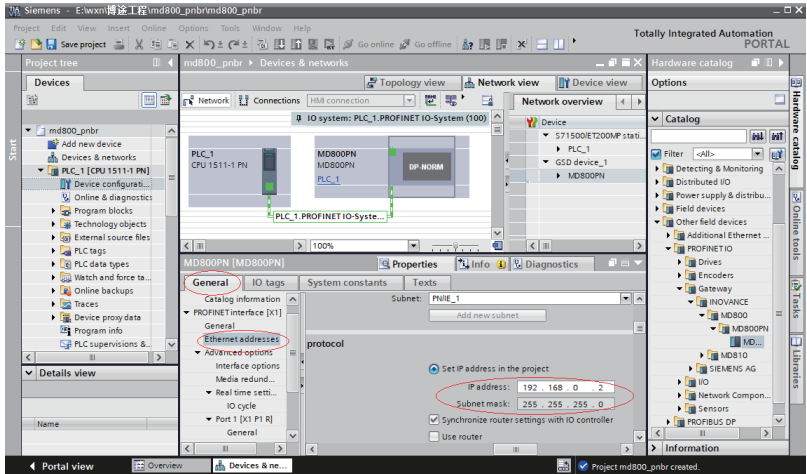
- c. In the "Hardware catalog" section on the right, locate MD800 and then double-click MD800PN.



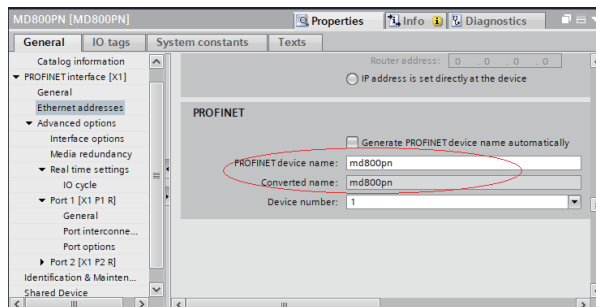
- d. Click "Not assigned" and select the master station system to which the slave station needs to connect.



- e. Select the slave station, choose "Properties" > "General". Under "PROFINET interface [X1]", select "Ethernet addresses", and then set the IP address.



- f. On the preceding page, drag the scroll bar to the "PROFINET" section, deselect "Generate PROFINET device name automatically". Input the name of the slave station in the "PROFINET device name" field. You can also select "Generate PROFINET device name automatically" and then the system automatically generates the device name.



4. Configure the CANopen slave station

Note

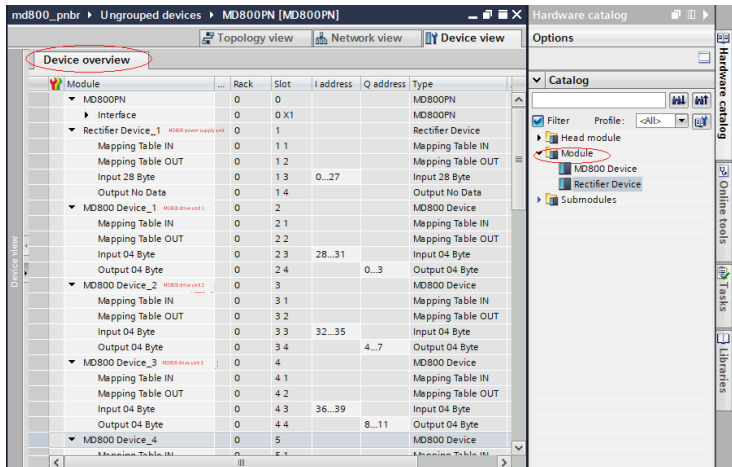
The PN card can be configured as follows:

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.

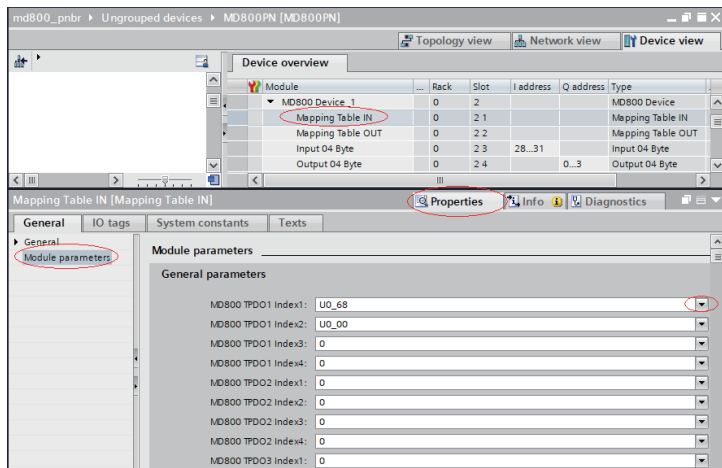
a. Add a slave station

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.

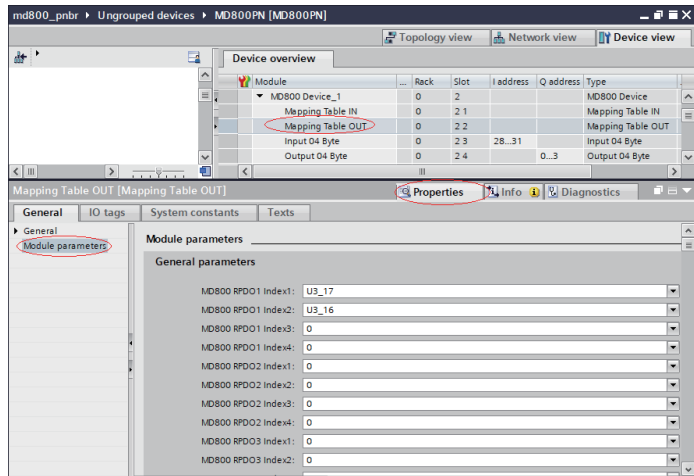


b. Configure the mapping

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

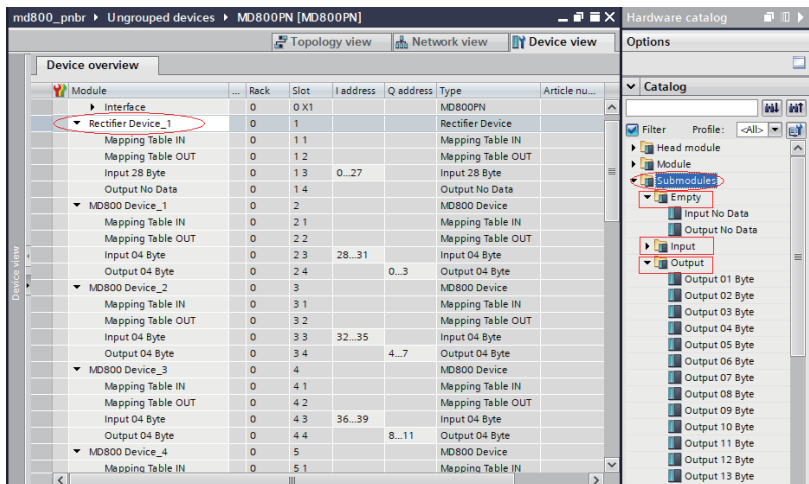


- 2). Select "Mapping Table OUT". Choose "Properties" > "General" > "Module parameters", select a mapping from the drop-down list for the slave station RPDO data.



c. Configure the process data

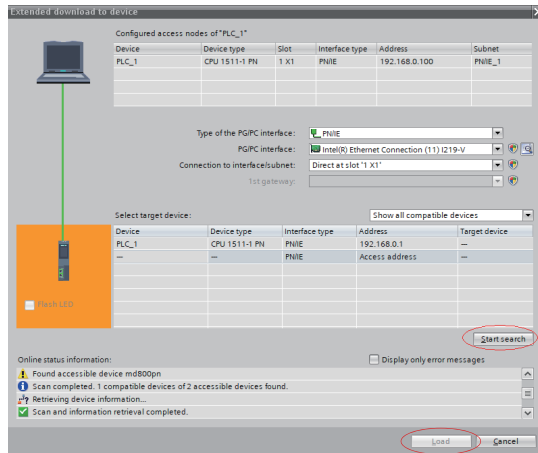
Select a module from the "Device overview" list. In the list of "Submodules" under "Catalog", three catalogs are available: Empty, Input, and Output, which are used to configure the process data length for the module. In the "Output" catalog, set the length of the master-to-slave process data. In the "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.



d. Download the project

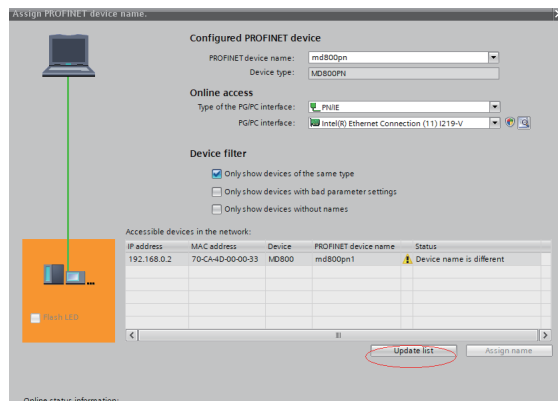
After configuration, save the project, set the PC IP address to be in the same segment of the PLC IP address (note that this IP address cannot be the same as that of the slave station. You can choose to automatically assign the PC IP

address), compile the project, click "Download" to download the generated file, select an interface, and then click "Start search".

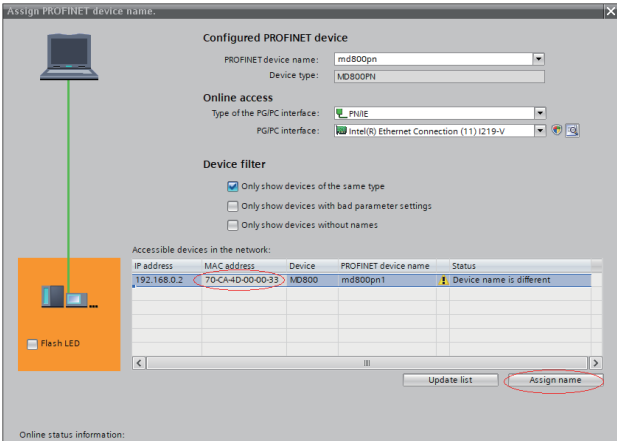


e. Assign a name for the device

- 1). After the project is downloaded, you need to assign a name for the slave station. Select the slave station, and then click "Assign device name" under "Go online" or right-click the slave station.

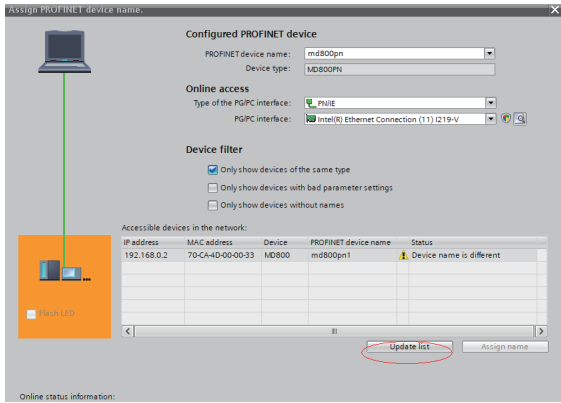


- 2). Among the accessible nodes in the network, select the slave station for which you want to assign a name (nodes are distinguished by MAC addresses) and then click "Assign name".



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 assignment, close the page or select another name from the drop-down list of "PROFINET device name" to assign a name for another site.

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).



4.7.2 MRP Function and Configuration

MRP Overview

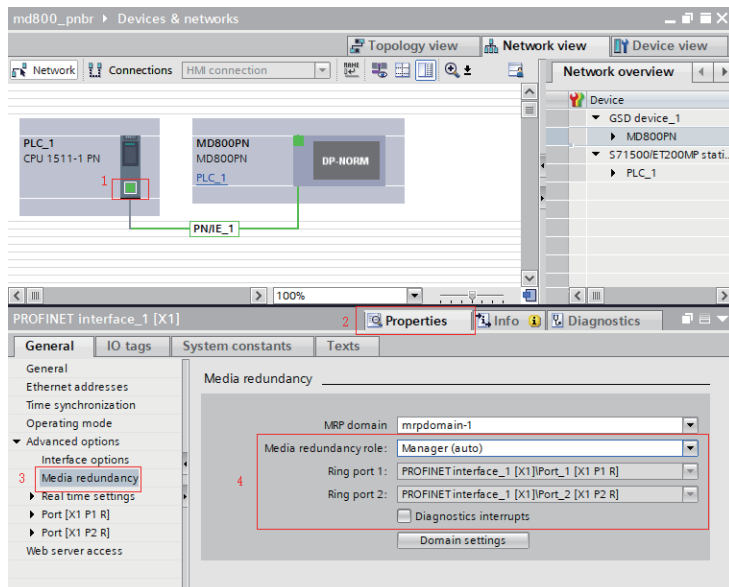
The AC drive adopts the standard Media Redundancy Protocol (MRP) that meets the IEC62439-2 standard. It provides a typical reconstruction time of 200 ms and supports up to 50 devices in each ring network.

MRP basic rules:

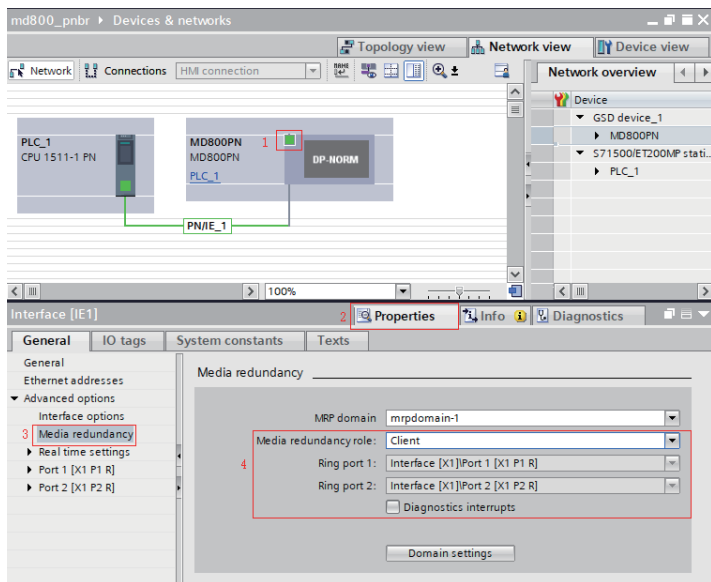
1. All nodes in the ring network must support and be enabled with MRP.
2. All devices are interconnected through ring ports.
3. All devices in the ring network are in the same redundancy domain.
4. A maximum of 50 devices can be connected in a ring network. More devices will prolong the reconstruction 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".

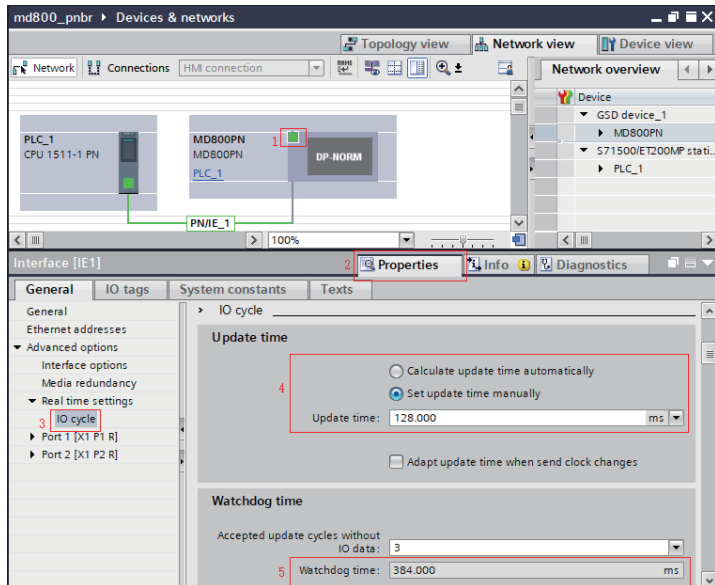


2. Select an I/O device port, choose "Properties" > "Media redundancy". In the drop-down list of "Media redundancy role", select "Client". Check the parameters of "Ring port 1" and "Ring port 2".



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 Troubleshooting

4.8.1 Communication Fault Code

When the communication function is incorrectly configured, the PLC and power supply unit operating panel report errors. You can view error messages for troubleshooting.

The power supply unit may report the following errors:

Table 4-5 Fault code of the power supply unit

Fault Code	Possible Cause	Solution	Reset Mode
E16.71	The communication between the PN card and the master station fails.	Check whether the connection between the communication card and PLC is in poor contact. Make sure that they are properly connected.	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	The communication between the communication card and the axis fails.	Check whether the connection between the communication card and power supply unit is in poor contact. Make sure that they are properly connected.	
None	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	The configuration is incorrect (the configured axis does not exist).	Check whether the configured slave station exists and ensure that startup with station lost is disabled (Fd-50 of the power supply unit is set to 0).	
E16.75	The process data and mapping of the drive unit do not match.	Check the process data and the number of mapping relations configured for the drive unit, and make sure that they match.	
E16.76	The process data and mapping of the power supply unit do not match.	Check the process data and the number of mapping relations configured for the power supply unit, and make sure that they match.	

4.8.2 PLC Diagnosis Information

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

Fault Code	Diagnosis 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 2.4 (corresponding to drive unit 1) has an error indicating that the process data of drive unit 1 does not match the mapping.

Project tree | **md800_pnbr** | **PLC_1 [CPU 1511-1 PN]**

Devices

- md800_pnbr
 - Add new device
 - Devices & networks
 - PLC_1 [CPU 1511-1 PN]
 - 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 f...
 - Online card data
 - Local modules

Diagnostics

- General
- Diagnostics status
- Diagnostics buffer**
- Cycle time
- Memory
- Display
- PROFINET interface [x1]
- Functions

Online access

No.	Time	Event	Status
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 commun...	✗
4	10/15/2021 1:50:59.809 PM	canopen slave communication objects error - canopen slave commun...	✗
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# 02:39C8	✗
9	10/15/2021 1:44:46.192 PM	Follow-on operating mode change - CPU changes from STOP to START...	✓

Details on event:

Details on event: **3** of **511** Event ID: **16# 561A:12CD**

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 object 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**

5 EtherCAT Communication

5.1 Overview

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.

When this card is installed on the AC drive, the AC drive networking function is implemented and the AC drive can serve as a slave station of the field bus and be controlled by the field bus master station, improving the communication efficiency. The EtherCAT communication card supports a minimum sync period of 500 μ s.

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 Installing

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

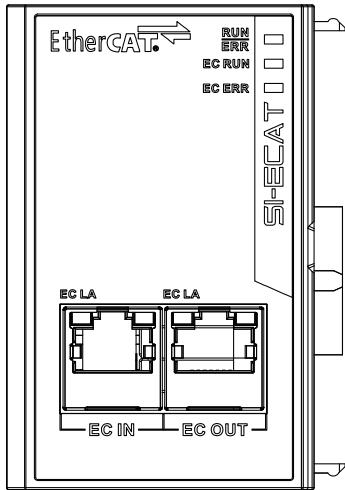


Figure 5-1 Arrangement of ECAT card terminals

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 Code	Terminal Name	Description
EC IN	Input port	After the ECAT card is installed, face the RJ45 socket, the port on your left is EC IN and that on your right is EC OUT. Do not connect them reversely. For operation stability, use Cat 5e shielded twisted pair LAN cables.
EC OUT	Output port	

Table 5-2 Description of ECAT card indicator

Indicator		Status Description	Solution
RUN/ERR	Steady ON in green	The communication is normal.	None
	Steady ON in red	The communication between the ECAT card and a node times out.	Check whether the connector has interference.
	Flicker slowly in red	The communication between the ECAT card and the power supply unit times out.	1. Check whether the communication card is properly installed. 2. Check whether the power supply unit is normal.
	Flicker quickly in red	The ECAT card fails.	Troubleshoot based on the fault code on the power supply unit display panel.
EC RUN	Green indicator OFF	The state of the EtherCAT state machine is INIT (Initializing).	None
	Flicker quickly in green	The state of the EtherCAT state machine is PREOP (Pre-operation).	None
	Flicker slowly in green	The state of the EtherCAT state machine is SAFEOP (Safe operation).	None
	Steady ON in green	The state of the EtherCAT state machine is OP (Operation).	None
EC ERR	Red indicator OFF	The EtherCAT communication is normal.	None
	Steady ON in red	The EtherCAT communication is faulty.	Check the fault code displayed on the power supply unit operating panel.
EC LA	Yellow indicator OFF	The previous EtherCAT device is not connected.	None
	Steady ON in yellow	The previous EtherCAT device is connected.	None
	Green indicator OFF	No data is exchanged at the network port.	None
	Flicker in green	Data is exchanged at the network port.	None

5.4 Networking 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.

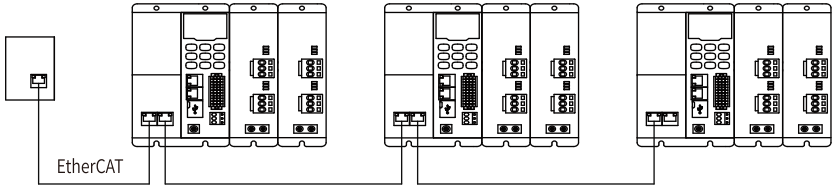


Figure 5-2 Bus topology

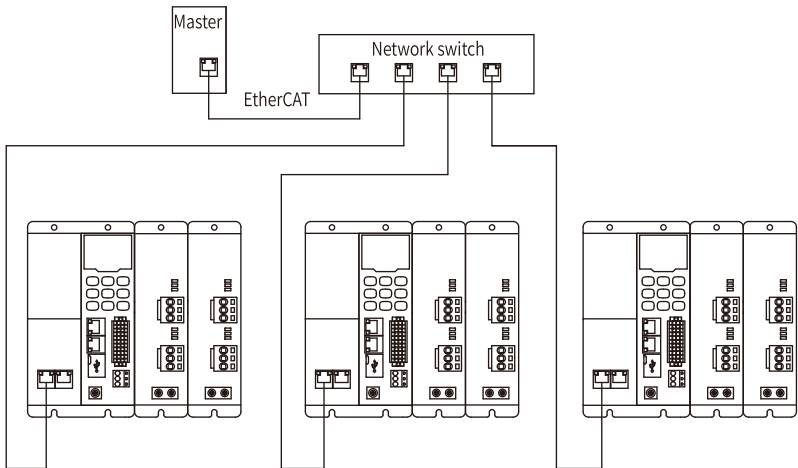


Figure 5-3 Star topology

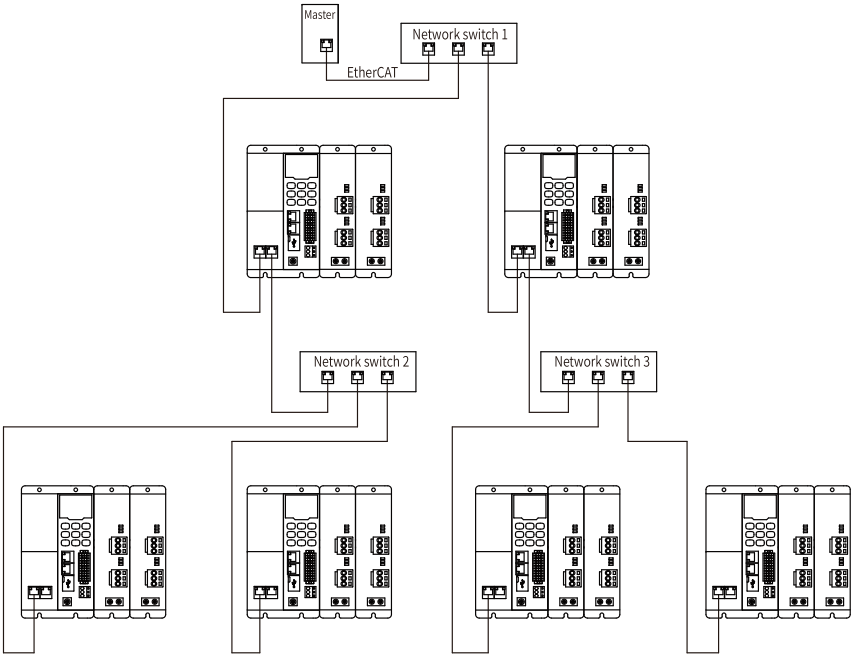


Figure 5-4 Tree topology

5.5 PDO Data

Description of PDO Data

The PDO data is used for the master station to modify and read AC drive data in real time and perform periodic data exchange. Data communication addresses are directly configured by the AC drive. It is mainly used to:

1. Set AC drive control command and target frequency in real time
2. Read AC drive state and operation frequency in real time
3. Exchange function parameters and monitor data real-time exchange between the AC drive and the EtherCAT master station in real time

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

Master-Axis 1 Sending PDO (1601h)			Corresponding Data PDO (1A01h) of AC Drive Axis 1		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive target frequency	Modifying function parameters of AC drive in real time	AC drive state	AC drive operation frequency	Reading function parameters of AC drive in real time
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

Master-Axis 2 Sending PDO (1602h)			Corresponding Data PDO (1A02h) of AC Drive Axis 2		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive target frequency	Modifying function parameters of AC drive in real time	AC drive state	AC drive operation frequency	Reading function parameters of AC drive in real time
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

Master-Axis 3 Sending PDO (1603h)			Corresponding Data PDO (1A03h) of AC Drive Axis 3		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive target frequency	Modifying function parameters of AC drive in real time	AC drive state	AC drive operation frequency	Reading function parameters of AC drive in real time
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

Master-Axis 4 Sending PDO (1604h)			Corresponding Data PDO (1A04h) of AC Drive Axis 4		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive target frequency	Modifying function parameters of AC drive in real time	AC drive state	AC drive operation frequency	Reading function parameters of AC drive in real time
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

Master-Axis 5 Sending PDO (1605h)			Corresponding Data PDO (1A05h) of AC Drive Axis 5		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive target frequency	Modifying function parameters of AC drive in real time	AC drive state	AC drive operation frequency	Reading function parameters of AC drive in real time
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

Master-Axis 6 Sending PDO (1606h)			Corresponding Data PDO (1A06h) of AC Drive Axis 6		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive target frequency	Modifying function parameters of AC drive in real time	AC drive state	AC drive operation frequency	Reading function parameters of AC drive in real time
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

Master-Axis 7 Sending PDO (1607h)			Corresponding Data PDO (1A07h) of AC Drive Axis 7		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive target frequency	Modifying function parameters of AC drive in real time	AC drive state	AC drive operation frequency	Reading function parameters of AC drive in real time
RPDO1	RPDO2	RPDO3 to RPDO16	TPDO1	TPDO2	TPDO3 to TPDO16

Master-Axis 8 Sending PDO (1608h)			Corresponding Data PDO (1A08h) of AC Drive Axis 8		
Fixed RPDO		Variable RPDO			
AC drive command	AC drive target frequency	Modifying function parameters of AC drive in real time	AC drive state	AC drive operation frequency	Reading function parameters of AC drive in real time
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

Data Sent by the Master Station

Table 5-3 RPDO of data sent by the master station

RPDO	Description
RPDO1	AC drive command word (command source F0-02 set to 2 (communication)) 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: Fault reset
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.

AC Drive Response Data

Table 5–4 TPDO of ac drive response data

RPDO	Description
TPDO1	AC drive running state AC drive running state is 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: Operation frequency not reached; 1: Operation frequency reached
TPDO2	AC drive operation frequency (unit: 0.01 Hz) The current AC drive operation 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 Data

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

The CoE service types of EtherCAT include: emergency message, SDO request, SDO response, TxPDO, RxPDO, remote TxPDO transmit request, remote RxPDO transmit request, and SDO information.

Currently, the AC drive supports SDO request and SDO response.

5.7 Parameters

Setting the ECAT Card of 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

Para. No.	Name	Value Range	Setpoint	Description
Fd-10	Communication protocol selection	1: CANopen 2: CANlink 3: Communication card mode	3	If it is set to 1, CANopen communication is selected. If it is set to 2, CANlink communication is selected. If it is set to 3, the communication card mode is selected.
Fd-50	Start with station lost	0: Disabled 1: Enabled	0	The AC drive can still run when this station is not mapped.
Fd-70	EtherCAT station name	0 to 65535	0	EtherCAT station name
Fd-71	EtherCAT station alias	0 to 65535	0	EtherCAT station alias
Fd-72	Number of synchronization interrupts allowed by EtherCAT	0 to 30	10	Number of synchronization interrupts allowed by EtherCAT
Fd-73	CRC check error of EtherCAT-Port0	0 to 65535	0	Maximum error value and invalid frames of EtherCAT port 0 per unit time
Fd-74	CRC check error of EtherCAT-Port1	0 to 65535	0	Maximum error value and invalid frames of EtherCAT port 1 per unit time
Fd-75	Data forwarding error of EtherCAT port 0/1	0 to 65535	0	Maximum forwarding error of EtherCAT port per unit time
Fd-76	EtherCAT processing unit and PDI error	0 to 65535	0	Maximum EtherCAT data frame processing unit error per unit time
Fd-77	Link loss of EtherCAT port 0/1	0 to 65535	0	Maximum link loss of EtherCAT port 0 per unit time
Fd-78	EtherCAT host type selection	0 to 65535	0	Determined by the host controller type. Reserved for non-standard models.
Fd-79	EtherCAT synchronization error monitoring mode setting	0 to 1	0	Sets the fault (synchronization frame loss) detection mode.
Fd-80	Number of EtherCAT synchronization frame loss	0 to 65535	0	Number of synchronization loss

Para. No.	Name	Value Range	Setpoint	Description
Fd-81	EtherCAT state machine and PHYLink status	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
Fd-84	EtherCAT FPGA firmware version	0 to 65535	0	FPGA software version
Fd-86	EtherCAT EEPROM reading time	0 to 65535	0	EtherCAT EEPROM reading time
Fd-87	EtherCAT DC gain	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	Communication extension card software version

Table 5-6 Parameters of drive unit

Para. No.	Name	Value Range	Setpoint	Description
F0-02	Command source selection	0: Operating panel of the power supply unit/LCD operating panel/Software tool 1: Terminal 2: Communication	2	For the drive unit, set this parameter to 2.
F0-03	Main frequency source X selection	0: Digital setting (preset frequency (F0-08) that can be changed by pressing UP/DOWN; non-retentive at power failure) 1: Digital setting (preset frequency (F0-08) that can be changed by pressing UP/DOWN; retentive at power failure) 2: AI1 3: AI2 4: AI3 5: Reserved 6: Multi-reference 7: Simple PLC 8: PID 9: Communication 10: Reserved	9	For the drive unit, set this parameter to 9.

Para. No.	Name	Value Range	Setpoint	Description
Fd-10	Switchover between CANopen and CANlink	1: CANopen 2: CANlink	1	CAN communication protocol display: Displays the communication protocol of the power supply unit. 1 means CANopen or communication extension card mode. 2 means CANlink. The parameter Fd-10 is read-only and set by the power supply unit.
Fd-11	CANopen402 selection	0: Disabled 1: Enabled	0	Selects the CANopen mode. 0: Normal 1: CIA402 Set this parameter when you need to control the motor by using the CANopen402 protocol.

Communication and Control Parameters

Table 5-7 Communication and control parameters

Para. No.		Description	Index	Sub-index
Communication and control word parameters of the drive unit	U3-16	Frequency reference 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 state	16#2070	16#08
	U0-08	DO/RO 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

Para. No.	Description	Index	Sub-index
Common parameters of the power supply unit	U0-00	Bus voltage	16#2170
	U0-01	Heatsink temperature	16#2170
	U0-03	Fan speed	16#2170
	U0-04	Input voltage U _{sr}	16#2170
	U0-05	Input voltage U _{st}	16#2170
	U0-06	Input voltage U _{tr}	16#2170
	U0-07	Three-phase unbalance factor (%)	16#2170

The position of the object dictionary in parameter tables is specified by its index and sub-index.

Index: specifies the position of the same-class objects in the object dictionary, expressed in hexadecimal.

Sub-index: specifies the offset of multiple objects 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
Drive unit	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

Device Type	Object Dictionary Index Range of I/O Device	Object Dictionary Index Range of CANopen402 Protocol
Drive unit axis 7	0x5000 to 0x50FF	0x9000 to 0x97FF
Drive unit axis 8	0x5800 to 0x58FF	0x9800 to 0x9FFF

When an MD800-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

Para. No.	Name	Unit	Decimal Address
U0-00	Operation 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	0.1 A	28676
U0-05	Output power	0.1 kW	28677
U0-06	Output torque	0.1%	28678
U0-07	DI state	1	28679
U0-08	DO/RO 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	Count 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	Voltage after AI1 gain and offset	0.001 V	28693
U0-22	Voltage after AI2 gain and offset	0.001 V	28694
U0-23	Voltage after AI3 gain and offset	0.001 V	28695

Para. No.	Name	Unit	Decimal Address
U0-24	Linear speed	1 m/min	28696
U0-25	Current power-on time	1 min	28697
U0-26	Current running time	0.1 min	28698
U0-28	Communication	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	Motor temperature	1°C	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
U0-41	DI state display	1	28713
U0-42	DO/RO state display	1	28714
U0-43	DI state display	1	28715
U0-44	DO/RO state display	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	Station number auto allocated	1	28727
U0-56	Recognized axis type	1	28728
U0-57	Fan speed	1 RPM	28729

Para. No.	Name	Unit	Decimal Address
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	Warning code	1	28760
U0-89	Warning 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
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

When an ECAT card is used, the PDO1 and PDO2 read by axes 1 to 8 of the drive unit are mapped to U0-68 and U0-69 respectively by default. Note that the first two items of TxPDO configured on the master station must be U0-68 and U0-69 in sequence.

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

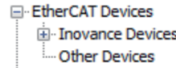
Software Acquisition and Hardware Wiring

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.

General Settings	+ Add ✎ Edit ✖ Delete Collapse Show All ☒ PDO Assign ☒ PDO Config				
Process Data	Input/Output	Name	Index	Subindex	Length
	☒ Output	Axis#1 Outputs	16#1601	16#00	4
Startup Parameters	☐ Output	Axis#2 Outputs	16#1602	16#00	4
	☐ Output	Axis#3 Outputs	16#1603	16#00	4
I/O Functional Mapping	☐ Output	Axis#4 Outputs	16#1604	16#00	4
	☐ Output	Axis#5 Outputs	16#1605	16#00	4
Information	☐ Output	Axis#6 Outputs	16#1606	16#00	4
	☐ Output	Axis#7 Outputs	16#1607	16#00	4
	☐ Output	Axis#8 Outputs	16#1608	16#00	4
State	☒ Input	Axis#1 Inputs	16#1A01	16#00	4
	☐ Input	Axis#2 Inputs	16#1A02	16#00	4
	☐ Input	Axis#3 Inputs	16#1A03	16#00	4
	☐ Input	Axis#4 Inputs	16#1A04	16#00	4
	☐ Input	Axis#5 Inputs	16#1A05	16#00	4
	☐ Input	Axis#6 Inputs	16#1A06	16#00	4
	☐ Input	Axis#7 Inputs	16#1A07	16#00	4
	☐ Input	Axis#8 Inputs	16#1A08	16#00	4
	☐ Input	Axis#16 Inputs	16#1A10	16#00	4

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.

Groups A0 to AF: Convert the high bit A to 4 and then add 0X2000.

Groups U0 to UF: Convert the high bit U 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.

Index	Subindex	Name	Sign	Type	Default Value
16#2073	16#000	Axis1 73canH_Address_Communication...	RW	USINT	
16#2074	16#000	Axis1 CANopen_402_Data_Monitoring...	RW	USINT	
16#2073	16#000	Axis2 73canH_Address_Communication...	RW	USINT	
16#2074	16#000	Axis2 CANopen_402_Data_Monitoring...	RW	USINT	
16#3074	16#000	Axis3 73canH_Address_Communication...	RW	USINT	
16#3074	16#000	Axis3 CANopen_402_Data_Monitoring...	RW	USINT	
16#3074	16#000	Axis4 73canH_Address_Communication...	RW	USINT	
16#3074	16#000	Axis4 CANopen_402_Data_Monitoring...	RW	USINT	
16#4073	16#000	Axis5 73canH_Address_Communication...	RW	USINT	
16#4074	16#000	Axis5 CANopen_402_Data_Monitoring...	RW	USINT	
16#4074	16#000	Axis6 73canH_Address_Communication...	RW	USINT	
16#4074	16#000	Axis6 CANopen_402_Data_Monitoring...	RW	USINT	

Name: Data type:
 Index: 16# Bit Length:
 Subindex: 16#

OK

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. I/O Functional 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.

☒ Hex display current value

Variable	Channel	Type
_I_Q1_0	Axis1 Communication control command	UINT
_I_Q1_1	Axis1 Frequency set through communication	UINT
_I_Q1_2	Axis1 AC drive running status word 2	UINT
_I_Q1_3	Axis1 Running frequency	UINT

General Settings

Process Data

Startup Parameters

I/O Functional Mapping

Information

State

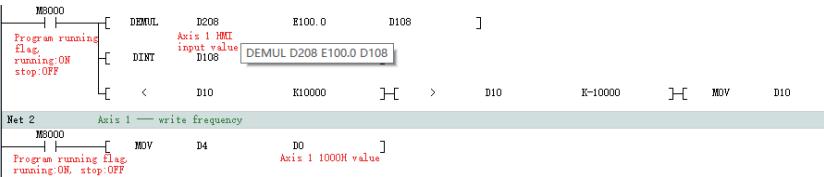
Click next to a variable to select the D element or other elements. After configuring the I/O mapping, you can perform programming based on the configured soft element.

Example

1. Write frequency (F0-03 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/stop control over the AC drive (F0-02 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: Forward run 2: Reverse run 3: Forward jog 4: Reverse jog 5: Coast to stop 6: Decelerate to stop 7: Fault reset

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

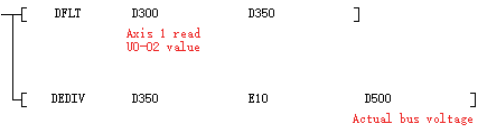


2000H corresponds to the PLC soft element address D2. When the D2 value is set to 1, the AC drive runs forward. To decelerate to stop, set D2 to 6.

3. Read 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 procedure is as follows:



4. Read output voltage

Based on the conversion rule, convert the output voltage U003 to 2070sub4 and then the reading is the actual output voltage. Based on the communication configuration, you can move or not move the D302 value to another D element.

```

-[ MOV      D302      D502      ]
  Axis 1 read  Axis 1 actual
  U0-03 value  output voltage

```

5. Read output current

Based on the conversion rule, convert the output current U004 to 2070sub5 and then divide the reading by 100 to obtain the actual output current. Based on the I/O mapping, read D304.

The procedure is as follows:

```

-[ DFLT      D304      D354      ]
  Axis 1 read  Axis 1 read
  U0-04 value  U0-04 value
- [
  DEIV      D354      E100      D504      ]
  Axis 1 actual
  output current

```

6. Read AC drive state

Read U061 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 D308.

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

The procedure is as follows:

```

-[ MOV      D308      D358      ]

```

7. Read DI state

Based on the conversion rule, convert the DI state U007 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 D310.

The procedure is as follows:

```

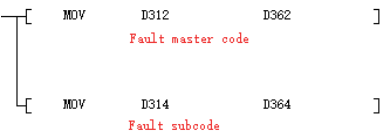
-[ MOV      D310      D360      ]
  DI status

```

8. Read fault code

Based on the conversion rule, convert the fault code U045 to 2070sub2E and fault sub-code U046 to 2070sub2E. Based on the I/O mapping, read D312 and D314.

The procedure is as follows:



FAQ 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 FAQ and Solutions

FAQ	Solution
Failure to write frequency	1. Check the address in the configuration table based on F0-03. 2. Check whether the termination resistor is connected. If not, connect the termination resistor and then power on the AC drive again.
Failure to start the AC drive	1. Ensure that F0-02 is set to 2 (communication). 0 means operating panel and 1 means terminal. 2. Check whether the termination resistor is connected. If not, connect the termination resistor and then power on the AC drive again.
Unstable connection	1. Ensure stable connection on PLC side. 2. Ensure stable connection on AC drive side. 3. Check whether the signal cable is close to the power cable. Keep the signal cable 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

The following takes the Beckhoff TwinCAT master station as an example to describe how to configure the ECAT card.

1. Install TwinCAT.

Windows XP system: tcat_2110_2230 is recommended.

32-bit Windows 7 system: 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.

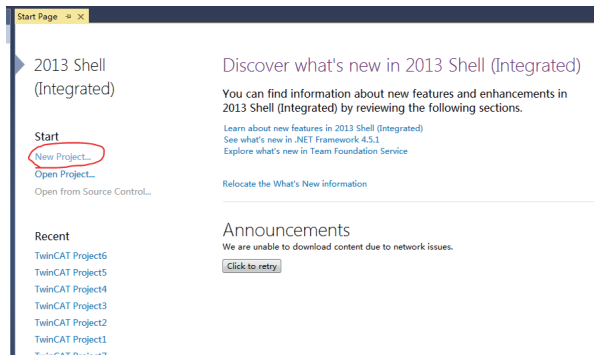
TwinCAT2 directory: TwinCAT\IO\EtherCAT.

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

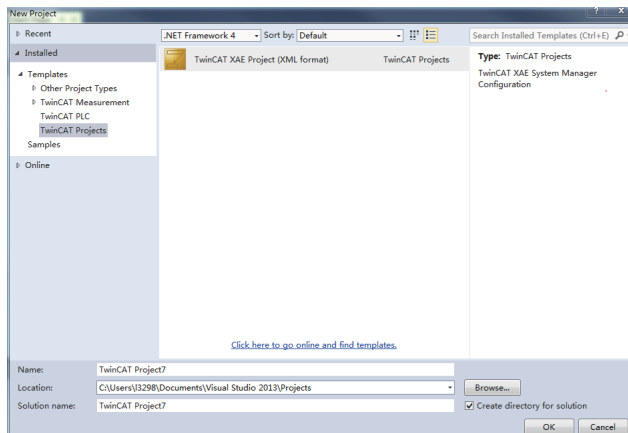
The following takes TwinCAT3 as an example. TwinCAT2 can be configured in the same way as TwinCAT3.

3. Run TwinCAT.

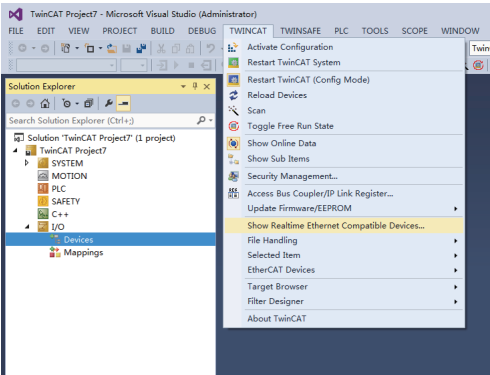
a. Click "New Project".



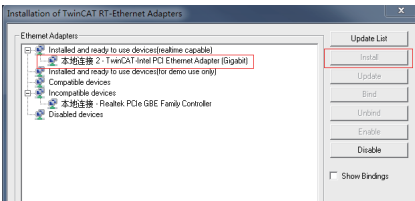
b. Click "OK". A new project is created.



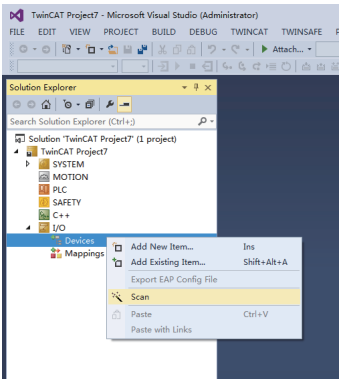
4. Install the TwinCAT network card drive.



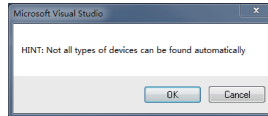
Access the menu "Show Real Time Ethernet Compatible Devices..." in the preceding figure. In the dialog box displayed, select the local device from the "Incompatible devices" field, and then click "Install". Then, the network card is installed and displayed in the "Installed and ready to use devices" column, as shown below.



- 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.



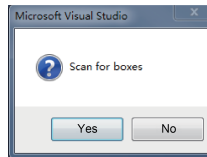
- b. Click "OK".



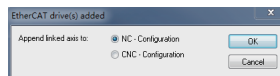
c. Click "OK".



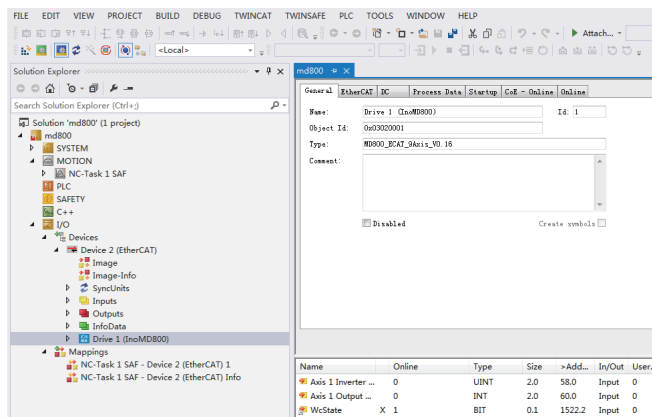
d. Click "Yes".



e. Click "OK".



f. Click "No". Then, the device searching is finished.

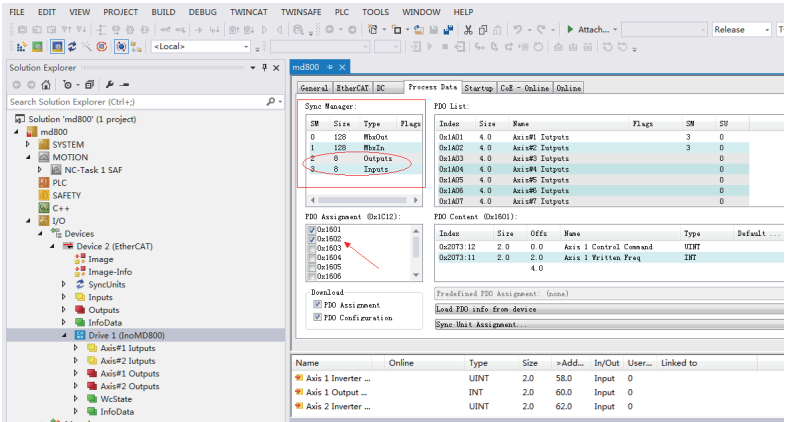


6. Configure the PDO parameters.

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

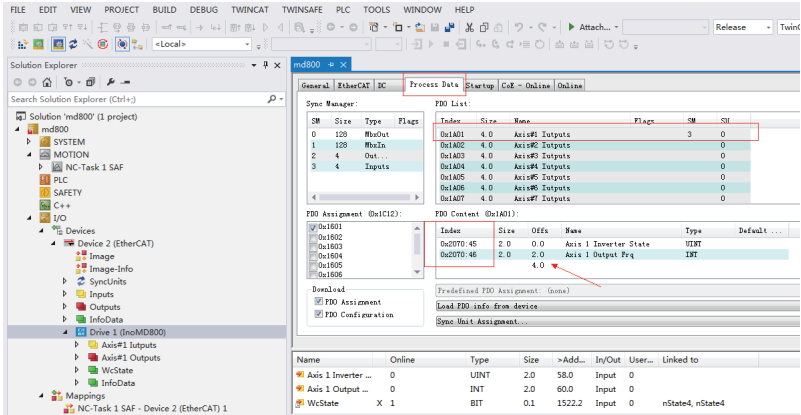
a. Configure the axis PDO.

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.



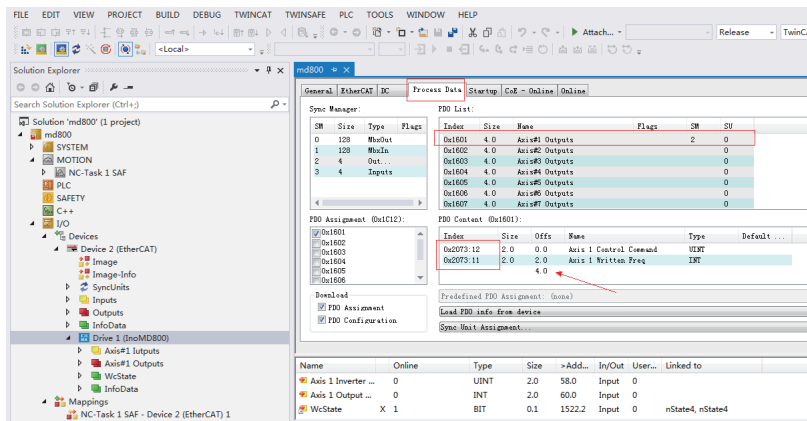
b. Configure TPDO.

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. Right-click the arrow position in the figure and add the required TPDO mapping.



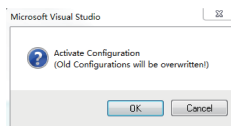
c. Configure RPDO.

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. Right-click the arrow position in the figure and add the required RPDO mapping.

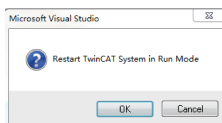


7. Configure the SDO list (not supported now).
8. Activate the configuration and switch the mode to OP.

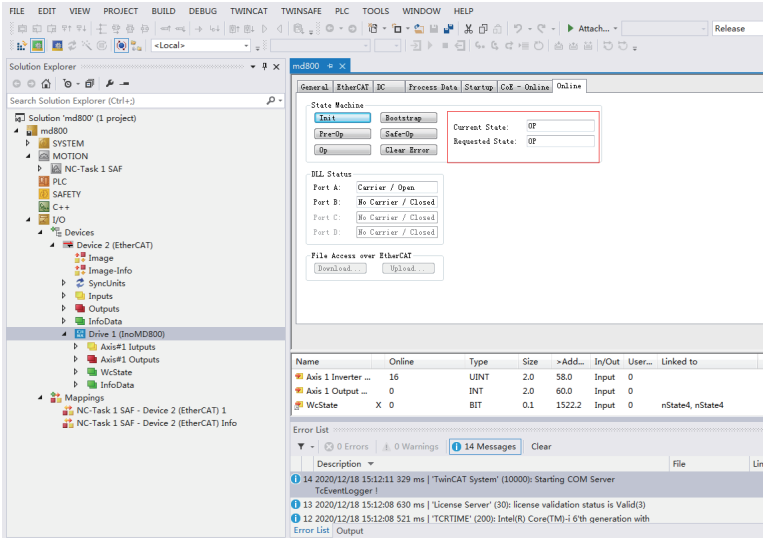
a. Click . The following page is displayed.



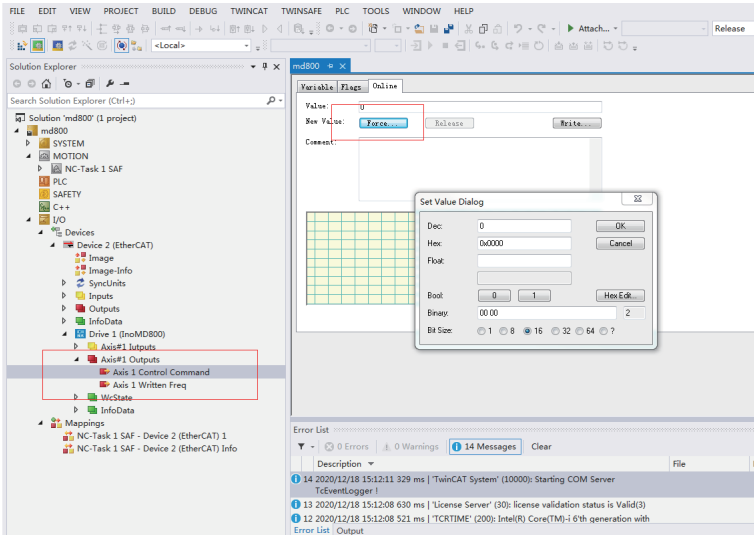
b. Click "OK".



c. Click "OK". The current state changes to OP.



9. Set PDO to control the AC drive operation mode.
Write a corresponding value to RPDO to control the AC drive operation mode.

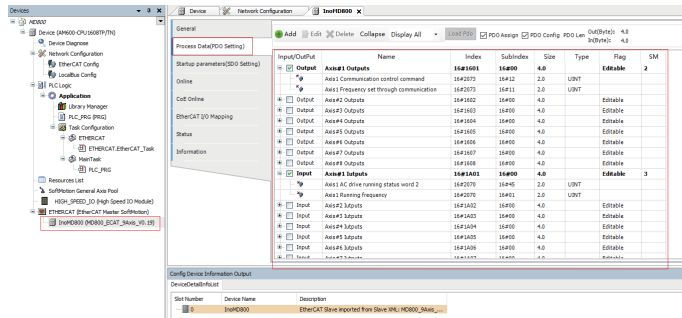


- b. Select a device from "Network Devices List" and add it as an AC drive slave station through drag-and-drop.

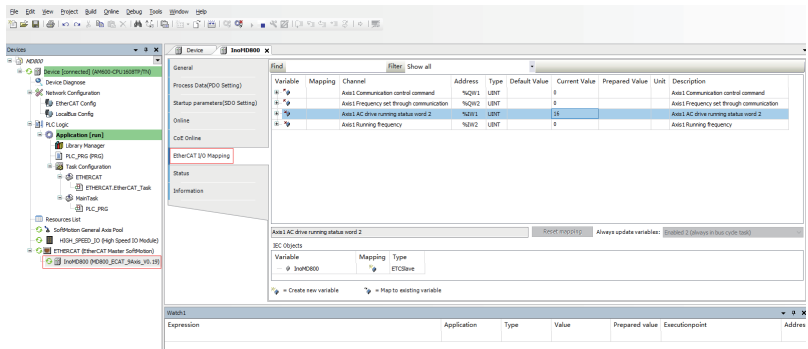


3. Configure the PDO parameters.

- a. Right-click the arrow position in the figure and add the required TPDO mapping. 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.
Click EtherCAT I/O Mapping, and you can view the TPDO data and RPDO data in real time.

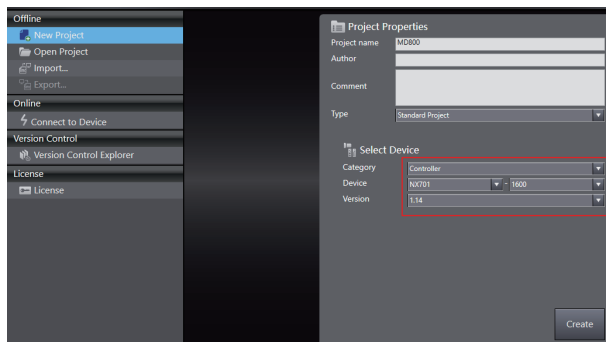


5.8.4 Example of Configuration on Omron Master Station Using ECAT Card

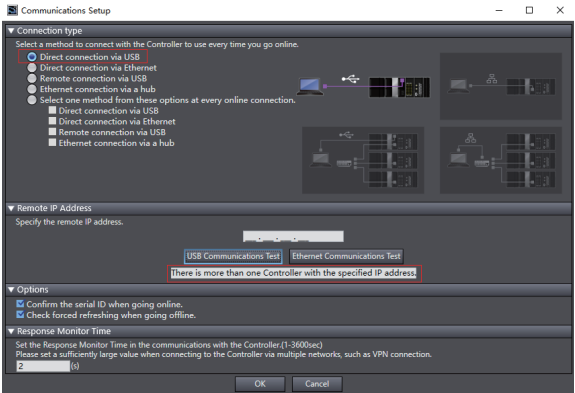
The following takes the Omron NX701-1600 master station as an example to describe how to configure the AC drive to work with the master station.

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 model of the controller.

Version: Select the device version.



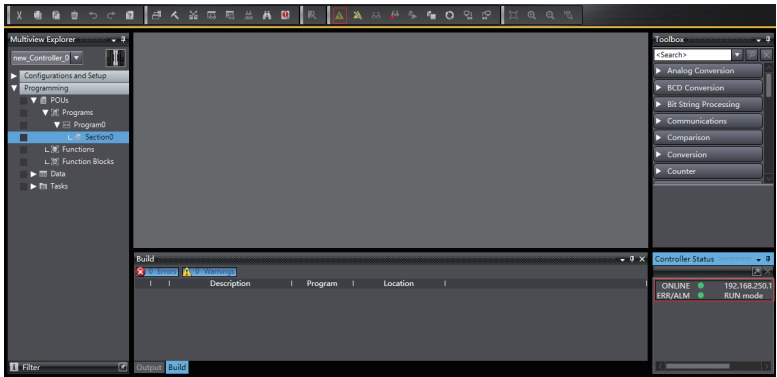
3. Configure communication parameters.
 - a. Access the main screen and choose "Controller" > "Communications Setup".
 - b. Select "Direct connection via USB". If the test is successful, proceed to the next step.



4. Scan the device.

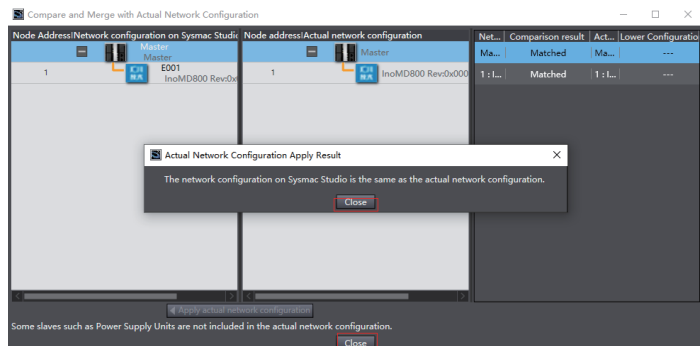
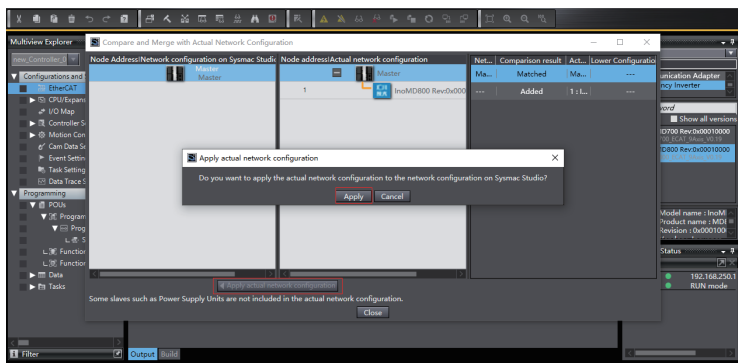
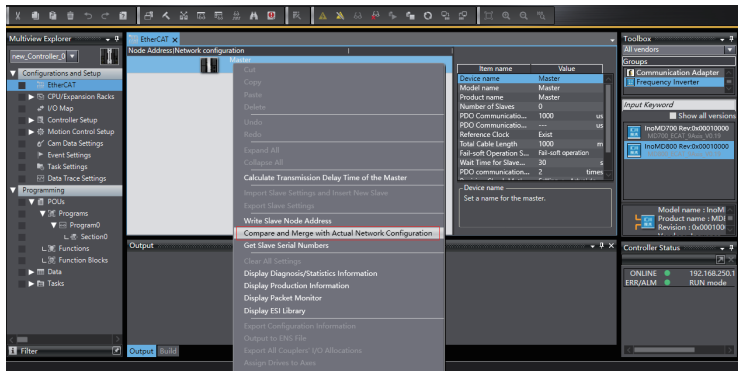
a. Switch the controller status to ONLINE and RUN mode.

The controller status is displayed in the lower right corner.



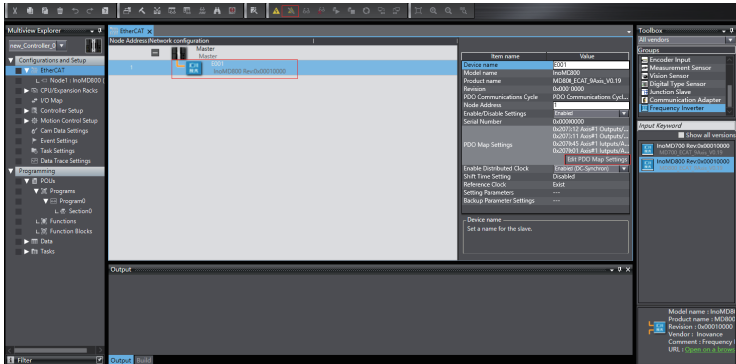
b. Scan the device and add a slave station.

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. The added slave station is displayed on the main screen.

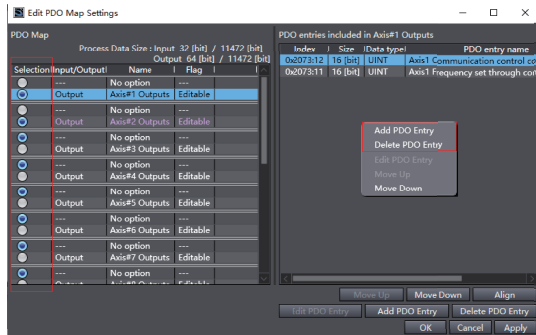


5. Configure the parameters.

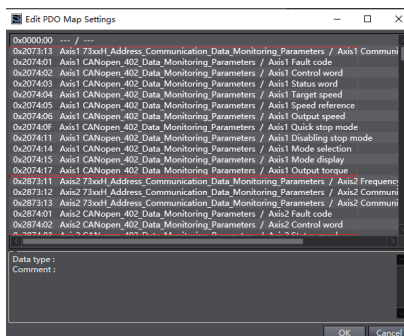
- Change the controller status to OFFLINE, select this device, and click "Edit PDO Map Settings".



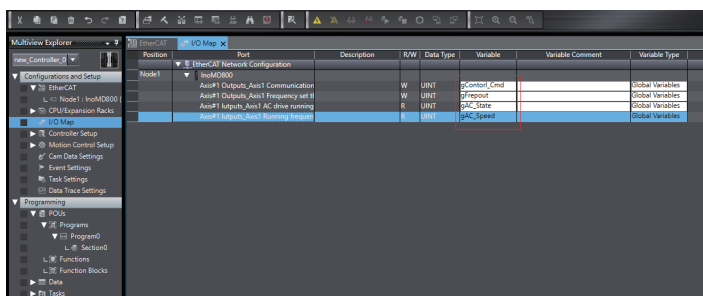
- b. On the "Edit PDO Map Settings" page displayed, select the axis number to be configured and right-click in the blank area on the right, and then click "Add PDO Entry" or "Delete PDO Entry" to add or delete a PDO entry.



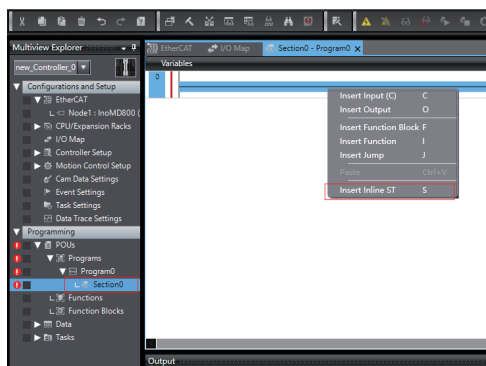
When adding a PDO entry, you must select the entry corresponding to the specific axis. Otherwise, an error is reported and the AC drive cannot run.

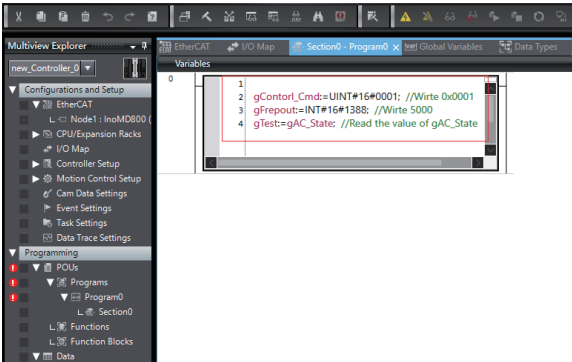


c. Set the PDO mapping (assign the I/O mapping).

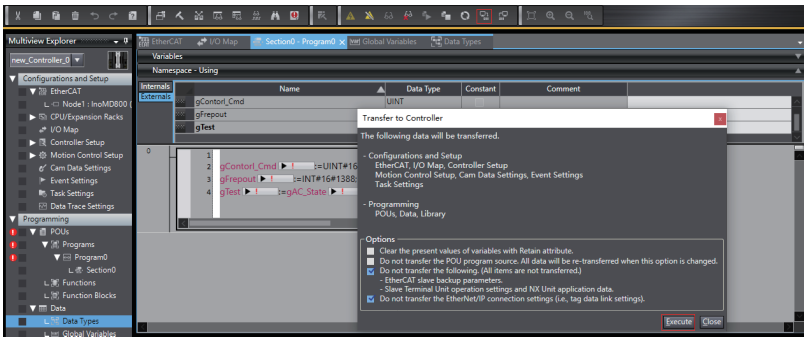


6. Edit the PLC program.





7. Download the PLC program to the controller.
- a. After finishing the configuration and programming, change the controller status to ONLINE, click "Execute" and then download the program to the controller.



Position	Port	Description	I/O	Data Type	Value	Variable	Variable Comment	Variable Type
Node1	EtherCAT Network Configuration	InoMD000						
		Axis1 Outputs_Axis1 Communication	W	UINT		gControl_Cmd		Global Variables
		Axis1 Outputs_Axis1 frequency set s	W	UINT	5000	gIrepout		Global Variables
		Axis1 Inputs_Axis1 AC drive running	R	UINT	78	gAC_State		Global Variables
		Axis1 Inputs_Axis1 Running Request	R	UINT	8	gAC_Speed		Global Variables

5.9 Troubleshooting

5.9.1 ECAT Card Communication Error

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

Table 5-12 ECAT card communication fault codes

Fault Code	Possible Cause	Solution	Reset Mode
E16.52	The EEPROM of the EtherCAT communication card is 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.	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	The slave control chip of the EtherCAT communication card is 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	The EtherCAT system parameters are incorrect.	When the master station goes wrong, check whether it sends the sync 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	The master station goes offline during operation of the communication card.	Check whether the connection between the communication card and PLC is in poor contact. Make sure that they are properly connected.	
E16.72	The internal slave station goes offline during operation of communication card.	Check whether the connection between the communication card and power supply unit is in poor contact. Make sure that they are properly connected.	
E16.74	The communication card configuration is incorrect.	Check whether the configured slave station exists and ensure that startup with station lost is disabled (Fd-50 of the power supply unit is set to 0).	
E16.75	The drive unit mapping configured by using the communication card is incorrect.	Check the process data and the number of mapping relations configured for the drive unit, and make sure that they match.	
E16.76	The power supply unit mapping configured by using the communication card is incorrect.	Check the process data and the number of mapping relations configured for the power supply unit, and make sure that they match.	



19011496A01

Copyright © Shenzhen Inovance Technology Co., Ltd.

Shenzhen Inovance Technology Co., Ltd.

www.inovance.com

Add.: Building E, Hongwei Industry Park, Liuxian Road,
Baocheng No. 70 Zone, Bao'an District, Shenzhen

Tel: (0755) 2979 9595

Fax: (0755) 2961 9897

Suzhou Inovance Technology Co., Ltd.

www.inovance.com

Add.: No. 16 Youxiang Road, Yuexi Town,
Wuzhong District, Suzhou 215104, P.R. China

Tel: (0512) 6637 6666

Fax: (0512) 6285 6720