MD500-ECAT EtherCAT
Communication Expansion Card
User Guide

Industrial Automation

Intelligent Elevator

New Energy Vehicle

Industrial Robot

Rail Transit

Data code 19012212 B00

Preface

About This Guide

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

⚠️ Caution

- The software version of the MD500-ECAT card required in this user guide is 1.00 or above, and the corresponding XML file is MD500_1Axis_V1.03.xml. After the card is installed and the drive is powered on, you can check the card software version by the parameter on the AC drive.
- This guide takes installing the MD500–ECAT cards to the MD500 and MD290 AC drives as examples. If you need to install the expansion card to other AC drives, check with your technical support engineers and obtain technical documentation.

Revision History

Date of Revision	Version	Revision
September 2021	B00	• Added 1.2 Applicable AC Drives, 1.3 Dimensions, 2.2.2 EMC Cabling Instructions, and 3.3.1 Communication Instances When the MD500 Is Controlled by the H5U. • Adjusted the manual structure. • Made minor corrections.

How to Obtain

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

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

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Safety Precautions

Safety Disclaimer

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

Safety Levels and Definitions

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

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

⚠ CAUTION indicates that failure to comply with the notice may result in minor personal injury or damage to the equipment.

Safety Precautions

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

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

⚠ **CAUTION**

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

Storage and Transportation

⚠ **WARNING**

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

⚠ **CAUTION**

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

Installation

⚠ **DANGER**

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

⚠️ WARNING

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

⚠️ CAUTION

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

Wiring

⚠️ DANGER

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

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

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

Power-on

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

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

Operation

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

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

Maintenance

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

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

Repair

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

> ⚠ **WARNING**
>
> - Require repair services according to the product warranty agreement.
> - When the fuse is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait for at least the time specified on the product warning label before power-on or further operations. Failure to comply may result in equipment damage, personal injury, or even death.
> - When the equipment fails or is damaged, designate qualified technicians to troubleshoot and repair the equipment in accordance with the maintenance instructions and keep a maintenance record.
> - Replace quick-wear parts of the equipment according to the replacement guide.
> - Do not use a damaged machine. Failure to comply may result in worse damages, personal injury, or even death.
> - Make sure to re-check the wiring and parameter setting after device replacement.

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

Safety Signs

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

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

1   Product Information

1.1   Introduction

The MD500-ECAT card is an EtherCAT fieldbus adapter card, which can be used on the industrial field ultra-high speed I/O network and the I/O layer. This card features high efficiency, flexible topology, and easy operation. It is installed in the MD series AC drive to improve the communication efficiency and implement the AC drive networking function, which enables the AC drive to be a slave controlled by the field bus master station.

Figure 1-1 MD500-ECAT card appearance

1.2   Applicable AC Drives

Expansion Card	Applicable AC Drive
MD500–ECAT	MD290
	MD480
	MD500
	MD500-PLUS
	MD510

⚠ Caution

This guide takes installing the MD500–ECAT cards to the MD500 and MD290 AC drives as examples. If you need to install the expansion card to other AC drives, check with your technical support engineers and obtain technical documentation.

1.3   Dimensions
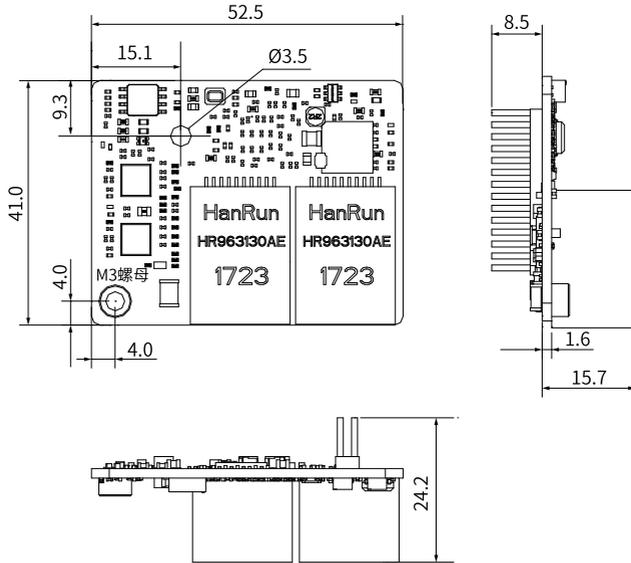
Figure 1-2 Dimensions (unit: mm) of the MD500–ECAT card

1.4   Terminals and Indicators

Terminal and indicator layout

The following figure describes terminals and indicators of the MD500-ECAT card. The pin header J7 on the back of the MD500-ECAT card is used to connect the AC drive. The MD500-ECAT card provides two network ports J4 and J6 for communication with the master station (or previous slave station) and the next slave station (if any).
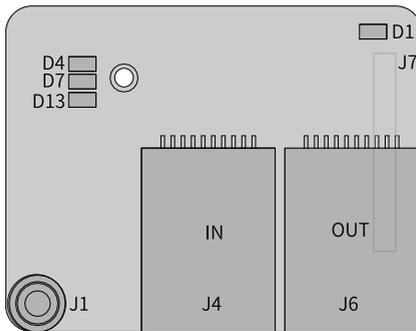
Figure 1-3 Terminal and indicator layout

Descriptions of terminals and indicators

Table 1–1 Descriptions of terminals and indicators

Terminal Mark	Terminal Name	Description
J7	Pin header	Used to connect the AC drive.
J4	Network port	The MD500-ECAT card provides two standard Ethernet RJ45 network ports J4 and J6 for communication with the master station (or previous slave station) and the next slave station (if any).
J6		
J1	EMC ground terminal	Used to connect the EMC ground terminal of the AC drive.
D13	Power supply indicator (green)	Used to indicate the status of the power supply. On: Normal Off: Abnormal. Check whether the card is installed properly.
D1	Communication status indicator (green)	For details, see *"Table 1–2 Descriptions of status indicators" on page 12*.
D4	EtherCAT interaction indicator (green)	
D7	ESC fault indicator (red)	

Caution

- The network port J4 of the MD500-ECAT card is the input port (ECAT IN) and the network port J6 is the output port (ECAT OUT). The two ports must be connected correctly.
- The Cat 5e shielded twisted pair (STP) network cable must be used for ensuring stability.

Descriptions of status indicators

Table 1–2 Descriptions of status indicators

Indicator		Status	Solution
D1	Steady green	Normal	N/A
	Steady off	The communication between the card and the AC drive is abnormal.	Set F0-28 to 1 and check whether the AC drive supports the MD500-ECAT card.
D4	Steady green	Working in the OP state	N/A
	Flashing green	Working in the PREOP/SAFEOP mode	Check the configuration. Check whether the AC drive supports the MD500-ECAT card and whether F0-28 is set to 1. Check whether the network port is connected correctly.
	Steady off	Master station disconnected or working in the Initial mode	Check whether the master station and network port are connected correctly.
D7	Steady off	Normal	N/A
	Steady red	ESC internal fault	Contact Inovance or the agent for technical support.

2   Installation and Wiring

2.1   Installation

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

After installing the MD500-ECAT card to the drive, connect the grounding terminals of the MD500-ECAT card and the drive properly, as shown in *"Figure 2–2 " on page 13* .
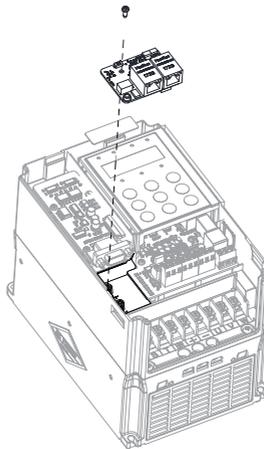
Figure 2-1 MD500-ECAT card installation
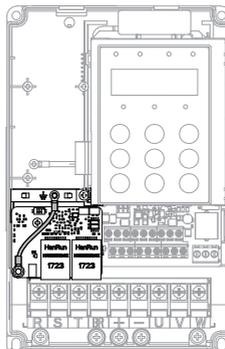
Figure 2-2 Grounding terminal connection between the MD500-ECAT card and AC drive

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⚠️ **Caution**

Do not remove or install the card with power ON.

2.2 Wiring

2.2.1 EtherCAT Connection Topology

EtherCAT supports various topological structures including star, bus, and tree topologies and their combinations. This enables flexible and convenient equipment connection and wiring. The following figure shows the bus topology.
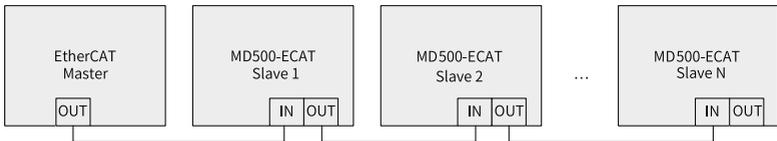
Figure 2-3 EtherCAT bus topology

2.2.2 EMC Routing Instructions

- During installation and commissioning on site, route communication signal cables and power cables through different routes. Failure to comply will result in communication interference.
- Connect the motor casing to the ground terminal (PE terminal) of the AC drive, and connect the ground cable of the motor casing properly. Failure to comply will result in poor grounding performance.
- It is recommended to use shielded cable. Connect the shield to the grounding terminal (PE) of the drive.
- Read the communication state through the status indicator on the card. See *"Table 1–2 " on page 12* for details.

3 Communication

3.1 EtherCAT Communication Protocol

In the DC mode, the DC synchronous mode period must be at least 1 ms but shorter then 100 ms. Otherwise, an EtherCAT communication fault will occur.

PDO data description

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. The data mainly includes the following:

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

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

PDO (0x1600) Sent by the Master Station		
Fixed RPDO		Variable RPDO
AC Drive Command	AC Drive Target Frequency	Real-Time Change of AC Drive Function Parameter
RPDO1	RPDO2	RPDO3 to RPDO10
PDO (0x1A00) Responded by the AC Drive		
AC Drive State	AC Drive Running Frequency	Real-Time Reading of AC Drive Function Parameter
TPDO1	TPDO2	TPDO3 to TPDO10

Note

A maximum of 10 RPDOs and 10 TPDOs can be configured.

Data sent by the master station

RPDO Sent by the Master Station		
RPDO1	AC drive command word (command source set to "communication")		
	01: Forward running	02: Reverse running	03: Forward jog	04: Reverse jog
	05: Coast to stop	06: Stop according to F6-10 (Stop mode)	07: Fault reset
RPDO2	AC drive target frequency (frequency source set to "communication") in the range of reverse frequency upper limit (negative value) to forward frequency upper limit (decimal places included, for example, 2000 corresponds to 20.00 Hz on the AC drive) When the given target frequency exceeds this range, the AC drive runs at the frequency upper limit.		
	For example, if the frequency upper limit is set to 50.00 Hz and the value set by communication is 6000, the AC drive will run at 50.00 Hz in the forward direction. If the frequency upper limit is set to 50.00 Hz and the value set by communication is -6000, the AC drive will run at 50.00 Hz in the reverse direction.		
RPDO3 to RPDO10	The values of function parameters in groups F and A are modified in real time and are not written into EEPROM.		
	FE-02 to FE-09 correspond to RPDO3 to RPDO10 respectively. For the configuration method, see PDO data configurations.		

Data responded by the AC drive

TPDO Responded by the AC Drive	
TPDO1	AC drive running state
	AC drive running states are determined by the bits as follows: • Bit 0 　▪ 　　0: Stop 　▪ 　　1: Running • Bit 1 　▪ 　　0: Forward running 　▪ 　　1: Reverse running • Bit 2 　▪ 　　0: No fault 　▪ 　　1: Fault • Bit 3 　▪ 　　0: Running frequency not reached 　▪ 　　1: Running frequency reached • Bit 4 to bit 7: Reserved • Bit 8 to bit 15: Fault code
TPDO2	AC drive running frequency (unit: 0.01 Hz)
	The current AC drive running frequency is returned. The returned data is 16-bit signed data and the received data is 16-bit unsigned data. Variables must be mapped to the 16-bit signed data.
TPDO3 to TPDO10	Real-time reading of function parameters in groups F and A and monitoring parameters in group U
	FE-22 to FE-29 correspond to TPDO3 to TPDO10 respectively. For the configuration method, see PDO data configurations.

Service data object (SDO)

The EtherCAT SDO is used to transfer non-cyclic data, such as communication or running parameter configurations of the drive. The CoE service type includes the following:

- Emergency message
- SDO request

- SDO response
- TxPDO
- RxPDO
- Remote TxPDO transmission request
- Remote RxPDO transmission request
- SDO information

Currently, the AC drive supports SDO requests and responses. For details about SDO-related parameters, see the MD500 and MD290 user guides.

3.2 Parameters Related to Communication

Communication Card Setting for the AC Drive

The AC drive software version needs to meet the following requirements:

- MD500: U76.62_U77.62 or later (U76.62 is defined by F7-10; U77.62 is defined by F7-11.)
- MD290: U29.12_U29.21 or later (U29.12 is defined by F7-10; U29.21 is defined by F7-11.)

The following parameters must be set to enable the MD500-ECAT card to communicate with the MD500/MD290 series AC drive and connect to the EtherCAT fieldbus network.

Parameter	Parameter Name	Value Range	Setpoint	Description
F0-02	Command source	0: Operating panel 1: Terminal 2: Communication	2	Set the command source to communication.
F0-03	Main frequency reference source	0: Digital setting (non-retentive at power failure) 1: Digital setting (retentive at power failure) 2: AI1 3: AI2 4: AI3 5: Pulse reference (DI5) 6: Multi-reference 7: Simple PLC 8: PID 9: Communication	9	Set the target frequency source to communication.

Parameter	Parameter Name	Value Range	Setpoint	Description
F0-28	Serial communication protocol	0: Modbus protocol 1: Communication card network bridge protocol	1	Select the special communication card network bridge as the serial communication protocol.
FD-02	Slave alias	1–247	To be determined	Alias of EtherCAT slave, which is 1 by default (It does not need to be specified when the slave name is used for communication.)

Communication Control Parameters

Parameter	Parameter Name	Value Range	Index	Sub-index
Communication control word parameters				
U3-16	Frequency reference	–Maximum frequency to +Maximum frequency 0.01 Hz	16#2073	16#11
U3-17	Control command	0001: Run in forward direction 0002: Run in reverse direction 0003: Jog in forward direction 0004: Jog in reverse direction 0005: Coast to stop 0006: Decelerate to stop 0007: Reset upon fault	16#2073	16#12
U3-18	DO control	Bit0: DO1 output control Bit1: DO2 output control Bit2: Relay 1 output control Bit3: Relay 2 output control Bit4: FMR output control Bit5: VDO1 Bit6: VDO2 Bit7: VDO3 Bit8: VDO4 Bit9: VDO5	16#2073	16#13
U3-19	AO1 control	0 to 7FFF, indicating 0% to 100%	16#2073	16#14
U3-20	AO2 control	0 to 7FFF, indicating 0% to 100%	16#2073	16#15
U3-21	FMP control	0 to 7FFF, indicating 0% to 100%	16#2073	16#16
U3-22	Reserved	Reserved	16#2073	16#17

Parameter	Parameter Name	Value Range	Index	Sub-index
U3-23	Speed control	–15000 RPM to +15000 RPM (The value range is also related to the number of motor pole pairs and the frequency range.)	16#2073	16#18
AC drive parameters (frequently used)				
F0-10	Maximum frequency	50.00 Hz to 500.00 Hz	16#20F0	16#0B
F0-17	Acceleration time	0.00s to 650.00s (F0-19 = 2) 0.0s to 6500.0s (F0-19 = 1) 0s to 65000s (F0-19 = 0)	16#20F0	16#12
F0-18	Deceleration time	0.00s to 650.00s (F0-19 = 2) 0.0s to 6500.0s (F0-19 = 1) 0s to 65000s (F0-19 = 0)	16#20F0	16#13
F0-19	Acceleration/ Deceleration time unit	0: 1s 1: 0.1s 2: 0.01s	16#20F0	16#14
F8-00	Jog frequency	0.00 Hz to the maximum frequency	16#20F8	16#01
F8-01	Jog acceleration time	0.0s to 6500.0s	16#20F8	16#02
F8-02	Jog deceleration time	0.0s to 6500.0s	16#20F8	16#03
A0-03	Torque reference in torque control mode	–200.0% to +200.0%	16#20A0	16#04
A0-05	Maximum forward frequency in torque control	0.00 Hz to the maximum frequency	16#20A0	16#06
A0-06	Maximum reverse frequency in torque control	0.00 Hz to the maximum frequency	16#20A0	16#07
U0-06	Output torque (%)	-	16#2070	16#07
U0-07	DI state	-	16#2070	16#08
U0-08	DO state	-	16#2070	16#09

Parameter	Parameter Name	Value Range	Index	Sub-index
U0-24	Current speed	-	16#2070	16#19
U0-38	Encoder position	-	16#2070	16#27
2001H	DO control	-	16#2020	16#02
8000H	Current fault	-	16#2080	16#01

The AC drive parameter indexes are described as below:

● Each object within the dictionary shall be addressed uniquely by using an index and sub-index.

   ■ The index (hexadecimal) specifies the position of the same type of objects in the dictionary.

   ■ The sub-index specifies the offset of each object in the same index in hexadecimal format.

● The mapping between AC drive parameters and the object dictionary is as follows:

   ■ Object dictionary index = 0x2000 + Parameter group number

   ■ Object dictionary sub-index = Hexadecimal value of offset in parameter group + 1

When the MD500-ECAT card is used, the written PDO1 and PDO2 are mapped to U3-17 and U3-16 respectively by default. Therefore, ensure that the first entry of RPDO is U3-17; otherwise, an operation exception will occur. Besides, if any non-zero value is written to the high-order 8 bits of U3-17, the AC drive will report the communication fault Err16.

Communication Monitoring Parameters

Parameter	Parameter Name	Unit	Index	Sub-index
U0-00	Running frequency (Hz)	0.01 Hz	16#2070	16#01
U0-01	Frequency reference (Hz)	0.01 Hz	16#2070	16#02
U0-02	Bus voltage (V)	0.1 V	16#2070	16#03
U0-03	Output voltage (V)	1 V	16#2070	16#04
U0-04	Output current (A)	0.01 A	16#2070	16#05
U0-05	Output power (kW)	0.1 kW	16#2070	16#06
U0-06	Output torque (%)	0.1%	16#2070	16#07

Parameter	Parameter Name	Unit	Index	Sub-index
U0-07	DI state	1	16#2070	16#08
U0-08	DO state	1	16#2070	16#09
U0-09	AI1 voltage (V)	0.01 V	16#2070	16#0A
U0-10	AI2 voltage (V)	0.01 V	16#2070	16#0B
U0-11	AI3 voltage (V)	0.01 V	16#2070	16#0C
U0-12	Count value	1	16#2070	16#0D
U0-13	Length value	1	16#2070	16#0E
U0-14	Load speed	1	16#2070	16#0F
U0-15	PID reference	1	16#2070	16#10
U0-16	PID feedback	1	16#2070	16#11
U0-17	PLC stage	1	16#2070	16#12
U0-18	Pulse input reference (Hz)	0.01 kHz	16#2070	16#13
U0-19	Feedback speed (Hz)	0.01 Hz	16#2070	16#14
U0-20	Remaining running duration	0.1 min	16#2070	16#15
U0-21	AI1 voltage before correction	0.001 V	16#2070	16#16
U0-22	AI2 voltage before correction	0.001 V	16#2070	16#17
U0-23	AI3 voltage before correction	0.001 V	16#2070	16#18
U0-24	Linear speed	1 m/min	16#2070	16#19
U0-25	Current power-on duration	1 min	16#2070	16#1A
U0-26	Current running duration	0.1 min	16#2070	16#1B
U0-27	Pulse input frequency	1 Hz	16#2070	16#1C
U0-28	Communication reference	0.01%	16#2070	16#1D
U0-29	Encoder feedback speed	0.01 Hz	16#2070	16#1E
U0-30	Main frequency X	0.01 Hz	16#2070	16#1F
U0-31	Auxiliary frequency Y	0.01 Hz	16#2070	16#20

Parameter	Parameter Name	Unit	Index	Sub-index
U0-32	Any memory address	1	16#2070	16#21
U0-33	Synchronous motor rotor position	0.1°	16#2070	16#22
U0-34	Motor temperature	1℃	16#2070	16#23
U0-35	Target torque (%)	0.1%	16#2070	16#24
U0-36	Resolver position	1	16#2070	16#25
U0-37	Power factor angle	0.1°	16#2070	16#26
U0-38	ABZ position	1	16#2070	16#27
U0-39	V/f separation target voltage	1 V	16#2070	16#28
U0-40	V/f separation output voltage	1 V	16#2070	16#29
U0-41	DI state display	1	16#2070	16#2A
U0-42	DO state display	1	16#2070	16#2B
U0-43	DI state display 1	1	16#2070	16#2C
U0-44	DI state display 2	1	16#2070	16#2D
U0-45	Fault information	1	16#2070	16#2E
U0-58	Z signal counter	1	16#2070	16#3B
U0-59	Frequency reference (%)	0.01%	16#2070	16#3C
U0-60	Running frequency (%)	0.01%	16#2070	16#3D
U0-61	AC drive state	1	16#2070	16#3E
U0-62	Current fault code	1	16#2070	16#3F
U0-63	Data sent by master during point-point communication	0.01%	16#2070	16#40
U0-64	Data sent by slave during point-point communication	0.01%	16#2070	16#41

Parameter	Parameter Name	Unit	Index	Sub-index
U0-65	Torque upper limit	0.1%	16#2070	16#42
U0-66	Expansion card model	100: CANopen 200: PROFIBUS DP 300: CANlink 400: PROFINET 500: EtherCAT	16#2070	16#43
U0-67	Expansion card version	0.01	16#2070	16#44
U0-68	AC drive state	1	16#2070	16#45
U0-69	Running frequency (Hz)	0.01 Hz	16#2070	16#46
U0-70	Motor speed	RMP	16#2070	16#47
U0-71	Output current	0.1 A	16#2070	16#48
U0-80	Name of EtherCAT slave	1	16#2070	16#51
U0-81	Alias of EtherCAT slave	1	16#2070	16#52
U0-82	EtherCAT ESM transmission error code	1	16#2070	16#53
U0-83	EtherCAT XML file version	0.01	16#2070	16#54
U0-84	EtherCAT synchronization loss count	1	16#2070	16#55
U0-85	Maximum errors and invalid frames of EtherCAT port 0 per unit time	1	16#2070	16#56
U0-86	Maximum errors and invalid frames of EtherCAT port 1 per unit time	1	16#2070	16#57
U0-87	Maximum forwarding errors of EtherCAT port per unit time	1	16#2070	16#58

Parameter	Parameter Name	Unit	Index	Sub-index
U0-88	Maximum error count of EtherCAT data frame processing unit per unit time	1	16#2070	16#59
U0-89	Maximum link loss of the EtherCAT port per unit time	1	16#2070	16#5A

When the MD500-ECAT card is used, the read PDO1 and PDO2 are mapped to U0-68 and U0-69 respectively by default. Therefore, ensure that the first entry of TPDO is U0-68; otherwise, an operation exception will occur.

3.3 Communication Instances

3.3.1 Communication Instance When the MD500 Is Controlled by the H5U

This section describes how to configure the MD500-ECAT card on the H5U to enable the MD500 to communicate with the H5U.

1. Open the software and create an H5U project.
   Select **H5U series**.
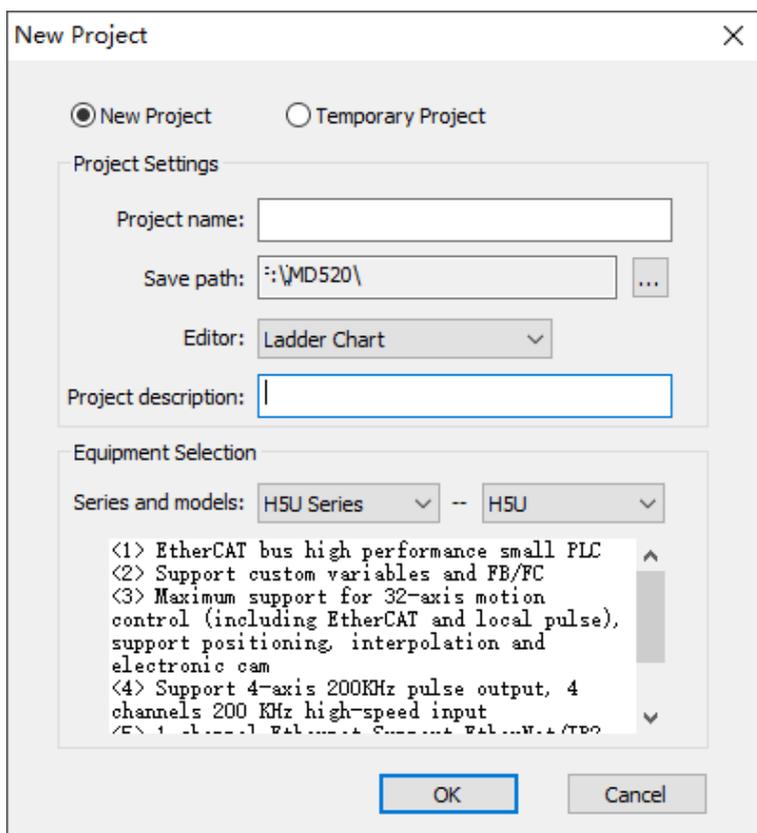
2. Import the EtherCAT configuration file of the MD500.

If the configuration file of other version exists, delete the existed configuration file before importing a new one, as shown below.
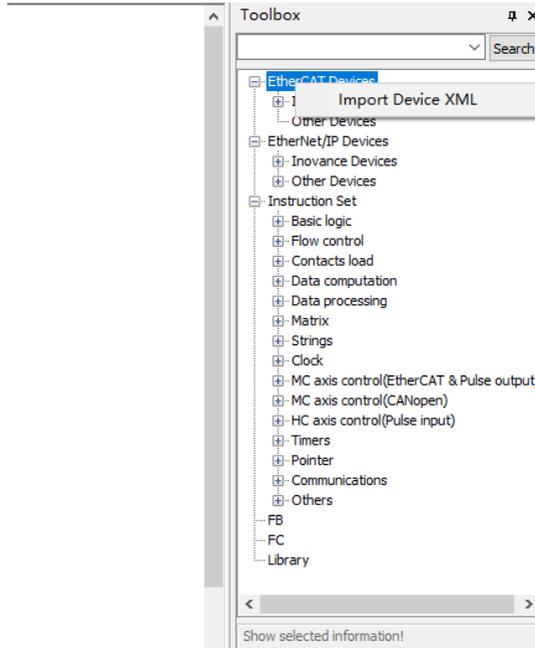
3. Add the MD500 AC drive slave station.

Open the network configuration, drag the device in the network device list to add the AC drive slave station.
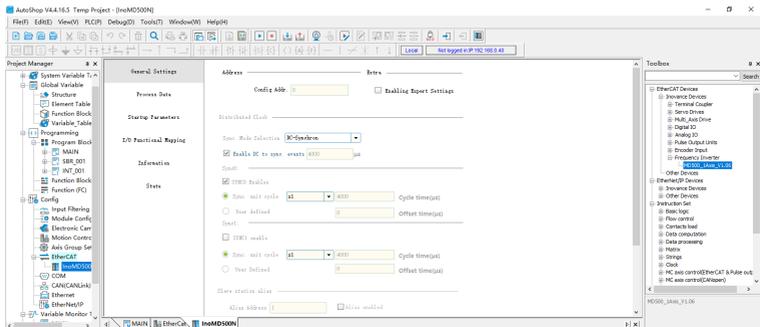
4. Configure PDO parameters.

In the device process data interface, add the TPDO mapping as required.
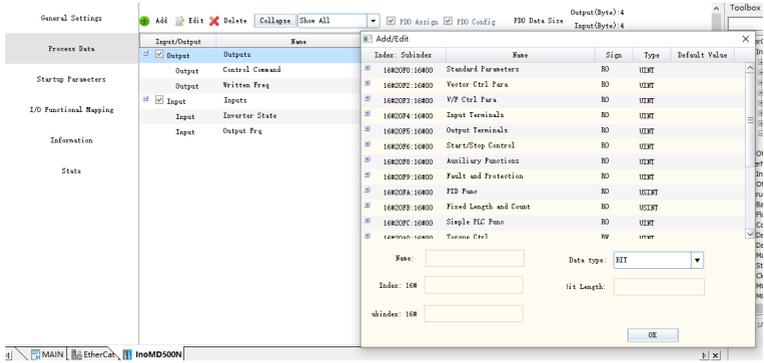
Note: Control Command of the RPDO and Inverter State of the TPDO cannot be changed and must be set as the first items. Otherwise, an exception will occur during operation.

5. Scan the H5U.

Click **Tools(T)**. In the **Communication Settings** dialog box, select **Ethernet** or **USB** for the communication type between the PC and the PLC, and scan the PLC.
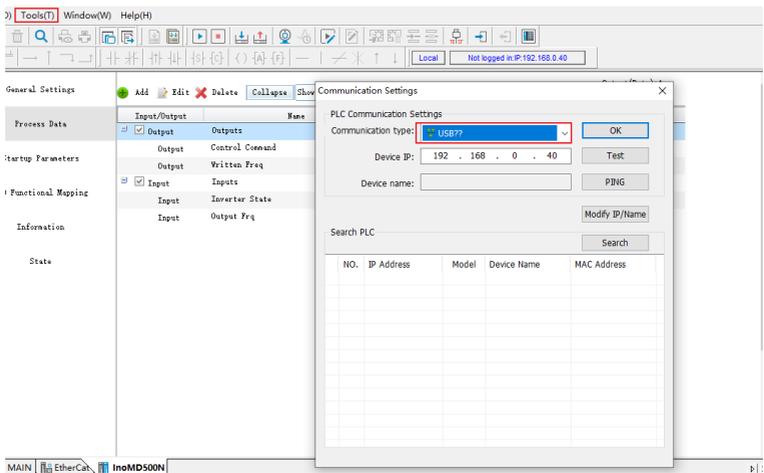
6. Download the project to the PLC and activate the PLC.

Download the compiled project file, click the running icon to activate the PLC, and then click the monitoring icon to view the motion data.
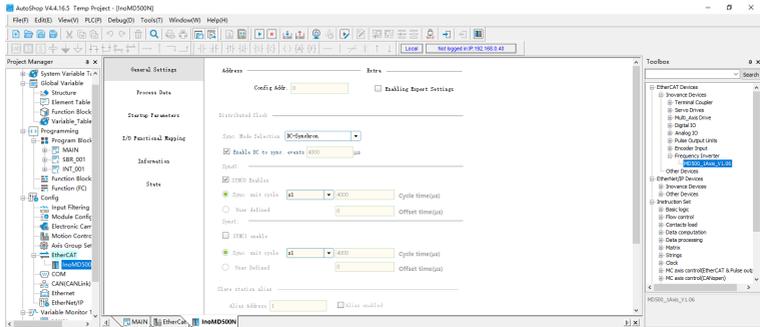
You can view TPDO data and write RPDO data in real time through EtherCAT I/O mappings.
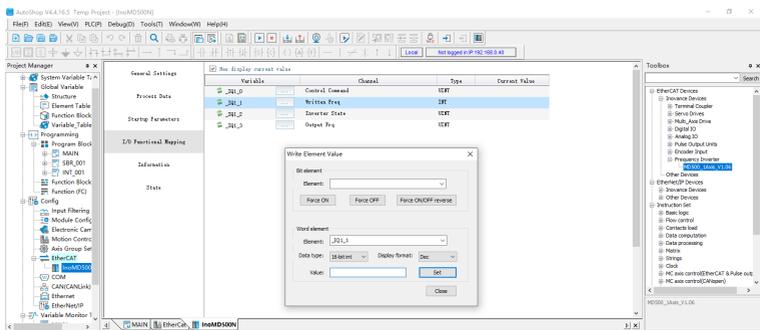
3.3.2 Communication Instance When the MD500 is Controlled by the AM600

This section describes how to configure the MD500-ECAT card on the AM600 to enable the MD500 to communicate with the AM600.

1. Open the software, and create an AM600 project.
   Select AM600-CPU1608TP.
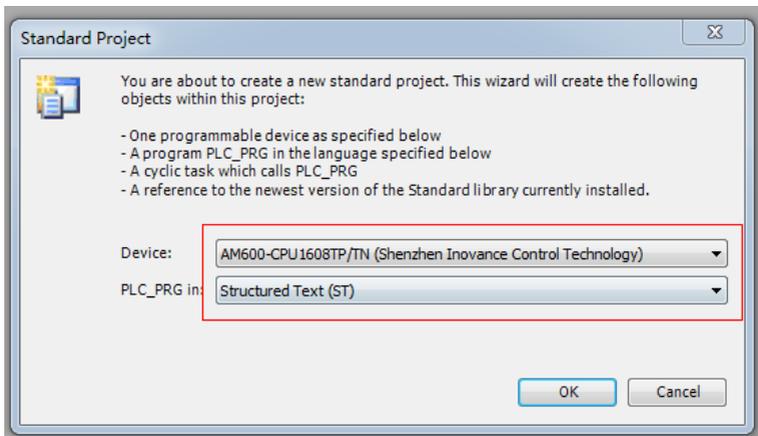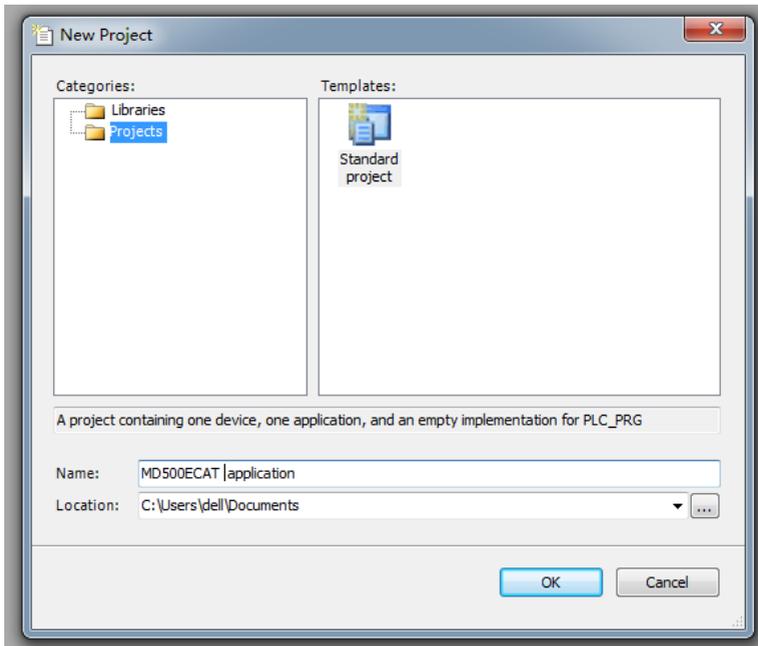
2. Add the MD500 AC drive slave station. Open the network configuration, import the EtherCAT configuration file of the MD500. If a configuration file of other version exists, delete the existed configuration file before importing a new one. Drag the device in the network device list to add the AC drive slave station, as shown below.
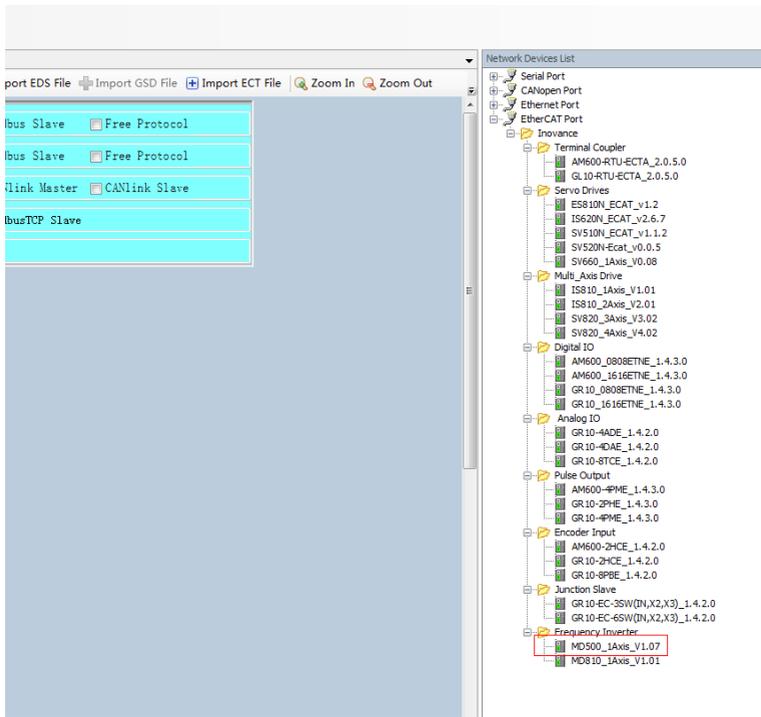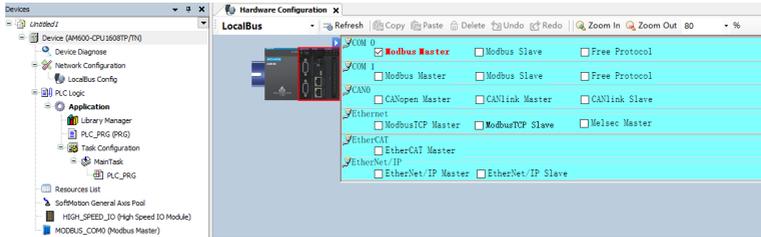
3. Configure PDO parameters.

   Right-click at the position indicated by the red rectangle in the following figure to add the TPDO mapping as required. Control Command of the RPDO and Inverter State of the TPDO cannot be changed and must be set as the first items. Otherwise, an exception will occur during operation.
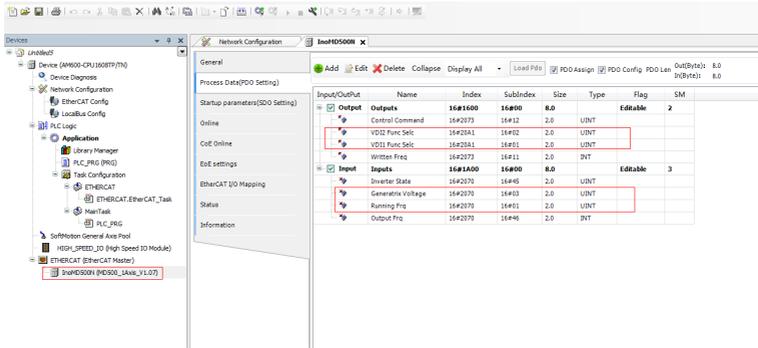
Scan the devices.
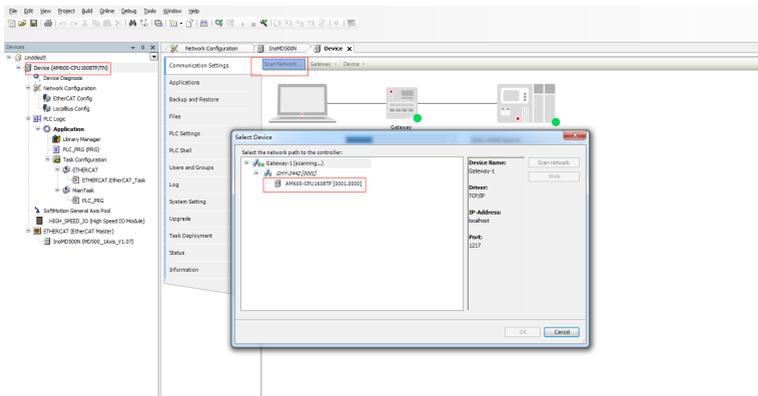
Download the project to the PLC.
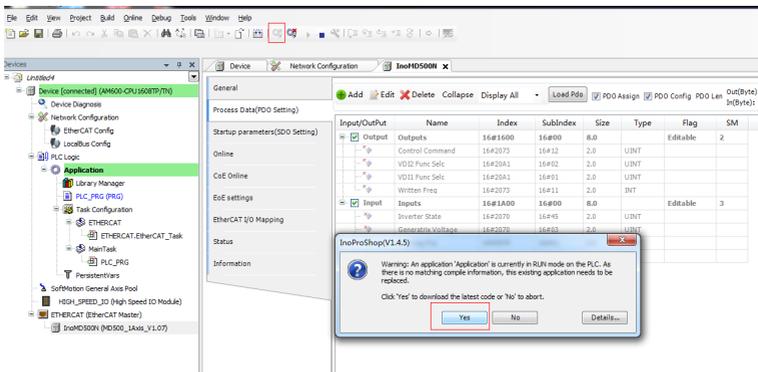
View TPDO data and write RPDO data in real time through EtherCAT I/O mappings.
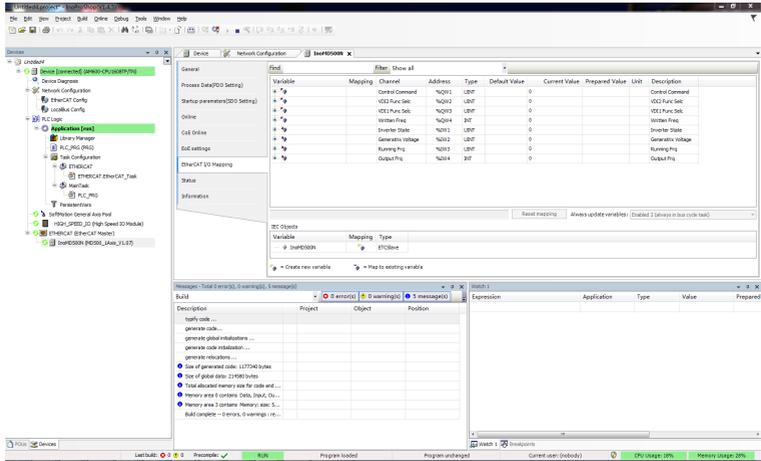
View and write parameter values through the online CoE.
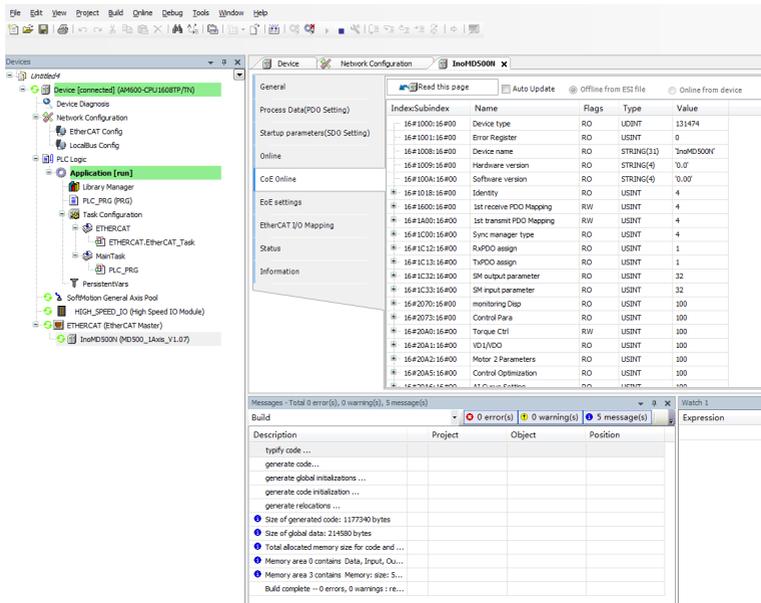
3.3.3 Communication Instance When the MD500 Is Controlled by the Beckhoff Controller

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

> ⚠️ **Caution**
>
> The 100 M network card with the Intel chip must be selected. If the network card of other brands is used, the EtherCAT communication may fail.

1. Install the TwinCAT software.
   - For Windows XP operating system, install tcat_2110_2230.
   - For Windows 7 32-bit operating system, install tcat_2110_2248.

2. Copy the EtherCAT configuration file (MD500_1Axis_V1.03.xml.XML) of the MD500 to the TwinCAT installation directory.
   - TwinCAT2 directory: TwinCAT\IO\EtherCAT
   - TwinCAT3 directory: TwinCAT\3.1\config\IO\EtherCAT

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

3. Start the TwinCAT.

   a. Click **New Project** to create a project.
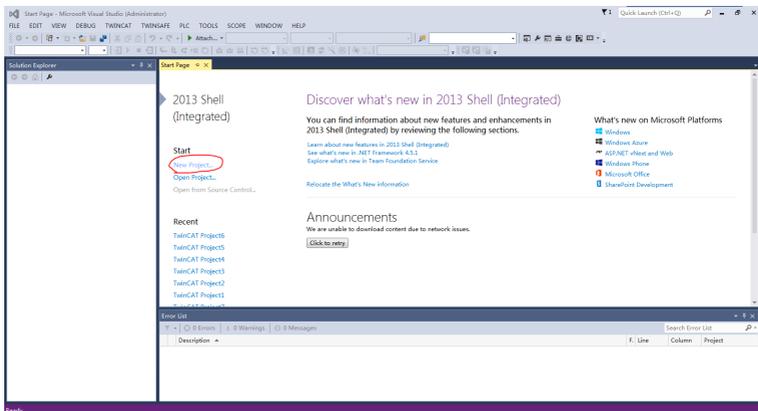
   b. Click **OK**.
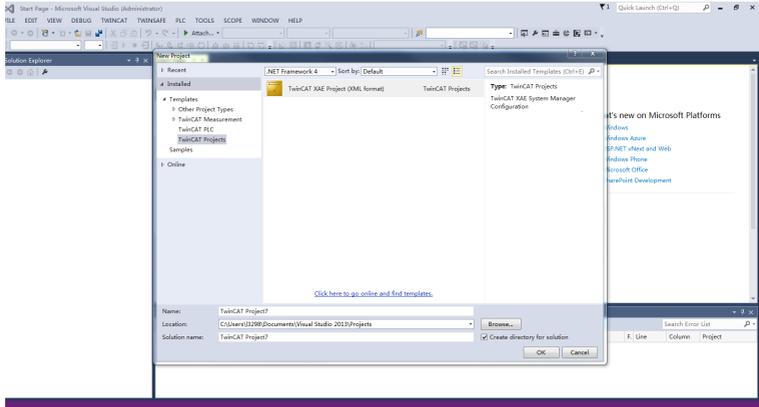
4. Install the TwinCAT network adapter driver.
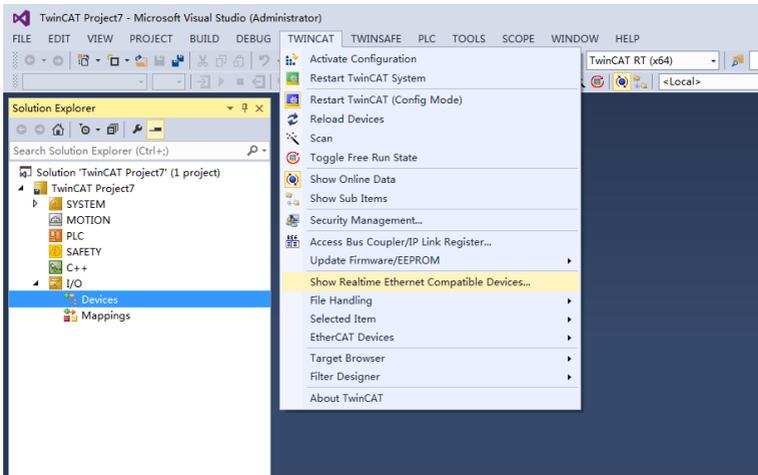
Go to **TWINCAT** > **Show Real Time Ethernet Compatible Devices**. Select the local connection under **Incompatible devices**, and then click **Install**. After installation is done, the network adapter installed will be displayed under **Installed and ready to use devices(realtime capable)**.
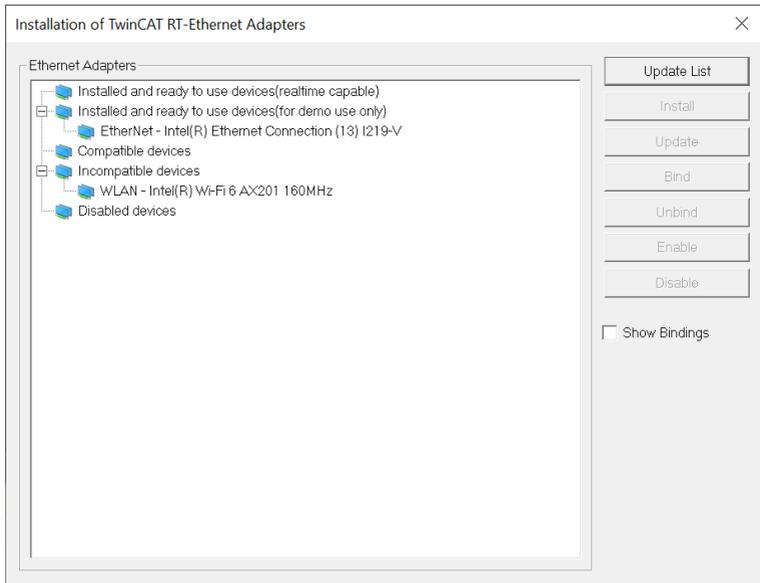
5. Search for devices.

    a. Create a project, right-click **Devices**, and then select **Scan** to search for devices.
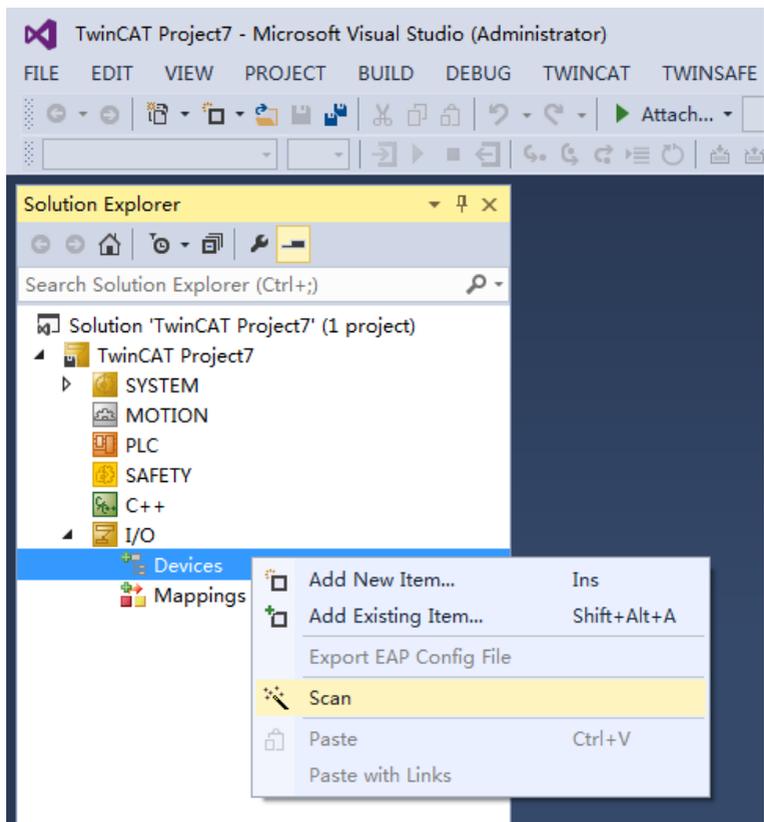
b. Click **OK**.
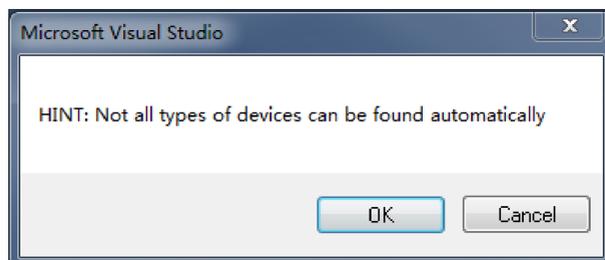
c. Click **OK**.
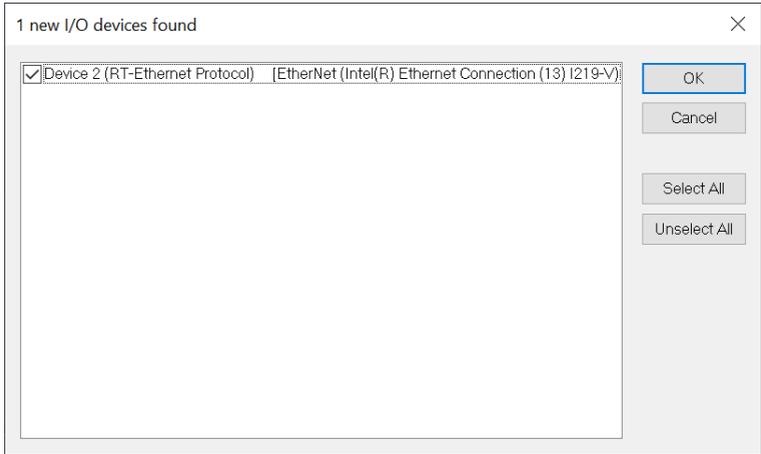
d. Click **Yes**.

e. Click **OK**.
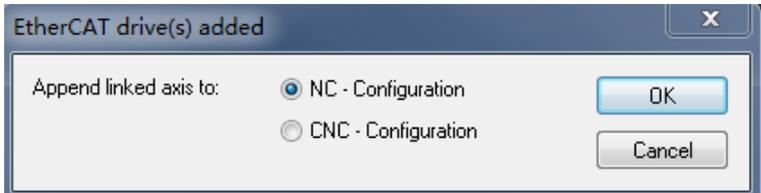
f. Click **No**.The device search is completed.
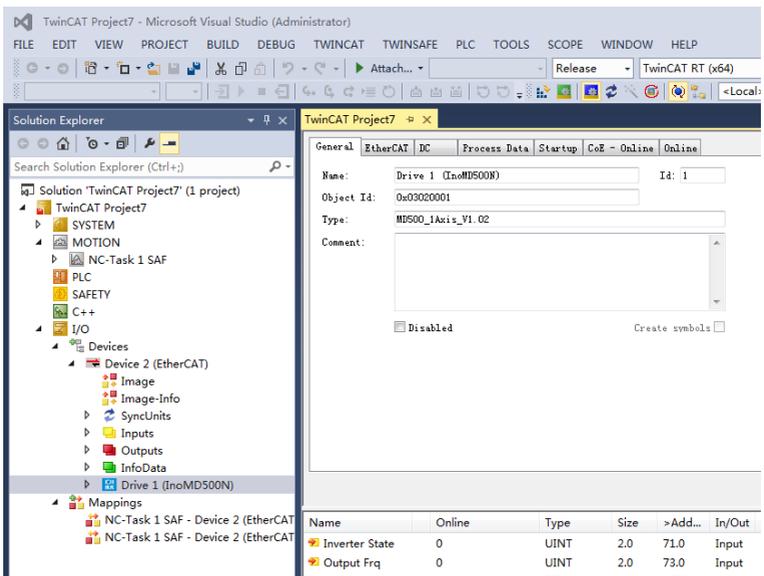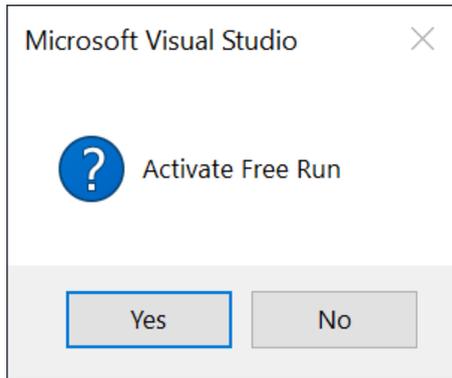
6. Configure PDO parameters.

   a. Configure the TPDO.

   Select 0x1A00 when configuring the TPDO. The first two items are set to TPDO by default and cannot be changed. Right-click at the position indicated by the red arrow in the following figure to add the TPDO mapping as required.
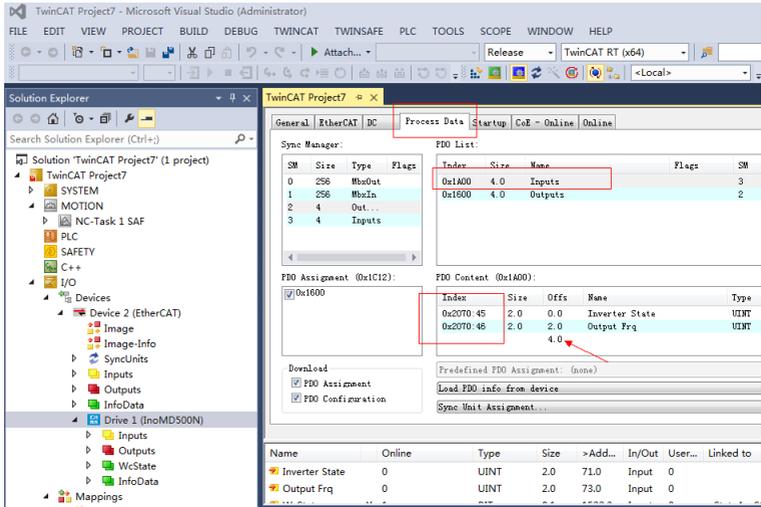
b. Configure the RPDO.

Select 0x1600 when configuring the RPDO. The first two items are set to RPDO by default and cannot be changed. Right-click at the position indicated by the red arrow in the following figure to add the RPDO mapping as required.
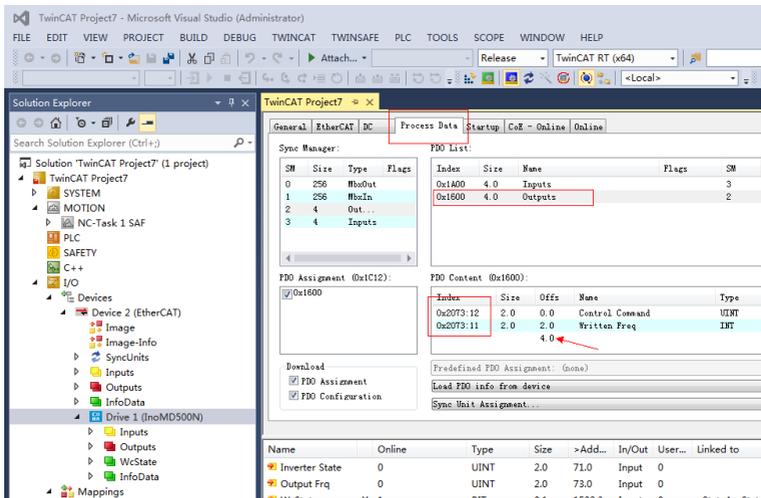
c. View the SDO data list.

After the OP state is activated, you can view real-time data in the SDO data list or double-click the object dictionary to modify the SDO data.
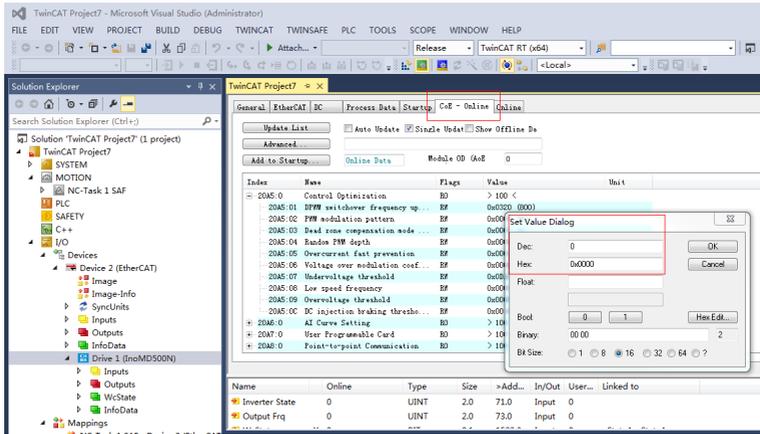
d. Activate the configuration and switch to the operation mode.

Click . The following figure appears.
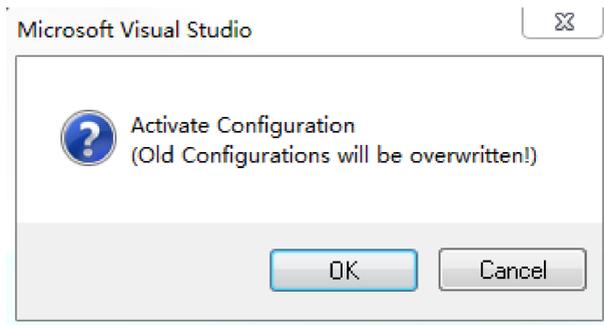
Click **OK**.
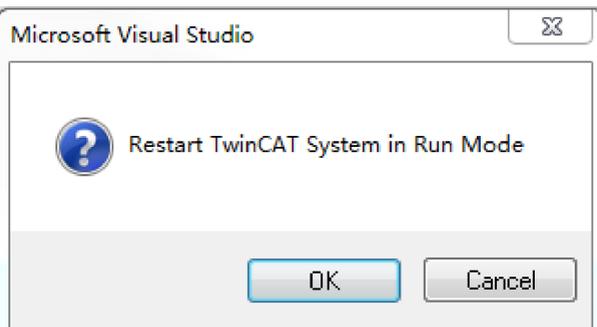
Click **OK** to enter the OP state.
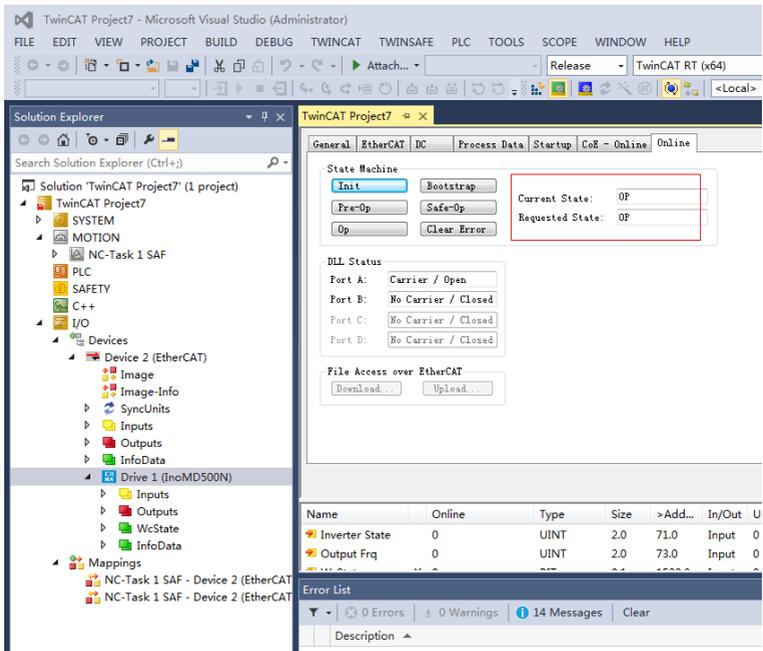
e. Control the AC drive through the PDO.

Write corresponding values through the configured RPDO to control the AC drive.
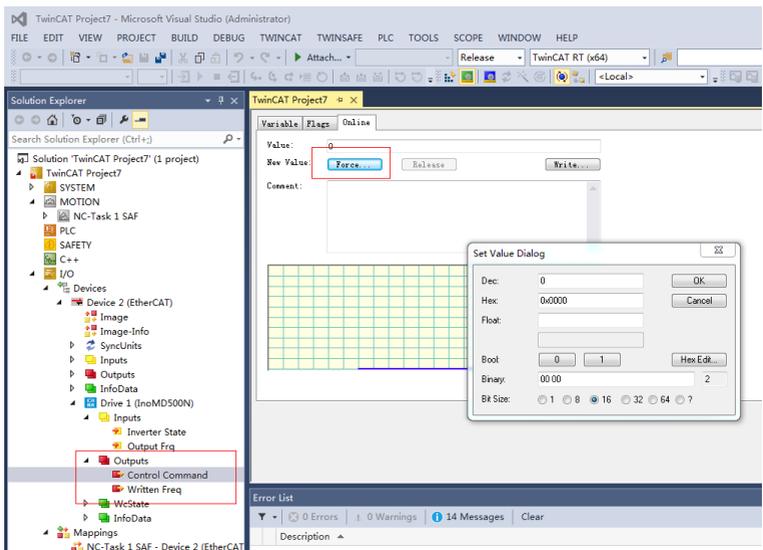
3.3.4 Communication Instance When the MD500 Is Controlled by the Omron Controller

This section describes how to configure the MD500-ECAT card on the NX1P2 master station of Omron to enable the MD500 to communicate with the NX1P2.

1. Create a project.

- Device: Set a device according to the actual controller model.
- Version: Use V1.09 or later versions. For NX1P2-1140DT, only V1.13 is supported.
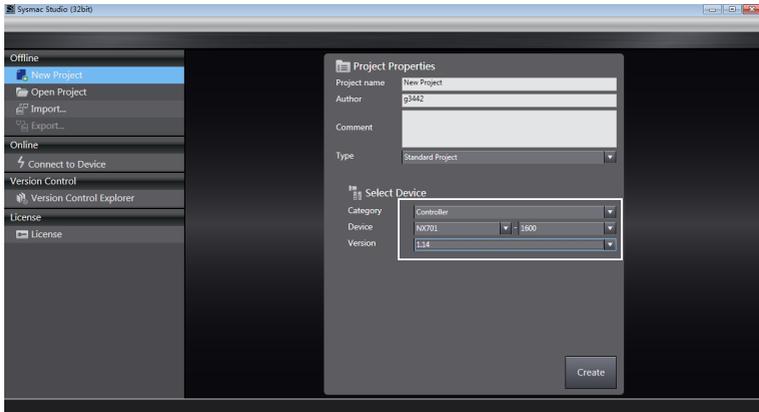
2. Configure communication.

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

   b. Select **Direct connection via Ethernet**. Go to the next step if the test is successful.
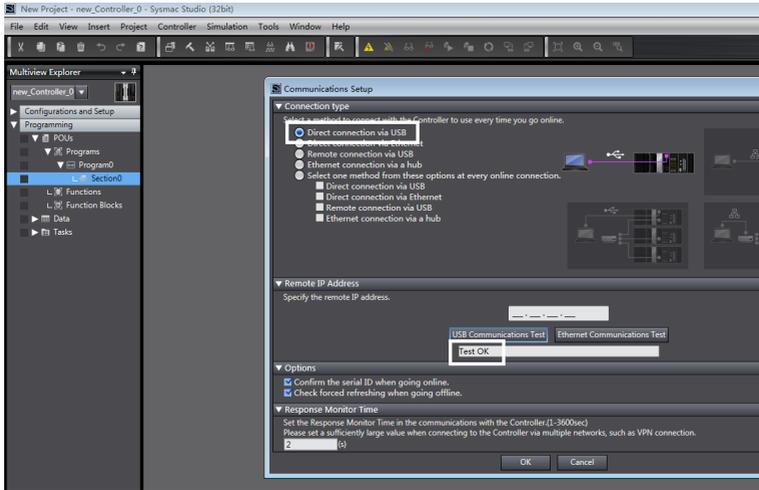
3. Import the XML configuration file.

   Double-click **EtherCAT** in the left pane. Right-click the master device and select **ESI Library**. Click **Install (File)**. Select the MD500-ECAT card XML configuration file and import it.
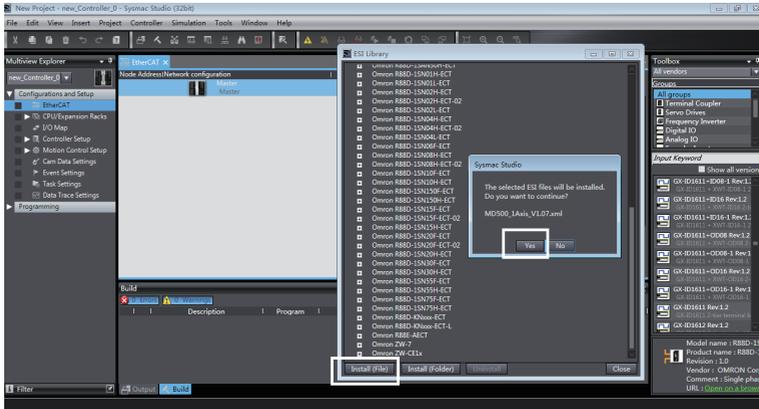
4. Scan the devices.

   Switch the controller to the online and running mode.

   Check that the controller status in the lower right corner is online and running.
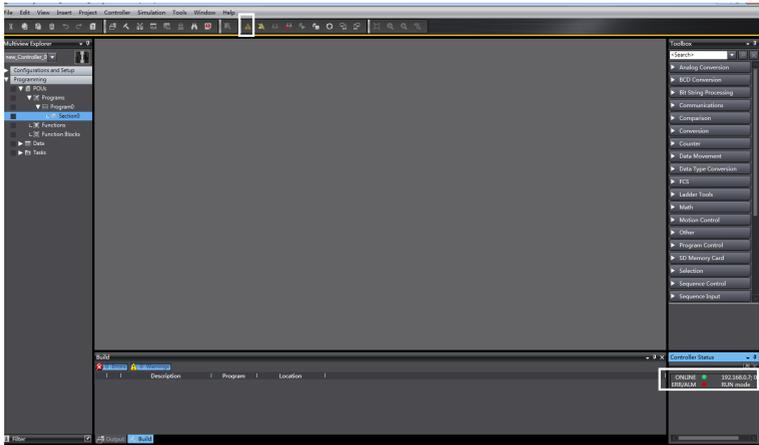
Scan the device and add the slave station. Go to **Configurations and Setup** > **EtherCAT**. Right-click **Master**, and then select **Compare and Merge with Actual Network Configuration** to enable the controller automatically to scan all slave stations in the network. A fault will be reported if any station number is 0. After the scanning is complete, click **Apply actual network configuration** in the displayed dialog box to add the slave station. You can view the added slave station in the main page.

Note

Before station alias change, ensure that the AC drive software version is updated to that in *"3.2 Parameters Related to Communication" on page 18*. You can change the station alias through the parameter FD-02 or the master station. The changed station alias takes effect upon next power-on.
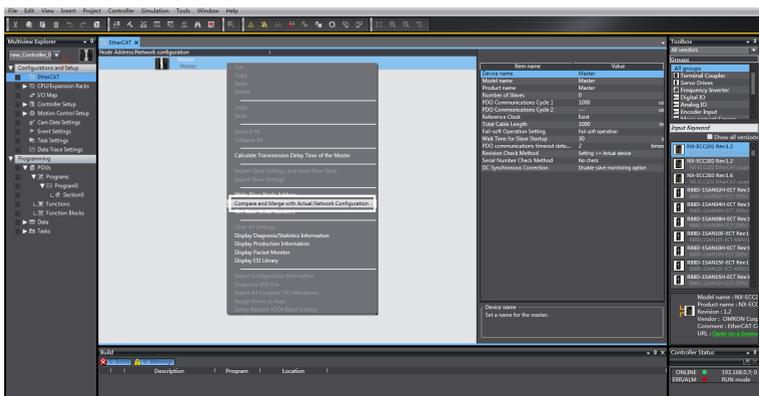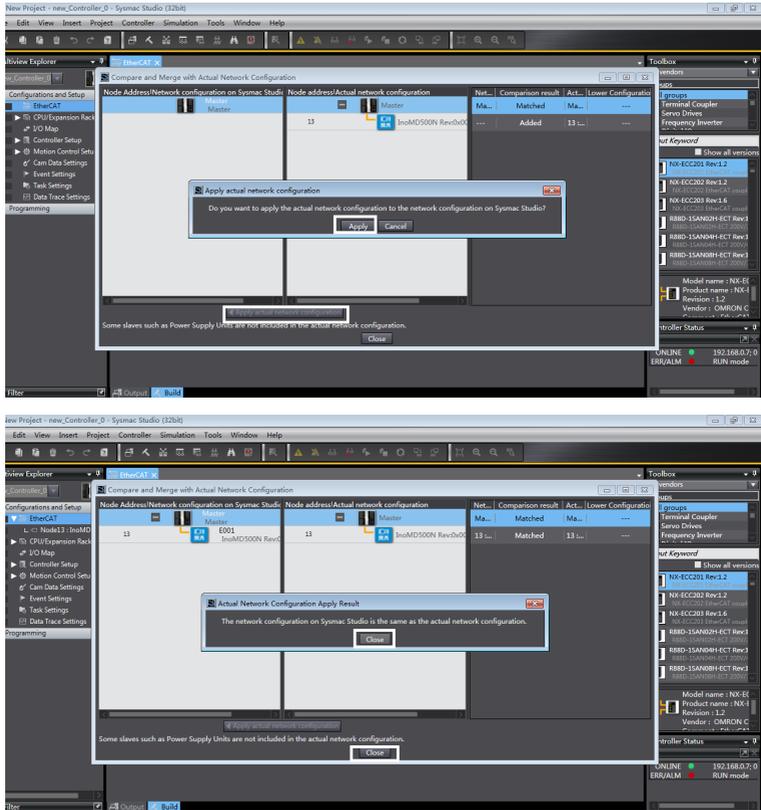
5. Configure parameters.

Switch the controller to the offline mode.
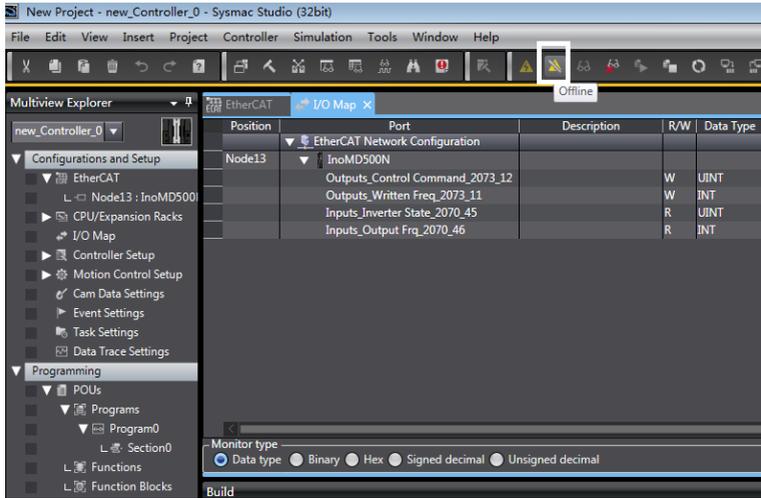
Set the PDO mapping (I/O mapping distribution).
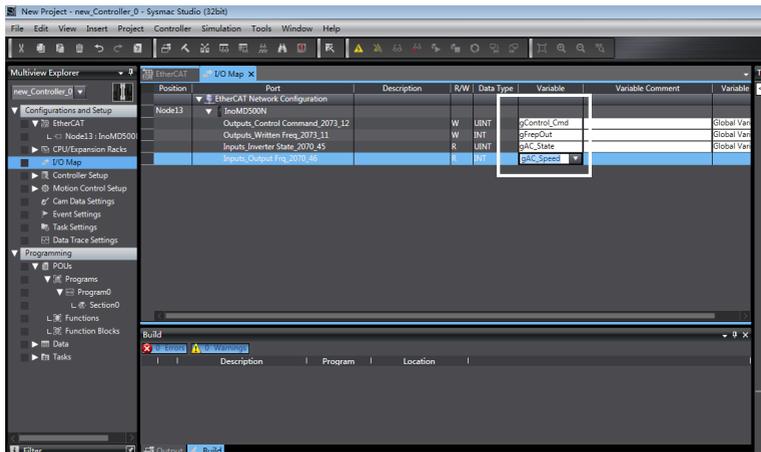
6. Edit the PLC program.
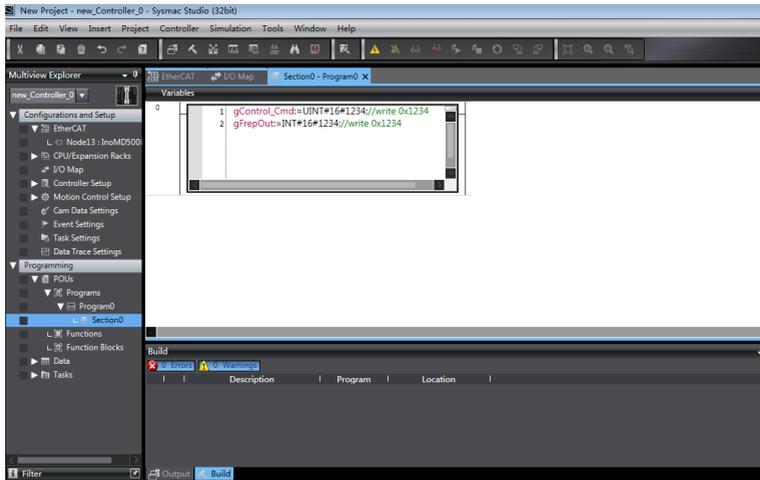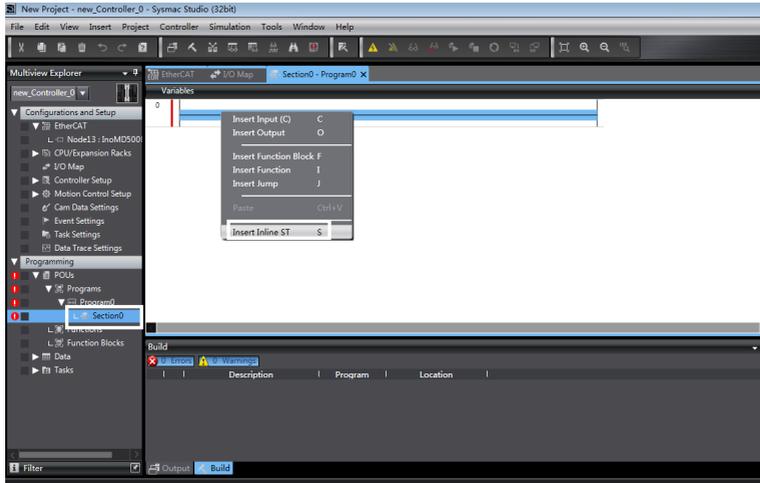
7. Download the program to the controller.

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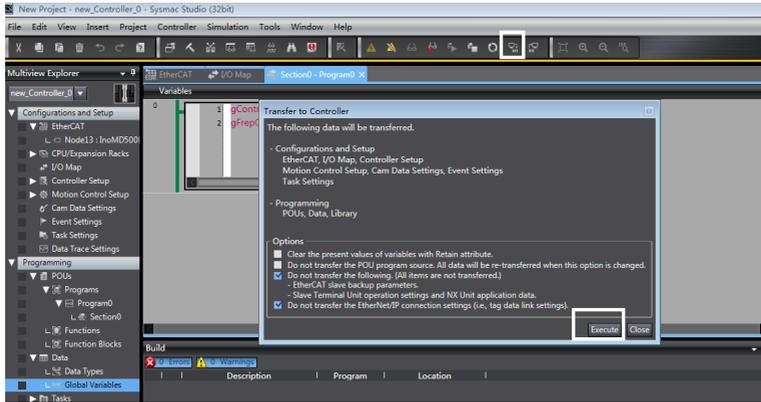
4 Troubleshooting

4.1 Troubleshooting

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

Table 4–1 Troubleshooting

Symptom		Cause	Solution
Communication between the MD500-ECAT card and AC drive fails.	The D1 indicator on the card is off.	The drive does not support the MD500-ECAT card.	Check whether the drive supports the MD500-ECAT card.
		The communication configuration of the MD500-ECAT card is incorrect.	Set F0-28 to 1.
		The MD500-ECAT card hardware is faulty.	Replace the MD500-ECAT card.
A communication error (Err16) is reported by the AC drive during running.	The D1 indicator on the card is off.	The communication data is abnormal.	Check whether the EtherCAT master station program is normal.
		The network cable is damaged or connected incorrectly.	Check whether the network cable is connected correctly. Replace the network cable if required.
		The AC drive suffers external interference.	Use the Cat 5e shielded twisted pair (STP) network cable as required. Check that the MD500-ECAT card is grounded correctly. Eliminate the external interference. Contact the agent or Inovance for technical support if necessary.
	The D4 indicator on the card flashes green.	The AC drive works in the PREOP/SAFEOP mode.	Check the configuration. Check whether the AC drive supports the MD500-ECAT card and whether F0-28 is set to 1. Check whether the network port is connected correctly.
	The D4 indicator on the card is off.	The master station is not connected or the AC drive works in the Initial mode.	Check whether the master station and network port are connected correctly.
	The D7 indicator on the card is solid red.	ESC internal fault	Contact Inovance or the agent for technical support.

The MD500-ECAT card can be replaced directly without reconfigurations only when a slave node is faulty caused by the MD500-ECAT card failure.

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

1. Ensure that the wiring sequence of the network cable before and after replacing the MD500-ECAT card is consistent.
2. The internal XML file version of the new MD500–ECAT card is the same as that of the old MD500–ECAT card.
3. If a station alias is configured for the MD500–ECAT card, the alias of the new card must be consistent with that of the old card.

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