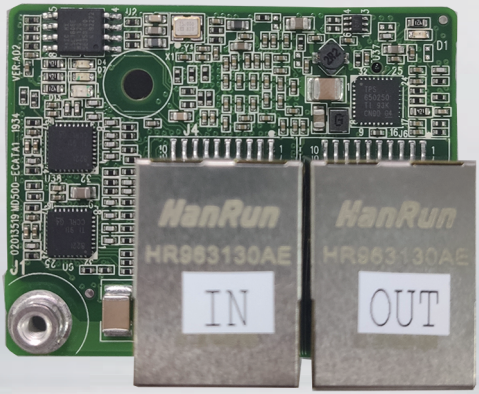
INOVANCE

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MD500-ECAT EtherCAT Communication Expansion Card

User Guide

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

Data code 19012212B03

Preface

Introduction

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



- This user guide is applicable to the MD500-ECAT card with the software version of 1.00 or later. You can query the version by viewing the parameter of the AC drive after the card is installed and the drive is powered on. The corresponding description XML file is MD500_1Axis_V1.03.xml.
- This guide takes installing MD500-ECAT card to the MD290, MD500, and MD520 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	Version	Description
August 2024	B03	• Updated *"1.5 Terminals and Indicators" on page 15*, and updated the solution for the D1 indicator to be steady on/off. • Updated *"3.2 Parameters Related to Communication" on page 23*, added the requirements for MD520 AC drive software version, and adjusted the value range of Parameter F0-28.
May 2024	B02	• Updated *" Front Cover" on page 1*, *" Preface" on page 1*, and *" Back Cover" on page 56*. • Updated *"1.5 Terminals and Indicators" on page 15* and revised the status description of D1 indicator of the MD-500-ECAT card. • Updated *"3.2 Parameters Related to Communication" on page 23* to add the description “the second item of RPDO must be U3-16” in Communication control parameters and the description “the second item of TPDO must be U0-69” in Communication monitoring parameters.

Date	Version	Description
November 2023	B01	• Updated *" Front Cover" on page 1*, *" Preface" on page 1*, *" " on page* , and *" Back Cover" on page 56*. • Updated *"1.2 Applicable AC Drive" on page 13* to update the applicable AC drive models for MD500-ECAT. • Updated *"2.2.1 EtherCAT Connection Topology" on page 19* . • Updated *"3.2 Parameters Related to Communication" on page 23* to adjust the value range of the parameter U3-16.
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.

Acess to the guide

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

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

Warranty Disclaimer

Inovance provides warranty service within the warranty period (as specified in your order) for any fault or damage that is not caused by improper operation of the user. You need to pay charges beyond the warranty listed in the purchase order.

The warranty does not cover any defect caused by:

- Damage caused by operations not following the instructions in the user guide
- Damage caused by fire, flood, or abnormal voltage
- Damage caused by unintended use of the product
- Damage caused by use beyond the specified scope of application of the product

- Damage or secondary damage caused by force majeure (natural disaster, earthquake, and lightning strike)

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

For details, see Product Warranty Card.

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Safety Instructions

Safety Disclaimer

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

Safety Levels and Definitions



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



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



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

General Safety Instructions

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

Unpacking
 • Do not install the equipment if you find damage, rust, or signs of use on the equipment or accessories upon unpacking. • Do not install the equipment if you find water seepage or missing or damaged components upon unpacking. • Do not install the equipment if you find the packing list does not conform to the equipment you received.
 • Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking. • Unpack the package by following the unpacking sequence. Do not strike the package violently. • Check whether there is damage, rust, or injuries on the surface of the equipment and equipment accessories before unpacking. • Check whether the number of packing materials is consistent with the packing list.

Storage and Transportation



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



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

Installation



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



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



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

Wiring



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Before wiring, cut off all the power supplies of the equipment, Wait as specified on the product warning sign before further operations because residual voltage exists after power-off. Measure the DC voltage of the main circuit and make sure that it is below the safety voltage. Failure to comply will result in an electric shock.
- Never perform wiring at power-on. Failure to comply will result in an electric shock.
- Make sure that the equipment is well grounded. Failure to comply will result in an electric shock.



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



- During wiring, follow the proper electrostatic discharge (ESD) procedure, and wear an antistatic wrist strap. Failure to comply can result in damage to the equipment or internal product circuits.
- Use shielded twisted pairs for the control circuit. Connect the shield to the grounding terminal of the equipment for grounding purpose. Failure to comply can result in equipment malfunction.

Power-on



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



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

Operation



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



- Do not touch the equipment casing, fan, or resistor with bare hands to feel the temperature. Failure to comply may result in personal injuries.
- Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in a fire or equipment damage.

Maintenance



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not maintain the equipment with power ON. Failure to comply will result in an electric shock.
- Before maintenance, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.
- In case of a permanent magnet motor, do not touch the motor terminals immediately after power-off because the motor terminals will generate induced voltage during rotation even after the equipment power supply is off. Failure to comply can result in an electric shock.



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

Repair



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not repair the equipment with power ON. Failure to comply can result in an electric shock.
- Before inspection and repair, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.



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

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

Safety Labels

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

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

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.

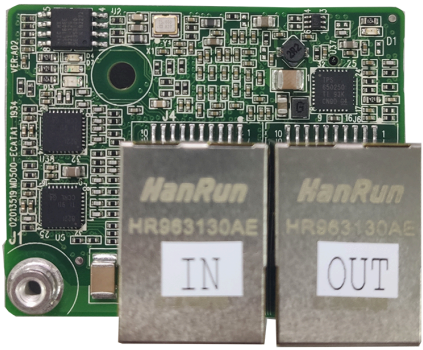


Figure 1-1 MD500-ECAT card appearance

1.2 Applicable AC Drive

Expansion Card	Applicable AC Drive
MD500-ECAT	MD290
	MD480 (T2 and above)
	MD480-PLUS
	MD500
	MD500-PLUS
	MD510
	MD520

Caution

This guide takes installing MD500-ECAT card to the MD290, MD500, and MD520 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 Technical Specification

Items	Technical Specification
Communication protocol	EtherCAT protocol
Service supported	CoE (PDO, SDO)
Network setup time (LINK)	< 2s
Synchronization mode	DC - Distributed clock (Minimum synchronization time: 500 μs) - Default mode FreeRun
Physical layer	100BASE-TX
Baud rate	100 Mbit/s (100BASE-TX)
Duplex mode	Full duplex
Topology	Linear typology, tree typology
Transmission medium	Shielded cables of Cat 5e or higher
Transmission distance	Less than 100 m between two nodes (with proper environment and cables)
EtherCAT frame length	44 bytes to 1,498 bytes
Process data	Maximum 1,486 bytes per Ethernet frame
Synchronous jitter of two slaves	< 1 μs
Communication code error rate	10^{-10} Ethernet standard

1.4 Outline Dimensions

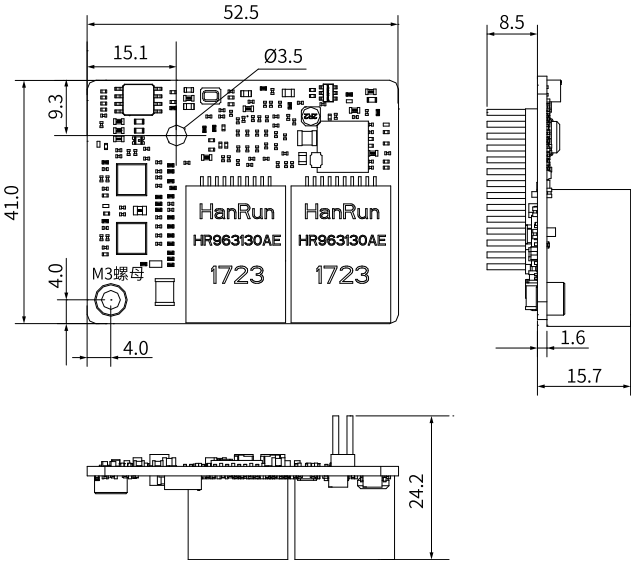


Figure 1-2 Dimensions of the MD500–ECAT card (mm)

1.5 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 drive. The MD500-ECAT card provides two network ports J4 and J6 for the card to communicate with the master station (or upstream slave) and the downstream slave (if any).

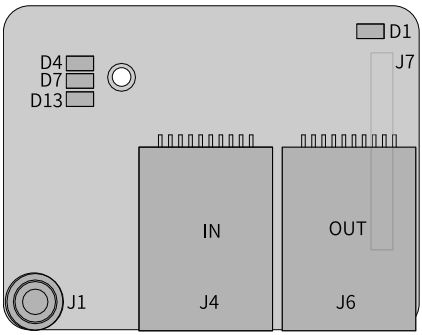


Figure 1-3 Terminal and indicator layout

Description of terminals and indicators

Table 1–1 Descriptions of terminals and indicators

Terminal mark	Terminal name	Function
J7	Pin header	It is used to connect the AC drive.
J4	Network port	The MD500-ECAT card uses the standard Ethernet RJ45 ports J4 and J6 for the card to communicate with the master (or the upstream slave) and the downstream slave (if any).
J6		
J1	EMC ground terminal	It is used to connect the EMC ground terminal of the AC drive.
D13	Power supply indicator (green)	It is 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 Status indicators of the MD500-ECAT card" on page 17*.
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 Status indicators of the MD500-ECAT card

Indicator		Status description	Solution
D1	Blinking green	Normal	None
	Steady green/ 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. Check whether the communication expansion card is firmly inserted.
D4	Steady green	The card works in the OP state.	/
	Blinking green	The card 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.
	Off	The master is disconnected or works in the Initial mode.	Check whether the master and upstream network port are connected correctly.
D7	Off	Normal	None
	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 embedded in the MD500 series AC drive. Before installation, power off the AC drive, wait at least 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 18* describes the installation of the card.

Note that the ground terminals of both the MD500-ECAT card and AC drive must be connected properly, as shown in *"Figure 2–2 " on page 18* .

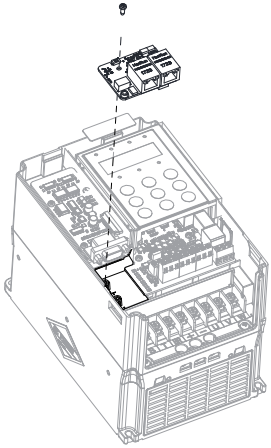


Figure 2-1 MD500-ECAT card installation

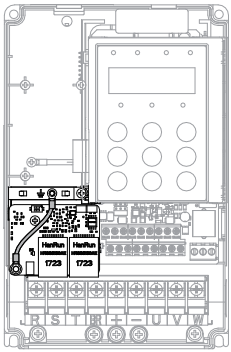


Figure 2-2 Connecting ground terminals of the MD500-ECAT card and AC drive

Caution

Do not install or disassemble the expansion 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 figures show the topologies.

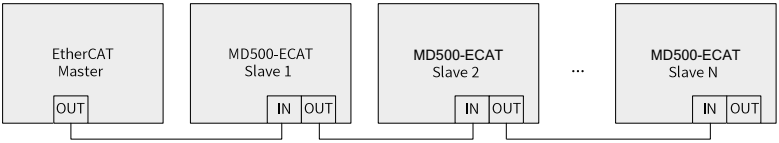


Figure 2-3 EtherCAT bus topology

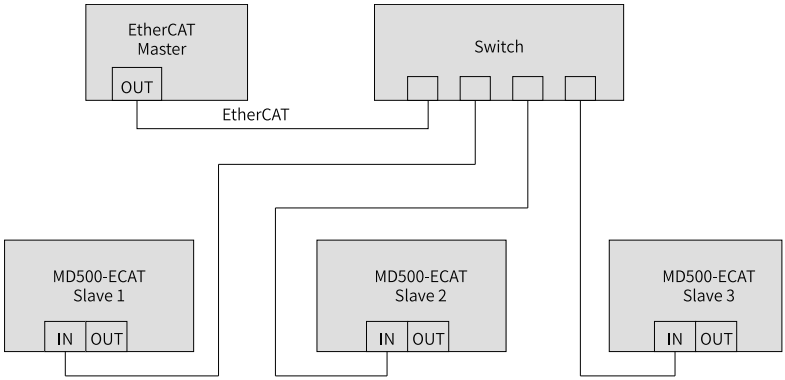


Figure 2-4 EtherCAT star topology

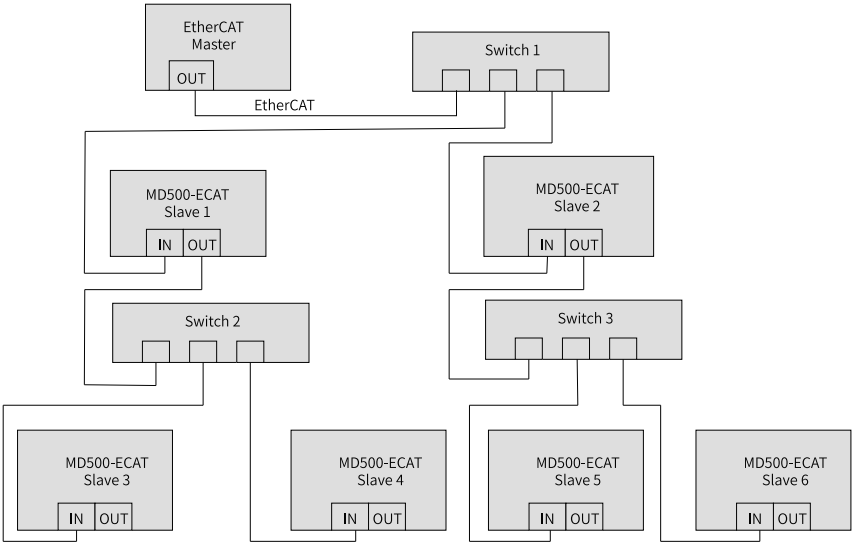


Figure 2-5 EtherCAT tree topology

2.2.2 EMC Cabling Instructions

- During installation and commissioning on site, route communication signal cables and power cables separate paths. Failure to comply will result in communication interference.
- Connect the motor enclosure to the PE terminal of the AC drive. Meanwhile, connect the grounding cable on the motor enclosure side properly. Failure to comply will result in poor grounding effect.
- 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 17* for details.

3 Communication Descriptions

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 enables the master to modify and read AC drive data in real time and perform periodic data exchange with the AC drive. 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 frequency reference	Real-time modification of AC drive parameters
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 parameters
TPDO1	TPDO2	TPDO3 to TPDO10

Note

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

Data sent by the master

Descriptions of RPDO sent by the master				
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: Reset upon fault
RPDO2	It indicates the 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 target frequency exceeds the 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	It specifies parameters (in group F and group A) to be modified in real time. The modification is not written to the EEPROM.			
	FE-02 to FE-09 correspond to RPDO3 to RPDO10. For the configuration, see PDO data configuration.			

Descriptions of data responded by the AC drive

TPDO Responded by the AC Drive
It indicates the AC drive 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
It indicates the 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.
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. For the configuration, see PDO data configuration.

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 settings for the AC drive

AC drive software version:

- MD290: U29.12_U29.21 and above (checked by parameters: F7-10 = U29.12; F7-11 = U29.21)
- MD500: U76.62_U77.62 and above (checked by parameters: F7-10 = U76.62; F7-11 = U77.62)
- MD520: U60.07_000.00 and above (checked by parameters: F7-10=U60.07; F7-11= U61.07； F7-15=000.00; F7-16=000.00)

Note

To enable the MD520 to support the Inobus protocol, select the MD520 with specific versions and set F0-28 to 2.

The following parameters must be set to enable normal communication between the MD500-ECAT card and MD290/MD500/MD520 series AC drive and connect the MD500-ECAT card to the EtherCAT fieldbus network.

Parameter	Parameter name	Range	Value range	Description
F0-02	Operation command source	0: Operating panel 1: Terminal 2: Communication	2	Running command given through communication
F0-03	Main frequency source	0: Digital setting (non-retentive at power failure) 1: Digital setting (retentive upon power failure) 2: AI1 3: AI2 4: AI3 5: Pulse reference (DI5) 6: Multi-reference 7: Simple PLC 8: PID 9: Communication setting	9	Target frequency given through communication
F0-28	Serial communication protocol	0: Modbus 1: Communication card network bridge protocol 2: MD520 Inobus protocol	1	Select the special communication expansion card protocol as the serial communication protocol.
FD-02	Slave alias	1 to 247	To be determined	Alias of EtherCAT slave (default value: 1) (No need to set when using the station name communication) The communication card version 1.25 does not support setting an alias.

Communication control parameters

Parameter	Parameter name	Range	Index	Sub-index
Communication control word parameters				
U3-16	Frequency reference	-327.68 Hz to +327.67 Hz	16#2073	16#11
U3-17	Control command	0001: Forward running 0002: Reverse running 0003: Forward jogging 0004: Reverse jogging 0005: Coast to stop 0006: Decelerate to stop 0007: Fault reset	16#2073	16#12

Parameter	Parameter name	Range	Index	Sub-index
U3-18	DO control	Bit 0: DO1 output control Bit 1: DO2 output control Bit 2: RELAY1 output control Bit 3: RELAY2 output control Bit 4: FMR output control BIT5: VDO1 BIT6: VDO2 BIT7: VDO3 BIT8: VDO4 BIT9: VDO5	16#2073	16#13
U3-19	AO1 control	0 to 7FFF represent 0% to 100%.	16#2073	16#14
U3-20	AO2 control	0 to 7FFF represent 0% to 100%.	16#2073	16#15
U3-21	FMP control	0 to 7FFF represent 0% to 100%.	16#2073	16#16
U3-22	Reserved	Reserved	16#2073	16#17
U3-23	Speed control	-15000 rpm to15000 rpm (The value range is also related to the number of motor pole pairs and frequency reference range.)	16#2073	16#18
AC drive parameters (commonly-used)				
F0-10	Maximum frequency	50.00 Hz to 500.00 Hz	16#20F0	16#0B
F0-107	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	Accelera tion/ Deceleration time unit	0: 1s 1: 0.1s 2: 0.01s	16#20F0	16#14
F8-00	Jogging frequency	0.00 Hz to maximum frequency	16#20F8	16#01
F8-01	Acceleration time of jogging	0.0s to 6500.0s	16#20F8	16#02
F8-02	Deceleration time of jogging	0.0s to 6500.0s	16#20F8	16#03

Parameter	Parameter name	Range	Index	Sub-index
A0-03	Torque digital setting in torque control	-200.0% to 200.0%	16#20A0	16#04
A0-05	Maximum forward frequency in torque control	0.00 Hz to maximum frequency	16#20A0	16#06
A0-06	Reverse maximum frequency in torque control mode	0.00 Hz to maximum frequency	16#20A0	16#07
U0-06	Output torque (%)	/	16#2070	16#07
U0-07	DI input state	/	16#2070	16#08
U0-08	DO output state	/	16#2070	16#09
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 indices are described as below:

- The position of the object dictionary in the parameter list is specified by the "Index" and "Sub-index".
  - Index: This field (in hexadecimal) specifies the position of the same type of objects in the object dictionary.
  - Sub-index: The sub-index (in hexadecimal) specifies the offset of each object in the same index.
- 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 offset within the parameter group + 1

By default, when the MD500-ECAT card is used, the written RPDO1 and RPDO2 are mapped to U3-17 and U3-16, respectively. Therefore, the first item of the RPDO must be U3-17 and the second item of RPDO must be U3-16; otherwise, the running will be abnormal. Besides, if the eight high-order bits of U3-17 are written with any non-zero value, the AC drive will report a communication fault (Err16).

Communication monitoring parameters

Parameter code	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
U0-07	DI input state	1	16#2070	16#08
U0-08	DO output 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	Counting value	1	16#2070	16#0D
U0-13	Length value	1	16#2070	16#0E
U0-14	Load speed display	1	16#2070	16#0F
U0-15	PID reference	1	16#2070	16#10
U0-16	PID feedback	1	16#2070	16#11
U0-17	PLC stage	1	16#2070	16#12
U0-18	Pulse input frequency (Hz)	0.01 kHz	16#2070	16#13
U0-19	Feedback speed (Hz)	0.01 Hz	16#2070	16#14
U0-20	Remaining running time	0.1 min	16# 2070	16# 15
U0-21	AI1 voltage before correction	0.001V	16#2070	16#16

Parameter code	Parameter name	Unit	Index	Sub-index
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 time	1 min	16#2070	16#1A
U0-26	Current operating time	0.1 min	16#2070	16#1B
U0-27	Pulse input frequency	1 Hz	16#2070	16#1C
U0-28	Communication setpoint	0.01%	16#2070	16#1D
U0-29	Encoder feedback speed	0.01 Hz	16#2070	16#1E
U0-30	Display of main frequency X	0.01 Hz	16#2070	16#1F
U0-31	Display of auxiliary frequency Y	0.01 Hz	16#2070	16#20
U0-32	Memory address view	1	16#2070	16#21
U0-33	Synchronous motor rotor position	0.1°	16#2070	16#22
U0-34	Motor temperature	1°C	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	Target voltage for V/f separation	1V	16#2070	16#28
U0-40	Output voltage for V/f separation	1V	16#2070	16#29
U0-41	DI input state display	1	16#2070	16#2A

Parameter code	Parameter name	Unit	Index	Sub-index
U0-42	DO output state display	1	16#2070	16#2B
U0-43	DI input state display 1	1	16#2070	16#2C
U0-44	DI input 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
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	rpm	16#2070	16#47
U0-71	Output current	0.1 A	16#2070	16#48
U0-80	EtherCAT slave name	1	16#2070	16#51
U0-81	EtherCAT slave alias	1	16#2070	16#52

Parameter code	Parameter name	Unit	Index	Sub-index
U0-82	Transmission error code of EtherCAT ESM	1	16#2070	16#53
U0-83	EtherCAT XML file version	0.01	16#2070	16#54
U0-84	Number of lost EtherCAT synchronization frames	1	16#2070	16#55
U0-85	Maximum number of error frames and invalid frames over EtherCAT port 0 per unit time	1	16#2070	16#56
U0-86	Maximum number of error frames and invalid frames over EtherCAT port 1 per unit time	1	16#2070	16#57
U0-87	Maximum number of error frames forwarded by EtherCAT port per unit time	1	16#2070	16#58
U0-88	Maximum number of error frames processed by EtherCAT data frame processing unit per unit time	1	16#2070	16#59
U0-89	Maximum number of lost links over the EtherCAT port per unit time	1	16#2070	16#5A

By default, when the MD500-ECAT card is used, the read TPDO1 and TPDO2 are mapped to U0-68 and U0-69, respectively. Therefore, the first item of the TPDO must

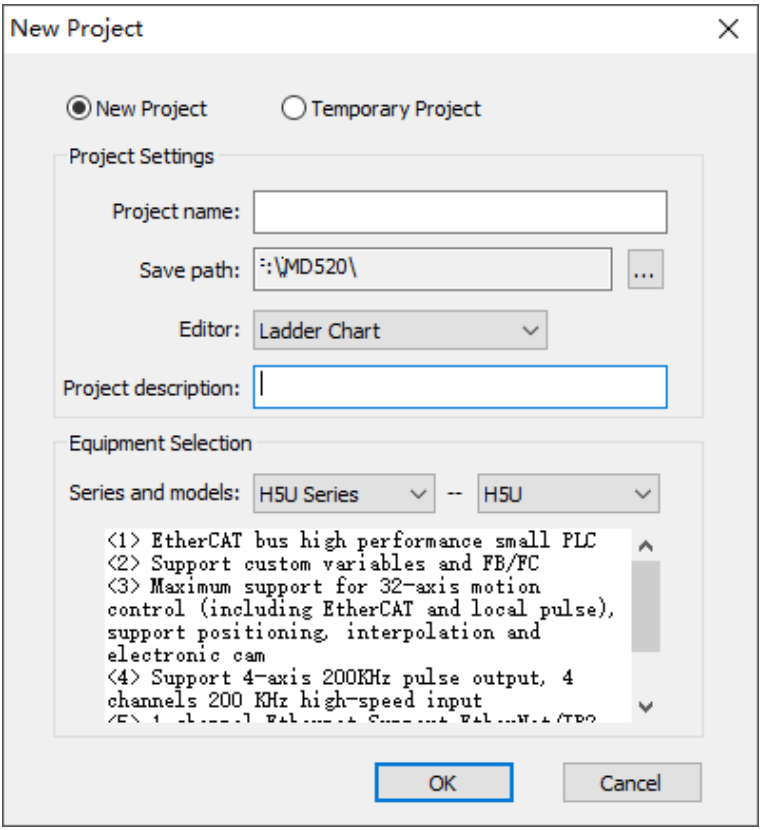
be U0-68 and the second item of TPDO must be U0-69; otherwise, the running will be abnormal.

3.3 Communication Instances

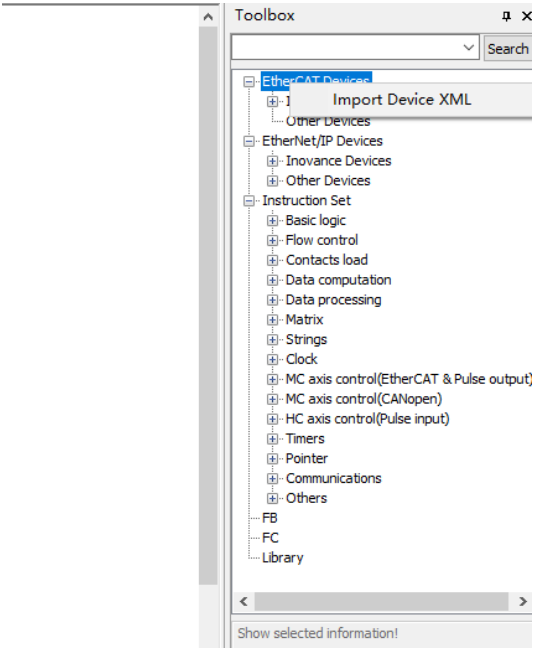
3.3.1 Communication Instance of Controlling the MD500 with the H5U

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** and **H5U**.

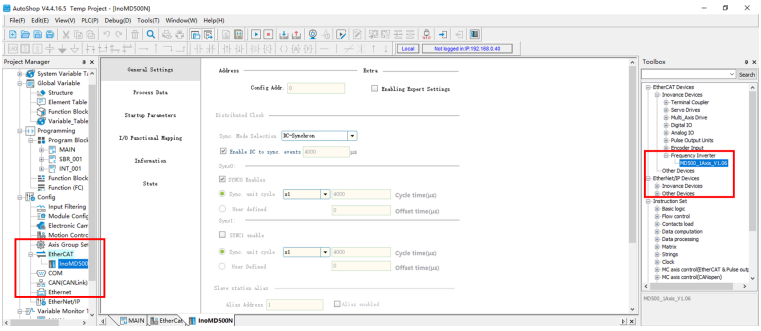


2. Import the EtherCAT configuration file of the MD500.
   If the configuration file of other version exists, delete the existed configuration file before importing a new one, as shown below.



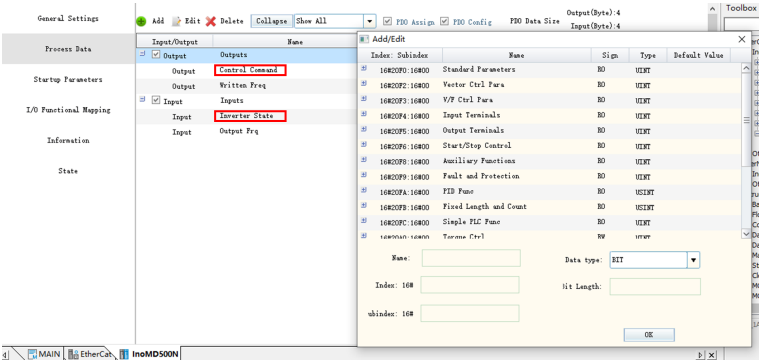
3. Add the MD500 slave station.

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



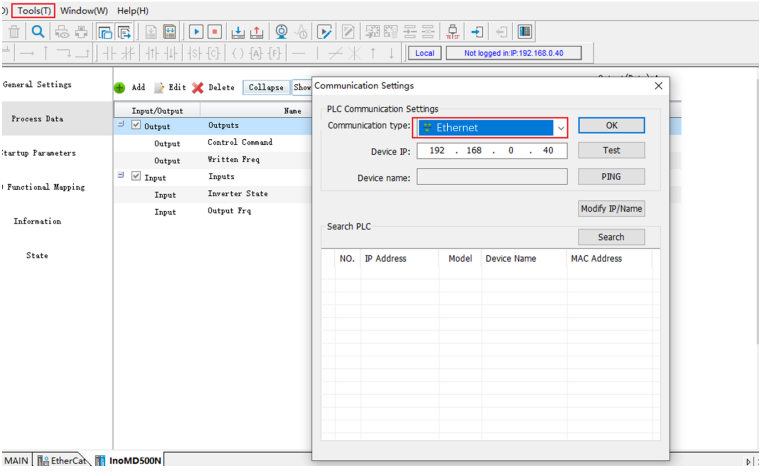
4. Configure PDO parameters.

   On the **Process Data** tab, add the TPDO mapping as required.

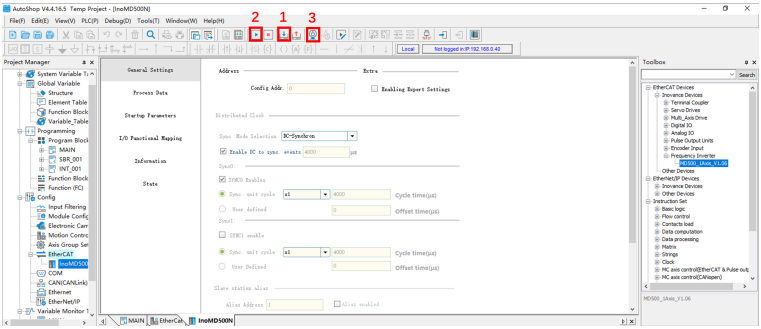


Note: Control Command of the RPDO and Inverter State of the TPDO cannot be changed and must be set as the first items. Otherwise, an exception will occur during operation.

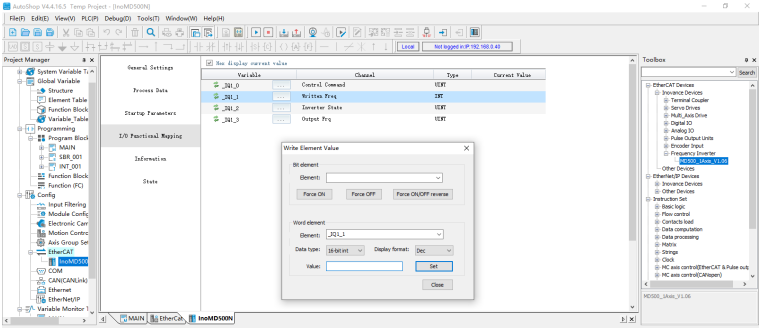
5. Scan the H5U PLC.
   Click **Tools (T)**. In the **Communication Settings** dialog box, select **Ethernet** or **USB** from the **Communication type** drop-down list for communication between the PC and the PLC, and scan the PLC.



6. Download the project to the PLC and activate the PLC.
   Download the compiled project file, click the running button to activate the PLC, and then click the monitoring button to view the motion data.



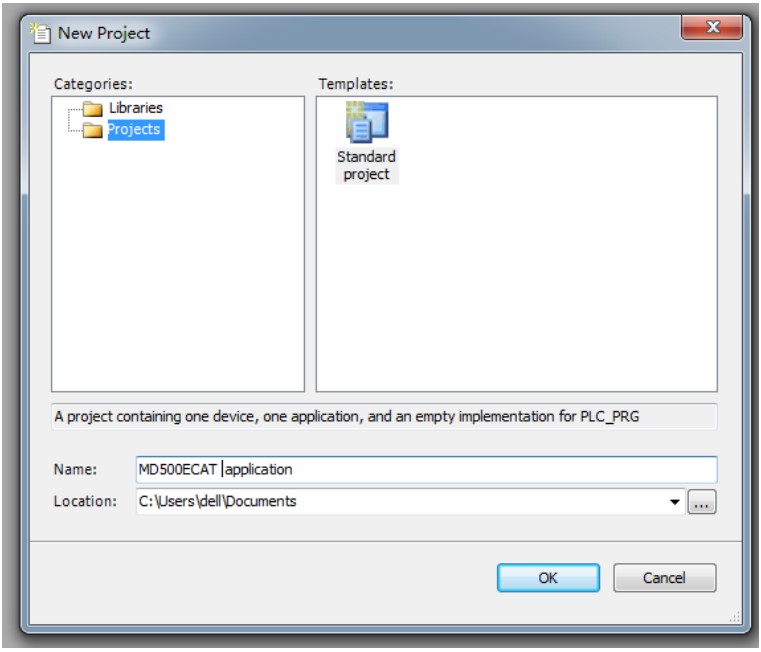
You can view TPDO data and write RPDO data in real time through EtherCAT I/O mappings.

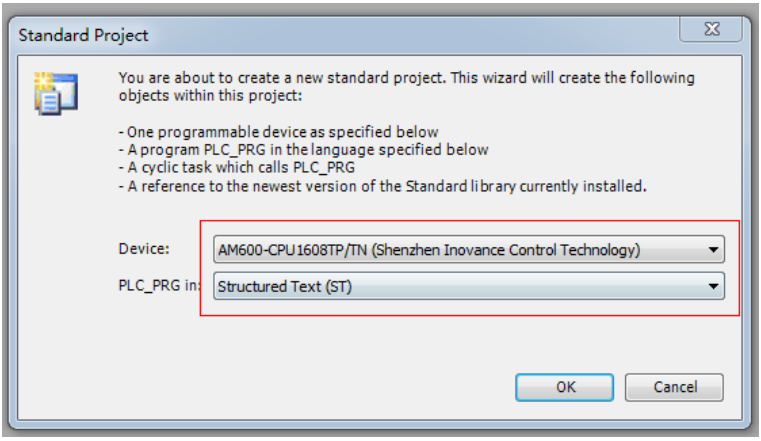


3.3.2 Communication Instance of Controlling MD500 with an AM600 Controller

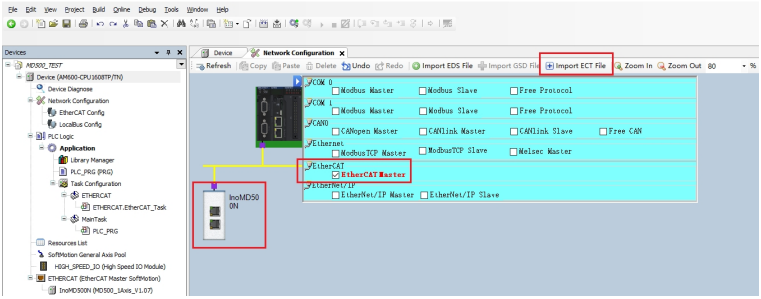
This section describes how to configure the MD500 on the AM600.

1. Open the software, and create an AM600 project.
   Select **AM600-CPU1608TP/TN** from the **Device** drop-down list.



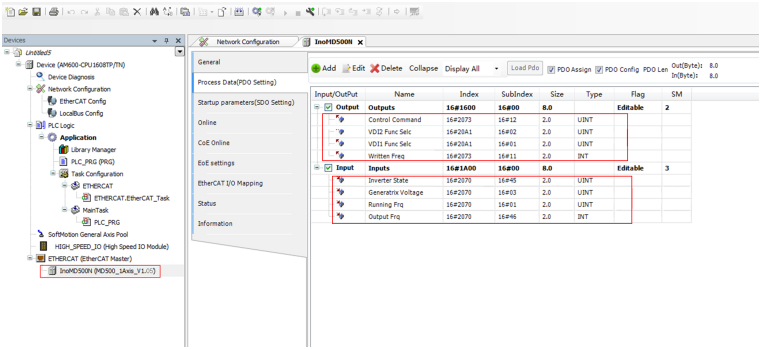


2. Add the MD500 slave station.. Open the network configuration, import the EtherCAT configuration file of the MD500. If a configuration file of other version exists, delete the existed configuration file before importing a new one. Drag the device in the network device list to add the AC drive slave station, as shown below.

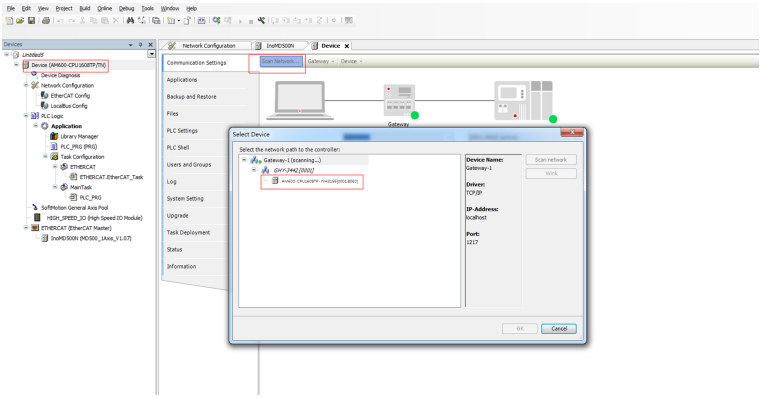


3. Configure the PDO parameters.

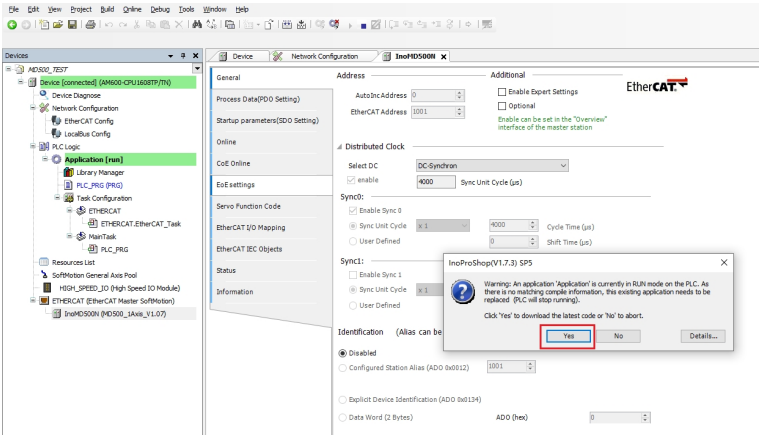
   Add the TPDO mapping as required in the following figure. Control Command of the RPDO and Inverter State of the TPDO cannot be changed and must be set as the first items. Otherwise, an exception will occur during operation.



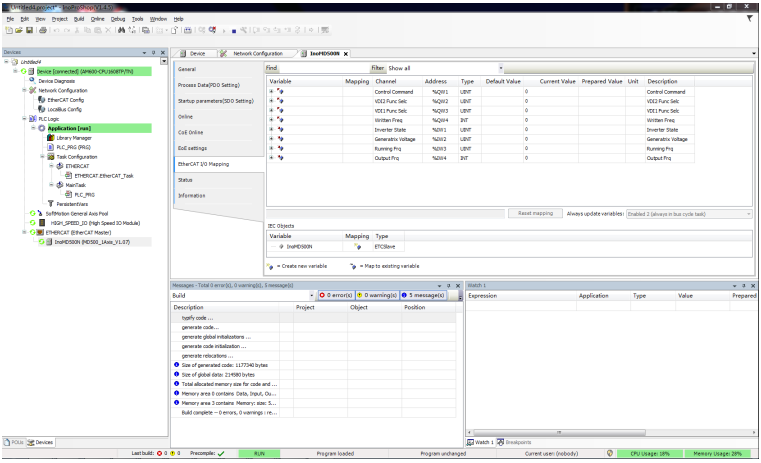
   Scan the device.



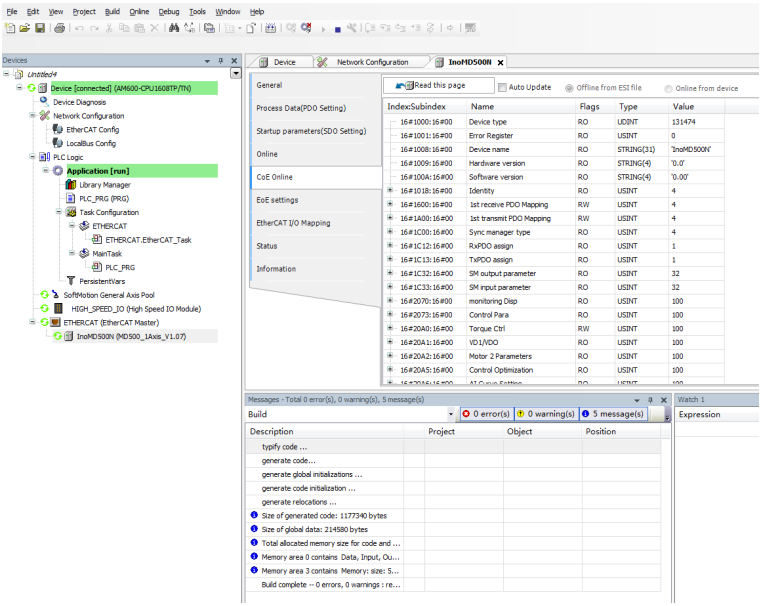
Download the project to the PLC.



You can 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 of Controlling the MD500 with an Beckhoff Controller

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

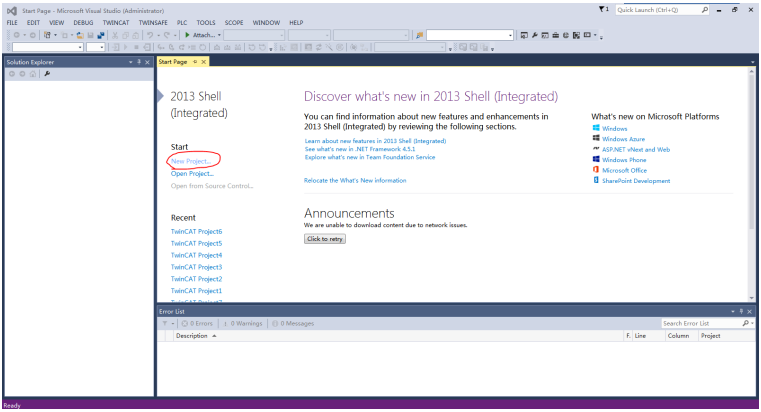
Caution

The Ethernet card must be 100 Mbps Ethernet card equipped with the Intel chip. If other brands are used, the EtherCAT communication may fail.

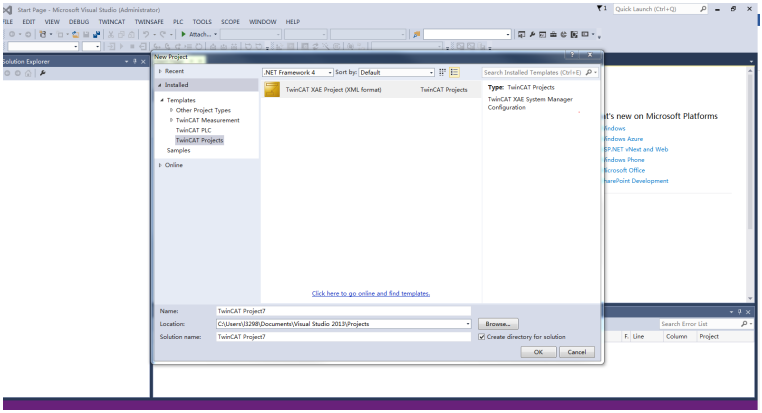
1. Install the TwinCAT software.
   - Windows XP: tcat_2110_2230 is recommended.
   - Windows 7 (32-bit): tcat_2110_2248 is recommended.
2. Copy the EtherCAT configuration file (MD500_1Axis_V1.03.xml) of the MD500 to the TwinCAT installation directory.
   - TwinCAT2 directory: TwinCAT\IO\EtherCAT
   - 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 to those for TwinCAT3.
3. Start the TwinCAT.

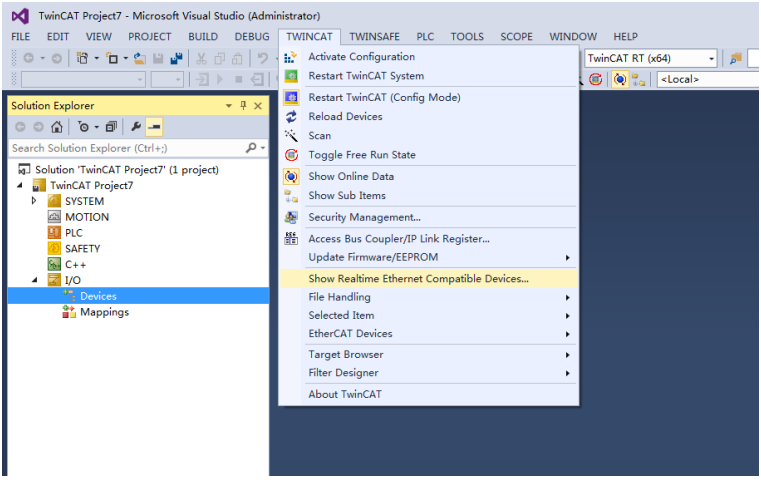
   a. Click **New Project** to create a project.



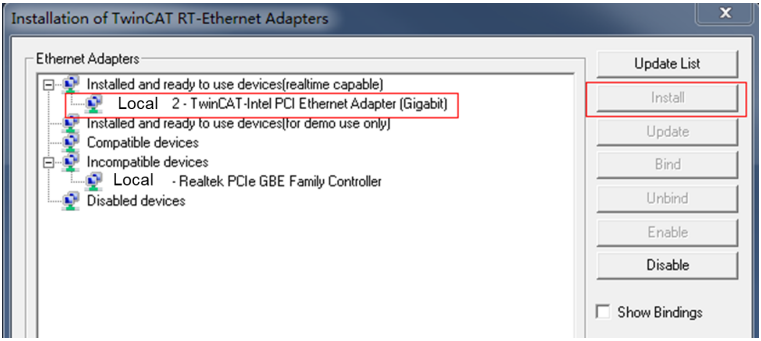
   b. Click **OK**.



4. Install the TwinCAT network card driver.

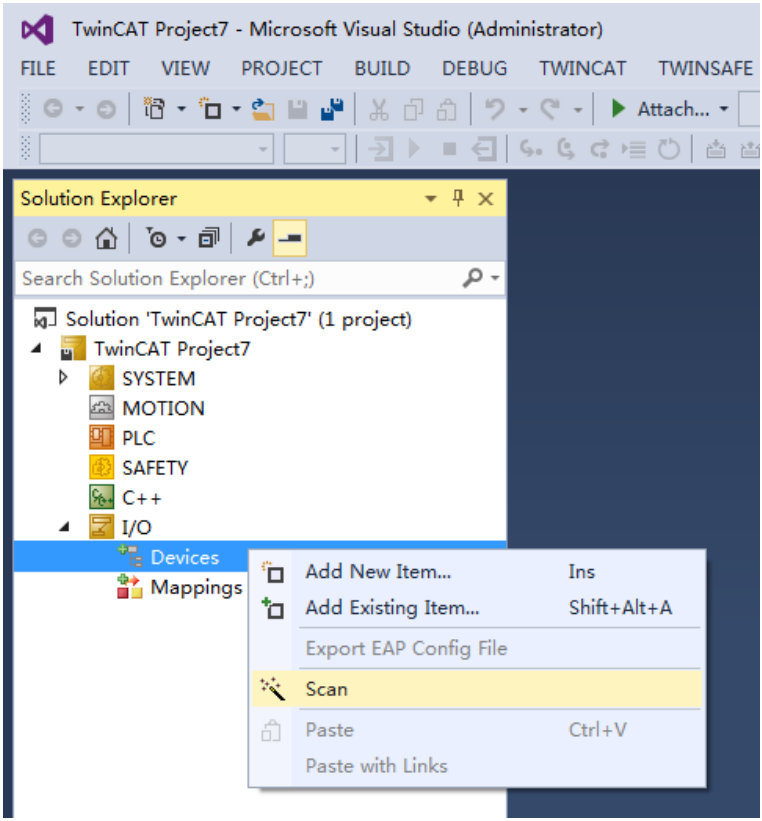


Go to **TWINCAT** > **Show Real Time Ethernet Compatible Devices**. Select the local connection under **Incompatible devices**, and then click **Install**. After installation is done, the network card will be displayed under **Installed and ready to use devices(realtime capable)**.

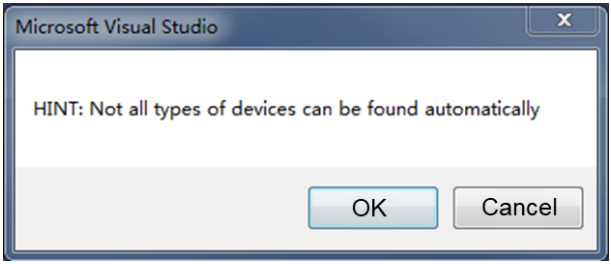


5. Search for devices.

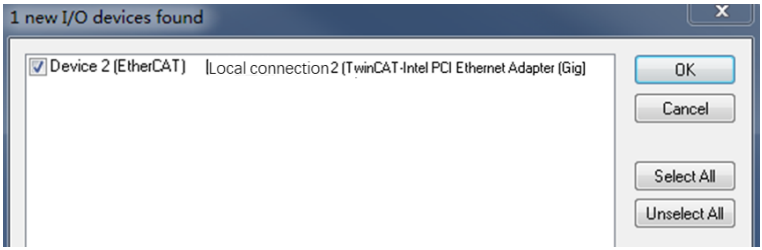
   a. Create a project, right-click **Devices**, and then select **Scan** to search for devices.



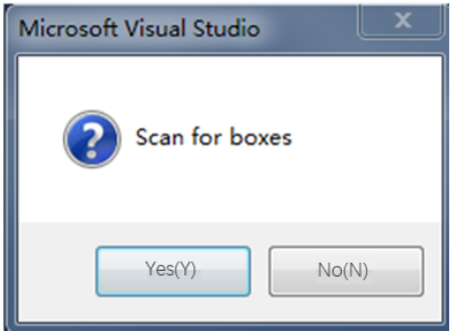
   b. Click **OK**.



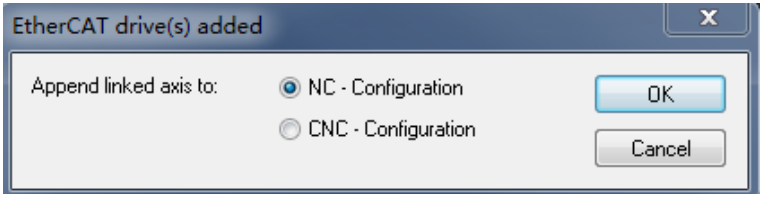
c. Click **OK**.



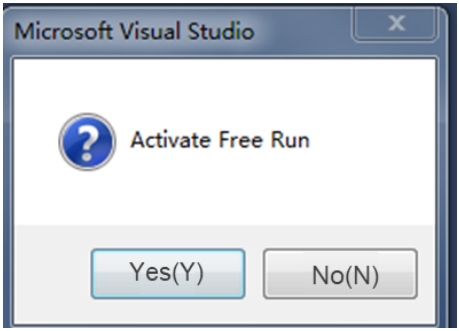
d. Click **Yes**.

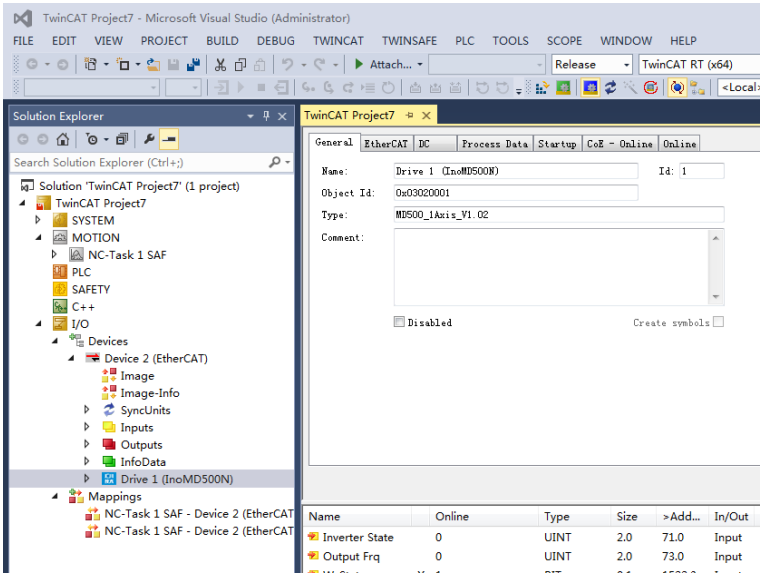


e. Click **OK**.



f. Click **No**.The device search is completed.

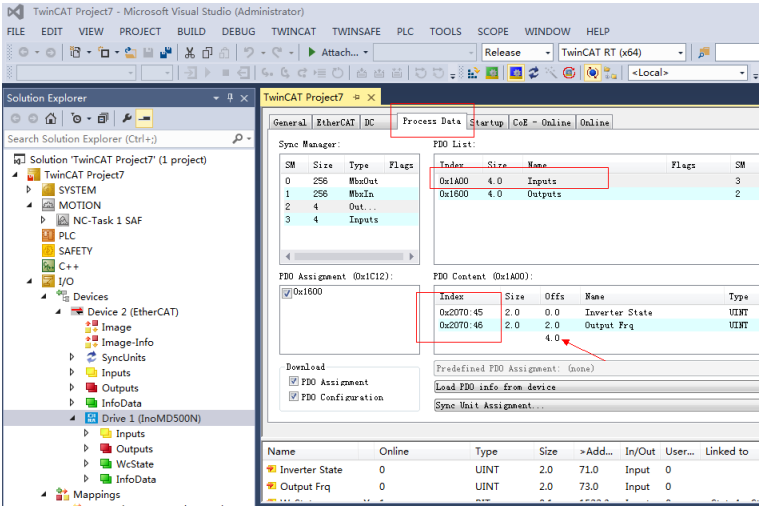




6. Configure PDO parameters.

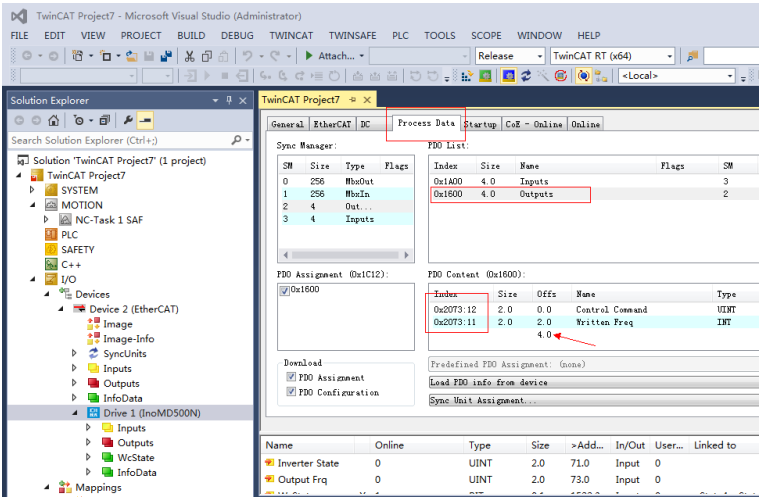
   a. Configure the TPDO.

      Select 0x1A00 when configuring the TPDO. The first two indexes (0x2070:45 and 0x2070:46) are the default TPDOs 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.



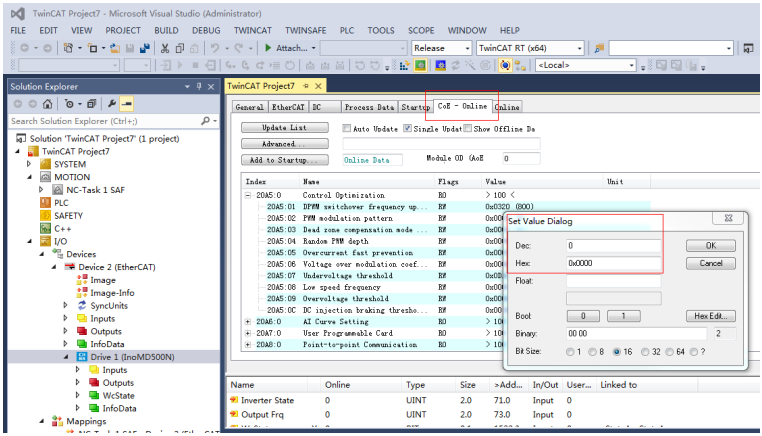
b. Configure the RPDO.

Select 0x1600 when configuring the RPDO. The first two items are the default RPDOs 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.



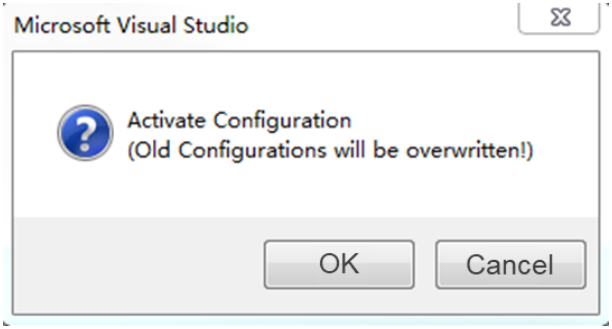
c. View the SDO data list.

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.

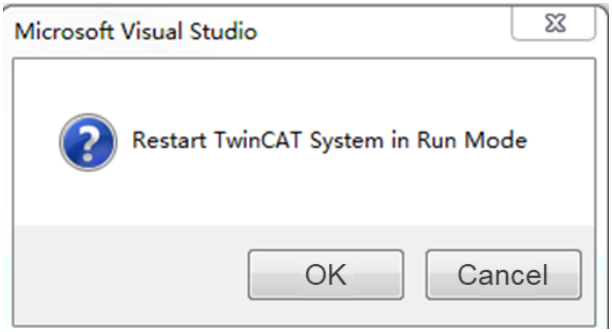


d. Activate the configuration and switch to the operation mode.

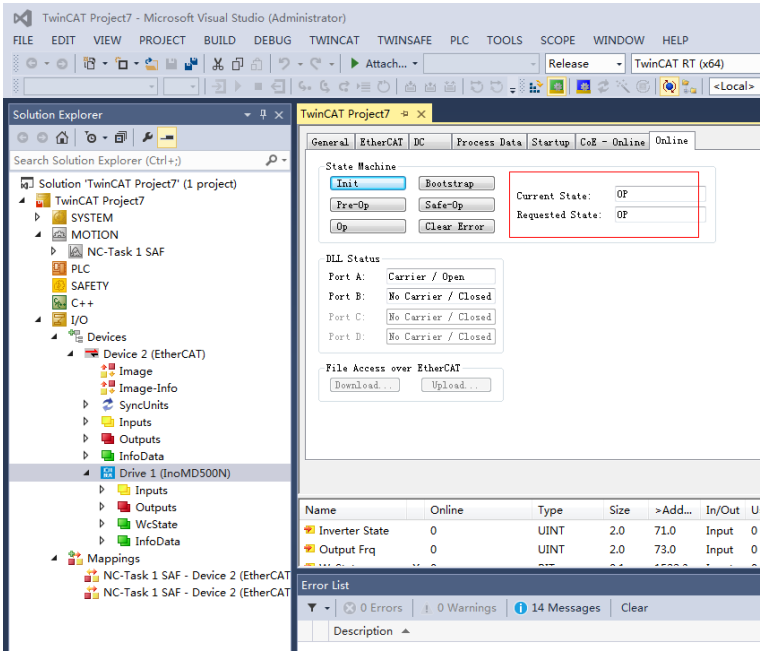
Click . The following figure appears.



Click **OK**.

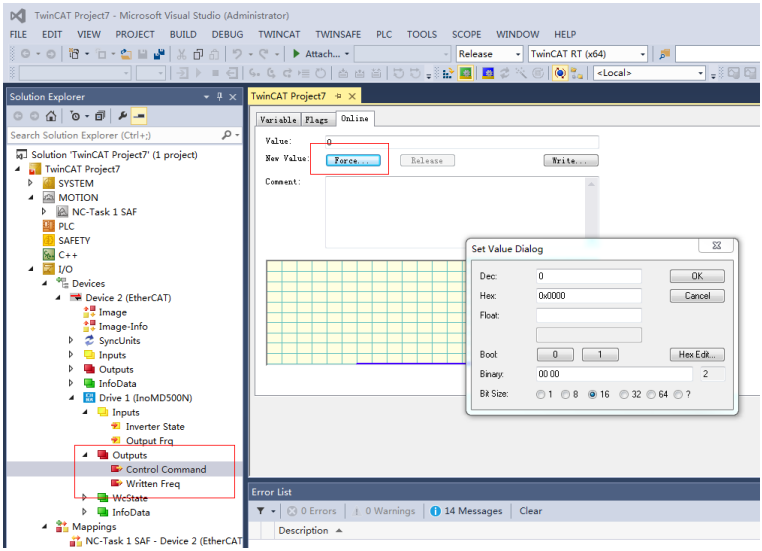


Click **OK** to enter the OP state.



e. Control the AC drive through the PDO.

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

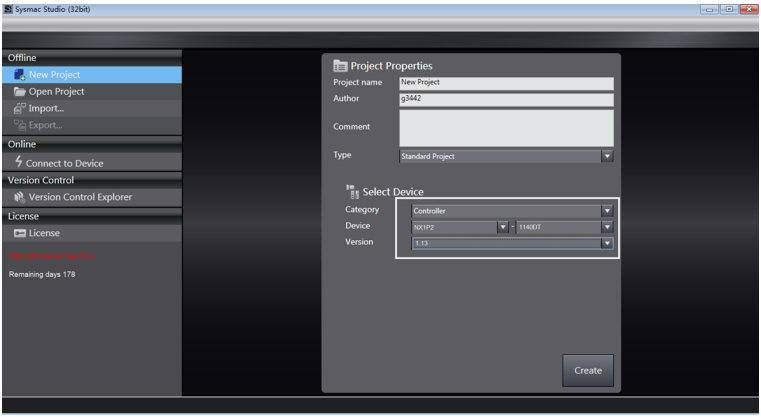


3.3.4 Communication Instance of Controlling the MD500 with an Omron Controller

This section describes how to configure the MD500 on the NX1P2 master station of Omron.

1. Create a project.

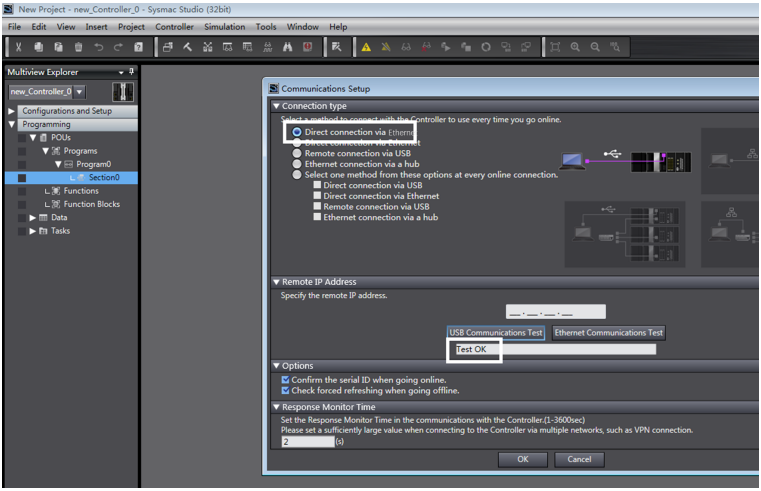
   - Device: Select the actual controller model.
   - Version: 1.09 or later version. Only NX1P2-1140DT V1.13 is supported.



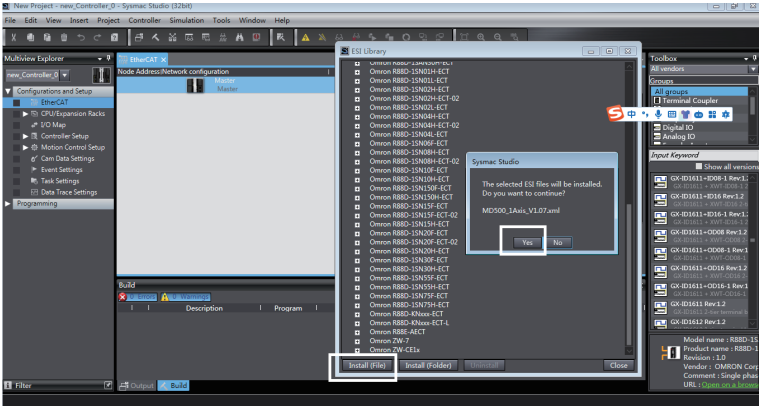
2. Configure communication

   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.

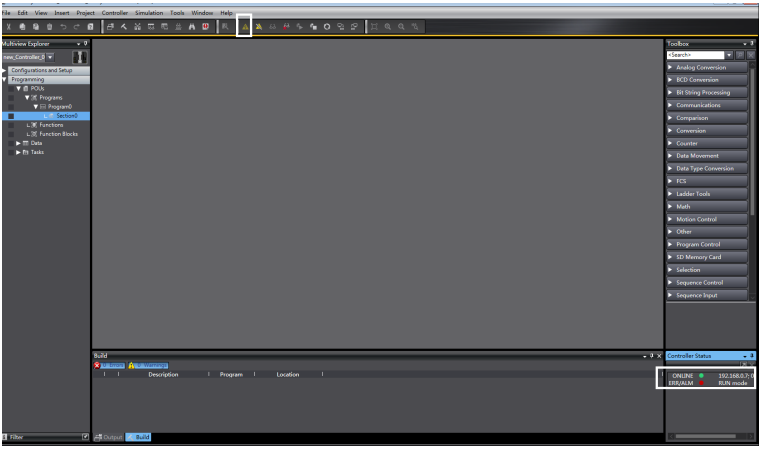


3. Import the XML configuration file.
   Double-click **EtherCAT** in the left pane. Right-click the master device and select **ESI Library**. Click **Install (File)**. Select the MD500-ECAT card XML configuration file and import it.



4. Scan the device.
   Switch the controller to the online and running mode.

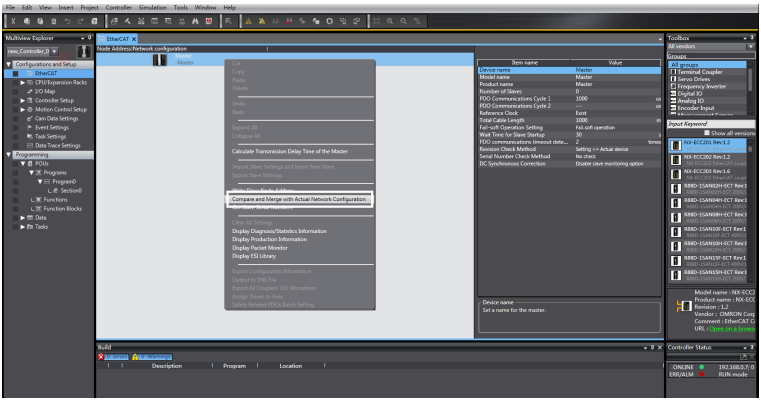
   Check that the controller status in the lower right corner is online and running.

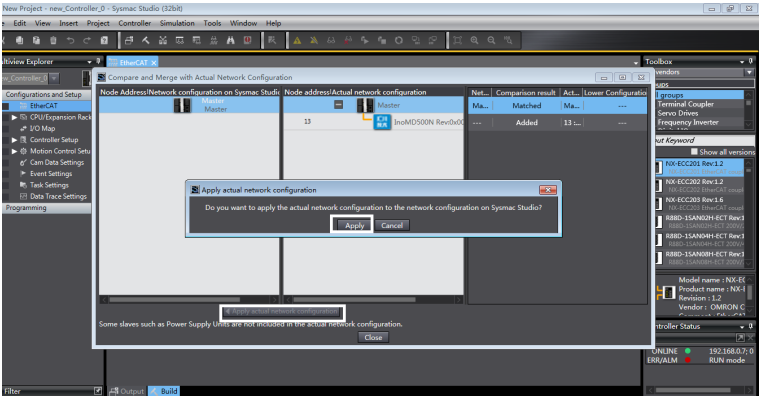


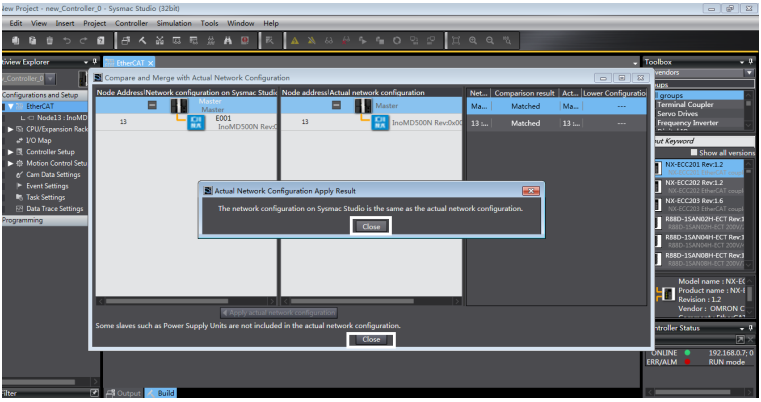
Scan the device and add the slave station. Right click Configurations and Setup→EtherCAT→Master, and select Compare and Merge with Actual Network Configuration. The controller scans all the slaves in the network (an error will be reported if the station number is 0). After scanning, click Apply actual network configuration in the pop-up window to add the slave. You can view the added slave station on the main interface.

Note

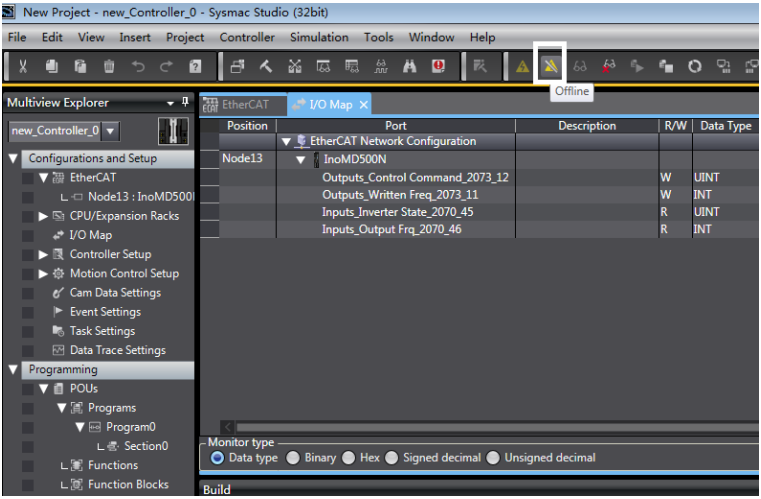
Before station alias change, ensure that the AC drive software version is updated to that in *"3.2 Parameters Related to Communication" on page 23*. You can change the station alias through the parameter FD-02 or the master station. The changed station alias takes effect upon next power-on.



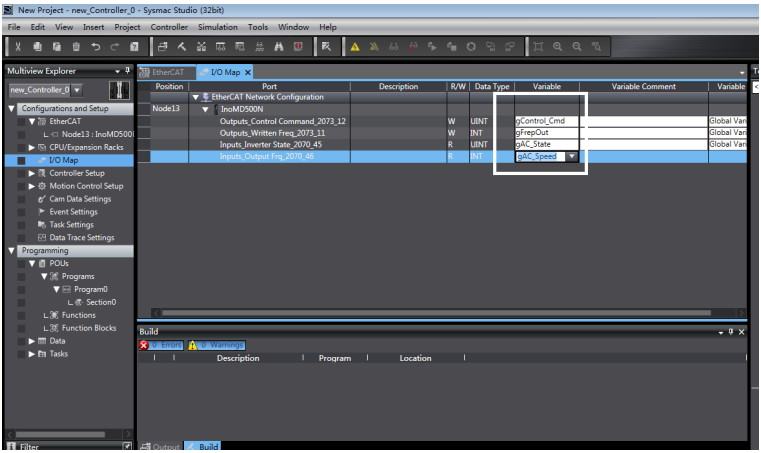




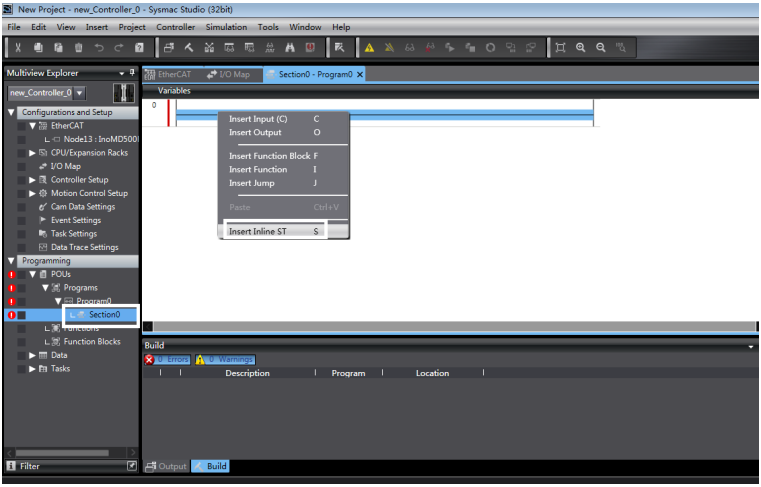
5. Configure parameters.
   Switch the controller to the offline mode.

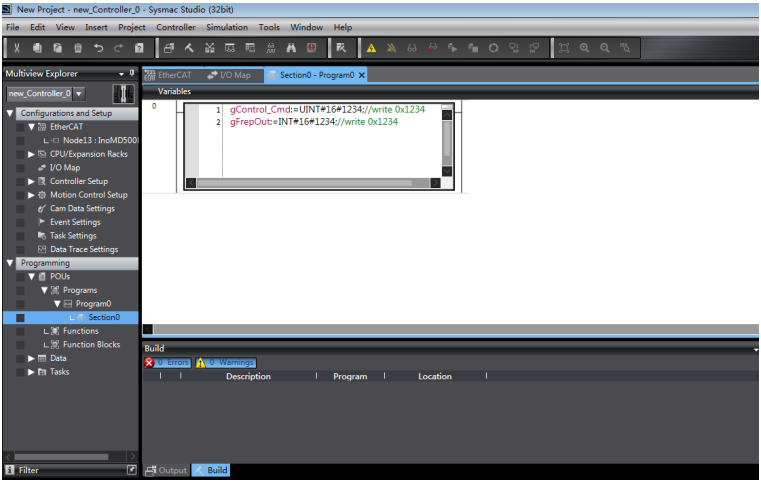


Set the PDO mapping (I/O mapping distribution).

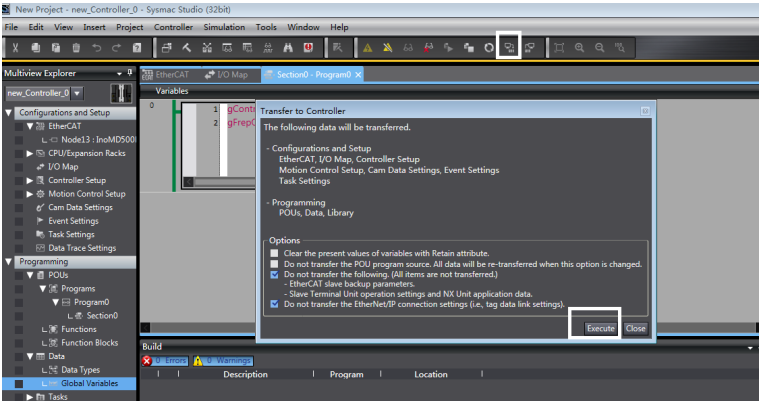


6. Edit the PLC program.





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.


New Project - new_Controller_0 - Sysmac Studio (32bit)
File Edit View Insert Project Controller Simulation Tools Window Help
Multiview Explorer
new_Controller_0
Configurations and Setup
EtherCAT
Node13 : InoMD500
CPU/Expansion Racks
I/O Map
Controller Setup
Motion Control Setup
Cam Data Settings
Event Settings
Task Settings
Data Trace Settings
Programming
POUs
Programs
Program0
Section0
Functions
Function Blocks
Data
Data Types
Global Variables
Tasks
EtherCAT
I/O Map
Section0 - Program0
Variables
Transfer to Controller
The following data will be transferred.
- Configurations and Setup
EtherCAT, I/O Map, Controller Setup
Motion Control Setup, Cam Data Settings, Event Settings
Task Settings
- Programming
POUs, Data, Library
Options
Clear the present values of variables with Retain attribute.
Do not transfer the POU program source. All data will be re-transferred when this option is changed.
Do not transfer the following. (All items are not transferred.)
- EtherCAT slave backup parameters.
- Slave Terminal Unit operation settings and NX Unit application data.
Do not transfer the EtherNet/IP connection settings (i.e., tag data link settings).
Execute
Close
Build
0 Errors
0 Warnings
Description
Program
Location

4 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

Fault Symptom		Fault cause	Solution
Communication between the MD500-ECAT card and AC drive fails.	The D1 indicator on the MD500-ECAT card is off.	The AC drive does not support the MD500-ECAT card	Check whether the AC 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 faulty MD500-ECAT card.
A communication error (Err16) is reported by the AC drive during running.	The D1 indicator on the MD500-ECAT 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 drive suffers external interference.	Use the Cat 5e shielded twisted pair (STP) cable as required. Check that the MD500-ECAT card is grounded correctly. Eliminate the external interference. Contact the technical support personnel if necessary.
	The D4 indicator on the MD500-ECAT card is blinking 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 MD500-ECAT 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 steady red.	ESC internal fault	Contact Inovance or the agent for technical support.

When a slave reports a MD500-ECAT card fault, the card installed in the slave can be replaced directly without configurations.

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 consistent with that of the old one.
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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