



MD500-EN1

Communication Expansion Card

User Guide



Industrial
Automation



Intelligent
Elevator



New Energy
Vehicle



Industrial
Robot



Rail
Transit



Data code 19011561 B00

Preface

Introduction

The MD500 series Ethernet/IP communication expansion card (hereinafter referred to as MD500-EN1 card) is an Ethernet/IP fieldbus adapter card and meets international Ethernet/IP bus standards. This card features high efficiency, flexible topology, and easy operation.

This user guide introduces in detail the specifications, dimensions, installation, wiring, communication protocol, communication-related parameters, and communication cases of MD500-EN1 expansion card.

Revision History

Date	Version	Change Description
April 2022	B00	Added 1.1 Applicable AC drive, the dimensions part in 1.3, and 2.2.2 EMC routing guide. Adjusted the architecture of the whole guide.
May 2021	A00	First release.

How to Obtain

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

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

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Safety Precautions

Safety Disclaimer

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

Safety Levels and Definitions



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



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



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

Safety Precautions

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

Unpacking and Acceptance



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

 CAUTION

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

Storage and Transportation

 WARNING

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

 CAUTION

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

Installation

 DANGER

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

**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 Applicable AC Drive

Expansion Card	Applicable AC Drive
MD500-EN1	MD500-PLUS
	MD520

1.2 Product Introduction

The MD500 series Ethernet/IP communication expansion card (hereinafter referred to as MD500-EN1 card) is an Ethernet/IP fieldbus adapter card and meets international Ethernet/IP bus standards. This card features high efficiency, flexible topology, and easy operation. It is installed in the MD series AC drive to increase 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.

The MD500-EN1 card software version required in this user guide is 1.00 or above (checked by the parameter U0-67 on the AC drive after the card is installed and powered on). The corresponding EDS file is MD500P_EIP_V1.00.eds. This user guide is applicable only for the MD500-PLUS series AC drive. If you need to use the MD500-EN1 expansion card on other AC drives, contact our technical engineers.

1.3 Appearance and Dimensions



Figure 1-1 Appearance of the MD500-EN1 card

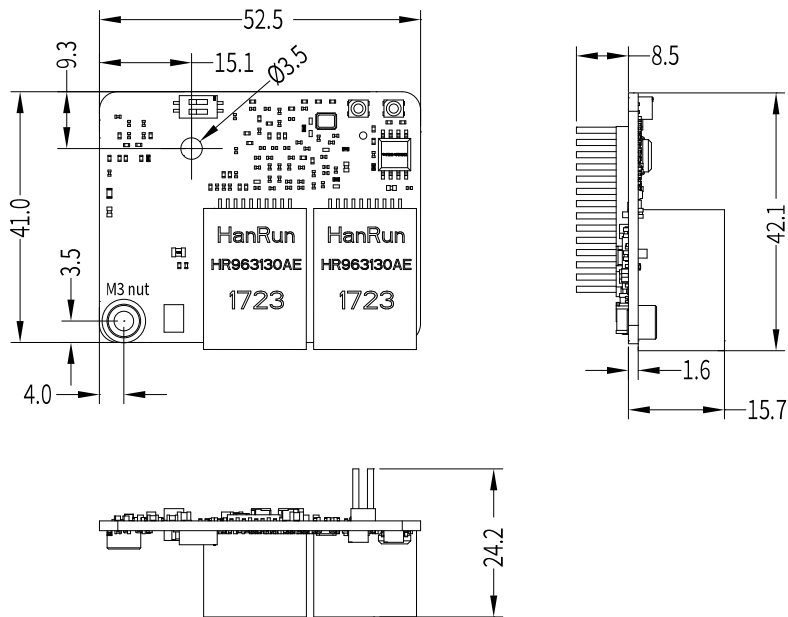


Figure 1-2 Dimensions of M500-EN1 card

1.4 Interface Layout and Description

The hardware layout of MD500-EN1 card is shown as ["Table 1-1 " on page 11](#) . The pin header J7 on the back of the MD500-PN1 card is used to connect the AC drive. The MD500-EN1 card provides two network ports J4 and J6 to communicate with the EtherNet/IP master (or other slave). For details about the hardware, see ["Table 1-1 " on page 11](#).

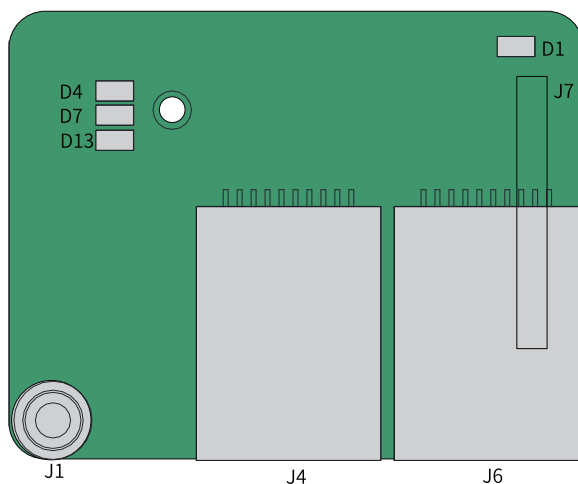


Figure 1-3 Interface layout of MD500-EN1 expansion card

Table 1-1 Interface description of MD500-EN1 expansion card

Symbol	Name	Function
J7	Pin header	Used to connect the AC drive.
J4	Network port	Standard Ethernet RJ45 type socket is used, direction insensitive. They are used for the connection between the MD500-EN1 and EtherNet/IP master station (or other slave stations). Their pin signal definitions are the same as those of the standard Ethernet pins. They can be connected using crossover cables or straight-through cables.
J6		
J1	EMC grounding terminal	Used to connect the EMC ground terminal of the AC drive.
D13	Power indicator (green)	Used to indicate the status of the power supply. ON: power-on normal OFF: power-on abnormal (Check whether the card is installed properly.)
D1	AC drive communication status indicator (green)	For details, see "Table 1-2 Description of indicators on the MD500-EN1" on page 12
D4	Ethernet/IP operation indicator (green)	
D7	Ethernet/IP fault indicator (red)	



Caution

- After the MD500-PN1 card is installed, J2 is on the left and J3 is on the right when facing the RJ45 interface. These two ports are direction-insensitive. You can connect either one to the near PLC end.
- The Cat5e shielded twisted pair network cable is recommended to ensure stability.

Table 1-2 Description of indicators on the MD500-EN1

Indicator	State description	Solution
D1 steady on in green	Normal	N/A
D1 steady off	Abnormal communication with the AC drive	Check whether FD-00 is 9 and whether FD-01 is 3.
D4 steady off, D7 steady on in red	System fault	Check the AC drive fault codes and the troubleshooting measures.
D4 steady off, D7 flashing in red	Waiting to obtain IP address	The expansion card is in DHCP mode and uses BOOTP and DHCP to assign IP addresses to the device.
D4 flashing in red, D7 flashing in red	Disconnected or connection timeout	Check whether the network cable is connected properly and whether the master station is in operation.
D4 flashing in green, D7 steady off	Waiting to connect to the master station	Confirm whether the network cable is connected normally and whether the master station is running.
D4 steady on in green, D7 steady off	Normal connection	N/A

2 Installation and Wiring

2.1 Installation

The MD500-EN1 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-EN1 card into the AC drive and fasten the screws to avoid damage caused by external signal cable tension on the signal socket between boards. *"Figure 2-1 " on page 13* shows the installation.

Note that the ground terminals of both the MD500-EN1 card and AC drive must be connected properly, as shown in *"Figure 2-2 Ground terminal connection between the MD500-EN1 card and AC drive" on page 14*.

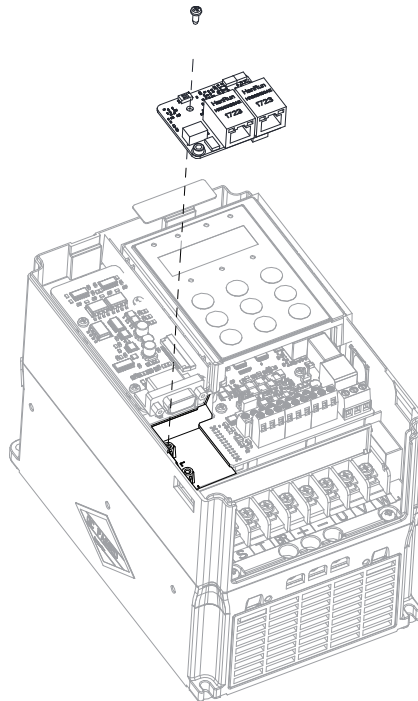


Figure 2-1 Installation of the MD500-EN1 card

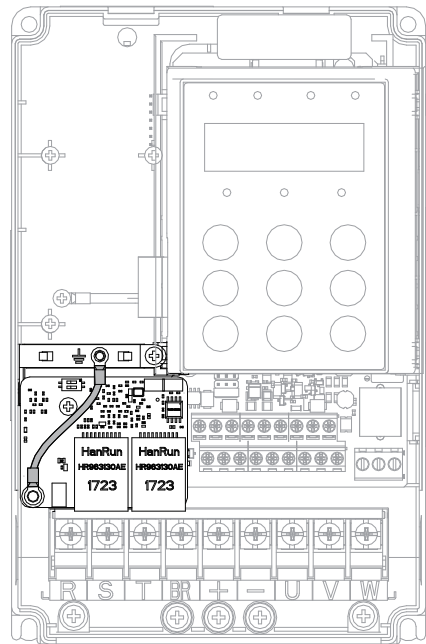


Figure 2-2 Ground terminal connection between the MD500-EN1 card and AC drive

2.2 Wiring

2.2.1 Topology

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

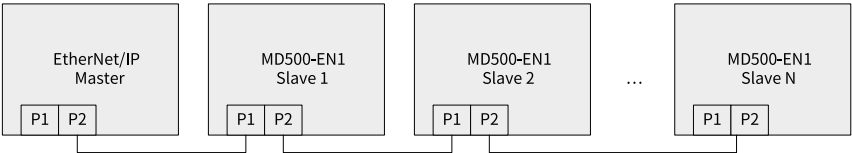


Figure 2-3 Bus topology

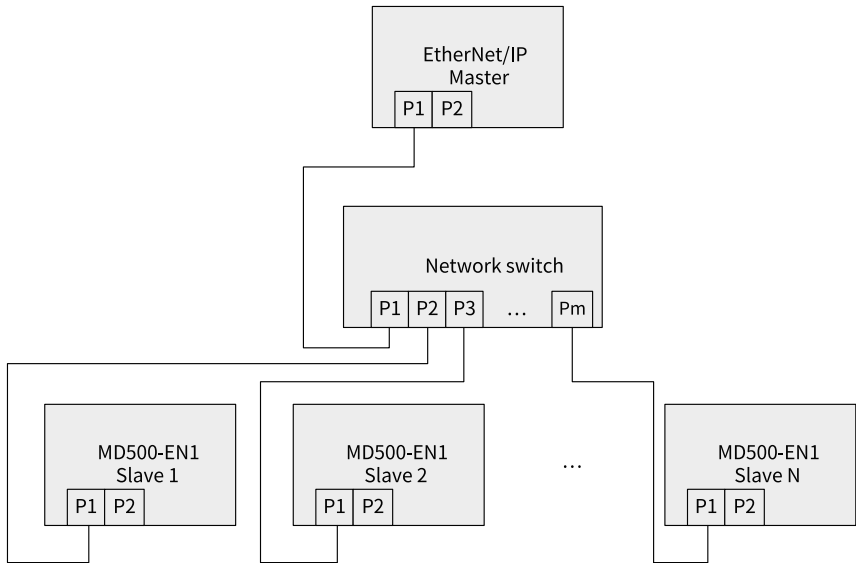


Figure 2-4 Star topology

2.2.2 EMC Routing Guide

- During on-site installation and commissioning, the communication signal cables and power cables must be laid in different ducts. Never bundle the communication signal cables and power cables together to prevent the communication interference.
- Motor housing must be connected to PE of the AC drive. Meanwhile, connect grounding cable of motor to motor housing reliably. Failure to comply will result in poor grounding effect.
- It is recommended to use the shielded cable. The shield must be connected to the PE terminal of the AC drive.

3 Ethernet/IP Communication Protocol

3.1 I/O Messages

The MD500-EN1 expansion card supports 24 I/O messages for data transmission, of which 12 are master-to-slave messages and 12 are slave-to-master messages.

The I/O messages enable the master to modify and read AC drive data in real time and perform periodic data exchange. The data communication addresses are directly configured by the AC drive. The specific functions are as follows:

- Setting the AC drive control command and target frequency in real time
- Reading the current state and running frequency of the AC drive in real time
- Exchanging function parameter and monitoring parameter data between the AC drive and EtherNet/IP master in real time

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

I/O Messages (O->T) Sent by Master		
AC Drive Command	AC Drive Target Frequency	AC Drive Parameters Modified in Real Time
Output I/O Messages[0]	Output I/O Messages[1]	Output I/O Messages[2–11]
I/O Messages (T->T) Returned by AC Drive		
AC Drive State	AC Drive Running Frequency	AC Drive Parameters Read in Real Time
Input I/O Messages[0]	Input I/O Messages[1]	Input I/O Messages[2–11]

3.2 Data Sent by the Master

The following table describes the data sent by the master.

I/O Message Data Sent by the Master		
I/O Messages 0	AC drive command word (command source set to communication)	
	00: Stop according to the stop mode defined by F6-10 01: Run in forward direction 02: Run in reverse direction 03: Jog in forward direction	04: Jog in reverse direction 05: Coast to stop 06: Stop according to the stop mode defined by F6-10 07: Reset upon fault
I/O Messages 1	AC drive target frequency (frequency reference source set to communication), which ranges from the 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 reference target frequency exceeds this range, the AC drive runs at the frequency upper limit.	
I/O Messages 2 to I/O Messages 11	Function parameter values (group F and group A) modified in real time, not written into EEPROM. FE-02 to FE-11 correspond to I/O Messages 2 to I/O Messages 11. For details about the configuration, see the I/O message data configuration.	

3.3 Data Returned by the AC Drive

The following table describes the data returned by the AC drive.

I/O Message Data Returned by the AC Drive	
I/O Messages 0	AC drive running state, which is described as follows by bit: Bit0: 0: Stopped; 1: Running Bit1: 0: Running in forward direction; 1: Running in reverse direction Bit2: 0: Not faulty; 1: Faulty Bit3: 0: Running frequency not reached; 1: Running frequency reached Bit4 to Bit7: Reserved Bit8 to bit15: AC drive fault code
I/O Messages 1	AC drive running frequency (unit: 0.01 Hz) The current AC drive running frequency is returned as 16-bit signed data.
I/O Messages 2 to I/O Messages 11	Function parameter values (group F and group A) and monitoring parameter values (group U) read in real time. FE-22 to FE-31 correspond to I/O Messages 2 to I/O Messages 11. For details about the configuration, see the I/O message data configuration.

4 Parameters Related to Communication

4.1 Communication Card Type Setting for the AC Drive

After the AC drive is powered on, set the parameter FD-00=9 (with a baud rate of 115200 bps) and FD-01=3 (no check 8-N-1) to enable communication between the MD500-EN1 card and the AC drive.

Parameter No.	Parameter Name	Setting Range	Value	Description
FD-00	Baud rate	0:300BPS 1:600BPS 2:1200BPS 3:2400BPS 4:4800BPS 5:9600BPS 6:19200BPS 7:38400BPS 8:57600BPS 9:115200BPS	9	Define the speed of data transmission between the communication expansion card and the AC drive.
FD-01	Modbus data format	0: No check (8-N-2) 1: Even parity check (8-E-1) 2: Odd parity check (8-O-1) 3: No check (8-N-1)	3	Define the format of Modbus data transmitted between the communication expansion card and the AC drive.

4.2 MD500-EN1 Card IP Address Configuration

The following table describes the communication card configuration parameters of the AC drive.

Parameter No.	Parameter Name	Value Range	Description
FD-37	DHCP function	0: Disabled 1: Enabled	Defines the DHCP function of the EtherNet/IP expansion card. After the DHCP function is enabled, the following IP address configuration parameters are invalid.
FD-38 to FD-41	Expansion card IP address	0–255	Defines the IP address of the EtherNet/IP expansion card.
FD-42 to FD-45	Expansion card subnet mask	0–255	Defines the subnet mask of the EtherNet/IP expansion card.
FD-46 to FD-49	Expansion card gateway address	0–255	Defines the gateway address of the EtherNet/IP expansion card.

The IP address can be a static IP address or DHCP dynamic IP address. The IP mode is defined by FD-37. The static IP address is set by FD-37 to FD-39. For example, if the static IP address is 192.168.0.6, the subnet mask is 255.255.255.0, and the gateway is 192.168.0.1, set as follows:

Parameter	Function	Setpoint
FD-37	DHCP function	0
FD-38	Most significant byte of the IP address	192
FD-39	Second most significant byte of the IP address	168
FD-40	Third byte of the IP address	0
FD-41	Least significant byte of the IP address	6
FD-42	Most significant byte of the subnet mask	255
FD-43	Second most significant byte of the subnet mask	255
FD-44	Third byte of the subnet mask	255
FD-45	Least significant byte of the subnet mask	0

Parameter	Function	Setpoint
FD-46	Most significant byte of the gateway	192
FD-47	Second most significant byte of the gateway	168
FD-48	Third byte of the gateway	0
FD-49	Least significant byte of the gateway	1

When the DHCP or BOOTP function is used, the MAC address of the expansion card is required. You can obtain the MAC address by checking the label on the expansion card, or viewing the related parameter of the AC drive.

The MD500-EN1 expansion card also supports the IP address conflict detection function. When the IP address of this card is the same as that of another device in the network, the red indicator D7 becomes steady on, and bit2 of FD-58 changes to 1.

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

No.	Scenario	Symptom	Solution
1	Both devices support IP address conflict detection. The two devices are powered on at different time.	The device powered on first keeps the IP address and continues to run, and the other device enters conflict mode.	Check device IP addresses and change duplicate addresses.
2	Both devices support IP address conflict detection. The two devices are powered on at almost the same time.	Both devices enter IP address conflict mode.	
3	One device supports IP address conflict detection while the other does not.	The device that does not support IP address conflict detection occupies the IP address no matter whether it is powered on first. The device that supports IP address conflict detection enters conflict mode.	

Note

- The expansion card implements active conflict detection upon power-on and DHCP IP address assignment, and it implements passive detection at other times. If the same dynamic (static) IP address is separately assigned to two devices, which are then connected to a network, neither of the two expansion cards will report an IP address conflict.
- IP address assignment by using the DHCP function will fail if an assignment conflict occurs during the process.

4.3 Parameters Related to AC Drive Communication Card

Parameter No.	Parameter Name	Unit	Description
FD-61	First two bytes of the expansion card MAC address	1	MAC address of the expansion card
FD-62	Middle two bytes of the expansion card MAC address	1	MAC address of the expansion card
FD-63	Last two bytes of the expansion card MAC address	1	MAC address of the expansion card
FD-58	Expansion card error code	1	Error code of the expansion card

4.4 Communication Control Parameters

Parameter No.	Parameter Name	Value Range		Decimal Address
U3-16	Frequency reference	–Maximum frequency to +Maximum frequency 0.01 Hz		29456
U3-17	Control command	0000: Stop according to the stop mode defined by F6-10 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	29457

Parameter No.	Parameter Name	Value Range	Decimal Address
U3-18	DO control	Bit0: DO1 output control Bit1: DO2 output control Bit2: Relay 1 output control Bit3: Relay 2 output control	29458
U3-19	AO1 control	0 to 7FFF, indicating 0% to 100%	29459
U3-20	AO2 control	0 to 7FFF, indicating 0% to 100%	29460
U3-21	FMP control	0 to 7FFF, indicating 0% to 100%	29461
U3-22	Reserved	Reserved	
U3-23	Speed control	Signed data, 1 RPM	29463

When the MD500-EN1 expansion card is used, the written I/O Messages 0 and I/O Messages 1 are mapped to U3-17 and U3-16 respectively by default. If a command or frequency fails to be written into the AC drive but I/O Messages 2 to I/O Messages 11 can be written and F0-02 and F0-03 are set to 2 and 9 respectively, check whether FE-00 and FE-01 are set to U3-17 and U3-16 respectively. If not, manually correct the values of FE-00 and FE-01.

4.5 Parameters Related to Communication Monitoring

Parameter No.	Parameter Name	Unit	Decimal Address
U0-00	Running frequency (Hz)	0.01 Hz	28672
U0-01	Frequency reference (Hz)	0.01 Hz	28673
U0-02	Bus voltage (V)	0.1 V	28674
U0-03	Output voltage (V)	1 V	28675
U0-04	Output current (A)	0.01 A	28676
U0-05	Output power (kW)	0.1 kW	28677
U0-06	Output torque (%)	0.10%	28678
U0-07	DI state	1	28679
U0-08	DO state	1	28680
U0-09	AI1 voltage (V)	0.01 V	28681
U0-10	AI2 voltage (V)	0.01 V	28682
U0-11	AI3 voltage (V)	0.01 V	28683
U0-12	Count value	1	28684
U0-13	Length value	1	28685
U0-14	Load speed display	0.001 Hz	28686
U0-15	PID setting	1	28687
U0-16	PID feedback	1	2868800.00%
U0-17	PLC phase	1	28689

Parameter No.	Parameter Name	Unit	Decimal Address
U0-18	Pulse input reference (Hz)	0.01 kHz	28690
U0-19	Feedback speed (Hz)	0.01 Hz	28691
U0-20	Remaining running time	0.1Min	28692
U0-21	AI1 voltage before calibration	0.001 V	28693
U0-22	AI2 voltage before calibration	0.001 V	28694
U0-23	Uncalibrated AI3 voltage	0.001 V	2869500.00%
U0-24	Linear speed	1 m/min	28696
U0-25	Current power-on time	1 min	28697
U0-26	Current running time	0.1 min	28698
U0-27	PULSE input pulse frequency	1 Hz	28699
U0-28	Communication setting value	0.01%	28700
U0-29	Encoder feedback speed	0.01 Hz	28701
U0-30	Main frequency X display	0.01 Hz	28702
U0-31	Auxiliary frequency Y display	0.01 Hz	28703
U0-32	Any memory address	1	28704
U0-33	Synchronous motor rotor position	0.1°	28705
U0-34	Motor temperature	1°C	28706
U0-35	Target torque (%)	0.10%	2870700.00%
U0-36	Resolver position	1	2870800.00%
U0-37	Power factor angle	0.1°	28709
U0-38	ABZ position	1	28710
U0-39	Target voltage upon V/F separation	1 V	28711
U0-40	Output voltage upon V/F separation	1 V	28712
U0-41	DI state visual display	1	28713
U0-42	DO state visual display	1	28714

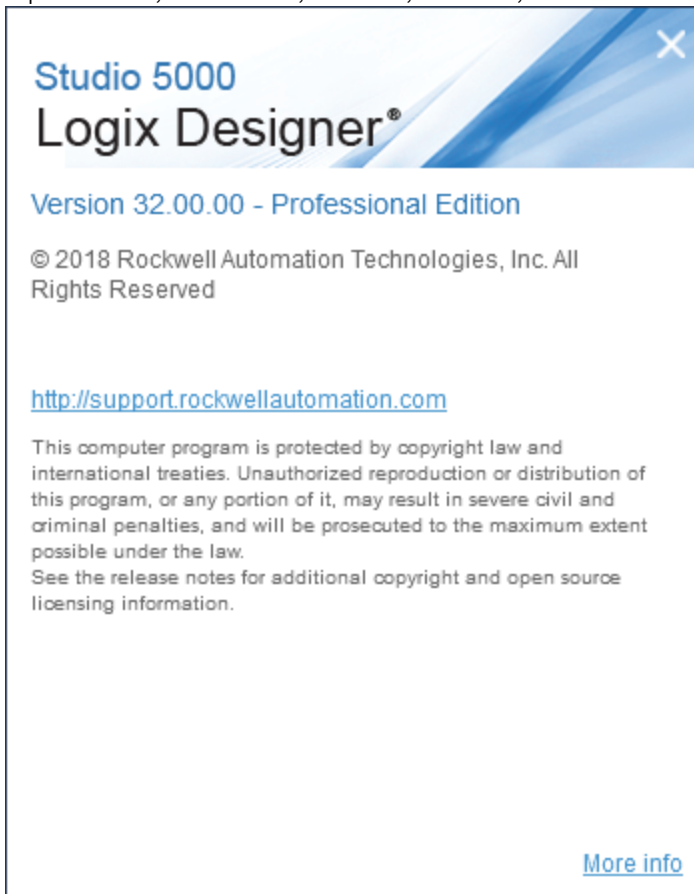
Parameter No.	Parameter Name	Unit	Decimal Address
U0-43	DI state visual display 1	1	28715
U0-44	DI state visual display 2	1	28716
U0-45	Fault Information	1	28717
U0-58	Z signal counting	1	28730
U0-59	Rated frequency (%)	0.01%	28731
U0-60	Running frequency	0.01%	28732
U0-61	AC drive state	1	28733
U0-62	Current fault code	1	28734
U0-63	Running frequency after droop control	0.01 Hz	38375
U0-64	Current back EMF	0.1 V	28736
U0-65	Reserved	-	-
U0-66	Expansion card model	100: CANopen 200: Profibus-DP 300: CANlink 400: Profinet 500: EtherCAT 600: Ethernet/IP	28738
U0-67	Expansion card version	0.01	28739
U0-68	AC drive state	1	28740
U0-69	Running frequency (Hz)	0.01 Hz	28741
U0-70	Motor speed	1 rpm	28742
U0-71	Output current	0.1 A	28743

By default, when the MD500-EN1 card is used, the read I/O Messages0 and I/O Messages1 are mapped to U0-68 and U0-69 respectively. If any state or running frequency cannot be read correctly but I/O Messages2 to I/O Messages11 can be read, check whether FE-20 and FE-21 are set to U0-68 and U0-69 respectively. If not, manually correct them to correct values.

5 Communication Instance

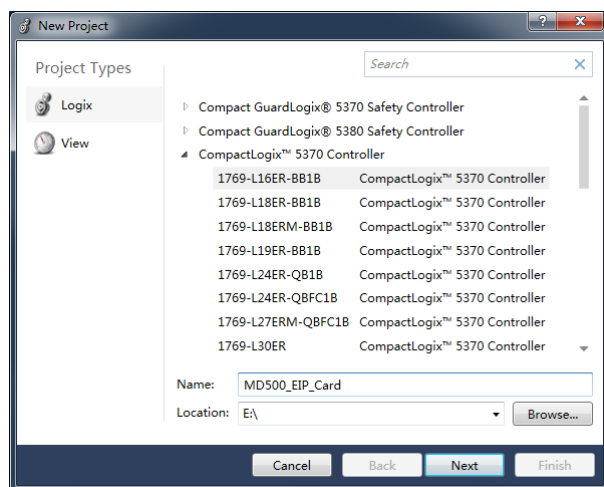
5.1 Using an MD500-EN1 Expansion Card on an Allen-Bradley L16ER Master

In this example, Studio5000 version 32.00.00 is used, the master is 1769-L16ER-BB1B, and the IP address and other information have been configured in advance according to the guide. Both network ports on the expansion card are available. To use the expansion card, set F0-02 to 2, F0-03 to 9, FD-00 to 9, and FD-01 to 3 on the AC drive.



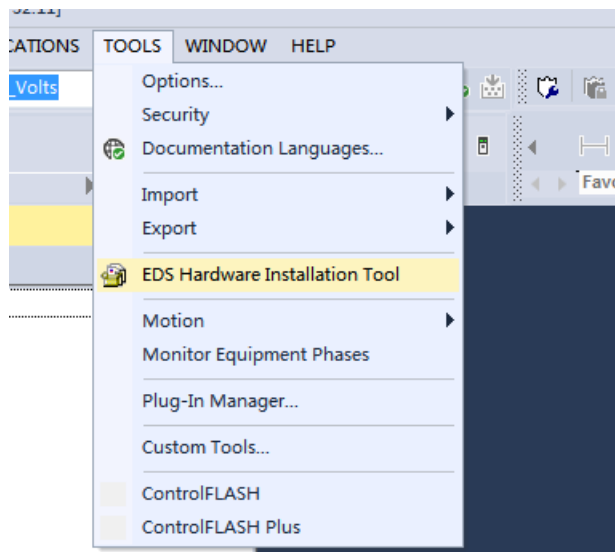
Step 1: Create a project.

Open Studio 5000 and create a project. Select **1769-L16ER-BB1B** under **CompactLogix 5370 Controller** as the controller model.

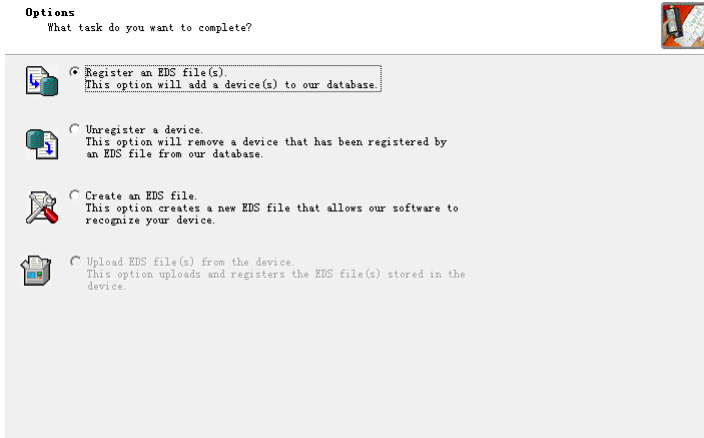


Step 2: Import the EDS file.

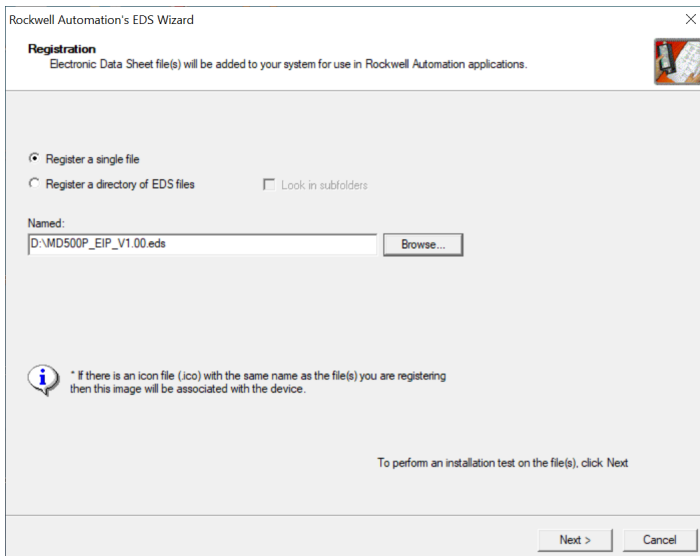
Choose **Tools > EDS Hardware Installation Tool**.



Click **Next**, and select **Register an EDS file(s)**.



Select the EDS file in your computer and click **Next**.



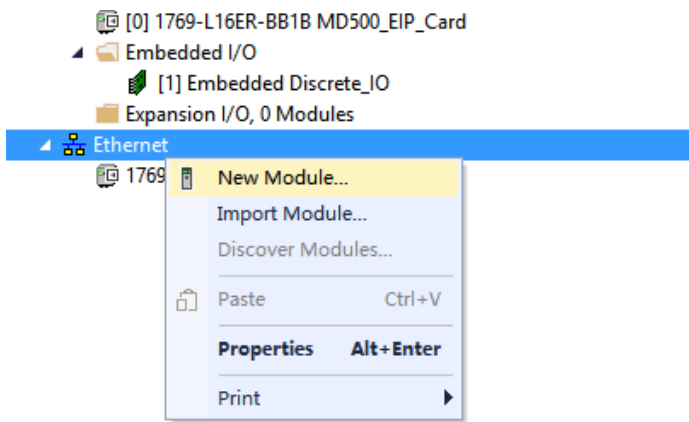
Then keep clicking **Next** until the **Finish** button appears, click **Finish**.

Step 3: Set the IP address for the expansion card. Take a static IP address as an example.

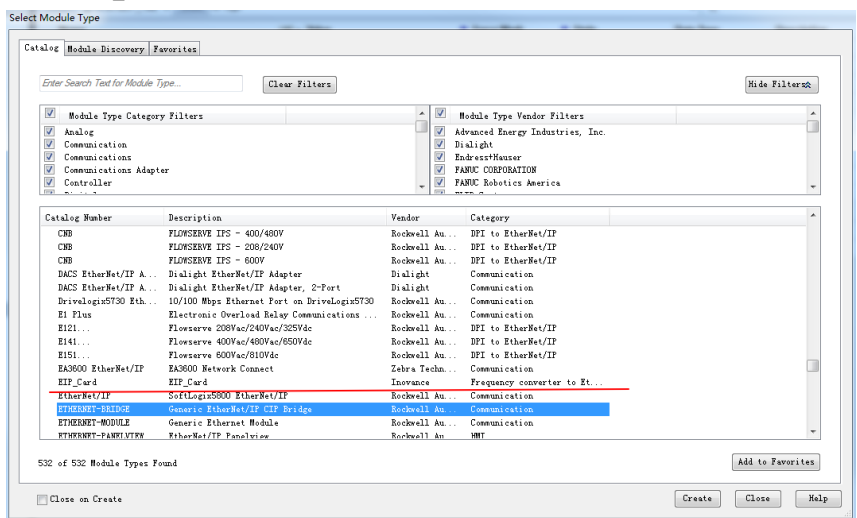
Set the AC drive parameters FD-37 to FD-49 to disable the DHCP function, set the IP address to 192.168.0.6, set the subnet mask to 255.255.255.0, and set the gateway address to 192.168.0.1.

Step 4: Configure the Studio 5000 project.

Click **Ethernet** on the left and choose **New Module**.



Locate **EIP_Card** and click **Create**.



On the displayed configuration interface, enter the configured IP address and specify the name.

General

Type: MD500_EtherNetIP_Card MD500_EtherNetIP_Card

Vendor: Inovance

Parent: Local

Name: MD500

Description:

Ethernet Address

☐ Private Network: 192.168.1.

☒ IP Address: 192.168.0.6

☐ Host Name:

Module Definition

Revision: 1.001

Electronic Keying: Compatible Module

Connections: RT Connection Point

Change...

Status: Offline

OK Cancel Apply Help

Click **Change**, select **INT** from the **SINT** drop-down list on the right, click **OK**, ignore the warning and click **Yes**.

Module Definition*

Revision: 1 001

Electronic Keying: Compatible Module

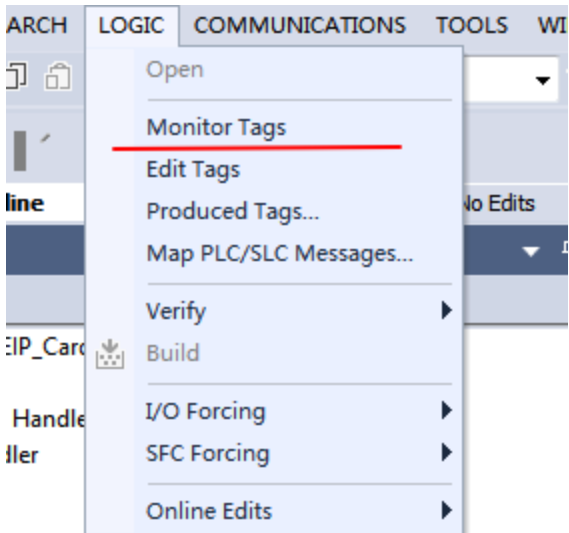
Connections:

Name	Input:	Size
RT Connection Point	24	SINT
	Output: 24	

SINT
INT
DINT
REAL

OK Cancel Help

Choose **LOGIC > Monitor Tags**.



Unfold **MD500:C.Data**, and select **Hex** in the **Style** column.

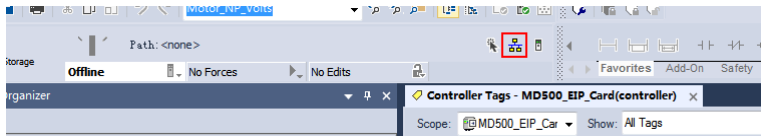
Name	Value	Force Mask	Style	Data Type	Description
Local:1:C		(...)	(...)	AB:Embedded_Disc...	
Local:1:I		(...)	(...)	AB:Embedded_Disc...	
Local:1:O		(...)	(...)	AB:Embedded_Disc...	
MD500:C		(...)	(...)	30099MD500_etherN...	
MD500:C.Data		(...)	Hex	SINT[48]	
MD500:C.Data[0]	16#44		Hex	SINT	
MD500:C.Data[1]	16#70		Hex	SINT	
MD500:C.Data[2]	16#45		Hex	SINT	
MD500:C.Data[3]	16#70		Hex	SINT	
MD500:C.Data[4]	16#00		Hex	SINT	
MD500:C.Data[5]	16#00		Hex	SINT	
MD500:C.Data[6]	16#00		Hex	SINT	
MD500:C.Data[7]	16#00		Hex	SINT	
MD500:C.Data[8]	16#00		Hex	SINT	
MD500:C.Data[9]	16#00		Hex	SINT	
MD500:C.Data[10]	16#00		Hex	SINT	
MD500:C.Data[11]	16#00		Hex	SINT	
MD500:C.Data[12]	16#00		Hex	SINT	

The parameters under **MD500:C.Data** are related to PDO mapping. Every two parameters form a group. 0–23 are I/O Messages Mapping(T->O), and 24–27 are I/O Messages Mapping(O->T). As shown in the figure, Data[0] is 0x44, and Data[1] is 0x70, indicating that TPDO1 is mapped to U0-68.

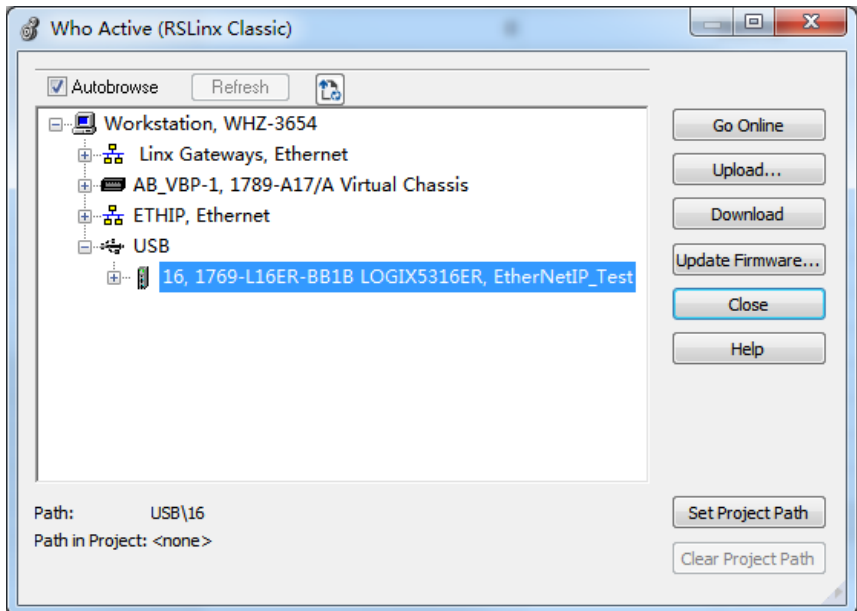
By default, I/O Messages Mapping(T->O)[0] is U0-68, I/O Messages Mapping(T->O)[1] is U0-69, I/O Messages Mapping(O->T)[0] is U3-17, and I/O Messages Mapping(O->T)[1] is U3-16. These four entries cannot be modified. Otherwise, a fault will occur. Other entries can be customized.

MD500:I.Data and MD500:O.Data are I/O data during transmission. Values written to O.Data are actually written into the corresponding parameters according to the configured mapping. The parameter configured in I/O Messages Mapping(T->O)[0] is uploaded to I.Data regularly.

After the configuration is complete, click the button marked with the red square in the figure below to search for the device.

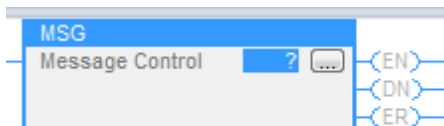


In this example, USB is used to connect the device. Select the device and click **Download** to download the code to the PLC.

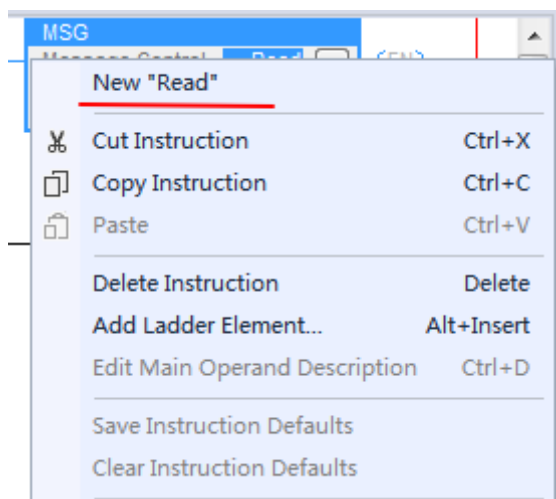


Step 5: Transmit data using explicit messages.

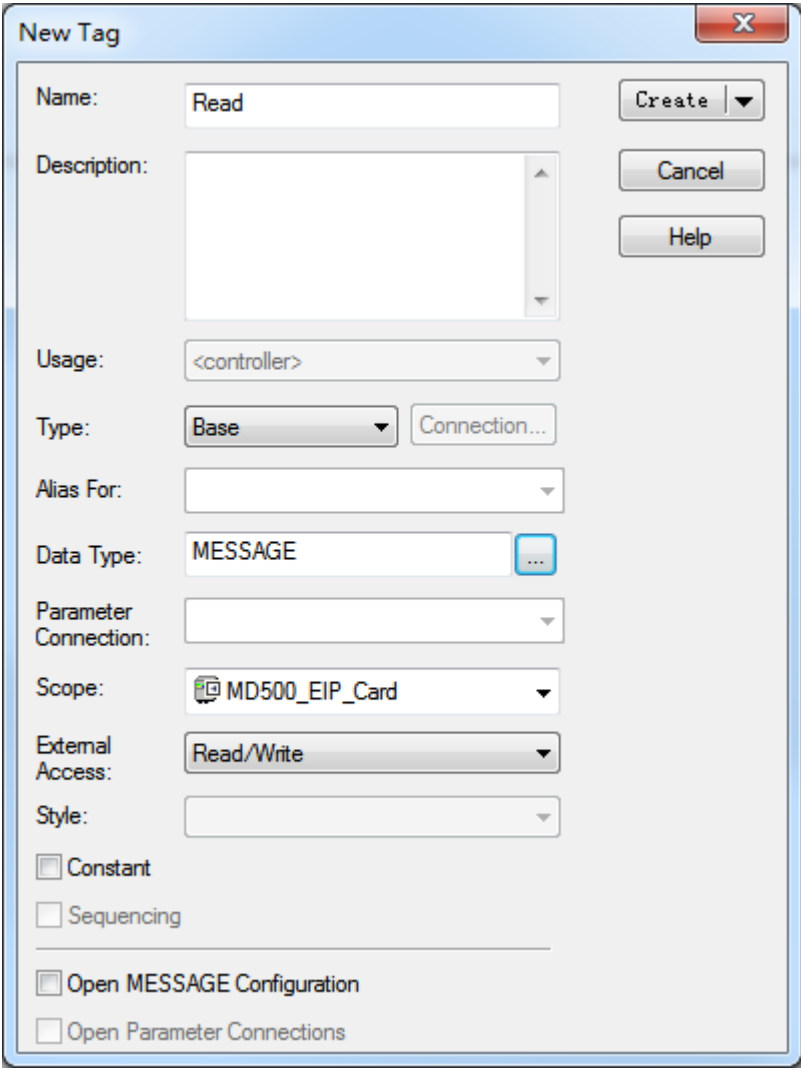
Open the program compiling part in the PLC, and click **MSG** under **Input/Output**.



Enter a name at the question mark (?), right-click the name, and choose **New "Read"**.



Click **Create**.

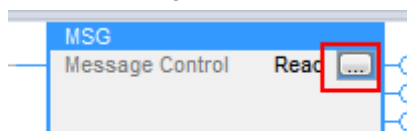


The 'New Tag' dialog box is shown with the following fields and options:

- Name:** Read
- Description:** (Empty text area)
- Usage:** <controller>
- Type:** Base (dropdown menu)
- Alias For:** (Empty dropdown menu)
- Data Type:** MESSAGE (dropdown menu)
- Parameter Connection:** (Empty dropdown menu)
- Scope:** MD500_EIP_Card (dropdown menu)
- External Access:** Read/Write (dropdown menu)
- Style:** (Empty dropdown menu)
- ☐ Constant
- ☐ Sequencing
- ☐ Open MESSAGE Configuration
- ☐ Open Parameter Connections

Buttons on the right: Create, Cancel, Help.

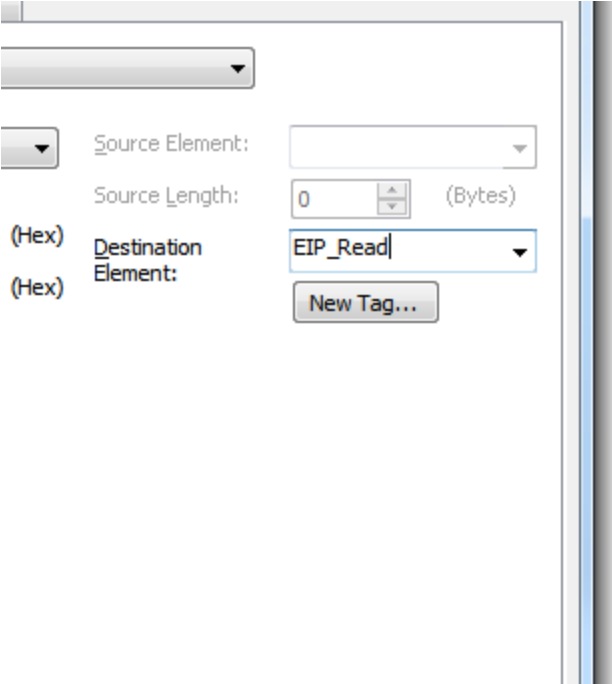
Click ... on the right under **MSG**.



Set the parameters according to the following figure.

Set **Service Type** to **Get Attribute Single** for reading parameters or **Set Attribute Single** for writing to parameters. **Class** is fixed to 0x93, **Attribute** is fixed to 0x9, and **Instance** is the decimal value converted from the parameter to be read. For example, FD-13, that is, FD0D, needs to be converted to the decimal value 64781, as shown in the preceding figure.

Select a position for storing the parameter from the **Destination Element** drop-down list on the right. You can also click **New Tag** to create a variable.



Click the **Communication** tab to select the AC drive.

Click **OK**. The master will read the parameter and store the data to the selected variable. You can choose **LOGIC > Monitor Tags** to view the value of the variable.

▶ MD500:I		{...}	{...}	_3039:MD500_EtherN...
▶ MD500:O		{...}	{...}	_3039:MD500_EtherN...
▶ Read		{...}	{...}	MESSAGE
▶ EIP_Read		1	Decimal	DINT
key		0	Decimal	BOOL

To write to a parameter, set the parameters according to the following figure.

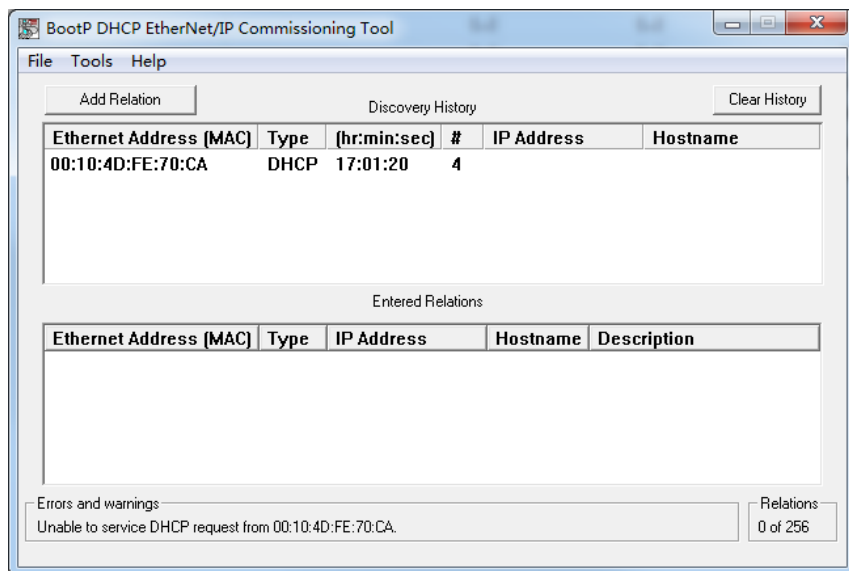
Step 6: Set the DHCP function.

Note: IP addresses assigned by using the DHCP function are not retained upon power failure.

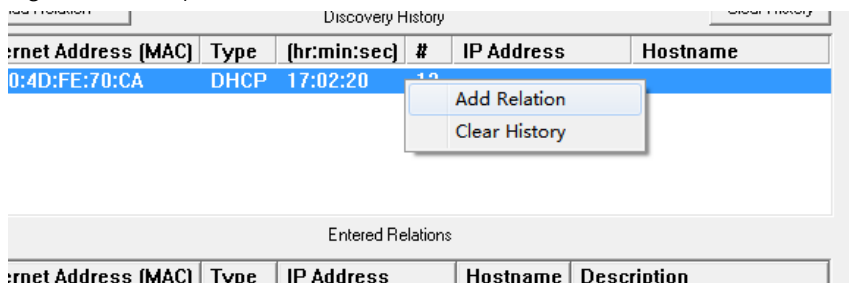
Set FD-37 to 1 to enable the DHCP function, power on the AC drive again, and connect the PC and AC drive to the same network.

Choose **BootP-DHCP Tool** from the start menu, and select the network adapter.

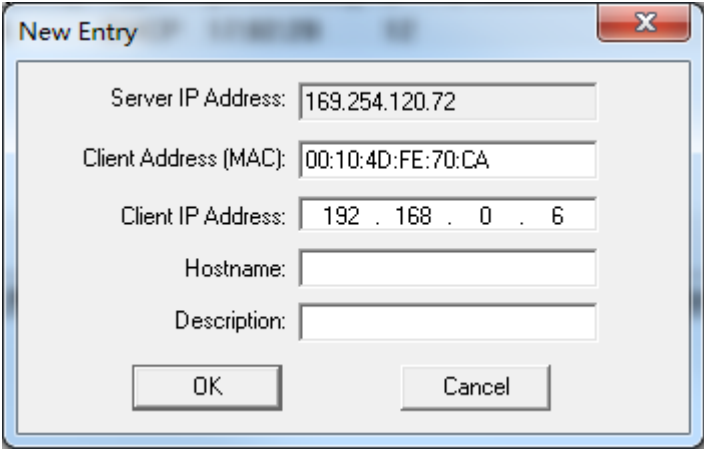
After power-on, you can find the device request in the BootP DHCP EtherNet/IP Commissioning Tool.



Right-click the request and choose **Add Relation**.

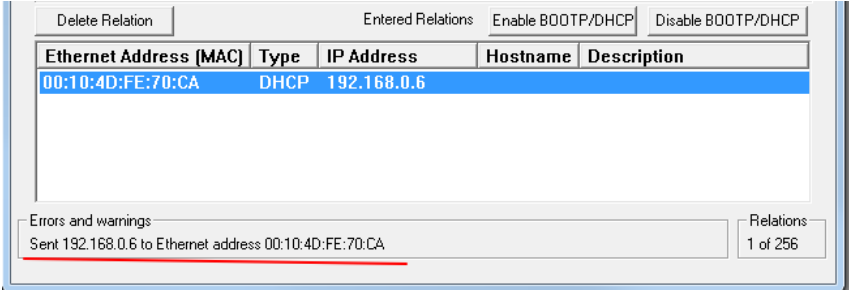


Set the IP address and click **OK**.



A dialog box titled "New Entry" with a close button (X) in the top right corner. It contains five input fields: "Server IP Address" with the value "169.254.120.72", "Client Address (MAC)" with the value "00:10:4D:FE:70:CA", "Client IP Address" with the value "192 . 168 . 0 . 6", "Hostname" which is empty, and "Description" which is empty. At the bottom are "OK" and "Cancel" buttons.

The IP address is written to the device.



The main configuration window shows a table of "Entered Relations". The table has columns: Ethernet Address (MAC), Type, IP Address, Hostname, and Description. One entry is listed: MAC "00:10:4D:FE:70:CA", Type "DHCP", IP Address "192.168.0.6". Above the table are buttons: "Delete Relation", "Entered Relations", "Enable BOOTP/DHCP", and "Disable BOOTP/DHCP". Below the table is an "Errors and warnings" section with the message "Sent 192.168.0.6 to Ethernet address 00:10:4D:FE:70:CA" and a "Relations" section showing "1 of 256".

Ethernet Address (MAC)	Type	IP Address	Hostname	Description
00:10:4D:FE:70:CA	DHCP	192.168.0.6		

5.2 Using an MD500-EN1 Expansion Card on an Inovance AM600 Master

In this example, InoProShop V1.5.2 is used, the master is AM600, and the IP address and other information have been configured in advance according to the guide. You can use either network port on the expansion card. To use the expansion card, set F0-02 to 2, F0-03 to 9, FD-00 to 9, and FD-01 to 3 on the AC drive.



Step 1: Create a project.

Open InoProShop and create a project. Select the device model AM600-CPU1608TP/TN.

Step 2: Import the EDS file and add a slave.

Click **Network Configuration** on the left, click the PLC, select **EtherNet/IP Master**, and click **Import EDS File** to import the EDS file for the EtherNet/IP expansion card. Import the device in the **Network Device List** on the right.

Step 3: Configure parameters for the slave.

Configure an IP address for the slave.

Click **Connections** on the left to configure the implicit message mapping. **Input I/O Messages Mapping(T->O)[x]** is the mapping of data sent from the slave to the master, and **Output I/O Messages Mapping (O->T)[x]** is the mapping of data sent from the master to the slave. Each entry can be configured with up to 12 mappings. By default, **Input I/O Messages Mapping(T->O)[0]** is mapped to U0-68 (28740 in decimal), **Input I/O Messages Mapping(T->O)[1]** is mapped to U0-69 (28741 in decimal); **Output I/O Messages Mapping(O->T)[0]** is mapped to U3-17 (29457 in decimal), and **Output I/O Messages Mapping(O->T)[1]** is mapped to U3-16 (29456 in decimal). Do not change these four default mappings. Other mappings are set to F0-00 (61440 in decimal) by default. You can modify the mappings as required here.

Convert the parameter address into a decimal value and enter the value. For example, for F0-12, enter 61452. Retain the default values for unneeded mappings.

Step 4: Configure the IP address for the master.

Scan the network for the master to be configured.

Assign an IP address to the network port of the master.

Download the project to the PLC.

You can view the I/O Messages(O->T) and I/O Messages(T->O) data based on the EtherNet/IP I/O mapping.

6 Troubleshooting

6.1 Troubleshooting

The following table describes the faults that may occur during use of the MD500-EN1 card and the AC drive.

Table 6–1 Fault analysis and solutions

Symptom	Possible Cause	Solution
Communication failure between the MD500-EN1 card and AC drive	1. The AC drive does not support EtherNet/IP communication. 2. The communication configuration of the MD500-EN1 card is incorrect. 3. The MD500-EN1 card hardware is faulty.	1. Check that the AC drive supports EtherNet/IP communication. 2. Set the MD500-EN1 communication parameters correctly. 3. Replace the MD500-EN1 card.
Err164 communication error reported by the AC drive during running	1. The communication data is abnormal. 2. The network cable is damaged or connected incorrectly. 3. External interference exists.	1. Check that the EtherNet/IP master program is normal. 2. Check that the network cable is connected properly, and replace the cable if necessary. 3. Use the Cat5e shielded twisted pair network cable as required. Check that the MD500-EN1 card is grounded correctly. Eliminate the external interference. Contact the technical support personnel if necessary.

A fault code is an 8-bit binary integer, of which each bit indicates a different fault. To obtain the fault code, read the value of FD-58 of the AC drive, and convert it into an 8-bit binary number. For example, if the read value of FD-58 is 3, its binary equivalent is 0000 0011, then the fault code is bit 0 and bit 1. The following table describes the corresponding fault description and troubleshooting.

Note: A fault code may be a combination of multiple faults.

Fault Code	Description	Solution
Bit7	None	None
Bit6	Communication with the AC drive fails, or the AC drive version is incorrect.	Upgrade the AC drive software to the version that supports EtherNet/IP.

Fault Code	Description	Solution
Bit5	The I/O Messages mapping configuration is incorrect.	Check the PLC configurations.
Bit4	Connection times out.	Check the connections and whether the master is running properly.
Bit3	Link loss occurs.	Check the wiring.
Bit2	An IP conflict occurs.	Check whether there is another device with the same IP address as this device.
Bit1	The MAC address is lost or not programmed.	Contact Inovance for technical support.
Bit0	An Ethernet hardware error occurs.	Contact Inovance for technical support.

If the fault code is 0, the green indicator D4 is steady off, and the red indicator D7 is steady on, the troubleshooting is the same as that of bit6.



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