



User Guide

MD500-EN1 Communication

Expansion Card

Preface

■ Introduction

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

This user guide describes the specifications, dimensions, installation, wiring, communication protocols, communication-related parameters, and communication examples of the MD500-EN1 expansion card.

■ Revision history

| Date | Version | Revision |
|-------------|---------|-----------------|
| August 2021 | A00 | ◆ First release |

■ Document acquisition

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Safety Instructions

Safety Precautions

- 1) Before installing, using, and maintaining this equipment, read the safety information and precautions thoroughly, and comply with them during operations.
- 2) To ensure the safety of humans and equipment, follow the signs on the equipment and all the safety instructions in this user guide.
- 3) "CAUTION", "WARNING", and "DANGER" items in the manual do not indicate all safety precautions that need to be followed; instead, they just supplement the safety precautions.
- 4) Use this equipment according to the designated environment requirements. Damage caused by improper usage is not covered by warranty.
- 5) Inovance shall take no responsibility for any personal injuries or property damage caused by improper usage.

Safety Levels and Definitions



DANGER

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



WARNING

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



CAUTION

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

Safety Instructions

Unpacking



CAUTION

- ◆ Check whether the packing is intact and whether there is damage, water seepage, damp, and deformation.
- ◆ Unpack the package by following the package sequence. Do not hit the package with force.
- ◆ Check whether there are damage, rust, or injuries on the surface of the equipment or equipment accessories.
- ◆ Check whether the number of packing materials is consistent with the packing list.



- ◆ Do not install the equipment if you find damage, rust, or indications of use on the equipment or accessories.
- ◆ Do not install the equipment if you find water seepage, component missing or damage upon unpacking.
- ◆ Do not install the equipment if you find the packing list does not conform to the equipment you received.

Storage and Transportation



- ◆ Store and transport this equipment based on the storage and transportation requirements for humidity and temperature.
- ◆ Avoid transporting the equipment in environments such as water splashing, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- ◆ Avoid storing this equipment for more than three months. Long-term storage requires stricter protection and necessary inspections.
- ◆ Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation.
- ◆ Never transport this equipment with other equipment or materials that may harm or have negative impacts on this equipment.



- ◆ Use professional loading and unloading equipment to carry large-scale or heavy equipment.
- ◆ When carrying this equipment with bare hands, hold the equipment casing firmly with care to prevent parts falling. Failure to comply may result in personal injuries.
- ◆ Handle the equipment with care during transportation and mind your step to prevent personal injuries or equipment damage.
- ◆ Never stand or stay below the equipment when the equipment is lifted by hoisting equipment.

Installation



- ◆ Thoroughly read the safety instructions and user guide before installation.
- ◆ Do not modify this equipment.
- ◆ Do not rotate the equipment components or loosen fixed bolts (especially those marked in red) on equipment components.
- ◆ Do not install this equipment in places with strong electric or magnetic fields.
- ◆ When this equipment is installed in a cabinet or final equipment, protection measures such as a fireproof enclosure, electrical enclosure, or mechanical enclosure must be provided. The IP rating must meet IEC standards and local laws and regulations.

**DANGER**

- ◆ Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed by only professionals.
- ◆ Installation, wiring, maintenance, inspection, or parts replacement must be performed by only experienced personnel who have been trained with necessary electrical information.
- ◆ Installation personnel must be familiar with equipment installation requirements and relevant technical materials.
- ◆ Before installing equipment with strong electromagnetic interference, such as a transformer, install an electromagnetic shielding device for this equipment to prevent malfunctions.

Wiring

**DANGER**

- ◆ Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed by only professionals.
- ◆ Never perform wiring at power-on. Failure to comply will result in an electric shock.
- ◆ Before wiring, cut off all equipment power supplies. Wait at least 10 minutes before further operations because residual voltage exists after power-off.
- ◆ Make sure that the equipment is well grounded. Failure to comply will result in an electric shock.
- ◆ During wiring, follow the proper electrostatic discharge (ESD) procedures, and wear an antistatic wrist strap. Failure to comply will result in damage to internal equipment circuits.

**WARNING**

- ◆ Never connect the power cable to output terminals of the equipment. Failure to comply may cause equipment damage or even a fire.
- ◆ When connecting a drive with the motor, make sure that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- ◆ Wiring cables must meet diameter and shielding requirements. The shielding layer of the shielded cable must be reliably grounded at one end.
- ◆ After wiring, make sure that no screws are fallen and cables are exposed in the equipment.

Power-on

 DANGER

- ◆ Before power-on, make sure that the equipment is installed properly with reliable wiring and the motor can be restarted.
- ◆ Before power-on, make sure that the power supply meets equipment requirements to prevent equipment damage or even a fire.
- ◆ At power-on, unexpected operations may be triggered on the equipment. Therefore, stay away from the equipment.
- ◆ After power-on, do not open the cabinet door and protective cover of the equipment. Failure to comply will result in an electric shock.
- ◆ Do not touch any wiring terminals at power-on. Failure to comply will result in an electric shock.
- ◆ Do not remove any part of the equipment at power-on. Failure to comply will result in an electric shock.

Operation

 DANGER

- ◆ Do not touch any wiring terminals during operation. Failure to comply will result in an electric shock.
- ◆ Do not remove any part of the equipment during operation. Failure to comply will result in an electric shock.
- ◆ Do not touch the equipment shell, fan, or resistor for temperature detection. Failure to comply will result in heat injuries.
- ◆ Signal detection must be performed by only professionals during operation. Failure to comply will result in personal injuries or equipment damage.

 WARNING

- ◆ Prevent metal or other objects from falling into the device during operation. Failure to comply may result in equipment damage.
- ◆ Do not start or stop the equipment using the contactor. Failure to comply may result in equipment damage.

Maintenance

 DANGER

- ◆ Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed by only professionals.
- ◆ Do not maintain the equipment at power-on. Failure to comply will result in an electric shock.
- ◆ Before maintenance, cut off all equipment power supplies and wait at least 10 minutes.

 WARNING

- ◆ Perform daily and periodic inspection and maintenance for the equipment according to maintenance requirements and keep a maintenance record.

Repair

**DANGER**

- ◆ Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed by only professionals.
- ◆ Do not repair the equipment at power-on. Failure to comply will result in an electric shock.
- ◆ Before inspection and repair, cut off all equipment power supplies and wait at least 10 minutes.

**WARNING**

- ◆ Require for repair services according to the product warranty agreement.
- ◆ When the equipment is faulty or damaged, require professionals to perform troubleshooting and repair by following repair instructions and keep a repair record.
- ◆ Replace quick-wear parts of the equipment according to the replacement guide.
- ◆ Do not operate damaged equipment. Failure to comply may result in worse damage.
- ◆ After the equipment is replaced, perform wiring inspection and parameter settings again.

Disposal

**WARNING**

- ◆ Dispose of retired equipment by following local regulations or standards. Failure to comply may result in property damage, personal injuries, or even death.
- ◆ Recycle retired equipment by following industry waste disposal standards to avoid environmental pollution.

Safety Signs

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

| Safety Sign | Description |
|---|---|
|  | <ul style="list-style-type: none">◆ Read the user guide before installation and operation. Failure to comply will result in an electric shock.◆ Do not remove the cover at power-on or within 10 minutes after power-off.◆ Before maintenance, inspection, and wiring, cut off input and output power, and wait at least 10 minutes until the power indicator is off. |

1 Product Information

1.1 Applicable AC drive

| Expansion Card | AC drive | Remark |
|----------------|------------|--------|
| MD500-EN1 | MD500-PLUS | - |
| | MD520 | - |

1.2 Introduction

MD500 series Ethernet/IP communication card (hereinafter referred to as MD500-EN1 card) is an adapter card for Ethernet/IP fieldbus. It complies with international Ethernet/IP bus standards and 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.

The MD500-EN1 card software version required is 1.00 or later (check the software version in U0-67 upon power-on after installing the card). The corresponding EDS file name 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 card with other AC drives, contact our technical support for details.

1.3 Appearance and Dimensions



Figure 1-1 2. Appearance of the M500-EN1 card

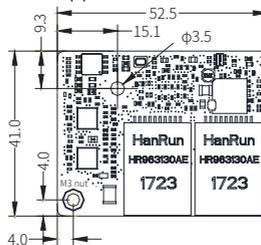


Figure 1-2 Dimensions of the M500-EN1 card

1.4 Interface Layout and Description

"[Figure 1-3 MD500-EN1 interface layout](#)" shows the hardware layout of the MD500-EN1 card. The pin header J7 on the back of the MD500-EN1 card is used to connect the AC drive. The MD500-EN1 card provides two network ports J4 and J6 for communication with Ethernet/IP master (or other slaves). For details about the hardware, see "[Table 1-1 Interface Description](#)".

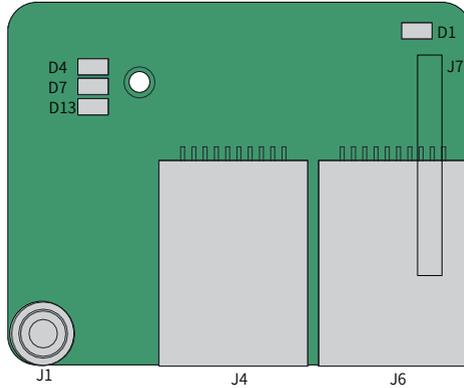


Figure 1-3 MD500-EN1 interface layout

Table 1-1 Interface Description

| Symbol | Interface Name | Function Description |
|--------|-------------------------|--|
| J7 | Pin header | Used to connect the AC drive. |
| J4 | Network port | Adopts the standard Ethernet RJ45 socket, direction insensitive. Used for MD500-EN1 card to establish communication with Ethernet/IP master station(or other slave stations). Its pin signal definitions are the same as those of the standard Ethernet pins. They can be connected using crossover cables or straight-through cables. |
| J6 | | |
| J1 | EMC ground terminal | Used to connect the EMC ground terminal of the AC drive. |
| D13 | Power indicator (green) | Used to indicate the power status. On: normal Off: abnormal (Check whether the installation is correct). |

| Symbol | Interface Name | Function Description |
|--------|---|---|
| D1 | AC drive communication status indicator (green) | See "Table 1-2 Description of indicators on the MD500-EN1 card" . |
| D4 | Ethernet/IP operation status indicator (green) | |
| D7 | Ethernet/IP fault indicator (red) | |



NOTE

- ◆ After the MD500-EN1 card is installed, J4 is on the left and J6 is on the right when you face the RJ45 interface. The two interfaces are direction-insensitive. Connect either of them to the PLC.
- ◆ The Cat5e shielded twisted pair (STP) network cable is recommended for operational stability.

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

| Indicator | State Description | Solution |
|--------------------------------------|--|---|
| D1 steady green | Normal | N/A |
| D1 steady off | Abnormal communication with the AC drive | Check whether FD-00 and FD-01 is set to 9 and 3 respectively. |
| D4 steady off D7 steady red | System fault | Check the following fault codes and solutions. |
| D4 steady off D7 flashing red | Waiting for obtaining IP address | The DHCP server assigns an IP address to the device by using BOOTP when the expansion card is in DHCP mode. |
| D4 flashing green D7 flashing red | Disconnection or timeout | Check whether the network cable is disconnected and the master station is running. |
| D4 flashing green D7 steady off | Waiting for connecting to the master station | Check whether the network cable connection is normal and the master station is running. |
| D4 steady green D7 steady off | Normal connection | N/A |

2 Installation and Wiring

2.1 Installation

The MD500-EN1 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. The installation is shown in "[Figure 2-1 Installation of the MD500-EN1 card](#)".

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 the AC drive](#)".

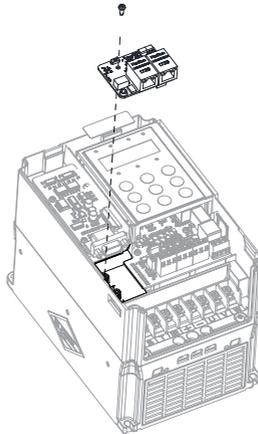


Figure 2-1 Installation of the MD500-EN1 card

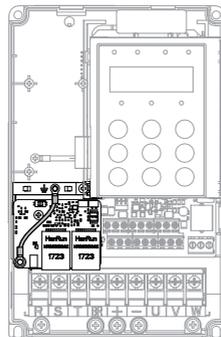


Figure 2-2 Ground terminal connection between the MD500-EN1 card and the AC drive

2.2 Wiring

2.2.1 Ethernet/IP Topology

The topological structures supported by Ethernet/IP include bus, star, and tree topologies. Various networking can be realized by using switches correctly.

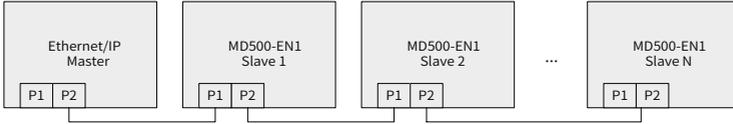


Figure 2-3 Bus topology

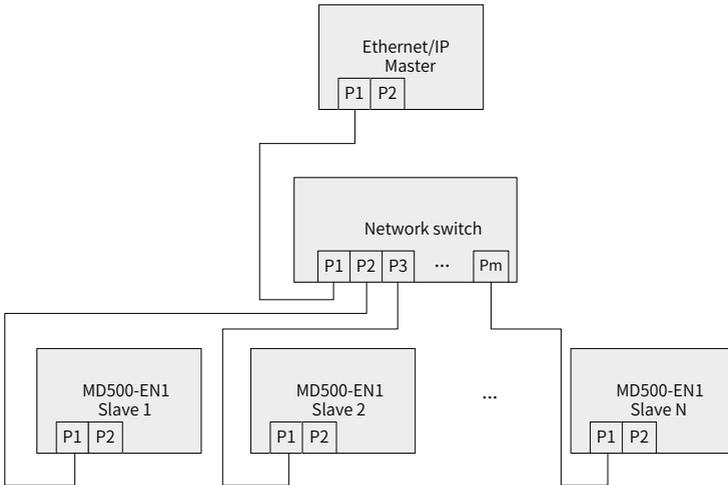


Figure 2-4 Star topology

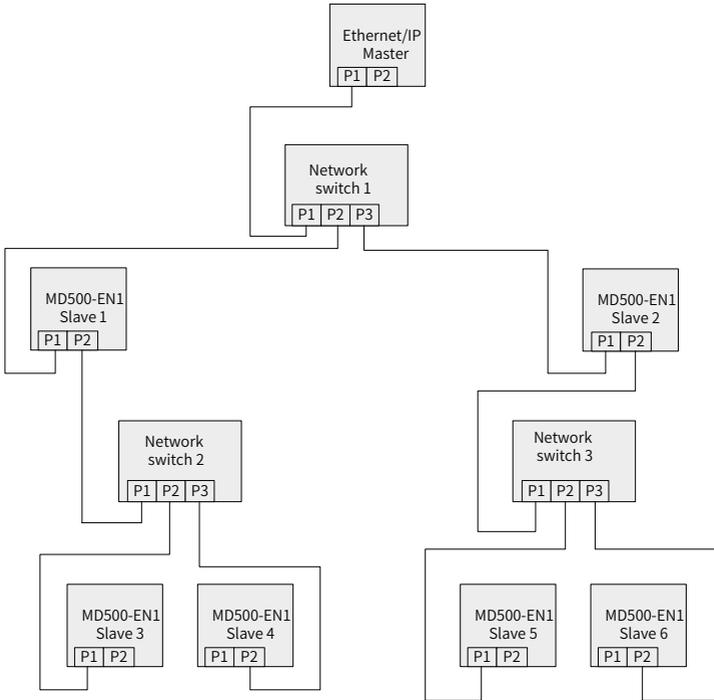


Figure 3-3 Tree topology

2.2.2 EMC Wiring

- During on-site installation and commissioning, the signal cables and power cables must be laid in different ducts. Never bundle the signal cables and power cables together to prevent communication interference.
- Motor enclosure must be connected to PE of the AC drive. Meanwhile, the grounding cable on the motor housing side must be connected properly. Failure to comply will result in poor grounding effect.
- Shielded cables are recommended. Connect the shield to PE of the AC drive.

3 Ethernet/IP Communication Protocol

3.1 Description of I/O Messages Data

24 I/O Messages are available in the MD500-EN1 expansion card for data transmission, in which 12 I/O messages transmit data from master station to slave station and another 12 I/O messages transmit data from slave station to master station.

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

- ◆ Real-time setting of AC drive control command and target frequency
- ◆ Real-time reading of AC drive current state and operating frequency
- ◆ Function parameter and monitoring data real-time exchange between the AC drive and Ethernet/IP master station

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

| I/O Messages (O->T) transmitted by the master | | |
|--|------------------------------|--|
| AC drive command | AC drive target frequency | Modifying function parameters of AC drive in real time |
| Output I/O Messages[0] | Output I/O Messages[1] | Output I/O Messages[2-11] |
| I/O Messages (T->O) responded to by the AC Drive | | |
| AC drive state | AC drive operating frequency | Reading function parameters of AC drive in real time |
| AC drive response I/O Messages (T->O) | Input I/O Messages[1] | Input I/O Messages[2-11] |

3.2 Description of Data Transmitted by the Master

For details on the data transmitted by the master, see the following table.

| Description of data transmitted by the master | | | | | | | | |
|---|--|--|---------------------|---------------------|-------------------|---------------------|--|---------------------|
| I/O Messages0 | AC drive command word (command source set to "communication") | | | | | | | |
| | <table border="0"> <tr> <td>00: Stop as defined by F6-10 (Stop mode)</td> <td>04: Reverse jogging</td> </tr> <tr> <td>01: Forward running</td> <td>05: Coast to stop</td> </tr> <tr> <td>02: Reverse running</td> <td>06: Stop as defined by F6-10 (Stop mode)</td> </tr> <tr> <td>03: Forward jogging</td> <td>07: Fault reset</td> </tr> </table> | 00: Stop as defined by F6-10 (Stop mode) | 04: Reverse jogging | 01: Forward running | 05: Coast to stop | 02: Reverse running | 06: Stop as defined by F6-10 (Stop mode) | 03: Forward jogging |
| 00: Stop as defined by F6-10 (Stop mode) | 04: Reverse jogging | | | | | | | |
| 01: Forward running | 05: Coast to stop | | | | | | | |
| 02: Reverse running | 06: Stop as defined by F6-10 (Stop mode) | | | | | | | |
| 03: Forward jogging | 07: Fault reset | | | | | | | |
| I/O Messages1 | 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 set target frequency exceeds this range, the AC drive runs at the frequency upper limit. | | | | | | | |

| Description of data transmitted by the master | |
|---|--|
| I/O Messages2 to I/O Messages11 | Used to change the function parameter values (groups F and A) in real time without writing the values into the EEPROM. FE-02 to FE-11 correspond to I/O Messages2 to I/O Messages11. For details about the configuration, see the I/O Messages data configuration. |

3.3 Description of Data Responded to by the AC Drive

For details on the data responded to by the AC drive, see the following table.

| Description of data responded to by the AC Drive | |
|--|---|
| I/O Messages0 | Indicates AC drive operating frequency, which is defined by bits as shown below: Bit0: 0: AC drive stop; 1: AC drive running Bit1: 0: Forward running; 1: Reverse running Bit2: 0: No fault; 1: AC drive fault Bit3: 0: Operating frequency not reached; 1: Operating frequency reached Bit4–7: Reserved Bit 8 to Bit 15: AC drive fault code |
| I/O Messages1 | Indicates feedback of the AC drive operating frequency (unit: 0.01 Hz), which is a signed Int16 value. |
| I/O Messages2 to I/O Messages11 | Indicates function parameter values (groups F and A) and monitoring parameter values (group U) read in real time. FE-22 to FE-31 correspond to I/O Messages2 to I/O Messages11. For details about the configuration, see the I/O Messages data configuration. |

4 Parameters Related to Communication

4.1 Communication Card Type Setting

After powering on the AC drive, set FD-00 and FD-01 to 9 (baud rate: 115200 bps) and 3 (no check, 8-N-1) respectively to enable communication between the MD500-EN1 card and the AC drive.

| Parameter No. | Parameter Name | Setting range | Default | Meaning |
|---------------|--------------------|--|---------|---|
| FD-00 | Baud rate | 0:300 bps 1: 600 bps 2:1200 bps 3:2400 bps 4:4800 bps 5:9600 bps 6:19200 bps 7:38400 bps 8:57600 bps 9:115200 bps | 9 | Used to set the data transmission rate 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 | Used to set the Modbus data format between the communication expansion card and the AC drive. |

4.2 IP Address Setting of MD500-EN1 Card

Communication card parameter setting for the AC drive.

| Parameter No. | Parameter Name | Setting Range | Description |
|----------------|---------------------------|---------------------------|--|
| FD-37 | DHCP function selection | 0: Disabled 1: Enabled | Used to set the DHCP function of the Ethernet/IP expansion card. Enabling the DHCP function deactivates IP address settings, namely parameters FD-38 to FD-41, FD-42 to FD-45, and FD-46 to FD-49. |
| FD-38 to FD-41 | Expansion card IP address | 0-255 | Used to set the IP address of Ethernet/IP expansion card. |

| Parameter No. | Parameter Name | Setting Range | Description |
|----------------|-----------------------------------|---------------|--|
| FD-42 to FD-45 | Subnet mask of expansion card | 0-255 | Used to set subnet mask of Ethernet/IP expansion card. |
| FD-46 to FD-49 | Gateway address of expansion card | 0-255 | Used to set gateway address of Ethernet/IP expansion card. |

IP address setting is divided into static IP and DHCP dynamic IP address. Select the IP mode in parameter No. FD-37. Set static IP address in parameter No. FD-37 to FD-49. For example, configure static IP address :192.168.0.6 , subnet mask:255.255.255.0, and gateway address:192.168.0.1, set the following parameters.

| Parameter No. | Function | Set Value |
|---------------|---|-----------|
| FD-37 | DHCP function selection | 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 most significant 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 most significant byte of the subnet mask | 255 |
| FD-45 | Least significant byte of the subnet mask | 0 |
| FD-46 | Most significant byte of the gateway | 192 |
| FD-47 | Second most significant byte of the gateway | 168 |
| FD-48 | Third most significant byte of the gateway | 0 |
| FD-49 | Least significant byte of the gateway | 1 |

View MAC address when DHCP/BOOTP function is used. To view the MAC address, read the label attached to the expansion card or check the related parameter (see ["4.3 Parameters of AC Drive Communication Card"](#) for details).

This card supports IP address conflict detection. When other devices in the network share the same IP address with the expansion card, D7 indicator will be steady ON and bit2 of FD-58 will be changed to 1.

The following three cases are present in IP address conflict detection.

| No. | Case | Symptom | Solution |
|-----|--|---|---|
| 1 | Both devices support IP address conflict detection. The two devices are powered on one after another. | The device powered on first uses the IP address and continues to operate. The device powered on later enters the conflict mode. | Check device IP address and then modify the repeated one. |
| 2 | Both devices support IP address conflict detection. The two devices are powered on at approximately the same time. | The two devices enter the IP address conflict mode simultaneously. | |
| 3 | One device supports IP address conflict detection and the second device does not. | Regardless of which device is powered on first, the device that does not support IP address detection uses the IP address. The device that supports IP address conflict detection enters the conflict mode. | |

**NOTE**

- ◆ When the DHCP server assigns an IP address to the expansion card, active conflict detection applies. Later, passive detection applies. If the devices are separately assigned with the same dynamic (static) IP address on the same network, both expansion cards do not report IP address conflict.
- ◆ When using the DHCP function to assign IP addresses, the address assignment would fail if IP address conflict occurs.

4.3 Parameters of AC Drive Communication Card

| Parameter No. | Parameter Name | Unit | Description |
|---------------|--|------|----------------------------|
| FD-61 | The first two bytes of expansion card MAC address | 1 | Expansion card MAC address |
| FD-62 | The middle two bytes of expansion card MAC address | 1 | Expansion card MAC address |
| FD-63 | The last two bytes of expansion card MAC address | 1 | Expansion card MAC address |
| FD-58 | Expansion card error code | 1 | Expansion card error code |

4.4 Parameter Related to Communication Control

| Parameter No. | Name | Setting Range | Decimal Address |
|---------------|-------------------|---|-----------------|
| U3-16 | Frequency setting | -Maximum frequency to +Maximum frequency 0.01 Hz | 29456 |

4 Parameters Related to Communication

| Parameter No. | Name | Setting Range | Decimal Address |
|---------------|-----------------|--|-----------------|
| U3-17 | Control command | 0000: Stop as defined by F6-10 (Stop mode) 0001: Forward running 0002: Reverse running 0003: Forward jogging 0004: Reverse jogging 0005: Coast to stop 0006: Decelerate to stop 0007: Fault reset | 29457 |
| U3-18 | DO control | Bit 0: DO1 control Bit 1: DO2 control Bit 2: RELAY1 control Bit 3: RELAY2 control | 29458 |
| U3-19 | AO1 control | 0 to 7FFF indicate 0% to 100%. | 29459 |
| U3-20 | AO2 control | 0 to 7FFF indicate 0% to 100%. | 29460 |
| U3-21 | FMP control | 0 to 7FFF indicate 0% to 100%. | 29461 |
| U3-22 | Reserved | Reserved | |
| U3-23 | Speed control | Signed data, 1 rpm | 29463 |

By default, when the MD500-EN1 card is used, the written I/O Messages0 and I/O Messages1 are mapped to U3-17 and U3-16, respectively. If any command or frequency cannot be written to the AC drive correctly but I/O Messages2 to I/O Messages11 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. | Name | Unit | Decimal Address |
|---------------|--------------------------|---------|-----------------|
| U0-00 | Operating 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 (%) | 0.1% | 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 |

| Parameter No. | Name | Unit | Decimal Address |
|---------------|------------------------------------|----------|-----------------|
| U0-13 | Length value | 1 | 28685 |
| U0-14 | Load speed display | 0.001 Hz | 28686 |
| U0-15 | PID reference | 1 | 28687 |
| U0-16 | PID feedback | 1 | 28688 |
| U0-17 | PLC stage | 1 | 28689 |
| U0-18 | Pulse input reference (Hz) | 0.01 kHz | 28690 |
| U0-19 | Feedback speed (Hz) | 0.01 Hz | 28691 |
| U0-20 | Remaining operating time | 0.1 min | 28692 |
| U0-21 | AI1 voltage before correction | 0.001 V | 28693 |
| U0-22 | AI2 voltage before correction | 0.001 V | 28694 |
| U0-23 | AI3 voltage before correction | 0.001 V | 28695 |
| U0-24 | Linear speed | 1 m/min | 28696 |
| U0-25 | Current power-on time | 1 min | 28697 |
| U0-26 | Current operating time | 0.1 min | 28698 |
| U0-27 | Pulse input frequency | 1 Hz | 28699 |
| U0-28 | Communication reference | 0.01% | 28700 |
| U0-29 | Encoder feedback speed | 0.01 Hz | 28701 |
| U0-30 | Display of main frequency X | 0.01 Hz | 28702 |
| U0-31 | Display of auxiliary frequency Y | 0.01 Hz | 28703 |
| U0-32 | Check on 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 (%) | 0.1% | 28707 |
| U0-36 | Resolver position | 1 | 28708 |
| 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 display | 1 | 28713 |
| U0-42 | DO state display | 1 | 28714 |
| U0-43 | DI state display 1 | 1 | 28715 |
| U0-44 | DI state 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 | Operating frequency (%) | 0.01% | 28732 |

4 Parameters Related to Communication

| Parameter No. | Name | Unit | Decimal Address |
|---------------|---------------------------------|--|-----------------|
| U0-61 | AC drive state | 1 | 28733 |
| U0-62 | Present fault code | 1 | 28734 |
| U0-63 | Operating frequency after droop | 0.01 Hz | 38375 |
| U0-64 | 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 | Operating 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 I/O Messages0 and I/O Messages1 being read are mapped to U0-68 and U0-69, respectively. If any state or operating 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 the values of FE-20 and FE-21.

5 Communication Examples

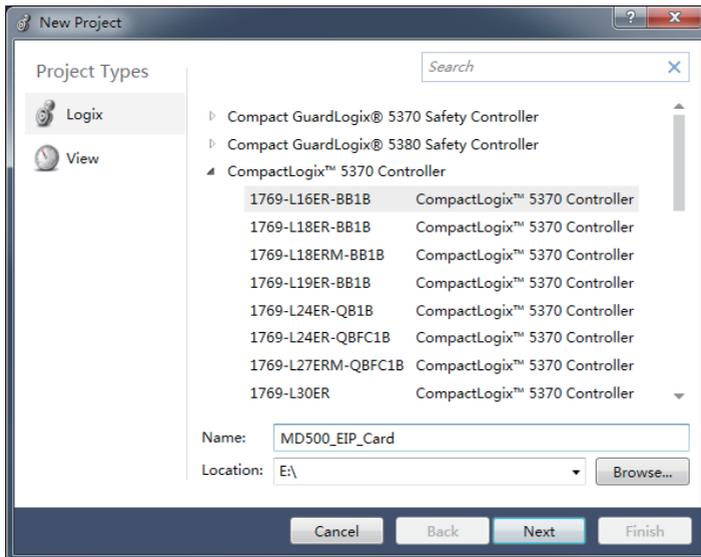
5.1 AB L16ER Controller as the Master

This example uses Studio5000 Logix Designer version 32.00.00 with 1769-L16ER-BB1B being the master. The information such as IP address has been configured according to the user guide. Connect either network port on the expansion card. Set F0-02, F0-03, FD-00, and FD-01 to 2, 9, 9, and 3 respectively before using the expansion card.



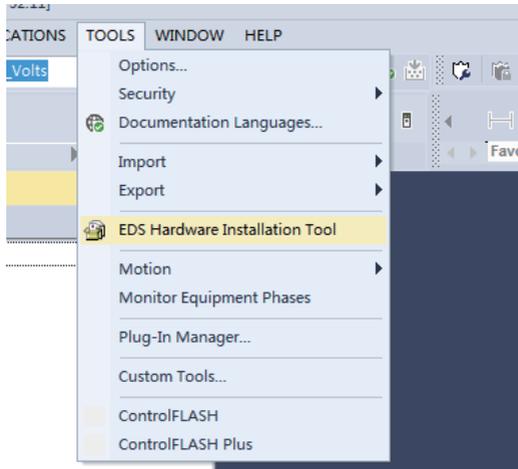
Step 1 : Create a new project.

Open **New project** window from Studio5000 software, select **1769-L16ER-BB1B in CompactLogix 5370 Controller**.

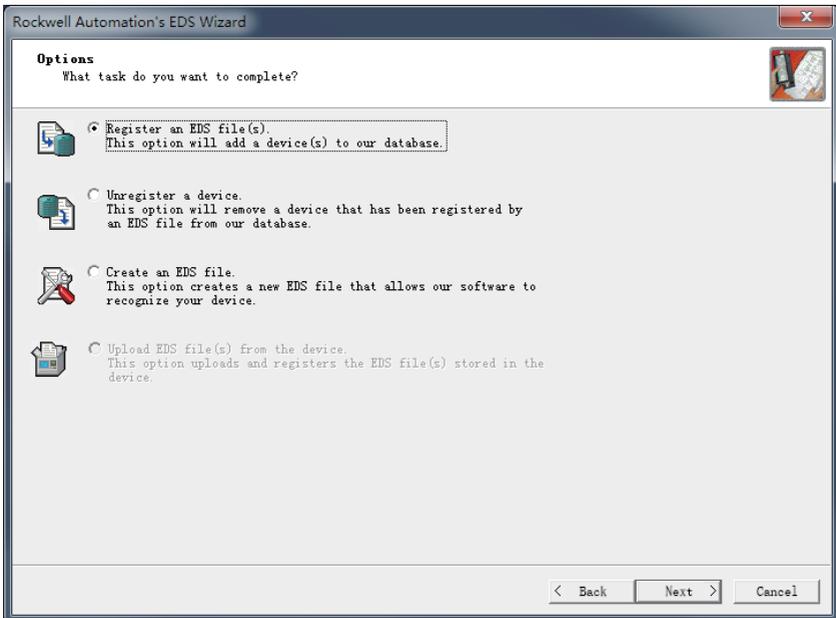


Step 2: Import the ESD file.

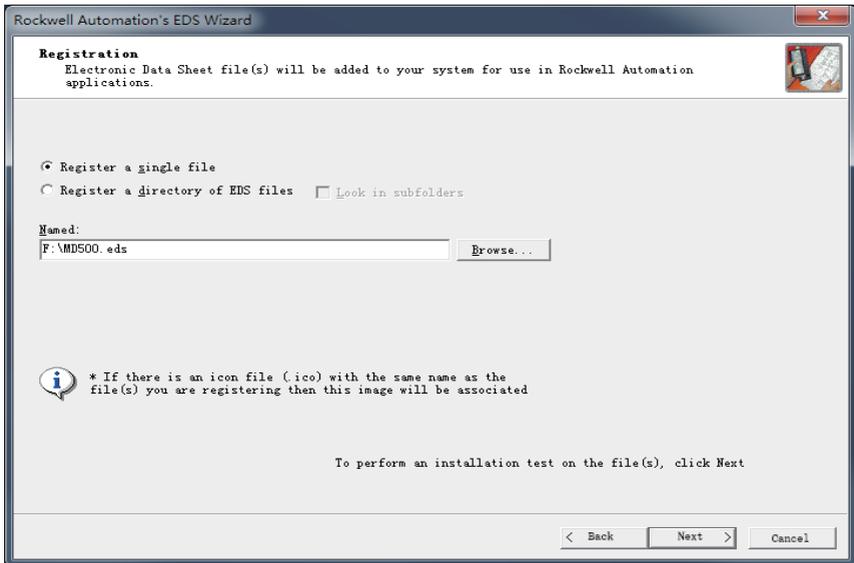
Choose **Tools > EDS Hardware Installation Tool** in the menu bar.



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



Choose EDS file on your computer and then click **Next**.



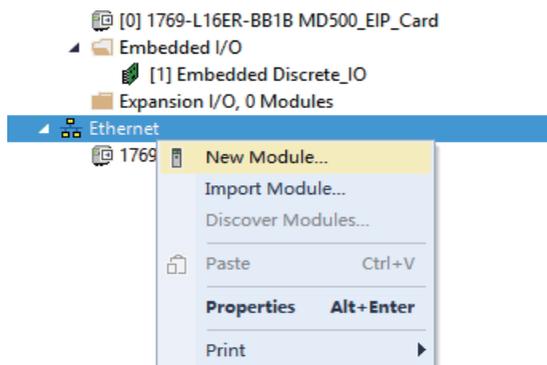
Keep clicking **Next** before the finish button shows and then click **Close**.

Step 3: Set the IP address of the expansion card, herein, take the static IP address as an example.

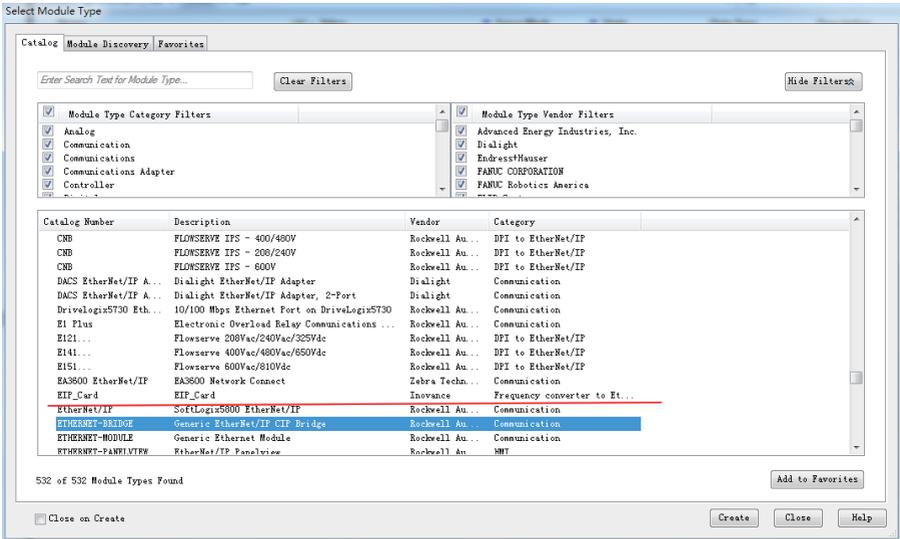
Set FD-37 – FD-49 to 0, 192.168.0.6, 255.255.255.0, and 192.168.0.1 respectively.

Step 4: Configure Studio5000 project.

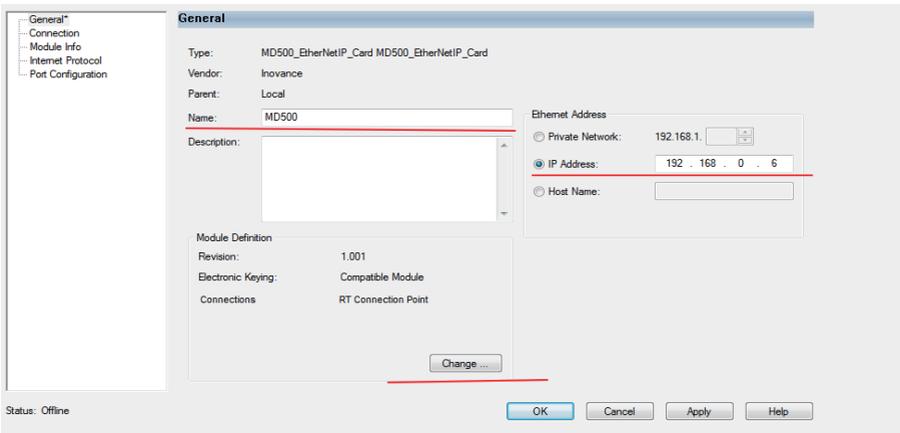
Choose **Ethernet** > **New Module** with left mouse button on the left navigation pane.



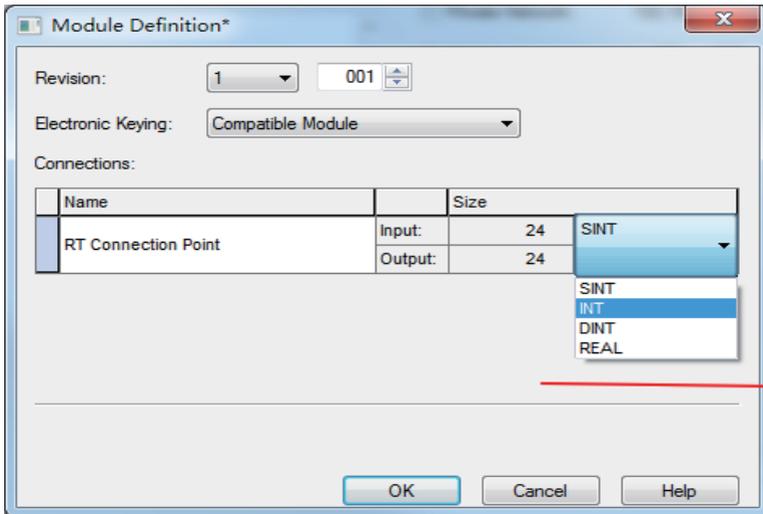
Locate **EIP_Card** on the interface and then click **Create**.



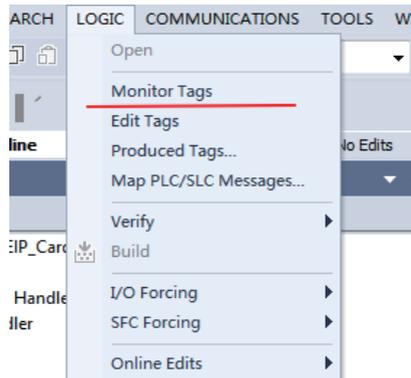
The configuration dialog box appears. Enter the preceding set IP address and type in a name.



Click **Change** in the **General** interface. Locate **SINT** and click to select **INT**. Next, Click **OK** and then **Yes** to proceed when an alert box appears.



Choose **Logic > Monitor Tags** in the menu bar.



Unfold **MD500:C.Data** and click **Style** to convert data type to **Hex**.

5 Communication Examples

| Name | Value | Force Mask | Style | Data Type | Description |
|--------------------|-------|------------|-------|----------------------|-------------|
| ▶ Local:1:C | | {...} | {...} | AB:Embedded_Discr... | |
| ▶ Local:1:H | | {...} | {...} | AB:Embedded_Discr... | |
| ▶ Local:1:O | | {...} | {...} | AB:Embedded_Discr... | |
| ▲ MD500:C | | {...} | {...} | 3039:MD500_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#F0 | Hex | SINT | |
| ▶ MD500:C.Data[6] | | 16#00 | Hex | SINT | |
| ▶ MD500:C.Data[7] | | 16#F0 | Hex | SINT | |
| ▶ MD500:C.Data[8] | | 16#00 | Hex | SINT | |
| ▶ MD500:C.Data[9] | | 16#F0 | Hex | SINT | |
| ▶ MD500:C.Data[10] | | 16#00 | Hex | SINT | |
| ▶ MD500:C.Data[11] | | 16#F0 | Hex | SINT | |
| ▶ MD500:C.Data[12] | | 16#00 | Hex | SINT | |

The following parameters are used to configure PDO mapping. Every two parameters form a group. 0-23 indicates I/O Messages Mapping(T->O) and 24-47 indicates I/O Messages Mapping(O->T). Data[0]=0x44 and Data[1]=0x70 shown in the figure represent that TPDO1 is mapped to U0-68.

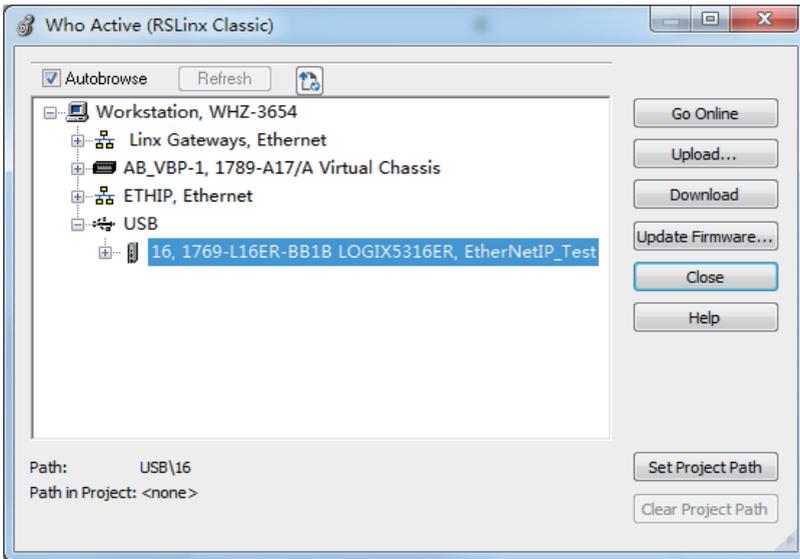
By default, I/O Messages Mapping(T->O)[0] is mapped to U0-68, I/O Messages Mapping(T->O)[1] is mapped to U0-69, I/O Messages Mapping(O->T)[0] is mapped to U3-17, and I/O Messages Mapping(O->T)[1] is mapped to U3-16. These four parameters cannot be changed, otherwise, a fault may occur. Other parameters can be user-defined as required.

MD500:I.Data and MD500:O.Data are IO data during data transmission. The written values in O.Data are written to the parameter corresponding to the mapping that is configured in the preceding process. Configured parameters corresponding to I/O Messages Mapping(T->O)[0] will be uploaded to I.Data regularly.

Click the following button marked in red to search for devices after configuration is finished.

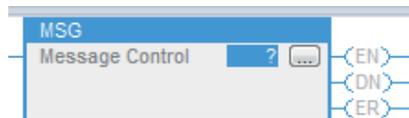


USB is used to connect the device in this example. Select device and then click **Download** to download code to PLC.

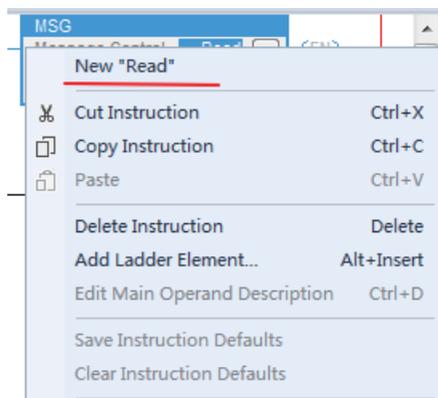


Step 5: Use explicit messaging for data transmission.

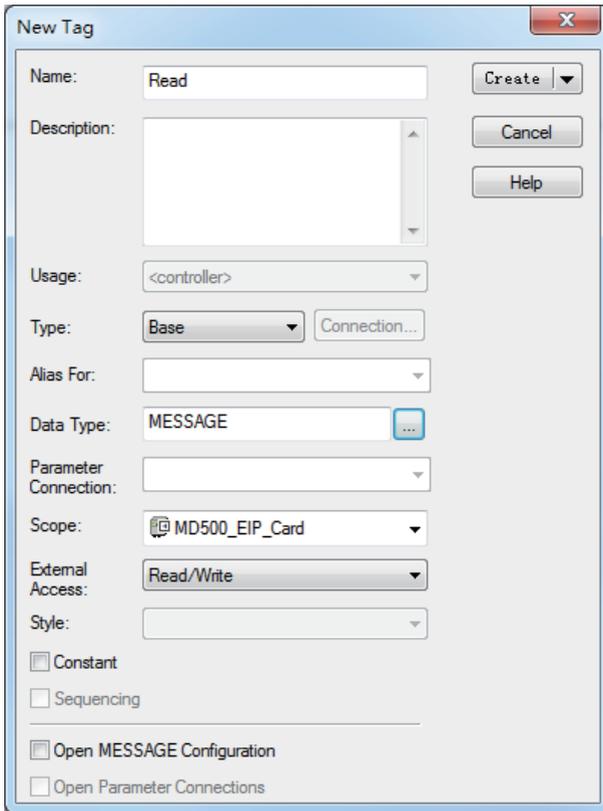
Open programming section in PLC, and choose **Input/Output** > **MSG**.



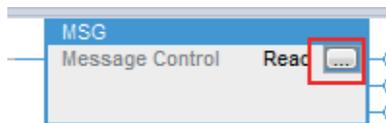
Enter a name in the field that holds the question mark and right-click **New "Read"**.



Click **Create**.



Click the ellipsis on the right side of **MSG**.



Configure according to the following figures.

Message Configuration - Read

Configuration* Communication Tag

Message Type: CIP Generic

Service Type: Get Attribute Single

Service Code: e (Hex) Class: 93 (Hex) Instance: 64781 Attribute: 9 (Hex)

Source Element: [Empty]

Source Length: 0 (Bytes)

Destination Element: [Empty]

New Tag...

Enable
 Enable Waiting
 Start
 Done
 Done 0

Error
 Extended Error
 Timed Out

Error Code:

Error

Select **Get Attribute Single** to read parameters while select **Set Attribute Single** to write parameters. **Class** and **Attribute** are set to fixed 0x93 and 0x9 respectively. **Instance** converts parameters required to be read to decimal format. FD-13 (FD0D) as shown in the figure is converted to the decimal format, which is **64781**.

Choose the path to saving the parameter by selecting **Destination Element** on the right side of the window. You can use **New Tag** to create a variable.

The screenshot shows a software configuration window with the following elements:

- A dropdown menu at the top.
- A "Source Element:" label next to an empty dropdown menu.
- A "Source Length:" label next to a numeric input field containing "0" and a "(Bytes)" label.
- A "(Hex)" label next to a "Destination Element:" label, which is followed by a dropdown menu containing the text "EIP_Read".
- A "New Tag..." button located below the Destination Element dropdown.

Click **Communication** to choose the AC drive.

Message Configuration - Read

Configuration* Communication* Tag

Path: MD500 Browse...
 MD500
 Broadcast: ▼

Communication Method

CIP DH+ Channel: 'A' ▼ Destination Link: 0 ▲▼
 CIP With Source ID Source Link: 0 ▲▼ Destination Node: 0 ▲▼ (Octal)

Connected Cache Connections ← Large Connection

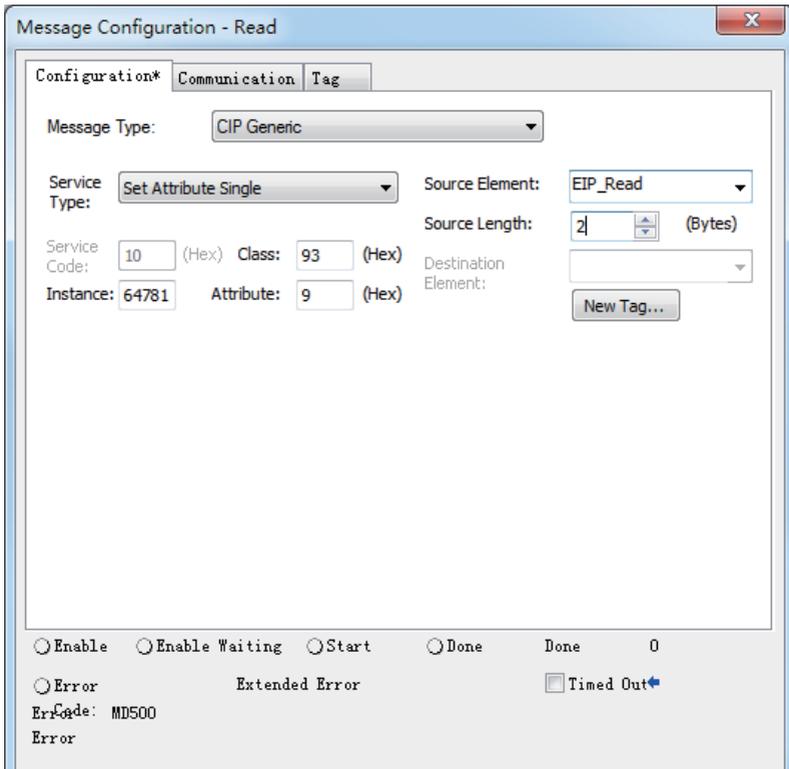
Enable Enable Waiting Start Done Done 0
 Error Extended Error Timed Out ←

ErrCode:
Error

Click **OK**. The master station will read this parameter and store the data into the selected variable. The value of this variable can be viewed in **Logic-Monitor Tags**.

| | | | | | |
|----------|--|-------|-------|---------|-----------------------|
| MD500-I | | (...) | (...) | | _3039:MD500_EtherN... |
| MD500-O | | (...) | (...) | | _3039:MD500_EtherN... |
| Read | | (...) | (...) | | MESSAGE |
| EIP_Read | | 1 | | Decimal | DINT |
| key | | 0 | | Decimal | BOOL |

Parameters being written are shown in the following figure.

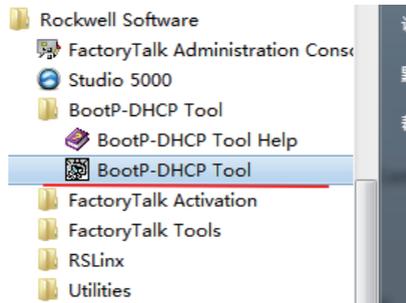


Step 6: Enable DHCP function.

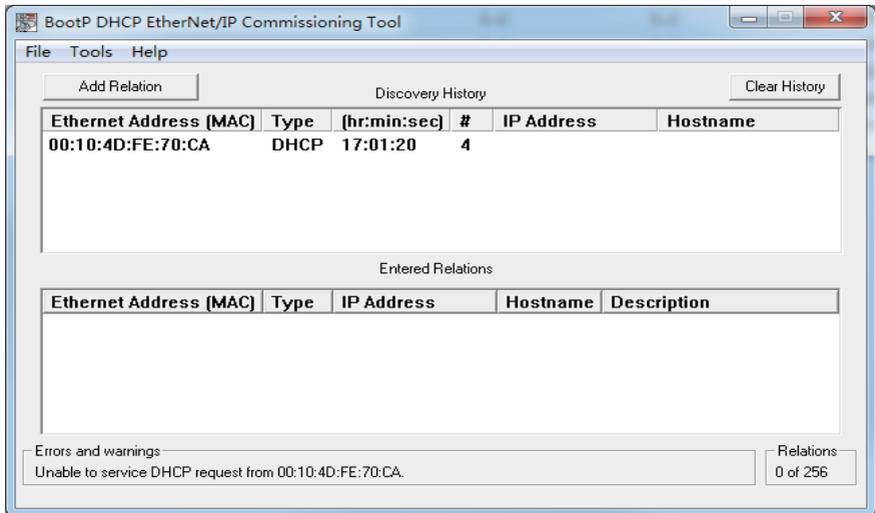
Note: IP address assigned from DHCP server cannot be saved at power-down state.

Set FD-37 to 1 to enter DHCP mode. Re-power on the AC drive and then connect the computer and the AC drive to the same network.

Choose **Start > BootP-DHCP Tool** and select the network adapter.



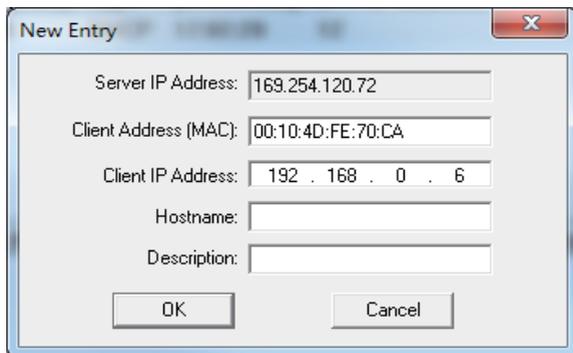
Device request can be seen in the software after power on.



Right-click to select **Add Relation**.



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



The IP address is written to the device.

| Delete Relation | | Entered Relations | | Enable BOOTP/DHCP | | Disable BOOTP/DHCP | |
|------------------------|------|-------------------|----------|-------------------|--|--------------------|--|
| Ethernet Address (MAC) | Type | IP Address | Hostname | Description | | | |
| 00:10:4D:FE:70:CA | DHCP | 192.168.0.6 | | | | | |

Errors and warnings
Sent 192.168.0.6 to Ethernet address 00:10:4D:FE:70:CA

Relations
1 of 256

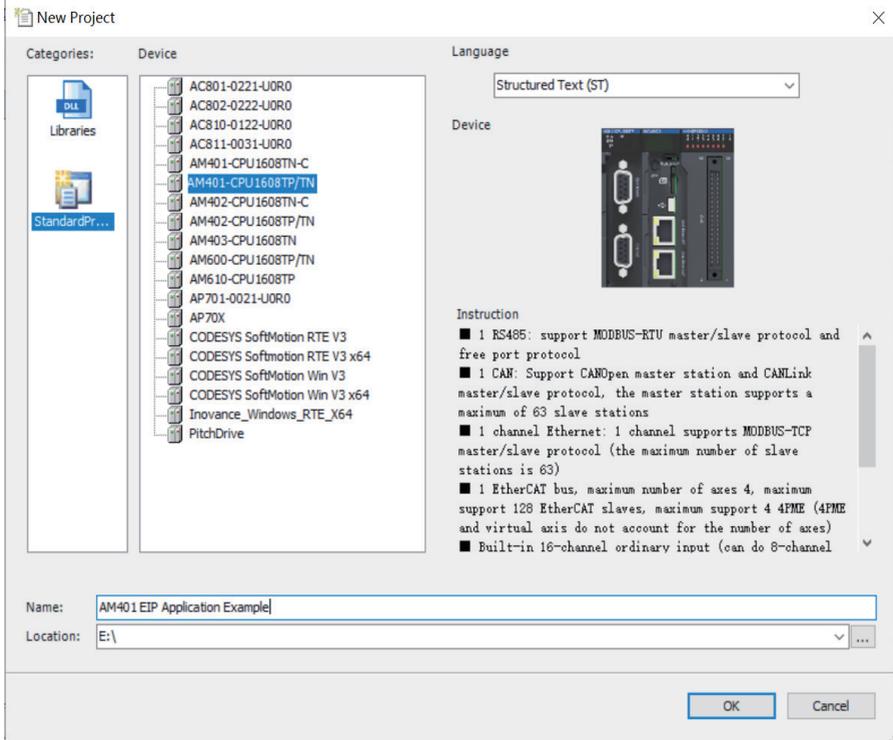
5.2 Inoance AM600 Controller as the Master

This example uses InoProShop version 1.5.2 with AM600 controller. The information such as IP address has been configured according to the user guide. Connect either network port on the left or right of the expansion card. Set F0-02, F0-03, FD-00, and FD-01 to 2, 9, 9, and 3 respectively before using the expansion card.



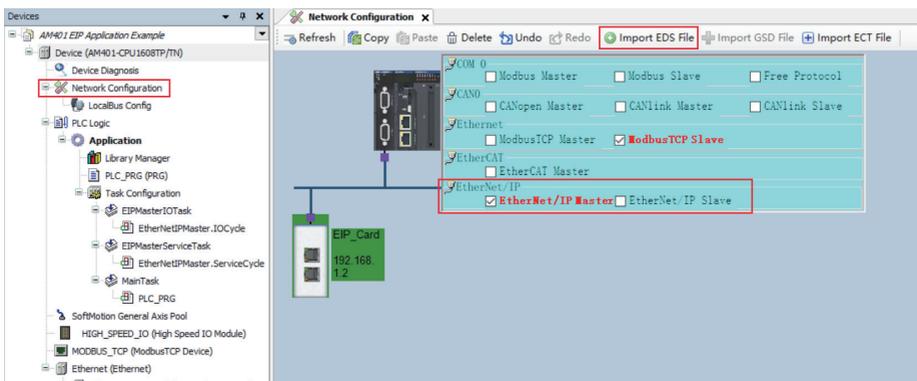
Step 1 : Create a new Project.

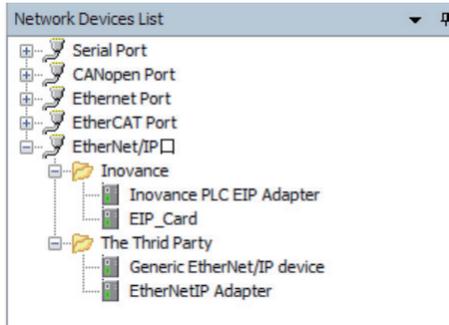
Open InoProShop to create a new project. Select device model: **AM600-CPU1608TP/TN**.



Step 2: Import the ESD file and add a slave station.

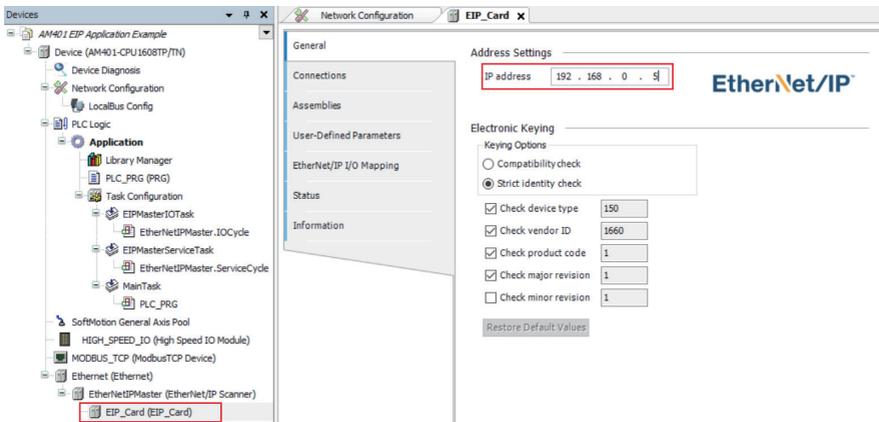
Open network configuration window, click PLC and select **Ethernet/IP master** as current communication protocol. Click **Import EDS file** to import EDS file of EIP card. Import device from **Network Device List** on the right side of the window.





Step 3: Configure the slave parameters.

Set the IP address of the slave station.



Click **Connections** on the left side of window to configure I/O messages mapping. Input I/O Messages Mapping(T->O)[x] indicates that the data is mapped from slave to master station. Output I/O Messages Mapping(O->T)[x] indicates that the data is mapped from master to slave station.

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). Output I/O Messages Mapping(O->T)[1] is mapped to U3-16(29456 in decimal).

These four default mappings can not be changed. Other mappings are configured to F0-00 (61440 in decimal) by default. For the mappings required to be modified, convert the parameter address into decimal format. For example, type in 61452 for F0-12. Keep the default value for the mappings not needed.

Configuration Data

Raw data values Show Parameter Groups

| Parameters | Value | Unit | Data Type | Minimum | Maximum | Default | Help String |
|--------------------------------------|-------|------|-----------|---------|---------|---------|-----------------|
| Exclusive Owner | | | | | | | |
| Target Config data | | | | | | | |
| Input I/O Messages Mapping(T->O)[0] | 28740 | | UINT | 0 | 65535 | 28740 | New Help String |
| Input I/O Messages Mapping(T->O)[1] | 28741 | | UINT | 0 | 65535 | 28741 | New Help String |
| Input I/O Messages Mapping(T->O)[2] | 61440 | | UINT | 0 | 65535 | 61440 | New Help String |
| Input I/O Messages Mapping(T->O)[3] | 61440 | | UINT | 0 | 65535 | 61440 | New Help String |
| Input I/O Messages Mapping(T->O)[4] | 61440 | | UINT | 0 | 65535 | 61440 | New Help String |
| Input I/O Messages Mapping(T->O)[5] | 61440 | | UINT | 0 | 65535 | 61440 | New Help String |
| Input I/O Messages Mapping(T->O)[6] | 61440 | | UINT | 0 | 65535 | 61440 | New Help String |
| Input I/O Messages Mapping(T->O)[7] | 61440 | | UINT | 0 | 65535 | 61440 | New Help String |
| Input I/O Messages Mapping(T->O)[8] | 61440 | | UINT | 0 | 65535 | 61440 | New Help String |
| Input I/O Messages Mapping(T->O)[9] | 61440 | | UINT | 0 | 65535 | 61440 | New Help String |
| Input I/O Messages Mapping(T->O)[10] | 61440 | | UINT | 0 | 65535 | 61440 | New Help String |
| Input I/O Messages Mapping(T->O)[11] | 61440 | | UINT | 0 | 65535 | 61440 | New Help String |
| Output I/O Messages Mapping(O->T)[0] | 29457 | | UINT | 0 | 65535 | 29457 | New Help String |
| Output I/O Messages Mapping(O->T)[1] | 29456 | | UINT | 0 | 65535 | 29456 | New Help String |
| Output I/O Messages Mapping(O->T)[2] | 41440 | | UINT | 0 | 65535 | 41440 | New Help String |

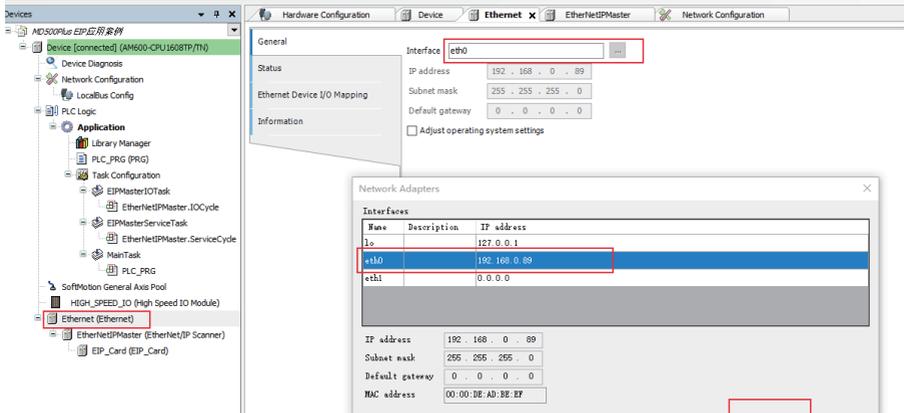
Step 4: Configure the IP address of the master station.

Scan for a network and select the master station to be configured.

The screenshot shows the SIMATIC Manager interface. The 'Communication Settings' window is open, displaying a network diagram with a laptop, a gateway, and a server. A 'Select Device' dialog box is overlaid, showing a list of discovered devices. The device 'AM600-CPU1688T/ITN (5059)' is selected, and its details are shown on the right, including the device name, address (0059), block driver (LCP), and target ID (10F4000).

Assign an IP address for the master network port.

5 Communication Examples



Download the project to the PLC.



View I/O Messages(O->T) and I/O Messages(T->O) in Ethernet/IP I/O mapping.

| Variable | Mapping | Channel | Address | Type | Default Value | Current Value | Prepared Value | Unit | Description |
|--------------------------|---------|------------------------|---------|-------|---------------|---------------|----------------|------|-----------------|
| * Inverter State | | Inverter State | %IW1 | UBINT | 0 | | | | New Help String |
| * Output Freq | | Output Freq | %QW2 | UBINT | 0 | | | | New Help String |
| * Input I/O Messages[2] | | Input I/O Messages[2] | %IWI3 | UBINT | 0 | | | | New Help String |
| * Input I/O Messages[3] | | Input I/O Messages[3] | %IWI4 | UBINT | 0 | | | | New Help String |
| * Input I/O Messages[4] | | Input I/O Messages[4] | %IWI5 | UBINT | 0 | | | | New Help String |
| * Input I/O Messages[5] | | Input I/O Messages[5] | %IWI6 | UBINT | 0 | | | | New Help String |
| * Input I/O Messages[6] | | Input I/O Messages[6] | %IWI7 | UBINT | 0 | | | | New Help String |
| * Input I/O Messages[7] | | Input I/O Messages[7] | %IWI8 | UBINT | 0 | | | | New Help String |
| * Input I/O Messages[8] | | Input I/O Messages[8] | %IWI9 | UBINT | 0 | | | | New Help String |
| * Input I/O Messages[9] | | Input I/O Messages[9] | %IWI10 | UBINT | 0 | | | | New Help String |
| * Input I/O Messages[10] | | Input I/O Messages[10] | %IWI11 | UBINT | 0 | | | | New Help String |
| * Input I/O Messages[11] | | Input I/O Messages[11] | %IWI12 | UBINT | 0 | | | | New Help String |
| * Control Command | | Control Command | %QWI1 | UBINT | 0 | | | | New Help String |
| * Written Freq | | Written Freq | %QWI2 | UBINT | 0 | | | | New Help String |
| * Output I/O Messages[2] | | Output I/O Messages[2] | %QWI3 | UBINT | 0 | | | | New Help String |
| * Output I/O Messages[3] | | Output I/O Messages[3] | %QWI4 | UBINT | 0 | | | | New Help String |
| * Output I/O Messages[4] | | Output I/O Messages[4] | %QWI5 | UBINT | 0 | | | | New Help String |
| * Output I/O Messages[5] | | Output I/O Messages[5] | %QWI6 | UBINT | 0 | | | | New Help String |
| * Output I/O Messages[6] | | Output I/O Messages[6] | %QWI7 | UBINT | 0 | | | | New Help String |
| * Output I/O Messages[7] | | Output I/O Messages[7] | %QWI8 | UBINT | 0 | | | | New Help String |
| * Output I/O Messages[8] | | Output I/O Messages[8] | %QWI9 | UBINT | 0 | | | | New Help String |
| * Output I/O Messages[9] | | Output I/O Messages[9] | %QWI10 | UBINT | 0 | | | | New Help String |

6 Troubleshooting

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

Table 6-1 Fault causes and solutions

| Symptom | Possible Cause | Solution |
|---|---|--|
| Communication failure between the MD500-EN1 card and AC drive | <ol style="list-style-type: none"> 1. Ethernet/IP communication is not supported by AC drive. 2. The communication configuration of the MD500-EN1 card is incorrect. 3. The MD500-ECAT card is faulty. | <ol style="list-style-type: none"> 1. Check whether Ethernet/IP communication is supported by the AC drive. 2. Correctly configure communication parameters of MD500-EN1 card. 3. Replace the MD500-EN1 card. |
| Err16 (communication error) reported by the AC drive during running | <ol style="list-style-type: none"> 1. The communication data is abnormal. 2. The network cable is damaged or connected incorrectly. 3. The AC drive suffers external interference. | <ol style="list-style-type: none"> 1. Check whether Ethernet/IP master program is normal. 2. Check whether the network cable is connected correctly. Replace the network cable if required. 3. Use the Cat5e shielded twisted pair (STP) network cable as required. Check that the MD500-EN1 card is grounded correctly. Eliminate the external interference. Contact the agent or Inovance for technical support if necessary. |

Fault code is 8-bit binary integer. Every bit represents a specific fault. Fault codes can be obtained through converting parameter values into 8-bit binary values. For example, the read value 3 of FD-58 is converted to binary value 0000 0011, then the fault codes are Bit0 and Bit1. The following table lists the fault description and solutions.

Note: Multiple faults may be present when a fault code appears.

| Fault Code | Description | Solution |
|------------|--|---|
| Bit 7 | N/A | N/A |
| Bit 6 | Communication with AC drive failed or AC drive version incorrect | Upgrade the AC drive software to the version that supports EIP. |
| Bit 5 | I/O Messages mapping Error | Check PLC configuration. |
| Bit 4 | Timeout | Check whether the circuit and master station operation is normal. |

| Fault Code | Description | Solution |
|------------|------------------------------------|--|
| Bit 3 | LINK loss | Check the wiring. |
| Bit 2 | IP address conflict | Check whether other devices have the same IP address as this device. |
| Bit 1 | MAC address not programmed or lost | Contact Inovance or the agent for technical support. |
| Bit 0 | Ethernet hardware error | Contact Inovance or the agent for technical support. |

If the fault code is 0, and indicator D4 is steady off in green and indicator D7 is steady on in red, then the solution is the same as that of Bit 6.

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