EtherNet/IP Card
INSTRUCTIONS MANUAL

Upon receipt of the product and prior to initial operation, read these instructions thoroughly and retain for future reference.

MOTOMAN INSTRUCTIONS
MOTOMAN XXXXXXX INSTRUCTIONS
DX100 INSTRUCTIONS
DX100 OPERATOR’S MANUAL
DX100 MAINTENANCE MANUAL

The DX100 operator’s manual above corresponds to specific usage. Be sure to use the appropriate manual.

Part Number: 156530-1CD
Revision: 2
MANDATORY

• This system manual provides an overview of the Motoman EtherNet/IP Card. Be sure to read and understand this manual thoroughly before installing and operating the EtherNet/IP Card.

• General items related to safety are listed in Section 2 of the DX100 Controller Manual. To ensure correct and safe operation, carefully read the DX100 Controller Manual before reading this manual.

CAUTION

• Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure that all covers and shields are replaced before operating this product.

• The drawings and photos in this manual are representative examples, and differences may exist between them and the delivered product.

• YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications.

• If such a modification is made, the revision number will also be revised.

• If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.

• YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the Motoman EtherNet/IP Card system.

In this manual, the Notes for Safe Operation are classified as “WARNING,” “CAUTION,” “MANDATORY,” or “PROHIBITED.”

![WARNING](image)
Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.

![CAUTION](image)
Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.

![MANDATORY](image)
Always be sure to follow explicitly the items listed under this heading.

![PROHIBITED](image)
Must never be performed.

Even items described as “CAUTION” may result in a serious accident in some situations. At any rate, be sure to follow these important items.

To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as "CAUTION" and "WARNING."
WARNING

• Before operating the manipulator, check that servo power is turned OFF by pressing the EMERGENCY STOP buttons on the front door of the DX100 controller and on the Programming Pendant (refer to Figure 1). When servo power is turned OFF, the SERVO ON LED on the Programming Pendant is turned OFF.

Injury or damage to machinery may result if the Emergency Stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the EMERGENCY STOP buttons do not function.

Figure 1: EMERGENCY STOP Button

• Release the EMERGENCY STOP button (refer to Figure 2). Once this button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

Figure 2: Release of EMERGENCY STOP Button

• Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  – View the manipulator from the front whenever possible.
  – Always follow the predetermined operating procedure.
  – Ensure that you have a safe place to retreat to in case of emergency.

Improper or unintended manipulator operation may result in injury.

• Confirm that no person is present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
  – Turning on the power for the DX100 controller.
  – Moving the manipulator with the Programming Pendant.
  – Running the system in the check mode.
  – Performing automatic operations.

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an EMERGENCY STOP immediately if there is a problem. The EMERGENCY STOP buttons are located on the right of the front door of the DX100 controller and on the Programming Pendant.
Definition of Terms Used Often in This Manual

The MOTOMAN manipulator is the YASKAWA industrial robot product. The manipulator usually consists of the controller, the Programming Pendant, and supply cables.

In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX100 controller</td>
<td>DX100</td>
</tr>
<tr>
<td>DX100 Programming Pendant</td>
<td>Programming Pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator cable</td>
</tr>
</tbody>
</table>

CAUTION

- Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately and be sure that all other necessary processing has been performed.
  - Check for problems in manipulator movement.
  - Check for damage to insulation and sheathing of external wires.
- Always return the Programming Pendant to the hook on the cabinet of the DX100 controller after use.
  The Programming Pendant can be damaged if it is left in the manipulator’s work area, on the floor, or near fixtures.
- Read and understand the Explanation of Warning Labels in the DX100 Controller Manual before using the EtherNet/IP Card.
**Explanation of Warning Labels**

The following warning labels are attached to the manipulator (refer to *Figure 3*).

Always follow the warnings on the labels.

Also, an identification label with important information is placed on the body of the manipulator. Prior to operating the manipulator, confirm the contents.

*Figure 3: Warning Labels Location*

![Diagram of warning labels and identification label on a manipulator](image)

- **Nameplate:**
  - **MOTOMAN**
  - **TYPE**
  - **PAYLOAD**
  - **ORDER NO.**
  - **SERIAL NO.**
  - **MASS** kg
  - **DATE**

- **WARNING Label A:**
  - **WARNING**
  - Moving parts may cause injury

- **WARNING Label B:**
  - **WARNING**
  - Do not enter robot work area.
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4 Network Configurations and Connections

4-1
This manual provides instructions for the Motoman EtherNet/IP PCI Interface cards (P/N 154310-1). The application of this board allows the transmission of DX100’s general-purpose I/O data with other devices connected to EtherNet/IP.

EtherNet/IP is an open low-level network that provides connections between simple industrial devices (such as sensors and actuators) and higher-level devices (such as robot controllers and computers). The EtherNet/IP (EtherNet Industrial Protocol) communication protocol uses CIP (Control and Information Protocol), TCP/IP and Ethernet. CIP is common to the EtherNet protocol and ControlNet protocol and uses TCP for transporting message data and UDP for transporting input/output data.

EtherNet/IP is managed by the ODVA (Open DeviceNet Vendors Association). You can obtain specifications for this protocol at the following address: http://www.odva.org.

This manual contains the following sections:

Section 1 – Introduction
This section provides general information about the EtherNet/IP Card and its components, a list of reference documents, and customer service contact information.

Section 2 – Hardware Specifications
This section provides specifications for the EtherNet/IP Card.

Section 3 – Installation
This section provides installation instructions for the EtherNet/IP Card.

Section 4 – Network Configurations and Connections
This section provides network configuration information for the EtherNet/IP Card.

1.1 System Configuration

The EtherNet/IP card interfaces with the DX100 controller, and does not require an I/O expansion rack. The 154446-1 single-channel card can be configured either as a Master or Slave (server or adapter) interface. One free PCI slot is required.

The EtherNet/IP card supports the FTP function, an extended application of the data transmission function (Ethernet), as a server or a client. Please refer to the FTP Function Manual (157178-1CD) for details.

1.1.1 Functionality of the AppliconIO® EtherNet/IP Master

- Connector Type: RJ45
- Speeds Supported:
  - Automatic
  - 10 Mbits (half and full duplex)
  - 100 Mbits (half and full duplex)
- TCP/IP Configuration:
  - Static
1 Introduction

1.2 Reference Documentation

- DHCP or BOOTP
- Devices Supported:
  - Maximum 8 devices
  - Device Type: “Generic EtherNet/IP
    - One input/output data connection with configuration data
    - One status data connection (optional)
  - Name of supported host (“Hostname” via DNS server)
  - EtherNet/IP functionality: Level 4 (I/O Messages - Client/Originator + Server/Target)
  - Input/Output Scanner
  - Class 1 I/O Connection - Implicit Messaging
  - Automatic organization of input/output memories
  - Total size of inputs/outputs: 127 bytes maximum

1.1.2 Functionality of the AppliconIO® EtherNet/IP Slave

- Supported Connections:
  - Cyclic type input/output connections
  - Input size: from 1 to 127 bytes
  - Output Size: from 1 to 127 bytes
  - Configuration size: from 0 words

1.2 Reference Documentation

For additional information on individual components of the EtherNet/IP Card system, refer to the following documentation that is included with your delivered system:

- Motoman DX100 Controller Manual (P/N 155494-1CD)
- Motoman Operator’s Manual for Arc Welding (P/N 155490-1CD)
- Motoman DX100 Concurrent I/O Manual (P/N 155491-1CD)
- Motoman INFORM User’s Manual (P/N 155493-1CD)
- Vendor manuals for system components not manufactured by Motoman
1.3 Customer Support Information

If you need technical assistance with any aspect of your EtherNet/IP Card system, please contact Motoman Customer Support at the following 24-hour support telephone number:

(937) 847-3200

Please have the following information ready before you call:

- System: EtherNet/IP Card, DX-Series
- Robot: MA1400, MH6, etc.
- Primary Application: Welding
- Controller: DX100
- Software Version: Access this information on the Programming Pendant display screen by selecting {MAIN MENU} - {SYSTEM INFO} - {VERSION}
- Robot Serial Number: Located on a data plate on the rear of each robot arm
- Robot Sales Order Number: Located on a data plate on the front door of the DX100 controller
2  Hardware Specifications

When the card is configured in the controller, the first byte of data from each channel is a status byte. The information defined in each byte is outlined in the chart below:

<table>
<thead>
<tr>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2xxx0 2xxx3 (bit 0 to 3)</td>
<td>Reserved</td>
</tr>
<tr>
<td>2xxx4 (bit 4)</td>
<td>In Master mode: Not used, always set to zero</td>
</tr>
<tr>
<td></td>
<td>In Slave mode: 0: Communication to master node OK</td>
</tr>
<tr>
<td></td>
<td>1: Communication Error to master node</td>
</tr>
<tr>
<td>2xxx5 (bit 5)</td>
<td>In Slave mode: Not used, always set to zero</td>
</tr>
<tr>
<td></td>
<td>In Master mode: 0: Communication to all slave nodes OK</td>
</tr>
<tr>
<td></td>
<td>1: Communication error to at least one slave node(s). Unlinked node exists.</td>
</tr>
<tr>
<td>2xxx6 (bit 6)</td>
<td>EtherNet/IP Communication Status</td>
</tr>
<tr>
<td></td>
<td>0: OK, 1: Error</td>
</tr>
<tr>
<td>2xxx7 (bit 7)</td>
<td>EtherNet/IP board status</td>
</tr>
<tr>
<td></td>
<td>0: OK, 1: Error</td>
</tr>
</tbody>
</table>

---

**NOTE**

Not all PLC systems are capable of passing 64 words of data. Consult the PLC owner’s manual to determine system maximum I/O capability.

2.1  Card Components

2.1.1  PCU-ETHIO Board

*Figure 2-1: Card Components*

1. RJ45 connector for connection to the Ethernet network
2. Ethernet transmission indicator lamps
2. Hardware Specifications
2.1 Card Components

3. Male SubD 9-pin connector for configuration by RS232 serial link
4. Configuration RS232 port transmission indicator lamps
5. Connector providing access to a discrete input and output through the ApplicomIO functions IO_SetWatchDog and IO_GetDigitalInput (Not used by Motoman functions)
6. Board number configuration jumpers (1 to 8)
   Default configuration: board 1
7. PCI configuration jumper (reserved for Applicom international use)
8. Socket for required 5RS232 module if configuration port is used

### Miscellaneous Characteristics
- Size of the PCU ETHIO board: 174 x 106 mm (excluding connectors and rear panel)
- Consumption: 5.5 W (5V)
- Operating temperature: 0 to +65° C
- Dielectric strength (galvanic isolation): 500 Volts
- MTBF: 100,000 hours

#### 2.1.2 PCU-ETHIO Cabling and Indicators

*Figure 2-2: Card Components*

1. RJ45 connector for connection to Ethernet network
2. Indicator lamps of the Ethernet channel (EtherNet/IP protocol)
   - 2A: Network Status
     - OFF - IP Address not received
     - Blinking Green - IP address received, no CIP connection established
     - ON - Connected
     - Blinking Red - At least one CIP connection is timed out
   - 2B: Module Status
     - OFF - Not powered or card not initialized
     - Blinking Green - Card not configured
     - ON (green) - Card operational
2 Hardware Specifications
2.1 Card Components

- Blinking Red - Minor fault
- Red - Major Fault
  - 2C: Ethernet Link OK
  - 2D: Transmission Speed
    - ON - 100 Mb/s
    - OFF - 10 Mb/s

2. Indicator lamps of the Ethernet channel (other protocols)
  - 2A: Transmission
  - 2B: Reception
  - 2C: Ethernet Link OK
  - 2D: Transmission Speed
    - ON - 100 Mb/s
    - OFF - 10 Mb/s

3. Female SubD 9-pin connector not used

4. Configuration port indicator lamps
  - 4A. Transmission
  - 4B. Reception

5. Connector providing access to a discrete input and output through the functions IO_SetWatchDog and IO_GetDigitalInput.
3 Installation

3.1 Materials

- Single Channel EtherNet/IP Card (P/N 154466-1)
  Includes EtherNet/IP Card and ApplicomIO PC Network Interface software on CD

3.1.1 Board Settings

No board settings are required.

3.1.2 Card Installation

- Remove all power from the controller before installing the DeviceNet PCI Card! Failure to remove power may result in injury or death!

- Follow all Electrical Static Discharge procedures, including use of anti-static straps, to avoid damage to the board. Never touch the mounting surfaces of the board parts directly with fingers.

1. Remove PCI card from static shielding bag.
2. Insert card in the DX100’s CPU rack slot: CPU OPTION 1.
3. Secure card with M3 x 10 screw.

CAUTION

- The EtherNet/IP Card should be installed by qualified personnel who are familiar with the installation and setup of a robotic system.
- The EtherNet/IP Card is not extremely fragile. It is, however, a sophisticated robotic component that can be damaged by rough handling. Be sure to handle all system components with care.

The following procedures outline how to configure the EtherNet/IP card (P/N 154466-1). The settings below should only be used if the end-user has not specified the card configuration.
3.2 Card Configuration

The controller must be properly configured to use the EtherNet/IP Card. The following modifications require the user to be in Maintenance Mode with Management Mode selected. Make certain EtherNet/IP Card is correctly mounted inside the controller and the main power supply is OFF before proceeding.

1. Turn ON main power to DX100 while simultaneously pressing the Main Menu button on the programming pendant. The Main Menu appears.

2. From the Main Menu select System > Security.

3. Select Management Mode.
4. Enter password (99999999).

5. Select System > Setup.

6. Select Option Board.
7. Verify EtherNet/IP board is detected as PCU-ETHIO. Board should be identified in slot CP02#1.

8. Press Select. PCU-ETHIO(CH1) and Device Information list is displayed. Select PCU-ETHIO(CH1).

9. Set IO SIZE (IN/OUT).

10. Select ETHERNET DETAIL and press SELECT.
11. At the NETWORK screen, select HOST SETUP: DETAIL.

12. Enter data in the HOST SETUP screen as specified below.

- Suggested Default Settings:
  - IP Address Setting: Manual
  - IP Address: 192.168.0.10
  - Subnet Mask: 255.255.255.0
  - Default Gateway: 0.0.0.0
  - DNS Settings: Not Used
  - DNS Server: 0.0.0.0
  - Server (Host PC): 0.0.0.0
  - SNTP Setting: Not Used

13. After setting values press the ENTER key to go to the NETWORK screen.

14. Press ENTER again to return to the "PCU-ETHIO" screen. Press ENTER a final time to receive the Modify prompt. Select YES.

15. See Sections 4.3.3 and 4.3.4 to set up the card as Master/Slave (Scanner/Adapter).

16. Press ENTER. The Modify prompt appears. Select YES.
17. After an auditory beep the "OPTION BOARD" menu is again displayed.

18. Press ENTER. Another Modify prompt appears. Press YES.

19. At the IO Module Screen, press ENTER once. Verify that PCU-ETHIO is registered as Station #16 with appropriate IO Count.

20. Press ENTER again. At the Modify prompt select Yes.

21. This completes the software setup in Maintenance Mode. Cycle power to the controller and restart normally.
3.3 Configuration

Sample Network

3.3.1 Definition of Terms and Screenshots

- **Network Screen:**

  ![Network Screen Image]

- **HOST NAME:**
  The computer system that is accessed by a robot controller.

- **DOMAIN NAME:**
  A Domain Name is the text name corresponding to the numeric IP address of a computer on the network. A domain name must be unique.
3.3.2 HOST SETUP Screen

- **IP Address:**
  An identifier for a computer or device on a TCP/IP network. Networks using the TCP/IP protocol route messages based on the IP address of the destination.

- **SUBNET MASK:**
  Subnet enables the network administrator to divide the host part of the address into two or more subnets.

- **DEFAULT GATEWAY:**
  A node on a computer network that serves as an access point to another network.

- **DNS SERVER:**
  Short for Domain Name System (or Service or Server), an Internet service that translates domain names into IP addresses.

- **SERVER (HOST PC):**
  A computer that delivers information and software to other computers linked by a network.

3.3.3 HOST SETUP Screen (Continued / Farther down)
3 Installation
3.3 Configuration

- **SNTP SERVER:**
  Simple Network Time Protocol, which is an adaptation of the Network Time Protocol (NTP) used to synchronize computer clocks in the Internet.

### 3.3.4 Setup with DHCP

- **DHCP:**
  Dynamic Host Configuration Protocol is a protocol for assigning dynamic IP addresses to devices on a network. With dynamic addressing, a device can have a different IP address every time it connects to the network. In some systems, the device's IP address can even change while it is still connected. DHCP also supports a mix of static and dynamic IP addresses.

  Dynamic addressing simplifies network administration because the software keeps track of IP addresses rather than requiring an administrator to manage the task. This means that a new computer can be added to a network without the hassle of manually assigning it a unique IP address.

### 3.3.5 Configuration Example #1 - Robot as Slave to ControlLogix PLC

- **RSLogix 5000 Setup:**
  1. Add Robot to the Ethernet network through the project explorer on the left hand side:
  
  ![Project Explorer Screenshot]
  
  2. Select the ETHERNET-MODULE from the module list.
3. Setup the modules properties to match the properties setup in the robot controller.

**NOTE**
Input Instance ID in PLC = Output Instance ID in Robot
Output Instance ID in PLC = Input Instance ID in Robot
4. If using RSLogix version 18.00.00 or greater, uncheck the setting "Use Unicast Connection over EtherNet/IP". This setting is not available in earlier versions of RSLogix and can be ignored.
3.3.6 Configuration Example #2 - Robot as Master on Ethernet/IP Network

1. Enter the Device Information List setup:

2. The following screen appears. Select a blank definition and press SELECT to add a new device.
3. Enter information for each specific device. Press ENTER when complete.

4. At Modify prompt, select YES to save device configuration.
5. Continue to add devices to the list until all devices for the network have been defined. Press ENTER to return to the initial screen.

6. Press SELECT while PCU-ETHIO DETAIL is selected.
7. Press SELECT on SCANNER DETAIL to define the network setup.

8. The Scanner network is initially blank.
9. Select the first item and press SELECT. MODIFY is the only option, press ENTER.

10. Select the device to be used from the list of previously configured adapters.
11. The device appears in the list. The ID number of the device or order of the devices in the list is not important.

12. Set the IP address for this device.
13. Add remaining devices following the same steps.

14. When list is completely populated press ENTER to return to the PCU-ETHIO menu. Press ENTER at this menu to receive a Modify prompt, select Yes.

15. After the auditory tone, the "OPTION BOARD" menu is again displayed.

16. Press ENTER to receive another Modify prompt. Press YES.
17. At the IO Module Screen, press ENTER once. Verify that PCU-ETHIO is registered as Station #16 with the appropriate IO Count.

18. Press ENTER again. At the Modify prompt select Yes.

19. To complete installation, contact Motoman Service at (937) 847-3200.
3.3.7 Monitoring the Network Status through the DX100 Teach Pendant:

**NOTE** Feature available on software version DS1.60-00 and higher.

1. To monitor the EtherNet/IP Network, select COM MONITOR from the IN/OUT menu.

2. Select the I/O Board to be monitored.

3. View network status.

This screen shows the card configured as an adapter.
For information on network configurations and connections for EtherNet/IP communications, please refer to the ODVA EtherNet/IP Infrastructure Guidelines (Pub 35) located at www.odva.org.