User's Manual

DXAdvanced R3

DX1000/DX1000N/DX2000 EtherNet/IP Communication Interface

vigilantplant®

YOKOGAWA
Yokogawa Electric Corporation

IM 04L41B01-18E
1st Edition

Preface

Thank you for purchasing Daqstation DX1000, DX1000N, or DX2000 (Hereafter, called "DX").
This manual explains the EtherNet/IP communication function of the DX. Read this manual together with other User's Manuals (IM04L41B01-01E, IM04L42B01-01E, and IM04L41B01-17E).

Notes

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History

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Symbols Used in This Manual

- **Units**
  - k: Denotes 1000. Examples: 5 kg, 100 kHz
  - K: Denotes 1024. Example: 640 Kbytes

- **Cautionary notes**
  In this User's Manual, cautionary notes are distinguished by the following symbols:

Refer to corresponding location on the instrument. This symbol appears on dangerous locations on the instrument which require special instructions for proper handling or use. The same symbol appears in the corresponding place in the manual to identify those instructions.

WARNING Calls attention to actions or conditions that could cause serious injury or death to the user, and precautions that can be taken to prevent such occurrences.

CAUTION Calls attentions to actions or conditions that could cause light injury to the user or damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.

Note Calls attention to information that is important for proper operation of the instrument.

- **Bold characters**
  Denotes key or character string that appear on the DX screen.
  The symbol ◇ indicates the key operation and menu selection procedure on the DX.

Assumption of Explanation

The explanation in this manual assumes that the DX is connected via communications with Rockwell Automation's Programmable Logic Controller (PLC) of the Allen-Bradley brand.The basic items for this configuration are explained. For the operation procedures of Rockwell Automation products, see the user's manuals of these products.

This manual is intended for those who have used an Allen-Bradley PLC and EtherNet/IP.

In this manual, the screens of the DX1000 are used. The content displayed on the DX2000 screens are not different from those displayed on the DX1000 screen.

Contents

Introduction of Features

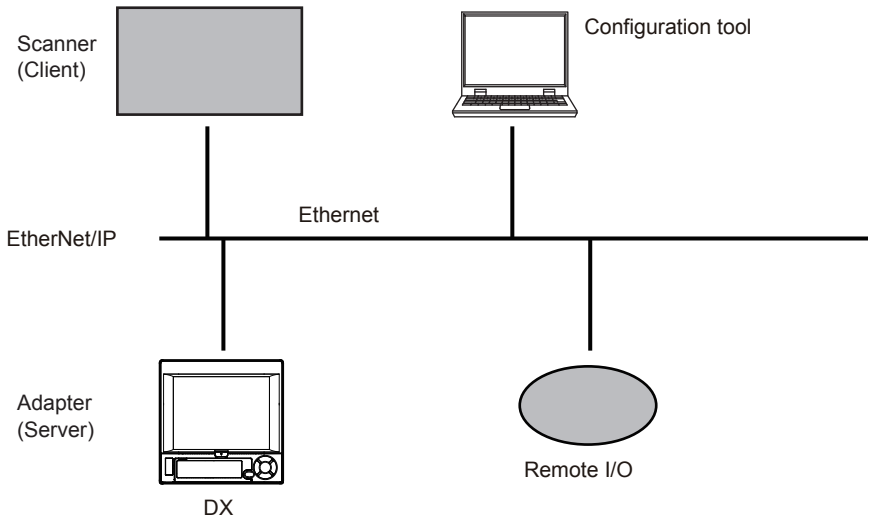
EtherNet/IP

EtherNet/IP is a protocol that extends Common Industrial Protocol (CIP) to Ethernet. The use of Ethernet enables high-speed and periodic exchange of massive control and monitoring data between control devices placed at dispersed locations.

Devices that support EtherNet/IP are available from many vendors. Among them, Rockwell Automation's Programmable Logic Controller (PLC) and Remote I/O of the Allen-Bradley brand are widely used. Yokogawa's DX, equipped with the EtherNet/IP server function, supports communications with these PLCs.

Configuration Components

- Scanner (Client)
  A device that launches a request on EtherNet/IP. This is either a PLC or PC. For the DX, PLCs such as Allen-Bradley PLC-2, PLC-5, SLC 500, MicroLogix, CompactLogix, and ControlLogix represent a Scanner (Client).
- Adapter (Server)
  A remote I/O device that the Scanner (Client) can access to read or write data. The DX is an Adapter (Server).
- Configuration tool
  A tool used to configure the system. This is either a PC on which configuration software has been installed or the software itself.
  Rockwell Automation RSLogix500 and RSLogix5000 and the communication driver software RSLinx are configuration tools.



Note

For details of EtherNet/IP, see the information supplied by the Open DeviceNet Vender Association (ODVA).

What the DX Can Do

The DX provides the following functions:

- Participate in an EtherNet/IP network as an Adapter (Server).
- Communicate with new and old Allen-Bradley PLCs such as MicroLogix, CompactLogix, ControlLogix, SLC 500, PLC-5, and PLC-2.
- Support both Explicit and I/O messages.
- PLCs can access internal data of the DX.

Data	Access
Measurement channel data	Read
Computation channel*1 data	Read
Communication input data*1*2	Read/write
External input channel data*3	Read/write

*1 Optional (/M1 and /PM1).

*2 Communication input data, if coded in a calculation expression in the computation channel, can be displayed on the DX.

*3 This function is available only on the DX2000. Optional (/MC1).

The following shows examples of usage.

- Data on devices on a network can be recorded by a PLC to the DX.
- Data measured by the DX can be acquired by a PLC.

Settings of the DX

The DX is ready to use after the following settings have been made.

- IP address and other settings required to connect to Ethernet
- Enabling of EtherNet/IP server function

Access to the DX

The DX is a passive device on an Ethernet network. The DX cannot launch a request. A PLC launches a request to the DX.

A request is called a "message". There are two message types: Explicit message and I/O messages (Implicit message). An Explicit message, included in control logic, is used to access the DX, only when required, and transmit data. An I/O message is used to transmit pre-specified DX data at intervals.

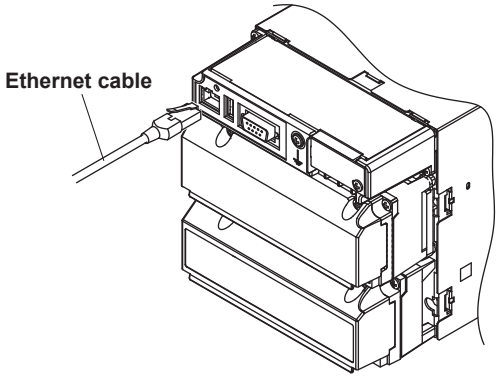
The DX supports communications with old-model Allen-Bradley PLCs not compatible with EtherNet/IP. The DX can also communicate with PLCs compatible with Programmable Controller Communication Command (PCCC) using conversion of PCCC to EtherNet/IP at the gateway. PCCC refers to serial communications that are also called DF1 communications.

The DX supports EtherNet/IP in which PCCC requests are encapsulated. It can communicate also with PLCs that support encapsulated PCCC.

Connection to a Network

Cable Connection

Connect the Ethernet cable to the Ethernet port provided on the back of the DX.



CAUTION

Be sure to connect an Ethernet cable with an FCC-compliant plug. Otherwise, the MV may malfunction.

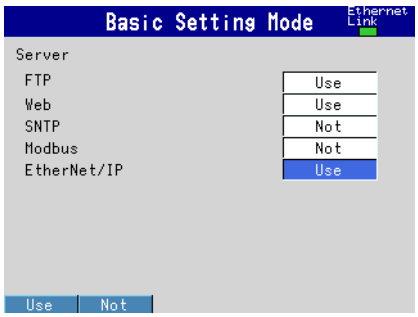
Settings of the DX

IP Address, Host Information, and DNS Setting, etc.

See Section 1.3 of the *Communication Interface User's Manual (IM04L41B01-17E)*.

EtherNet/IP Server Settings

◇ Press **MENU** (to switch to setting mode), hold down **FUNC** for 3 s (to switch to basic setting mode), and select the **Menu** tab > **Communication (Ethernet)** > **Server** > **Server modes**.



- **Server**
  Set **EtherNet/IP** to **Use**.

Note

The EtherNet/IP server settings can be checked on the Network Information Screen of the DX. You can open the Network Information Screen by pressing the **FUNC** > **Network info** soft key.

Other

When the DX is in the basic setting mode, communications are available but input/output data is invalid.

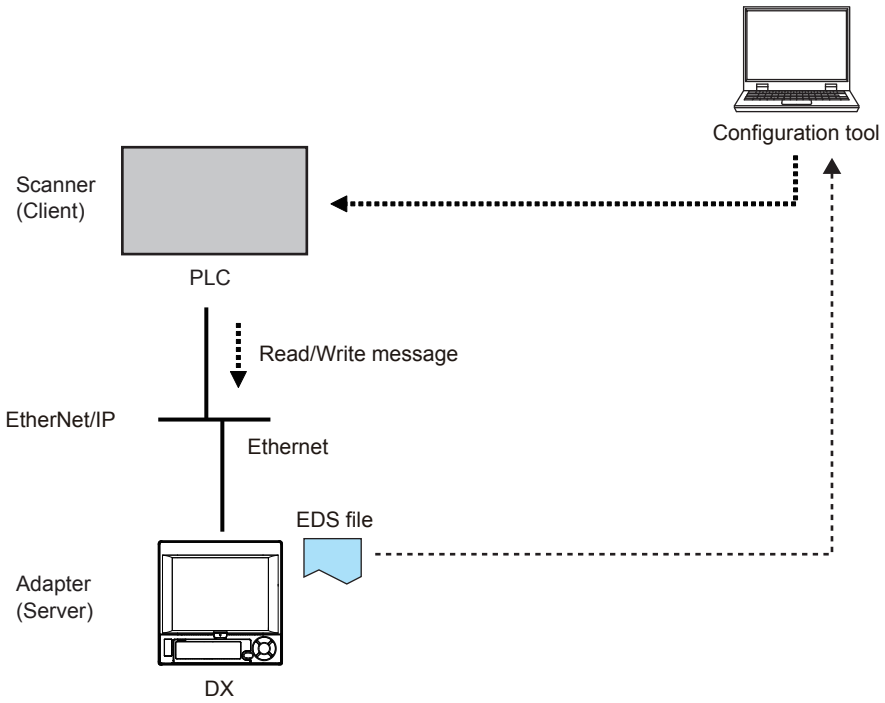
Preparation for PLC

EDS File

Installation

To have the DX participate in a network, first install the DX device profile (Electronic Data Sheet; EDS file) in the configuration tool. A PLC communicates with the DX based on the information in the EDS file.

Conduct installation using the "EDS Hardware Installation Tool" of RSLinx. For information on using the configuration tool, see the user's manual of the configuration tool.



How to Obtain the EDS File

Obtain the EDS file from the Yokogawa Web site:

URL: www.yokogawa.com/ns/dxadv/download/

System Configuration

Use the configuration tool to make the communication settings.

Use RSLinx, RSLogix500, or RSLogix5000 to make an Explicit message or I/O message, download it to the PLC, and execute it.

For information on using the configuration tool and a PLC, see the user's manuals of these products.

Explicit Message

An Explicit message is a point-to-point, request/response-type communication.

System Configuration on PLC

Use the configuration tool to code an Explicit message as an MSG instruction in the control logic. In the MSG instruction, set all the information including a target device, target register, and read/write. Download the created control logic to a PLC and execute it.

On the DX, the data count to be accessed per MSG instruction should be 100 or less.

In Case of PLC-2, PLC-5, and SLC

- **Commands**

  When creating an MSG instruction, specify a command. The DX supports the following commands:

Target PLC	Command name
PLC-2	PLC2 Unprotected Read/Write
PLC-5	PLC5 Word Range Read/Write
	PLC5 Typed Read/Write
SLC	SLC Typed Read/Write

- **Specification of data to be accessed**

  Specify which of the data in the DX should be accessed. The PLC-2, PLC-5, and SLC manage data to be accessed in units of "files."

  For an external input channel, separate access destinations are used for reading and writing.

Command: PLC2 Unprotected Read/Write

Data to be accessed		File number
Type	Number	Data type: INT16
Measurement channel	1	1000
	2	1001
	• • •	• • •
	47	1046
	48	1047
Computation channel	101	2000
	102	2001
	• • •	• • •
	159	2058
	160	2059
Communication input data	C01	3000
	C02	3001
	• • •	• • •
	C59	3058
	C60	3059
External input channel (for writing)	201	4000
	202	4001
	• • •	• • •
	439	4238
	440	4239
External input channel (for reading)	201	4500
	202	4501
	• • •	• • •
	439	4738
	440	4739

"• • •" stands for data in numerical order.

Commands: PLC5 Word Range Read/Write, PLC5 Typed Read/Write, and SLC Typed Read/Write

Data to be accessed		File number		
Type	**Number**	**Data type INT16**	**Data type INT32**	**Data type FLOAT**
Measurement channel	1	N10:00	L10:00	F10:00
	2	N10:01	L10:01	F10:01
	• • •	• • •	• • •	• • •
	47	N10:46	L10:46	F10:46
	48	N10:47	L10:47	F10:47
Computation channel	101	N20:00	L20:00	F20:00
	102	N20:01	L20:01	F20:01
	• • •	• • •	• • •	• • •
	159	N20:58	L20:58	F20:58
	160	N20:59	L20:59	F20:59
Communication input data	C01	N30:00	L30:00	F30:00
	C02	N30:01	L30:01	F30:01
	• • •	• • •	• • •	• • •
	C59	N30:58	L30:58	F30:58
	C60	N30:59	L30:59	F30:59
External input channel (for writing)	201	N40:00	L40:00	F40:00
	202	N40:01	L40:01	F40:01
	• • •	• • •	• • •	• • •
	439	N42:38	L42:38	F42:38
	440	N42:39	L42:39	F42:39
External input channel (for reading)	201	N45:00	L45:00	F45:00
	202	N45:01	L45:01	F45:01
	• • •	• • •	• • •	• • •
	439	N47:38	L47:38	F47:38
	440	N47:39	L47:39	F47:39

Specify a data address, for example, as N10:0 (where N is INT16, the file number is 10, and the element number is 0).
Use only N file for command, "PLC5 Word Range Read/Write"
"• • •" stands for data in numerical order.

In Case of CompactLogix, etc.

- **Command: CIP Data Table Read/Write**

  The DX supports the following commands:

Target PLC	Command name
CompactLogix, etc.	CIP Data Table Read/Write

- **Specifying data to be accessed**

  Specify which of the data in the DX should be accessed. For Logix, data can be accessed by a "tag name".

  For an external input channel, separate access destinations are used for reading and writing.

Data to be accessed		Tag name		
Type	**Number**	**Data type INT16**	**Data type INT32**	**Data type FLOAT**
Measurement channel	1	int[1000]	int[1000]	real[1000]
	2	int[1001]	dint[1001]	real[1001]
	• • •	• • •	• • •	• • •
	47	int[1046]	dint[1046]	real[1046]
	48	int[1047]	dint[1047]	real[1047]
Computation channel	101	int[2000]	dint[2000]	real[2000]
	102	int[2001]	dint[2001]	real[2001]
	• • •	• • •	• • •	• • •
	159	int[2058]	dint[2058]	real[2058]
	160	int[2059]	dint[2059]	real[2059]
Communication input data	C01	int[3000]	dint[3000]	real[3000]
	C02	int[3001]	dint[3001]	real[3001]
	• • •	• • •	• • •	• • •
	C59	int[3058]	dint[3058]	real[3058]
	C60	int[3059]	dint[3059]	real[3059]
External input channel (for writing)	201	int[4000]	dint[4000]	real[4000]
	202	int[4001]	dint[4001]	real[4001]
	• • •	• • •	• • •	• • •
	439	int[4238]	dint[4238]	real[4238]
	440	int[4239]	dint[4239]	real[4239]
External input channel (for reading)	201	int[4500]	dint[4500]	real[4500]
	202	int[4501]	dint[4501]	real[4501]
	• • •	• • •	• • •	• • •
	439	int[4738]	dint[4738]	real[4738]
	440	int[4739]	dint[4739]	real[4739]

"• • •" stands for data in numerical order.

Data Type

For a PLC, you can specify the type of read or write data using a file number or tag name in a command. However, the data type is fixed to INT16 for commands "PLC2 Unprotected Read/Write" and "PLC5 Word Range Read/Write."

On the other hand, the data types on the DX are determined as shown in the following section, "Data on the DX". For values to be used when the data type specified for a PLC in a command is different from the type of data on the DX, see "Communication Considerations" (on Page 14).

Data on the DX

Data Count

The data count on the DX is as follows:

Model	Measurement channel		Computation channel		Communication input data		External input channel	
	Count	Number	Count	Number	Count	Number	Count	Number
DX1002	2	001 – 002	12	101 – 112	24	C01 – C24	-	-
DX1004	4	001 – 004						
DX1006	6	001 – 006	24	101 – 124				
DX1012	12	001 – 012						
DX2004	4	001 – 004	12	101 – 112	60	C01 – C60		
DX2008	8	001 – 008						
DX2010	10	001 – 010	60	101 – 160			240	201 – 440
DX2020	20	001 – 020						
DX2030	30	001 – 030						
DX2040	40	001 – 040						
DX2048	48	001 – 048						

Data Type

The data types on the DX are shown in the following table:

Data	Data type		Remarks
Measurement channel data	INT16	16-bit signed integer	To acquire a physical value, it is necessary to obtain the decimal place and unit information in advance.
Computation channel data	INT32	32-bit signed integer	
Communication input data	FLOAT	32-bit floating-point number	-
External input channel data	INT16	16-bit signed integer	To acquire a physical value, it is necessary to obtain the decimal place and unit information in advance.

I/O Messages

System Configuration on PLC

An I/O message is also called an Implicit message. An I/O message is used to transmit pre-specified I/O data at intervals. An I/O message is exchanged via a connection path which is first set in RSLinx and read into RSLogix. A connection path defines the IP address of the DX, communication port of the PLC, and distinction of input/output.

A device, once configured in RSLinx, can be downloaded into an RSLogix project. The DX is configured as a "Generic Ethernet Module" in RSLogix.

Instance ID

Each data on the DX corresponds to the instance ID of an Assembly object. In an I/O message, use an instance ID to code the data on the DX to be accessed. The following table lists instance IDs, sizes, and data types.

Type	Number	Operation type	Instance ID	Size	Data type
Measurement channel	001 – 048	Producer	110	192 (4 x 48)	INT32
	001 – 048	Producer	115	192 (4 x 48)	FLOAT
Computation channel	101 – 160	Producer	120	240 (4 x 60)	INT32
	101 – 160	Producer	125	240 (4 x 60)	FLOAT
Communication input data	C01 – C60	Producer / Consumer	130	240 (4 x 60)	INT32
	C01 – C60	Producer / Consumer	135	240 (4 x 60)	FLOAT
External input channel	201 – 300	Producer / Consumer	140	400 (4 x 100)	INT32
	301 – 400	Producer / Consumer	141	400 (4 x 100)	INT32
	401 – 440	Producer / Consumer	142	160 (4 x 40)	INT32
	201 – 300	Producer / Consumer	145	400 (4 x 100)	FLOAT
	301 – 400	Producer / Consumer	146	400 (4 x 100)	FLOAT
	401 – 440	Producer / Consumer	147	160 (4 x 40)	FLOAT
	201 – 300	Producer	150	400 (4 x 100)	INT32
	301 – 400	Producer	151	400 (4 x 100)	INT32
	401 – 440	Producer	152	160 (4 x 40)	INT32
	201 – 300	Producer	155	400 (4 x 100)	FLOAT
	301 – 400	Producer	156	400 (4 x 100)	FLOAT
	401 – 440	Producer	157	160 (4 x 40)	FLOAT
-		Configuration	190	0	-
-		Producer / Consumer	191	0	-

Explanation

- The DX data can be accessed using the INT32 or FLOAT type. Data can be accessed by the type based on the specified instance ID.
- The operation type "Producer" indicates a read-only instance and "Producer/ Consumer" indicates a read/write instance.
- For an external input channel, instance IDs 150 to 157 are for reading and 140 to 147 are for writing.

Data on the DX

See the explanation in the previous section on Explicit messages.

Communication Considerations

About Communication Interval

Data Update

The DX data is updated in a scan interval. Even if a PLC accesses the data at shorter intervals than the DX scan intervals, the data is updated only at scan intervals.

Communication Interval

A PLC should access the DX at intervals of 125 ms or longer.

* This is required to maintain compatibility with other protocols supported by the DX than EtherNet/IP.

Access to Non-existent Data

If non-existent data is accessed, either of the following operations occur.

- 0 is read if non-existent data is read.
- Nothing is done if non-existent data is written.

When the DX Data Type Differs from the Data Type Specified in a Command

Each data on the DX has a fixed data type.

Data on the DX which includes special data accessed using the same data type is transmitted unchanged. Data on the DX accessed using a different data has its data type converted. The following explains the conversion rules:

Reading Data on the DX

DX		Data type to be specified in a command		
Type	**Data type**	**INT16**	**INT32**	**FLOAT**
Measurement channel	INT16	The data is read without change.	The data is converted into INT32 (including special data).	The data is computed based on the decimal point information set in each channel.*1
Computation channel	INT32	There are limitations of INT16.*2	The data is read without change.	The data is computed based on the decimal point information set in each channel.*1
Communication input data	FLOAT	The data is converted to INT16.	The data is converted to INT32.	The data is read without change.
External input channel (for reading)	INT16	The data is read without change.	The data is converted into INT32 (including special data).	The data is computed based on the decimal point information set in each channel.*1

*1 Special data will have the following values:

Data	Value
+ Over	7f800000H (+∞)
– Over	ff800000H (–∞)
Skip	ff800002H (Nan)
Error	ff800004H (Nan)
INVALID	ff800005H (Nan)
Burnout (Up)	7f800006H (Nan)
Burnout (Down)	ff800006H (Nan)

*2 The following values are used.

Data	Value
+ Over	32767
– Over	–32768
Skip	–32768
Error	–32768
INVALID	–32768
Less than -32768	–32768
More than 32767	32767
Other than the above	The data is read without change as INT16.

Writing Data to the DX

DX		Data type to be specified in a command		
Type	**Data type**	**INT16**	**INT32**	**FLOAT**
Communication input data	FLOAT	The data is written without change.	The data is written without change.	The data is written without change.
External input channel (for writing)	INT16	The data is written without change.*1	The data is written without change.*1	The data is converted to INT16.*2

*1

Input value	DX value
More than 30000	7FFFH
–30000 to 30000	The data is written without change.
Less than –30000	8001H

*2 The data is converted as follows:
A FLOAT value with the same number of decimal places as the one specified for the channel is converted to INT16. Other numbers are ignored.
Example: If the number of decimal places of channel 201 is "2" (For example, the range can be set is from -200.00 to 200.00),
A FLOAT value up to two decimal places is rounded to an integer. See the example in the following table.

Input value FLOAT	DX value INT16 (fixed point)
12.34	1234
12.6	1260
0.0012	0
0.004	0
0.005	1
300.00	30000
300.01	7FFFH (+ Over)
–300.00	–30000
–300.01	8001H (– Over)

The following values are written.

Input value (value after conversion)	DX value
More than 30000	7FFFH
–30000 to 30000	The data is written without change.
Less than –30000	8001H

Specifications

The following table shows the basic specifications of the EtherNet/IP server function of the DX.

Specifications	Description
Implementation level	Level 2 (Message Server + I/O Server)
Maximum number of connections	20 connections (10 sessions)*1*2
Ports used	44818/tcp, 44818/udp, 2222/udp*3
Supported protocols	EIP/PCCC, EIP/native*4
Messaging	Explicit (UCMM, Class 3) + I/O (Class 1)
Object	Assembly, PCCC, Data Table*5
Authentication	File No. 10591 (Sep 4, 2007)

*1 A "session," a framework of connection management in the encapsulation protocol layer of EtherNet/IP, provides similar functions as a TCP connection to carry out message communications.

*2 Although multiple connections can be made in one session, the total number of connections cannot exceed the maximum number of connections.

*3 44818/tcp is used mainly for Explicit messages, 2222/udp for I/O messages, and 44818/udp for communications of response to RSWho of RSLinx.

*4 CSP/PCCC (Allen Bradley Ethernet) is not supported.

*5 The description of common object is omitted.

Example of an Explicit Message Using RSLogix 5000

This is an example of using RSLogix 5000 to configure an Explicit message to be sent to the DX by a PLC supporting the CIP Data Table Read/Write command.
This section assumes that the reader is familiar with the operations of RSLogix 5000 and RSLinx and that RSLogix 5000 can communicate with the target DX via RSLinx.

Tag

Making tags initially will be useful. Go to Controller Organizer (a tree on the left side of the screen) and open Controller Tag to make a tag with Data Type of Message (Name the tag as MSG1). Also, make a tag used to retain data to be written to the DX (Name the tag as DATATransfer and store 10 FLOAT values). Make a bit used to launch a message as WriteMessageBit.

Controller Tags

Name	Data Type
DATATransfer	REAL[10]
MSG1	Message
WriteMessageBit	BOOL

MSG Instruction

Go to the Input/Output tab, then the Ladder Element toolbar to select MSG. The MSG block is inserted as ladder output. Tag MSG1 is assigned to the MSG block.

Make the MSG block settings (Click the ... button in the MSG block). The following shows an example in which the PLC writes data to the communication input data C01 to C10 on the DX.
Set the Message Type as "CIP Data Table Write," Source Element as "DATATransfer" (a tag in the PLC described earlier), Number of Element as "10" (which can be set to a larger value if more data should be read or written per message). Set the Destination Element as "real[3000]. "This corresponds to communication input data C01 on the DX.

Message Configuration

Configuration Tab	
Message Type	CIP Data Table Write
Source Element	DATATransfer
Number Of Element	10
Destination Element	real[3000]

Next, go to the Communication tab and set a connection path to the DX. The path name should consist of the PLC Ethernet port name (LocalENB in this example), comma, 2, comma, and the DX IP address in this order.

Message Configuration

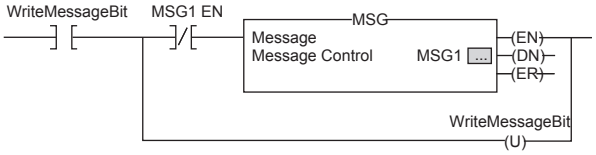
Communication Tab	
Path	LocalENB,2,192.168.1.126

If the connection path to the DX is configured using RSLinx, the connection path is changed to an automatically named pathname (DXADV of ETHERNET-MODULE DXADV shown in the figure below in this example). If the DX is not configured, the I/O Configuration tree does not show ETHERNET-MODULE DXADV. The connection path in the Communication tab is not replaced, either.

I/O Configuration

Message Launch Logic

Lastly, configure the message launch logic. In the example shown in the figure below, the MSG block is launched and writes data to the DX when the WriteMessageBit is On. At the same time, the WriteMessageBit is changed to Off and writing is ended.



Example of I/O Message Using RSLogix 5000

Connection with DX

First, define the connection with DX using RSLinx. Go to Communication on the menu bar and select Configure Drivers.

Next, select Ethernet Devices and click Add New....

Enter a driver name. In this example, DXADV is entered but other names can also be entered.

Enter the IP address of DX and click OK.

DX is displayed on the RSWho list of RSLinx.

Configuration of Communication Settings

Open RSLogix 5000 and select a PLC used to communicate with DX. Right-click Ethernet in I/O Configuration and select New Module.

Click + to open the list. Select ETHERNET-MODULE and click OK. An ETHERNET-MODULE setup window will open.

The following shows an example of reading data in measurement channels 001 to 010 and writing the data to communication input data C01 to C20. Data can be accessed using the INT32 type.

In the Name field, enter DXADV (or other communication connection name). Since data is accessed using INT32, keep Comm Format as Data-DINT. In IP Address, enter the IP address of DX.

In Connection Parameter, define the input and output. In Input and Output, enter a respective instance ID and size. In Configuration, enter an instance ID of 190 and a size of 0.

New Module

Name	DXADV
Comm Format	Data-DINT
Address/Host Name	
IP Address	10.0.232.126

Connection Parameter			
	Assembly Instance	**Size**	
Input	110	10	(32-bit)
Output	130	20	(32-bit)
Configuration	190	0	(8-bit)

Tag

In Controller Tag, the DXADV:I and DXADV:O tags to be used in control logic have been made. Click + to expand the tag and see all the points of a size specified in the module definition.