CP-series Function Block Practices Guide

Ethernet Send/Receive Data

■ Introduction

This guide describes examples of using function blocks.

Omron does NOT warrant that the function blocks work properly at all times in actual programs and machines.

Please obtain the user's manuals of the used devices and be sure to understand the important precautions and reminders described on the manuals before attempting to start operation.

■ Intended Audience

This guide is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).

- Personnel in charge of installing FA systems
- Personnel in charge of designing FA systems
- Personnel in charge of managing FA systems and facilities

■ Related Manuals

Cat. No.	Model	Manual name
W613 (CP2E)	CP2E-E□□D□-□ CP2E-S□□D□-□ CP2E-N□□D□-□	CP Series CP2E CPU Unit Hardware User's Manual
W614 (CP2E)	CP2E-E□□D□-□ CP2E-S□□D□-□ CP2E-N□□D□-□	CP Series CP2E CPU Unit Software User's Manual
W483 (CP1E/CP2E)	CP1E-E□□D□-□ CP1E-N□□D□-□ CP2E-E□□D□-□ CP2E-S□□D□-□ CP2E-N□□D□-□	CP Series CP1E/CP2E CPU Unit Instructions Reference Manual
W446	CXONE-AL□□D-V4	CX-Programmer Ver.9.□ Operation Manual
W342	CS/CJ/CP/NSJ Series	Communications Commands Reference Manual

Practices Guide

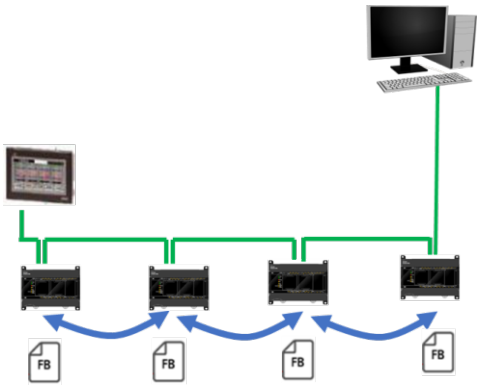
1 Ethernet Send/Receive Data Function Blocks

Function Blocks to Exchange Data between the CP2E CPU Units Using Built-in Ethernet Ports

1.1 Overview of Function Blocks

Data can be exchanged between the CP2E-N-type CPU Units using the built-in Ethernet ports.

The function blocks to send and receive data simplify data exchange between CP2E-N-type CPU Units. No complicated programming is required.



This guide provides two examples.

1) Complete link method

Each CP2E-N-type CPU Unit exchanges data with all other CP2E-N-type CPU Units.

Each node sends data to the other nodes to share data.

Node A 		Node B 		Node C 		Node D 
Local area (A)	→	A	→	A	→	A
B	←	Local area (B)	→	B	→	B
C	←	C	←	Local area (C)	→	C
D	←	D	←	D	←	Local area (D)

2) Polling Unit link method

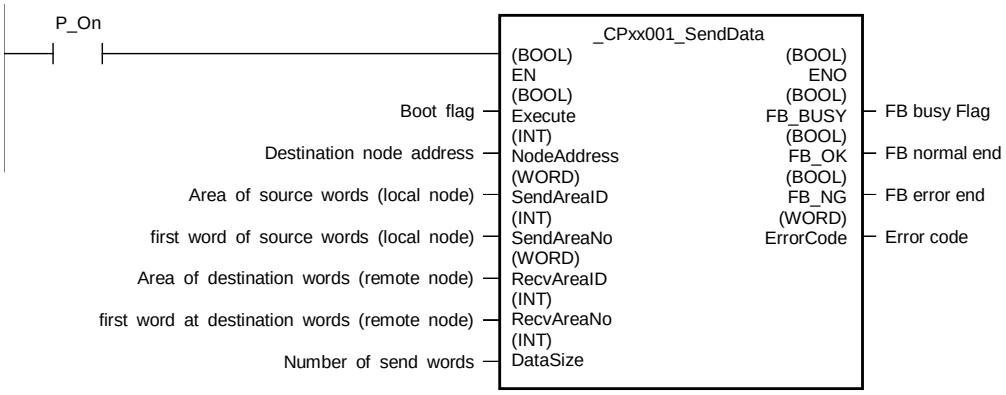
The Polling Unit exchanges data with all Polled Units, and each Polled Unit exchanges data only with the Polling Unit. The Polling Unit sends data to all Polled Units and receives data from each Polled Unit. The advantage of the Polling Unit link method is that the addresses allocated for the local Polled Unit data are the same in each Polled Unit, allowing data to be accessed using common ladder programming.

Polling Unit: Node A 		Polled Unit: Node B 		Polled Unit: Node C 		Polled Unit: Node D 
Local area (A)	→	A	→	A	→	A
B	←	Local area (B)		Local area (C)		Local area (D)
C	←	(Not used)		(Not used)		(Not used)
D	←	(Not used)		(Not used)		(Not used)

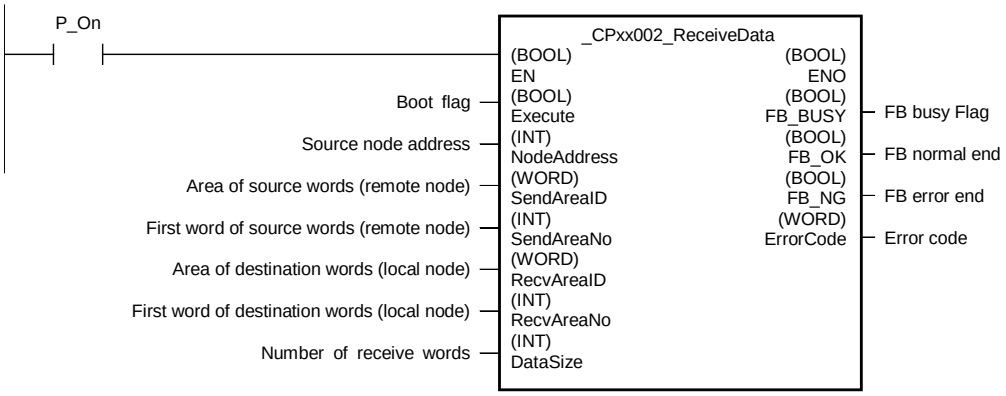
1.2 Function Block to Use

The Send Data: _CPxx001_SendData Function Block to send data from the built-in Ethernet port to a node on the local network and the Receive Data: _CPxx002_ReceiveData Function Block to receive data from a node are used for data exchange. For details on the function blocks, refer to *Specifications of Function Blocks*.

Send Data: _CPxx001_SendData Function Block



Receive Data: _CPxx002_ReceiveData Function Block

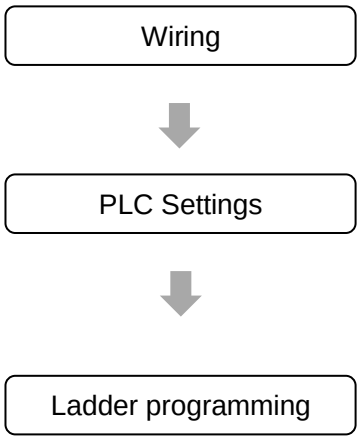


Precautions for Correct Use of Function Blocks

- These function blocks use the automatic allocation function of the logical communications ports for network communications instructions.
  Use exclusive control in the ladder program so that 9 or more instructions (_CPxx001_SendData, _CPxx002_ReceiveData, SEND/RECV/CMND instructions) are not executed at the same time.
- The destination unit address is always set to CPU (#00).
- The destination network address is always set to local network (#00). The CP2E-N-type CPU Unit cannot be used as a rely node for the network.
- The maximum number of FINS/TCP connections for the built-in Ethernet port of the CP2E-N-type CPU Unit is 3. When you use FINS/TCP, up to 3 connections can be used at a time.

2 Operating Procedure

Exchange data between the CP2E CPU Units via the built-in Ethernet ports using FINS/UDP.



Connect the CP2E CPU Units using Ethernet cables.

Make built-in Ethernet settings at PLC Settings in the CX-Programmer and transfer the settings to the CP2E CPU Units.
When power is turned ON, setting is read by CPU Unit

Insert the function blocks to send or receive data and execute them.

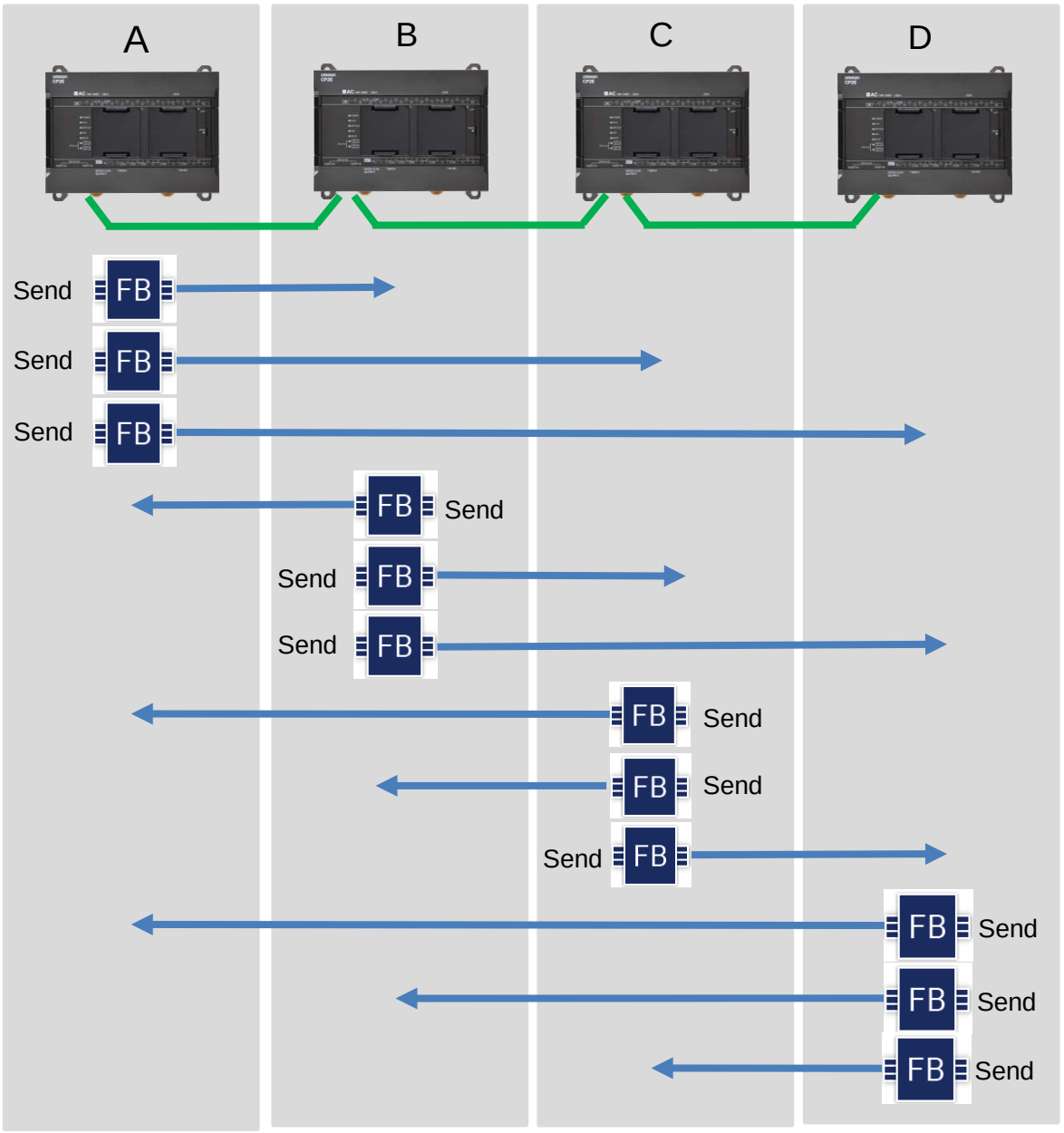
3 Programming Examples

3.1 Complete Link Method

Data is exchanged between four CP2E-N-type CPU Units. Each node sends data in 100 words of the Data Memory Area (D) to the other node to exchange data between CP2E CPU Units. Use the Send Data: _CPxx001_SendData Function Block.

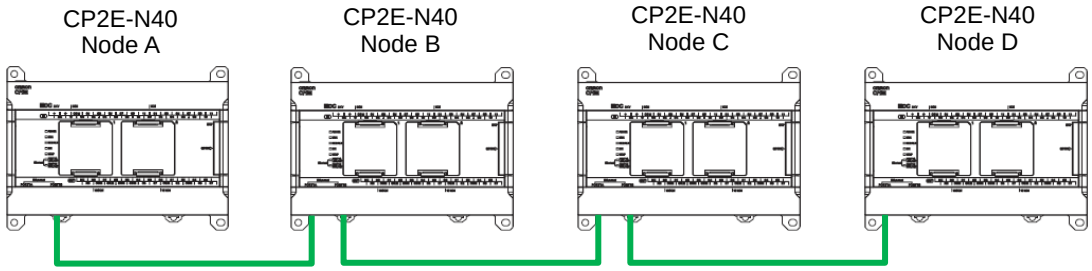
IP addresses, FINS node addresses, and areas for data exchange of the CP2E CPU Units are as follows:

	Node A		Node B		Node C		Node D
IP address	192.168.250.10		192.168.250.11		192.168.250.12		192.168.250.13
FINS node address	10		11		12		13
D10000-D10099	Local area (A)	→	A	→	A	→	A
D10100-D10199	B	←	Local area (B)	→	B	→	B
D10200-D10299	C	←	C	←	Local area (C)	→	C
D10300-D10399	D	←	D	←	D	←	Local area (D)



3.1.1 Wiring Example

Connect the CP2E CPU Units using Ethernet cables.



* CP2E-N30/40/60 CPU Unit: Both PORT1A and PORT1B can be used for connection.

* CP2E-N14/20 CPU unit: Use a switching hub to connect the CP2E CPU Unit.

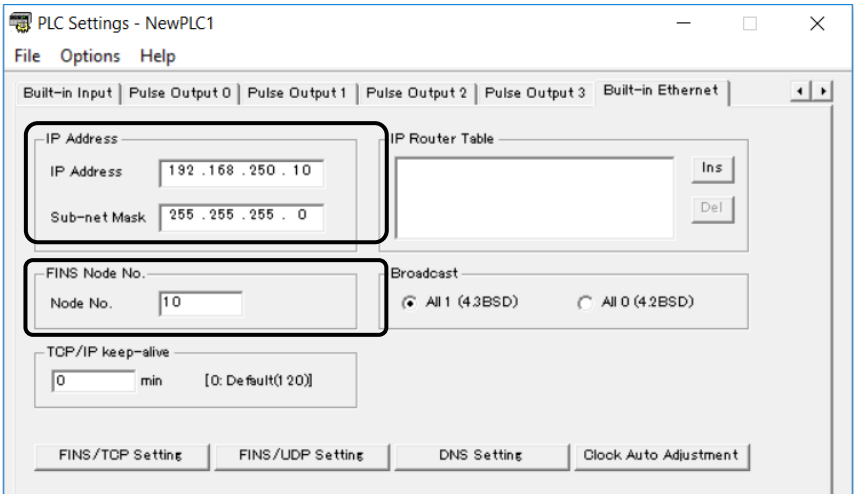
3.1.2 PLC Settings Example

(1) Ethernet Setting

Start the CX-Programmer.

Select the Built-in Ethernet Tab in the PLC Settings.

Set the IP address, subnet mask, and FINS node number of each CP2E CPU Unit.



Setting example

Item	Node A	Node B	Node C	Node D
IP Address	192.168.250.10	192.168.250.11	192.168.250.12	192.168.250.13
Sub-net Mask	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
FINS Node No.	10	11	12	13

Details of settings

Item	Description
IP Address	Set the local IP address.
Sub-net Mask	Set the subnet mask.
FINS Node No.	Set the FINS node address. Set the same value as the host ID (last 1 byte) of the IP address. In the above example (IP address = 192.168.250.10), the FINS node address is 10.

You don’t need to change the default FINS/UDP settings. (Change the settings according to the system configuration if required.)

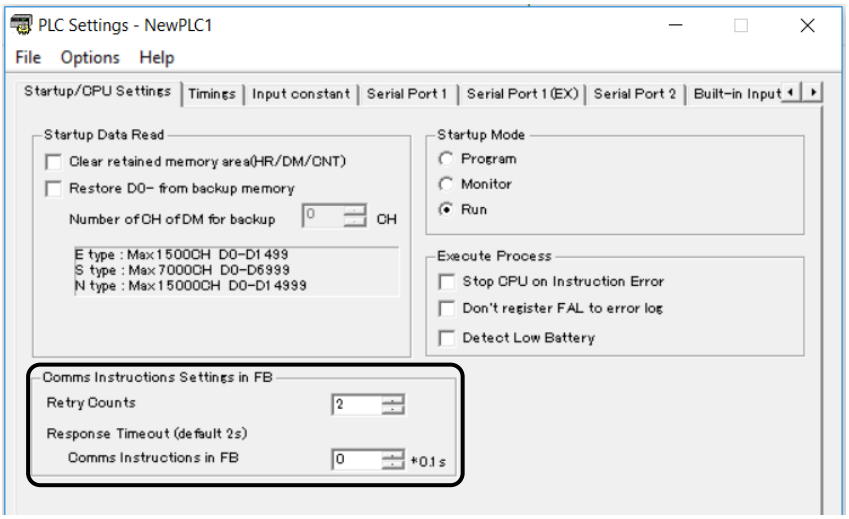
- FINS/UDP Port: 9600
- Conversion: Auto (dynamic)

- FINS/UDP Option: Destination IP is changed dynamically

(2) Communications Setting

Select the Startup/CPU Settings Tab in the PLC Settings.

Set the retry counts and response timeout in the *Comms Instructions Settings in FB* Field.



Setting example

Item	Node A	Node B	Node C	Node D
Retry Counts	2	2	2	2
Response Timeout	0 (default: 2 s)	0 (default: 2 s)	0 (default: 2 s)	0 (default: 2 s)

Details of settings

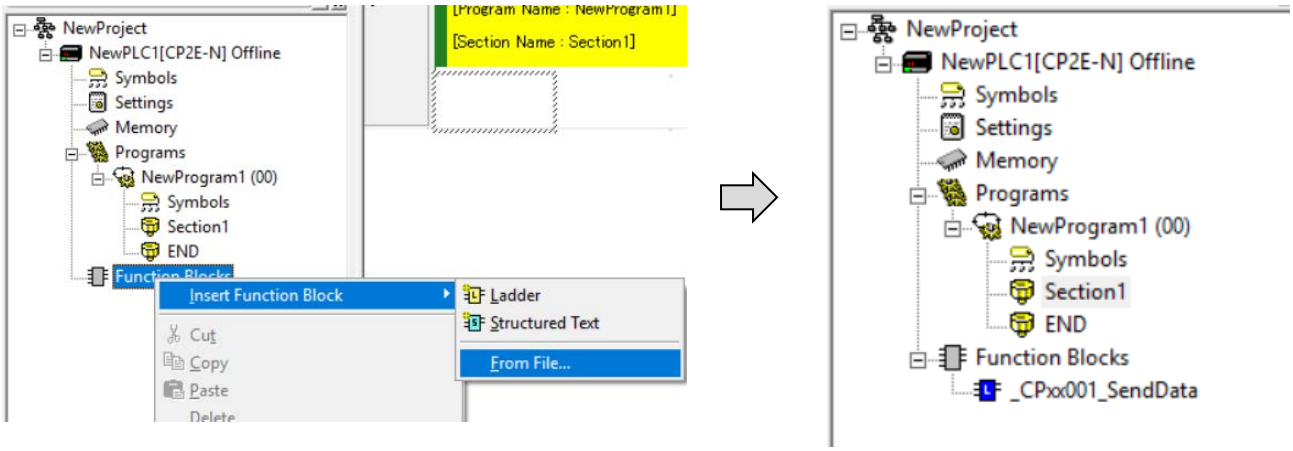
Item	Description
Retry Counts	Set the number of retries of communications instructions used in the function block.
Response Timeout	Set the FINS response monitoring time of the function block.

3.1.3 Ladder Programming Example

(1) Inserting the Function Block

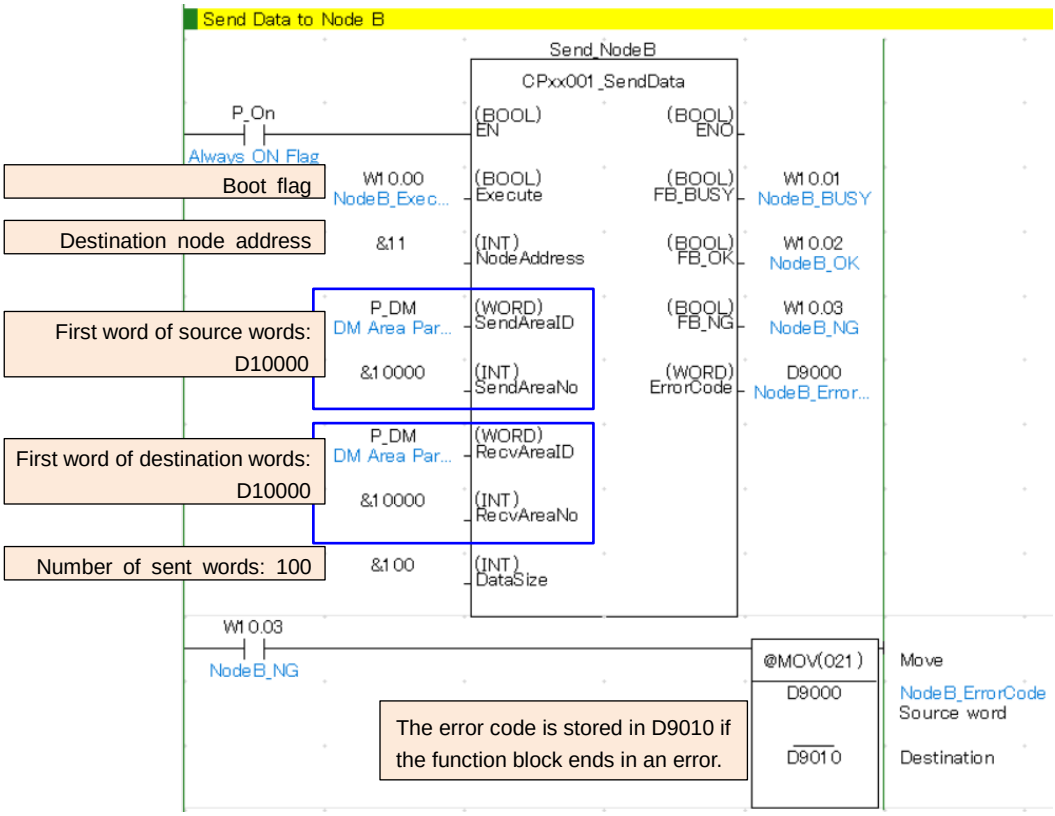
Save the Send Data: _CPxx001_SendData Function Block file to your PC beforehand.

Right-click ***Function Blocks*** at the project workspace in the CX-Programmer and select ***Insert Function Blocks*** - ***From File*** from the pop-up menu to load the _CPxx001_SendData.cxf file.



(2) Ladder Programming Example for Node A

Create a program to send data from Node A to Node B.

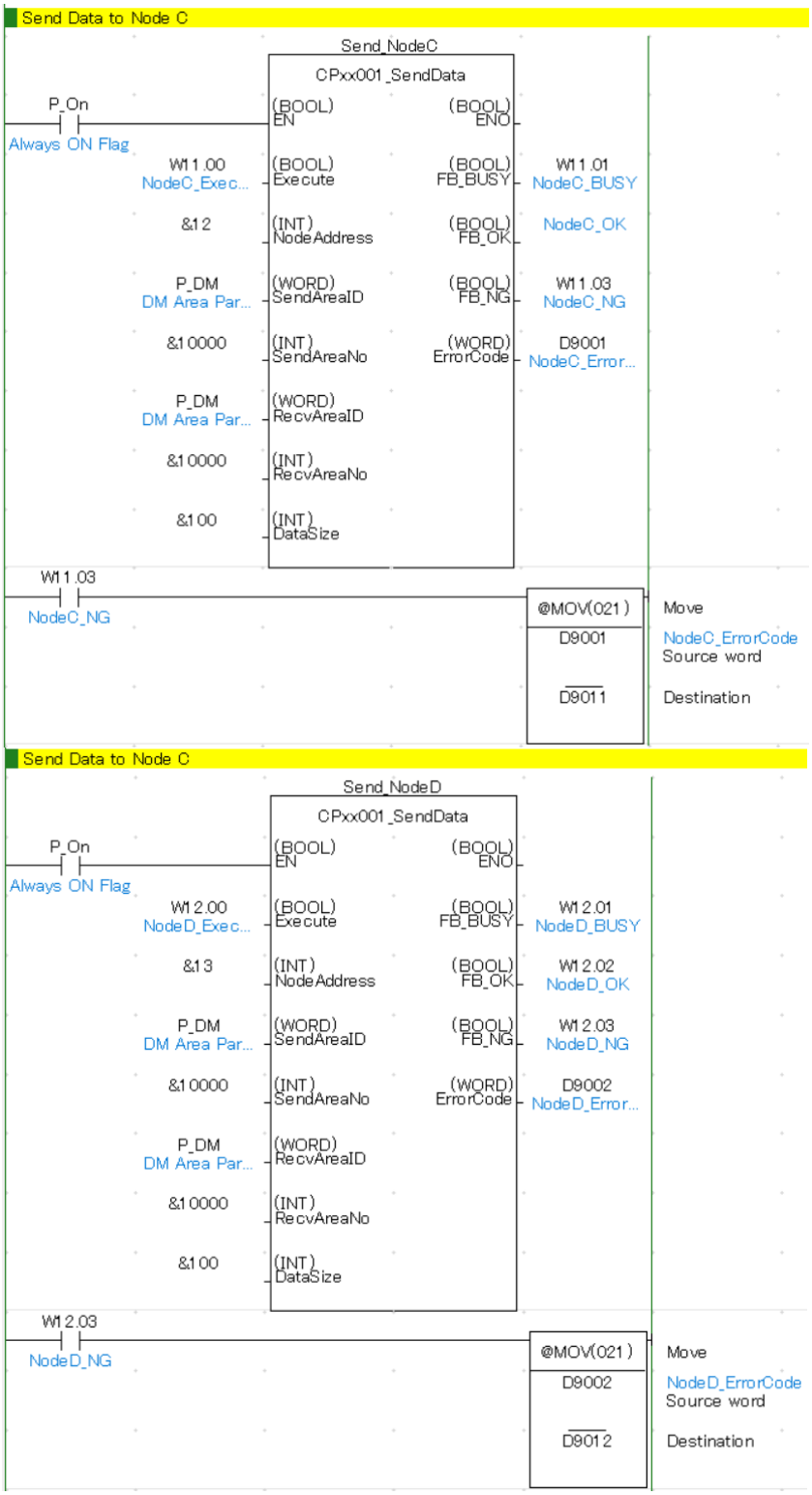


- The function block sends data in 100 words from D10000 to D10099 in Node A to the words from D10000 to D10099 in Node B (node address: 11).
- When Boot flag *Execute* (W10.00) is turned ON, data sending starts.
  While Boot flag *Execute* is ON, data sending is repeated.
  When Boot flag *Execute* is turned OFF, data sending stops.
- *FB_BUSY* (W10.01) is ON during sending.
- *FB_OK* (W10.02) is turned ON when sending is completed. *FB_NG* (W10.03) is turned ON when sending is failed.
- The error code is stored in D9000 if the function block ends in an error (fails to send data).
  When sending the data successfully next time, the function block clears D9000 and stores the error code in D9010.

In the same way, create programs to send data from Node A to Node C and Node D respectively.

Give each FB instance a different name.

Set the destination node address for Node C to 12 and Node D to 13.



The programs to send data from Node A to Node B, Node C, and Node D have now been created.

(3) Ladder Programming Example for Node B, Node C, and Node D

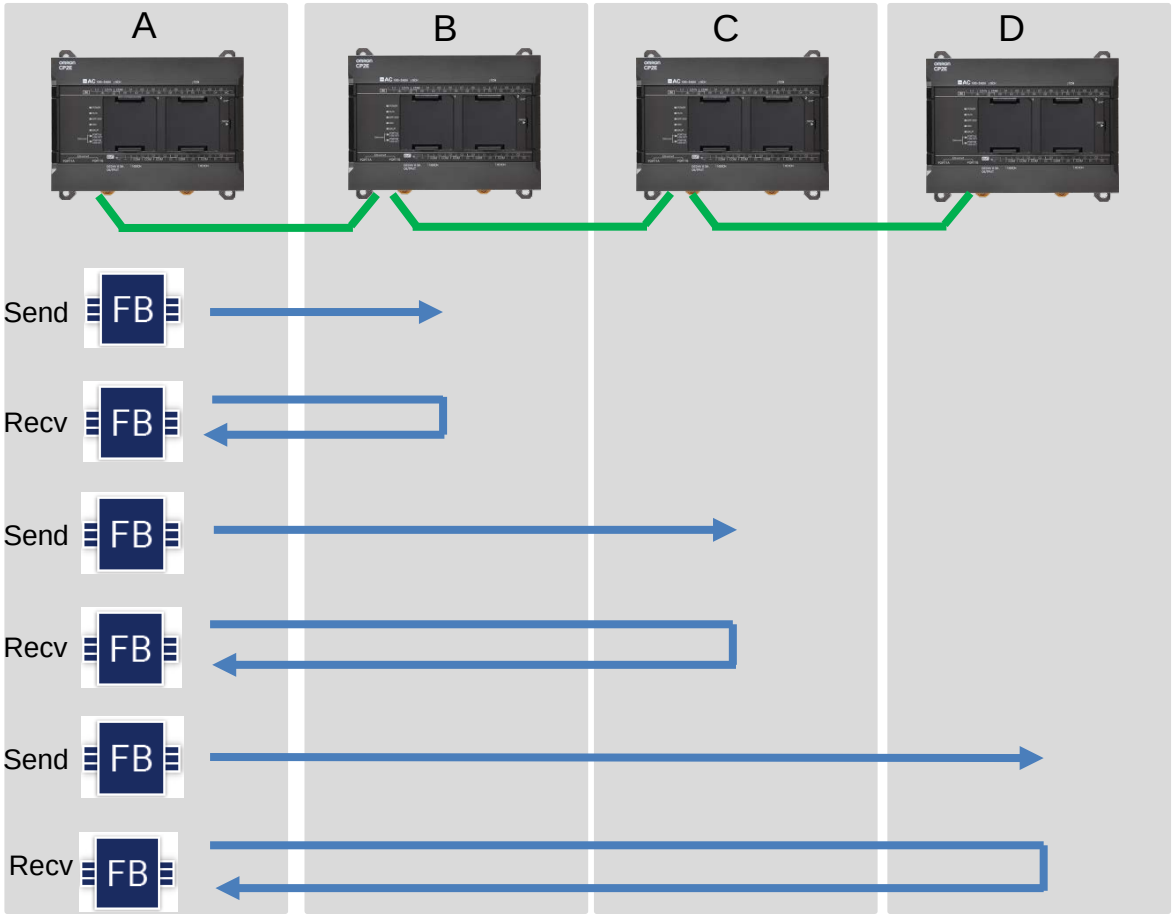
In the same way, insert the function blocks and create ladder programs.

3.2 Polling Unit Link Method

Data is exchanged between four CP2E-N-type CPU Units. The Polling Unit sends and receives data to/from all the Polled Units to exchange data in 100 words of the Data Memory Area (D) between them. The Send Data: _CPxx001_SendData Function Block and the Receive Data: _CPxx002_ReceiveData Function Block are used.

IP addresses, FINS node addresses, and areas for sending and receiving data of the CP2E CPU Units are as follows:

CP2E-N type	Polling Unit: Node A		Polled Unit: Node B		Polled Unit: Node C		Polled Unit: Node D
IP address	192.168.250.10		192.168.250.11		192.168.250.12		192.168.250.13
FINS node address	10		11		12		13
D10000-D10099	Local area (A)	→	A	→	A	→	A
D10100-D10199	B	←	Local area (B)		Local area (C)		Local area (D)
D10200-D10299	C	←	(Not used)		(Not used)		(Not used)
D10300-D10399	D	←	(Not used)		(Not used)		(Not used)



3.2.1 Wiring Example

Use the same wiring as the complete link method. Refer to *3.1.1 Wiring Example*.

3.2.2 PLC Settings Example

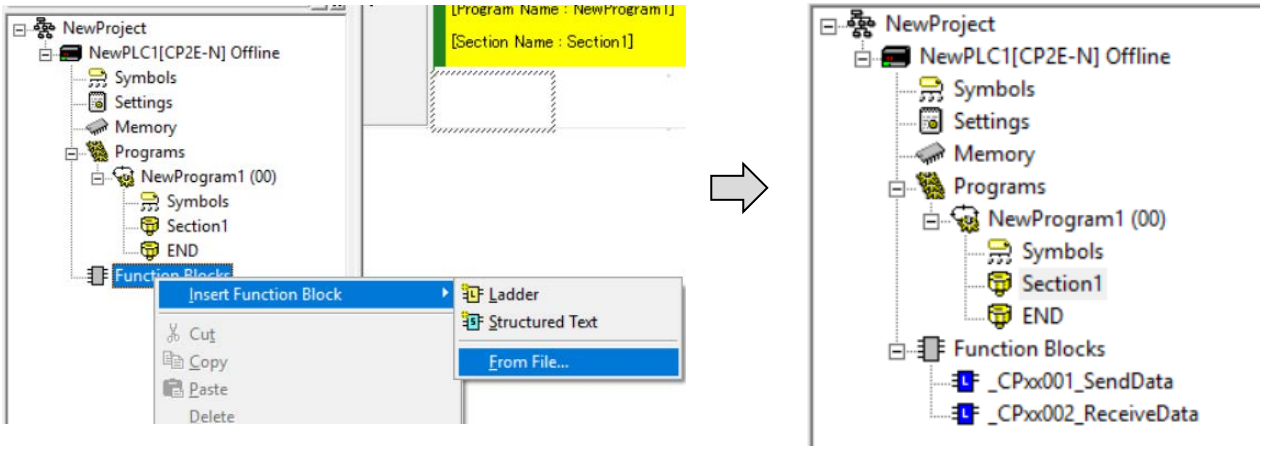
Make the same Ethernet Setting as the complete link method. Make the same Communications Setting of Node A as the complete link method. Refer to *3.1.2 PLC Settings Example*.

3.2.3 Ladder Programming Example

(1) Inserting the Function Blocks

Save the Send Data: _CPxx001_SendData Function Block file and the Receive Data: _CPxx002_ReceiveData Function Block file to your PC beforehand.

Right-click ***Function Blocks*** at the project workspace in the CX-Programmer and select ***Insert Function Blocks*** - ***From File*** from the pop-up menu to load the CPxx001_SendData.cxf file and the CPxx002_ReceiveData.cxf file.

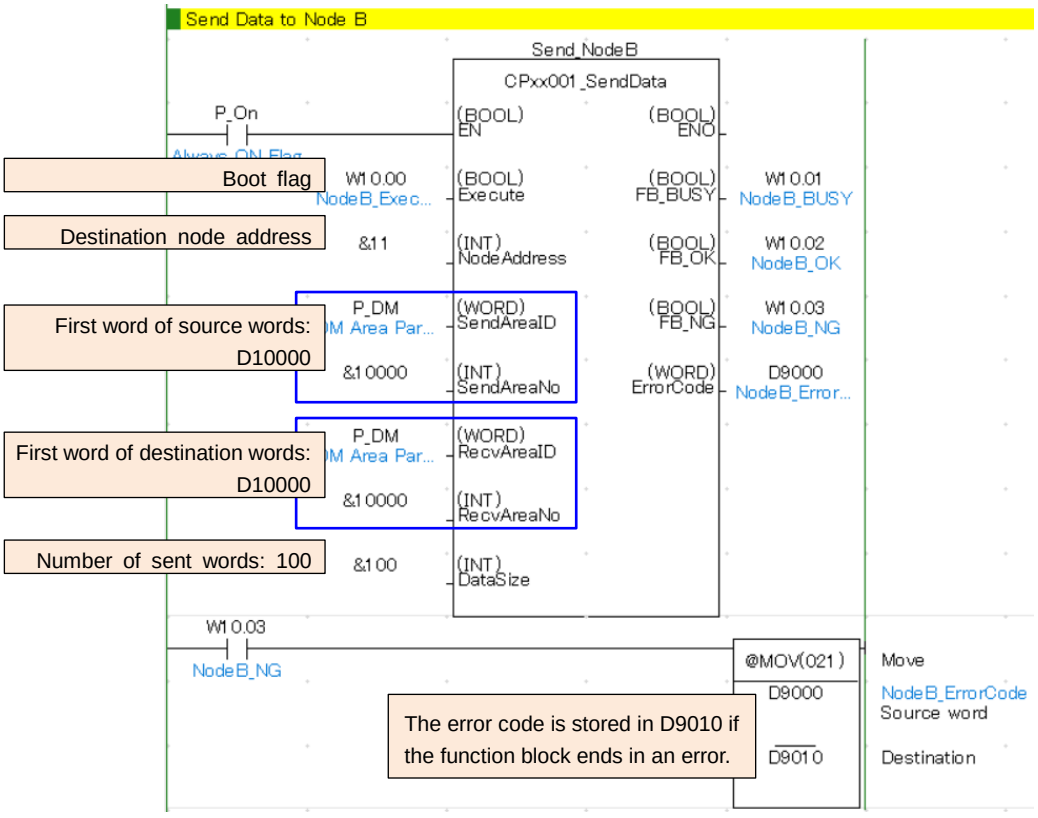


(2) Ladder Programming Example for Node A

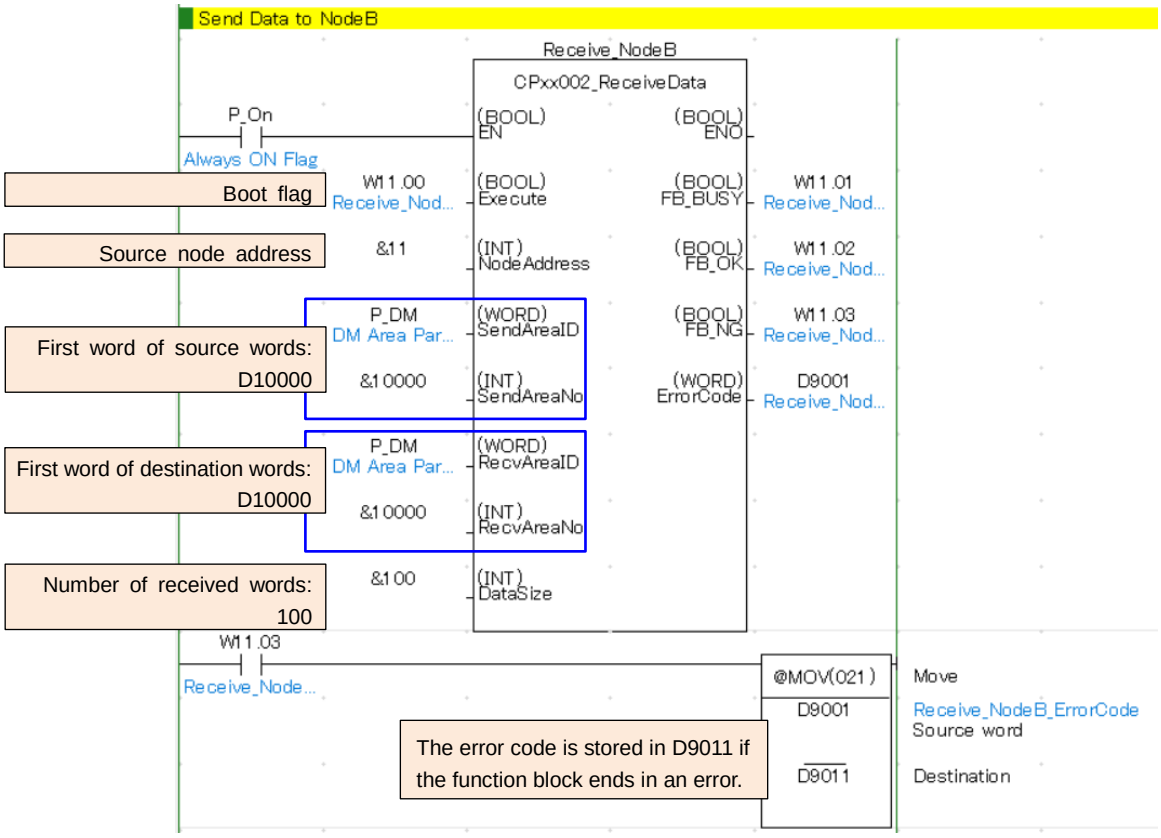
Create programs for Node A in the CX-Programmer.

Firstly create a program to exchange data between Node A and Node B.

Program to send data from Node A to Node B



Program where Node A receives data from Node B



In the same way, create programs to exchange data between Node A and Node C and between Node A and Node D.

Give each FB instance a different name.

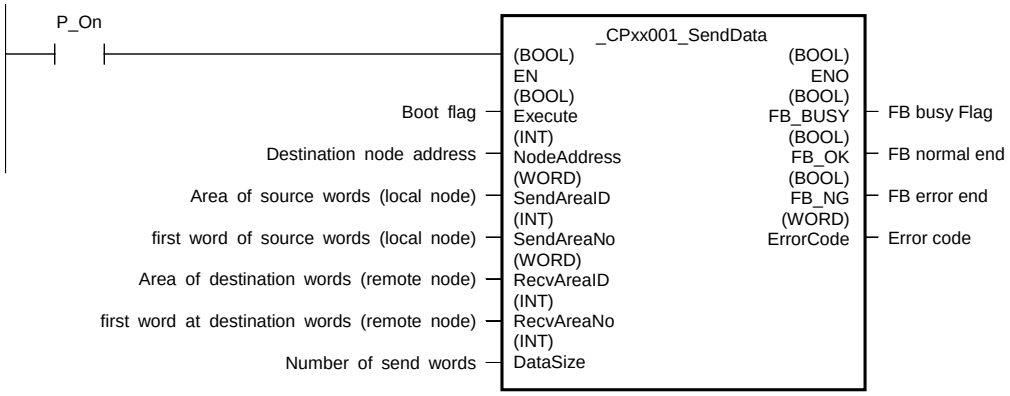
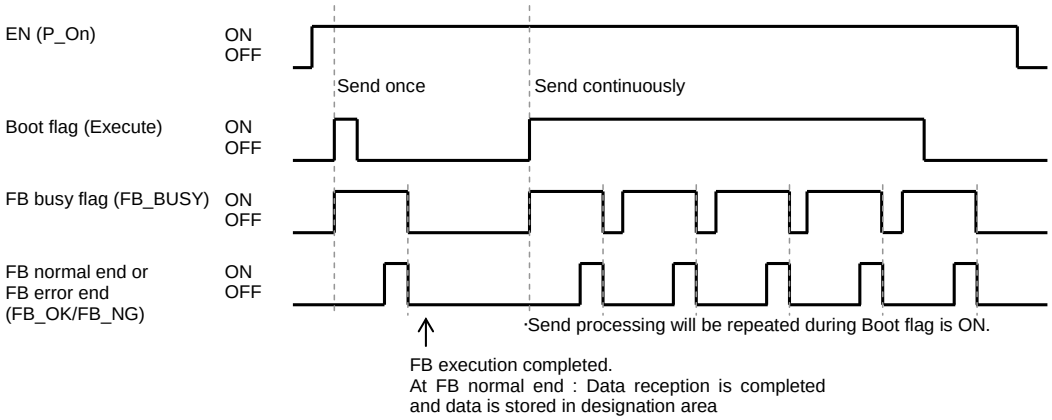
You don’t need to create programs for Node B, Node C, and Node D to exchange data.

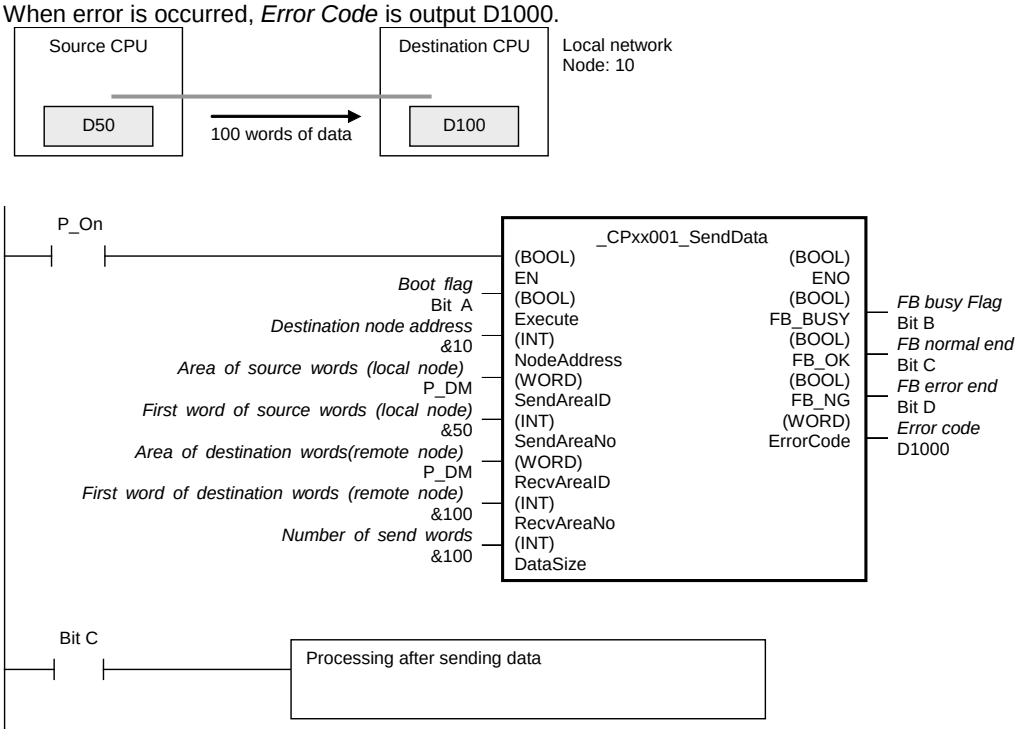
■Practices Guide －Revision History

Version	Date	Revised content
A	October 2019	Original production

Description of functions

CPxx 001	Send Data: _CPxx001_SendData

Basic function	Sends data to a node on the local network by Built-in Ethernet Port.	
Symbol		
File name	_CPxx001_SendData.cxf	
Applicable models	CPU Unit	CP2E
	CX-Programmer	Version 9.72 or higher
Conditions for usage	Settings ・PLC Setup: Comms Instructions Setting in FB Response Timeout (default: 2 s) Retry Counts (default: 0) ・Logical communications ports (Using automatic port allocation)	
Function description	・When *Boot flag (Execute)* is turned ON, send the specified data to the CPU unit (remote node) specified by the *Destination node address (NodeAddress)*. ・Send processing will be repeated during *Boot flag (Execute)* is ON. ・Send processing will be stopped during *Boot flag (Execute)* is OFF. ・The data word designations are specified using the area type and first word address. For example, for D1000, the area type is set to P_DM and the first word address is set to &1000. ・If send processing is completed normally, ON is set to *FB normal end (FB_OK)* and “#0000” is stored in *Error code*. ・If the send processing produces an error, ON is set to *FB error end (FB_NG)* and FINS end code (response code) will be output to the *Error code.* Timechart 	
Kind of FB definition	Connect Always ON type Connect the *EN* input to the *Always ON Flag (P_On)* ・The same instance can not be used in two or more places.	

FB precautions	・The FB is processed over multiple cycles. The *FB busy flag (FB_BUSY)* output variable can be used to check whether the FB is being processed. ・Destination unit address is fixed CPU (#00). ・Destination network address is fixed local network (#00). It cannot be passed through a network hierarchy. ・The FB is used Logical communications ports with Automatic allocation. There are 8 logical communications ports provided. So, Exclusive control must be used when more than 8 instructions (_CPxx001_SendData, _CPxx002_ReceiveData, SEND/RECV/CMND instructions) are executed.
EN input condition	・Connect the EN input to the A*lways ON Flag (P_On)*. ・If a different type of bit is connected to *EN*, the FB outputs will be maintained when the connected bit is turned OFF.
Restrictions Input variables	・Use the *Always ON Flag (P_On)* for *EN*. ・Use one cycle only condition for *Boot flag (Execute)* when data will be sent once, and use ON condition for *Boot flag (Execute)* when data will be sent continuously. ・Do not turn ON *EN* and *Boot flag (Execute)* at the same time. If *EN* and *Boot flag (Execute)* are turned ON at the same time, data will not be sent. ・If the input variables are out of range, the *ENO* will turn OFF and the FB will not be processed. If [*First source words* + *Number of send words*] or [*First destination words* + *Number of send words*] is out of range, the *ENO* will turn OFF and the FB will not be processed. Example When *Number of send words* is 20CH, it cannot be set *First source words* to over W109. When *Number of send words* is 100CH, it cannot be set *First destination words* to over D16284
Application example	When bit A turns ON, 100 words from Source CPU (D50-D149) is sent to Destination CPU (D100-D199). When error is occurred, *Error Code* is output D1000. 
Related manuals	*Communications Commands Reference Manual* (W342) 5-1-3 End Codes

■ **Variable Tables**

Input Variables

Name	Variable name	Data type	Default	Range	Description
EN	EN	BOOL			1 (ON): FB started. 0 (OFF): FB not started.
Boot flag	Execute	BOOL			1 (ON): Start to send data 0 (OFF): Stop to send data
Destination node address	NodeAddress	INT	&1	&1 - &254	
Area of source words (local node)	SendAreaID	WORD	#0082	At right	P_WR (#00B1): Work Area P_HR (#00B2): Holding Area P_DM (#0082): Data Memory Area
First word of source words (local node)	SendAreaNo	INT	&0	At right	W0 – W127 H0 – H127 D0- D16383
Area of destination words (remote node)	RecvAreaID	WORD	#0082	At right	P_WR (#00B1): Work Area P_HR (#00B2): Holding Area P_DM (#0082): Data Memory Area
First word of destination words (remote node)	RecvAreaNo	INT	&0	At right	W0 – W127 H0 – H127 D0- D16383
Number of send words	DataSize	INT	&1	&1 - &100	The maximum send data size is 100 words. [*First source words + Number of send words*] or [*First destination words + Number of send words*] will be set below range. W0 – W127 H0 – H127 D0- D16383

Output Variables

Name	Variable name	Data type	Range	Description
ENO	ENO	BOOL		1 (ON): FB processed normally. 0 (OFF): FB not processed or ended in an error.
FB Busy Flag	FB_BUSY	BOOL		Automatically turns OFF when processing is completed.
FB Normal end	FB_OK	BOOL		Turns ON for one cycle when processing ends normally.
Error end	FB_NG	BOOL		Turns ON for one cycle when processing ends in an error.
Error code	ErrorCode	WORD		Outputs the error code when execution ends in an error in the communications command level. Refer to the *Communications Commands Reference Manual* (W342) for details on the error codes.

■ **Version History**

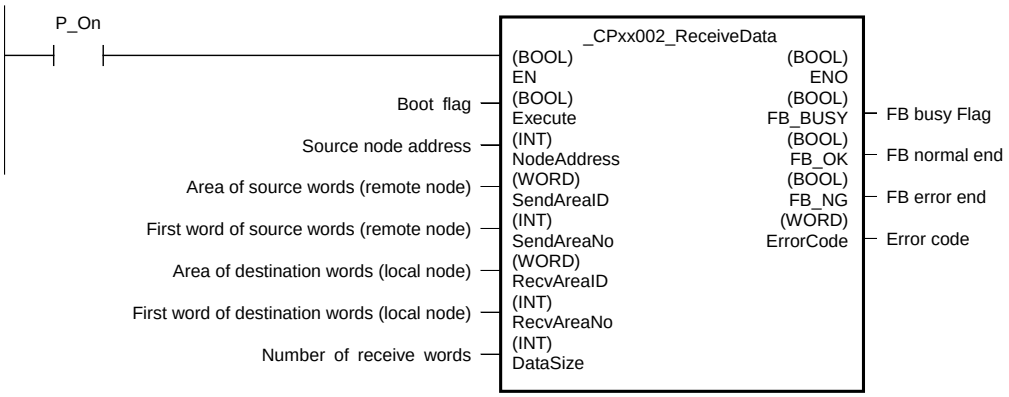
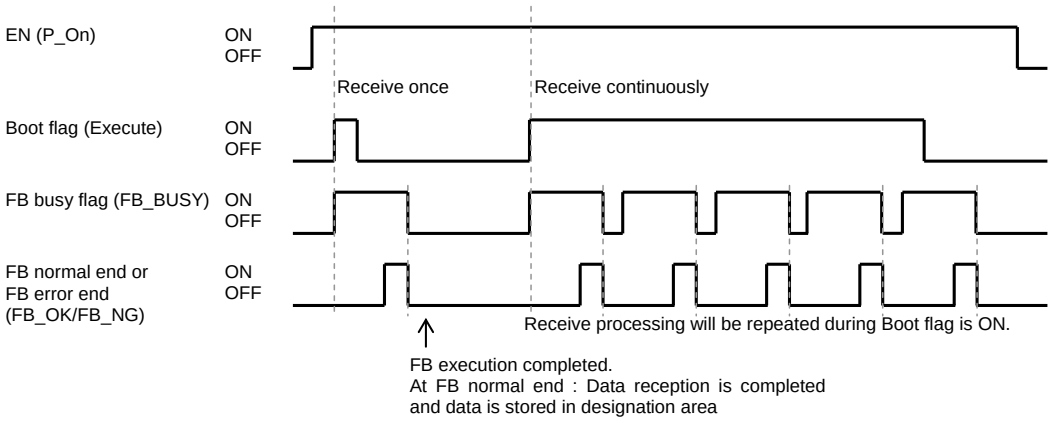
Version	Date	Contents
1.00	2019.10	Original production

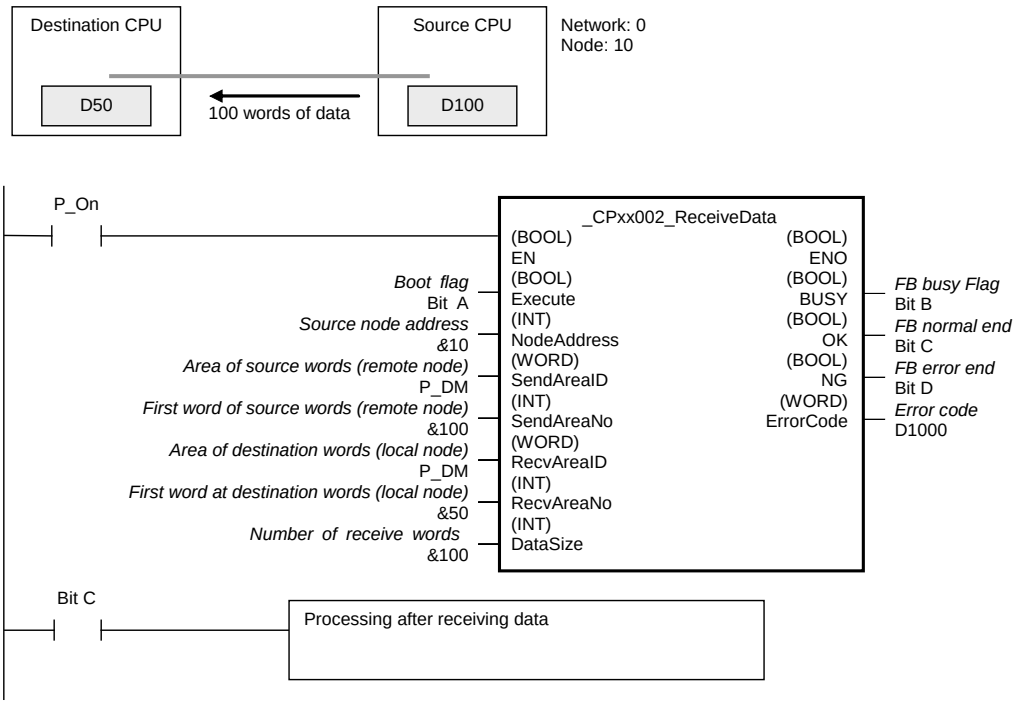
Note

This manual is a reference that explains the function block functions.

It does not explain the operational limitations of Units, components, or combinations of Units and components. Always read and understand the Operation Manuals for the system's Units and other components before using them.

CPxx 002	Receive Data: _CPxx002_ReceiveData

Basic function	Receives data from a node on the local network by Built-in Ethernet port.
Symbol	
File name	_CPxx002_ReceiveData.cxf
Applicable models	CPU Unit: CP2E CX-Programmer: Version 9.72 or higher
Conditions for usage	Settings ・PLC Setup: Comms Instructions Setting in FB Response Timeout (default: 2 s) Retry Counts (default: 0) ・Logical communications ports (Using automatic port allocation)
Function description	・When *Boot flag (Execute)* is turned ON, receive the specified data from the CPU unit (remote node) specified by the *Source node address (NodeAddress)*. ・Receive processing will be repeated during *Boot flag (Execute)* is ON. ・Receive processing will be stopped during *Boot flag (Execute)* is OFF. ・The data word designations are specified using the area type and first word address. For example, for D1000, the area type is set to P_DM and the first word address is set to &1000. ・If receive processing is completed normally, ON is set to *FB normal end (FB_OK)* and "#0000" is stored in *Error code*. ・If the receive processing produces an error, ON is set to *FB error end (FB_NG)* and FINS end code (response code) will be output to the *Error code.* Timechart 
Kind of FB definition	Connect Always ON type Connect the EN input to the *Always ON Flag (P_On)* ・The same instance can not be used in two or more places.
FB precautions	・The FB is processed over multiple cycles. The *FB busy flag (FB_BUSY)* output variable can be used to check whether the FB is being processed. ・Source unit address is fixed CPU (#00). ・Source network address is fixed local network (#00). It cannot be passed through a network hierarchy. ・The FB is used Logical communications ports with Automatic allocation. There are 8 logical communications ports provided. So, Exclusive control must be used when more than 8 instructions (_CPxx001_SendData, _CPxx002_ReceiveData, SEND/RECV/CMND instructions) are executed.

EN input condition	・Connect the *EN* input to the A*lways ON Flag (P_On)*. ・If a different type of bit is connected to *EN*, the FB outputs will be maintained when the connected bit is turned OFF.
Restrictions **Input variables**	・Use the *Always ON Flag (P_On)* for *EN*. ・Use one cycle only condition for *Boot flag (Execute)* when data will be received once, and use ON condition for *Boot flag (Execute)* when data will be received continuously. ・Do not turn ON *EN* and *Boot flag (Execute)* at the same time. If *EN* and *Boot flag (Execute)* are turned ON at the same time, data will not be received. ・If the input variables are out of range, the *ENO* will turn OFF and the FB will not be processed. If [*First source words* + *Number of receive words*] or [*First destination words* + *Number of receive words*] is out of range, the *ENO* will turn OFF and the FB will not be processed. Example When *Number of receive words* is 20CH, it cannot be set *First source words* to over W109. When *Number of receive words* is 100CH, it cannot be set *First destination words* to over D16284
Application example	When bit A turns ON, 100 words to destination CPU (D50-D149) is received from Source CPU (D100-D199). When error is occurred, Error Code is output D1000. 
Related manuals	*Communications Commands Reference Manual* (W342) 5-1-3 End Codes

■ **Variable Tables**

Input Variables

Name	Variable name	Data type	Default	Range	Description
EN	EN	BOOL			1 (ON): FB started 0 (OFF): FB not started.
Boot flag	Execute	BOOL			1 (ON): Start to receive data. 0 (OFF): Stop to receive data.
Source node address	NodeAddress	INT	&1	&1 - &254	
Area of source words (remote node)	SendAreaID	WORD	#0082	At right	P_WR (#00B1): Work Area P_HR (#00B2): Holding Area P_DM (#0082): Data Memory Area
First word of source words (remote node)	SendAreaNo	INT	&0	At right	W0 – W127 H0 – H127 D0- D16383
Area of destination words (local node)	RecvAreaID	WORD	#0082	At right	P_WR (#00B1): Work Area P_HR (#00B2): Holding Area P_DM (#0082): Data Memory Area
First word of destination words (local node)	RecvAreaNo	INT	&0	At right	W0 – W127 H0 – H127 D0- D16383
Number of receive words	DataSize	INT	&1	&1 - &100	The maximum receive data size is 100 words. [*First source words + Number of receive words*] or [*First destination words + Number of receive words*] will be set below range. W0 – W127 H0 – H127 D0- D16383

Output Variables

4 Name	Variable name	Data type	Range	Description
ENO	ENO	BOOL		1 (ON): FB processed normally. 0 (OFF): FB not processed or ended in an error.
FB busy Flag	BUSY	BOOL		Automatically turns OFF when processing is completed.
FB normal end	OK	BOOL		Turns ON for one cycle when processing ends normally.
FB eError end	NG	BOOL		Turns ON for one cycle when processing ends in an error.
Error code	ErrorCode	WORD		Outputs the error code when execution ends in an error in the communications command level. Refer to the *Communications Command Reference Manual* (W342) for details on the error codes.

■ **Version History**

Version	Date	Contents
1.00	2019.10	Original production

Note

This manual is a reference that explains the function block functions.

It does not explain the operational limitations of Units, components, or combinations of Units and components. Always read and understand the Operation Manuals for the system's Units and other components before using them.