azbil

No. CP-SP-1313E

Network Instrumentation Module User's Manual

Network Design Version

Thank you for purchasing the Network Instrumentation Module.

This manual contains information for ensuring the correct use of the Network Instrumentation Module. It also provides necessary information for installation, maintenance, and troubleshooting.

This manual should be read by those who design and maintain equipment that uses the Network Instrumentation Module. Be sure to keep this manual nearby for handy reference.

Yamatake Corporation

IMPORTANT

Follow this manual carefully for proper network design.

Otherwise successful control and monitoring may not be possible.

NOTICE

Be sure that the user receives this manual before the product is used.

Copying or duplicating this user's manual in part or in whole is forbidden. The information and specifications in this manual are subject to change without notice.

Considerable effort has been made to ensure that this manual is free from inaccuracies and omissions. If you should find an error or omission, please contact Yamatake Corporation.

In no event is Yamatake Corporation liable to anyone for any indirect, special or consequential damages as a result of using this product.

Conventions Used in This Manual

■ In describing the product, this manual uses the icons and conventions listed below.

: Use caution when handling the product.

: The indicated action is prohibited.

: Be sure to follow the indicated instructions.

Design Precautions : Design Precautions indicate items that the user should pay attention to when designing a network.

Note : Notes indicate information that might benefit the user.

: This indicates the item or page that the user is requested to refer to.

■ Abbreviations

At times, the following abbreviations may be used in this manual.
Controller module : TC
Digital input/pulse input module: DX
Supervisor module: SV
Communication adapter : CA
Terminal adapter : TA
Communication box : CB
Smart Loader Package : SLP-NX

■ Term definitions

Terms are defined in this manual as follows.
Module :
A physical configuration unit. However, CA and TA are not included.

Node :
A module with a communication function. CA, TA, and CB are not included.

Chain connection :
The basic connection method for the Network Instrumentation Module. It means that modules are linked in a daisy chain. In addition, connections via Ethernet cable using communication adapters are included.

Connection between chains:
Multiple module groups of modules linked in a chain can be connected via Ethernet cable when a communication box is attached to the far left of each group.

■ An explanation of R and N notations used in charts

● Node notations

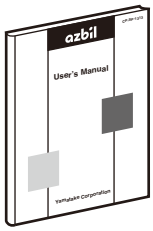
Notation	Explanation
R	Ring communication type
N	Non-ring communication type

● CB notations

Notation	Explanation
RR	Chain connection : Ring communication type Connection between chains : Ring communication type
RN	Chain connection : Ring communication type Connection between chains : Non-ring communication type
NR	Chain connection : Non-ring communication type Connection between chains : Ring communication type
NN	Chain connection : Non-ring communication type Connection between chains : Non-ring communication type

The Role of This Manual

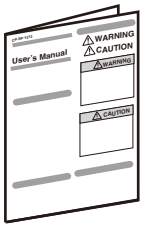
A total of 10 different manuals are available for the Network Instrumentation Module. Read them as necessary for your specific requirements. If a manual you require is not available, contact Yamatake Corporation or its dealer. Alternatively, you can download the necessary manuals from “http://www.azbil.com”.



Network Instrumentation Module
User’s Manual Network Design Version

Manual No. CP-SP-1313E

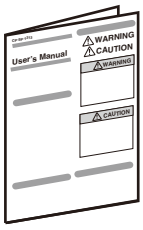
This Manual.
Personnel who are in charge of design of a network using the Network Instrumentation Module should read this manual thoroughly. It describes how to design a network and gives examples.



Network Instrumentation Module
NX-D15/25/35 Controller Module User’s Manual for Installation

Manual No. CP-UM-5561JE

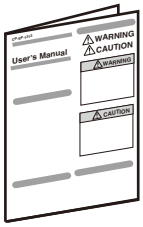
This manual is supplied with the NX-D15/25/35. Personnel in charge of design and/or manufacture of a system using the NX-D15/25/35 should thoroughly read this manual. It describes safety precautions, installation, wiring, and primary specifications.



Network Instrumentation Module
NX-DX1/DX2 for Installation

Manual No. CP-UM-5560JE

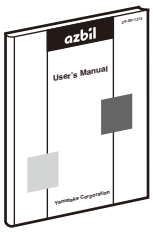
This manual is supplied with the NX-DX1/DX2.
Personnel in charge of design and/or manufacture of a system using the NX-DX1/DX2 should read this manual thoroughly. It describes safety precautions, installation, wiring, and primary specifications.



Network Instrumentation Module
Supervisor Module NX-S11/12/21 User’s Manual for Installation

Manual No. CP-UM-5557JE

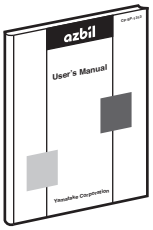
This manual is supplied with the NX-S11/12/21.
Personnel in charge of design and/or manufacture of a system using the NX-S11/12/21 should thoroughly read this manual. It describes safety precautions, installation, wiring, and primary specifications.



Network Instrumentation Module
NX-D15/25 Controller Module User’s Manual

Manual No. CP-SP-1308E

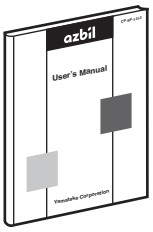
Personnel who are using the NX-D15/25 for the first time or who are in charge of hardware design and/or maintenance of a control panel containing the NX-D15/25 should read this manual thoroughly. This manual describes the hardware, surveys the NX-D15/25 and other products used with it, explains installation, wiring, and troubleshooting, and gives hardware specifications.



Network Instrumentation Module
Digital Input/Pulse Input Module NX-DX1/DX2

Manual No. CP-SP-1323E

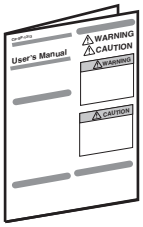
Personnel who are using the NX-DX1/DX2 for the first time or who are in charge of hardware design and/or maintenance of a control panel containing the NX-DX1/DX2 should read this manual thoroughly. This manual describes the hardware, surveys the NX-DX1/DX2 and other products used with it, explains installation, wiring, and troubleshooting, and gives hardware specifications.



Network Instrumentation Module
Supervisor Module NX-S11/12/21

Manual No. CP-SP-1324E

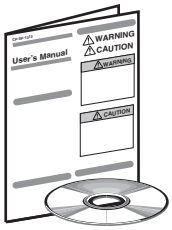
Personnel who are using the NX-S11/12/21 for the first time or who are in charge of hardware design and/or maintenance of a control panel containing the NX-S11/12/21 should read this manual thoroughly.
This manual describes the hardware, surveys the NX-S11/12/21 and other products used with it, explains installation, wiring, and troubleshooting, and gives hardware specifications.



Network Instrumentation Module
NX-CB1 Communication Box User's Manual for Installation

Manual No. CP-UM-5558JE

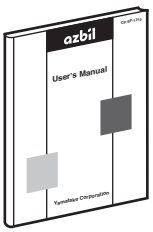
This manual is supplied with the NX-CB1. Personnel in charge of design and/or manufacture of a system using the NX-CB1 should read this manual thoroughly. It describes safety precautions, installation, wiring, and primary specifications.



Network Instrumentation Module
Smart Loader Package SLP-NX Installation Guide

Manual No. CP-UM-5559JE

This manual is supplied with the SLP-NX Smart Loader Package and describes installation of the software on a personal computer.



Network Instrumentation Module
Smart Loader Package SLP-NX User's Manual

Manual No. CP-UM-5636E

This manual is included in the SLP-NX Smart Loader Package as a PDF file.
Personnel in charge of design or configuration of a system using the Network Instrumentation Module should read this manual thoroughly.
The manual describes the software used to configure the Network Instrumentation Module using a personal computer. It also describes installation of the software on a personal computer, operation of the personal computer, various functions, and setup procedures.

Organization of This User's Manual

This manual is organized as follows:

Chapter 1 Overview

Provides an overview of the Network Instrumentation Module

Chapter 2 Configuration of Ethernet Communications

Explains basic points and specific connection configurations for constructing an Ethernet network.

Chapter 3 Configuration of Serial Communications

Explains basic points and specific connection configurations for constructing a serial network.

Chapter 4 Network Function Design

Explains functional limits etc. for designing a network configuration with the Network Instrumentation Modules.

Chapter 5 Function for Transmitting Data Between Modules

Configuration methods for the data transfer function between modules are described.

Chapter 6 Multi-Loop Cooperative Control

Configuration methods for multi-loop cooperative control are described.

Appendix

Communications glossary

Contents

Chapter 3 Configuration of Serial Communications

Chapter 4 Network Function Design

Chapter 5 Function for Transmitting Data Between Modules

Chapter 6 Multi-Loop Cooperative Control

Appendix

Chapter 1 Overview

1 - 1 Overview and Features

■ Overview

The Network Instrumentation Module uses Ethernet as standard to achieve distributed instrumentation and high-speed communications, and reduce the required wiring and engineering.
This gives customers the value of improved environments, quality and productivity.

■ Features

● Higher communication speed

- Ethernet equipped as standard
  Each module is equipped with an Ethernet communication function.
  When modules are connected or distributed, the use of a daisy chain connection method greatly reduces the required wiring.
  Each module is also equipped with an RS-485 communication function.
  High-speed communications are possible to devices such as host systems, programmable logic controllers (PLCs) and display devices.
  The system can be upgraded to the Yamatake Monitor and Control System.
- Delivers full-scale distributed configuration
  When connected by Ethernet, the system can be used with a distributed configuration that has no functional differences from a connected configuration.
- Communication redundancy
  Two communication configurations are available for the Ethernet network: non-ring and ring.
- Linkages between modules make it possible to use input and output from other modules.

● Engineering tools

Smart Loader Package SLP-NX is available (sold separately).
The Ethernet connection enables simultaneous connection to multiple modules.
This provides centralized management, setting and monitoring, which contributes to reduced engineering requirements.

1 - 2 Model Numbers

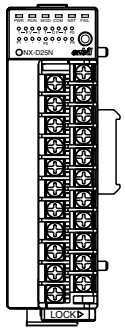
This manual applies to the following model numbers. These model numbers are simply called “modules” from here on.

Model No.	Name
NX-D_5_____	Controller Module
NX-DX_____	Digital Input/Pulse Input Module
NX-S_____	Supervisor Module
NX-CB1__04__	Communication Box
NX-C_1000000	Communication Adapter
NX-T_1000000	Terminal Adapter

1 - 3 Explanation of Module Features

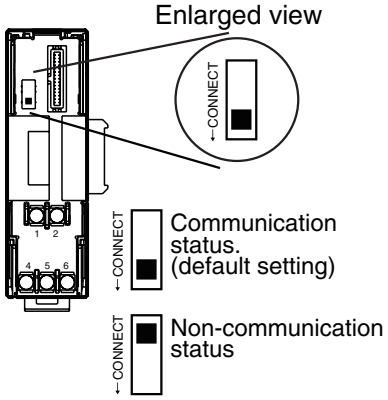
This section explains module features.

■ Controller module, Digital input/pulse input module, supervisor module



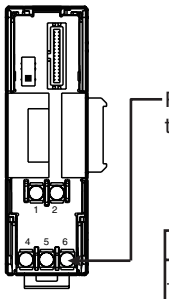
This is a controller module diagram.
Side connectors are located on the both side of the base.
A daisy chain connection for Ethernet communications or for serial communications by using side connectors to link each module.
An Ethernet cable can be connected by linking a communication adapter or a communication box.
To choose chain connection ring communications or non-ring communications via Ethernet, refer to model numbers.
☞Section 2-2, Model Number Selection (Page 2-3).

● RS-485 cutoff switch



The RS-485 cutoff switch is located on the base.
It is used to disconnect communications from the right module.

● RS-485 communication terminals



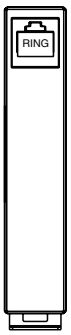
No.	Signal
4	DA
5	DB
6	SG

There are RS-485 communication terminals (3-wire) on the base. Use these communication terminals for serial communications.

■ Communication adapters

A communication adapter is connected to a side connecter of a module so that an Ethernet cable connection is possible.
Adapters for the right side and left side are available to support module's both side connectors (right and left).
These adapters do not function as communication nodes.
Adapters are not included in the devices used for power supply design.

■ Terminal adapters

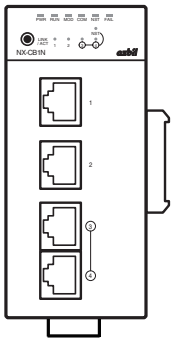


Terminal adapters are connected to a side connector of a module and are used as a chain connection ring communication terminal (Ethernet communication path inside the base).
An Ethernet cables cannot be connected.
Adapters for the right side and left side are available to support module's both side connectors (right and left).
These adapters do not function as communication nodes.
The adapters are not included in the devices used for power supply design.

■ Cables

For the Ethernet cable, use a 4-way straight-wire UTP cable of Cat 5e or higher (shieldless twisted pair cable) as defined by ANSI/TIA/EIA-568-B.
This module is not compatible with an STP cable (shielded twisted pair cable).

■ Communication boxes

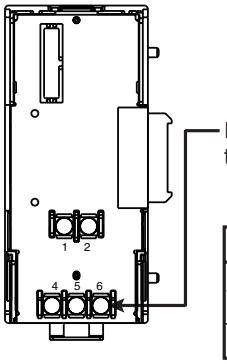


Ethernet communications are possible through the (four) front ports and right connecter of the communication box.
The box that is linked to the left side of chain-connected modules is used for a cascade connection of multiple chains or as connection ports for multiple Ethernet devices or the SLP-NX.
Since ring and non-ring communications are possible for both chain connection (using the side connector) and connection between chains (using front ports 3 and 4), 4 models are available in all combinations.
Connect Ethernet cables to the front ports as shown below
<Ethernet ports 1 and 2> (general-purpose Ethernet ports)
For communications with the host device or the SLP-NX, regardless of ring/non-ring communications
<Ethernet ports 3 and 4> (daisy chain Ethernet ports)
For connection between chains. Connect communication boxes to each other.

Note

- The connection between chains in Ethernet ports 3 and 4 is limited to non-ring communications models. These ports can be used as a connection port for communications with the host device and the SLP-NX.

● RS-485 communication terminals

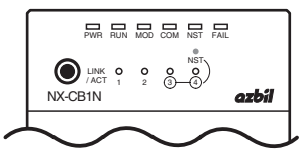


No.	Signal
4	DA
5	DB
6	SG

There are RS-485 communication terminals (3-wire) on the base. (3-wire). Use these communication terminals for serial communications.

● Operation display

LEDs on the front of the box indicate the state of operation.
LEDs blink fast (0.2 sec. cycle) or slow(1.4 sec. cycle).
Display area:



- PWR, RUN, MOD, COM, NST, FAIL (top row)

LED name	Color	Lighting pattern	Description
PWR	Green	Lit	Power ON (energized)
		Off	Power OFF (not energized)
RUN	Green	Lit	Normal operation
		Slow blink	Hardware failure (errors in some ports)
		Off	Hardware failure (errors in all ports)
MOD	Orange	Off	Normal operation mode
COM	Green	Lit	Sending Ethernet packets to the side connector network
		Off	Not sending Ethernet packets to the side connector network
NST	Orange	Lit	Chain connection is non-ring communications
		Fast blink	The ring is disconnected in the chain connection (the ring is disconnected somewhere)
		Slow blink	The ring is disconnected in the chain connection (the ring connection to the main node or the next node is disconnected)
		Off	Ring communication for the chain connection is normal
FAIL	Red	Lit	Hard Failure
		Slow blink	Soft Failure
		Off	No errors

- NST (middle row)

LED name	Color	Lighting pattern	Description
NST	Orange	Lit	Connection between chains is non-ring communication
		Fast blink	The ring is disconnected in the connection between chains (the ring is disconnected somewhere)
		Slow blink	The ring is disconnected in the connection between chains (the ring connecting to this CB or the next CB is disconnected)
		Off	Ring communication for the connection between chains is normal

- LINK/ACT1-4 (bottom row)

LED name	Color	Lighting pattern	Description
LINK/ACT1	Orange	Lit	Port 1 is linked
		Flashing	Port 1 Ethernet packet send/receive in progress
		Off	Port 1 is not linked
LINK/ACT2	Orange	Lit	Port 2 is linked
		Flashing	Port 2 Ethernet packet send/receive in progress
		Off	Port 2 is not linked
LINK/ACT3	Orange	Lit	Port 3 is linked
		Flashing	Port 3 Ethernet packet send/receive in progress
		Off	Port 3 is not linked
LINK/ACT4	Orange	Lit	Port 4 is linked
		Flashing	Port 4 Ethernet packet send/receive in progress
		Off	Port 4 is not linked

● Display when power turned ON

When the power is turned ON, the LEDs light as shown in the following table. This is different from the operation displays.
The LEDs then transition to the operation displays.

Order	LED lighting state (○: Lit, –: Off, ◊: Blinking, ✻: Depends on the state)								State/Processing
	Top LEDs						Middle LEDs	Bottom LEDs	
	PWR	RUN	MOD	COM	NST	FAIL	NST	LINK/ ACT1-4	
1	–	–	–	–	–	–	–	–	Power-off
2	○	○	○	○	✻	○	✻	✻	Shortly after power-on
3	○	✻	✻	✻	✻	✻	✻	✻	Operation display

● LED lighting pattern under special conditions

Priority Level	LED lighting state (○:Lit, –:Off,◊:Slow blink, ♦:Fast blink, ✻:Depends on the state)								State/Processing
	Top LEDs						Middle LEDs	Bottom LEDs	
	PWR	RUN	MOD	COM	NST	FAIL	NST	LINK/ ACT1-4	
	○	♦	♦	✻	✻	♦	✻	✻	A wrong module is inserted into the base. The model number information for the module and the base does not match. Check to see if the model number of the module is correct. If the model number is correct, the model number of the base might be incorrect. Replace it with a base that has the correct model number.

Note

- The hard failure display takes priority when a hard failure occurs.

● Actions when a fault occurs

When a communication box fails, the “FAIL” LED is lit or blinks.

- Hard Failure
  When a hardware failure occurs it is treated as a hard failure and the “FAIL” LED is lit. Since the communication box breaks down when a hard failure occurs, the box should immediately be replaced with a normal communication box.
- Soft Failure
  Errors in the base EEPROM or the main Flash ROM parameters, and errors with the Ethernet port, are treated as soft failure and the “FAIL” LED blinks slowly.
  When parameter errors occur, use functioning parameters in the base EEPROM or main Flash ROM and continue operations.
  When Ethernet port errors occur, the failed ports will not function.
  If this happens, the “RUN” LED blinks slowly or turns off.
  If a soft failure occurs, replace the box with a functioning communication box.

! Design Precautions

- The “FAIL” LED blinks fast even in special circumstance (a wrong module inserted). However, this is not an error.
  When a wrong module is inserted, the “RUN” LED and “MOD” LED also blink fast.
  The model number information for the module and the base does not match. Check to see if the model number of the module is correct.
  If the model number of the module is correct, the model number of the base might be incorrect. Replace it with a base that has the correct model number.

Chapter 2 Configuration of Ethernet Communications

This chapter describes the configuration of Ethernet communications for modules, including basic points, model number selection, and specific connection configurations.

2 - 1 Network Types

■ Ring communications/non-ring communications

There are basically two types of networks for these modules. They are connected using daisy chain topology, and are either:

- ring communications, or
- non-ring communications

depending on whether redundancy is supported.

● Ring communications

A redundant network communication path for modules is referred to as ring communications.
Having redundancy on a path avoids communication failures in communication paths that have failed as a result of an error or abnormality in a single node.
Ring communications are achieved through a configuration that allows networks connected using a daisy chain-type topology to connect in a single closed ring.

🕮 Note

- To avoid a malfunction due to communication failure, use a reverse communication path in which the target node will not travel, and perform loop back communication.

[!] Design Precautions

- This does not avoid all communication failures relating to a node failure or error status. Make sure that you understand the structure and use the system in a way that does not create problems for applications that you are using.

● Non-ring communications

The method of connecting the network for these modules without redundancy, using a daisy chain connection, is referred to as non-ring communications.

[!] Design Precautions

- Unlike ring communications (ring-type topology), the communication path has no redundancy. If the communication path fails as a result of a failure or error status in one node, communications are not established for any of the nodes from the problem node onwards in the chain connection.
  Be careful to use the system in a way that does not create problems for applications that you are using.

🕮 Note

- For a definition of topology,

☞Appendix - Explanation of General Terminology.

2 - 2 Model Number Selection

■ Important points when Selecting the model number

If you will be conducting Ethernet communications, specify the desired network functions for each module by selecting the model numbers shown below.

• Controller module:

NX-D_5 _ _ _ _ _ _

N: Chain connection (side connector), non-ring communications
R: Chain connection (side connector), ring communications

• Digital input/pulse input module:

NX-DX_ _ _ _ _ _ _ _

N: Chain connection (side connector), non-ring communications
R: Chain connection (side connector), ring communications

• Supervisor module:

NX-S_ _ _ _ _ _ _ _ _

N: Chain connection (side connector), non-ring communications
R: Chain connection (side connector), ring communications

• Communication boxes

NX-CB1 _ _ 0400

N: Connection between chains (front panel port), non-ring communications
R: Connection between chains (front panel port), ring communications
N: Chain connection (side connector), non-ring communications
R: Chain connection (side connector), ring communications

! Design Precautions

- Ring and non-ring communication modules cannot be combined in chain connection or in connection between chains.
- If a non-ring communication module is connected in ring mode, the status changes to congested and communications will not be possible.

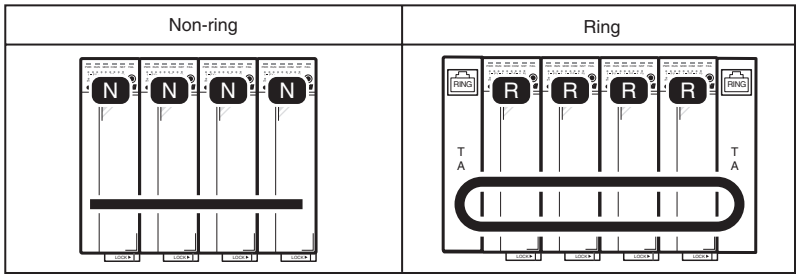
2 - 3 Network Configuration

■ Overview

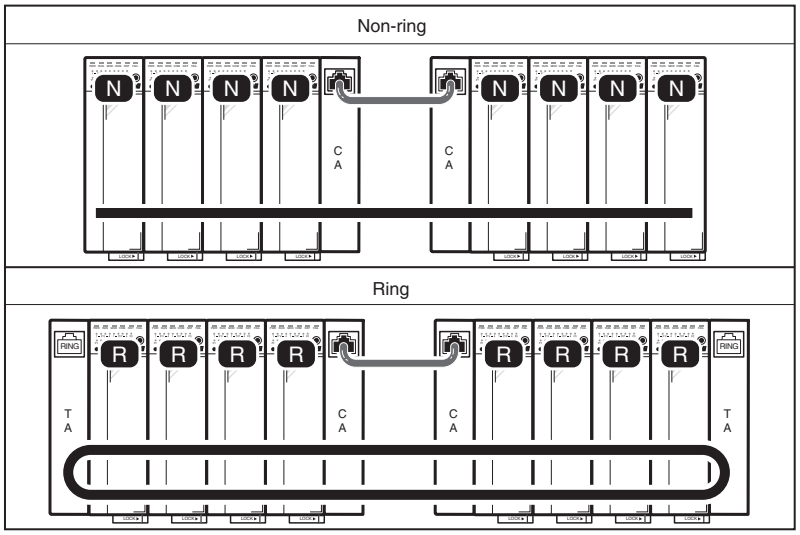
This section explains the basic patterns for configuring Ethernet communications.
For details,
☞Section 2-4, Configuration Methods (Page 2-6).

■ Basic network configuration

The network is configured by linking modules.



A distributed configuration can be achieved using a Ethernet cable.

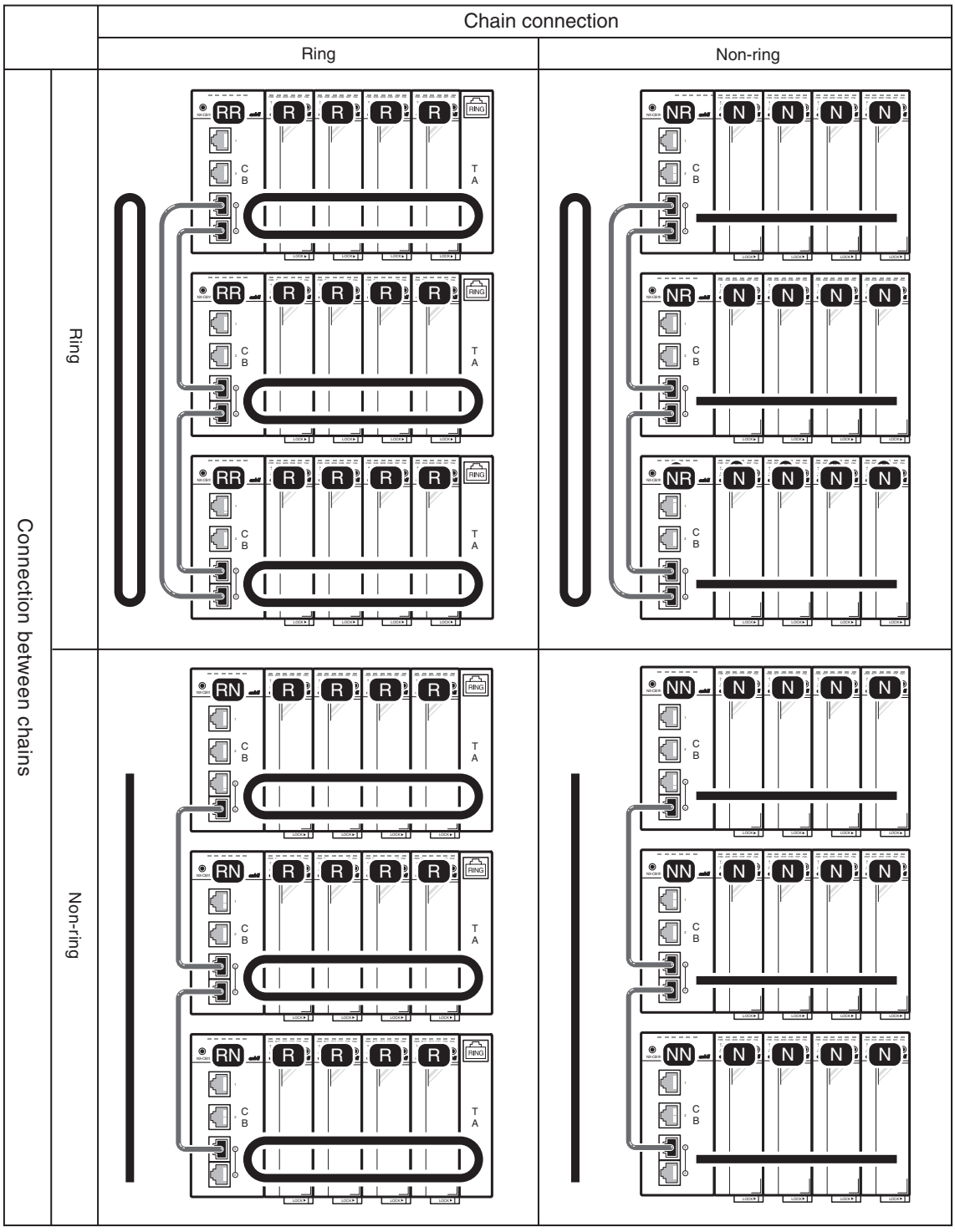


Even if modules are connected using Ethernet cables, they are recognized as one chain in the SLP-NX

This type of distributed configuration is suitable when modules are located relatively close together, for example, in the same platform or a neighboring platform (with a connecting cable that is less than 50 m in length).
For network configurations with the modules in separate locations,
☞■ Network configuration when using communication boxes (next page).

■ Network configuration when using communication boxes

The following four types of network configurations are possible, depending on the model number of the communication box.



Communication adapters can be used to set up a distributed configuration for chain connections (the horizontal connections in this diagram).

Connections between chains (the vertical connections in this diagram) are performed when connecting modules located in different locations.

2 - 4 Configuration Methods

This section explains how to configure Ethernet communications. The following five types of configurations are possible:

- Chain connection: non-ring communications
- Chain connection: ring communications
- Connection between chains : non-ring communications
- Connection between chains : ring communications
- Long-range connection

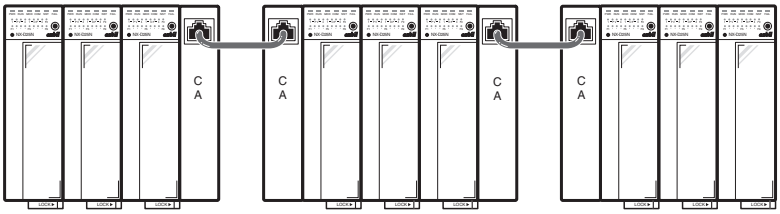
The details of each type are explained below.

■ Chain connection : non-ring communications

Basically, this type of connection is built using daisy chain topology without using a hub.

For network configurations with nodes in separate locations,

☞ ■ Network configuration when using communication boxes (previous page).



● Selecting the model number

Use the non-ring communication model number for all nodes being used.

● Forming connections between nodes

The following two methods can be used for connections between nodes:

- connect the modules by linking them
- use a communication adapter and connect the nodes with an Ethernet cable

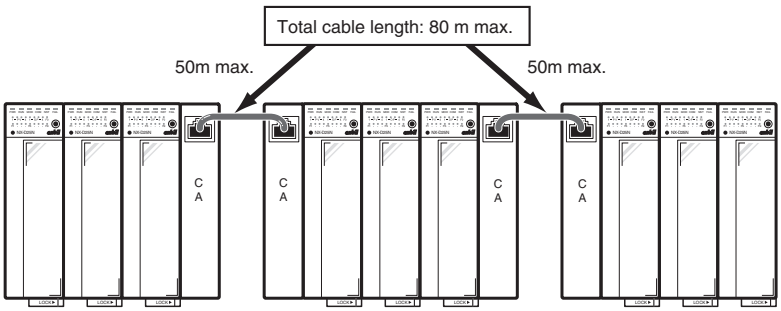
You can also use a combination of these connections methods.

● Number of nodes that can be connected

A maximum of 31 nodes can be connected in a single chain.

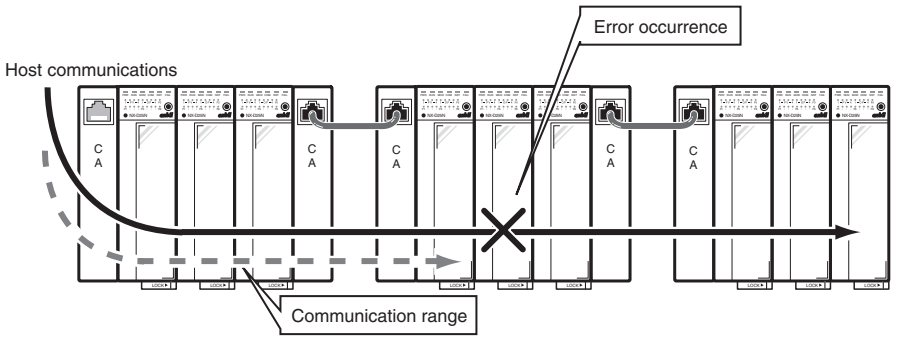
● When setting up a distributed configuration using Ethernet cables,

the maximum cable length that can be used is 50 meters. The maximum length for the total amount of cable used in a chain is 80 meters.

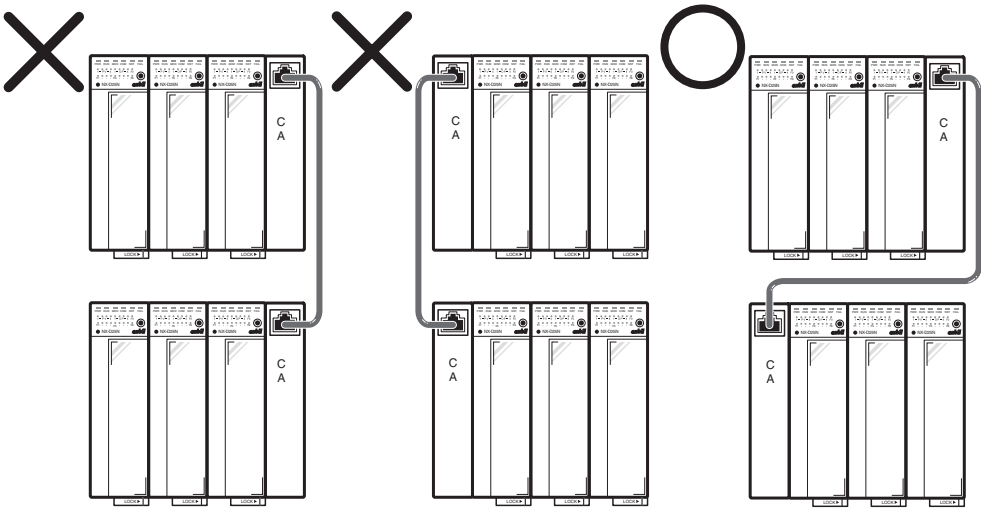


Design Precautions

- Unlike ring communications, the communication path has no redundancy. If the communication path fails as a result of a failure or error status in one node (including no power), communications is not established for any of the nodes from the problem node onwards in the chain connection.
  Be careful to use the system in a way that does not create problems for applications that you are using.



- Communications are not guaranteed if a cable exceeds the maximum length.
- For a distributed configuration using communication adapters, connect right-side communication adapters to left-side communication adapters using Ethernet cables.
  We cannot guarantee correct operations when two right-side adapters, or two left-side adapters, are connected using a Ethernet cable.



- For the Ethernet cable, use a 4-way straight-wire UTP cable of Cat 5e or higher (shieldless twisted pair cable) as defined by ANSI/TIA/EIA-568-B. This module is not compatible with an STP cable (shielded twisted pair cable).
- Use non-ring communication nodes for all modules being connected.
- Do not connect terminal adapters when using non-ring communications. If you do so, the path will become congested and communications will not be possible.

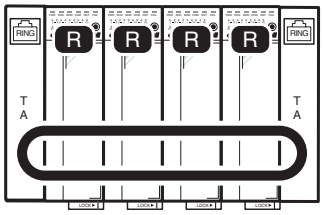
■ Chain connection: ring communications

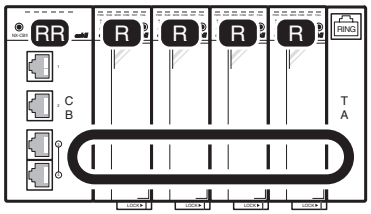
You can build a redundant communication path by connecting daisy chain topology to ring topology.
For network configurations with nodes in separate locations,
☞ ■ Network configuration when using communication boxes (Page 2-5).

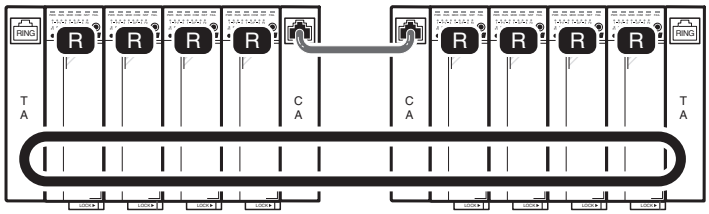
This connection method has the following design limitations:

- In a distributed configuration, there is one physical Ethernet cable so it is not a redundant control system because the cable can be removed or disconnected.
- A communication box is required to connect to a PC.

Your selection should be based on considerations such as the network reliability required for the devices and applications that you are using, and the distance between the distributed modules when setting up a distributed configuration.







● Selecting the model number

Ring communication modules should be used for all nodes.
For information on selecting model numbers,
☞ Section 2-2, Model Number Selection (Page 2-3).

! Design Precautions

- Ring and non-ring communication modules cannot be combined in chain connection or in connection between chains.
- If a non-ring communication module is connected in ring mode, the status changes to congested and communication will not be possible.

- Forming connections between nodes

  The following two methods can be used for connections between nodes:
  - Linking modules
  - Using communication adapters and Ethernet cables to connect modules

  You can also use these methods together.

- Configuring ring communications

  Ring communications can be configured in the following two ways:
  - Connecting terminal adapters at both ends of the chain
  - Connecting a communication box at the left end of the chain and a terminal adapter at the right end of the chain

  When terminal adapters are connected to both ends, there are no ports available to connect an Ethernet cable. Use the loader jack of a module and configure settings.
  Host communications are conducted via RS-485.
  When using the SLP-NX or executing host communications via Ethernet, place a communication box at the left end. Connect a terminal adapter at the right end.

- Host communication connection methods

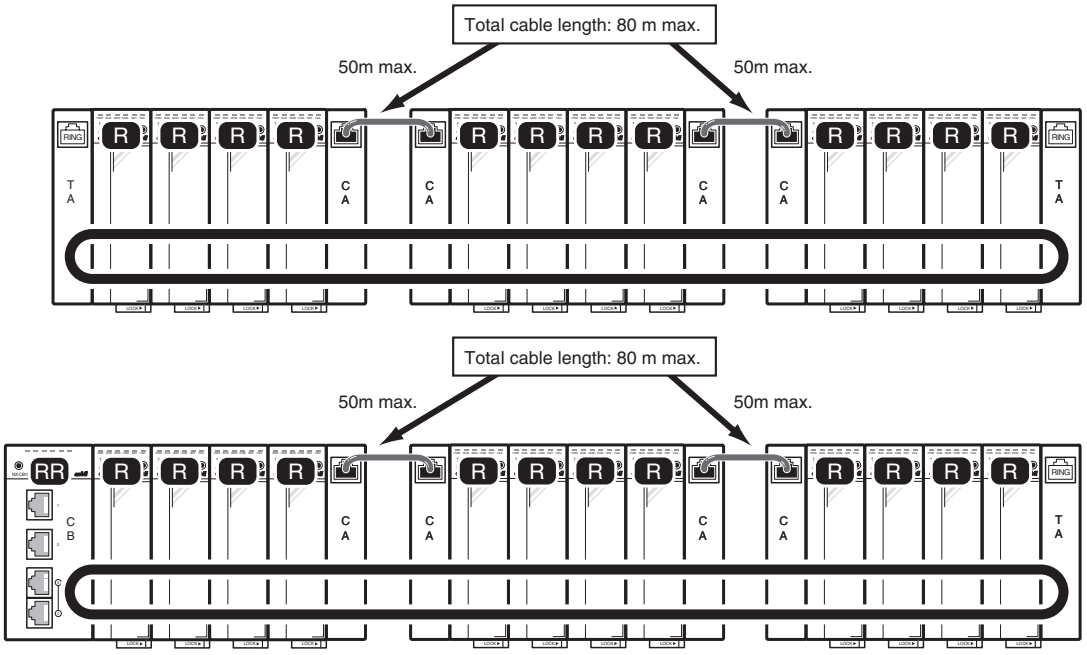
  Use a communication box and connect to ports 1 and 2 at the front. If you are using the communication box model that uses non-ring communications for the front ports, you can also use ports 3 and 4.

- Number of nodes that can be connected

  A maximum of 31 nodes can be connected in a single chain.

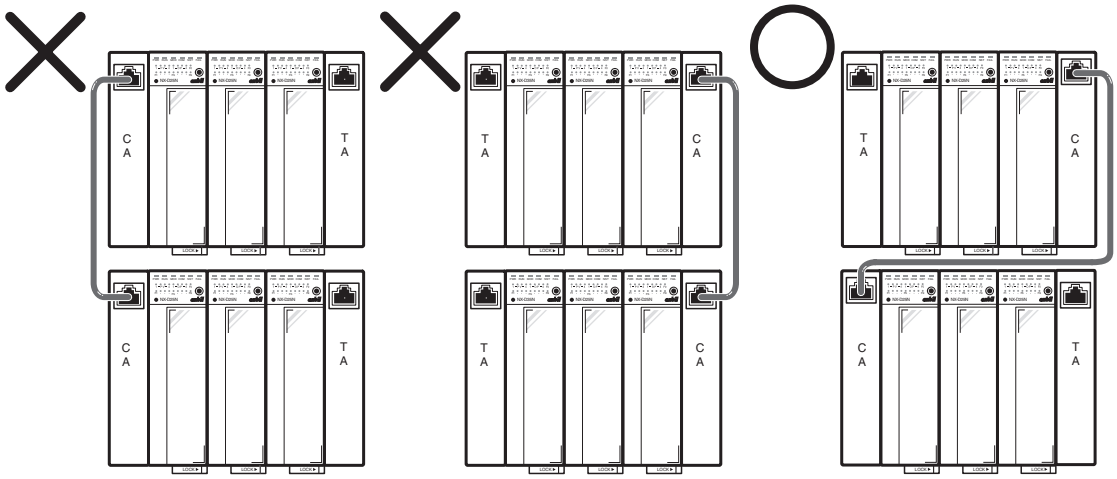
- When setting up a distributed configuration using Ethernet cables,

  the maximum cable length that can be used is 50 meters. The maximum length for the total amount of cable used in a chain is 80 meters.



! Design Precautions

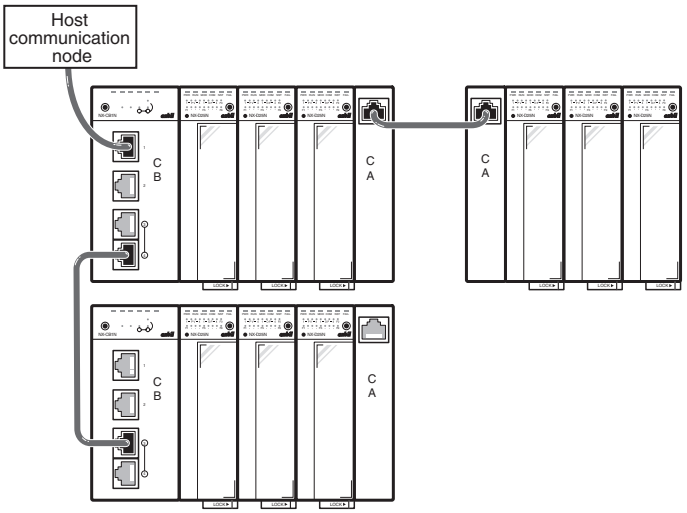
- This configuration uses a ring network and provides redundancy in the communication path. However, there is no guarantee that the redundancy function will work or that the communication path will be effective if a node fails or has an error status.
  Be careful to use the system in a way that does not create problems for applications that you are using.
- If a non-ring communication module is connected in a ring communication configuration, the system may become congested and crash. All connected modules should be a ring communication type.
- Communication is not guaranteed if a cable exceeds the maximum length.
- For a distributed configuration using communication adapters, connect a right-side communication adapter to a left-side communication adapter using a Ethernet cable. We cannot guarantee correct operations when two right-side adapters or two left-side adapters are connected using a Ethernet cable.



- For the Ethernet cable, use a 4-way straight-wire UTP cable of Cat 5e or higher (shieldless twisted pair cable) as defined by ANSI/TIA/EIA-568-B. These modules do not support STP (shielded twisted pair) cable.

■ Connection between chains: non-ring communications

Chains can be connected using communication boxes and daisy chain topology.



● Selecting the model number

Select a communication box model that uses non-ring communications for the front ports. The communication type on the chain side should be either all ring communications or all non-ring communications.

● Method for connecting between communication boxes

Connect to ports 3 and 4 at the front using Ethernet cables.
Typically, you should connect port 4 of the communication box to port 3 of the destination communication box. Non-ring communications will still function even if you connect to port 3 or 4 on both communication boxes.

● Host communication connection methods

Use a communication box and connect to ports 1 and 2 at the front. If you are using the communication box model that uses non-ring communications for the front ports, you can also use port 3 and 4.

● Number of communication boxes that can be connected (as a cascade connection)

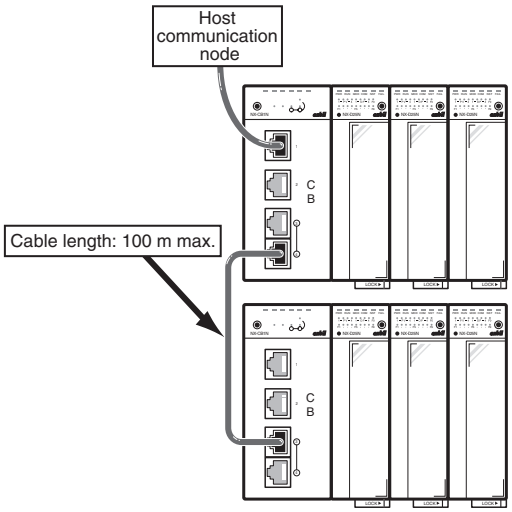
When connecting between chains, a maximum of 100 communication boxes can be connected.

! Design Precautions

- SLP-NX can configure multiple chains in the same project. However, the maximum total number of nodes that can be configured is 31.
  If the number of nodes for the entire system exceeds 31, divide the project into multiple projects. For details,
  ☞ ■SLP-NX (Page 2-18).

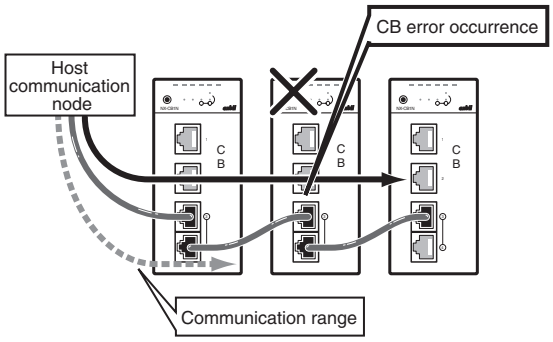
● Maximum length of Ethernet cable between chains

The cable length between each communication box must be less than 100 meters.



! Design Precautions

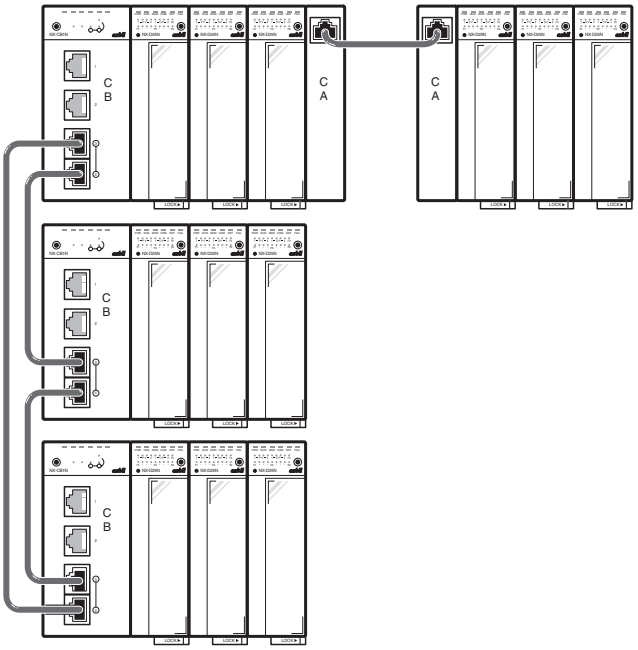
- Unlike with ring connection (ring-type topology), if a communication path failure occurs due to the malfunction or error of a certain communication box (with the power OFF) with no redundancy, communication cannot be performed with any communication boxes connected to that particular communication box thereafter.
  Be careful to use the system in a way that does not create problems for applications that you are using.



- communications are not guaranteed if a cable exceeds the maximum length.
- Non-ring communication devices should be used for all communication boxes being connected.
  If a non-ring communication module is connected in a ring-type network, the status changes to congested and communications will not be possible.
- For the Ethernet cable, use a 4-way straight-wire UTP cable of Cat 5e or higher (shieldless twisted pair cable) as defined by ANSI/TIA/EIA-568-B. These modules do not support STP (shielded twisted pair) cable.

■ Connection between chains: ring communications

Redundant communications can be built using a communication box and daisy chain topology in a ring-type network.
Use this configuration if the level of network reliability required by the devices and applications being used makes it necessary to use ring communications, and the distributed configuration extends across platforms, or the management unit is split into multiple chains within one platform.



● Selecting the model number

Select all communication box models that use ring communications for the front ports. The communication type on the chain side should be either all ring communications or all non-ring communications.

● Method for connecting between communication boxes

Use ports 3 and 4 at the front to connect using an Ethernet cable.
You should connect port 4 of a communication box to port 3 of the destination communication box.
Ring communications will still function even if you connect to port 3 or 4 on both communication boxes.

● Number of communication boxes that can be connected

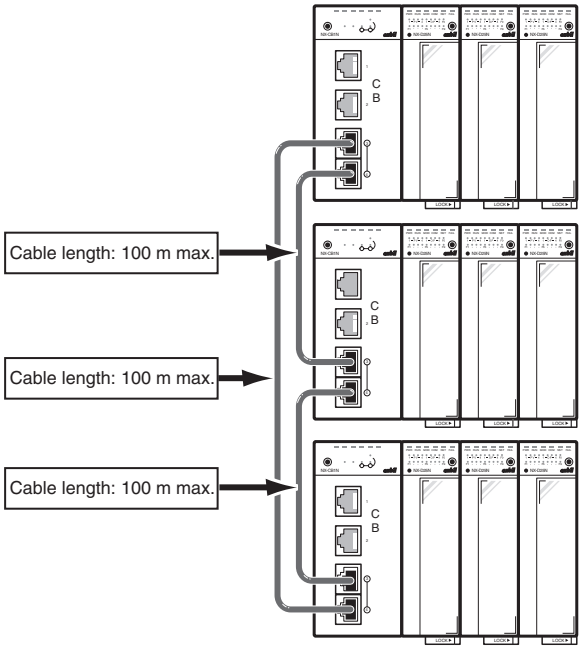
When connecting between chains, a maximum of 100 communication boxes can be connected.

! Design Precautions

- SLP-NX can configure multiple chains in the same project. However, the maximum total number of nodes that can be configured is 31.
  If the number of nodes for the entire system exceeds 31, divide the project into multiple projects. For details,
  ☞ ■SLP-NX (Page 2-18).

● Ethernet cable length between communication boxes

The cable length between each communication box must be less than 100 meters.



! Design Precautions

- This system uses a ring communication network and provides redundancy in the communication path. However, there is no guarantee that the redundancy function will work or that the communication path will be effective if a communication box fails or has an error status (including no power).
  Be careful to use the system in a way that does not create problems for applications that you are using.
- If a communication box that supports non-ring communications are connected in a ring communication configuration by mistake, the system may become congested and crash. Ring communication devices should be used for all modules being connected.
- Communications are not guaranteed if a cable exceeds the maximum length.
- Communications will not work in a connection between chains, even if the connection uses ports 3 and 4 of a communication box that supports ring communications for host communications or the SLP-NX.
- For the Ethernet cable, use a 4-way straight-wire UTP cable of Cat 5e or higher (shieldless twisted pair cable) as defined by ANSI/TIA/EIA-568-B. These modules do not support STP (shielded twisted pair) cable.

■ Long-range connections

This section explains how to connect chains using a communication box when the distance is 100 meters or more.

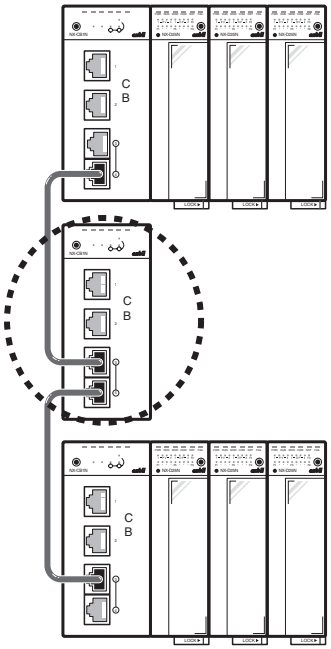
! Design Precautions

- Chain connections cannot be extended.

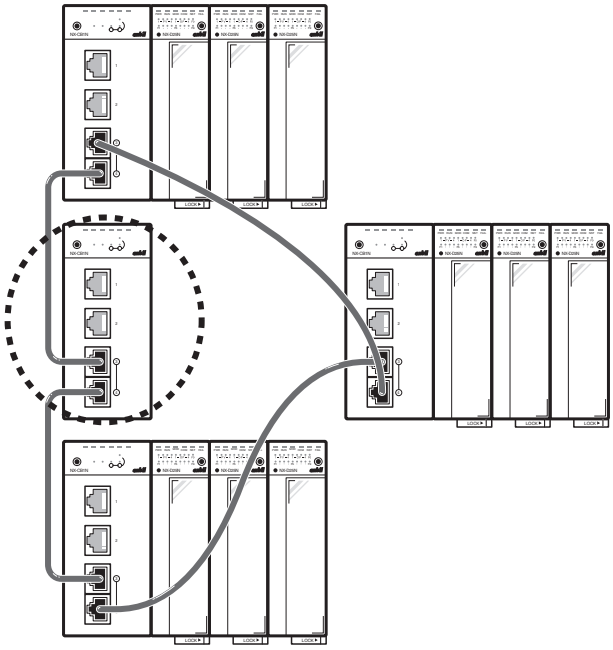
● Extensions using communication boxes

This refers to a connection that uses communication boxes as relays (repeaters).

- Example of non-ring communication



- Example of ring communication



The communication box that will be used as a relay must have the same model number as other communication boxes (ring communications or non-ring communications). A host communication device or the SLP-NX can be connected to an available Ethernet port on the relay communication box.

! Design Precautions

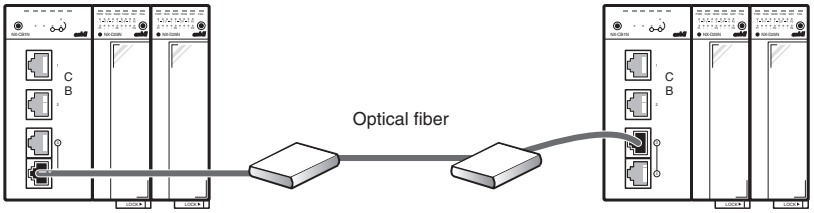
- Make sure that the model numbers for the communication boxes are the same.
- The communication box that will be used as a relay must be located in an environment that can supply DC 24V power.

● Extensions using media converters

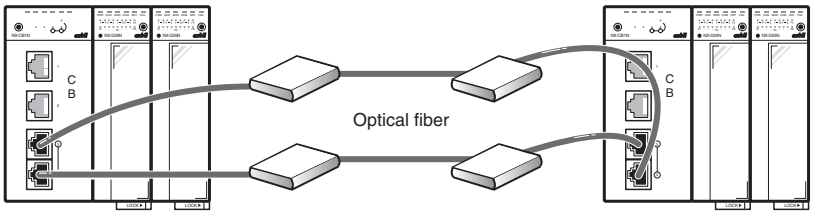
This is an optical fiber method that uses a general-purpose (commercially available) media converter for converting 100BASE-TX to 100BASE-FX.

! Design Precautions

- There is no guarantee that the general-purpose (commercially available) media converter will work correctly. Before using a converter, avoid potential problems by first making sure that it works correctly.
  For information on general-purpose (commercially available) media converters, contact the applicable manufacturer or retail outlet.
- Example of non-ring communications



- Example of ring communications



The optical fiber section is not affected by noise. It can be connected in a differently grounded environments and between different buildings.

- Required specifications for optical media converters

Item	Required Specification
Bridge function	Not built in Media converters cannot be used if the specifications on the converter state any of the following: • Built-in bridge function or With bridge function • Built-in L2 switching function • Transfer method (switching method): store and forward • The buffer capacity is listed • The TP port can support 10BASE-T • The aging time is listed Note: Specifications are listed differently by each manufacturer. If they are unclear, contact the manufacturer.
TP port (Local port)	100BASE-TX (IEEE802.3u) Full Duplex Auto Negotiation support is mandatory
FX port (optical ports and remote ports)	100BASE-FX (IEEE802.3u) compliant Consider the distance of the connection when deciding on optical fiber specifications
Environment conditions	Depends on the installation environment

2 - 5 Configuration With Other Devices

This section explains the configuration for modules when other devices are connected via the Ethernet (network).

! Design Precautions

- When connecting to other devices such as PCs using ports 3 or 4 on a communication box or a communication adapter, use the settings below for those devices.
  Transmission speed: 100 Mbps Full Duplex
  Auto-Negotiation : ON (Enable)

■ SLP-NX

SLP-NX is an engineering tool for monitoring the various settings and operational states for modules.
Using the SLP-NX, you can do the following module operations via an Ethernet connection or a loader jack connection on a module or workgroup basis. Batch operations can only be performed via Ethernet.

- Checking/configuring communication settings such as IP addresses
- Reading/writing parameters
- Monitoring online data, online/offline trend data, and changing parameters

For information on SLP-NX functions rather than configurations of connections.
☞ Smart Loader Package SLP-NX User's Manual (CP-UM-5636E)

● Projects and workgroups

In the SLP-NX, a workgroup is the unit that configures nodes, including data transfers between modules.
Multiple workgroups can be managed in batches. This is referred to as a project.
A maximum of 31 nodes can be registered in one project.
Within a workgroup, you can establish module linkages for transferring data between modules, and read/write parameters in batches.
A workgroup is made up of all of the nodes within the same chain.

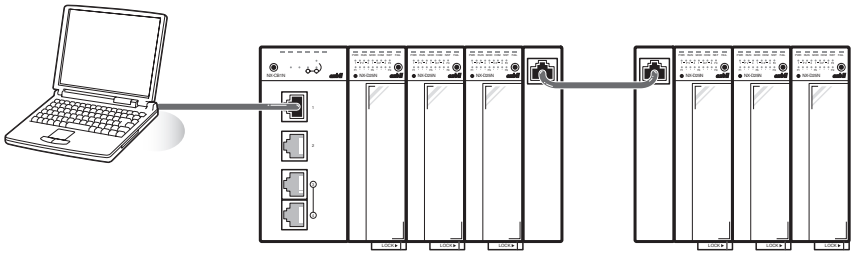
! Design Precautions

- If the number of nodes for the entire system exceeds 31, divide the project into multiple projects.
  Configure the network so that it consists of multiple projects that contain less than 31 nodes each without cables between chains.
  If you want to configure the network using the cables between chains, to design the chain connections for non-ring communications, install a communication adapter on the extreme right of a chain, connect the SLP-NX to the adapter, and configure each chain separately.

- When setting up a configuration with multiple nodes in the same project, connect the SLP-NX via Ethernet. In this case, the range for the nodes that can be configured varies depending on the connection location. For details,
  ☞ ● Range of configurable nodes and connection examples (next page).
- If you are configuring multiple chains in one project, note that the displayed order of chains might be different to the physical order of the chains when the actual module configuration is being detected.
  This is because the order is displayed according to chains that contain nodes that responded quickly to the inquiry message for node discovery sent out by the SLP-NX, when the actual model is comprised of multiple chains.
  From the SLP-NX, use the wink function to check how the actual module configuration nodes displayed in the SLP-NX, and the modules that are actually installed, are handled.

● Connecting via Ethernet

You can configure workgroups comprised of multiple nodes by connecting the SLP-NX via Ethernet.



! Design Precautions

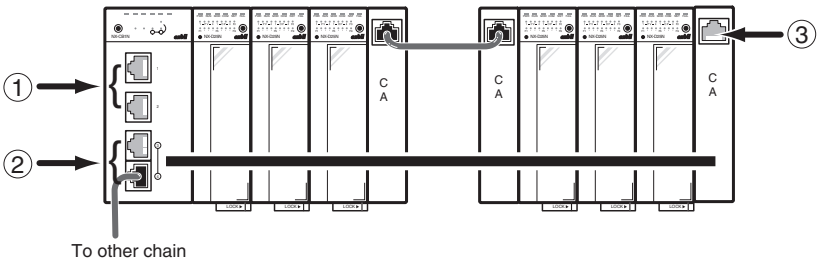
- An SLP-NX connection can be established with a node. The SLP-NX cannot simultaneously establish multiple connections with nodes. Do not use a router between these nodes and a PC where the SLP-NX is installed.

● Range of configurable nodes and connection examples

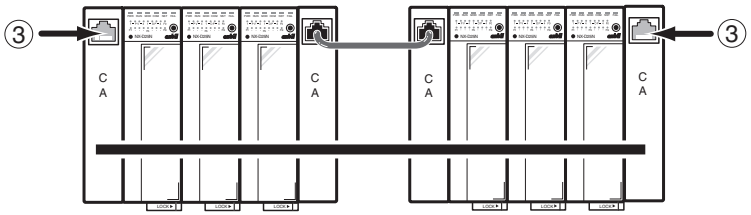
When connecting SLP-NX via Ethernet (the network), the range for the nodes that can be configured is shown below, according to the connection location.

● Chain connection: non-ring communications

<If there is a communication box>



<If there is no communication box>



1. When connecting to ports 1 and 2 of a communication box, you can configure multiple connected chains altogether.
   Even if there is a general-purpose switching hub between the communication box and PC that you are running the SLP-NX on, it is still possible to connect.

2. When connecting to ports 3 and 4 of a communication box, you can configure multiple connected chains altogether. Even if there is a general-purpose switching hub between the communication box and PC that you are running the SLP-NX on, it is still possible to connect.

! Design Precautions

- If the communication box that connects the chains supports ring communications (Model number: NX-CB1RR0400), you cannot connect the SLP-NX to ports 3 or 4 of the communication box.

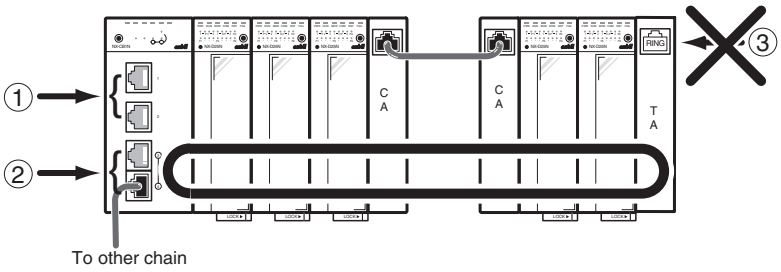
3. When connecting to a communication adapter,
you can configure a single connected chain.

Design Precautions

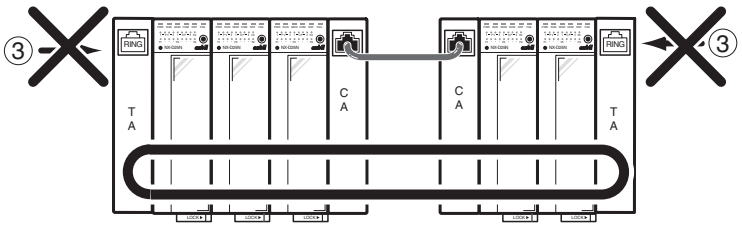
- Connect the communication adapter directly to the PC that the SLP-NX will be run on. If you place a general-purpose switching hub between the two, the module configuration within the chain may not be reflected in the SLP-NX in accordance with the actual configuration.
- The SLP-NX cannot display the chain in accordance with the actual configuration while a general-purpose switching hub is connected to the communication adapter. Disconnect the switching hub and configure each chain as a separate project.

● Chain connection: ring communications

<If there is a communication box>



<If there is no communication box>



1. When connecting to ports 1 and 2 of a communication box,
you can configure multiple connected chains altogether.
Even if there is a general-purpose switching hub between the communication box and PC that you are running the SLP-NX on, it is still possible to connect.

2. When connecting to ports 3 and 4 of a communication box,
you can configure multiple connected chains altogether.
Even if there is a general-purpose switching hub between the communication box and PC that you are running the SLP-NX on, it is still possible to connect.

Design Precautions

- If the communication box that connects the chains supports ring communications (Model number: NX-CB1RR0400), you cannot connect the SLP-NX to ports 3 or 4 of the communication box.

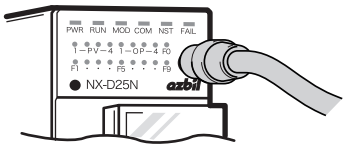
3. Cannot connect to a terminal adapter.
Either connect to a communication box or set up modules individually in a single module configuration via the loader jack.

Design Precautions

- If the chain connection is ring communications, do not connect the SLP-NX to a communication adapter. Modules cannot be communicated with.

● Connecting to a loader jack

In a single module project configuration, the SLP-NX can be used when the loader cable is connected to the loader jack at the front of the module.

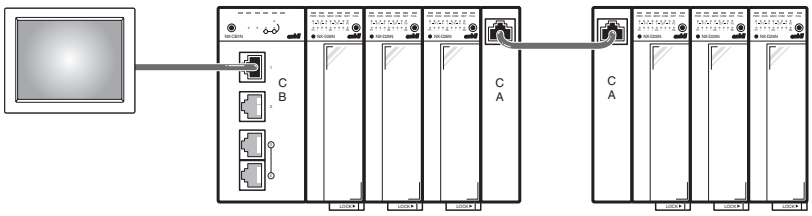


! Design Precautions

- Use the dedicated Yamatake cable (USB loader cable) to connect to the loader jack. A D-Sub loader cable cannot be used.
- The SLP-NX can access only the node whose loader jack is connected to the PC.
- This configuration is limited to the single module configuration. If you need to link multiple nodes for communication functions between modules, connect via Ethernet and create a single project.

■ Host communications

This section explains the connection configuration for host communications via Ethernet (the network), and the nodes that can be supported.



● Connection method

- Communication boxes

  Connect a Ethernet cable to port 1 or 2 (general-purpose Ethernet ports) at the front of a communication box.

  You can connect host communication devices to ports 3 and/or 4 if you are not performing ring communication between chains or if you are not using ports 3 and/or 4 for a cascade between multiple chains.

- Communication protocol

  Host communications can be connected using MODBUS/TCP.

  For an explanation of a protocol and communication address map,

  ☞ instruction manuals for each module.

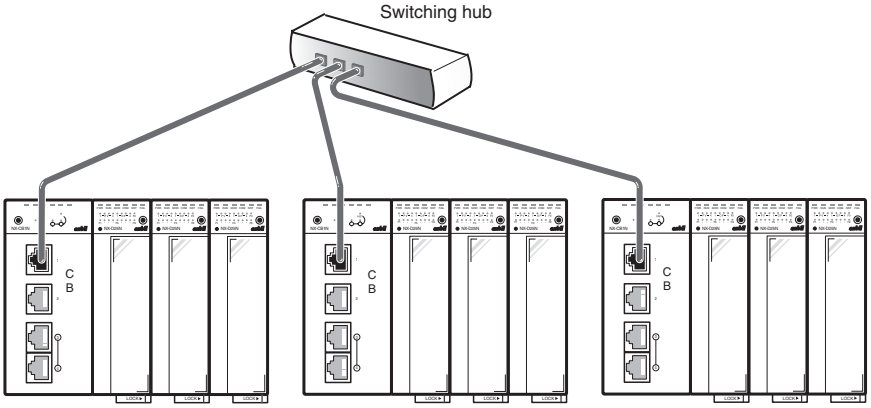
2 - 6 Typical Wiring Examples and Prohibited

This section provides typical wiring examples for Ethernet connections to modules, along with configurations that are not permitted.

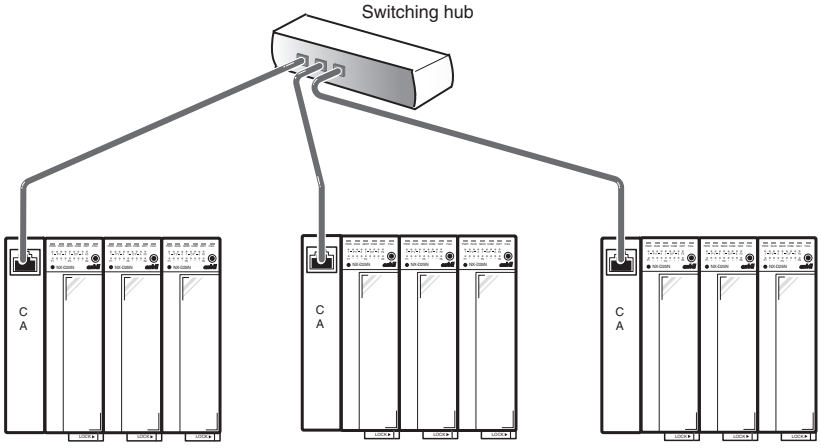
■ Typical examples of wiring

● A star topology configuration using a general-purpose (commercially available) switching hub

- When using communication boxes
  When you need to configure communication boxes in a star topology using a general-purpose (commercially available) switching hub, connect to port 1 or 2 of each communication box.



- When using communication adapters
  This method connects modules with communication adapters using a general-purpose (commercially available) switching hub.



! Design Precautions

- If the SLP-NX is connected using the switching hub, the physical configuration will not be displayed correctly.
  After the removal of the cables between the modules and the switching hub, connect the SLP-NX to the modules to configure each module as a separate project, or connect it to each module using the loader jack for configuration.

● When using an intranet

Modules can only be connected using an intranet if the conditions below have been met.
In this configuration, the switching hub in the configuration on the previous page will actually become an intranet.

<Condition 1>

• The intranet is separated from other devices using the VLAN function *1
The intranet is configured so that data sent from other devices on the intranet does not pass through modules, and data sent from these modules does not pass through devices other than these modules.

<Condition 2>

• Fixed IP addresses can be assigned
Only IPv4 is supported. (IPv6 is not supported)
Address classes and network addresses can be arbitrarily configured.
Automatic address retrieval through DHCP is not supported.

<Specifications for the destination network>

• Specifications for the destination network when using communication boxes
100BASE-TX/10BASE-T (1000BASE-T is not supported)
Full Duplex/Half Duplex
• Specifications for the destination network when using communication adapters
100BASE-TX (1000BASE-T/10BASE-T is not supported)
Full Duplex (Half Duplex is not supported)
The Auto Negotiation function is mandatory.

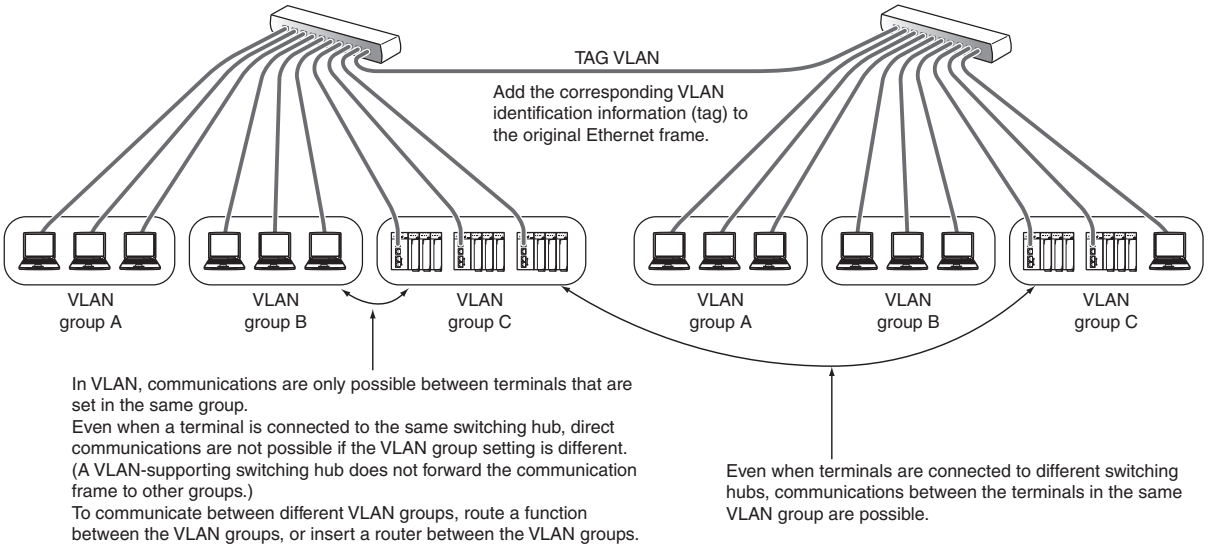
! Design Precautions

• If the SLP-NX is connected to chains of modules through switching hub with communication adapters instead of communication boxes, the physical configuration will not be displayed correctly.
After the removal of the cables between the modules and the switching hub, connect the SLP-NX to the modules to configure each module as a separate project, or connect it to each module using the loader jack for configuration.

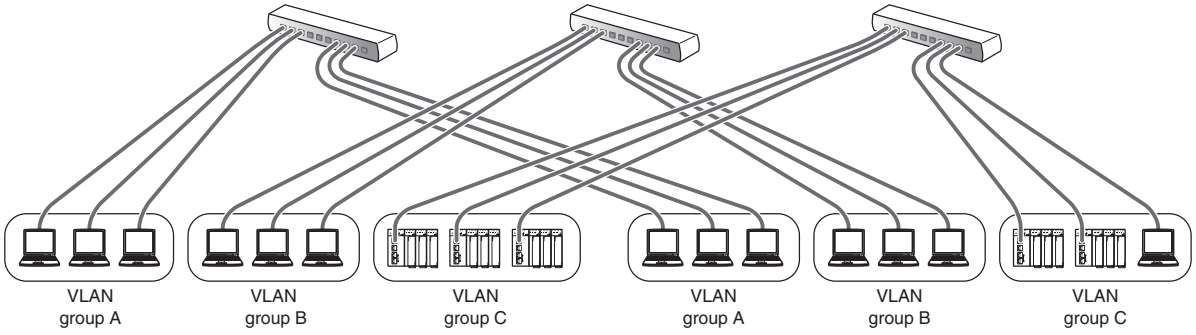
*1. Explanation of VLAN

This is an abbreviation for Virtual LAN. Divide the network into any virtual groups, regardless of the actual physical connection configuration.
This can be achieved using a VLAN-compatible switching hub.
By creating a VLAN configuration, you can isolate networks and create networks that are not affected by external influences.
Prepare separate routing devices for communications between networks that have been separated using a VLAN.

- Actual connection configuration



- Virtual operations described above



■ Example of wiring not permitted

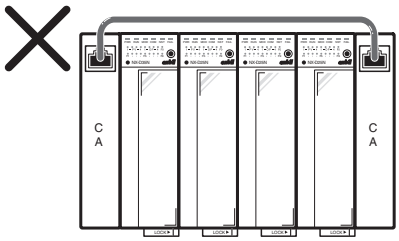
The examples below are representative of wiring examples that are not permitted.

! Design Precautions

- Not all prohibited examples have been listed.
  These examples also apply to extensions between modules using communication adapters.

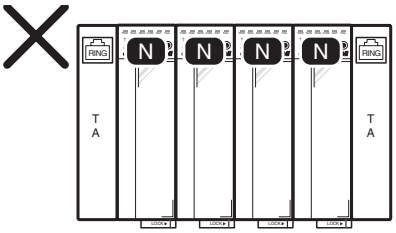
● Connecting communication adapters using a ring network

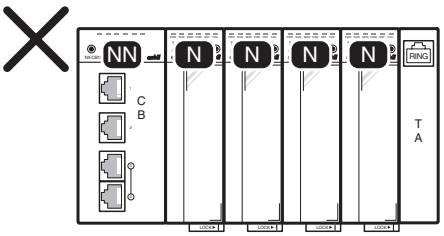
Do not connect communication adapters to the left or right.

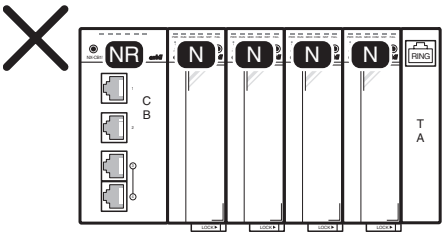


● Connecting terminal adapters to non-ring modules

Do not connect non-ring modules and terminal adapters.

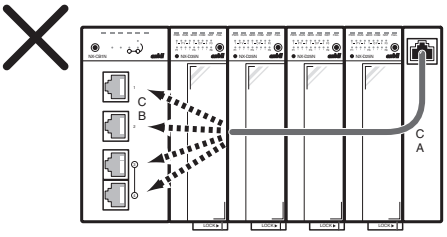






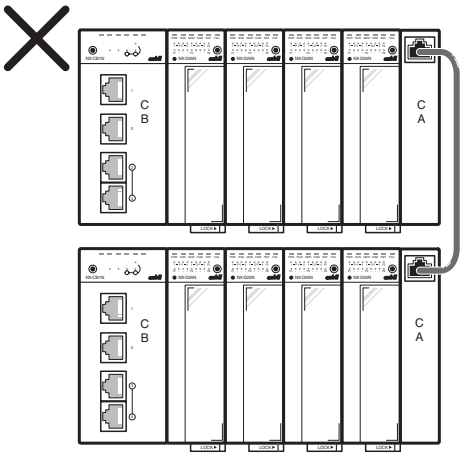
● Connecting communication adapters and communication boxes

Do not connect the front ports of communication adapters and communication boxes.



- Connecting communication adapters (with communication boxes)

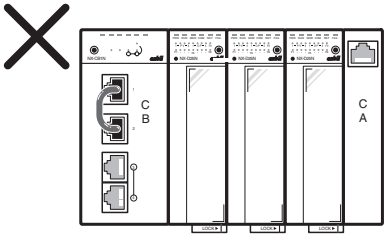
  Do not set up connections between right-side communication adapters of chains connected to communication boxes.



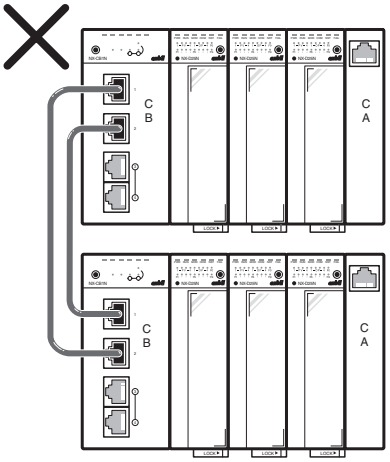
- Connections between the front ports of communication boxes

  When connecting communication boxes, do not set up connections using multiple paths, unless the ports are ring-compatible (ports 3 and 4 of NX-CB1 R0400).

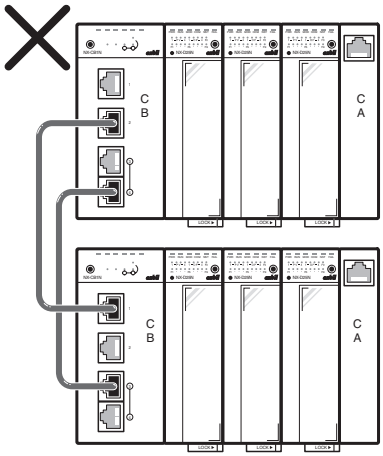
  - Front ports of the same communication box



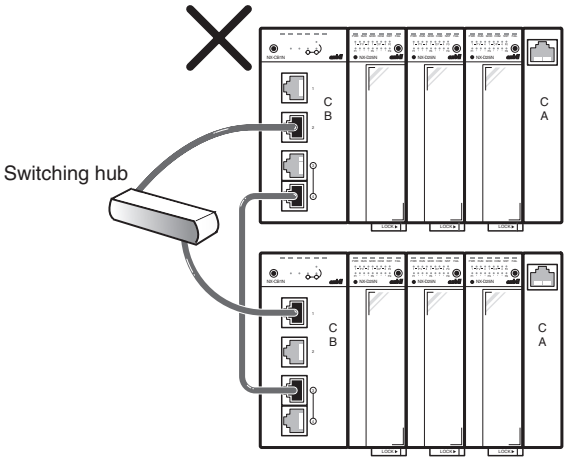
  - Connection between front ports 1 and 2 of the communication boxes



- Connection between front ports 1 and 2 of the communication boxes while front ports 3 and 4 of the communications boxes are connected using a daisy chain connection (includes ring connections).



- Connection between front ports 1 and 2 of the communication boxes using a general-purpose (commercially available) switching hub while ports 3 and 4 of the communications boxes are connected using a daisy chain connection.



2 - 7 Precautions for Placement of Ethernet Cables

This section explains some precautions for placement of Ethernet cables.

■ Minimum bend radius

The minimum bend radius of a Ethernet cable is 50 mm or greater.
Otherwise, deterioration of cable characteristics or disconnection may result.
Deterioration of cable characteristics causes communication errors.

* If a cable is installed not exceeding the minimum bend radius, its characteristics can be guaranteed for a long time.

■ Installing communication cables

When installing a Ethernet cable, do not deform the cable with clamps and metal brackets.
If the cable is deformed, deterioration of cable characteristics or disconnection may result. Deterioration of cable characteristics causes communications errors.

■ Separation from sources of electromagnetic interference

Avoid electromagnetic sources when routing Ethernet cables. Electromagnetic interference causes communications errors.
Electromagnetic sources include motors, transformers, copy machines, and machine tools, and power cables to these types of equipment.
Ethernet cables should be away from power cables as far as shown in the table below. These values are specified for modules based on ANSI/TIA/EIA-569.

Conditions	Minimum separation distance		
	Less than 2kVA	2-5kVA	Over 5kVA
Unshielded electrical devices or power lines that are close to a communications line which is exposed or in a non-metallic path	300 mm or more	600 mm or more	1200 mm or more
Unshielded electrical devices or power lines that are close to a communications line in a grounded metal conduit	150 mm or more	300 mm or more	600 mm or more
Power lines contained in a grounded metal conduit that are close to a communications line in a grounded metal conduit	_	150 mm or more	300 mm or more

! Design Precautions

- For the Ethernet cable, use a 4-way straight-wire UTP cable of Cat 5e or higher (shieldless twisted pair cable) as defined by ANSI/TIA/EIA-568-B. This module is not compatible with an STP cable (shielded twisted pair cable).

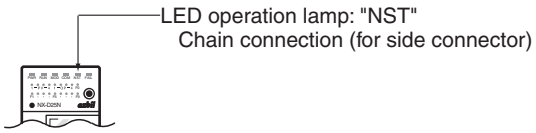
2 - 8 Ethernet Status Display ”NST” LEDs

You can verify the status of the Ethernet network on modules using the “NST” LED display for each module. This section explains the “NST” LED.

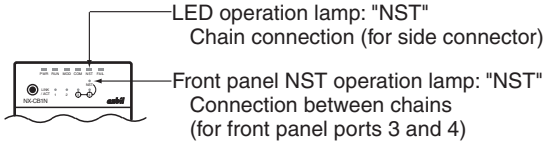
■ “NST” LEDs

Each module has “NST” LEDs.

• For controller modules:



• For communication boxes:



“NST” LEDs are:

• chain connection (for side connectors) LEDs

• LED (communication boxes only) between chain connections (for front ports 3 and 4)

The details are explained in the next section.

● LED operation lamp: “NST” LED
Front-side NST operation lamp: “NST” LED (communication boxes only)
This "NST" LED shows network status between chains.

- Lit: non-ring communication devices
- Fast blink: Ring communication error status
  The ring is disconnected in the connection between chains (the ring is disconnected somewhere)
- Slow blink: Ring communication error status
  The ring is disconnected in the connection between chains (the ring connecting to the main node or the next node is disconnected)
- Off Ring: Ring communication normal status
  communication for the connection between chains is normal

■ “NST” LED status when the network is normal

The examples below are “NST” LED status when the network is normal.

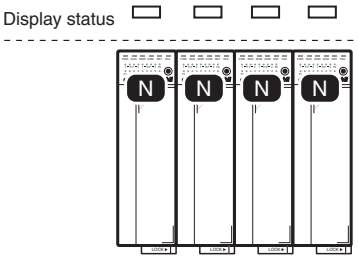
The symbols used for each “NST” LED are shown below.

- LED operation lamp “NST” LED: ▭
- Front NST operation lamp “NST” LED: ○

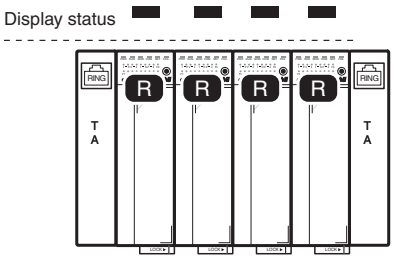
The symbols used for the status display are also shown below.

- Lit : ▭ ○
- Fast blink : ▭ ○
- Slow blink : ▭ ○
- Off : ■ ●

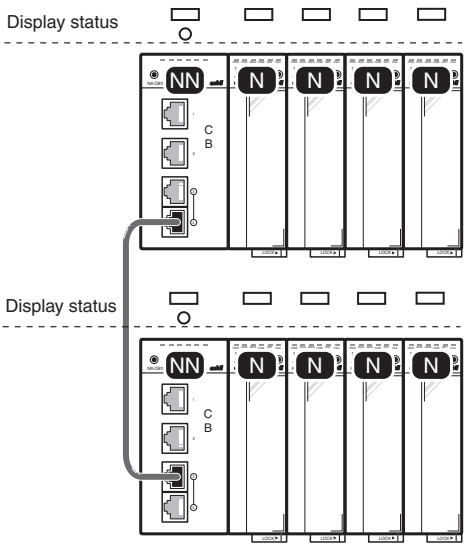
● Chain connection: non-ring communications



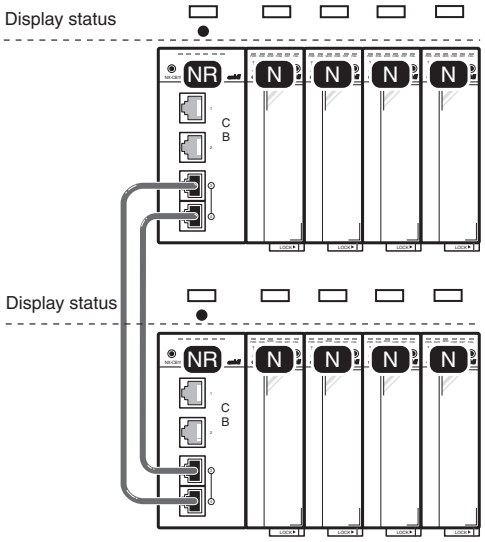
● Chain connection: ring communications



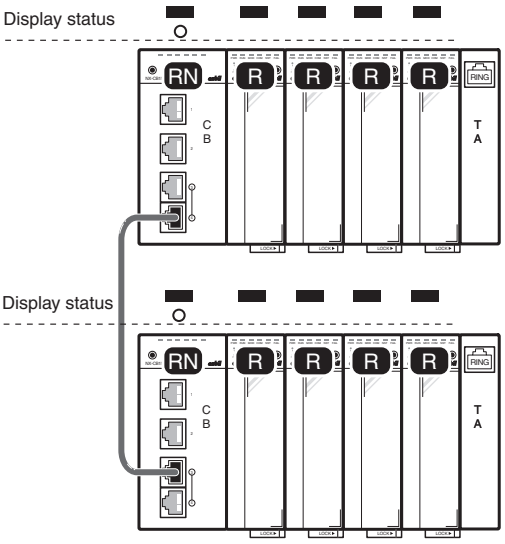
● Chain connection: non-ring communications Connection between chains: non-ring communications



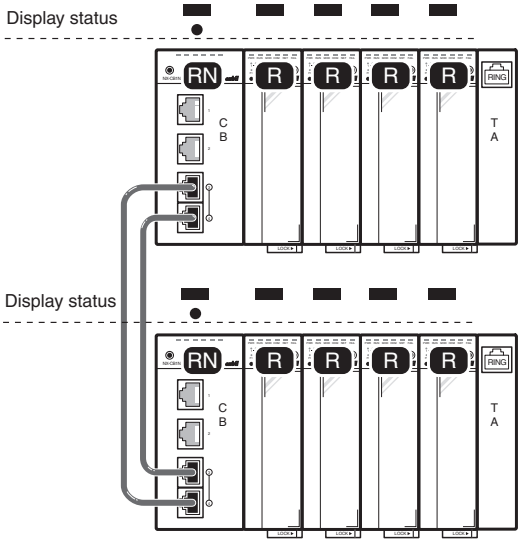
- Chain connection: non-ring communications Connection between chains: ring communications



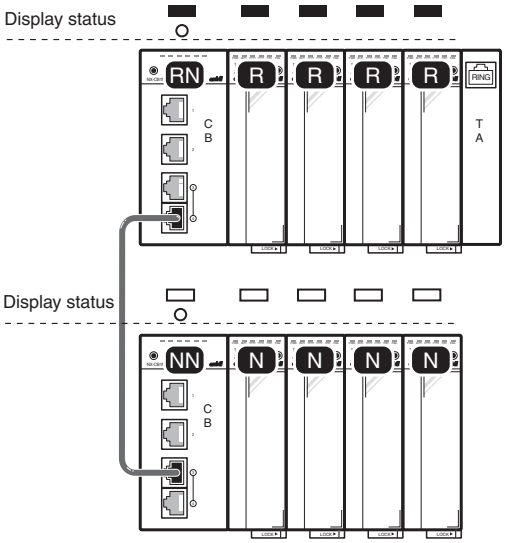
- Chain connection: ring communications Connection between chains: non-ring communications



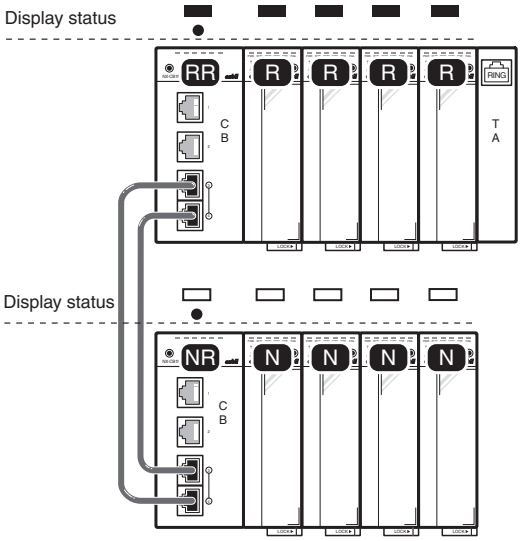
- Chain connection: ring communications Connection between chains: ring communications



● Chain connection: ring communications/non-ring communications Connection between chains: non-ring communications



● Chain connection: ring communications/non-ring communications Connection between chains: ring communications



■ Example of “NST” LED status when there is an error on the network

The examples below are the typical “NST” LED status when there is an error on the network.

The symbols used for each “NST” LED are shown below.

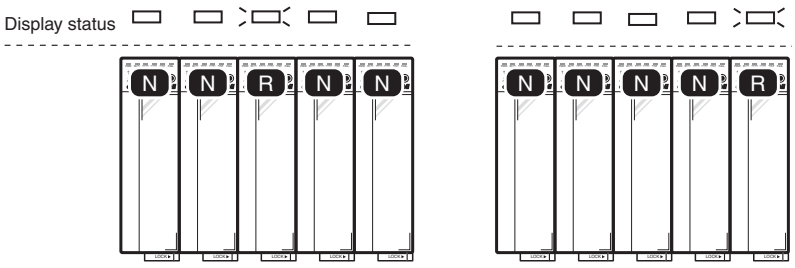
- LED operation lamp “NST” LED: ▭
- Front NST operation lamp “NST” LED: ○

The symbols used for the status display are also shown below.

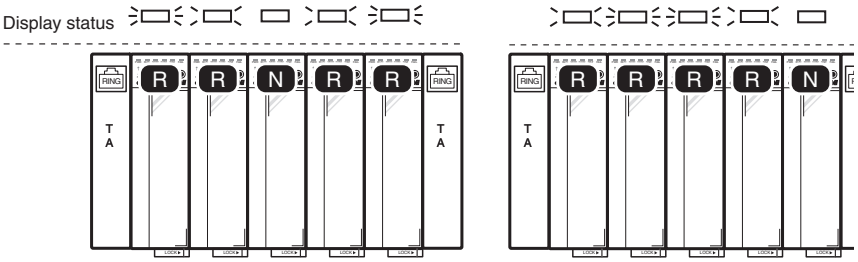
- Lit : ▭ ○
- Fast blink : ▭ ○
- Slow blink : ▭ ○
- Off : ■ ●

● Combination of ring communications and non-ring communication modules

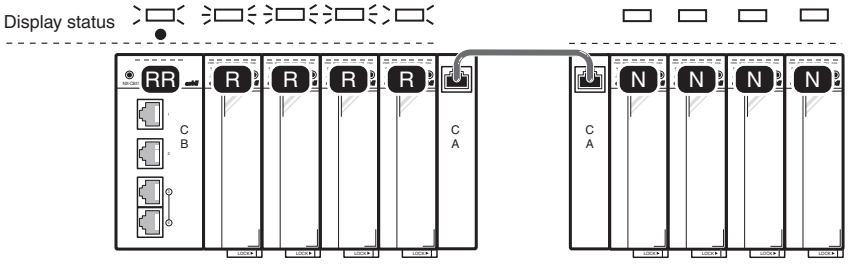
- Connecting a ring communication module in a non-ring communication module



- Connecting a non-ring communication module in a ring communication module

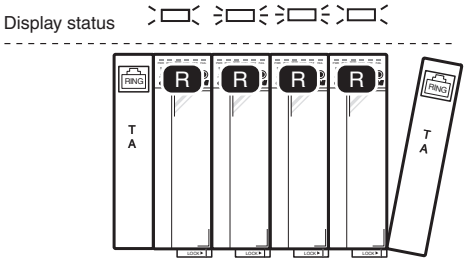


- Connecting a ring communication module chain and a non-ring communication module chain



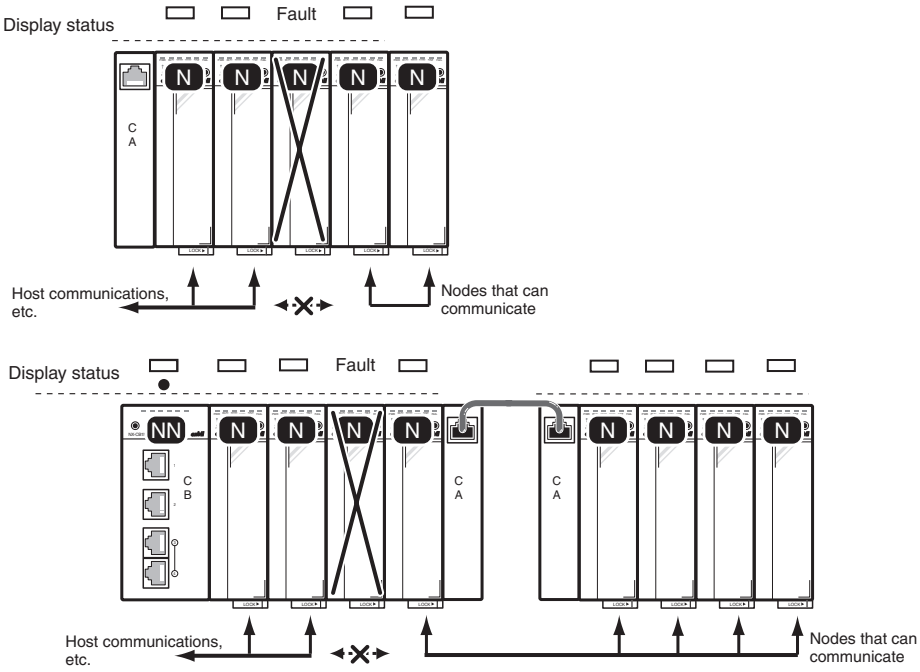
● Terminal adapters removed

- Chain connection: ring communications



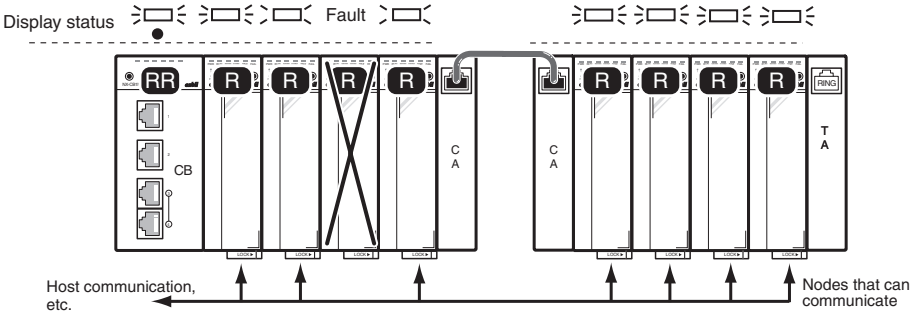
● Module fault

• Chain connection: non-ring communications



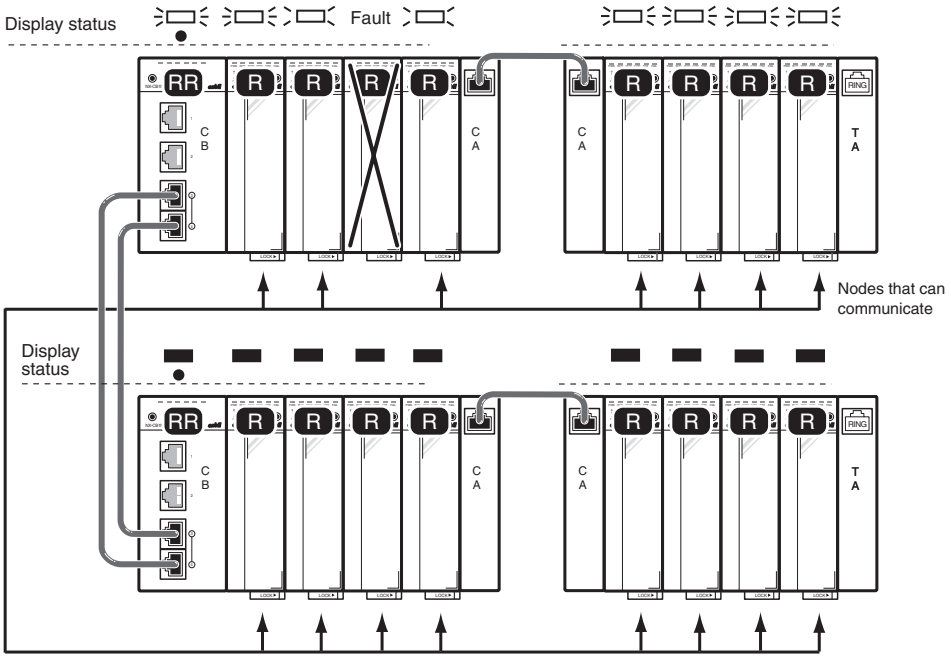
Errors cannot be detected by an “NST” LED in non-ring communications.
Communications are divided.
Host communications can only be established until the module before the faulty module as seen from the host device.

• Chain connection: ring communication



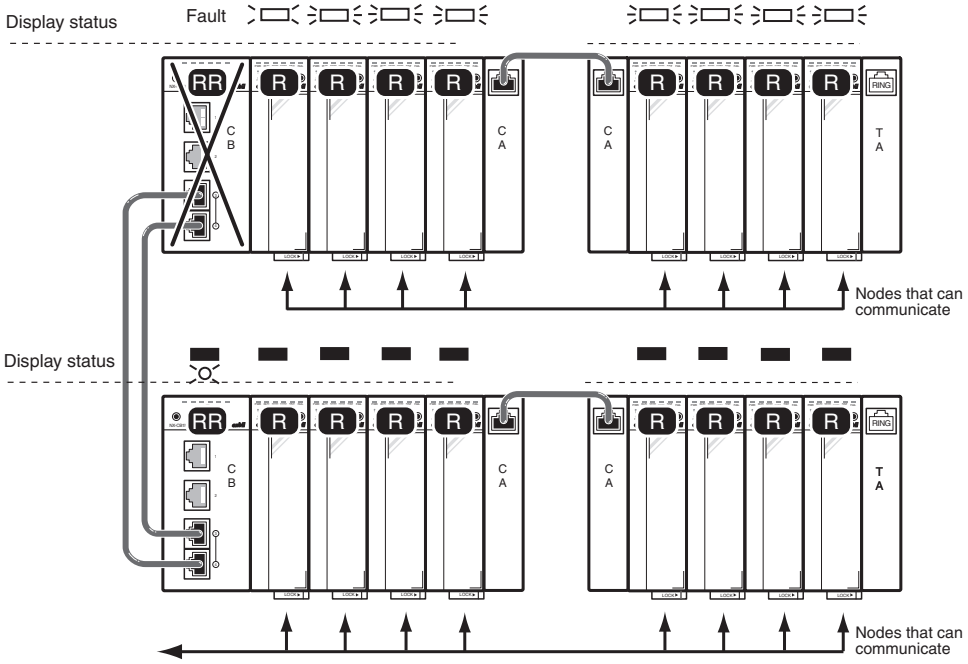
Communications between normal nodes continue.

- Chain connection: ring communications Connection between chains: ring communications



Communications between normal nodes continue.

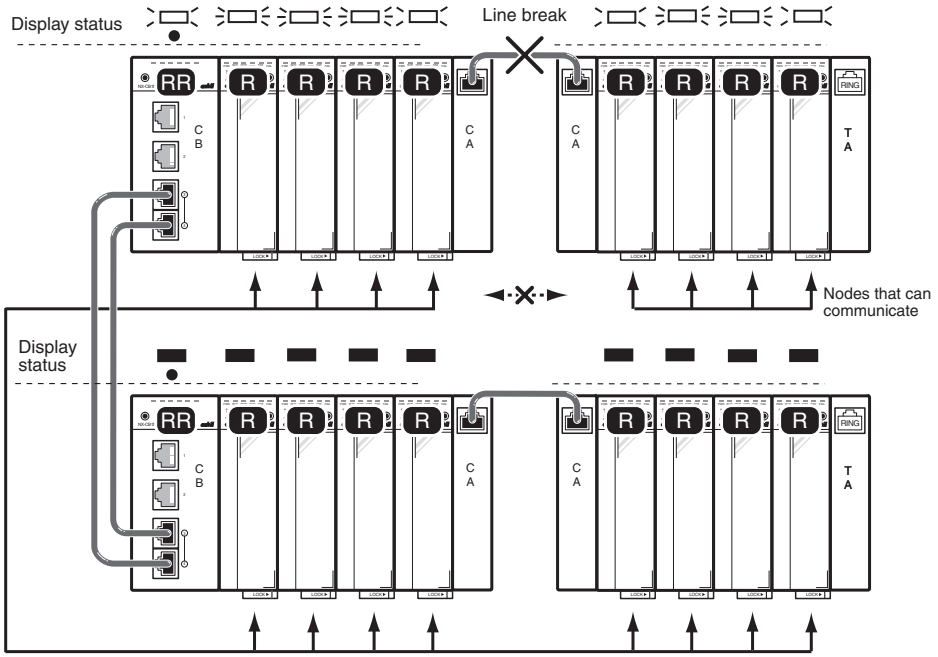
- Chain connection: ring communications Connection between chains: ring communications (when a communication box fails)



Communications between the chain with the faulty communication box and the other chain are not possible.

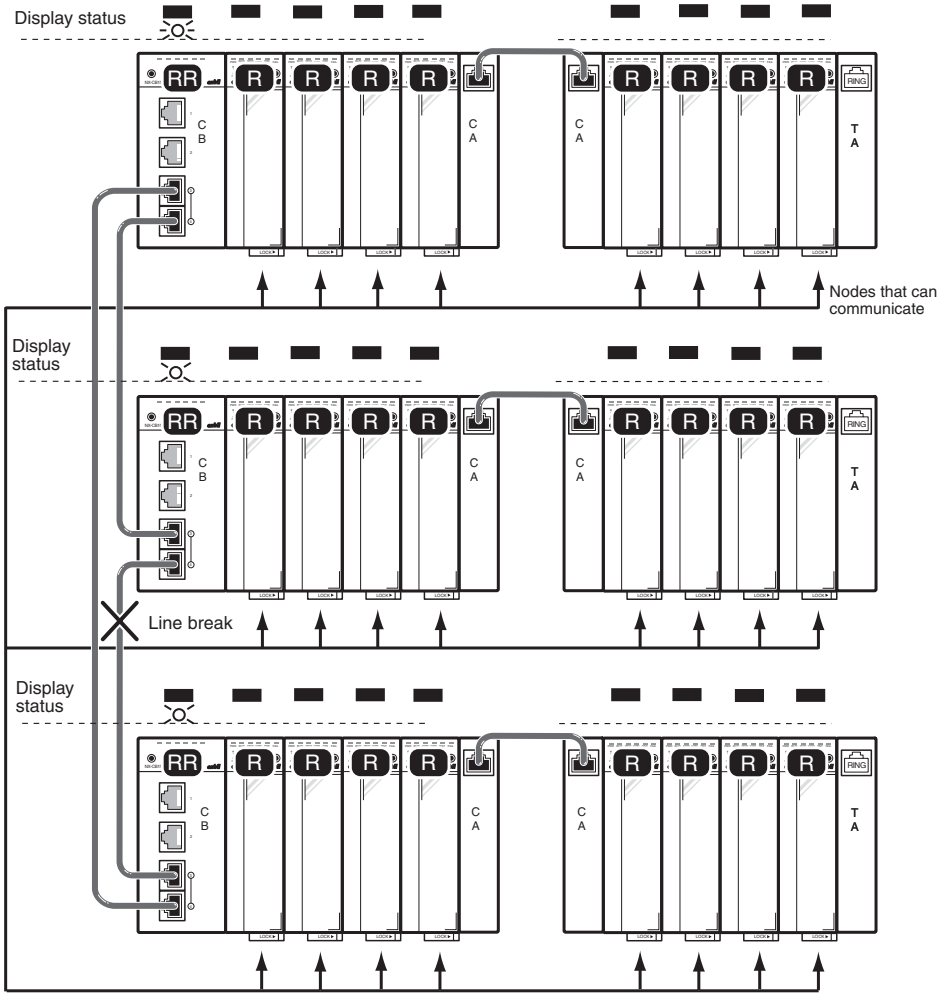
● Disconnected cable, etc.

• A disconnected cable between communication adapters



The communications area is divided.

• A disconnected cable between communication adapters



Communications can be established between all nodes.

- When there is network congestion (refer to the prohibited wiring examples)

  Except for communication boxes, when [RUN], [MOD], [COM], [NST], and [FAIL] LEDs are flashing fast in multiple modules, the network is congested and communications cannot be established.

! Design Precautions

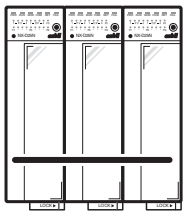
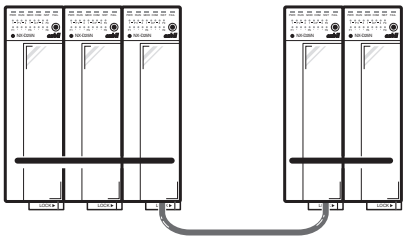
- Even when the network is congested, [RUN], [MOD], [COM], [NST], and [FAIL] LEDs do not always change to a flashing mode.
- If the [RUN], [MOD], [COM], [NST], and [FAIL] LEDs are only flashing in one module, a wrong module may be inserted.
- If communications cannot be established regardless of the LED status, there may be a wiring error.

Chapter 3 Configuration of Serial Communications

This chapter describes the configuration of serial communications for modules, including the basic points, module information, and specific connection modes.

3 - 1 Basic Configuration

The basic combinations for configuring serial communications are shown below.

Connection	Distributed layout
	

3 - 2 Serial Communications Wiring

This section explains wiring for serial communications on modules.

■ Wiring rules for serial communications

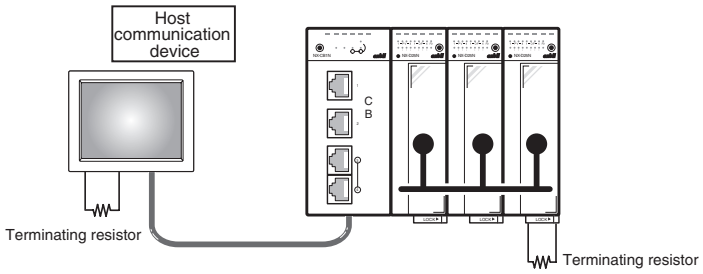
- Serial communication lines are connected by linking modules.
  Make sure that the RS-485 cutoff switch on the base of the controller module is set to the communication status (default setting).
  To see the position of the switch,
  ☞ ● RS-485 cutoff switch (Page 1-3).
- Wire modules that will use serial communications so that they are all in series without branching. Branch wiring cannot be used.
  Always wire the module located at either end of linked modules.
  Communication adapters are not included even if being used.
- The total length of lines in a path is 500 meters.
- Attach a terminating resistor (150 Ω, 1/2 W or more) to devices at both ends of the wiring.
  If there is any device that allows no terminating resistors on the same line, follow the rules for the device.
- Use twisted-pair cable for the communication lines and connect pairs of twisted wires to DA/DB.
- Be sure to wire the SG.

! Design Precautions

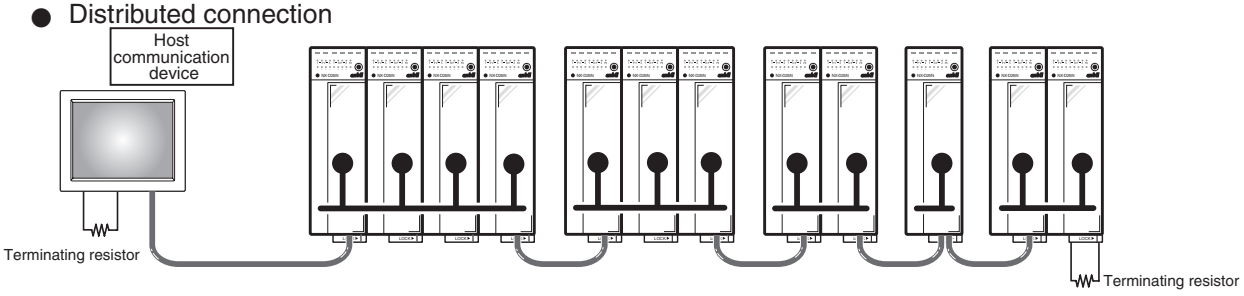
- Communication boxes have RS-485 communication terminals on the base. The communication line is connected through the side connectors. However, the communication box itself is not a communication node.

■ Example of wiring

● Linked connection



● Distributed connection

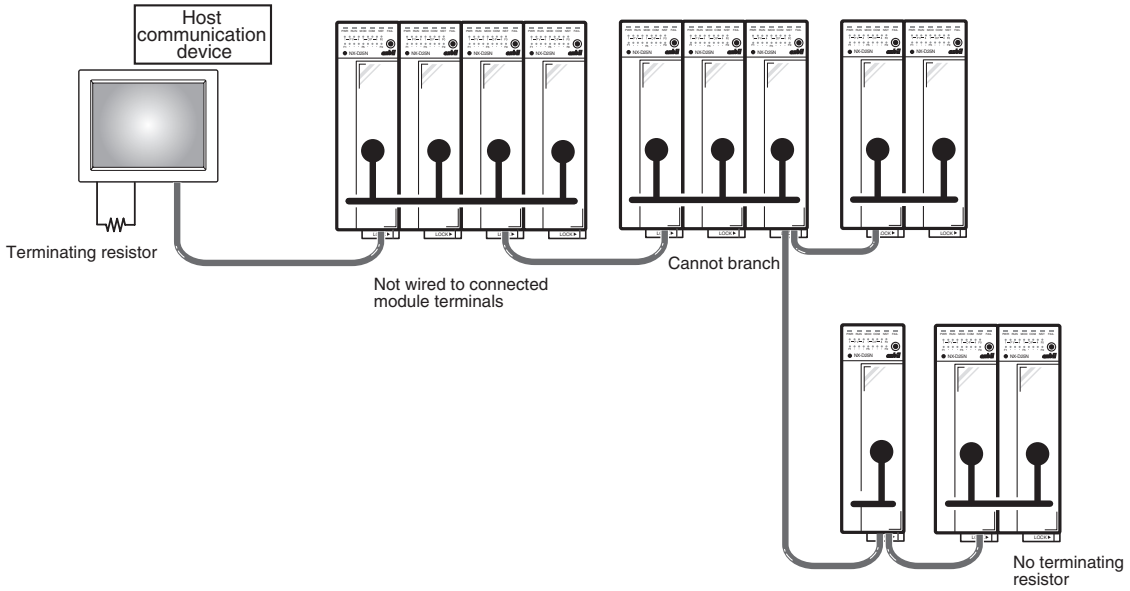


! Design Precautions

- In a distributed configuration, connect the cable to the exterior of the module.

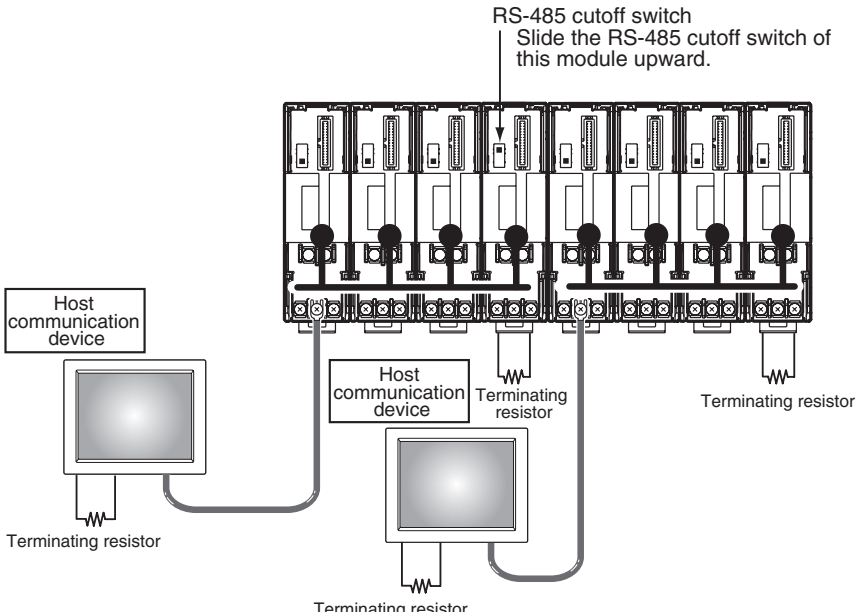
● Example of prohibited wiring

This diagram is representative of inhibited wiring.



■ When there are linked connections but you want to separate serial communications

There is a RS-485 cutoff switch on the base of a module.
If you want to separate serial communications from those of linked modules on the right, slide the switch upward.
Example:



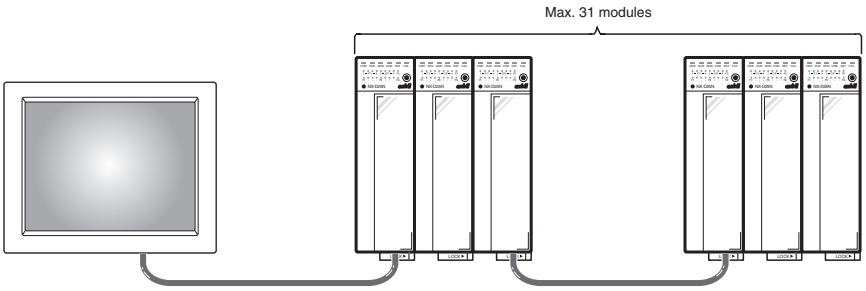
🕮 Note

• For information on the RS-485 cutoff switch,
☞ ● RS-485 cutoff switch (Page 1-3).

3 - 3 Configuration Methods

■ Number of connected devices

A maximum of 31 nodes can be connected to one host device (display device, programmable logic controller (PLC), PC, etc.).

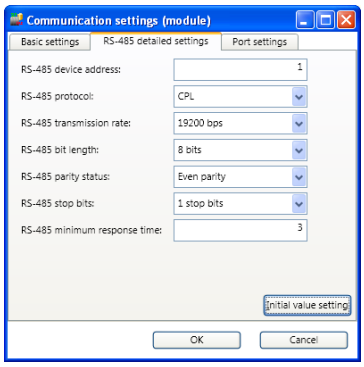


(Connection example)

■ Setting up device addresses

When using a module in RS-485 communication, set the device addresses in the SLP-NX. For information about the setup method,

☞ Smart Loader Package SLP-NX User's Manual (CP-UM-5636E)



! Design Precautions

- For the module, the normal parameters and communincations configuration are independent. Both Ethernet and RS-485 communications configurations are classified as communications configuration.

■ Connecting to CMC (communication controller) series

This section explains how to connect modules to the Yamatake CMC series.

! Design Precautions

- The module and the CMC unit cannot be linked using side connector.

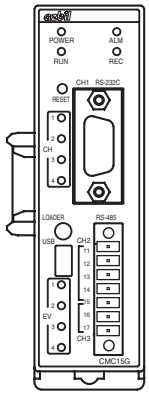
● Connecting to the CMC15G (multifunction gateway)

Connect using CPL communications (RS-485). For information on CMC15G settings,

☞ CMC15G User's Manual (CP-UM-5463JE).

! Design Precautions

- Connecting at a transmission speed of 115 kbps.
  The module supports 115 kbps for RS-485 communications. When connecting to a CMC15G, the maximum CPL transmission rate varies depending on communication channels in the CMC15G.



CH1 : 115 kbps max.
RS-232C(D-Sub9pin)

CH2 : 115 kbps max.
RS-485 (5 wires)

CH3 : 19.2 kbps max.
RS-485 (3 wires)

CH4 : 38.4 kbps max.
RS-485 (3 wires)

● Connecting to the CMC10L (RS-232C/RS-485 conversion device)

This module is for the RS-485 (three-wire). Use it for a connection with an RS-232C serial communication master node. For information on CMC10L settings,

☞ CMC10L User's Manual (CP-UM-5130JE).

! Design Precautions

- Connecting at a transmission speed of 115 kbps.
  The CMC10L does not support 115 kbps. (max. 38.4 kbps)
  When connecting the CMC10L to the module, set the transmission speed to 38.4 kbps or less.

Chapter 4 Network Function Design

4 - 1 Functions and Connection Specifications of Participating Modules

■ Participating modules

The following is the participating module in the network.

Name	Participating Module*
Controller module	○
Digital input/pulse input module	○
Supervisor module	○
Communication box	×

* A participating module has data passing functions in communications.

■ Target functions and connection specifications

The target network functions are shown below.

Type	Function	Path	Additional
Host communications	MODBUS/TCP communication function	Ethernet	Slave function
	MODBUS (RTU and ASCII) communication function	Serial	
	CPL communication function	Serial	
Tool communications	SLP-NX connection function	Ethernet	Communication with multiple modules is possible
		Loader jack	One-to-one communication with a module
Communications between modules	Function for transferring data between modules	Ethernet	Function for communicating between modules
	Multi-loop cooperative control		

● Host communication function

This is a function that connects to host communication devices, such as touch panels.
You can select a connection via Ethernet (MODBUS/TCP), RS-485 (MODBUS/RTU, MODBUS/ASCII, and CPL), or a combination of both.
A maximum of two host communication devices can be connected (when there is one connection per module).
However, only one device can be connected if the host device uses two Ethernet connections per module.

Note

- For information on the host communication function,

☞ Controller Module NX-D15/25 (CP-SP-1308E)
☞ Digital input/pulse input module NX-DX1/DX2 (CP-SP-1323E)
☞ Supervisor module NX-S11/S12/S21 (CP-SP-1324E)

Design Precautions

- A host communication device can have up to two connections per module.
- A maximum of two TCP connections can be supported as MODBUS/TCP. However, please check the restrictions for other communications and communication devices.

- Tool communication function

  This is the function that connects to the SLP-NX. One SLP-NX can be connected per module.

- Function for communicating between modules

  Data can be exchanged between modules via Ethernet.
  For details,
  ☞ Chapter 5 Function for Transmitting Data Between Modules
  ☞ Chapter 6. Multi-Loop Cooperative Control

4 - 2 Connection Configuration

Set up network functions in accordance with the applications being used, and based on 4-1 Functions and Connection Specifications of Participating Modules (previous page).

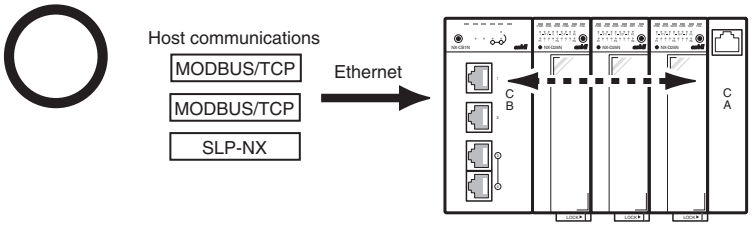
Design Precautions

- There is no guarantee that connections will operate properly if they exceed the connection specifications.

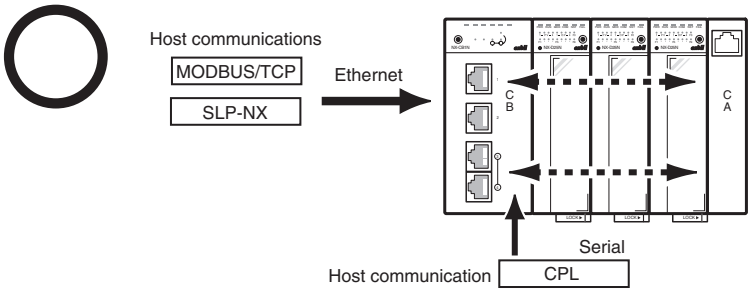
● Usage example

SLP-NX is required for setup and monitoring. Always include it in the configuration.

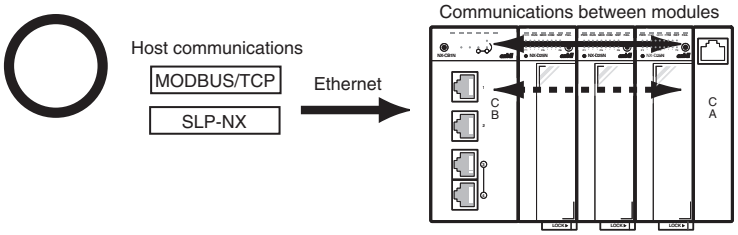
Example 1: Ethernet host communications (2 master configuration)



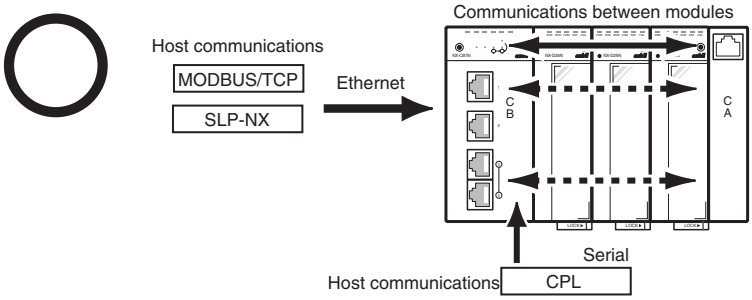
Example 2: Ethernet host communications (1 master configuration) + serial host communications



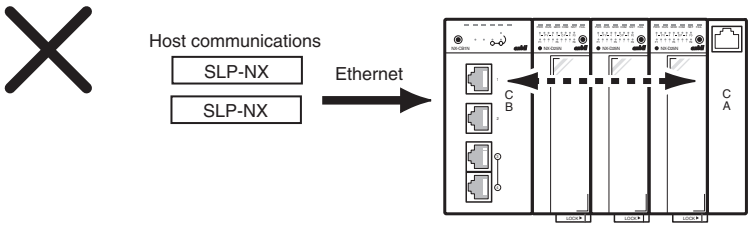
Example 3: Communications between modules + Ethernet host communication



Example 4: Ethernet host communications (1 master configuration) + serial host communications + communications between modules



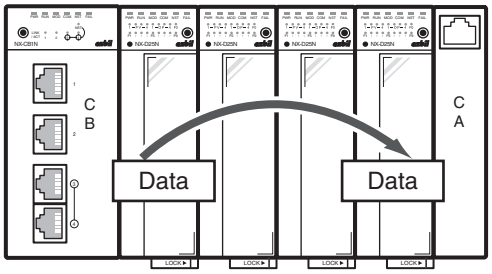
Example 5: SLP-NX (2 programs) + Ethernet host communications



Chapter 5 Function for Transmitting Data Between Modules

5 - 1 Overview

Transmitting data between modules is a function to refer to data of other modules.
This function configures parameters as remote data using the SLP-NX.



In addition to operating modules independently, such as:

- creating function linkages and typical input/output signals by sharing information with other modules
- establishing distributed configuration by positioning modules close to sensors/ actuator terminals, and
- propagating settings changes from host devices to other modules,

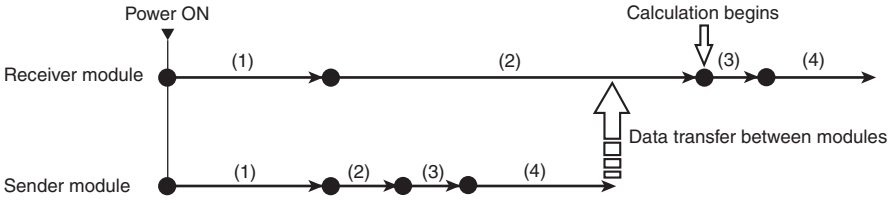
a wide range of applications can also be supported.

Point

- Data can be transferred to a maximum of 4 modules (send and receive).
- The maximum number of data records that a single module can send to one destination module is 16.
- The maximum number of data records that a single module can receive is 48. (Numerical value 16, bit 32)
- This function is performed using Ethernet communications.
  It can be used for linked connections and distributed configurations.
- The communication cycle is fixed at 400 ms.

Design Precautions

- This function is not available for the NX-D15 controller module or the supervisor module.
- Modules performing multi-loop cooperative control cannot use this function.
- Settings for this function are made by using the SLP-NX. Reading and writing are not possible from host communications.
- If you want to begin calculations as soon as the receiver module receives data after the power is turned on, make the parameter for start delay at power ON of the receiver module at least 7 seconds more than that of the sender module.
  Otherwise, calculations will begin before the data is received.
  * Be careful, for example, when 2 modules send and receive data to and from each other.
  Be sure to fully consider the design for power supply and start-up before use.



(1) Running : 9 seconds (fixed)
(2) Start delay at power ON : 2 seconds (initial value) *1
(3) Waiting time until host communications begin data reception : 1 seconds (fixed)
(4) Waiting time until data transfer between modules begins : 5 seconds (fixed)

*1 : After the setup time has elapsed, calculations will begin.
*2 : The initial value will very depending on the module model number.

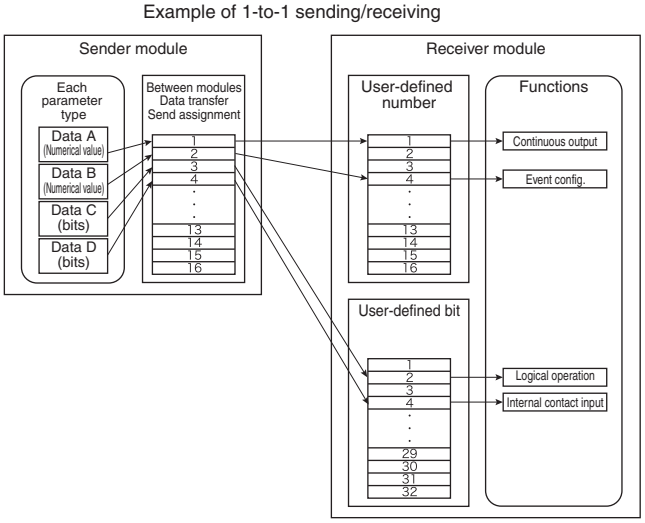
5 - 2 Functions

■ Function for transmitting data between modules.

The function for transmitting data between modules is a function that writes specified data from one module to another module using dedicated communications.

■ Data flow

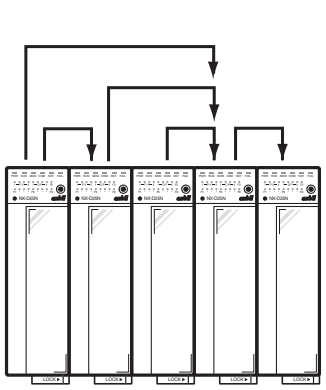
The data transfer flow is shown below.



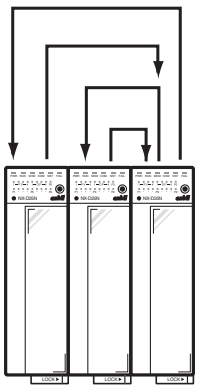
The sender module will write its data to user-defined numbers or user-defined bits of the receiver module through communications.
Using the SLP-NX, assign user-defined numbers or user-defined bits as remote data selected from parameters for functions compatible with the data transfer between modules.

■ Number of connected modules that can be used in this function

For each module, you can set up data exchange with up to four other modules.
Set the total number of sender and receiver modules to 4 or less.



Reception	0	1	0	3	1
Transmission	2	1	1	1	0
Total	2	2	1	4	1



Reception	1	1	2
Transmission	1	1	2
Total	2	2	4

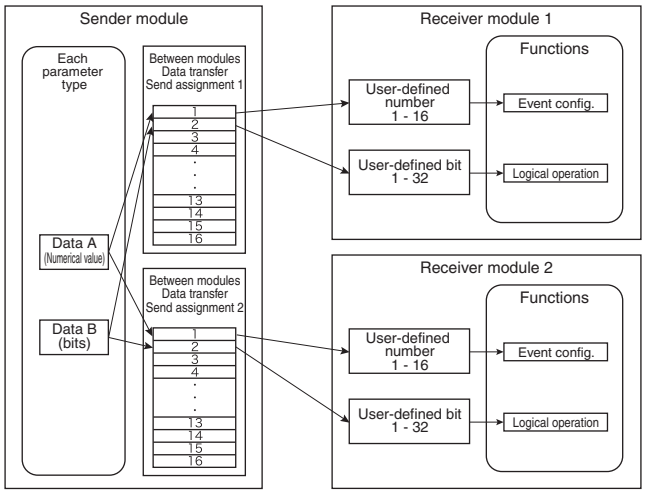
! Design Precautions

- If you want to begin calculations as soon as the receiver module receives data after the power is turned on, a single module cannot simultaneously send and receive data. Designate each module as a sender or receiver.

■ Number of data that can be sent

Up to 16 data records can be sent from one module to another.
If the same data records are sent to multiple
modules, they are counted on a destination module basis.

Image: Example of 1-to-2 sending/receiving



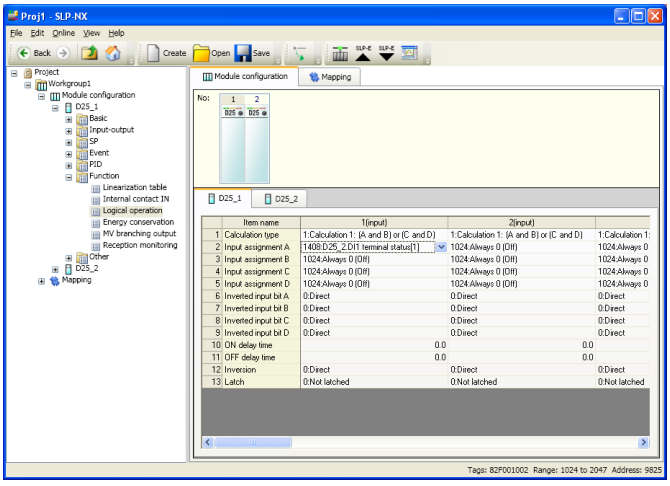
■ Number of data records that can be received

Set up the data to be transferred between modules by assigning the remote data to be received in that module to user-defined numbers 1-16 or user-defined bits 1-32. For data reception, you can specify a total of 48 data records in user-defined numbers and user-defined bits per module.

■ Setting through the SLP-NX

Data passing and other functions that use this function can be set in the SLP-NX. The settings are configured in the data receiver module by assigning the data received by this with desired functions to remote data.

Example: The DI input terminal status from another module is added to input assignment A data in the Logical Operation function.



■ Supported functions

The parameters that are supported for each target module in this function are shown below.

• NX-D25

Folder name	Bank Name	Parameter Name	Numerical Value	Bits
Basic	Loop (assigned input)	Assigned PV	○	–
	Loop (assigned input)	Assigned RSP	○	–
	Loop (assigned input)	Assigned AI	○	–
Input-output	OUT/DO output	Output type	○	○
	Continuous output	Output type	○	–
Event setup	Event config.	Loop/channel definition * Operation type (standard number type)	○	–
Function	Internal contact input	Input type	–	○
	Logical operation	Input assignments A to D	–	○
	MV branching output	Loop assignment	○	–
Other	UF LED settings	Conditions for lighting	–	○

Supported functions differ according to the version. For details,
☞ Controller Module NX-D15/25 (CP-SP-1308E)

• NX-DX1

Folder name	Bank Name	Parameter Name	Numerical Value	Bits
Other	UF LED settings	Conditions for lighting	–	○

• NX-DX2

Folder name	Bank Name	Parameter Name	Numerical Value	Bits
Input-output	EV Output	Output type	–	○
Other	UF LED settings	Conditions for lighting	–	○

! Design Precautions

- The communication cycle between modules is fixed at 400 ms.
  For this reason, a notification of a data change within 400 ms may fail.
  In applications that require to capture data changes without fail for each control cycle, make sure to use data from the same module.
- When assigning remote data, assign numeric parameters to user-defined numbers, and bit parameters (0 or 1) to user-defined bits.
- If using this function with the NX-D25 controller module, set 400 ms for the periodic cycle parameters.
- If using a module that performed this function with another instrument, make sure to clear all parameters. (Parameters are cleared on the SLP-NX screen.)

■ Error monitoring function

The error monitoring function includes:

- Transmission time-out monitoring (a function for communications between modules)
- Reception monitoring

- Transmission time-out monitoring (a function for communications between modules)

  This is the error monitoring function for the sender module.
  If there is no response after the same data is sent 3 consecutive times, an error occurs and is reflected to the standard bit.

Standard bit code	Name	Additional
1980	Transmit time-out	Time-out detection time = 1s (fixed)

Factors for transmission time-out monitoring may include:

- Incorrect data read/write settings
- Incorrect communication settings such as the node address for the communication partner module.
- The communication partner module is turned off
- An Ethernet cable has been disconnected
- Network problems
- Hardware failures

Check these items and take countermeasures.

- Reception monitoring

  If there is no communication access within the timeout for the communication addresses of user-defined bits and user-defined numbers in the dedicated communications (including this function) and host communications (including via Ethernet and RS-485), an error occurred and is reflected to the standard bit.

Bank		Parameter Name	Remarks
Function	Reception monitoring	Address	Set with a host communication address of user-defined bits and user-defined numbers.
		Time-out	0 – 65535 s
		Mode	Function disabled (0)/enabled (1)

Standard bit code	Name	Remarks
1920-1935	Reception monitoring 1-16	—
1979	Reception monitoring (1-16 typical) (AL31)	OR for 1-16

This function uses user-defined numbers or user-defined bits. Specify the host communication address for user-defined numbers and user-defined bits.
Factors for reception monitoring may include:

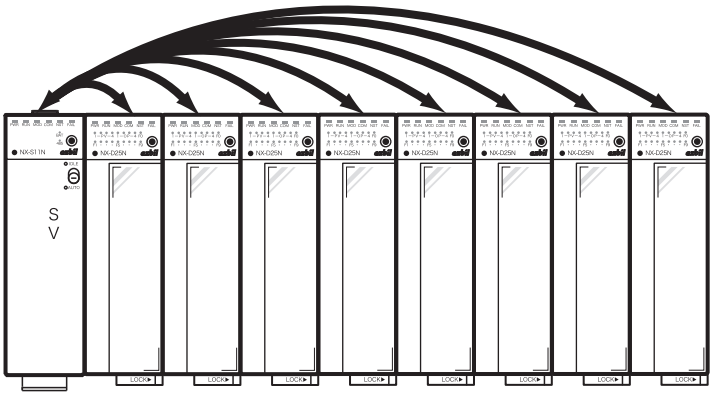
- Incorrect reception monitoring settings
- Incorrect communication settings such as node addresses
- The data write function for the partner communication module being accessed
- Incorrect data read function settings
- The communication partner module is turned off
- An Ethernet cable has been disconnected
- Network problems
- Hardware failures

Check these items and take countermeasures.

Chapter 6 Multi-Loop Cooperative Control

6 - 1 Overview

Multi-loop cooperative control is achieved by combination of a supervisor module and multiple controller modules.



Multi-loop cooperative control enables support of a wide range of applications, such as shown below, that cannot be supported by individual module operations:

- Zone-to-zone temperature difference control
- Optimal startup control
- Peak power suppression control

Note

- A supervisor module can be controlled cooperatively with up to eight controller modules.
- This function is operated using Ethernet communication.
  It can be used for a connected operation or a distributed layout within the same chain.
- The control cycle is fixed at 200 ms.
- Up to eight groups can be controlled.

Design Precautions

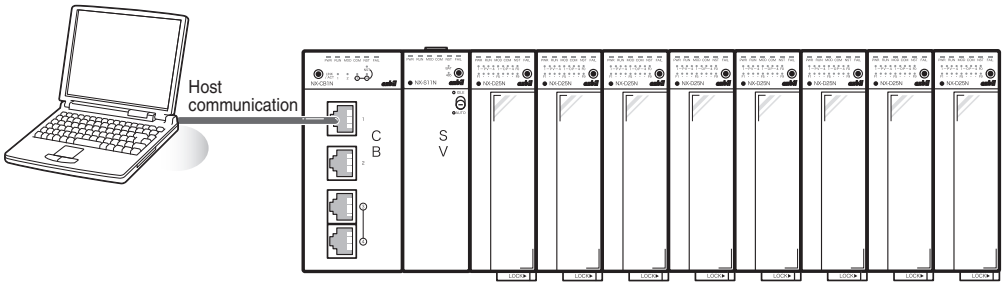
- Controller modules that are operating the multi-loop cooperative control cannot use the inter-module data forwarding function.
- Controller module “NX-D15” does not support this function.

6 - 2 Configuration

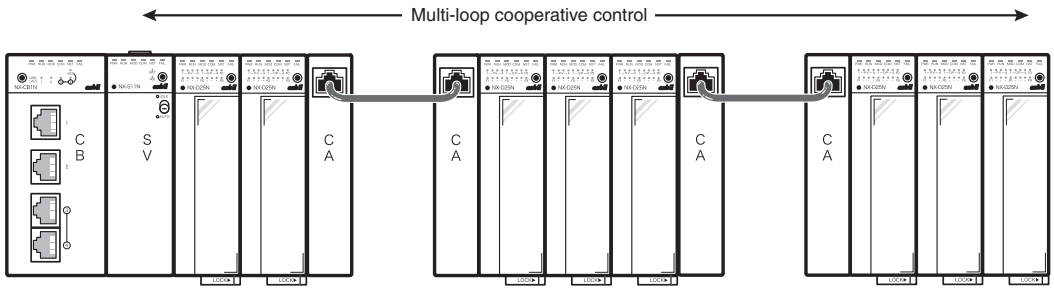
When performing a host communication connection with a chain that operates a multi-loop cooperative control using Ethernet communication, ensure that a host device is connected using a communication box.
Note that the “NX-CB1RR” communication box is not supported.

! Design Precautions

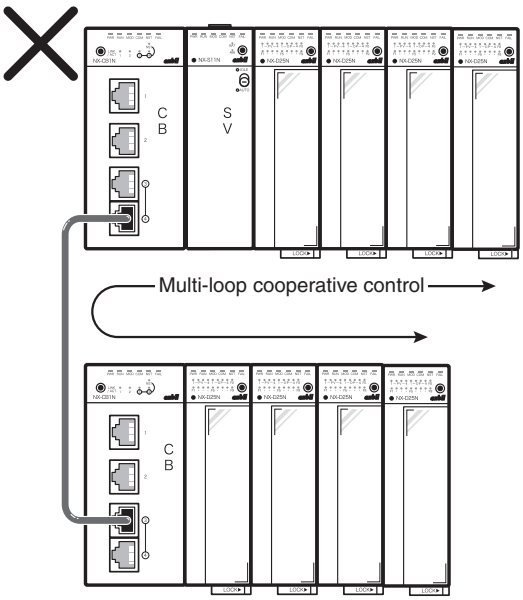
- Note that the “NX-CB1RR” communication box is not supported.



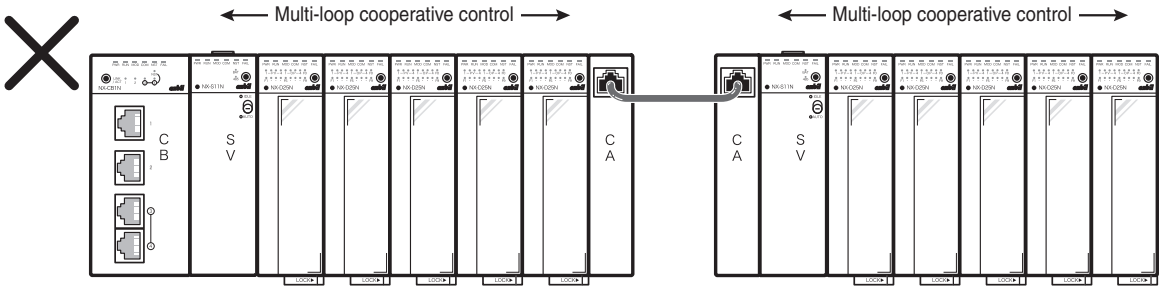
Modules that operate a multi-loop cooperative control must be located within the same chain.
They can be used for either a connected operation or a distributed layout as long as they located within the same chain.
There are no restrictions on the location of the supervisor module within the same chain.



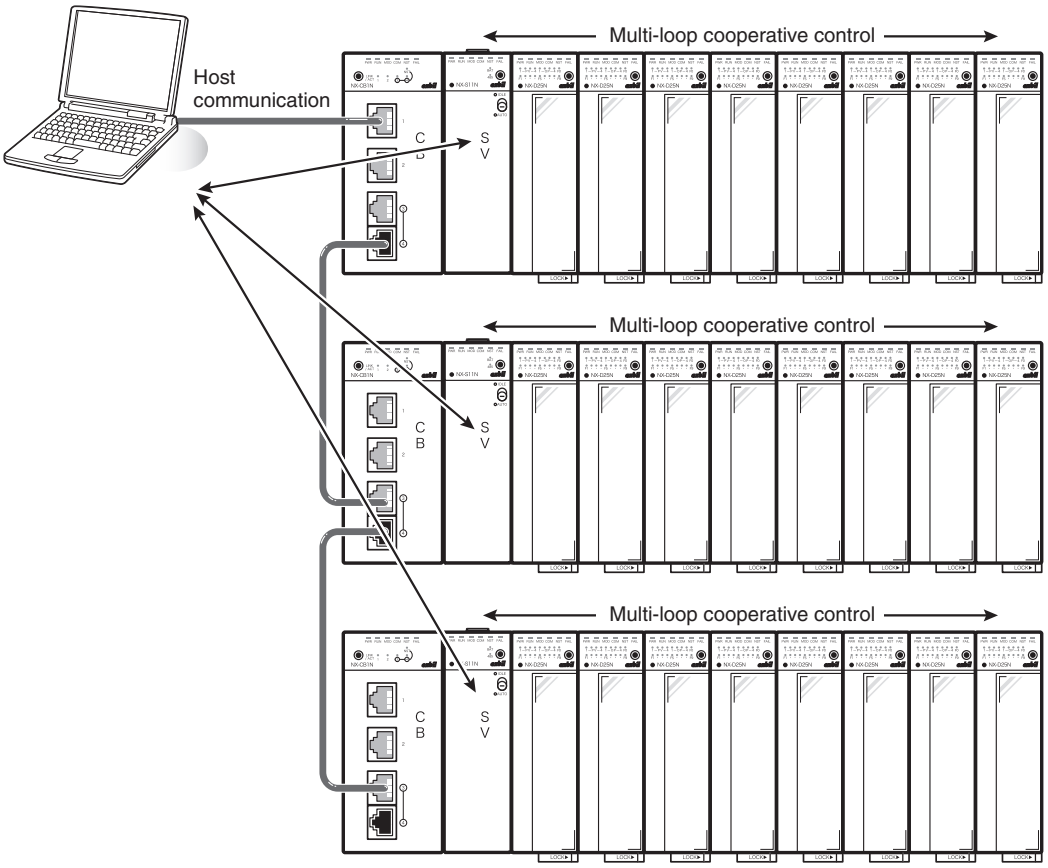
Multi-loop cooperative control cannot be operated via a communication box.



Only a single supervisor module can be located within the same chain.



Two or more multi-loop cooperative controls can be administered on a single host device.



Note

- Refer to the following document regarding the functions and settings of multi-loop cooperative control:

☞ Supervisor Modules NX-S11/S12/S21 Description of Functions (CP-SP-1324E)

Appendix

Explanation of General Terminology

A list of general Ethernet terminology is provided below as a reference.

■ OSI (Open Systems Interconnection) Layer

There are seven layers in the hierarchical structure conversion system used for creating OSI (Open Systems Interconnection model) protocol. This is based on the ISO (International Standards Organization) network configuration design plan for data communications.

Layer 7	Application layer	Rule for between applications (HTTP, etc... MODBUS and CPL are also in this layer)
Layer 6	Presentation layer	Method for expressing data (SMTP, etc.)
Layer 5	Session layer	Procedures for sessions (NetBIOS, etc.)
Layer 4	Transport layer	Method for communicating between applications (TCP, UDP, etc.)
Layer 3	Network layer	Method for communicating between two nodes (IP, ICMP, etc.)
Layer 2	Data link layer	Method for transferring data between multiple nodes connected to a network medium. (Ethernet MAC)
Layer 1	Physical layer	Method for converting signals passing through or above a network medium (In Ethernet communications, this refers to PHY and cables)

■ Ethernet

Developed by Xerox, this is a Base Band LAN standardized as IEEE802.3. (Ethernet is the registered trademark of Xerox)
Strictly speaking, there are some specification differences between Ethernet and the IEEE802.3 standard. However, these are generally not differentiated between. In this document, the IEEE802.3 standard is generally referred to as Ethernet.
The Ethernet bandwidths currently in use are 10 Mbps (Ethernet), 100 Mbps (Fast Ethernet), 1 Gbps (Gigabit Ethernet), and 10 Gbps (10GbE). In addition, 40 Gbps and 100 Gbps are currently being formulated as wide-band standards.
Only the 100 Mbps 100BASE-TX is used for the Network Instrumentation Modules.

■ 100BASE-TX

IEEE802.3u: This is the most wide spread of the Fast Ethernet (100 Mbps) standards.
It is a point-to-point connection using two Cat 5 UTP cables (unshielded twisted-pair cables).
Data is encoded in 4B/5B and communications are conducted using the MLT-3 modulation method.

Other Fast Ethernet

100BASE-T2: Use two CAT 5 UTP cables
100BASE-T4: Use four CAT 3 UTP cables
100BASE-FX: Connect using optical fiber cable

■ UTP (Unshielded Twist Pair) Cable

UTP cable is unshielded twisted-pair cable.
It is classified according to the “performance” and “modular plug” connection methods.
The details of each are explained below.

- Performance

  Performance is standardized as ANSI/TIA/EIA-568 and classified as shown below.

  Cat 3: Prescribed up to the 16 MHz frequency bandwidth (10BASE-T)
  Cat 5: Prescribed up to the 100 MHz frequency bandwidth (100BASE-TX/10BASE-T)
  Cat 5e: Adds the regulation on interference from remote communication lines to Cat 5 (1000BASE-T/100BASE-TX/10BASE-T)
  Cat 6: Prescribed up to the 250 MHz frequency bandwidth
  Cat 6a: Prescribed up to the 500 MHz frequency bandwidth, with UTP and ScTP (bundle shield)
  Cat 6e: Cable manufacturer-specific standards.

The electrical characteristics, including the modular plug, and the processing method are strictly regulated in ANSI/TIA/EIA-568. The cables that are being used are cables with modular plugs sold at retail stores. However, some cables do not meet the standards for modular plug characteristics/processing methods.
If cables do not meet the standards, communications may be unstable.

- Modular plugs

  These are classified according to straight wires and cross wires.
  Straight wires connect with the same pins as the opposing modular plug. Always align pins with the corresponding twisted pair as shown below.

  Pair 1: n 4–Pin 5
  Pair 2: n 1–Pin 2
  Pair 3: n 3–Pin 6
  Pair 4: n 7–Pin 8

Only use four pairs of straight wires for the Network Instrumentation Modules. The cable length is more than 0.5 meters and less than 100 meters.
Different restrictions apply to the cable length depending on the configuration.

☞ Chapter 4 Network Configuration

The locations for cross wires are different for each transmission standard (1000BASE-T/1000BASE-TX/100BASE-TX) and there is no compatibility.

■ STP (Shielded Twist Pair) Cable

Twisted-pair cable with a shield.
The Network Instrumentation Modules do not support STP cables.

■ Bandwidth

Communications capacity in a certain amount of time. This is normally expressed by how many bits of data can be sent in OSI Layer 2 in one second.
Example: 100 Mbps

■ Node

A terminal that has communication functions.
Each Network Instrumentation Modules is a node on the network. Communication boxes, communication adapters, and terminal adapters are not a node.

■ Port

An interface component for exchanging data with external components.
Originally, this also included software. However, in this case it refers to a component that is contacted electrically.
Communication adapters convert the functions of these ports.

■ Hub

The line concentrator relayed in an OSI Layer 1 used in a star-type LAN.
A hub has multiple ports and data that is input in one port is transferred to all other ports. All connected nodes share bandwidth.
The functions are different to those of a switching hub. Although they may be both referred to as a hub, they need to be clearly distinguished. A hub is referred to as a dumb hub if there is a need to distinguish it from a switching hub.

■ Switching Hub

The line concentrator relayed in an OSI Layer 2 used in a star-type LAN.
A switching hub has multiple ports. It analyzes entered data frame destination addresses and uses bandwidth efficiently by only transmitting to the relevant ports. All connected ports can use all bandwidths.
In addition, you can typically connect devices with different bandwidths to each port.
It also has switches that relay in OSI Layer 3 and Layer 4.

■ Router

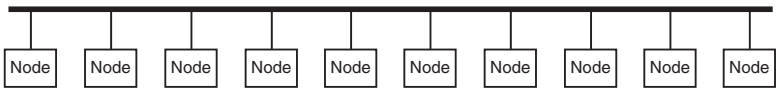
This is a device that relays to other networks in OSI Layer 3 (and part of Layer 4). It has a route analysis function that determines which route to use for transferring entered data, and management functions, such as a filtering function for determining protocols and IP.

■ Topology

Topology is a network's connection configuration. A typical topology is shown below.

● Bus topology

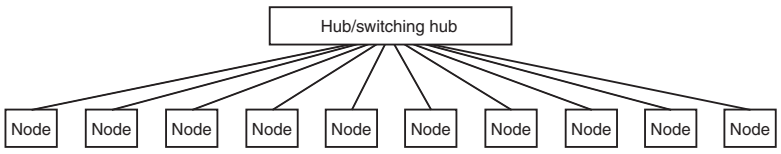
This topology is suitable for 10BASE-5/10BASE-2/RS-485 and other coaxial cables.



In this configuration, multiple communication nodes are connected to one main cable. All connected nodes share bandwidth. For this reason, there needs to be a system to prevent the transmitted data from colliding. (In Ethernet communications, data collisions are avoided using the CSMA/CD method. There are also buses that use the token passing method.) Network usage efficiency declines.
It is unlikely that the entire network will go down as a result of a single node going down. However, if a cable fails, there is a high probability that communications will fail in all nodes.

- Star topology

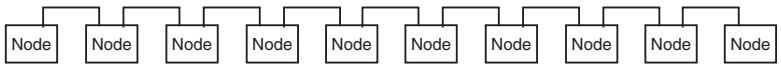
Star topology is appropriate for 10BASE-T, 100BASE-TX, and 1000BASE-T(GbE).



In this configuration, connections are made in a broadcasting state using line concentrators and relay devices (such as switching hubs). Line concentrators and relay devices can be connected in a cascade. Nodes are connected to line concentrators and relay devices using a point-to-point connection. (Other nodes are not connected in between).
Line concentrators and relay devices have dumb hubs and switching hubs. The network topology of a dumb hub is logically the same as a bus topology because all connected nodes share bandwidth in the hub.
In switching hubs, bandwidth is guaranteed in each port, improving the efficient use of a network.
It is unlikely that the entire network will go down as a result of a single node going down. However, if there is a line concentrator or relay device error, communication will fail in all nodes.
A tree topology is similar to this topology. Tree topology is typified by USB. It uses a hub with master nodes that connect to slave nodes.

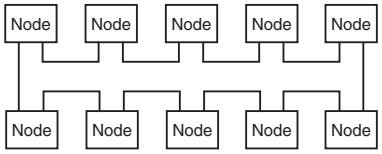
- Daisy chain topology

Daisy chain topology is appropriate for SCSI and IEEE1394 (i.LINK/FireWire). This topology is rarely used in typical Ethernet communications.



In this configuration, all nodes have two sets of ports, and they are strung together in series using point-to-point connections. Data is transferred by relaying it using intermediate nodes. This configuration is advantageous because wiring for connections is easy. However, if an intermediate node fails, the network becomes divided.
Signals flow between multiple nodes, with the exception of the nodes located at either end. The bandwidth usage efficiency is inferior to star topology connected through a switching hub, but it is better than a bus topology.

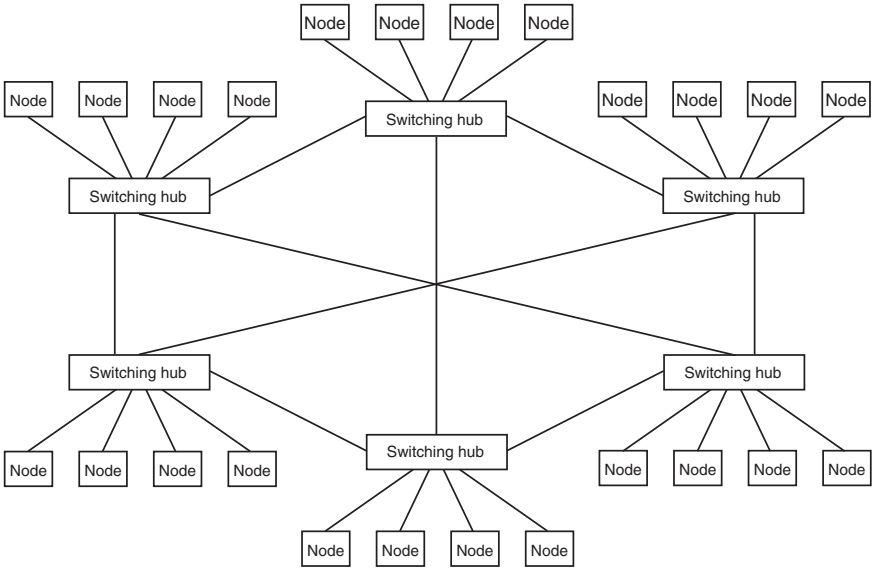
- Ring topology



This configuration improves the fault tolerance performance of daisy chain topology. (A single point of failure does not inhibit communications between healthy nodes.)
In this configuration, all nodes have two sets of ports. They are strung together in series using point-to-point connections that form one closed ring. Data is transferred via intermediate nodes.

● Mesh topology

This is a variation of star topology.



It is a redundant connection method that connects through multiple paths (mesh states) when establishing connections between multiple switching hubs. Note that the switching hubs must support a spanning tree protocol. (If this protocol is not supported, the network becomes congested.)
This configuration can support a failure in an intermediate switching hub. However, it cannot support a failure in a switching hub that has nodes connected.

■ Full Duplex

This is a two-way communication method that has two communication path systems and allows receiving and sending to be performed simultaneously.
Most switching hubs support full duplex.

■ Half Duplex

This is a two-way communication method that only has one communication path system and splits its time switching between sending and receiving.
Half duplex is used in a bus topology such as 10BASE-5, and a star topology when using dumb hubs.

■ Auto Negotiation

There are different bandwidth standards for Ethernet connected using UTP cables. There are also differences between full duplex and half duplex. If there are these differences between communication partners connected to each other using a point-to-point connection, communications will not be possible. The auto negotiation exchanges information with connection partners as soon as a cable is connected and automatically adjusts the bandwidth to the most appropriate one.

■ AutoMDI/MDI-X

The AutoMDI/MDI-X function determines whether the destination port type is MDI or MDI-X and automatically switches MDI wires and MDI-X wires.
This makes it possible to connect using straight wires, regardless of the port type on the partner side.
In 100BASE-TX, communications are performed using two sets of twisted-pair cable, with one set for sending and one set for receiving.
This wiring assignment has MDI and MDI-X.
☞ ■ MDI Wiring and ■ MDI-X wiring on the next page.

When connecting MDI-wired devices and MDI-X-wired devices, you should use standard straight cables because these devices send/receive data to/from a different type of devices.
On the other hand, to connect an MDI device to another or an MDI-X device to another, use a crossover cable so that data sending and receiving can be crossed.

■ MDI Wiring

Node-side wiring
Send: Use pins 1-2 Receive: Use pins 3-6

■ MDI-X Wiring

Switching hub-side wiring
Send: Use pins 3-6 Receive: Use pins 1-2

■ Address

Ethernet communications use MAC addresses and IP addresses to identify the destination devices that are communicating.

● MAC address

This is an address that identifies devices in OSI Layer 2. In Ethernet communications, MAC addresses have 48 bits. The first 24 bits are a code assigned by the vendor. The last 24 bits are assigned so that they do not duplicate the vendor code.

● IP address

This is an address that identifies devices in OSI Layer 3. These addresses are assigned by the user. IP addresses are IPv4 or IPv6. Unless otherwise specified, IPv4 is used.
IPv4 is a 32 bit address. It is divided into a network address section and a host address section.
It is divided into four lots of 8 bits. Each lot is converted into decimal, with a dot "." entered in between.

Example: 192.168.0.1

Basically, you can only communicate with devices with the same network address. To communicate with devices with a different network address, you need a device relaying data in OSI Layer 3 (such as a router or L3 switch).

1. Network address
   Network addresses do not allow overlapping. For this reason, they are managed on an international level by organizations such as ICANN. You cannot assign a network address yourself. (Global address)
   However, these restraints do not apply to assigning addresses to be used in private LANs without connecting to the internet.
   Such addresses are called private addresses.
   Network addresses are divided into classes according to the number of hosts that can be connected. (Host means more or less the same thing as node). The classes are Class A, B, C, and D (and E).

2. Private address
   This is an IP address that can be used freely but cannot connect directly to the internet. Private addresses are assigned to each class.

3. Class A
   Network address = 8 bits Host address = 24 bits
   Network address range: 0.xx.xx.xx-127.xx.xx.xx
   (xx is the host address)
   Private address range: 10.xx.xx.xx (xx is the host address)

4. Class B
   Network address = 16 bits Host address = 16 bits
   Network address range: 128.0.xx.xx-191.255.xx.xx
   (xx is the host address)
   Private address range: 172.16.xx.xx-172.32.xx.xx
   (xx is the host address)

5. Class C
   Network address = 24 bits Host address = 8 bits
   Network address range: 192.0.0.xx-223.255.255.xx
   (xx is the host address)
   Private address range: 192.168.0.xx-192.168.255.xx
   (xx is the host address)

6. Class D (Multicast address: simultaneous data transfer to multiple nodes)
   Network address = 32 bits Host address = 0 bits
   Network address range: 224.0.0.00-239.255.255.255

7. Class E (reserved)
   Network address = 32 bits Host address = 0 bits
   Network address range: 224.0.0.00-255.255.255.255

8. Subnet mask
   Specifies how many host bits in a 32-bit IPv4 address are considered to be the network address. This is normally used when one network address is split into multiple network addresses.

9. Default gateway
   If a specific gateway address has not been set for accessing addresses in a different network, data is sent to the default gateway address.
   A device relaying data in OSI Layer 3 (such as a router or L3 switch) is normally set.

■ Unicast Transmission

This is the transmission method used in point-to-point communications in IP communications. Data is sent to specific nodes.
It uses the Class A, Class B, and Class C unicast addresses.
When sending to the same network address, data is sent directly to partner nodes. To communicate with a different network address, you need a device relaying data in OSI Layer 3 (such as a router or L3 switch).

■ Multicast Transmission

This method transmits to multiple nodes on a network at the same time. It sends to Class D addresses. The receiving node must determine whether it is data that it needs.
The addresses are broadly divided into the following three types:

- Link local address: 244.0.0.0-244.0.0.255
  An address that uses network protocol. For example, RIP and OSPF. It normally cannot go beyond devices that are relaying data in OSI Layer 3 (such as a router or L3 switch).
- Global scope address: 224.0.1.0-238.255.255.255
  Must be assigned from ICANN.
- Limited scope address: 239.0.0.0-239.255.255.255
  Can be assigned freely.

■ Broadcast Transmission

Data transmission to all nodes on a network. Data is transmitted to the following two types of addresses:

- Limited broadcast addresses
  All IP address bits are set to 1. It is sent to all nodes on the same network address (same network segment).
  It is not sent beyond OSI level 3 devices (router, L3 switch, etc.).
- Directed broadcast addresses
  Leave the network address as it is and set all bits in the host address section to 1. They will be sent to all nodes of the network address. This type of address is normally used when reporting to different network addresses. They are transferred by devices relaying data in OSI Layer 3 (such as a router or L3 switch).

■ VLAN

Virtual LAN. A virtual LAN divides a network into arbitrary groups, regardless of the actual physical connection configuration. This can be achieved using a VLAN-compatible switching hub. By creating a VLAN configuration, you can isolate networks and create networks that are not affected by external influences. Separate routing devices are separately required for communications between networks that are separated using a VLAN.

■ SNMP

Simple Network Management Protocol. This is one type of protocol for managing devices connected to a network.

■ Routing

Relaying communications in OSI Layer 3. This is performed by a router or an L3 switch.

■ RIP

Routing Information Protocol. This is the protocol that determines the routing path. It is the same as OSPF and BGP.

■ NAT

Network Address Translator. This technology converts IP addresses during routing. It is used for accessing an external global address device from a private address. There must be the same number of global addresses as the number of private addresses.

■ IP Masquerade (=NAPT)

This technology is the same as a NAT for accessing an external global address device from a private address. However, multiple private addresses are assigned to one global address.

■ IPv4 Address

This address identifies devices in OSI Layer 3. The address architecture is 32 bit.

■ IPv6 Address

This address identifies devices in OSI Layer 3. IPv4 32-bit addresses are extended to 128 bits in IPv6.
This is not supported in the Network Instrumentation Modules.

■ Congestion

An excess number of packets (traffic) flowing through the network exceeds the processing ability of the network causing congestion.
Congestion in Ethernet communications is often caused by broadcast storms.

■ Broadcast Storm

When Ethernet wiring is configured like a loop, frames to broadcast addresses or multicast addresses continues to loop around and will spend all of the network bandwidth.
To resolve a broadcast storm, correct the network configuration.

■ Spanning Tree Protocol (STP)

If a network connected in OSI Layer 2 has simple path redundancy, it becomes congested as a result of a broadcast storm. STP is the protocol used to avoid this. It is standardized as IEEE802.1d. There is also RSTP (Rapid Spanning Tree Protocol) which speeds up operations.

Revision History

Printed date	Manual Number	Edition	Revised pages	Description
Oct. 2010	**CP-SP-1313E**	**1st Edition**		
Feb. 2011		**2nd Edition**		**Overall revision**

Terms and Conditions

We would like to express our appreciation for your purchase and use of Yamatake products.
You are required to acknowledge and agree upon the following terms and conditions for your purchase of Yamatake products (field instruments, control valves, and control products), unless otherwise stated in any separate document, including, without limitation, estimation sheets, written agreements, catalogs, specifications and instruction manuals.

1. Warranty period and warranty scope

1.1 Warranty period

Yamatake products shall be warranted for one (1) year from the date of your purchase of the said products or the delivery of the said products to a place designated by you.

1.2 Warranty scope

In the event that Yamatake product has any failure attributable to Yamatake during the aforementioned warranty period, Yamatake shall, without charge, deliver a replacement for the said product to the place where you purchased, or repair the said product and deliver it to the aforementioned place.
Notwithstanding the foregoing, any failure falling under one of the following shall not be covered under this warranty:

(1) Failure caused by your improper use of Yamatake product
(noncompliance with conditions, environment of use, precautions, etc. set forth in catalogs, specifications, instruction manuals, etc.);
(2) Failure caused for other reasons than Yamatake product;
(3) Failure caused by any modification or repair made by any person other than Yamatake or Yamatake's subcontractors;
(4) Failure caused by your use of Yamatake product in a manner not conforming to the intended usage of that product;
(5) Failure that the state-of-the-art at the time of Yamatake's shipment did not allow Yamatake to predict; or
(6) Failure that arose from any reason not attributable to Yamatake, including, without limitation, acts of God, disasters, and actions taken by a third party.

Please note that the term "warranty" as used herein refers to equipment-only-warranty, and Yamatake shall not be liable for any damages, including direct, indirect, special, incidental or consequential damages in connection with or arising out of Yamatake products.

2. Ascertainment of suitability

You are required to ascertain the suitability of Yamatake product in case of your use of the same with your machinery, equipment, etc. (hereinafter referred to as "Equipment") on your own responsibility, taking the following matters into consideration:

(1) Regulations and standards or laws that your Equipment is to comply with.
(2) Examples of application described in any documents provided by Yamatake are for your reference purpose only, and you are required to check the functions and safety of your Equipment prior to your use.
(3) Measures to be taken to secure the required level of the reliability and safety of your Equipment in your use
Although Yamatake is constantly making efforts to improve the quality and reliability of Yamatake products, there exists a possibility that parts and machinery may break down.
You are required to provide your Equipment with fool-proof design, fail-safe design, anti-flame propagation design, safety design, or the like so that the said Equipment may satisfy the level of the reliability and safety required in your use, whereby preventing any occurrence of physical injuries, fires, significant damage, and so forth.

3. Precautions and restrictions on application

Yamatake products other than those explicitly specified as applicable (e.g. Yamatake Limit Switch For Nuclear Energy) shall not be used in a nuclear energy controlled area (radiation controlled area).
Any Yamatake products shall not be used for/with medical equipment.
In addition,
you are required to conduct a consultation with our sales representative and understand detail specifications, cautions for operation, and so forth by reference to catalogs, specifications, instruction manual, etc. in case that you intend to use Yamatake product for any purposes specified in (1) through (6) below.
Moreover, you are required to provide your Equipment with fool-proof design, fail-safe design, anti-flame propagation design and other designs of protection/safety circuit on your own responsibility to ensure the reliability and safety, whereby preventing problems caused by failure or nonconformity.

(1) For use under such conditions or in such environments as not stated in technical documents, including catalogs, specification, and instruction manuals
(2) For use of specific purposes, such as:
* Nuclear energy/radiation related facilities
[For use outside nuclear energy controlled areas] [For use of Yamatake Limit Switch For Nuclear Energy]
* Machinery or equipment for space/sea bottom
* Transportation equipment
[Railway, aircraft, vessels, vehicle equipment, etc.]
* Antidisaster/crime-prevention equipment
* Burning appliances
* Electrothermal equipment
* Amusement facilities
(3) Supply systems such as electricity/gas/water supply systems, large-scale communication systems, and traffic/air traffic control systems requiring high reliability
(4) Facilities that are to comply with regulations of governmental/public agencies or specific industries
(5) Machinery or equipment that may affect human lives, human bodies or properties
(6) Other machinery or equipment equivalent to those set forth in items (1) to (5) above which require high reliability and safety

4. Precautions against long-term use

   Use of Yamatake products, including switches, which contain electronic components, over a prolonged period may degrade insulation or increase contact-resistance and may result in heat generation or any other similar problem causing such product or switch to develop safety hazards such as smoking, ignition, and electrification. Although acceleration of the above situation varies depending on the conditions or environment of use of the products, you are required not to use any Yamatake products for a period exceeding ten (10) years unless otherwise stated in specifications or instruction manuals.

5. Recommendation for renewal

   Mechanical components, such as relays and switches, used for Yamatake products will reach the end of their life due to wear by repetitious open/close operations.
   In addition, electronic components such as electrolytic capacitors will reach the end of their life due to aged deterioration based on the conditions or environment in which such electronic components are used.
   Although acceleration of the above situation varies depending on the conditions or environment of use, the number of open/close operations of relays, etc. as prescribed in specifications or instruction manuals, or depending on the design margin of your machine or equipment, you are required to renew any Yamatake products every 5 to 10 years unless otherwise specified in specifications or instruction manuals.
   Field instruments (sensors such as pressure/flow/level sensors, regulating valves, etc.) will reach the end of their life due to aged deterioration of parts.
   For those parts that will reach the end of their life due to aged deterioration, recommended replacement cycles are prescribed. You are required to replace parts based on such recommended replacement cycles.

6. Other precautions

   Prior to your use of Yamatake products, you are required to understand and comply with specifications (e.g., conditions and environment of use), precautions, warnings/cautions/notices as set forth in the technical documents prepared for individual Yamatake products, such as catalogs, specifications, and instruction manuals to ensure the quality, reliability, and safety of those products.

7. Changes to specifications

   Please note that the descriptions contained in any documents provided by Yamatake are subject to change without notice for improvement or for any other reason.
   For inquires or information on specifications as you may need to check, please contact our branch offices or sales offices, or your local sales agents.

8. Discontinuance of the supply of products/parts

   Please note that the production of any Yamatake product may be discontinued without notice.
   For repairable products, we will, in principle, undertake repairs for five (5) years after the discontinuance of those products. In some cases, however, we cannot undertake such repairs for reasons, such as the absence of repair parts.
   For field instruments, we may not be able to undertake parts replacement for similar reasons.

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1st Edition: Issued in Oct. 2010 (T)
2nd Edition: Issued in Feb. 2011 (M)