User's Manual

FL-net (OPCN-2) Interface Module

Model: F3LX02-1N

IM 34M06H32-02E

YOKOGAWA
Yokogawa Electric Corporation

IM 34M06H32-02E
2nd Edition

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Applicable Product

- **Range-free Multi-controller FA-M3**
  - Model Code : F3LX02-1N
  - Model Name: FL-net (OPCN-2) Interface Module

The document number and document model code for this manual are given below.

Refer to the document number in all communications; also refer to the document number or the document model code when purchasing additional copies of this manual.

- Document No. : IM 34M06H32-02E
- Document Model Code : DOCIM

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Important

■ About This Manual

- This Manual should be passed on to the end user.
- Before using the controller, read this manual thoroughly to have a clear understanding of the controller.
- This manual explains the functions of this product, but there is no guarantee that they will suit the particular purpose of the user.
- Under absolutely no circumstances may the contents of this manual be transcribed or copied, in part or in whole, without permission.
- The contents of this manual are subject to change without prior notice.
- Every effort has been made to ensure accuracy in the preparation of this manual. However, should any errors or omissions come to the attention of the user, please contact the nearest Yokogawa Electric representative or sales office.

■ Safety Precautions when Using/Maintaining the Product

- The following safety symbols are used on the product as well as in this manual.

Danger. This symbol on the product indicates that the operator must follow the instructions laid out in this instruction manual to avoid the risk of personnel injuries, fatalities, or damage to the instrument. Where indicated by this symbol, the manual describes what special care the operator must exercise to prevent electrical shock or other dangers that may result in injury or the loss of life.

Protective Ground Terminal. Before using the instrument, be sure to ground this terminal.

Function Ground Terminal. Before using the instrument, be sure to ground this terminal.

Alternating current. Indicates alternating current.

Direct current. Indicates direct current.

The following symbols are used only in the instruction manual.

WARNING

Indicates a “Warning”.

Draws attention to information essential to prevent hardware damage, software damage or system failure.

CAUTION

Indicates a “Caution”

Draws attention to information essential to the understanding of operation and functions.

TIP

Indicates a “TIP”

Gives information that complements the present topic.

SEE ALSO

Indicates a “SEE ALSO” reference.

Identifies a source to which to refer.

- For the protection and safe use of the product and the system controlled by it, be sure to follow the instructions and precautions on safety stated in this manual whenever handling the product. Take special note that if you handle the product in a manner other than prescribed in these instructions, the protection feature of the product may be damaged or impaired. In such cases, Yokogawa cannot guarantee the quality, performance, function and safety of the product.
- When installing protection and/or safety circuits such as lightning protection devices and equipment for the product and control system as well as designing or installing separate protection and/or safety circuits for fool-proof design and fail-safe design of processes and lines using the product and the system controlled by it, the user should implement it using devices and equipment, additional to this product.
- If component parts or consumable are to be replaced, be sure to use parts specified by the company.
- This product is not designed or manufactured to be used in critical applications which directly affect or threaten human lives and safety — such as nuclear power equipment, devices using radioactivity, railway facilities, aviation equipment, air navigation facilities, aviation facilities or medical equipment. If so used, it is the user’s responsibility to include in the system additional equipment and devices that ensure personnel safety.
- Do not attempt to modify the product.

■ Exemption from Responsibility

- Yokogawa Electric Corporation (hereinafter simply referred to as Yokogawa Electric) makes no warranties regarding the product except those stated in the WARRANTY that is provided separately.
- Yokogawa Electric assumes no liability to any party for any loss or damage, direct or indirect, caused by the use or any unpredictable defect of the product.

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- Yokogawa Electric makes no other warranties expressed or implied except as provided in its warranty clause for software supplied by the company.
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- Reverse engineering, such as decompiling of the software, is strictly prohibited.
- No portion of the software supplied by Yokogawa Electric may be transferred, exchanged, or sublet or leased for use by any third party without prior permission by Yokogawa Electric.

■ General Requirements for Using the FA-M3 Controller

- **Avoid installing the FA-M3 controller in the following locations:**
  - Where the instrument will be exposed to direct sunlight, or where the operating temperature exceeds the range 0°C to 55°C.
  - Where the relative humidity is outside the range 10 to 90%, or where sudden temperature changes may occur and cause condensation.
  - Where corrosive or flammable gases are present.
  - Where the instrument will be exposed to direct mechanical vibration or shock.
  - Where the instrument may be exposed to extreme levels of radioactivity.

- **Use the correct types of wire for external wiring:**
  - Use copper wire with temperature ratings greater than 75°C.

- **Securely tighten screws:**
  - Securely tighten module mounting screws and terminal screws to avoid problems such as faulty operation.
  - Tighten terminal block screws with the correct tightening torque as given in this manual.

- **Securely lock connecting cables:**
  - Securely lock the connectors of cables, and check them thoroughly before turning on the power.

- **Interlock with emergency-stop circuitry using external relays:**
  - Equipment incorporating the FA-M3 controller must be furnished with emergency-stop circuitry that uses external relays. This circuitry should be set up to interlock correctly with controller status (stop/run).

- **Low impedance grounding:**
  - For safety reasons, connect the [FG] grounding terminal to a Japanese Industrial Standards (JIS) Class D Ground[*1] (Japanese Industrial Standards (JIS) Class 3 Ground). For compliance to CE Marking, use braided or other wires that can ensure low impedance even at high frequencies for grounding.

    *1 Japanese Industrial Standard (JIS) Class D Ground means grounding resistance of 100Ω max.

- **Configure and route cables with noise control considerations:**
  - Perform installation and wiring that segregates system parts that may likely become noise sources and system parts that are susceptible to noise. Segregation can be achieved by measures such as segregating by distance, installing a filter or segregating the grounding system.

- **Configure for CE Marking Conformance:**
  - For compliance to CE Marking, perform installation and cable routing according to the description on compliance to CE Marking in the “Hardware Manual” (IM34M06C11-01E).

- **Keep spare parts on hand:**
  - Stock up on maintenance parts including spare modules, in advance.
- **Discharge static electricity before operating the system:**
  - Because static charge can accumulate in dry conditions, first touch grounded metal to discharge any static electricity before touching the system.
- **Never use solvents such as paint thinner for cleaning:**
  - Gently clean the surfaces of the FA-M3 controller with a cloth that has been soaked in water or a neutral detergent and wringed.
  - Do not use volatile solvents such as benzine or paint thinner or chemicals for cleaning, as they may cause deformity, discoloration, or malfunctioning.
- **Avoid storing the FA-M3 controller in places with high temperature or humidity:**
  - Since the CPU module has a built-in battery, avoid storage in places with high temperature or humidity.
  - Since the service life of the battery is drastically reduced by exposure to high temperatures, take special care (storage temperature should be from –20°C to 75°C).
  - There is a built-in lithium battery in a CPU module and temperature control module which serves as backup power supply for programs, device information and configuration information. The service life of this battery is more than 10 years in standby mode at room temperature. Take note that the service life of the battery may be shortened when installed or stored at locations of extreme low or high temperatures. Therefore, we recommend that modules with built-in batteries be stored at room temperature.
- **Always turn off the power before installing or removing modules:**
  - Failing to turn off the power supply when installing or removing modules, may result in damage.
- **Do not touch components in the module:**
  - In some modules you can remove the right-side cover and install ROM packs or change switch settings. While doing this, do not touch any components on the printed-circuit board, otherwise components may be damaged and modules may fail to work.
- **Do not wire unused terminals:**
  - Do not wire unused terminals of external connection terminal blocks or unused pins of connectors of the module. Doing so may affect the function of the module.

■ Waste Electrical and Electronic Equipment

Waste Electrical and Electronic Equipment (WEEE), Directive 2002/96/EC

(This directive is only valid in the EU.)

This product complies with the WEEE Directive (2002/96/EC) marking requirement.
The following marking indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category

With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a “Monitoring and Control instrumentation” product.

Do not dispose in domestic household waste.

When disposing products in the EU, contact your local Yokogawa Europe B. V. office.

Introduction

■ Overview of the Manual

This manual describes the FL-net (OPCN-2) Interface Module to be installed in an I/O slot of the FA-M3 controller.

■ Other Instruction Manuals

- **For additional information on CPU functions:**
  - Sequence CPU Instruction Manual - Functions (for F3SP28-3N/3S, F3SP38-6N/6S, F3SP53-4H/4S, F3SP58-6H/6S and F3SP59-7S) (IM34M06P13-01E)
  - Sequence CPU Instruction Manual - Instructions (IM34M06P12-03E)
- **For additional information on ladder programming:**
  - FA-M3 Programming Tool WideField2 (IM34M06Q15-01E)
- **For information on FA-M3 specifications and configuration*1, installation and wiring, test run, maintenance, and module installation restrictions for the whole system:**

  *1: Refer to the relevant product manuals for specifications except for power supply modules, base modules, input/output modules, cables and terminal units.

  - Hardware Manual (IM 34M06C11-01E)

■ Definitions of Terms

Technical and other related terms used in this manual are defined as follows:

(1) Technical terms defined in ISO, JIS, and other international and Japanese standards are used in this manual according to such definitions, unless otherwise defined herein.

■ Definition of Basic Terms Used in this Manual

The basic terms used in this manual have the following meanings:

FA controller	:	FA system component equipment to be connected to the FL-net (OPCN-2). It may be a programmable controller (PLC), robot controller (RC), computerized numerical controller (CNC), or PC.
Network	:	In FL-net (OPCN-2), this term refers to an IEEE802.3 compliant local area network (LAN) corresponding to the data link layer. The current specification refers to 10BASE5, 10BASE-T, and other 10M bps communication.
Node	:	Logical representation of a FA controller connected to the FL-net (OPCN-2). FL-net supports up to 254 nodes, identified with node numbers from 1 to 254.
Communication unit	:	A communication board or communication module in an FA controller used for FL-net (OPCN-2) communication.
Networking equipment	:	IEEE802.3 compliant communication cables, transceivers, hubs, and other communication devices used for communication on the FL-net.

Copyrights and Trademarks

■ Copyrights

■ Trademarks

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FA-M3

FL-net (OPCN-2) Interface Module

IM 34M06H32-02E 2nd Edition

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Revision Information i

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1. Overview

1.1 What Is FL-net (OPCN-2)?

FL-net (OPCN-2) is an open network for connecting various programmable controllers (PLC), computerized numerical controllers (CNC) and other factory automation (FA) controllers (including personal computers (PC)) from multiple vendors. Sitting between information network and field network in the system configuration hierarchy, it enables monitoring and control among FA controllers.

■ Concepts of FL-net (OPCN-2)

FL-net (OPCN-2) is an FA controller network based on Ethernet technology. It supports both cyclic transmission and message transmission. Its basic concept is as follows:

- It uses Ethernet as communication media (physical and data link layers) to connect FA controllers;
- It uses the common UDP/IP protocol to implement basic data delivery on top of Ethernet;
- It controls media access by network nodes to avoid collision and guarantee transmission within a stipulated time frame.

FL-net (OPCN-2) is designed for data exchange between programmable controllers (PLC), robot controllers (RC), computerized numerical control (CNC) machines, and other FA controllers (including PCs) that are networked within a production system.

Fig. 1.1 shows where it is positioned in the system configuration hierarchy.

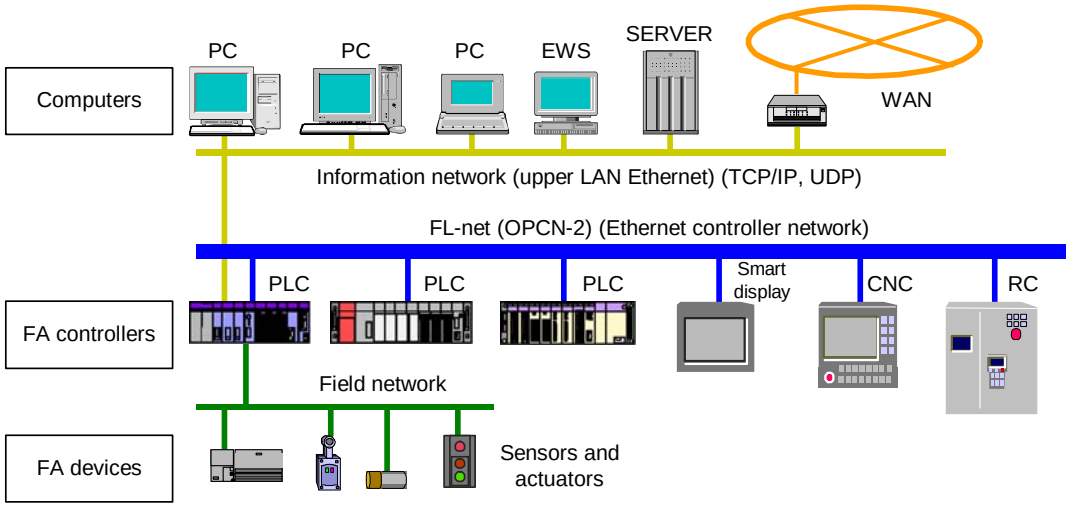


Fig. 1.1 FA Controller Network Configuration Example

FL-net (OPCN-2) was developed as an open FA network by the JOP work group of the Manufacturing Science and Technology Center (MSTC) under the Ministry of Economy, Trade and Industry of Japan. Today, it is defined by the JEM1479 standard.

1.2 Features of FL-net (OPCN-2)

Features of FL-net (OPCN-2) can be classified into two broad categories:

- Features related to compliance with common networking standards
- Features required for communication between FA Controllers

■ Features Related to Compliance with Common Network Standards

FL-net (OPCN-2) enables efficient communication using the UDP/IP protocol based on the Ethernet standard, which is widely used for connecting office automation (OA) equipment. By adopting the Ethernet network standard, it enjoys the following benefits:

- **Lower cost**

  The use of widely available communication devices translates to lower implementation cost for an FL-net (OPCN-2) network.

- **Use of common networking equipment**

  Common Ethernet transceivers, hubs, cables, PC LAN cards and other networking equipment can be used.

- **Promise of even higher transmission rates**

  Technological developments in the future are expected to deliver even higher transmission rates (10M bps → 100M bps → 1G bps).

- **Flexibility of optical communication**

  Through the use of optical fibers and common optical repeaters for Ethernet in selected parts of the network, it enables long distance transmission exceeding 500 m, improved noise immunity, and protection against lightning surge (when used outdoor).

■ Features Required for Communication Between FA Controllers

FL-net (OPCN-2) supports the following features required for communication in factory automation.

- **Large network**

  Up to 254 FA controllers (nodes) can be connected.

- **Two transmission modes**

  Cyclic transmission is used for “real-time” data sharing among all nodes through the use of common memory. Message transmission is used for on-demand communication between two nodes.

- **Large common memory**

  The common memory can be as large as 8K bits plus 8K words.

- **Fast response**

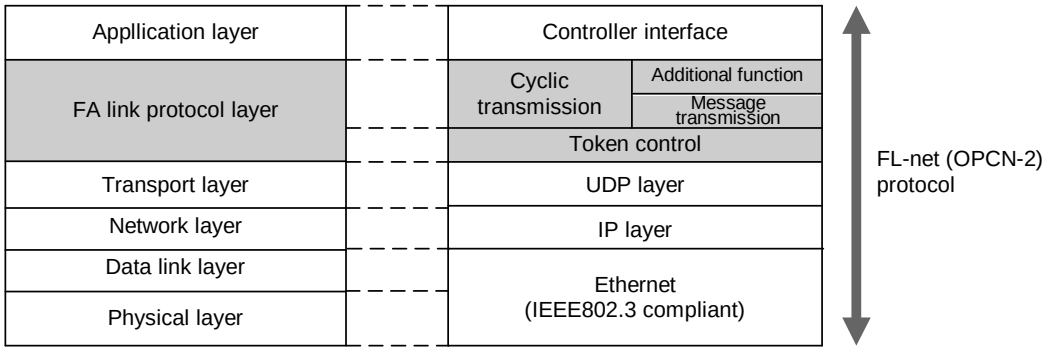
  Fast response of 50 ms for 32 nodes is achievable (with common memory size of 2K bits plus 2K words).

- **High reliability by master-less control**

  As FL-net (OPCN-2) uses no master, a node can safely connect to or disconnect from the network without affecting other nodes. Any node can be switched on, switched off or removed for maintenance at any time.

■ FL-net (OPCN-2) Protocol

FL-net (OPCN-2) consists of six protocol layers as shown in Fig. 1.2.



Note: The FL-net (OPCN-2) protocol adopts Ethernet for the data link layer and UDP/IP for the transport and network layers.

Fig. 1.2 FL-net (OPCN-2) Protocol

■ Features of FL-net (OPCN-2) Data Transmission

The FA link protocol layer of FL-net (OPCN-2) features:

- Collision prevention by master-less transmission control.
- Guaranteed refresh cycle time through controlled token circulating speed.
- Token handover after cyclic data transmission.
- Token transmission starting with the node with the smallest node number at startup.
- Token transmission by the next node if token is not delivered within a given time.
- Master-less token control to prevent network error due to a failed node.
- Monitoring of remote nodes using operation mode (RUN/STOP), hardware error (ALARM), and other management information.

1.3 FAQ on FL-net (OPCN-2)

Table 1.1 FAQ on FL-net (OPCN-2) (1/2)

	Questions	Answers
1	What is Ethernet?	Ethernet is a network standard, widely adopted in local area networks (LAN). Ethernet supports data transmission among computers at transmission rates between 10M bps and 1G bps. Ethernet networks commonly used in office automation (OA) employs 10M or 100M bps twisted-pair cables (UTP).
2	What is FL-net (OPCN-2)?	FL-net (OPCN-2) is a network standard for connecting programmable controllers (PLC), computerized numerical controllers (CNC), and other factory automation (FA) controllers for control purposes. It is designed for high-speed exchange of control data between FA controllers. It employs the same cables and repeaters as Ethernet networks.
3	What is the difference between FL-net (OPCN-2) and Ethernet?	Ethernet connects an FA controller with an upper layer computer, such as a PC, and is primarily used for exchange of file data for information acquisition and control purposes such as production control and performance monitoring. FL-net (OPCN-2) connects FA controllers and enables high-speed exchange of control data. If an FA controller is installed with both Ethernet and FL-net (OPCN-2) interfaces, make sure that cables are connected correctly.
4	How can I use FA controllers in FL-net (OPCN-2)?	Programmable controllers (PLC), computerized numerical controllers (CNC), and other FA controllers must first be installed with FL-net (OPCN-2) interface equipment for connect ion to FL-net (OPCN-2). Once you have assigned a station number (node number) and common memory (link registers) to each controller for linking, the controllers can exchange data cyclically, just like ordinary PLC link units. Controllers on an FL-net (OPCN-2) network do not require special communication program for sending and receiving, or reading and writing memory data and communication parameters from a PC. Communication programs are required, however, if individual controller nodes performs data exchange using message transmission.
5	What is a protocol? What protocols does FL-net (OPCN-2) support?	A protocol is a set of rules for regulating communication. FL-net (OPCN-2) supports two protocols: UDP/IP protocol for the lower layer and FA link protocol for the higher layer.
6	Can I connect my PC to FL-net (OPCN-2)?	Yes, but you need to be aware of the following limitations. An FL-net (OPCN-2) interface device installed in a PLC, CNC and other FA controller is an intelligent board provided with a microprocessor. The Ethernet card in a PC is a dumb board, and requires protocol processing to be done by software, thus increasing the load on the PC. Although it depends on PC performance and usage, an intelligent FL-net (OPCN-2) board is generally recommended.
7	What is a topology?	Networking topology refers to the wiring configuration of a network. There are three basic wiring configurations: star (tree), bus, and ring (loop). Topology indicates a physical wiring configuration rather than a logical configuration. 10BASE-T, which is used in FL-net (OPCN-2), uses a star topology, while 10BASE5 uses a bus topology.
8	Tell me about network cables, their maximum allowable length, and the maximum number of FA controllers that can be connected.	The commonly used Ethernet cables have the following general specifications (values in brackets apply when repeaters are used): 10BASE-T : Twisted-pair cable with maximum transmission range of 100 (500) m per segment, connecting up to 254 FA controllers per segment. 10BASE5 : Thick coaxial cable with maximum transmission range of 500 (2500) m per segment, connecting up to 100 (254) FA controllers per segment. 10BASE-FL : Optical fiber cable with maximum transmission range of 2000 m per segment, connecting up to 254 FA controllers per segment.
9	Are special Ethernet specifications required for building systems using FL-net (OPCN-2) communication?	No. FL-net (OPCN-2) requires only standard Ethernet specifications (as per IEEE802.3 standard).
10	How can I connect different FA controllers to FL-net (OPCN-2)?	Different types of Ethernet media of FA controllers may be interconnected using repeaters and media conversion adaptors, which are commercially available from many vendors.

Table 1.1 FAQ on FL-net (OPCN-2) (2/2)

	Questions	Answers
11	Which network cables should I use for FL-net (OPCN-2) connection?	The general rule is: - Use 10BASE5 (thick coaxial cable, also known as yellow cable) for trunk lines. - Use 10BASE-T (twisted-pair cable, TP category 5) within a control panel or in an office. - Use 10 BASE –FL (optical fiber cable) in the vicinity of high-voltage power sources or other noise sources.
12	How should I set up the IP address of an FA controller in FL-net (OPCN-2)?	An IP address for FL-net (OPCN-2) consists of two parts: network address and host address (node number). The network address is fixed at 192.168.250, while the node number is a number between 1 and 254. The node numbers 250-254 are reserved for maintenance tools.
13	How can I be assured that an FA controller is compatible with FL-net (OPCN-2)?	All FL-net (OPCN-2) compliant products are provided with FL-net (OPCN-2) certificates issued by a certification body that ensures compatibility by conducting conformity and interconnectivity tests.

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2. F3LX02-1N

2.1 Features

- **High-speed data transmission based on the proprietary RRR (triple-R) technology**

  The FL-net (OPCN-2) interface module enables fast data transfer between FA controllers through high-speed protocol processing (for shorter token response time) and link refreshing based on the triple-R technology.

  The RRR technology features rapid refresh and reflection thanks to fast data processing within the module and fast data exchange between the interface module and the CPU module that reduces the time taken for a ladder application program to recognize transferred data between PLCs (FA-M3R) (delivery time).

2.2 Specifications

■ Model and Suffix Codes

Model	Suffix Code	Style Code	Option Code	Description
F3LX02	-1N	……	……	254 stations max. 10 Mbps 10BASE5/10BASE-T FL-net (OPCN-2) Ver. 2.00

■ Compatible CPU Modules

This module is compatible with the following CPU modules.

Compatible CPU Modules	Version
F3SP28-3N, F3SP38-6N, F3SP53-4H, and F3SP58-6H	REV. 05:00 or later
F3SP28-3S, F3SP38-6S, F3SP53-4S, F3SP58-6S, and F3SP59-7S	REV. 00:00 or later

■ Compatible Communication Setup Tools

The following communication setup tool can be used when setting up this module.

FA-M3 Program Development Tool WideField2	Applicable Revisions
SF620-ECW	1.01 or later

■ General Specifications

Table 2.1 General Specifications

Item		Specifications
Interface *1		AUI and 10BASE-T
Transmission	Access control	CSMA/CD
	Transmission rate	10 Mbps
	Transmission mode	Base band
Protocol		UDP, IP, ICMP, and ARP*5
Number of installed modules *2		F3SP28, F3SP53 : 1 F3SP38, F3SP58, F3SP59 : 2
Internal current consumption		460 mA max.
External power supply*3		12 VDC, 500 mA max.
Fuse		2-A time lag fuse (not replaceable as is embedded in the power supply terminal block)
External dimensions*4		28.9 (W) x 100 (H) x 83.2 (D) mm
Weight		130 g

*1: The AUI and the 10BASE-T port cannot be used at the same time.

*2: Installation of this module may restrict the installation of other modules. This module may not be installed in a sub-unit.

*3: Required only if power supply must be provided through the AUI port to a transceiver, taking into consideration maximum voltage drop across this module of 0.4 V.

*4: Excluding projections.

*5: Software from the Regents of University of California is used.

■ Scope of Services

This module supports the following services:

Table 2.2 Scope of Services

Functions			Supported or not	
			Client functions	Server functions
Data communication	Cyclic transmission	Area 1*1	✓	✓
		Area 2*2	✓	✓
	Message transmission	Byte block read	✓*3	×*4
		Byte block write	✓*3	×*4
		Word block read	✓*3	✓*4
		Word block write	✓*3	✓*4
		Read network parameters	✓*3	✓*4
		Write network parameters	✓*3*5	✓*4
		Stop command	✓*3	✓*4
		Start command	✓*3	✓*4
		Read profile	✓*3	✓*4
		Transparent message	✓	✓
		Read log data	✓*3	✓*4
		Clear log data	✓*3	✓*4
		Echo message	✓*3	✓*4
		Vendor specific message	✓*3	×*4
Network management	Local node management information		✓	
	Participating node management information		✓	
	Network management information		✓	

✓: Supported

×: Not supported

*1: Allocated to a maximum of 8192 link relays (L)

*2: Allocated to a maximum of 8192 link registers (W)

*3: Using transparent messages

*4: Automatic processing by the module (such as receiving request messages and sending response messages)

*5: FA-M3 Program Development Tool WideField2 may be used for transmission.

2.3 Components and Their Functions

■ Appearance

Fig. 2.1 shows the appearance of the module.

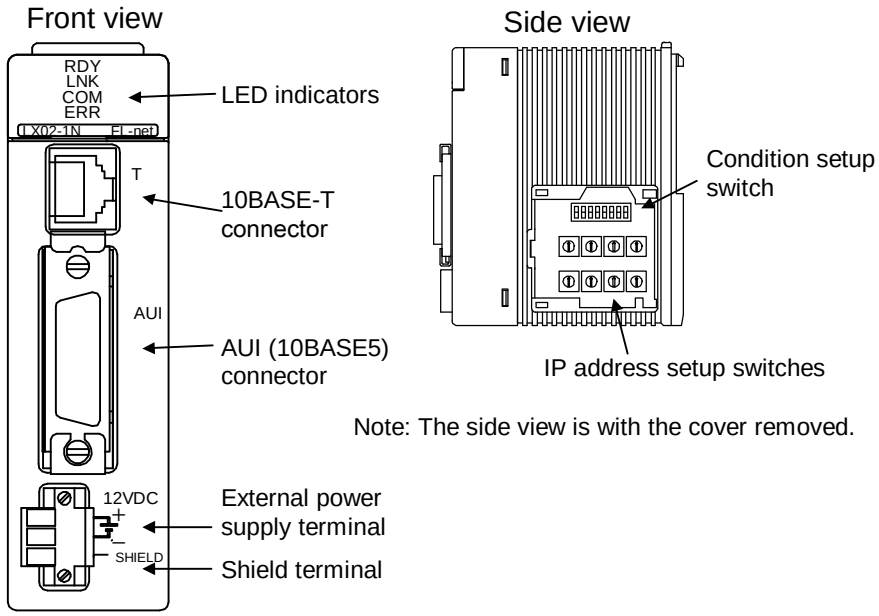


Fig. 2.1 Parts Identification

■ Component Functions

● LED indicators

The LEDs indicate operation status as follows:

LEDs (color)	Indication	Lit	Blinking	Not lit
RDY (green)	Internal circuitry status	Normal		Error
LNK (green)	FL-net (OPCN-2) connection status	Online		Offline
COM (green)	Data transmission status	Carrier detected		No carrier
ERR (red)	Error status	Error	Parameter error	No error

● AUI connector

For connection to a transceiver.

● 10BASE-T connector

For 10BASE-T (UTP/STP) cable connection.

CAUTION

The 10BASE-T and AUI ports may not be used at the same time. Connect a communication cable to only one of the ports.

- **External power supply terminals**

  An external power supply must be connected to these terminals if a transceiver is powered from the AUI connector. No external power supply is needed if the 10BASE-T connector is used instead of the AUI connector.

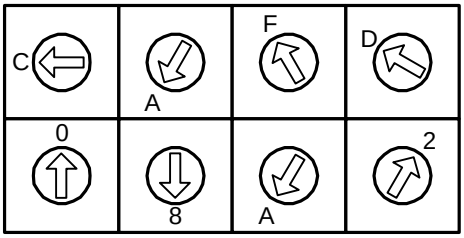
- **Shield terminal**

  This terminal comes into contact with the shield of the communication cable. It is isolated from the FG terminal of the power supply module.

- **IP address switches**

  Eight hexadecimal rotary switches for IP address setup.

  Example: If the IP address is 192.168.250.210, set the switches as follows:



Hexa-decimal	C0	A8	FA	D2
	↑	↑	↑	↑
Decimal	192 .	168 .	250 .	210

- **Condition switch**

  Eight-element switch for operation condition setup.

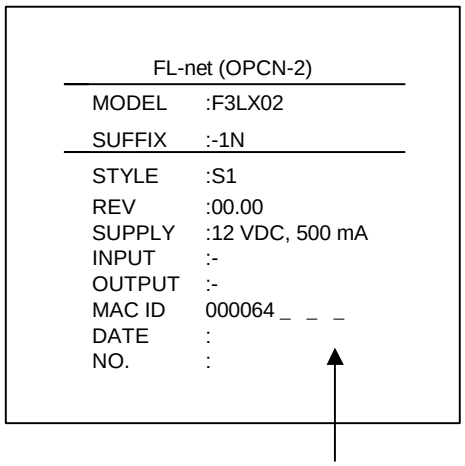
Elements	Function	OFF	ON
1	Reserved	Always OFF	Do not turn ON.
2			
3			
4	Port selection	Automatic	10BASE-T
5	Reserved	Always OFF	Do not turn ON.
6			
7			
8			

CAUTION

When setting the condition switch, do not touch other components inside the module. Otherwise, the components may be damaged or malfunction.

- **MAC address**

  The MAC address of the module is marked on the left side of the module.



MAC address:
The MAC address is a 12-digit hexadecimal number unique to each module.

2.4 External Dimensions

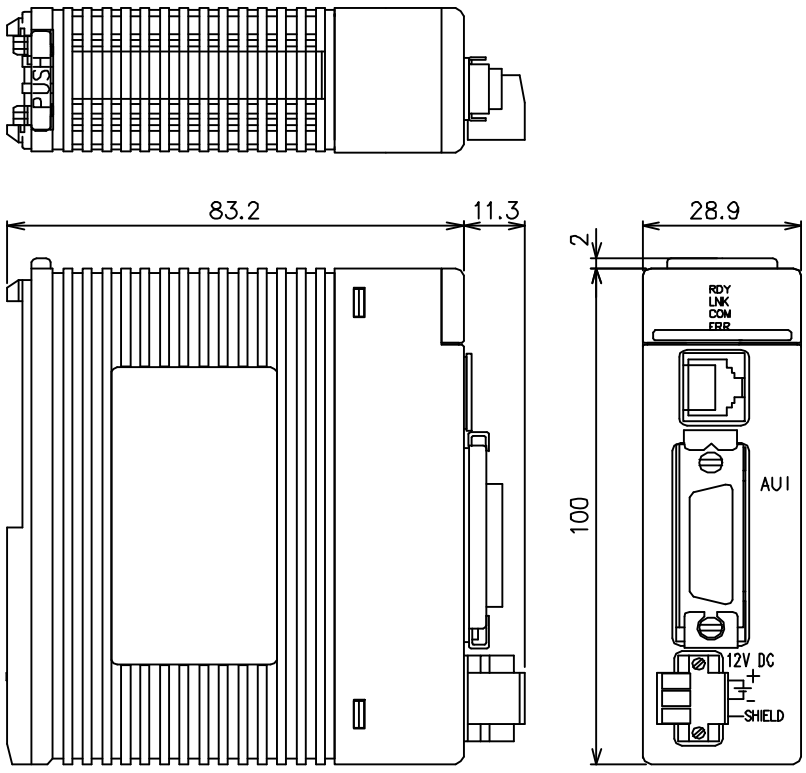


Fig. 2.2 External Dimensions

2.5 I/O Relays and Registers

■ I/O Relays

Table 2.3 List of I/O Relays

Input Relays	Description
X0□□01	Receive accepted
X0□□02	Send 1 accepted
X0□□03	Send 1 completed
X0□□04	Send 2 accepted
X0□□05	Send 2 completed
X0□□06	Send 3 accepted
X0□□07	Send 3 completed
X0□□08	
X0□□09	
X0□□10	
X0□□11	
X0□□12	
X0□□13	
X0□□14	
X0□□15	
X0□□16	
X0□□17	Parameter setup completed
X0□□18	Read local node management information completed
X0□□19	Read participating node management information completed
X0□□20	Read network management information completed
X0□□21	
X0□□22	
X0□□23	
X0□□24	
X0□□25	
X0□□26	
X0□□27	Invalid communication detected
X0□□28	Overlapping address detected
X0□□29	Duplicate node number
X0□□30	Token monitoring time error
X0□□31	Waiting to receive
X0□□32	Initialization error

Output Relays	Description
Y0□□33	Receive completed
Y0□□34	Send request 1
Y0□□35	
Y0□□36	Send request 2
Y0□□37	
Y0□□38	Send request 3
Y0□□39	
Y0□□40	
Y0□□41	
Y0□□42	
Y0□□43	
Y0□□44	
Y0□□45	
Y0□□46	
Y0□□47	
Y0□□48	
Y0□□49	Parameter setup request
Y0□□50	Read local node management information request
Y0□□51	Read participating node management information request
Y0□□52	Read network management information request
Y0□□53	
Y0□□54	
Y0□□55	
Y0□□56	
Y0□□57	
Y0□□58	
Y0□□59	
Y0□□60	
Y0□□61	
Y0□□62	
Y0□□63	
Y0□□64	

□□: Slot number

■ Registers

Table 2.4 List of Registers (1/3)

Data Position Number	Description		Remarks
1-512	Receive message area		1024 bytes max.
513-1024	Send handle 1 send message area		1024 bytes max.
1025-1536	Send handle 2 send message area		1024 bytes max.
1537-2048	Send handle 3 send message area		1024 bytes max.
2049	Message receive parameters	Source node number	
2050		Destination node number	
2051		Message type	
2052		TCD	
2053		Message offset in virtual address space	Low-order word
2054			High-order word
2055		Virtual address space block size	
2056		Data size	
2057-2064		Reserved	
2065-2069		Vendor name	Valid only when receiving vendor-specific messages
2070-2072		Subcode	Valid only when receiving vendor-specific messages
2073-2080		Reserved	
2081	Message send parameters 1	Destination node number	
2082		Reserved	
2083		Message type	
2084		TCD	
2085		Message offset in virtual address space	Lower-order word
2086			Higher-order word
2087		Virtual address space block size	
2088		Data size	
2089-2094		Reserved	
2095		Timeout monitoring time	
2096		Send completion status	
2097-2101		Vendor name	Valid only when sending vendor-specific messages
2102-2104		Subcode	Valid only when sending vendor-specific messages
2105-2112		Reserved	

Table 2.4 List of Registers (2/3)

Data Position Number	Description		Remarks
2113	Message send parameters 2	Destination node number	
2114		Reserved	
2115		Message type	
2116		TCD	
2117		Message offset in virtual address space	Low-order word
2118			High-order word
2119		Virtual address space block size	
2120		Data size	
2121-2126		Reserved	
2127		Timeout monitoring time	
2128		Send completion status	
2129-2133		Vendor name	Valid only when sending vendor-specific messages
2134-2136		Subcode	Valid only when sending vendor-specific messages
2137-2144		Reserved	
2145	Message send parameters 3	Destination node number	
2146		Reserved	
2147		Message type	
2148		TCD	
2149		Message offset in virtual address space	Lower-order word
2150			Higher-order word
2151		Virtual address space block size	
2152		Data size	
2153-2158		Reserved	
2159		Timeout monitoring time	
2160		Send completion status	
2161-2165		Vendor name	Available only when sending vendor-specific messages
2166-2168		Subcode	Available only when sending vendor-specific messages
2169-2176		Reserved	
2177-2560	Reserved		
2561	Network parameter setup	Area 1 top address	
2562		Area 1 size	
2563		Area 2 top address	
2564		Area 2 size	
2565		Token watchdog time	
2566		Reserved	
2567-2571		Node name (equipment name)	
2572-2592		Reserved	

Table 2.4 List of Registers (3/3)

Data Position Number	Description		Remarks
2593	Local node management information	Local node number	
2594		Area 1 top address	
2595		Area 1 size	
2596		Area 2 top address	
2597		Area 2 size	
2598		Upper layer status	
2599		Token watchdog time	
2600		Minimum allowable frame interval	
2601-2605		Vendor name	
2606-2610		Vendor equipment designation	
2611-2615		Node name (equipment name)	
2616		Protocol type	
2617		Link status	
2618		IP address	Low-order word
2619			High-order word
2620-2624		Reserved	
2625	Participating node management information	Node number for read request	
2626-2632		Reserved	
2633		Node number	
2634		Area 1 top address	
2635		Area 1 size	
2636		Area 2 top address	
2637		Area 2 size	
2638		Upper layer status	
2639		Allowable refresh cycle time	
2640		Token watchdog time	
2641		Minimum allowable frame interval	
2642		Link status	
2643-2656		Reserved	
2657	Network management information	Minimum allowable frame interval	
2658		Current RCT value	
2659		Measured RCT value	
2660		Maximum measured RCT value	
2661		Minimum measured RCT value	
2662-2688		Reserved	

2.6 Attaching/Detaching Modules

■ Attaching/Detaching Modules

Fig. 2.3 shows how to attach the FL-net (OPCN-2) interface module to the base module. First ensure that the system is turned off. Then hook the anchor slot at the bottom of the interface module onto the anchor pin at the bottom of the base module. Push the top of the interface module towards the base module until the anchor/release button clicks into place.

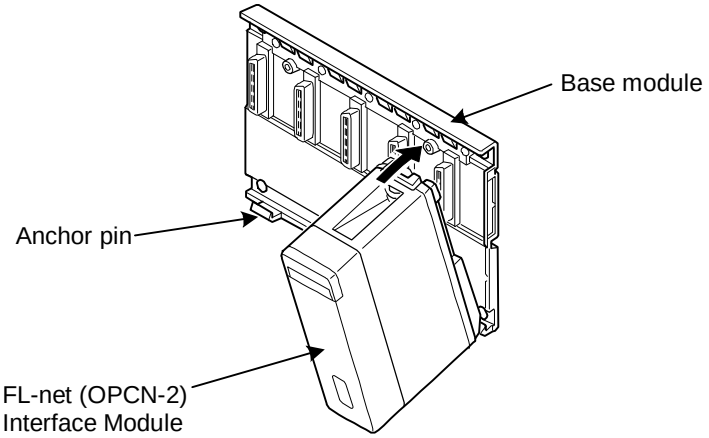


Fig. 2.3 Attaching Modules

CAUTION

When attaching the interface module to the base module, be careful so that the connector pins at the rear of the interface module are not bent. Do not attempt to forcibly push it in. Otherwise the pins may be damaged and the module may become defective.

■ Detaching Modules

The procedure to detach the interface module from the base module is just the reverse of the attaching procedure. Press the anchor/release button on the top of the interface module to unlock it and tilt it away from the base module. Then lift the interface module off the anchor pin of the base module.

■ Attaching Modules in Intense Vibration Environments

If the module is used in intense vibration environments, fasten the module with a screw as shown in Fig. 2.4. Insert a screw of the type specified below into the screw hole at the top of the module and tighten the screw with a Phillips screwdriver. As you have to orient the screwdriver in somewhat a slanted position, ensure that a duct or any other surrounding is at least 80 mm above the module to provide necessary work space.

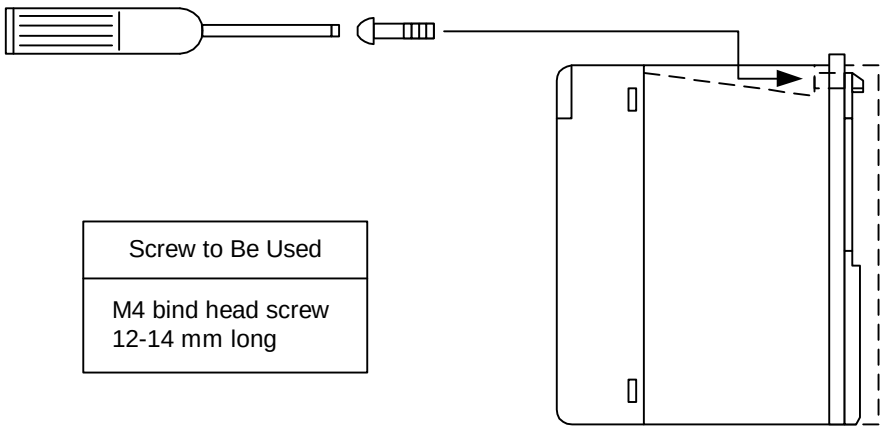


Fig. 2.4 Securing the Module with a Screw

CAUTION

Do not overtighten the screw.

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3. FL-net (OPCN-2) Interface F3LX02-1N

3.1 Basics of FL-net (OPCN-2)

3.1.1 FL-net (OPCN-2) IP Address

An IP address is an address identifying a particular node, or station, participating in Internet protocol (IP) communication. Each FL-net (OPCN-2) node must be assigned a unique class-C IP address. The default IP address of an FL-net (OPCN-2) node is 192.168.250.***, where 192.168.250 is the network address and *** is a host number (= node number).

Network Address	Host Number (= node number)
192.168.250	N (where N is 1 to 254)

Fig. 3.1 FL-net (OPCN-2) IP Address

3.1.2 Number of Connected Nodes and Node Number

A maximum of 254 nodes can be connected together. A node number is between 1 and 254.

Node numbers: 1-249	Assigned to ordinary FL-net (OPCN-2) equipment.
Node numbers: 250-254	Normally assigned to maintenance equipment (reserved for use by maintenance tools). They may also be assigned to ordinary FL-net (OPCN-2) equipment.
Node number: 255	Used internally for broadcasting. Node number 255 may not be used to address a specific node.
Node number: 0	No node has node number 0. Node number 0 may not be used to address a node.

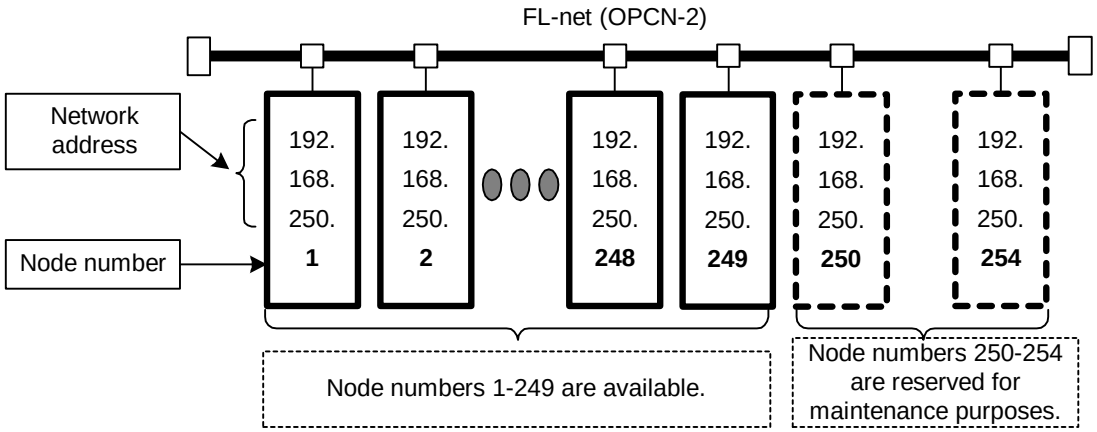


Fig. 3.2 FL-net (OPCN-2) Node Numbers

3.1.3 Data Transmission Methods

FL-net (OPCN-2) supports two data transmission methods: cyclic and message transmission.

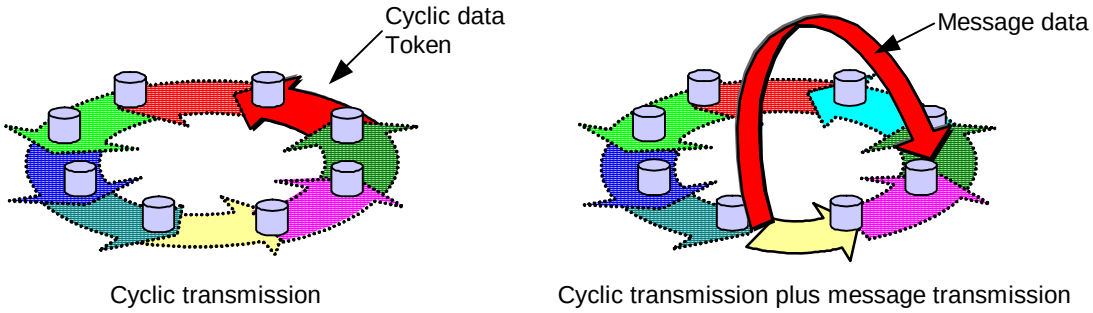


Fig. 3.3 FL-net (OPCN-2) Data Transmission Methods

■ Cyclic Transmission

In cyclic transmission, data is transmitted cyclically. A node can share data with other nodes via the common memory.

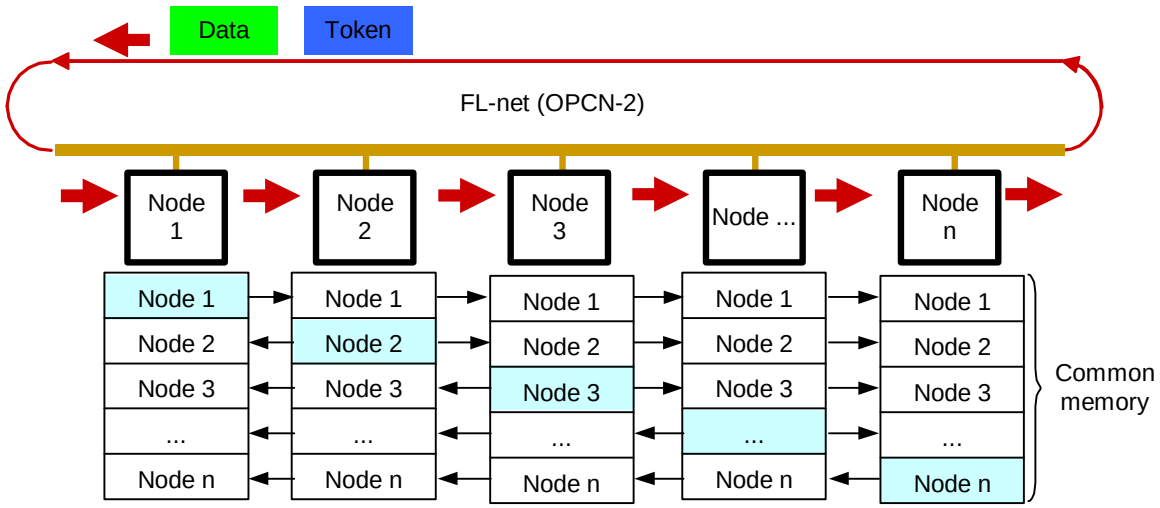


Fig. 3.4 Common Memory and Cyclic Transmission

■ Message Transmission

Message transmission is used to transmit data to a specific node upon request.

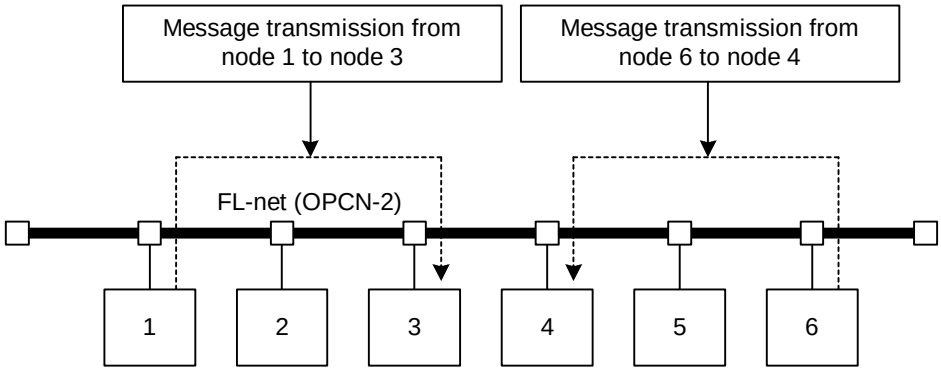


Fig. 3.5 Example for Message Transmission

3.1.4 Transmission Data Size

■ Cyclic Transmission

The network has 8.5K words (8K bits, or 0.5K words, plus 8K words) of common memory, accessible to each node for data sharing. (One word is two bytes, and one byte is eight bits.)

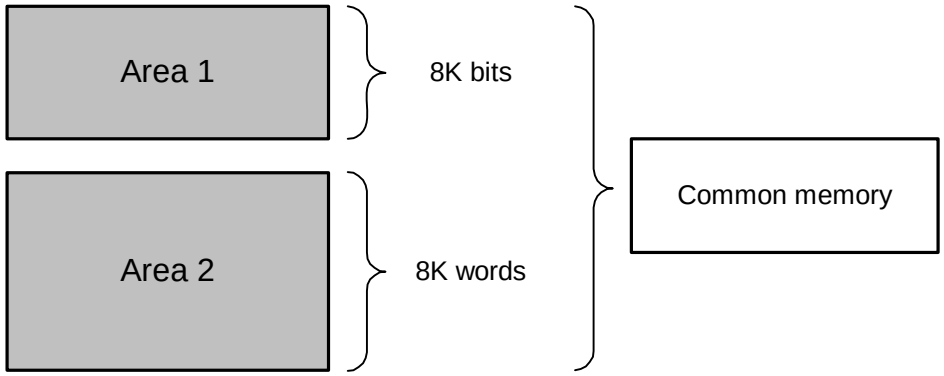


Fig. 3.6 Transmission Data Size in Cyclic Transmission

■ Message Transmission

One message frame can carry up to 1024 bytes of data (excluding the header).

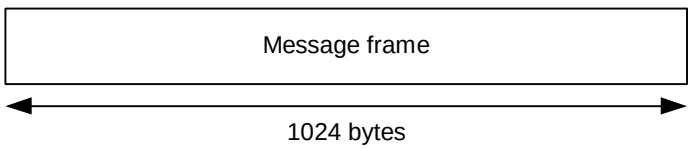


Fig. 3.7 Transmission Data Size in Message Transmission

3.1.5 Refresh Cycle

Cyclic transmission updates, or refreshes, the content of the common memory periodically. Message transmission is so controlled as to prevent common memory refreshing time from exceeding the maximum allowable refresh cycle time.

Each node measures the period from the time it receives the token to the time it next receives the token. The base token rotation period is defined as the period during which no message frame is detected. The maximum allowable refresh cycle time is set to 120% of the base token rotation period. Thus, the maximum allowable refresh cycle time is determined dynamically, taken into consideration the number of nodes currently participating in the network.

3.1.6 Data Areas and Memory

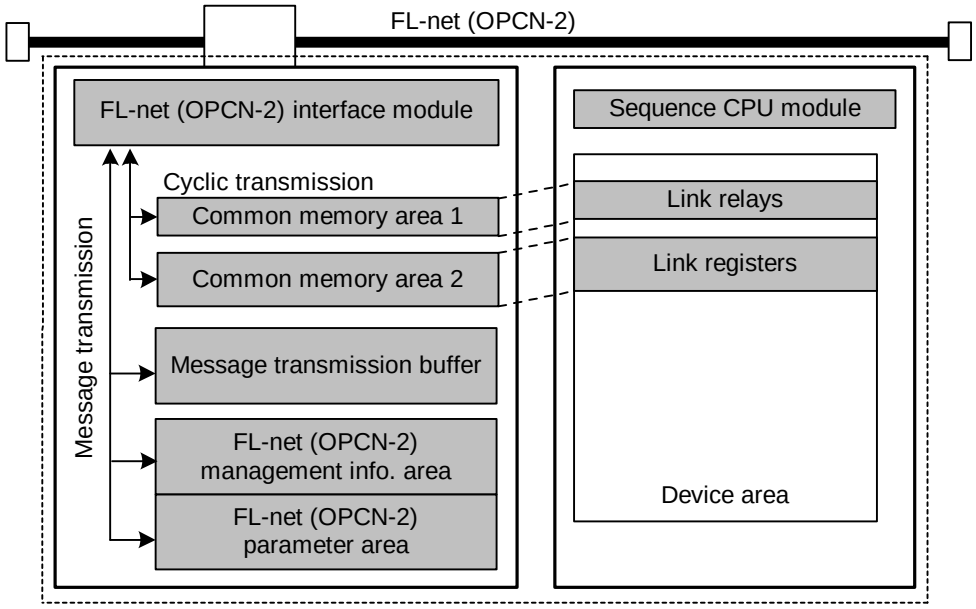


Fig. 3.8 Data Areas of Physical Memory

3.1.7 Communication Management information

Nodes are managed using the local node management information, participating node management information, and network management information.

■ Local Node Management Information

Local node management information contains parameter setup information of the local node.

Table 3.1 Local Node Management Information

Parameter	Description
Node number	1-254
Top address of area 1 in common memory	0-511 ($0 to $1ff) as word address
Size of area 1 in common memory	0-512 ($0 to $200) in units of words
Top address of area 2 in common memory	0-8191 ($0 to $1fff) as word address
Size of area 2 in common memory	0-8192 ($0 to $2000) in units of words
Upper layer status	RUN/STOP, ALARM/WARNING/NORMAL, operation information, error information, etc.
Token watchdog timer	1-255 in units of milliseconds
Minimum allowable frame interval	0-50 in units of 100 microseconds
Vendor name	10-byte vendor name in ASCII
Vendor equipment designation	Vendor-defined 10-byte equipment designation in ASCII
Node name (equipment name)	User-defined 10-byte node name in ASCII
Protocol type	Always $80
Link status	Participating or failed
Local node status	Duplicate node number detected, etc.

■ Participating Node Management Information

Participating node management information contains parameter setup information of all participating nodes.

Table 3.2 Participating Node Management Information

Parameter	Description
Node number	1-254
Upper layer status	RUN/STOP, ALARM/WARNING/NORMAL, operation information, error information, etc.
Top address of area 1 in common memory	0-511 ($0 to $1ff) as word address
Size of area 1 in common memory	0-512 ($0 to $200) in units of words
Top address of area 2 in common memory	0-8191 ($0 to $1fff) as word address
Size of area 2 in common memory	0-8192 ($0 to $2000) in units of words
Refresh cycle time	0-65535 in units of milliseconds
Token watchdog timer	1-256 in units of milliseconds
Minimum allowable frame interval	0-50 in units of 100 microseconds
Link status	Participating or failed

■ Network Management Information

Network management information is used to manage network-wide information.

Table 3.3 Network Management Information

Parameter	Description
Token holding node number	The node number (1-254) of the node currently holding the token
Minimum allowable frame interval	0-500 in units of 100 microseconds
Refresh cycle time	0-65535 in units of milliseconds
Measured refresh cycle time (current value)	0-65535 in units of milliseconds
Measured refresh cycle time (maximum value)	0-65535 in units of milliseconds
Measured refresh cycle time (minimum value)	0-65535 in units of milliseconds

3.1.8 Cyclic Transmission and Common Memory

■ Token and Cyclic Transmission

Cyclic transmission allows nodes to share ever-changing data of each node at certain intervals.

- Cyclic transmission implements common memory data sharing.
- A node transmits data only when it holds the token.
- A node participating in the network may or may not participate in cyclic transmission.
- A node transmits cyclic data that it must send when it holds the token.

Token	:	Only one token should be present in the network. If two or more tokens are present in the network, the token with the smallest destination node number is retained but the other tokens are discarded.
Token frame	:	A frame containing the token is called the token frame. It contains the node number (destination node number) of a node to which the token is addressed and the node number (source node number) of a node which has sent the token. A node that has received the token addressed to itself is called the token holding node.
Token rotation	:	The token is passed among participating nodes in ascending order of the node numbers registered in the participating node management information. The node with the largest node number returns the token to the node with the smallest node number.

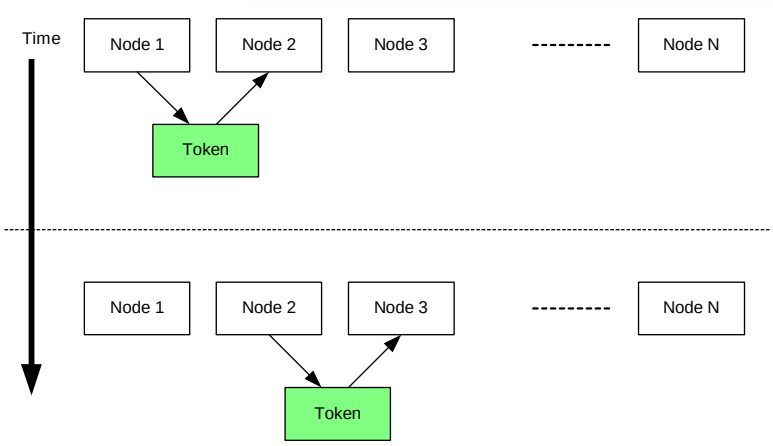


Fig. 3.9 Token Rotation in Cyclic Transmission (1)

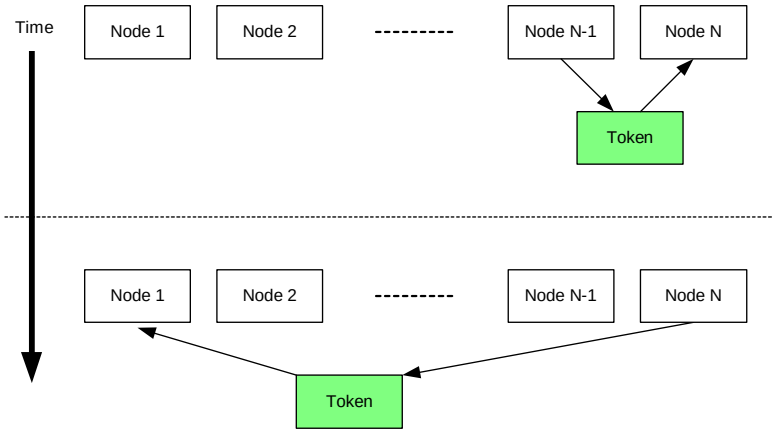


Fig. 3.10 Token Rotation in Cyclic Transmission (2)

■ Common Memory

The common memory works as follows:

- The common memory is shared by all nodes participating in cyclic transmission.
- Each node is allocated two types of send area in common memory: area 1 and area 2.
- A node sends data in frames. Each frame can contain up to 1024 bytes of data. Two or more frames are used to send larger data size.
- If data is sent in two or more frames, the common memory is updated only when all the frames are received to ensure data concurrency.
- Each node has its own common memory having a fixed size of 8.5K words (= 8K bits + 8K words).
- The size of the send areas (area 1 and area 2) in common memory allocated to a node is limited only by the common memory size.
- The send areas allocated to a node map to receive areas on other nodes. By having each node broadcasts data to its allocated send areas periodically, all nodes in the FL-net (OPCN-2) network can exchange and share common data.

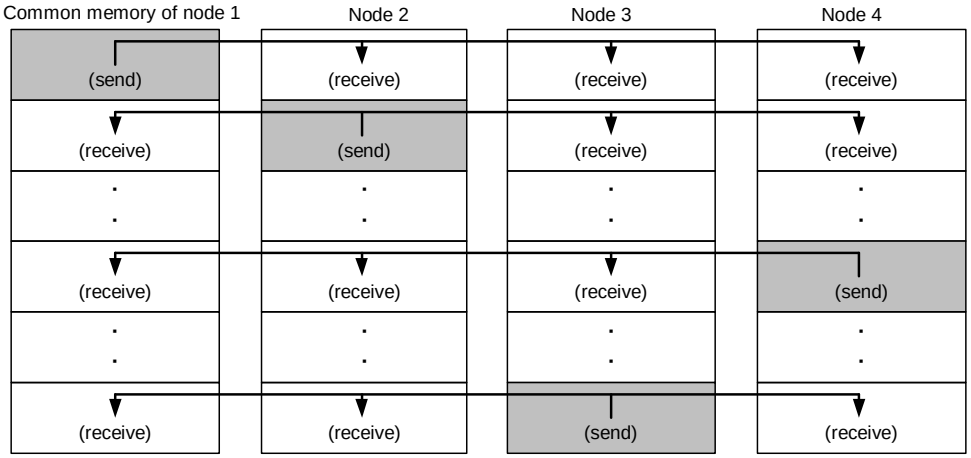


Fig. 3.11 Example 1 of Common Memory Configuration in Cyclic Transmission

A node may be set up not to broadcast data, in which case its common memory will consist only of receive areas.

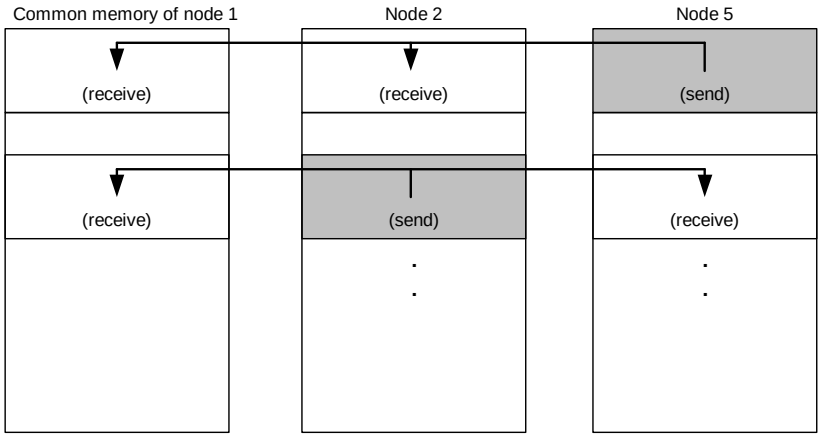


Fig. 3.12 Example 2 of Common Memory Configuration in Cyclic Transmission

■ Area 1 and Area 2

Each node can be allocated two types of send areas in the common memory: area 1 and area 2. Each send area is defined by a top address and a size (in units of words). Area 1 of all nodes occupies a total of 0.5K words, while Area 2 of all nodes occupies a total of 8K words.

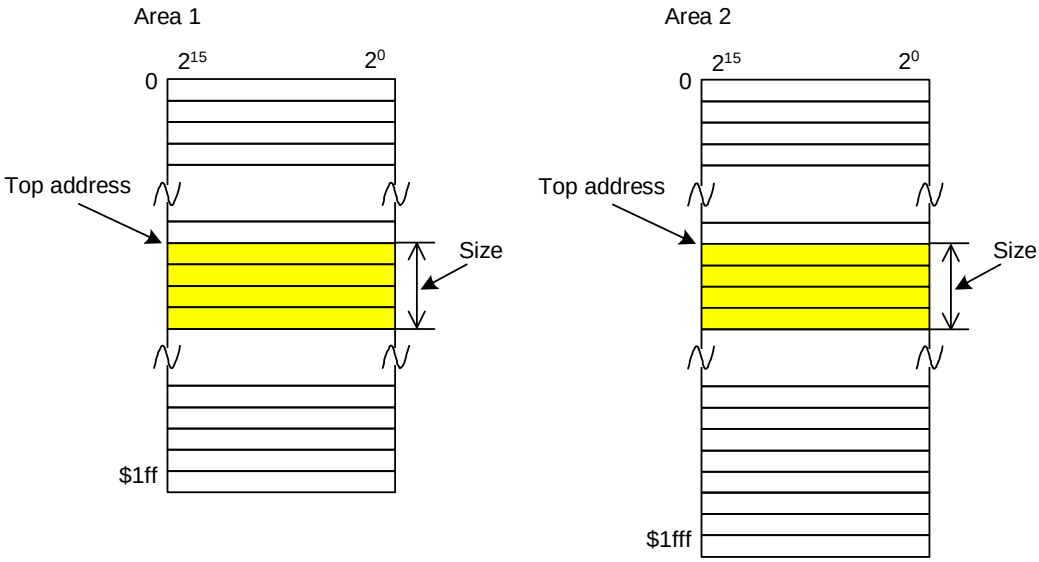


Fig. 3.13 Area 1 and Area 2 of Common Memory

■ Ensuring Data Concurrency

In cyclic transmission, multiple frames may be sent depending on the data size to be transmitted. In this case, data concurrency of common memory data is ensured using the following protocol.

● Send timing

When the module receives a send request from its upper layer, it copies the cyclic data of the local node in a buffer, and transmits the data as a frame. If the data to be transmitted exceeds the frame size, it splits the data across multiple frames.

● Timing of common memory refreshing

A receiving node updates its common memory after receiving all cyclic data from a sending node, in synchronization with its upper layer.

If the cyclic data was transmitted over multiple frames, the receiving node updates its common memory only after receiving all cyclic frames. If the cyclic frames received are incomplete, the receiving node discards all of them.

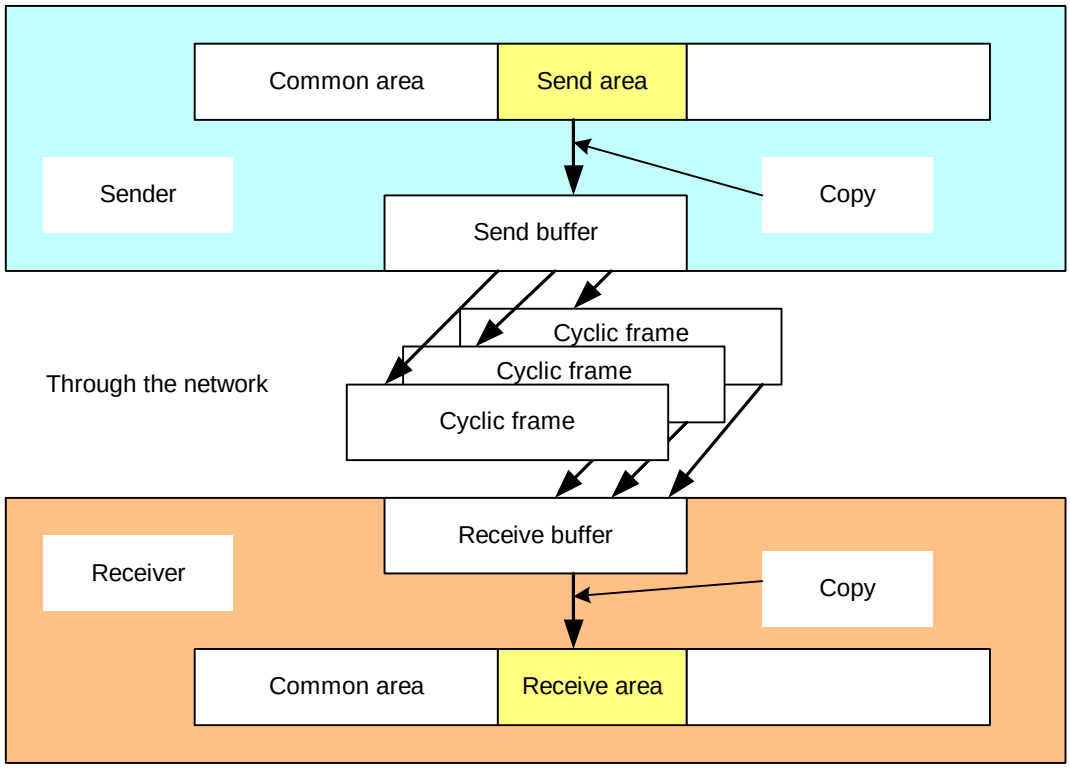


Fig. 3.14 Ensuring Data Concurrency

3.1.9 Message Transmission

■ Basics of Message Transmission

Message transmission enables on-demand (asynchronous) data exchange between specific nodes. The basics of message transmission are as follows:

- A token holding node can send up to one message frame before cyclic frames.
- A message frame can carry up to 1024 bytes of data. An algorithm manages message transmission such that the maximum allowable refresh cycle time of cyclic transmission is observed.
- Message transmission supports both node-to-node transmission and broadcasting.
- In node-to-node transmission, a receiving node acknowledges successful delivery.

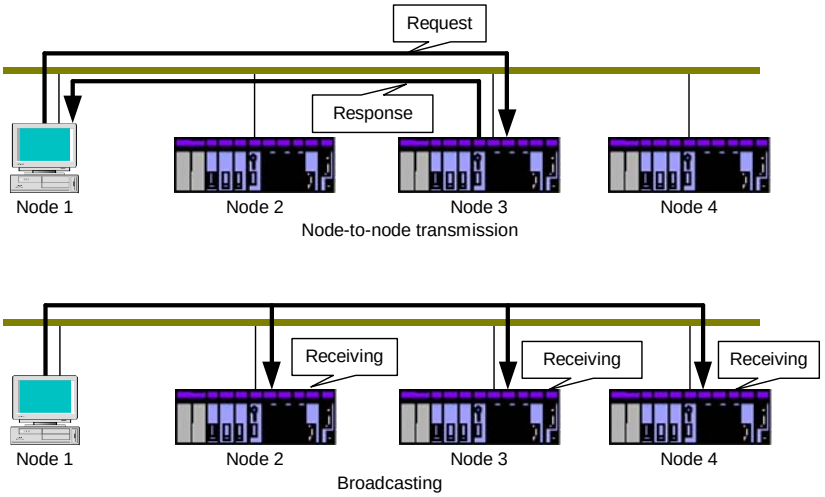


Fig. 3.15 Basics of Message Transmission

■ Message Types

● Byte Block Read

This message reads data bytes (1 byte=8 bits) from a 32-bit virtual address space of a remote node.

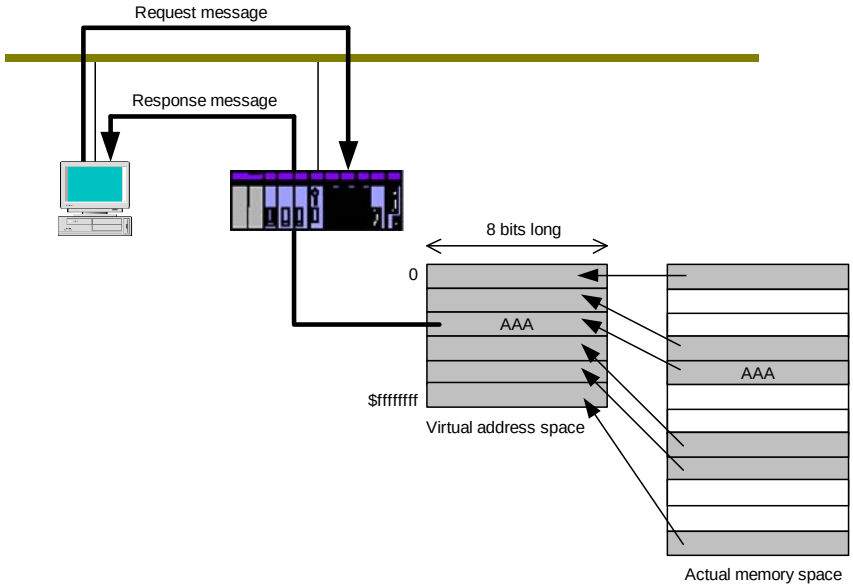


Fig. 3.16 Byte Block Read

● Byte Block Write

This message writes data bytes (1 byte=8 bits) to a 32-bit virtual address space of a remote node.

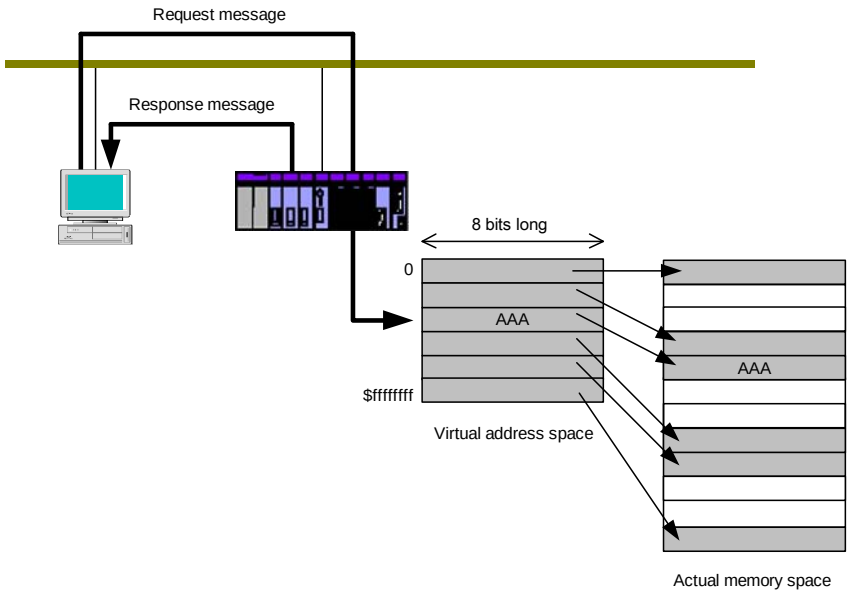


Fig. 3.17 Byte Block Write

Word Block Read

This message reads data words (1 word = 16 bits) from a 32-bit virtual address space of a remote node.

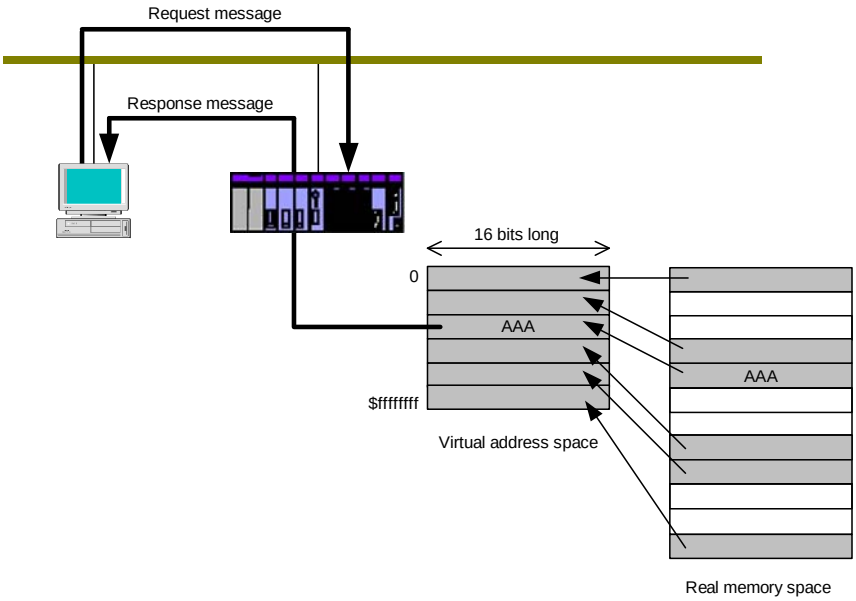


Fig. 3.18 Word Block Read

Word Block Write

This message writes data words (1 word = 16 bits) to a 32-bit virtual address space of a remote node.

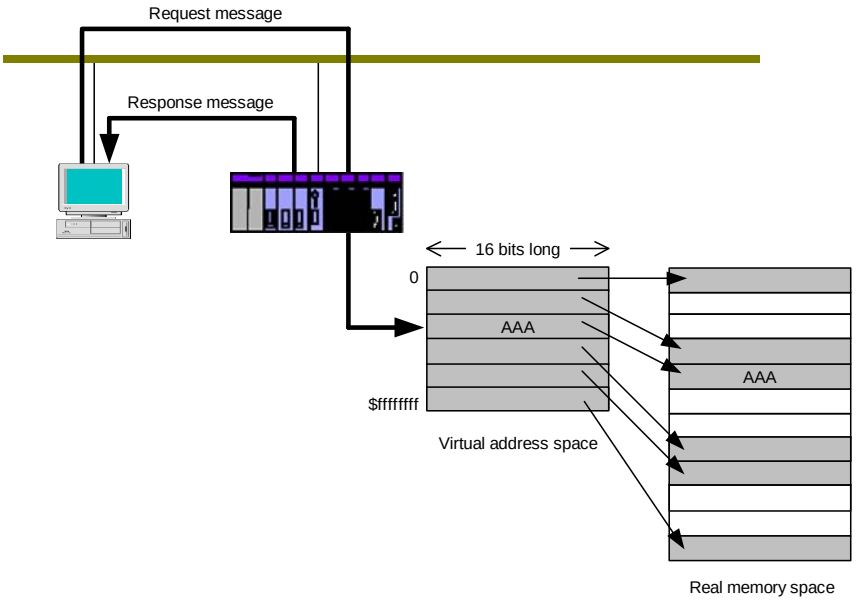


Fig. 3.19 Word Block Write

Read Network Parameters

This message reads network parameter information from a remote node. Table 3.4 shows the information retrieved.

Table 3.4 Network Parameter Information

Node number
Node name (equipment name)
Vendor name
Vendor equipment designation
Common memory address and size
Token watchdog time
Minimum allowable frame interval
Link status
Protocol type
Upper layer status
Allowable refresh cycle time (calculated value)
Refresh cycle time (measured value)

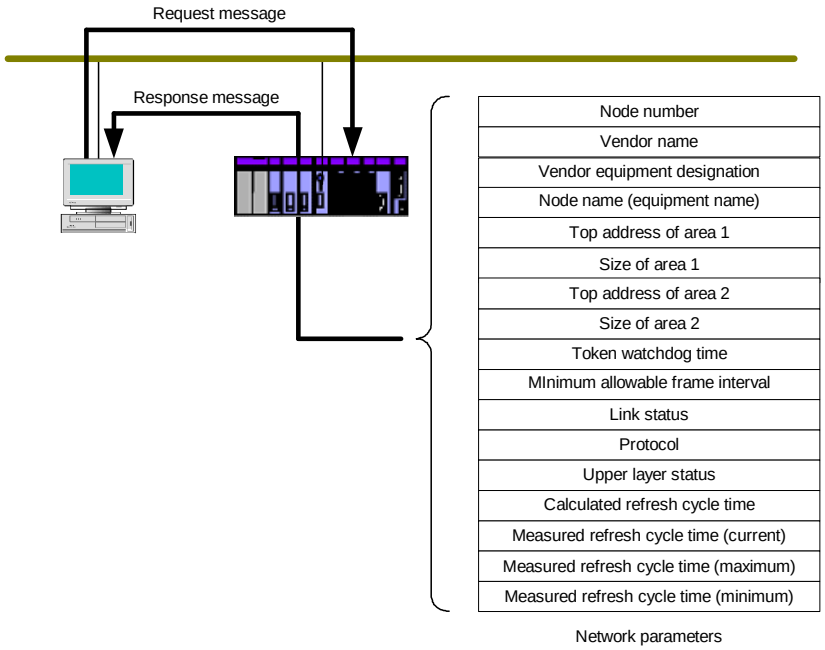


Fig. 3.20 Read Network Parameters

Write Network Parameters

This message updates network parameter information on a remote node. Table 3.5 shows the information that can be updated.

Table 3.5 Network Parameters

Node number
Common memory address and size

If the common memory address and size of the remote node is changed, the node will be temporarily withdrawn from the network, and then again participate in the network. If only the name of a node is changed, the node will not be withdrawn from the network.

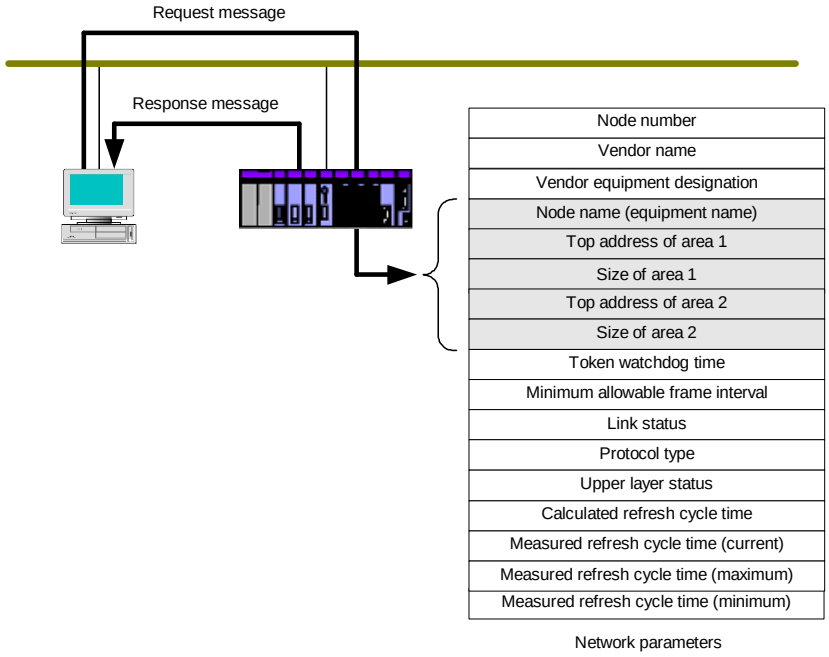


Fig. 3.21 Write Network Parameters

Start/stop Command

This message stops or starts a remote device connected to the FL-net (OPCN-2) network.

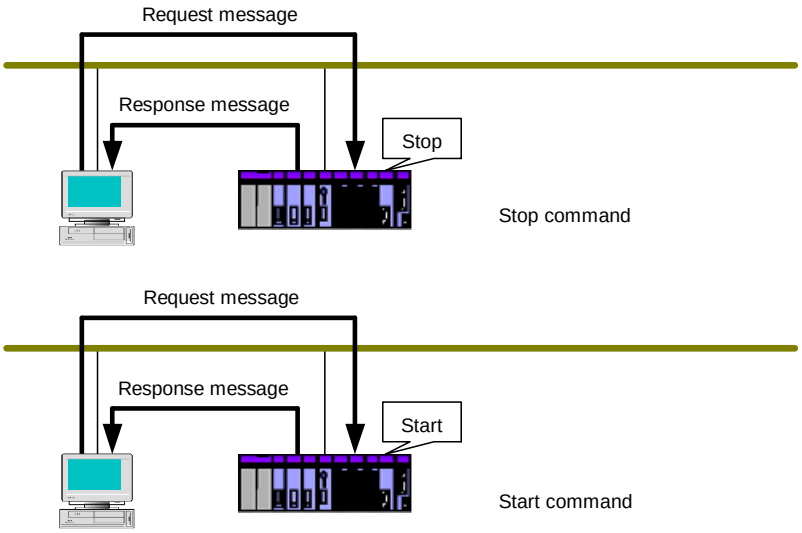


Fig. 3.22 Start/Stop Command

Read Profile

This message reads the device profile (system parameters) of a remote node, as shown below.

Table 3.6 Device Profile

Common parameters (required)
Device-specific parameters (optional)

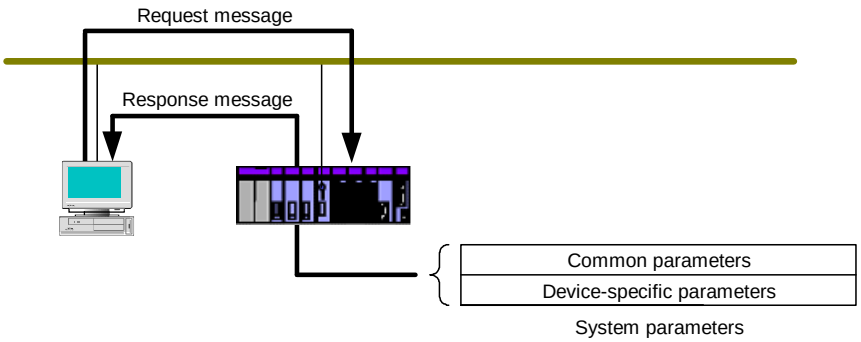


Fig. 3.23 Read Profile

- **Read Log Data**

  This message reads the log data of a remote node.

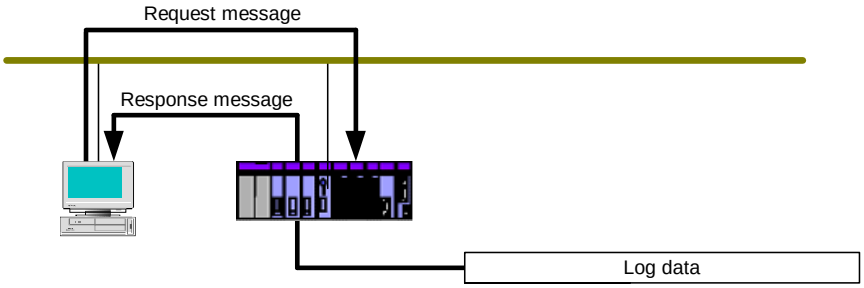


Fig. 3.24 Read Log Data

- **Clear Log Data**

  This message clears the log data of a remote node.

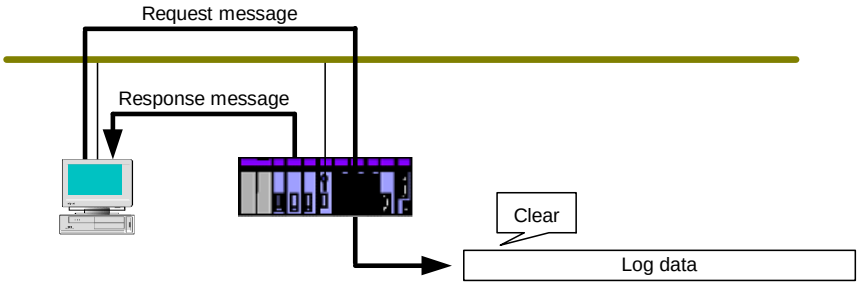


Fig. 3.25 Clear Log Data

- **Echo Message**

  This message echoes a test message sent from the source node. It can be used to test the message transmission function of a remote node.

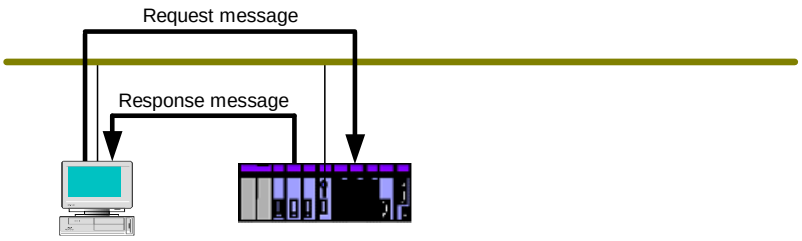


Fig. 3.26 Echo Message

- **Transparent Message**

  A transparent message is directly sent to the upper layer (message receiving area) of a remote node. The application layer is responsible for returning a response message (if required).

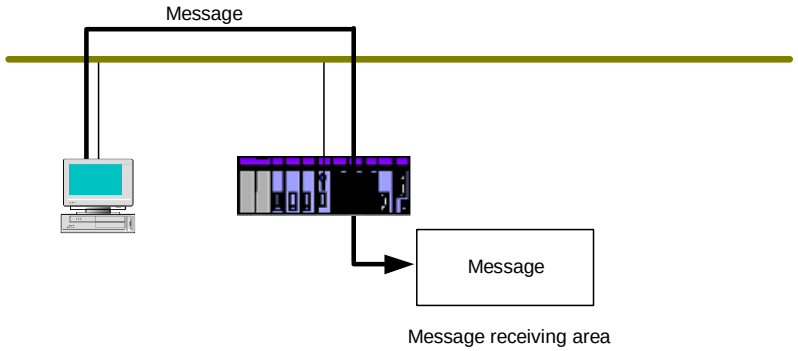


Fig. 3.27 Transparent Message

- **Vendor-specific Message**

  This message requests for equipment-specific message from a remote node.

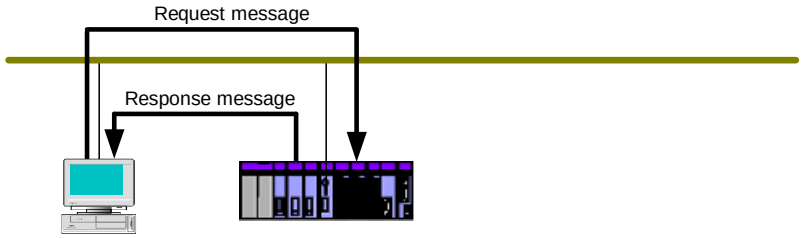


Fig. 3.28 Vendor-specific Message

3.1.10 Node Status

The following node statuses are available.

- Upper layer status
- Link status
- Local node status

■ Upper Layer Status

The upper layer status contains the operation status and error information of the upper layer.

Table 3.7 Operation Status of the Upper layer

Status	Description
RUN	Program of the upper layer is running.
STOP	Program of the upper layer is not running.

Table 3.8 Error Information of the Upper Layer

Error	Description
NORMAL	The upper layer is operating normally; cyclic and message transmissions are available.
WARNING	A non-critical error is detected in the upper layer; cyclic and message transmissions are still available.
ALARM	A fatal error is detected in the upper layer; cyclic and message transmissions are not available.

■ Link Status

Link status of a node contains information on whether it is participating in the network and whether it has detected an unknown token frame. Other information specific to a node is contained in a frame circulating in the network.

Table 3.9 Link Status Flags

Flags	Description
Overlapping address detected	It is set when there is address duplication in common memory.
Common memory setup completed	It is set when the common memory of a node is set up and available.
Common memory data valid	It is set when data is available for cyclic transmission.
Upper layer operation signal error	It is set when no heartbeat signal is received from the upper layer.
Invalid communication detected	It is set when an unknown token frame is detected in the network.
Node participation status	It is set when a node is participating in the network.

■ Local Node Status

Local node status contains information of the local node to be delivered to its upper layer.

Table 3.10 Local Node Status Flags

Flags	Description
Duplicate node number	It is set when another node in the network has the same node number as the local node.
Token watchdog time error	It is set when a node fails to complete transmission within its token watchdog time.
Waiting to receive	It is set when a node is waiting to receive but has yet to receive any frame during network initialization.
Initialization error	It is set when invalid parameters are detected during initialization setup or re-setup.

3.2 Setting Up F3LX02-1N

3.2.1 Startup Preparation

Fig. 3.29 shows a startup preparation flowchart for using an F3LX02-1N module installed in a FA-M3 system.

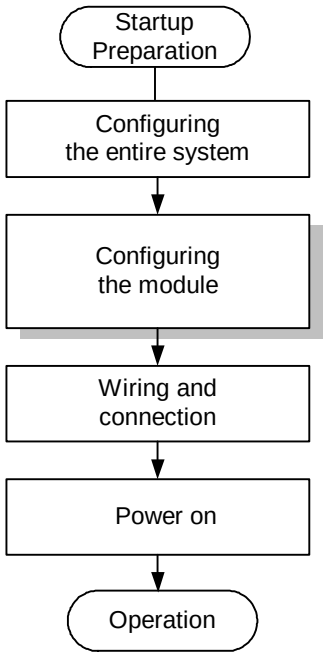
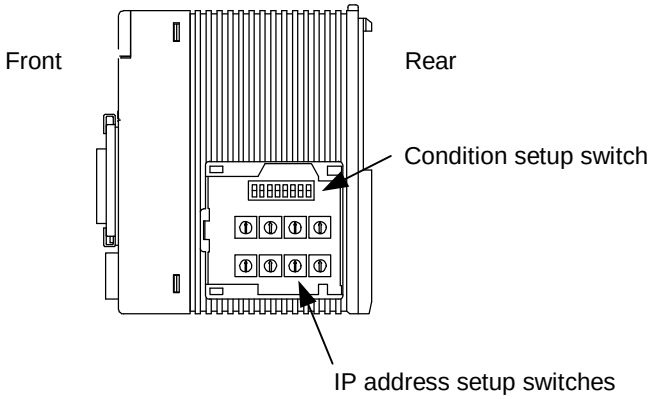


Fig. 3.29 Startup Preparation Flowchart

3.2.2 Configuring the Module

Set up the module switches before installing the module on the FA-M3 base module. Fig. 3.30 shows the locations of these switches.

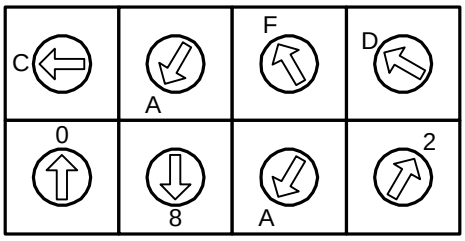


Note: This view is shown with the cover removed.

Fig. 3.30 Module Switches

■ IP Address Setup Switches

Use the IP address setup switches to set up the IP address of this module as shown in Fig. 3.31. These are eight hexadecimal rotary switches inside the cover. The IP address of the module is set to 192.168.250.0 at the factory.



Hexa-decimal	C0	.	A8	.	FA	.	D2
	↑		↑		↑		↑
Decimal	192	.	168	.	250	.	210

Fig. 3.31 IP Address Setup

- **Node number**

  The node number of the module is represented by the lowest eight bits of its IP address. For example, if the IP address of the module is 192.168.250.210, the node number of the module is 210. Do not set the node number to 0 or 255. Otherwise, a node number error would occur.

- **Subnet mask**

  The subnet mask consists of 24 bits.

■ Condition Setup Switch

The condition setup switch of the module is an eight-element DIP switch inside the cover. It is used for setting the operation condition.

Table 3.11 Condition Setup Switch

Elements	Function	OFF	ON
1	Reserved	Always OFF	Do not turn on.
2			
3			
4	Port selection	Automatic	10BASE-T
5	Reserved	Always OFF	Do not turn on.
6			
7			
8			

● Port selection

When switch element 4 is set to OFF, the module automatically detects the port in use: AUI port or 10BASE-T port. However, automatic detection may fail for a 10BASE-T connection depending on the specifications of the hub used. If the 10BASE-T port is used but not automatically detected, set switch element 4 to ON.

Table 3.12 Status of Switch Element 4

Status	Description
OFF	Automatic detection
ON	10BASE-T (fixed)

3.2.3 Wiring and Connection

■ Connecting a Communication Cable

● Connecting a 10BASE5 transceiver cable

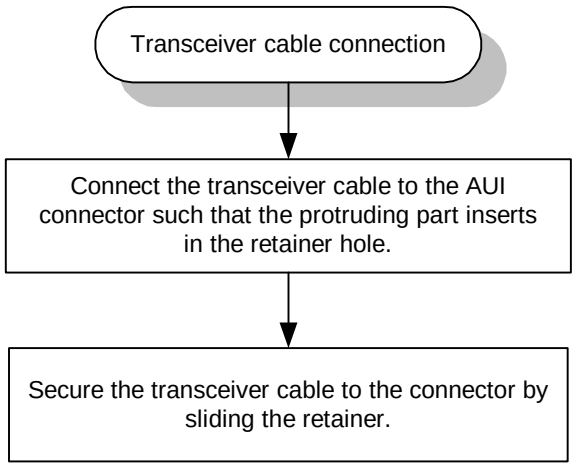


Fig. 3.32 Transceiver Cable Connection Flowchart

● Connecting a 10BASE-T cable

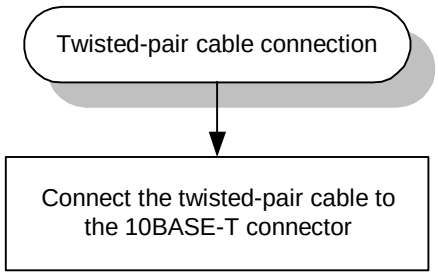


Fig. 3.33 10BASE-T Cable Connection Flowchart

CAUTION

Transceiver cables and twisted-pair cables cannot be used at the same time. Wiring of Ethernet cables requires strict safety rules to be observed, and should preferably be done by cabling professionals.

■ Wiring the Power Supply

If 10BASE5 is used, a 12-VDC external power supply may be required for the transceiver depending on its specification. 10BASE-T requires no external power supply. If a 10BASE5 transceiver requiring an external power supply is used, supply power using wires of AWG22-14. Screws fixing the wires to the power supply connector must be tightened to a torque of 0.25 N-m (2.25 lbf-in).

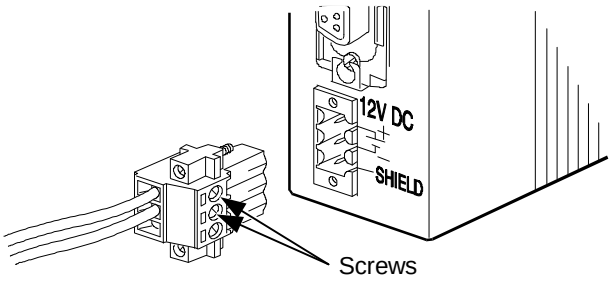


Fig. 3.34 Power Supply Wiring

CAUTION

Ensure that the external power supply is turned off before connecting the transceiver cable to the module. Connecting or disconnecting the cable while the external power supply is turned on may result in module failure.

TIP

IEEE802.3 specifications:

Voltage at transceiver's input end:	12 V - 6% to 15 V + 5%
DC resistance of transceiver cable:	40 Ω/km max. (50 m long max.)
Maximum current consumption of transceiver:	500 mA max.

Considering a voltage drop of 0.4 V within the module, the external power supply should provide a voltage between 12.68 and 15.75 V. Beware that not all IEEE802.3-compliant transceivers satisfy the 12 V - 6% to 15 V + 5% specification.

■ Shielding

If a transceiver cable or a shielded twisted-pair (STP) cable is used, ground the shield properly (if required). The shield of a transceiver cable is connected to the shell of the connector and, connects to the shield terminal of the module when the connector is engaged. The shield terminal of the module must be directly connected to a low impedance middle plate or ground terminal of a panel. The grounding wire used must be AWG22-14 in size. The screw that fixes the grounding wire to the connector must be tightened to a torque of 0.25 N-m (2.25 lbf-in). For better shielding effect, ground the shield according to the description entitled "■ CE-marking Compliant Grounding".

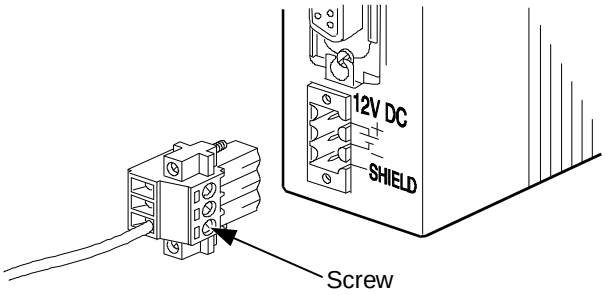


Fig. 3.35 Shield Grounding

■ Attaching the Power Supply Connector to the Module

Engage the connector to the module as shown in Fig. 3.36. Tighten the connector securing screws to a torque of 0.25 N-m (2.25 lbf-in).

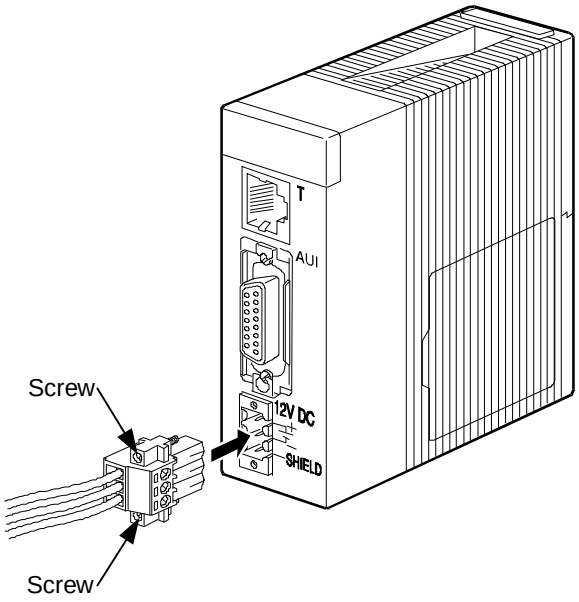
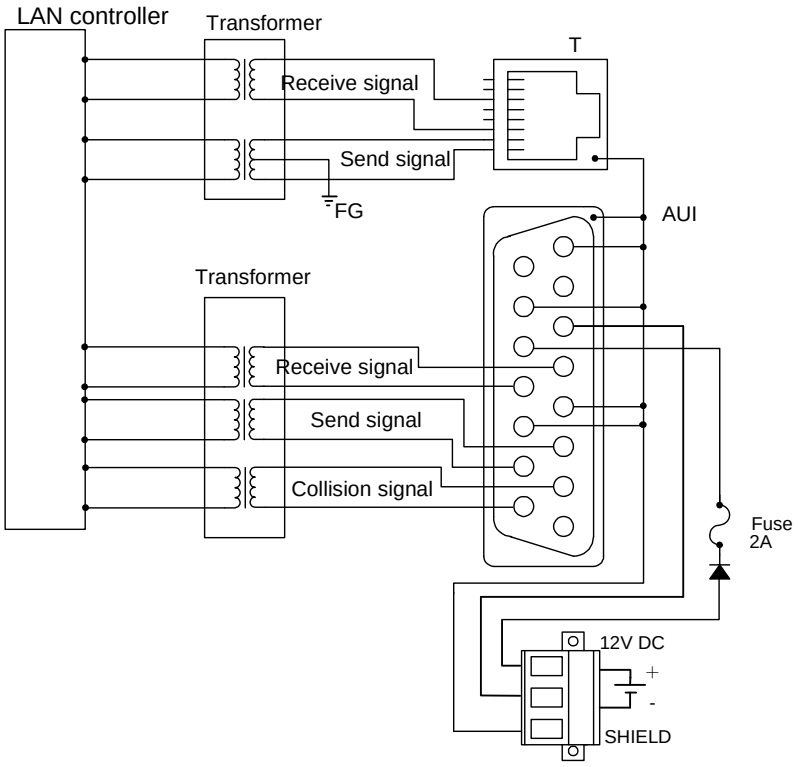


Fig. 3.36 Attaching the Connector to the Module

■ Internal Connector Wiring

Fig. 3.37 shows the internal connector wiring in the module.



Note: The connectors are as seen from the front.

Fig. 3.37 Internal Connector Wiring

■ CE-marking Compliant Grounding

To ensure compliance to CE Marking for a system incorporating this module, use a shielded cable for connecting to the module. Peel part of the insulation off the shielded cable to expose the shield, and apply an FG clamp to the shield to secure and ground it as shown in Fig. 3.38.

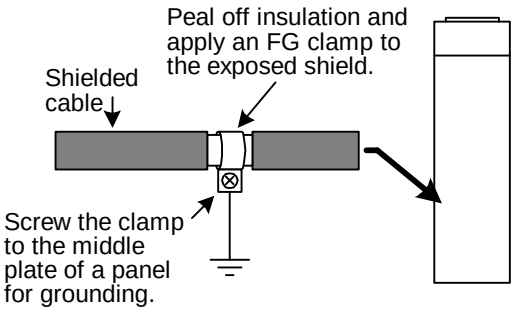


Fig. 3.38 Grounding the Shielded Cable

3.3 Using F3LX02-1N

3.3.1 Network Parameters

Network parameters are the information required for a node to participate in the network. They consist of the following parameters:

- **Node number**

  A node number is a number between 1 and 254 that identifies a specific node. All nodes participating in the same network must have a unique node number. A node that attempts to participate in a network with a duplicate node number will be rejected.

- **Top address and data size of area**

  The top address and data size of area 1 and area 2 of a node refer to the starting address and the size of the area of the common memory allocated to the node for data transmission. If the area size of a node is set to 0, this means that the node has no send area (but it can still process a token). The top address is specified as a word address, and the area size is specified in word units.

  The top address of area 1 can be specified as any value between 0 and 511, and its size can be between 0 and 512 words. The top address of area 2 can be between 0 and 8191, and its size can be between 0 and 8192 words.

- **Token watchdog time**

  Token watchdog time is the information delivered to all nodes for the purpose of node failure detection. It is in units of milliseconds and can be set to any value between 1 and 255.

- **Minimum allowable frame interval**

  The minimum allowable frame interval of a node is the minimum period after which the node can send a frame. The minimum allowable frame interval of a network is the largest of all minimum allowable frame intervals of participating nodes. It is in units of 100 microseconds and can be set to any value between 0 and 50.

- **Vendor name, Vendor equipment designation**

  Vendor name is the name of the manufacturer supplying equipment for a node. Equipment designation is the code or designation of the node equipment as specified by the manufacturer. It is fixed and cannot be modified by the user.

- **Node name (equipment name)**

  Node name is the name of a node as specified by the user. It is in ASCII characters and may be up to 10 bytes long.

3.3.2 Setting Network Parameters

Network parameters may be set up using one of the following methods:

- Using the setup tool (WideField2)
- Using a ladder program
- Using the Write Network Parameters request message

Table 3.13 shows what parameters can be set up using these methods.

Table 3.13 Network Parameter Setup

Item	Using WideField2 setup tool	Using Ladder Program	Using Write Network Parameters Request Message
Node number	Fixed value (lower 8 bits of IP address)	Fixed value (lower 8 bits of IP address)	Fixed value (lower 8 bits of IP address)
Area 1 top address	✓	✓	✓
Area 1 size	✓	✓	✓
Area 2 top address	✓	✓	✓
Area 2 size	✓	✓	✓
Token watchdog time	✓	✓	×
Minimum allowable frame interval	0 (fixed)	0 (fixed)	×
Vendor name	“YOKOGAWA “ (fixed value)	“YOKOGAWA “ (fixed value)	×
Vendor equipment designation	“F3LX02-1N” (fixed value)	“F3LX02-1N” (fixed value)	×
Node name (equipment name)	✓	✓	✓

✓: Can be specified.

×: Cannot be specified.

Network parameters are stored in the flash memory of a module and, once set up, need not be set up again after each powering up.

CAUTION

The number of write operations allowed for the flash memory of the module is limited to 100,000. Therefore, do not create a ladder program that writes network parameters into the module flash memory at each powering up. Do not turn off power during network parameter setup.

The network parameters indicate whether a node is participating in or has withdrawn from the network. For information on network participation and withdrawal, see Section 5.4, “FL-net (OPCN-2) Participation and Withdrawal”.

■ Setup Using the Setup Tool (WideField2)

You can use the FA-M3 programming tool WideField2 to set up the network parameters. For information on how to use WideField2, see the instruction manual “FA-M3 Programming Tool WideField2 (IM34M06Q15-01E)”.

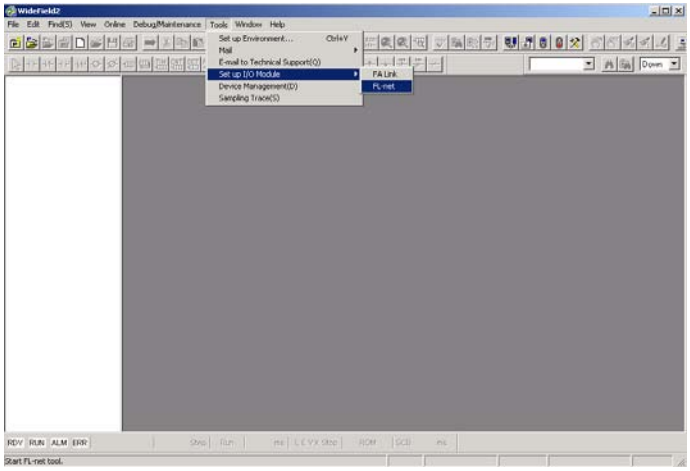


Fig. 3.39 Parameter Setup Tool

■ Setup Using a Ladder Program

● Setup procedure

Fig. 3.40 shows the procedure for setting up the network parameters using a ladder program.

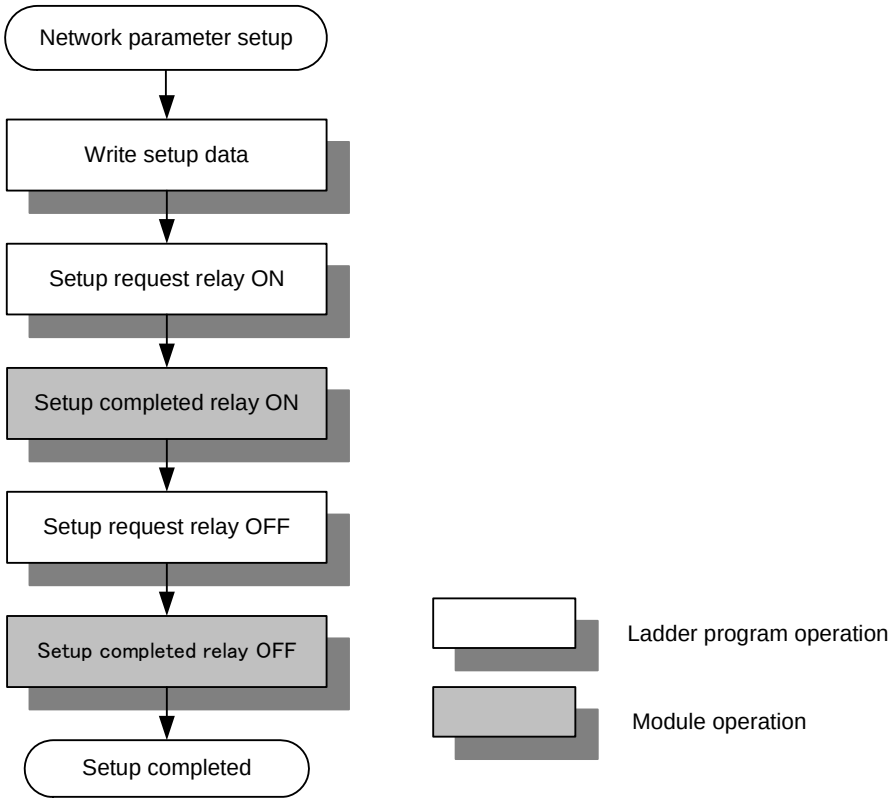


Fig. 3.40 Procedure for Setting up Network Parameters Using a Ladder Program

Writing setup data

Setup data is written into the setup areas of a module using the WRITE instruction. Table 3.14 shows the setup areas for the network parameters.

Table 3.14 Network Parameter Setup Areas

Data Position Number	Description	Setup Range
2561	Area 1 top address (word address)	0-511
2562	Area 1 size (word size)	0-512
2563	Area 2 top address (word address)	0-8191
2564	Area 2 size (word size)	0-8192
2565	Token watchdog time	1-255 (in ms)
2566	Reserved	Always 0
2567-2571	Node name (equipment name)	10 bytes in ASCII

Setup request relay

After writing setup data, turn on the setup request relay to initiate setup. After completing the setup, the setup completed relay turns on to acknowledge a successful setup. Turning off the setup request relay turns off the setup completed relay. Information on the setup request relay and the setup completed relay is given in Table 3.15.

Table 3.15 Network Parameter Setup Relays

Designation	Name	Function
Y0□□49	Network parameter setup request	Request to setup network parameters
X0□□17	Network parameter setup completed	Notification of setup completion

□□: Slot number

Setup example

Fig. 3.41 shows a sample program for the setup given in Table 3.16.

Table 3.16 Contents of Example Network Parameter Setup

Item	Description
Area 1 top address	4
Area 1 size	4 words long
Area 2 top address	64
Area 2 size	64 words long
Token watchdog time	20 ms
Node name (equipment name)	TestNode

This example assumes the setup trigger relay is /I00001 and the module is installed in slot 13.

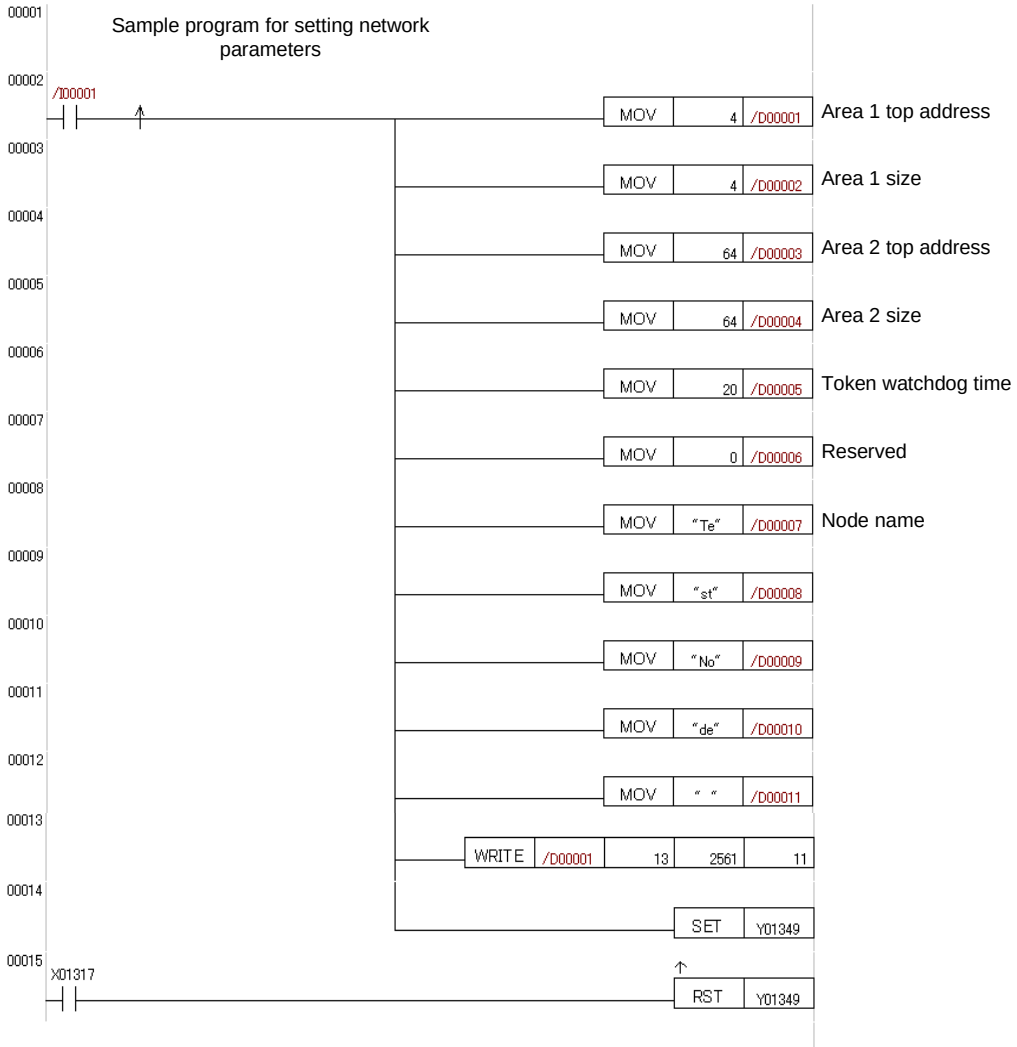


Fig. 3.41 Sample Program for Setting up Network Parameters

TIP

When setting up network parameters using a ladder program, follow the procedure below to reduce the number of write operations to the module's flash memory:

Read the module's node management information to obtain the current network parameters for the node, and compare the values with the new network parameters. Write the new network parameters into the flash memory only if differences are found.

■ Setup Using a Write Network Parameters Request Message

You can set up network parameters using a Write Network Parameters request message, which is included in the message transmission function. For details on the message, see the user's manual for the node that supports the message.

■ Default Values of Network Parameters

The default values (factory setting) of the network parameters are shown in Table 3.17.

Table 3.17 Default Values of Network Parameters

Parameters	Defaults
Vendor name	YOKOGAWA
Vendor equipment designation	F3LX02-1N
Node name (equipment name)	LX02No.### *1
Area 1 top address	0
Area 1 size	0
Area 2 top address	0
Area 2 size	0
Token watchdog time	50 (ms)
Minimum allowable frame interval	0 (100μs)

*1: '###' represents a node number in three-digit decimal.

TIP

When determining the token watchdog time, you must consider the minimum allowable frame interval of the network, as the token transmission time depends on both the minimum allowable frame interval and the transmission data size (allocated common area size). For example, if the minimum allowable frame interval is 5 ms, a node needs additional 5 ms to transmit each 1K-byte of data. A node needs still additional time if it also transmits a message. Thus an appropriate token watchdog time depends on individual systems.

3.3.3 Common Memory

● Area 1

Each allocated memory location (1 word) in Area 1 of the common memory maps to a set of 16 link relays (L) of a sequence device as shown in Table 3.18 and Fig. 3.42 below.

Table 3.18 Mapping between Area 1 Addresses and Link Relays

Address in Area 1	Link Relays
0 ($0000)	L□0001 to L□0016
1 ($0001)	L□0017 to L□0032
…	…
510 ($01FE)	L□8161 to L□8176
511 ($01FF)	L□8177 to L□8192

□: Link system number minus 1

Fig. 3.42 shows how the bits of an area 1 memory location map to 16 link relays. For more information on link system number, see Subsection 3.4.3, “Link System Number”.

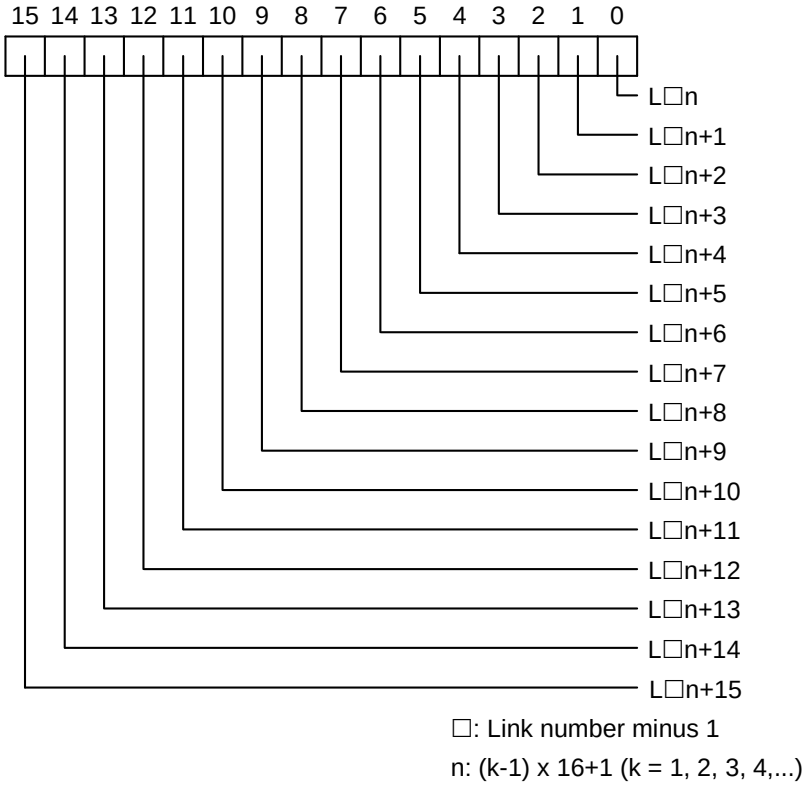


Fig. 3.42 Mapping Between Bits of Area-1 Address Location and Link Relays

● Area 2

Each allocated memory location (1 word) in Area 2 of the common memory maps to a link register (W) of a sequence device as shown in Table 3.19 below.

Table 3.19 Mapping between Area 2 Addresses and Link Registers

Address in Area 2	Link Registers
0 ($0000)	W□0001
1 ($0001)	W□0002
…	…
8190 ($1FFE)	W□8191
8191 ($1FFF)	W□8192

□: Link number minus 1

3.3.4 Message Transmission

This subsection describes the message transmission function.

■ List of Supported Messages

The module supports the following message services:

Table 3.20 List of Supported Messages

No.	Messages	Client Function*4	Server Function*5
1	Byte block read	✓	×*1*2
2	Byte block write	✓	×*1*2
3	Word block read	✓	✓*1
4	Word block write	✓	✓*1
5	Read network parameters	✓	✓*1
6	Write network parameters	✓	✓*1
7	Start command	✓	✓*1*3
8	Stop command	✓	✓*1*3
9	Read profile	✓	✓*1
10	Read log data	✓	✓*1
11	Clear log data	✓	✓*1
12	Echo message	✓	✓*1
13	Transparent message	✓	✓
14	Vendor-specific message	✓	×*2

✓: Supported

×: Not supported

*1: A response message is automatically returned for these request messages without involving the upper link. Hence, these incoming request messages cannot be detected by a sequence CPU program.

*2: A response message “M_RLT=2” (“Not Installed”) is returned.

*3: For a multi-CPU system, the Start or Stop command applies to all CPUs.

*4: A client sends a request message to and receives a response message from a server in message transmission.

*5: A server receives a request message from and sends a response message to a client in message transmission.

3.3.4.1 Sending Messages

A message can be sent using a send handle. Messages of any transaction code (TCD number) can be sent to a destination node by specifying its destination node number. Acknowledgement is done for node-to-node transmission.

- **What is a send handle?**

  A send handle contains a parameter setup area, a message area, a send request relay and a send completed relay to be used in message transmission. The module uses three send handles to allow for three independent messages.

- **Send procedure**

  Fig. 3.43 shows the process flow for message transmission.

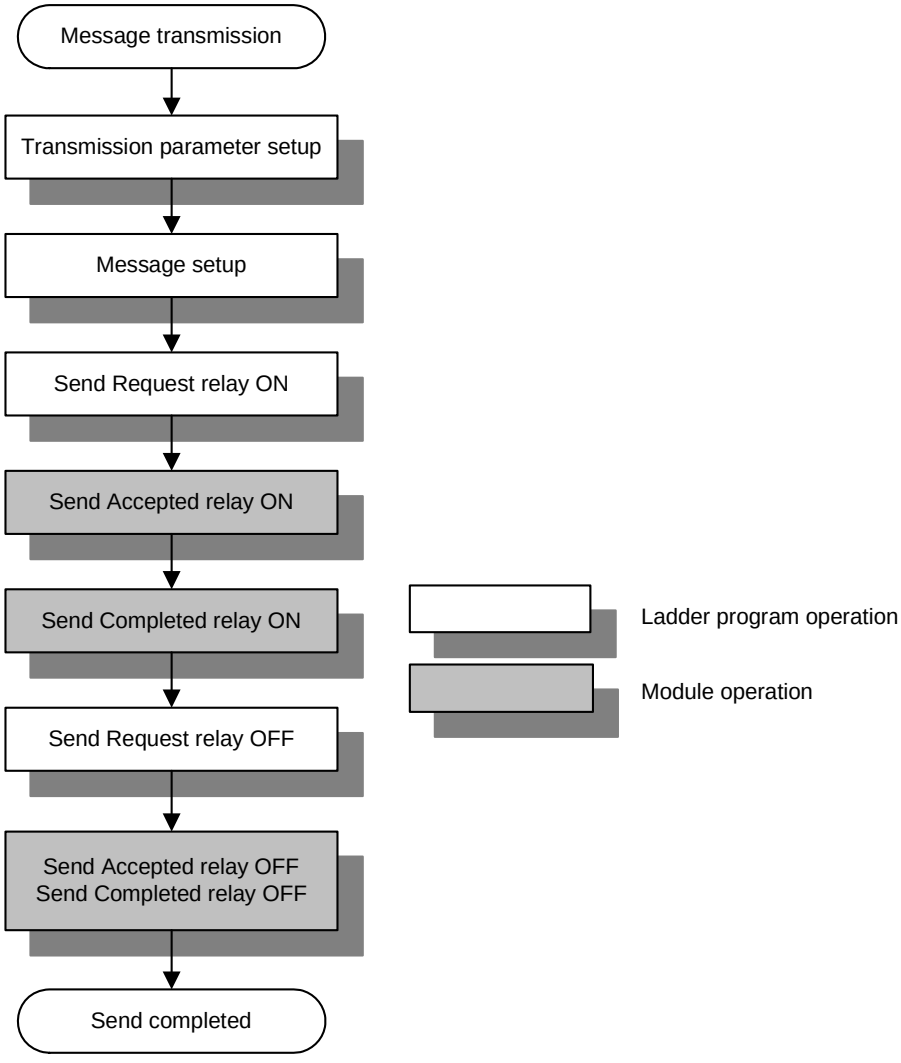


Fig. 3.43 Procedure for Sending a Message

■ Setting Up Message Transmission Parameters

Before message transmission, you must set up destination node number, transaction code (TCD) and other message transmission parameters.

Use WRITE instructions in a ladder program to write message transmission parameters into the message transmission parameter setup area of the module as shown in Table 3.21 below.

Table 3.21 Message Transmission Parameter Setup Area

Data Position Number			Description	Valid Data Range
Send handle 1	Send handle 2	Send handle 3		
2081	2113	2145	Destination node number	1-255
2082	2114	2146	Reserved	
2083	2115	2147	Message type	0-2
2084	2116	2148	TCD	$0 to $FFFF
2085	2117	2149	Message offset in virtual address space	$0 to $FFFFFFFF
2086	2118	2150		
2087	2119	2151	Virtual address space block size	
2088	2120	2152	Data size	0-1024
2089	2121	2153	Reserved	
2090	2122	2154		
2091	2123	2155		
2092	2124	2156		
2093	2125	2157		
2094	2126	2158		
2095	2127	2159	Timeout monitoring time	
2097	2129	2161	Vendor name (applicable only when sending a vendor-specific message)	
2098	2130	2162		
2099	2131	2163		
2100	2132	2164		
2101	2133	2165		
2102	2134	2166	Subcode (applicable only when sending a vendor-specific message)	
2103	2135	2167		
2104	2136	2168		

● Destination node number

The node number of a node to which a message is addressed. Set its value to 255 for broadcasting to all nodes.

● Message type

A response message result code (M_RLT) to be written in the message header according to Table 3.22. M_RLT is specified only for a response message. It is set to 0 for other types of message.

Table 3.22 M_RLT Values for Message Transmission

M_RLT	Meaning
0	Normal
1	Error
2	Not installed

● TCD

The transaction code (TCD) of a message. For more information, see the description under “FL-net (OPCN-2) Transaction Codes” in section 5.3, “Defining a Network System”.

- **Message offset in virtual address space**

  A Message offset in virtual address space (M_ADD) to be written in the message header. M_ADD is specified only for a message using a virtual address area. It is set to 0 for other types of message.

- **Virtual address space block size**

  A virtual address space block size (M_SZ) to be written in the message header. M_SZ is specified only for a message using a virtual address area. It is set to 0 for other types of message.

- **Data size**

  The message size in bytes, excluding the message header and the subheader.

- **Timeout monitoring time**

  The time in units of milliseconds within which a message transmission process (from the start to end of a transmission) must be completed. If an ACK fails to arrive within this time period in node-to-node transmission, a transmission error is reported.

- **Vendor name**

  A vendor name to be written in the subheader of a vendor-specific message. It need not be specified for other types of message.

- **Subcode**

  A subcode to be written in the subheader of a vendor-specific message. It need not be specified for other types of message.

■ Setting Up A Transmission Message

Use the ladder programming WRITE instruction to write a message into the transmission message area of the module as shown in Table 3.23 below.

Table 3.23 Transmission Message Area

Data Position Number			Description
Send handle 1	Send handle 2	Send handle 3	
513 to 1024	1025 to 1536	1537 to 2048	Transmission message

- **Transmission message**

  A transmission message is stored in the transmission message area sequentially starting from the top address of the area. The area consists of words each containing two bytes. When a message contains an odd number of bytes, the last byte of the message must be stored in the high byte of the last word location.

■ Send Request/Send Completed Relays

Turning on the Send Request relay starts message transmission. When the module detects a rising change in the Send Request relay, it turns on the Send Accepted relay. When the module finishes sending the message, it turns on the Send Completed relay. Further information on these relays is given in Table 3.24.

Table 3.24 Send Request/Send Completed Relays

Relay Number			Description
Send handle 1	Send handle 2	Send handle 3	
Y0□□34	Y0□□36	Y0□□38	Send Request relay
X0□□02	X0□□04	X0□□06	Send Accepted relay
X0□□03	X0□□05	X0□□07	Send Completed relay

□□: Slot number

● Send Request relay

Turning on this relay causes a message to be sent according to the transmission parameters. Always check that both the Send Accepted relay and the Send Completed relay are off before turning on the Send Request relay.

● Send Accepted relay

Turning on the Send Request relay causes the corresponding Send Accepted relay to be turned on, signifying that the module is ready to receive a message.

● Send Completed relay

This relay is turned on when a message has been transmitted successfully. For node-to-node message transmission, successful transmission is indicated by an ACK sent from the destination node. This relay is also turned on when an error is detected.

■ Send Completion Status

When the Send Completed relay is turned on, the transmission status is stored in the send completion status area as shown in Table 3.25 below.

Table 3.25 Send Completed Status Area

Data Position Number			Description
Send handle 1	Send handle 2	Send handle 3	
2096	2128	2160	Send Completion Status

● Send Completion Status

Table 3.26 lists possible values for the send completion status.

Table 3.26 Send Completion Status Values

Value	Meaning	Description
$0000	Normal exit	Message transmission is successful.
$0001	Insufficient send buffer space	Send buffer is not available.
$0002	Invalid parameters	Transmission parameters are invalid.
$0003	Timeout	Transmission fails to complete within the timeout monitoring time.
$0004	No ACK	No ACK is received even after a specified number of re-transmissions.
$0005	Insufficient receive buffer space	R_STS=2 is returned.
$0006	Receiver not initialized	R_STS=3 is returned.
$0007	Receiver version error	R_STS=5 is returned.
$0008	Receiver parameter error	R_STS=6 is returned.
$8000	Others	Internal error

R_STS: ACK status returned from the remote node.

■ Example

A sample program is shown in Fig. 3.44 using the conditions given in Table 3.27. The sample program sets up the TCD, destination node number, size and other message transmission parameters, as well as a message using WRITE instructions, and then sends the message using the Send Request and other I/O relays.

The Send Accepted relay is turned on when a send request is accepted. You can use this relay to control timing. Once a send request is issued, message transmission cannot be interrupted.

You can confirm the completion of message transmission by checking whether the Send Completed relay has been turned on. Once you confirm such completion, read the transmission status from the Send Completion Status area using a READ instruction.

Table 3.27 Example Message Transmission Parameters

Message Transmission Parameters	Values
Destination node number	100
Message type (M_RLT)	0
TCD	40000 ($9C40)
Message offset in virtual address space	0
Virtual address space block size	0
Data size	14 bytes for the text “ABCDEFGHIJKLMN”
Timeout monitoring time	5 s

This sample program assumes that the transmission trigger is /I0001; the module is installed in slot 5; and send handle 1 is used.

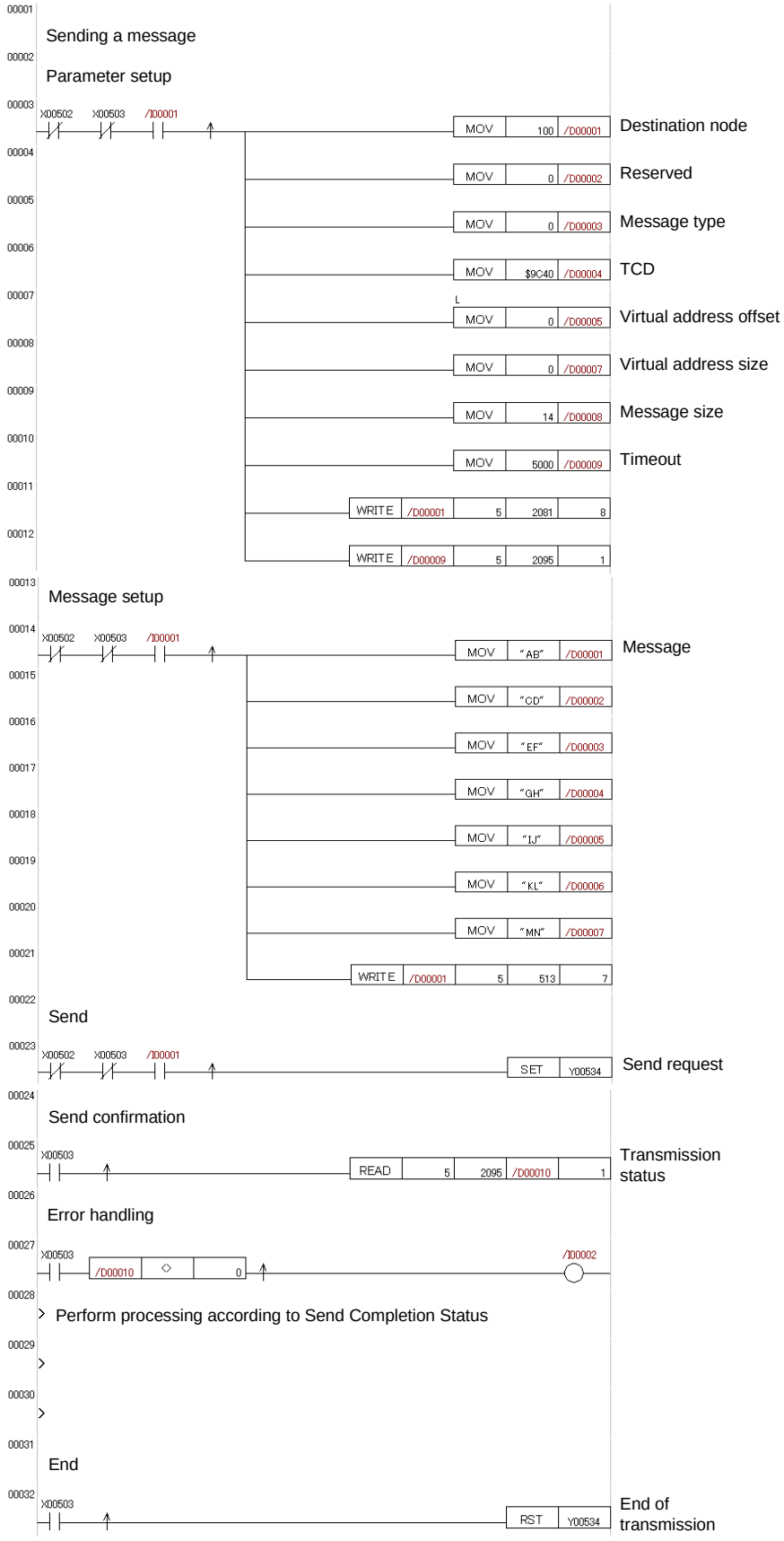


Fig. 3.44 Sample Program for Sending a Message

3.3.4.2 Receiving Messages

A sequence CPU can receive a message from a node via this module using a receive handle. Acknowledgment of successful delivery is provided for node-to-node transmission.

- **What is a receive handle?**

  A receive handle contains a parameter area (accessible when a message is received), a message area, a Receive Request relay and a Receive Completed relay. The module uses one receive handle for all messages.

- **Receive procedure**

  Fig. 3.45 shows the process flow for message receiving.

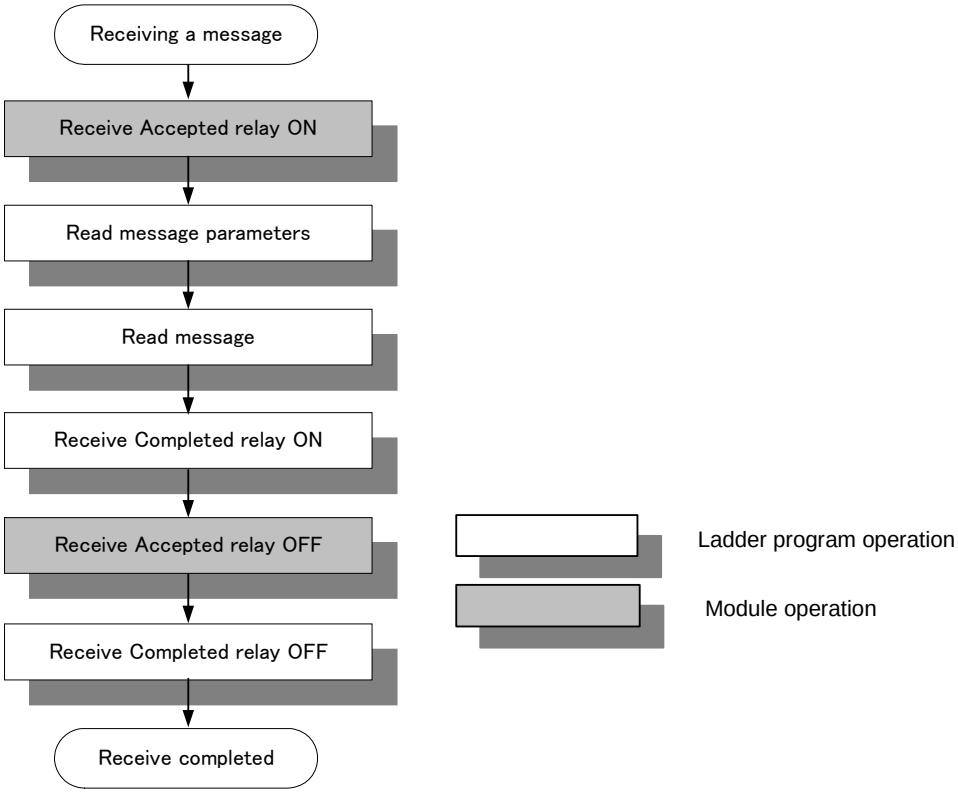


Fig. 3.45 Procedure for Receiving a Message

■ Receive Parameters

The source node number, destination node number, TCD and other receive parameters of a received message are stored in the parameter area.

Using ladder programming READ instructions, you can retrieve the receive parameters from the parameter area of the module as shown in Table 3.28.

Table 3.28 Receive Parameter Area

Data Position Number	Description	Setup Range
2049	Source node number	1-255
2050	Destination node number	Local node number or 255
2051	Message type	0-2
2052	TCD	$0 to $FFFF
2053	Message offset in virtual address space	$0 to $FFFFFFFF
2054		
2055	Virtual address space block size	
2056	Data size	0-1024
2065	Vendor name (Valid only for vendor-specific messages)	
2066		
2067		
2068		
2069		
2070	Subcode (Valid only for vendor-specific messages)	
2071		
2072		

● Source node number

The node number of the node that has sent the message.

● Destination node number

The node number of a node to which the message is addressed (for node-to-node transmission). For broadcasting to all nodes, it is set to 255.

● Message type

A response message result code (M_RLT) stored in the message header. M_RLT is specified only for a response message according to Table 3.29.

Table 3.29 M_RLT Values for Message Receive

M_RLT	Meaning
0	Normal
1	Error
2	Not installed

● TCD

The transaction code (TCD) of a message. For more information, see the description under “FL-net (OPCN-2) Transaction Codes” in section 5.3, “Defining a Network System”.

● Message offset in virtual address space

Message offset in virtual address space (M_ADD) value stored in the message header. M_ADD is valid only for a message using a virtual address area.

- **Virtual address space block size**

  Virtual address space block size (M_SZ) stored in the message header. M_SZ is valid only for a message using a virtual address area.

- **Data size**

  The message size in bytes, excluding the message header and the subheader.

- **Vendor name**

  A vendor name stored in the subheader of a vendor-specific message

- **Subcode**

  A subcode stored in the subheader of a vendor-specific message

■ Storing Received Messages

A received message is stored in the receive message area.

Using the ladder programming READ instruction, you can retrieve a message from the receive message area of the module shown in Table 3.30.

Table 3.30 Receive Message Area

Data Position Number	Description
1 to 512	Received message

- **Received messages**

  A received message is stored in the receive message area sequentially, starting from the top address of the area. The area consists of words each containing two bytes. When a message contains an odd number of bytes, the last byte of the message is stored in the high byte of the last word location.

■ Receive Accepted/Receive Completed Relays

When the module receives a message, it turns on the Receive Accepted relay. You should turn on the Receive Completed relay after reading the message. Turning on the Receive Completed relay causes the Receive Accepted relay to turn off. Further information on these relays is given in Table 3.31.

Table 3.31 Receive Accepted/Receive Completed Relays.

Relay number	Description
X0□□01	Receive Accepted relay
Y0□□33	Receive Completed relay

□□: Slot number

- **Receive Accepted relay**

  When a message is received, the content of the header is stored in the receive parameter area; the message body is stored in the receive message area; and the Receive Accepted relay is turned on. If another message is received while this relay is on, it is stored in an internal buffer.

- **Receive Completed relay**

  After you have read a message and turned on the Receive Completed relay, the Receive Accepted relay will be turned off. If another message is received while the Receive Accepted relay is on, it is stored in an internal buffer.

■ Messages Not Receivable by a Sequence CPU

Not all received messages can be read by the ladder program of a sequence CPU. Messages (TCDs) that cannot be received by a sequence CPU module are listed in Table 3.32. They are processed within this module.

Table 3.32 Messages Not Receivable by a Sequence CPU

TCD	Description
60000 to 64999	Reserved
65000	Token frame
65001	Cyclic frame
65002	Participation request frame
65003	Byte block read (request)
65004	Byte block write (request)
65005	Word block read (request)
65006	Word block write (request)
65007	Read network parameters (request)
65008	Write network parameters (request)
65009	Stop command (request)
65010	Start command (request)
65011	Read profile (request)
65012	Trigger frame
65013	Read log data (request)
65014	Clear log data (request)
65015	Echo message (request)
65016	Vendor-specific message (request)
65200 to 65202	Reserved (for future use)
65212	Reserved
65400 to 65535	Reserved

No messages can be received while waiting to receive a Write Network Parameters (response) message (TCD = 65208) after sending a Write Network Parameters (request) message.

■ Example

When a message is received, the event is reflected on relevant I/O relays. Specifically, when a message is received, the content of the header (source node number, destination node number, TCD, data size, etc.) and message body (data) are stored and the Receive Accepted relay is turned on. After checking that the relay is on, you can retrieve the data using a READ instruction. Turning on the Receive Completed relay after reading the data turns off the Receive Accepted relay. You should then turn off the Receive Completed relay. Any message received while the Receive Accepted relay or the Receive Completed relay is on will be stored in an internal buffer of the module. In this case, when both relays are turned off, the header and the message body of the message will be stored in the parameter area and the message area respectively, and the Receive Accepted relay is turned on.

A sample program for receiving a message is shown in Fig. 3.46. It assumes that this module is installed in slot 5.

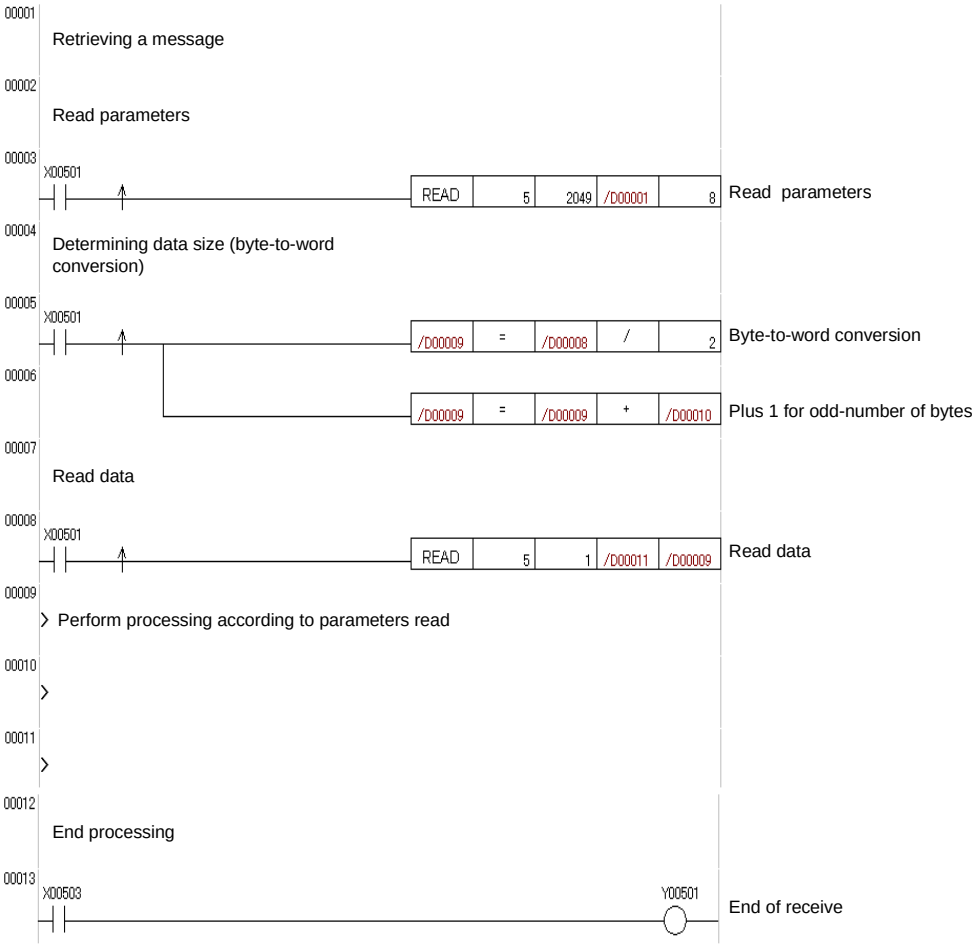


Fig. 3.46 Sample Program to Receive a Message

Table 3.33 shows how data is stored after the sample program is executed.

Table 3.33 How Data Is Retrieved and Stored

Devices	Description
/D00001	Message source node number
/D00002	Message destination node number (Local node number or 255)
/D00003	Message type (M_RLT)
/D00004	TCD
/D00005	Message offset in virtual address space
/D00006	
/D00007	Virtual address space block size
/D00008	Data size (in bytes)
/D00011 ⋮	Received data

3.3.4.3 Message Transmission Setup Format

This subsection describes the message transmission parameter/data setup format in accordance with the FL-net (OPCN-2) standard.

■ Byte Block Read

● Sending a request message

A byte block read (request) message has its data size fixed to 0. Table 3.34 describes its format.

Table 3.34 Send Format for Byte Block Read (Request) Message

Data Position Number			Parameters	Description
Send handle 1	Send handle 2	Send handle 3		
2081	2113	2145	Destination node number	Specify the node number of the requested node.
2082	2114	2146	Reserved	0
2083	2115	2147	Message type	0
2084	2116	2148	TCD	65003 ($FDEB)
2085	2117	2149	Message offset in virtual address space	Specify the first address to be read.
2086	2118	2150		
2087	2119	2151	Virtual address space block size	Specify the number of blocks (bytes) to be read.
2088	2120	2152	Data size	0
2095	2127	2159	Timeout monitoring time	Specify the time within which ACK must be returned.

● Receiving a response message

A byte block read (response) message returns requested data.

Table 3.35 Received Format for Byte Block Read (Response) Message

Data Position Number	Parameters	Description
2049	Source node number	Contains the node number of a requested node.
2050	Destination node number	Contains the local node number.
2051	Message type	0: Normal, 1: Error, and 2: Not installed
2052	TCD	65203 ($FEB3)
2053	Message offset in virtual address space	Contains the requested first address.
2054		
2055	Virtual address space block size	Contains the number of blocks (bytes) requested.
2056	Data size	Size of received message: Size of received data for message type 0; Size of error code for message type 1; or 0 for message type 2
If message type is 0:		
1 to 512	Received message	Data to be read*1
If message type is 1:		
1 to 512	Received message	Error code*2

*1: Data is stored in bytes, starting from the high byte of data position number 1.

*2: Data is stored starting at data position number 1. If the received data contains word data, the high byte and low byte must be swapped after reading.

■ Byte Block Write

● Sending a request message

A byte block write (request) message contains write data.

Table 3.36 Send Format for Byte Block Write (Request) Message

Data Position Number			Parameters	Description
Send handle 1	Send handle 2	Send handle 3		
2081	2113	2145	Destination node number	Specify the node number of a requested node.
2082	2114	2146	Reserved	0
2083	2115	2147	Message type	0
2084	2116	2148	TCD	65004 ($FDEC)
2085	2117	2149	Message offset in virtual address space	Specify the first address for writing.
2086	2118	2150		
2087	2119	2151	Virtual address space block size	Specify the number of blocks (bytes) to be written.
2088	2120	2152	Data size	Specify the number of blocks to be written.
2095	2127	2159	Timeout monitoring time	Specify the time within which ACK must be returned.
513 to 1024	1025 to 1536	1537 to 2948	Send message	Write data*1

*1: Set up write data starting from the high byte of data position number 513, 1025, or 1537.

● Receiving a response message

A byte block write (response) message returns the result of a write operation.

Table 3.37 Receive Format for Byte Block Write (Response) Message

Data Position Number	Parameters	Description
2049	Source node number	Contains the node number of a requested node.
2050	Destination node number	Contains the local node number.
2051	Message type	0: Normal, 1: Error, and 2: Not installed
2052	TCD	65204 ($FEB4)
2053	Message offset in virtual address space	Contains the requested first address.
2054		
2055	Virtual address space block size	Contains the number of blocks (bytes) requested to be written.
2056	Data size	Size of received message: 0 for message type 0; Size of error code for message type 1; or 0 for message type 2
If message type is 1:		
1 to 512	Received message	Error code*1

*1: Data is stored, starting from the high byte of data position number 1. If the received data contains word data, the high byte and the low byte must be swapped after reading.

■ Word Block Read

● Sending a request message

A word block read (request) message has its data size fixed to 0. Table 3.38 describes its format.

Table 3.38 Send Format for Word Block Read (Request) Message

Data Position Number			Parameters	Description
Send handle 1	Send handle 2	Send handle 3		
2081	2113	2145	Destination node number	Specify the node number of a requested node.
2082	2114	2146	Reserved	0
2083	2115	2147	Message type	0
2084	2116	2148	TCD	65006 ($FDEE)
2085	2117	2149	Message offset in virtual address space	Specify the first address to be read.
2086	2118	2150		
2087	2119	2151	Virtual address space block size	Specify the number of blocks (words) to be read.
2088	2120	2152	Data size	0
2095	2127	2159	Timeout monitoring time	Specify the time within which ACK must be returned.

● Receiving a response message

A word block read (response) message returns requested data.

Table 3.39 Receive Format for Word Block Read (Response) Message

Data Position Number	Parameters	Description
2049	Source node number	Contains the node number of a requested node.
2050	Destination node number	Contains the local node number.
2051	Message type	0: Normal, 1: Error, and 2: Not installed
2052	TCD	65205 ($FEB5)
2053	Message offset in virtual address space	Contains the requested first address.
2054		
2055	Virtual address space block size	Contains the number of blocks (words) requested.
2056	Data size	Size of received message: Two times the number of blocks for message type 0; Size of error code for message type 1; or 0 for message type 2
If message type is 0:		
1 to 512	Received message	Data to read*1
If message type is 1:		
1 to 512	Received message	Error code*2

*1: Data is stored as words, starting from data position number 1. The high byte and low byte of a word must be swapped after reading.

*2: Data is stored starting from the high byte of data position number 1. If the received data contains word data, the high byte and low byte must be swapped after reading.

■ Word Block Write

● Sending a request message

A word block write (request) message contains write data.

Table 3.40 Send Format for Word Block Write (Request) Message

Data Position Number			Parameters	Description
Send handle 1	Send handle 2	Send handle 3		
2081	2113	2145	Destination node number	Specify the node number of a requested node.
2082	2114	2146	Reserved	0
2083	2115	2147	Message type	0
2084	2116	2148	TCD	65006 ($FDEE)
2085	2117	2149	Message offset in virtual address space	Specify the first address for writing.
2086	2118	2150		
2087	2119	2151	Virtual address space block size	Specify the number of blocks (words) to be written.
2088	2120	2152	Data size	Specify two times the number of blocks to be written.
2095	2127	2159	Timeout monitoring time	Specify the time within which ACK must be returned.
513 to 1024	1025 to 1536	1537 to 2948	Send message	Write data*1

*1: Swap the high byte and the low byte of a word before setting up write data in word units starting from data position number 513, 1025, or 1537.

● Receiving a response message

A word block write (response) message returns the result of a write operation.

Table 3.41 Receive Format for Word Block Write (Response) Message

Data Position Number	Parameters	Description
2049	Source node number	Contains the node number of a requested node.
2050	Destination node number	Contains the local node number.
2051	Message type	0: Normal, 1: Error, and 2: Not installed
2052	TCD	65206 ($FEB6)
2053	Message offset in virtual address space	Contains the requested first address.
2054		
2055	Virtual address space block size	Contains the number of blocks (words) requested.
2056	Data size	Size of the received message: 0 for message type 0; Size of error code for message type 1; or 0 for message type 2
If message type is 1:		
1 to 512	Received message	Error code*1

*1: Data is stored starting from the high byte of data position number 1. If the received data contains word data, the high byte and low byte must be swapped after reading.

■ Read Network Parameters

● Sending a request message

A read network parameters (request) message has its data size fixed to 0.

Table 3.42 Send Format for Read Network Parameters (Request) Message

Data Position Number			Parameters	Description
Send handle 1	Send handle 2	Send handle 3		
2081	2113	2145	Destination node number	Specify the node number of a requested node.
2082	2114	2146	Reserved	0
2083	2115	2147	Message type	0
2084	2116	2148	TCD	65007 ($FDEF)
2085	2117	2149	Message offset in virtual address space	0
2086	2118	2150		
2087	2119	2151	Virtual address space block size	0
2088	2120	2152	Data size	0
2095	2127	2159	Timeout monitoring time	Specify the time within which ACK must be returned.

● Receiving a response message

A read network parameter (response) message returns requested data.

Table 3.45 Receive Format for Read Network Parameters (Response) Message

Data Position Number	Parameters	Description
2049	Source node number	Contains the node number of a requested node.
2050	Destination node number	Contains the local node number.
2051	Message type	0: Normal, 1: Error, and 2: Not installed
2052	TCD	65207 ($FEB7)
2053	Message offset in virtual address space	0
2054		
2055	Virtual address space block size	0
2056	Data size	Size of received message: 56 for message type 0; or Size of error code for message type 1
If message type is 0:		
1-5	Received message	Node name (equipment name)
6-10		Vendor name
11-15		Vendor equipment designation
16		Area 1 top address*1
17		Area 1 size*1
18		Area 2 top address*1
19		Area 2 size*1
20		Token watchdog time
21		Minimum allowable frame interval
22		Link status
23		Protocol type
24		Upper layer status*1
25		Refresh cycle allowable time setup*1
26		Refresh cycle allowable time (current value)*1
27		Refresh cycle allowable time (maximum value)*1
28		Refresh cycle allowable time (minimum value)*1
If message type is 1:		
1-512	Received message	Error code*2

*1: The high byte and the low byte of a word must be swapped after reading.

*2: Data is stored, starting from the high byte of data position number 1. If the received data contains word data, the high byte and the low byte must be swapped after reading.

■ Write Network Parameters

● Sending a request message

A Write Network Parameters (request) message contains write data.

Table 3.44 Send Format for Write Network Parameters (Request) Message

Data Position Number			Parameters	Description
Send handle 1	Send handle 1	Send handle 1		
2081	2113	2145	Destination node number	Specify the node number of a requested node.
2082	2114	2146	Reserved	0
2083	2115	2147	Message type	0
2084	2116	2148	TCD	65008 ($FDF0)
2085	2117	2149	Message offset in virtual address space	0
2086	2118	2150		
2087	2119	2151	Virtual address space block size	0
2088	2120	2152	Data size	20
2095	2127	2159	Timeout monitoring time	Specify the time within which ACK must be returned.
513	1025	1537	Send message	Setup parameter flag*1
514	1026	1538		Area 1 top address*2
515	1027	1539		Area 1 size*2
516	1028	1540		Area 2 top address*2
517	1029	1541		Area 2 size*2
518	1030	1542		Node name (equipment name)
519	1031	1543		
520	1032	1544		
521	1033	1545		
522	1034	1546		

*1: Specify these values:
$0001 if only address and size are specified;
$0002 if only node name (equipment name) is specified; or
$0003 if address, size, and node name are specified.

*2: Swap the high byte and the low byte of a word.

● Receiving a response message

A Write Network Parameters (response) message returns the result of a write operation.

Table 3.45 Receive Format for Write Network Parameters (Response) Message

Data Position Number	Parameters	Description
2049	Source node number	Contains the node number of a requested node.
2050	Destination node number	Contains the local node number.
2051	Message type	0: Normal, 1: Error, and 2: Not installed
2052	TCD	65208 ($FEB8)
2053	Message offset in virtual address space	0
2054		
2055	Virtual address space block size	0
2056	Data size	Size of received message: 0 for message type 0; Size of error code for message type 1; or 0 for message type 2
If message type is 1:		
1 to 512	Received message	Error code*1

*1: Data is stored, starting from the high byte of data position number 1. If the received data contains word data, the high byte and the low byte must be swapped after reading.

■ Stop Command

● Sending a request message

A stop command (request) message has its data size fixed to 0.

Table 3.46 Send Format for Stop Command (Request) Message

Data Position Number			Parameters	Description
Send handle 1	Send handle 2	Send handle 3		
2081	2113	2145	Destination node number	Specify the node number of a requested node.
2082	2114	2146	Reserved	0
2083	2115	2147	Message type	0
2084	2116	2148	TCD	65009 ($FDF1)
2085	2117	2149	Message offset in virtual address space	0
2086	2118	2150		
2087	2119	2151	Virtual address space block size	0
2088	2120	2152	Data size	0
2095	2127	2159	Timeout monitoring time	Specify the time within which ACK must be returned.

● Receiving a response message

A stop command (response) message returns the execution result.

Table 3.47 Receive Format for Stop Command (Response) Message

Data Position Number	Parameters	Description
2049	Source node number	Contains the node number of a requested node.
2050	Destination node number	Contains the local node number.
2051	Message type	0: Normal, 1: Error, and 2: Not installed
2052	TCD	65209 ($FEB9)
2053	Message offset in virtual address space	0
2054		
2055	Virtual address space block size	0
2056	Data size	Size of received message: 0 for message type 0; Size of error code for message type 1; or 0 for message type 2
If message type is 1:		
1 to 512	Received message	Error code[*1]

*1: Data is stored, starting from the high byte of data position number 1. If the received data contains word data, the high byte and the low byte must be swapped after reading.

■ Start Command

● Sending a request message

A start command (request) message has its data size fixed to 0.

Table 3.48 Send Format for Start Command (Request) Message

Data Position Number			Parameters	Description
Send handle 1	Send handle 2	Send handle 3		
2081	2113	2145	Destination node number	Specify the node number of a requested node.
2082	2114	2146	Reserved	0
2083	2115	2147	Message type	0
2084	2116	2148	TCD	65010 ($FDF2)
2085	2117	2149	Message offset in virtual address space	0
2086	2118	2150		
2087	2119	2151	Virtual address space block size	0
2088	2120	2152	Data size	0
2095	2127	2159	Timeout monitoring time	Specify the time within which ACK must be returned.

● Receiving a response message

A start command (response) message returns the execution result.

Table 3.49 Receive Format for Start Command (Response) Message

Data Position Number	Parameters	Description
2049	Source node number	Contains the node number of a requested node.
2050	Destination node number	Contains the local node number.
2051	Message type	0: Normal, 1: Error, and 2: Not installed
2052	TCD	65210 ($FEBA)
2053	Message offset in virtual address space	0
2054		
2055	Virtual address space block size	0
2056	Data size	Size of received message: 0 for message type 0; Size of error code for message type 1; or 0 for message type 2
If message type is 1:		
1 to 512	Received message	Error code[*1]

*1: Data is stored, starting from the high byte of data position number 1. If the received data contains word data, the high byte and the low byte must be swapped after reading.

■ Read Profile

● Sending a request message

A read profile (request) message has its data size fixed to 0.

Table 3.50 Send Format for Read Profile (Request) Message

Data Position Number			Parameters	Description
Send handle 1	Send handle 2	Send handle 3		
2081	2113	2145	Destination node number	Specify the node number of a requested node.
2082	2114	2146	Reserved	0
2083	2115	2147	Message type	0
2084	2116	2148	TCD	65011 ($FDF3)
2085	2117	2149	Message offset in virtual address space	0
2086	2118	2150		
2087	2119	2151	Virtual address space block size	0
2088	2120	2152	Data size	0
2095	2127	2159	Timeout monitoring time	Specify the time within which ACK must be returned.

● Receiving a response message

A read profile (response) message returns device profile data.

Table 3.51 Receive Format for Read Profile (Response) Message

Data Position Number	Parameters	Description
2049	Source node number	Contains the node number of a requested node.
2050	Destination node number	Contains the local node number.
2051	Message type	0: Normal, 1: Error, and 2: Not installed
2052	TCD	65211 ($FEBB)
2053	Message offset in virtual address space	0
2054		
2055	Virtual address space block size	0
2056	Data size	Size of received message: Received data size for message type 0; or Size of error code for message type 1
If message type is 0:		
1 to 512	Received message	Device profile (using ASN.1 transfer syntax)
If message type is 1:		
1 to 512	Received message	Error code*1

*1: Data is stored, starting from the high byte of data position number 1. If the received data contains word data, the high byte and the low byte must be swapped after reading.

■ Read Log Data

● Sending a request message

A read log data (request) message has its data size fixed to 0.

Table 3.52 Send Format for Read Log Data (Request) Message

Data Position Number			Parameters	Description
Send handle 1	Send handle 2	Send handle 3		
2081	2113	2145	Destination node number	Specify the node number of a requested node.
2082	2114	2146	Reserved	0
2083	2115	2147	Message type	0
2084	2116	2148	TCD	65013 ($FDF5)
2085	2117	2149	Message offset in virtual address space	0
2086	2118	2150		
2087	2119	2151	Virtual address space block size	0
2088	2120	2152	Data size	0
2095	2127	2159	Timeout monitoring time	Specify the time within which ACK must be returned.

Receiving a response message

A read log data (response) message returns log data.

Table 3.53 Receive Format for Read Log Data (Response) Message (1/3)

Data Position Number	Parameters	Description
2049	Source node number	Contains the node number of a requested node.
2050	Destination node number	Contains the local node number.
2051	Message type	0: Normal, 1: Error, and 2: Not installed
2052	TCD	65213 ($FEBD)
2053	Message offset in virtual address space	0
2054		
2055	Virtual address space block size	0
2056	Data size	Size of received message: 512 for message type 0; Size of error code for message type 1; or 0 for message type 2
If message type is 0:		
1	Received message	Total number of transmissions at socket unit*1
2		
3		Total number of transmission errors at socket unit*1
4		
5		Number of Ethernet transmission errors*1
6		
7 to 12		Reserved
13		Total number of receptions at socket unit*1
14		
15		Total number of reception errors at socket unit*1
16		
17		Number of Ethernet reception errors*1
18		
19 to 24		Reserved
25		Number of tokens transmitted*1
26		
27		Number of cyclic frames transmitted*1
28		
29		Number of peer-to-peer messages transmitted*1
30		
31		Number of broadcast messages transmitted*1
32		
33 to 36		Reserved
37		Number of tokens received*1
38		
39		Number of cyclic frames received*1
40		
41		Number of peer-to-peer messages received*1
42		
43		Number of broadcast messages received*1
44		
45 to 48		Reserved
49		Number of cyclic reception errors*1
50		
51		Number of cyclic address size errors*1
52		
53		Number of cyclic CBN errors*1
54		
55		Number of cyclic TBN errors*1
56		
57		Number of cyclic BSIZE errors*1
58		

Table 3.53 Receive Format for Read Log Data (Response) Message (2/3)

Data Position Number	Parameters	Description
59 to 72	Received message	Reserved
73		Number of message retransmissions*1
74		
75		Number of message retransmissions exceeding retries limit*1
76		
77 to 84		Reserved
85		Number of message reception errors*1
86		
87		Number of message version-of-sequence number errors*1
88		
89		Number of message sequence number retransmissions recognized*1
90		
91 to 96		Reserved
97		Number of ACK errors*1
98		
99		Number of ACK version-of-sequence number errors*1
100		
101		Number of ACK sequence number errors*1
102		
103		Number of ACK node number errors*1
104		
105		Number of ACK TCD errors*1
106		
107 to 120		Reserved
121		Number of duplicate tokens recognized*1
122		
123		Number of tokens discarded*1
124		
125		Number of tokens re-issued*1
126		
127 to 132		Reserved
133		Number of token holding timeouts*1
134		
135		Number of token monitoring timeouts*1
136		
137 to 144		Reserved
145		Total service time*1
146		
147		Number of frame waiting states*1
148		
149		Number of participations*1
150		
151		Number of self-withdrawals*1
152		
153		Number of withdrawals by skipping*1
154		

Table 3.53 Receive Format for Read Log Data (Response) Message (3/3)

Data Position Number	Parameters	Description
155	Received message	Number of withdrawals of other nodes recognized*1
156		
157 to 168		Reserved
169 to 184		List of participation recognized nodes*1
185 to 224		Reserved
225 to 226		Vendor definable area (Reserved)
If message type is 1:		
1 to 512	Received message	Error code*2

*1: The high byte and the low byte of a word must be swapped after reading.

*2: Data is stored, starting from the high byte of data position number 1. If the received data contains word data, the high byte and the low byte must be swapped after reading.

■ Clear Log Data

● Sending a request message

A clear log data (request) message has its data size fixed to 0.

Table 3.54 Send Format for Clear Log Data (Request) Message

Data Position Number			Parameters	Description
Send handle 1	Send handle 2	Send handle 3		
2081	2113	2145	Destination node number	Specify the node number of a requested node or 255.
2082	2114	2146	Reserved	0
2083	2115	2147	Message type	0
2084	2116	2148	TCD	65014($FDF6)
2085	2117	2149	Message offset in virtual address space	0
2086	2118	2150		
2087	2119	2151	Virtual address space block size	0
2088	2120	2152	Data size	0
2095	2127	2159	Timeout monitoring time	Specify the time within which ACK must be returned.

● Receiving a response message

A clear log data (response) message returns an execution result.

No response message is returned, however, if a clear log data (request) message is broadcasted using node number 255.

Table 3.55 Receive Format for Clear Log Data (Response) Message

Data Position Number	Parameters	Description
2049	Source node number	Contains the node number of a requested node.
2050	Destination node number	Contains the local node number.
2051	Message type	0: Normal, and 1: Error
2052	TCD	65214 ($FEBE)
2053	Message offset in virtual address space	0
2054		
2055	Virtual address space block size	0
2056	Data size	Size of received message: 0 for message type 0; or Size of error code for message type 1
If message type is 1:		
1 to 512	Received message	Error code[*1]

*1: Data is stored, starting from the high byte of data position number 1. If the received data contains word data, the high byte and the low byte must be swapped after reading.

■ Echo Message

● Sending a request message

An echo message (request) message can contain any send data of 0 to 1024 bytes.

Table 3.56 Send Format for Echo Message (Request) Message

Data Position Number			Parameters	Description
Send handle 1	Send handle 2	Send handle 3		
2081	2113	2145	Destination node number	Specify the node number of a requested node.
2082	2114	2146	Reserved	0
2083	2115	2147	Message type	0
2084	2116	2148	TCD	65015 ($FDF7)
2085	2117	2149	Message offset in virtual address space	0
2086	2118	2150		
2087	2119	2151	Virtual address space block size	0
2088	2120	2152	Data size	Specify the size of send data.
2095	2127	2159	Timeout monitoring time	Specify the time within which ACK must be returned.
513 to 1024	1025 to 1536	1537 to 2948	Send message	Send data

● Receiving a response message

An echo message (response) message returns the exact data that has been sent earlier with an echo message (request) message.

Table 3.57 Receive Format for Echo Message (Response) Message

Data Position Number	Parameters	Description
2049	Source node number	Contains the node number of a requested node.
2050	Destination node number	Contains the local node number.
2051	Message type	0: Normal, and 1: Error
2052	TCD	65215 ($FEBF)
2053	Message offset in virtual address space	0
2054		
2055	Virtual address space block size	0
2056	Data size	Size of received message: Data size of the sent request message for message type 0; or Size of error code for message type 1
If message type is 0:		
1 to 512	Received message	The same data sent earlier in the request message.
If message type is 1:		
1 to 512	Received message	Error code[*1]

*1: Data is stored, starting from the high byte of data position number 1. If the received data contains word data, the high byte and the low byte must be swapped after reading.

■ Vendor-specific Message

● Sending a request message

A vendor-specific message (request) can contain any send data of 0 to 1024 bytes.

Table 3.58 Send Format for Vendor-specific Message (Request)

Data Position Number			Parameters	Description
Send handle 1	Send handle 2	Send handle 3		
2081	2113	2145	Destination node number	Specify the node number of a requested node.
2082	2114	2146	Reserved	0
2083	2115	2147	Message type	0
2084	2116	2148	TCD	65016 ($FDF8)
2085	2117	2149	Message offset in virtual address space	0
2086	2118	2150		
2087	2119	2151	Virtual address space block size	0
2088	2120	2152	Data size	Specify the size of send data.
2095	2127	2159	Timeout monitoring time	Specify the time within which ACK must be returned.
2097 to 2101	2129 to 2133	2161 to 2165	Vendor name	Specify a 10-byte vendor name in ASCII
2102 to 2104	2134 to 2136	2166 to 2168	Subcode	Subcode (6 bytes max.)
513 to 1024	1025 to 1536	1537 to 2948	Send message	Send data

● Receiving a response message

A vendor-specific message (response) returns processing result for a vendor-specific message.

Table 3.59 Receive Format for Vendor-specific message (Response)

Data Position Number	Parameters	Description
2049	Source node number	Contains the node number of a requested node.
2050	Destination node number	Contains the local node number.
2051	Message type	0: Normal, and 1: Error
2052	TCD	65216 ($FEC0)
2053	Message offset in virtual address space	0
2054		
2055	Virtual address space block size	0
2056	Data size	Size of received message: Size of received data for message type 0; Size of error code for message type 1; or 0 for message type 2
2065 to 2069	Vendor name	Contains the vendor name as specified in the sent request message.
2070 to 2072	Subcode	Contains the subcode as specified in the sent request message.
If message type is 0:		
1 to 512	Received message	Received data
If message type is 1:		
1 to 512	Received message	Error code*1

*1: Data is stored, starting from the high byte of data position number 1. If the received data contains word data, the high byte and the low byte must be swapped after reading.

3.3.5 Virtual Address Space

This subsection describes the virtual address space used for message transmission by byte block read, byte block write, word block read, and word block write messages.

■ Byte Block Virtual Address Space

No byte block virtual address space is defined for the module because read and write request messages using a byte block virtual address space are not supported.

■ Word Block Virtual Address Space

The virtual address space is a 32-bit address space where one address location consists of 16 bits (= 1 word).

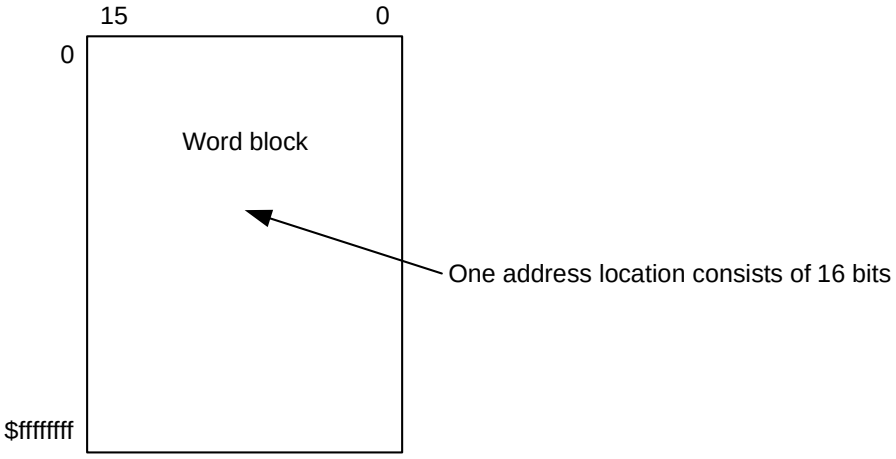


Fig. 3.47 Word Block Virtual Address Space

The offset address of a virtual address space is defined as follows:

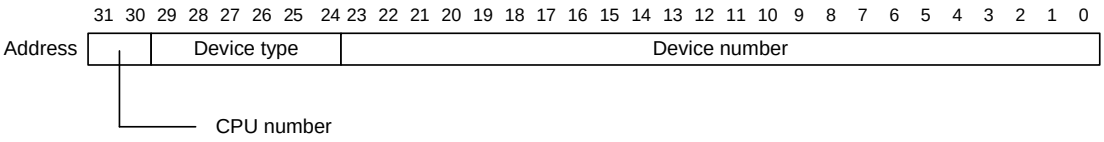


Fig. 3.48 Virtual Address Details

The mapping between the virtual address space and sequence devices is explained below.

● CPU device areas

The virtual address space is divided into four areas to accommodate CPU modules installed in each slot. Therefore, the virtual address space can accommodate all device areas of a multi-CPU system. A separate CPU device area is allocated to each CPU module as follows:

$00000000	CPU 1 device area
$40000000	CPU 2 device area
$80000000	CPU 3 device area
$c0000000	CPU 4 device area

Fig. 3.49 Virtual Address Space and CPU Device Areas

Contents of a CPU device area

Each CPU device area is further divided into sub-areas to accommodate the devices of a CPU module as follows:

Address relative to each area	
$00000000	Reserved
$02000000	File register (B)
$03000000	Counter relay (C)
$04000000	Data register (D)
$05000000	Shared relay (E)
$06000000	Reserved
$09000000	Internal relay (I)
$0a000000	Reserved
$0c000000	Link relay (L)
$0d000000	Special relay (M)
$0e000000	Reserved
$12000000	Shared register (R)
$13000000	Reserved
$14000000	Timer relay (T)
$15000000	Reserved
$16000000	Index register (V)
$17000000	Link register (W)
$18000000	Input relay (X)
$19000000	Output relay (Y)
$1a000000	Special register (Z)
$1b000000	Reserved
$20000000	Timer preset value (TS)
$21000000	Timer current value (TP)
$22000000	Reserved
$25000000	Timer current value (TI) (count-up type)
$26000000	Reserved
$30000000	Counter preset value (CS)
$31000000	Counter current value (CP)
$32000000	Reserved
$35000000	Counter current value (CI) (count-up type)
$36000000	Reserved
$40000000	

Fig. 3.50 Device Areas in Virtual Address Space

- Relay devices

  A group of 16 relay devices are allocated to 16 bits according to their device numbers.
- Register devices

  A register device is allocated to an address location. You can access a group of register devices by specifying the first address and the number of words.

  Examples:

  The internal relay I00101 of CPU1 is allocated as shown in Fig. 3.51. You can access 16 bits of data starting from I00101 by specifying a single address.

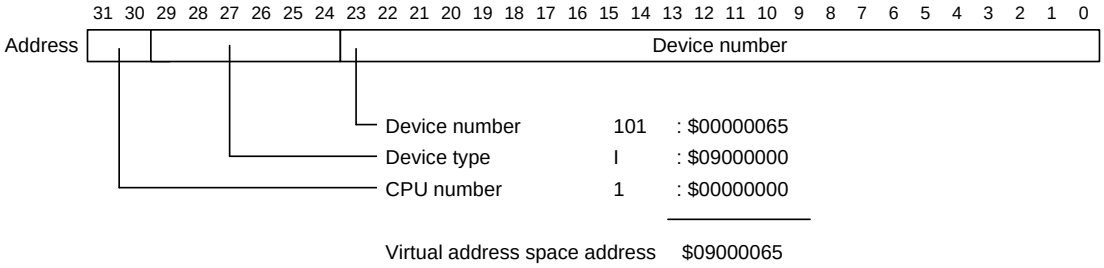


Fig. 3.51 Virtual Address Space Address Offset Example (1)

The data register D00101 of CPU1 is allocated as shown in Fig. 3.52.

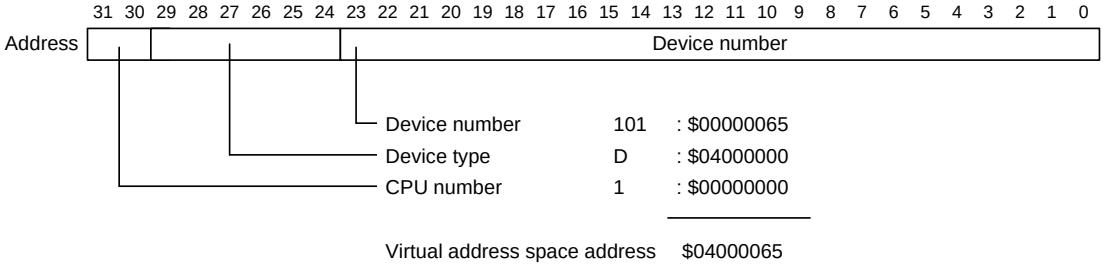


Fig. 3.52 Virtual Address Space Address Offset Example (2)

3.3.6 Management Information

Management information includes management information for the local node, other participating nodes, the network, and the link status. It can be monitored using a setup tool (WideField2) or a ladder program. This subsection describes the following:

- Monitoring using a setup tool (WideField2)
- Monitoring using a ladder program.

3.3.6.1 Monitoring using the Setup Tool (WideField2)

You can monitor the management information with the WideField2 setup tool. For more information on how to perform monitoring, see the “FA-M3 Programming Tool WideField2 Instruction Manual” (IM34M06Q15-01E).

3.3.6.2 Monitoring using a Ladder Program

■ Local Node Management Information

Local node management information is stored in the local node management information area when the Read Local Node Management Information request relay is turned on. You can retrieve the stored information using the ladder programming READ instruction.

- **Procedure for reading**

Fig. 3.53 shows the process flow for reading local node management information.

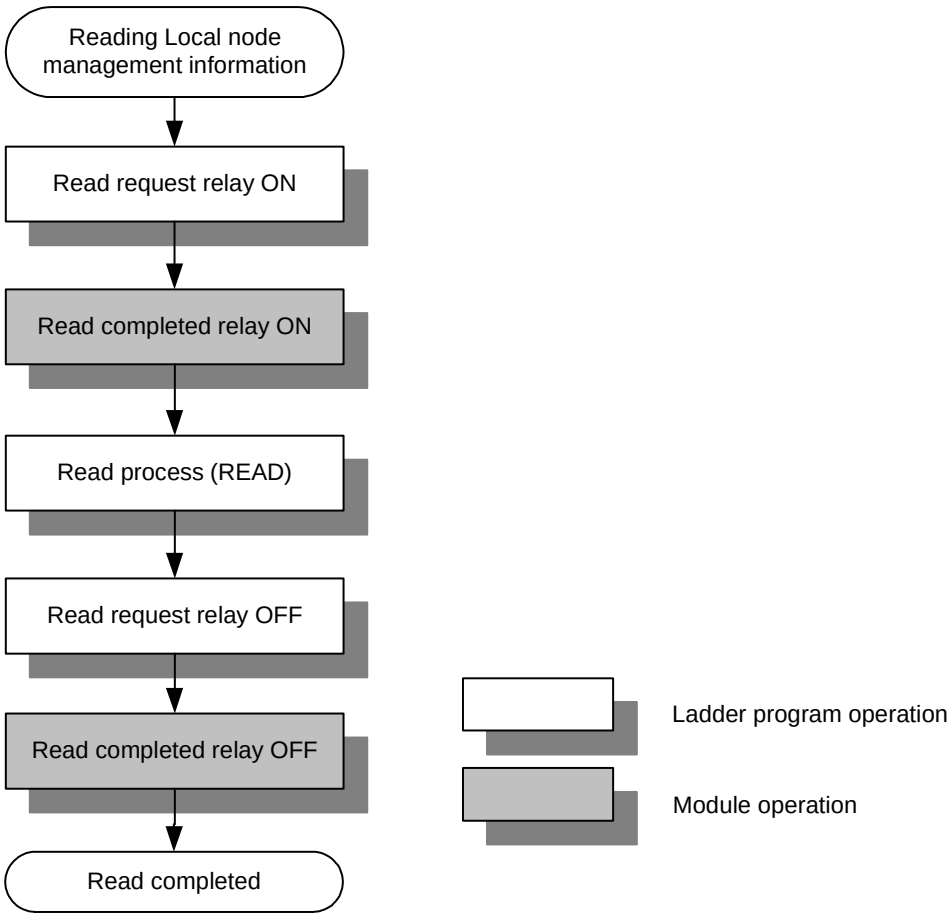


Fig. 3.53 Reading Local Node Management Information Using a Ladder Program

Read Local Node Management Information request relay

When the Read Local Node Management Information request relay is turned on, management data is stored in the local node management information area, and the Read Local Node Management Information Completed relay is turned on. After you have retrieved the data, turn off the read request relay, and the read completed relay will turn off. Additional information on these relays is given in Table 3.60.

Table 3.60 Relays for Reading Local Node Management Information

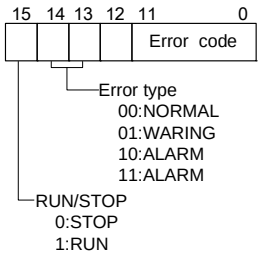
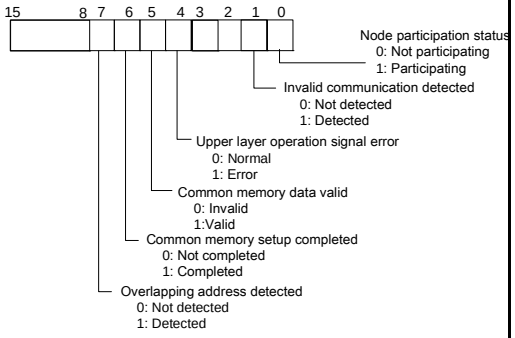
I/O Relays	Relay Name	Description
Y0□□50	Read local node management information request relay	Read request
X0□□18	Read local node management information completed relay	Read completed notification

□□: Slot number

Local node management information area

When management data is stored in the local node management information area, the Read Local Node Management Information Completed relay is turned on, signaling that you can read the data using the ladder program READ instruction. Additional information on the local node management information area is given in Table 3.61.

Table 3.61 Local node Management Information Area

Data Position Number	Parameter	Description
2593	Local node number	1-254
2594	Area 1 top address	0-511 (word address)
2595	Area 1 size	0-512 (words)
2596	Area 2 top address	0-8191 (word address)
2597	Area 2 size	0-8192 (words)
2598	Upper layer status	
2599	Token watchdog time	0-255 (1 ms)
2600	Minimum allowable frame interval	0-50 (100 μs)
2601 to 2605	Vendor name	“YOKOGAWA “
2606 to 2610	Vendor equipment designation	“F3LX02-1N “
2611 to 2615	Node name (equipment name)	10 bytes in ASCII
2616	Protocol type	$80
2617	Link status	
2618	IP address	Low order word
2619		High order word

Example for reading local node management information

A sample program for reading local node management information is shown in Fig. 3.54. It uses devices shown in Table 3.62 to store retrieved data.

Table 3.62 Devices for Storing Local Node Management Information

Device	Description
/D00001	Local node number
/D00002	Area 1 top address
/D00003	Area 1 size
/D00004	Area 2 top address
/D00005	Area 2 size
/D00006	Upper layer status
/D00007	Token watchdog time
/D00008	Minimum allowable frame interval
/D00009 to /D00013	Vendor name
/D00014 to /D00018	Vendor equipment designation
/D00019 to /D00023	Node name (equipment name)
/D00024	Protocol type
/D00025	Link status
/D00026	IP address
/D00027	

This sample program assumes that the trigger relay is /I00001 and the module is installed in slot 13.

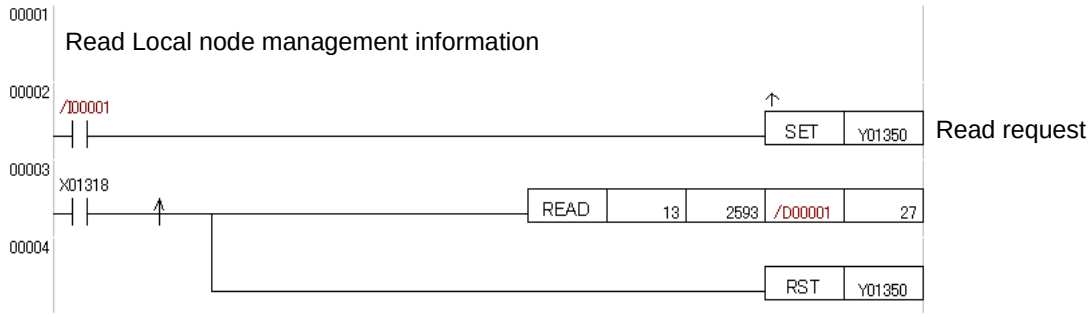


Fig. 3.54 Sample Program for Reading Local node Management Information

■ Participating Node Management Information

Management information of participating nodes is stored in the participating node management information area when you turn on the Read Participating Node Management Information request relay, specifying the requested node number. You can then read the stored data using the ladder programming READ instruction.

● Procedure for reading

Fig. 3.55 shows the process flow for reading participating node management information.

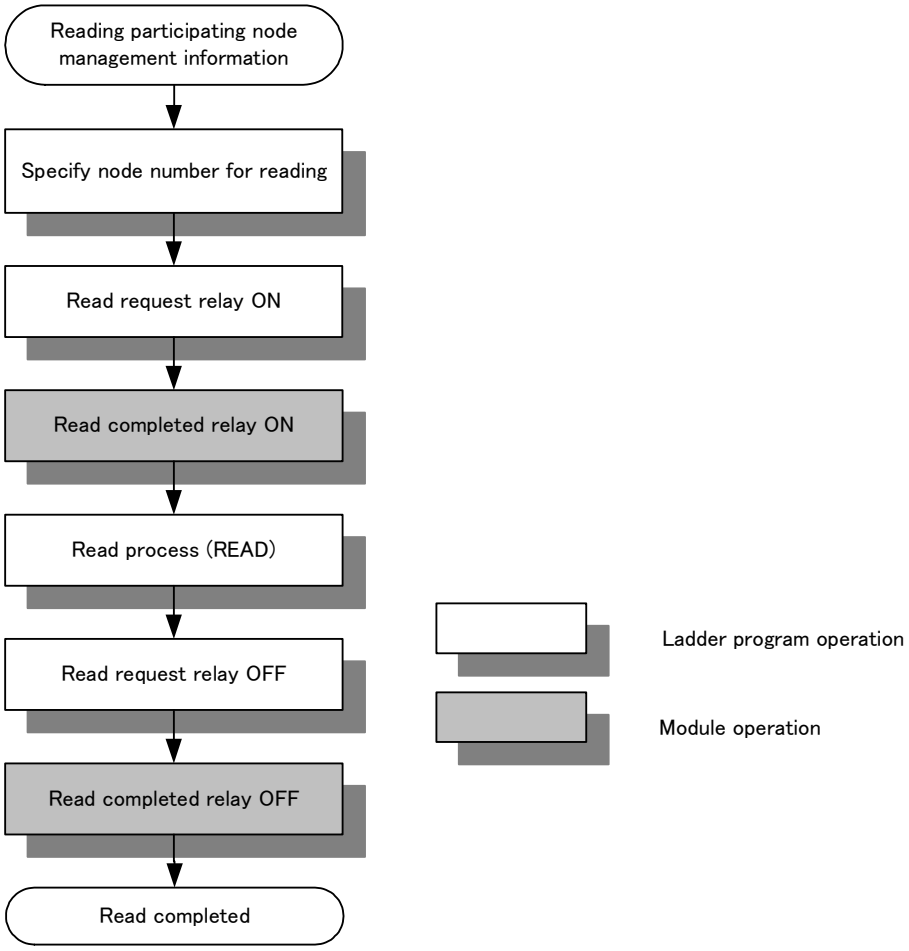


Fig. 3.55 Reading Participating Node Management Information Using a Ladder Program

● Specifying a node number

Specify the number of the node you want to check. To do this, use the ladder program WRITE instruction to write the node number into the area given in Table 3.63.

Table 3.63 Area to Receive the Node Number of a Node to Be Checked

Data Position Number	Parameter	Description
2625	Node number for read request	1-254

● Read Participating Node Management Information request relay

When you turn on the Read Participating Node Management Information request relay, management data is stored in the participating node management information area, and the Read Participating Node Management Information Completed relay is turned on. After you have read the data, turn off the read request relay, and the read completed relay will turn off. Additional information on these relays is given in Table 3.64.

Table 3.64 Relays for Reading Participating Node Management Information

I/O Relays	Relay Name	Description
Y0□□51	Read participating node management information request relay	Read request
X0□□19	Read participating node management information completed relay	Read completed notification

□□: Slot number

● Participating node management information area

When management data is stored in the participating node management information area, the Read Participating Node Management Information Completed relay is turned on, signaling that you can retrieve the data using the ladder program READ instruction. Additional information on the participating node management information area is given in Table 3.65.

Table 3.65 Participating node Management Information Area

Data Position Number	Parameter	Description
2633	Node number	1-254
2634	Area 1 top address	0-511 (word address)
2635	Area 1 size	0-512 (words)
2636	Area 2 top address	0-8191 (word address)
2637	Area 2 size	0-8192 (words)
2638	Upper layer status	15 14 13 12 11 0 Error code Error type 00:NORMAL 01:WARING 10:ALARM 11:ALARM RUN/STOP 0:STOP 1:RUN
2639	Refresh cycle time	(1ms)
2640	Token watchdog time	0-255 (1ms)
2641	Minimum allowable frame interval	0-50 (100 μs)
2642	Link status	15 8 7 6 5 4 3 2 1 0 Node participation 0: Not participat 1: Participating Invalid communication detecte 0: Not detected 1: Detected Upper layer operation signal error 0: Normal 1: Error Common memory data valid 0: Invalid 1:Valid Common memory setup completed 0: Not completed 1: Completed Overlapping address detected 0: Not detected 1: Detected

Example for reading participating node management information

A sample program for reading participating node management information is shown in Fig. 3.56. It uses devices shown in Table 3.66 to store retrieved data.

Table 3.66 Devices for Storing Participating Node Management Information

Device	Description
/D00002	Node number
/D00003	Area 1 top address
/D00004	Area 1 size
/D00005	Area 2 top address
/D00006	Area 2 size
/D00007	Upper layer status
/D00008	Refresh cycle time
/D00009	Token watchdog time
/D00010	Minimum allowable frame interval
/D00011	Link status

This sample program assumes that the trigger relay is /I00001, the module is installed in slot 13, and the node number is stored in /D00001.

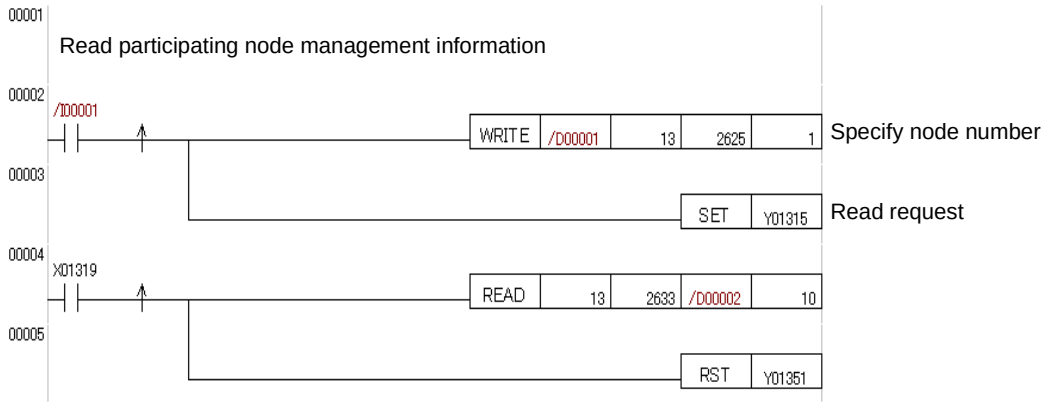


Fig. 3.56 Sample Program for Reading Participating Node Management Information

■ Network Management Information

Network management information is stored in the network management information area when the Read Network Management Information request relay is turned on. You can retrieve the stored information using the ladder programming READ instruction.

● Procedure for reading

Fig. 3.57 shows the process flow for reading network management information.

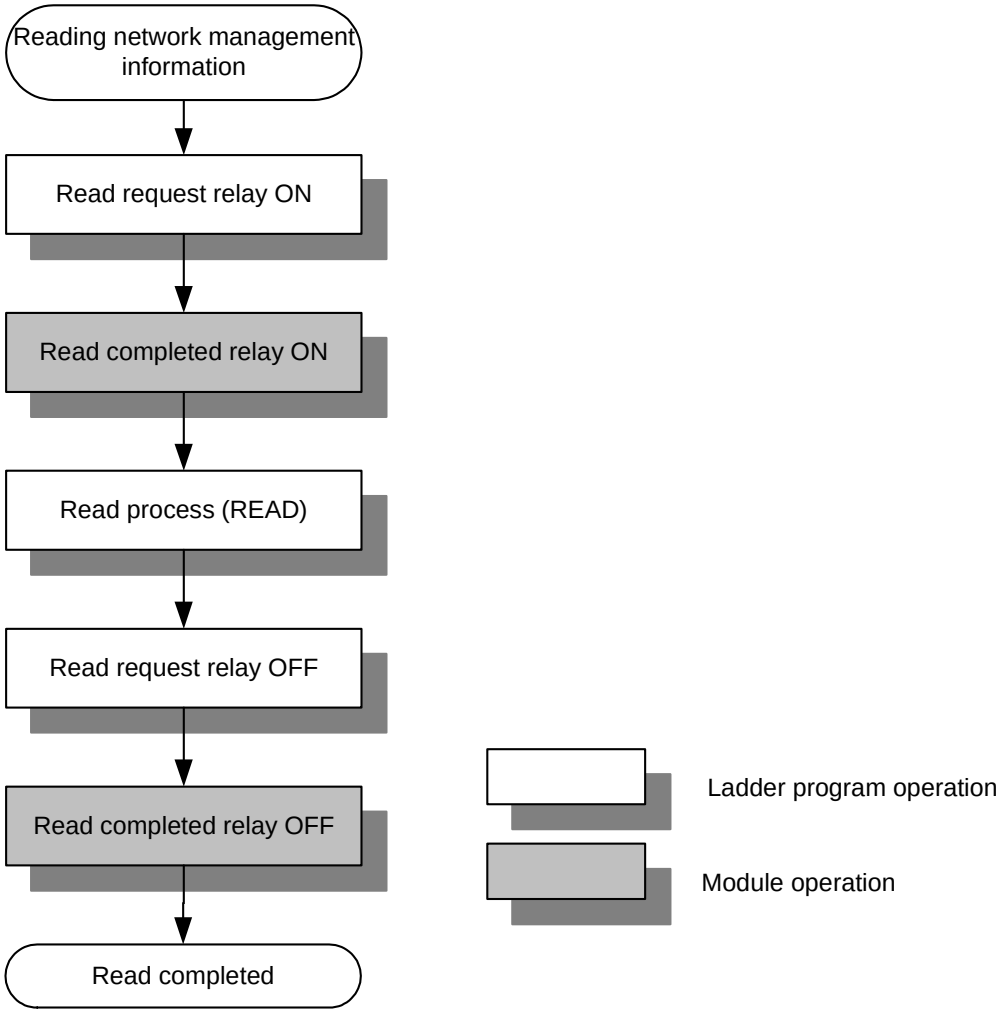


Fig. 3.57 Reading Network Management Information Using a Ladder Program

● Read Network Management Information request relay

When you turn on the Read Network Management Information request relay, management data is stored in the network management information area, and the Read Network Management Information Completed relay is turned on. After you have retrieved the data, turn off the read request relay, and the read completed relay will turn off. Additional information on these relays is given in Table 3.67.

Table 3.67 Relays for Reading Network Management Information

I/O Relays	Relay Name	Description
Y0□□52	Read network management information request relay	Read request
X0□□20	Read network management information completed relay	Read completed notification

□□: Slot number

Network management information area

When management data is stored in the network management information area, the Read Network Management Information Completed relay is turned on, signaling that you can retrieve the data using the ladder programming READ instruction. Additional information on the network management information area is given in Table 3.68.

Table 3.68 Network Management Information Area

Data Position Number	Parameter	Description
2657	Minimum allowable frame interval	0-50
2658	Refresh cycle current value	(Calculated value)
2659	Refresh cycle measured value	(Measured value)
2660	Maximum measured refresh cycle	(Maximum measured value)
2661	Minimum measured refresh cycle	(Minimum measured value)

Example for reading network management information

A sample program for reading network management information is shown in Fig. 3.58. It uses devices shown in Table 3.69 to store retrieved data.

Table 3.69 Devices for Storing Network Management Information

Device	Description
/D00001	Minimum allowable frame interval
/D00002	Refresh cycle current value
/D00003	Refresh cycle measured value
/D00004	Maximum measured refresh cycle
/D00005	Minimum measured refresh cycle

This sample program assumes that the trigger relay is /I00001 and the module is installed in slot 13.

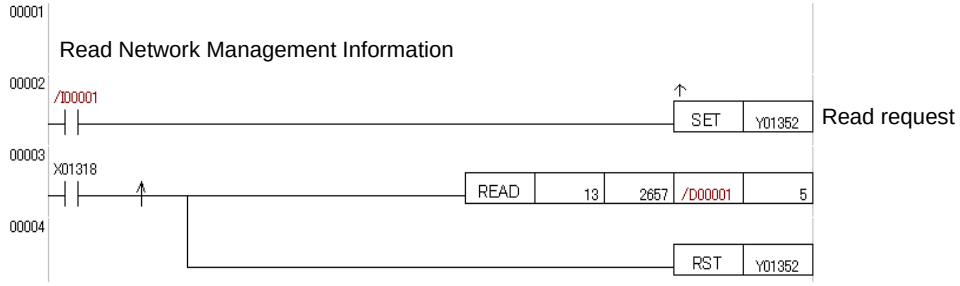


Fig. 3.58 Sample Program for Reading Network Management Information

■ Link Status

The link status of the local node is reflected on input relays of the module, while link status of other participating nodes are reflected on special relays of sequence devices.

● Link status of local node

The link status of the local node is reflected on input relays. When a specific link status condition is detected, the corresponding input relay turns on (see Table 3.70).

Table 3.70 Mapping between Local Node Status and Input Relays

Relay	Status	Description
X0□□27	Invalid communication detected	Invalid token mode
X0□□28	Overlapping address detected	Overlapping common memory allocation
X0□□29	Duplicate node number	Duplicate node number
X0□□30	Token monitoring time error	Token holding time timeout
X0□□31	Waiting to receive	Token not detected
X0□□32	Initialization error	Invalid setup parameter

□□: Slot number

● Link status of other participating nodes

The link status conditions of participating nodes, such as network participation, upper layer status, operation status, and common memory data availability, are reflected on special relays of respective sequence devices (see Table 3.71).

Table 3.71 Mapping between Participating Node Status and Special Relays

Special Relay		Condition	Description
Link 1	Link 2		
M3521 to M3774	M4561 to M4814	Node participation status	1: Participating 0: Not participating
M3777 to M4030	M4817 to M5070	Upper layer operation signal error	1: Error 0: Normal
M4033 to M4286	M5073 to M5326	Operation status	1: Run 0: Stop
M4289 to M4542	M5329 to M5582	Common memory data valid	1: Valid 0: Invalid

Table 3.72 Mapping between Special Relays and Participating Nodes for Link 1 (1/2)

Node Number	Participation status	Upper layer status	Operation status	Data Validity
1	M3521	M3777	M4033	M4289
2	M3522	M3778	M4034	M4290
3	M3523	M3779	M4035	M4291
4	M3524	M3780	M4036	M4292
5	M3525	M3781	M4037	M4293
6	M3526	M3782	M4038	M4294
7	M3527	M3783	M4039	M4295
8	M3528	M3784	M4040	M4296
9	M3529	M3785	M4041	M4297
10	M3530	M3786	M4042	M4298
11	M3531	M3787	M4043	M4299
12	M3532	M3788	M4044	M4300
13	M3533	M3789	M4045	M4301
14	M3534	M3790	M4046	M4302
15	M3535	M3791	M4047	M4303
16	M3536	M3792	M4048	M4304
17	M3537	M3793	M4049	M4305
18	M3538	M3794	M4050	M4306
19	M3539	M3795	M4051	M4307
20	M3540	M3796	M4052	M4308
21	M3541	M3797	M4053	M4309
22	M3542	M3798	M4054	M4310
23	M3543	M3799	M4055	M4311
24	M3544	M3800	M4056	M4312
25	M3545	M3801	M4057	M4313
26	M3546	M3802	M4058	M4314
27	M3547	M3803	M4059	M4315
28	M3548	M3804	M4060	M4316
29	M3549	M3805	M4061	M4317
30	M3550	M3806	M4062	M4318
31	M3551	M3807	M4063	M4319
32	M3552	M3808	M4064	M4320
33	M3553	M3809	M4065	M4321
34	M3554	M3810	M4066	M4322
35	M3555	M3811	M4067	M4323
36	M3556	M3812	M4068	M4324
37	M3557	M3813	M4069	M4325
38	M3558	M3814	M4070	M4326
39	M3559	M3815	M4071	M4327
40	M3560	M3816	M4072	M4328
41	M3561	M3817	M4073	M4329
42	M3562	M3818	M4074	M4330
43	M3563	M3819	M4075	M4331
44	M3564	M3820	M4076	M4332
45	M3565	M3821	M4077	M4333
46	M3566	M3822	M4078	M4334
47	M3567	M3823	M4079	M4335
48	M3568	M3824	M4080	M4336
49	M3569	M3825	M4081	M4337
50	M3570	M3826	M4082	M4338
51	M3571	M3827	M4083	M4339
52	M3572	M3828	M4084	M4340
53	M3573	M3829	M4085	M4341
54	M3574	M3830	M4086	M4342
55	M3575	M3831	M4087	M4343
56	M3576	M3832	M4088	M4344
57	M3577	M3833	M4089	M4345
58	M3578	M3834	M4090	M4346
59	M3579	M3835	M4091	M4347
60	M3580	M3836	M4092	M4348
61	M3581	M3837	M4093	M4349
62	M3582	M3838	M4094	M4350
63	M3583	M3839	M4095	M4351
64	M3584	M3840	M4096	M4352

Node Number	Participation status	Upper layer status	Operation status	Data Validity
65	M3585	M3841	M4097	M4353
66	M3586	M3842	M4098	M4354
67	M3587	M3843	M4099	M4355
68	M3588	M3844	M4100	M4356
69	M3589	M3845	M4101	M4357
70	M3590	M3846	M4102	M4358
71	M3591	M3847	M4103	M4359
72	M3592	M3848	M4104	M4360
73	M3593	M3849	M4105	M4361
74	M3594	M3850	M4106	M4362
75	M3595	M3851	M4107	M4363
76	M3596	M3852	M4108	M4364
77	M3597	M3853	M4109	M4365
78	M3598	M3854	M4110	M4366
79	M3599	M3855	M4111	M4367
80	M3600	M3856	M4112	M4368
81	M3601	M3857	M4113	M4369
82	M3602	M3858	M4114	M4370
83	M3603	M3859	M4115	M4371
84	M3604	M3860	M4116	M4372
85	M3605	M3861	M4117	M4373
86	M3606	M3862	M4118	M4374
87	M3607	M3863	M4119	M4375
88	M3608	M3864	M4120	M4376
89	M3609	M3865	M4121	M4377
90	M3610	M3866	M4122	M4378
91	M3611	M3867	M4123	M4379
92	M3612	M3868	M4124	M4380
93	M3613	M3869	M4125	M4381
94	M3614	M3870	M4126	M4382
95	M3615	M3871	M4127	M4383
96	M3616	M3872	M4128	M4384
97	M3617	M3873	M4129	M4385
98	M3618	M3874	M4130	M4386
99	M3619	M3875	M4131	M4387
100	M3620	M3876	M4132	M4388
101	M3621	M3877	M4133	M4389
102	M3622	M3878	M4134	M4390
103	M3623	M3879	M4135	M4391
104	M3624	M3880	M4136	M4392
105	M3625	M3881	M4137	M4393
106	M3626	M3882	M4138	M4394
107	M3627	M3883	M4139	M4395
108	M3628	M3884	M4140	M4396
109	M3629	M3885	M4141	M4397
110	M3630	M3886	M4142	M4398
111	M3631	M3887	M4143	M4399
112	M3632	M3888	M4144	M4400
113	M3633	M3889	M4145	M4401
114	M3634	M3890	M4146	M4402
115	M3635	M3891	M4147	M4403
116	M3636	M3892	M4148	M4404
117	M3637	M3893	M4149	M4405
118	M3638	M3894	M4150	M4406
119	M3639	M3895	M4151	M4407
120	M3640	M3896	M4152	M4408
121	M3641	M3897	M4153	M4409
122	M3642	M3898	M4154	M4410
123	M3643	M3899	M4155	M4411
124	M3644	M3900	M4156	M4412
125	M3645	M3901	M4157	M4413
126	M3646	M3902	M4158	M4414
127	M3647	M3903	M4159	M4415
128	M3648	M3904	M4160	M4416

Table 3.72 Mapping between Special Relays and Participating Nodes for Link 1 (2/2)

Node Number	Participation status	Upper layer status	Operation status	Data Validity
129	M3649	M3905	M4161	M4417
130	M3650	M3906	M4162	M4418
131	M3651	M3907	M4163	M4419
132	M3652	M3908	M4164	M4420
133	M3653	M3909	M4165	M4421
134	M3654	M3910	M4166	M4422
135	M3655	M3911	M4167	M4423
136	M3656	M3912	M4168	M4424
137	M3657	M3913	M4169	M4425
138	M3658	M3914	M4170	M4426
139	M3659	M3915	M4171	M4427
140	M3660	M3916	M4172	M4428
141	M3661	M3917	M4173	M4429
142	M3662	M3918	M4174	M4430
143	M3663	M3919	M4175	M4431
144	M3664	M3920	M4176	M4432
145	M3665	M3921	M4177	M4433
146	M3666	M3922	M4178	M4434
147	M3667	M3923	M4179	M4435
148	M3668	M3924	M4180	M4436
149	M3669	M3925	M4181	M4437
150	M3670	M3926	M4182	M4438
151	M3671	M3927	M4183	M4439
152	M3672	M3928	M4184	M4440
153	M3673	M3929	M4185	M4441
154	M3674	M3930	M4186	M4442
155	M3675	M3931	M4187	M4443
156	M3676	M3932	M4188	M4444
157	M3677	M3933	M4189	M4445
158	M3678	M3934	M4190	M4446
159	M3679	M3935	M4191	M4447
160	M3680	M3936	M4192	M4448
161	M3681	M3937	M4193	M4449
162	M3682	M3938	M4194	M4450
163	M3683	M3939	M4195	M4451
164	M3684	M3940	M4196	M4452
165	M3685	M3941	M4197	M4453
166	M3686	M3942	M4198	M4454
167	M3687	M3943	M4199	M4455
168	M3688	M3944	M4200	M4456
169	M3689	M3945	M4201	M4457
170	M3690	M3946	M4202	M4458
171	M3691	M3947	M4203	M4459
172	M3692	M3948	M4204	M4460
173	M3693	M3949	M4205	M4461
174	M3694	M3950	M4206	M4462
175	M3695	M3951	M4207	M4463
176	M3696	M3952	M4208	M4464
177	M3697	M3953	M4209	M4465
178	M3698	M3954	M4210	M4466
179	M3699	M3955	M4211	M4467
180	M3700	M3956	M4212	M4468
181	M3701	M3957	M4213	M4469
182	M3702	M3958	M4214	M4470
183	M3703	M3959	M4215	M4471
184	M3704	M3960	M4216	M4472
185	M3705	M3961	M4217	M4473
186	M3706	M3962	M4218	M4474
187	M3707	M3963	M4219	M4475
188	M3708	M3964	M4220	M4476
189	M3709	M3965	M4221	M4477
190	M3710	M3966	M4222	M4478
191	M3711	M3967	M4223	M4479
192	M3712	M3968	M4224	M4480

Node Number	Participation status	Upper layer status	Operation status	Data Validity
193	M3713	M3969	M4225	M4481
194	M3714	M3970	M4226	M4482
195	M3715	M3971	M4227	M4483
196	M3716	M3972	M4228	M4484
197	M3717	M3973	M4229	M4485
198	M3718	M3974	M4230	M4486
199	M3719	M3975	M4231	M4487
200	M3720	M3976	M4232	M4488
201	M3721	M3977	M4233	M4489
202	M3722	M3978	M4234	M4490
203	M3723	M3979	M4235	M4491
204	M3724	M3980	M4236	M4492
205	M3725	M3981	M4237	M4493
206	M3726	M3982	M4238	M4494
207	M3727	M3983	M4239	M4495
208	M3728	M3984	M4240	M4496
209	M3729	M3985	M4241	M4497
210	M3730	M3986	M4242	M4498
211	M3731	M3987	M4243	M4499
212	M3732	M3988	M4244	M4500
213	M3733	M3989	M4245	M4501
214	M3734	M3990	M4246	M4502
215	M3735	M3991	M4247	M4503
216	M3736	M3992	M4248	M4504
217	M3737	M3993	M4249	M4505
218	M3738	M3994	M4250	M4506
219	M3739	M3995	M4251	M4507
220	M3740	M3996	M4252	M4508
221	M3741	M3997	M4253	M4509
222	M3742	M3998	M4254	M4510
223	M3743	M3999	M4255	M4511
224	M3744	M4000	M4256	M4512
225	M3745	M4001	M4257	M4513
226	M3746	M4002	M4258	M4514
227	M3747	M4003	M4259	M4515
228	M3748	M4004	M4260	M4516
229	M3749	M4005	M4261	M4517
230	M3750	M4006	M4262	M4518
231	M3751	M4007	M4263	M4519
232	M3752	M4008	M4264	M4520
233	M3753	M4009	M4265	M4521
234	M3754	M4010	M4266	M4522
235	M3755	M4011	M4267	M4523
236	M3756	M4012	M4268	M4524
237	M3757	M4013	M4269	M4525
238	M3758	M4014	M4270	M4526
239	M3759	M4015	M4271	M4527
240	M3760	M4016	M4272	M4528
241	M3761	M4017	M4273	M4529
242	M3762	M4018	M4274	M4530
243	M3763	M4019	M4275	M4531
244	M3764	M4020	M4276	M4532
245	M3765	M4021	M4277	M4533
246	M3766	M4022	M4278	M4534
247	M3767	M4023	M4279	M4535
248	M3768	M4024	M4280	M4536
249	M3769	M4025	M4281	M4537
250	M3770	M4026	M4282	M4538
251	M3771	M4027	M4283	M4539
252	M3772	M4028	M4284	M4540
253	M3773	M4029	M4285	M4541
254	M3774	M4030	M4286	M4542

Table 3.73 Mapping between Special Relays and Participating Nodes for Link 2 (1/2)

Node Number	Participation status	Upper layer status	Operation status	Data Validity
1	M4561	M4817	M5073	M5329
2	M4562	M4818	M5074	M5330
3	M4563	M4819	M5075	M5331
4	M4564	M4820	M5076	M5332
5	M4565	M4821	M5077	M5333
6	M4566	M4822	M5078	M5334
7	M4567	M4823	M5079	M5335
8	M4568	M4824	M5080	M5336
9	M4569	M4825	M5081	M5337
10	M4570	M4826	M5082	M5338
11	M4571	M4827	M5083	M5339
12	M4572	M4828	M5084	M5340
13	M4573	M4829	M5085	M5341
14	M4574	M4830	M5086	M5342
15	M4575	M4831	M5087	M5343
16	M4576	M4832	M5088	M5344
17	M4577	M4833	M5089	M5345
18	M4578	M4834	M5090	M5346
19	M4579	M4835	M5091	M5347
20	M4580	M4836	M5092	M5348
21	M4581	M4837	M5093	M5349
22	M4582	M4838	M5094	M5350
23	M4583	M4839	M5095	M5351
24	M4584	M4840	M5096	M5352
25	M4585	M4841	M5097	M5353
26	M4586	M4842	M5098	M5354
27	M4587	M4843	M5099	M5355
28	M4588	M4844	M5100	M5356
29	M4589	M4845	M5101	M5357
30	M4590	M4846	M5102	M5358
31	M4591	M4847	M5103	M5359
32	M4592	M4848	M5104	M5360
33	M4593	M4849	M5105	M5361
34	M4594	M4850	M5106	M5362
35	M4595	M4851	M5107	M5363
36	M4596	M4852	M5108	M5364
37	M4597	M4853	M5109	M5365
38	M4598	M4854	M5110	M5366
39	M4599	M4855	M5111	M5367
40	M4600	M4856	M5112	M5368
41	M4601	M4857	M5113	M5369
42	M4602	M4858	M5114	M5370
43	M4603	M4859	M5115	M5371
44	M4604	M4860	M5116	M5372
45	M4605	M4861	M5117	M5373
46	M4606	M4862	M5118	M5374
47	M4607	M4863	M5119	M5375
48	M4608	M4864	M5120	M5376
49	M4609	M4865	M5121	M5377
50	M4610	M4866	M5122	M5378
51	M4611	M4867	M5123	M5379
52	M4612	M4868	M5124	M5380
53	M4613	M4869	M5125	M5381
54	M4614	M4870	M5126	M5382
55	M4615	M4871	M5127	M5383
56	M4616	M4872	M5128	M5384
57	M4617	M4873	M5129	M5385
58	M4618	M4874	M5130	M5386
59	M4619	M4875	M5131	M5387
60	M4620	M4876	M5132	M5388
61	M4621	M4877	M5133	M5389
62	M4622	M4878	M5134	M5390
63	M4623	M4879	M5135	M5391
64	M4624	M4880	M5136	M5392

Node Number	Participation status	Upper layer status	Operation status	Data Validity
65	M4625	M4881	M5137	M5393
66	M4626	M4882	M5138	M5394
67	M4627	M4883	M5139	M5395
68	M4628	M4884	M5140	M5396
69	M4629	M4885	M5141	M5397
70	M4630	M4886	M5142	M5398
71	M4631	M4887	M5143	M5399
72	M4632	M4888	M5144	M5400
73	M4633	M4889	M5145	M5401
74	M4634	M4890	M5146	M5402
75	M4635	M4891	M5147	M5403
76	M4636	M4892	M5148	M5404
77	M4637	M4893	M5149	M5405
78	M4638	M4894	M5150	M5406
79	M4639	M4895	M5151	M5407
80	M4640	M4896	M5152	M5408
81	M4641	M4897	M5153	M5409
82	M4642	M4898	M5154	M5410
83	M4643	M4899	M5155	M5411
84	M4644	M4900	M5156	M5412
85	M4645	M4901	M5157	M5413
86	M4646	M4902	M5158	M5414
87	M4647	M4903	M5159	M5415
88	M4648	M4904	M5160	M5416
89	M4649	M4905	M5161	M5417
90	M4650	M4906	M5162	M5418
91	M4651	M4907	M5163	M5419
92	M4652	M4908	M5164	M5420
93	M4653	M4909	M5165	M5421
94	M4654	M4910	M5166	M5422
95	M4655	M4911	M5167	M5423
96	M4656	M4912	M5168	M5424
97	M4657	M4913	M5169	M5425
98	M4658	M4914	M5170	M5426
99	M4659	M4915	M5171	M5427
100	M4660	M4916	M5172	M5428
101	M4661	M4917	M5173	M5429
102	M4662	M4918	M5174	M5430
103	M4663	M4919	M5175	M5431
104	M4664	M4920	M5176	M5432
105	M4665	M4921	M5177	M5433
106	M4666	M4922	M5178	M5434
107	M4667	M4923	M5179	M5435
108	M4668	M4924	M5180	M5436
109	M4669	M4925	M5181	M5437
110	M4670	M4926	M5182	M5438
111	M4671	M4927	M5183	M5439
112	M4672	M4928	M5184	M5440
113	M4673	M4929	M5185	M5441
114	M4674	M4930	M5186	M5442
115	M4675	M4931	M5187	M5443
116	M4676	M4932	M5188	M5444
117	M4677	M4933	M5189	M5445
118	M4678	M4934	M5190	M5446
119	M4679	M4935	M5191	M5447
120	M4680	M4936	M5192	M5448
121	M4681	M4937	M5193	M5449
122	M4682	M4938	M5194	M5450
123	M4683	M4939	M5195	M5451
124	M4684	M4940	M5196	M5452
125	M4685	M4941	M5197	M5453
126	M4686	M4942	M5198	M5454
127	M4687	M4943	M5199	M5455
128	M4688	M4944	M5200	M5456

Table 3.73 Mapping between Special Relays and Participating Nodes for Link 2 (2/2)

Node Number	Participation status	Upper layer status	Operation status	Data Validity
129	M4689	M4945	M5201	M5457
130	M4690	M4946	M5202	M5458
131	M4691	M4947	M5203	M5459
132	M4692	M4948	M5204	M5460
133	M4693	M4949	M5205	M5461
134	M4694	M4950	M5206	M5462
135	M4695	M4951	M5207	M5463
136	M4696	M4952	M5208	M5464
137	M4697	M4953	M5209	M5465
138	M4698	M4954	M5210	M5466
139	M4699	M4955	M5211	M5467
140	M4700	M4956	M5212	M5468
141	M4701	M4957	M5213	M5469
142	M4702	M4958	M5214	M5470
143	M4703	M4959	M5215	M5471
144	M4704	M4960	M5216	M5472
145	M4705	M4961	M5217	M5473
146	M4706	M4962	M5218	M5474
147	M4707	M4963	M5219	M5475
148	M4708	M4964	M5220	M5476
149	M4709	M4965	M5221	M5477
150	M4710	M4966	M5222	M5478
151	M4711	M4967	M5223	M5479
152	M4712	M4968	M5224	M5480
153	M4713	M4969	M5225	M5481
154	M4714	M4970	M5226	M5482
155	M4715	M4971	M5227	M5483
156	M4716	M4972	M5228	M5484
157	M4717	M4973	M5229	M5485
158	M4718	M4974	M5230	M5486
159	M4719	M4975	M5231	M5487
160	M4720	M4976	M5232	M5488
161	M4721	M4977	M5233	M5489
162	M4722	M4978	M5234	M5490
163	M4723	M4979	M5235	M5491
164	M4724	M4980	M5236	M5492
165	M4725	M4981	M5237	M5493
166	M4726	M4982	M5238	M5494
167	M4727	M4983	M5239	M5495
168	M4728	M4984	M5240	M5496
169	M4729	M4985	M5241	M5497
170	M4730	M4986	M5242	M5498
171	M4731	M4987	M5243	M5499
172	M4732	M4988	M5244	M5500
173	M4733	M4989	M5245	M5501
174	M4734	M4990	M5246	M5502
175	M4735	M4991	M5247	M5503
176	M4736	M4992	M5248	M5504
177	M4737	M4993	M5249	M5505
178	M4738	M4994	M5250	M5506
179	M4739	M4995	M5251	M5507
180	M4740	M4996	M5252	M5508
181	M4741	M4997	M5253	M5509
182	M4742	M4998	M5254	M5510
183	M4743	M4999	M5255	M5511
184	M4744	M5000	M5256	M5512
185	M4745	M5001	M5257	M5513
186	M4746	M5002	M5258	M5514
187	M4747	M5003	M5259	M5515
188	M4748	M5004	M5260	M5516
189	M4749	M5005	M5261	M5517
190	M4750	M5006	M5262	M5518
191	M4751	M5007	M5263	M5519
192	M4752	M5008	M5264	M5520

Node Number	Participation status	Upper layer status	Operation status	Data Validity
193	M4753	M5009	M5265	M5521
194	M4754	M5010	M5266	M5522
195	M4755	M5011	M5267	M5523
196	M4756	M5012	M5268	M5524
197	M4757	M5013	M5269	M5525
198	M4758	M5014	M5270	M5526
199	M4759	M5015	M5271	M5527
200	M4760	M5016	M5272	M5528
201	M4761	M5017	M5273	M5529
202	M4762	M5018	M5274	M5530
203	M4763	M5019	M5275	M5531
204	M4764	M5020	M5276	M5532
205	M4765	M5021	M5277	M5533
206	M4766	M5022	M5278	M5534
207	M4767	M5023	M5279	M5535
208	M4768	M5024	M5280	M5536
209	M4769	M5025	M5281	M5537
210	M4770	M5026	M5282	M5538
211	M4771	M5027	M5283	M5539
212	M4772	M5028	M5284	M5540
213	M4773	M5029	M5285	M5541
214	M4774	M5030	M5286	M5542
215	M4775	M5031	M5287	M5543
216	M4776	M5032	M5288	M5544
217	M4777	M5033	M5289	M5545
218	M4778	M5034	M5290	M5546
219	M4779	M5035	M5291	M5547
220	M4780	M5036	M5292	M5548
221	M4781	M5037	M5293	M5549
222	M4782	M5038	M5294	M5550
223	M4783	M5039	M5295	M5551
224	M4784	M5040	M5296	M5552
225	M4785	M5041	M5297	M5553
226	M4786	M5042	M5298	M5554
227	M4787	M5043	M5299	M5555
228	M4788	M5044	M5300	M5556
229	M4789	M5045	M5301	M5557
230	M4790	M5046	M5302	M5558
231	M4791	M5047	M5303	M5559
232	M4792	M5048	M5304	M5560
233	M4793	M5049	M5305	M5561
234	M4794	M5050	M5306	M5562
235	M4795	M5051	M5307	M5563
236	M4796	M5052	M5308	M5564
237	M4797	M5053	M5309	M5565
238	M4798	M5054	M5310	M5566
239	M4799	M5055	M5311	M5567
240	M4800	M5056	M5312	M5568
241	M4801	M5057	M5313	M5569
242	M4802	M5058	M5314	M5570
243	M4803	M5059	M5315	M5571
244	M4804	M5060	M5316	M5572
245	M4805	M5061	M5317	M5573
246	M4806	M5062	M5318	M5574
247	M4807	M5063	M5319	M5575
248	M4808	M5064	M5320	M5576
249	M4809	M5065	M5321	M5577
250	M4810	M5066	M5322	M5578
251	M4811	M5067	M5323	M5579
252	M4812	M5068	M5324	M5580
253	M4813	M5069	M5325	M5581
254	M4814	M5070	M5326	M5582

3.4 Ladder Program Configuration Setup

Before you can use this module, you must perform the following configuration setup using a ladder program:

- Device capacities
- Refreshing method
- Link system number
- Data lock-up range at power failure

You can also use WideField2 for this configuration setup. See the instruction manual “FA-M3 Programming Tool WideField2 (IM34M06Q15-01E)”.

3.4.1 Device Capacities

Before you can use this module, you must define the device capacities of link devices. The default link device capacity values for F3SP38 and F3SP58 are given in Fig. 3.59.

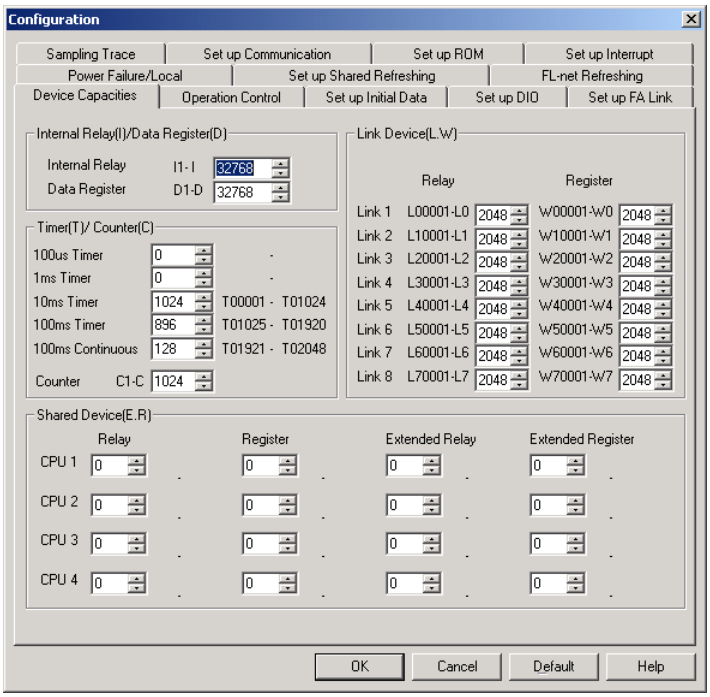


Fig. 3.59 Default Link Device Capacity Values for F3SP38 and F3SP58

If only one sequence CPU module is used in the FA-M3 system, set up the link device capacity as shown in Fig. 3.60.

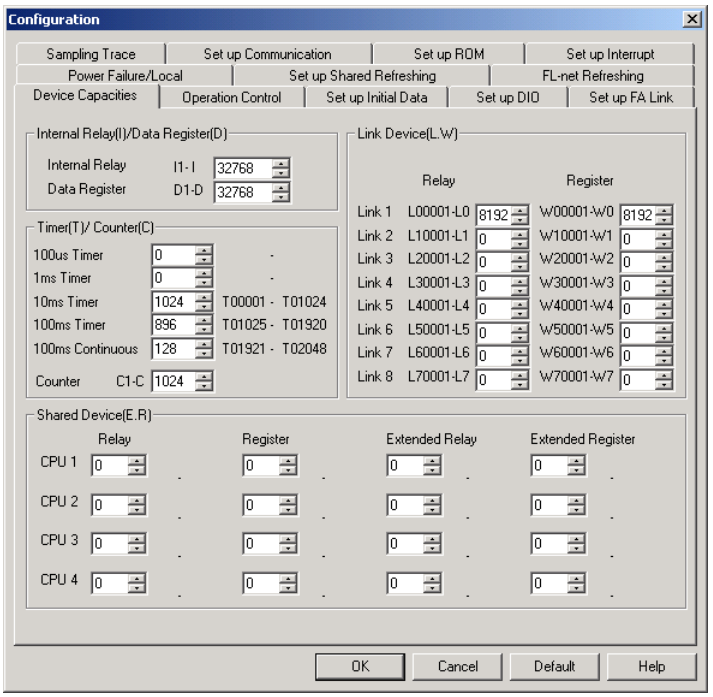


Fig. 3.60 Link Device Capacity Setup

For this module, the number of link devices must be set to 8192.
For details on how to perform setup for a multi-CPU system, see Subsection 3.5.1, “Multi-CPU System”.

3.4.2 Link Refreshing

You can define the following items related to link refreshing:

- Link refreshing method
- Link refreshing range

● Link refreshing method

You can select between peripheral process refreshing and control process refreshing. Select peripheral process refreshing if the scan time of the ladder program is important; Select control process refreshing if the transmission rate of common area data is important.

In peripheral processing refreshing, the scan time is least affected. In control process refreshing, link refreshing is least affected by command processing although the scan time becomes longer.

● Link refreshing range

You can specify whether to perform link refreshing for individual nodes.

Nodes not involved in data communication need not have their common areas read. Excluding such a node from refreshing reduces the processing time required for ink refreshing. Regardless of this setting, data of nodes not participating in the network are also not read.

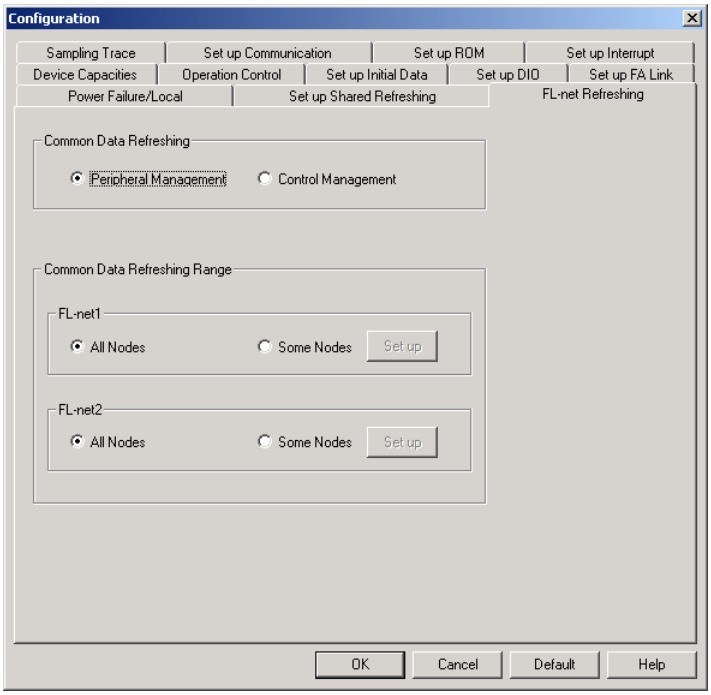


Fig. 3.61 Link Refreshing Setup

3.4.3 Link System Number

If two or more F3LX02-1N modules are installed, they are identified with link numbers starting with 1. An F3LX02-1N module installed in a slot with a smaller slot number is automatically assigned a smaller link number as shown in Fig. 3.62.

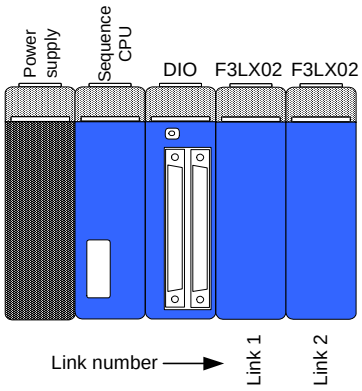


Fig. 3.62 Link Number

You can override this automatic link number assignment by using this link number setup. For instance, if you want to manually assign link numbers as shown in Fig. 3.64, perform link setup as shown in Fig. 3.63.

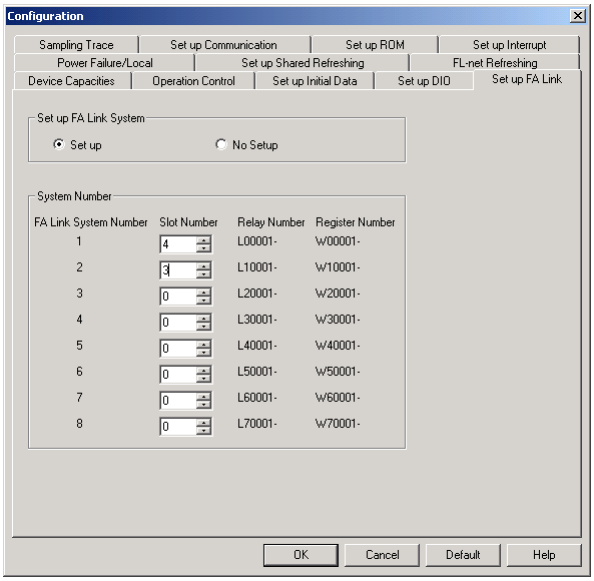


Fig. 3.63 Link System Number Setup

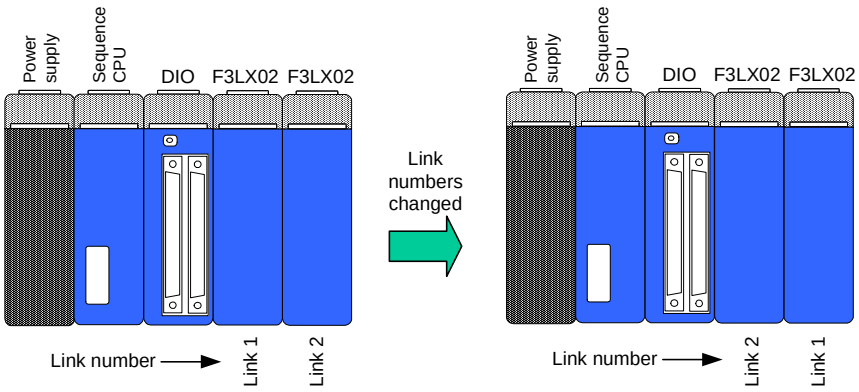


Fig. 3.64 Example of Manual Link Number Assignment

3.4.4 Data Lock-up Range at Power Failure

To retain link device data in the event of a power failure, perform the following setup.

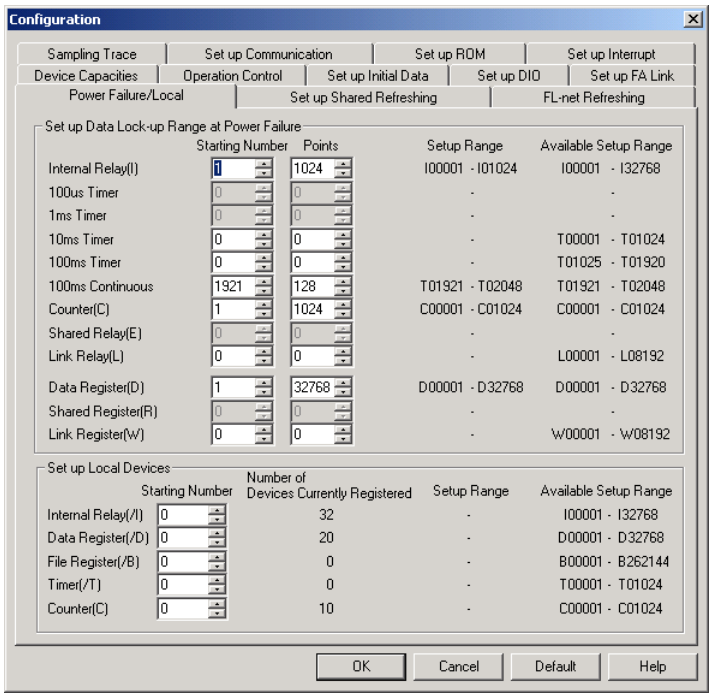


Fig. 3.65 Power Failure Setup for Link Device

For more information on data retention in the event of a power failure, see “Sequence CPU Instruction Manual - Functions (for F3SP28-3N/3S, F3SP38-6N/6S, F3SP53-4H/4S, F3SP58-6H/6S and F3SP59-7S)” (IM34M06P13-01E).

3.5 Important Notes

3.5.1 Multi-CPU System

An FA-M3 system can have more than one sequence CPU module. Even in a multi-CPU system, however, one FL-net (OPCN-2) interface module can only be accessed by one sequence CPU module. In other words, the link devices of an FL-net (OPCN-2) interface module cannot be shared by multiple sequence CPU modules.

Use device capacities setup in configuration setup to set device capacities for the FL-Net interface module to 0 for sequence CPU modules that are not assigned to access the FL-net interface module.

Using word block read or write request messages, you can read from or write to any sequence CPU module.

3.5.2 Installing Multiple FL-net (OPCN-2) Interface Modules

One sequence CPU module can access more than one FL-net (OPCN-2) interface module. An FA-M3 system can be installed with FA Link Modules (F3LP01-0N), FA Link H Modules (F3LP02-0N), and Fiber-optic FA Link H Modules (F3LP12-0N), together with the FL-net (OPCN-2) interface modules (F3LX02-1N), restricted only by the link device capacities. When these interface modules are installed within the same FA-M3 system, they are automatically assigned unique link system numbers (see Fig. 3.66), which may be overridden manually using configuration setup.

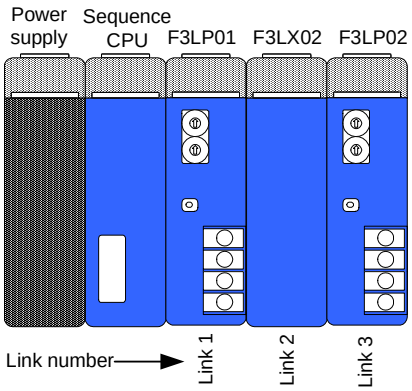


Fig. 3.66 Automatic Link Number Assignment Example

An FA-M3 system can accommodate up to eight of these interface modules using link numbers 1 to 8, subject to the following restrictions:

- One sequence CPU module can support up to two FL-net (OPCN-2) interface modules.
- One sequence CPU module can support up to six of Personal Computer Link Modules and the FL-net (OPCN-2) Interface modules combined.

3.6 Error Codes

3.6.1 Upper Layer Status (ULS)

The upper layer status stores a 12-bit error code. Fig. 3.67 shows the structure of an error code and Table 3.74 shows a list of error codes with their description.

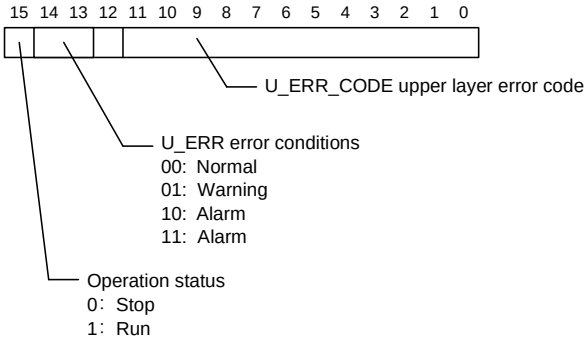


Fig. 3.67 Upper Layer Status

Table 3.74 Upper Layer Status Error Code

Error Code	Error Name	Description	Corresponding special relays*
$08	Subunit transmitter switching has occurred	Transmission path switching has occurred during loop configuration.	M211
$10	Startup error	CPU initialization process has failed.	M193
$11	SPU error	Sequence operation CPU has failed.	
$12	Memory error	Program checksum error	
		Run/debug/stop mode flag has been overwritten.	
		Device memory R/W check error	
		System memory R/W check error	
$13	Momentary power failure	Momentary power failure has occurred.	M195
$14	Scan timeout	Scan time monitoring time has been exceeded.	M204
	Sensor control scan timeout	The total of I/O refresh time and execution time in a sensor control block has exceeded the time limit.	M212
$17	Invalid instruction detected	An invalid instruction has been detected.	M193
		No END instruction in a program.	
$18	Battery error	Backup battery has failed.	M194
$20	Program error	JMP, SUB, or RET instruction error	M193
	I/O points exceeded	There are too many I/O points.	
$21	Instruction error	Parameter error	M201
		Invalid data	
		BIN-BCD conversion error	
		Invalid FIFO table pointer value	
		Device limit has been exceeded.	
		FOR-NEXT instruction error	
$22	Subroutine error	Missing return. RET instruction not executed.	
		Nesting level exceeded maximum limit (8).	
$23	Interrupt error	Missing return. IRET instruction not executed.	
		The number of pending interrupts exceeded maximum limit (8).	
$24	I/O mismatch error	Actual I/O module configuration is not correctly reflected in a program. Too many HRD/HWR instructions	M202
		READ/WRITE error	
		HRD/HWR error	
$40	Inter-CPU communication error	Shared device communication error	M196
$80	I/O error	Reading from or writing to an I/O module has failed. Fiber-optic FA bus module communication error. A sequence CPU module in a multi-CPU system has been reset.	M203
$82	ROM pack error	Incompatible ROM pack	M193
		Reading from or writing to a ROM pack has failed.	
$83	Subunit transmission error	Reading from or writing to a subunit has failed.	M210

*: These special relays turn on when an error is detected.

For information on how to handle these errors, see “Sequence CPU Instruction Manual - Functions (for F3SP28-3N/3S, F3SP38-6N/6S, F3SP53-4H/4S, F3SP58-6H/6S and F3SP59-7S)” (IM34M06P13-01E).

3.6.2 Error Response in Message Transmission

If a response message in message transmission is an error message, it contains a 2-byte error code as shown in Table 3.75.

Table 3.75 Message Transmission Error Code

Error Code	Error name	Description
$0004	Setup error	Invalid parameter
$0005	Data out of range	Too many data items
$1□□□	Self-diagnosis error	CPU has failed self-diagnosis.
$2□□□	Program error	Sequence program has failed.
$4□□□	Inter-CPU communication error	Shared device communication error
$8□□□	Device access error	I/O module inaccessible.
$9□□□	Command error	Unsupported command
$A□□□	Parameter error	No device allocated to specified virtual address space.
$B□□□	Operation mode error	Invalid command execution mode.
$C□□□	Parameter error	No device allocated to specified virtual address space.
$F□□□	System error	Internal error
$5100	CPU timeout	No response from specified CPU.

Note: □ denotes any digit.

4. Troubleshooting

4.1 Initial Troubleshooting Checklist

Table 4.1 Initial Troubleshooting Checklist

	Answer the following (all answers must be yes):
1	Is the module correctly installed?
2	Is the condition setup switch of the module correctly set?
3	Are the IP address setup switches of the module correctly set?
4	Are the common memory areas correctly configured?
5	Are the connectors securely attached to the module?
6	Is the communication cable properly connected?
7	Is the 10BASE5 cable (if used) provided with a terminating resistor?
8	Is the grounding of the 10BASE5 cable (if used) correctly connected?
9	Is the 10BASE-T cable (if used) a straight cable (do not use a crossed cable)?
10	Is the 10BASE-T cable (if used) compliant with the category-5 specification?
11	Is the Ethernet HUB or repeater switched on?

4.2 Common Network Problems

■ No Communication

Table 4.2 Troubleshooting Network Problems (no communication)

Check:	Check if:	Remedy
Power supply	Main power lamp on equipment is lit.	Ensure that the power supplies, power cables, and output voltage are correct.
	Power lamp on the communication module is lit.	
	Power lamp on AUI power supply unit is lit.	
	Output voltage of AUI power supply unit is correct (12 V).	
	Power lamp on HUB is lit.	
	AUI power cable is connected to equipment correctly.	
Connection between communication cable and transceiver	Transceiver is installed securely.	Install transceiver correctly.
	Transceiver is adjusted correctly as checked with the transceiver tester.	Adjust transceiver correctly. Relocate transceiver if necessary.
	Transceiver is isolated correctly.	Ensure that transceiver is installed correctly.
	Communication cable is correctly connected to transceiver as indicated by the marker.	Ensure that the connection is correct.
Connection between transceiver cable and transceiver	Transceiver cable is securely connected to transceiver.	Ensure that the connection is secure. Re-tighten if necessary.
	Transceiver is installed correctly as checked with the transceiver tester.	Check the installation according to the user's manual of the tester.
	Transceiver is locked correctly.	Lock transceiver properly.
	Transceiver LEDs are lit normally.	Ensure that the power supplies, power cables, and output voltage are correct.
Connection between transceiver cable and equipment	Transceiver cable is securely connected to equipment.	Ensure that the connection is correct. Re-tighten if necessary.
	SND and RCV LEDs on equipment are lit normally.	Troubleshoot according to LED status.
	SQE and any other media switches are correctly set.	Ensure that the setup is correct.

■ Unreliable Communication

Table 4.3 Troubleshooting Network Problems (unreliable communication)

Check:	To See If:	Remedy
Transmission path	Shield of coaxial cable is grounded only at one point.	Ground the shield correctly.
	Shield of AUI cable is grounded correctly.	Ground the cable correctly according to the user's manual for the cable.
	All nodes respond to the Ping command correctly.	Check the power supply and cable of equipment that does not respond.
	Collision lamp on transceiver/HUB does not light up frequently.	Ensure that cables and connectors are correctly connected. Use an analyzer to find the cause of frequent collision.
	Repeaters are used for up to 4 segments.	Ensure that the configuration is proper.
	All segments are within length limits.	
	Each end of transmission path is provided with a terminating resistor.	
	The number of devices connected to a segment is within limit.	
	The number of segments to which devices are connected is three or less.	
	Repeater is switched on.	Ensure that the power supplies, power cables, and output voltage are proper.
Setup of participating nodes	Network IP address is correctly set.	Check IP address using support tool and/or analyzer.
	Node number is correctly set.	Check node number using support tool and/or analyzer.
	Node parameters are correctly set.	Check node parameters using support tool.
	COM (carrier detect) lamp is lit (steady or blinking).	Check communication cable and AUI power supply.
	SND (send) lamp is lit (steady or blinking).	Check equipment for correct parameter setup.
	LNK (link) lamp is lit (steady).	Check equipment for correct parameter setup.

■ Checking IP Address Using the Ping Command from PC

Even if no network analyzer or other dedicated tool is available, you can still check FL-net (OPCN-2) connection and IP address setup using the Ping command from a PC. How to use the Ping command is described below.

Suppose that the IP address of FL-net (OPCN-2) equipment in question is 192.168.250.13.

```
\>ping 192.168.250.13
```

Fig. 4.1 Issuing the Ping Command

If network connection is normal, the display will look as follows:

```
\>ping 192.168.250.13

Pinging 192.168.250.13 with 32 bytes of data:

Reply from 192.168.250. 13: bytes=32 time<10ms TTL=255
Reply from 192.168.250. 13: bytes=32 time<10ms TTL=255
Reply from 192.168.250. 13: bytes=32 time<10ms TTL=255
Reply from 192.168.250. 13: bytes=32 time<10ms TTL=255

Ping statistics for 192.168.250.13:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss)
Approximate round trip times in milliseconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Fig. 4.2 Ping Response Screen (if network connection is normal)

If there is a network connection error, the display will look as follows:

```
\>ping 192.168.250.13

Pinging 192.168.250.13 with 32 bytes of data:

Request timed out:
Request timed out:
Request timed out:
Request timed out:

Ping statistics for 192.168.250.13:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss)
Approximate round trip times in milliseconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Fig. 4.3 Ping Response Screen (if there is a network connection error)

4.3 Limitations and Precautions When Using FL-net (OPCN-2)

For details on the FL-net (OPCN-2) transmission path specifications, see the earlier sections and the IEEE802.3 standard. Table 4.4 lists some important limitations and precautions for FL-net (OPCN-2).

Table 4.4 Limitations and Precautions when Using FL-net (OPCN-2)

<table>
<tr><th></th><th>Description</th></tr>
<tr><td>1</td><td>FL-net (OPCN-2) must be isolated from other Ethernet local area networks.</td></tr>
<tr><td>2</td><td>Do not connect FL-net (OPCN-2) to a router.</td></tr>
<tr><td>3</td><td>Switching HUBs do not work in FL-net (OPCN-2).</td></tr>
<tr><td>4</td><td>Using IR or other wireless communication media may significantly reduce the transmission rate over an FL-net (OPCN-2).</td></tr>
<tr><td>5</td><td>Using a PC as a node may significantly reduce the transmission rate, depending on the performance, operating system, and applications on the PC.</td></tr>
<tr><td>6</td><td>Set IP addresses correctly. The network address must be the same for all IP addresses (the default network address is 192.168.250). The node number (station number) of an IP address should preferably be set as follows:
<table>
<tr><th>Network Address</th><th>Node Number</th></tr>
<tr><td>192.168.250</td><td>1-249</td></tr>
</table>
Checking for duplicate node numbers cannot be done at initial setup. Duplicate node numbers can be detected only when transmission attempts are made.</td></tr>
<tr><td>7</td><td>Grounding must be done correctly. Grounding wires must be of the correct size.</td></tr>
<tr><td>8</td><td>Keep away from noise sources. Route power supply cables separately from communication cables.</td></tr>
<tr><td>9</td><td>When message transmission is used with cyclic transmission, cyclic transmission rate may be affected depending on the traffic volume of message transmission.</td></tr>
<tr><td>10</td><td>Common memory area used for cyclic transmission may be divided into smaller isolated areas.</td></tr>
<tr><td>11</td><td>If the transceiver has an SQE switch, set up the switch correctly according to the user’s manual for the switch.</td></tr>
<tr><td>12</td><td>Data concurrency over the entire network depends on the processing power of individual nodes. In particular, the minimum allowable frame interval of the network is determined by the slowest node. Therefore, a slow node participating in the network may significantly degrade network data concurrency.</td></tr>
<tr><td>13</td><td>The header of a message frame is transferred as big endian data but the message body (data) is transferred as little endian data, except for system parameters in the message body (data) of a read profile message frame. Big endian data transfer means that bits are sent, starting with the most significant bit (MSB).</td></tr>
<tr><td>14</td><td>All nodes in the network must adopt the same protocol version and mode. Otherwise, request for participation may not be allowed.</td></tr>
</table>

4.4 Troubleshooting Flowcharts

Starting with this main troubleshooting flowchart, and branch off to individual flowcharts according to the nature of the problem.

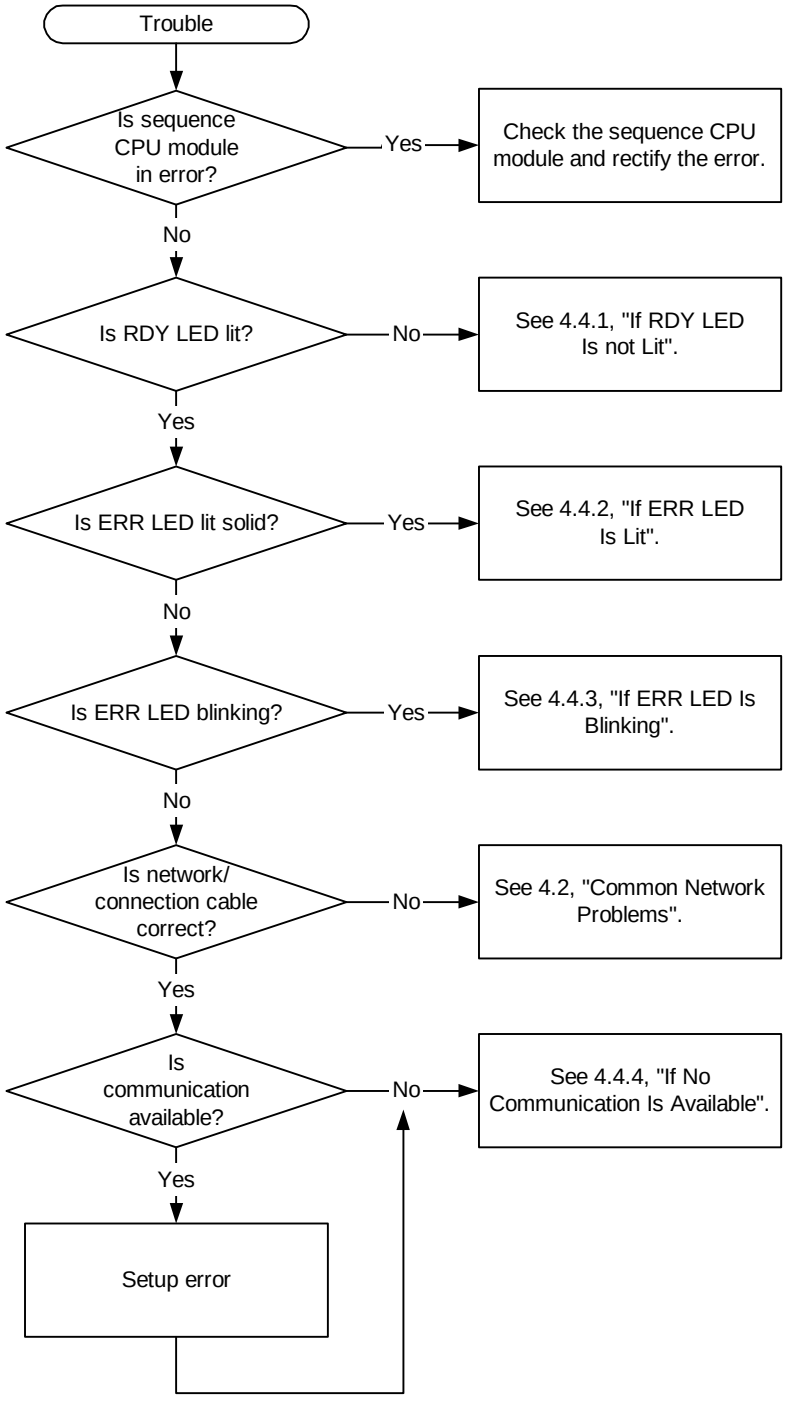


Fig. 4.4 Main Troubleshooting Flowchart

4.4.1 If RDY LED Is not Lit

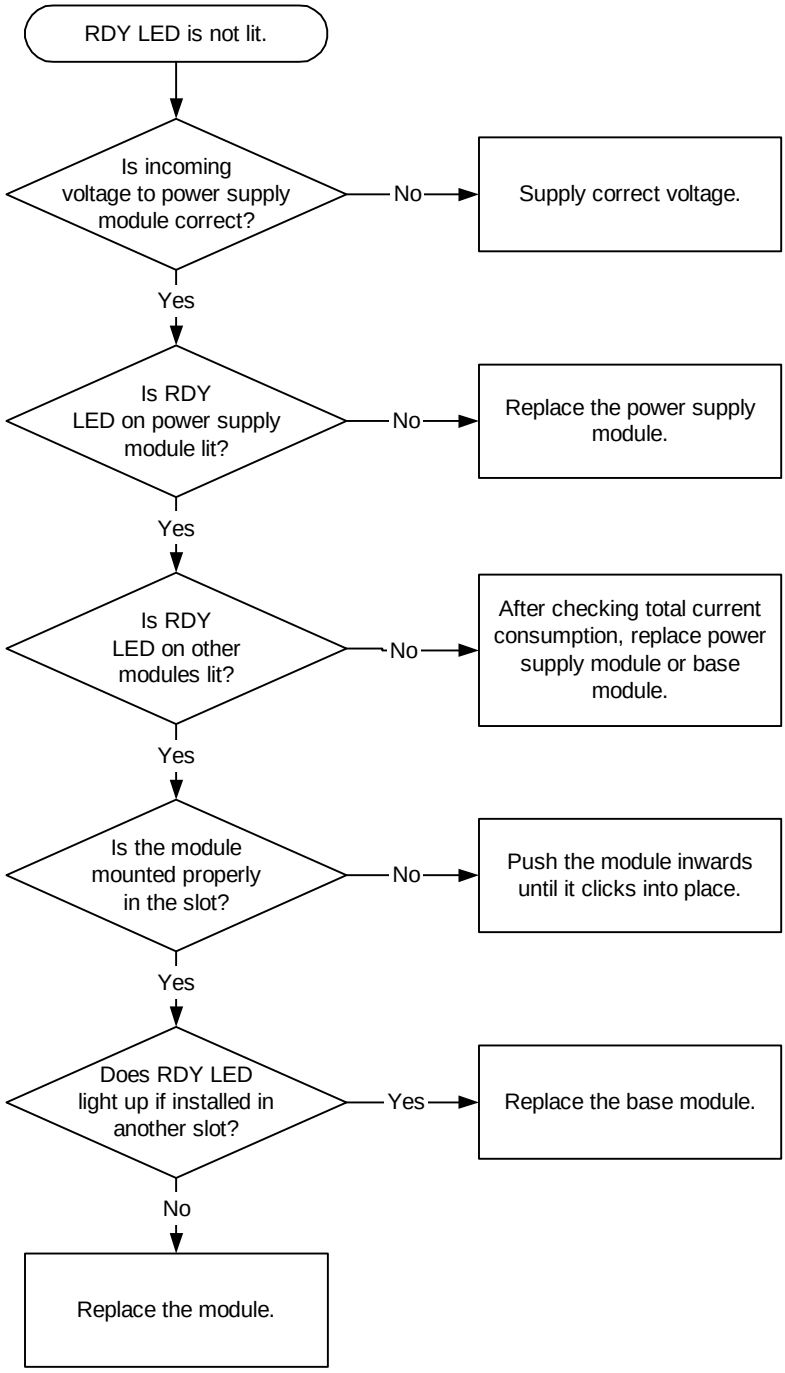


Fig. 4.5 Troubleshooting Flowchart When RDY LED Is not Lit

4.4.2 If ERR LED Is Lit

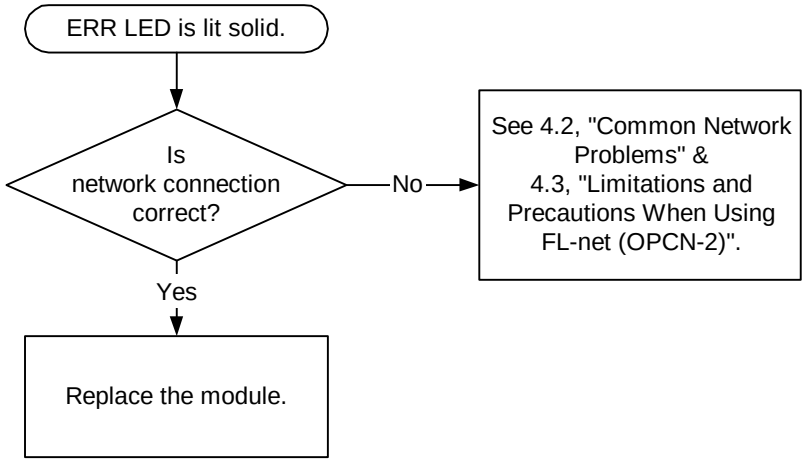


Fig. 4.6 Troubleshooting Flowchart When ERR LED Is Lit

4.4.3 If ERR LED Is Blinking

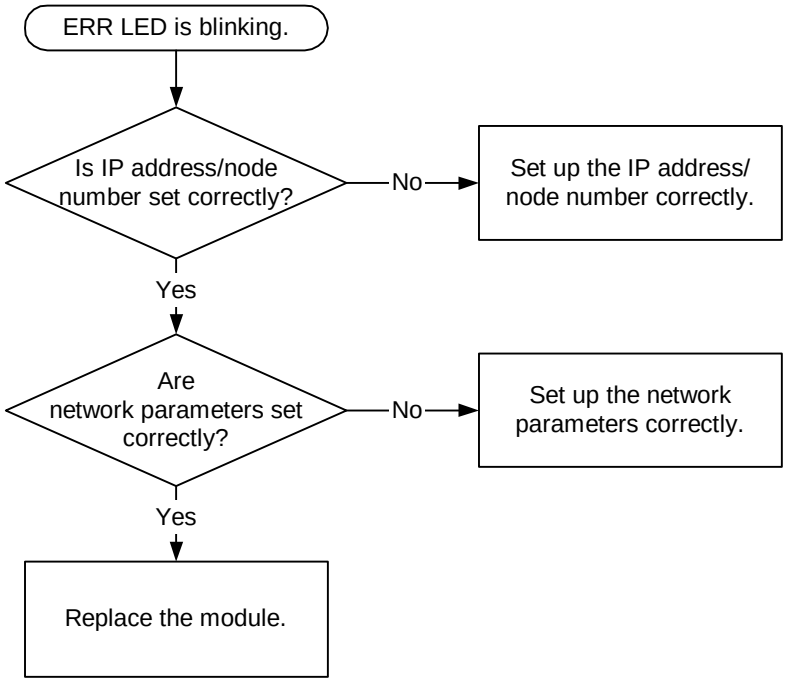


Fig. 4.7 Troubleshooting Flowchart When ERR LED Is Blinking

4.4.4 If No Communication Is Available

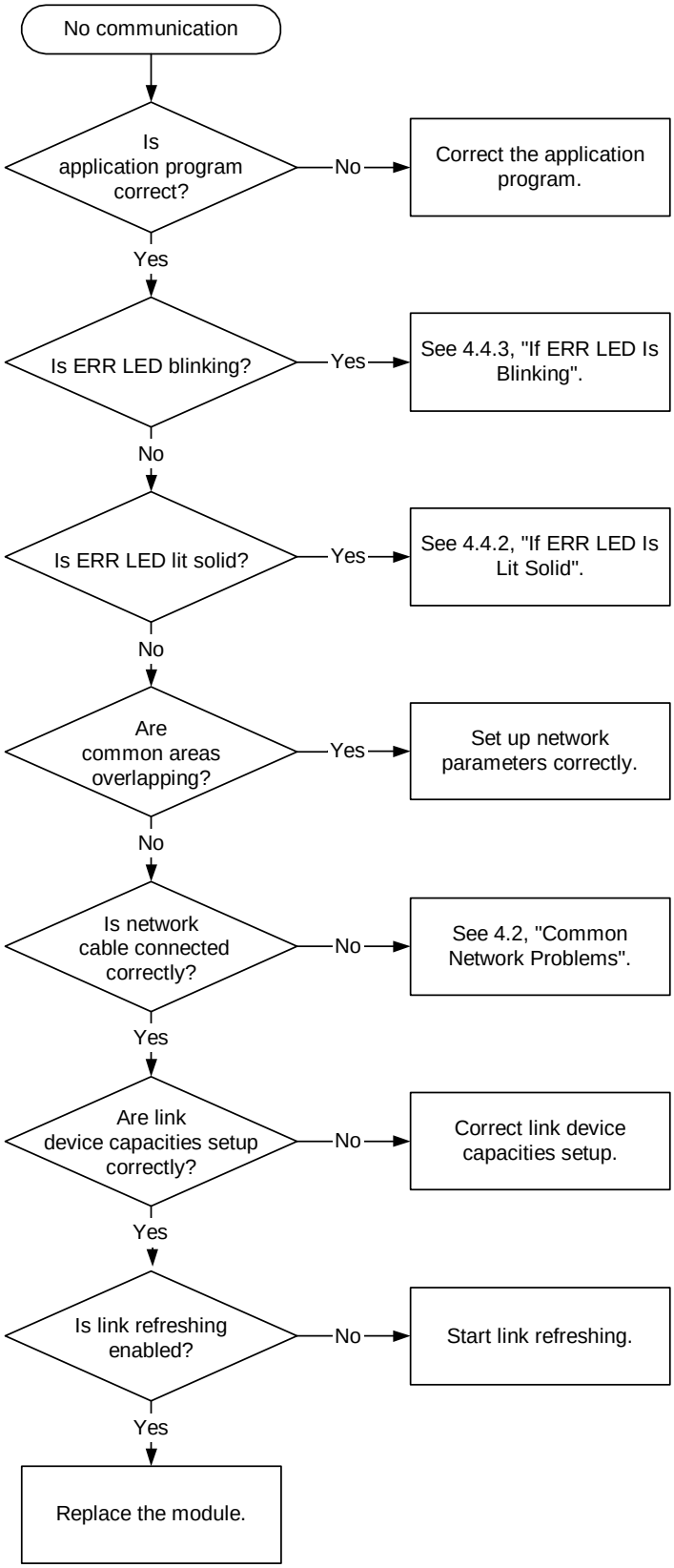


Fig. 4.8 Troubleshooting Flowchart When No Communication Is Available

5. Appendix

5.1 System Configuration Guide

■ Basics of Ethernet

Ethernet is a standard for communications over a local area network (LAN) connecting personal computers, printers, and other equipment. It provides standards on communication data formats, cables, and connectors. The Ethernet standard has been developed by the IEEE802.3 Ethernet working group, which has formulated the 10BASE5, 10BASE2, and 10BASE-T specifications, and is now working on the 1000BASE-T specification and other future technologies. Fig. 5.1 summarizes the standardization efforts of the working group.

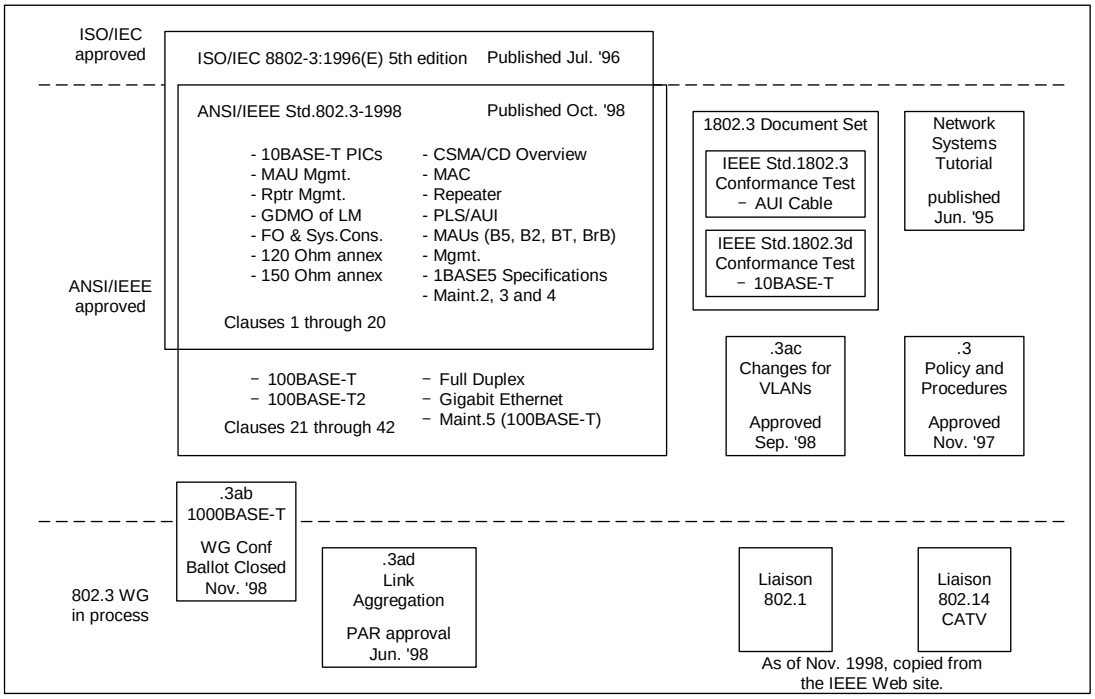


Fig. 5.1 Standardization Efforts of the IEEE802.3 Working Group

■ 10BASE5 Specification

● General

10BASE5 is an Ethernet connection method using a 10-mm size coaxial cable (also known as thick cable or yellow cable). The string “10” in the name “10BASE5” denotes 10M bps transmission rate, “BASE” denotes base band transmission, and “5” denotes 500 m trunk line transmission range. To connect a PC to the 10BASE5 cable, install a transceiver on the cable, and connect the PC to the transceiver with a transceiver cable (also known as AUI cable). The 10BASE5 cable is not so commonly used in office LANs because it is thicker and thus cannot be easily routed. It is often used as a trunk line, however, as it has a longer transmission range. Fig. 5.2 shows how to connect a PC to it.

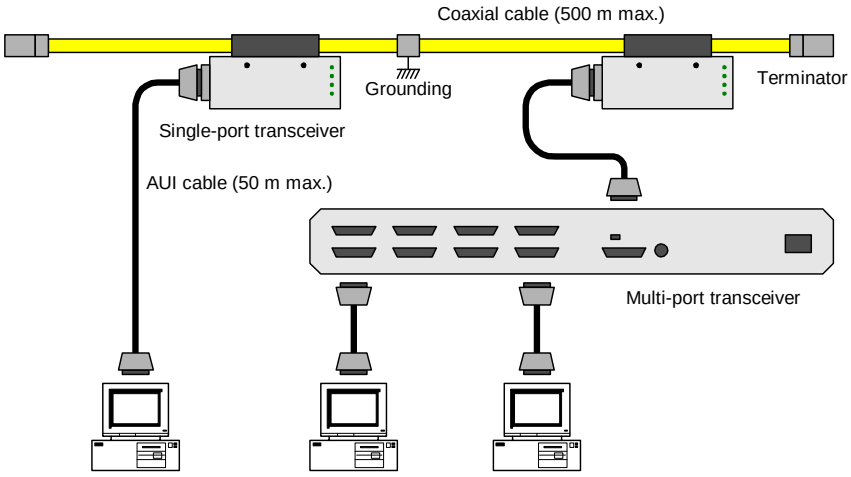


Fig. 5.2 Simple 10BASE5 Ethernet Configuration

TIP

- If a multi-port transceiver is used, the total length of an AUI cable leading from the coaxial cable to any PC must not exceed 50 m.
- No more than two multi-port transceivers may be cascaded.

Basic configuration

As one trunk line segment can be up to 500 m long, if nodes are more than 500 m apart, you may use a repeater to connect two segments together as shown below. Fig. 5.3 shows an example configuration for a network where nodes can be up to 1500 m apart. In this case, you must arrange segments and repeaters such that there are no more than two repeaters between any two nodes.

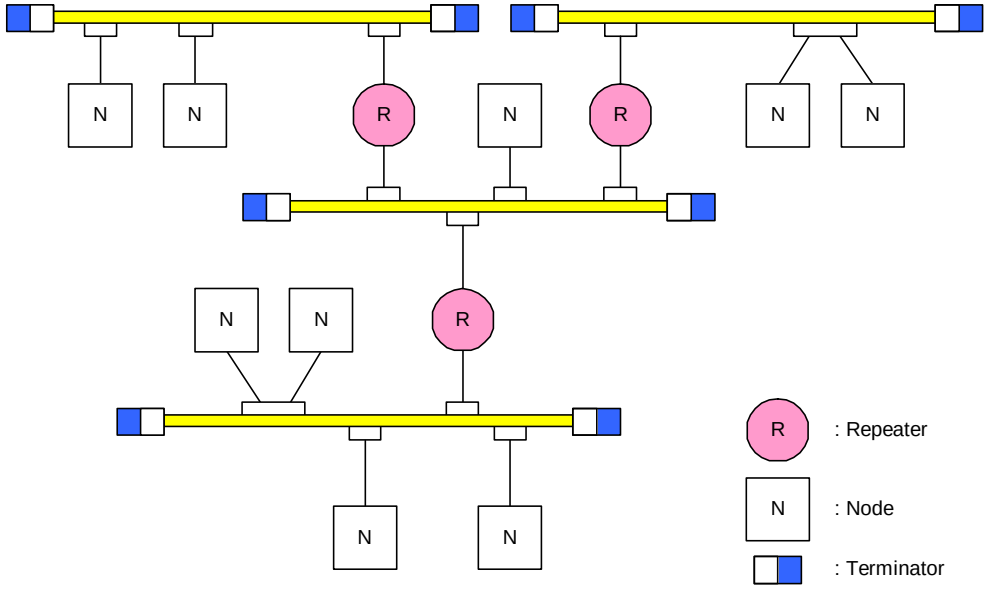


Fig. 5.3 Basic 10BASE5 Ethernet Connection (using repeaters for 1500 m transmission range)

CAUTION

A repeater must be connected to a coaxial cable through a transceiver cable and a transceiver. It may be connected to any transceiver on a coaxial cable. The distance between two transceivers on the same coaxial cable must be a multiple of 2.5 m.

Fig. 5.4 shows an example configuration using link segments for a network where nodes can be up to 2500 m apart. A link segment is a link cable (500 max. if coaxial) that is provided with a repeater on each end but has no nodes attached to it. Each link segment is enclosed within a dotted-line box in Fig. 5.4 and can be considered as one repeater as far as the restriction on the number of repeaters is concerned.

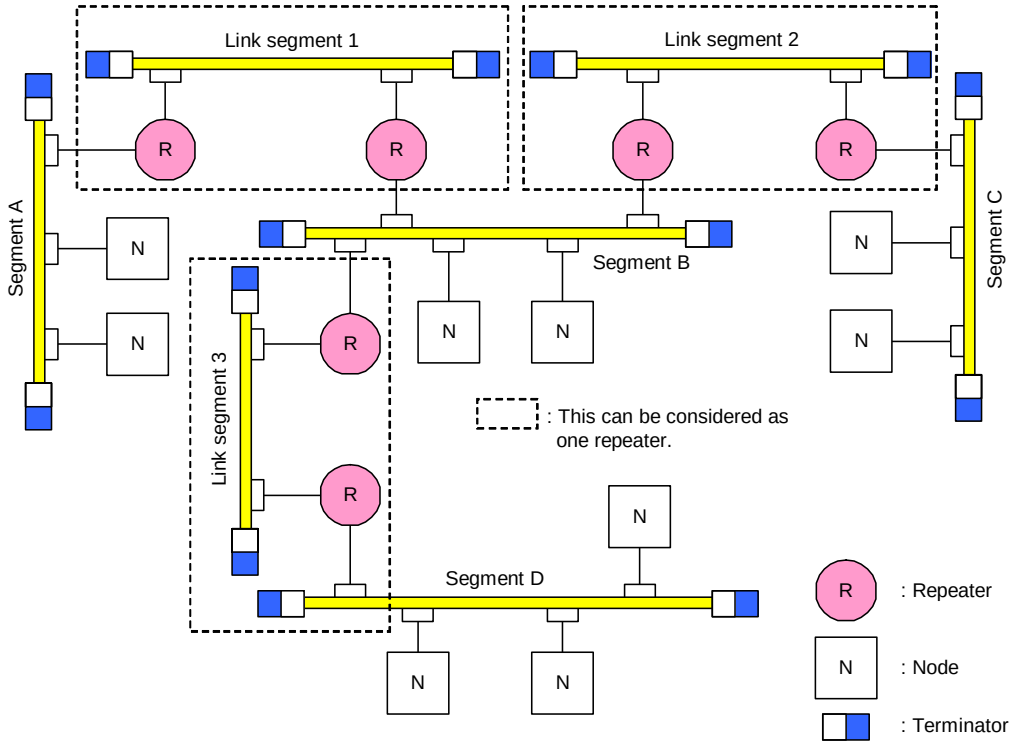


Fig. 5.4 Basic 10BASE5 Ethernet Connection (using repeaters for 2500 m transmission range)

CAUTION

- A link segment is 500 m long max.
- Do not connect any node to a link segment.
- A link segment, as indicated by a dotted-line box in Fig. 5.4, can be considered as one repeater when counting repeaters between two nodes.
- There must be no more than two repeaters between any two nodes.
- Only one segment in the network can have more than two repeaters attached to it.

Table 5.1 lists 10BASE5 Ethernet configuration parameters.

Table 5.1 10BASE5 Ethernet Configuration Parameters

Parameters	Specifications
Maximum segment length	500 m
Maximum number of transceivers attached to a segment	100 transceivers
Maximum distance between nodes	2500 m (excluding transceiver cables)
Maximum number of nodes in a network	254 nodes
Maximum transceiver cable (AUI cable) length	50 m
Maximum distance between transceiver and repeater	2 m (recommended)
Maximum number of repeaters between nodes	2 repeaters (a link segment provided with two repeaters can be considered as one repeater)

■ 10BASE-T Specification

● General

10BASE-T is an Ethernet connection method using a twisted-pair cable. The string “10” in the name “10BASE-T” denote 10M bps transmission rate, “BASE” denotes base band transmission, and “-T” denotes twisted-pair cable. In a 10BASE-T Ethernet network, PCs and other equipment must be connected to a HUB in a star configuration. They may not be connected to each other directly (equipment-to-equipment direct connection is possible using a crossed cable, but not practical in normal networking). The maximum allowable distance between a HUB and equipment is 100 m. The 10BASE-T cable is commonly used in office LANs, as it is thinner and thus can be easily routed. Connection and disconnection of equipment is also easier. Fig. 5.5 shows an example 10BASE-T Ethernet configuration.

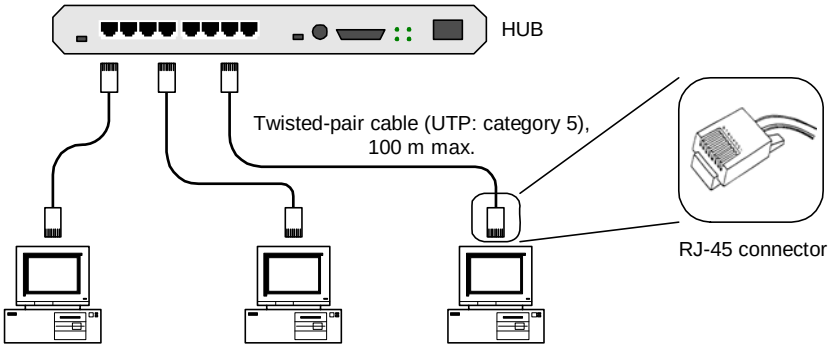


Fig. 5.5 Simple 10BASE-T Ethernet Configuration

Basic configuration

You may connect a HUB to a transceiver with a transceiver cable (AUI cable) so that nodes can be connected to the HUB with 10BASE-T cables (twisted-pair cables) as shown in Fig. 5.6.

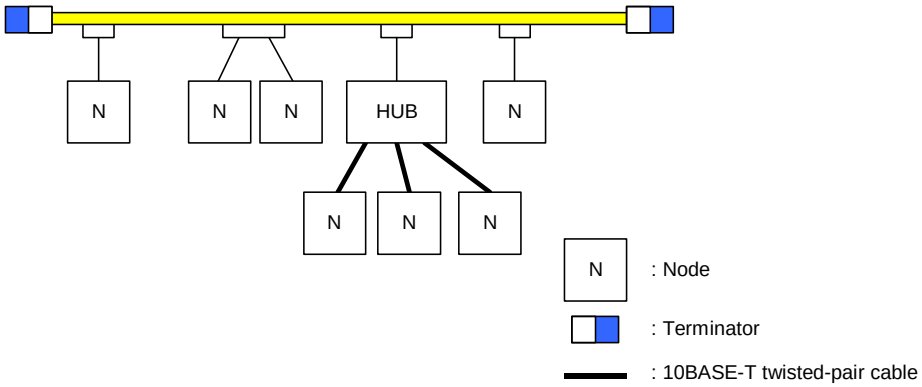


Fig. 5.6 Basic 10BASE-T Ethernet Connection

If nodes are near each other, the 10BASE-T Ethernet configuration may consist only of a HUB with connected nodes, but without any coaxial cable or transceiver.

■ Other Ethernet Specifications

● 10BASE2 specification

10BASE2 is an Ethernet connection method using a 5-mm size coaxial cable (also known as thin cable). The string “10” in the name “10BASE2” denotes 10M bps transmission rate, “BASE” denotes base band transmission, and “2” denotes 200 m (or more accurately 185 m) trunk line transmission range. To form a 10BASE2 Ethernet network of PCs and other equipment, attach a T-type branch connector to each PC, and connect the PCs in series through their connectors using 10BASE2 coaxial cables as shown in Fig. 5.7.

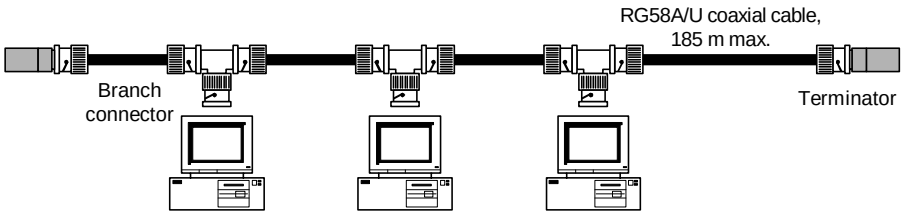


Fig. 5.7 10BASE2 Ethernet Configuration

● Fiber-optic specification

Fiber-optic Ethernet is an Ethernet connection method using a fiber-optic cable. It is used for long-distance transmission (over 500 m) or for applications where higher noise-immunity is required. Fiber-optic Ethernet specifications defined in IEEE802.3 include 10BASE-FP, 10BASE-FB, 10BASE-FL, 100BASE-FX, 1000BASE-LX, and 1000BASE-SX. Fig. 5.8 shows a basic fiber-optic Ethernet configuration.

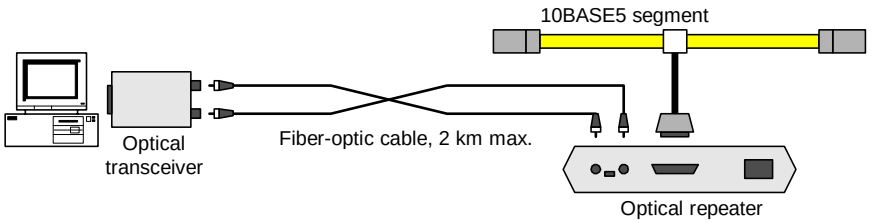


Fig. 5.8 Fiber-optic Ethernet Configuration

- **Wireless specification**

Wireless LAN is a LAN using radio wave, infrared ray, or other wireless means as transmission medium. It is useful for connecting mobile equipment to a LAN. Standardization efforts are now being undertaken by the IEEE802.11 wireless LAN working group. A wireless LAN requires a bridge device for connecting to Ethernet, because it uses a different MAC protocol. Fig. 5.9 shows a basic wireless Ethernet configuration.

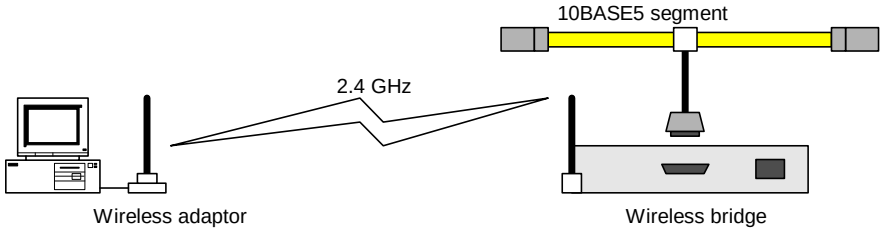


Fig. 5.9 Wireless Ethernet Configuration

■ Ethernet IP Address

The UDP/IP protocol uses 32-bit IP addresses (theoretical). An IP address is a combination of a network address and a host address as shown in Fig. 5.10. A private address normally uses a class-C IP address.

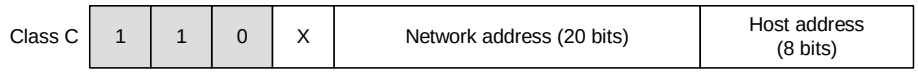


Fig. 5.10 Ethernet Class-C IP Address

An IP address is given in decimal-dot notation, consisting of four decimal numbers delimited by the period (.), where each number maps to 8 bits. Fig. 5.11 shows how an IP address is represented using a class-C IP address as an example.

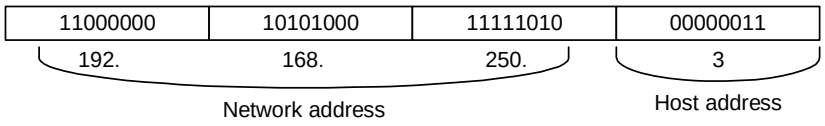


Fig. 5.11 Example of Class-C IP Address

TIP

FL-net (OPCN-2) uses default IP addresses in the form of 192.168.250.N (where N, the node number, is an integer between 1 and 254).

■ Concept of FL-net (OPCN-2) Network

FL-net (OPCN-2) is a network for connecting programmable controllers, robot controllers, numerical controllers, and other factory automation (FA) controllers to allow real-time communication. It has an upper layer that sits on top of the Ethernet UDP/IP protocol layer and implements cyclic transmission and message transmission using token passing broadcast technology.

■ Difference between Ethernet and FL-net (OPCN-2)

Based on Ethernet technology, FL-net (OPCN-2) has the following characteristics:

- **Designed for FA applications**

  Not all Ethernet-compliant equipment is suited for FA applications. In particular, Ethernet does not provide for high noise immunity or environmental resistance required in industrial applications.

- **Fast response supports real-time control applications.**

  Controllers must be FL-net (OPCN-2) compliant before they can be connected to an FL-net (OPCN-2) network.

- **Cyclic transmission using UDP/IP broadcasting on 10BASE5/10BASE-T**

  The current FL-net (OPCN-2) standard has the following limitations:

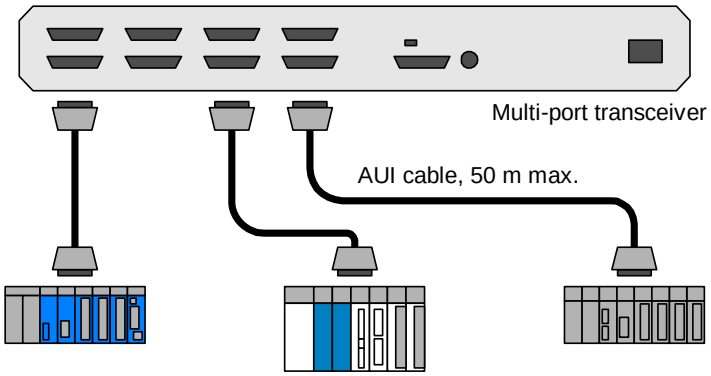
  - It can be used only for equipment that supports 10M bps Ethernet LAN.
  - It does not support interconnection with Ethernet.
  - It does not support TCP/IP communication.
  - Using a switching HUB gives no benefit.
  - It may fail if connected to a router.

5.2 FL-net (OPCN-2) Configuration Examples

■ Simple Configuration

The simple configuration consists of multiple FA controllers connected to a single multi-port transceiver or HUB.

- **Using a multi-port transceiver**



- **Using a HUB**

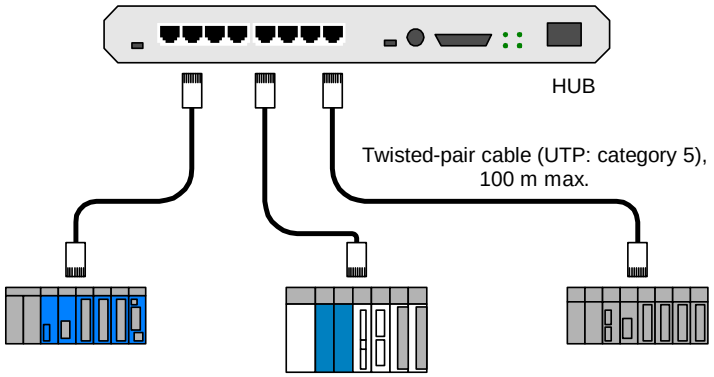


Fig. 5.12 Simple Configuration

■ Basic Configuration

The basic configuration consists of multiple FA controllers groups, each connected to a multi-port transceiver or HUB installed on a single coaxial cable. This type of configuration can typically support tens of FA controllers.

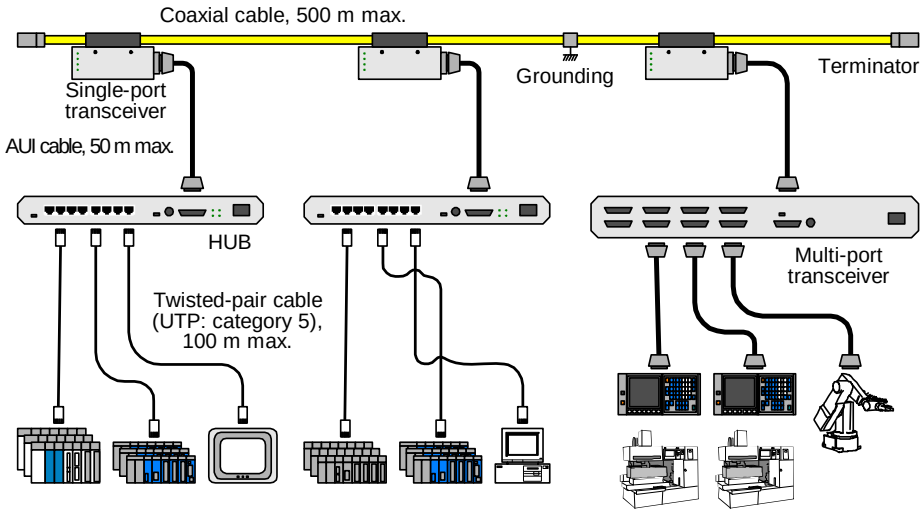


Fig. 5.13 Basic Configuration

TIP

- If a multi-port transceiver is used, the total length of AUI cables leading from the coaxial cable to any FA controller must not exceed 50 m.
- No more than two multi-port transceivers may be cascaded.
- The total number of repeaters and HUBs between any two FA controllers must not exceed four.

■ Large-scale Configuration

A large-scale configuration, typically supporting hundreds of FA controllers, is implemented by connecting multiple 10BASE5 network segments using repeaters.

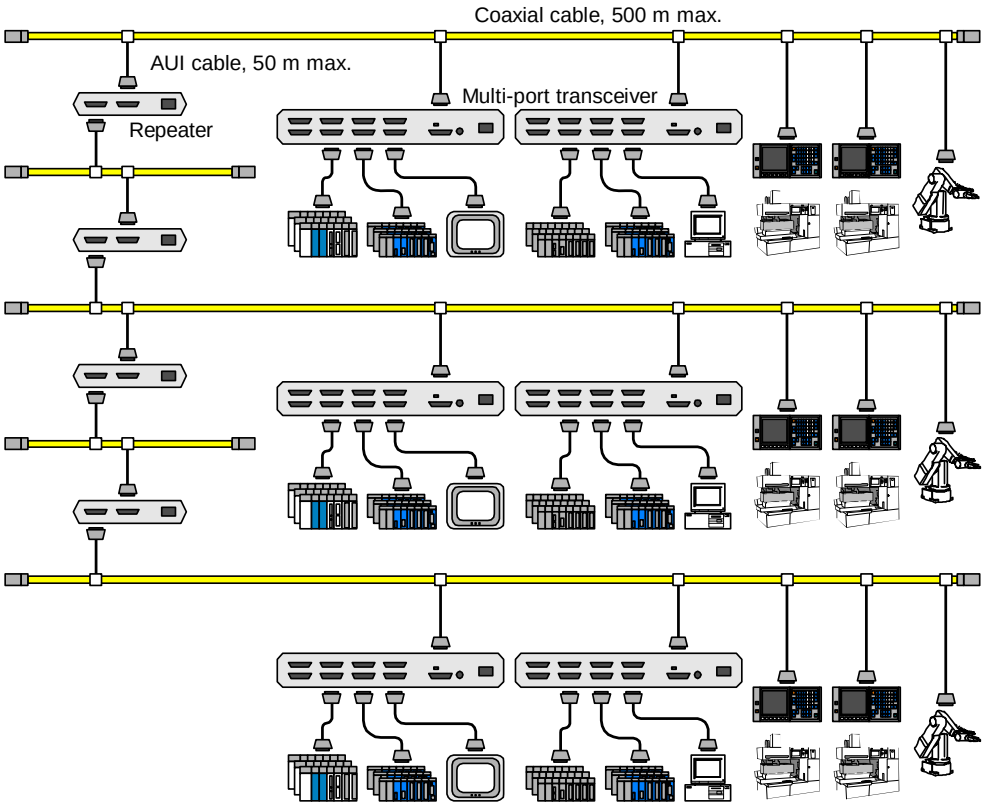


Fig. 5.14 Large-scale Configuration

TIP

- If a multi-port transceiver is used, the total length of AUI cables leading from the coaxial cable to any FA controller must not exceed 50 m.
- No more than two multi-port transceivers may be cascaded.
- The total number of repeaters and HUBs between any two FA controllers must not exceed four.

■ Long-distance Distributed Configuration

A long-distance distributed configuration is used when the distance between network segments exceed the maximum transmission distance of 10BASE5 (500 m). In a long-distance distributed configuration, each network segment is connected to an optical repeater, and every two repeaters are connected using a fiber optic cable, which support a maximum transmission distance of 2 km.

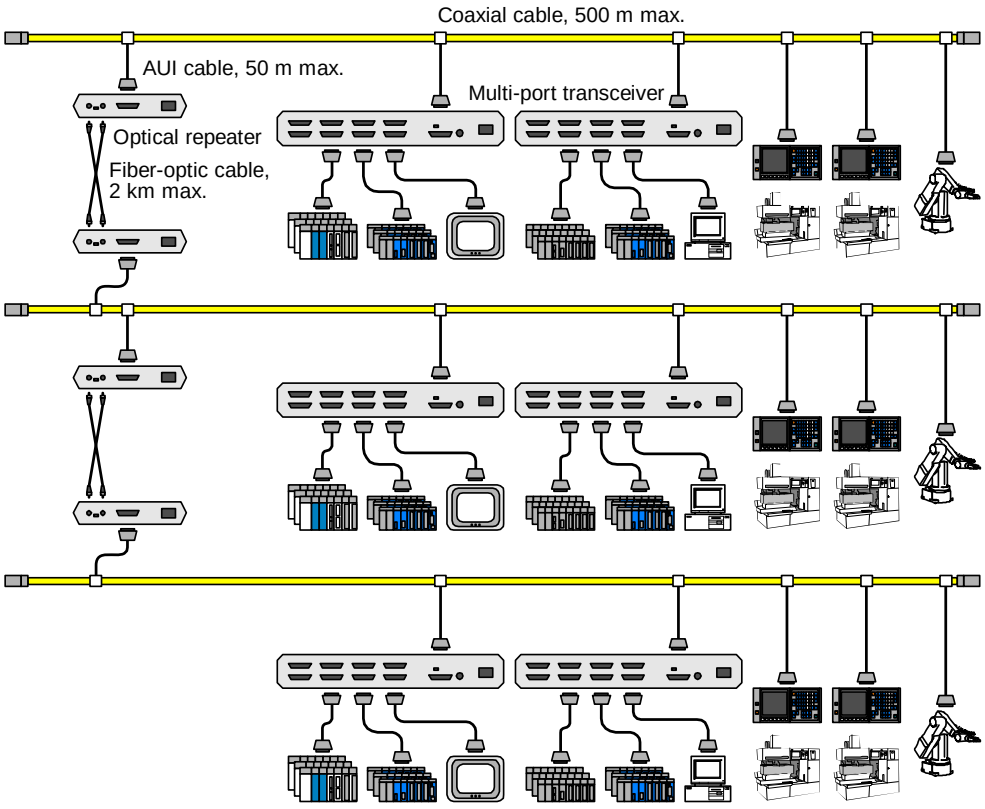


Fig. 5.15 Long-distance Distributed Configuration

TIP

- If a multi-port transceiver is used, the total length of AUI cables leading from the coaxial cable to any FA controller must not exceed 50 m.
- No more than two multi-port transceivers may be cascaded.
- The total number of repeaters and HUBs between any two FA controllers must not exceed four.

■ Locally-Concentrated Configuration

A locally-concentrated configuration is a modified version of a basic configuration where tens of FA controllers form a local group. It uses stackable HUBs to provide more ports.

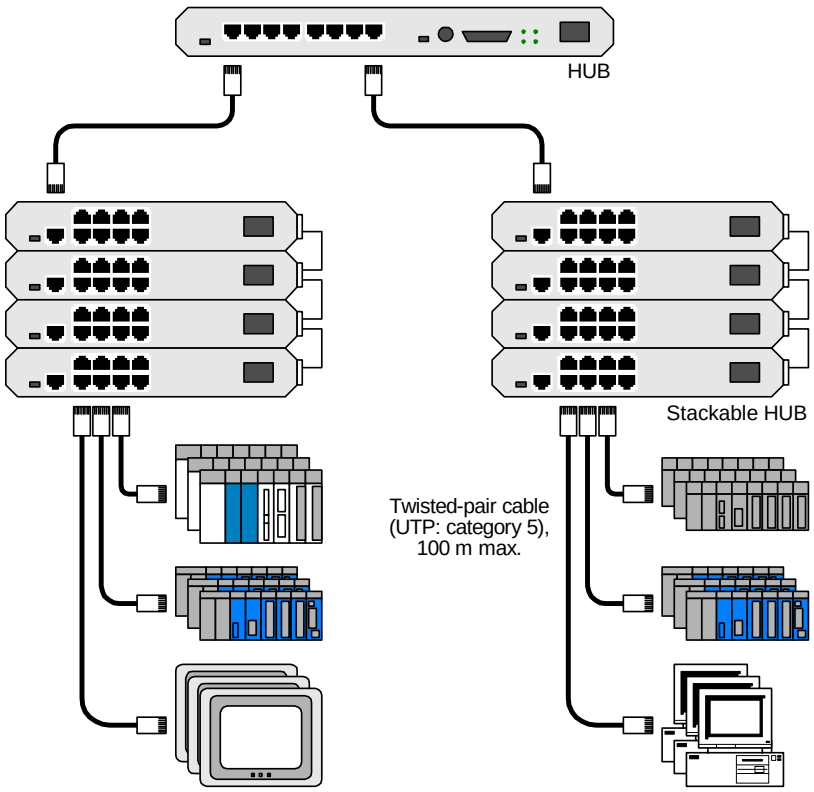


Fig. 5.16 Locally-Concentrated Configuration

■ Long-distance Distributed Configuration with Local concentration

A long-distance distributed configuration with local concentration is a modified version of a basic configuration where a specific group of FA controllers is far away from other groups or where an ordinary repeater cannot be used to connect groups because of a nearby high voltage power supply or other noise source. It uses a fiber-optic cable to connect groups so as to ensure noise-free long-distance transmission.

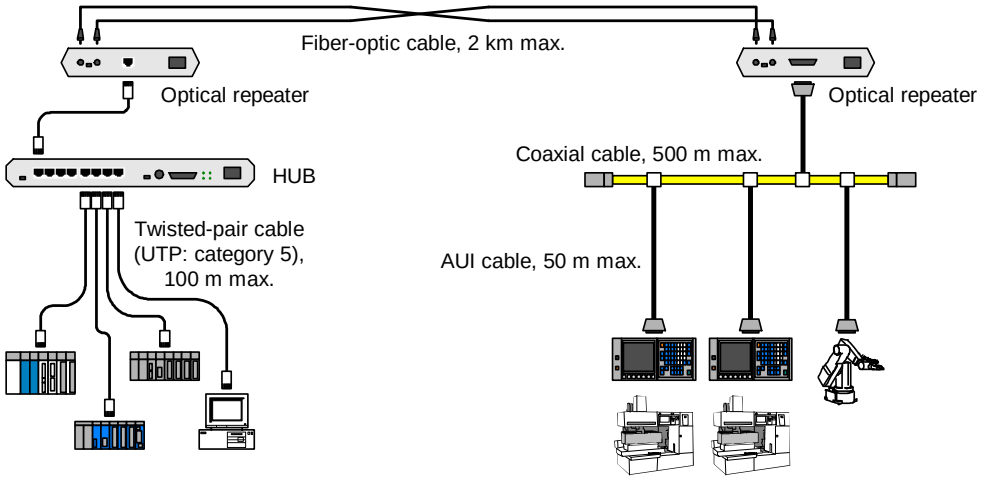


Fig. 5.17 Long-distance Distributed Configuration with Local concentration

5.3 Defining a Network System

■ Communication Protocols and Standards

A communication protocol is a set of rules that governs how device communicate with each other through a transmission medium. The FL-net (OPCN-2) communication protocols comply with the standards listed in Table 5.2.

Table 5.2 FL-net (OPCN-2) Communication Protocols

Protocols	Standards
FL-net (OPCN-2)	JEM1479: 2002 (a JEM standard for FL-net (OPCN-2) FA controller network developed by the Japan Electrical Manufacturers' Association)
UDP	RFC768
IP and ICMP	RFC791, 792, 919, 922, and 950
ARP	RFC826 and 894
Ethernet	IEEE802.3

■ Communication Protocol Hierarchy

Fig. 5.18 compares a six-layer communication protocol hierarchy model with the FL-net (OPCN-2) protocol layers.

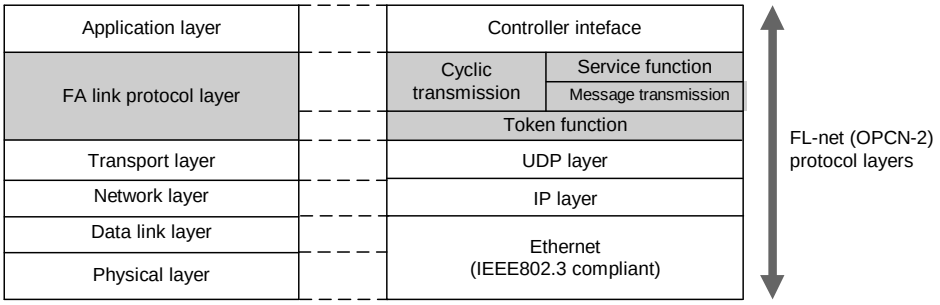


Fig. 5.18 FA Link Protocol Layers

■ Physical Layer of FL-net (OPCN-2)

The physical layer of Ethernet supports 10BASE5, 10BASE2, 10BASE-T, 10BASE-F, and 10BROAD36 for 10M bps transmission rate. Ethernet also supports 100M bps transmission. The physical layer of FL-net (OPCN-2) supports 10BASE5 (recommended), 10BASE2, and 10BASE-T.

■ FL-net (OPCN-2) IP Address

An IP address identifies a communication device participating in an Ethernet network. Each Ethernet communication device must be assigned a unique IP address. An IP address consists of a network address and a host address, where the network address identifies a network and the host address identifies a host. A network is either class A, B, or C depending on its size (special classes include class D and class E).

Table 5.3 IP Address Classes

	First Octet Value	Network Address	Host Address
Class A	0-127	xxx.xxx.xxx.xxx	xxx.xxx.xxx.xxx
Class B	128-191	xxx.xxx.xxx.xxx	xxx.xxx.xxx.xxx
Class C	192-223	xxx.xxx.xxx.xxx	xxx.xxx.xxx.xxx

Note: The shaded part xxx of an IP address represents a network or host address.

The IP address of each communication device participating in a network has a common network address and a unique host address. The default IP address of an FL-net (OPCN-2) device is a class-C IP address in the form of 192.168.250.N, where host address N (also known as node number) is in the range 1-254. FL-net (OPCN-2) recommends making the node number of a device the same as the lower digits of its host address.

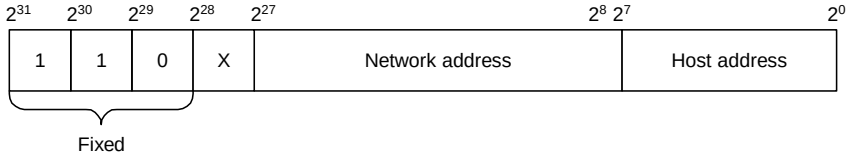


Fig. 5.19 FL-net (OPCN-2) IP Address

■ FL-net (OPCN-2) Subnet Mask

The subnet mask for FL-net (OPCN-2) is fixed to 255.255.255.0, thus defining all FL-net (OPCN-2) IP addresses as class C addresses. FL-net (OPCN-2) users need not set the subnet mask.

■ TCP/IP and UDP/IP Protocols

TCP, UDP, and IP protocols are all important Ethernet protocols. IP corresponds to the network layer of the communication protocol hierarchy model. It controls network traffic. Both TCP and UDP correspond to the transport layer, which is right above the network layer. Both of them operate on IP but have very different characteristics.

TCP provides a reliable service to the upper layer, and keeps the splitting of data into smaller datagrams for transmission transparent to the upper layer. On the other hand, UDP passes datagrams received from IP directly to the upper layer, without guarantee of successful delivery. Therefore, data delivery acknowledgement and retransmission request must be done by the upper layer. Although UDP is less reliable than TCP, it has the advantage of fast response because of smaller overheads. For this reason, FL-net (OPCN-2) adopts UDP so that it can enjoy fast communication while letting the upper layer (FL-net (OPCN-2) protocol layer) handle token rotation and frame disassembly/reassembly.

■ Port Numbers of FL-net (OPCN-2)

FL-net (OPCN-2) uses port numbers as shown in Table 5.4 so that it can perform services required in the FL-net (OPCN-2) protocol layer, which is right above the transport layer. This information is for your interest only. You do not have to worry about port numbers at parameter setup.

Table 5.4 Port Numbers of FL-net (OPCN-2)

	Port	Port Number
1	Port number for token and cyclic frames	55000 (fixed)
2	Port number for message frames	55001 (fixed)
3	Port number for trigger and participation request frames	55002 (fixed)
4	Port number for transmission	55003 (fixed)

■ FL-net (OPCN-2) Data Format

● General

User data received in FL-net (OPCN-2) is added with a header at each protocol layer before it is passed down to the next lower layer as shown in Fig. 5.20.

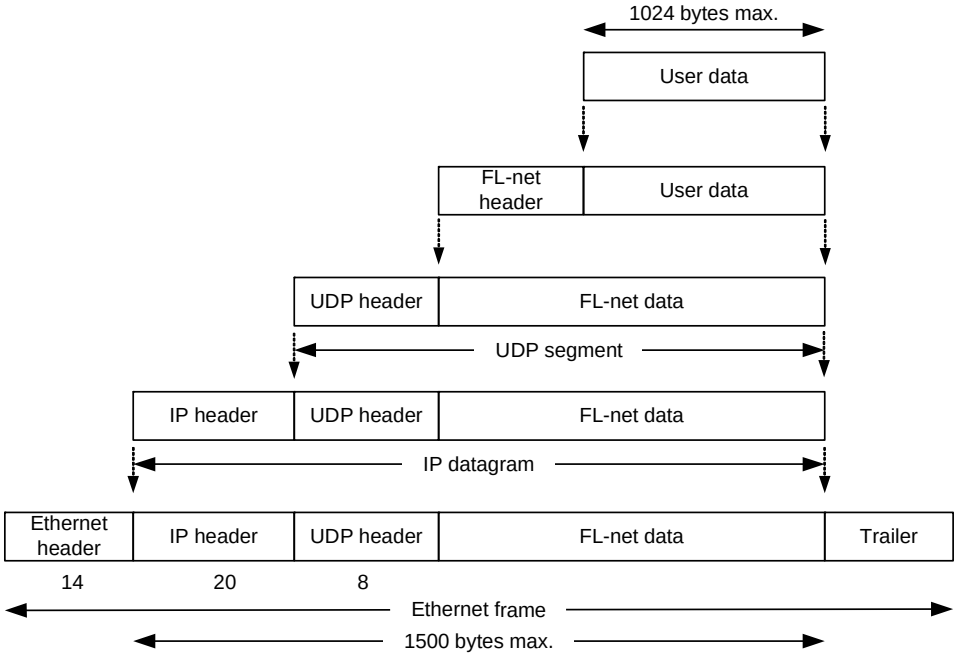


Fig. 5.20 FL-net (OPCN-2) Data Format

Fig. 5.21 shows an example of a 136-byte cyclic frame, which is actually observed on a communication line.

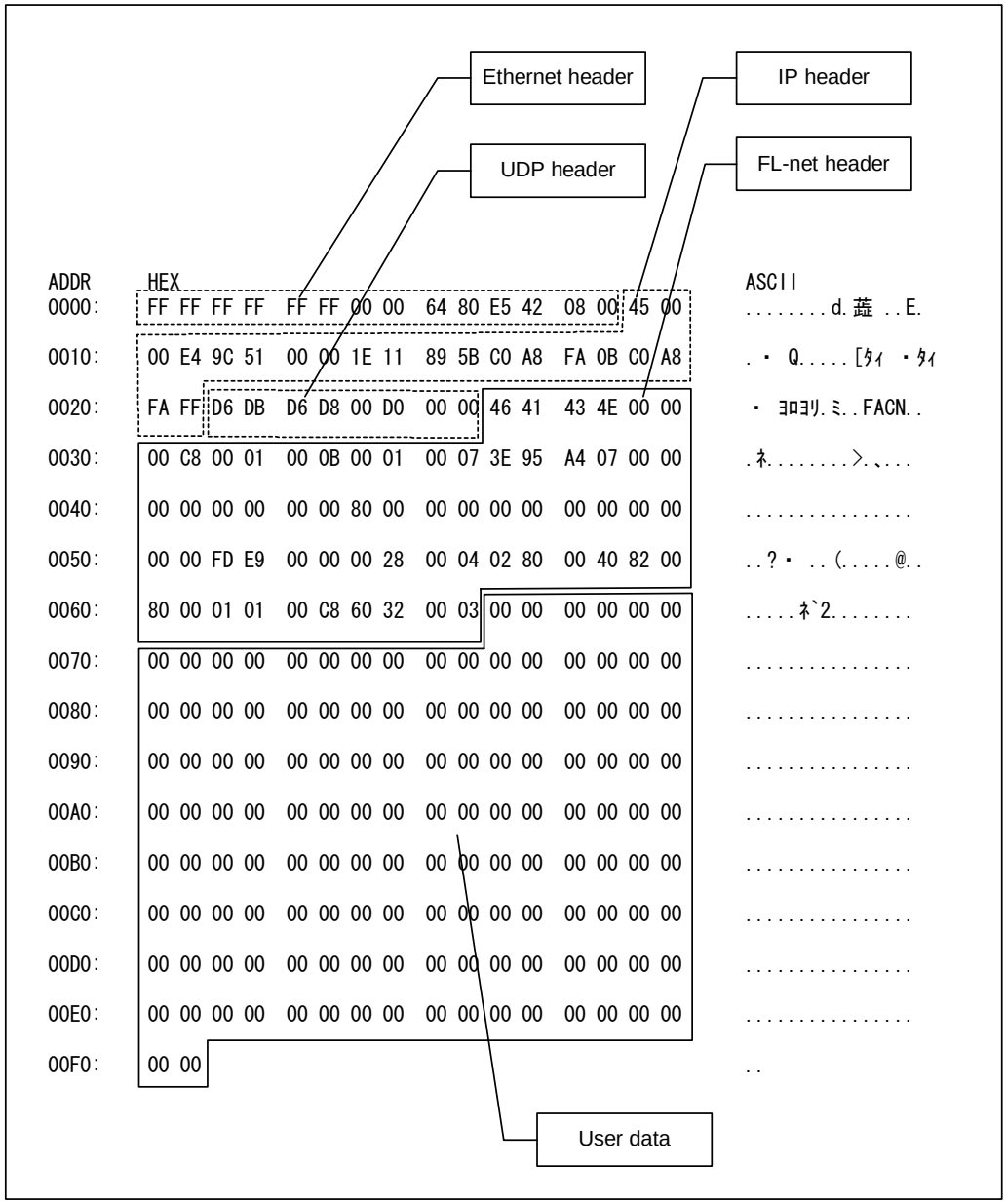


Fig. 5.21 One Frame of Data (example)

FL-net Header

The FL-net header is 64 to 96 bytes long.

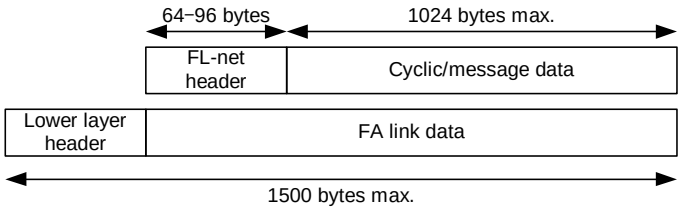


Fig. 5.22 FL-net Header

The FL-net header is attached to each frame to form FA link data to be processed in the FL-net (OPCN-2) protocol layer.

■ FL-net (OPCN-2) Transaction Codes (TCD)

FL-net (OPCN-2) message transmission supports the services listed in Table 5.5.

Table 5.5 List of Message Transmission Services

	FL-net (OPCN-2) Message Transmission Services
1	Byte block read
2	Byte block write
3	Word block read
4	Word block write
5	Read network parameters
6	Write network parameters
7	Stop command
8	Start command
9	Read profile
10	Read log data
11	Clear log data
12	Echo message
13	Vendor-specific message
14	Transparent message

Each service is executed in the form of request and response message frames delivered which are identified with a transaction code in their header.

Table 5.6 Message Frames and their Transaction Code

Transaction Code	Message Frames
0-9999	Reserved
10000-59999	Transparent message frame
60000-64999	Reserved
65000	Token frame
65001	Cyclic frame
65002	Participation request frame
65003	Byte block read (request) frame
65004	Byte block write (request) frame
65005	Word block read (request) frame
65006	Word block write (request) frame
65007	Read network parameters (request) frame
65008	Write network parameters (request) frame
65009	Stop command (request) frame
65010	Start command (request) frame
65011	Read profile (request) frame
65012	Trigger frame
65013	Read log data (request) frame
65014	Clear log data (request) frame
65015	Echo message (request) frame
65016	Vendor specific message (request) frame
65017-65202	Reserved (for future use)
65203	Byte block read (response) frame
65204	Byte block write (response) frame
65205	Word block read (response) frame
65206	Word block write (response) frame
65207	Read network parameters (response) frame
65208	Write network parameters (response) frame
65209	Stop command (response) frame
65210	Start command (response) frame
65211	Read profile (response) frame
65212	Reserved
65213	Read log data (response) frame
65214	Clear log data (response) frame
65215	Echo message (response) frame
65216	Vendor specific message (response) frame
65217-65399	Reserved (for future use)
65400-65535	Reserved

5.4 FL-net (OPCN-2) Network Control

■ FL-net (OPCN-2) Token Control

● Token

Basically, a node can send out data only when it is holding the token. Exceptions to this are token reissue resulting from a lost token and participation request frame transmission for a new participation request.

- FL-net (OPCN-2) has one token circulating through all nodes participating in the same network.
- A node has the right to send out frames when it is holding the token, and loses the right once it passes the token to the next node.
- Each node monitors the circulation time of the token. If it fails to reach a particular node within a specified interval, it is deemed lost and automatically reissued.
- If two or more tokens are circulating in the network, extra tokens are automatically removed so that only one token is present.

● How the token circulates

Normally only one token circulates in the network. If a node encounters two or more different tokens, it retains the token with the smallest destination node number, and discards the rest.

The token is contained in a frame, which is called the token frame. The token frame contains a token destination node number and a token source node number. A node is called the token holding node when it receives a token frame that contains a token destination node number referring to itself. The token holding node changes from one node to another as the token destination node number of the token frame is overwritten by a receiving node. The rotation of the token holding node is referred to as the rotation of the token. The token is rotated according to the node numbers that are included in the participating node management information. More specifically, the token is rotated in ascending order of node numbers. When the token reaches a node with the largest node number, it is returned to the node with the smallest node number.

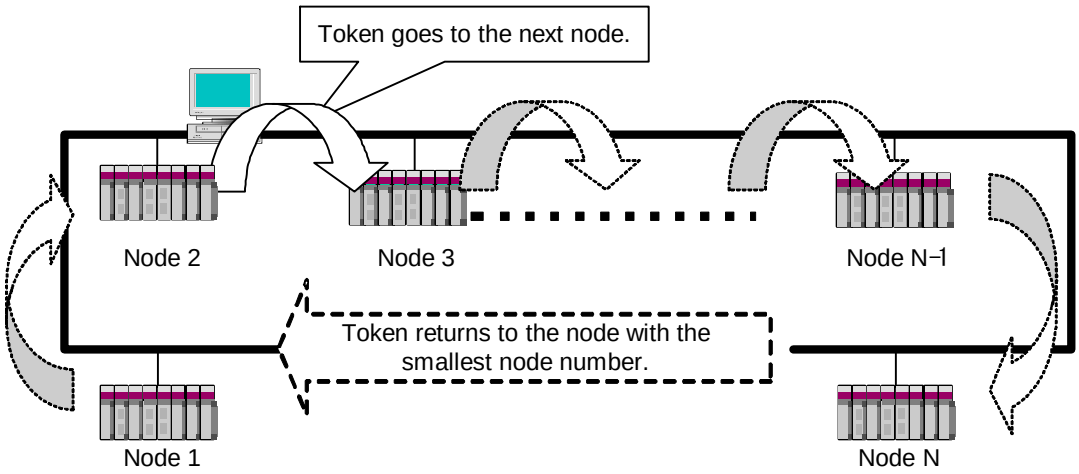
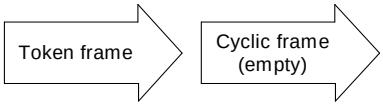
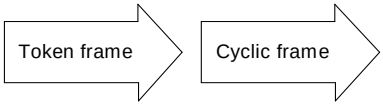
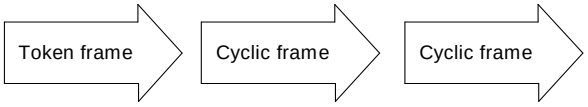
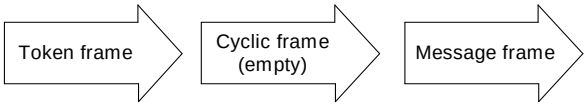
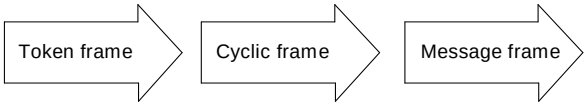
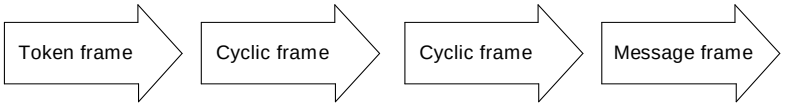


Fig. 5.23 Rotation of the Token

Token and data

The token is sent in one of the following six data patterns.

Table 5.7 Token and Data

No.	Item	Description
1	With no cyclic data	First an empty cyclic frame, then the token frame.
		
2	With cyclic data only	First a cyclic frame, then the token frame.
		
3	With two frames of cyclic data only	First cyclic frames, then the token frame.
		
4	With message data only	First a message frame followed by an emply cyclic frame, then the token frame.
		
5	With cyclic data and message data	First a message frame followed by a cyclic frame, then the token frame.
		
6	With message data and two frames of cyclic data	First a message frame followed by two cyclic frames, then the token frame.
		

Frame interval and minimum allowable frame interval

The time required for a node to transmit frames after receiving a token is the frame interval (or token response time) of that node. The minimum allowable frame interval is the time period that each node must wait before sending out frames after receiving a token. The minimum allowable frame interval is common to all FL-net (OPCN-2) nodes. Whenever a new node joins a network or a participating node withdraws from the network, the minimum allowable frame interval is reset to the maximum of the frame intervals of all participating nodes.

■ FL-net (OPCN-2) Participation and Withdrawal

● Participation in FL-net (OPCN-2)

After powering up, each node monitors the line for the token. If a node receives the token within the joining token detection time, it assumes that the network is up and running, and attempts a halfway participation. Otherwise, it assumes that the network is starting up and attempts a new participation. Halfway and new participations are described below.

● New participation

If a node fails to receive the token within the joining token detection time, it prepares to transmit a trigger after a certain delay, calculated as 4 ms multiplied by the remainder of its node number when divided by 8. If it receives a trigger from another node during this delay, it refrains from transmitting its own trigger. After receiving a trigger, a node transmits the participation request frame after a certain delay, calculated as 4 ms multiplied by its node number, and waits for up to 1200 ms (participation request frame acceptance time) for all nodes to transmit their participation request frame, all the time updating the participating node management information and checking for duplicate node numbers and overlapping addresses. During this time period, if a node finds a duplicate node address in the participation request frame received from another node, it resets its area 1 and area 2 top addresses and sizes to 0 and transmits no cyclic data; sets the overlapping address detected flag; resets the common memory data valid notification flag; and refrains from participating in any communication. When the participation request frame acceptance time expires, a node with the smallest node number transmits the token according to the participating node management information.

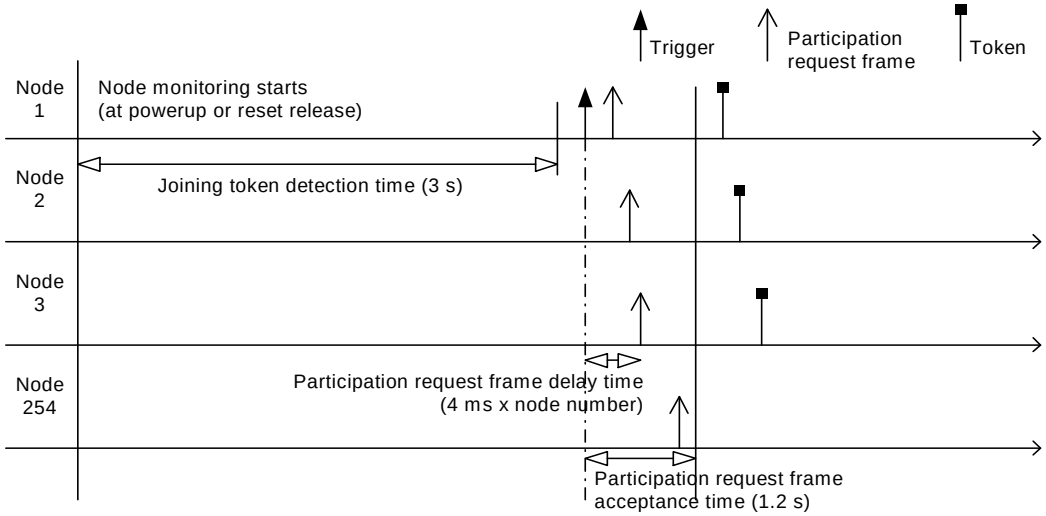


Fig. 5.24 Startup Time Chart (1)

Halfway participation

If a node receives the token within the joining token detection time, it assumes that the network is up and running, and waits until the token completes three rotations before transmitting a participation request frame. During this waiting period, it checks all node numbers and addresses it has received for duplicates, and updates the participating node management information. If it finds a duplicate node address in a participation request frame received from other nodes, it resets its area 1 and area 2 start addresses and sizes to 0 and transmits no cyclic data; sets the overlapping address detected flag; resets the common memory data valid notification flag; refrains from transmitting the participation request frame; and refrains from participating in any communication. If it finds no duplicate node number, it transmits the participation request frame after a certain delay irrespective of whether it is holding the token.

TIP

Joining token detection time: A time period for checking whether the network is up and running.

Token rotation: One token rotation is deemed completed when a node receives the token addressed to the node with the smallest node number.

Participation request frame delay time: A delay required before a node transmits the participation request frame so that only one node transmits a participation request frame at a time. The delay for a specific node is calculated as 4 ms multiplied by its node number.

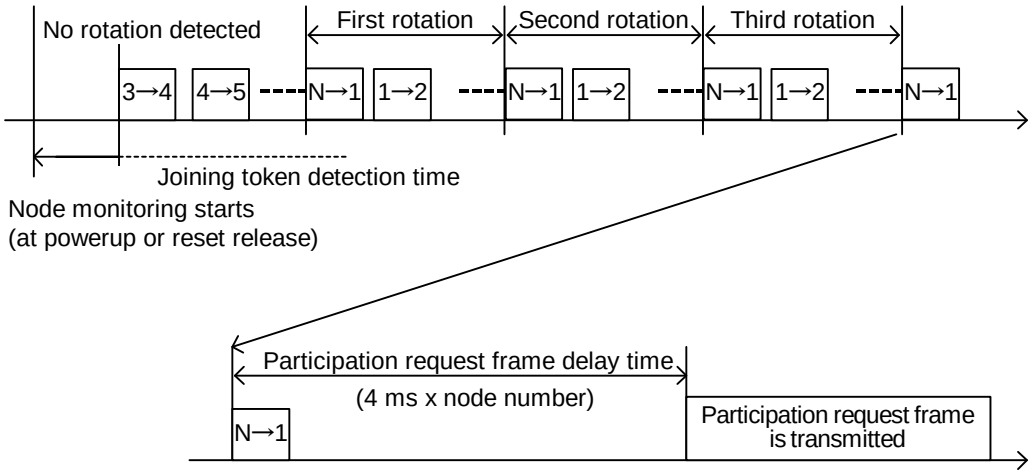


Fig. 5.25 Startup Time Chart (2)

Withdrawal from FL-net (OPCN-2)

A node is deemed to have withdrawn from the network if no token frame is transmitted within the token watchdog time by that node in three consecutive node rotations.

When a node is deemed to have withdrawn from the network, its information is deleted from the participating node management information.

5.5 Data Returned by Read Log Data Service

Table 5.8 shows which data items of the Read Log Data service defined in the FL-net (OPCN-2) standard are implemented.

Table 5.8 Contents of Log Data Read Service

Contents		Implementation	Remarks
Send/receive	Total number of transmissions at socket unit	✓	
	Total number of transmission errors at socket unit	✓	
	Number of Ethernet transmission errors	×	
	Total number of receptions at socket unit	✓	
	Total number of reception errors at socket unit	✓	
	Number of Ethernet reception errors	×	
Frame	Number of tokens transmitted	×	
	Number of cyclic frames transmitted	×	
	Number of peer-to-peer messages transmitted	×	
	Number of broadcast messages transmitted	×	
	Number of tokens received	×	
	Number of cyclic frames received	×	
	Number of peer-to-peer messages received	×	
	Number of broadcast messages received	×	
Cyclic transmission	Number of cyclic reception errors	✓	
	Number of cyclic address size errors	✓	
	Number of cyclic CBN errors	✓	
	Number of cyclic TBN errors	✓	
	Number of cyclic BSIZE errors	✓	
Message transmission	Number of message retransmissions	✓	
	Number of message retransmissions exceeding limit	✓	
	Number of message reception errors	✓	
	Number of message version-of-sequence number errors	✓	
	Number of message sequence number retransmissions recognized	✓	
ACK	Number of ACK errors	✓	
	Number of ACK version-of-sequence number errors	✓	
	Number of ACK sequence number errors	✓	
	Number of ACK node number errors	✓	
	Number of ACK TCD errors	✓	
Token	Number of duplicate tokens recognized	✓	
	Number of tokens discarded	✓	
	Number of tokens re-issued	✓	
	Number of token holding timeouts	✓	
	Number of token monitoring timeouts	✓	
Status 1	Total service time	✓	
	Number of frame waiting states	✓	
	Number of participations	✓	
	Number of self-withdrawals	✓	
	Number of withdrawals by skipping	✓	
	Number of withdrawals of other nodes recognized	✓	
Status 2	List of participating nodes recognized	✓	

✓: Implemented

×: Not implemented

5.6 Data Returned by Read Device Profile Service

Table 5.9 shows the items returned by the Read Device Profile service.

Data types: Boo, Int, Bit, Oct, Nul, Seq, and Str (Str means printable string)

Table 5.9 Contents of Device Profile Read Service

Type	Size	Contents	Remarks
Seq	113	—	
Seq	111	—	
Str	6	COMVER	
Int	1	1	
Str	2	ID	
Str	7	SYSPARA	
Str	3	REV	
Int	1		
Str	7	REVDATE	
Seq	10	—	
Int	2		
Int	1		
Int	1		
Str	10	DVCATEGORY	
Str	3	PLC	
Str	6	VENDOR	
Str	10	YOKOGAWA	
Str	7	DVMODEL	
Str	10	F3LX02-1N	

5.7 Communication Performance

■ Token Response Time

The token response time, or frame interval, of a node is the time taken for it to transmit the token addressed to the next node after receiving the token addressed to itself.

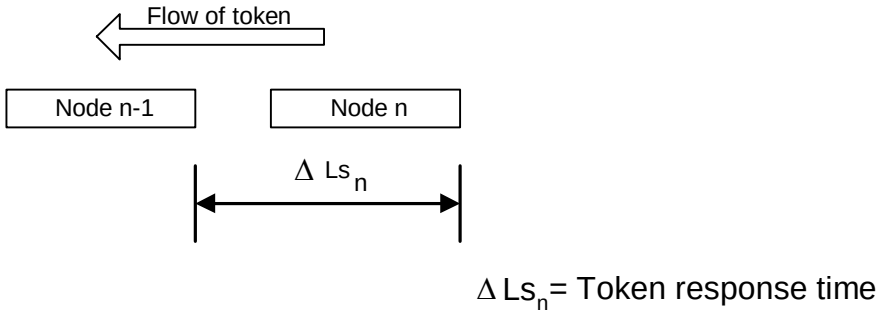


Fig. 5.26 Token Response Time

Table 5.10 shows the typical token response time of this module as a function of common area data size. The token response time of a node depends on the size of data addressed to it and the size of data it transmits to another node. The token response time of a node also depends on its internal processing time. Table 5.10 assumes that all nodes have the same common area size and transmit the same size of data to each other.

Table 5.10 Token Response Time of the Module

Common Area Data Size (in units of words per node)		Token Response Time (ms)
Area 1	Area 2	
1	16	0.72
2	32	0.75
4	64	0.85
8	128	1.06
16	256	1.38
32	512	2.18
64	1024	3.25
96	1536	4.23
128	2048	5.39
160	2560	6.33
192	3072	7.76
224	3584	8.46
256	4096	9.42

For the token response time of equipment from other vendors, see the user's manual for that equipment.

TIP

You can calculate the refresh cycle time from the token response time of each participating node as follows:

Refresh cycle time = $\Sigma\Delta Ls_n$

■ Communication Time

This module allows for high-speed data communication between FA-M3 systems, thanks to its triple-R technology (for rapid refresh and reflection).

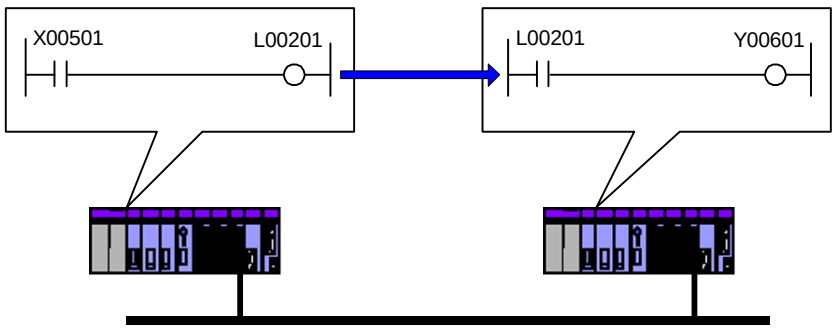


Fig. 5.27 Data Communication between FA-M3 Systems

Fig. 5.28 illustrates how quickly the FA-M3 systems can communicate with each other (as a function of the number of nodes). The time required for nodes to communicate with each other, or communication time, depends on the size of data that a node transmits and the number of nodes (common memory size). Fig. 5.28 assumes that each node has the same common memory area size. In an actual application, the communication time also depends on the scan time of the user programs on the transmission and receiving end.

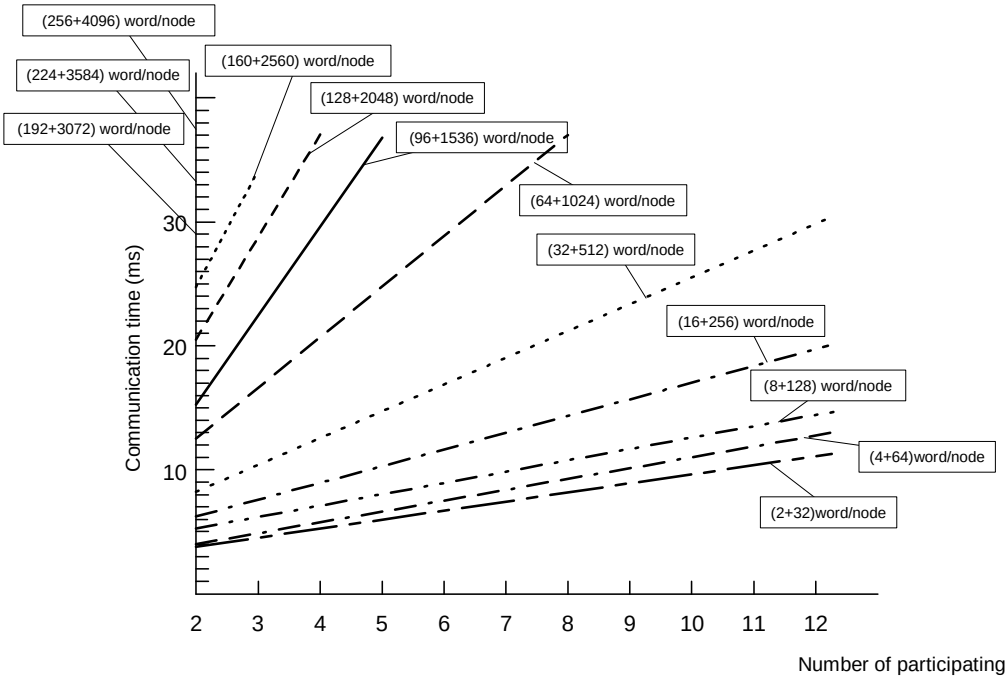


Fig. 5.28 Communication Time (under control process refreshing)

TIP

Communication time also depends on how the top address and the size of a common memory area are specified even for the same common memory area size. Specifically, communication time is shortest if the top address is an even-numbered address and the size is an even number of words, while it is longest if the top address is an odd-numbered address and the size is an odd number of words. Fig. 5.28 assumes that the top address is an even-numbered address and the size is an even number of words. Also, it is longer if If peripheral process refreshing method is specified.

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FA-M3

FL-net (OPCN-2) Interface Module

IM 34M06H32-02E 2nd Edition

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