FANUC Series 30*i*-MODEL A/B FANUC Series 31*i*-MODEL A/B FANUC Series 32*i*-MODEL A/B FANUC Series 35*i*-MODEL B FANUC Power Motion *i*-MODEL A FANUC Series 0*i*-MODEL F

FL-net Board CONNECTION MANUAL

B-64163EN/04

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In this manual we have tried as much as possible to describe all the various matters.

However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities.

Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible".

This manual contains the program names or device names of other companies, some of which are registered trademarks of respective owners. However, these names are not followed by @ or $^{\text{\tiny TM}}$ in the main body.

SAFETY PRECAUTIONS

"SAFETY PRECAUTIONS" describes the safety precautions related to the use of CNC units, to ensure safe operation of machines fitted with FANUC CNC units. Read this section carefully before attempting to use any function described in this manual.

Users should also read the relevant descriptions in the Operator's Manual of the CNC to become fully familiar with the functions to be used.

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GENERAL WARNINGS AND CAUTIONS	s-2
GENERAL WARNINGS FOR CNC APPLICATION DEVELOPMENT	s-3

DEFINITION OF WARNING, CAUTION, AND NOTE

This manual includes safety precautions for protecting the user and preventing damage to the machine. Precautions are classified into Warnings and Cautions according to their bearing on safety. Also, supplementary information is described as Notes. Read the Warnings, Cautions, and Notes thoroughly before attempting to use the machine.

⚠ WARNING

Applied when there is a danger of the user being injured or when there is a danger of both the user being injured and the equipment being damaged if the approved procedure is not observed.

↑ CAUTION

Applied when there is a danger of the equipment being damaged, if the approved procedure is not observed.

NOTE

The Note is used to indicate supplementary information other than Warning and Caution.

• Read this manual carefully, and store it in a safe place.

GENERAL WARNINGS AND CAUTIONS

⚠ WARNING

- 1 Before operating the machine, thoroughly check the entered data. Operating the machine with incorrectly specified data may result in the machine behaving unexpectedly, possibly causing damage to the tool, machine, and/or workpiece, or injury to the user.
- 2 Never attempt to machine a workpiece without first checking the programmed value, compensation value, current position, and external signal settings. Also, never attempt to machine a workpiece without first checking the operation of the machine. Before starting a production run, ensure that the machine is operating correctly by performing a trial run using, for example, the single block, feedrate override, or machine lock function, or by operating the machine with neither a tool nor workpiece mounted. Failure to confirm the correct operation of the machine may result in the machine behaving unexpectedly, possibly causing damage to the workpiece and/or machine itself, or injury to the user.
- 3 Ensure that the specified feedrate is appropriate for the intended operation. Generally, for each machine, there is a maximum allowable feedrate. The appropriate feedrate varies with the intended operation. Refer to the manual provided with the machine to determine the maximum allowable feedrate. If a machine is turn at other than the correct speed, unexpected load may be applied to the machine, possibly causing damage to the tool, machine, and/or workpiece, or injury to the user.
- 4 When using a tool compensation function, thoroughly check the direction and amount of compensation. Operating the machine with incorrectly specified data may result in the machine behaving unexpectedly, possibly causing damage to the tool, machine, and/or workpiece, or injury to the user.
- The parameters for the CNC and PMC are factory-set. Usually, there is no need to change them. When, however, there is no alternative other than to change a parameter, ensure that you fully understand the function of the parameter before making any change.

 A failure to set a parameter correctly may result in the machine behaving
 - unexpectedly, possibly causing damage to the tool, machine, and/or workpiece, or injury to the user.

! CAUTION

- Immediately after switching on the power, do not touch any of the keys on the MDI unit until the position display or alarm screen appears on the CNC unit. Some of the keys on the MDI panel are dedicated to maintenance or other special operations. Pressing any of these keys may place the CNC unit in other than its normal state. Starting the machine in this state may cause it to behave unexpectedly.
- 2 The operator's manual for the CNC describes all the basic functions of the CNC, including the optional functions. The selected optional functions vary with the machine. Some functions described in this manual may not, therefore, be supported by your machine. Check the machine specifications before using the optional functions.

⚠ CAUTION

- 3 Some machine operations and screen functions are implemented by the machine tool builder. For an explanation of their usage and related notes, refer to the manual provided by the machine tool builder. For example:
 - On some machines, executing a tool function causes the tool change unit to operate. When executing a tool function on such a machine, stand well clear of the tool change unit. Otherwise, there is a danger of injury to the operator.
 - Many auxiliary functions trigger physical operations, such as rotation of the spindle. Before attempting to use an auxiliary function, therefore, ensure that you are fully aware of the operation to be triggered by that function.

NOTE

Command programs, parameters, and variables are stored in nonvolatile memory in the CNC. Generally, the contents of memory are not lost by a power on/off operation. However, the contents of memory may be erased by mistake, or important data in nonvolatile memory may have to be erased upon recovering from a failure.

To enable the restoration of data as soon as possible if such a situation arises, always make a backup of the data in advance.

GENERAL WARNINGS FOR CNC APPLICATION DEVELOPMENT

⚠ WARNING

Be careful enough for the following warnings when you develop two or more applications or use networks.

If you neglect them, there is a danger of the user being injured or there is a danger of both the user being injured and the equipment being damaged.

1 Be careful enough if you write an identical CNC data, an identical PMC data or a series of related data set by two or more above applications including network functions. Because they are executed based on each individual cycles (in other words, asynchronous cycles), there is a possibility that the data will be written in an unexpected order.

Therefore, do NOT write above data in the following cases.

- Applications and network functions
- Two or more applications
- Two or more network functions

Data, applications and network functions of interest are listed in below. However, all may not be listed completely because new features will be added in the future.

- 2 Be careful enough that you must prevent PMC signals in the same byte from being written by the following two or more applications including network functions. While an application reads and writes one byte of PMC signals, other applications may write the same byte.
- Be careful enough if you process a PMC signal set that is related to a CNC function by using the following two or more applications including network functions. Because they are executed based on each individual cycles (in other words, asynchronous cycles), there is a possibility that the NC may receive the PMC signal set in an unexpected order.

⚠ WARNING

4 Generally, when multi-byte data are read or written at once among the following two or more applications including network functions, the coherency of the read multi-byte data (in other words, reading all latest data at once) is not guaranteed. To ensure the coherency of the multi-byte data, prepare flags to notify the completion of reading or writing process that is separated from the entity of the data and make the handshaking process to access the data by using the flags.

Data List Table

Category	Data
General data for CNC	Parameter, Tool compensation value and related data, Work zero offset value and related data, Workpiece coordinate system shift value and related data, Macro variable, P-CODE variable, Program and related data, Tool management function data, Tool life management data, Error compensation related data, Overtravel check (Interference check) related data, Software operator's panel related data
PMC data	PMC signal, PMC parameter
Data for Laser, Punch press or Wire cut	Tool data for punch press and related data, Safety zone data and related data, Laser cutting condition data and related data, Laser oscillator setting data and related data, Wire consumption compensation data, Guide position compensation data, Workpiece leveling data
Other data	Parameters for Data Server, Parameters for network setting

List Table of Applications and Network Functions

Category	Functions		
Applications	PMC Ladder, Macro Executor, C Language Executor, FANUC PICTURE, FOCAS2		
Network functions	FL-net, EtherNet/IP, PROFINET, Modbus/TCP, PROFIBUS-DP, DeviceNet, CC-Link		

- 5 CNC has functions that read or write PMC signals in other than the G/F address. Be careful enough if the above mentioned applications and network read or write PMC signals used by these functions. When reading or writing the same PMC signal, applications or CNC functions may work in an unexpected manner.
 - For the relevant CNC functions, refer to "LIST OF FUNCTIONS USING PMC SIGNALS OTHER THAN G/F ADDRESS" in Appendix in the CONNECTION MANUAL (FUNCTION) of the relevant CNC.

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I. GENERAL



1 GENERAL

This chapter explains the organization of this manual and how to read this manual.

1.1 ORGANIZATION OF THIS MANUAL

This manual consists of the following parts:

SAFETY PRECAUTIONS

Describes the precautions which must be observed when any of the functions explained in this manual is used.

I. GENERAL

Explains the organization of this manual, lists applicable models, and provides an overview of the FL-net function.

II. SPECIFICATION

Describes the specifications of the FL-net function.

III. SETTING

Describes the settings for FL-net communication and notes on creating a ladder program.

IV. CONNECTION

Describes how to connect devices to enable FL-net communication, as well as related precautions.

V. MAINTENANCE

Describes FL-net board drawing numbers and the meanings of LED indications

APPENDIX

Describes the Safety function by FL-net.

1.2 APPLICABLE MODELS

The models covered in this manual are as follows. The abbreviations listed below may be used to refer to the corresponding models.

Model name	Abbreviation			
FANUC Series 30 <i>i</i> -MODEL A	Series 30i-A	Series 30 <i>i</i> /31 <i>i</i> /32 <i>i</i> -A		
FANUC Series 31i-MODEL A	Carias 21: A			
FANUC Series 31 <i>i</i> -MODEL A5	Series 31 <i>i</i> -A			
FANUC Series 32i-MODEL A	Series 32i-A			Series
FANUC Series 30i-MODEL B	Series 30i-B			
FANUC Series 31i-MODEL B	Corios 21: D	Series	Series	30 <i>i</i> /31 <i>i</i> /32 <i>i</i> -A/B, 35 <i>i</i> -B. PM <i>i</i> -A
FANUC Series 31i-MODEL B5	Series 31 <i>i</i> -B	30i/31i/32i-B 30i/31i/32i-B or 30i/31i/32i/35i-B		33 <i>i</i> -B, i ivi <i>i-A</i>
FANUC Series 32i-MODEL B	Series 32i-B			
FANUC Series 35i-MODEL B	Series 35i-B	Series 35i-B		
FANUC Power Motion i-MODEL A	Power Motion i-A	Power Motion i-A	PM <i>i</i> -A	
FANUC Series 0i-MODEL F	Series 0i-F	Series 0i-F	Series 0i-F	0 <i>i</i> -F

1.3 RELATED MANUALS

The related manuals are shown below.

See also the following manuals together with this manual. This manual is indicated by an asterisk(*).

Manual name	Specification number
Related to Series 30i/31i/32i-A	
DESCRIPTIONS	B-63942EN
CONNECTION MANUAL (HARDWARE)	B-63943EN
CONNECTION MANUAL (FUNCTION)	B-63943EN-1
OPERATOR'S MANUAL (Common to Lathe System/Machining Center System)	B-63944EN
OPERATOR'S MANUAL (For Lathe System)	B-63944EN-1
OPERATOR'S MANUAL (For Machining Center System)	B-63944EN-2
MAINTENANCE MANUAL	B-63945EN
PARAMETER MANUAL	B-65950EN
Related to Series 30i/31i/32i-B	•
DESCRIPTIONS	B-64482EN
CONNECTION MANUAL (HARDWARE)	B-64483EN
CONNECTION MANUAL (FUNCTION)	B-64483EN-1
OPERATOR'S MANUAL (Common to Lathe System/Machining Center System)	B-64484EN
OPERATOR'S MANUAL (For Lathe System)	B-64484EN-1
OPERATOR'S MANUAL (For Machining Center System)	B-64484EN-2
MAINTENANCE MANUAL	B-64485EN
PARAMETER MANUAL	B-64490EN
Related to Series 35i-B	
DESCRIPTIONS	B-64522EN
CONNECTION MANUAL (HARDWARE)	B-64523EN
CONNECTION MANUAL (FUNCTION)	B-64523EN-1
OPERATOR'S MANUAL	B-64524EN
MAINTENANCE MANUAL	B-64525EN
PARAMETER MANUAL	B-64530EN
Related to Power Motion i-A	<u>'</u>
DESCRIPTIONS	B-64572EN
CONNECTION MANUAL (HARDWARE)	B-64573EN
CONNECTION MANUAL (FUNCTION)	B-64573EN-1
OPERATOR'S MANUAL	B-64574EN
MAINTENANCE MANUAL	B-64575EN
PARAMETER MANUAL	B-64580EN
Related to Series 0 <i>i</i> -F	
DESCRIPTIONS	B-64602EN
CONNECTION MANUAL (HARDWARE)	B-64603EN
CONNECTION MANUAL (FUNCTION)	B-64603EN-1
CONNECTION MANUAL (FUNCTION) (For Series 0 <i>i</i> -PF)	B-64623EN
OPERATOR'S MANUAL (Common to Lathe System/Machining Center System)	B-64604EN
OPERATOR'S MANUAL (For Series 0:-PF)	B-64624EN
OPERATOR'S MANUAL (For Lathe System)	B-64604EN-1
OPERATOR'S MANUAL (For Machining Center System)	
MAINTENANCE MANUAL	B-64604EN-2
	B-64605EN
PARAMETER MANUAL PARAMETER MANUAL (For Series 0 <i>i</i> -PF)	B-64610EN
	B-64630EN
PMC	D 00000EN
PMC PROGRAMMING MANUAL (For Series 30i/31i/32i-A)	B-63983EN
PMC PROGRAMMING MANUAL	B-64513EN
(For Series 30i/31i/32i/35i-B, Power Motion i-A, Series 0i-F)	

Manual name	Specification number	
Network		
PROFIBUS-DP Board CONNECTION MANUAL	B-63993EN	
Industrial Ethernet CONNECTION MANUAL	B-64013EN	
Fast Ethernet / Fast Data Server OPERATOR'S MANUAL	B-64014EN	
DeviceNet Board CONNECTION MANUAL	B-64043EN	
FL-net Board CONNECTION MANUAL	B-64163EN	*
CC-Link Board CONNECTION MANUAL	B-64463EN	
Dual Check Safety		
Dual Check Safety CONNECTION MANUAL	B-64483EN-2	
(For Series 30i/31i/32i/35i-B, Power Motion i-A, Series 0i-F)		
PC Tool		
CNC SETTING TOOL OPERATOR'S MANUAL	B-64174EN	

2 OVERVIEW OF FL-net FUNCTIONS

This chapter describes the specifications of FL-net functions.

2.1 WHAT IS THE FL-net

The FL-net is a control-level open FA network which connects FA controllers including programmable controllers (PLCs) and numerical control units (CNCs) and exchanges control data between controllers at high speed.

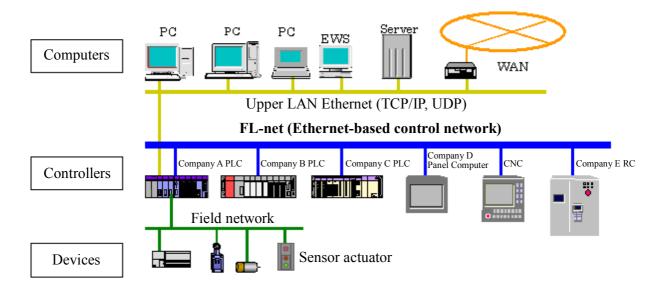
The FL-net can interconnect various types of FA controllers such as PLCs and CNCs, and personal computers that are manufactured by many different manufacturers to control and monitor them.

Features of the FL-net

The FL-net has the following features:

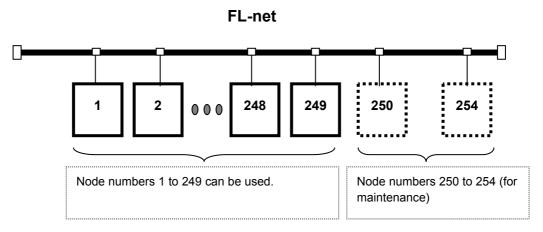
Multi-vendor environment using an open network

The FL-net conforms not to the FANUC-specific communication standard, but to the open FA network standard so that communication devices manufactured by different vendors (manufacturers) can communicate with each other.



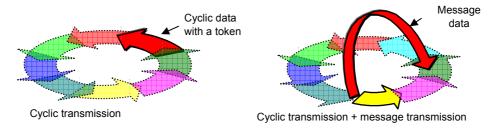
Large-scale network

Up to 249 communication devices (nodes) can be connected to share data among them.



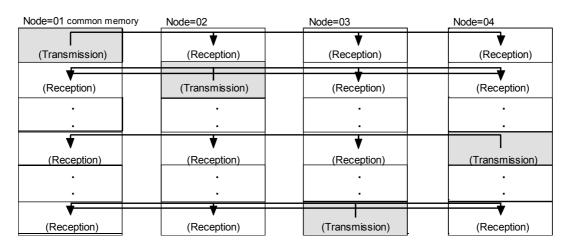
Two communication functions available according to the application

The FL-net supports both the common memory function and message communication function. The common memory function uses cyclic data transmission to allow the nodes to always share the same data. The message communication function allows the nodes to exchange only required information as required.



Large-capacity common memory

As common memory, 8K bits + 8K words (a total of 17K bytes) of large-capacity common memory can be shared among all nodes.



Fast response

The FL-net provides a fast response of 50 ms/32 nodes (at 2K bits + 2K words/32 nodes).

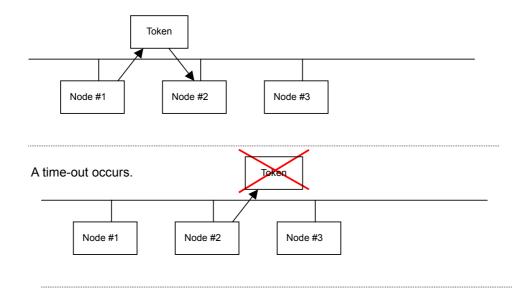
NOTE

This value indicates the speed at which a token is passed through nodes. It does not indicate the time from when data is set in a node to when it seems to be data in a different node.

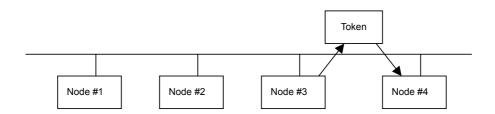
High reliability

Each node can participate in or be disconnected from the FL-net at any time. So, the power to each node can be turned on or off without restraint to provide high maintainability.

The masterless token method allows communication to be continued without stopping the network by the token management if a failure occurs in a communication device.



A token is reissued.



Low cost

The use of cables for Ethernet, which is now widespread in the OA field, can reduce the cost of communication devices such as transceivers and hubs.

High maintainability

Various types of management tables are available. The management tables can be referenced to identify a faulty node quickly.

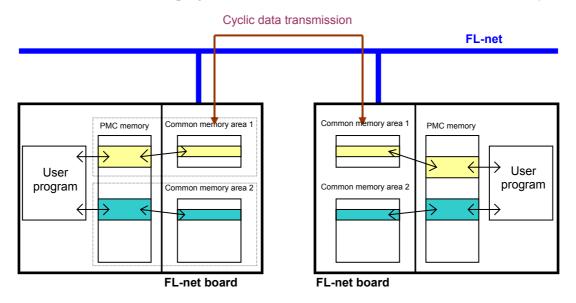
NOTE

For information about the FL-net, see the following home page of The Japan Electrical Manufacturers' Association (JEMA): http://www.jema-net.or.jp/

2.2 FANUC FL-net FUNCTIONS

Cyclic data transmission

With the FANUC FL-net, part of large-capacity common memory can be allocated in the PMC E area, R area, or D area to allow the user program to read and write data in the FL-net common memory.



The FL-net common memory contains two areas: an 8K-bit (= 0.5K-word) area called area 1 and an 8K-word area called area 2.

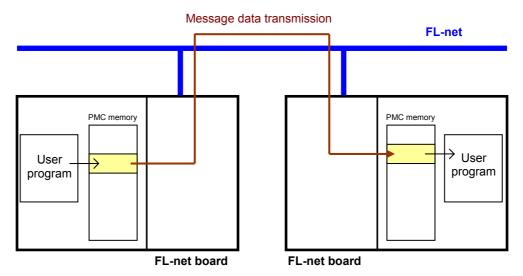
Generally, common memory area 1 is used for treating bit data and common memory area 2 is used for treating numeric data.

For how the PMC memory area corresponds to each common memory area and how to allocate common memory areas, see Sections 2.1, "COMMON MEMORY AREA 1 CYCLIC TRANSMISSION," and 2.2, "COMMON MEMORY AREA 2 CYCLIC TRANSMISSION," in Part II, "SPECIFICATION."

Message data transmission

The message data transmission function is the other FL-net function. With this function, the user program also executes message data transmission services via PMC memory areas.

To perform message data transmission, the user program writes the transmission request code of message data transmission in the PMC memory area that has been set as a message data transmission interface in advance. The user program also reads received message data via a PMC memory area. Part of message data transmission server (request receiver) processing may be performed in the FL-net board without user-program intervention.



For details of message data transmission, see Chapter 3, "MESSAGE TRANSMISSION," in Part II, "SPECIFICATION."

NOTE

The FL-net communication standards have two versions: version 1.00 and version 2.00 or later. A device which complies with version 1.00 cannot be made to communicate with any device that complies with version 2.00 or later. The FANUC FL-net complies with the FL-net communication standards version 2.00. So, when FL-net devices manufactured by FANUC are used, the entire network system must comply with the FL-net communication standards version 2.00 or later.

About transmission speed

The FANUC FL-net supports two transmission speeds of 10Mbps and 100Mbps. Please confirm the following items when you use the transmission speed of 100 Mbps.

- (1) Uses a switching hub with 100 Mbps / Full Duplex.
- (2) If you use A02B-0303-J566#656K (the past control software for FL-net function) for Series 30*i*/31*i*/32*i*-A, you must make auto-negotiation function effective. See Section 1.1, "PARAMETERS FOR FL-net FUNCTION" in Part III, "SETTING."
- (3) Auto-negotiation function is effective in default at A02B-0303-J566#656U (control software for FL-net/Ethernet coexisting function) for Series 30i/31i/32i-A, A02B-0323-J561#658K for Series 30i/31i/32i/35i-B and Power Motion i-A, and A02B-0339-J561#658B for Series 0i-F.

NOTE

Prepare the switching hub to communicate surely with 100 Mbps / Full Duplex when the FL-net/Ethernet coexisting function is used. The performance of the FL-net communication decreases because the FL-net communication is obstructed by the other data than the FL-net communication when the hub whose transmission speed is 10 Mbps / Half Duplex or 100 Mbps / Half Duplex is used.

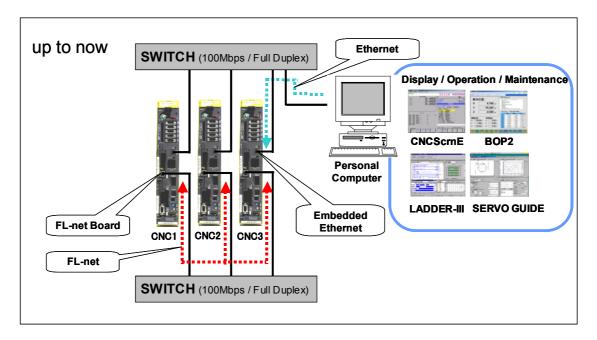
3 OVERVIEW OF FL-net/Ethernet COEXISTING FUNCTIONS

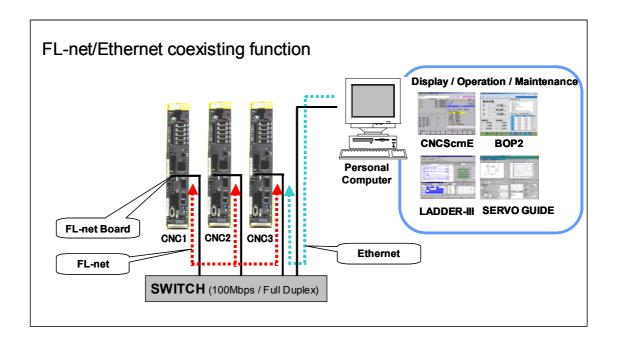
This chapter describes the specifications of FL-net/Ethernet coexisting functions.

3.1 WHAT IS THE FL-net/Ethernet coexisting FUNCTIONS

The FL-net/Ethernet coexisting function is a function that the FL-net communication can be used at the same time as Ethernet communication (FTP, "FOCAS2/Ethernet").

Two Ethernet cables were necessary when the FL-net communication and the Ethernet communication were used at the same time. However, by using FL-net/Ethernet coexisting function, the Ethernet cable can be wired with one line.





3.2 SPECIFICATION OF THE FL-net/Ethernet coexisting FUNCTIONS

In the FL-net/Ethernet coexisting function, the following functions can be used.

- (1) FL-net function
- (2) FOCAS2/Ethernet function (including Basic Operation Package 2 and SERVO GUIDE)
- (3) CNC screen display function
- (4) FANUC LADDER-III
- (5) FTP file transfer function
- (6) Unsolicited messaging function
- (7) DNS client function

Refer to "FANUC FAST Ethernet / FAST Data Server OPERATOR'S MANUAL"(B-64014EN) for details concerning the above-mentioned function.

In the FL-net/Ethernet coexisting function, the following functions cannot be used.

- (1) Data server function
- (2) Machine remote diagnosis function
- (3) DHCP client function

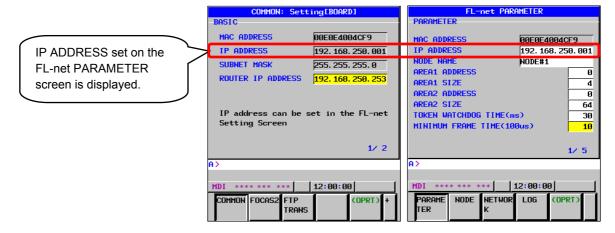
NOTE

- 1 When the FL-net/Ethernet coexisting function is used, it is recommended that 10 or more is set to the allowable minimum frame interval of the basic parameters. When the value of the allowable minimum frame interval is enlarged, both the refresh cycle time of FL-net and the process time of other communications will increase. Therefore, please do not set an excessively big value to the allowable minimum frame interval.
 - Refer to section 1.1 "PARAMETERS FOR FL-net FUNCTION" in part III "Setting" about the allowable minimum frame interval and refer to section 1.3 "MAINTENANCE SCREENS OF FL-net FUNCTION" in part III "Setting" about the refresh cycle time.
- 2 Notes on using the FL-net/Ethernet coexisting function with the Series 30*i*/31*i*/32*i*-A are listed below:
 - (1) To use the FL-net/Ethernet coexisting function, the conditions on the supported software including the series and edition must be satisfied.
 - (2) The FL-net/Ethernet coexisting function cannot be used with software for FL-net function, A02B-0303-J566#656K.
 - (3) To use the FL-net/Ethernet function, the FL-net/Ethernet coexisting function (R951) option as well as the Ethernet function (S707) and FL-net function (J692) options are required.
 - (4) An FL-net board with the FL-net/Ethernet coexisting function and a FAST Ethernet or FAST Data Server board with the FOCAS2/Ethernet or Data Server function cannot be used simultaneously. In this case, on the FL-net board, use only the FL-net function with A02B-0303-J566#656K (conventional software dedicated to the FL-net function), and on the FAST Ethernet or FAST Data Server board, use the FOCAS2/Ethernet or Data Server function with A02B-0303-J561#6569 (Fast Ethernet function software).
 - (5) The 7 segments LED of CNC enter the state of blinking "9" by satisfying all of the three following conditions, and CNC stops. Detach the FAST Ethernet / FAST Data Server board from the option slot.
 - a) The FL-net board is inserted in the option slot.
 - b) The FAST Ethernet / FAST Data Server board is inserted in the option slot.
 - c) A02B-0303-J566#656U (control software for FL-net/Ethernet coexisting function) is stored in Flash ROM of CNC.
- 3 Notes on using the FL-net/Ethernet coexisting function with the Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A and Series 0*i*-F are listed below:
 - (1) To use the FL-net/Ethernet coexisting function, only the Ethernet function (S707) and FL-net function (J692) options are required.
 - (2) When the Data Server function is used, the FL-net/Ethernet coexisting function cannot be used. In this case, be sure to operate the Ethernet function on the hardware component on which the Data Server function operates and operate only the FL-net function on the hardware component on which the FL-net function operates.

3.3 LIMITATION OF THE FL-net/Ethernet coexisting FUNCTIONS

There are the following limitations about the FOCAS2/Ethernet function when the FL-net/Ethernet coexisting function is used.

"IP address" cannot be set on the Ethernet setting screen (common). The setting range of "IP address" is limited to "192.0.0.1 - 223.255.255.254", and "Subnet mask" is fixed to "255.255.255.0". Set "IP address" on the FL-net parameter screen.



The setting range of "Interval time" of the Ethernet setting screen (FOCAS2/Ethernet) is limited to "0, 100 - 65535".



NOTE

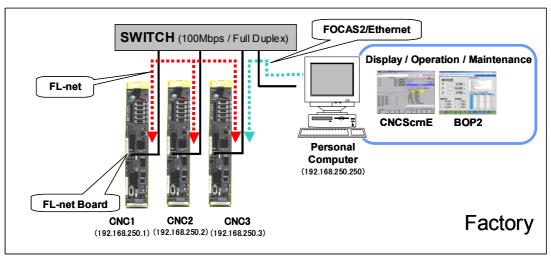
With the FOCAS2/Ethernet function using FL-net/Ethernet coexisting function, up to 5 FOCAS2/Ethernet clients can be connected to one CNC.

3.4 NETWORK CONFIGURATION RECOMMENDED BY FL-net/Ethernet coexisting FUNCTION

Use the switching hub whose transmission rate is 100 Mbps / Full Duplex when you use the FL-net/Ethernet coexisting function. Refer to Subsection 2.4.4, "HUB" in Part IV, "CONNECTION" for our recommending switching hub.

The following is the examples of recommending network configuration.

When using a local network

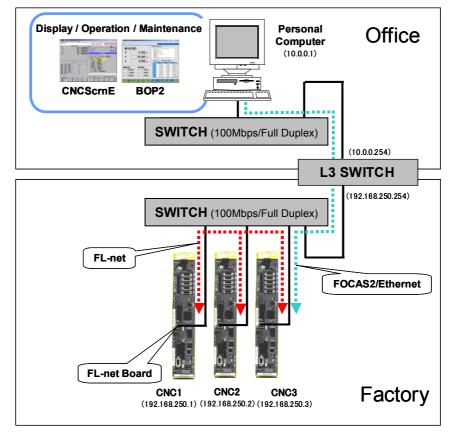


⚠ CAUTION

The FL-net equipment with the FL-net/Ethernet coexisting function must not connect to the FL-net equipment without the FL-net/Ethernet coexisting function, including the FL-net equipment of the other companies. The FL-net equipment might malfunction because the other data than the FL-net communication flow on the network.

A communication failure may also occur in a communication device that does not support the FL-net function since the device cannot handle the FL-net data.

When connecting with Office LAN



NOTE

If Office LAN is not separated from Factory LAN, on the one hand FL-net data using UDP/IP broadcast flow from Factory LAN into Office LAN and on the other hand many unnecessary data flow from Office LAN into Factory LAN. These might make the network performance decreased. So, we recommend strongly that Office LAN and Factory LAN are separated by the Layer 3 Switch (Router is also possible) to prevent them.

4

OUTLINE OF SAFETY FUNCTION BY FL-net

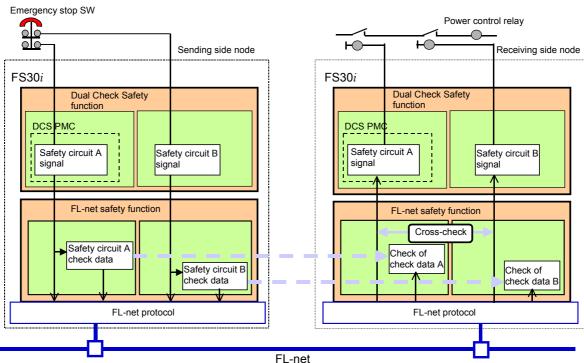
In a machine system such as a transfer machine, stations are each equipped with an operator's panel having an emergency stop button. It is necessary to implement a safety circuit for the entire system so that when the emergency stop button at any station is pressed the emergency stop signal can be transferred to all CNCs.

Use of the Safety function by FL-net ensures transmission of safety-related signals among the general-purpose safety circuits in multiple CNCs connected via FL-net, so, all inter-node connections can be integrated into FL-net, which makes system cabling very simple.

The Safety function by FL-net is an additional function of the dual check safety function. It operates on two CPUs as well as the dual check safety function. Please refer to "Dual Check Safety CONNECTION MANUAL (B-64483EN-2)" for details of the dual check safety function.

Basic elements of the Safety function by FL-net are two nodes of the sending side node and the receiving side node. A safe circuit for the line is implemented by the combination of these nodes.

The sending node adds check data to each of duplicated signals of the general-purpose safety circuit and sends these signals. The receiving node checks the check data and cross-checks the received signal data to ensure that there is no error in FL-net communication.



Main specification

Item	Description		
Supported CNC Series 30i/31i/32i/35i-B, Power Motion i-A, Series 0i-F			
Number of connectable nodes 30			
Number of safety signals per a node	7bits		
Necessary options	- Safety function by FL-net (S851) - FL-net function (J692)		
	- Dual Check Safety function (S661)		



II. SPECIFICATION



PARAMETERS FOR FL-net FUNCTION

↑ WARNING

To use the FL-net, fully understand the instructions described in this manual before making the setting. If you make the setting without fully understanding them, the machine may behave unexpectedly when started, possibly causing damage to the tool, machine, and/or workpiece, or injury to the user. After making the communication setting for the first time or changing any communication setting, conduct communication tests thoroughly.

↑ CAUTION

If connecting to communication devices made by other companies, thoroughly read the manuals supplied with the communication devices made by the other companies and sufficiently conduct connection tests beforehand.

The parameters for the FL-net function are divided into six major groups:

- (1) Basic parameters
- (2) State monitoring parameters
- (3) Area 1 allocation parameters
- (4) Area 2 allocation parameters
- (5) Message allocation parameters
- (6) Bit parameters

Each parameter is detailed below.

(1) Basic parameters

These parameters are defined by the FL-net communication standards and must be set for every FL-net device of any manufacturer.

Table 1-1 Basic Parameters

Parameter name	Description	Parameter number
IP address	IP address of the local node (The host address section (the last numeric value) of this IP address is the node number of the local node.)	Pa10
Address of area 1	Start address of a common memory area 1 area allocated as DO of the local node	Pa11
Area 1 size	Data size of a common memory area 1 area allocated as DO of the local node	Pa12
Address of area 2	Start address of a common memory area 2 area allocated as DO of the local node	Pa13
Area 2 size	Data size of a common memory area 2 area allocated as DO of the local node	Pa14
Token monitoring time	Token hold time of the local node	Pa15
Allowable minimum frame interval	Inter-frame time interval requested to another node	Pa16
Node name	Equipment name of the local node	Pa17

(2) State monitoring parameters

These parameters are used to assign local node status data and remote node status data to the PMC area so that the user program can monitor the statuses of the local node and remote nodes.

Table 1-2 State Monitoring Parameters

Parameter name	Description	Parameter number
Local node status	Start address of an area in the PMC E/R area used as the	Pa20
	output destination of status information about the local node	

Parameter name	Description	Parameter number
List of participating nodes	Start address of an area in the PMC E/R area used as the output destination of a list of all nodes participating in the	Pa21
	network	

(3) Area 1 allocation parameters

These parameters are used to specify addresses to perform data exchange between common memory area 1 and the PMC area.

Table 1-3 Area 1 Allocation Parameters

Parameter name	Description	Parameter number
PMC start address	Start address of an area in the PMC E/R area allocated to	Pa30
(shared by DI/DO)	common memory area 1	
Area 1 start address	Start address of common memory area 1 allocated to an	Pa31
(shared by DI/DO)	area in the PMC E/R area	
Allocation size	Size of data to be exchanged	Pa32
(shared by DI/DO)		

(4) Area 2 allocation parameters

These parameters are used to specify addresses to perform data exchange between common memory area 2 and the PMC area.

Since common memory area 2 is larger than the PMC area, allocating separate DI and DO areas is permitted as well as allocating DI and DO at a time in the same way as for common memory area 1.

Table 1-4 Area 2 Allocation Parameters (Shared by DI and DO)

Parameter name	Description	Parameter number
PMC start address	Start address of an area in the PMC E/R/D area allocated to	Pa47
(shared by DI/DO)	common memory area 2	
Area 2 start address	Start address of common memory area 2 allocated to an	Pa48
(shared by DI/DO)	area in the PMC E/R/D area	
Allocation size	Size of data to be exchanged	Pa49
(shared by DI/DO)		

 Table 1-5
 Area 2 Allocation Parameters (Separate Allocation for Each of DI and DO)

Parameter name	Description	Parameter number
PMC start address	Start address of a common memory area in the PMC E/R/D	Pa40
(for DO)	area that serves as the source of data to be written to area 2	
Allocation size	Size of data written to common memory area 2	Pa41
(for DO)		
PMC start address	Start address of a common memory area in the PMC E/R/D	Pa42
(for DI)	area that serves as the read destination of information about	
	other nodes and data from area 2	
Allocation condition setting	Address of a common memory area in the PMC D area that	Pa43
(for DI/DO)	is used to specify conditions on data exchange with area 2	
Condition switch flag	Flag for switching between specified conditions at the area 2	Pa44
(for DI/DO)	data exchange condition allocation address above	
Area 2 start address	Start address of static common memory area 2 to be	Pa45
(for DI)	allocated in the PMC area	
Allocation size	Size of data statically exchanged	Pa46
(for DI)		

(5) Message allocation parameters

These parameters are used to specify interface areas for making service requests for message transmission and passing a received message to the user program.

Table 1-6 Message Allocation Parameters

Parameter name	Description	Parameter number
Client function interface	Start address of the PMC E/R/D area that serves as the	Pa50

Parameter name	Description	Parameter number
	interface used by the message transmission client function	
Interface size	Maximum allowable size of the interface area used above	Pa51
Server function interface	Start address of the PMC E/R/D area that serves as the	Pa52
	interface used by the message transmission server function	
Interface size	Maximum allowable size of the interface area used above	Pa53

(6) Bit parameters

Table 1-7 Bit parameters

Parameter name	Description	Parameter number
Parameter 1	Parameter for FL-net data transfer	Pa60
Parameter 2	Parameter for FL-net operation	Pa61

For each FL-net function used, the parameters below need to be set.

A. Cyclic transmission of common memory area 1

Basic parameters

Area 1 allocation parameters

B. Cyclic transmission of common memory area 2

Basic parameters

Area 2 allocation parameters

C. Message transmission

Basic parameters

Message allocation parameters

For B (Cyclic transmission of common memory area 2) and C (message transmission) above, operation based on a user program needs to be performed as required. For information about required operation, see Section 2.2, "COMMON MEMORY AREA 2 CYCLIC TRANSMISSION" and Chapter 3, "MESSAGE TRANSMISSION", respectively.

When the state monitoring parameters are set, the user program can monitor the state of the local node and the network participation state of other nodes. Perform node state monitoring as required.

CYCLIC TRANSMISSION

↑ WARNING

Target DI signals for FL-net cyclic transmission are posted to the PMC area according to the setting. If a communication error occurs, the status of the signals in the PMC area is kept and these signals are not cleared to 0. Build a system in which the network participation status of the local and other nodes is monitored when required to make the system operate safely. If a safety system is not built, the machine may behave unexpectedly, possibly causing damage to the tool, machine, and/or workpiece, or injury to the user when the machine is operated.

This chapter details how to use the cyclic data transmission function of the FL-net function.

2.1 COMMON MEMORY AREA 1 CYCLIC TRANSMISSION

Those areas of common memory area 1 that are to be used for data exchange can be allocated in the PMC E area or R area in direct image.

Related parameters

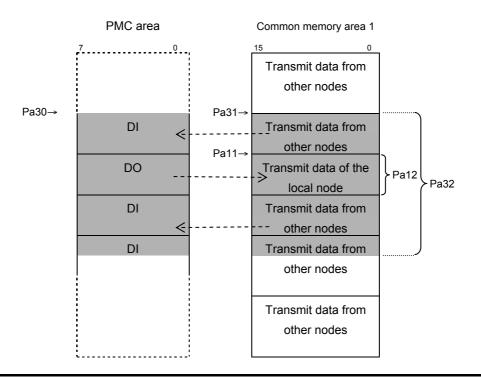
(1) Pal1: Area 1 address

(2) Pa12: Area 1 size (in words) (3) Pa30: PMC start address (4) Pa31: Area 1 start address

(5) Pa32: Allocation size (in words)

PMC area and common memory area 1

If an allocated area includes a mixture of DI and DO areas as shown below, data exchange is performed by making a distinction between a DI area and a DO area.



NOTE

When 0 is set in Pa32 (allocation size), the data of common memory area 1 is not exchanged.

2.2 COMMON MEMORY AREA 2 CYCLIC TRANSMISSION

Data exchange with common memory area 2 is performed using one of the following two methods:

- (1) Simultaneous allocation of DI and DO areas
 - Like the method for data exchange with common memory area 1, common memory areas are directly allocated to the PMC area just as they are allocated in common memory.
- (2) Separate allocation of DI and DO areas
 - DI and DO areas are separately allocated for data exchange between common memory area 2 and the PMC area.

When this method is used, there are two DI area allocation methods: (1) A method that allows DI data areas to be changed dynamically on a node-by-node basis, and (2) a method that statically uses fixed DI data areas independent of nodes.

NOTE

- 1 When a small amount of data is exchanged, allocation method (1) should be used because method (1) is simpler than method (2).
- 2 Setting bit 2 of Pa61 (parameter 2) switches between the above two allocation methods.
 - For details, see Section 1.1, "PARAMETERS FOR FL-net FUNCTION" in Part III, "SETTING."

2.2.1 Simultaneous DI and DO Area Allocation

Areas of common memory area 2 that are to be used for data exchange can be allocated to the E, R, or D area of the PMC just as they are allocated in common memory.

Related parameters

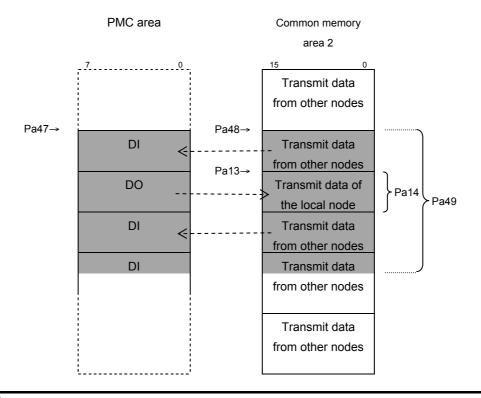
(1) Pa13: Area 2 address

(2) Pa14: Area 2 size (in words)
(3) Pa47: PMC start address
(4) Pa48: Area 2 start address

(5) Pa49: Allocation size (in words)
(6) Pa61: Bit 2 (DTL) of parameter 2 = 0

PMC area and common memory area 2

Even when an allocated area contains both DI and DO areas as follows, data exchange is performed with the DI and DO areas distinguished from each other.



NOTE

When 0 is set in Pa49 (allocation size), data exchange with common memory area 2 is not performed.

2.2.2 Separate Allocation of DI and DO Areas

For data exchange with common memory area 2, DI and DO areas can be set separately to allocate them to the E, R, or D area of the PMC.

NOTE

When a small amount of data in common memory area 2 is to be exchanged, make settings for data exchange between common memory area 2 and the PMC area according to the method described in Subsection 2.2.1, "Simultaneous DI and DO Area Allocation."

2.2.2.1 DO data allocation

In data exchange of DO data in common memory area 2, data can be shifted by an offset when the data is transferred from the PMC area to common memory area in case the PMC area that can be allocated is smaller than the common memory area of the local node.

General DO data allocation

Related parameters

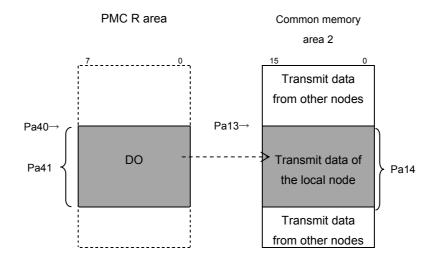
(1) Pa13: Area 2 address

(2) Pa14: Area 2 size (in words)

(3) Pa40: PMC start address (for DO)

(4) Pa41: Allocation size (for DO) (in words)
(5) Pa61: Bit 2 (DTL) of parameter 2 = 1

PMC area and common memory area 2



NOTE

When 0 is set in Pa41 (allocation size (for DO)), DO data exchange from the PMC area to common memory area 2 is not performed.

Allocation when common memory area 2 of the local node is too large

When common memory area 2 of the local node is too large to prepare DO data of the local node in the PMC area at one time, an offset can be specified by a user program (such as a ladder program) at the time of DO data transfer from the PMC area to common memory area 2.

Related parameters

(1) Pa13: Area 2 address

(2) Pa14: Area 2 size (in words)

(3) Pa40: PMC start address (for DO)

(4) Pa41: Allocation size (for DO) (in words)

(5) Pa43: Allocation condition setting (for DI/DO)

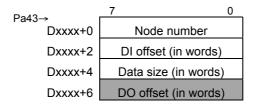
(6) Pa44: Condition switch flag (for DI/DO)

(7) Pa61: Bit 2 (DTL) of parameter 2 = 1

Allocation condition setting organization

Organization of area 2 data exchange condition allocation:

When PMC data is transferred to common memory by shifting the data by an offset, the following must be set:



NOTE

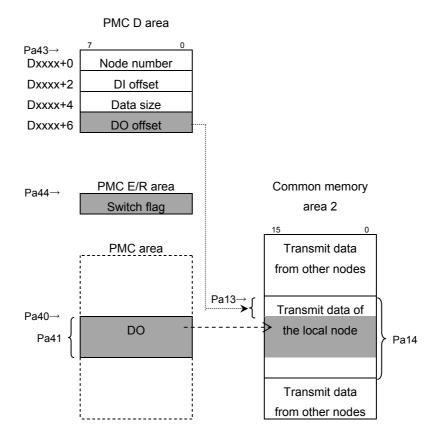
The parts except the shaded part are not used by this function.

Procedure

Procedure for changing the offset of DO data in common memory area 2 by using the user program:

- (1) The user program specifies the following in the PMC D area specified by Pa43 (allocation condition setting (for DI/DO)):
 - DO offset
- (2) At a later time, the user program writes FFh in the PMC E or R area specified by Pa44 (condition switch flag (for DI/DO)) (called the switch flag hereinafter).
- (3) The CNC monitors the switch flag at all times. When FFh is written, the CNC reads the DO offset set in the PMC D area as internal information, and sets the switch flag to $00h^{(Note 1)}$.
- (4) Unless FFh is written in the switch flag, the CNC uses the same DO offset value to write DO data placed in the PMC area allocated by Pa40 (allocation address(for DO)) into common memory area 2.

PMC area and common memory area 2



- 1 When the offset is dynamically changed for DO data allocation of common memory area 2, the node number, DI offset, and data size are also changed. To change only the DO data offset, carefully change the setting not to change other values.
- 2 There are the following restrictions on DO data exchange:
 - When 0 is set in Pa41 (allocation size (for DO)), DO data exchanged from the PMC area to common memory area 2 is not performed.
 - When the PMC area for Pa43 (allocation condition setting (for DI/DO)) is not set, the DO offset is assumed to be 0.
 - When the PMC area for Pa44 (condition switch flag (for DI/DO)) is not set, it
 is impossible to change the DO offset dynamically.
 - When (DO offset + Pa41) > Pa14, DO data exchange is not performed.

2.2.2.2 DI data allocation

Whether to perform dynamic allocation or static allocation of DI data of common memory area 2 can be specified by the setting of Pa46 (allocation size (for DI)).

Dynamic DI data allocation of common memory area 2

The user program switches to the DI data area for a target node and reads the DI data for the node. By specifying a node number, the DI data from the node and status information of the node can be read.

Related parameters

(1) Pa42: PMC start address (for DI)

(2) Pa43: Allocation condition setting (for DI/DO)

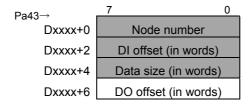
(3) Pa44: Condition switch flag (for DI/DO)

(4) Pa46: Allocation size (for DI) = 0

(5) Pa61: Bit 2 (DTL) of parameter 2 = 1

Allocation condition setting organization

Organization of area 2 data exchange condition allocation:



NOTE

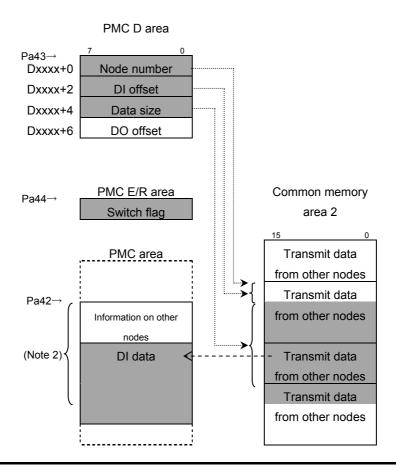
The parts except the shaded part are not used by this function.

Procedure

Procedure for changing dynamic DI allocation of common memory area 2 by using the user program:

- (1) The user program specifies the following in the PMC D area specified by Pa43 (allocation condition setting (for DI/DO)):
 - Node number
 - DI offset
 - Data size
- (2) Then, the user program writes FFh to the area (switch flag) in the PMC E area or the PMC R area specified by Pa44 (condition switch flag (for DI/DO)).

- (3) The CNC monitors the switch flag at all times. When FFh is written, the node number, DI offset, and data size set in the PMC D area are taken in as internal information, and the switch flag is set to 00h. At this time, the CNC once reads DI data according to the new settings before the switch flag is set to 00h. So, the user program can read DI data immediately after checking that the switch flag is set to 00h.
- (4) Until FFh is written to the switch flag, the user program can read the node information of a specified node number and area 2 DI data from the PMC area.
- (5) Until FFh is written to the switch flag, the CNC writes the node information of a specified node number and area 2 DI data to the specified area in the PMC area.



- 1 When node information or DI data is dynamically changed for dynamic DI data allocation of common memory area 2, the DO offset is also changed. To change only the DI data, carefully change the setting not to change another value.
- 2 Information on other nodes is 4 bytes in size. So, for an area in the PMC area to be allocated for DI, allocate an area 4 bytes larger than the value set in Dxxxx+4 (data size (in words). When the user program handles DI data in area 2, the data at the address 4 bytes shifted from the address set in Pa42 (PMC start address (for DI)) is handled.

- 3 There are the following restrictions on dynamic DI data exchange:
 - Set a value of 0 in Pa46 (allocation size (for DI)).
 - When the PMC area for Pa42 (PMC start address (for DI)) is not set, transfer of information on other nodes and DI data exchange are not performed.
 - When the PMC area for Pa43 (allocation condition setting (for DI/DO)) is not set, transfer of information on other nodes and DI data exchange are not performed.
 - When 0 is specified in Dxxxx+4 (data size) specified by Pa43 (allocation condition setting (for DI/DO)), transfer of information on other nodes and DI data exchange are not performed.
 - When the PMC area for Pa44 (condition switch flag (for DI/DO)) is not set, it is impossible to change the DI data source dynamically.
- 4 When DI data exchange is performed with a size specification with which the local node transmit data area is contained, data transfer from the common memory area to the PMC area may overwrite the PMC area data with the common memory data. Carefully specify the data size so that the local node transmit data area is not contained.
- When a node specified for node switching is disconnected, the status of the node is indicated, but the DI data of the previous node before switching stays unchanged because a common memory area cannot be determined. Therefore, when switching between nodes, first check the status information to ensure that the new node participates in the network, then reference DI data. If the new node is disconnected, DI data will be updated to the DI data of the node as soon as the node participates in the network.

Static DI data allocation of common memory area 2

This allocation method fixes the DI data area. With this method, an area larger than that allocated with the dynamic allocation method can be allocated in the PMC area.

Only node status information can be read by dynamic change.

Related parameters

- (1) Pa42: PMC start address (for DI)
- (2) Pa43: Allocation condition setting (for DI/DO)
- (3) Pa44: Condition switch flag (for DI/DO)
- (4) Pa45: Area 2 start address (for DI)
- (5) Pa46: Allocation size (for DI)
- (6) Pa61: Bit 2 (DTL) of parameter 2 = 1

NOTE

When node status information is unnecessary, Pa43 and Pa44 need not be set. Furthermore, "Allocation condition setting organization" and "Procedure" given below are unnecessary.

Allocation condition setting organization

Organization of area 2 data exchange condition allocation:

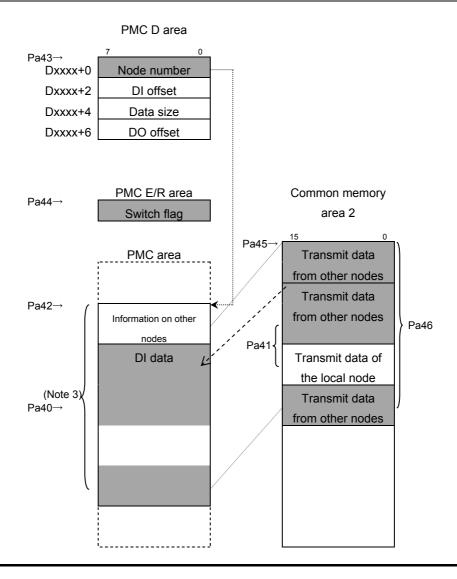
Pa43→	7 0
Dxxxx+0	Node number
Dxxxx+2	DI offset (in words)
Dxxxx+4	Data size (in words)
Dxxxx+6	DO offset (in words)

The parts except the shaded part are not used by this function.

Procedure

Procedure of node information change by the user program:

- (1) The user program specifies the following in the PMC D area specified by Pa43 (allocation condition setting (for DI/DO)):
 - Node number
- (2) Then, the user program writes FFh to the area (switch flag) in the PMC E area or the PMC R area specified by Pa44 (condition switch flag (for DI/DO)).
- (3) The CNC monitors the switch flag at all times. When FFh is written, the node number set in the PMC D area are taken in as internal information, and the switch flag is set to 00h. At this time, the CNC once updates the specified node status information according to the new settings before the switch flag is set to 00h. So, the user program can read the status information immediately after checking that the switch flag is set to 00h.
- (4) Until FFh is written to the switch flag, the user program can read the node information of a specified node number from the PMC area.
- (5) Until FFh is written to the switch flag, the CNC writes the node information of a specified node number to the specified area in the PMC area. The DI data can be read regardless of whether the switch flag is set to 00h.

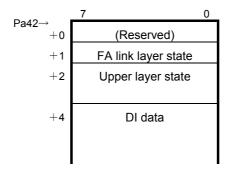


- 1 As shown in the above example, the area specified by Pa46 (allocation size (for DI)) can contain the local node transmit data area. In this case, the corresponding PMC area can be specified for Pa40 (PMC start address (for DO)) to allocate no wasted PMC area.
 - To make such a setting, however, carefully set Pa40 (PMC start address (for DO)) not to duplicate PMC area setting.
- 2 Node information can also be changed dynamically with static DI data allocation of common memory area 2. When node information is changed, however, the DO offset is also changed. To change only the node information, carefully change the setting not to change the DO offset.
- 3 Information on other nodes is 4 bytes in size.
 So, for an area in the R area to be allocated for DI, allocate an area 4 bytes larger than the value set in Pa46 (allocation size (for DI)).
 When the user program handles DI data in area 2, the data at the address 4 bytes shifted from the address set in Pa42 (allocation address (for DI)) is handled.

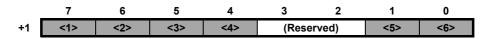
- 4 There are the following restrictions on static DI data exchange:
 - When a value of 0 is specified for Pa46 (allocation size (for DI)), DI data exchange with dynamic allocation is performed.
 - When the PMC area for Pa42 (allocation address (for DI)) is not set, transfer of information on other nodes and DI data exchange are not performed.
 - When the PMC area for Pa43 (allocation condition setting (for DI/DO)) is not set, transfer of information on other nodes is not performed.
 - When the PMC area for Pa44 (switch flag allocation address) is not set, it is impossible to change node information dynamically.

2.2.2.3 Nodes information

Information on other nodes and DI data are allocated in the PMC area as follows:



FA link layer state: 1 byte



- <6> Node participation flag (1: Participate)
- <5> Communication disable detection flag (1: Detected)
- <4> Upper layer operation signal error flag (1: Error)
- <3> Common memory data valid flag (1: Valid)
- <2> Common memory setting complete flag (1: Complete)
- <1> Duplicate address detection flag (1: Duplicate address detected)

Upper layer state: 2 bytes

-	7	6	5	4	3	2	1	0
+2	<8>	<9>	<10>	<11>	<12>	<13>	<14>	<15>
+3	<1>	<2>	<3>	(Reserved)	<4>	<5>	<6>	<7>

U ERR CODE

<4> (Highest bit) to <15> (Lowest bit)

<2>, <3> U_ERR

00: NORMAL 01: WARNING 1x: ALARM

<1> RUN/STOP

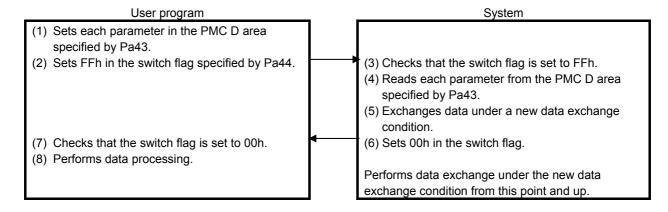
0: STOP 1: RUN

For details of each bit, see Subsection 2.3.1, "Allocation of Local Node State."

2.2.2.4 Timing of switching between conditions on data exchange with common memory area 2

In data exchange between common memory area 2 and the PMC area, the user can switch between data (nodes information) exchange conditions.

The timing of data switching specified by the user program is described below.



⚠ CAUTION

- 1 If the setting of a parameter in the PMC D area specified by Pa43 (allocation condition setting (for DI/DO)) is incorrect (for example, if a specified DI offset exceeds the common memory area of a specified node number), data exchange is not performed. So, be careful when making a data exchange condition modification.
- 2 Do not access the DI data of common memory area 2 until the switch flag is set to 00h after the switch flag is set to FFh by the user program. Otherwise, invalid data may be read.

NOTE

Immediately after the power is turned on, data exchange is performed according to each parameter set in the PMC D area specified by Pa43 (allocation condition setting (for DI/DO)) even if no instruction is provided by the user program.

2.3 NODE STATE MONITORING

2.3.1 Allocation of Local Node State

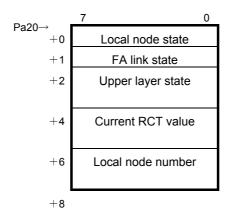
The state of the local node can be monitored by allocating the 8-byte state code of the local node in the PMC E area or the PMC R area.

Related parameters

<1> Pa20: Local node status

Data structure

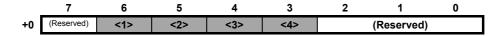
Local node information is allocated in the PMC E area or the PMC R area as follows:



NOTE

- 1 An 8-byte area is always used
- 2 When Pa20 (local node status) is not set, local node information is not posted.

Local node state: 1 byte

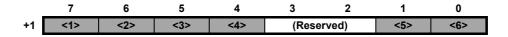


- <4> Token monitoring time error flag (1: Error detected)
- <3> Initialization error flag (1: Error detected)
- <2> Reception wait state flag (1: Reception wait state)
- <1> Duplicate node number flag (1: Duplicate node number detected)

Table 2-1 Local Node State

Item	Description
Token monitoring time error flag	Set when transmission does not terminate within the token monitoring time (Pa15) set for the local node.
Initialization error flag	Set when an initialization parameter or a parameter set again is invalid.
Reception wait state flag	Set when the node enters the frame reception wait state without receiving any frame during network initialization.
Duplicate node number flag	Set when a node having the same node number as for the local node is detected in the network.

FA link state: 1 byte



- <6> Node participation flag (1: Participate)
- <5> Communication disable detection flag (1: Detected)
- <4> Upper layer operation signal error flag (1: Error)
- <3> Common memory data valid flag (1: Valid)
- <2> Common memory setting complete flag (1: Complete)
- <1> Duplicate address detection flag (1: Duplicate address detected)

Table 2-2 FA Link State

Item	Description
Node participation flag	Set when the local node participates in the network (communicating with another node).
Communication disable detection flag	Set when communication is disabled because a device in a different token mode is detected.
Upper layer operation signal error flag	Currently, not supported.
Common memory data valid flag	Set when cyclic data is valid, in other words, when PMC area allocation is normal.
Common memory setting complete flag	Set when common memory setting for the node is completed. This means that this flag is set when the parameters related to the common memory setting (Pa11, Pa12, Pa13, and Pa14) are correct.
Duplicate address detection flag	Set when a common memory setting for a node connected to the network is duplicate, in other words, when the value specified for a parameter (Pa11, Pa12, Pa13, or Pa14) for another device is specified for a parameter related to the common memory setting (Pa11, Pa12, Pa13, or Pa14).

Upper layer state: 2 bytes

	7	6	5	4	3	2	1	0
+2	<8>	<9>	<10>	<11>	<12>	<13>	<14>	<15>
+3	<1>	<2>	<3>	(Reserved)	<4>	<5>	<6>	<7>

U ERR CODE

<4> (Highest bit) to <15> (Lowest bit) (This code is not used with this device.)

<2>, <3> U_ERR 00: NORMAL 01: WARNING 1x: ALARM

<1> RUN/STOP 0: STOP

1: RUN

Table 2-3 Upper Layer State

ltem	Description
U_ERR_CODE	Currently, not supported.
U_ERR	Currently, not supported.
RUN/STOP	The RUN/STOP state of the 1st PMC ladder program is set. (Note)

NOTE

When a multi-path PMC is used, the status of the ladder program for the first PMC path is set.

Current RCT value: 2 bytes

	7	6	5	4	3	2	1	0
+4	<9>	<10>	<11>	<12>	<13>	<14>	<15>	<16>
+5	<1>	<2>	<3>	<4>	<5>	<6>	<7>	<8>

Current RCT value: <1> (Highest bit) to <16> (Lowest bit)

Table 2-4 Current RCT value

Item	Description		
Current RCT value	Refresh Cycle Time		
	120% of the actual time required for a token to circulates among all		
	nodes (refresh cycle measurement time) (unit: 1 ms)		

Local node number: 2 bytes



Local node number: <1> (Highest bit) to <8> (Lowest bit)

Table 2-5 Local node number

ltem	Description
Local node number	Node number of the local node (1 to 254)

2.3.2 Allocation of a List of Participating Nodes

A list of the numbers of the nodes participating in the network can be allocated in the PMC E area or the PMC R area to monitor the participation state.

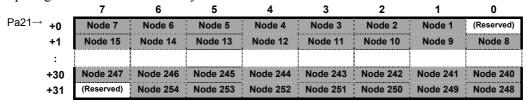
Related parameters

(1) Pa21: A list of participating nodes

Data structure

Participating node information as indicated below is allocated in the PMC E area or the PMC R area.

Participating node information: 32 bytes



The bits corresponding to the node number of nodes participating in the network (including the local node) are set to 1.

∴ CAUTION

Usually, machining processing of the CNC is not affected even when the CNC is disconnected from FL-net communication.

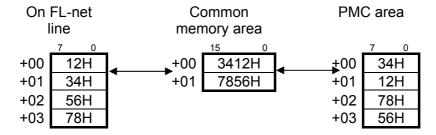
When the entire system is to be stopped by the detection of a disconnected communication device, however, the CNC operation should be designed according to the system so that, for example, the CNC is placed in the emergency stop state immediately, or that the CNC is stopped after the tool is retracted to an allowable extent.

- 1 A 32-byte area is always used.
- When Pa21 (a list of participating nodes) is not set, participating-node list information is not posted.

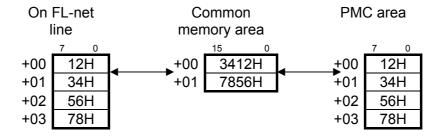
2.4 BYTE LIST OF CYCLIC DATA

A byte list in a common memory area is related with a byte list in the PMC area as described below.

Common memory area and the PMC area



The data list in the PMC area can be changed as shown below by setting bit 0 (CYC) of FL-net parameter Pa60 (parameter 1) to 1:



NOTE

The data width of each address in a common memory area of the FL-net is 16 bits.

On the other hand, the data width of each address in the PMC area is 8 bits. So, data is exchanged between the common memory areas and the PMC area according to the relationships shown above.

3 MESSAGE TRANSMISSION

This chapter details how to use the message transmission function of the FL-net function.

3.1 LIST OF MESSAGE TRANSMISSION SERVICES

The message transmission function of the FANUC FL-net function supports the services listed in Table 3-1.

Table 3-1 List of Services Supported

Message service item	Client function	Server function
Byte block read	0	0
Byte block write	0	0
Word block read	0	0
Word block write	0	0
Network parameter read	-	0
Network parameter write	-	0
Stop command	-	-
Start command	-	-
Profile read	-	0
Log data read	-	0
Log data clear	-	0
Transparent message	O (Note)	O (Note)
Echo back message (for test)	-	0

NOTE

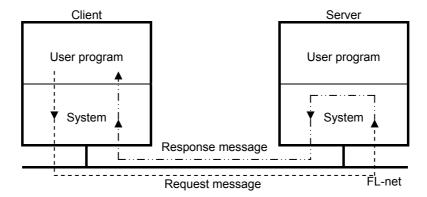
Among the transaction codes assigned to transparent messages, 50000 to 59999 are used for this transparent message.

3.2 OVERVIEW OF THE MESSAGE TRANSMISSION FUNCTION

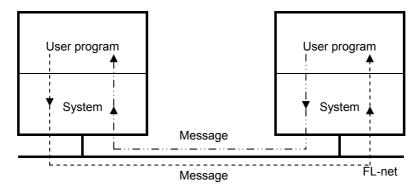
The function for transmitting messages other than transparent messages involves a client function and server function. For a message transmitted from the client, the server returns a response message. In short, the client is a service requester, and the server is a service receiver.

Basically, when the message transmission server function of the FANUC FL-net function receives a request message, the server function automatically returns a response message to the client without involving the user program.

With the client function, the user program transmits a message by using the interface area set by Pa50 (client function interface).



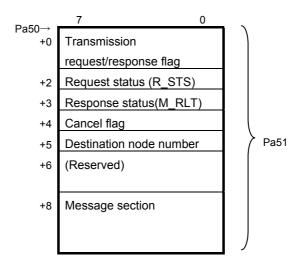
A transparent message can be handled freely by the user program without making a client/server distinction. So, two interface areas are required: one for transmission and the other for reception. As the transmit interface area, the interface area set by Pa50 (client function interface) used with a client message is used. As the receive interface area, the interface area set by Pa52 (server function interface) is used.



The format of each interface area is described below.

Transmit interface for the client and transparent messages

The interface area specified by Pa50 (client function interface) has the format shown below.



NOTE

The message section does not include a data buffer area.

Table 3-2 Transmit Interface Items

Interface item	Description	Direction		
Transmission	Flag set by the user program to request message transmission, and	U→S		
request/response flag (Note 1, 2)	set by the CNC to post the reception of a response message or the occurrence of an error. O001h: The user program requests message transmission.	S→U		
	8000h: The system posts the reception of a normal response message. The system posts the transmission of a normal			
	transparent message.			
	8100h and up: The system posts a request message format error.			
	8200h and up: The system posts a request message transmission error.			
	8300h and up: The system posts the reception of an abnormal response message.			
	8800h: The system posts the acceptance of cancellation from the user program.			
Request status	Status for checking whether a request message has been transmitted	S→U		
(R_STS)	to the server (destination node).			
	01h: A request message has been delivered to the server normally. 02h: Server buffer file			
	03h: The server is not initialized yet. 05h: Serial number/version number error 06h: Format error			
Response status	Status for checking a response message	S→U		
(M_RLT)	00h: Normal response			
	01h: Abnormal response			
	02h: Server service not supported			
Cancel flag	Set a value other than 0 for service cancellation before a message	U→S		
(Note 3)	responding to a transmission request is returned. The purpose of			
	this cancellation is just to allow the system to accept the next			
	transmission request. This cancellation is not intended to cancel			
	message transmission with the FL-net function.			
Destination node	Message transmission destination node number	U→S		
number				
Message section	Area for setting a message transaction code, parameters, and so	U→S		
	forth. The information set in this area depends on the type of	S→U		
	message transmission service.			

The column of direction in the table above indicates whether each item is posted from the user program to the system $(U \rightarrow S)$ or is posted from the system to the user program $(S \rightarrow U)$.

NOTE

1 Transmission starts when the user program writes 0001h into the transmission request/response flag. Therefore, set 0001h after setting data in all other interface areas.

While the transmission request/response flag is 0001h, the user program must not rewrite data in this interface area.

If the content of this area is rewritten, message transmission cannot sometimes end normally.

- When the message transmission service ends, the system returns 8000h or a larger value to the transmission request/response flag. At the time of normal end, 8000h is returned; at the time of abnormal end, a value other than 8000h is returned. When an abnormal end occurs, check the value and correct the cause.
 - For error codes returned by the system, see Table 3-3.
- 3 After a message transmission request is made, this interface does not allow the next transmission request to be made until a response message is received or an error occurs. So, if a response message cannot be received for a cause on the server, the next message transmission request cannot be made until the power is turned off. In such a case, the cancel flag allows the system to exit from the response message wait state and wait for the next message transmission request. The purpose of this cancellation is just to allow the system to accept the next message transmission request. This cancellation is not intended to cancel message transmission with the FL-net function. (The FL-net function does not have a function for canceling message transmission.) This means that when this cancellation function is used, the response message for the previous message request may be treated as a response to the next message request by mistake.
- 4 If a response message is received before ACK is returned in response to a request message, the request status (R STS) is sometimes not set to 01h.

Table 3-3 Error Codes of the Transmit Interface

Erro	r code	Description
1st byte	2nd byte	Description
81h	01h	A specified node number is incorrect.
	02h	A specified transaction code is incorrect.
	03h	An area specified as a transmit/receive buffer in the PMC R area exceeds the allowable range.
	04h	In word block data, an odd address is specified as a transmit/receive buffer area in the PMC R area.
	05h	Excessive data size
82h	02h	Server buffer file
	03h	The server is not initialized yet.
	05h	Server serial number/version number error
	06h	Server format error
	10h	Retry failure (no response from the server)
83h	01h	Abnormal response reception
	02h	Server service not supported

Receive interface for server function and transparent messages

The interface area specified by Pa52 (server function interface) has the format shown below.

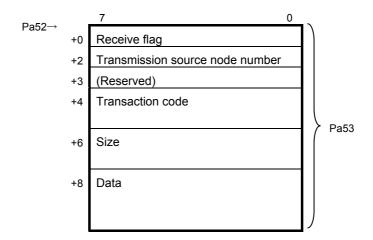


Table 3-4 Receive Interface Items

Interface item	Description	Direction
Receive flag	Flag used by the system to post the reception of a message to the	S→U
(NOTE)	user program.	U→S
	0001h: The system posts the reception of a message.	
	0000h: The user program posts the completion of message	
	receive processing.	
Transmission source node	Message transmission source node number	S→U
number		
Transaction code	Transaction code of a received message	S→U
Size	Number of words of data contained in a received message	S→U
Data	Data contained in a received message	S→U

NOTE

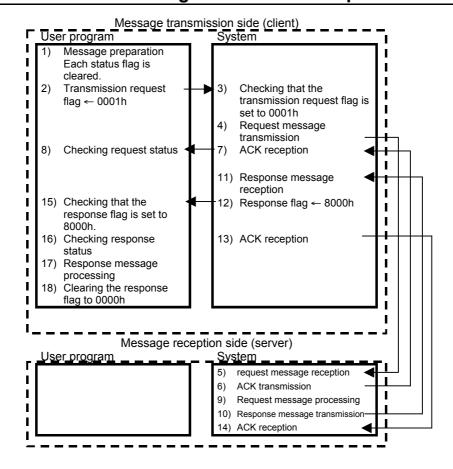
The system sets the receive flag to 0001h when receiving a message to be posted to the user program. The user program must clear this flag to 0 after completing processing on the received message.

While this flag is 0001h, the system does not receive another message.

3.3 PROCEDURE FOR MESSAGE TRANSMISSION OPERATION

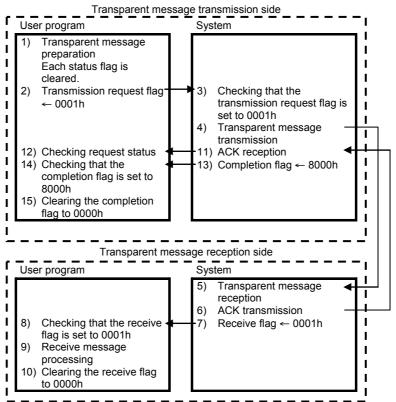
This section explains how the user program exchanges data with the system when messages are transmitted or received through message transmission.

3.3.1 Procedure for Message Transmission Operation



3.3.2 Procedure for operating the transparent message transmission

Because no response message is used for transparent messages, there is no need to wait for a response message.



3.4 MESSAGE TRANSMISSION CLIENT FUNCTION

This section explains in detail the interfaces in the message section of each service of the message transmission client function.

3.4.1 Byte Block Read

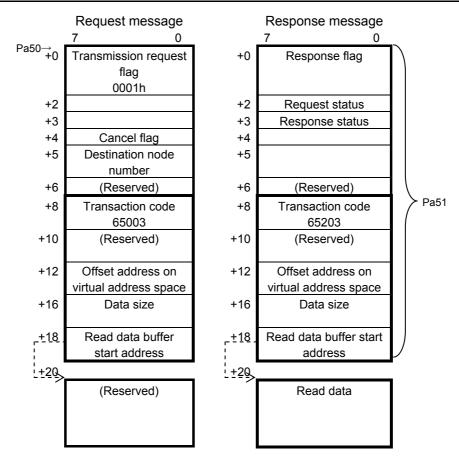


Table 3-5 Byte Block Read Interface Items

Interface item		Description	Direction
Transaction code	Request message:	65003	U→S
	Response message:	65203	S→U
Offset address on	Request message:	Offset address on virtual address space of	U→S
virtual address space		byte block data to be read from the server	
	Response message:	Same as above	
Data size	Request message:	Size of byte block data to be read from the	U→S
		server (in bytes)	S→U
	Response message:	Size of byte block data actually read from the	
		server (in bytes)	
Read data buffer start	Request message:	Start address of an area in the PMC area used	U→S
address (Note 1)		to store byte block data read from the server	
	Response message:	Same as above	
Read data	Request message:	Reserved	S→U
	Response message:	Byte block data actually read from the server.	
		When an abnormal response is returned, an	
		error code is stored.	

- 1 The read data buffer is allocated to the same PMC area as for this interface. Therefore, when this interface is allocated to the R area of the first PMC, the read data buffer is also allocated to the R area of the first PMC.
- 2 For an error code stored when an abnormal response is returned, refer to the manual of the equipment of a message transmission destination.

3.4.2 Byte Block Write

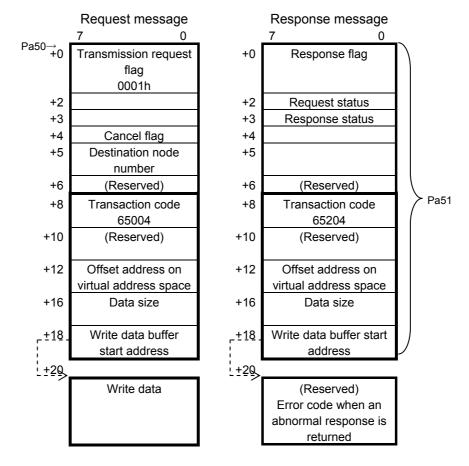


Table 3-6 Byte Block Write Interface Items

Interface item		Description	Direction
Transaction code	Request message:	65004	U→S
	Response message:	65204	S→U
Offset address on	Request message:	Offset address on virtual address space of	U→S
virtual address space		byte block data to be written to the server	
	Response message:	Same as above	
Data size	Request message:	Size of byte block data to be written to the	U→S
		server (in bytes)	S→U
	Response message:	Size of byte block data actually written to the	
		server (in bytes)	
Write data buffer start	Request message:	Start address of an area in the PMC area	U→S
address (Note 1)		storing byte block data to be written to the	
		server	
	Response message:	Same as above	
Write data	Request message:	Byte block data to be written to the server	U→S
	Response message:	An error code is stored when an abnormal	S→U
		response is returned.	

- 1 The write data buffer is allocated to the same PMC area as for this interface. Therefore, when this interface is allocated to the R area of the first PMC, the write data buffer is also allocated to the R area of the first PMC.
- 2 For an error code stored when an abnormal response is returned, refer to the manual of the equipment of a message transmission destination.

3.4.3 Word Block Read

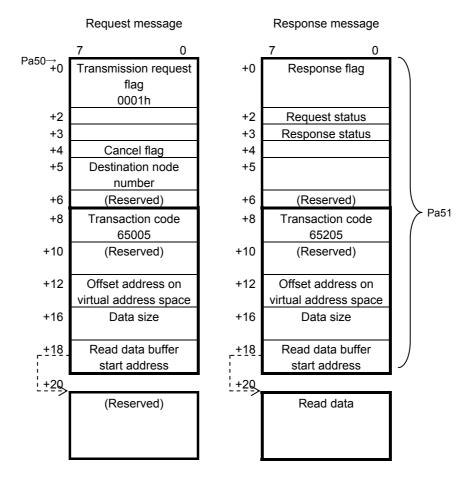


Table 3-7 Word Block Read Interface Items

Interface item		Description	Direction
Transaction code	Request message:	65005	U→S
	Response message:	65205	S→U
Offset address on	Request message:	Offset address on virtual address space of word	U→S
virtual address space		block data to be read from the server	
	Response message:	Same as above	
Data size	Request message:	Size of word block data to be read from the	U→S
		server (in words)	S→U
	Response message:	Size of word block data actually read from the	
		server (in words)	
		Start address of an area in the PMC area used	U→S
address (Note 1)		to store word block data read from the server	
	Response message:	Same as above	

Interface item		Direction	
Read data	Request message: Reserved		S→U
	Response message: Word block data actually read from the server.		
		When an abnormal response is returned, an	
		error code is stored.	

- 1 The read data buffer is allocated to the same PMC area as for this interface. Therefore, when this interface is allocated to the R area of the first PMC, the read data buffer is also allocated to the R area of the first PMC.
- 2 or an error code stored when an abnormal response is returned, refer to the manual of the equipment of a message transmission destination.

3.4.4 Word Block Write

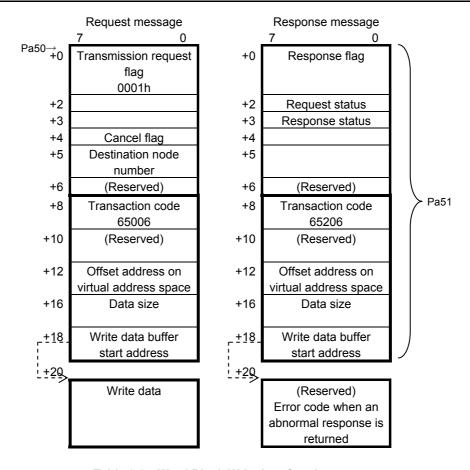


Table 3-8 Word Block Write Interface Items

Interface item		Description		
Transaction code	Request message:	65006	U→S	
	Response message:	65206	S→U	
Offset address on virtual address space	Request message: Response message:	Offset address on virtual address space of word block data to be written to the server Same as above	U→S	
Data size	Request message:	Size of word block data to be written to the server (in words)	U→S S→U	
	Response message:	Size of word block data actually written to the server (in words)		

Interface item		Direction	
Write data buffer start address (Note 1)	Request message:	Start address of an area in the PMC R area storing word block data to be written to the server	U→S
	Response message:	Same as above	
Write data	Request message:	Word block data to be written to the server	U→S
	Response message:	An error code is stored when an abnormal response is returned.	S→U

- 1 The write data buffer is allocated to the same PMC area as for this interface. Therefore, when this interface is allocated to the R area of the first PMC, the write data buffer is also allocated to the R area of the first PMC.
- 2 For an error code stored when an abnormal response is returned, refer to the manual of the equipment of a message transmission destination.

3.5 MESSAGE TRANSMISSION SERVER FUNCTION

3.5.1 Error Code List

In response to a request from a client, the message data transmission server function automatically returns a response message without involving the user program.

When the message transmission server detects an abnormality, the FANUC FL-net function returns one of the following error codes to the client:

Erro	code	Beautistian	
1st byte	2nd byte	Description	
80h	01h	An attempt was made to access a nonexistent PMC area.	
	02h	A specified data size exceeded 1024 bytes.	
	03h	An attempt to allocate a parameter storage area failed.	
	04h	A request was made to write to a write-prohibited area.	

Table 3-9 List of Server Function Error Codes

3.5.2 Virtual Address Space Allocation

Virtual address space used to read/write byte block and read/write word block is allocated in the PMC area as described below.

Virtual address space for byte block data

Table 3-10 Virtual Address Space for Byte Block Data

Allocation in PMC		Allocation in PMC		Virtual address space	Remarks
Symb	ol	Type of signal	Address (decimal)	(hexadecimal) (NOTE 1)	
	Χ	Signal from machine to PMC	X0000 or higher	00x00000h or higher	
	Υ	Signal from PMC to machine	Y0000 or higher	00x04000h or higher	Dood Only
	F	Signal from NC to PMC	F0000 or higher	00x08000h or higher	Read Only
Multi-	G	Signal from PMC to NC	G0000 or higher	00x0C000h or higher	
path	R	late as al salas.	D0000 or bigher	00x10000h or higher	
PMC	K	Internal relay	R0000 or higher	00x30000h or higher (NOTE 4)	
	7	Data table	D0000 bib	00x14000h or higher	Read/Write
	D Data table D000	D0000 or higher	00x20000h or higher (NOTE 3, 4)		
	Е	Extra relay	E0000 or higher	00x18000h or higher	

- 1 "x" of virtual address space is "0", "1", "2", "3", or "4" according to the 1st, 2nd, 3rd, 4th, or 5th PMC path.
 - For example, address E0000 for the 2nd PMC is 00118000h.
- 2 The existence of multi-PMC and the size of PMC address are different in your CNC system, depending on the PMC option configuration. An attempt to access nonexistent PMC space results in an error.
- 3 When using PMC Memory-C, please use virtual address of Data table from 00x20000h to 00x24E1Fh.
 - However, if you use Data table from D0000 to D16383, you can use the virtual address space from 00x14000h to 00x17FFFh or from 00x20000h to 00x23FFFh because of keeping compatibility.
 - ("x" of virtual address space is "0", "1" or "2" according to the 1st, 2nd or 3rd PMC path.)
- 4 When using PMC Memory-D, use virtual address spaces 00x20000h to 00x24E1Fh and 00x30000h to 00x3EA5Fh for the data table and internal relay. However, if you use the data table from D0000 to D16383 and internal relay from R0000 to R16383, you can use the virtual address spaces from 00x14000h to 00x17FFFh and from 00x10000h to 00x13FFFh or the virtual address spaces from 00x20000h to 00x23FFFh and from 00x30000h to 00x33FFFh because of keeping compatibility.

Virtual address space for word block data

Table 3-11 Virtual Address Space for Word Block Data

	Allocation in PMC			Virtual address space	Remarks
Symb	ol	Type of signal	Address (decimal)	(hexadecimal) (NOTE 1)	
	Χ	Signal from machine to PMC	X0000 or higher	00x00000h or higher	
	Υ	Signal from PMC to machine	Y0000 or higher	00x02000h or higher	Dood Only
	F	Signal from NC to PMC	F0000 or higher	00x04000h or higher	Read Only
Multi-	G	Signal from PMC to NC	G0000 or higher	00x06000h or higher	
path	R		DOOOO or birbor	00x08000h or higher	
PMC	K	Internal relay	R0000 or higher	00x18000h or higher (NOTE 4)	
	D	Data table	D0000 or bigher	00x0A000h or higher	Read/Write
	U	Data table	D0000 or higher	00x10000h or higher (NOTE 3, 4)	
	Ε	Extra relay	E0000 or higher	00x0C000h or higher	

NOTE

- 1 "x" of virtual address space is "0", "1", "2", "3", or "4" according to the 1st, 2nd, 3rd, 4th, or 5th PMC path.
 - For example, address E0000 for the 2nd PMC is 0010C000h.
- 2 The existence of multi-PMC and the size of PMC address are different in your CNC system, depending on the PMC option configuration. An attempt to access nonexistent PMC space results in an error.
- 3 When using PMC Memory-C, please use virtual address of Data table from 00x10000h to 00x1270Fh.
 - However, if you use Data table from D0000 to D16383, you can use the virtual address space from 00x0A000h to 00x0BFFFh or from 00x10000h to 00x11FFFh because of keeping compatibility.
 - ("x" of virtual address space is "0", "1" or "2" according to the 1st, 2nd or 3rd PMC path.)

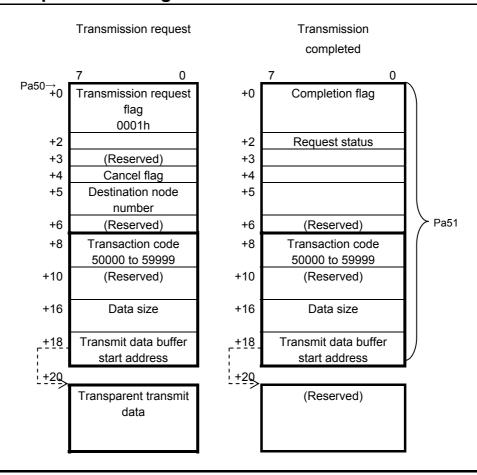
4 When using PMC Memory-D, use virtual address spaces 00x10000h to 00x1270Fh and 00x18000h to 00x1F52Fh for the data table and internal relay. However, if you use the data table from D0000 to D16383 and internal relay from R0000 to R16383, you can use the virtual address spaces from 00x0A000h to 00x0BFFFh and from 00x08000h to 00x09FFFh or the virtual address spaces from 00x10000h to 00x11FFFh and from 00x18000h to 00x19FFFh because of keeping compatibility.

3.6 TRANSPARENT MESSAGE TRANSMISSION FUNCTION

With the FANUC FL-net function, a transparent message of a transaction code (50000 to 59999) can be used as a transparent message for data transmission/reception by the user program.

This section explains in detail the interfaces of the transparent message transmission function in the message section at transmission and at reception.

3.6.1 Transparent Message Transmission



NOTE

When the destination node number is set to 255, the message is transmitted to all nodes.

Table 3-12 Transparent Transmit Message Interface Items

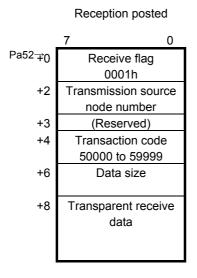
Interface item	Description	Direction
Transaction code	50000 to 59999	U→S

Interface item	Description	Direction
Data size	Size of transparent data to be transmitted (in words)	U→S
Transmit data buffer start address (Note)	Start address of an area in the PMC area storing transparent data to be transmitted	U→S
Transparent transmit data	Transparent data to be transmitted	U→S

The transmission data buffer is allocated to the same PMC area as for this interface.

Therefore, when this interface is allocated to the R area of the first PMC, the transmission data buffer is also allocated to the R area of the first PMC.

3.6.2 Transparent Message Reception



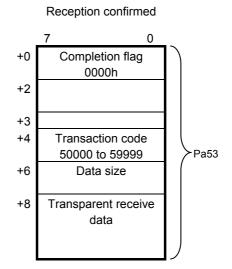


Table 3-13 Transparent Receive Message Interface Items

Interface item Description		Direction
Receive flag /	When a transparent message is received, this flag is set to	S→U
completion flag	0001h after the interface items below are set.	U→S
	The user program must clear this flag to 0 after completing	
	reception processing for the transparent message.	
Transmission source node	Node number of a transmission source that transmitted a	S→U
number	transparent message	
Transaction code	50000 to 59999	S→U
Data size	Size of received transparent data (in words)	S→U
Transparent receive data	Transparent data received	S→U

When a transparent message is received, a R_STS code with a meaning indicated below may be returned to the transparent message transmission client.

Table 3-14 Meanings of R STS Codes Returned to the Transparent Message Transmission Side

Table 6 14 modifings of K_616 Godde Retained to the Transparent modeling transmission Glas		
R_STS value	Description	
02 (buffer full)	The previously received transparent message is not processed by the user program.	
03 (not initialized)	An interface area for receiving a transparent message is not allocated.	
06 (format error)	A transparent message actually received is larger than a receive data area allocated by this interface. Transparent data actually received consists of an odd number of bytes.	

3.7 SERVER FUNCTION OF TRANSMITTING A MESSAGE WITH CONFIRMATION

When an ordinary byte block read/write or word block read/write service of the message transmission server function is executed, data is exchanged with the client without user-program intervention. Data can also be exchanged with user-program intervention using a specific virtual address space specification. This specification can be used to establish the concurrency of data tens to hundreds of bytes long easily. In this case, the user program must transmit a response message, however.

This section details the interfaces used for transmission and reception using the function of transmitting a message with confirmation.

These interfaces use the transmission and reception areas for transparent message transmission.

To perform transmission of a message with confirmation, specify an address with an offset of 01000000h in the ordinary virtual address space.

NOTE

In message transmission with confirmation, the server must return a response message through the user program. Unless the user program on the server side returns a response message, the client cannot complete the message transmission operation.

3.7.1 Reception of a Message with Confirmation

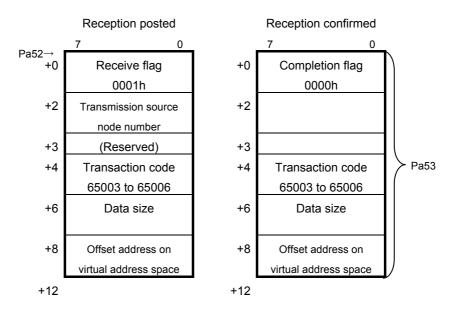


Table 3-15 Receive Message Interface Items

Interface item	Description	Direction
Receive flag /	When a message is received, this flag is set to 0001h	S→U
completion flag	after the interface items below are set.	U→S
	The user program must clear this flag to 0 after	
	completing message reception processing.	
Transmission source node	Number of the node which transmitted a message	S→U
number		
Transaction code	65003 to 65006	S→U
Data size	Size of received message data	S→U
Offset address on virtual address	Offset address on virtual address space	S→U
space		

When a message with confirmation is received, an R_STS code with a meaning indicated below may be returned to the message transmission client.

Table 3-16 Meanings of R_STS Codes Returned to the Transmission Side of Transmission of a Message with Confirmation

R_STS value	Description
02 (buffer full)	The previously received message is not processed by the user program.
03 (not initialized)	An interface area for receiving a message is not allocated.
06 (format error)	A message actually received is larger than a receive data area allocated by this
	interface.
	Word block data actually received consists of an odd number of bytes.

3.7.2 Response Message Transmission

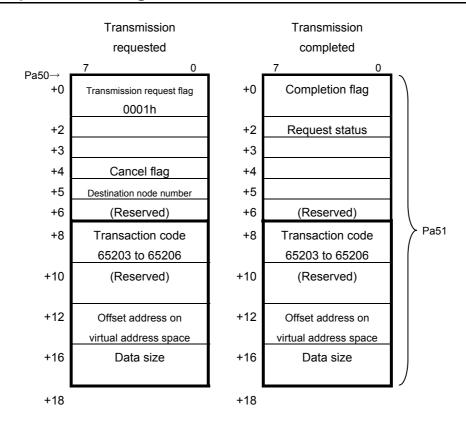


Table 3-17 Response Message Interface Items

Interface item	Description	Direction
Transaction code	65203 to 65206	U→S
Offset address on virtual address	Offset address on virtual address space	U→S
space		
Data size	Size of data to be transmitted	U→S

NOTE

The procedure for transmission of a message with confirmation is the same as for the transparent message transmission function.

3.7.3 Virtual Address Space Allocation

Virtual address space used for byte block read/write and word block read/write with confirmation is allocated in the PMC area as described below.

Virtual address space for byte block data with confirmation

Table 3-18 Virtual Address Space for Byte Block Data with Confirmation

	Allocation in PMC			Virtual address space	
Symbol		Type of signal	Address (decimal)	(hexadecimal) (NOTE 1)	Remarks
	Χ	Signal from machine to PMC	X0000 or higher	01x00000h or higher	
	Υ	Signal from PMC to machine	Y0000 or higher	01x04000h or higher	Dood Only
	F	Signal from NC to PMC	F0000 or higher	01x08000h or higher	Read Only
Multi-	G	Signal from PMC to NC	G0000 or higher	01x0C000h or higher	
path	R	Internal relay	D0000 or bigher	01x10000h or higher	
PMC	K	Internal relay	R0000 or higher	01x30000h or higher (NOTE 4)	
	7	Data table	D0000 or bigher	01x14000h or higher	Read/Write
	D	Data table	D0000 or higher	01x20000h or higher (NOTE 3, 4)	
	Ε	Extra relay	E0000 or higher	01x18000h or higher	

NOTE

- 1 "x" of virtual address space is "0", "1", "2", "3", or "4" according to the 1st, 2nd, 3rd, 4th, or 5th PMC path.
 - For example, address E0000 for the 2nd PMC is 01118000h.
- 2 The existence of multi-PMC and the size of PMC address are different in your CNC system, depending on the PMC option configuration. An attempt to access nonexistent PMC space results in an error.
- 3 When using PMC Memory-C, please use virtual address of Data table from 00x20000h to 00x24E1Fh.
 - However, if you use Data table from D0000 to D16383, you can use the virtual address space from 01x14000h to 01x17FFFh or from 01x20000h to 01x23FFFh because of keeping compatibility.
 - ("x" of virtual address space is "0", "1" or "2" according to the 1st, 2nd or 3rd PMC path.)
- 4 When using PMC Memory-D, use virtual address spaces 01x20000h to 01x24E1Fh and 01x30000h to 01x3EA5Fh for the data table and internal relay. However, if you use the data table from D0000 to D16383 and internal relay from R0000 to R16383, you can use the virtual address spaces from 01x14000h to 01x17FFFh and from 01x10000h to 01x13FFFh or the virtual address spaces from 01x20000h to 01x23FFFh and from 01x30000h to 01x33FFFh because of keeping compatibility.

Virtual address space for word block data with confirmation

Table 3-19 Virtual Address Space for Word Block Data with Confirmation

	Allocation in PMC		Vistual address areas		
Symbol		Type of signal	Address (decimal)	Virtual address space (hexadecimal) (NOTE 1)	Remarks
	Χ	Signal from machine to PMC	X0000 or higher	01x00000h or higher	
	Υ	Signal from PMC to machine	Y0000 or higher	01x02000h or higher	Dood Only
	F	Signal from NC to PMC	F0000 or higher	01x04000h or higher	Read Only
Multi-	G	Signal from PMC to NC	G0000 or higher	01x06000h or higher	
path	R		DOOOO or birbor	01x08000h or higher	
PMC	ĸ	Internal relay	R0000 or higher	01x18000h or higher (NOTE 4)	
	D	Data table	D0000 or bigher	01x0A000h or higher	Read/Write
	U	Data table	D0000 or higher	01x10000h or higher (NOTE 3, 4)	
	Ε	Extra relay	E0000 or higher	01x0C000h or higher	

NOTE

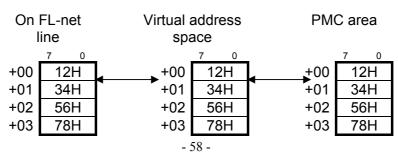
- 1 "x" of virtual address space is "0", "1", "2", "3", or "4" according to the 1st, 2nd, 3rd, 4th, or 5th PMC path.
 - For example, address E0000 for the 2nd PMC is 0110C000h.
- 2 The existence of multi-PMC and the size of PMC address are different in your CNC system, depending on the PMC option configuration.

 An attempt to access nonexistent PMC space results in an error.
- When using PMC Memory-C, please use virtual address of Data table from 01x10000h to 01x1270Fh. However, if you use Data table from D0000 to D16383, you can use the virtual address space from 01x0A000h to 01x0BFFFh or from 01x10000h to 01x11FFFh because of keeping compatibility. ("x" of virtual address space is "0", "1" or "2" according to the 1st, 2nd or 3rd PMC path.)
- 4 When using PMC Memory-D, use virtual address spaces 01x10000h to 01x1270Fh and 01x18000h to 01x1F52Fh for the data table and internal relay. However, if you use the data table from D0000 to D16383 and internal relay from R0000 to R16383, you can use the virtual address spaces from 01x0A000h to 01x0BFFFh and from 01x08000h to 01x09FFFh or the virtual address spaces from 01x10000h to 01x11FFFh and from 01x18000h to 01x19FFFh because of keeping compatibility.

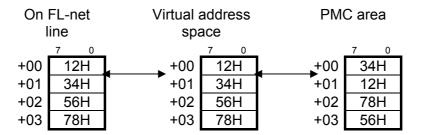
3.8 BYTE LIST OF MESSAGE DATA

In message transmission, the relationships between the sequence of data transmission over the network and the byte list in the virtual address space and PMC area are shown below.

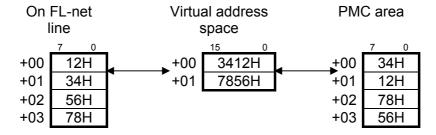
Byte block data and the PMC area



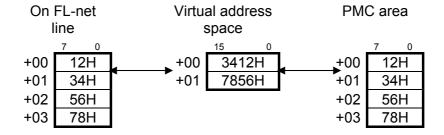
The data list in the PMC area can be changed as shown below by setting bit 2 of FL-net parameter Pa60 (parameter 1) to 1.



Word block data and the PMC area Transparent data and the PMC area



The data list in the PMC area can be changed as shown below by setting bit 1 of FL-net parameter Pa60 (parameter 1) to 1.



NOTE

The data width of FL-net word block data and transparent messages in the virtual address space is 16 bits.

On the other hand, the data width of each address in the PMC area is 8 bits. So, the relationships indicated above apply when data is exchanged between FL-net messages and the PMC area.

4

ABOUT USE WITH 30i/31i/32i/35i-B, PMi-A, 0i-F

The hardware of Series 30i/31i/32i/35i-B, Power Motion i-A, and Series 0i-F is different from one of Series 30i/31i/32i-A.

In this section, the difference of the specification is described.

4.1 HARDWARE OPTIONS

The following hardware options are prepared for FL-net.

Kind of hardware	Description
Multi-function Ethernet	Fast Ethernet circuit mounted on the main board of the LCD-mounted type Series 30i/31i/32i/35i-B and Power Motion i-A (Connector name: CD38B)
Fast Ethernet board	Option board mounted in the optional slot (Connector name: CD38R)

The above hardware can be used as hardware for the Fast Ethernet according to the setting of the NC parameters (No.970-972).

The information when the hardware is used as hardware for FL-net is described in this manual. Refer to "Fast Ethernet/Fast Data Server OPERATOR'S MANUAL" (B-64014EN) regarding the Fast Ethernet function.

NOTE

- 1 The maximum number of hardware options that can be mounted is 3, including Multi-function Ethernet and/or Fast Ethernet boards. For the stand-alone type Series 35*i*-B, the stand-alone type Power Motion *i*-A and Series 0*i*-F, however, the maximum number of hardware options that can be mounted is 2.
- 2 Multi-function Ethernet cannot be used on a stand-alone type CNC or Series 0*i*-F.

4.2 SOFTWARE OPTIONS

The following software functions can be used by the hardware options shown in Section 4.1.

Function name Drawing		Description
Ethernet function	A02B-xxxx-S707	Ethernet function (ex. FOCAS2/Ethernet) can be used.
Data Server function A02B-xxxx-S737		Data Server function can be used. (Note 3)
FL-net function	A02B-xxxx-J692	FL-net function can be used.
FL-net PORT2 function	A02B-xxxx-R964	Two FL-net functions can be used simultaneously.(Note 1)

- 1 It is possible to operate two FL-net functions at the same time on the Series 30*i*/31*i*/32*i*/35*i*-B and Power Motion *i*-A. In this case, two hardware options are necessary.
 - In Series 0*i*-F, the number of FL-net functions that can be operated at the same time is one, and FL-net PORT2 function cannot be used.
- 2 In the Series 30*i*/31*i*/32*i*-A, the special software and software options are necessary to use the FL-net/Ethernet coexisting function. But, in the Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, and Series 0*i*-F, it is possible to use FL-net/Ethernet coexisting function by only Ethernet function and FL-net function.
 - Please refer to "4.3 RELATED NC PARAMETERS" about the setting for FL-net/Ethernet coexisting function.
- 3 In the Series 35i-B and Power Motion i-A, the Data Server function cannot be used.

4.3 RELATED NC PARAMETERS

0970	Select hardware that operates Ethernet or Data Server function
0971	Select hardware that operates first FL-net function
0972	Select hardware that operates second FL-net function

[Input type] Parameter input

[Data type] Byte

[Valid data range] -1 to 6

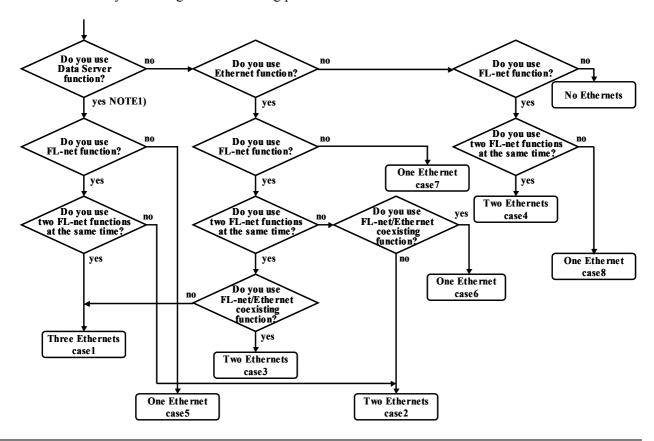
Hardware that operates each function is selected. Please refer to the next section, too.

Value	Hardware	
-1	Not used	
0	Unsetting (NOTE1)	
1	Multi-function Ethernet (NOTE2)	
2	(reserved)	
3	Fast Ethernet board mounted in slot 1	
4	Fast Ethernet board mounted in slot 2	
5	Fast Ethernet board mounted in slot 3	
6	Fast Ethernet board mounted in slot 4	

- 1 When one hardware option is mounted and the software option is uniquely decided, the function can run even if NC parameters No.970-972 are set to 0.
- 2 The Data Server function cannot be used on Multi-function Ethernet. If using the Data Server function, don't set 1 to NC parameter No.970.
 - With a stand-alone type CNC or Series 0*i*-F, do not set 1 (Multi-function Ethernet) to parameter No. 970.
- When the Ethernet function and the FL-net function are available, these functions can operate on the same hardware by specifying the same hardware on the NC parameters No.970 and 971 as the FL-net/Ethernet coexisting function.
 - And, each function can operate on the different hardware by specifying the different hardware.
 - Please refer to "3 OVERVIEW OF FL-net/Ethernet COEXISTING FUNCTIONS" of "I GENERAL" about FL-net/Ethernet coexisting function
- 4 When the Ethernet function and the Data Server function are available, these functions must operate on the same hardware according to the NC parameter No.970.
 - These functions cannot operate on the different hardware.
- When the Ethernet function, the Data Server function, and the FL-net function are available, the NC parameters No.970 and 971 have to set the different hardware. In this case, the Ethernet function and the FL-net function cannot operate on the same hardware.
- 6 In Series 0*i*-F, do not set a value other than 0 or -1 to parameter No.972.

4.4 SELECTION PROCEDURE OF HARDWARE AND SOFTWARE OPTIONS

When using the Ethernet function, Data Server function, and FL-net function, please select hardware and software basically according to the following procedure.



LCD-mounted type Series 30i/31i/32i/35i-B and Power Motion i-A

		Required hardware	Required software option	NC parameters
		Multi-function Ethernet	J692	No.970 = 3
case 1	Three Ethernets	Fast Ethernet board (slot1)	S737 (+S707)	No.971 = 1
		Fast Ethernet board (slot2)	R964	No.972 = 4
2000 2	Two Ethernets	Multi-function Ethernet	J692	No.970 = 3
case 2	Two Ethernets	Fast Ethernet board (slot1)	S737 (+S707)	No.971 = 1
		Multi-function Ethernet	S707 + J692	No.970 = 1
case 3	Two Ethernets			No.971 = 1
		Fast Ethernet board (slot1)	R964	No.972 = 3
case 4	Two Ethernets	Multi-function Ethernet	J692	No.971 = 1
		Fast Ethernet board (slot1)	R964	No.972 = 3
case 5	One Ethernet	Fast Ethernet board (slot1)	S737 (+S707)	No.970 = 3
2222 0	One Ethernet	Multi function Ethernet	6707 + 1600	No.970 = 1
case 6	One Ethernet	Multi-function Ethernet	S707 + J692	No.971 = 1
case 7	One Ethernet	Multi-function Ethernet	S707	No.970 = 1
case 8	One Ethernet	Multi-function Ethernet	J692	No.971 = 1

Stand-alone type Series 30i/31i/32i/35i-B and Power Motion i-A LCD-mounted type / Stand-alone type Series 0i-F

		Required hardware	Required software option	NC parameters
0000 1		Fast Ethernet board (slot1)	J692	No.970 = 3
case 1 (NOTE 2)	Three Ethernets	Fast Ethernet board (slot2)	S737 (+S707)	No.971 = 4
(NOTE 2)		Fast Ethernet board (slot3)	R964	No.972 = 5
2000	Two Ethernets	Fast Ethernet board (slot1)	J692	No.970 = 3
case 2	Two Ethernets	Fast Ethernet board (slot2)	S737 (+S707)	No.971 = 4
		Foot Ethernet heard (slot1)	S707 1602	No.970 = 3
case 3	Two Ethernets	Fast Ethernet board (slot1)	S707 + J692	No.971 = 3
		Fast Ethernet board (slot2)	R964	No.972 = 4
0000 4	Two Ethernets	Fast Ethernet board (slot1)	J692	No.971 = 3
case 4	Two Ethernets	Fast Ethernet board (slot2)	R964	No.972 = 4
case 5	One Ethernet	Fast Ethernet board (slot1)	S737 (+S707)	No.970 = 3
0	0	F + F + + (- - + 4)	0707 : 1000	No.970 = 3
case 6	One Ethernet	Fast Ethernet board (slot1)	S707 + J692	No.971 = 3
case 7	One Ethernet	Fast Ethernet board (slot1)	S707	No.970 = 3
case 8	One Ethernet	Fast Ethernet board (slot1)	J692	No.971 = 3

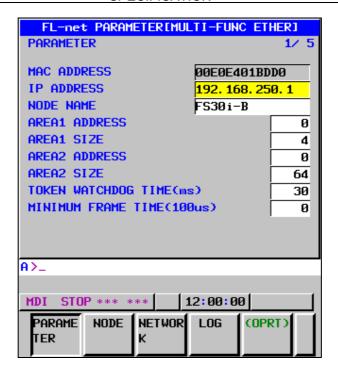
NOTE

- 1 When the Data Server function is selected, whether the Ethernet function is selected does not affect the subsequent selection procedure because the Ethernet and Data Server functions always operate on the same hardware.
- 2 It is not selectable because only two option boards can be mounted in the stand-alone type of Series 35i-B and Power Motion i-A, and LCD-mounted type / stand-alone type of Series 0i-F.

4.5 SCREEN LAYOUT

In this manual, each screen has described the example of the screen of Series 30i/31i/32i-A. The basic contents are the same as for Series 30i/31i/32i/35i-B, Power Motion i-A, and Series 0i-F, but the detailed layout might be different.

The hardware can be confirmed in title part of each screen of Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, and Series 0*i*-F.



The kind of the hardware is shown on the title bar as the above example like [MULTI –FUNC ETHER].

Title	Description
[MUTI-FUNC ETHER]	Fast Ethernet circuit mounted on the main board of the LCD-mounted type Series 30 <i>i</i> /31 <i>i</i> /32 <i>i</i> /35 <i>i</i> -B and Power Motion <i>i</i> -A
[BOARD(SLOT1)]	Option board mounted in the optional slot 1
[BOARD(SLOT2)]	Option board mounted in the optional slot 2
[BOARD(SLOT3)]	Option board mounted in the optional slot 3
[BOARD(SLOT4)]	Option board mounted in the optional slot 4

In Series 30i/31i/32i/35i-B and Power Motion i-A, there are two soft keys [FL-net 1CH] and [FL-net 2CH] because two FL-net functions can operate at the same time.

The hardware specified with NC parameter No.971 is corresponding to the soft key [FL-net 1CH] and the hardware specified with NC parameter No.972 is corresponding to the soft key [FL-net 2CH].

In Series 0*i*-F, there is a soft key [FL-net 1CH] only because the number of FL-net functions that can be operated at the same time is one.



III. SETTING



1 SETTING OF FL-net FUNCTION

This part describes how to set the FL-net function

⚠ WARNING

Before allocating DI/DO data and status data to a PMC area, fully understand the instructions written in "GENERAL WARNINGS FOR CNC APPLICATION DEVELOPMENT" in "SAFETY PRECAUTIONS" at the beginning of this manual, and in this chapter.

Allocate the PMC area so that multiple communication functions do not write it. Immediately after setting all communication parameters including those for allocation to the PMC area, make sure that DI/DO data and status data operate correctly in the status in which safety is ensured before starting operation. If operation is started without checking the above, the machine may behave unexpectedly, possibly causing damage to the tool, machine, and/or workpiece, or injury to the user.

NOTE

- 1 In this manual, each screen has described the example of the screen of Series 30*i*/31*i*/32*i*-A. The basic contents are the same as for Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A and Series 0*i*-F, but the detailed layout might be different.
- 2 For the Series 30*i*/31*i*/32*i*/35*i*-B and Power Motion *i*-A, the hardware specified with NC parameter No. 971 corresponds to soft key [FL-net 1CH] and the hardware specified with NC parameter No. 972 corresponds to soft key [FL-net 2CH].
- 3 The FL-net setting tool is provided as a personal computer tool related to the FL-net function.

(product name :CNC Setting Tool, drawing number: A08B-9510-J540) The FL-net setting tool allows you to easily create FL-net function parameters on your personal computer.

1.1 PARAMETERS FOR FL-net FUNCTION

The parameters for the FL-net function are divided into six major groups:

- (1) Basic parameters
- (2) State monitoring parameters
- (3) Area 1 allocation parameters
- (4) Area 2 allocation parameters
- (5) Message allocation parameters
- (6) Bit parameters

Each parameter is detailed below.

(1) Basic parameters

These parameters are defined by the FL-net communication standards and must be set for every FL-net device of any manufacturer.

Table 1-1 Basic Parameters

Parameter name	Description	Parameter number
IP address	IP address of the local node (The host address	Pa10
	section (the last numeric value) of this IP address is	
	the node number of the local node.)	
Address of area 1	Start address of a common memory area 1 area	Pa11
	allocated as DO of the local node	
Area 1 size	Data size of a common memory area 1 area	Pa12
	allocated as DO of the local node	
Address of area 2	Start address of a common memory area 2 area	Pa13
	allocated as DO of the local node	
Area 2 size	Data size of a common memory area 2 area	Pa14
	allocated as DO of the local node	
Token monitoring time	Token hold time of the local node	Pa15
Allowable minimum frame interval	Inter-frame time interval requested to another node	Pa16
Node name	Equipment name of the local node	Pa17

(2) State monitoring parameters

These parameters are used to assign local node status data and remote node status data to the PMC area so that the user program can monitor the statuses of the local node and remote nodes.

Table 1-2 State Monitoring Parameters

Parameter name	Description	Parameter number
Local node status	Start address of an area in the PMC E/R area used	Pa20
	as the output destination of status information about	
	the local node	
List of participating nodes	Start address of an area in the PMC E/R area used	Pa21
	as the output destination of a list of all nodes	
	participating in the network	

(3) Area 1 allocation parameters

These parameters are used to specify addresses to perform data exchange between common memory area 1 and the PMC area.

Table 1-3 Area 1 Allocation Parameters

Parameter name	Description	Parameter number
PMC start address	Start address of an area in the PMC E/R area	Pa30
(shared by DI/DO)	allocated to common memory area 1	
Area 1 start address	Start address of common memory area 1 allocated	Pa31
(shared by DI/DO)	to an area in the PMC E/R area	
Allocation size	Size of data to be exchanged	Pa32
(shared by DI/DO)		

(4) Area 2 allocation parameters

These parameters are used to specify addresses to perform data exchange between common memory area 2 and the PMC area.

Since common memory area 2 is larger than the PMC area, allocating separate DI and DO areas is permitted as well as allocating DI and DO at a time in the same way as for common memory area 1.

Table 1-4 Area 2 Allocation Parameters (Shared by DI and DO)

Parameter name	Description	Parameter number
PMC start address	Start address of an area in the PMC E/R/D area allocated to	Pa47
(shared by DI/DO)	common memory area 2	
Area 2 start address	Start address of common memory area 2 allocated to an area in	Pa48
(shared by DI/DO)	the PMC E/R/D area	
Allocation size	Size of data to be exchanged	Pa49
(shared by DI/DO)		

Table 1-5 Area 2 Allocation Parameters (Separate Allocation for Each of DI and DO)

Parameter name	Description	Parameter number
PMC start address (for DO)	Start address of a common memory area in the PMC E/R/D area that serves as the source of data to be written to area 2	Pa40
Allocation size (for DO)	Size of data written to common memory area 2	Pa41
PMC start address (for DI)	Start address of a common memory area in the PMC E/R/D area that serves as the read destination of information about other nodes and data from area 2	Pa42
Allocation condition setting (for DI/DO)	Address of a common memory area in the PMC D area that is used to specify conditions on data exchange with area 2	Pa43
Condition switch flag (for DI/DO)	Flag for switching between specified conditions at the area 2 data exchange condition allocation address above	Pa44
Area 2 start address (for DI)	Start address of static common memory area 2 to be allocated in the PMC area	Pa45
Allocation size (for DI)	Size of data statically exchanged	Pa46

(5) Message allocation parameters

These parameters are used to specify interface areas for making service requests for message transmission and passing a received message to the user program.

Table 1-6 Message Allocation Parameters

Parameter name	Description	Parameter number
Client function interface	Start address of the PMC E/R/D area that serves as the	Pa50
	interface used by the message transmission client function	
Interface size	Maximum allowable size of the interface area used above	Pa51
Server function interface	Start address of the PMC E/R/D area that serves as the	Pa52
	interface used by the message transmission server function	
Interface size	Maximum allowable size of the interface area used above	Pa53

(6) Bit parameters

Table 1-7 Bit parameters

Parameter name	Description	Parameter number	
Parameter 1	Parameter for FL-net data transfer	Pa60	
Parameter 2	Parameter for FL-net operation	Pa61	

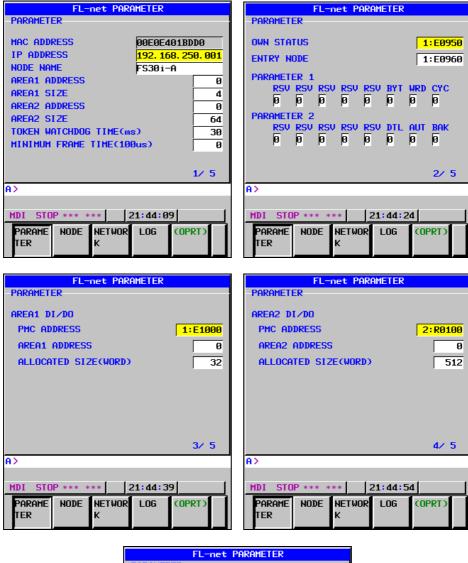
Displaying the parameter screen

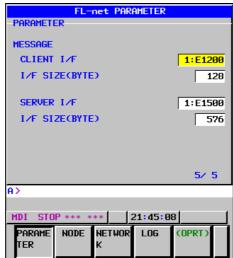
Procedure

1 Press function key



- The [FL-net] ([FL-net 1CH] or [FL-net 2CH] for the Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, [FL-net 1CH] for the Series 0*i*-F) soft key appears. (If the [FL-net] soft key is not displayed, press the next-menu key several times, which is located at the right end of soft keys.)
- Pressing the [FL-net] soft key displays the FL-net PARAMETER screen, the FL-net NODE MONITOR screen, the FL-net NETWORK screen, or the FL-net LOG screen.
- 4 Press the [PARAMETER] soft key to display the parameter screen (Screen 1-1).
- 5 You can change pages of the parameter screen by using page keys Apace Page 1
- 6 Move the cursor to the item you want to set, and enter a parameter value.



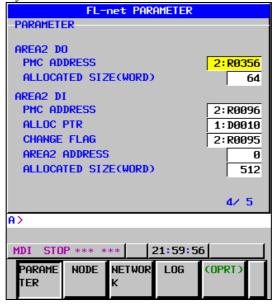


Screen 1-1 FL-net PARAMETER Screen

As necessary, press the [(OPRT)] soft key, then use the following soft key:



8 If you set bit 2 (DTL) of Pa61 (parameter 2) to 1, the screen for DI/DO allocation of common memory area 2 on the fourth page is displayed as follows (Screen 1-2), allowing you to set the DI area and DO area separately:



Screen 1-2 FL-net PARAMETER Screen (Setting of Details)

Display item

The following display item is explained:

Table 1-8 MAC Address

ltem	Description
MAC ADDRESS	MAC address set for the local FL-net board

Setting item

Each setting item is described below.

Basic parameters

Parameters for the FL-net function are set.

Table 1-9 Basic Parameters

Item		Description
IP ADDRESS		IP address of the local node.
	Pa10	The host address section (last numeric value) of this IP address is the node
		number of the local node.
		Only an IP address in class C can be specified.
NODE NAME		An arbitrary node name not longer than 10 characters can be specified.
	Pa17	
AREA1 ADDRESS		Start address of common memory area 1 of the local node. A value from 0 to 511
(Note 1)	Pa11	can be set.
AREA1 SIZE		Data size of common memory area 1 of the local node. A value from 0 to 512
(Note 1)	Pa12	can be set.
AREA2 ADDRESS		Start address of common memory area 2 of the local node. A value from 0 to
(Note 1)	Pa13	8191 can be set.
AREA2 SIZE		Data size of common memory area 2 of the local node. A value from 0 to 8192
(Note 1)	Pa14	can be set.
TOKEN WATCHDOG TIME		Token monitoring time.
(Note 2)		Maximum duration of time for which the local node can hold the token.
	Pa15	A value from 1 to 255 can be set. (Unit: 1msec)

Item	Description
MINIMUM FRAME (Note 3, 4)	Minimum allowable frame time interval. Set an inter-frame time interval so that the local node can receive data frames in
Pa16	succession. A value from 0 to 50 can be specified. (Unit: 100 μsec)

NOTE

- 1 When the area set for common memory area 1 or 2 overlaps with an area of another node, the node that participated in the network later is to participate in the network with the start addresses and sizes of common memory areas 1 and 2 set to 0. Note that this means that the node participates in the network without its own output area.
- 2 A token monitoring time is set to reissue a token. If the local node does not issue a token when the time specified in this parameter has elapsed, the next node reissues a token. This means that an adequate value needs to be set in connection with the amount of transmit data of the local node. Usually, set 30 (30 msec).
 - When the Safety function by FL-net is used, it is necessary to correct the value depending on the number of nodes that participate in the network. For details, see Subsection A.1.1, "Mode of the Safety Function by FL-net" in "APPENDIX".
- When a value of 0 is set to the minimum allowable frame interval, the FL-net function performs communication at the fastest rate, but a slower device cannot participate in the network. For this reason, set an appropriate value to the minimum allowable frame interval when connecting such a device.
- 4 We recommend that 10 (1 msec) or more is set to the minimum frame time when using the FL-net/Ethernet coexisting function. When the value of the minimum frame time is enlarged, both FL-net refresh cycle time and the process time of other communications will increase. Therefore, please do not set an excessively big value to the minimum frame time.

State monitoring parameters

The state monitoring parameters are used to allocate areas in the PMC area to which the states of the local node and other nodes are posted.

Table 1-10 Area 1 Allocation Parameters

Item		Description
OWN STATUS		Specify the start address of an area in the PMC E/R area to which the communication
	Pa20	state of the local node is posted.
		An 8-byte area starting at the start address is used as the local node status area.
ENTRY NODE		Specify the start address of an area in the PMC E/R area to which the network
	Pa21	participation state of other nodes is posted.
		A 32-byte area starting at the start address is used as the participating node list area.

⚠ CAUTION

- 1 In the PMC area, the R area, and E area in volatile memory are all set to 0 immediately after power-on.
- 2 The E area in the PMC area is normally allocated to volatile memory. However, it can also be used as nonvolatile memory by setting the option.

 When the area is used as nonvolatile memory, the contents of the area are retained even after the power is turned off. So, special attention should be paid not to cause an unpredictable operation when the power is turned on next time.

⚠ CAUTION

3 Be careful not to cause an overlap between an area such as the input data area of the user program and a PMC area used for other purposes.

NOTE

- 1 When the above area is not used, enter a space. "---" appears, indicating that the area is not used.
- 2 Only a PMC area at an even-numbered address can be set for the above area.
- 3 When setting the PMC area, note the following:

For a multi-path PMC, enter an PMC address as follows:

<Path number>:<PMC address>

For R0500 for the second PMC path, for example, enter "2:R500". When only a PMC address (R500) is entered, it is assumed to be the PMC address for the first path (1:R0500).

If the <:> key is not provided, the </> or <EOB> key can be used instead.

Bit parameters

The bit parameters are used to specify data conversion at the time of FL-net data transfer and to make other settings.

Table 1-11 Bit Parameters

		Table 1-11 Bit Parameters
Item		Description
Parameter 1	D 00	Bit parameters for FL-net data transfer.
	Pa60	Bit 0: CYC
		Byte swapping of cyclic data in common memory areas 1 and 2 is:
		0: Not performed.
		1: Performed.
		Bit 1: WRD
		Byte swapping of word block data and transparent message data is:
		0: Not performed.
		1: Performed.
		Bit 2: BYT
		Byte swapping of byte block data is:
		0: Not performed.
		1: Performed. Bits 7-3: RSV
		Be sure to set 0.
Parameter 2		
Parameter 2	Pa61	Bit parameters for FL-net operation Bit 0: BAK
	Faui	Be sure to set 0.
		Bit 1: AUT (Note)
		Auto negotiation (Automatic discrimination of 10Mbps/100Mbps and Full Duplex/Half
		Duplex) is:
		0: Not used.
		1: Used.
		Bit 2: DTL
		By using specifications compatible with the old model, common memory area 2
		allocation parameters are:
		0: Not set.
		1: Set.
		Bits 7-3: RSV
		Be sure to set 0.

NOTE

Bit 1 (AUT) of Parameter 2 is available only to A02B-0303-J566#656K (the control software for FL-net function) for Series 30*i*/31*i*/32*i*-A.

Area 1 allocation parameters

The area 1 allocation parameters are used for allocation-related settings to enable data exchange between common memory area 1 and the PMC E/R area.

Table 1-12 Area 1 Allocation Parameters

Item		Description
PMC ADDRESS (Note 1)	Pa3	Specify the start address of an area in the PMC E/R area used for data exchange with common memory area 1.
0		
AREAR1 ADDRESS		Specify the start address of an area in common memory area 1 used for data
	Pa31	exchange with the PMC E/R area.
ALLOCATED SIZE(WO	ORD)	Specify the size of data exchanged between common memory area 1 and the PMC
(Note 3)		E/R area (Unit: Words).
	Pa32	When data exchange between common memory area 1 and the PMC is not
		performed, set 0 in this parameter.

⚠ CAUTION

- 1 In the PMC area, the R area, and E area in volatile memory are all set to 0 immediately after power-on.
- 2 The E area in the PMC area is normally allocated to volatile memory. However, it can also be used as nonvolatile memory by setting the option.

 When the area is used as nonvolatile memory, the contents of the area are retained even after the power is turned off. So, special attention should be paid not to cause an unpredictable operation when the power is turned on next time.
- 3 Be careful not to cause an overlap between an area such as the input data area of the user program and a PMC area used for other purposes.

NOTE

- 1 Only a PMC area at an even-numbered address can be set for the above area.
- 2 When setting the PMC area, note the following:

For a multi-path PMC, enter an PMC address as follows:

<Path number>:<PMC address>

For R0500 for the second PMC path, for example, enter "2:R500". When only a PMC address (R500) is entered, it is assumed to be the PMC address for the first path (1:R0500).

If the <:> key is not provided, the </> or <EOB> key can be used instead.

3 The unit of size set in this parameter is words. This means that for an area used in the PMC E/R area, the number of bytes as many as the size set in this parameter multiplied by 2 is required.

Area 2 allocation parameters

The area 2 allocation parameters are used for allocation-related settings to enable data exchange between common memory area 2 and the PMC E/R/D area.

Table 1-13 Area 2 Allocation Parameters (Shared by DI and DO)

Table 1-10 Area 2 Anocation 1 arameters (onarea by brains bo)		
Item		Description
PMC ADDRESS		Specify the start address of an area in the PMC E/R/D area used for data
(Note 1)	Pa47	exchange with common memory area 2.
AREAR2 ADDRESS		Specify the start address of an area in common memory area 2 used for data
	Pa48	exchange with the PMC E/R/D area.

Item	Description
ALLOCATED SIZE(WORD) (Note 3)	Specify the size of data exchanged between common memory area 2 and the PMC E/R/D area (Unit: Words).
Pa49	When data exchange between common memory area 2 and the PMC is not performed, set 0 in this parameter.

⚠ CAUTION

- 1 In the PMC area, the R area, and E area in volatile memory are all set to 0 immediately after power-on.
- 2 The D area in the PMC area is allocated to nonvolatile memory. In addition, the E area in the PMC area is normally allocated to volatile memory. However, it can also be used as nonvolatile memory by setting the option. When the area is used as nonvolatile memory, the contents of the area are retained even after the power is turned off. So, special attention should be paid not to cause an unpredictable operation when the power is turned on next time.
- 3 Be careful not to cause an overlap between an area such as the input data area of the user program and a PMC area used for other purposes.

NOTE

- 1 Only a PMC area at an even-numbered address can be set for the above area.
- 2 When setting the PMC area, note the following:

For a multi-path PMC, enter an PMC address as follows:

<Path number>:<PMC address>

For R0500 for the second PMC path, for example, enter "2:R500". When only a PMC address (R500) is entered, it is assumed to be the PMC address for the first path (1:R0500).

- If the <:> key is not provided, the </> or <EOB> key can be used instead.
- 3 The unit of size set in this parameter is words. This means that for an area used in the PMC E/R/D area, the number of bytes as many as the size set in this parameter multiplied by 2 is required.
- 4 As with the old model, DI and DO for common memory area 2 can also be allocated to the PMC area separately.
 - When making such settings, see Subsection 2.2.2, "Separate Allocation of DI and DO Areas" in Part II, "SPECIFICATION."

Table 1-14 Area 2 Allocation Parameters (Separate Allocation of DI and DO)

Item		Description
AREA2 DO		Specify the start address of an area in the PMC E/R/D area used for DO data
PMC ADDRESS		exchange with common memory area 2.
(Note 1)	Pa40	This parameter allows only an even address to be set.
AREA2 DO		Specify the size of DO data exchanged between common memory area 2 and
ALLOCATED SIZE(WO	RD)	the PMC E/R/D area (Unit: Words). When DO data exchange between common
(Note 3)	Pa41	memory area 2 and the PMC is not performed, set 0 in this parameter.
AREA2 DI		Specify the start address of an area in the PMC E/R/D area used for DI data
PMC ADDRESS		exchange with common memory area 2.
	Pa42	When DI data exchange is not performed between common memory area 2 and
		PMC, specify a space. "" appears, indicating that this area is not used.
		This parameter allows only an even address to be set.
AREA2 DI		Set the PMC D area for setting DI/DO data allocation conditions.
ALLOC PTR		When DI/DO data allocation conditions are not set, specify a space. ""
(Note 4)		appears, indicating that this area is not used.
	Pa43	This parameter allows only an even address to be set.

ltem	Description
AREA2 DI	Specify the PMC E/R area for indicating the time when the above allocation
CHANGE FLAG	conditions are changed.
(Note 4)	When the allocation conditions are not changed dynamically, specify a space.
Pa44	"" appears, indicating that this area is not used.
AREA2 DI	Specify the start address of common memory area 2 to be statically allocated in
AREA2 ADDRESS	the PMC area as DI data
(Note 4) Pa45	
AREA2 DI	Specify the size of DI data statically exchanged between common memory area
ALLOCATED SIZE(WORD)	2 and the PMC area (Unit: Words)
(Notes 3, 4) Pa46	

⚠ CAUTION

- 1 In the PMC area, the R area, and E area in volatile memory are all set to 0 immediately after power-on.
- 2 The D area in the PMC area is allocated to nonvolatile memory. In addition, the E area in the PMC area is normally allocated to volatile memory. However, it can also be used as nonvolatile memory by setting the option.

 When the area is used as nonvolatile memory, the contents of the area are
- retained even after the power is turned off. So, special attention should be paid not to cause an unpredictable operation when the power is turned on next time.
- 3 Be careful not to cause an overlap between an area such as the input data area of the user program and a PMC area used for other purposes.

NOTE

- 1 In these parameters, set a size in words.
- 2 When setting the PMC area, note the following:

For a multi-path PMC, enter an PMC address as follows:

<Path number>:<PMC address>

For R0500 for the second PMC path, for example, enter "2:R500". When only a PMC address (R500) is entered, it is assumed to be the PMC address for the first path (1:R0500).

If the <:> key is not provided, the </> or <EOB> key can be used instead.

- 3 The area sizes used in the PMC area require twice as many bytes as the values set in these parameters.
- 4 By using parameters Pa45 (area 2 start address) and Pa46 (allocation size), a large area can be set between common memory 2 and the PMC area regardless of the node number.

When Pa46 (allocation size) is set to 0, dynamic DI data switching is performed for each node without static allocation.

When Pa46 (allocation size) is set to a value other than 0, data in common memory area 2 starting at the start address set by Pa45 (area 2 start address) is transferred to the PMC area specified by (Pa42 (PMC start address) plus 4), and dynamic DI data switching is disabled. In this case, Pa43 (allocation condition setting) and Pa44 (condition switch flag) are used only for switching node status information.

Message allocation parameters

The message allocation parameters are used to allocate a message transmit interface area in the PMC E/R/D area.

Table 1-15 Message Allocation Parameters		
Item		Description
CLIENT I/F (Note 1)		Specify the start address of an interface area in the PMC E/R/D area used when the message transmission client function is used.
	Pa50	
I/F SIZE(BYTE)		Specify the size of the interface area above (Unit: Bytes).
	Pa51	When the message transmission client function is not used, set 0 in this parameter.
SERVER I/F (Note 1)		Specify the start address of the PMC E/R/D area used as the interface area when the message transmission server function is used.
	Pa52	
I/F SIZE(BYTE)	Pa53	Specify the size of the interface area above (Unit: Bytes). When the message transmission client function is not used, set 0 in this parameter.

Table 1-15 Message Allocation Parameters

⚠ CAUTION

- 1 In the PMC area, the R area, and E area in volatile memory are all set to 0 immediately after power-on.
- 2 The D area in the PMC area is allocated to nonvolatile memory. In addition, the E area in the PMC area is normally allocated to volatile memory. However, it can also be used as nonvolatile memory by setting the option. When the area is used as nonvolatile memory, the contents of the area are retained even after the power is turned off. So, special attention should be paid not to cause an unpredictable operation when the power is turned on next time.
- 3 Be careful not to cause an overlap between an area such as the input data area of the user program and a PMC area used for other purposes.

NOTE

- 1 Only a PMC area at an even-numbered address can be set for the above area.
- 2 When setting the PMC area, note the following:
 - For a multi-path PMC, enter an PMC address as follows:
 - <Path number>:<PMC address>
 - For R0500 for the second PMC path, for example, enter "2:R500". When only a PMC address (R500) is entered, it is assumed to be the PMC address for the first path (1:R0500).
 - If the <:> key is not provided, the </> or <EOB> key can be used instead.

1.2 BACKING UP AND RESTORING COMMUNICATION PARAMETERS

After the completion of communication parameter setting, communication parameters can be backed up as a batch, and previously backed up communication parameters can be restored as a batch.

As the input/output device to which to backup communication parameters and from which to restore them, the memory card or USB memory can be used. To select an input/output device, use parameter No.20. For details of this parameter, see "Related NC parameters" in this section.

⚠ WARNING

When [RESTORE] is executed for communication parameters, the communication parameters including the allocation of a PMC area to FL-net function are all restored. When [ALL RESTORE] is executed for communication parameters, the communication parameters valid for embedded, Ethernet, Fast Ethernet/Fast Data Server, PROFIBUS-DP master/slave, DeviceNet master/slave, FL-net, CC-Link remote device, EtherNet/IP Scanner/Adapter, Modbus/TCP Server, and PROFINET IO Controller/IO Device are all restored. When the unsolicited messaging function is enabled, the allocation of macro variables is also restored.

For this reason, immediately after executing [RESTORE] or [ALL RESTORE] for communication parameters, fully understand instructions written in "GENERAL WARNINGS FOR CNC APPLICATION DEVELOPMENT" in "SAFETY PRECAUTIONS" at the beginning of this manual and carefully check the setting of the communication parameters of the relevant communication functions before starting operation.

For any communication function for which any PMC area or macro variable is allocated, make sure that DI/DO data, status data, and macro variable operate correctly before starting operation.

If operation is started without checking the above, the machine may behave unexpectedly, possibly causing damage to the tool, machine, and/or workpiece, or injury to the user.

⚠ CAUTION

While an external input/output device such as the memory card or USB memory is being accessed, do not turn the power to the CNC off or remove the external input/output device. Doing so may damage the external input/output device.

NOTE

- 1 A backup or restore operation for communication parameters can only be performed in the MDI mode, EDIT mode, or emergency stop state.
- 2 On the Series 30*i*/31*i*/32*i*/35*i*-B and Power Motion *i*-A, two FL-net boards can be mounted simultaneously. The communication parameters are set for the two FL-net boards at a time. They cannot be set individually for the boards. For this reason, the communication parameters backed up from a device on which two FL-net boards are mounted simultaneously cannot be restored on a device on which only one FL-net board is mounted. The communication parameters backed up from a device on which only one FL-net board is mounted cannot also be restored on a device on which two FL-net boards are mounted simultaneously.
- 3 It is not possible to backup and restore the communication parameters by using devices other than the memory card and the USB memory. With Series 30*i*/31*i*/32*i*-A, the USB memory cannot be used.

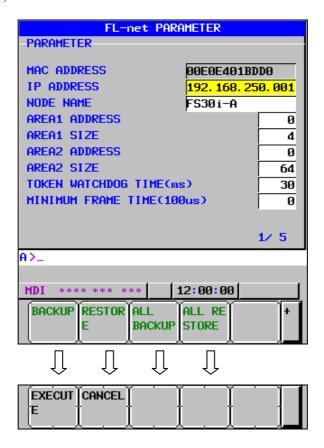
Procedure

1 Press function key



2 Soft key [FL-net] ([FL-net 1CH] or [FL-net 2CH] for the Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, [FL-net 1CH] for the Series 0*i*-F) appears. (When soft key [FL-net] does not appear, press the continue key located at the right end of soft keys several times.)

- If you press soft key [FL-net], the FL-net PARAMETER screen, FL-net NODE MONITOR screen, FL-net NETWORK screen, or FL-net LOG screen appears.
- When you press soft keys [PARAMETER] [(OPRT)], and then press soft key [+], soft keys [BACKUP], [RESTORE], [ALL BACKUP], and [ALL RESTORE] for backing up and restoring communication parameters appear as shown below.
- 5 When you press any of soft keys [BACKUP], [RESTORE], [ALL BACKUP], and [ALL RESTORE], soft keys [EXECUTE] and [CANCEL] appear.
- 6 Enter in the key-in buffer the name of a file to which the parameters are backed up or from which the parameters are restored, and then press soft key [EXECUTE] to perform a backup or restore operation.
 - During the operation, "EXECUTING" blinks.



Operation

BACKUP

This soft key is used to save to the input/output device the communication parameters for the FL-net function stored in the SRAM of the CNC.

When a file name is specified in the key-in buffer, the parameters are saved to a file with the specified name in the input/output device. Otherwise, a file called "FLNET.MEM" is used.

RESTORE

This soft key is used to read the communication parameters for the FL-net function from the input/output device and save them to the SRAM of the CNC.

When a file name is specified in the key-in buffer, the file with the specified name is read from the input/output device. Otherwise, a file called "FLNET.MEM" is used.

ALL BACKUP

This soft key is used to save to the input/output device all of the valid communication parameters for the embedded Ethernet, Fast Ethernet/Fast Data Server, PROFIBUS-DP master/slave, DeviceNet

master/slave, FL-net, CC-Link remote device, EtherNet/IP Scanner/Adapter, Modbus/TCP Server, and PROFINET IO Controller/IO Device stored in the SRAM of the CNC.

When a file name is specified in the key-in buffer, the parameters are saved to a file with the specified name in the input/output device. Otherwise, a file called "NETWORK.MEM" is used.

ALL RESTORE

This soft key is used to read all of the valid communication parameters for the embedded Ethernet, Fast Ethernet/Fast Data Server, PROFIBUS-DP master/slave, DeviceNet master/slave, FL-net, CC-Link remote device, EtherNet/IP Scanner/Adapter, Modbus/TCP Server, and PROFINET IO Controller/IO Device from the input/output device and save them to the SRAM of the CNC.

If a communication function associated with some of the valid parameters is disabled in the CNC, however, the communication parameters for that function are not saved to the SRAM.

When a file name is specified in the key-in buffer, the file with the specified name is read from the input/output device. Otherwise, a file called "NETWORK.MEM" is used.

NOTE

When communication parameters are restored, an alarm condition occurs that requires power-off.

Related NC parameters

0020

I/O CHANNEL: Input/output device selection, or interface number for a foreground input/output device

[Input type] Setting input

[Data type] Byte

[Valid data range] 4:

4: Selects the memory card as the input/output device.

17: Selects the USB memory as the input/output device.

It is not possible to backup and restore the communication parameters by using other devices.

NOTE

In case of Series 30i/31i/32i-A, the memory card is used regardless for this NC parameter.

1.3 MAINTENANCE SCREENS OF FL-net FUNCTION

The FL-net maintenance screens include the FL-net NODE MONITOR screen, the FL-net NETWORK screen, and the FL-net LOG screen.

The FL-net NODE MONITOR screen provides information such as nodes participating in the network and parameters of each node.

The FL-net NETWORK screen provides network information such as the communication cycle of the network.

The FL-net LOG screen provides information such as the number of times an error has occurred on the network.

Procedure

1 Press function key



- The [FL-net] ([FL-net 1CH] or [FL-net 2CH] for the Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, [FL-net 1CH] for the Series 0*i*-F) soft key appears. (If the [FL-net] soft key is not displayed, press the next-menu key several times, which is located at the right end of soft keys.)
- Pressing the [FL-net] soft key displays the FL-net PARAMETER screen, the FL-net NODE MONITOR screen, the FL-net NETWORK screen, or the FL-net LOG screen.

4 Press the [NODE], [NETWORK], or [LOG] to display a desired screen.

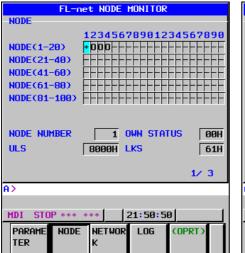
1.3.1 Participating-Node Management Table

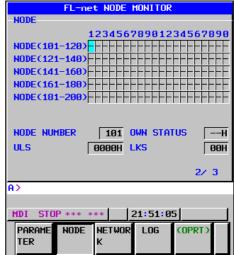
Nodes participating in the FL-net network, parameters of each node, and other information are displayed on this screen.

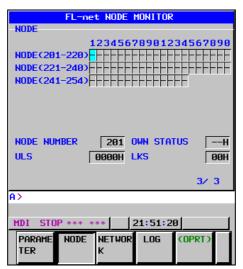
Procedure

Press the [NODE] soft key. The NODE MONITOR screen (Screen 1-3 FL-net Node Monitor Screen) then appears.

2 You can change pages of the NODE MONITOR screen by using page keys PAGE PAGE







Screen 1-3 FL-net Node Monitor Screen

- 3 As you move the cursor to a node number, information on the node with the node number is displayed.
- 4 As necessary, press the [(OPRT)] soft key, then use the following soft keys:



SELECT NODE

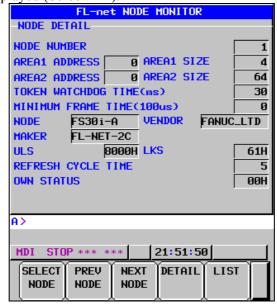
When you enter a node number by using the MDI keys then press the [SELECT NODE] soft key, information about the entered node number is displayed.

PREV NODE NEXT NODE

When you press the [PREV NODE] or [NEXT NODE] soft key, you can change the node number to the node number preceding or following the node on which the cursor is currently positioned.

DETAIL

When you press the [DETAIL] soft key, detailed information on the node with the node number on which the cursor is positioned is displayed (Screen 1-4).



Screen 1-4 FL-net NODE MONITOR Screen (Details)

LIST

When you press the [LIST] soft key, the screen display returns to the original list screen (Screen 1-3 FL-net Node Monitor Screen).

Display item

oping item	
Item	Description
Node status list	A list of the statuses of nodes is displayed.
	*: Local node
	O: Node participating in the network
	-: Node not participating in the network
NODE NUMBER	Indicates a node number.
	A number from 1 to 254 is displayed.

ltem	Description
OWN STATUS	When the node on which the cursor is positioned is the local node, the status of the
	local node is indicated in hexadecimal notation.
	When the node is not the local node, "H" is displayed.
	Bit 7: Reserved.
	Bit 6: Node number duplicate flag
	This bit is set to 1 when a node having the same node number as the local node
	is detected on the network.
	Correct the setting so that the local node has a unique node number among the
	node numbers of other nodes on the network.
	Bit 5: Reception wait flag
	This bit is set to 1 when there is no other node on the network.
	Bit 4: Initialization error flag
	This bit is set to 1 when an error is detected during parameter initialization.
	Correct the parameter settings.
	Bit 3: Token monitoring time error flag
	This bit is set to 1 when data cannot be transmitted within a half of the token
	monitoring time set in parameter Pa15.
	·
	Increase the setting of the token monitoring time (Pa15). Bits 2-0: Reserved.
ULS	
ULS	The upper layer status of a node on which the cursor is positioned is indicated in hexadecimal notation.
	Bit 15: RUN/STOP
	Whether the upper layer is running(1) or stopped (0) can be checked.
	Bits 14,13: U_ERR
	The error status of the upper layer can be checked.
	Bit 12: Unused.
	Bits 11-0: U_ERR_CODE
	The error code of the error status of the upper layer can be checked.
LKS	The FA link layer status of a node on which the cursor is positioned is indicated in
	hexadecimal notation.
	Bit 7: Duplicate address detection flag
	This bit is set to 1 when a setting for common memory area 1 or 2 is the same
	as a setting in another node.
	Check and correct the parameter settings.
	Bit 6: Common memory setting completion flag
	This bit is set to 1 when the setting of common memory is completed. This
	means that this bit is set to 1 when the parameters related to common memory
	(Pa11, Pa12, Pa13, and Pa14) are correct.
	Bit 5: Common memory data validity notification flag
	This bit is set to 1 when cyclic data in common memory is normally exchanged
	with the PMC area.
	Bit 4: Upper-layer operation signal error flag
	This bit is not used at present.
	Bits 3,2: Unused
	Bit 1: Communication disable detection flag
	This bit is set to 1 when a device in a different token mode is detected ^(Note1) .
	Bit 0: Node participation/disconnection
	This bit is set to 1 when the node is participating in the network.
AREA1 ADDRESS	Indicates the start address of common memory area 1 of a node on which the cursor
	is positioned.
AREA1 SIZE	Indicates the size of common memory area 1 of a node on which the cursor is
	positioned.
AREA2 ADDRESS	Indicates the start address of common memory area 2 of a node on which the cursor
, , L. , L. D. I . L. O.	is positioned.
AREA2 SIZE	Indicates the size of common memory area 2 of a node on which the cursor is
ANLAZ SIZE	positioned.
	į positioneu.

Item	Description
TOKEN WATCHDOG	Indicates the token monitoring time of a node on which the cursor is positioned. (Unit:
TIME	1 ms)
MINIMUM FRAME TIME	Indicates the minimum allowable frame interval of a node on which the cursor is
	positioned. (Unit: 100 μs)
NODE	Indicates the node name of a node on which the cursor is positioned. (Note 2)
VENDOR	Indicates the vendor name of a node on which the cursor is positioned. (Note 2)
MAKER	Indicates the manufacturer's model number of a node on which the cursor is positioned. (Note 2)
REFRESH CYCLE TIME	Indicates the permissible refresh cycle time of a node on which the cursor is positioned.

NOTE

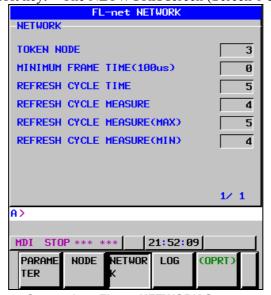
- 1 The token mode varies depending on whether the version of the FL-net communication standards is version 1.00, or version 2.00 or later. If the communication disable detection flag is set, ensure that all nodes comply with FL-net communication standards version 2.00 or later.
 - FANUC FL-net devices comply with FL-net communication standards version 2.00.
- 2 These information items are indicated when the node pointed to by the cursor participates in the network at the same time or at a later time.

1.3.2 Network Management Table

The FL-net network management table screen allows the user to reference the parameters of each node in the FL-net network management table.

Procedure

Press the [NETWORK] soft key. The NETWORK screen (Screen 1-5) then appears.



Screen 1-5 FL-net NETWORK Screen

2 As necessary, press the [(OPRT)] soft key, then use the following soft keys:



Display item

Item	Description				
TOKEN NODE	Indicates the node number of a node having a token.				
MINIMUM FRAME TIME	Indicates the maximum value among the minimum allowable frame intervals of the nodes participating in the network. (Unit: 100 us)				
REFRESH CYCLE TIME	Indicates the current allowable refresh cycle time measured for the local node. (Unit: 1 ms) This value is 120% of the refresh cycle measurement time.				
REFRESH CYCLE MEASURE	Indicates the current refresh cycle measurement time measured for the local node. (Unit: 1 ms)				
REFRESH CYCLE MEASURE(MAX)	Indicates the maximum value among the refresh cycle measurement times measured for the local node. (Unit: 1 ms)				
REFRESH CYCLE MEASURE(MIN)	Indicates the minimum value among the refresh cycle measurement times measured for the local node. (Unit: 1 ms)				

CLEAR

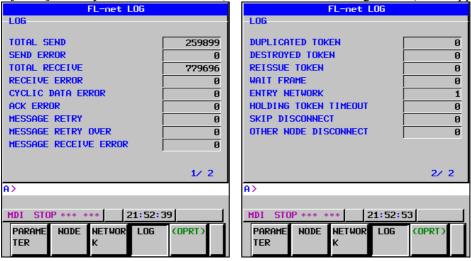
Pressing the [CLEAR] soft key resets the maximum value and minimum value of refresh cycle measurement times.

1.3.3 Log Information Management Table

This screen provides network log information of the local node.

Procedure

1 Press the [LOG] soft key. The LOG screen (Screen 1-6 FL-net Log Screen) then appears.



Screen 1-6 FL-net Log Screen

2 As necessary, press the [(OPRT)] soft key, then use the following soft key:



Display item

Item	Description			
TOTAL SEND	Indicates the number of transmitted frames.			
SEND ERROR	Indicates the number of times a transmission error occurred.			
TOTAL RECEIVE	Indicates the number of received frames.			

Item	Description
RECEIVE ERROR	Indicates the number of times a reception error occurred.
	The reception of a frame not complying with the FL-net communication standards is
	also counted as a reception error.
CYCLE DATA ERROR	Indicates the number of times an error occurred during cyclic data transmission.
ACK ERROR	Indicates the number of times an ACK error occurred during message transmission.
MESSAGE RETRY	Indicates the number of times a message was retransmitted.
MESSAGE RETRY OVER	Indicates the number of times the message retransmission limit was exceeded.
	A message is retransmitted up to three times in one message transmission operation.
	A failure in normal message transmission after three retransmissions is counted.
MESSAGE RECEIVE	Indicates the number of times a reception error occurred during message
ERROR	transmission.
DUPLICATED TOKEN	Indicates the number of times a duplicate token was detected.
DESTROYED TOKEN	Indicates the number of times a token was discarded when its duplication was
	detected,
REISSUE TOKEN	Indicates the number of times a token was reissued because no token was
	transmitted from the node preceding the local node.
WAIT FRAME	Indicates the number of times the frame wait state was entered because there was
	no other node on the network.
ENTRY NETWORK	Indicates the number of times the local node participated in the network.
HOLDING TOKEN	Indicates the number of times a token hold timeout was detected.
TIMEOUT	
SKIP DISCONNECT	Indicates the number of times the local node was disconnected from the network
	because no token was passed to the local node after its participation in the network.
OTHER NODE	Indicates the number of times other nodes were disconnected from the network.
DISCONNECT	
BAUDRATE	Displays the communication rate and mode.
(Series 30i/31i/32i/35i-B,	Communication rate: 100 Mbps or 10 Mbps
PMi-A,0i-F only)	Communication mode: Full duplex or Half duplex
	: Not connected to HUB

CLEAR

Pressing the [CLEAR] soft key clears all communication log data to 0 so that counting starts from the beginning.

1.4 NOTES ON LADDER PROGRAM CREATION

This section provides necessary notes on ladder program creation to build a safety system that uses the FL-net.

⚠ CAUTION

- 1 The time after the power is turned on until FL-net communication is actually started may vary depending on the CNC system configuration and setting. For this reason, to determine the timing of the start of FL-net communication, not wait for the specified time, but check the signals actually used for communication.
- 2 Create a ladder program so that even if a communication error occurs, the system operates safely.

Input and output signals

An output signal from the CNC is processed by a ladder program, and written in a register. read by refresh processing of the FL-net function, and is sent out on the FL-net network. receives data, the node outputs the data as an output signal. Input signals flow through a similar path in the reverse direction.

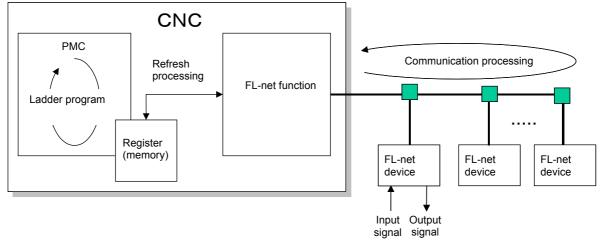


Fig. 1-1 Input and Output Signals

Ladder program processing and refresh processing of FL-net function

Ladder program processing and refresh processing of the FL-net function operate asynchronously. Because ladder program processing can be performed independently of refresh processing of the FL-net function, the ladder program can run repeatedly at high speed.

((m+1)th) ((m+2)th) Ladder program processing: Content of register A: Q Q Content of register B: Refresh processing of 2 3, 3 FL-net function: (nth) ((n+1)th)((n+2)th) ((n+3)th)Transferred to other nodes

Fig. 1-2 is a timing diagram of the inside of the CNC when a ladder program outputs signals.

Fig. 1-2 Timing Diagram

In the upper part of the diagram, the ladder program performs processing cyclically and writes data in registers A and B.

In the middle part, how the contents of registers A and B in the PMC are updated at this time. Even within one-time execution of the ladder program, data is not written to register A and register B at the same time. Therefore, register A and register B are not updated at the same time, and there is a time difference in updating register A and updating register B.

In the lower part, refresh processing of the FL-net function is performed cyclically to read the contents of register A and register B. Since there is a time difference in updating register A and register B, data written in one ladder program operation cannot sometimes be read at a time as shown in the (n+1)th refresh processing.

Also when input signals from a slave are processed by the ladder program, register contents written by one refresh operation cannot sometimes be read by one ladder program operation.

⚠ CAUTION

Refresh processing of the FL-net function is performed not in synchronization with the execution of the ladder program. Therefore, when creating a ladder program, note the following:

- <1> When an FL-net input signal set at a specified PMC address is read at two places in the ladder program, there is no guarantee that the same value will be read even if the ladder program can be executed in one cycle.
- <2> When the ladder program writes an output signal to the FL-net at a specified PMC address, the signal may be transferred to another node before the ladder program execution completes.

Concurrency of data

When DI data or DO data is handled with the ladder program, the concurrency of long data (4-byte data) and word data (2-byte data) is guaranteed (there are no data segmentation) under the corresponding constraints described below.

⚠ CAUTION

If the following constraints are not satisfied, the concurrency of long data or word data is not guaranteed.

Concurrency of long data (4-byte data)

To guarantee the concurrency of data, satisfy the following two conditions.

- <1> In the ladder program, the following commands are used in units of four bytes. MOVD, MOVN, XMOVB, SETND, XCHGD, DSCHB, TBLRD, TBLWD, DSEQD, DSNED, DSGTD, DSLTD, DSGED, DSLED, DMAXD, DMIND, EQD, NED, GTD, LTD, GED, LED, RNGD, COMPB, EOR, AND, OR, NOT, EORD, ANDD, ORD, NOTD, SHLD, SHRD, ROLD, RORD, BSETD, BRSTD, BTSTD, BPOSD, BCNTD, CODB, DCNVB, DECB, TBCDD, FBCDD, ADDB, SUBB, MULB, DIVB, NUMEB, ADDSD, SUBSD, MULSD, DIVSD, MODSD, INCSD, DECSD, ABSSD, NEGSD
- <2> When DI data or DO data is assigned to PMC R, E, or D address, the address is on 4-byte boundaries.
 - Example) 1:R0000, 2:R0004, 3:R0008, 1:E0000, 2:D0012

Concurrency of word data (2-byte data)

To guarantee the concurrency of data, satisfy the following two conditions.

<1> In the ladder program, the following commands are used in units of two bytes. MOVW, MOVN, XMOVB, SETNW, XCHGW, DSCHB, TBLRW, TBLWW, DSEQW, DSNEW, DSGTW, DSLTW, DSGEW, DSLEW, DMAXW, DMINW, EQW, NEW, GTW, LTW, GEW, LEW, RNGW, COMPB, EOR, AND, OR, NOT, EORW, ANDW, ORW, NOTW, SHLW, SHRW, ROLW, RORW, BSETW, BRSTW, BTSTW, BPOSW, BCNTW, CODB, DCNVB, DECB, TBCDW, FBCDW, ADDB, SUBB, MULB, DIVB, NUMEB, ADDSW, SUBSW, MULSW, DIVSW, MODSW, INCSW, DECSW, ABSSW, NEGSW

<2> When DI data or DO data is assigned to PMC R, E, or D address, the address is on 2-byte boundaries.

Example) 1:R0000, 2:R0002, 3:R0004, 1:E0002, 2:D0006

Concurrency of byte data (1-byte data)

There are no special constraints. The concurrency is always guaranteed in 1-byte data.

2 EXAMPLE OF CONNECTION

This chapter describes an example of connection using the FL-net function with the Series 30*i*/31*i*/32*i*-A.

2.1 EXAMPLE OF CONFIGURATION

Using the example of configuration shown below, this section describes the setting of each parameter.

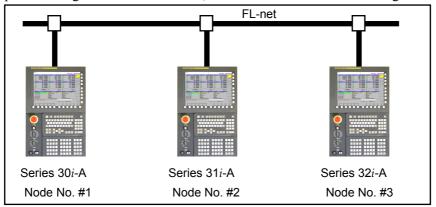
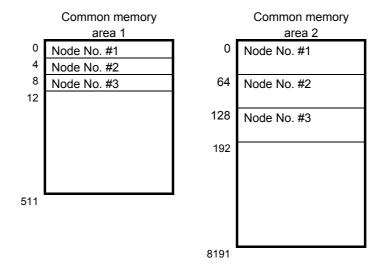


Fig. 2-1 Example of FL-net Configuration

The parameter settings and PMC area allocation state when 4-word DO data in common memory area 1 and 64-word DO data in common memory area 2 are exchanged at all of the three nodes are described below.

The common memory of each node is allocated as shown below.



2.2 EXAMPLE OF PARAMETER SETTINGS

Assume that the address map of the PMC R area of each node is as shown below. Then, the parameters of each node are set as indicated in Table 2-1 through Table 2-3.

PMC R area 1:R0000 Local node information 1:R0008 Participating node list 1:R0040 Free space 1:R0100 Node No. #1 Common memory area 1:R0108 Node No. #2 1 data 1:R0116 Node No. #3 1:R0124 Free space 1:R0200 Node No. #1 1:R0328 Common memory area Node No. #2 2 data 1:R0456 Node No. #3 1:R0584 Free space 1:R0600 Interface 1:R0620 Message transmission Read/write client buffer 1:R1644

Table 2-1 Parameters of Node No. #1

Table 2-1 Farameters of Node No. #1						
Item Setting		ltem		Setting		
Pa10	IP ADDRESS	192.168.250.1	Area 1 DI/DO allocation		-	
Pa17	NODE NAME	FS30i-A	Pa30	PMC ADDRESS	1:R0100	
Pa11	AREA 1 ADDRESS	0	Pa31	AREA 1 ADDRESS	0	
Pa12	AREA 1 SIZE	4	Pa32	ALLOCATED SIZE	12	
Pa13	AREA 2 ADDRESS	0	Area 2 DI/DO allocation		-	
Pa14	AREA 2 SIZE	64	Pa47	PMC ADDRESS	1:R0200	
	TOKEN WATCHDOG	30		AREA 2 ADDRESS	0	
Pa15	TIME		Pa48			
Pa16	MINIMUM FRAME	0	Pa49	ALLOCATED SIZE	192	
Pa20	OWN STATUS	1:R0000	Message transmission		-	
Pa21	ENTRY NODE	1:R0008	Pa50	CLIENT I/F	1:R0600	
Pa60	PARAMETER 1	00000000	Pa51	I/F SIZE	20	
Pa61	PARAMETER 2	00000000	Pa52	SERVER I/F		
			Pa53	I/F SIZE	0	

Table 2-2 Parameters of Node No. #2

Item		Setting	Item		Setting
Pa10	IP ADDRESS	192.168.250.2	Area 1 DI/DO allocation		-
Pa17	NODE NAME	FS31i-A	Pa30	PMC ADDRESS	1:R0100
Pa11	AREA 1 ADDRESS	4	Pa31	AREA 1 ADDRESS	0
Pa12	AREA 1 SIZE	4	Pa32	ALLOCATED SIZE	12
Pa13	AREA 2 ADDRESS	64	Area 2 DI/DO allocation		-
Pa14	AREA 2 SIZE	64	Pa47	PMC ADDRESS	1:R0200
	TOKEN WATCHDOG	30		AREA 2 ADDRESS	0
Pa15	TIME		Pa48		
Pa16	MINIMUM FRAME	0	Pa49	ALLOCATED SIZE	192
Pa20	OWN STATUS	1:R0000	Message transmission		-
Pa21	ENTRY NODE	1:R0008	Pa50	CLIENT I/F	1:R0600
Pa60	PARAMETER 1	00000000	Pa51	I/F SIZE	20
Pa61	PARAMETER 2	00000000	Pa52	SERVER I/F	
			Pa53	I/F SIZE	0

Table 2-3 Parameters of Node No. #3

ltem 5		Setting	ltem		Setting
Pa10	IP ADDRESS	192.168.250.3	Area 1 DI/DO allocation		-
Pa17	NODE NAME	FS32i-A	Pa30	PMC ADDRESS	1:R0100
Pa11	AREA 1 ADDRESS	8	Pa31	AREA 1 ADDRESS	0
Pa12	AREA 1 SIZE	4	Pa32	ALLOCATED SIZE	12
Pa13	AREA 2 ADDRESS	128	Area 2 DI/DO allocation		-
Pa14	AREA 2 SIZE	64	Pa47	PMC ADDRESS	1:R0200
Pa15	TOKEN WATCHDOG TIME	30	Pa48	AREA 2 ADDRESS	0
Pa16	MINIMUM FRAME	0	Pa49	ALLOCATED SIZE	192
Pa20	OWN STATUS	1:R0000	Message transmission		-
Pa21	ENTRY NODE	1:R0008	Pa50	CLIENT I/F	1:R0600
Pa60	PARAMETER 1	00000000	Pa51	I/F SIZE	20
Pa61	PARAMETER 2	00000000	Pa52	SERVER I/F	
			Pa53	I/F SIZE	0

2.3 IMAGE OF DATA EXCHANGE

When data exchange is performed with the examples of configuration and parameter settings described earlier, the illustration below shows how the data of each node is viewed in the PMC R area of each node.

	Node No.		Node No.	Node No.	
	#1		#2		#3
1:R0000		1:R0000		1:R0000	
1:R0100	Area 1 #1	1:R0100	Area 1 #1	1:R0100	Area 1 #1
1:R0108	Area 1 #2	1:R0108	Area 1 #2	1:R0108	Area 1 #2
1:R0116	Area 1 #3	1:R0116	Area 1 #3	1:R0116	Area 1 #3
1:R0124		1:R0124		1:R0124	
1:R0200	Area 2 #1	1:R0200	Area 2 #1	1:R0200	Area 2 #1
		•		•	
1:R0328	Area 2 #2	1:R0328	Area 2 #2	1:R0328	Area 2 #2
1:R0456	Area 2 #3	1:R0456	Area 2 #3	1:R0456	Area 2 #3
1:R0584		1:R0584		1:R0584	

Message transmission can be performed by using a PMC area starting at 1:R0600.



IV. CONNECTION



1 INSTALLATION

This chapter provides information required for installation of the FL-net board.

1.1 Series 30*i*/31*i*/32*i*-A

1.1.1 Specifications

Ordering information of optional board	A02B-0303-J272
Drawing number of printed circuit board	A20B-8101-0031
Applicable models	Series 30i/31i/32i-A

NOTE

When using the optional board, observe the installation condition (environment condition within the cabinet) of the CNC control unit where the board is mounted.

The power supply rating and heat dissipation of the FL-net board are listed below. For the amount of heat output by the main CNC unit and other optional units, refer to the CONNECTION MANUAL (HARDWARE) of the CNC.

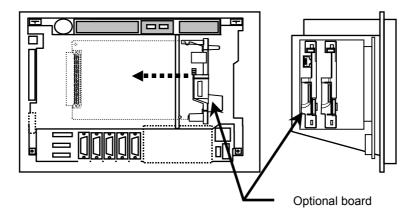
Name	Power supply rating	Heat dissipation
FL-net board	0.2A	5W

1.1.2 Installation

This section describes information about the installation of the FL-net board.

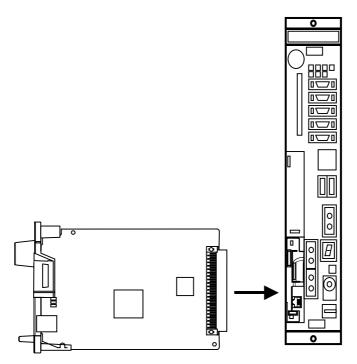
1.1.2.1 Mounting into the LCD-mounted type unit

The optional board is mounted into an option slot of the control unit. It occupies one slot. The option slot does not have mounting limitations.

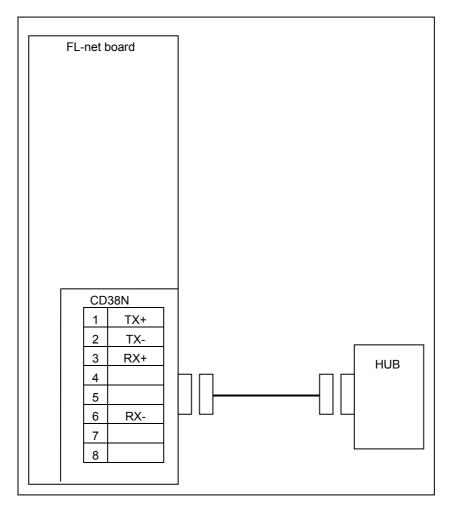


1.1.2.2 Mounting into the stand-alone type unit

The optional board is mounted into an option slot of the control unit. It occupies one slot. The option slot does not have mounting limitations.



1.1.2.3 Total Connection Diagram



1.2 Series 30*i*/31*i*/32*i*/35*i*-B, PM*i*-A,0*i*-F

1.2.1 Specifications

In case of using the FL-net function, specify the control unit with Multi-function Ethernet (LCD-mounted type CNC) or the Fast Ethernet board.

For the Series 30i/31i/32i/35i-B, Power Motion i-A, Series 0i-F the FL-net function operates on the Fast Ethernet board.

Ordering information of optional board	A02B-0323-J147
Drawing number of printed circuit board	A20B-8101-0770
Applicable models	Series 30i/31i/32i/35i-B, Power Motion i-A

Ordering information of optional board	A02B-0338-J147
Drawing number of printed circuit board	A20B-8101-0770
Applicable models	Series 0 <i>i</i> -F

NOTE

- 1 Refer to the order list of each CNC, for ordering information for Multi-function Ethernet. In the LCD-mounted type Series 0*i*-F, Multi-function Ethernet cannot be used.
- 2 When using the optional board, observe the installation condition (environmental condition inside the cabinet) of the CNC control unit where the board is installed.

The power supply rating and heat dissipation of the Fast Ethernet board are listed below. For the amount of heat output by the main CNC unit and other optional units, refer to the CONNECTION MANUAL (HARDWARE) of the CNC.

Name	Power supply rating	Heat dissipation
Fast Ethernet board	0.1A	3W

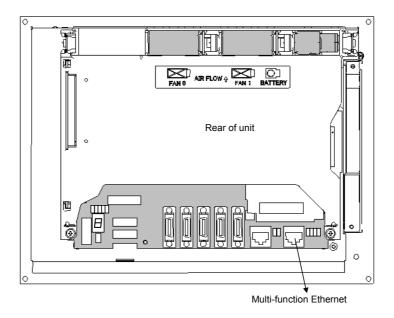
NOTE

For the control unit with Multi-function Ethernet (LCD mounted type CNC), refer to the CONNECTION MANUAL of the CNC.

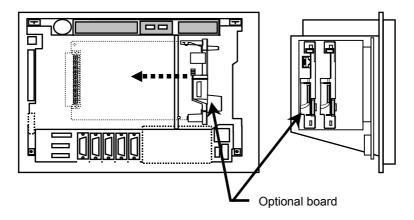
1.2.2 Installation

1.2.2.1 Installation on an LCD-mounted type unit

For the control unit with Multi-function Ethernet, the Fast Ethernet is installed on the main board.

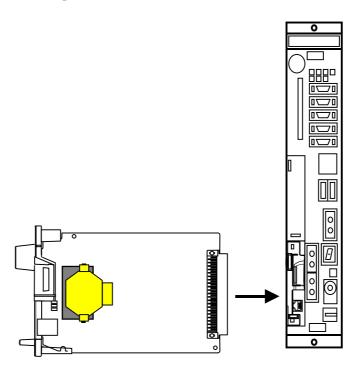


The optional board is installed in an optional slot of the control unit. It occupies one slot. No restriction is imposed on installation in the optional slot.

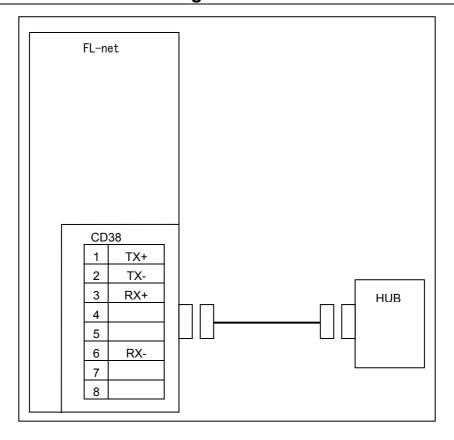


1.2.2.2 Installation on a stand-alone type unit

The optional board is installed in the optional slot of the control unit. One slot is occupied. No restriction is imposed on installation in the optional slot.



1.2.2.3 Total connection diagram



2 CABLE CONNECTION

This chapter describes information relating to the Ethernet connection.

⚠ CAUTION

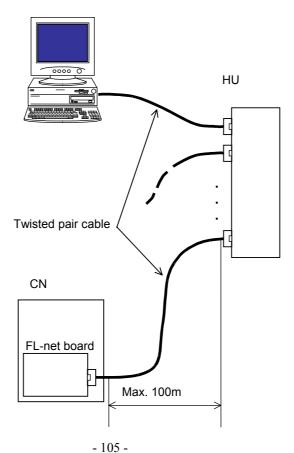
- 1 Before connecting a cable to or detaching it from the FL-net board, turn off the power to the CNC, and confirm that the power is off.
- 2 Please inquire of each manufacturer about the construction of network or the condition of using the equipment except the FL-net board (HUB, transceiver, cable etc.). When configuring your network, you must take other sources of electrical noise into consideration to prevent your network from being influenced by electrical noise. Make sure that network wiring is sufficiently separated from power lines and other sources of electrical noise such as motors, and ground each of the devices as necessary. Also, a high and insufficient ground impedance may cause interference during communications. After installing the machine, conduct a communications test before you actually start operating the machine.

We cannot ensure operation that is influenced by network trouble caused by a device other than the FL-net board.

2.1 CONNECTING TO ETHERNET

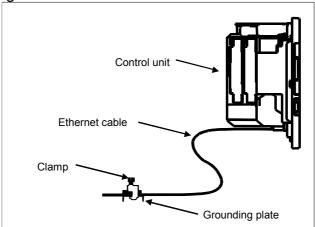
The FL-net board is provided with a 100BASE-TX interface.

Prepare a HUB for connecting the FL-net board to the Ethernet trunk. The following shows an example of a general connection.



NOTE

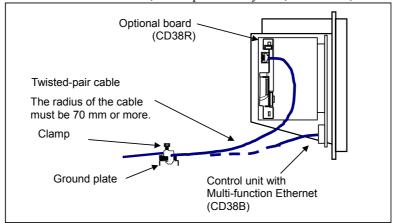
- 1 The cable can be up to 100 m long (for the FANUC- recommended cable for movable sections, up to 50 m). Do not make the cable longer than necessary.
- 2 An Ethernet cable needs clamping to make system operation stable. For details of clamping, see Subsection 2.5.2, "Cable Clamp and Shield Processing". The clamp for grounding the shield of the cable can also fix the cable.



3 Some of the units (hub, transceiver, etc.) required to build a network are not dust-proof. They should be enclosed in a dust-proof cabinet. Using them in an atmosphere with dust or oil mist may lead to a communication error or failure.

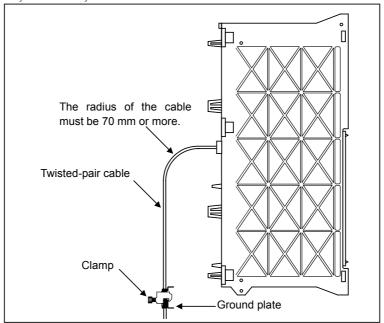
2.2 LEADING OUT THE ETHERNET CABLE

LCD-mounted type Select the control unit with Multi-function Ethernet or optional board. For the location of the connector, see Subsection 1.1.1 or 1.2.1, "Component Layout", in Part VI, "MAINTENANCE".



2) Stand-alone type

Select the optional board. For the location of the connector, see Subsection 1.1.1 or 1.2.1, "Component Layout", in Part VI, "MAINTENANCE".



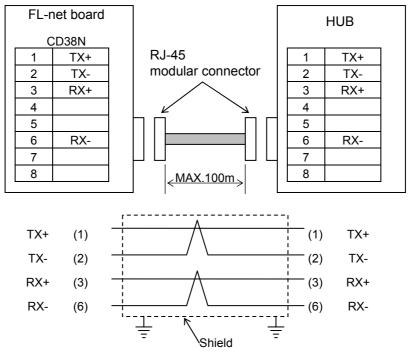
2.3 RJ-45 CONNECTOR PIN ASSIGNMENTS

Pin No.	Signal name	Description
1	TX+	Send +
2	TX-	Send -
3	RX+	Receive +
4		Not used
5		Not used
6	RX-	Receive -
7		Not used
8		Not used

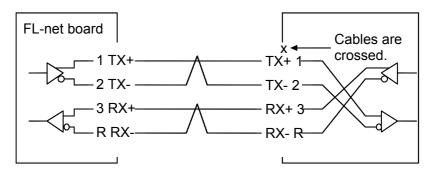
2.4 TWISTED-PAIR CABLE SPECIFICATION

2.4.1 Cable Connection

The cable used for connection between the 100BASE-TX interface of the FL-net board and the HUB is connected as follows:



- Keep the total cable length within 100 m.
 - Do not extend the cable more than is necessary.
- The figure above shows the cable connection when cables are crossed in the HUB.
 - "X" is usually indicated at the port of the HUB to signify that cables are crossed in the HUB.



2.4.2 Cable Materials

A CAUTION

Unshielded cable (UTP cable) is commercially available as 10BASE-T, 100BASE-TX twisted-pair cable: You should, however, use shielded Category 5 twisted-pair cable (STP cable) to improve the resistance to electrical noise in an FA environment.

Recommended Cables

Manufacturer	Specification	Remarks
Furukawa Electric Co., Ltd.	DTS5087C-4P	Twisted-pair cable
Nissei Electric Co., Ltd.	F-4PFWMF	Single-conductor cable

Inquiries

Manufacturer	Contact address	Remarks
Furukawa Electric Co., Ltd.	2-6-1 Marunouchi, Chiyoda-ku. Tokyo 100-8322	
Sales Headquarters	TEL: (+81)-3-3286-3126 FAX: 03-3286-3979	
Nissei Electric Co., Ltd.	3F MU Bldg., 1-9-1 Minami-narise, Machida City, Tokyo	A finished cable with
Machida Branch	194-0045	connectors at both ends can
	TEL: (+81)-427-29-2531 FAX: 0427-29-3375	be offered.
Overseas Sales Office	IWATANI International Corporation	
	Tokyo Head Office	
	21-8 Nishi-shinbashi 3-chome, Minato-ku, TOKYO,	
	105-8458, JAPAN	
	TEL: (+81)-3-5405-5810	
	FAX: (+81)-3-5405-5666	
	Telex: 2524256 IWATYO J	

NOTE

The above recommended cables cannot be connected to moving parts.

Recommended cable (for movable parts)

Manufacturer	Specification	Remarks
Oki Electric Cable Co., Ltd.	AWG26 4P TPMC-C5-F(SB)	Dadiastad ta FANILO
Shinko Electric Industrial Co., Ltd.	FNC-118	Dedicated to FANUC

Specification

• Electric characteristics:

Conforms to EIA/TIA 568A Category 3 and Category 5.

From the viewpoint of attenuation performance, ensure that the length to the HUB is 50 m or less.

• Structure:

Group shielded (braided shield). A drain wire is available.

The conductor is an AWG26 annealed copper twisted wire, with a sheath thickness of 0.8 mm and an outer diameter of 6.7 mm ± 0.3 mm.

• Fire retardancy:

UL1581 VW-1

Oil resistance

Conforms to the FANUC internal standards (equivalent to the conventional oil-resistant electric cables).

• Flexing resistance:

1,000,000 times or more with a bending radius of 50 mm (U-shaped flex test)

• UL style No.:

AWM 20276 (80°C/30V/VW-1)

NOTE

Be sure to use the connector TM21CP-88P(03) manufactured by Hirose Electric Co., Ltd. for this cable.

Inquiries

Manufacturer	Contact address		Remarks
Oki Electric Cable Co., Ltd.	Nagano Sales Office	TEL: (+81)-266-27-1597	
Shinko Electric Industrial Co., Ltd.	Tokyo Sales Office	TEL: (+81)-3-3492-0073	

Cable assembly

Oki Electric Cable Co., Ltd. can also supply the cable assembly mentioned above.

Contact Oki Electric directly to determine the specifications (length, factory test, packing, and so forth) for purchase.

2.4.3 Connector Specification

Use an 8-pin modular connector (RJ-45) with the twisted-pair cable for the Ethernet connection. The following connector must be used.

Specification	Manufacturer	Remarks
TM21CP-88P(03)	Hirose Electric Co., Ltd.	NOTE

NOTE

Information about TM21CP-88P(03):

Connector (standard product of the manufacturer)

Drawing number: A63L-0001-0823#P Manufacturer: Hirose Electric Co., Ltd.

Manufacturer type number: TM21CP-88P(03)

Conforms to EIA/TIA 568A Category 3 and Category 5.

For assembly with a cable, contact Hirose Electric Co., Ltd. directly. (From Hirose Electric Co., Ltd., "TM21CP-88P(03) Connection Procedure Manual (Technical Specification No. ATAD-E2367)" is available as a technical

document.)

2.4.4 HUB

FL-net device supports the two transmission speed (10Mbps, 100Mbps). Please use the Recommended HUB as shown below.

Recommended HUB 10BASE-T/100BASE-TX

Manufacturer	Specification	Remarks
Phoenix Contact	FL SWITCH SFN 5TX	10BASE-T/100BASE-TX, 5 ports
Phoenix Contact	FL SWITCH SFN 8TX	10BASE-T/100BASE-TX, 8 ports

NOTE

- 1 Before using the HUB, refer to the operation manual supplied by the manufacturer.
- 2 The use of a switching hub causes a delay time in data transmission for reasons of device characteristics. For this reason, use as small number of switching hubs as possible when required and fully consider the data delay time when designing the system.

Contact points

	Manufacturer	Contact address
Phoenix	Contact	
	Headquarters	Yuusen Sin-yokohama 1-Chome Building, Sin-yokohama, Kohoku Ward,
		Yokohama, 222-0033
		TEL: (+81)-45-471-0030
		FAX: (+81)-45-471-0031
		URL: http://www.phoenixcontact.co.jp

2.5 ELECTRICAL NOISE COUNTERMEASURES

2.5.1 Separating Signal Lines

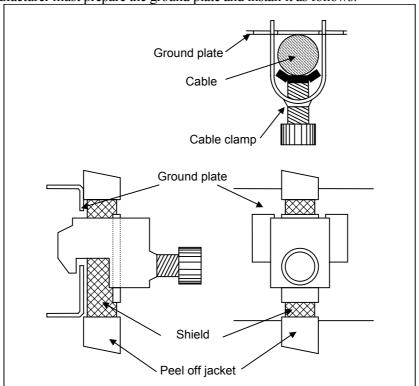
For signal line separation, refer to the description of noise protection in the Connection Manual (Hardware) of CNC. The wiring for the Ethernet cable is of group C.

2.5.2 Clamping and Shielding Cables

Clamp an Ethernet twisted pair cable according to the method described below, as with cables that need to be shielded. Clamping cables provides support and shielding and is extremely important to the safe operation of the system. Never overlook cable clamping.

Peel off part of the jacket as shown in the figure to expose the outer coating of the shield, and press this outer coating against the ground plate with the clamp fixture.

The machine manufacturer must prepare the ground plate and install it as follows:



NOTE

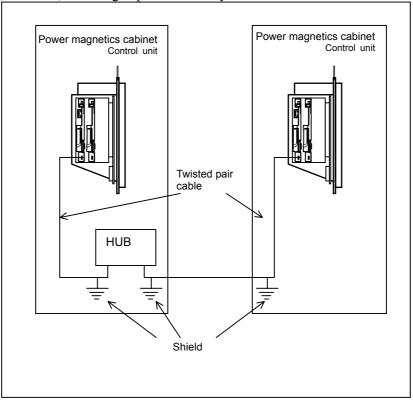
To ensure the safe operation of the system, clamp and shield the cables.

The FL-net boards in an optional slots of CNC machines are connected to the HUB through twisted pair cables. The cables are shielded with clamping hardware.

Be sure to perform shielding since it is very important for stabilization of the system operation. Shielding must be performed for both ends of the cable as close as possible to the connectors on the CNC and HUB sides.

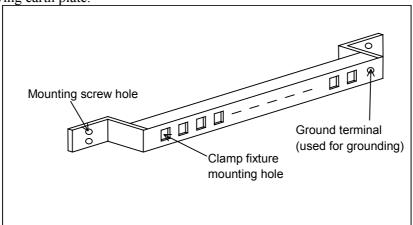
When the cables are short and the connectors on the CNC and HUB sides are accommodated in the power

magnetics cabinet, however, shielding is performed only on the HUB side.

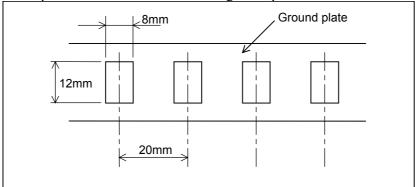


Example of shielding of transceiver cable (When LCD-mounted type Series 30*i*-A)

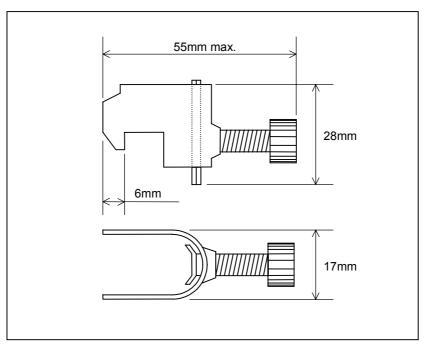
Prepare the following earth plate.



Use a nickel-plated iron plate at least 2 mm thick as the ground plate.



Details of clamp fixture mounting holes



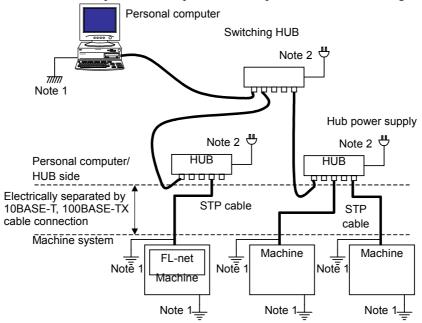
External dimensions of clamp fixture

NOTE

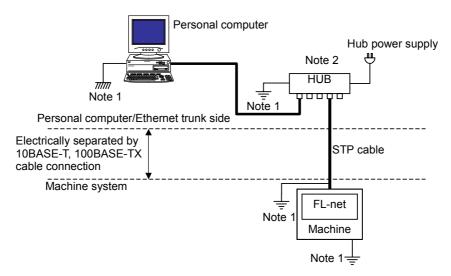
- Unlike ordinary Ethernet communication, FL-net communication does not perform retransmission processing that is performed at intervals of several seconds. This is to achieve high-speed response. Therefore, FL-net cable installation must be more resistant to noise than ordinary Ethernet cable installation.
- 2 After cable installation, conduct sufficient communication tests not only before system operation but also after system operation to ensure noise resistance.

2.5.3 Grounding the Network

Even if the grounding condition on the machine side is satisfied, the communication line can pick up noise from the machine, depending on the machine installation condition and environment, thus resulting in a communication error. To protect against such noise, the machine should be separated and insulated from the Ethernet trunk cable and personal computer. Examples of connection are given below.



Large-Scale Network



Small-Scale Network

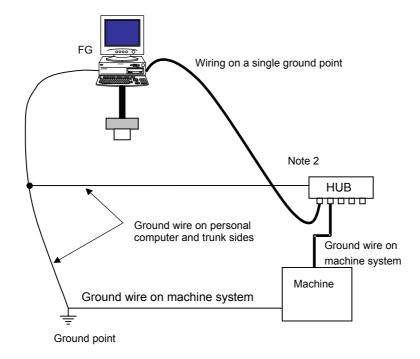
NOTE

1 The ground between PC/HUB side and machine system side must be separated. If it is impossible to separate the ground because there is only one grounding point, connect the ground cable for each system to the grounding point independently. (See figure below.)

The resistance for grounding must be less than 100-ohm (Class D). The thickness of the ground cable is the same as the thickness of AC power cable or more. At least thickness of 5.5mm2 is necessary.

NOTE

- 2 Note that the number of allowable HUB-to-HUB connections depends on the type of HUB when using a repeater HUB.
- There is possibility that noise makes the obstacle of communication even if the ground is separated using the 10BASE-T, 100BASE-TX. In the case of using the FL-net board under the worst environment, please separate between the PC/Trunk line side and machine system side completely using the 10BASE-FL, 100BASE-FX (Optical fiber media).



2.6 CHECK ITEMS AT INSTALLATION

The following table lists check items at installation.

	Check item	Description	Check
Et	hernet cable		
		Use cables which satisfies all the following conditions:	
	Type	1) With shielding	
	Туре	2) Twisted-pair cable	
		3) Category 5	
	Length	The cable length shall be within 100 m (50 m for a movable cable recommended by FANUC).	
		For a twisted-pair cable, the following pins shall be paired:	
	Connection	1) Pin No. 1 (TX+) – pin No. 2 (TX-)	
		2) Pin No. 3 (RX+) – pin No. 6 (RX-)	
		The Ethernet cables shall be bound separately from the following cables or	
	Separation	covered with an electromagnetic shield:	
	Separation	1) Group A: AC power lines, power lines for motors, and others	
		2) Group B: DC power lines (24 VDC) and others	
	Shielding	For a shielded cable, the part of which outer coating is peeled off and exposed	
	Officiality	shall be fixed to the ground plate with a clamp fixture.	
	Clamping	The ground plate shall be located as nearest to the CNC as possible (to make the	
		cable between the ground plate and CNC hard to be affected by noise).	
	Connectors	Any cable connector shall not be pulled (to prevent poor contact of the connector).	
	Wiring	No cable shall be laid under a heavy object.	
	Bending radius	The bending radius shall be at least four times as long as the diameter of the cable.	
	For movable part	For a movable part, a cable for a movable part shall be used.	
CI	NC and cabinet		
	CNC grounding	The CNC ground (frame ground) shall be connected properly and the length of the ground wire shall be within 300 mm.	
	Mounting	The optional board shall be inserted in a CNC slot properly.	
Н	JB		
	Use conditions	The "cautions on use" of the hub shall be observed (A terminating resistor shall be mounted properly if required).	
	Grounding	The hub shall be grounded.	
	Cabinet	The hub shall be installed in an enclosed cabinet.	
	Vibration	The hub shall be installed so that it is not affected by vibration.	
	Bending radius	The bending radius shall be at least four times as long as the diameter of the cable.	

V. MAINTENANCE

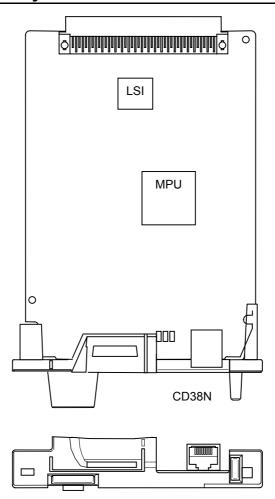


1 HARDWARE MAINTENANCE INFORMATION

This chapter provides hardware maintenance information related to the FL-net functions.

1.1 Series 30*i*/31*i*/32*i*-A

1.1.1 Component Layout

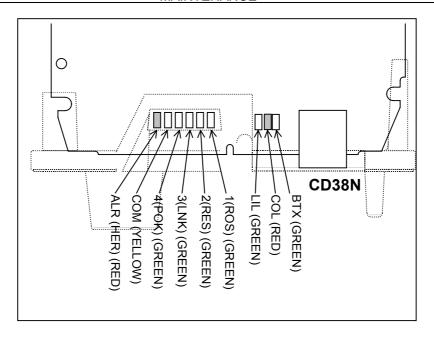


Name	PCB drawing No.	Remarks
FL-net board	A20B-8101-0031	

1.1.2 LED Indications and Meanings

The FL-net board has four green LEDs (1 to 4) and one red LED (ALM) for state indication, and two green LEDs (BTX and LIL), one red LED (COL), and one yellow LED (COM) for communication status indication. The locations and meanings of the LEDs are described below. In the description below, the following marks are used to represent the display states of each LED:

□: Off ■: On ☆: Blinking ◊: Don't care



NOTE

The face plate is indicated using dotted lines.

LED display transition for LED1, LED2, LED3, and LED4 (during power-on)

	LED indication 4 3 2 1	Status	Meaning
	0000	Power-off	
	****	Immediately after power-on	Initial state entered immediately after power-on. If the optional board is stopped in this condition, the cause is one of the following: → The software is not stored in the Flash ROM of the CNC.
		Start of optional board	 → The optional board is defective. The optional board has started. If the optional board is stopped in this condition, the optional board may be defective.
		Completion of software downloading	The software has been downloaded to the optional board. If the optional board is stopped in this condition, the optional board may be defective.
	■□□□	Firmware OS started.	The software OS has started. If the optional board is stopped in this condition, the cause is one of the following: → The software stored in the flash ROM of the CNC is destroyed. → The optional board is defective.
		Completion of software OS initialization	Initialization of the software OS is completed. If the optional board is stopped in this condition, the cause is one of the following: → The software in the flash ROM of the CNC is destroyed. → The optional board is defective.
, [◇◇□☆	Start completion	The optional board has started normally.

LED display transition for LED1, LED2, LED3, and LED4 (during normal operation)

LED indication	Status	Meaning
ROS ☆	Normal software operation	Blinks at 1-second intervals when the communication software
		on the optional board operates normally.

RES □]	Normally OFF	Normally, off
LNK ■		Participating in network	Turned on when the node participates in the FL-net network
POK ■		Normal parameters	Turned on when all FL-net parameters are valid.

BTX, LIL, COM, and ALM LED indications (during normal operation)

LED indication	Status	Meaning
BTX ■	100BASE-TX connection in progress	The communication rate is 100BASE-TX.
BTX □	10BASE-T connection in progress	The communication rate is 10BASE-T.
LIL ■	Connected to hub	The board is connected to the hub.
COM ■	Transmission/reception in progress	Data is being transmitted or received.
ALM \square	No alarm	No alarm is issued
(HER)		

LED1, LED2, LED3, and LED4 indications (when abnormality occurs)

The STATUS LEDs are turned on and off repeatedly with long on-time and short on-time.

LED indication [Long on-time] 4 3 2 1	LED indication [Short on-time] 4 3 2 1	Status	Description
	□□□■	Error on another board	A defect on another board or a problem on another board was detected.
		Bus error	Software has a problem, or the optional board is defective.
		Parity alarm	The optional board is defective.
		Illegal general instruction	Software has a problem, or the optional board is defective.
	□□□■	Illegal slot instruction	Software has a problem, or the optional board is defective.
		CPU address error	Software has a problem, or the optional board is defective.

NOTE

If an error occurs with the LEDs turned on and off with long on-time and short on-time in a manner not indicated above, contact FANUC.

COL, LIL, and ALM LED indications (when abnormality occurs)

LED indication	Status	Description
COL ■ COL ☆	Collision occurs. (Data collision occurs.)	When a data collision occurs on the network, the LED is lit or blinks. (Note)
LIL 🗆	Not connected to hub	The board is not connected to the hub properly. The LIL LEF stays off also when the power to the hub is off. Check whether the board is connected to the hub properly.
ALM ■ (HER)	Parity error occurs.	A parity error occurred in memory on the optional board. The optional board is defective.

NOTE

The FL-net manages the token-based transmission right so that no collision occurs. If this LED is turned on frequently, a communication error has occurred due to noise, or an Ethernet compliant product other than the FL-net is connected.

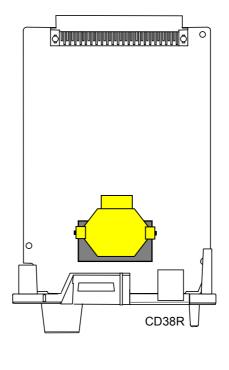
In such a case, check the devices connected to the network and the network installation status.

In case of an Ethernet compliant product other than the FL-net is connected, please use a swithcing HUB.

1.2 Series 30*i*/31*i*/32*i*/35*i*-B, PM*i*-A,0*i*-F

1.2.1 Component Layout

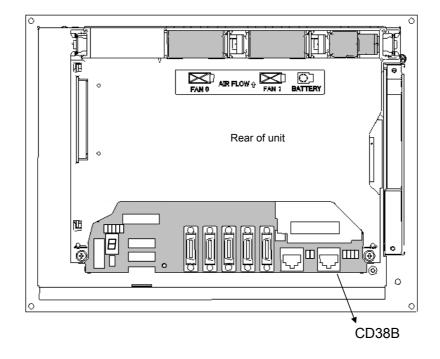
Optional board (common to LCD-mounted type/Stand-alone type)





Name	PCB drawing No.	Remarks
Fast Ethernet board	A20B-8101-0770	

Control unit with Multi-function Ethernet (LCD-mounted type)

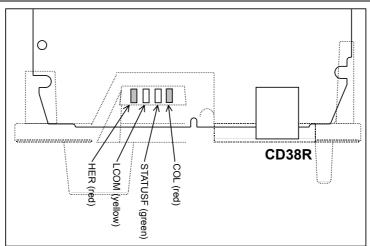


1.2.2 LED Indications and Meanings

The board provides one green LED (STATUSF) and one yellow LED (LCOM) for status indication, and two red LEDs (HER, COL).

The figure below shows the locations of these LEDs. The table below explains the LED lighting state.

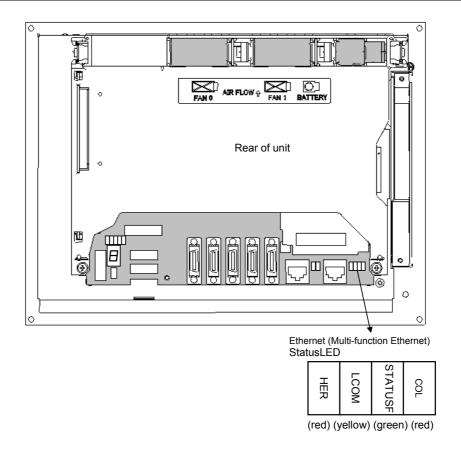
Optional board (common to LCD-mounted type/Stand-alone type)



NOTE

The face plate is indicated using dotted lines.

Control unit with Multi-function Ethernet (LCD-mounted type)



In the following explanations, the LED lighting states are expressed as follows:

□: Off ■: On ☆: Blinking

LED display transition for STATUSF (during power-on)

	LED display	Status	Meaning
П		Power-off	
	•	Immediately after power-on	Initial state entered immediately after power-on. If the board is stopped in this condition, the cause is one of the following: → The CNC communication software may not be running normally. Check whether the communication software is installed properly. → The hardware may be faulty. Replace the optional board (main board when Multi-function Ethernet is used).
Į	☆	Start completion	The board has started normally.

LED display for STATUSF (during normal operation)

LED display	Status	Meaning
*	Normal status	The board is operating normally.

LED display for LCOM

LED display	Status	Meaning
	Not connected to hub	The board is not connected to the hub properly. The LED stays off also when the power to the hub is off. Check whether the board is connected to the hub properly.
	Connected to hub	The board is connected to the hub.
*	Transmission/reception in progress	Data is being transmitted or received.

LED display for COL

LED display	Status	Meaning	
	Normal status	The board is operating normally.	
■	Collision occurs. (Data collision occurs.)	The LED is on or blinks at short intervals when the Ethernet communication traffic (communication amount) is high or ambient noise is high.	

LED display for HER

LED display	Status	Meaning
	Normal status	The board is operating normally.
•	Error detected in the Ethernet circuit on the main board or option board.	The cause may be the faulty optional board (main board when Multi-function Ethernet is used) or a malfunction due to noise.
☆	Error detected in the software	

2 SOFTWARE MAINTENANCE INFORMATION

This chapter provides software maintenance information related to the FL-net functions.

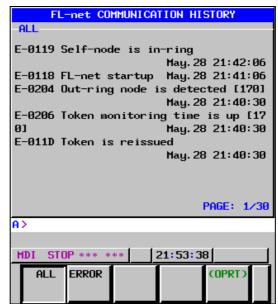
2.1 FL-net COMMUNICATION HISTORY

Communication history of the FL-net function is displayed.

FL-net COMMUNICATION HISTORY screen

Procedure

- 1 Press function key NESSAGE
- 2 Press the [FL-net MSG] ([FL-net 1CH] or [FL-net 2CH] for the Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A, [FL-net 1CH] for the Series 0*i*-F) soft key. The FL-net COMMUNICATION HISTORY screen for the FL-net function then appears. (When the soft key is not displayed, press the next-menu key.)



Screen 2-1 FL-net COMMUNICATION HISTORY Screen

The most recent message in the communication history information is displayed on the top of the screen. Displayed at the right end is the time and date of the issuance of the message. The month (MMM), day (DD), hour (hh), minute (mm), and second (ss) are indicated in the format "MMM.DD hh:mm:ss". In the uppermost example on the above screen, "21:42:06 on May 28" is indicated.

To clear the FL-net communication history, press the [(OPRT)] soft key, then press the [CLEAR] soft key.

CLEAR

The displayed contents can be changed by using soft keys on the FL-net COMMUNICATION HISTORY screen.

- (1) [ALL] soft key
 Displays all communication history information related to FL-net communication.
- (2) [ERROR] soft key
 Displays only error-related communication history information in the FL-net communication history.

The following lists major communication history information:

Error message		Meaning and action to be taken		
		Token hold time of the local node is insufficient.		
E-0113	Token Holding time is up	Set a larger value in the token monitoring time parameter.		
		Received data is destroyed.		
		Data may have been destroyed by noise or by connection of a		
E-0115	Sum-check of IP layer is invalid	non-FL-net device.		
		Check the connected devices and the network cable installation		
		status.		
E-0118	El not startun	The local device has started normally at power-on. This is not an		
E-0110	FL-net startup	error.		
E-0119	Self-node is in-ring	The local device has participated in the network.		
L-0119	Sell-flode is ill-fillig	This is not an error.		
		When only the local device is connected to the network, the device		
E-011A	Wait for any frame	is waiting for data from another device.		
		This is not an error.		
E-011D	Token is reissued	When a token is not transmitted from the node preceding the local		
		node, a token is reissued.		
E-012B	Send Error(Retry over)	A transmission error occurred.		
E-012C	Send Error(Collision)	Data may have been destroyed by noise or by connection of a		
E-012D	Send Error(Carrier Lost)	non-FL-net device.		
E-012E	Send Error(No Carrier)	Check the connected devices and the network cable installation		
E-012F	Send Error(Bad frame)	status.		
E-0130	Receive Error(Bad CRC)			
E-0131	Receive Error(PHY-LSI)	A reception error occurred.		
E-0132	Receive Error(Short frame)	Data may have been destroyed by noise or by connection of a		
E-0133	Receive Error(Long frame)	non-FL-net device.		
E-0134	Receive Error(Nonoctet Aligned	Check the connected devices and the network cable installation		
	frame)	status.		
E-0135	Receive Error(Overflow)			
		The node number of the local device is the same as the node		
E-0201	Node number is duplicated [999]	number of another device. Correct the IP address setting not to		
		duplicate the node number. The duplicated node number is		
		[999]. A device with a different protocol version (node number [999]) was		
E-0202	Protocol version is different [999]	detected on the network. All devices must comply with the FL-net		
L-0202	1 TOLOCOL VELSION IS UNICICIN [999]	communication standards version 2.00 or later.		
		The protocol version of the local node is different from the protocol		
	My protocol version is different	version of the already existing network. The FANUC FL-net		
E-0203	[999]	employs FL-net communication standards version 2.00, so all		
	[]	nodes must comply with version 2.00 or later.		
E-0204	Out-ring node is detected [999]	Disconnection of a node with node number [999] was detected.		
		When the local node held a token, the local node received another		
E-0205	Duplicated token is detected [999]	token from a node with node number [999].		
E 0000	Talan manifesia (inchis	Transmission of a token from node number [999] could not be		
E-0206	Token monitoring time is up [999]	detected, and the token monitoring time expired.		

Error message		Meaning and action to be taken	
E-0207	Token is scrapped [999]	When the local node held a token, the local node received another token from a node with node number [999]. Since the node number of the other node was smaller than the node number of the local node, the token of the local node was discarded.	
E-0400	Common memory is overlapped [9999, 9999]	The setting for common memory area 1 or 2 of the local node is the same as the setting of common memory of another node. The former value in [9999, 9999] indicates the start address of common memory area 1, and the latter value indicates the start address of common memory area 2.	

2.2 ALARM AND DIAGNOSIS INFORMATION

NOTE

This function is valid only for the Series 30i/31i/32i/35i-B, Power Motion i-A, Series 0i-F.

When using the FL-net function on the Series 30i/31i/32i/35i-B, Power Motion i-A, Series 0i-F, the following alarms might be displayed.

In this case, please confirm the diagnosis information and take the countermeasure.

Number	Message	Description
PW0050	POWER MUST BE OFF (INITIALIZED	When the power was turned on, communication
(NOTE)	COMMUNICATION)	hardware was initialized.
		Please turn the power off.
SR2038	WRONG COMMUNICATION COMBINATION	The combination of the communication hardware and
		the software options is illegal.
		Details of an illegal combination are notified to
		diagnosis number No.4400 and 4401.

NOTE

An alarm PW0050 might be generated when the power is turned on after the option boards are added or are exchanged and the software option is changed.

	#7	#6	#5	#4	#3	#2	#1	#0
Diagnosis 4400			BD4	BD3	BD2	BD1		MFE

When the communication alarm SR2038 occurs, the detail information of wrong hardware is indicated.

#0 MFE Multi-function Ethernet

BD1 Option board mounted in slot1

BD2 Option board mounted in slot2

#4 BD3 Option board mounted in slot3

BD4 Option board mounted in slot4

NOTE

When the communication alarm SR2038 does not occur, all bits are "0".

Diagnosis	4401	Detailed number of alarm SR2038
-		

When the communication alarm SR2038 occurs, the information is indicated.

Number	Description
0	The combination of the communication functions is correct.

Number	Description
1	The number of mounted the hardware option exceeds limitation. The number of the hardware options that can be mounted is up to three.
2	The hardware option that DGN No.4400 indicates doesn't exist. Confirm the hardware option specified for NC parameter No.970-972.
3	In the hardware option that DGN No.4400 indicates, the working function is not specified. NC parameters No.970-972 are wrong though the hardware option exists. Specify "-1" for No.970-972 When not using it.
4	In the hardware option that DGN No.4400 indicates, the Data Server function and the FL-net function are specified at the same time. Specify a separate hardware option for NC parameter No.970, No.971 or 972 because the Data Server function and the FL-net function are exclusive functions.
5	In the hardware option that DGN No.4400 indicates, a necessary software option is not effective. The same hardware option is specified for NC parameter No.970, No.971 or No.972.
6	In the hardware option that DGN No.4400 indicates, a necessary software option is not effective.

2.3 COMMUNICATION RETRY MONITORING FUNCTION

When the FL-net function on the Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A and Series 0*i*-F is used, FL-net communication errors are checked at intervals of 10 seconds. If the number of errors detected during the last 1 minute reaches the value set for parameter No. 11534, warning signal is output. The value set for parameter No. 11534 is used for both FL-net 1CH and 2CH. As a warning signal, however, WFLN1 is output for FL-net 1CH and WFLN2 is output for FL-net 2CH.

When the FL-net/Ethernet coexisting function is used, the total number of FL-net communication errors and Ethernet communication errors is checked at intervals of 10 seconds. If the number of errors detected during the last 1 minute reaches the value set for parameter No. 11533, the warning signal (WETF) is output.

Since the number of detected communication errors is checked at intervals of 10 seconds, the warning signal is also output at intervals of 10 seconds. The signal output is reset by turning the power off, then on again.

NOTE

- 1 This function is valid only for the Series 30*i*/31*i*/32*i*/35*i*-B, Power Motion *i*-A and Series 0*i*-F.
- 2 The maximum value for network error counters is 65535. If an overflow occurs, no warning is issued and the error count returns to 0.

Parameter

11533 Warning value for the number of fast Ethernet error detection occurrences

[Input type] Parameter input

[Data type] Byte

[Unit of data] Number of detection occurrences/minute

[Valid data range] 0 to 128

Recommended setting = 0

Set a warning value for the number of FAST Ethernet error detection occurrences.

When the number of 1- minute error detection occurrences becomes higher than or equal to the setting, the warning signal is output.

If the setting is 0, monitoring is performed on a 10 occurrences/minute basis.

NOTE

When this parameter is set, the power must be turned off before operation is continued.

11534

Warning value (common to FL-net boards 1 and 2) for the number of FL-net error detection occurrences

[Input type] Parameter input

[Data type] Byte

[Unit of data] Number of detection occurrences/minute

[Valid data range] 0 to 128

Recommended setting = 0

Set a warning value for the number of FL-net error detection occurrences.

When the number of 1- minute error detection occurrences becomes higher than or equal to the setting, the warning signal is output.

If the setting is 0, monitoring is performed on a 3 occurrences/minute basis.

NOTE

When this parameter is set, the power must be turned off before operation is continued.

FAST Ethernet communication abnormality warning signal WETF<F0535.5>

[Classification] Output signal

[Operation] This signal is output when a warning occurs.

[Function] If the total number of various errors detected by the communication hardware of the FAST Ethernet function is equal to or greater than the setting of parameter No. 11533 (standard setting 0, which means 10 retries per one minute), this signal is set to 1.

Once this signal is set to 1, the value is kept until the CNC power is turned off.

FL-net1 communication abnormality warning signal WFLN1<F0535.6>

[Classification] Output signal

[Operation] This signal is output when a warning occurs.

[Function] If the total number of various errors detected by the communication hardware of the FL-net1 function is equal to or greater than the setting of parameter No. 11534 (standard setting 0, which means 3 retries per one minute), this signal is set to 1.

Once this signal is set to 1, the value is kept until the CNC power is turned off.

FL-net2 communication abnormality warning signal WFLN2<F0535.7>

[Classification] Output signal

[Operation] This signal is output when a warning occurs.

[Function] If the total number of various errors detected by the communication hardware of the FL-net2 function is equal to or greater than the setting of parameter No. 11534 (standard setting 0, which means 3 retries per one minute), this signal is set to 1.

Once this signal is set to 1, the value is kept until the CNC power is turned off.

APPENDIX





SAFETY FUNCTION BY FL-net

This chapter explains about the Safety function by FL-net.

A.1 OUTLINE

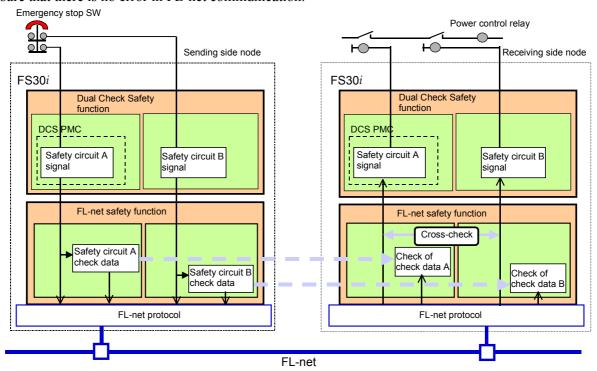
In a machine system such as a transfer machine, stations are each equipped with an operator's panel having an emergency stop button. It is necessary to implement a safety circuit for the entire system so that when the emergency stop button at any station is pressed the emergency stop signal can be transferred to all CNCs.

Use of the Safety function by FL-net ensures transmission of safety-related signals among the general-purpose safety circuits in multiple CNCs connected via FL-net, so, all inter-node connections can be integrated into FL-net, which makes system cabling very simple.

The Safety function by FL-net is an additional function of the dual check safety function. It operates on two CPUs as well as the dual check safety function. Please refer to "Dual Check Safety CONNECTION MANUAL (B-64483EN-2)" for details of the dual check safety function.

Basic elements of the Safety function by FL-net are two nodes of the sending side node and the receiving side node. A safe circuit for the line is implemented by the combination of these nodes.

The sending node adds check data to each of duplicated signals of the general-purpose safety circuit and sends these signals. The receiving node checks the check data and cross-checks the received signal data to ensure that there is no error in FL-net communication.



Main specification

Item	Description		
Supported CNC	Series 30i/31i/32i/35i-B, Power Motion i-A, Series 0i-F		
Number of connectable nodes	30		
Number of safety signals per a node	7bits		
Necessary options	- Safety function by FL-net (S851)		
	- FL-net function (J692)		
	- Dual Check Safety function (S661)		

In Series 30*i*/31*i*/32*i*/35*i*-B and Power Motion *i*-A, FL-net functions can be operated on up to two hardware at the same time. However, only one Safety feature by FL-net can be operated. The first and the second hardware that FL-net function runs on are specified by the CNC parameter. The Safety function by FL-net runs on the first hardware. In other words, the Safety function by FL-net runs on the hardware specified by CNC parameter No.971.

For details of the CNC parameter about FL-net function, please refer to section 4.3 "RELATED NC PARAMETER" in part II "SPECIFICATION".

NOTE

- 1 The range of node number for the Safety function by FL-net is 1 to 30. Maximum 30 CNCs can be connected to the network of the Safety function by FL-net.
- 2 Signal of seven bits can be transmitted from one node to other nodes through the Safety function by FL-net. The safety data is made adding the inspection data to this signal data. This safety data is actually sent and received between nodes.
- 3 The Safety function by FL-net uses first six words of common memory area 1 allocated to each node exclusively to send and receive the safety data. Therefore, the allocation size of common memory area 1 of the node that composes the network of the Safety function by FL-net is larger than six words. Both common memory area 1 other than the above-mentioned six words and common memory area 2 can be used as a normal data area.
- 4 When the Safety function by FL-net is used, it is necessary to set the safety parameter described later besides the FL-net communication parameters. Moreover, some part of the FL-net communication parameter is not used. Please refer to section A.3 "PARAMETERS" for the setting of parameters.
- 5 If multiple nodes are disconnected from the network at the same time, a node which continues to communication may detect a cross-check error. Do not disconnect multiple nodes from the network at the same time.

A.1.1 Mode of the Safety Function by FL-net

Mode 1

In mode 1, if any remote node that communicates the safety data using the Safety function by FL-net does not participate in the network, an error occurs.

In this mode, if the counter in the safety data is not updated in any node due to a reason such as power-off, an error occurs in all other nodes and the communication of the safety signals cannot be continued. Moreover, even if a node once disconnected from the network participates in the network again, the communication of the safety signals cannot be restarted.

Mode 2

In mode 2, even if the power to any remote node that communicates the safety data using the Safety function by FL-net is off due to a reason such as maintenance or is not turned on, no error occurs in other nodes and the communication of the safety signals can be made.

In this mode, even if the counter in the safety data is not updated in any node due to a reason such as power-off, other nodes can continue to communicate the safety signals. Moreover, a node can participate in the safety network at any time, and after that, the participating nodes can communicate the safety signals.

Operation in mode 2 is the same as that in mode 1, except that communication is continued even if the counter is not updated.

If the counter is not updated, bit 7 of safety DI is set to ON. Perform necessary processing by the ladder program of the dual check safety function according to the value of the safety DI.

At power-on, bit 7 of safety DI is set to ON in each remote node that communicates the safety data using the Safety function by FL-net. Each bit of safety DI can be referenced from the ladder program after the own node safety effective notification area is set to ON. When safety data is received, bit 7 of safety DI is set to OFF and the value of the safety signal is reflected.

NOTE

- 1 Only either of mode 1 and mode 2 can be specified for all nodes in the same network.
- 2 In mode 1, to make a node for which the Safety function is disabled (general node) participate in a network for which the Safety function is used, set the token monitoring time for each general node so that the total of the token monitoring times for all general nodes is up to 80 percent of the communication time-out specified for the Safety function.

In mode 2, set the token monitoring time for each node so that the total of the token monitoring times for all nodes that are to participate in a network for which the Safety function is used is up to 80 percent of the communication time-out for the Safety function.

The recommended value for the token monitoring time is 10 (10 msec) or more.

A.2 SAFETY SIGNAL AREA

This chapter explains the safety signal area that is the interface of the dual check safety function and the Safety function by FL-net. Two paths (PMC and DCS PMC) corresponding to the doubled signals of dual check safety function are prepared in this area. On the dual check safety function side, the ladder program to read data from this area and to write data to this area in each path is necessary.

This area is allocated to PMC address specified by the safety parameters described later. Please refer to chapter A.3 "PARAMETERS" for details of each parameter.

⚠ WARNING

Before allocating the safety signal area to a PMC area, fully understand the instructions written in "GENERAL WARNINGS FOR CNC APPLICATION DEVELOPMENT" in "SAFETY PRECAUTIONS" at the beginning of this manual, and in this section.

Allocate the PMC area so that multiple communication functions do not write data to it. Immediately after setting all communication parameters including those for allocation to the PMC area, make sure that the safety signals operate normally in the status in which safety is ensured before starting operation. If operation is started without checking the above, the machine may behave unexpectedly, possibly causing damage to the tool, machine, and/or workpiece, or injury to the user.

Sent safety signal area

The signal data sent from the dual check safety function to other nodes via Safety function by FL-net is composed of the safety signals in seven bits. Bit 7 is reserved and can not be used.

Sent	safety	signal	area

	#7	#6	#5	#4	#3	#2	#1	#0
+0000	(Reserved)	Safety signal						

- 1 This area uses the PMC area specified by the parameters.
- 2 If Bit 7 is set to 1 by the ladder program, the Safety function by FL-net detects that it is abnormal and an alarm is issued. If CNC CPU detects the alarm, the alarm (PW0499) SAFETY FUNCTION BY FL-net ERROR (CNC) is generated, and if FL-net CPU detects it, the alarm (PW0500) SAFETY FUNCTION BY FL-net ERROR (FL-net) is generated.

Received safety signal area

The signal data that is received from other nodes via Safety function by FL-net and passed to the dual check safety function is composed of the one bit system signal and 7 bits safety signal per node. There is signal data for 30 nodes.

Moreover, the safety function target node information area (four bytes) is allocated after the received safety signal area. The bit 0 of this area is the own node safety effective notification area.

Received safety	signal area
-----------------	-------------

	#1	#6	#5	#4	#3	#2	#1	#0
+0000		Received safety signal area from node 1						
+0001			Received saf	ety signal are	a from node 2	2		
								_
+0028		ı	Received safe	ety signal area	a from node 2	9		
+0029			Received safe	etv signal area	a from node 3	0		

Safety function target node information area (Bit 0 is the own node safety effective notification area)

	#7	#6	#5	#4	#3	#2	#1	#0
+0030	Node 7	Node 6	Node 5	Node 4	Node 3	Node 2	Node 1	Own node
+0031	Node 15	Node 14	Node 13	Node 12	Node 11	Node 10	Node 9	Node 8
+0032	Node 23	Node 22	Node 21	Node 20	Node 19	Node 18	Node 17	Node 16
+0033	(Reserved)	Node 30	Node 29	Node 28	Node 27	Node 26	Node 25	Node 24

Details of Received safety signal area for each node

#7	#6	#5	#4	#3	#2	#1	#0
System signal	Safety signal						

When the error is detected by the Safety function by FL-net, the System signal in Received safety signal area is set to 1.

NOTE

In mode 2, the system signal in the node in which the counter is detected not being updated is set to 1, and all safety signals are set to 0.

Safety function target node information area leading to the received safety signal area is a bit signal area represents the target node of communication by using the Safety function by FL-net. Each bit from Node 1 to Node 30 shows each node. The logical add of safety parameter N01 to N30 (No.13862 to No.13865 and No.13876 to No.13879) and safety parameter T01 to T30 (No.13850 to No.13853 and No.13854 to No.13857) is reflected to this area.

If the value is 0, the communication to that node is executed and if the value is 1, the communication to that node is not executed. The value of the bit that corresponds to the own node becomes 1.

Moreover, bit 0 of the safety function target node information area is the own node safety effective notification area. This bit shows whether the safety function of own node is effective or not. After the validity of the safety parameter is confirmed when the power supply is turned on, the logical add of safety

parameter FSE (No.13860#0) and safety parameter FSE (No.13866#0) is reflected to this area. The value 0 shows the safety function is not effective, and the value 1 shows effective.

NOTE

The received safety signal area and safety function target node information area are prepared in two paths (PMC and DCS PMC) respectively. After the power supply is turned on, a value is set to the safety function target node information area including own node safety effective notification area. The timing that the signal is turned on by two paths is not completely the same. There is some gap. When making the ladder program, please note that the timing to which the own node safety effective notification area is turned on in two paths is not the same.

A.3 PARAMETERS

A.3.1**Safety Parameters**

The parameters related to the Safety function by FL-net are protected with a password of safety parameters (parameter No. 3225), and it is the same as the parameters related to the dual check safety function. Except when the same value as a password for safety parameters is set as the key for safety parameters (parameter No. 3226), the settings of the safety parameters cannot be modified in any cases. For the details of the parameter No. 3225, the key for safety parameters No.3226, please refer to "Dual Check Safety CONNECTION MANUAL (B-64483EN-2)". The new setting of the safety parameter becomes valid when the power is turned on again.

		_	#7	#6	#5	#4	#3	#2	#1	#0
Ī	13860							MD2		FSE
Ī	13866							MD2		FSE
-	ET	7 1	D , .							

[Input type] Parameter input

[Data type] Bit

FSE The Safety function by FL-net is:

- Disabled. 0:
- Enabled. 1:

NOTE

- 1 When this parameter is set, the power must be turned off before operation is continued.
- 2 The same value must be set in bit 0 of parameter No. 13860 and bit 0 (FSE) of parameter No. 13866. When bit 0 of parameter No.13860 or bit 0 (FSE) of parameter No. 13866 is set to 1, the Safety function by FL-net is enabled, and the alarm (PW0499) and alarm (PW0500) are issued if the values set in these bits are different.

MD2 The mode of the Safety function by FL-net is set to:

- Mode 1.
- Mode 2. 1.

NOTE

1 When this parameter is set, the power must be turned off before operation is continued.

2 The same value must be set in bit 2 (MD2) of parameter No. 13860 and bit 2 (MD2) of parameter No. 13866. If the values set in these bits are different, alarms PW0499 and PW0500 are issued.

13861

Local node number for the Safety function by FL-net

[Input type] Parameter input

[Data type] Byte

[Valid data range] 1 to 30

Set the local node number on FL-net.

NOTE

- 1 When this parameter is set, the power must be turned off before operation is continued.
- 2 When the values other than 1-30 are set, alarm (PW0499) and alarm (PW0500) are generated by the parameter check when the power supply is turned on.

13	862
13	863
13	864
13	865

#7	#6	#5	#4	#3	#2	#1	#0
N07	N06	N05	N04	N03	N02	N01	
N15	N14	N13	N12	N11	N10	N09	N08
N23	N22	N21	N20	N19	N18	N17	N16
	N30	N29	N28	N27	N26	N25	N24

13876
13877
13878
13879

N07	N06	N05	N04	N03	N02	N01	
N15	N14	N13	N12	N11	N10	N09	N08
N23	N22	N21	N20	N19	N18	N17	N16
	N30	N29	N28	N27	N26	N25	N24

[Input type] Parameter input

[Data type] Bit

N01 to N30 Communication with a corresponding node through the Safety function by FL-net is:

- Enabled. 0:
- Disabled.

Specify nodes with which safety data communication is to be performed using the Safety function by FL-net. Bits N01 to N30 indicate node numbers.

It is necessary for nodes that communicate with each other to mutually set the node number of the other node.

NOTE

- 1 When this parameter is set, the power must be turned off before operation is continued.
- 2 Be sure to set 1 in the bit corresponding to the local node.
- 3 The same settings must be made in parameter No.13862 to 13865 and parameter No. 13876 to 13879. If the settings in parameter No. 13862 to 13865 are different from the settings in parameter No. 13876 to 13879, safety alarm (PW0499) and safety alarm (PW0500) are generated.

Bits 0 and 31 are not used. These bits are automatically set to 1 at power-on.

13867

Address type for placing received data for the Safety function by FL-net (CNC CPU side)

[Input type] Parameter input

[Data type] Byte

[Valid data range] 1

Specify the address type of the PMC area in which the data received via Safety function by FL-net of CNC CPU side is placed. The relation between the setting value and address type is as follows:

Setting	Address type
1	R area of DCS PMC

! CAUTION

The R area in the DCS PMC area is all set to 0 immediately after power-on.

NOTE

- 1 When this parameter is set, the power must be turned off before operation is continued.
- 2 If the setting values is out of range, alarm (PW0499) and alarm (PW0500) are generated by the parameter check when the power supply is turned on.

13868

Address type for placing sent data for the Safety function by FL-net (CNC CPU side)

[Input type] Parameter input

[Data type] Byte

[Valid data range] 1

Specify the address type of the PMC area in which the data to be sent via Safety function by FL-net of CNC CPU side is placed. The relation between the setting value and address type is as follows:

Setting	Address type
1	R area of DCS PMC

↑ CAUTION

The R area in the DCS PMC area is all set to 0 immediately after power-on.

NOTE

- 1 When this parameter is set, the power must be turned off before operation is continued.
- 2 If the setting values is out of range, alarm (PW0499) and alarm (PW0500) are generated by the parameter check when the power supply is turned on.

13869

Start address of received data for the Safety function by FL-net (CNC CPU side)

[Input type] Parameter input

[Data type] 2-word

Specify the start address of the DCS PMC area in which the data received via Safety function by FL-net of CNC CPU side is placed. The safety signals and target node information are contained in this area. The size of this area is 34 bytes and it consists of 30 bytes of the safety signals and 4 bytes of the target node information. A consecutive 34 bytes area is necessary.

- 1 When this parameter is set, the power must be turned off before operation is continued.
- 2 If the start address where a necessary size can not be allocated is set, alarm (PW0499) and alarm (PW0500) are generated by the parameter check when the power supply is turned on.

13870

Start address of sent data for the Safety function by FL-net (CNC CPU side)

[Input type] Parameter input

[Data type] 2-word

Specify the start address of the DCS PMC area in which the data to be sent via Safety function by FL-net of CNC CPU side is placed. The sent data is 1 byte long safety signal.

- 1 When this parameter is set, the power must be turned off before operation is continued.
- 2 If the start address where a necessary size can not be allocated is set, alarm (PW0499) and alarm (PW0500) are generated by the parameter check when the power supply is turned on.

13872

Address type for placing received data for the Safety function by FL-net (FL-net CPU side)

[Input type] Parameter input

[Data type] Byte

[Valid data range] 1, 2, 11, 12, 21, 22, 31, 32, 41, 42

Specify the address type of the PMC area in which the data received via Safety function by FL-net of FL-net CPU side is placed. The relation between the setting value and address type is as follows:

Setting	Address type
1	Internal relay (R) area in 1 st PMC
2	Extra relay (E) area in 1 st PMC
11	Internal relay (R) area in 2 nd PMC
12	Extra relay (E) area in 2 nd PMC
21	Internal relay (R) area in 3 rd PMC
22	Extra relay (E) area in 3 rd PMC
31	Internal relay (R) area in 4 th PMC
32	Extra relay (E) area in 4 th PMC
41	Internal relay (R) area in 5 th PMC
42	Extra relay (E) area in 5 th PMC

⚠ CAUTION

- In the PMC area, the R area, and the E area allocated to volatile memory are all set to 0 immediately after power-on.
- 2 The E area in the PMC area is normally allocated to volatile memory. It, however, can also be used optionally as nonvolatile

When nonvolatile memory is used, the data is held after power-off. So, be very careful not to cause a malfunction at the next power-on.

- 1 When this parameter is set, the power must be turned off before operation is continued.
- 2 If the setting values is out of range, alarm (PW0499) and alarm (PW0500) are generated by the parameter check when the power supply is turned on.

13873

Address type for placing sent data for the Safety function by FL-net (FL-net CPU side)

[Input type] Parameter input

[Data type] Byte

[Valid data range] 1, 2, 11, 12, 21, 22, 31, 32, 41, 42

Specify the address type of the PMC area in which the data to be sent via Safety function by FL-net of FL-net CPU side is placed. The relation between the setting value and address type is as follows:

Setting	Address type
1	Internal relay (R) area in 1 st PMC
2	Extra relay (E) area in 1 st PMC
11	Internal relay (R) area in 2 nd PMC
12	Extra relay (E) area in 2 nd PMC
21	Internal relay (R) area in 3 rd PMC
22	Extra relay (E) area in 3 rd PMC
31	Internal relay (R) area in 4 th PMC
32	Extra relay (E) area in 4 th PMC
41	Internal relay (R) area in 5 th PMC
42	Extra relay (E) area in 5 th PMC

↑ CAUTION

- 1 In the PMC area, the R area, and the E area allocated to volatile memory are all set to 0 immediately after power-on.
- 2 The E area in the PMC area is normally allocated to volatile memory. It, however, can also be used optionally as nonvolatile memory.

When nonvolatile memory is used, the data is held after power-off. So, be very careful not to cause a malfunction at the next power-on.

NOTE

- 1 When this parameter is set, the power must be turned off before operation is continued.
- 2 If the setting values is out of range, alarm (PW0499) and alarm (PW0500) are generated by the parameter check when the power supply is turned on.

13858

Start address of received data for the Safety function by FL-net (FL-net CPU side)

[Input type] Parameter input

[Data type] 2-word

Specify the start address of the PMC area in which data received via Safety function by FL-net of FL-net CPU side is placed. The safety signals and target node information are contained in this area. The size of this area is 34 bytes and it consists of 30 bytes of the safety signals and 4 bytes of the target node information. A consecutive 34 bytes area is necessary.

- 1 When this parameter is set, the power must be turned off before operation is continued.
- 2 If the start address where a necessary size can not be allocated is set, alarm (PW0499) and alarm (PW0500) are generated by the parameter check when the power supply is turned on.

13859

Start address of sent data for the Safety function by FL-net (FL-net CPU side)

[Input type] Parameter input

[Data type] 2-word

Specify the start address of the DCS PMC area in which the data to be sent via Safety function by FL-net of FL-net CPU side is placed. The sent data is 1 byte long safety signal.

NOTE

- 1 When this parameter is set, the power must be turned off before operation is continued.
- 2 If the start address where a necessary size can not be allocated is set, alarm (PW0499) and alarm (PW0500) are generated by the parameter check when the power supply is turned on.

13871

Timer for received data checking for the Safety function by FL-net

[Input type] Parameter input

[Data type] Word

[Unit of data] millisecond

[Valid data range] 0 to 500

The FL-net safety function transfers data of independent two safety circuits from the sending node to receiving node. On the receiving node, the CNC CPU and FL-net CPU mutually monitor the data of these two paths. If an inconsistency is present for more than the parameter-set time, safety alarm is issued. If CNC CPU detects the alarm, alarm (PW0499) is issued and if FL-net CPU detects the alarm, alarm (PW0500) is issued.

NOTE

- 1 When this parameter is set, the power must be turned off before operation is continued.
- 2 If the setting value is more than 500, 500 milliseconds are adopted as a timer for received data checking.

13874

Start timer after power-on for the Safety function by FL-net

[Input type] Parameter input

[Data type] Word

[Unit of data] second

[Valid data range] 0 to 255

When the parameter-set time has passed since power-on, the Safety function by FL-net starts checking received data. However, when all nodes that participate in the Safety function by FL-net participate in the network, the confirmation of the received data is begun even if the time set to this parameter doesn't pass.

The value to be set in this parameter must not be longer than the time required for all nodes using the Safety function by FL-net to start up and start FL-net communication. In mode 2, the Safety function starts immediately after the safety data is received,

regardless of this setting.

- 1 When this parameter is set, the power must be turned off before operation is continued.
- 2 If the setting value is from 0 to 60, 60 seconds are adopted as the start timer.
- 3 If the setting values is out of range, alarm (PW0499) and alarm (PW0500) are generated by the parameter check when the power supply is turned on.

13850
13851
13852
13853
•

#7	#6	#5	#4	#3	#2	#1	#0
T07	T06	T05	T04	T03	T02	T01	
T15	T14	T13	T12	T11	T10	T09	T08
T23	T22	T21	T20	T19	T18	T17	T16
	T30	T29	T28	T27	T26	T25	T24

13854	
13855	
13856	
13857	

T07	T06	T05	T04	T03	T02	T01	
T15	T14	T13	T12	T11	T10	T09	T08
T23	T22	T21	T20	T19	T18	T17	T16
	T30	T29	T28	T27	T26	T25	T24

[Input type] Par [Data type] Bit

[Input type] Parameter input

T01 to T30 The node corresponding to each bit of this parameters:

- 0: Participates in the network of Safety function by FL-net.
- 1: Is temporarily detached from the network of Safety function by FL-net.

A group of nodes that communicate safety data using the Safety function by FL-net is defined with remote node bit parameters N01 to N30 (No.13862 to 13865 and No.13876 to 13879).

Use these parameters if, in the process of starting up facilities, the Safety function by FL-net of one of the nodes is to be temporarily disabled and detached from the group.

For details, please refer to section A5.3 "Temporarily Detaching Node from Safety function by FL-net".

Set 1 in the bit corresponding to the node that is to be temporarily detached from the network of the Safety function by FL-net. Each of the T01 to T30 bits represents a node number.

NOTE

- 1 When this parameter is set, the power must be turned off before operation is continued.
- 2 If one of the bits of these parameters is set to 1, alarm DS5368 "SAFETY FUNCTION BY FL-net DETACHMENT SETTING" is issued when the power is turned on.
- 3 The same value must be specified in safety parameters from T01 to T30 (No. 13850 to 13853) and in safety parameters from T01 to T30 (No. 13854 to 13857). If the setting value is different, alarm (PW0499) and alarm (PW0500) are generated by the parameter check when the power supply is turned on.

Neither bit 0 nor bit 31 is used. Please specify 0.

A.3.2 FL-net Communication Parameter

The related FL-net communication parameters are as follows.

For the method of setting the FL-net communication parameter, please refer to section 1.1 "PARAMETERS FOR FL-net FUNCTION" in part III "SETTING".

Basic parameters

Parameter nam	е	Description
IP ADDRESS		IP address of the local node
		The host address section (the last numeric value) of this IP address is the node
(NOTE 2)	Pa10	number of the local node.
		Only an IP address in class C can be specified.
AREA 1 ADDRESS		Start address of common memory area 1 of the local node.
	Pa11	A value from 0 to 511 can be set.
AREA 1 SIZE		Data size of common memory area 1 of the local node.
(NOTE 3)	Pa12	A value from 0 to 512 can be set.

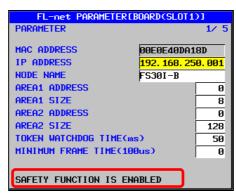


Fig. A-1 Setting screen when the Safety function by FL-net is effective

NOTE

- 1 If the Safety function by FL-net is enabled (safety parameter FSE (No.13860#0)=1 and FSE (No.13866#0)=1), the message that the safety function is enabled is displayed on the FL-net parameter screen as shown in Fig.
- 2 If the Safety function by FL-net is enabled, the value of safety parameter (No.13861) is regarded as the own node number of FL-net. Therefore, the value that is set in the host address part of Pa10 is ignored. The value of the safety parameter (No.13861) is displayed in the host address part of Pa10 in the FL-net parameter screen. However, the setting value of the host address part in Pa10 is not over-written. The form that can be set on the FL-net parameter screen is an Internet Protocol address form of class C. Moreover, the value that can be set is the same value as the safety parameter (No.13861). If the Safety function by FL-net is disabled, the node number that is set in the host address part of Pa10 becomes available.
- 3 The Safety function by FL-net uses six words from the head of common memory area 1 of each node. Therefore, when the Safety function by FL-net is enabled, it is necessary to set Pa12 to six or more.

State monitoring parameters

Parameter name	Description
ENTRY NODE Pa21	Specify the start address of an area in the PMC E/R area to which the network participation state of other nodes is posted. A 32-byte area starting at the start address is used as the participating node list area.

If the value is set to Pa21, the bit that corresponds to the node number that participates in the FL-net network becomes 1. The own node is included in it.

Moreover, if the value is set to Pa21 when the Safety function by FL-net is enabled, the safety normal communication signal is used. This signal uses bit 0 of the first address in the PMC area specified with Pa21 as shown in the figure below.

Pa21→	7	6	5	4	3	2	1	0
+0	Node 7	Node 6	Node 5	Node 4	Node 3	Node 2	Node 1	Safety Normal Comm. Signal
+1	Node 15	Node 14	Node 13	Node 12	Node 11	Node 10	Node 9	Node 8
:								
+30	Node 247	Node 246	Node 245	Node 244	Node 243	Node 242	Node 241	Node 240
+31	(Reserved)	Node 254	Node 253	Node 252	Node 251	Node 250	Node 249	Node 248

The safety normal communication signal is used to notify the PMC ladder whether the Safety function by FL-net normally communicates with all valid nodes. The specifications of the signal are described below.

- Only the nodes participating in the Safety function by FL-net are targeted. The temporarily detached nodes are not targeted. Targeted nodes are specified by the safety parameter N01 to N30 (No.13682 to 13865 and No.13876 to 13879). Temporarily detached nodes are specified by the safety parameter T01 to T30 (No.13850 to 13853 and No.13854 to 13857).
- When all target nodes participate in Safety function by FL-net, this signal is set to 1. When any of the target nodes is detached from network, this signal is set to 0. However, when a node not participating in the FL-net safety function is detached from the network, this signal does not change even if the detachment is detected.
- These signals always report the latest state, and they are not linked with the state of the safety signals. That is, even if an alarm is issued by the detection of the node detachment, this signal changes from 0 to 1 if the node participates in the network again. The state at which the alarm was issued is not kept.

Area 1 allocation parameters

Parameter name		Description
PMC ADDRESS		Specify the start address of an area in the PMC E/R area used for data
	Pa30	exchange with common memory area 1.
AREA 1 ADDRESS		Specify the start address of an area in common memory area 1 used for data
	Pa31	exchange with the PMC E/R area.
ALLOCATED SIZE		Specify the size of data exchanged between common memory area 1 and the
(NOTE)		PMC E/R area (Unit: Words).
		When data exchange between common memory area 1 and the PMC is not
	Pa32	performed, set 0 in this parameter.

NOTE

If communicating a normal signal, using common memory area 1, besides using the area with the Safety function by FL-net, set the overall size of the normal signal plus "6 words used by the Safety function by FL-net * number of nodes" to Pa32.

A.4 ALARM

The alarm that relates to the Safety function by FL-net cannot be released by the reset. To release the alarm, 1) turn off the power, 2) remove the cause of the alarm, 3) turn on the power again. However, the alarm generated by the temporary detachment setting can be released by the reset.

When the power disconnection alarm of PW0499 and PW0500 is generated, the dual check safety function sets the value of MCC off signal (*DCALM) to 0.

Alarm number	MCC off signal (*DCALM)
PW0499	DCS PMC : F000#7
PW0500	PMC: F0748#7

NOTE

When MCC off signal (*DCALM) becomes 0 because of the generation of the alarm of PW0499 or PW0500, the MCC off timer specified by parameter No.1948 is effective. It means that when PW0499 or PW0500 is issued, MCC off signal (*DCALM) becomes 0 after the period specified in parameter No.1948 is expired.

Power disconnection alarm (PW alarm)

Number	Message	Description		
PW0499	V0499 SAFETY FUNCTION BY FL-net Safety function by FL-net (CNC) detected the abn			
	ERROR (CNC) safety data. Please confirm the content of the alarm of			
		diagnosis screen of the Safety function by FL-net.		
PW0500	Safety function by FL-net (FL-net) detected the abnormalit			
	SAFETY FUNCTION BY FL-net	the safety data. Please confirm the content of the alarm on the		
	ERROR (FL-net)	diagnosis screen of the Safety function by FL-net.		

Other alarm (DS alarm)

Number	Message	Description	
DS5368	SAFETY FUNCTION BY FL-net	Temporary detaching parameter of Safety function by FL-net	
	DETACHMENT SETTING	(No.13850 to No.13857) is set to 1.	

A.5 STARTING UP

A.5.1 Procedure to Follow If Using the Safety Function by FL-net

Step 1 (Start up each facility independently)

First, disable the Safety function by FL-net (Safety parameter FSE:No.13860#0=0 and FSE:No.13866#0=0), and start up each facility independently, following the procedure described in "Dual Check Safety CONNECTION MANUAL (B-64483EN-2)".

Step 2 (Connect with the Safety function by FL-net)

- (1) On the FL-net parameter screen, set the parameters necessary for FL-net communication. The items of FL-net communication parameter necessary for using the Safety function by FL-net are Pa10 (IP ADDRESS), Pa11 (AREA 1 ADDRESS) and Pa12 (AREA 1 SIZE). Please set other FL-net communication parameters if necessary.
 - For details of each item, refer to section A3.2 "FL-net communication parameter".
- (2) On the parameter screen of the CNC, set the Safety parameters of the Safety function by FL-net. For details of each item, refer to section A3.1 "Safety parameters".

A.5.2 Data Exchange Between Common Memory Area 1 and PMC Area

When the Safety function by FL-net is used, the data exchange between common memory area 1 and the PMC area has a different point from a usual FL-net communication.

The node that participates in the Safety function by FL-net uses six first words of common memory area 1 as the safety data. The normal data uses the area since six words of allocated common memory area 1. The safety data is different from the normal data, and the data exchange between the usual PMC areas specified with Pa30 (PMC start address) of the FL-net parameter is not done. Safety data is exchanged by the safety signal area specified by the safety parameter (No.13867 to No.13870, No.13872, No.13874, No.13858, No.134859). The data exchange with a usual PMC area is done only about the normal data.

NOTE

- 1 If the node whose safety function is disabled participates in the network of the safety function, the safety data can be seen in the common memory area 1 of the node whose safety function is disabled.
- 2 Please allocate common memory area 1 in order with small node number regardless of enable/disable of the safety function of each node when you use the Safety function by FL-net.
 - When this order shifts, the data with the PMC area is not correctly exchanged.
- 3 Please specify all the data size that contains the safety data for the data exchange size with the PMC area if the Safety function by FL-net is used and the data between the normal data and PMC common memory area 1 is exchanged.

Example of data exchange

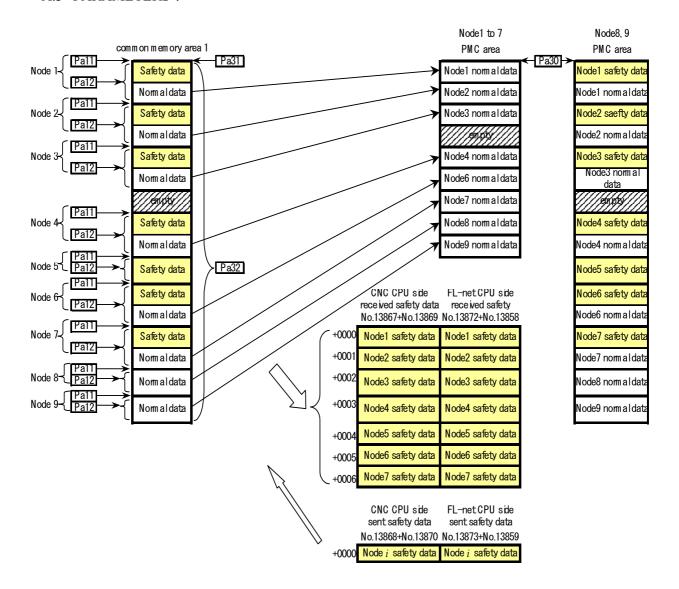
The following figure shows the example of the data exchange in common memory area 1 in the network that consists of nine nodes in total (safety function enabled node 1 to 7, safety function disabled node 8, and 9).

As for the safety function enabled nodes, node 5 communicates only the safety data, and node 1 to 4, 6, and 7 communicate the safety data and the normal data.

At the node 1 to 7, only the normal data that does not contain the safety data is allocated to a usual PMC area, and only the safety data is allocated to the safety signal area.

At the node 8 and 9, the safety data and the normal data are allocated to a usual PMC area.

For the details of the safety parameters and the FL-net communication parameters, please refer to section A.3 "PARAMETERS".



A.5.3 Temporarily Detaching Some Nodes from the Safety function by FL-net

In the process of starting up facilities, there may arise needs to configure the system and operate it with some of the planned nodes being removed. For example, such needs arise if an FL-net network is to be configured by disconnectively some nodes completely from the network and by using the remaining nodes only, and if the only Safety function by FL-net is to be disabled even if nodes are connected to the network.

In such cases, if the safety parameters N01 to N30 (No.13862 to 13865 and No. 13876 to 13879) are changed, it is not possible to communicate normal data (not safety data) unless the values of the FL-net parameters (such as Pa11, 12, 31, and 32) of all nodes are adjusted accordingly. (There occur differences in the positions of normal data in the PMC area.)

To avoid such an inconvenience and temporarily detach some nodes from the Safety function by FL-net, use the temporary detachment parameters (No. 13850 to 13853 and No. 13854 to 13857).

Using the temporary detachment parameters

In accordance with the final system configuration planned, set the FL-net safety parameters and FL-net parameter of all nodes, referring to section A 5.1, "Procedure to follow if using the Safety function by FL-Net".

Afterwards, in each node, please set the corresponding bit of the temporarily detaching parameter to 1. That is, in the temporarily detaching node, please set the bit of own node at the temporarily detaching parameter to 1. And in other nodes that compose the Safety function by FL-net, please set the bit of the temporarily detaching node at the temporarily detaching parameter to 1.

This makes it possible to detach the specific node from the network of the Safety function by FL-net without changing the values of other parameters.

The value of the remote node bit in the PMC area that corresponds to the node for which 1 is set in the temporary detachment parameter becomes 1. Please make the ladder program that ignores the signals transmitted from the node where the remote node bit is 1.

If 1 is set in any of the bits of the temporary detachment parameters, DS alarm 5368 is issued when the power is turned on. To operate the CNC, the alarm must be cleared with the reset button.

A.6 DIAGNOSIS SCREEN

The diagnosis screen of the Safety function by FL-net is a screen to confirm the state of the Safety function by FL-net and the cause when the safety alarm is generated.

Displaying the screen

Procedure

1 Press the function key



- The soft key [DUAL CHECK] is displayed. If the soft key [DUAL CHECK] is not displayed, press the continuous menu key [+] several times.
- 3 Press the soft key [DUAL CHECK] and then, press the soft key [FL-net SAFETY]. Diagnosis for Safety function by FL-net screen is displayed. If the soft key [FL-net SAFETY] is no displayed, press the continuous menu key several times.

4 Use the page keys to switch between the screens.

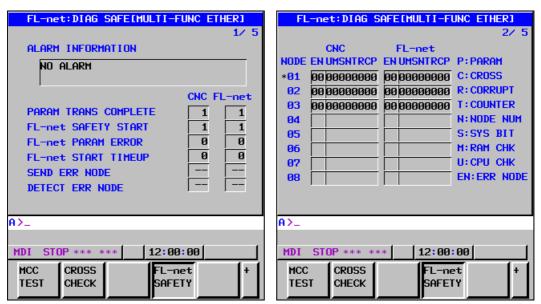
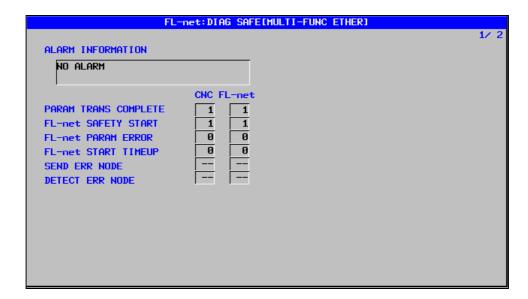


Fig. A.6 (a) Diagnosis screen of the Safety function by FL-net (10.4")

Displaying the screen (15"/19" LCD)

Procedure

- 1 Press the function key
- 2 The soft key [DUAL CHECK] is displayed. If the soft key [FL-net SAFETY] is no displayed, press vertical soft key [NEXT PAGE] several times.
- 3 Press the soft key [DUAL CHECK] and then, press the soft key [FL-net SAFETY]. Diagnosis for Safety function by FL-net screen is displayed. If the soft key [FL-net SAFETY] is no displayed, press vertical soft key [NEXT PAGE] several times.
- -1 4 Use the page keys to switch between the screens.



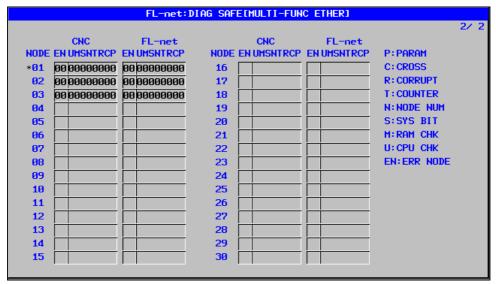


Fig. A.6 (b) Diagnosis screen of the Safety function by FL-net (15"/19")

Display Item (page 1)

In the upper area of the screen, whether the alarm of Safety function by FL-net was issued is displayed. (alarm information)

Under the alarm information, the statuses of Safety function by FL-net on power-up of the system and error node information (send error node and detect error node) when the alarm was issued are displayed. The status detected by CPUs both on the CNC and the FL-net board are displayed side by side.

ALARM INFORMATION

Whether a Safety function by FL-net alarm was issued is displayed.

Alarm status	Message
Normal	NO ALARM
Alarm	SAFETY FUNCTION BY FL-net ERROR (CNC)
Detected by CNC CPU	
Alarm	SAFETY FUNCTION BY FL-net ERROR (FL-net)
Detected by FL-net CPU	
Alarm	SAFETY FUNCTION BY FL-net ERROR (CNC/FL-net)
Detected by both CPU	

STATUS INFORMATION

The status information of the Safety function by FL-net is displayed.

Status information	Description
PARAM TRANS COMPLETE	When the power is turned on, the parameters related to the Safety function by
	FL-net are transferred from the CNC to the FL-net board. Upon completion of
	transfer, the value is changed from 0 into 1.
FL-net SAFETY START	When all nodes that use the Safety function by FL-net participate in the network
	after the power is turned on, the FL-net safety check function starts operation. At
	this time, the value is changed from 0 into 1.
FL-net PARAM ERROR	When the value of a parameter related to the Safety function by FL-net is
	abnormal, the value is changed from 0 into 1.
FL-net START TIMEUP	When the time set in the safety parameter (No. 13874) has elapsed, the FL-net
	safety check function starts operation, regardless of whether all nodes are
	participating in the network. At this time, the value is changed from 0 into 1.

ERROR NODE INFORMATION

Error node information (send error node and detect error node) when the alarm was issued by the Safety function by FL-net is displayed.

Status information	Description
SEND ERR NODE	The node number that sent the error is displayed in two digits.
	"" is displayed when it is normal.
DETECT ERR NODE	The node number that detected the error is displayed in two digits.
	"" is displayed when it is normal.

Display Item (page 2 or later)

Error information included in the data received from other nodes is displayed.

A node number (01 to 30) is displayed at the left end, and "*" is displayed at the head of the own node number.

Error information received from the node number is displayed. The left half is error information that CNC CPU detected, and the right half is error information that FL-net CPU detected. The first two digits (EN) of each error information indicate the node on which an error was detected, and the remaining eight digits indicate the cause of the error.

The meaning of node (EN) where the error was detected is as follows.

Node	EN	Meaning
XX	00	No error is detected.
XX	nn	Node xx detected the alarm at the received data from node nn. (On the screen of the node xx,
		nn is displayed as 00.)

The table below indicates the meanings of errors.

Symbol	Name	Meaning	
Р	Parameter error	The safety parameters of Safety function by FL-net safety function are periodically checked. If an error is detected, this error bit is set to 1.	
С	Cross-check error	The receiving node cross-checks dual safety data. If a mismatch lasts longer than the period of time set in safety parameter (No. 13871), this error bit is set to 1.	
R	Corruption error	When the safety data is transmitted to other nodes, the Safety function by FL-net forwards the value of CRC together. The receiving node calculates the value of CRC from the safety data and collates it. When abnormality is found, this error bit is set to 1.	
Т	Counter error	Data transferred by the Safety function by FL-net to another node includes the value of a counter that counts up at certain intervals. The receiving node monitors the value of the counter. If the value of the counter does not change when the period of time set in the safety parameter (No.13871) has elapsed, this error bit is set to 1. In mode 2, however, even if the value of the counter does not change, this error bit is not set to 1 and the system signal of the safety signals of the relevant node is set to 1.	
N	Node number error	When transferring safety data to another node, the Safety function by FL-net transfers the local node number together with the data. The receiving node checks the node number. If an error is detected, this error bit is set to 1.	
S	System bit error	Bit 7 of the FL-net safety DO data is used by the system. If this bit is set to ON inadvertently, this error bit is set to 1.	
М	RAM check error	When the Safety function by FL-net checks the RAM area related to the safety function, if an error is detected in the RAM area, this error bit is set to 1.	
U	CPU Self check error	The Safety function by FL-net performs the CPU self test for both CPUs on CNC and on FL-net board. If this test shows an abnormality, this error bit is to 1.	

Example when error occurs

For example, in a system consisting of nodes N01, N02, and N03, when nodes 01 and 02 detect a verification error (cross-check error) in the data sent from node 03, the display of 1st page and 2nd page or later is shown below. (On the screen of node 03, the value of DETECT ERR NODE might be 02 instead of 01 depending on the visiting order of the token.)

Page	Node 01	Node 02	Node 03
1 st page	SEND ERR NODE 03	SEND ERR NODE 03	SEND ERR NODE 03
	DETECT ERR NODE 01	DETECT ERR NODE 02	DETECT ERR NODE 01
2 nd page	*01 00 00000000	01 03 00000010	01 03 00000010
or later	02 03 00000010	*02 00 00000000	02 03 00000010
	03 00 00000010	03 00 00000010	*03 00 00000000

A.7 FL-net COMMUNICATION HISTORY

For details of the FL-net COMMUNICATION HISTORY screen, see Section 2.1, "FL-net COMMUNICATION HISTORY" in Part V, "MAINTENANCE".

The following table lists communication history information related to the Safety function by FL-net.

Error message		Meaning and action to be taken	
E-0122	Safety by FL-net is enabled	The Safety function by FL-net is enabled.	
		This is not an error.	
E-0123	Safety by FL-net parameters are	An invalid safety parameter is set for the Safety function by	
	invalid	FL-net. Correct the safety parameter setting.	
	Safety by FL-net reverse parameters	SRAM for the Safety function by FL-net may have been	
E-0124	are invalid	destroyed. Output required data to a text file and clear all	
	aro invalid	SRAM.	
E-0125	Safety by FL-net control flag is invalid	The values of parameters Nos. 13860 and 13866 are different.	
	Salety by 12 hot sometimes hag to invalid	Set the same value in parameters Nos. 13860 and 13866.	
		The values of parameters Nos. 13862 to 13865 are different	
E-0126	Safety by FL-net pair-node is invalid	from the values of parameters Nos. 13876 to 13879. Set the	
		same values in parameters Nos. 13862 to 13865 and	
		parameters Nos. 13876 to 13879.	
E-0127	Safety by FL-net DI signal(A) is invalid	The value of parameter No. 13867 or 13869 is out of range.	
		Set an appropriate value in parameter No. 13867 or 13869.	
E-0128	Safety by FL-net DO signal(A) is	The value of parameter No. 13868 or 13870 is out of range.	
	invalid	Set an appropriate value in parameter No. 13868 or 13870.	
		The size of common memory area 1 is insufficient. To use the	
E-0129	Size of Area1 is not enough	Safety function by FL-net, set at least 6 words as the size of	
		common memory area 1.	
	0.64 1.51 1.5	An error was detected by a periodic check for the safety	
E-012A	Safety by FL-net Parameter error is	parameters of the Safety function by FL-net.	
	detected	When this error occurs, a software problem or hardware failure	
		may occur.	
E-0136	Safety by FL-net pair-node of	The values of parameters Nos. 13850 to 13853 and 13854 to	
E-0136	temporary detaching is invalid	13857 are different. Set the same value in parameters Nos.	
		13850 to 13853 and 13854 to 13857	
E-0137	Safety by FL-net DI signal(B) is invalid	The value of parameter No. 13872 or 13858 is out of range.	
	Safaty by El not DO signal/P\ is	Set an appropriate value in parameter No. 13872 or 13858. The value of parameter No. 13873 or 13859 is out of range.	
E-0138	Safety by FL-net DO signal(B) is invalid	Set an appropriate value in parameter No. 13873 or 13859 is out of range.	
	Safety by FL-net System bit error is	Bit 7 of the transmit safety signal for the Safety function by	
E-0139	1		
	detected	FL-net is set to ON. This bit is reserved. Do not use the bit.	

Error message		Meaning and action to be taken	
	S .	An error was detected by a RAM check for the Safety function	
	Safety by FL-net RAM check error is	by FL-net.	
E-013A	detected	When this error occurs, a software problem or hardware failure	
		may occur.	
		An error was detected by a CPU Self test for the Safety	
	Safety by FL-net CPU check error is	function by FL-net.	
E-013B	detected	When this error occurs, a software problem or hardware failure	
	detected	may occur.	
	Safety by FL-net self-node is invalid	The value set in parameter No. 13861 [999] is out of range.	
E-020B	[999]	Set a value between 1 and 30 in parameter No. 13861.	
	[[999]		
	Outside the Filmont No. 10 and	An error was detected in the node number [999] in the data	
E-020C	Safety by FL-net Node number error	received from the remote node of the Safety function by	
	is detected [999]	FL-net.	
<u> </u>		The node [999] may not participate in the network.	
		An error was detected in the node number [9999] in the data	
		received from the remote node [999] of the Safety function by	
	Safety by FL-net Node number error	FL-net.	
E-0501	is detected [999, 9999]	When the node number is [0], node [999] may not participate in	
		the network.	
		When the node number is not [0], a software problem or	
		hardware failure may occur.	
		An inconsistency between the safety signals from two paths	
E-020D	Safety by FL-net Cross-check error is	that were received from the remote node [999] of the Safety	
E-020D	detected [999]	function by FL-net lasted longer than the period set in	
		parameter No. 13871.	
		An inconsistency between the safety signals from two paths	
		that were received from the remote node [999] of the Safety	
E-0502	Safety by FL-net Cross-check error is	function by FL-net lasted longer than the period set in	
	detected [999, 9999]	parameter No. 13871. [9999] is the exclusive OR of the	
		safety signals from the two paths.	
		The counter value of the data received from the remote node	
	Safety by FL-net Counter error is	[999] of the Safety function by FL-net does not change for at	
E-020E	detected [999]	least the period set in parameter No. 13871.	
		The node [999] may be disconnected from the network.	
		An error [9999] was detected in the counter value of the data	
		received from the remote node [999] of the Safety function by	
		FL-net.	
	Safety by FL-net Counter error is	When the error value is not [0], the token monitoring time	
E-0503		setting may not be appropriate. Correct the token monitoring	
_ 0000	detected [999, 9999]	time according to the instructions described in Subsection	
		A.1.1, "Mode of the Safety Function by FL-net".	
		When the error value is [0], a software problem or hardware	
		failure may occur.	
	Safaty by El not start timer is invalid		
E-0305	Safety by FL-net start timer is invalid	The value [9999] of parameter No. 13874 is out of range. Set a	
	[9999]	value within the range.	
	O-f-t-h- El m-t-detected and	The detection of the error [9999] in the remote node [999] of	
E-0500	Safety by FL-net detected error is	the Safety function by FL-net was detected.	
	received [999, 9999]	Check details in the diagnosis screen of the Safety function by	
		FL-net.	
		The CRC value in the data received from the remote node	
		[999] of the Safety function by FL-net is different from the CRC	
E-0600	Safety by FL-net Corruption error is	value calculated at the receive side [9999, 9999] and the	
	detected [999, 9999, 9999]	corruption of the receive data was detected.	
		When this error occurs, a software problem or hardware failure	
		may occur.	

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B-64163EN/04 REVISION RECORD

REVISION RECORD

Edition	Date	Contents
04	Sep., 2015	Applied to Series 0 <i>i</i> -F
		Correction of errors
03	Mar., 2014	Applied to Power Motion <i>i</i> -A
		Addition of mode 1 and mode 2 of the Safety function by FL-net
		Addition of warnings to "Safety Precautions"
		Correction of errors
02	Nov., 2010	Applied to Series 30i/31i/32i/35i-B
		Addition of safety functions using FL-net
		Correction of errors
01	Jan., 2009	Changing of manual name and specification number
		New: FANUC Series 30i/300i/300is, 31i/310i/310is, 32i/320i/320is-MODEL A (FL-net Board)
		CONNECTION MANUAL (B-64163EN)
		Old: FANUC FL-net Board For FANUC Series 30i/300i, 31i/310i, 32i/320i-MODEL A
		OPERATOR'S MANUAL (B-64164EN)

