TABLE OF CONTENTS

1 GENERAL

This manual describes the FL-net functions of the FANUC Series 30*i*/300*i*, 31*i*/310*i*, 32*i*/320*i* -A.
This chapter explains the organization of this manual and applied models.

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

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*-A	Series 30*i*-A	30*i*-A	30*i*-A
FANUC Series 300*i*-A	Series 300*i*-A	300*i*-A	
FANUC Series 31*i*-A	Series 31*i*-A	31*i*-A	31*i*-A
FANUC Series 31*i*-A5			
FANUC Series 310*i*-A	Series 310*i*-A	310*i*-A	
FANUC Series 310*i*-A5			
FANUC Series 32*i*-A	Series 32*i*-A	32*i*-A	32*i*-A
FANUC Series 320*i*-A	Series 320*i*-A	320*i*-A	

1.3 RELATED MANUALS

The related manuals are shown below.
See also the following manuals together with this manual.

Related manuals of FANUC Series 30*i*/300*i*, 31*i*/310*i*, 32*i*/320*i* -A

Manual name	Specification number
DESCRIPTIONS	B-63942EN
CONNECTION MANUAL (HARDWARE)	B-63943EN
CONNECTION MANUAL (FUNCTION)	B-63943EN-1
USER'S MANUAL (Common to Lathe System/Machining Center System)	B-63944EN
USER'S MANUAL (For Lathe System)	B-63944EN-1
USER'S MANUAL (For Machining Center System)	B-63944EN-2
MAINTENANCE MANUAL	B-63945EN
PARAMETER MANUAL	B-63950EN

2 OVERVIEW OF FL-net FUNCTIONS

This chapter describes the specifications of FL-net functions.

2.1 WHAT IS THE FL-net

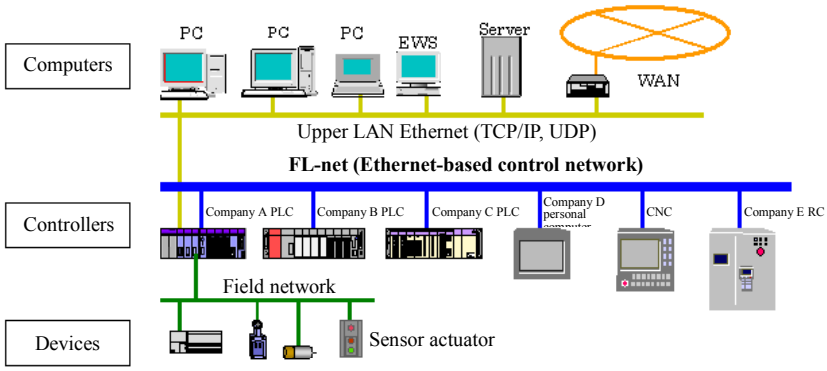
The FL-net is a control-level, open FA network standardized by the FA Open Systems Promotion Forum (FAOP) in the Manufacturing Science and Technology Center, which is an outside organization of the Ministry of Economy, Trade and Industry.
The FL-net can interconnect various types of FA controllers such as programmable controllers (PLCs) and computer numerical controllers (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:

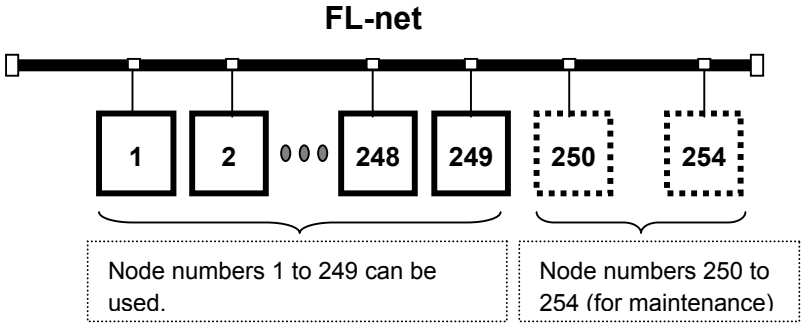
Multi-vendor environment using an open network

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.



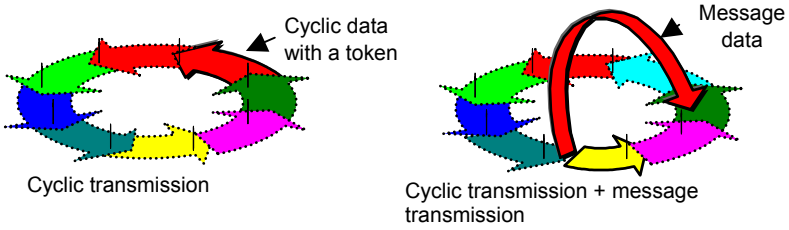
Large-scale network

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



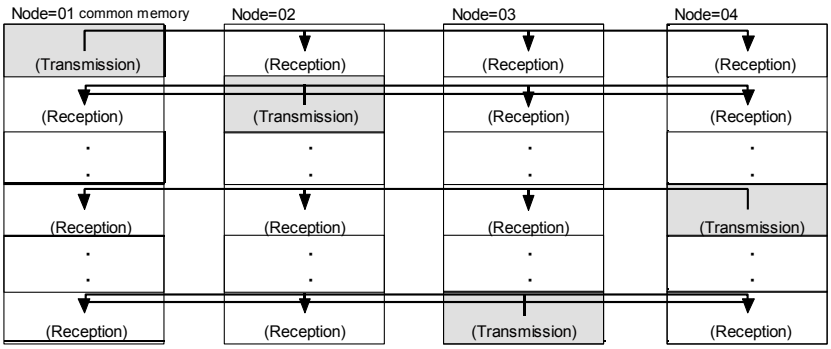
Two communication functions available according to the application

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).

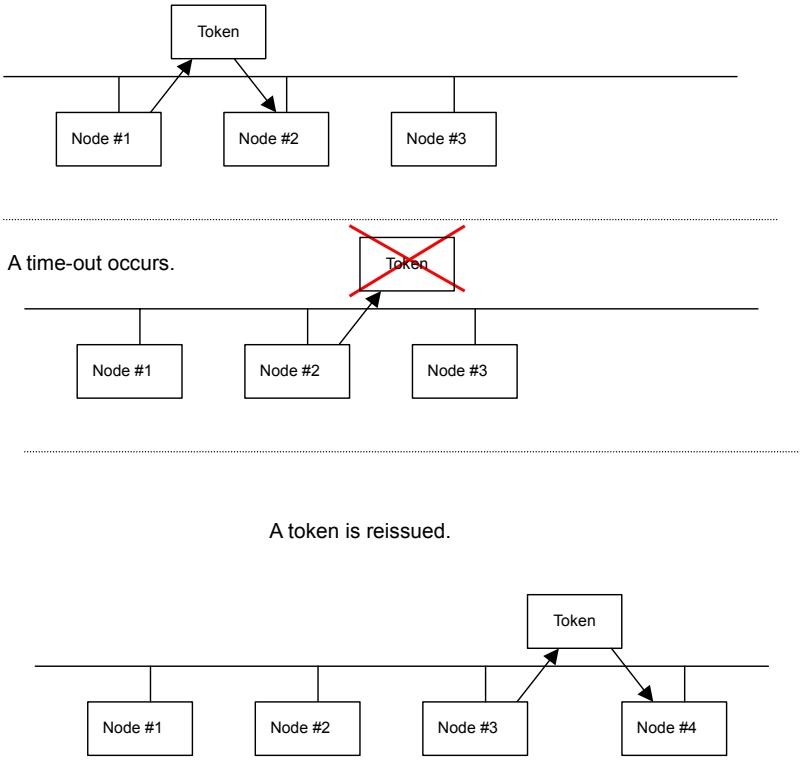
NOTE

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.



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.

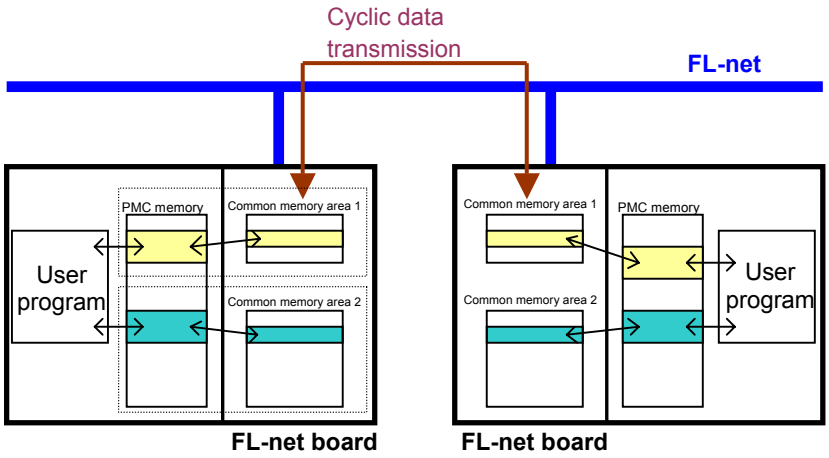
NOTE

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

2.2 FANUC FL-net FUNCTIONS

Cyclic data transmission

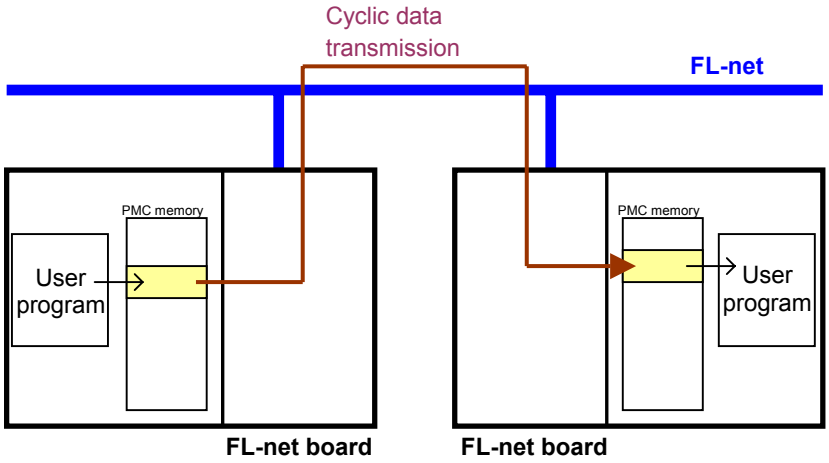
With the FANUC FL-net, part of large-capacity common memory can be allocated in the PMC E area, R area, or D area to allow the user program to read and write data in the FL-net common memory.



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 "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 an 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 "II. Specification."

NOTE

The FL-net communication standards have two versions: version 1.00 and version 2.00. These versions cannot be used together.
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.

II. SPECIFICATION

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 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 output destination of status information about the local node	Pa20
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 network	Pa21

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

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

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 area, R area, or 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 R area or 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, or D area that serves as the interface used by the message transmission client function	Pa50
Interface size	Maximum allowable size of the interface area used above	Pa51
Server function interface	Start address of the PMC E, R, or D area that serves as the interface used by the message transmission server function	Pa52
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.

2 CYCLIC TRANSMISSION

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

2.1 COMMON MEMORY AREA 1 CYCLIC TRANSMISSION

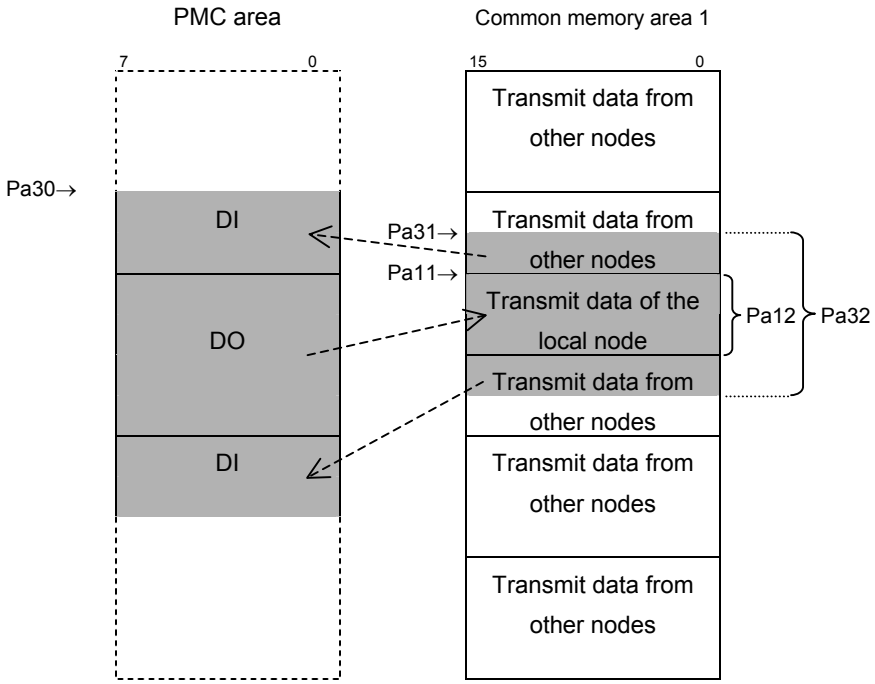
Those areas of common memory area 1 that are to be used for data exchange can be allocated in the PMC E area or R are in direct image.

Related parameters

(1) Pa11: 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 "III. SETTING".

2.2.1 Simultaneous DI and DO Area Allocation

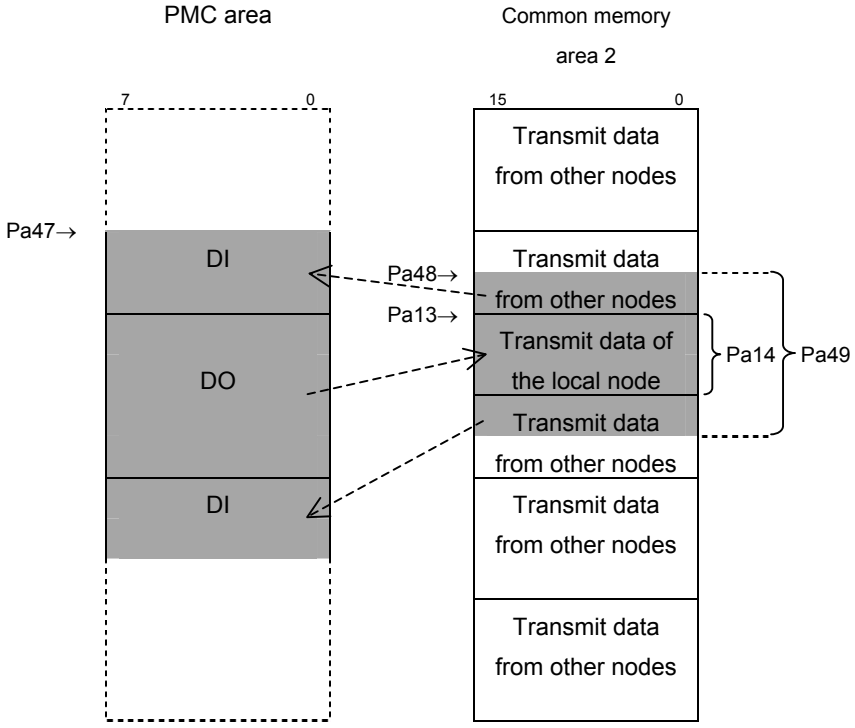
Areas of common memory area 2 that are to be used for data exchange can be allocated to the E, R, or D area of the PMC just as they are allocated in common memory.

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

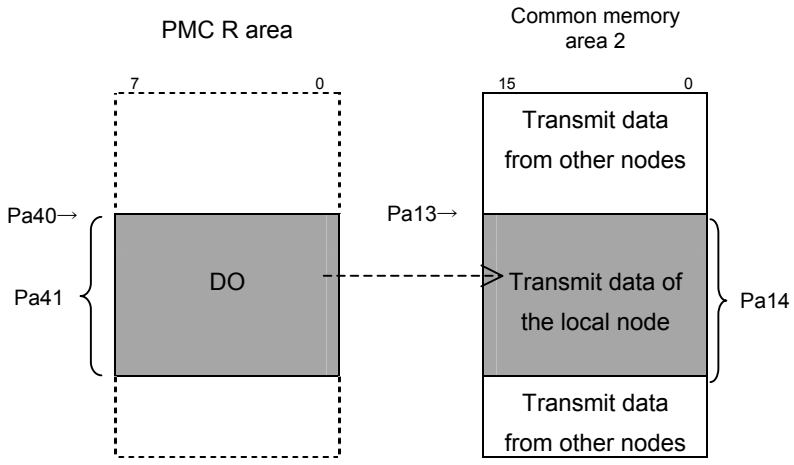
In data exchange of DO data in common memory area 2, data can be shifted by an offset when the data is transferred from the PMC area to common memory area in case the PMC area that can be allocated is smaller than the common memory area of the local node.

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.

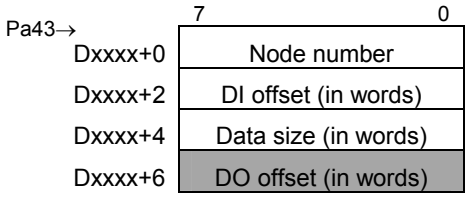
Related parameters

(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:



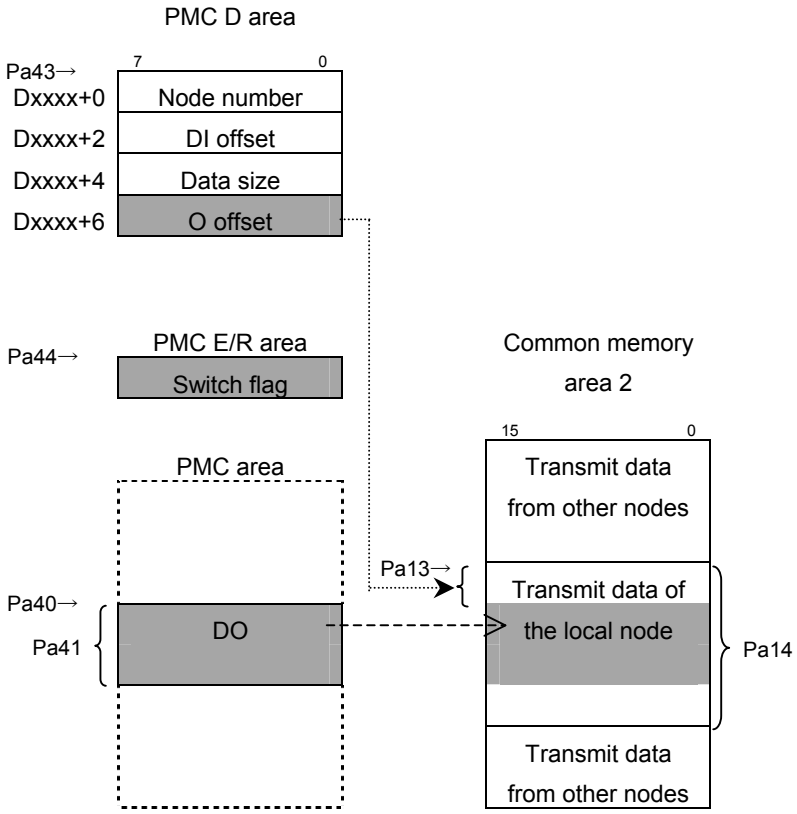
NOTE
The parts except the shaded part are not used by this function.

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



NOTE

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

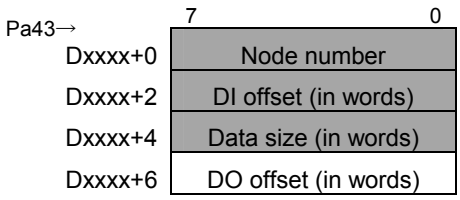
The user program switches to the DI data area for a target node and reads the DI data for the node. By specifying a node number, the DI data from the node and status information of the node can be read.

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:

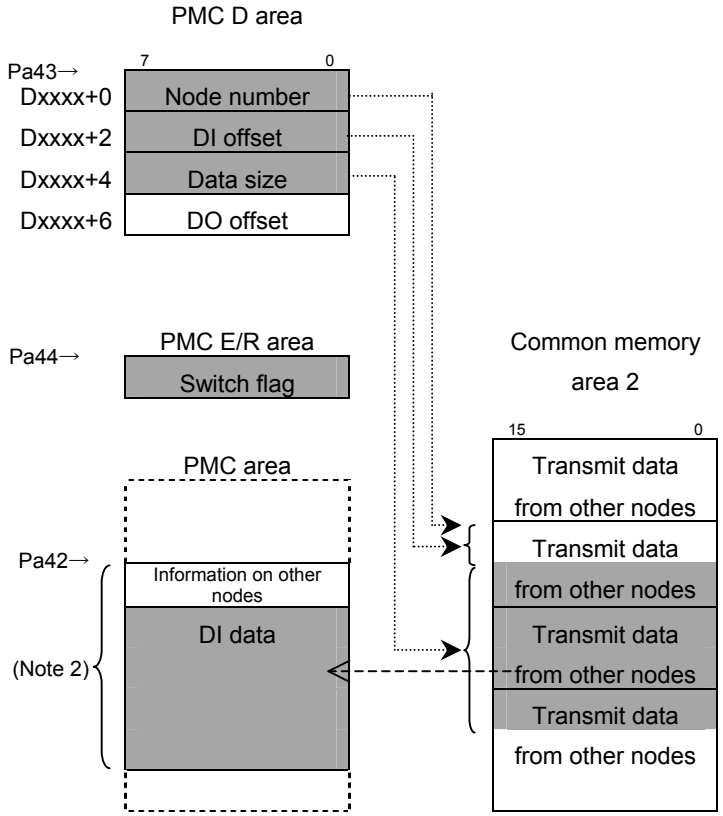
(1) The user program specifies the following in the PMC D area specified by Pa43 (allocation condition setting (for DI/DO)):
- Node number
- DI offset
- Data size

(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.



NOTE

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.

NOTE

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.

5 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.

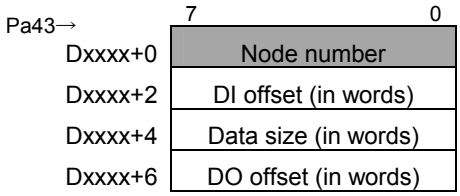
Related parameters

(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:



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

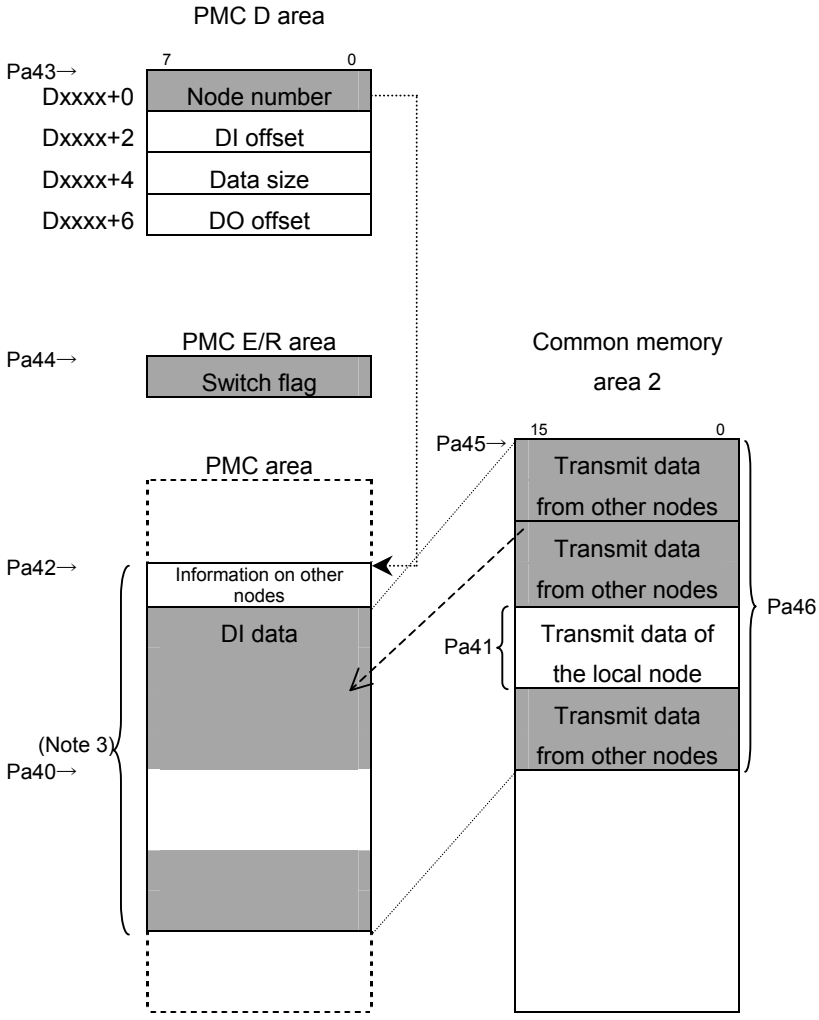
Procedure

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.



NOTE

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.

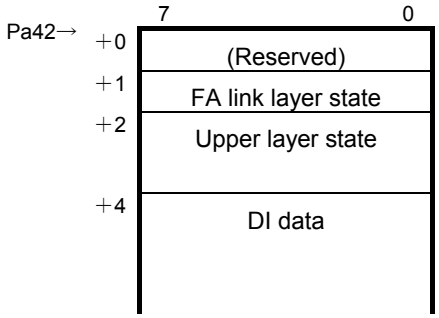
2 Node information can also be changed dynamically with static DI data allocation of common memory area 2. When node information is changed, however, the DO offset is also changed. To change only the node information, carefully change the setting not to change the DO offset.

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

	7	6	5	4	3	2	1	0
+1	<1>	<2>	<3>	<4>	(Reserved)		<5>	<6>

<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)

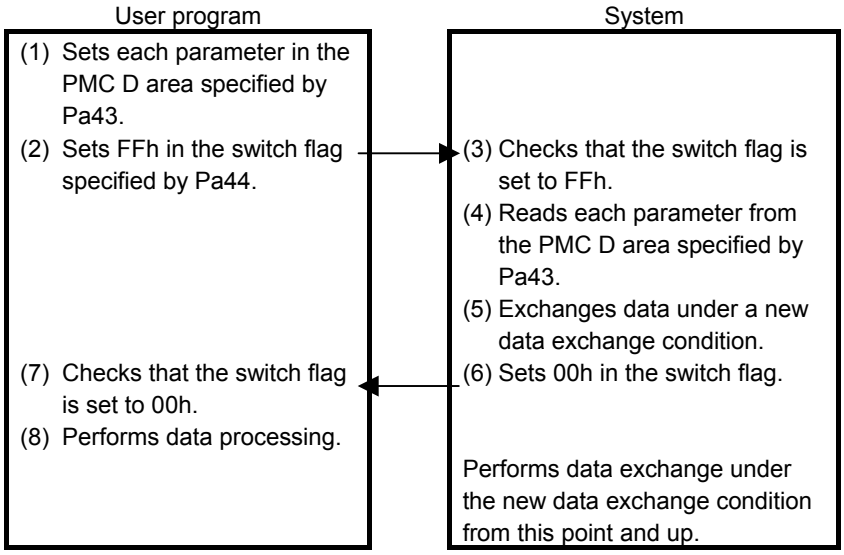
<2>, <3> U_ERR
00: NORMAL
01: WARNING
1x: ALARM

<1> RUN/STOP
0: STOP
1: RUN

NOTE
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

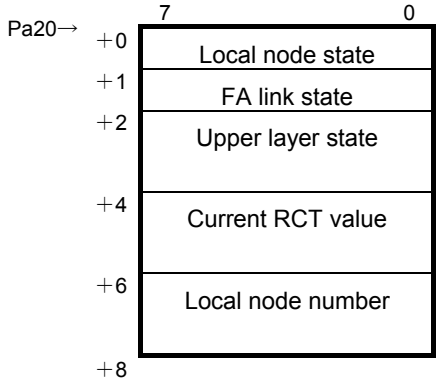
The state of the local node can be monitored by allocating the 8-byte state code of the local node in the PMC E area or the PMC R area.

Related parameters

<1> Pa20: Local node status

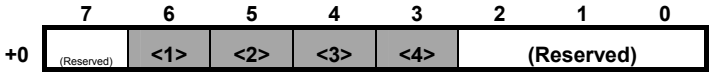
Data structure

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

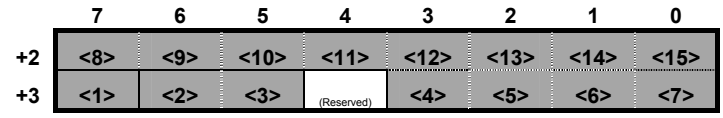
	7	6	5	4	3	2	1	0
+1	<1>	<2>	<3>	<4>	(Reserved)		<5>	<6>

<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



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

Item	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

	7	6	5	4	3	2	1	0
+6	<1>	<2>	<3>	<4>	<5>	<6>	<7>	<8>
+7	(Reserved)							

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

Table 2-5 Local node number

Item	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) Pa20: 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

Pa21→	7	6	5	4	3	2	1	0
+0	Node 7	Node 6	Node 5	Node 4	Node 3	Node 2	Node 1	(Reserved)
+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 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.

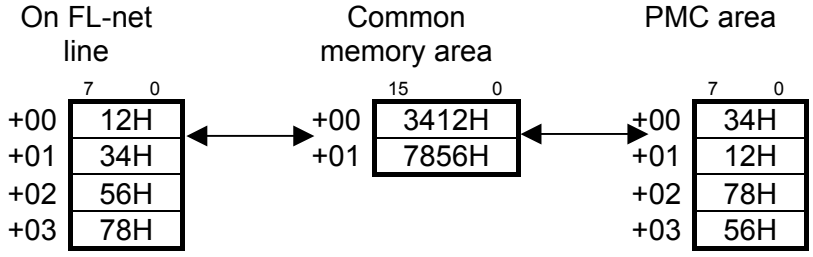
NOTE

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

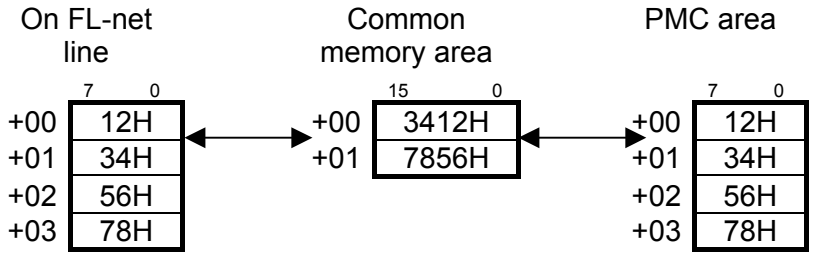
2.4 BYTE LIST OF CYCLIC DATA

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

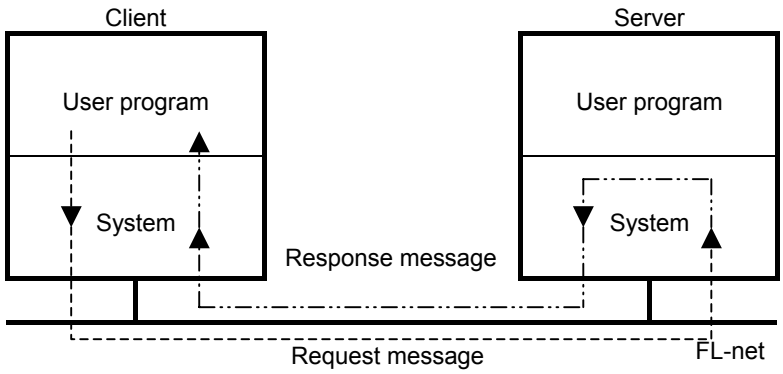
Message service item	Client function	Server function
Byte block read	○	○
Byte block write	○	○
Word block read	○	○
Word block write	○	○
Network parameter read	-	○
Network parameter write	-	○
Stop command	-	-
Start command	-	-
Profile read	-	○
Log data read	-	○
Log data clear	-	○
Transparent message	○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

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

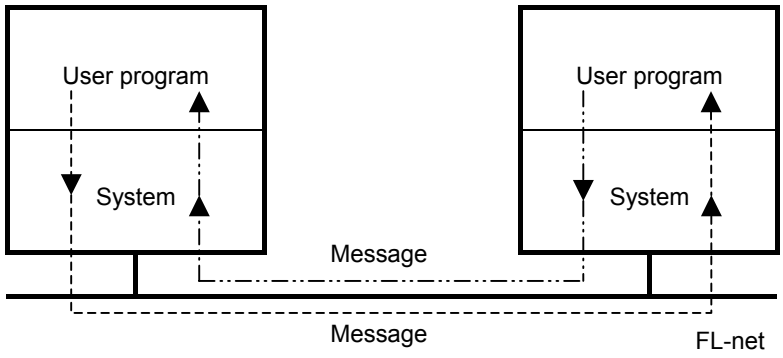
3.2 OVERVIEW OF THE MESSAGE TRANSMISSION FUNCTION

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).



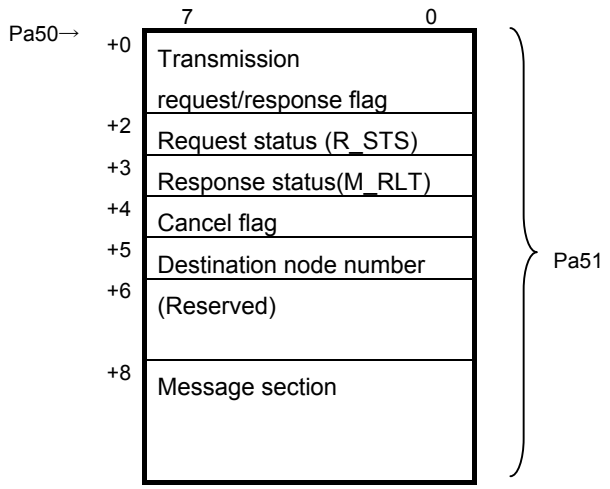
A transparent message can be handled freely by the user program without making a client/server distinction. So, two interface areas are required: one for transmission and the other for reception. As the transmit interface area, the interface area set by Pa50 (client function interface) used with a client 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 request/response flag (Note 1, 2)	Flag set by the user program to request message transmission, and set by the CNC to post the reception of a response message or the occurrence of an error. 0001h: The user program requests message transmission. 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.	U→S S→U
Request status (R_STS)	Status for checking whether a request message has been transmitted 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	S→U
Response status (M_RLT)	Status for checking a response message 00h: Normal response 01h: Abnormal response 02h: Server service not supported	S→U
Cancel flag (Note 3)	Set a value other than 0 for service cancellation before a message 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.	U→S
Destination node number	Message transmission destination node number	U→S
Message section	Area for setting a message transaction code, parameters, and so forth. The information set in this area depends on the type of message transmission service.	U→S S→U

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

2 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

Error code		Description
1st byte	2nd byte	
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.

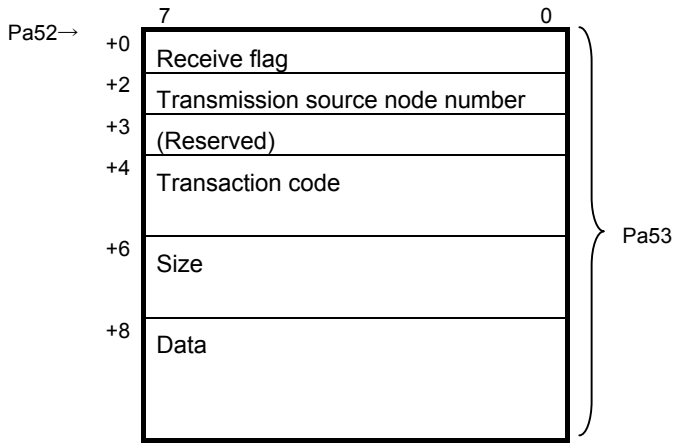


Table 3-4 Receive Interface Items

Interface item	Description	Direction
Receive flag (Note 3)	Flag used by the system to post the reception of a message to the user program. 0001h: The system posts the reception of a message. 0000h: The user program posts the completion of message receive processing.	S→U U→S
Transmission source node number	Message transmission source node number	S→U
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

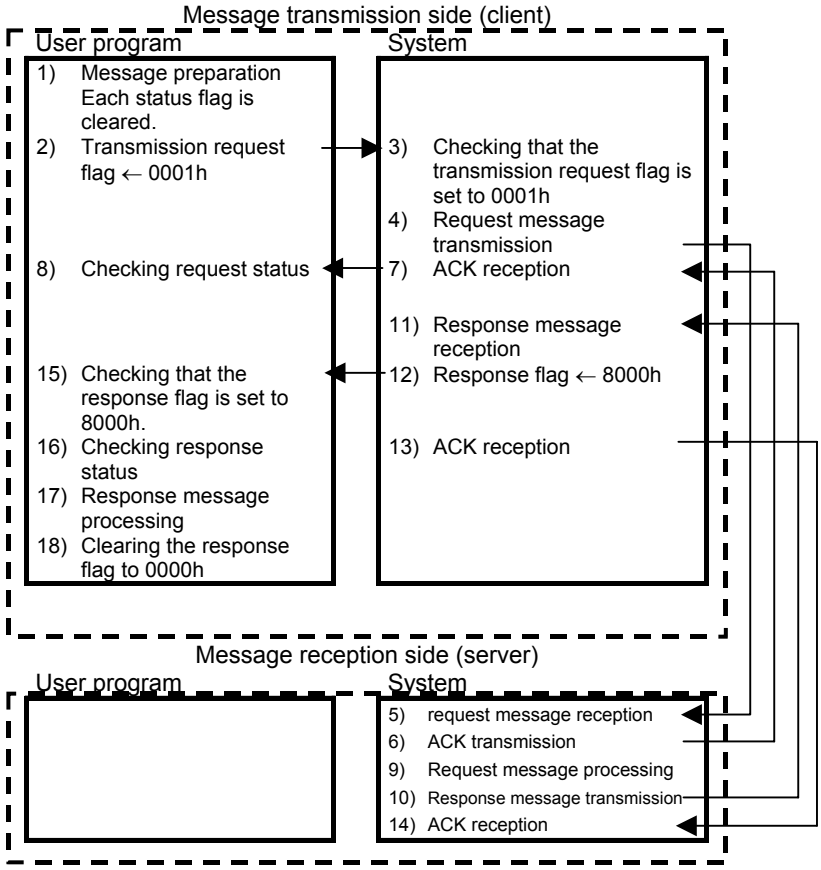
NOTE

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

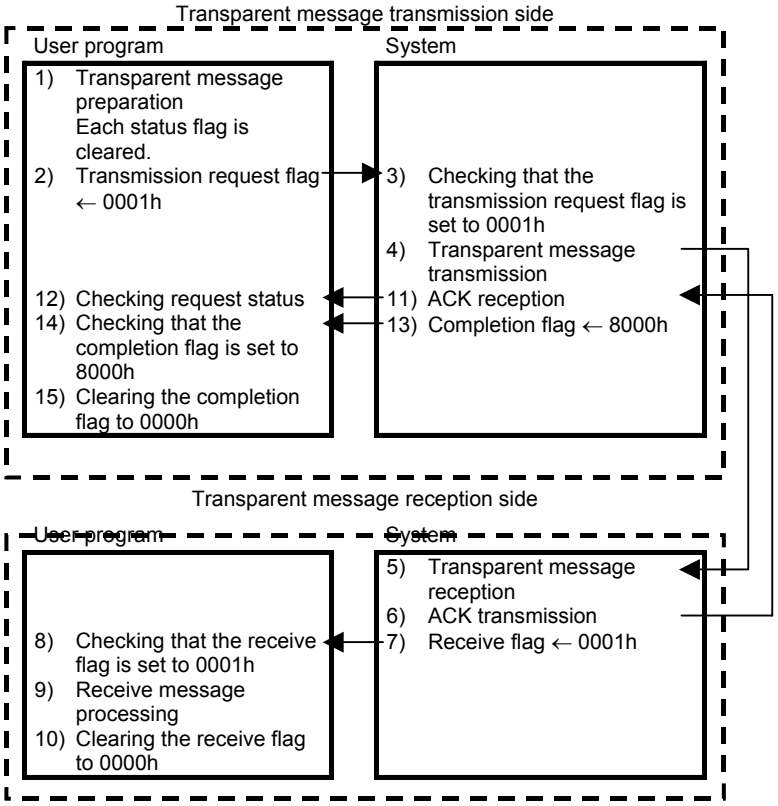
This section explains how the user program exchanges data with the system when messages are transmitted or received through message transmission.

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

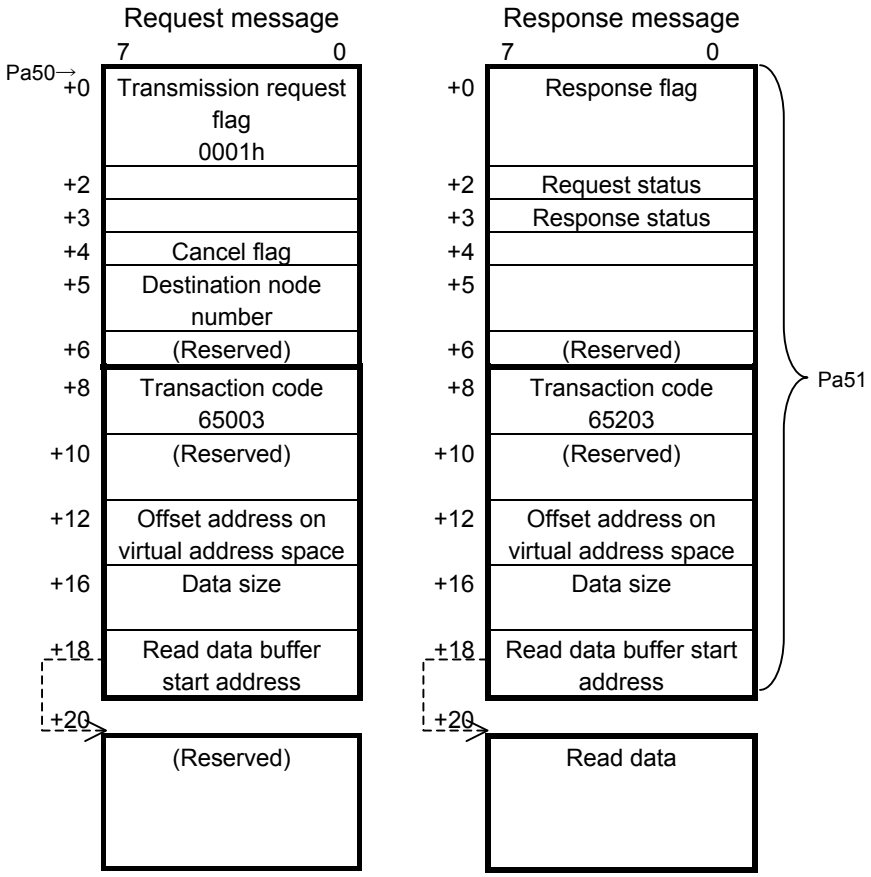


Table 3-5 Byte Block Read Interface Items

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

NOTE
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.