Instruction Manual

FA-M3

DeviceNet Scanner Module

IM 34M6H28-01E

YOKOGAWA
Yokogawa Electric Corporation

IM 34M6H28-01E
1st Edition

Applicable Product:

FA-M3 Range-free Multi-Controller
Model: F3LD01-0N
Name: DeviceNet Scanner Module

The document number and document model code for this manual are as follows:

Document No.: IM 34M6H28-01E
Document Model Code: DOCIM

Refer to the document number in all communications; also refer to the document number or the document model code when purchasing additional manuals.

Media No. IM 34M6H28-01E (CD) 1st Edition : Feb. 1999 (YK)

◆ Important

■ About This Manual

(1) This manual should be passed on to the end user.

(2) Before using the module, read this manual completely to get a thorough understanding of the module.

(3) This manual explains the functions contained in this product, but does not warrant that those will suit the particular purpose of the user.

(4) Under absolutely no circumstances may the contents of this manual be transcribed or copied, in part or in whole, without permission.

(5) The contents of this manual are subject to change without prior notice.

(6) Every effort has been made to ensure accuracy in the preparation of this manual. However, should any errors or omissions come to the attention of the user, please contact the nearest Yokogawa Electric representative or sales office.

■ Safety Precautions when Using/Maintaining the Product

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

CAUTION

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

⏚

Protective ground terminal

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

⏚

Function ground terminal

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

~ Indicates alternating current.

⎓ Indicates direct current.

(1) The following symbols are used only in the instruction manual.

WARNING

Indicates that the operator must refer to the instructions in this manual in order to prevent the instrument (hardware) or software from being damaged, or a system failure from occurring.

CAUTION

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

TIP

Gives information that complements the present topic.

SEE ALSO

Identifies a source to which to refer.

(2) For the protection and safe use of the product and the system controlled by it, be sure to follow the instructions and precautions on safety stated in this manual whenever handling the product. Take special note that if you handle the product in a manner other than prescribed in these instructions, safety cannot be guaranteed.

(3) If separate protection and/or safety circuits for this product or the system which is controlled by this product are to be installed, ensure that such circuits are installed external to the product.

(4) If component parts or consumables are to be replaced, be sure to use parts specified by the company.

(5) Do not attempt to make modifications or additions internal to the product.

■ Force Majeure

(1) Yokogawa Electric Corporation (hereinafter referred to as Yokogawa Electric) makes no warranties regarding the product except those stated in the WARRANTY that is provided separately.

(2) Yokogawa Electric assumes no liability to any party for any loss or damage, direct or indirect, caused by the user or any unpredictable defect of the product.

■ Software Supplied by the Company

(1) Yokogawa Electric makes no other warranties expressed or implied except as provided in its warranty clause for software supplied by the company.

(2) Use the relevant software with one specified computer only. You must purchase another copy of the software for use with each additional computer.

(3) Copying the software for any purpose other than backup is strictly prohibited.

(4) Store the floppy disks (originals) of this software in a safe place.

(5) Reverse engineering, such as decompiling of the software, is strictly prohibited.

(6) No portion of the software supplied by Yokogawa Electric may be transferred, exchanged, or sublet or leased for use by any third party without prior permission by Yokogawa Electric.

■ General Requirements for Using FA-M3 Controllers

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

- Securely tighten screws:
  - Securely tighten module mounting screws and terminal screws to avoid problems such as faulty operation.

- Securely fasten connectors of interconnecting cables:
  - Securely fasten connectors of interconnecting cables, and check them thoroughly before turning on the power.

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

- Ground FA-M3 controllers to an independent Japanese Industrial Standard (JIS) Class 3 Ground:
  - Avoid grounding the FG terminal of the FA-M3 controller to the same ground as high-voltage power lines. Ground the terminal to an independent JIS Class 3 ground (ground resistance up to 100 Ω).

- Observe countermeasures against noise:
  - When assigning inputs/outputs, the user should avoid locating AC-supplied I/O modules in the vicinity of the CPU module.

- Keep spare parts on hand:
  - Stock up on maintenance parts, including spare modules, in advance.

- Discharge static electricity before operating the system:
  - Because static charge can accumulate in dry conditions, first touch grounded metal to discharge any static electricity before touching the system.

- Never use solvents such as paint thinner for cleaning:
  - Gently clean the surfaces of the FA-M3 controllers with a piece of soft cloth soaked in water or a neutral detergent.
  - Do not use solvents such as paint thinner for cleaning, as they may cause deformation, discoloration, or malfunctioning.

- Avoid storing the FA-M3 controllers in places with high temperature or humidity:
  - Since the CPU module has a built-in battery, avoid storing it in places with high temperature or humidity.
  - Since the service life of the battery is drastically reduced by exposure to high temperatures, so take special care (storage temperature can be from -20° to 75°C).

- Always turn off the power before installing or removing modules:
  - Turn off power to the power supply module when installing or removing modules, otherwise damage may result.

- When installing ROM packs and changing switch settings:
  - In some modules you can remove the right-side cover and install ROM packs or change switch settings. While doing this, do not touch any components on the printed-circuit board, otherwise components may be damaged and modules fail.

◆ Introduction

■ Overview of the Manual

This is the instruction manual of the DeviceNet Scanner Module of the FA-M3 Multi-controller.

■ Other Instruction Manuals

Consult the following FA-M3 manuals as necessary when using this module:

- Sequence CPU Instruction Manual – Functions (IM 34M6P12-02E)
- Sequence CPU Instruction Manual – Instructions (IM 34M6P12-03E)
- Sequence CPU Instruction Manual (for F3FP36) (IM 34M6P22-01E)
- Personal Computer Link Command Module Instruction Manual (IM 34M6P41-01E)
- Ladder Diagram Support Program M3 Instruction Manual (IM 34M6Q13-01E)
- BASIC CPU Module and BASIC Programming Tool M3 Instruction Manual (IM 34M6Q22-01E)

■ Copyright/Trademarks

- DeviceNet is a registered trademark of ODVA (Open DeviceNet Vendor Association, Inc.).
- COMBICON is a registered trademark of Phoenix Contact Co., Ltd.
- All the product names and company names mentioned in this manual are the trademarks or registered trademarks of their respective companies.
- The copyright of the software loaded in this module belongs to SST Inc. (S-S Technologies).

■ Terminology Used

- This manual uses terminology in the DeviceNet Specification published by ODVA.

Blank Page

FA-M3
DeviceNet Scanner Module

IM 34M6H28-01E 1st Edition

CONTENTS

1. Overview

The F3LD01-0N DeviceNet Scanner Module (hereafter referred to as this module) is a module for connecting to DeviceNet.

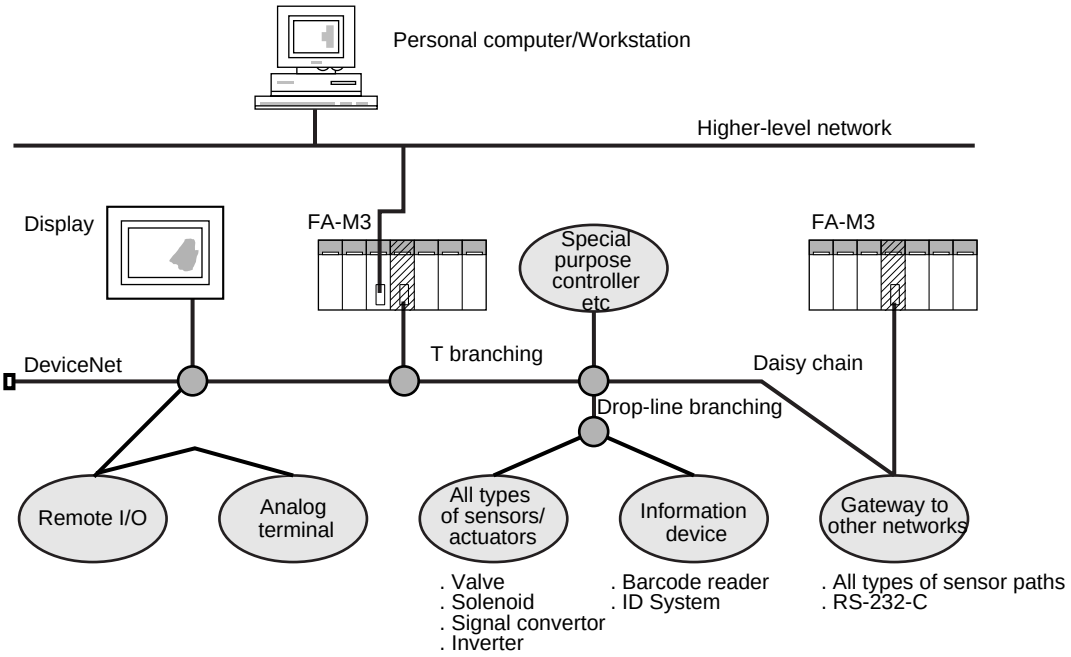
■ What is a DeviceNet?

DeviceNet is an open field network and is mainly used in manufacturing equipment or in production lines. In a multi-vendor environment, a wide range of devices, ranging from sensors and actuators to advanced equipment which is compatible with DeviceNet, can be connected.

As the specifications of DeviceNet are open and licensing is not required, many manufacturers, both in Japan and overseas, are developing new devices which, when connected with DeviceNet, allow exchanges of I/O data. Overseas service has also become possible. Further, many types of I/O communications and message communications are supported. Decentralized control with multi-master systems is also possible now.

A maximum of 64 machines (masters + slaves) can be connected to DeviceNet. The maximum data rate is 500 kbps and the maximum trunk line distance is 500 m (when the data rate is 125 kbps). Thus, with these special characteristics of high connectability to many stations, a high data rate and a long distance, DeviceNet can be used in a wide range of applications. Wiring can be done effectively by freely combining the T-branching method and daisy chain method, with no wastage.

Each equipment type is defined by a device profile (specifications which define the operation of the equipment). Equipment is built according to these profiles, thus resulting in the compatibility and interchangeability of the equipment.



* : Mass flow controller, temperature control and monitoring guage, robot controller, etc.

F0101.EPS

Figure 1.1 Example of a DeviceNet Connection

■ Features of this module

This module has the master functions of DeviceNet. Using this module, you can exchange I/O data periodically with other connected devices and exchange message data like parameters and status.

The following are the main features of this module.

- A maximum of 63 slave machines can be connected.
- Data rate is 125/250/500 kbps.
- Supports an I/O communication function which regulates and controls I/O data of 16,000 points (input 8,000 points; output 8,000 points). Anything from small-scale I/O data to multiple-point analog data and information data can be handled in real time.
- A message communication function is supported. If required, the exchange of message data like parameters and status is also possible. Therefore, the time required for system configuration is reduced, and maintenance as well as calibration becomes easier.
- Operation in a multi-master environment with decentralized control is also possible.
- 16 modules of this kind can be installed in a single FA-M3. It is easy to manage multiple-point I/O data and to add new lines.
- The transmission time interval of I/O data can be set for every 5 msec. Thus, it is compatible even with a slow-responding slave.

2. Overview of DeviceNet

An explanation of the functions which are supported by this module and which are related to the DeviceNet specifications is given here.

SEE ALSO

1) For details on the DeviceNet specifications, see also to the DeviceNet Specifications Manual, published by ODVA (Open Device Net Vendor Association, Inc.). ODVA is a non-profit company, formed by vendors with the objective to promote and manage the DeviceNet specifications.
2) For product information of third-party products required for network configuration, refer to Appendix 2, “Information on Third-party Products.”

2.1 Network Configuration

The network configuration of DeviceNet is given below.

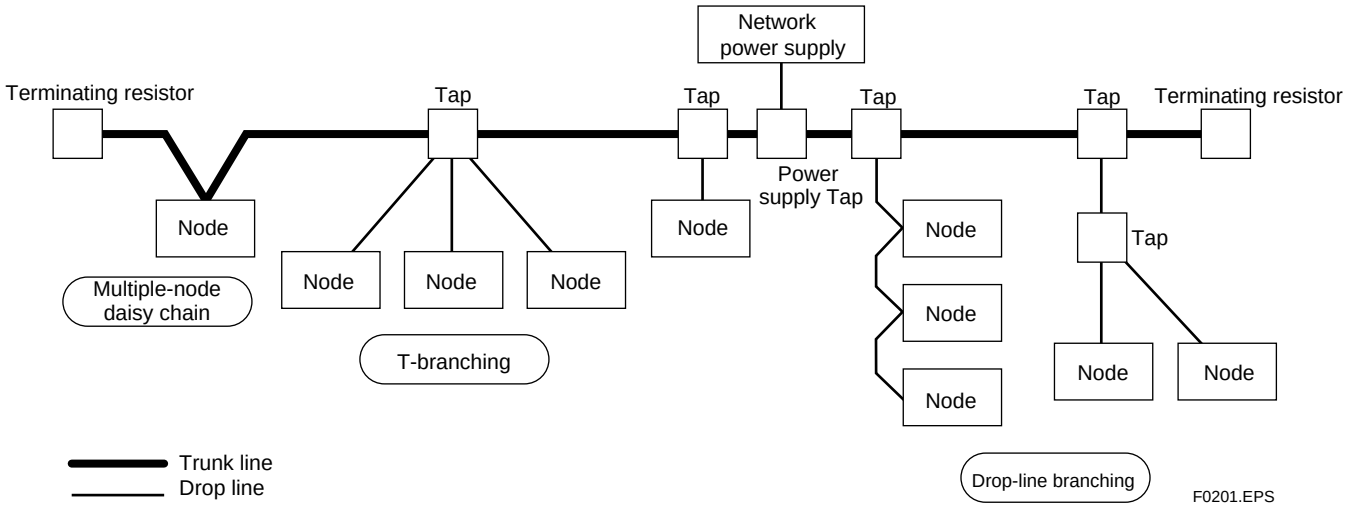


Figure 2.1 Network Media Topology

The elements of the network configuration are explained below.

- Node

A device (equipment) that is connected to DeviceNet is called a node. A node can be either a master, which collects and distributes data, or a slave, which outputs and inputs data according to the instructions received from the master.

There are no restrictions on the arrangements or maximum number of devices that can be connected to the master of each of the slaves. A maximum of 64 devices can be freely connected (without arrangement restrictions).

An address from 0 to 63, called MACID (Media Access Control Identifier), is assigned to each node. In this manual, these addresses are called node addresses.

- Cable

  Five special purpose cables (2 signal lines, 2 power supply lines, and 1 SHIELD cable) are used. There are 2 types of cables, namely, thick cables and thin cables .

- Trunk Line

  Terminating resistors are attached at both ends of this cable. Both thick and thin cables can be used. They can also be used together.

  For a thin cable, the maximum network length is 100 m. In the case of thick cables, the length limits depends on the data rate (see Table 2.1).

- Drop line

  This is a branch cable from the trunk line and normally, thin cables are used for this purpose.

  The length (the distance from the point of branching from the trunk line to the end of the drop line) of a drop-line cable should be 6 m or less. (There are no minimum distance limits.) Generally, the total drop-line length depends on the data rate (see Table 2.1).

Table 2.1 Maximum Cable Length of DeviceNet

Data rate	Maximum cable length of trunk line		Length of drop line	
	Only thick cables used	Only thin cable used	Maximum	Cumulative
125 kbps	500 m	100 m	6 m	156 m
250 kbps	250 m			78 m
500 kbps	100 m			39 m

T0201.EPS

- Connection Method

  There are 2 methods of wire connection, the T-branching (using the T-branching tap) and multiple-node daisy-chain methods. In a trunk line/ drop line, both methods can be combined.

- Terminating Resistor

  Terminating resistors (121Ω) are attached to both ends of a trunk line. This reduces the reflection of signals and stabilizes communication.

  In this module, there is a built-in terminating resistor. Therefore, when connecting the trunk line using the daisychain method, you can turn on the terminating resistor setting switch and use the built-in terminating resistor. In other connection methods, please turn the switch off so that the built-in terminating resistor is not used.

- Network Power Supply

  Out of the 5 special-purpose cables, two are for the 24 V DC network power supply. It is necessary to supply power to each node of the network using the cables. If a single network power supply source is used in a network, you can connect the power supply directly to the trunk line. However, if multiple power supply sources are to be used in the network, it is necessary to use special-purpose power supply taps.

2.2 I/O Communications (I/O Slave Message)

This is a communication function which allows the exchange of control information (I/O data) between the master and a slave in real time.

This module supports the following two types of I/O communications protocols of DeviceNet.

Polling ..... Sends polling instructions containing output data from the master to a specified slave; the master then receives a response containing the input data from the slave

(1 : 1 communication).

Bit Strobe ..... Multicasts (broadcasts) Bit Strobe request instructions from the master to multiple slave systems and receives a response with input data from each slave. A communication request that can be transmitted to multiple slaves at a time (1:N communications) will improve network throughput. However, this is possible only in the case of slave systems with input data of less than 8 bytes.

In this module, transmission of I/O communications requests is cyclic. This period (transmission time interval) can be specified for all the slaves in a batch in 5 ms intervals.

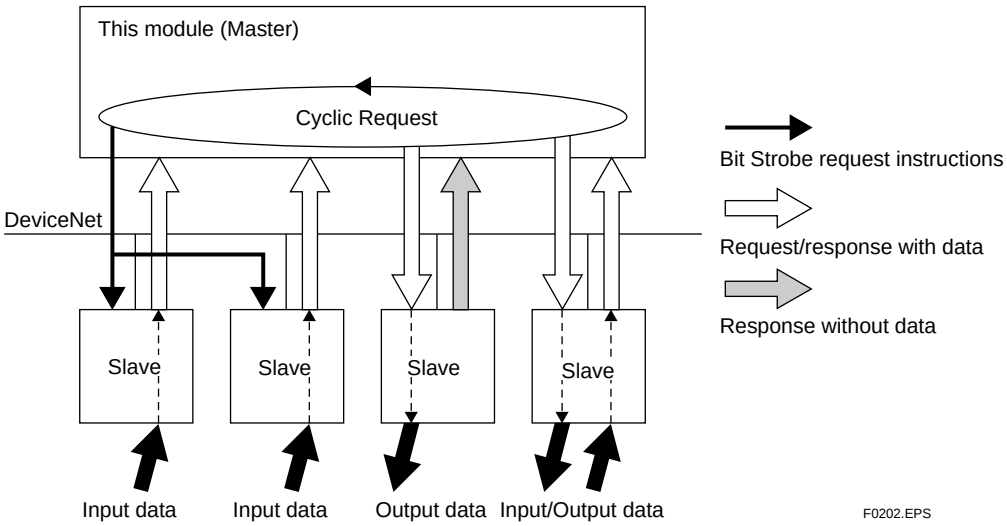


Figure 2.2 I/O Communications Concept Diagram

SEE ALSO

For information on I/O communications functions other than Polling and Bit Strobe, see also the “DeviceNet Specification” published by ODVA.

2.3 Message Communications (Explicit Peer-to-Peer Message)

This is a function for setting and reading parameters, controlling and managing operations and exchanging information between nodes (1: 1) when necessary. In this module, it is possible to send a service request to other nodes (master and slaves) using the explicit messages defined in DeviceNet.

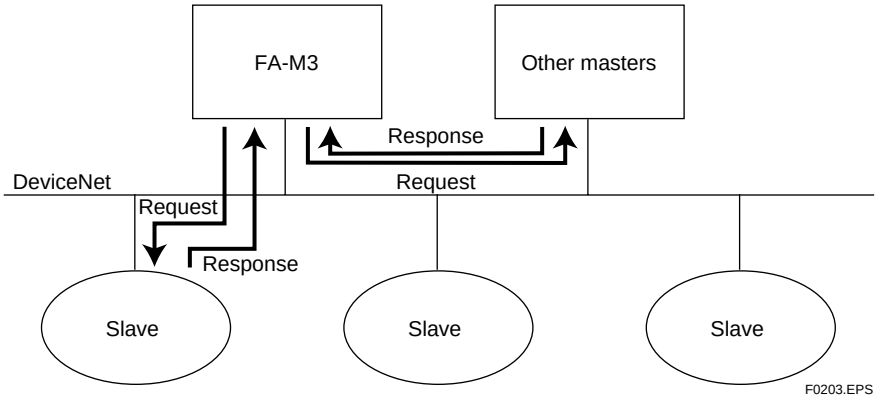
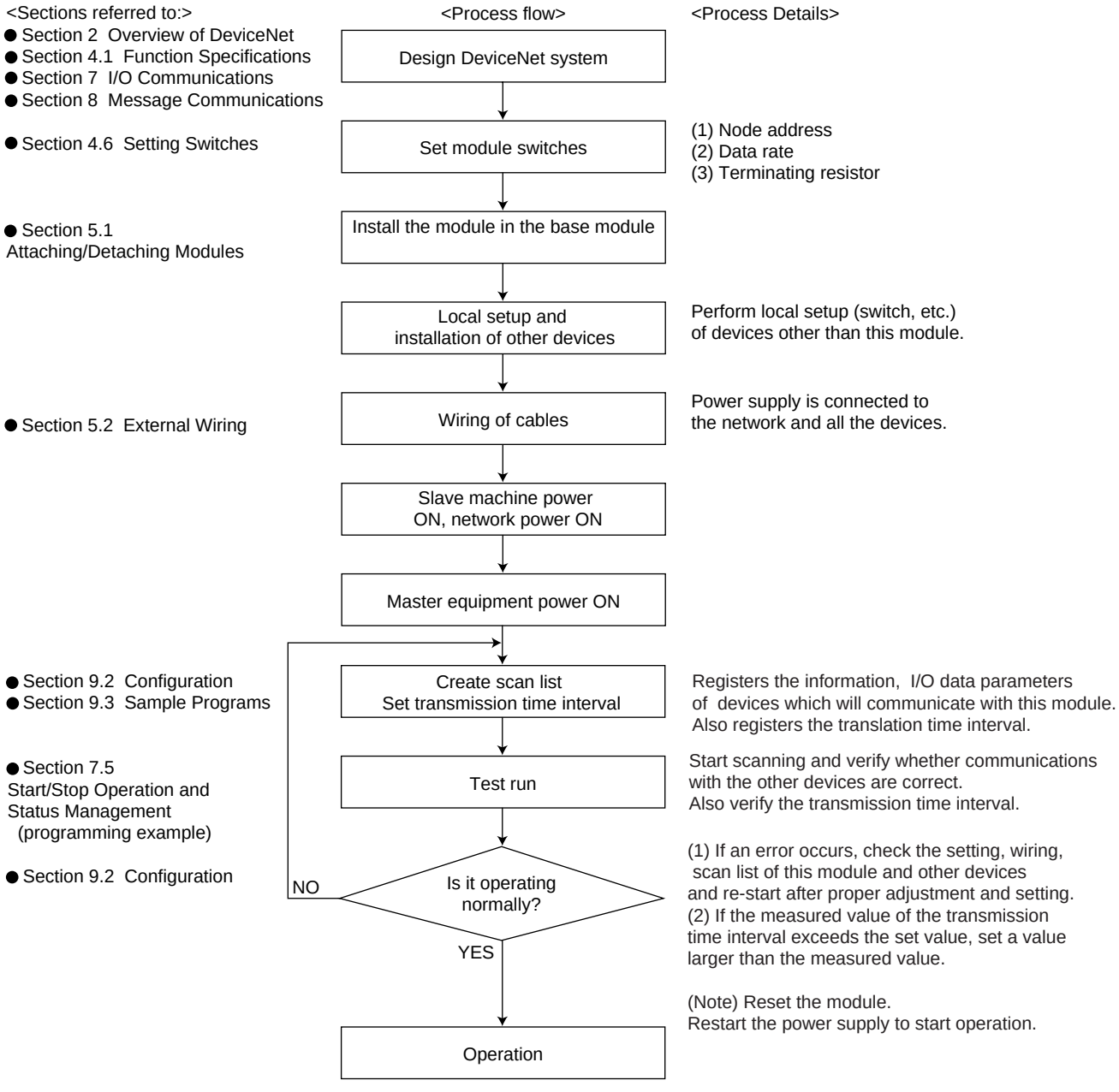


Figure 2.3 Message Communications Concept Diagram

3. Preparations for Operation

The preparations required before starting the operation are shown in Figure 3.1.



F0301.EPS

Figure 3.1 Operation Procedure Flow

SEE ALSO

(1) For details on the interface of the CPU module and this module related to operation preparations, see also the following sections of this manual:

- Section 6.1 I/O Relay
- Section 6.2 I/O Data Register
- Section 8.2 Interface (Message Communications)
- Section 9.1 Tool Commands

(2) For overview of DeviceNet, see Section 2, “Overview of DeviceNet,” of this manual.

(3) For information on the DeviceNet features supported in this module, see Section 4.1, “Function Specifications,” of this manual.

(4) For informatio on I/O functions supported by this module, see Section 7, “I/O Communications,” provided later in this manual.

4. Module Specifications

The specifications of this module are explained herein.

4.1 Function Specifications

The range of DeviceNet functions supported by this module is shown in the following table.

Table 4.1 Supported DeviceNet Functions

DeviceNet functions				
Device	Communication adaptor		Master/Scanner	Y
Explicit peer-to-peer message		Y	I/O slave message	
I/O peer-to-peer message		N	. Bit strobe	Y
Configuration consistency value		N	. Polling	Y
Fault node recovery		N	. Cyclic	N
Baud rate	125K, 250K, 500K		. Change of state (COS)	N

T0401.EPS

(Y: Supported; N: Not supported)

SEE ALSO

For details on unsupported functions, see also the DeviceNet Specification published by ODVA.

The function specifications are shown in Table 4.2.

Table 4.2 General Specifications

Items	Specifications				
Interface	Conforms to DeviceNet.				
Data rate	125/250/500 kbps (selected by switch positions)				
Transmission medium	5 special cables (2 for signals, 1 SHIELD, 2 for power supply)				
Transmission distance	Data rate	Maximum length of trunk line		Length of drop line	
		Only thick cables	Only thin cables	Maximum	Cumulative
	125 kbps	500 m	100 m	6 m	156 m
	250 kbps	250 m			78 m
	500 kbps	100 m			39 m
Connection method	Multiple-mode daisy chain method, T-branching method				
Number of connected nodes	64 devices (including the master)				
Error detection	CRC error, node address check, scan list check				
Power supply for communication	Voltage: 11 to 25 V DC Current consumption: Less than 40 mA (24 V DC) (supplied via a DeviceNet connector)				
Terminating resistor	121Ω (built-in, specified using switches when terminating)				
No. of I/O points	Input 8,000 points, Output 8,000 points, Total 16,000 points (1,000 words)				
Maximum message length	Transmission: 84 bytes, receive: 88 bytes (service data)				
No. of installed modules	16 max.				
Current consumption	200 mA (5 V DC)				
External dimensions	28.9 (W) × 100 (H) ×83.2 (D) mm*1				
Mass	110g				

T0402.EPS

*1 : Dimensions excluding protrusions (see External Dimensions for details)

4.2 Operating Environment

There are no restrictions on the CPU modules that can be used with this module.

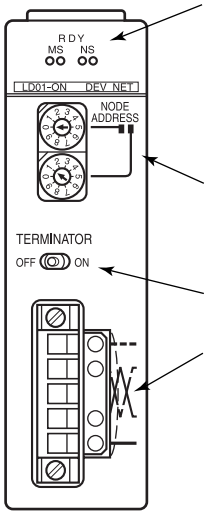
4.3 Model and Suffix Codes

Model	Suffix Code	Style Code	Option Code	Description
F3LD01	-0N	···	···	DeviceNet 1 port

T0403-1.EPS

4.4 Components

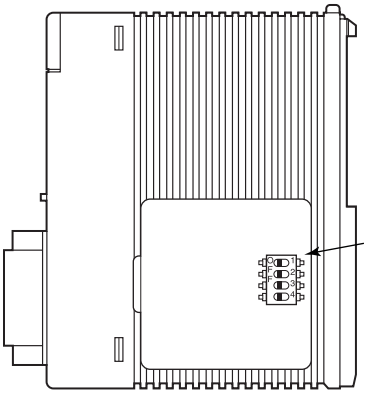
■ Front view



Indicators
RDY: Lit when the internal circuitry is in normal operation.
MS: Indicates the module status.
Green light is on when normal.
NS: Indicates the network status.
Green light is on when communications are proper.
Node address setting switch:
Sets node address (0 to 63)
Sets 00 at the factory.
Terminating resistor setting switch:
Used to terminate modules.
DeviceNet connector:
Connects the communication cable.

F0404-1.EPS

■ Right side view



Operation mode setting switch
SW1 and 2 : Data rate
SW3 : System reserved
SW4 : System reserved
All switches are set to OFF at the factory.

F0401.EPS

Figure 4.1 Components

4.5 Display Panel

The display panel of this module displays the status of the module and the network.

■ RDY LED

The RDY LED is on when the module is working normally and off when there is no proper power supply or if an error has occurred in the module.

When the power supply is turned on, the LED turns on after a self-diagnosis.

■ MS LED/NS LED

MS LED and NS LED conform to the DeviceNet communication protocol. The MS LED indicates the module status and the NS LED indicates the network status. The meaning of each status of the LEDs is displayed in Table 4.3.

Table 4.3 Explanation of LED Status

LED	Color	Status	Status Name	Explanation
MS	-	Off	No power	There is no power supply. Resetting is in progress.
	Green	On	Device in normal operation	Normal operation.
		Flashing	Device in standby	Initialization in progress / Reading settings.
	Red	On	Unrecoverable fault	A hardware failure or internal error has occurred.
		Flashing	Minor fault *1	Switch setting is out of range.
NS	-	Off	No power / not on-line *2	No network power supply
	Green	On	Link OK, on-line, connected *3	Network normal: scanning
		Flashing	On-line, not connected *4	Network normal: scanning stopped.
	Red	On	Critical link failure *5	Node address duplication; bus-off bus-off has occurred.
		Flashing	Connection time-out *6	A communication error has occurred in some nodes. (Scanning continues.)

T0403.EPS

*1 Minor fault
The switch setting is out of range; therefore, operation is not possible. Set the switch properly and restart the module.

*2 No power/not on-line
No network power supply. Waits for network power supply.

*3 Link OK, on-line, connected
Module is in the network and scanning.
Scanning is the status in which I/O communications are cyclically executed and a request for message communications is received. Message communications are executed whenever a message communications request is received during scanning.

*4 On-line, not connected
Module is in the network. However, scanning is not performed.
It takes approximately 6 seconds after starting the module for it to come on-line.

*5 Critical link failure
If the node address is duplicated or a bus-off error has occurred, communication becomes impossible and the module stops operating. Remove the node address duplication or improve the network environment and restart the module.
A bus-off error occurs when the error rate in the network is very high.

*6 Connection time-out
When the scan operation mode is specified as "continue," even if the node information mismatches, or if the node is absent, scanning continues with the flashing red NS LED indicating abnormal communication.
When the scan operation mode is specified as "stop," scanning stops on a communication error. (NS LED: flashing in green)
A node information mismatch is said to have occurred if the information obtained from the target node through communication at the beginning of scanning and the information that is already registered are found to be different.
"Node absent" means that no response has been received from the target node.
During scanning, if an FA-M3 system failure occurs, scanning stops regardless of the value of the scan operation mode.

4.6 Setting Switches

An explanation about the switch settings of this module is given in this section.

4.6.1 Node Address Setting Switch

Node addresses can be set using 2 decimal rotary switches which are on the front side of this module.

Set the switch to a value from 0 to 63, before switching the power supply on. If the switch is set to 64 or higher, operation will not be normal.

Settings that are mode after switching the power supply on have no effect.

The factory setting is 0.

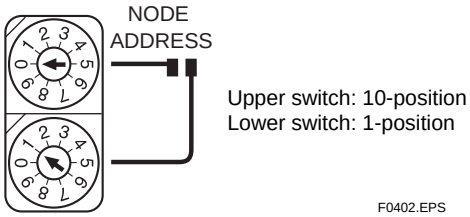


Figure 4.2 Node Address Setting Switch

4.6.2 Operation Mode Setting Switch

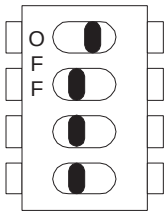
Four DIP switches can be seen when the cover on the right side of the module is removed.

The operation mode is set by setting the switches to on or off.

Set the switches before switching the power supply on.

Settings that are made after turning the power supply on have no effect.

The factory setting for all the switches is off.



Number	Functions
1	Data rate (see the table below.)
2	
3	System reserved (Make sure it is off)
4	

• Data rate

Status of number 1	Status of number 2	Data rate
Off	Off	125 kbps
On	Off	250 kbps
Off	On	500 kbps
On	On	Invalid setting

F0403.EPS

Figure 4.3 Operation Mode Setting Switches

4.6.3 Terminating Resistor Setting Switch

Using the knife switch on the front face of module, the built-in resistors can be used as terminating resistors of a trunk line.

The built-in resistors are used only when connecting to the trunk line using daisy chain method when they are installed at both ends of a trunk line.

External terminating resistors can be used in place of the built-in terminating resistors.

If the built-in terminating resistor is used when this module is not installed in a terminal, the operation may not be correct.

The factory setting of this switch is off.

OFF: Terminating resistor disable
ON: Terminating resistor enable

F0404.EPS

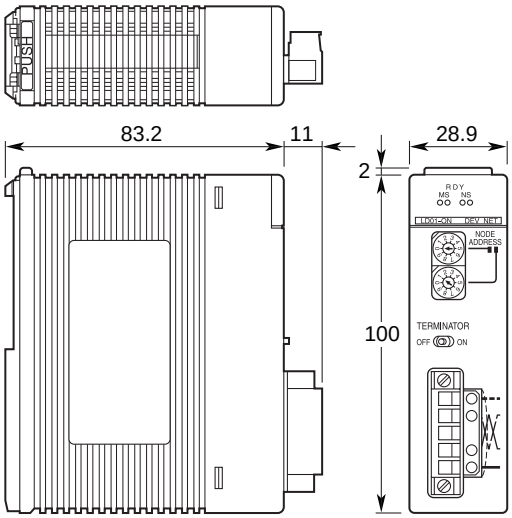
Figure 4.4 Terminating Resistor Setting Switch

CAUTION

If the built-in terminating resistor is used when this module is not placed on the terminal, the operation may not be proper.

4.7 External Dimensions

Unit: mm



(*) When connecting the base module, the DeviceNet connector and cable leave enough space for the cable to bend properly.
(See Section 5.1, “Attaching and Detaching a Module.”)

F0405.EPS

Figure 4.5 External Dimensions

Blank Page

5. Attaching and Wiring

The explanation about attaching/ detaching a module and wiring is given in this section.

5.1 Attaching and Detaching a Module

(1) Attaching Module

Figure 5.1 shows how to attach this module to the base module. First hook the anchor slot at the bottom of the module to be attached onto the anchor pin on the bottom of the base module. Push the top of this module in the direction of the arrow shown in the figure (toward the base module) until top button clicks into place.

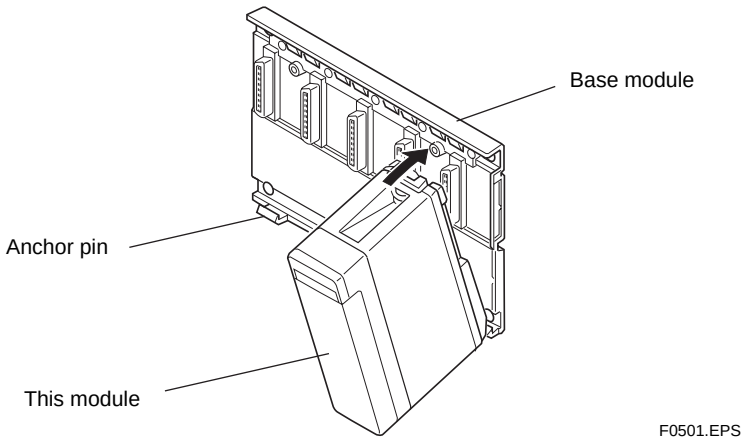


Figure 5.1 Attaching and Detaching Module

CAUTION

- DO NOT bend the connector pins on the rear of the module by force during the above operation. If the module is forcibly pushed with an improper connection, the pins of the connector may bend and this damage will cause a Module Installation Error during the self-diagnosis.

(2) Detaching Module

To remove this module from the base module, reverse the operation by pressing the top button to unlock it and tilting the module away from the base module. Then lift the module off of the anchor pin at the base.

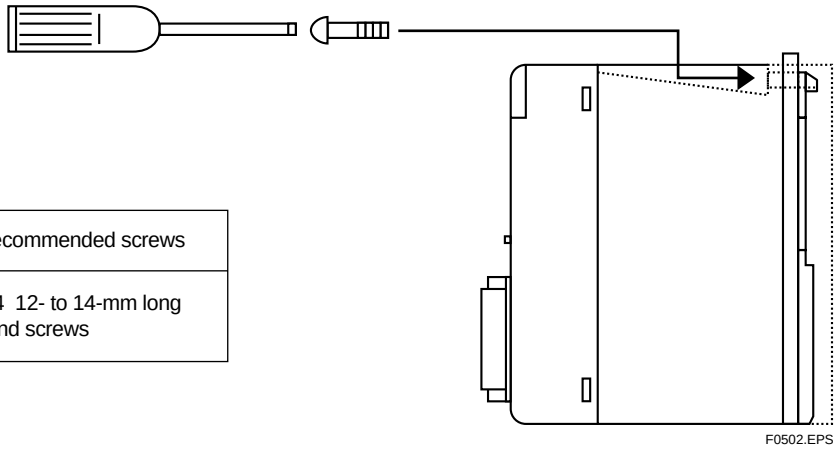
(3) Attaching Module in Intense Vibration Environments

If the module is used in intense vibration environments, fasten the modules with a screw directly beneath the yellow anchor/release button as shown in the Figure 5.2.

With a Phillips screwdriver, tighten the upper side of the module. During this operation, the user must tilt the screwdriver somewhat using the guide channel at the top of the module. A clearance of approximately 80mm between the module and the duct above it is necessary to allow the screwdriver to access the screw.

CAUTION

Do not overtighten the module fixing screw.



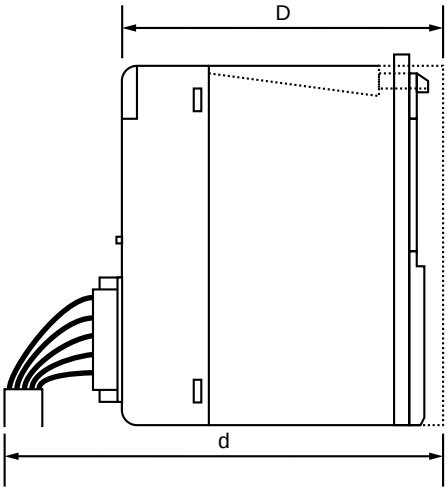
Recommended screws
M4 12- to 14-mm long bind screws

F0502.EPS

Figure 5.2 Tightening Module Using Screws

(4) The Depth for Attachment

The depth between the rear surface of the base module and the front surface of this module should be 89.9 mm. When attaching a cable with the connector, leave enough space for the cable to bend. The depth of attachment of this module is shown in Figure 5.3.



Module Name	D (mm)	d (mm)
DeviceNet Scanner module	89.9	140 *1

*1 The dimensions of necessary depth differ according to the thickness, hardness of the cable and length of the cable without insulation.

F0503.EPS

Figure 5.3 Attachment Depth of This Module

5.2 External Wiring

The explanation about the wiring of this module and communication cables is given in this section. For details on the network configuration, refer to Appendix1, “Network Configuration Details.”

■ Wiring of communication cables to the connector

Attach the cable to the connector by attaching the signal line and power supply line crimp-on terminal to the cable and processing it with vinyl tape or heat compression tube. Proper torque for tightening the screw of the cable is 0.5 N.m.

On the connector of this module, the seals corresponding to the colors of the cables are affixed. Please note that the color of the seals and the cable should match during wiring.

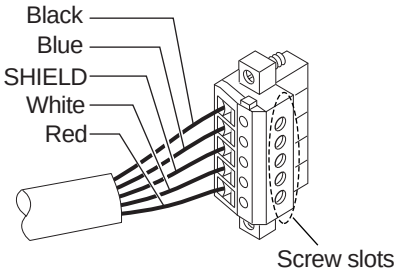


Figure 5.4 Wiring to the Connector

Color	Signal Line
Black	V-
Blue	CAN L
–	SHIELD
White	CAN H
Red	V+

F0504.EPS

CAUTION

- Switch OFF the power supply to the FA-M3 and network and then connect the communication cables.
- Use crimp-on terminals for wiring. The following products can be used as crimp-on terminals of the cables. Contact the manufacturer for details.

  Product Name: AI Series

  Manufacturer : Phoenix Contact Co., Ltd.

- Attaching the connector to this module

Insert the connector in the module as shown below. Proper torque for tightening the screw of the cable is 0.3 N.m.

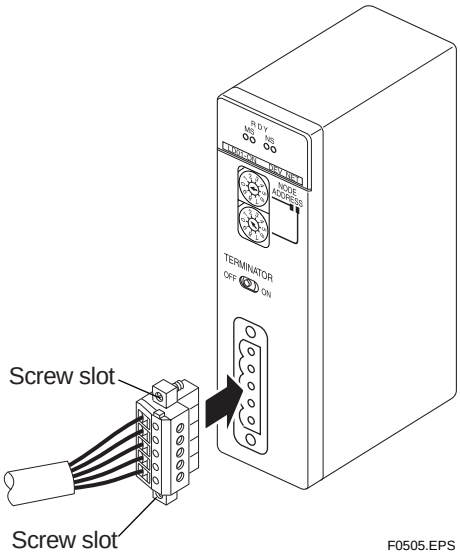


Figure 5.5 Attaching Connector to This Module

6. Module Access

The interface and access method of this module is explained in this section.

6.1 I/O Relay

The I/O relays that can be used in this module are given in Tables 6.1 and 6.2.

In this module, interrupt processing is not supported. The relays that are not defined in Tables 6.1 and 6.2 cannot be used.

In the boxes□□□ following X and Y, like X□□□** and Y□□□** in Tables 6.1 and 6.2, insert the slot number where this module is installed.

CAUTION

In a multi-CPU system, only one CPU module can be set to use this module. For details on configuration setting, refer to the Ladder Diagram Support Program M3 (IM 34M6Q13-01E).

Table 6.1 Input Relays

Input Relay	Signal Name	Description	Relationship with Other Relays
X□□□01	Module error	On if there is a hardware failure or the switch setting is incorrect.	Indicates the current status.
X□□□02	Communication not possible	On if switch number is duplicated or when a bus-off error has occurred.	Same as above
X□□□03	No Network power supply	On if the network power supply is off.	Same as above
X□□□04	Communication error	On if a communication error occurs during scanning. Stays on until scanning is stopped.	Same as above
X□□□07	Scan list ot set	On if there is no registration in the device list.	Same as above
X□□□08	System failure	On if a system failure occurs in the FA-M3.	Same as above
X□□□09	Scan status	On during scanning; Off if not scanning.	Off if Y□□□41 is off.
X□□□10	Scan operation mode	Operation mode on error. (On: stop scanning on communication error; Off: continue scanning on error.)	Y□□□42 request is reflected.
X□□□17	Clear error completed	On if error information is cleared.	Off if Y□□□49 is off.
X□□□26	Execute tool command completed	On if execution of tool command ends.	Off when Y□□□58 is off.

T0601.EPS

Table 6.2 Output Relays

Output Relay	Signal Name	Description	Relationship with Other Relays
Y□□□41	Request to start/stop scanning	Request to start/stop scanning (On/Off)	Operation status is displayed in X□□□09.
Y□□□42	Scan operation mode request	Defines operation if communication error occurs during scanning. (Off: continue; On: stop)	The current operation mode is displayed in X□□□10.
Y□□□49	Request to clear error	Request to clear the error information	Turns off after confirming that X□□□17 is on.
Y□□□58	Request to execute tool command	Request to execute a tool command	Turns off after confirming that X□□□26 is on.

T0602.EPS

6.2 I/O Data Register

The list of I/O data registers is shown in Table 6.3.

The I/O data registers that are not defined in Table 6.3 cannot be used.

Table 6.3 I/O Data Register List

Data Position Number		Data Name	Description
Ladder	BASIC		
1 to 99		Module information	Register which stores the operation status, error code.
100 to 299		Control flag	Flag which controls message communication and I/O communication for each node.
400 to 449		Tool command buffer	Register which stores the commands that perform settings and information reading of this module (see Section 9.1.3, “Basic Format of Commands”).
500 to 999		Input data buffer	Register in which the data input for slave is stored (see Section 7.1, "Scan List").
1000 to 1499		Output data buffer	Register in which the data output for slave is stored (see Section 7.1, “Scan List”).
1501 to 1550		Message communication transmission buffer	Register in which the request command for message communication is stored (see Section 8.2, “ Interface”).
1551 to 1600		Message communication receive buffer	Register in which the response command for message communication is stored (see Section 8.2, “Interface”).

T0603.EPS

■ Module Information

Module information displays the status of the module and communication status and the settings. The list is displayed in Table 6.4.

Table 6.4 Module Information

Data Position Number	Type*1	Contents	Explanation	Default Value
1	R	Status	Reflects the status of the module (X□□□01 to 16).	0
5	R	Data rate	Data rate 0:125; 1: 250; 2: 500 kbit/s	Switch set value
6	R	Node address	Node address 0 to 63	Switch set value
7	R	Transmission time interval	Transmission time interval set value [msec]	Flash memory stored value
8	R	Transmission time interval measured value	Transmission time interval measured value [msec]	0
17	R	Error code *1	Error code of the module (EC1) Cleared if Y□□□49 is turned on. (Latched type)	0
18	R	Error code*2	Error code of the module (EC2) Cleared if Y□□□49 is turned on. (Latch type)	0
21 to 24*2	R	Scan list information	The bits corresponding to the nodes registered in the scan list are on.	Flash memory stored value
25 to 28*2	R	Status information of other nodes	During scanning, the bits corresponding to the nodes that are communicating normally with this module are on.	0
29 to 32*2	R	Information of the node in error	The bits corresponding to the nodes in which a communication error has occurred, are on. Cleared if Y□□□49 is turned on. (Latched type)	0

T0604-1.EPS

*1 Type ..... Type of access available from the CPU module. (R: Read only)

*2 Bit position corresponding to the node address

Data position number

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
n+1	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
n+2	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48
n+3																

T0604-2.EPS

■ Control Flag

A control flag is used to control the message communications and I/O communications of each node . The list is given in Table 6.5.

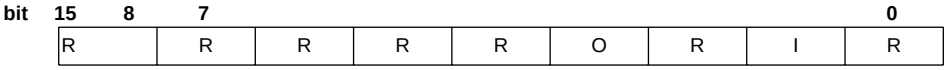
Table 6.5 Control Flag

Data Position Number	Type*1	Content	Explanation	Default Value
100 to 163*2	R/W	Control for each node	Control request for I/O communications of each node	0
200 to 263*3	R	Status of each node	Control status for communication of each node	0
191*4	R/W	Message communications control	Message communications control request	0
291*5	R	Message communications status	Message communications control status	0

T0605.EPS

*1 Type Type of access available from the CPU module. (R: Read only; R/W: Read/write)
*2 Data position number = 100 + node address

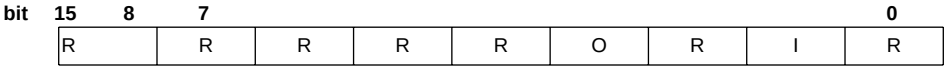
Explanation of flag



F0602-1.EPS

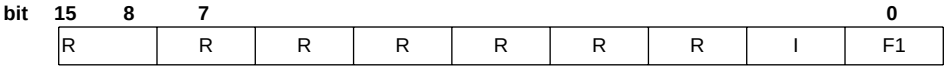
R : System reserved (Operation prohibited)
I : Request to prohibit input data update (On: Request to prohibit update; Off: Release request)
O : Request to prohibit output data access (On: Prohibit request; Off: Release request)
*3 Data position number = 200 + node address

Explanation of flag



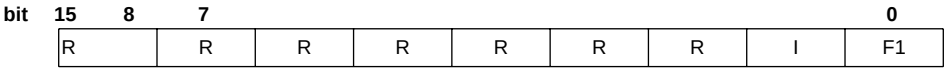
F0602-2.EPS

R : System reserved (Operation prohibited)
I : Input data update status (On: Not during update; Off: During update)
O : Output data access status (On: Not during transmission; Off: During transmission)
*4 Explanation of flag



F0602-3.EPS

R : System reserved (Operation prohibited)
F1 : Message communications request (On: Transmission request; Off: Release request)
*5 Explanation of flag



F0602-4.EPS

R : System reserved (Operation prohibited)
F1 : Message communications completion (On: Communication completed/response received; Off: During communication or no request (for communication))
(Supplement) When the execution flag is turned off, then the completion flag also turns off automatically.

6.3 Access from the CPU Module

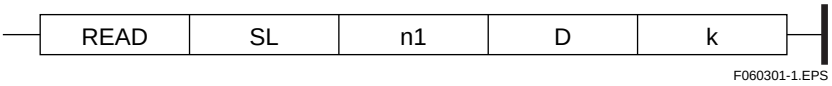
The method for accessing from the CPU module is explained in this section. See the sample programs in Sections 7 to 9 for more details.

6.3.1 Access Using Ladder Sequence

When using the ladder sequence, use the following instructions to access from the CPU module. For details on each instruction, see “Sequence CPU Instruction Manual” (IM34M6P12-03E).

Using the following instructions, the reading and writing of the I/O data registers can be performed.

- Special Module Read command (READ command)



F060301-1.EPS

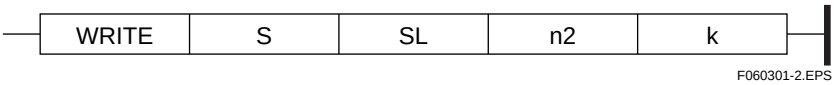
SL : Slot number of the module (3 digits)

n1 : First data position number to read

D : First device number in which to write the data read

k : Number of words transmitted

- Special Module Write command (WRITE command)



F060301-2.EPS

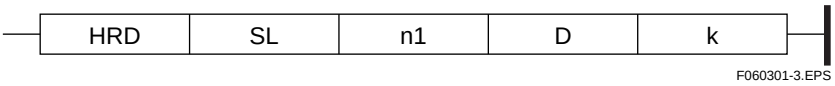
S : First device number for write data

SL : Slot number of the module (3 digits)

n2 : First data position number to write

k : Number of words transmitted

- Special Module High-speed Read command (HRD command)



F060301-3.EPS

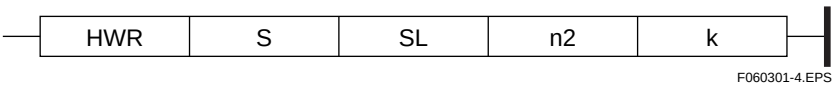
SL : Slot number of the module (3 digits)

n1 : First data position number to read

D : First device number in which to write the data read

k : Number of words transmitted

- Special Module High-speed Write command (HWR command)



F060301-4.EPS

S : First device number for write data

SL : Slot number of the module (3 digits)

n2 : First data position number to write

k : Number of words transmitted

6.3.2 Access Using BASIC

In BASIC, the following instructions are used to access from the CPU module. For the details on each instruction, see “BASIC CPU, BASIC Programming Tool M3” (IM34M6Q22-01E).

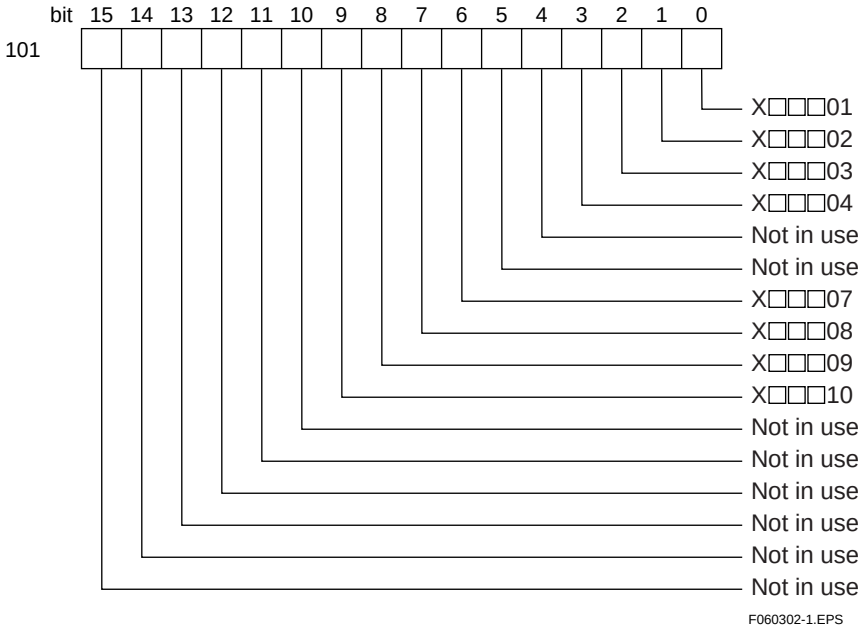
The following BASIC statements can be used for this module. If statements other than the following are used, the operation cannot be guaranteed.

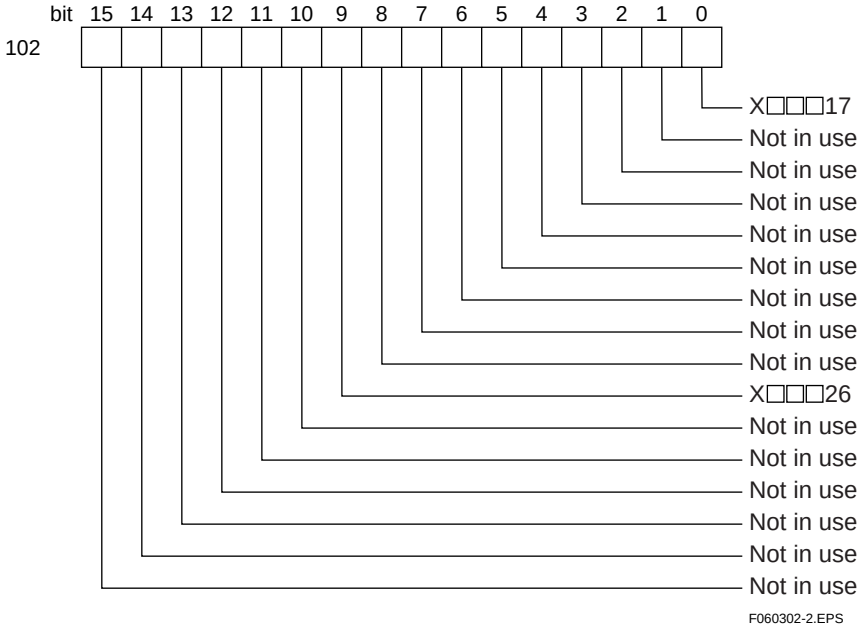
Table 6.6 Statements

Functions	Statement Type	Explanation
Module use declaration	ASSIGN LD01=SL SL: Slot number	Declares use of module and CPU module.
Reading from I/O data register	ENTER SL, n NOFORMAT;I SL: Slot number n: Data position number I: Variable name to store read data	The data of data position number n of the module, which is installed in slot number SL, are read and stored in input variable I.
Writing to I/O data register	OUTPUT SL, n, NOFORMAT;I SL: Slot number n: Data position number I: Integer variable name or integer array variable name	The contents that are specified in variable I are stored in data position number n of the module which is installed in slot number SL.
Reading status of input relay	STATUS SL, n; P SL: Slot number n: Data position number (101, 102) P: Variable to store the value read.	The status of the input relay of the module which is installed in slot number SL is read and stored in variable P.
Writing to output relay	CONTROL SL, n; P, M SL: Slot number n: Data position number (101, 102) P: Output data M: Mask pattern	The value of variable P is output to the output relay status of the module which is installed in slot number SL. By using the mask pattern, you can output to only specific relays.

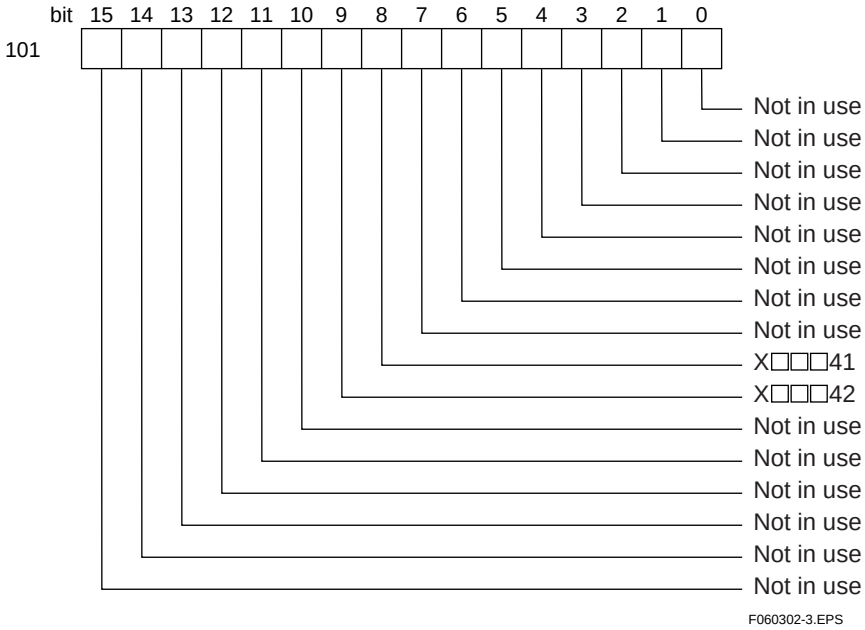
T0606.EPS

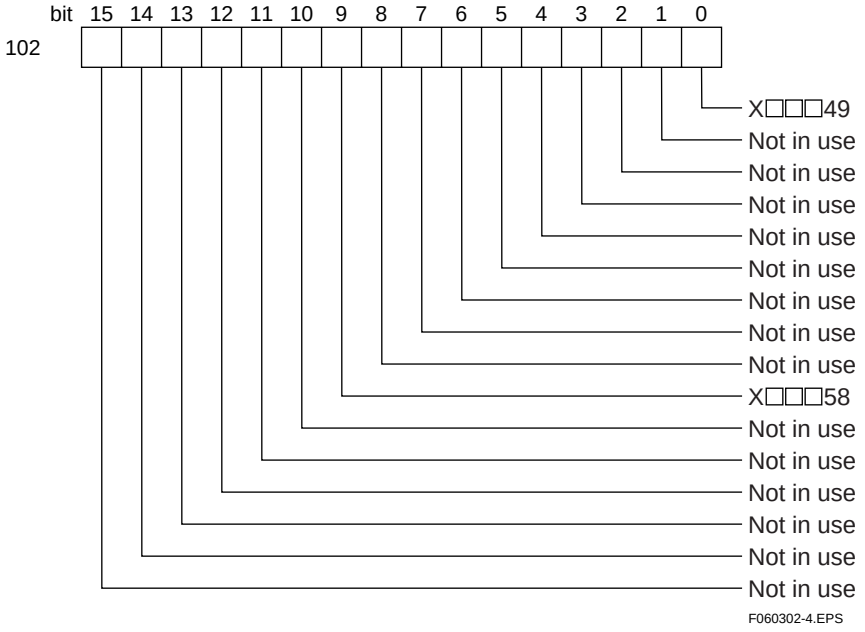
Input relays are allocated to 2 words in bits as shown below:





Output relays are allocated to 2 words in bits as shown below:





Blank Page

7. I/O Communications

The operation of this module related to scanning and I/O communications is explained here.

7.1 Scan List

The scan list of this module is explained here.

■ What is a scan list?

Node identification information, the communication type, I/O data size and I/O data storage location are stored in the scan list for each node that communicates with this module. The communication target node is managed and I/O communications and message communications are executed according to this list.

Register the following information as Node Identification Information.

- Vendor ID : Identifier for the company manufacturing the device
- Device type : Code indicating the type of device
- Product code : Code indicating device model

Register the communication type by selecting the following options.

- I/O communications (select from Polling/Bit Strobe) / None
- Message communications / None

Register the I/O data size by specifying the size of the I/O data for I/O communications in the number of bytes and register the location for storing the I/O data by specifying the relative location (Offset from the start of the input data buffer or from the start of the output data buffer) in the I/O data buffer of this module.

An example showing the registration of a device list is given below.

Example: SI Unit Compatible with DeviceNet (SMC Co., Ltd.)

Item	Example
Vendor ID	7 (SMC Co., Ltd.)
Device type	16
Product code	288
Communications type	polling only
Input data size (bytes)	2
Input data offset (bytes)	100
Output data size (bytes)	2
Output data offset (bytes)	100

T0701-1.EPS

SEE ALSO

For information on the node identification information, the communications type supported and the I/O data size, see also the device handling manual or data sheet (hard or soft copy). You can also inquire at the sales department of the company manufacturing the device.

■ Register and Save

The scan list and transmission time interval (see Section 7.5, “Transmission Time Interval”) are registered in the memory using the Register Device/Register Transmission Time Interval commands of the Tool commands (see Section 9.1.4 of this manual for details on the commands) using a Ladder/BASIC program in the CPU module. These are stored in the flash memory with the Store in Flash Memory command. The information which is stored in the flash memory is preserved even if the power supply is turned off.

CAUTION

One can write to flash memory 100,000 times. Make sure that the Ladder/BASIC program that performs flash memory storage is not created every time operation starts.

Create the program for registration/saving by referring to the programming example (Section 9.3, “Sample Program”).

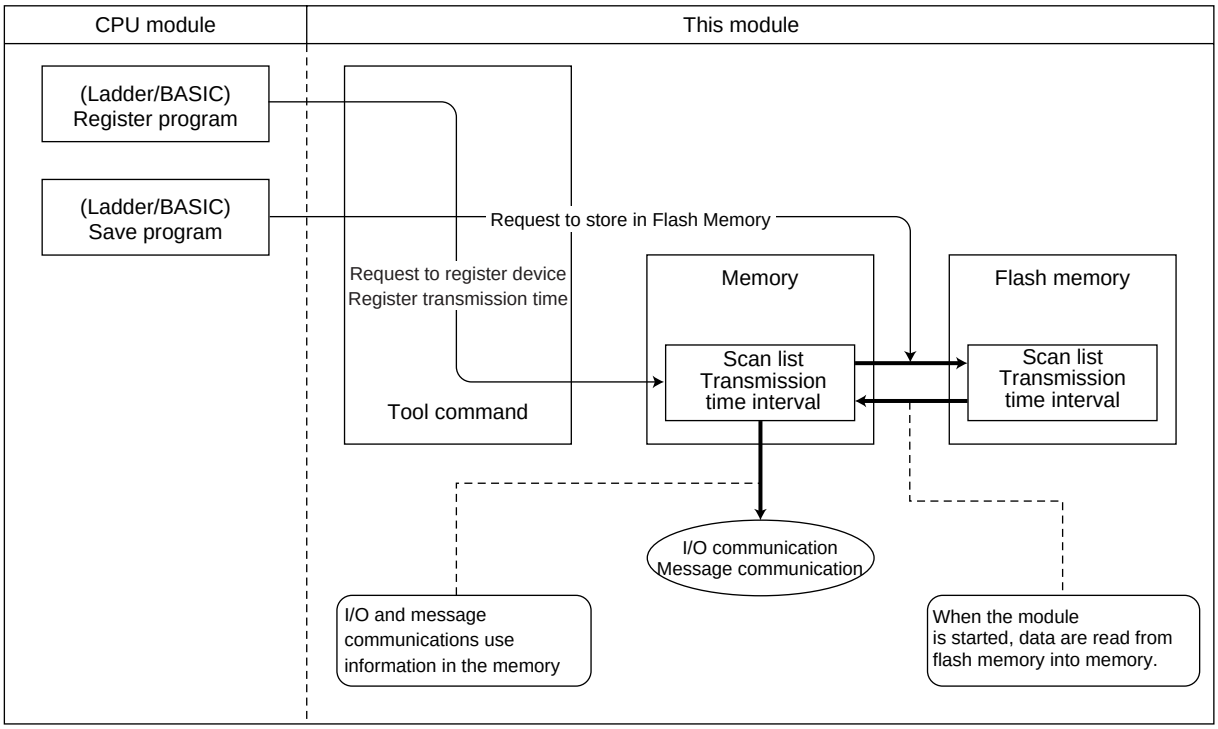


Figure 7.1 Register and Save Sequence

■ Allocation of I/O data storage location

The storage location for I/O data is allocated in the I/O data buffer (see Section 6.2, “I/O Data Register,” in this Manual) according to the following rules.

- Select the type (polling/bit strobe/none) of the I/O communications method. (When using message communications, select separately from I/O Communications).
- Make sure to allocate data with more than 2 bytes to even addresses. Registration is not possible if an odd address is specified. One-byte data can be allocated to an odd address.
- The buffer need not be used in ascending order of the node address.
- If there is a duplicate allocation with another device outside the area, registration is not possible.
- In a multi-master environment, it is not possible to share the slave in polling/bit strobe communication.

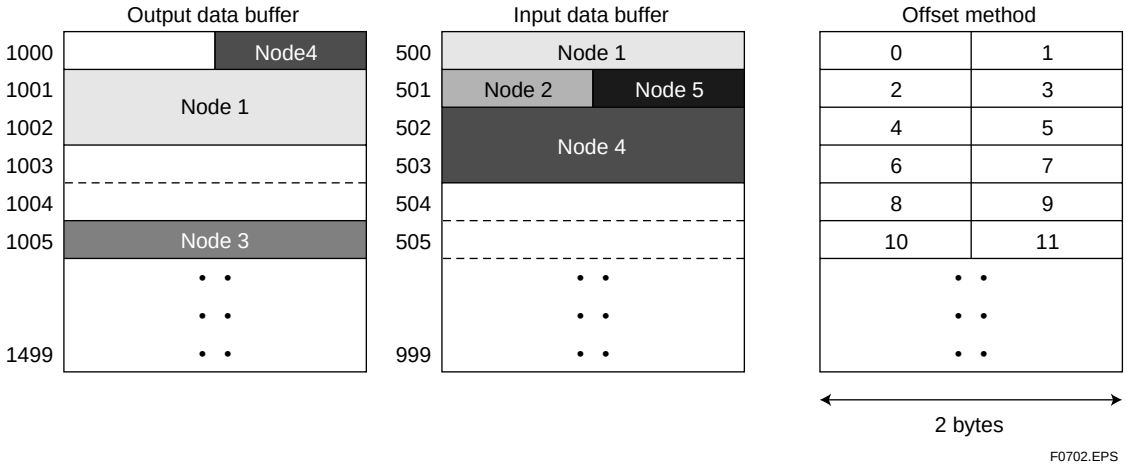
Size and offset are specified in bytes. Offset is the offset from the start of the input data buffer or output data buffer.

Size and offset in bytes

Node Address	Type of I/O Communications	Output Data		Input Data	
		Size	Offset	Size	Offset
1	P	4	2	2	0
2	B			1	2
3	P	2	10		
4	P	1	1	4	4
5	B			1	3

P: polling, B: bit strobe

T0701-2.EPS



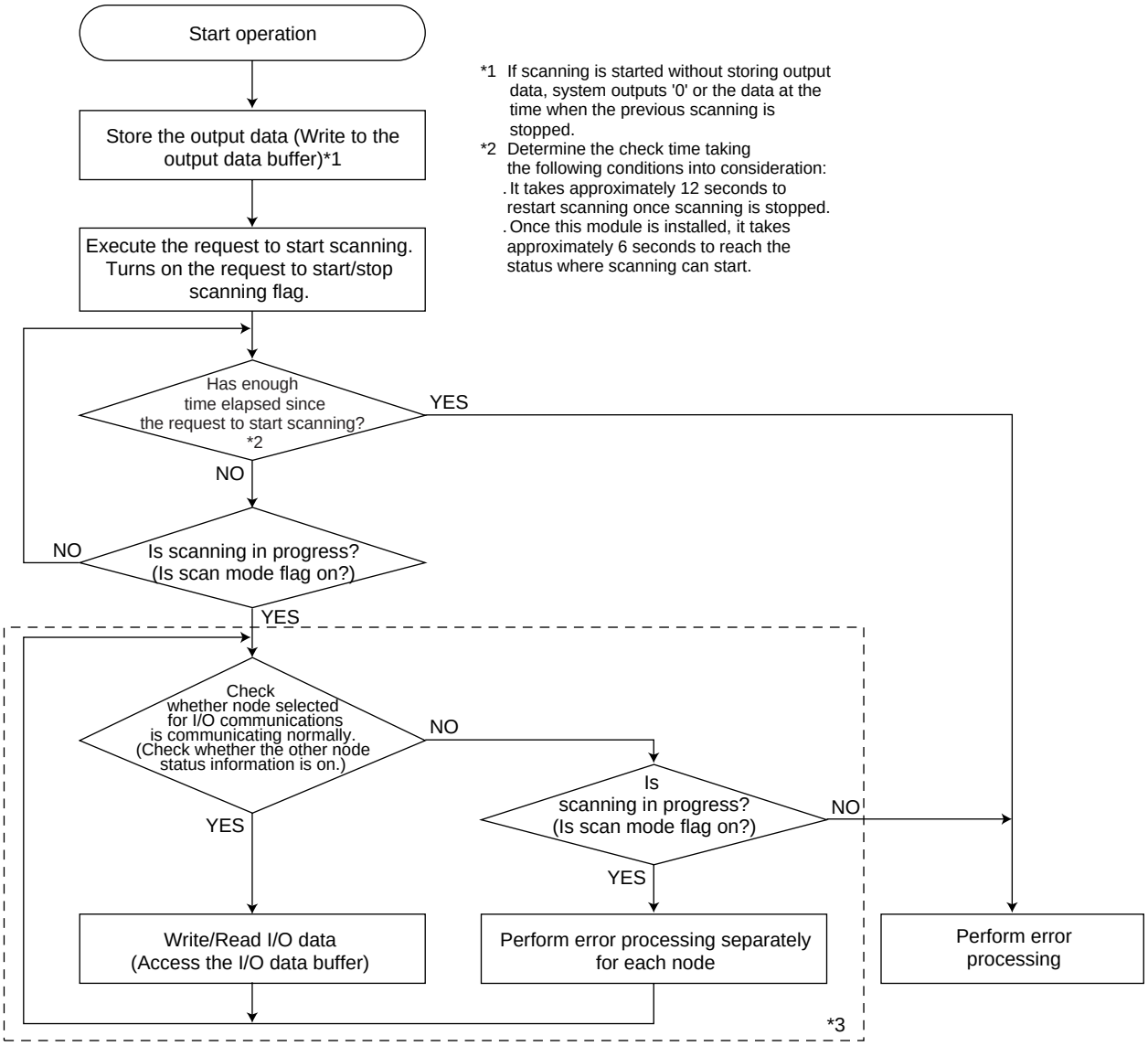
F0702.EPS

Figure 7.2 Example of Allocation

7.2 Module Operation

■ Normal Operation

Perform the operations following the steps below. The operation of this module is shown in Figure 7.3.



*3 Perform this step for all the nodes which I/O communications are to be established.

F0702-1.EPS

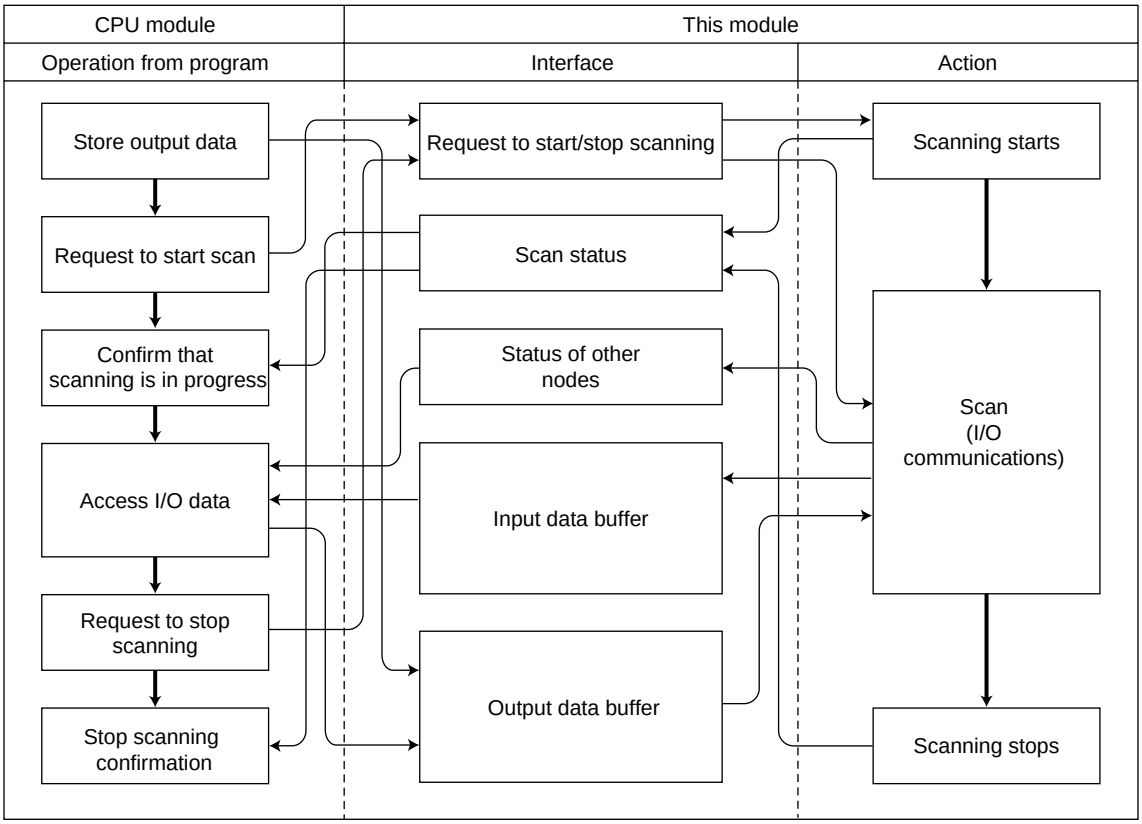


Figure 7.3 Operation Sequence and Operation of Module

■ Error processing during scanning

If an error occurs during I/O communications, two operation modes are provided as options, namely continue/ stop. During I/O communications, information possessed by the slave may not be in agreement with the information of the scan list, or the stop/continue operation can be specified when a slave is absent.

If "continue" is specified, communication continues with the slaves other than the one in which the error has occurred. Communication automatically resumes when the slave in which the error has occurred becomes available again. However, the red NS LED continues to blink until scanning stops (see Section 4.5, "Displays Panels," in this document.)

Slave operation when communication stops varies with the specifications of the slave.

Check the specification of the slave.

■ Ensuring data concurrency

I/O data are concurrent in every input/output data register (1 word). There are flags that ensure data concurrency in all nodes when handling data that exceed 2 bytes, for instance, when concurrency is required between NC data and data of a barcode reader or between multiple data, etc. However, concurrency should be ensured when the slave transmits the data.

- Input Data

  Flags

  - Request to Prohibit Input Data Update flag in control flag of each node
  - Input Data Update Status flag in status flag of each node

Operation from Ladder/BASIC program of CPU module

1. When you wish to read the data, turn on the "request to prohibit input data update flag" of the target node.
2. Wait until the update status flag turns on. When it does, read the data and turn off the prohibit update flag.

Actions of the module

1. Confirms the request flag at the time of I/O communications to the target node. If it is on, updates to the latest input data, turns on the update status flag and enters the stop mode. Henceforth, the prohibit update flag is checked following the I/O communications timing of the target node and if it is found to be on, the input data are not updated.
2. When the prohibit update request turns off, turn off the update status flag and update the input data.

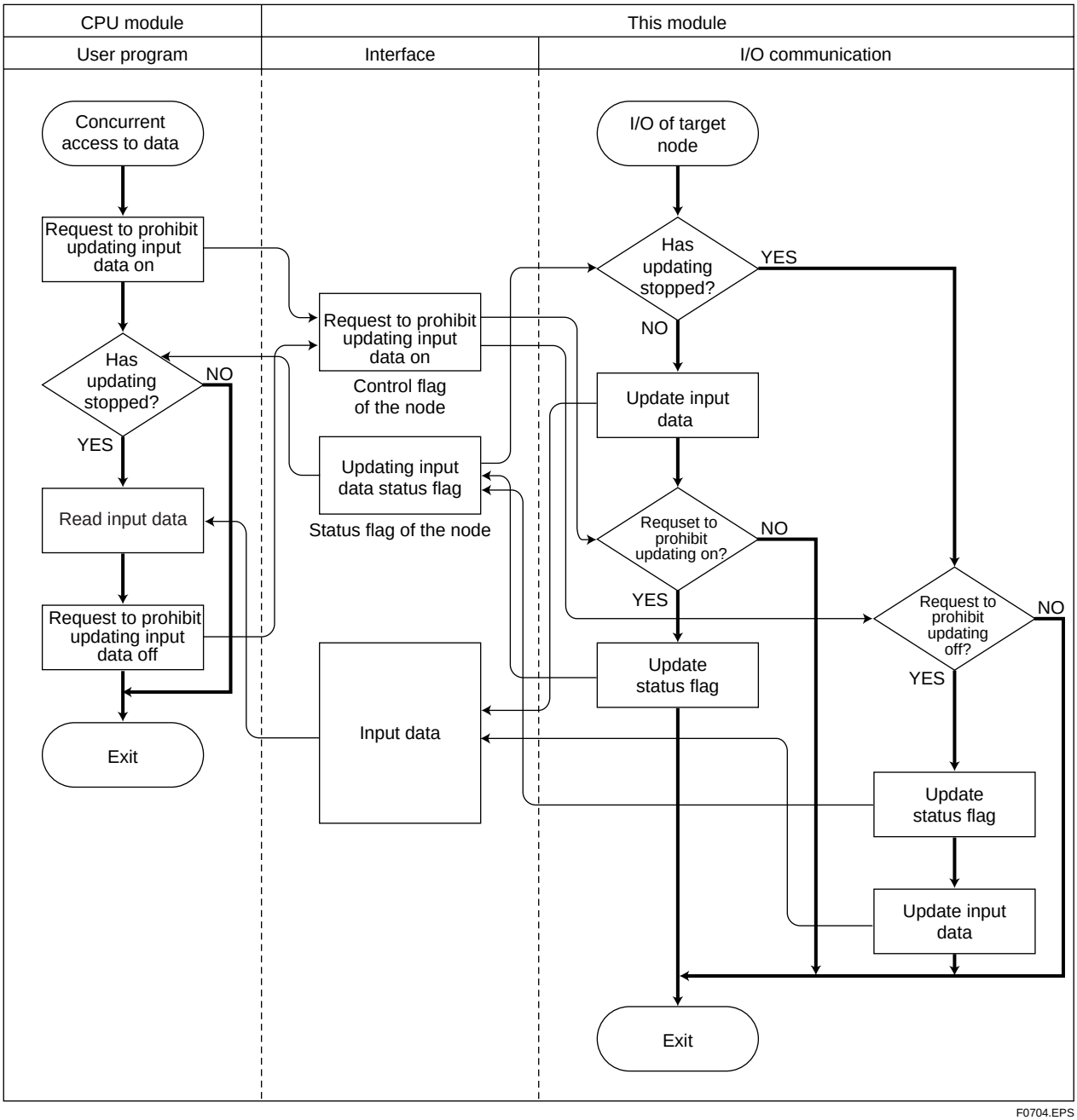


Figure 7.4 Ensuring Concurrency of Input Data

- Output Data

Flags

- Request to Prohibit Output Data Access flag in control flag of each node.
- Output Data Access Status flag in status flag of each node.

Operation from Ladder/BASIC program of CPU module

1. When you wish to output new data, turn on the request to prohibit output data access flag of the target node.
2. Wait until the access status flag turns on, write the output data in the output data area and turn off the request to prohibit access flag.

Actions of the module

1. If the request to prohibit access flag is on during I/O communications to the target node, the previous data are transmitted to the slave. If in the output data access stop mode, the access status flag is turned on.
2. When the request to prohibit access flag is off, access prohibition is cancelled, the access status flag is turned off and the new output data are transmitted to the slave.

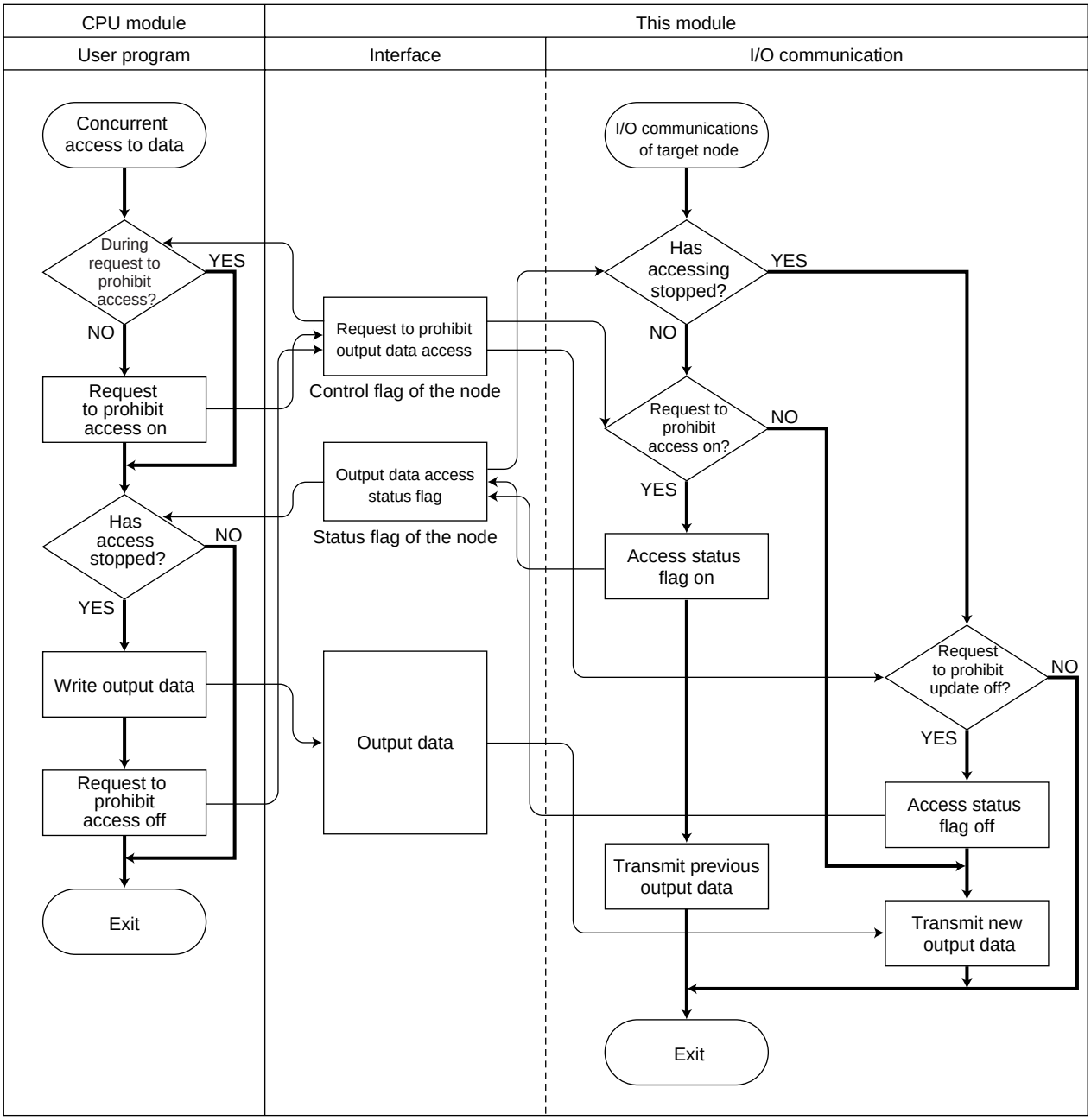


Figure 7.5 Ensuring Concurrency of Output Data.

■ High order/ low order byte swapping of multiple byte data

The encoding rules are different for data on the FA-M3 and DeviceNet. Hence in multiple-byte data it is necessary to swap the high order/low order bytes every 2 bytes.

Examples are shown in Figures 7.6 and 7.7. For programming, see Section 7.6, “I/O Data Access (Example of Programming).”

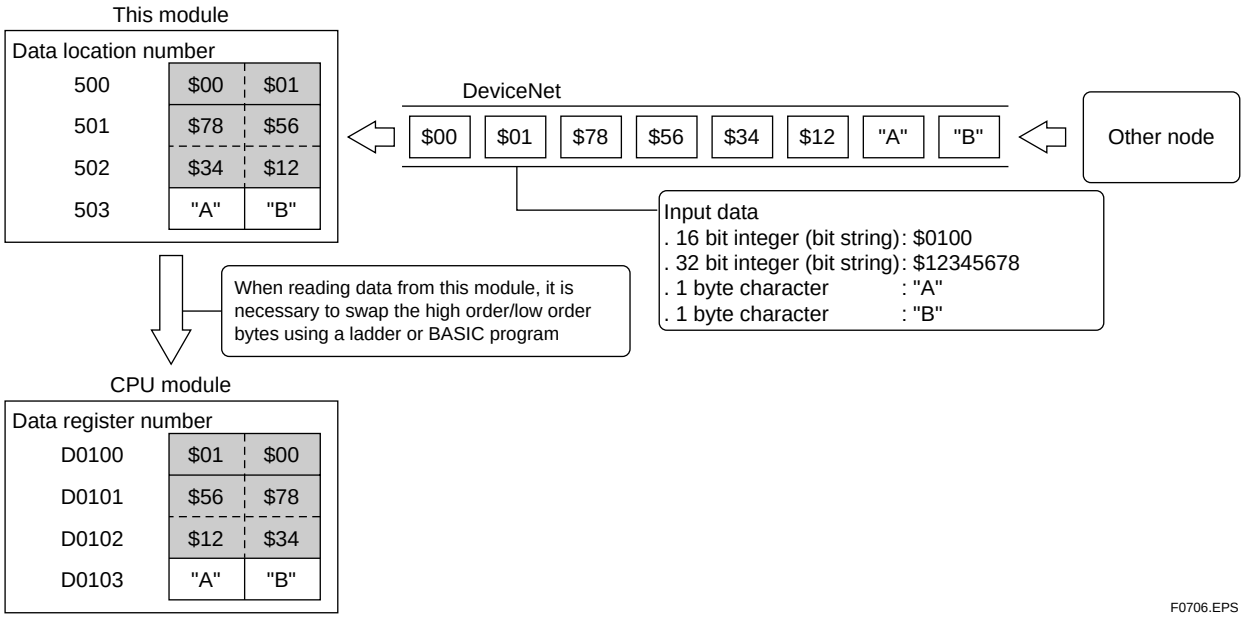


Figure 7.6 Example of Swapping of Input Data

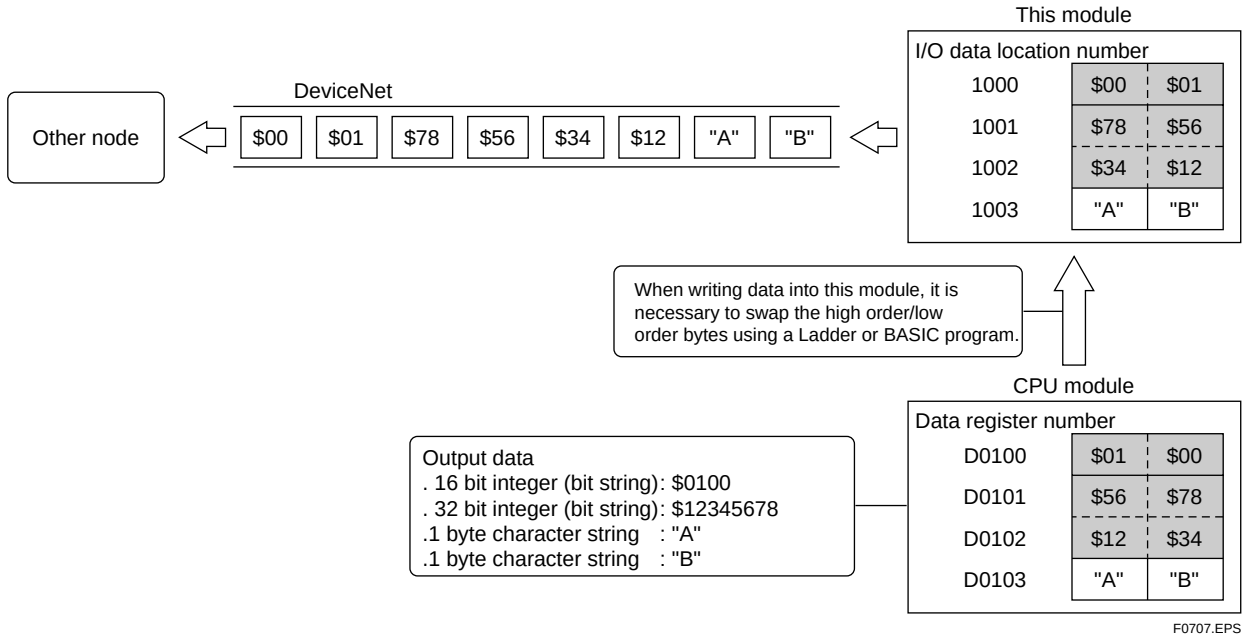


Figure 7.7 Example of Swapping of Output Data

7.3 Transmission Time Intervals

The transmission time interval is the period in which I/O communications are performed cyclically. The interval can be specified in the range of 0 to 5000 ms in units of 5 ms using the tool commands. The setup value and value measured at the time of actual operation (measured value) can be stored in the module information of the I/O data register and read. It can also be read using the tool command.

As the transmission time interval not only depends on the number of nodes connected, the type of communication and the capacity of data but also on the performance of the module and the response time of each connected device, it cannot be determined theoretically.

Perform the transmission under actual operating conditions and set a value which is larger than the measured value of the transmission time interval. If the measured value is unsteady, then set it to the maximum measured value.

If there is a delayed response from the slave, and if there were no response when the transmission completes, a situation occurs which is as if the slave were not present at all. In such a case set a long enough transmission time interval.

When the time needed for the transmission to all nodes is greater than the set value, then operate it with a time period that is larger than the set value.

The standard transmission time intervals for a single master configuration with data rate of 500 kbps are displayed in Table 7.1.

Table 7.1 Standard Transmission Time Intervals

Number of slave nodes	Transmission time interval (ms)
Up to 9	10
Up to 23	20
Up to 37	30
Up to 51	40
Up to 63	50

T0701.EPS

7.4 I/O Response Time

The I/O response time is the time from the start of input to the slave, followed by ladder program processing, until output from the slave.

From a ladder program, read the input data from this module using the special module read command READ. Perform the required processing and write the output data to the module using the special module write command WRITE. The maximum I/O response time required for the above processing is estimated as follows.

Maximum I/O response time = transmission time interval × 2 + 1 scan time

+ input delay in slave + output delay in slave

It is the same whether the transmission time interval is longer or the time for one scan is longer.

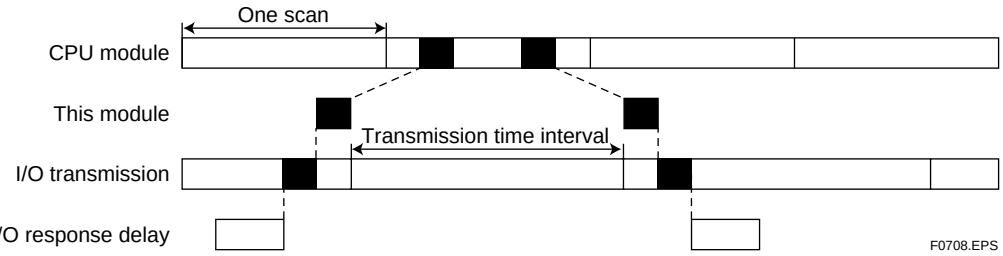


Figure 7.8 Maximum I/O Response

7.5 Start/Stop Operation and Status Management (Example of Programming)

This sample program shows how to start/stop an operation and how to manage the status.

This sample program is based on the following conditions:

- This module is installed in the 4th slot.
- The scan list is registered.
- The sample program is executed only when all the nodes registered in the scan list are communicating normally. (The scanning stops when a transmission error occurs in any node.)
- The sample program stops when normal communication for all nodes is not achieved 20 seconds after turning ON the power supply.

This sample program is described separately in:

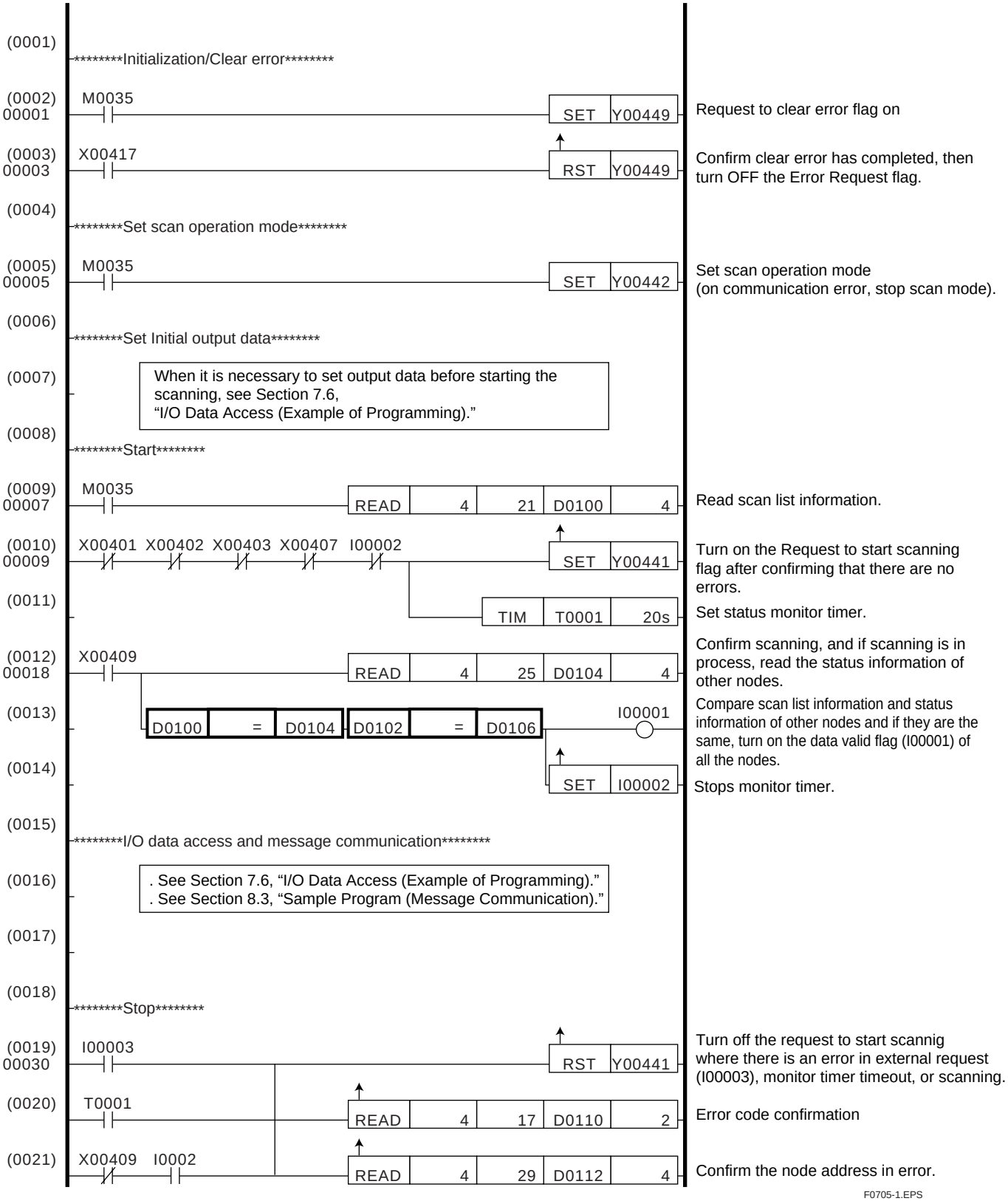
(1) Section 7.6, “I/O Data Access” (Example of Programming)

(2) Section 8.1, “Module Operation,” and

(3) Section 8.3, “Sample Program.”

Consult these sections for more details.

■ Example of Ladder Programming



F0705-1.EPS

■ Example of BASIC Programming

```
10  ! ********************************************************
20  ! * F3LD01-ON SAMPLE PROGRAM
30  ! * Start/Stop Operation and Status Management
40  ! ********************************************************
50  ! ****Initial setup****
60  DEFINT A-Z
70  DIM DLIST (3), DSTS (3)
80  LDSLOT = 4
90  ASSIGN LD01 = LDSLOT
100 !
110 !****Initialization Clear Error****
120 CONTROL LDSLOT, 102; $0001, $FFFF      : ! Request to Clear Error (Y□□□49)
                                               on, and other relays off
130 CONTROL LDSLOT, 101; $0000, $FFFF      : ! Other relays off
140 STS=0
150 WHILE BIT (STS, 0) = 0                 : ! Wait till Clear Error Confirmation
    (X□□□17) is turned ON
160 STATUS LDSLOT, 102; STS
170 END WHILE
180 CONTROL LDSLOT, 102; $0000, $0001      : ! Request to clear Error (Y□□□49)
                                               is off
190 !
200 ! ****Preparations for the operation****
210 ON TIMER #1,20000 GOTO ERROR@          : ! set 20 second timer
220 !
230 FOR I=0 TO 3                           : ! Read scan list
240 ENTER LDSLOT, 21+I NOFORMAT;DLIST (I)
250 NEXT  I
260 !
270 !
280 GOSUB DWRITE@                          : ! Write output data
290 !
400 !****Start operation****
410 CONTROL LDSLOT,101; $0200,$0200        : ! Set scan operation mode (Y□□□
                                               42 ON)
420 CONTROL LDSLOT,101; $0100,$0100        : ! Request to start scanning (Y□□□41
                                               ON)
430 !
440 LOOP1@
450   STS=0
460   STATUS LDSLOT,101;STS                : ! Wait till X□□□9 turns on
470   SCANON=BIT(STS,8)
480   IF SCANON<>1 THEN LOOP1@
490 FOR I=0 TO 3                           :! Confirm the status information of
                                               other nodes
```

```
500   ENTER LDSLOT,25+I NOFORMAT;DSTS (I)
510 IF DLIST (I) <> DSTS (I) THEN LOOP1@      : ! Compare with scan list (Wait
                                                  till it matches)
520 NEXT  I
530 !
540 !
600 ! ****Valid data****
610 OFF TIMER #1                              : ! 20 second timer interrupt off
620 !
630 GOSUB MESSEGE@                            : ! Message Communication request
640 !
650 LOOP2@
660 STS=0
670 STATUS LDSLOT,101;STS                     : ! Confirm that X□□□9 is ON
680 SCANON=BIT (STS,8)
690 IF SCANON=0 THEN ERROR@
700 !
720 GOSUB DREAD@                              : ! Read input data
730 GOSUB DWRITE@                             : ! Write output data
740 GOTO LOOP2@                               : ! Repeat the execution during
                                                  scanning
750 !
800 ! ****Error processing****                : ! Error processing
810 ERROR@
820 ENTER LDSLOT,17 NOFORMAT;ERCODE1
830 ENTER LDSLOT,18 NOFORMAT;ERCODE2
840 ENTER LDSLOT,29 NOFORMAT;ERCODE1          : ! ead the node address in error
850 ENTER LDSLOT,30 NOFORMAT;ERCODE2
860 ENTER LDSLOT,31 NOFORMAT;ERCODE3
870 ENTER LDSLOT,32 NOFORMAT;ERCODE4
880 DP  "ERCODE1=",HEX$ (ERCODE1)             : ! Error code 1(hexadecimal
                                                  display)
890 DP  "ERCODE2=",HEX$ (ERCODE2)             : ! Error code 2(hexadecimal
                                                  display)
900 DP  "ERCODE1=",HEX$ (ERCODE1)             : ! Display error node
                                                  (hexadecimaldisplay)
910 DP  "ERCODE2=",HEX$ (ERCODE2)
920 DP  "ERCODE3=",HEX$ (ERCODE3)
930 DP  "ERCODE4=",HEX$ (ERCODE4)
940 CONTROL LDSLOT, 101;$0000,$FFFF           : ! Request to stop scanning
950 STOP
3000  END
```

7.6 I/O Data Access (Example of Programming)

A programming example of I/O data access is shown below. In this program, the scan list is registered in the input and output data areas and normal communication is performed.

Input data

Data position no.	Data type		Data register (used in Ladder)	Input variable (used in BASIC)
	High order 8 bits	Low order 8 bits		
510	Word data		D0001	IN1
511	Word data		D0002	IN2
512	Word data		D0003	IN3
513	Unused	Byte data	D0004	IN4

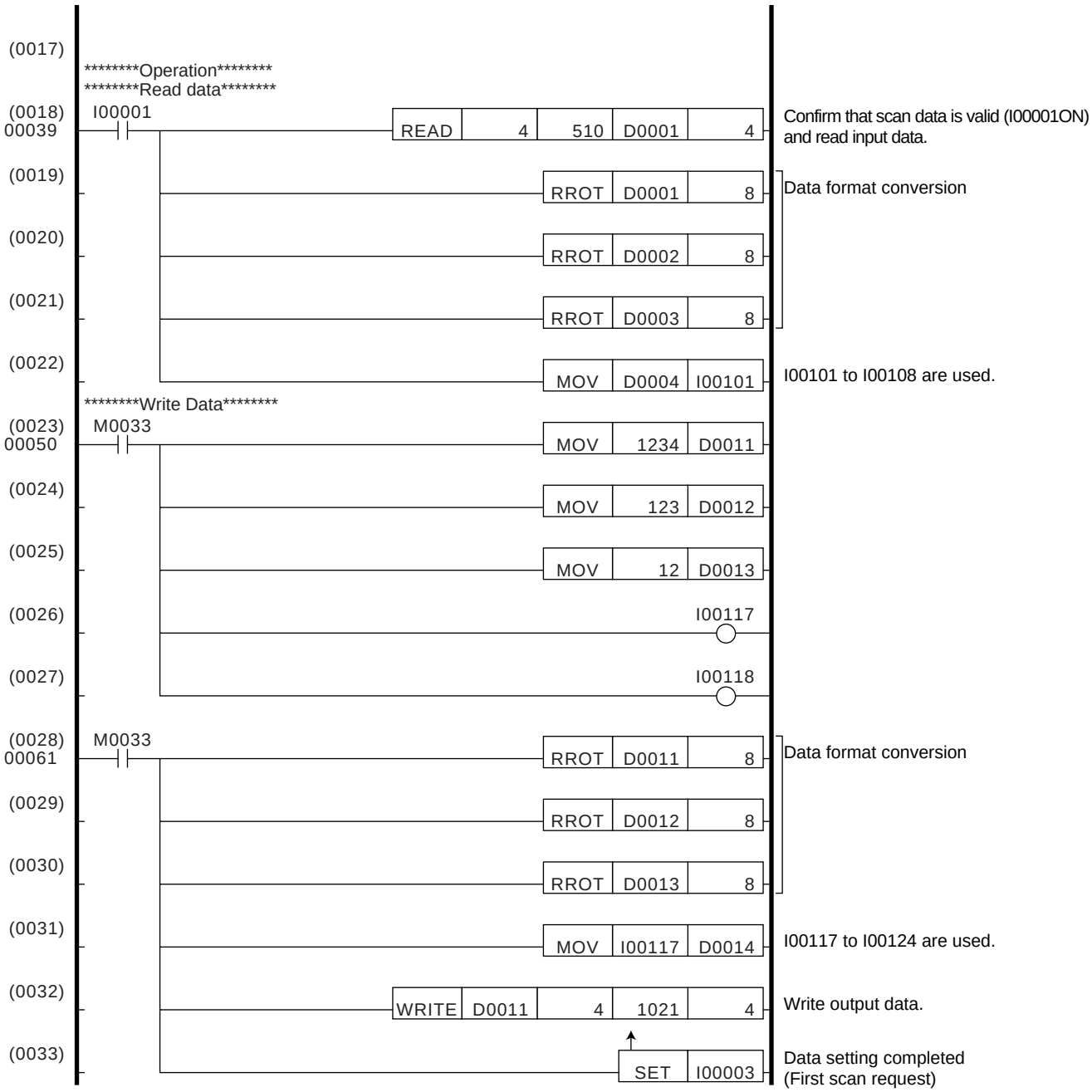
T0706-1.EPS

Output data

Data position no.	Data type		Data register (used in Ladder)	Input variable (used in BASIC)
	High order 8 bits	Low order 8 bits		
1021	Word data		D0011	OUT1
1022	Word data		D0012	OUT 2
1023	Word data		D0013	OUT 3
1024	Unused	Byte data	D0014	OUT 4

T0706-2.EPS

■ Example of Ladder Programming



F0706-1.EPS

■ Example of BASIC Programming

This program is only a subroutine and is called from the program described in Section 7.5, “Start/Stop Operation and Status Management.”

```
1000  ! ****Read input data****
1010  DREAD@
1020    ENTER LDSLOT ,511 NOFORMAT ;IN1    : ! Read input data
1030      IN1=ROTATE(IN1,8)                : ! Data 8-bit rotate
1040    ENTER LDSLOT ,512 NOFORMAT ;IN2
1050      IN2=ROTATE(IN2,8)
1060    ENTER LDSLOT ,513 NOFORMAT ;IN3
1070      IN3=ROTATE(IN3,8)
1080    ENTER LDSLOT ,514 NOFORMAT ;IN4
1090      IN4=BINAND ($FF00,IN4)           : ! High order 8-bit truncation
1100  RETURN
1200  ! ****Write output data****
1210  DWRITE@
1220    OUT1=1234
1230    OUT2=123
1240    OUT3=12
1250    OUT4=2
1260    OUT=ROTATE(OUT1,8)                 : ! Data 8-bit rotation
1270    OUT=ROTATE(OUT2,8)
1280    OUT3=ROTATE(OUT3,8)
1290    OUTPUT LDSLOT, 1021 NOFORMAT ;OUT1 :  ! Write output data
1300    OUTPUT LDSLOT, 1022 NOFORMAT ;OUT2
1310    OUTPUT LDSLOT, 1023 NOFORMAT ;OUT3
1320    OUTPUT LDSLOT, 1024 NOFORMAT ;OUT4
```

8. Message Communications

In this section, operation of message communications in this module and the interface is explained.

8.1 Module Operation

Operation during message communications in this module are explained here.

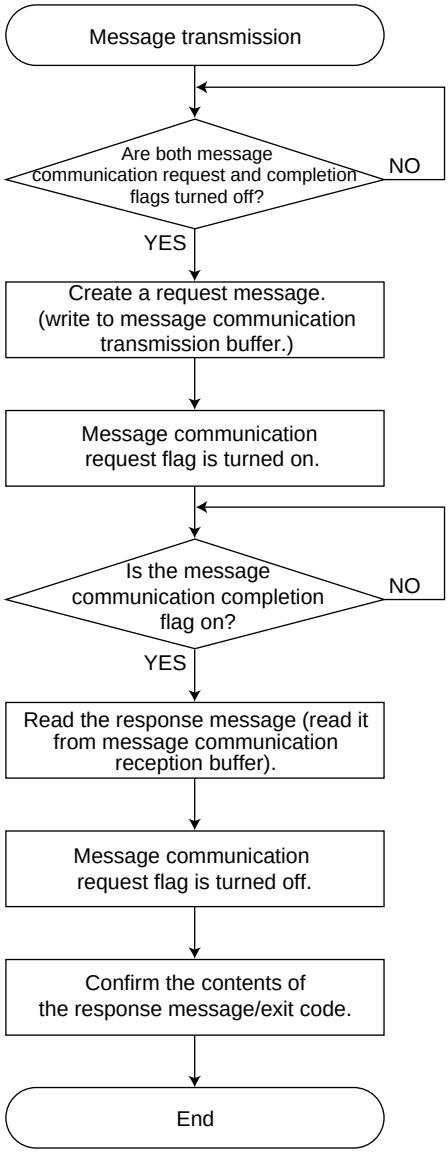
■ Conditions for request to receive communication

When the following conditions are satisfied, a request to receive communication is transmitted.

- "Message communications" are registered in the communications type of the target node in the scan list.
- Scanning is in process
- The target node and the node information match and communication is in progress.

■ Transmission procedure

Use the CPU module's Ladder/BASIC program and follow the procedure below for communication.


Message transmission
Are both message communication request and completion flags turned off?
NO
YES
Create a request message. (write to message communication transmission buffer.)
Message communication request flag is turned on.
Is the message communication completion flag on?
NO
YES
Read the response message (read it from message communication reception buffer).
Message communication request flag is turned off.
Confirm the contents of the response message/exit code.
End

F0801-1.EPS

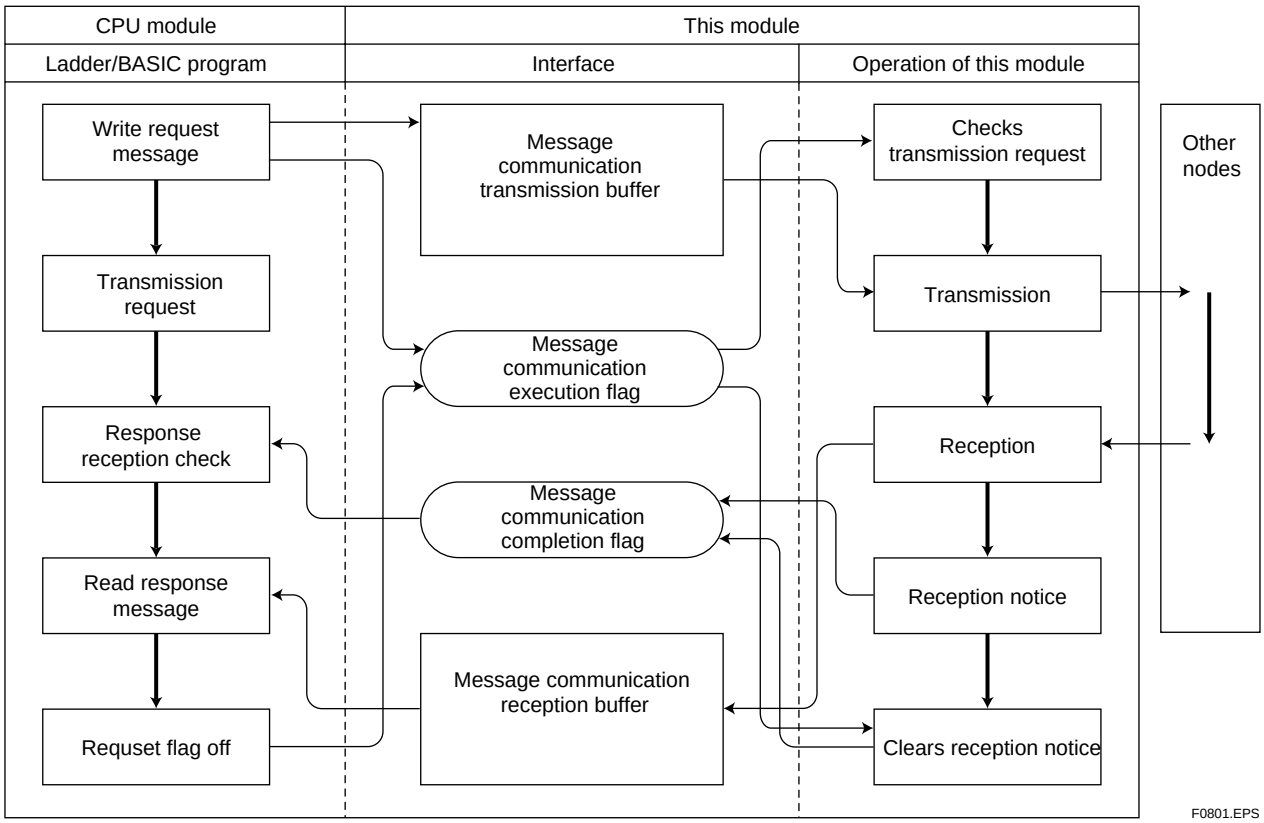


Figure 8.1 Transmission Procedure and Actions of the Module

8.2 Interface

8.2.1 Request and Response Formats

The request and response formats in the message communication transmit/receive buffer are as follows:

- Request

Data position no.	Contents
1501	0 (reserved)
1502	Transmission destination node address
1503	0
1504	0
1505	Size of service data (number of bytes)
1506	Service code specified for DeviceNet
1507	Class ID of transmission destination
1508	Instance ID of transmission destination
1509 (up to 1550)	Service data

T080201-1.EPS

- Response message

Data position no.	Contents
1551	0 (reserved)
1552	Response source node address
1553	Exit code
1554	0 (reserved)
1555	Size of service data (number of bytes)
1556	Service code specified for DeviceNet
1557 (up to 1600)	Service data

T080201-2.EPS

- Limit of service data size
  - Service data (for Request) has a maximum of 84 bytes.
  - When service data (for Response Messages) exceeds 88 bytes, code for "abnormal exit" is stored in the exit code area of the response. In such situations, the first 88 bytes of the service data is kept in the response message.

- High order / low order byte swapping of multiple-byte data in service data

The encoding rules are different for data on FA-M3 and DeviceNet. Hence, in multi-byte data, it is necessary to swap the byte high order/ low order byte every 2 bytes.

See also Section 7.2, “Module Operation.”

SEE ALSO

For information on the service code, service data, class ID and instance ID, refer to the “DeviceNet Specification” published by ODVA.

8.2.2 Exit Codes

The exit codes used for message communications are described herein.

Error code	Description	Troubleshooting
$0100	Connection for message communications is unavailable.	Target node may be absent or message communications are not registered as communication type in scan list. Confirm the network status and device list.
$0101	Parameter error (Class ID)	Class ID specification area for target node is less than or equal to 255, but a value above 256 is specified. Specify a valid value.
$0102	Parameter error (instance ID)	Instance ID specification range for the target node is less than or equal to 255, but a value above 256 is specified. Specify a valid value.
$F101	Receive buffer size overflow for response message	Normal receive is not possible for this service. First 88 bytes of the service data is stored in receive buffer.
$F102	Parameter error (node address)	Specify the correct node address in the range from 0 to 63.
$E112	Network power failure during communications	See error codes (see Section 10, “Errors and Troubleshooting”).
$E144	No response from target device (timeout)	See error codes (see Section 10, “Errors and Troubleshooting”).

T080202-1.EPS

8.3 Sample Programs

Remote setting of operation (output cut-off/maintain) during abnormal communications of a discrete output device is given as a sample program of message communications.

The target device supports the following services and attributes.

- Service

  SetAttribute_Single (DeviceNet common service, $10)

- Attribute

  Class ID = 9, Instance ID = 1, Attribute ID = 5

  (Prescribed attribute value for operation during a communication error)

- Setup value

  8-bit integer (0 = Cut off, 1 = Maintain)

Message request format

Data position no.	Data	Contents
1501	0	Reserved
1502	1	Transmission destination node address
1503	0	Reserved
1504	0	Reserved
1505	2	Service data size (byte)
1506	$10	Service code "Set_Attribute_Single"
1507	9	Class ID
1508	1	Instance ID
1509 High-order 8 bits	$05	Service data Attribute ID, 5
1509 Low-order 8 bits	$01	Service data Setup value, 1

T0803-1.EPS

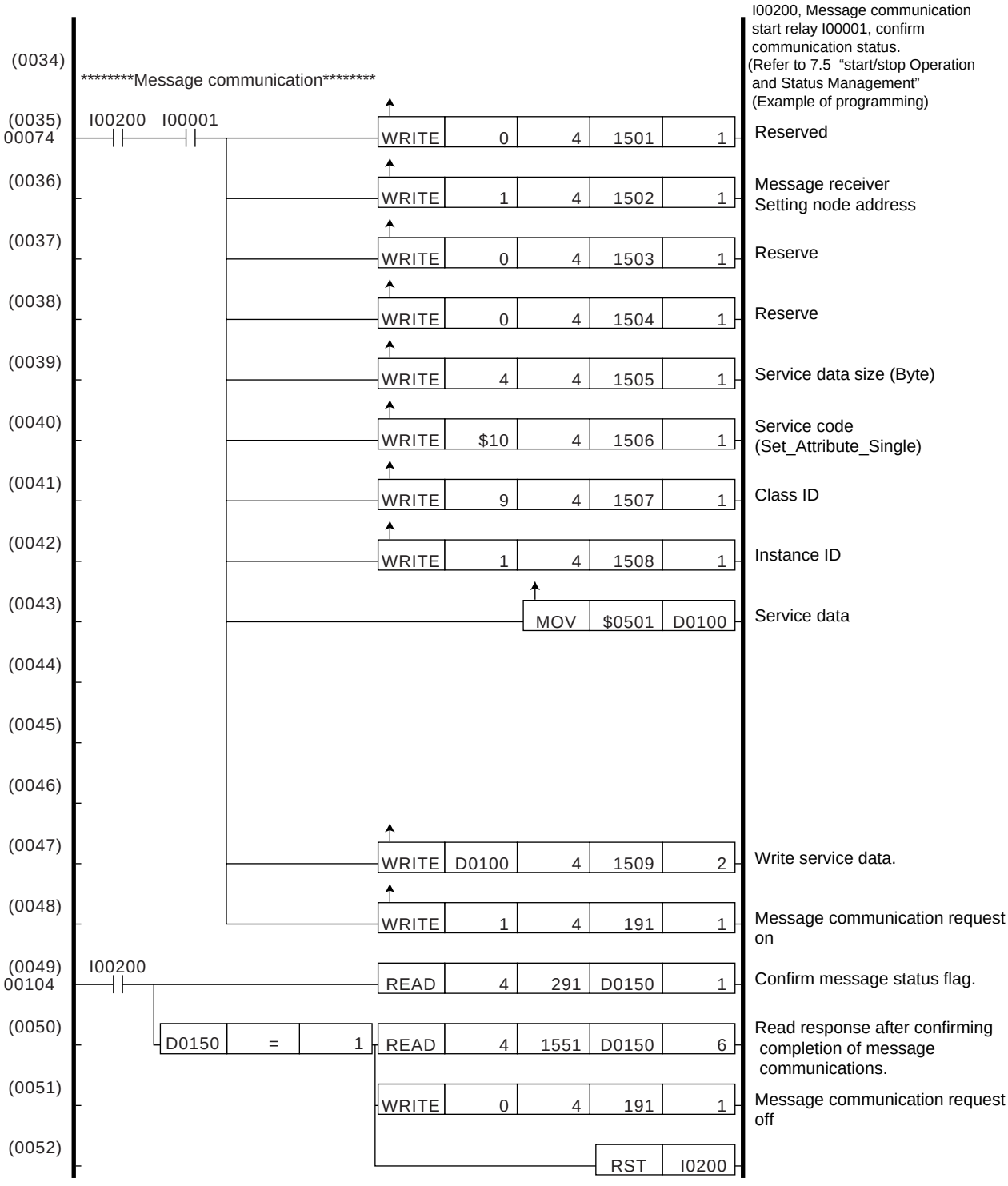
Message response format (during normal exit)

Data position no.	Data	Contents
1551	0	Reserved
1552	1	Transmission destination node address, 1
1553	0	Error code, 0
1554	0	Reserved
1555	0	Size of service data, 0 byte
1556	$90	Service code ($80 + service code)

T0803-2.EPS

■ Example of Ladder Programming

Only message communications are given in this program. Use it with the program given in Section 7.5, “Start/Stop Operation and Status Management.”



F0803-1.EPS

■ Example of BASIC Programming

This program is only a subroutine and can be called from the program described in Section 7.5, “Start/Stop Operation and Status Management.”

```
2000  ! ****Message communication****
2010  MESSEGE@
2020    OUTPUT LDSLOT ,1501 NOFORMAT ;0       : ! Reserved
2030    OUTPUT LDSLOT ,1502 NOFORMAT ;1       : ! Node number
2040    OUTPUT LDSLOT ,1503 NOFORMAT ;0       : ! Reserved
2050    OUTPUT LDSLOT ,1504 NOFORMAT ;0       : ! Reserved
2060    OUTPUT LDSLOT ,1505 NOFORMAT ;2       : ! Service data size (Byte)
2070    OUTPUT LDSLOT ,1506 NOFORMAT ;$10     : ! Service code2080
      OUTPUT LDSLOT ,1507 NOFORMAT ;9         : ! Class ID
2090    OUTPUT LDSLOT ,1508 NOFORMAT ;1       : ! Instance ID
2100    SEND1=$0501                           :  ! Service data
2140    OUTPUT LDSLOT ,1509 NOFORMAT ;SEND1   : ! Write service data
2150    OUTPUT LDSLOT ,1510 NOFORMAT ;SEND2   : !
2160    OUTPUT LDSLOT ,191 NOFORMAT ;1        : !Message communication request
2170    !
2180    MSTS=0
2190    WHILE MSTS=0                          : ! Wait till message status flag
                                                  turns ON
2200    ENTER LDSLOT 291, NOFORMAT ;MSTS
2210    END WHILE
2220    ENTER LDSLOT ,1551 NOFORMAT ;MSG1     : ! Read response
2230    ENTER LDSLOT ,1552 NOFORMAT ;MSG2
2240    ENTER LDSLOT ,1553 NOFORMAT ;MSG3
2250    ENTER LDSLOT ,1554 NOFORMAT ;MSG4
2260    ENTER LDSLOT ,1555 NOFORMAT ;MSG5
2270    ENTER LDSLOT ,1556 NOFORMAT ;MSG6
2280    !
2290    OUTPUT LDSLOT ,191 NOFORMAT ;0        : ! Release Message Comm.  Request
2300  RETURN
```

9. Configuration

Configuration includes the following:

- Creating a scan list
- Registering the transmission time interval
- Storing in flash memory
- Remote setting of other nodes (see Section 8.3, “Sample Programs,” in this manual)

Configuration is performed by starting the Ladder/BASIC program for setting configuration on the CPU module which is defined when this module is used. Configuration is confirmed using Ladder Diagram Support Program Tool M3 or BASIC Programming Tool M3.

9.1 Tool Commands

Tool command are an interface that can be used to define the actions of this module using the Ladder/BASIC program when preparing for operation.

Please do not use the tool commands during operation.

9.1.1 Commands

Tool commands are given in Table 9.1.

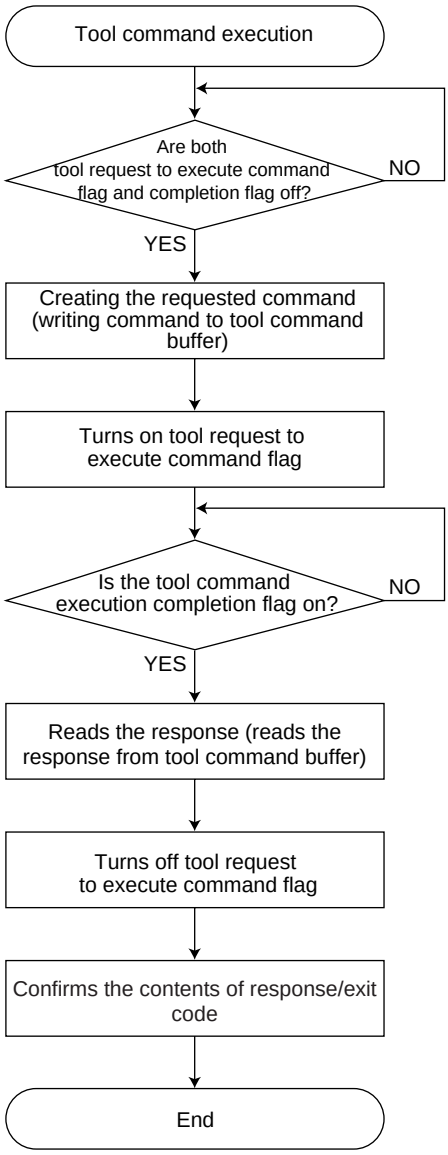
Table 9.1 Commands

Command no.	Command
$03	Register Device (Scan List)
$04	Read Device (Scan List)
$05	Delete Device (Scan List)
$71	Store Flash Memory (Transmission Time Interval/Scan List)
$72	Register Transmission Time Interval
$73	Read Master Information

T0901.EPS

9.1.2 Request Procedure

The request procedure for the tool commands is given below.



F090102-1.EPS

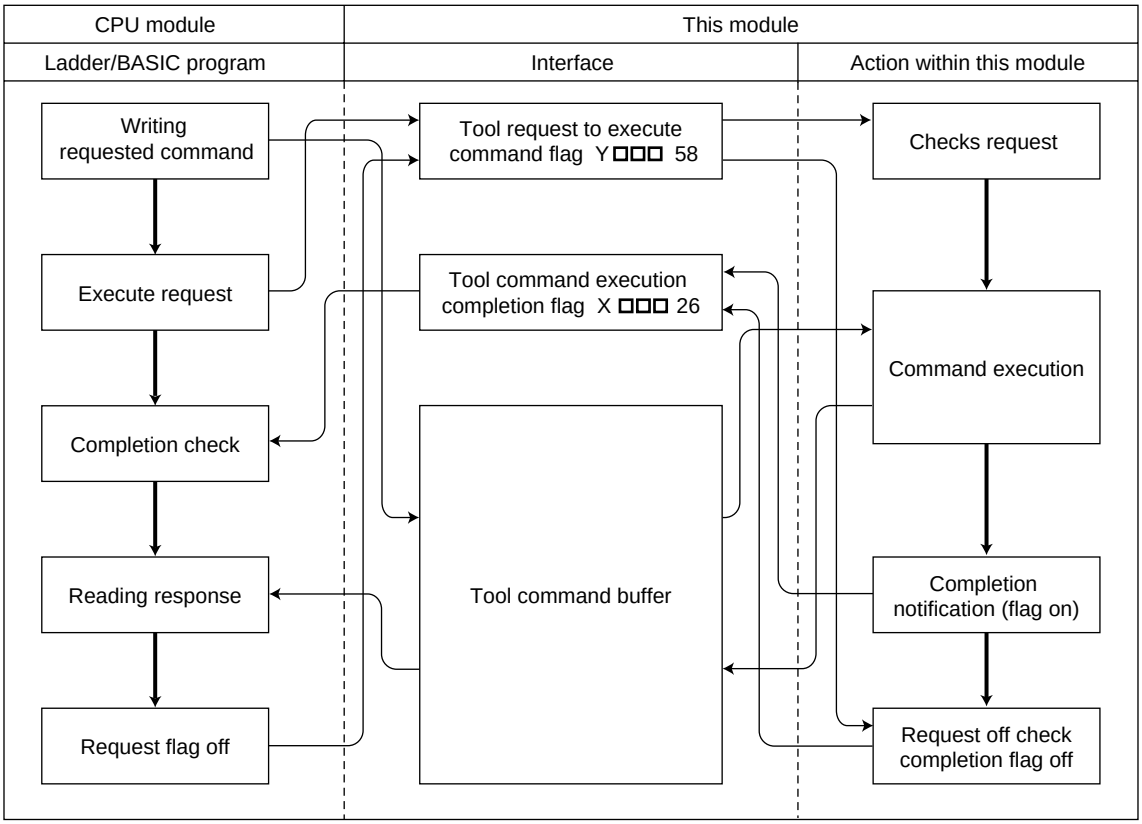


Figure 9.1 Tool Command Request Procedures and Actions of the Module

9.1.3 Basic Command Formats

The format for a request/response (normal exit/error exit) is given below.

- Request

Data position no.	Content
400	Command number
401 to 449	Parameters

T090103-1.EPS

- Response (normal exit)

Data position no.	Content
400	Command number
401 to 449	Parameters

T090103-2.EPS

- Response (error exit)

Data position no.	Content
400	Command number+$8000
401	Exit code

T090103-3.EPS

TIP

The tool command buffer uses the same area for requests and responses.

9.1.4 Details of Commands

1) Register device

Registers device information for each node in the scan list. Nodes already registered cannot be registered again. Perform registration after deleting the devices and emptying the information in the scan list.

- Request

Data position no.	Content
400	Command = $03
401	Node number
402	Vendor ID
403	Device type
404	Product code
405-407	Reserved
408	Communications type
409-411	Reserved
412	Size of output data (bytes)
413	Offset of output data (bytes)
414-415	Reserved
416	Size of input data (bytes)
417	Offset of input data (bytes)
418-426	Reserved

T090104-1.EPS

- Response (normal exit)

Data position no.	Content
400	Command = $03

T090104-2.EPS

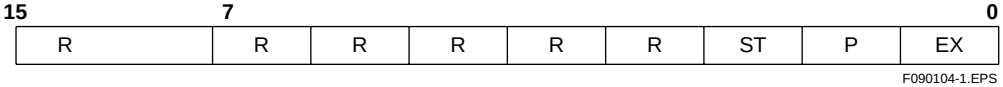
- Response (error exit)

Data position no.	Content
400	$8003
401	Exit code

T090104-3.EPS

- Supplement
  - Set reserved area to 0.
  - Communications type

Use only one method of I/O communications. Both I/O communications and message communications can be selected.



F090104-1.EPS

R: System reserved

EX: Message communications

P: I/O communications: Polling

ST: I/O communications : Bit strobe

- The I/O data offset is the relative position from the beginning of every I/O data buffer. The unit for the I/O data offset/size is bytes.
- The input data size of a Bit Strobe should be less than or equal to 8 bytes.
- Set the size/offset to 0 when no I/O communications are being carried out.
- Registration is not possible during scanning.

2) Read device

Reads device information of a node from the scan list.

- Request

Data position no.	Content
400	Command = $04
401	Node number

T090104-4.EPS

- Response (normal exit)

Data position no.	Content
400	Command = $04
401	Node number
402	Vendor ID
403	Device type
404	Product code
405-407	Reserved
408	Communications type
409-411	Reserved
412	Size of output data (bytes)
413	Offset of output data (bytes)
414-415	Reserved
416	Size of input data (bytes)
417	Offset of input data (bytes)
418-426	Reserved

T090104-5.EPS

- Response (error exit)

Data position no.	Content
400	$8004
401	Exit code

T090104-6.EPS

- Supplement
  - For information on communications type/offset, refer to the description of device registration.

3) Delete device

Deletes the device information of a node from the scan list.

- Request

Data position no.	Content
400	Command = $05
401	Node number

T090104-7.EPS

- Response (normal exit)

Data position no.	Content
400	Command = $05

T090104-8.EPS

- Response (error exit)

Data position no.	Content
400	$8005
401	Exit code

T090104-9.EPS

- Supplement
  - Deletion is not possible during scanning.

4) Store in flash memory

Writes the transmission time interval/device list to flash memory.

- Request

Data position no.	Content
400	Command = $71

T090104-10.EPS

- Response (normal exit)

Data position no.	Content
400	Command = $71

T090104-11.EPS

- Response (error exit)

Data position no.	Content
400	$8071
401	Exit code

T090104-12.EPS

- Supplement
  - Writing is not possible during scanning.

5) Register transmission time interval

Registers transmission time intervals.

- Request

Data position no.	Content
400	Command = $72
401-402	Reserved
403	Transmission time interval [msec]

T090104-13.EPS

- Response (normal exit)

Data position no.	Content
400	Command = $72

T090104-14.EPS

- Response (error exit)

Data position no.	Content
400	$8072
401	Exit code

T090104-15.EPS

- Supplement
  - Set reserved areas to 0.
  - Valid range for the transmission time interval is 0 to 5000 [ms].
  - Registration cannot be carried out during scanning.

6) Read master information

Reads information related to the master.

- Request

Data position no.	Content
400	Command = $73

T090104-16.EPS

- Response (normal exit)

Data position no.	Content
400	Command = $73
401-402	Reserved
403	Transmission time interval [msec]
404	Reserved
405	Vendor ID
406	Device type
407	Product code
508	Revision
409	Status
410-411	Serial number
412-429	Product name
430	Reserved

T090104-16.EPS

- Response (error exit)

Data position no.	Content
400	$8073
401	Exit code

T090104-17.EPS

- Supplement

This module keeps the module information shown in Table 9.2, in accordance with the DeviceNet specification. This information can be read using the read master information command.

Table 9.2 Module Information Summary

Name	Description	Value of this module
Vendor ID	Identifier of device manufacturer	$FA
Device type	Code indicating device type	$C
Product code	Code indicating device model	1
Revision	Product revision of device	*1
Status	Module status of device	*2
Serial number	Serial number of device	*3
Product name	Product name of device	*4

T0902.EPS

*1 The revision starts from 1.1 ($0101) in the DeviceNet manual.
*2 The status codes given in the DeviceNet manual are used.
*3 Each device is given a unique number.
*4 FA-M3 LD01 Scanner Module

9.1.5 Exit Codes

The unique exit codes used in response to tool commands are given in Table 9.3. In the case of an incorrect response to a request, either confirm the command number/parameter or delete device/stop scanning before the request, according to the exit code.

Table 9.3 Summary of Exit Codes

Item	Exit code	Description
Unsupported command	$0001	The specified command is not supported.
Node number error	$0002	The specified node number is beyond the range.
Device already registered	$0005	The device is already registered.
Device is not set	$0006	The scan list is empty.
Scanning in progress	$000A	Execution is not possible during scanning.
Outside the data area range	$000D	Value specified is outside the range of the I/O data area.
Communications type error	$000F	The specified communications type is not supported.
Flash memory error	$1283	Unable to write to flash memory due to exceeding the limit allowed for writing to flash memory.
Connection not used	$8000	Offset/size are specified even though I/O communications is not selected.
Data area undefined	$8001	Offset/size are not specified even though I/O communications is selected.
Duplication of data area	$E131	The data area being used is duplicated in another node.
Master information error	$E133	Beyond the range of master information parameter (transmission time interval).

T0903.EPS

9.2 Configuration Procedure

Configuration involves the following steps:

1. Create a scan list and set the transmission time interval.

   Register the nodes with which communication is to be established (create a scan list) and set the transmission time interval using the tool command. Set the transmission time interval to either 0 msec. or to a specific value (it is necessary to set the values again using values measured during the test run).

   In the sample program in Section 9.3 of this manual, the steps for registering the devices and setting the transmission time interval are given. After the setting is done, execute the program.

2. Test Run

   Start scanning and verify whether communication is taking place properly with the devices registered in the scan list. If there is an error, check the settings, wiring, scan list, etc. of this module and other devices, then re-adjust and set again.

   Once normal communication with all the nodes is confirmed, compute the transmission time interval measured value (Data position no. 8 of I/O data register) (If the measured values are unsteady, record the maximum value).

   For operation, see the sample program in Section 7.5, “Start/Stop Operation and Status Management (Example of Programming),” in this manual.

3. Evaluate Configuration Results

   If communication does not take place properly and if the measured value of the transmission time interval (actual value during scanning) exceeds the set value, set an appropriate value again, and then test run and confirm the operation.

CAUTION

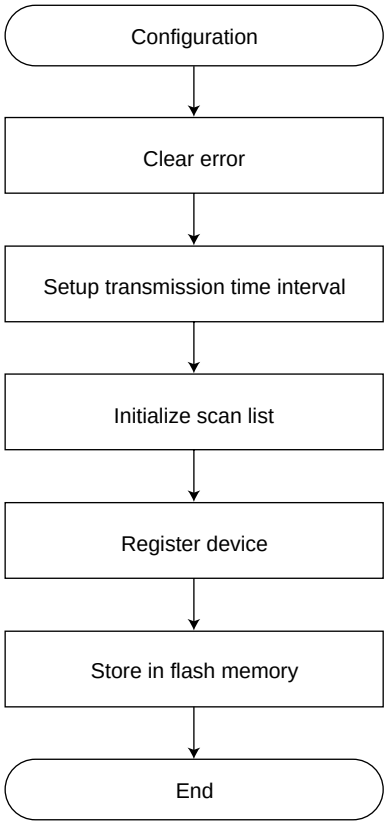
(1) In the sample program given in Section 9.3 of this manual, the processes necessary for configuration (Setting transmission time interval / Initialising scan list / device registration / storing in flash memory) are carried out in one program. When changing the configuration, re-run the program after making the necessary changes.

(2) The transmission time interval/scan list is stored in the flash memory all at once. Please note that this deletes all the previous data in the flash memory.

9.3 Sample Program

A sample program for configuration is given here.

Configuration is carried out as follows:



Clears the error flags of this module.

Sets up transmission time interval.

Deletes all the registered devices from the scan list.

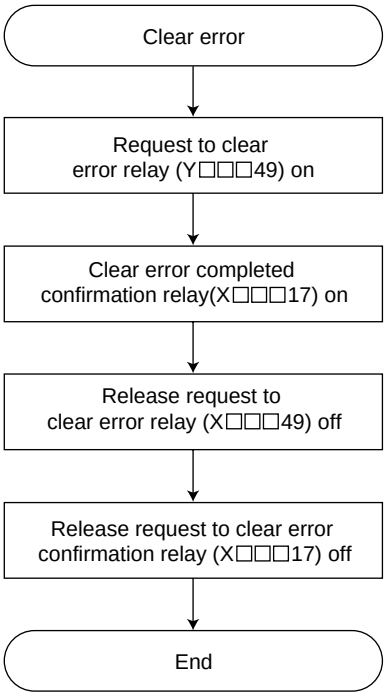
Registers device and creates a scan list.

Stores the register scan list and transmission time interval in flash memory. If it is not stored in flash memory, the scan list is lost when power is switched to off.

F0903-1.EPS

- Clear Error

  The clear error command is carried out as follows:

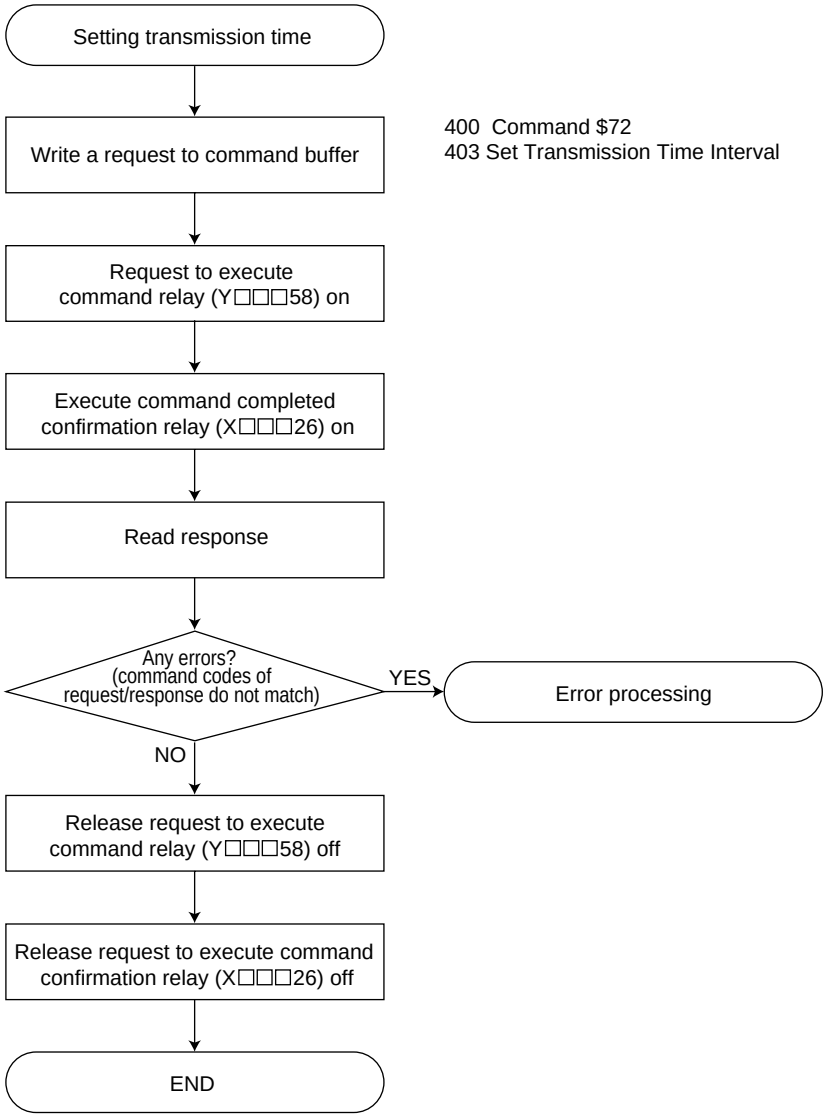


F0903-2.EPS

- Setting Transmission Time Interval

  Setting the transmission time interval is carried out as shown below.

  In the sample program, the transmission time interval is set to 20 ms.

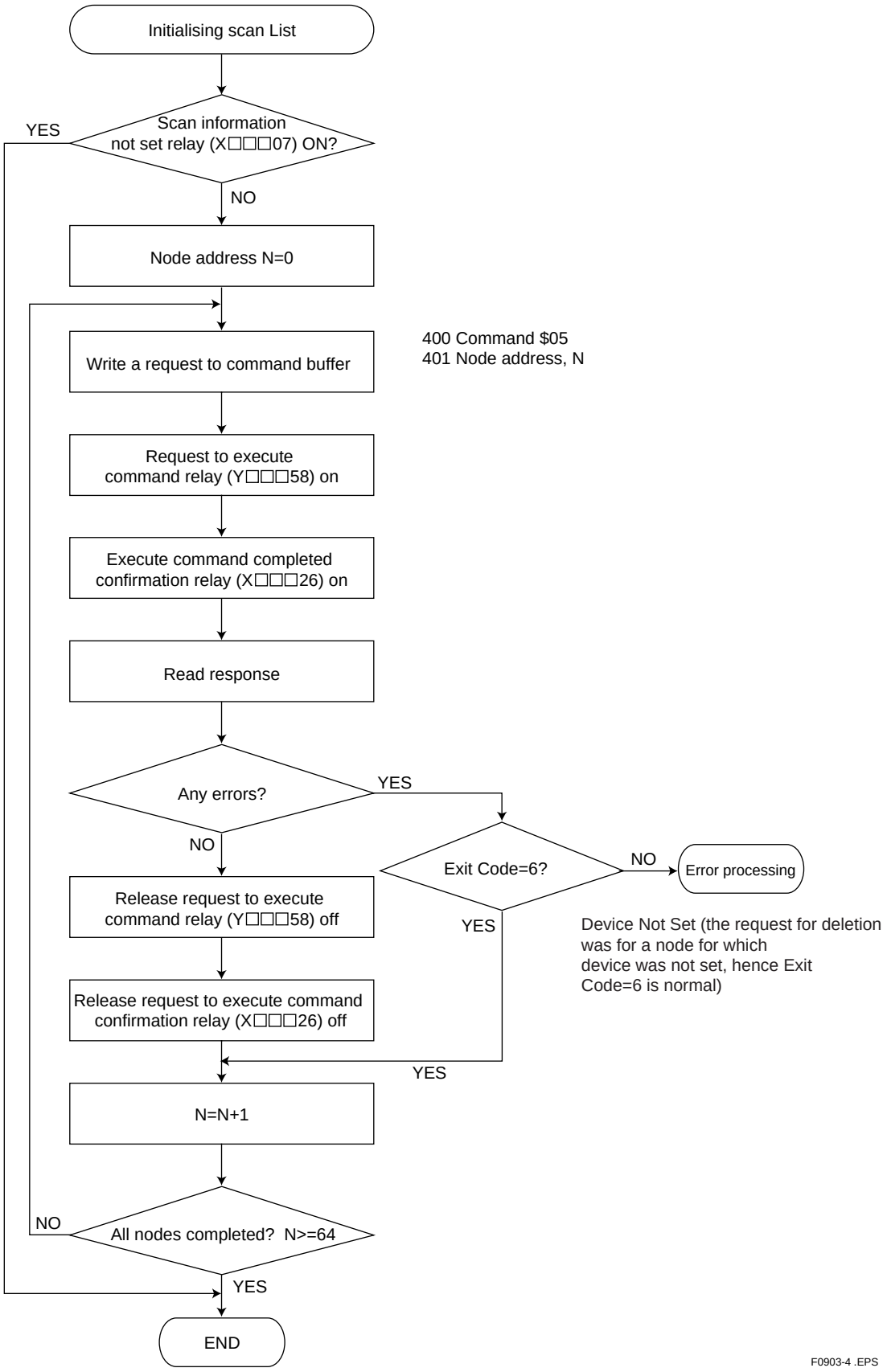

Setting transmission time
Write a request to command buffer
400 Command $72
403 Set Transmission Time Interval
Request to execute command relay (Y□□□58) on
Execute command completed confirmation relay (X□□□26) on
Read response
Any errors? (command codes of request/response do not match)
YES
Error processing
NO
Release request to execute command relay (Y□□□58) off
Release request to execute command confirmation relay (X□□□26) off
END

F0903-3.EPS

- Initalizing Scan list

If there are registered devices, they are deleted from the scan list.

Deletion from the scan list is carried out in the following manner.



F0903-4 .EPS

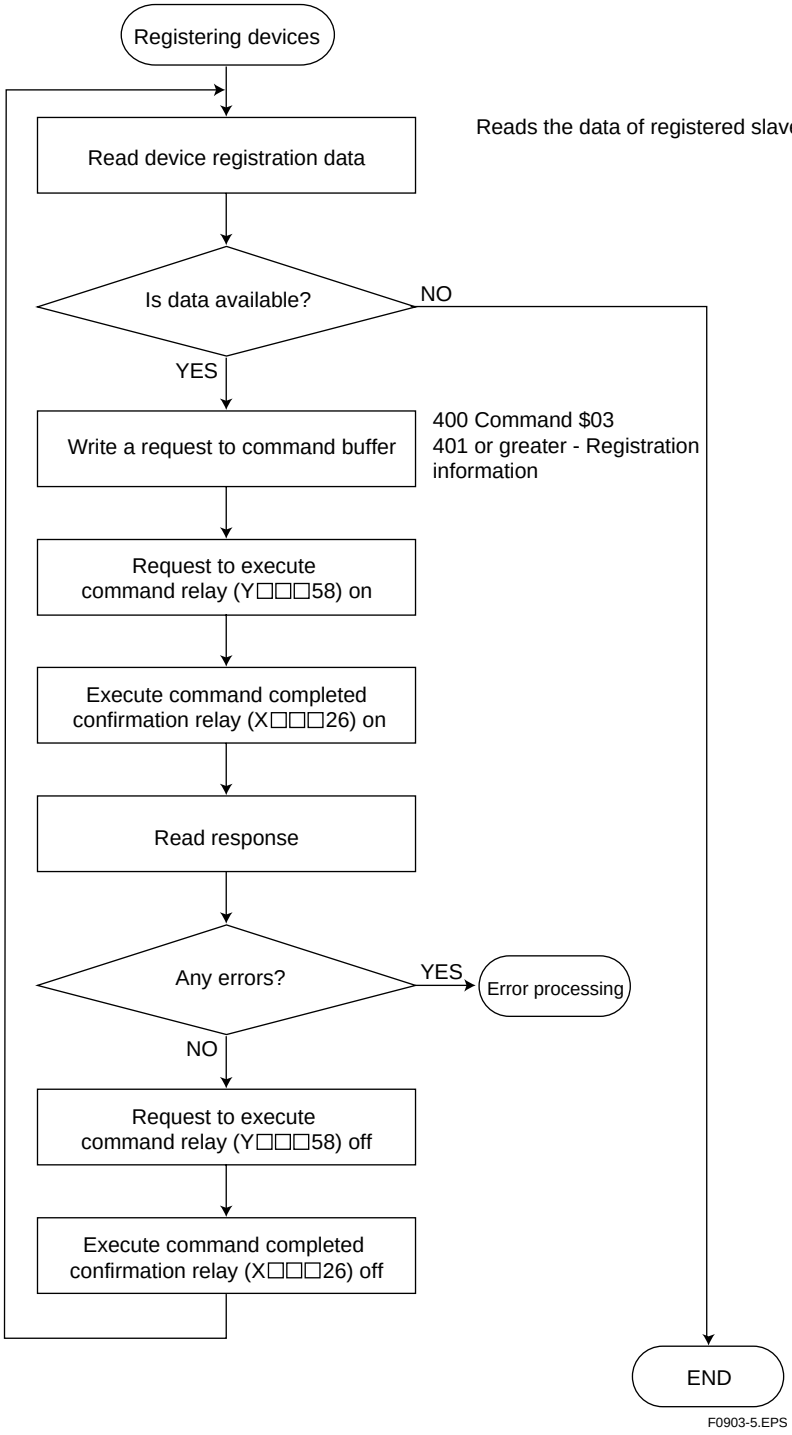
- Registering Devices

The procedure for device registration is given below.

In the sample program, the following two devices are being registered.

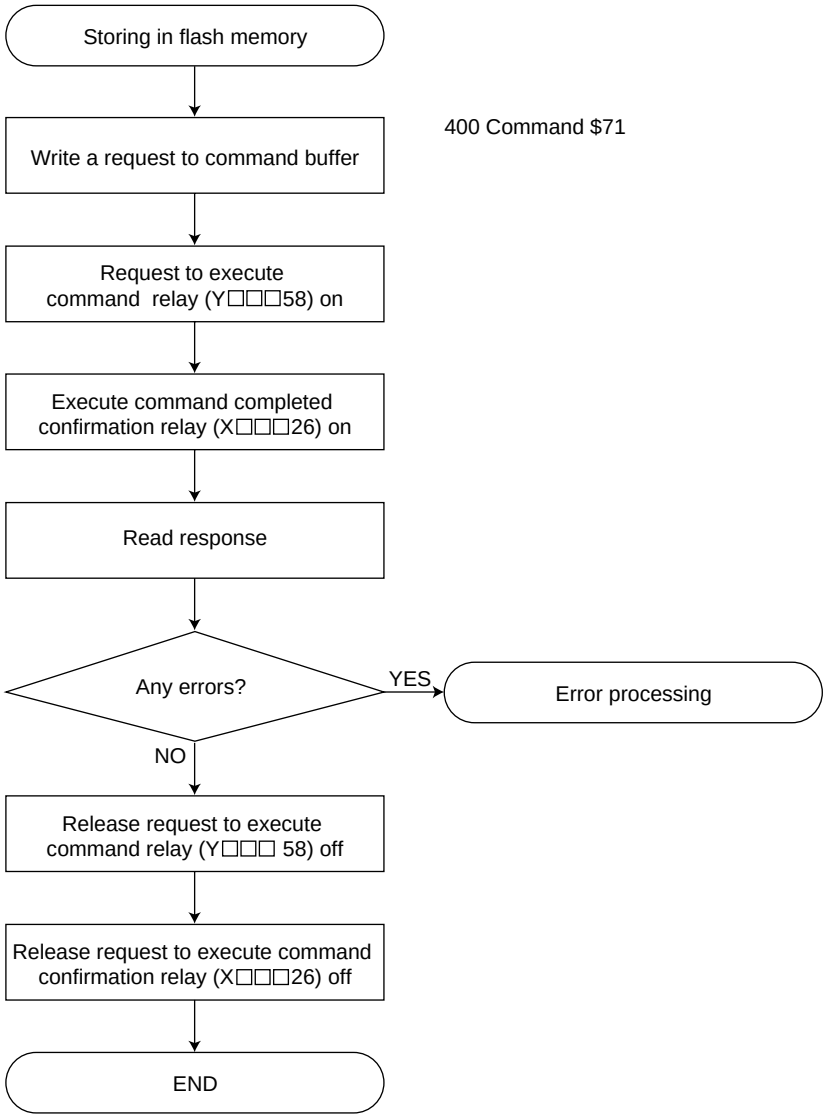
Item	Data	Data
Node no	1	2
Vendor ID	47 (Omron Corporation)	47 (Omron Corporation)
Device type	0	0
Product code	100 (Type DRT1-ID08)	101 (Model DRT1-OD08)
Communication type	4 (Bit Strobe)	3 (Polling and message communications)
Input data size (bytes)	1	0
Input data offset (bytes)	27 (Input data position 513 low order)	0
Output data size (bytes)	0	1
Output data offset (bytes)	0	49 (Output data position 1024 low order)

T0903-1.EPS


Registering devices
Read device registration data
Reads the data of registered slave one by one.
Is data available?
NO
YES
Write a request to command buffer
400 Command $03
401 or greater - Registration information
Request to execute command relay (Y□□□58) on
Execute command completed confirmation relay (X□□□26) on
Read response
Any errors?
YES
Error processing
NO
Request to execute command relay (Y□□□58) off
Execute command completed confirmation relay (X□□□26) off
END
F0903-5.EPS

- Storing in flash memory

The steps for storing in flash memory are given below.



■ Sample Program Using Ladder Program

A sample program using ladder programs is shown here. The sample program is created based on the following conditions.

- This module is installed in slot 4.
- The contents for device registration should be set in advance as given below.

  D0051 ~ information for first item

  D0101 ~ information for second item

  D0051+50×N information for Nth item

  Set -1 at the end of the data.

- Handling internal register

  D0001 = 6 Normal exit

  D0001 = 7 Error has occurred

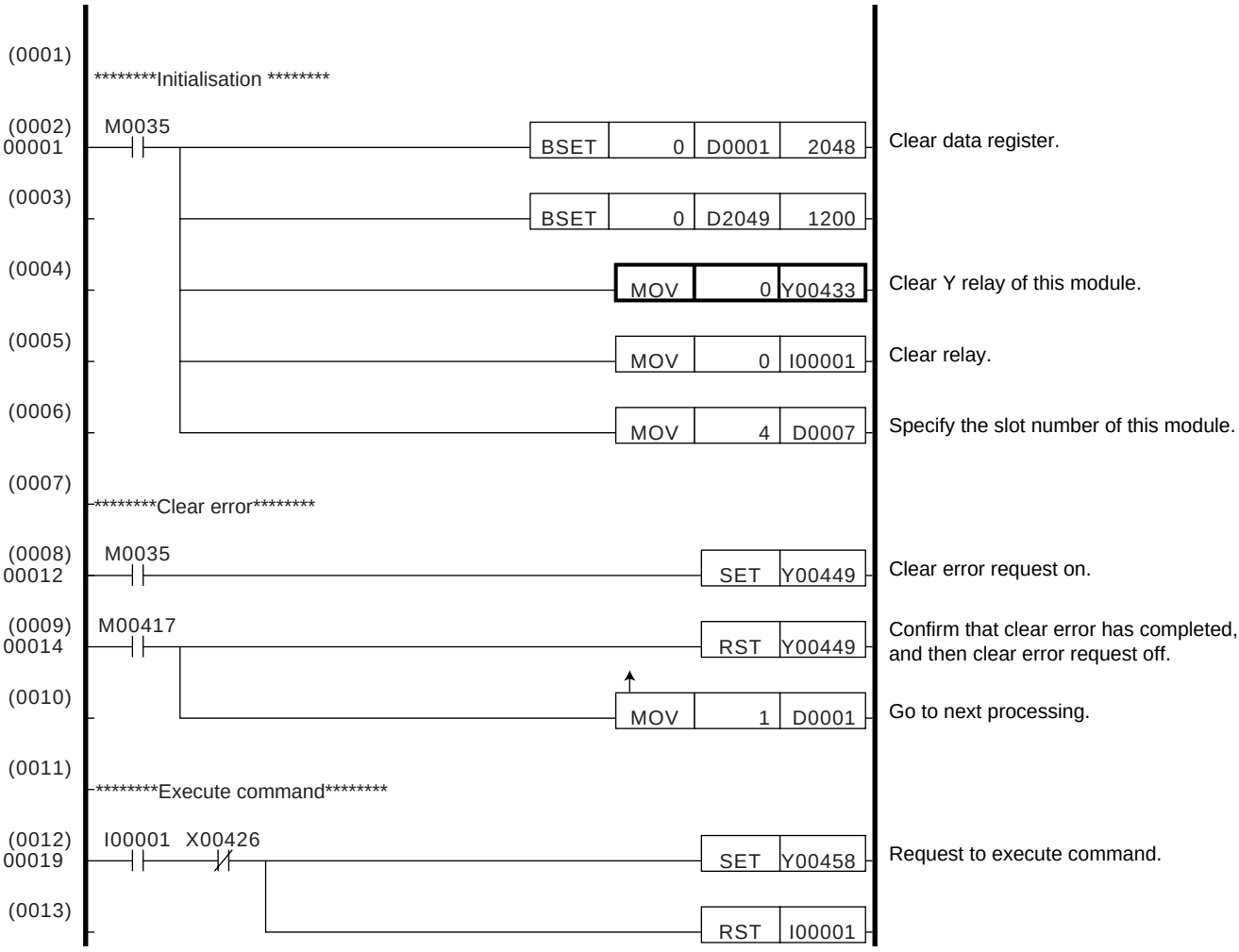
  D0011: Process number where an error has occurred

  D0012: Node address where an error has occurred (during device deletion)

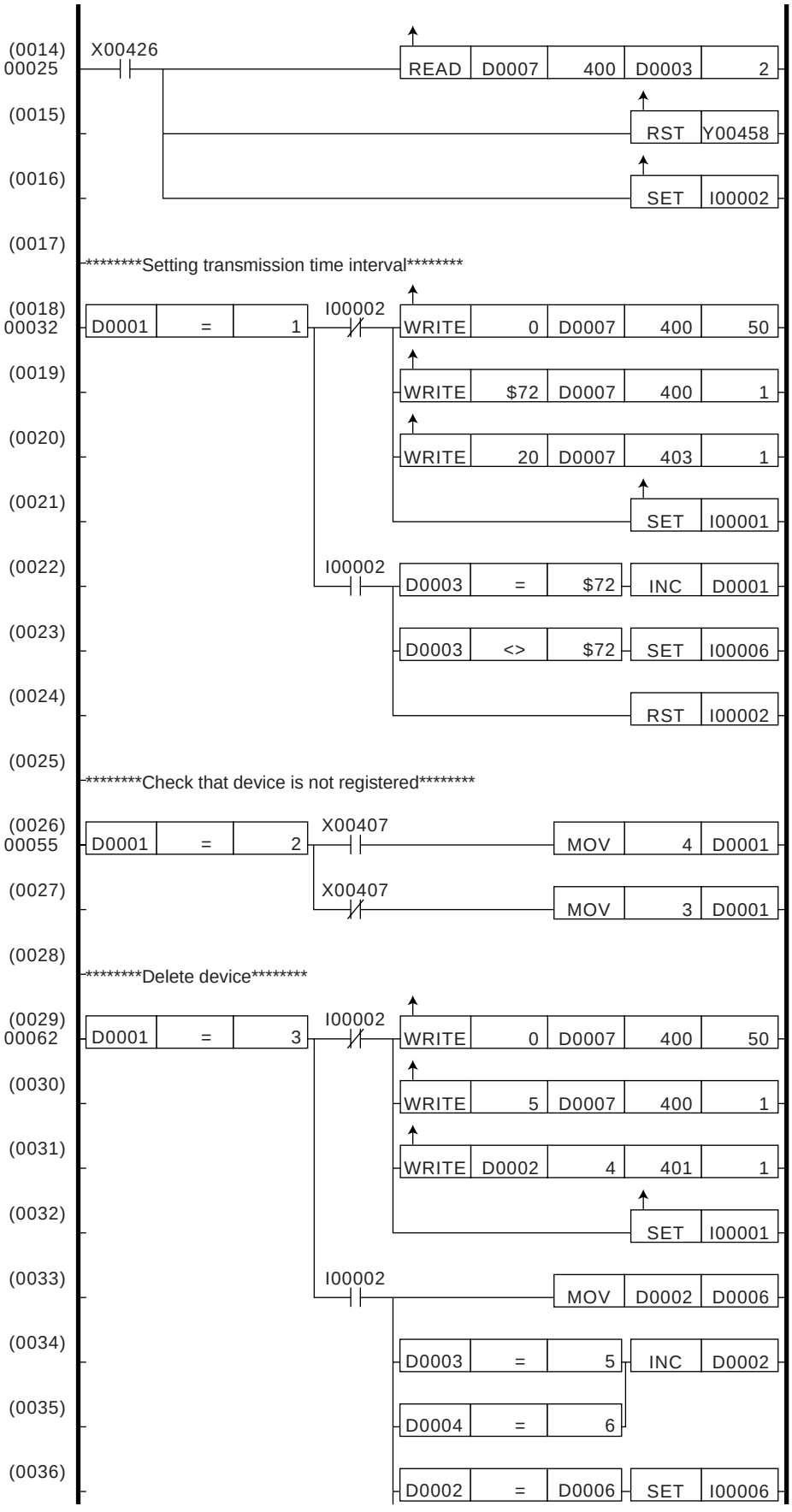
  Information of (N-1)th device where an error has occurred (during device registration)

  D0013: Command where an error has occurred ($8000+command number)

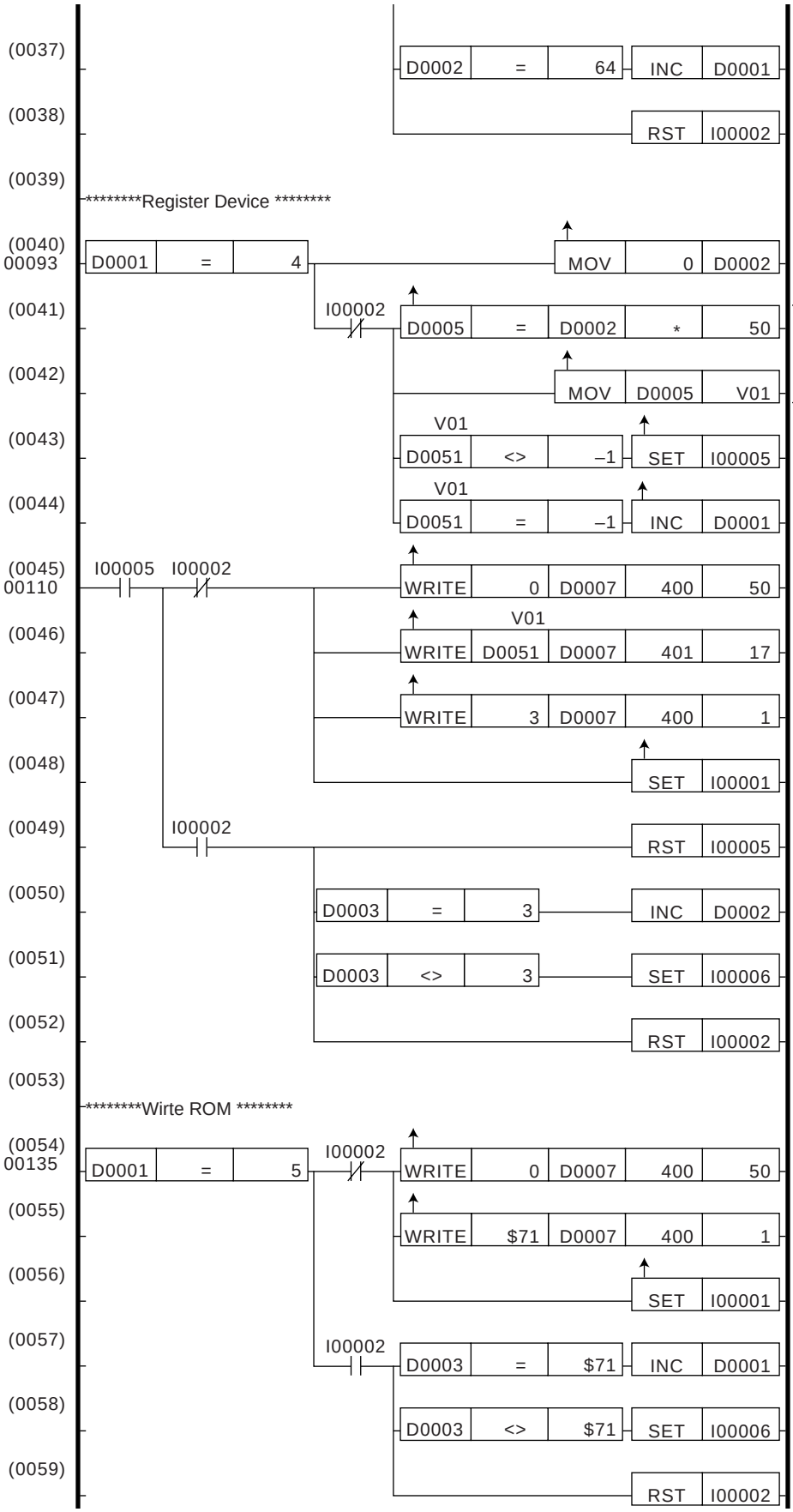
  D0014: Exit code when an error has occurred


(0001)
********Initialisation ********
(0002)
00001
M0035
BSET 0 D0001 2048
Clear data register.
(0003)
BSET 0 D2049 1200
(0004)
MOV 0 Y00433
Clear Y relay of this module.
(0005)
MOV 0 I00001
Clear relay.
(0006)
MOV 4 D0007
Specify the slot number of this module.
(0007)
********Clear error********
(0008)
00012
M0035
SET Y00449
Clear error request on.
(0009)
00014
M00417
RST Y00449
Confirm that clear error has completed, and then clear error request off.
(0010)
MOV 1 D0001
Go to next processing.
(0011)
********Execute command********
(0012)
00019
I00001 X00426
SET Y00458
Request to execute command.
(0013)
RST I00001

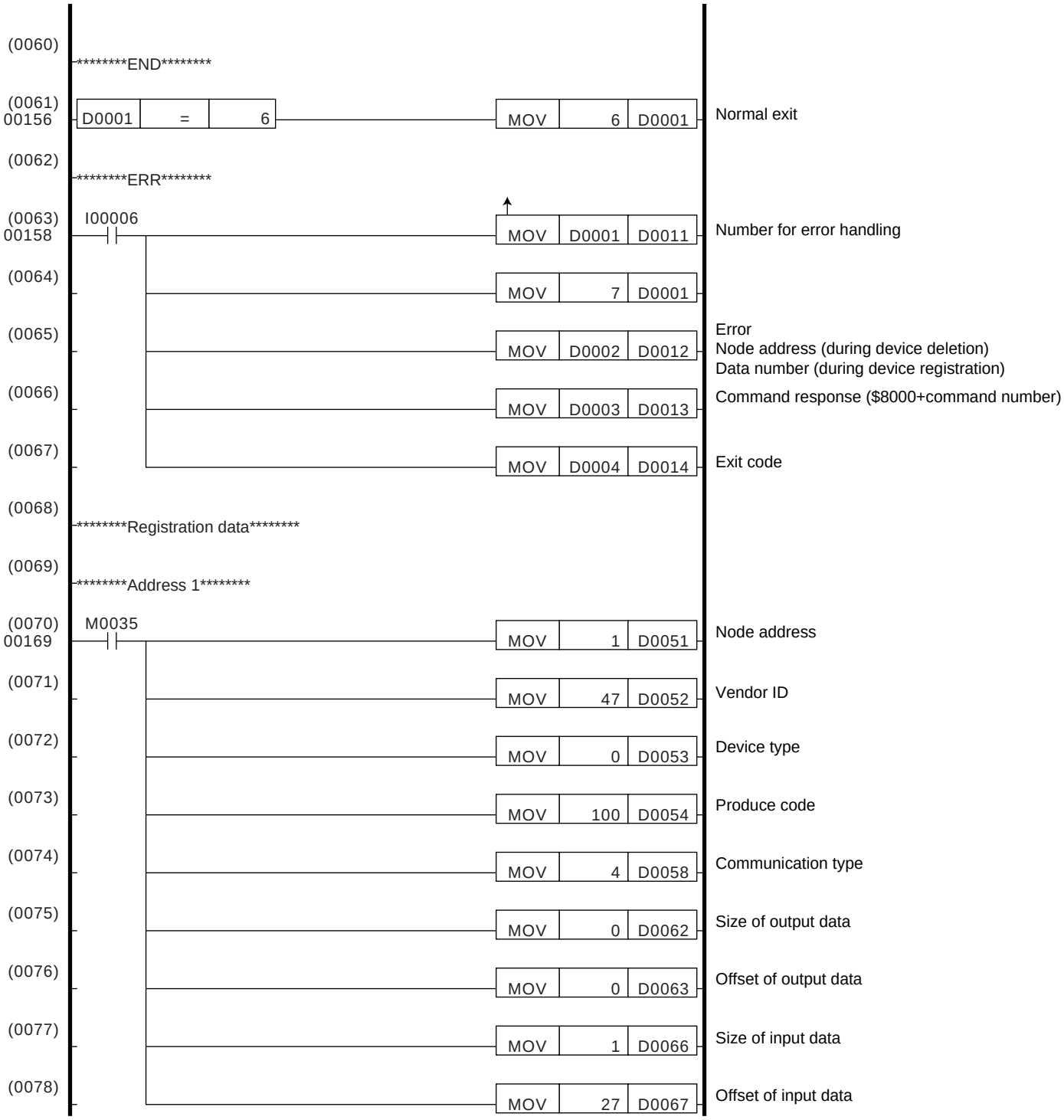
F0903-7.EPS


(0014)
00025
X00426
READ D0007 400 D0003 2
Confirm that command execution has completed, and then read response.
(0015)
RST Y00458
Request to execute command off.
(0016)
SET I00002
(0017)
********Setting transmission time interval********
(0018)
00032
D0001 = 1
I00002
WRITE 0 D0007 400 50
Clear tool command buffer.
(0019)
WRITE $72 D0007 400 1
Command $72
(0020)
WRITE 20 D0007 403 1
Set transmission time interval to 20ms.
(0021)
SET I00001
Request to execute command.
(0022)
I00002
D0003 = $72 INC D0001
Proceed to next processing on normal exit.
(0023)
D0003 <> $72 SET I00006
Proceed to error processing on error.
(0024)
RST I00002
(0025)
********Check that device is not registered********
(0026)
00055
D0001 = 2
X00407
MOV 4 D0001
Proceed to device registration if device is not registered.
(0027)
X00407
MOV 3 D0001
Proceed to device deletion if device is registered.
(0028)
********Delete device********
(0029)
00062
D0001 = 3
I00002
WRITE 0 D0007 400 50
Clear tool command buffer.
(0030)
WRITE 5 D0007 400 1
Tool comand $5
(0031)
WRITE D0002 4 401 1
Specify node address to be deleted.
(0032)
SET I00001
Command request
(0033)
I00002
MOV D0002 D0006
Keep the node address specified earlier.
(0034)
D0003 = 5 INC D0002
Proceed to next node address on normal exit
Do not change node address on error.
(0035)
D0004 = 6
(0036)
D0002 = D0006 SET I00006
Proceed to error processing if node address is not changed (i.e., if error has occurred).

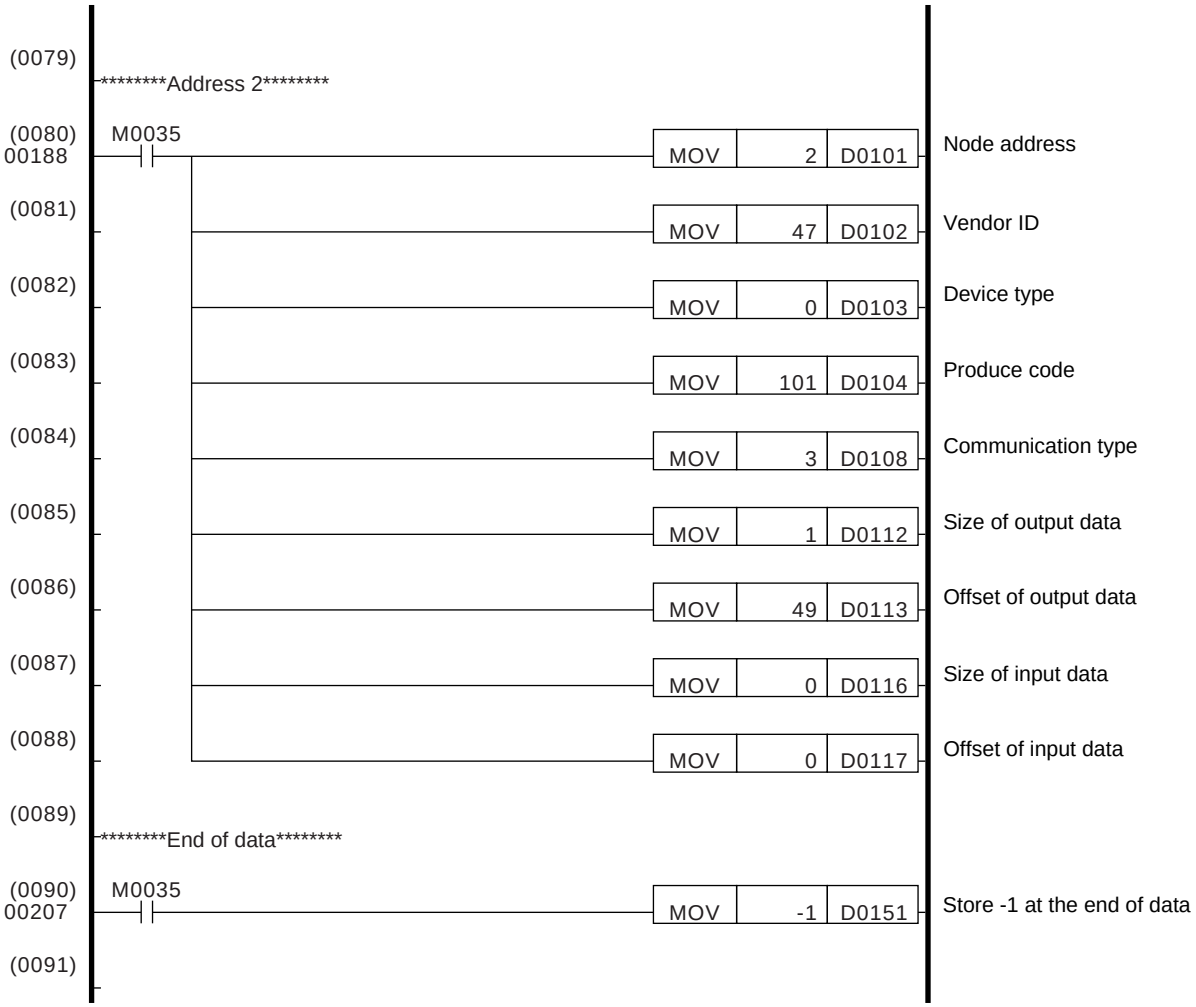
F0903-8.EPS


(0037)
D0002 = 64 INC D0001
Proceed to the next process if node number is 64.
(0038)
RST I00002
(0039)
********Register Device ********
(0040)
00093
D0001 = 4 MOV 0 D0002
Clear D2 register (N-th item).
(0041)
I00002
D0005 = D0002 * 50
Specify data position of N-th item.
(0042)
MOV D0005 V01
(0043)
V01
D0051 <> –1 SET I00005
Proceed to data registration if data is valid (if it does not begin with -1).
(0044)
V01
D0051 = –1 INC D0001
Proceed to the next process after the last data is registered (if it does not begin with -1).
(0045)
00110
I00005 I00002
WRITE 0 D0007 400 50
Clear tool command buffer.
(0046)
V01
WRITE D0051 D0007 401 17
Write registration data.
(0047)
WRITE 3 D0007 400 1
Tool command $3
(0048)
SET I00001
Execute tool command.
(0049)
I00002
RST I00005
(0050)
D0003 = 3 INC D0002
Proceed to next data on normal exit.
(0051)
D0003 <> 3 SET I00006
Proceed to error processing on error.
(0052)
RST I00002
(0053)
********Wirte ROM ********
(0054)
00135
I00002
D0001 = 5 WRITE 0 D0007 400 50
Clear tool command buffer.
(0055)
WRITE $71 D0007 400 1
Tool command $71
(0056)
SET I00001
Execute tool command.
(0057)
I00002
D0003 = $71 INC D0001
Proceed to next process on normal exit.
(0058)
D0003 <> $71 SET I00006
Proceed to error processing on error.
(0059)
RST I00002

F0903-9.EPS


(0060)
********END********
(0061)
00156
D0001 = 6
MOV 6 D0001
Normal exit
(0062)
********ERR********
(0063)
00158
I00006
MOV D0001 D0011
Number for error handling
(0064)
MOV 7 D0001
(0065)
MOV D0002 D0012
Error
Node address (during device deletion)
Data number (during device registration)
(0066)
MOV D0003 D0013
Command response ($8000+command number)
(0067)
MOV D0004 D0014
Exit code
(0068)
********Registration data********
(0069)
********Address 1********
(0070)
00169
M0035
MOV 1 D0051
Node address
(0071)
MOV 47 D0052
Vendor ID
(0072)
MOV 0 D0053
Device type
(0073)
MOV 100 D0054
Produce code
(0074)
MOV 4 D0058
Communication type
(0075)
MOV 0 D0062
Size of output data
(0076)
MOV 0 D0063
Offset of output data
(0077)
MOV 1 D0066
Size of input data
(0078)
MOV 27 D0067
Offset of input data

F0903-10.EPS


(0079)
********Address 2********
(0080)
00188
M0035
MOV 2 D0101
Node address
(0081)
MOV 47 D0102
Vendor ID
(0082)
MOV 0 D0103
Device type
(0083)
MOV 101 D0104
Produce code
(0084)
MOV 3 D0108
Communication type
(0085)
MOV 1 D0112
Size of output data
(0086)
MOV 49 D0113
Offset of output data
(0087)
MOV 0 D0116
Size of input data
(0088)
MOV 0 D0117
Offset of input data
(0089)
********End of data********
(0090)
00207
M0035
MOV -1 D0151
Store -1 at the end of data
(0091)

F0903-11.EPS

■ Sample BASIC Program

An example of a BASIC program is given here.

- This module is installed in slot 4.
- The contents to be registered in the scan list are set using a DATA statement.
- -1 is set at the end of the data.
- "END OK" is displayed on normal exit.
- If an error occurs, "ERROR" and error code are displayed.

```
10  ! ********************************************
20  ! *             F3LD01-ON SAMPLE PROGRAM         *
30  ! *                 Scan list registration       *
40  ! ********************************************
50  !
60  ! ****Initialisation ****
70  DEFINT A-Z
80  DIM SDATA (17)
90  LDSLOT=4
100 ASSIGN LD01=LDSLOT
110 !
120 CONTROL LDSLOT, 102; $0000, $FFFF   : ! All output relays OFF
130 CONTROL LDSLOT, 101; $0000, $FFFF
140 GOSUB TBCLEAR@                      : ! Clear Tool Command Buffer
150 !
160 !
200 !  ****Clear error****
210 CONTROL LDSLOT, 102; $0001, $FFFF   : ! Request to Clear Error (Y□□□49) ON
220 STS = 0
230 WHILE BIT (STS, 0) = 0              : ! Clear Error Confirmation (Wait for
                                            X□□□17 ON)
240 STATUS LDSLOT, 102; STS
250 END WHILE
260 CONTROL LDSLOT, 102; $0000, $0001   : ! Reqest to Clear Error (Y□□□49) OFF
270 !
300 ! **** Set transmission time interval ****
310 MODE$="Set CycleTime"
320 NA = -1
330 GOSUB TBCLEAR@                      : ! Clear Tool Command Buffer
340 OUTPUT LDSLOT, 400 NOFORMAT; $72    : ! Command $72
350 OUTPUT LDSLOT, 403 NOFORMAT; 20     : ! Set transmission time interval to 20ms
360 GOSUB COMMAND@                      : ! Execute command
370 IF RES1<>$72 THEN GOTO ERROR@       : ! Proceed to error processing on error
380 !
400 ! ******** Delete Device ********
410 MODE$ = "Del Device"
420 STATUS LDSLOT, 101; STS             : ! Read output relay
```

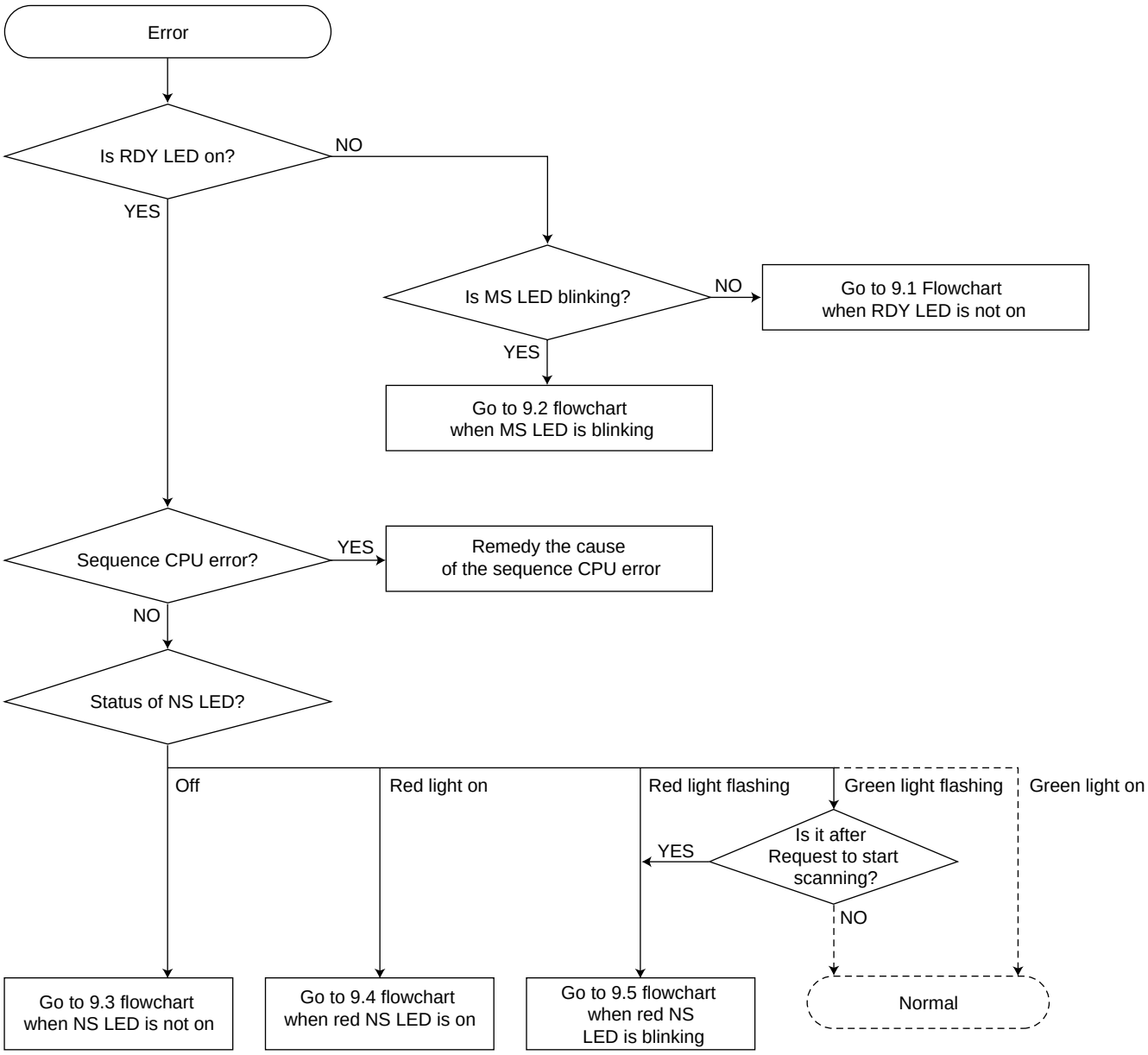
```
430 IF BIT (STS, 6) = 1 THEN GOTO SSET@ : ! Skip if scan list is not registered
440 FOR NA = 0 TO 63
450 GOSUB TBCLEAR@
460 OUTPUT LDSLOT, 400 NOFORMAT; $05    : ! Command $05
470 OUTPUT LDSLOT, 401 NOFORMAT; NA     : ! Node address of device to be deleted
480 GOSUB COMMAND@
490 IF (RES1<>$5) AND (RES2<>$6) THEN GOTO ERROR@
500 NEXT NA                             : ! Proceed to error processing if error
                                            occurs  and next node if normal
510 !
600 ! **** Register Device ****
610 SSET@
620 MODE$="Add Device"
630 LOOP@
640 READ SDATA (0)                      : ! Confirm first data item (Node number)
650 NA  =  SDATA (0)
660 IF NA = -1 THEN GOTO SAVEROM@       : ! Proceed to Store to flash memory if
                                            (?1) is stored at the end of data
670 GOSUB TBCLEAR@                      : ! Clear Tool Command Buffer
680 OUTPUT LDSLOT, 400 NOFORMAT; $03    : ! Command $03
690 OUTPUT LDSLOT, 401 NOFORMAT; NA     : ! Write node address
700 FOR N = 1 TO 16
710 READ SDATA (N)                      : ! Read and write data one by one
720 OUTPUT LDSLOT, 401+N NOFORMAT; SDATA (N)
730 NEXT   N
740 GOSUB COMMAND@                      : ! Execute command
750 IF RES1 <> $03 THEN GOTO ERROR@     : ! Proceed to an error processing if an
error occurs
760 GOTO  LOOP@                         : ! Proceed to registration of next data
770 !
800 ! **** Store in Flash memory ****
810 SAVEROM@
820 MODE$="Rom Write"
830 NA = -1
840 OUTPUT LDSLOT, 400 NOFORMAT; $71    : ! Command $71
850 GOSUB COMMAND@                      : ! Execute command
860 IF RES1 <> $71 THEN GOTO ERROR@     : ! Proceed to error processing if an
                                            error occurs
870 PRINT "END OK"                      : ! Normal exit
880 STOP
890 !
900 ! **** Subroutine - Clear tool command buffer****
910 TBCLEAR@
920                         FOR I   =  0  TO  49
930 OUTPUT LDSLOT, 400+I NOFORMAT; 0    : ! Clear Tool Command Buffer
940 NEXT  I
950 I = 0
```

```
960 RETURN
970 !
1000  ! **** Subroutine – Execute command****
1010  COMMAND@
1020  CONTROL LDSLOT, 102; $0200, $FFFF       : ! Request to Execute Command
                                                  relay(Y□□□58) ON
1030  STS = 0
1040  WHILE BIT (STS, 9) = 0                  : ! Clear Error Confirmation (Wait
                                                  for Clear Error Confirmation
                                                  (X□□□26) ON)
1050  STATUS LDSLOT, 102; STS
1060    END WHILE
1070    ENTER LDSLOT, 400 NOFORMAT; RES1      : ! Read response
1080    ENTER LDSLOT, 401 NOFORMAT; RES2
1090    CONTROL LDSLOT, 102; $0000, $FFFF     : ! Request to Execute Command
Relay (Y□□□58) OFF
1100  RETURN
1110  !
1200  ! **** Error processing****
1210  ERROR@
1220  PRINT     "ERROR"                       : ! Display error
1230  PRINT      MODE$                        : ! Display Error operation
1240  PRINT     "RES1=", HEX$ (RES1)          : ! Display response1 (Hexadecimal)
1250  PRINT     "RES2=", HEX$ (RES2)          : ! Display response2 (Hexadecimal)
1260  PRINT     "NA=",NA                      : ! Display node address where an
                                                  error has occurred (decimal)
1270  STOP
1280  !
1300  ! **** Registration data****
1310  ! * Position 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413,
                     414, 415, 416, 417,
1320  DATA      1,   47,     0, 100,  0, 0,  0,  4, 0, 0, 0, 0, 0, 0,
               0,     1,   27,
1330  DATA      2,   47,      0, 101, 0, 0, 0, 3, 0, 0, 0, 1, 49, 0,
               0,     0,      0,
1340  DATA      -1,                           : ! End of data (write -1 at the
                                                  end)
1350  END
```

Blank Page

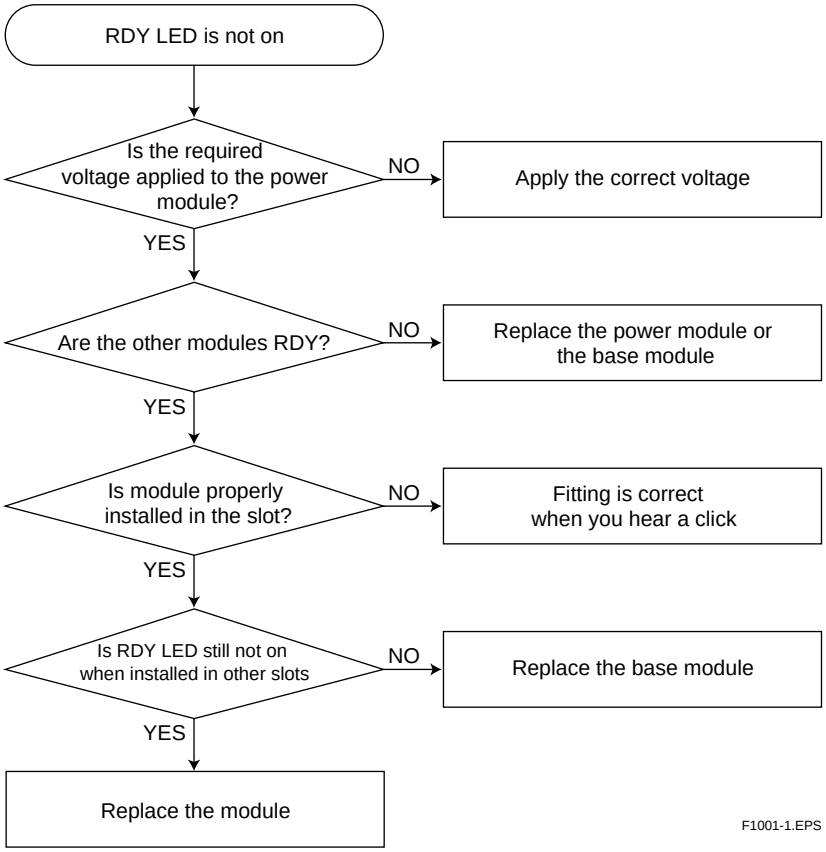
10. Errors and Troubleshooting

Troubleshooting of this module is shown in the following flowcharts.

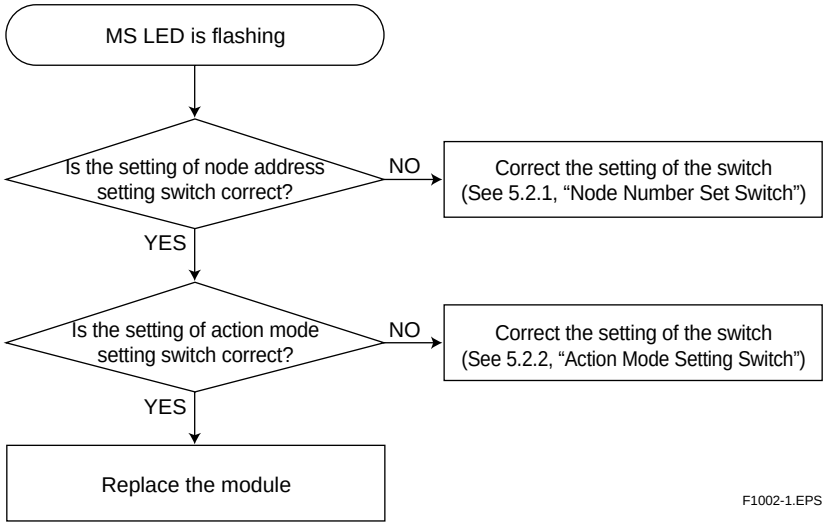


F10-1.EPS

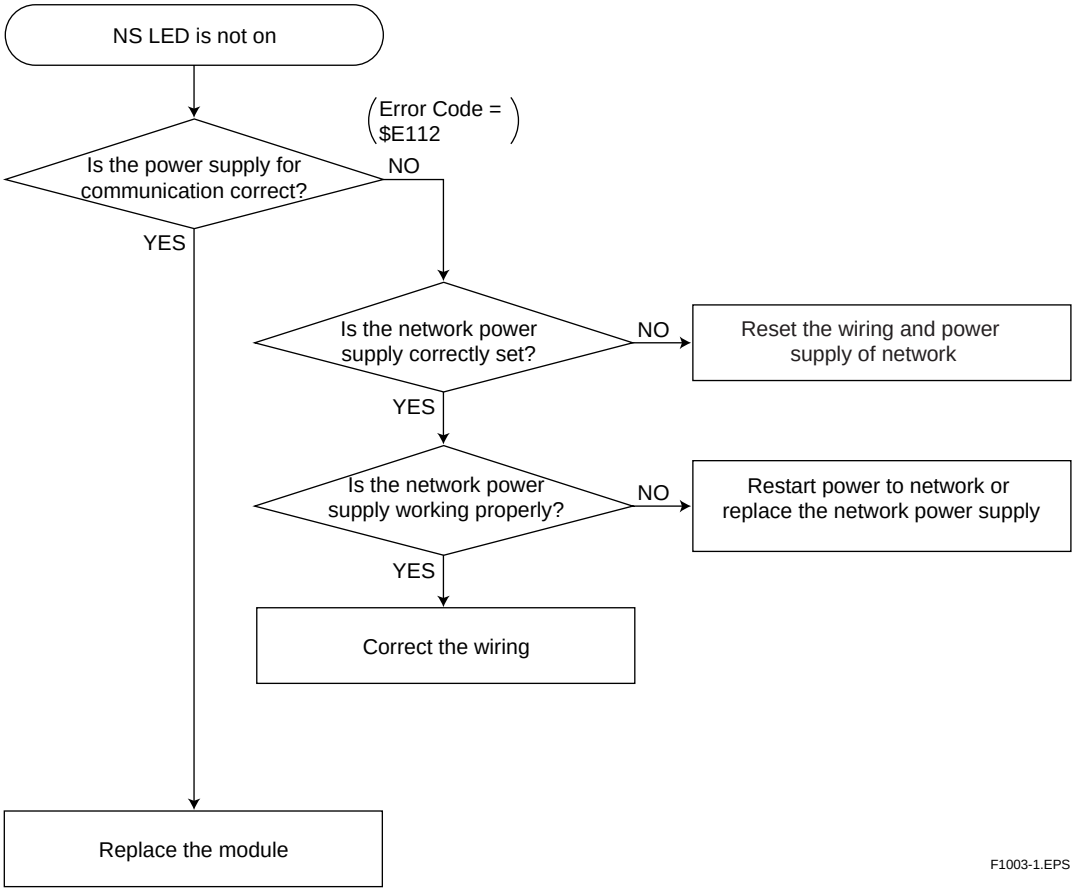
10.1 Flowchart When RDY LED Is Not ON



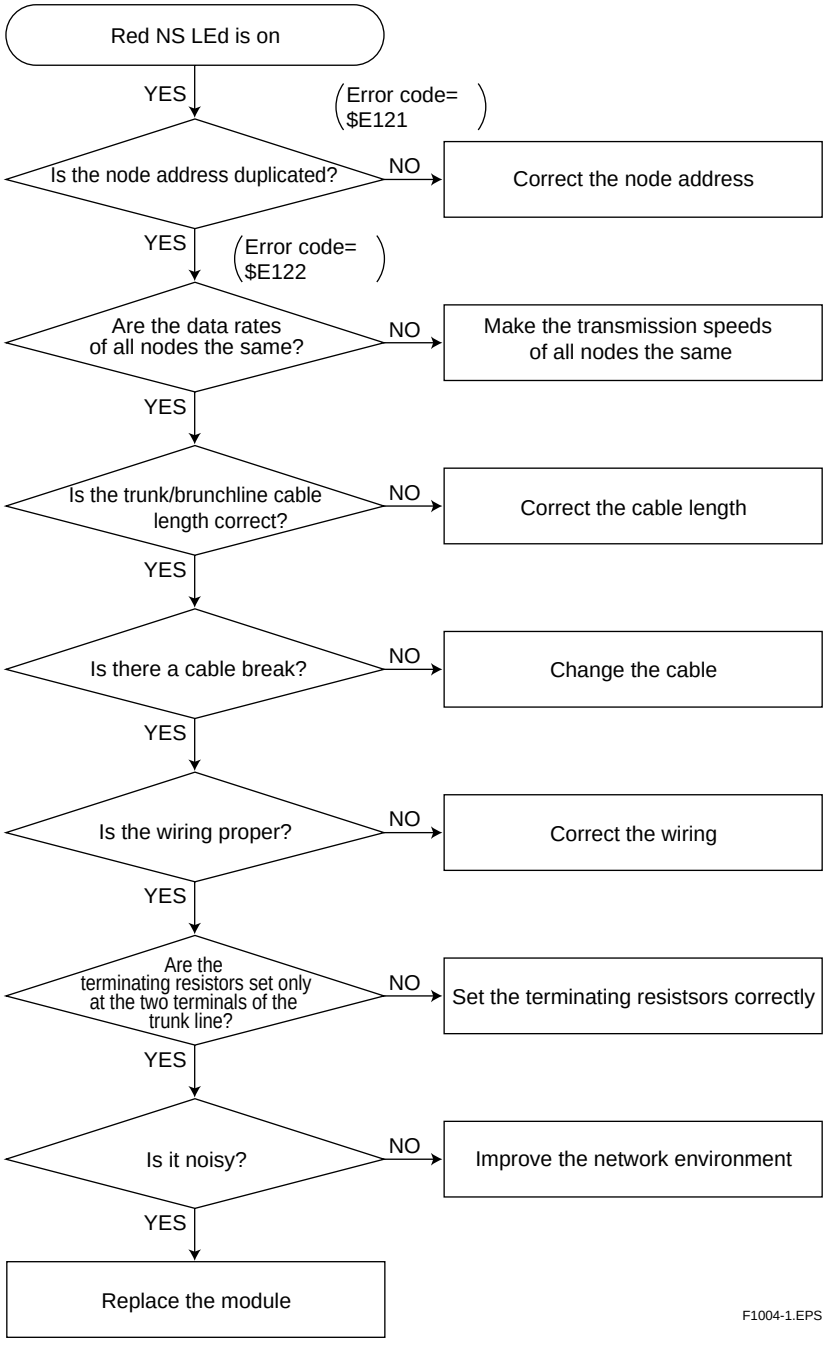
10.2 Flowchart When MS LED Is Flashing



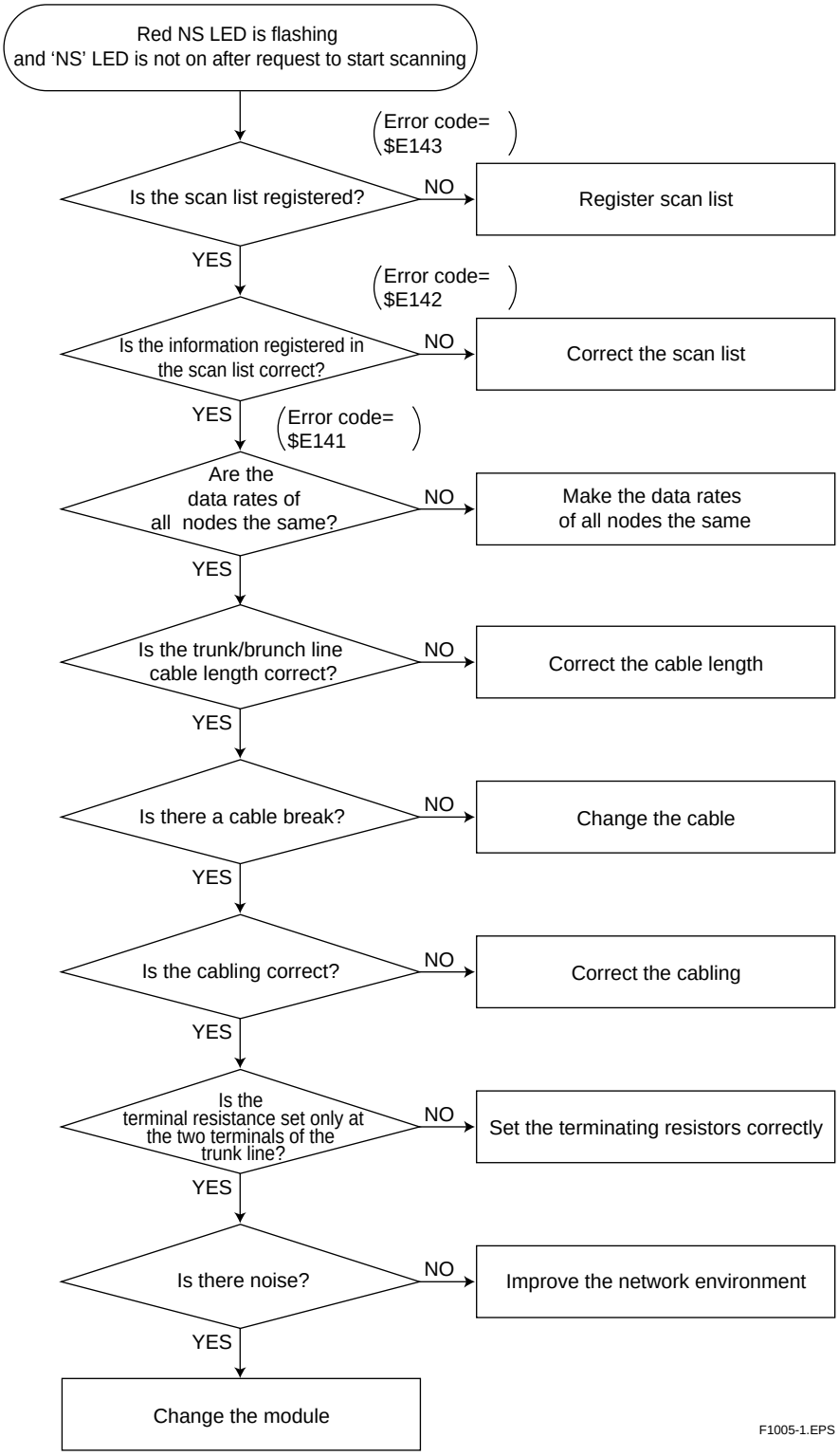
10.3 Flowchart When NS LED Is Not ON



10.4 Flowchart When Red NS LED Is ON



10.5 Flowchart When Red NS LED Is Flashing



10.6 Error Codes

This module conveys error status not only by LED but also by input relay (X□□□01 to 16), error codes and other node error information.

The error codes within the module information of the input/output data register and the node error information is of latched type. The latest error information is maintained until a Request to Clear Error is executed.

The error codes are given in Table 10.1.

Table 10.1 Error Codes

Item	EC1	EC2	Relay	OT	MS-LED	NS-LED	Description
Internal error	$1005	–	1	No	Red On	Off	Internal discrepancy in the basic program
Memory error	$1203	–	1	No	Red On	Off	RAM error
Flash memory error 1	$1281	–	1	No	Red On	Off	Error in the part of flash memory which stores the program
Flash memory error 2	$1282	–	1	No	Red On	Off	Error in the part of the flash memory which stores DeviceNet information
Flash memory error 3	$1283	–	1	No	Red On	Off	Failure in storing scan list and transmission time interval in flash memory
Watchdog timer error	$1285	–	1	No	Red On	Off	Watchdog timer error
CAN error 1	$1286	–	1	No	Red On	Off	CAN controller error (cannot cancel reset)
CAN error 2	$1287	–	1	No	Red On	Off	CAN controller error (data bus error)
CAN error 3	$1288	–	1	No	Red On	Off	CAN controller error (address bus error)
System failure	$1289	–	8	No	–	–-	System failure occurred
Node Busy	$1305	Node no.	4	Yes	Green On	Red flashing	Communications not possible because of communicating with another master
Switch setting invalid	$E111	Data position no.	1	No	Red flashing	Off	Switch setting error (node address, data rate, etc)
Network power error	$E112	–	3	No	Green On	Off	No power to network
Duplicate node address	$E121	Node no.	2	No	Green On	Red On	The current node has the same address as another node and as a result cannot join the network
Bus-off detected	$E122	–	2	No	Green On	Red On	Numerous data errors on the network
Node absent	$E141	Node no.	4	Yes	Green On	Red flashing	No response from the registered node in the scan list
Node information mismatch	$E142	Node address	4	Yes	Green On	Red flashing	The information read from the scan list and node differs.
Scan list not registered	$E143	–	7	No	–	–	There are no registered devices in the scan list. There is nothing stored in the flash memory.

T1001.EPS

Relay: The input relay no. (** in X□□□**) that is on in the status.

OT: Reflected in the error code storage information of other nodes (input/output data registers 29 to 32)

SEE ALSO

1) See also Section 8.2.2, “Exit Codes,” in this manual for the exit codes of message communications.
2) See also Section 9.1.5, “Exit Codes,” in this manual for the exit codes of tool commands.

11. DeviceNet Glossary

■ Bus-off:

Indicates that the error rate in the network is very high.

■ CAN:

CAN is short for Controller Area Network. It is a communications protocol

developed as a LAN for use in an automobile. DeviceNet employs CAN technology.

■ I/O communications:

This is a communications function which allows the exchange of control information (I/O data) between masters and slaves in real time. This module supports the following two types of I/O communications protocols of DeviceNet.

Polling:

Sends a polling instruction containing output data from the master to a specified slave; the master then receives a response containing the input data from the slave (1 : 1 communication).

Bit Strobe:

Multicasts (broadcasts) a bit strobe request instruction from the master to multiple slave systems and receives a response containing input data from each slave. Improves network throughput as a request can be communicated to multiple slave systems simultaneously (1: N communication). However, this is possible only in the case of slave systems with input data of less than 8 bytes.

■ ODVA :

ODVA is short for Open DeviceNet Vendor Association, Inc. It is a non-profit organization formed by machine vendors with the aim to administer and popularize the DeviceNet specification.

■ Connection:

This is a logical communication channel for facilitating communications between nodes. Maintains and manages communications between nodes.

■ Device Profile:

Standardizes the configuration and behavior (the smallest data configuration and operation) of devices of the same type (equipment, etc.). Provides mutual exchangeability between devices of the same type. Also known as a device model.

■ Node:

Devices (equipment) linked in DeviceNet are called nodes.

■ Master/Slave:

A node can be either a master which collects and distributes data or a slave which outputs and inputs data according to the instructions received from the master.

■ Message communications:

These are functions for parameter setting/reading, operation control/management, information exchange, etc. between nodes (1 : 1) as and when necessary. It is also called an explicit peer-to-peer message.

In this module, it is possible to request service from other nodes (master and slaves) using the explicit message defined in DeviceNet.

Appendix 1. Details on Network Configuration

The network configuration of a DeviceNet is given below.

For configuration components, refer to Section 2.1, “Network Configuration.”

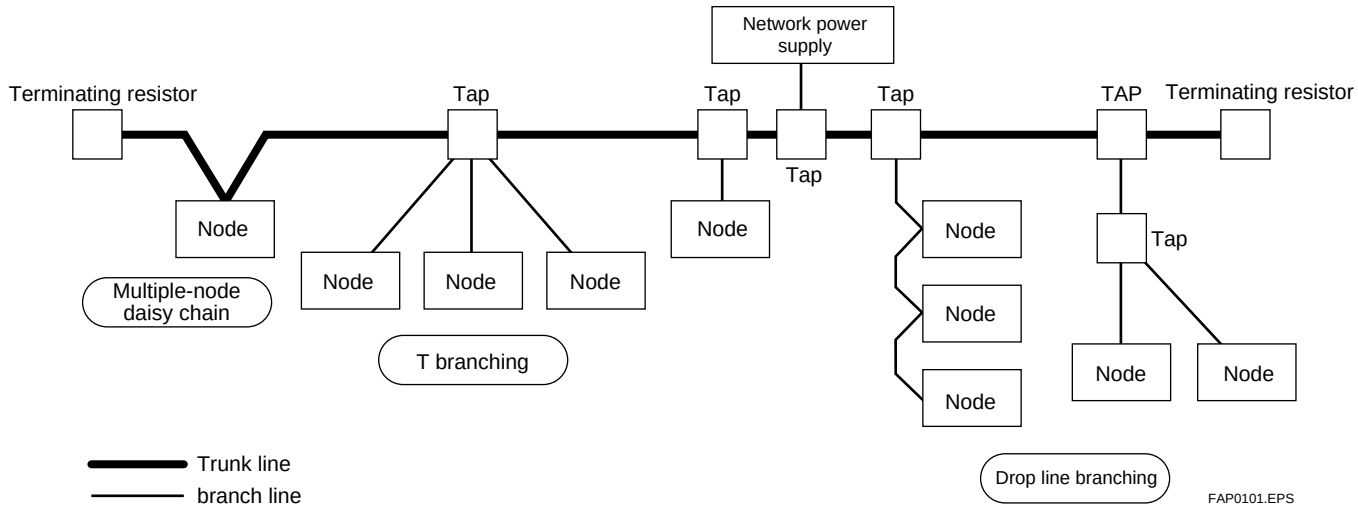


Figure 1.1 Network Media Toplogy

Appendix 1.1 Cable Length

■ Cable to be used exclusively for DeviceNet

Two types of cables are exclusively used for DeviceNet; thick cable and thin cables.

Thin cables are softer as compared to thick cables. When using these cables, take note that the network distance differs for the thick and thin cables.

CAUTION

Use the cables that are exclusively recommended for DeviceNet; If other cables are used, they may cause a communications error.

■ Maximum cable length

The maximum allowable node distance is called the maximum cable length.

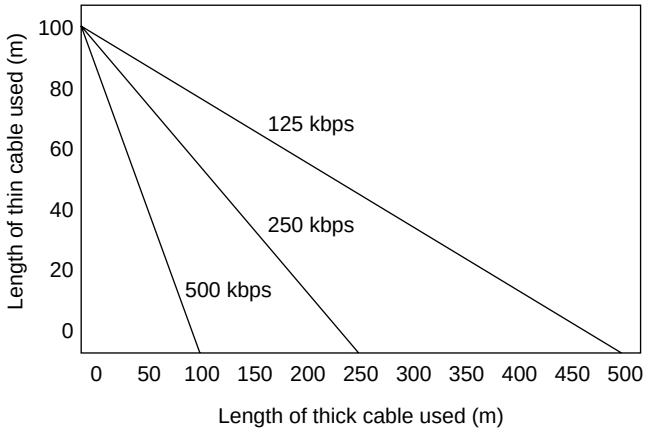
Maximum cable lengths according to the type of cable used are given in Table 1.1.

Table 1.1 Maximum Cable Length

Data rate	Thick cable	Thin cable
125 kbps	500 m	100 m
250 kbps	250 m	
500 kbps	125 m	

TA0101.EPS

For instances where both thick and thin cables are used, see Figure 1.2 for maximum cable length.



L (thick) + 5 X L (thin) = 500 at 125 kbps
L (thick) + 2.5 X L (thin) = 250 at 250 kbps
L (thick) + L (thin) = 100 at 500 kbps

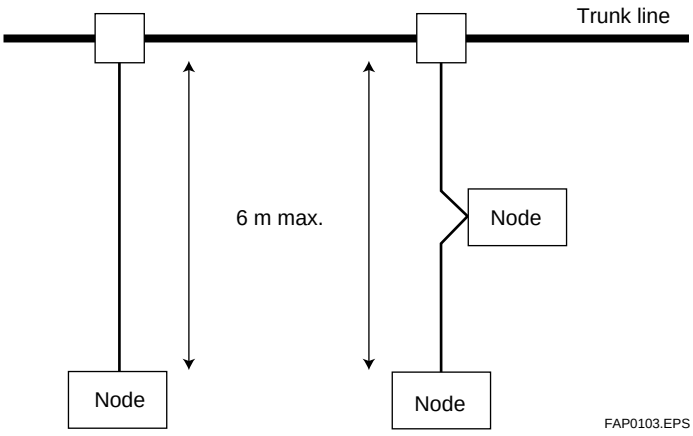
L (thick) and L (thin) are the length of thick and thin cables respectively.

FAP0102.EPS

Figure 1.2 Maximum Cable Length

■ Maximum length of drop line

The maximum length of individual drop line is 6 m. However the total length of the drop line generally changes with the data rate.



FAP0103.EPS

Figure 1.3 Maximum Drop Line Length

Table 1.2 Maximum Drop-line Length and Data Rate

Transmission speed	Length of drop line	
	Maximum	Cumulative
125 kbps	6 m	156 m
250 kbps		78 m
500 kbps		39 m

TA0102.EPS

Appendix 1.2 Connection Methods

There are two types of connection methods for DeviceNet; T-branching (using T-branching tap) and daisy chain method. The two types of methods can be mixed for trunk line/ drop line.

■ T-branching method

T-branching is achieved by using a branching tap that is exclusively used for DeviceNet.

T-branching is possible from both trunk lines and drop lines.

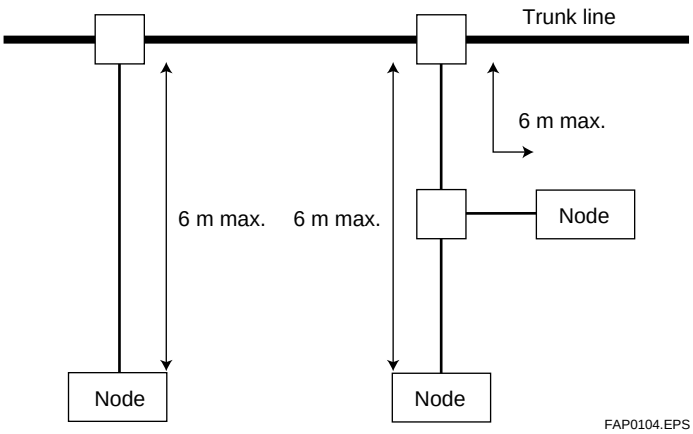


Figure 1.4 T-branching

CAUTION

Use the T-branching tap that is exclusively recommended for DeviceNet. If other T-branching tap is used, it may cause a communications error.

■ Daisy Chain method

Both trunk lines and drop lines can be connected using the daisy chain method.

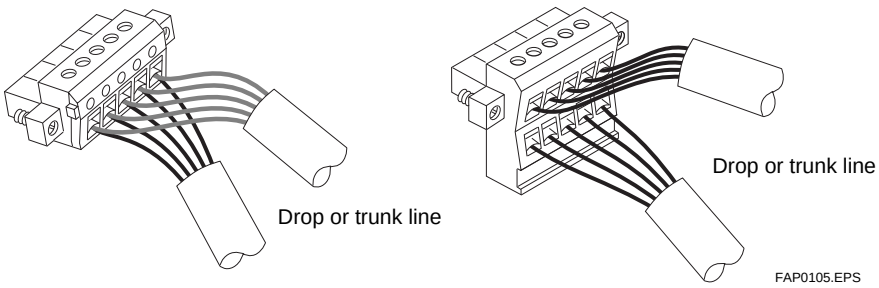


Figure 1.5 Daisy Chain

CAUTION

The DeviceNet connector provided cannot be used for Daisy Chain type connection using thick cables as the cables are too thick. In this case, the connection can be made using the COMBICON plug mentioned below as the connector for multi-drop wiring.

However, as the connectors protrude from both sides of the module, pay special attention to the two adjacent modules. For details on the equipment, contact the manufacturer.

Model No. : TMSTBP 2.5/5-STF-5.08AU

Manufactured by : Phoenix Contact Co., Ltd.

Appendix 1.3 Terminating Resistor

Installing terminating resistors (121Ω) at both ends of a trunk line reduces reflection and stabilizes communications.

The terminating resistor should satisfy the following specifications.

- 121Ω
- 1% of metallic film resistance
- 1/4 W

Terminating resistors are in-built in this module. When connecting to the terminals of a trunk line using the daisy chain method, turn on the terminating resistor setting switch and use the built-in terminating resistors. In situations other than this, make sure that the switch is off and the terminating resistors are not in use.

Appendix 1.4 Configuration of Network Power Supply

Two lines out of the five special cables are 24 V DC power supply lines used for communication. It is necessary to provide power supply to the connectors of all nodes through these cables.

When using only one power supply to a single network, you can connect it directly to the trunk line. However, when using multiple network power supply, use the special power supply tap.

■ Power Supply Specifications

Power supply specifications of DeviceNet is shown in the following table. Use the power supply that meets these specifications.

Table 1.3 Power Supply Specifications for DeviceNet

Specifications	Parameter
Initial tolerance	24 V ± 1% or adjustable to 0.2%
Line regulation	0.3% max.
Load regulation	0.3% max.
Temperature coefficient	0.03% per deg. C max.
Input voltage range	120 V ± 10% 230 V ± 10% (if necessary) or automatic switching in range 95 to 250V
Input frequency range	48 to 62 Hz minimum.
Output ripple	250 mVp-p
Load capacitance	7000 µF max.
Temperature limits	When operating : 0 to 60°C* When not operating: -40 to 85°C * Operating at 60°C will lower the rated output.
Inrush current limit	Less than 65 amps peak
Overvoltage protection	Available (No set value)
Overcurrent protection	Available (Current Limit : 125% max.)
Turn-on time (with full load)	250 m sec max./ 5% of final value
Turn-on overshoot	0.2% max.
Stability	0 to 100% of load (for all conditions)
Insulation	Insulated from AC and chassis ground
Agency approvals	Required : UL Optional : FCC Class B, CSA, TUV, VDE
Humidity	5 to 95% (non-condensing)
Output voltage	24V±1%
Output current	Up to 16A continuous
Surge current capacity	10% reverse capability

TA0103.EPS

■ Special Purpose Power Supply Tap

Special purpose power supply taps are configured as shown in Figure1.6. Always use it when there are more than two-power supply sources on a single network.

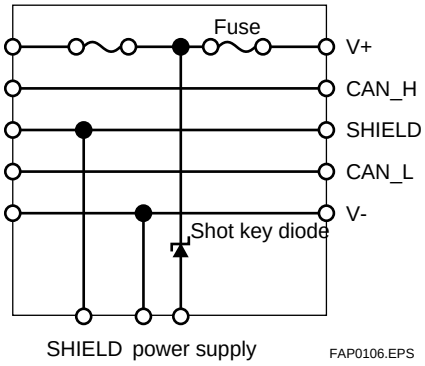


Figure 1.6 Power Supply Tap

■ Network Power Supply Configuration

Network power supply configuration depends on electricity consumption of all nodes and by the maximum current capacity of the network cable. Please use the calculation in configuration 1 and 2 as reference when installing the power supply.

TIP

Maximum current capacity of cables in DeviceNet is as follows.

Table 1.4 Maximum Current (amp) Based on Network Thick Cable Length

Cable length (m)	0	25	50	100	150	200	250	300	350	400	450	500
Max. current capacity (amp)	8.00	8.00	5.42	2.93	2.01	1.53	1.23	1.03	0.89	0.78	0.69	0.63

TA0104.EPS

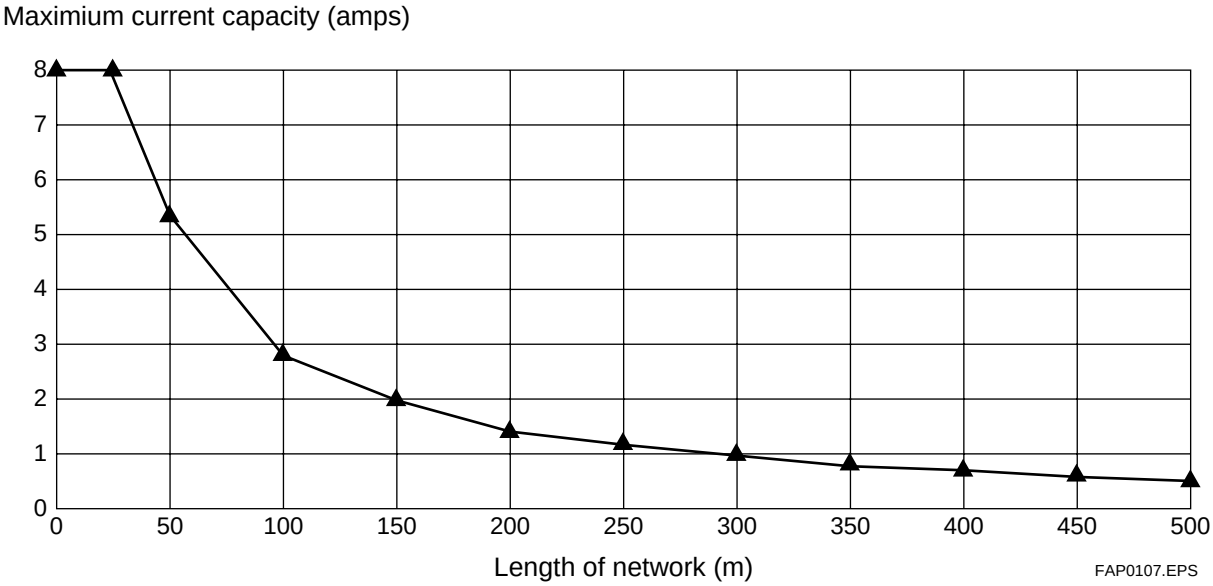


Figure 1.7 Maximum Current Available on Thick Cable DeviceNet Power Supply Bus

Table 1.5 Maximum Current (amps) Available Based on Network Thin Cable Length

Cable length (m)	0	10	20	30	40	50	60	70	80	90	100
Max. current (amps)	3.00	3.00	3.00	2.06	1.57	1.26	1.06	0.91	0.80	0.71	0.64

TA0105.EPS

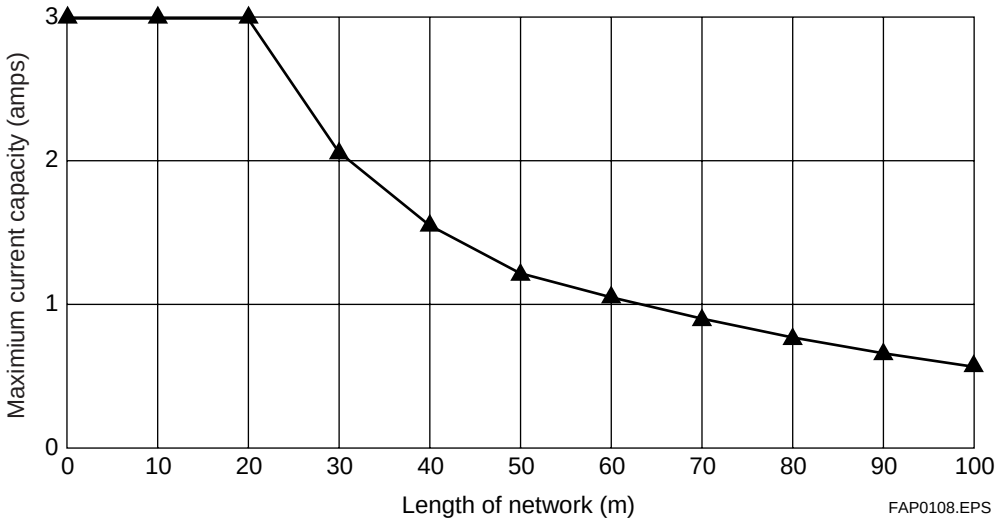


Figure 1.8 Maximum Current Available on Thin Cable DeviceNet power Supply Bus

- Configuration example 1

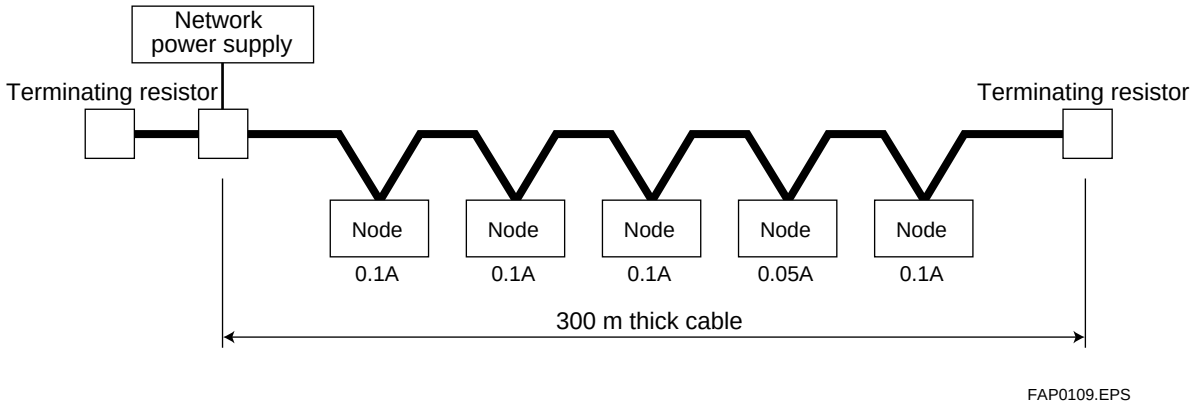


Figure 1.9 Network Power Supply Configuration (Example 1)

Total length of network = 300 m

Total current consumption = 0.1 A + 0.1 A + 0.1 A + 0.05 A + 0.1 A = 0.45 A

Maximum current capability over the 300 m of a thick cable = 1.03 A

The total current consumption is less than the maximum current capacity of cables, so this network configuration is possible.

- Configuration example 2

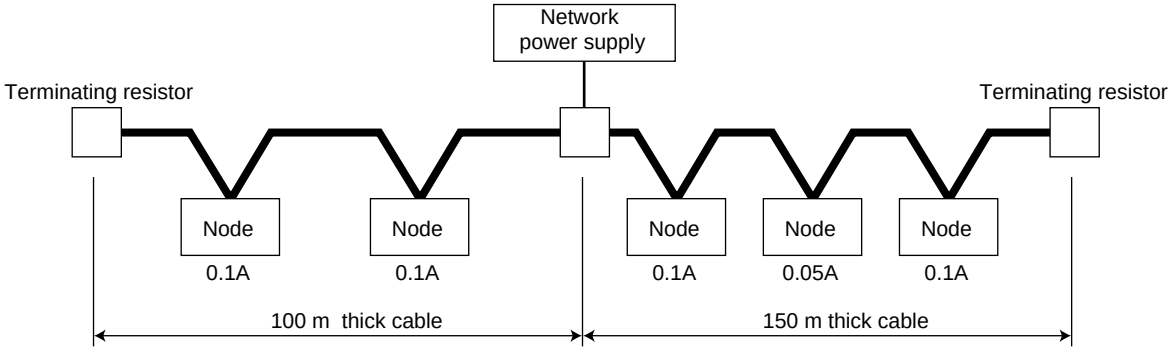


Figure 1.10 Network Power Supply Configuration (Example 2)

Total length of network on right side = 150 m

Total current consumption on right side = 0.1 A + 0.05 A + 0.1 A = 0.25 A

Maximum current capability of 150 m of a thick cable = 2.01 A

Total length of network on left side = 100 m

Total current consumption on left side = 0.1 A + 0.1 A =0.2 A

Maximum current capability of 100 m of a thick cable = 2.93 A

In both the right and left networks, the total electricity consumption is less than the max. current capability of cables, so this network configuration is possible.

Appendix 1.5 Network Grounding

DeviceNet uses one-point grounding. As far as possible, ground it in the vicinity of the center of the network through the SHIELD terminal of the power supply tap.

If the tap is not used, ground the GND cable directly.

Retain the grounding resistance up to 100 Ω (JIS Class 3 grounding).

Appendix 2. Information on Third-party Products

■ Obtaining Information on Third-party Products

DeviceNet is a multi-vendor network, and devices conforming to DeviceNet specifications are supplied by many vendors.

A list of devices that conform to the DeviceNet specifications and the relevant contacts are given in the "Product Catalog (Catalog of devices conforming to DeviceNet)" published by ODVA and it can be obtained from ODVA or ODVA Japan. It is also described in the homepages of ODVA and ODVA Japan.

URL of ODVA http://www.odva.org/

URL of ODVA Japan http://www.odva.astem.or.jp

TIP

The homepage address may be changed without prior notice. Please verify the address.

■ Cable/T- branching Tap/Power Supply Tap/Terminating Resistor

The items minimally required in a network configuration are cables, T-branching tap, power supply tap and terminating resistor. One third-party supplier is given here for each item. For more details, make inquiries to the respective manufacturers provided by ODVA.

Type	Manufacturer	Model name	Specification/Remarks
Thick cable	Showa Electric wire & Cable Co., Ltd.	TDN18-100G	Length: 100 m, Color: Light gray
		TDN18-300G	Length: 300 m, Color: Light gray
		TDN18-500G	Length: 500 m, Color: Light gray
Thin cable		TDN24-100G	Length: 100 m, Color: Light gray
		TDN24-300G	Length: 300 m, Color: Light gray
		TDN24-500G	Length: 500 m, Color: Light gray
T-Branching tap	Omron Corporation	DCN1-1C	With three connectors for connection (You can mount one terminating resistor with one drop line.)
		DCN1-3C	With five connectors for connection (You can mount one terminating resistor with three drop lines.)
Terminating resistor	Omron Corporation	DRS1-T	Terminal block type terminating resistor

TA0106.EPS

TIP

The model name may be changed without prior notice. Please verify the model names.

Blank Page

Revision History

Edition	Date	Revised Item
1st	Feb. 1999	New publication

Written by Product Marketing Section, PLC Center
Industrial Automation Business Head Quarter.
Yokogawa Electric Corporation
Published by Yokogawa Electric Corporation
2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750, JAPAN
Printed by Yokogawa Graphic Arts Co., Ltd.

Blank Page