SYSMAC CS1 Series CS1W-ETN01 Ethernet Unit

OPERATION MANUAL



CS1W-ETN01 Ethernet Unit

Operation Manual

Produced February 1999



Notice:

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to property.

- **DANGER** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
- **Caution** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

OMRON Product References

All OMRON products are capitalized in this manual. The word "Unit" is also capitalized when it refers to an OMRON product, regardless of whether or not it appears in the proper name of the product.

The abbreviation "Ch," which appears in some displays and on some OMRON products, often means "word" and is abbreviated "Wd" in documentation in this sense.

The abbreviation "PC" means Programmable Controller and is not used as an abbreviation for anything else.

Visual Aids

The following headings appear in the left column of the manual to help you locate different types of information.

- **Note** Indicates information of particular interest for efficient and convenient operation of the product.
- 1, 2, 3... 1. Indicates lists of one sort or another, such as procedures, checklists, etc.

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No patent liability is assumed with respect to the use of the information contained herein. Moreover, because OMRON is constantly striving to improve its high-quality products, the information contained in this manual is subject to change without notice. Every precaution has been taken in the preparation of this manual. Nevertheless, OMRON assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained in this publication.

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About this Manual:

This manual describes the installation and operation of the SYSMAC CS1-series CS1W-ETN01 Ethernet System and includes the sections described on the next page.

An Ethernet Unit is classified and treated as a CPU Bus Unit in PC processing.

This manual is based on Ethernet* networks comprised of Ethernet Unit nodes and UNIX* host computer nodes. Although details can vary, theoretically any device supporting the same Ethernet protocols as the Ethernet Unit can form nodes on the network.

Note *Ethernet is a trademark of the Xerox Corporation. UNIX is a registered trademark of USL.

Please read this manual and all related manuals listed in the following table carefully and be sure you understand the information provided before attempting to install and operate an Ethernet Unit.

Name	Cat. No.	Contents
SYSMAC CS1-series CS1W-ETN01 Ethernet Unit	W343-E1-1	Describes the installation and operation of CS1W-ETN01 Ethernet Unit.
Operation Manual		Refer to the <i>CX-Programmer User's Manual</i> for information on setting the CPU Bus Unit Setup for the Ethernet Unit.
		Refer to the CS1G/H-CPU - Programmable Controllers Communications Commands Reference Manual (W342) for information on FINS commands that can be addressed to CS1-series CPU Units. (This manual)
SYSMAC CS1-series CS1G/H-CPU -E Programmable Controllers Operation Manual	W339-E1-1	Describes the installation and operation of the CS1-series PCs.
SYSMAC CS1-series CS1G/H-CPU -E Programmable Controllers Programming Manual	W340-E1-1	Describes the ladder diagram programming instructions supported by CS1-series PCs.
SYSMAC CS1-series C200H-PRO27-E, CQM1-PRO01-E Programming Consoles Operation Manual	W341-E-1	Provides information on how to program and operate CS1-series PCs using a Programming Console.
SYSMAC CS1-series CS1G/H-CPU - E, CS1W-SCB21/41, CS1W-SCU21 Communications Commands Reference Manual	W342-E1-1	Describes the C-series (Host Link) and FINS communications commands used with CS1-series PCs.
SYSMAC WS02-CXP□□-E CX-Programmer Operation Manual		Provides information on how to use the CX-Programmer, a programming device that supports the CS1-series PCs.
SYSMAC CS1-series CS1W-SCB21/41, CS1W-SCU21 Serial Communications Boards and Serial Communications Unit Operation Manual	W336-E1-1	Describes the use of Serial Communications Unit and Boards to perform serial communications with external devices, including the usage of standard system protocols for OMRON products.
SYSMAC WS02-PSTC1-E CX-Protocol Operation Manual	W344-E1-1	Describes the use of the CX-Protocol to create protocol macros as communications sequences to communicate with external devices.

WARNING Failure to read and understand the information provided in this manual may result in personal injury or death, damage to the product, or product failure. Please read each section in its entirety and be sure you understand the information provided in the section and related sections before attempting any of the procedures or operations given.

About this Manual, Continued

This manual contains the following sections.

Section 1 introduces the overall structure of an Ethernet network, outlines the features of the Ethernet Unit, describes the communications protocols used by an Ethernet network, and provides basic precautions for use of an Ethernet network.

Section 2 provides an overview of the communications functions that can be used with the Ethernet Unit.

Section 3 explains how to install the Ethernet Unit and make the initial settings required for operation.

Section 4 explains the system setup and the words allocated in the CIO Area and the DM Area for Ethernet Unit operations.

Section 5 provides information on communicating on Ethernet networks and interconnected networks using FINS commands. The information provided in the section deals only with FINS communications in reference to Ethernet Units. FINS commands issued from a PC are sent via the SEND(090), RECV(098), and CMND(490) instructions programmed into the user ladder-diagram program. Refer to the *CS1-series CS1G/H-CPU*___*-E Programmable Controllers Programming Manual (W340)* for further details on programming these instructions.

Section 6 describes the functionality provided by the Ethernet Unit via the socket services.

Section 7 describes the functions provided by the FTP server.

Section 8 explains the Ethernet Unit's mail function.

Section 9 describes functions that allow you to test communications.

Section 10 describes information and procedures that can be used to troubleshoot problems that sometimes occur with Ethernet Unit and Ethernet communications.

Section 11 describes the FINS commands that can be sent to an Ethernet Unit and the responses that are returned by the Ethernet Unit.

Various Appendices are provided for reference. Refer to the table of contents for a list of the appendices.

PRECAUTIONS

This section provides general precautions for using the CS1-series Programmable Controllers (PCs) and related devices.

The information contained in this section is important for the safe and reliable application of Programmable Controllers. You must read this section and understand the information contained before attempting to set up or operate a PC system.

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1 Intended Audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).

- Personnel in charge of installing FA systems.
- Personnel in charge of designing FA systems.
- Personnel in charge of managing FA systems and facilities.

2 General Precautions

The user must operate the product according to the performance specifications described in the operation manuals.

Before using the product under conditions which are not described in the manual or applying the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety equipment, and other systems, machines, and equipment that may have a serious influence on lives and property if used improperly, consult your OMRON representative.

Make sure that the ratings and performance characteristics of the product are sufficient for the systems, machines, and equipment, and be sure to provide the systems, machines, and equipment with double safety mechanisms.

This manual provides information for programming and operating the Unit. Be sure to read this manual before attempting to use the Unit and keep this manual close at hand for reference during operation.

WARNING It is extremely important that a PC and all PC Units be used for the specified purpose and under the specified conditions, especially in applications that can directly or indirectly affect human life. You must consult with your OMRON representative before applying a PC System to the above-mentioned applications.

3 Safety Precautions

- **WARNING** Do not attempt to take any Unit apart while the power is being supplied. Doing so may result in electric shock.
- **WARNING** Do not touch any of the terminals or terminal blocks while the power is being supplied. Doing so may result in electric shock.
- WARNING Do not attempt to disassemble, repair, or modify any Units. Any attempt to do so may result in malfunction, fire, or electric shock.
- WARNING Do not touch the Power Supply Unit while power is being supplied or immediately after power has been turned OFF. Doing so may result in electric shock.
 - **Caution** Tighten the screws on the terminal block of the AC Power Supply Unit to the torque specified in the operation manual. The loose screws may result in burning or malfunction.

4 Operating Environment Precautions

Do not operate the control system in the following places:

- Locations subject to direct sunlight.
- Locations subject to temperatures or humidity outside the range specified in the specifications.
- Locations subject to condensation as the result of severe changes in temperature.
- Locations subject to corrosive or flammable gases.
- Locations subject to dust (especially iron dust) or salts.
- Locations subject to exposure to water, oil, or chemicals.
- Locations subject to shock or vibration.
- **Caution** Take appropriate and sufficient countermeasures when installing systems in the following locations:
 - Locations subject to static electricity or other forms of noise.
 - Locations subject to strong electromagnetic fields.
 - Locations subject to possible exposure to radioactivity.
 - Locations close to power supplies.
- **Caution** The operating environment of the PC System can have a large effect on the longevity and reliability of the system. Improper operating environments can lead to malfunction, failure, and other unforeseeable problems with the PC System. Be sure that the operating environment is within the specified conditions at installation and remains within the specified conditions during the life of the system. Follow all installation instructions and precautions provided in the operation manuals.

5 Application Precautions

Observe the following precautions when using the PC System.

WARNING Always heed these precautions. Failure to abide by the following precautions could lead to serious or possibly fatal injury.

- Always connect to a class-3 ground (to 100 Ω or less) when installing the Units. Not connecting to a class-3 ground may result in electric shock.
- A class-3 ground (to 100 Ω or less) must be installed when shorting the GR and LG terminals on the Power Supply Unit.
- Always turn OFF the power supply to the PC before attempting any of the following. Not turning OFF the power supply may result in malfunction or electric shock.
 - Mounting or dismounting I/O Units, CPU Units, Inner Boards, or any other Units.
 - Assembling the Units.
 - Setting DIP switches or rotary switches.
 - Connecting cables or wiring the system.

Failure to abide by the following precautions could lead to faulty operation of the PC or the system, or could damage the PC or PC Units. Always heed these precautions.

• Fail-safe measures must be taken by the customer to ensure safety in the event of incorrect, missing, or abnormal signals caused by broken signal lines, momentary power interruptions, or other causes.

5

- Interlock circuits, limit circuits, and similar safety measures in external circuits (i.e., not in the Programmable Controller) must be provided by the customer.
- Always use the power supply voltages specified in the operation manuals. An incorrect voltage may result in malfunction or burning.
- Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied. Be particularly careful in places where the power supply is unstable. An incorrect power supply may result in malfunction.
- Install external breakers and take other safety measures against short-circuiting in external wiring. Insufficient safety measures against short-circuiting may result in burning.
- Be sure that all the mounting screws, terminal screws, and cable connector screws are tightened to the torque specified in the relevant manuals. Incorrect tightening torque may result in malfunction.
- Leave the label attached to the Unit when wiring. Removing the label may result in malfunction if foreign matter enters the Unit.
- Remove the label after the completion of wiring to ensure proper heat dissipation. Leaving the label attached may result in malfunction.
- Use crimp terminals for wiring. Do not connect bare stranded wires directly to terminals. Connection of bare stranded wires may result in burning.
- Wire all connections correctly.
- Double-check all wiring and switch settings before turning ON the power supply. Incorrect wiring may result in burning.
- Mount Units only after checking terminal blocks and connectors completely.
- Be sure that the terminal blocks, Memory Units, expansion cables, and other items with locking devices are properly locked into place. Improper locking may result in malfunction.
- Check the user program for proper execution before actually running it on the Unit. Not checking the program may result in an unexpected operation.
- Do not lay communications cables near power lines or high-voltage lines.
- Always lay communications cables in ducts.
- Do not pull on the communications cables or bend the communications cables beyond their natural limit. Doing either of these may break the cables.
- Do not place objects on top of the communications cables or other wiring lines. Doing so may break the cables.
- Before touching a Unit, be sure to first touch a grounded metallic object in order to discharge any static built-up. Not doing so may result in malfunction or damage.
- When transporting or storing Units, place them in special packing boxes and do not allow them to be subject to excessive shock or vibration during transportation.

6 Conformance to EC Directives

6-1 Applicable Directives

- EMC Directives
- Low Voltage Directive

6-2 Concepts

EMC Directives

OMRON devices that comply with EC Directives also conform to the related EMC standards so that they can be more easily built into other devices or the overall machine. The actual products have been checked for conformity to EMC standards (see the following note). Whether the products conform to the standards in the system used by the customer, however, must be checked by the customer.

EMC-related performance of the OMRON devices that comply with EC Directives will vary depending on the configuration, wiring, and other conditions of the equipment or control panel on which the OMRON devices are installed. The customer must, therefore, perform the final check to confirm that devices and the overall machine conform to EMC standards.

Note Applicable EMC (Electromagnetic Compatibility) standards are as follows:

EMS (Electromagnetic Susceptibility): EN61131-2 EMI (Electromagnetic Interference): EN50081-2

(Radiated emission: 10-m regulations)

Low Voltage Directive

Always ensure that devices operating at voltages of 50 to 1,000 VAC and 75 to 1,500 VDC meet the required safety standards for the PC (EN61131-2).

SECTION 1 Features and System Configuration

This section introduces the overall structure of an Ethernet network, outlines the features of the Ethernet Unit, describes the communications protocols used by an Ethernet network, and provides basic precautions for use of an Ethernet network.

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1-1 Features

Wide-ranging Control Capability Using Ethernet	The Ethernet Unit enables a Programmable Controller (PC) to support a wide range of protocols via Ethernet, including data communications by TCP/IP and UDP/IP socket services, FINS command execution (OMRON's standard protocol), FTP file transfers, and SMTP message communications.
Communications by UDP/IP and TCP/IP	The Ethernet Unit supports the standard Ethernet protocols, UDP/IP and TCP/ IP, so it can communicate with other Ethernet devices, workstations, personal computers, and Ethernet Units produced by other manufacturers. It can utilize up to eight socket ports for the various protocols, allowing it to be employed in a wide range of applications.
Easy Use of Socket Services	TCP or UDP socket services can be easily accessed either by executing the CMND(490) instruction or by presetting parameters and then manipulating dedi- cated control switches in memory. Presetting parameters eliminates the need for ladder programs to monitor the completion timing of instructions and socket service processing, and thereby reduces the work hours involved in program development.
FINS Message Communications	The Ethernet Unit also supports FINS message communications, OMRON's standard communications service, so other OMRON PCs can be accessed by using SEND(090), RECV(098), and CMND(490) instructions in ladder programs. In addition, the FINS gateway function can be used to allow access to other PCs on not only the same Ethernet network but also on other networks such as Controller Link and SYSMAC Link.
File Transfers Between PC and Host Computer (FTP Server Function)	The Ethernet Unit has a built-in FTP server function, so any workstation or per- sonal computer with an FTP client function can be used for reading files from or writing files to the PC. This enables large amounts of data to be transferred at one time without any need for writing a ladder program.
E-mail Capability	User-defined messages, Unit error information, status information, and so on, can be sent from the PC to the mail server as e-mail. This function allows information generated at the production site to be sent out as e-mail.
24-VDC Power Supply for Transceiver	A 24-VDC power supply can be used as the power supply for the transceiver. The Ethernet Unit voltage output provides for a voltage drop in the transceiver cables, so there is no need to adjust the power supply voltage.
Controller Link Network Connection	Ethernet, the information-system network, can be connected to Controller Link, the control-system network, using the FINS communications service. This allows a PC on the Controller Link network to be monitored from a PC on the Ethernet network, and, conversely, for data to be exchanged between a PC on the Controller Link network and a PC on the Ethernet network.
Abundant Troubleshooting	The Ethernet Unit is provided with a variety of troubleshooting functions for prompt recovery in case of errors.
	Self-diagnostic function at startup
	 PING command for checking remote nodes
	 Inter-nodal tests for checking remote nodes
	 Error log for recording error history data
	 E-mail notification when errors occur

1-2 System Configuration

1-2-1 Device Configuration



- **Note** 1. Transmission distance (from Terminator to Terminator): 500 meters/segment max.
 - 2. When segments are indirectly connected by a repeater: 2.5 km/network
 - 3. Node interval (from transceiver to transceiver): Integral multiples of 2.5 m
 - 4. Transceiver cable length: 50 m max.

1-2-2 Node Connections

Minimal Configuration: 1 Segment



Configuration With Segment Extension Use repeaters to extend the distance between nodes or to increase the number of connected nodes.



1-3 Devices Required in a Network

The basic configuration of an Ethernet System consists of a single coaxial cable together with the transceivers, transceiver cables, nodes, and so on, that are connected to it. In an Ethernet System, this basic configuration is called a "segment."



The devices shown in the following table must be obtained to configure a network using an Ethernet Unit, so prepare them in advance. Use only devices in the network that conform to IEEE802.3 standards.

Network device	Contents
CS1 Ethernet Unit	The Ethernet Unit is a Communications Unit that connects a CS1-series PC to an Ethernet network.
24-VDC power supply	This is a external 24-VDC power supply for the purpose of providing power to the transceivers via transceiver cable. Use a power supply with an output current of at least 0.3 A per node. The power is converted within the Unit to the transceiver power supply voltage, and is provided to the transceiver.
Transceiver	The transceiver is a device for interfacing between the coaxial cable and the nodes.
	Note: The Ethernet Unit can provide a maximum current of 0.4 A to the transceiver, so use a transceiver with a current consumption of not more than 0.4 A. Check with the manufacturer for information regarding transceiver current consumption.
Transceiver cable (AUI cable)	This is the cable for connecting between transceivers and nodes.
Coaxial cable	The coaxial cable comprises the main line of the Ethernet System.
Terminator for coaxial cable (terminating resistance)	The Terminators connect to both ends of the coaxial cable.

Note 1. It is also possible to use 10BASE-T twisted-pair cable by connecting the Ethernet Unit to a 10BASE-T conversion adapter.

2. A 24-VDC power supply is required even if a 10BASE-T conversion adapter is used.



1-4 Related Programming Devices

The Ethernet Unit functions as a node on the Ethernet network. The basic settings for operation are made in the CPU Bus Unit System Setup in the CS1-series CPU Unit. Use the CX-Programmer to make the settings.

Ethernet Unit

CS1-series CPU Uni	t
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The following ite	ms are include	ed in the S	ystem Setup.
			· · ·

Screen	Item	Default
Setup Screen	Broadcast setting	All 1 (4.3BSD specifications)
	Address conversion method	Automatic generation
	FINS UDP port number	9600
	Subnetwork mask	0.0.0.0 (Uses value corresponding to IP address class.)
	FTP login name	CONFIDENTIAL
	FTP password	Not set.
	IP address table	Not set.
IP router table		Not set.
Mail Setup Screen	Mail settings	None set.
	User-created mail data address	Not set.
	Local node address	Not set.
	Destination address	Not set.
	SMTP server address	0.0.0.0 (Not set.)

When using the default values that are already stored in the CS1-series CPU Unit, there is no need to make any settings with the CX-Programmer. Refer to *4-2 CPU Bus Unit System Setup* for details on the above settings.

1-5 Specifications

Item			Specifications
Model number			CS1W-ETN01
Applicable PCs			CS1-series PCs
Unit classification			CPU Bus Unit
Mounting locat	ion		CPU Rack or Expansion Rack
Number of Uni	ts that can be m	ounted	4 max. (including Expansion Racks)
Transfer	Media access	method	CSMA/CD
specifications	Modulation		Baseband
	Transmission p	oaths	Bus
	Baud rate		10 Mbps
	Transmission r	nedia	Coaxial cable
	Transmission	Segment length	500 m max.
	distance	Distance between nodes	2,500 m max.
	Number of con	nectible nodes	100/segment max.
	Distance betwe	een nodes	Multiples of 2.5 m
	Transceiver ca	ble length	50 m max.
Current consul	mption (Unit)		400 mA max. at 5 VDC
External power supply			Capacity: 0.3 A min. at 24 VDC (per node) Inrush current: 2.5 A max. (when 24-VDC startup time is 5 ms) Permissible voltage fluctuation range: 20.4 VDC to 26.4 VDC (24 VDC -15% to +10%) Recommended power supply: OMRON S82J-series
Power supply to transceiver			Capacity: 0.4 A at 12 V Voltage fluctuation range: 13.05 VDC to 14.48 VDC Ripple: 2% p-p
Vibration resistance			Conforms to JIS C0911. 10 to 57 Hz, 0.075-mm amplitude, 57 to 150 Hz, acceleration: 9.8 m/s^2 (1G) in X, Y, and Z directions for 80 minutes each (Time coefficient; 8 minutes × coefficient factor 10 = total time 80 minutes)
Shock resistance			Conforms to JIS C0912. 147 m/s ² (15G) three times each in X, Y, and Z directions
Ambient temperature			Operating: 0 to 55°C Storage: –20 to 75°C
Humidity			10% to 90% (with no condensation)
Atmosphere			Must be free from corrosive gas.
Weight			300 g max.
Dimensions			35 x 130 x 101 mm (W x H x D)

Dimensions



1-6 Software Configuration

The software supported by the Ethernet Unit runs in the layers shown in the following diagram. The components that form the various layers are defined below the diagram.



Ethernet	The Version-2.0 Ethernet frame format is used for communications.
IP	Internet Protocol: Transfers datagrams to target nodes using IP addresses.
ICMP	Internet Control Message Protocol: Supports IP communications by signalling errors in data transfers.
ARP	Address Resolution Protocol: Determines the Ethernet address (i.e., physical address) by broadcasting based on the target IP address.
UDP	User Datagram Protocol: Performs datagram communications. Data resends, priority control, flow control, and other measures to ensure communications reli-

	ability are not performed for UDP communications, i.e., there is no way of guar- anteeing normal communications without programming special measures to do so into the user's application program.
ТСР	Transmission Control Protocol: Performs communications after establishing a connection (i.e., a virtual circuit) with the target node to provide a highly reliable communications method.
FINS	Factory Interface Network Service: A protocol that sends messages between PCs on any of various OMRON FA networks. The user must provide measures such as retry processing to ensure that transmitted messages arrive at the destination node.
SMTP	Simple Mail Transfer Protocol: A communications protocol for sending e-mail by TCP/IP.
FTP	File Transfer Protocol: Transfers data files.

1-7 IP Addresses

Ethernet networks use IP addresses for communications. IP addresses (Internet addresses) identify both the Ethernet network and the node (host computer, Ethernet Unit, etc.) on the Ethernet network. IP addresses must be set and controlled so that they are not duplicated.

1-7-1 IP Address Configuration

IP addresses are made up of 32 bits of binary data divided into four 8-bit fields called octets. These four octets provide the network number (net ID) and host number (host ID). The network number identifies the network and the host number identifies the node (or host) on the network.

The network numbers in an IP addresses are divided into three classes, A, B, and C, so that the address system can be selected according to the scale of the network. (Classes D and E are not used.) The configuration of the IP address for each of these classes is shown in the following diagram.



The number of networks in each class and the number of nodes possible on the network differ according to the class.

Class	Number of networks	Number of hosts
Class A	Small	2 ²⁴ – 2 max. (16,777,214 max.)
Class B	Medium	2 ¹⁶ – 2 max. (65.534 max.)
Class C	Large	2 ⁸ – 2 max. (254 max.)

IP addresses are represented by the decimal equivalent of each of the four octets in the 32-bit address, each separated by a period. For example, the binary address 10000010 00111010 00010001 00100000 would be represented as 130.58.17.32.

Note The same network number must be set for every node on the same Ethernet network.

1-7-2 Allocating IP Addresses

IP (Internet Protocol) is a standard communications protocol used throughout the world and is designed to enable communications between any Ethernet nodes regardless of the networks on which they exist. To achieve this, network numbers are allocated by the Network Solutions, InterNIC Registration Services, to ensure that all Ethernet networks have unique numbers regardless of where they exist. The local system administrator is left the responsibility of allocating unique host numbers locally. You therefore should obtain a network number from the InterNIC Registration Services to ensure uniqueness and allow for future network expansions if required.

1-7-3 IP Address Settings

An IP address must be set for the Ethernet Unit before Ethernet communications can proceed. The IP address is set for each Ethernet Unit by the rotary switch on the back of the Unit. For more details, refer to 3-4-3 Setting the Local IP Address.

1-7-4 Subnet Masks

Operation and management of a network may become very difficult if too many nodes are connected on a single network or if a single organization has to manage too many network numbers. It can therefore be convenient to divide a single network up into several subnetworks by using part of the host number as a subnet number. Internally the network can be treated as a number of subnetworks, but from the outside it acts as a single network and uses only a single network number.

To establish subnetworks, the host number in the IP address is divided into a subnet number and a host number by using a setting called the subnet mask. The subnet mask indicates which part of the host number is to be used as the subnet number. The user must first determine the number of bits of the host number to be used as the subnet number and then set the subnet mask accordingly. All bits in the subnet mask that correspond to the bits in the IP address used either as the network number or subnet number are set to "1" and the remaining bits, which will correspond to the bits in the IP address actually used for the host number, are set to "0".

The following example shows the subnet mask for an 8-bit subnet number used in a class-B IP address. This subnet mask is structured as follows:

This would thus be a class-B IP address masked as a class-C IP address, i.e., externally it would be allocated a class-B IP address but internally it can be addressed using class-C IP addresses.

Subnet mask: <u>11111111</u> <u>11111111</u> <u>11111111</u> <u>00000000</u> (FFFFF00)

It is only necessary to set subnet masks if subnetworks are used. If a subnet mask is not set by the user, a default mask will be set automatically according to the IP address class to indicate that the entire host number will be used as the host number, i.e., no bits will be assigned for use as the subnet number.

All nodes on the network that are going to belong to the same subnetwork must have the same subnet mask.

In this case, the following subnet mask values will be used depending on the IP address class.

Class	Network mask value
Class A	255.0.0.0
Class B	255.255.0.0.0
Class C	255.255.255.0.0.0

1-8 Precautions

Be sure to observe the following precautions when installing and using an Ethernet Unit.

1-8-1 Installation

Observe the following precautions when installing an Ethernet System. (Refer to *Section 3 Installation and Initial Setup* for details.)

- **1, 2, 3...** 1. Use transceiver cable that meets IEEE802.3 standards to ensure high noise resistance.
 - 2. Use a transceiver with a current consumption of not more than 0.4 A per port.
 - 3. Always turn off the power supply to the PC before connecting or disconnecting the transceiver cable.
 - 4. Be sure not to exceed the current capacity of the Power Supply Unit on the Rack to which the Ethernet Unit is mounted. The current consumption of the Ethernet Unit is 400 mA maximum. This value added to the current consumption of all other Units mounted to the same Rack must not exceed the capacity of the Power Supply Unit.
 - 5. Do not install the transceiver cables or coaxial cables of the Ethernet System near power supply lines. If installation near possible sources of noise is unavoidable, install the cables in grounded metal ducts or take other measure to eliminate noise interference.

1-8-2 Ethernet and IEEE802.3 Standards

The Ethernet Unit was designed based on version-2 Ethernet standards and not on the international IEEE802.3 standards, which were developed based on Version-2.0 Ethernet specifications. Although these two sets of standards are similar, they are not necessarily the same. Particularly, different frame formats are used, making direct communications impossible between systems that do not support the same standards. Standards for equipment used to configure networks are the same, allowing IEEE802.3-standard equipment to be used with the Ethernet Unit. Particularly the transceiver cable for the IEEE802.3 standards provides superior noise resistance and should be used for the Ethernet Unit.

Terminology also differs between Version-2.0 Ethernet and IEEE802.3 standards. These differences are shown in the following table. Version-2.0 Ethernet terminology is used in this manual.

Version-2 Ethernet	IEEE802.3
Transceiver	MAU
Transceiver cable	AUI
Ethernet address	MAC address
Ethernet	10BASE5

SECTION 2 Communications Functions

This section provides an overview of the communications functions that can be used with the Ethernet Unit.

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2-1 Communications Functions

The following table shows the communications service functions that are available with the Ethernet Unit.

Function		FINS communications	Socket services	FTP server	Mail
Client to server	PC to PC	By executing SEND(090), RECV(098) or CMND(490) FINS command	By executing CMND(490) or manipulating dedicated control switches in memory.		
	PC to host computer	By executing SEND(090), RECV(098), or CMND(490) Host computer (with FINS Gateway function) FINS command	At PC: By executing CMND(490) or manipulating dedicated control switches in memory. Host computer (without FINS Gateway function) (Passive open) Any data (Active open)		E-mail can be set to be sent when specified bits turn ON, when errors occur, or at fixed intervals.
	Host computer to PC	By sending FINS messages from the host computer. Host computer (with FINS Gate- way function) FINS command	At PC: By executing CMND(490) or manipulating dedicated control switches in memory. Host computer (with- out FINS Gateway function) (Active open) Any data	FTP commands executed by host computer Host computer File	
Data typ)e	FINS commands (various commands for I/O memory communications in the PC, changing the operating mode, reading and writing files, and so on)	Any data (PC's internal I/O memory)	DOS files in File Memory (Memory Card or EM File Memory)	User-defined messages, error log information, status information
Maximu	m data size	PC to PC: 1,980 bytes max. PC to host computer: 1,980 bytes max. Host computer to PC: 2,000 bytes max.	1,984 bytes max.	No particular limit.	User-defined messages: 1,024 bytes max.
Feature	S	Enables control of PC and host computer that support FINS commands.	Communications by standard TCP/IP and UDP/IP via Ethernet. No need to set FINS addresses.	Files are read by means of simple commands and applications from host computers with FTP client functions.	Ethernet Unit status is obtained by e-mail. Notification of errors is received by e-mail.
Referen	ICE	Section 5 FINS Communications	Section 6 Socket Services	Section 7 FTP Server	Section 8 Mail

2-1-1 Ethernet Unit Functions

Function	Contents
FINS communications	• A SEND(090), RECV(098), or CMND(490) instruction from the PC's ladder program is used to send a FINS command to a remote node, and a response is received.
	• A FINS command is received from a remote node. If the command is ad- dressed to the local Unit, it is processed internally. If it is addressed to another Unit, a request is made to the CPU Unit and the result is sent back to the remote node as a response.
	• Following the FINS header information, the Ethernet Unit serves as a gate- way for FINS commands and responses between other Communications Units mounted to the same PC.
Socket services	The Ethernet Unit supports up to 16 ports (8 TCP ports and 8 UDP ports) for socket interface with respect to the ladder program. When this function is used, communications can be carried out by either TCP or UDP with various devices on the Ethernet network.
	This function can be used by either manipulating dedicated control switches in memory or by executing CMND(490).
	 Manipulating dedicated control switches in memory: Socket services can be used by first setting the required parameters in the Socket Service Parameter Area allocated in the DM Area (refer to 4-4 DM Area Allocations) and then turning ON dedicated control switches in memory. There is no need to monitor the completion timing for instructions or socket services, so the work hours involved in developing ladder programs can be reduced. Only eight socket ports (UDP and TCP combined) can be used with this method. For any ports that exceed that number, use the CMND(490) instruction.
	 Using CMND(490) Socket services can be used by utilizing the CMND(490) instruction to execute FINS commands. Up to 16 socket ports can be used with CMND(490).
FTP server	The FTP server function allows data files to be transferred between a client workstation or personal computer and the PC's file system (Memory Card or EM Area).
Mail	The types of data listed below can be sent as e-mail when a dedicated control switch in memory is turned ON, when an error occurs, or when a preset time interval elapses. Any of the following types of data can be specified for transmission with any of these timing methods. (Refer to <i>Section 8 Mail.</i>)
	User-created data (Data at PC: ASCII, 1,024 bytes max.)
	Error log information (64 records)
	Status information
	A mail server must be provided separately in order to use the mail function.

2-1-2 Socket Ports Used By the Ethernet Unit

Port n	umber	Application
UDP	9600	Used for FINS. (Can be changed by CPU Bus Unit System Setup.)
TCP	20	Used for FTP server function (for data transfer).
	21	Used for FTP server function (for connection).

2-1-3 Selecting Communications Services

Refer to the following guidelines to select the appropriate communications service to use in a given situation.



2-2 FINS Communications

FINS commands can be sent to or received from other PCs or computers on the same Ethernet network by executing SEND(090), RECV(098), or CMND(490) instructions in the ladder-diagram program. This enables control operations such as the reading and writing of I/O memory between PCs, mode changes, and file memory operations. (When a FINS message is sent on an Ethernet network, a UDP/IP header is automatically added to the message.)

The FINS gateway function allows access not only to PCs on the same Ethernet network, but also to PCs on other networks such as SYSMAC LINK or Controller Link.



Executing from the host computer FINS commands with UDP/IP headers added enables various control operations such as the reading and writing of I/O memory of PCs on the Ethernet network, mode changes, and file memory operations.



2-3 Socket Services

By Manipulating Dedicated Control Switches The socket services allow devices on the Ethernet to send and receive various data using the UDP or TCP protocol. There are two ways to use socket services, as explained below. (For details, refer to *Section 6 Socket Services*.)

The first way to use socket services is to set the required parameters in the parameter area allocated in the DM Area, and then to request particular UDP or TCP socket services by turning ON dedicated control switches in memory. The Ethernet Unit turns OFF the same bit when the requested process has been completed. Data that is sent or received is automatically handled according to the I/O memory locations specified in the parameter area. There is no need to execute the CMND(490) instruction or to monitor the completion timing and actual processing of the instruction, so this helps to simplify ladder programming.

A total of eight ports (UDP and TCP combined) can be used for socket services.



By Executing CMND(490)

The other way to use socket services is to request a UDP or TCP socket service by sending a FINS command to the Ethernet Unit by executing CMND(490) from the CPU Unit. When the Ethernet Unit receives the socket service request, it returns a response to the CPU Unit to confirm that it received the request and then begins the requested processing. When the processing is completed, the results are stored in the Results Storage Area in the CPU Unit.

Eight TCP ports and eight UDP ports can be used.



2-4 FTP Server

The Ethernet Unit has a built-in FTP server function, so other computers on the Ethernet can read or write individual files in a Memory Card mounted to the CPU Unit or in EM file memory. This allows files to be exchanged between the host computer and the PC, with the host computer functioning as an FTP client and the PC as an FTP server. For details, refer to Section 7 FTP Server.



2-5 Mail

Data such as user-created information (1,024 bytes max. in ASCII), Ethernet Unit error log information (64 records max.), and status information can be sent as e-mail to specified addresses.

The e-mail can be sent with any of the following three types of timing. (Simultaneous specification is also possible.)

- When the Mail Send Switch turns ON.
- When an error occurs (when an error log is recorded.)
- At regular intervals.

This enables periodic e-mail and error messages to be sent from the PC to the mail server.



- Note
 - e 1. A mail server is required in order to use the mail function.
 - 2. Mail server settings require specialized knowledge, so they should always be handled by the network administrator.
 - 3. Be sure you have a clear understanding of the mail system before using this function.

4. Mail delivery is not guaranteed. Depending on factors such as the condition of the network, mail that has been sent may not arrive at its destination.

SECTION 3 Installation and Initial Setup

This section explains how to install the Ethernet Unit and make the initial settings required for operation.

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3-1 Before Operation

In order to connect the Ethernet Unit to an Ethernet network, it is necessary to set the IP address. This section explains the process of address conversion, which is required information for determining the Ethernet Unit's IP address.

Address Conversion (for FINS Communications Only) When using the FINS communication service, it is necessary to specify the nodes according to the FINS address system. Even in this case, data must be sent and received on the Ethernet network using IP addresses. Therefore, IP addresses are converted from FINS addresses.



There are three ways to convert addresses, as follows:

- Automatic generation (the default)
- IP address table
- Combined method (using both automatic generation and I/O address table)

Use the CX-Programmer to select the address conversion method in the System Setup. For an explanation of how to make the setting, refer to 4-2 CPU Bus Unit System Setup.

3-1-1 Automatic Address Generation

Automatic address generation converts addresses using the FINS node number as the host number of the IP address. The network ID of the local IP address is used for the network ID. The IP address of a remote node is calculated from the local Ethernet Unit's IP address, the subnet mask, and the remote node number (Fins node number), as follows:

Remote IP address =

(local IP address AND subnet mask) OR remote FINS node number

Example

The remote IP address is calculated for the node using the following settings:

Local IP address: 130.25.36.8 (decimal) Subnet mask: 255.255.255.0 (decimal) Remote FINS node number: 5

SS	Local IP address Subnet mask	130.25.36. 8 255.255.255.0	AND
S node number	Remote FINS no	130.25.36.0 5	OR
lddress	Remote IP addre	130.25.36.5	

Note The rightmost byte of the host number becomes the FINS node number, and the rest of the host number becomes all zeroes.

Example 1 Local IP address: Subnet mask: Remote FINS node number:	130.25.36.8 255.255.0.0 5
↓ H	lost number
Remote IP address 130.2	25. <u>0</u> .5
	🖢 Becomes 0.
Example 2 Local IP address: Subnet mask: Remote FINS node number:	130.25.36.8 255.0.0.0 5
Ļ	
Ho	st number
Remote IP address 130.	. <u>0.0</u> .5
	^I Becomes 0.

Note When using either the address conversion method (the default) or the combined method, set the local IP address switches 7 and 8 on the back of the Ethernet Unit and the node number to the same values, and set the other host settings to 0. If the values are wrong, the ERC indicator will flash.

Characteristics of Automatic Generation Method

The automatic address generation method has the advantage of clarifying the correspondence between the FINS address and the IP address, but it also has the following restrictions.

- 1, 2, 3... 1. It cannot be applied outside of the range with the same network ID.
 - 2. The remote host number must be within the range of FINS node numbers (1 to 126).
 - 3. The Ethernet Unit's host number and the node number must be set to the same value.

The automatic address generation method is the default setting, so there is no need to set it with the CX-Programmer if the setting has not been changed.

The IP address table method converts the FINS node number to an IP address based on a preset correspondence table called an IP address table. The IP address table is prepared in the System Setup, using the CX-Programmer. For details on the System Setup, refer to 4-2 CPU Bus Unit System Setup. With different segments, nodes with different network IDs can also be registered.



Characteristics of IP Address Table Method

The IP address table method provides a simple correspondence table, so it has the advantage of allowing FINS node numbers and IP address to be freely allocated. It does, however, have the following restrictions.

IP Address Table

- 1, 2, 3...1. Not more than 32 pairs of node number and IP addresses can be registered in the IP address table, so that limits the number of nodes, including the local node, to 32.
 - 2. The correspondences must be preset, or the remote FINS node numbers will not be recognized.

Combined Method

The combined method incorporates both the automatic generation method and the IP address table method. It first refers to the IP address table, and if there is an applicable FINS address, it reads the corresponding IP address. If there is no applicable FINS address, it uses the automatic generation method to calculate an IP address.



3-2 Overview of Startup Procedure

- 1, 2, 3...1. Determine the local IP address and the address conversion method. Refer to 3-1 Before Operation.
 - 2. Set the unit number of the Ethernet Unit as a CPU Bus Unit. Refer to *3-4 Switch Settings.*
 - 3. Set the node address.

Refer to 3-4 Switch Settings.

4. Set the local IP address.

Refer to 3-4 Switch Settings.

5. Mount the Unit to the Backplane.

Refer to 3-5 Mounting to a Backplane.

6. Connect to the network. Connect the transceiver cable and external 24-VDC power supply.

Refer to 3-6 Connecting to the Network.

- 7. Turn ON the external 24-VDC power supply and turn ON power to the CPU Unit. When turning ON the power supply, either first turn ON the external power supply (i.e., the power to the transceiver), and then turn ON the power to the CPU Unit afterwards, or else turn them both ON at the same time. If the power is turned ON first to the CPU Unit, a communications error will be generated.
- 8. Create the I/O tables using a Programming Device, such as a CX-Programmer or Programming Console. (This step can be omitted if the I/O table has already been created.)

Refer to 3-7 Creating an I/O Table.

9. Create the routing tables using the CX-Programmer. (This step is required only if FINS communications are used, or if CMND(490) is used by a PC with multiple Communications Units mounted to it.)

Refer to 3-8 Creating Routing Tables.

10. Make the settings in the System Setup using the CX-Programmer. (Create the IP address table and IP router table.)

Refer to 3-9 System Setup, 3-10 Creating an IP Address Table, and 3-11 Creating an IP Router Table.

This step is required only in the following cases:

- . When using a method other than automatic generation for IP address conversion. (Address conversion method, IP address table.)
- When using the mail notification function.
- When setting a subnet mask.
- When setting an FTP login name and password.
- When Ethernet is configured in multiple segments. (IP router table)
- When Ethernet 4.28 is used (broadcast settings)
- When the UDP port number for FINS is changed to something other than the default setting (9600).
- 11. Check communications. (Use PING command and an internode test.)

Refer to 3-12 Checking Communications.

3-3 **Unit Components**

This section explains the Ethernet Unit's components, settings, and LED indicators. For details regarding the settings, refer to the individual explanations later in this section.

3-3-1 Nomenclature



Back
Each communications device connected to the Ethernet network is allocated a unique Ethernet address. For the Ethernet Unit, this Ethernet address is shown on the right side of the Unit as a 12-digit hexadecimal number.



Note The Ethernet address can also be checked using the FINS command, CON-TROLLER DATA READ. (Refer to 11-3-2 CONTROLLER DATA READ.)

3-3-2 Indicators

The status of the indicators show the operating status of the Unit.



Indicator	Color	Status	Meaning
RUN	Green	Not lit	Operation stopped.
			Hardware error.
		Lit	Normal operation.
P/S	Green	Not lit	Power is not being supplied to the transceiver.
(Power Supply)		Lit	Power is being supplied to the transceiver.
ERC	Red	Not lit	Unit normal.
(Ethernet Unit Error)		Lit	Node number not between 1 and 126.
			• A hardware (e.g., internal memory) error has occurred.
		Flashing	An illegal IP address has been set. With automatic address generation, the rightmost two digits of the IP address do not match the node number. (Refer to <i>3-4-3 Setting the Local IP Address.</i>)
ERH	Red	Not lit	PC normal.
(PC Error)		Lit	A PC error has occurred.
			• An error exists in I/O table, unit number, system data, or routing table settings.
SD Yello		Not lit	Not sending data. (Ready to send.)
(Send Data)		Lit	Sending data.
RD	Yellow	Not lit	Not receiving data. (Ready to receive.)
(Receive Data)		Lit	Receiving data.
ТСР	Yellow	Not lit	None of the eight TCP sockets provided for socket services is in use.
(TCP Socket in Use)		Lit	At least one of the eight TCP sockets provided for socket services is in use.
FTP Yellow Not lit FTP server on stand-by.		FTP server on stand-by.	
(File Server Service)		Lit	FTP server operating.
TS	Yellow	Not lit	Not running internode test.
(Internode Testing)		Lit	Running internode test.

3-4 Switch Settings

This section explains how to set the various switches on the Ethernet Unit.

3-4-1 Setting the Unit Number

The unit number is used to identify individual CPU Bus Units when more than one CPU Bus Unit is mounted to the same PC. Use a small screwdriver to make the setting, taking care not to damage the rotary switch. The unit number is factory-set to 0.





Note

te 1. Turn OFF the power supply before setting the unit number.

2. If the unit number is being set for the first time or changed, then an I/O table must be created for the PC.

With CS1-series PCs, words are automatically allocated in the CIO Area and the DM Area. The Ethernet Unit uses these words for receiving control data from the CPU Unit and for notifying the CPU Unit of Ethernet Unit and communications status. The word addresses in the allocated areas for the CPU Bus Unit are important in creating the user program for using the Ethernet Unit, so be careful to take them into account when setting the unit number.

The following table shows the areas allocated for the CPU Bus Unit by unit number. This table only shows the correspondences between unit numbers and the areas allocated for the CPU Bus Unit. For more details, refer to *Section 4 System Setup and Allocated Areas*.

CIO Area Allocations

Unit Number and CPU

Bus Unit Allocations

Unit No. (decimal)	Allocated words	Unit No. (decimal)	Allocated words
0 (0)	CIO 1500 to CIO 1524	8 (8)	CIO 1700 to CIO 1724
1 (1)	CIO 1525 to CIO 1549	9 (9)	CIO 1725 to CIO 1749
2 (2)	CIO 1550 to CIO 1574	A (10)	CIO 1750 to CIO 1774
3 (3)	CIO 1575 to CIO 1599	B (11)	CIO 1775 to CIO 1799
4 (4)	CIO 1600 to CIO 1624	C (12)	CIO 1800 to CIO 1824
5 (5)	CIO 1625 to CIO 1649	D (13)	CIO 1825 to CIO 1849
6 (6)	CIO 1650 to CIO 1674	E (14)	CIO 1850 to CIO 1874
7 (7)	CIO 1675 to CIO 1699	F (15)	CIO 1875 to CIO 1899

DM Area Allocations

Unit No. (decimal)	Allocated words	Unit No. (decimal)	Allocated words
0 (0)	D30000 to D30099	8 (8)	D30800 to D30899
1 (1)	D30100 to D30199	9 (9)	D30900 to D30999
2 (2)	D30200 to D30299	A (10)	D31000 to D31099
3 (3)	D30300 to D30399	B (11)	D31100 to D31199
4 (4)	D30400 to D30499	C (12)	D31200 to D31299
5 (5)	D30500 to D30599	D (13)	D31300 to D31399
6 (6)	D30600 to D30699	E (14)	D31400 to D31499
7 (7)	D30700 to D30799	F (15)	D31500 to D31599

3-4-2 Setting the Node Number

With the FINS communications service, when there are multiple Ethernet Units connected to the Ethernet network, the Ethernet Units are identified by node

numbers. Use the Node Number Switches to set the node number between 01 and 7E hexadecimal (1 to 126 decimal). Do not set a number that has already been set for another node on the same network.



The left switch sets the sixteens digit (most significant digit) and the right switch sets the ones digit (least significant digit). The node number is factory-set to 01.

When using the automatic generation method for address conversion, set the node number to the same value as that of the Local IP Address Switches. If this is not possible, then either the IP address table method or the combined method must be used for address conversion. For details, refer to *4-2 CPU Bus Unit System Setup*.

If the FINS communications service is not being used over the Ethernet network, then there is no problem if the node number duplicates that of another Ethernet Unit. The node number must still be set from 01 to 7E, however, or the ERC indicator will light.

Note Turn OFF the power supply before setting the node number.

3-4-3 Setting the Local IP Address

The nodes on an Ethernet network are identified by IP addresses. Each IP address is set with 32 bits of binary data. These 32 bits are divided into four 8-bit fields called octets, and each octet is expressed as four decimal numbers. At the Ethernet Unit, four bits are expressed as on hexadecimal digit, and the eight hexadecimal rotary switches (the Local IP Address Switches) on the back of the Unit are used to set the local IP address. Set the eight switches in hexadecimal as shown below, combining SW1 and SW2, SW3 and SW4, SW5 and SW6, and SW7 and SW8. Each switch can be set from 0 to F.



Local IP Address Switch No. 12.34.56.78.

The switches are all factory-set to 0 (00.00.00.00). The Ethernet Unit cannot be used with this setting; a proper IP address must be set. The following settings cannot be made for the IP address, or the ERC indicator will flash.

All bits in the network number field set to 0 or 1.

All bits in the host number field set to 0 or 1.

All bits in the subnet number field set to 1.

The beginning of the IP address set to 127 (7F Hex) Example: 127.35.21.16

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- **Note** 1. When using the automatic generation method for address conversion, set switches 7 and 8 to the same values as the node number setting, and set the rest of the host number to zeroes. For details regarding the host number, refer to *1-7 IP Addresses*. The value for the host number field in the IP address must match the value for the node number or the ERC indicator will flash.
 - 2. If a subnet mask is to be set, use the CX-Programmer to set it in the CPU Bus Unit System Setup. For details, refer to *4-2 CPU Bus Unit System Setup*.

3-5 Mounting to a Backplane

3-5-1 Mounting Position

Ethernet Units can be mounted to any slots in either a CS1-series CPU Rack or a CS1-series Expansion CPU Rack, but the number of slots to which they can be mounted depends on the Backplane. Up to four Ethernet Units can be mounted to a single PC. If it is mounted in combination with other CPU Bus Units (e.g., Controller Link Units), the maximum total number of CPU Bus Units that can be mounted is 16.

Note Tighten PC Backplane mounting screws to a torque of 1.2 N•m, and the Unit's screws to a torque of 0.8 N•m.



Up to four Units can be mounted to the slots shown in the diagrams on the left.

CPU: CPU Unit PS: Power Supply Unit

- Note 1. The Ethernet Unit's maximum current consumption is 400 mA. (The power provided to the transceiver is not included because it comes from a 24-VDC power supply connected to the Unit's power supply terminals.) Make sure that the total current consumption of all the Units connected to the same CPU Backplane or Expansion Backplane does not exceed the output capacity of the Power Supply Unit.
 - 2. When mounting other CPU Bus Units at the same time, make sure that the total amount of memory required for the CPU Bus Unit System Setups does not exceed the size of the System Setup Area (approximately 5K words, or 10,752 bytes). The Ethernet Unit uses 412 bytes.

3-6 Connecting to the Network

3-6-1 Ethernet Network Installation

When installing an Ethernet network, be sure to take all appropriate safety measures and to follow the applicable standards (ISO 8802-3). You must obtain a copy of these specifications and be sure you understand them before attempting to install an Ethernet System. Unless you are already experienced in installing communications systems, we strongly recommend that you employ a professional to install your system.

For information regarding basic installation precautions, equipment, recommended products, and installation examples, refer to *Appendix A Network Installation*.

3-6-2 Ethernet Connectors

The following standards and specifications apply to the connectors for the Ethernet transceiver cable.

• Electrical specifications: Conforming to IEEE802.3 standards.

Connector pin	Signal name	Abbr.	Signal direction
1	Signal ground	GND	
2	Collision detection signal +	COL+	Input
3	Send data +	TX+	Output
4	Signal ground	GND	
5	Receive data +	RX+	Input
6	Power ground (common with signal ground)	VC	
7	Not used		
8	Signal ground	GND	
9	Collision detection signal –	COL-	Input
10	Send data –	TX–	Output
11	Signal ground	GND	
12	Receive data –	RX–	Input
13	Transceiver +12 VDC power supply	+12 V	Output
14	Signal ground	GND	
15	Not used		
Connector hood	Frame ground	FG	

Lock structure: IEEE802.3 standards for slide latches

3-6-3 Connecting the Transceiver Cable

Joaulion

1, 2, 3... 1. Prepare a coaxial cable.

er cable.

- 2. Connect the transceivers to the coaxial cable.
 - Mark the coaxial cable at intervals of 2.5 meters. Then connect the transceivers at those marks.

Turn OFF the PC's power supply before connecting or disconnecting transceiv-

- The transceiver connection method depends on the type of transceiver, so refer to the transceiver operation manual.
- 3. Prepare the transceiver cable, and then connect it to the transceivers.

For more details regarding these steps, refer to *Appendix A Network Installation*. The cable preparation should be performed by an experienced professional.

- 4. Connect the transceiver cable to the Ethernet Unit connector. The Ethernet Unit connector has a slide latch conforming to IEEE802.3 specifications that serves as a lock mechanism. To connect the transceiver cable, operate the slide latch as described below.
 - a) First push the slide latch upwards.
 - b) Insert the cable connector into the Ethernet Unit's connector with the two locking posts at the end of the cable connector aligned with the holes in the slide latch.
 - c) Then push the slide latch down to lock the cable connector in place.



3-6-4 Connecting the Power Supply

Connect a 24-VDC power supply to the power supply terminals. The Ethernet Unit converts this 24-VDC power supply to the power supply voltage for the transceivers and provides it through the transceiver cable.



Crimp terminals must be used for the power supply cable. The applicable M3 crimp terminals and recommended products are shown below.



Maker	Model	Specifications	Applicable power line range (stranded wire)	
J.S.T.MFG.CO., LTD	V1.25-N3A	Fork terminal with vinyl insulation	0.25 to 1.65 mm ² (AWG: #22 to #16)	
	V1.25-MS3	Ring terminal with vinyl insulation		
MOLEX JAPAN CO.,LTD	VSY1.25-3.5L	Fork terminal with vinyl insulation	0.3 to 1.65 mm ² (AWG: #22 to #16)	
RAV1.25-M3		Ring terminal with vinyl insulation		

Caution

ion Be sure to turn OFF the power supply to the PC before connecting to the power supply terminal block.

Note

- 1. Do not connect a power supply with a voltage other than 24 VDC.
 - 2. To reduce the effects of noise, wire the power supply cable separately from power lines and high-voltage lines.
 - 3. Crimp terminals must be used for wiring. Do not just twist loose wire strands.
 - 4. Use the recommended crimp terminals.
 - 5. Use the proper tools and procedure for installing the crimp terminals. Consult with the terminal manufacturers for instructions. If the proper tools and procedure are not used, it may cause the cable to become disconnected.
 - 6. When installing the crimp terminals, use a length of cable that will not need to be bent too much when combined with the terminals. Also, cover the terminal and the end of the cable with insulating tape and heat-absorbing tubing.
 - 7. Be careful not to mistake the plus and minus terminals when connecting the power supply.
 - 8. Tighten the terminal block screws to a torque of 0.5 N m. If the screws are too loose, it may result in short-circuiting, malfunctioning, or fire damage.
 - 9. Check the wiring carefully before turning ON the power.
- 10. Use a dedicated power supply, and do not use the same power supply for the I/O power supply, motor power lines, or control power lines.
- 11. Position the power supply as close as possible to the Unit, and separate the power supply cable by at least 20 cm from other power lines in order to avoid adverse effects from high-voltage lines.
- 12. Noise influence may be reduced by installing a noise filter near the primary side of the power supply.
- 13. Carefully twist the power supply cable that is to be connected to the Unit.
- 14. Do not excessively bend or stretch the cable.
- 15. Do not place anything on top of cables or cords.
- 16. If errors occur due to noise related to an external power supply, it may be possible to solve the problem by not grounding the communications power supply. Normally the switching power supply is connected to the case and capacitor, as shown in the following diagram, so along with isolating the FG

terminal it is necessary to insulate the power supply itself from the control panel.

General Switching Power Supply Configuration



- 17. If communications are adversely affected by noise from the Unit's power supply terminals, the problem may be solved by implementing the measures shown below.
 - a) Add to the communications retry processing at the application. In particular, noise resistance capacity can be improved by increasing the number of retries for applications using UDP.
 - b) Insert a noise filter right next to the Unit's power supply terminals.



Recommended filter: MAS-1206-33 by Nemic-Rambda K.K.

Rated voltage: 250 V (AC, DC) Rated current: 6 A

Dimensions

Specifications

105.5 x 52.5 x 40 mm (W x H x D) (Not including connector.)

Power Supply Specifications

The following table shows the power supply specifications. Make sure that these specifications are met.

ltem	Specifications
Power supply voltage	24 VDC
Allowable power supply voltage fluctuation	20.4 VDC to 26.4 VDC (24 VDC -15% + 10 %)
Current consumption	300 mA max. at 24 VDC (per node)
Inrush current	2.5 A max. (24 VDC when rise time is 5 ms)

OMRON's S82J Series is recommended for the power supply.

- **Note** 1. Use a power supply that meets these specifications.
 - 2. If the power supply is separate from a node, make sure that these specifications are met at the node's terminal block.
 - 3. Turn ON the Unit's power supply either before or at the same time as the CPU Unit's power supply. If the CPU's power is turned ON first, a communications error may be generated.
 - 4. Use a power supply with double or reinforced insulation.
 - 5. Confirm that the Power Status Bit is ON before starting communications. (Refer to *Power Status (Bit 15)* in *4-3 CIO Area Allocations.*)
 - 6. In the IEEE802.3 standards, the transceiver power supply specifications require a voltage of 11.28 V (12 V 6%) to 15.75 V (15 V + 5%) at the transceiver inputs. The voltage output by the Ethernet Unit takes into account a voltage drop at the transceiver cable.

3-7 Creating an I/O Table

After the hardware settings and connections have been completed, turn ON the power supply to the PC and create an I/O table.

3-7-1 I/O Table Overview

An I/O table is used to identify Units connected to the PC and to allocate I/O to them. If any change is made to the Unit configuration of a CS1-series PC, an I/O table must be created to register the Units to the CPU Unit.

3-7-2 Connecting Programming Devices to the PC

To create the I/O table, connect a Programming Device (such as a Programming Console or CX-Programmer) to the PC.

Applicable Programming Devices

The following Programming Devices can be used with CS1-series PCs.

Programming Console

Model number	Key Sheet (required)	Recommended cable (required)
C200H-PRO27-E	CS1W-KS001-E	CS1W-CN224 (cable length: 2.0 m) CS1W-CN624 (cable length: 6.0 m)
CQM1-PRO01-E		CS1W-CN114 (cable length: 0.1 m)

CX-Programmer

Model number: WS02-CXP

The operations are explained here using a Programming Console. For details regarding the CX-Programmer, refer to the *CX-Programmer User's Manual*.

Connecting Programming Devices To connect a Programming Console, attach a CS1-series Key Sheet and then connect the Console to the PC's peripheral port. (It cannot be connected to the RS-232C port.)

3-7-3 Procedure for Creating an I/O Table

The procedure for creating an I/O table is shown here, taking as an example an I/O table that is generated automatically for a PC connected online. In this example, a Programming Console is used for creating the I/O table. For an explanation of how to create an I/O table using a CX-Programmer, refer to the *CX-Programmer User's Manual*.

Use the following procedure to create the I/O table.



3-8 Creating Routing Tables

When the FINS communications service is used, routing tables must be created in advance. Routing tables are required in the following circumstances.

- When the FINS communications service is used on an Ethernet network (including when communications are only carried out between FA networks via an Ethernet network).
- When there are multiple Communications Units mounted to the PC, and socket services are requested by executing the CMND(490) instruction.

If neither of these circumstances apply, then a routing table is not required. In that case, proceed to 3-9 System Setup.

The routing table is required not only for nodes communicating via the FINS communications service but for all relay nodes on the network.

3-8-1 Routing Table Overview

The routing tables describe the transmission path for FINS messages when the FINS communications are used. It consists of two tables: A local network table and a relay network table.

Local Network Table

The local network table is a table describing the correspondences among unit numbers of the Communications Units and Boards mounted to each node (PC or FA Computer).



Local Network Table			
Local network address	Unit number		
1	04		
2	05		
3	06		
4	07		

- **Note** 1. The unit number is set (from 0 to F: 1 to 15) by the rotary switch on the front of the Ethernet Unit.
 - The network address is the number of the network (from 1 to 127) to which the Communications Unit or Board is connected. It is set when the local network table is created.

Relay Network Table A relay table is a table that shows the nodes to which data should be sent first in order to send data to a network that is not connected to the local node. It shows the correspondence between the address of the final destination network, and the network address and node number of the first relay point of the path to reach there. When internetwork communications are carried out, the end network can be reached by following the relay points.

The following example shows a routing table for sending data from PC #1 (the local node: network address 1, node number 1) to PC #4 (the destination node: network address 3, node number 2).



3-8-2 Connecting and Using a Peripheral Device for the PC

Routing tables must be created by a CX-Programmer connected to the PC. (They cannot be created using a Programming Console.) For details on how to connect and use a CX-Programmer, refer to the *CX-Programmer User's Manual*.

- **Note** 1. To transfer routing tables for multiple nodes to a PC in one batch, connect the CX-Programmer to a PC with only one Communications Unit mounted. Routing tables cannot be transferred to other nodes from a PC with multiple Communications Units mounted.
 - 2. Routing tables can only be transferred as a batch to multiple nodes within the same network as the PC to which the CX-Programmer is connected.

Routing Table Setting Examples

Example 1: Local Network Table for a PC With Multiple Units Mounted

This example shows the local network table settings for a PC to which multiple CPU Bus Units are mounted.



Local Network T	Table
-----------------	-------

No.	Local network	CPU Bus Unit
1	A	а
2	В	b

Example 2: Three Interconnected Networks

This example shows the relay network table settings for three different interconnected networks.



In the table for PC #3, for example, if network #A is taken as the end network, then network #B becomes the relay network and node #c becomes the relay node. If network #C is taken as the end network, then network #B still becomes the relay network and node #e becomes the relay node.

Example 3: All Nodes

This example uses the following configuration to show the routing tables for all nodes.



					(
0.	Local network	CPU Bus Unit No.	No	End netwo	r
1	030	06	[ī	010	
2			2	2 020	
3			3	3	
				,	

(Relay network table)

 No.	End network	Relay network	Relay node
 1 2 3	010 020	030 030	015 015

3-9 System Setup

The settings for the Ethernet Unit's basic and special functions are made in the CPU Bus Unit System Setup. These settings, and the situations in which the settings must be made, are shown in the following table. For details on how to make the settings, refer to *4-2 CPU Bus Unit System Setup*.

3-9-1 When Settings are Required

Settings	When settings are required
Broadcast setting	When Ethernet is used with UNIX 4.2BSD specifications.
Address conversion method	When the FINS communications service is used on an Ethernet network.
	• When it is necessary to set a value outside of the range of 1 to 126 for the least significant byte of the local IP address.
UDP port number for FINS	When it is necessary to set a value other than the default (9600) for the FINS UDP port number.
Subnet mask	When it is necessary to set a subnet mask.
FTP login name FTP password	When setting the login name and password at the FTP server.
IP address table	When the FINS communications service is used on an Ethernet network.
	• When it is necessary to set a value outside of the range of 1 to 126 for the least significant byte of the local IP address.
IP router table	When the Ethernet network is configured with multiple segments.
Mail function	When the mail function is used.

Refer to 4-2 CPU Bus Unit System Setup for details.

3-9-2 Using a Programming Device

The settings for the CPU Bus Unit System Setup must be made by a CX-Programmer connected to the PC. The settings cannot be made using a Programming Console. For details on how to connect and use a CX-Programmer, refer to the *CX-Programmer User's Manual*.

3-9-3 CPU Bus Unit System Setup Defaults

The following table shows the items in the CPU Bus Unit System Setup, and their default settings.

ltem	Default
Broadcast settings	All 1 (4.3BSD specifications)
Address conversion method	Automatic address generation
UDP port number for FINS	9600
Subnet mask	0.0.0.0 (A value corresponding to the IP address is used.)
FTP login name	CONFIDENTIAL
FTP password	Not set.
IP address table	Not set.
IP router table	Not set.
Mail settings	None set.
User-created mail data address	Not set.
Local mail address	Not set.
Destination mail address	Not set.
SMTP server address	0.0.0.0 (Not set.)

For information on IP address table settings, refer to 3-10 Creating an IP Address Table. For information on IP router table settings, refer to 3-11 Creating an IP Router Table. For information on IP mail transmission settings, refer to Section 8 Mail.

3-10 Creating an IP Address Table

	An IP address table is a table of correspondences between node numbers and IP addresses, and it is used for finding IP addresses from FINS node numbers. It is necessary to register an IP address table when using the IP address table method as the method for address conversion. (For details regarding preliminary procedures, refer to <i>3-1 Before Operation</i> .)
	An IP address table does not necessarily need to be registered in order to use the combined method for address conversion. If none is registered, however, the automatic address generation method will always be used.
	If the automatic address generation method is to be used exclusively, then there is no need to register an IP address table. In that case, proceed to 3-11 Creating an IP Router Table.
Connecting and Using a Programming Device for the PC	The IP address table must be created by a CX-Programmer connected to the PC. It cannot be created using a Programming Console. For details on how to connect and use a CX-Programmer, refer to the <i>CX-Programmer User's Manual</i> .

3-11 Creating an IP Router Table

An IP router table is a table of correspondences between IP router IP addresses and the network numbers of segments relayed by the IP router. If the Ethernet network is configured of multiple segments, an IP router table must be registered for communications between the segments. (For details on segments and connecting nodes, refer to *1-2-2 Node Connections*.)

If the Ethernet network has the minimal configuration of just one segment, there is no need to create an IP router table. In that case, proceed to *3-12 Checking Communications*.

Note An IP router table needs to be created only when the IP address table method or the combined method is used for address conversion.

Connecting and Using a Programming Device for the PC The IP router table must be created by a CX-Programmer connected to the PC. It cannot be created using a Programming Console. For details on how to connect and use a CX-Programmer, refer to the *CX-Programmer User's Manual*.

3-12 Checking Communications

The Ethernet Unit supports the PING command, which is also widely supported by host computers. It also supports a function for internode testing in the FINS communications service by simply manipulating bits with a Programming Device.

After the settings and connections have been completed, use either the PING command or the internode test function as required to check communications with the remote nodes.

3-12-1 PING Command and Internode Testing

The following table outlines the points of difference between the PING command and internode testing.

Item	PING command	Internode testing
Main application	Testing communications as an Ethernet node.	Checking settings such as FINS addresses for using the FINS communications service.
Test objects	Ethernet Units and Ethernet devices that support PING.	OMRON Units and Boards that support FINS communications service internode testing.
Network classification	Within Ethernet networks (including between segments).	Up to three levels of Ethernet networks, and FA networks.
Address system used	IP addresses	FINS address system (network and node numbers) Note: Requires routing tables.
Transmission from Ethernet Unit	PING command is issued to Ethernet Unit by CMND(490) instruction in user program.	Set required parameters in DM from Programming Device, and manipulate start switch bit.
Reception at Ethernet Unit	When PING command is received, it is automatically returned.	When internode test message is received, it is automatically returned.

3-12-2 PING Command

The PING command checks communications with another node by sending an echo back request packet and receiving a response packet. Use the PING command as required to check communications. Using the PING command between nodes that support the PING command makes it possible to check whether internode communications are normal.

For details on using the PING command, refer to 9-2 PING Command.

3-12-3 Internode Test

The internode test is a function for checking a network by sending data to and from specified nodes and checking the responses. Use the internode test as required to check the FINS communications service settings. Using it between Communications Units and Boards that support it makes it possible to check whether the FINS communications service settings are correct.

For details on using the internode test, refer to 9-3 Internode Test.

- **Note** 1. The internode test can be easily carried out by manipulating dedicated control switches for the Ethernet Unit. For details, refer to *9-3 Internode Test*.
 - 2. Internode testing of the FINS communications service can also be carried out by means of the FINS commands INTERNODE ECHO TEST and BROADCAST TEST RESULTS READ. For details, refer to 11-3-4 INTER-NODE ECHO TEST and 11-3-5 BROADCAST TEST RESULTS READ.

SECTION 4 System Setup and Memory Allocations

This section explains the System Setup and the words allocated in the CIO Area and the DM Area for Ethernet Units.

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4-3	CIO Area Allocations	50
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4-1 Allocated Words

The Ethernet Unit is allocated words in the the following three areas for reading settings and status.

- System Setup for CPU Bus Units Stores initial setup for the Ethernet node.
- Allocated Words in the CIO Area Stores software switches and status information for functions.
- Allocated Words in the DM Area Stores software switch and status information for functions.



The words in the CIO Area and DM Area are allocated according to the unit number as shown in the following tables. The 25 words are allocated per Unit in the CIO Area and 100 word are allocated per Unit in the DM Area.

CIO Area Allocations

Unit No. (decimal)	Allocated words	Unit No. (decimal)	Allocated words
0 (0)	CIO 1500 to CIO 1524	8 (8)	CIO 1700 to CIO 1724
1 (1)	CIO 1525 to CIO 1549	9 (9)	CIO 1725 to CIO 1749
2 (2)	CIO 1550 to CIO 1574	A (10)	CIO 1750 to CIO 1774
3 (3)	CIO 1575 to CIO 1599	B (11)	CIO 1775 to CIO 1799
4 (4)	CIO 1600 to CIO 1624	C (12)	CIO 1800 to CIO 1824
5 (5)	CIO 1625 to CIO 1649	D (13)	CIO 1825 to CIO 1849
6 (6)	CIO 1650 to CIO 1674	E (14)	CIO 1850 to CIO 1874
7 (7)	CIO 1675 to CIO 1699	F (15)	CIO 1875 to CIO 1899

DM Area Allocations

Unit No. (decimal)	Allocated words	Unit No. (decimal)	Allocated words
0 (0)	D30000 to D30099	8 (8)	D30800 to D30899
1 (1)	D30100 to D30199	9 (9)	D30900 to D30999
2 (2)	D30200 to D30299	A (10)	D31000 to D31099
3 (3)	D30300 to D30399	B (11)	D31100 to D31199
4 (4)	D30400 to D30499	C (12)	D31200 to D31299
5 (5)	D30500 to D30599	D (13)	D31300 to D31399
6 (6)	D30600 to D30699	E (14)	D31400 to D31499
7 (7)	D30700 to D30799	F (15)	D31500 to D31599

4-2 CPU Bus Unit System Setup

To operate the Ethernet Unit as a node on an Ethernet network, the required parameters must be set in the CPU Bus Unit System Setup, part of the CPU Unit's Parameter Areas. If any of the following items apply, then the system parameters must be set.

- Either the IP address table or both the IP address table and automatic address generation are used as the destination IP address conversion method.
- Transmissions are broadcast using a host number set to all zeroes as the broadcast address (when UNIX 4.2BSD specifications are used for the broadcast address).
- The FINS UDP port number is set to a value other than 9600.
- A subnet mask other than the one determined from the IP address is set.
- A login name other than CONFIDENTIAL is used for the FTP server function.
- Communications between segments are required.
- The mail function is used.

Newly set parameters go into effect after the Ethernet Unit has been restarted or after the CPU Unit is started again.

The settings are made using the CX-Programmer.

Note The CPU Bus Unit System Setup is located in the CPU Unit's Parameter Area, and not in I/O Memory; parameters cannot be written using instructions or by editing I/O Memory. The settings can be made only using the CX-Programmer.

4-2-1 Settings

Item	CX-Programmer default
Broadcast setting	All 1s (4.3BSD specifications)
Address conversion method	Automatic address generation
FINS UDP port number	9600
Subnet mask	0.0.0.0 (A value corresponding to the IP address is used.)
FTP login name	Not set. (CONFIDENTIAL)
FTP password	Not set.
IP address table	Not set.
IP router table	Not set.

Broadcast Settings

Set the method for specifying the broadcast address.

Setting	Meaning
All 1s (4.3BSD) (Default)	Broadcast with host number set to all ones. (4.3BSD specifications)
All 0s (4.2BSD)	Broadcast with host number set to all zeroes. (4.2BSD specifications)

Address Conversion Method

Set the method for converting the FINS node number to an IP address.

Setting	Meaning
Automatic generation (Default)	Uses automatic address generation. The IP address is automatically generated from the FINS node number without using an IP address table.
IP address table	Uses an IP address table.
Combined	Uses both automatic address generation and an I/O address table.

Automatic Address Generation

With the automatic generation, the FINS node number is regarded as the host number of the IP address, just as it is.

Destination IP address = (Local IP address and subnet mask) + Destination FINS node number)

<u>Example</u>

Local IP address: 130.25.36.8 Subnet mask: 255.255.0.0 Destination FINS node number: 5 \rightarrow Destination IP address = 130.25.0.5

Note When using automatic address generation (the default) for address conversion, set local IP address DIP switches 7 and 8 on the back of the Ethernet Unit to the same value as the node number setting on the front of the Unit, and set all other host settings to 0. If the IP address host number does not match the node number, the ERC indicator will flash.

IP Address Table

With an IP address table, the address is converted according to a preset table of correspondences (i.e., an IP address table) between FINS node numbers and IP addresses.

The following is an example of an IP address table.

FINS messages addressed to FINS node number 23 are sent to the node with IP address 150.31.3.68.

Automatic Address Generation and IP Address Table

With the combined method, first the IP address table is referenced. If the applicable node is not registered, then the automatic address generation method is used.

FINS UDP Port Number

Set the method for specifying the UDP port number for FINS communications.

Setting	Meaning
9600 (Default)	Uses the default value of 9600.
User-defined	Uses the input value (from 1 to 65535).

Subnet Mask

Set all bits in the subnet mask that correspond to the bits in the IP address used for the network number and the bits used for the subnet number to "1," and set all bits in the subnet mask that correspond to the bits in the IP address used for the host number to "0". The subnet mask must be set only when configuring a system which includes subnetworks.

If no subnet mask is set, the subnet mask will be automatically set to one of the following values, depending on the local IP address setting:

Class	Subnet mask value
Class-A IP address	255.0.0.0
Class-B IP address	255.255.0.0
Class-C IP address	255.255.255.0

The default is 0.0.0.0. (A value corresponding to the IP address class is used.)

FTP Login Name

Enter the user's FTP server login name using up to 12 characters. Alphanumeric characters, hyphens, commas, quotation marks, and underlines can be used in login name. Once the login name has been set, a password must also be set or both the FTP login name and FTP password will be invalid.

If the login name is incorrectly specified, or if no login name is specified at all, the default login name of "CONFIDENTIAL" will be used and no FTP password will be required. The default is for no FTP login name to be set.

FTP Password

Enter the Unit's FTP server password using up to eight characters. Alphanumeric characters, hyphens, commas, quotation marks, and underlines can be used as password characters. If a login name has been set, then a password must also be set or both the FTP login name and FTP password will be invalid. The default is for no FTP password to be set.

IP Address Table

This table contains the conversion data used to generate IP addresses from FINS node numbers when using FINS communications. This table is ignored if the IP address conversion method is set to automatic generation only. The IP address table cannot be edited. It is configured as follows by the CX-Programmer:

FINS node number	IP address
11	150.31.2.83
23	150.31.6.68

Setting range: 1 to 126 Setting range: 0.0.0.0 to 255.255.255.255.

Up to 32 records can be registered. The default is for nothing to be set.

For an explanation of how to make the settings, refer to the *CX-Programmer User's Manual.*

IP Router Table

The IP router table sets how the Ethernet Unit communicates via the IP router with nodes on other IP network segments. This table cannot be edited when the FINS node number IP address

automatic generation method is used for address conversion.



The IP router table is configured by the CX-Programmer as shown below. For the IP network number, set the network number of the other IP network segment that is to be communicated with. The length of the network number varies depending on the IP address class. Four bytes are provided in the field for setting the IP network number, so set the network from the beginning and then set 00 in the remainder.

Settings

The following settings are for node A when network No. 130.26.X.X is connected by the IP router with IP address 130.25.36.253. (Refer to the preceding diagram.)



A maximum of eight records can be registered. The default is for nothing to be set.

For an explanation of how to make the settings, refer to the CX-Programmer User's Manual.

4-2-2 Mail Settings

ltem	CX-Programmer default
Mail settings	None set.
User-created mail data address	Not set.
Local mail address	Not set.
Destination mail address	Not set.
SMTP server address	0.0.0.0 (Not set.)

Mail Settings

User Data in User Mail

Specify whether or not user data is to be added to mail contents when mail is sent by turning ON the Mail Send Switch in the CPU Unit's I/O Memory. (Refer to page 51.) The user data is ASCII data stored with the CPU Unit's I/O memory address set for the mail function's user-created mail data address. When user data is sent, 1,024 bytes or the data up to the null code (00 Hex) will be sent.

Setting	Meaning
Not selected (Default)	User data not included in user mail.
Selected	User data included in user mail.

Error Log in User Mail

Specify whether or not all error log information is to be added to mail contents when mail is sent by turning ON the Mail Send Switch in the CPU Unit's I/O Memory. (Refer to *Mail Send Switch* in 2-2 CIO Area Allocations.)

Setting	Meaning
Not selected (Default)	Error log information not included in user mail.
Selected	Error log information included in user mail.

Status in User Mail

Specify whether or not status information is to be added to mail contents when mail is sent by turning ON the Mail Send Switch in the CPU Unit's I/O Memory. (Refer to *Mail Send Switch*) in 2-2 CIO Area Allocations.)

Setting	Meaning
Not selected (Default)	Status information not included in user mail.
Selected	Status information included in user mail.

Sending Mail for Errors

Specify whether or not mail is to be sent to a preset mail address whenever an error is registered in the error log. The following types of data can be specified to be sent as mail.

- User Data (Refer to Sending User Data for Errors below.)
- Error Log Information (Refer to Sending Error Log Information for Errors below.)
- Status Information (Refer to Sending Status Information for Errors below.)

If none of these types of data is selected, mail will not be sent even if the setting is made for mail to be sent whenever an error is registered.

Setting	Meaning
Not selected (Default)	Mail not sent when error is registered in error log.
Selected	Mail not sent when error is registered in error log.

Sending User Data for Errors

Specify whether or not user data is to be added to mail contents when mail is sent whenever an error is registered to the error log.

Setting	Meaning
Not selected (Default)	User data not included in mail when error is registered to error log.
Selected	User data included in mail when error is registered to error log.

Sending Error Log Information for Errors

Specify whether or not all error log information is to be added to mail contents when mail is sent whenever an error is registered to the error log.

Setting	Meaning
Not selected (Default)	Error log information not included in mail when error is registered to error log.
Selected	Error log information included in mail when error is registered to error log.

Sending Status Information for Errors

Specify whether or not status information is to be added to mail contents when mail is sent whenever an error is registered to the error log.

Setting	Meaning
Not selected (Default)	Status information not included in mail when error is registered to error log.
Selected	Status information included in mail when error is registered to error log.

Periodic Mail

Specify whether or not mail is to be sent at the time intervals set for the mail interval in the mail settings. The following types of data can be specified to be sent as mail.

- User data
 (Refer to Periodic Mail for User Data below.)
- Error log information (Refer to *Perio dic Mail for Error Log Information* below.)
- Status information (Refer to *Periodic Mail for Status Information.*)

If none of these types of data is selected, mail will not be sent even if the setting is made for mail to be sent whenever an error is registered.

Setting	Meaning
Not selected (Default)	Mail is not sent periodically.
Selected	Mail is sent periodically.

Mail Interval

When mail is sent periodically, it is sent at the time interval that is set here. The setting range is 1 to 1,440, in units of 10 seconds, so the mail can be sent at intervals of from once every 10 seconds to once every 10 days. This setting is only enabled when the periodic mail setting (see above) is selected.

If the mail interval is set to 0, then mail will not be sent periodically. If it is set to a value greater than 1,440, it will be processed as 1,440 (10 days).

The default setting is 0 (mail not sent periodically).

Periodic Mail for User Data

Specify whether or not user data is to be added to mail contents when mail is sent periodically. The user data is ASCII data stored with the CPU Unit's I/O memory address set for the mail function's "user-created mail data address" at the beginning. (When user data is sent, 1,024 bytes or the data up to the null code (00 Hex) is transmitted.)

Setting	Meaning
Not selected (Default)	User data not included in periodic mail.
Selected	User data included in periodic mail.

Periodic Mail for Error Log Information

Specify whether or not all error log information (64 records max.) is to be added to mail contents when mail is sent periodically.

Setting	Meaning
Not selected (Default)	Error log information not included in periodic mail.
Selected	Error log information included in periodic mail.

Periodic Mail for Status Information

Specify whether or not status information is to be added to mail contents when mail is sent periodically.

	Setting	Meaning						
	Not selected (Default)	Status information not included in periodic mail.						
	Selected	Status information included in periodic mail.						
User-created Mail Data Address	Specify, by area classifi memory address for the data is sent by user requ	cation and beginning word address, the CPU Unit's data (user-created information) to be transmitted when lest. The default setting is for no address to be set.						
Local Mail Address	In 50 or fewer characters, specify the mail address to be entered in the "From field in the mail.							
Destination Mail Address	In 50 or fewer characters	s, specify the address to which the mail is to be sent.						
SMTP Server Address	Specify the IP address o setting range is 0.0.0.0 to	f the mail server (i.e., the SMTP server address). The 255.255.255.255. The default is 0.0.0.0 (nothing set).						

4-3 CIO Area Allocations

The various kinds of data are stored in the offset positions shown in the following diagram, from the beginning word in the area for each Unit.

The beginning word n is calculated by the following equation:

Beginning word n = CIO 1500 + (25 x unit number)

Offset	Dit				
	15	8 7	0	Data direction	Related communications services
n	Unit Co	ontrol Switch		CPU Unit to Ethernet Unit	Socket Services
n+1	UDP Sock	et No. 1 Status			(Refer to Section 6
n+2	UDP Sock	et No. 2 Status			Socket Services.)
n+3	UDP Sock	et No. 3 Status			Mail Function
n+4	UDP Sock	et No. 4 Status			
n+5	UDP Sock	et No. 5 Status			1
n+6	UDP Sock	et No. 6 Status			
n+7	UDP Sock	et No. 7 Status			
n+8	UDP Sock	et No. 8 Status			
nn+9	TCP Soci	ket No. 1 Status		Ethernet Unit to CPU Unit	Socket Services
n+10	TCP Soci	ket No. 2 Status			(Refer to Section 6
n+11	TCP Soci	ket No. 3 Status			
n+12	TCP Soci	ket No. 4 Status			
n+13	TCP Soci	ket No. 5 Status			
n+14	TCP Soci	ket No. 6 Status			
n+15	TCP Soci	ket No. 7 Status			i
n+16	TCP Soci	ket No. 8 Status			
n+17	Serv	ice Status			FTP Service, etc
n+18	Errc	or Status			All error conditions
n+19	Socket Service Re- quest Switches 2	Socket Service Re- quest Switches 1		CPU Unit to Ethernet Unit	Socket Services (Refer to Section 6
n+20	Socket Service Re- quest Switches 4	Socket Service Re- quest Switches 3			Socker Services.)
n+21	Socket Service Re- quest Switches 6	Socket Service Re-			
n+22	Socket Service Re- quest Switches 8	Socket Service Re- quest Switches 7			
n+23	(No	t used.)			
n+24+	(No	ot used.)			

n+25

The following items in the diagram can also be checked using the CX-Programmer.

- The status of UDP/TCP sockets 1 to 8 (Opening Flag, Receiving Flag, Sending Flag, Closing Flag, Results Storage Error Flag, Socket Open Flag)
- Service status (FTP status)

For explanations of how to use the related communications services listed in the above diagram, refer to the indicated sections.

Unit Control Switches (CPU Unit to Ethernet Unit)



Bit	Switch	Status	Manipulated by	Unit operation	Reference		
0	(Not used.)						
1	Internode Test Start Switch	ON	User	Executes internode test while ON.	9-3		
	OFF		User	Stops internode test.	Test		
2	Socket Force-close Switch	ON	User	All sockets are forcibly closed when this bit turns ON.	Page 109		
		OFF	Unit	Turned OFF by Unit after sockets are closed.			
3	Mail Send Switch	ON	User	User mail is sent when this bit turns ON.	8-1-3		
		OFF	Unit	Turned OFF by Unit after user mail has been sent.	Sending Mail		
4 to 15	(Not used.)						

Internode Test Start Switch (Bit 1)

Internode testing is executed and stopped by turning ON and OFF this switch. The parameters for designating the remote node for testing, and so on, are set in the allocated words in the DM Area. For details, refer to *9-3 Internode Test*. The CX-Programmer can also be used to set parameters and control internode tests.

Socket Force-close Switch (Bit 2)

All UDP and TCP sockets used for socket services can be force-closed by turning ON this switch. This can be used for operations such as error processing.

Be careful not to force-close sockets during communications, or an error will occur. After all sockets have been force-closed, the Ethernet Unit will turn the switch OFF again. Do not attempt to forcibly manipulate this switch before it is automatically turned OFF by the Unit.

Ports used exclusively by the Ethernet Unit will not be closed.

Mail Send Switch (Bit 3)

User mail can be sent by turning ON this switch. The contents of the user mail are set in the CPU Bus Unit System Setup.

After the user mail has been sent, the Ethernet Unit will turn this switch OFF again. Do not attempt to forcibly manipulate this switch before it is automatically turned OFF by the Unit.

Status of UDP/TCP Sockets 1 to 8 (Ethernet Unit to CPU Unit)



Bit	Flag	Status	Manipulated by	Unit operation	Reference		
0	Opening Flag	ON	Unit	ON during open processing. (Turns ON when open request is received.)	Section 6 Socket		
		OFF	Unit	Turns OFF when open processing has been completed.	Services		
1	Receiving Flag	ON	Unit	ON during receive processing. (Turns ON when receive request is received.)			
		OFF	Unit	Turns OFF when receive processing has been completed.			
2	Sending Flag ON Unit ON during send processing. (Turns send request is received.)		ON during send processing. (Turns ON when send request is received.)				
	OFF Unit		Unit	Turns OFF when send processing has been completed.			
3	Closing Flag ON		Unit	ON during close processing. (Turns ON when close request is received.)			
		OFF	Unit	Turns OFF when close processing has been completed.			
4 to 13	(Not used.)						
14	Results Storage Error Flag	ON	Unit	Turns ON if there is an error in storing the results when socket services are used by means of the CMND(490) instruction.	Section 6 Socket Services		
		OFF	Unit	Turns OFF when the next request is received. (Connected by TCP.)			
15	TCP/UDP Open Flag	ON	Unit	Turns ON when open processing has been completed.			
		OFF	Unit	Turns OFF when close processing has been completed. (Stays OFF for abnormal open processing completion.)			

Note The status of these flags can also be checked using the CX-Programmer.

Opening Flag (Bit 0)

Turns ON when an open request is received either by control switch manipulation or the CMND(490) instruction, and turns OFF again when the open processing has been completed. When CMND(490) is used, the Results Storage Error Flag (bit 14) will turn ON at the same time as the Opening Flag turns OFF if there is an error in the Results Storage Area designation.

Receiving Flag (Bit 1)

Turns ON when a receive request is received either by control switch manipulation or the CMND(490) instruction, and turns OFF again when the receive processing has been completed. When CMND(490) is used, the Results Storage Error Flag (bit 14) will turn ON at the same time as the Receiving Flag turns OFF if there is an error in the Results Storage Area designation.

Sending Flag (Bit 2)

Turns ON when a send request is received either by control switch manipulation or the CMND(490) instruction, and turns OFF again when the send processing has been completed. When CMND(490) is used, the Results Storage Error Flag (bit 14) will turn ON at the same time as the Sending Flag turns OFF if there is an error in the Results Storage Area designation.

Closing Flag (Bit 3)

Turns ON when a close request is received either by control switch manipulation or the CMND(490) instruction, and turns OFF again when the close processing has been completed. When CMND(490) is used, the Results Storage Error Flag (bit 14) will turn ON at the same time as the Closing Flag turns OFF if there is an error in the Results Storage Area designation.

Results Storage Error Flag (Bit 14)

Turns ON if there is an error in the Results Storage Area for a socket service request (open, receive, send, close) made using CMND(490). This flag turns ON at the same time as the services request processing flags (bits 0 to 3) turn OFF. It remains ON until the next services request is received, and then it turns OFF again. When this flag turns ON, check the set values in the Results Storage Area.

The Results Storage Error Flag does not operate when socket services are requested by control switch manipulation.

TCP/UDP Open Flag (Bit 15)

Remains ON while a socket is open by by means of control switch manipulation or the CMND(490) instruction. In the case of TCP, it indicates a connection. When the socket is closed, this flag turns OFF again. (If the socket did not close properly, the flag remains ON.)

Check to be sure that this flag is ON before executing a send or receive request.

Service Status (Ethernet Unit to CPU Unit)



Bit	Name	Status	Manipulated by	Unit operation	Reference
0	FTP Status Flag	tus Flag ON Unit		FTP server operating. (FTP client connected.)	Page 151
		OFF	Unit	FTP server on standby. (FTP client not connect.	
2 to 14	(Not used.)				
15	Power status ON Unit		Power is being supplied to transceiver.	Page 29	
		OFF	Unit	Power is not being supplied to transceiver.	

FTP Status (Bit 0)

Turns ON while connected to an FTP client, and OFF while not connected. With the FTP server function only one FTP client can be connected at a time, so while this bit is ON no other clients can connect to the server.

The FTP status is also shown by the Ethernet Unit's FTP indicator, as follows:

- Not lit: FTP server on standby. (FTP status: OFF)
- Lit: FTP server operating. (FTP status: ON)

Power Status (Bit 15)

Turns ON while power is being supplied from the Ethernet Unit to the transceiver, and OFF when power is not being supplied. Check to be sure that this bit is ON before beginning communications.

Error Status (Ethernet Unit to CPU Unit)

The status of errors that occur at the Ethernet Unit is reflected as shown in the following diagram.



Bit	Error	Status	Manipulated by	Unit operation
0	(Not used.)			
1	Transceiver echo test error	ON	Unit	ON if an error occurred during the self diagnostic testing after the Unit was turned ON or reset.
		OFF	Unit	OFF if the self diagnostic testing after the Unit was turned ON or reset was normal.
2	IP address setting error	ON	Unit	ON if any of the following conditions apply to the IP address.
				 All bits in the host ID are 0 or 1.
				 All bits in the network ID are 0 or 1.
				 All bits in the subnet ID are 1.
				 The IP address begins with 127 (0x7F)
		OFF	Unit	OFF when the IP address is normal.
3	IP address table error	ON	Unit	On if the IP address table information is incorrect.
		OFF	Unit	OFF when the IP address table is normal.
4	IP router table error	ON	Unit	ON if the IP router table information is incorrect.
		OFF	Unit	OFF when the IP address table is normal.
5	(Not used.)			
6	Routing table error	ON	Unit	ON if the routing table information is incorrect.
		OFF	Unit	OFF when the routing table is normal.
7	Transceiver error	ON	Unit	ON when the transceiver cable is disconnected, the transceiver is not receiving power, or the transceiver is defective. Once this bit turns ON, it will not turn back OFF even if the transceiver status returns to normal.
		OFF	Unit	OFF when the transceiver is normal.
8	Internode Test Flag	ON	Unit	ON during internode testing.
		OFF	Unit	OFF while internode testing is stopped.
9 to 13	(Not used.)			
14	Address disagreement	ON	Unit	ON if the remote IP address is set to automatic generation but the local IP address host number and FINS node number do not agree.
		OFF	Unit	OFF under all other circumstances.
15	EEPROM error	ON	Unit	ON if an error has occurred in the EEPROM memory.
		OFF	Unit	OFF when the EEPROM memory is normal.

Socket Service Request Switches 1 to 8 (CPU Unit to Ethernet Unit)

When a socket service request is executed by control switch manipulation, it is the following bits that are manipulated. For details, refer to 6-2 Using Socket Services with Socket Service Request Switches.



В	it	Switch	Status	Manipulated by	Unit operation	Page
8	0	UDP Open	ON	User	UDP socket opened when switch is turned ON.	98 to
		Request Switch	OFF	Unit	Unit turns OFF switch when open processing has been completed (i.e., when a connection has been made).	103
9	1	TCP Passive Open Request Switch	ON	User	Passive TCP socket opened when switch is turned ON.	
			OFF	Unit	Unit turns OFF switch when open processing has been completed (i.e., when a connection has been made).	
10	2	TCP Active Open	ON	User	Active TCP socket opened when switch is turned ON.	
		Request Switch	OFF	Unit	Unit turns OFF switch when open processing has been completed (i.e., when a connection has been made)	
11	3	Send Request Switch	ON	User	Send processing executed when switch is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.)	
			OFF	Unit	Unit turns OFF switch when send processing has been completed.	
12	4	Receive Request Switch	ON	User	Receive processing executed when switch is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.)	
			OFF	Unit	Unit turns OFF switch when receive processing has been completed.	
13	5	Close Request Switch	ON	User	Close processing executed when switch is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.)	
				Unit	Unit turns OFF switch when close processing has been completed.	
14	6	(Not used.)				
15	7	(Not used.)				

4-4 DM Area Allocations

The various kinds of data are stored in the offset positions shown in the following diagram, from the beginning word in the area for each Unit.

The beginning word m is calculated by the following equation:

Beginning word m = D30000 + (100 x unit number)

Offset

Bit

	15	8	7	0	Data direction	Related communications services
m	Internode test remote ne	twork	addres	s and node number	CPU Unit to Ethernet Unit	Internode Test Function
m+1	Internode test numbe	r of s	send by	/tes		(Refer to 9-3 Internode Test.)
m+2	Internode test respon	se m	nonitori	ng time		
m+3	Internode test status				Ethernet Unit to CPU Unit	
m+4	Number of internode	test	runs			i l
m+5	Number of internode	test	timeou	terrors		i i
m+6	Number of internode	test	respon	se errors		
m+7	Number of internode	test	send e	rrors		
m+8	Number of times inter	node	e test c	lata did not match	-	
m+9	TCP socket No. 1 cor	nnec	tion sta	atus	-	Socket Services
:					-	(Refer to Section 6 Socket Services.)
m+16	TCP socket No. 8 cor	nnec	tion sta	atus	+	
m+17	Mail status					Mail function (Refer to Section 8 Mail.)
m+18	Socket Services Para	met	er Area	1	CPU Unit to Ethernet Unit	-
m+28	Socket Services Para	met	er Area	2]	Socket Services
1						(Refer to Section 6
m+88	Socket Services Para	met	er Area	8		Socker Services.)
m+98					Ethernet Unit to CPU Unit	⊤
m+99		iea			<u> </u>	

The meanings of the items shown in the above diagram are explained on the following pages. For details regarding the related communications services shown in the diagram, refer to the indicated sections.

Internode Test Remote Network Address and Node Number (CPU Unit to Ethernet Unit)

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
m	Remote network address									Rei	mote	node	e nur	nber		

Specify the remote network address and node number in hexadecimal within the following ranges:

Remote network address: 00 to 7F Hex (0 to 127 decimal) Remote node number: 01 to 7E Hex (0 to 126 decimal)

If a remote network address is set to 00, it will specify the local network (i.e., the network to which the Ethernet Unit is connected.)

Internode Test Number of Send Bytes (CPU Unit to Ethernet Unit)

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

 m+1
 Number of send bytes (0000 to 07CC Hex)

Specify, in hexadecimal, the number of bytes of test data to be sent between nodes.

0000 (Hex): 1,996 bytes 0001 to 07CC (Hex): 1 to 1,996 bytes

Internode Test Response Monitoring Time (CPU Unit to Ethernet Unit)

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

 m+2
 Response monitoring time (0000 to FFFF Hex)

Specify, in hexadecimal, the amount of time to wait for the internode test response.

0000 (Hex): 2 seconds 0001 to FFFF (Hex): 0.01 to 655.35 seconds

Internode Test Status (Ethernet Unit to CPU Unit)



Internode test results are reflected here. (The bits all turn back OFF when the internode test is started.)

Bits 0 to 5 turn ON when their applicable error occurs.

The error code for the error that occurred is stored in bits 13 to 15. The meanings of the error codes are shown in the following table.

	Bit		Meaning					
15	14	13						
0	0	0	Normal					
0	0	1	Timeout error					
0	1	0	Response (response code) error					
0	1	1	Send error					
1	0	0	Data disagreement error					
1	0	1	Routing table error (See note.)					
1	1	0	Send parameter error (See note.)					

Note When a routing table error or a sent parameter error occurs, the number of internode test runs is not incremented.

Number of Internode Test Runs (Ethernet Unit to CPU Unit)

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

 4
 Number of test runs (0000 to FFFF Hex)

Internode tests are executed repeatedly as long as the Internode Test Start Switch, one of the Unit Control Switches in the CIO area, remains ON.

In this word, specify in hexadecimal the number of times that the internode test is actually to be executed.

0000 to FFFF (Hex): 0 to 65,535 times

When the count reaches FFFF (Hex), it will start over again at 0. The count value will be retained until the internode test is restarted.

Note When a routing table error or a transmission parameter error occurs, the number of internode tests is not incremented.

Number of Internode Test Timeout Errors (Ethernet Unit to CPU Unit)

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 m+5 Number of timeout errors (0000 to FFFF)

The number of timeout errors that have occurred in the internode test is stored in this word in hexadecimal.

0000 to FFFF (Hex): 0 to 65,535 times

When the count reaches FFFF (Hex), it will not go any further. The count value will be retained until the internode test is restarted.

Number of Internode Test Response Errors (Ethernet Unit to CPU Unit)

The number of response errors that have occurred in the internode test is stored in this word in hexadecimal.

0000 to FFFF (Hex): 0 to 65,535 times

When the count reaches FFFF (Hex), it will not go any further. The count value will be retained until the internode test is restarted.

Number of Internode Test Transmission Errors (Ethernet Unit to CPU Unit)

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

 m+7
 Number of transmission errors (0000 to FFFFHex)

The number of transmission errors that have occurred in the internode test is stored in this word in hexadecimal.

0000 to FFFF (Hex): 0 to 65,535 times

When the count reaches FFFF (Hex), it will not go any further. The count value will be retained until the internode test is restarted.

Number of Times Internode Test Data Did Not Match (Ethernet Unit to CPU Unit)

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

 n+8
 Number of data disagreement errors (0000 to FFFF)

The number of data disagreement errors that have occurred in the internode test is stored in this word in hexadecimal.

0000 to FFFF (Hex): 0 to 65,535 times

When the count reaches FFFF (Hex), it will not go any further. The count value will be retained until the internode test is restarted.

TCP Socket No. (1 to 8) Connection Status (Ethernet Unit to CPU Unit)



The connection status for each TCP socket is stored by code in this word. For details, refer to *Appendix 4 TCP Status Transitions*.

Mail Status (Ethernet Unit to CPU Unit)



The transmission statuses of user mail, periodic mail, and error log mail are stored in this word as shown in the following table.

	Bits		Status
2	1	0	
6	5	4	
10	9	8	
OFF	OFF	OFF	Mail is either waiting to be sent or can be sent using the Mail Send Switch. No mail is being sent.
OFF	OFF	ON	Mail is being sent.
OFF	ON	OFF	Mail is either waiting to be sent or can be sent using the Mail Send Switch. The previous mail transmission was completed normally.
ON	ON	OFF	Mail is either waiting to be sent or can be sent using the Mail Send Switch. An error occurred in the previous mail transmission.
ON	ON	ON	Mail cannot be sent (system setting error).

Socket Services Parameter Area 1 to 8 (Ethernet Unit to CPU Unit)

Offset	Socket No. 1	 Socket No. 8	15 1	4	13	12	11	10	9	8	7	6	5	4	3	2	1	0
+0	m+18	 m+88	UDP	/TC	CP so	ocke	t nur	nber	(1 to	8)								
+1	m+19	m+89	Loca	I UI	DP/1	ГСР	port	numt	ber ((0000	to Fl	FFF	Hex)					
+2	m+20	m+90	Rem	Remote IP address (00000000 to FFFFFFF Hex)														
	m+21	m+91		`````														
+4	m+22	 m+92	Rem	ote	UDI	P/TC	P po	ort nu	mbe	r (00	00 to	FFF	F He	ex)				
+5	m+23	m+93	Num	ber	of s	end/	rece	ive b	ytes	(000	0 to ()7C0	Hex	(198	34))			
+6	m+24	m+94	Sen	l/re	ceiv	e dat	ta ad	dres	5									
	m+25	m+95	(San	ne a	as Fl	NS۱	/aria	ble a	rea c	lesigi	natio	n me	thod	.)				
+8	m+26	m+96	Time	out	valu	Je (0	000	to FF	FF F	lex)								
+9	m+27	 m+97	Res	on	se c	ode												

When socket services are requested by control switch manipulation, the settings must be made in advance in a Socket Service Parameter Area. The parameters used will vary depending on the service requested. For details, refer to 6-2 Using Socket Services With Socket Service Request Switches.

IP Address Display Area

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
m+98		S١	V1		SW2				SW3				SW4			
m+99		S١	N5		SW6				SW7				SW8			

The set values of the Local IP Address Switches (rotary switches 1 to 8) on the back of the Ethernet Unit are read and stored here when the power is turned ON. If an incorrect address is set, 0000 (Hex) will be stored here and the ERC indicator will flash. (Refer to *3-4-3 Setting the Local IP Address.*)
SECTION 5 FINS Communications

This section provides information on communicating on Ethernet Systems and interconnected networks using FINS commands. The information provided in the section deals only with FINS communications in reference to Ethernet Units.

FINS commands issued from a PC are sent via the SEND(090), RECV(098), and CMND(490) instructions programmed into the user ladder-diagram program. Although an outline of these instructions is provided in this section, refer to the CS1-series CS1G/H-CPU $\Box\Box$ -E Programmable Controllers Programming Manual (W340) for further details on programming these instructions.

5-1	Overvie	iew of FINS Communications				
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5-1 Overview of FINS Communications

The FINS communications service enables client control of operations such as reading or writing server PC memory area data without the need to program these operations into the server PC user program. The Ethernet Unit uses a dedicated UDP/IP port to execute the FINS communications service. (Refer to *FINS UDP Port Number* under *4-2-1 Settings*.)

5-1-1 Communications On an Ethernet Network

Data is sent and received as UDP packets on an Ethernet network. The FINS port number (default value: 9600) set in the CPU Bus Unit System Setup is used for FINS communications. (Refer to *4-2 CPU Bus Unit System Setup*.)



When a FINS command is issued from the Ethernet Unit, the IP address is found from the FINS address specified by CMND(490). For details, refer to 3-1 Before Operation.

Note The UDP/IP protocol does not provide communications control to ensure communications reliability. Consequently, the FINS communications services using the UDP/IP protocols cannot guarantee that any message arrived safely and unaltered at the destination. Methods to ensure reliability, such as retries and appropriate processing of FINS responses, must be programmed into the user application.

5-1-2 FINS Communications Service Features

The FINS communications service is a function for controlling operations such as sending and receiving data, changing modes, and so on, between nodes on OMRON factory automation networks. It provides the following features.

- Communications instructions are executed in the user program.
- Writing data, changing modes, reading detailed information about Units, and so on, can be executed without any particular knowledge of communications procedures or network classification.

- Units and Boards that support FINS commands return responses automatically, so there is no need for a program at the receiving end.
- The FINS communications service is mainly used between OMRON CPU Bus Units, CPU Units, and Support Boards for FA Computers. By correctly setting information such as headers, however, it can also be used from ordinary Ethernet communications devices.

The FINS communications service can be used from a PC with either of the following three instructions:

• SEND(090)/RECV(098)

SEND(090) and RECV(098) are used to send and receive data (area reading and writing).

• CMND(490)

CMND(490) is used to send FINS commands. The particular FINS commands that are supported vary depending of the type of Unit or Board. For details on FINS commands addressed to Ethernet Units, refer to Section 11 FINS Commands Addressed to Ethernet Units. For details regarding FINS commands addressed to CS1-series CPU Units, refer to the CS1-series CS1G/H-CPU - E Programmable Controllers Communications Commands Reference Manual (W342).

The following table shows how the FINS communications service is used by the communications source and destination, for PC to PC and host computer to PC.



5-2 Procedure Before Using FINS Communications



5-3 Sending Commands From a PC

FINS commands can be sent from the user's ladder-diagram program in the PC by using the SEND(090), RECV(098), and CMND(490) instructions.

SEND(090): Writes I/O data from the local node to another node. RECV(098): Reads I/O data from another node to the local node. CMND(490): Issues FINS commands for controlling operations such as sending and receiving I/O memory data to and from other nodes, reading information regarding other nodes, and so on.

5-3-1 Communications Specifications

The following table shows the specifications for PC communications using the SEND(090), RECV(098), and CMND(490) instructions.

Item	Specifications			
Destination	1:1 SEND(090), RECV(098), CMND(490) instructions1:N SEND(090), CMND(490) instructions (broadcasting)			
Data length	SEND(090):990 words (1,980 bytes) max.; broadcasting: 727 words (1,454 bytes)RECV(098):990 words (1,980 bytes) max.CMND(490):1,990 bytes max.; broadcasting: 1,462 bytes (after FINS command code)			
Data contents	The following data is sent and received with the execution of each instruction.			
	SEND(090):Sends request for remote node to receive data, and receives response data.RECV(098):Sends request for remote node to send data, and receives response data.CMND(490):Sends any FINS command and receives response data.			
Communications port number	Ports 0 to 7 (Eight transmissions can occur simultaneously.)			
Response monitor time	0000: 2 s (default) 0001 to FFFF: 0.1 to 6,553.5 s in 0.1-s increments (specified by user)			
Number of retries	0 to 15 retries			

- Note 1. The maximum data length is limited to 512 bytes for data exchange between the PC and SYSMAC LINK Systems or the PC and SYSMAC BUS/2 Remote I/O Systems.
 - 2. When broadcasting, do not require a response.

PC Communications Data Areas

The following table shows the I/O data areas involved when SEND(090) and RECV(098) are used.

Area	Range		
CIO Area	CIO 0000 to CIO 6143		
Work Area	W000 to W511		
Holding Area	H000 to H511		
Auxiliary Area	A000 to A959 (See note 1.)		
Timer Area	TIM0000 to 4095		
Counter Area	CNT0000 to 4095		
DM Area	D00000 to D32767		
EM Area	E00000 to E32767 (See note 2.)		

Note 1. Data cannot be written to words A000 to A447 in the Auxiliary Area.

2. A maximum of 13 banks in the EM Area can be used. For details regarding the EM Area, refer to the operation manual for the PC that is used.

Using SEND(090), RECV(098), and CMND(490)

Make the settings shown below when using the SEND(090), RECV(098), and CMND(490) instructions in the user's ladder-diagram program in the PC.

SEND(090)

The SEND(090) instruction sends the data in n number of words, starting from the beginning word S at the local node, to the words starting from the beginning word D at the remote destination node (node number N).



Note The message service does not guarantee that a message will reach the destination node. A message may be lost during transmission due to factors such as noise. To prevent this from occurring when using message services, it is common to set up retry processing at the node from which instructions are issued. With the SEND(090), RECV(098), and CMND(490) instructions, retry processing is executed automatically by specifying the number of retries, so specify a number other than 0.

RECV(098)

With the RECV(098) instruction, the data in m number of words, starting from the beginning word S at the remote node (node number M) is received at the words starting from the beginning word D at the local node.



Note The message services function does not guarantee that a message will reach the destination node. A message may be lost during transmission due to factors such as noise. In order to prevent this from occurring when using message services, it is common to set up retry processing at the node from which instructions are issued. With the SEND(090), RECV(098), and CMND(490) instructions, retry processing is executed automatically by specifying the number of retries, so specify a number other than 0.

CMND(049)

The CMND(049) instruction sends n bytes of command data, starting from the beginning word S at the local node, to the node at node number N. the data in m number of words, starting from the beginning word S at the remote node (node number M) is received at the words starting from the beginning word D at the local node.



setting the destination node number to FF (Hex).

The range of node addresses is different for networks other than Ethernet.

Note The message services function does not guarantee that a message will reach the destination node. A message may be lost during transmission due to factors such as noise. In order to prevent this from occurring when using message services, it is common to set up retry processing at the node from which instructions are issued. With the SEND(090), RECV(098), and CMND(490) instructions, retry processing is executed automatically by specifying the number of retries, so specify a number other than 0.

Commands Addressed to CS1-series CPU Units

The following table provides a list of FINS commands that can be processed by a CS1-series CPU Unit. For details, refer to the CS1-series CS1G/H-CPU \square -*E* Programmable Controllers Communications Commands Reference Manual (W342).

For details on FINS commands that can be processed by the Ethernet Unit, refer to Section 11 FINS Commands Addressed to Ethernet Units.

Usage	Command code		Name	Function	
	MR SR				
I/O memory area access	01	01	MEMORY AREA READ	Reads the contents of consecutive I/O memory area words.	
	01	02	MEMORY AREA WRITE	Writes the contents of consecutive I/O memory area words.	
	01	03	MEMORY AREA FILL	Writes the same data to the specified range of I/O memory area words.	
	01	04	MULTIPLE MEMORY AREA READ	Reads the contents of specified non-consecutive I/O memory area words.	
	01	05	MEMORY AREA TRANSFER	Copies the contents of consecutive I/O memory area words to another I/O memory area.	
Parameter area access	02	01	PARAMETER AREA READ	Reads the contents of consecutive parameter area words.	
	02	02	PARAMETER AREA WRITE	Writes the contents of consecutive parameter area words.	
	02	03	PARAMETER AREA FILL (CLEAR)	Writes the same data to the specified range of parameter area words.	
Program area	03	06	PROGRAM AREA READ	Reads the UM (User Memory) area.	
access	03	07	PROGRAM AREA WRITE	Writes to the UM (User Memory) area.	
	03	08	PROGRAM AREA CLEAR	Clears the UM (User Memory) area.	
Operating mode changes	04	01	RUN	Changes the CPU Unit's operating mode to RUN or MONITOR.	
	04	02	STOP	Changes the CPU Unit's operating mode to PROGRAM.	
Machine	05	01	CPU UNIT DATA READ	Reads CPU Unit data.	
configuration reading	05	02	CONNECTION DATA READ	Reads the model numbers of the device corresponding to addresses.	
Status reading	06	01	CPU UNIT STATUS READ	Reads the status of the CPU Unit.	
	06	20	CYCLE TIME READ	Reads the maximum, minimum, and average cycle time.	
Time data access	07	01	CLOCK READ	Reads the present year, month, date, minute, second, and day of the week.	
	07	02	CLOCK WRITE	Changes the present year, month, date, minute, second, or day of the week.	
Message display	09	20	MESSAGE READ/CLEAR	Reads and clears messages, and reads FAL/FALS messages.	
Access rights	0C	01	ACCESS RIGHT ACQUIRE	Acquires the access right as long as no other device holds it.	
	0C	02	ACCESS RIGHT FORCED ACQUIRE	Acquires the access right even if another device already holds it.	
	0C	03	ACCESS RIGHT RELEASE	Releases the access right that has been acquired.	
Error log	21	01	ERROR CLEAR	Clears errors or error messages.	
	21	02	ERROR LOG READ	Reads the error log.	
	21	03	ERROR LOG POINTER CLEAR	Clears the error log pointer.	

Usage	Command code		Name	Function
	MR	SR		
File memory	22	01	FILE NAME READ	Reads file memory data.
	22	02	SINGLE FILE READ	Reads a specified length of file data from a specified position within a single file.
	22	03	SINGLE FILE WRITE	Writes a specified length of file data from a specified position within a single file.
	22	04	FILE MEMORY FORMAT	Formats (initializes) the file memory.
	22	05	FILE DELETE	Deletes specified files stored in the file memory.
	22	07	FILE COPY	Copies files from one file memory to another file memory in the same system.
	22	08	FILE NAME CHANGE	Changes a file name.
	22	0A	MEMORY AREA-FILE TRANSFER	Transfers or compares data between the I/O memory area and the file memory.
	22	0B	PARAMETER AREA–FILE TRANSFER	Transfers or compares data between the parameter area and the file memory.
	22	0C	PROGRAM AREA-FILE TRANSFER	Transfers or compares data between the UM (User Memory) area and the file memory.
	22	15	CREATE/DELETE DIRECTORY	Creates or deletes a directory.
Debugging	23	01	FORCED SET/RESET	Force-sets or force-resets bits, or releases force-set status.
	23	02	FORCED SET/RESET CANCEL	Cancels all bits that have been force-set or force-reset.

Writing Programs

Programs incorporating the SEND(090), RECV(098), and CMND(490) instructions are generally created using the Communications Port Enabled Flag and the Communications Port Error Flag as input conditions. CS1-series CPU Units have eight communications ports. Only one instruction can be executed at any given port at one time, however, so the program must not overlap the use of any of the ports. A program example is provided below.



There are eight communications ports, so up to eight communications instructions can be executed at a time. The number of messages that can be sent or received with a single CPU Bus Unit service, though, is not more than two each for the CPU Unit to the Ethernet Unit and for the Ethernet Unit to the CPU Unit.



Communications Flags

The execution status of the SEND(090), RECV(098), and CMND(490) instructions is always reflected by the communications flags (i.e., the Communications Port Enabled Flag and the Communications Port Error Flag). The CS1-series CPU Unit's communications flags are allocated in the Auxiliary Area as shown in the following table.

Flag name		Address	Contents		
	Word	Bits			
Communications Port Enabled Flag	A202	Bit 7: Port 7 Bit 6: Port 6 Bit 5: Port 5 Bit 4: Port 4 Bit 3: Port 3 Bit 2: Port 2 Bit 1: Port 1 Bit 0: Port 0	OFF: Execution enabled (being executed) ON: Execution disabled (not being executed)		
Communications Port Error Flag	A219	Bit 7: Port 7 Bit 6: Port 6 Bit 5: Port 5 Bit 4: Port 4 Bit 3: Port 3 Bit 2: Port 2 Bit 1: Port 1 Bit 0: Port 0	OFF: Normal completion ON: Abnormal completion		

Note With CS1-series PCs, communications ports 0 to 7 are also used for executing the PCMR(260) (PROTOCOL MACRO) instruction, so these flags are used in common for SEND(090), RECV(098), CMND(490), and PCMR(260). While PCMR(260) is being executed, SEND(090), RECV(098), and CMND(490) cannot be executed at the same communications port.

Communications Port Completion Codes

The status of a SEND(090), RECV(098), and CMND(490) instruction after execution is reflected as a communications port completion code, in one word (two bytes) of data as shown in the following table. (The value is 0000 during instruction execution.) The recorded status is saved until execution of the next instruction.

Word	Contents
A203	Communications Port 0 Completion Code
A204	Communications Port 1 Completion Code
A205	Communications Port 2 Completion Code
A206	Communications Port 3 Completion Code
A207	Communications Port 4 Completion Code
A208	Communications Port 5 Completion Code
A209	Communications Port 6 Completion Code
A210	Communications Port 7 Completion Code

The meanings of the communications port completion codes are the same as those for FINS commands and responses. When CMND(490) is used, however, even if a FINS command has an abnormal completion, it will not be reflected in the communications port completion code. For details, refer to *Communications Port Error Flag and Completion Codes for CMND(490)* below.

Bits 08 to 15 in the communications port completion code correspond to the first byte of the response code, and bits 00 to 07 correspond to the second byte. For details, refer to *10-6 Troubleshooting With Response Codes*.

Communications Port Error Flag and Completion Codes CMND(490)

Errors that occur when CMND(490) is used generate a Communications Port Error Flag and are recorded in a communications port completion code only in the following cases:

- When a response timeout error has occurred.
- When the number of communications data bytes exceeds the maximum value for the Unit (i.e., 2,000 bytes for the Ethernet Unit).
- When the actual number of response bytes is greater than the number of reception bytes that has been set. (The response is not stored in this case.)

Errors other than these are recorded in the response codes of the responses stored from the beginning response storage word onwards. Be careful of these, because there are no Communications Port Error Flags and they are not recorded in a communications port completion code.

Timing of Communications Flag Changes

- The Communications Port Enabled Flag remains OFF during communications and turns ON when they are completed (regardless of whether or not an error occurs).
- The Communications Port Error Flag retains its status until the next transmission or reception.
- The Communications Port Error Flag turns OFF with the execution of the next communications instruction even if there was an abnormal completion.

Example

Communications Port Enabled Flag	110]									
Communications instruction: SEND(090), RECV(098), CMND(490)		Instruction 1 being executed.			Instruction 2 being executed.			Instruction 3 being executed.			
Communications Port Error Flag	¦-										
Communications Port Completion Code	L_	0000			0000			0000			
	Compl	letion 0000	(Norma	l compl	etion) (Unit a	 02 address	02 setting	0000 g error)	(Normal	compl	etion

5-3-2 Program Example



Sending Commands From a PC



Note With CS1-series PCs, the Communications Port Enabled Flags at bits 0 to 7 in word A202 turn OFF even when the PCMR(260) instruction is being executed using the ports corresponding to those flags.

5-3-3 Transmission Delays

The methods of computing the maximum time required from execution of the SEND(090), RECV(098), and CMND(490) instructions until processing is completed are described in this section. These times, however, do not take transmission delay times on the network into account, so they may be increased depending on the conditions under which the instructions are executed.

SEND(090)

The transmission delay for the SEND(090) instruction can be calculated using the following equation, which is illustrated in the following diagram.

Max. delay =Local node service cycle + local node service processing time + transmission processing time + reception processing time + remote node service cycle + remote node service processing time + CPU data set processing time (remote node)



CPU Bus Unit Service Cycle	The CPU Bus Unit service cycle is a single PC cycle.				
CPU Bus Unit Service Processing Time	This is the time required to process CPU Bus Units and is approximately 1 ms for Ethernet Units.				
Transmission Processing Time	Number of words transferred x 0.011 + 3 m	S			
Reception Processing Time	Number of words transferred x 0.011 + 3 m	S			
CPU Data Set Processing	Number of words transferred x 0.02 + 20 m	S			
Note Example Calculations	 The actual operating environment can cause transmission delays larger than those calculated with the methods given here. Among the causes of longer delays are the following: traffic on the network, window sizes at net- work nodes, traffic through the Ethernet Unit (e.g., socket servicing, FTP server communications, etc.), and the system configuration. The CPU data set processing time is the standard when the peripheral ser- vice time is set in the CPU Unit System Setup to the default of 4%. As this value is increased, the processing time is shortened. The following example shows calculations for sending 256 words between two PC nodes using SEND(090). The local node's CPU cycle time is 10 ms, and the remote node's CPU cycle time is 5 ms. Calculations are shown in the following 				
	Item	Calculation			
	CPU Bus Unit service cycle (local node)	PC cycle time = 10 ms			
	CPU Bus Unit service processing time (local node)	1 ms			
	Transmission processing time	256 x 0.011 + 3 = 5.816 6 ms			
	Reception processing time	256 x 0.011 + 3 = 5.816 6 ms			
	CPU Bus Unit service cycle (remote node)	5 ms			
	CPU Bus Unit service processing time (remote node)	1 ms			
	CPU data set processing time (remote node)	256 x 0.02 + 20 = 25.12 25 ms			
	Total	10 + 1 +6 + 6 + 5 + 1 + 25= 54 ms			

RECV(098)

The transmission delay for the RECV(098) instruction can be calculated using the following equation, which is illustrated in the following diagram.

Max. delay =Local node service cycle + local node service processing time + transmission processing time (command) + reception processing time (command) + remote node service cycle + remote node service processing time + CPU data read processing time (remote node) + remote node service processing time + transmission processing time (response) + reception processing time (response) + local node service cycle + local node service processing time + CPU data set processing time (local node)



CPU Bus Unit Service Cycle	The CPU Bus Unit service cycle is a single PC cycle.				
CPU Bus Unit Service Processing Time	This is the time required to process CPU Bus Units and is approximately 1 ms for Ethernet Units.				
Transmission and Reception Processing Times	Command: Response:	3 ms Number of words transferred x 0.011 + 3 ms			
CPU Data Read Processing Time	PU Data Read The CPU data read processing time is the integer portion of the minir time, which satisfies the following formula.				
	Number of words transferred x 0.02 + 20 ms < Integer portion of remote node cycle time				
CPU Data Set Processing Time	Number of words transferred x 0.02 + 20 ms				

Example Calculations

The following example shows calculations for receiving 256 words between two PC nodes using RECV(098). The local node's CPU cycle time is 10 ms, and the remote node's CPU cycle time is 15 ms. Calculations are shown in the following table.

Item	Calculation
CPU Bus Unit service cycle (local node)	PC cycle time = 10 ms
CPU Bus Unit service processing time (local node)	1 ms
Transmission processing time (command)	3 ms
Reception processing time (command) + Remote node service cycle + CPU Bus Unit service processing time (remote node)	3 + 15 + 1 + (256 x 0.011 + 3) = 24.816 25 ms
CPU data read processing time (remote node)	256 x 0.02 + 20 = 25.12 30 ms
Service processing	1 ms
Transmission processing time (response)	256 x 0.011 + 3 = 5.816 6 ms
Reception processing time (response) + Local node service cycle + CPU Bus Unit service processing time (local node)	(256 x 0.011 + 3) + 10 + 1 = 16.816 17 ms
CPU data set processing (local node)	256 x 0.02 + 20 = 25.12 25 ms
Total	10 + 1 + 3 + 25 + 30 + 1 + 6 + 17 + 25 = 118 ms

5-4 Sending Commands From a Host Computer

Commands and responses sent from host computers must be in the formats described in this section and must provide the proper FINS header information. These formats can also be used to decode commands and responses received from other network nodes.

5-4-1 Designating Remote Addresses

UDP sockets are used when sending FINS commands from a host computer to a PC. This section provides examples of addressing remote PCs from the host computer for communications.

- Note 1. The FINS UDP port number at the Ethernet Unit is set to the default of 9600. It can be changed in the CPU Bus Unit System Setup, but the same FINS UDP port number must be set for all of the Ethernet Units on the same Ethernet network.
 - 2. Even if the Ethernet network is comprised of multiple segments, set the same value for the FINS network number.



The FINS communications service is carried out through the exchange of FINS command frames and their corresponding response frames. (There are also commands with no responses.)

Both command frames and response frames are comprised of a FINS header for storing transfer control information, a FINS command field for storing a command, and a FINS parameter/data field for storing command parameters and transmission/response data.

FINS Command Frame Configuration

		Size (bytes)	Contents
(ICF] 1	Displays frame information
	<u>RSV</u>	1	Reserved by system.
	GCT	1	Permissible number of gateways
		1	Destination network address
FINS header	DA1	1	Destination node address
	<u>D</u> A2	1	Destination unit address
	SNA	1	Source network address
	SA1	1	Source node address
	SA2	_ 1	Source unit address
Ĺ	SID	1	Service ID
FINS command	MRC	_ 1	Main request code
	SRC	1	Sub-request code
FINS parameter/data	Parameter/ data field	2000 max.	Command parameters and send data The data length depends on the MRC and SRC.

FINS Response Frame Configuration

The response code (one byte each for MRES and SRES) for the command is added at the beginning of the FINS parameter/data field in the response frame.



FINS Header Information

ICF (Information Control Field)



RSV (Reserved by system) Set to 00 (Hex).

GCT (Permissible Number of Gateways) Set to 02 (Hex).

DNA (Destination Network Address)

Specifies the number of the network where the destination node is located. 00 (Hex): Local network 01 to 7F (Hex): Destination network number (1 to 127) DA1 (Destination Node Address)

Specifies the number of the node where the command is being sent. This node number is the address used for FINS, and is different from the IP address used for Ethernet.

00 (Hex): Local PC Unit

01 to 7E (Hex): Destination node number (1 to 126)

FF (Hex): Broadcasting

When multiple Communications Units are mounted, DA1 specifies the node number of the Unit connected to the network specified by DNA.

DA2 (Destination Unit Address)

Specifies the number of the Unit at the destination node.

00 (Hex):PC (CPU Unit)10 to 1F (Hex):CPU Bus Unit #0 to #15 (16 to 31)E1 (Hex):Inner BoardFE (Hex):Unit connected to network.

SNA (Source Network Address)

Specifies the number of the network where the source node is located. 00 (Hex): Local network

01 to 7F (Hex): Source network number (1 to 127)

SA1 (Source Node Address)

Specifies the local node number. The ranges of numbers that can be specified are the same as for DA1.

SA2 (Source Node Address)

Specifies the number of the Unit at the source node. The ranges of numbers that can be specified are the same as for DA2.

SID (Service ID)

The SID is used to identify the process that data is sent from. Set any desired number from 00 to FF for the SID. The same number will be returned in the response, allowing you to match commands and responses in your application.

5-4-3 Sample Program

Operation Overview	This program reads 150 words of the PC memory beginning at D00100 by send- ing an FINS command (MEMORY AREA READ, command code 0101) from a UNIX workstation to the PC on the Ethernet network. If no response is received within two seconds of sending the FINS command, the command will be resent.
Settings	The Ethernet Unit IP address is 196.36.32.100, and the FINS node number is 100. IP address conversion is set to automatic generation.
	The workstation's IP address is 196.36.32.50 and its FINS node number is 50.
	The FINS UDP port number is 9600 (default).

Sample Program

```
#include <errno.h>
1
 2
   #include <stdio.h>
 3
   #include <sys/types.h>
 4
   #include <sys/socket.h>
 5
   #include <netinet/in.h>
 б
   #include <signal.h>
 7
8
   #define FINS UDP PORT 9600
   #define SERV IP ADDR "196.36.32.100"
                                                /*Ethernet Unit IP ADDRESS*/
9
   #define MAX_MSG
10
                          2010
   #define RESP_TIMEOUT 2
11
12
13
14
15
   * FINS COMMUNICATIONS SAMPLE PROGRAM
```

```
16
   */
17
    main(argc,argv)
18
    int
          argc;
19
    char
          *argv[];
20
    {
21
          int
                 sockfd;
22
         struct sockaddr in , ws addr, cv addr;
23
                 fins_cmnd[MAX_MSG],fins_resp[MAX_MSG];
          char
24
          int
                 sendlen,recvlen,addrlen;
25
         char
                 sid=0;
26
         extern recv_fail();
27
28
          / *GENERATE UDP SOCKET* /
          if((sockfd=socket(AF_INET,SOCK_DGRAM,0))<0)</pre>
29
               err_exit("can't open datagram socket");
30
31
32
          /*ALLOCATE IP ADDRESS AND PORT # TO SOCKET*/
33
         bzero((char*)&ws_addr,sizeof(ws_addr));
34
         ws_addr.sin_family=AF_INET;
35
         ws_addr.sin_addr.s_addr=htonl(INADDR_ANY);
36
         ws_addr.sin_port=htons(FINS_UDP_PORT);
37
          if(bind(sockfd,(struct sockaddr*)&ws_addr,sizeof(ws_addr))<0)
38
               err_exit("can't bind local address");
39
          /*
40
          *GENERATE MEMORY AREA READ COMMAND
41
42
          * (READ 150 WORDS FROM D00100.)
43
          /*
44
         fins_cmnd[0]=0x80;
                               /*ICF*/
                               /*RSV*/
45
          fins_cmnd[1]=0x00;
46
                               /*GCT*/
         fins_cmnd[2]=0x02;
          fins_cmnd[3]=0x01;
47
                               /*DNA*/
                                            /*Ethernet Unit FINS NODE NUMBER*/
48
         fins_cmnd[4]=0x64;
                               /*DA1*/
49
                               /*DA2*/
          fins_cmnd[5]=0x00;
50
          fins_cmnd[6]=0x01;
                               /*SNA*/
51
         fins_cmnd[7]=0x32;
                               /*SA1*/
                                            /*WS FINS NODE NUMBER*/
                               /*SA2*/
52
          fins_cmnd[8]=0x00;
53
         fins cmnd[9]=++sid; /*SID*/
54
          fins_cmnd[10]=0x01; /*MRC*/
55
          fins_cmnd[11]=0x01; /*SRC*/
56
          fins_cmnd[12]=0x82; /*VARIABLE TYPE: DM*/
57
         fins_cmnd[13]=0x00; /*READ START ADDRESS: 100*/
          fins_cmnd[14]=0x64;
58
59
          fins_cmnd[15]=0x00;
60
          fins_cmnd[16]=0x00; /*WORDS READ: 150*/
61
          fins_cmnd[17]=0x96;
62
63
          /*SEND FINS COMMAND*/
64
65
         bzero((char*)&cv addr,sizeof(cv addr));
66
          cv_addr.sin_family=AF_INET;
         cv_addr.sin_addr.s_addr=inet_addr(SERV_IP_ADDR);
67
68
         cv_addr.sin_port=htons(FINS_UDP_PORT);
69
70
         singnal((SIGALRM, recv fail);
71
72
    CMND_SEND:
73
         sendlen = 18;
74
         if(sendto(sockfd,fins_cmnd,sendlen,0,&cv_addr,sizeof(cv_addr))
          ==sendlen){
75
                alarm(RESP TIMEOUT); /*START RESPONSE MONITOR TIMER*/
76
                printf("send length %d¥n",sendlen);
77
78
         else{
79
                err_exit("send error");
80
          }
81
          /*RECEIVE FINS RESPONSE*/
82
```

```
83
          if((recvlen = recvfrom(sockfd,fins_resp,MAX_MSG,0,&cv_addr,&addrlen))
          <0){
84
                 if(errno == EINTR)
                       goto CMND_SEND; /*RE-SEND FINS COMMAND*/
85
86
                 err_exit("receive error");
87
          }
          else{
88
                 alarm(0); /*STOP RESPONSE MONITOR TIMER*/
89
90
                printf("recv length %d¥n",recvlen);
91
                 if(recvlen<14) /*ILLEGAL RESPONSE LENGTH CHECK*/
                 err_exit("FINS length error");
if((fins_cmnd[3]!=fins_resp[6])||(fins_cmnd[4]!=fins_resp[7])
92
93
94
                        ||(fins_cmnd[5]!=fins_resp[8])){ /*DESTINATION ADDRESS CHECK*/
95
                       err_exit("illegal source address error");
96
97
                 if(fins_cmnd[9]!=fins_resp[9]) /*SID CHECK*/
98
                       err_exit("illegal SID error");
99
          }
100
101
102
          /*CLOSE SOCKET*/
103
          close(sockfd);
104 }
105 /*
106 * ERROR PROCESSING FUNCTIONS
107 */
108 err_exit(err_msg)
109 char
           *err_msg;
110 {
111
          printf("client: %s %x¥n",err_msg,errno);
112
          exit(1);
113 }
114
115 /*
116 *SIGNAL CAPTURE FUNCTIONS
117 */
118 recv_fail()
119 {
120
          printf("response timeout error \u00e4n");
121 }
```

5-4-4 Delays for Accessing PC Memory

The time for the response to be received after a remote node on the Ethernet network sends a memory area read or write command to a PC can be calculated using the following formula. This time does not take network transmission delays into account, so it may be extended under some operating conditions.

Write command delay time (ms) =

Remote node communications processing time + 4 + (0.011 x number of words written) + CPU cycle time + CPU data set processing time

Read command delay time (ms) =

Remote node communications processing time + 8 + (0.011 x number of words read) + CPU cycle time + CPU data read processing time

- **Note** 1. The transfer time may exceed the calculated value due to the actual operating environment. Factors affecting the transfer time are network traffic, the window size of each node, Ethernet Unit traffic (e.g., socket services, FTP server communications, etc.), and the system configuration.
 - 2. The CPU data set processing time is the standard when the peripheral service time is set in the CPU Unit System Setup to the default of 4%. As this value is increased, the processing time is shortened.

Example This example shows the calculations for a host computer sending a write command for 256 words to the PC. The standard for the maximum transfer delay time is as follows when the PC's CPU cycle time is 10 ms. Maximum transfer delay time

- = Host computer communications processing time + (0.011 x 256) + 10
- + (256 x 0.02 + 20) = host computer communications processing time + 42 ms

5-5 FINS Server

The following table shows the FINS commands that can be addressed to the Ethernet Units. The Ethernet Units automatically send responses for these commands. For details, refer to *Section 11 FINS Commands Addressed to Ethernet Units*.

MRC	SRC	Name
04	03	RESET
05	01	CONTROLLER DATA READ
06	01	CONTROLLER STATUS READ
08	01	INTERNODE ECHO TEST
	02	BROADCAST TEST RESULTS READ
	03	BROADCAST DATA SEND
21	02	ERROR LOG READ
	03	ERROR LOG CLEAR
27	01	UDP OPEN REQUEST
	02	UDP RECEIVE REQUEST
	03	UDP SEND REQUEST
	04	UDP CLOSE REQUEST
	10	PASSIVE TCP OPEN REQUEST
	11	ACTIVE TCP OPEN REQUEST
	12	TCP RECEIVE REQUEST
	13	TCP SEND REQUEST
	14	TCP CLOSE REQUEST
	20	PING
	50	IP ADDRESS TABLE WRITE
	60	IP ADDRESS TABLE READ
	61	IP ROUTER TABLE READ
	62	PROTOCOL STATUS READ
	63	MEMORY STATUS READ
	64	SOCKET STATUS READ
	65	ADDRESS INFORMATION READ

SECTION 6 Socket Services

This section describes the functionality provided by the Ethernet Unit via the socket services.

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6-1 Overview

6-1-1 Socket Service Functions

The socket services allow devices on the Ethernet to send and receive various data using the UDP or TCP protocol. The socket services can be used by CS1-series PCs through the user program by manipulating dedicated bits (called Socket Service Request Switches) or by executing the CMND(490) instruction.

The two methods of using the socket services are as follows:

- Dedicated Bits (Socket Service Request Switches) Requests can be made to a socket service by setting parameters and then merely manipulating specific Socket Service Request Switches.
- CMND(490)

Requests can be made to a socket service by sending service request commands to the Ethernet Unit.

Note One of the main differences between using Socket Service Request Switches and using CMND(490) is in the number of sockets that can be connected simultaneously, as shown in the following table.

Protocol	Socket Service Request Switches	CMND(490)		
UDP	Total of 8 sockets max.	8 sockets max.		
TCP		8 sockets max.		

Using Socket Service Request Switches



- **Note** 1. Socket Service Request Switches in the CPU Bus Unit Area in the CIO Area are used to send a service request from the CPU Unit to the Ethernet Unit.
 - 2. The Socket Service Parameters in the CPU Bus Unit Area in the DM Area are used to specify the service being requested from the Ethernet Unit. The CPU Bus Unit Area in the DM Area is also used to receive results of processing from the Ethernet Unit to the CPU Unit.

Using CMND(490)



Specific Socket Service Functions

The socket service functions listed in the following table can be executed either using Socket Service Request Switches or using CMND(490).

Protocol	Socket service request
UDP	Open UDP socket
	Receive via UDP socket
	Send via UDP socket
	Close UDP socket
TCP	Open TCP socket, passive
	Open TCP socket, active
	Receive via TCP socket
	Send via TCP socket
	Close TCP socket

6-1-2 Sockets

Sockets are interfaces that allow TCP and UDP protocols to be used directly from the user program. With personal computers, socket are provided as C language interface libraries, which allow TCP or UDP protocols to be programming using library functions. With UNIX computers, socket interfaces are supported in the form of system calls.

The CS1-series PCs support the socket service from the user program. The user program requests service functions either by manipulating Socket Service Request Switches in the CPU Bus Unit Area in the CIO Area or by sending FINS commands to the Ethernet Unit by executing CMND(490) instruction in the ladder diagram.

Socket communications services can be used to transfer arbitrary data between a PC and a host computer or between two PCs. The Ethernet supports two socket services: a UDP socket service and a TCP socket service. Refer to 2-1-3 Selecting Communications Services for a comparison of the socket services and the FINS communications service.

6-1-3 Using Sockets with the Ethernet Unit

The Ethernet Unit supports up to 16 simultaneous socket connections for the socket services, 8 each for UDP and TCP sockets. Socket numbers 1 to 8 are assigned to sockets for both UDP and TCP sockets. Sockets are managed from the ladder-diagram program by assigning a socket port for each socket number. The socket port number is assigned when the socket is opened.



6-1-4 Socket Port Numbers

Port numbers up to 1023 on a UNIX workstation can be used by the superuser only. Port numbers 0 to 255 are reserved for well-known ports. Consequently, port numbers 1024 and above should be used for socket services. The Ethernet Unit does not support port #0.

Some port numbers over 1024 may be reserved on some workstations (for example, the X-window server is port #6000). Do not use port numbers that are already reserved for other processes.

The setting status of the UNIX workstation port numbers can be checked in /etc/ services.

6-1-5 Differences between TCP and UDP

There are differences in the socket services between TCP and UDP.

TCP Communications The following procedure is followed each time data is transmitted to ensure that the data arrives normally at the remote node:

- 1, 2, 3... 1. The remote node returns ACK when data is received normally.
 - 2. The local node sends the next data after it receives ACK, or it resends the same data if ACK is not returned within the specified time.



Local node

With the TCP protocol, the remote IP address and remote TCP port number are specified when an open request is made for a socket. When a send request is made, the number of bytes to send and the send data are specified. When a receive request is made, the number of bytes to receive is specified.

With the TCP protocol, communications with another remote device are not possible until the socket that was opened has been closed.

UDP Communications

Data is simply sent to the remote. Unlike TCP, the reception of data is not checked and data is not resent. To increase communication reliability, data resends must be programmed by the user in user application.



Local node

Remote node

With the UDP protocol, the remote IP address and remote TCP port number are not specified when an open request is made for a socket. When a send request is made, the remote IP address, the remote TCP port number, the number of bytes to send, and the send data are specified. When a receive request is made, the number of bytes to receive is specified (the IP address and UDP port number from which data was received are provided in the response data).

With the UDP protocol, communications with another remote device are possible even if the socket that was opened is not closed.

6-1-6 Opening TCP Sockets

To achieve highly reliable data communications, TCP establishes a virtual communications circuit between the two nodes before starting data transmissions. The virtual communications circuit is known as a "connection."

Passive OPEN and Active OPEN

An open command is executed for a node to establish a connection. The open method differs depending on whether the node is a client or server. A passive open method is used to open the node as a server and the active open method is used to open the node as a client.



- Note 1. TCP sockets must be closed once a connection has been made before communications are possible with other TCP sockets. This is true for other server and client sockets. Up to eight TCP sockets can be open simultaneously.
 - 2. With UDP sockets, communications are possible with more than one other UDP socket even without closing the connection.
 - 3. When a connection is made between two nodes, the process at the node providing a service is called the server, and the process at the node requesting the service is called the client. The server is started first and waits for a service request from a client. The client requests to the server that a connection be opened and then transmits data. When the TCP protocol is used, however, the client–server relationship does not need to be programmed in the application because it is automatically handled by the protocol.

TCP Communications Procedure

The communications procedure is shown below for communications between a host computer and Ethernet Unit using a TCP socket. In this example, the host computer is the server and the Ethernet Unit is the client.



6-1-7 Fragmentation of Send Data

The Ethernet Unit fragments data for TCP transmission into units of 1,024 bytes and data for UDP transmission into units of 1,472 bytes. TCP requires one reception request to receive each unit of data. UDP, however, restores the original data before passing it to the user process, allowing all the data in a single transmission to be received with one reception request.

Cautions when Using TCP An example of the fragmentation and transmission of data using the TCP is shown in the following illustration.

- *1, 2, 3...* 1. The sending user program sends a request to send 1,984 bytes of data.
 - 2. The Ethernet Unit fragments the send data into Data A with 1,024 bytes and Data B with 960 bytes.
 - 3. Data A and Data B are sent consecutively.
 - 4. The receiving user program sends a request to receive 1,984 bytes of data. However, only data A is sent in the first packet, and data B is not received.
 - 5. Another receive request to receive data must be made before the remaining data, Data B, is received.



When using TCP protocol, the fragmented data is passed to the user program. Therefore, the receiving user program must be able to evaluate the end of the data transmission, and repeatedly send receive requests until all data has been received. The receive request is sent twice in the example shown above, but the data would be even more fragmented if a router was included in the communications path, and the number of receive requests would need to be increased accordingly.

When making the receive request, it is not necessary to specify the same data length as the sent data length. For example, if the length setting is shorter than the actual length of the data, all the data can be received by repeating the receive requests.

Note If communications are with a different segment and data is sent via the TCP protocol, data will be fragmented into units of 536 bytes.

Cautions when Using UDP An example of fragmentation and transmission of data using the UDP is shown in the following illustration.

- *1, 2, 3...* 1. The transmission user program sends a request to send 1,984 bytes of data.
 - 2. The Ethernet Unit fragments the send data into Data A with 1,472 bytes and Data B with 512 bytes.
 - 3. Data A and Data B are sent consecutively.

4. When the receiving user program sends a request to receive 1,984 bytes of data, Data A and Data B are linked to restore the original data, which is passed to the user program.



As shown above, the UDP protocol handles data communications as datagrams, so that the send data is restored to the original data before being passed to the user program. Consequently, if the data length in the receive request is set to the length of the send data, the entire data can be received using a single receive data request. However, if the data length in the receive data request is set smaller than the actual length of the data, all received data exceeding the set data length will be discarded.

6-1-8 Maximum Transmission Delays

The transmission delays for socket service is calculated as the sum of the communications processing times for both nodes.

Transmission delay = Remote node send processing time + Local node receive processing time + Local node send processing time + Remote node receive processing time

Calculate the maximum Ethernet Unit transmission delays for sending and receiving using the following formulas. These times are the same for both UDP and TCP.

Note The delay times calculated here ignore delays that can occur on the Ethernet network. Actual delays can be much longer depending on actual conditions on the network.

Delay Time for Socket Service using Socket Service Request Switches = Send processing time = receive processing time = PC cycle time x 14 + A (ms)

Delay Time for Socket Service using CMND(490)= Send processing time = receive processing time = PC cycle time x 5 + A x 2 + B (ms)

A is the lowest multiple of the PC cycle time that is greater than 20 ms.

B is the lowest multiple of the PC cycle time that is greater then 20 ms + 0.01 x number of send/receive bytes.

- **Note** 1. The formulas above calculate guideline figures for the transfer delays when the Ethernet Unit uses a single socket only. The user program execution time is not included in these calculations.
 - 2. The communications time for the remote node varies according to the equipment used. If the remote node is not an Ethernet Unit, refer to the documentation for the actual equipment to calculate the communications time.
 - 3. The delay times may exceed the calculated values due to the operating environment. Factors affecting the delay times are the network load ratio (amount of network traffic), the window size of each node, the load on the Ethernet Unit (including operating multiple socket services, FTP server, etc.), and the system configuration.
 - 4. The values for A and B given above are guideline values for when the peripheral service time in the PC Setup in the CPU Unit is set to the default value of 4%. If the peripheral service time setting is increased, the values of A and B will decrease.

Example

The following table shows calculation of the approximate maximum transfer delay for sending 512 bytes of data between two PCs using CMND(490) for a TCP socket.

Local PC cycle time: 5 ms Remote PC cycle time: 10 ms

Item	Formula
Local receive processing time	5 x 5 + 20 x 2 + 30 = 95 ms
Local send processing time	5 x 5 + 20 x 2 + 30 = 95 ms
Remote send processing time	10 x 5 + 20 x 2 + 30 = 95 ms
Remote receive processing time	10 x 5 + 20 x 2 + 30 = 95 ms
Maximum transmission delay	95 + 95 + 95 + 95 = 380 ms

6-1-9 Precautions in Using Socket Services

UDP and TCP Socket Services • If a short response monitor time is specified in CMND(490) control data and the Ethernet Unit is operating under a high load, a result may be stored even if the response code indicates a time-out. If this occurs, increase the monitor time specified with CMND(490).

	• The socket status area in the CIO Area is zeroed when the PC's operating mode is changed (e.g., from PROGRAM to RUN). The actual Ethernet Unit socket status, however, will remain unchanged after the socket status area is zeroed. To avoid this problem, use the IOM Hold setting in the PC Setup. Refer to the PC's operation manuals for details on settings.
	 The Results Storage Error Flag will turn ON in the socket status to indicate that the specified Results Storage Area does not exist in the PC. Correct the user program.
	• Communications time may increase if multiple Ethernet Unit functions are used simultaneously or due to the contents of the user program.
	• Communications efficiency may decrease due to high communications loads on the network.
	• All data is flushed from the socket's communications buffer when a socket is closed with the CLOSE REQUEST command. In some cases, the transmit data for the SEND REQUEST command issued just before the socket was closed may not be sent.
	• When sockets are open, the Ethernet Unit provides a 4,096-byte buffer for each TCP socket and 9,016-byte buffer for each UDP socket to allow data to be received at any time. These buffers are shared by all open sockets. Receive data will be discarded for a socket if the buffer becomes full. The user application must therefore issue RECEIVE REQUEST commands frequently enough to prevent the internal buffers from becoming full.
UDP Socket Service	• The UDP socket sets a broadcast address for the remote node address to broadcast data to all nodes of the network simultaneously. The maximum length of broadcast data is 1,472 bytes. Data in multiple fragments (over 1,473 bytes for a UDP socket) cannot be broadcast.
	• The UDP socket does not check the transmitted data to ensure communica- tions reliability. To increase communication reliability, communications checks and retries must be included in the user application program.
TCP Socket Service	 If the TCP socket of the remote node closes (the connection is broken) during communications, the TCP socket at the local node must also be closed. The communications Results Storage Area can be used to check if the connection has been broken. Close the local socket immediately after detecting that the remote TCP socket has closed. The following situations indicate that the re- mote socket has closed.
	TCP Receive Results Storage Area: Response code = 004B (error at remote node)
	TCP Send Results Storage Area: Response code = 0020 (connection broken with remote socket during trans- mission)
	• Data can remain in a buffer at the local node if the remote TCP socket closes during communications. Any data remaining in the buffer will be discarded when the TCP socket is closed. To avoid problems of this nature, steps will have to be taken in the application program, such as sending data to enable closing, and then only closing once reception of this data has been confirmed.
	 When closing a connection for a TCP socket, the first port to be closed cannot be reopened for at least 60 seconds after the other port closes. However, this restriction does not apply for a port opened using the TCP ACTIVE OPEN RE- QUEST command with a local TCP port number of 0 (port number automatical- ly assigned) which is closed from the side that actively opened the socket.
	• A connection is established for a passively opened socket by actively opening it from another socket. You cannot actively open multiple connections to a socket passively opened at the Ethernet Unit.

Precautions in Using Socket Service Request Switches

- The Ethernet Unit TCP sockets have no KEEP ALIVE function to check that the connection is normal if communications do not occur for a set time period through a communications line for which a connection has been established. The Ethernet Unit's TCP sockets make no checks to the socket at the other node. Checks made by the remote node, however, are received as responses, so that it is not necessary for the user program to consider the KEEP ALIVE function.
- Send and reception processing can not be performed at the same time when Socket Service Request Switches are used for socket services because there is only one Socket Service Parameter Area for each socket. For example, if the Send Request Switch is turned ON when data is being received, the response code will be 110C Hex, indicating that a Request Switch was turned ON during communications processing. (The response code for the reception will overwrite this code when processing has been completed.)
- If more than one Request Switch is turned ON simultaneously, the response code will be 110C Hex and all requested processing will end in an error.
- Close processing can be performed, however, even during open, send, or receive processing. This enables emergency close processing. Also, the only parameter required for close processing is the socket number, so a socket can be closed even when parameters are set for another process.

6-2 Using Socket Services with Socket Service Request Switches

Socket services can be used by setting the parameters in a Socket Service Parameter Area in the CPU Bus Unit Area and then turning ON a Socket Service Request Switch.

When using Socket Service Request Switches, a maximum of 8 sockets can be opened simultaneously for the UDP and TCP combined. Also, the same socket number cannot be used simultaneously for both UDP and TCP. (There is only one Socket Service Parameter Area for each socket, i.e., the same area must be used for both UDP and TCP.)

An illustration of using Socket Service Request Switches to execute socket services is provided below.



- **Note** 1. Socket Service Request Switches in the CPU Bus Unit Area in the CIO Area are used to send a service request from the CPU Unit to the Ethernet Unit.
 - 2. The Socket Service Parameters in the CPU Bus Unit Area in the DM Area are used to specify the service being requested from the Ethernet Unit. The CPU Bus Unit Area in the DM Area is also used to receive results of processing from the Ethernet Unit to the CPU Unit.

After setting the required parameters in a Socket Service Parameter Area in the CPU Bus Unit Area in the DM Area, the Socket Service Request Switches can be used to request opening, sending, receiving, or closing for either the UDP or TCP protocol. When requesting a send, send data at the send/receive data addresses set in the parameter area is sent. When requesting a reception, data is received to the send/receive data addresses set in the parameter area.

6-2-1 Socket Service Parameters

The Socket Service Parameter Areas in which parameters are set to request socket services is in the CPU Bus Unit Area in the DM Area of the CPU Unit. The Socket Service Parameter Areas are allocated as shown in the following diagrams. The first word of in the DM Area allocated to the Ethernet Unit as a CPU Bus Unit is referred to as "m" and is computed as follows:



m = D30000 + (100 x unit number)

The configuration of each of the Socket Service Parameter Areas is shown in the following diagram.

Offset	
+0	UDP/TCP socket number (0001 to 0008 Hex)
+1	Local UDP/TCP port number (0000 to FFFF Hex)
+2	Remote IP address (00000000 to FFFFFFF Hex)
+3	
+4	Remote UDP/TCP port number (0000 to FFFF Hex)
+5	Number of bytes to send/receive (0000 to 07C0 Hex)
+6	Send/receive data address
+7	
+8	Timeout value (0000 to FFFF Hex)
+9	Response code

Parameter Settings

The following table shows the parameters that are required for each service and the use of the parameters by the socket service.

UDP Socket Services

Parameter	No. of	Range	Socket service			
	words	(decimal values in paren- theses)	UDP open	UDP receive	UDP send	UDP close
UDP/TCP socket No.	1	0001 to 0008 Hex (1 to 8)	W	W	W	W
Local UDP/TCP port No.	1	0000 to FFFF Hex (0 to 65,535)	W			
Remote IP address	2	00000000 to FFFFFFF Hex (0.0.0.0 to 255.255.255.255		R	W	
Remote UDP/TCP port No.	1	0000 to FFFF Hex (0 to 65,535)		R	W	
Number of bytes to send/receive	2	0000 to 07C0 Hex (0 to 1,984 bytes)		RW	RW	
Send/Receive data address	1	Memory area address		W	W	
Time out time	1	0000 to FFFF Hex (0 to 65,535) (0: No limit, 0.1 to 6,553.5 s)		W		
Response code	1		R	R	R	R

Note W:

Written by user.

- RW: Written by user at execution and then read for results at completion
- R: Read by user for results at completion
- ---: Not used.

TCP Socket Services

Parameter	No. of	Range	Socket service				
	words	(decimal values in parentheses)	TCP passive open	TCP active open	TCP receive	TCP send	TCP close
UDP/TCP socket No.	1	0001 to 0008 Hex (1 to 8)	W	W	W	W	W
Local UDP/TCP port No.	1	0000 to FFFF Hex (0 to 65,535)	W	RW			
Remote IP address	2	00000000 to FFFFFFF Hex (0.0.0.0 to 255.255.255.255	RW	W			
Remote UDP/TCP port No.	1	0000 to FFFF Hex (0 to 65,535)	RW	W			
Number of bytes to send/receive	2	0000 to 07C0 Hex (0 to 1,984 bytes)			RW	RW	
Send/Receive data address	1	Memory area address			W	W	
Time out time	1	0000 to FFFF Hex (0 to 65,535) (0: No limit, 0.1 to 6,553.5 s)	W		W		
Response code	1		R	R	R	R	R

Note W:

Written by user.

- RW: Written by user at execution and then read for results at completion
- R: Read by user for results at completion
- ---: Not used.

UDP/TCP Socket No.

Specify the number of the UDP or TCP socket to open.
Local UDP/TCP Port No.

Specify the number of the UDP or TCP port for the socket to use for communications.

- Do not specify the port being used as the FINS UDP port (default: 9600) in an open request for a UDP socket.
- Do not specify FTP server TCP port numbers 20 and 21 in an open request for a TCP port.
- Do not specify mail communications TCP port number 25.
- As a rule, use port numbers 1,024 and higher.

If port number 0 is specified when for an active TCP open, the TCP port number will be automatically allocated and the number of the port that was opened will be stored in the local UDP/TCP port number in the Socket Service Parameter Area (i.e., the actual port number will be overwritten on the value of 0 set by the user).

Remote IP Address

Specify the IP address of the remote device.

- This parameter is not used when making a receive request for a UDP socket. The remote IP address will be stored with the response data and will be written as the Remote IP Address in the Socket Service Parameter Area.
- When opening a passive TCP socket, the combination of the remote IP address and the remote TCP port number can be used to affect processing as shown in the following table.

Remote IP Address	Remote TCP Port No.	Processing
0	0	All connection requests accepted.
0	Not 0	Connection requests accepted only for the same port number.
Not 0	0	Connection requests accepted only for the same IP address.
Not 0	Not 0	Connection requests accepted only for the same port number and IP address.

If the Remote IP Address is set to 0, a connection can be made to any remote node and the remote IP address of the node that is connected will be stored as the Remote IP Address in the Socket Service Parameter Area. If a specific remote I/O address is set, then a connection can be made only to the node with the specified address.

If the Remote TCP Port No. is set to 0, a connection can be made to any remote node regardless of the TCP port number it is using. If a specific remote TCP port number is set, then a connection can be made only to a node using the specified TCP port number.

Remote UDP/TCP Port No.

Specify the UDP or TCP port number used by the remote device.

- This parameter is not used when making a receive request for a UDP socket. The remote UDP/TCP port number will be stored with the response data and will be written as the Remote UDP/TCP Port No. in the Socket Service Parameter Area.
- When opening a passive TCP socket, the combination of the remote IP address and the remote TCP port number can be used to affect processing as shown in the table for the Remote IP Address, above. If the Remote UDP/TCP Port No. is set to 0, the UDP/TCP port number of the remote device will be written as the Remote UDP/TCP Port No. in the Socket Service Parameter Area.

Time Out Time

Set the time limit in units of 0.1 s for completion of communications from the time that the Send Request Switch is turned ON. A response code of 0080 Hex (timeout) will be stored if communications time out. If 0 is set, the requested service will not be timed.

Number of Bytes to Send/Receive

Send the number of bytes to be sent or the number of bytes to receive. When the transfer has been completed, the actual number of bytes that have been sent or received will be written here.

Send/Receive Data Address

Specify the address of the first word to send or the address of the first word where data is to be received. Always set the bit number to 00 Hex.

Offset	15	8	7		0
+7	Area designation			Leftmost 2 digits of word address	
+8	Rightmost 2 digits of word address			Bit number (always 00 Hex)	

The following specifications can be used.

Area		Word address	Area designation (Hex)	Word address (Hex)
CIO, HR,	CIO	0000 to 6143	B0	0000 to 17FF
and AR	HR	H000 to H511	B2	0000 to 01FF
Aleas	AR	A448 to A959	B3	01C0 to 03BF
DM Area	DM	D00000 to D32767	B2	0000 to 7FFF
EM Area	Bank 0	E0_00000 to E0_32767	A0	0000 to 7FFF
	:	:	:	:
	Bank C	EC_00000 to EC_32767	AC	0000 o 7FFF

6-2-2 Response Codes

When processing of a request has been completed for socket services executed using Socket Service Request Switches, a response code will be stored in the Response Code word in the Socket Service Parameter Area. The following response codes will be stored depending on the service that was requested.

UDP Socket Open Request

Response code	Meaning
0000	Normal end
0105	Local IP address setting error.
0302	CPU Unit error; cannot execute.
1100	UDP socket number is not 1 to 8 or local UDP port number is 0.
110C	Request Switch turned ON during other processing.
220F	Specified socket is already open.
2211	Unit is busy; cannot execute.
2606	Specified socket is already open as TCP socket; cannot open UDP socket.
2607	Specified Socket Service Parameter Area is already being used for another socket.
003E	Internal buffer cannot be obtained due to high reception traffic (ENOBUFS).

Response code	Meaning
0049	The same UDP port number has been specified more than once (EADDRINUSE).
0081	The specified socket was closed during open processing.

UDP Socket Receive Request

Response code	Meaning
0000	Normal end
0302	CPU Unit error; cannot execute.
1100	Number of bytes to receive is not in allowable range.
1101	The area designation of the Send/Receive Data Address is not in allowable range.
1103	The bit number in the Send/Receive Data Address is not 00.
110C	Request Switch turned ON during other processing.
220F	Specified socket is already processing a receive request.
2210	The specified socket is not open.
2211	Unit is busy; cannot execute.
2607	Specified Socket Service Parameter Area is already being used for another socket.
003E	Internal buffer cannot be obtained due to high reception traffic (ENOBUFS).
0066	Internal memory cannot be obtained; cannot execute.
0080	Reception request timeout
0081	The specified socket was closed during receive processing.

UDP Socket Send Request

Response code	Meaning
0000	Normal end
0302	CPU Unit error; cannot execute.
1100	Number of bytes to send is not in allowable range or the remote IP address is 0.
1101	The area designation of the Send/Receive Data Address is not in allowable range.
1103	The bit number in the Send/Receive Data Address is not 00.
110C	Request Switch turned ON during other processing.
220F	Specified socket is already processing a send request.
2210	The specified socket is not open.
2211	Unit is busy; cannot execute.
2607	Specified Socket Service Parameter Area is already being used for another socket.
003E	Internal buffer cannot be obtained due to high reception traffic (ENOBUFS).
0042	The remote IP address is a broadcast address and the number of bytes to send is greater than 1,472 bytes (EMSGSIZE).
004C	The network ID is incorrect or the remote IP address is incorrect (EADDRNOTAVAIL)
004E	The network ID is not in the IP router table, router settings are incorrect, or the remote IP address is incorrect (ENETUNREACH).
0051	The router settings are incorrect or the remote IP address is incorrect (EHOSTUNREACH).
0081	The specified socket was closed during send processing.

UDP Socket Close Request

Response code	Meaning
0000	Normal end
0302	CPU Unit error; cannot execute.
2210	The specified socket is not open.
2211	Unit is busy; cannot execute.
2607	Specified Socket Service Parameter Area is already being used for another socket.

TCP Socket Passive Open Request

Response code	Meaning
0000	Normal end
0105	Local IP address setting error.
0302	CPU Unit error; cannot execute.
1100	TCP socket number is not 1 to 8 or local TCP port number is 0.
110C	Request Switch turned ON during other processing.
220F	Specified socket is already open or already processing an open request.
2211	Unit is busy; cannot execute.
2606	Specified socket is already open as UDP socket; cannot open TCP socket.
2607	Specified Socket Service Parameter Area is already being used for another socket.
003E	Internal buffer cannot be obtained due to high reception traffic (ENOBUFS).
0042 (See note.)	The remote IP address is a broadcast address and the number of bytes to send is greater than 1,472 bytes (EMSGSIZE).
0045	Error in communications with remote node (ECONNABORTED).
0049	The same TCP port number has been specified more than once (EADDRINUSE).
004A (See note.)	Error (ECONNREFUSED).
004B (See note.)	Error in communications with remote node (ECONNRESET).
004E (See note.)	Remote IP address parameter error (ENETUNREACH).
0051 (See note.)	Remote IP address parameter error (EHOSTUNREACH).
0053	Error in communications with remote node (ETIMEDOUT) or remote node does not exist.
0066	Internal memory cannot be obtained; cannot execute.
0080	Open request timed out.
0081	The specified socket was closed during open processing.
0082	Connection could not be established with specified remote node.

Note These response codes will be returned only on large, multilevel networks.

TCP Socket Active Open Request

Response code	Meaning
0000	Normal end
0105	Local IP address setting error.
0302	CPU Unit error; cannot execute.
1100	TCP socket number is not 1 to 8 or local TCP port number is 0.

Response code	Meaning
110C	Request Switch turned ON during other processing.
220F	Specified socket is already open or already processing an open request.
2211	Unit is busy; cannot execute.
2606	Specified socket is already open as UDP socket; cannot open TCP socket.
2607	Specified Socket Service Parameter Area is already being used for another socket.
000D	Remote IP address parameter error (EACCES).
003E	Internal buffer cannot be obtained due to high reception traffic (ENOBUFS).
0042 (See note.)	Error (EMSGSIZE).
0044	ICMP data received (ENOPROTOOPT).
0045	Error in communications with remote node (ECONNABORTED).
0049	The same port number has been specified more than once (EADDRINUSE).
004A	Error (ECONNREFUSED) or the remote node has not been opened as passive socket.
004B (See note.)	Error in communications with remote node (ECONNRESET).
004C	Remote IP address parameter error (EADDRNOTAVAIL). Wrong parameter designation. An attempt was made to set the local TCP port of the local node to Active Open.
004E	Remote IP address parameter error (ENETUNREACH). The network ID is not in the IP router table or router settings are incorrect.
0051	Remote IP address parameter error (EHOSTUNREACH). The router settings are incorrect.
0053	Communications error with remote node (ETIMEDOUT). No remote node.
0081	The specified socket was closed during open processing.

Note These response codes will be returned only on large, multilevel networks.

TCP Socket Receive Request

Response code	Meaning
0000	Normal end
0302	CPU Unit error; cannot execute.
1100	Number of receive bytes not in allowable range.
1101	The area designation of the Send/Receive Data Address is not in allowable range.
1103	The bit number in the Send/Receive Data Address is not 00.
110C	Request Switch turned ON during other processing.
2210	The specified socket is not open.
220F	Specified socket is already processing a receive request.
2210	Specified socket has not been connected.
2211	Unit is busy; cannot execute.
2607	Specified Socket Service Parameter Area is already being used for another socket.
003E	Internal buffer cannot be obtained due to high reception traffic (ENOBUFS).

Response code	Meaning
0042 (See note.)	ICMP data received (EMSGSIZE).
0044 (See note.)	ICMP data received (ENOPROTOOPT).
0045 (See note.)	Error in communications with remote node (ECONNABORTED).
004B	Error in communications with remote node (ECONNRESET).
004E (See note.)	ICMP data received (ENETUNREACH).
004F (See note.)	ICMP data received (EHOSTDOWN).
0051 (See note.)	ICMP data received (EHOSTUNREACH).
0053	Error in communications with remote host (ETIMEDOUT).
0066	Internal memory cannot be obtained; cannot execute.
0080	Receive request timed out.
0081	The specified socket was closed during receive processing.

Note These response codes will be returned only on large, multilevel networks.

TCP Socket Send Request

Response code	Meaning
0000	Normal end
0302	CPU Unit error; cannot execute.
1100	Number of bytes to send not in allowable range.
1101	The area designation of the Send/Receive Data Address is not in allowable range.
1103	The bit number in the Send/Receive Data Address is not 00.
110C	Request Switch turned ON during other processing.
220F	Specified socket is already processing a send request.
2210	The specified socket is not open.
2211	Unit is busy; cannot execute.
2607	Specified Socket Service Parameter Area is already being used for another socket.
0020	Connection with remote socket broken during send (EPIPE).
003E	Internal buffer cannot be obtained due to high reception traffic (ENOBUFS).
0042 (See note.)	The remote IP address is a broadcast address and the number of bytes to send is greater than 1,472 bytes (EMSGSIZE).
0044 (See note.)	ICMP data received (ENOPROTOOPT).
0045 (See note.)	Error in communications with remote node (ECONNABORTED).
004A (See note.)	Error in communications with remote node (ECONNREFUSED)
004B (See note.)	Error in communications with remote node (ECONNREFUSED)
004E (See note.)	Remote IP address parameter error (ENETUNREACH).
004F (See note.)	ICMP data received (EHOSTDOWN).
0051 (See note.)	Remote IP address parameter error (EHOSTUNREACH).

Response code	Meaning
0053 (See note.)	Error in communications with remote node (ETIMEDOUT).
0081	The specified socket was closed during send processing.

Note These response codes will be returned only on large, multilevel networks.

TCP Socket Close Request

Response code	Meaning
0000	Normal end
2210	The specified socket is not open.
2211	Unit is busy; cannot execute.
2607	Specified Socket Service Parameter Area is already being used for another socket.
0302	CPU Unit error; cannot execute.

6-2-3 Socket Service Request Switches

Socket Service Request Switches are manipulated to request socket services. These bits are called Socket Service Request Switches, and are turned ON in the CPU Unit to request socket services through the Ethernet Unit.

The Socket Service Request Switches are allocated in the CPU Bus Unit Area in the CPU Area starting at the the word n+19. The value of n can be calculated from the unit number as follows:

n = 1500 + (25 x unit number)



The configuration of each set of Socket Service Request Switches is shown in the following diagram.



E	Bit	Switch	Status	Manipulated by	Unit operation
8	0	UDP Open	ON	User	UDP socket opened when switch is turned ON.
		Request Switch	OFF	Unit	Unit turns OFF switch when open processing has been completed (i.e., when a connection has been made).
9	1	TCP Passive Open	ON	User	Passive TCP socket opened when switch is turned ON.
		Request Switch	OFF	Unit	Unit turns OFF switch when open processing has been completed (i.e., when a connection has been made).
10	2	TCP Active Open	ON	User	Active TCP socket opened when switch is turned ON.
		Request Switch	OFF	Unit	Unit turns OFF switch when open processing has been completed (i.e., when a connection has been made)
11	3	Send Request Switch	ON	User	Send processing executed when switch is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.)
			OFF	Unit	Unit turns OFF switch when send processing has been completed.
12	4	Receive Request Switch	ON	User	Receive processing executed when switch is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.)
			OFF	Unit	Unit turns OFF switch when receive processing has been completed.
13	5 Close Request Switch		ON	User	Close processing executed when switch is turned ON. (The protocol (TCP/UDP) is determined when the socket is opened.)
			OFF	Unit	Unit turns OFF switch when close processing has been completed.

As shown in the above table, the Request Switches are turned OFF by the Ethernet Unit when the requested processes has been completed. The ladder diagram should be programmed to check the response code when the relevant Socket Service Request Switch turns OFF.

Note There is also a Socket Force-close Switch in bit 2 of the first word allocated to the Ethernet Unit in the CPU Bus Unit Area in the CIO Area. When the Socket Force-close Switch is turned ON, all sockets that are open will be force-closed. Refer to page 51 for details.

6-2-4 UDP/TCP Socket Status

The status of the UDP and TCP sockets is provided in the Socket Status Words shown in the following diagram. There is a status word for each socket for both UDP and TCP. The Socket Status Words are allocated in the CPU Bus Unit Area in the CPU Area starting at the the word n+ 1. The value of n can be calculated from the unit number as follows:

	15	8 7	0
n+1		UDP Socket No. 1 Status	
n+2		UDP Socket No. 2 Status	- 1
n+3		UDP Socket No. 3 Status	1
n+4		UDP Socket No. 4 Status	1
n+5		UDP Socket No. 5 Status	
n+6		UDP Socket No. 6 Status	- 1
n+7		UDP Socket No. 7 Status	1
n+8		UDP Socket No. 8 Status	
n+9		TCP Socket No. 1 Status	
n+10		TCP Socket No. 2 Status]
n+11		TCP Socket No. 3 Status	1
n+12		TCP Socket No. 4 Status	- 1
n+13		TCP Socket No. 5 Status	1
n+14		TCP Socket No. 6 Status	1
n+15	[TCP Socket No. 7 Status]
n+16		TCP Socket No. 8 Status	

n = 1500 + (25 x unit number)

The flags shown in the following diagram are provided in the Socket Status Words for socket service requests made with the Socket Service Request Switches.



Bit	Switch	Status	Manipulated by	Unit operation
0	Opening Flag	ON	Unit	Turns ON when an open request is received.
		OFF		Turns OFF when open processing has been completed.
1	Receiving Flag	ON		Turns ON when a receive request is received.
		OFF		Turns OFF when receive processing has been completed.
2	Sending Flag	ON		Turns ON when a send request is received.
		OFF		Turns OFF when send processing has been completed.
3	Closing Flag	ON		Turns ON when an close request is received.
		OFF		Turns OFF when close processing has been completed.
15	Socket Open Flag	ON		Turns ON when open processing has been completed (i.e., when a connection is made).
		OFF		Turns OFF when close processing has been completed. (Will remain OFF when open processing ends in an error.)

Note The TCP socket connection status is also provided as codes in the following words of the words allocated to the Ethernet Unit in the CPU Bus Unit Area in the

DM Area: D30000 + (100 x unit number) +9 to +16. Refer to *TCP Socket Connection Status* on page 58 and to *Appendix D TCP Status Transitions* for details.

6-2-5 Application Procedure

Procedure

1, 2, 3... 1. Set the socket service parameters in the CPU Bus Unit Area in the DM Area.



2. Turn ON the Socket Service Request Bits in the CPU Bus Unit Area in the CIO Area.



3. When a send or receive request is made, the data will be automatically sent or received according to the send/receive data address in the Socket Service Parameter Area. When processing has been completed, a response code will be automatically stored in the Socket Service Parameters.



Precautions

A Socket Service Parameter Area cannot be used for other sockets once open processing has been successfully completed for it. Check the socket status before attempting to open a socket. TCP socket status is provided in words m+9 to m+16 in the DM Area for sockets 1 to 8.

TCP Connection Status

The TCP connection status is provided for ports for which TCP sockets have been opened. When a port is closed, the previous status will remain in the DM

Area until a socket is opened again. Writing data to the DM Area, however, is not synced with writing to the Socket Status Areas, and timing may vary somewhat.



Status in indicated in bits 0 to 3 using the 1-digit hexadecimal codes shown in the following table.

Code	Status	Meaning
0	CLOSED	Connection closed.
1	LISTEN	Waiting for connection.
2	SYN SENT	Active and waiting for SYN.
3	SYN RECEIVED	SYN sent and received.
4	ESTABLISHED	Connection established.
5	CLOSE WAIT	FIN received and waiting for close.
6	FIN WAIT1	Finished and FIN sent.
7	CLOSING	Finished and FIN exchanged. Waiting for acknowledgement of FIN arrival.
8	LAST ACK	FIN received and finished. Waiting for acknowledgement of FIN arrival.
9	FIN WAIT2	FIN arrival acknowledged. Waiting for FIN.
A	TIME WAIT	Finished and waiting for silence for twice the maximum segment life (2MSL).

6-2-6 Socket Services and Socket Status

When using socket services, it is important to consider the timing of the status changes in the Socket Status Area. The diagram below shows a flowchart for opening UDP.

The flow is similar for other socket services. Replace the names of the appropriate flags in the flowchart to adapt it to other socket services.



6-2-7 Timing Charts

The timing of flags for socket services (Opening, Receiving, Sending, or Closing Flag) when the Request Switches are used and the changes in the response code are shown in the following chart.



Closing during Other Processes

The Close Request Switch or Force-close Switch can be used to close a socket even when open, receive, or send processing is being executed. Closing is the only other process that is possible during other processes.

Close Request Switch

The processing results are stored as the response code when the Close Request Switch is used. There will always be one PC cycle time between turning OFF the Request Switch for the canceled process and turning of the Close Request Switch, allowing time for the response code to be read.



Note The Open Flag will not turn ON at all if a close request is made during open processing.

Force-close Switch

The requested processes are canceled and an response code is stored when the Force-close Switch is used.



Note The Open Flag will not turn ON at all if a force-close request is made during open processing.

6-2-8 TCP/IP Communications Programming Example

The following programming example illustrates transferring 100 bytes of data between an Ethernet Unit and a host computer using TCP/IP communications.

System Configuration The programming example uses the following system configuration. For the TCP connection, the Ethernet Unit uses a passive open and the host computer uses an active open.



Data Flow

The data will flow between the CPU Unit, Ethernet Unit, and host computer as shown in the following diagram.



Note Here, "execution bits" refer to CIO 000000 to CIO 000003, which are used in the ladder diagram to control execution of communications.

Basic Operations

- CIO 000000 is turned ON to request opening a TCP socket from the Ethernet Unit.
- CIO 000001 is turned ON to request closing the TCP socket from the Ethernet Unit.
- CIO 000002 is turned ON to request sending data from the Ethernet Unit. Data (100 bytes) is sent beginning at D00000.
- CIO 000003 is turned ON to request receiving data from the Ethernet Unit. The data that is received (100 bytes) is stored beginning at D01000.
- One of the bits between CIO 000100 and CIO 000103 will turn ON if an error occurs. Refer to 6-2-2 Response Codes for information on errors.

Program Memory Map

The send and receive data and bits (flags) used by the program are shown in the following diagram.

DM Area



CIO Area

The following bits and flags are used to control CMND(490) execution. The bits in CIO 0000 are used to signal execution, the bits in CIO 0001 are used to signal errors, and the bits in CIO 0002 are used to control the program so that the instruction is executed only once.

	15	to 8	7	6	5	4	3	2	1	0
CIO 0000							TCP Receive Bit	TCP Send Bit	TCP Close Bit	TCP Open Bit
CIO 0001							TCP Receive Error Flag	TCP Send Error Flag	TCP Close Error Flag	TCP Open Error Flag
CIO 0002							TCP Receiving Flag	TCP Sending Flag	TCP Closing Flag	TCP Opening Flag

Programming Example

000000		TCP Passivo Opon
	@RSET	When the TCP Open Bit (CIO 000000) turns ON, the TCP
	000100	Open Error Flag (CIO 000100) is turned OFF and the TCP
	@SET	Opening Flag (CIO 000200) is turned ON to initialize pro-
	000200	oooling.
000000 000200		When the TCR Opening Flag (CIO 000200) turne ON, the
	MOV(21)	following parameters are written to the parameter area for
	#0001	socket number 1.
	D30018	D30018: 0001 Hex = UDP/TCP socket No. 1
	MOV(21)	D30020 and D30021:
	#1000	C424 2037 Hex =
	D30019	D30022: 0000 Hex = Any remote UDP/TCP port No.
	MOV(21)	D30026: 0000 Hex = No timeout time
	#C424	
	D30020	
	MOV(21)	
	#2037	
	D30021	
	MOV(21)	
	#0000	
	D30022	
	MOV(21)	
	#0000	
	D30026	
000000 000200		
	SEI	After the parameters have been set, the TCP Passive
	151901	Den Request Switch (CIO 151901) is turned ON and the TCP Opening Flag (CIO 000200) is turned OFF
	RSET	
	000200	If the TCP Passive Open Request Switch (CIO 151901)
		turns OFF while the TCP Opening Flag (CIO 000200) is
	000100	OFF, the contents of the response code (D30027) in the
130027	000100	0000 Hex (normal end), the TCP Open Error Flag (CIO
000000 000200 151901 #0000		000100) is turned ON.
	RSET	After the execution results have been checked, the TCP
	000000	Open Bit (CIO 000000) is turned OFF.
	@RSFT	TCP Close
	000101	When the TCP Close Bit (CIO 000001) turns ON, the TCP
		Closing Flag (CIO 000201) is turned ON to initialize proces-
	@SET	sing.
	000201	
000001 000201		
├──┤┝───┤├────	MOV(21)	When the TCP Closing Flag (CIO 000201) turns ON, the following parameter is written to the parameter area for
	#0001	socket number 1.
	D30018	D30018: 0001 Hex = UDP/TCP socket No. 1
000001 000201		After the parameter has been set, the Close Request
	I SEI	Switch (CIO 151905) is turned ON and the TCP Closing
	151905	Flay (CIO 000201) is turned OFF.
	RSET	the TCP Opening Flag (CIO 000201) is OFF, the contents
	000201	of the response code (D30027) in the Socket Service Pa-
t Continued on pout page		rameter Area is checked, and if it is not 0000 Hex (normal end) the TCP Close Error Eleg (CIO 000101) is turned ON
Conunded on next page.		

After the execution results have been checked, the TCP Close Bit (CIO 000001) is turned OFF.

Using Socket Services with Socket Service Request Switches

Section 6-2

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6-2-9 UDP/IP Communications Programming Example

The following programming example illustrates transferring 100 bytes of data between an Ethernet Unit and a host computer using UDP/IP communications.

System Configuration

The programming example uses the following system configuration.



Basic Operations

- CIO 000000 is turned ON to request opening a UDP socket from the Ethernet Unit.
- CIO 000001 is turned ON to request closing the UDP socket from the Ethernet Unit.
- CIO 000002 is turned ON to request sending data from the Ethernet Unit.

- CIO 000003 is turned ON to request receiving data from the Ethernet Unit. The data that is received (100 bytes) is stored beginning at D01000.
- One of the bits between CIO 000100 and CIO 000103 will turn ON if an error occurs. Refer to 6-2-2 Response Codes for information on errors.

Program Memory Map

The send and receive data and bits (flags) used by the program are shown in the following diagram.

DM Area



CIO Area

The following bits and flags are used to control CMND(490) execution. The bits in CIO 0000 are used to signal execution, the bits in CIO 0001 are used to signal errors, and the bits in CIO 0002 are used to control the program so that the instruction is executed only once.

	15	to 8	7	6	5	4	3	2	1	0
CIO 0000							TCP Receive Bit	TCP Send Bit	TCP Close Bit	TCP Open Bit
CIO 0001							TCP Receive Error Flag	TCP Send Error Flag	TCP Close Error Flag	TCP Open Error Flag
CIO 0002							TCP Receiving Flag	TCP Sending Flag	TCP Closing Flag	TCP Opening Flag

Programming Example



Continued on next page.

Using Socket Services with Socket Service Request Switches



Continued on next page.

Using Socket Services with Socket Service Request Switches

Section 6-2



6-3 Using Socket Services with CMND(490)

Service request commands can be sent to the Ethernet Unit by executing the CMND(490) instruction in the ladder diagram. The CS1 Ethernet Unit supports the same functionality as the CV-series Ethernet Unit, so heritage programs can be easily corrected and reused.

Up to 16 sockets can be connected using CMND(490): 8 UDP sockets and 8 TCP sockets.

The socket service request commands that can be used are listed in the following table. Refer to Section 11 FINS Commands Addressed to Ethernet Units for details on these commands.

Command code		Name
MRC	SRC	
27	01	UDP OPEN REQUEST
	02	UDP RECEIVE REQUEST
	03	UDP SEND REQUEST
	04	UDP CLOSE REQUEST
10TCP PASSIVE OF11TCP ACTIVE OP		TCP PASSIVE OPEN REQUEST
		TCP ACTIVE OPEN REQUEST
	12	TCP RECEIVE REQUEST
	13	TCP SEND REQUEST
	14	TCP CLOSE REQUEST

Requests sent to the Ethernet Unit by sending commands through execution of CMND(40), and when the Unit receives a command, it will return a response. The response does not, however, indicate that processing has been completed, and the status of the flags in the Socket Status Words allocated to the Unit must be used to determine when processing has been completed.

The results of processing will be stored in the words specified when CMND(490) was executed once the requested processing has been completed.

Basic FINS Command Format

The basic format for FINS commands used for socket services is shown in the following diagram.



Command Code:

Specifies the process code requested from the socket.

Socket Number

Specifies the socket number for the process, between 1 and 8.

Results Storage Area

Specifies the area to store the results of the requested process.

Parameters

Specifies the parameters defined for the command code.

Note If there is more than one Communications Unit mounted to the PC, the FINS network address must be set as a parameter for CMND(490) and a local network table must be created in the routing tables from the CX-Programmer.

6-3-1 UDP/TCP Socket Status

The status of the UDP and TCP sockets is provided in the Socket Status Words shown in the following diagram. There is a status word for each socket for both UDP and TCP. The Socket Status Words are allocated in the CPU Bus Unit Area in the CPU Area starting at the the word n+ 1. The value of n can be calculated from the unit number as follows:

n = 1500 + (25 x unit number)

	15	8 7	0
n+1		UDP Socket No. 1 Status	
n+2		UDP Socket No. 2 Status	
n+3		UDP Socket No. 3 Status	
n+4		UDP Socket No. 4 Status	-]
n+5		UDP Socket No. 5 Status]
n+6		UDP Socket No. 6 Status	
n+7		UDP Socket No. 7 Status	- 1
n+8		UDP Socket No. 8 Status]
n+9		TCP Socket No. 1 Status	
n+10		TCP Socket No. 2 Status	-]
n+11		TCP Socket No. 3 Status	
n+12		TCP Socket No. 4 Status	
n+13		TCP Socket No. 5 Status	- 1
n+14		TCP Socket No. 6 Status	- 1
n+15		TCP Socket No. 7 Status	
n+16	[TCP Socket No. 8 Status	-]

The flags shown in the following diagram are provided in the Socket Status Words for socket service requests made with CMND(490).



Bit	Flag	Status	Manipulated by	Unit operation
0	Opening Flag	ON	Unit	Turns ON when an open request is received.
		OFF		Turns OFF when open processing has been completed.
1	Receiving Flag	ON		Turns ON when a receive request is received.
		OFF		Turns OFF when receive processing has been completed.
2	Sending Flag	ON		Turns ON when a send request is received.
		OFF		Turns OFF when send processing has been completed.
3	Closing Flag	ON		Turns ON when an close request is received.
		OFF		Turns OFF when close processing has been completed.
14	Results Storage Error Flag	ON	Unit	Turns ON when there is an error in the Results Storage Area specified for the service request command to the Ethernet Unit. This flag will turn ON at the same timing as turning OFF bits 0 to 3 (i.e., at completion of processing).
		OFF]	Turns OFF when the next request is received for processing.

Bit	Flag	Status	Manipulated by	Unit operation
15	Socket Open Flag	ON	Unit	Turns ON when open processing has been completed (i.e., when a connection is made).
		OFF		Turns OFF when close processing has been completed. (Will remain OFF when open processing ends in an error.)

Note The TCP socket connection status is also provided as codes in the following words of the words allocated to the Ethernet Unit in the CPU Bus Unit Area in the DM Area: D30000 + (100 x unit number) +9 to +16. Refer to *TCP Socket Connection Status* on page 58 and to *Appendix D TCP Status Transitions* for details.

Response Codes in the Command Response

A response code is returned in the command response as a 2-byte code that indicates the results of command execution. The response code is returned just after the command code in the response. The first byte of the response code provides the overall result of command execution and is called the main response code (MRES). The second byte provides details and is called the sub-response code (SRES).

Response Codes in the Results Storage Areas

The response code stored in the Results Storage Area is a 2-byte code that indicates the processing results of the socket service requested by the command. This response code is stored in the Results Storage Area when processing has been completed.

Using Socket Service

Each Ethernet Unit has eight TCP sockets and eight UDP sockets. Open, close, send, and receive processes are available for communications with sockets.

Open

Enables communications on a specified socket. A socket must be opened before it can be used for socket services. Opening a TCP socket establishes a connection.

Close

Ends use of the socket. Breaks the connection for a TCP socket.

Send

Sends data from a specified open socket.

Receive

Specifies an open socket and receives data from that socket.

These processes are carried out by sending FINS commands to the Ethernet Unit. The process from sending a request for processing to completion is shown in the following illustrations.

1, 2, 3... 1. Execute a socket service request command (MRC: 27) for the Ethernet Unit using CMND(490).



2. CMND(490) ends normally when the socket service request command is received and a response is returned (response code: 0000).



3. The Ethernet Unit starts the process requested by the parameters in the socket service request command.



4. When the process has been completed, the result is stored in the results storage area defined in the socket service request command and the socket status will indicate completion of processing.



6-3-2 Socket Services and Socket Status

When using socket services, it is important to consider the timing of the status changes in the socket status area. The diagram below shows a program flow-chart for opening UDP.

Program flow is similar for other socket services. Replace the names of the appropriate flags in the flowchart to adapt it to other socket services.



6-3-3 Communications Timing Chart

The timing of the status changes of the bits in the socket status area and the Port Enabled Flag is shown in the following diagram.



6-3-4 Socket Service Timing Chart

The timing of the socket service open, send, receive, and close request commands are shown in the following diagrams.



Using Socket Services with CMND(490)

SEND REQUEST

Port Enabled Flag	1 - 0		Running		Running		
CMND(490) response code	-			Error res	ponse code	Normal respo	onse code
		1	1	1			
Send Flag	1 0	 	 	1			
Opening Flag	1 ⁻ 0	1	1	1	1		
Results storage area	-				 	/	Store normal response code
	SEN corr	ND REQUE	EST Err eived end	or SEND d comma	REQUEST and received	Send cor (normal e	mplete end)
RECEIVE REQUEST							
Port Enabled Flag	1 0		Running		Running		
CMND(490) response code			1 1 1	Error resp	onse code	Normal res	sponse code
Receive Flag	1 0		1 1 1	1 1 1			
Opening Flag	1 0			 	1 1 1 1		
Results storage area			1	1 1 1	1		Store normal response code
	REC comr	EIVE REQ nand recei	UEST Ei ved er	rror RECEI nd comma	VE REQUEST	Receive ((normal e	complete and)
CLOSE REQUEST during	g RE		REQUEST				
RECEI	VE R	EQUEST	command rece	eived CLO		command rece	pived
Port Enabled Flag	1 - 0		Running		Running		
CMND(490) (RECEIVE REQUEST) response command	-			Normal res	sponse code		
CMND(490) (CLOSE REQUEST) response command	-		(Normal respo	nse code
Receive Flag	1 0 _)			
Close Flag	1 0 –					(
Opening Flag	1 ⁻ 0						
Results storage area for RECEIVE REQUEST	_					Sto	pre error response code
Results storage area for	-						Store normal response code

Note The timing shown in the above diagram occurs if a CLOSE REQUEST command is executed during SEND REQUEST command execution. The timing

CLOSE REQUEST

shown in the diagram also applies if a CLOSE REQUEST command is executed during OPEN REQUEST command execution, with the exception of the status of the Opening Flag.

6-3-5 TCP/IP Communications Programming Example

The following programming example illustrates transferring 100 bytes of data between an Ethernet Unit and a host computer using TCP/IP communications.

System Configuration

The system configuration for the program example and the Ethernet Unit system setup are shown below. To establish a TCP connection, the Ethernet Unit is passively opened and the host computer actively opened.



Data Flow

The data will flow between the CPU Unit, Ethernet Unit, and host computer as shown in the following diagram.



Note Here, "execution bits" refer to CIO 000000 to CIO 000003, which are used in the ladder diagram to control execution of communications and are not system flags, such as the Port Enabled Flags (A20200 to A20207).

Basic Operations

- CIO 000000 is turned ON to request opening a passive TCP socket from the Ethernet Unit.
- CIO 000001 is turned ON to request closing the TCP socket from the Ethernet Unit.
- CIO 000002 is turned ON to request sending data from the Ethernet Unit. Data (100 bytes) is sent beginning at D02005.
- CIO 000003 is turned ON to request receiving data from the Ethernet Unit. The data that is received (100 bytes) is stored beginning at D04022.

 One of the bits between CIO 000100 and CIO 000103 will turn ON if an error occurs. Refer to 6-2-2 Response Codes for information on errors. The following areas can be used to access details about errors:

CMND(490) response codes Response codes in results storage area Network Communications Error Flags (A21900 to A21907) Completion codes (A203 to A210)

Program Memory Maps

The send and receive data and bits (flags) used by the program are shown in the following diagrams. The following example shows how the memory maps are structured.

Legend

Describes the meaning of the data. 0 1 2 CMND(490) control data D0000 0012H 0004H 0001H 00

Indicates the contents of D00001 is 0004 Hex. Indicates the contents of D00000 is 0012 Hex.

	15	to 8	7	6	5	4	3	2	1	0)
CIO 0000							TCP Receive Bit	TCP Send Bit	TCP Close Bit	TCI Ope Bit	P en

Indicates that CIO 000001 is used as the TCP Close Bit.

Indicates that CIO 000000 is used as the TCP Open Bit.

DM Area

	0	1	2	3	4	5	6	7	8	9
D00000	CMN	D(490) o	control d	ata for T	CP PAS	SIVE OF		QUEST	1	
	0012H	0004H	0001H	0110H	0000H	0032H				
		Num	- Numbe ber of by	Ren Network Nod Unit r bytes t /tes to se	note Eth work add le numbe address o receive end: 18	Port nur ernet Un dress: 01 er: 01 _{hex} s: 10 _{hex} e: 4 byte (0012 _{hex}	Respons mber: Po it desigr hex s	se monit ort #0 nation	or time:	5 s
	0	1	2	3	4	5	6	7	8	9
D00010	CMN	D(490) o	control d	ata for T	CP CLC		UEST			
	0008H	0004H	0001H	0110H	0000H	0032H				

Number bytes to receive: 4 bytes

Number of bytes to send: 8 bytes

	0		1	2	3	4	5	6	7	8	9
D00020	CN	/NE	D(490) d	control d	ata for T	CP SEN	ID REQI	JEST			
	006E	н	0004H	0001H	0110H	0000H	0032H				
				Numbor	hytes to	rocoivo	· 1 hytos				

Number of bytes to send: 110 (006E_{hex}) bytes

Command format = 10 bytes + 100 bytes send data

	0	1	2	3	4	5	6	7	8	9
D00030	CMN	l D(490) c	control d	ata for T	CP REC	EIVE RI		Γ Γ	1	
	000CH	0004H	0001H	0110H	0000H	0032H				

Number bytes to receive: 4 bytes

—— Number of bytes to send: 12 bytes (000C_{hex})

Number of bytes received specified in command data.



	0	1	2	3	4	5	6	7	8	9
D01010	TCP	PASSIV	E OPEN	N REQU	EST res	ponse				
DOTOTO	2710H	Re- sponse code								

Stores the response after command execution.

	0	1	2	3	4	5	6	7	8	9
D01020	TCP F Re- sponse code	PASSIVE Remo addre	OPEN ote IP ess	REQUE Remote TCP port No.	ST resu	lts stora	ge area			

	0	1	2	3	4	5	6	7	8	9
D1030	TCP	CLOSE	REQUE	ST com	mand da	ta				
	2714H	0001H	8204H	1A00H						
			тс	P socket	- Result t numbe	s storage to close	e area: s e: set to	et to D0 1 (0001 ₁	1050 (04 nex)	41A _{hex})
		— Co	mmand	code				, ,		

	0	1	2	3	4	5	6	7	8	9			
D01040	TCP C	LOSE R	EQUES	T respoi	nse								
	2714H	sponse code											
D01050	TCP C Re-	LOSE F	EQUES	T results	s storage	e area							
	code	<u> </u>											
	1	1								1			
	0	1	2	3	4	5	6	7	8	9			
D02000	TCP	SEND R	EQUES	T comma	and data	 							
	2713H	0001H	820BH	C200H	0064H	Se	end data	: 100 by	tes (006	4 _{hex})			
		No. of send bytes: 100 bytes (0064 _{he}) Results storage area: set to D03010 (0BC2 _{hex}) TCP socket number											

	0	1	2	3	4	5	6	7	8	9
D03000	TCP SEND REQUEST response									
	2713H	sponse	<u> </u>							
D03010	TCP SEND REQUEST results storage area									
	sponse code	bytes sent								

	C)	1	2	3	4	5		6	7	8	9	
D04000	TCP RECEIVE REQU			EST con	 nmanc	l data							
	2712H 000		0001H	820FH	B400H	0064	н 000	ЭН					
No. c									Tin D. of byte e area: S	meout va es to rec Set to D(alue: Not eive: 10 04020 (0	: set 0 bytes (FB4 _{hex})	0064 _{hex})
	TCP socket number												
Command code													

	0	1	2	3	4	5	6	7	8	9
D04010	TCP F	RECEIVI	E REQU	EST res	ponse					
	2712H	sponse code								
D04020	TCP F Re- sponse code	RECEIVI No. of bytes received	E REQU	EST res	ults stor	age area data: 100	a) bytes (0064 _{hex}))	

CIO Area

The following bits and flags are used to control CMND(490) execution. The bits in CIO 0000 are used to signal execution, the bits in CIO 0001 are used to signal errors, and the bits in CIO 0002 are used to control the program so that the instruction is executed only once.

	15	to 8	7	6	5	4	3	2	1	0
CIO 0000							TCP Receive Bit	TCP Send Bit	TCP Close Bit	TCP Open Bit
CIO 0001							TCP Receive Error Flag	TCP Send Error Flag	TCP Close Error Flag	TCP Open Error Flag
CIO 0002							TCP Receiving Flag	TCP Sending Flag	TCP Closing Flag	TCP Opening Flag

Programming Example




6-3-6 UDP/IP Communications Programming Example

The following programming example illustrates transferring 100 bytes of data between an Ethernet Unit and a host computer using UDP/IP communications.

System Configuration

The system configuration for the program example and the Ethernet Unit system setup are shown below.



Basic Operations

- CIO 000000 is turned ON to request opening a UDP socket from the Ethernet Unit.
- CIO 000001 is turned ON to request closing the UDP socket from the Ethernet Unit.
- CIO 000002 is turned ON to request sending data from the Ethernet Unit. Data (100 bytes) is sent beginning at D02008.
- CIO 000003 is turned ON to request receiving data from the Ethernet Unit. The data that is received (100 bytes) is stored beginning at D04025.
- One of the bits between CIO 000100 and CIO 000103 will turn ON if an error occurs. Refer to 6-2-2 Response Codes for information on errors. The following areas can be used to access details about errors:

CMND(490) response codes Response codes in results storage area Network Communications Error Flags (A21900 to A21907) Completion codes (A203 to A210)

Program Memory Maps

The send and receive data and bits (flags) used by the program are shown in the following diagrams.

DM Area



Using Socket Services with CMND(490)

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	0	1	2	3	4	5	6	7	8	9
D00010	CMND(490) control data for UDP CLOSE REQUEST									
	0008H 0004H		0001H	0110H	0000H	0032H				

Number bytes to receive: 4 bytes

Number of bytes to send: 8 bytes

	0	1	2	3	4	5	6	7	8	9			
D00020	CMN	CMND(490) control data for UDP SEND REQUEST											
	0074H	0004H	0001H	0110H	0000H	0032H							

Number bytes to receive: 4 bytes

Number of bytes to send: 114 (0072_{hex}) bytes Command format = 14 bytes + 100 bytes send data

	0	1	2	3	4	5	6	7	8	9			
D00030	CMN	CMND(490) control data for UDP RECEIVE REQUEST											
	000CH	0004H	0001H	0110H	0000H	0032H							

L - Number bytes to receive: 4 bytes

- Number of bytes to send: 12 bytes (000Chex)

Number of bytes received is specified in command data.

	0		1		2		3		4		5	6		7	8	9
D01000	UDP OPEN REQUEST command data															
	270 ²	1H	0001	Н	8203	3H	FC0	он	100	он						

Local port number: set to 4096 (1000_{hex}) Results storage area: set to D01020 (03FChex) (Refer to page 192 for details on formats for socket services) UDP socket number (Ethernet Unit socket number): set to 1

Command code

	0	1	2	3	4	5	6	7	8	9
D01010	UDP C	PEN re	sponse							
DOTOTO		Re-								
	2701H	sponse								
		code								

Stores the response after command execution.

	0	1	2	3	4	5	6	7	8	9
D01020	UDP Re- sponse code		EQUES	T results	s storage	e area				

	()	1	I	2	3	4	5	6	7	8	9
D1030	UDP CLOSE REQUEST command data											
	270)4H	000)1H	8204H	1A00H						

 Results storage area: set to D01050 (041A_{hex}) UDP socket number closed: set to 1 (0001hex) Command code

	0	1	2	3	4	5	6	7	8	9
D01040	UDP C	LOSE F	REQUES	T respo	nse					
001040		Re-								
	2704H	sponse code								
D01050	UDP C	LOSE F	REQUES	T result	s storag	e area				
D01050	Re-				l					
	sponse code									

	0		1	2	3	4	5	6	7	8	9	
D02000	UDF	SEN	ID R	EQUES	T comma	and data						
	2703H	1 00	01H	820BH	C200H	C424H	2037H	1000H	0064H			
									- - -	lo. of se	nd bytes	s: 100 bytes (0064 _{hex})
									- Remote	e port: P	ort #409	6 (1000 _{hex})
								Remo	te addres	ss: 196.3	36.32.55	
						I		⁻ (C4 _{hex}	.24 _{hex} .2	0 _{hex} .37 _h	ex)	
						 Result 	is storag	e area:	Set to D	03010 (0	BC2 _{hex}))
				— U	OP socke	et numbe	er					
			– C	ommand	l code							

	0	1	2	3	4	5	6	7	8	9
D03000	UDP	SEND R Re-	EQUES	T respor	ise					
	2703H	sponse code								
D03010	UDP S Re- sponse code	SEND R No. of send bytes	EQUES	T results	storage	area				

		0	1	2	3	4	5	6	7	8	9
	D04000	UDP	RECEIV	E REQU	EST cor	nmand o	data				
		2702H	0001H	820FH	B400H	0064H	0000H				
Timeout value: No. of bytes to receive: 1 Results storage area: set to D04020											t set 0 bytes (FB4 _{hex})
UDP socket number used											

	0	1	2	3	4	5	6	7	8	9
D04010	UDP I	RECEIV	E REQU	EST res	ponse					
	2702H	sponse code								
D04020	UDP I Re- sponse code	RECEIV Sour addr	E REQU ce IP ess	EST res Source port number	ults stor No. of bytes to receive	age area R	a eceive da	 ata: 100 b 	ytes (006	4 _{hex})

CIO Area

The following bits and flags are used to control CMND(490) execution. The bits in CIO 0000 are used to signal execution, the bits in CIO 0001 are used to signal errors, and the bits in CIO 0002 are used to control the program so that the instruction is executed only once.

	15	to 8	7	6	5	4	3	2	1	0
CIO 0000							UDP Receive Bit	UDP Send Bit	UDP Close Bit	UDP Open Bit
CIO 0001							UDP Receive Error Flag	UDP Send Error Flag	UDP Close Error Flag	UDP Open Error Flag
CIO 0002							UDP Receiving Flag	UDP Sending Flag	UDP Closing Flag	UDP Opening Flag

Programming Example





SECTION 7 FTP Server

This section describes the functions provided by the FTP server.

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7-1 Overview

The Ethernet Unit supports the server functions of FTP (file transfer protocol), a standard protocol in TCP/IP. A host computer functioning as an FTP client on the Ethernet can read or write individual files in a Memory Card mounted to the CPU Unit or in EM file memory.

Only one FTP client can connect at the same time.



Note The PC, however, is unable to read or write files at other nodes using FTP because the Ethernet Unit does not support FTP client functions.

File System

The file system in the CPU Unit that can be accessed by the Ethernet Unit includes files in any Memory Card mounted in the CPU Unit and files in EM file memory. The directory tree is shown below.



A connection will be initially made to the root directory.

- **Note** 1. The date of the MEMCARD directory displayed for ls or dir commands in the root directory will be the date of the file system volume label.
 - 2. The login date will be displayed for EM files and for MEMCARD if a volume label has not been created.

Connecting to the FTP Server

The host computer must connect to the FTP server before the FTP server functions can be used. The login name and password set in the CPU Bus Unit Setup will be used when connecting (Refer to *4-2 CPU Bus Unit System Setup*.)

The FTP server in the Ethernet Unit can connect to only one client at a time. If a client attempts to connect when the FTP server is in use, a message will be returned and connection will be refused.

Login Messages

Status	Message		
Normal connection	220 xxx.xx.xx.xx CS1W-ETN01 FTP server (FTP Version y-yy) ready.		
	xxx.xx.xx: IP address of Ethernet Unit y.yy: Firmware version of Ethernet Unit		
FTP server busy	221 FTP server busy, Goodbye.		

7-2 Setting Login Names and Passwords

The default FTP login name is "CONFIDENTIAL" and no password is required. Login is completed by typing only "CONFIDENTIAL". A different login name and a password can be set as required using the CPU Bus Unit Setup.

Setting Restrictions		The following restrictions apply to login names and passwords.
		• The login name and password must consist of alphanumeric characters, hyphens, and/or underscores. They are not case sensitive.
		 A login name consists of 12 characters.
		 A password consists of 8 characters.
		• Always set a password when setting a new login name. The login name will not be valid unless a password is set for it.
		• If a login name is not set or contains illegal characters, the default login name, CONFIDENTIAL, must be used. No password is required and any password that is set will be ignored.
Setting Method		A new login name and password can be set in the CPU Bus Unit Setup using the CX-Programmer.
	Note	The CPU Bus Unit Setup is not contained in I/O memory, but in a parameter area. The Setup cannot be written using instructions or edited as I/O memory. Settings can be made only with the CX-Programmer.
		Refer to the CX-Programmer User's Manual for actual setting methods.

7-3 Using File Memory

There are two media that can be used to store files in memory for CS1-series PCs:

- Memory Cards
- EM File Memory



File Memory

Media	Memory type	Capacity	Model	File data recognized by CPU Unit	
CS1-series	Flash	8 MB	HMC-EF861	 Complete user program 	
Memory	memory	15 MB	HMC-EF171	 Specified portions of I/O Memory 	
Calus		30 MB	HMC-EF371	Parameter area data (e.g. PC Setup)	
EM File Memory	RAM	Max. capacity of EM Area in CPU Unit (Largest EM Area: 832 KB in CS1H-CPU67)	All EM Area banks from specified bank in I/O Memory (specified in PC Setup)		

	Note	The HMC-AP001 PC Card Adapter can be used to mount a Memory Card in a PC card slot on a computer.
File Types		
		The MS-DOS file format is used, allowing the files to be handled as normal files on a Windows-based computer.
File Names		Files are distinguished by assigning file names and extensions. The following characters can be used in file names and extensions:
		Alphanumeric characters: A to Z and 0 to 9. (Names converted to all-caps) $!$ & \$ $\#$ ' [] - ^ () _
		The following characters cannot be used in files names and extensions:
		, . / \ ? * " : ; < > = + (spaces)
		File names are not case sensitive and will be converted to all-caps in the PC file system. File names can be up to 8 character long with 3-character extensions. An error will occur if a file name or extension is too long. The first period (.) in a file name will be taken as the delimiter between the file name and extension. Extensions are determined by the file type.
Directories		Up to five levels of directories (including root as the first level) can be created as file storage locations. A maximum of 65 characters can be used in directory names.

File Names Handled by CPU Unit

The files described in the following table can be read or written by the CPU Unit.

File type		File name	Extension	Contents	Description
Data file		*****	.IOM	Specified ranges of I/O Memory	 Contains word (16-bit) data from a starting word through an end word in one memory area.
					 The following areas can be used: CIO, HR, WR, AR, DM, and EM.
Program file		*****	.OBJ	Complete user program	• Contains all the programs for cyclic tasks and interrupt tasks, as well as task information for one CPU Unit.
Parameter area file		*****	.STD	 PC Setup Registered I/O tables Routing tables CS1 CPU Bus Unit Setup and other Setup data (See 	 Contains all of the parameter data for one CPU Unit. There is no need for the user to distinguish the various types of data contained in the file. The file can be automatically read to or written from the CPU Unit simply by specifying the optencien (STD).
Files trans- ferred at startup	Data files	AUTOEXEC	.IOM	Note 1.) I/O Memory data for the specified number of words starting from D20000	 There does not necessarily need to be a data file in the Memory Card when the automatic file transfer function is used at startup. The AUTOEXEC.IOM file always contains DM Area data starting at D20000. All data in the file will be transferred to memory starting at D20000 at startup.
	Program files	AUTOEXEC	.OBJ	Complete user program	 There must be a program file in the Memory Card when the automatic file transfer func- tion is used at startup. Contains all the programs for cyclic tasks and interrupt tasks, as well as task informa- tion for one CPU Unit.
	Parameter area file	AUTOEXEC	.STD	 PC Setup Registered I/O tables Routing tables CS1 CPU Bus Unit Setup and other Setup data (See Note 1.) 	 There must be a parameter file in the Memory Card when the automatic file transfer function is used at startup. Contains all of the parameter data for one CPU Unit. There is no need for the user to distinguish the various types of data contained in the file. All parameters in the file will be automatically transferred to specified locations in memory at startup.

- **Note** 1. Refer to information on file memory in the *CS1-series CS1G/H-CPU*□□*-E Programmable Controllers Operation Manual (W339).*
 - 2. All files transferred automatically at startup must have the name AUTOEX-EC.

Initializing File Memory

Memory	Initialization method
Memory	1. Insert the Memory Card into the CPU Unit.
Cards	 Initialize the Memory Card from a Programming Device (Programming Consoles included).
EM File Memory	1. Specify in the PC Setup the first bank to convert to file memory.
	2. Initialize EM File Memory from the CX-Programmer.

Using File Memory

Data File Format

The format of data files (files with .IOM extensions) is shown in the following diagram.



Set the reserved bytes to all zeros (00 Hex).

Writing Data Files via FTP In this example, the put command (see page 148) is used to write the following data to a file called DMDATA.IOM on a Memory Card, and then the READ DATA FILE instruction (FREAD(700)) is used to write 5 words of data from the beginning of the DMDATA.IOM file to D00000 to D00004.

S2: Filename

5C

4D

41

41

44

44

54

00 A

\ D

M D

ΑT

D00100









Data Read from File

Word	Contents
D00000	133A
D00001	E4F3
D00002	CC0B
D00003	3C5F
D00004	A200

- **Note** 1. FREAD(700) will not be able to read the last byte in a file if the files contains an odd number of bytes. Add 00 Hex to the end of the file if necessary to make an even number of bytes.
 - 2. The UM and DM Areas contain binary data. Set the data type to binary using the type command (see page 148) before reading or writing files using FTP.
 - 3. Refer to the CS1-series CS1G/H-CPU -E Programmable Controllers Programming Manual (W340) for information on the File Memory Instructions.

7-4 FTP Server Application Example

The following procedure shows how to use the FTP server by connection with the default login name, CONFIDENTIAL. No password is required.

- **Note** The login name and a password must be set in the CPU Bus Setup for the Ethernet Unit in the CPU Unit to use any login name other than CONFIDENTIAL.
- *1, 2, 3...* 1. Make sure that a Memory Card is inserted in the CPU Unit and turn ON the power supply to the PC.
 - 2. If EM File Memory is to be used, create the EM File Memory.
 - 3. Connect to the FTP server from a computer on the Ethernet by entering the text that is underlined in the following diagram.

IP address of the Ethernet Unit

\$ <u>ftp 150.31.2.83</u> connected to 150.31.2.83 220 **IPaddress** CSIW-ETN01 FTP server (FTP**version**) ready	} Results
Name: CONFIDENTIAL	Login name
230 Guest logged in.	

4. Enter FTP commands (underlined in the following diagram) to read and write files. The following directory tree is used in this example



Note 1. The current status of the FTP server can be obtained from the service status in the words allocated to the Ethernet Unit in the CPU Bus Unit Area in the CIO Area. The first word allocated to the Ethernet Unit is n and is computed as follows: n = 1500 + (25 x unit number)



- 2. The FTP server can handle only one command at a time.
- 3. Do not simultaneously write a file with the same name to the same file device in a CPU Unit from more than one Ethernet Unit or ladder diagram program. Exclusive control is not performed.

7-5 Using FTP Commands

This section describes the FTP commands which the host computer (FTP client) can send to the Ethernet Unit's FTP server. The descriptions should also apply to most UNIX workstations, but slight differences may arise. Refer to your workstation's operation manuals for details.

7-5-1 Table of Commands

The FTP commands which can be sent to the Ethernet Unit are listed in the following table.

Command	Description
open	Connects the specified host FTP server.
user	Specifies user name for the remote FTP server.
ls	Displays the Memory Card file names.
dir	Display the Memory Card file names and details.
rename	Changes a file name.
mkdir	Creates a new directory in the working directory in the remote host.
rmdir	Deletes a new directory from the working directory in the remote host.
cd	Changes the Ethernet Unit work directory to the specified directory.
cdup	Changes the working directory at the remote host to the parent directory.
pwd	Displays the Ethernet Unit work directory.
type	Specifies the data type of transferred files.
get	Transfers the specified file from the Memory Card to the local host.
mget	Transfers multiple files from the Memory Card to the local host.
put	Transfers the specified local file to the Memory Card.
mput	Transfers multiple local files to the Memory Card.
delete	Deletes the specified file from the Memory Card.
mdelete	Deletes multiple files from the Memory Card.
close	Disconnects the FTP server.
bye	Closes the FTP (client).
quit	Closes the FTP (client).

• The Ethernet Unit is considered to be the remote host and the host computer (FTP client) is considered to be the local host.

• A remote file is a file on the Memory Card or in EM File Memory in the CPU Unit.

A local file is one in the host computer (FTP client).

• The parent directory is the directory one above the working directory.

7-5-2 Using the Commands

<u>open</u>	
Format	open [IP_address or host_name_of_FTP_server]
Function	Connects the FTP server. Normally when the FTP client is booted, the FTP server IP address is specified to execute this command automatically.
<u>user</u>	
Format	user [user_name]
Function	Specifies the user name. Specify the FTP login name set in the Ethernet Unit system setup. The default FTP login name is "CONFIDENTIAL."
	If a non-default login name is used, it must be followed by the password. In this case, enter the FTP password set in the system setup.
	The user name is automatically requested immediately after connection to the FTP server.
ls	
Format	ls [-1] [REMOTE_FILE_NAME [local_file_name]]
Function	Displays the remote host (Memory Card or EM File Memory) file names.
	Set the switch [-I] to display not only the file names but the creation date and size as well. If the switch is not set, only the file names will be displayed.
	You can specify a file name in the Memory Card or EM File Memory if desired.
	If a local file name is specified, the file information will be stored in the specified file in the host computer.
Example	ls /
dir	
Format	dir [REMOTE_FILE_NAME [local_file_name]]
Function	Displays the file names, date created, and size of the files in the remote host (Memory Card or EM File Memory). It displays the same information as command "Is $-I$ ".
	Specify a file name in the Memory Card or EM File Memory as the remote file name.
	If a local file name is specified, the file information is stored in the specified file in the host computer.
Example	dir /
rename	
Format	rename CURRENT_FILE_NAME
Function	Changes the specified current file name to the specified new file name.
	rename can be used only to change the file name. It cannot be used to move the file to a different directory.
mkdir	
Format	mkdir DIRECTORY_NAME
Function	Creates a directory of the specified name at the remote host (Memory Card or EM File Memory).
	An error will occur if a file or directory of the same name already exists in the working directory.

<u>rmdir</u>	
Format	rmdir DIRECTORY_NAME
Function	Deletes the directory of the specified name from the remote host (Memory Card or EM File Memory).
	The directory must be empty to delete it.
	An error will occur if the specified directory does not exist or is empty.
pwd	
Format	pwd
Function	Displays the remote host's (Ethernet Unit) current work directory.
<u>cd</u>	
Format	cd [directory_name]
Function	Changes the remote host (Ethernet Unit) work directory to the specified remote directory.
	The files in the Memory Card are contained in the MEMCARD directory under the root directory (/). The files in EM File Memory are contained in the EM direc- tory under the root directory (/). The root directory (/) is the directory used when logging into the Ethernet Unit. No MEMCARD directory will exist if a Memory Card is not inserted in the PC or if the Memory Card power indicator is not lit. No EM directory will exist if EM File Memory does not exist.
<u>cdup</u>	
Format	cdup
Function	Changes the working directory at the remote host to the parent directory (one directory above the current working directory).
type	
Format	type data_type
Function	Specifies the file data type. The following data types are supported:
	ascii: Files are transferred as ASCII data binary (image): Files are transferred as binary data.
	All files are treated by the PC as binary files. Before reading or writing any files, always use the $t_{YP}e$ command to set the file type to binary. File contents cannot be guaranteed if transferred as ASCII data.
	The default file type is ASCII.
<u>get</u>	
Format	get FILE_NAME [receive_file_name]
Function	Transfers the specified remote file from the Memory Card or EM File Memory to the local host.
	A receive file name can be used to specify the name of the file in the local host.
<u>mget</u>	
Format	mget FILE_NAME
Function	Allows the use of a wildcard character (*) to transfer multiple remote files from the Memory Card or EM File Memory to the local host.
put	
Format	<pre>put file_name [DESTINATION_FILE_NAME]</pre>

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Function	Transfers the specified local file to the remote host (Memory Card or EM File Memory).
	A destination file name can be used to specify the name the file is stored under in the Memory Card or EM File Memory.
	Any existing file with the same name in the remote host (Memory Card or EM File Memory) will be overwritten by the contents of the transferred file.
	If an error occurs during file transfer, the file being transferred will be deleted and the transmission will end in an error.
mput	
Format	mput <i>FILE_NAME</i>
Function	Allows the use of a wildcard character (*) to transfer multiple local files to the re- mote host (Memory Card or EM File Memory).
	Any existing file with the same name in the remote host (Memory Card or EM File Memory) will be overwritten by the contents of the transferred file.
	If an error occurs during file transfer, the file being transferred will be deleted and the transmission of that file will end in an error. However, mput execution will continue and remaining files will be transferred.
<u>delete</u>	
Format	delete <i>FILE_NAME</i>
Function	Deletes the specified remote file from the Memory Card or EM File Memory.
<u>mdelete</u>	
Format	mdelete <i>FILE_NAME</i>
Function	Allows the use of a wildcard character (*) to delete multiple remote files from the Memory Card or EM File Memory.
<u>close</u>	
Format	close
Function	Disconnects the Ethernet Unit's FTP server.
<u>bye</u>	
Format	bye
Function	Ends the FTP (client).
quit	
Format	quit
Function	Ends the FTP (client).

7-5-3 Error Messages and FTP Status

Error Messages

The error messages returned by the Ethernet Unit are listed in the following table.

Message	Meaning		
PPP is a directory.	The path name indicated at PPP is a directory.		
PPP is not a directory.	The path name indicated at PPP is not a directory.		
Another unit has access authority (FINS error 0 x 3001)	Another Unit currently has the access right.		
Bad sequence of commands.	The RNFR command has not been executed.		
Can't create data socket (X.X.X.X, YY)	A socket cannot be created.		
Cannot access a device (FINS error 0 x 250F).	A file device error has occurred.		
Cannot get memory blocks.	A message memory block cannot be allocated.		
Command format error (FINS error 0 x 1003).	The command format is incorrect.		
Connect error.	A connection error has occurred.		
Directories of the old and the new paths are not same.	The directories before and after changing the name are different.		
Directory name length exceeded max. size.	The directory name is too long.		
Directory not empty (FINS error 0 x 2108).	The directory must be empty to delete it.		
Fatal error (FINS error 0 x 1101).	A parameter error has occurred.		
Fatal error (FINS error 0 x 1103).			
File or directory already exists.	The specified file or directory name already exists.		
File or directory already exists (FINS error 0 x 2107).			
File or directory name illegal.	The file or directory name is incorrect.		
File or directory name illegal (FINS error 0 x 110C).			
File read error (FINS error 0 x 1104).	An error occurs when reading the file.		
File read error (FINS error 0 x 110B).			
File write error (FINS error 0 x 2106).	An error occurs when reading the file.		
File write error (FINS error 0 x 2107).			
FINS error MRES 0 x XX: SRES 0 x XX.	Some other FINS error has occurred.		
Length of directory name too long.	The path name of the directory is too long.		
No space to create entry (FINS error 0 x 2103).	There are too many files to create a new one.		
No such device (FINS error 0 x 2301).	The file device cannot be found.		
No such file or directory.	The specified file or directory does not exist.		
No such file or directory (FINS error 0 x 2006).			
No such file or directory (FINS error 0 x 2106).			
No enough memory.	The communications buffers are full.		
Not enough space in the system. (FINS error 1104).	The file device is full.		
PLC communication error (timeout).	File access timed out.		
Socket canceled.	The socket was canceled.		
Socket error NN.	A socket bind error occurred. The error code will be given at NN.		
Socket receive error NN.	A data reception error occurred. The error code will be given at NN.		
Socket send error NN.	A data send error occurred. The error code will be given at NN.		
Timeout (900 seconds): closing control connection.	The connection was closed because the client did not respond for 15 minutes.		
Too many open files.	Too many sockets have been created.		
Write access denied.	Writing is not possible.		
Write access denied. (FINS error 0 x 2101).]		

- PPP: Path name
- XXX: IP address
- YY: Port number
- MM: FINS error code
- NN: Socket error code

Checking FTP Status

- Note 1. File operations for files on the Memory Card are performed during FTP communications. Do not remove the Memory Card or turn OFF power to the PC while FTP is being used.
 - 2. When using File Memory Instruction from the program in the CPU Unit, program exclusive control using the FTP Status Flag so that the same data is not manipulated simultaneously by more than one instruction.

FTP Status Flag

The current status of the FTP server can be obtained from the service status in the words allocated to the Ethernet Unit in the CPU Bus Unit Area in the CIO Area. The word containing the FTP Status Flag can be computed as follows: 1500 + (25 x unit number) + 17



Status of bit 00	Meaning
1	FTP server busy
0	FTP server free

Note The FTP status can also be checked from the CX-Programmer.

FTP Indicator

The FTP indicator on the Ethernet Unit indicates FTP status as shown in the following table.

FTP indicator	Meaning	
Lit	FTP server busy	
Not lit	FTP server free	

FTP File Transfer Time

File transfers using FTP can require up to 5 or 10 minutes depending on the capacity of the file. Approximate file transfer time are provided in the following table for reference.

All times are in seconds unless otherwise specified.

File system		Memory Card		EM File Memory	
CPU Unit status	Operating mode	PROGRAM	RUN	PROGRAM	RUN
	Cycle time		20 ms		20 ms
Transfers using	1 KB	3	17	1	3
put	30 KB	10	53	5	24
	60 KB	17	91	11	52
	120 KB	31	173	24	128
Transfers using	1 KB	1	2	1	1
get	30 KB	6	22	4	14
	60 KB	10	43	9	37
	120 KB	19	100	22	113

Note 1. The above times assume that the peripheral servicing time setting in the PC Setup is set to the default value of 4%.

2. If the peripheral servicing time setting in the PC Setup is increased, FTP files will be transferred faster.

7-6 UNIX Application Example

The following procedure provides an example of FTP operations from a UNIX workstation. In this example, the following assumptions are made.

- The IP address of the Ethernet Unit is registered in /etc/hosts on the workstation as "cs1".
- The default FTP login name is being used (CONFIDENTIAL).
- A processing results data file called RESULT.IOM already exists on the Memory Card in the CPU Unit.
- A processing instructions data file called PLAN.IOM already exists on the workstation.

The following procedure transfers the processing results file RESULT.IOM from the Memory Card in the CPU Unit to the workstation and then the processing instructions file PLAN.IOM is transferred from the workstation to the Memory Card in the CPU Unit.

Underlined text is keyed in from the FTP client. The workstation prompt is indicated as \$ and the cursor is indicated as \blacksquare .

1, 2, 3... 1. Start FTP and connect to the Ethernet Unit.

```
$ <u>ftp cs1</u> ... FTP started.
connected to cs1
220 **IPaddress** CS1W-ETN01 FTP server(FTP**version**)ready
Name(cs1:root):■
```

2. Enter the login name.

```
Name(cs1:root):CONFIDENTIAL ···· Login name
230 Guest logged in.
ftp>
```

3. Make sure the Memory Card is inserted. The MEMCARD directory will be displayed if there is a Memory Card in the CPU Unit.

```
ftp> <u>is</u> ... Used to check for Memory Card.
200 PORT command successful.
150 opening data connection for Is(**IPaddress**port#**)(0 bytes).
MEMCARD
226 Transfer complete.
15 bytes received in 0 seconds(**bytes/s)
ftp> ■
```

4. Change to the MEMCARD directory.

```
      ftp> cd MEMCARD
      ... Change to MEMCARD directory.

      250 CWD command successful.

      ftp> ■
```

5. Change data type to binary.

```
ftp> <u>type binary</u> ··· Binary data type set.
200 Type set to I.
ftp>■
```

6. Transfer the file RESULT.IOM to the workstation.

```
ftp> get RESULT.10M ··· File read.
200 PORT command successful.
150 opening data connection for result.iom (**IPaddress**port#**) (**bytes).
226 Transfer complete.
** bytes received in *.*** seconds (**bytes/s)
ftp> III
```

7. Write the file PLAN.IOM to the Memory Card.

```
ftp> put PLAN.IOM ··· File written
200 PORT command successful.
150 opening data connection for plan.iom (**IPaddress**port#**) .
226 Transfer complete.
** bytes received in *.** seconds (**bytes/s)
ftp> ■
```

8. End FTP.

ftp> <u>bye</u> ···· FTP ended. 221 Goodbye. \$ ■

SECTION 8 Mail

This section explains the Ethernet Unit's mail function.

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8-1 Overview of Mail Function

The mail function can be used to send user-created information, error log information, and status information as e-mail to an address set in the CPU Bus Unit System Setup. Mail can be triggered in any of the following ways:

- When an error is registered to the error log.
- At regular intervals.
- When a dedicated control switch is turned ON.
- **Note** A mail server is required in order to use the mail function. Mail server settings require specialized knowledge and should always be handled by the network administrator. Be sure you have a clear understanding of the mail system before using this function. Mail delivery is not guaranteed. Depending on factors such as the condition of the network, mail that has been sent may not arrive at its destination.

8-1-1 Mail Contents

	Date and time		
			Ethernet Unit e-mail address
(Date: Fri, 1 Jan 1999 13:00:00 +0900 From: alpha@arron.co.jp Message-Id: <xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx< td=""><td></td><td>Destination e-mail address</td></xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx<>		Destination e-mail address
Hondor	Subject: OWARON Element Unit Mail Service (posted at regular intervals) — Content-Type: text/plain; charset=US-ASCII		Title (fixed)
Header	Content-Transfer-Encoding: 7bit		Content type (fixed)
l	This is OMIRON ethernet unit mail posting service. This mail have been posted at regular intervals.		
[Ethernet Unit Identification		Ethernet Unit model (required)
	Model : CS1W-ETN01		Unit version number (required)
	Subnet mask : XXX, XXX, XXX, XXX IP conversion : Table used		Ethernet Unit IP address (required)
	Second	٦	
	User wessage		User-created information (optional)
	Free las las atom	R	
	www.com/yrear.com/article/arti		- - - - - - - - - -
	01/01/99 12:00:00 0006 0000 CPU unit error 01/01/99 12:30:00 0121 0101 Destination IP address not registered		Error log information (optional)
	Status Information	ĺ	
Body	*Error Status IP router table error : OFF IP address table error : OFF Routing table error : OFF Address mismatch : OFF Transceiver error : OFF Transceiver loopback test error : OFF EEP-ROM error : OFF Executing the Internode test : OFF		
	*UDP Socket Connection Status UDP Socket No.1 connection status : Opened UDP Socket No.2 connection status : Closed UDP Socket No.3 connection status : Closed UDP Socket No.4 connection status : Closed UDP Socket No.5 connection status : Closed UDP Socket No.7 connection status : Closed UDP Socket No.7 connection status : Closed UDP Socket No.8 connection status : Closed	}	Status information (optional)
	*TCP Socket Connection Status TCP Socket No.1 connection status : Established TCP Socket No.2 connection status : Closed TCP Socket No.3 connection status : Closed TCP Socket No.4 connection status : Closed TCP Socket No.5 connection status : Closed TCP Socket No.5 connection status : Closed TCP Socket No.7 connection status : Closed TCP Socket No.8 connection status : Closed		
	*Number Information Total number of receive packets : 123,456 Total number of receive errors : 0 Total number of send packets : 234,567 Total number of send errors : 0 Total number of send collisions : 0		
l		J	

Header

The following header information is attached.

- Subject:
 - Content-Type:
- OMRON SYSMAC CS1 Ethernet Unit Mail Service text/plain;charset=US-ASCII

 - Content-Transfer-Encoding: 7 bit

Ethernet Unit Information

- The following Ethernet Unit information is always attached to the mail.
- Model
- Version

- IP address (decimal notation)
- Subnet mask (decimal notation)
- ID address conversion method

Optional InformationThe optional information that can be sent is shown in the following table. Different information can be selected with each mail trigger, and it is also possible to make multiple selections. (The selections are specified in the CPU Bus Unit System Setup.) If not even one is selected, however, no e-mail will be sent even when the trigger condition is met.

Item	Contents
User-created information	User-created information is data set by the user, in ASCII, in the CPU Unit's memory. A maximum of 1,024 bytes of data is sent from the user-created information address set in the CPU Bus Unit Area. If there is a null code (00 Hex) in the data, however, only the data up to that point will be sent.
	The data set by the user is sent just as it is, and the code is not converted. The relevant words are always read by the Ethernet Unit, so the contents of the mail can be changed by changing the contents of the words.
Error log information	The error log information includes the entire error log in RAM. A maximum of 64 records can be saved. For details, refer to <i>10-3 Error Log</i> .
Status information	The following data is sent.
	(1) Open/closed status of UDP sockets 1 to 8
	(2) TCP status of TCP sockets 1 to 8
	(3) Unit error information
	(4) Counter information
	Total number of receive packets
	Total number of receive errors
	Total number of send packets
	Total number of send errors
	Total number of send collisions

The Ethernet Unit processes error log and status data in ASCII so that it can be easily read as e-mail.

Note Set user-created information in ASCII.

8-1-2 Mail Triggers

The user can select any of the following trigger conditions for e-mail. The designation is made in the CPU Bus Unit System Setup. The particular information to be sent can be selected individually for each trigger condition.

Name	Trigger condition	Contents
User mail	When Mail Send Switch turns ON.	Mail is sent when the Mail Send Switch set in the words allocated to the CPU Bus Unit in the CIO Area turns from OFF to ON (leading edge).
Error mail	When an error is recorded in the error log.	Mail is sent when an error occurs and is recorded in the error log.
Periodic mail	Fixed time intervals	Mail is sent each time the interval set in the CPU Bus Unit Area elapses. The interval can be set to anything from 10 minutes to 10 days.

8-1-3 Sending Mail

Triggered by Mail Send Switch

To send mail only as required, use the Mail Send Switch (bit 3) from among the Unit Control Switches in the CIO Area words allocated to the CPU Bus Unit. When the Ethernet Unit detects that the Mail Send Switch has turned ON, the mail transmission is started according to the mail settings that have previously been made in the CPU Bus Unit System Setup.

If a transmission is restarted while the mail processing is still in progress, it will be invalid. After the transmission has been completed, the Ethernet Unit will automatically turn the switch OFF again. Once the switch has been turned OFF, another mail message can be sent. Unit Control Switches: CIO 1500 + (25 x unit number) 14 13 12 11 Mail Send Switch Triggered by Error Log If there is a need for immediate notification when an error occurs, e-mail can be Recording sent at the same time as an error is recorded in the error log. When an error to be recorded in the error log occurs, the e-mail transmission is started according to the mail settings that have previously been made in the CPU Bus Unit System Setup. **Note** If several errors in a row are recorded in the error log, the notification of these errors may all be included in the same e-mail message. Triggered at Regular If there is a need to periodically check the Ethernet Unit's status, e-mail can be Intervals sent at regular intervals. With this method, e-mail is sent at fixed time intervals according to the mail interval and mail information settings in the CPU Bus Unit System Setup. **Note** After the mail processing has been completed, the next e-mail will be sent when the fixed time interval elapses. There may be discrepancies in the transmission intervals if the Ethernet Unit status causes the processing to take more time.

8-1-4 Mail Status

The mail status is reflected in the Mail Status areas in the CPU Bus Unit words allocated in the DM Area. It can be checked as required.

Mail Status: D30000 + (100 x unit number)



	Bits		Status
2	1	0	
6	5	4	
10	9	8	
0	0	0	Waiting for mail, or mail ready to send according to Mail Send Switch, or no mail is being sent.
0	0	1	Mail being processed.
0	1	0	Waiting for mail, or mail ready to send according to Mail Send Switch. Previous mail transmission completion was normal.
1	1	0	Waiting for mail, or mail ready to send according to Mail Send Switch. Previous mail transmission completion was abnormal.
1	1	1	Mail cannot be sent (due to System Setup error).

Note 0: OFF; 1: ON

8-2 Sending Mail

The procedure for sending mail is as follows:

- 1, 2, 3... 1. Make the following settings in the CPU Bus Unit System Setup.
 - Mail send information
 - Mail timing
 - User-created mail data address
 - SMTP server address
 - Local mail address
 - Destination mail address
 - 2. Turn ON the Mail Send Switch (word n, bit 3) in the allocated CIO Area words.

8-3 Mail Example

This section shows how to use the mail function, taking as an example the settings and operations involved in sending user mail. Only the settings are covered here. For details on CX-Programmer operations, refer to the *CX-Programmer User's Manual*.

- Use the CX-Programmer, a Programming Device for the PC, to make the initial mail settings in the CPU Bus Unit System Setup in the CPU Unit. For the purposes of this example, make the settings shown below. (For details regarding the CPU Bus Unit System Setup, refer to 4-2-2 Mail Settings.)
 - User mail: Send user-created information and status information.
 - Error mail: Not used.
 - Periodic mail: Not used.

<u>Settings</u>

- User mail: Enabled (selected)
- User mail status information transmission: Enabled (selected) (Leave all other checkboxes for mail settings not selected.)
- User-created mail data address: DM00200 (See below.)
- Ethernet Unit mail address
- Destination mail address
- SMTP server address (mail server IP address)

From DM00200 onwards, store data to be sent as mail (user-created information) in ASCII as shown below.

	15	87	0
DM00200	53 (S)	79 (y)	
DM00201	73 (s)	74 (t)	
DM00202	65 (e)	6D (m)	
DM00203	31 (1)	20 ()	
DM00204	69 (i)	73 (s)	
DM00205	20 ()	77 (w)	
DM00206	6F (o)	72 (r)	
DM00207	68 (k)	69 (i)	
DM00208	6E (n)	67 (g)	
DM00209	00		

2. Turn ON the Mail Send Switch in the CIO Area words allocated to the CPU Bus Unit.



For Unit #5, for example, the Mail Send Switch address is CIO 162503.



The status, such as mail being processed, and so on, is reflected in the User Mail Status Area in the DM Area words allocated to the CPU Bus Unit. Check the status as required.

Bits			Status		
2	1	1 0			
0	0	0	Waiting for mail, or mail ready to send according to Mail Send Switch, or no mail is being sent.		
0	0	1	Mail being processed.		
0	1	0	Waiting for mail, or mail ready to send according to Mail Send Switch. Previous mail transmission completion was normal.		
1	1	0	Waiting for mail, or mail ready to send according to Mail Send Switch. Previous mail transmission completion was abnormal.		
1	1	1	Mail cannot be sent (due to System Setup error).		

Note 0: OFF; 1: ON

SECTION 9 Testing Communications

This section describes functions that allow you to test communications.

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9-1 Communications Testing Functions

The Ethernet Unit provides two functions that allow communications with other node to be tested.

- PING Command The PING command is a common way to perform echoback tests on Ethernet networks. The PING command can be executed to see if nodes are physically connected properly and to be sure that IP address are set for the correct Ethernet nodes.
- Internode Testing Echoback tests with specific nodes can also be performed by setting parameters in the DM Area and then manipulating specific bits in memory. This type of internode test can be performed only for remote nodes that support the FINS internode testing function. Internode testing can be used to make sure settings for FINS communications services are correct.

9-2 PING Command

The PING command sends an echo request packet to a remote node and receives an echo response packet to confirm that the remote node is communicating correctly. The PING command uses the ICMP echo request and responses. The echo response packet is automatically returned by the ICMP.

The PING command is normally used to check the connections of remote nodes when configuring a network. The Ethernet Unit supports both the ICMP echo request and reply functions.

If the remote node returns a normal response to the PING command, then the nodes are physically connected correctly and Ethernet node settings are correct.



9-2-1 Ethernet Unit

The Ethernet Unit automatically returns the echo response packet in response to an echo request packet sent by another node (host computer or other Ethernet Unit). An echo request packet can be sent to another node by issuing the FINS command to execute the PING command from the PC. Refer to page 211 for details on the PING command.

9-2-2 Host Computer

The PING command can be executed from the host computer to send an echo request packet to an Ethernet Unit. The method for using the PING command from a UNIX computer is given next.

Method

Input the following at the host computer prompt (\$):

\$ ping IP_address (host_name)

The destination is specified by its IP address or host name. If the host name is used, the host name must be defined in file /etc/hosts.

Note The PING command is not supported by some host computers.

Application Examples

These examples show sending the PING command to the node at IP address 130.25.36.8. The "\$" on the example screen represents the host computer prompt. User inputs are underlined. Comments are placed after semicolons.

Normal Execution	\$ ping 130.25.36.8 PING 130.25.36.8: 56	data bytes		; Executes PING command
	64 bytes from 130.25	.36.8: icmp_s	seq=0.	time=0.ms
	64 bytes from 130.25	5.36.8: icmp_s	seq=0.	time=0.ms
			•	
	•	•	•	
			•	
	64 bytes from 130.25	5.36.8: icmp_s	seq=0.	time=0.ms
	\leftarrow Enter Ctrl+C Key t	o cancel.		
	130.25.36.8 PING	G Statistics		
	9 packets transmitte	ed, 9 packets	receiv	ed, 0% packets loss
	round-trip (ms) min/	avg/max = 0/1	/16	
	\$			
Abnormal Execution	\$ ping 130.25.36.8			; Executes PING command
	PING 130.25.36.8: 56	data bytes		
	\leftarrow Enter Ctrl+C Key t	o cancel.		
	130.25.36.8 PING	Statistics		
	9 packets transmitte	ed, 0 packets	receiv	ed, 100% packets loss
	\$			
	Refer to operating syste about using the host cor	em documentati nputer's PING c	on for y comman	our host computer for details

9-3 Internode Test

The internode test sends data to and from specified nodes and uses the responses to check the network. The Ethernet Unit has a built-in function to run the internode test.

If a normal response is returned for an internode test, it means that the settings for FINS communications services are correct. If a response is not received, execute the PING command for the same remote node to see if the Ethernet connection and settings are correct. If the PING command can be executed successfully, then the FINS settings, such as the routing tables, node addresses, or address conversion method, are incorrect.

9-3-1 Running the Test

The test parameters are set and the test is started and stopped by writing the required data to memory in the PC used to start the internode test. These setting are made using the a Programming Device, such as a Programming Console.

Test Procedure

- *1, 2, 3...* 1. Write the test parameters into PC memory. The test parameters are described following this procedure.
 - 2. Turn ON the Internode Test Start Switch allocated to the Ethernet Unit in the CPU Bus Unit Area. The Internode Test Start Switch is described following the test parameters. This will begin the internode test.
 - 3. If desired, the test parameters can be changed while the internode test is actually running. Use the same procedure as used in step 1.

- 4. Turn OFF the Internode Test Start Switch allocated to the Ethernet Unit in the CPU Bus Unit Area to stop the test.
- **Note** 1. The test parameters are effected as soon as they are set or changed. It is not necessary to reboot or restart. If the test parameters are changed during the test, however, the new parameters will not be used until the Internode Test Start Switch is turned OFF and then back ON.
 - 2. Line traffic on the Ethernet network will increase during the test, possibly affecting system performance.

Setting the Test Parameters

Before starting the test, set the following parameters in the software switches in the words in the DM area allocated to the Ethernet Unit. The test parameters become effective immediately after they are set. It is not necessary to reboot or restart the PC.

Configuration of the Software Switches

The software switches are stored at offsets from the first word calculated with the formula: first word = D03000 + (100 x unit number).

Offset	Contents		
+0	Bits 8 to 15: Remote network address	Bits 0 to 7: Remote node number	
+1	Number of send bytes		
+2	Response monitor time		

Setting Range

The parameter setting ranges are given in the following table.

Parameter	Range
Remote network address	00 Hex: Local network 01 to 7F Hex (1 to 127 decimal)
Remote node number	01 to 7E Hex (0 to 126 decimal)
Number of send bytes	0000 Hex specifies the max. length of 1,996 bytes. 0001 to 07CC Hex (1 to 1996 decimal)
Response monitor time (Unit: 10 ms)	0000 Hex specifies 2 s. 0001 to FFFF Hex (1 to 65535 decimal)

- **Note** 1. The following limits apply to the number of bytes sent when running the test through a SYSMAC NET or SYSMAC LINK network:
 - SYSMAC NET: 1,986 bytes
 - SYSMAC LINK: 512 bytes
 - 2. Broadcast transmissions (target node address = FF) cannot be used for the internode test.
 - 3. A timeout error will occur if no response is received within the set response monitor time.

Starting and Stopping the Internode Test

Bit 01 of the first word in the words allocated to the Ethernet Unit in the CPU Bus Unit Area is used as the Internode Test Start Switch. Turn ON bit 01 to start the internode test and turn bit 01 OFF to stop the internode test. The address of the word containing the Internode Test Start Switch is calculated by the following formula:



Internode test run status is shown on the TS indicator on the Unit's front panel.

TS indicator	Run status	
Lit	Internode test running	
Not lit	Internode test stopped	

9-3-2 Checking Results

The results of the internode test are stored in the fourth through ninth words of the portion of the CPU Bus Unit Area allocated to the Ethernet Unit. The status information area stores the test status and numbers of test runs and errors.

Test Status

The result of the test run and descriptions of errors are stored as the test status. The test status is stored at the word whose address is calculated by the following formula:



Error Code

Error Flags

If the test is run repeatedly, the code for the latest test results is stored.

Bit			Description	
15	14	13		
0	0	0	Normal	
0	0	1	Timeout error	
0	1	0	Response (response code) error	
0	1	1	Send error	
1	0	0	Data not matched	
1	0	1	Routing table error (see note)	
1	1	0	Send parameter error (see note)	

Note The internode test does not count errors when a routing table error or send parameter error has occurred.

The bits corresponding to errors are turned ON if errors occur. The flag status is maintained until the internode test is run again.

Number of Test Runs and Errors

The number of test runs and total errors from the time the test is started until it is stopped is stored. The configuration of this area is shown in the following table. Each result is stored at a word relative to the first word the address of which can be calculated using the following formula:

Word = D03000 + (100 x unit number) + 4 to +8

Offset	Contents
+4	Number of internode test runs
+5	Number of timeout errors
+6	Number of response errors
+7	Number of send errors
+8	Number of times data did not match

- **Note** 1. The contents of the test status area and test runs/errors area are maintained until the internode test is run again.
 - 2. When the number of tests counts to the maximum value (FFFF), subsequent internode test runs are counted from 0. However, the maximum value is maintained and further errors are not counted when the number of errors reaches the maximum value.

SECTION 10 Troubleshooting

This section describes information and procedures that can be used to troubleshoot problems that sometimes occur with Ethernet Unit and Ethernet communications.

The Ethernet Unit makes up part of a network. Repair a defective Ethernet Unit as soon as possible as it can have a negative effect on the entire network. We recommend that customers keep one or more spare Ethernet Units to allow immediate recovery of the network.

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10-1 Troubleshooting with Indicators

The indicators on the Ethernet Unit can be used to troubleshoot some error. The probable cause and correction for errors that can be determined from the RUN, ERC, and ERH indicators are listed in the following table.

RUN	ERC	ERH	Probably cause	Correction
Not lit	Not lit	Not lit	Power is not being supplied to the CPU Unit or the power supply voltage is too low.	Supply power. Make sure that the correct voltage is being supplied.
			The Ethernet Unit is faulty.	Replace the Ethernet Unit.
			The CPU Unit or Backplane is faulty.	Replace the CPU Unit or the Backplane.
			The mounting screws on the Ethernet Unit are loose.	Tighten the mounting screws to the specified torque.
Not lit	Not lit	Lit	The unit number on the Ethernet Unit is not set correctly on the rotary switch.	Correct the unit number setting.
			The I/O tables are not registered in the CPU Unit.	Register the I/O tables.
			The same unit number is being used on another Unit as well.	Correct the unit number.
			The CPU Unit is faulty.	Restart the CPU Unit. If the problem persists, replace the CPU Unit.
Lit		Lit	There is a mistake in the CPU Bus Unit Setup or routing tables.	Read the error history and correct the data that is causing the error. If the problem persists, replace the CPU Unit.
			Memory in the CPU Unit is faulty.	Restart the CPU Unit. If the problem persists, replace the CPU Unit.
			The CPU Unit is faulty.	Restart the CPU Unit. If the problem persists, replace the CPU Unit.
Not lit	Lit	Not lit	The node address is set outside the correct range on the rotary switches.	Set the node number to between 01 and 7F Hex.
			The Ethernet Unit is faulty.	Restart the PC. If the problem persists, replace the Ethernet Unit.
Lit	Lit		An error occurred in EEPROM.	Restart the PC. If the problem persists, replace the Ethernet Unit.
Lit	Flashing		The IP address is set incorrectly on the rotary switches on the back of the Unit.	Correct the IP address. Do not set any of the following IP addresses.
				Host IDs that are all 0 or all 1.
				Network IDs that are all 0 or all 1.
				Subnetwork IDs that are all 1.
				Addresses beginning with 127 (7F Hex).
			The node number set on the rotary switch on the front of the Unit does not agree with the host ID in the IP address. This	Make sure that the node number and the last byte of the IP address are the same and set other host IDs to 0.
			probably can occur when the address conversion method is set for automatic address generation.	Change the address conversion method.
10-2 Error Status

The Ethernet Unit will output error status to the following word in the CIO Area of the CPU Unit. This information can be used in troubleshooting errors.





The corresponding bit will turn ON when an error occurs

Bit	Name	Correction
01	Transceiver echo test error	Check the transceiver or transceiver cable.
02	IP address setting error	Set the correct IP address on the rotary switches on the back of the Unit. Do not set any of the following IP addresses.
		Host IDs that are all 0 or all 1.
		Network IDs that are all 0 or all 1.
		Subnetwork IDs that are all 1.
		 Addresses beginning with 127 (7F Hex).
03	IP address table error	Correct the IP address table. If the problem persists, replace the CPU Unit.
04	IP router table error	Correct the IP router table. If the problem persists, replace the CPU Unit.
06	Routing table error	Correct the routing tables. If the problem persists, replace the CPU Unit.
07	Transceiver error	Check the transceiver or transceiver cable.
14	Address disagreement	Make sure that the node number and the last byte of the IP address are the same and set other host IDs to 0.
		Change the address conversion method.
15	EEPROM error	Restart the PC. If the problem persists, replace the Ethernet Unit.

10-3 Error Log

The Ethernet Unit provides an error log that records errors that have occurred during Ethernet Unit operation. The contents of the error log can be read or cleared from a Programming Device, such as the CX-Programmer, or it can be read or cleared using FINS commands from a workstation or computer. (See *11-3-7 ERROR LOG READ* and *11-3-8 ERROR LOG CLEAR*).

Logged Errors

The following errors are recorded in the error log.

- Errors in network operation
- Errors in data transfers
- Error in the CPU Unit

Error Log Table	Each error is recorded as one record in an error log table. Up to 64 records can
	be saved. If more than 64 errors occur, the oldest errors will be deleted from the
	error log and the most recent error will be recorded.
	The following information is recorded in the error log table

The following information is recorded in the error log table.

- Main error code (See table later in this section.)
- Detailed error code (See table later in this section.)
- Time stamp (from the clock in the CPU Unit)

Error Log Location When an error is detected, the error codes and time stamp are recorded in the error log in RAM inside the Ethernet Unit. Serious errors are also recorded in EEPROM. The errors recorded in EEPROM will be saved even if the Unit is restarted or power is turned OFF. When the Ethernet Unit is started, the contents of the error log in EEPROM is copied to RAM.

When a FINS command is used to read the error log, the log held in RAM is read. When a FINS command is used to clear the error log, the logs held in both RAM and EEPROM are cleared.

FINS Commands for
Error LogsThe following FINS commands can be used to read or clear the error log. Refer
to Section 11 FINS Commands Addressed to Ethernet Units.

Com	mand de	Function
MRC	SRC	
21	02	ERROR LOG READ
	03	ERROR LOG CLEAR

10-4 Error Log Error Codes

The error codes are described in the following table. The detailed error code will provide detailed information on an error.

Error	Meaning	Detailed e	error code	Correction	EE-
code		1st byte	2nd byte		PROM
0001	Watchdog timer error in CPU Unit	00	00	Replace the CPU Unit.	Saved
0002	CPU Unit service monitor error	Monitor time (I	ms)	Check the operating environment.	Saved
0006	Other CPU error	Bit 11: Unit no I/O Tables	t in Registered	Create the I/O tables.	Saved
000F	CPU Unit initialization error	00	00	Replace the CPU Unit.	Saved
0010	Insufficient System Setup Area	00	00	Reduce the number of CPU Bus Units.	Saved
0011	Event timed out	MRC	SRC	Replace the CPU Unit.	Saved
0012	CPU Unit memory error	01: Read error	03: Routing table	01: Recreate the data specified by the 2nd byte of the detailed error	Saved
		02: Write error	04: Setup error	code. 02: Clear memory using procedure	
			05: CPU Bus Unit Words (CIO/DM)	in the PC operation manual.	
0013	CPU Unit protected	00	00	Remove protection from CPU Unit memory.	Saved

Error Log Error Codes

Error	Meaning	Detailed	error code	Correction	EE-
code		1st byte 2nd byte]	PROM
0103	Resend count exceeded (send failed)	Commands Bit 15:	OFF	Check transceiver at remote node.	
0105	Node address setting error (send failed)	Bits 08 to 14: Bits 00 to 07:	SNA SA1	Set the IP address correctly.	
0107	Remote node not in network (send failed)	Responses Bit 15:	ON	Check the connection to the remote node.	
0108	No Unit with specified unit address (send failed)	Bits 08 to 14: Bits 00 to 07:	DNA DA1	Check the unit address at the remote node.	
010B	CPU Unit error (send failed)			Troubleshoot the error in the CPU Unit using the PC operation manual.	
010D	Destination address not in routing tables (send failed)			Set the destination address in the routing tables.	
010E	No routing table entry (send failed)			Set the local node, remote node, and relay nodes in the routing tables.	
010F	Routing table error (send failed)			Create the routing tables correctly.	
0110	Too many relay points (send failed)			Reconstruct the network or correct the routing tables so that commands are sent to within a 3-level network range.	
0111	Command too long (send failed)			Check the command format and set the correct command data.	
0112	Header error (send failed)			Check the command format and set the correct command data.	
0117	Internal buffers full; packet discarded			Change the network so that traffic is not concentrated.	
0118	Illegal packet discarded			Check for nodes sending illegal packets.	
0119	Local node busy (send failed)			Change the network so that traffic is not concentrated.	
0120	Unexpected routing error	-		Check the routing tables.	
0121	No setting in IP address table; packet discarded			Set the remote node in the IP address table.	
0122	Service not supported in current mode; packet discarded			Select the IP address table or both methods for the address conversion method.	
0123	Internal send buffer full; packet discarded			Change the network so that traffic is not concentrated.	
0124	Maximum frame size exceeded; routing failed			Reduce the size of events.	
021A	Logic error in setting table	00	01: Data link table	Recreate the data specified by the 2nd byte of the detailed error	Saved
			02: Network parameters	code.	
			03: Routing tables		
			04: Setup		
			05: CPU Bus		
			Unit Words (CIO/DM)		

Error	Meaning	Detailed	error code	Correction	EE-	
code		1st byte	2nd byte		PROM	
0300	Parameter error; packet discarded	Commands Bit 15: Bits 08 to 14: Bits 00 to 07:	OFF SNA SA1	Check the command format and set the correct command data.		
		Responses Bit 15: Bits 08 to 14: Bits 00 to 07:	ON DNA DA1			
0601	CPU Bus Unit error	Arbitrary		Restart the CPU Unit. If the problem persists, replace the Ethernet Unit.	Saved	
0602	CPU Bus Unit memory error	01: Read error	06: Error log	Restart the CPU Unit. If the problem persists, replace the	Saved (except	
		02: Write error		Ethernet Unit.	for error log)	

Note 1. The time information in the CPU Unit is used in the CPU Bus Units.

- 2. If the time information cannot be read from the CPU Unit, the time stamp in the error log will be all zeros. This can occur due to CPU Unit startup error, unit number errors, CPU error, and model number errors. If the time is read out from a Programming Device, the time will be shown as all zeros in the year 2000.
- 3. The battery must be installed in the CPU Unit, the power turned ON, and then the time set before the clock in the CPU Unit can be used. The time will not be set correctly in the error log unless the clock time is set correctly.
- 4. An error record is not created in EEPROM when a CPU Bus Unit memory error occurs.

10-5 Troubleshooting Procedures

The following procedures can be used to troubleshoot various problems in system operation.

10-5-1 Startup Problems

Most of the initial steps in these procedures are in question form. Continue in sequence until a "True" answer tells you to jump to a specified step or until you are told to perform a specific action that corrects the problem. If performing the action does not correct the problem, return to the beginning of the procedure and start over.

1, 2, 3... 1. RUN indicator lit?

True Step 14.

- 2. ERH indicator lit?
 - True Step 12.
- 3. ERC indicator lit?
 - True
 Step 9.
- 4. Power not supplied to CPU Unit?

True
Make sure that sufficient power is supplied to the CPU Unit.

- 5. Ethernet Unit loose on Rack?
 - True A Make sure that Unit is firmly mounted and tighten the mounting screws firmly.

6. Do the RUN and ERH indicators not light if another CPU Unit is mounted to the Rack?

True
Replace the Ethernet Unit.

- 7. Replace the CPU Unit that didn't work.
- 8. ERC indicator not lit?
 - True
 Step 14.
- 9. Is the same node number used by another Unit?True ♦ Set the node numbers so that each one is used only once.
- 10. Create the I/O tables in the CPU Unit.
- 11. Replace the following components one at a time in the order given and discard any faulty ones: transceiver cable, transceiver, Ethernet Unit.
- 12. Is the node number set between 01 and 7E Hex?
 - True Replace the following items in order to eliminate the faulty part: Ethernet Unit, transceiver, transceiver cable.
- 13. Set the unit number to between 01 and 7E Hex.
- 14. ERH indicator not lit?
 - True 🛊 Step 18.
- 15. Is the same unit number used by another CPU Bus Unit? True Set the unit numbers correctly.
- 16. Has a CPU Unit error occurred in the PC's CPU Unit?
 True ♦ Restart the CPU Unit. If the error persists, replace the CPU Unit.
- 17. Set the Setup and routing tables correctly.
- 18. ERH indicator not flashing?
 - True So to 10-5-6 Network Connection Problems on page 180.
- 19. Is the IP address incorrect?
 - True Correct the IP address in the System Setup, and read out the controller status using the READ CONTROLLER STATUS command in FINS communications and correct any problems indicated.
- 20. Make sure that the node number and the last byte of the IP address are the same and set other host IDs to 0, or change the address conversion method to use and IP address table or "both methods."

10-5-2 FINS Communications Problems (SEND(090)/RECV(098)/CMND(490))

Most of the initial steps in these procedures are in question form. Continue in sequence until a "True" answer tells you to jump to a specified step or until you are told to perform a specific action that corrects the problem. If performing the action does not correct the problem, return to the beginning of the procedure and start over.

- 1, 2, 3...
 1. Refer to 10-6 Troubleshooting with Response Codes on page 184 and remove any causes of the problem discovered there before proceeding with this procedure.
 - 2. Is the control data for the instruction set incorrectly?
 - True A Make sure that the FINS network address is not set to 0 for the Ethernet Unit and check the network address, node number and unit address.
 - 3. Is a CMND(194) instruction being addressed to the local node, e.g. for socket services?

True So to 10-5-6 Network Connection Problems on page 180.

4. Are different UDP port numbers set for FINS communications for both the local node and the remote node?

True Set the same port number for both nodes.

- 5. Are the local and remote nodes both on the same network, i.e. do they have the same network number in their IP addresses?True Step 10.
- 6. Is the IP address of the remote node missing from the IP address table?
 - True Set the IP address of the remote node in the local IP address table. (Note: Use of the IP address table must be set in the mode settings for the IP address table to be effective.)
- 7. Is the IP address of the remote node missing from the IP router table?True Set the network number of the remote node in the IP router table.
- 8. Are the FINS network addresses of the local and remote nodes different?True ♦ Set both nodes to the same FINS network address.
- 9. Are you attempting a broadcast transmission?
 - True Do not attempt to broadcast to a node with a different network number. You can broadcast only to nodes on the same IP network.
- 10. Set the IP address of the remote node in the IP address table or use automatic address conversion.
- 11. Are you attempting to communicate with a PC on another network?True ♦ Go to 10-5-6 Network Connection Problems on page 180.
- 12. Are the routing tables set improperly?
 - True Set routing tables at the local node, target node, and any relay nodes.

10-5-3 UDP Socket Problems

Most of the initial steps in these procedures are in question form. Continue in sequence until a "True" answer tells you to jump to a specified step or until you are told to perform a specific action that corrects the problem. If performing the action does not correct the problem, return to the beginning of the procedure and start over.

General Problems

- **1, 2, 3...** 1. Go through the procedure in 10-5-2 FINS Communications Problems (SEND(090)/RECV(098)/CMND(490)) before starting this procedure.
 - 2. Is the response code a value other than 0000?

True Go to 10-6 Troubleshooting with Response Codes on page 184.

- 3. Is the response code in the results storage area a value other than 0000?
 - True Go to 10-7 Results Storage Area Response Codes on page 186. (There will be no response code in the results storage area if Socket Service Request Switches are being used.)
- 4. Go to 10-5-6 Network Connection Problems on page 180.

Opening and Closing Problems	Refer to General Problems on page 176.				
Reception Problems					
1, 2, 3	 Is reception processing finishing? True ♦ Step 10. 				
	2. Is the remote node not processing to send data?				
	True Adjust the remote node to process send data.				
	Read controller status using the FINS command READ CONTROLLER STATUS.				
	4. Have any reception errors occurred?				
	True There may be noise affecting the network. Increase the number of retries or take measures against noise as described in Appendix A Network Installation or 3-6-4 Connecting the Power Supply.				
	5. Read memory status using the FINS command READ MEMORY STATUS.				
	6. Is the network memory being used more than 80%?				
	True There may be too much load on the Ethernet Unit. If the memory exhaustion records show counts, UDP data may be corrupted. Check your applications.				
	 Read protocol status using the FINS command READ PROTOCOL STA- TUS. 				
	8. Are any of the first three items in the status being counted?				
	True The UDP protocol of the remote node may not be compatible with that of the Ethernet Unit. Use another communications service.				
	9. Check the remote node for transmission problems using the next proce- dure. If nothing is uncovered, go to 10-5-6 Network Connection Problems on page 180.				
	10. Return to the procedure for general problems.				
Transmission Problems					
1, 2, 3	1. Is send processing not finishing?				
	True Return to the procedure for general problems.				
	 Read protocol status using the FINS command READ PROTOCOL STA- TUS. 				
	3. Have any failures to reach the destination been counted in the ICMP status?				
	True The UDP socket specified by the destination UDP port number in the send parameters is not opening at the remote node.				
	 Read controller status using the FINS command READ CONTROLLER STATUS. 				
	5. Have any send errors occurred?				
	True A. There may be too much traffic on the network and UDD restucts may				

- 6. Check the reception status on the remote node.
- 7. Return to the procedure for general problems.

10-5-4 TCP So	cket Pr	oblems
		Most of the initial steps in these procedures are in question form. Continue in sequence until a "True" answer tells you to jump to a specified step or until you are told to perform a specific action that corrects the problem. If performing the action does not correct the problem, return to the beginning of the procedure and start over.
General Problems		
	1, 2, 3	 Go through the procedure in 10-5-2 FINS Communications Problems (SEND(090)/RECV(098)/CMND(490)) before starting this procedure. Is the response code a value other than 0000? True Go to 10-6 Troubleshooting with Response Codes on page 184. Is the response code in the results storage area a value other than 0000? True Go to 10-7 Results Storage Area Response Codes on page 186.
		(There will be no response code in the results storage area if Socket Service Request Switches are being used.)
		 4. Read controller status using the FINS command READ CONTROLLER STATUS. 5. Have any send collisions occurred?
		True There may be too much traffic going on the network. Reduce net- work traffic.
		6. Go to 10-5-6 Network Connection Problems on page 180.
Opening Problems		
	1, 2, 3	 Are you attempting an active open? True ♦ Step 3.
		 Is the passive open not finishing? True Is use an active open at the remote node.
		 Is the response code in the results storage area a value other than 0049? True ♦ Step 6.
		 4. Read socket status using the FINS command READ SOCKET STATUS. 5. Does the port number being used exist at the local node? True A Make sure that the same port number is not being used simultaneously by more than one process, including FTP services. Sockets can remain in ESTABLISHED or some later status even if closed; be sure to close ports from both sides of the connection. A socket can remain open in TIME WAIT status for up to one minute on the side that closes the socket first; we recommend that the active-side port number be set to 0 and that you close the socket from the active side. If you are using the Socket Service Request Switches, check the response code to see if it is 0049 Hex.
		6. Return to General Problems on page 178.
Closing Problems		Refer to General Problems on page 178.
Reception Problems	6	
	1, 2, 3	 Is reception processing not finishing? True ♦ Step 6.

- 2. Is the remote node not processing to send data?
 - True Adjust the remote node to process send data.
- 3. Read memory status using the FINS command READ MEMORY STATUS.
- 4. Is the network memory being used more than 80%?
 - True There may be too much load on the Ethernet Unit. If the memory exhaustion records show counts, processing may be slow. Check your applications.
- 5. Return to the procedure for general problems.
- 6. Is the response code in the results storage area a value other than 0000? (If you are using the Socket Service Request Switches, check the response code to see if it is other than 0000 Hex.)
 - True Return to the procedure for general problems.
- 7. Is the number of bytes received in the results storage area 0?
 - True
 True

Transmission Problems

- *1, 2, 3...* 1. Is send processing finishing?
 - True Return to the procedure for general problems.
 - 2. Read socket status using the FINS command READ SOCKET STATUS.
 - 3. Is there the maximum number of bytes in the send queue (4,096 bytes)?
 - True A Make sure that reception processing is being performed at the remote note.

10-5-5 FTP Service Problems

Most of the initial steps in these procedures are in question form. Continue in sequence until a "True" answer tells you to jump to a specified step or until you are told to perform a specific action that corrects the problem. If performing the action does not correct the problem, return to the beginning of the procedure and start over.

Connection Problems

- 1, 2, 3...1. Are you unable to connect to the Ethernet Unit's FTP server? True ♦ Step 5.
 - 2. If the FTP indicator lit?
 - True The FTP server is connected to another client. Wait until the client has finished.
 - 3. Are the parameter settings in the host computer incorrect?
 - True Correct the computer settings. Refer to the documentation for your computer.
 - 4. Go to 10-5-6 Network Connection Problems on page 180.
 - 5. Are you unable to log in?
 - True Check the login name and password settings.
 - 6. Is a Memory Card being used?

True Step 11.

- Can you display the EM directory using 1s from the host computer? True ♦ End.
- Have specified banks of the EM Area been converted to EM File Memory? True
 Step 9.
- 9. Has the EM File Memory been initialized?True ♦ Replace the CPU Unit.
- 10. Initialize the EM File Memory from the CX-Programmer or other Programming Device.
- Can you display the MEMCARD directory using ls from the host computer? True ♦ End.
- 12. Is a Memory Card not inserted in the PC? True ♦ Insert a Memory Card.
- 13. Is the Memory Card faulty?True Initialize the Memory Card. If the problem persists, replace the Memory Card if necessary.

File Transfer Problems

- 1, 2, 3...1. Are you not connected to the FTP server? True ♦ Return to the previous procedure.
 - 2. Is the current directory not MEMCARD or EM?
 True Make MEMCARD or EM the current directory (execute cd /MEM-CARD or cd /MEMCARD).
 - 3. Can you execute get? True • Step 6.
 - 4. Is the file you are attempting to get not actually on the Memory Card? True ♦ Designate a file actually in the file system.
 - 5. Return to 10-5-1 Startup Problems on page 174.
 - Can you execute put? True ♦ Step 9.
 - 7. Is there insufficient free space available in the file system?True
 Delete unneeded files or use a different Memory Card.
 - 8. Return to 10-5-1 Startup Problems on page 174.
 - 9. Is the data in the file transferred with put or get normal (i.e., not corrupted)? True ♦ End
 - 10. Use the \mathtt{type} command and change the file data type to binary before executing <code>put or get</code>.

10-5-6 Network Connection Problems

Most of the initial steps in these procedures are in question form. Continue in sequence until a "True" answer tells you to jump to a specified step or until you are told to perform a specific action that corrects the problem. If performing the action does not correct the problem, return to the beginning of the procedure and start over.

1, 2, 3... 1. Go through the procedure in *10-5-1 Startup Problems* before starting this procedure.

- 2. Is the P/S indicator lit?
 - True
 Step 5..
- 3. Is a 24-VDC power supply connected?
 - True Replace the following items in order to remove the faulty part: Power supply cable, Power Supply Unit, Ethernet Unit.
- 4. Connect a 24-VDC power supply.
- 5. Is the power supply indicator lit on the transceiver? True
 Step 8.
- 6. Is the transceiver cable loose?

True
Connect the cable firmly.

- 7. Replace the following components one at a time in the order given and discard any faulty ones: transceiver cable, transceiver, Ethernet Unit.
- 8. Execute ping at each node for all nodes on the network to see if communications are possible.
- 9. Was not even one response received at every node in the network?

True Check terminators, the coaxial cable, and transceiver cables.

- 10. Were responses not received only between certain nodes?
 - True Make sure the distance between transceivers on the coaxial cable is a multiple of 2.5 m.
 Check IP address settings.
 Make sure that the remote node supports ICMP.
- 11. Is an FTP client not mounted on the remote node? True ♦ Mount an FTP client.
- 12. Are you using FINS communications (e.g., SEND(090), RECV(098), or CMND(490))?

True
 Do an internode test.

13. Read protocol status using the FINS command READ PROTOCOL STA-TUS and check the following parameters in the returned status data. If any of these items have actually been counted, the remote node may not support the relevant service.

IP (all communications): Items 2 through 6

ICMP (PING): Items 5 through 8

TCP (FTP and TCP sockets): Items 4 through 6 under reception status UDP (FINS and UDP sockets): Items 1 through 3

If item 4, 8, or 9 under the IP status is being counted, there may be too much traffic through the Ethernet Unit. Check your user applications.

10-5-7 Mail Problems

Most of the initial steps in these procedures are in question form. Continue in sequence until a "True" answer tells you to jump to a specified step or until you are told to perform a specific action that corrects the problem. If performing the action does not correct the problem, return to the beginning of the procedure and start over.

1, 2, 3... 1. Is the ERH indicator lit?

True Correct mistakes in the Setup

Correct the SMTP server address (it is set to 255.255.255.255 or 127.*.*).

Correct the local mail address.

Correct the notification destination mail address.

- 2. Is notification given for user mail?
 - True 🖡 Step 9.
- 3. Is the user mail send status "7"?
 - True Correct mistakes in the Setup Correct the SMTP server address (it is set to 0.0.0.0). Correct the user mail send information settings (the user data, error log information, or status data is not set in the send information).
- 4. Is the user mail send status "0"?
 - True True Turn ON the Send Mail Switch from the user program. (The Send Mail Switch has not been turned ON since power was turned ON or since the Unit was restarted.)
- 5. Is the user mail send status "6"?
 - True Check the communications path.
 Correct the SMTP server address.
 Correct the IP router table.
 Something is blocking communications or equipment on the communications path is not set correctly.
- 6. Is the destination mail address incorrectly set?
 - True Correct the destination mail address in the Setup. (Error mail will be held at the SMTP server if the destination mail address is incorrect. Be sure the send destination mail address is set correctly.)
- 7. Is required information missing from the mail data?
 - True Correct the mail send information settings in the Setup (the user data, error log information, or status data is not set in the send information).
- 8. Was it impossible to obtain the required information from the mail data?
 - True Correct the following errors.
 Correct the user-generated mail address.
 Check the user application to be sure that there is not too much traffic at the Ethernet Unit.
- 9. Is notification given for recurring mail?

True Step 16.

- 10. Is the send status for recurring mail "7"?
 - True Correct mistakes in the Setup Correct the SMTP server address (it is set to 0.0.0.0). Correct the recurring mail send information settings (the user data, error log information, or status data is not set in the send information).
- 11. Is the send status for recurring mail "0"?
 - True If sending recurring mail is not set in the Setup, make the proper settings.

If sending recurring mail is set in the Setup, go to Step 24.

- 12. Is the send status for recurring mail "6"?
 - True Check the communications path. Correct the SMTP server address.

Correct the IP router table.

Something is blocking communications or equipment on the communications path is not set correctly.

- 13. Is the destination mail address incorrectly set?
 - True Correct the destination mail address in the Setup. (Error mail will be held at the SMTP server if the destination mail address is incorrect. Be sure the send destination mail address is set correctly.)
- 14. Is required information missing from the mail data?
 - True Correct the mail send information settings in the Setup (the user data, error log information, or status data is not set in the send information).
- 15. Was it impossible to obtain the required information from the mail data?
 - True Correct the following errors.
 Correct the user-generated mail address.
 Check the user application to be sure that there is not too much traffic at the Ethernet Unit.
- 16. Is notification given for error mail?

True 🖡 End

- 17. Is the send status for error mail "7"?
 - True Correct mistakes in the Setup Correct the SMTP server address (it is set to 0.0.0.0). Correct the error mail send information settings (the user data, error log information, or status data is not set in the send information).
- 18. Is the send status for error mail "0"?
 - True If sending error mail is not set in the Setup, make the proper settings. If sending error mail is set in the Setup, no system errors have occurred and the system should be operating correctly.
- 19. Is the send status for error mail "6"?
 - True Check the communications path. Correct the SMTP server address. Correct the IP router table. Something is blocking communications or equipment on the communications path is not set correctly.
- 20. Is the destination mail address incorrectly set?
 - True Correct the destination mail address in the Setup. (Error mail will be held at the SMTP server if the destination mail address is incorrect. Be sure the send destination mail address is set correctly.)
- 21. Is required information missing from the mail data?
 - True Correct the mail send information settings in the Setup (the user data, error log information, or status data is not set in the send information).
- 22. Was it impossible to obtain the required information from the mail data?
 - True Correct the following errors.

Correct the user-generated mail address.

Check the user application to be sure that there is not too much traffic at the Ethernet Unit.

23. End

24. Check the setting of the mail send timing in the Setup. The timing may not be set or may be set longer than intended.

10-6 Troubleshooting with Response Codes

You can troubleshoot the errors in FINS communications from the response codes when the SEND(090), RECV(098), or CMND(490) instructions have been used. For the storage areas of the response codes refer to information on page 72.

The table below lists response codes (main and sub-codes) returned after execution of FINS commands, the probable cause of errors, and recommended remedies. The response codes provided here are for the Ethernet Unit. Refer to the *FINS Command Reference Manual (W227)* or the operation manuals for the relevant Unit for further information on response codes.

The 6th, 7th, and 15th bits of the response codes have specific functions. The 6th bit will be ON when a non-fatal error has occurred in the PC at the remote node; the 7th bit will be ON when a fatal error has occurred in the PC at the remote node; and the 15th bit will be ON when a network relay error has occurred. Refer to information given after the following table for more information on relay errors.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
			Ma	ain re	spon	ise co	bde	1			Su	b res	spon	se co	de	
	1: Relay Error Flag								.	, 	- 1:	PC N	lon-fa	atal E	rror	Flag
						L .		- 1.	PC F	atal I	Frror	Flag				

Main code	Sub- code	Probable cause	Remedy		
00: Normal completion	00				
01: Local node error	03	Send error in local node was caused by lack of available space in internal buffers.	Reduce the load (traffic) on the Ethernet Unit. Check your user applications.		
	05	The network cannot be accessed because the IP address setting is not correct.	Correct the local IP address.		
	07	The internal buffers are full because there is too much traffic at the local node, preventing data from being sent.	Correct the user application to reduce traffic at the Ethernet Unit.		
02: Remote node error	01	IP address of remote node not set correctly in IP address table or IP router table.	Set IP address of remote node into IP address table and, if internetwork transmission is required, into the IP router table.		
	02	No node with the specified unit address.	Check the remote node's unit address and make sure the correct one is being used in the control data.		
	05	Message packet was corrupted by trans- mission error.	Check the protocol and controller status by reading them with FINS commands. Increase the number of transmit retry attempts.		
		Response time-out, response watchdog timer interval too short.	Increase the value for the response monitor time in the control data.		
		The transmission frame may be corrupted or the internal reception buffer full.	Read out the error log and correct as required.		

Main code	Sub- code	Probable cause	Remedy			
03: Communications controller error	01	Error occurred in the communications controller, ERC indicator is lit.	Take corrective action, referring to troubleshooting procedures in this section.			
	02	CPU Unit error occurred in the PC at the remote node.	Check CPU Unit indicators at the remote node and clear the error in the CPU Unit (refer to the PC's operation manuals)			
	04	Unit number setting error	Make sure the unit number is within the specified range and that the same unit number is not used twice in the same network.			
04: Not executable (Service not	01	An undefined command has been used.	Check the command code and be sure the command is supported by the Unit to which you are sending it.			
supported.)		A short frame (4 bytes) is being used for the FINS header frame.	Check the FINS header frame length. The Ethernet Unit does not support short headers.			
05: Routing error	01	Remote node is not set in the routing tables.	Set the destination address in the routing tables.			
	02	Routing tables aren't registered completely.	Set routing tables at the local node, remote node, and any relay nodes.			
	03	Routing table error	Set the routing tables correctly.			
	04	The maximum number of relay nodes (2) was exceeded in the command.	Redesign the network or reconsider the routing table to reduce the number of relay nodes in the command. Communications are possible on three network levels, including the local network.			
10: Command format error	01	The command is longer than the max. permissible length.	Check the command format of the command and set it correctly. Be sure broadcast transmissions don't exceed 1,473 bytes.			
	02	The command is shorter than min. permissible length.	Check the command format of the command and set it correctly.			
	03	The designated number of data items differs from the actual number in the command data.	Check the number of items and the data, and make sure that they agree.			
	05	Data for another node on the same network was received from the network.	Check the header parameters in the command data and be sure the correct command format is being used.			
		data for a broadcast address.				
11: Parameter error	00	The parameters in the command data are incorrect.	Check the parameters.			
		The UDP/TCP socket number was not within the proper range.	Be sure the socket number is between 1 and 8.			
		The local UDP port number might be set to 0.	Set the Local UDP port number correctly.			
	01	A correct memory area code has not been used or EM Area is not available.	Check the command's memory area code in the Results Storage Area and set the appropriate code.			
	03	The first word is in an inaccessible area or the bit number is not 00.	Set a first word that is in an accessible area. The bit number must be 00 for Ethernet Units.			
	04	The address set in the command is not correct.	Correct the address in the command data, being sure that the start address plus the number of words does not exceed accessible memory.			
	0B	The response frame is too long.	Correct the number of data elements or other parameters in the command data for which the response is being returned.			
	0C	Parameters are set incorrectly in the command data	Check the command data and correct any parameters that are incorrect			

Main code	Sub- code	Probable cause	Remedy
22: Status error (operating mode disagreement)	0F	The same socket service is already in progress at the specified socket number.	Use the socket status flag in PC memory to be sure that socket service has finished before starting services again.
	10	The specified socket is not open.	Open the socket. For TCP sockets, be sure to wait until connection is made.
	11	The internal buffers are full because there is too much traffic at the local node, preventing data from being sent.	Correct the user application to reduce traffic at the Ethernet Unit.
23: Environment error (no such Unit)	05	IP address conversion failed.	Check the IP address and subnet mask in the System Setup and be sure that settings are correct.
	07	IP address conversion is set for automatic conversion only.	Check the mode settings in the System Setup. This error will be generated for the READ IP ADDRESS command only.

Network Relay Errors

For network relay errors using SEND(090) or RECV(098), check the path of the command using the routing tables and the nature of the error using the response code to eliminate the cause of the error.

For network relay errors using CMND(490), the location of the relay error is recorded in the second through third words of the response, as shown below.



10-7 Results Storage Area Response Codes

The response codes stored in the Results Storage Area can be used to troubleshoot socket service problems. Refer to 6-2 Using Socket Services with Socket Service Request Switches or 6-3 Using Socket Services with CMND(490) for the location of the response codes stored in the Results Storage Area.

The UNIX socket service error messages corresponding to the response codes are given in the following table. Refer to the documentation for the devices involved when communicating between an Ethernet Unit and other devices.

Response code	UNIX error message	Description	Probable remedy
0003	ESRCH	No such process	Close the local socket and try reopening it.
0006	ENXIO	No such device or address	
0009	EBADF	Bad file number (incorrect socket specification)	
000D	EACCES	Permission denied (Broadcast address specified for re- mote IP address for active TCP open)	Check the IP address of the remote node and try to reconnect.

Response code	UNIX error message	Description	Probable remedy	
000E	EFAULT	Bad address (copy failed between kernel and user area)	Close the local socket and try reopening it.	
0011	EEXIST	File exists		
0016	EINVAL	Invalid argument (socket library ar- gument error)		
0018	EMFILE	Too many open files (More than 32 sockets)		
0020	EPIPE	Broken pipe (remote node closed socket)	Close the local socket.	
003C	EPROTONO- SUPPORT	Protocol not supported (protocol other than UDP, TCP, or RAW specified)	Close the local socket and try reopening it.	
003D	EPROTOTYPE	Protocol wrong type for socket		
003E	ENOBUFS	No buffer space available	There is too much load (traffic) on the Ethernet Unit. Check your user applications.	
003F	EISCONN	Socket is already connected (con- nection attempted to open socket)	Close the local socket and try reopening it.	
0040	ENOTCONN	Socket is not connected (send at- tempted to closed socket)		
0041	EALREADY	Operation already in progress (con- nection attempted to existing non- block connection)		
0042	EMSGSIZE	Message too long	Check the length of send data.	
			UDP or TCP: 1 to 1,982 bytes UDP broadcasts: 1 to 1,472 bytes	
0043	EDESTADDRREQ	Destination address required (des- tination address not specified)	Close the local socket and try reopening it.	
0044	ENOPROTOOPT	Protocol not available (unsupported option specified)		
0045	ECONNABORTED	Software caused connection abort (another task closed socket)		
0046	EINPROGRESS	Operation now in progress (non- block connection ended during pro- cessing)		
0047	ENOTSOCK	Socket operation on non-socket]	
0048	EOPNOTSUPP	Operation not supported on socket	.et	
0049	EADDRINUSE	Address already in use (UDP or	Check the port number.	
		TCP open request sent for port al- ready in use)	TCP ports can remain unusable for 1 min after closing.	
004A	ECONNREFUSED	Connection refused (TCP socket (active open) processing refused by remote node)	Passively open a remote TCP socket, check- ing the remote IP address and remote TCP port number.	
004B	ECONNRESET	Connection reset by peer (TCP socket closed by remote node)	Close the local socket and try reconnecting.	
004C	EADDRNOTAVAIL	Can't assign requested address (mistake in remote IP address)	Check the setting of the remote IP address and try reconnecting.	
004D	EAFNOSUPPORT	Address family not supported by protocol family	Close the local socket and try reopening it.	
004E	ENETUNREACH	Network is unreachable	Set the path to the remote node in the IP router table.	
004F	EHOSTDOWN	Host is down	Check the remote host and communications path.	
0050	EWOULDBLOCK	Operation would block	Close the local socket and try reopening it.	
0051	EHOSTUNREACH	No route to host	The specified node does not exist on the des- ignated IP network segment. Check the com- munications path.	

Response code	UNIX error message	Description	Probable remedy	
0053	ETIMEDOUT	Connection timed out (TCP timed out)	Check the remote host and communications path.	
0063	ESELABORT	Used for internal Ethernet Unit pro- cessing	bro- Close the local socket and try reopening it.	
0066	(None)	Internal memory cannot be allocated for processing; the service cannot be provided.	Traffic is too high at the Ethernet Unit. Correct the user application to reduce traffic at the Ethernet Unit.	
0080	(None)	Timed out for passive TCP open re- quest	Either the remote node is not executing an ac- tive TCP open or there is a block on the net- work.	
0081	(None)	Closed by close command during socket servicing	No action is necessarily called for.	
0082	(None)	Connection with remote node not achieved for passive TCP open re- quest	The remote IP address and TCP port number settings differ from those of the remote socket (active side).	

SECTION 11 FINS Commands Addressed to Ethernet Units

This section describes the FINS commands that can be sent to an Ethernet Unit and the responses that are returned by the Ethernet Unit.

11-1	Comma	nd Codes and Response Codes
	11-1-1	Command Code List
	11-1-2	Response Code List
11-2	Socket .	Applications
	11-2-1	Format
	11-2-2	PC Memory Areas
11-3	Comma	nd/Response Reference
	11-3-1	RESET
	11-3-2	CONTROLLER DATA READ
	11-3-3	CONTROLLER STATUS READ
	11-3-4	INTERNODE ECHO TEST
	11-3-5	BROADCAST TEST RESULTS READ
	11-3-6	BROADCAST DATA SEND
	11-3-7	ERROR LOG READ
	11-3-8	ERROR LOG CLEAR
	11-3-9	UDP OPEN REQUEST
	11-3-10	UDP RECEIVE REQUEST
	11-3-11	UDP SEND REQUEST
	11-3-12	UDP CLOSE REQUEST
	11-3-13	PASSIVE TCP OPEN REQUEST
	11-3-14	ACTIVE TCP OPEN REQUEST
	11-3-15	TCP RECEIVE REQUEST
	11-3-16	TCP SEND REQUEST
	11-3-17	TCP CLOSE REQUEST
	11-3-18	PING
	11-3-19	IP ADDRESS TABLE WRITE
	11-3-20	IP ADDRESS TABLE READ
	11-3-21	IP ROUTER TABLE READ
	11-3-22	PROTOCOL STATUS READ
	11-3-23	MEMORY STATUS READ
	11-3-24	SOCKET STATUS READ
	11-3-25	ADDRESS INFORMATION READ

11-1 Command Codes and Response Codes

11-1-1 Command Code List

The command codes listed in the following table can be sent to an Ethernet Unit.

Comma	nd code	Name	Page
MRC	SRC		
04	03	RESET	193
05	01	CONTROLLER DATA READ	193
06	01	CONTROLLER STATUS READ	195
08	01	INTERNODE ECHO TEST	196
	02	BROADCAST TEST RESULTS READ	197
	03	BROADCAST DATA SEND	197
21	02	ERROR LOG READ	197
	03	ERROR LOG CLEAR	198
27	01	UDP OPEN REQUEST	199
	02	UDP RECEIVE REQUEST	200
	03	UDP SEND REQUEST	201
	04	UDP CLOSE REQUEST	203
	10	PASSIVE TCP OPEN REQUEST	204
	11	ACTIVE TCP OPEN REQUEST	206
	12	TCP RECEIVE REQUEST	207
	13	TCP SEND REQUEST	209
	14	TCP CLOSE REQUEST	210
	20	PING	211
	50	IP ADDRESS TABLE WRITE	212
	60	IP ADDRESS TABLE READ	213
	61	IP ROUTER TABLE READ	214
	62	PROTOCOL STATUS READ	215
	63	MEMORY STATUS READ	219
	64	SOCKET STATUS READ	221
	65	ADDRESS INFORMATION READ	221

11-1-2 Response Code List

Response codes are 2-byte codes which indicate the results of command execution. They are returned in the response following the command code.

The first byte of a response code is the MRES (main response code), which categorizes the results of command execution. The second byte is the SRES (sub-response code) which specifies the results.

Com code	mand	Resp code	onse	
MRC	SRC	MRE		s

MRC: Main request code SRC: Sub-request code MRES: Main response code SRES: Sub-response code The MRES codes are shown in the following table along with the results they indicate. Refer to *10-6 Troubleshooting with Response Codes* for details on response codes including the SRES.

MRES	Execution results
00	Normal completion
01	Local node error
02	Remote node error
03	Unit error (controller error)
04	Service not supported
05	Routing error
10	Command format error
11	Parameter error
22	Status error
23	Operating environment error
25	Unit error

11-2 Socket Applications

The format of the following FINS commands partially differs when the sockets are used.

Command code		Name	Page
MRC	SRC		
27	01	UDP OPEN REQUEST	199
	02	UDP RECEIVE REQUEST	200
	03	UDP SEND REQUEST	201
	04	UDP CLOSE REQUEST	203
	10	PASSIVE TCP OPEN REQUEST	204
	11	ACTIVE TCP OPEN REQUEST	206
	12	TCP RECEIVE REQUEST	207
	13	TCP SEND REQUEST	209
	14	TCP CLOSE REQUEST	210

11-2-1 Format

The basic format of these commands is shown in the diagram below.



Command Code	Specifies the requested process.
Socket Number	Specifies the socket number for which the process is requested, from 1 to 8.
Results Storage Area	Specifies the area to store the results of the requested process.
Parameters	Specifies the parameters for the command code. Parameters depend on the command being executed; for details, refer to the following pages.

11-2-2 PC Memory Areas

The memory areas of the PC that can be specified for results storage when executing commands from the PC are listed in the table below. The *Variable type* is set in the first byte of the results storage area. The remaining three bytes contain the address for communications.

Addresses in the *Addresses for communications* column are not the same as the actual memory addresses.

Memory area	Da	ta type	Word addresses	Addresses for communications	Variable type	Bytes
Bit Areas	Current	CIO	CIO 0000 to CIO 6143	000000 to 17FF00	B0 (80)*	2
	value of	HR	H000 to H511	0A0000 to 01FF00	B2	
	word	А	A448 to A959	0B0000 to 03BF00	B3	
DM Area		DM	D00000 to D32767	000000 to 7FFF00	82	2
EM Area		Bank 0	E0_E00000 to E0_E32765	000000 to 7FFF00	A0 (90)*	2
		Bank 1	E1_E00000 to E1_E32765	000000 to 7FFF00	A1 (91)*	
		Bank 2	E2_E00000 to E2_E32765	000000 to 7FFF00	A2 (92)*	
		Bank 3	E3_E00000 to E3_E32765	000000 to 7FFF00	A3 (93)*	
		Bank 4	E4_E00000 to E4_E32765	000000 to 7FFF00	A4 (94)*	
		Bank 5	E5_E00000 to E5_E32765	000000 to 7FFF00	A5 (95)*	
		Bank 6	E6_E00000 to E6_E32765	000000 to 7FFF00	A6 (96)*	
		Bank 7	E7_E00000 to E7_E32765	000000 to 7FFF00	A7 (97)*	
		Bank 8	E8_E00000 to E8_E32765	000000 to 7FFF00	A8	2
		Bank 9	E9_E00000 to E9_E32765	000000 to 7FFF00	A9	2
		Bank A	EA_E00000 to EA_E32765	000000 to 7FFF00	AA	2
		Bank B	EB_E00000 to EB_E32765	000000 to 7FFF00	AB	2
		Bank C	EC_E00000 to EC_E32765	000000 to 7FFF00	AC	2
		Current bank	E00000 to E32765	000000 to 7FFF00	98	2

Note The variable types (area designations) given in parentheses can also be used, allowing CV-series or CVM1 programs to be more easily corrected for use with CS1-series PCs.

Word and Bit Addresses Three bytes of data are used to express data memory addresses of PCs. The most significant two bytes give the word address and the least significant byte gives the bit number between 00 and 15. The word address combined with the bit number expresses the bit address. The bit number is always 00 because Ethernet Units can handle only word data, i.e., individual bits cannot be addressed.



Word addresses for specific memory area words can be calculated by converting the normal decimal word address to hexadecimal and adding it to the first word in the *Addresses for communications* column in the above table. For example, the address for communications for D00200 would be 0000 (from above table) plus C8 (decimal 200 converted to hexadecimal), or 00C8.

11-3 Command/Response Reference

This section describes the FINS commands that can be sent to Ethernet Units and the responses to each command.

The command, response, and (where applicable) the results storage blocks are given with the commands in graphic form as shown in the following diagram. If the data is fixed, it is included in the blocks. If the data is variable, it is described following the blocks. Each box represents 1 byte; ever two boxes; 1 word. The following diagram shows 2 bytes, or 1 word.



The results storage format is the format used to store transfer results and data for socket services requested with command codes 2701 to 2714.

Response codes applicable to the command are described at the end of the command description. If any UNIX error codes are generated, these are also described. Refer to your UNIX error symbol definition file /usr/include/sys/errno.h for details. UNIX errors are returned in the results storage area.

11-3-1 RESET

Command Block

Reset the Ethernet Unit.

Response

code

04	03	
Comm code	nand	

03

04

code

Command

Response Block

Precautions

No response will be returned if the command ends normally. A response will be returned only if an error occurs.

In some cases, send requests (SEND(192)/RECV(193) instructions) made from the PC to the Ethernet Unit just before execution of the RESET command may not be executed.

Except for the FINS communications service sockets, all open sockets (for sockets services, FTP server, or mail transmission) are closed immediately before resetting.

Response Codes

Response code	Description
1001	Command too large

11-3-2 CONTROLLER DATA READ

Reads the following data from the Ethernet model, version, IP address, subnet mask, FINS UDP port number, mode settings, Ethernet address.

Command Block

05	01
Comr code	nand

Response Block

05	01		20 bytes	20 bytes	4 bytes	4 bytes			6 bytes
Com code	mand	Response code	Model	Version	IP address	Subnet mask	FINS UDP	Mode setting	Ethernet address

Parameters

Model, Version (Response)	The Ethernet Unit mo ing 20 bytes each (i.e. ing bytes will be all sp	de and version are returned as ASCII characters occupy, 20 characters each). If all bytes are not used, the remain- baces (ASCII 20 Hex).			
	Example Model:	CS1W-ETN01			
	Version:	V1.00			
IP Address, Subnet Mask (Response)	The Ethernet Unit's IF	P address and subnet mask are returned as 4 bytes each.			
FINS UDP Port Number (Response)	The Ethernet Unit's UDP port number for FINS is returned as 2 byte				
Mode Setting (Response)	The mode setting in t	he system setup is returned.			
	Bit 15				

Broadcast Setting

- 0: All 1s for host number (4.3BSD specification)
- 1: All 0s for host number (4.2BSD specification)

IP Address Conversion

- 00, 01: Automatic generation
- 10: IP address table
- 11: Both methods (IP address table + automatic generation)

FINS UDP Port Number Designation

- 0: Default value (9600)
- 1: System setup value

Ethernet Address (Response) The Ethernet address of the Ethernet Unit is returned. The Ethernet address is the address marked on the label on the side of the Ethernet Unit.

Response Codes

Response code	Description		
0000	Normal		
1001	Command too large		

Broadcast setting IP address conversion FINS UDP port number

designation

11-3-3 CONTROLLER STATUS READ

Reads the controller status.

Command Block

06	01
Com code	mand

Response Block

06	01			2 bytes	4 bytes	4 bytes	4 bytes	4 bytes	4 bytes
Comr code	mand	Resp code	onse	Error flags	Total number of packets received	Total number of receive errors	Total number of packets sent	Total number of errors sent	Total number of send collisions

Parameters

Error Flags (Response)

Indicates the operating status and errors that occurred when the Ethernet Unit was started.



The cause of each error is listed below.

Transceiver Echo Test Error

An error occurred during the self diagnostic testing after the Unit was turned on or reset.

IP Address Error

All bits for the network number or host number are set to 0 or 1.

IP Address Table Error

More than 32 records exist in the IP address table.

IP Router Table Error

More than 8 records exist in the IP router table.

Routing Table Error

Local network table contains 0 or more than 16 records. Relay network table contains more than 20 records.

Transceiver Error

The transceiver cable is disconnected or the transceiver is defective.

Address Disagreement

The address conversion method was set for automatic generation, but the node number and the last byte of the local IP address do not agree, or other host sections are 0.

EEPROM Error

An error occurred in the EEPROM memory in the Ethernet Unit.

Total Number of Packets Received (Response)	The total number of packets received by the Ethernet Unit is returned.
Total Number of Receive Errors (Response)	The total number of errors detected while the Ethernet Unit was receiving is re- turned. The types of error detected are short packet errors, alignment errors, and CRC errors.
Total Number of Packets Sent (Response)	The total number of packets sent by the Ethernet Unit is returned.
Total Number of Errors Sent (Response)	The total number of packet errors detected while the Ethernet Unit was sending is returned.
Total Number of Send Collisions	The number of packets damaged by 16 collisions with data from other nodes during Ethernet Unit transmissions.
<u>Precautions</u>	Counting of the total number of packets received, total number of receive errors, total number of packets sent, total number of errors sent, and total number of send collisions is discontinued when the counted value reaches the maximum value.

Response Codes

Response code	Description
0000	Normal
1001	Command too large

11-3-4 INTERNODE ECHO TEST

Runs the echo test between specified nodes.

	Re	spon	se code	Dese	cription
<u>Response Codes</u>	— ——			-	
	Alwa tion.	iys sp	ecify the u	nit address of the Ethernet	Unit in the CMND(194) instruc-
	The instr	test d uction	estination operands	node is the destination noc.	le specified in the CMND(194)
Precautions					
<u>Parameters</u> Test Data (Command, Response)	This bytes cified spor	comm s can d in th ise dif	nand speci be specifie e comman fers from t	fies the data to be sent to th ed. The response sends bac d. An abnormality is assume he test data sent.	ne specified nodes. Up to 1,998 k data identical to the data spe- ed if the data returned in the re-
D	code	imand ;	Response code	lest data	
<u>Response Block</u>	08	01		1,998 bytes max.	
	Com	imand ?		Test data	_
Command Block	08	01		1,998 bytes max.	

Respense sede	
0000	Normal
1001	Command too large
1002	Command too small (No test data)

11-3-5 BROADCAST TEST RESULTS READ

Reads the results (number of times data received) of the broadcast test.

08	02				
Comi code	mand				
08	02				
Comi	mand	Resp code	onse	Tim	es eived

Parameters

Times Received (Response)

The number of times the data has been received normally during the broadcast send test is returned as a hexadecimal number. The number of times received is cleared each time the result is read.

Response Codes

Command Block

Response Block

Response code	Description
0000	Normal
1001	Command too large

11-3-6 BROADCAST DATA SEND

Sends test data simultaneously to all nodes on the network.

Command Block

08	03	1,460 bytes max.
Command code		Test data

Parameters

Test Data (Command)

This command specifies the data to be sent to the specified nodes. Up to 1,460 bytes can be specified.

Precautions

No response is made to this command.

When using this command, set the FINS header parameters (or the control data for the CMND(194) instruction) as follows:

Destination node number: Destination unit address: Response/no response flag: FF (broadcast data) FE (Ethernet Unit) 1 (no response)

11-3-7 ERROR LOG READ

Reads the error log.



Parameters

Beginning Record Number (Command)

The first record to be read. The first record number can be specified in the range between 0000 and 003F (0 to 63 decimal) where 0000 is the oldest record.

Command/Response Reference

Number of Records (Command, Response)

Maximum Number of Stored Records (Response)

The number of records to read is specified between 0001 and 0040 (1 to 64 decimal) in the command. The response returns the actual number of records read.

The maximum number of records that can be stored in the error log. Care is required as the error log differs according to the type of PC or CPU Bus Unit. In an Ethernet Unit, the maximum number of stored records is fixed at 40 (64 decimal).

The number of records stored at the time the command is executed is returned.

Number of Stored Records (Response)

Error Log Data (Response)

The specified number of error log records from the beginning record number is returned sequentially. The total number of bytes in the error log is calculated as the number of records x 10 bytes/record. Each error log record thus comprises 10 bytes, configured as follows:



Error Code, Detailed Information

Details of the error stored in the record. Refer to *Section 10 Troubleshooting* for details.

Minute, Second, Day, Hour, Year, Month

Indicate the time at which the error stored in the record occurred.

Precautions

If the error log contains fewer records than the number specified in the number of records parameter, all records stored in the error log at the time the command is executed will be returned and the command executed will end normally.

Response Codes

Response code	Description
0000	Normal
1001	Command too large
1002	Command too small
1103	Beginning record number is out of range
110C	The number of read records is 0.

11-3-8 ERROR LOG CLEAR

Clears the number of records stored in the Ethernet Unit error log.

Command Block



Response Block

code				
21	03			
-		_		

Command Response code

Response Codes

Response code	Description
0000	Normal
1001	Command too large

Section 11-3

11-3-9 UDP OPEN REQUEST

Requests processing to open a socket.

<u>Command Block</u>	27 01 Command code	UDP socket number	Results storage area	Local UDP port number	
<u>Response Block</u>	27 01 Command code	Response code			
<u>Results Storage Format</u>	Results stor response co	age			
<u>Parameters</u> UDP Socket Number (Command)	The UDP s	socket nun	nber to be opened sp	ecified as 2	bytes between 1 and 8.
Results Storage Area (Command)	The area in specifies the specify the details abo	n which the he memory beginning but the var	e results of the comma y area and data type address of the result iable types and addre	nd execution (variable typ s storage are esses that ca	are stored. The first byte e). The 2nd to 4th bytes ea. Refer to page 192 for an be specified.
Local UDP Port Number (Command)	The UDP p (0 cannot b specified in UDP socke ber (defau	port numbe be specified in the UDP et to this po It value 96	er for communications d). Packets received a socket number, and s ort. The port number s 00) cannot be used.	with the sock t this port are send packets specified as t	et is specified as 2 bytes distributed to the socket are distributed from the he FINS UDP port num-

Response Codes

Response code	Description
0000	Normal
0105	Local IP address setting error
0302	CPU Unit error; execution not possible.
1001	Command too large
1002	Command too small
1100	UDP socket number is out of range.
	Local UDP port number is 0.
1101	The variable type for the results storage area is out of range.
1103	Non-zero bit address specified for the results storage area.
220F	Specified socket is already open or is being closed.
2211	High traffic at Unit; cannot execute service.

Results Storage Area Response Codes

Response code	Description
0000	Normal
003E	Internal buffer cannot be reserved due to high receive load (ENOBUFS).
0049	Duplicate UDP port number (EADDRINUSE).

11-3-10 UDP RECEIVE REQUEST

Requests that data be sent from a UDP socket.

Command Block	27 02					
	Command code	d UDP socket number	Results s	torage area	Number of reception bytes	Timeout value
<u>Response Block</u>	27 02 Comman code	d Respons code	se			
Results Storage Format						Received bytes
	Results storage respons code	66 66	Source IP address	Source UDP port number	Number of reception bytes	Received data
Parameters						
UDP Socket Number (Command)	The UDF	o socket nu	umber to rec	eive data s	specified as	2 bytes between 1 and 8.
Results Storage Area (Command)	The area specifies specify th details al	in which t the memo ne beginni bout the v	he results of ory area and ng address o ariable type:	the comma d data type of the resul s and addr	and executio (variable ty ts storage a resses that	on are stored. The first byte ype). The 2nd to 4th bytes area. Refer to page 192 for can be specified.
Number of Reception Bytes (Command, Results Storage Area)	The maximum number of bytes of data to be received is given in the command. The number of bytes of data received will be stored in the results storage area. Up to 1,984 bytes can be specified.					
Timeout Value (Command)	The max the result as the res out time	imum con t. If this set sults stora will be unl	trol time bet t time limit is ge response imited if the	tween rece exceeded, code. The value is se	tiving the re the code fo value is set to 0.	ceive request and storing r a timeout error will be set in units of 0.1 s. The time-
Source IP Address (Results Storage Area)	The IP a	ddress of	the node se	nding data	l.	
Source UDP Port Number (Results Storage Area)	The port	number o	f the node s	ending dat	ta.	
Received Data (Results Storage Area)	The data	sent from	the remote	node.		
Precautions	lf a packe <i>Number</i> bytes wil	et is receiv of reception I be stored	ved which co on bytes spe d and the re	ontains mo ecified in th mainder of	re bytes that the command the bytes v	an the number specified in d, the specified number of vill be discarded.

Response Codes

Response code	Description
0000	Normal
0105	IP address setting error
0302	CPU Unit error; execution not possible.
1001	Command too large
1002	Command too small
1100	UDP socket number or number of reception bytes is out of range.
1101	The variable type for the results storage area is out of range.
1103	Non-zero bit address specified for the results storage area.
220F	The specified socket is currently receiving data.
2210	The specified socket is not open.
2211	High traffic at Unit; cannot execute service.

Results Storage Area Response Codes

Response code	Description
0000	Normal
003E	Internal buffer cannot be reserved due to high reception load (ENOBUFS).
0066	Internal memory cannot be allocated; cannot execute service.
0080	A receive request timeout error occurred.
0081	The specified socket was closed while receiving data.

11-3-11 UDP SEND REQUEST

Requests that data be received by a UDP socket.

Command Block



Destination UDP Port Number (Command)

Number of Bytes Sent (Command, Results Storage Area) The UDP port number of the node to which data is being sent.

The number of bytes in the data sent by this command. Up to 1,984 bytes can be specified, or up to 1,472 bytes can be specified if the broadcast address is specified as the send destination. The results storage area stores the actual number of bytes sent.

Send Data (Command)

Response Codes

Specifies the data sent to the remote node.

Response code	Description
0000	Normal
0105	Local IP address setting error
0302	CPU Unit error; execution not possible.
1001	Command too large
1002	Command too small
1003	The number of bytes sent does not match the sent data length.
1100	UDP socket number or number of bytes sent is out of range. The destination IP address is 0. Local UDP port number is 0.
1101	The variable type for the results storage area is out of range.
1103	Non-zero bit address specified for the results storage area.
220F	Specified socket is currently sending.
2210	The specified socket is not open.
2211	High traffic at Unit; cannot execute service.

Results Storage Area Response Codes

Response code	Description
0000	Normal
003E	Internal buffer cannot be reserved due to high reception load (ENOBUFS).
0042	The send destination IP address is a broadcast address and the number of bytes sent exceeds 1,472. (EMSGSIZE)
004C	Incorrect network number. Incorrect destination IP address (EADDRNOTAVAIL).
004E	Incorrect destination IP address (ENETUNREACH). No network number in IP router table. Router incorrectly set.
0051	Router incorrectly specified. Incorrect destination IP address (EHOSTUNREACH).

UDP CLOSE REQUEST 11-3-12

Requests processing to close a socket.

Commond Diodi								1
Command Block	27	04	'			1	1	1
	Com code	mand	UDP sock num	et ber	Re	sults	storage	e area
<u>Response Block</u>	27	04						
	Com code	imand e	Resp code	onse				
Results Storage Format								
	Resp code	oonse e						
Parameters								

UDP Socket Number (Command)

The UDP socket number to be closed specified as 2 bytes between 1 and 8.

Results Storage Area (Command)

The area in which the results of the command execution are stored. The first byte specifies the memory area and data type (variable type). The 2nd to 4th bytes specify the beginning address of the results storage area. Refer to page 192 for details about the variable types and addresses that can be specified.

Response Codes

Response code	Description
0000	Normal
0105	Local IP address setting error
0302	CPU Unit error; execution not possible.
1001	Command too large
1002	Command too small
1100	UDP socket number is out of range.
1101	The variable type for the results storage area is out of range.
1103	Non-zero bit address specified for the results storage area.
2210	Specified socket is not open.
2211	High traffic at Unit; cannot execute service.

Results Storage Area Response Codes

Response code	Description
0000	Normal

11-3-13 PASSIVE TCP OPEN REQUEST

Requests processing to open a TCP socket. The socket will wait to be connected to another node.

Command Block

	27	,	10																	
	Cc co	omm de	and	TCF sock num	ket Nber	Re	sults st	orage	area	Loc TC por nur	al P t nber	Time valu	eout e	Ren add	note IF ress)	1	Remot port nu	te TCF umber)
<u>Response Block</u>						27 Comr	10	Pesp	0250											
							code	nanu	code	01150										
<u>Resul</u>	ts	Sto	ora	ge F	orm	<u>at</u>	1		1											
						L	Respo code	onse		Remo addres	te IP ss		Remo numbe	te por er	t					
Param	net	ers	5																	
TCP So (Comm	an	et N d)	lum	ber		-	The T	CP s	ocket	t num	ber to	o be d	opene	d spe	cified	d as :	2 byte	es bet	tweer	n 1 and 8.
Results (Comm	s St and	ora d)	ige .	Area		- 9 0	The a specif specif details	rea in ies th y the s abo	i whic ne me begii out the	th the mory nning e vari	resul area addro able t	ts of t a and ess o types	he cor data t f the re and a	nmar ype (esults iddre	nd exe varia s stora sses	ecutio ble ty age a that	on are /pe). area. can b	e store The 2 Refer be spe	ed. Th 2nd to to pa ecifieo	e first byte 9 4th bytes 9ge 192 for 9.
Local T (Comm Storage	CP and e A	Po d, F rea	ort N lesu)	lumb Ilts	er	- (The T (0 car #21).	CP p not b	ort nu be spe	imbei ecifie	r for c d). Do	ommi o not :	unicati specify	ons v y the	vith th port i	ne so numt	cket i ber of	s spea the F	cified TP s	as 2 bytes erver (port
Timeout Value (Command)						, - I t t	The m result the re time is	naxim . If thi sults s unli	ium c s set stora mitec	ontro time ge res I if the	l time limit is spons e valu	e betw s exce se coo ie is s	veen re eeded, de. The set to (eceivi , the (e valu).	ng th code ie is s	e op for a set in	en re timec units	quest out err s of 0.2	and : or wil 1 s. T	storing the Il be set as he timeout
Remote (Comm Storage	ldre lesi)	ss Ilts		; ; ; ;	Specify the remote node's IP address. If all zeroes are set, no remote node is specified and connection is awaited from any node. If any other value is set, connection is awaited from the specified remote node. The IP address of the connected remote node will be stored in the results storage area.															
Remote Port Number (Command, Results Storage Area)						: - -	Specify the remote TCP port number with this command. If all zeroes are set, no remote TCP port number is specified. If any other value is set, it specifies the TCP port number of the remote node. The TCP port number of the connected remote node will be stored in the results storage area.													
<u>Preca</u>	<u>uti</u>	<u>on</u>	<u>s</u>			l	Proce pinatio	ssing on of	ı varie remc	es as ote IP	show addr	/n in t ess a	he tab nd rer	ole be note	low a TCP	accor port	ding numb	to the per.	spec	cified com-
							R	emot addre	e IP ss		Rem	ote T(port	CP			l	Descr	iption)	
						ŀ	0			0	ľ	-			00000	tion r		to roo	aivad	

Response Codes

Response code	Description
0000	Normal
0105	Local IP address setting error
0302	CPU Unit error; execution not possible.
1001	Command too large
1002	Command too small
1100	TCP socket number is out of range.
	Local TCP port number is 0.
1101	The variable type for the results storage area is out of range.
1103	Non-zero bit address specified for the results storage area.
220F	The specified socket (connection) is already open or is currently being opened.
2211	High traffic at Unit; cannot execute service.

Results Storage Area Response Codes

Response code	Description
0000	Normal
003E	Internal buffer cannot be reserved due to high reception load (ENOBUFS).
0042 (see note)	An error occurred (EMSGSIZE).
0045	A communication error occurred with the remote node (ECONNABORTED).
0049	Duplicated port numbers (EADDRINUSE).
004A (see note)	An error occurred (ECONNREFUSED).
004B (see note)	A communication error occurred with the remote node (ECONNRESET).
004E (see note)	A parameter error occurred at the remote IP address (ENETUNREACH).
0051 (see note)	A parameter error occurred at the remote IP address (EHOSTUNREACH).
0053	A communication error occurred with the remote node (ETIMEDOUT). No remote exists.
0066	Internal memory cannot be allocated; cannot execute service.
0080	An open request timeout error occurred.
0081	Socket was closed during opening procedure.
0082	Connection could not be established with the specified remote.

Note These errors occur only in large multilayered networks.

11-3-14 ACTIVE TCP OPEN REQUEST

Requests processing to open a TCP socket. The socket will be connected to another node.

Command Block	27	11					I			1			
	Com code	imand 9	TCP socke numb	et ber		Result area	s sto	rage	Local TCP port number	Remo addres	te IP ss		Remote TCP port number
<u>Response Block</u>		27 Comr	11 mand	Resp	ponse	e							
Results Storage Form	<u>nat</u>	Resp	onse	Loc	al p	Dort							
Parameters													
TCP Socket Number (Command)		The ⁻	TCP s	socke	et nu	umbe	r to l	be ope	ned specifie	d as 2 by	/tes l	oetwee	n 1 and 8.
Results Storage Area (Command)		The a speci speci detai	area i ifies t ify the Is abo	n whie he m e begi out th	ch th emc innir ie va	ne res ory ar ng ad ariabl	sults ea a dres e typ	of the nd dat s of the bes an	command ex a type (varia e results stor d addresses	ecution a able type) age area that can	re sto . The . Ref be s	ored. T e 2nd t fer to pa specifie	he first byte o 4th bytes age 192 for d.
Local TCP Port Number (Command, Results Storage Area)		The ⁻ (0 ca #21).	TCP p nnot An a	bort n be sp waila	umb becif ble	ber for ied). TCP	r cor Do r port	nmunic iot spe numbe	cations with t cify the port er is automat	he socke number tically as	t is sp of the signe	pecified FTP s ed if 0 is	l as 2 bytes server (port s specified.
Remote IP Address (Command)		Spec	ify th	e rem	note	node	e's IF	P addre	ess (must be	e non-zer	o).		
Remote Port Number (Command)		Spec	ify th	e rem	note	TCP	por	t numb	oer (must be	non-zero	o).		

Response Codes

Response code	Description
0000	Normal
0105	Local IP address setting error
0302	CPU Unit error; execution not possible.
1001	Command too large
1002	Command too small
1100	TCP socket number is out of range. Remote IP address is 0. Remote TCP port number is 0.
1101	The variable type for the results storage area is out of range.
1103	Non-zero bit address specified for the results storage area.
220F	The specified socket (connection) is already open or is being opened.
2211	High traffic at Unit; cannot execute service.
Results Storage Area Response Codes

Response code	Description
0000	Normal
000D	A parameter error occurred at the remote IP address (EACCES).
003E	Internal buffer cannot be reserved due to high receive load (ENOBUFS).
0042 (see note)	An error occurred (EMSGSIZE).
0044	Received ICMP data (ENOPROTOOPT).
0045	Local socket closed (ECONNABORTED).
0049	Duplicated port numbers (EADDRINUSE).
004A	An error occurred (ECONNREFUSED). Passive remote is not available.
004B (see note)	A communication error occurred with the remote node (ECONNRESET).
004C	A parameter error occurred at the remote IP address (EADDRNOTAVAIL). A parameter was specified incorrectly. An attempt was made to actively open local TCP port.
004E	A parameter error occurred at the remote IP address (ENETUNREACH). No network number in IP router table or incorrect router setting.
0051	A parameter error occurred at the remote IP address (EHOSTUNREACH). Incorrect router setting.
0053	A communication error occurred with the remote node (ETIMEDOUT). No remote exists.
0081	Socket was closed during opening procedure.

Note These errors occur only in large multilayered networks.

11-3-15 **TCP RECEIVE REQUEST**

Requests that data be sent from a TCP socket.

Command Block		1							
	27	12		1					
	Comm code	and	TCP socke numbe	t er	Result area	s storage	Number of reception bytes	Timeout value	
<u>Response Block</u>	27	12							
	Comm code	nand	Resp code	onse					
Results Storage Format						Received by	tes		
	Respo code	nse	Numbe receptio bytes	r of on	Receiv	ed data			
<u>Parameters</u>									
TCP Socket Number (Command)	The T	CP s	ocket	num	ber to rec	eive data s	pecified as 2	2 bytes bet	ween 1 and 8.
Results Storage Area (Command)	The a specif specif detail	rea ir ies th y the s abo	n which ne me begin out the	n the mory ining varia	results of area and address able type	the comma d data type of the result s and addre	and execution (variable typ ts storage ar esses that c	n are store pe). The 2 rea. Refer an be spe	d. The first byte nd to 4th bytes to page 192 for cified.
Number of Reception Bytes (Command, Results Storage Area)	The n The n Up to	naxim umbe 1,98	num ni er of b 4 byte	umbe ytes s cai	er of bytes of data re n be spec	s of data to ceived will cified.	be received be stored in	is given in the result	the command. s storage area.

Timeout Value (Command)	The maximum control time between receiving the receive request and storing the result. If this set time limit is exceeded, the code for a timeout error will be set as the results storage response code. The value is set in units of 0.1 s. The time- out time is unlimited if the value is set to 0
	out time is unlimited if the value is set to 0.

Received Data (Results Stores the received data. Storage Area)

Response Codes

Response code	Description
0000	Normal
0105	Local IP address setting error
0302	CPU Unit error; execution not possible.
1001	Command too large
1002	Command too small
1100	TCP socket number or number of reception bytes is out of range.
1101	The variable type for the results storage area is out of range.
1103	Non-zero bit address specified for the results storage area.
220F	The specified socket is receiving data.
2210	No connection could be established to the specified socket.
2211	High traffic at Unit; cannot execute service.

Results Storage Area Response Codes

Response code	Description
0000	Normal
003E	Internal buffer cannot be reserved due to high receive load (ENOBUFS).
0042 (see note)	Received ICMP data (EMSGSIZE).
0044 (see note)	Received ICMP data (ENOPROTOOPT).
0045 (see note)	A communication error occurred with the remote node (ECONNABORTED).
004B	A communication error occurred with the remote node (ECONNRESET).
004E (see note)	Incorrect destination IP address (ENETUNREACH). No network number in IP router table. Router incorrectly set.
004F (see note)	Received ICMP data (EHOSTDOWN).
0051 (see note)	Received ICMP data (EHOSTUNREACH). Router incorrectly set.
0053	A communications error occurred with the remote node (ETIMEDOUT).
0066	Internal memory cannot be allocated; cannot execute service.
0080	A receive request timeout error occurred.
0081	Socket was closed while receiving.

Note These errors occur only in large multilayered networks.

11-3-16 TCP SEND REQUEST

Requests that data be received at a TCP socket.

Command Block									
Command Block	27 13					1,984 bytes max.			
	Command code	TCP socket number	Results storaç area	ge N b	lumber of oytes sent	Data sent			
<u>Response Block</u>	27 13 Command code	Response							
<u>Results Storage Format</u>	Response code	Number of bytes sent							
Parameters									
TCP Socket Number (Command)	The TCP s	ocket numb	er to send th	ne data sp	ecified as	s 1 byte between 1 and 8.			
Results Storage Area (Command)	The area in which the results of the command execution are stored. The first specifies the memory area and data type (variable type). The 2nd to 4th the specify the beginning address of the results storage area. Refer to page 19 details about the variable types and addresses that can be specified.								
Number of Bytes Sent (Command, Results Storage Area)	The numberstorage are	er of bytes ir ea stores th	n the data sei le actual nun	nt specifie nber of by	ed betwee /tes sent.	n 1 and 1,984. The results			
Data Sent (Command)	Specifies t	he data to t	be sent.						

Response code	Description
0000	Normal
0105	Local IP address setting error
0302	CPU Unit error; execution not possible.
1001	Command too large
1002	Command too small
1003	The number of bytes sent does not match the amount of data.
1100	The TCP socket number or number of bytes sent is out of range.
1101	The variable type for the results storage area is out of range.
1103	Non-zero bit address specified for the results storage area.
220F	The specified socket is sending data.
2210	No connection could be established to the specified socket.
2211	High traffic at Unit; cannot execute service.

Results Storage Area Response Codes

Response code	Description
0000	Normal
0020	Connection to the remote socket was broken during transmission (EPIPE).
003E	Internal buffer cannot be reserved due to high receive load (ENOBUFS).
0042 (see note)	An error occurred (EMSGSIZE).
0044 (see note)	Received ICMP data (ENOPROTOOPT).
0045 (see note)	A communication error occurred with the remote node (ECONNABORTED).
004B (see note)	A communication error occurred with the remote node (ECONNRESET).
004E (see note)	A parameter error occurred at the remote IP address (ENETUNREACH).
004F (see note)	Received ICMP data (EHOSTDOWN).
0051 (see note)	A parameter error occurred at the remote IP address (EHOSTUNREACH).
0053 (see note)	A communication error occurred with the remote node (ETIMEDOUT).
0081	The specified socket was closed during transmission.

Note These errors occur only in large multilayered networks.

11-3-17 TCP CLOSE REQUEST

Requests processing to close a TCP socket. Other processing being carried out is forcibly ended and a code is recorded in the results storage area.

Command Block]
Command Block	27	14				· I		
	Comm code	and	TCP socke numb	t er	Result: area	s storaç	je	1
<u>Response Block</u>	27	14	Poor					
	code	anu	code	;				
<u>Results Storage Format</u>	Respo	nse						
Parameters								
TCP Socket Number (Command)	The T	CP s	ocket	numl	ber to be	close	d spe	cified as 2 bytes between 1 and 8.
Results Storage Area (Command)	The a specif specif details	rea ir ies th y the s abo	n whick ne me begir but the	n the i mory ining a varia	results of area and address o able types	the co I data of the s and	ommar type (results addre	nd execution are stored. The first byte variable type). The 2nd to 4th bytes s storage area. Refer to page 192 for sses that can be specified.
<u>Precautions</u>	Any of this clo in the	ther p ose c resu	oroces comma lts sto	sing, and is rage	such as s execute area to ir	sendin d will I ndicate	ng or re be forc e that	eceiving data, being carried out when bibly ended and a code will be stored this processing was forcibly ended.

Response Codes

Response code	Description								
0000	Normal								
0105	Local IP address setting error								
0302	CPU Unit error; execution not possible.								
1001	Command too large								
1002	Command too small								
1100	The TCP socket number is out of range.								
1101	The variable type for the results storage area is out of range.								
1103	Non-zero bit address specified for the results storage area.								
2210	No connection could be established to the specified socket.								
2211	High traffic at Unit; cannot execute service.								

Results Storage Area Response Codes

Response code	Description
0000	Normal

11-3-18 PING

Equivalent processing to the UNIX computer ping command (see below).

Command Block

Command Block	27	20		1	1	l I		
	Comr code	nand	Des	stinatio	n IP ac	dress	Timeout value	_
<u>Response Block</u>	27	20						
	Comm code	nand	Resp code	onse				
Parameters								
Destination IP Address (Command)	The II packe	P add et.	lress	of the	e des	tinatio	on node f	or the PING command echo request
Timeout Value (Command)	The w time is not re result	vait tin s set a ceive s stor	ne for at 20 d with age r	the e secor in the espo	echo r nds if set ti nse c	eply p the va me lir ode.	backet. Th alue is spe nit, the co	e value is set in seconds. The timeout ecified as 0. If the echo reply packet is de for a timeout error will be set as the
<u>Remarks</u>								
	PING	Com	man	d				
	The F PING	VING of comr	comr nand	nand i is ex	uns ti ecute	he ec d, an	hoback te echo requ	st using the ICMP protocol. When the lest packet is sent to the remote node

col. When the remote node ICMP. Correct communications are confirmed when the returned response packet is received normally. The echo reply packet is automatically returned by the remote node ICMP. Refer to 9-2 PING Command.

Response Codes

Response code	Description
0000	Normal (echo reply received from the remote node)
0205	Timeout error
1001	Command too large
1002	Command too small
1100	Zero destination address
220F	PING command currently being executed
2211	High traffic at Unit; cannot execute service.

11-3-19 IP ADDRESS TABLE WRITE

Writes the IP address table.

Command Block	27 50		6 bytes	6 bytes
	Command code	Number of records	IP addre table recor	dess rds
<u>Response Block</u>	27 50 Command code	Response code		
Parameters				
Number of Records (Command)	The numbe mal) in the so that no	er of records command. records are	s to write is specifi If this value is set e registered.	ied between 0000 and 0020 (0 to 32 deci- t to 0, the IP address table will be cleared
IP Address Table Records	Specify the	e IP addres	s table records. T	he number of records specified must be

IP Address Table Records (Command) Specify the IP address table records. The number of records specified must be provided. The total number of bytes in the IP address table records is calculated as the number of records x 6 bytes/record. The configuration of the 6 bytes of data in each record is as shown in the following diagram.



FINS Node Number

Node number for communications via the FINS command.

IP Address

IP address used by TCP/IP protocol.

Precautions

The new I/O address table records will not be effective until the PC is restarted or the Ethernet Unit is reset.

An error response will be returned if the IP address conversion method in the system mode settings is set for automatic generation.

Response code	Description
0000	Normal (echo reply received from the remote node)
1001	Command too large
1002	Command too small
1003	The number of records specified does not match the sent data length.
110C	The number of records is not between 0 and 32. The FINS node number is not between 1 and 126 The IP address is 0.
2307	IP address conversion method is set for automatic generation.

11-3-20 IP ADDRESS TABLE READ

Reads the IP address table.

Response Block

27	60]								
Comm code	nand	Numb record	er of Is									
27	60									6 bytes		6 bytes
Comm code	and	Respo code	onse	Maxin numb of sto recor	aximum umber stored cords		mber red ords	Nu of rec	mber ords	IP add	lress tabl	le records

Parameters

Number of Records (Command, Response)	The number of records to read is specified between 0000 and 0020 (0 to 32 deci- mal) in the command. If this value is set to 0, the number of stored records is returned but the IP address table records are not returned. The response returns the actual number of records read.
Maximum Number of Stored Records (Response)	The maximum number of records that can be stored in the IP address table is returned. The maximum number of stored records is fixed at 32.
Number of Stored Records (Response)	The number of IP address table records stored at the time the command is executed is returned as a hexadecimal number.
IP Address Table Records (Response)	The number of IP address table records specified in the number of records parameter is returned. The total number of bytes in the IP address table records is calculated as the number of records x 6 bytes/record. The configuration of the



6 bytes of data in each record is as shown in the following diagram.

FINS Node Number

Node number for communications via the FINS command.

IP Address

IP number used by TCP/IP protocol.

Precautions

If the IP address table contains fewer records than the number specified in the *number of records* parameter, all the records contained in the IP address table when the command is executed will be returned and the command execution will end normally.

An error response will be returned if the IP address conversion method in the system mode settings is set to the automatic generation method.

Response code	Description
0000	Normal
1001	Command too large
1002	Command too small
2307	IP address conversion method is set to the automatic generation method.

11-3-21 IP ROUTER TABLE READ

Reads the IP router table.

Command Block	27 61 Command code	Number of records							
<u>Response Block</u>	27 61					8 bytes	8 bytes		
	Command code	Response code	Maximum number of stored records	Number of stored records	Number of records	IP router tab	le records		
Parameters									
Number of Records (Command, Response)	The numb mal) in the returned b turns the a	The number of records to read is specified between 0000 and 0008 (0 to 8 deci- mal) in the command. If this value is set to 0, the number of stored records will be returned but the IP router table records will not be returned. The response re- turns the actual number of records read.							
Maximum Number of Stored Records (Response)	The maximum number of records that can be stored in the IP router table is re- turned. The maximum number of stored records is fixed at 0008 (8 records).								
Number of Stored Records (Response)	The number of IP router table records stored at the time the command is executed is returned.								
IP Router Table Records (Response)	The numb eter is retu lated as th of data in	er of IP rou Irned. The e number o each recor	ter table re total numb of records > d is showr	ecords specer er of bytes k 8 bytes/re h below.	cified in the in the IP ro ecord. The	number of rec outer table reco configuration o	<i>ords</i> param- rds is calcu- f the 8 bytes		



IP Address

The network ID from the IP address in hexadecimal. The network ID part corresponding to the address class (determined by the leftmost 3 bits; refer to 1-7 IP Addresses) set here, is enabled.

Router IP Address

The IP address of a router connected to a network specified with IP addresses.

Precautions

If the IP router table contains fewer records than the number specified in the *number of records* parameter, all the records contained in the IP router table when the command is executed will be returned and the command execution will end normally.

Response code	Description
0000	Normal
1001	Command too large
1002	Command too small

11-3-22 PROTOCOL STATUS READ

Reads the Ethernet Unit protocol status.

Command Block	27 62						
	Command code						
Response Block	27 62 48 bytes 184 bytes 184 bytes 12 bytes						
	Command Response IP status ICMP status TCP status UDP status code						
Parameters							
IP Status (Response)	Twelve types of IP status information occupying 4 bytes each are returned in the following sequence. Each value is returned as an 8-digit hexadecimal value.						
1, 2, 3	1. Total number of IP packets received.						
	The number of IP packets discarded due to an error with the checksum in the packet header.						
	The number of IP packets discarded because the received packet was larg- er than the overall packet length value in the packet header.						
	4. The number of IP packets discarded because the minimum size of the IP header data could not be stored in the first short buffer when an attempt was made to store the packet. Refer to 11-3-23 MEMORY STATUS READ and Appendix F Buffer Configuration.						
	5. The number of packets discarded for one of the following reasons:						
	 The IP header length value in the IP header was smaller than the smallest size of the IP header. 						
	 The size of the first short buffer was smaller than the IP header length value in the IP header when storing the packet. 						
	The number of IP packets discarded because the IP header length was larg- er than the overall packet length value in the packet header.						
	7. The number of fragmented packets received.						
	The number of received fragmented IP packets discarded because a queue for reassembly could not be secured.						
	The number of fragmented IP packets discarded because they could not be reassembled within 12 seconds after being received.						
	10. Always 0.						
	 The number of packets addressed to other networks that have been dis- carded. 						
	12. Always 0.						
ICMP Status (Response)	Ten types (46 items) of ICMP status information occupying 4 bytes each are re- turned in the following sequence. Each value is returned as an 8-digit hexadeci- mal value.						
1, 2, 3	 The number of times the ICMP error routine was called. The ICMP error rou- tine uses ICMP packets to inform the source about errors. The routine is called when an illegal packet is received (error in IP option processing or error in relay processing) or if the object port does not exist when using UDP. 						
	∠. Aiways 0. 3. Always 0.						

4. Total number of outputs of each packet type during ICMP output. The 19 statistical values are returned in the order shown below. Contents are defined for 13 types only; all other types contain 0. Only #0, #3, #14, #16, and #18 are counted by the Ethernet Unit.

#0	#1	#2	#3	#4	#5	to	#15	#16	#17	#18
							-			

4 bytes

Type number	Description
#0	Echo reply
#1, #2	Undefined, always 0
#3	Destination unreachable
#4	Source quench
#5	Routing redirect
#6, #7	Undefined, always 0
#8	Echo
#9, #10	Undefined, always 0
#11	Time exceeded
#12	Parameter problem
#13	Time stamp
#14	Time stamp reply
#15	Information request
#16	Information request reply
#17	Address mask request
#18	Address mask reply

- 5. The number of received ICMP packets discarded because the type-indication code was out of range.
- 6. The number of received ICMP packets discarded because the overall packet length value in the packet header was smaller than the minimum ICMP packet length.
- 7. The number of received ICMP packets discarded because of an incorrect checksum value in the packet header.
- 8. The number of received ICMP packets discarded because the ICMP header length value in the packet header did not match the lengths of individual header types.
- 9. The number of responses returned to received ICMP packets requiring a response.

Command/Response Reference

10. Total number of inputs of each packet type during ICMP input. The 19 statistical values are returned in the order shown below. Contents are defined for 13 types only; all other types contain 0.

#0	#1	#2	#3	#4	#5	to	#15	#16	#17	#18
4										

4 bytes

Type number	Description
#0	Echo reply
#1, #2	Undefined, always 0
#3	Destination unreachable
#4	Source quench
#5	Routing redirect
#6, #7	Undefined, always 0
#8	Echo
#9, #10	Undefined, always 0
#11	Time exceeded
#12	Parameter problem
#13	Time stamp
#14	Time stamp reply
#15	Information request
#16	Information request reply
#17	Address mask request
#18	Address mask reply

TCP Status (Response)

Three types (46 items) of TCP status information occupying 4 bytes each are returned in the following sequence. Each value is returned as an 8-digit hexadecimal value.

1) Connection Information (60 Bytes)

Fifteen items are returned in the following sequence:

- 1, 2, 3... 1. The number of times active connections were correctly established.
 - 2. The number of times a SYN packet was received while waiting to establish a passive connection.
 - 3. The number of times active or passive connections were correctly established.
 - 4. The number of times an established connection was cut off.
 - 5. The number of times the connection wait status was cut off.
 - 6. The number of times protocol control blocks or other actively allocated structures were released.
 - 7. The number of segments for the round-trip time (time from segment transmission to ACK).
 - 8. The number of times the round-trip time was changed.
 - 9. The number of times a delayed acknowledgement (ACK) was sent. If the order of the received segments is reversed, ACK is sent with a packet of data separate from ACK (response to input data, etc.) or is immediately sent with the ACK for other data.
 - 10. The number of times the connection was cut off because no ACK was returned after several resend attempts.
 - 11. The number of times no ACK was returned within the resend timer set time. (The resend timer sets the maximum time limit between the data being output and ACK being returned.)

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- 12. The number of times no window advertisement is received within the time set on the duration timer. (The duration timer sets the maximum time limit for a window advertisement to be received if the transmission window is smaller than necessary and the resend timer is not set. If no window advertisement is received within the time limit, the number of segments permitted by the transmission window are sent. If the transmission window is set to 0, a window probe (1 octet of data) is sent before the timer restarts.)
- 13. The number of times no segment was sent or received within the time set on the hold timer.
- 14. The number of times the hold packet is resent. (Always 0.)
- 15. The number of times the hold packet is sent without response before the connection is cut off.

2) Send Information (40 Bytes)

Ten information items are returned in the following sequence:

- 1, 2, 3... 1. The total number of packets sent.
 - 2. The number of data packets sent.
 - 3. The number of data bytes sent.
 - 4. The number of data packets resent.
 - 5. The number of data bytes resent.
 - 6. The number of ACK packets sent.
 - 7. The number of window probes (1 octet of data) sent.
 - 8. The number of emergency data packets sent. (Always 0.)
 - 9. The number of window advertisement packets sent.
 - 10. The number of control packets (SYN, FIN, RST) sent.

3) Receive Information

Twenty-one information items are returned in the following sequence:

- 1, 2, 3... 1. The total number of packets received.
 - 2. The number of packets received continuously.
 - 3. The number of bytes received continuously.
 - 4. The number of received packets discarded due to an incorrect checksum.
 - 5. The number of packets discarded because the TCP header was smaller than the minimum size for a TCP header or was larger than the IP packet.
 - 6. The number of packets discarded because the TCP header and IP header could not be stored in the first short buffer.
 - 7. The number of resent packets received.
 - 8. The number of bytes in the resend packets.
 - 9. The number of duplicated resend packets received.
 - 10. The number of bytes in the duplicated resend packets received.
 - 11. The number of out-of-range data packets received. (Always 0.)
 - 12. The number of bytes in the out-of-range data packets received. (Always 0.)
 - 13. The number of packets where the data was larger than the window.
 - 14. The number of bytes in the packets where the data was larger than the window.
 - 15. The number of packets received after closing.
 - 16. The number of window probe packets received.
 - 17. The number of resent ACK packets received.
 - 18. The number of ACK packets received with no data set.
 - 19. The number of ACK packets received.

- 20. The number of ACK packets received for received transmission acknowledgements (ACK). 21. The number of window advertisement packets received. Three items of UDP information occupying 4 bytes each are returned in the fol-UDP Status (Response) lowing sequence. Each value is returned as an 8-digit hexadecimal value. 1, 2, 3... 1. The number of packets discarded because the size of the first short buffer was smaller than the minimum size (28) of the IP header and UDP header when the packet was stored. 2. The number of packets discarded due to an incorrect checksum in the UDP header. 3. The number of packets discarded because the IP overall length in the IP header was shorter than the UDP overall length in the UDP header. **Precautions** All the above values are set to 0 if network operation stops due to incorrect settings in the system setup. Counting will be stopped when a count reaches the maximum value. The maximum values are as follows:
 - IP, ICMP, or UDP status: 7FFFFFF (2,147,483,647 decimal) TC status: FFFFFFF (4,294,967,295 decimal)

Response Codes

Response code	Description
0000	Normal
1001	Command too large

MEMORY STATUS READ 11-3-23

Reads the status of the Ethernet Unit's network memory. The network memory contains 196K bytes that are used as required as for communications buffers for communications servicing. The network memory consists of 1,056 short buffers (128 bytes each) and 64 long buffers (1,024 bytes each). Refer to Appendix C Buffer Configuration.

Command Block	27	63]		
	Comma code	and	1		
<u>Response Block</u>	27	63		92 bytes	
	Comma code	and	Response code	Memory status	
Parameters					
Memory Status (Response)	A total consis	of 2 ts o	23 data ite f 4 bytes.	ms in six areas	are returned in the following order. Each item
1. 2. 3	1. Sł	nort	Buffer Ap	plication: Two	items are returned (8 bytes).

- ytes).
 - a) The number of short buffers currently being used.
 - b) The number of short buffers in the system (fixed at 1,056 decimal).
 - 2. Short Buffer Application by Type: Thirteen items are returned (52 bytes).
 - a) The number of short buffers used for storing communications data.
 - b) The number of short buffers used for protocol headers (TCP, UDP, IP, ICMP, ARP)
 - c) The number of short buffers used in socket structures

- d) The number of short buffers used as protocol control blocks
- e) The number of short buffers used for routing tables
- f) Not used (always 0)
- g) Not used (always 0)
- h) The number of short buffers used for IP fragment re-assembly queue headers
- i) The number of short buffers used for storing socket addresses
- j) Not used (always 0)
- k) The number of short buffers used for storing socket options
- I) The number of short buffers used for storing access rights
- m) The number of short buffers used for storing interface addresses
- 3. Long Buffer Application: Two items are returned (8 bytes).
 - a) The number of long buffers currently being used.
 - b) The number of long buffers in the system (fixed at 64 decimal).
- 4. Not Used: Always 0. (4 bytes)
- 5. Network Memory Application: Two items are returned.
 - a) The number of bytes used (in K bytes)
 - b) The percentage used.
- 6. Memory Exhaustion Log (12 bytes)

Counts for the following values indicate a high load on the Ethernet Unit. These high loads may be caused by problems in communications, particularly FINS communications and UDP sockets. If these values are consistently high, check your applications.

- a) The number of times an attempt was made to secure a short buffer without WAIT when there were no short buffers available.
- b) The number of times an attempt was made to secure a short buffer with WAIT when there were no short buffers available.
- c) The number of times an attempt was made to release and secure a short buffer already being used by another socket when there were no short buffers available.

Precautions

All the above values are set to 0 if Ethernet communications functions are stopped due to improper settings in the system setup.

These values are cleared when the Ethernet Unit is started or reset. Values will be counted only until the maximum values are reached.

Response code	Description
0000	Normal
1001	Command too large

11-3-24 SOCKET STATUS READ

Reads the Ethernet Unit network socket status.

Command Block

Response Block

27 64		
Command code	-	
27 64		32 bytes
Command code	Response code	Socket status

Parameters

Socket Status (Response)

Returns eight types of information in records of 32 bytes each. A maximum of 64 records can be returned. The format of each record is shown below.

Protocol

The protocol used for the socket is returned as a number. 00 00 00 06: TCP; 00 00 00 11: UDP

Receive Queue

The number of bytes in the reception queue.

Send Queue

The number of bytes in the send queue.

Local IP Address

The local IP address allocated to the socket.

Local Port Number

The local port number allocated to the socket.

Remote IP Address

The remote IP address allocated to the socket.

Remote Port Number

The remote port number allocated to the socket.

TCP Transitions

The TCP connection status is returned as one of the numbers shown in the following table. Refer to *Appendix D TCP Status Transitions* for a diagram of transitions.

Number	Stage	Status
00 00 00 00	CLOSED	Closed.
00 00 00 01	LISTEN	Waiting for connection.
00 00 00 02	SYN SENT	SYN sent in active status.
00 00 00 03	SYN RECEIVED	SYN received and sent.
00 00 00 04	ESTABLISHED	Already established.
00 00 00 05	CLOSE WAIT	Received FIN, waiting to close.
00 00 00 06	FIN WAIT 1	Completed and FIN sent.
00 00 00 07	CLOSING	Completed and exchanged FIN. Awaiting ACK.
00 00 00 08	LAST ACK	FIN sent and completed. Awaiting ACK.
00 00 00 09	FIN WAIT 2	Close completed and ACK received. Awaiting FIN.
00 00 00 0A	TIME WAIT	After closing, pauses twice the maximum segment life (2MSL).

Precautions

All the above values are set to 0 if Ethernet communications functions are stopped due to improper settings in the system setup.

Response Codes

Response code	Description
0000	Normal
1001	Command too large

11-3-25 ADDRESS INFORMATION READ

Reads FINS node numbers and IP addresses

Command Block

27	65	
Comr code	nand	

Response Block

27	65			6 bytes
Comm code	nand	Response code	Number of addresses	Address information

Parameters

Number of Addresses (Response)

The number of pairs of FINS node numbers and IP addresses being returned. The Ethernet Unit is always 0001 (1 decimal).

Address Information

Pairs of FINS node numbers and IP addresses. Each pair requires 6 bytes and has the following configuration.



FINS Node Number

Node number set on the Ethernet Unit (hexadecimal).

IP Address

IP address set on the Ethernet Unit (hexadecimal).

Response code	Description
0000	Normal
1001	Command too large

Appendix A Network Installation

Basic Installation Precautions

- Take the greatest care when installing the Ethernet System, being sure to follow ISO 8802-3 specifications. You must obtain a copy of these specifications and be sure you understand them before attempting to install an Ethernet System. Unless you are already experienced in installing communications systems, we strongly recommend that you employ a professional to install your system.
- Do not install Ethernet equipment near sources of noise. If noise-prone environments are unavoidable, be sure to take adequate measures against noise interference, such as installing network components in grounded metal cases, using optical links in the system, etc. Further information on measures that can be taken against noise is given later in this section.

Recommended Products

The following products are recommended for use with the CS1W-ETN01 Ethernet Unit.

Part	Company	Model
Transceiver	Hirakawa Hewtech Corp.	MTX-210TZ
	Mitsubishi Cable Industries,Ltd.	ET-10081
Transceiver cable	Mitsubishi Cable Industries,Ltd.	Transceiver cables (molded type)
24-VDC Power Supply	OMRON	S82J Series

Coaxial Cable Installation Precautions

Basic Precautions

- As a rule, always lay coaxial cables indoors. Laying coaxial cables outdoors requires special measures that should be performed only by a professional. If coaxial cable must be used outdoors, request the work from a professional.
- Attach a terminator to each end of the coaxial cable.
- Cover all exposed metal portions of the coaxial cable except ground points with protective covers or PVC tape to prevent contact with grounds or other metal objects.
- Ground the external shield of the coaxial cable to 100 W or less using AWG 14 wire (cross-sectional area of 2 mm²) or better and a ground cable length of 20 m or less. Ground each segment of the network at one location only. Do not use the same ground for other equipment.
- The physical properties (e.g., minimum bending radius) of coaxial cable vary with the manufacturer. Follow all recommendations and specifications of the manufacturer.

Environmental Precautions

- Do not install coaxial cables together with power cables.
- Do not install coaxial cable near sources of noise.
- Do not install coaxial cable in environments subject to excessive dirt, dust, oil mist, etc.
- Do not install coaxial cable in environments subject to high temperatures or high humidity.

Terminator Installation Precautions

- You must attach a Terminator to each end of the coaxial cable for communications to be possible.
- Insulate Terminators when attaching them to be sure they do not come into contact with metal objects.

Transceiver Installation Precautions

- Transceivers can be attached to coaxial cables only at intervals of 2.5 m. These locations should be marked on the cable.
- Connection methods can vary with the manufacturer of the cable. Follow all recommendations and specifications of the manufacturer.
- Mount the transceiver onto an insulating object, such as a wooden board.
- Ground the transceiver through the shield of the transceiver cable and through the Ethernet Unit.
- Do not install transceivers near sources of noise.
- Do not install coaxial cable in environments subject to excessive dirt, dust, oil mist, etc.
- Do not install coaxial cable in environments subject to high temperatures or high humidity.

Transceiver Cable Installation Precautions

- Make sure that the transceiver cable is firmly and completely connected to both the transceiver and the Ethernet Unit. Be sure that the slide latches are engaged.
- Do not install transceiver cables together with power cables.
- Do not install transceiver cable near sources of noise.
- Do not install transceiver cable in environments subject to high temperatures or high humidity.

Grounding

- Ground all devices requiring grounding to 100 W or less using AWG 14 wire (cross-sectional area of 2 mm²) or better and a ground cable length of 20 m or less. Electrical shock can occur between ungrounded devices in the system. The lack of proper grounds can also corrupt data.
- Use one safety ground on each segment of the network.
- Inductive voltages can be generated due to lightning surges when coaxial cable is installed outdoors, requiring special measures. Request outdoor installation from a professional.

Transceiver Installation Examples

The following illustrations show examples of installing transceivers in the ceiling and under the floor.



Ceiling Installation

Free-access Floor Installation

Ceiling Installation Examples



Installation Examples for Noise-prone Environments

Ethernet networks do not withstand noise very well and require special installation measures if installed where subject to noise. The remainder of this section describes measures for dealing with noise.

Note Although the measures described in this section are suitable to certain levels of noise, programming retries in communications will still be required. Although some protocols provide for automatic retries, UDP/IP (FINS communications and UDP sockets) does not, and the user must program retries in user applications.

Metal Ducts

- 1, 2, 3... 1. Place the coaxial cable in metal ducts.
 - 2. Place transceivers into metal boxes, placing a wooden board or other insulating board between the box and the transceiver. The transceiver and the metal box must be electrically insulated from each other.
 - 3. If the transceiver cable is also in a noise-prone area, place it into a metal duct as well.



4. Refer to the CS1-series CS1G/H-CPU□□-E Programmable Controllers Operation Manual (W339) for information on wiring inside distribution boxes.



- **Note** 1. Cover all metal portions of cables with insulating tape to be sure they do not come into contact with the metal ducts or boxes.
 - 2. Securely ground all distribution boxes and metal boxes around transceivers. The lower the ground resistance, the more effective the shields will be.

Multipoint Transceivers

Multipoint transceivers can be used to eliminate the need for coaxial cable (which is easily affected by noise) and replace it with transceiver cable as shown in the following diagram. This will increase overall system resistance to noise.

Note Up to two sets of multipoint transceivers can be used in a network. The length of the network will be limited to the maximum length of transceiver cable.



Optical Ethernet Systems

Some manufacturers provide optical fiber components for Ethernet networks to provide high resistance to noise. The following illustrations show some simple examples of optical installations. See the manufacturer for specifics.

Use as Noise Countermeasure

The following illustration shows how optical components can be used to convert to optical fiber cable through areas highly prone to noise.



Outdoor Installations

The following example shows how optical fiber cable can be used to connect a network between two buildings, eliminating possible adverse affects of lightning.



Note Consult with the manufacturer for details on optical Ethernet devices.

Using Contact Outputs

Communications errors can occur when Contact Output Units are mounted to the same Rack as an Ethernet Unit due to noise generated by the contact outputs. Use one or more of the following measures when installing Contact Output Units and Ethernet Units on the same Rack.

Mounting Location

Mount any Contact Output Units as far away from the Ethernet Unit as possible.



Cable Location

Separate the transceiver cable connecting the Ethernet Unit as far from the wiring to the Contact Output Units as possible. The coaxial cable must also be placed as far away from the Contact Output Units and their wiring as possible.



Transceiver Measures

Attach several ferrite cores designed for EMI countermeasures on the transceiver cable near the transceiver. The transceiver must also be placed as far away from the Contact Output Units and their wiring as possible.



Appendix B Ethernet Network Parameters

Parameter	Value	Description
TCP send buffer	4,096 bytes	Maximum capacity of the TCP send buffer
TCP receive buffer	4,096 bytes	Maximum capacity of the TCP receive buffer
UDP send buffer	9,000 bytes	Maximum capacity of the UDP send buffer
UDP receive buffer	9,016 bytes	Maximum capacity of the UDP receive buffer
RAW send buffer	2,048 bytes	Maximum capacity of the RAW send buffer
RAW receive buffer	2,048 bytes	Maximum capacity of the RAW receive buffer
FINS receive buffer	16,383 bytes	Maximum capacity of the FINS receive buffer
Hold timer	75 s (12 min max.)	The hold timer is used for active open processing of TCP sockets. A ETIMEDOUT error will occur if connection is not completed within 75 s.
Resend timer	Initial value: 1 s Maximum value: 64 s	The resend timer is used to monitor completion of reception of arrival confirmations when transferring data via socket services, including FTP server and mail transfer TCP sockets. If the timer setting is exceeded before arrival confirmation is received, data is resent. Resends are performed from the first timeout (1 s) through the 12th timeout (64 s). A ETIMEDOUT error will occur after the 12th timeout.
Continue timer	Initial value: 5 s Maximum value: 60 s	The continue timer starts if preparations have been completed to send data but the send window is too small (either 0 or too small) to send the data and the remote node has not requested that communications be restarted. Confirmation of the window size is requested from the remote node when the continue timer times out. The initial value of the timer is 5 s and confirmation processing will continue consecutively with increasingly longer times until the maximum time of 60 s is reached.
2MSL timer	60 s	The 2MSL timer starts at the TCP socket that first closes the socket and will run for 60 s in the TIME_WAIT status.
IP reassemble timer	12 s	A fragmented IP packet is discarded if it cannot be reassembled within 12 seconds.
ARP timer	20 min/3 min	If a complete ARP table entry (with an Ethernet address) is not referred to for 20 minutes, it is removed from the table.
		An incomplete ARP table entry (no response yet returned to the ARP request) is removed from the table after 3 minutes.
Window size	4,096 bytes	The initial value of the maximum capacity used to control the convergence of TCP sockets. Actually, the node negotiates with the remote node and uses the smaller of the values for the two nodes. The window size will fluctuate with the available space in the TCP reception buffers of the remote node when processing communications.
Fragment size	1,500 bytes	UDP data is separated into 1,472-byte fragments. The remaining 28 bytes are for the IP header.
Segment size	1,024 bytes	TCP data is separated into 1,024-byte units, unless the segments are different, in which case it will be separated into 536-byte units.
TTL (Time to Live)	30	Decremented each time an IP router is passed.

Appendix C Buffer Configuration



Network Memory

Most of the buffers used for communications servicing by the Ethernet Unit are administered in a buffer configuration called network memory. Network memory consists of 196K bytes of memory divided into short and long buffers. The use of short and long buffers is determined by the status of the various services when the Ethernet Unit is running. The capacity of all buffers cannot be used due to limits in the mounted memory capacity. The status of the short and long buffers can be accessed by execution the FINS command MEMORY STATUS READ (2763).

- **Note** 1. The status of UDP and TCP socket reception request buffers can be accessed by executing the FINS command SOCKET STATUS READ (2764).
 - 2. The status of UDP and TCP socket send request buffers can be accessed by executing the FINS command SOCKET STATUS READ (2764).

Appendix D TCP Status Transitions

The TCP socket status can be confirmed using the socket status data returned for the FINS command SOCKET STATUS READ (2764).



Appendix E Auxiliary Area Data

The following table and descriptions cover the words and bits in the Auxiliary Area of PC memory that are related to the Ethernet Unit.

Read-only Bits/Words

Word(s)	Bit(s)	Name	Function	Settings
A202	A20200 to A20207	Communications Port Enabled Flags	Bits A20200 to A20207 turn ON when a network instruction (SEND, RECV, CMND, or PMCR) can be executed with the corresponding port number. Bits 00 to 07 correspond to communications ports 0 to 7.	0: Network communications running 1: No network communications
				running
A203 to A210		Communications Port Completion Codes	These words contain the completion codes for the corresponding port numbers when network instructions (SEND, RECV, CMND, or PMCR) have been executed. Words A203 to A210 correspond to communications ports 0 to 7.	0000: No error Not 0000: Error code
A219	A21900 to A21907	Communications Port Error Flags	Bits A21900 to A21907 turn ON when an error occurred during execution of a network instruction (SEND, RECV, CMND, or PMCR). Bits 00 to 07 correspond to communications ports 0 to 7.	0: Normal end 1: Error end
A302	A30200 to	CPU Bus Unit	0: Not initializing	
	A30215	Initializing Flags	corresponding CPU Bus Units (Units #0 through #15, respectively) are initializing. The bits will turn ON either when power is turned ON or when a CPU Bus Unit Restart Bit (A50100 to A50115) is turned ON.	1: Initializing (System will automatically turn the flag OFF when initilization has been complted.)
A402	A40203	CS1 CPU Bus Unit Setting Error Flag (Non-fatal error)	Bit A40203 is turned ON when the CPU Bus Units actually installed differ from the Units registered in the I/O table. The ERR/ALM indicator on the front of the CPU Unit will flash, but CPU operation will continue.	0: No setting error 1: Setting error
			The unit number of the CPU Bus Unit involved is stored in word A427.	
	A40207	CS1 CPU Bus Unit Error Flag	Bit A40207 is turned ON when an error occurs during the transmission of data between the CPU	0: No unit number error
		(Non-fatal error)	and CPU Bus Units. The ERR/ALM indicator on the front of the CPU Unit will flash, but CPU operation will continue. The Unit where the error occurred will stop.	1: Unit number error
			The unit number of the CPU Bus Unit involved is stored in word A422.	
A403	A40300 to	Memory Error	When a memory error occurs, the Memory Error	0: Normal
	A40308	Location	Flag (A40115) is turned ON and one of the following flags is turned ON to indicate the memory area where the error occurred.	1: Error
			A40300: User program A40304: PC Setup A40305: Registered I/O Table A40307: Routing Table A40308: CS1 CPU Bus Unit Settings	
			The ERR/ALM indicator on the front of the CPU Unit will light and CPU operation will stop.	

Word(s)	Bit(s)	Name	Function	Settings
A410	A41000 to A41015	CS1 CPU Bus Unit Number Duplication Flags	The Duplication Error Flag (A40113) and the corresponding flag in A410 will be turned ON when a CS1 CPU Bus Unit's unit number has been duplicated. Bits 00 to 15 correspond to unit	0: No duplication 1: Duplication
			numbers 0 to F. The ERR/ALM indicator on the front of the CPU Unit will light and CPU operation will stop.	
A417	A41700 to A41715	CS1 CPU Bus Unit Error, Unit Number Flags	When an error occurs in a data exchange between the CPU Unit and a CS1 CPU Bus Unit, the CS1 CPU Bus Unit Error Flag (A40207) and the corresponding flag in A417 are turned ON. Bits 00 to 15 correspond to unit numbers 0 to F.	0: No error 1: Error
			The ERR/ALM indicator on the front of the CPU Unit will flash, but CPU operation will continue.	
A427	A42700 to A42715	CS1 CPU Bus Unit Setting Error, Unit Number Flags	When a CS1 CPU Bus Unit Setting Error occurs, A40203 and the corresponding flag in A27 are turned ON. Bits 00 to 15 correspond to unit numbers 0 to F.	0: No setting error 1: Setting error
			The ERR/ALM indicator on the front of the CPU Unit will flash, but CPU operation will continue.	

Read/Write Bits

Word	Bits	Name	Description	Settings
A501	A50100 to A50115	CPU Bus Unit Restart Bits	Bits A50100 through A50115 can be turned ON to reset CPU Bus Units number #0 through #15, respectively. The Restart Bits are turned OFF automatically when restarting is completed. The CPU Bus Unit Initializing Flags (A30200 to A30215) will turn ON when initialization of the Units begins and turn OFF when it is completed.	OFF to ON: Unit restarted. Automatically turned OFF by system after restart processing has been completed.

Appendix F CPU Bus Unit Allocations in the CPU Unit

The CPU Bus Units, including Ethernet Units, are allocated words in the CPU Unit's CIO Area and DM Area according to the unit numbers. This appendix is provided for easy reference. For details, refer to *Section 4 System Setup and Memory Allocations*.

CIO Area Allocations

Each Unit is allocated 25 words in the CIO Area, as shown in the following table.

Unit No. (decimal)	Allocated words	Unit No. (decimal)	Allocated words
0 (0)	CIO 1500 to CIO 1524	8 (8)	CIO 1700 to CIO 1724
1 (1)	CIO 1525 to CIO 1549	9 (9)	CIO 1725 to CIO 1749
2 (2)	CIO 1550 to CIO 1574	A (10)	CIO 1750 to CIO 1774
3 (3)	CIO 1575 to CIO 1599	B (11)	CIO 1775 to CIO 1799
4 (4)	CIO 1600 to CIO 1624	C (12)	CIO 1800 to CIO 1824
5 (5)	CIO 1625 to CIO 1649	D (13)	CIO 1825 to CIO 1849
6 (6)	CIO 1650 to CIO 1674	E (14)	CIO 1850 to CIO 1874
7 (7)	CIO 1675 to CIO 1699	F (15)	CIO 1875 to CIO 1899

Area Configuration

Offset	
	Rit

	15 8	7 0	Data direction	Related communications services
n	Unit Cor	trol Switch	CPU Unit to Ethernet Unit	
n+1	UDP Socke	t No. 1 Status		(Refer to Section 6
n+2	UDP Socke	t No. 2 Status		Socker Services.)
n+3	UDP Socke	t No. 3 Status		Mail Function
n+4	UDP Socke	t No. 4 Status		
n+5	UDP Socke	t No. 5 Status		
n+6	UDP Socke	t No. 6 Status		
n+7	UDP Socke	t No. 7 Status		
n+8	UDP Socke	t No. 8 Status		
n+9	TCP Socke	t No. 1 Status	Ethernet Unit to CPU Unit	Socket Services
n+10	TCP Socke	t No. 2 Status		(Refer to Section 6
n+11	TCP Socke	t No. 3 Status	_	
n+12	TCP Socke	t No. 4 Status		
n+13	TCP Socke	t No. 5 Status		
n+14	TCP Socke	t No. 6 Status		
n+15	TCP Socke	t No. 7 Status		i i
n+16	TCP Socke	t No. 8 Status		
n+17	Service	e Status		FTP Service, etc
n+18	Error	Status		All error conditions
n+19	Socket Service Re- quest Switches 2	Socket Service Re- quest Switches 1	CPU Unit to Ethernet Unit	Socket Services (Refer to Section 6
n+20	Socket Service Re- quest Switches 4	Socket Service Re- quest Switches 3		Socket Services.)
n+21	Socket Service Re- quest Switches 6	Socket Service Re- quest Switches 5	-	
n+22	Socket Service Re- quest Switches 8	Socket Service Re- quest Switches 7	-	
n+23	(Not	used.)		
n+24+	(Not	used.)	_	
n+25				

Unit Control Switches (CPU Unit to Ethernet Unit)





Status of UDP/TCP Sockets 1 to 8 (Ethernet Unit to CPU Unit)



Socket Service Request Switches 1 to 8 (CPU Unit to Ethernet Unit)



DM Area Allocations

Each Unit is allocated 100 words in the DM Area, as shown in the following table.

Unit No. (decimal)	Allocated words	Unit No. (decimal)	Allocated words
0 (0)	D30000 to D30099	8 (8)	D30800 to D30899
1 (1)	D30100 to D30199	9 (9)	D30900 to D30999
2 (2)	D30200 to D30299	A (10)	D31000 to D31099
3 (3)	D30300 to D30399	B (11)	D31100 to D31199
4 (4)	D30400 to D30499	C (12)	D31200 to D31299
5 (5)	D30500 to D30599	D (13)	D31300 to D31399
6 (6)	D30600 to D30699	E (14)	D31400 to D31499
7 (7)	D30700 to D30799	F (15)	D31500 to D31599

Area Configuration

Offset		
	Bit 15 8 7	0
m	Internode test remote network address and node number	_
m+1	Internode test number of send bytes	- 1
m+2	Internode test response monitoring time	
m+3	Internode test status	
m+4	Number of internode test runs	
m+5	Number of internode test timeout errors]
m+6	Number of internode test response errors	
m+7	Number of internode test send errors	
m+8	Number of times internode test data did not match	
m+9	TCP socket No. 1 connection status	
m+16	TCP socket No. 8 connection status	
m+17	Mail status	
m+18	Socket Services Parameter Area 1	
m+28	Socket Services Parameter Area 2	- 1
:		- 1
m+88	Socket Services Parameter Area 8	
m+98	ID Address Display Area	
m+99	P Address Display Area	

Internode Test Remote Network Address and Node Number (CPU Unit to Ethernet Unit)

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
m	Remote network address									Re	mote	nod	e nur	nber		

(00 to 7F Hex)

(01 to 7F Hex)

Internode Test Number of Send Bytes (CPU Unit to Ethernet Unit)



(1,996 bytes when set to 0000 Hex)

Internode Test Response Monitoring Time (CPU Unit to Ethernet Unit)



(2 seconds when set to 2 seconds)

TCP connection status



Internode Test Status (Ethernet Unit to CPU Unit)







Socket Services Parameter Area 1 to 8 (Ethernet Unit to CPU Unit)

Offset	Socket No. 1		Socket No. 8	15 ⁻	4	13	12	11	10	9	8	7	6	5	4	3	2	1	0
+0	m+18		m+88	UDF	UDP/TCP socket number (1 to 8)														
+1	m+19		m+89	Loca	Local UDP/TCP port number (0000 to FFFF Hex)														
+2	m+20		m+90	Rem	Remote IP address (00000000 to FFFFFFF Hex)														
	m+21		m+91		. ,														
+4	m+22		m+92	Rem	ote	UDF	P/TC	Ррс	ort nu	mbe	r (000	00 to	FFF	F He	x)				
+5	m+23		m+93	Num	ber	of s	end/	rece	ive by	/tes	(000) to ()7C0	Hex	(198	34))			
+6	m+24		m+94	Sen	d/rec	ceive	e dat	a ad	dress	6									
	m+25		m+95	(Sar	ne a	s Fl	NS \	/aria	ole ai	ea d	lesigi	natio	n me	thod	.)				
+8	m+26		m+96	Time	Timeout value (0000 to FFFF Hex)														
+9	m+27		m+97	Res	Response code														

IP Address Display Area

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
m+98	SW1 SW2									S	W3		SW4			
m+99		S١	N5			SV			S	W7		SW8				

The set values of the Local IP Address Switches (rotary switches 1 to 8) on the back of the Ethernet Unit are read and stored here when the power is turned ON. If an incorrect address is set, 0000 (Hex) will be stored here and the ERC indicator will flash. (Refer to *3-4-3 Setting the Local IP Address.*)
Appendix G ASCII Characters

Bits 1 to 4		Bits 5 to 7								
Binary		0000	0001	0010	0011	0100	0101	0110	0111	
	Hex	0	1	2	3	4	5	6	7	
0000	0	NUL	DLE	Space	0	@	Р		р	
0001	1	SOH	DC ₁	!	1	А	Q	а	q	
0010	2	STX	DC ₂	"	2	В	R	b	r	
0011	3	ETX	DC ₃	#	3	С	S	С	S	
0100	4	EOT	DC ₄	\$	4	D	Т	d	t	
0101	5	ENQ	NAK	%	5	E	U	е	u	
0110	6	ACK	SYN	&	6	F	V	f	v	
0111	7	BEL	ETB	,	7	G	W	g	w	
1000	8	BS	CAN	(8	Н	Х	h	х	
1001	9	HT	EM)	9	I	Y	i	у	
1010	Α	LF	SUB	*	:	J	Z	j	Z	
1011	В	VT	ESC	+	;	К	[k	{	
1100	С	FF	FS	,	<	L	١	1		
1101	D	CR	GS	-	=	М]	m	}	
1110	E	SO	RS		>	N	^	n	~	
1111	F	SI	US	/	?	0	_	0	DEL	

Appendix H Dimensions



Appendix I Maintenance

The Ethernet Unit makes up part of a network. Repair a defective Ethernet Unit as soon as possible as it can have a negative effect on the entire network. We recommend that customers keep one or more spare Ethernet Units to allow immediate recovery of the network.

Replacing an Ethernet Unit

Observe the following precautions when replacing the Ethernet Unit.

- Always turn OFF the power supply before replacing the Ethernet Unit.
- Check that the spare Ethernet Unit is operating normally before replacing a defective Unit with it.
- When returning a defective Unit for repairs, provide as much written information as possible on the symptoms of the problem.
- If a problem occurs with poor contacts, wipe the contacts with a clean cloth soaked with industrial alcohol. Carefully remove any lint remaining on the contacts before replacing the Unit.

Settings after Replacing an Ethernet Unit

After replacing an Ethernet Unit, set the following to the same settings as were used on the previous Unit.

- Unit number
- Node number
- IP address

Settings After Replacing a CPU

The EEPROM in the PC's CPU holds the information listed below. This information must be stored in any new CPU used to replace a defective one.

- Routing tables
- System Setup for the Ethernet Unit

Appendix J Inspections

Carry out regular inspections to ensure the Ethernet Unit is functioning perfectly.

Items

Most of the parts that make up an Ethernet Unit are semiconductor components. None of the parts in the Unit will wear out after a specific lifetime, but some parts may deteriorate due to extreme operating condition. Therefore, it is important to inspect the Unit regularly.

Inspection Interval

Normally inspect once or twice per year. Choose the inspection period according to the severity of the operating conditions. New installation should be inspected more frequently until they are judged to be stable.

Inspection Items

ltem	Details	Standard	
Environment	Temperature around Unit	0 to 55°C	
	Humidity around Unit	10% to 90% (with no condensation)	
	Accumulated dust	No accumulated dust	
Mounting	Ethernet Unit firmly attached	No looseness	
	Transceiver cable connector fully pushed in	No looseness	
	Condition of transceiver cable	No visible abnormality	

Correct any of the items in the table below not conforming to the specified standard.

Tools Required for Inspection

The following tools are needed to inspect the Ethernet Unit:

Standard Tools

- Flat-blade and Phillips screwdrivers
- Tester or digital voltmeter
- Industrial alcohol and a clean cloth

Tools Required Under Special Circumstances

- Synchroscope
- Pen oscilloscope
- Thermometer and hygrometer

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- Revision code

The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

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1	February 1999	Original production