Ethernet Module EN311

for T3H

Instruction Manual

REQUIREMENTS

- Keep this instruction manual where it can be easily referred to by users and those responsible for the equipment.
- Read this instruction manual carefully before using the equipment.
- After this instruction manual has been read, keep it beside the equipment.

May, 1997

TOSHIBA CORPORATION

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Safety Precautions

Thank you for purchasing the Toshiba EN311 Ethernet module, which is for use with the T3H programmable controller.

This document describes the usage and handling of the EN311 and presents important cautionary items.

To use the EN311 safely, please read this document and all other related documentation thoroughly and acquire thorough knowledge of the equipment and points that require care before installing, operating, maintaining, or inspecting the EN311.

[Concerning Important Points]

1. The EN311 is designed and manufactured for use with general industrial equipment, including all types of production line control and manufacturing equipment.

   The EN311 is not designed or manufactured for use in equipment or systems on which human lives depend.

   Consult with your Toshiba sales representative in advance if you need to use an EN311 in a equipment or systems that are used in transportation equipment (such as trains), medical applications, aerospace applications, nuclear reactor control, or underwater relay equipment or other special contexts.

2. Although the EN311 is manufactured under strict quality control, if an EN311 is to be used in critical equipment in which human lives could be endangered or in which large losses could occur should the EN311 fail, install safety equipment so that such catastrophes cannot occur.

3. The EN311 should only be installed, wired, used, or maintained by persons who have a general knowledge of the handling of control equipment. Electrical shock, fires, failures, and malfunctions can occur if an EN311 is handled incorrectly. Persons whose knowledge of control and electrical equipment is inadequate should avoid installing, wiring, using, or maintaining this equipment, and should instead employ persons with the requisite specialized knowledge.

4. This document and the related separate documentation is written for persons with a general knowledge of programmable controllers and control equipment.

   If you have any questions about the contents of this documentation, please feel free to contact you Toshiba representative.

Safety Precautions (continued)

[Warning indications]

This instruction manual provides important information to allow these products to be used safely and correctly, to prevent in advance dangers to people managing or using this equipment or other persons, and to prevent in advance losses to property. Be sure you thoroughly understand the displays and symbols described below and follow the cautionary items and warnings included in this document carefully.

Store this document carefully so that you can refer to it at any time even after you have read it.

Description of Safety Signs

Safety sign	Meaning
⚠ **WARNING**	**Indicates a potentially hazardous situation which could result in death or serious injury if you do not follow the instructions.**
⚠ **CAUTION**	**Indicates a potentially hazardous situation which may result in minor or moderate injury and/or property damage if you do not follow the instructions.**

Explanations of Safety Symbols

Safety symbol	Meaning
△	**This means "Hazard Alert" or "Beware of Hazard". The exact nature of the hazard is shown in the triangle or described in text near the triangle.**
⚠	**This is a safety alert symbol indicating a potential hazard. This symbol is used together with a signal word.**

Safety Precautions (continued)

· **Precautions for operation**

⚠ WARNING

1. Build emergency stop, interlock, and similar circuits outside the PC that includes the EN311.

   If a breakdown or malfunction occurs in the PC or the EN311, there is the danger that someone could be hurt or fatally injured. Also, other equipment could be damaged or a breakdown could occur.

T3/T3H User's Manual - Hardware
3. Preparing for Operation (Hardware)

⚠ CAUTION

2. Take all necessary safety precautions before performing operations such as changing a running program, forcing output, or switching to RUN (operate) or HALT (stop) modes.

   Equipment can be damaged and breakdowns can be caused by operating this equipment incorrectly.

T3/T3H User's Manual - Hardware
Programmer's Operation Manual
3. Preparing for Operation (Hardware)

· **Two connected switches for 10BASE5/10BASE2 changeover**

⚠ CAUTION

1. The EN311 cannot be connected to both a 10BASE5 and a 10BASE2 network at the same time.
2. Do not connect a network cable of the unused type to the EN311. This can damage the EN311 or cause it to malfunction.
3. Do not change the 10BASES/10BASE2 selection switch setting while a data transfer is in progress. This can damage the EN311 or cause it to malfunction.
4. When changing this switch setting, throw both switches together at the same time. Only throwing one of the switches at a time will not result in normal correct switching between the networks.

3.2 Switch Settings

Safety Precautions (continued)

· **Mounting in the base unit**

⚠ CAUTION

1. The EN311 is designed specially for the T3H and should only be mounted and used in a T3H base unit. Do not use this module independently or mounted in any other equipment. Such usage could result in electrical shocks, personal injury, or damage to the EN311 and other equipment.
2. The EN311 itself should only be mounted or removed when all power is turned off. Similarly, connections to the terminal block should only be made or removed when all power is turned off. Not observing this precaution could result in electrical shocks, malfunctions, or damage to the EN311 or other equipment.
3. Do not allow foreign objects such as wire shreds to get into the EN311. This could result in fire, breakdown, or malfunction.
4. Verify that connectors, cables, and the mounting of the EN311 itself in the base unit are all secured with screws or stops and that there is no play, missing screws, or disconnections in any of these parts.

   If any of these parts is inadequately secured, breakdown or malfunction could occur as the result of vibration.

3.3 Mounting in the Base Unit

· **Connecting to the network**

⚠ CAUTION

1. The EN311 cannot be connected to both a 10BASE5 and a 10BASE2 network at the same time.
2. Do not connect a network cable of the unused type to the EN311. This can damage the EN311 or cause it to malfunction.
3. Do not connect or disconnect cables when either the T3H or MAU power supply is turned on. This can damage the EN311 or cause it to malfunction.
4. When installing a 10BASE5 or 10BASE2 network, the cabling must be laid with adequate safety precautions and in accordance with all applicable standards. Installation and wiring should be performed by a qualified professional.

   See the **ISO/IEC8802-3** standard for installation environment standards.

3.4 Connecting to the Network

Safety Precautions (continued)

· **MAU power supply**

⚠ CAUTION

1. When providing a voltage to the MAU power supply terminal block, always provide the correct +/- 12-VDC voltage. Any other voltage can damage the EN311.
2. When wiring the module, use either an insulated crimp-type terminal or wrap conducting sections with insulating tape so that no conducting sections are exposed.

   Be sure to handle the terminal block cover carefully so that it does not fall off or become damaged. Be sure to reinstall the terminal block cover after completing the wiring.

   Electrical shock is possible if any conductors are left exposed.
3. External power should be turned on and off as close to the same time as the T3H power as is possible.

   If simultaneous power supply on/off operations are not possible, turn these power supplies on and off in the following sequences.

   Power on: T3H power supply → external power supply

   Power off: External power supply → T3H power supply

   Failure to follow the above procedures can result in equipment failures, malfunctions, or shorting.

3.5 MAU Power Supply

· **Network Wiring Equipment**

⚠ CAUTION

1. When installing a 10BASE5 or 10BASE2 network, the cabling must be laid with adequate safety precautions and in accordance with all applicable standards. Installation and wiring should be performed by a qualified professional.

   See the **ISO/IEC8802-3** standard for installation environment standards.

3.6 Network Wiring Equipment

Safety Precautions (continued)

Concerning:

- **Preparing for operation (software)**
- **Computer link protocol and the PC link protocol transmission**
- **Socket interface communication**
- **RAS information**

⚠ CAUTION

1. Chapters 4 - 7 present information related to using the functions provided by the EN311 from a T3H, including the instruction (request) format, important items that require attention, and sample programs. That chapter also presents items considered necessary when using the EN311.

   Make a point of understanding the content of chapter 4 thoroughly before writing programs that use the EN311. The sample programs present basic examples of EN311 usage, and should be reviewed carefully before use in an actual system.

   4. Preparing for operation (software)
   5. Computer link protocol and the PC Link protocol transmission
   6. Socket interface communication
   7. RAS information

- **Installation environment and base unit mounting**

⚠ CAUTION

1. Only use this equipment in the environment described in the T3/T3H User's Manual - Hardware.

   Use in any other environment can cause electrical shocks, fires, failures, and malfunctions.

2. Mount this equipment according to the mounting method specified in the T3/T3H User's Manual - Hardware.

   Mounting in any direction other than the specified direction, or defective or inadequate mounting, can result in the equipment falling, fires, failures, and malfunctions.

   9.1 Installation Environment and Base Unit Mounting

Safety Precautions (continued)

· **Mounting and removing modules**

⚠ CAUTION

1. The EN311 is designed specially for the T3H and should only be mounted and used in a T3H base unit. Do not use this module independently or mounted in any other equipment. Such usage could result in electrical shocks, personal injury, or damage to the EN311 and other equipment.
2. The EN311 itself should only be mounted or removed when all power is turned off. Similarly, connections to the terminal block should only be made or removed when all power is turned off. Not observing this precaution could result in electrical shocks, malfunctions, or damage to the EN311 or other equipment.
3. Do not allow foreign objects such as wire shreds to get into the EN311. This could result in fire, breakdown, or malfunction.
4. Verify that connectors, cables, and the mounting of the EN311 itself in the base unit are all secured with screws or stops and that there is no play, missing screws, or disconnections in any of these parts.

   If any of these parts is inadequately secured, breakdown or malfunction could occur as the result of vibration.

9.2 Mounting and Removing Modules

· **Power supply wiring and grounding**

⚠ CAUTION

1. Turn off all power before laying or connecting any cables.

   Laying or connecting cables with the power on can lead to electrical shocks.
2. Either use crimp-on connectors with sheaths or wrap exposed conductors with insulating tape so that no conductors are exposed.

   Also, handle the terminal block cover so that it is not lost or damaged. When the wiring operations are done, do not fail to reinstall the terminal block cover on the terminal block.

   Leaving conductors exposed can lead to electrical shocks.
3. Ground the equipment

   Electrical shocks and malfunctions are possible if equipment is not grounded correctly. In particular, the MAU power supply terminal grounding is critical for AUI cable noise prevention.
4. Connect a power source that matches the ratings for the MAU power supply terminal block.

   Be sure to connect the 12-VDC power + and - sides correctly. Use of incorrect wiring or a power supply with an incorrect rating can cause explosions or fires.
5. All wiring operations should be performed by qualified personnel only.

   Incorrect wiring can cause fires, breakdowns, and electrical shocks.

9.3 Power Supply Wiring and Grounding

Safety Precautions (continued)

· **Basic points in laying out a network**

⚠ CAUTION

1. When laying network cable, take adequate safety measures and perform all operations in accordance with the relevant standards. See the **ISO/IEC8802-3** standard for details on laying networks.
2. We strongly recommend hiring a qualified contractor who has specialized knowledge about safety precautions and standards.
3. Avoid installing 10BASE5 or 10BASE2 networks in environments that have high noise levels. If it is necessary to install network cables in an environment subject to noise (electromagnetic interference), use the noise reduction measures described elsewhere in this document.

9.4 Network Wiring

· **Maintenance**

⚠ CAUTION

1. Always turn off the power before attaching or removing modules, the terminal block, or cables.
   Electrical shock, malfunctions, and breakdowns are possible if these operations are performed with the power on.
2. To keep the system operating normally at all times and to prevent trouble in advance, perform daily inspections, periodic inspections, and cleaning.
3. Refer to the section on error recovery in this document if the EN311 does not operate correctly.
   Contact your local Toshiba dealer or service representative if a breakdown occurs, and request that the module be repaired or returned to Toshiba.
   Operation and safety cannot be guaranteed if service is performed by anyone other than an authorized Toshiba service representative.
4. Do not disassemble or modify the module hardware, and do not modify the module software.
   Breakdowns or malfunctions may lead to fire, electrical shock, or injury.
5. When measuring the voltages at the module terminal block during inspections, use adequate caution.
   There is a danger of electrical shock during this operation.
6. Only exchange modules with the power completely off.
   Exchanging modules with the power on can lead to malfunctions, breakdowns, and electrical shock.
7. Do not continue to use the module if it emits smoke or unusual odors, or if it is in an abnormal state of any type.
   Using the module in an abnormal state can lead to malfunctions, breakdowns, and electrical shock.
   In such cases, immediately turn of all power and contact your local Toshiba dealer or service representative.
   Customers should never attempt repairs or modifications to this equipment themselves: repair and modification operations are extremely dangerous.

Appendix 1 Maintenance and Inspection

Safety Precautions (continued)

· **Change/correct functions on the firmware (Rev. E)**

⚠ CAUTION

1. From Rev. E on, in the case of the TCP socket, if it is confirmed that the RCLOSE bit is ON while making sure to check the RCLOSE bit at each scanning, immediately issue the close request from the T3H. If the Active Open request is issued from the remote station to the socket in the RCLOSE state, the socket in the RCLOSE state returns a response to the destination station, thus making the destination station conclude that the connection has been established.

Appendix 8 An additional function of firmware (Rev.E)

Usage Recommendations

This section collects the knowledge and operations that should be known by all users of this equipment. Read this section carefully in conjunction with the safety precautions, thoroughly master knowledge of the equipment, safety information, and the items that require attention, and use the equipment correctly.

· **Support for both 10BASE5 and 10BASE2 networks**

Usage Recommendations
1. Do not exceed the maximum number of MAUs (100) or the maximum cable length (500 m) in systems using 10BASE5. 2. Adjacent MAUs must be mounted at least 2.5 meters apart in systems using 10BASE5. 3. The AUI cable length must not exceed 50 meters in systems using 10BASE5. 4. Do not exceed the maximum number of MAUs (30) or the maximum cable length (185 m) in systems using 10BASE2. 5. Adjacent nodes must be separated by at least 0.5 meter in systems using 10BASE2. 1.3 Basic Functionality

· **Reset switch**

Usage Recommendations
1. To press the reset switch, use a pointed object, such as a ball-point pen, to press the switch through the hole in the front panels. Be sure to press the switch all the way down. 2.3 Component Functions 4.3 EN311 Reset

Usage Recommendations (continued)

· **Connecting to the network**

Usage Recommendations
1. Do not exceed the maximum number of MAUs (100) or the maximum cable length (500 m) in systems using 10BASE5. 2. Adjacent MAUs must be mounted at least 2.5 meters apart in systems using 10BASE5. 3. The AUI cable length must not exceed 50 meters in systems using 10BASE5. 4. An MAU and an AUI cable are required in systems configured using a 10BASE5 network. (See section 3.6, "Network Wiring Equipment.") These parts must be ordered separately if required. 5. Do not exceed the maximum number of MAUs (30) or the maximum cable length (185 m) in systems using 10BASE2. 6. Adjacent nodes must be separated by at least 0.5 meter in systems using 10BASE2. 7. Terminators and T connectors are required in systems configured using a 10BASE2 network. (See section 3.6, "Network Wiring Equipment.") These parts must be ordered separately if required. 3.4 Connecting to the Network

· **EN311 module registration**

Usage Recommendations
1. Before performing the settings described in this chapter, register the EN311 as T3H I/O. The I/O type is OPT. 4.1 Module Setup Flowchart (Software)

· **Restrictions on subnet masks**

Usage Recommendations
1. The EN311 does not allow the user to set the subnet mask. Therefore the EN311 cannot be used in systems that operate a subnetwork. 4.4 Parameter Setup Request

Usage Recommendations (continued)

· **Computer link protocol transmission**

Usage Recommendations
1. Since UDP/IP does not provide control functions to guaranteed communication reliability, higher level protocols (such as retry) are required. 2. No processing is performed if a computer link protocol and a PC link protocol transmission messages are received at any point other than a message transmission UDP socket. 5.1 Computer Link Protocol Transmission 5.3 PC Link Protocol Transmission (Data write) 5.4 PC Link Protocol Transmission (Data read)

· **Limitations on the T3H SEND and RECV instructions**

Usage Recommendations
When using the SEND and RECV instructions: 1. Use transmission modules **mounted in the main base unit**. As compared to modules mounted in the main base unit, modules mounted in an expansion base unit can transmit fewer words of data and the interrupt periods that can be set are longer. 2. When using fixed period interrupt programs, there are limitations on the interrupt periods that can be set. 3. There are limitations on the number of words that can be specified when using the SEND or RECV instruction with each module when multiple transmission modules are mounted. Appendix 4 Limitations on the T3H SEND and RECV Instructions

· **Computer link/PC link protocol minimum transmission delay times**

Usage Recommendations
1. There are cases where the transmission delay time will be longer than the calculated value due to details of the actual environment used. Factors that can cause the transmission delay time to increase include network load, EN311 load (on both the local and remote stations), and the T3H operating state. Appendix 6 Minimum Transmission Delay Times

· **Socket interface transmission processing time**

Usage Recommendations
1. There are cases where the transmission delay time will be longer than the calculated value due to details of the actual environment used. Factors that can cause the transmission delay time to increase include network load, EN311 load, and the T3H operating state. Appendix 7 Socket Interface Transmission Processing Time

· **Relationship between the firmware (Rev. E) and the T3H-OS version**

Usage Recommendations
1. It is recommended that the EN311 of the firmware (Rev. E) be used in combination with T3H-V1.2 and upwards. Appendix 8 An additional function of firmware (Rev.E)

· **Transmission via router**

Usage Recommendations
1. It is recommended that the TCP socket be used for transmission when connecting the EN311 to LANs in general via router. When using the UDP socket, the computer link or the PC link, the transmission reliability should be secured by receive check and retransmission, etc. on the user program side. Appendix 7 Routing Function Addition

Before Reading This Document:

Thank you for purchasing a Toshiba PROSEC T3H multi-purpose programmable controller.

This manual describes the T3H specifications and usage, and presents sample programs for the Ethernet module (referred to as the EN311) used with the PROSEC T3H.

When using this product, use the product correctly based on a thorough reading of this manual. This document is organized as follows.

Chapter 1: Ethernet Module Overview

Presents an overview of the EN311, including its functions, specifications, and systems in which it can be used. Refer to this chapter to understand the basic performance of the EN311.

Chapter 2: EN311 Parts and Functions

Describes the function and names of the components of the EN311. Since this chapter presents information required to understand the hardware settings described in the next chapter, read this chapter carefully and use the EN311 correctly.

Chapter 3: Preparing for Operation (Hardware)

Describes the hardware preparations and settings required to operate the EN311 normally.

Chapter 4: Preparing for Operation (Software)

Describes the software settings required to operate the EN311 normally, and presents sample programs.

Chapter 5: Computer Link Protocol and the PC Link Protocol Transmission

Describes the instruction format used with computer link protocol and PC link protocol transmission, and presents sample programs.

Chapter 6: Socket Interface Communication

Presents an overview of the socket interface, cautionary items, and the instruction format used on the EN311 with the socket interface, and presents sample programs.

Chapter 7: RAS Information

Describes the instruction format and the format of the EN311 RAS information (including station status and down information), and presents sample programs.

Chapter 8: Error Handling

Describes techniques for determining the causes of errors when EN311 operation is abnormal, and procedures for recovering from those errors.

Chapter 9: Installation and Wiring

Describes the procedures for installing the EN311 (and T3H), procedures for laying transmission cable, and the nature of the construction required.

Appendix

Presents request code, completion status value, and error code tables and describes the minimum transmission delay times and execution times for each instruction.

Note that in addition to this manual, Toshiba also provides a T3 User's Manual - Hardware, a T3 User's Manual - Function, a T-series Instruction Set, and a T-series Computer Link Operation Manual. All these manuals should be read together.

• T3 User's Manual - Hardware (UM-TS03***-E002)	Describes the configuration, specifications, installation and wiring techniques, maintenance, and preventive maintenance procedures for the T3/T3H base system hardware.
• T3 User's Manual - Function (UM-TS03***-E003)	Describes the functions provided by the T3/T3H CPU and the use of that CPU, and presents information required for creating user programs for the T3/T3H.
• T-series Instruction Set (UM-TS03***-E004)	Describes the detailed specifications of the instruction words for the ladder and SFC program languages, which are two of the programming languages supported on the T3/T3H.
• T-series Computer Link Operation Manual (UM-TS03***-E008)	Describes the specifications and use of computer link protocol transmission, which is built into the T3/T3H CPU.

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Contents

1. Ethernet Module Overview

1.1 System Configuration Using the EN311 Ethernet Module

This section describes the systems that can be configured using the EN311 Ethernet module for the PROSEC T3H programmable controller. The remainder of this document refers to the PROSEC T3H programmable controller as the T3H, and the Ethernet module as the EN311.

The EN311 is an interface module for connecting a T3H system to either a 10BASE5 (Ethernet) or 10BASE2 (cheapernet) LAN (local area network). It is used mounted in a T3H I/O slot. The T3H connects to the above mentioned LAN through the EN311 and exchanges data with host computers (workstations or personal computers) or other programmable controllers on the LAN.

The EN311 can be connected to either a 10BASE5 Ethernet or a 10BASE2 cheapernet by setting a switch on the EN311 appropriately.

The remainder of this section presents a system that uses the EN311. In this example, the T3H is connected to host machines such as workstations and personal computers over a 10BASE5 or 10BASE2 LAN and the T3H is connected to lower level controllers using a Toshiba proprietary control LAN.

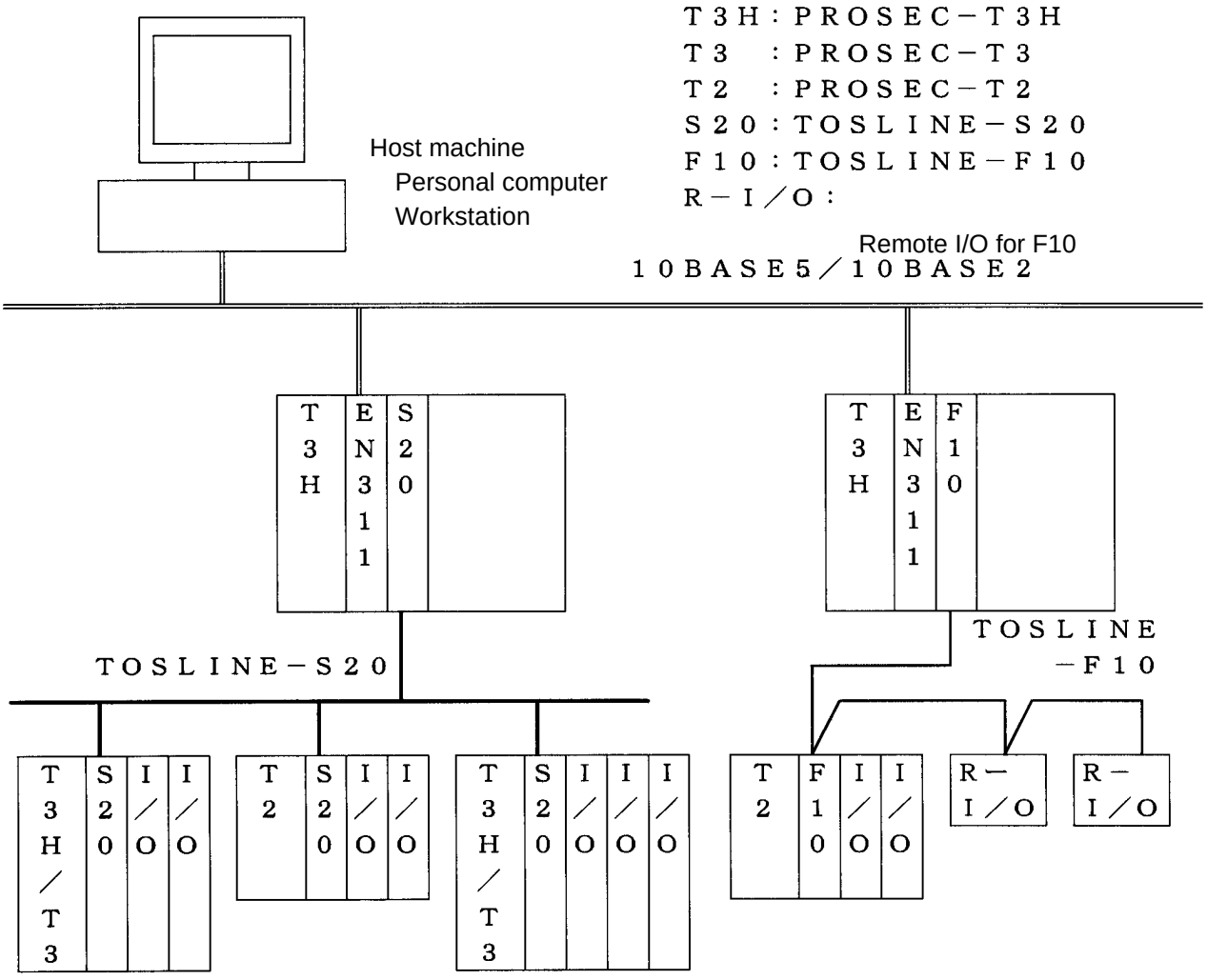


Figure 1.1 System Configuration Examples

1.2 LAN Standards and Terminology

The LANs commonly referred to as Ethernet LANs are defined by two standards, the Ethernet version 2.0 standard (DIX) developed by DEC, Intel, and Xerox, and the ISO 8802-3 standard (IEEE 802.3), which is an international version of the DIX standard. Since the ISO 8802-3 includes the DIX standard, network equipment built to those standards will be basically compatible.

Since the EN311 physical layer has a structure that conforms to the ISO 8802-3 standard, users must be sure to **use network equipment that conforms to the ISO 8802-3 standard**.

The networking terminology used in this document is the terminology used in the ISO 8802-3 standard. Table 1.1 presents the correspondence between the DIX standard terminology (common terms) and the ISO 8802-3 standard terminology.

Table 1.1 Networking Terminology Correspondences

DIX Standard	ISO 8802-3 Standard
Ethernet	10BASE5
Cheapernet	10BASE2
Coaxial cable	Coaxial cable
Transceiver cable	AUI (attachment unit interface) cable
Transceiver	MAU (medium attachment unit)
Ethernet address	MAC address

Ethernet is a registered trademark of Xerox, Corporation.

Cheapernet is not a registered trademark, but rather is a common name.

1.3 Basic Functionality

The EN311 has the following main features.

1. T series computer link protocol transmission (slave station)

The host machine can upload or download user programs, execute control commands, and read or write register data to a T3H on the 10BASE5/2 LAN using the T series computer link protocol. This function can be used simply by making basic settings on the EN311 from the T3H; there is no need to write special user programs for the T3H.

Computer link protocol uses UDP/IP as the transmission protocol.

UDP/IP: User datagram protocol/Internet protocol.

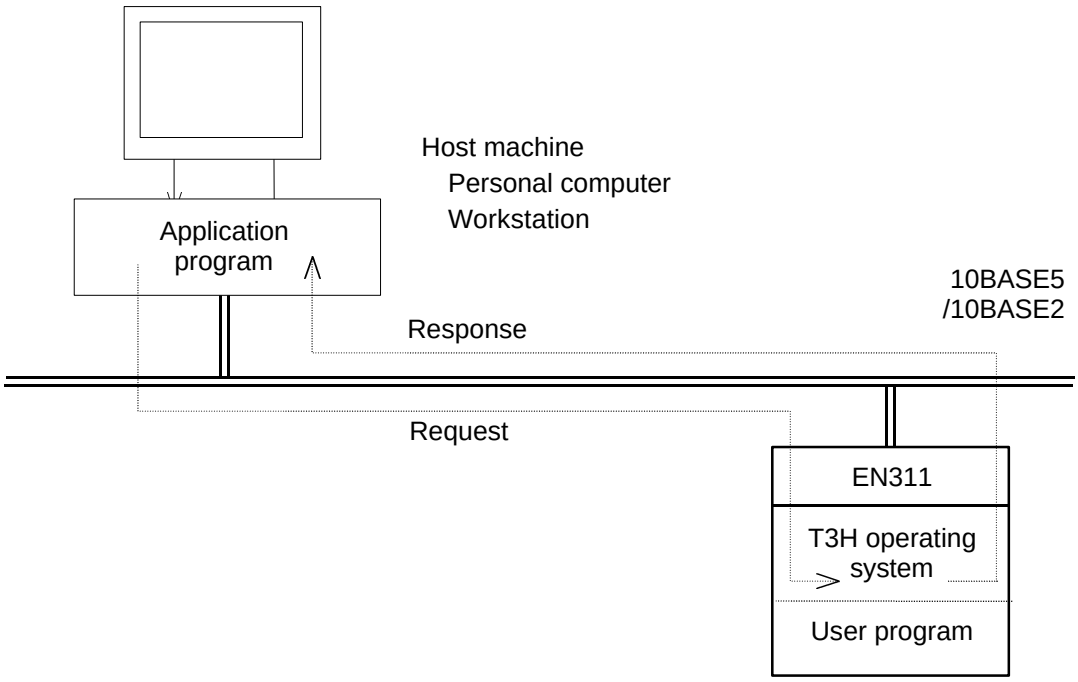


Figure 1.2 T Series Computer Link Protocol Transmission (slave station)

2. T series/PC link protocol transmission

The T3H can use the T series/PC link protocol to read or write register data on another T3H on the 10BASE5/2 LAN.

While T3H user programs for reading and writing are necessary to use the host functions, only the basic EN311 settings performed from the T3H are required to use the slave functions, and no special user programs are required on the T3H.

PC link protocol transmission uses UDP/IP as the transmission protocol.

UDP/IP: User datagram protocol/Internet protocol.

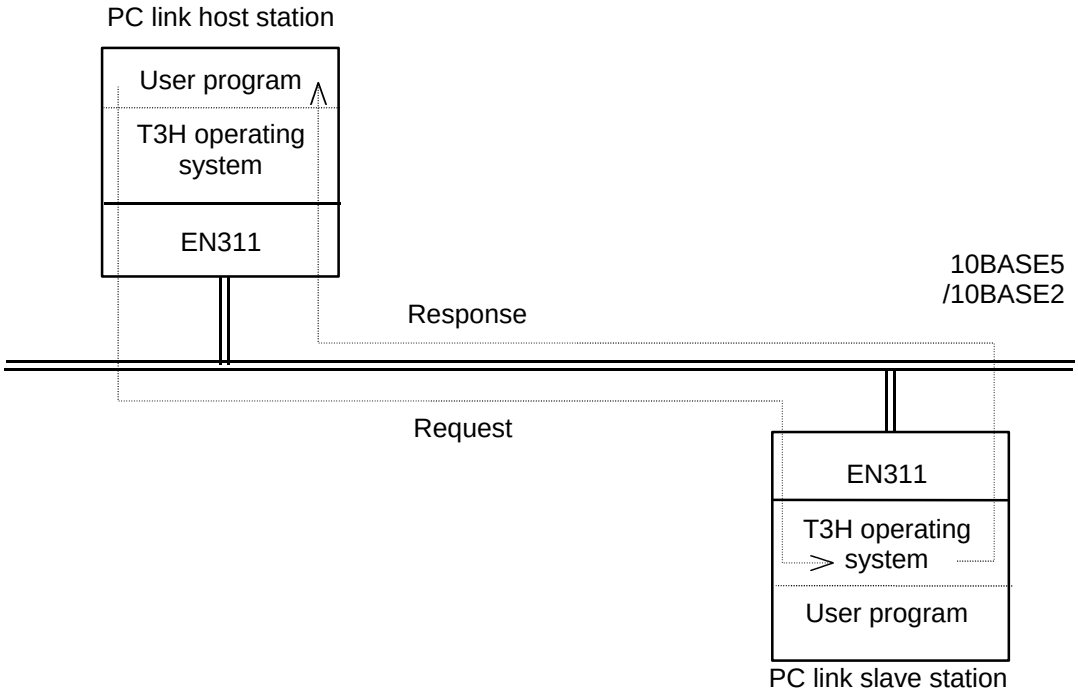


Figure 1.3 T Series/PC Link Protocol Transmission

3. Socket interface support

This is a standard communications technique used on engineering workstations and similar computers. Transmission between user programs on the T3H and host machines is possible using the socket interface. There are eight sockets on an EN311 and the transmission protocol (TCP/IP or UDP/IP) can be specified for each socket.

TCP/IP: Transmission control protocol/Internet protocol

UDP/IP: User datagram protocol/Internet protocol

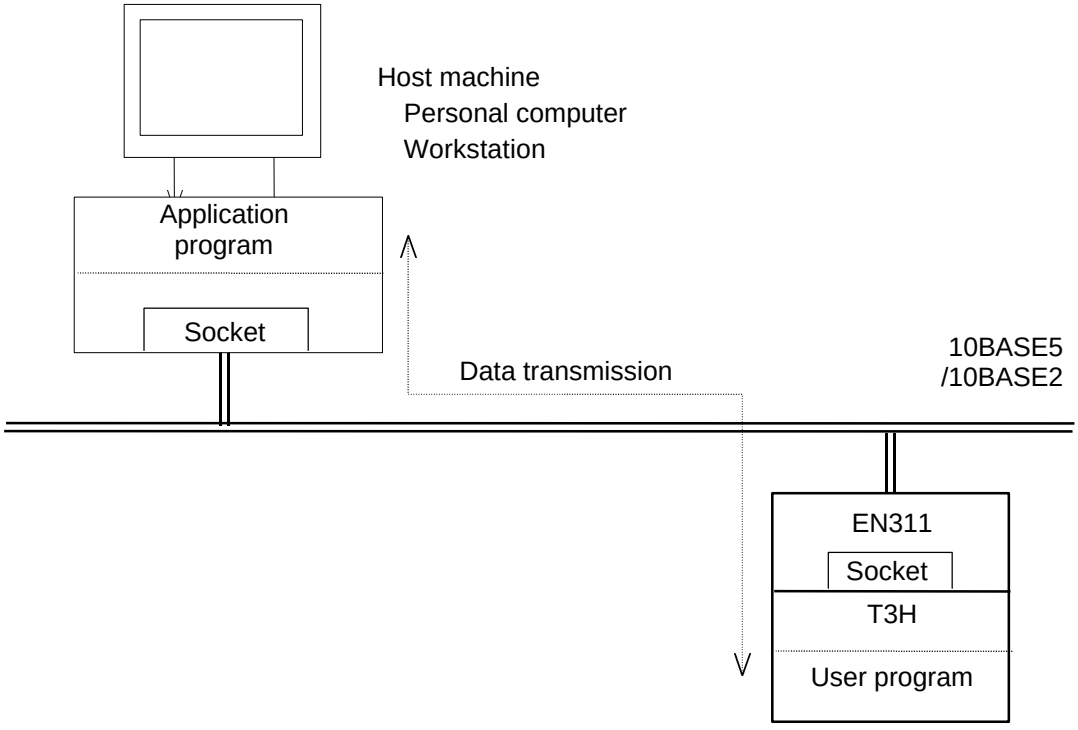


Figure 1.4 Socket Interface

4. PC (programmable controller) gateway function

∗ This function is under development, but is currently not supported.

Toshiba plans to add support to the T3H for a gateway function between the EN311 and the TOSLINE-S20 data transmission unit. This function will allow access to stations (PROSEC-T3H/T3/T2) on the TOSLINE-S20 from nodes on the 10BASE5/2 LAN using the computer link protocol.

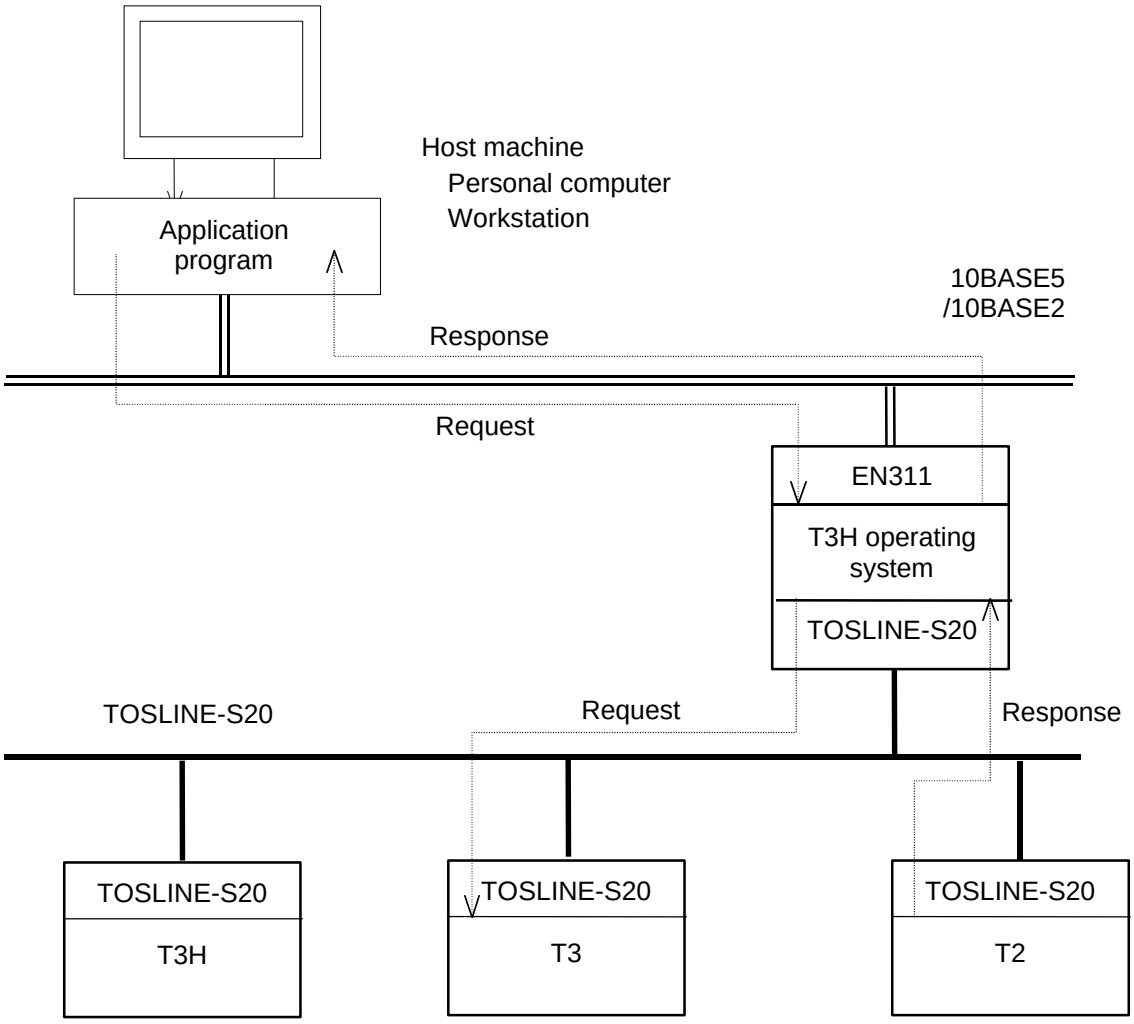


Figure 1.5 Gateway Function

5. Support for both 10BASE5 and 10BASE2 Networks

The EN311 can connect to either a 10BASE5 or a 10BASE2 network simply by switching a switch on the front panel, although simultaneous connection to both networks is not possible.

a. 10BASE5

10BASE5 is a LAN technology that uses baseband transmission, provides a data transmission rate of 10 Mbps, and supports single segments of up to 500 meters in length.

The minimum distance between MAUs is 2.5 m.

This network uses 50Ω coaxial cable as the transmission cable.

The EN311 can implement systems such as the one shown in the figure using 10BASE5 coaxial cable.

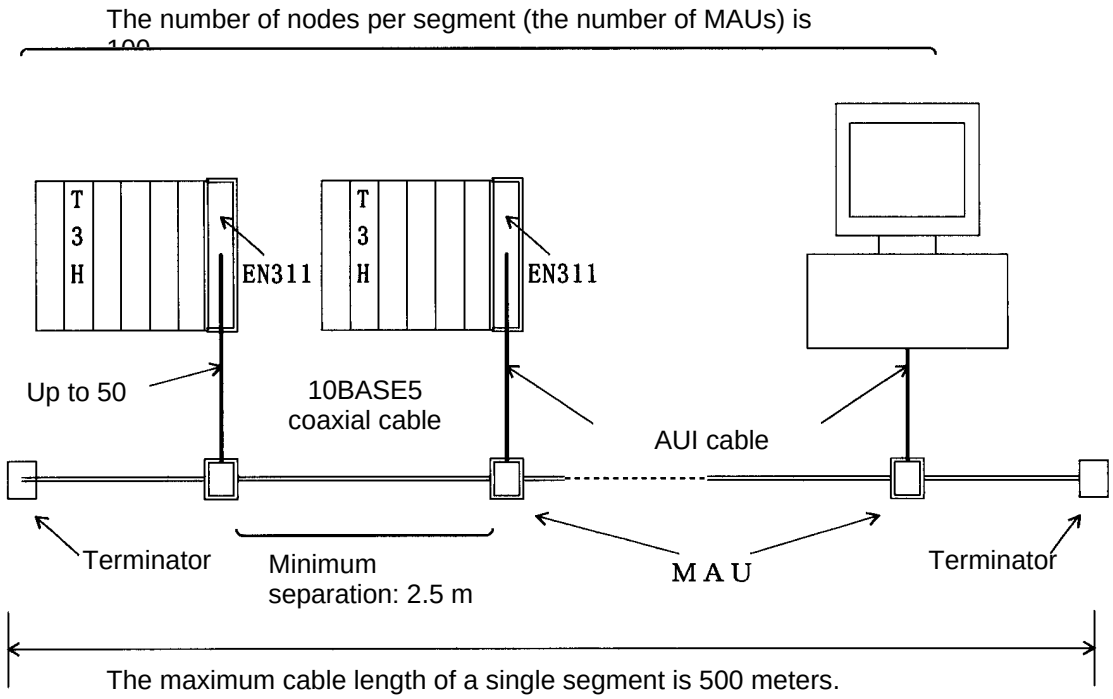


Figure 1.6 10BASE5

Usage Recommendations	
1.	Do not exceed the maximum number of MAUs (100) or the maximum cable length (500 m) in systems using 10BASE5.
2.	Adjacent MAUs must be mounted at least 2.5 meters apart in systems using 10BASE5.
3.	The AUI cable length must not exceed 50 meters in systems using 10BASE5.

b. 10BASE2 (The MAU is built into the EN311)

10BASE2 is a LAN technology that uses baseband transmission, provides a data transmission rate of 10 Mbps, and supports single segments of up to 185 meters in length.

This network uses 50Ω coaxial cable as the transmission cable.

The EN311 can implement systems such as the one shown in the figure using 10BASE2 coaxial cable.

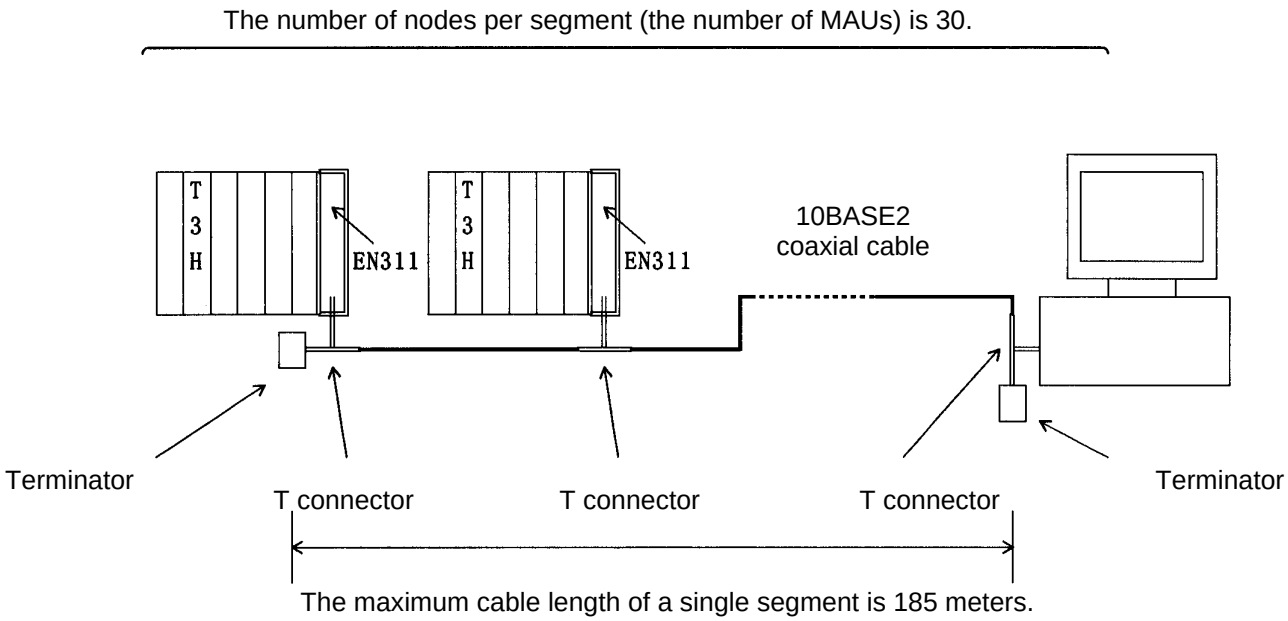


Figure 1.7 10BASE2

Usage Recommendations	
4.	Do not exceed the maximum number of MAUs (30) or the maximum cable length (185 m) in systems using 10BASE2.
5.	Adjacent nodes must be separated by at least 0.5 meter in systems using 10BASE2.

1.4 EN311 Specifications

Table 1.2 lists the EN311 specifications. The general specifications of the EN311 conform to those of the T3H main unit.

Table 1.2 Functional Specifications

Item		Specification	
Module type		EN311	
Transmission specifications		10BASE5 (Ethernet)	10BASE2 (Cheapernet)
	Media access method	CSMA/CD	
	Modulation	Baseband	
	Transmission topology	Bus type	
	Transmission speed	10 Mbps	
	Maximum distance between nodes	2500 m	925 m
	Maximum segment length	500 m	185 m
	Maximum number of MAUs	100 units per segment	30 units per segment
	Minimum node separation	2.5 m	0.5 m
	Connector	15-pin D-SUB (female) with locking fitting	BNC connector
	Connecting cable	AUI cable conforming to the ISO8802-3 standard AUI cable: up to 50 meters in length	Coaxial cable (RG-58/U: with BNC connectors) using T connectors
Transmission services		1. T series computer link protocol (slave station) 2. T series/PC link protocol 3. Socket interface (8 sockets) 4. PC gateway function (currently unsupported)	
RAS functions		1. Self diagnostics at power on ROM, RAM, LAN controller, T3H interface buffer memory, MAC address 2. Test functions accessible from user programs • Remote station verification request • Remote station loopback test (Only between T3H systems) 3. Data provided by RAS data readout • Event trace • LAN controller (network) information • Protocol state 4. Time/date setup function 5. Station status in the T3H special registers (SW) 6. Socket information in the T3H interface buffer	
Consumed current [A]		0.7A (5V DC), 0.5A (12V DC)	
External dimensions [mm]		33.0 (W) ×250 (H) × 110 (D)	
Weight [grams]		480	
Board specifications		One slot (slot width)	
Mounting method		In the T3H main base unit (The basic base unit is recommended.) I/O slot	
Number of modules mountable		4 modules per T3H	
Access method		SEND/RECV instructions (module control and transmission functions)	

* Segment: A network unit formed from a single transmission medium (coaxial cable)

The figure below shows the maximum internode separation and segment length.

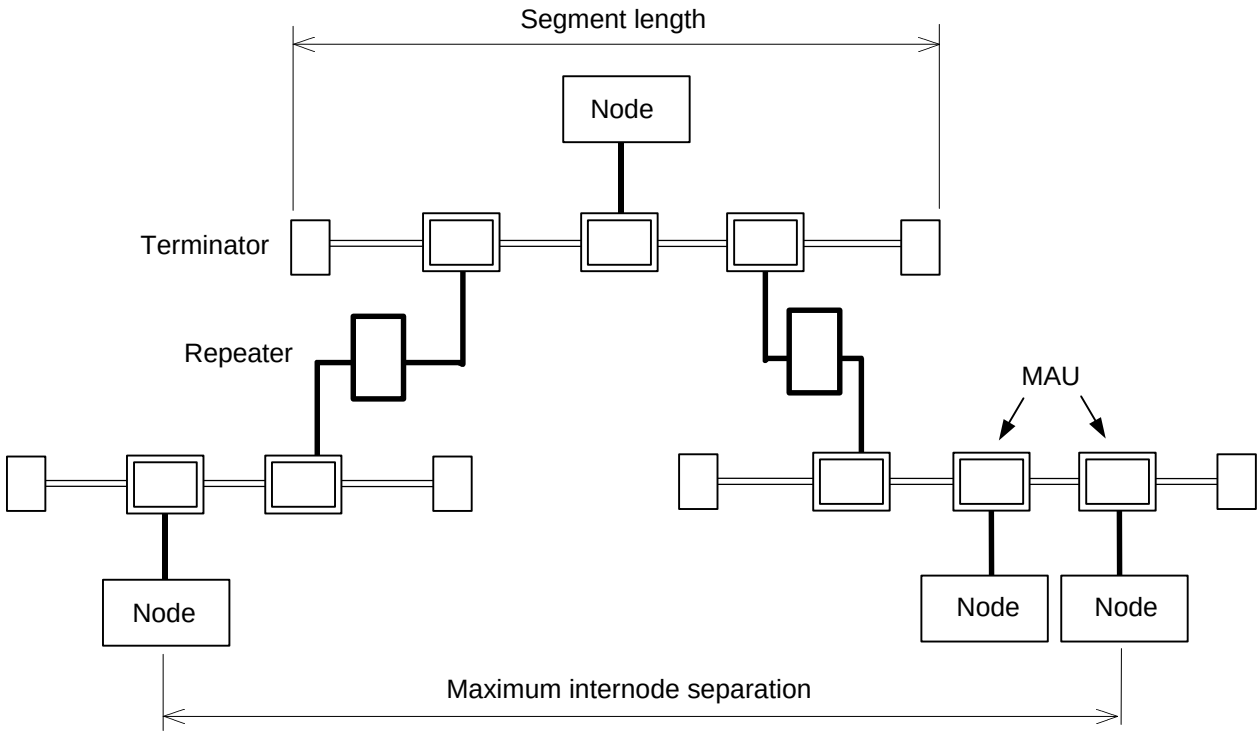


Figure 1.8 Internode Separation

1.5 Software Organization

The EN311 transmission functions (computer link protocol transmission and socket interface transmission) are implemented with the software organization shown in the figure.

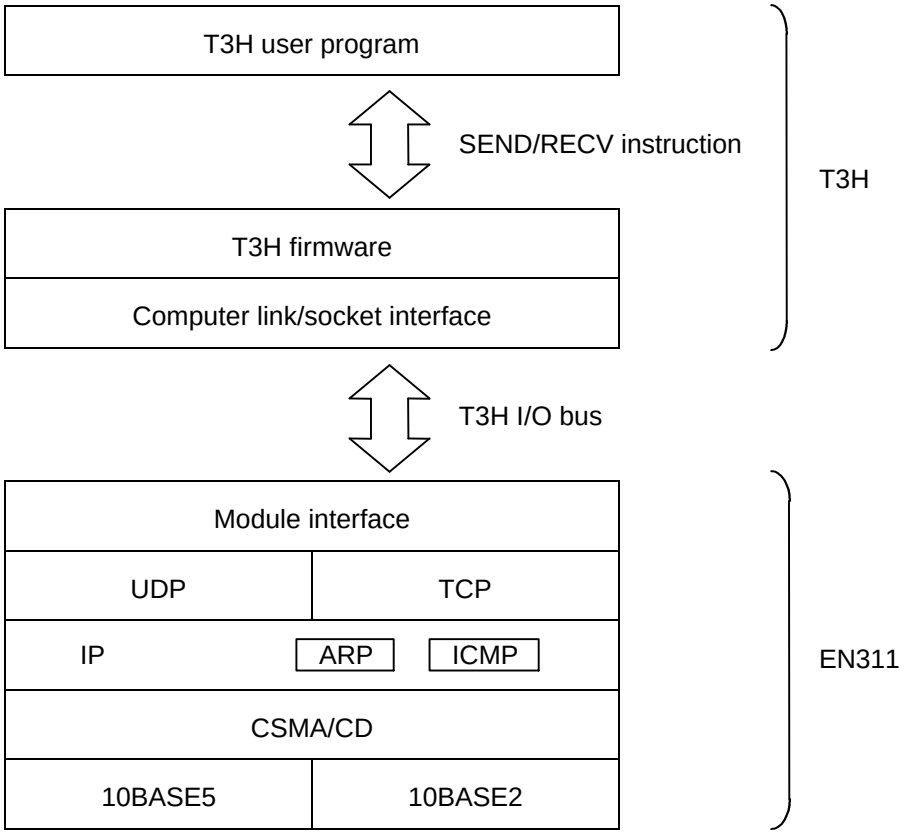


Figure 1.9 Software Organization

TCP (transmission control protocol)

Before transferring data with the remote node, a connection (virtual communication circuit) is first established and then data is transferred. Transmission reliability is guaranteed by packet order control, retransmission, flow control, and other techniques.

The EN311 supports the following:

- Response bit (ACK)
- Push bit (PSH)
- Synchronized bit (SYN)
- Fin bit (FIN)
- Retransferring
- Window (flow) control
- Segment division
- Reporting of the maximum receivable segment length
- Although the reset packet (in which the RST bit is set to ON) is capable of receiving, it is not capable of transmission.

UDP (User datagram protocol)

Transfers data with the remote node in datagram units. Provides high-speed transfers since a connection is not used, but does not have control functions that assure reliability, as does TCP. Thus it requires support from a higher level protocol.

The EN311 supports the:

- the UDP checksum

function.

IP (Internet protocol)

Sends and receives data in the datagram format. Sends data in datagram units to the remote node according to the IP address.

The EN311 supports:

- Data fragmentation and reassembly,
- Direct routing, and
- Broadcast

functions.

The EN311 does not support the indirect routing and multicast functions.

Although the EN311 physical layer structure conforms to the ISO8802-3 standard, it adopts DIX standard frames as the data link frames (the IP datagram send/receive frames).

ARP (Address resolution protocol)

Searches for a node MAC address (Ethernet address) that has a specified IP address.

ICMP (Internet control message protocol)

Reports IP packet errors, verifies the state of the IP network, and supports related functions.

The EN311 supports the:

- Echo request/reply,
- Timestamp request/reply, and
- Information request

functions.

The EN311 does not support the:

- Destination unreachable,
- Source quench,
- Redirect,
- Time exceeded for a datagram,
- Parameter problem on datagram,
- Information reply,
- Address mask request, and
- Address mask reply

functions.

2. EN311 Parts and Functions

This chapter describes the sections of the EN311 and their functions.

2.1 External Dimensions

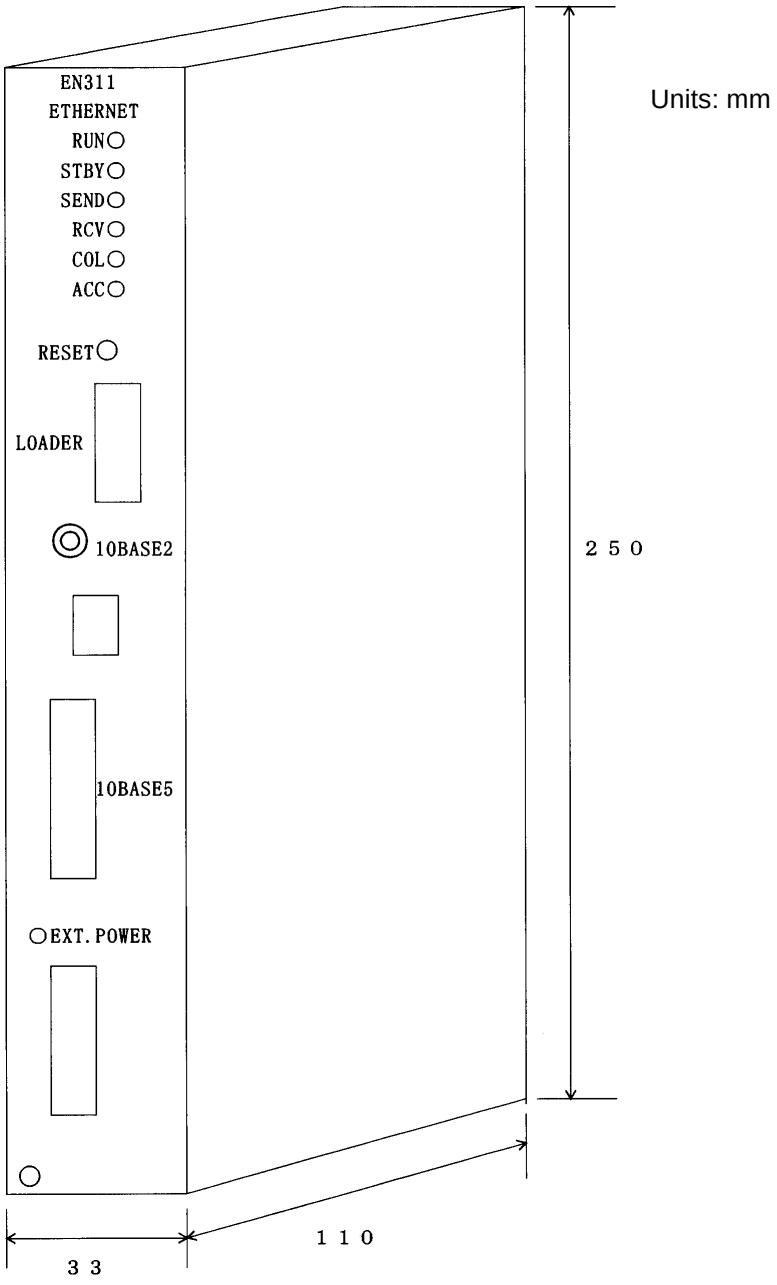
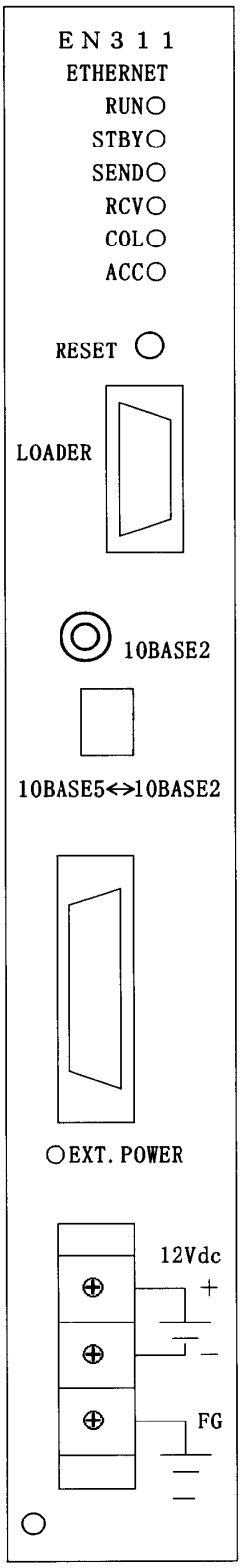


Figure 2.1 EN311 External Dimensions

2.2 Components



LED Displays

RUN:	Green
STBY:	Red
SEND:	Green
RCV:	Green
COL:	Red
ACC:	Green

Reset switch

Test connector (9-pin D-SUB connector)

10BASE2 connector (BNC)

10BASE2/10BASE5 selection switch

10BASE5 connector

(15-pin D-SUB connector with sliding latch)

LED Display

EXT. POWER: Green

MAU power supply terminal block (Provide a 12-V DC power supply.)

Base unit mounting screw hole

Figure 2.2 EN311 Front Panel

2.3 Component Functions

(1) LED Display

Indicators that display the EN311 operating state. See section 2.4, "LED Display", for detailed information.

(2) Reset switch

Used to reset the EN311 module as a unit.

Usage Recommendations
1. To press the reset switch, use a pointed object, such as a ball-point pen, to press the switch through the hole in the front panels. Be sure to press the switch all the way down.

(3) Test connector

This connector is used for maintenance, and is not used during normal operation.

(4) 10BASE2 connector

Connector used to connect the EN311 to a 10BASE2 coaxial cable. See section 3.4, "Connecting to the Network", for details on connection techniques.

(5) 10BASE5 connector

Connector used to connect an AUI cable (the cable between the EN311 and the MAU) to the EN311. See section 3.4, "Connecting to the Network", for details on connection techniques for AUI cables and the 10BASE5 connector and for AUI cable and the MAU.

(6) 10BASE2/10BASE5 selection switch

Switch for selecting what kind of network, 10BASE5 or 10BASE2, the EN311 is connected to. See section 3.2, "Switch Settings", for details on switching between 10BASE5 and 10BASE2 LANs.

(7) MAU power supply terminal block

Terminal block for providing 12-V DC power to the 10BASE5 MAU and the EN311 internal 10BASE2 MAU. **Always provide 12-V DC power, regardless of which network is used**. If the T3H side power supply is operating normally and 12-V DC power is supplied, then the EN311 "EXT. POWER" LED will light. See section 3.5, "MAU Power Supply", for details on providing the required voltage to the MAU power supply terminal block.

2.4 LED Display

The EN311 provides state display LEDs on its front panel. These LEDs display the operating state of the EN311.

(1) Front Panel Display

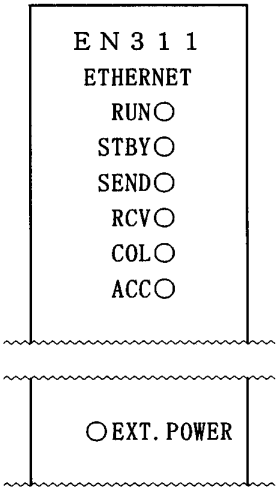


Figure 2.3 Front Panel LED Displays

(2) Content Displayed

Table 2.1 LED Display Content

LED	Content
RUN (Run)	Indicates whether or not the module is operating normally. On....The module is operating normally. Off....A module error occurred.
STBY (Standby)	Indicates the operating mode while the module is operating normally or the outline of the cause when the module is down. On.....Standby (while operating normally) Off.....Run (while operating normally)/self-diagnostic error (when the module is down) Blinking...The module went down while operating (when the module is down).
SEND (Send)	Indicates whether or not the module is transmitting data. On....Data transmission in progress Off....Data is not being transmitted.
RCV (Receive)	Indicates whether or not the module is receiving data from the transmission line. On....Data is present on the transmission line. Off....The transmission line is empty.
COL (Collision)	Indicates whether or not a collision is occurring on the transmission line during a data transmission. On....Collision(s) occurred. Off....No collisions occurred.
ACC (Access)	Indicates whether or not the T3H is accessing the module. On....The T3H is accessing the module. Off....The T3H is not accessing the module.
EXT. POWER (External Power)	Indicates whether or not 12-V DC power is supplied to the MAU power supply terminal block. On....The 12-V power is supplied normally. Off....The 12-V power is either not supplied, or is abnormal. Note that this LED will not light unless the T3H power is turned on.

The module state (run, standby or down) is indicated by the combination of the RUN LED and the STBY LED.

Table 2.2 Combined LED Display Content

Combination of LED statuses	Content
RUN on, STBY on	The module is operating normally in standby mode* (Parameter setting wait state)
RUN on, STBY off	The module is operating normally in run mode* (Data transfer possible state)
RUN off, STBY blinking	An error occurred while the module was operating. (Down mode)*
RUN off, STBY off	An error was detected during power-on self diagnostics. (Down mode)*

* See section 4.5, "Operating Mode Control Requests", for detailed information on run, standby and down mode.

3. Preparing for Operation (Hardware)

3.1 EN311 Setup Flowchart

This section presents the flowchart for EN311 setup.

⚠ WARNING

1. Build emergency stop, interlock, and similar circuits outside the PC that includes the EN311.

   If a breakdown or malfunction occurs in the PC or the EN311, there is the danger that someone could be hurt or fatally injured. Also, other equipment could be damaged or a breakdown could occur.

⚠ CAUTION

2. Take all necessary safety precautions before performing operations such as changing a running program, forcing output, or switching to RUN (operate) or HALT (stop) modes.

   Equipment can be damaged and breakdowns can be caused by operating this equipment incorrectly.

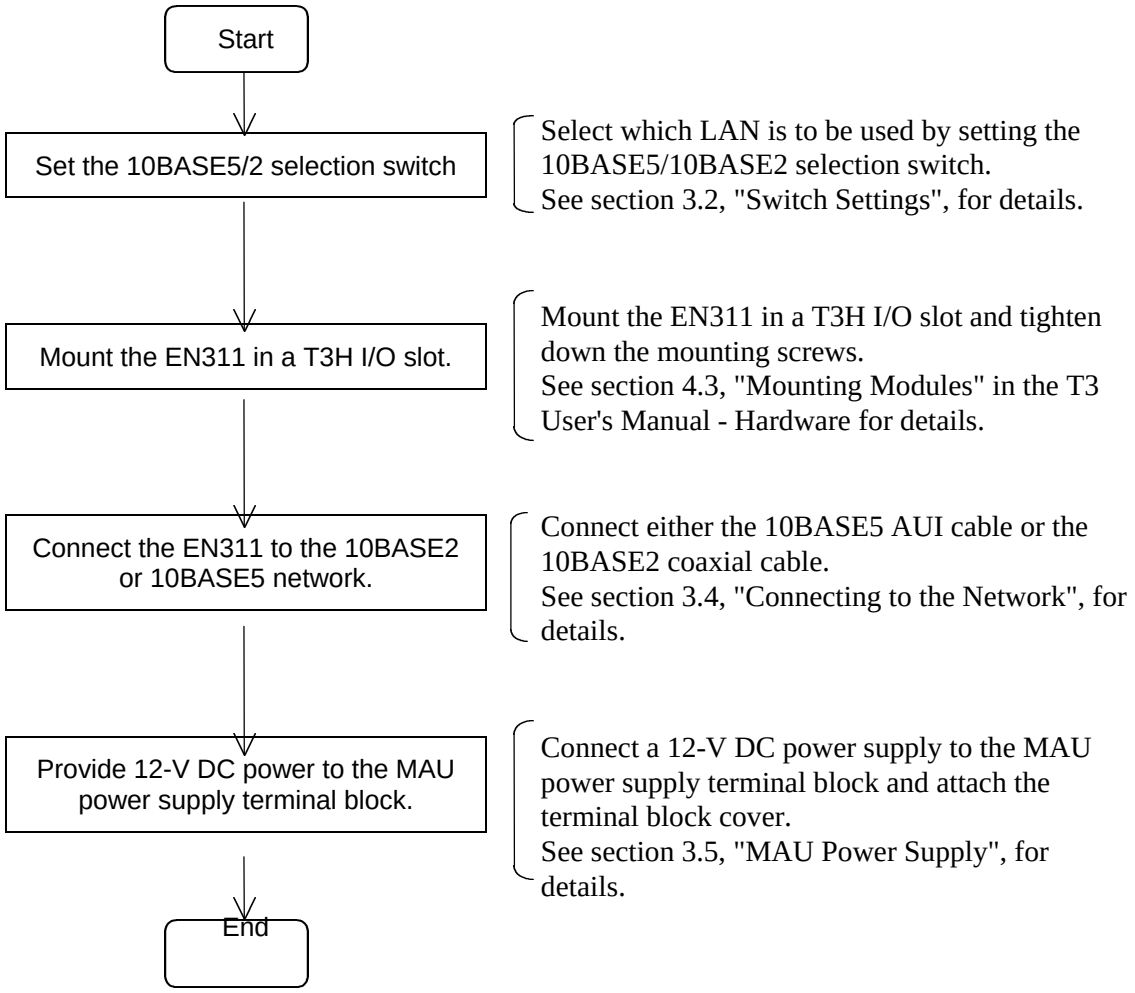


Figure 3.1 EN311 Setup Flowchart

3.2 Switch Settings

The EN311 provides two connected switches that are used to switch between 10BASE5 and 10BASE2 networks, i.e., to select the connected network type.

⚠ CAUTION

1. The EN311 cannot be connected to both a 10BASE5 and a 10BASE2 network at the same time.
2. Do not connect a network cable of the unused type to the EN311. This can damage the EN311 or cause it to malfunction.
3. Do not change this switch setting while a data transfer is in progress. This can damage the EN311 or cause it to malfunction.
4. When changing this switch setting, throw both switches together at the same time. Only throwing one of the switches at a time will not result in normal correct switching between the networks.

(1) 10BASE5

Throwing the two connected DIP switches on the front panel to the left allows a 10BASE5 network to be connected.

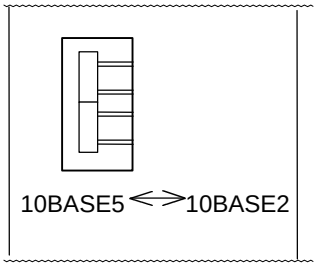


Figure 3.2 Switch Settings when a 10BASE5 Network is Used (front view)

(2) 10BASE2

Throwing the two connected DIP switches on the front panel to the right allows a 10BASE2 network to be connected.

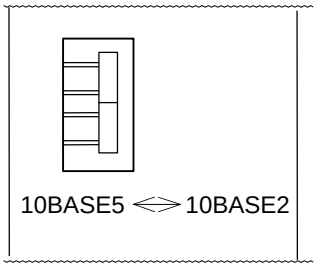


Figure 3.3 Switch Settings when a 10BASE2 Network is Used (front view)

3.3 Mounting in the Base Unit

Mount the EN311 in the T3H and secure it with the locks and screws.

See section 4.3, "Mounting Modules" in the T3 User's Manual - Hardware for the mounting procedure.

⚠ CAUTION

1. The EN311 is designed specially for the T3H and should only be mounted and used in a T3H base unit. Do not use this module independently or mounted in any other equipment. Such usage could result in electrical shocks, personal injury, or damage to the EN311 and other equipment.
2. The EN311 itself should only be mounted or removed when all power is turned off. Similarly, connections to the terminal block should only be made or removed when all power is turned off. Not observing this precaution could result in electrical shocks, malfunctions, or damage to the EN311 or other equipment.
3. Do not allow foreign objects such as wire shreds to get into the EN311. This could result in fire, breakdown, or malfunction.
4. Verify that connectors, cables, and the mounting of the EN311 itself in the base unit are all secured with screws or stops and that there is no play, missing screws, or disconnections in any of these parts.

   If any of these parts is inadequately secured, breakdown or malfunction could occur as the result of vibration.

Up to four EN311 modules may be mounted in a single T3H unit. While the EN311 modules may be mounted in either the main base unit or an expansion base unit, we recommend mounting in the main base unit, since access from the T3H is faster.

Low-power system I/O modules including the EN311 should be mounted at the left side of the unit, and high-power system I/O modules should be mounted at the right side of the unit. In cabling as well, low-power system cables and high-power system cables should be separated. Section 9.4, "Network Wiring", describes network cable wiring.

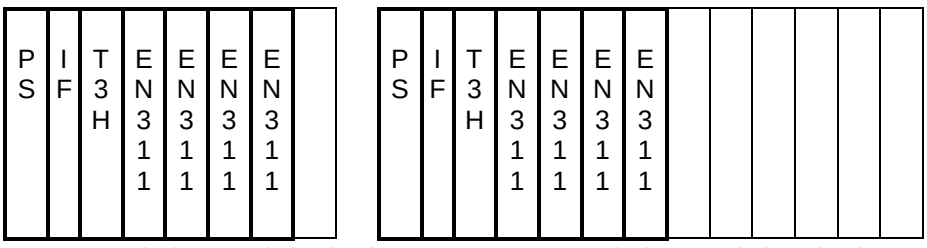


Figure 3.4 Base Unit Mounting

The EN311 draws 0.7 amperes from the T3H power supply (5 VDC). For details on determining the power supply capacity, see section 1.9, "Examining the Power Supply Capacity" in the T3 User's Manual - Hardware.

3.4 Connecting to the Network

Since the EN311 supports both 10BASE5 and 10BASE2 networks, select either a 10BASE5 or 10BASE2 network according to your system needs.

⚠ CAUTION

1. The EN311 cannot be connected to both a 10BASE5 and a 10BASE2 network at the same time.
2. Do not connect a network cable of the unused type to the EN311. This can damage the EN311 or cause it to malfunction.
3. Do not connect or disconnect cables when either the T3H or MAU power supply is turned on. This can damage the EN311 or cause it to malfunction.

(1) Connection to a 10BASE5 Network

This section describes the connection procedure starting from the state where the 10BASE5 coaxial cable, the MAU, and the AUI cable are already supplied and ready to be connected. See section 9.4, "Network Wiring", for details on wiring the 10BASE5 coaxial cable, MAUs, and AUI cables.

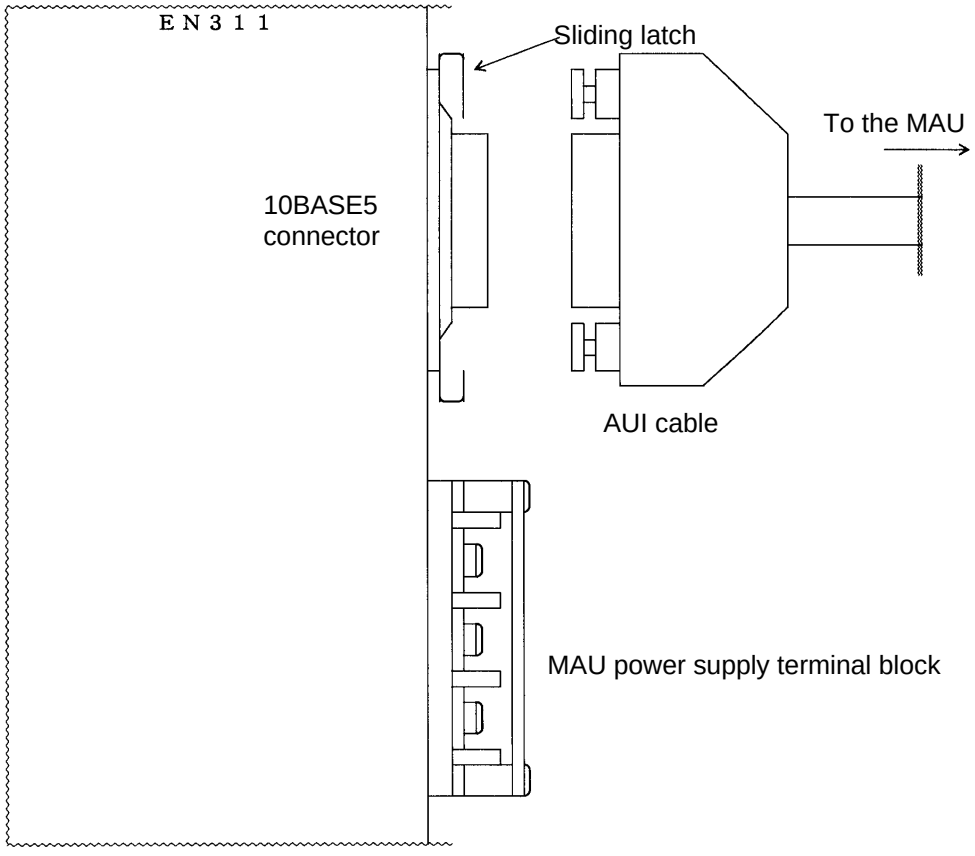


Figure 3.5 AUI Cable Connection

(1) Push the 10BASE5 connector sliding latch up.
(2) Align the AUI cable connector with the 10BASE5 connector and push it in.
(3) Push the 10BASE5 connector sliding latch down. Verify that the cable is locked and cannot be pulled out.

⚠ CAUTION
1. When installing a 10BASE5 or 10BASE2 network, the cabling must be laid with adequate safety precautions and in accordance with all applicable standards. Installation and wiring should be performed by a qualified professional. See the **ISO/IEC8802-3** standard for installation environment standards.

Usage Recommendations
1. Do not exceed the maximum number of MAUs (100) or the maximum cable length (500 m) in systems using 10BASE5.
2. Adjacent MAUs must be mounted at least 2.5 meters apart in systems using 10BASE5.
3. The AUI cable length must not exceed 50 meters in systems using 10BASE5.
4. An MAU and an AUI cable are required in systems configured using a 10BASE5 network. (See section 3.6, "Network Wiring Equipment.") These parts must be ordered separately if required.

(2) Connection to a 10BASE2 Network

This section describes the connection procedure starting from the state where the 10BASE2 coaxial cable, the MAU, and the AUI cable are already supplied and ready to be connected. See section 9.4, "Network Wiring", for details on wiring the 10BASE2 coaxial cable.

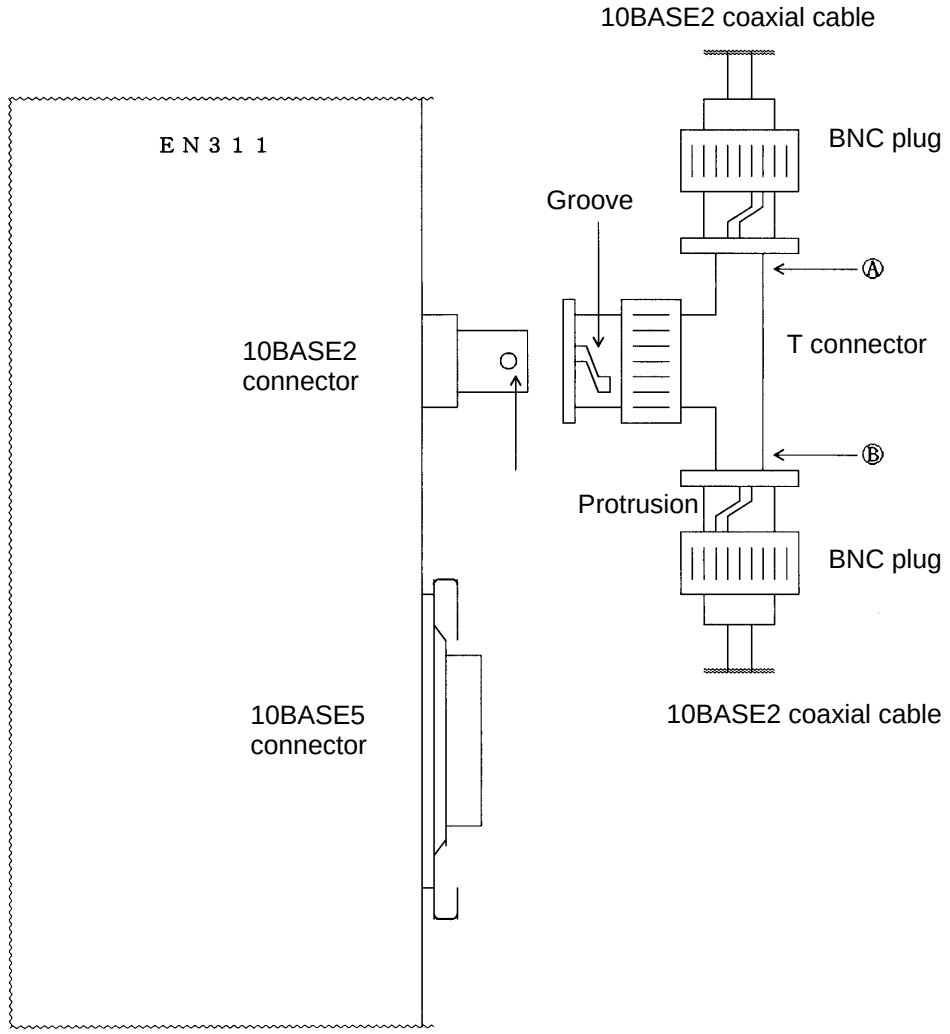


Figure 3.6 10BASE2 Coaxial Cable Connection

(1) Align the groove in the T connector with the protrusion on the 10BASE2 connector and insert the connector in the plug.

(2) With the connector inserted in the plug, rotate the ring on the plug 1/4 turn in the clockwise direction to lock the BNC connector in place.

(3) Insert the BNC plugs on the 10BASE2 cable into the Ⓐ and Ⓑ sections of the T connector and lock them in place in the same way.

(4) Verify that the cables and connectors are locked and cannot be pulled apart.

⚠ CAUTION
1. When installing a 10BASE5 or 10BASE2 network, the cabling must be laid with adequate safety precautions and in accordance with all applicable standards. Installation and wiring should be performed by a qualified professional. See the **ISO/IEC8802-3** standard for installation environment standards.

Usage Recommendations
1. Do not exceed the maximum number of MAUs (30) or the maximum cable length (185 m) in systems using 10BASE2.
2. Adjacent nodes must be separated by at least 0.5 meter in systems using 10BASE2.
3. Terminators and T connectors are required in systems configured using a 10BASE2 network. (See section 3.6, "Network Wiring Equipment.") These parts must be ordered separately if required.

3.5 MAU Power Supply

Since the EN311 supplies 12-V DC power to the 10BASE5 MAU and the 10BASE2 MAU (the latter of which is incorporated in the EN311), an external 12-V DC power supply must be connected to the MAU power supply terminal block. This means that **12-V DC power must be provided to the EN311, regardless of which network type is used**. The EXT. POWER LED will light if the T3H power supply is operating normally and 12-V DC power is supplied to the EN311.

Also note that the **FG terminal in the MAU power supply terminal block must be grounded to a class 3 ground** (as defined in the JIS standards; 100Ω or less ground resistance) provided for the sole use of control equipment. This ground is critical for reducing noise in the AUI cable. Figure 3.7 shows the method used to provide this power.

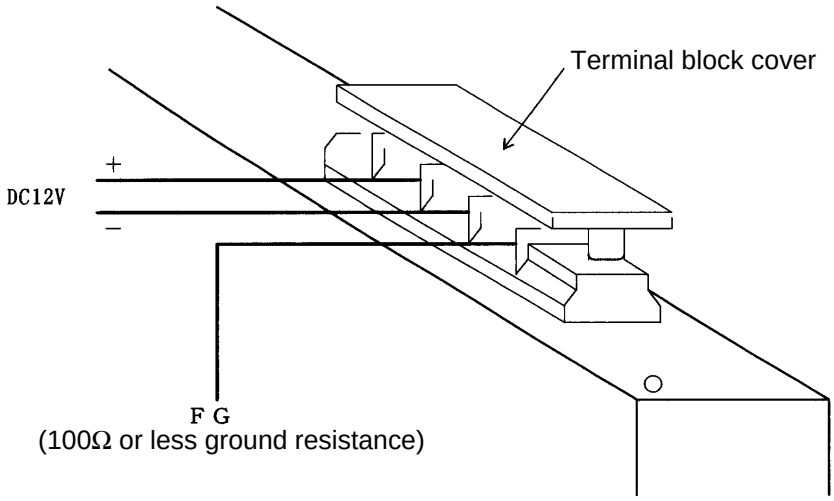


Figure 3.7 Providing 12-VDC Power

Since an external power supply is not included with the EN311, installations will have to provide this equipment separately. Select an external power supply that matches the environment in which the EN311 is used and the number of EN311 units supplied. The table below lists a line of recommended power supply units.

Model	SR □-12
Manufacturer	Nemic-Lambda

□: Output power (in watts)

Select the actual model according to the number of EN311 modules to which power must be supplied.

Procedure for Applying External Power

External power should be turned on and off **as close to the same time as the T3H power** as is possible.

If simultaneous power supply on/off operations are not possible, turn these power supplies on and off in the following sequences.

Power on: T3H power supply → external power supply

Power off: External power supply → T3H power supply

Data can be neither transmitted to nor received from the network if the external power is not provided.

Also note that the EN311 may be damaged if only external power is supplied. Furthermore, since the EXT. POWER LED will not light in this state, it is possible that the external power supply could be shorted.

⚠ CAUTION

1. When providing a voltage to this terminal block, always provide the correct +/- 12-VDC voltage. Any other voltage can damage the EN311.
2. When wiring the module, use either an insulated crimp-type terminal or wrap conducting sections with insulating tape so that no conducting sections are exposed.

   Be sure to handle the terminal block cover carefully so that it does not fall off or become damaged. Be sure to reinstall the terminal block cover after completing the wiring.

   Electrical shock is possible if any conductors are left exposed.
3. External power should be turned on and off as close to the same time as the T3H power as is possible.

   If simultaneous power supply on/off operations are not possible, turn these power supplies on and off in the following sequences.

   Power on: T3H power supply → external power supply

   Power off: External power supply → T3H power supply

   Failure to follow the above procedures can result in equipment failures, malfunctions, or shorting.

3.6 Network Wiring Equipment

This section describes the wiring and related equipment that makes up the network to which the EN311 is connected. Since the EN311 conforms to the ISO 8802-3 (IEEE 802.3) standard, users should select equipment to be used in the network that also conforms to this standard.

The following section introduces recommended wiring and related equipment. We strongly recommend that these models be used when new items are needed.

Contact the manufacturer directly for detailed information on this equipment.

(1) 10BASE5

- Coaxial cable

Catalog no.	EEA-9202-☐M+TMJ x 2	☐: Length
Standard outside diameter	10.3 mm diameter, with terminators at both ends	
Manufacturer	Showa Electric Wire & Cable Co., Ltd.	

- Plugs

Catalog no.	EPL-6213
Manufacturer	Showa Electric Wire & Cable Co., Ltd.

- Terminators

Catalog no.	EEJ-6213
Manufacturer	Showa Electric Wire & Cable Co., Ltd.

- Adapters

Catalog no.	EAD-6213
Manufacturer	Showa Electric Wire & Cable Co., Ltd.

- Grounding clamps

Catalog no.	EEL-6213
Manufacturer	Showa Electric Wire & Cable Co., Ltd.

- AUI cable

Catalog no.	AUI15-☐M	☐: Length
Standard outside diameter	6.5 mm diameter (thin wire), molded connectors	
Length	1, 2, 3, 5, 10, and 15 meters	
Manufacturer	Showa Electric Wire & Cable Co., Ltd.	

Catalog no.	AUI50-☐M	☐: Length
Standard outside diameter	10.5 mm diameter (thick wire), molded connectors	
Length	20, 30, 40, and 50 meters	
Manufacturer	Showa Electric Wire & Cable Co., Ltd.	

- MAU

Catalog no.	ETR-6071 02
Manufacturer	Showa Electric Wire & Cable Co., Ltd.

(2) 10BASE2

- Coaxial cable

Catalog no.	RG-58A/U
Standard outside diameter	5.0 mm diameter, with BNC plugs at both ends
Manufacturer	Showa Electric Wire & Cable Co., Ltd.

- BNC plugs

Catalog no.	EPL-1067
Manufacturer	Showa Electric Wire & Cable Co., Ltd.

- T connectors

Catalog no.	ETS-8191
Manufacturer	Showa Electric Wire & Cable Co., Ltd.

- Adapters

Catalog no.	EAD-8191
Manufacturer	Showa Electric Wire & Cable Co., Ltd.

- Terminators

Catalog no.	EEJ-8191
Manufacturer	Showa Electric Wire & Cable Co., Ltd.

⚠ CAUTION

1. When installing a 10BASE5 or 10BASE2 network, the cabling must be laid with adequate safety precautions and in accordance with all applicable standards. Installation and wiring should be performed by a qualified professional.

   See the **ISO/IEC8802-3** standard for installation environment standards.

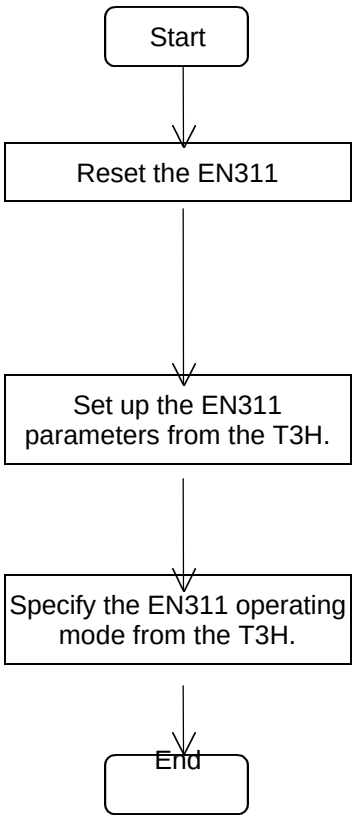
4. Preparing for Operation (Software)

This section describes setting up the EN311 software for operation.

⚠ CAUTION
1. Chapter 4 presents information related to using the functions provided by the EN311 from a T3H, including the instruction (request) format, important items that require attention, and sample programs. That chapter also presents items considered necessary when using the EN311. Make a point of understanding the content of chapter 4 thoroughly before writing programs that use the EN311. The sample programs present basic examples of EN311 usage, and should be reviewed carefully before use in an actual system.

4.1 Module Setup Flowchart (Software)

This section presents the flowchart for EN311 setup.



There are three ways to reset the EN311:
- Turn on the T3H power.
- Press the reset switch.
- Apply the reset operation from a user program on the T3H.

For details on these reset operations, see section 4.3, "EN311 Reset."

The EN311 parameters required for network transmission are set up by a user program running on the T3H. For details on these setup operations, see section 4.4, "Parameter Setup Request."

In this state, the system can handle remote station verification requests. See section 7.3, "Remote Station Verification Request." In this state, the system can respond to existence verification requests from other stations.

The EN311 operating mode is set by user programs running on the T3H. For details on these operations, see section 4.5, "Operating Mode Control Requests."

In this state, the PC link and computer link protocol transmission slave station functions are operating.
(Assuming that they have not been explicitly disabled by the operating mode settings.)

Figure 4.1 EN311 Setup Flowchart (Software)

Usage Recommendations
Before performing the settings described in this chapter, register the EN311 as T3H I/O. The I/O type is OPT.

4.2 EN311 Operation Modes and Station Statuses

The EN311 operation modes and its station statuses allocated to the SW registers of the T3H are described here. The method for controlling the operation modes is described in "4.6 Operation Mode Control Requests". The EN311 operation modes include the following:

(1) Initialize mode

- Indicates that the EN311 is processing the reset.
- When the reset processing is completed, the mode is changed to "Standby mode".
- If the reset processing is completed abnormally (such as by error in self-testing etc.), the mode is changed to "Down mode".
- During Initialize mode, the instructions from the T3H side user program cannot be executed.

(2) Standby mode

- In this mode, the EN311 parameter can be set for the EN311.
- Other than the Standby mode, it is not possible to set the EN311 parameter.
- After setting the EN311 parameter, the mode can be changed to "Run mode" by the T3H side user program instruction.

(3) Run mode

- In this mode, the EN311 can perform transmission with other nodes.
- The mode can be changed to "Standby mode" by the T3H side user program instruction.
- In Run mode, whether the computer link and PC link procedure can be transmitted or not and whether the socket interface can be transmitted or not can be specified separately.

(4) Down mode

- Indicates that the EN311 is placed in the irrecoverably abnormal condition.
- Once the mode is changed to the Down mode, it can be recovered only by turning on the power again or using the resetting switch.
- The details of the Down mode can be checked by means of the data on the I/F buffer memory with the T3H.

  (Please refer to "7.2 Down Information".)

Fig. 4.2 shows the EN311 mode transition diagram. The EN311 operation modes are indicated in rectangular frames. The operation modes inside in heavy bordered frames can be controlled by the user program. The thick arrows in the diagram indicate requests which can be specified by the user program.

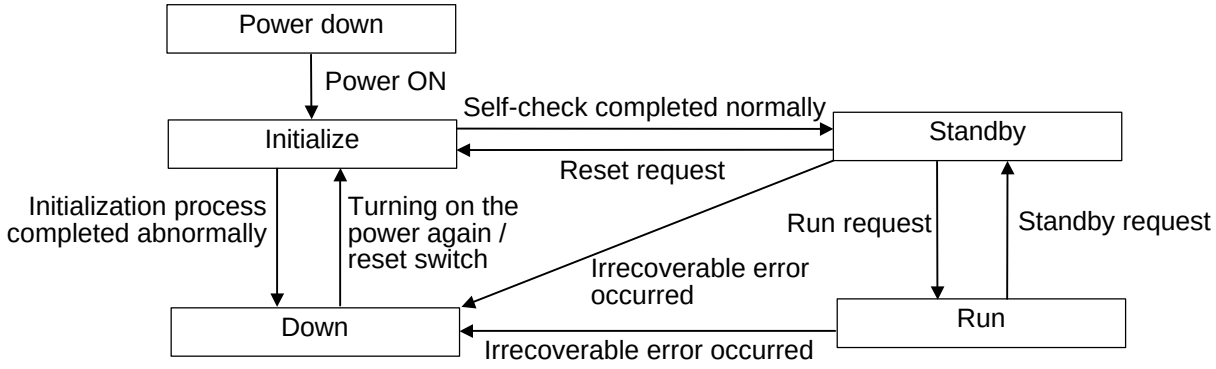


Fig. 4.2 EN311 Mode Transition

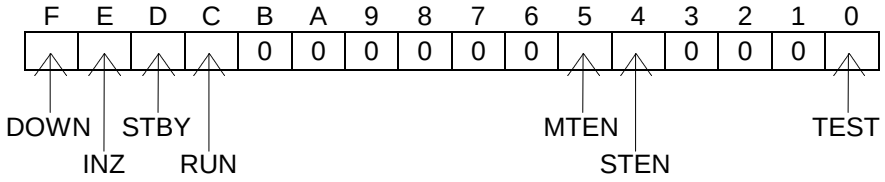
The EN311's operation statuses (station statuses) are allocated to the special registers of the T3H. The T3H reads the station statuses out of the EN311 and copies them onto the SW registers **(100ms cycle updating)**. Each bit of the station status has the following meaning. **In judging whether the mode is Initialize, Run or Standby, view the value as a register.**

Special Register	Name
SW063	CH1 station status
SW064	CH2 station status
SW065	CH3 station status
SW066	CH4 station status

Supplement:

If the OS version of the T3H (can be checked with T-PDS) is 1.1□, SW064 to 067 are cleared to "0" into with the first scan of HALT→RUN of the T3H. If the OS version of the T3H is 1.2 or up, none are cleared to "0".

Station status format



Bit	Name	1	0
F	DOWN: Down mode	Down mode	Other than the Down mode
E	INZ: Initializing mode	Initialization being processed	Initialization processing complete
D	STBY: Standby mode	Standby mode	Other than the Standby mode
C	RUN: Run mode	Run mode	Other than the Run mode
5	MTEN: Message transmission	Permit	Inhibit
4	STEN: Socket I/F transmission	Permit	Inhibit
0	TEST: Test	Test function being executed	Test function complete or in waiting request state

EN311 operation modes and station statuses

EN311 Mode	Station Status
Initialization being processed (Power-ON, Reset request, Reset SW)	4000H
Standby mode (Initialization processing completed normally)	2000H
Run mode: Message transmission permit	1020H
Run mode: Socket I/F transmission permit	1010H
Run mode: Message transmission; socket I/F transmission permit	1030H

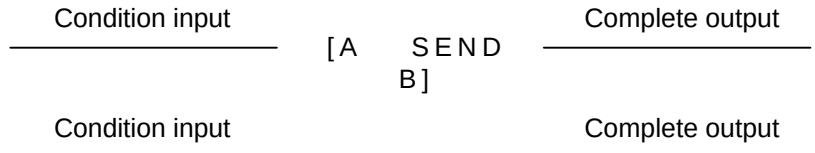
4.3 EN311 Instruction Specifications

Before discussing the software side of the EN311 setup procedure, this section presents an overview of the SEND and RECV instructions, which are the instructions that are used to control the EN311 from T3H user programs. EN311 module control and transmission control (PC link protocol transmission and socket interface transmission) are performed solely using the SEND and RECV instructions.

See the individual items for details on the actual requests sent to the EN311.

(1) Instruction format

Figure 4.3 shows the formats of the SEND and RECV instructions.



Operand

	Name	Device						Register												INDEX				Index Con-stant
		X	Y	S	L	R	Z	XW	YW	SW	LW	RW	W	T	C	D	F	IW	OW	I	J	K		
A	Transfer parameter							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						✓
B	Completion status								✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						✓

Condition input	Operation		Completion output	ERF
OFF	No execution		OFF	OFF
ON	Execution	Transmission port instruction busy/instruction execution in progress (response wait)	OFF	OFF
		Response reception complete (normal complete)	ON	OFF
		Instruction error	ON	ON

Figure 4.3 SEND/RECV Instruction Formats

<Important items>

a. ERF is the S0051 special relay. See the T-series Instruction Set for information on ERF usage.
b. For these instructions, **instruction execution starts at the point the condition input changes state from off to on.**
c. Since these instructions span multiple scans, applications must **hold the condition input in the on state until the output goes to the on state**.
   If the condition input is turned off before the output goes on, the system will not be able to execute the following instruction processing and the other SEND and RECV instructions normally.
d. After instruction execution terminates, it is possible to start execution again by applying a new input.

(2) Transfer parameters (A)

The data required for a request to the EN311 is set up in an area that starts in the register indicated by [A]. Then the application executes a SEND or RECV instruction. Here we present an overview of the structure of the transfer parameters. Tables 4.1 and 4.2 list the requests that can be issued to an EN311.

A	3□00H	Module designation
A + 1	CMD	Command number: Indicates the request type to the EN311.
A + 2 A + 3 M	Parameters	Parameters: This data differs depending on the type of the request to the EN311.

Module designation: Designates the EN311 mounted in the T3H.

3 (Module ID): Must be set to 3 for an EN311.

□ (channel number): The values 1, 2, 3, and 4 are allocated in order starting with the EN311 closest to the T3H.

00 (station number): This two-digit field must be set to 00.

<Important items>

e. Do not modify the contents of the transfer parameters while an instruction execution is in progress.
The SEND or RECV instruction may not complete.

Table 4.1 Instructions (Requests) to the EN311 (Part 1)

Request	Function	Instruction	CMD	
Reset request	Resets the module.	SEND	0011H	✶
Parameter setup request	Sets up the EN311 parameters.	SEND	0012H	✶
Operating mode control request	Sets the operating mode.	SEND	0013H	✶
Remote station verification request	Verifies the existence of another node on the network.	SEND	0014H	✶
RAS information readout request	Reads out the module RAS information.	RECV	0015H	✶
Time set request	Sets the module internal clock Time information for event trace (RAS information)	SEND	0018H	✶
Register read request (PC link function)	Reads register data from remote T3H into registers in the local T3H.	RECV	0021H	✸
Register write request (PC link function)	Writes register data from the local T3H to registers in remote T3H.	SEND	0021H	✸
Remote station loopback request	Performs a loopback operation with another EN311 on the network.	SEND	000FH	✸
UDP open request	Opens a socket interface (UDP).	SEND	0031H	✹
UDP send request	Sends data from a socket interface in the UDP open state.	SEND	0032H	✹
UDP receive request	Reads data received by a socket interface in the UDP open state.	RECV	0033H	✹
UDP close request	Closes (terminates) a socket interface in the UDP open state.	SEND	0034H	✹

CMD (command number):Indicates the request type to the EN311.

Table 4.2 Instructions (Requests) to the EN311 (Part 2)

Request	Function	Instruction	CMD
TCP open request	Opens a socket interface (TCP).	SEND	0035H
TCP send request	Sends data from a socket interface in the TCP open state.	SEND	0037H
TCP receive request	Reads data received by a socket interface in the TCP open state.	RECV	0038H
TCP close request	Closes (terminates) a socket interface in the TCP open state.	SEND	0039H

CMD (command number): Indicates the request type to the EN311.

<Important items>

f. Items (1) to (3) are CMD classes. Class (1) is module control, (2) is PC link protocol transmission, and (3) is socket interface transmission.
- For a single EN311 module, it is not possible to request another class (1) CMD while a class (1) CMD is executing. This is also true for class (2) CMDs. If such a request is issued, the status (described in the following status information) will be transmission port busy, and the request will go to the wait state.
- For a single EN311 module, when requesting a class (3) CMD, it is not possible to request another class (3) command for a socket for which an instruction is executing. If such a request is issued, the status (described in the following status) will be transmission port busy, and the request will go to the wait state.
- There are eight sockets, and each can independently accept and execute a class (3) instruction.

g. If the T3H switches from the run to the halt state and then back to the run state while an instruction is executing, it is possible that the EN311 could execute the request issued immediately prior to the halt state. This section describes the handling required after returning to the run state.
- The T3H should always set the EN311 to standby mode after the T3H returns to run mode. (See 4.6.)
- Setting the EN311 to standby mode causes all the requests issued to the EN311 to be discarded, computer link and PC link protocol transmissions to be stopped, and the socket interface to be initialized, i.e. set to the closed state. (See 4.4.)
- The same status as in the method above can be obtained by initializing the EN311 with the Reset button while the T3H is halting. (See 4.4.)

(3) Status (B)

The status during the execution of a SEND or RECV instruction and after that instruction terminates is stored in the register shown at B. When TermSTS = 0BH, the detailed information (EN311 error information) will be loaded into the registers indicated at location B + 1. Figure 4.4 shows the structure of the status information. Tables 4.3 and 4.4 list the TermSTS values, and table 4.5 lists the contents of the detailed information.

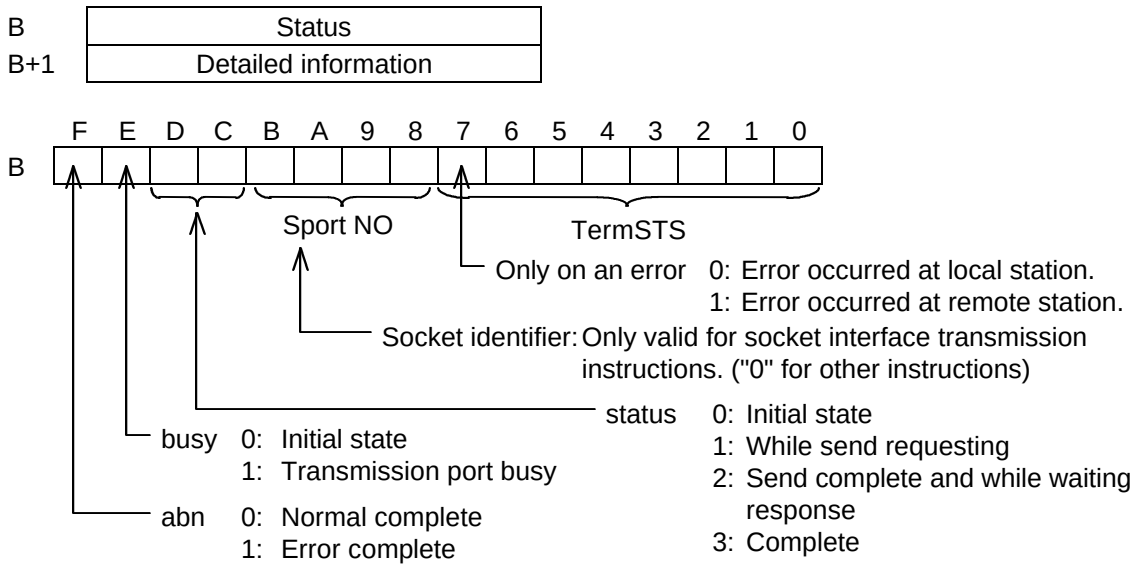


Figure 4.4 Status Structure

<Important items>

h. The **user program must set bits C and D to 0** before first activating a SEND/RECV instruction. Failure to do so will cause the SEND/RECV instruction to not complete.

i. Also, **do not write to the status during instruction execution**. This will cause the SEND/RECV instruction to not complete.

j. If multiple SEND/RECV instructions are used in the user program and are to be executed simultaneously, **separate the complete status and the detail information registers in terms of each instruction.** This will stop the SEND/RECV instructions from being completed.

Table 4.3 TermSTS (Part 1)

TermSTS	Status	Meaning
00H	Normal complete	
01H	Register specification error	• Occurs if a register other than XW, YW,W, LW, RW, D, F, T, C, or SW is specified as the data storage register in one of the following requests. Requests: RAS information readout, remote station loopback, UDP send/receive, TCP send/receive, register read/write. • In a register read or write request, the request specified a read or write from a T register to a register other than a T register. (This also applies to C registers.)
02H	Response timeout	• Occurs if a response is not received within the specified time for a remote station loopback or register read/write request.

Table 4.4 TermSTS (Part 2)

TermSTS	Status	Meaning
03H	Parameter error	• Occurs if a value other than 3 is specified for the module ID. • Occurs if a value other than 1, 2, 3, or 4 is specified for the channel number. • Occurs if a command number other than one of the following is specified for a SEND instruction. 000FH, 0011H - 0014H, 0018H, 0021H, 0031H, 0032H, 0034H, 0035H, 0037H, 0039H • Occurs if a command number other than one of the following is specified for a RECV instruction. 0015H, 0021H, 0033H, 0038H • Occurs if a value other than 1 to 8 is specified for the socket identifier. (See section 6.4 "Using the EN311 Socket Interface".) • Occurs if an incorrect parameter is specified in a RAS information readout request. (See section 7.6 "RAS Information Readout ".)
04H	Memory write protect	• Occurs if an attempt to write is made when the remote registers were write protected. • Occurs if an attempt to read is made when the local registers were write protected.
05H	(Reserved)	
06H	Module error Initialization in progress Transmission complete timeout	• Occurs if the module is down. • Occurs if the module is initializing. • Occurs if a T3H internal timer times out. Requests: UDP open, UDP send, UDP close, TCP send, TCP close
07H	No send channel (CH)	• Occurs if the corresponding EN311 is not installed.
08H	Station address out of range	• Occurs if the local station IP address was specified for the remote destination IP address. Requests: Remote station loopback, register read/write
09H	Incorrect transmission word count	• Occurs if either 0 words or 486 or more words were specified for either a register read/write or a remote station loopback request. • Occurs if either 0 words or 1001 or more words were specified for a UDC/TCP send/receive request.
0AH	Boundary error	• Occurs if the specified area (start address + register range) does not exist in the T3H data storage registers. Requests: RAS information readout, remote station loopback, UDP send/receive, TCP send/receive, register read/write
0BH	Transmission error	• Occurs if the EN311 returns an error response. Detailed information (the EN311 response status) is stored at B+1.
0CH	No I/O response	• Occurs if the T3H cannot access the EN311.
0DH	IC card specification error	• Occurs if an error occurs when the T3H IC card is being used as registers (expansion F registers). (See the T3H Instruction Manual.) Requests: Register read/write
0EH	Send data capacity exceeded	• Occurs if a request is discarded when a T3H internal resource insufficiency occurs due to increasing amounts of transfer data. • Occurs if a T3H retransmission times out.
0FH	(Reserved)	

Table 4.5 Detailed Information (EN311 Error Responses) (Part 1)

Error	Code	Description
Normal complete	0001H	Request completed normally
Local station fault	0002H	The local station is in down mode
Local station standby	0003H	In standby mode data transmission (socket interface transmission or PC link protocol transmission) was requested.
Timeout	0020H	Timeout occurred during TCP open processing or receive processing, or during UDP receive processing.
Length error	0030H	Incorrect send data length
Station mode error	0040H	One of the following requests was issued in a mode other than standby mode: a. Parameter setup, b. MAC address setup, c. Reset
MAC/IP not set up	0050H	Occurs if the MAC address or IP address is not set up.
Transmission prohibited state	0060H	• Occurs if a PC link request was issued from the T3H in run mode in the message transmission prohibited state. • Occurs if a socket open, close, send, or receive request is issued by the T3H in run mode in the socket interface transmission prohibited state.
Format error	0070H	Occurs when there is a format error in the request text.
	0071H	Port number error
	0072H	Request code error
	0073H	Time setting: Year
	0074H	Time setting: Month
	0075H	Time setting: Day
	0076H	Time setting: Hour
	0077H	Time setting: Minute
	0078H	Time setting: Second
Opened	0080H	Occurs if an open request is issued for an already open socket.
Unopened	0081H	Occurs if send, receive, or close request is issued for an unopened socket.
Incorrect socket identifier	0082H	Occurs if the socket identifier is out of range (1 to 8).
Incorrect control request specification	0083H	Occurs if a request that was prohibited by an operating mode control request is issued. • Occurs if a run request is issued in run mode. • Occurs if a standby request is issued in standby mode. • Occurs if a run request and a standby request are issued at the same time.
LAN controller driver error	0090H	Occurs if the setting of the local station IP address and port number in the area reserved for transmission fails.
	0091H	• Error in the TCP or UDP protocol (such as a transmission phase error) • Due to the remote-station down, the TCP socket made the request to send to the socket where the NOACK bit of the socket status is ON.
	0092H	• Occurs if the setting of the remote station IP address in the remote station information area (the NETDATA table) fails. • Occurs if the remote station IP address network address differs from the local station IP address network address.
Memory pool allocation failure	00A0H	Occurs if the EN311 internal OS fails to allocate memory.
Port 2 task start failure	00A1H	Occurs if computer link or PC link socket identifier acquisition fails.

Table 4.5 Detailed Information (EN311 Error Responses) (Part 2)

Error	Code	Description
Broadcast specification error	00A2H	Occurs if the remote IP address is broadcast on a remote station verification request.
MAC address specification error	00B0H	BCC error
	00B1H	Occurs if an error occurs after address saving on a MAC setup request.
Insufficient resources error	00C0H	• TOccurs if there are insufficient resources for UDP send or PC link transmission. • The UDP socket made the request to send when the buffer in the EN311 was full without taking the received data over to the T3H side.

4.4 EN311 Reset

This section describes the EN311 reset procedures. There are three ways to reset an EN311 as follows:

(1) T3H power on

(2) Reset switch

(3) Reset by a user program running on the T3H

In EN311 reset processing, when one of the above resets occurs, the module first performs the self check described below. If the self check completes normally, the module switches to standby mode (the parameter setting wait state), thus completing the reset sequence. If an error is discovered during the self check, the module goes to the down state.

- EN311 module self check items
  - System ROM check
  - System RAM check
  - LAN controller check
  - T3H interface buffer memory check

See section 4.6, "Operating Mode Control Requests", for more information on the EN311 operating modes.

(1) T3H power on

When power is applied to the T3H, power is also applied to the EN311, and the EN311 performs its reset processing sequence.

(2) Reset switch

EN311 reset processing is performed when the EN311 reset switch is pressed. This technique should be used when it is desirable to reset the EN311 without stopping the T3H.

Supplement:

In the event of initializing the EN311 with the reset switch while the T3H is in the RUN state, make sure that the programming is made in such a manner that various requests to the EN311 are started after a lapse of 100ms after the station status of the EN311 is changed to the Standby mode. The current EN311 has the above restriction. However, through changes in the software in the EN311, it is expected that the 100ms wait will become unnecessary.

Usage Recommendations
1. When pressing the reset switch, use a pointed object, such as a ball-point pen, to press the switch through the hole in the front panels. Be sure to press the switch all the way down.

(3) Reset request from the T3H

It is possible to initiate reset processing from user programs on the T3H. This section describes the format of the reset processing instruction.

Reset request (using the SEND instruction)

a. Function

Reset request from a user program to an EN311.

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0011H	CMD number

c. Completion status (See figure 4.4 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					0	0	0	0	TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

d. Important items

An error will occur if the EN311 is in run mode or down mode.

Run mode - Completion status: Transmission error (TermSTS = 0BH)
Detailed information: Station mode error (0040H)

Down mode - Completion status: Module error/initialization in progress (TermSTS = 06H)

e. Sample program

This sample ladder program issues a reset request to the channel 1 EN311.

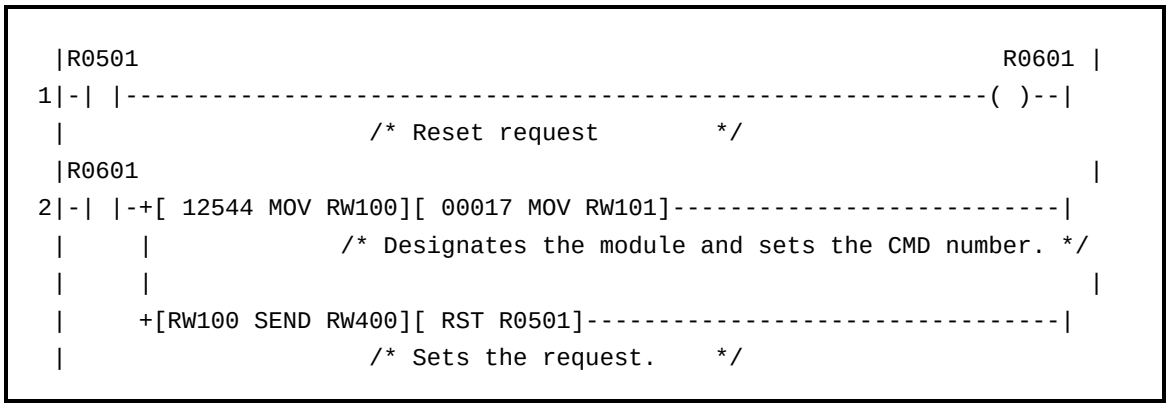
This program is executed by turning on the R0501 A contact.

Transfer Parameters

	F 0		Register allocation
A	3100H	Module designation	RW100
A+1	0011H	CMD number	RW101

Completion status

	F 0		Register allocation
B		Completion status	RW400
B+1		Detailed information	RW401


|R0501 R0601 |
1|-| |----------( )--|
/* Reset request */
|R0601 |
2|-| |-+[12544 MOV RW100][00017 MOV RW101]----------|
/* Designates the module and sets the CMD number. */
+[RW100 SEND RW400][RST R0501]----------|
/* Sets the request. */

4.5 Parameter Setup Request

This section describes the procedure for EN311 parameter setup in the EN311 from a T3H user program. The EN311 parameters consist of the following:

(1) Local station IP address

(2) UDP port number for computer link and PC link transmission

Here we first describe the IP address, subnet mask, and port number, which are the parameters required for TCP/IP and UDP/IP transmission.

(1) IP address

The IP address is the address that specifies a particular node (station) when transmitted data using the IP (internet protocol). Therefore IP addresses must be set and managed so that they are not duplicated. The following presents an overview of IP addresses.

a. IP address format

An address consists of a network address and a host address. The network address is an address that specifies a particular network, and the host address is an address that specifies a particular node (station) on that network. The same network address must be assigned to all nodes (stations) on the same (i.e., any given) network.

An IP address is a 32-bit data item. IP addresses are written as the decimal values of each byte in the 32-bit datum, with the decimal values separated by dots.

Example: 11000000 00000000 00000000 00000001 → 192.0.0.1

IP addresses are divided into five classes, A through C, according to how many bits in the 32-bit value are used as the network address. (The networking standards also define classes D and E, but the EN311 does not support them.) Figure 4.4 shows the classes A though C.

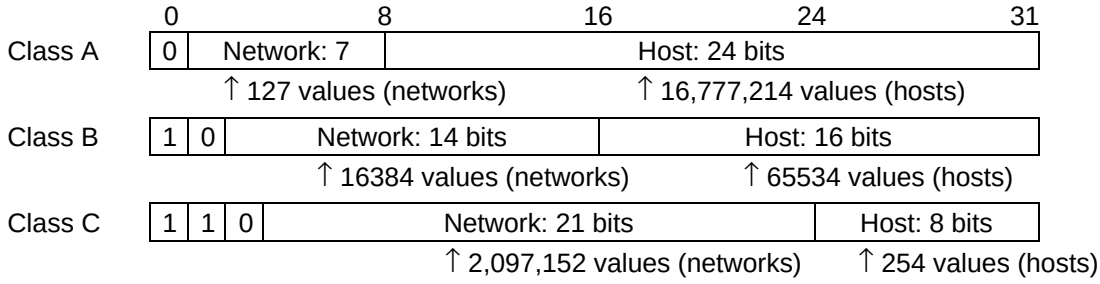


Figure 4.5 IP Address Class Divisions

In this system, networks with a large number of connected nodes use class A addresses and networks with s small number of connected nodes use class C addresses. Class B addresses are used for networks that fall between classes A and C. Expressed in decimal, the first byte of the class A through C networks will be: 0 to 127 for class A, 128 to 191 for class B, and 192 to 223 for class C.

b. IP address acquisition

Taking future uses into account, we strongly recommend acquiring an official IP address.

c. Notes on IP addresses

The following IP addresses cannot be used with the EN311, both for the local station and for remote station addresses.

- Addresses starting with 127 (7FH).
- Addresses in which the network address is all zeros or all ones.
- Addresses in which the host address is all zeros or all ones.

d. Broadcast addresses

The only broadcast address that can be used with the EN311 is 255.255.255.255 (FF.FF.FF.FF). The broadcast address 0.0.0.0 used on some UNIX systems (4.2 BSD) cannot be used.

UNIX is an operating system used on engineering workstations (EWS) and other computers. There are several versions of UNIX, including ones developed by AT&T Bell Laboratories Inc., and ones developed by the University of California at Berkeley. In particular, 4.2 BSD is a version developed at Berkeley.

(2) Subnets and the subnet mask

One technique for managing a network with a large number of nodes (stations) is to divide that network into multiple subnets. A subnet operates by taking some number of bits in the host address of the IP address for each class, and using those bits as a subnetwork address. This allows the installation to operate the network internally as multiple subnetworks, while the network is recognized externally as a single network.

The subnet mask is used to determine how many bits of the host address to allocate as the subnet address. In the subnet mask, the network address field and the subnetwork address field are set to 1 and the remaining field (the subnet host address field) is set to 0.

Example: When a subnetwork address field of 12 bits is used in a class A IP address.

1111 1111 1111 1111 1111 0000 0000 0000 (FFFFF000)

Network address field	Subnetwork address field	Host address field

When a subnet mask is used, all nodes (stations) on the subnetwork must use the same subnet mask.

In the EN311, the subnet mask cannot be set by the user. The subnet masks (with the network address field filled with ones) for each class are generated automatically as shown in table 4.6 from the specified IP address.

Table 4.6 Relationship between the Local IP Address and the Generated Subnet Mask on the EN311

Local IP Address	Subnet mask
class A	255.0.0.0 (FF000000)
class B	255.255.0.0 (FFFF0000)
class C	255.255.255.0 (FFFFFF00)

Usage Recommendations
1. The EN311 does not allow the user to set the subnet mask. Therefore the EN311 cannot be used in systems that operate a subnetwork.

(3) Port number

An IP address identifies a particular node (station) on a network. However, since, on any given node, there will be multiple applications using TCP/IP or UDC/IP to communicate with applications on other nodes, the question of to which application the data should be passed arises.

UDP ports have the role of acting as the point of contact between UDP and applications that transfer data using UDP. UDP ports are managed using port numbers. In the same manner, TCP uses TCP ports.

The combination of a port number and an IP address is called a socket. The EN311 transmits data to or from other nodes using these sockets in the computer link protocol, the PC link protocol, and in socket interface transmission.

The range of port numbers that can be used with the EN311 is from 1024 to 65535, for both TCP and UDP. However, note that the same port number cannot be used for both TCP and UDP on the EN311. This is because UNIX allocates port numbers 1 to 1023 for standard services.

The following section describes the format of the parameter setup request.

Parameter setup request (using the SEND instruction)

a. Function

This is a request from a user program that sets up the EN311 parameters in an EN311 in standby mode.

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0012H	CMD number
A+2 A+3	Local station IP address for the EN311	
A+4	UDP port number for message	UDP port number used for computer link or PC link protocol transmission.

- IP address setup procedure: For the address 133.113.90.10

↓

85H. 71H. 5AH. 0AH

	F	8 7	0
A+2	71H	85H	
A+3	0AH	5AH	

- Message transmission UDP port number

  As described in chapter 1, UDP/IP is used for both computer link and PC link protocol transmission, which are collectively referred to as message transmission. These techniques use dedicated UDP sockets that are separate from those used by socket interface transmission.

  Set the port number to a value in the range 1024 to 65535. (UNIX allocates port numbers 1 to 1023 for standard services.)

  The UDP port number specified at A+4 is the UDP port number allocated for message transmission (receive). The two port numbers following that port number are automatically allocated for message transmission (send). If computer link protocol/PC link protocol reception is performed directed at the message transmission UDP port number specified at A+4, the EN311/T3H will process the received data in the order received and send the result from one of the message transmission send ports. (See figure 4.5.)

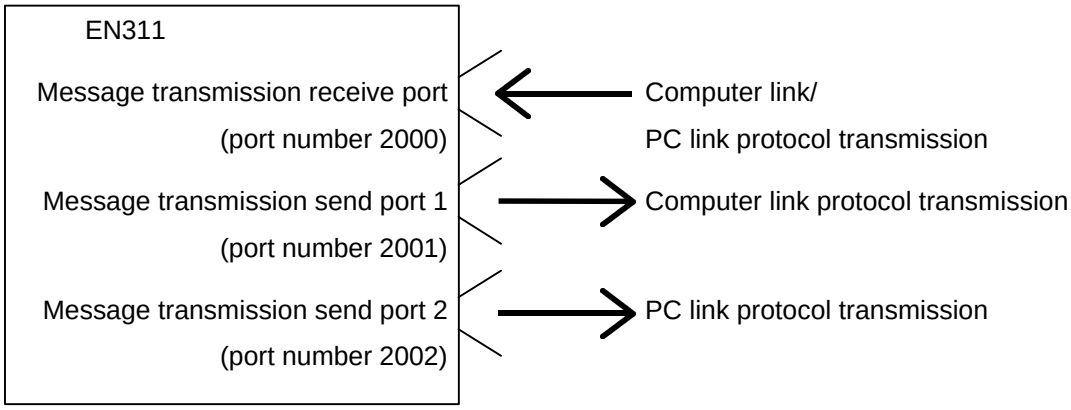


Figure 4.6 Relationship between Message Transmission Send and Receive Port Numbers

As mentioned in the section on socket interface transmission, UDP port numbers used for message transmission must not duplicate UDP socket port numbers or TCP socket port numbers.

c. Status (See figure 4.3 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					0	0	0	0	TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

d. Important items

- An error will occur if the EN311 is in run mode or down mode.

  Run mode - Status: Transmission error (TermSTS = 0BH)
  Detailed information: Station mode error (0040H)
  Down mode - Status: Module error (TermSTS = 06H)

- An error occurs if a UDP port number is set to a value outside the range 1024 to 65535.

  Status: Transmission error (TermSTS = 0BH)
  Detailed information: Port number error (0071H)

e. Sample program

This sample ladder program issues a parameter setup request to the channel 1 EN311.

This program is executed by turning on the R0502 A contact.

Parameters: 12544:3100H, 00018:0012H

29061:7185H, 02658:0A62H

Transfer Parameters

	F 0		Register allocation
A	3100H	Module designation	RW100
A+1	0012H	CMD number.	RW111
A+2	7185H	Local station IP address	RW112
A+3	0A5AH		RW113
A+4	0401H	UDP port number for message transmission	RW114

Local station IP address : 133. 113. 90. 10

↓ ↓ ↓ ↓

85H. 71H. 5AH. 0AH

UDP port number for message transmission : 1025

Completion status

	F 0		Register allocation
B		Completion status	RW402
B+1		Detail information	RW403

```
 |R0502                                                          R0602 |
1|-| |-------------------------------------------------------------( )--|
 |                    /* Parameter setup request */
 |R0602                                                               |
2|-| |-+[ 12544 MOV RW110][ 00018 MOV RW111]--------------------------|
 |     |             /* Designates the module and sets the CMD number. */
 |     |                                                              |
 |     +[ 173699461 DMOV RW113•RW112][ 01025 MOV RW114]---------------|
 |     |             /* Sets the IP address, Port number. */
 |     |                                                              |
 |     +[RW110 SEND RW402][ RST R0502]-------------------------------|
 |                   /* Sets the request.      */
 |                                                                    |
```

Parameters: [7]699461:0A5A7185H

↓

85H. 71H. 5AH. 0AH

4.6 Operating Mode Control Requests

This section describes the procedures for controlling the EN311 operating mode from user programs on the T3H.

This section describes the operating mode control request instruction format.

Operating mode control request (using the SEND instruction)

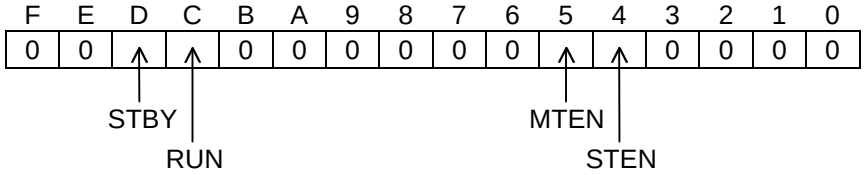
a. Function

This is a request from a user program that controls the EN311 operating mode.

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0013H	CMD number
A+2	Specified information	

Specified information



Bit D: STBY (standby request)
Switches the EN311 from run mode to standby mode.

Bit C: RUN (run request)
Switches the EN311 from standby mode to run mode.

Bit 5: MTEN (message transmission enable/prohibit request)
Computer link/PC link protocol transmission enable/prohibit
1: Enable, 0: Prohibit

Bit 4: STEN (socket interface transmission enable/prohibit request)
Socket interface transmission enable/prohibit
1: Enable, 0: Prohibit

Examples: Standby request - 2000H

Run request - 1030H (Allows both message transmission and socket interface transmission)
1010H (Allows socket interface transmission only)
1020H (Allows message transmission only)

c. Status (See figure 4.3 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					0	0	0	0	TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

d. Important items

- Values other than 1010H, 1020H, 1030H, and 2000H may not be specified for the specification information.
  → Status: Transmission error (TermSTS = 0BH)
  Detailed information: Incorrect control request specification (0083H)
- Simultaneous run mode and standby mode requests (30x0H) cannot be executed.
  → Status: Transmission error (TermSTS = 0BH)
  Detailed information: Incorrect control request specification (0083H)
- A mode that has already been established cannot be requested. However, requests that change the MTEN/STEN state within the same mode do not cause an error.
  → Status: Transmission error (TermSTS = 0BH)
  Detailed information: Incorrect control request specification (0083H)
- No execution is possible in down mode.
  → Status: Module error/initialization in progress (TermSTS = 06H)
- An error occurs if a control request that switches the EN311 to run mode is issued without first setting the IP address.
  → Status: Transmission error (TermSTS = 0BH)
  Detailed information: MAC/IP not set up (0050H)

e. Sample program

This sample ladder program issues a operating mode control request to the channel 1 EN311.

This program is executed by turning on the R0503 A point.

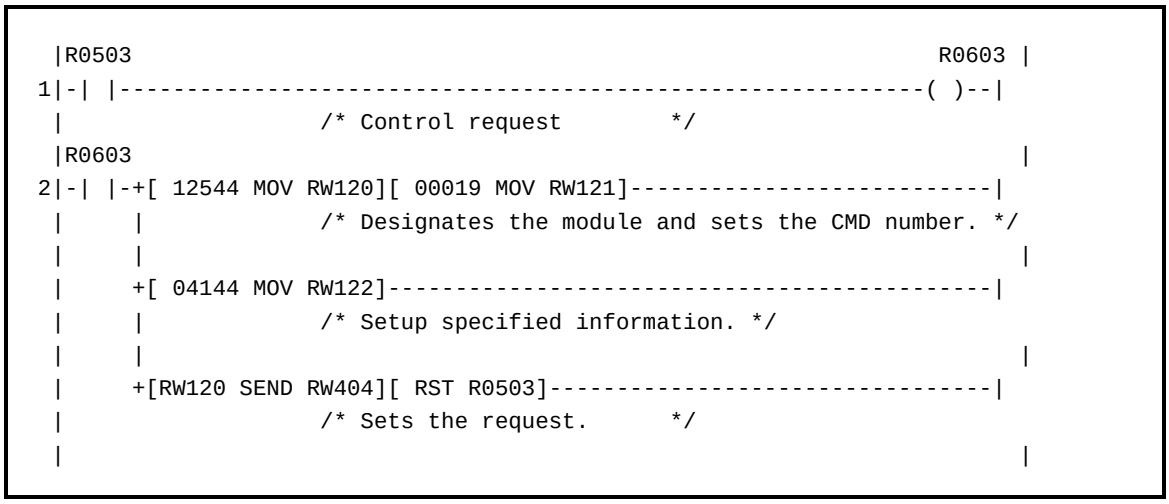
Transmission parameters

	F 0		Register allocation
A	3100H	Module designation	RW120
A+1	0013H	CMD Number	RW121
A+2	1030H	Designation information	RW122

Designation information : 1040H = Run mode, Socket/message permission (4144)

Completion status

	F 0		Register allocation
B		Completion status	RW404
B+1		Detailed information	RW405


|R0503 R0603 |
1|-| |----------( )--|
/* Control request */
|R0603 |
2|-| |-+[12544 MOV RW120][00019 MOV RW121]----------|
/* Designates the module and sets the CMD number. */
+[04144 MOV RW122]----------|
/* Setup specified information. */
+[RW120 SEND RW404][RST R0503]----------|
/* Sets the request. */

5. Computer Link Protocol and the PC Link Protocol Transmission

⚠ CAUTION
1. Chapter 5 presents information related to using the functions provided by the EN311 from a T3H, including the instruction (request) format, important items that require attention, and sample programs. That chapter also presents items considered necessary when using the EN311. Make a point of understanding the content of chapter 4 thoroughly before writing programs that use the EN311. The sample programs present basic examples of EN311 usage, and should be reviewed carefully before use in an actual system.

This chapter describes computer link protocol transmission from a host computer and PC link protocol transmission with the T3H.

5.1 Computer Link Protocol Transmission

The T series computer link protocol transmission was developed by Toshiba for use in controlling the PROSEC-T Series programmable controllers. A host computer can, with respect to a T3H, upload or download user programs, issue control commands, or read and write register data using the T series computer link protocol.

When a T3H and a host computer communicate over an EN311 using the computer link protocol, they use UDP/IP as the transmission protocol.

When a host computer transmits to a T3H using computer link protocol, the host computer's UDP socket is used. (Socket refers to the combination of an IP address and a port number.) The host computer sends commands and data from its own UDP socket to the EN311 message transmission UDP socket.

When the T3H uses computer link protocol transmission, it simply performs the:

- Parameter setup (IP address and the UDP port number for message transmission) and
- Operating mode control (message transmission permission)

that were described in an earlier chapter. There is no need to create any special user programs on the T3H.

See the T Series Computer Link Operation Manual (UM-TS03***-E008) for details on the functions, specifications, and usage of T series computer link protocol transmission.

Usage Recommendations
1. Since UDP/IP does not provide control functions to guaranteed communication reliability, higher level protocols (such as retry) are required.
2. No processing is performed if a computer link protocol transmission message is received at any point other than a message transmission UDP socket.

5.2 Sample Computer Link Protocol Program

This section presents a sample program that runs on the host computer (a personal computer or workstation) and that uses computer link protocol transmission.

This program issues a read/write request for 32 words from the start of the T3H D registers.

Operating environment

- Hardware: Personal computer, PC/AT compatible
  3Com Etherlink III (3C509/B)
- Software: PC-NFS Pro 1.1.1.0
  Microsoft VisualC++ 1.0

Transfer parameters

- Local IP address: 133. 113. 98. 200
- Local UDP port number: 3001
- Remote IP address: 133. 113. 98. 10
- Remote UDP port number: 3001

```
/*********************************************************************/
/*                                                                   */
/*   SAMPLE.H                                                        */
/*                                                                   */
/*                                                                   */
/*   Write and read requests can be issued to other T3H units        */
/*   by modifying this definition file.                              */
/*                                                                   */
/*                                                                   */
/*                                                                   */
/*   (C) Copyright TOSHIBA Corporation 1995                          */
/*       All Rights Reserved                                         */
/*                                                                   */
/*********************************************************************/
/*---------------------------*/
/* Definition declarations   */
/*---------------------------*/
#define  MY_PORT   3001             /* Local port number      */
#define  DST_PORT  3001             /* Remote port number     */
#define  DST_IP    "133.113.98.10"  /* Remote IP address      */
#define  LOOP      10               /* Data transmission execution count */
#define  DATASIZ   32               /* Data length            */
                                    /* Computer link function = word units */
#define  RECVTOUT  30               /* RECVFROM timeout time  */
#define  REG_TYPE  "D"              /* Register type          */
#define  REG_ADR   "0000"           /* Register start address */
```

```
/*********************************************************************/
/*                                                                   */
/*   Sample program implementing register read and write processing  */
/*   using the computer link protocol.                               */
/*                                                                   */
/*   This program is a sample program designed to verify the T3H     */
/*   Ethernet module computer link function.                         */
/*   This program issues read and write requests to the specified    */
/*   T3H registers.                                                  */
/*   Also note that registers in other stations can be accessed       */
/*   by modifying the SAMPLE.H definition file.                      */
/*                                                                   */
/*                                                                   */
/*                                                                   */
/*   (C) Copyright TOSHIBA Corporation 1995                          */
/*       All Rights Reserved                                         */
/*                                                                   */
/*********************************************************************/
/*---------------------------*/
/* Include declarations      */
/*---------------------------*/
#define WIN31       /* This is a Windows 3.1 application. */
#define USECOMM     /* The COMM API is required.          */

#include <string.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <memory.h>
#include <sys¥types.h>
#include <fcntl.h>
#include <errno.h>
#include <sys¥socket.h>
#include <sys¥timeb.h>
#include <time.h>
#include <sys¥in.h>
#include <sys¥netdb.h>
#include "sample.h"
```

```
/*---------------------------*/
/* Prototype declarations    */
/*---------------------------*/
int   cl_send( int );              /* Register read/write processing */

void main()
{
int   ists;                        /* Return status     */
int   isdp ;                       /* Socket identifier */
int   i    ;                       /* Loop counter      */
struct  sockaddr_in   Soc;
WORD  wVersionRequested = (0,1);   /* WINSOC version number specification */
WSADATA  WsaDtata ;                /* WINSOC data structure          */
                                   /* initialization                 */
   ists = 0 ;                      /* Initial value setting          */
                                   /* Windows socket initialization  */
   ists = WSAStartup( wVersionRequested, &WsaDtata ) ;
   if( ists == 0 ){                          /* If normal return:   */
      isdp = socket(AF_INET, SOCK_DGRAM, 0);   /* Create socket (UDP) */
      if( isdp != INVALID_SOCKET ){            /* If normal return:   */
         Soc.sin_family = AF_INET;
         Soc.sin_addr.s_addr = 0 ;         /* Set local IP address.   */
         Soc.sin_port = htons( MY_PORT );  /* Set local port number.  */
                                           /* Execute bind processing. */
         ists = bind(isdp, (struct sockaddr *)&Soc, sizeof(Soc) );
         if( ists != SOCKET_ERROR ){       /* If bind completed normally: */
            for( i = 0; i < LOOP; i++){    /* Loop for the specified number of
times. */
               ists = cl_send( isdp );     /* Register read/write processing */
               if( ists != 0 )             /* If an error occurred in register
read/write processing: */
                  break ;          /* Terminate processing.      */
            }
         }
         closesocket( isdp ) ;     /* Socket close processing    */
      }
   }
   WSACleanup() ;                  /* Report WINSOC termination. */
}
```

```
/* SLW */
/*********************************************************************/
/*                                                                   */
/*       cl_send - Register read/write processing                    */
/*                                                                   */
/*********************************************************************/
/*                                                                   */
/*       Calling sequence                                            */
/*                                                                   */
/*           cl_send();                                              */
/*                                                                   */
/* Arguments:  Isdp   : int    I   : socket identifier               */
/*                                                                   */
/*             ists   : int    O   : return status                   */
/*                                                                   */
/*********************************************************************/
int cl_send( int Isdp )
{
   int   j, k     ;                 /* Loop counter          */
   int   ists = 0 ;                 /* Return status         */
   int   iret     ;                 /* Return status         */
   int   ircvsiz  ;                 /* Reception data length */
   int   isndsiz  ;                 /* Data length           */
   int   icunt    ;                 /* Data setup index      */
   int   idat     ;                 /* Temporary             */
   char  csnd[ 1000 ] ;             /* Data send buffer      */
   char  crcv[ 1000 ] ;             /* Data receive buffer   */
   fd_set ibits;                    /* SELECT() bit mask     */
   struct timeval timeout;          /* SELECT() timer value  */
   struct  sockaddr_in   Snd, Rcv;

   iret = -1 ;
   memset( &Snd, 0x00, sizeof( Snd ) );
   memset( &Rcv, 0x00, sizeof( Rcv ) );
   memset( csnd, 0x00, sizeof( csnd ) );   /* Clear the send data buffer.    */
   memset( crcv, 0x00, sizeof( crcv ) );   /* Clear the receive data buffer. */
                                    /* Set up the register write send data. */
   sprintf( &csnd[ 0 ], "(A01DW" ) ; /* Set up the register write command.   */
                                    /* Set the starting register number.    */
   sprintf( &csnd[ strlen(csnd)], "%s", REG_TYPE );
   sprintf( &csnd[ strlen(csnd) ], "%04s", REG_ADR );
   sprintf( &csnd[ strlen( csnd) ], "," ) ;
   idat = DATASIZ ;                 /* Set the data count. */
   sprintf( &csnd[ strlen( csnd ) ], "%02d", idat ) ;
   sprintf( &csnd[ strlen( csnd) ], "," ) ;
   icunt = 0 ;                      /* Comparison data storage index. */
   for( j = 0, k = 0; k < DATASIZ; k++ ){  /* Set register write data. */
       sprintf( &csnd[ strlen( csnd) ], "%04X", k ) ;
       j = j + 4 ;
```

```
    sprintf( &csnd[ strlen( csnd) ], "," ) ;
    j = j + 1 ;
    icunt = icunt + 4 ;
}
sprintf( &csnd[ (strlen( csnd )) - 1], ")¥r" ) ;
isndsiz = strlen( csnd );                 /* Set the send data length.   */

Snd.sin_family = AF_INET;
Snd.sin_addr.s_addr = inet_addr( DST_IP ); /* Set the remote IP address.  */
Snd.sin_port = htons( DST_PORT );          /* Set the remote port number. */
                                        /* Send a register write request. */
ists = sendto( Isdp, csnd, isndsiz, 0,
         (struct sockaddr *)&Snd,sizeof( Snd ) );
if ( ists == isndsiz ){          /* If the send length was OK. */
                                 /* Set the SELECT argument.   */
    memset(&ibits,0x00,sizeof(fd_set));   /* Set the BIT initial value. */
    timeout.tv_sec = RECVTOUT;   /* Set the timeout time. */
    FD_SET(Isdp,&ibits);         /* BIT setup             */
    ists = select( 1, &ibits,0,0,(struct timeval *)&timeout);
    if(ists > 0){                /* If normal return:     */
                                 /* Register write response reception */
       ists = recvfrom( Isdp, crcv, sizeof( crcv ), 0
                    ,(struct sockaddr *)&Rcv, &ircvsiz) ;
       if ( ists > 5 ){
          if( crcv[ 4 ] == 'C' && crcv[ 5 ] == 'E' ||
              crcv[ 4 ] == 'E' && crcv[ 5 ] == 'E' ){
             return( -1 ) ;      /* Register write response error  */
          }
                                 /* Register read request creation */
          memset( csnd, 0x00, sizeof( csnd ) ) ;
          memset( crcv, 0x00, sizeof( crcv ) ) ;
          sprintf( &csnd[ 0 ] , "(A01DR" );/* Register read command setup */
                                          /* Set up the starting reg. no. */
          sprintf( &csnd[ strlen(csnd)], "%s", REG_TYPE );
          sprintf( &csnd[ strlen(csnd) ], "%04s", REG_ADR );
          sprintf( &csnd[ strlen( csnd) ], "," ) ;
                                  /* Set the data count.        */
          idat = DATASIZ ;        /* Register read data length. */
          sprintf( &csnd[ strlen( csnd ) ], "%02d", idat ) ;
          sprintf( &csnd[ strlen( csnd )], ")¥r" ) ;
          isndsiz = strlen(csnd) ;/* Set up the data transmission length. */
                                  /* Send the register read command.      */
          ists = sendto( Isdp, csnd, isndsiz, 0,
                       (struct sockaddr *)&Snd,sizeof( Snd ) );
          if( ists == isndsiz ){
                                 /* Set the BIT initial value. */
             memset(&ibits,0x00,sizeof(fd_set));
             timeout.tv_sec = RECVTOUT;   /* Set the timeout time. */
                                          /* BIT setup             */
```

```
                FD_SET(Isdp,&ibits);
                ists = select( 1, &ibits,0,0,
                            (struct timeval *)&timeout);
                if(ists <= 0){      /* If timeout and error: */
                   return( -1 ) ;   /* recvfrom timed out.   */
             }
                                    /* Register read response reception   */
                ists = recvfrom( Isdp, crcv, sizeof( crcv ), 0
                               ,(struct sockaddr *)&Rcv, &ircvsiz) ;
                if ( ists > 5 ){
                   if( crcv[ 6 ] == 'C' && crcv[ 7 ] == 'E' ){
                      iret = -1 ;   /* Register read response error       */
                   }
                   else{            /* Register read response was normal. */
                      iret = 0 ;
                   }
                }
             }
          }
       }
    }
    return( iret ) ;
}
```

5.3 PC Link Protocol Transmission (Data write)

The T series PC link protocol allows one T3H on a network to write register data to another T3H.

As is the case with the computer link protocol, the PC link protocol uses UDP/IP as its transmission protocol.

The PC link main station uses a UDP socket for message transmission and transmits to the slave station EN311 message transmission UDP socket. The user program that runs on the T3H of the main station is discussed later.

When this function is used on the PC link slave station, the T3H simply performs the:

- Parameter setup and
- Operating mode control (message transmission permission)

that were described in an earlier chapter. There is no need to create any special user programs on the T3H.

Usage Recommendations
1. Since UDP/IP does not provide control functions to guarantee communication reliability, higher level protocols (such as retry) are required.
2. No processing is performed if a PC link protocol transmission message is received at any point other than a message transmission UDP socket.

Register write request (using the SEND instruction)

a. Function

The register data specified by the local station (T3H) is written to the specified register on the remote station (T3H).

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0021H	Command number
A+2	WordSize	(1) Transfer register data length: 1 to 485 words
A+3	SRID	(2) Local station register type code
A+4	SRegNO	(3) Local station register number
A+5	DRID	(4) Remote station register type code
A+6	DRegNO	(5) Remote station register number
A+7	Timecnt	(6) Timer count
A+8 A+9	D-IPAddress	Remote station IP address (The input format is the same as that for parameter setup requests.)
A+10	D-UDP PortNO	Remote station message transmission UDP port number

(1) Transferred register data length

Specifies the transmission data length in word units. (1 to 485 words)

For the T/C registers, the data length will be between 1 and 323 words.

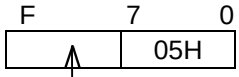
(2) Local station register type code

This code indicates the type of register in which the local station transmission source data is stored.

RID	Meaning	RID	Meaning	
0000H	XW/YW registers	**05H	F register (0 - 32767)	*1
0001H	W register	**06H	F register (0 - 65535)	*2
0002H	LW register	0007H	T register	*3
0003H	RW register	0008H	C register	*3
0004H	D register	0009H	SW register	

Figure 5.1 Register Type Code

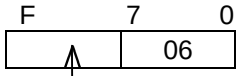
*1 Includes the expansion F registers. One bank has 8k words (0 to 8191).



Bank number... 00H: T3H internal registers
F0000 to F32767

01H to 0FH: Expansion F registers (IC card)
F0000 to F8191

*2 Includes the expansion F registers. One bank has 64k words (0 to 65535).



Bank number... 00H: T3H internal registers
F0000 to F32767

01H: Expansion F registers (IC card)
F0000 to F65535

02H: Expansion F registers (IC card)
F0000 to F57343

*3 The T and C registers hold data that has flags attached.

Supplement:

The transfer data length has **a maximum of 323 words** when data is transferred over the Ethernet.

For the T registers, **it is not possible to specify a range that spans both the basic T registers (0 to 511) and the expansion T registers (512 to 1023)**.

(3) Local station register number

Specifies the starting number of the register specified by the local station register type code.

(4) Remote station register type code

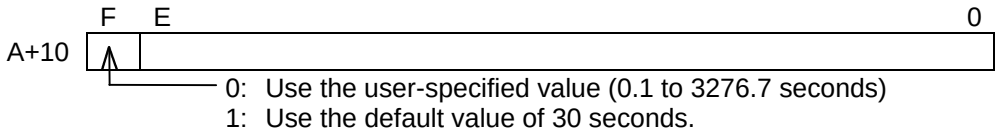
This code specifies the type of the register at the remote station to which the transmitted data will be written. See table 5.1 for the codes that can be specified.

(5) Remote station register number

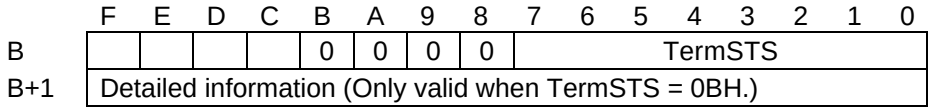
Specifies the starting number of the register specified by the remote station register type code.

(6) Timer count

Specifies a time used to limit the response time from the remote station in 0.1 second units.



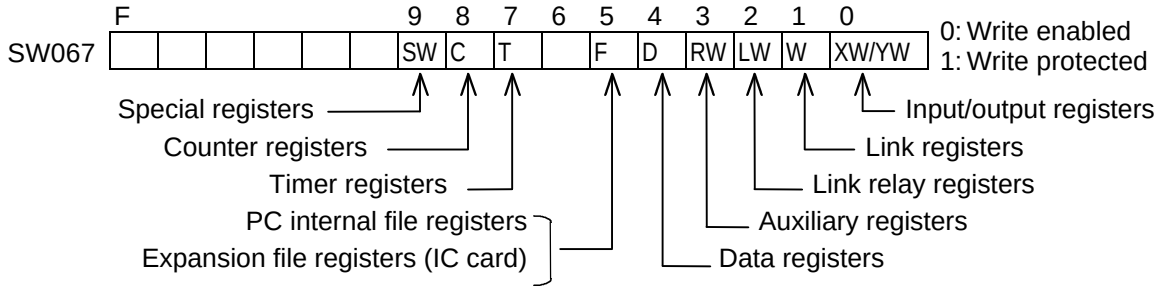
c. Status (See figure 4.3 for details on bits C, D, E and F.)



d. Important items

- **The write operation is not synchronized with the remote station T3H scan operation.** If synchronization is necessary, applications must perform synchronization processing, such as transferring the data to a separate registers at the start of the T3H scan.
- The command number (0021H) is the same as the "Data Read".
- A transfer word count error (TermSTS = 09H) occurs if the transferred register data length exceeds the range 1 to 485 words (or 1 to 323 words for the T and C registers).
- A register specification error (TermSTS = 01H) occurs if a value other than a stipulated value is specified for the register type codes (SRID/DRID).
- A register specification error (TermSTS = 01H) occurs if 0007H (the T register) is specified for the local station register type code and a register other than the T register is specified for the remote station register type code. This also holds for the C register.
- A boundary error (TermSTS = 0AH) occurs if a range spanning both the base T registers (0 to 511) and the expansion T registers (512 to 1023) is specified for the T register.
- For data storage registers, a boundary error occurs if the specified area (start register + register range) does not exist in either the local or remote stations.

  Local station: TermSTS = 0AH, remote station: TermSTS = 8AH
- A response timeout error (TermSTS = 02H) occurs if the response time from the remote station exceeds the time specified by the timer counter value.
- Write protection can be specified for each register type on the local T3H by using the special coil settings described below. In this case, a memory write protect error (TermSTS = 04H) will occur.



- **When PC link transmission and the UDP socket interface are used together, if an application repeatedly transmits to a nonexistent remote station at short intervals (less than 100 ms)**, an insufficient resources error (detailed information = 00C0H) may occur. Applications should either stop transmitting to the nonexistent remote station or increase the interval between transmissions to prevent this error from occurring.

5.4 PC Link Protocol Transmission (Data read)

The T series PC link protocol allows a T3H on the network to read register data from another T3H station's registers into its own registers.

As is the case with the computer link protocol, the PC link protocol uses UDP/IP as its transmission protocol.

The PC link main station uses a UDP socket for message transmission and transmits to the slave station EN311 message transmission UDP socket. The user program that runs on the main station is discussed later.

When this function is used on the PC link slave station, the T3H simply performs the:

- Parameter setup and
- Operating mode control (message transmission permission)

that were described in an earlier chapter. There is no need to create any special user programs on the T3H.

Usage Recommendations	
1.	Since UDP/IP does not provide control functions to guarantee communication reliability, higher level protocols (such as retry) are required.
2.	No processing is performed if a PC link protocol transmission message is received at any point other than a message transmission UDP socket.

Register read request (using the RECV instruction)

a. Function

The register data specified by the remote station (T3H) is read to the specified register on the local station (T3H).

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0021H	Command number
A+2	WordSize	(1) Transfer register data length: 1 to 485 words
A+3	SRID	(2) Local station register type code
A+4	SRegNO	(3) Local station register number
A+5	DRID	(4) Remote station register type code
A+6	DRegNO	(5) Remote station register number
A+7	Timecnt	(6) Timer count
A+8 A+9	D-IPAddress	Remote station IP address (The input format is the same as that for parameter setup requests.)
A+10	D-UDP PortNO	Remote station message transmission UDP port number

(1) Transferred register data length

Specifies the transmission data length in word units. (1 to 485 words)

For the T/C registers, the data length will be between 1 and 323 words.

(2) Local station register type code

This code specifies the type of the local station register into which the data read out will be stored. See table 5.1 for the codes that can be specified here.

(3) Local station register number

Specifies the starting number of the register specified by the local station register type code.

(4) Remote station register type code

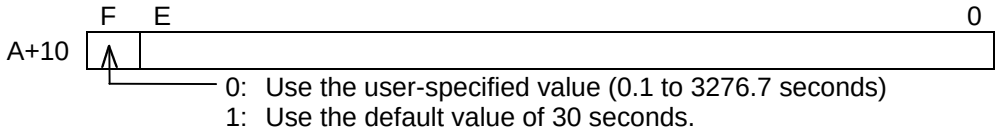
This code specifies the type of the remote station register that holds the transmission source data. See table 5.1 for the codes that can be specified.

(5) Remote station register number

Specifies the starting number of the register specified by the remote station register type code.

(6) Timer count

Specifies a time used to limit the response time from the remote station in 0.1 second units.



c. Status (See figure 4.3 for details on bits C, D, E and F.)

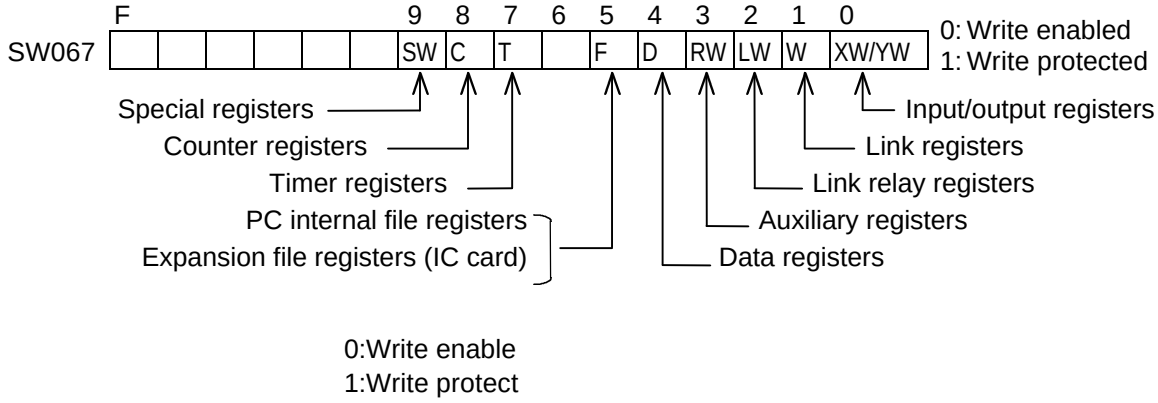
	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					0	0	0	0	TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

d. Important items

- **The read operation is not synchronized with the remote station T3H scan operation.** If synchronization is necessary, applications must perform synchronization processing, such as transferring the data to a separate registers at the start of the T3H scan.
- The command number (0021H) is the same as the "Data Write".
- A transfer word count error (TermSTS = 09H) occurs if the transferred register data length exceeds the range 1 to 485 words (or 1 to 323 words for the T and C registers).
- A register specification error (TermSTS = 01H) occurs if a value other than a stipulated value is specified for the register type codes (SRID/DRID).
- A register specification error (TermSTS = 01H) occurs if 0007H (the T register) is specified for the local station register type code and a register other than the T register is specified for the remote station register type code. This also holds for the C register.

- A boundary error (TermSTS = 0AH) occurs if a range spanning both the base T registers (0 to 511) and the expansion T registers (512 to 1023) is specified for the T register.
- For data storage registers, a boundary error occurs if the specified area (start register + register range) does not exist in either the local or remote stations.

  Local station: TermSTS = 0AH, remote station: TermSTS = 8AH
- A response timeout error (TermSTS = 02H) occurs if the response time from the remote station exceeds the time specified by the timer counter value.
- Read protection can be specified for each register type on the local T3H by using the special coil settings described below. In this case, a memory write protect error (TermSTS = 04H) will occur.



- **When PC link transmission and the UDP socket interface are used together, if an application repeatedly transmits to a nonexistent remote station at short intervals (less than 100 ms)**, an insufficient resources error (detailed information = 00C0H) may occur. Applications should either stop transmitting to the nonexistent remote station or increase the interval between transmissions to prevent this error from occurring.

5.5 Sample PC Link Protocol Transmission Program

This section presents a sample program that uses PC link protocol transmission.

This program creates increment data within the local station and writes it to the remote station's registers. Next it reads out the same area and compares it with the data within the local station to check that the function succeeded.

Figure 5.2 shows Flow of PC Link Procedure Transmission Processing.

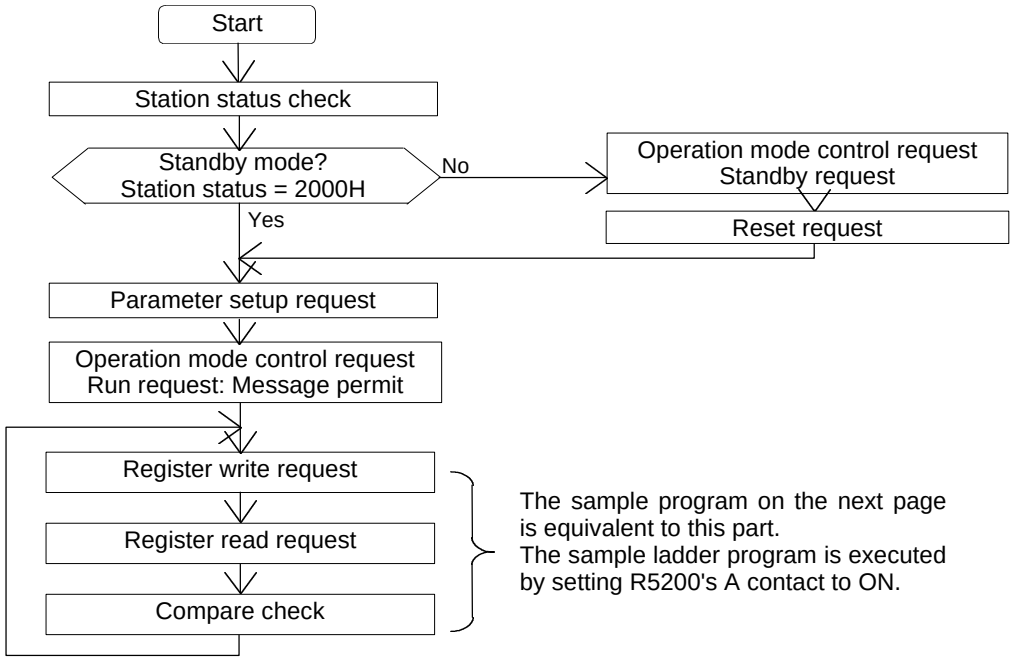


Figure 5.2 Flow of PC Link Procedure Transmission Processing

a. Parameters in the sample program

Local station IP address: 133. 113. 98. 10 (85H. 71H. 62H 0AH)

Local station message transmission UDP port number: 2000

RW090: Execution count specification (1 to 32767)

RW091: Operation when a comparison error occurs (continue: 0, stop: 1)

RW092: Transfer register data length (1 to 485 words)

RW093: Write time transfer source register type

RW094: Write time transfer source register start number

RW095: Write time transfer destination register type/read time readout source register type

RW096: Write time transfer destination register start number/read time readout source register start number

RW097: Read time storage register type

RW098: Read time storage register start number

PW261·PW260 : Remote station IP address = 133. 113. 98. 20
↓ ↓ ↓ ↓
85H. 71H. 62H. 14H

RW262: Remote station message transmission UDP port No = 1025

b. Register write request (SEND instruction)

Register write request to the EN311 of Channel 1.

Transmission parameters

	F 0		Register allocation
A	3100H	Module designation	RW200
A+1	0021H	CMD number	RW201
A+2	RW092	Transfer register size (Word)	RW202
A+3	RW093	Transmission data storage register type	RW203
A+4	RW094	Transmission data storage register's leading number	RW204
A+5	RW095	Remote station data storage register type	RW205
A+6	RW096	Remote station data storage register's leading number	RW206
A+7	0064H	Timer count (Time limit for response)	RW207
A+8	RW260	Remote station IP address	RW208
A+9	RW261		RW209
A+10	RW262	UDP port number for remote station message transmission	RW210

Completion status

	F 0		Register allocation
B		Completion status	RW420
B+1		Detail information	RW421

C. Register read request (RECV instruction)

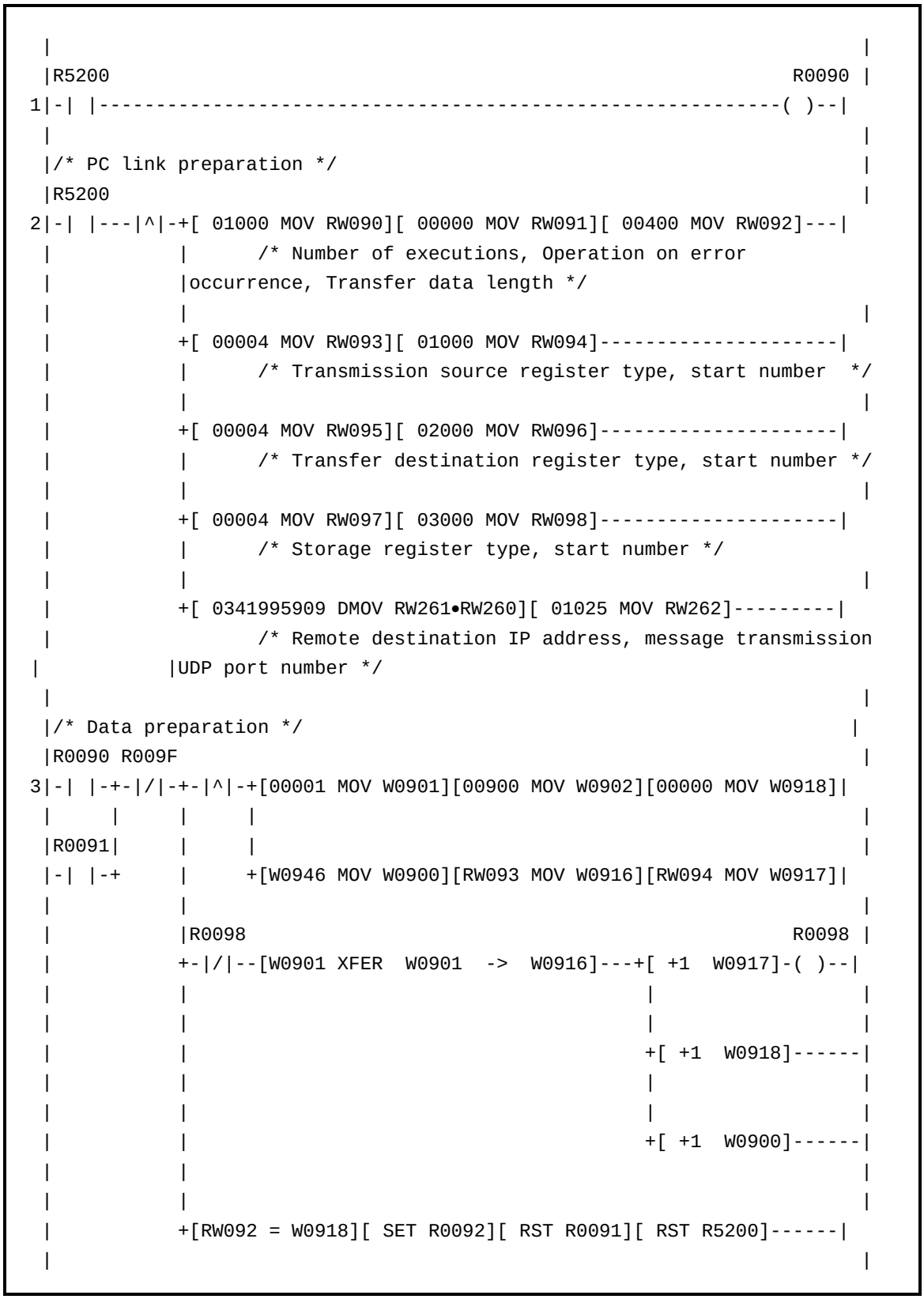
Register read request to the EN311 of Channel 1.

Transmission parameters

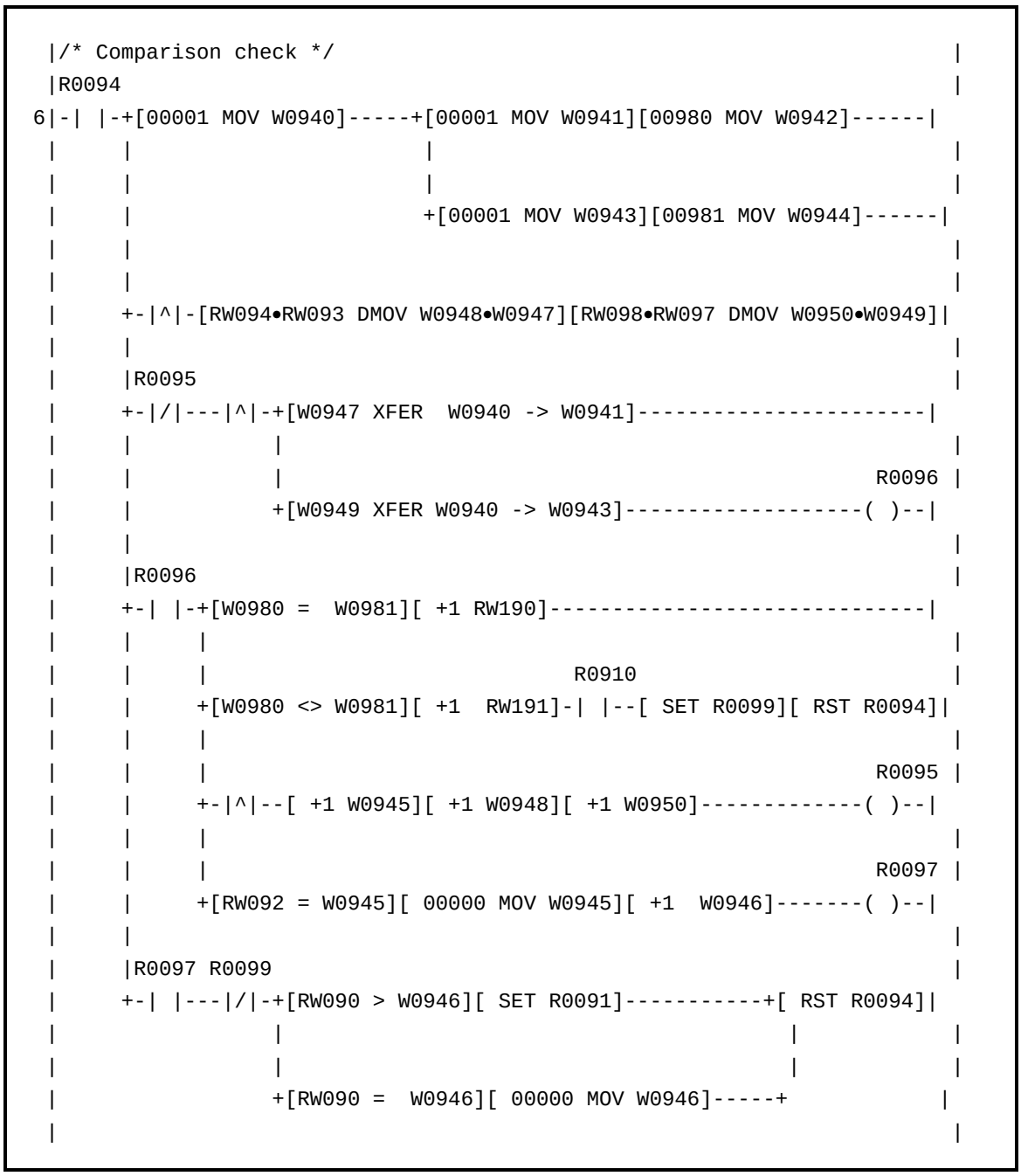
	F 0		Register allocation
A	3100H	Module designation	RW220
A+1	0021H	CMD number	RW221
A+2	RW092	Transfer register size (Word)	RW222
A+3	RW097	Read data storage register type	RW223
A+4	RW098	Read data storage register's leading number	RW224
A+5	RW095	Remote station data storage register type	RW225
A+6	RW096	Remote station data storage register's leading number	RW226
A+7	0064H	Timer count (Time limit for response)	RW227
A+8	RW260	Remote station IP address	RW228
A+9	RW261		RW229
A+10	RW262	UDP port number for remote station message transmission	RW230

Completion status

	F 0		Register allocation
B		Completion status	RW422
B+1		Detail information	RW423


R5200
R0090
1
/* PC link preparation */
R5200
2
[01000 MOV RW090][00000 MOV RW091][00400 MOV RW092]
/* Number of executions, Operation on error
occurrence, Transfer data length */
[00004 MOV RW093][01000 MOV RW094]
/* Transmission source register type, start number */
[00004 MOV RW095][02000 MOV RW096]
/* Transfer destination register type, start number */
[00004 MOV RW097][03000 MOV RW098]
/* Storage register type, start number */
[0341995909 DMOV RW261•RW260][01025 MOV RW262]
/* Remote destination IP address, message transmission
UDP port number */
/* Data preparation */
R0090 R009F
3
[00001 MOV W0901][00900 MOV W0902][00000 MOV W0918]
R0091
[W0946 MOV W0900][RW093 MOV W0916][RW094 MOV W0917]
R0098
R0098
[W0901 XFER W0901 -> W0916]
[+1 W0917]
[+1 W0918]
[+1 W0900]
[RW092 = W0918][SET R0092][RST R0091][RST R5200]

```
 |/* Register write */                                                  |
 |R0092                                                                |
4|-| |-+[ 12544 MOV RW200][ 00033 MOV RW201]-------------------------|
 |     |  /* Designates the module and sets the CMD number. */
 |     |                                                               |
 |     +[RW092  MOV RW202]-----------------------------------------------|
 |     |  /* Sets the transfer register data length.    */
 |     |                                                               |
 |     +[RW093  MOV RW203][RW094  MOV RW204]-------------------------|
 |     |  /* Sets the transmission source register type, start number.  */
 |     |                                                               |
 |     +[RW095  MOV RW205][RW096  MOV RW206]-------------------------|
 |     |  /* Sets the transfer destination register type, start number. */
 |     |                                                               |
 |     +[ 00100 MOV RW207]-----------------------------------------------|
 |     |  /* Sets the response time limit (10 seconds). */
 |     |                                                               |
 |     +[RW261•RW260 DMOV RW209•RW208][RW262  MOV RW210]---------------|
 |     |  /* Remote destination IP address, message transmission UDP port
 |        number */
 |     |                                                               |
 |     +[W0200 SEND W0420][ SET R0093][ RST R0092]---------------------|
 |        /* Sets the request, and starts post-completion readout. */
 |                                                                     |
 |/* Register readout */                                              |
 |R0093                                                                |
5|-| |-+[ 12544 MOV RW220][ 00033 MOV RW221]-------------------------|
 |     |  /* Designates the module and sets the CMD number.    */
 |     |                                                               |
 |     +[RW092  MOV RW222]-----------------------------------------------|
 |     |  /* Sets the transfer register data length.       */
 |     |                                                                 |
 |     +[RW097  MOV RW223][RW098  MOV RW224]-------------------------|
 |     |  /* Sets the storage register type, start number. */
 |     |                                                               |
 |     +[RW095  MOV W0925][RW096  MOV RW224]-------------------------|
 |     |  /* Sets the transfer destination register type, start number. */
 |     |                                                               |
 |     +[ 00100 MOV W0927]-----------------------------------------------|
 |     |  /* Sets the response time limit (10 seconds).    */
 |     |                                                               |
 |     +[RW261•RW260 DMOV RW229•RW228][RW262  MOV RW230]---------------|
 |     |  /* Remote destination IP address, message transmission UDP port
 |        number */
 |     |                                                               |
 |     +[RW220 RECV RW422][ SET R0094][ RST R0093]---------------------|
 |        /* Sets the request, and starts post-completion comparison. */
```


/* Comparison check */
R0094
6
R0095
R0096
R0097 R0099
R0910
R0096
R0095
R0097
[00001 MOV W0940]
[00001 MOV W0941][00980 MOV W0942]
[00001 MOV W0943][00981 MOV W0944]
[RW094•RW093 DMOV W0948•W0947][RW098•RW097 DMOV W0950•W0949]
[W0947 XFER W0940 -> W0941]
[W0949 XFER W0940 -> W0943]
[W0980 = W0981][+1 RW190]
[W0980 <> W0981][+1 RW191]
SET R0099][RST R0094]
[+1 W0945][+1 W0948][+1 W0950]
[RW092 = W0945][00000 MOV W0945][+1 W0946]
[RW090 > W0946][SET R0091]
[RST R0094]
[RW090 = W0946][00000 MOV W0946]

6. Socket Interface Communication

⚠ CAUTION

1. Chapter 6 presents information related to using the functions provided by the EN311 from a T3H, including the instruction (request) format, important items that require attention, and sample programs. That chapter also presents items considered necessary when using the EN311.

   Make a point of understanding the content of chapter 4 thoroughly before writing programs that use the EN311. The sample programs present basic examples of EN311 usage, and should be reviewed carefully before use in an actual system.

This chapter describes the functions and positioning of the socket interface, and the differences between the UDP socket interface and the TCP socket interface. Nex t, this chapter presents notes on using the EN311 socket interface and describes the procedures for using this functionality.

6.1 Overview

This section describes the functions and positioning of the socket interface, and the differences between the UDP socket interface and the TCP socket interface.

1. Positioning and functionality

The socket interface is a programming interface that allows user programs to use the TCP/IP and UDP/IP functions. Socket interface communication is a communication technique that has become standard on engineering workstations (EWS) and other networked computer systems.

The socket interface can be used for communication between host application programs and user programs running on the T3H.

The EN311 socket interface provides eight sockets, and the communication protocol (TCP/IP or UDP/IP) used with the remote destination can be specified for each socket. User programs on the T3H use the SEND and RECV instructions to use the socket interface.

TCP/IP (Transmission Control Protocol/Internet Protocol)
UDP/IP (User Datagram Protocol/Internet Protocol)

Figure 6.1 shows the positioning of the socket interface.

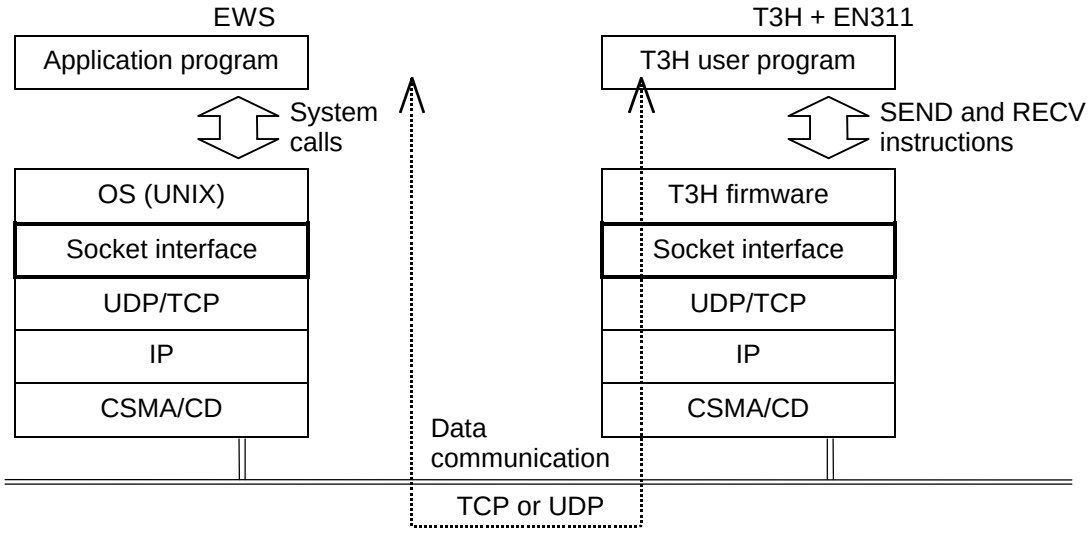


Figure 6.1 Positioning of the Socket Interface

2. Differences between the UDP socket interface and the TCP socket interface

a. UDP socket interface (See figure 6.2.)

- Provides an in/out port (socket) for data communication between a transmission source node and a transmission destination node.
- Data for the transmission source and transmission destination (IP addresses and port numbers) is specified in the send/receive data.
- Since the transmission source and transmission destination are specified in each data item, a UDP socket can communicate with multiple remote UDP sockets.
- The UDP socket interface provides no control functionality such as reception verification using, e.g. ACK (acknowledge) responses, or retransmission processing to assure transmission reliability. Therefore, reliability must be assured by higher level protocols implemented by user programs.

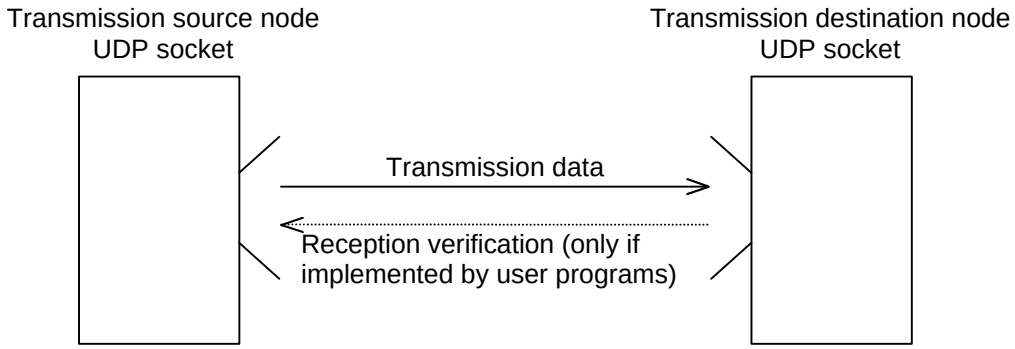


Figure 6.2 UDP Sockets

b. TCP socket interface (See figures 6.3 and 6.4.)

- In TCP communication, a pipe-like virtual communications line (connection) is established between sockets on two nodes that are communicating (sending and receiving), and since the protocol handles control of reception verification and retransmission processing, it provides a highly reliable communication.
- There are two methods for establishing a connection: passive open and active open. In passive open, the local socket is put into a state in which it is waiting for a request to establish a connection from another node. In active open, a request is issued for the establishment of a connection with a socket in the passive open state.
- When establishing a connection between two nodes, one node must first open a socket in passive open mode, and the other node must perform an active open on a local socket with respect to a remote socket that is in the passive open state.
- Since the passive open socket node "provides" data transmission and other services, it is called the "server."
- Since the active open socket node "requests" services, it is called the "client."
- A socket for which a connection has been established is unable to transfer data with any other sockets unless that connection is first released.
- Since sockets are connected by connections, there is no need to specify the transmission source or transmission destination with every data item transmitted.

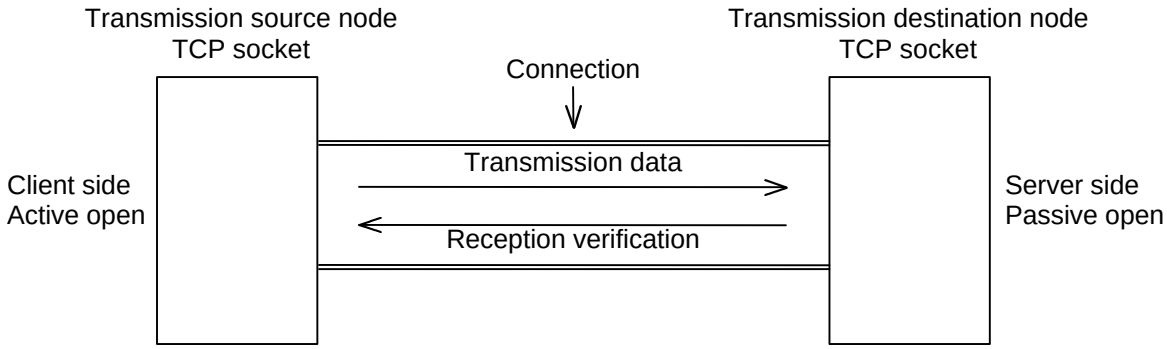


Figure 6.3 TCP Socket (Connection)

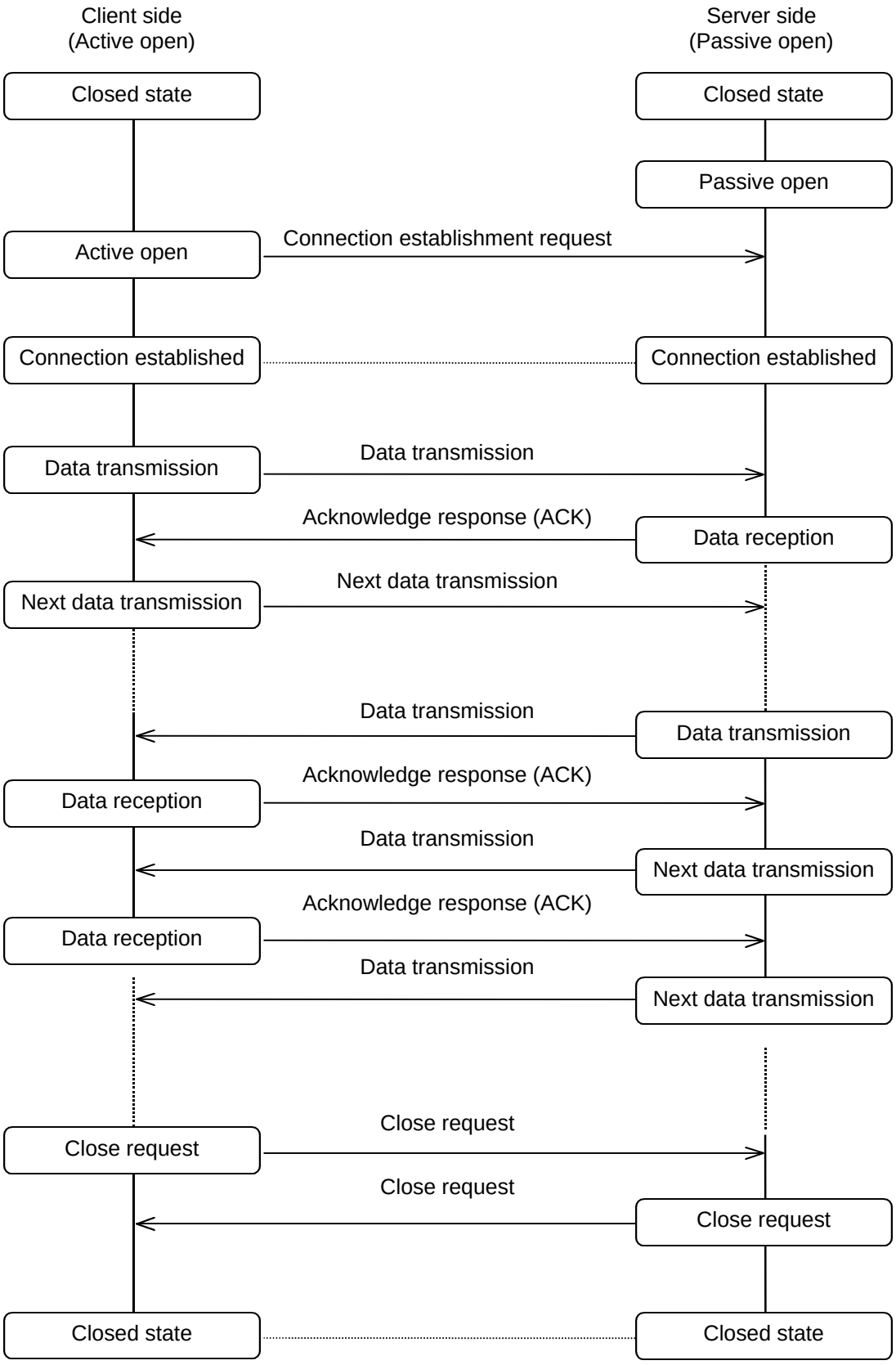


Figure 6.4 TCP Connection Communication Procedure (Overview)

6.2 EN311 Socket Interface Usage Notes

This section presents points that require attention when using the socket interface on the EN311 for data transmission.

1. Data handling and data segmentation in UDP socket interface transmission and reception

a. In UDP socket interface transmission, data sent in a single transmission is handled by the receiving EN311 as a single data unit, and that data is transmitted to the T3H in a batch operation by a receive request.

b. The size of data units that can be handled by the EN311 socket interface in a single operation is limited to a maximum of 2000 bytes. If the sending node sends a data unit larger than 2000 bytes, the EN311 UDP socket interface will not be able to receive that data. Users should determine the maximum size of the data units to be sent or received at the system design stage.

c. Transmitted data that exceeds 1472 bytes is divided (fragmented) into units of 1472 bytes. This is the limit of the length of packets (data units flowing on the network) transmitted over the network (10BASE5/2). (See figure 6.8.)

For example, when transmitting a 2000 byte data set, which is the largest data size that can be handled by the EN311, the phenomenon shown in figure 6.5 can occur.

(1) The sending T3H user program requests a transmission of 2000 bytes.

(2) The transmitted data is divided into two fragments, A (with 1472 bytes) and B (with 528 bytes) by the send side EN311.

(3) A and B are put onto the network in order.

(4) The receive side EN311 connects the received data A and B, recovering the original data.

(5) The data is accepted by a receive request from the receive side T3H for 2000 bytes of data and the data is stored in the specified register. (See section 6.4 (3).)

d. In the UDP socket interface, after the transmitted data is reassembled to the original data it is passed to the user program and stored in the specified register.

(The fragments A and B are reassembled to the original data by UDP/IP processing.)

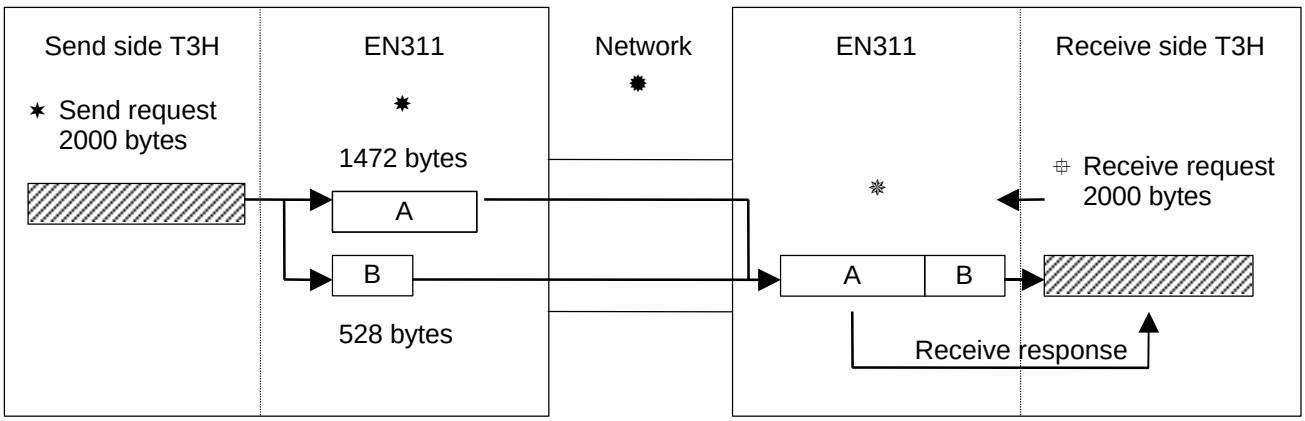


Figure 6.5 Transmission Data Fragmentation in the UDP Socket Interface

e. **In receive request programs from the T3H, set the size of reception data to a value equal to or larger than that of the maximum size for the transmission data in a single operation.**

f. **Allocate an area one word larger than the transmitted data size as the T3H register area that will hold the received data.** As the result of a receive request, information indicating the size of the transmitted data for the single operation plus the data transmitted in the single operation will be stored in that area.

g. If the size of the data transmitted in a single operation is larger than the size specified for the received data in the receive request program, the section of the transmitted data that exceeds the specified reception data size will be transferred to the area following the register area allocated for storing the reception data. As a result, the contents of a section of the register area corresponding to the size of the excess data will be destroyed.

Supplement:

Although the limitations listed in items e, f, and g above apply to the current combination of the T3H and EN311, Toshiba is planning to modify the T3H OS so that the contents of registers are not destroyed in this case.

2. Data handling and data segmentation in TCP socket interface transmission and reception

a. When using the TCP socket interface for data transmission, the data transmitted in a single operation is handled by the receive side EN311 as one section of a continuous data stream that comes from the sender. (See figure 6.6.)

In this technique, the data is not handled as a single unit, as it is in UDP socket interface transmission.

b. The amount of data transmitted to the T3H from the TCP socket interface due to a T3H receive request will vary depending on both the timing with which the T3H issues the receive request, and the timing with which the data arrives at the TCP socket interface.

c. In the EN311 TCP socket interface, up to 4380 bytes of received data can be stored per socket. Also note that up to 2000 bytes of data can be transferred to the T3H for a single receive request from the T3H. For example, if the remote node sends 800 bytes at a time, then the amount of received data per socket may be either 800, 1600, 2400, 3200, or 4000 bytes. If the amount of received data is 800 or 1600 bytes, those 800 or 1600 bytes can be acquired by the T3H by a receive request from the T3H. In cases where the amount of received data is 2400, 3200, or 4000 bytes, 2000 bytes will be transferred by the first receive request from the T3H, and the remaining 400, 1200, or 2000 bytes can be transferred by issuing another receive request from the T3H.

d. Therefore, to handle one unit of transmitted data as a single unit of data on the receiving side as well, at the system design stage users must analyze both the data format (head/tail delimiting codes, data sequencing) and the amount of data to be transmitted, and provide routines to decode the transmitted data in the receiving T3H user software.

e. **Receive request programs on the T3H must specify the received data size to be 2000 bytes, i.e. 1000 words.**

f. **Always allocate 2002 bytes (1001 words) for the register area that will hold the transferred data.** If less that 2002 bytes are allocated as the register area to hold the transferred data, the contents of the registers following the register area may be destroyed by transferred data.

Supplement:

Although the limitations listed in items e and f above apply to the current combination of the T3H and EN311, Toshiba is planning to modify the T3H OS so that the contents of registers are not destroyed in this case.

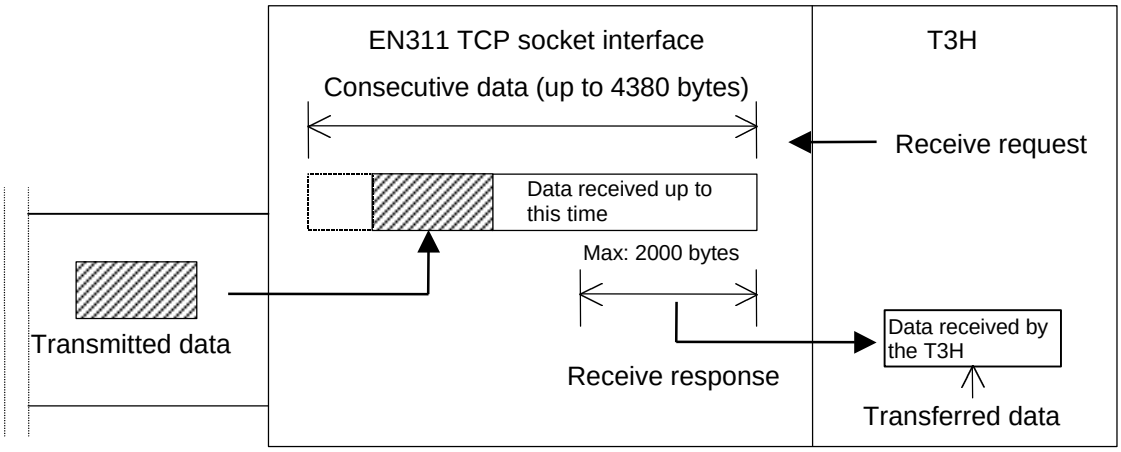


Figure 6.6 Handling of Transmitted Data in the TCP Socket Interface

g. When the TCP socket interface is used, transmitted data is divided (fragmented) into units of a size determined when the connection between the two sockets was established. The upper limit of the fragment size is 1460 bytes. This is the limit of the length of packets (data units flowing on the network) transmitted over the network (10BASE-5/2). (See figure 6.8.)

For example, when transmitting a 2000 byte data set, which is the largest data size that can be handled by the EN311, the phenomenon shown in figure 6.7 can occur. The largest segment size that can be received in this case is 1024 bytes.

✶ The sending T3H user program requests a transmission of 2000 bytes.

✷ The transmitted data is divided into two units called **segments**, A (with 1024 bytes) and B (with 976 bytes) by the send side EN311.

✹ A and B are put onto the network in order.

❋ The data that arrived at the receive side EN311 is acquired by a receive request for 2000 bytes from the T3H, and stored in the user specified register area. (See section 6.3 (7).)

The amount of data that can be acquired by a TCP receive request differs depending on the timing with which the T3H issues the receive request and the timing with which the data arrives at the EN311.

- If data has not yet arrived at the receive side EN311 when the receive request is issued:
  → When segment A arrives at the EN311, only segment A will be passed to the requester.
- If only segment A has arrived at the receive side EN311 when the receive request is issued:
  → Only segment A will be passed to the requester.
- If segments A and B have arrived at the receive side EN311 when the receive request is issued:
  → A data item consisting of A and B will be passed to the requester.

⌖ If B was not received, another receive request can be issued from the T3H to acquire B.

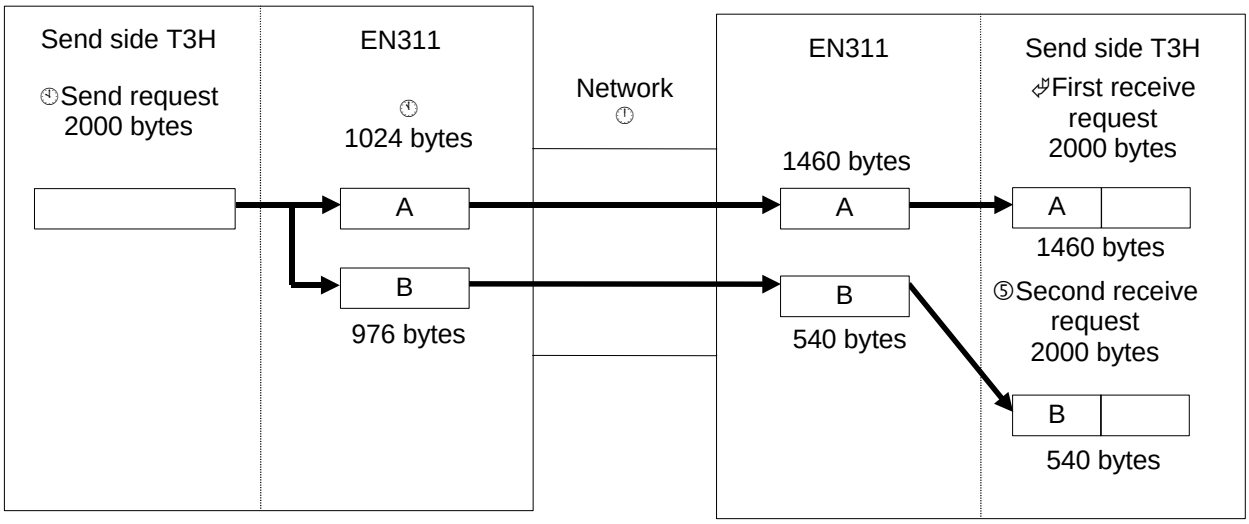


Figure 6.7 Transmission Data Fragmentation in the TPC socket Interface

h. When the transmission data is fragmented as discussed above, the amount of data transferred to the T3H in a TCP socket interface receive request differs depending both on the timing with which the T3H issues the receive request and the timing with which the data arrives at the EN311.

i. To handle single units of transmission data on the receiving side as single units as well, the user software on the receiving side must recognize the end of the transferred data (either by using counts in the transmitted data or by including an end marker in the transmitted data) and iterate receive requests until all the transmitted data has been received.("B" does not arrive at the EN311 earlier than "A" through the TCP/IP processing.)

j. **User programs must store all incoming data so that the register area used to transfer data to the T3H is not overwritten when using iterated receive requests.**

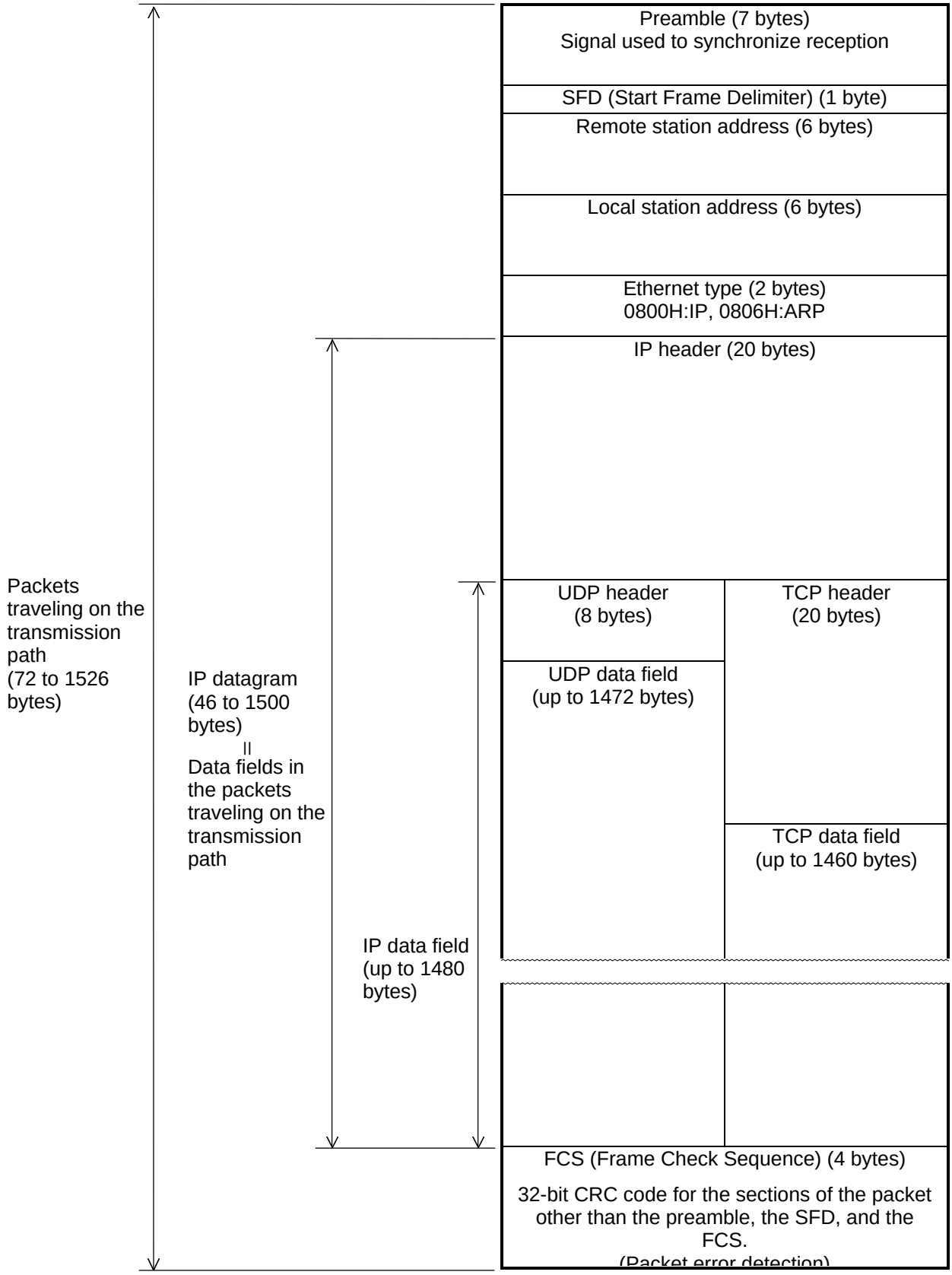


Figure 6.8 Packet Format/IP Datagram

3. Socket interface port numbers

a. **Set the port numbers for local TCP and UDP sockets to values in the range 1024 to 65535.** The EN311 will issue an error if any other values are used. This is because the port numbers from 1 to 1023 are allocated for UNIX workstation standard services.

b. There are cases where there are reserved ports with numbers outside the 1 to 1023 range on specific workstations. Verify this on the workstations actually being used, and be sure that these reserved port numbers are not duplicated on the EN311.

c. The same port number cannot be assigned to multiple sockets for TCP and UDP sockets. Be especially careful not to duplicate UDP port numbers used for message transmission (computer link protocol and PC link protocol transmission).

d. When TCP sockets and UDP sockets are used together in the same EN311, the same port number cannot be used for both TCP and UDP sockets.

4. Notes that apply to both the UDP and the TCP socket interface

a. **Careful attention to changes in bits in the socket status is required when using socket interface send/receive requests.**

b. When using multiple EN311 functions at the same time, communication processing may become slower, depending on the details of the user programs executing.

c. Communication efficiency may degrade if the network to which the EN311 is connected is heavily loaded.

d. Since processing a close request requires processing the send and receive requests issued to that socket before the close request was issued, a significant amount of time may be required to process some close requests.

e. The EN311 includes a reception buffer (of about 60 Kbytes) to hold data addressed to the local station. Since a TCP socket can receive up to a maximum of 4,380 bytes of data, it is impossible even for eight TCP sockets to fill up this buffer, which is 60K bytes. With UDP sockets, there is no limit on the receive data quantity per socket; therefore, in the event that data have been sent from other nodes to an open socket, the receive buffer may become full unless the data being received by the socket is taken over by the T3H side. In this case, the newly arrived data will be damaged thus making data transmission impossible (the transmission request will end in "Resource shortage error"). To avoid this situation, make sure to use the user program to issue constantly receive requests to read data from the receive buffer or use the socket status (6.3 Socket Interface Information) to monitor the availability of receive data to perform the receiving. If a "resource shortage error" occurs without taking over the receive data, resolve the problem by closing the socket where the receive data has accumulated.

f. Since EN311 receive requests (both TCP and UDP) put the object socket in a wait state waiting for data from the remote node, transmission over that socket is not possible.
If full-duplex communication with the remote node is required, set up two sockets, one for transmission and one for reception.

g. There are a total of eight requests used for socket interface transmission. Of those, the T3H waits internally for completion for the timeout time for five requests, namely,

- UDP open, send, and close requests
- TCP send and close requests

If the timeout time expires, the "transmission complete timeout (no instruction response)" error is issued. Since this error has the same code as module failure errors, first check whether or not the module has failed before attempting to recover from the error.

h. User programs specify the time limit until completion for the following three requests used in socket interface transmission:

- UDP receive request
- TCP open request
- TCP receive request

If this time limit is exceeded, a "timeout" error is issued. In particular, the EN311 reports the timeout error to the T3H.

i. The EN311 uses a priority ordering in processing sockets 1 through 8. Therefore, systems constructed so that socket 1 is activated frequently may not be able to process socket 8, resulting in "Transmission completion timeout" errors occurring. When constructing a system, take the socket utilization conditions into account when allocating sockets.

Since the send/receive processing for each socket requires about 50 ms, applications that issue send or receive requests to a given socket should leave an interval of at least 50 ms times the number of sockets used between each request.

(Interval between requests to the same socket) ³ (Number of sockets used ´ 50 ms)

Similarly, the above intervals averaging 50 ms should be left between transmissions from remote nodes to the local node.

(Interval between remote node transmissions) ³ (Number of remote nodes ´ 50 ms)

5. UDP socket interface notes

a. In transmission using UDP sockets, the user program must implement any processing required to assure transmission reliability, such as verifying the reception of transmitted data and retransmission.

b. It is possible to broadcast to all nodes on the network using UDP sockets.

Send side: Set the transmission destination address to "255.255.255.255". This is "FF.FF.FF.FF" in hexadecimal. The "0.0.0.0" used by some UNIX versions (in particular, 4.2 BSD) cannot be used.
Set the UDP port number for the socket to which you want to issue a broadcast as the transmission destination object socket UDP port number. It is convenient to prepare a dedicated socket in advance if broadcast transmission is to be used.

Receive side: Specify "0.0.0.0" as the transmission source IP address.
Specify 0 as the transmission source UDP port number.

c. Data transmission between sockets on the same node is not supported by UDP.

d. **If a transmission is repeated in a fast cycle (less than 100ms) to a non-existent remote station, a "resource shortage error (detail information = 00C0H) may occur.** In this case, take a countermeasure such as stopping the transmission to the non-existent remote station or elongating the transmission interval.

6. TCP socket interface notes

a. When a passive open is executed, the specified socket is put in the active open wait state. If the remote IP address (DIPAddress) and the remote node object socket TCP port number (DTCP_PORTNO) values are set to 0, the socket will be able to handle active opens from any remote node.

b. A connection is established by an active open from another socket applied to a socket in the passive open state. A connection cannot be established by a passive open from another socket applied to a socket in the passive open state. Similarly, a connection cannot be established by an active open from another socket applied to a socket in the active open state. That is, the roles of two sockets for which a connection is to be established must be determined in advance.

c. For a socket in the passive open state, it is not possible to open multiple connections from other nodes by issuing multiple active opens.

d. Connections cannot be established between sockets on the same node.

e. If transmission is impossible due to network congestion or other reason when a send request is executed, the send request is stored internally in the EN311 so that it can be sent later. The number of items that can be stored is three per socket. If the EN311 cannot store the request, is returns an error.

f. If a close request is issued first for a connection that is being established, then it will be possible to execute the next open request for the object sockets at the point when the close request processing completes normally. On engineering workstation and personal computer systems, TCP sockets on the node that performed the close processing for the open connection cannot be opened again for a fixed period, usually about 1 to 2 minutes, although this time varies between systems.

g. When ending the connection from the EN311, the EN311 which has received the close request of the T3H waits for the end request (TCP level) on the remote station side for 15 seconds after sending the end request to the remote station. If there is the end request from the remote station side during the wait time, the EN311 performs the own-station close processing and informs the T3H that the processing is completed. Therefore, the TCP close request of the T3H may have to wait for up to 15 seconds.

h. If a close request comes from the remote node TCP socket while a connection is established, the local node must also close the socket. As a technique for checking for the reception of close requests from the remote TCP socket, user programs should monitor the RCLOSE and CONN bits in the socket status. (See section 6.3.) RCLOSE is set to 1 and CONN is set to 0 when a close request is received from the remote TCP socket. The EN311 will return an error if send or receive requests are issued in this state. A receive request in the receive wait state also returns an error.

i. The EN311 in the current state does not support a keep alive function for TCP connections. Verification from the EN311 side to other nodes is not performed. However, the EN311 does respond to verifications from other nodes. (Responding to verifications from other nodes is performed independently of user programs.)

   Therefore, the disappearance of remote nodes cannot be detected at the TCP level. We recommend using the detection techniques described in items j and k below to detect this condition.

   Keep alive function: A function that checks, at the TCP protocol level, whether or not the connection is operating normally if there has been no activity over the connection for a certain fixed period.

j. For a TCP receive request, the EN311 simply waits for data from the remote node. In situations where data is sent periodically from the remote node, reception wait timeouts, i.e. no response from the remote node states, can be detected by setting a reception wait time limit. The following techniques, among others, can be used to detect no response states when data is sent with no fixed period.

- Periodic execution of existence verification requests (See section 7.3.)
- The techniques described in the next section, which use a separate TCP connection

One of the following problems may have occurred when there is no response from the remote node:

- The remote node may have gone down.
- Power may have been lost.
- The remote and local nodes may have become disconnected from the network.

k. With a connection established, if the no response state from the remote node continues when data is sent and the EN311 internal resend processing times out (the timeout time is about 1 minute), the NOACK bit in the socket status (See section 6.3.) will be set to 1. User programs should close such sockets.

Also note that the EN311 will return an error if send or receive requests are issued in this state.

User program send requests are seen as completing as soon as they are received by the EN311. This means that **even if the remote node goes to the no response state, a number of send requests equal to the EN311 internal storage capacity (i.e., three requests) will complete normally**. When the number of send requests exceeds the EN311 internal storage capacity, errors will be returned for all further send requests.

l. Segments with the reset bit (RST) set to 1 (reset segments) are not supported by the EN311. If a reset segment is received from the remote node, the NOACK bit in the socket status (see section 6.3) will be set to 1 about 32 seconds later. Such sockets should be closed.

Reset segment: A transmitted segment used to forcibly close a connection from one of the nodes. Connections are forcibly closed in this manner if an error that cannot be recovered from by normal means such as retransmission has occurred, or if a node has recovered after having gone down.

m. **In the EN311 TCP socket interface, when reception data in the EN311 is read out by a receive request from the T3H, the EN311 sends an ACK (acknowledge response) to the node that sent the data.** Since an ACK will not be sent to the sending node if the received data remains in the EN311 if the T3H does not read out that received data, the sending node will resend the data. If this state continues for a predetermined period, the sending node may will decide that the TCP connection is abnormal and close the connection. To prevent this from occurring, the T3H software should monitor the RCV (receive data present) bit and issue receive requests when necessary.

6.3 Socket Interface Information

The information for the eight socket interface sockets held by the EN311 can be read out with the T3H READ instruction. The EN311 holds five words of socket status information for each socket. User programs should access this information as necessary when using socket interface transmission.

- Remote node TCP/UDP port number
- Remote node IP address
- TCP/UDP port number for this socket
- Socket status

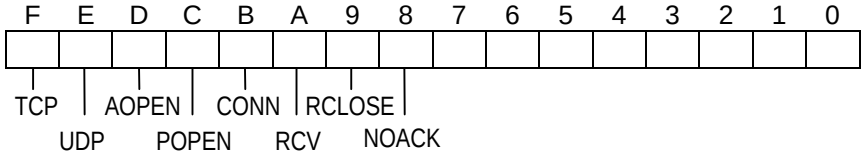
Table 6.1 lists the structure of the socket interface information and the extended memory area addresses.

Table 6.1 Socket Interface Information

	Socket identifier							
	1	2	3	4	5	6	7	8
Remote node port number (TCP only)	7E43H	7E4BH	7E53H	7E5BH	7E63H	7E6BH	7E73H	7E7BH
Remote node IP address (TCP only)	7E44H 7E45H	7E4CH 7E4DH	7E54H 7E55H	7E5CH 7E5DH	7E64H 7E65H	7E6CH 7E6DH	7E74H 7E75H	7E7CH 7E7DH
Local node TCP/UDP port number	7E46H	7E4EH	7E56H	7E5EH	7E66H	7E6EH	7E76H	7E7EH
Socket status	7E47H	7E4FH	7E57H	7E5FH	7E67H	7E6FH	7E77H	7E7FH

For UDP sockets, the remote node port number and IP address data are invalid.

The socket status has the following structure.



The conditions for each bit to become 1 as well as those for becoming 0 are listed in Tables 6.2 and 6.3.

<Important items>

This area is dedicated to reading. Do not write data with the "WRITE instruction". If you do, data may no longer be read correctly.

Table 6.2 Condition of Socket status bits

Bit no.	Bit	Condition under which the bit is set to 1	Condition under which the bit is reset to 0
F	TCP	TCP used by the socket	The socket closed in response to a close request
E	UDP	UDP used by the socket	The socket closed in response to a close request
D	AOPEN	TCP socket in active open state	The socket closed in response to a close request
C	POPEN	TCP socket in passive open state or UDP socket in open state	The socket closed in response to a close request
B	CONN	TCP connection established	Disconnected by the local node with a close request Disconnected by the remote node
A	RCV	Received text present	No received text
9	RCLOSE	An established TCP connection disconnected by the remote node	The socket closed in response to a close request
8	NOACK	No response received from the remote node for a local node send operation in a state where a TCP connection was established, and the TCP resend function resulted in a timeout (because the remote node was down, etc.).	The socket closed in response to a close request
		If the wait time exceeds the set value during a TCP active open request. This bit is not set to 1 for a TCP passive open request timeout.	When a TCP active open request is reissued.

A socket status in which neither AOPEN nor POPEN is set to 1 indicates that the socket is in the closed state.

Important items

This area is a read-only area. Do not attempt to write this data with the WRITE instruction. It will no longer be possible to acquire correct data after such an operation.

Sample: Socket interface information readout program

```
 |                                                                    |
 |R0700                                                               |
1|-| |-[32323 MOV RW071][00005 MOV RW072][H0001 READ RW071 -> RW073]--|
 |                                                                    |
READ instruction description
  H0001:  Module designation.Upper 2 digits:    unit specification,
                             lower 2 digits:    slot specification
                             H0001 specifies slot 1 in the main base unit.
                             H000A specifies slot 10 in the main base unit.
  RW071:  Specifies the start address of the socket status information.
          If 32323 (7E43H) is specified, the socket status information for socket
          1 will be read out.
  RW072:  Specifies the number of words (00005) to be read out.
  RW073:  Specifies the starting address of the area to hold the read out socket
          status information.
          In this case, the read out downloaded information is stored at locations
          RW073 to RW077.
  ⊙ Setting R0700 to 1 will store the socket status information for socket
        1 at locations RW073 to RW077.
```

6.4 Using the EN311 Socket Interface

This section describes the requests used by T3H user programs to use UDP and TCP sockets. There are eight types of request as listed below.

- UDP socket (open request, send request, receive request, close request)
- TCP socket (open request, send request, receive request, close request)

Even when performing transmission by using the socket interface, it is necessary to set the module of the EN311 in the same manner as the computer link or PC link procedure transmission.

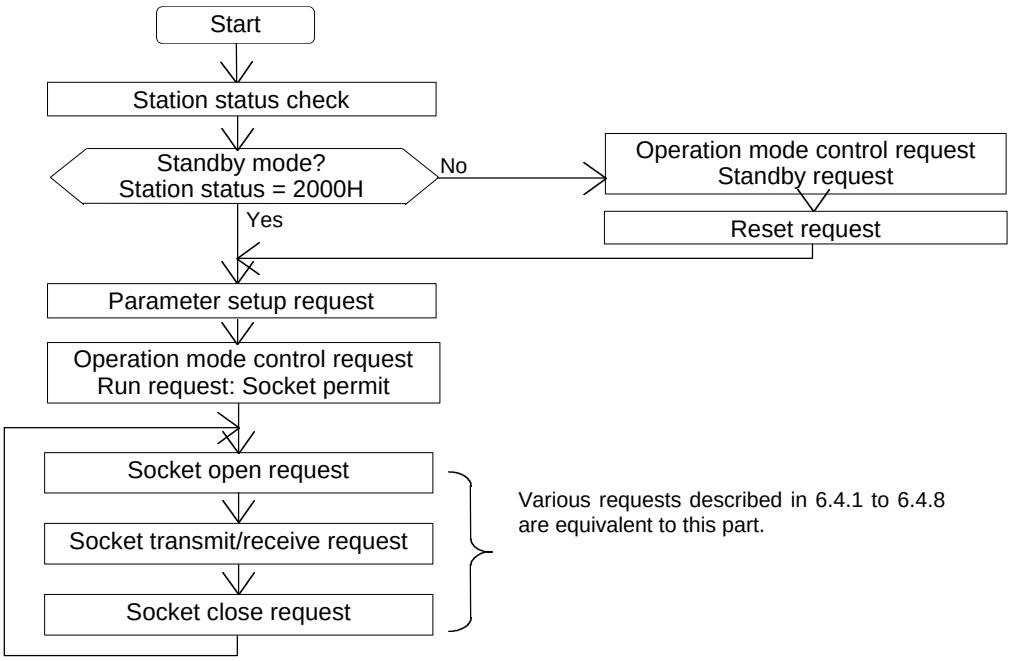


Fig. 6.9 Flow of Socket Interface Transmission Processing

1. UDP open request (using the SEND instruction)

a. Function

This request opens any of the eight sockets.

Transmission protocol: UDP/IP

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0031H	Command number
A+2	SportNO	Socket identifier (1 to 8)
A+3	UDP_PORTNO	Local node specified socket UDP port number (1024 to 65535)

c. Completion status (See figure 4.4 for details on bits C, D, E and F.)

F E D C B A 9 8 7 6 5 4 3 2 1 0

B					SportNO	TermSTS
B+1	Detailed information (Only valid when TermSTS = 0BH.)					

SportNO: Socket identifier (1 to 8)
TermSTS: See tables 4.3 and 4.4.
Detail information: See table 4.5.

d. Important items

- After this request completes normally, UDP send, receive or close requests can be sent to the socket.
- An error is returned if an open request is issued for an already open socket.

  Status: Transmission error (TermSTS = 0BH)

  Detailed information: Already open (0080H)
- An error is returned if a value other than 1 to 8 is specified as the socket identifier.

  Status: Transmission error (TermSTS = 0BH)

  Detailed information: Illegal socket identifier (0082H)
- An error is returned if a value other than a local node specified socket UDP port number is specified.

  Status: Transmission error (TermSTS = 0BH)

  Detailed information: Port number error (0071H)

- Not only must the specified socket UDP port number on the local station not overlap with UDP port numbers used for message transmission and previously used UDP port numbers, **but it also must not overlap with any TCP port number.** An error will occur if the port number overlaps.

  Status: Transmission error (TermSTS = 0BH)

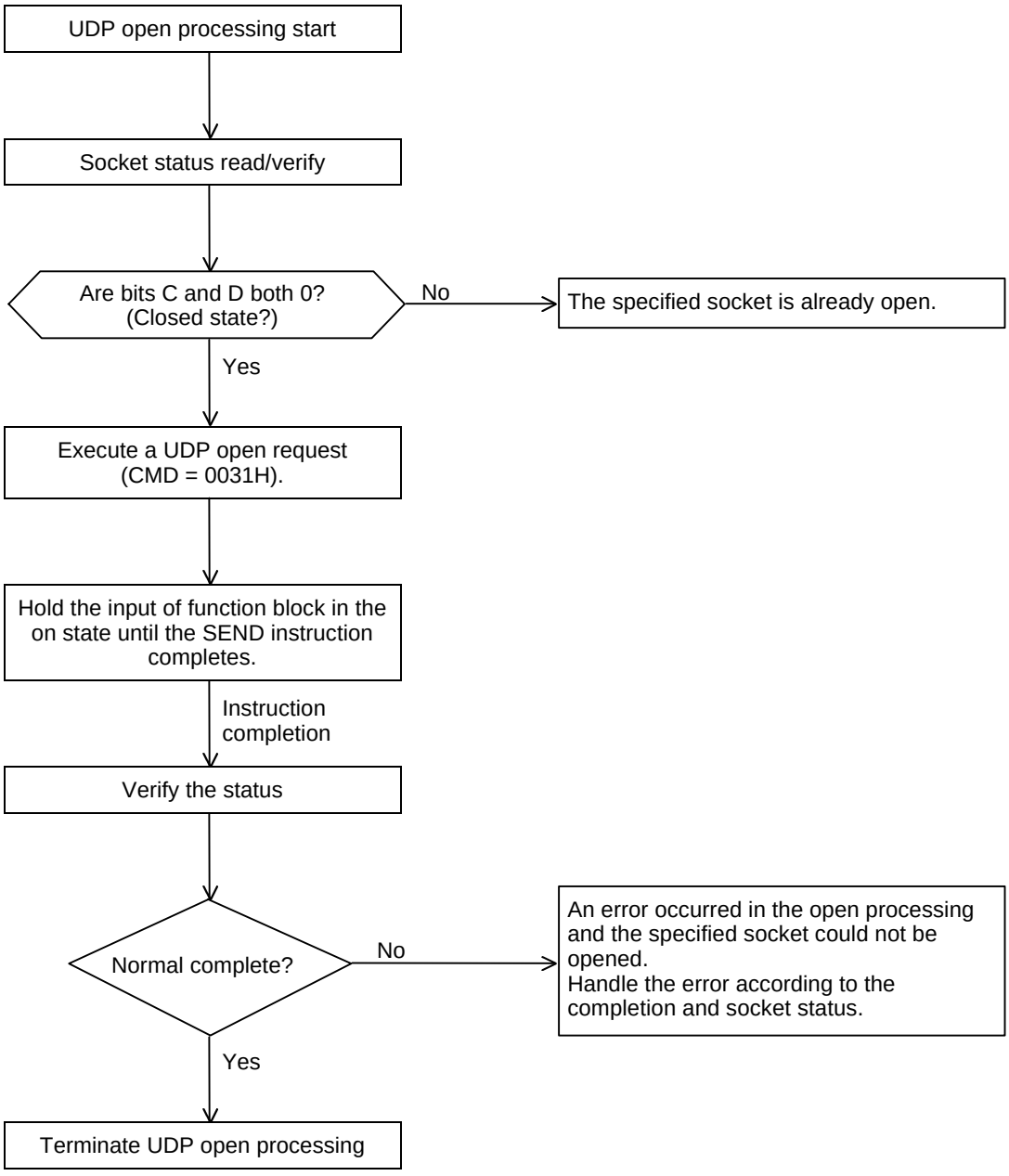
  Detailed information: Already open (0080H)
- If the T3H internal completion wait time limit (2 seconds) is exceeded for this request, the error listed below is returned.

  Completion status: Send completion timeout (TermSTS = 06H)

  In this case, first verify that the module is not in the down state by checking the station status, and then verify the open/closed state of the socket in the socket status.

e. UDP open processing example

Ladder program flowchart **Error result**



2. UDP send request/broadcast send request (using the SEND instruction)

a. Function

This request sends local node register data using an open UDP socket.

Amount of data sent: 1 to 1000 words

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0032H	Command number
A+2	SportNO	Socket identifier (1 to 8)
A+3	DIPAddress	Transmission destination IP address
A+4		(The input format is the same as that for the parameter setup request.)
A+5	D_UDP_PORTNO	Transmission destination object socket UDP port number
A+6	WordSize	Transmission data length: 1 to 1000 words
A+7	SRID	Transmission data storage register type code
A+8	StregNO	Transmission data storage register number

Transmission data storage register type code: Type code for the register that holds the transmission data. (See Figure 5.1)

Transmission data storage register number: Starting number of the registers that hold the transmission data.

c. Completion status (See figure 4.4 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					SportNO				TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

SportNO: Socket identifier (1 to 8)
TermSTS: See tables 4.3 and 4.4.
Detail information: See table 4.5.

d. Important items

- The T/C register flag data is not transmitted if the T/C registers are not specified as storage registers for transmitted data.
- An error is returned if a send request is issued for a socket that is not yet opened.

  Completion status: Transmission error (TermSTS = 0BH)

  Detailed information: Unopened (0081H)
- An error is returned if a value other than 1 to 8 is specified as the socket identifier.

  Completion status: Transmission error (TermSTS = 0BH)

  Detailed information: Illegal socket identifier (0082H)
- If the IP address of the local node is specified as the transmission destination IP address, it will be possible to send data, but it will not be possible to receive that data with a receive request.

- Values in the range 1024 to 65535 can be specified as the object socket UDP port number for the transmission destination. An error will be returned if a value outside that range is specified.

  Completion status: Transmission error (TermSTS = 0BH)

  Detailed information: Port number error (0071H)

- An error will be returned if a value of 0 words or 1001 or more words is specified as the transmission data size.

  Status: Transmission word count error (TermSTS = 09H)

- The T3H performs an area check for the register area based on the transmission data storage register type and number, and if an error is found it returns an error.

  Completion status: Boundary error (TermSTS = 0AH)

- If the T3H internal completion wait time limit (2 seconds) is exceeded for this request, the error listed below is returned.

  Status: Send completion timeout (TermSTS = 06H)

  In this case, first verify that the module is not in the down state by checking the station status, and then perform the required error handling (the send request etc.).

- The EN311 uses a priority ordering in processing sockets 1 through 8. Therefore, systems constructed so that socket 1 is activated frequently may not be able to process socket 8, resulting in the following error response:

  Status: Send completion timeout (TermSTS = 06H)

  When constructing a system, take the socket utilization conditions into account when allocating sockets. Since the send/receive processing for each socket requires about 50 ms, applications that issue send or receive requests to a given socket should leave an interval of at least 50 ms times the number of sockets used between each request.

  (Interval between requests to the same socket) ³ (Number of sockets used ´ 50 ms)

  Similarly, the above intervals averaging 50 ms should be left between transmissions from remote nodes to the local node.

  (Interval between remote node transmissions) ³ (Number of remote nodes ´ 50 ms)

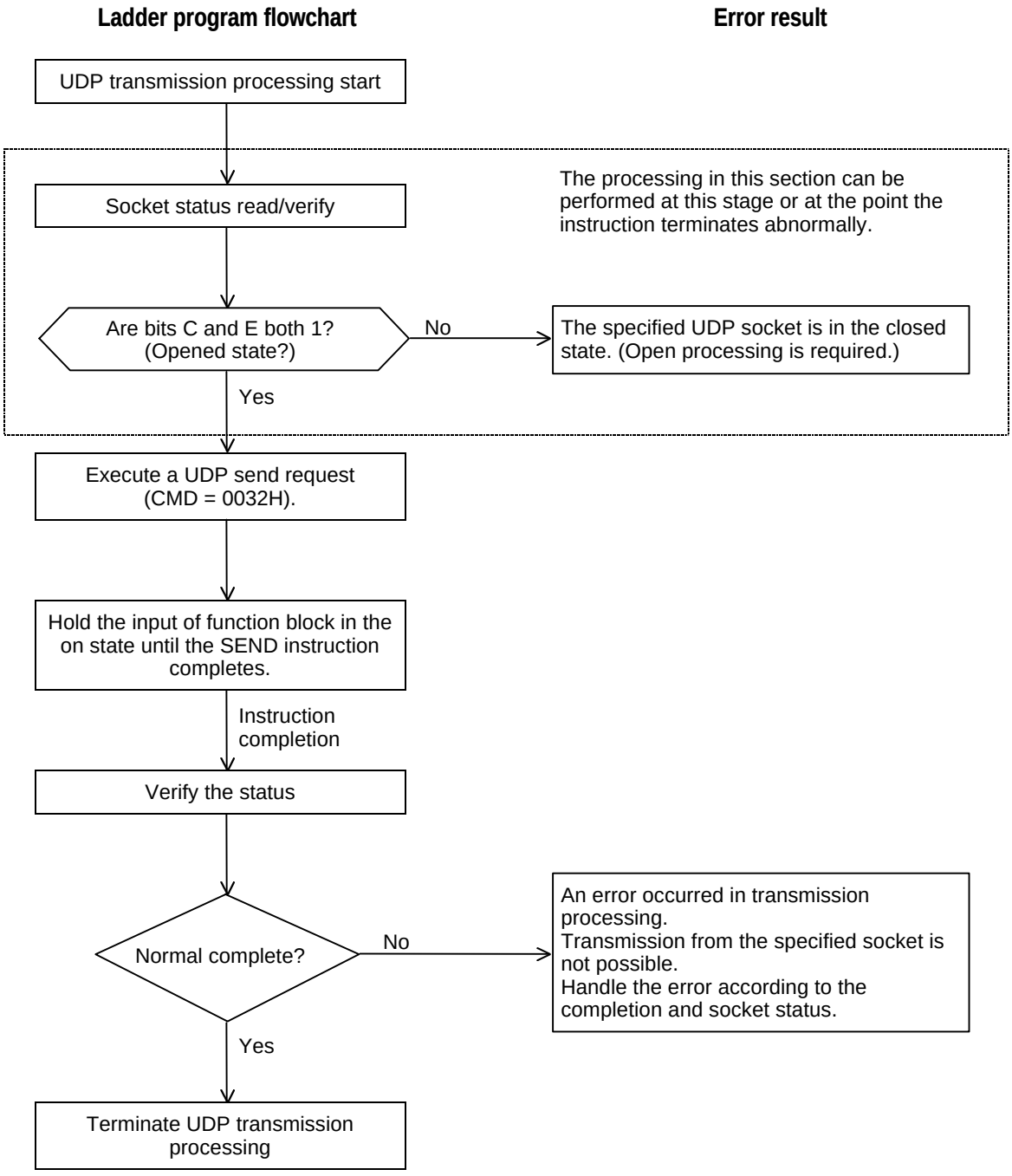
- **When PC link transmission and the UDP socket interface are used together, if an application repeatedly transmits to a nonexistent remote station at short intervals (less than 100 ms)**, an insufficient resources error (detailed information = 00C0H) may occur. Applications should either stop transmitting to the nonexistent remote station or increase the interval between transmissions to prevent this error from occurring.

e. Broadcast transmission

It is possible to broadcast to all nodes on the network using UDP sockets.

Send side: Set the transmission destination address to "255.255.255.255", ("FF.FF.FF.FF" in hexadecimal).
The "0.0.0.0" used by some UNIX versions (in particular, 4.2 BSD) cannot be used.
Specify the UDP port number for the socket to which you want to issue a broadcast as the transmission destination object socket UDP port number.

f. UDP transmission processing example



3. UDP receive request/broadcast receive request (using the RECV instruction)

a. Function

If an opened UDP socket receives data, read the received data into registers on the local node.

If no data has been received, wait until data arrives (the wait time can be set) and then, after reception, read the received data into the local node registers.

Reception data size: 1 to 1000 words.

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0033H	Command number
A+2	SportNO	Socket identifier (1 to 8)
A+3	DIPAddress	Transmission destination IP address
A+4		(The input format is the same as that for the parameter setup request.)
A+5	D_UDP_PORTNO	Transmission source object socket UDP port number
A+6	WordSize	Reception data length: 1 to 1000 words
A+7	DRID	Reception data storage register type code
A+8	DregNO	Reception data storage register number
A+9	TimeCNT	Reception wait timeout time

Reception data length: Set this parameter to a value greater than or equal to the largest size for transmission data that could be sent to the object socket in a single operation.

Reception data storage register type code: Type code for the register that stores the received data. (See Figure 5.1)

Reception data storage register number: Starting number of the registers that store the received data.

Reception wait timeout time: Specified in 0.1 second units. (1 to 65535)
If zero is specified, the system is set to an unlimited (infinite) wait state.

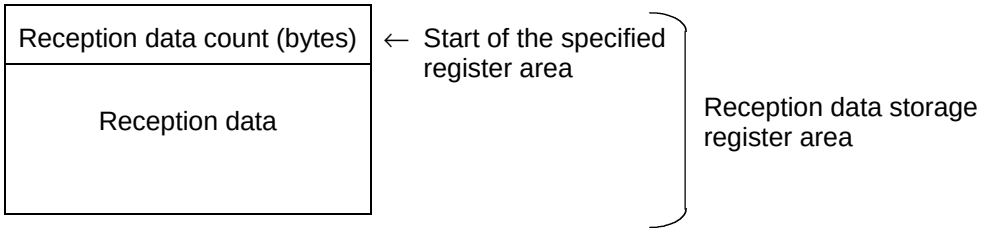
c. Completion status (See figure 4.4 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					SportNO				TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

SportNO: Socket identifier (1 to 8)
TermSTS: See tables 4.3 and 4.4.
Detail information: See table 4.5.

d. Methods for storing reception data

- Allocate a reception data storage register area with a size equal to the size of the reception data plus one word. The reception data count (the size of the transmission data for a single operation) and the transmission data for a single operation will be stored in this area as shown in the figure.



- The T3H checks for register area allocation of the reception data size plus one word and returns an error if the register area does not exist.

  Completion status: Boundary error (TermSTS = 0AH)

  In this case, data is not transferred to the register area, and the data is discarded. The data is not retained in the EN311 either.

e. Important items

- An error is returned if a receive request is issued for a socket that is not yet opened.

  Completion status: Transmission error (TermSTS = 0BH)

  Detailed information: Unopened (0081H)

- An error is returned if a value other than 1 to 8 is specified as the socket identifier.

  Completion status: Transmission error (TermSTS = 0BH)

  Detailed information: Illegal socket identifier (0082H)

- It is not possible to receive data sent from the local node, even if the local node IP address is specified at the transmission source IP address.

- Values in the range 1024 to 65535 can be specified as the object socket UDP port number for the transmission source. An error will be returned if a value outside that range is specified.

  Completion status: Transmission error (TermSTS = 0BH)

  Detailed information: Port number error (0071H)

- An error will be returned if a value of 0 words or 1001 or more words is specified as the reception data size.

  Completion status: Transmission word count error (TermSTS = 09H)

- An error will be returned if the reception timeout time is exceeded.

  Completion status: Transmission error (TermSTS = 0BH)

  Detailed information: Timeout(0020H)

- **Set the reception data size to a value greater than or equal to the largest size of transmission data that could be sent to the object socket in a single operation.**

- **Allocate a reception data storage register area with a size equal to the size of the transmission data plus one word.** The size of the transmission data for the single operation and the transmission data for the single operation will be stored in this area.

- If the transmission data size for a single operation is larger than the reception data size, the section of the transmitted data that exceeds the specified reception size will be transferred to the register area after the allocated reception data storage register area. As a result, the contents of the registers in that area may be destroyed.

  Supplement:

  Although the limitation listed in the item above applies to the current combination of the T3H and EN311, Toshiba is planning to modify the T3H OS so that the contents of registers are not destroyed in this case.

- The EN311 uses a priority ordering in processing sockets 1 through 8. Therefore, systems constructed so that socket 1 is activated frequently may not be able to process socket 8, resulting in the following error response:

  Completion status: Send completion timeout (TermSTS = 06H)

  When constructing a system, take the socket utilization conditions into account when allocating sockets. Since the send/receive processing for each socket requires about 50 ms, applications that issue send or receive requests to a given socket should leave an interval of at least 50 ms times the number of sockets used between each request.

  (Interval between requests to the same socket) ³ (Number of sockets used ´ 50 ms)

  Similarly, the above intervals averaging 50 ms should be left between transmissions from remote nodes to the local node.

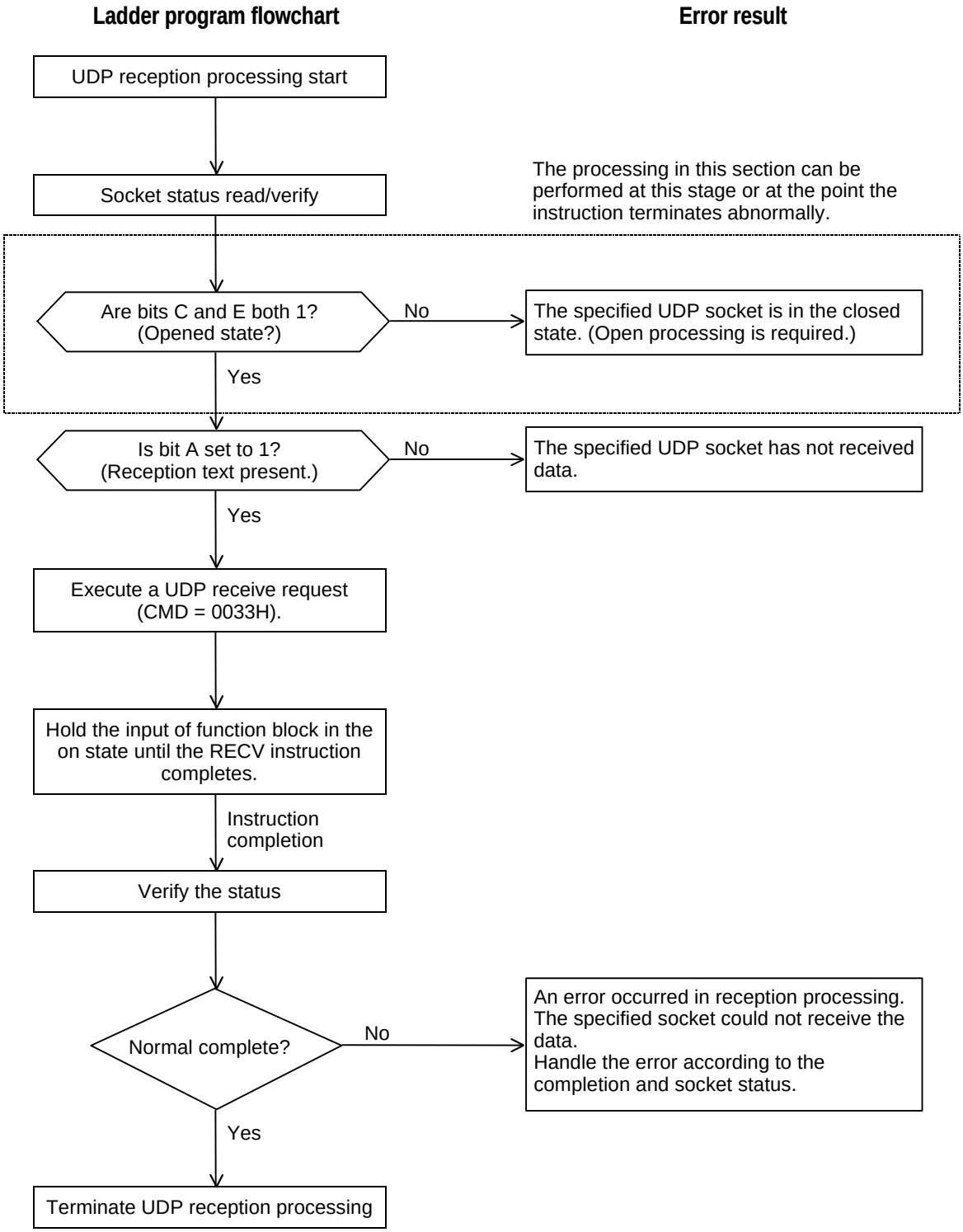
  (Interval between remote node transmissions) ³ (Number of remote nodes ´ 50 ms)

f. Broadcast reception

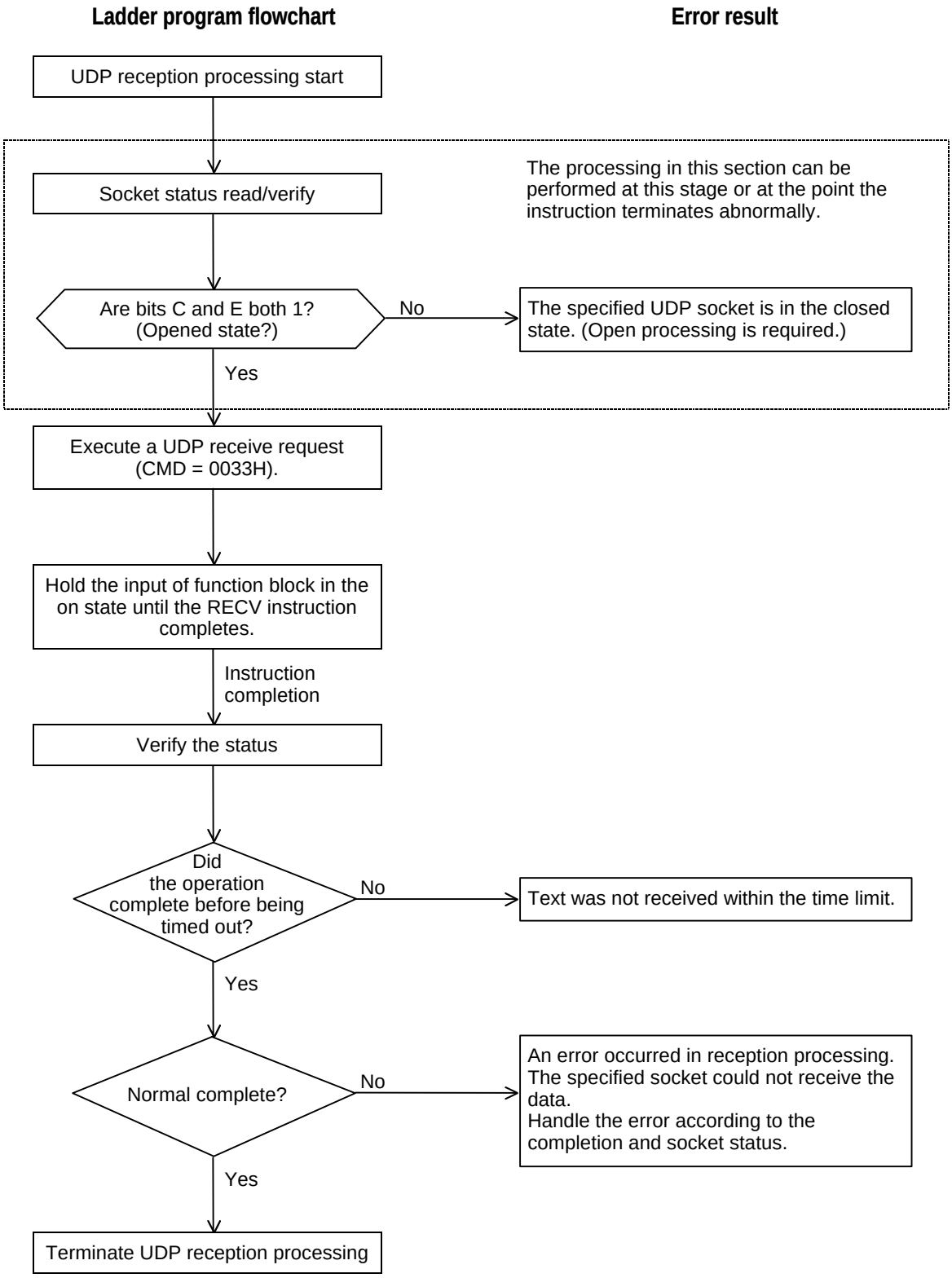
It is possible to broadcast to all nodes on the network using UDP sockets.

Receive side: Specify the transmission source IP address to be "0.0.0.0".
Specify the transmission source UDP port number to be the UDP port number of broadcast transmitting socket .

g. UDP reception processing example (Socket status monitoring type)



h. UDP reception processing example (Receive request issued first type)



4. UDP close request (using the SEND instruction)

a. Function

Close the open UDP socket.

Release the (unlimited wait state) receive request and terminate the UDP socket.

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0034H	Command number
A+2	SportNO	Socket identifier (1 to 8)

c. Completion status (See figure 4.4 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					SportNO				TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

SportNO: Socket identifier (1 to 8)
TermSTS: See tables 4.3 and 4.4.
Detail information: See table 4.5.

d. Important items

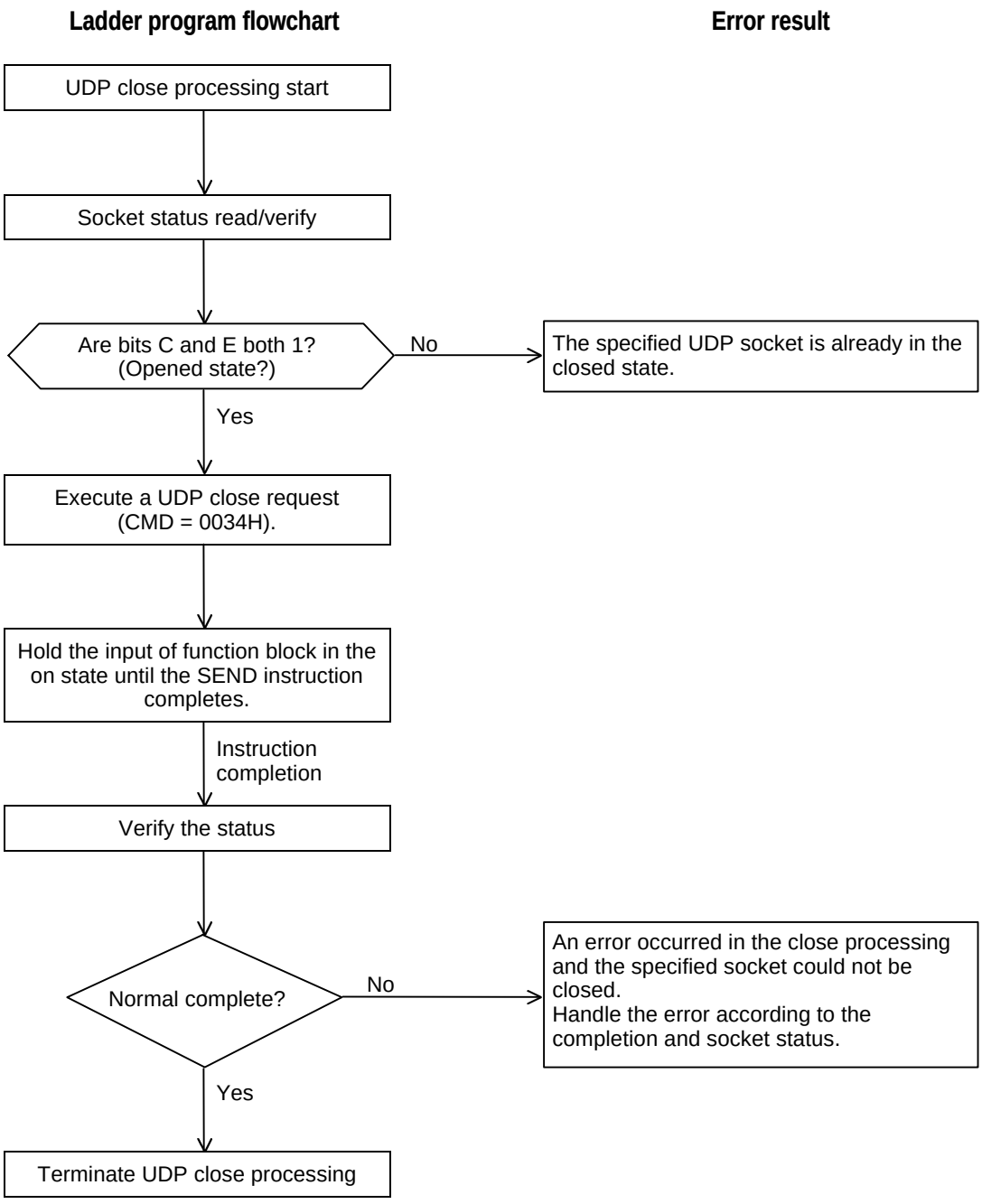
- UDP close requests are processed with the highest priority and other executing requests are discarded, even if the object socket is executing a UDP open, send, or receive request. Other requests during the execution of this request will be discarded.
- The next open request for the object socket can be executed as soon as the close request completes normally.
- An error is returned if a close request is issued for a socket that is not yet opened.
  Completion status: Transmission error (TermSTS = 0BH)
  Detailed information: Unopened (0081H)
- An error is returned if a value other than 1 to 8 is specified as the socket identifier.
  Completion status: Transmission error (TermSTS = 0BH)
  Detailed information: Illegal socket identifier (0082H)
- A UDP receive request will result in an error being returned if an unlimited wait state UDP receive request is terminated with this request.
  Completion status: Transmission completion timeout (TermSTS = 06H)

  Supplement:

  The T3H sees its requests (module control and socket interface transmission) to the EN311 as being "transmission" requests. As a result, when a request is forcibly terminated and a response is not received from the EN311, the result is a send request timeout even if the instruction was a RECV instruction.
- If the T3H internal completion wait time limit (2 seconds) is exceeded for this request, the error listed below is returned.
  Status: Send completion timeout (TermSTS = 06H)

  In this case, first verify that the module is not in the down state by checking the station status, and then verify the open/closed state of the socket in the socket status.

e. UDP close processing example



5. TCP open request (using the SEND instruction)

a. Function

This request opens (active/passive) any of the eight sockets.

Transmission protocol: TCP/IP

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0035H	Command number
A+2	SportNO	Socket identifier (1 to 8)
A+3	Kind	Open type
A+4	DIPAddress	Remote node IP address
A+5		
A+6	DTCP_PORTNO	Remote node object socket TCP port number
A+7	STCP_PORTNO	Local node specified socket TCP port number
A+8	TimeCNT	Open wait timeout time

Open type (1 or 2) 1: Active open (client side)
2: Passive open (server side)

Open wait timeout time: specified in 0.1 second units. (1 to 65535) If zero is specified, the system is set to an unlimited (infinite) wait state.

c. Status (See figure 4.4 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					SportNO				TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

SportNO: Socket identifier (1 to 8)
TermSTS: See tables 4.3 and 4.4.
Detail information: See table 4.5.

d. Important items

- After this request completes normally, TCP send, receive or close requests can be sent to the socket.
- An error is returned if an open request is issued for an already open socket.

  Completion status: Transmission error (TermSTS = 0BH)

  Detailed information: Already open (0080H)
- An error is returned if a value other than 1 to 8 is specified as the socket identifier.

  Completion status: Transmission error (TermSTS = 0BH)

  Detailed information: Illegal socket identifier (0082H)
- An error will be returned if a value outside the range 1024 to 65535 is specified for the local node specified socket TCP port number.

  Completion status: Transmission error (TermSTS = 0BH)

  Detailed information: Port number error (0071H)

- Not only must the specified socket TCP port number on the local station not overlap with any TCP port number already in use in a local station socket, but it also must not overlap with any **UDP port numbers or UDP port numbers used for message transmission.** An error will occur if the port number overlaps.

  Status: Transmission error (TermSTS = 0BH)

  Detailed information: Already open (0080H)

- A connection to the local node itself cannot be established, even if the local node IP address is specified as the remote node IP address.
- Values in the range 1024 to 32767 can be specified as the object socket TCP port number for the remote node. An error will be returned if a value outside that range is specified.

  Status: Transmission error (TermSTS = 0BH)

  Detailed information: Port number error (0071H)

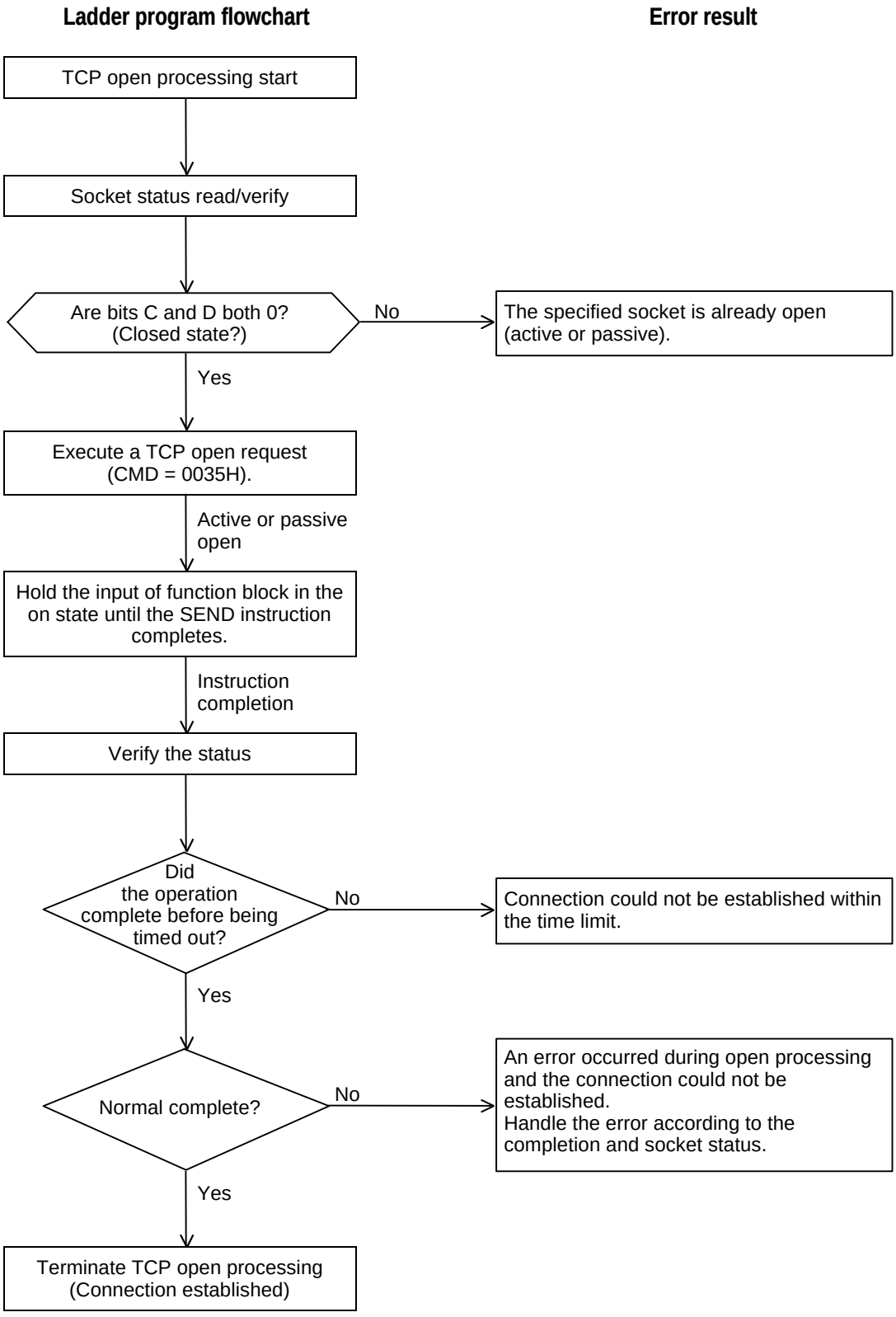
- An error will be returned if the open timeout time is exceeded.

  Status: Transmission error (TermSTS = 0BH)

  Detailed information: Timeout(0020H)

- While the open wait timeout limit can be set to any value in the range 0.1 to 6553.5 seconds or unlimited (infinite), **we recommend that the timeout limit be set in the range 0.1 to 32 seconds for active opens.** This is because the EN311 processing continuation time for active open processing is 32 seconds. Even if the timeout limit is set to a value over 32 seconds, once 32 seconds has elapsed, the open processing will never actually be performed. The system will be in an idle state until the specified time has elapsed.
- When a passive open operation is executed, the specified socket goes to the active open wait state. If the DIPAddress and DTCP_PORTNO values are set to 0, the socket is set to the state in which a particular remote node is not specified. (In this state the socket can handle an active open from any other (i.e., any remote) node on the network.)
- A connection is established by an active open from another socket applied to a socket in the passive open state. A connection cannot be established by a passive open from another socket applied to a socket in the passive open state. Similarly, a connection cannot be established by an active open from another socket applied to a socket in the active open state.
- For a socket in the passive open state, it is not possible to open multiple connections from other nodes by issuing multiple active opens.

e. TCP open processing example



6. TCP send request (using the SEND instruction)

a. Function

This request sends local node register data using an open TCP socket.

Amount of data sent: 1 to 1000 words

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0037H	Command number
A+2	SportNO	Socket identifier (1 to 8)
A+3	WordSize	Transmission data length: 1 to 1000 words
A+4	SRID	Transmission data storage register type code
A+5	StreqNOD	Transmission data storage register number

Transmission data storage register type code: Type code for the register that holds the transmission data. (See Figure 5.1)

Transmission data storage register number: Starting number of the registers that hold the transmission data.

c. Status (See figure 4.4 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					SportNO				TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

SportNO: Socket identifier (1 to 8)
TermSTS: See tables 4.3 and 4.4.
Detail information: See table 4.5.

d. Important items

- Send requests complete at the point they are stored in the EN311. This is to allow the send to be performed later even if that send request cannot be executed immediately due to network congestion or other problems. The EN311 can store up to three requests per socket, and the EN311 returns an error for send requests that it cannot store.

  Completion Status: Transmission error (TermSTS = 0BH)

  Detailed information: Timeout(0020H)

- The T/C register flag data is not transmitted if the T/C registers are not specified as storage registers for transmitted data.

- An error is returned if a send request is issued for a socket that is not yet opened.

  Completion Status: Transmission error (TermSTS = 0BH)

  Detailed information: Unopened (0081H)

- An error is returned if a value other than 1 to 8 is specified as the socket identifier.

  Completion Status: Transmission error (TermSTS = 0BH)

  Detailed information: Illegal socket identifier (0082H)

- An error will be returned if a value of 0 words or 1001 or more words is specified as the transmission data size.

  Completion Status: Transmission word count error (TermSTS = 09H)

- The T3H performs an area check for the register area based on the transmission data storage register type and number, and if an error is found it returns an error.

  Completion Status: Boundary error (TermSTS = 0AH)

- If a close request from the remote node TCP socket has arrived while a connection is established, and the user program issues a send request, the EN311 returns the following error.

  Completion Status: Transmission error (TermSTS = 0BH)

  Detailed information: Unopened (0081H)

  Verify the socket status (see section 6.3) RCLOSE and CONN bits, and close the socket.

- With a connection established, if a no response state from the remote node continues when data is sent and the EN311 internal resend processing times out (the timeout time is about 1 minute), the NOACK bit in the socket status will be set to 1. User programs should close such sockets. Errors will be returned for send/receive requests issued in this state.

  Completion Status: Transmission error (TermSTS = 0BH)

  Detailed information: Protocol error (0091H)

  However, note that the EN311 will return normal complete responses for TCP send requests issued prior to the timeout, since the send requests from the T3H are stored internally by the EN311.

  When the number of send requests that can be stored is exceeded, errors will be returned for that and all following send requests.

  Completion Status: Transmission error (TermSTS = 0BH)

  Detailed information: Timeout (0020H)

- One of the following problems may have occurred when there is no response from the remote node:
  - The remote node may have gone down.
  - Power may have been lost.
  - The remote and local nodes may have become disconnected from the network.

- If the T3H internal completion wait time limit (2 seconds) is exceeded for this request, the error listed below is returned.

  Status: Send completion timeout (TermSTS = 06H)

  In this case, first verify that the module is not in the down state by checking the station status, and then perform the required error handling.

- The EN311 uses a priority ordering in processing sockets 1 through 8. Therefore, systems constructed so that socket 1 is activated frequently may not be able to process socket 8, resulting in the following error response:

  Completion Status: Send completion timeout (TermSTS = 06H)

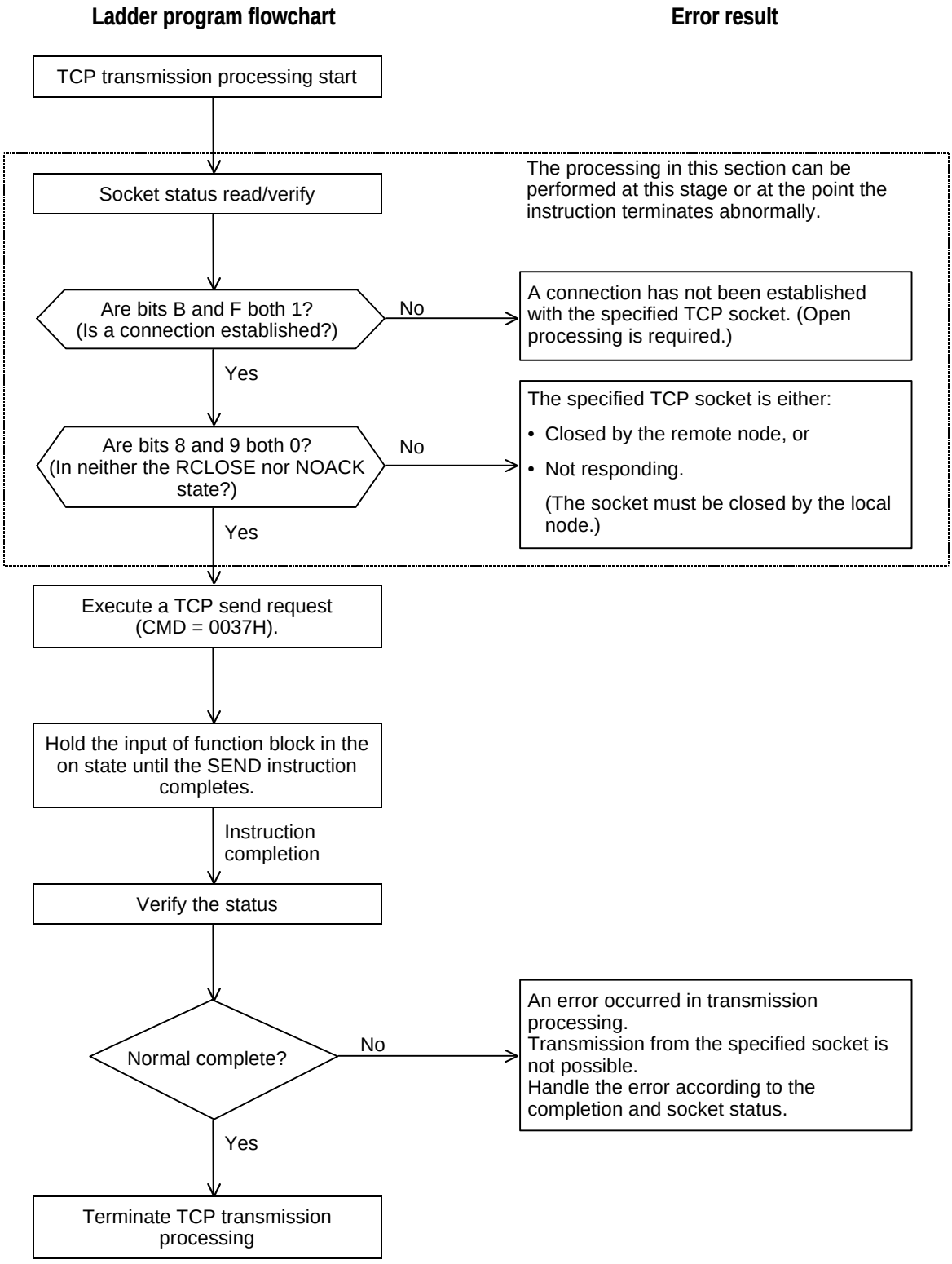
  When constructing a system, take the socket utilization conditions into account when allocating sockets. Since the send/receive processing for each socket requires about 50 ms, applications that issue send or receive requests to a given socket should leave an interval of at least 50 ms times the number of sockets used between each request.

  (Interval between requests to the same socket) ³ (Number of sockets used ´ 50 ms)

  Similarly, the above intervals averaging 50 ms should be left between transmissions from remote nodes to the local node.

  (Interval between remote node transmissions) ³ (Number of remote nodes ´ 50 ms)

e. TCP transmission processing example



7. TCP receive request (using the RECV instruction)

a. Function

If an opened TCP socket receives data, read the received data into registers on the local T3H.

If no data has been received, wait until data arrives (the wait time can be set) and then, after reception, read the received data into the local T3H registers.

Reception data size: 1000 words (fixed)

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0038H	Command number
A+2	SportNO	Socket identifier (1 to 8)
A+3	WordSize	Reception data length: 1000 words
A+4	DRID	Reception data storage register type code
A+5	DregNO	Reception data storage register number
A+6	TimeCNT	Reception wait timeout time

Reception data length: This parameter must be set to 1000 words.

Reception data storage register type code: Type code for the register that holds the received data. (See Figure 5.1)

Reception data storage register number: Starting number of the registers that hold the received data.

Reception wait timeout time: specified in 0.1 second units. (1 to 65535)
If zero is specified, the system is set to an unlimited (infinite) wait state.

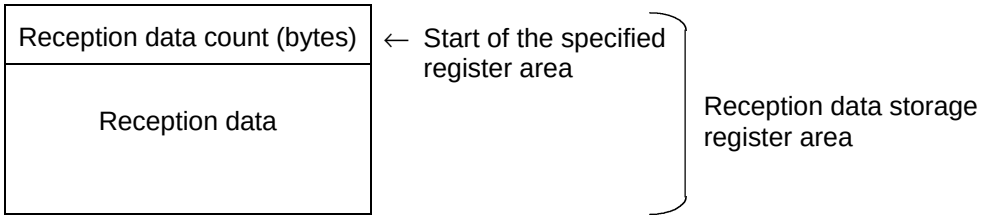
c. Status (See figure 4.4 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					SportNO				TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

SportNO: Socket identifier (1 to 8)
TermSTS: See tables 4.3 and 4.4.
Detail information: See table 4.5.

d. Methods for storing reception data

- Applications must allocate a reception data storage area of 1001 words. The reception data count and the reception data (the data received by the object socket at the point the receive request was issued) will be stored in this area as shown below.



- The T3H checks for register area allocation of the reception data size plus one word and returns an error if the register area does not exist.

  Completion Status: Boundary error (TermSTS = 0AH)

  In this case, data is not transferred to the register area, and the data is discarded. The data is not retained in the EN311 either.

e. Important items

- An error is returned if a receive request is issued for a socket that is not yet opened.

  Completion Status: Transmission error (TermSTS = 0BH)

  Detailed information: Unopened (0081H)

- An error is returned if a value other than 1 to 8 is specified as the socket identifier.

  Completion Status: Transmission error (TermSTS = 0BH)

  Detailed information: Illegal socket identifier (0082H)

- An error will be returned if a value of 0 words or 1001 or more words is specified as the reception data size.

  Completion Status: Transmission word count error (TermSTS = 09H)

- An error will be returned if the reception timeout time is exceeded.

  Completion Status: Transmission error (TermSTS = 0BH)

  Detailed information: Timeout(0020H)

- If a close request from the remote node TCP socket has arrived while a connection is established, and the user program issues a receive request, the EN311 returns the following error. Issuing a receive request in the receive wait state will also result in the following error being returned.

  Completion Status: Transmission error (TermSTS = 0BH)

  Detailed information: Unopened (0081H)

  Verify the socket status (see section 6.3) RCLOSE and CONN bits, and close the socket.

- **The reception data length must be set to 1000 words.**

- **Applications must allocate a reception data storage register area of 1001 words (2002 bytes) for each socket.** If this register area is smaller than 1001 words, the contents of the register area following this area may be destroyed, depending on the transmitted data.

  Supplement:

  Although the limitation listed in the item above applies to the current combination of the T3H and EN311, Toshiba is planning to modify the T3H OS so that the contents of registers are not destroyed in this case.

- Since a TCP receive request merely places the socket in the receive wait state, it cannot detect remote nodes that are not responding. Use one of the following methods to prevent this state.
  - Monitor for a no-response state by sending data periodically over a separate (different) TCP connection.
  - Execute a remote node presence verification request for the remote node periodically. (See section 7.3.)
  - Monitor the interval between data receptions when data is being received periodically.
    (Receive request issued first type: specify a limited timeout limit.)
    (Socket status monitoring type: monitor the interval between points when the received text present bit is set to the on state.)

- One of the following problems may have occurred when there is no response from the remote node:
  - The remote node may have gone down.
  - Power may have been lost.
  - The remote and local nodes may have become disconnected from the network.
- **In the EN311 TCP socket interface, when reception data in the EN311 is read out by a receive request from the T3H, the EN311 sends an ACK (acknowledge response) to the node that sent the data.** Since an ACK will not be sent to the sending node if the received data remains in the EN311 if the T3H does not read out that received data, the sending node will resend the data. If this state continues for a predetermined period, the sending node may will decide that the TCP connection is abnormal and close the connection. To prevent this from occurring, the T3H software should monitor the RCV (receive data present) bit and issue receive requests when necessary.
- With TCP receive requests, the amount of data transferred to the reception data storage register area will differ with both the timing with which the T3H issued the receive request and the timing with which the data arrives at the EN311. To handle single units of transmission data on the receiving side as single units as well, the user software on the receiving side must recognize the end of the transferred data (either by using counts in the transmitted data or by including an end marker in the transmitted data) and iterate receive requests until all the transmitted data has been received.
- User programs must save all incoming data so that the register area used to transfer data to the T3H is not overwritten when using iterated receive requests.
- The EN311 uses a priority ordering in processing sockets 1 through 8. Therefore, systems constructed so that socket 1 is activated frequently may not be able to process socket 8, resulting in the following error response:

  Status: Send completion timeout (TermSTS = 06H)

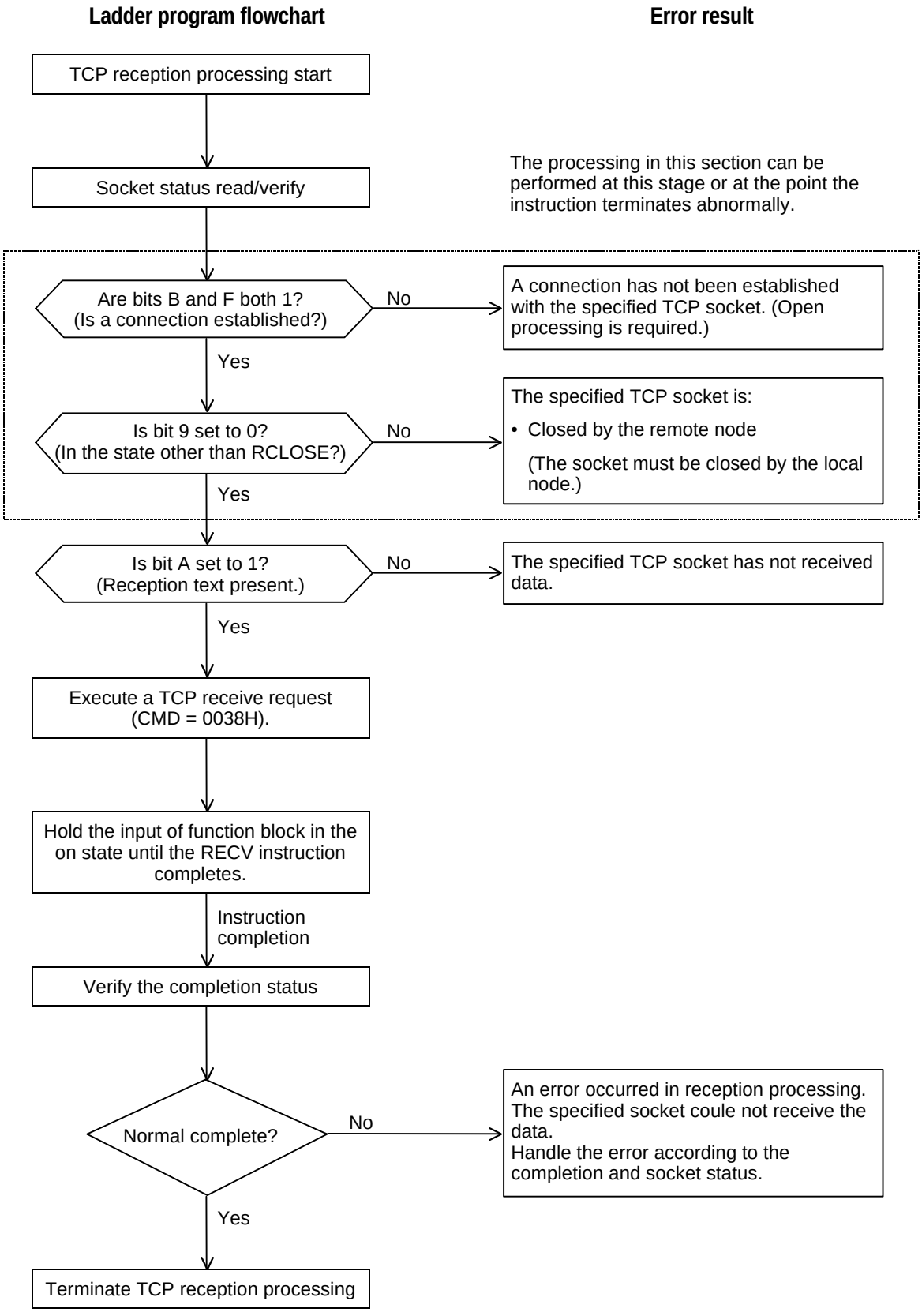
  When constructing a system, take the socket utilization conditions into account when allocating sockets. Since the send/receive processing for each socket requires about 50 ms, applications that issue send or receive requests to a given socket should leave an interval of at least 50 ms times the number of sockets used between each request.

  (Interval between requests to the same socket) ³ (Number of sockets used ´ 50 ms)

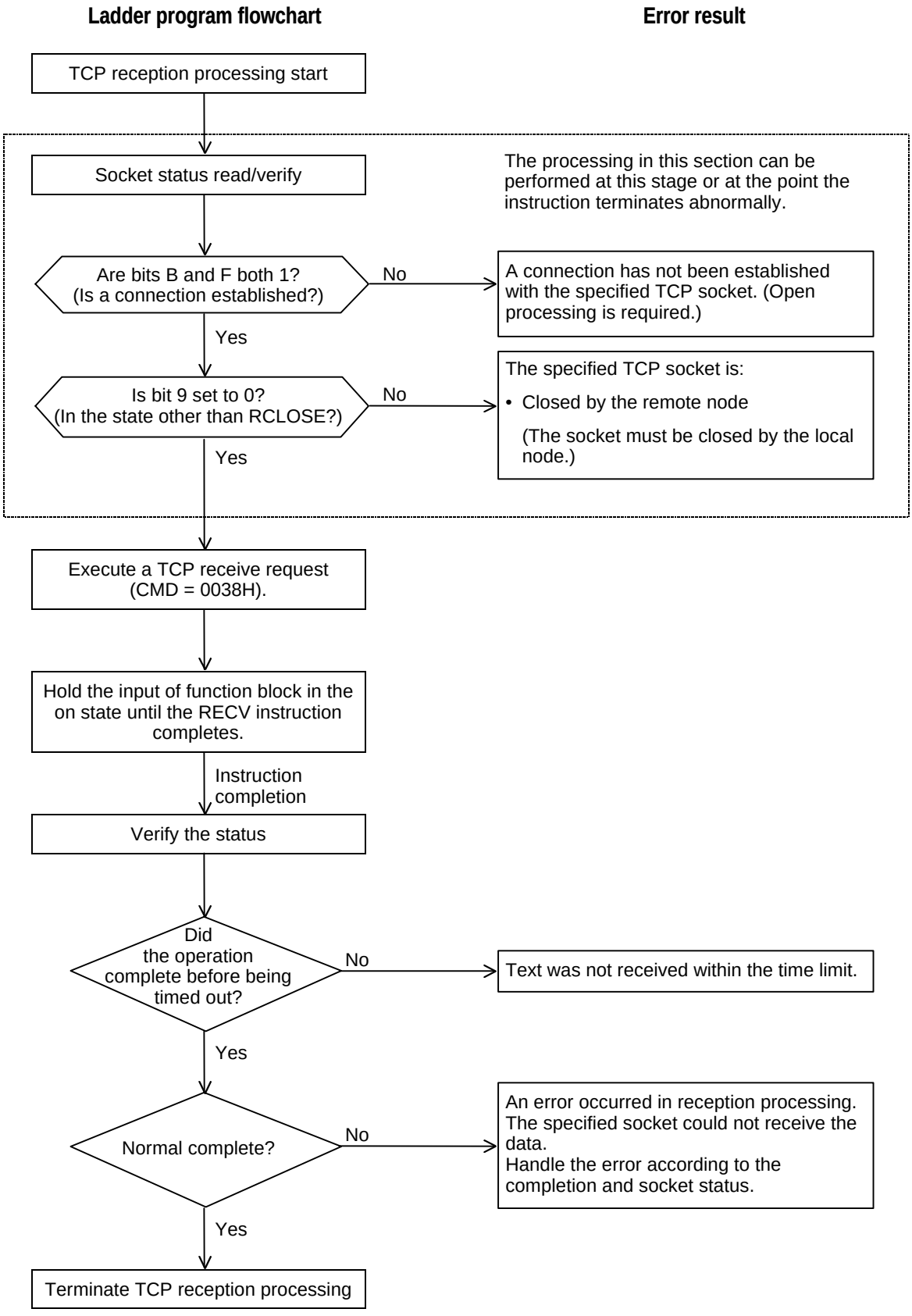
  Similarly, the above intervals averaging 50 ms should be left between transmissions from remote nodes to the local node.

  (Interval between remote node transmissions) ³ (Number of remote nodes ´ 50 ms)

f. TCP reception processing example (Socket status monitoring type)



g. TCP reception processing example (Receive request issued first type)



8. TCP close request (using the SEND instruction)

a. Function

Close the open TCP socket.

Release the (unlimited wait state) receive request and terminate the TCP socket.

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0039H	Command number
A+2	SportNO	Socket identifier (1 to 8)

c. Status (See figure 4.3 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					SportNO				TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

SportNO: Socket identifier (1 to 8)
TermSTS: See tables 4.3 and 4.4.
Detail information: See table 4.5.

d. Important items

- TCP close requests are processed with the highest priority and other executing requests are discarded, even if the object socket is executing a TCP open, send, or receive request. Other requests during the execution of this request will be discarded.
- An error is returned if a close request is issued for a socket that is not yet opened.

  Completion Status: Transmission error (TermSTS = 0BH)

  Detailed information: Unopened (0081H)
- An error is returned if a value other than 1 to 8 is specified as the socket identifier.

  Completion Status: Transmission error (TermSTS = 0BH)

  Detailed information: Illegal socket identifier (0082H)
- **A TCP receive requests will result in an error being returned** if an unlimited wait state TCP open request/receive request is terminated with this request.

  Completion Status: Transmission completion timeout (TermSTS = 06H)

  Supplement:

  The T3H sees its requests (module control and socket interface transmission) to the EN311 as being "transmission" requests. As a result, when a request is forcibly terminated and a response is not received from the EN311, the result is a send request timeout even if the instruction was a RECV instruction.
- If a close request is comes from the remote node TCP socket while a connection is established, the local node must also close the socket. As a technique for checking for the reception of close requests from the remote TCP socket, user programs should monitor the RCLOSE and CONN bits in the socket status. (See section 6.3.)
- If the T3H internal completion wait time limit (15 seconds) is exceeded for this request, the error listed below is returned.

  Completion Status: Send completion timeout (TermSTS = 06H)

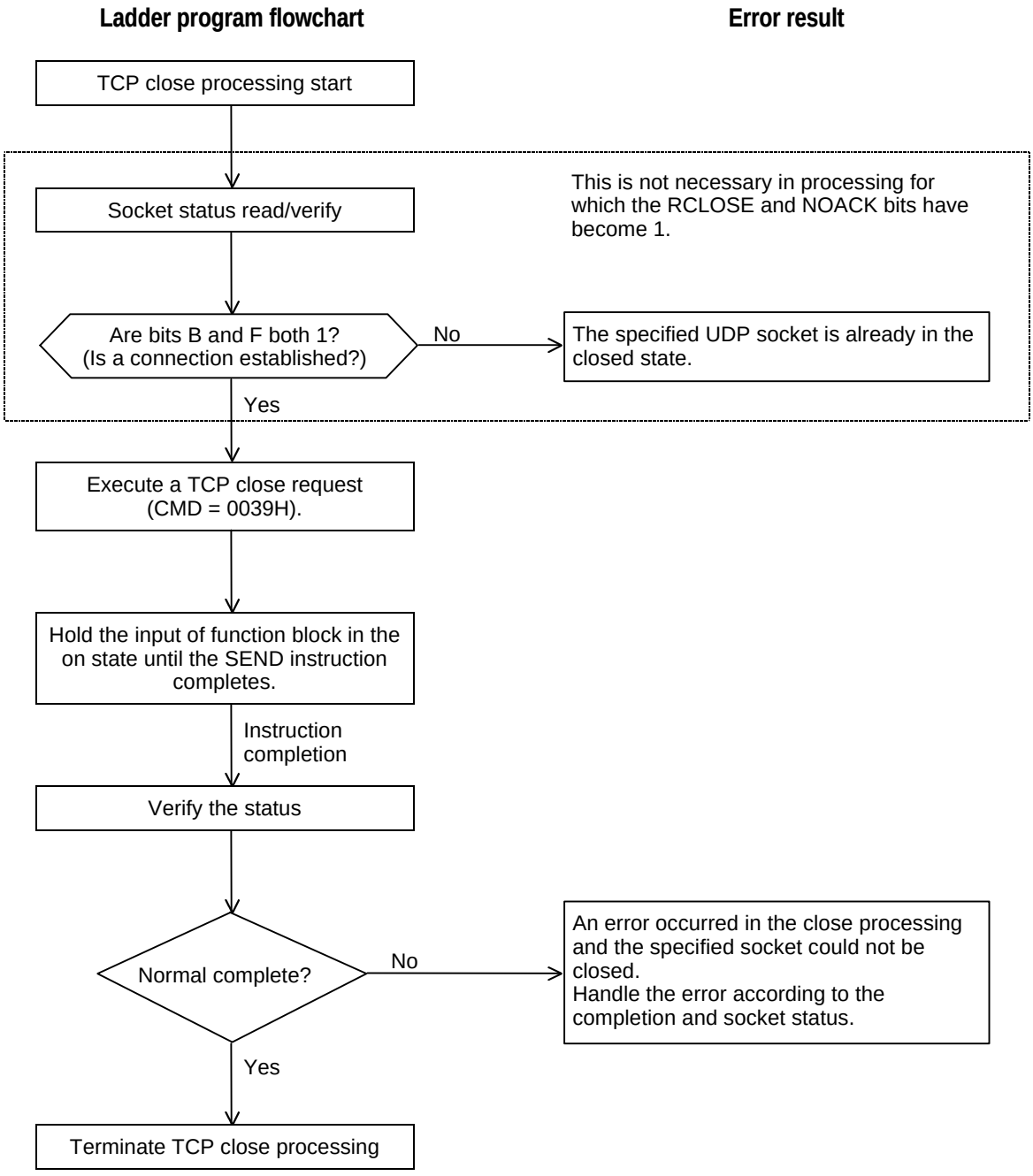
In this case, first verify that the module is not in the down state by checking the station status, and then verify the open/closed state of the socket in the socket status.

- When ending the connection from the EN311, the EN311 which has received the close request of the T3H waits 15 seconds after sending the end request to the remote station waits for the end request (TCP level) of the remote station side. If there is the end request of the remote station side during the wait time, the EN311 performs the own-station close processing and informs the T3H that the processing is completed.
  If the wait time is up, the EN311 performs the own-station close processing and informs the T3H that the processing is completed.
  Therefore, the TCP close request may have to wait for up to 15 seconds.
- When the remote station sends the end request after more than 15 seconds have elapsed since the EN311 sent the end request, the EN311 does not respond. Therefore, on the remote station side, make sure to monitor periodically the end request from the EN311 on the application program.
- When ending the connection from the EN311 side, the following open request can be executed for the target socket at the stage when the close request of the T3H has been completed normally.

Supplement:

Depending on the EWS or the PC, it may not be possible, for a specified period of time, to reopen the TCP socket of the side which has performed the close processing earlier while establishing the connection.

e. TCP close processing example



6.5 Sample Programs

This section presents sample programs using UDP and TCP sockets.

1. UDP sockets

This is a sample program that issues the requests used with UDP sockets. It assumes that the parameter set up and operating mode control requests (run mode/socket interface transmission enable) have already completed.

a. UDP open request

This program issues a UDP open request for socket number 2 on the EN311 channel 1.

This ladder program is executed by turning on the A contact on the R0620.

Transmission parameters

	F 0		Register allocation
A	3100H	Module designation	RW300
A+1	0031H	CMD Number	RW301
A+2	0002H	Socket identifier	RW302
A+3	0FA0H	UDP port number	RW303
		UDP port number = 400	

Completion status

	F 0		Register allocation
B		Completion status	RW430
B+1		Detailed information	RW431

```
 |  /* UDP open request: executed when R0620 is set on.    */
 |                                                                  |
 |R0620                                                             |
1|-| |-+[12544 MOV RW300][00049 MOV RW301]---------------------------|
 |     |       /* Module designation, CMD number setup     */
 |     |                                                            |
 |     +[00002 MOV RW302][04000 MOV RW303]---------------------------|
 |     |       /* Socket identifier, UDP port number setup */
 |     |                                                            |
 |     +[RW300 SEND RW430][RST R0620]---------------------------------|
 |             /* Turn R0620 off after request setup and completion. */
 |                                                                  |
```

b. UDP close request

This program issues a UDP close request for socket number 2 on the EN311 channel 1.

This ladder program is executed by turning on the A contact on the R0623.

Transmission parameters

	F 0		Register allocation
A	3100H	Module designation	RW330
A+1	0034H	CMD Number	RW331
A+2	0002H	Socket identifier	RW332

Completion status

	F 0		Register allocation
B		Completion status	RW436
B+1		Detailed information	RW437

```
 |  /* UDP close request: executed when R0623 is set on. */           |
 |                                                                     |
 |R0623                                                                |
1|-| |-+[12544 MOV RW330][00052 MOV RW331]---------------------------|
 |     |       /* Module designation, CMD number setup   */
 |     |                                                             |
 |     +[00002 MOV RW332]-----------------------------------------|
 |     |       /* Socket identifier setup */
 |     |                                                             |
 |     +[RW330 SEND RW436][RST R0623]---------------------------------|
 |             /* Turn R0623 off after request setup and completion. */
 |                                                                     |
```

c. UDP send request

This program issues a UDP send request for socket number 2 on the EN311 channel 1.

This ladder program is executed by turning on the A contact on the R0622.

Transmission parameters

	F 0		Register allocation
A	3100H	Module designation	RW320
A+1	0032H	CMD number	RW321
A+2	0002H	Socket identifier	RW322
A+3	7185H	} Transmission node IP address	RW323
A+4	1462H		RW324
A+5	0BB8H	Transmission node UDP port number	RW325
A+6	03E8H	Transmission data word count	RW326
A+7	0004H	Transmission data storage register type	RW327
A+8	03E8H	Transmission data storage register number	RW328

Transmission node IP address : 133. 113. 98. 20
↓ ↓ ↓ ↓
85H. 71H. 62H. 14H

Transmission node UDP port number : 3000
Transmission data word count : 1000
Transmission data storage : D1000 ~

Completion status

	F 0		Register allocation
B		Completion status	RW434
B+1		Detail information	RW435

```
 |  /* UDP send request: executed when R0622 is set on. */            |
 |                                                                    |
 |R0622                                                               |
1|-| |-+[12544 MOV RW320][00050 MOV RW321]--------------------------|
 |     |      /* Module designation, CMD number setup  */
 |     |                                                            |
 |     +[00002 MOV RW322]-------------------------------------------|
 |     |      /* Socket identifier setup */
 |     |                                                            |
 |     +[0341995909 DMOV RW324•RW323][03000 MOV RW325]---------------|
 |     |      /* Remote node IP address, port number setup */
 |     |                                                            |
 |     +[01000 MOV RW326]-------------------------------------------|
 |     |      /* Transmission data word count setup    */
 |     |                                                            |
 |     +[00004 MOV RW327][01000 MOV RW328]--------------------------|
 |     |      /* Transmission data storage register type, storage register
 |         number setup */
 |     |                                                            |
 |     +[RW320 SEND RW434][RST R0622]-------------------------------|
 |             /* Turn R0622 off after request setup and completion. */
```


Parameter : 341995909 : 14627185H

↓

85H. 71H. 62H. 14H

d. UDP receive request

This program issues a UDP send request for socket number 2 on the EN311 channel 1.

This ladder program is executed by turning on the A contact on the R0621.

Transmission parameters

	F 0		Register allocation
A	3100H	Module designation	RW310
A+1	0033H	CMD number	RW311
A+2	0002H	Socket identifier	RW312
A+3	7185H	} Transmission source IP address	RW313
A+4	1462H		RW314
A+5	0BB8H	Transmission source UDP port number	RW315
A+6	03E8H	Reception data word count	RW316
A+7	0004H	Reception data storage register type	RW317
A+8	09C4H	Reception data storage register number	RW318
A+9	4650H	Reception timeout time	RW319

Transmission source IP address : 133. 113. 98. 20
↓ ↓ ↓ ↓
85H. 71H. 62H. 14H

Transmission source UDP port number : 3000
Reception data word count : 1000
Reception data storage : D2500 ~
Reception timeout time : 1800 second

Completion status

	F 0		Register allocation
B		Completion status	RW432
B+1		Detail information	RW433

```
 |  /* UDP receive request: executed when R0621 is set on.  */         |
 |                                                                      |
 |R0621                                                                 |
1|-| |-+[12544 MOV RW310][00051 MOV RW311]----------------------------|
 |     |      /* Module designation, CMD number setup     */
 |     |                                                               |
 |     +[00002 MOV RW312]-----------------------------------------------|
 |     |      /* Socket identifier setup */
 |     |                                                               |
 |     +[0341995909 DMOV RW314•RW313][03000 MOV RW315]-----------------|
 |     |      /* Remote node IP address, port number setup */
 |     |                                                               |
 |     +[01000 MOV RW316]-----------------------------------------------|
 |     |      /* Reception data word count setup */
 |     |                                                               |
 |     +[00004 MOV RW317][02500 MOV RW318][18000 MOV RW319]-----------|
 |     |       /* Reception data storage register type, storage register
 |number, timeout time setup */
 |     |                                                               |
 |     +[RW310 RECV RW432][RST R0621]---------------------------------|
```

```
|           /* Turn R0621 off after request setup and completion. */
|                                                                    |
```

Parameter : 341995909 : 14627185H

↓

85H. 71H. 62H. 14H

2. TCP sockets

This is a sample program that issues the requests used with TCP sockets. It assumes that the parameter set up and operating mode control requests (run mode/socket interface transmission enable) have already completed.

a. TCP open request (passive)

This program issues a TCP open request (passive) for socket number 8 on the EN311 channel 1.

This ladder program is executed by turning on the A contact on the R0630.

Transmission parameters

	F 0		Register allocation
A	3100H	Module designation	RW350
A+1	0035H	CMD number	RW351
A+2	0008H	Socket identifier	RW352
A+3	0002H	Open type	RW353
A+4	7185H	Remote node IP address	RW354
A+5	1462H		RW355
A+6	0FA0H	Remote node TCP port number	RW356
A+7	0FA0H	Local station TCP port number	RW357
A+8	4650H	Open request timeout time	RW358

Open type : Passive
Remote node IP address : 133. 113. 98. 20
↓ ↓ ↓ ↓
85H. 71H. 62H. 14H
Transmission source UDP port number : 3000
Remote node TCP port number : 4000
Local station TCP port number : 4000
Reception timeout time : 1800 second

Completion status

	F 0		Register allocation
B		Completion status	RW450
B+1		Detail information	RW451

```
 |  /* TCP passive open request: executed when R0630 is set on. */    |
 |                                                                     |
 |R0630                                                                |
1|-| |-+[12544 MOV RW350][00053 MOV RW351]---------------------------|
 |     |      /* Module designation, CMD number setup */
 |     |                                                               |
 |     +[00008 MOV RW352][00002 MOV RW353]---------------------------|
 |     |      /* Socket identifier, open type setup   */
 |     |                                                               |
 |     +[0341995909 DMOV RW355•RW354][04000 MOV RW356]----------------|
 |     |      /* Remote node IP address and port number setup  */
 |     |                                                               |
 |     +[04000 MOV RW357][18000 MOV RW358]---------------------------|
```

```
|     |       /* Local node port number, timeout time setup    */
|     |                                                                |
|     +[RW350 SEND RW450][RST R0630]---------------------------------|
|            /* Turn R0630 off after request setup and completion. */
|                                                                      |
```

Parameter : 341995909 : 14627185H

↓

85H. 71H. 62H. 14H

b. TCP open request (active)

This program issues a TCP open request (active) for socket number 8 on the EN311 channel 1.

This ladder program is executed by turning on the A contact on the R0640.

Transmission parameters

	F 0		Register allocation
A	3100H	Module designation	RW360
A+1	0035H	CMD number	RW361
A+2	0008H	Socket identifier	RW362
A+3	0001H	Open type	RW363
A+4	7185H	Remote node IP address	RW364
A+5	1462H		RW365
A+6	0FA0H	Remote node TCP port number	RW366
A+7	0FA0H	Local station TCP port number	RW367
A+8	4650H	Open request timeout time	RW368

Open type : Active
Remote node IP address : 133. 113. 98. 20
↓ ↓ ↓ ↓
85H. 71H. 62H. 14H
Transmission source UDP port number : 3000
Remote node TCP port number : 4000
Local station TCP port number : 4000
Reception timeout time : 1800 second

Completion status

	F 0		Register allocation
B		Completion status	RW452
B+1		Detail information	RW453

```
 |  /* TCP active open request: executed when R0640 is set on. */      |
 |                                                                      |
 |R0640                                                                 |
1|-| |-+[12544 MOV RW360][00053 MOV RW361]---------------------------|
 |     |      /* Module designation, CMD number setup */
 |     |                                                               |
 |     +[00008 MOV RW362][00001 MOV RW363]---------------------------|
 |     |      /* Socket identifier, open type setup   */
 |     |                                                               |
 |     +[0341995909 DMOV RW365•RW364][04000 MOV RW366]----------------|
 |     |      /* Remote node IP address and port number setup */
 |     |                                                               |
 |     +[04000  MOV RW367][18000 MOV RW368]---------------------------|
 |     |      /* Local node port number, timeout time setup   */
 |     |                                                               |
 |     +[RW360 SEND RW452][RST R0640]---------------------------------|
 |            /* Turn R0640 off after request setup and completion. */
 |                                                                      |
```

Parameter : 341995909 : 14627185H

↓

85H. 71H. 62H. 14H

c. TCP close request

This program issues a TCP close request for socket number 8 on the EN311 channel 1.

This ladder program is executed by turning on the A contact on the R0633.

Transmission parameters

	F 0		Register allocation
A	3100H	Module designation	RW390
A+1	0039H	CMD number	RW391
A+2	0008H	Socket identifier	RW392

Completion status

	F 0		Register allocation
B		Completion status	RW458
B+1		Detail information	RW459

```
 |  /* TCP close request: executed when R0633 is set on. */           |
 |                                                                     |
 |R0633                                                                |
1|-| |-+[12544 MOV RW390][00057 MOV RW391]---------------------------|
 |     |      /* Module designation, CMD number setup   */
 |     |                                                               |
 |     +[00008 MOV RW392]-----------------------------------------------|
 |     |      /* Socket identifier setup */
 |     |                                                               |
 |     +[RW390 SEND RW458][RST R0633]-----------------------------------|
 |            /* Turn R0633 off after request setup and completion. */
 |                                                                     |
```

d. TCP send request

This program issues a TCP send request for socket number 8 on the EN311 channel 1.

This ladder program is executed by turning on the A contact on the R0632.

Transmission parameters

	F 0		Register allocation
A	3100H	Module designation	RW380
A+1	0037H	CMD number	RW381
A+2	0008H	Socket identifier	RW382
A+3	03E8H	Transmission data word count	RW383
A+4	0004H	Transmission data storage register type	RW384
A+5	0000H	Transmission data storage register number	RW385

Transmission data word count : 1000
Transmission data storage register number : D1000~

Completion status

	F 0		Register allocation
B		Completion status	RW456
B+1		Detail information	RW457

```
 |  /* TCP send request: executed when R0632 is set on. */             |
 |                                                                      |
 |R0632                                                                 |
1|-| |-+[12544 MOV RW380][00055 MOV RW381]---------------------------|
 |     |      /* Module designation, CMD number setup  */
 |     |                                                               |
 |     +[00008 MOV RW382]-----------------------------------------------|
 |     |      /* Socket identifier setup */
 |     |                                                               |
 |     +[01000 MOV RW383]-----------------------------------------------|
 |     |      /* Transmission data word count setup    */
 |     |                                                               |
 |     +[00004 MOV RW384][00000 MOV RW385]---------------------------|
 |     |      /* Transmission data storage register type, storage register
 |        number setup */
 |     |                                                               |
 |     +[RW380 SEND RW465][RST R0632]---------------------------------|
 |            /* Turn R0632 off after request setup and completion. */
 |                                                                      |
```

e. TCP receive request

This program issues a TCP receive request for socket number 8 on the EN311 channel 1.

This ladder program is executed by turning on the A contact on the R0631.

Transmission parameters

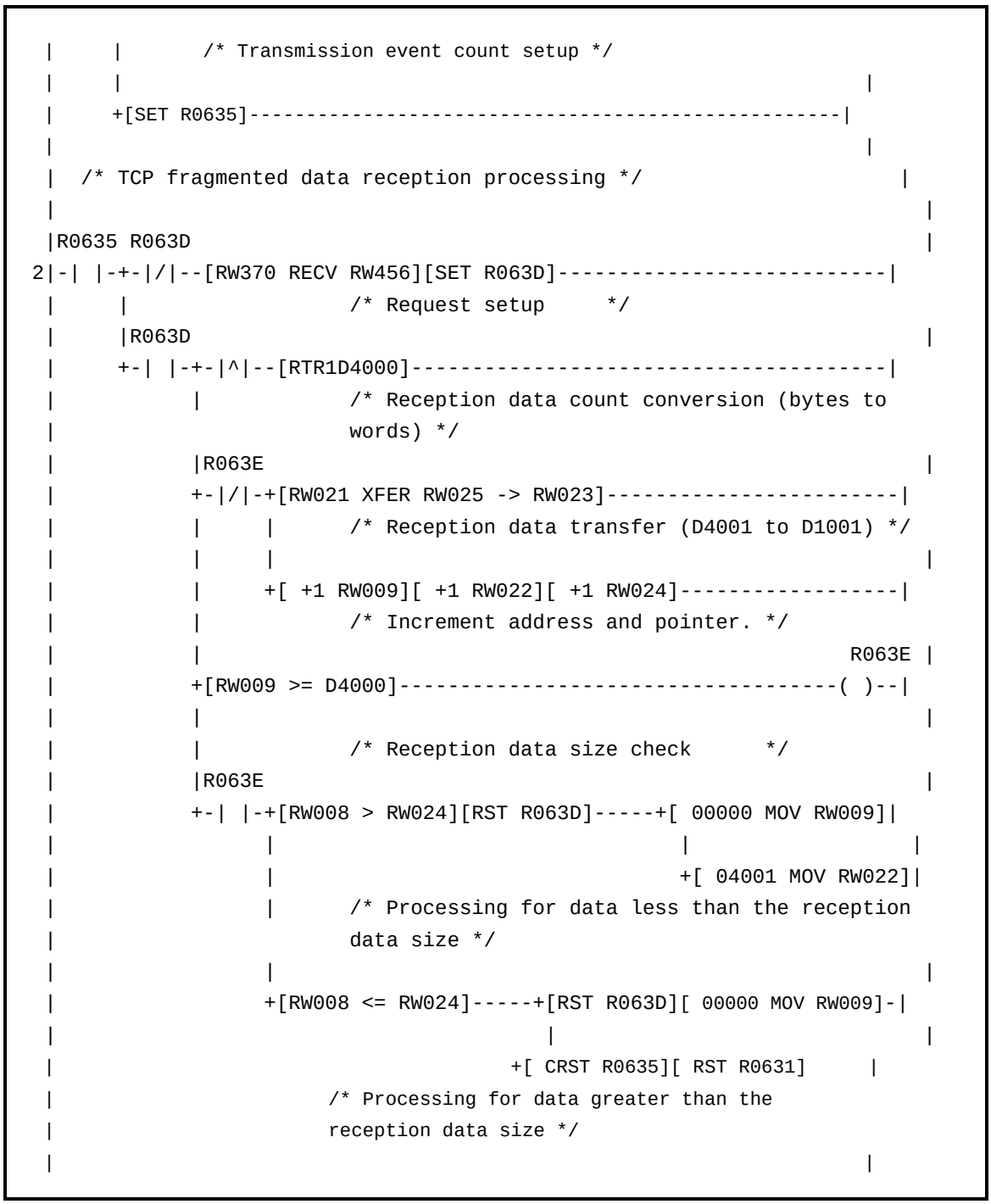
	F 0		Register allocation
A	3100H	Module designation	RW370
A+1	0033H	CMD number	RW371
A+2	0002H	Socket identifier	RW372
A+3	RW103	Reception data word count	RW373
A+4	0004H	Reception data storage register type	RW374
A+5	0FA0H	Reception data storage register number	RW375
A+6	4650H	Reception timeout time	RW376

Reception data word count : RW103
Reception data storage register : D4000~
Reception data transfer destination register : D1001~
Reception timeout time : 1800 second

Completion status

	F 0		Register allocation
B		Completion status	RW454
B+1		Detail information	RW455

```
 |  /* TCP receive request: executed when R0631 is set on. */          |
 |                                                                      |
 |R0631                                                                 |
1|-| |-+[12544 MOV RW370][00056 MOV RW371]----------------------------|
 |     |       /* Module designation, CMD number setup    */
 |     |                                                               |
 |     +[00008 MOV RW372][RW103 MOV RW373]----------------------------|
 |     |       /* Socket identifier, reception data word count setup */
 |     |                                                               |
 |     +[00004 MOV RW374][04000 MOV RW375][18000 MOV RW376]-----------|
 |     |       /* Reception data storage register type, register number,
 |        timeout time setup */
 |     |                                                               |
 |     +-|^|-+[00004 MOV RW021][04001 MOV RW022]----------------------|
 |     |     | /* Data transfer source register type, number setup   */
 |     |     |                                                         |
 |     |     +[00001 MOV RW025]-----------------------------------------|
 |     |     | /* Data transfer count setup      */
 |     |     |                                                         |
 |     |     +[00004 MOV RW023][01001 MOV RW024]----------------------|
 |     |     | /* Data transfer destination register type, number setup */
 |     |     |                                                        |
 |     |     +[RW103 +  01000 ->  RW008]----------------------------|
```


/* Transmission event count setup */
+[SET R0635]
/* TCP fragmented data reception processing */
R0635 R063D
2 +-+-/-[RW370 RECV RW456][SET R063D]
/* Request setup */
R063D
+-+-^-[RTR1D4000]
/* Reception data count conversion (bytes to words) */
R063E
+-/-+[RW021 XFER RW025 -> RW023]
/* Reception data transfer (D4001 to D1001) */
+[+1 RW009][+1 RW022][+1 RW024]
/* Increment address and pointer. */
R063E
+[RW009 >= D4000]
/* Reception data size check */
R063E
+-+-+[RW008 > RW024][RST R063D]-----+[00000 MOV RW009]
+[04001 MOV RW022]
/* Processing for data less than the reception data size */
+[RW008 <= RW024]-----+[RST R063D][00000 MOV RW009]-
+[CRST R0635][RST R0631]
/* Processing for data greater than the reception data size */

7. RAS Information

This chapter describes the following RAS functions provided by the EN311.

⚠ CAUTION
1. Chapter 7 presents information related to using the functions provided by the EN311 from a T3H, including the instruction (request) format, important items that require attention, and sample programs. That chapter also presents items considered necessary when using the EN311. Make a point of understanding the content of chapter 4 thoroughly before writing programs that use the EN311. The sample programs present basic examples of EN311 usage, and should be reviewed carefully before use in an actual system.

1. EN311 status information
   - Station status (T3H special registers)
   - Down information (T3H interface buffer)
2. Test functions from user programs
   - Remote station verification request (corresponds to the UNIX ping command)
   - Inter-node loopback test (only between T3H units)
3. Time setting function
4. Information provided by RAS information readout
   - LAN controller (network circuit) information
   - Protocol state
   - State of the T3H/EN311 interface
   - Event trace

7.1 T3H Special Relays and Registers

The EN311 status information is reflected in the T3H special relays and special registers.

a. Special relays

Special relay	Name	Function
S000B	EN311 error (warning)	1: One of the installed EN311 units is down. (The T3H continues to operate.) 0: Reset the system from a user program after resolving the error in the down EN311.

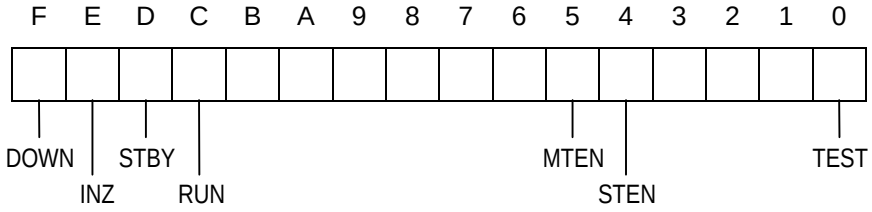
b. Special registers : Refers to the station status in the EN311, which has been read and copied by the T3H onto the SW register.

Special registers	Name
SW063	CH1 station status
SW064	CH2 station status
SW065	CH3 station status
SW066	CH4 station status

Supplement:

If the OS version of the T3H (can be checked with T-PDS) is 1.1□, SW064 to 067 are cleared to 0 with the first scan of HALT→RUN of the T3H. If the OS version of the T3H is 1.2 or up, none are cleared to "0".

c. Station status format



- Bit F: DOWN (down).....1: Down mode, 0: Other than down mode
- Bit E: INZ (initialization).....1: Initialization in progress
  0: Initialization completed
- Bit D: STBY (standby).....1: Standby mode
  0: Other than standby mode
- Bit C: RUN (run).....1: Run mode, 0: Other than run mode
- Bit 5: MTEN (Message transmission).....1: Enabled, 0: Prohibited
- Bit 4: STEN (socket interface transmission).....1: Enabled, 0: Prohibited
- Bit 0: TEST (test).....1: Test function execution in progress

d. EN311 operation modes and station statuses

Bits of the station status are following means. A register value is used for judgement on the Initialization mode, Run mode or Standby mode.

EN311 Mode	Station Status
Initialization being processed (Power-ON, Reset request, Reset SW)	4000H
Standby mode (Initialization processing completed normally)	2000H
Run mode: Message transmission permit	1020H
Run mode: Socket I/F transmission permit	1010H
Run mode: Message transmission; socket I/F transmission permit	1030H

7.2 Down Information

When an EN311 goes to down mode, the factor that caused that transition is stored in the T3H interface buffer as one word of data. This data can be read by the T3H with the READ instruction.

Table 7.1 lists the down information error codes and the factors that caused the transition to down mode.

Table 7.1 Down Information

Error code (H)	Interpretation
0010	Watchdog timeout
0020	Memory bus stall
0030	A TRAP occurred
0040	Jabbering timeout
0050	LAN controller check error
0160	ROM BCC check data match error
0260	System RAM area check error
0360	T3H interface buffer check error
0500, 0501	Semaphore acquisition error
0502, 0503	Semaphore acquisition error
0504	MBX receive error
0505	MBX send error
0506	TCP resend queue full
0507	Acquired buffer in use
0508	Error in acquiring initial buffer

Important items

This is a read-only area. Do not write to this area with the WRITE instruction. Subsequent reads will not return correct down information.

Sample: Down information readout

```
 |R0000                                                                    |
1|-| |--[ 32510 MOV RW010][ 00001 MOV RW011][ H0001 READ RW010 -> D1000]--|
 |                                                                         |
```

READ instruction description

H0001: Module specification ... Upper 2 digits: unit specification, lower 2 digits: slot specification

H 0 0 0 1 specifies slot 1 in the main base unit.

Main base unit Slot 1

RW010: Specifies the 32510 (7EFEH) down information area.
7EFEH is the down information area for the EN311.

RW011: Specifies the number of words (00001) to be read out.

D1000: Specifies the register in which to store the read out down information.
In this case, the down information that is read out is stored in D1000.

The down information is stored in D1000 by turning R0000 on.

7.3 Remote Station Verification Request

This request verifies the existence of the specified remote station, and corresponds to the UNIX ping command. This request can be issued when the EN311 operating mode is either run or standby mode. The EN311 will respond to this request if its operating mode is either run or standby mode.

Remote station verification request (using the SEND instruction)

a. Function

This is a request that verifies the existence of the specified remote station.

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0014H	CMD number
A+2 A+3	D- IP address	IP address of the remote station whose existence is to be verified. (The input format is the same as that for the parameter setup request.)

c. Status (See figure 4.3 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					0	0	0	0	TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

d. Important items

- This request is possible in run and standby modes. (The IP address of the local station must be set up.)
- The EN311 returns a response to this request in run and standby modes. (The IP address of the local station must be set up.)
- If the remote station exists: Normal return
- If the remote station does not exist (within 4 seconds):

  Status: Transmission error (TermSTS = 0BH)

  Detailed information: Timeout occurred (0020H)
- When another station check request is issued to multiple remote stations, a "release shortage error" occurs in the PC link transmission and the UDP socket transmission due to EN311's internal processing relations. If the request is issued to a single remote station, the "release shortage error" does not occur.
  As a restoring method when in this state, place the EN311 in the standby status.

Note:

The current EN311 is restricted by the above. However, we are planning to support other station status check requests to multiple remote stations by changing the software in the EN311.

e. Sample program

This sample ladder program issues a remote station verification request to the channel 1 EN311.

This program is executed by turning on the R0504 A point.

Parameters: 12544:3100H, 00020:0014H, 341995909;14627185H

Transfer Parameters

	F 0		Register allocation
A	3100H	Module designation	RW130
A+1	0014H	CMD number.	RW131
A+2	7185H	Remote station IP address	RW132
A+3	1462H		RW133

Remote station IP address : 133. → 85H. 113. → 71H. 98. → 62H. 10 → 14H

Completion status

	F 0		Register allocation
B		Completion status	RW406
B+1		Detail information	RW407

```
 |R0504                                                          R0604 |
1|-| |-------------------------------------------------------------( )--|
 |             /* Remote station verification request */
 |R0604                                                               |
2|-| |-+[ 12544 MOV RW130][ 00020 MOV RW131]-----------------------------|
 |     |       /* Designates the module and sets the CMD number. */
 |     |                                                              |
 |     +[ 341995909 DMOV RW133•RW132]-----------------------------------|
 |     |       /* Sets remote station IP address */
 |     |                                                              |
 |     +[RW130 SEND RW406][ RST R0504]----------------------------------|
 |             /* Sets the request. */
 |                                                                    |
```

Parameter : 341995909 : 14627185H

↓

85H.71H.62H.14H

7.4 Remote Station Loopback (for an EN311)

This request sends test data to the specified remote EN311 (T3H) and verifies that transmission is being performed correctly by receiving that data looped back from the remote station. A user program must compare the transmitted and received data for equivalence.

Remote station loopback request (using the SEND instruction)

a. Function

This request sends test data to the specified remote EN311 (T3H) and verifies that transmission is being performed correctly by receiving that data looped back from the remote station. The T3H OS creates the test data.

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 000FH	CMD number
A+2	WordSize	Loopback data length: 1 to 485 words
A+3	SRID	Send data storage register type code
A+4	SRegNO	Send data storage register number
A+5	DRID	Loopback data storage register type code
A+6	DRegNO	Loopback data storage register number
A+7	Timecnt	Timer count
A+8 A+9	D-IPAddress	Loopback destination IP address (The input procedure is the same as that for the parameter setup request.)
A+10	D-UDP PortNO	Loopback destination message transmission UDP port number

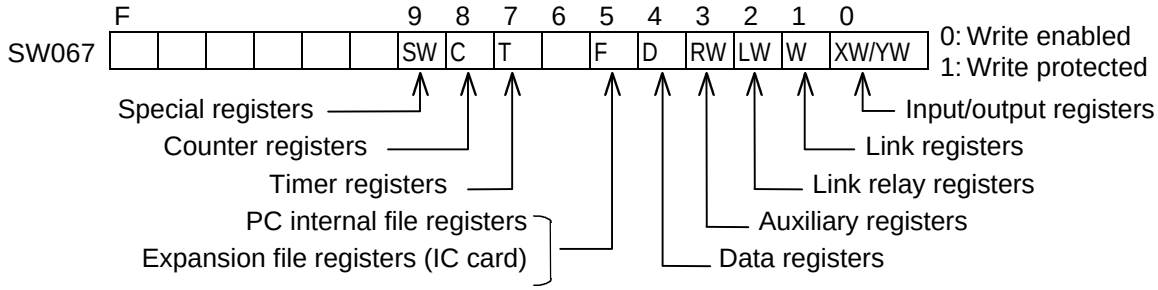
c. Status (See figure 4.3 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					0	0	0	0	TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

d. Important items

- This request cannot be executed unless message transmission is enabled with an operating mode control request.
- In response to a request from a user program, the T3H OS performs the processing using the EN311 PC link protocol.
- User programs on the loopback destination do not take part in this operation.
- A user program must compare the transmitted and loopback data for equivalence.
- A transfer word count error (TermSTS = 09H) occurs if the loopback data length exceeds the range 1 to 485 words (or 1 to 323 words for the T and C registers).
- A register specification error (TermSTS = 01H) occurs if a value other than a stipulated value is specified for the register type codes (SRID/DRID).
- A register specification error (TermSTS = 01H) occurs if 0007H (the T register) is specified for the send data storage register type code and a register other than the T register is specified for the loopback data storage register type code. This also holds for the C register.

- A boundary error (TermSTS = 0AH) occurs if a range spanning both the base T registers (0 to 511) and the expansion T registers (512 to 1023) is specified for the T register.
- For data storage registers, a boundary error (TermSTS = 0AH) occurs if the specified area (start register + register range) does not exist in the local station.
- A response timeout error (TermSTS = 02H) occurs if the loopback response time exceeds the time specified by the timer counter value.
- If the local station registers are write protected by setting the special coil, the memory write protected status (TermSTS = 04H) is returned.



e. Sample program

This sample ladder program issues a remote station loopback request to the channel 1 EN311.

This program is executed by turning on the R0092 A point.

A user program must compare the transmitted and loopback data for equivalence.

Transfer Parameters

	F 0		Register allocation
A	3100H	Module designation	RW240
A+1	000FH	CMD number	RW241
A+2	01E5H	Loop-back data size	RW242
A+3	0004H	Transmission data storage register type register type	RW243
A+4	0000H	Transmission data storage register number	RW244
A+5	0004H	Loop-back data storage register type	RW245
A+6	01F4H	Loop-back data storage register number	RW246
A+7	0064H	timer count	RW247
A+8	1462H	} Loop-back destination IP address	RW248
A+9	7185H		RW249
A+10	0401H	Loop-back destination message transmission UDP port number	RW250

Loop-back data size : 485 words
Transmission data storage register : D0000~
Loop-back data storage register : D0500~
timeout time : 10 seconds
Remote station IP address : 133. 113. 98. 20
↓ ↓ ↓ ↓
85H. 71H. 62H. 14H
Loop-back destination message transmission UDP port number : 1025

Completion status

	F 0		Register allocation
B		Completion status	RW424
B+1		Detail information	RW425

```
 |R0095                                                              |
1|-| |-+[12544 MOV RW240][00015 MOV RW241]--------------------------|
 |     |      /* Designates the module and sets the CMD number. */
 |     |                                                            |
 |     +[00485 MOV RW242]-----------------------------------------|
 |     |      /* Sets the loopback data length. */
 |     |                                                            |
 |     +[00004 MOV RW243][00000 MOV RW244]--------------------------|
 |     |      /* Sets the send source register type and starting register
 |            number. */
 |     |                                                            |
 |     +[00004 MOV RW245][00500 MOV RW246]--------------------------|
 |     |      /* Sets the loopback destination register type and starting
 |            register number. */
 |     |                                                            |
 |     +[00100 MOV RW247]-----------------------------------------|
 |     |      /* Sets the response time limit. (10 seconds) */
 |     |                                                            |
 |     +[341995909 DMOV RW249•RW248][01025 MOV RW250]----------------|
 |     |      /* Loopback destination IP address, message transmission UDP
 |            port number */
 |     |                                                            |
 |     +[RW240 SEND RW424][RST R0095]-------------------------------|
 |            /* Sets the request. */
 |                                                                  |
```

Parameter : 341995909 : 14627185H

↓

85H.71H.62H.14H

7.5 Time Setting

The EN311 internal time is set from the T3H. This information is used as the time information in the EN311 event trace.

Time set request (using the SEND instruction)

a. Function

This request sets the EN311 internal time from a user program.

b. Transfer parameters

A	3□00H		Module designation, □: channel number
A+1	CMD = 0018H		CMD number
A+2	Month	Year	
A+3	Hour	Day	
A+4	Seconds	Minute	

- **Enter the year, month, day, hour, minute, and seconds as BCD codes.**

  The date July 20, 1996 14:30:00 would be entered as:

A	3100H	12544
A+1	0018H	00024
A+2	0796H	01942
A+3	1404H	05124
A+4	0030H	00048

c. Status (See figure 4.3 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					0	0	0	0	TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

d. Important items

- This request can be executed in run or standby mode.
- The time set here is updated by the EN311 internal timer, and thus may get out of synchronization with the T3H time.

  We recommend setting the EN311 time once a day.

e. Sample program

This sample ladder program issues a time set request to the channel 1 EN311.

This program is executed by turning on the R0508 A point.

Transfer Parameters

	F 0		Register allocation
A	3100H	Module designation	RW150
A+1	0018H	CMD number.	RW151
A+2	0796H	Month / Year	RW152
A+3	1404H	Hour / Day	RW153
A+4	0030H	Second / Minute	RW154

Designate time : 1996.7.4. 14:30:00

Completion status

	F 0		Register allocation
B		Completion status	RW406
B+1		Detail information	RW407

```
 |R0508                                                          R0608 |
1|-| |-----------------------------------------------------------( )--|
 |            /* Time set request */
 |R0608                                                               |
2|-| |-+[12544 MOV RW150][00024 MOV RW151]---------------------------|
 |     |      /* Designates the module and sets the CMD number.         */
 |     |                                                              |
 |     +[01942 MOV RW152][05124 MOV RW153][00048 MOV RW154]-----------|
 |     |      /* Sets the year, month, day, hour, minute, and seconds. */
 |     |                                                              |
 |     +[RW150 SEND RW410][RST R0508]--------------------------------|
 |            /* Sets the request. */
 |                                                                    |
```

7.6 RAS Information Readout

This request reads out the EN311 RAS information (internal error information and phenomenon history) from a user program.

RAS information readout request (using the RECV instruction)

a. Function

This request reads out the EN311 RAS information from a user program.

b. Transfer parameters

A	3□00H	Module designation, □: channel number
A+1	CMD = 0015H	CMD number
A+2	DRID	RAS information storage register type
A+3	DRegNO	RAS information storage register start address
A+4	Kind	RAS request type
A+5	Start	Start position: Valid when Kind is 2 or 4.
A+6	ReadCnt	Number of items read out: Valid when Kind is 4.

(1) RAS information storage register type code

This code specifies the type of the register used to store the read out RAS information.

See figure 5.1 for the type codes that can be specified here.

(2) RAS information storage register start address

Specifies the start address for the registers specified by the local station register type code.

(3) RAS request type: specifies the type of RAS information read out

1: RAS counter .....LAN controller (line) information (See table 7.2.)

2: MIB information .....LAN controller interface, IP, TCP, and UDP information (See tables 7.3 to 7.6.)

3: Maintenance data (Cannot be used.)

4: Event trace information (See table 7.7.)

5: RAS information clear

(4) Start position: Only valid when the readout request type is 2 (MIB information) or 4 (trace information).

MIB information (2) .....0 = MIB_IF
1 = MIB_IP
2 = MIB_TCP
3 = MIB_UDP

Trace information (4).....0 to 160; 0 corresponds to the most recent information.

(5) Number of items read out: Only valid when the readout request type is 4 (trace information).

1 to 30 items.

c. Status (See figure 4.4 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
B					0	0	0	0	TermSTS							
B+1	Detailed information (Only valid when TermSTS = 0BH.)															

d. Important items

- This request can be used in run and standby modes.
- The read out RAS information is stored in the specified register area as shown below.

RAS information word count	←	Specified register start address
RAS information	←	A register area whose size is the size of the read out RAS information plus one word must be allocated.

- A boundary error (TermSTS = 0AH) occurs if it is not possible to allocate an area that is the size of the read out RAS information plus one word for the RAS information storage area.
- A parameter error (TermSTS = 03H) occurs on any of the following transfer parameter settings.
  - If the RAS request type (Kind) is out of range (a value other than 1 to 5).
  - If the start position (Start) is out of range (a value of 4 or larger) for MIB information.
  - If the start position (Start) is out of range (a value of 161 or larger) for event trace information.
  - If the read count (ReadCnt) is out of range (a value of 31 or larger) for event trace information.

e. Sample program

This sample ladder program issues a RAS information readout to the channel 1 EN311.

RAS storage registers : Starting at D0000.

RAS information type : Event trace information, reads out 30 items starting with the most recent data.

This program is executed by turning on the R0505 A point.

Transfer Parameters

	F 0		Register allocation
A	3100H	Module designation	RW140
A+1	0015H	CMD number.	RW141
A+2	0004H	RAS information storage register type	RW142
A+3	0000H	RAS information storage register's leading number	RW143
A+4	0004H	RAS request type : ?? trace	RW144
A+5	0000H	Start position : Newest data	RW145
A+6	001EH	Reading unit : 30	RW146

Completion status

	F 0		Register allocation
B		Completion status	RW408
B+1		Detail information	RW409

```
 |R0505                                                          R0605 |
1|-| |-------------------------------------------------------------( )--|
 |            /* RAS information readout    */
 |R0605                                                                |
2|-| |-+[12544 MOV RW140][00021 MOV RW141]----------------------------|
 |     |      /* Designates the module and sets the CMD number.         */
 |     |                                                               |
 |     +[00004 MOV RW142][00000 MOV RW143]----------------------------|
 |     |      /* Sets the RAS storage register type and start number    */
 |     |                                                               |
 |     +[00004 MOV RW144]+[00000 MOV RW145][00030 MOV RW146]----------|
 |     |      /* Sets the RAS request type, the information readout start
position and count */                                          |     |
|
 |     +[RW140 RECV RW408][RST R0505]---------------------------------|
 |            /* Sets the request.          */
 |                                                                     |
```

f. RAS information details

(1) RAS counters.....LAN controller (line) information
Reads out 128 words of data using RAS information readout.

Table 7.2 RAS Counters

Symbol	Description
RAS_CNT [0]	Normal reception count
RAS_CNT [1]	Bus read error (reception buffer read failure) count
RAS_CNT [2]	Remote reset packet reception count (Packets whose Ethernet header type was set to 0900H.)
RAS_CNT [3]	Short packet (packet length under 60 bytes) reception count
RAS_CNT [4]	Alignment error (The number of bits in the received data was not divisible by 8.) count
RAS_CNT [5]	CRC error (received packet CRC check error) count
RAS_CNT [6]	Overflow (Incoming packets discarded due to full receive buffer.) count
RAS_CNT [7]	Remaining registers unused
RAS_CNT [8]	•
• • •	• • •
RAS_CNT [127]	•

(2) MIB information: MIB_IF.....LAN controller interface information
Reads out 12 words of data using RAS information readout.

Table 7.3 MIB_IF

Symbol	Description
MIB_IF [0]	Total number of octets (bytes) received by the interface
MIB_IF [1]	Number of non-broadcast/non-multicast packets transferred upstream
MIB_IF [2]	Number of broadcast/multicast packets transferred upstream
MIB_IF [3]	Number of packets discarded due to reception resource limitation (1)
MIB_IF [4]	Number of packets discarded due to format errors
MIB_IF [5]	Number of packets sent to an undefined protocol
MIB_IF [6]	Total number of octets sent by the interface
MIB_IF [7]	Number of packets from upstream that were not broadcast or multicast packets
MIB_IF [8]	Number of normal EN311 send driver send requests
MIB_IF [9]	Number of packets discarded due to reception time resource limitations (2)
MIB_IF [10]	Number of EN311 send driver memory pool acquisition errors (1)
MIB_IF [11]	Number of EN311 send driver memory pool acquisition errors (2)

Packet: A unit of data flowing on the transmission path. (See figure 7.1.)

(3) MIB information: MIB_IP.....IP protocol information
Reads out 14 words of data using RAS information readout.

Table 7.4 MIB_IP

Symbol	Description
MIB_IP [0]	Total number of IP datagrams received from the LAN controller interface
MIB_IP [1]	Number of IP datagrams discarded due to format errors
MIB_IP [2]	Number of IP datagrams discarded due to incorrect delivery.
MIB_IP [3]	Number of IP datagrams sent out.
MIB_IP [4]	Number of IP datagrams sent to an undefined protocol
MIB_IP [5]	Number of IP datagrams discarded due to resource limitations
MIB_IP [6]	Number of IP datagrams transferred from upstream
MIB_IP [7]	Number of IP datagrams transferred upstream
MIB_IP [8]	Number of send IP datagrams discarded even though transferred without problem
MIB_IP [9]	Number of received IP datagrams that required reassembly
MIB_IP [10]	Number of IP datagrams that were reassembled successfully
MIB_IP [11]	Number of IP datagrams for which reassembly failed
MIB_IP [12]	Number of IP datagrams that were fragmented successfully
MIB_IP [13]	Number of IP datagrams for which fragmentation failed an which were discarded
MIB_IP [14]	Number of created IP fragments

IP datagram: The IP header and IP data sections of a packet (See figure 7.1.)

IP fragment: Items that are divided into multiple IP datagrams when sending over 1500 bytes of data.

Reassembly: Restoring data to its original form from fragmented IP datagrams

(4) MIB information: MIB_TCP... TCP protocol information
Reads out 10 words of data using RAS information readout.

Table 7.5 MIB_TCP

Symbol	Description
MIB_TCP [0]	Unused
MIB_TCP [1]	Number of active open connections
MIB_TCP [2]	Number of passive open connections
MIB_TCP [3]	Number of times the connection open operation failed
MIB_TCP [4]	Number of times a connection was reset
MIB_TCP [5]	Number of currently open connections
MIB_TCP [6]	Number of segments received
MIB_TCP [7]	Number of segments sent
MIB_TCP [8]	Number of segments resent
MIB_TCP [9]	Number of segments discarded due to format errors
MIB_TCP [10]	Number of generated resets

Segment: The TCP header and TCP data block in an IP datagram (See figure 7.1.)

(5) MIB information: MIB_UDP .. UDP protocol information
Reads out 4 words of data using RAS information readout.

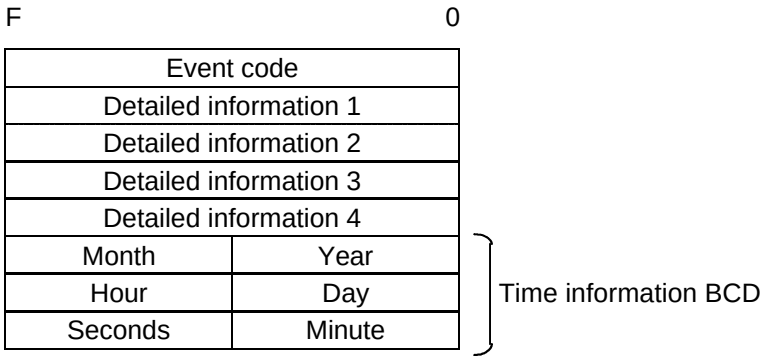
Table 7.6 MIB_UDP

Symbol	Description
MIB_UDP [0]	Number of UDP datagrams transferred upstream
MIB_UDP [1]	Number of UDP datagrams addressed to unused ports
MIB_UDP [2]	Number of UDP datagrams discarded due to format errors
MIB_UDP [3]	Number of UDP datagrams transferred from upstream

UDP datagrams: The UDP header and UDP data block in an IP datagram (See figure 7.1.)

(6) Event trace information

- Record size: 16 bytes
- Number of records: 160
- Operation on overflow: Old information is updated. This means that it is always possible to verify the 160 most recent event trace records.
- Format: Since this format is for EN311 internal data, it is binary codes. However, the time is expressed in BCD.



- Event trace item: See table 7.7

Table 7.7 Event Trace Items

Event code	Detail information 1 (H)	Detail information 2 (H)	Detail information 3 (H)	Detail information 4 (H)	Content
0001H	ROM error (0160) RAM error (0260) DPRAM error (0360)				Initialization error
0002H	Program address	Error code	NMI (0000) TRAP (0001) Watchdog timer check (0002) Watchdog timer check (0003)	Read port contents None Watchdog timer flag Watchdog timer flag	NMI occurrence factor
0004H	Power on (0001)				Start type
	Reset switch (0002)				
	Software reset (0003)	Request code	Station status	Write port contents	
0005H	Initialization (0000)	Mode prior to change	Mode after change		Mode change (station status)
	Control request (0001)	Mode prior to change	Mode after change		
0007H	Task ID	Memory pool number	Error code		Instruction storage buffer allocation error
0008H	Task ID	Station status			Transmission prohibit
0009H	Receive response code				T3H driver reception or response code error
0100H	CMD number (0011)	Error code	Station status	Write port contents	T3H/EN311 interface completion error
	CMD number (0012)		UDP port (0001)	UDP port number	
			Station status (0002)	Station status	
	CMD number (0013)		Mode prior to change	Mode after change	
			Task start number	Task completion status	
			MAC setting flag	IP setting flag	
0200H	Task ID	Error code	socket (0001)		Message transmission completion error
			bind (0002)		
			sendto (0003)		
			length (0004)	Length	
			recvfrom (0005)		
0300H	Task ID	Request code	Error code		Socket transmission completion error

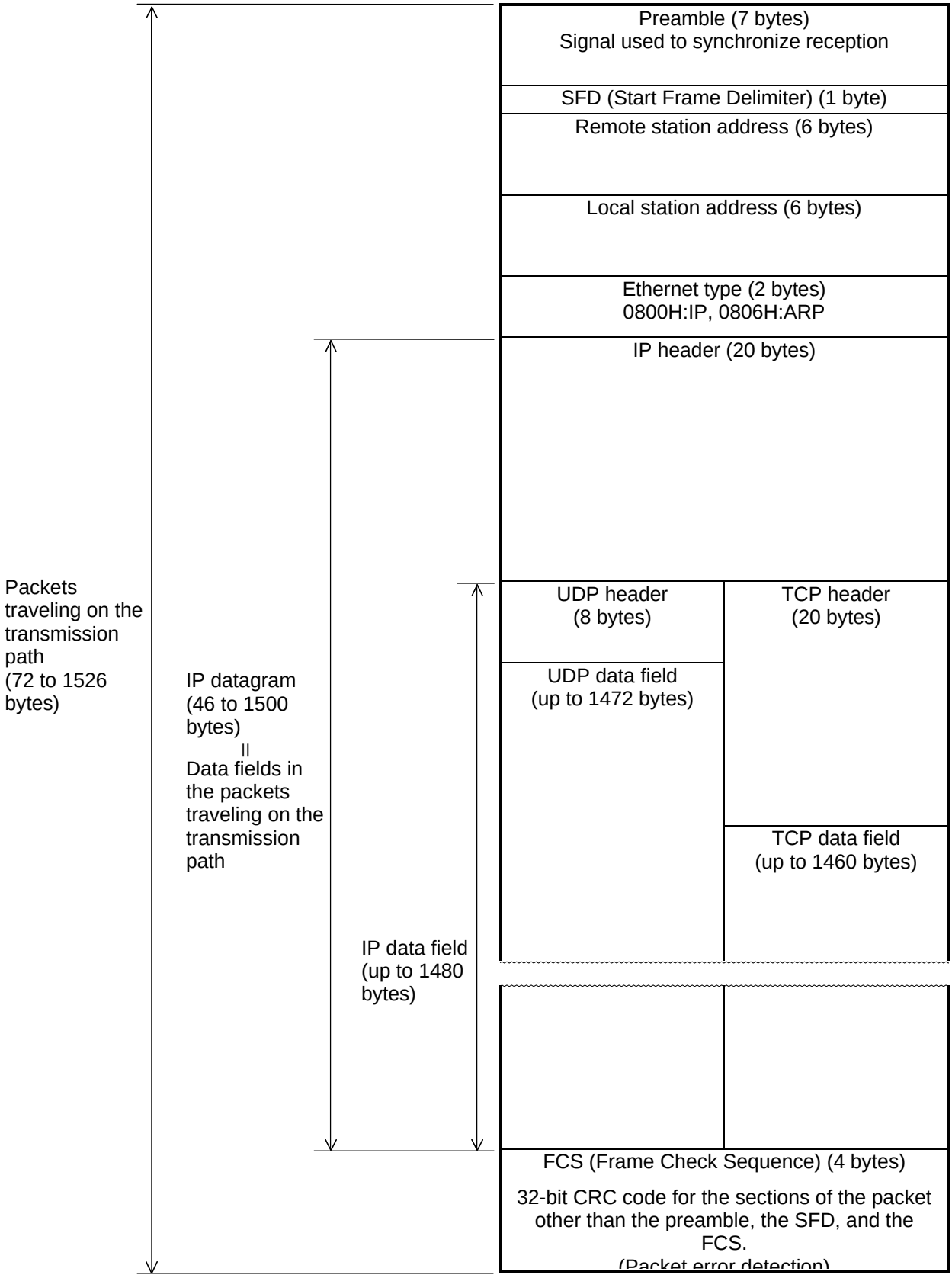


Figure 7.1 Packet Format/IP Datagram

8. Error Handling

This chapter describes the error analysis and recovery procedures for errors that occur while using the EN311. Also refer to the T3H user's manual when recovering from EN311-related errors.

8.1 LED Display

The EN311 indicates its module status in the RUN, STBY, ACC, and EXT.POWER LEDs.

Table 8.1 lists the states indicated by the RUN and STBY LEDs. Note that the EN311 operating mode can be determined by the combination of the RUN and STBY LED display states as listed in table 8.2. User programs should read out and verify the down information error codes listed in table 8.2 using the READ instruction issued for the down information in the T3H interface buffer. (See section 7.2, Down Information.)

Modules that fail (go to the down state) should be replaced.

Table 8.1 States Indicated by the RUN and STBY LEDs

LED display	State
RUN (Run)	Indicates the module normal/error (down mode) status. Lit ..... Module normal Off ..... Module error (down)
STBY (Standby)	Indicates the module operating mode when the module is operating normally and an abbreviate error indication when the module is down. Lit ..... Standby (normal mode) Off ..... Run (normal mode)/Self-diagnostics error (down mode) Blinking .... Module went down during operation (down mode)

Table 8.2 Module Down States Indicated by RUN/STBY LED Combinations

LED combination displayed	State	
RUN lit, STBY lit	Module operating normally in standby mode (parameter setup wait state) The module goes to this state after power is first applied and after a reset.	
RUN lit, STBY off	Module operating normally in run mode (transmission possible) The module switches to this mode in response to an operating mode control request. (Parameter setup is required to switch the module to run mode.)	
RUN off, STBY blinking	An error occurred during operation and the module is down.	
	Possible causes of the module going down	Down information error code
	Watchdog timeout occurred	0010
	Memory bus stall occurred	0020
	Trap occurred	0030
	Jabbering timeout occurred	0040
	Semaphore acquisition error	0500, 0501
	Semaphore acquisition error	0502, 0503
	MBX reception error	0504
	MBX transmission error	0505
	No empty TCP resend queue	0506
	Acquired buffer was in use	0507
	Initial buffer acquisition error	0508
RUN off, STBY off	Down mode due to the occurrence of an error during self diagnostics at power on.	
	Possible causes of the module going down	Down information error code
	LAN controller check error	0050
	ROM BCC check found a discrepancy	0160
	System RAM area check error	0260
	T3H interface buffer check error	0360

The ACC LED indicates when the T3H is accessing the EN311 and the EXT.POWER LED indicates when 12-VDC power is supplied to the MAU power supply terminals.

Table 8.3 States Indicated by the ACC and EXT.POWER LEDs

LED display	State
ACC (Access)	Indicates whether or not the T3H is accessing the module. • Lit .....The T3H is accessing the module. • Off .....The T3H is not accessing the module. • Lights after EN311 initialization completes when power is first applied. (Access starts.) If this LED does not light after power is turned on: 1. First, verify that the T3H and the EN311 are correctly connected to the base unit. Then: Check the modules by 2. Combining the EN311 with a different T3H. 3. Combining the T3H with a different EN311. If this LED does not light at step 2 above, then the EN311 itself is defective. Replace the EN311. If this LED (in the alternate EN311) does not light at step 3 above, then the T3H firmware does not support the EN311 or the T3H itself is defective. If the T3H is defective replace it. **Supplement:** We recommend keeping spares on hand to minimize the time required to determine the location of the fault using the above procedure and to minimize the time required for recovery.
EXT.POWER (External power)	Indicates whether or not 12-VDC power is supplied to the MAU power supply terminals. • Lit .....12-V power is supplied normally. • Off .....12-V power is either not supplied, or is abnormal. • If the T3H side power is not turned on, this LED will not light. If this LED does not light even if the T3H power is turned on, check: 1. whether or not the external power supply is operating correctly 2. whether or not the external power supply is connected with reverse polarity. Replace the module if neither of the above caused the problem.

8.2 Completion status (error status)

The completion status indicates the status during SEND/RECV instruction execution or after execution completes. If a SEND/RECV instruction does not complete normally, refer to the detailed information (EN311 error response) and the status and review the instruction word format at the T3H and EN311 states (operating modes).

For information on the completion status configuration, please refer to Fig. 4.4. For information on the contents of TermsSTS, refer to Tables 4.3 and 4.4. For information on the contents of the detail information, refer to Table 4.5.

8.3 Status in the T3H Special Relays and Registers

The statuses of the EN311 are reflected in the special relay (S00B) of the T3H. The station statuses of the EN311 are reflected in the special registers (SW063 to SW066). Please refer to "7.1 T3H Special Relay/Registers".

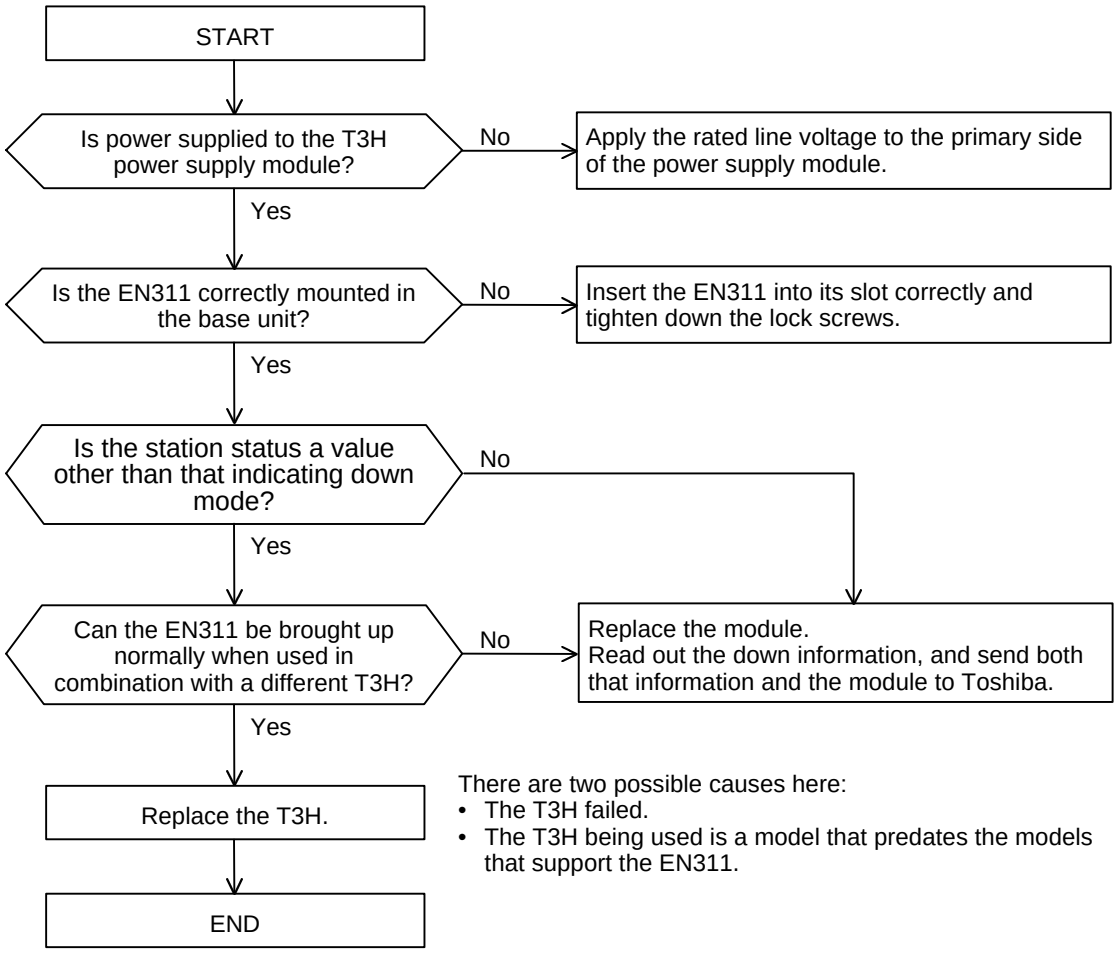
8.4 Socket Interface Information

The information for the eight socket interface sockets held by the EN311 can be read out with the T3H READ instruction. (See Section 6.3 Socket Interface Information.) The EN311 holds five words of socket status information for each socket(See Table 6.1).

8.5 Troubleshooting

1. If the module fails to come up normally (i.e., does not reach standby state.)

If the module is functional, then the EN311 can be initialized and brought to the standby state (with the RUN and STBY LEDs lit) by applying power, by pressing the reset switch, or by issuing a reset request.



2. If the EN311 fails during operation

Recovery procedure	**Replace the module.** Before replacing the module, read out the down information, and then send both that information and the module to Toshiba.

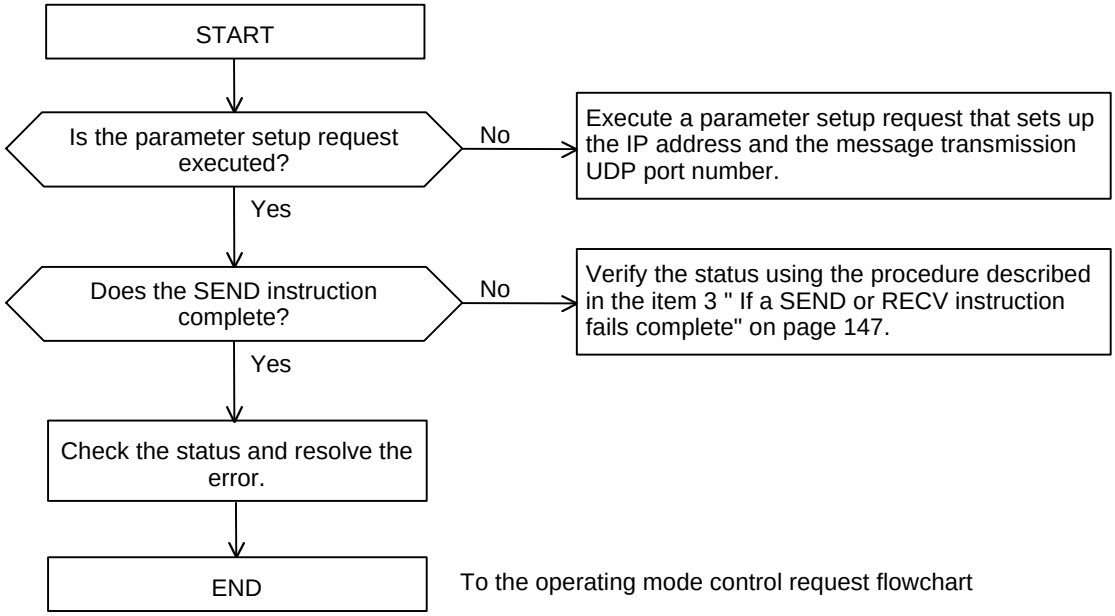
3. If a SEND or RECV instruction fails complete

Recovery procedure	(1) Verify that the inputs of function block are held in the on state until the instruction completes. (2) Determine whether the user program is writing to the status register while the instruction is executing.

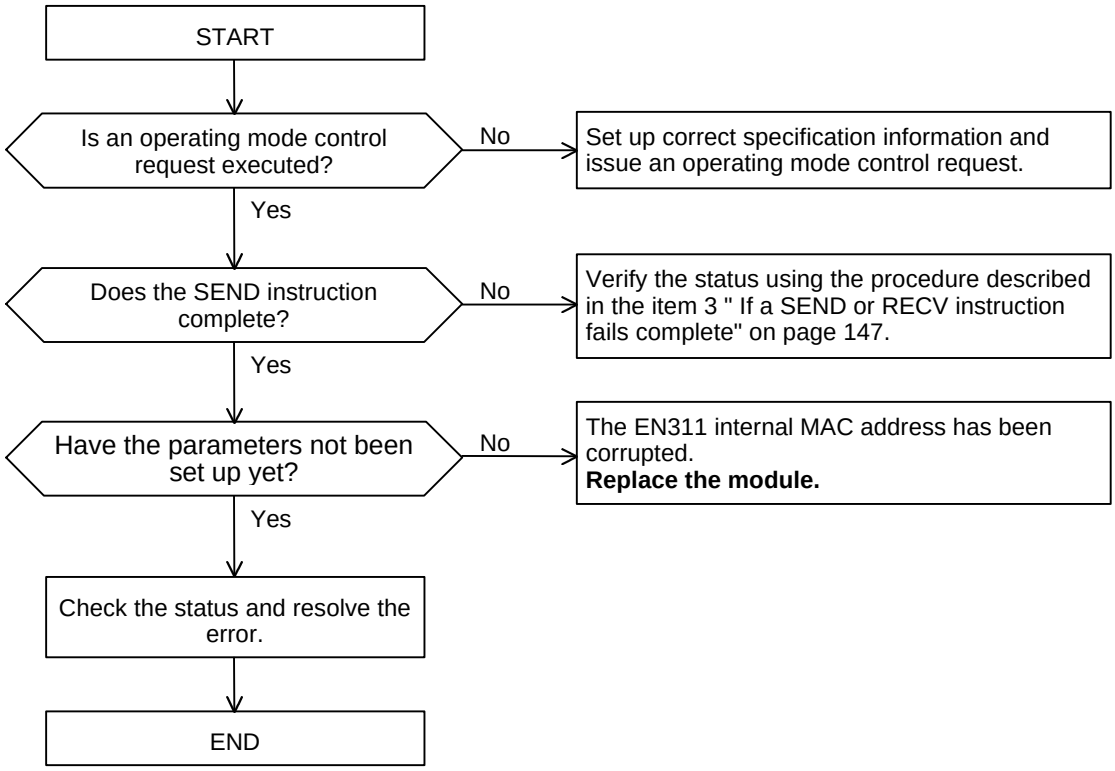
4. If the EN311 fails to enter run mode

This section assumes that the module has come up normally up to this point. Note that the parameters must be set up with a parameter setup request before issuing the operating mode control request used to switch the module from standby mode to run mode.

a. Parameter setup request

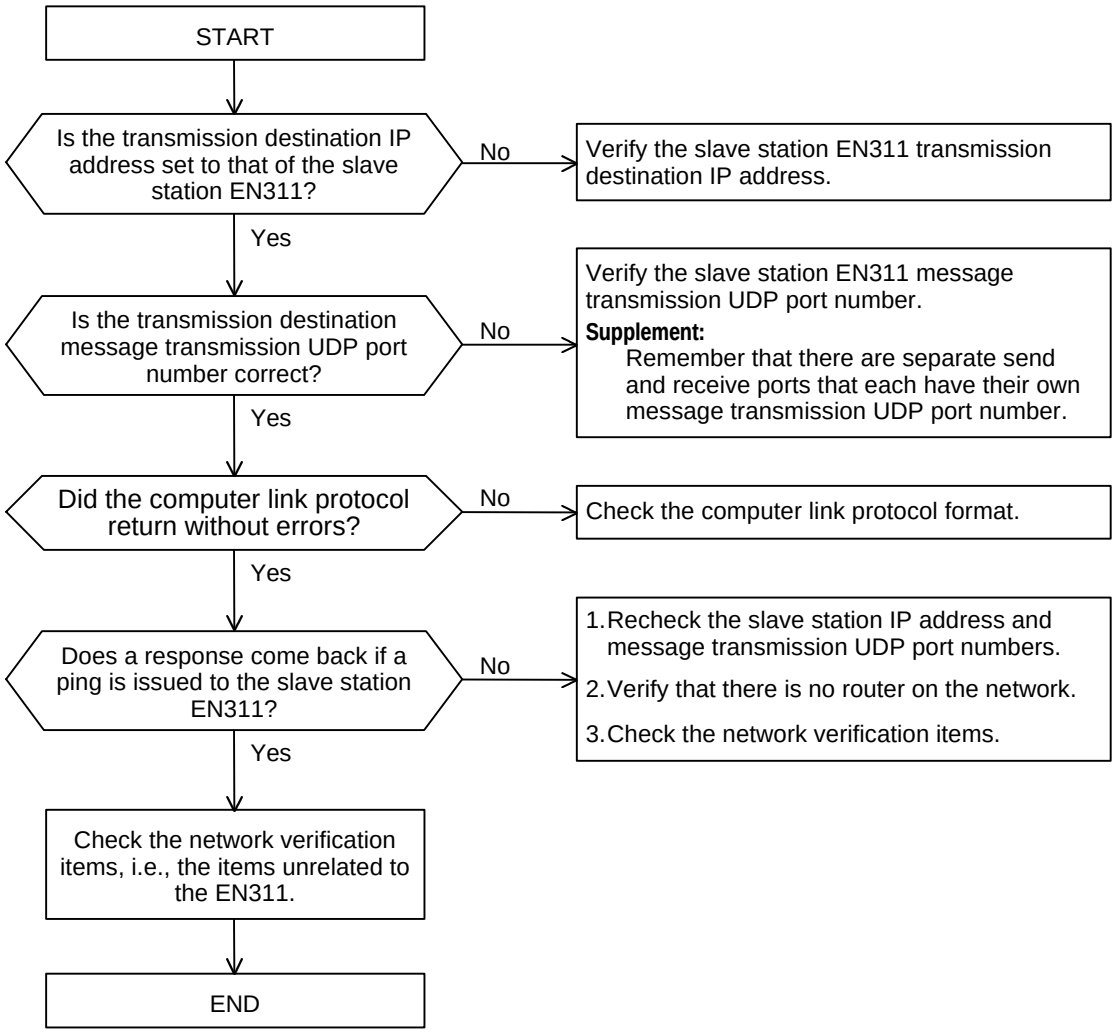


b. Operating mode control request

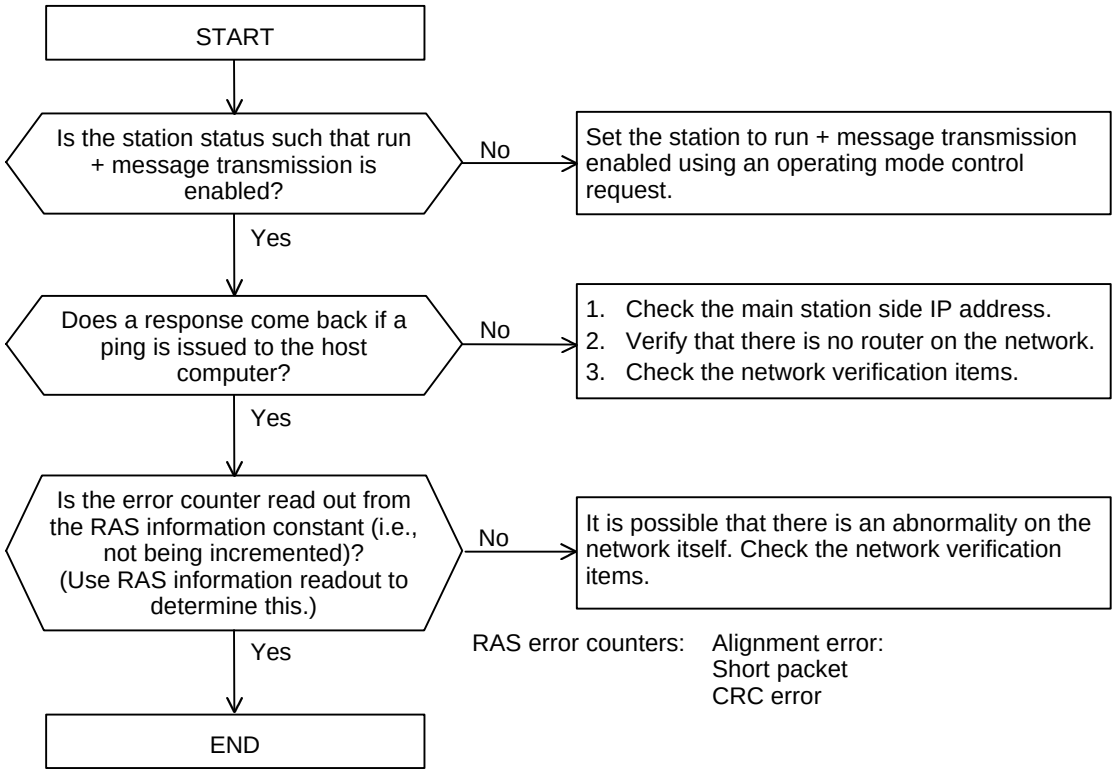


5. If computer link protocol transmission fails

a. Host computer side (main station)

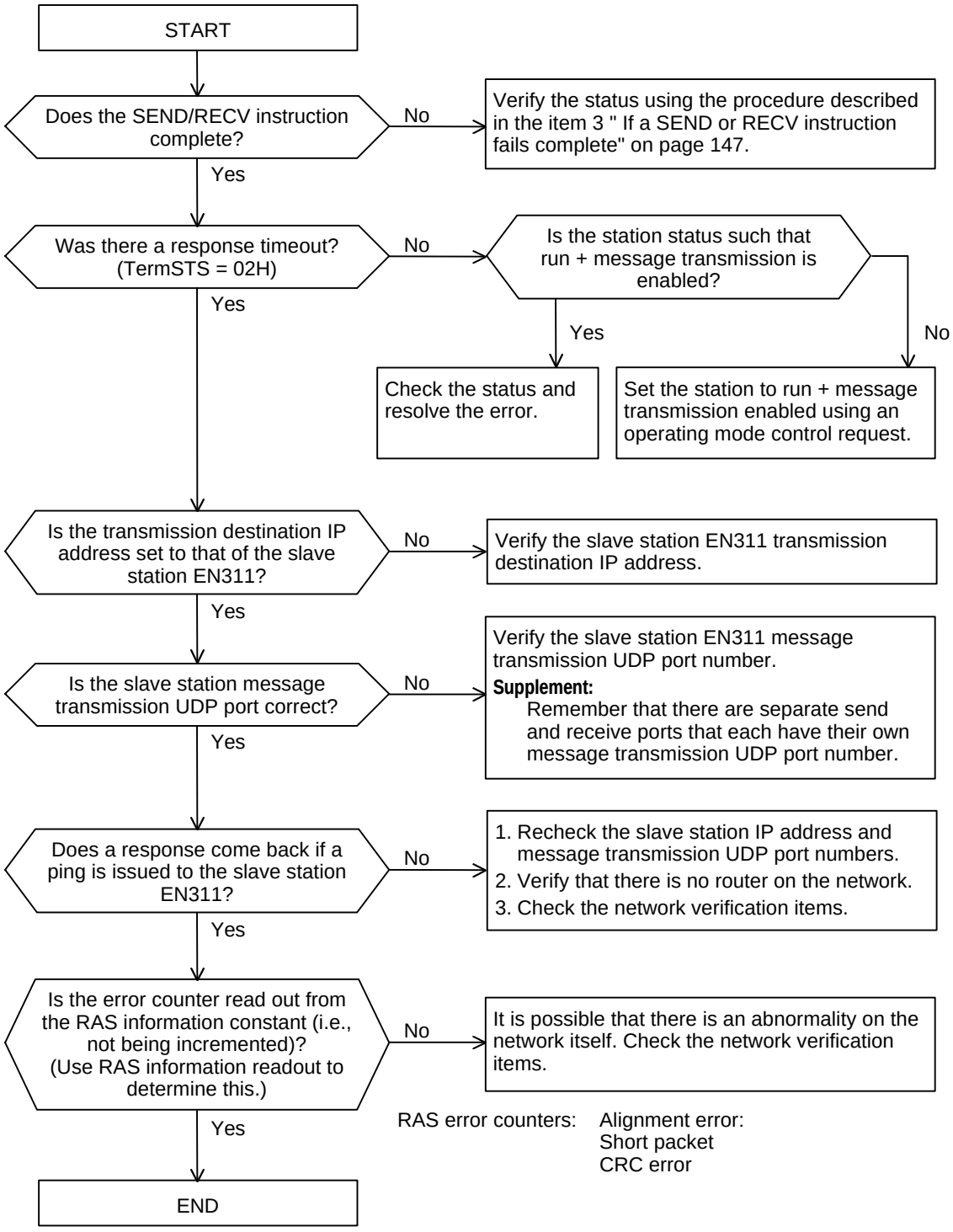


b. EN311 side (slave station)

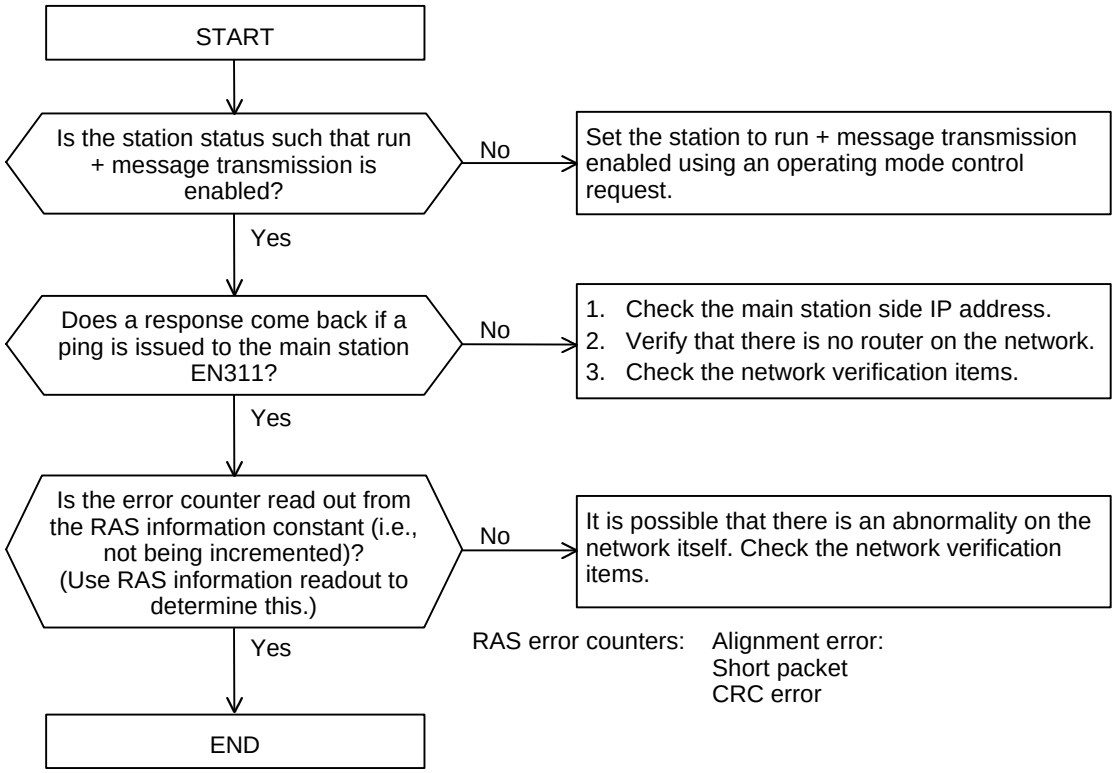


6. If PC link protocol transmission fails

a. Main station side EN311

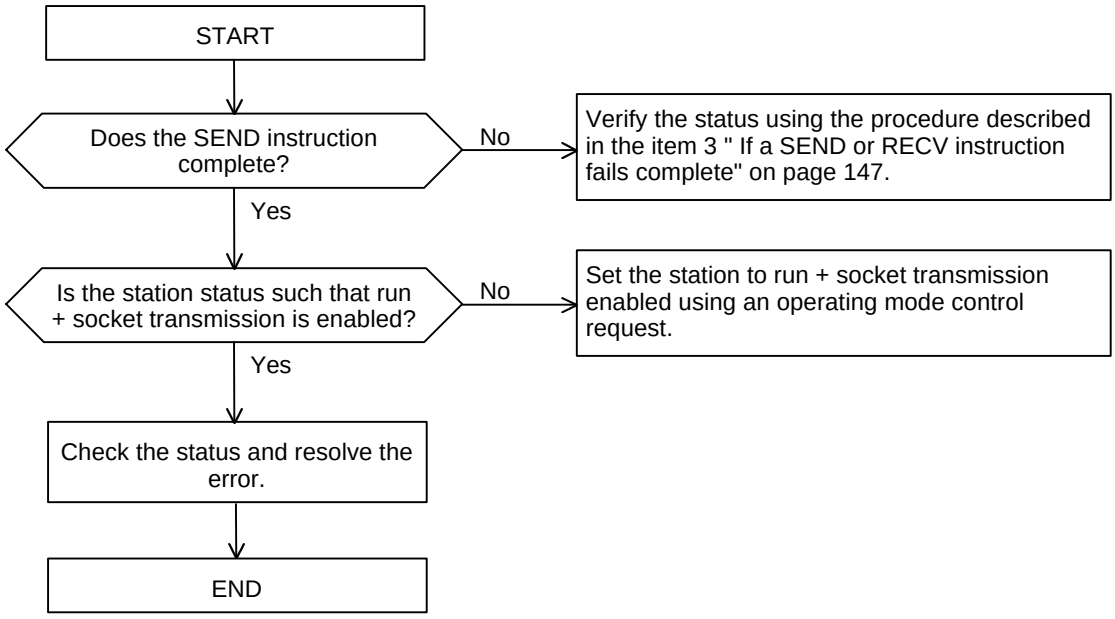


b. EN311 side (slave station)

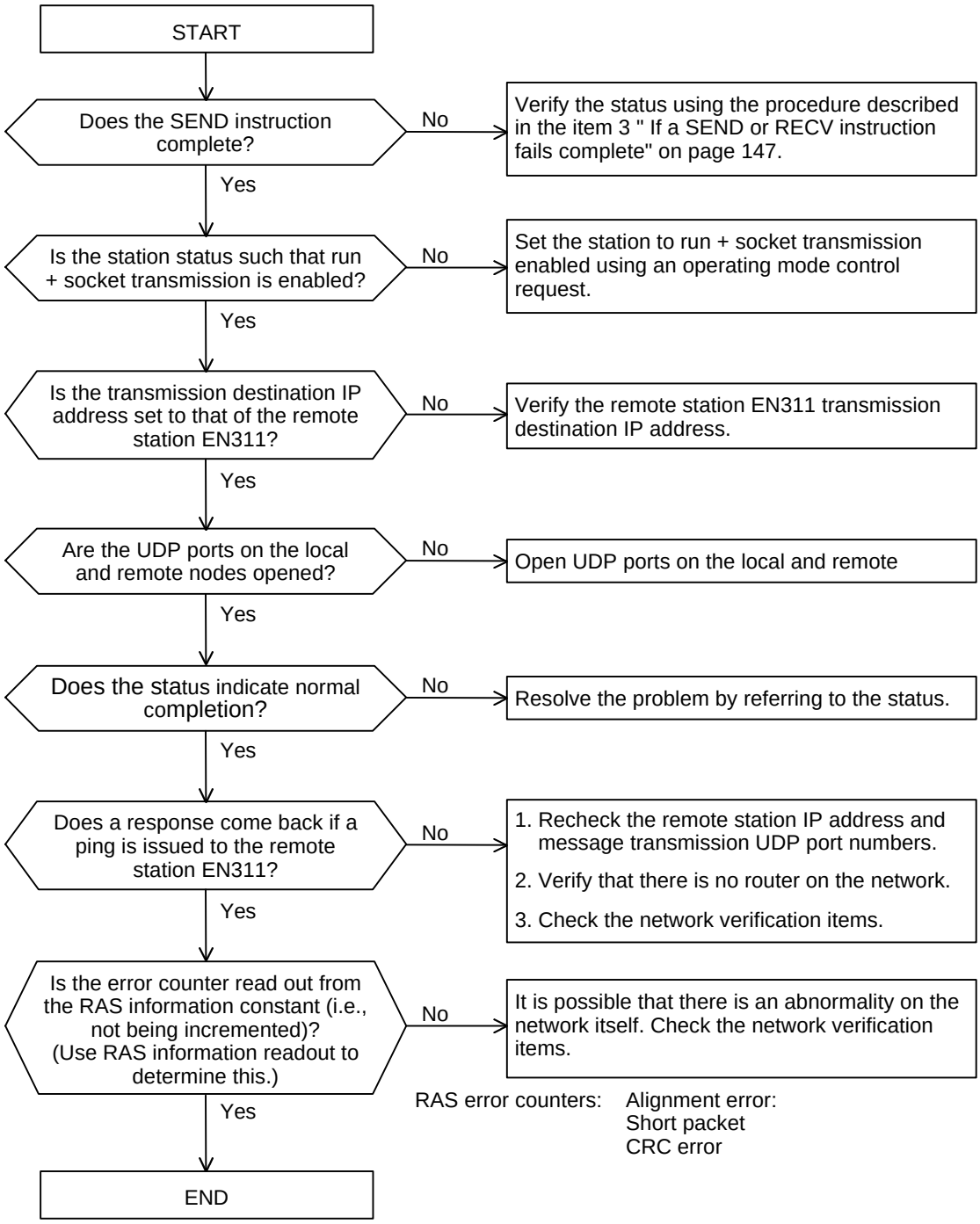


7. If transmission using UDP sockets fails

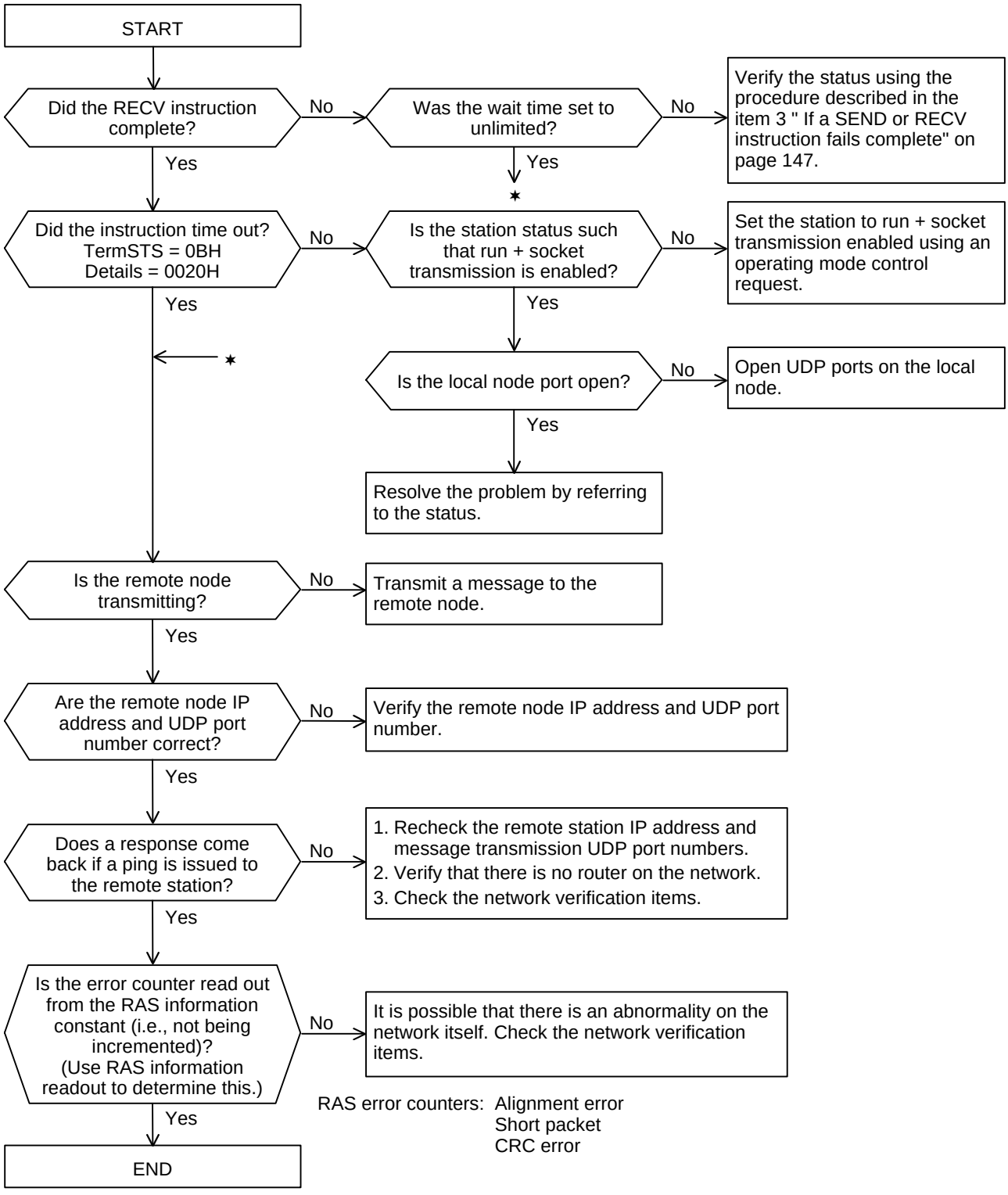
a. Open and close requests



b. Send request



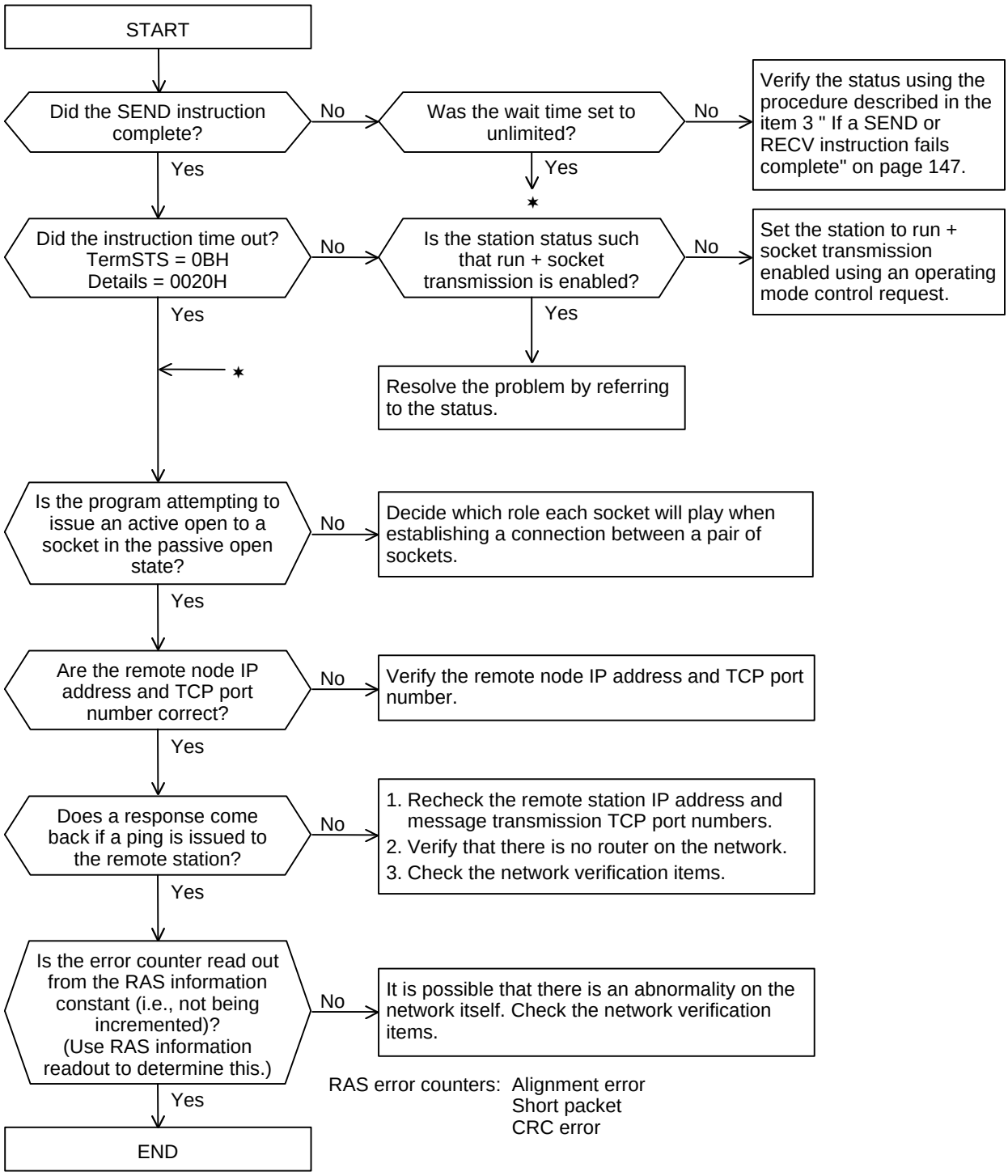
c. Receive request



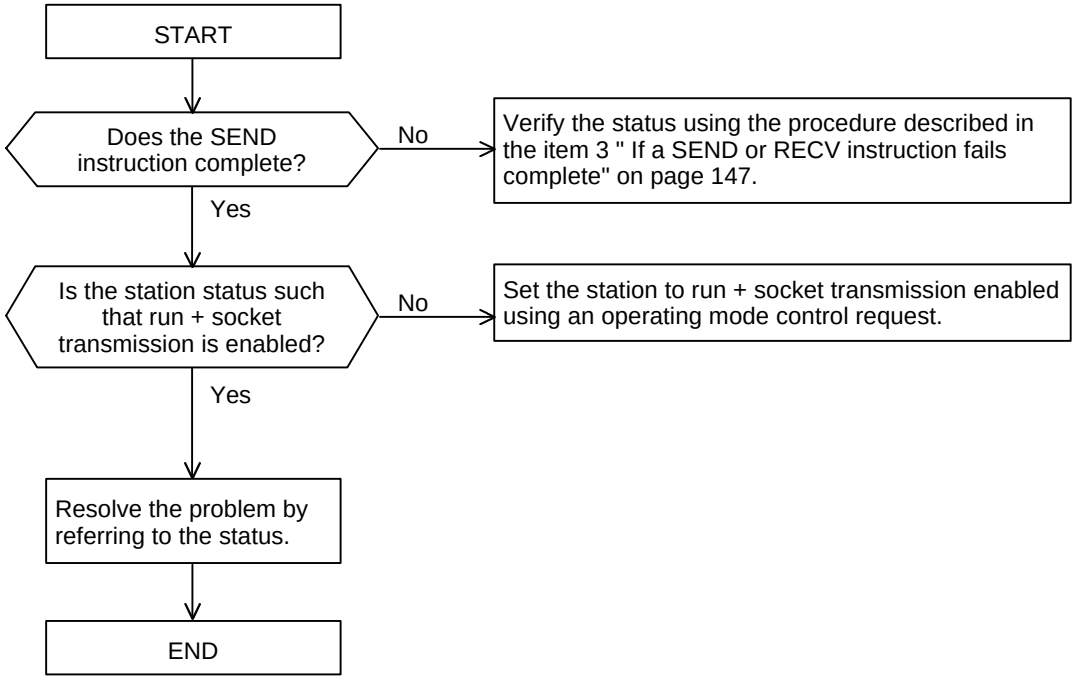
8. If Transmission Using TCP Sockets Fails

When troubleshooting TCP sockets, also refer to the section "TCP socket interface notes" in section 6.2, EN311 Socket Interface Usage Notes.

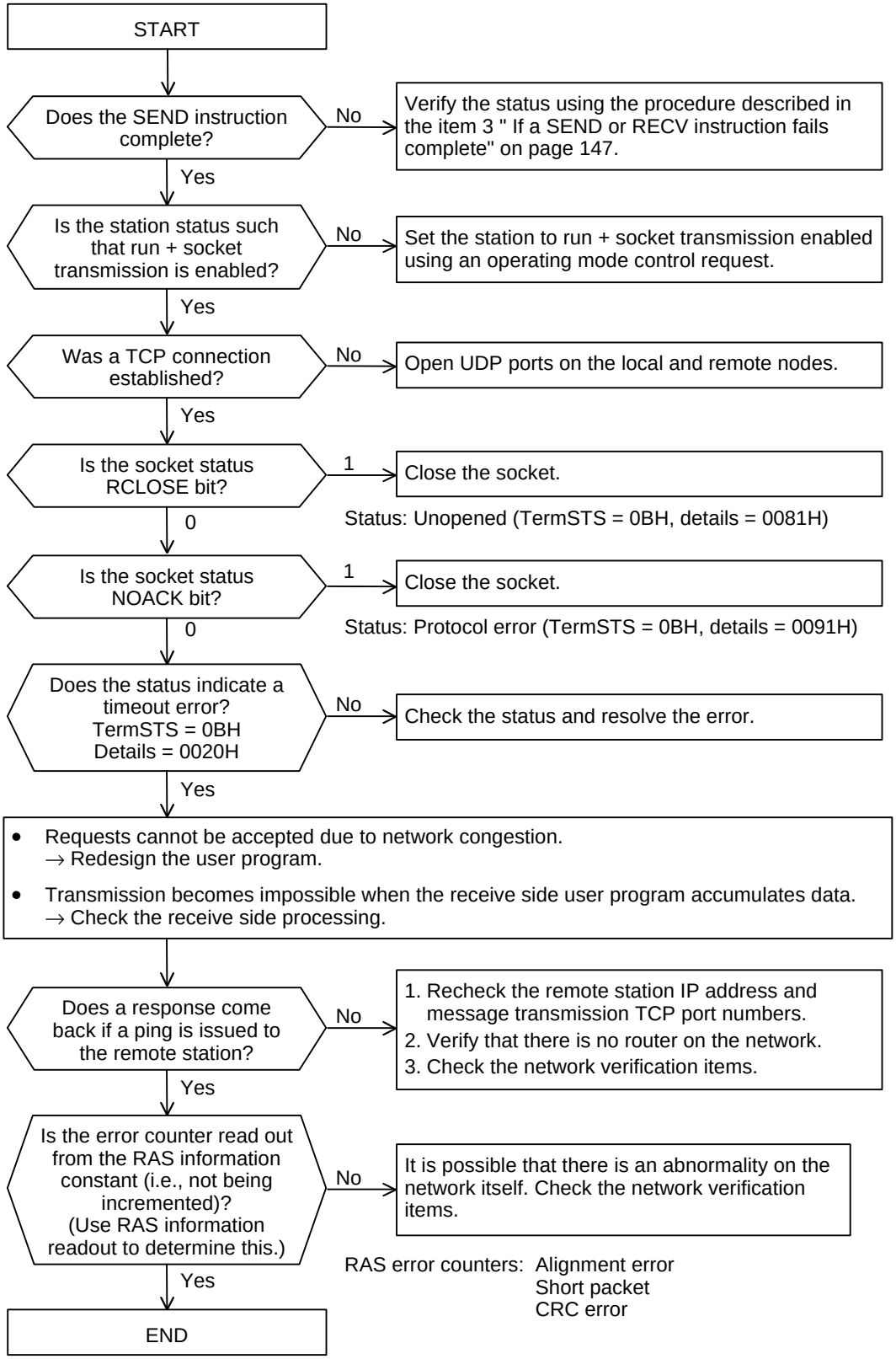
a. Open request



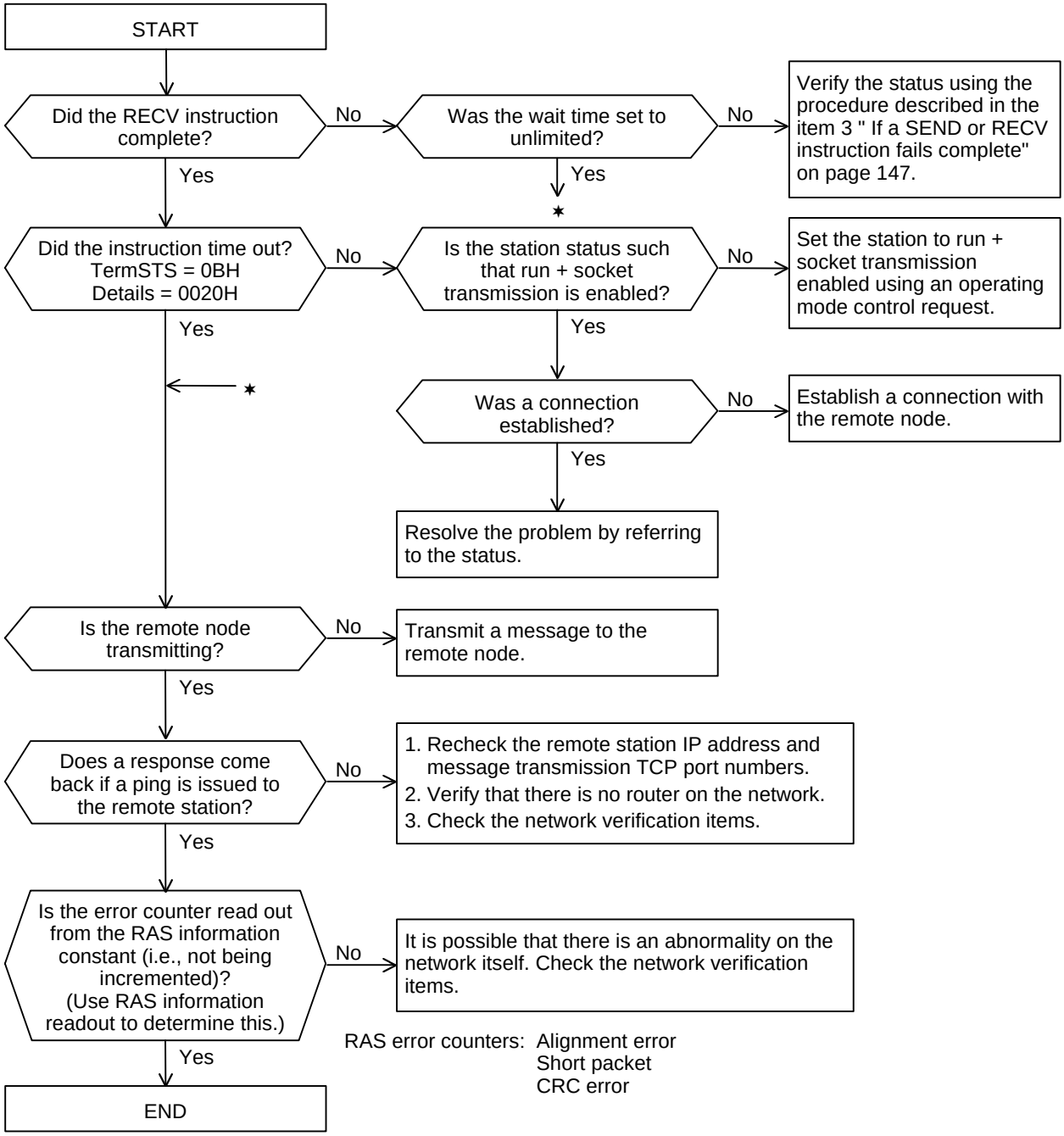
b. Close request



c. Send request



d. Receive request



9. Network check items (EN311)

	Check items	Countermeasure
EN311 external power supply	1. Is the 10BASE5/10BASE2 switch set to the position corresponding to the transmission medium actually used?	1. Set the 10BASE5/10BASE2 switch to the correct position.
	2. Is the EXT.POWER LED lit?	2. Check whether or not the 12-VDC power is supplied to the MAU power supply terminals. If the LED does not light even when the 12-VDC power is supplied, -> replace the module.
Transmission medium installation 10BASE5	1. Is the AUI cable connected between the EN311 and the MAU?	1. Verify the AUI cable connections between the EN311 and MAU units.
	2. Are the MAU units installed with a spacing of 2.5 meters of coaxial cable between units?	2. Connect the MAU units correctly at the marked sections of the cable. Marked section spacing: 2.5 meters
	3. Are the MAU 12-VDC power supply LEDs lit?	3. Exchange the AUI cables and the MAUs with other units to verify their operation. **Supplement:** We recommend keeping spares on hand to minimize the time required to determine the location of the fault using the above procedure and to minimize the time required for recovery.
	4. How long (in meters) are the AUI cable?	4. The maximum AUI cable length is 50 meters.
	5. How long (in meters) are the coaxial cable (i.e. segment lengths)?	5. The maximum segment length for 10BASE5 cabling is 500 meters.
Transmission medium installation 10BASE2	1. Is the coaxial cable connected to the EN311?	1. Verify the AUI cable connections between the EN311 and MAU units. (These are the T-connector connections.)
	2. Is the spacing between stations (nodes) as mounted at least 0.5 meter?	2. Set the cable length so that the mounting spacing is at least 0.5 meter.
	3. How long (in meters) are the coaxial cable (i.e. segment lengths)?	3. The maximum segment length for 10BASE2 cabling is 185 meters.
Network cable check	1. Is the coaxial cable (10BASE5 or 10BASE2) grounded to a single point with a resistance to ground of 100 Ω or less?	1. Coaxial cables must be grounded to a single point with a resistance to ground of 100 Ω or less.
	2. Do all nodes on the network respond to ping correctly?	2. Inspect the coaxial cables for missing termination resistors and damage.
	3. Is the collision (COL) indicator blinking frequently?	3. Since network loading is heavy: • Transmission efficiency can be degraded (TCP), and • There is an increased possibility of packet loss (UDP). Therefore, the circuit usage conditions should be reviewed.
	4. Are the error counters read out from the RAS information increasing as time passes? Error counters: Alignment error, Short packet, CRC error	4. Check whether there are any defective (or substandard) connections on the cables and at the MAUs and T-connectors. Check for the presence of noise sources in the vicinity of the network cables.

9. Installation and Wiring

9.1 Installation Environment and Base Unit Mounting

The EN311 must be used in the installation environment described in section 4.1, "Installation Environment," of the T3 User's Manual - Hardware. Also, the EN311 panel must be installed in conformance with the notes and cautionary advice presented in section 4.1, "Installation Environment."

The T3H base unit must also be mounted in conformance with the notes and cautionary advice presented in section 4.2, "Installing Units," of the T3 User's Manual - Hardware.

⚠ CAUTION

1. Only use this equipment in the environment described in the T3 User's Manual - Hardware.

   Use in any other environment can cause electrical shocks, fires, failures, and malfunctions.

2. Mount this equipment according to the mounting method specified in the T3 User's Manual - Hardware.

   Mounting in any direction other than the specified direction, or defective or inadequate mounting, can result in the equipment falling, fires, failures, and malfunctions.

9.2 Mounting and Removing Modules

Be sure to follow the notes and cautionary advice presented in section 4.3, "Mounting Modules," in the T3 User's Manual - Hardware.

⚠ CAUTION

1. The EN311 is designed specially for the T3H and should only be mounted and used in a T3H base unit. Do not use this module independently or mounted in any other equipment. Such usage could result in electrical shocks, personal injury, or damage to the EN311 and other equipment.
2. The EN311 itself should only be mounted or removed when all power is turned off. Similarly, connections to the terminal block should only be made or removed when all power is turned off. Not observing this precaution could result in electrical shocks, malfunctions, or damage to the EN311 or other equipment.
3. Do not allow foreign objects such as wire shreds to get into the EN311. This could result in fire, breakdown, or malfunction.
4. Verify that connectors, cables, and the mounting of the EN311 itself in the base unit are all secured with screws or stops and that there is no play, missing screws, or disconnections in any of these parts.

   If any of these parts is inadequately secured, breakdown or malfunction could occur as the result of vibration.

9.3 Power Supply Wiring and Grounding

1. Power supply wiring

a. T3H power supply wiring

Wire the T3H power according to the items presented in section 4.6, "Wiring of the Power Supply," in the T3 User's Manual - Hardware.

Use shielded transformers and noise filters if the power supply has a high noise level.

b. Power supply wiring for the MAU power supply terminals

See section 3.5, "MAU Power Supply," in this document.

2. Grounding

a. T3H Grounding

Wire the T3H power according to the items presented in section 4.5, "Grounding," in the T3 User's Manual - Hardware.

b. Grounding for the MAU power supply terminals

See section 3.5, "MAU Power Supply." This ground is critical for noise prevention for the 10BASE5 AUI cables.

⚠ CAUTION

1. Turn off all power before laying or connecting any cables.

   Laying or connecting cables with the power on can lead to electrical shocks.

2. Either use crimp-on connectors with sheaths or wrap exposed conductors with insulating tape so that no conductors are exposed.

   Also, handle the terminal block cover so that it is not lost or damaged. When the wiring operations are done, do not fail to reinstall the terminal block cover on the terminal block.

   Leaving conductors exposed can lead to electrical shocks.

3. Ground the equipment

   Electrical shocks and malfunctions are possible if equipment is not grounded correctly. In particular, the MAU power supply terminal grounding is critical for AUI cable noise prevention.

4. Connect a power source that matches the ratings for the MAU power supply terminal block.

   Be sure to connect the 12-VDC power + and - sides correctly. Use of incorrect wiring or a power supply with an incorrect rating can cause explosions or fires.

5. All wiring operations should be performed by qualified personnel only.

   Incorrect wiring can cause fires, breakdowns, and electrical shocks.

9.4 Network Wiring

See section 3.6, "Network Wiring Equipment," for details on the equipment that makes up the network. This section presents an outline of the wiring laid inside the control panel and outside the control panel. This section also presents individual notes on the coaxial cables used, the AUI cables, and the MAUs.

Basic points in laying out a network

⚠ CAUTION

1. When laying network cable, take adequate safety measures and perform all operations in accordance with the relevant standards. See the **ISO/IEC8802-3** standard for details on laying networks.
2. We strongly recommend hiring a qualified contractor who has specialized knowledge about safety precautions and standards.
3. Avoid installing 10BASE5 or 10BASE2 networks in environments that have high noise levels. If this is unavoidable, adopt the noise prevention measure described below.

1. Overview of wiring outside the control panel

a. Layout environment and required work

Lay out cables in a manner appropriate for the environment. The steps listed in the following table are generally required.

Table 9.1 Wiring Environment and Work Operations

Environment in which cable is laid		Work operations
Major categories	**Minor categories**	
Locations where cables will not be damaged		Installation without protective pipes Installation with protective pipes
Location where cables could be damaged	Places where there is normally motion of people and objects	Installation with protective pipes
	Places where cables may be influenced by humidity, chemicals, oils, or heat	Installation with protective metal pipes
	Places where cables may be damaged by rats, mice, or other animals.	Installation with protective pipes
	Places where cables may receive strong mechanical shocks, or where heavy physical loads may be placed on the cables.	Installation with protective metal pipes
Locations where there is a likelihood of electromagnetic interference		Protective installation and separation of cables. Installation with protective metal pipes

The term "installation with protective pipes" means that either metal or PVC pipes may be used.

b. Overview of wiring without protective pipes

(1) To protect the cables, cables should be passed through flooring ducts or wire protecting cable covers should be used.

Note that these cables should not be laid adjacent to cables carrying high currents.

(2) Lay cables in gaps in the walls so that they will not be damaged, and run cables under the flooring under equipment so that electromagnetic interference will not occur.

(3) Observe the applicable cable separation standards when running cables in parallel with, when crossing, or when approaching low-voltage indoor power lines.

(4) Fasten cables every 3 meters so that the cables are not damaged when attaching cables to walls to position the away from the floor, or when running cables vertically.

(5) When bending cables, be sure that the radius of curvature of the bend does not exceed the bending limit for the cable used.

c. Notes on piped cabling

(1) Do not run coaxial cable and lines carrying high currents in the same pipe.

(2) When bending pipes, do not bend pipes to an angle sharper than 90 degrees.

(3) When bending pipes, the radius of curvature must be at least 6 times the internal diameter of the pipe, and must be no smaller than the minimum radius of curvature for bending of the enclosed cables.

(4) Ground metal pipes.

d. Separation from other wiring

As a general principle, coaxial cable should be separated by at least 2 meters from power lines and equipment that generates electric or magnetic fields. If it is difficult to achieve a separation of 2 meters, look up the actual voltage and current of the induction source in the table below to determine the separation distance. However, since transmitted signals are weak signals, restrict induction sources to no more than 440 volts and 100 amperes.

Table 9.2 Recommended Minimum Separation Distance

Induction source	Minimum separation for parallel lines (mm)			
Voltage, current	Over 100 A	Up to 100 A	Up to 50 A	Up to 10 A
Over 440 V	2000	2000	2000	2000
Up to 440 V	2000	600	600	600
Up to 220 V	2000	600	600	500
Up to 110 V	2000	600	500	300
Up to 60 V	2000	500	300	150

Considering resistance to noise, we recommend using either covered metal cable ducts or protective steel pipe. Table 9.3 lists the recommended minimum separations for parallel lines in this case.

Table 9.3 Recommended Minimum Separation Distance (Covered metal ducts and metal pipe) (Units: mm)

Cable installation method		Covered metal ducts or metal pipe					
Parallel separation		Up to 10 meters	Up to 25 meters	Up to 100 meters	Up to 200 meters	Up to 500 meters	501 meters or over
Power cable	Up to 125 V, up to 10 A	10	10	50	100	200	250
	Up to 250 V, up to 50 A	10	50	150	200	250	250
	Up to 400 V, up to 100 A	50	100	200	250	250	250
	Up to 500 V, up to 200 A	100	200	250	250	250	250
	Levels exceeding the above	At least 500					

When using cable ducts, install steel separators to separate power cables from coaxial cables as shown in the figure below.

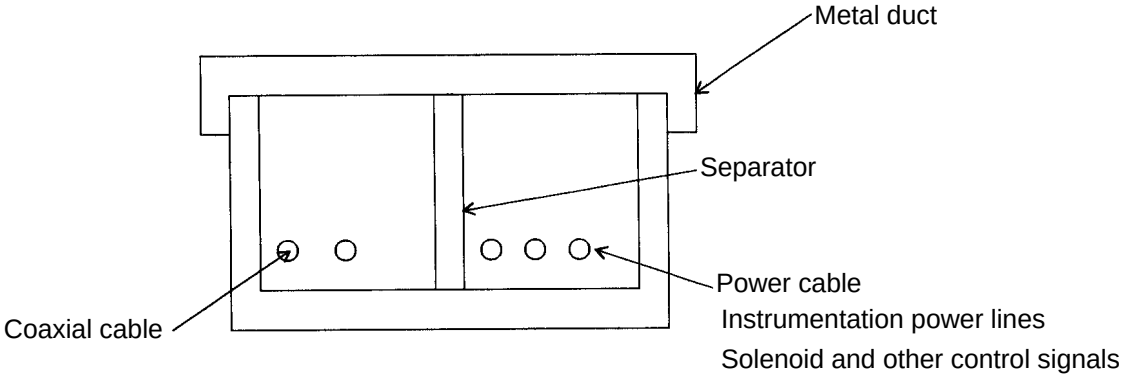


Figure 9.1 Duct Internal Layout Example

When laying cables in a pit, use separators in the same manner as when ducts are used.

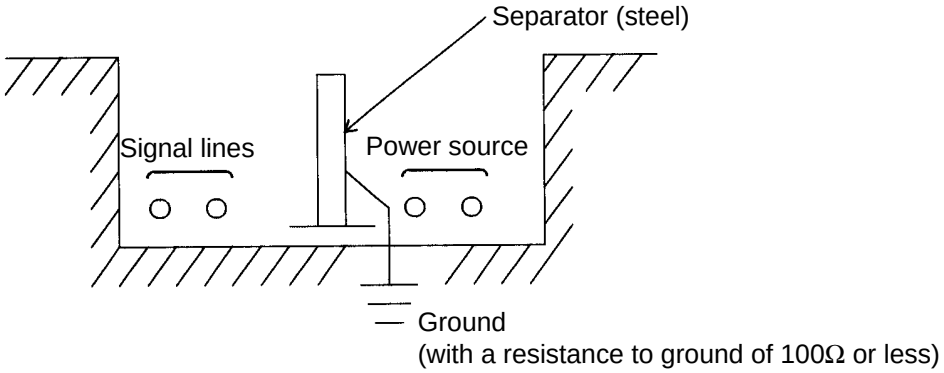


Figure 9.2 Pit Internal Layout Example

e. Wiring routes

The desirable routes for laying the transmission cable can be ordered as follows.

(1) Using a dedicated route

(2) Using a route dedicated to computer system related lines

(3) Using a route dedicated to general measurement equipment

(4) Using a route dedicated to plant control related lines

2. Overview of panel internal wiring

When 10BASE2 cable is used with the EN311, coaxial cable is connected to the EN311, and when 10BASE5 cable is used, AUI cable is connected to the EN311. Keep the following points in mind when wiring inside the control panel.

a. Wiring path

Use the weak-signal route within the panel for wiring the coaxial cable.

In particular, keep the coaxial cable at least 50 cm away from power supply cables.

b. Securing coaxial cable

Secure the coaxial cable with clamp materials so that the weight of the cable is not applied to the cable's connectors.

Remember that the cable not must be bent beyond its minimum bending radius.

3. Notes on laying and wiring 10BASE2 and 10BASE5 coaxial cable

a. Only use this coaxial cable indoors. Consult with a specialist contractor if coaxial cable must be routed outdoors.

b. Connect terminators to both ends of the coaxial cable.

c. Insulate all exposed metal parts other than the coaxial cable installation point from ground and other metal parts.

   10BASE5: Plugs, adapters, terminators

   10BASE2: BNC plugs, adapters, terminators, T connectors.

d. For safety, ground, at a single point, the coaxial cable's external conductor to a point with a resistance to ground of 100 Ω or less.

   Also, prepare a dedicated network system ground that is not shared with other equipment.

e. Contact the manufacturer of the cable with regard to the physical characteristics value of the coaxial cable allowable minimum bending radius.

f. Avoid locations with high temperature, high humidity, dust, or oil mist when installing coaxial cable.

4. Notes on laying and wiring AUI cable

a. When connecting the AUI cable to the EN311 or MAU connectors, use the slide latches to secure the connectors firmly.

b. Since the AUI cable external conductor is connected to the EN311 MAU power supply connection terminal block FG pin, be sure to ground the FG pin with a resistance to ground of 100 Ω or less.

c. Contact the manufacturer of the cable with regard to the physical characteristics value of the AUI cable allowable minimum bending radius.

d. Avoid locations with high temperature, high humidity, dust, or oil mist when installing AUI cable.

5. Notes on MAU (10BASE5) installation

a. Attach MAUs at the 2.5-meter separated marks on the coaxial cable.

b. Since the procedure for attaching MAUs to coaxial cable differs between manufacturer, refer to the MAU user's manual.

c. Since the coaxial cable is grounded, the MAU main unit should be mounted insulated from ground.

d. Do not install MAUs in the vicinity of equipment that generates electrical noise. If a MAU must be installed in such a location, provide a MAU enclosure box, and mount the MAU inside the box insulated from that box. Be sure to ground the MAU enclosure box.

e. Avoid locations with high temperature, high humidity, dust, or oil mist when installing MAU cable.

Appendix 1 Maintenance and Inspection

Periodic Inspection

Check the following items periodically, once every six months. Also, check these points if any surrounding conditions or any aspect of the environmental changes.

Table A.1 Periodic Inspection Items

Inspection item	Inspection	Criterion	Resolution procedure
Power supply systems (T3H power supply/MAU power supply)	Measure the power-supply voltage at the power-supply terminals.	Voltages must be within the stipulated ranges.	Adjust the input voltages to be within the stipulated ranges.
	Check for loose screws at the power-supply terminals.	There must be no looseness.	Turn off (remove power from) the power supply and tighten down the screws with a screwdriver.
	Check for damage to the power-supply cables.	There must be no damage.	Turn off (remove power from) the power supply and replace the damaged cables.
Installation state	Is the module firmly locked in place?	There must be no looseness or play.	Tighten down the screws with a screwdriver.
Transmission cable connections	10BASE5: Are the AUI cables firmly locked in place?	There must be no looseness or play. The 10BASE5 connector slide latches must be in their locked positions.	First press the cable firmly into the connector and then slide the slide latch to the locked position.
	10BASE2: Are the coaxial cables firmly locked in place?	There must be no looseness or play. The T-connector locks must be engaged.	First press the T-connector firmly into position and then engage the T-connector lock.
Transmission cable wiring (See section 9.4, "Network Wiring".)	10BASE5/2: Check for damage to the cables.	There must be no damage.	Stop the system, turn off (remove power from) the power supply and replace the damaged cables.
	Are the cables installed near any power or other cables?	There must be no power or other similar cables in the vicinity.	Separate the cables from the power lines. Shield the cables.
Ambient conditions	Verify that temperature, humidity, vibration, and dust levels are all within the stipulated ranges.	The values must be within the ranges from the general specifications for the module.	Improve the environment so that all aspects are within the ranges stipulated in the specifications.

⚠ CAUTION

1. Always turn off the power before attaching or removing modules, the terminal block, or cables.

   Electrical shock, malfunctions, and breakdowns are possible if these operations are performed with the power on.

2. To keep the system operating normally at all times and to prevent trouble in advance, perform daily inspections, periodic inspections, and cleaning.

3. Refer to the section on error recovery in this document if the EN311 does not operate correctly.

   Contact your local Toshiba dealer or service representative if a breakdown occurs, and request that the module be repaired or returned to Toshiba.

   Operation and safety cannot be guaranteed if service is performed by anyone other than an authorized Toshiba service representative.

4. Do not disassemble or modify the module hardware, and do not modify the module software.

   Breakdowns or malfunctions may lead to fire, electrical shock, or injury.

5. When measuring the voltages at the module terminal block during inspections, use adequate caution.

   There is a danger of electrical shock during this operation.

6. Only exchange modules with the power completely off.

   Exchanging modules with the power on can lead to malfunctions, breakdowns, and electrical shock.

7. Do not continue to use the module if it emits smoke or unusual odors, or if it is in an abnormal state of any type.

   Using the module in an abnormal state can lead to malfunctions, breakdowns, and electrical shock.

   In such cases, immediately turn of all power and contact your local Toshiba dealer or service representative.

   Customers should never attempt repairs or modifications to this equipment themselves: repair and modification operations are extremely dangerous.

Appendix 2 Request Code Table

This table lists the request codes (CMD) used with SEND/RECV instructions sent to the EN311. Refer to the section/item indicated in the reference column in the table for detailed explanations of the request codes.

Table A.2 Instructions (Requests) to the EN311

Request	Function	Instruction	CMD/Class	Reference
Reset request	Resets the module.	SEND	0011H/(1)	Section 4.3
Parameter setup request	Sets up the EN311 parameters.	SEND	0012H/(1)	Section 4.4
Operating mode control request	Sets the operating mode.	SEND	0013H/(1)	Section 4.5
Remote station verification request	Verifies the existence of another node on the network.	SEND	0014H/(1)	Section 7.3
RAS information readout request	Reads out the module RAS information.	RECV	0015H/(1)	Section 7.6
Time set request	Sets the module internal clock Time information for event trace	SEND	0018H/(1)	Section 7.5
Register read request (PC link function)	Reads register data from remote T3H into registers in the local T3H.	RECV	0021H/(2)	Section 5.4
Register write request (PC link function)	Writes register data from the local T3H to registers in remote T3H.	SEND	0021H/(2)	Section 5.3
Remote station loopback request	Performs a loopback test with another EN311 on the network.	SEND	000FH/(2)	Section 7.4
UDP open request	Opens a UDP socket.	SEND	0031H/(3)	Section 6.4
UDP send request	Transmits data from an open UDP socket.	SEND	0032H/(3)	Section 6.4
UDP receive request	Reads out data received by an open UDP socket.	RECV	0033H/(3)	Section 6.4
UDP close request	Closes (terminates) an open UDP socket.	SEND	0034H/(3)	Section 6.4
TCP open request	Opens a TCP socket.	SEND	0035H/(3)	Section 6.4
TCP send request	Transmits data from an open TCP socket.	SEND	0037H/(3)	Section 6.4
TCP receive request	Reads out data received by an open TCP socket.	RECV	0038H/(3)	Section 6.4
TCP close request	Closes (terminates) an open TCP socket.	SEND	0039H/(3)	Section 6.4

- The request code (CMD) types (1) to (3) have the following meanings.

  Class (1) is module control, (2) is PC link protocol transmission, and (3) is socket interface transmission.

- For a single EN311 module, it is not possible to request another class (1) CMD while a class (1) CMD is executing. This is also true for class (2) CMDs. If such a request is issued, the status will be transmission port busy, and the request will go to the wait state.

- For a single EN311 module, when requesting a class (3) CMD, it is not possible to request another class (3) command for a socket for which an instruction is executing. If such a request is issued, the status will be transmission port busy, and the request will go to the wait state.

- There are eight sockets, and each can independently accept and execute a class (3) instruction.

Appendix 3 Completion status Table

Figure a.1 lists the completion status and detailed information stored in the specified registers during SEND/RECV instruction execution or at instruction completion. Tables A.3 and A.4 list the contents of the TermSTS completion status, and table A.5 lists the contents of the detailed information (the EN311 error response) loaded into the next register after the register used for the completion status.

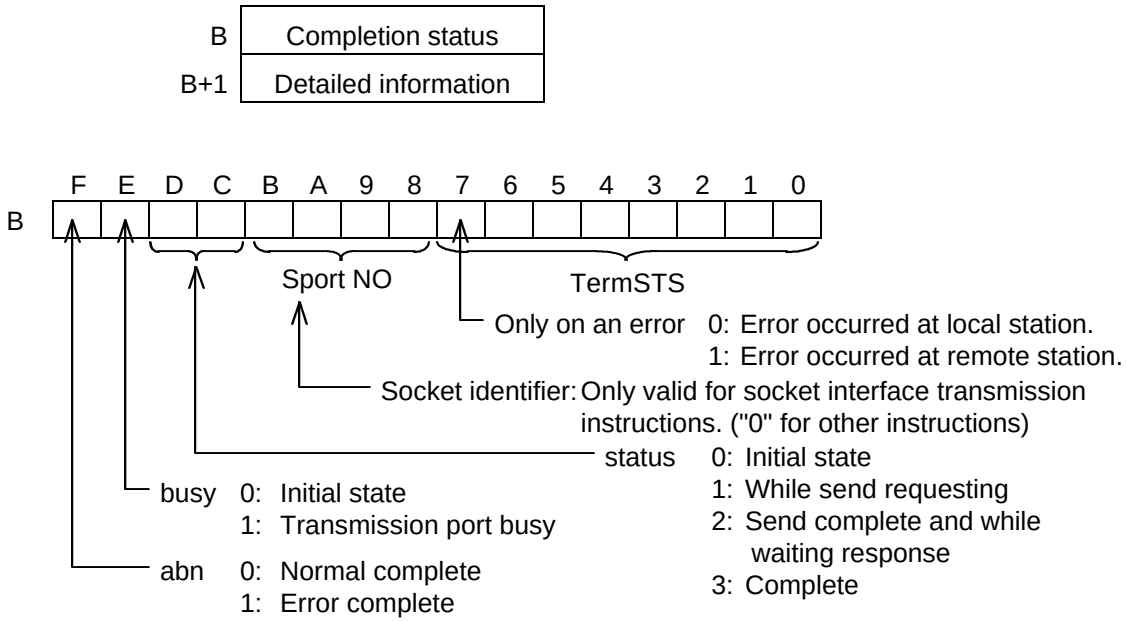


Figure A.1 Status Structure

Table A.3 TermSTS (Part 1)

TermSTS	Status	Meaning
00H	Normal complete	
01H	Register specification error	・ Occurs if a register other than XW, YW,W, LW, RW, D, F, T, C, or SW is specified as the data storage register in one of the following requests. Requests: RAS information readout, remote station loopback, UDP send/receive, TCP send/receive, register read/write. ・ In a register read or write request, the request specified a read or write from a T register to a register other than a T register. (This also applies to C registers.)
02H	Response timeout	・ Occurs if a response is not received within the specified time for a remote station loopback or register read/write request.
03H	Parameter error	・ Occurs if a value other than 3 is specified for the module ID. ・ Occurs if a value other than 1, 2, 3, or 4 is specified for the channel number. ・ Occurs if a command number other than one of the following is specified for a SEND instruction. 000FH, 0011H - 0014H, 0018H, 0021H, 0031H, 0032H, 0034H, 0035H, 0037H, 0039H ・ Occurs if a command number other than one of the following is specified for a RECV instruction. 0015H, 0021H, 0033H, 0038H ・ Occurs if a value other than 1 to 8 is specified for the socket identifier. (See section 6.4 "Using the EN311 Socket Interface".) ・ Occurs if an incorrect parameter is specified in a RAS information readout request. (See section 7.6 "RAS Information Readout ".)

Table A.4 TermSTS (Part 2)

TermSTS	Status	Meaning
04H	Memory write protect	· Occurs if an attempt to write is made when the remote registers were write protected. · Occurs if an attempt to read is made when the local registers were write protected.
05H	(Reserved)	
06H	Module error	· Occurs if the module is down.
	Initialization in progress	· Occurs if the module is initializing.
	Transmission complete timeout	· Occurs if a T3H internal timer times out. Requests: UDP open, UDP send, UDP close, TCP send, TCP close
07H	No send channel (CH)	· Occurs if the corresponding EN311 is not installed.
08H	Station address out of range	· Occurs if the local station IP address was specified for the remote destination IP address. Requests: Remote station loopback, register read/write
09H	Incorrect transmission word count	· Occurs if either 0 words or 486 or more words were specified for either a register read/write or a remote station loopback request. · Occurs if either 0 words or 1001 or more words were specified for a UDC/TCP send/receive request.
0AH	Boundary error	· Occurs if the specified area (start address + register range) does not exist in the T3H data storage registers. Requests: RAS information readout, remote station loopback, UDP send/receive, TCP send/receive, register read/write
0BH	Transmission error	· Occurs if the EN311 returns an error response. Detailed information (the EN311 response status) is stored at B+1.
0CH	No I/O response	· Occurs if the T3H cannot access the EN311.
0DH	IC card specification error	· Occurs if an error occurs when the T3H IC card is being used as registers (expansion F registers). (See the T3H Instruction Manual.)
0EH	Send data capacity exceeded	· Occurs if a request is discarded when a T3H internal resource insufficiency occurs due to increasing amounts of transfer data. · Occurs if a T3H retransmission times out.
0FH	(Reserved)	

Details on the EN311 error response when a transmission error (0Bh) occurs are stored in the register following the status. (See table A5.)

Table A.5 Detailed Information (EN311 Error Responses) (Part 1)

Error	Code	Description
Normal complete	0001H	Request completed normally
Local station fault	0002H	The local station is in down mode
Local station standby	0003H	Data transmission in standby mode (socket interface transmission or PC link protocol transmission) was requested.
Timeout	0020H	Timeout occurred during TCP open processing or receive processing, or during UDP receive processing.
Length error	0030H	Incorrect send data length
Station mode error	0040H	One of the following requests was issued in a mode other than standby mode: a. Parameter setup, b. MAC address setup, c. Reset
MAC/IP not set up	0050H	Occurs if the MAC address or IP address is not set up.
Transmission prohibited state	0060H	・ Occurs if a PC link request was issued from the T3H in run mode in the message transmission prohibited state. ・ Occurs if a socket open, close, send, or receive request is issued by the T3H in run mode in the socket interface transmission prohibited state.
Format error	0070H	Occurs when there is a format error in the request text.
	0071H	Port number error
	0072H	Request code error
	0073H	Time setting: Year
	0074H	Time setting: Month
	0075H	Time setting: Day
	0076H	Time setting: Hour
	0077H	Time setting: Minute
	0078H	Time setting: Second
Opened	0080H	Occurs if an open request is issued for an already open socket.
Unopened	0081H	・ Occurs if send, receive, or close request is issued for an unopened socket. ・ The TCP socket was used to make the transmit/receive request to the socket (with the RCLOSE bit of the socket status ON) which is receiving CLOSE from the remote station.
Incorrect socket identifier	0082H	Occurs if the socket identifier is out of range (1 to 8).
Incorrect control request specification	0083H	Occurs if a request that was prohibited by an operating mode control request is issued. ・ Occurs if a run request is issued in run mode. ・ Occurs if a standby request is issued in standby mode. ・ Occurs if a run request and a standby request are issued at the same time.
LAN controller driver error	0090H	Occurs if the setting of the local station IP address and port number in the area reserved for transmission fails.
	0091H	・ Error in the TCP or UDP protocol (such as a transmission phase error) ・ The TCP socket was used to make the transmit request to the socket (with the RCLOSE bit of the socket status is ON) due to remote-station down.
	0092H	・ Occurs if the setting of the remote station IP address in the remote station information area (the NETDATA table) fails. ・ Occurs if the remote station IP address network address differs from the local station IP address network address.
Memory pool allocation failure	00A0H	Occurs if the EN311 internal OS fails to allocate memory.
Port 2 task start failure	00A1H	Occurs if computer link or PC link socket identifier acquisition fails.
Broadcast specification error	00A2H	If the remote destination was specified to be broadcast in a remote station verification request.

Table A.5 Detailed Information (EN311 Error Responses)(Part 2)

Error	Code	Description
MAC address specification error	00B0H	BCC error
	00B1H	Occurs if an error occurs after address saving on a MAC setup request.
Insufficient resources error	00C0H	・ Occurs if there are insufficient resources for UDP send or PC link transmission. ・ The UDP socket was used to make the transmit request when the buffer in the EN311 became full without taking the receive data over to the T3H side.

Appendix 4 Limitations on the T3H SEND and RECV Instructions

When transmissions using the EN311 occur with high frequency, the T3H internal processing load increases and it is possible for this to interfere with the T3H periodic interrupts and other internal operations. For example, the T3H processing load increase greatly when requests from other stations and requests from the local station occur at the same time in a single EN311, or when transmission requests from multiple installed EN311 units occur at the same time. Therefore, the EN311 must be used with the following limitations enforced.

Usage Recommendations
When using the SEND and RECV instructions: 1. Use transmission modules **mounted in the main base unit**. As compared to modules mounted in the main base unit, modules mounted in an expansion base unit can transmit fewer words of data and the interrupt periods that can be set are longer. 2. When using fixed period interrupt programs, there are limitations on the interrupt periods that can be set. 3. There are limitations on the number of words that can be specified when using the SEND or RECV instruction with each module when multiple transmission modules are mounted.

(1) When using the PC link protocol with the EN311

The number of words that can be set for the SEND and RECV instructions is stipulated to be either:

- The **number of words that the local station transmitted** with the SEND instruction.

or:

- The **number of words that the local T3H transmitted** in response to a data request issued with the RECV instruction from a remote T3H.

When some number of words are transmitted by the local T3H with the SEND instruction and some other number of words are transmitted due to a RECV instruction request from a remote, we focus on the larger of the two word counts when transmission is through the same transmission module.

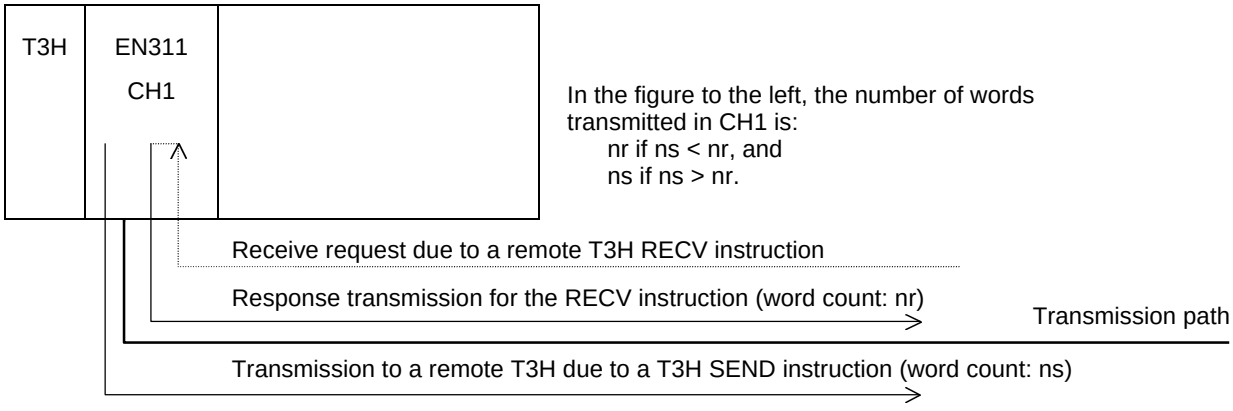


Figure A2 Word Counts Considered with the PC Link Protocol

Table A.6 Number of Words that can be Transmitted Using PC Link Protocol with the EN311

[When TCP/UDP socket transmission is not used]

Number of units installed (main base unit)		Minimum period that can be set for fixed period interrupt programs	Maximum specifiable number of transmission words per channel for local T3H SEND instructions or remote T3H RECV instructions
S20 (LP)	EN311		
None	1 unit	5 ms (minimum)	485 words (maximum)
	2 units	8 ms (minimum)	485 words (maximum)
	3 units	10 ms (minimum)	450 words (maximum)
	4 units	10 ms (minimum)	330 words (maximum)
1 unit	1 unit	6 ms (minimum)	485 words (maximum)
	2 units	9 ms (minimum)	485 words (maximum)
	3 units	10 ms (minimum)	410 words (maximum)
	4 units	10 ms (minimum)	300 words (maximum)
2 units (no interlayer transmission)	1 unit	7 ms (minimum)	485 words (maximum)
	2 units	10 ms (minimum)	485 words (maximum)
	3 units	10 ms (minimum)	360 words (maximum)
	4 units	10 ms (minimum)	260 words (maximum)
2 units (interlayer transmission used)	1 unit	8 ms (minimum)	485 words (maximum)
	2 units	10 ms (minimum)	420 words (maximum)
	3 units	10 ms (minimum)	270 words (maximum)
	4 units	10 ms (minimum)	200 words (maximum)

Conditions for the above table:

a. For the T3H configuration, this table assumes the configuration of figure A3, in which all transmission modules (EN311 and S20(LP)) are mounted in the main base unit.

b. This table assumes that the SEND and RECV instructions appear in the main program for user programs that do not include the ten instructions listed below.

The XFER, READ, WRITE, EI, DI, STLS, STLR, CLND, CLDS, and WDT instructions

c. This table assumes that for each S20(LP), 128 words is specified for PC link protocol transmission (local station SEND and remote station RECV instructions). However, if PC link protocol transmission is not used, use the "None" row for the number of S20(LP) units mounted in the above table, even if there are S20(LP) units installed.

d. If the number of words set with the SEND and RECV instructions is reduced, the length of the interrupt period that can be set for fixed period interrupt programs can be reduced from the values listed in table A6. [See the formulas in supplement 1.]

e. If less than 128 words are used with the S20(LP) PC link protocol transmission, the number of words that can be specified during PC link transmission on the EN311 can be increased over the values listed in table A6. [See the formulas in supplement 1.]

f. If user programs include the instructions listed above, the maximum number of words that can be specified during PC link transmission on the EN311 is reduced from the values listed in table A6. [See the formulas in supplement 1.]

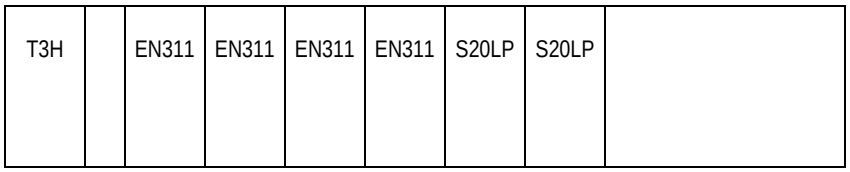


Figure A3 T3H Configuration when Using the PC Link Protocol

(2) When using socket transmission (TCP or UDP) with the EN311

Table A.7 Number of Words that can be Transmitted Using TCP/UDP Socket Transmission with the EN311 [When the PC link protocol is not used]

Number of units installed (main base unit)		Minimum period that can be set for fixed period interrupt programs	Maximum number of words per socket or channel that can be specified in socket transmission.
S20 (LP)	EN311		
None	1 unit	7 ms (minimum)	1000 words (maximum)
	2 units	10 ms (minimum)	700 words (maximum)
	3 units	10 ms (minimum)	460 words (maximum)
	4 units	10 ms (minimum)	340 words (maximum)
1 unit	1 unit	9 ms (minimum)	1000 words (maximum)
	2 units	10 ms (minimum)	630 words (maximum)
	3 units	10 ms (minimum)	420 words (maximum)
	4 units	10 ms (minimum)	310 words (maximum)
2 units (no interlayer transmission)	1 unit	10 ms (minimum)	1000 words (maximum)
	2 units	10 ms (minimum)	560 words (maximum)
	3 units	10 ms (minimum)	370 words (maximum)
	4 units	10 ms (minimum)	270 words (maximum)
2 units (interlayer transmission used)	1 unit	10 ms (minimum)	870 words (maximum)
	2 units	10 ms (minimum)	430 words (maximum)
	3 units	10 ms (minimum)	280 words (maximum)
	4 units	10 ms (minimum)	210 words (maximum)

Conditions for the above table:

a. For the T3H configuration, this table assumes the configuration of figure A4, in which all transmission modules (EN311 and S20(LP)) are mounted in the main base unit.

b. This table assumes that the SEND and RECV instructions appear in the main program for user programs that do not include the ten instructions listed below.

The XFER, READ, WRITE, EI, DI, STLS, STLR, CLND, CLDS, and WDT instructions

c. This table assumes that for each S20(LP), 128 words is specified for PC link protocol transmission (local station SEND and remote station RECV instructions). However, if PC link protocol transmission is not used, use the "None" row for the number of S20(LP) units mounted in the above table, even if there are S20(LP) units installed.

d. If the number of words set with the SEND and RECV instructions is reduced, the length of the interrupt period that can be set for fixed period interrupt programs can be reduced from the values listed in table A7. [See the formulas in supplement 1.]

e. If less than 128 words are used with the S20(LP) PC link protocol transmission, the number of words that can be specified during PC link transmission on the EN311 can be increased over the values listed in table A7. [See the formulas in supplement 1.]

f. If user programs include the instructions listed above, the maximum number of words that can be specified during PC link transmission on the EN311 is reduced from the values listed in table A7. [See the formulas in supplement 1.]

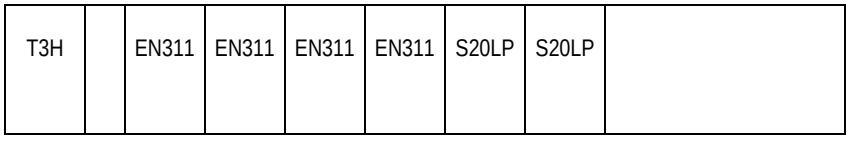


Figure A4 T3H Configuration when Using the Socket Interface

[Supplement 1] Limitation condition formulas for the minimum period that can be set for fixed period interrupt programs and for the maximum number of words that can be specified with the SEND and RECV instructions.

Let Tcyc be the minimum period that can be set for fixed period interrupt programs.

a. When only PC link transmission using the SEND/RECV instructions is used in EN311 channels CH1 to CH4.

For CHi, where i = 1 to 4, let Nsi be the maximum number of words transmitted with the SEND instruction and let Nri be the maximum number of words transmitted due to RECV instruction executed on other stations to this T3H. Then let Ni be the larger of each of these Nsi and Nri values.

$$8000\ [\mu s] > \sum_{i=1}^{4} Ki \times (Ni + 18) + Ts20 + Tx \quad \text{..... (1)}$$

And:

$$Tcyc - 2000\ [\mu s] > \sum_{i=1}^{4} Ki \times (Ni + 18) + Ts20 + Tx \quad \text{..... (2)}$$

Ki = 5.6 [μs].... When the transmission module is mounted in the main base unit

Ki = 9.6 [μs].... When the transmission module is mounted in an expansion base unit

These conditional equations determine Tcyc.

[Ts20 = 0 if no S20(LP) units are installed.]

[Tx = 0 if none of the instructions listed in the box below are used.]

The XFER, READ, WRITE, EI, DI, STLS, STLR, CLND, CLDS, and WDT instructions

b. When only socket transmission (UDP/TCP) is used in EN311 channels CH1 to CH4

For CHi, where i = 1 to 4, Nsi, the maximum number of words transmitted with socket transmission, is given by the following conditional equations.

$$8000\ [\mu s] > \sum_{i=1}^{4} Ki \times (NSi + 8) + Ts20 + Tx \quad \text{..... (3)}$$

And:

$$Tcyc - 2000\ [\mu s] > \sum_{i=1}^{4} Ki \times (NSi + 8) + Ts20 + Tx \quad \text{..... (4)}$$

Ki = 5.6 [μs].... When the transmission module is mounted in the main base unit

Ki = 9.6 [μs].... When the transmission module is mounted in an expansion base unit

These conditional equations determine Tcyc.

[Ts20 = 0 if no S20(LP) units are installed.]

[Tx = 0 if none of the instructions listed in the box below are used.]

The XFER, READ, WRITE, EI, DI, STLS, STLR, CLND, CLDS, and WDT instructions

c. When both PC link transmission with the SEND and RECV instructions and socket transmission (UDP/TCP) are used in EN311 channels CH1 to CH4

For CHi, where i = 1 to 4, let Nsi be the maximum number of words transmitted with the SEND instruction and let Nri be the maximum number of words transmitted due to RECV instruction executed on other stations to this T3H. Then let Ni be the larger of each of these Nsi and Nri values. Also, let NSi be the maximum number of words transmitted in socket transmission.

$$8000\ [\mu s] > \sum_{i=1}^{4} Ki \times (Ni + 18) + \sum_{i=1}^{4} Ki \times (NSi + 8) + Ts20 + Tx \quad \text{.....(5)}$$

And:

$$Tcyc - 2000\ [\mu s] > \sum_{i=1}^{4} Ki \times (Ni + 18) + \sum_{i=1}^{4} Ki \times (NSi + 8) + Ts20 + Tx \quad \text{.....(6)}$$

Ki = 5.6 [μs].... When the transmission module is mounted in the main base unit

Ki = 9.6 [μs].... When the transmission module is mounted in an expansion base unit

These conditional equations determine Tcyc.

[Ts20 = 0 if no S20(LP) units are installed.]

[Tx = 0 if none of the instructions listed in the box below are used.]

The XFER, READ, WRITE, EI, DI, STLS, STLR, CLND, CLDS, and WDT instructions

[Supplement 2]

a. When only PC link transmission in CH1 and/or CH2 S20(LP) units is used

For S20(LP) units in CHi, where i = 1 to 2, let nsi be the maximum number of words transmitted with the SEND instruction and let nri be the maximum number of words transmitted due to RECV instructions executed on other stations with respect to this T3H. Then let ni be the larger of each of these nsi and nri values.

$$Ts20 = \sum_{i=1}^{2} Ki \times (ni + 14) + Tmsg$$

Ki = 5.6 [μs]....When the transmission module is mounted in the main base unit

Ki = 9.6 [μs]....When the transmission module is mounted in an expansion base unit

(Tmsg = 0 when interlayer message transmission is not used.)

b. When two S20(LP) units are installed and interlayer message transmission is used

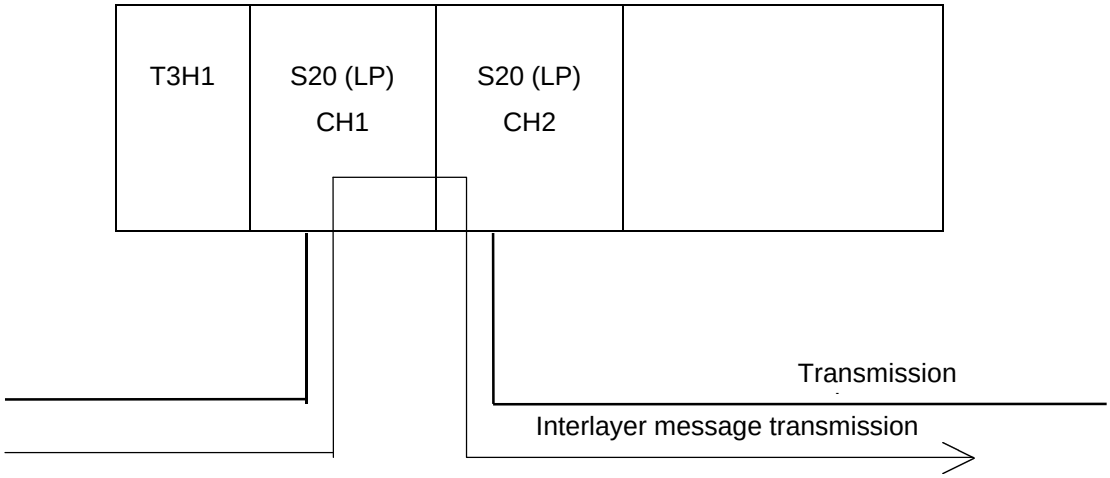


Figure A.5 Interlayer Message Transmission Using S20(LP) Units

When interlayer message transmission is used by, for example, specifying remote programming between S20(LP) layers, the processing time required for interlayer message transmission, Tmsg, is given be the following formula:

$$Tmsg = Ki \times 261$$

Ki = 5.6 [μs]....When both transmission modules are installed in the main base unit

Ki = 9.6 [μs]....When one of the transmission modules is installed in an expansion base unit

c. Let Tx be the maximum instruction execution time when one of the instructions listed in the box below is used.

Refer to the T3 User's Manual - Function manual for the processing times for the instructions listed in the box below.

The XFER, READ, WRITE, EI, DI, STLS, STLR, CLND, CLDS, and WDT instructions

Appendix 5 SEND and RECV Instruction Execution Times

Since execution of the SEND and RECV instructions involves instruction processing that extends across multiple scans, the execution times differ in each of the states at instruction activation time, response wait time, and instruction completion time.

(1) For PC link transmission

The follow operations are performed for PC link transmission:

Scan during instruction activation ... Transmission request or reception request to the remote station

During the next and later scans..... Checking the response wait state from the remote station or completion processing

Table A.8 Instruction Execution Times for PC Link Transmission

CMD	Function	Execution time (ms)			
		SEND instruction		RECV instruction	
21H	PC link	At instruction activation	600 + 5.6N [When mounted in the main base unit]	At instruction activation	600
			600 + 9.6N [When mounted in an expansion base unit]		
		During response wait or completion processing	95/90	During response wait or completion processing	95/90

N: Number of words transmitted (1 to 485)

2. For EN311 module control

The follow operations are performed during EN311 module control:

Scan during instruction activation ...Execution of commands to the local station (EN311)
During the next and later scans.....Checking the response wait state from the local station (EN311) and completion processing

Table A.9 Module Control Request Instruction Execution Times

CMD	Function	Execution time (ms)			
		SEND instruction		RECV instruction	
11H	Reset request	At instruction activation	340	—	
		During response wait or completion processing	95/90		
12H	Parameter setup request	At instruction activation	350	—	
		During response wait or completion processing	95/90		
13H	Operating mode control request	At instruction activation	340	—	
		During response wait or completion processing	95/90		
14H	Remote station verification request	At instruction activation	345	—	
		During response wait or completion processing	95/90		
15H	RAS information readout request	—		At instruction activation	360
				During response wait or completion processing	95/90
18H	Time set request	At instruction activation	350	—	
		During response wait or completion processing	95/90		

3. For socket interface transmission

The following operations are performed during socket interface transmission (TCP/UDP)

Scan during instruction activation ... Transmission requests or reception requests to remote stations

During the next and later scans ..... Checking the response wait state from remote stations or completion processing

Table A.10 Socket Interface Transmission Instruction Execution Times

CMD	Function	Execution time (ms)			
		SEND instruction		RECV instruction	
31H	UDP open request	At instruction activation	375	—	
		During response wait or completion processing	95/90		
32H	UDP send request	At instruction activation	482 + 4.6N [When mounted in the main base unit]	—	
			482 + 8.6N [When mounted in an expansion base unit]		
		During response wait or completion processing	95/90		
33H	UDP receive request	—		At instruction activation	402
				During response wait or completion processing	95/90
34H	UDP close request	At instruction activation	365	—	
		During response wait or completion processing	95/90		
35H	TCP open request	At instruction activation	403	—	
		During response wait or completion processing	95/90		
37H	TCP send request	At instruction activation	433 + 4.6N [When mounted in the main base unit]	—	
			433 + 8.6N [When mounted in an expansion base unit]		
		During response wait or completion processing	95/90		
38H	TCP receive request	—		At instruction activation	384
				During response wait or completion processing	95/90
39H	TCP close request	At instruction activation	365	—	
		During response wait or completion processing	95/90		

N: Number of words transmitted (1 to 1000)

Appendix 6 Minimum Transmission Delay Times

(1) Minimum delay time for computer link protocol transmission

The minimum delay time from the point the host computer issues a request to the T3H to the point a response is received for computer link protocol transmission is:

(Computer link protocol transmission minimum delay time)
= (Host computer transmission processing time) + (T3H response time)

The T3H response time depends on the instructions in the user program and the T3H scan time. When the T3H receives a computer link protocol transmission request, it performs computer link response text creation processing. Normally, the response text creation processing is performed in parallel with user program execution. However, if the user program includes any of the following 12 instructions, the execution of those instructions takes precedence. Therefore, if the user program includes large numbers of these instructions, the response text creation processing will be performed in the empty space in each scan that follows the user program execution time.

The processing time required for response text creation differs for each request command as listed in table A.11. If this processing is not completed in the empty space within the first scan it will be divided across multiple scans continuing with the next scan.

The XFER, READ, WRITE, EI, DI, STLS, STLR, CLND, CLDS, and WDT instructions

Table A.11 Computer Link Response Text Creation Processing Times

Command	Type	Response text creation time (ms)
DR	1 word	1.1
	Continuous, 32 words	2.7
	Multiple types, 32 words	16.6
DW	1 word	1.2
	Continuous, 32 words	3.2
	Multiple types, 32 words	10.2
ER, WT ST, RT SR, S2 EC, TR	—	Less than 1.0
BR	—	2.4
BW	—	3.1
RB	—	3.3
WB	—	4.2
CR	Without comments	0.5
	With comments	3.3
CW	—	4.7

Below we present the technique for calculating the response time at the T3H main unit for computer link protocol transmission.

a. For fixed scan

If a fixed scan period is used, the following condition must be fulfilled:

(T3H scan time) > (User program execution time)

The computer link response text creation processing will be one of the following:

- If the value [(T3H scan time) – (user program execution time)] is larger than the (response text creation processing time), the creation processing can be executed within a single scan. However, due to the timing of the arrival of the request with respect to the T3H scan timing, the time required will be as follows:

  (Response time at the T3H) = (T3H scan time) × 2

- If the value [(T3H scan time) – (user program execution time)] is smaller than the (response text creation processing time), since the processing will be performed across n scans (where n > 1), the time required will be as follows:

  (Response time at the T3H) = (T3H scan time) × (n+1)

  n = int [(response text creation processing time)
  / {(T3H scan time) – (user program execution time)} + 1]

b. For floating scan

If a floating scan period is used, one millisecond is allocated in each scan for computer link response text creation processing, and the time required will be as follows:

(Response time at the T3H) = (T3H scan time) × (n+1)

n = int [(response text creation processing time) / 1 (ms) + 1]

Usage Recommendations
1. There are cases where the transmission delay time will be longer than the calculated value due to details of the actual environment used. Factors that can cause the transmission delay time to increase include network load, EN311 load (on both the local and remote stations), and the T3H operating state.

(2) Minimum delay time for PC link protocol transmission

For PC link protocol transmission instructions, the time from the point the instruction is invoked to the point that instruction completes, that is the transmission delay time from the point a transmission or reception request is initiated to the point the response is received from the remote station will be as follows, assuming no collisions occur on the network and the EN311 units in both the local and remote stations are mounted in the main base units.

(Time from the point an instruction is invoked to the point that instruction completes (in ms))
= (the T3H scan time (in ms)) + 25 ms + ((the number of words transmitted) × 0.035 ms)

PC link protocol transmission differs from computer link protocol transmission in that the PC link protocol processing/responding happens at the remote station at the point the request occurs. Thus the PC link protocol transmission delay time does not depend on the scan time at the remote station.

Usage Recommendations
1. There are cases where the transmission delay time will be longer than the calculated value due to details of the actual environment used. Factors that can cause the transmission delay time to increase include network load, EN311 load (on both the local and remote stations), and the T3H operating state.

Appendix 7 Socket Interface Transmission Processing Time

The send/receive processing times (for the T3H and the EN311) in socket interface transmission can be determined from the following formulas.

Conditions:

1. The EN311 is mounted in the main base unit.
2. Only one socket is used in the EN311.
3. The user program execution time itself is not included.
4. The processing times are given for data size ranges for which no packet division occurs. The size ranges for which packet division does not occur are:

   - UDP: 1 to 736 words
   - TCP: 1 to the maximum receivable segment size determined when the connection was established.
   - UDP send processing time
     (from SEND instruction activation to EN311 transmission completion)
     (UDP send processing time)
     = 7.28 (ms) + 0.0181 (ms) × (the number of words transferred)
   - UDP reception processing time 1: Reception request issued first type
     From the start of EN311 reception to completion of RECV instruction execution
     (UDP reception processing time 1)
     = (T3H scan time)+ 8.35 (ms) + 0.000820 (ms) × (the number of words transferred)
   - UDP reception processing time 2: Socket status monitoring type
     From RECV instruction activation to instruction completion (when EN311 data reception has completed)
     (UDP reception processing time 2)
     = (T3H scan time) + 0.402 (ms) + 0.0056 (ms) × (the number of words transferred)
   - TCP send processing time (from SEND instruction activation to EN311 transmission completion)
     (TCP send processing time)
     = 7.23 (ms) + 0.0174 (ms) × (the number of words transferred)
   - TCP reception processing time 1: Reception request issued first type
     From the start of EN311 reception to completion of RECV instruction execution
     (TCP reception processing time 1)
     = (T3H scan time)+ 14.3 (ms) + 0.105 (ms) × (the number of words transferred)
   - TCP reception processing time 2: Socket status monitoring type
     From RECV instruction activation to instruction completion (when EN311 data reception has completed)
     (TCP reception processing time 2)
     = (T3H scan time) + 0.384 (ms) + 0.0056 (ms) × (the number of words transferred)

Usage Recommendations
1. There are cases where the transmission delay time will be longer than the calculated value due to details of the actual environment used. Factors that can cause the transmission delay time to increase include network load, EN311 load, and the T3H operating state.

Appendix 8.1 Routing Function Addition

1. Routing Function

With the firmware preceding the Rev. E, the EN311 of Attached Diagram 6 was able to exchange data with workstations only. To perform data exchange with the PC in Attached Diagram 6, it is necessary for the EN311 to pass the transmit data to the router. This is called the indirect routing of the routing function and is supported by the firmware of Rev. E.

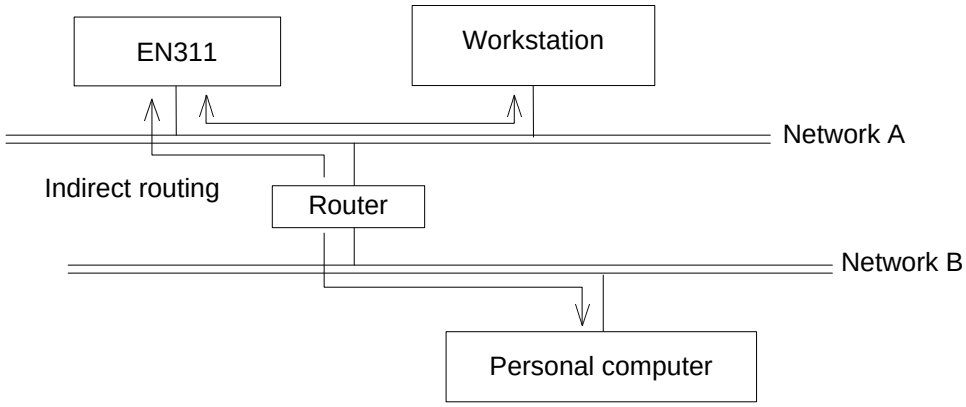


Figure A.6 Direct Routing and Indirect Routing

2. EN311's Indirect Routing

The indirect routing method supported by Rev. E's firmware is a default route method. This method is for sending transmission data to the default router in the event that the destination to which the EN311 is about to send data is not in the same network as that of the EN311.
One router address (IP address) can be registered in the EN311. The destination of this router is required to have the network of the remote station to which the EN311 is intending to send data. To send data from the EN311 on Network A to the workstation on Network B, it is necessary for the IP addresses of Router A to be registered in the EN311.
When using Router A as the router of the EN311, the EN311 cannot send data to PCs on Network C. To transmit data to PCs on Network C, change the mode of the EN311 to Standby and register Router B in the router before changing the mode to Run. In this state, the EN311 cannot transmit data to workstations on Network B.

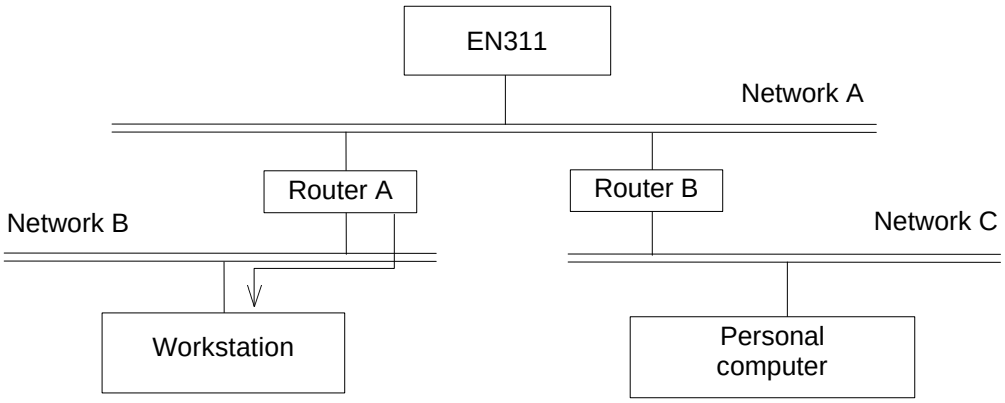


Figure A.7 Direct Routing and Indirect Routing

3. Router IP Address Setup Request (using the SEND instruction)

a. Function

To make a request from the user program to the EN311 in Standby mode, it is necessary to set the IP address of the router. The CMD number is 0019H; and the SEND instruction is used. This request can be used on a combination of the EN311 (Rev. E) and the T3H-V1.2 or up.

b. Transmission parameter configuration

A	3□00H	Module specification, □: Channel number
A+1	CMD=0019H	CMD number.
A+3 A+4	Router's IP address	

·IP address setup method: In the event of "133. 113. 90. 100"

↓

85H. 71H. 5AH.64H

	F 87 0	
B	71H	85H
B+1	64H	5AH

c. Completion status configuration (See figure 4.4 for details on bits C, D, E and F.)

	F	E	D	C	B	A	9	8	7 6 5 4 3 2 1 0
B					0	0	0	0	TermSTS
B+1	Detailed information (Only valid when TermSTS = 0BH.)								

d. Important items

- The EN311 can change its mode to Run with the "Operation Mode Control Request" even without setting the router's IP address. In this case, the routing function does not operate.
- Will result in an error when the EN311 is in Run mode.

  Completion status : "Transmission error" (TermSTS=OBH)

  Detail information : "Station mode error" (0040H)
- Will result in an error when the EN311 is in Down mode.

  Completion status : "Module error" (TermSTS=06H)
- To issue this request, it is necessary to set the own-station IP address. Issuing this request without setting the own-station IP address will result in an error.

  Completion status : "Transmission error" (TermSTS=OBH)

  Detail information : "MAC/IP unset" (0050H)
- If the network address part of the own-station IP address and that of the router IP address differ from each other, it will result in an error as follows.

Completion status : "Transmission error" (TermSTS=OBH)

Detail information : "Station mode error" (0071H)

- Combination of EN311 (before Rev. E) and T3H (earlier than V1.2)

  Completion status : "Parameter error" (TermSTS=03H)

- Combination of EN311 (Rev. E) and T3H (earlier than V1.2)

  Completion status : "Parameter error" (TermSTS=03H)

- Combination of EN311 (before Rev. E) and T3H (V1.2 or up)

  Completion status : "Transmission error" (TermSTS=0BH)

  Detail information : "Request code error" (0072H)

e. Sample program

Router IP address setup request to the EN311 of Channel 1.
This ladder program is executed by setting Contact A of R0509 to ON.

Transfer Parameters

	F 0		Register allocation
A	3100H	Module designation	RW160
A+1	0019H	CMD number.	RW161
A+2	7185H	Router IP address	RW162
A+3	645AH		RW163

Router IP address : 133. 113. 90. 100
↓ ↓ ↓ ↓
85H. 71H. 5AH. 64H

Completion status

	F 0		Register allocation
B		Completion status	RW412
B+1		Detail information	RW413

```
 |R0509                                                          R0609|
1|-| |-------------------------------------------------------------( )-|
 |     |      /* Router IP address setup request. */
 |R0609                                                              |
2|-| |-+[12544 MOV RW160][00025 MOV RW161]----------------------------|
 |     |      /* Module specification, CMD No. setting. */
 |     |                                                             |
 |     +[29061 MOV RW162][25690 MOV RW163]----------------------------|
 |     |      /* Router IP address setting. */
 |     |                                                             |
 |     +[RW160 SEND RW412][RST RW509]---------------------------------|

 |            /* Sets the request. */

 |                                                                   |
```

Parameter : 12544 : 3100H,00025 : 0019H,
29061 : 7185H,25690 : 645AH

Usage Recommendations
When using the SEND and RECV instructions: 1. It is recommended that the TCP socket be used for transmission when connecting the EN311 to LANs in general via router. When using the UDP socket, the computer link or the PC link, the transmission reliability should be secured with receive check and retransmission, etc. on the user program side.

Appendix 8.2 Addition of Error Codes (Detail Information) : The additional portions are highlighted.

Table A.13 Detail Information (EN311 Error Response)(Part 1)

Error	Code	Description
Normal completion	0001H	Normal completion of the request
Own-station failure	0002H	Own-station in Down mode
Own-station standby	0003H	Data transmission (socket interface/PC-link procedure transmission) was requested in Standby mode.
Time out	0020H	Time out occurred in TCP open/receiving or in UDP receiving.
Length error	0030H	The transmission data length is in error
Station mode error	0040H	The following requests were made in other than Standby mode. a) Parameter setup, b) MAC address setting, c) Resetting
MAC/IP non-setup	0050H	In the event that the MAC address or the IP address is not set
Transmission inhibit state	0060H	・ The PC link request was made in Run mode (message transmission inhibit). ・ The socket open/close/transmit/receive request was made in Run mode (socket interface transmission inhibit).
Format error	0070H	Format error in request text.
	0071H	Port No. error / **IP address error**
	0072H	Request code error
	0073H	Time setting: Year
	0074H	Time setting: Month
	0075H	Time setting: Day
	0076H	Time setting: Hour
	0077H	Time setting: Minute
	0078H	Time setting: Second
Opened	0080H	The open request was made to the opened socket.
Not open	0081H	・ The transmit/receive/close request was made to an unopen socket. ・ The TCP socket was used to make the transmit/receive request from the remote station to the socket which is receiving CLOSE (with the RCLOSE bit of the socket status is ON).
Illegal socket identifier	0082H	In the event that the socket identifier lies outside the range (1 to 8)
Illegal control request specification	0083H	Inhibited operation mode control requests were made. ・ Issued the Run request during Run mode. ・ Issued the Standby request during Standby mode. ・ Issued the Run request and the Standby request simultaneously.
LAN controller driver error	0090H	Failed in setting the own-station IP address/port number in the area secured for transmission.
	0091H	・ Errors on the TCP/UDP protocol (such as the transmission phase error) ・ Due to the remote-station down, the TCP socket was used to make the transmission request to the socket where the NOACK bit of the socket status is ON.
	0092H	・ Failed in setting the remote-station IP address for the remote-station information area. ・ The network part of the remote-station IP address differs from that of the own-station IP address.
Memory pool acquisition failure	00A0H	The OS in the EN311 failed in securing memory.
Port-2 task startup failure	00A1H	Failed in obtaining the socket identifier for the computer link or for the PC link.

Table A.13 Detail Information (EN311 Error Response)(Part 2)

Error	Code	Description
Broadcast specification error	00A2H	The destination IP address was set to Broadcast at the other-station check request.
MAC address specification error	00B0H	BCC error
	00B1H	An error occurred after saving the address with the MAC setup request.
Resource shortage error	00C0H	・ The UDP socket or PC link transmission was used to repeat the transmission to the non-existent station in a cycle of less than 100ms. ・ The UDP socket was used to make the transmit request when the buffer in the EN311 became full without taking the receive data over to the T3H side.
Error in receive request (word count) from T3H	00C1H	**Size instructed by user program < Data size received by EN311**
	00C2H	**The size instructed by the user program lies outside the range of "1 to 1000 words".**

Appendix 8-3 Addition of ICMP to MIB Information

From the firmware Rev. E, the ICMP (Internet Control Message Protocol) was added to the MIB information (which is read with the "RAS information read request"). The ICMP informs of the IP packet error and checks the IP network status, etc. Part of other MIB information is also changed.

1. RAS Information Read Request

The MIB information of the ICMP became readable with the RAS information read request. The configuration of other MIB information (LAN controller I/F, IP, TCP, UDP) was also changed. The configuration of the MIB information is shown in Tables A14 to A18.

Transfer Parameters

A	3□00H	Module designation, □ : Channel number
A+1	CMD=0015H	CMD number.
A+2	DRID	a) RAS information storage register type
A+3	DRegNO	b) RAS information storage register leading number
A+4	Kind	c) RAS request type
A+5	Start	d) Starting position: Valid when Kind = 2 or 4
A+6	ReadCnt	e) Read count: Valid when Kind = 4

a) RAS information storage register type

This code specifies the register type storing the RAS information which has been read. For information on the specifiable type code, please refer to Fig. 5.1.

b) RAS information storage register leading number

Specifies the leading number of the register specified with the own-station register type code.

c) RAS request type: Specifies the type of the RAS information which has been read.

1: RAS counter: LAN controller (line) information (see Table 7.2)

2: MIB information: LAN controller I/F, IP, TCP, UDP and ICMP information (see Tables A14 to A18)

3: Maintenance data (cannot be used)

4: Event trace information (see Table 7.7)

5: RAS information clear

d) Starting position: Valid only when the read request type is 2 (MIB information) or 4 (trace information).

If MIB information --- 0 = MIB_IF

1 = MIB_IP

2 = MIB_TCP

3 = MIB_UDP

4 = MIB_ICMP ← Added this time

If trace information: The read starting position (0 to 160) / 0 is the latest information.

e) Read count : Valid only when the read request type is 4 (trace information). 1 to 30 items.

2. RAS Information Details

a) MIB_IF: LAN controller I/F information

13 words' worth is read by means of the RAS information read.

Table A.14 MIB_IF

Symbol Name	Description
MIB_IF[0]	Interface No. usable on this system
MIB_IF[1]	Reservation
MIB_IF[2]	Interface type of the protocol that constitutes IP's lowest level
MIB_IF[3]	Elapsed time since the interface status change
MIB_IF[4]	Total number of octets (bytes) received by the interface
MIB_IF[5]	Number of packets that are not Broadcast/Multicast transferred to the high end
MIB_IF[6]	Number of Broadcast/Multicast packets transferred to the high end
MIB_IF[7]	Number of packets disposed of due to resource restrictions on receipt
MIB_IF[8]	Number of packets disposed of due to format error
MIB_IF[9]	Number of packets sent to the undefined protocol destination
MIB_IF[10]	Total number of octets sent by the interface
MIB_IF[11]	Number of packets from the high end, which are not Broadcast/Multicast
MIB_IF[12]	Number of Broadcast/Multicast packets from the high end

Packet : A data block transmitted in the transmission line(See Figure 7.1) .

b) MIB_IP: IP protocol information

17 words' worth is read by means of the RAS information read.

Table A.15 MIB_IP (Part 1)

Symbol Name	Description
MIB_IP[0]	Flag indicating whether the IP gateway is in operation or not
MIB_IP[1]	Default TTL (Time to Live) of the IP packet
MIB_IP[2]	Total number of IP datagrams received from the LAN controller interface
MIB_IP[3]	Number of IP datagrams disposed of due to format error

Table A.15 MIB_IP (Part 2)

Symbol Name	Description
MIB_IP[4]	Number of IP datagrams disposed of due to erroneous delivery
MIB_IP[5]	Number of IP datagrams that have been issued
MIB_IP[6]	Number of IP datagrams sent to the undefined protocol
MIB_IP[7]	Number of IP datagrams transferred to the higher end
MIB_IP[8]	Number of IP datagrams transferred from the higher end
MIB_IP[9]	Number of datagrams disposed of because the route does not exist
MIB_IP[10]	Maximum value of seconds for received fragments are held waiting to be reassembled
MIB_IP[11]	Number of received IP fragments which need to be reassembled
MIB_IP[12]	Number of IP datagrams which have succeeded in reassembly
MIB_IP[13]	Number of IP datagrams which have failed in reassembly
MIB_IP[14]	Number of IP datagrams which have succeeded in fragmentation
MIB_IP[15]	Number of IP datagrams which have failed in fragmentation, thus disposed of
MIB_IP[16]	Number of IP fragments which have been generated

IP datagram: IP header and IP data part in the packet (see Fig. 7.1)
IP fragment: Divided into multiple IP datagrams when data of more than 1500 bytes is sent.
Reassemble: To return data from fragmented IP datagrams to its original state

c) MIB_TCP: TCP protocol information

10 words' worth is read by means of the RAS information read.

Table A.16 MIB_TCP

Symbol Name	Description
MIB_TCP[0]	Maximum retransmit timeout time (in milliseconds)
MIB_TCP[1]	Number of active open connections
MIB_TCP[2]	Number of passive open connections
MIB_TCP[3]	Number of connection establishment failures
MIB_TCP[4]	Number of connections currently established
MIB_TCP[5]	Number of received segments
MIB_TCP[6]	Number of transmitted segments
MIB_TCP[7]	Number of retransmitted segments
MIB_TCP[8]	Number of segments disposed of due to format error
MIB_TCP[9]	Number of generated resets

Segment: TCP header and TCP data part in the IP datagram (see Fig. 7.1)

d) MIB_UDP: UDP protocol information

4 words' worth is read by means of the RAS information read.

Table A.17 MIB_UDP

Symbol Name	Description
MIB_UDP[0]	Number of UDP datagrams transferred to the higher end
MIB_UDP[1]	Number of UDP datagrams sent to the unused port
MIB_UDP[2]	Number of UDP datagrams disposed of due to format error
MIB_UDP[3]	Number of UDP datagrams transferred from the higher end

UDP datagram: UDP header and UDP data part in the IP datagram (see Fig. 7.1)

e) MIB_ICMP: ICMP protocol information

5 words' worth is read by means of the RAS information read.

Table A.18 MIB_ICMP

Symbol Name	Description
MIB_ICMP[0]	Number of ICMP messages received
MIB_ICMP[1]	Number of ICMP messages determined to contain ICMP-unique error
MIB_ICMP[2]	Total number of ICMP messages transmitted
MIB_ICMP[3]	Reservation
MIB_ICMP[4]	Reservation

Appendix 8.4 Addition of TCP/IP Functions

Table A.19 List of EN311 TCP/IP Functions (Part 1)

Function	Support	Remarks
TCP(Transmission Control Protocol)	○	
URG	○	Supported by Rev. E
ACK	○	
PSH	○	
RST	○	Supported by Rev. E
SYN	○	
FIN	○	
Retransfer (Retransmission timer service)	○	
Window control (Flow control)	○	
Segment partition	○	
Option (Maximum Segment Size)	○	
UDP(User Datagram Protocol)	○	
Checksum	○	
IP(Internet Protocol)	○	
Service type	○	Supported by Rev. E
Option	×	
Fragmentation & reassemble	○	
Direct routing (With the destination on the same network.)	○	
Indirect routing (With the destination not on the same network)	○	Supported by Rev. E
Path control	×	
Default path	○	
Host-specified path	×	
Broadcast transmission	○	
Multicast transmission	×	
TTL (Time to Live)	○	Supported by Rev. E
ICMP(Internet Control Message Protocol)	○	
Echo reply	○	Supported by Rev. E
Destination unreachable	○	Supported by Rev. E
Source quench	○	Supported by Rev. E
Redirect	○	
Echo request	○	Supported by Rev. E
Time exceeded for a datagram	○	Supported by Rev. E

Table A.19 List of EN311 TCP/IP Functions (Part 2)

Function		Support	Remarks
ICMP(Internet Control Message Protocol)		○	
	Parameter problem on datagram	○	
	Timestamp request	○	
	Timestamp reply	○	
	Information request	○	
	Information reply	×	
	Address mask request	○	
	Address mask reply	×	
ARP(Address Resolution Protocol)		○	
RARP(Reverse Address Resolution Protocol)		×	

Appendix 9 Change/Correct Function on Firmware (Rev. E)

The items which have been changed or corrected on the firmware (Rev. E) are described below.

Table A.20 Comparison of Firmware Versions (between Rev. E and those preceding it)

No		
1	**EN311: Reset switch initialization (T3H: Running)**	
	Before Rev. E	The station status is Standby, thus making it necessary to start various requests to the EN311 after 100ms have elapsed.
	Rev. E	The wait time (100ms) after the station status is changed to Standby became unnecessary.
2	**Other-station check request (Check request to multiple remote stations)**	
	Before Rev. E	If the other-station check request is repeatedly made to multiple remote stations, the "resource shortage error" occurs to the PC link transmission and to the UDP socket transmission.
	Rev. E	Even when the other-station check request is repeatedly made to multiple remote stations, the "resource shortage error" does not occur to the PC link transmission or to the UDP socket transmission.
3	**UDP socket request to send(Remote station which does not exist on the network)**	
	Before Rev. E	Repeating the request to send to a remote station which does not exist on the network results in the following error (Request interval: Less than 100ms).
		Completion status: Transmission error (TermSTS=0BH)
		Detail information: Resource shortage (00C0H)
	Rev. E	Making the request to send to a remote station which does not exist on the network results in the following error.
		Completion status: Transmission error (TermSTS=0BH)
		Detail information: Time out (0020H)
4	**TCP socket active open (Remote station which does not exist on the network)**	
	Before Rev. E	Refers to the error code when the active open request is issued to a remote station which does not exist on the network.
		Completion status: Transmission error (TermSTS=0BH)
		Detail information: Time out (0020H)
	Rev. E	Refers to the error code when the active open request is issued to a remote station which does not exist on the network.
		Completion status: Transmission completion time out (TermSTS=06H)
		Detail information: None
		When reissuing the active open request, wait until at least 5 seconds have elapsed from the previous time-out. Reissuing it within 5 seconds will result in the following error.
		Completion status: Transmission error (TermSTS=0BH)
		Detail information: LAN controller driver error (0090H)

Table A.21 Comparison of Firmware Versions (between Rev. E and those preceding it)

No		
5	**TCP socket close request (when the connection is ended from the remote-station side)**	
	Before Rev. E	・ After checking the RCLOSE bit, the close request of the T3H is issued. At the stage that the close request is completed, the open request can be issued by using the same port number for the same socket. ・ Each bit of the socket status is changed to 0 at the point when the close request of the T3H is completed.
	Rev. E	・ **While making sure that the RCLOSE bit is checked at each scanning, issue the close request from the T3H to the relevant socket if it is confirmed that the RCLOSE bit is set to ON. If the active open request is issued to the RCLOSE state socket from the remote station, the RCLOSE state socket returns the reply to the remote station side; therefore, this will cause the remote station side to judge that the connection has been established.** ・ **For reopening with the same port number even when the close request of the T3H is completed, issue the open request after waiting for at least 10 seconds.** **Making the open request by using the same port number within 10 seconds will result in the following error.** Completion status: Transmission error (TermSTS=0BH) Detail information: LAN controller driver error (0090H/0092H) ・ Each bit of the socket status is changed to 0 at the point when the close request of the T3H is completed.

⚠ CAUTION

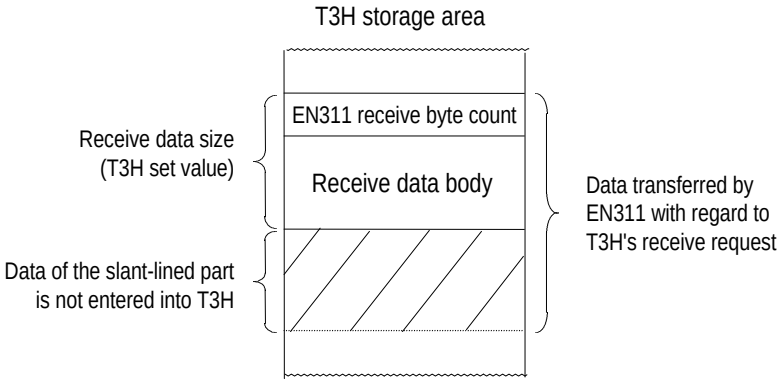
1. From Rev. E on, in the case of the TCP socket, while making sure that the RCLOSE bit is checked at each scanning, issue the close request from the T3H if it is confirmed that the RCLOSE bit is set to ON.
   If the active open request is issued to the RCLOSE state socket from the remote station, the RCLOSE state socket returns the reply to the remote station side; therefore, this will cause the remote station side to judge that the connection has been established.

Table A.22 Comparison of Firmware Versions (between Rev. E and those preceding it)

No		
6	**TCP socket close request (when the connection is ended from the EN311 side)**	
	Before Rev. E	1)The EN311 which has received the close request of the T3H waits for the end request (TCP level) of the remote station side for 15 seconds after transmitting the end request to the remote station. 2) If there is the end request of the remote station side during the waiting time, the EN311 processes the close of the own station. 3)If there is the end request of the remote station side during the waiting time, the EN311 processes the close of the own station and informs the T3H that the processing is completed. **As a result, the close request of the T3H may wait for up to 15 seconds until the close request of the T3H is completed.** ・ At the stage the close request of the T3H is completed, the open request can be issued to the same socket by using the same port number. ・ Each bit of the socket status is changed to 0 at the point when the close request of the T3H is completed. ・ **When the remote station transmits the end request after 15 seconds has elapsed since the EN311 transmitted the end request to the remote station, the EN311 does not reply. Use the application program of the remote station side to monitor periodically the end request of the EN311.**
	Rev. E	1)The EN311 which has received the close request of the T3H completes **the close request of the T3H without the waiting time in order to reply to the T3H that the request was received.** 2) The EN311 waits for the end request (TCP level) of the remote station side for 10 seconds after transmitting the end request to the remote station. 3) If there is the end request of the remote station side during the waiting time, the EN311 processes the close of the own station. 4) Even when the waiting time has run out, the EN311 processes the close of the own station. ・ **If the same port number is used to reopen even when the close request of the T3H is completed, wait for at least 20 seconds before issuing the open request.** **Making the open request by using the same port number within 20 seconds will result in the following error.** Completion status: Transmission error (TermSTS=0BH) Detail information: Opened (0080H) or LAN controller driver error (0090H/0092H) ・ Each bit of the socket status is changed to 0 at the point when the close request of the T3H is completed. ・ **If the remote station transmits the end request to the EN311 after at least 10 seconds have elapsed since the EN311 transmitted the end request to the remote station, the EN311 transmits the "reset packet (TCP packet is used to set the reset bit to ON): Used for forced disconnection of the connection" to the remote station.**

Table A.23 Comparison of Firmware Versions (between Rev. E and those preceding it)

<table>
<tr><th>No</th><th colspan="2"></th></tr>
<tr><td>7</td><td colspan="2">TCP socket receive request (Combined with the T3H-OS version)</td></tr>
<tr><td></td><td>Before Rev. E
+
T3H earlier than V1.2</td><td>・ Make sure that the "receive data size (in words)" in the transmission parameter is specified as 1,000 words.
・ Make sure to secure 1,001 words (2,002 bytes)' worth of spare for the receive data storage register area of the T3H side.
・ If the storage register area is smaller than 1,001 words, the contents of the register area coming after the storage register area may be damaged.</td></tr>
<tr><td></td><td>Before Rev. E
+
T3H V1.2 or up</td><td>・ Make sure that the "receive data size (in words)" in the transmission parameter is specified as 1,000 words.
・ Make sure to secure 1,001 words (2,002 bytes)' worth of spare for the receive data storage register area of the T3H side.
・ If the storage register area is smaller than 1,001 words, the contents of the register area coming after the storage register area may be damaged.

・ Setting no more than 1,000 words for the "receive data size" may result in the following error, depending on the data quantity being received by the EN311.
Completion: Transmission error (TermSTS=10H)
Detail information: Receive data size shortage (00C1H)
・ When this error has occurred, the following data is entered into the receive data storage register area of the T3H side. The data of the slant-lined part is disposed of without being incorporated into the T3H.
・ This is because, with the TCP socket of the EN311 preceding Rev. E, it is so arranged that all the data stored in the own station is transferred to the T3H in response to the receive request of the T3H (the transfer data quantity being up to 1,000 words).
 

・ In the event that no more than 1,000 words have been set for the "receive data size," secure the "receive data size" plus one word's worth of spare for the receive data storage register area of the T3H side.</td></tr>
<tr><td></td><td colspan="2">It is recommended that the T3H (V1.2 or up) be used in combination with the EN311 of the firmware (Rev. E).</td></tr>
</table>

Table A.24 Comparison of Firmware Versions (between Rev. E and those preceding it)

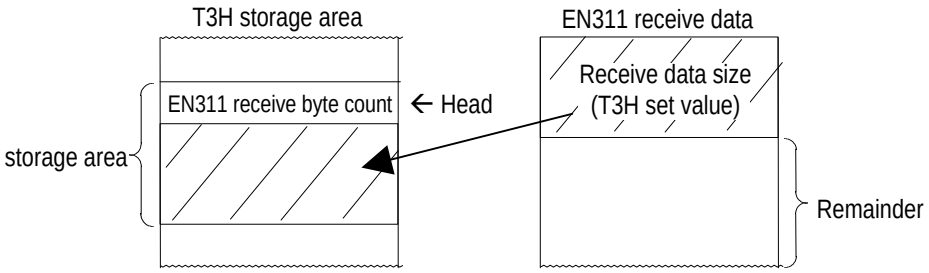
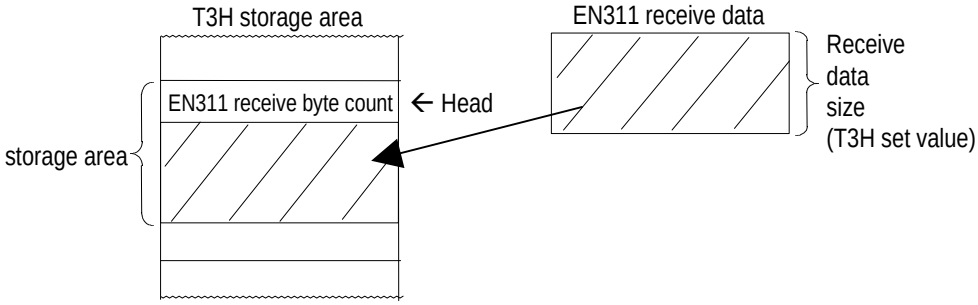
No		
8	**TCP socket receive request (Combined with the T3H-OS version)**	
	Before Rev. E + **T3H earlier than V1.2**	・ The operation on a combination with the T3H earlier than V1.2 is the same as that before Rev. E. ・ The precautions in handling the receive request are the same as for a combination between the EN311 before Rev. E and the T3H earlier than V1.2.
	Rev. E + **T3H V1.2 or up**	・ Data can be taken over from the EN311 to the T3H in terms of the specified quantity of the "receive data size (in words)" in the transmission parameter. ・ Secure the "receive data size" plus one word's worth of spare for the receive data storage register area of the T3H side. If receive data size < Total receive data quantity in EN311 The "receive data size" worth of data is entered into the receive data storage register area of the T3H side from the head of the receive data in the EN311. The remaining data in the EN311 can be taken over to the T3H side by issuing the receive request again from the T3H.  If receive data size ≥ Total receive data quantity in EN311 All of the EN311 receive data is entered into the T3H receive data storage register area. 
	It is recommended that the T3H (V1.2 or up) be used in combination with the EN311 of the firmware (Rev. E).	

Table A.25 Comparison of Firmware Versions (between Rev. E and those preceding it)

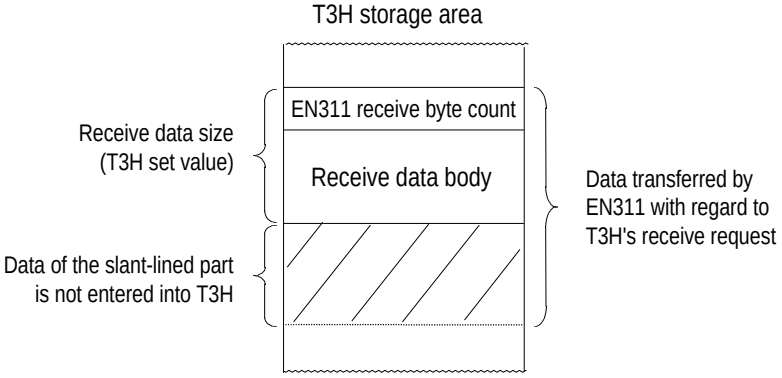
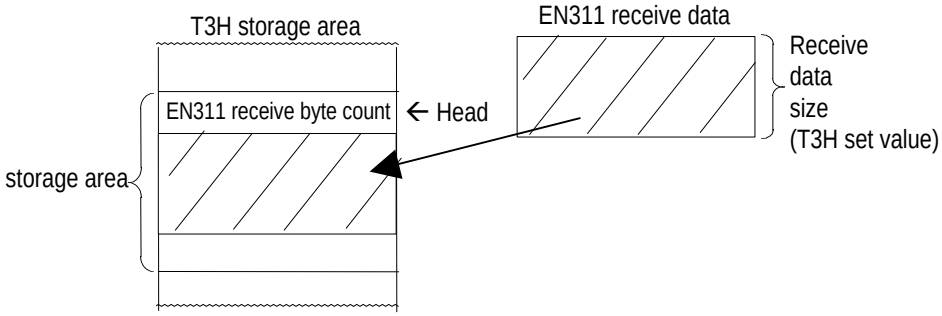
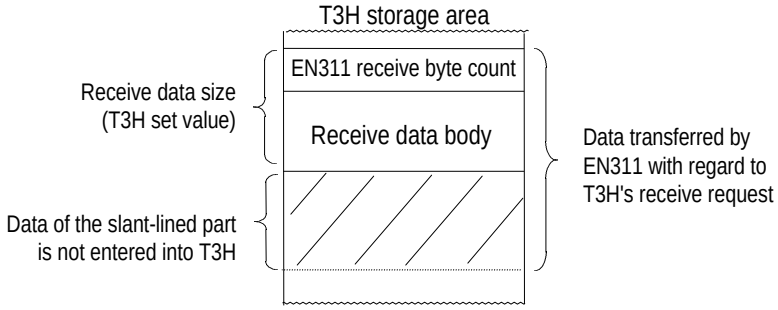
<table>
<tr><th>No</th><th colspan="2"></th></tr>
<tr><td>9</td><td colspan="2">UDP socket receive request (Combined with the T3H-OS version)</td></tr>
<tr><td></td><td>Before Rev. E
+
T3H earlier than V1.2</td><td>・ Make sure that the "receive data size (in words)" in the transmission parameter is a value greater than the maximum size of one-time data sent by the remote station to the relevant socket.
・ Make sure to secure data the size of one time's worth plus the area of one word for the receive data storage register area of the T3H side.
・ If the data the size of one time's worth is greater than the storage register area, the contents of the register area coming after the storage register area may be damaged.</td></tr>
<tr><td></td><td>Before Rev. E
+
T3H V1.2 or up</td><td>・ Make sure that the "receive data size (in words)" in the transmission parameter is a value greater than the maximum size of one-time data sent by the remote station to the relevant socket.
・ Make sure to secure data the size of one time's worth plus the area of one word for the receive data storage register area of the T3H side.
・ If the data the size of one time's worth is greater than the storage register area, the contents of the register area coming after the storage register area may be damaged.</td></tr>
<tr><td></td><td></td><td>・ If the data size of one time's worth is greater than the "receive data size," it may result in the following error.
Completion: Transmission error (TermSTS=10H)
Detail information: Receive data size shortage (00C1H)
・ When this error has occurred, the following data is entered into the receive data storage register area of the T3H side. The data of the slant-lined part is disposed of without being incorporated into the T3H. Neither does it remain in the EN311.
・ This is because, with the UDP socket of the EN311, it is so arranged that the data sent from the remote station is transferred in a batch to the T3H in response to the receive request of the T3H.
 
</td></tr>
<tr><td></td><td colspan="2">It is recommended that the T3H (V1.2 or up) be used in combination with the EN311 of the firmware (Rev. E).</td></tr>
</table>

Table A.26 Comparison of Firmware Versions (between Rev. E and those preceding it)

<table>
<tr><th>No</th><th colspan="2"></th></tr>
<tr><td>10</td><td colspan="2">UDP socket receive request (Combined with the T3H-OS version)</td></tr>
<tr><td></td><td>Before Rev. E
+
T3H earlier than V1.2</td><td>・ The operation on a combination with the T3H earlier than V1.2 is the same as that before Rev.E.
・ The precautions in handling the receive request are the same as for a combination between the EN311 before Rev. E and the T3H earlier than V1.2.</td></tr>
<tr><td></td><td>Rev. E
+
T3H V1.2 or up</td><td>・ Make sure that the "receive data size (in words)" in the transmission parameter is a value greater than the maximum size of one-time data sent by the remote station to the relevant socket.
・ Secure the "receive data size" plus one word's worth for the receive data storage register area of the T3H side.
If receive data size ≥ a quantity of one time's worth of UDP receive data
Data of one time's worth of data is entered into the receive data storage register area of the T3H side.
 

If receive data size < a quantity of one time's worth of UDP receive data
it may result in the following error.
Completion: Transmission error (TermSTS=0BH)
Detail information: Receive data size shortage (00C1H)
When this error has occurred, the following data is entered into the receive data storage register area of the T3H side. The data of the slant-lined part is disposed of without being incorporated into the T3H. Neither does it remain in the EN311. This is because, with the UDP socket of the EN311, it is so arranged that the data sent from the remote station is transferred in a batch to the T3H in response to the receive request of the T3H.
 
</td></tr>
<tr><td></td><td colspan="2">It is recommended that the EN311 of the firmware (Rev. E) be used in combination with the T3H V1.2 or up.</td></tr>
</table>

Appendix 10 Change/Correct Functions on Firmware (Rev. F)

Items which have been changed or corrected on the firmware (Rev. E) are described below. The firmware (Rev. E) is introduced from products with the EN311 serial number is 8400001.

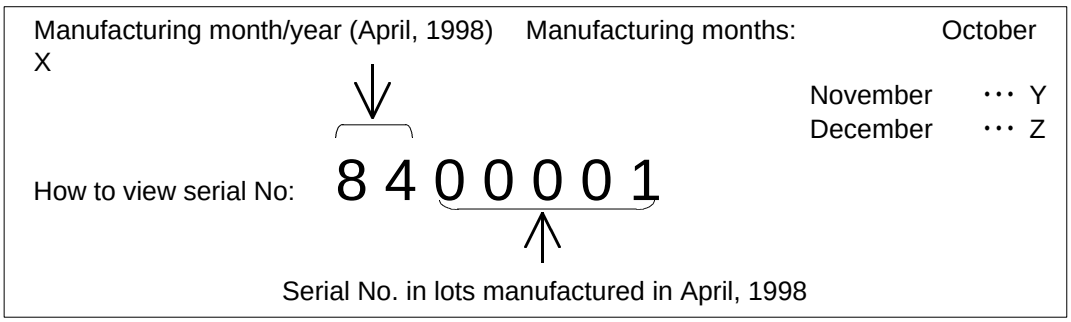


Table A.27 Comparison of Firmware Versions (between Rev. F and those preceding it)

No		
1	**PC link transmission (Immediately after parameter setup request)**	
	Before Rev. F	Start the transmission after 1 second has elapsed since executing the "parameter setup request". Performing the transmission within 1 second will result in the following error. Completion status: Time out (TermSTS=02H)
	Rev. F	The waiting time of 1 second from the "parameter setup request" until the transmission is started is no longer necessary.
2	**TCP socket (Bit with reception)**	
	Before Rev. F	When incorporating the data sent from the remote station into the T3H with the receive request, the bit with reception may be returned to 0 despite data still remaining in the EN311. As a measure to deal with this phenomenon, gather information on the data transmitted from the remote station, check the data quantity to be incorporated with the receive request and, if the transmit data quantity is insufficient, reissue the receive request.
	Rev. F	At the point when the entire data sent from the remote station is incorporated into the T3H side, return the bit with reception to 0.

Measures are also available in Rev. F to deal with the following phenomena that have occurred to the firmware (Rev. E).

Table A.28 Comparison of Firmware Versions (between Rev. F and those preceding it)

No		
1	**TCP active open request (Remote station which does not exist on the network)**	
	Before Rev. F	Do not issue the active open request to the remote station which does not exist on the network. If issued, the first request will result in the time-out error (TermSTS=06H); and the second and later ones will result in the following error. Completion status: Transmission error (TermSTS=0BH) Detail information: LAN controller driver error (0090H) When placed in this state, set the port number of the own station of the active open request to another port number.
	Rev. F	Repeating the active open request to the remote station which does not exist on the network will also result in the following error. Completion status: Transmission completion time-out (TermSTS=06H) Detail information: None However, when reissuing the active open request, make sure to wait for at least 5 seconds after the previous time-out.