WS01-PSTF1-E
Protocol Support Tool

Operation Manual

Produced August 1997

Notice:

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

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

⚠ DANGER Indicates information that, if not heeded, is likely to result in loss of life or serious injury.

⚠ WARNING Indicates information that, if not heeded, could possibly result in loss of life or serious injury.

⚠ Caution Indicates information that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.

OMRON Product References

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

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

The abbreviation “PLC” means Programmable Controller and the abbreviation “PC” means personal computer and are not used as abbreviations for anything else.

The abbreviation “PSB” stands for Protocol Support Board and is also used to indicate the Communications Board.

Visual Aids

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

Note Indicates information of particular interest for efficient and convenient operation of the product.

1, 2, 3... 1. Indicates lists of one sort or another, such as procedures, checklists, etc.

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About this Manual:

This manual describes the installation and operation of the Protocol Support Tool and includes the sections described below.

This is one of two manuals provided for the Protocol Support Boards. The other manual is the *C200HW-COM01 to C200HW-COM06-E Communications Board Operation Manual*, and it is provided separately. The *C200HX/C200HG/C200HE Operation Manual* and *Installation Guide* may also be required when developing actual applications.

This manual is intended for the following personnel:

Personnel in charge of installing FA devices
Personnel designing FA systems
Personnel managing FA facilities

Please read this manual carefully and be sure you understand the information provided before attempting to install and/or operate the Protocol Support Tool. **Be sure to read the precautions provided in the following section.**

Section 1 Introduction outlines the Protocol Macro function and the SYSMAC-PST.

Section 2 Environment/Installation/Uninstallation/Starting/Editing outlines the functions of SYSMAC-PST and describes the operating environment, installation procedure, and the setting of the usage environment.

Section 3 Protocol Macro describes details of the Protocol Macro functions.

Section 4 Using the Protocol Macro Function describes various precautions in using the Protocol Macro function.

Section 5 Other Functions describes monitoring PLC words and tracing transmission lines.

Section 6 Hardware Configuration describes the hardware settings that can be configured for SYSMAC-PST.

Section 7 Protocol Creation and Ending describes how to edit and manage protocols and sequences.

Section 8 Editing Send & Receive message and Receive Matrices describes editing and managing send/receive messages and receive matrices.

Section 9 Managing Protocol Data describes how to manage, save, and retrieve protocol data that has been created, and how to transfer the protocol data to the PLC.

Section 10 Trace/Monitor describes monitoring PLC words and the transmission line tracing.

Section 11 Help System describes the on-line help services provided with SYSMAC-PST.

Section 12 Troubleshooting describes the symptoms of errors and the methods for handling them.

Appendix A Creating the Protocol Applications shows some examples of data transmission between personal computers using the Protocol Macro function.

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

PRECAUTIONS

This section provides general precautions for using the Programmable Controller (PLC) and related devices.

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

1 Intended Audience

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

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

2 General Precautions

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

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

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

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

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

3 Safety Precautions

⚠ WARNING Never attempt to disassemble any Units while power is being supplied. Doing so may result in serious electrical shock or electrocution.

⚠ WARNING Never touch any of the terminals while power is being supplied. Doing so may result in serious electrical shock or electrocution.

4 Operating Environment Precautions

Do not operate the control system in the following places.

- Where the PLC is exposed to direct sunlight.
- Where the ambient temperature is below 0°C or over 55°C.
- Where the PLC may be affected by condensation due to radical temperature changes.
- Where the ambient humidity is below 10% or over 90%.
- Where there is any corrosive or inflammable gas.
- Where there is excessive dust, saline air, or metal powder.
- Where the PLC is affected by vibration or shock.
- Where any water, oil, or chemical may splash on the PLC.

⚠ Caution The operating environment of the PLC System can have a large effect on the longevity and reliability of the system. Improper operating environments can lead to malfunction, failure, and other unforeseeable problems with the PLC System. Be sure that the operating environment is within the specified conditions at installation and remains within the specified conditions during the life of the system.

5 Application Precautions

Observe the following precautions when using the PLC.

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

- Always ground the system to 100 Ω or less when installing the system to protect against electrical shock.
- Always turn off the power supply to the PLC before attempting any of the following. Performing any of the following with the power supply turned on may lead to electrical shock:
  - Mounting or removing any Units (e.g., I/O Units, CPU Unit, etc.) or memory cassettes.
  - Assembling any devices or racks.
  - Connecting or disconnecting any cables or wiring.

⚠ Caution Failure to abide by the following precautions could lead to faulty operation or the PLC or the system or could damage the PLC or PLC Units. Always heed these precautions.

- Use the Units only with the power supplies and voltages specified in the operation manuals. Other power supplies and voltages may damage the Units.
- Take measures to stabilize the power supply to conform to the rated supply if it is not stable.
- Provide circuit breakers and other safety measures to provide protection against shorts in external wiring.
- Do not apply voltages exceeding the rated input voltage to Input Units. The Input Units may be destroyed.
- Do not apply voltages exceeding the maximum switching capacity to Output Units. The Output Units may be destroyed.
- Always disconnect the LG terminal when performing withstand voltage tests.
- Install all Units according to instructions in the operation manuals. Improper installation may cause faulty operation.
- Provide proper shielding when installing in the following locations:
  - Locations subject to static electricity or other sources of noise.
  - Locations subject to strong electromagnetic fields.
  - Locations subject to possible exposure to radiation.
  - Locations near to power supply lines.
- Be sure to tighten Backplane screws, terminal screws, and cable connector screws securely.
- Do not attempt to take any Units apart, to repair any Units, or to modify any Units in any way.

⚠ Caution The following precautions are necessary to ensure the general safety of the system. Always heed these precautions.

- Provide double safety mechanisms to handle incorrect signals that can be generated by broken signal lines or momentary power interruptions.
- Provide external interlock circuits, limit circuits, and other safety circuits in addition to any provided within the PLC to ensure safety.

6 Software Operating Procedures

Observe the following precautions when using the Support Tool.

⚠ WARNING Confirm safety at the destination node before transferring a protocol to another node or editing the I/O area. Doing either of these without confirming safety may result in injury.

⚠ Caution Check the user protocol for proper execution before actually running it in the Unit. Not checking the protocol may result in an unexpected operation.

⚠ Caution Confirm that no adverse effect will occur in the system before changing the operating mode of the PLC. Not doing so may result in an unexpected operation.

⚠ Caution Confirm that no adverse effect will occur in the system before changing the present value of any word in the memory area. Not doing so may result in an unexpected operation.

⚠ Caution Confirm that no adverse effect will occur in the system before transferring the communications port A/B settings to the Protocol Support Boards (PSB).

⚠ Caution The SYSMAC-PST and SYSMAC-CPT cannot be connected online when using both at the same time. If the SYSMAC-CPT has been started and connected online, therefore, set the SYSMAC-CPT offline and then connect the SYSMAC-PST online. When connecting the SYSMAC-CPT online, set the SYSMAC-PST offline and then connect the SYSMAC-CPT online.

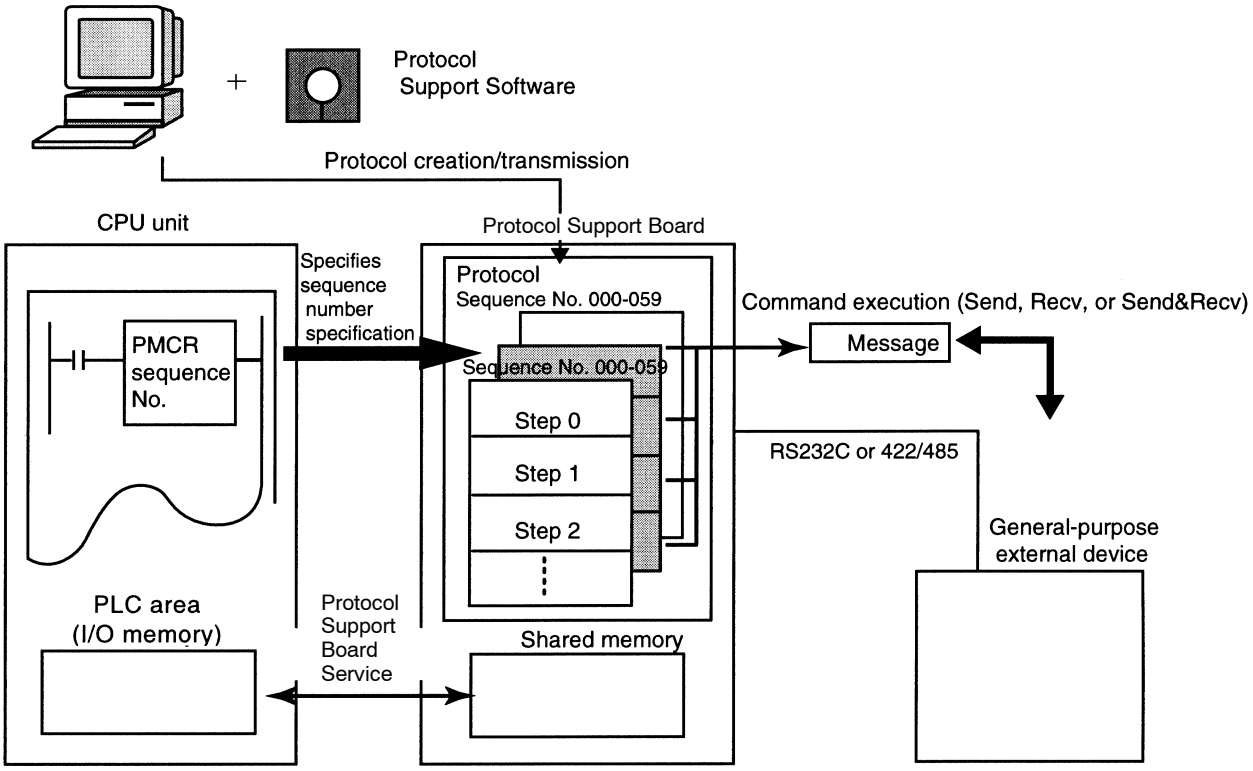
SECTION 1
Introduction

1-1 Protocol Support Tool Outline

The Protocol Support Tool is the software for creating a procedure (or protocol) for sending or receiving data to or from general-purpose external devices connected to a Protocol Support Board (PSB) through RS-232C or RS-485/422.

A protocol consists of a set of communications sequences. The system sends a protocol to the PSB, specifies the sequence number of the protocol using the PMCR instruction on the CPU unit, and executes the communications sequence.

The communications sequence consists of several steps and allows the user to iterate, branch, or end these steps according to the result of the process.



1-2 Features

1-2-1 Features of the Protocol Macro Function

Support for a wide range of communications protocols

Supports communications with almost all external general-purpose devices that have RS-232C or RS-422/485 ports and support half-duplex and start-stop synchronization mode (refer to Section 4-1 for restrictions).

Creation of send frames and receive (expected) frames according to the desired communications frame specifications

Enables creation of almost all send frames (frames composed of commands, data, and so on) and receive (expected) frames (frames composed of responses and so on) according to the communications frame (message) specifications of external devices.

Support for operation functions relating to communications

Supports error check code calculation, frame length calculation during transmission process, and numeral data conversion between ASCII and HEX.

Support for the send and receive time monitoring function

Supports the receive wait monitoring, receive finish monitoring, and send finish monitoring functions. This function lets you specify whether to finish send/re-

ceive process or to start retry process when those monitoring times are exceeded.

Support for retry process

Lets you specify, only by specifying the number of retries, whether to automatically execute send/receive retries when an error occurs.

Integration of variables for read/write process with PLC into send frames and receive (expected) frames

Enables integration of variables for read process from PLC's I/O memory into send frames (messages) themselves. Data in the PLC that has been read during transmission process can be used for addresses (destinations) or data. This function also enables integration of variables for write process to PLC's I/O memory into receive frames (messages) themselves. Addresses (destinations) or data can be written into the PLC during receive process.

Easy realization of rich functions including 1:N communications and switching data write destinations, using repetition variables

Lets you specify repeat variables for send/receive process (repeat counter) in variables. With this function, a wide variety of process can be easily realized: for example, sending the same data to multiple addresses (destinations) by switching them during 1:N communications; switching write destination addresses in PLC's I/O memory during data receive process.

Enhanced functions of the protocol macro function

In addition to the conventional features of the protocol macro function, the following enhanced functions are provided.

Notice that the following functions are available only when your PSB is the C200HW-COM**-EV1.

- SUM2 (2's complement of SUM) and CRC-16 are added as error check codes.
- Repeat counter N current value, sequence End finish flag, and sequence Abort finish flag are added to auxiliary area.
- A check code can be located behind a terminator in messages.
- Swap between high byte and low byte can be specified for error check codes.

1-2-2 Features of the SYSMAC-PST Protocol Support Tool

Simultaneous display of tree (hierarchical) view and list (table) view

The SYSMAC-PST displays data in the form of a tree in the left pane, which gives you easier understanding of hierarchical structure of data you are setting/monitoring.

Object-oriented operation

Double-clicking target data, instead of choosing from menus, opens its corresponding popup dialog, which enables you to create protocols quickly without thorough understanding of operation menus.

Supplied standard system protocols

Data exchange protocols for OMRON's components (temperature controllers, panel meters, bar code readers, modems, and so on) are included as standard system protocols.

Notice that those standard system protocols are included also in the PSB.

Possible to trace send/receive message

By executing the trace function from the SYSMAC-PST, the PSB can trace and save chronological data of send/receive messages upto 670 bytes. Each data can be displayed for reading and saved as trace file.

1-3 Checking the Contents of the Package

After purchase, first, check the contents of your SYSMAC-PST package.

Model of the SYSMAC-PST

Product Name	Model	Setup Disk	Version
Protocol Support Tool	WS01-PSTF1-E	3.5” FD (1.44 MB)	Ver. 1.0

Components of the SYSMAC-PST

Check that all the following components of the SYSMAC-PST are included in your package.

WS01-PSTF1-E

Item	Quantity
Setup disk (3.5”/2HD)	4
Operation manual (this book)	1
User registration card	1

1-4 Supported PLC Models and Personal Computers

1-4-1 Supported PLC Models

The SYSMAC-PST supports the following PLCs (programmable controllers).

Series	Model of CPU Unit
SYSMAC α	C200HX-CPU34-E/44-E/54-E/64-E/34-ZE/44-ZE/54-ZE/64-ZE/65-ZE/85-ZE C200HG-CPU33-E/43-E/53-E/63-E/33-ZE/43-ZE/53-ZE/63-ZE C200HE-CPU-32-E/42-E/32-ZE/42-ZE

1-4-2 Supported PSBs

Product Name	Installation	Model	Enhanced Functions (See Note)	Specifications
PSB	Installed into the CPU unit	C200HW-COM-04-E	---	CPU bus interface + RS-232C port x 1 With the protocol macro function
		C200HW-COM-04-EV1	○	
		C200HW-COM-05-E	---	RS-232C port x 2With the protocol macro function
		C200HW-COM-05-EV1	○	
		C200HW-COM-06-E	---	RS-232C port x 1 + RS-422/485 port x 1 With the protocol macro function
		C200HW-COM-06-EV1	○	

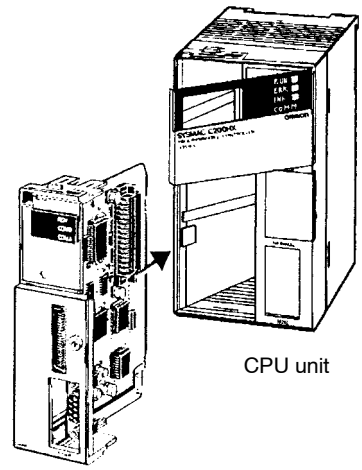
Note The enhanced functions are as follows:

- SUM2 (2’s complement of SUM) and CRC-16 are added as error check codes.
- Repeat counter N current value, sequence End finish flag, and sequence Abort finish flag are added to auxiliary area.
- A check code can be located behind a terminator in messages.
- Swap between high byte and low byte can be specified for error check codes.

1-4-3 Supported Personal Computers

Item	Minimum Requirements	Recommended Requirements
Personal computers	IBM PC/AT or compatible personal computers	
CPU	486DX 100 MHz	Pentium 90 MHz or higher
Operating system	Microsoft Windows 95	
Memory	16 Mbytes	24 Mbytes or more
Hard disk drive	20 Mbytes or more of available area	50 Mbytes or more of available area
Monitor	VGA or higher	SVGA or higher
Floppy disk drive	1 or more drives (1.44-Mbyte drive)	

Note 1. Does not run on Microsoft Windows 3.1.
2. Installing the PSB into the CPU unit

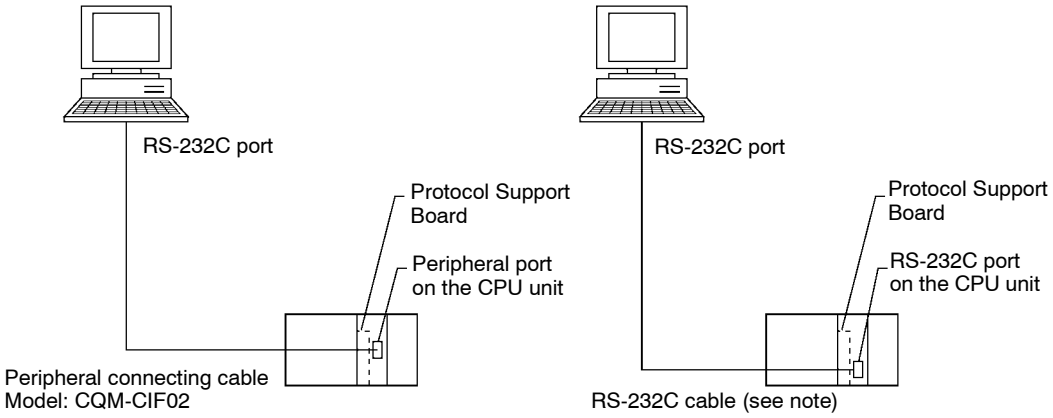


1-5 System Configuration

1-5-1 Connecting the SYSMAC-PST and the PLC

Connect the peripheral port on the CPU unit to the built-in RS-232C port.

Note Can be connected to the PSB port if the port is set to the host link mode.

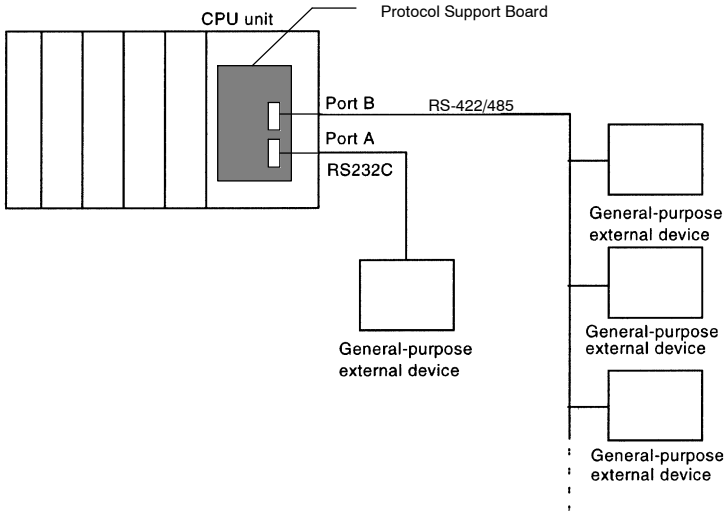


Note 2m model: XW2Z-200S
5m model: XW2Z-500S

Note For IBM PC/AT or compatible computers, a conversion connector from D-SUB 25P (female) to 9P (female) is required for the personal computer side connector.

1-5-2 Connecting the PLC to External Devices

The following figure shows the system configuration of the PSB in the PLC and external devices. The RS-232C port provides 1:1 connection and the RS-422/485 port 1:N connection.



Types of PSBs (Only Models Having the Protocol Macro Function)

Model	Communications Port	Communications Function					
		Protocol Macro	Host link	No-procedural	1:1 link	NT link 1:1, 1:N	CPU bus
C200HW-COM04-EV1	CPU bus interface	---	---	---	---	---	○
	RS-232C (port A)	○	○	○	○	○	---
C200HW-COM05-EV1	RS-232C (port A)	○	○	○	○	○	---
	RS-232C (port B)	○	○	○	○	○	---
C200HW-COM06-EV1	RS-422/485 (port A)	○	○ (see note)	○ (see note)	○ (see note)	○	---
	RS-232C (port B)	○	○	○	○	○	---

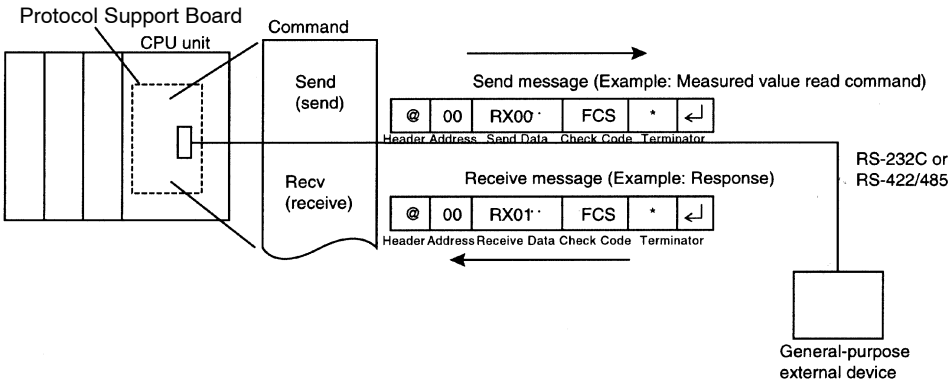
Model C200HW-COM**-EV1: Enhanced function model.

Note Not available for RS-485.

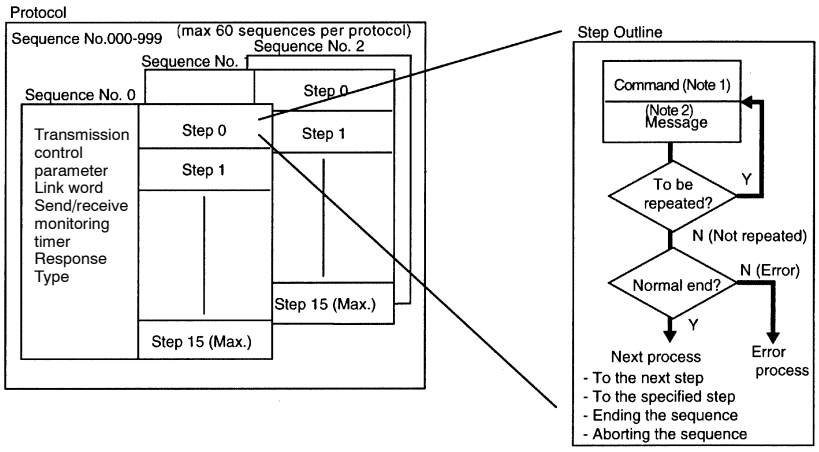
1-6 Protocol Macro Structure

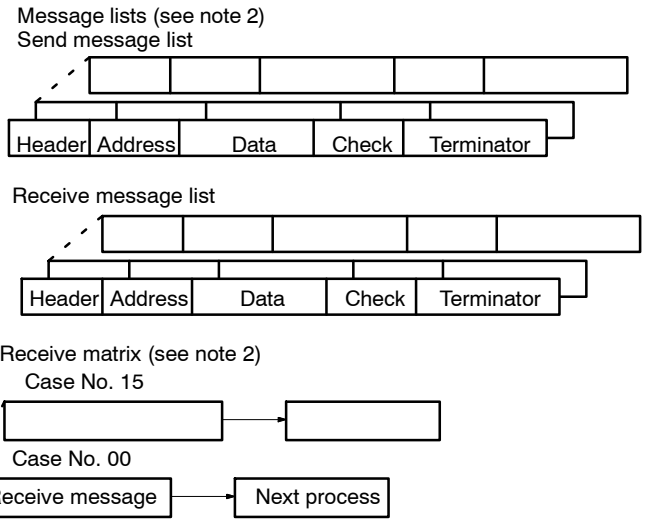
The protocol consists of a communications sequence (”sequence” in short), which is an independent process for the general-purpose external device (for example, reading a process variable from a temperature controller). One sequence consists composed of some steps, each of which is composed of a Send, Recv, or Send&Recv command, send/receive message, branch or end according to the result of the process.

For example, the sequence to read a process value from the temperature controller sends to the controller a send message (a string containing the read command with a header, address, check code, and terminator), and then receives a receive message (a string containing a response to the read command with a header, address, check code, and terminator).



The sequence determines, according to the result of process, whether to send the same send message again (called retry) or execute the next process (for example, reading process value from the temperature controller linked to another address), for example.





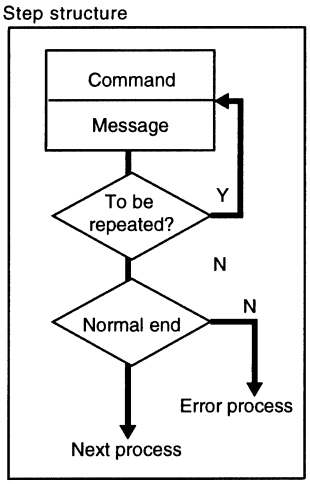
Note 1. The command is the Send, Receive, or Send&Recv command.

- The protocol can retry only on the Send&Recv command.
- The protocol can wait for starting to send a send message on the Send or Send&Recv commands.
- The protocol can select the next process according to the content of the received message, using a receive matrix.

2. There are 3 types of messages: send messages, receive (expected) messages, and receive matrixes that switch processes according to multiple receive (expected) messages. Those messages are managed by lists, separated from sequences.

1-7 Step Structure

Each step has the fixed processing framework as follows. Users create protocols by setting parameters for each framework.



Setup parameters that commonly affects steps (in each sequence)

Parameter	Description
Transmission control parameter	Sets the control mode for control signals including flow control.
Link word	Sets area in which data is shared between the PLC and the PSB.
Monitoring time	Sets monitoring time for send and receive process.
Response type	Sets timing of writing receive data into PLC's I/O memory.

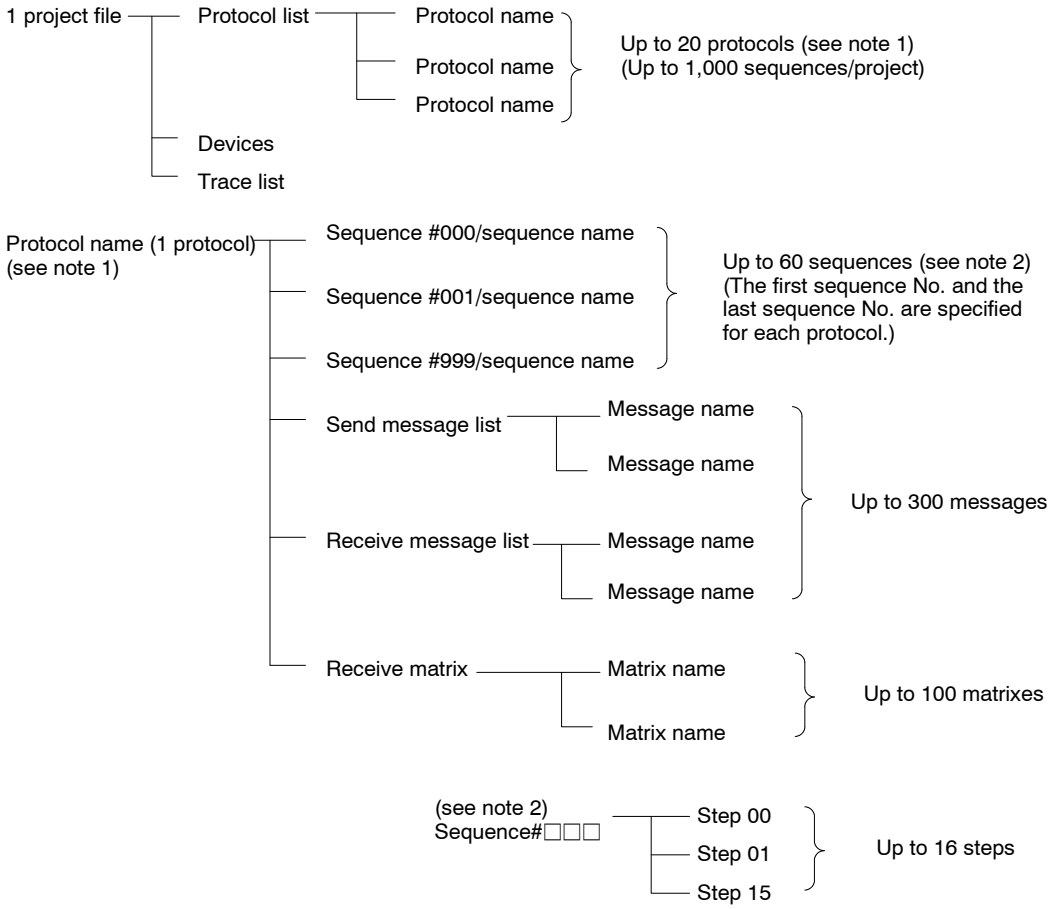
Setup parameters for each step

Parameter		Setup content
Command		Send, Recv, or Send&Recv
Message	Send message	Sets message to be sent for the Send command.
	Receive message	Sets message expected to be received for the Recv command.
	Send message and receive message	Sets messages to be sent and expected to be received for the Send&Recv command
	Receive matrix	Selects the next process according to the content of the received message when the command is Recv, or Send&Recv and max.15 messages can be expected to be received.
Repeat counter		The number of times iterating the step (0-255). Using this parameter N allows to change the content of send and receive messages.
Retry count		(Used only for Send&Recv command) Retries the command when a retry cause such as an error occurs (0-9 times).
Send wait time		(Used only for Send or Send&Recv command) Set the waiting time before starting to send data.
With/Without Response Writing		Specifies whether to write received data.
Next process		Set the next step to which the step transits or the sequence exit if it ends normally.
Error process		Set the next step to which the step transits or the sequence exit if it ends abnormally.

1-8 Data Created by the Protocol Support Tool

The Protocol Support Tool creates/manages data by file unit, called “project”.

Project files consist of the following data:



Project files are stored with an extension .PSW.

The Protocol Support Tool incorporates standard system protocols. The project file that includes these standard system protocols is protocol.bin (read only).

Note To transfer standard system protocols to the PSB or create a new protocol by partially modifying one of the standard system protocols, first copy the required standard system protocol to another project file and then use the project file. The standard system protocols themselves cannot be edited or transferred.

The standard system protocols have been installed into the PSB at our factory.

Files that can be read or written by SYSMAC-PST

Type of PSS file	Content	File extension	Readable	Writable
PST project files (see note)	SYSMAC-PST project files consisting of the following: Protocol data Device (communications conditions between PLC and PC, communications port (A/B) setting of the PSB) Trace data	*.PSW	YES	YES
PSS system setting file	File that contains communications port (A/B) setting data of the PSS Protocol Support Board	*.pts	YES	NO
PSS protocol file	File that contains only PSS protocol data	*.pt1	YES	NO
Trace data file	File that contains only trace data	*.ptr	YES	YES

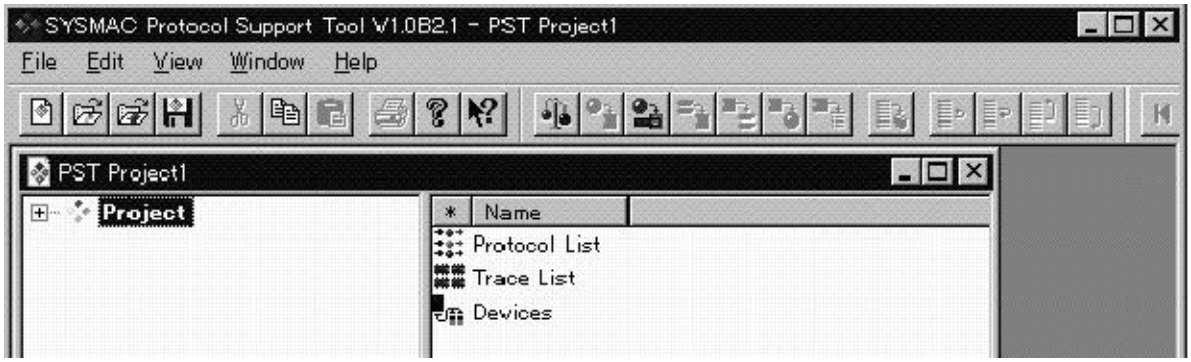
Note PST project files cannot be read by the PSS (Protocol Support Tool of DOS version).

1-9 Major Screens of the Protocol Support Tool

The Protocol Support Tool displays the tree view of the hierarchical data structure in the left pane. For the highlighted data in the left pane, the list view of its contents is displayed in the right pane.

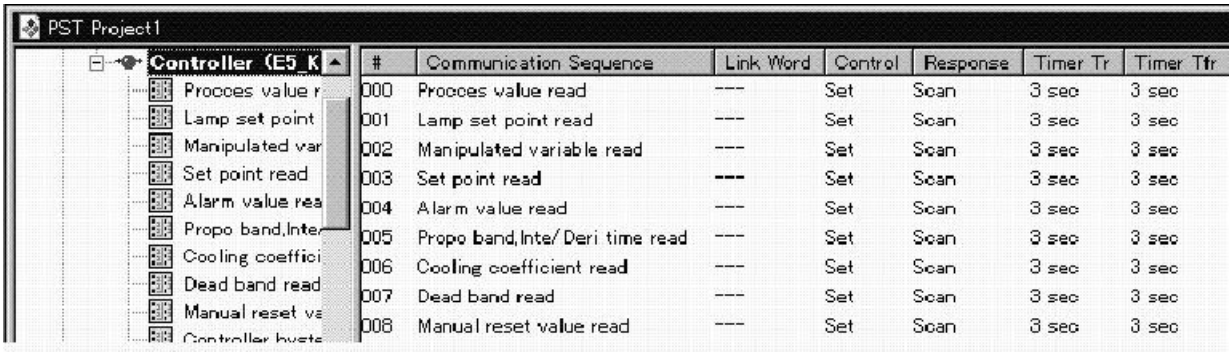
Contents of a project

A project consists of protocol list, trace list, and device manager.



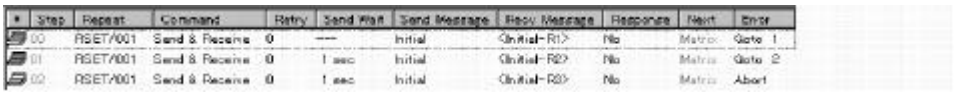
Display of sequences in a protocol

A protocol consists of sequences.



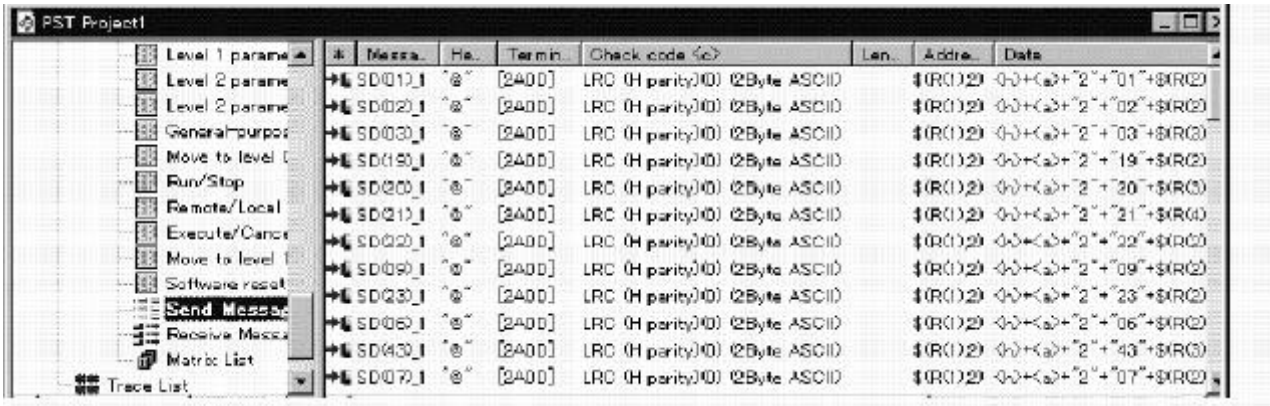
Display of each step in a sequence

A sequence consists of steps and their setup parameters for each sequence (transmission control parameter and so on).



Display of messages in a message list

Messages are managed separately from sequences. Messages can be referred to by their names from each step in a sequence.

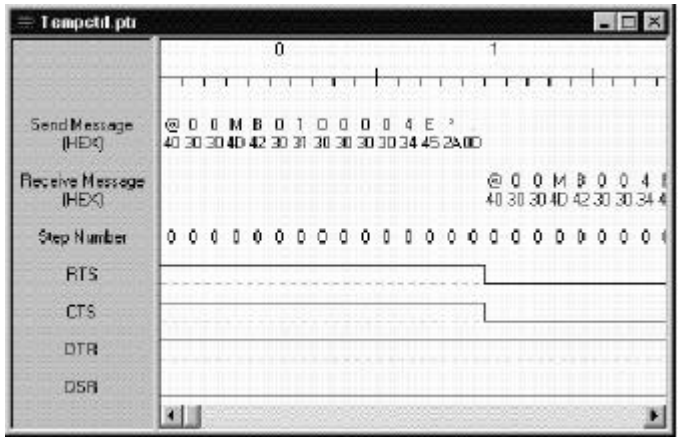


Display of cases in a receive matrix

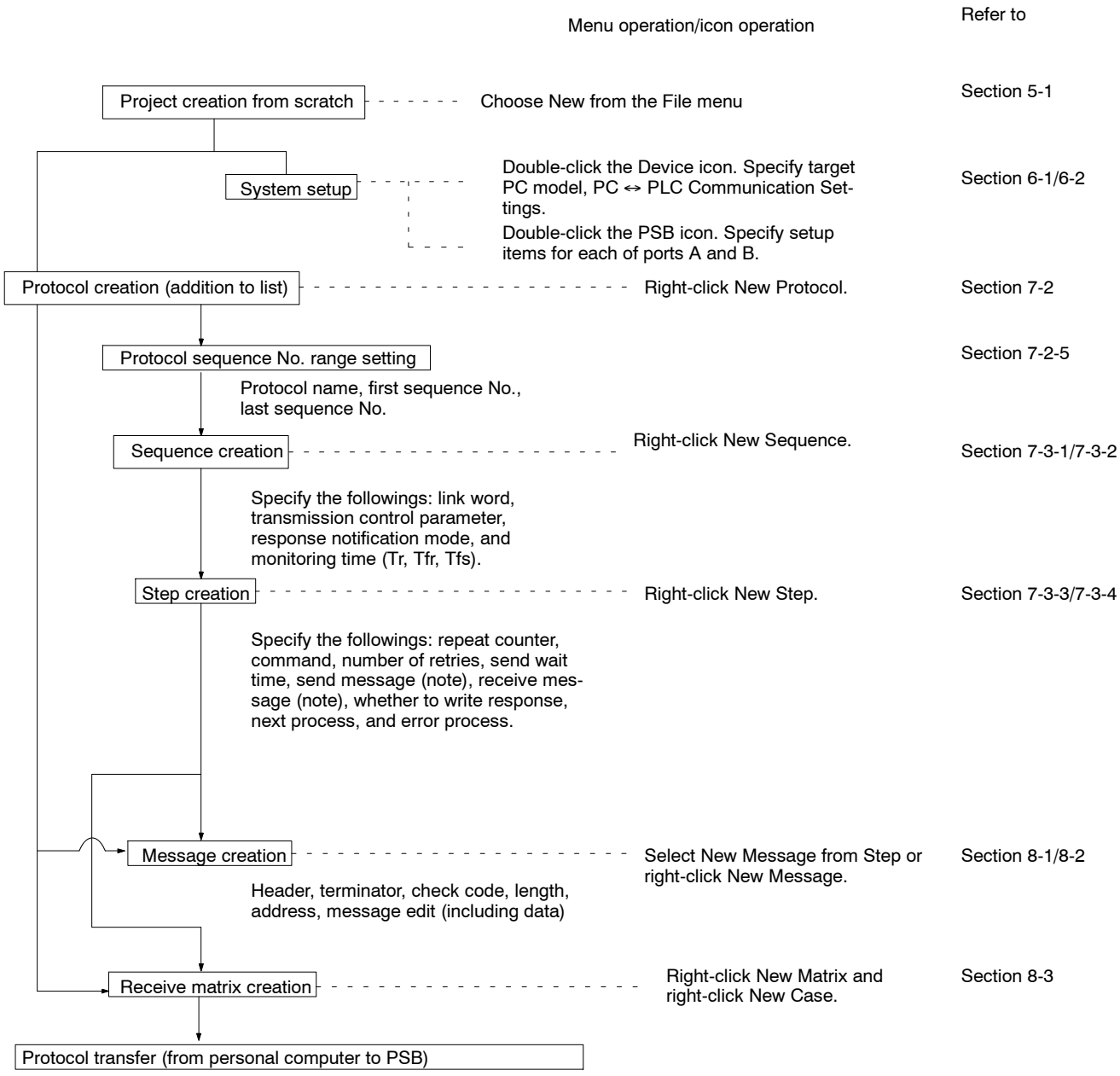
Receive matrixes are managed separately from sequences. Matrixes can be referred to by their names from each step in a sequence.

Display of trace data

Displays the send and receive messages in chronological order up to the maximum of 670 bytes (characters).



1-10 Overview of Flow of Project Creation



Note

- A send message in a step can be specified by choosing its message name in the send message list.
- A receive message in a step can be specified by choosing its message name in the receive message list or receive matrix name in the receive matrix list.
- Therefore, you can create a message part during step creation more easily by choosing a message name of the desired send message, receive message, or receive matrix that you have created in advance.

1-11 Incorporated Standard System Protocol

The Protocol Support Tool provides the following 12 types of incorporated standard system protocols.

Choose File and then Load Standard Protocol from the main menu to load them.

Note To transfer standard system protocols to the PSB or create a new protocol by partially modifying one of the standard system protocols, first copy the required standard system protocol to another project file and then use the project file. The standard system protocols themselves cannot be edited or transferred.

The standard system protocols have been installed into the PSB at our factory.

Protocol Name	Function
E5_K Digital Controller Read	Protocol for controlling an E5_K Digital Controller via the PSB. Procedures for reading the MV the operating parameter setting.
E5_K Digital Controller Write	Protocol for controlling an E5_K Digital Controller via the PSB. Procedures for writing set points and operating parameters.
E5ZE Temperature Controller Read	Protocol for controlling an E5ZE Temperature Controller via the PSB. Procedures for reading measured temperature and operating parameter setting.
E5ZE Temperature Controller Write	Protocol for controlling an E5ZE Temperature Controller via the PSB. Procedures for writing control temperatures and operating parameters.
E5_J Temperature Controller	Protocol for controlling a E5_J Temperature Controller via the PSB. Procedures for writing set points, reading output amounts, and reading/writing operating parameters.
ES100_ Controller	Protocol for controlling a ES100 Temperature Controller via the PSB. Procedures for writing adjustment parameters, reading operation amounts, and writing/reading operating parameters.
Digital Panel Meter	Protocol for controlling a Digital Panel Meter via the PSB. Procedures for writing comparison values and reading display values are set.
V500/V520 Bar Code Reader	Protocol for controlling a Bar Code Reader via the PSB. Procedures for controlling the Bar Code Reader in remote mode, reading the data that has been read by the Bar Code Reader, and reading/writing operating parameters.
3Z4L Laser Micrometer	Protocol for controlling a Laser Micrometer via the PSB. Procedures for controlling the Laser Micrometer in remote mode, reading measured data, and writing/reading operating parameters.
F200/F300/F350 Visual Inspection Systems	Protocol for controlling a Visual Inspection System via the PSB. Procedures for controlling the Visual Inspection System in remote mode, reading measured values, and writing/reading operating parameters.
V600/V620 ID Controllers	Protocol for controlling an ID Controller via the PSB. Procedures for performing Read/Write operations of the ID Controller and writing/reading operating parameters.
Hayes modem AT commands	Protocol for controlling a Hayes modem (AT commands) via the PSB. Procedures for initialization of the modem, dialing, data transmission, switching to escape mode, and disconnecting the line.

For more information on each protocol, refer to the Communications Board Operation Manual (No. W304).

Example: Protocol for the Controller (E5_K read)

Sequence No.	Communications Sequence
000	Read process value
001	Read set point during SP ramp
002	Read MV
003	Read set point
004	Read alarm value
005	Read proportional band, integral time, and derivative time

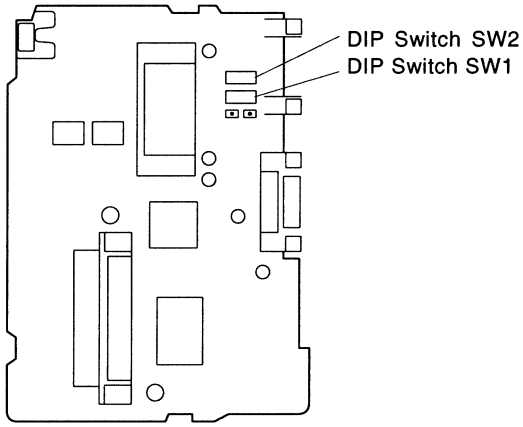
1-12 Basic Procedure of the Protocol Macro Usage

Procedure 1 PSB Setup

DIP Switches Setup on the PSB (For the C200HW-COM06-EV1 model only)

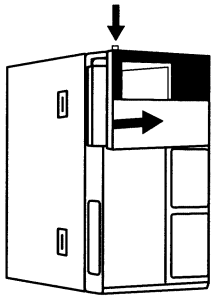
SW1: Switch between two-wire and four-wire methods

SW2: On/Off of terminator resistance (On during using RS-422/485 board)

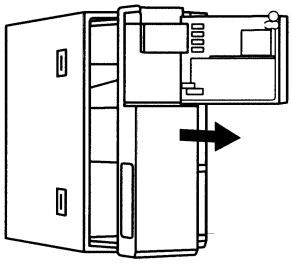


Procedure 2 PSB Mounting

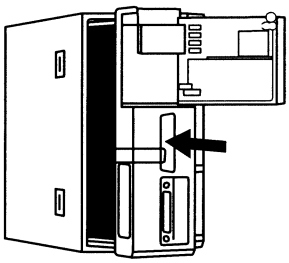
1, 2, 3... 1. Open the memory cassette cover.



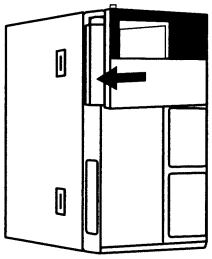
2. Remove the PSB cover.



3. Insert the PSB sliding in the slit completely.

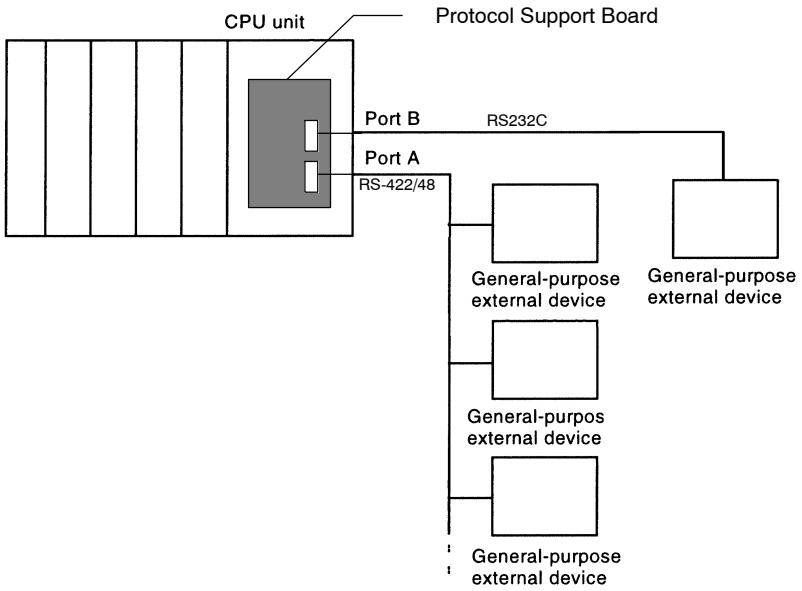


4. Close the memory cassette cover.



Procedure 3 Connection with External Devices

Connect through RS-232C or RS-422/485.



Note For connector pin arrangements and connection methods, refer to the SYSMAC Communications Board Operation Manual (W304) and other relevant manuals for general-purpose external devices.

Procedure 4 System Setup3.

1, 2, 3...

1. For how to connect cables between the PLC and the SYSMAC-PST, refer to “2.2 Connecting the SYSMAC-PST to PLC”.
2. System setup of the CPU unit and the PSB.

   System setup to connect between the PLC and the SYSMAC-PST.

   Perform the following setups (a) and (b). The communications conditions specified in (a) and (b) must be coherent.

   Target PLC model setting from the personal computer (SYSMAC-PST) and communications setup between the personal computer and the PLC

   a) Using the SYSMAC-CPT or SYSMAC Support Software or Programing Console, specify a target PLC model from the device manager and perform communications setup between the personal computer and the PLC.

   b) PLC system setup on the CPU unit
   Using a peripheral tool for PLC’s CPU unit, perform PLC system setup according to a connected port.

   • When connected to the peripheral port:
   Communications setup of the peripheral port:
   DM6650 - 6654 in PLC system setup

   • When connected to the CPU unit built-in RS-232C port:
   Communications setup of the RS-232C port:
   DM6645 - 6649 in PLC system setup

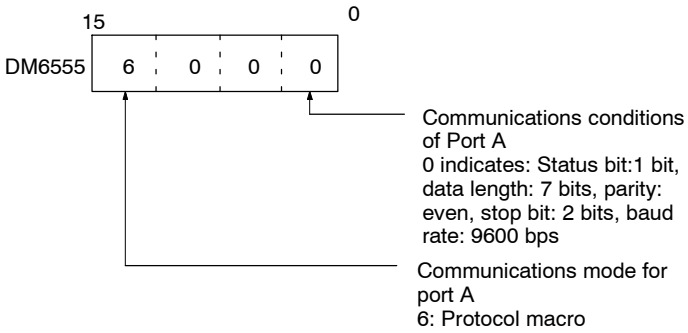
   System setup of the PSB

   Use one of the following methods to perform system setup of the PSB port A/B.

   c) Using a SYSMAC-CPT, SYSMAC Support Software, or Programing Console, perform the following PLC system setup.
   PSB system setup
   Port A: DM6555 - 6559 in PLC system setup
   Port B: DM6550 - 6554 in PLC system setup

   Example: PLC system area DM6555

   Example: When setting communications conditions to the default (standard)



   d) Using the SYSMAC-PST, perform setup of communications port A/B from the device manager and transfer the setting to the PLC.
   For more information, refer to “Transferring Data to the PSB”.

3. Setup of external devices

   Perform required processes including setting up DIP switches on external devices.

Procedure 5 Protocol Design → Refer to the Section 3 and the Section 4

1, 2, 3... 1. Creates the status transition chart of communications sequence.

2. Disassembles the protocol into the sequences and the steps and set them up.

3. Creates the send and the receive messages.

Procedure 6 Project (Protocol Data) Creation and Transfer by SYSMAC-PST

For the brief flow, refer to 1.6.

1, 2, 3... 1. Creates a new project.
Refer to 5-1-1 Create a New Project of 5-1 Project Creation in Section 5.

2. Creates a new communications sequence.
Refer to 7-3-2 Set Sequence List Attribute of 7-3 Edit a Protocol in Section 7.

3. Creates each step.
Refer to 7-3-4 Edit a Step of 7-3 Edit a Protocol in Section 7.

4. Creates each message (Note).
Refer to Section 8 Editing Send & Receive Messages and Receive Matrices.

5. Transfers the created projects to the PSB.

Refer to 9-2 Transfer Protocol Data in Section 9.

Note Each step can be created after each message creation (by specifying the message name).

Procedure 7 The Ladder Program Creation

1, 2, 3... 1. Allocates function code for the PMCR instruction.

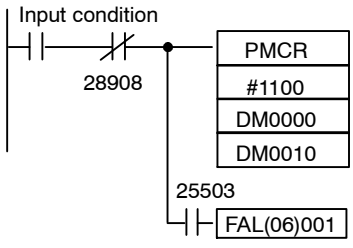
1 Sets to “ON” the DIP switch SW4 of CPU unit (Enable the application commands setup).

1 Allocate function code for the PMCR instruction by a peripheral tool for the CPU unit.

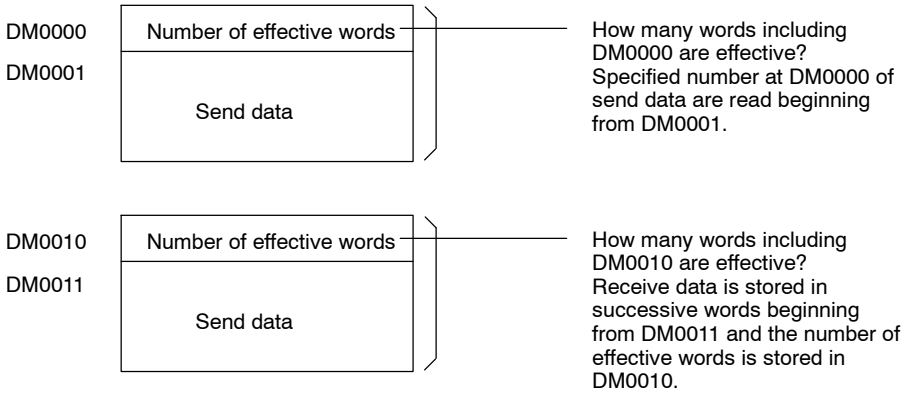
Note If your PLC is the C200H∗-CPU∗∗-ZE, FUN No. 260 is assigned to the PMCR instruction by default.

2. Describes the PMCR instruction.

Example:



When the input condition is set to “ON” and the protocol macro execution flag is set to “OFF”, the communications sequence number 100 registered on PSB is called to send and receive data via port A of the PSB.



3. Execute the PMCR instruction.

Procedure 8 Confirmation of Operations → Refer to Section 10 Trace/Monitor.

1, 2, 3... 1. Traces the transmission lines

Trace the data in the send and the receive messages and the control codes flowing on the transmission line (RS-232C or RS-422/485).

2. Monitors the I/O memory

Monitor the send and the receive data and the status of flags.

1-13 Specifications

1-13-1 Protocol Macro Specifications

Item		Description	
Number of Protocol		20 Max.	Can be created and registered by the Protocol Support Tool.
Number of Sequence		1000 Max.	
Per protocol	Sequence count	60 Max.	
	Message count	300 Max.	
	Receive matrix count	100 Max.	
Number of steps per sequence		16 Max.	
Sequence execution condition		Specified by the PMCR instruction on the PLC's CPU unit (by giving a sequence No.).	
Sequence content (common parameter to all steps)	Transmission control parameters	One of X-on/X-off flow, RTS/CTS flow, delimiter control, or contention control, and modem control can be specified.	
	Response method	(Mode for writing received data to the I/O memory area specified by the third operand of the PMCR instruction.) Either the scan mode or interrupt mode can be specified.	
	Monitoring time for sending/ receiving	Receive wait, receive finish, or send finish can be monitored. Setup range: 0.01-0.99 s, 0.1-9.9 s, 1-99 s, or 1-99 minutes	
	Link word	Data are exchanged between the PLC's CPU unit and the PSB when I/O is refreshed. Two area for sending data, and two area for receiving data.	
Step content	Command	Send, Recv, or Send&Recv	
	Repeat counter	1-255 times	
	Retry count	0-9 (Can be specified only for Send&Recv command)	
	Send wait time	0.01-0.99 s, 0.1-9.9 s, 1-99 s, or 1-99 minutes (Can be specified only for Send or Send&Recv command)	
	With/Without response writing (operand addressing)	Specifies whether to store the receive message after data receiving is completed (when storing received data to the area specified by the third operand of the PMCR instruction.)	
	Next process	Specifies the next process as follows when the step ends normally: End (end the sequence), Next (go to the next step number), Goto (go to a specified step number), or Abort (abort the step to end the sequence).	
	Error process	Specifies the next process as follows when the step ends abnormally: End (end the sequence), Next (go to the next step number), Goto (go to a specified step number), or Abort (abort the step to end the sequence).	
	Send message	Data sent to the specified address when the command is Send or Send&Recv.	Consists of a header (Note 1), address (Note 2), length, data (Note 2), error check code (Note 3), and terminator (Note 1).
	Receive message	Data received from the specified address when the command is Recv or Send&Recv.	

Item		Description					
Step content	Receive matrix	When the command is Recv or Send&Recv, the receive matrix sets up the message expected to be received (up to 15 sets) to switch next process by comparing the data.	Specify a receive message and next process for each of case Nos. 00 - 15. At least one of 16 cases must be specified to Other for its receive message type (other than the specified receive message).				
	Note 1) Data attribute of header and terminator	Constant	ASCII data, HEX data, or control code.				
Step content	Note 2) Address attributes and data attributes in send or receive message	Constant	ASCII data, HEX data, or control code (For address, the control code cannot be used.)				
		Variable	No conversion, HEX to ASCII conversion, or ASCII to HEX conversion (Direction of read / write can be specified.)				
			Specification mode	(X,Y) X: Effective address (source or destination address) Y: Data size (1-255) (Data size is equal to the number of bites on transmission path.)			
			X	Word specification	Word read (I/O memory → send data)	Specified by the second operand of the PMCR instruction	Specified start address + n (The linear expression aN+b, which includes the repeat counter N, can be specified for n.)
						Specified by the link word.	
						Specified directly.	
					Word write (receive data → I/O memory)	Specified by the third operand of the PMCR instruction.	
						Specified by the link word.	
						Specified directly.	
				Wild Card	*	Receive any data/address (only for receive message)	
				Repeat Counter	N		

Item		Description					
Step content	Note 2) Address attributes and data attributes in send or receive message	Variable	Y	Linear expression or constant including the repeat counter	aN+b	a: 0-255 b: 1-255 N: Repeat counter value	
				Wild card	*	Receive any length of data.	
				Word specification	Word read(I/O memory → send data)	Specified by the second operand of the PMCR instruction	Specified start address + n(The linear expression aN + b, which includes the repeat counter N, can be specified for n.)
						Specified by the link word.	
						Specified directly.	
	Note 3) Error check code	Supports calculation of LRC, CRC-CCITT, CRC-16, SUM, and SUM2.					
	The maximum length of the send or the receive message	256 bytes (Except 200 bytes of one-step receiving message at a control of RS/CS flow, X-on/X-off flow, or delimiter)					
Trace function		Possible to trace chronological data of send/receive messages up to 670 bytes (characters). Possible to trace changes in the control signals such as step No., RS, or CS.					

1-13-2 Specifications of the Protocol Support Tool

Item	Description		
Basic function	Creation of protocols, edition of standard system protocols, transfer of protocols to the PSB, tracing/file saving		
File creation unit	Project unit		
	Components of project	Protocol list	Up to 20 protocols (components of protocol: sequence, send/receive message, receive matrix)
		Devices	Target PLC, network setup, comms port setup
		Trace list	
Other functions	- Tracing of transmission lines - Monitoring of PLC's I/O memory - Print of protocols - Standard system protocol procedure		
Supported OS	Microsoft Windows 95		
Supported network	Host link (SYSWAY)		
Connection with PLCs	Peripheral port on the CPU unit or built-in RS-232C or RS-232C port on the PSB (only in the host link mode)		
Personal computers	IBM PC/AT or compatible computer		
CPU	486DX 100 MHz or higher		
Memory	16 Mbytes or more		
Hard disk	20 Mbytes or more of available area		
Monitor	VGA or higher		
Floppy disk drive	1 or more 1.44-Mbyte drives		

SECTION 2
Environment/Installation/Uninstallation/ Starting/Ending

This section outlines the functions of SYSMAC-PST and describes the operating environment, installation procedure, and the setting of the usage environment.

2-1 Environment Requirements

SYSMAC-PST requires the following minimum computer configuration requirements for effective running.

- 100 MHz 80486dx or better CPU.
- At least 16 Mbytes of RAM.
- hard disk storage with at least 20 Mbytes of free space.
- VGA or better display system.
- Microsoft Windows 95.
- Mouse.

SYSMAC-PST operates with the following PLC's which support PSBs.

- C200HX (CPU85, CPU65, CPU64, CPU54, CPU44, CPU34) -E/-ZE.
- C200HE (CPU42, CPU32) -E/-ZE.
- C200HG (CPU63, CPU53, CPU43, CPU33) -E/-ZE.

SYSMAC-PST supports the following PSB's.

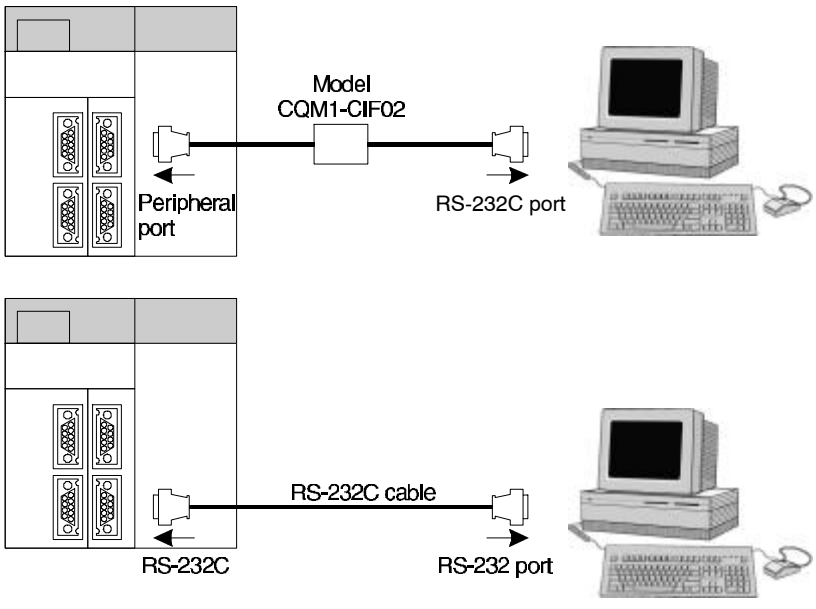
- C200HW-COM04-E/-EV1.
- C200HW-COM05-E/-EV1.
- C200HW-COM06-E/-EV1.

2-2 Connecting to a PLC

When transferring protocol data created by SYSMAC-PST, use the following cables to connect the computer and PLC.

Communications procedure	Cable used	Connector on the computer	Connector on the PC
Peripheral bus	CQM1-CIF02	RS-232C	Peripheral port

Note A personal computer can be connected to the PSB port if the port is set to the host link mode.



When creating a specific RS-232C cable, join the connectors as follows.

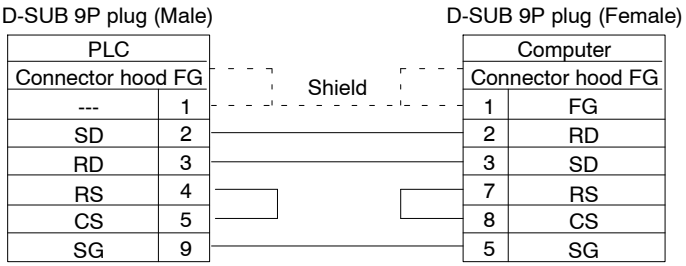
Connectors and Cables

Component name	Model	Manufacturer
D-sub connector (9-pin, PLC side, male)	Model XM2A-0901 (connector)	OMRON
	Model XM2S-0911 (connector hood)	
D-sub connector (9-pin, Computer side, female)	Model XM2D-0901 (connector)	OMRON
	Model XM2S-0911 (connector hood)	
Recommended Cable	UL2464 AWG28 × 5P IFS RVV SB (UL item)	Fujikura Wire
	AWG28P × 5P IFVV-SB (non-UL item)	
	UL2464-SB 5P × AWG28 (UL item)	Hitachi Wire
	CO-MA-VV-SB 5P × AWG28 (non-UL item)	
Wire path length	Up to 15 m	

Connection Signals Computer

Pin number	Symbol	Circuit name
1	FG	Protective Ground
2	RD	Receive Data
3	SD	Send Data
7	RTS	Request To Send
8	CTS	Clear To Send
5	SG	Signal Ground

Wiring Cables The following diagram shows the wiring of cables connecting a PLC and computer:



2-3 Installation

Use the following procedure to install SYSMAC-PST and SYSMAC-CDM (see note) Version 1.3 on to a computer running Microsoft Windows 95.

Note SYSMAC-CDM is a communications-associated application software used in the SYSMAC-PST. Users do not need to be concerned about this software except when installing the software and when error messages are displayed.

If SYSMAC-CPT and SYSMAC-PST applications are installed on the same PC be sure that SYSMAC-CDM will be installed in the same directory for both applications.

1, 2, 3...

1. Turn on the computer and activate Windows 95.

2. Select the **Start** push-button from the taskbar and choose *Settings...*.
3. Select the Windows Control Panel.
4. Select the *Add/Remove Programs* setting
5. The Add/Remove Programs Properties dialog is displayed.

Select the **Install...** push-button to install SYSMAC-PST.

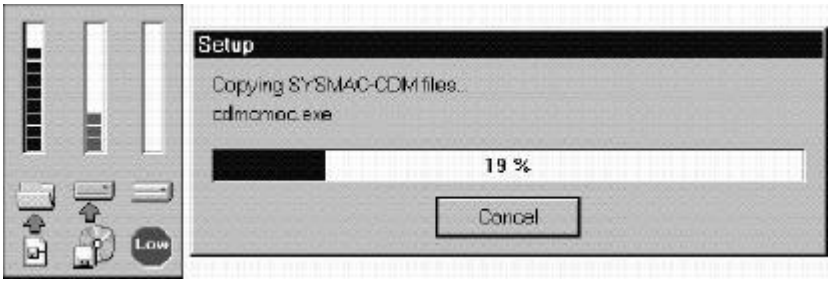
6. Insert disk 1 of SYSMAC-PST into the computer's floppy drive. Select the **Next>** push-button. Ensure that the *Command Line for Installation Program:* field reads "a:\setup.exe", where 'a:\' is the location of the floppy drive (letter case is not important), and select the **Finish** push-button. If required, select the **Browse...** push-button to find the setup.exe file.
7. The setup program takes a few moments to initialise, as indicated by the displayed progress indicator. Once the progress indicator reaches '100%

complete', installation begins. The Welcome dialog is displayed. Read the information on the Welcome dialog and Select the **Next>** push-button.

8. The Choose Destination Location dialog is displayed. Select the **Browse...** push-button to locate a destination directory for SYSMAC-PST. If a destination directory does not currently exist, it is created by the installation process following confirmation by the user. Select the **Next>** push-button to continue.

   Note If any Windows-version support tool other than the SYSMAC-PST has already been installed, such as the SYSMAC-CPT, be sure to install the SYSMAC-PST in the same directory.
   For example, if the SYSMAC-CPT is installed in "C:\Program Files\Sysmac", designate the following drive and path name at the time of installation as in "C:\Program Files\Sysmac\..."

9. If a version of SYSMAC-PST already exists in the selected destination directory, the SYSMAC-PST Already Installed dialog is displayed. Select the **Next>** push-button to overwrite the current version of SYSMAC-PST or the **<Back** push-button to choose a different destination location.
10. The installation process completes by copying files from the floppy disk to the computer. When prompted, insert the required disk in the floppy drive and select the **OK** push-button. If necessary, select the **Browse...** push-button to find the required disk.



The file progress indicator illustrates how far installation of the current file has progressed.

The disk progress indicator illustrates how far installation of the current disk has progressed.

The hard disk progress indicator illustrates how much disk space is left at the destination location.

11. Read the information dialogs that are displayed prior to the closure of the installation program. Select the **Finish** push-button.

⚠ Caution Premature Cancellation of the installation of SYSMAC-PST is not advised as files may have already been copied on to the computer.

2-4 Uninstallation

Use the following procedure to remove SYSMAC-PST and SYSMAC-CDM Version 1.3 from the computer.

1, 2, 3...

1. Select the **Start** push-button from the taskbar and choose *Settings...*.
2. Select the Windows Control Panel.
3. Select the *Add/Remove Programs* setting.
4. The Add/Remove Programs Properties dialog is displayed.

Select the 'SYSMAC-PST' entry from the *Uninstall* and select the **Add/Remove...** push-button.

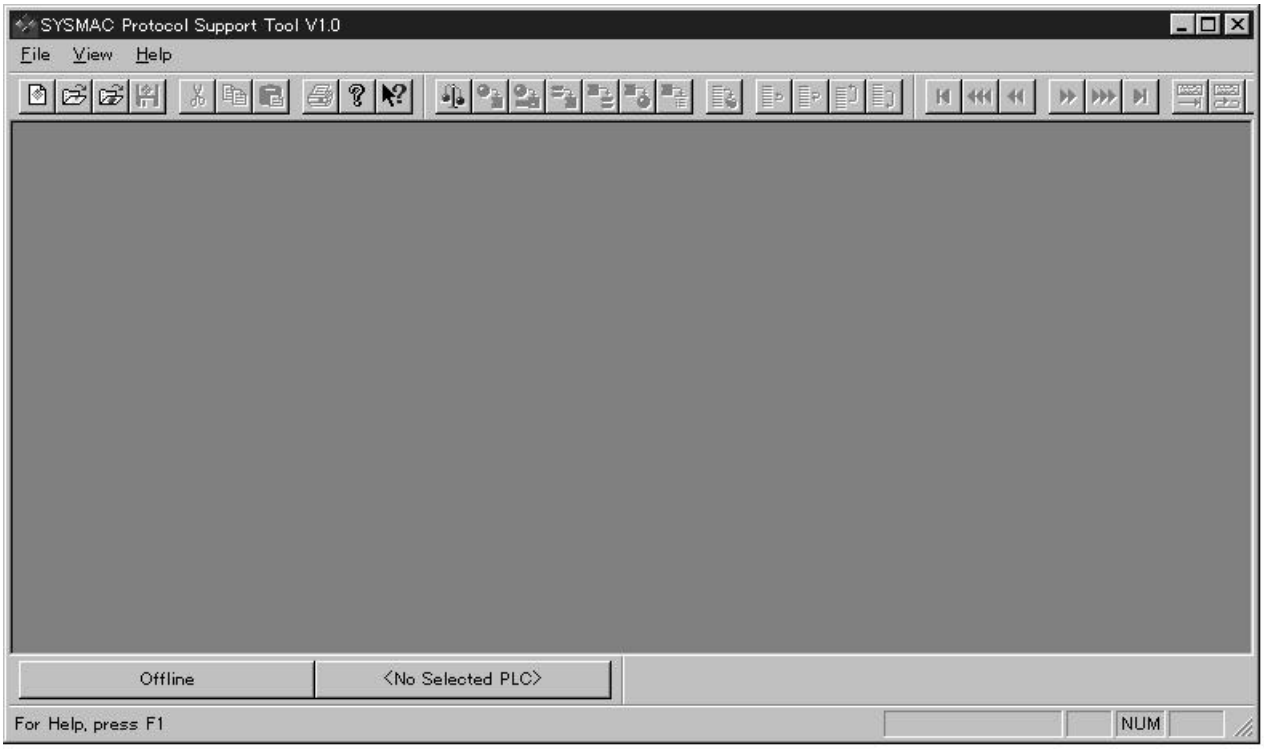
5. SYSMAC-PST and SYSMAC-CDM is removed from the computer. Select the **OK** push-button on confirmation.

2-5 Start Up

Use the following procedure to start SYSMAC-PST.

1, 2, 3...

1. Select the **Start** push-button from the taskbar and choose *Programs...*.
2. Select the **Omron** folder.
3. Select the **SYSMAC-PST** program. SYSMAC-PST is activated.



2-6 Shut Down

Use one of the following methods to shut down SYSMAC-PST.

Select the control menu in the title bar and choose the *Close* option.

Click the right mouse button in the title bar and choose the *Close* option.

Select *File* from the menu bar and select the *Exit* menu option.

Select the **Close** button in the title bar.

Press Alt+F4.

A confirmation dialog is displayed if any information currently open in SYSMAC-PST has not been saved.

Select the **Yes** push-button to Save the changes. Select the **No** push-button to discard the changes. SYSMAC-PST closes. Select the **Cancel** push-button to abort the operation and return to SYSMAC-PST.

2-7 Setting the User Interface

The SYSMAC-PST user interface can be configured to suit the individual needs of the user in a number of ways:

- Setting the display area.
- Moving, removing and re-displaying toolbars within the display area.
- Removing and re-displaying the status bar.

2-7-1 Setting the Display Area

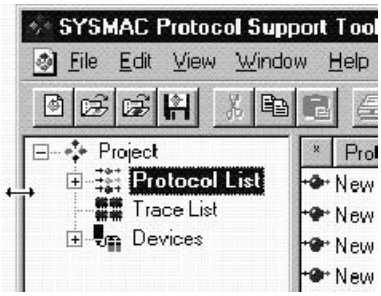
The display area of SYSMAC-PST can be moved and resized in a number of ways.

The display area can be moved by selecting the title bar with the left mouse button and dragging the window to a new destination, or by selecting *Move* from the project window control menu.

Use the following procedure to resize the display area.

1, 2, 3...

1. Move the mouse pointer or input device over a window boundary. The mouse pointer changes shape.

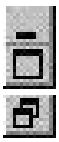


2. Once the mouse pointer has changed, click and hold the left mouse button and drag the boundary to its new position.

Note By selecting the corners of the project window boundary, the project window can be resized ensuring that the aspect ratio of the window is preserved.

A project window can also be resized by selecting *Size* from the project window control menu.

The display area can be maximized to fill the full display or minimized to the taskbar.



To minimize the display area, select the **Minimize** button from the title bar.

To maximize the display area, select the **Maximize** button from the title bar.

To restore the display area to its usual size from its maximized state, select the **Restore** button from the title bar (the **Restore** button replaces the **Maximize** button if the display area is already maximized).

The above functions can also be accessed by selecting the control menu.

2-7-2 Toolbars

The dockable toolbars used by SYSMAC-PST can be moved to maximize use of the display area. The following toolbars are used by SYSMAC-PST.

- The Project toolbar.
- The Protocol toolbar.
- The Trace toolbar.
- The PLC toolbar.

A dockable toolbar can be moved about the display area by selecting the toolbar surround (not a toolbar button) with the left mouse button, and dragging it to its new position in the display area. The toolbar inherits its own title bar if moved from its original position. A double-click in the title bar returns the toolbar to its original position.

To remove a particular toolbar from the display, select *View* from the menu bar, followed appropriately by the *Project Toolbar, Protocol Toolbar, Trace Toolbar* or *PLC Toolbar* option. Repeat this procedure to redisplay the toolbar.

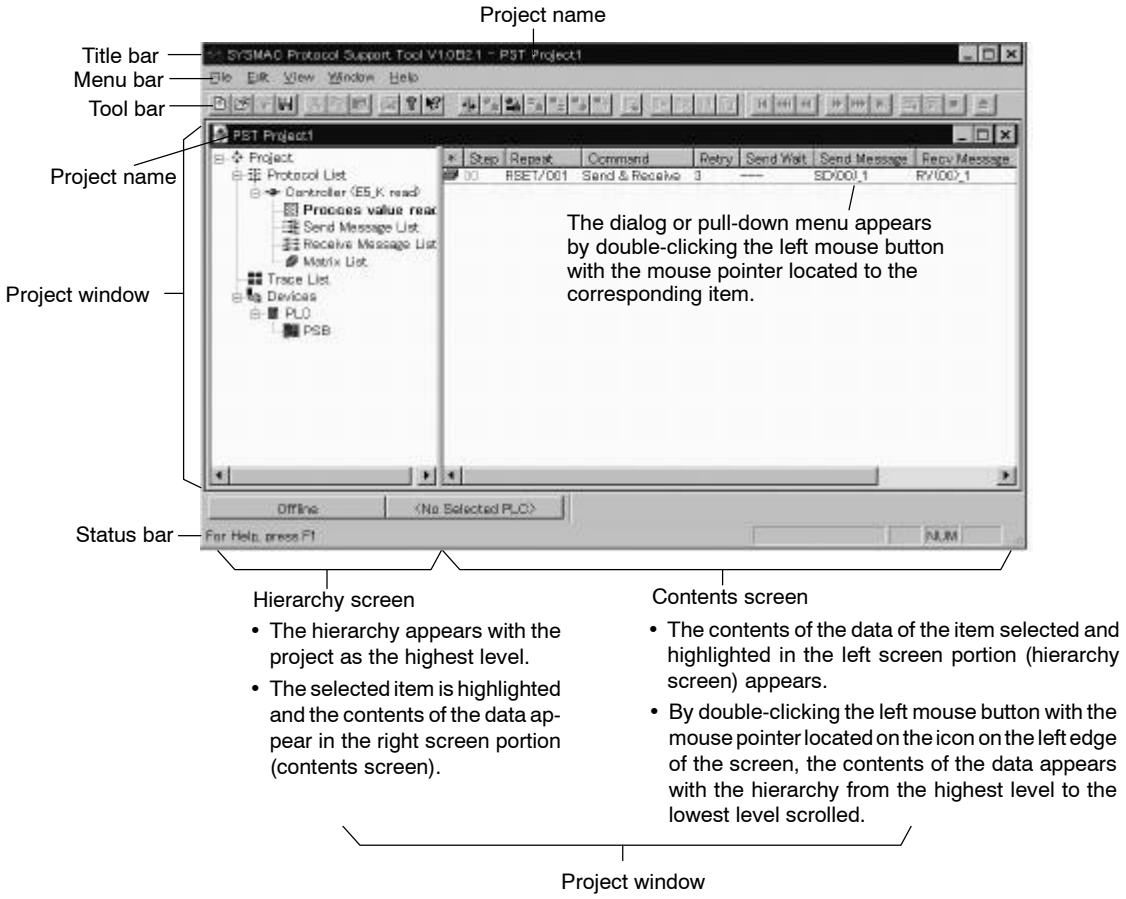
If the toolbar has been moved and has its own title bar, it can be removed by selecting the **Close** button and subsequently redisplayed by using *View* from the menu bar.

2-8 Common User Interface

For clarity, access to functions is not discussed in following sections, but described here.

2-8-1 Outline of Common User Interface

The following is the basic screen configuration provided by SYSMAC-PST.



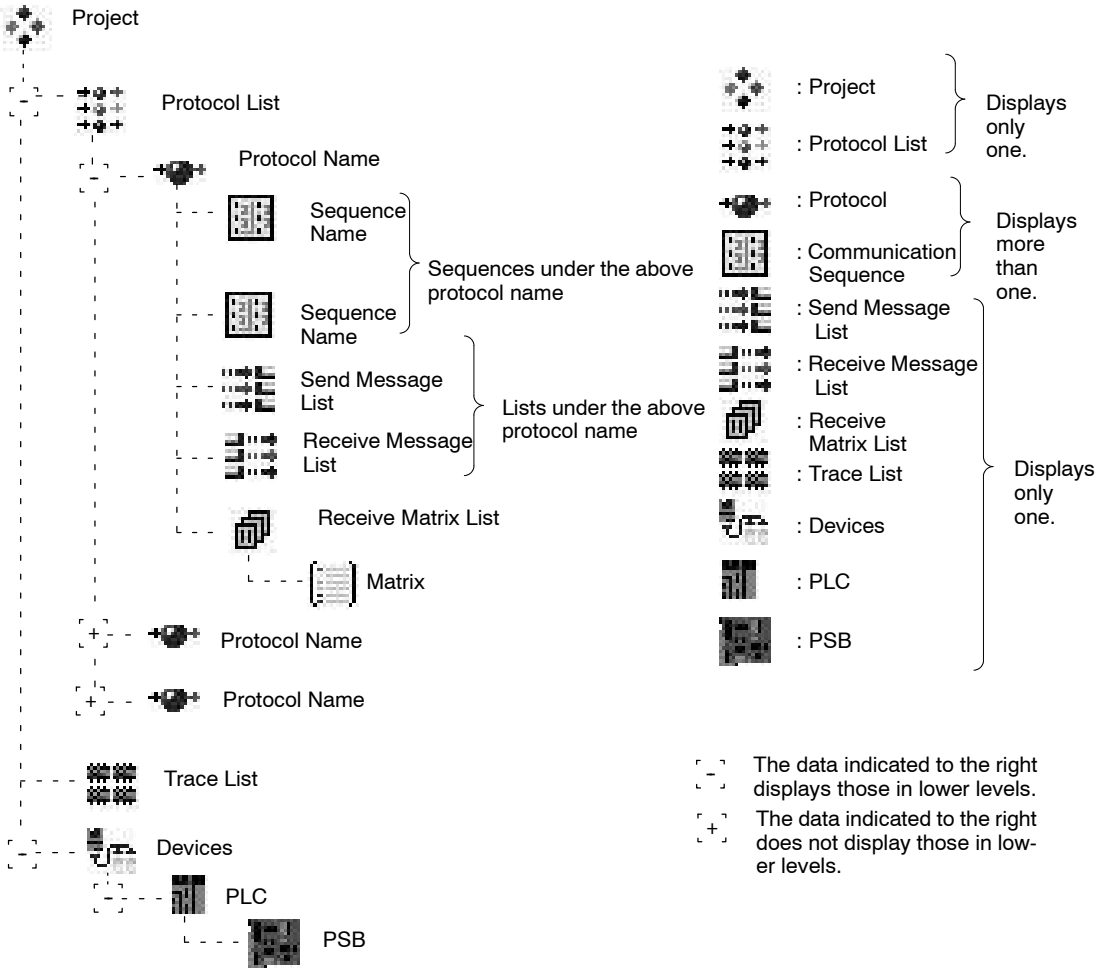
1, 2, 3... 1. The main screen in the project window is divided into two panes (i.e., the left and right panes).
   - The data hierarchy appears in the left pane in a tree format. The left pane is called hierarchy screen.
   - The contents of designated data (i.e., highlighted data) in the left pane appear in a table format in the right screen portion. The right pane is called contents screen.
2. The menu and tool bars are used for basic Windows functions, such as file and edit functions, and protocol and trace operating functions.
3. The following are the basic operations required to create, edit, and download protocols.
   - The screen is scrolled from the highest level to the lowest level where the data in detail can be checked if the left mouse button is double-clicked with the mouse pointer located on the icon in the left or right pane (i.e., the hierarchy or contents screen). By pressing the ESC Key, the screen is scrolled from the lowest level to the highest level.
   - To create a new object, such as a protocol, sequence, step, or message, click the right mouse button with the mouse pointer located on the Edit menu or press the Shift and F10 Keys so that the Edit menu will pop up, and select Create New Object. Then a new object appears in the right pane (contents screen).
   - Data is input into the list in the right pane (contents screen). To input the data, trouble-click the left mouse button with the mouse pointer located on the input-field cell so that the set dialog will appear. Then input the set value into the set dialog.
   - The menu is used for setting the communications port of the PSB, uploading protocols, tracing data, or downloading trace data after clicking the right mouse button with the mouse pointer located on the menu or pressing the Shift and F10 Keys so that the menu will pop up.

Note The pop-up menu appearing with the right mouse button clicked is a useful feature of SYSMAC-PST. The kind of pop-up menu appearing depends on what is pointed while the right mouse button is clicked. The user should understand that the main functions of SYSMAC-PST are available with the pop-up menus of SYSMAC-PST. Such functions include functions used for creating new protocols, sequences, messages, matrices, and matrix cases, setting the communications port of the PSB, uploading protocols, and tracing data.

Project Window

Left Pane (Hierarchy Screen)

Data appears in the following hierarchy.



Right Pane (Contents Screen)

The item appears according to the selected data (i.e., the highlighted data) in the left pane (hierarchy screen).

Selected data in left pane (hierarchy screen)		Item in right pane (contents screen)										
	Project	*	Name	---	---	---	---	---	---	---	---	--- ---
	Protocol List	*	Protocol Name	Seq Start	Seq End	Type	---	---	---	---	---	---
	Protocol Name	*	# (Sequence Number)	Communication Sequence	Link Word	Control	Response	Timer Tr	Timer Tfr	Timer Tfs	---	---
	Sequence Name	*	Step	Repeat	Command	Retry	Send Wait	Send Message	Receive Message	Response	Next	Error
	Send Message List	*	Message Name	Header <h>	Terminator <t>	Check Code <c>	Length <l>	Address <a>	Data	---	---	---
	Receive Message List	*	Message Name	Header <h>	Terminator <t>	Check Code <c>	Length <l>	Address <a>	Data	---	---	---
	Matrix List	*	Matrix Table	Case Steps	---	---	---	---	---	---	---	---
	Matrix	*	Case Number	Receive Message	Next Process	---	---	---	---	---	---	---
	Trace List	*	Description	Uploaded	Size	---	---	---	---	---	---	---
	Devices	*	Device	Current Configuration	---	---	---	---	---	---	---	---
	PLC	*	PLC Component	Description	---	---	---	---	---	---	---	---
	PSB	*	PSB Component	Description	---	---	---	---	---	---	---	---

The highlighting cursor is available in both the left screen portion (hierarchy screen) and the right screen portion (contents screen) of the project window.

The focused portion (i.e., the portion actually selected in operation) is surrounded by ---. If a line in the right screen portion (contents screen) is selected, the focused portion is in the right screen portion (contents screen).

To switch over the focus between the left and right screen portions (hierarchy and contents screens), press the Tab Key or select Focus Select from the View menu or click either of the screens.

4. The mouse, Up, Down, Left, or Right Key, or Function Key can be used to select the elements in projects.

The following operations are available without the mouse.

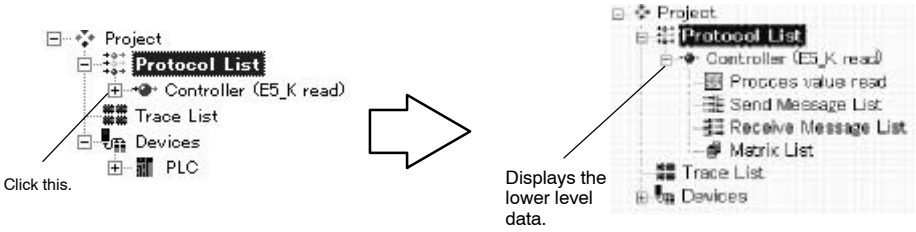
- The following are possible in either of the screens by pressing the Up or Down Key while the focus is in the screen.

The scrolling of the tree in the left screen portion (hierarchy screen).

The scrolling of the rows of the tables in the right screen portion (contents screen).

- The next higher level is reached by pressing the ESC Key or the Backspace Key.
- The right screen portion (contents screen) is scrolled for a single-screen portion whenever the Page-up or Page-down Key is pressed.

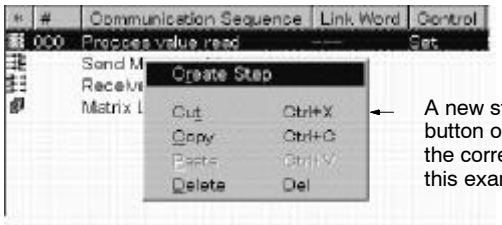
- The next active window of SYSMAC-PST is reached by pressing the Ctrl and F6 Keys or selecting Next Window from the Control menu.
- The size ratio of the left screen portion (hierarchy screen) to the right screen portion (contents screen) is changeable by moving the border line.
- The width of each item in the right screen portion (contents screen) is changeable by moving the border line.
- The hierarchy in the left screen portion (hierarchy screen) is selectable by clicking the "+" or "-" portion. After the "-" portion is clicked, the "+" portion appears at the final hierarchy level, in which case only the display of the left screen portion (hierarchy screen) changes but the display of contents screen does not change.



5. The hierarchy is scrolled downwards by double-clicking the left mouse button with the mouse pointer located on either of the icons or pressing the Down Key while the focus in the screen. The selected and highlighted data in the left screen portion (hierarchy screen) is scrolled.

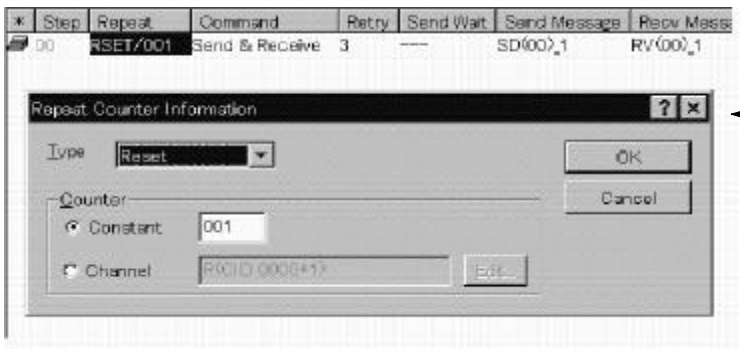
   By pressing the ESC Key or selecting Parent in the View menu, the hierarchy screen is scrolled in the higher level direction.

6. Click the right mouse button with the mouse pointer located on the pop-up Edit menu to select Create New Data**.**



A new step is created after clicking the right mouse button or pressing the Shift and F10 Keys to select the corresponding item in the pop-up Edit menu. In this example, **Create Step** is selected.

7. Input data of each item by double-clicking the left mouse button with the mouse pointer located on the item of the table in the right screen portion (contents screen).



This dialog appears by double-clicking the left mouse button.

Control Menu

Menu and Short-cut Key

Main menu	Sub menu	Description	Short-cut key	Icon on tool bar
File	**New**	Creates a new project.	Ctrl+N	○
	Open	Opens the existing project selected.	Ctrl+O	○
	Open System Protocols	Opens the system protocol.	---	○
	Close	Closes the project worked on.	---	---
	Save	Overwrites and saves the project file worked on.	Ctrl+S	○
	Save As	Saves the project file worked on as a new file.	---	---
	Download Protocols to PSB	Downloads the protocols selected to the PSB.	---	○
	Protocol Compare	Compares the data of two protocols.	---	○
	Upload Protocols From PSB	Uploads the protocols from the PSB.	---	○
	Display PSB Protocols	Displays the list of protocols stored in the PSB.	---	○
	Display Object Code Size	Displays the quantity of object code data.	---	○
	Print	Prints the protocols or trace selected.	Ctrl+P	○
	Print Preview	Displays the image of print output.	---	---
	Print Setup	Sets the printer model, paper size, and printing direction.	---	---
	Recent File	Displays a maximum of four files recently used.	---	---
	Exit	Exits SYSMAC-PST.	---	---
Edit	**Undo**	Undoes the previous operation.	Ctrl+Z	---
	Cut	Cuts and transfers the range designated to the clipboard.	Ctrl+X	○
	Copy	Copies and transfers the range designated to the clipboard.	Ctrl+C	○
	Paste	Pastes the contents of the clipboard to the position designated.	Ctrl+V	○
	Delete	Deletes the range designated.	Del	○
	Accept	Accepts the results of input.	---	---

Main menu	Sub menu	Description	Short-cut key	Icon on tool bar
Edit	**Cancel**	Cancels the results of input.	---	---
	Field	Enables the selected field in the contents screen ready for input, the effect of which is equivalent to that of the double-click operation of the mouse.	---	---
	Select All	Selects the data of all rows.	Ctrl+A	---
	Inverse Selection	Selects data other than the data focused.	Ctrl+I	---
	Move	Scrolls the steps or matrix case upwards or downwards to the top or bottom.	---	○
View	**Project Toolbar**	Shows or not shows the project tool bar.	---	---
	Protocol Toolbar	Shows or not shows the protocol tool bar.	---	---
	Trace Toolbar	Shows or not shows the trace tool bar.	---	---
	PLC Toolbar	Shows or not shows the PC tool bar.	---	---
	Parent	Scrolls the displayed hierarchy portion in the project window to the one upper.	Esc	---
	Swap Focus	Switch over the focus between the hierarchy and contents screens.	Tab	---
Window	**New Window**	Creates an identical new window.	---	---
	Cascade	Shows windows in cascade status.	---	---
	Tile	Shows windows laid vertically.	---	---
	Arrange Icons	Arrange icons to align with one another.	---	---
Help	**Help Topics**	Shows Search Topic in SYSMAC-PST's Help.	---	○
	About PST	Shows the version of SYSMAC-PST.	---	○

Pop-up Menu

If either of the following objects is selected, the pop-up menu according to the hierarchy appears by clicking the right mouse button or pressing the Shift and F10 Keys.

• Pop-up Edit Menu

Selected object	Pop-up Edit menu
Project	Properties
Protocol List	Create Protocol
	Cut
	Copy
	Paste
	Delete
Protocol	Create Communication Sequence
	Create Matrix
	Create Receive Message
	Create Send Message
	Cut
	Copy
	Paste
	Delete
Communication Sequence	Create Step
	Cut
	Copy
	Paste
	Delete
Step	Edit Send Message Edit Receive Message Cut Copy Paste Delete
Send Message List	Create Send Message
	Cut
	Copy
	Paste
	Delete
Receive Message List	Create Receive Message
	Cut
	Copy
	Paste
	Delete
Matrix List	Create Matrix
	Cut
	Copy
	Paste
	Delete
Matrix	Create Matrix Case
	Cut
	Copy
	Paste
	Delete

Selected object	Pop-up Edit menu
Matrix Case	Cut Copy Paste Delete
Trace	Delete

• Pop-up Operation menu (in On-line Operation)

Selected object	Pop-up Edit menu	
PSB	Upload Protocols From PSB	
	Display PSB Protocols	
Trace Memory A/B	Start Trace	Continuous Trace
		One-Shot Trace
	Stop Trace	
	Upload Trace From PSB	
Comms port A/B	Edit Settings	
	Download Settings To PLC	
	Upload Settings From PLC	

Tool-bar Icons

• Project Tool Bar

These icons are for the operation of project-related functions.

• Trace Tool Bar

These icons are for the operation of trace-related functions.

• Protocol Tool Bar

These icons are for the operation of protocol-related functions.

• PLC Tool Bar

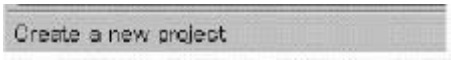
The PLC modes, such as off-line, program, and monitor modes, and corresponding PLC models are displayed.

List of Tool-bar Icons

Tool bar	Icon	Corresponding menu	Tool bar	Icon	Corresponding menu
Project toolbar		New	Protocol toolbar		Compare
		Open			Download Protocols
		Open System Protocol			Object Code Size
		Save			Download Port Settings
		Cut			Upload Port Settings
		Copy			Upload Protocols
		Paste			PSB Protocol List
		Print			Delete
		About			Up
		Help			Down
Trace toolbar		Start of Trace			Top
		Fast Rewind			Bottom
		Rewind	PLC toolbar		PLC Mode
		Forward			PLC Model
		Fast Forward			---
		End of Trace			
		Start one-shot trace			
		Start Continuous trace			---
		Stop trace			---
		Upload trace			

Status Bar

The status bar displays the explanation of the menu or icon of the position where the cursor is located.



Note Select the toolbar icon by referring to the corresponding explanation of the icon appearing on the status bar.

The right portion of the status bar displays either one of the following keys that are locked.

CAP: Uppercase keys are locked.

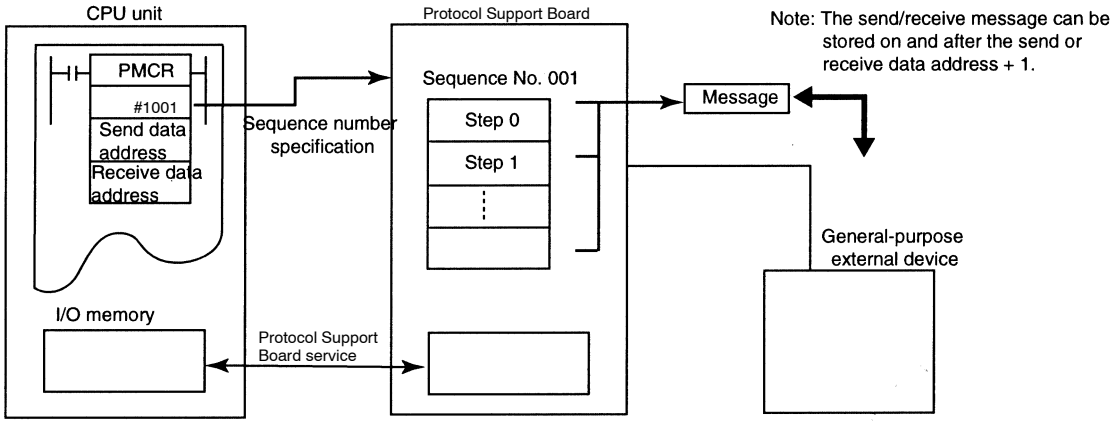
NUM: Number keys are locked.

SCRL: Scroll keys are locked.

SECTION 3
Protocol Macro

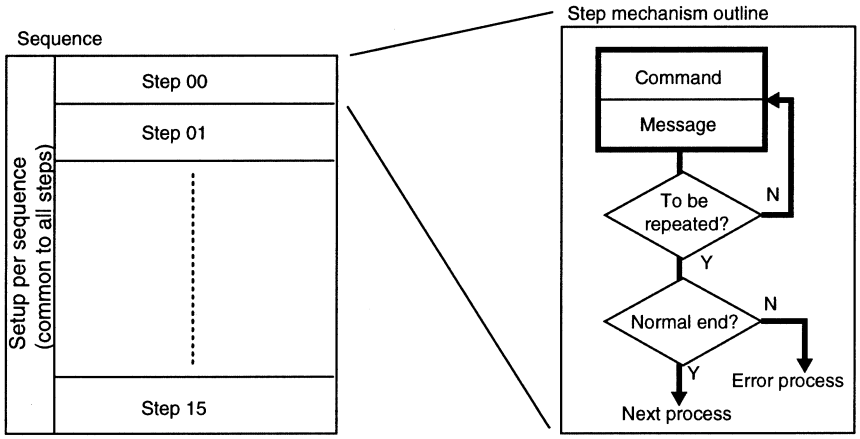
3-1 Protocol Macro Outline

The Protocol Support Tool allows users to freely create and edit protocols, which are procedures for sending data to and receiving data from general-purpose devices connected to the PSB through RS-232C or RS-422/485. The Protocol Macro is a function to implement the sending and the receiving messages by the execution of starting instruction for the protocol macro (PMCR instruction) of the user program on the CPU unit.



3-1-1 Sequence/Step Structure

One sequence consists of up to 16 steps. One step includes one command (Send, Receive, or Send&Receive) and one or two messages (Send, Receive, or Send&Receive). Step transition is specified by the “next process” within the step.



1, 2, 3... 1. Sequence-specific data (common to all steps)

Setup Item	Description
Transmission control parameter	X-on/X-off flow control, RTS/CTS flow control, modem control, delimiter control, or contention control
Link word	Shared memory area between the PLC and the PSB.
Monitoring time	Time for monitoring send and receive processing.
Response Type	Timing for writing received data.

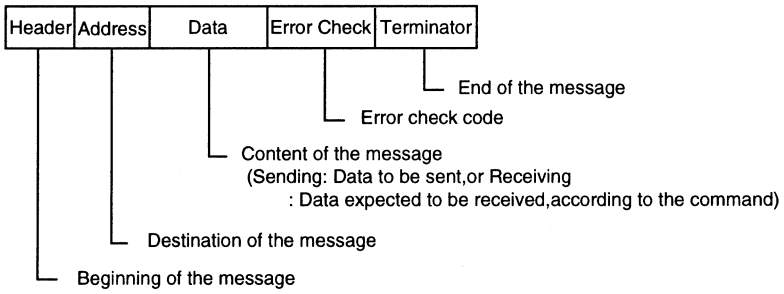
2. Step-specific data

Setup Item	Description	Command type		
		Send	Receive	Send& Receive
Command	Send, Receive, or Send&Receive			
Repeat counter	The number of times iterating the step (0-255)	O	O	O
Send message	The contents set here is sent as a message.	O		O
Receive message	The message that was actually received is compared with the data set here.	---	O	O
Receive matrix	Selects the next process according to message expected to be received (up to 15 types).	---	O	O
Retry count	The number of times for retrying the command when some retry factor such as an error arises.	---	---	O
Send wait time	Wait time for starting data sending for a Send command.	O	---	O
With/Without Response Writing (operand addressing)	Specifies whether to write received data .	---	O	O
Next process	Specifies the next step to which control goes when the system ends normally.	O	O	O
Error process	Specifies the next step to which control goes when the system ends abnormally.	O	O	O

3. Message structure and content

Messages to be sent and received are generally structured as follows:

1) Messages containing header and terminator

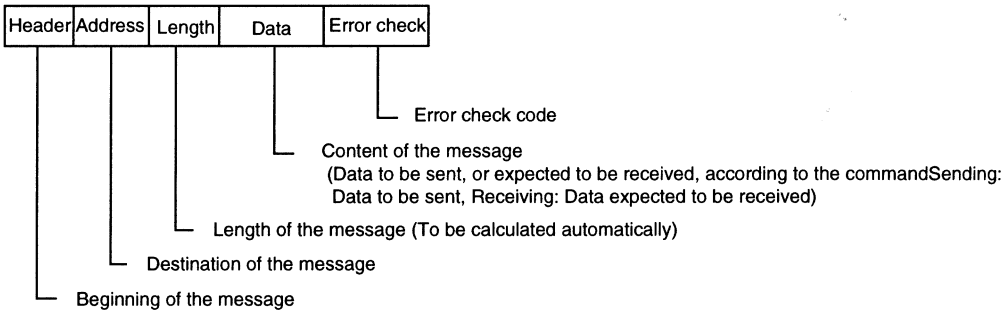


The check code and the terminator can be replaced each other.

Note Possible only when the Communications Board C200HW-COM**-EV1 is used.

Header	Address	Data	Terminator	Check code

2) Messages containing header and data length



Setup Item	Meaning	Data attributes	
		Constant	Variable
Header	Beginning of message	O	---
Address	Message destination	O	O
Length	Message length	---	---
Data	Message body	O	O
Check code	Error check code	---	---
Terminator	End of message	O	---

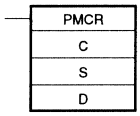
- Input the constant in the header and terminator.
- Either the constant or variable can be input in the address and data. By including variables in the address and data, the address or data can be retrieved from the designated area of the I/O memory and the transmitted or received data can be written in the designated area of the I/O memory.

3-1-2 Communications Sequences and the PMCR Instruction

The PMCR instruction will specify a communication port number and sequence number. In addition, the user can specify the source I/O memory address and the destination I/O memory address of the message.

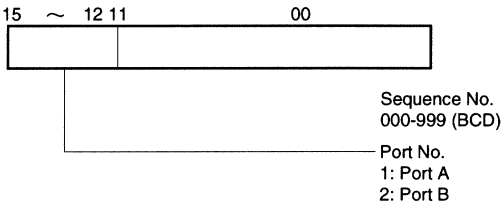
PMCR Instruction

Specification

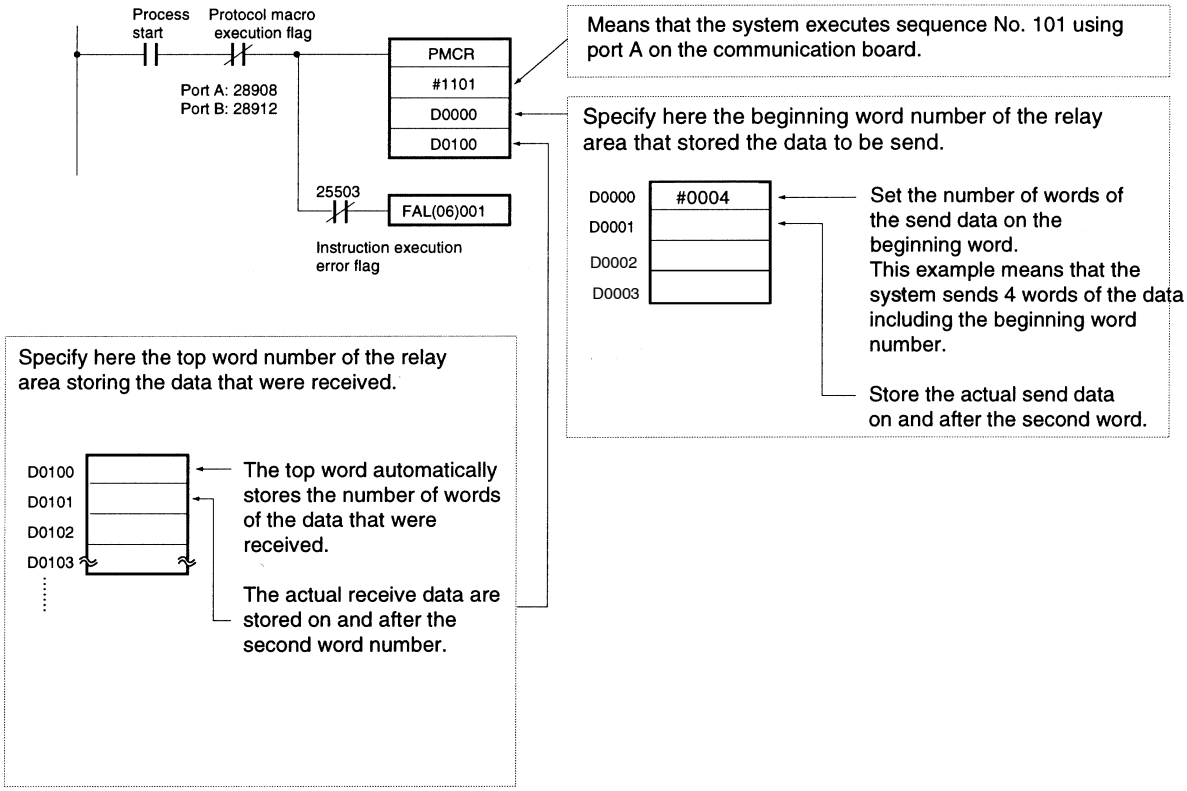


C: Control data
S: Send data beginning word number
D: Receive data store beginning word number

Control Data



Ladder Program



Note 1. The protocol macro execution flag is set to "ON" at the start of the PMCR instruction, and set to "OFF" when the sequence ends and the received data is safely stored in the specified relay area. Therefore, to execute the next PMCR instruction, the ladder program first checks that the flag is set to "OFF".

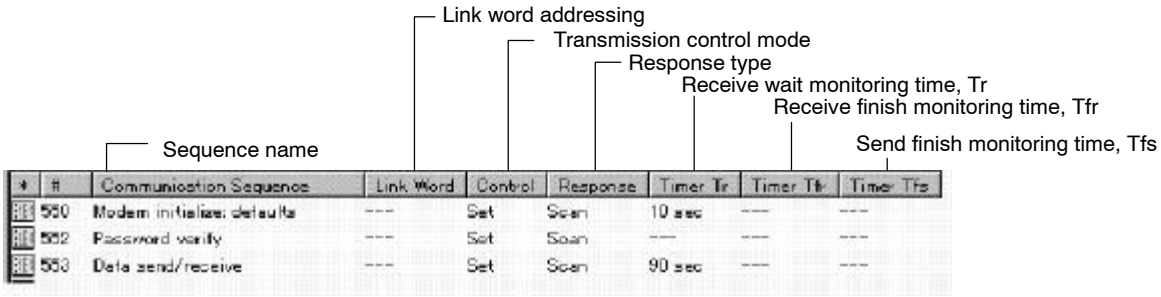
2. The FAL instruction is used to check whether PMCR instruction parameters, etc. are correctly set.

3-2 Sequence Attributes (common to all steps)

3-2-1 Setting

Setup Item	Description
Transmission control parameter	X-on/X-off flow control, RTS/CTS flow control, modem control, delimiter control, or contention control
Link word	Shared memory area between the PLC and the PSB.
Response Type	Timing for writing received data.
Monitoring time	Time for monitoring send and receive processing.

3-2-2 SYSMAC-PST Setup Screen



For the details of setup method, refer to 7-3-2 Set Sequence List Attribute of 7-3 Edit a Protocol in the Section 7.

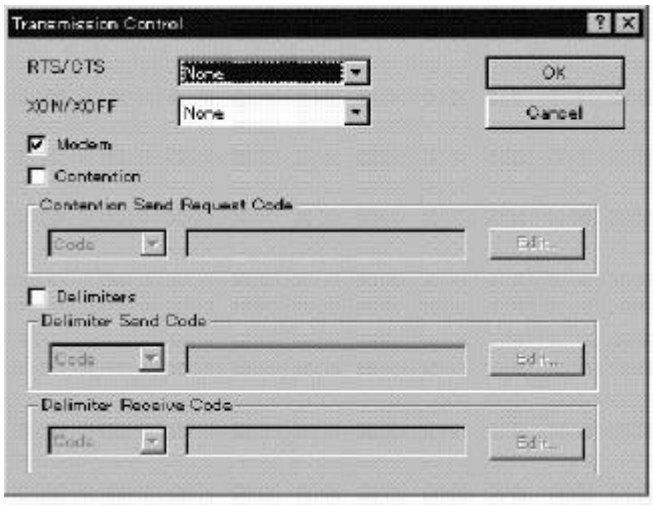
3-2-3 Transmission Control Parameter

Control parameters set transmission control modes controlling the flow, RTS, CTS, DTR, DSR, etc. The following 5 types of transmission control are supported. You shall set the same transmission control modes as for the external device to communicate with. Notice that the modem control parameter can be specified together with other parameters.

Transmission control parameter	Function	Usage
Xon/Xoff flow control	Executes flow control by software using Xon (11 Hex) and Xoff (13 Hex) codes.	Set when the external device supports the Xon/Xoff flow control.
RTS/CTS flow control	Executes flow control by hardware using the RTS and CTS signals.	Set when the external device supports the RTS/CTS flow control.
Modem control	Holds DTR “ON” during execution of a PMCR instruction, and RTS “ON” during sending of data.	Set when the external device checks the DSR status.Must be used if you want to use the internal RS422 port.Must be used also if an external RS422/RS485 converter is connected to RS-232C port.
Delimiter control	For sending or receiving a large quantity of data, this procedure separates data into several frames with delimiters.	Set when the external device supports delimiter control.
Contention control	Transmission control mode for getting the send right in point-to-point contention communication, such as the SECS protocol.	Set when the external device supports contention control.

Note Unless modem control is set, the DTR on the port of the PSB cannot be turned ON. When both modem control and RTS/CTS control are set, the DTR complies with modem control, and the RTS and CTS comply with RTS/CTS flow control.

Transmission control parameter	Settings on the SYSMAC-PST
RTS/CTS flow control	None: No RTS/CTS flow control Send: RTS/CTS flow control only during sending Receive: RTS/CTS flow control only during receiving Send&Receive: RTS/CTS flow control during both sending and receiving
Xon/Xoff flow control	None: No Xon/Xoff flow control Send: Xon/Xoff flow control only during sending Receive: Xon/Xoff flow control only during receiving Send&Receive: Xon/Xoff flow control during both sending and receiving
Modem control	Yes/No
Contention control	No Yes: Send request code; Control code: either ASCII or HEX
Delimiter control	No Yes: Send request code; Control code: either ASCII or HEX Receive request code; Control code: either ASCII or HEX



3-2-4 Link Word Addressing

1, 2, 3... 1. Addressing of Send or Receive Data users can specify where to store send/receive data using the following 3 modes case by case.
However, the direct addressing and the operand addressing are not set here, because they are set within communication message. Only the link word addressing is set by sequence as described below in the column enclosed by bold lines:

Addressing	Function	Identification Code in Messages	Usage
Operand addressing (Set within a send or receive message)	Addresses an I/O memory within a send or receive message using the second operand (send data store beginning word number) and the third operand (receive data store beginning word number) of the PMCR instruction included in the ladder program. The system sends or receives data using the specified I/O memory. This item determines the timing at which receive data is written into the specified I/O memory area according to the response notification mode in a sequence (in addition to that, this item lets you specify whether to write responses for each step). • Scan The system writes receive data to PLC at every PLC scan. • Interrupt The board interrupts the PLC at reception of data for write to the specified I/O memory. (Fixed Nos. and receive case Nos. are available as interrupt program Nos.)	Word read: R(z) Word specified by the second operand of the PMCR instruction + z word Word write: W(z) Word specified by the third operand of the PMCR instruction + z word	By the PMCR instruction included in the ladder program, users can dynamically set a relay area to be commonly used in the sequence. The interrupt function implements a high response processing.
Direct addressing (Set within a send or receive message)	Because these words are refreshed at every PLC scan, writing operation to the I/O memory does not synchronize with data receiving, inducing some time lag.	CIO□□□ LR□□ HR□□ AR□□ DM□□□□ EM□□□□ □: Word No.	This mode is used to assign a fixed relay area used separately by the step. Changing addresses needs modification and retransmission of the step.
Link word addressing (Set by sequence)	Specifies an area on which data are shared between the PLC and the PSB. Two sets of link word, link word 1 and 2, can be set as such areas. Link word 1: IN (for storing receive data) OUT (for storing send data) Link word 2: IN (for storing receive data) OUT (for storing send data) Set these areas using the reserved words: I1, I2, O1, or O2. Because these words are refreshed at every PLC scan, writing operation to the I/O memory does not synchronize with data receiving, inducing some time lag.Directly addresses an I/O memory within a send or receive message.	I1 (IN of link word 1) O1 (OUT of link word 1) I2 (IN of link word 2) O2 (OUT of link word 2)	This mode is used to assign a fixed relay area commonly used by all steps in a sequence. Changing link words needs modification and retransmission of the sequence.

Note For the store area of send or receive data, the following IOM areas can be specified:

CIO: 000 ~ 511

LR: 00 ~ 63

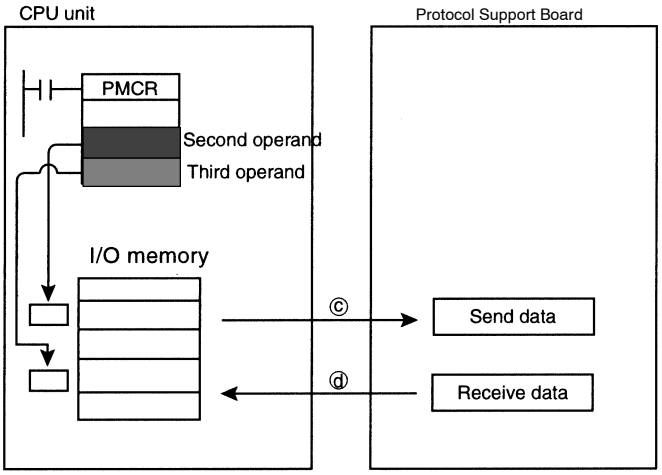
HR: 00 ~ 99

AR: 00 ~ 27

DM: 0000 ~ 6655

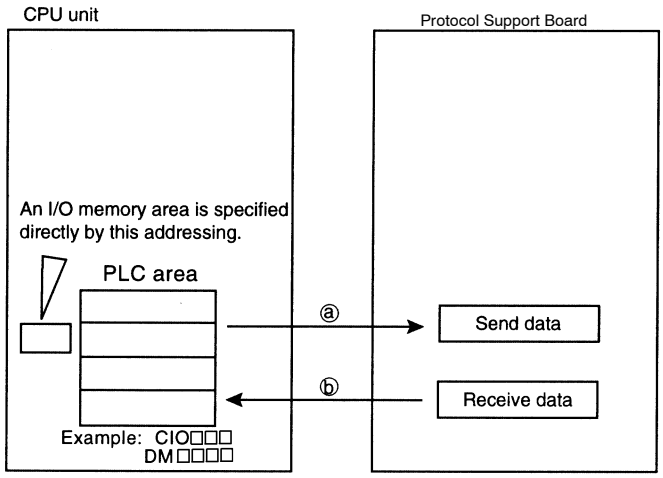
EM: 0000 ~ 6143

1) Operand Addressing



c: PMCR instruction execution
d: The data are transmitted when the response notification, which is set step by step, is set as available, or when the execution of the sequence ends. The timing the receive data are reflected to the I/O memory depends on the setup of the response notification mode.

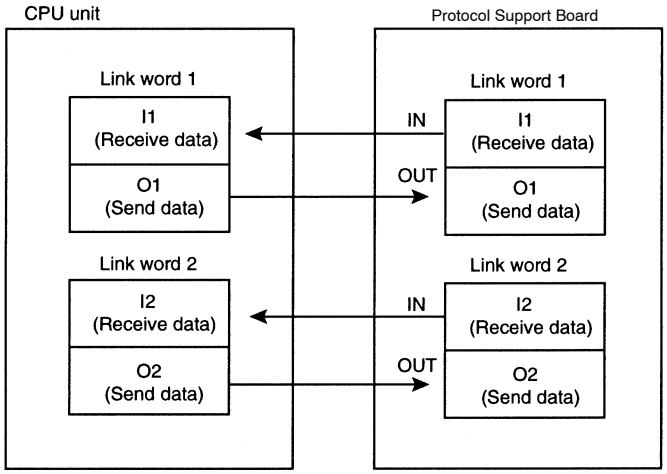
2) Direct Addressing



a: Message sending
b: Message receiving

When the received data is reflected to I/O memory depends on the timing of PC scans.

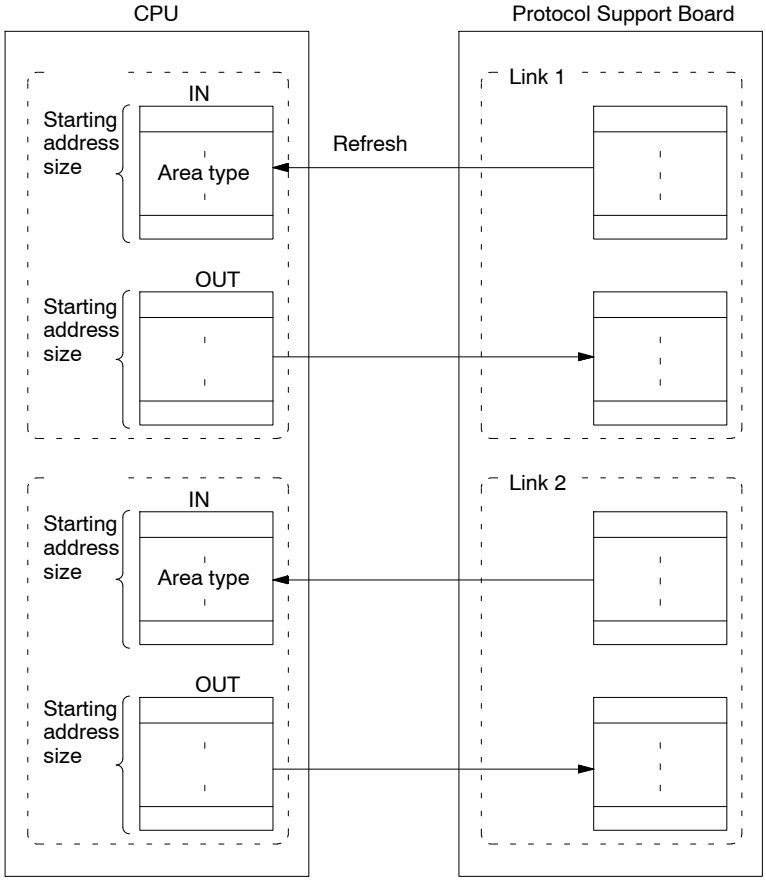
3) Link word Addressing

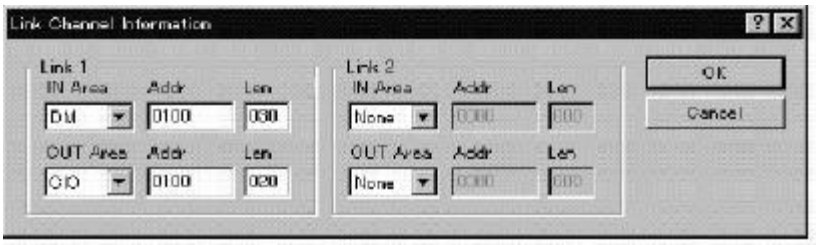


Settings:
Link word 1
IN : Beginning word address (area type and address)
Word count (0-128) Note
OUT: Beginning word address (area type and address)
Word count (0-128) Note
Link word 2
IN : Beginning word address (area type and address)
Word count (0-128) Note
OUT: Beginning word address (area type and address)
Word count (0-128) Note

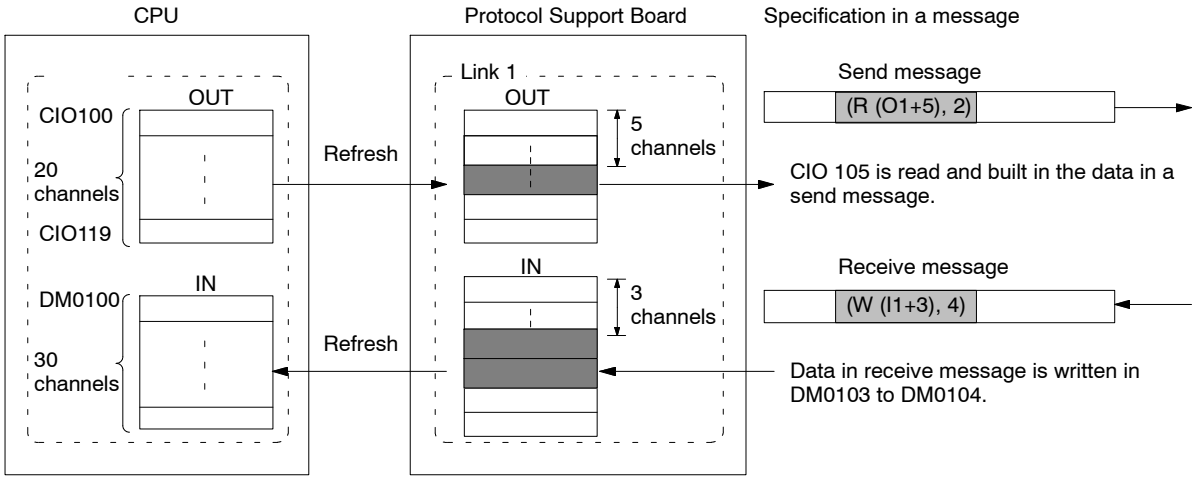
Note: The total number of all the words in link word (1/2 and IN/OUT) shall be 128 or less.

Link channel specification





Example: Read and write part of data assigned in the above in a message.



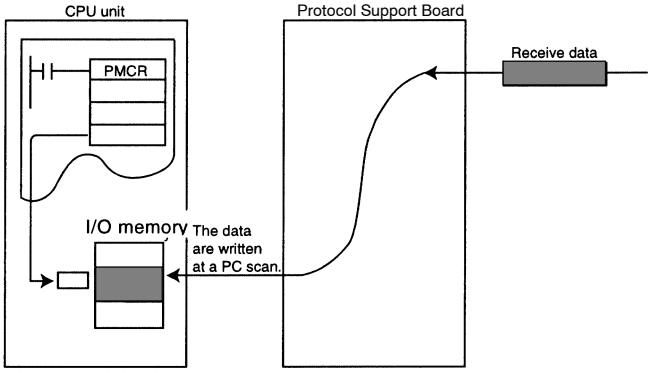
CIO105 is read and built in the data in a send message. Receive message(W (I1+3), 4)Data in receive message is written in DM0103 to DM104.

3-2-5 Response Type

The response type specifies when to write the receive data to the I/O memory specified by the third operand of the PMCR instruction and how to notify this write processing to the CPU unit. One of the following 3 modes can be used as this mode.

1, 2, 3... **1. Scan Mode**

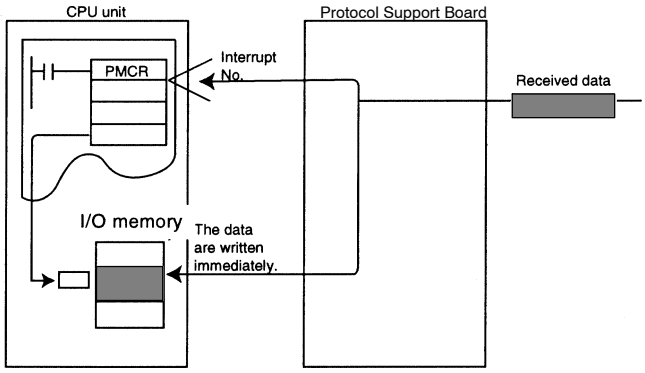
This mode writes the receive data to the I/O memory at a scan of the CPU unit.



2. Interrupt Mode: Fixed #

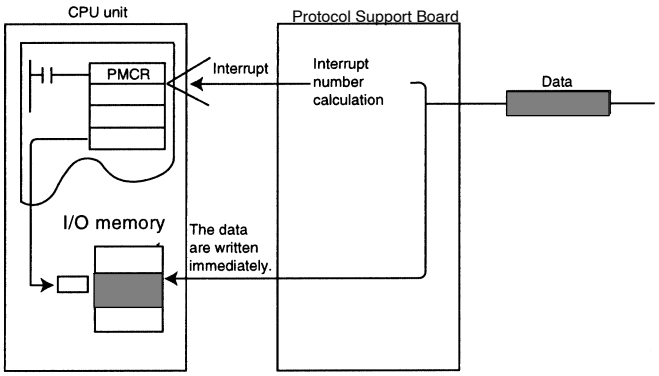
This mode writes the received data to the I/O memory at the same time of the

data receiving. In addition, this mode specifies the appropriate interrupt program number to have the CPU unit execute this program.



3. Interrupt Mode: Receive Case #

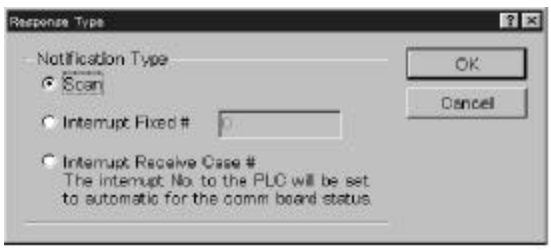
This mode writes the receive data to the I/O memory at the same time of the data receiving. In addition, this mode calculates the interrupt program No. using the following method to have the CPU unit execute this interrupt program.



Interrupt program No. = □□ XX (HEX)
- XX: When using a receive matrix: Case No. of the receive matrix; Otherwise: 0
- □: Step No. of the sequence that was executed

Example: When the step No. = 2 and the receive matrix case number = 11 (HEX),Interrupt program No. = 2B (HEX) = 43 (Decimal)

Setting up using Protocol Support Tool.



3-2-6 Monitoring Time

Users specify the time for monitoring the send or receive processing. The following types of monitor time can be specified. However, Ts (send wait time) is omitted here because the value is set step by step.

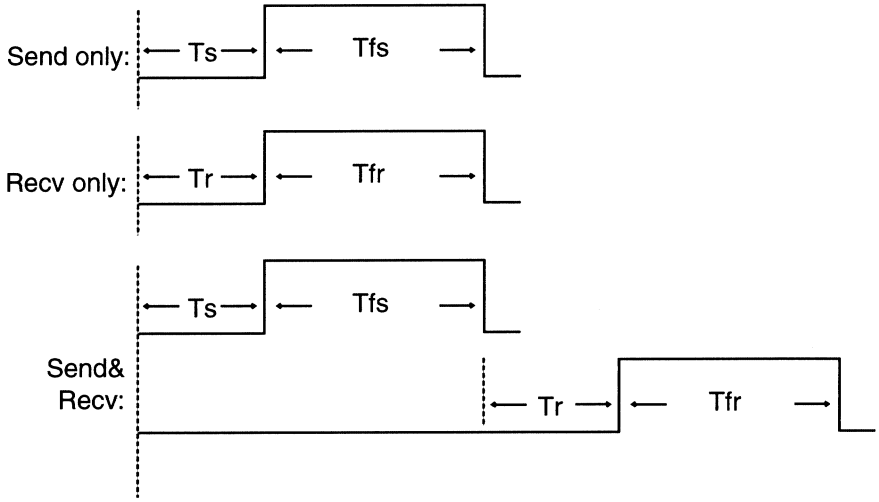
Set the monitoring time by sequence as only described below in the columns enclosed by bold lines:

Monitoring time	Description	Command type		
		Send	Receive	Send & Receive
Receive wait monitoring time: Tr	Monitors the time from when the receive command of the step in the sequence is recognized (receive command execution) until the first byte (header) is received. When receiving no data in the specified Tr (Note 1), the system executes the error process set in the step.	---	O	O
Receive finish monitoring time: Tfr	Monitors the time from reception of the first byte to reception of the last byte of the data in the step in the sequence. When the receiving is not finished in the specified Tfr (or the terminator does not come) (Note 2), the system executes the error process set in the step.	---	O	O
Send finish monitoring time: Tfs	Monitors the time from transmission of the first byte to transmission of the last data . Unless the transmission ends within this specified watchdog time (Note 1), the system iterates the step up to the times specified in the step. If even after the repeating transmission does not come to an end, the system executes the appropriate error process.	O	---	O
Send wait time: Ts	Sets the time from when the send command of the step is recognized until the first byte is sent. For example, when sending the data over an extension line through the modem, unless waiting for a while to send the telephone number after dialing 0, the dialing may not be successful.	O	---	O

O : Available, —: Not available

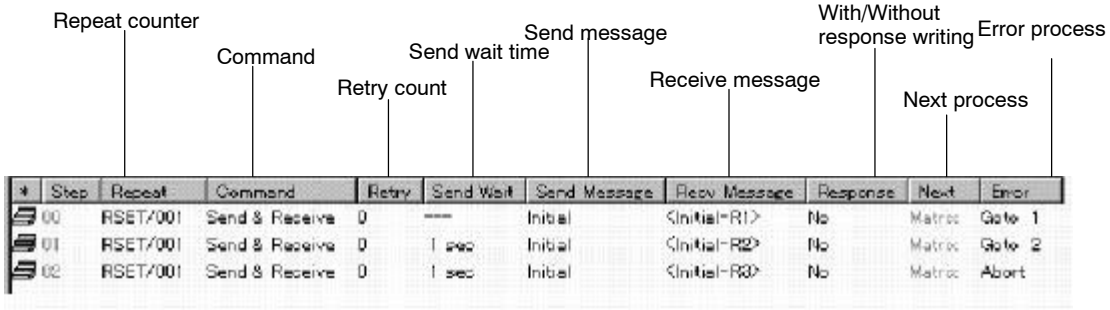
Note 1. When a retry count of Send&Receive is set for the step, the system repeats the step up to the times of the retry count. If all retries fail or a time-out occurs, the system executes the appropriate error process.

2. Be sure to set both the Receive wait monitor time Tr and Receive finish monitor time Tfr. If either one of them is not set, the other side is invalidated.



3-3 Step Attributes

3-3-1 SYSMAC-PST Setup Screen



For the details of setup method, refer to 7-3-4 Edit a Step of 7-3 Edit a Protocol in the Section 7.

3-3-2 Setting

Parameter	Description	Remark	Command		
			Send	Receive	Send & Receive
Repeat counter	Sets the number of times of iterating the step (1-255). The system increases the value of the repeat counter N at every step.	Incorporating a linear expression including the repeat counter N into the send or receive message allows users to freely change the destination of the message or the I/O memory to which the message is stored.	O	O	O
Command	Sets one of the following 3 types of command: Send: Sends data Receive: Receives data Send&Receive: Sends and receives data	When sending and receiving the data by consecutive turns, using the Send&Receive command allows users to set the steps efficiently. Because the retry count for an error can be set, the error process is described simply.			
Retry count	Valid only for Send&Receive command. The system executes the current step up to the specified times (0-9) when some retry factor such as an error occurs. If the retry factor still remains, the control goes to the error process.	During retrying, the send wait time is ignored. Therefore, the send wait time has to be provided by an error process during retrying. Likewise, a retry process has to be provided by an error process for Send or Receive command.	---	---	O
Send wait time	Sets the wait time (Ts) as waiting time for data sending to start.	Set a send wait time when the communication partner can not receive data immediately.	O	---	O
Send message	Sets the send message when the command is Send or Send&Receive.	See Section 3-4.	O	---	O
Recv message	Sets the expected receive message when the command is Receive or Send&Receive.	See Section 3-4.	---	O	O
With/Without Response Writing (operand addressing)	Sets whether received data is to be written. Valid only when the receive data are stored using the operand addressing mode.	Setting this parameter to “available” always needs to specify the response method	---	O	O
Next process	Sets the next transit step when the step ends normally.	End: Executes the step and ends the sequence. Next: Executes the next step. Goto∗∗: Executes the step specified by ∗∗. Abort: Aborts the step and end the sequence.	O	O	O
Error process	Sets the next transit step when the step ends abnormally.	Same as above.	O	O	O

O : Available, ---: Not available

3-3-3 Repeat Counter

1, 2, 3... 1. Initial value specification

One of the following parameters can be set as the initial value in the corresponding step of the repeat counter variable N.

Reset: After the repeat counter variable N is reset to 0 when the step is started, the step is repeatedly executed by a specified number of times.

Hold: When the step is started, the current value of the repeat counter variable is held as it is, and the step is repeatedly executed by a specified number of times.

2. Number of iterations set

The number of iteration times to repeatedly execute the step can be specified by one of the followings:

- Setting constant 1 to 255.
- Using a channel read R ( )

Example) R (1) The content (binary) of the low-order byte at the channel of the second operand +1 of a PMCR instruction is specified as the number of iterations.

Example) R (DM0000) The content (binary) of the low-order byte in DM0000 is specified as the number of iterations.

Note How to specify channel read

R ( )

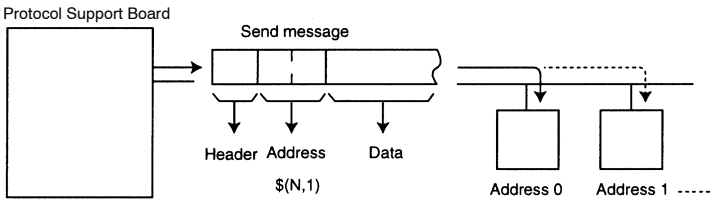
Start channel + constant

How to specify a channel	Symbol to be specified	Example	
		When constant=0	When constant=2
Operand specification	None	Cannot be set.	R(2)
Link channel specification	O1,I1, O2, I2	R(O1)	R(O1 + 2)
Direct specification	CIO□□□, LR□□, HR□□, AR□□, DM□□□□, EM□□□□ : Channel#	R(DM0000)	R(DM0000 + 2)

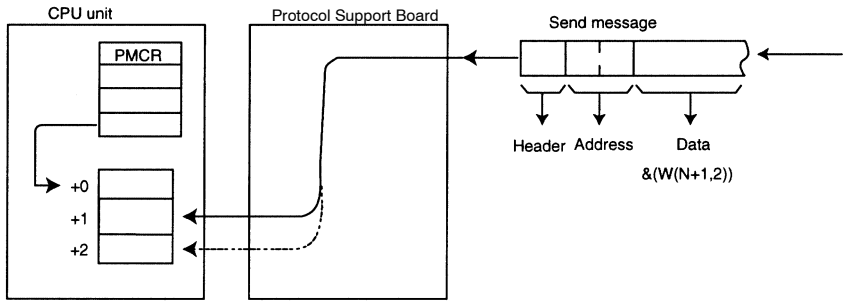
The content of the low-order byte at the start channel + constant channel is read as binary data to indirectly specify the number of bytes.

- During step execution by the number of counts in the repeat counter, control is not shifted to the transition destination specified for the next processing or error processing. After the step is executed by the number of set iterations, control is shifted to the specified destination for the next processing or error processing.
- Use the repeat counter variable N for specifying a send/receive message address or data enables the following:

Example: When the same send message is sent to a multiple of N-connected external unit Use the repeat counter variable N at the send message address.



Example: If you want to specify different addresses for different steps to store receive massages, include the repeat counter variable N in the data in the receive message.



& (W(N+1),2 Two-byte receive data is converted from ASCII to HEX and stored at the address of the third operand specified address + (repeat counter variable N + 1) CH of a PMCR instruction.

Note Refer to Message item data attributes

3-3-4 Commands

Set either Send, Receive, or Send & Receive.

Send: Sends a send message set in a step.

Receive: Handles a receive message in a step or receive message in a receive matrix as an expected message, and receives data. (Note)

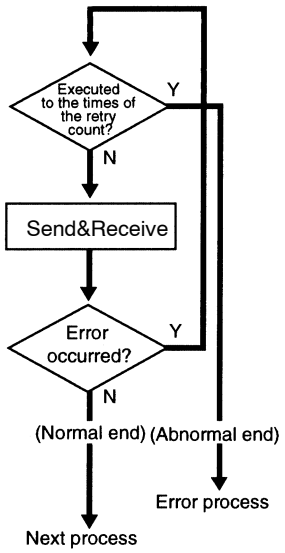
Send & Receive: After sending a send message set in a step, handles the receive message set in a step or receive message in a receive matrix as an expected message, and receives data (Note)

Note Compare an actually received message and set receive (expected) message, and if they are matched, go to the next processing. If they are not matched, control is shifted to the error processing for the receive message, and for the receive matrix, to the next processing specified with “Other” (other than the set receive message group.)
Generally, when a command is sent and a response is received, set Send&Receive.
Send&Receive allows retry to be specified. At retry, no transmission wait can be applied. If you want to apply a transmission wait at retry, divide the retry in the Send step and Receive step.

3-3-5 Retry count

When the retry count of the Send&Receive command is set, if a retry factor among the above error factors occurs,(Refer to the table of error factors on the following page) the system executes the Send&Receive command repeatedly. If this error factor still remains after the specified number of retry repetitions, the system goes to the error process.

When retrying, the system sends data regardless of the send wait time Ts.



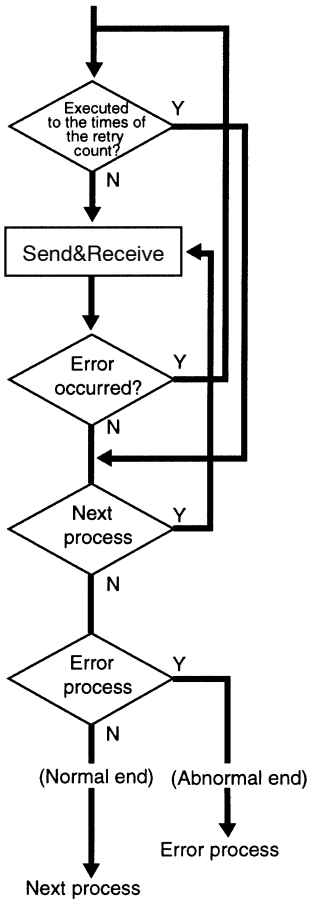
Note To execute the retry process as an error process, it is necessary to set the steps as follows. As you will see, the description of the error process is more complicated than using Send&Receive commands with specifying the retry count.

Example: Retrying the same process 3 times.

		Next process	Error process	
Step 00	Retry count 0	End	Goto 01	(or Next)
Step 01	Same content as step 00	End	Goto 02	(or Next)
Step 02	Same content as step 00	End	Abort	

Note When both the repeat counter N and the retry count is set, until the system executes the steps for the times of the retry count, the counter N is not updated.

When the retry factor disappears or the system has executed the steps for the times of the retry count, the counter N is updated.



3-3-6 Send Wait Time

For the Send or Send&Receive command, set the wait time taken from the corresponding step to come to data transmission.

3-3-7 Send Message/Receive Message

3-3-8 With/Without Response Writing

Set whether or not received data is written.

This setting is valid when the data in a send message is specified with a variable and the starting channel address is operand-specified.

3-3-9 Next Process/Error Process

When a step is normally terminated or abnormally terminated, set which step control will be shifted to.

When a reception matrix is specified as a receive message, the above setting is invalid, and the next processing specified with the receive matrix is valid.

Goto:** After execution of the step, shift to the specified step ** (0 to 15).

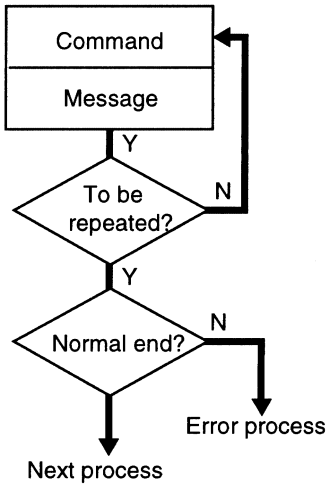
Next: After execution of the step, shift to the next (+1) step.

End: After execution of the step, terminate the entire sequence including the step.

Abort: If an error factor occurs in execution of the step, interrupt execution of the step and terminate the entire sequence including the step.

Setting using the Protocol Support Tool

When one of the following error factors occurs, the step ends abnormally, and then the system goes to the appropriate error process.



Errors		Command type			When retry is specified;
		Send	Receive	Send & Receive	
The Message that was received is not the same as the expected receive message.			O	O	step is retried
Monitoring time expired	The data (,or header) are not received within “receive wait monitoring time.”		O	O	
	Data receiving is not finished within “receive finish monitoring time.”		O	O	
	Data sending is not finished within “send finish monitoring time.”	O		O	
A transmission error occurs during data receiving (The communication error flag 28304 or 28312 is set to “on”).			O	O	
An error is detected in error check code.			O	O	
Received data exceeds the specified area at attempting to write them in the I/O memory (PMCR instruction execution error flag (11 or 12 of 268CH) of FAL9C is set to “on” and the protocol macro error code is “3”).			O	O	step is not retried

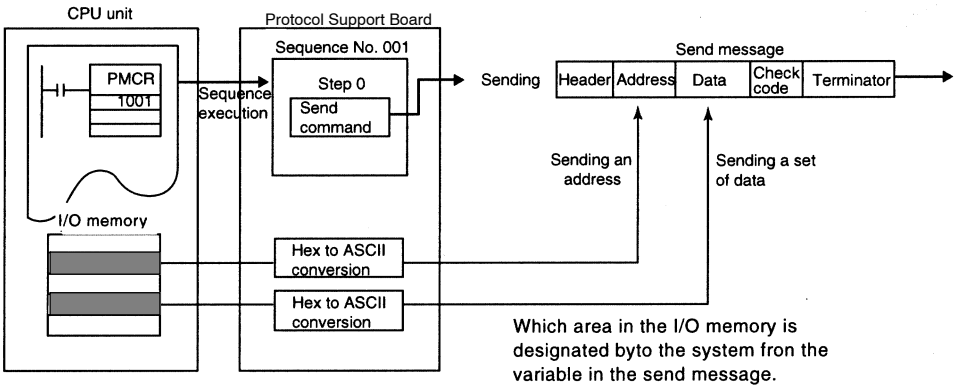
3-4 Communication Message Attributes

3-4-1 Communication Mechanism

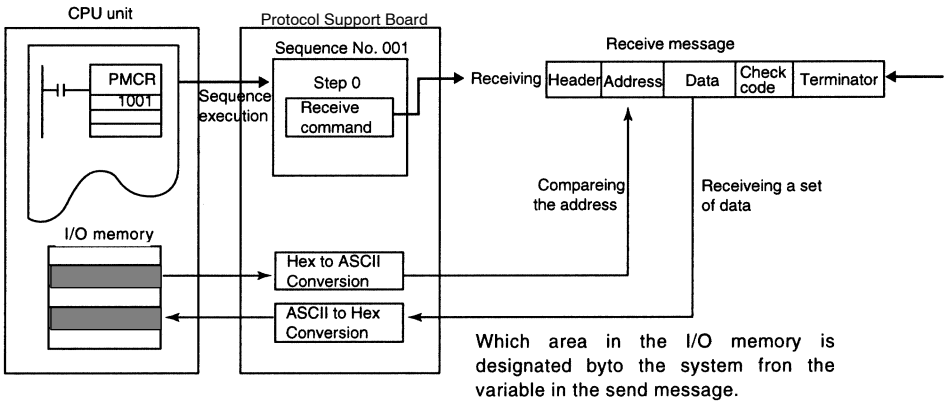
As shown below, one of the features of data sending and receiving using the protocol macro function is that designations of reading/writing from or to the I/O memory on the CPU unit are included in the communication message itself.

Specifically, when the communication message includes the variable responsible either for “Direct Addressing” which directly addresses I/O memory or for “Operand Addressing” which addresses I/O memory using the second or third operand of the PMCR instruction, user can send or receive data in I/O memory. Refer to 3.2.4 Link Word Addressing for the details on addressing.

Sending



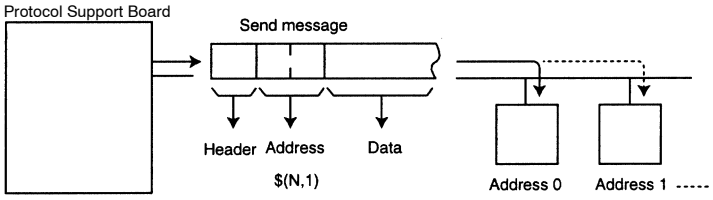
Receiving



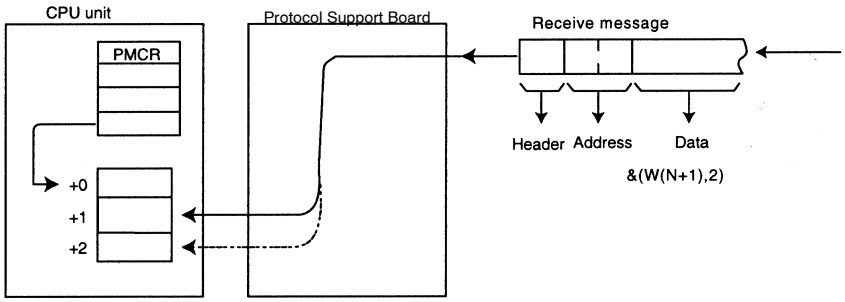
$(N, 1) Use a repeat counter (1 byte) as an address.

In addition, the inclusion of repeat counter N as a variable allows users to change the address of I/O memory at every sending or receiving, and to change the address of send message.

Example: When sending the same message to more than one external device connected in one-to-n configuration, you can use the repeat counter variable N as the address of the send message.



Example: If you want to specify different addresses for different steps to store receive massages, include the repeat counter variable N in the data in the receive message.



&(W(N+1),2) Two-byte receive data is converted from ASCII to HEX and stored at the address of the third operand specified address + (repeat counter variable N + 1) CH of a PMCR instruction.

Note Refer to Message item data attributes

3-5 Communication Message Structure

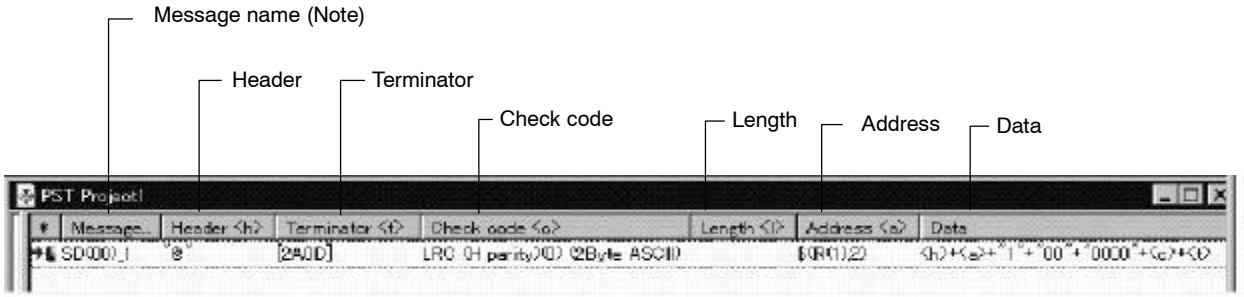
The Communication message contains 6 items: header, address, length, data, error check code, and terminator.

Header	Address	Length	Data	Check code	Terminator

Parameter	Description	Data attributes
Header	Sets the data that indicate the beginning of the communication message frame. At reception, data from the header is received as the message.	Constant only
Address	Sets the unit number or other information to be used as the message's destination. • The system identifies whether the receiving data is addressed to itself. • When "Word writes" or "Wild card" is set as a data attribute, the system receives all the messages as addressed to itself without identifying whether it is addressed to itself (broadcast addressing. • The message sending address can automatically be updated by using the repeat counter.	Constant (Reserved characters are not available.) Variable
Length	• Indicates the length (number of bytes) of a message. Based on the calculation method set at transmission (length size/data format), calculates and message length and append the value before sending, • At the message reception, this data is not checked.	Automatic variable
Data	• For sending messages Set the data to be sent. • For receiving messages Set the data expected to be received. When the data of the actually received message frame is different from the specified data, the system executes the error process.	Constant Variable
Error check code	• At send processing, the check code of the send message frame is automatically calculated according to the setup, and appended to the message frame to be sent. • At receive processing, error checking is executed that compares the check code that was received with the check code locally calculated from the received data. • When both check codes are not the same, the control goes to the error process.	Automatic variable (LRC,SUM, LRC, CRC-16, SUM2, CRC-CCITT, or No-Check)
Terminator	Marks the end of a message frame. • When sending a message, the system finishes a frame of the message sending after it sent the terminator. If the terminator is not set, the system finishes the sending when it sent the data set at the end of the send message. • At receiving message, the system finishes the receiving when it received the terminator. If the terminator is not set, the system finishes the receiving when it received the data set at the end of the receive message. • If the number of bites of data set at the end of the receive message is "Wild card", the system finishes the receiving when the buffer becomes full (256 bytes). However, if a flow control (X-on/X-off, RTS/CTS) is set, the system sends out the X-off code when the buffer is filled up to 75% (200 bytes) of its size and finishes the receiving.	Constant only

Note The above six items can be eliminated in the following cases:
At sending: The header, the address, the length, the error check code, and the terminator can be eliminated.
At receiving: If the terminator exists, the header, the address, the length, and the error check code can be eliminated. If the data length is fixed, the terminator can be eliminated as well.

3-5-1 SYSMAC-PST Setup Screen



For the details of setup method, refer to the Section 8 Editing Send & Receive Messages and Receive Matrices.

Note After the creation of communication message, users can create steps by specifying the message name.

3-5-2 Header

Indicates the beginning of a message. Only a constant can be specified.

Selects the message type (ASCII, HEX, control code), and enters data.

Example: Type: ASCII, data: @ (screen display: “@”)

3-5-3 Address

Specify the address when a message is subjected to 1:N communication. A constant or variable can be specified. A constant and a variable can be combined as a string. Using the repeat counter variable N for the variable can change the address for each sending and receiving.

Select the address type (constant, variable), and enter data.

Example: Type: Variable, conversion: None, data: (R(1),2) (screen display: (R(1),2))

3-5-4 Length

At sending, automatically calculates the length of the entire message (excluding this item itself), and adds the item. Unit: No. of bytes.

At reception, this length data is not checked.

Specify the length size (one byte, two bytes), data type (ASCII, BIN) according to the communication specification of the unit at the communication partner.

Example: 1 byte, BIN, initial value: 0 (screen display: (0) (1-byte BIN))

Note The length calculation range is set in the “Range” of the [Edit Message] dialog.

3-5-5 Data

At sending, specify data to be sent. At reception, specify expected data.

A constant or variable can be specified. A constant and a variable can be combined as a string.

Specifying a variable allows the I/O memory channel data to be used as part of data (At sending: read, at reception: write). Further, using the repeat counter variable N for the variable allow data to be changed for each sending and receiving.

Select the data type (constant, variable), and enter data.

Example: Type: Constant (ASCII), data: RX0
Type: Variable (HEX), data: &(N,R (1))
Type: Constant (ASCII), data: 00

↓

(Screen display: “RX0” + &(N,R(1)) + “00”)

3-5-6 Error check code

Specify the error check code when data is sent.

LRC, CCITT, CRC-16, SUM (1-byte/2-byte), and SUM2 (1-byte/2-byte) can be specified. As the data type, BIN or ASCII can be selected. The data size, default, and swap between high byte and low byte can be specified.

Example: Type: LRC, data type: ASCII, data size; 2 bytes, initial value: 0 (screen display): LRC (H parity) (0) (2-byte ASC)

Note
1. The error check code range is set in the “Range” of the [Edit Message] dialog.
2. SUM2, CRC-16, and swap between high byte and low byte are possible only when the Communications Board is C200HW-COM**-EV1.

3-5-7 Terminator

With reception of this code, data reception is completed. (When data is received without this code, data reception will be completed when the data that corresponds to the length of the message set in the reception message inside the step is received.)

With sending of this code, data sending is completed. (When data is sent without this code, data sending is completed at the time when the last data is sent.)

Only a constant can be specified.

Select the terminator type (ASCII, HEX, control code) according to the communication specification of the unit of the communication partner, and enter data.

Example: Type: HEX, data: 2A0D (screen display [2A0D])

3-5-8 Message item data attributes

Users can set the following constants or variables as message items.

Constant (can be set for header, address, data, or terminator)

Constant	Specifying method	Examples
ASCII data	Specify between double quotes as in “12345”.	“12345”
HEX data	Specify between square brackets as in [5A2B].	[5A2B]
Control code	Specify by selecting the special code such as CR, LF, or STX from the list.	[OD] for CR

Variable (can be set for address or data)

Variables read and write into the I/O memory of PLC, and utilize repeat counter variables.

1. Format

Specify in the form of (X, Y).

X: The effective address

Specifies where to read or write in the I/O memory, or the liner expression including N, or the wild card. One of the followings can be used for specify these items.

a) Both the read/write options and the starting channel + (the linear expression including N)

b) Linear expression including N.

c) Wildcard (∗)

Note Wildcard can be specified only in the receive message.

Y: Data size (0-255)

Specifies the number of bytes to read or to write, when the data are not converted. (Specifies 1 when reading the value of N.)

Specifies the number of bytes on the transmission, when the data are converted. The number of bytes on I/O memory are as follows.

Option	Data size on the I/O memory	
	$ (HEX→ASCII)	& (ASCII→HEX)
R (Read from the PC→Send)	Y/2 bytes	Y x 2 bytes
W (Receive→Write to the PC)	Y x 2 bytes	Y/2 bytes

One of the following can be used for specify items.

1, 2, 3...

1. Linear expression including N.
2. Wildcard (*)

   Note Wildcard can be specified only in the receive message.

3. Both the read option and starting channel + (the linear expression including N)

   Note Reads bits 0 to 11 of the word as 3-digit BCD.

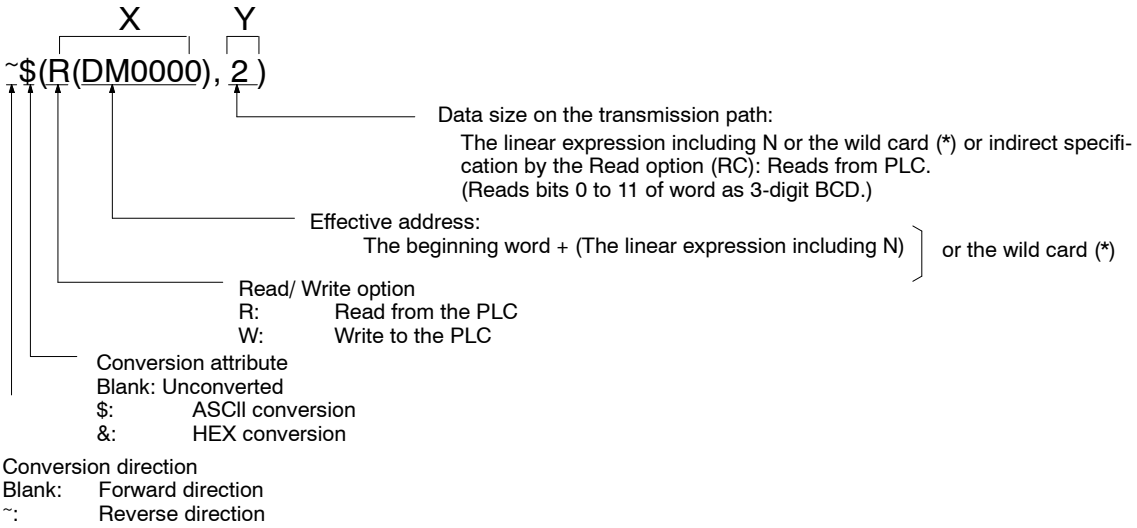
There are three types of variables as shown below. For each variable, users can set the attribute which specifies the direction (forward or reverse direction) to read or to write the data to be converted.

Forward direction : Bit: High-order → low-order, channel: high-order → low-order

Reverse direction : Bit: High-order → low-order, channel: low-order → high-order

Variable	Read/write direction		Function	
Unconverted variable	**Forward**	**Reverse**	**Read**	**Write**
	(X, Y)	~ (X, Y)	Y bytes of data from the address specified by X are processed without conversion.	
Variable converted to ASCII	$(X, Y)	~$ (X, Y)	Y/2 bytes of HEX data from the address specified by X are converted to Y bytes of ASCII data.	Y bytes of HEX data is converted into ASCII data equivalent to Y*2 bytes before storage with the address specified by X as the beginning.
Variable converted to HEX	& (X, Y)	~& (X, Y)	Y*2 bytes of ASCII data from the address specified by X are converted to Y bytes of HEX data.	Y bytes of ASCII data is converted into HEX data equivalent to Y/2 bytes before storage with the address specified by X as the beginning.

Variable Format



Note How to specify a channel

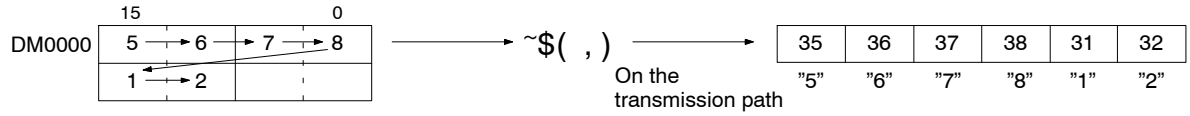
How to specify a channel	Symbol to be specified	Example	
		When linear expression including N=0	When linear expression including N=1
Operand specification	None	Cannot be set.	R(1)
Link channel specification	O1, I1, O2, I2	R(O1)	R(O1+1)
Direct specification	CIO□□□, LR□□, HR□□, AR□□, DM□□□□, EM□□□ □ : Channel #	R(DM0000)	R(DM0000+1)

Note For converted variables:

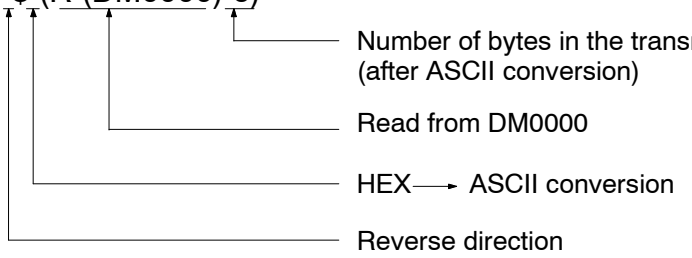
When the frame format of instructions (commands) that the partner machine can translate is configured by ASCII code, the numeral HEX data in the I/O memory have to be converted to HEX data by $(,) before they are sent, and the numeral ASCII data have to be converted to HEX data by &(,) before they are received.

- When converting data (HEX data) in the I/O memory into ASCII codes before sending

Example: Convert a 6-digit numeric value (3 bytes in the I/O memory) for the DM0000 into the ASCII code in the Reverse direction

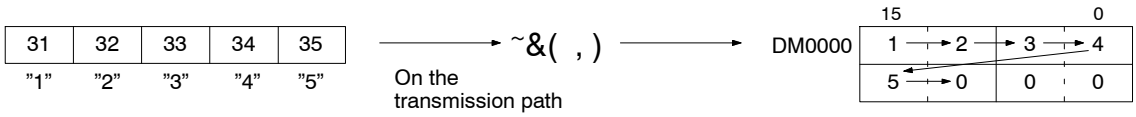


How to specify: ~$ (R (DM0000) 6)

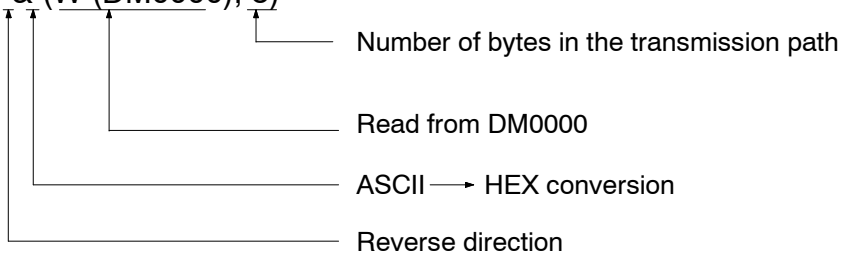


- When converting the numeric data (ASCII data) from the mating unit into the HEX data and receiving and writing it

Example: Converting a 5-digit numeric data (5 bytes in ASCII data) into the Hex data, and write it from the I/O memory DM0000 in the reverse direction.



How to specify: ~& (W (DM0000), 5)



Users can set the following contents on the X and Y of variable (X,Y).

Contents of X and Y

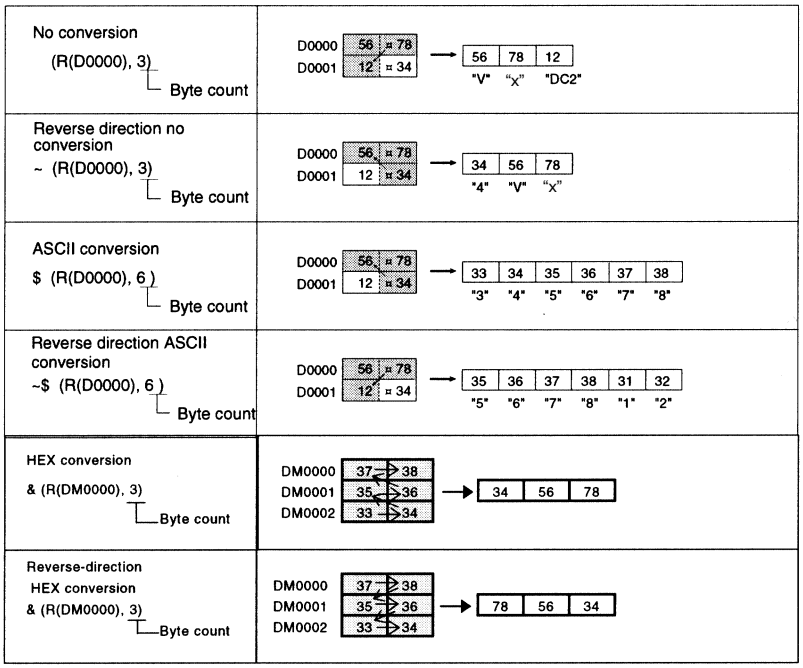
How to set X and Y				Specification	Example	Items available			
						Send		Receive	
						Address	Data	Receive	Data
How to set X	Reading /writing the I/O memory	Word reading	Operand addressing	R (z) Beginning CH + (Linear expression including N) Read option Read from the beginning CH + (yN + x)CH	(R (1),1) The system reads one byte from the second operand of the PMCR instruction + 1 location to send it with no conversion	O	O	O	O
			Link word addressing	R (z) Beginning CH + (Linear expression including N) Read option Read from the beginning CH + (yN + x)CH	$(R(O1+5),2) The system reads 2 bytes from the 5th word in the link word's output area 1to send it with conversion to ASCII form.	O	O	O	O
			Direct addressing		$(R(DM0000),3) The system reads 3 bytes from DM0000 to send it with conversion to ASCII form.	O	O	O	O

How to set X and Y				Specification	Example	Items available			
						Send		Receive	
						Address	Data	Receive	Data
How to set X	Reading /writing the I/O memory	Word writing	Operand addressing	W (z) Beginning CH + (Linear expression including N) Write option Read from the beginning CH + (yN + x) CH	(W(1),1) The system writes one byte of receive data to the (third operand of the PMCR instruction + 1)th word with no conversion.	---	O	---	O
			Link word addressing	W (z) Beginning CH + (Linear expression including N) Write option Read from the beginning CH + (yN + x) CH	&(W(I1+5),2) The system writes 2 bytes of receive data to the input area 1 of the link word's 5th word with hexadecimal conversion.	---	O	---	O
			Direct addressing		&(W(LR0060),3) The system writes 3 bytes of receive data to LR0060 with conversion to HEX form.	---	O	---	O
	Wild card			Can be set only in the address part or data part of the receive message. • Setting the wild card in the address part The system receives all the messages without checking the address data. • Setting the wild card in the data part The system receives all data without checking the received data.	With (∗, 2) specified in the address part, 2 bytes can be received from any address. With (∗, 5) specified in the address part, 5 bytes can be received from any address.	---	O	---	O
	N (repeat counter)			N	(N, 1) repeat counter value	O	O	O	O
How to set Y	Linear expression including N (repeat counter)			yN+x Constant. Sets the number of bytes (1-255). Repeat counter value Coefficient (0-255).	$(R(1),2) The system repeatedly reads 2 bytes starting at word No. (second operand of the PMCR instruction + 1) to send it converted to ASCII form.	O	O	O	O

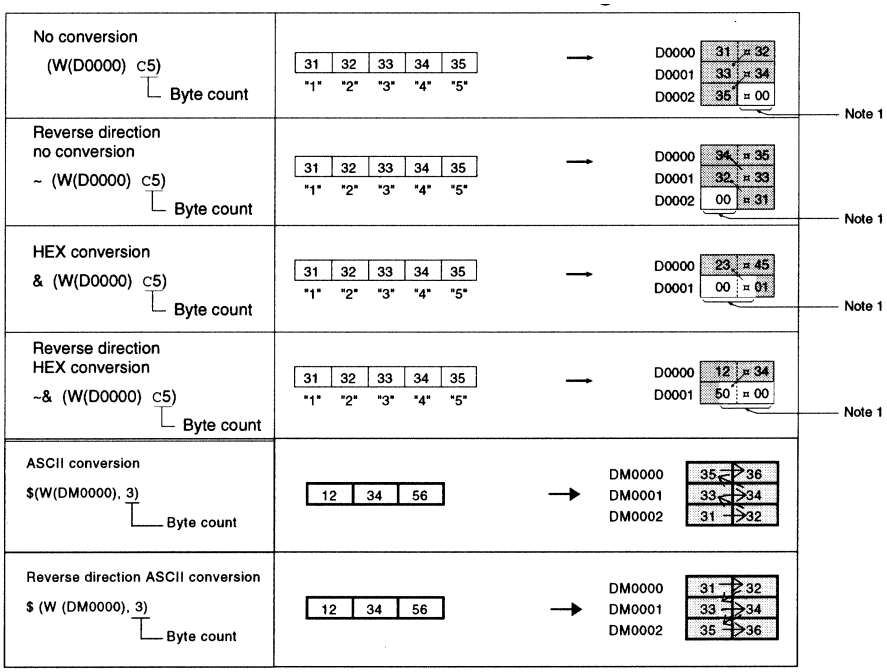
How to set X and Y				Specification	Example	Items available			
						Send		Receive	
						Address	Data	Receive	Data
How to set Y	Wild card			Can be set only in the data part of the receive message. Setting the wild card in the data part The system receives all the messages without checking the received data.	&(W(1),*) The system receives data from the third operand of the PMCR instruction + 1 to store it with conversion to HEX form regardless of the length.	---	O	---	O
	I/O Channel read	Chan-nel read	Operand specification	R (z) Beginning channel + (linear expression including N) Read option Beginning channel + (linear expression including N) Read option The content of the low-order byte of the starting CH + (yN + x) CH is read as a binary value and handled as a byte.	(*,R(1)): Set in receive data. Any receive data is received by the number of bytes of the contents CH + 1CH specified using the third operand.	O	O	O	O
			Link channel	R (z) Beginning channel + (linear expression including N) Read option Beginning channel + (linear expression including N) Read option The content of the low-order byte of the starting CH + (yN + x) CH is read as a binary value and handled as a byte.	(R(1) , R(O1): Set in send data. Data is sent by the number of bytes of the contents of the starting CH at the link channel output area | from CH + 1CH specified with the second operand of a PMCR instruction.	O	O	O	O
			Direct		(R (DM0000), R (DM0100)): Set in send data. Data is sent by the number of bytes of the contents from DM0000CH to DM0100.	O	O	O	O

Examples of the variable

CPU to Unit PSB Reading

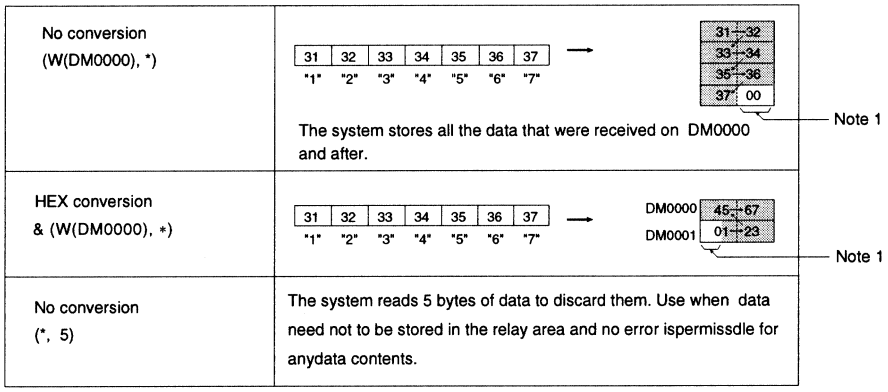


PSB to CPU Unit Writing



Note 1. 0 is stored in an empty bit in a word whose write data is less than 16 when writing into the CPU unit.

When the receive data has variable length, use the wild card (*).



Convert other than numerical data in the following way:

- The negative sign (-) is recognized as a minus value and the highest digit is stored as FHex.
- The decimal point is ignored when the data is stored.
- Symbols and characters other than 0 to F are stored as 0Hex.

Receive data string (Example)	Variable (ASCII to HEX conversion)	After conversion
HEX: 2D 31 32 33 34 35 ASCII: - 1 2 3 4 5	& (W(DM000,6)	DM0000 23 45 DM0001 00 01
HEX: 31 32 33 2E 34 35 ASCII: 1 2 3 . 4 5		DM0000 23 45 DM0001 00 01
HEX: 31 2F 33 34 35 36 ASCII: 1 / 3 4 G 6		DM0000 34 06 DM0001 00 10

Note Error Check Code

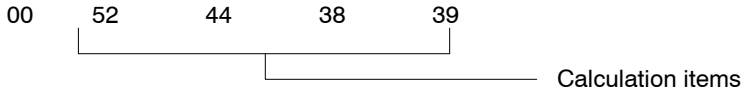
For protocol macros, the following 8 types of check code can be set:

Calculation method	Data type		Reverse direction (see note 2)	Initial value
LRC	BIN	1 byte	Unavailable	0-255
	ASCII	2 byte (see note 1)	Available	
Sum (1 byte)	BIN	1 byte	Unavailable	0-255
	ASCII	2 byte	Available	
Sum (2 bytes)	BIN	2 byte	Available	0-65535
	ASCII	4 byte	Available	
Sum2 (1 byte)	BIN	1 byte	Unavailable	0-255
	ASCII	2 byte	Available	
Sum2 (2 bytes)	BIN	2 byte	Available	0-65535
	ASCII	4 byte	Available	
CRC-CCITT	BIN	2 byte	Available	---
	ASCII	4 byte	Available	
CRC-16	BIN	2 byte	Available	0-65535
	ASCII	4 byte	Available	

Note

1. Swap between high byte and low byte of the error check code is possible only when the Communications Board is C200HW-COM**-EV1.
2. The host link (SYSWAY) uses an error check code: LRC ASCII 2-byte (sequential direction).

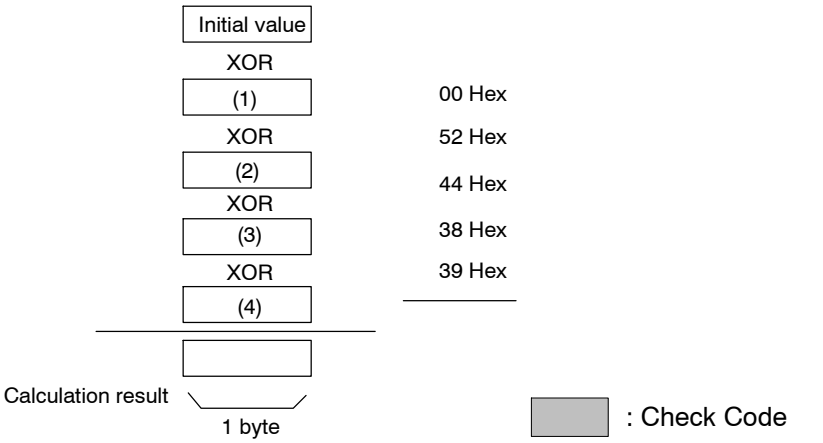
The followings are the examples of the calculation:
Example) Following message items are used to calculate the check code when the initial value is 0.



1, 2, 3...

1. LRC (Longitudinal Redundancy Check)

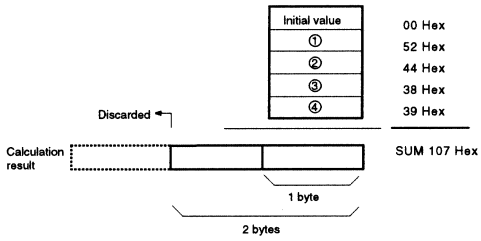
This mode calculates the exclusive OR (XOR) of the characters of a set of data to create a check code.



LRC 2byte ASCII	00 52 44 38 39 31 37 0D
LRC 2byte ASCII	00 52 44 38 39 37 31 0D
LRC 1byte ASCII	00 52 44 38 39 17 0D

2. SUM

This mode adds arithmetically the characters of a set of data to create a check code. Users can specify either of the directions for storing the SUM, as with variables.



: Check Code

SUM (1 byte) ASCII 2byte	00 52 44 38 39 30 37 0D
SUM (2 byte) ASCII 4byte	00 52 44 38 39 30 31 30 37 0D
SUM (1 byte) BIN 1byte	00 52 44 38 39 07 0D
SUM (2 byte) BIN 2byte	00 52 44 38 01 07 0D
~SUM (1 byte) ASCII 2byte	00 52 44 38 39 37 31 0D
~SUM (2 byte) ASCII 4byte	00 52 44 38 39 31 30 37 30 0D
~SUM (2 byte) BIN 2byte	00 52 44 38 39 07 01 0D

Note SUM2 is the 2's complement of SUM.

3. CRC (Cyclic Redundancy Check Code)

This mode regards the whole data as a bit string (message polynomial), divides this string by the fixed constant (generative polynomial), and defines the remainder as the check code.

CRC detects errors better than the vertical parity or horizontal parity, and is used widely in LANs, etc (For example, the SYSMAC LINK uses CRC-CCITT).

Various kinds of CRC can be used. The calculation mode defined according to the CCITT recommendation is called CRC-CCITT, where $X^{16}+X^{12}+X^{5}+1$ is used as the generative polynomial. (Incidentally, CRC-16 ($X^{16}+X^{12}+X^{2}+1$) is also often used as a generating polynomial.)

: Check Code

CRT-CCITT 4byte ASCII	02 52 44 38 39 33 36 46 42 0D
CRT-CCITT 2byte BIN	02 52 44 38 39 36 FB 0D

CRT-16 4byte ASCII	02 52 44 38 39 42 46 46 41 0D
CRT-16 2byte BIN	02 52 44 38 39 BF FA 0D

Note Reverse direction is available. Default value can be set for the CRC-16

The generating function in the calculation mode of the CRC that is mounted on the C200HW-COM04/05/06-EV1 is uniquely determined as CRC-CCITT or CRC-16. Data for each character of CRC-CCITT is treated differently from that for CRC-16 as shown below.

If a message with “n” characters, which is subject to check code calculation, is expressed as shown in the following table, the MSB (Most Significant Bit) and LSB (Least Significant Bit) in every character for CRC-16 will be reversed as shown in the following tables.

C_0	C_1	---	C_{n-1}
D0(7) to D0(0)	D1(7) to D1(0)	---	Dn-1(7) to Dn-1(0)

Note D: 0 or 1

CRC-CCITT

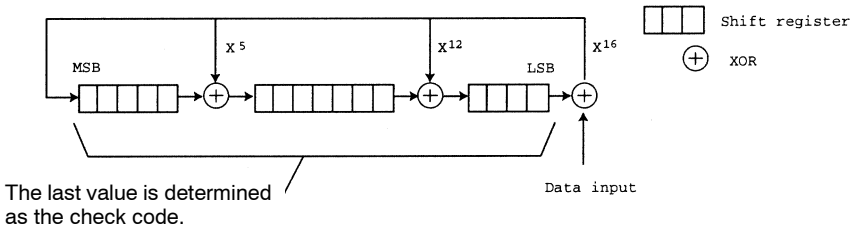
C_0	C_1	---	C_{n-1}
D0(7) D0(6) to D0(0)	D1(7) D1(6) to D1(0)	---	Dn-1(7) Dn-1(6) to Dn-1(0)

CRC-16

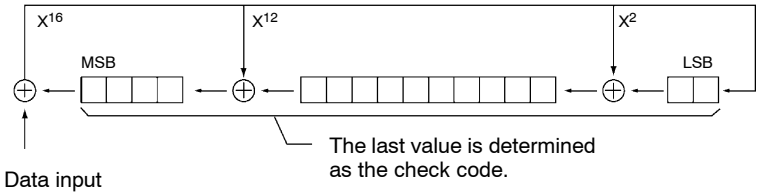
C_0	C_1	---	C_{n-1}
D0(0) D0(1) to D0(7)	D1(0) D1(1) to D1(7)	---	Dn-1(0) Dn-1(1) to Dn-1(7)

Therefore, algorithm for each one becomes as shown below.

• CRC-CCITT algorithm



• CRC-16 algorithm



3-5-9 Supplemental Notes on Message Setup

1, 2, 3... **1. Specifying more than one constant or variable**

To specify more than one constant or variable, use + as follows:

Example: Sending a command (”RX0” + word number + “00” (code number)) to determine the PV (Process variable) of the temperature controller

”RX0” + $(N,1) + “00”

↓

A message “RX0N00” (N is the value of the repeat counter, 0-255) is sent.

N = 0: “RX0000”

N = 1: “RX0100”

N = 2: “RX0200”

2. Word writing for receive messages

For receive messages, the system needs to compare the “address part” of

the message frame that was received, confirm whether this part has the self unit number or not, receive the data part if so, and store this "data part" to the appropriate area on the PLC by "word writing."

- Specify the data needed for comparison such as an address using a constant, variable with constant X, variable (word reading), wild card, etc.
- Specify the data necessary to be stored to the area on the PLC using a "variable (word writing)."

Example: Comparing the address part (2 bytes long) and receiving the data part succeeding the address part to store in the I/O memory on the PLC

Address specification

: $(R(1),2) When the received message is for the receiver (the received address is the same as the address (2 bytes long) set in the second operand of the PMCR instruction + 1, and then converted to ASCII form), the data part succeeding this address part is received.

Note Note: The message to be compared (expectation message) is word read (R option).

: (∗,2) Whichever unit address the destination of the receive message has, the data part succeeding the address part is received.

Note Note: For the address part, the wild card (∗) can be used only on X.

Data addressing

: &(W(1), ∗) The data that were received are written to the third operand of the PMCR + 1 with conversion to HEX form regardless of the length.

Note Note: To store the data that were received into the area on the PLC, use word writing (W option) to specify.

Example: Comparing some part of the receive data and storing the other part of the data to the PLC area.
The system checks the command string "TX∗∗" in the data that were received, and then stores the succeeding data to the area in the PLC.

Data specification:

"TX"+(∗,2)+&(W(1), ∗) When receiving the command TX, the system does not compare the next 2 bytes of data, and stores the subsequent data with converting to HEX form regardless of the length.

- If the wild card (∗) is set at the data size part of "variable (word write)", the system finishes the message receiving when the buffer becomes full (256 bytes) with the message.
- If the wild cards are set at the data sizes of consecutively specified "variables (words write)" (separated by "+"), the first "variable (word write)" only is effective.
  For example, (W(1), ∗)+(W(10), ∗) is equal to (W(1), ∗).
- If "+"s separated by a constant or a check code are specified between "variables (words write)" the data sizes of which the wild cards are set,
  the constant or the check code is deemed a delimiter.

For example, if "12345ABC5678" is received while (W(1), ∗)+"ABC"+(W(10), ∗) is set, "12345" corresponds to (W(1), ∗) and "5678" corresponds to (W(10), ∗).

3. Setting the header, check code, and terminator

- For the header or terminator, various special codes such as @, CR, LF, STX, or ETX are used according to the mating communication unit. Always set on the message the same header or terminator as the mating communication unit.

- Most of the mating communication unit can send or receive only ASCII codes. In this case, convert the HEX code into ASCII before sending and convert received data from ASCII to HEX conversion before storage. Consider the data format and reading/writing direction which allows sending/receiving of the mating unit, and convert it into a data format which can be handled with the data conversion-available variable before sending and receiving.

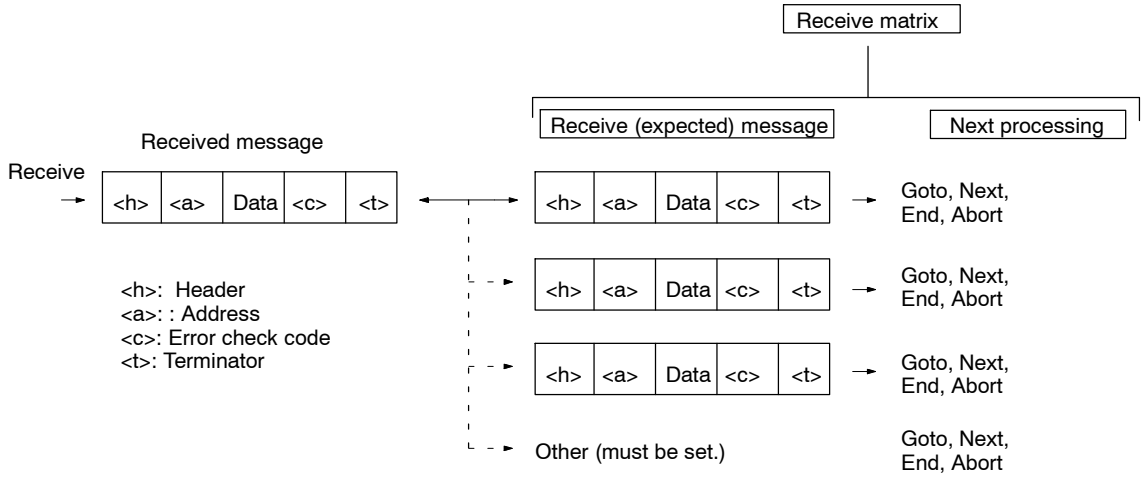
3-6 Creating Receive Matrices

Receive matrices are set when more than one receive messages are expected to be received or when users want to change next process for each receive message.

Up to 15 types of message can be set in a receive matrix (case no.00 ~15). In a receive matrix, next processes such as End, Next, Goto∗∗, or Abort set for each one of the up to 15 types maximum of receive message.

"Other" must also be set to enable processing when some message other than the receive messages specified in the matrix is received.

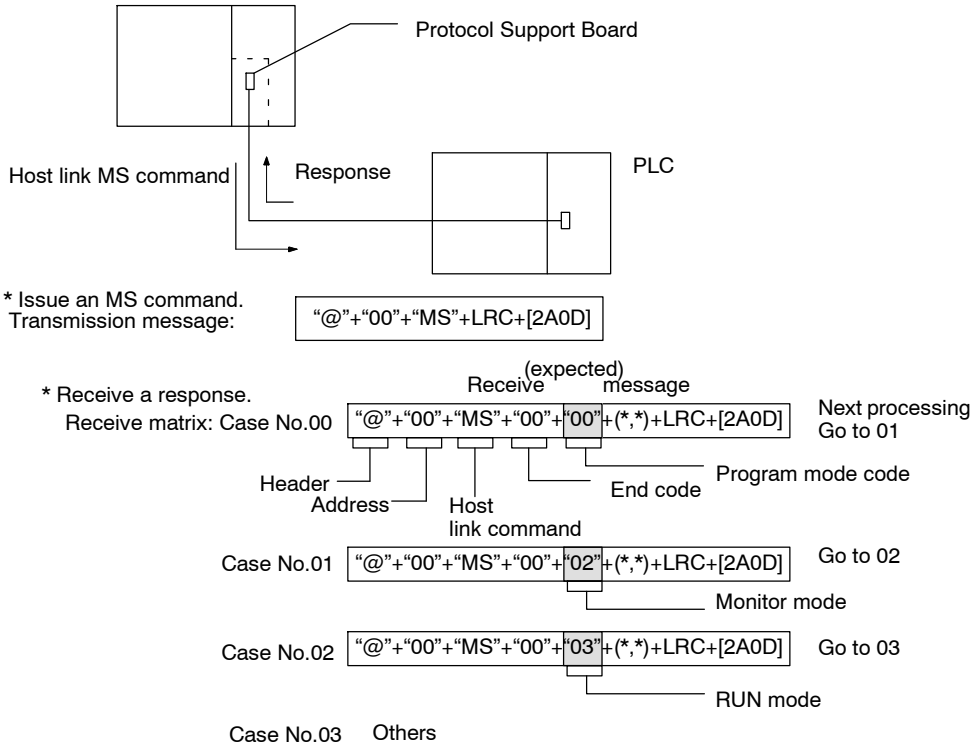
Note The unit by which the system compares the expected value with the actually received value in the receive matrix is not of data, but of messages.



Note: Maximum of 16 cases are possible including "Other."

For example, using a receive matrix allows users to efficiently create the following communication sequence.

Example: Via the host link (SYSWAY), change over the processing according to the response (Program/Monitor/RUN mode) for the status read command.

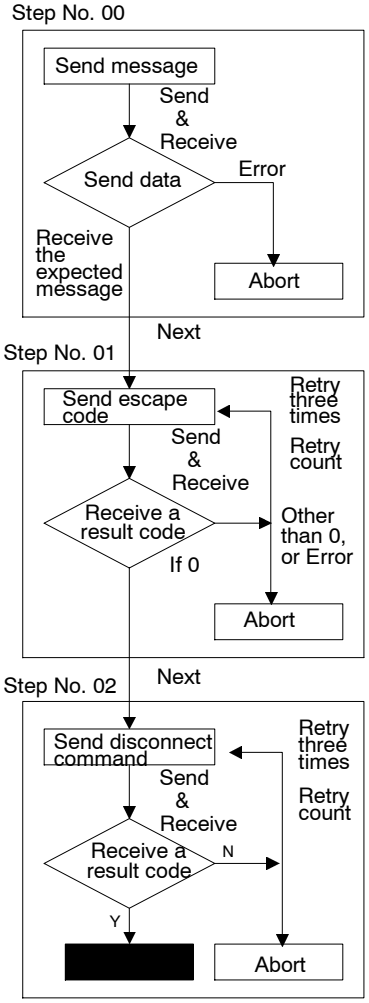


By using the receive matrix, identify the difference in the status in the response data (section in the above), and change over the processing according to the mode of the PLC.

An example of using the receive matrix

Change over the processing according to the ACK, NAK reception.

In the following example, the entire message structure is omitted and only data is indicated with "".



Step structure

Step No.	Repeat counter	Command	Retry	Second wait	Second message	Receive message	Response notification	Next process	Error process
00	R/001	Send&Receive	_	_	”ENQ”	”ACK”	_	Next	Goto o00
01	R/001	Send&Receive	–	1 s	Message	Receive matrix	–	–	Goto o00
02	R/001	Send&Receive	–	–	”EOT”	–	–	End	Abort

Receive matrix

Case No.	Receive message	Next process
00	”ACK”	Goto02
01	”NAK”	Goto01
~		
15	Other	Abort

Set next processes (End, Next, Goto**, or Abort) for each one of the up to 15 types of receive message.

For “Other case, set the next process to be executed when the message that was received is not equal to any of the expectation messages.

Note Set same header and same terminator for all the receive messages set by the receive matrix. If headers or terminators are different by case number, the system shall make a comparison for the received message based on the header and the terminator (or the data length, if the terminator is unavailable) of a received message set as case number 00. For example, therefore, if the header of case number 00 is “@” and the header of case number 01 is [02](STX), the system identifies that the comparison results in the unmatched even if the header of actually received message is [02], because it is different from the header “@” of case number 00.

3-7 Example of standard system protocols

3-7-1 Example: “Current-value read” sequence of the regular (type E5K read system) protocol

Level	Item	Contents of setting
Sequence	Link word	---
	Transmission control parameter	Modem control
	Response Type	Scan
	Receive wait monitoring time Tr	3s
	Receive finish monitoring time Tfr	3s
	Send finish monitoring time Tfs	3s
Step	Step No.	00
	Repeat counter	RSET/001
	Command	Send&Recv
	Retry counter	3
	Send wait time	---
	Send message	SD(00)_1
	Receive message	RV(00)_1
	With/Without response writing	Yes
	Next process	End
	Error process	Abort
Send message SD(00)_1	Header <h>	”@”
	Terminator <t>	[2A0D]
	Error check code <c>	LRC (H parity) (0) (2-byte ASCII)
	Length <l>	---
	Address <a>	$(R(1)),2)
	Message editing	<h>+<a>+”1”+”00”+”0000”+<c>+<t> Data
Reception message RV(00)_1	Header <h>	”@”
	Terminator <t>	[2A0D]
	Error check code <c>	LRC(H parity)(0) (2-byte ASCII)
	Length<l>	---
	Address<a>	&(R(1)),2)
	Message editing	<h>+<a>+”00”+”00”+&(W(1),4)+<c>+<t> Data

3-7-2 Modem Initialization (MD24FB10V) sequence of Modem Hayes AT command Protocol

Level	Item	Contents of setting		
Sequence	Link word	---		
	Transmission control parameter	RS/CS flow (receiver), modem control		
	Response type	Scan		
	Receive wait monitoring time Tr	10s		
	Receive finish monitoring time Tfr	---		
	Send finish monitoring time Tfs	---		
Step	Step No.	00	01	02
	Repeat counter	RSET/001	RSET/001	RSET/001
	Command	Send &Recv	Send &Recv	Send &Recv
	Retry counter	0	0	0
	Send wait time	---	1s	1s
	Send message	MD24FB10V	MD24FB10V	MD24FB10V
	Receive message	<Initial-R1>	<Initial-R2>	<Initial-R3>
	With/Without response writing	None	None	None
	Next process	Matrix	Matrix	Matrix
	Error process	Goto 1	Goto 2	Abort
Send message MD24FB10V _1	Header <h>	---		
	Terminator <t>	CR		
	Error check code <c>	---		
	Length <l>	---		
	Address <a>	---		
	Message editing	”ATE0V0X4¥V2¥N3%C0*C0¥X1&M0”+”S26=10”+<t> Data		
Receive matrix <Initial-R1> <Initial-R2> <Initial-R3>	Case No.	00		
	Receive message	RxD.0		
	Next process	End		
Receive message RXD.0	Header <h>	---		
	Terminator <t>	CR		
	Error check code <c>	---		
	Length <l>	---		
	Address <a>	---		
	Message editing	”0” + <t> Data		

3-8 Example of Communication Sequence

Shown below is an example of sequence to read process values from a 8CH type temperature controller (E5ZE):

3-8-1 Sequence Setup Content

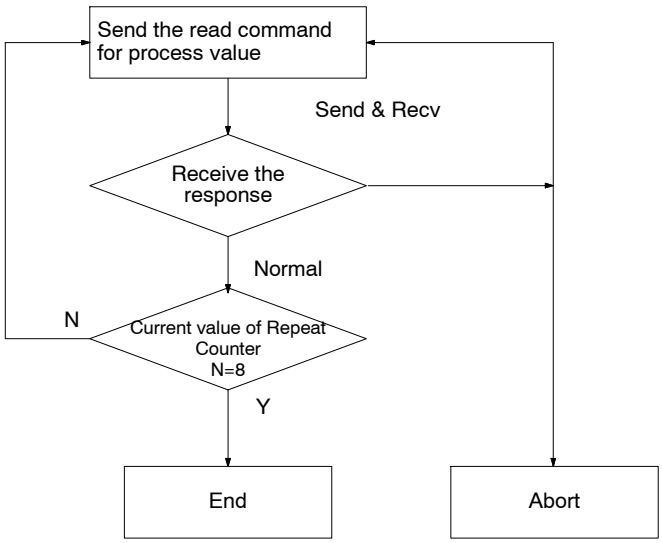
Sequence No. 101

Link word	Transmission control mode	Response type	Monitor time, Tr	Monitor time, Tfr	Monitor time Tfs
---	Modem control	Scan mode	3s	3s	3s

3-8-2 Step Setup Content

Create a process flow as follows:

Step No. 00



Normal

The system sends the read command for a process value and waits the response from the temperature controller. It converts the process value data to HEX codes and store them in I/O memory. It uses the repeat counter to switch the PLC area, sends the read command for the next process value until eight words process values are read and stored in the PLC areas.

Abnormal

According to a set retry count (three times), the same step is repeatedly executed up to three times automatically at any of the following error occurrences:

- The send finish monitoring time Tfr, the receive wait monitoring time Tfr, or the receive finish monitoring time Tfr is expired.
- A receiving communication error occurred (port A: CIO28304 or port B: 28312 is “ON”).
- Wrong receive message.
- An error in the error check code.

Step No. 00

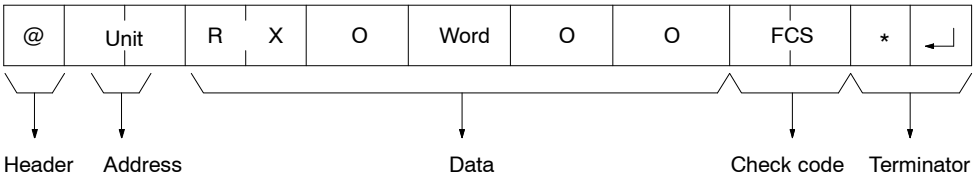
Repeat counter	Command	Retry count	Send wait time	Send message	Receive message	With/Without response writing	Next process	Error process
RSET/008	Send& Recv	3	---	Described below	Described below	With	End	Abort

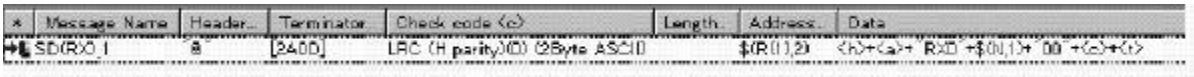
3-8-3 Send and Receive Messages Creation

The system can read the PV (process variable) of the specified word on the temperature controller (E5ZE) by sending the “RX0N00” (N is the word number of the controller) command. Only one word of data can be read in one time of data sending or receiving. When reading 8 words of data, it is necessary to execute the Send&Recv command 8 times repeatedly.

Send message

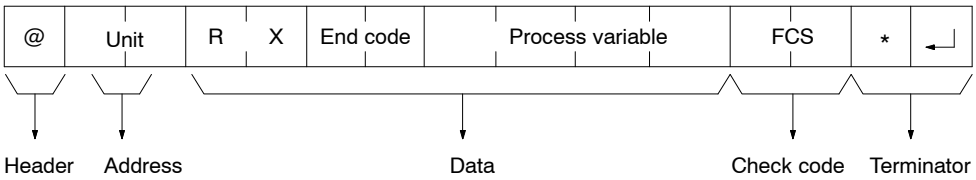
Example: A frame of read command for the process variable

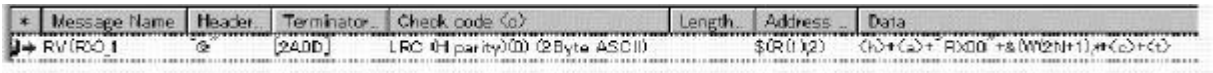




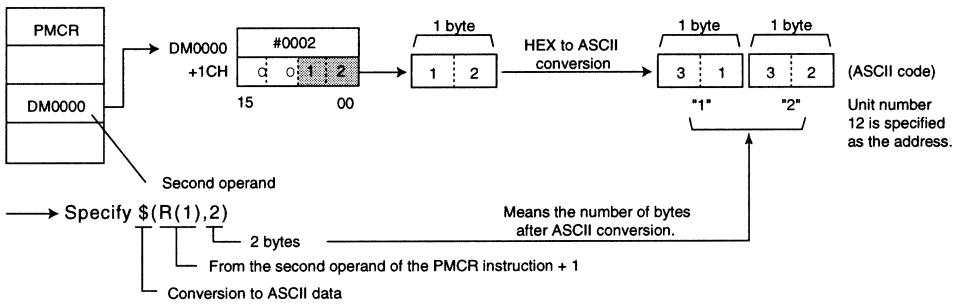
Receive message

Example: A frame of the response to the read command for the process variable

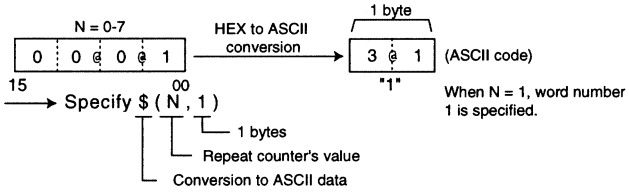




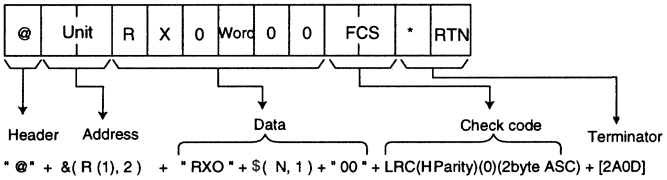
- Specifying the unit number as 2 characters (1 byte) beginning from the second operand of the PMCR instruction + 1



• Specifying the word number of the measured temperature as 1 digit of the repeat counter N

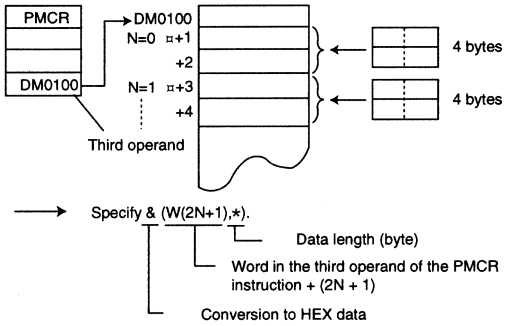


As a result, create the send message as follows.

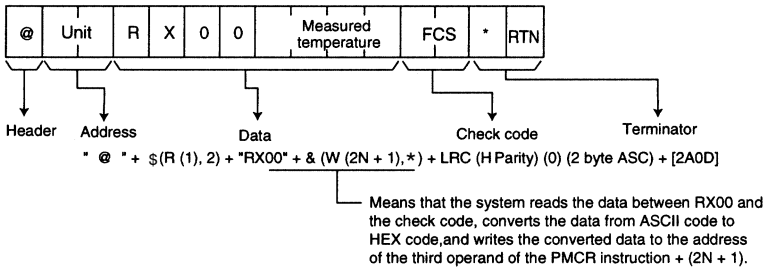


3-8-4 Receive Message Creation

• Writing the data of the measured temperature to the third operand of the PMCR instruction + (2N + 1) without fixing the length.
Note: N means the value of the repeat counter.



Create the receive message as follows.



3-8-5 Contents of sequence

Measuring temperature reading in sequence No. 10 of the temperature control (Model E52 reading series) protocol

• Sequence unit setting

Item	Contents
Link word	No setting
Transmission control parameter	Modem control available
Response type	Scan posting method
Receive wait monitoring time (Tr)	3s
Receive finish monitoring time (Tfr)	3s
Send finish monitoring time (Tfs)	3s

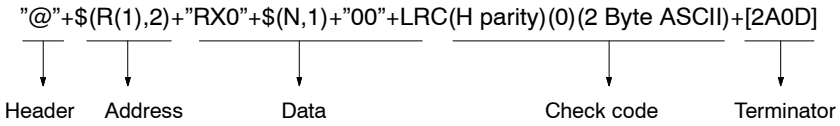
• Step unit setting

Step 00 (only)

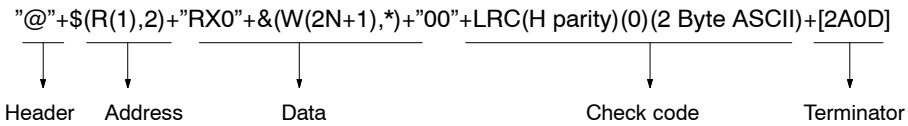
Item	Contents
Repeat counter	Repeat type: Reset
	Counter: 8 (constant)
Command	Send & Receive
No. of retries	3
Send wait time	None
Send message	Message name: SD (RX)1
Receive message	Message name: RV (RX)x1
With/Without Response Writing	Yes
Next process	End
Error process	Abort

• Presence of send/receive message

Send message name <SD(RX)1>



Receive message name <RV(RX)1>



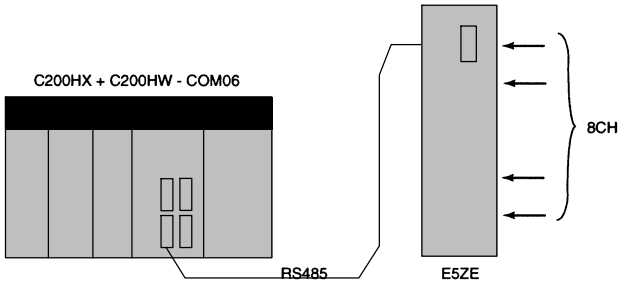
3-9 Executing Created Communications Sequence

This section describes how to execute the communication sequence described so far. It is necessary to transfer the protocol that was created to the PSB in advance. However, the previously mentioned communication sequence is registered in sequence number 101 of the incorporated standard system protocol, so the following describes the procedure for executing sequence number 101.

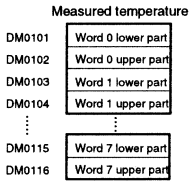
Note It is assumed that the standard protocol is under the initial status. When the sequence is changed by the Protocol Support Tool or other modes, return to the original sequence before execution.

3-9-1 Device Connection

It is assumed as an example that a PLC (Model C200HX), Communications Board (Model C200HW-COM06), and temperature control device (Model E5ZE) are connected as follows.

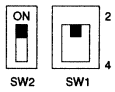


8 bits of measured temperature are assumed to be stored to DM101-116.



3-9-2 Initial Setup

1, 2, 3... 1. Set the dip switch on the PSB.



SW1 2: 2 wire system, 4: 4 wire system
SW2 ON: Terminator available, OFF: Terminator not available

2. Set the PLC system setup of C200HX as follows:
Use DM6555 #6000:

Note Communications mode as the protocol macro function to set the communications requirements as follows:

Note1: #6000

The communication requirement of port A
0: Standard setup
The mode used by port A

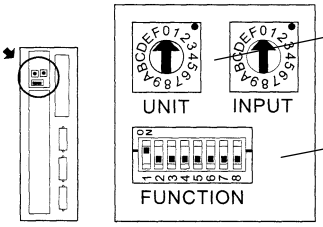
Standard setup contents

Start bit	1 bit
Data length	7 bits
Parity	Even parity
Stop bit	2 bits
Baud rate	9600bps

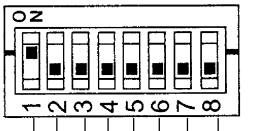
Note For more information of the PLC system setup area related to the protocol macro function.

3. Set the temperature control device (E5ZE)

Set the unit number to “0” and baud rate to “9600 bps”.



Switch Function



Hardware mode
Not used (Must be OFF)
Temperature unit (°C or °F)
Operation mode when the power is ON
Connection of E5ZD-SDL Setting Indicator
Memory bank designation method
1: ON, 2* OFF (Set to 9600 bps)

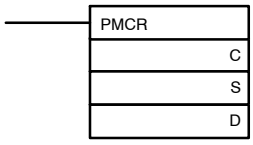
Note After changing the dip switch's setting, turn OFF and ON the power supply once.

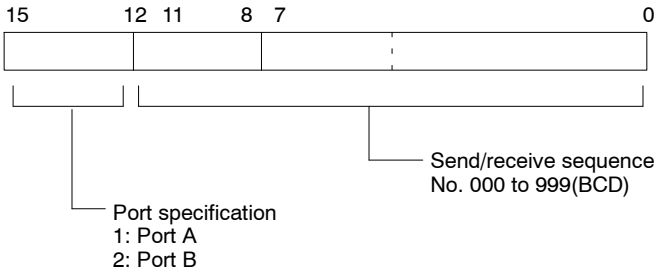
3-9-3 Creating Ladder Programs

The protocol is executed by the PMCR instruction of the PLC.

- PMCR instruction specification
  - Function: Calls the send/receive sequence No. registered in the PSB, and executing the send/receive sequence of the corresponding sending/reception sequence and sends/receives data to/from the general-purpose external unit through port A or B of the PSB.
  - Meaning of operand:

C: Control data





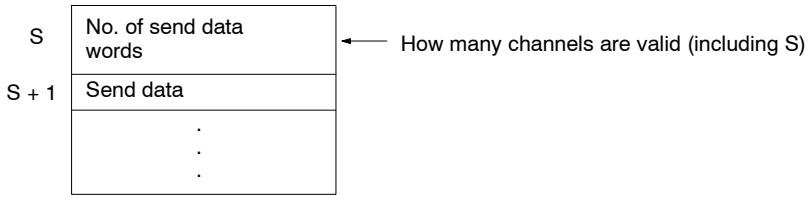
S: Send data starting channel number

Set the starting channel at the CH area where data required for setting is stored.

Note When no send data is found, be sure to set #0000. Setting the other constant or channel generates an error (ER flag 25505 is ON), and the PMCR instruction is not executed.

Send data of how many words are valid at S and the following is stored in S.

Actually send data is stored in S+1 and the following.



D: Receive data storage starting address number

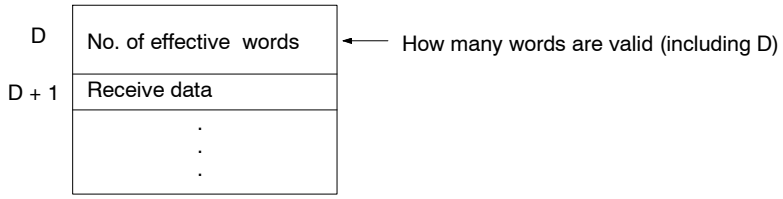
Set the starting address at the CH area where receive data is stored.

Note When no receive data is found, be sure to set a dummy channel. Setting a constant (#0000 to FFFF) generates an error (ER flag 25503 is ON), and the PMCR instruction is not executed.

Data is not written in the dummy channel. It can be used for the others.

Receive data is not stored in D and the following.

The number of effective addresses is stored in D1–, D+ 1 and the following,.



• Flag

Value	ON	OFF
ER(25503)	• When *DM (Indirect) is specified, the DM content is neither 6656 or higher nor BCD, • For D, the DM content is neither 6144 nor higher or BCD, • When the instruction is executed or already in execution • When neither 1 nor 2 is specified for the port	Other than the cases in the left

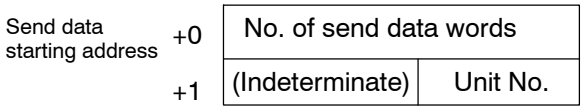
• Data contents

Model	C200HX/HG/HE		
Operand	C	S	D
Relay area 1	000-255	000-2555	000-252
Relay area 2	256-511	256-511	256-511
Hold relay	HR00-99	HR00-99	HR00-99
Auxiliary relay	AR00-27	AR00-27	AR00-27
Link relay	LR00-63	LR00-63	LR00-63
Timer/counter	T/C000-511	T/C000-511	T/C000-511
Temporary relay	---	---	---
Data memory	D0000-6655	D0000-6655	D0000-6143
Indirect data memory	*D0000-6655	*D0000-6655	*D0000-6655
Constant	See the above.	#0000-FFFF	---

Contents of send/receive data word assignment to read the process value in sequence No.101of the standard system protocol “E5ZE Temperature Controller Read” (from the Communications Board Operation Manual)

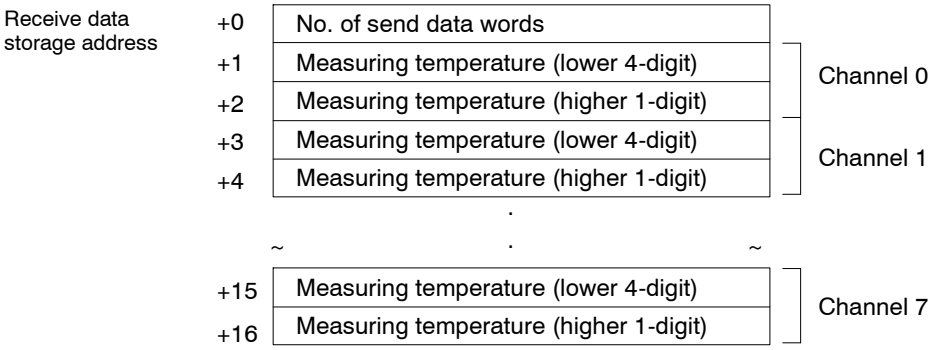
Read the process value and store the result in the specified address.

• Send data word assignment (Second operand of PMCR instruction)

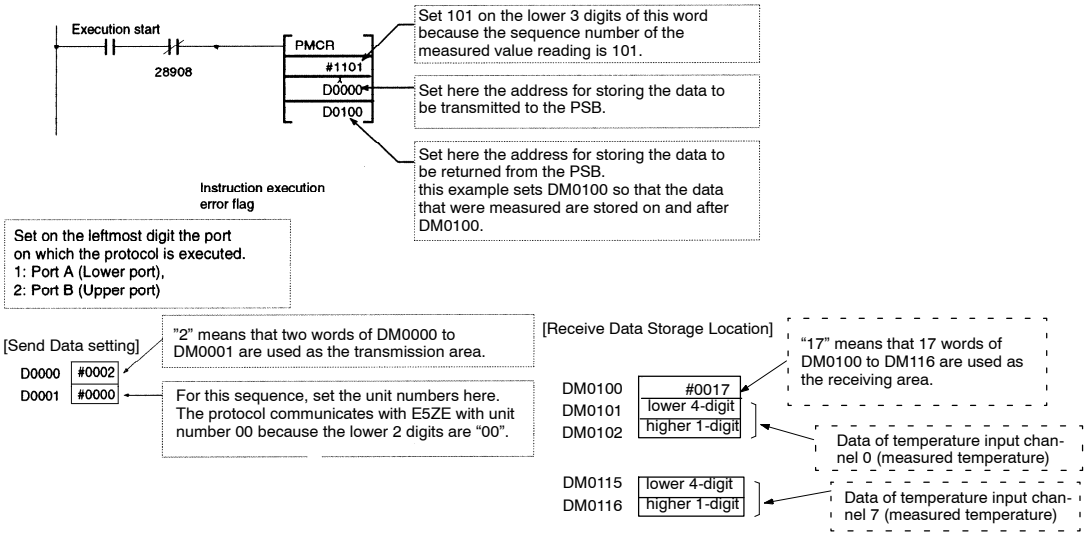


Offset	Contents(Data format)	Data
+0	No. of send data channels(BCD 4-digit)	0002 (fixed)
+1	Unit No. (HEX 2-digit)	00 to 0F

• Receive data word assignment (Third operand of PMCR instruction)



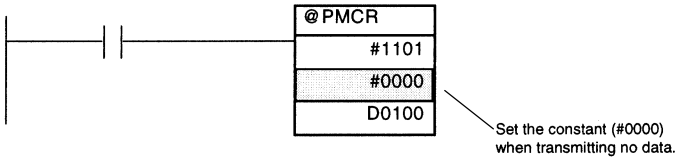
Offset	Contents(Data format)	Data
+0	No. of receive data words (BCD 4-digit)	0017
+1	CH0 Measuring temperature (lower 4-digit) (BCD 4-digit)	Differs depending on the temperature measuring type. Refer to the Model E5ZE Manual F denotes - (minus).
+2	CH0 Measuring temperature (higher 1-digit) (BCD 1-digit)	
to	to	to
+15	CH7 Measuring temperature (lower 4-digit) (BCD 4-digit)	Differs depending on the temperature measuring type. Refer to the Model E5ZE Manual. F denotes -.
+16	CH7 Measuring temperature (higher 1-digit) (BCD 1-digit)	



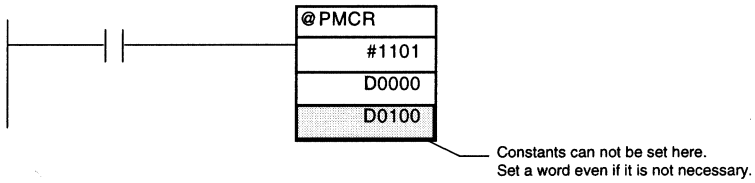
Settings of the PMCR Instruction

Note The following shows the cautions in using the PMCR instruction.

• Transmitting no data to the PSB



• Storing no data to the relay area on the PLC



• Related Special Auxiliary Relay
The PSB status (execution status of sequence/step) is allocated on the following special auxiliary relay of the PLC. Use them in the ladder programs.

• Special Auxiliary Relay (PSB Allocation Area)

Word	Bit(s)	Function	Read: R/ Write: W	Flag	
				System	User
268CH PSB error area of detailed information for the system continuation error FAL9C occurrence	00	Watchdog timer error for the PSB	R	○	---
	01	Port recognition error (hardware error)	R		
	02	Protocol data error (protocol data checksum error due to memory corruption)	R		
	03 to 10	Reserved for future expansion	R		
	11	Port B protocol macro error (error relating to PMCR instruction execution)	R		
	12	Port A protocol macro error (error relating to PMCR instruction execution)	R		
	13 to 15	15: "System setting error occurrence" 14: Above error for port A 13: Above error for port B	R		
283CH	00 to 03	Port A error codes 0: No error 1: Parity error 2: Framing error 3: Overrun error 4: FCS error 5: Time-out error 6: Checksum error 7: Command error	R		
	04	ON for communication error at Port A	R		
	07	Port A Sequence Abort Termination Flag (see note 1)	R		
	08 to 11	Port B error codes 0: No error 1: Parity error 2: Framing error 3: Overrun error 4: FCS error 5: Time-out error 6: Checksum error 7: Command error	R		
	12	ON for communication error at Port B	R		
	15	Port B Sequence Abort Termination Flag (see note 1)	R		
284CH	00 to 07	Port A Current Repeat Count (01-FF) (see note 1)	R		
285CH	00 to 07	Port B Current Repeat Count (01-FF) (see note 1)	R		
286CH	00	Port A Trace In-progress Flag (see note 2)	R		
	01	Port B Trace In-progress Flag (see note 2)	R		
	08 to 11	Port A Protocol macro error codes : No error 1: No protocol macro function 2: Sequence number error 3: Receive data write same area exceeded 4: Protocol data error	R		
	12 to 15	Port B Protocol macro error code : No error 1: No protocol macro function 2: Sequence number error 3: Receive data write same area exceeded 4: Protocol data error	R		

Word	Bit(s)	Function	Read: R/ Write: W	Flag	
				System	User
287CH	00 to 03	Port A execution completion receive case No. (0 to F)	R	○	---
	04 to 07	Port A execution completion step No. (0 to F)	R		
	15	Port A Execution Completion Storage Flag 0: No 287CH storage 1: 287CH storage present	R		
288CH	00 to 03	Port B execution completion matrix case No. (0 to F)	R		
	04 to 07	Port B execution completion step No. (0 to F)	R		
	15	Port B Execution Completion Storage Flag 0: No 288CH storage 1: 288CH storage present	R		
289CH	00	Port A Restart Flag	W	---	○
	01	Port B Restart Flag	W		
	02	Port A Continuous Trace Start/Stop Flag (see note 2)	W	---	○
	03	Port B Continuous Trace Start/Stop Flag (see note 2)	W		
	04	Port A Shot Trace Start/Stop Flag (see note 2)	W		
	05	Port B Shot Trace Start/Stop Flag (see note 2)	W		
	08	Port A Instruction Execution Flag	R	○	---
	09	Port A Step Error Processing Execution Flag	R		
	10	Port A Sequence End Termination Flag	R		
	11	Port A Forced Abort Flag	W	---	○
	12	Port B Execution Instruction Flag	R	○	---
	13	Port B Step Error Processing Execution Flag	R		
	14	Port B Sequence End Termination Flag (see note 1)	R		
	15	Port B Forced Abort Flag	W	---	○

Note 1. It is valid only when the Communications Board is the model C200HW-COM**-EV1.

2. The exclusive flags used only in the Protocol Support Tool.

Note The instruction execution error caused by the PMCR instruction operand setting failure is reflected on the ER flag (25503).

• Flag/Switch Description

Flag/Switch Name	Content		Word		Flag Type	
			Port A	Port B	System	User
Instruction Execution Flag	Becomes 1 (turned ON) when the PMCR instruction is executed. Remains unchanged to be 0 (OFF) when the execution failed. Becomes 0 (OFF) when the sequence is terminated (by the End or Abort termination).	1: PMCR instruction executing 0: No PMCR instruction executing	28908	28912	○	---
Step Error Processing Execution Flag	Becomes 1 (turned ON) when the step ends by error. Becomes 0 (OFF) when the step ends in normal.	1: Step error termination 0: No step error termination	28909	28913	---	○

Flag/Switch Name	Content		Word		Flag Type	
			Port A	Port B	System	User
Sequence End Termination Flag	Becomes 1 (ON) when the sequence is terminated by the End of the next process or the error process. However, it is invalid when the instruction executing flag is 1 but it is valid when that flag is 0. Note: The normal termination of sequence execution is identified with this flag by setting the End (Abort for the termination with error) for the sequence End termination.	1: Sequence End termination (changes from OFF to ON when the instruction execution flag changes from ON to OFF) 0: Not the sequence End termination	28910	28914	○	---
Sequence Abort Termination Flag	Becomes 1 (ON) when the sequence is terminated by the Abort of the next process or the error process. However, it is invalid when the instruction executing flag is 1 but it is valid when that flag is 0.	1: Sequence Abort termination (changes from OFF to ON when the instruction execution flag changes from ON to OFF) 0: Not the sequence Abort termination	28307	28315	○	---
Forced Abort Flag	Use to Abort the step execution to be forced to stop in the executing sequence by the user program.	Changes from 0 to 1 at the forced Abort execution	28911	28915	---	○
Restart Flag	Use to initialize the communication buffer and the special auxiliary relay 283CH to 285CH by the user program or the Programming Devices. If the Restart Flag is changed from 0 to 1 during the sequence execution, the restart process will be executed after the sequence execution or abortion.	Changes from 0 to 1 when the communication port is initialized (automatically becomes 0 after the initialization completion).	28900	28901	---	○
Execution Completion Step No.	The execution-completed step No. is stored. The bit 15 is turned ON when the No. is stored.	0 to FHex	287CH 04 to 07	288CH 04 to 07	○	---
Execution Completion Receive Case No.	The receive case No. selected in accordance with the receive message is stored when the receive matrix is set. The bit 15 is turned ON when the No. is stored.	0 to FHex	287CH 00 to 03	288CH 00 to 03	○	---
Execution Completion (step No. or the receive case No.) Storage Flag	Becomes 1 (ON) when the execution completion step No. or the execution completion receive case No. is stored. The read is performed as this flag is the input condition.	1: Stored 0: Not stored	28715	28815	○	---
Current Repeat Count	The step repeat count N value is reflected	01 to FFHex	284CH 00 to 07	285CH 00 to 07	○	---

Note See the section 4-5 for the error related flags.

3-9-4 Operation

The following describes the system's operation when executing the ladder program shown in 3-9-3 *Creating Ladder Programs*.

1, 2, 3... 1. When starting to execute a PMCR instruction, the system transmits the information set in the operand of the PMCR instruction such as the starting

sequence number and communication data store area, and sets the port A instruction execution flag (28908) ON.

2. The PSB reads the communication sequence with the appropriate sequence number set in the PMCR instruction.
3. The system sends “RX0 Word No. 00” (the command measuring the temperature of the temperature control device’s specified word) to the unit number (00) of the temperature control device (E5ZE) stored in DM0001.
4. The system receives “RX00” (the response from the temperature control device, 00 means the end code.) from the device (E5ZE) with unit number 00 to store the succeeding measured temperature into DM0101 and DM0102 through the PLC scan.
5. The system increases the value of the repeat counter by 1 8 times repeatedly. Every time the repeat counter is increased, the following contents are changed.

   • The word number of the temperature control device specified by $(N,1) in the send message changes between 0 and 7.

   • The DM area storing the measured temperature specified by &(W(2N+1,*) in the receive message changes as follows:

   →DM0101→DM0103→DM0105→DM0107→DM0109→DM0111
   →DM0113→DM0115
6. When the system ends the execution of the sequence, the port A instruction execution flag (28908) is set OFF.

3-9-5 Confirming the Operation

When the process variable is not stored successfully, confirm the following points.

• System error FAL01 or FAL9C.

  • Confirm that the PLC’s system setup is set correctly.

  • Confirm the setups of the PMCR instruction’s parameter and data.

• Flag 28909 (port A step error processing flag) is ON.

  • Confirm that the PLC’s system setup is correct. (Especially confirm whether port A and port B are not specified conversely)

  • Confirm that the line distribution (See Communication Board User’s Manual to connect the line is correct).

  • Confirm the communication rate, flame, and unit number of the 5ZE.

• No error, but data are not stored.

  • Confirm that the RUN LED of E5ZE is lit. (For details, refer to the *E5ZE Operation Manual.)*

• Other errors
  When some error occurs during the operation of the PSB, the system shows this error using the LEDs on the PLC’s CPU unit or the error code on the programmable console, as well as stores the type or the location of the error into the relay area related to the PSB. When an error occurs, see the following to troubleshoot properly.

SECTION 4
Using the Protocol Macro Function

4-1 Applicable Range of the Protocol Macro Function

Using the Protocol Support Tool allows users to create several communications sequence (or protocol) compatible with communications control modes discussed in this chapter.

However, they are not compatible with communications control modes such as the full duplex, the synchronous communication, frame synchronous mode (HDLC: High level Data Link Communication), etc.

Transmission mode	Half duplex and single direction
Synchronizing mode	Start-step synchronization mode
Transmission control mode	Contention mode (Point to point connection) Polling selecting mode (Point to multi-point connection) Modem control mode
Flow control mode	Software flow: Xon/Xoff flow control Hardware flow: RS/CS flow control
	Delimiter control
Transmission error control mode	LRC, CRC-CCITT, CRC-16*, SUM, SUM2 (see note)
Message format	Header+Address+Length+Data+Check Code+Terminator, or Header+Address+Length+Data+Terminator+Check Code (see note)

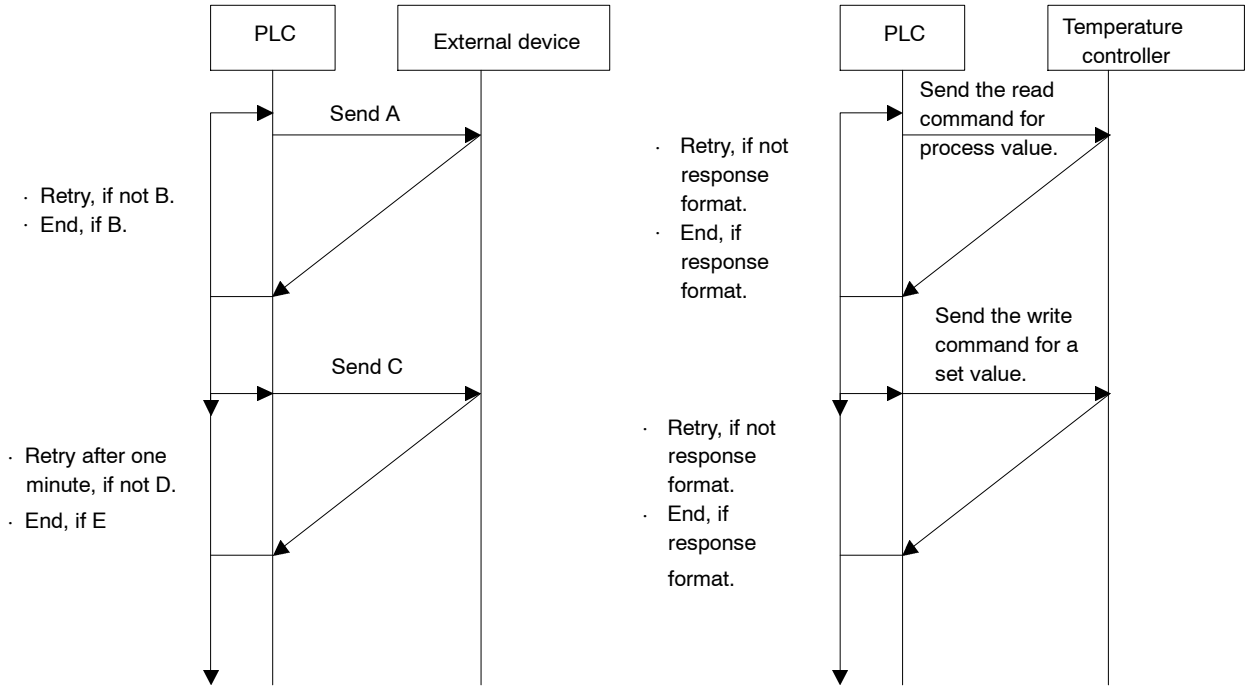
Note It is valid only when the Communications Board is the model C200HW-COM**-EV1.

- The message length must be 256 bytes or less. For a message whose length is 257 bytes or more, the data exceeding 256 bytes cannot be sent nor received.
- Data operating process functions are the calculations of the Error Check Code and the frame length to be sent and the numeral data conversion between ASCII code and HEX data only. The other operation or conversion is handled by the ladder program, if necessary.
- The signal line cannot be controlled optionally by any mode other than the modem control and the RS/CS flow control.
- Such process is infeasible that determines the number of receiving bytes by the use of the beginning data of a received frame.
- The data in the buffer is cleared before the sequence execution and after the receive command execution. Therefore, such process cannot be used that reads one byte by one from the content of receive buffer.
- Maximum number of branched process according to received data (sent command etc.) is 15. If more branches are necessary, the ladder has to manage it.

4-2 Protocol Creation Process

- Create the status transition chart of communications sequence.
  Before users create a protocol by using the Protocol Support Tool, it is recommended to firstly draw such a status transition charts to illustrate the communications sequences with the communicating machine as shown below for example. Then, users can convert them to “sequences” and “steps” editable by the Protocol Support Tool.

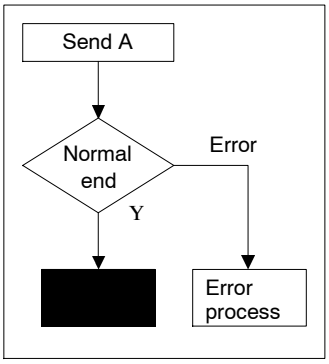
Example:



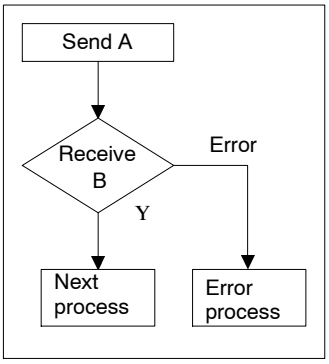
- Disassembling the protocol into “sequences” and “steps” to be editable by the Protocol Support Tool.
  - Disassemble into sequences
    Take out a block from the above process as a “sequence” which shall be started (or switched) by the ladder program.
    For example, either “Read the process value of temperature controller” or “Write the set value of temperature controller” becomes “sequence”.
  - Disassemble into steps

• Disassemble sequences into squares (steps) as shown below:

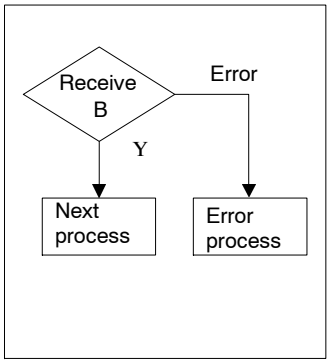
Send



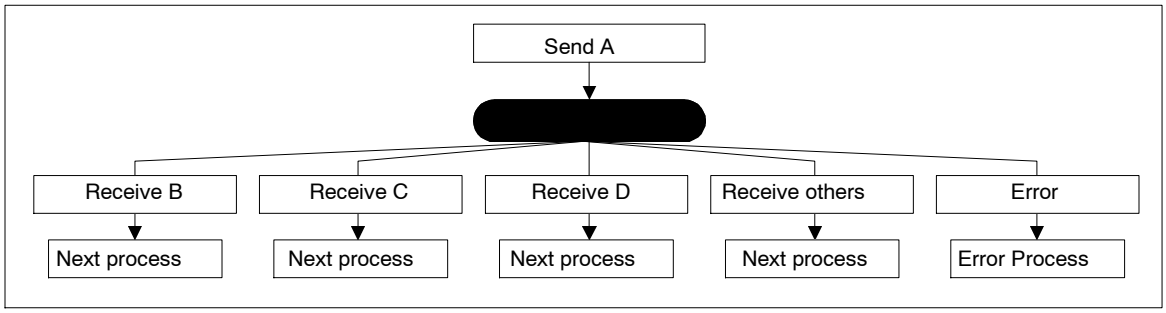
Send&Recv



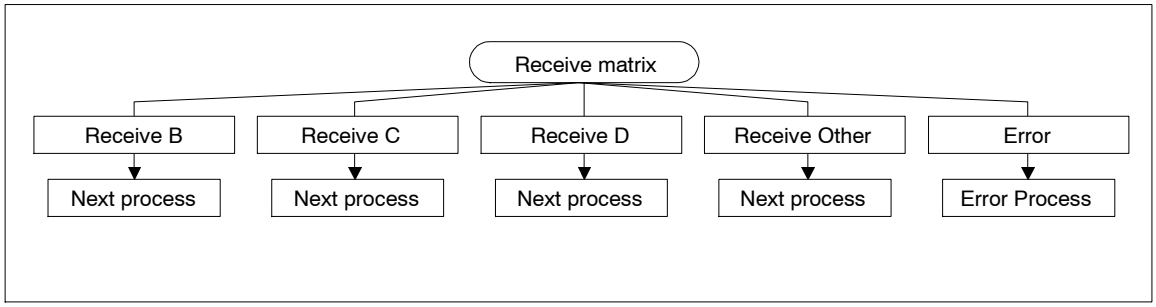
Recv



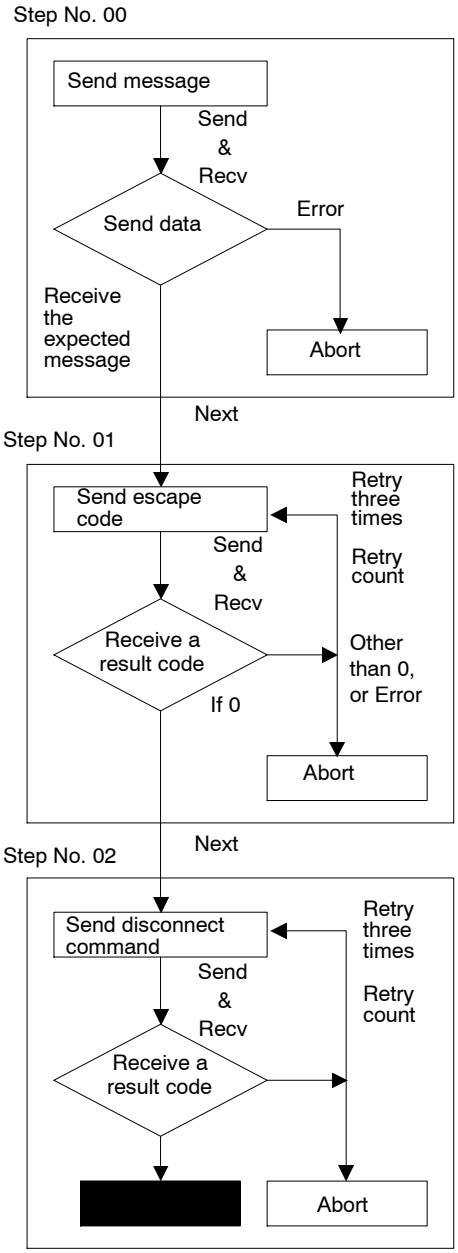
Send&Recv (Receive matrix)



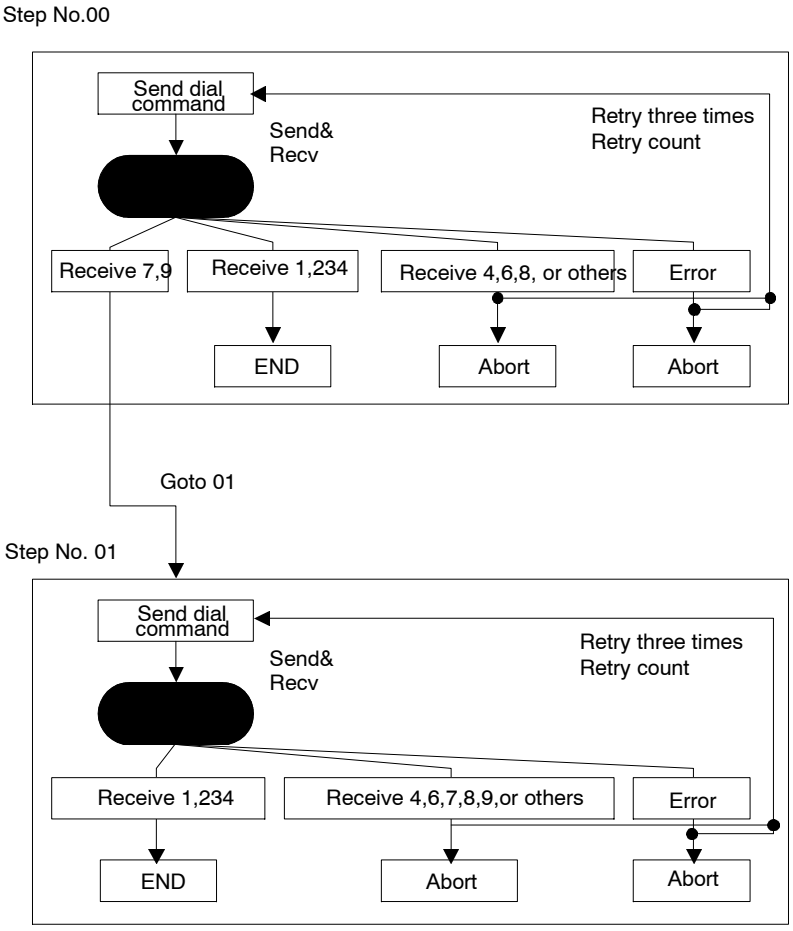
Recv (Receive matrix)



Example 1:


Step No. 00
Send message
Send
&
Recv
Send data
Error
Receive the expected message
Abort
Next
Step No. 01
Send escape code
Retry three times
Send
&
Recv
Retry count
Receive a result code
Other than 0, or Error
If 0
Abort
Next
Step No. 02
Send disconnect command
Retry three times
Send
&
Recv
Retry count
Receive a result code
Abort

Example 2:



When configuring the steps, the enough consideration is necessary not only for the normal course (the process is completed in normal) but for the error course (the process is terminated by error). The error courses are often set to be aborted (intermittent process stop) all together. However, if the abort is set as the simple “others than normal course”, the process stops there.

Add the description to switch from the error course to the normal course by setting Next and Goto as far as possible if the error cause is predicted and the process can be continued by the other steps even if the errors occur.

Besides, if the error causes are identified, the debug becomes easy even when the recovery is impossible by describing the steps. For example, for the device such as modems which returns the specific result codes, the result codes can be set in the receive matrix in order to confirm the sent result codes and to ease the error cause identification.

4-3 Transmission Control Mode Setup

The Protocol Macro function supports such transmission control modes as the flow control (Xon/Xoff flow control by software and RTS/CTS flow control by hardware), the delimiter control, the contention control, and the modem control. Pleas note that the system cannot freely control the signal line by the other mode.

Examples of their general use are as follows:

- The external device is compatible with the RTS/CTS flow control. Select the RTS/CTS flow control.
- The external device is compatible with the Xon/Xoff flow control. Select the Xon/Xoff flow control.

- The connection in one-to-n configuration is used for the external device.
  Select the modem control.
- The external device is a modem.
  Select the modem control.
- The external device is a modem compatible with the RTS/CTS flow control (or the Xon/Xoff flow control).
  Select both the modem control and the RTS/CTS flow control (or the Xon/Xoff flow control).
- The external device compatible with the RTS/CTS flow control (or the Xon/Xoff flow control) is connected in 1:N configuration.

Note

The RS/CS flow control sets the CTS signal from receiving terminal to "OFF" to stop the data sending temporally when the receiving speed exceeds the processing in a no-procedural communication. When the receiving process finished, it sets the CTS signal to "ON" again to resume the sending.

This control is a kind of hardware flow controls. The signal line of RS-232C cable is used.

The Xon/Xoff flow control sends the Xoff (13H) signal from receiving terminal to stop data sending temporally when the receiving speed exceeds the processing in a no-procedural communication. When the receiving process becomes available, it sends the Xon (11H) signal to start the data sending again. This is a kind of software flow controls. (However, the Xon and the Xoff signals are control codes, therefore they might be included in the sending data when they are binary. On the contrary, the Xon and the Xoff signals might be mixed in the data. Thus, this control is not used for a binary data communication).

The modem control is a specific function to the Protocol Macro function.

It sets ER(DTR) signal to "ON" from the start of Protocol Macro execution through the end.

It sets RS(RTS) signal to "ON" during the data sending.

The contention control is a data transmission mode which establishes a data link from the data sending terminal before the communication. Since mutually communicating terminals are in the equal relations, either terminal can establish the link to send data anytime.

The delimiter control sends a delimiter, which has been set by the send code, at the end of the send data if no terminator is defined for the send message. At the next step, it does not send until it receives a delimiter, which has been set by the receive code, from the communicating terminal.

If a terminal received a delimiter set by the receive code, it sends a delimiter set by the send code and continues the data receiving.

When the received data exceeds 200 bytes in the RS/CS flow control, the Xon/Xoff flow control, or the delimiter control mode.

The received data is 200 bytes maximum a step in the RS/CS flow control, the Xon/Xoff flow control, or the delimiter control. If data more than 200 bytes are expected to receive, it is necessary to design the sequence to receive them by plural steps.

Example: When receiving 300 bytes

Step No.	Command	Send message	Receive message	Next process
00	Send&Recv	A command	200 bytes	Next
01	Recv	---	100 bytes	End

Note on the selection of the contention control mode

When the contention control mode is set, the send request code is automatically sent at the beginning of the sequence, the successive process has to be set in the sequence.

When the communicating partner does not have a priority. (Execute the communication process after the receipt of partner's receive permission code)

Step No.	Command	Send message	Receive message	Next process	Error process
00	Recv	---	Receive permission code	Next	Goto00
01	Send&Recv	Data	Data	End	Abort

When the communicating partner has a priority.

(Send the receive permission code if the received data is not the partner's receive permission code)

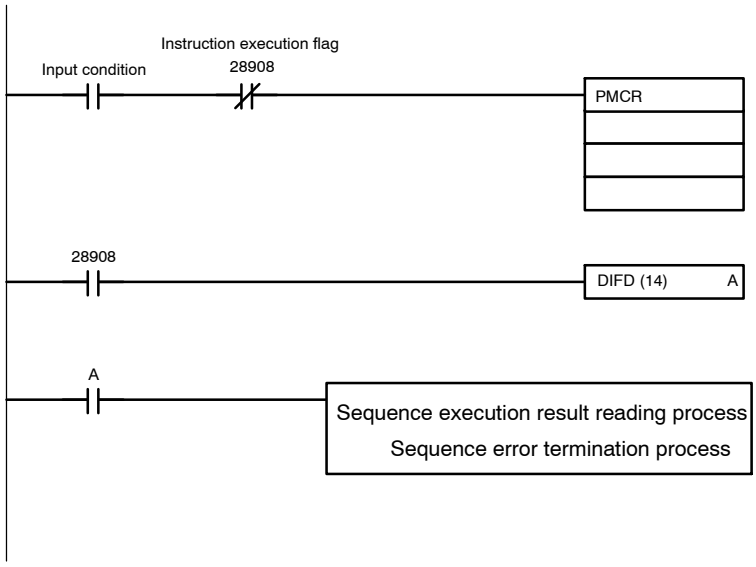
Step No.	Command	Send message	Receive message	Next process	Error process
00	Recv	---	Receive permission code	Next	Goto02
01	Send&Recv	Data	Data	End	Abort
02	Send&Recv	Receive permission code	Data	Next	Abort
03	Send	Data	---	End	Abort

4-4 Ladder Programming Method

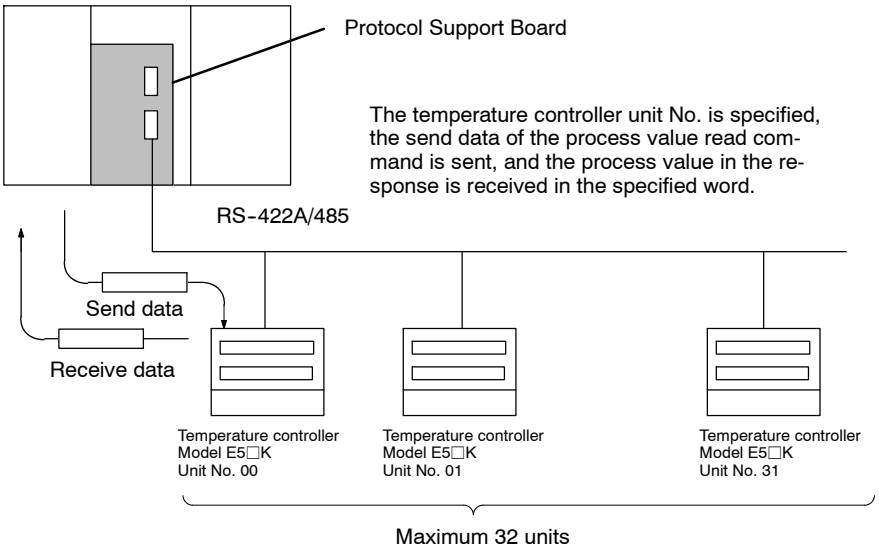
4-4-1 Ladder Programming Method

- The instruction execution flag shall be the Normally closed input condition in order to avoid the PMCR instruction execution during the PMCR instruction execution.
- Perform the sequence execution result read process and the sequence error termination process under the condition that the instruction execution flag is cleared.

Example:



Example: The execution of the protocol name Temperature Controller (Model E5□K Read System) sequence No. 000 (read process value)



- **The Send/Receive Word Allocation Contents of the Sequence No. 000 (read process value)**

Read Process Value (Sequence No. 000)
Read the process value and stores the results in the specified words.
Send data word allocation (2nd operand of PMCR)

First word of send data	+0	Number of send data words	
	+1	(Undefined)	Unit No.

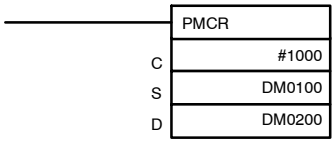
Offset	Contents(data format)	Data
+0	Number of send data words (4 digits BCD)	0002 (fixed)
+1	Unit No. (2 digits BCD)	00 to 31

Receive data word allocation (3rd operand of PMCR)

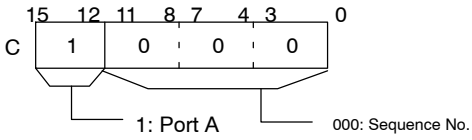
Receive data storage words	+0	Number of send data words
	+1	Process value

Offset	Contents(data format)	Data
+0	Number of send data words (4 digits BCD)	0002
+1	Process value (4 digits BCD)	

- **PMCR Instruction Operand Setting Contents**
  In case the unit No. 03 E5□K process value is read, received and stored in the DM201:

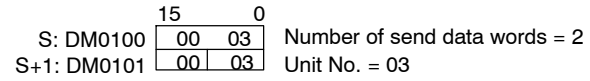


C: Control data



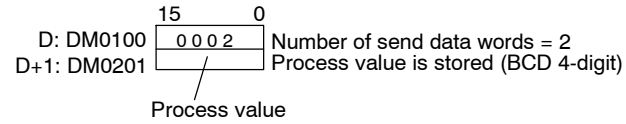
S: The first word number of the send data

S: DM0100



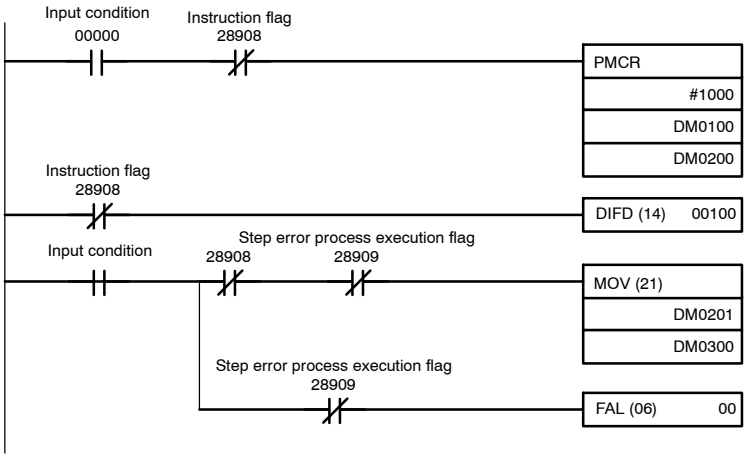
D: The first word number of the receive data storage

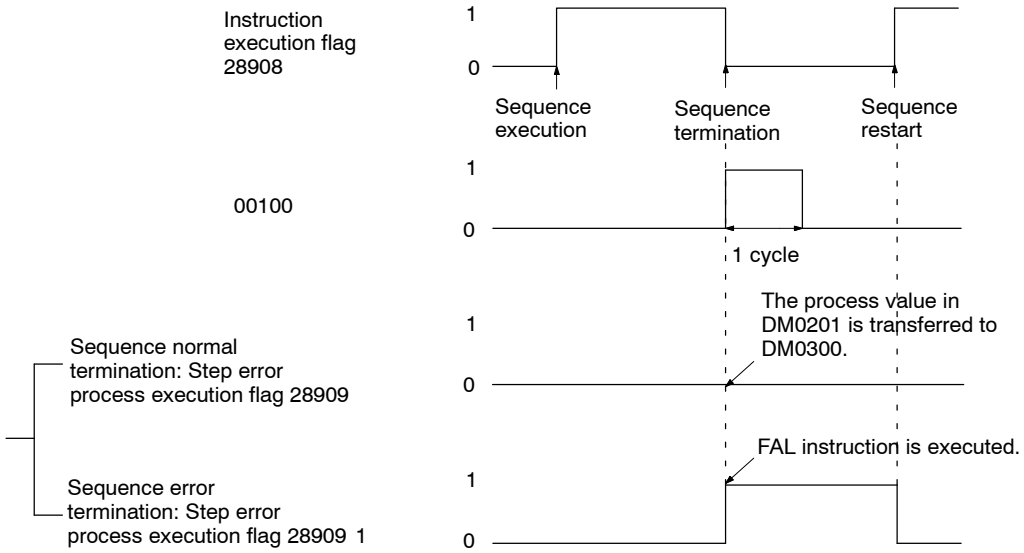
D: DM0200



- **Example of the Ladder Program Creation**
  The following example shows that the protocol name Temperature Controller (Model E5□K Read System) sequence No. 000 (current value) is executed by the PMCR

instruction and the read process value is transferred to the other word at the normal completion of the sequence:





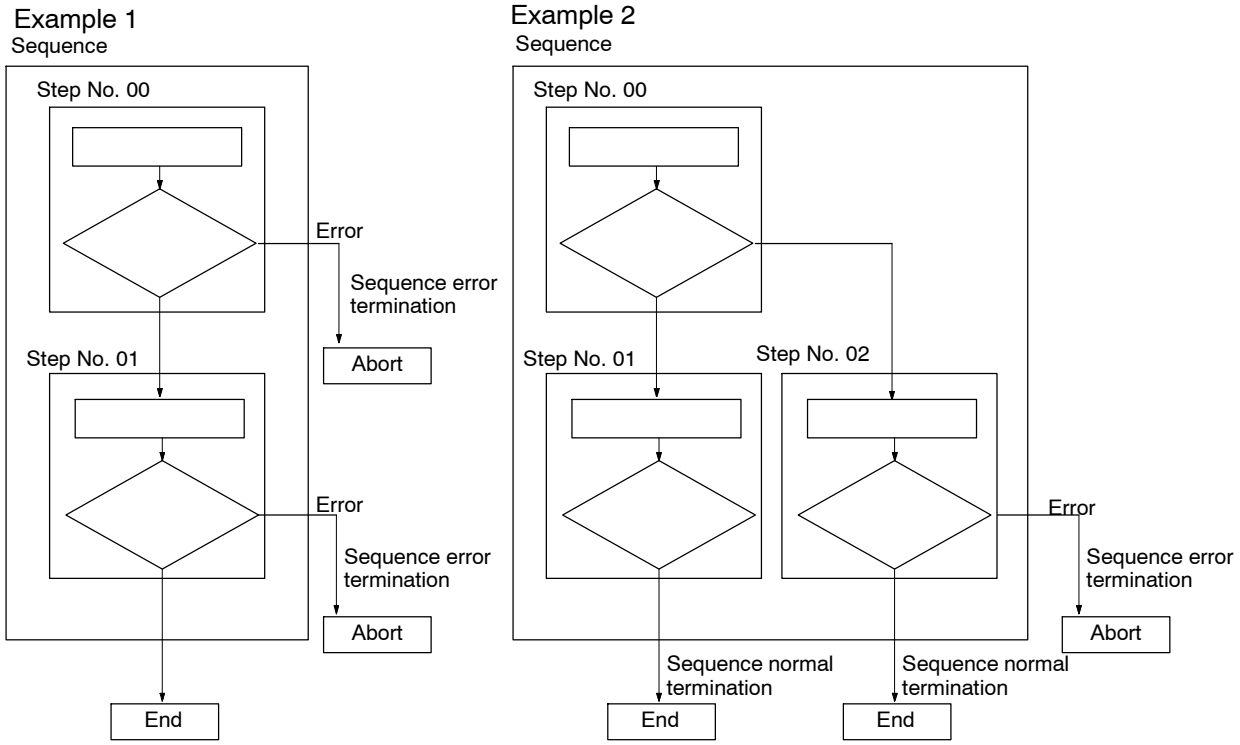
For the reference:

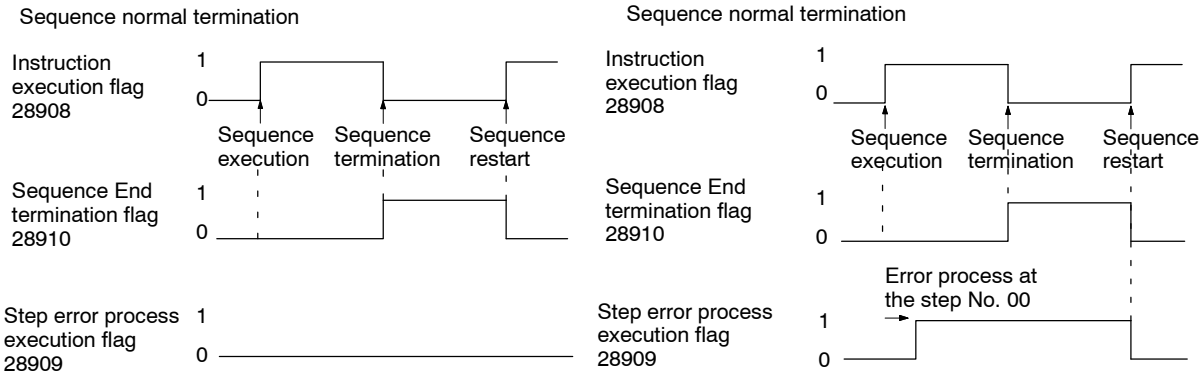
Sequence Error Termination Process

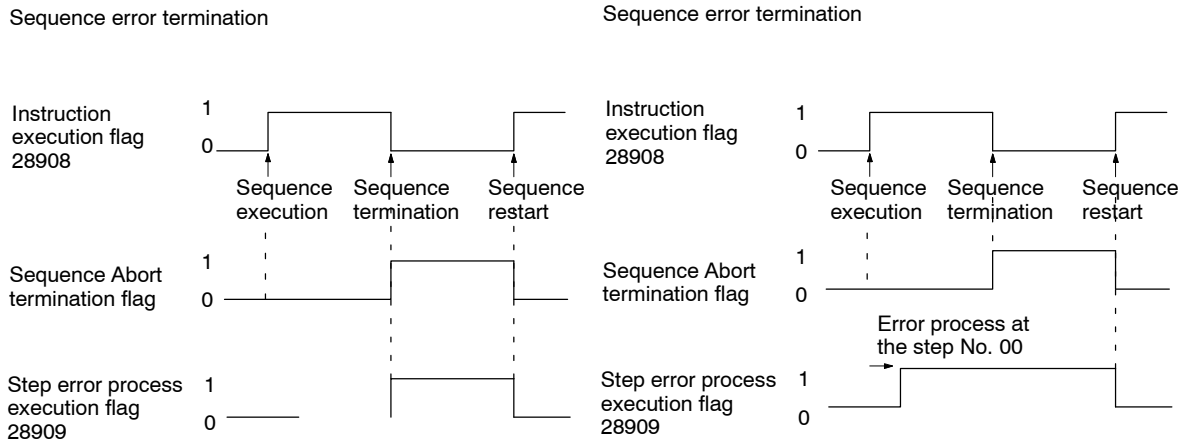
If the End is set for the normal sequence termination and the Abort is set for the error termination as follows, either the normal sequence termination or the error termination can be identified by the sequence End termination flag and the se-

quence Abort termination flag.

Example 2





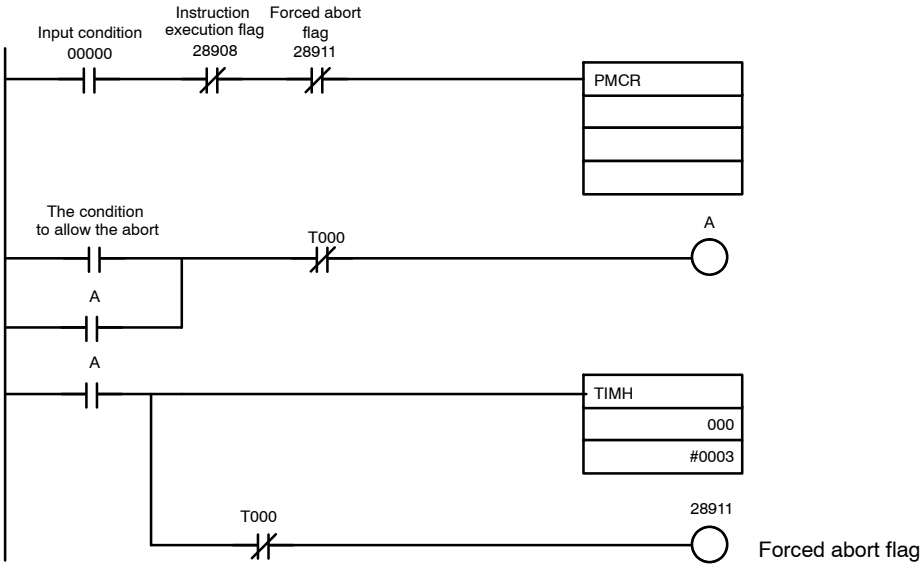


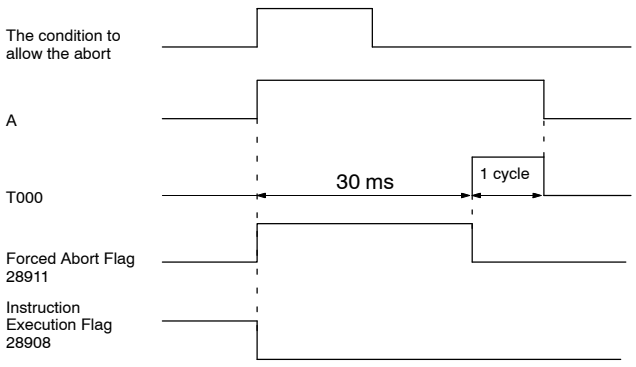
Note The step error process flag is not a flag for all the sequence, but a flag to see whether the error process is executed at a step in the sequence. Therefore, as

the above example 2, if the consecutive step terminates in normal after the error process execution during the sequence (step No. 00), the flag remains unchanged to be 1 (ON). Thus it shall be reminded that this flag is not always useful as the error termination flag for all the system.

Note Use the forced abort flag by keeping the following points in mind:
The instruction execution flag changes from ON to OFF when the user program changes the forced abort flag from OFF to ON. Therefore, the abort process is not executed if the forced abort flag in turned OFF when the instruction execution flag becomes OFF. Set the forced abort flag to OFF after the minimum [CPU unit cycle time + 15 ms] of the ON held. When the instruction execution flag B-bit is the PMCR instruction execution condition, the PMCR instruction is executed during the forced abort process and causes the FAL9C error. Therefore, execute the PMCR instruction after the period of minimum [CPU unit cycle time + 15 ms] after the forced abort flag is changed from OFF to ON when using the forced abort flag.

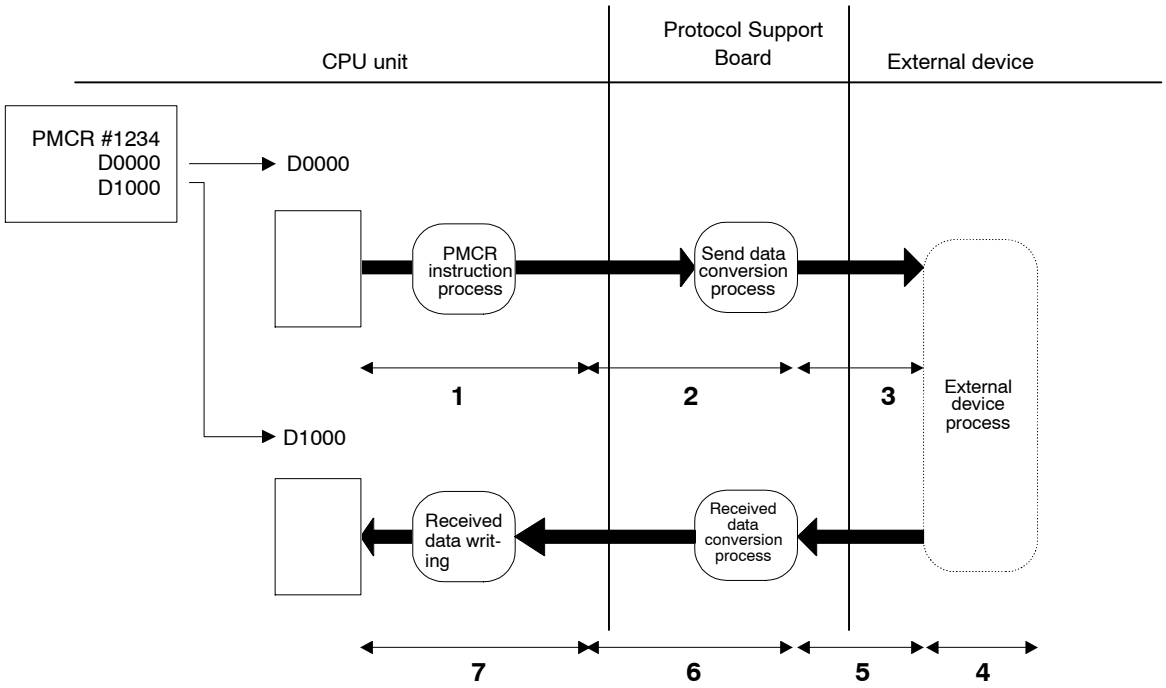
Example: The forced abort flag is turned ON and the 30 ms period is elapsed, then the forced abort flag is turned OFF and simultaneously the PMCR instruction interlock is released.





4-5 Calculation Method of Monitoring Time

The calculation method of monitoring time for the operand addressing (without response writing) is shown here. Referring to this calculation method, calculate the monitor times for the operand addressing (with response writing), link word addressing, and direct addressing. When actually setting the monitor times as sequence data, be sure to provide sufficient allowance.



Number	Function	Time Required	Description
1	The PMCR instruction's process time	About 40-70μ second	A time from the start of PMCR instruction to the end of the send data transfer
2	The send data conversion process time	Depends on number of conversion bytes	A time from the end of the send data conversion based on the specified conversion method to the start of the send data to the external device.
3	The send data transmission time	Number of data characters x one character bit/ transmission rate	A time required to the send data transmission to the external device. When designing, use double the calculated time because an idle time exists between the send characters.
4	The external device process time	Depends on the external devices' process	A time required by the external device to process according to the command from the PLC until the start of the send response data.
6	The received data transmission time	Number of data characters x one character bit/ transmission rate	A time required to transmit the received data from the external device. When designing, use two to five times the calculated time because an idle time exists between the receive characters.

Number	Function	Time Required	Description
6	The received data conversion process time	Depends on number of conversion bytes	A time required for the conversion of the received data from the external device based on the specified conversion method
7	Received data writing time	A time of one cycle time minute maximum	A time required to finish the received data transfer to the I/O memory.

Note Although the data conversion process times of 2 and 6 vary according to the PLC operation status, the maximum values can roughly be estimated by the following calculation formula:
2 The send data conversion process time = 10000μ second + one-byte conversion time x number of conversion bytes
(one-byte conversion time→No conversion: 15 μ second, ASCII conversion: 40μ second, HEX conversion: 55μ second)
6 The receive data conversion process time = 100μ second + one-byte conversion time x number of conversion bytes
(one-byte conversion time→No conversion: 15μ second, ASCII conversion: 30μ second, HEX conversion: 15μ second)

• Example of the Send Wait Time Calculation

The send wait time (Ts) is a waiting time from the execution of the send command to the sending of the beginning one-byte (the start character). Therefore, it is equal to a total of 1 +2 in the above table and it can be set in the range where the following equation is satisfied:

The send wait time >1+2

Ts is waiting time before starting sending. Therefore users have to consider the time period before communication line and related devices become available when continuous data are sent by plural steps. For example, when users send a telephone number from an intercom via modem, they firstly send number 0 (to connect with public line), then put the send wait to be set for a short period (1 second) before sending the telephone number.

• Example of Calculation of the Send Finish Monitoring Time, (Tfs)

The send finish monitoring time, Tfs >
Number of data characters one-character bit x 2/ transmission rate

Example: @ + 5 + HEX data of 5 words + CRC-CCITT (BIN) 2 bytes + CR = 15 characters (120 bits)

1 + 1 + 10 + 2 + 1 = 15

One character equals 12 bits under the following condition:

Start bit: 1 bit; Data: 8 bits; Parity: Yes; Stop Bit: 2 bits

Therefore, 15 x 2 = 180 bits

180/9600 = 0.01875 seconds

In practice, however, it must be set to a value double the calculated time because an idle time exists between characters sent from the PSB as shown below:

0.01875 x 2 = 0.0375 seconds

Because the unit of the monitoring time is in the range of from 0.01 seconds (10 ms) to 99 minutes, users can set the Tfs 0.02 seconds after which the system executes the error process or the retry process.

• Example to Set Up the Receive Wait Monitoring Time (Tr)

The receive wait monitoring time (Tr) sets the monitoring time from the system's recognition of the received command in the applicable step and to the receiving of the beginning one-byte (the start character). In the above table, it refers to a total of 4+5 for the beginning character and it can be set in the range where the following equation is satisfied:

The receive wait monitor time, Tr > 4+5 for the beginning character

When this time is up, the system executes the error process or the retry process.

• The Receive Finish Monitoring Time (Tfr)

The receive finish monitoring time (Tfr), monitors the receiving time from the receipt of the beginning one-byte (the start character) to the receipt of the last one-byte data (the end character). In the above table, it refers to 5. As in the case of the send finish monitor time, an idle time exists between receive characters and depending on devices to be connected, the time varies. Therefore, it is recommended that the time be set to two to five times of the calculated time. It can be set in the following range:

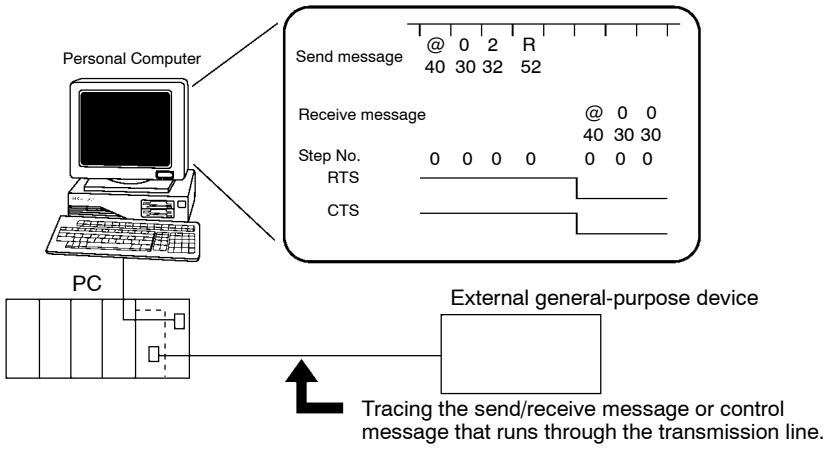
The receive finish monitor time, Tfr > 5 x (2 to 5)

When this time is expired, the system executes the error process or the retry process.

4-6 Operation Confirmation

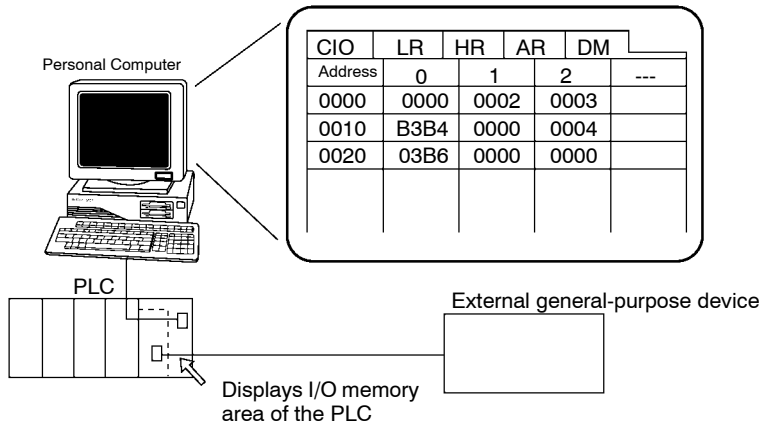
To confirm the operation of created ladder program, there are "The Trace Function of the Transmission Line" and "The Area Monitoring Function of the PLC Channel" in the Protocol Support Tool.

- **Tracing the Transmission Line**
  Users trace the transmission data and the control signals flowing on the transmission line (RS232C or RS422/485). By this function, users can confirm the data and signals flowing on the transmission line, even if they do not have the protocol analyzer.



- **The I/O memory Monitor of the PC**
  This is a function to monitor or to change the I/O memory areas on the PC. By this function, users can confirm the contents of sent and stored data in the PLC's relay area, the contents of received data, and the status on various flags. It also enables a trial run

where users can change the values of communication data and execute again the ladder program.



When an error occurs in the ladder program execution, users can search the error cause by checking the various flags as follows:

- **System Error FAL9C (The ALM/ERR lamp on the CPU unit blinks on and off)**
  When the system error FAL9C occurs, the ALM/ERR lamp on the CPU unit blinks on and off. In this case, see the following table and take a necessary action:

Word	Bit(s)	Function name	Actions	Read/ Write
268CH	00	Watchdog timer error for the PSB (hardware error, software error (runaway))	The PSB becomes unable to operate. Change the communication	---
	01	Port recognition error (hardware error)	board and supply the power again.	R
	02	Protocol data error (protocol data checksum error due to memory corruption)	ON for 25503 (ER) as well. Transfer the protocol again. After the recovery, the reset abnormality enables the continuous operation.	R
	11	Port B protocol macro error (error relating PMCR)	PMCR instruction is not executable. Detailed error	R
	12	Port A protocol macro error (error relating PMCR)	codes are indicated in the flag as follows: Port A: 28612-15 Port B: 28608-11	R
	13	System setting error for port B	Review the system setup and restart the relating port.	R
	14	System setting error for port A		R
	15	System setting error	See the actions for bit 13 and 14	R

- **Other Errors**

If an error other than system FAL9C occurs, users can search the error cause by checking each flag in the table below. Search the error cause and take necessary actions.

Note The step number, the receive matrix case number, and the repeat count which have just finished before the error occurrence are indicated by the following flags:

Step number	Port A: 28704-07,	Port B: 28804-07	0-F
Receive matrix number	Port A: 28700-03,	Port B: 28800-03	0-F
Repeat counter	Port A: 28400-07,	Port B: 28500-07	01-FF

Words	Bit(s)	Function name	Read/ Write
283CH	00-03	Port A error codes 0: No error 1: Parity error 2: Framing error 3: Overrun error 4: FCS error 5: Timeout error 6: Checksum error 7: Command error	R
	04	ON for communication error	R
	07	Port A Sequence Abort Termination Flag (see note 1)	R
	08-11	Port B error codes 0: No error 1: Parity error 2: Framing error 3: Overrun error 4: FCS error 5: Time-out error 6: Checksum error 7: Command error	R
	12	ON for communication error	R
	15	Port B Sequence Abort Termination Flag	R
284CH	00-07	Port A Current Repeat Count (01 to FF) (see note 1)	R
285CH	00-07	Port B Current Repeat Count (01 to FF) (see note 1)	R
286CH	00	Port A Trace In-progress Flag (see note 2)	R
	01	Port B Trace In-progress Flag (see note 2)	R
	08-11	Port A Protocol macro error code 0: No error 1: No protocol macro function 2: Sequence number error 3: Receive data write area exceeded 4: Protocol data error	R
	12-15	Port B Protocol macro error code 0: No error 1: No protocol macro function 2: Sequence number error 3: Receive data write area exceeded 4: Protocol data error	R
287CH	00-03	Port A execution completion matrix case No. (0 to F)	R
	04-07	Port A execution completion step No. (0 to F)	R
	15	Port A 288CH storage enable 0: Disable; 1: Enable	R
288CH	00-03	Port B execution completion matrix case No. (0 to F)	R
	04-07	Port B execution completion step No. (0 to F)	R
	15	Port B 287CH storage enable 0: Disable; 1: Enable	R
289CH	00	Port A Restart Flag	W
	01	Port B Restart Flag	W
	02	Port A Continuous Trace Start/Stop Flag (see note 2)	W
	03	Port B Continuous Trace Start/Stop Flag (see note 2)	W
	04	Port A Short Trace Start/Stop Flag (see note 2)	W
	05	Port B Short Trace Start/Stop Flag (see note 2)	W
	08	Port A Instruction Execution Flag	R
	09	Port A Step Error Processing Execution Flag	R
	10	Port A Sequence End Termination Flag (see note 1)	R
	11	Port A Forced Abort Flag	W
	12	Port B Execution Instruction Flag	R
	13	Port B Step Error Processing Execution Flag	R
	14	Port B Sequence Termination End Flag (see note 1)	R
	15	Port B Forced Abort Flag	W

Note 1. It is valid only when the Communications Board is the model C200HW-COM∗∗-EV1.

2. The exclusive flags used in the Protocol Support Tool only. They can not be used in the ladder program, etc.

4-7 Errors at the Protocol Execution

When an error listed below occurs, take an appropriate action, referring to the following table:

Problem	Findings		Cause	Action
PSB does not operate.	The “RDY” LED lights OFF.		PSB is abnormal	Replace the PSB and reconnect the power.
System error FAL9C occurred.	26800 is ON		PSB is abnormal.	Replace the PSB and reconnect the power.
	26801 is ON and the “RDY” LED lights OFF.		This error occurs when the RS232C port is not recognized when the power is turned ON by such as an abnormal hardware.	Replace the PSB and reconnect the power.
	26802 is ON		PSB protocol data are abnormal.	Rewrite the protocol data by using the Protocol Support Tool.
System errors FAL9C and FAL9B occurred	26815 is ON and the “RDY” LED blinks.		• The PSB system setting (DM6550 to DM6559) has incorrect setting values. If 26813 is ON, the port B has a problem. If 26814 is ON, the port A has a problem. • The PSB does not support the protocol macro function.	• Check the PSB system setting contents of the problem port and restart the system. • Use the PSB which supports the protocol macro function.
System error FAL9C occurred when the PMCR instruction is executed.	26811 is ON (Port B) or 26812 is ON (Port A).		The protocol macro error (PMCR instruction relating error) occurred. The details are registered as error codes.	Take necessary actions in accordance with the error codes.
Instruction execution flag is not set to ON. 28908 is Port A. 28912 is Port B.	Error codes 28608 to 11 (Port A) 28612 to 15 (Port B)	Error code: 1	• The PSB system (DM6550 to DM6559) is not set to the protocol macro mode. • The PSB does not support the protocol macro function.	• Check the PSB system setting contents of the problem port. • Use the PSB which supports the protocol macro function.
		Error code: 2	The sequence number is not present.	Reset the first operand of the PMCR instruction. Otherwise, transfer the sequence No. to the PSB.
		Error code: 3	The received data overflowed when writing it in the I/O memory.	Specify the other area. Otherwise, reduce the receive data size.
		Error code: 4	The PSB data error.	Rewrite the protocol data by using the Protocol Support Tool.
The data send/receive is not well executed despite the PMCR instruction execution.	28909 is ON (Port A) or 28913 is ON (Port B).		The step is executing the error process during the sequence caused by an error such that the receive message does not match with the expected receive message.	Search the error cause and add the appropriate process.

Problem	Findings	Cause	Action
The instruction execution flag is ON. 28908 is Port A. 28912 is Port B	28304 is ON (Port A) or 28312 is ON (Port B).	The communication error occurred during the message receive.	Confirm the communication route to the connected devices.
The communication with the connected devices is impossible.	28304 is ON (Port A) or 28312 is ON (Port B).	This error occurs by the abnormal communication route to the connected devices or by the communication condition setting failure. The details are registered as error codes. 28300 to 03 (Port A) 28608 to 11 (Port B)	• Restart the problem port or initialize each relay by executing the RXD and PMCR instructions. • Confirm the communication route. • Check the communication condition setting.
The PMCR instructions are not executed.	ER flag (25503) is ON.	This error occurs by the instruction operand setting failure.	Check the instruction operand.

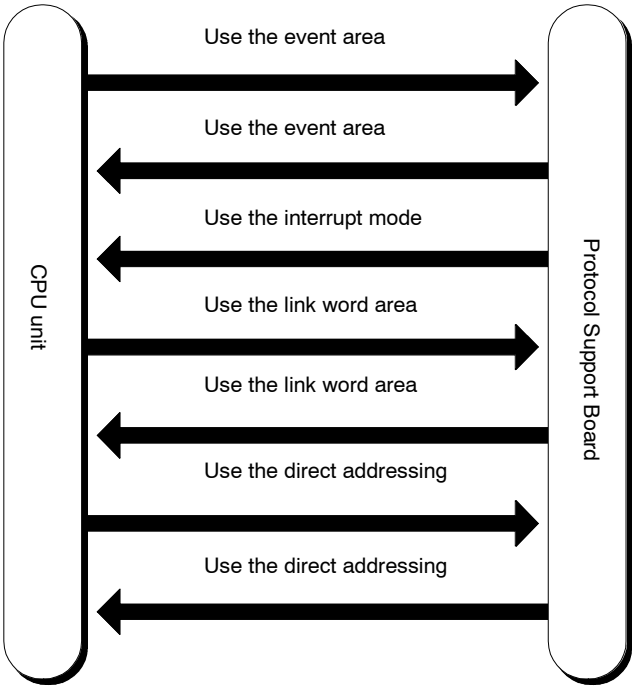
4-8 Performance (Communication Response Time)

The response performance of communication with the external devices using PMCR instruction, which varies according to the definition of the Protocol Macro, is divided in the following four modes:

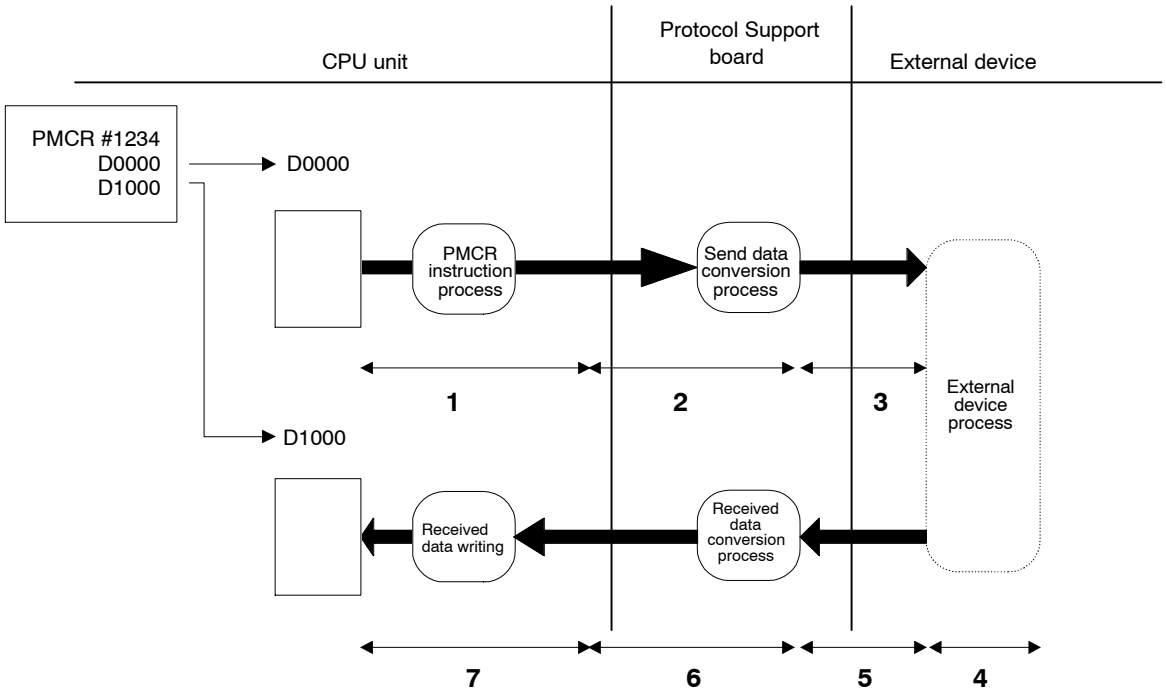
- Use the event (operand addressing) areas
- Use the interrupt mode for the response method
- Use the link word area
- Use the direct addressing

The above four modes are different in the data transmission mode between the CPU unit and the PSB. There are three kinds of data transfer modes from the CPU unit to the PSB, while there are four kinds of those modes from the PSB to

the CPU unit. The communication response time varies according to the combination of those modes.



- Communication Response Time Using the Event (operand addressing) Area
  Illustrated below is the data flow when the communication area addressed by the second and the third operand of the PMCR instruction is used:



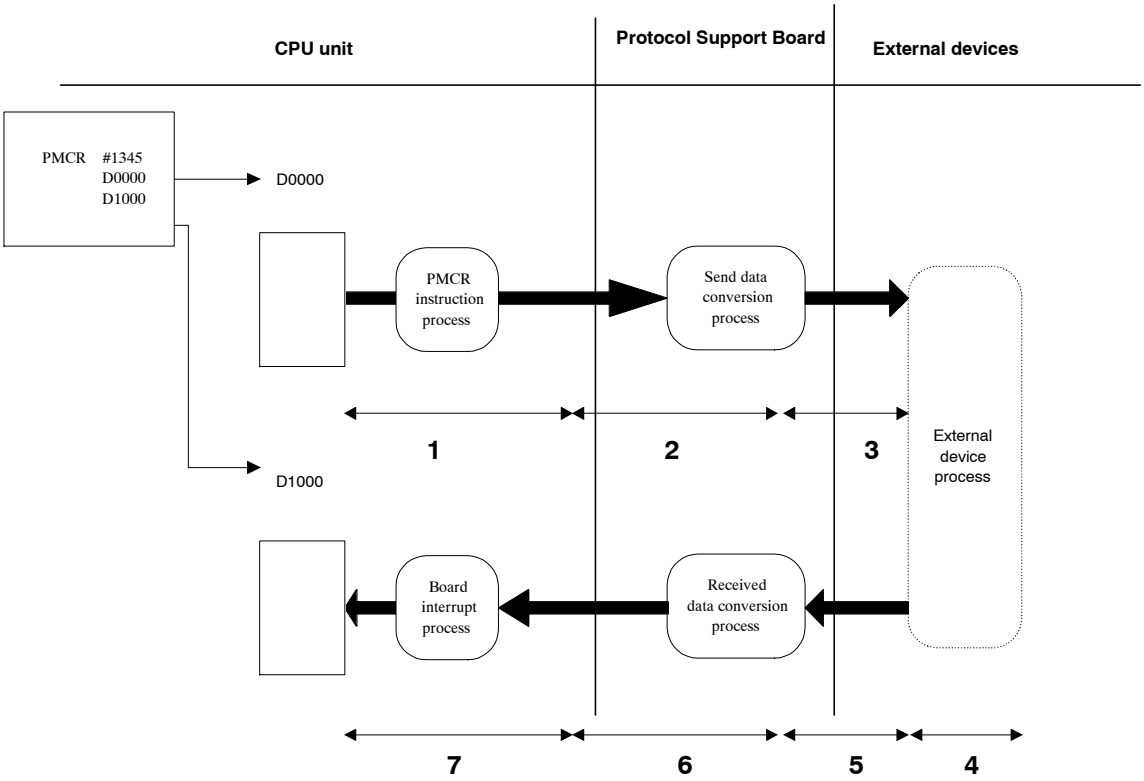
The communication response time is total from 1 to 7 in the above figure.

Number	Function	Time Required	Description
1	PMCR instruction process time	About 40 to 70μ second	The time from the start of PMCR instruction to the end of the data transfer
2	Send data conversion process time	Depends on the number of conversion bytes	The time required for the send data conversion based on the specified conversion mode which finishes at the start of data sending to the external device.
3	Send data transmission time	Number of data characters x one-character bit/ transmission rate	The time required for the send data transmission to the external device. (Use double the calculated time because an idle time exists between send characters.)
4	External device process time	Depends on the external device process	The time required for the external device process according to the PLC's command which finishes by the start of the response data sending.
5	Received data transmission time	Number of data characters x one-character bit/ transmission rate	The time required for the received data transmission from the external device. (Use two to five times the calculated time because an idle time exists between the receive characters.)
6	Received data conversion process time	Depends on the number of conversion bytes	The time required for the received data conversion from the external device based on the specified conversion mode which finishes at the end of data transfer
7	Received data writing process time	One-cycle time maximum	The time required to finish received data transfer to IOM.

Note Although the data conversion process times of 2 and 6 vary according to the PLC operation status, the maximum values can roughly be estimated by the following calculation formula:
2 The send data conversion process time = 10000μ second + one-byte conversion time x number of conversion bytes
(one-byte conversion time → No conversion: 15μ second, ASCII conversion: 40μ second, HEX conversion:
55μ second)

6 The receive data conversion process time = 100μ second + one-byte conversion time x number of conversion bytes (one-byte conversion time→No conversion: 15μ second, ASCII conversion: 30μ second, HEX conversion:
15μ second)

- Communication Response Performance Using the Interrupt Notification Mode
  Illustrated below is the data flow when the event area (operand addressing) is used and the response method is the interrupt mode:



The communication response time is total time from 1 to 7 in the above figure.

Number	Function	Time Required	Description
1	PMCR instruction process time	About 40 to 70 micron second	The time from the start of PMCR instruction to the end of the data transfer.
2	Send data conversion process time	Depends on the number of conversion bytes	The time required for the DP-RAM's send data conversion based on the specified conversion mode which finishes at the start of data sending to the external device.
3	Send data transmission time	Number of data characters x one-character bit/ transmission rate	The time required for the send data transmission to the external device. (Use double the calculated time because an idle time exists between send characters.)
4	External device process time	Depends on the external device process	The time required for the external device process according to the PLC's command which finishes by the start of the response data sending.
5	Received data transmission time	Number of data characters x one-character bit/ transmission rate	The time required for the received data transmission from the external device. (Use two to five times the calculated time because an idle time exists between the receive characters.)
6	Received data conversion process time	Depends on the number of conversion bytes	The time required for the received data conversion from the external device based on the specified conversion mode which finishes at the end of data transfer.
7	PSB interrupt process time	About 50 micron second	The time started by the response interrupt notification and ended by the end of the received data transfer to IOM.

Note Although the data conversion process times of 2 and 6 vary according to the PLC operation status, the maximum values can roughly be estimated by the following calculation formula:

2 The send data conversion process time = 10000μ second + one-byte conversion time x number of conversion bytes

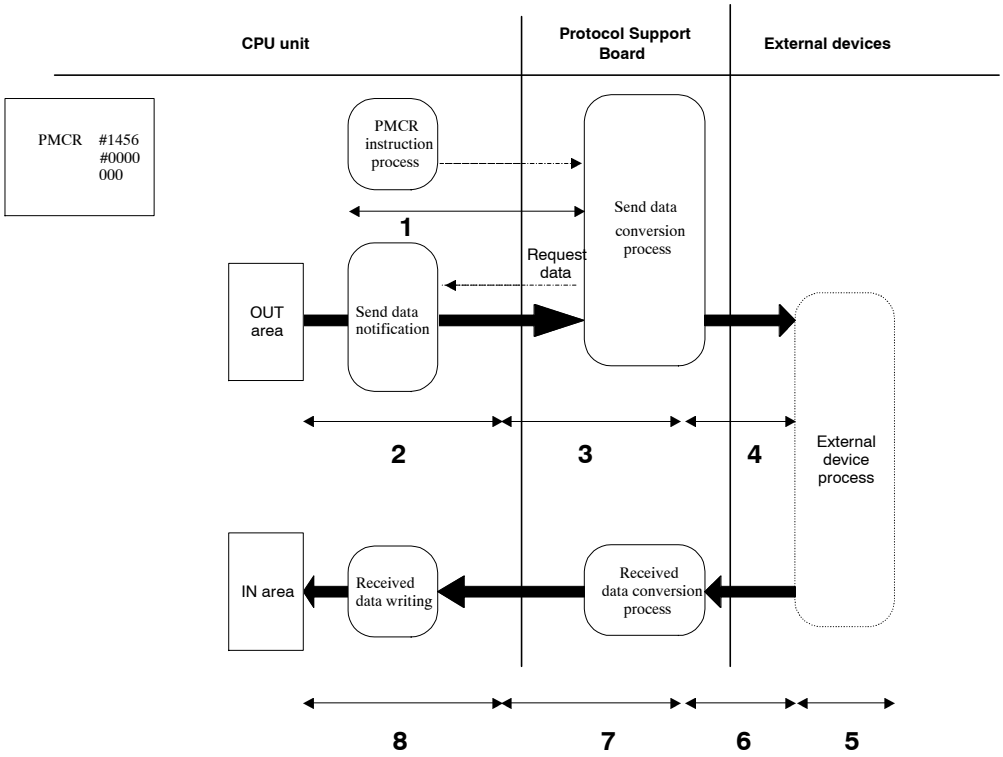
(One-byte conversion time→No conversion: 15μ second, ASCII conversion: 40μ second, HEX conversion:

55μ second)

6 The received data conversion process time = 100μ second + one-byte conversion time x number of conversion bytes

(one-byte conversion time→No conversion: 15μ second, ASCII conversion: 30μ second, HEX conversion: 15μ second)

- Communication Response Performance Using the Link Word Area
  Illustrated below is the data flow when the link word area is used for the communication data storing area:

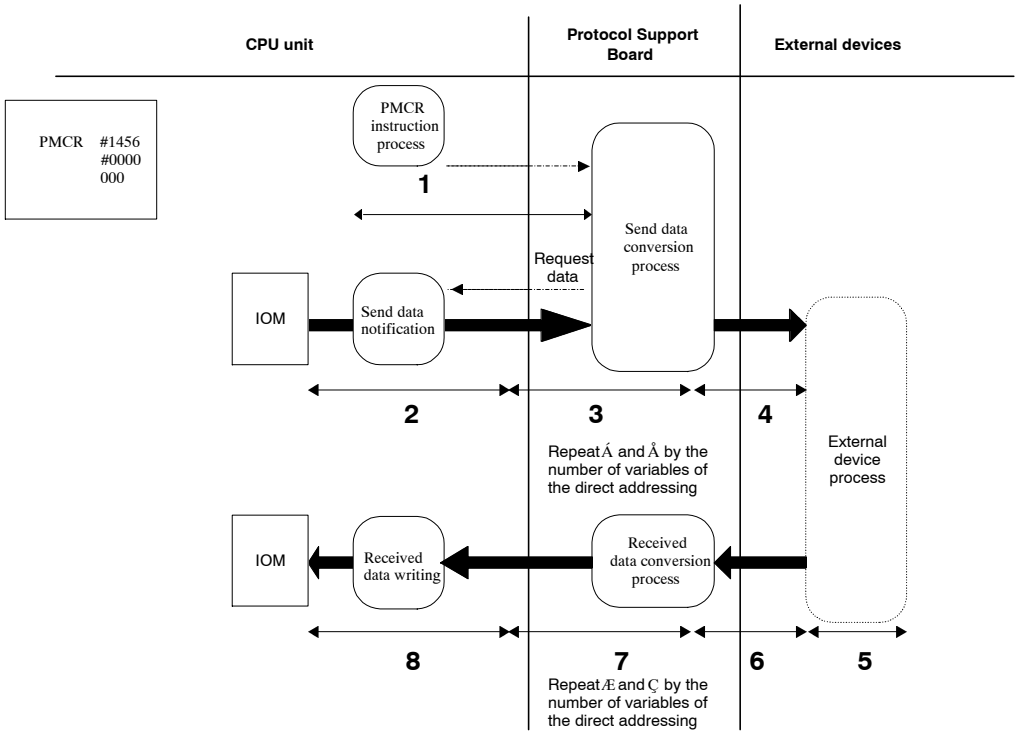


The communication response time is total from 1 to 8 in the above figure.

Number	Function	Time Required	Description
1	PMCR instruction executing notification process time	About 40 μ second	The time from the start of PMCR instruction to the end of the instruction notification to the PSB.
2	Send data notification process time	One-cycle time maximum	The time required for the data transfer based on the PSB request.
3	Send data conversion process time	Depends on the number of conversion bytes	The time required for the data conversion based on the specified conversion mode which finishes at the start of data sending to the external device.
4	Send data transmission time	Number of data characters x one-character bit/ transmission rate	The time required for the data transmission to the external device. (Use double the calculated time because an idle time exists between send characters.)
5	External device process time	Depends on the external device process	The time required for the external device process according to the PLC's command which finishes by the start of the response data sending.
6	Received data transmission time	Number of data characters x one-character bit/ transmission rate	The time required for the receive data transmission from the external device. (Use two to five times the calculated time because an idle time exists between the receive characters.)
7	Received data conversion process time	Depends on the number of conversion bytes	The time required for the receive data conversion from the external device based on the specified conversion mode which finishes at the end of data.
8	Received data writing process time	One-cycle time maximum	The time required for the received data transfer to IOM.

Note Although the data conversion process times of 2 and 6 vary according to the PLC operation status, the maximum values can roughly be estimated by the following calculation formula:
2 The send data conversion process time = 10000μ second + one-byte conversion time x number of conversion bytes
(one-byte conversion time→No conversion: 15μ second, ASCII conversion: 40μ second, HEX conversion:
55μ second)
6 The receive data conversion process time = 100μ second + one-byte conversion time x number of conversion bytes
(one-byte conversion time→No conversion: 15μ second, ASCII conversion: 30μ second, HEX conversion:
15μ second)

• Communication Response Time Using the Direct Addressing
Illustrated below is the data flow when the direct addressing is used:



The communication response time is total from 1 to 8 in the above figure. The functions 2 and 3 are repeated by the number of variables of the direct addressing of the send message while 7 and 8 are repeated by those of the receive message.

Number	Function	Time Required	Description
1	PMCR instruction executing notification process time	About 40 μ second	The time from the start of PMCR instruction to the end of the instruction notification to the PSB.
2	Send data notification process time	One-cycle time maximum	The time required for the send data transfer based on the PSB request.
3	Send data conversion process time	Depends on the number of conversion bytes	The time required for the sent data conversion based on the specified conversion mode which finishes at the start of data sending to the external device.
4	Send data transmission time	Number of data characters x one-character bit/ transmission rate	The time required for the data transmission to the external device. (Use double the calculated time because an idle time exists between send characters.)
5	External device process time	Depends on the external device process	The time required for the external device process according to the PLC's command which finishes by the start of the response data sending.
6	Received data transmission time	Number of data characters x one-character bit/ transmission rate	The time required for the received data transmission from the external device. (Use two to five times the calculated time because an idle time exists between the receive characters.)
7	Received data conversion process time	Depends on the number of conversion bytes	The time required for the received data conversion from the external device based on the specified conversion mode which finishes at the end of data.
8	Received data writing process time	One-cycle time maximum	The time required for the DP-RAM's received data transfer to IOM.

Note Although the data conversion process times of 2 and 6 vary according to the PLC operation status, the maximum values can roughly be estimated by the following calculation formula:

2 The send data conversion process time = 10000μ second + one-byte conversion time x number of conversion bytes

(one-byte conversion time→No conversion: 15μ second, ASCII conversion: 40μ second, HEX conversion:

55μ second)

6 The receive data conversion process time = 100μ second + one-byte conversion time x number of conversion bytes

(one-byte conversion time→No conversion: 15μ second, ASCII conversion: 30μ second, HEX conversion: 15μ second)

- The Overhead at I:N Connection
  When the repeat count is specified by a step, the time from the end of the previous step execution to the next start of the same step execution is about 20μ seconds. This time period is from the end of the communication with the previous machine to the start of the process with the next machine in the system of 1:N connection. When the link word area or the direct addressing area is used, the send data is transferred from the CPU unit at every step, therefore an additional time is required before the actual start of the data sending as follows:
- When the link word area is used: The total time of Á + Å in the above figure (the link word)
- When the direct addressing is used: The total time of Á + Å in the above figure (the direct addressing)

These times are not required if the event (operand addressing) area is used, because the beginning of sequence only in the send data is transferred from the PLC's CPU unit.

SECTION 5
Project Creation and Display

This section describes how to edit and manage projects.

5-1 Project Creation

A project contains all protocol and system setting data. Each project consists of a protocol list and devices: a protocol list defines all the protocols within a project consisting of sequences, steps, messages and matrices; devices define the system settings.

A SYSMAC-PST project has the same concept as projects in other products, such as SYSMAC-CPT and SYSWIN, in that the project contains both ladder and PLC to Computer communications information. The project hierarchy also follows standard Windows 95 concepts, such as Explorer.

SYSMAC-PST provides the user with the following capabilities associated with projects.

- Creating a new project.
- Opening an existing project.
- Renaming an existing project.
- Copying a project.
- Saving a project.

For more information about protocol lists, protocols, sequences and steps, refer to *Section 7 Protocol Creation and Editing*. For more information about messages, refer to *Section 8 Editing Send & Receive Messages and Receive Matrices*. For more information about traces, refer to *Section 11 Trace/Monitor*. For more information about system settings, refer to *Section 6 Hardware Configuration*.

Observe the following precautions when using a floppy disk:

- Copy project files contained in a floppy disk onto the hard disk.
- Do not save project files directly on a floppy disk. Save them on the hard disk once and then, using Windows Explorer, etc., copy the files from the hard disk to a floppy disk.
- Do not remove the floppy disk from the drive while using a project file on a floppy disk.
- If the message “Disk full while accessing xxx” appears while saving a project file, the file saving will have failed due to insufficient disk space. In such a case, be sure to resave the project file onto the hard disk.

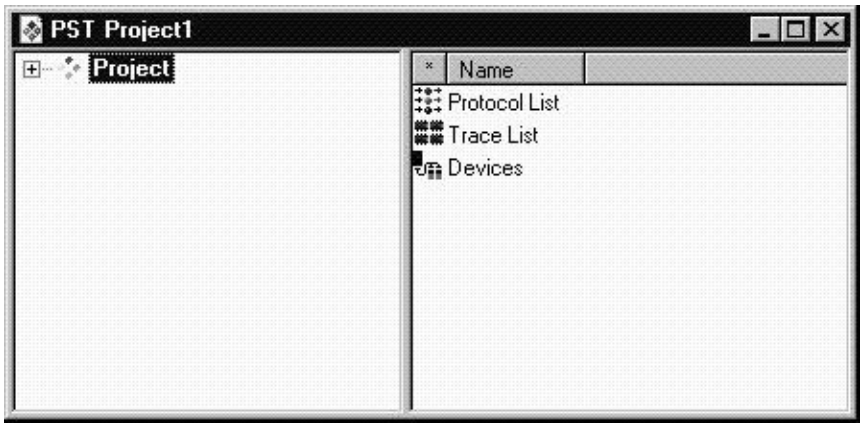
5-1-1 Create a New Project

Use the following procedure to create a new project.

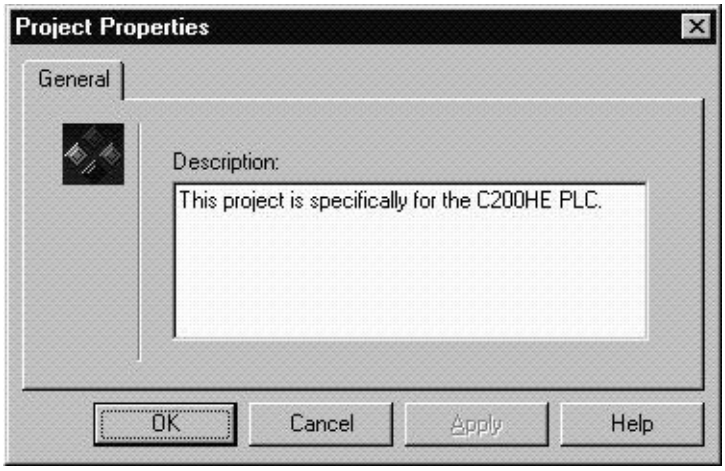
1, 2, 3...

1. Select *New* from the *File* menu or click on the **New** button from the Toolbar. Alternatively, a new project can be created by pressing Ctrl+N.

Each new project is given a default name displayed in the title bar which may be changed prior to saving the project.



A description for the project can be applied by selecting the project in the left pane with the right mouse button and clicking Properties. The Project Properties dialog is displayed.



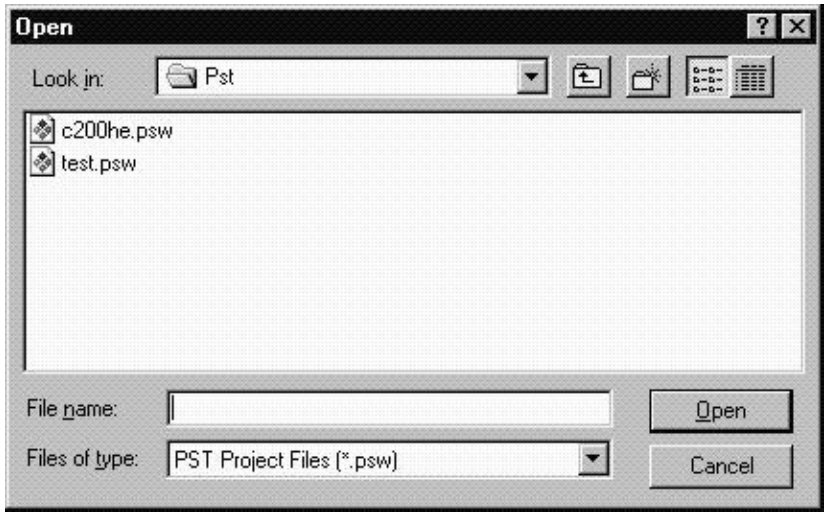
Enter a meaningful description for the project and click on the **OK** push-button. Click on the **Cancel** push-button to abort.

5-1-2 Open an Existing Project

Use the following procedure to open an existing project.

1, 2, 3...

1. Select *Open* from the *File* menu or click on the **Open** button from the Toolbar. Alternatively, an existing project can be opened by pressing Ctrl+O.
2. The Open dialog is displayed.



Select a project from the Open dialog list. Project files (*.psw) are displayed by default. Other types of files can be selected from the *Files of type:* drop-down list. The current folder can be changed by selecting another folder from the *Look in:* drop-down list.

3. Click the **Open** push-button or double-click on the selected project to open the project with the specified filename, file type and location. Click the **Cancel** push-button to close the Open dialog without opening a project.

5-1-3 Save a Project

Use the following procedure to save a project.

1, 2, 3...

1. Select *Save* from the *File* menu or click on the **Save** button from the Toolbar. Alternatively, an existing project can be saved by pressing Ctrl+S.
2. The project is saved using the current project name. For a new project which has not been saved before, the Save operation activates the Save As operation, described in *Section 5-1-4 Save a Project As*.

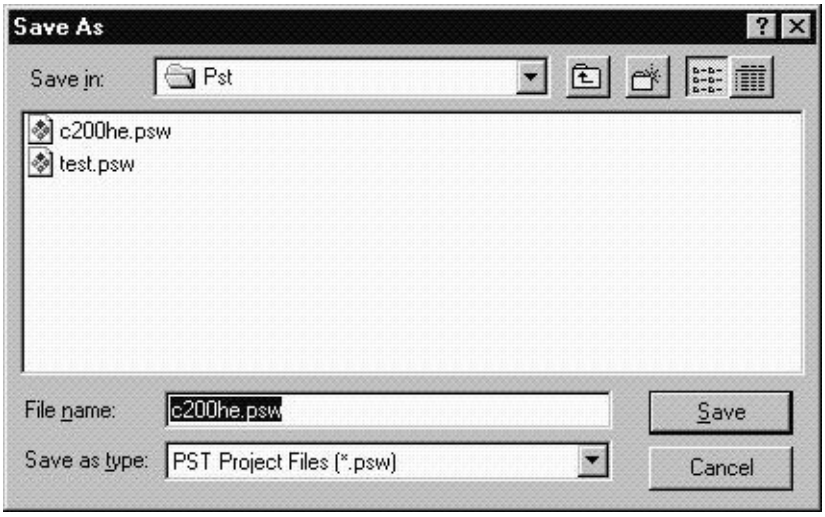
5-1-4 Save a Project As

The Save As operation permits the saving of an existing project under a different project name. It is also used to provide a new project with a project name for the first time.

Use the following procedure to save a project under a different project name.

1, 2, 3...

1. Select *Save As* from the *File* menu.
2. The Save As dialog is displayed.



To ensure only a project is saved, the *Save as type:* field is set to “PST Project Files (*.psw)”. The current folder can be changed by selecting another folder from the *Save in:* Drop-down list.

Type a project name in the *File name:* field. A project can be overwritten by selecting the project from the list. It is not possible to overwrite a read-only project.

3. Click the **Save** push-button to save the project with the specified filename, file type and location. Click the **Cancel** push-button to close the Save As dialog without saving the project.

   Confirmation is required if a project is to be overwritten.

Select the **Yes** push-button to overwrite the existing project. Select the **No** push-button to abort this operation. A project that is read-only cannot be overwritten.

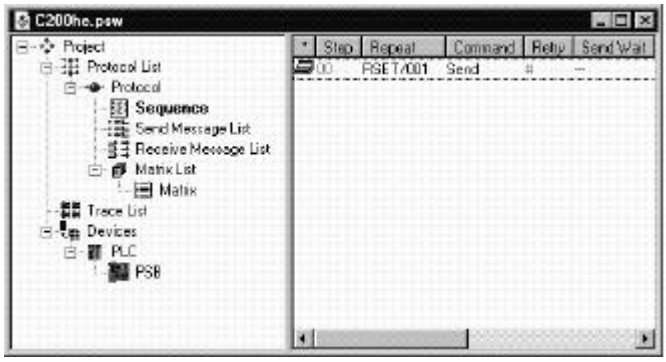
5-1-5 Close a Project

To close a currently open project select *Close* from the *File* menu or select the **Close** button from the project window title bar. Closing a project requires confirmation if the project has not been saved since its last amendment.

Select the **Yes** push-button to Save the project. If the project has been saved before, a Save operation is activated as described in *Section 5-1-3 Save a Project*. If the project has not been saved before, a Save As operation is activated as described in *Section 5-1-4 Save a Project As*. Select the **No** push-button to lose any changes to the project since its last Save operation. Click the **Cancel** push-button to close the project without saving changes to the project.

5-2 Project Display

The project window is used to perform all actions associated with a project.



The project window consists of two panes: the left pane contains the project hierarchical structure, the right pane contains information referring to the emboldened item in the left pane. It is possible to navigate from one pane to the other by selecting *Swap Focus* from the *View* menu or by pressing Tab. The full hierarchical structure is as follows:

Project
  Protocol list
    Protocol
      Sequence
        Step
      Send Message List
        Send Message
      Receive Message List
        Receive Message
      Matrix List
        Matrix
Matrix Care
Trace List
    Trace
  Devices
    PLC

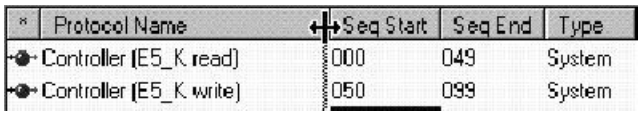
PLC Memory
PSB
Trace Memory A/B
Communications Port Settings A/B
PC<-->PLC Comms Settings

The hierarchical structure can be expanded by selecting the plus icon in the left pane, or by selecting an item in the right pane. Navigation up a level is achieved by selecting the minus icon in the left pane, selecting *Parent* from the *View* menu or by pressing Esc.

To amend settings in the right pane, select the appropriate icon in the left, for instance, the project icon.

The width of the fields is automatically adjusted to fit the text. The widths can be further adjusted in the right pane. Use the following procedure to further adjust the column widths.

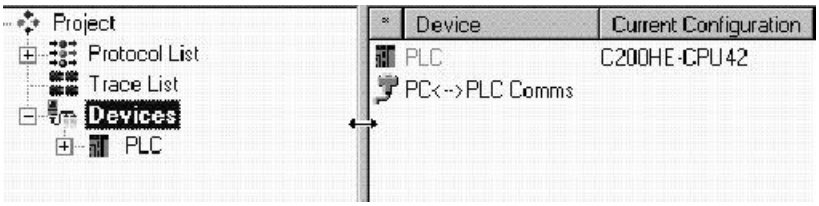
1, 2, 3... 1. Move the mouse pointer or input device over the header fields of the right pane. Between columns the mouse pointer changes shape.



2. Once the mouse pointer has changed, click and hold the left mouse button and drag the column width to the new position.

The divider bar separating the left and right frame can also be moved in the same manner. Use the following procedure to adjust the pane size.

1, 2, 3... 1. Move the mouse pointer or input device over the divider bar between panes. The mouse pointer changes shape.



2. Once the mouse pointer has changed, click and hold the left mouse button and drag the divider bar to the new position.

5-3 Project Windows

It is possible to include more than one project window within SYSMAC-PST. A new window can contain a project currently open in another window, or a different project.

To add a new project window for an already open project, select *New Window* from the *Window* menu. The new project window is placed to the front, cascading from its predecessor project window. All windows are provided with a unique

identifier and can be used independently to navigate through, and amend, the project.

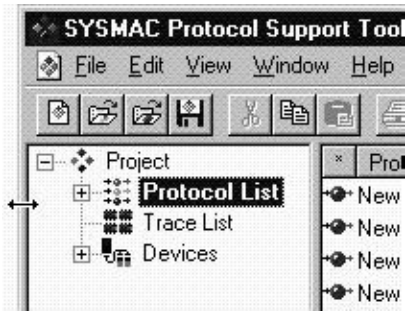
To add a new project window for a different project, use the Open method described in *Section 5-1-2 Open an Existing Project*. The new project window is placed in front cascading from its predecessor project window.

To activate a project window, select the appropriate title bar or press Ctrl+F6 to jump to the next project window.

A project window can be moved within the SYSMAC-PST application by selecting the project window button title bar with the left mouse and dragging the project window to its new destination, or by selecting *Move* from the project window control menu.

A project window can be resized. Use the following procedure to resize a project window.

1, 2, 3... 1. Move the mouse pointer or input device over a project window boundary. The mouse pointer changes shape.



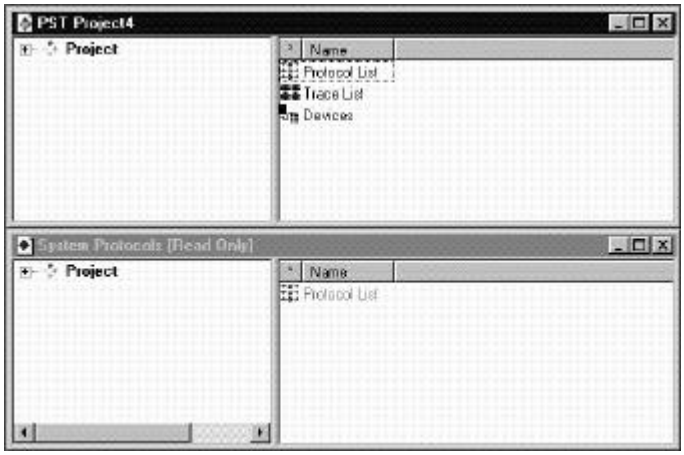
2. Once the mouse pointer has changed, click and hold the left mouse button and drag the boundary to its new position.

Note By selecting the corners of the project window boundary, the project window can be resized ensuring that the aspect ratio of the window is preserved.

A project window can also be resized by selecting *Size* from the project window control menu.

Multiple windows can be fully viewed within SYSMAC-PST. However, the more project windows that are opened, the less information can be viewed within each one.

To arrange project windows so they can be fully viewed, select *Tile* from the *Window* menu.



Multiple windows can be returned to their cascaded state by selecting *Cascade* from the *Window* menu.

Multiple windows can be maximized and minimized on an individual basis in the same manner as the display area. Refer to *Section 2 Environment/Installation/Uninstallation/Starting/Ending* for further information.

SECTION 6
Hardware Configuration

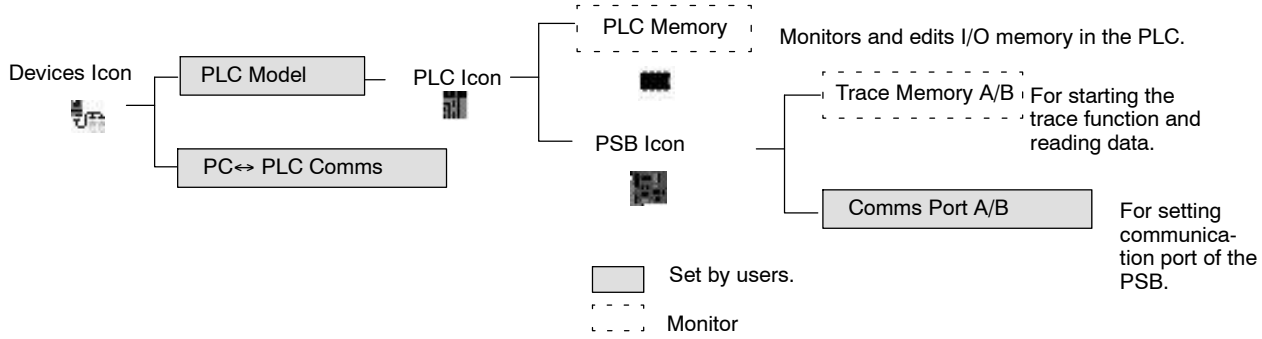
This section describes the hardware settings that can be configured for SYSMAC-PST.

6-1 Devices Configuration

The Devices are configured as follows.

1, 2, 3...

1. The Devices consist of a PLC and PC ↔ PLC Comms.
2. The PLC consists of a PLC Memory and PSB.
3. The PSB consists of a Trace Memory A, Trace Memory B, Comms Port A, and Comms Port B.



Outline of operation

Select the Devices icon and double-click the left button to set the PLC model and the conditions of communications between the PLC and personal computers.

Select the PLC icon in the left pane and click the left button to connect the PLC on-line.

1, 2, 3...

1. Double-click on the PLC Memory in the right pane to monitor or edit the I/O memory in the PLC.
2. Uploading and displaying the protocol in the PSB is also possible.

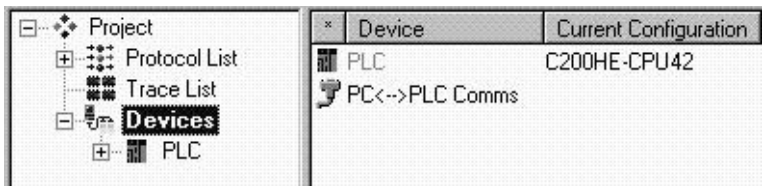
Select the PSB icon in the right or left pane and double-click the left button to set or transfer the Comms Port A/B of the PSB or to start or read the Trace Memory A/B.

6-2 Computer-to-PLC Communications

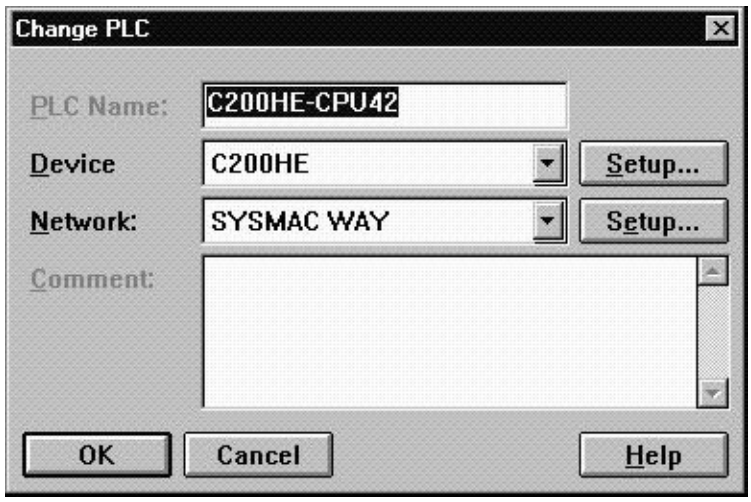
Use the following procedures to change the computer to PLC communications.

1, 2, 3...

1. Double-left-click on the devices icon.
2. Double-left-click on the *Current Configuration* setting to select a PLC. Press Return or select *Accept* form the *Edit* menu, or press Alt+E followed by A.



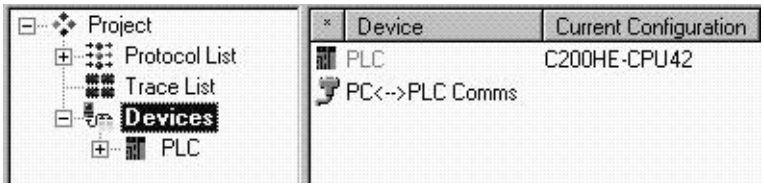
3. Double-left-click on the PC ↔ PLC Comms icon to use the SYSMAC-CDM application to amend the PLC. Within the SYSMAC-CDM application, the Change PLC dialog is displayed.



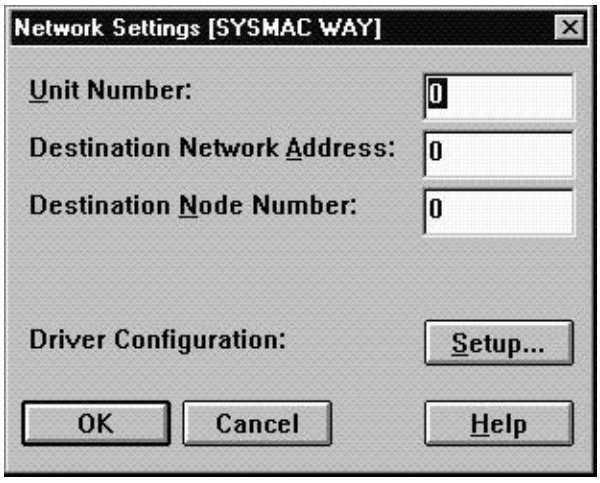
4. The Change PLC dialog allows the configuration of a PLC to be modified. The Network settings may be altered using the *Network:* drop-down list and the adjacent **Setup...** push-button.

⚠ Caution Do not change the settings in the *PLC Name:* field and *Device Type:* drop-down list unless necessary. The PLC Name; field cannot be edited.

5. Select the **OK** push-button to accept the settings. Select the **Cancel** push-button to leave the settings unchanged. Once the settings have been accepted, an error message is displayed if the PLC Type and CPU does not conform to the selected PLC, or the PLC Type and CPU does not conform to the PLC and CPU supporting the PSB. The selected PLC is displayed as the *PLC Type:* setting.



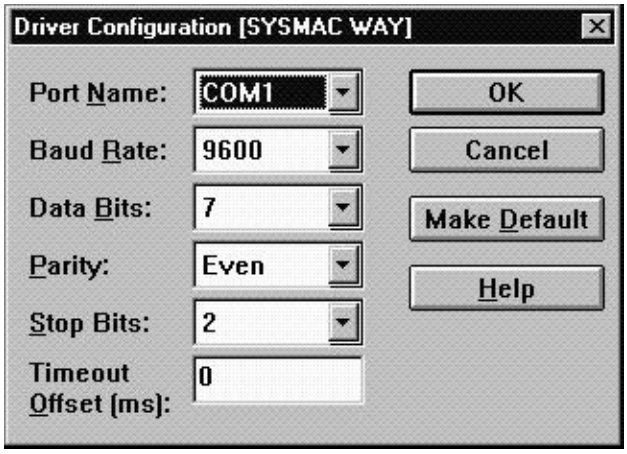
The Network can be amended by selecting the **Setup...** push-button adjacent to the Network: drop-down list.



Use the following procedure to amend the Network settings.

1, 2, 3...

1. Enter the Unit Number associated with the network being configured in the Unit Number: field.
2. Enter the Destination Network Address in the Destination Network Address: field and Destination Node Number for the network node (or connection point) in the Destination Node Number: field.
3. If necessary, enter configuration information to ensure that data is transmitted correctly over the network, by selecting the **Setup...** push-button. The Driver Configuration dialog is displayed.



Select the Port Name, Baud Rate, data Bits, Parity and Stop Bits from the associated drop-down lists. Alternatively, select the **Make Default** push-button. Select the **OK** push-button to accept the settings. Select the **Cancel** push-button to leave the settings unchanged. The Network Settings dialog is re-displayed.

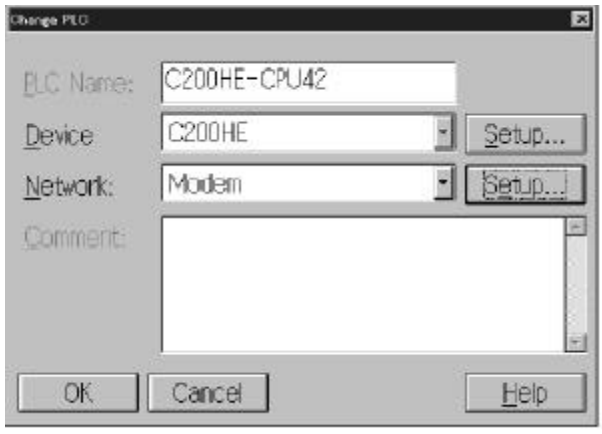
4. Select the **OK** push-button to accept the settings. Select the **Cancel** push-button to leave the settings unchanged.

6-2-1 Connection to PLC via Modem

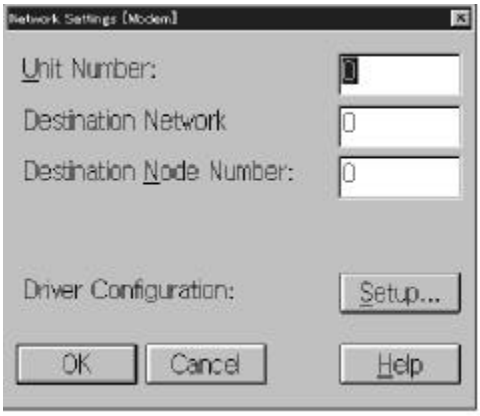
Use the following procedure when connecting to the PLC via modem.

1, 2, 3...

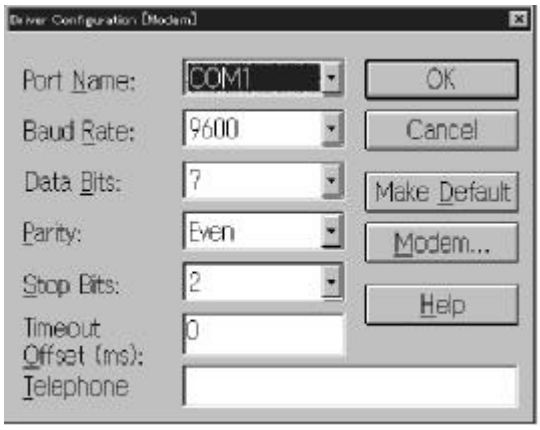
1. Select *Modem* in the *Network* filed.



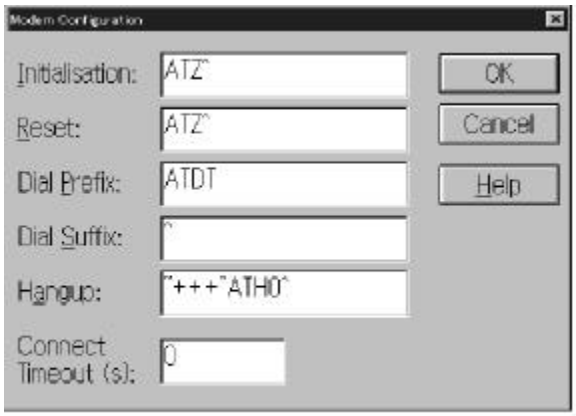
2. Click the **Setup** push-button located to the right of the *Network* field. *Network Settings [Modem]* dialog will be displayed.



3. Click the **Setup** push-button located to the right of *Driver Configuration*. *Driver Configuration [Modem]* dialog will be displayed. Input the communications conditions and phone number.



4. Click the **Modem** push-button to set commands for the modem. *Modem Configuration* dialog will be displayed. Input an appropriate command in each one of the following fields; *Initialization, Reset, Dial Prefix, Hangup, and Connect Timeout(s)*.



5. Press the **OK** push-button.

PLC Connection Example via Modem

The following section describes the modem setting procedure for a PLC connection via modem. AT commands and S register settings are explained for use with an OMRON MD144FB5V modem. (With the MD144FB5V, baud rate can be set up to 9,600 bps.) When using other modems, refer to the manual supplied with the modem and make similar settings.

Modem Settings on the Personal Computer Side

Setting Items

Set the following items as shown in the table. Other settings vary depending on the type of telephone line or the modem model and, therefore, must be appropriately set for the system in use.

Item	Settings
Baud rate (see note 1)	2,400, 4,800, 9,600 or 19,200 bps
Data length (see note 1)	7 bits
Parity (see note 1)	Even
Stop bit (see note 1)	1 bit
Data error correction, data compression (see note 2)	Data error correction: Yes Data compression: No MNP class 4 or V.42
Flow control (see note 2)	No (CS/RS: No, XON/OFF control: No)
Automatic reception (see note 2)	No
Terminal speed fixed (see note 2)	No
Abort timer (see note 2)	For example, set to a 10-minute interval

Note Do not perform data compression.
Do not fix the terminal speed.

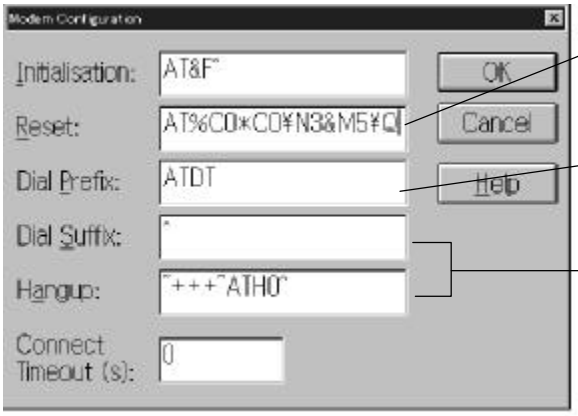
Note 1 Set these items on the *Driver Configuration [Modem]* dialog box.

2 Set these items on the *Modem Configuration* dialog box.

The following special symbols are used in the *Modem Configuration* dialog box.

Symbol	Meaning
^	Issues an AT command
!	Waits 0.1 second
~	Waits 1.1 second

Setting Example



Input an AT command. In this example, input:
`AT%C0*C0¥N3&M5¥Q0S26=10X3¥V2¥J1^`

If the telephone line is in pulse mode, input `ATDP`.

Default settings can be used. No need to change them.

Be sure to add a suffix of "^" to the AT command to be input in the *Initialization, Preset, Dial Prefix,* and *Hangup* fields. If this suffix is not added, the line cannot be connected or disconnected.

Note Depending on the modem, continuous issue of the AT commands might cause an error. If such an error occurs, input "!" in the *Reset* and *Dial Prefix* fields. For example: `!ATDT`

Meanings of the AT commands and S registers used in the just-described example:

Command	Function	Settings
AT&F	Initializes the modem.	
AT%C0	MNP class setting	MNP class 4 (No data compression)
AT*C0	V.42bis compression setting	No compression
AT¥N3	MNP setting	Auto-reliable mode
AT&M5	V.42 setting	Auto-reliable mode
AT¥Q0	Flow control between the terminal and modem	No flow control
ATS26=10	Abort timer	10 minutes
ATX3	Display of baud rate, busy and dial tone detection	Yes
AT¥V2	Error correction (Yes/No) display	Yes
AT¥J1	Terminal speed fixing	No

Modem Settings on the PLC Side

Setting Items

Set the following items as shown in the table. Other settings vary depending on the type of telephone line or the modem model and, therefore, must be set as suited for the system in use.

Note Be sure to write the modem settings on the PLC side into the nonvolatile memory.

Item	Settings
Data length	7 bits
Parity	Even
Stop bit	1 bit
Data error correction, data compression	Data error correction: Yes Data compression: No MNP class 4 or V.42
Flow control	No (RTS/CTS: No, XON/OFF control: No)
Automatic reception	No
ER signal	Always ON
Terminal speed fixed	No
Abort timer	For example, set to a 10-minute interval

Note Do not perform data compression.
Do not fix the terminal speed.
When setting the baud rate, set Automatic Speed Response at Reception to Yes.

Setting the Nonvolatile Memory

Save the AT commands and S registers in the nonvolatile memory using the communications software as described below.

1, 2, 3... 1. Turn OFF the power supply to the modem.

2. Start the communications software and input as follows:
```
AT%C0*C0¥N3&M5¥Q0S0=1S26=10X3¥V2¥J1&D0&W1↵
OK
```

Note "OK" is a message from the modem which indicates that the command has ended.

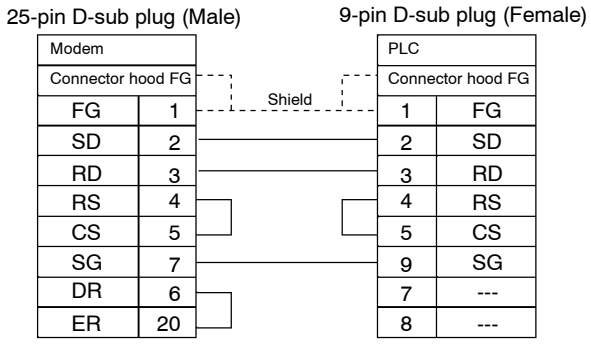
Meanings of the AT commands and S registers used in the just-described example:

Command	Function	Settings
AT%C0	MNP class setting	MNP class 4 (No data compression)
AT*C0	V.42bis compression setting	No compression
AT¥N3	MNP setting	Auto-reliable mode
AT&M5	V.42 setting	Auto-reliable mode
AT¥Q0	Flow control between the terminal and modem	No flow control
ATS0=1	Automatic reception and reception calls setting	Automatic reception: Yes Number of calls: 1
ATS26=10	Abort timer	10 minutes
ATX3	Display of baud rate, busy and dial tone detection	Yes
AT¥V2	Error correction (Yes/No) display	Yes
AT¥J1	Terminal speed fixing	No
AT&D0	ER signal	Always ON
AT&W1	Writing to the nonvolatile memory area 1	Writes the contents of the present value area in the nonvolatile memory area.

6-2-2 Cable Connection between Modem and PLC

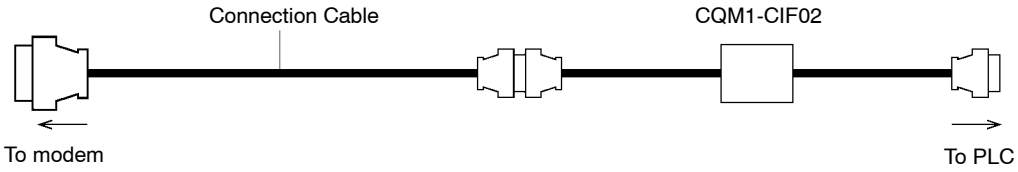
Cable connection varies depending on the communications port to be used. Connect cables appropriately for the system to be used.

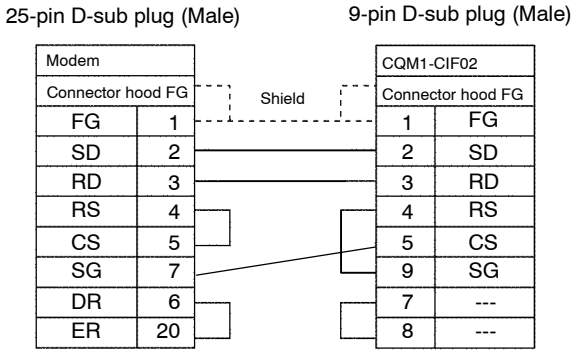
Cable Connection between Modem and Internal Host Link Port of PLC



Cable Connection between Modem and Internal Peripheral Port of PLC

Connect the CQM1-CIF02 Connecting Cable to the peripheral port of the PLC and connect the modem connecting cable to the other end of the CQM1-CIF02 Connecting Cable.





Note For connecting the modem to a personal computer, use the cable supplied with the modem.

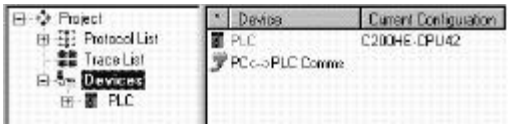
6-3 PLC Configuration

6-3-1 PLC Selection

Use the following procedure to select a PLC.

1, 2, 3...

1. Double-left-click on the devices icon.
2. Double-left-click on the *Current Configuration* setting or alternatively click on the *Current Configuration* setting and press Return or select *Field* from the *Edit* menu.



3. Select a PLC from the drop-down list and press Return, or select *Accept* from the *Edit* menu.
4. If required, double-left-click on the PC ↔ PLC Comms icon to use the SYSMAC-CDM application to amend the PLC.

6-3-2 Online Connection

Use the following procedure for online connection.

1, 2, 3...

1. Double-left-click the Devices icon.
2. If *No selected PLC* is displayed in the *Current Configuration* field of the PLC, double-left-click the display and select the applicable CPU Unit model from the drop-down list. Press Return, or select *Accept* from the *Edit* menu.
3. If the *PC <->PLC Comms* does not coincide with the communications settings of the port connected to the CPU Unit, change the communications

settings between the PC and PLC or change the settings on the CPU Unit side.

4. Left-click the PLC icon in the left or right pane. The PC mode will change from *Offline* to *Online* and the PC tool bar will change from *Offline* to *Program*, *Monitor*, or *Run*.

⚠ Caution The SYSMAC-PST and SYSMAC-CPT cannot be connected online when using both at the same time.
If the online connection of the SYSMAC-PST is attempted while the SYSMAC-CPT is connected online, the message “Unable to open the PLC” will be displayed, and online connection will not be possible.
If the SYSMAC-CPT has been started and connected online, therefore, set the SYSMAC-CPT offline and then connect the SYSMAC-PST online.

Set the SYSMAC-CPT offline according to the following procedure:
Select *Go Offline* from the *Online* on the main menu. Refer to *SYSMAC-CPT User Manual (W333)*.

When connecting the SYSMAC-CPT online, set the SYSMAC-PST offline and then connect the SYSMAC-CPT online. For setting the SYSMAC-PST offline, refer to the following section.

6-3-3 Switching to Offline Connection

For changing the SYSMAC-PST connection from online (*Program*, *Monitor*, or *Run*) to offline, follow either one of the following procedures. The PC tool bar will change to *Offline*.

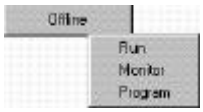
- Click an icon or object (from Project to Devices) located above the PLC icon.
- Perform a file operation (Create File, Open, Read Standard Protocol, Close) using the main menu or project tool bar.

6-3-4 PLC Mode Selection

Use the following procedure to change the current mode of the PLC.

1, 2, 3...

1. Double-left-click on the devices icon.
2. Double-left-click on the PLC icon to enable the **PLC Mode** push-button on the toolbar.
3. Select the **PLC Mode** push-button from the display area.
4. Select *Run*, *Monitor*, or *Program* from the pop-up menu. The mode of the PLC changes accordingly.



⚠ Caution Confirm that no adverse effect will occur in the system before changing the operating mode of the PLC. Not doing so may result in an unexpected operation.

Note 1 If no PLC is connected, the mode of the PLC is *Offline*. For a project to be online, the devices icon must be selected.

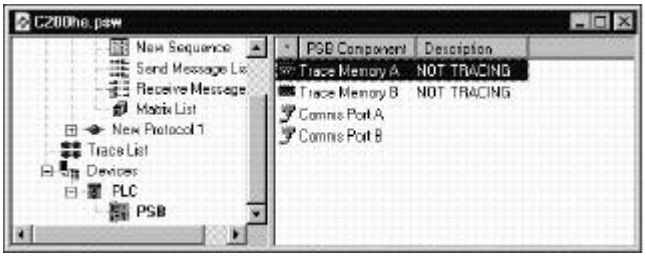
2 When a project is online, any other projects that are opened are offline and need to be changed manually.

6-3-5 PSB Selection

Use the following procedure to select the PSB.

1, 2, 3...

1. Double-left-click on the devices icon.
2. Double-left-click on the PLC icon.
3. Double-left-click on the PSB icon.
4. Select the Comms Port A icon or the Comms Port B icon, according to the PSB setup.

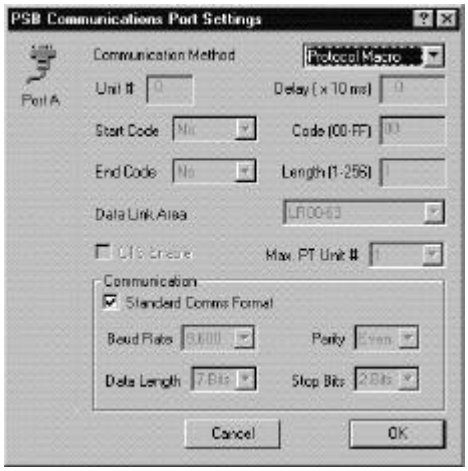


6-3-6 PSB Communications

Use the following procedure to set the PSB communication settings for Port A or Port B.

1, 2, 3...

1. Select the appropriate PSB Port, as described in *Section 6-2-3 PSB Selection*.
2. Double-left-click on the appropriate PSB Port, either Port A or Port B. Alternatively, select *Edit Settings* from the right mouse button menu. The PSB Communications Port Settings dialog is displayed.



Edit the fields as appropriate. Click the **OK** push-button to accept the settings. Select the **Cancel** push-button to close the dialog without changing the settings.

The number of fields that can be edited is dependant on the communications method. The dialogs are identical for Port A and Port B.

Communications Method	Options that can be Set	Remarks
Non-standard Host Link	Unit # field Delay (× 10 ms) field CTS Enable field Baud Rate field Stop Bits field Parity field Data Length field	
Standard Host Link	Unit # field Delay (10 ms) field CTS Enable field	The *Baud Rate*, *Stop Bits*, *Parity* and *Data Length* fields are applicable, but the default settings cannot be changed
Non-standard RS232C	Delay (× 10 ms) field Start Code field End Code field CTS Enable field Baud Rate field Stop Bits field Parity field Data Length field	If the *Start Code* field or *End Code* field is set to 'Yes', then the adjacent *Code (00 - FF)* field can also be set. If the End Code field is set to 'No', then the adjacent *Length (1 - 256)* field can be set.
Standard RS232C	Delay (× 10 ms) field Start Code field End Code field CTS Enable field	If the *Start Code* field or *End Code* field is set to 'Yes', then the adjacent *Code (00 - FF)* field can also be set. If the End Code field is set to 'No', then the adjacent *Length (1 - 256)* field can be set. The *Baud Rate*, *Stop Bits*, *Parity* and *Data Length* fields are applicable, but the default settings cannot be changed.
1:1 Link Slave	CTS Enable field	
1:1 Link Master	Data Link Area field CTS Enable field	
1:1 NT Link	None	
1:N NT Link	Max PT Unit # field	
Non-standard Protocol Macro	Baud Rate field Stop Bits field Parity field Data Length field	
Standard Protocol Macro	None	The *Baud Rate*, *Stop Bits*, *Parity* and *Data Length* fields are applicable, but the default settings cannot be changed.

6-3-7 Transferring Port Settings to the PSB

Transferring Port Settings to the PLC

Transfer the communications port settings to the PSB according to the following procedure.

1, 2, 3...

1. Select the Comms Port A or B.
2. Left-click the *Download Port Settings* icon on the tool bar or click the right button and select the *Download Settings to PLC* from the popup menu.
3. The message "Downloading Port Settings to PLC" will be displayed. When the transfer has been completed, the dialog "Downloaded PSB communications Settings OK" will be displayed.

⚠ Caution Confirm that no adverse effect will occur in the system before changing the operating mode of the PLC. Not doing so may result in an unexpected operation.

⚠ Caution Confirm that no adverse effect will occur in the system before transferring the communication port A/B settings to the PSB.

Reading Port Settings from the PSB

Read the communications port settings from the PSB according to the following procedure.

1, 2, 3...

1. Select the Comms Port A or B.
2. Left-click the *Upload Port Settings* icon on the tool bar or click the right button and select the *Upload Settings from PLC* from the popup menu. When reading has been completed, the dialog “PSB Communications Port Settings” will be displayed.

Note Read or write the contents of DM 6550 to DM 6654 (Port B) or DM 6555 to DM 6559 (Port A) set by PLC Setup in the CPU Unit according to the above procedure. This setting operation can also be performed by the peripheral devices of the PLC Unit.

6-4 Printer Setup

The printer configuration can be setup using the Print Setup dialog. Use the following procedure to set up the printer configuration from within SYSMAC-PST.

1, 2, 3...

1. Select *Print Setup*... from the *File* menu or press Alt+F followed by R.
2. The Print Setup dialog is displayed.

Select the printer from the *Name:* drop-down list. Use the Properties push-button to display the Properties dialog to configure the specific printer settings.

3. Select the paper size from the *Size:* drop-down list in the Print Setup dialog or from the Properties dialog for the selected printer.
4. Select the paper source from the *Source:* drop-down list in the Print Setup dialog or from the Properties dialog for the selected printer.
5. Select the orientation from the *Orientation* options in the Print Setup dialog or from the Properties dialog for the selected printer.
6. Click the OK push-button to accept the settings or click the Cancel push-button to leave the settings unchanged.

Refer to specific Printer documentation for further details on printer configuration.

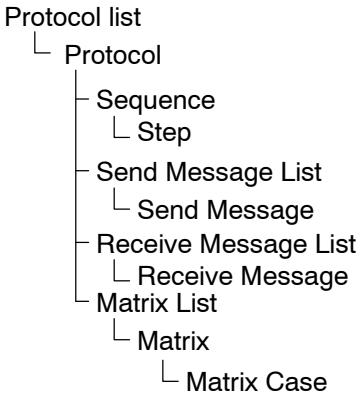
SECTION 7
Protocol Creation and Editing

This section describes how to edit and manage protocols and sequences.

7-1 Overview of Protocol Sequence Creation

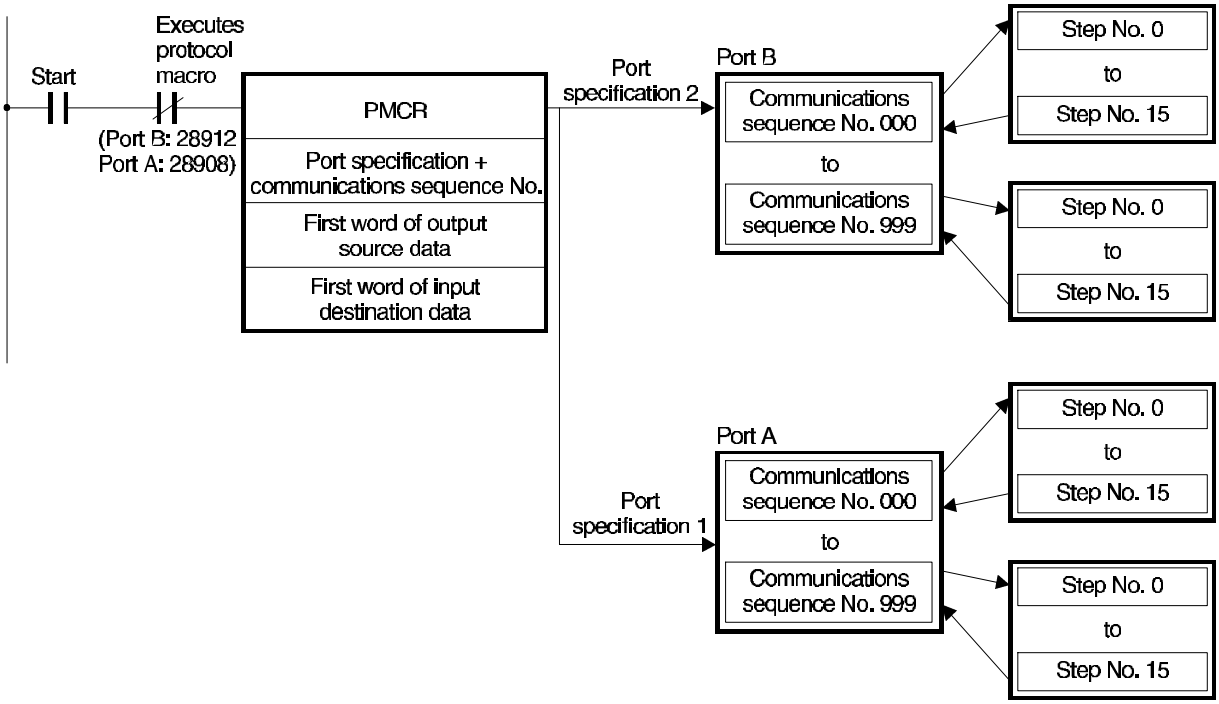
The protocol macro function allows a user to create original communications procedures. Users can freely edit communications procedures (called sequences) for various external devices, such as general-purpose components connected to RS-232C or RS-422/485 interfaces. These procedures are initiated by the PMCR instruction contained within a running PLC program.

The structure of a protocol is as follows:



7-1-1 Sequence Settings

Up to 1,000 (0 to 999) sequences can be registered and used, although only 60 can be allocated to one protocol. Each sequence consists of up to 16 steps.



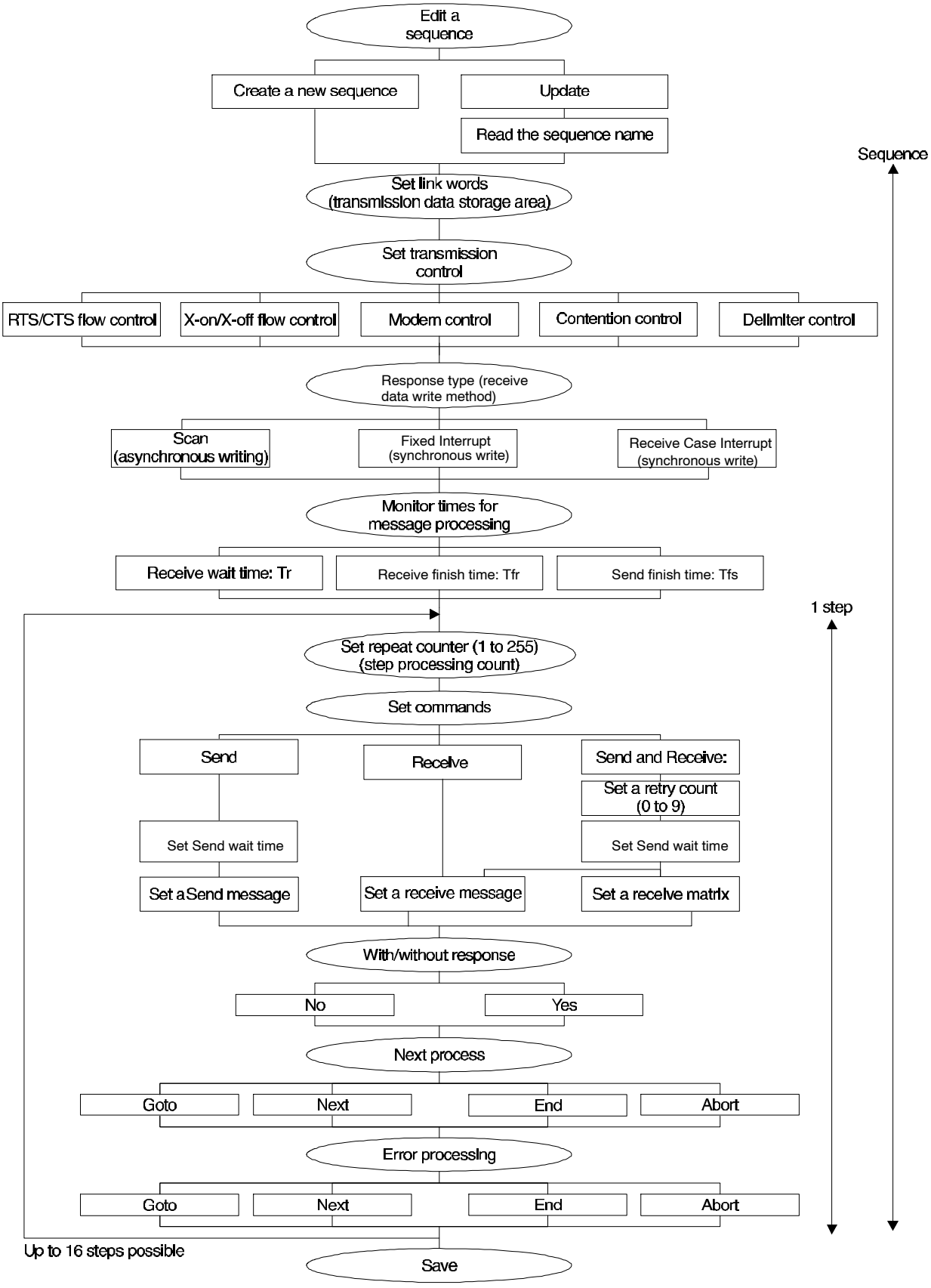
7-1-2 Sequence Settings

The settings that can be made for sequences using SYSMAC-PST are shown in the following table.

Level	Item	Action	Settings
Sequence	Link Words	Set words for which data is shared between the PLC and a PSB.	CIO, LR, HR, AR, DM or EM effective starting address and length for Input or Output Area 1 or 2.
	Transmission Control	Set transmission control method such as Xon/Xoff flow control or RTS/CTS flow control.	Xon/Xoff control, RTS/CTS control, modem control, delimiter control, and contention control.
	Response Type	Set the response method for writing data to the PLC.	Scan mode, Fixed Interrupt notification or Receive Case Interrupt notification.
	Timers	Set the period for monitoring sent/receive processing.	Receive wait time, receive finish time, send finish time. Units (0 to 99) of 0.01 s, 0.1 s, 1 s, or 1 min.
Step	Repeat Counter	Set the step repeat counter.	Reset or hold (Reserve). Constants 1 to 255, CIO channel, LR channel, HR channel, AR channel, DM channel, EM channel, I1, I2, O1, O2 or Operand effective address.
	Command	Set the communications commands.	Send, Receive, or Send & Receive.
	Retry Count	Set an error retry count when the command setting is Send & Receive.	0 to 9.
	Send Wait time	Set the wait time required to send data at transmission.	Units (0 to 99) of 0.01 s, 0.1 s, 1 s, or 1 min.
	Send Message	Set send data when the command is Send or Send & Receive.	The settings detail can be viewed in the Send Message setting drop-down list for a step or the Send Message List.
	Receive Message	Set expected received data when the command is Receive or Send & Receive.	The settings detail can be viewed in the Receive Message setting drop-down list for a step or the Receive Message List.
	Receive Matrix	Set expected received data (up to 15 sets) and change the processing according to the received data when the command is Receive or Send & Receive.	The matrix settings can be viewed in the Matrix list (matrix columns cannot be seen in the Step List).
	With/Without Response Writing	Set whether to save the receive data to the PLC.	No or Yes.
	Next Process	Set the next step to which control is to be passed when a step is terminated normally.	Goto (0 to 15), End, Abort, Next.
	Error Process	Set the next step to which control is to be passed when a step is terminated abnormally.	Goto (0 to 15), End, Abort, Next.

7-1-3 Creating Sequences

The following diagram shows an example of how the setting of a sequence and the entire setting procedure could flow. Refer to *Section 7-2 Edit a Protocol List* and *Section 7-3 Edit a Protocol* for individual settings and setting procedures.


Edit a sequence
Create a new sequence
Update
Read the sequence name
Sequence
Set link words (transmission data storage area)
Set transmission control
RTS/CTS flow control
X-on/X-off flow control
Modem control
Contention control
Delimiter control
Response type (receive data write method)
Scan (asynchronous writing)
Fixed Interrupt (synchronous write)
Receive Case Interrupt (synchronous write)
Monitor times for message processing
Receive wait time: Tr
Receive finish time: Tfr
Send finish time: Tfs
1 step
Set repeat counter (1 to 255) (step processing count)
Set commands
Send
Receive
Send and Receive:
Set a retry count (0 to 9)
Set Send wait time
Set Send wait time
Set a Send message
Set a receive message
Set a receive matrix
With/without response
No
Yes
Next process
Goto
Next
End
Abort
Error processing
Goto
Next
End
Abort
Up to 16 steps possible
Save

7-2 Edit a Protocol List

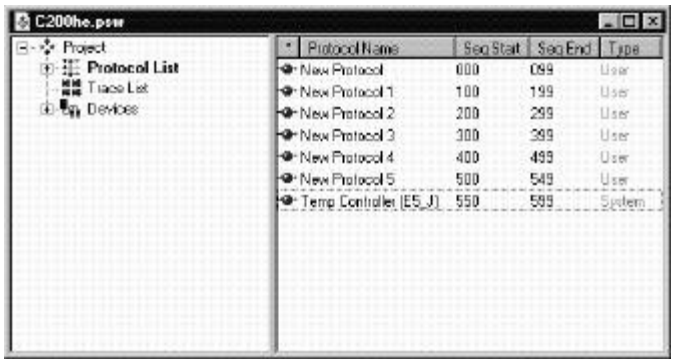
7-2-1 Display a Protocol List

Use the following procedure to display a protocol list for a project.

1, 2, 3...

1. Click on the project icon in the left pane to show the name of the protocol list.
2. Double-left-click on the protocol list icon to show all protocols in the protocol list.

Note Alternatively, double-left-click on the protocol list icon in the right pane.



7-2-2 Create a New Protocol in the List

Use the following procedure to create a new protocol in the protocol list.

1, 2, 3...

1. Click on the project icon.
2. Select the protocol list to add a new protocol into.
3. Select the protocol list icon in the left pane, more than one protocol in the right pane, or a free area in the right pane, outside the protocol list, with the right mouse button and select *Create Protocol...*.

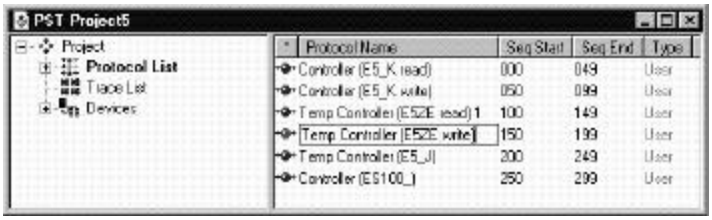
7-2-3 Rename a Protocol in the List

Use the following procedure to rename a registered protocol.

Note The “System” type protocols cannot be changed.

1, 2, 3...

1. Double-left click on the appropriate *Protocol Name* setting in the protocol list or select the *Protocol Name* setting and press Return. Alternatively, select the *Protocol Name* setting and select *Field* from the *Edit* menu. The current protocol name becomes an editable field.



2. Type in a new name for the protocol and press Return or select *Accept* from the *Edit* menu. It is possible to select a portion of the current protocol name and overtype. The new protocol name may not exceed 30 characters.

7-2-4 Delete a Protocol from the List

Use the following procedure to delete a protocol. ‘System’ type Protocols cannot be deleted.

1, 2, 3...

1. Select the icon of the protocol to be deleted from the protocol list. More than one protocol can be selected by pressing Shift and selecting another protocol to extend the selection, or by pressing Ctrl and selecting another protocol to add to the selection.

2. Select the **Delete** button from the toolbar or press Delete. Alternatively, select *Delete* from the *Edit* menu or press Alt+E followed by D. Select the **OK** push-button from the confirmation dialog to confirm deletion or the **Cancel** push-button to cancel the deletion.

A protocol can also be deleted by selecting the **Cut** button from the Toolbar or pressing Ctrl+X or press Alt+E followed by T. Alternatively, select *Cut* from the right mouse button dialog or *Cut* from the *Edit* menu. Select the **Paste** button from the Toolbar or press Ctrl+V or press Alt+E followed by P to retrieve the last delete action using the Cut operation. Alternatively, select *Paste* from the right mouse button dialog or *Paste* from the *Edit* menu. The pasted protocols are placed at the end of the protocol list.

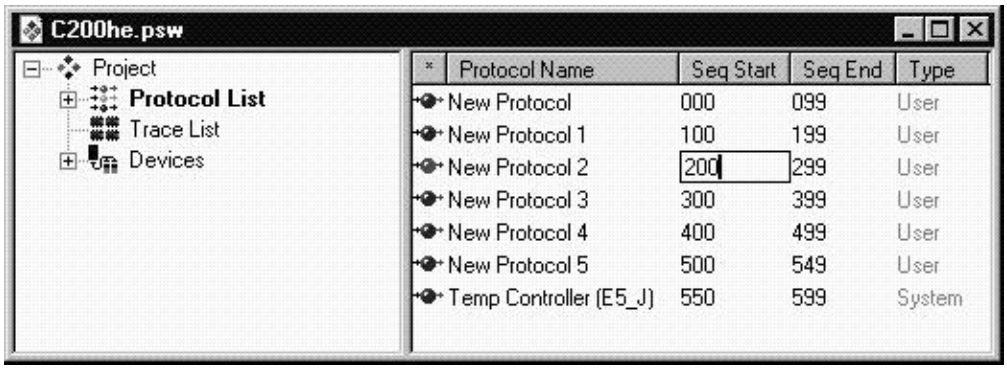
7-2-5 Set the Protocol Sequence Number Range

Use the following procedure to specify the range of sequence numbers that are used by a specified protocol. An error occurs if the specified range is smaller than the range associated with the registered sequence.

Note Sequence number ranges belonging to “System” type protocols cannot be changed.

1, 2, 3...

1. Double-left-click on the *Seq Start* setting associated with the protocol in the protocol list. Alternatively, select the *Seq Start* setting and press Return or select the *Seq Start* setting and select *Field* from the *Edit* menu. The current sequence start becomes an editable field.



2. Enter a starting number and press Return or select *Accept* from the *Edit* menu.
3. If necessary, double-left-click on the *Seq End* setting associated with the protocol in the protocol list. Alternatively, select the *Seq End* setting and press Return or select the *Seq End* setting and select *Field* from the *Edit* menu. Enter an end number and press Return or select *Accept* from the *Edit* menu.

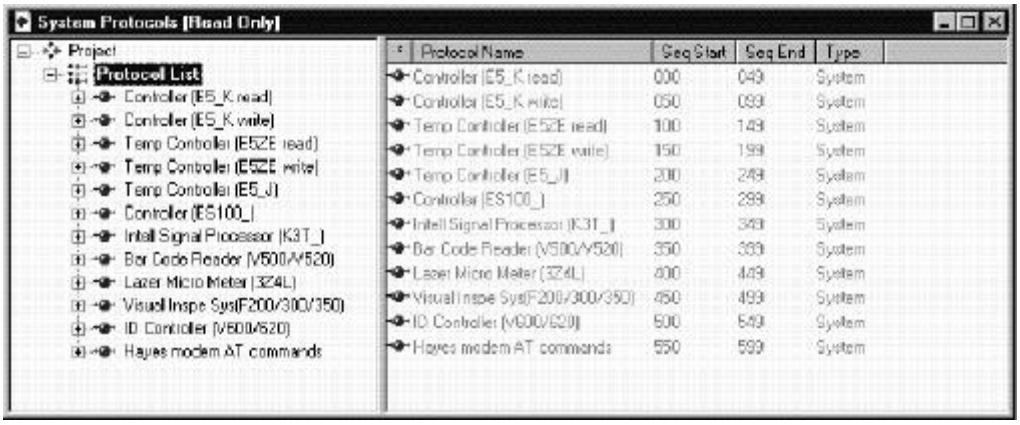
If an illegal number is entered in either the *Seq Start* or *Seq End* fields for the associated protocol, the number turns red.

Note

1. If the *Seq Start* setting is changed, then all communication sequences within that protocol are renumbered by the same amount. For instance, if the *Seq Start* setting is changed from 200 to 210, all communication sequences within that protocol are incremented by ten.
2. The *Seq Start* setting and *Seq End* setting range must be large enough to hold all existing communication sequences.

7-2-6 Retrieve an Existing Protocol

SYSMAC-PST is supplied with a number of predefined coded system protocols. Select the **Open System Protocols** button from the toolbar to retrieve the predefined protocols. Alternatively, select *Open System Protocols* from the *File* menu or press Alt+F followed by Y. The protocols and their contents cannot be edited directly, but can be copied to a user defined protocol.



7-2-7 Copy Protocol

Use the following procedure to copy a protocol. 'System' type protocols can be copied, but the protocol type changes to 'User' once pasted into a new protocol list.

1, 2, 3...

1. Select the icon of the protocol to be copied from the protocol list in the right pane. More than one protocol can be selected by pressing Shift and selecting another protocol to extend the selection, or by pressing Ctrl and selecting another protocol to add to the selection.

2. Select the **Copy** button from the Toolbar or press Ctrl+C or press Alt+E followed by C. Alternatively, select *Copy* from the right mouse button dialog or select *Copy* from the *Edit* menu.

3. Select a protocol list or display the protocols in the right pane into which to paste the copied protocol or protocols.

4. Select the **Paste** button from the Toolbar or press Ctrl+V or press Alt+E followed by P. Alternatively, select *Paste* from the right mouse button dialog or select *Paste* from the *Edit* menu. The pasted protocols are placed at the end of the protocol list.

Note The entire protocol is copied, including the sequences, steps, messages and matrices.

7-3 Edit a Protocol

7-3-1 Edit a Sequence List

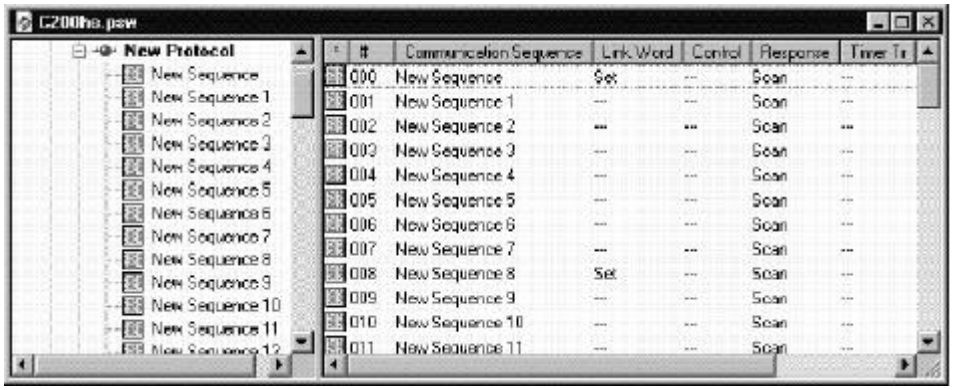
Display a Sequence List

Use the following procedure to display a sequence list within a protocol.

1, 2, 3...

1. Double-left-click on the protocol list to show all protocols.

2. Double-left-click on the protocol containing the sequences in the left pane or double-left-click the protocol in the right pane to list all sequences contained within the protocol.



Create a New Sequence in the List

Use the following procedure to create a new sequence in the protocol.

1, 2, 3...

1. Double-left-click on the protocol list to show all protocols.
2. Select the protocol to which to add a new sequence.
3. Select the protocol icon in the left pane, or more than one communications sequence in the right pane, or a free area in the right pane outside the sequence list, with the right mouse button and select *Create Communications Sequence...*

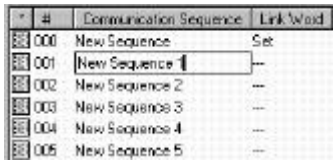
Rename a Sequence in the List

Use the following procedure to rename a sequence that has been registered.

Note Sequences belonging to “System” type protocols cannot be changed.

1, 2, 3...

1. Double-left-click on the appropriate *Communication Sequence* setting from the associated protocol. Alternatively, select the *Communication Sequence* setting and press Return or select the *Communication Sequence* setting and select *Field* from the *Edit* menu. The current sequence name becomes an editable field.



2. Type in a new name for the sequence and press Return or select *Accept* from the *Edit* menu. It is possible to select a portion of the current sequence name and overtype. The new sequence name may not exceed 30 characters.

Edit a Sequence List

Use the following procedure to edit the communications sequence number in a sequence list.

1, 2, 3...

1. Display the sequence list.
2. Double-left-click on a # setting within the sequence. Alternatively, select the # setting and press Return or select the # setting and select *Field* from the *Edit* menu. The current sequence number becomes an editable field.

3. Type in a new sequence number and press Return or select *Accept* from the *Edit* menu. It is possible to select a portion of the current sequence number and overtype. The new sequence number must not exceed the limit expressed in the *Seq Start* and *Seq End* protocol settings. The new sequence number must not be a sequence number currently in use.

Note It is not possible to directly edit a sequence belonging to a protocol of type 'System', unless it is copied to a protocol of type 'User'.

Cut/Copy/Paste Sequences in the List

Use the following procedure to copy a sequence.

1, 2, 3...

1. Select the icon of the sequence to be copied in the right pane. More than one sequence can be selected by pressing Shift and selecting another sequence to extend the selection, or by pressing Ctrl and selecting another sequence to add to the selection.

2. Select the **Copy** button from the Toolbar or press Ctrl+C or press Alt+E followed by C. Alternatively, select *Copy* from the right mouse button dialog or select *Copy* from the *Edit* menu.

3. Select a protocol or display the sequence list in the right pane into which to paste the copied sequence or sequences.

4. Select the **Paste** button from the Toolbar or press Ctrl+V or press Alt+E followed by P. Alternatively, select *Paste* from the right mouse button dialog or select *Paste* from the *Edit* menu. The pasted sequences are placed at the end of the appropriate protocol and are given the next available sequence numbers.

Use the following procedure to delete a sequence. Sequences within protocols that are of type System cannot be deleted.

1, 2, 3...

1. Select the icon of the sequence to be deleted. More than one sequence can be selected by pressing Shift and selecting another sequence to extend the selection, or by pressing Ctrl and selecting another sequence to add to the selection.

2. Select the **Delete button** from the toolbar or press Delete. Alternatively, select *Delete* from the right mouse button dialog or select *Delete* from the *Edit* menu or press Alt+E followed by D. Select the **OK** push-button from the confirmation dialog to confirm deletion or the **Cancel** push-button to cancel the deletion.

A sequence can also be deleted by selecting the **Cut** button from the Toolbar or pressing Ctrl+X or press Alt+E followed by T. Alternatively, select *Cut* from the right mouse button dialog or select *Cut* from the *Edit* menu. Select the **Paste** button from the Toolbar or press Ctrl+V or press Alt+E followed by P to retrieve the last delete action using the Cut operation. Alternatively, select *Paste* from the right mouse button dialog or *Paste* from the *Edit* menu. The pasted sequences are placed at the end of the appropriate sequence and are given the next available sequence numbers.

Note

1. Once a sequence has been pasted, the referred message data within the step is lost.
2. It is not possible to paste all the sequences if the number of sequences exceeds the maximum of 60.

7-3-2 Set Sequence List Attributes

The settings that can be made for sequence list attributes using SYSMAC-PST are shown in the following table.

Attribute	Content			
Link Word	Link 1	IN	IN Area	None, CIO, LR, HR, AR, DM, EM.
			Address	
			Length	
		OUT	OUT Area	None, CIO, LR, HR, AR, DM, EM.
			Address	
			Length	
	Link 2	IN	IN Area	None, CIO, LR, HR, AR, DM, EM.
			Address	
			Length	
		OUT	OUT Area	None, CIO, LR, HR, AR, DM, EM.
			Address	
			Length	
Transmission Control	RTS/CTS	None, Send, Receive, Send & Receive		
	XON/XOFF	None, Send, Receive, Send & Receive		
	Modem (see note 1)			
	Contention	Send Request Code		Code, ASCII, HEX
	Delimiters	Delimiter Send Code		Code, ASCII, HEX
		Delimiter Receive Code		Code, ASCII, HEX
Response Type	Scan, Interrupt mode: Fixed #, Interrupt mode: Receive Matrix Case #			
Timer Tr	Value	00 to 99		
	Timer Unit	0.01s, 0.1s, 1s, 1 min		
Timer Tfr	Value	00 to 99		
	Timer Unit	0.01s, 0.1s, 1s, 1 min		
Timer Tfs	Value	00 to 99		
	Timer Unit	0.01s, 0.1s, 1s, 1 min		

Note 1. Default Setting

Link Words for Data Shared by the PSB and PLC

Specifies a data area which is shared between the PLC and the PSB. The settings for Link Words are as follows.

- Word area in the PLC
  This specifies the PLC area type to be used as link words.
- First link word
  This specifies the first word of the link words.
- Total number of link words
  This specifies the total number of link words.

The Area and Range settings depend upon the PLC selected. If no PLC is selected, the values shown in the following table are used by default.

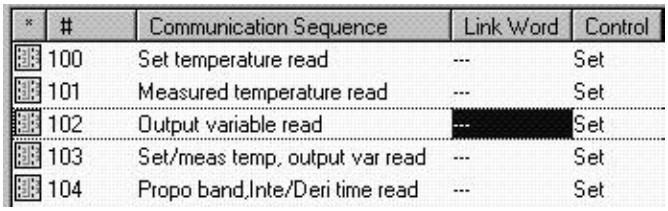
Area	Range
CIO	000 to 511
LR	00 to 63
HR	00 to 99
AR	00 to 27
DM	0000 to 6655
EM	0000 to 6143
None	Not used

Caution Changing the PLC selection may force these settings to become invalid. Invalid settings are not highlighted or checked at download.

Use the following procedure to set the link words for data shared by the PSB and PLC.

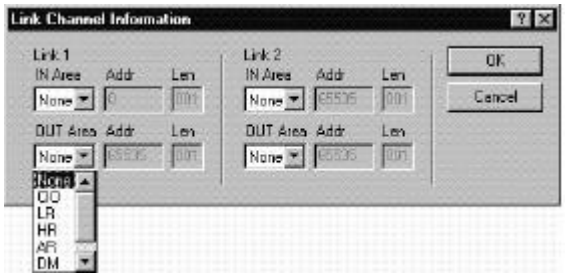
1, 2, 3...

1. Double-left-click on a *Link Word* setting for a sequence. Alternatively, select the *Link Word* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.



*	#	Communication Sequence	Link Word	Control
	100	Set temperature read	---	Set
	101	Measured temperature read	---	Set
	102	Output variable read	---	Set
	103	Set/meas temp, output var read	---	Set
	104	Propo band,Inte/Deri time read	---	Set

The Link Word Information dialog is displayed.



2. For link words required for received data, select the Area from the *IN Area* drop-down list.
3. Select the effective address of the first word of the link words to receive data in the *IN Addr* field.
4. Select the total number of words to be allocated from the first word that stores the received data in the *IN Len* field. This value must be less than 128 bytes.
5. Repeat steps 2 to 4 for the *OUT Area* drop-down list, *OUT Addr* field and *OUT Len* field for link words used for send data. The *Len* value must be less than 128 bytes.
6. Repeat steps 2 to 5 if a second link word is required.
7. Select the **OK** push-button to accept the settings, or select the **Cancel** push-button to leave the settings unchanged.

Transmission Control Method

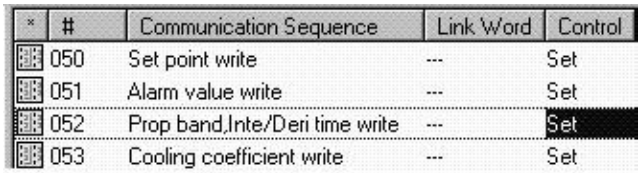
Five transmission control methods are available as indicated in the following table. Set the same transmission control method as that specified by the external device (communications partner).

Transmission control	Function
RTS/CTS flow control	Controls data flow using signals called RTS and CTS so that the data size does not exceed the buffer size when a large amount of data is transmitted.
Xon/Xoff flow control	Controls data flow using the Xon code (13H) and Xoff code (11H) so that the data size does not exceed the buffer size when a large amount of data is transmitted.
Modem control (default setting)	Used for handshaking with a modem. This transmission control method is also used for 1:N connection on a RS422/485 transmission line.
Contention control	Used to obtain the transmission right in point to point contention communications (SECS protocol, etc.).
Delimiter control	Used to transmit a large amount of data by delimiting the data into multiple frames using a delimiter.

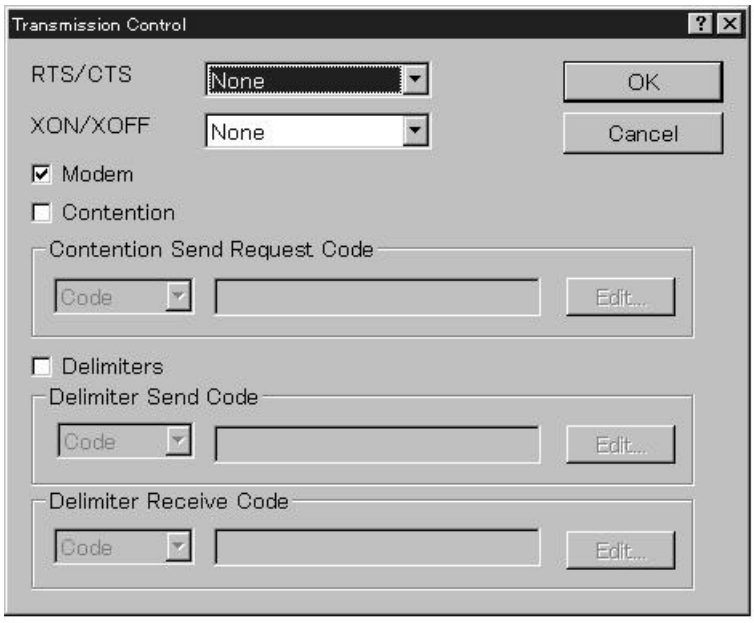
Use the following procedure to set the transmission control method for a sequence.

1, 2, 3...

1. Double-left-click on a *Control* setting for a sequence. Alternatively, select the *Control* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.



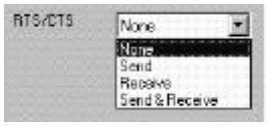
2. The Transmission Control dialog is displayed.



Amend the transmission control settings as appropriate (these are discussed in the following paragraphs).

3. Select the **OK** push-button to accept the settings, or the **Cancel** push-button to leave the settings unchanged.

RTS/CTS
Data can be transmitted through RTS/CTS flow control. Select a RTS/CTS control method from the drop-down list.



If the *RTS/CTS* field is set to 'None', RTS/CTS flow control is not performed.

If the *RTS/CTS* field is set to 'Send', RTS/CTS flow control is performed only when sending.

If the *RTS/CTS* field is set to 'Receive', RTS/CTS flow control is performed only when receiving.

If the *RTS/CTS* field is set to 'Send & Receive', RTS/CTS flow control is performed for both send and receive processing.

XON/XOFF
Data can be transmitted through Xon/Xoff flow control. Select an Xon/Xoff control method from the drop-down list: None, Send, Receive and Send & Receive are available.

If the *XON/XOFF* field is set to 'None', Xon/Xoff flow control is not performed.

If the *XON/XOFF* field is set to 'Send', Xon/Xoff flow control is performed only when sending.

If the *XON/XOFF* field is set to 'Receive', Xon/Xoff flow control is performed only when receiving.

If the *XON/XOFF* field is set to *Send & Receive*, Xon/Xoff flow control is performed for both send and receive processing.

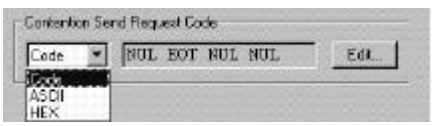
Modem
Data can be transmitted through modem control. Select the *Modem* check box to either enable or disable modem control.

If the *Modem* check box is not set, modem control is not performed. If the *Modem* check box is set, modem control is performed.

Contention
Data can be transmitted under contention control. Select the Contention check box to either enable or disable contention control.

If the *Contention* check box is not set, contention control is not performed.

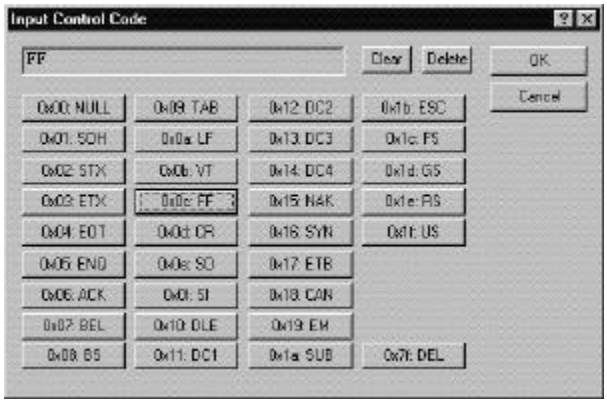
If the *Contention* check box is set, contention control is performed. This means that in order to obtain the right to send, a 'send request code' must be transmitted.



A send request code can be sent as Code, ASCII or Hexadecimal. The send request code can be selected from the drop-down list.

[Code]

If the send request code is set to 'Code', a control code is used as the send request code. Select the **Edit...** push-button to construct the control code.

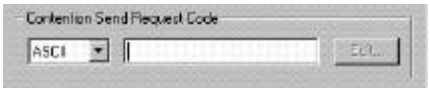


The Input Control Code dialog is displayed. Select a push-button associated with one of the special codes. Up to four special codes may be entered, these appear at the top of the dialog. If a fifth special code is entered, the oldest entry is lost. Any of the four codes can be directly amended by selecting the codes. This inserts a cursor: the amended code is inserted at this point. Select the **Clear** push-button to clear all special codes and start again. Select the **Delete** push-button to delete the last special code entered. Select the **OK** push-button to accept the special codes entered or the **Cancel** push-button to leave the settings unchanged.

Accepted codes are subsequently displayed in the Transmission Control dialog.

[ASCII]

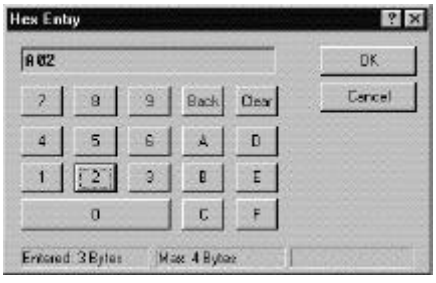
If the send request code is set to 'ASCII', ASCII characters are used as the send request code.



Type in ASCII characters (up to four characters) in the associated field to be sent as the send request code and press Tab.

[HEX]

If the send request code is set to 'HEX', hexadecimal digits are used as the send request code. Select the **Edit...** push-button to construct the HEX data.



The HEX Entry dialog is displayed. Select a push-button associated with one of the Hexadecimal digits or press 0 to 9, A to F. Up to eight digits may be entered, these appear at the top of the dialog. A zero is added to a Hex entry for an odd number of digits entered. If the buffer is full, the values are shifted left and the truncating indicator in the status bar is momentarily displayed. Any of the eight digits can be directly amended by selecting the digits to insert a cursor. The next

digit entered is inserted at this point. Select the **Clear** push-button to clear all digits and start again. Select the **Back** push-button to delete the last digit entered. Select the **OK** push-button to accept the digits entered or the **Cancel** push-button to leave the settings unchanged.

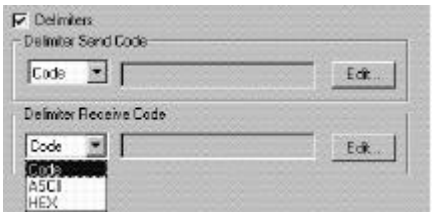
Accepted codes are subsequently displayed in the Transmission Control dialog.

Delimiters

Data can be transmitted through delimiter control. Select the *Delimiters* check box to either enable or disable delimiter control.

If the *Delimiters* check box is not set, delimiter control is not performed.

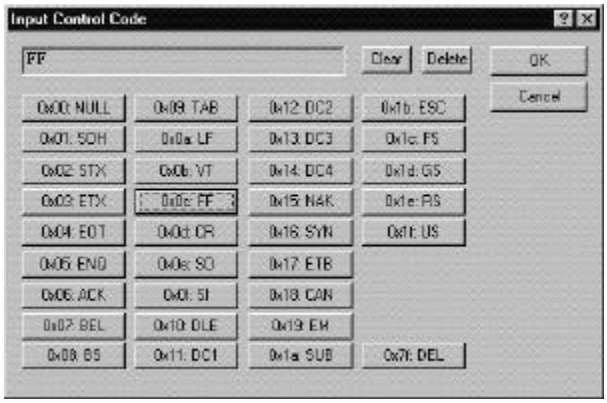
If the *Delimiters* check box is set, delimiter control is performed.



The delimiter set in the send and receive code can be specified as Code, ASCII or Hexadecimal. These can be selected from the *Delimiter Send Code* and *Delimiter Receive Code* drop-down lists.

[Code]

If a delimiter code is set to ‘Code’, a control code is used as the send request code. Select the **Edit...** push-button to construct the code.



The Input Control Code dialog is displayed. Select a push-button associated with one of the special codes. Up to four special codes may be entered, these appear at the top of the dialog. If a fifth special code is entered, the oldest entry is lost. Any of the four codes can be directly amended by selecting the codes. This inserts a cursor. The amended code is inserted at this point. Select the **Clear** push-button to clear all special codes and start again. Select the **Delete** push-button to delete the last special code entered. Select the **OK** push-button to accept the special codes entered or the **Cancel** push-button to leave the settings unchanged.

Accepted codes are subsequently displayed in the Transmission Control dialog.

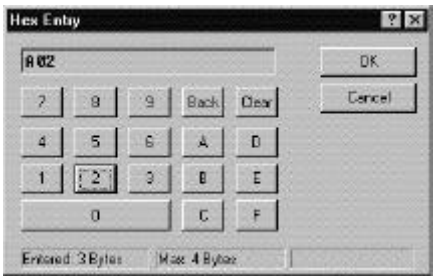
[ASCII]

If a delimiter code is set to ‘ASCII’, ASCII characters are used as the code.

Type in ASCII characters (up to four characters) in the associated field to be sent as the delimiter code and press Tab.

[HEX]

If a delimiter code is set to 'HEX', hexadecimal digits are used as the code. Select the **Edit...** push-button to construct the HEX data.



The HEX Entry dialog is displayed. Select a push-button associated with one of the Hexadecimal digits or press 0 to 9, A to F. Up to eight digits may be entered, these appear at the top of the dialog. A zero is added to a Hex entry for an odd number of digits entered. If the buffer is full, the values are shifted left and the truncating indicator in the status bar is momentarily displayed. Any of the eight digits can be directly amended by selecting the digits to insert a cursor. The next digit entered is inserted at this point. Select the **Clear** push-button to clear all digits and start again. Select the **Back** push-button to delete the last digit entered. Select the **OK** push-button to accept the digits entered or the **Cancel** push-button to leave the settings unchanged.

Accepted codes are subsequently displayed in the Transmission Control dialog.

Response Type

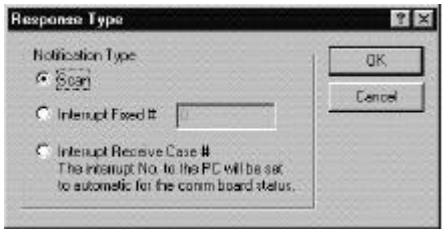
Use the following procedure to set the timing for writing data that was received and the notification method of it to the PLC. This setting is valid only when the write area is indicated in the third operand of the PMCR instruction and Yes is specified for the setting of the With/Without response writing. The Notification Types Scan, Interrupt mode: Fixed # and Interrupt mode: Receive Case # are available.

1, 2, 3...

1. Double-left-click on a *Response* setting for a sequence. Alternatively, select the *Response* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.

*	#	Communication Sequence	Link Word	Control	Response
	050	Set point write	---	Set	Scan
	051	Alarm value write	---	Set	Scan
	052	Prop band,Inte/Deri time write	---	Set	Scan
	053	Cooling coefficient write	---	Set	Scan
	054	Dead band write	---	Set	Scan

2. The Response Type dialog is displayed.



Select an option button: *Scan mode*, *Interrupt mode: Fixed #* or *Interrupt mode: Receive Case #* option button. Additionally, if the *Interrupt mode: Fixed #* option button is set, specify an interrupt program number between 0 and 255 in the corresponding field.

Scan mode
The timing of writing received data in the memory area of the PLC depends on the PLC scan (receive processing and write processing are performed asynchronously).

Interrupt mode: Fixed #
An interrupt is issued for the PLC whenever data is received and immediately written to the memory area. In this case, the executed interrupt program number is a Fixed number (0 to 255).

Interrupt mode: Receive Case #
An interrupt is issued for the PLC whenever data is received and received data is immediately written to the memory area. In this case, the executed interrupt program number (0 to 255) is automatically calculated according to the execution state of the PSB.

The interrupt program number is calculated as follows:
Upper digit (HEX): Step No. of executed sequence
Lower digit (HEX): Step No. of executed receive matrix

Example: Interrupt number is 2B (HEX) = 43 (dec)
when receive matrix case 11 (0BH) is executed for step 2 (02H)

Lower digit is 0 when receive matrix is not used.

By creating an interrupt program according to the calculation expression described above, the related interrupt program can be executed according to the execution state of the PSB.

3. Select the **OK** push-button to accept the settings, or the **Cancel** push-button to leave the settings unchanged.

Monitor Times for Message Processing

The following procedure can be used to set monitor times for transmission processing. Four units of time can be enabled and the precision is 1 ms maximum. When the time exceeds the monitor time, the retry process and error process for each step is performed.

Monitor Time Ranges
The following table lists the units and ranges of monitor times that can be set.

Time Unit	Value
0.01 s (10 ms)	00 to 99
0.1 s (100 ms)	00 to 99
1 s	00 to 99
1 min	00 to 99

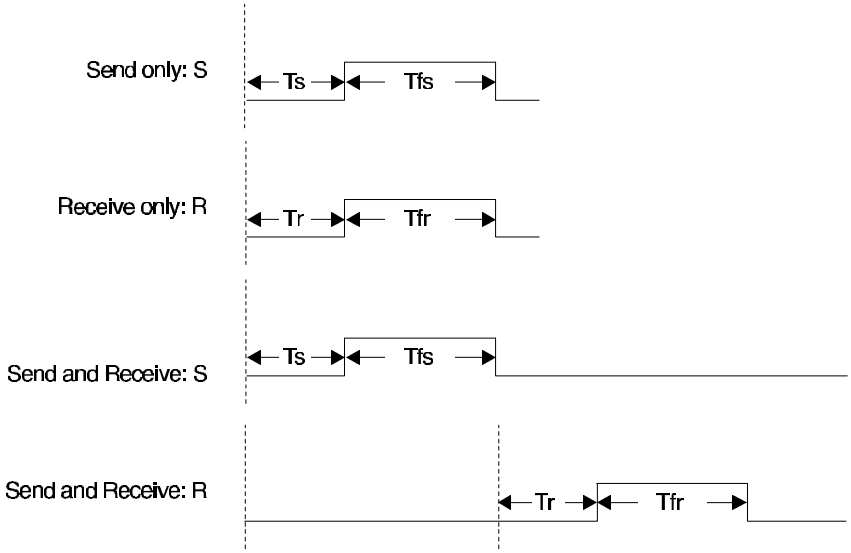
Contents Monitored

The following table lists the items that can be set for monitoring.

Type	Contents
Receive wait time: Tr	Monitors the time until the first byte (start character) is received after the receive command of the step is recognised.
Receive finish time: Tfr	Monitors the time from reception of the first byte (start character) to reception of the last byte of the data (end character).
Send finish time: Tfs	Monitors from transmission of the first byte (start character) to transmission of the last byte of the data (end character).

Monitor Time Timing Chart

The monitor time timing chart for each send and receive process is shown below:



1, 2, 3... 1. Double-left-click on a timing setting for a sequence, either *Timer Tr*, *Timer Tfr* or *Timer Tfs*. Alternatively, select the timing setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.

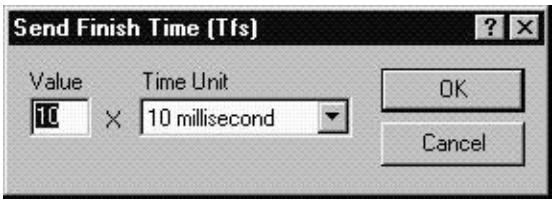
*	#	Communication Sequence	Timer Tr	Timer Tfr	Timer Tfs
	100	Set temperature read	3 sec	3 sec	3 sec
	101	Measured temperature read	3 sec	3 sec	3 sec
	102	Output variable read	3 sec	3 sec	3 sec
	103	Set/meas temp, output var read	3 sec	3 sec	3 sec
	104	Propo band,Inte/Deri time read	3 sec	3 sec	3 sec

2. The dialog for the appropriate timing setting is displayed.

   For receive wait time, Tr, set in the *Value* field a monitor time (0 to 99) from recognition of a receive command to reception of the first byte of data (start character).

   For receive finish time, Tfr, set in the *Value* field a monitor time (0 to 99) from reception of the first byte of the data (start character) to the last byte of the data (end character).

For send finish time, Tfs, set in the *Value* field a monitor time (0 to 99) from the transmission of the first byte of the data (start character) to the last byte of the data (end character).



3. Set a time unit in the *Time Unit* field.
4. Select the **OK** push-button to accept the settings, or the **Cancel** push-button to leave the settings unchanged.

Note Send Wait Time (Ts) is defined in a step, refer to *Section 7-3-4 Edit a Step*.

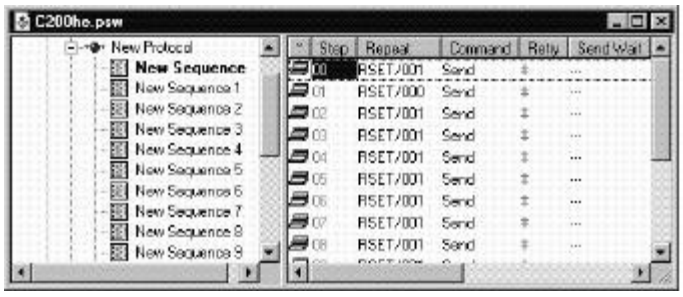
7-3-3 Edit Step List

Display the Step List

Use the following procedure to display the steps within a sequence list.

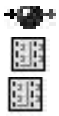
1, 2, 3...

1. Double-left-click on the protocol icon to show all sequences within the protocol. Alternatively, select the protocol in the left pane.
2. Double-left-click on a sequences icon button to show all steps within a sequence. Alternatively, select the sequence in the left pane.



Create a New Step in the Step List

Use the following procedure to create a new step in the sequence.



1, 2, 3...

1. Select the protocol icon.
2. Select the sequence to which to add a new step.
3. Select the sequence icon in the left pane, or more than one step in the right pane, or a free area outside the step list in the right pane, with the right mouse button and select *Create Step...*.

Edit the Step List

The order of the steps can be changed by moving a selected step. Use the following buttons to change the order of the steps.

Note Step lists belonging to “System” type protocol cannot be changed.

Select a step and use the **Up** button on the toolbar to move the step up one.

Select a step and use the **Down** button on the toolbar to move the step down one.

Select a step and use the **Top** button on the toolbar to move the step as the first step.

Select a step and use the **Bottom** button on the toolbar to move the step as the last step.

Note It is possible to move a step by selecting the step and dragging it to the position to which the step is to be moved.

Delete/Cut/Copy/Paste Steps in the Step List

Use the following procedure to delete a step.

Note Steps within "System" type protocols cannot be deleted.

1, 2, 3...

1. Select the icon of the step to be deleted. More than one step can be selected by pressing Shift and selecting another step to extend the selection, or by pressing Ctrl and selecting another step to add to the selection.

2. Select the **Delete** button from the toolbar or press Delete. Alternatively, select *Delete* from the right mouse button dialog or select *Delete* from the *Edit* menu or press Alt+E followed by D. Select the **OK** push-button from the confirmation dialog to confirm deletion or the **Cancel** push-button to cancel the deletion.


A step can also be deleted by selecting the **Cut** button from the Toolbar or pressing Ctrl+X or press Alt+E followed by T. Alternatively, select *Cut* from the right mouse button dialog or *Cut* from the *Edit* menu. Select the **Paste** button from the Toolbar or press Ctrl+V or press Alt+E followed by P to retrieve the last delete action using the Cut operation. Alternatively, select *Paste* from the right mouse button dialog or *Paste* from the *Edit* menu. The pasted steps are placed at the end of the appropriate sequence and are given the next available step numbers.

Ensure that another Copy or Cut operation does not take place during this procedure as this erases the current copy operation.

Use the following procedure to copy and paste a step.

1, 2, 3...

1. Select the icon of the step to be copied. More than one step can be selected by pressing Shift and selecting another step to extend the selection, or by pressing Ctrl and selecting another step to add to the selection.

2. Select the **Copy** button from the Toolbar or press Ctrl+C or press Alt+E followed by C. Alternatively, select *Copy* from the right mouse button dialog or select *Copy* from the *Edit* menu.

3. Select a sequence or display the step list in the right pane into which to paste the copied Step or Steps.

4. Select the **Paste** button from the Toolbar or press Ctrl+V or press Alt+E followed by P. Alternatively, select *Paste* from the right mouse button dialog or *Paste* from the *Edit* menu. The pasted steps are placed at the end of the appropriate sequence and are given the next available step numbers.

Note

1. Once a step has been pasted, the referred message data within the step is lost.
2. It is not possible to paste all the steps if the number of steps exceeds the maximum of 16.

7-3-4 Edit a Step

The settings that can be made for step attributes using SYSMAC-PST are shown in the following table.

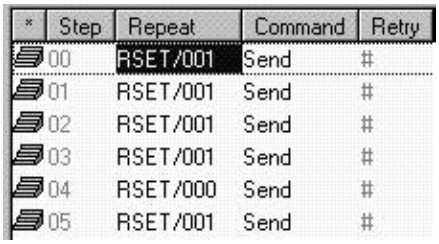
Attribute	Content	
Repeat	Type	Reset / Hold (Reserve)
	Counter	Constant (1 to 255)
		Channel
Command	Send, Receive, Send & Receive	
Retry	0 to 9	
Send Wait	Value	00 to 99
	Time Unit	0.01s, 0.1s, 1s, 1 min
Send Message	Refer to *Section 8, Editing Send & Receive Messages and Receive Matrices*	
Receive Message	Refer to *Section 8, Editing Send & Receive Messages and Receive Matrices*	
Response	Yes, No	
Next	End, Next, Goto, Abort	
Error	End, Next, Goto, Abort	

Message Repeat Counter

Set the number of times the step is to be repeated. The count can be set by entering a constant (1 to 255) or by specifying the address of a word, the content of which is the count (without conversion). When a constant is set in the repeat counter, the value of counter N will be incremented whenever the step is executed. The Repeat Types of Reset, Hold (Reserve) are available. The Counter of Constant (1 to 255) or Channel are available.

1, 2, 3...

1. Double-left-click on a *Repeat* setting for a step. Alternatively, select the *Repeat* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.



*	Step	Repeat	Command	Retry
	00	RSET/001	Send	#
	01	RSET/001	Send	#
	02	RSET/001	Send	#
	03	RSET/001	Send	#
	04	RSET/000	Send	#
	05	RSET/001	Send	#

2. The Repeat Counter Information dialog is displayed.

Select a repeat type from the *Type* drop-down list.

If the 'Reset' option is selected, the step is executed the specified number of times after the value of counter N is initialized to 0.

If the 'Hold (Reserve)' option is selected, the step is executed the specified number of times while retaining the current value of counter N.

3. To specify a repeat counter, select the *Constant* option button and enter the number of times (1 to 255) the step is to be repeated in the *Constant* field.

   To specify a word address, select the *Channel* option button and select the **Edit...** push-button to construct the word address.

The Channel dialog is displayed.

Note The maximum number of EM banks that can be specified in the EM Bank # field is dependent on the PLC selected.

Amend the settings as necessary, described following, and select the **OK** push-button to accept the settings from the Channel dialog, or the **Cancel** push-button to leave the settings unchanged.

4. Select the **OK** push-button to accept the settings from the Repeat Counter Information dialog, or the **Cancel** push-button leave the settings unchanged.

When specifying a word address, the address types that can be selected from the *Address* drop-down list are 'Channel', 'I1', 'I2', 'O1', 'O2' or 'Operand'. If Channel is selected as the Address Type, a setting in the *Area* drop-down list and a value for the *Channel #* field are required.

For a Send Message, the *Area* and *Channel #* settings should correspond to the area specified in the second operand of the PMCR instruction and the effective address of the first word.

For a Receive Message, the *Area* and *Channel #* settings should correspond to the area specified in the third operand of the PMCR instruction and the effective address of the first word.

The parameters for the *Primary Expression (yN+x)* fields define the channel offset.

Command

Set one of the following three transmission commands for execution in a step.

Send
The send messages set in the step are sent.

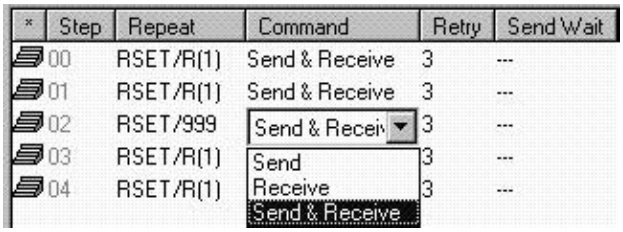
Receive
The receive messages that were set in the step, or messages that were sent based on the receive matrix, are received.

Send & Receive
After the send messages that were set in the step are sent, the receive messages that are set in the step and the messages that were sent based on the receive matrix are received.

The following table lists the items that can be set for each command.

Setting item		Command		
		Send	**Receive**	**Send & Receive**
Sequence	Link words	Yes	Yes	Yes
	Receive wait time: Tr	---	Yes	Yes
	Receive finish time: Tfr	---	Yes	Yes
	Send finish time: Tfs	Yes	---	Yes
	Response Type	---	Yes	Yes
	Transmission control	Yes	Yes	Yes
Step	Repeat counter	Yes	Yes	Yes
	Retry count	No	No	Yes
	Send wait time	Yes	No	Yes
	Send messages	Yes	No	Yes
	Receive messages	No	Yes	Yes
	With/Without Response Writing	Yes	Yes	Yes
	Next process No.	Yes	Yes	Yes
	Error process No.	Yes	Yes	Yes

1, 2, 3... 1. Double-left-click on a *Command* setting for a step. Alternatively, select the *Command* setting and press Return or select the *Command* setting and select *Field* from the *Edit* menu or press Alt+E followed by F.



2. Select the appropriate transmission command from the drop-down list and press Return or select *Accept* from the *Edit* menu or press Alt+E followed by A.

Retry Count

A retry count is valid only when Send & Receive is set for the transmission commands. When a retry occurs, the current step is re-executed. When the step is executed for the specified number of retries, control is passed to the error process if a retry occurs again.

Allowed retry counts

0 to 9 (when 0 is specified, no retries are executed).

Retry factors

- The send finish time has been reached.
- The receive wait time has been reached.
- The receive finish time has been reached.
- A transmission error occurred during receive processing (a factor that turned CIO28304 or CIO28312 ON).
- A message, excepting the message set in receive messages, is received.
- An error occurred in the Error Check code.

Note For retries, send processing is executed regardless of the wait time.

1, 2, 3...

1. Double-left-click on a *Retry* setting for a step. Alternatively, select a *Retry* setting for a step and press Return or select the *Retry* setting and select *Field* from the *Edit* menu or press Alt+E followed by F.

2. Enter the number of retries (0 to 9) and press Return or select *Accept* from the *Edit* menu or press Alt+E followed by A.

   If an illegal number is entered, the original number of retries is displayed once the count has been set.

Send Wait Time: Ts

Set the time to be waited until a send message is sent for send processing. The counting of a wait time starts from the following point and the accuracy is 10 ms maximum.

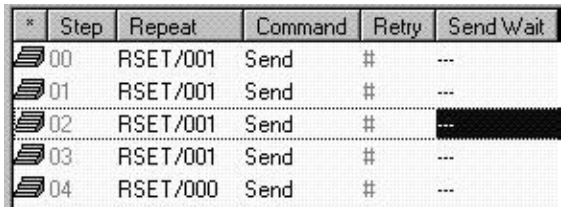
- Send or Send & Receive of the step is recognized.
- The entire processing has completed when repetition is specified for the step.

The send wait time setting range is from 0 to 99 (0: no wait). The setting unit can be selected from the following four types.

Time Unit	Value
0.01 s (10 ms)	00 to 99
0.1 s (100 ms)	00 to 99
1 s	00 to 99
1 min	00 to 99

1, 2, 3...

1. Double-left-click on a *Send Wait* setting for a step. Alternatively, select the *Send Wait* setting for a step and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.



2. The Send Wait Time (Ts) dialog is displayed.

Set a time value in the *Value* field.

3. Set a time unit in the *Time Unit* field.
4. Select the **OK** push-button to accept the settings, or the **Cancel** push-button to leave the settings unchanged.

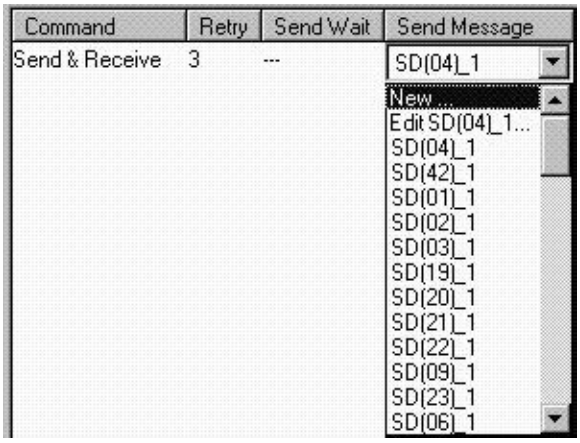
Send Message

Select a Message from the Send Message List

Use the following procedure to select a send message reference for a step. This setting is only valid for a step whose command is Send or Send & Receive.

1, 2, 3...

1. Double-left-click on a *Send Message* setting for a step. Alternatively, select the *Send Message* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.



2. Select a send message reference from the drop-down list and press Return or select *Accept* from the *Edit* menu or press Alt+E followed by A.

The send message references are taken from the send message list, located after the sequences in a protocol. Use the procedures described in the following paragraphs for amending send messages in the context of a step. Refer to *Section 8 Editing Send & Receive Messages and Receive Matrices* for further information.

Create a New Send Message

Use the following procedure to create a new send message.

1, 2, 3...

1. Double-left-click on a *Send Message* setting for a step. Alternatively, select the *Send Message* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.
2. Select the *New...* option from the drop-down list and press Return or select *Accept* from the *Edit* menu or press Alt+E followed by A.
3. The Message Data dialog is displayed. Type in a message name in the *Message Name* field.
4. Create the message as appropriate. Refer to *Section 8 Editing Send & Receive Message and Receive Matrices* for details on how to construct a message.
5. Click the **OK** push-button to accept the settings. Click the **Cancel** push-button to leave the settings unchanged.

Edit an Existing Send Message

Use the following procedure to edit a message from the send message list.

1, 2, 3...

1. Double-left-click on a *Send Message* setting for a step. Alternatively, select the *Send Message* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.
2. Select the send message from the drop-down list.
3. Select *Accept* from the *Edit* menu or press return, or press Alt+E followed by A.
4. The *Edit....* item in the drop-down list includes the name of the selected message.
5. Select *Edit....* followed by the message name from the drop-down list and press Return or select *Accept* from the *Edit* menu or press Alt+E followed by A.
6. The Message Data dialog is displayed. Edit the message as appropriate. Refer to *Section 8 Editing Send & Receive Message and Receive Matrices* for details on how to construct a message.

7. Click the **OK** push-button to accept the settings. Click the **Cancel** push-button to leave the settings unchanged.

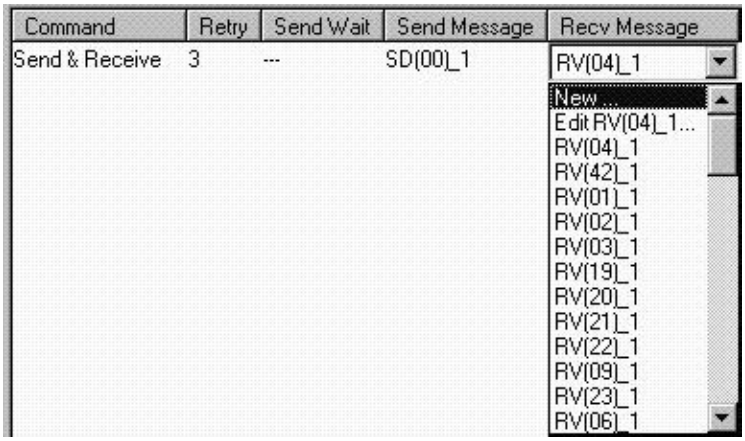
Receive Message/Receive Matrix

Select a Message or Matrix from the Receive Message List

Use the following procedure to select a receive message reference for a step. This setting is only valid for a step whose command is Receive or Send & Receive.

1, 2, 3...

1. Double-left-click on a *Receive Message* setting for a step. Alternatively, select the *Receive Message* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.



2. Select a receive message reference from the drop-down list and press Return or select *Accept* from the *Edit* menu. A receive matrix can also be selected from this drop-down list.

The receive message or receive matrix references are respectively taken from the receive message list or receive matrix list, located after the sequences in a protocol. Use the procedures described in the following paragraphs for amending receive messages in the context of a step. Refer to *Section 8 Editing Send & Receive Messages and Receive Matrices* for further information.

Note It is not possible to create a new receive matrix from the reference.

Create a New Receive Message

Use the following procedure to create a new receive message.

1, 2, 3...

1. Double-left-click on a *Receive Message* setting for a step. Alternatively, select the *Receive Message* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.
2. Select the *New...* option from the drop-down list and press Return or select *Accept* from the *Edit* menu or press Alt+E followed by A.
3. The Message Data dialog is displayed. Type in a message name in the *Message Name* field.
4. Create the message as appropriate. Refer to *Section 8 Editing Send & Receive Message and Receive Matrices* for details on how to construct a message.
5. Click the **OK** push-button to accept the settings. Click the **Cancel** push-button to leave the settings unchanged.

Edit a Receive Message or Receive Matrix

Use the following procedure to edit an existing receive message or receive matrix.

1, 2, 3...

1. Double-left-click on a *Receive Message* setting for a step. Alternatively, select the *Receive Message* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.
2. Select the receive message from the drop-down list.

3. Select *Accept* from the *Edit* menu and press Return, or press Alt+E followed by A
4. The *Edit....*item in the drop-down list includes the name of the selected message.
5. Select *Edit....*followed by the message name from the drop-down list and press Return or select *Accept* from the *Edit* menu or press Alt+E followed by A.
6. The Message Data dialog is displayed. Edit the message as appropriate. Refer to *Section 8 Editing Send & Receive Message and Receive Matrices* for details on how to construct a message.
7. Click the **OK** push-button to accept the settings. Click the **Cancel** push-button to leave the settings unchanged.

Create a New Receive Matrix

1, 2, 3...

1. Select the protocol icon in the right pane or a free area in the right pane with the right mouse button, outside the sequence list, Send Message list, Receive Message list or matrix list, and select *Create Matrix*. Alternatively, select the matrix list or more than one sequence in the right pane and select *Create Matrix* from the right mouse button menu.

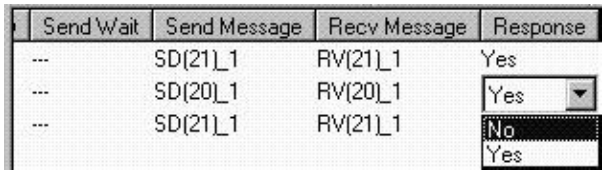
With/Without Response Writing Required

Set whether received data are to be stored in PLC memory. This setting is valid only when received data are stored by the third operand of the PMCR instruction.

- Response: Yes. Received data is stored in PLC memory. A Response Type must be set in the sequence list attributes.
- Response: No. Received data is Read-only (not stored in memory).

1, 2, 3...

1. Double-left-click on a With/Without *Response* Writing setting for a step. Alternatively, select the *Response* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.



2. Select either 'Yes' or 'No' from the drop-down list and press Return or select *Accept* from the *Edit* menu or press Alt+E followed by A.

Next Process

Use the following procedure to set the next transit step.

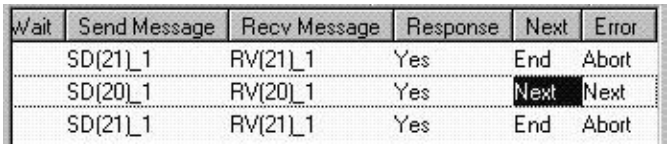
If a receive matrix is set for the receive message, control is passed to the next step based on the next process set in the receive matrix.

The following four types of contents can be set.

Next process	Processing details
End	When this step is terminated, the sequence is terminated.
Next	When this step is terminated, the next step is executed.
Goto **	When this step is terminated, control is passed to the step number specified in **.
Abort	When this step is terminated, the step is aborted and the sequence is terminated.

Note If the position of a case with a Goto # instruction is changed or the position of a case referenced by a Goto # instruction is changed, the corresponding Goto number is automatically updated.

1, 2, 3... 1. Double-left-click on a *Next* setting for a step. Alternatively, select the *Next* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.



Wait	Send Message	Recv Message	Response	Next	Error
	SD(21)_1	RV(21)_1	Yes	End	Abort
	SD(20)_1	RV(20)_1	Yes	Next	Next
	SD(21)_1	RV(21)_1	Yes	End	Abort

2. The Next Process dialog is displayed.

Select the next process from the *Jump* option buttons. In the event of 'Goto' being selected, enter a case number in the corresponding field. The *Next* option cannot be selected for the last step.

3. Select the **OK** push-button to accept the settings, or the **Cancel** push-button to leave the settings unchanged.

Error Process

Use the following procedure to set the next transit step when the step is terminated abnormally. When a step is terminated normally, control is passed to the next step based on the specification of the next process.

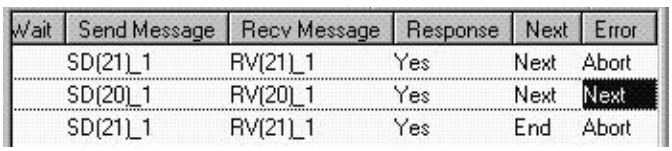
If a receive matrix is also set in a receive message, control is passed to the next step based on the setting in the error process for error termination.

The following four types of contents can be set.

Error process	Processing details
End	When this step is abnormally terminated, the sequence is terminated.
Next	When this step is abnormally terminated, the next step is executed.
Goto **	When this step is abnormally terminated, control is passed to the step number specified in **.
Abort	When this step is abnormally terminated, the step is aborted and the sequence is terminated.

Note If the position of a case with a Goto # instruction is changed, or the position of a case referenced by a Goto # instruction is changed, the corresponding Goto number is automatically updated.

1, 2, 3... 1. Double-left-click on an *Error* setting for a step. Alternatively, select the *Error* setting and press Return or select *Field* from the *Edit* menu, or press Alt+E followed by F.



Wait	Send Message	Recv Message	Response	Next	Error
	SD(21)_1	RV(21)_1	Yes	Next	Abort
	SD(20)_1	RV(20)_1	Yes	Next	Next
	SD(21)_1	RV(21)_1	Yes	End	Abort

2. The Error Process dialog is displayed.

Select the next process from the *Jump* option buttons. In the event of 'Goto' being selected, enter a case number in the corresponding field. The *Next* option cannot be selected for the last step.

3. Select the **OK** push-button to accept the settings, or the **Cancel** push-button to abort the operation.

SECTION 8
Editing Send & Receive Messages and Receive Matrices

This section describes editing and managing send/receive messages and receive matrices.

8-1 Edit a Message

8-1-1 Display a Message

Use the following procedure to display a message within the message list.

1, 2, 3...

1. Double-left-click on the protocol list to show all protocols.
2. Double-left-click on the protocol containing the send and receive message lists, located after the sequences.
3. Double-left-click on the send message list icon or receive message list icon to display all messages in the right pane.

Each setting associated with a message can be edited. The Copy and Paste operations can be used to set the same settings of one of the messages already in existence, or to set similar settings of one of the messages already in existence. Refer to *Section 8-2-3 Cut/Copy/Paste Messages in a Message List* for further information.

8-1-2 Amend a Message

The settings that can be made for messages using SYSMAC-PST are shown in the following table.

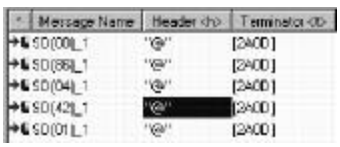
Attribute	Content	
Header <h>	Type	None, Code, ASCII, HEX
	Data	
Terminator <t>	Type	None, Code, ASCII, HEX
	Data	
Check Code <c>	Type	None, LRC, CRC-CCITT, CRC-16, SUM (1 byte), SUM (2 bytes), SUM2 (1 byte), SUM2 (2 bytes)
	Default	0 to 255 if Type is LRC, SUM (1 byte), SUM2 (1 byte) 0 to 65535 if Type is SUM (2 bytes), SUM2 (2 bytes) or CRC-16. Not applicable for CRC-CCITT.
	Conversion	Reverse Order
		Data Type: BIN, ASCII
Length <l>	Type	None, 1 byte, 2 bytes
	Default	0 to 255 if Type is 1 byte; 0 to 65535 if Type is 2 bytes
	Conversion	BIN, ASCII
Address <a>	Type	None, Constant, ASCII, Constant HEX, Variable, Variable ASCII, Variable HEX, Variable (Reverse), Variable ASCII (Reverse), Variable HEX (Reverse)
	Data	
Data	Message Part	

Header <h>

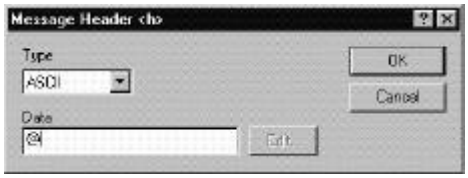
Use the following procedure to set the Header (data that indicates the beginning of the message). Data types ASCII, HEX and Code are available.

1, 2, 3...

1. Double-left-click on a *Header <h>* setting for a message. Alternatively, select the *Header <h>* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.



2. The Message Header <h> dialog is displayed.

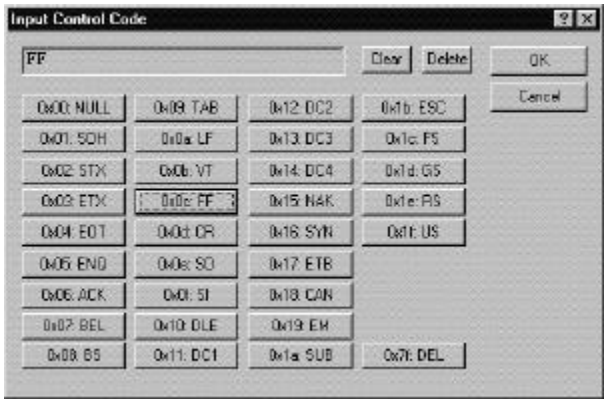


Select a header type in the *Type* drop-down list (refer to Code, ASCII and HEX following) and set Data field.

3. Select the **OK** push-button to accept the settings, or the **Cancel** push-button to leave the settings unchanged.

None
If 'None' is selected in the *Type* drop-down list, no data is set to a header.

Code
If 'CODE' is selected in the *Type* drop-down list, a special code can be assigned to the header by selecting the **Edit...** push-button.



The Input Control Code dialog is displayed. Select a push-button associated with one of the special codes. Up to four special codes may be entered, these appear at the top of the dialog. If a fifth special code is entered, the oldest entry is lost. Any of the four codes can be directly amended by selecting the codes. this inserts a cursor. The amended code is inserted at this point. Select the **Clear** push-button to clear all special codes and start again. Select the **Delete** push-button to delete the last special code entered. Select the **OK** push-button to accept the special codes entered or the **Cancel** push-button to leave the settings unchanged.

Accepted codes entered are subsequently displayed in the *Data* field within the Message Header <h> dialog.

ASCII
If 'ASCII' is selected in the *Type* drop-down list, an ASCII character can be assigned to the header. Type in ASCII characters (up to four characters) in the *Data* field and press Tab.

HEX

If 'HEX' is selected in the *Type* drop-down list, hexadecimal data can be assigned to the header by selecting the **Edit...** push-button.

The HEX Entry dialog is displayed. Select a push-button associated with one of the Hexadecimal digits or press 0 to 9, A to F. Up to eight digits may be entered, these appear in the field at the top of the dialog. A zero is added to a Hex entry for an odd number of digits entered. If the buffer is full, the values are shifted left and the truncating indicator in the status bar is momentarily displayed. Any of the eight digits can be directly amended by selecting the digits to insert a cursor. The next digit entered is inserted at this point. Select the **Clear** push-button to clear all digits and start again. Select the **Back** push-button to delete the last digit entered. Select the **OK** push-button to accept the digits entered or the **Cancel** push-button to leave the settings unchanged.

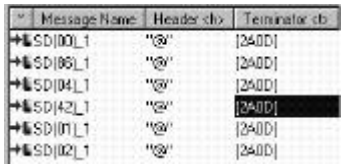
Accepted codes entered are subsequently displayed in the *Data* field within the Message Header <h> dialog.

Terminator <t>

Use the following procedure to set the Terminator (data that indicates the end of the message). The Data types Code, ASCII and HEX are available.

1, 2, 3...

1. Double-left-click on a *Terminator* <t> setting for a message. Alternatively, select the *Terminator* <t> setting and press Return or select *Field* from the *Edit* menu, or press Alt+E followed by F.



2. The Message Terminator <t> dialog is displayed.

Select a terminator type in the *Type* drop-down list and set Data field. (these are discussed in the Header <h> paragraphs previously).

3. Select the **OK** push-button to accept the settings, or the **Cancel** push-button to leave the settings unchanged.

Check Code <c>

Use the following procedure to specify an error check code calculation method. The Check Code types LRC, CRC-CCITT, CRC-16, SUM (1 byte), SUM (2 bytes), SUM2 (1 byte), SUM2 (2 bytes), are available.

1, 2, 3... 1. Double-left-click on a *Check code <c>* setting for a message. Alternatively, select the *Check Code <c>* setting and press Return or select *Field* from the *Edit* menu, or press Alt+E followed byF.

2. The Error Check Code <c> dialog is displayed.

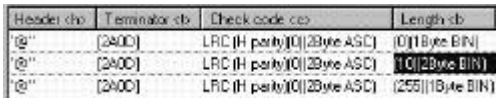
Select a check code type in the *Type* drop-down list. For all types except 'CRC-CCITT' the *Default* fields become active. For all types except 'None', the *Data Type* options become active.

3. For types 'LRC', 'CRC-16', 'SUM (1 byte)', 'SUM (2 byte)', 'SUM2 (1 byte)' and SUM2 (2 bytes), enter the Default number of words for the check code calculation range. For 'LRC', 'SUM (1 byte)' and 'SUM2 (1 byte)' the range is 0 to 255. For 'SUM (2 byte)' and 'SUM2 (2 byte)', 'CRC-16' the range is 0 to 65535.
4. For all types other than 'None', select the *BIN* conversion type or *ASCII* conversion type. For 'LRC', 'SUM (1 byte)' and 'SUM2 (1 byte)', BIN refers to a binary data type (1 word) and ASCII refers to an ASCII data type (2 words). For 'CRC-CCITT', 'CRC-16', 'SUM (2 byte)' and 'SUM2 (2 byte)', BIN refers to a binary data type (2 words) and ASCII refers to an ASCII data type (4 words).
5. Select the *Reverse Order* check box to set the reverse check code. This check box is not applicable if the *Type* setting is 'LRC', 'SUM (1 byte)', 'SUM2 (1 byte)' and the *Data Type* setting is set to *BIN.*
6. Select the **OK** push-button to accept the settings, or the **Cancel** push-button to leave the settings unchanged.

Length <l>

Use the following procedure to set the Length (the number of bytes of the message). The data length is the length following the Length <l> setting in a frame and is calculated automatically at send processing. The Length <l> data is added when sending. The Length types 1 byte or 2 bytes are available. The Conversion types BIN and ASCII are available.

1, 2, 3... 1. Double-left-click on a *Length <l>* setting for a message. Alternatively, select the *Length <l>* setting and press Return or select *Field* from the *Edit* menu, or press Alt+E followed by F.



2. The Message Length <l> dialog is displayed.

Select a length type in the *Type* drop-down list. For '1 Byte', the data size of the length is set to one word. For '2 Bytes', the data size of the length is set to two words.

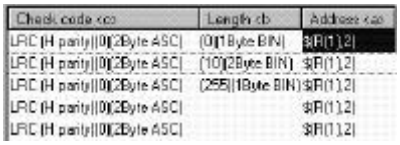
3. Enter the length in the *Default* field. The range is 0 to 255 for '1 Byte' or 0 to 65535 for '2 Bytes'.
4. Select the *BIN* conversion type or *ASCII* conversion type.
5. Select the **OK** push-button to accept the settings, or the **Cancel** push-button to leave the settings unchanged.

Address <a>

Use the following procedure to set the effective address (unit number or other information to be used as the message destination). The effective Address types 'None', 'Constant ASCII', 'Constant HEX', 'Variable', 'Variable ASCII', 'Variable HEX', 'Variable (Reverse)', 'Variable ASCII (Reverse)' and 'Variable HEX (Reverse)' are available.

1, 2, 3...

1. Double-left-click on an *Address <a>* setting for a message. Alternatively, select the *Address <a>* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.

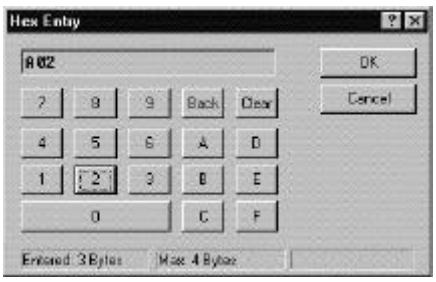


2. The Message Address <a> dialog is displayed.

Select an effective address type in the *Type* drop-down list.

3. For the 'Constant ASCII' type, enter up to four ASCII characters

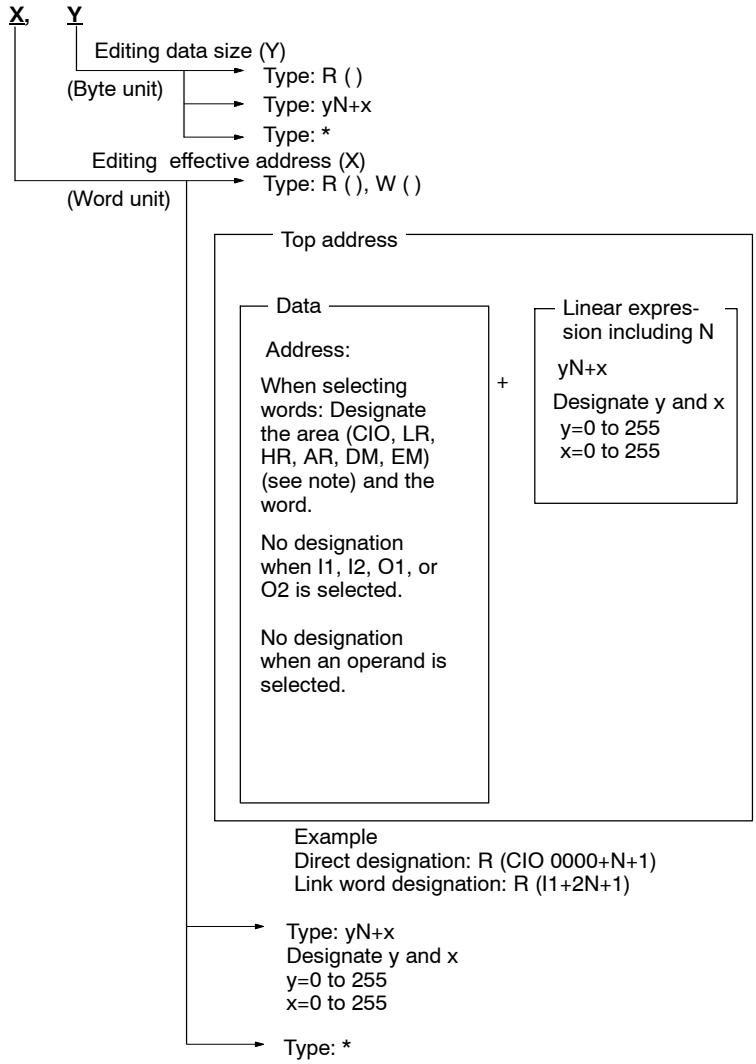
   For the 'Constant HEX' type, select the **Edit HEX...** push-button to enter HEX values into the *Data* field (the **Edit HEX...** push-button appears in place of the **Edit Variable...** push-button and **Edit Length...** push-button).



The HEX Entry dialog is displayed. Select a push-button associated with one of the Hexadecimal digits or press 0 to 9, A to F. Up to eight digits may be entered, these appear at the top of the dialog. A zero is added to a Hex entry for an odd number of digits entered. If the buffer is full, the values are shifted left and the truncating indicator in the status bar is momentarily displayed. Any of the eight digits can be directly amended by selecting the digits to insert a cursor. The next digit entered is inserted at this point. Select the **Clear** push-button to clear all digits and start again. Select the **Back** push-button to delete the last digit entered. Select the **OK** push-button to accept the digits entered or the **Cancel** push-button to leave the settings unchanged.

For the 'Variable' types, compose a data size using the **Edit Variable...** push-button and **Edit Length...** push-button. The Channel dialog is displayed.

Setting of Variables



Note Area code for word designation

CIO:	I/O relay, internal auxiliary relay, and special auxiliary relay
LR:	Link relay
HR:	Holding relay
AR:	Auxiliary memory relay
DM:	Data memory

Setting [Channel] Dialog Box

a) Select Read R ( ) or yN+x in the [Type] field.

b) Select an effective address type (“Channel”, ”I1”, ”I2”, ”O1”, ”O2”, or ”Operand”) from the [Address] drop-down list in the [Data (D)] field. If “Channel” is selected, select an area code (CIO, LR, HR, AR, DM or EMxx) from the [Area] drop-down list. Set a value in the [Channel #] field.

c) Designate an offset from the top word (designated in the above [Data] field) in the [Primary Expression (yN+x)] field. Input y and x.

d) Press the [OK] button to confirm the [Channel] dialog box or [Cancel] button to cancel the process.

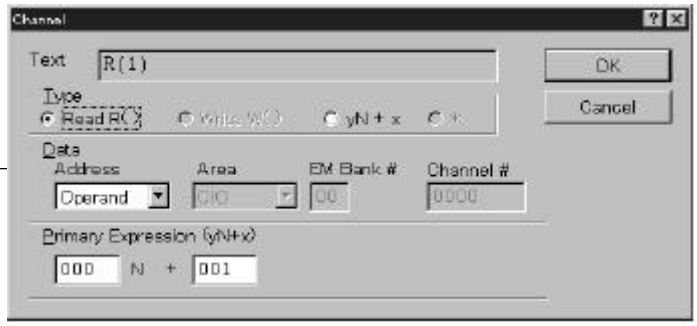
Note If the [EMxx] option is selected from the [Area] drop-down list, be sure to input the bank number (0 to F) in the [EM Bank #] field. The maximum number of the

EM bank that can be designated in the [EM Bank #] field depends on the selected PC.

Address Setting Examples

Variable $(R(1), 2)

Effective Address (X): R (1)



Data size (Y): 2

4. Press the [OK] button to confirm the setting or [Cancel] button to cancel the process.

Note The maximum number of EM banks that can be specified in the *EM Bank #* field is dependant on the PLC selected.

Amend the settings as necessary, described following, and select the **OK** push-button to accept the settings from the Channel dialog, or the **Cancel** push-button to leave the settings unchanged.

5. Select the **OK** push-button to accept the settings from the Message Address <a> dialog, or the **Cancel** push-button to leave the settings unchanged.

When specifying a word address, the address types that can be selected from the *Address* drop-down list are ‘Channel’, ‘I1’, ‘I2’, ‘O1’, ‘O2’ or ‘Operand’. If Channel is selected as the Address Type, a setting in the *Area* drop-down list and a value for the *Channel#* field are required.

For a Send Message, the *Area* and *Channel#* settings should correspond to the area specified in the second operand of the PMCR instruction and the effective address of the first word.

For a Receive Message, the *Area* and *Channel#* settings should correspond to the area specified in the third operand of the PMCR instruction and the effective address of the first word.

The parameters for the *Primary Expression (yN+x)* fields define the channel offset.

Use the following procedure while editing a Send Message.

1, 2, 3...

1. Select the variable type from the *Type* options. If the *Read R ()* option is selected, specify an address type from the ADDRESS drop-down list. *Area* setting and *Channel#* setting.
2. Enter the y and x parameters in the *Primary Expression (yN+x)* fields. If the *Read R()* option is selected, the permitted ranges are as follows:

   If the 'Operand' address type is selected, the y parameter must not exceed 128. If the y parameter is 0, the x parameter must not exceed 128. If the y parameter is greater than 0. the x parameter must not exceed 127.

   If one of the other address types is selected, the x and y parameters must not exceed 127.

   If the yN+x option is selected, the x and y parameters must not exceed 255.

Use the following procedure while editing a Receive Message.

1, 2, 3...

1. Select the variable type from the *Type* options. If the *Read R ()* option or the *Write W ()* option is selected, specify an address type from the *Address* drop-down list. *Area* setting and *Channel#* setting.
2. Enter the y and x parameters in the *Primary Expression (yN+x)* fields. If the *Read R ()* option or the *Write W ()* option is selected, the permitted ranges are as follows:

   If the 'Operand' address type is selected, the y parameter must not exceed 128. If the y parameter is 0, the x parameter must not exceed 128. If the y parameter is greater than 0, the x parameter must not exceed 127.

   If one of the other address types is selected, the x and y parameters must not exceed 127.

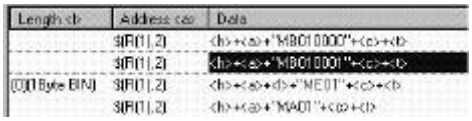
   If the *yN+x* option is selected, the x and y parameters must not exceed 255.

Data

Use the following procedure to set the message.

1, 2, 3...

1. Double-left-click on a *Data* setting for a message. Alternatively, select the *Data* setting and press Return and select *Field* from the *Edit* menu, or press Alt+E followed by F.



2. The Message Data dialog is displayed.

The Message data dialog allows the composition of a message to be edited. Insert a message name in the *Message Name* field.

3. Select the **OK** push-button to accept the settings, or the **Cancel** push-button to leave the settings unchanged.

The *Data* settings are color coded: message data associated with a Check Code is displayed in blue, message data associated with a Length is displayed in red, message data associated with both Check Code and Length is displayed in magenta.

The Insert toolbar provides the following operations to be included in the message.

The **Header <h>** button inserts the header setting into the message via the Message Header <h> dialog described previously. The header is automatically placed at the top of the list. If a header already exists in the message, it is not possible to select this button.

The **Terminator <t>** button inserts the terminator setting into the message via the Message Terminator <t> dialog described previously. The terminator is automatically placed at the bottom of the list. If a terminator already exists in the message, it is not possible to select this button.

The **Check Code <c>** button inserts the check code setting into the message via the Message Check Code <c> dialog described previously. If a check code is entered after the terminator, the check code is placed at the bottom of the list. If a check code already exists in the message, it is not possible to select this button.

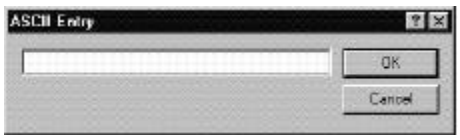
The **Length <l>** button inserts the length setting into the message via the Message Length <l> dialog described previously. If a length already exists in the message, it is not possible to select this button.

The **Address <a>** button inserts the effective address setting into the message via the Message Address <a> dialog described previously. If an effective address already exists in the message, it is not possible to select this button.

The **Control Code** button allows a special code to be inserted into the message via the Input Control Code dialog, described previously.

The **HEX** button allows hexadecimal characters to be inserted into the message via the HEX Entry dialog, described previously.

The **ASCII** button allows ASCII characters to be inserted into the message via the ASCII Entry dialog.

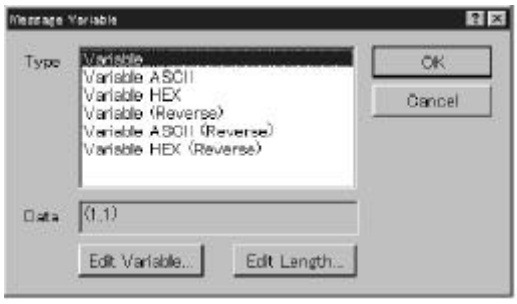


Insert valid ASCII characters into the field. Select the **OK** push-button to accept the characters, or the **Cancel** push-button to abort the operation.

The **Message Variable** button allows a message address to be inserted into the message via the Message Variable dialog.

Use the following procedure to set the message variable. The message variable types ‘Variable’, ‘Variable ASCII’, ‘Variable HEX’, ‘Variable (Reverse)’, ‘Variable ASCII (Reverse)’ and ‘Variable HEX (Reverse)’ are available.

1, 2, 3... 1. Left-click the Message Variable button to display the Message Variable dialog.



2. Select a Variable Type in the Type drop-down list.
3. Compose a data size using the Edit Variable push-button and Edit Length push-button.
4. Edit the settings in the Channel dialog, as described previously for editing the Message Address <a>.
5. Select the OK push-button to accept the settings in the Message Variable dialog, or select the Cancel push-button to close the dialog without saving the changes.

Note If an insertion is made in the Message Data dialog when a message part has already been selected, the insertion is placed before the selection.

Provided either a check code or length has been specified in the message, a check code or length can be associated to a message entry by selecting a message entry and clicking on the **Check Code** push-button or the **Length** push-button. A check code or length can be applied to a range of message entries by pressing Shift and selecting another message entry to extend the selection. Only items that appear above the Check Code in the list can be assigned the Check Code. Only items that appear below the Length in the list can be assigned the Length. Message entries that have a Check Code or Length specified are displayed with a '*' in the appropriate column in the dialog, <*c*> or </>.

To delete a message entry, select the message entry and click on the **Delete** push-button.

To complete, select the **OK** push-button to accept the message data, or the **Cancel** push-button to leave the message data unchanged.

Note Message output data must be less than 257 bytes.

8-2 Edit Message Lists

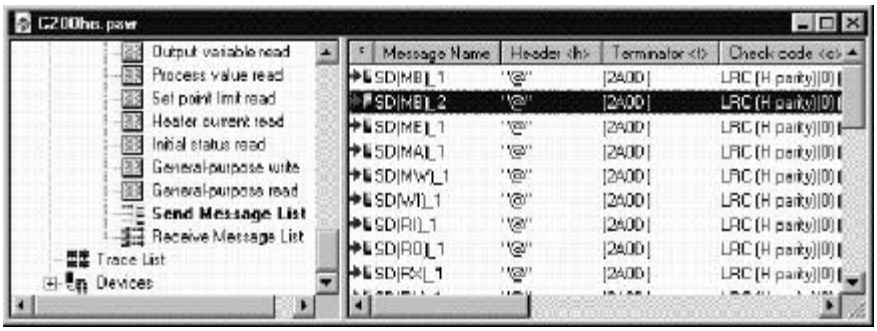
8-2-1 Display the Send Message and Receive Message Lists

Use the following procedure to display a message within a protocol.

1, 2, 3...

1. The send message list and receive message list are listed in the left and right pane of the window following all the sequences.

2. Left-click on the send message or receive message list icon in the left pane to show all messages within a message list. Alternatively, double-left-click on the send message list or receive message list icons. Messages are listed in the right pane of the window.

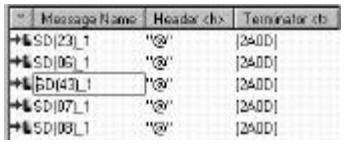


8-2-2 Rename Messages in the List

Use the following procedure to rename a message in the send or receive message lists. Messages belonging to 'System' type protocols cannot be changed.

1, 2, 3...

1. Double-left-click on the *Message Name* setting to be renamed from the message list. Alternatively, select the *Message Name* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F. The current message name becomes an editable field.



2. Type in a new name for the message and press Return or select *Accept* from the *Edit* menu, or press Alt+E followed by A. It is possible to select a portion of the current message name and overtype. The new message name must not exceed 10 characters.

8-2-3 Cut/Copy/Paste Messages in a Message List

Use the following procedure to copy a message. Messages within 'System' type protocols can be copied, but the protocol type changes to 'User' once pasted into a message list.

1, 2, 3...

1. Select the icon of the message to be copied, either from the send message list or the receive message list. More than one message can be selected by pressing Shift and selecting another message to extend the selection, or by pressing Ctrl and selecting another message to add to the selection.

2. Select the **Copy** button from the Toolbar or press Ctrl+C or press Alt+E followed by C. Alternatively, select *Copy* from the right mouse button dialog or select *Copy* from the *Edit* menu.

3. Select a message list or display the messages in the right pane, to which the copied message or messages are to be pasted.

4. Select the **Paste** button from the Toolbar or press Ctrl+V or press Alt+E followed by P. Alternatively, select *Paste* from the right mouse button dialog or select *Paste* from the *Edit* menu. The pasted messages are placed at the end of the associated message list.

Ensure that another Copy or Cut operation does not take place during this procedure as this erases the current copy operation.

Use the following procedure to cut a message. Messages within 'System' type protocols cannot be deleted.

1, 2, 3...

1. Select the icon of the message to be deleted, either from the send message list or the receive message list. More than one message can be selected by pressing Shift and selecting another message to extend the selection, or by pressing Ctrl and selecting another message to add to the selection.
2. Select the **Delete** button from the toolbar or press Delete or press Alt+E followed by D. Alternatively, select *Delete* from the right mouse button dialog or select *Delete* from the *Edit* menu. Select the **OK** push-button from the confirmation dialog to confirm deletion or the **Cancel** push-button to cancel the deletion.

A message can also be deleted by selecting the **Cut** button from the Toolbar or pressing Ctrl+X or press Alt+E followed by T. Alternatively, select *Cut* from the right mouse button dialog or *Cut* from the *Edit* menu. Select the **Paste** button from the Toolbar or press Ctrl+V , or press Alt+E followed by P to retrieve the last delete action using the Cut operation. Alternatively, select *Paste* from the right mouse button dialog or select *Paste* from the *Edit* menu. The pasted messages are placed at the end of the message list.

8-3 Edit a Receive Matrix

Use the procedures described in the following paragraphs to set a receive matrix when more than one received message is expected and the next process is to be changed for each receive message.

8-3-1 Display a Receive Matrix

Use the following procedure to copy a message in a receive matrix case. Messages within 'System' type protocols can be copied, but the protocol type changes to 'User' once pasted into a message list.

1, 2, 3...

1. Double-left-click on the protocol list icon to show all protocols. Alternatively, select the protocol list in the left pane.
2. Double-left-click on the protocol icon containing the send and receive message lists, located after the sequences. Alternatively, select the protocol in the left pane.
3. Double-left-click on the matrix list icon to display the matrix cases in the right pane. Alternatively, select the matrix list in the left pane.
4. Double-left-click on the matrix cases icon to display the individual cases in the right pane. Alternatively, select the matrix in the left pane.

8-3-2 Creating a New Case for a Receive Matrix

Use the following procedure to create a new message in a receive matrix.

1, 2, 3...

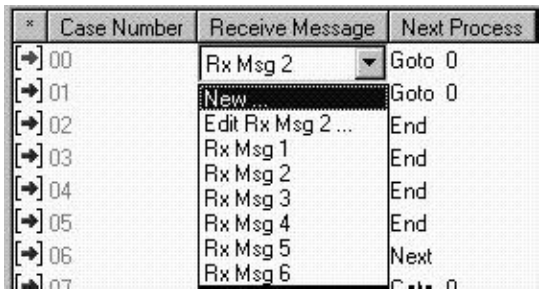
1. Double-left-click on the matrix list icon. Alternatively, select the matrix list in the left pane.
2. Select a matrix with the right mouse button and select *Create Matrix Case*.

8-3-3 Specifying a Message in a Receive Matrix from the Receive Message Lists

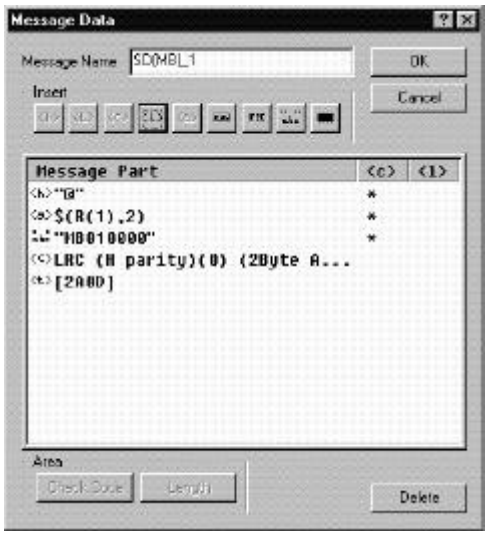
Use the following procedure to add a message to a receive matrix.

1, 2, 3...

1. Double-left-click on a matrix case to show all cases. Alternatively, select the matrix in the left pane.
2. Double-left-click on a *Receive Message* setting. Alternatively, select the *Receive Message* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.



3. Select a message from the drop-down list. Select *New...* from the drop-down list to create a new receive message, or select *Edit...* from the drop-down list to edit an existing receive message. The Message Data dialog is displayed, as described previously.



8-3-4 Cut/Copy/Paste Cases in a Receive Matrix

Use the following procedure to copy a receive matrix case in a receive matrix list.

1, 2, 3...

1. Select the icon of the case to be copied. More than one case can be selected by pressing Shift and selecting another case to extend the selection, or by pressing Ctrl and selecting another case to add to the selection.

2. Select the **Copy** button from the Toolbar or press Ctrl+C or press Alt+E followed by C. Alternatively, select *Copy* from the right mouse button dialog or select *Copy* from the *Edit* menu.

3. Select a receive matrix or display the matrix case in the right pane, into which the copied receive matrix case or cases are to be pasted.

4. Select the **Paste** button from the Toolbar or press Ctrl+V or press Alt+E followed by P. Alternatively, select *Paste* from the right mouse button dialog or select *Paste* from the *Edit* menu. The pasted cases are placed at the end of the associated message list.

Use the following procedure to cut a message in a receive matrix case. Messages within 'System' type protocols cannot be deleted.

1, 2, 3...

1. Select the icon of the case to be deleted. More than one case can be selected by pressing Shift and selecting another case to extend the selection, or by pressing Ctrl and selecting another case to add to the selection.

2. Select the **Cut** button from the Toolbar or press Ctrl+X or Alt+E followed by T. Alternatively, select *Cut* from the right mouse button dialog or select *Cut* from the *Edit* menu.

Select the **Paste** button from the Toolbar or press Ctrl+V or press Alt+E followed by P to retrieve the last delete action using the Cut operation. Alternatively, select *Paste* from the right mouse button dialog or select *Paste* from the *Edit* menu. The pasted cases are placed at the end of the associated matrix case.

8-3-5 Define the Next Case in a Receive Matrix

Use the following procedure to define a new case in a matrix.

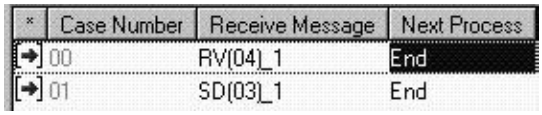
1, 2, 3...

1. Select the matrix icon in the left pane, or more than one case in the right pane or a free area in the cases list of the right pane, with the right mouse button and select *Create Matrix Case....*

Use the following procedure to edit the next process.

1, 2, 3...

1. Double-left-click on a matrix to show all cases. Alternatively, select the matrix in the left pane.
2. Double-left-click on a *Next Process* setting. Alternatively, select the *Next Process* setting and press Return or select *Field* from the *Edit* menu, or press Alt+E followed by F.



3. The Next Process dialog is displayed.

Select the next process from the *Jump* option buttons. In the event of 'Goto' being selected, enter a case number in the corresponding field. An invalid case number entered in this field results in a Goto statement passing control to the last case in the matrix.

4. Select the **OK** push-button to accept the settings, or the **Cancel** push-button to leave the settings unchanged.

SECTION 9
Managing Protocol Data

This section describes how to manage, save, and retrieve protocol data that has been created, and how to transfer the protocol data to the PLC.

9-1 Import Protocol Data from PSS-Dos Files

Protocol data from the SYSMAC-PST predecessor application 'PSS Dos' can be imported into SYSMAC-PST by loading PSS-Dos files into SYSMAC-PST (PSS-Dos files may be loaded into SYSMAC-PST, but the file may not be changed).

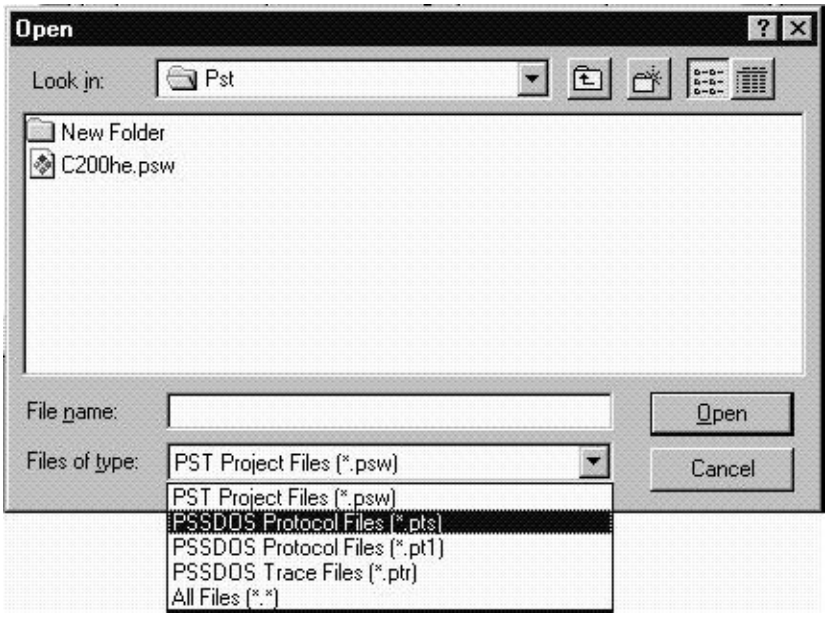
The PSS-Dos application is able to save and retrieve many types of files. These files are listed as follows, and are opened in SYSMAC-PST as a Project so that protocol data may be copied.

Type of PSS-Dos file	File extension
PSS-Dos Protocol files	*.pts
A PSS-Dos Protocol file	*.pt1
PSS-Dos Trace files	*.ptr

Use the following procedure to import Protocol data from PSS-Dos files.

1, 2, 3...

1. Select *Open* from the *File* menu or click on the **Open** button from the Toolbar. Alternatively, a PSS-Dos file can be opened by pressing Ctrl+O or press Alt+F followed by O.
2. The Open dialog is displayed.



   Select a file type from the *Files of type:* Drop-down list box.
3. Select a file from the Open dialog list that corresponds with the PSS-Dos file type. The current folder can be changed by selecting another folder from the *Look in:* Drop-down list.
4. Click the **Open** push-button to import a PSS-Dos file with the specified filename, file type and location. Click the **Cancel** push-button to close the Open dialog without opening a project.

The PSS-Dos file that has been opened does not alter in content, and is made into a project with the exception of a PSS-Dos trace file. For instance, opening a PSS-Dos protocol file in SYSMAC-PST, a new project is created containing that protocol, with heading details from the *.pt1 file within the project properties. PSS-Dos trace files must be uploaded to a project, refer to *Section 10 Trace/ Monitor* although they can be viewed when opened as part of a SYSMAC-PST project.

Note The setting data imported from the PSS system setting file cannot be copied to another communications port.

9-2 Transfer Protocol Data Between the Computer and the PSB

In order to transfer protocol data between the computer and the PSB, ensure that the computer is connected to a PLC, and that configuration and communication settings are correct. Refer to *Section 6. Hardware Configuration* for details.

9-2-1 Transfer Data from the Computer to the PSB

⚠ Caution Confirm safety at the destination node before transferring a protocol to another node or editing the I/O area. Doing either of these without confirming safety may result in injury.

⚠ Caution Confirm that no adverse effect will occur in the system before changing the operating mode of the PLC. Not doing so may result in an unexpected operation.

⚠ Caution Check the user protocol for proper execution before actually running it in the Unit. Not checking the protocol may result in an unexpected operation.

Use the following procedure to download protocols to the PSB from the computer.

1, 2, 3...

1. Double-left-click the protocol list icon to list the protocols in the right pane. Alternatively, select the protocol list in the left pane.

2. Select a protocol to download. Multiple protocols can be selected for printing by pressing Shift and selecting another protocol to extend the selection, or by pressing Ctrl and selecting another protocol to add to the selection.

3. Select the **Download Protocols** button on the toolbar. Alternatively, select *Download Protocols To PSB* from the *File* menu, or press Alt+F followed by D. The Protocol Download To PSB dialog is displayed.

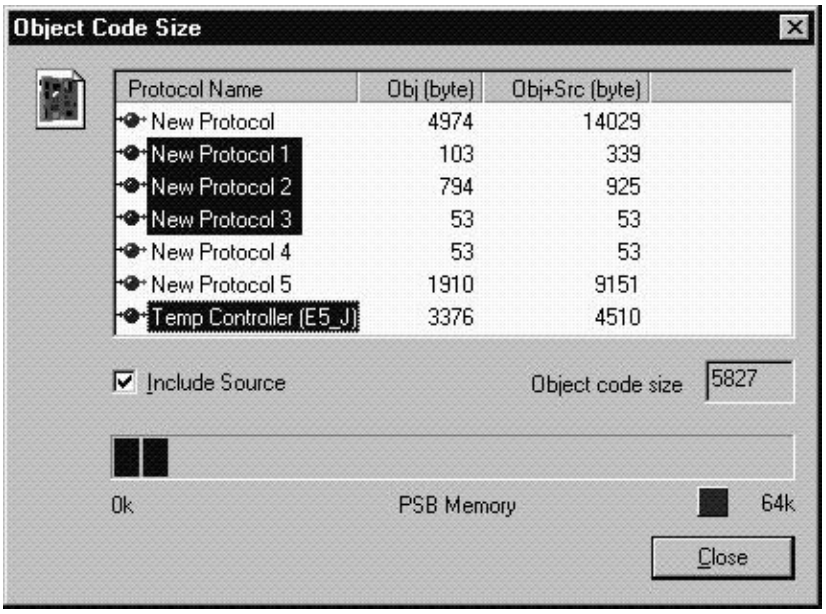
4. Prior to download, a password can be applied to protect the protocol. Select the *Password Protection Required* check box to enable password protection. Enter a password in the *Password* field (up to eight characters). Enter the password in the *Confirmation* field to confirm the action.
5. Click the **OK** push-button to accept the settings and download the protocol. Click the **Cancel** push-button to close the dialog without changing the settings.
6. If the protocols already in the PSB are password protected, the user is required to enter the password before the new protocols can be downloaded.

The downloading of protocols to the PSB can be dependent on the capacity limit of the PSB. To reduce the size of protocol data downloaded to the PSB, ensure the *Include Protocol Source* field of the Protocol Download To PSB dialog is not set. The amount of protocol data to be downloaded can be analysed via the Object Code Size dialog.

Use the following procedure to analyse the amount of protocol data to be downloaded to the PSB.

1, 2, 3...

1. Select the **Object Code Size** button from the toolbar. Alternatively, select *Display Object Code Size* from the *File* menu or press Alt+F followed by B.
2. The Object Code Size dialog is displayed.



All the protocols within the protocol list are listed in this dialog. Select a protocol. Multiple protocols can be selected by pressing Shift and selecting another protocol to extend the selection, or by pressing Ctrl and selecting another protocol to add to the selection. As the number of protocols selected increases, the *Object code size* field and the PSB Memory progress indicator updates to provide a total amount to download. When the amount nears the PSB limit, the red box by the progress indicator illuminates.

3. To reduce the size of protocol data downloaded to the PSB, ensure the *Include Source* field is not set.

   Note To reduce the protocol data size to be transmitted to the PSB, turn off the check mark in the [**Include Source**] box. Once the [**Include Source**] box is turned off, protocol data cannot be read from the PSB.

4. On completion, select the **Close** push-button. A download to the PSB can now take place.

Note IF 'Invalid' appears in the *Obj (byte)* or *Obj+Src (byte)* values, the object could not be created.

9-2-2 Transfer Data from the PSB to the Computer

Use the following procedure to upload protocols to the computer from the PSB.

1, 2, 3...

1. Double-left-click on the devices icon.
2. Double-left-click on the associated PLC icon.
3. Select the PSB icon with the right mouse button and click on the *Upload Protocols From PSB* option or select *Upload Protocols From PSB* from the *File* menu, or press Alt+F followed by U.

4. If the protocol data was originally downloaded with password protection, the password must be entered in the PSB Password dialog prior to upload.

"Uploading Protocol from PSB" will be displayed in the status bar. Once uploading is completed, uploaded protocols are uploaded into a new project window. Uploaded data cannot be directly edited but instead can be pasted into a project for editing. The uploaded information is saved as an Uploaded Protocol Data file and can be opened at a later time in the same manner as a project.

⚠ Caution If the data format of each message item is set to the control code/ASCII format, that portion will be displayed in the hexadecimal format when the protocol is read from the PSB to the personal computer.
Example: .... "1" when read to a personal computer: ..... [31]
..... SOH when read to a personal computer: ..... [01]

9-2-3 Display Data on the PSB

Use the following procedure to display protocol data within the PSB.

1, 2, 3...

1. Double-left-click on the devices icon.
2. Double-left-click on the associated PLC icon.
3. Select the PSB icon with the right mouse button and click on the *Display PSB Protocols* option or select *Display PSB Protocols* from the *File* menu or press Alt+F followed by L.
4. The PSB Protocol List dialog is displayed, listing the protocols on the PSB and the sequence range.

Click the **OK** push-button to close the dialog.

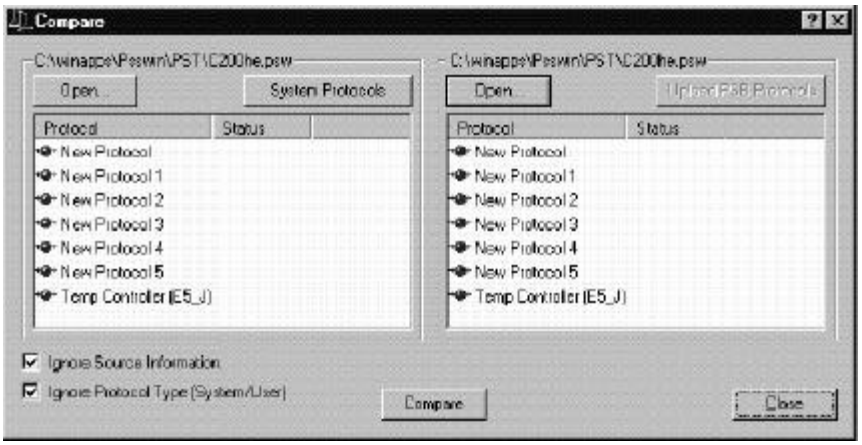
9-3 Compare Protocol Data

Protocol data saved in the computer can be compared with the protocol data that is stored in a PLC.

Use the following procedure to compare protocol data.

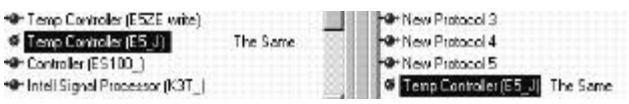
1, 2, 3...

1. Select the **Compare** button on the toolbar. Alternatively, select *Protocol Compare* from the *File* menu or press Alt+F followed by T.
2. The Compare dialog is displayed.



Select the **Open 1...** push-button on the left side of the dialog or press Alt+1 to open a project to compare. Alternatively, select the **System Protocols** push-button or press Alt+S to open the predefined coded system protocols.

3. If the **Open 1...** push-button is selected, the Open dialog is displayed. Select a project to open. Refer to *Section 5 Project Creation and Display* for instructions on how to open a project. The protocols within the opened project are listed on the left side of the dialog.
4. Select the **Open 2...** push-button on the right side of the dialog or press Alt+2 to open a project to compare against the first, ensuring the project names are the same. Alternatively, select the **Upload PSB Protocols** push-button or press Alt+U to open the protocols from the PSB (refer to *Section 9-3 Transfer Protocol Data Between the PLC and the PSB* for further information).
5. If the **Open 2...** push-button is selected, the Open dialog is displayed. Select a project to open. Refer to *Section 5 Project Creation and Display* for instructions on how to open a project. The protocols within the opened project are listed on the right side of the dialog.
6. Set the *Ignore Source Information* check box or press Alt+I to exclude source information, such as meaningful names specified to protocols, as part of the comparison. Set the *Ignore Protocol Type (System/User)* check box or press Alt+T to exclude the protocol type as part of the comparison (for instance, a system protocol that is copied as a user protocol with identical content would be raised as a difference if this check box was not set).
7. Select the **Compare** push-button or press Alt+M to compare the two sets of protocols. The results of the comparison are displayed within the Compare dialog.



8. Select the **Close** push-button or press Alt+C to close the dialog.

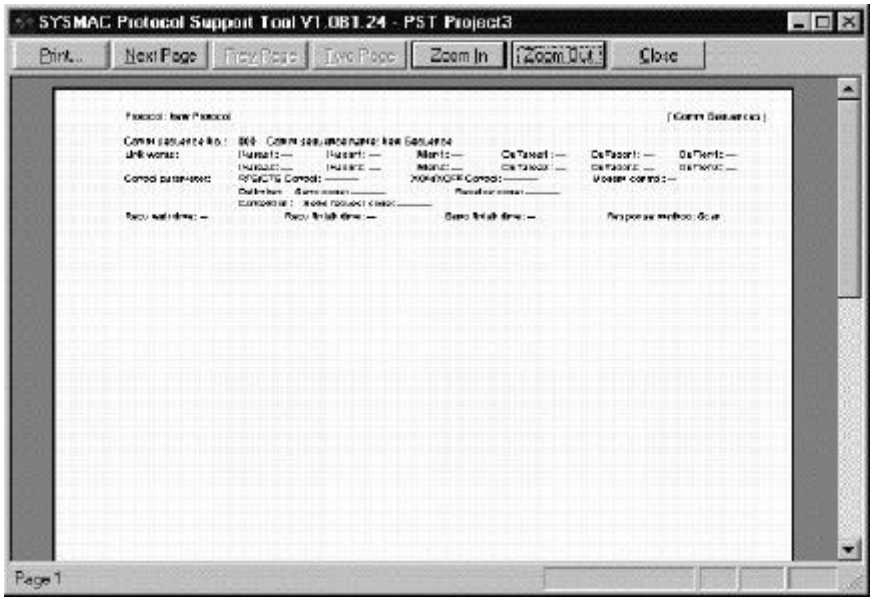
9-4 Print Protocols

Protocols can be printed directly from the Protocol Support Software. Use the following procedure to print a protocol.

1, 2, 3...

1. Double-left-click the protocol list icon to list the protocols in the right pane. Alternatively, left-click the protocol list icon in the right pane.

2. Select a protocol to print. Multiple protocols can be selected for printing by pressing Shift and selecting another protocol to extend the selection, or by pressing Ctrl and selecting another protocol to add to the selection.
3. If desired, the protocols can be previewed by selecting *Print Preview* from the *File* or pressing Alt+F followed by V. The Preview dialog is displayed

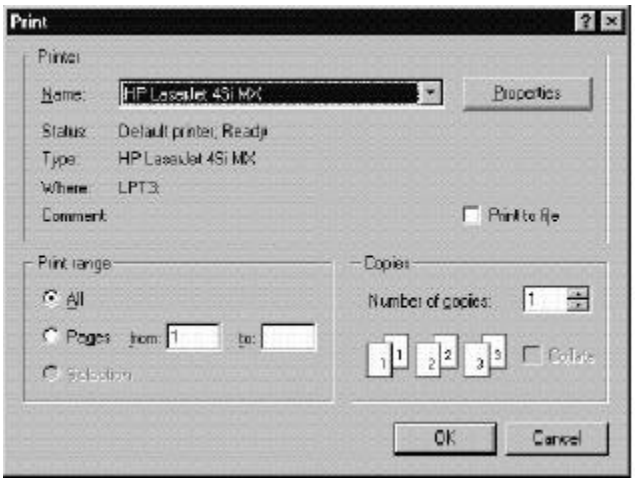


The following functions can be accessed.

- Select the **Next Page** push-button or **Prev Page** push-button to navigate through the pages of the print-out.
- Select the **Two Page** push-button to view two pages of the print-out at once. This push-button then changes to the **One Page** push-button to revert back.
- Select the **Zoom In** push-button and the **Zoom Out** to push-button zoom in and out of the print-out. Once the **Zoom In** push-button has been selected, the **One Page** push-button is disabled until the default size is re-selected using the **Zoom Out** pushbutton.
- Select the **Close** push-button to close the dialog.

4. Select the **Print** button from the toolbar. Alternatively, select *Print* from the *File* menu or press Ctrl+P or press Alt+F followed by P. It is also possible to print directly from the Print Preview dialog by pressing the **Print** push-button.

5. The Print dialog is displayed.



Select the printer from the *Name:* drop-down list. Use the **Properties** push-button to display the Properties dialog and configure the specific printer settings. Set the *Print to file* check box to create a print file instead of printing hard copy.

6. Select the required print range.
7. Select the required number of copies from the *Number of copies:* field and set the collation method in the *Collate* check box if two or more copies are to be printed.

Note The *Collate* check box is only enabled if supported by the Printer hardware.

8. Click the **OK** button to print the protocol. Click the **Cancel** button to close the dialog without printing the protocol.

Refer to specific Printer documentation for further details on printer configuration.

Note Message data may extend beyond the printing frame depending on its length. If this happens, select [Printer Setting] from the [File Menu] and change the printing setting to landscape or change the printer type.

SECTION 10
Trace/Monitor

This section describes monitoring PLC words and the transmission line tracing.

10-1 Tracing Transmission Lines

Transmission data and transmission signals of up to 670 characters can be traced to debug sequences.

Tracing Method

The following two tracing methods are available.

- **Continuous Traces**
  The trace is executed until stopped. When the trace buffer becomes full during tracing, data will be discarded starting from the oldest data.
- **One-shot Traces**
  The trace is terminated when the trace buffer becomes full. The entire trace data from the start of trace remains in the trace buffer.

Trace-related bits

Trace related flags are listed in the following table.

Type	Port	Effective Address	State
Continuous Trace Start/Stop Bit	Port A	28902	The continuous trace starts on the rising edge and is terminated on the falling edge.
	Port B	28903	This bit is invalid during one-shot traces.
One-shot Trace Start/Stop Bit	Port A	28904	The one-shot trace starts on the rising edge and is terminated on the falling edge.
	Port B	28905	This bit is invalid during continuous traces.
Trace Execution/Completion Flag	Port A	28600	ON: Continuous or one-shot trace being executed.
	Port B	28601	OFF: One-shot trace stopped by full buffer (when One-shot Trace Start/Stop Bit is still on.

Note a) The ON/OFF status of control signals is not sampled accurately. Use the results as reference only.

b) The ON/OFF status of the RTS, CTS, DTR and DSR signals is sampled when one character of transmission data is sent or received. Changes without data transmission or changes during transmission of one character are not sampled.

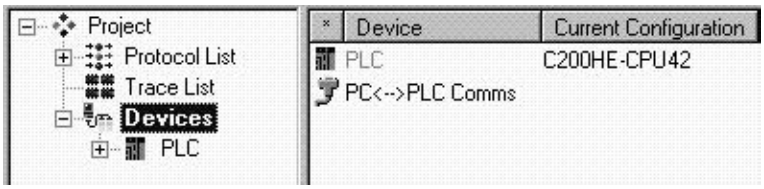
c) The ON/OFF status of the CTS and DSR signals may be different before or after the reception of the finished data of a receive message.

10-1-1 Start/Stop a Trace

Use the following procedure to start and stop a trace.

1, 2, 3...

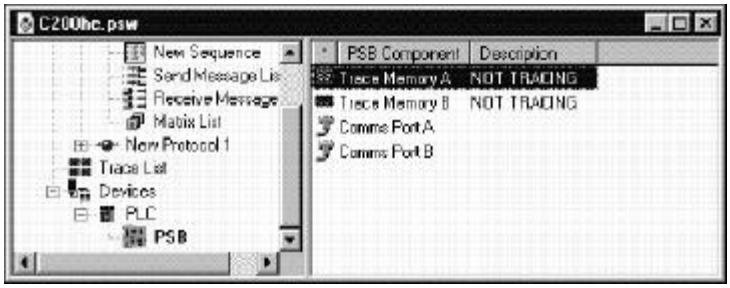
1. Double-left-click on the devices icon.
2. Double-left-click on the *Current Configuration* setting to select a PLC. Alternatively, select the *Current Configuration* setting and press Return or select *Field* from the *Edit* menu or press Alt+E followed by F.



3. Select the required PLC from the drop-down list and press Return or select *Accept* from the *Edit* menu, or press Alt+E followed by A.
4. Double-left-click on the associated PLC icon.
5. Double-left-click on the PSB icon.

   Select the Trace Memory A icon or the Trace Memory B icon, according to the PLC setup with the right mouse button and click on *Start Trace* followed

by either *Continuous* or *One-shot* from the right mouse button dialog. Alternatively, select the **Continuous** or **One-shot** buttons from the toolbar.



The *Description* setting shows the current activity on the PSB.

⚠ Caution Change the operating mode of the PLC only after checking that there will be no influence on the facility. Changing the mode abruptly can have serious or unexpected results.

6. To stop a trace, Select the Trace Memory A icon or the Trace Memory B icon with the right mouse button as in step 5, and click on *Stop Trace* or select the *Stop Trace* button.

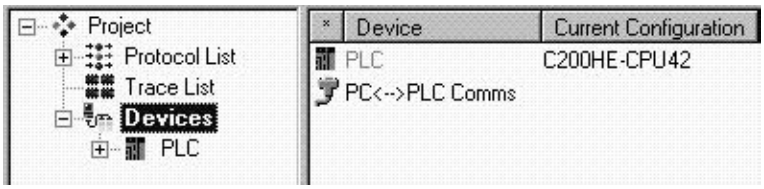
Refer to *Section 6 Hardware Configuration* for further details of PLC Selection.

10-1-2 Read Trace Data from the PSB

Previously traced data can be uploaded from the PSB to the project. Use the following procedure to read trace data from the PSB.

1, 2, 3...

1. Double-left-click on the devices icon.
2. Double-left-click on the *Current Configuration* setting to select a PLC. Alternatively, select the *Current Configuration* setting and press Return or select *Field* from the *Edit* menu.

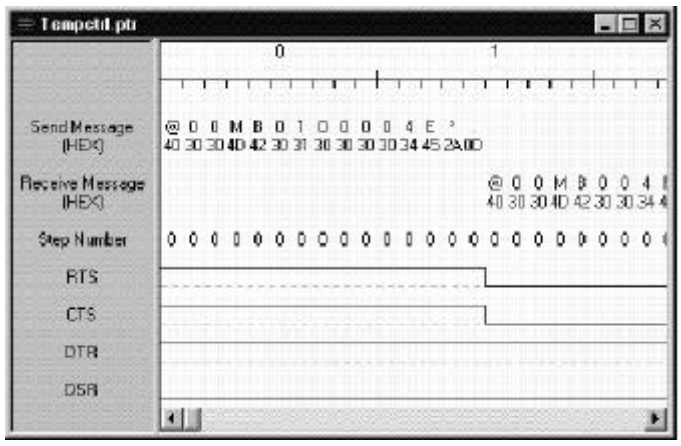


3. Select the required PLC from the drop-down list and press Return or select *Accept* from the *Edit* menu, or press Alt+E followed by A.
4. Double-left-click on the associated PLC icon.
5. Double-left-click on the PSB icon.
6. Select the Trace Memory A icon or the Trace Memory B icon, according to the PLC setup with the right mouse button and click on *Upload Trace* from the right mouse button menu or select the **Upload** button from the toolbar.

Refer to *Section 6 Hardware Configuration* for further details of PLC Selection.

10-1-3 Analyse Trace Data

Trace information is displayed to assist debugging sequences once it has been uploaded (refer to *Section 10-1-2 Read Trace Data from the PSB*).



- Data displayed above is traced from left to right with the leftmost point being the trace starting point.
- The numbers 0 to 66 at the top row indicate every 10 bytes.
- The send message is shown above and the receive message below. HEX data is displayed below the ASCII statement.
- Execution step No. will be displayed. If an error occurs when receiving messages, either “e” or “f” will be displayed in the step number.
- The RS, CS, ER, and DR signals are indicated in red above the dotted baseline and in blue below the dotted baseline.

Note The ON/OFF state of the control signal is not sampled correctly. Use the sampling results only for reference. The ON/OFF state of the RS, CS, ER, or DR signal is sampled when one character of the Send or Receive data is sent or received. Changes of signals that are not sent or received or changes in one-character signals that are sent or received are not sampled.
The ON/OFF state of the CS or DR signal may differ depending on whether the message transmission has been completed or not.

The information displayed for Send Message (HEX) or Receive Message (HEX) is colored red if an error has occurred. The RTS, CTS, DTR and DSR signals are colored blue on the dotted baseline, and red if above it.

Use the following buttons to analyse trace data.

To go to the start of the trace, select the **Start of Trace** button. Alternatively, select *Start of Trace* from the right mouse button menu.

To skip the next full page of trace data from the right, select the **Fast Rewind** button. Alternatively, select *Fast Rewind* from the right mouse button menu.

To step the trace from the right, select the **Rewind** button. Alternatively, select *Rewind* from the right mouse button menu.

To step the trace from the left, select the **Forward** button. Alternatively, select *Forward* from the right mouse button menu.

To skip to the next full page of trace data from the left, select the **Fast Forward** button. Alternatively, select *Fast Forward* from the right mouse button menu.

To go to the end of the trace, select the **End of Trace** button. Alternatively, select *End of Trace* from the right mouse button menu.

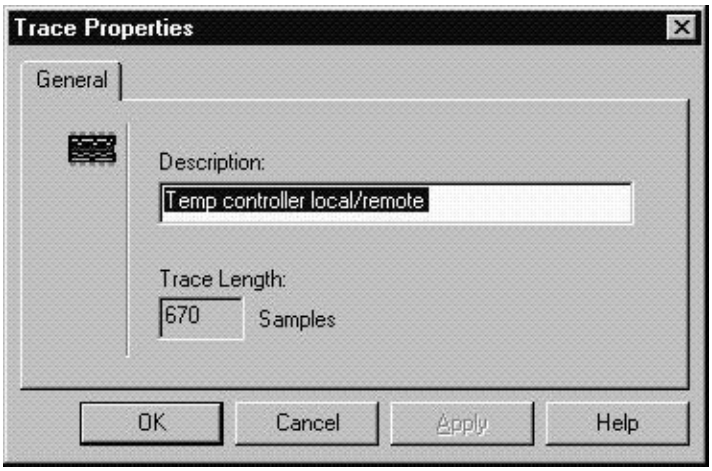
The scroll bars at the bottom of the display can also be used to analyse the trace left and right.

10-1-4 Adding a Trace to a Project

An uploaded trace can be added to, and be saved as part of a project. Use the following procedure to add a trace to a project.

1, 2, 3...

1. Upload the trace from the PSB as described in *Section 10-1-2 Read Trace Data from the PSB*.
2. The trace is displayed. Click in the trace with the right mouse button and select *Properties*. The Trace Properties dialog is displayed.



Enter a meaningful description for the trace and click on the **OK** push-button. Click on the **Cancel** push-button to abort.

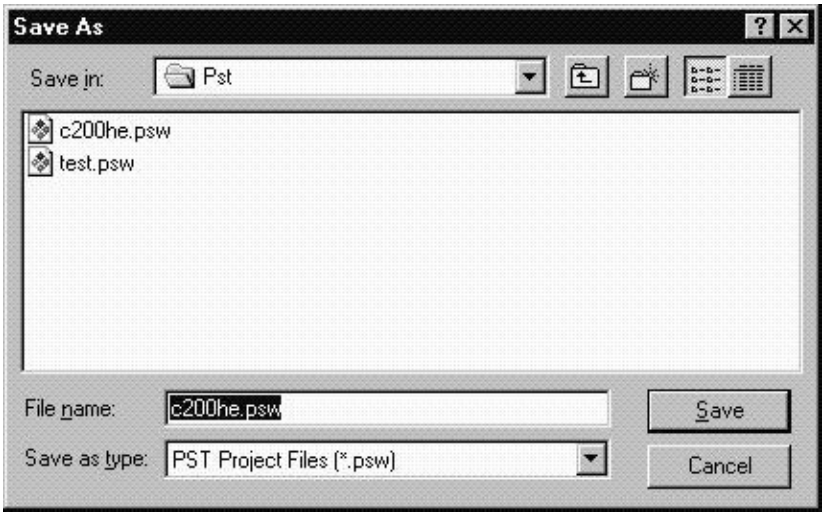
3. Select the uploaded trace with the right mouse button and click on *Add to Project*. The trace appears in the project Trace list and can be saved with the project.

10-1-5 Save Trace Data to File

Use the following procedure to save trace data to a file.

1, 2, 3...

1. Select *Save As* from the *File* menu, or press Alt+F followed by A.
2. The Save As dialog is displayed.



To ensure only trace data is saved, ensure the *Save As type:* field is set to "PSSDOS Trace Files (*.ptr)". The current folder can be changed by selecting another folder from the *Save in:* Drop-down list.

Type a name in the *File name:* field. Trace data can be overwritten by selecting any trace data from the Save As dialog list.

3. Click the **Save** push-button to save the trace with the specified filename, file type and location. Click the **Cancel** push-button to close the Save As dialog without saving the trace file.

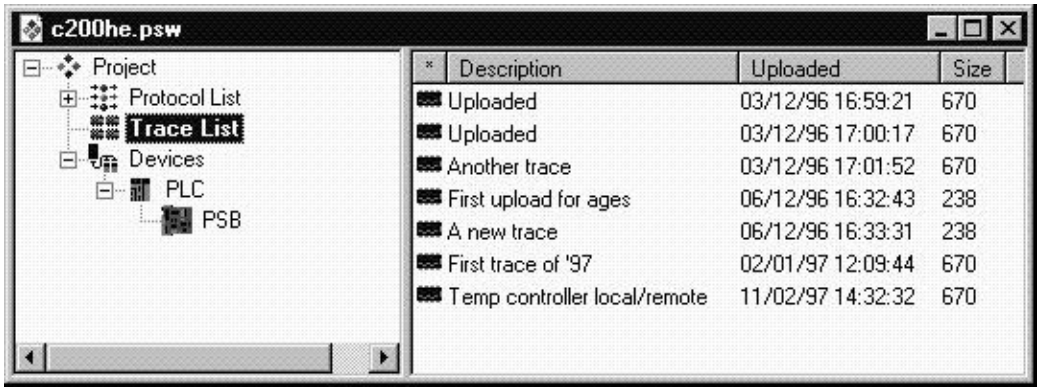
   Confirmation is required if a trace file is overwritten. Select the **Yes** push-button to overwrite the existing trace file. Select the **No** push-button to leave the existing trace file unchanged.

10-1-6 Retrieve Trace Data

Trace data can be retrieved from a file or from a project. Use the following procedure to retrieve a trace from the trace list.

1, 2, 3...

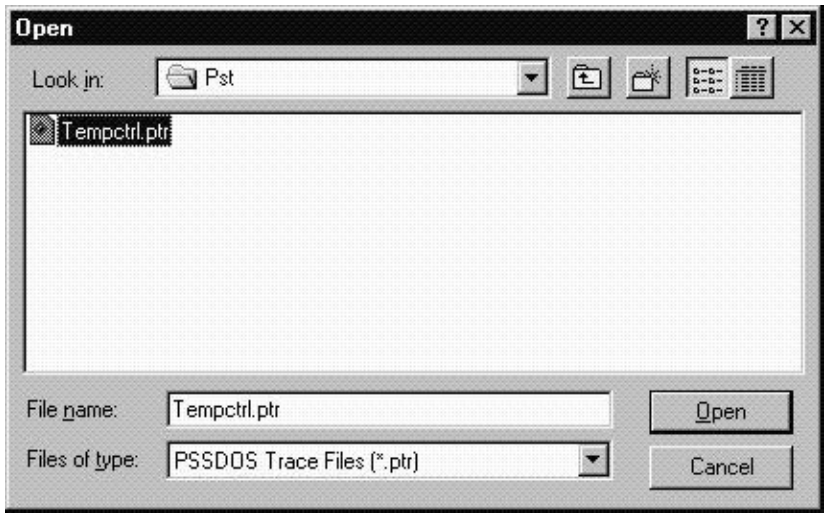
1. Left-click on the project icon to show the name of the protocol list.
2. Double-left-click on the trace list icon.
3. Double-left-click on a trace within the trace list.



Use the following procedure to open existing trace data. Trace data retrieved from file cannot be added to a project.

1, 2, 3...

1. Select *Open* from the *File* menu or click on the **Open** button from the Toolbar. Alternatively, existing trace data can be opened by pressing Ctrl+O, or press Alt+F followed by O.
2. The Open dialog is displayed.



   To ensure only trace data is opened, the *Files of type:* field is preset to "PSSDOS Trace Files (*.ptr)". Select a trace file from the list. The current folder can be changed by selecting another folder from the *Look in:* Drop-down list.

3. Click the **Open** push-button or double-left-click on the selected file to open the trace with the specified filename, file type and location. Click the **Cancel** push-button to close the Open dialog without opening a trace file.

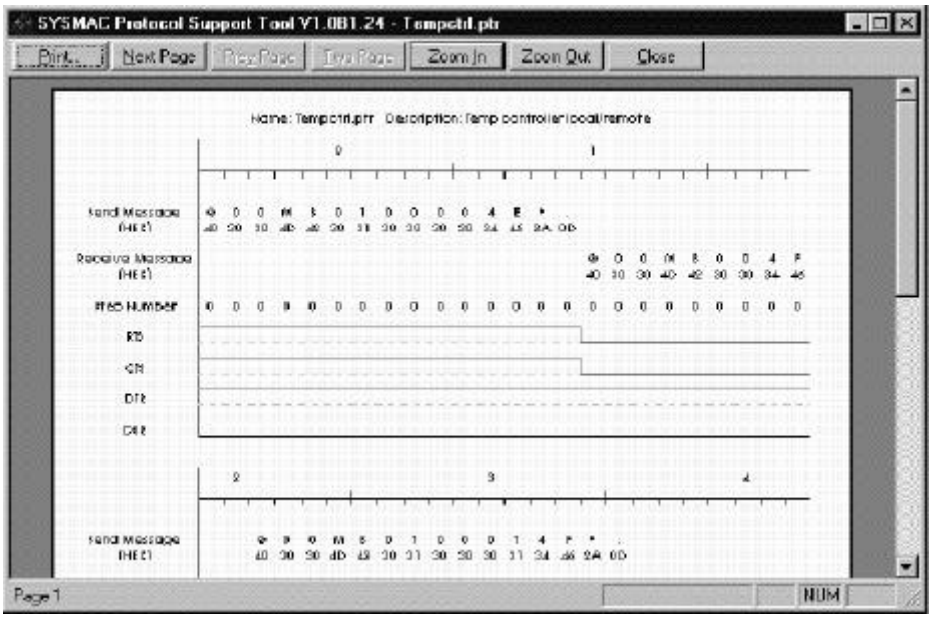
Note A *.ptr file can only be opened and added to a project if the session of the project during which the trace was created is still open. When this session is closed, the *.ptr file cannot be added to a project.

10-1-7 Print Trace Data

Traces can be printed directly from SYSMAC-PST. Use the following procedure to print a trace.

1, 2, 3...

1. Double-left-click the trace list icon to list the traces in the right pane.
2. Double-left-click on a trace to display it. A trace can be printed if opened from file.
3. If desired, the trace can be previewed by selecting *Print Preview* from the *File* menu or press Alt+F followed by V. The Preview dialog is displayed



The following functions can be accessed.

- Select the **Print...** push-button to amend the setup of the print-out. Refer to *Section 6 Hardware Configuration* for further details.
- Select the **Next Page** push-button or **Prev Page** push-button to navigate through the pages of the print-out.
- Select the **Two Page** push-button to view two pages of the print-out at once. This push-button then changes to the **One Page** push-button to revert back.
- Select the **Zoom In** push-button and the **Zoom Out** push-button zoom in and out of the print-out. Once the **Zoom In** push-button has been selected, the **One Page** push-button is disabled until the default size is re-selected using the **Zoom Out** push-button.
- Select the **Close** push-button to close the dialog.

4. Select the **Print** button from the toolbar.

10-2 Monitoring PLC words

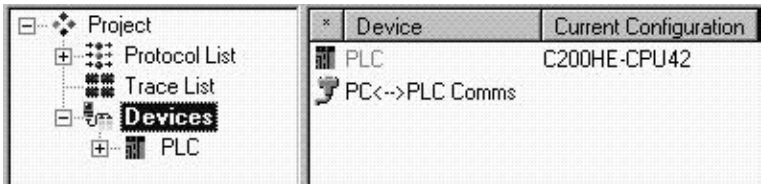
PLC words can be monitored or changed to a new value. This is used to edit or monitor the message data which is sent from the PLC data memory or received into the PLC memory.

10-2-1 Selecting PLC Data Areas

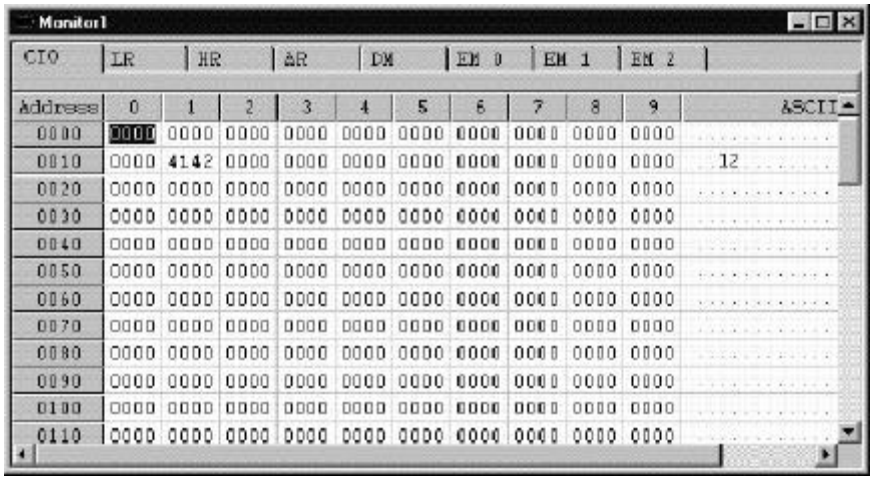
Use the following procedure to select a PLC data area for monitoring.

1, 2, 3...

1. Double-left-click on the devices icon.
2. Double-left-click on the *Current Configuration* setting. Alternatively, select the *Current Configuration* setting and press Return or select *Field* from the *Edit* menu, or press Alt+E followed by F.



3. Select a PLC from the *Current Configuration* drop-down list and press Return or select *Accept* from the *Edit* menu or press Alt+E followed by A.
4. Double-left-click on the associated PLC icon.
5. Double-left-click on the associated PLC Memory icon. The monitor window is displayed.



The higher digits of the effective address are listed down the left side of the tab, with the lowest digit of the effective address displayed along the top.

6. Select the tab for the data area to be monitored, or press Tab or Shift+Tab to navigate through each tab in-turn. Only data areas available for the chosen PLC are displayed. Not all PLC's have EM. The CIO data is displayed initially.

Note The ranges for the PLC data areas are as follows:

- CIO: 0000 to 0511
- LR: 0000 to 0063
- HR: 0000 to 0099
- AR: 0000 to 0027
- DM: 0000 to 6655
- EM: 0000 to 6143 (if the PLC has EM)

The chosen EM bank number is shown in the corresponding EM tab.

Refer to *Section 6 Hardware Configuration* for further details of PLC Selection.

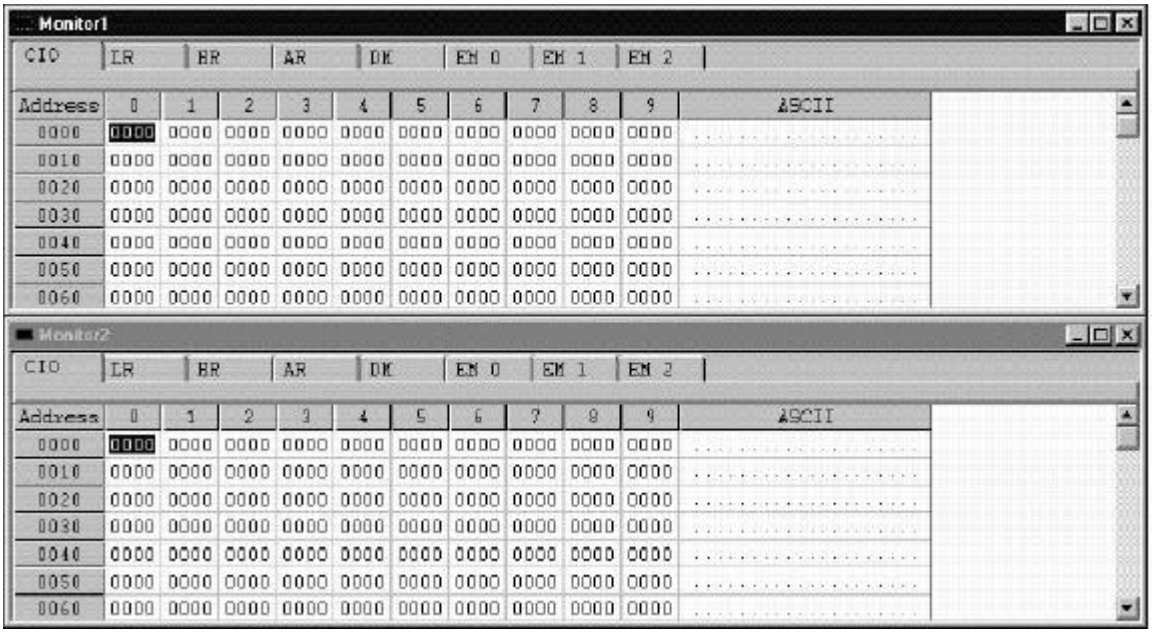
It is possible to display more than one data area at the same time. Use the following procedure to display more than one data area at the same time:

1, 2, 3...

1. Open a second monitor window.

Note When opening the second monitor window, if an icon other than the PLC icon or PSB icon is selected in the left pane (hierarchy screen), an offline condition will occur and the first window will be closed.

2. Select the tab for the data area to be monitored, or press Tab or Tab to navigate through each tab in-turn.
3. Select *Tile* from the *Window* menu or press Alt+W followed by T.



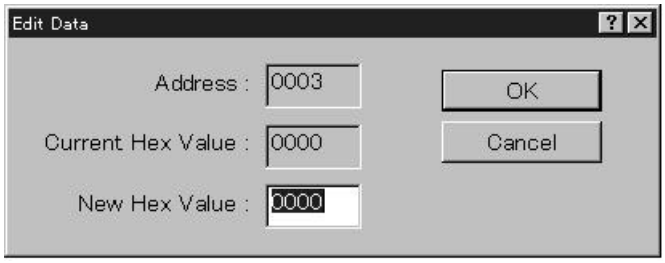
10-2-2 Editing PLC Data Area Words

Use the following procedure to edit the HEX value of a data area word.

Note ASCII values are read-only.

1, 2, 3...

1. Navigate the monitor window using the scroll bars or press PageUp and PageDown to display the desired word.
2. Double-left-click on the word or select the word and press Return. The Edit Data dialog is displayed if the PLC is in Monitor Mode or Program Mode. Word values cannot be changed if the PLC is offline in Run Mode or the word is read-only. Refer to *Section 6 Hardware Configuration* for more information about PLC mode selection.



3. Type a new HEX value in the *New HEX Value:* field.
4. Select the **OK** push-button to change the word Value or to accept the current Value. The new value is transferred to the PLC. Select the **Cancel** push-button to leave the value unchanged.

⚠ WARNING Confirm safety at the destination node before transferring a protocol to another node or editing the I/O area. Doing either of these without confirming safety may result in injury.

⚠ Caution Confirm that no adverse effect will occur in the system before changing the present value of any word in the memory area. Not doing so may result in an unexpected operation.

The cursor keys can also be used to supplement the amendment of PLC data area words:

- Home. Moves the cursor to column 0. If the cursor is in column 0, the Home key moves the display to row Address 0000.
- End. Moves the cursor to the end of the current row. If the cursor is already at the end of the current row, the End key moves the display to the end of the data area.
- Ctrl+left arrow. Scrolls the display to the left.
- Ctrl+right arrow. Scrolls the display to the right.

SECTION 11
Help System

This section describes the on-line help services provided with SYSMAC-PST.

11-1 Help by Topic

Procedures for using SYSMAC-PST can be verified using on-line help. Use the following procedure to use on-line help.

1, 2, 3...

1. Select *Help Topics* from the *Help* menu or press Alt+H followed by H.

   The Help Topics: SYSMAC-PST Help dialog is displayed. On-line help can be retrieved from this dialog using the Index and Find tabs.

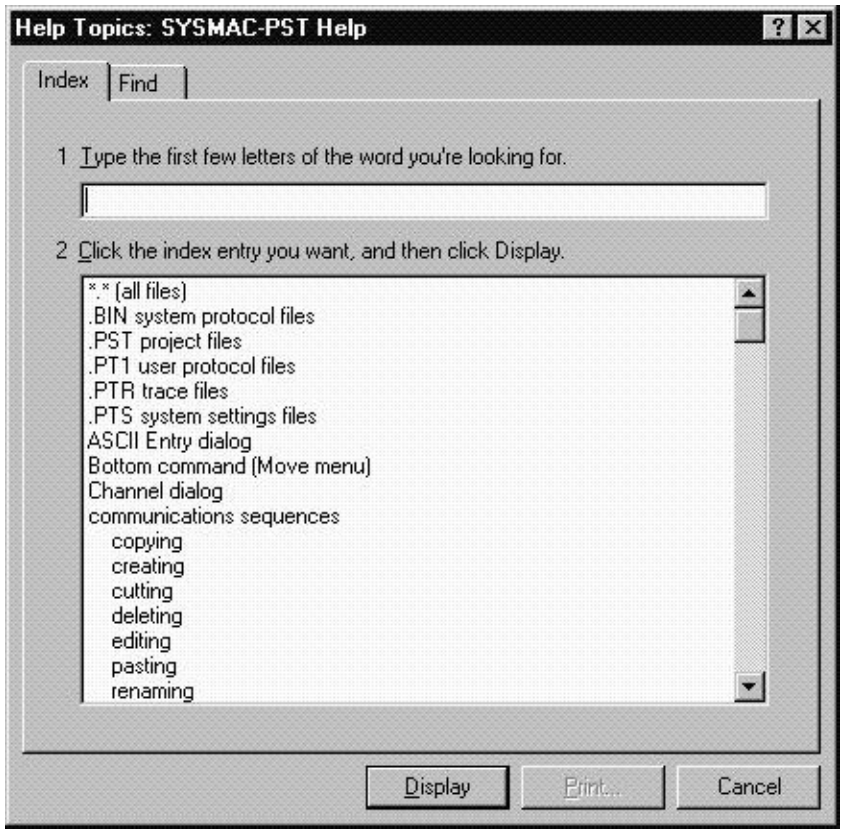
2. Select the **Cancel** push-button if necessary to close the Help Topics: SYSMAC-PST Help dialog.

11-1-1 Index

Use the following procedure to retrieve on-line help from the Index tab of the Help Topics: SYSMAC-PST Help dialog.

1, 2, 3...

1. Select the Index tab.
2. Enter a text query into the first step field. The second step field is refreshed according to the query entered in the first step field.



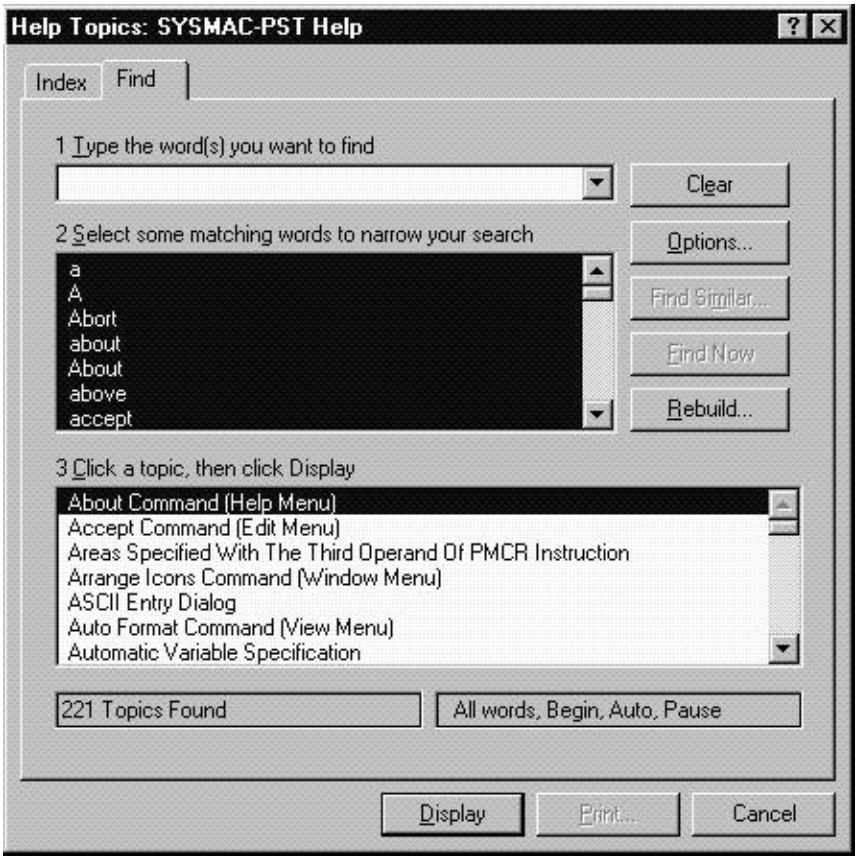
3. Select an entry in the second step field and select the **Display** push-button, or double-left-click on the index entry.
4. If an entry is linked to two or more topics, the names of the topics are displayed in the Topics Found dialog. Select a topic and choose the **Display** push-button or double-left-click on the topic.

11-1-2 Find

Use the following procedure to retrieve on-line help from the Find tab of the Help Topics: SYSMAC-PST Help dialog.

1, 2, 3...

1. Select the Find tab.
2. Enter a text query into the first step field. The second step field is refreshed according to the query entered in the first step field. Previous text queries can be retrieved by selecting from the drop-down list in the first step field.
3. Select a word that matches the query - some words may be automatically selected. More than one word can be selected by pressing Shift and selecting another word to extend the selection, or by pressing Ctrl and selecting another word to add to the selection. The third step field is refreshed according to the word or words selected. The number of topics found are shown at the bottom of the dialog.

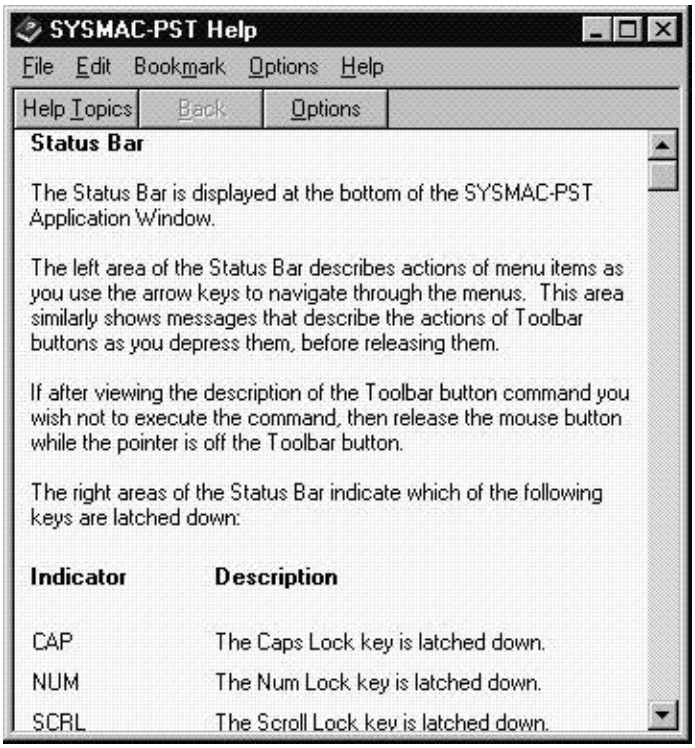


4. Select a topic from the third step field and select the **Display** push-button, or double-left-click on the topic from the third step field. Select the **Clear** push-button to restart the find operation.

The Find operation can be enhanced by the use of the **Options...** push-button and **Rebuild...** push-button. Refer to *Microsoft Windows 95 documentation* for further information.

11-1-3 On-line Help Display

Once the desired on-line help topic has been selected, the topic is displayed.



The display has additional operations than can enhance the use of on-line help. Refer to *Microsoft Windows 95 documentation* for further information.

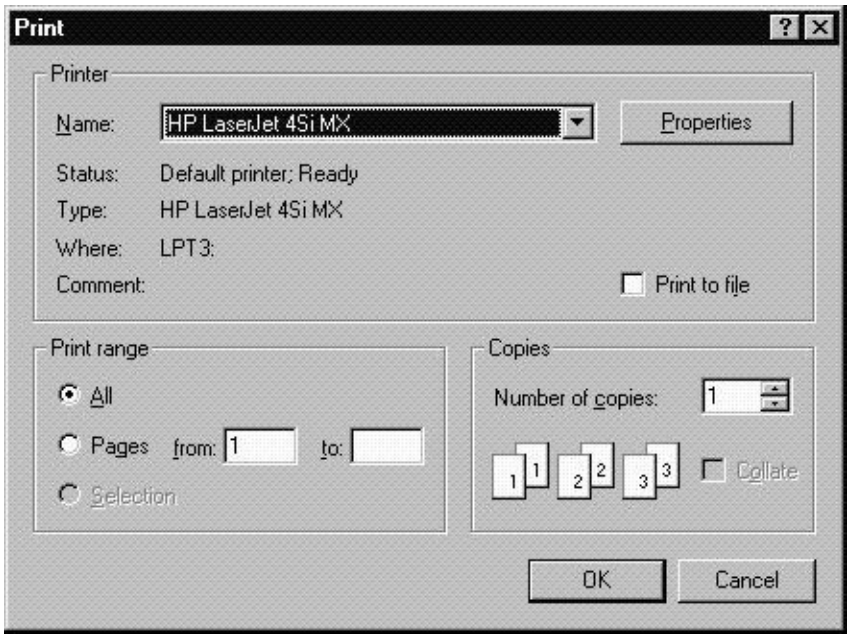
11-1-4 Print

An on-line help topic can be printed. Use the following procedure to print an on-line help topic.

1, 2, 3...

1. Open an on-line topic using a method discussed in this section.
2. Select *Print* from the *File* menu in SYSMAC-PST Help or press Alt+F followed by P in SYSMAC-PST Help.

3. The Print dialog is displayed.



Select the printer from the *Name:* drop-down list. Use the **Properties** push-button to display the Properties dialog and configure the specific printer settings.

4. Click the **OK** button to print the on-line topic. Click the **Cancel** button to close the Print dialog without printing a topic.

Refer to specific Printer documentation for further details on printer configuration.

11-2 Context-sensitive Help

SYSMAC-PST supports the use of context-sensitive help. The relevant on-line help topic is provided automatically by selecting the current area of the display responsible for carrying out those actions.

Use the following procedure to access on-line help for the current action.

1, 2, 3...

1. During the course of using SYSMAC-PST, select the **Help** button on the toolbar.
2. Select the area of the display to receive on-line help. The relevant on-line help topic is displayed.

Alternatively, it is possible to access on-line help by selecting the area of display and pressing F1.

11-3 About SYSMAC-PST

Use the following procedure to view the SYSMAC-PST About box.

1, 2, 3...

1. Select *About SYSMAC-PST* from the *Help* menu or select the **About** button from the toolbar. Alternatively, press Alt+H followed by A.

   The About box is displayed. It provides a copyright statement and version number of SYSMAC-PST.

SECTION 12
Troubleshooting

This section describes the symptoms of errors and the methods for handling them.

12-1 Protocol Troubleshooting

The errors described in the following table are associated with protocols. Refer to *Section 12-7 PSB Troubleshooting* for errors associated with the transfer of protocols to and from the PSB.

Error Message/Symptom	Cause	Action
Maximum protocol reached. Only 20 protocols per project.	The project limit of protocols has been reached.	Reconfigure the project to ensure the problem is not encountered in the future.
No sequence numbers available within this protocol...	The sequence start and sequence end of a protocol does not permit the addition of new sequences.	Increase the range of the sequence start and sequence end for the protocol and try again. Increase the sequence end first.

12-2 Sequence and Step Troubleshooting

The errors described in the following table are associated with sequences and their steps.

Error Message/Symptom	Cause	Action
Channel Number out of range.	A Channel Number has been entered for the Repeat Counter that is outside the range for the selected Channel area.	Enter a valid Channel Number.
Combination of Link Channel Address and Length beyond selected data area.	The combination of the effective starting address and the specified length is beyond the limit of the selected data area.	Change the starting address and/or the Length so that they are within the permitted range.
Communications sequence name already in use...	A name has been supplied to a sequence which is identical for an existing sequence.	Change the sequence name so that it is unique within the protocol.
Contention Send Request Code not valid.	The Contention Send Request Code has been selected but not entered.	Enter the Contention Send Request.
Delimiter Send/Receive request code not valid.	The Delimiter Send Request Code or Delimiter Receive Request Code has been selected but not entered.	Enter the Delimiter Send Request or Delimiter Receive Request code.
Expression constant out of range.	A primary expression constant has been entered for the Repeat Counter that is greater than 128.	Enter a valid expression constant.
Goto number too large.	An invalid step number has been specified with the Goto selection for the Next Process or Error Process.	Enter a valid step number.
Invalid Goto number.	A step number has been entered into the *Next* setting or *Error* setting for a step that does not exist in the current step list.	Enter a valid step number.
Link Channel Address out of range.	Effective starting address out of permitted range for a selected area.	Change the effective starting address so it is within range.
Link Channel Length larger than 128.	Link Channel Address Length longer than the maximum of 128 words.	Change the Length so it is within the permissible range.
Maximum sequence reached. Only 60 Sequences per Protocol.	The protocol limit of sequences has been reached.	Reconfigure the project to ensure the problem is not encountered in the future. For instance, move sequences to another protocol.
Maximum step reached. Only 16 Steps per Sequence.	The sequence limit of steps has been reached.	Reconfigure the project to ensure the problem is not encountered in the future. For instance, move steps to another sequence.
Message not selected.	The *Edit...* setting has been selected in a Send/Receive Message reference for a step without selecting a message.	Select a message first.
Repeat Counter Channel number out of range.	A channel number has been entered for the Repeat Counter Channel that is out of range for the selected data area.	Enter a valid number.
Repeat Counter constant out of range.	A value greater than 255 has been entered for the Repeat Counter constant.	Enter a valid value.
The sequence number is already in use by *another sequence*.	The sequence number specified is the same as *another sequence*.	Specify a sequence number not used by the other sequences in the protocol.

12-3 Message and Matrix Troubleshooting

The errors described in the following table are associated with send and receive messages, and receive matrices.

Error Message/Symptom	Cause	Action
Channel Number larger than selected data area size.	A Channel Number has been entered for the Variable or Length that is out of range for the data area.	Enter a valid Channel Number.
Check Code <c> defined in message but no check code area selected.	A Check Code <c> entry has been made in the Message Data dialog, but the check code has not been specified for an appropriate entry.	Specify a Check code area to an entry.
Expression constant is outside the permitterd range.	An expression factor has been entered for the Variable or Length that is out of range for the selected address type.	Enter a valid expression.
Expression factor is outside the permitted range.	An expression factor has been entered for the Variable or Length that is outside the range for the selected address type.	Enter a valid expression.
Inconsistent constant data - setting message address.	Constant ASCII or Constant selected for Address <a> but no valid data entered.	Enter valid data.
Length <l> defined in message but no length area selected.	A Length <l> entry has been made in the Message Data dialog, but the length has not been specified for an appropriate entry.	Specify a Length area to an entry.
Matrix name already in use...	A name has been supplied to a matrix which is identical for an existing matrix.	Change the matrix name so that it is unique within the protocol.
Maximum case reached. Only 16 cases per protocol.	The matrix limit of cases has been reached.	Reconfigure the project to ensure the problem is not encountered in the future. For instance, create a new protocol for the additional matrices.
Maximum matrix reached. Only 100 matrices per protocol.	The protocol limit of matrices has been reached.	Reconfigure the project to ensure the problem is not encountered in the future. For instance, create a new protocol for the additional matrices.
Maximum message reached. Only 300 messages per protocol.	The protocol limit of Send/Receive messages has been reached.	Reconfigure the project to ensure the problem is not encountered in the future. For instance, create a new protocol for the additional messages.
Message name already in use...	A name has been supplied to a message which is identical for an existing message.	Change the message name so that it is unique.
The total output message size must be less than 257 bytes, your message data contains output data which is *xxx* in length...	Message output size exceeds limit.	Reduce the size of the output data for a single message.
The total output size must be less than 257 bytes, your message output exceeds this value...	Message output size exceeds limit.	Reduce the size of any constants or reduce unnecessary output data (variable output expressions must also be less than 256 characters).
This matrix has the following references which must be removed before this object can be deleted or cut.	Attempting to remove a matrix from the project that is referred to by steps within the project.	Check the message references within each step that refers to each message. If desired, remove the step and try again.
This message has the following references which must be removed before this object can be deleted or cut.	Attempting to remove a message from the project that is referred to by steps within the project.	Check the message reference within each step that refers to the message. If desired, remove the step and try again.

12-4 Trace Troubleshooting

The errors described in the following table are associated with tracing.

Error Message/Symptom	Cause	Action
Connected to a PLC of a different type to that selected. Proceed with Trace operation anyway.	Attempting to trace a PLC not currently selected.	Select the **Yes** push-button to continue. Select the **No** push-button to abort the operation. Check the *Current Configuration* settings. Check that the correct PLC is connected.
File is not a valid SYSMAC-PST Trace file.	Attempting to open a *.ptr file that does not contain trace information.	Select another *.ptr file.
Start, Stop and Upload Trace operations disabled on buttons menu.	The PLC is offline.	Re-establish PLC communications by selecting the Devices icon followed by the PLC icon or PSB icon.
There is no Communications Trace in progress on Port A/B.	Attempting to stop a trace before it has started for the selected port.	Start a new trace. Check connections.
There is no Trace data available for the specified port.	Attempting to access trace data for a port that has no trace data.	Start a new trace for that port.
Unable to complete a trace.	The application ladder has not been downloaded.	Download the application ladder.
Unable to complete a trace.	The correct value has not been set in the PLC memory.	Set the correct value to the PLC memory.
Unable to start Communications Trace on Port A/B.	Attempting to trace from a port without the expected response.	Try again on the other port. Check connections.
Unable to Stop Communications Trace on Port A/B.	Attempting to stop a trace from a port without the expected response.	Check connections.
Unable to upload Trace data from Port A/B.	Attempting to upload a trace without a response from the PSB.	Check the connections and try again.

12-5 Monitor Troubleshooting

The errors described in the following table are associated with monitoring.

Error Message/Symptom	Cause	Action
Connected to a PLC of a different type to that selected. Proceed with Monitor data anyway.	Attempting to monitor a PLC not currently selected.	Select the **Yes** push-button to continue. Select the **No** push-button to abort the operation. Check the *Current Configuration* settings. Check that the correct PLC is connected.
Monitoring cannot be started for the selected PLC...	Attempting to monitor a selected PLC not currently connected.	Check the *Current Configuration* settings. Check that the correct PLC is connected.
Unable to edit data. Address is read-only.	Attempting to edit read-only data.	Refrain from editing the data.
Unable to edit data. PLC is in RUN mode.	Trying to edit data whilst the PLC is in 'Run' mode.	Change the mode of the PLC to 'Monitor' or 'Program'.
Unable to edit data. PLC is offline.	Communications have failed.	Check PLC connections and try again.

12-6 PLC Troubleshooting

The errors described in the following table are associated with the PLC connection.

Error Message/Symptom	Cause	Action
An error has occurred in the Special I/O Units.	PLC error.	Refer to the PLC operation manual.
Batteries are not connected or the batteries have run out or discharged.	PLC error.	Refer to the PLC operation manual.
Connected PLC is not a valid type for use with SYSMAC-PST.	Attempting to connect to a PLC Type not supported by SYSMAC-PST.	Connect and select a PLC that is supported by SYSMAC-PST.
Connected to a PLC of a different type to that selected. Proceed with download protocol anyway.	Attempting to download to a PSB with conflict of selected and connected PLC.	Select the **Yes** push-button to continue. Select the **No** push-button to abort the operation. Check the *Current Configuration* settings. Check that the correct PLC is connected.
No PLC connected.	A PLC is not connected to the computer.	Connect a PLC to the computer.
PLC Error light.	PSB RDY light is flashing following a FAL9C error.	Refer to PLC Operating Manual.
PLC not selected.	Attempting to download protocols to the PSB without selecting a PLC.	Select a PLC.
The cycle time execution of the program was too long.	PLC error.	Refer to the PLC operation manual.
The I/O table does not match the actual state of the I/O Units that are installed.	PLC error.	Refer to the PLC operation manual.
The number of I/O units exceeded the limit.	PLC error.	Refer to the PLC operation manual.
The PLC cannot be opened. It may be in use by another application.	Connection has failed.	Reboot the computer and try again.
The PLC must be in PROGRAM mode to download the Protocol to the PSB...	Attempting to download protocols to the PSB whilst in 'Program' mode.	Select the **Yes** push-button to switch the PLC to 'Program' mode.
The program contains no END instruction.	PLC error.	Refer to the PLC operation manual.
The user memory of the PLC contains an error.	PLC error.	Refer to the PLC operation manual.
There is an error between the CPU and an I/O Unit.	PLC error.	Refer to the PLC operation manual.
There must be a PLC selected before any changes may be made to the communications settings.	Attempting to change communication settings before selecting PLC.	Select a PLC and try again.
Unable to establish communications to the selected PLC...	SYSMAC-PST cannot communicate with the selected PLC.	Check the *Current Configuration* settings. Check the PLC connections.
You must change the 'PC ↔ PLC Comms' Device/CPU type to match the 'PLC Current Config'.	The PLC Device Type dialog settings do not match the *Current Configuration* setting.	Change the *Current Configuration* settings to match the *Current Configuration* settings.

12-7 PSB Troubleshooting

The errors described in the following table are associated with the PSB connection and the transfer of protocols to and from the PSB.

Error Message/Symptom	Cause	Action
Cannot download protocols to the PSB: Too large Protocol size: *xxx*, PSB memory size: *yyy*.	The protocol data selected for download to the PSB is in excess of the capacity of the PSB.	Use the Object Code Size dialog to monitor the amount of protocol data to download and try again. Set the *Include Source* option to OFF and then try again.
Error occurred during the upload of Trace data from the PSB.	Attempting to upload a trace without the expected response from the PSB.	Check the connections and try again.
No connected PSB available...	Connection has failed.	Reboot the computer and try again.
The PSB does not support the PMCR instruction.	The PSB firmware does not support the protocol Macro (PMCR) instruction. SYSMAC-PST protocols cannot be downloaded or executed.	Replace the PSB with a suitable COM04, COM05 or COM06 model which supports the PMCR instruction.
The PSB Protocol password has not been correctly entered. The PSB transfer cannot proceed.	The protocol in the PSB has a password assigned to it. An incorrect password has been entered.	To upload the protocol from the PSB or to download a new protocol to the PSB, type in the correct password.
The *Upload Protocols from PSB* option does not upload any data.	There are no protocols currently on the PSB.	No action.
Unexpected delay transferring protocols to or from the PSB.	Either: more data is being transferred than was expected; communications have failed; slow performance computer.	Disconnect the cable to stop the transfer.

12-8 SYSMAC-CDM Troubleshooting

The errors described in the following table are associated with SYSMAC-CDM.

Note SYSMAC-CDM is a communications-associated application software used in the SYSMAC-PST.

Error Message/Symptom	Cause	Action
SYSMAC-CDM failed to initialise correctly - no further PLC communications may be performed...	Connection has failed.	Reboot the computer and try again.
SYSMAC-CDM has encountered an internal error condition in trying to complete an operation.	Connection has failed.	Reboot the computer and try again.
SYSMAC-CDM has reported that the PLC device is currently locked by another communications activity.	Connection has failed.	Exit SYSMAC-PST and check that no other communications software is using or locking the PLC. If this fails, reboot the computer and try again.
SYSMAC-CDM has returned an unknown error status.	Connection has failed.	Reboot the computer and try again.
SYSMAC-CDM Initialisation Failed.	SYSMAC-PST could not initialise SYSMAC-CDM and the application and therefore cannot function properly. The possible causes are as follows: 1) Path setting of the communications driver (CDM) is incorrect. 2) SYSMAC-PST has not been properly installed or the necessary files do not exist. 3) If the above items 1) and 2) are not applicable, the Windows operating system (file system, registry, etc.) may have been destroyed.	Exit the application and try again. If this fails, reboot the computer and try again. If the failure persists reinstall SYSMAC-PST. 1) Check the contents of the \Windows\Cdm.ini file using a text editor such as a memo file, change the PATH entry settings of the [SYSTEM] section as shown below, and then start the SYSMAC-PST. Contents of the Cdm.ini (When installed in C:\Program Files\SYSMAC): [SYSTEM] PATH=C:\Program Files\SYSMAC\CDM 2) Reinstall SYSMAC-PST. 3) Reinstall Windows (or repair it using a software tool sold in the market) and then install SYSMAC-PST.
SYSMAC-CDM is unable to complete the PLC command because the PLC is not open, or because the command is not supported by the PLC.	Connection has failed.	Exit SYSMAC-PST and check that no other communications software is using or locking the PLC. If this fails, reboot the computer and try again.
Unable to open SYSMAC-CDM project file. SYSMAC-PST unable to communicate to PLC devices. SYSMAC-PST performs automatic shutdown.	The file pst.cdm is not in the application folder or pst.cdm is set as read-only.	Ensure pst.cdm is in the application folder and is not read-only. If not, locate pst.cdm and move back to application folder. If pst.cdm cannot be found, reinstall SYSMAC-PST.

12-9 Communications Troubleshooting

The errors described in the following table are associated with communication failures and settings.

Error Message/Symptom	Cause	Action
A message references a link word not specified in the Link Channel Information dialog.	Attempting to download a message in a protocol that references a word not specified in the Link Channel Information dialog.	Alter the reference.
A matrix case does not contain a message reference.	Attempting to download a matrix case in a protocol that does not contain a message reference.	Enter a message reference.
Address is larger than the selected data area size. Enter a value up to *xxx*.	Attempting to specify an effective address that is larger than the data area.	Specify an effective address not in excess of *xxx.*
Cannot select O1 or O2 when variable type is write.	The address O1 or O2 has been selected for a Write channel type. This is not permitted.	Select a different address for a Write channel type.
Channel number is larger than the selected data area size.	Attempting to specify a Channel number that is larger than the data area.	Specify a channel number not in excess of *xxx.*
Combination of address and length extend beyond the selected data area.	Attempting to specify a Length or an effective address that is larger than the data area.	Specify a length and effective address not in excess of *xxx.*
Communications error with the PLC.	Communications have failed.	Reboot the computer and try again.
Length is larger than the maximum allowed value. Enter a value up to *xxx*.	Attempting to specify a Length that is larger than the data area.	Specify a length not in excess of *xxx.*
Matrix case contains non-existent or invalid message reference.	Attempting to download a matrix case in a protocol that contains a non-existent or invalid message reference.	Modify the reference.
Matrix contains a reference to a non-existent case in the Next Process column.	Attempting to download a matrix in a protocol that contains a reference to a non-existent case in the Next Process column.	Modify the reference.
Protocol does not contain any messages.	Attempting to download a protocol that does not contain any messages.	Enter messages in the protocol.
PSB does not support CRC-16.	Attempting to download to a PSB that does not support CRC-16.	Change the check code type or change PSB for one that supports this facility.
Sequence does not contain any steps.	Attempting to download a communications sequence in a protocol that does not contain any steps.	Enter steps into the communications sequence.
Step does not contain a message reference.	Attempting to download a step in a protocol that does not contain a message reference.	Enter a message reference in the step.
The PSB does not allow a check code to appear after a terminator in a message.	Attempting to download to a PSB that does not allow a check code to appear after a terminator in a message.	Change the order of the message or change the PSB for one that supports this facility.

Error Message/Symptom	Cause	Action
Unable to determine PLC mode. Cannot proceed with downloading protocols to the PSB...	Communications have failed.	Check PLC connections and try again.
You must terminate PLC communications before the communications settings for the PLC may be changed.	Attempting to change communication settings with a PLC selected.	Select the **OK** push-button to terminate the communications and change the settings. select the **Cancel** push-button to abort the operation.

12-10 General Troubleshooting

The errors described in the following table are associated with other miscellaneous items.

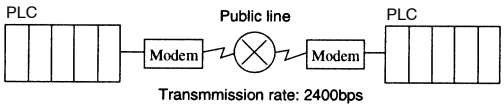
Error Message/Symptom	Cause	Action
Internal application error in file...	Internal error.	Reboot the computer and try again. If this fails, reinstall SYSMAC-PST. If the problem persists, contact the vendor.
OLE initialisation has failed. SYSMAC-PST cannot continue.	Microsoft Windows' OLE (Object Linking and Embedding) library has failed to initiate.	Reinstall Windows 95. Reinstall SYSMAC-PST and try again.
Disk full while accessing xxx.	Failure when saving a project file due to insufficient disk space.	Resave on the hard disk.

Appendix A
Creating the Protocol Applications

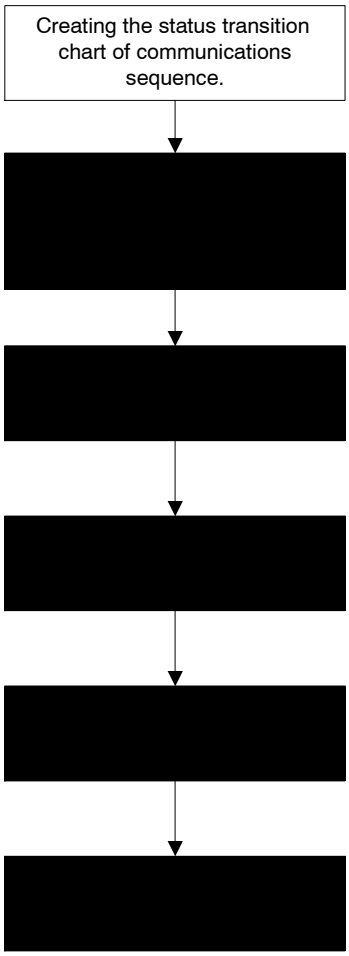
Communication between PLCs via Modems: example

In this chapter, a protocol is created which implements communications between PLCs via telephone line using modems. The connection structure and the flow of the protocol creation procedure are as shown below:

Connection Structure

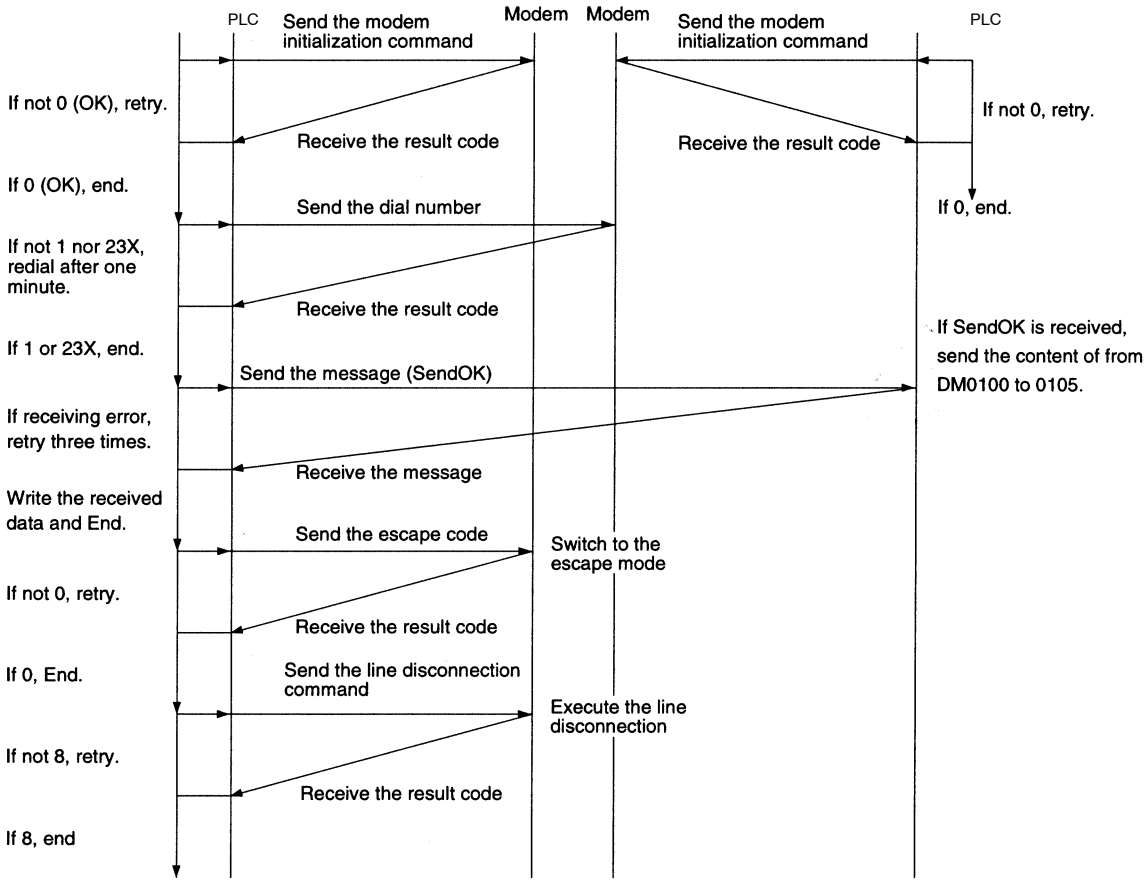


Protocol Creation Procedure



Creating the Status Transition Chart of Communications Sequence.

When the data sending and receiving between PLCs are conducted via telephone line using modems, the outline of the communications sequences is as shown below:



Note The information about the AT commands to be sent to the modem i.e. the initialization command, the dial command, the escape code sending, the line disconnection command, etc. and the result codes (response) is described in the manual of the modem in use. The modem used in this example is "MD24FB10V (made by OMRON)". AT commands and result codes supported by the modem are listed below.

• List of Commands Used in This Example

AT command	Setting item	Settings
Modem initialization ATE0V0X4\V2\N3%CO*CO\X1	Command echo	Not available
	Result code display format	Numerical
	Speed display when connection has been completed	Available
	Busy, dial tone detection	Available
	Display of error corrections and compressed data when connection has been completed	Available
	MNP setting	Available (auto reliable mode)
	MNP class	Class 4
	V.42 compression, error setting	Not available
	Flow control between terminal modems	Not available
	ER signal control	Always ON
	Escape code	+
Dial command ATDT dial number	Dial class	Tone
Escape signal code transmission ++++	Mode selection	Online mode to escape mode
Line off command ATH0	Line off	

• List of Result Codes

Numerical format	Character format	Content
0	OK	Properly ended
1	CONNECT	Connection completed
2	RING	Signal receive detection
3	NO CARRIER	Line off
4	ERROR	Command error
5	CONNECT 1200	Connection to 1,200 bps
6	NO DIAL TONE	No-dial-tone detection
7	BUSY	Busy detection
8	NO ANSWER	No answer detection
9	HAND SET IN USE	Busy
234	CONNECT 2400/REL4	Connection to 2400 MNP class

Disassembling of the Process Contents into the “Sequences” and the “Steps” Editable by the Protocol Support Tool

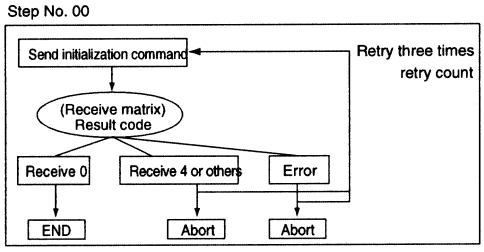
The above communications sequences are firstly disassembled into the following sequences by the process block.

Sequence No. 000: Modem initialization
001: Dial operation
002: Send message/Receive data, Switch modes, Line disconnection

Then the steps are configured for each sequence.

Sequence No. 000: Modem initialization

Step No. 00



Normal

The system sends the modem initialization command and waits the result code from the modem. Because there is more than result code, the following receive matrix is set:

0: End for the normal end of the initialization.

4: This is a command error. The cause will be a wrong setup for the initialization command. The abort and the correct setup for the initialization command are necessary.

Other: Abort.

Note Although the next process of "4" (command error) is same with that of "Other", it is set as a separate receive Matrix case. This is because the checking of the matrix number from the flag at an error occurrence allows the confirmation of the error cause and eases the debugging.

Abnormal

By the setting of the retry count (three times), the system automatically retries the same step up to three times at the following error occurrences:

- The send finish monitoring time Tfs, the receive wait monitoring time Tr, or the receive finish monitoring time Tfr is up.
- A transmission error (CIO28304 or 28312 is ON) occurs at the receiving.
- Wrong receive message
- An error occurs in the error check code

If the initialization fails even after the maximum three times of retry, it is handled by the error process.

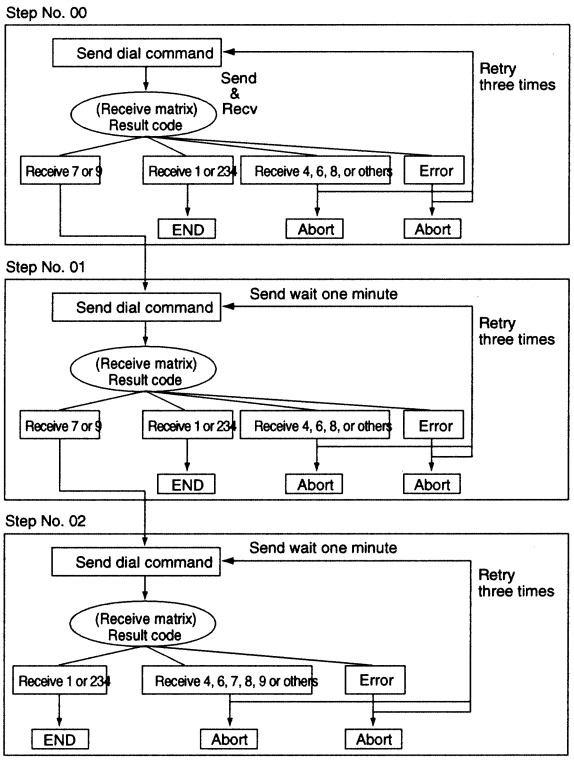
An error at this stage may be caused by wrong PLC system setup or wrong wiring, which step description cannot handle. Therefore, the abort is set for this error process.

Sequence No. 000: Modem initialization

Step No.	Repeat Counter	Command	Retry Count	Send Wait	Send Message	Receive Message		Response Notification	Next Process	Error Process
00	R/001	Send&Recv	3	–	Initialization Command	0	End	–	–	Abort
						4	Abort			
						Other	Abort			

Note The partner machine creates similar steps and executes the initialization of the local modem.

Sequence No. 001: Dial Operation



Normal

When the modem is initialized, the system dials the telephone number and secures the communication line with the partner PLC. Besides the line connection completion “1 (CONNECT)”, there are several result codes for the dial command. For example, 7 (BUSY) is the connection failure because of the busy line this case, if the other step (to redial after one minute) is configured specifying its step number with “goto”, the sequence execution is not aborted but can be continued.

1 (CONNECT):	Line connection completion	End
4 (ERROR):	Command error	Abort
	Confirm the contents of the dial command setup	
6 (NO DIALTONE):	No dialtone detected	Abort
	Confirm the dial type (tone or pulse)	
7 (BUSY):	Connection failure for the busy line.	
	Redial after one minute	Goto01
8 (NO ANSWER):	No answer tone detected	Abort
	Confirm if the partner modem is receivable.	
9 (HAND SET IN USE):	Connection failure for the telephone calling.	
	Redial after one minute	Goto01
234 (CONNECT 2400/REL4	Line connection completion	End
Others	Abort	

Note In the second and later retry process executions, the send wait time is ignored. Therefore, another step 01 is created whose send wait time is one minute for the case the result code is 7 (BUSY). Thus the retry process should not be set in such process that needs to put the send wait time.

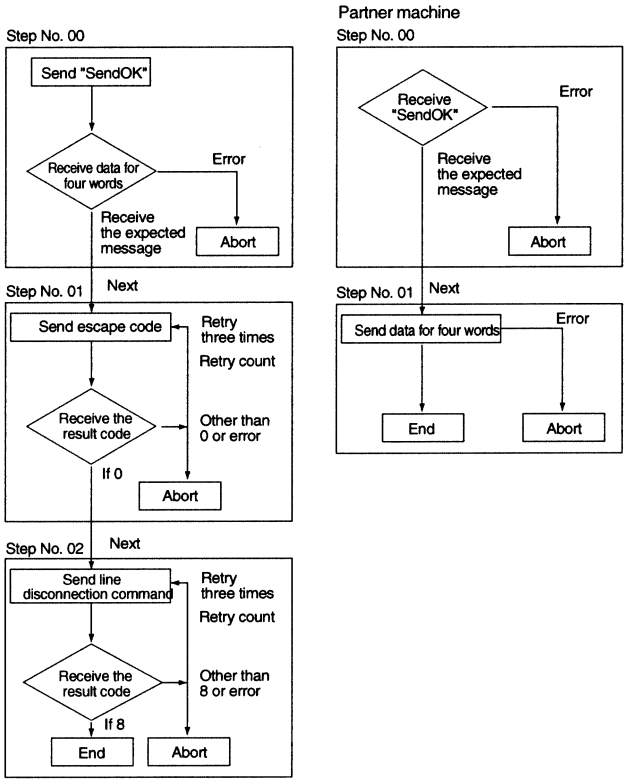
Abnormal

An error cause other than the receive matrix may be caused by wrong modem's transmission rate or abnormal line status. Because any step description can not avoid these errors, it is necessary to abort and to confirm the transmission rate and the line condition when the communication fails even in the third retry.

Sequence No. 001: Dial operation

Step No.	Repeat Counter	Command	Retry Count	Send Wait	Send Message	Receive Message		Response Notification	Next Process	Error Process
00	R/001	Send&Recv	3	–	Dial number	1	End	–	–	Abort
						4	Abort			
						6	Abort			
						7	Goto01			
						8	Abort			
						9	Goto01			
						234	End			
						Other	Abort			
01	R/001	Send&Recv	3	One minute	Dial number	1	End	–	–	Abort
						4	Abort			
						6	Abort			
						7	Goto02			
						8	Abort			
						9	Goto02			
						234	End			
						Other	Abort			
02	R/001	Send&Recv	3	One minute	Dial number	1	End	–	–	Abort
						4	Abort			
						6	Abort			
						7	Goto02			
						8	Abort			
						9	Goto02			
						234	End			
						Other	Abort			

SendOK Message Sending/Data Receiving, Mode Switch, Line Disconnection (Sequence No. 002)



Normal

When the connection with the communication partner is established, the system sends the message (SendOK) and waits the data from the partner machine. The communication partner sends four words data stored in from DM0100 to DM0105 after the receipt of the “SendOK” message.

When the system receives the four words data, it writes them from DM0200, sends the escape code (+++) after the end of the receipt. Then, it switches the escape mode to receive AT command from the on-line mode, and sends the line disconnection command.

Abnormal

Most presumable errors here would be the time-up error of the monitoring time, the receiving error on the transmission, the wrong message reception, the error check code error. For these errors, the three times of retry process is set. Further error occurs, the system aborts and checks the modem’s transmission rate and line condition.

Following are both steps configurations:

(The sequence configuration of the sending PLC)

Sequence No. 002:
The message sending/the data receiving, the mode switch, and the line disconnection

Step No.	Repeat Counter	Command	Retry Count	Send Wait	Send Message	Receive Message	Response Notification	Next Process	Error Process
00	R/001	Send&Recv	3	–	SendOK	Writing from DM0200 (W(1), 8)	–	Next	Abort
01	R/001	Send&Recv	3	–	Escape code	0 (result code)	–	Next	Abort
02	R/001	Send&Recv	3	–	Line disconnection command	8 (result code)	–	End	Abort

(The sequence configuration of the receiving PLC)

Sequence No. 000: The message receiving/the data sending

Step No.	Repeat Counter	Command	Retry Count	Send Wait	Send Message	Receive Message	Response Notification	Next Process	Error Process
00	R/001	Recv	3	–	–	SendOK	–	Next	Abort
01	R/005	Send	3	–	Contents of four words starting from DM0200 (R(1), 8)	–	–	End	Abort

Configurating the Communication Messages Contents

For the communication messages setup, the send and receive data storing mode and the message format are necessary to be set up.

The Send and Receive Data Storing Mode

There are four kinds of modes as the send and receive data storing modes as follow:

- Constant addressing
- Operand addressing (with/without response method)
- Link word addressing
- Direct addressing

In this example, each mode is differentiated according to the features of communication data as follows:

Communication Data	Feature	Storing Method
Initialization command	It is directly set up in the message due to no need to change during the same modem use.	Constant addressing
Dial command	It is desirable to be dynamically set up for the possible change in accordance with the environment.	Operand addressing
Send data (SendOK)	It is directly set up in the message due to no need to change.	Constant addressing
Five words of send data	It is desirable to be dynamically set up for the possible change in accordance with the environment.	Operand addressing
Receive result code	It is directly set up in the message due to no need to change during the same modem use.	Constant addressing

Message Format

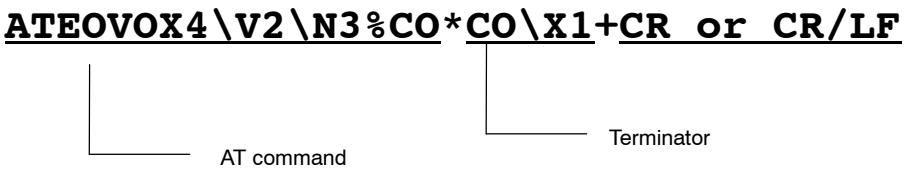
In the modem control procedure, the communication is done by the instruction (AT command) from a terminal (the PLC in this example) and the modem's response (result code) to the instruction. Because AT commands and the result codes consist of a character string delimited by CR and CR/LF, the message format is as follows:
Data + Terminator (CR or CR/LF)

Note The header, the address, the length, and the error check code are not set.

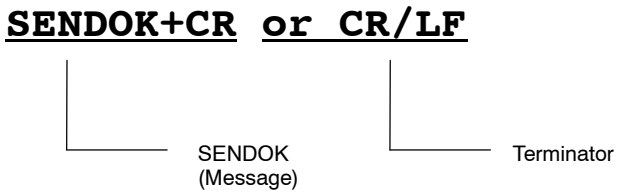
- Constant addressing

In the constant addressing communication message, CR or CR/LF shall be set after the initialization command, the send data (SendOK), the receive result code, etc.

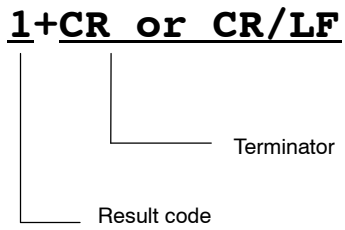
Example of the initialization command setting:



Example of the sent data (SendOK) setting:



Example of the result code setting:

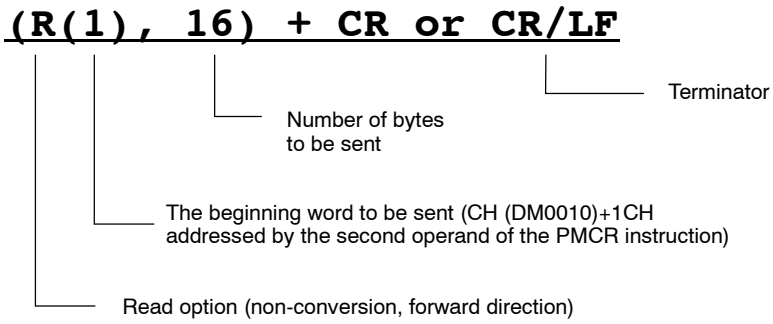


• Operand addressing

For the operand addressing communication data, the communication data must be stored in the area set by the PMCR instruction after PMCR instruction specification (the both beginning word numbers of the send data storing and the received data storing) are determined. The configuration of the operand addressing communication data used in this example is as follows:

Example of the dial command setting:

• The send message content to be described in the step No. 00 to 02 of the sequence No. 001 for the PLC which sends SendOK message



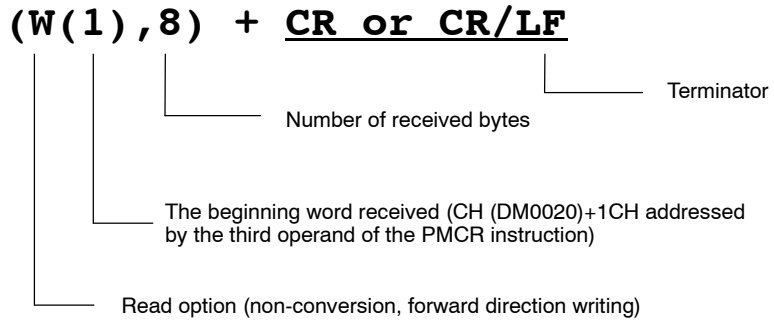
• Actual data sent and stored in the addressed word

DM0010	DM0011	DM0012	DM0013	DM0014	DM0015	DM0016	DM0017	DM0018
0009	4154	4454	3033	2D30	3132	332D	3435	3637
9	AT	DT	03	-0	12	3-	45	67

Set in the first word is the total number of words of the data to be sent

Example of the setting for four-word receive data stored in DM0201

• The received message described in the step No. 00 of the sequence No. 002 for the PC which sent the SendOK message.



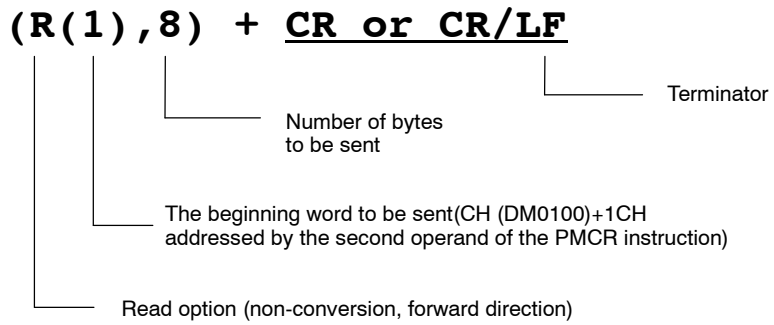
• The received data actually written in the addressed word

DM0200	DM0201	DM0202	DM0203	DM0204
0005	3130	3135	3230	3532
5	10	15	20	52

Number of words to be received (set automatically)

Example of setting for four words data sending:

• The send message described in the step No. 01 of the sequence No. 000 for the PC which receives SendOK message



• The send data content to be actually stored in the addressed word

DM0100	DM0101	DM0102	DM0103	DM0104
0005	3130	3135	3230	3532
5	10	15	20	52

Set the total number of words of the data to be sent

Setting the Transmission Control Mode

"Modem Control" is specified as the transmission control mode for the one-to-one communication between PLCs via modems. The modem control mode is held by the instructions from terminals (PLCs) and the modems' responses to the instructions. Those instructions (AT commands) and the responses (result codes) consist in a character string delimited by delimiters, CR and CR/LF.

For the modem control, the RS/CS flow control or the Xon/Xoff flow control can be set as a flow control. However, these flow controls are not set in this example, because the communication messages are short.

Note 1. For the details of the setup method for the transmission control modes, refer to *4-3 Transmission Control Mode Setup*.

2. The protocol is created by Hayes-compatible AT mode in this example, while there are AT mode and V.25bis mode for the modem control.

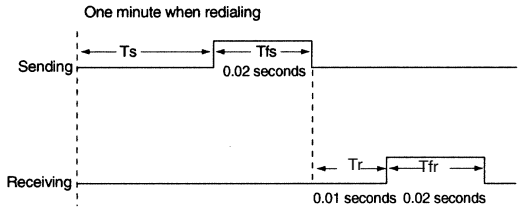
Setting Monitoring Time

If the monitor time (the send finish monitoring time: Tfs, the receive wait monitoring time: Tr, and the receive finish monitoring time: Tfr) has been set, when the send or receive process is not executed in the monitor time, the error is detected and the process can be switched to the error process or the retry process immediately before the step finishes (in the send or receive step).

If it is used in the combination with the retry process, when the following retry factors occurred, the step can be re-executed without any description of the error process and the protocol or the ladder program description can remarkably be simplified.

- The send finish monitoring time Tfs, the receive wait time Tr, or the receive finish monitoring time Tfr is up.
- A transmission error (CIO28304 or 28312 is ON) occurs at the receiving.
- The received message is different from the setup one.
- An error occurs with the error check code

In this example, the monitoring time is set as shown below. For the calculation method of the monitoring time, refer to *4-5 Calculation Method of Monitoring Time*.

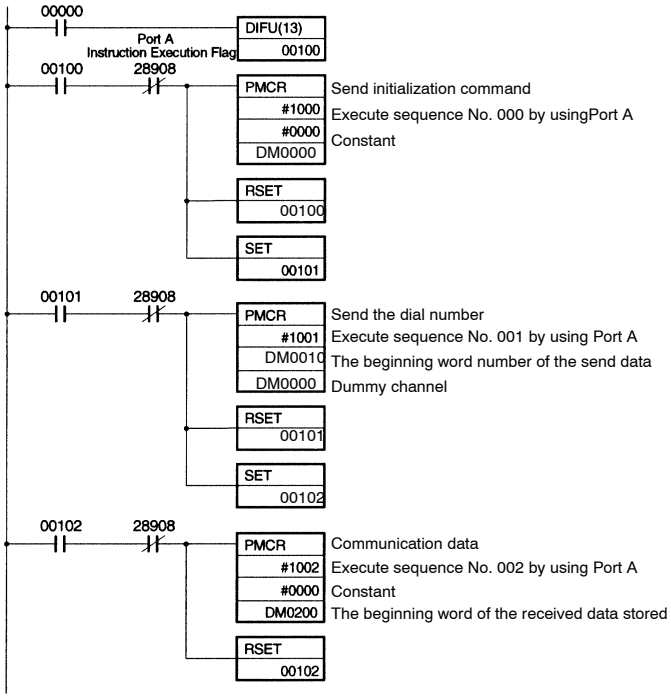


Note 1. The retry count can be set only for the step in which Send&Recv command are set.

2. If both the repeat counter and the retry count are set, the counter does not increment while the step is being retried by the number of the retry count. When the retry factor resolved or the step was executed by the number of retry count, the counter increments.

Creating the Ladder Program

The ladder program to execute the created protocol is described and transferred to the PLC. An example of the ladder program is shown below:



Appendix B
PC Setup and PSB Settings

PC Setup

Word(s)	Bit(s)	Function	Default
RS-232C Port Settings (DM 6645 to DM 6649)			
The following settings are accessed continually while the PC is ON.			
DM 6645	00 to 03	Port settings 0: Standard (1 start bit, 7-bit data, even parity, 2 stop bits, 9,600 bps) 1: Settings in DM 6646	Standard
	04 to 07	CTS control setting 0: Disable CTS control 1: Enable CTS control	Disable
	08 to 11	Words linked for 1:1 link 0: LR 00 to LR 63; 1: LR 00 to LR 31; 2: LR 00 to LR 15 Maximum PT node number for 1:N NT Link 1 to 7 BCD (1 to 3 with a C200HE-CPU□□-E PC)	LR 00 to LR 63
	12 to 15	Communications mode 0: Host link; 1: RS-232C; 2: 1-to-1 link slave; 3: 1-to-1 link master; 4: NT link (1:1); 5: NT link (1:N)	Host Link
DM 6646	00 to 07	Baud rate 00: 1.2K, 01: 2.4K, 02: 4.8K, 03: 9.6K, 04: 19.2K	1.2 K
	08 to 15	Frame format Start / Length / Stop / Parity 00: 1 bit / 7 bits / 1 bit / Even 01: 1 bit / 7 bits / 1 bit / Odd 02: 1 bit / 7 bits / 1 bit / None 03: 1 bit / 7 bits / 2 bit / Even 04: 1 bit / 7 bits / 2 bit / Odd 05: 1 bit / 7 bits / 2 bit / None 06: 1 bit / 8 bits / 1 bit / Even 07: 1 bit / 8 bits / 1 bit / Odd 08: 1 bit / 8 bits / 1 bit / None 09: 1 bit / 8 bits / 2 bit / Even 10: 1 bit / 8 bits / 2 bit / Odd 11: 1 bit / 8 bits / 2 bit / None	1 start bit, 7-bit data, 1 stop bit, even parity
DM 6647	00 to 15	Transmission delay 0000 to 9999: BCD in 10-ms units.	0 ms

Word(s)	Bit(s)	Function	Default
Peripheral Port Settings (DM 6650 to DM 6654)			
The following settings are accessed continually while the PC is ON.			
DM 6650	00 to 03	Port settings 0: Standard (1 start bit, 7-bit data, even parity, 2 stop bits, 9,600 bps) 1: Settings in DM 6651	Standard
	04 to 11	Reserved	---
	12 to 15	Communications mode 0: Host link; 1: RS-232C	Host Link
DM 6651	00 to 07	Baud rate 00: 1.2K, 01: 2.4K, 02: 4.8K, 03: 9.6K, 04: 19.2K	1.2 K
	08 to 15	Frame format Start / Length / Stop / Parity 00: 1 bit / 7 bits / 1 bit / Even 01: 1 bit / 7 bits / 1 bit / Odd 02: 1 bit / 7 bits / 1 bit / None 03: 1 bit / 7 bits / 2 bit / Even 04: 1 bit / 7 bits / 2 bit / Odd 05: 1 bit / 7 bits / 2 bit / None 06: 1 bit / 8 bits / 1 bit / Even 07: 1 bit / 8 bits / 1 bit / Odd 08: 1 bit / 8 bits / 1 bit / None 09: 1 bit / 8 bits / 2 bit / Even 10: 1 bit / 8 bits / 2 bit / Odd 11: 1 bit / 8 bits / 2 bit / None	1 start bit, 7-bit data, 1 stop bit, even parity
DM 6652	00 to 15	Transmission delay (Host Link) 0000 to 9999: in 10-ms units.	0 ms
DM 6653	00 to 07	Node number (Host link) 00 to 31 (BCD)	0

PSB Settings

Word(s)	Bit(s)	Function	Default
PSB Port B Settings (DM 6550 to DM 6554)			
The following settings are accessed continually while the PC is ON.			
DM 6550	00 to 03	Port settings 0: Standard (1 start bit, 7-bit data, even parity, 2 stop bits, 9,600 bps) 1: Settings in DM 6551	Standard
	04 to 07	CTS control setting 0: Disable CTS control 1: Enable CTS control	Disable
	08 to 11	Words linked for 1:1 link (Can't be changed once set in the 1:1 link Master.) 0: LR 00 to LR 63; 1: LR 00 to LR 31; 2: LR 00 to LR 15 Maximum PT node number for 1:N NT Link 1 to 7 BCD (1 to 3 with a C200HE-CPU□□-E PC)	LR 00 to LR 63
	12 to 15	Communications mode 0: Host link; 1: RS-232C; 2: 1-to-1 link slave; 3: 1-to-1 link master; 4: NT link (1:1); 5: NT link (1:N); 6: Protocol Macro	Host Link

Word(s)	Bit(s)	Function	Default
DM 6551	00 to 07	Baud rate 00: 1.2K, 01: 2.4K, 02: 4.8K, 03: 9.6K, 04: 19.2K	1.2 K
	08 to 15	Frame format Start / Length / Stop / Parity 00: 1 bit / 7 bits / 1 bit / Even 01: 1 bit / 7 bits / 1 bit / Odd 02: 1 bit / 7 bits / 1 bit / None 03: 1 bit / 7 bits / 2 bit / Even 04: 1 bit / 7 bits / 2 bit / Odd 05: 1 bit / 7 bits / 2 bit / None 06: 1 bit / 8 bits / 1 bit / Even 07: 1 bit / 8 bits / 1 bit / Odd 08: 1 bit / 8 bits / 1 bit / None 09: 1 bit / 8 bits / 2 bit / Even 10: 1 bit / 8 bits / 2 bit / Odd 11: 1 bit / 8 bits / 2 bit / None	1 start bit, 7-bit data, 1 stop bit, even parity
PSB Port A Settings (DM 6555 to DM 6559) The following settings are read continually while the PC is ON.			
DM 6555	00 to 03	Port settings 0: Standard (1 start bit, 7-bit data, even parity, 2 stop bits, 9,600 bps) 1: Settings in DM 6556	Standard
	04 to 07	CTS control setting 0: Disable CTS control 1: Enable CTS control	Disable
	08 to 11	Words linked for 1:1 link (Can't be changed once set in the 1:1 link Master.) 0: LR 00 to LR 63; 1: LR 00 to LR 31; 2: LR 00 to LR 15 Maximum PT node number for 1:N NT Link 1 to 7 BCD (1 to 3 with a C200HE-CPU□□-E PC)	LR 00 to LR 63
	12 to 15	Communications mode 0: Host link; 1: RS-232C; 2: 1-to-1 link slave; 3: 1-to-1 link master; 4: NT link (1:1); 5: NT link (1:N); 6: Protocol Macro	Host Link
DM 6556	00 to 07	Baud rate 00: 1.2K, 01: 2.4K, 02: 4.8K, 03: 9.6K, 04: 19.2K	1.2 K
	08 to 15	Frame format Start / Length / Stop / Parity 00: 1 bit / 7 bits / 1 bit / Even 01: 1 bit / 7 bits / 1 bit / Odd 02: 1 bit / 7 bits / 1 bit / None 03: 1 bit / 7 bits / 2 bit / Even 04: 1 bit / 7 bits / 2 bit / Odd 05: 1 bit / 7 bits / 2 bit / None 06: 1 bit / 8 bits / 1 bit / Even 07: 1 bit / 8 bits / 1 bit / Odd 08: 1 bit / 8 bits / 1 bit / None 09: 1 bit / 8 bits / 2 bit / Even 10: 1 bit / 8 bits / 2 bit / Odd 11: 1 bit / 8 bits / 2 bit / None	1 start bit, 7-bit data, 1 stop bit, even parity

Appendix C
Wiring RS-232C Cable Connectors

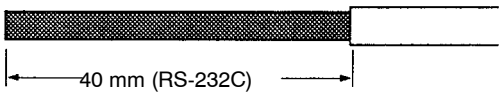
Cable Processing (End Connected to FG)

See the diagrams for the lengths required in each set.

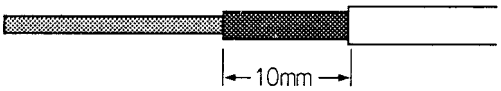
1, 2, 3...

1. Cut the cable to the required length.

2. Peel the sheath using a razor blade without damaging the shield weaving.



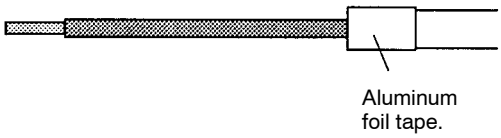
3. Remove the shield using scissors.



4. Peel the core wire of each wire using a stripper.

5. Fold back the shield wire.

6. Wrap aluminum foil tape on top of the folded shield.

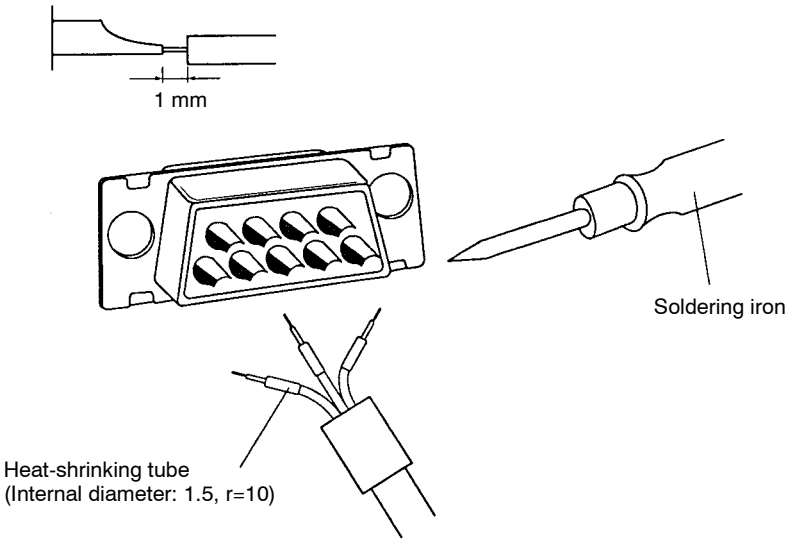


Soldering

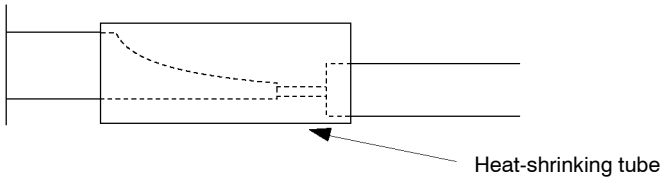
Solder as described next.

1, 2, 3...

1. Place a heat-shrinking tube around each wire.
2. Presolder each wire and to its connector pin.
3. Solder each wire firmly in place.

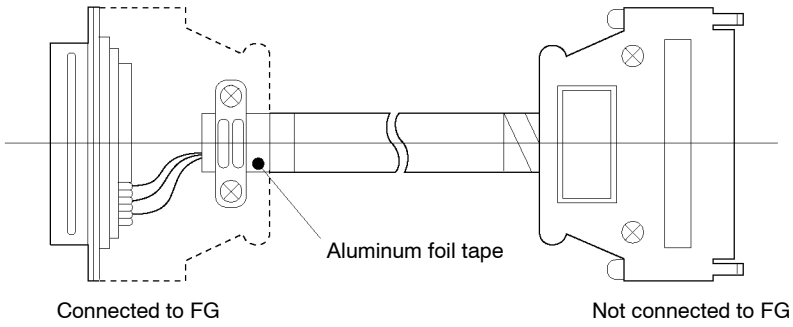


4. Move the heat-shrinking tube to the soldered section and shrink the tube by heating it.



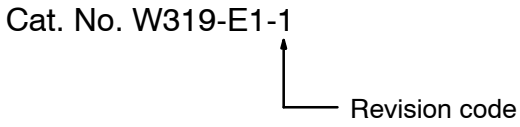
Assembling Hood

Assemble the connector hood as shown below.



Revision History

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.



The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

Revision code	Date	Revised content
1	August 1997	Original production