

KV Nano Series Serial Communication Function

Built-In Serial Port Extension Cassette KV-N10L/N11L Extension adapter KV-NC10L/NC20L

User's Manual

Read this manual before using the product.
Keep this manual in a safe place for later reference.

| | |
|------------|---|
| Chapter 1 | CONFIGURATION AND SPECIFICATIONS |
| Chapter 2 | UNIT INSTALLATION AND MAINTENANCE |
| Chapter 3 | ACCESS WINDOW OPERATIONS |
| Chapter 4 | USING THE BUILT-IN FUNCTION MONITOR TO CHECK OPERATIONS |
| Chapter 5 | KV MODE (HOST LINK) |
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| Chapter 8 | NON-PROCEDURE MODE |
| Chapter 9 | Modbus MASTER MODE |
| Chapter 10 | Modbus SLAVE MODE |
| Chapter 11 | SERIAL PLC LINK MODE |
| | APPENDICES |



Supported Base Units
KV-N10L/KV-N11L
• KV-N14**
• KV-N24**
• KV-N40**
• KV-N60**
KV-NC10L/KV-NC20L
• KV-NC32T

Preface

This manual provides an overview of the KV Nano Series Serial Communication Function as well as describes the functions of and how to use the serial communication function.

Be sure to thoroughly read and fully understand this manual before using the product. In addition, store this manual in a safe place so that you can retrieve it whenever necessary.

■ KV Nano Series serial communication function related manuals

Read the following manuals together with this manual when you use the KV Nano Series Serial Communication Function.

All the following PDF manuals can be found and opened in the help file of KV STUDIO. In addition, the latest versions of the PDF manuals can be downloaded from the KEYENCE website.

To request printed versions of these manuals, use the appropriate phone number listed on the back of this manual.

| Name | Description |
|---|--|
| KV Nano Series User's Manual | This manual describes the system configuration and specifications of the KV Nano Series. It also describes the CPU built-in functions and how to create ladder programs. |
| KV-5500/5000/3000/1000 Series and KV Nano Series Instruction Reference Manual | This manual describes the instructions that are available in ladder programming. |
| KV-5500/5000/3000/1000 Series and KV Nano Series Script Programming Manual | This manual describes how to create script programs and the available operators, control sentences, and functions. |
| KV STUDIO User's Manual | This manual describes how to operate KV STUDIO. |

Safety Precautions

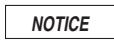
This manual describes how to operate the KV Nano Series Serial Communication Function. This manual also describes other information such as operating procedures and precautions related to the serial communication function.

To ensure proper use of the KV Nano Series Serial Communication Function, read this manual carefully and ensure that you fully understand the information contained within.

Store this manual in a safe place so that you can retrieve it whenever necessary.
Provide this manual to the end-users of the product.

■ Symbols

This document contains notices that you should observe to ensure your own personal safety, as well as to protect the product and connected equipment. These notices are marked according to the level of danger as shown below.

| | |
|---|--|
|  DANGER | It indicates a hazardous situation which, if not avoided, will result in death or serious injury. |
|  WARNING | It indicates a hazardous situation which, if not avoided, could result in death or serious injury. |
|  CAUTION | It indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. |
|  NOTICE | It indicates a situation which, if not avoided, could result in product damage as well as property damage. |



It indicates cautions and limitations that must be followed during operation.



It indicates additional information on proper operation.



It indicates tips for better understanding or useful information.



Indicates a page to be referred to in this manual or other manuals.

■ General precautions

- Before you use this product, verify its functionality and performance at startup and during operation.
- Provide a safety circuit that bypasses the PLC to enable failsafe operation of the entire system in the event that the PLC fails.
- Internal circuit malfunctions sometimes prevent control from being performed normally. Be sure to provide a safety circuit in control systems where circuit malfunction may lead to fire or other serious accidents.
- Proceed with care when modifying the product or when using it in a manner that falls outside of the ranges indicated in its specifications since KEYENCE is unable to guarantee product functionality or performance in such situations.
- Use this product in combination with other products only after careful consideration since the product may fail to satisfy its functionality and performance capabilities as a result of factors such as its usage conditions and the environment in which it is used.
- Do not use the product with the purpose of protecting human beings.

■ Note

When using this product under the following conditions or operating environments, consult with your KEYENCE agent in addition to implementing safety measures such as failsafe provisions and product operation that provides room regarding ratings and functions.

- Use of the product under conditions or environments not described in this manual.
- Use of the product in nuclear power generation control, railroad facilities, aviation facilities, vehicles, combustion devices, medical equipment, entertainment machinery, safety equipment, etc.
- Use in applications where a major influence on human life and property is anticipated, and where safety in particular is required.

■ CE marking and UL standard

For details on limitations regarding CE marking and on limitations for UL508 compliance, see  the "KV Nano Series User's Manual."

Manual Organization

| | | |
|-----------------------|---|---|
| Chapter 1 | CONFIGURATION AND SPECIFICATIONS | This chapter describes what you can do with the serial communication function, the operation modes, the names and functions of parts, the specifications, and the system configuration. |
| Chapter 2 | UNIT INSTALLATION AND MAINTENANCE | This chapter describes the installation environment of the KV Nano Series, how to install extension cassettes and extension adapters on the base unit, and how to connect peripherals. |
| Chapter 3 | ACCESS WINDOW OPERATIONS | This chapter describes the operations of the access window that you can monitor when you have installed an extension access window cassette (KV-N1AW). |
| Chapter 4 | USING THE BUILT- IN FUNCTION MONITOR TO CHECK OPERATIONS | This chapter describes how to use the built-in function monitor of Ladder Support Software KV STUDIO. |
| Chapter 5 | KV MODE (HOST LINK) | This chapter describes the communication specifications, commands, and responses in KV mode (host link). |
| Chapter 6 | KV MODE (TEXT TRANSMISSION) | This chapter describes the programming that is required to communicate in KV mode (text transmission). |
| Chapter 7 | KV STUDIO MODE | This chapter describes the settings to configure when you are using KV STUDIO or when you have connected a VT3 Series. |
| Chapter 8 | NON-PROCEDURE MODE | This chapter describes the programming that is required to communicate in non-procedure mode. |
| Chapter 9 | Modbus MASTER MODE | This chapter describes the communication specifications of and how to use Modbus master mode. |
| Chapter 10 | Modbus SLAVE MODE | This chapter describes the communication specifications of and how to use Modbus slave mode. |
| Chapter 11 | SERIAL PLC LINK MODE | This chapter describes the communication specifications of and how to use Serial PLC Link mode. |
| | APPENDICES | The appendices contain an ASCII code table, error remedies, and the differences between the KV-5000/3000 Series and the KV Nano Series. |

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Conventions Used In This Manual

This section describes how to use the sample ladder programs (mnemonics lists) that are written in this manual.

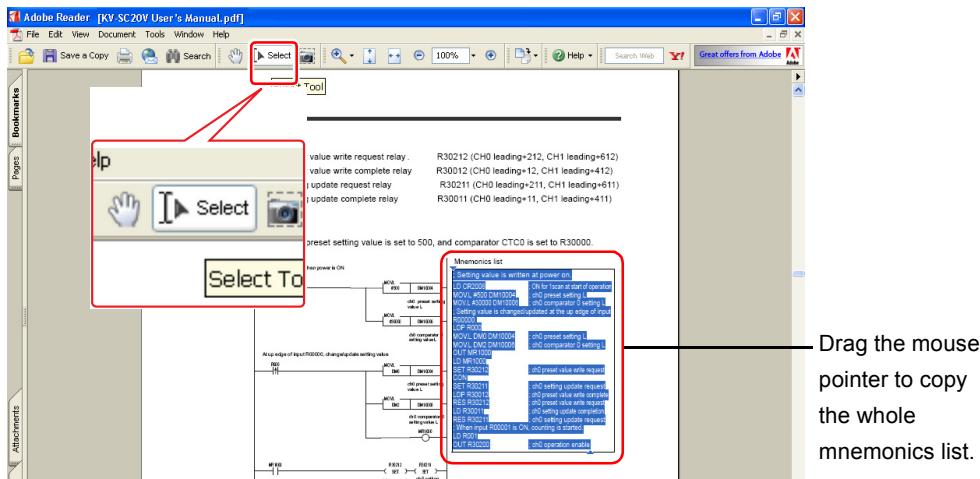
How to Use Mnemonics List

A mnemonics list is written on each page in which a sample ladder program is introduced.

You can use mnemonic lists to easily enter ladder programs.

1 Use Adobe Reader to display the manual.

2 Use the "Select" tool to copy a mnemonic list.



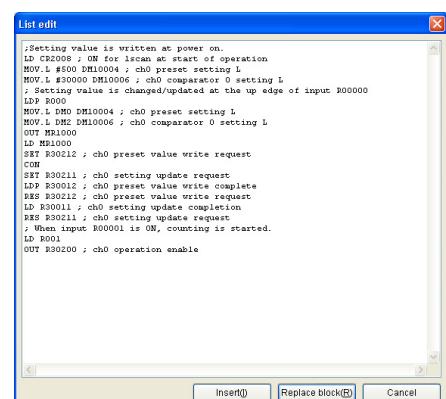
3 In the ladder editing area of KV STUDIO, click the cell where you want to insert the sample ladder program, and then, on the "Edit" menu, click "Edit list" to display the "List edit" dialog box.

Alternative procedure

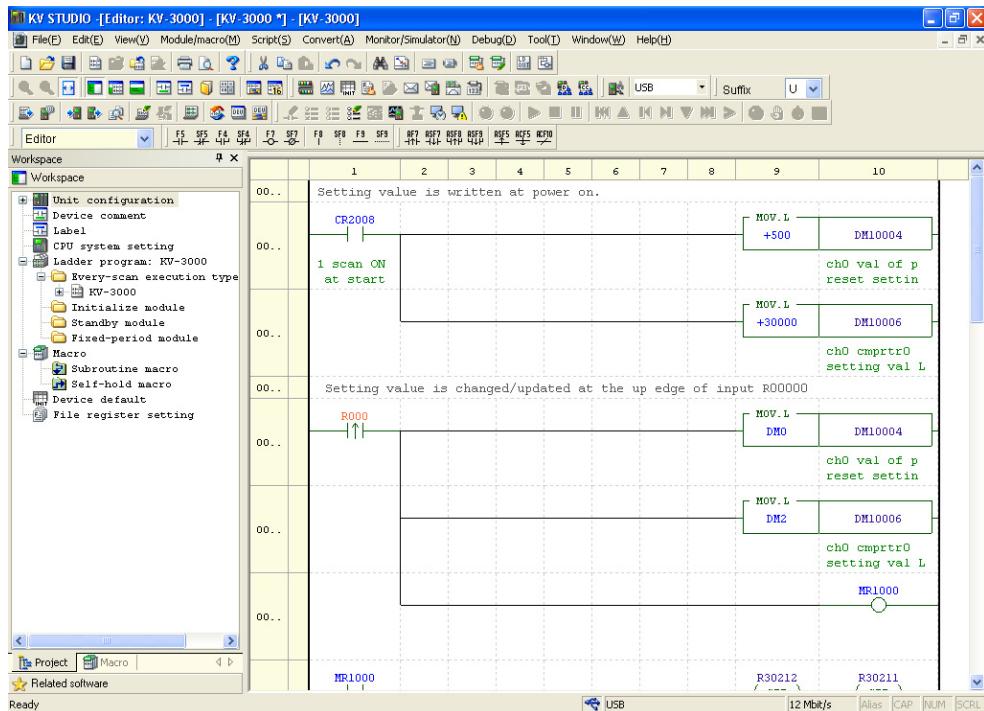
- **[Ctrl]** + **D**

Paste the copied mnemonic list into the "List edit" dialog box.

To paste the list, right-click the "List edit" dialog box, and then click "Paste."



4 Click "Insert" to display the sample ladder program.



Terminology

This manual uses the following terminology excluding some instances.

| Terminology | Description |
|----------------|---|
| Base unit | This refers to KEYENCE KV Nano Series (KV-N14**, KV-N24**, KV-N40**, KV-N60**, and NC32T) programmable controllers. |
| Expansion unit | This refers to expansion I/O units and special expansion units, other than the base unit, that can be used with the KV Nano Series. |
| PLC | This is an abbreviation of Programmable Logic Controller. |
| KV STUDIO | This refers to the software that supports the creation of KV Nano Series programs. |
| Ladder program | This refers to programs that are created with KV STUDIO. |

MEMO

1

CONFIGURATION AND SPECIFICATIONS

This chapter describes what you can do with the serial communication function, the operation modes, the names and functions of parts, the specifications, and the system configuration.

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1-1 What You Can Do with the Serial Communication Function

The KV Nano Series Serial Communication Function has seven operation modes, and can communicate with a variety of serial communication units.

About Operation Modes

An overview of what you can do with the serial communication function and the corresponding operation modes are shown below.

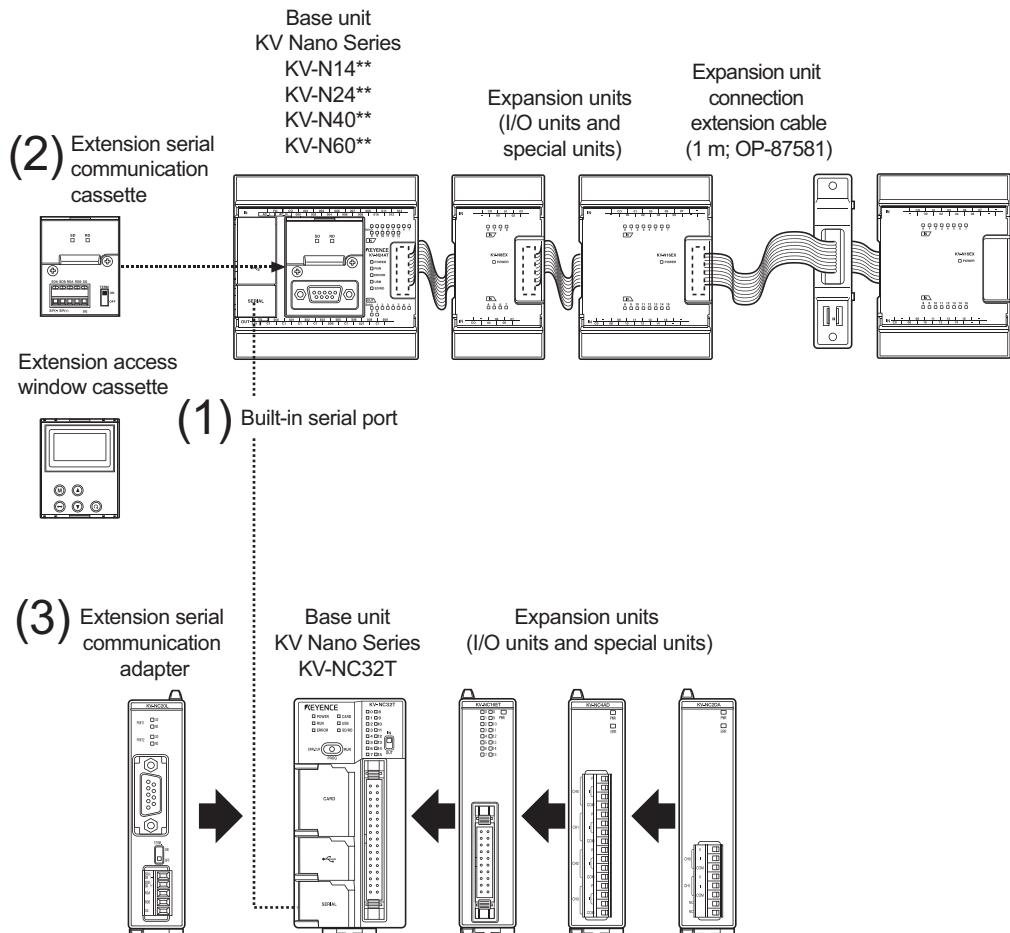
| What You Can Do | Description | See |
|--|---|---|
| Transfer and monitor ladder programs | You can connect a PC to the product in order to transfer and monitor ladder programs from KV STUDIO. You do not need to write a communication program. | "Chapter 7 KV STUDIO MODE" |
| Connect to VT3 Series units | You can connect to Touch Panel Display VT3 Series units. You do not need to write a communication program. | "Chapter 7 KV STUDIO MODE" |
| Share data with other PLCs | You can share data with other KV Nano Series base units and with KV-5000/3000 Series CPU units. You do not need to write a communication program. | "Chapter 11 SERIAL PLC LINK MODE" |
| Connect to the Modbus master unit | You can connect to the Modbus master unit as a slave unit. You do not need to write a communication program. | "Chapter 10 Modbus SLAVE MODE" |
| Connect to Modbus slave units | You can connect to Modbus slave units as the master unit. You need to write a communication program. | "Chapter 9 Modbus MASTER MODE" |
| Perform communication using the publically available protocol of the KV Series | From a peripheral, you can perform communication that matches the publically available protocol of the KV Series. You do not need to write a communication program. | "Chapter 5 KV MODE (HOST LINK)" |
| Perform communication that matches the protocol of a peripheral | Use this feature when you want to freely set the format (header, delimiter, and data length) of the communication procedure to match the communication procedure of and communicate with a peripheral. You need to write a communication program. | "Chapter 8 NON-PROCEDURE MODE" |
| Send and receive text data | You can send and receive text data. You need to write a communication program. | "Chapter 6 KV MODE (TEXT TRANSMISSION)" |

1-2 System Configuration

This section describes the KV Nano Series Serial Communication Function and the systems that you can build using the serial communication function.

KV Nano Series Serial Communication Function

- (1) If you will use the built-in serial port, you do not need an extension cassette or adapter.
- (2) If you will use an extension serial communication cassette (KV-N10L or KV-N11L), connect it to the extension cassette socket of the KV Nano Series.
Be sure to turn the power off before you make the connection.
For the KV-N14** and KV-N24**, you can only connect one extension cassette per base unit. For the KV-N40** and KV-N60**, you can connect up to two extension cassettes per base unit.
- (3) If you will use an extension serial communication adapter (KV-NC10L/KV-NC20L), connect it to the adapter connection connector of the KV-NC32T.
Be sure to turn the power off before you make the connection.
Only 1 extension adapter can be connected to the KV-NC32T.



For details on constructing other systems, see "1-1 System Configuration" in the "KV Nano Series User's Manual."

1-2 System Configuration**Systems That You Can Build Using the Serial Communication Function**

You can use the KV Nano Series Serial Communication Function to build systems like those shown below.

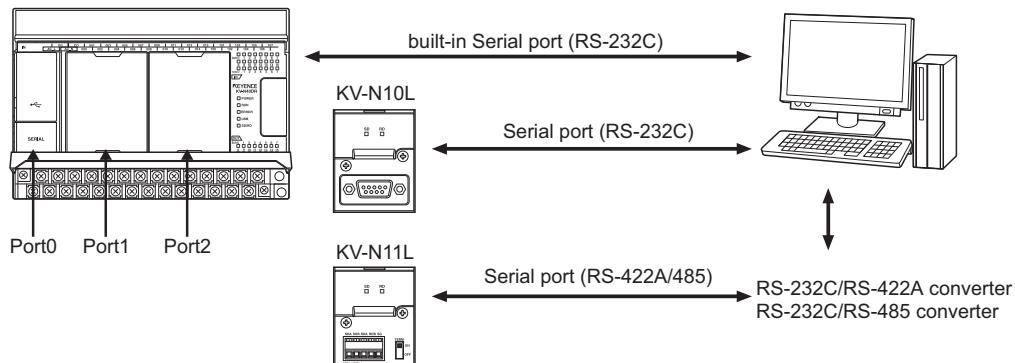
■ One peripheral and one KV Nano Series unit (1:1)

Connect one peripheral, such as a PC or a touch panel display, to one KV Nano Series unit.

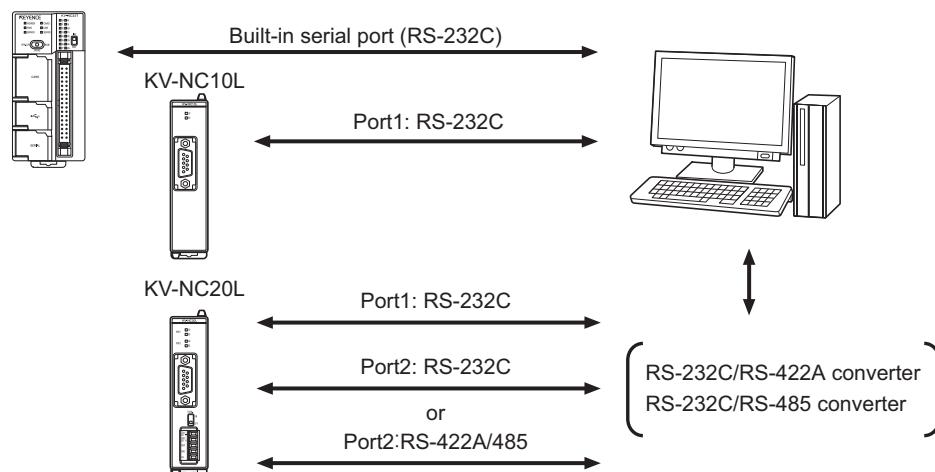
Use the built-in serial port, an extension cassette (KV-N10L or KV-N11L) or an extension adapter (KV-NC10L or KV-NC20L) to make the connection.

● When using an extension serial communication cassette

Base unit
KV Nano Series
KV-N14/N24/N40/N60

**● When using an extension serial communication adapter**

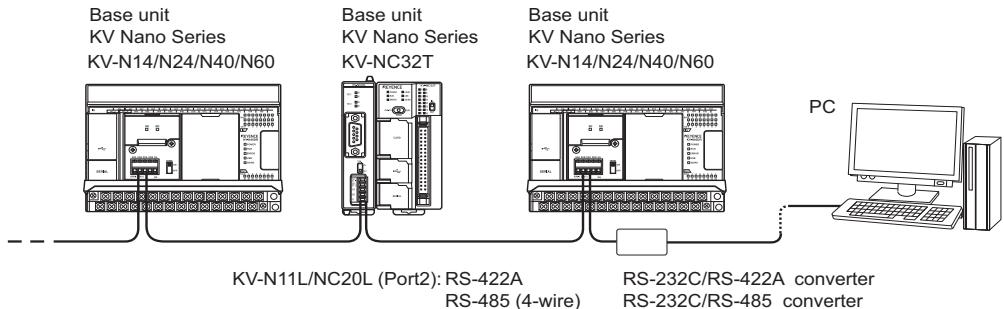
Base unit
KV Nano Series
KV-NC32T



■ One peripheral and multiple KV Nano Series units (1:N)

Connect one peripheral, such as a PC or a PLC, to multiple KV Nano Series units in a multi-drop configuration. The peripheral is the host, and it can read data from and write data to the base units.

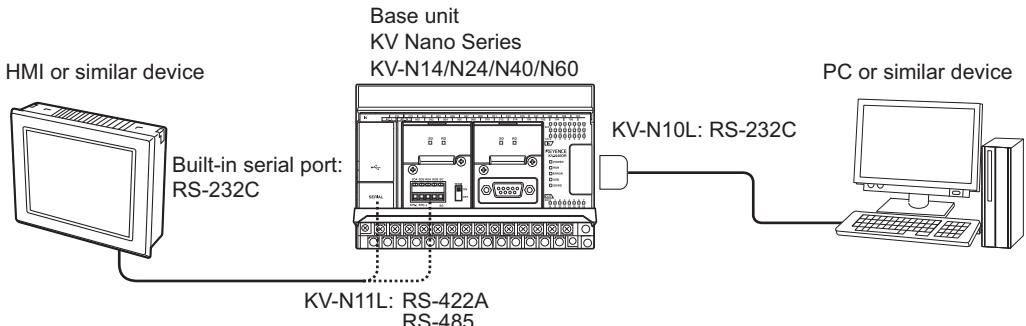
When you connect multiple KV Nano Series units, set the KV-N11L or KV-NC20L to RS-422A or RS-485 (4-wire type). When connecting to a PC, do so through an RS-232C/RS-422A or RS-232C/RS485 converter.



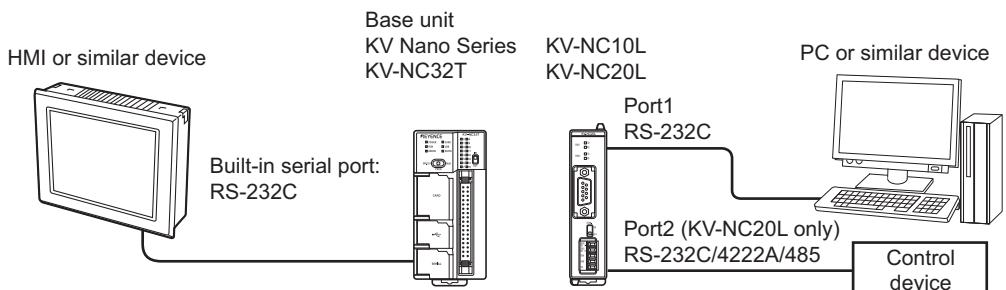
■ Two or three peripherals and one KV Nano Series unit (N:1)

Connect two or three peripherals, such as a PC and an HMI, to one KV Nano Series unit. Use the built-in serial port and an extension cassette (KV-N10L or KV-N11L) or an extension adapter (KV-NC10L or KV-NC20L) to make the connections.

● When using an extension serial communication cassette



● When using an extension serial communication adapter



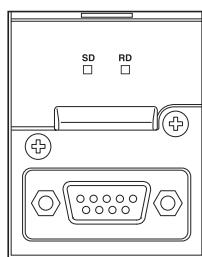
- You can connect two extension cassettes to the KV-N40AR, KV-N40AT, KV-N40DR, KV-N40DT, KV-N60AR, and KV-N60AT, so, together with the built-in serial port, you can connect up to three peripherals to these units.
- When using the KV-NC32T, together with the inbuilt serial port you can connect two peripherals when using extension adapter KV-NC10L, and three peripherals when using extension adapter KV-NC20L.

1-3 Checking the Package Contents

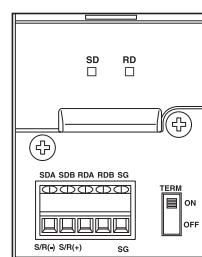
The following items are included in the extension cassette KV-N10L and KV-N11L, and the extension adapter KV-NC10L and KV-NC20L, packages.

KV-N10L and KV-N11L

KV-N10L



KV-N11L



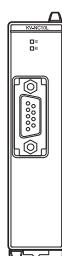
or

Function extension adapter/
extension cassette
Instruction Manual (1)

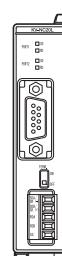
KV Nano Series
Function extension
adapter/extension
cassette
Instruction Manual

KV-NC10L and KV-NC20L

KV-NC10L



KV-NC20L

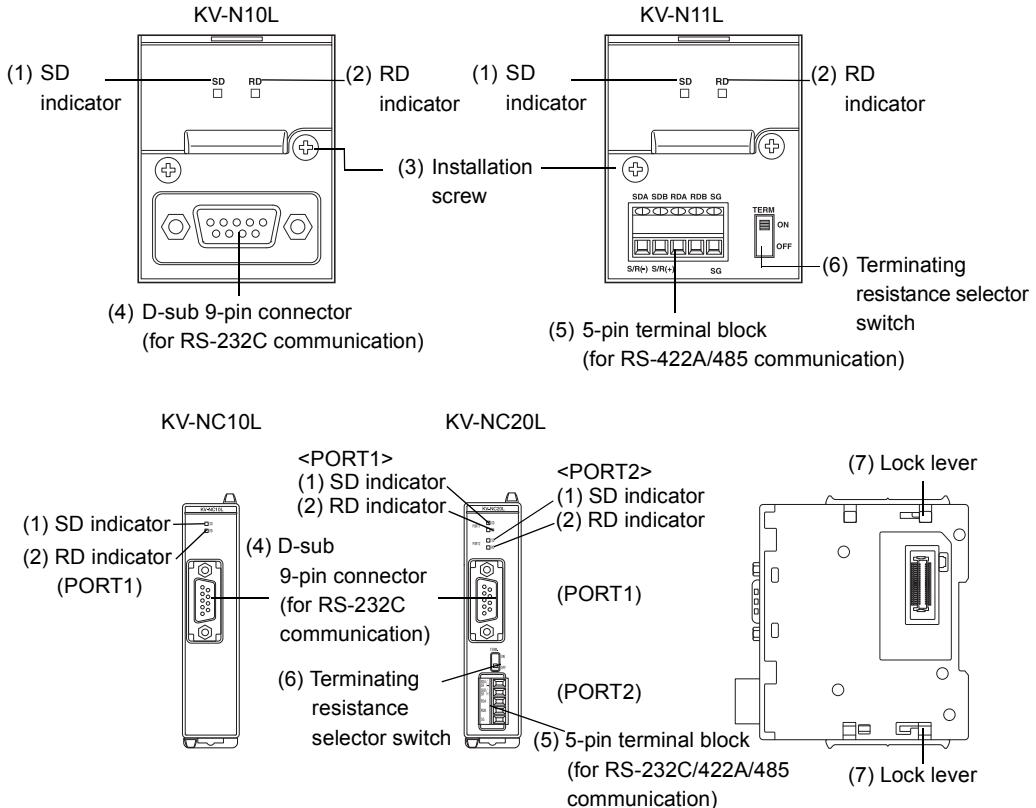


or

Function extension adapter/
extension cassette
Instruction Manual (1)

KV Nano Series
Function extension
adapter/extension
cassette
Instruction Manual

This section describes the names and functions of the parts of the KV-N10L and KV-N11L extension serial communication cassettes, and the KV-NC10L and KV-NC20L extension serial communication adapters. For details on the base unit and the built-in serial port, see "2-2 Base Unit Shared Specifications" in the "KV Nano Series User's Manual."



| Number | Name | Function |
|--------|--|--|
| (1) | SD indicator | This lights in orange when data is being sent. |
| (2) | RD indicator | This lights in orange when data is being received. |
| (3) | Installation screw | Tighten this screw to install the cassette on a base unit. (When using KV-N10L or KV-N11L) |
| (4) | D-sub 9-pin connector | This is a D-sub 9-pin male connector. |
| (5) | 5-pin terminal block | This is a connector that is used for communication. The KV-NC20L terminal block can be removed. |
| (6) | Terminating resistance selector switch | This switch selects whether the terminating resistance is on or off. ON: The terminating resistance is used. OFF: The terminating resistance is not used. Only set this to ON when RS-422A/485 is used in Port2 for the KV-N11L or KV-NC20L, and it is wired as the terminator of the main line. Point Be sure to set it to OFF when RS-232C is used as Port2 for the KV-NC20L. |
| (7) | Lock lever | Lock this when connected to the base unit. (When using KV-NC10L or KV-NC20L) |

1-5 Specifications and Outline Drawings

The general specifications, performance specifications, and outline drawings of the built-in serial port of the KV Nano Series, the KV-N10L and KV-N11L extension serial communication cassettes, and the KV-NC10L and KV-NC20L extension serial communication adapters are shown below.

Specifications

■ General specifications

| Item | KV-N10L/N11L/NC10L/NC20L |
|--|----------------------------------|
| Operating environment | Less dust and corrosive gases |
| Operating ambient temperature | 0° C to 55° C |
| Operating ambient humidity | 5%RH to 95%RH |
| Storage ambient temperature | -25° C to +75° C |
| Storage ambient humidity | 35%RH to 85%RH (no condensation) |
| Number of times that the product can be connected and disconnected | 80(KV-N10L and KV-N11L) |

* For details on the base unit (built-in serial port), see "2-2 Base Unit Shared Specifications" in the "KV Nano Series User's Manual."

■ Communication format specifications

Use the Unit Editor to configure the settings of each mode.

| Operation Mode | Available Interface | | | |
|-----------------------------|----------------------|---------|---------------------------|----------------------|
| | Built-In Serial Port | | KV-N10L | KV-N11L |
| | RS-232C | RS-232C | RS-422A/485 (4-Wire Type) | RS-485 (2-Wire Type) |
| KV mode (host link) | Yes | Yes | Yes | No |
| KV mode (text transmission) | Yes | Yes | Yes | Yes |
| KV STUDIO mode | Yes | Yes | Yes | Yes |
| Non-procedure mode | Yes | Yes | Yes | Yes |
| Modbus master mode | Yes | Yes | Yes | Yes |
| Modbus slave mode | Yes | Yes | Yes | Yes |
| Serial PLC Link mode | No | No | No | Yes |

| Operation Mode | Available Interface | | | | |
|-----------------------------|---------------------|---------|----------|---------------------------|----------------------|
| | KV-NC10L | | KV-NC20L | | |
| | RS-232C | Port1 | Port2 | | |
| | | RS-232C | RS-232C | RS-422A/485 (4-Wire Type) | RS-485 (2-Wire Type) |
| KV mode (host link) | Yes | Yes | Yes | Yes | No |
| KV mode (text transmission) | Yes | Yes | Yes | Yes | Yes |
| KV STUDIO mode | Yes | Yes | Yes | Yes | Yes |
| Non-procedure mode | Yes | Yes | Yes | Yes | Yes |
| Modbus master mode | Yes | Yes | Yes | Yes | Yes |
| Modbus slave mode | Yes | Yes | Yes | Yes | Yes |
| Serial PLC Link mode | No | No | No | No | Yes |

■ Serial communication specifications

● Built-in serial port

| | | | Specification |
|-----------------------------|------------------------|------------------------------|----------------------|
| Interface | Communication standard | | RS-232C |
| | Connection | | Modular connector |
| Transmission specifications | RS-232C | Transmission speed | |
| | | Transmission mode | |
| | | Data format | Start bit |
| | | | 7 bits, 8 bits |
| | | | Stop bits |
| | | Error detection | Parity |
| | | Transmission distance | |
| | | Number of units transmitting | |
| | | Indication | SD (green), RD (red) |

● KV-N10L, KV-NC10L and KV-NC20L (Port1)

| | | | Specification |
|-----------------------------|--------------------------|------------------------------|----------------|
| Interface | Communication standard | | RS-232C |
| | Connection | | D-sub 9-pin |
| Transmission specifications | RS-232C | Transmission speed | |
| | | Transmission mode | |
| | | Data format | Start bit |
| | | | 7 bits, 8 bits |
| | | | Stop bits |
| | | Error detection | Parity |
| | | RS/CS flow control | |
| | | Transmission distance | |
| | | Number of units transmitting | |
| Indication | SD (orange), RD (orange) | | |

1-5 Specifications and Outline Drawings

● KV-N11L

| | | | Specification |
|-----------------------------|------------------------------------|-------------------------------------|---|
| Interface | Communication standard | | RS-422A, RS-485 (4-wire type), RS-485 (2-wire type) |
| | Connection | | European terminal block (cannot be removed or reinserted) |
| Transmission specifications | RS-422A RS-485 (4-wire type) | Transmission speed | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps |
| | | Transmission mode | Full-duplex |
| | | Start bit | 1 bit |
| | | Data bits | 7 bits, 8 bits |
| | | Stop bits | 1 bit, 2 bits |
| | | Error detection | Parity |
| | | | Even, odd, none |
| | | Transmission distance | Total length of cable within 1,200 m |
| | | Number of units transmitting | 32 |
| | | Terminating resistance (terminator) | Set by a switch on the front panel |
| RS-485 (2-wire type) | RS-485 (2-wire type) | Transmission speed | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps |
| | | Transmission mode | Half-duplex |
| | | Start bit | 1 bit |
| | | Data bits | 7 bits, 8 bits |
| | | Stop bits | 1 bit, 2 bits |
| | | Error detection | Parity |
| | | | Even, odd, none |
| | | Transmission distance | Total length of cable within 1,200 m |
| | | Number of units transmitting | 32 |
| | | Terminating resistance (terminator) | Set by a switch on the front panel |
| Indication | | | SD (orange), RD (orange) |

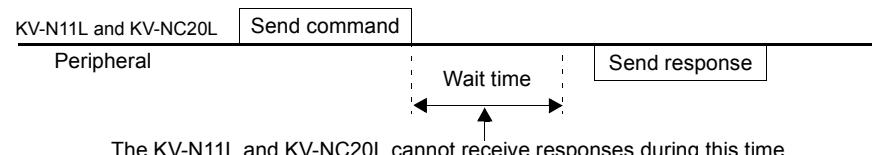
● KV-NC20L(Port2)

| | | | Specification |
|-----------------------------|------------------------------------|--|--|
| Interface | Communication standard | | RS-232C, RS-422A, RS-485 (4-wire type), RS-485 (2-wire type) |
| | Connection | | European terminal block (can be removed or reinserted) |
| Transmission specifications | RS-232C | Transmission speed | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps |
| | | Transmission mode | Full-duplex |
| | | Data format | Start bit 1 bit |
| | | | Data bits 7 bits, 8 bits |
| | | | Stop bits 1 bit, 2 bits |
| | | Error detection | Parity Even, odd, none |
| | | Transmission distance | 15 m |
| | RS-422A RS-485 (4-wire type) | Number of units transmitting | 1 |
| | | Transmission speed | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps |
| | | Transmission mode | Full-duplex |
| | | Data format | Start bit 1 bit |
| | | | Data bits 7 bits, 8 bits |
| | | | Stop bits 1 bit, 2 bits |
| | | Error detection | Parity Even, odd, none |
| | RS-485 (2-wire type) | Transmission distance | Total length of cable within 1,200 m |
| | | Number of units transmitting | 32 |
| | | Terminating resistance (terminator) | Set by a switch on the front panel |
| | | Transmission speed | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps |
| | | Transmission mode | Half-duplex |
| | | Data format | Start bit 1 bit |
| | | | Data bits 7 bits, 8 bits |
| | | | Stop bits 1 bit, 2 bits |
| | | Error detection | Parity Even, odd, none |
| | | Transmission distance | Total length of cable within 1,200 m |
| | | Number of units transmitting | 32 |
| | | Terminating resistance (terminator) | Set by a switch on the front panel |
| Indication | | | SD (orange), RD (orange) |

1-5 Specifications and Outline Drawings

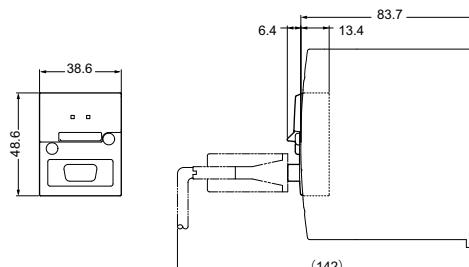
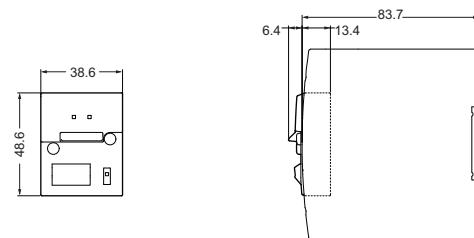
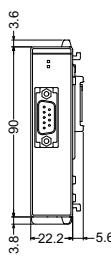
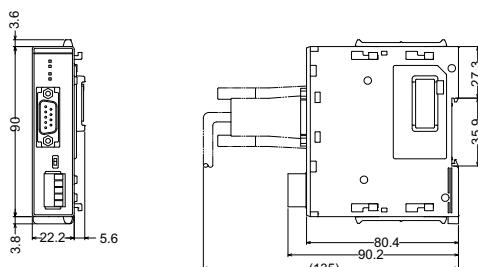
**Precautions when using RS-485 (2-wire type)**

For RS-485 (2-wire type), because data to send and received data both flow on the same communication line (S/R(+) and S/R(-)), after the KV-N11L or KV-NC20L sends a command to peripherals, the KV-N11L or KV-NC20L cannot receive responses from peripherals for the lengths of time shown in the following table. Peripherals should send responses to the KV-N11L or KV-NC20L after the wait times shown in the following table have elapsed.



Wait times of the KV-N11L and KV-NC20L during RS-485
(2-wire type) communication.

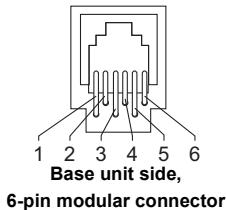
| Baud Rate (bps) | Wait Time (ms) |
|-----------------|----------------|
| 115200 | 1 |
| 57600 | 1 |
| 38400 | 1 |
| 19200 | 1 |
| 9600 | 1.5 |
| 4800 | 2.6 |
| 2400 | 5.1 |
| 1200 | 10.2 |

Outline Drawings**■ KV-N10L****■ KV-N11L****■ KV-NC10L****■ KV-NC20L**

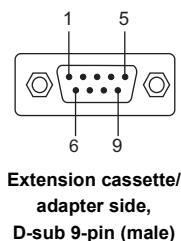
1-6**Terminal Arrangement and Internal Circuit Diagrams**

This section describes the terminal arrangement and internal circuit diagrams of the built-in serial port of the KV Nano Series, the KV-N10L and KV-N11L extension serial communication cassettes, and the KV-NC10L and KV-NC20L extension serial communication adapters.

For the wiring diagrams for connecting to peripherals, see □ "2-3 Connecting Peripherals" (page 2-6).

Terminal Arrangement**■ Built-in serial port**

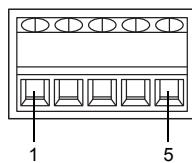
| Pin Number | Signal Name | Signal Direction |
|------------|--------------------|------------------|
| 1 | +5V | (Output) |
| 2 | +5V | (Output) |
| 3 | RD (received data) | Input |
| 4 | SG (signal ground) | - |
| 5 | SD (data to send) | Output |
| 6 | SG (signal ground) | - |

■ KV-N10L, KV-NC10L and KV-NC20L (Port1)

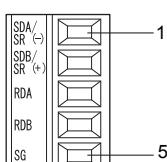
| Pin Number | Signal Name | Signal Direction |
|------------|---------------------------------|------------------|
| 1 | - | - |
| 2 | RD (received data) | Input |
| 3 | SD (data to send) | Output |
| 4 | ER (data terminal ready) | Output |
| 5 | SG (signal ground) | - |
| 6 | DR (data set ready) | Input |
| 7 | RS (send request) ^{*1} | Output |
| 8 | CS (send ready) ^{*2} | Input |
| 9 | - | - |

*1 This signal is set to low when reception is no longer possible. Normally, this signal is set to high.

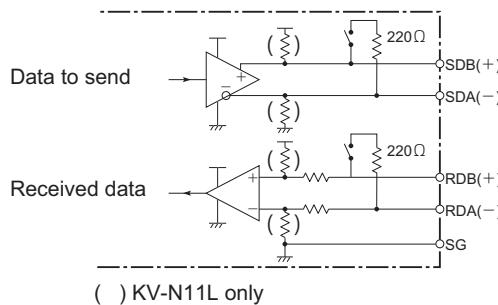
*2 Normally set this signal to high. To disable reception, set it to low.

■ KV-N11L

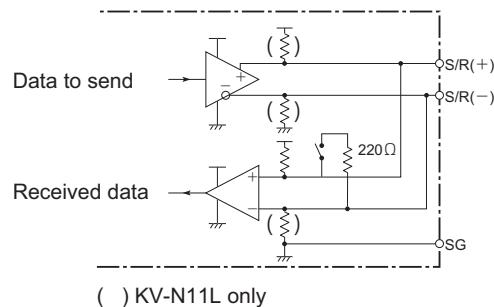
| Pin Number | RS-422A/RS-485 (4-Wire Type) | | RS-485 (2-Wire Type) | |
|------------|------------------------------|-----------|----------------------|-----------|
| | Signal Name | Direction | Signal Name | Direction |
| 1 | SDA (-) | Output | S/R (-) | - |
| 2 | SDB (+) | Output | S/R (+) | - |
| 3 | RDA (-) | Input | - | - |
| 4 | RDB (+) | Input | - | - |
| 5 | SG | - | SG | - |

■ KV-NC20L

| Pin Number | RS-232C | | RS-422A/RS-485 (4-Wire Type) | | RS-485 (2-Wire Type) | |
|------------|-------------|-----------|------------------------------|-----------|----------------------|-----------|
| | Signal Name | Direction | Signal Name | Direction | Signal Name | Direction |
| 1 | SD | Output | SDA (-) | Output | S/R (-) | - |
| 2 | - | - | SDB (+) | Output | S/R (+) | - |
| 3 | - | - | RDA (-) | Input | - | - |
| 4 | RD | Input | RDB (+) | Input | - | - |
| 5 | SG | - | SG | - | SG | - |

1-6 Terminal Arrangement and Internal Circuit Diagrams**KV-N11L/KV-NC20L (Port2) Internal Circuit Diagrams****■ Block diagram of the RS-422A and RS-485 (4-wire type) interface function**

* SG is isolated from the internal GND of the base unit.

■ Block diagram of the RS-485 (2-wire type) interface function

* SG is isolated from the internal GND of the base unit.

2

UNIT INSTALLATION AND MAINTENANCE

This chapter describes the installation environment of the KV Nano Series, how to install extension cassettes and extension adapters on the base unit, and how to connect peripherals.

| | | |
|-----|--|------|
| 2-1 | Installation Procedure | 2-2 |
| 2-2 | Installing Units on the Base Unit | 2-3 |
| 2-3 | Connecting Peripherals | 2-6 |
| 2-4 | Setting the Terminating Resistance Selector Switch | 2-11 |
| 2-5 | Using Unit Editor to Configure Settings | 2-12 |
| 2-6 | Maintenance | 2-14 |

2-1 Installation Procedure

This section describes the procedure for installing extension cassettes and extension adapters on the base unit and for connecting peripherals.

- 1 Check the installation environment

Check whether the location in which you want to install the KV Nano Series is appropriate.
☞ "3-2 Unit Installation" in the "KV Nano Series User's Manual"
- 2 Install the KV-N10L, KV-N11L, KV-NC10L or KV-NC20L

Install the KV-N10L, KV-N11L, KV-NC10L or KV-NC20L on the base unit.
☞ "2-2 Installing Units on the Base Unit" (page 2-3)
- 3 Connect peripherals

Connect peripherals to the ports that you will use.
☞ "2-3 Connecting Peripherals" (page 2-6)
- 4 Configure peripheral settings

Configure settings such as the communication specifications of the connected peripherals.
☞ User's Manuals for Peripherals
- 5 Configure the communication settings of the KV Nano Series

Use the Unit Editor to configure the communication settings of the ports that you will use.
☞ "2-5 Using Unit Editor to Configure Settings" (page 2-12)
Also, create ladder programs if necessary.
- 6 Test operation

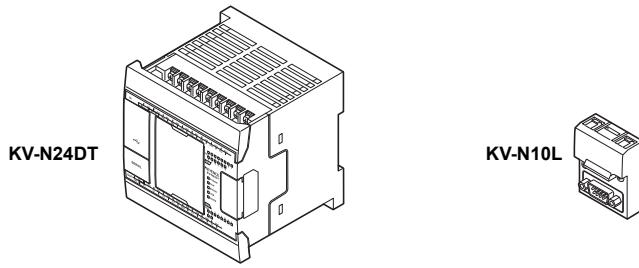
☞ "Chapter 4 USING THE BUILT-IN FUNCTION MONITOR TO CHECK OPERATIONS" (page 4-1)

2-2 Installing Units on the Base Unit

This section describes the procedure for installing the KV-N10L and KV-N11L extension cassettes, and KV-NC10L and KV-NC20L extension adapters on the base unit.

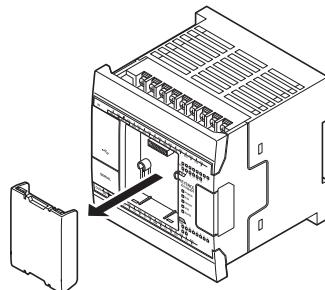
Installing Extension Cassettes

As an example, this section describes how to install a KV-N10L on the KV Nano Series base unit.

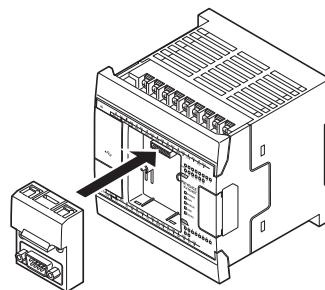
**NOTICE**

Be sure to turn each unit off before you connect them.

- 1 Remove the socket cover for the extension cassette on the base unit.



- 2 Insert the extension cassette's connector into the extension cassette socket.

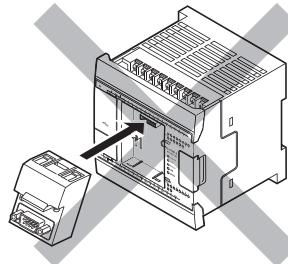


2-2 Installing Units on the Base Unit

Reference

When you insert the connector, ensure that it has a perpendicular orientation. Inserting the cassette into the socket at an angle may damage the products.

2

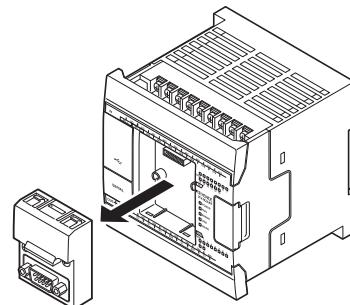


- When you want to use the base unit after removing the extension cassette, you will require the extension cassette socket cover. Therefore, be sure to store the extension cassette socket cover in a safe place.

- 3** Tighten the two fixation screws (included, M3, 5 mm in length). (Use a maximum tightening torque of 5 kgf-cm.)

■ Removing the cassette

- 1 Loosen the two fixation screws (included, M3, 5 mm in length).
- 2 Grasp the sunken part centered at the top of the extension cassette, and pull it free of the base unit.



Reference

When you want to use the base unit after removing the extension cassette, first attach the extension cassette socket cover.

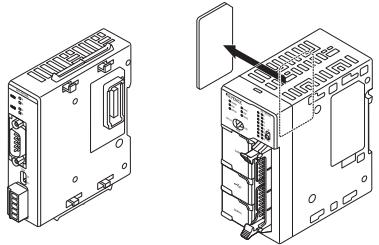
NOTICE

Be sure to turn the power off before you remove the extension cassette.

2-2 Installing Units on the Base Unit

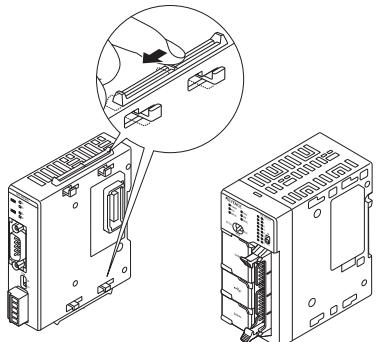
Installing the extension adapter

- 1 Remove the extension adapter connection connector cover (left) on the base unit.**



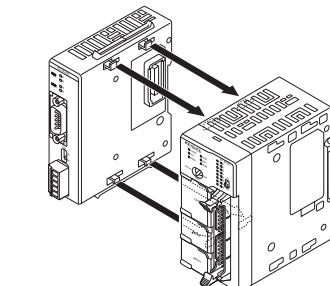
- 2 Release the lock levers attached to the top and bottom of the extension adapter.**

Put your finger on the depression and slide it towards the front of the unit to release it.



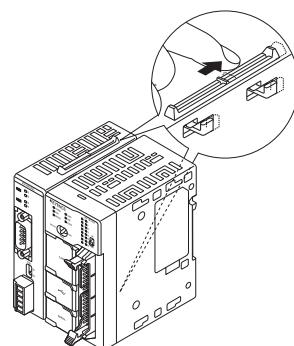
- 3 Insert the extension adapter's lock lever into the lock lever slot on the base unit.**

They can be easily connected by holding them parallel and aligning the positions of the connectors.



- 4 Lock the lock levers attached to the top and bottom of the extension adapter.**

Perform the reverse of step 2 by putting your finger on the depression and slide it towards the back of the unit. Check that there is not a gap between the units. If there is a gap, they are not properly connected.



2-3 Connecting Peripherals

This section describes how to connect peripherals, such as a PC or a touch panel display, to the KV Nano Series.

For details on the terminal arrangement and the internal circuit diagrams, see "1-6 Terminal Arrangement and Internal Circuit Diagrams".

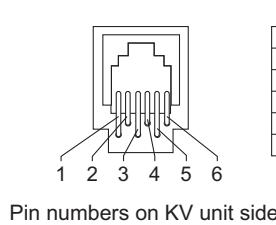
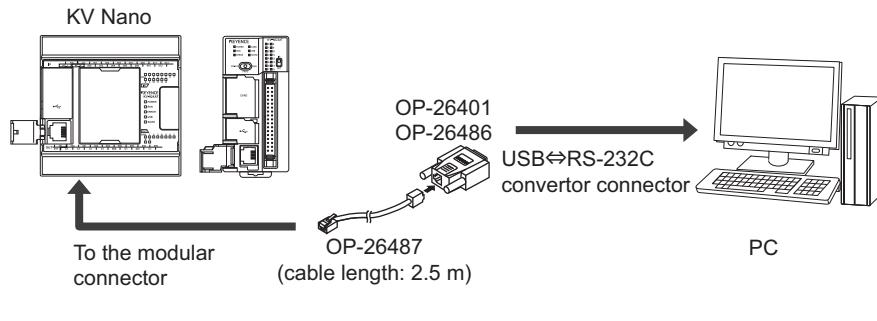
NOTICE

- Do not short the SG terminal or other signal terminals. Doing so might cause malfunctions.
- When using the KV Nano Series with the RS-232C interface, limit the length of the connector cable to 15 m.

Built-In Serial Port

■ How to connect to a PC

To connect the KV Nano Series and a PC, use the dedicated connection cable (OP-26487) and a D-sub 9-pin connector (OP-26401 or OP-26486).



Pin numbers on KV unit side
Pins 1 and 2 on the unit side
are the 5 V power supply.
Pins 4 and 6 on the unit side
are GND.

| KV side | | D-sub 9-pin on the PC side | |
|---------|---|----------------------------|----|
| RD | 3 | 3 | SD |
| SD | 5 | 2 | RD |
| +5V | 1 | 6 | DR |
| +5V | 2 | 4 | ER |
| SG | 6 | 7 | RS |
| SG | 4 | 8 | CS |
| | | 5 | SG |

*3.9kΩ 1/4W

Straight cable OP-26487
+
D-sub 9-pin connector OP-26486
(cross-over wiring)

| KV side | | D-sub 9-pin on the PC side | |
|---------|---|----------------------------|----|
| RD | 3 | 3 | SD |
| SD | 5 | 2 | RD |
| +5V | 1 | 6 | DR |
| +5V | 2 | 4 | ER |
| SG | 6 | 7 | RS |
| SG | 4 | 8 | CS |
| | | 5 | SG |

Straight cable OP-26487
+
D-sub 9-pin connector OP-26401
(cross-over wiring)

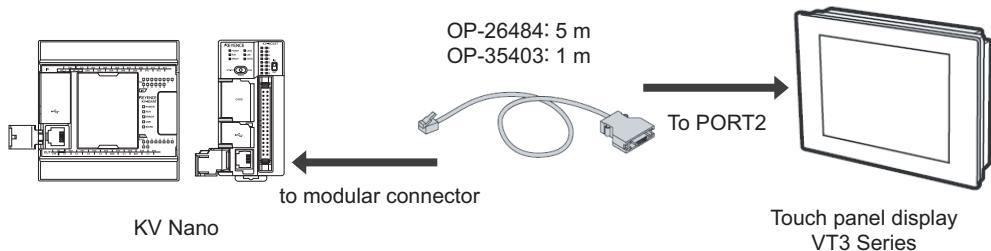


The SG of the DC power supply type KV Nano Series is shared with 0 V of the power supply input terminal.

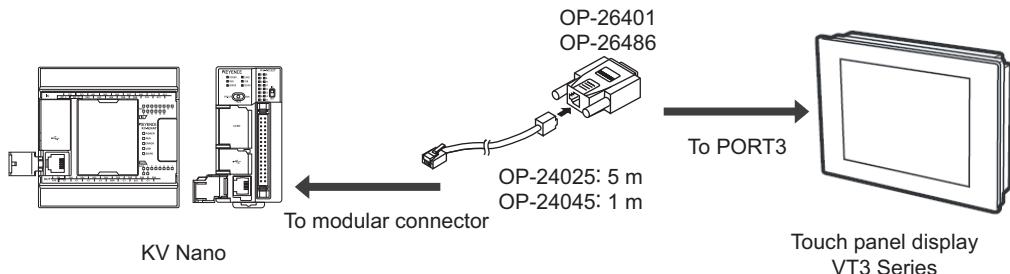
■ How to connect to the VT3 Series

To connect the KV Nano Series and a VT3 Series touch panel display, use a dedicated KV Series program-controlled port, direct-connect cable (OP-26484: 5 m or OP-35403: 1 m).

● Connecting to PORT2 of a VT3



● Connecting to PORT3 of a VT3



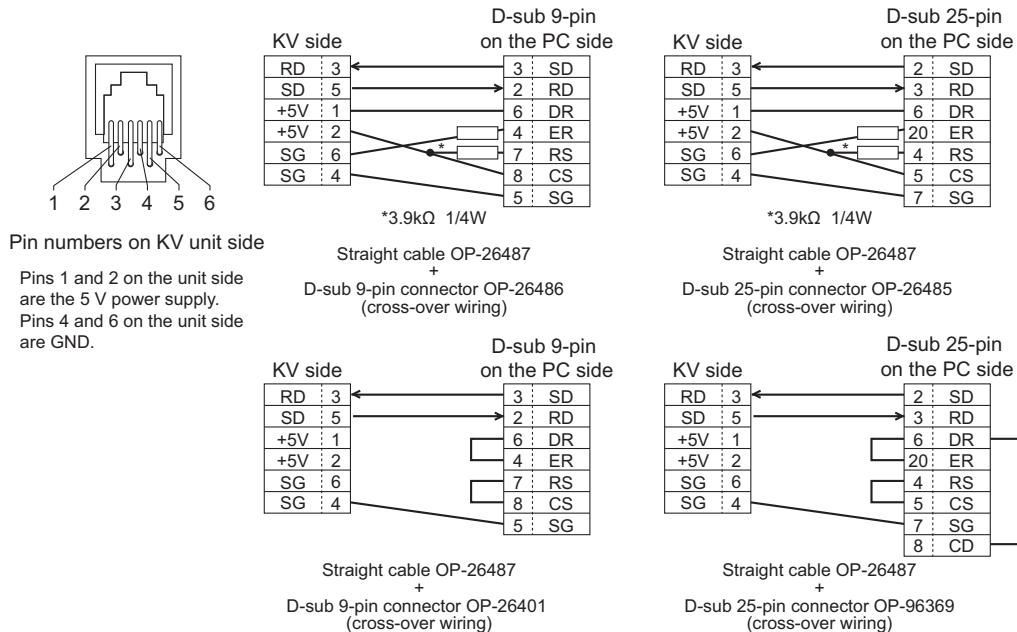
Reference

- No settings need to be configured on the KV Nano Series side.
 - For details on connecting to a VT3 Handy Series or VT3-W4 Series unit, see the "VT3 PLC Connection Manual."
- For details on the settings to configure on the VT3 side, see the "VT3 PLC Connection Manual."

2-3 Connecting Peripherals

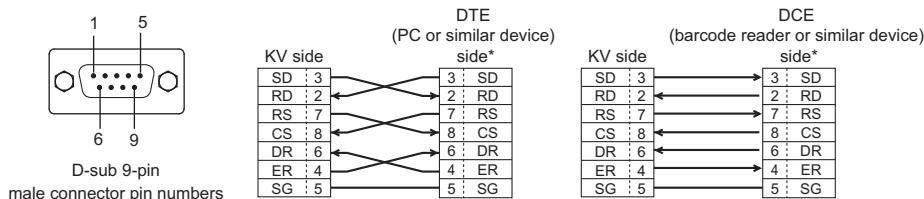
■ How to connect to other peripherals

To connect peripherals to the KV Nano Series, see the following wiring diagrams for connecting to a PC, and then connect the peripheral according to the shape of the peripheral's connector.



When the peripheral to be connected complies with the modem definition, use a cross-over cable such as OP-96607 instead of the OP-26487 cable.

KV-N10L, KV-NC10L and KV-NC20L (Port1)



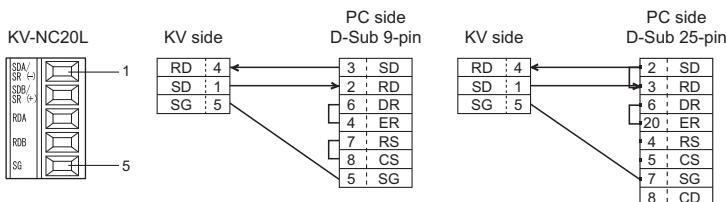
* When a D-sub 9-pin connector is used (the pin numbers are different when a D-sub 25-pin connector is used).

NOTICE

- Limit the cable length to 15 m.
- For fixation screws, use UNC #4-40 screws.

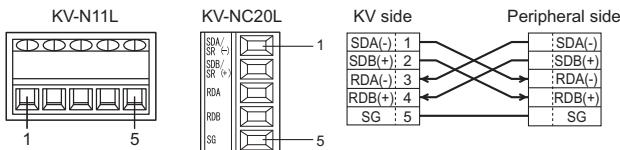
KV-N11L and KV-NC20L (Port2)

■ Connecting units with RS-232C (KV-NC20L (Port2) only)

**NOTICE**

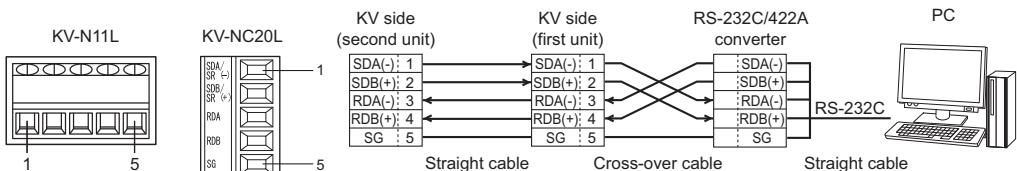
- Limit the cable length to 15 m.
- When using KV-NC20L, be sure to switch the terminating resistance OFF.

■ Connecting units using the RS-422A or RS-485 (4-wire type) interface

**NOTICE**

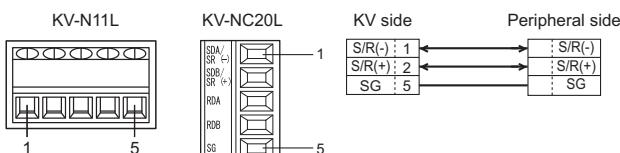
When you make a connection using the RS-422A interface, you may have to replace SDA (-) and SDB (+) as well as RDA (-) and RDB (+) depending on the peripheral. In addition, the signal names on the peripheral side may be different from those shown above. Check this information in the User's Manual of the peripheral.

● Connecting KV Nano Series units in a multi-drop configuration

**NOTICE**

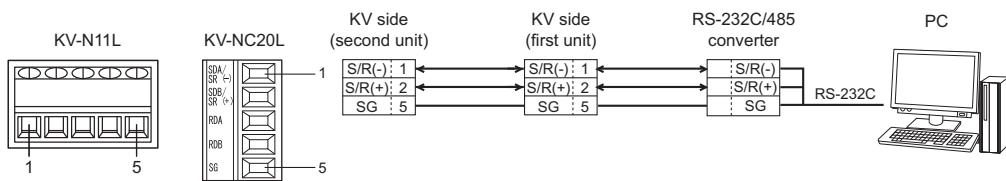
- If you attach an RS-232C/RS-422A converter to the PC's RS-232C connector, you can connect to the PC using the RS-422A interface. Depending on the model of the RS-232C/RS-422A converter, you may not be able to perform communication with the KV Nano Series. For details, contact the converter's manufacturer.
- Use a cross-over cable to wire the PC and the first KV Nano Series unit. Use straight cables to wire other units.

■ Connecting units using the RS-485 (2-wire type) interface



2-3 Connecting Peripherals

■ Connecting KV Nano Series units in a multi-drop configuration



NOTICE

If you attach an RS-232C/485 converter to the PC's RS-232C connector, you can connect to the PC using the RS-485 interface. Depending on the model of the RS-232C/485 converter, you may not be able to perform communication with the KV Nano Series. For details, contact the converter's manufacturer.

■ Terminal specifications

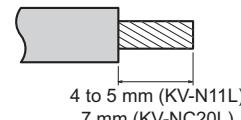
| Item | Description | |
|--------------------------|---|---|
| | For KV-N11L | For KV-NC20L |
| Compatible cable size | AWG22 to AWG20 (0.3 mm ² to 0.5 mm ²) | AWG22 to AWG20 (0.3 mm ² to 0.5 mm ²) |
| Length of stripped cable | 4 to 5 mm | 5 to 7 mm |
| Tightening torque | 0.2 N·m | 0.23 N·m |
| Recommended tool | Blade: 0.42 × 2.5 mm | |

■ Cables

● Cables used with the terminal block

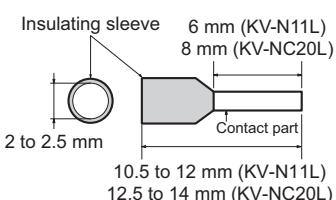
(1) When processing stranded wires or single wires as is

- (a) Twist the tip of stranded wires so that there are no loose wires.
- (b) Do not solder plate the tips of single wires.



(2) When using rod terminals with insulating sleeves

Depending on the thickness of the wire's sheath, it may be difficult to insert the wire into the insulating sleeve. Therefore, use the outline diagram as a reference when you select wires.



● Recommended cable

| Item | Shape | | Specification |
|------------------------------------|-------------|--------------------------|---------------|
| | For KV-N11L | For KV-NC20L | |
| Cable type | | Shielded cable | |
| Number of pairs | | 3 | |
| Conductor resistance (at 20° C) | | 88 Ω/km or less | |
| Insulation resistance | | 10 MΩ/km or less | |
| Withstand voltage | | 500 VDC for 1 minute | |
| Electrostatic capacity (1 kHz) | | Average 60 nF/km or less | |
| Characteristic impedance (100 kHz) | | 110 ± 10 Ω | |

* If you are using Serial PLC Link mode, use the dedicated cable.

"Usable cables" (page 11-11)

2-4 Setting the Terminating Resistance Selector Switch

You can set the terminating resistance selector switch of the KV-N11L and KV-NC20L (Port2).

Reference

Use the Unit Editor to configure settings such as the operation mode, communication specification, and station number.

"2-5 Using Unit Editor to Configure Settings"

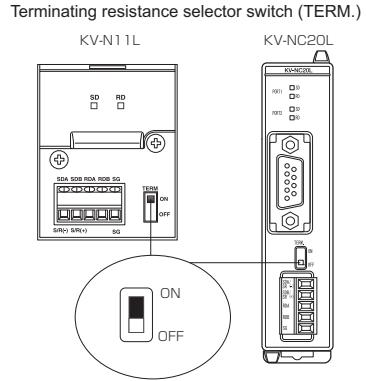
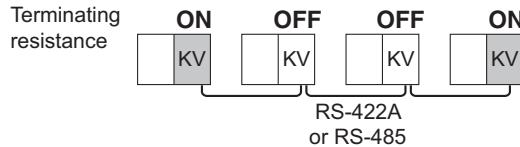
■ Default setting

The switch is set as follows before the unit is shipped from the factory.

| Item | Default Setting |
|--|-----------------|
| Terminating resistance selector switch (TERM.) | OFF |

Setting the Terminating Resistance

- If the unit is already installed on the base unit, turn the base unit off.
- Use the terminating resistance selector switch (TERM.) to set the terminating resistance.
 - Use a small screwdriver or similar tool to change the switch setting.
 - Set the terminating resistance to ON for the first and last extension cassettes or adapters that you connect, and set the terminating resistance to OFF for all other extension cassettes or adapters.



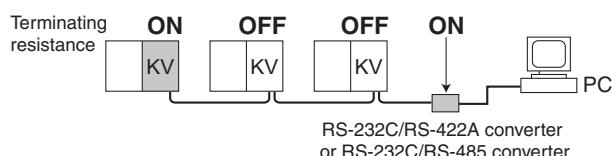
| Setting | Switch Position |
|----------------------------|-----------------|
| Terminating resistance on | ON (up) |
| Terminating resistance off | OFF (down) |

NOTICE

Be sure to set it to OFF when RS-232C is used as Port2 for the KV-NC20L.

■ Terminating resistance setting example

- When using an RS-232C/422A converter or an RS-232/485 converter to connect a PC, set the terminating resistance on the converter and the last extension cassette or adapter that you connect to ON.



2-5 Using Unit Editor to Configure Settings

This section describes how to configure settings using the KV STUDIO Unit Editor.

What Is the Unit Editor?

The Unit Editor is a software program included with Ladder Support Software KV STUDIO. Use the Unit Editor to construct KV Nano Series systems and to configure settings related to the serial communication function. These settings are required when you want to use the KV Nano Series in a mode other than KV STUDIO mode.

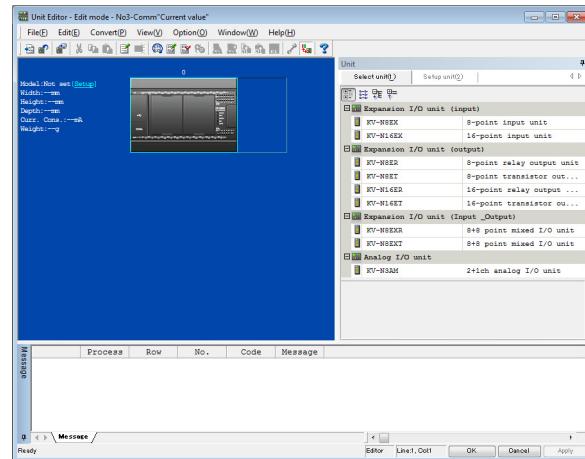
How to Configure Settings

1 Start the KV STUDIO Unit Editor (version 7 or later).

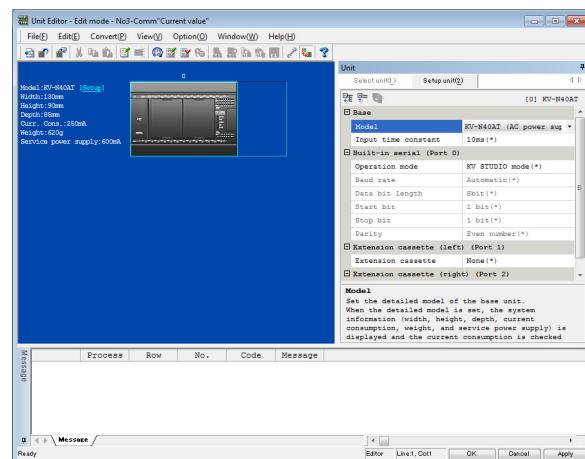
In KV STUDIO, on the "Tool" menu, click "Unit Editor."

Alternative procedure

- Click .
- Right-click the unit construction in the workspace, and then click "Unit Editor" in the menu that appears.



2 Select the "Setup unit (2)" tab.



2-5 Using Unit Editor to Configure Settings

3 Click the setup items of the port that you want to use, and select or enter the values.**● When using the built-in serial port (Port0)**

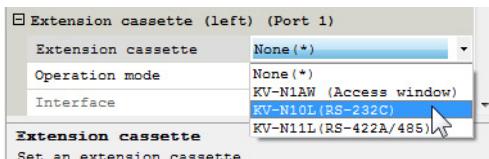
Set the items of the built-in serial port (Port0).

| Built-in serial (Port 0) | |
|--------------------------|--------------------|
| Operation mode | KV STUDIO mode (*) |
| Baud rate | Automatic (*) |
| Data bit length | 8bit (*) |
| Start bit | 1 bit (*) |
| Stop bit | 1 bit (*) |
| Parity | Even number (*) |

For details on the settings, see "Communication Specifications and Unit Editor Settings" or "Setting Items on Unit Editor" in each chapter.

● When using the extension cassette (left; Port1) or extension cassette (right; Port2).

Set the items of the extension cassette (left; Port1) or extension cassette (right; Port2).

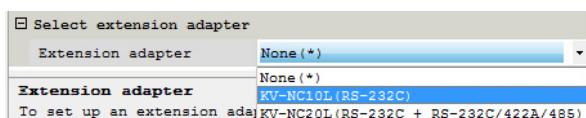


To set an extension cassette, select "KV-N10L(RS-232C)" or "KV-N11L(RS-422A/485)."

For details on the other settings, see "Communication Specifications and Unit Editor Settings" or "Setting Items on Unit Editor" in each chapter.

● When using an extension adapter (KV STUDIO version 7.1 or later)

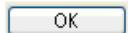
Set the items in the extension adapter selection.



Select KV-NC10L or KV-NC20L in the extension adapter selection.

For details on the other settings, see "Communication Specifications and Unit Editor Settings" or "Setting Items on Unit Editor" in each chapter.

4 On the "File" menu, click "Close." Save the system that you have created, and then return to the editor.**Alternative procedure**

- Click .
- Click .

2-6 Maintenance

This section describes how to perform inspections and maintenance.

■ Inspection

When the unit is used for a long time, problems such as the connecting sections of the connectors becoming loose can occur. Continued use of the unit in this state may cause trouble during operation. For this reason, periodically inspect the PLC and the parts that are wired to it.

The main items to inspect are shown below.

- Are the connecting sections of the connectors disconnected or loose?
- Are the communication terminal screws loose?
- Are the wiring cables between the unit and the other units damaged?

■ Maintenance

Dirt adheres to the PLC when it is used for a long time.

Clean off any dirt from the units using a clean, dry cloth.

Dust and dirt on fine components such as the connector part can be cleaned off with a cotton swab or similar item after first removing the connector.



Be sure to turn the power off before performing maintenance and inspections.

3

ACCESS WINDOW OPERATIONS

This chapter describes the operations of the access window that you can monitor when you have installed an extension access window cassette (KV-N1AW).

| | | |
|-----|--|-----|
| 3-1 | How to Use the Access Window | 3-2 |
|-----|--|-----|

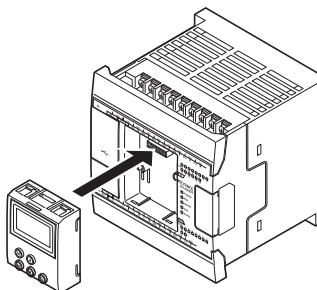
3-1 How to Use the Access Window

When using a KV-N10L or KV-N11L extension serial communication cassette, some of the settings of the base unit (terminal block type) access window can be monitored or changed.

This section describes how to use the access window.

Installing the Extension Access Window Cassette (KV-N1AW)

To use the access window, you have to install an extension access window cassette (KV-N1AW) in the base unit (terminal block type).



Base unit (terminal block type)
KV-N14**
KV-N24**
KV-N40**
KV-N60**

For the installation procedure, see "Attaching Cassettes" in the "KV Nano Series Base unit (terminal block type) User's Manual."

NOTICE

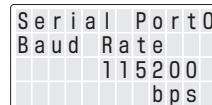
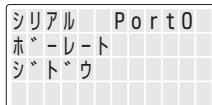
Be sure to turn each unit off before you connect them.

Reference

The access window cannot be used with KV-NC32T.

How to Operate the Access Window

You can use the access window to check communication settings such as the operation mode, interface, and parity. You can also change some settings such as the baud rate.



For details on how to operate the access window, see "CPU Monitor" in the "KV Nano Series Base Unit (terminal block type) User's Manual."

4

USING THE BUILT-IN FUNCTION MONITOR TO CHECK OPERATIONS

This chapter describes how to use the built-in function monitor of Ladder Support Software KV STUDIO.

| | | |
|-----|---|-----|
| 4-1 | About the Built-In Function Monitor | 4-2 |
| 4-2 | Serial Base Monitor | 4-3 |
| 4-3 | Trace Monitor | 4-4 |

4-1 About the Built-In Function Monitor

You can use the built-in function monitor of Ladder Support Software KV STUDIO to monitor information such as the setting information, error information, the data to send, and the received data of the serial communication ports that can be used with the KV Nano Series.

If you are using Serial PLC Link mode, see "Chapter 4 USING THE BUILT-IN FUNCTION MONITOR TO CHECK OPERATIONS" (page 4-1).

Startup Method

4

About the Built-In Function Monitor

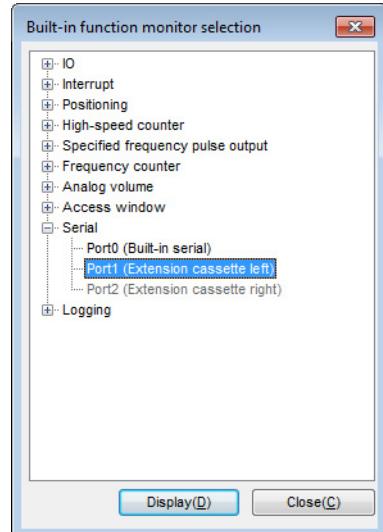
Follow the procedure below to display the monitor of the serial communication function from KV STUDIO.

- 1 While using KV STUDIO to perform monitoring, on the "Monitor/Simulator" menu, click "Built-in Function Monitor."

[Alternative procedure]

- Right-click the base unit in the workspace, and then click "Built-in Function Monitor" in the menu that appears.

The "Built-in function monitor selection" dialog box appears.



- 2 In the "Built-in function monitor selection" dialog box, select the port that you want to monitor, and then click "Display."

The "Serial base monitor" dialog box appears.

4-2 Serial Base Monitor

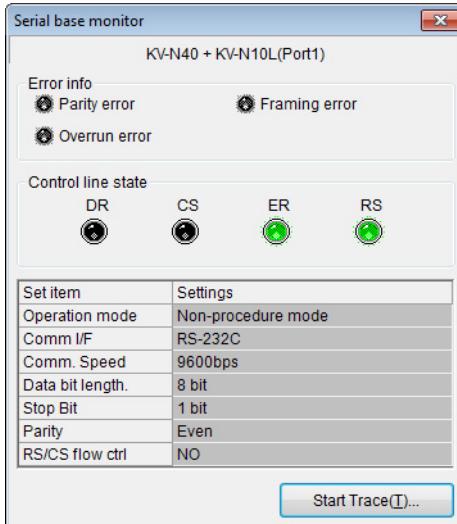
You can use the serial base monitor to monitor information such as the setting information, error information, and the state of control lines of each port of the KV Nano Series.

Startup Method

In "Serial" in the "Built-in function monitor selection" dialog box, select the port that you want to monitor, and then click "Display."

 "4-1 About the Built-In Function Monitor" (page 4-2)

Serial Base Monitor



| Item | Description |
|---------------------|--|
| Error info | The error information is displayed here. When an error occurs, the corresponding indicator lights. |
| Control line state* | This displays the state of the control lines. When a control line is transmitting, the corresponding indicator lights. |
| Settings | This displays the contents that have been set with Unit Editor. These contents cannot be changed. |
| Start Trace | Press this to start tracing. When you click the button, the "Trace monitor" dialog box appears. |

* Valid only when KV-N10L, KV-NC10L or KV-NC20L (Port1) is selected.

4-3 Trace Monitor

You can use the trace monitor to trace the data to send and the received data of each port of the KV Nano Series.

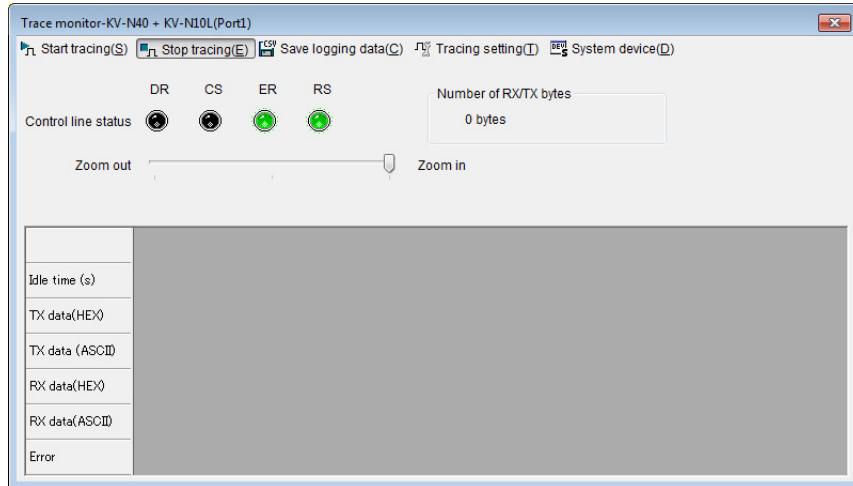
If you are using Modbus master mode, see "9-8 Modbus Dedicated Trace Monitor" (page 9-49).

Startup Method

In the serial base monitor, click "Start Trace."

"4-2 Serial Base Monitor" (page 4-3)

Trace Monitor



| Item | Description |
|-------------------|---|
| Start tracing | (ON): Tracing is being executed. The trace data display is not updated until trace execution is completed. (OFF): Tracing has been stopped. Click this to start tracing and change the button to its ON state. |
| Stop tracing | (ON): Tracing has been stopped. (OFF): Tracing is being executed. Click this to stop tracing and change the button to its ON state. |
| Save logging data | Click this to save, in CSV format, the logging data that has been traced (the data to send and the received data). You cannot save the logging data while the trace is being executed. |
| Tracing setting | Set the data capacity to trace and whether to execute traces cyclically. You cannot configure the settings while the trace is being executed. "Configuring tracing settings" (page 4-6) |
| System device | Click this to display a list of devices that are related to the mode that you are using. You can also display the list while the trace is being executed. |

4-3 Trace Monitor

| Item | | Description |
|--------------------------------|---|--|
| Control line status | DR (data set ready signal) CS (send enable signal) | These are signals that are sent from peripherals to the KV Nano Series. Lit in red: High level. Off: Low level. |
| | ER (data terminal ready signal) RS (send request signal) | These are signals that are sent from the KV Nano Series to peripherals. Lit in green: High level. Off: Low level. |
| Tracing display adjustment bar | Zoom in | A variety of information such as the idle time, the data to send and the received data (in hexadecimal and ASCII), and the verify relay number is all displayed in character format. |
| | Middle | The data to send and the received data (ASCII) is displayed in character format. |
| | Zoom out | No characters are displayed. Use this setting when you want to detect information such as the position that an error occurred. |
| Number of RX/TX bytes | | This displays the number of bytes that have been sent and received since tracing started. This information is updated while the trace is being executed. |
| Idle time(sec) | | This displays the communication standby time (in units of 0.1 second). |
| Send data | HEX | This displays the data that has been sent to peripherals from the KV Nano Series in hexadecimal format. |
| | ASCII | This displays the data that has been sent to peripherals from the KV Nano Series in character string format. |
| Received data | HEX | This displays the data that has been received by the KV Nano Series from peripherals in hexadecimal format. |
| | ASCII | This displays the data that has been received by the KV Nano Series from peripherals in character string format. |
| Error | | This displays "ERR" when a communication error occurs. Click this to display the error details. |

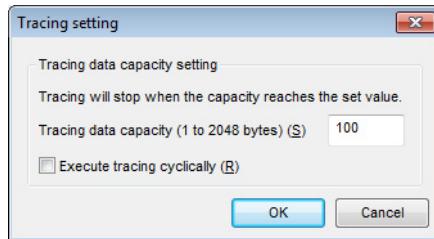


The timing that tracing data is acquired is different from the timing that data is sent and received on the actual communication line.

- Data to send: The point in time that data is stored in the send buffer.
- Received data: The point in time that data is taken out of the receive buffer.

4-3 Trace Monitor

■ Configuring tracing settings



| Item | Description |
|----------------------------|--|
| Tracing data capacity | Specify the data capacity to trace. Setting range: 1 to 2048 bytes (default value: 100) |
| Execute tracing cyclically | If you select this check box, as soon as a trace finishes, the next trace will start automatically (default value: cleared). |

KV MODE (HOST LINK)

This chapter describes the communication specifications, commands, and responses in KV mode (host link).

| | | |
|-----|--|-----|
| 5-1 | Outline and Procedure Prior to Operation | 5-2 |
| 5-2 | Communication Specifications and Unit Editor Settings | 5-4 |
| 5-3 | Communication Procedure..... | 5-5 |
| 5-4 | List of Commands | 5-7 |
| 5-5 | Explanation of Commands and Responses | 5-8 |

5-1 Outline and Procedure Prior to Operation

This section briefly describes KV mode (host link).

Outline

■ Application

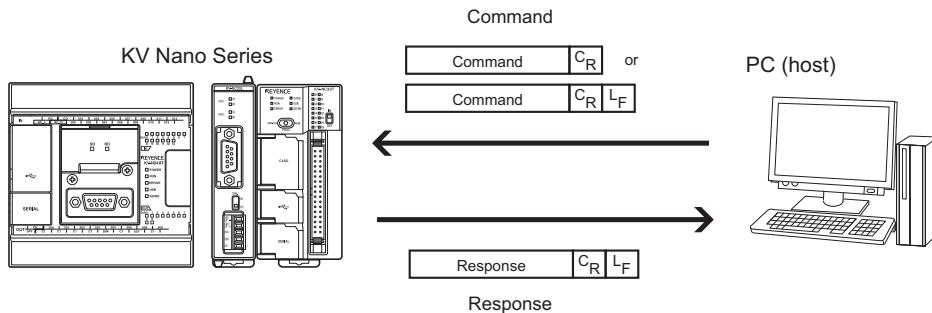
This mode is used when performing communication using Keyence's proprietary protocol. A response is automatically returned to a command that arrives from a peripheral. No communication program is required on the KV Nano Series side.

A connection can be made with a PC or similar product.

This specification is upwardly compatible with KZ mode of the PC Link Unit KZ-L2 for the KZ-300/350 and with KV mode (host link) of the KV-5000/3000/1000/700 Series. Connected peripherals can be left as is without any changes to their settings.

■ Communication configuration

In KV mode (host link), programming on the peripheral side is easy because the protocol is simple. With the host link, peripherals such as PCs operate as the host. By sending commands from the PC to the KV Nano Series and receiving the responses from the KV Nano Series, you can monitor the operating status of the base unit as well as read and write data.



Procedure Prior to Operation

This section describes the basic procedure to follow when using KV mode (host link).

If you are using an extension cassette or adapter, see "2-2 Installing Units on the Base Unit" (page 2-3) and install the extension cassette or adapter on the base unit.

Configure the KV STUDIO Unit Editor settings.*

- Set the operation mode of the ports that you are using to "KV mode (host link)."
- Configure items such as the baud rate (the communication speed) as necessary.

"5-2 Communication Specifications and Unit Editor Settings" (page 5-4)



Transfer the project that you have created to the base unit.

For details on how to check the installation environment and on how to install units on the base unit, see "Chapter 2 UNIT INSTALLATION AND MAINTENANCE" (page 2-1).



Connect the peripheral, and start transmitting data from the peripheral.

Connect the peripheral, and set the communication specifications of the peripheral so that they are the same as those of the KV Nano Series.

"2-3 Connecting Peripherals" (page 2-6)



Check the operations.

In KV STUDIO, on the "Monitor/Simulator" menu, click "Built-in Function Monitor" to check operations.*

"Chapter 4 USING THE BUILT-IN FUNCTION MONITOR TO CHECK OPERATIONS" (page 4-1)

* Use version 7 or later (version 7.1 when using an extension adapter) of KV STUDIO.

5-2 Communication Specifications and Unit Editor Settings

This section describes the communication specifications of KV mode (host link). Use the Unit Editor to configure the communication settings.

Setting Items on Unit Editor

Set the operation mode to "KV mode (host link)." Configure the other settings as shown below. For details on how to configure settings, see  "2-5 Using Unit Editor to Configure Settings" (page 2-12).



Match the communication specifications of peripherals with those of the KV Nano Series. Communication cannot be performed if the settings are different.

● Built-in serial port, KV-N10L, KV-NC10L, KV-NC20L (Port1)

| Item | Setting | Default Value |
|---------------------|---|---------------|
| Interface* | RS-232C | RS-232C |
| Baud rate | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps | 9600 bps |
| Data bit length | 8 bits | 8 bits |
| Start bit | 1 bit | 1 bit |
| Stop bit | 1 bit | 1 bit |
| Parity | Even | Even |
| RS/CS flow control* | OFF, ON | OFF |

* This does not display for the built-in serial port.

● KV-N11L, KV-NC20L (Port2)

| Item | Setting | Default Value |
|-------------------------------------|---|------------------------------|
| Interface | RS-232C ¹ , RS-422A/485 (4-wire type) | RS-422A/485 (4-wire type) |
| Baud rate | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps | 9600 bps |
| Data bit length | 8 bits | 8 bits |
| Start bit | 1 bit | 1 bit |
| Stop bit | 1 bit | 1 bit |
| Parity | Even | Even |
| RS/CS flow control ² | OFF | OFF |
| KV mode station number ³ | 0 to 9 | 0 |

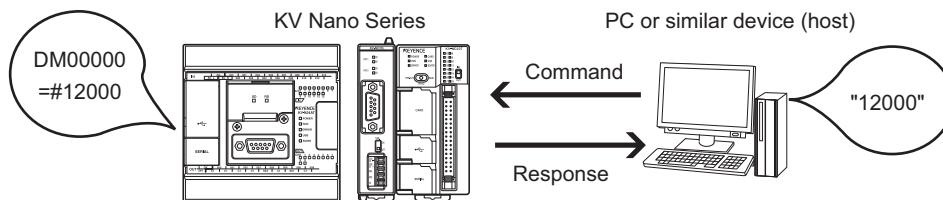
*1 This can only be set for the KV-NC20L (Port2).

*2 This is only displayed for the KV-N11L.

*3 This is displayed when the RS-422A/485 (4-wire type) is selected on the interface.

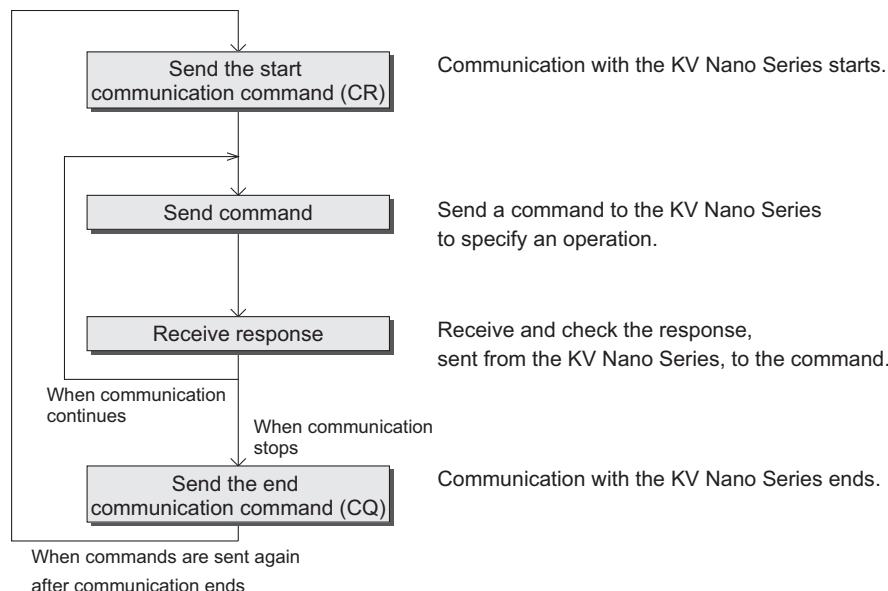
Communication Procedure

In KV mode (host link), a peripheral such as a PC operates as the host. The current value and set value of timers and counters can be read from the base unit and data can be written to and read from the base unit by sending a command to the KV Nano Series from the PC and receiving a response from the KV Nano Series. For example, when the "Read DM00000" command is sent from the PC, the KV Nano Series reads the data stored in DM00000 (for example, #12000), and returns the response "12000."



■ Command send procedure

Commands are sent from peripherals to the KV Nano Series according to the following procedure.



5-3 Communication Procedure

Send the start communication command (CR)

When the KV Nano Series is connected in a multi-drop configuration, use the start communication command to specify the station number of the KV Nano Series that you want to communicate with. To communicate with a different KV Nano Series after having started communication with a certain KV Nano Series, send the CQ command to end the current communication session, and then use the start communication command to specify the station number again.

Sending commands and receiving responses

Communication in KV mode (host link) is performed with command and response pairs. When creating a program for controlling the KV Nano Series from a peripheral, check that a response has been received before sending the next command.

Send the end communication command (CQ)

To end communication, send the end communication command.

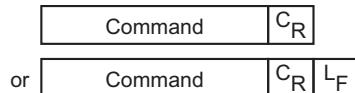
Format of Commands and Responses

The command and response formats are shown below.

■ Command format

Follow the format shown below when you send commands to the KV Nano Series from a peripheral.

C_R (0DH) is the delimiter. On the KV Nano Series, L_F (0AH) is ignored, and the text following L_F (0AH) is recognized as the next command.



■ Response format

The KV Nano Series returns responses to commands according to the following format. When you are creating programs on a peripheral, follow this response format to ensure that processing can be performed.



5-4 List of Commands

This section gives a list of the KV mode (host link) commands.

| Function | Command | See Page |
|---|-------------|----------|
| Start communication | CR | 5-8 |
| End communication | CQ | 5-9 |
| Model query | ?K | 5-13 |
| Check operation mode | ?M | 5-13 |
| Check error number | ?E | 5-11 |
| Change mode | Mn | 5-9 |
| Error clear | ER | 5-10 |
| Set the date and time | WRT | 5-14 |
| Forced set and forced reset | ST and RS | 5-15 |
| Continuous forced set and continuous forced reset | STS and RSS | 5-16 |
| Read data | RD | 5-17 |
| Read continuous data | RDS | 5-17 |
| Write data | WR | 5-22 |
| Write continuous data | WRS | 5-22 |
| Write set value | WS | 5-24 |
| Write continuous set values | WSS | 5-24 |
| Register monitor | MBS and MWS | 5-26 |
| Read monitor | MBR and MWR | 5-28 |
| Read comment | RDC | 5-29 |
| Read expansion unit buffer memory | URD | 5-30 |
| Write expansion unit buffer memory | UWR | 5-31 |

5-5 Explanation of Commands and Responses

This section describes (1) how to set each of the commands and (2) the contents of the responses to each command.

Start Communication [CR]

Send the start communication command when you want to start communication with the KV Nano Series. When the response to the start communication command is returned normally, you can send other commands.

When the station number is not appended

■ Command

| | | |
|-----|-----|----------------|
| C | R | C _R |
| 43H | 52H | 0DH |

When the station number (00 to 09) is appended

■ Command

| | | | | |
|-----|-----|-----|----------------|----------------|
| C | R | | Station number | C _R |
| 43H | 52H | 20H | | 0DH |

■ Response

| | | | |
|-----|-----|----------------|----------------|
| C | C | C _R | L _F |
| 43H | 43H | 0DH | 0AH |

■ Response

| | | | | | |
|-----|-----|-----|----------------|----------------|----------------|
| C | C | | Station number | C _R | L _F |
| 43H | 43H | 20H | | 0DH | 0AH |

CC : When the command has been processed normally, the code "CC" is entered in the response to indicate this.



If you are using the KV-N11L or KV-NC20L (Port2) connected in a multi-drop configuration, to communicate with a different base unit after having started communication with a certain base unit, send the CQ command to end the current communication session, and then use the start communication command to specify the station number again.



- If you are using the KV-N11L or KV-NC20L (Port2) connected in a multi-drop configuration, be sure to append the station number.
- When you are using the KV-N11L or KV-NC20L (Port2) connected in a multi-drop configuration, if the unit receives a command that specifies a station number that is different from the unit's own station number, the unit will not send a response.

Cautions common to commands other than "CR start communication"

- When you perform communication using the RS-422A or RS-485 interface, even if the KV Nano Series receives a command before it receives CR_station number C_R, the KV Nano Series will not send a response to this other command.
- After a unit receives a CR command and successfully sends a response, the unit will return responses to other commands that it receives.
- When you perform communication using the RS-232C interface, if you send a command before first sending the CR command, an error will occur, and the response "E1" will be returned.

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

E1: Command error



"Responses during Errors" (page 5-32)

End Communication [CQ]

This command ends a serial communication session with a KV Nano Series.

■ Command

| | | |
|-----|-----|----------------|
| C | Q | C _R |
| 43H | 51H | 0DH |

■ Response

| | | | |
|-----|-----|----------------|----------------|
| C | F | C _R | L _F |
| 43H | 46H | 0DH | 0AH |

CF : When the command has been processed normally, the code "CF" is entered in the response to indicate this.

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

 "Responses during Errors" (page 5-32)

Change Mode [Mn]

This command switches the base unit to PROG mode or to RUN mode.

■ Command

| | | |
|-----|-------------|----------------|
| M | Mode number | C _R |
| 4DH | 0DH | |

Mode number : If you specify "0," the base unit switches to PROG mode.
If you specify "1," the base unit switches to RUN mode.

■ Response

| | | | |
|-----|-----|----------------|----------------|
| O | K | C _R | L _F |
| 4FH | 4BH | 0DH | 0AH |

OK : When the command has been processed normally, the code "OK" is entered in the response to indicate this.

5-5 Explanation of Commands and Responses

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

E1: Mode number

| | | | |
|-----|-----|----------------|----------------|
| E | 2 | C _R | L _F |
| 45H | 32H | 0DH | 0AH |

E2: Program not registered

| | | | |
|-----|-----|----------------|----------------|
| E | 5 | C _R | L _F |
| 45H | 35H | 0DH | 0AH |

E5: Main unit error



Error Clear [ER]

This command clears the error that is currently occurring on the base unit.

■ Command

| | | |
|-----|-----|----------------|
| E | R | C _R |
| 45H | 52H | 0DH |

■ Response

| | | | |
|-----|-----|----------------|----------------|
| O | K | C _R | L _F |
| 4FH | 4BH | 0DH | 0AH |

OK : When the command has been processed normally, the code "OK" is entered in the response to indicate this.

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

E1: Command error



Check Error Number [?E]

This command checks the error or abnormality that is currently occurring on the base unit. Use the error number table to check the details of the error.

■ Command

| | | |
|-----|-----|----------------|
| ? | E | C _R |
| 3FH | 45H | 0DH |

■ Response

| | | |
|--------------|----------------|----------------|
| Error number | C _R | L _F |
| 0DH | 0AH | |

Error number : The contents of the error currently occurring on the base unit are entered in the response as an error number (with no zero suppression).

If no errors are occurring on the base unit, "000" is entered in the response.

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

 "Responses during Errors" (page 5-32)

For how to remedy errors, see the base unit User's Manual.

5-5 Explanation of Commands and Responses**Error number table**

| Number | Description | Number | Description | Number | Description |
|---------------|--------------------------|---------------|--------------------------|---------------|------------------------------------|
| 010 | CALL Nest | 081 | RAM Failure | 120 | Watchdog Timer |
| 011 | FOR Nest | 082 | AW Data Failure | 122 | System Error |
| 015 | Convert | 085 | Clock Data Lost | 123 | Invalid Device |
| 022 | MACRO Nest | 086 | RTC Failure | 125 | ErrorBuffer Overflow |
| 030 | Scan Time Over | 092 | AW Cassette Failure | 127 | Auto Loading Failed |
| 040 | No Ladder Program | 095 | File Access Busy | 128 | Ladder Calc |
| 050 | Unit Checksum | 096 | Extension Unit Failure | 129 | Unit Error |
| 051 | Unit Setting Information | 097 | Extension Unit Type | 131 | FLASH ROM Format |
| 052 | No Unit Connected | 098 | Unsupported Ext.Unit | 132 | Invalid Ladder File |
| 053 | Unit Timeout | 099 | Hot Plugged/Unplugged | 140 | AW Writing Power OFF |
| 054 | Number Of Units | 101 | Extension Unit Version | 250 | AccessWindow E250 Connection Error |
| 055 | Unit Type | 102 | POWER OFF Error | 251 | AccessWindow E251 Connection Error |
| 056 | ExpansionBus Comm Error | 103 | Shutdown Timeout | | |
| 058 | ExpansionBus Comm range | 104 | Excess Power Consumption | | |
| 059 | Unit Version | 105 | Power-off Hold Format | | |
| 060 | Excessive I/O Points | 106 | Abnormal Reset | | |
| 061 | Assign Device Overlap | 107 | System Error | | |
| 080 | Flash ROM Failure | 118 | Invalid Data | | |

Model Query [?K]

This command checks the PLC model.

■ Command

| | | |
|-----|-----|----------------|
| ? | K | C _R |
| 3FH | 4BH | 0DH |

■ Response

| | | |
|-------|----------------|----------------|
| Model | C _R | L _F |
| 0DH | 0AH | |

- Model : The PLC model is entered as a number in the sections labeled "model" of the response.
- | | |
|----------|-------------------------|
| KV-N14** | : "135" (31H, 33H, 35H) |
| KV-N24** | : "134" (31H, 33H, 34H) |
| KV-N40** | : "133" (31H, 33H, 33H) |
| KV-N60** | : "132" (31H, 33H, 32H) |
| KV-NC32T | : "128" (31H, 32H, 38H) |

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

□ "Responses during Errors" (page 5-32)

Check Operation Mode [?M]

This command checks the current operating status of the base unit.

■ Command

| | | |
|-----|-----|----------------|
| ? | M | C _R |
| 3FH | 4DH | 0DH |

■ Response

| | | |
|------|----------------|----------------|
| Data | C _R | L _F |
| 0DH | 0AH | |

- Data : The current status (mode) of the base unit is entered in the response as a number. If the base unit is in PROG mode or no ladder programs are registered, "0" is entered in the response. If the base unit is in RUN mode, "1" is entered in the response.

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

□ "Responses during Errors" (page 5-32)

5-5 Explanation of Commands and Responses

Set the Date and Time [WRT]

This command sets the date and time of the base unit.

■ Command



- Data 1 : Enter the year using two digits. "00" is the year 2000. Enter a value in the range of 00 to 99.
- Data 2 : Enter the month using two digits. Enter a value in the range of 01 to 12.
- Data 3 : Enter the day using two digits. Enter a value in the range of 01 to 31.
- Data 4 : Enter the hour using two digits. Enter a value in the range of 00 to 23.
- Data 5 : Enter the minute using two digits. Enter a value in the range of 00 to 59.
- Data 6 : Enter the second using two digits. Enter a value in the range of 00 to 59.
- Data 7 : Enter the day of the week using one digit. The relationships between the days of the week and the input values are shown in the following table.
Enter a value in the range of 0 to 6.

| Input value | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|-----------------|--------|--------|---------|-----------|----------|--------|----------|
| Day of the week | Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |

■ Response



- OK : When the command has been processed normally, the code "OK" is entered in the response to indicate this.

■ Error response



"Responses during Errors" (page 5-32)

Forced Set [ST] and Forced Reset [RS]

These commands forcibly turn the contact of the specified device ON or OFF.

■ Command

<Forced set>

| | | | | | |
|-----|-----|-----|-------------|---------------|----------------|
| S | T | □ | Device type | Device number | C _R |
| 53H | 54H | 20H | | | 0DH |

<Forced reset>

| | | | | | |
|-----|-----|-----|-------------|---------------|----------------|
| R | S | □ | Device type | Device number | C _R |
| 52H | 53H | 20H | | | 0DH |

| Device Name | Device Type | Device Number ^{*1} |
|---|--------------------|-----------------------------|
| Relay ^{*2} | R (can be omitted) | 00000 to 59915 |
| Link relay | B | 0000 to 1FFF |
| Internal auxiliary relay ^{*2} | MR | 00000 to 59915 |
| Latch relay ^{*2} | LR | 00000 to 19915 |
| Control relay | CR | 0000 to 8915 |
| Timer | T | 0000 to 511 |
| Counter | C | 0000 to 255 |
| High-speed counter comparator ^{*3} | CTC | 0 to 7 ^{*4} |
| Work relay | VB | 0000 to 1FFF |

*1 The device number allows zero suppression.

*2 Relays, internal auxiliary relays, and latch relays allow XYM marking.

□ "XYM Marking" (page 5-32)

*3 Only the RS command (forced reset) can be used with high-speed counter comparators.

*4 The device numbers that you can use vary depending on the base unit.

KV-N14 and KV-N24 : CTC0 to CTC3

KV-N40 : CTC0 to CTC5

KV-N60 : CTC0 to CTC7

KV-NC32T : CTC0 to CTC5

■ Response

| | | | |
|-----|-----|----------------|----------------|
| O | K | C _R | L _F |
| 4FH | 4BH | 0DH | 0AH |

OK : When the command has been processed normally, the code "OK" is entered in the response to indicate this.

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | 0 | C _R | L _F |
| 45H | 30H | 0DH | 0AH |

E0: Device number error

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

E1: Command error

□ "Responses during Errors" (page 5-32)

5-5 Explanation of Commands and Responses

Continuous Forced Set [STS] and Continuous Forced Reset[RSS]

This command forcibly turns the contacts of the specified number of devices ON or OFF.

■ Command

<Forced set>

| | | | | | | | | |
|-----|-----|-----|-----|-------------|---------------|-----|--------------------------------|-----|
| S | T | S | □ | Device type | Device number | □ | Number of data blocks to write | C_R |
| 53H | 54H | 53H | 20H | | | 20H | | 0DH |

<Forced reset>

| | | | | | | | | |
|-----|-----|-----|-----|-------------|---------------|-----|--------------------------------|-----|
| R | S | S | □ | Device type | Device number | □ | Number of data blocks to write | C_R |
| 52H | 53H | 53H | 20H | | | 20H | | 0DH |

| Device Name | Device Type | Device Number ^{*1} | Number of Devices to Write ^{*1} |
|--|--------------------|-----------------------------|--|
| Relay ^{*2} | R (can be omitted) | 00000 to 55915 | 01 to 16 |
| Link relay | B | 0000 to 1FFF | 01 to 16 |
| Internal auxiliary relay ^{*2} | MR | 00000 to 55915 | 01 to 16 |
| Latch relay ^{*2} | LR | 00000 to 19915 | 01 to 16 |
| Control relay | CR | 0000 to 8915 | 01 to 16 |
| Work relay | VB | 0000 to 1FFF | 01 to 16 |

*1 The device number and the number of devices to write allow zero suppression.

*2 Relays, internal auxiliary relays, and latch relays allow XYM marking.

□ "XYM Marking" (page 5-32)

■ Response

| | | | |
|-----|-----|-----|-----|
| O | K | C_R | L_F |
| 4FH | 4BH | 0DH | 0AH |

OK : When the command has been processed normally, the code "OK" is entered in the response to indicate this.

■ Error response

| | | | |
|-----|-----|-----|-----|
| E | O | C_R | L_F |
| 45H | 30H | 0DH | 0AH |

E0: Device number error

| | | | |
|-----|-----|-----|-----|
| E | 1 | C_R | L_F |
| 45H | 31H | 0DH | 0AH |

E1: Command error

□ "Responses during Errors" (page 5-32)

Read Data [RD] and Read Continuous Data [RDS]

RD : This command reads one piece of data from the specified device.

RDS : This command continuously reads the data of a specified number of devices.

■ Command

| | | | | | | |
|-----|-----|-----|-------------|---------------|--------------|-----|
| R | D | □ | Device type | Device number | Data format* | C_R |
| 52H | 44H | 20H | | | 0DH | |

| | | | | | | | | | |
|-----|-----|-----|-----|-------------|---------------|--------------|---|-------------------------------|-----|
| R | D | S | □ | Device type | Device number | Data format* | □ | Number of data blocks to read | C_R |
| 52H | 44H | 53H | 20H | | | 20H | | 0DH | |

* The data format (suffix) of the device is specified as .U, .S, .D, .L, or .H or is unspecified.

.U: Unsigned, 16-bit decimal

.L: Signed, 32-bit decimal

.S: Signed, 16-bit decimal

.H: 16-bit hexadecimal

.D: Unsigned, 32-bit decimal

Unspecified: Varies depending on the device type

"Data Simultaneity When You Specify the .D or .L Data Format" (page 5-33)

| Device Name | Device Type | Device Number ^{*1} | Data Format Unspecified | Number of Devices to Read ^{*1} | |
|--|--------------------|-----------------------------|----------------------------|---|------------|
| | | | | Bit, .U, .S, and .H | .D and .L |
| Relay ^{*2} | R (can be omitted) | 00000 to 59915 | (Bit) | 001 to 256 | 001 to 128 |
| Link relay | B | 0000 to 1FFF | (Bit) | 001 to 256 | 001 to 128 |
| Internal auxiliary relay ^{*2} | MR | 00000 to 59915 | (Bit) | 001 to 256 | 001 to 128 |
| Latch relay ^{*2} | LR | 00000 to 19915 | (Bit) | 001 to 256 | 001 to 128 |
| Control relay | CR | 0000 to 8915 | (Bit) | 001 to 256 | 001 to 128 |
| Work relay | VB | 0000 to 1FFF | (Bit) | 001 to 256 | 001 to 128 |
| Data memory ^{*2} | DM | 00000 to 32767 | .U | 001 to 256 | 001 to 128 |
| Link register | W | 0000 to 3FFF | .U | 001 to 256 | 001 to 128 |
| Temporary data memory | TM | 000 to 511 | .U | 001 to 256 | 001 to 128 |
| Index register | Z | 01 to 12 | .U | 01 to 12 | 01 to 12 |
| Timer | T | 000 to 511 | .D | 01 to 64 | 01 to 64 |
| Timer (current value) | TC | 000 to 511 | .D | 01 to 64 | 01 to 64 |
| Timer (set value) | TS | 000 to 511 | .D | 01 to 64 | 01 to 64 |
| Counter | C | 000 to 255 | .D | 01 to 64 | 01 to 64 |
| Counter (current value) | CC | 000 to 255 | .D | 01 to 64 | 01 to 64 |
| Counter (set value) | CS | 000 to 255 | .D | 01 to 64 | 01 to 64 |
| High-speed counter | CTH | 0 to 3 ^{*3} | .D | 1 to 4 | 1 to 4 |
| High-speed counter comparator | CTC | 0 to 7 ^{*3} | .D | 1 to 8 | 1 to 8 |
| Control memory | CM | 0000 to 8999 | .U | 001 to 256 | 001 to 128 |
| Work memory | VM | 0000 to 9999 | .U | 001 to 256 | 001 to 128 |

*1 The device number and the number of devices to read allow zero suppression.

*2 Relays, internal auxiliary relays, latch relays, and data memory allow XYM marking. See "XYM Marking" (page 5-32).

*3 The device numbers that you can use vary depending on the base unit.

KV-N14 and KV-N24 : CTH0 and CTH1; CTC0 to CTC3

KV-N40 : CTH0 to CTH2; CTC0 to CTC5

KV-N60 : CTH0 to CTH3; CTC0 to CTC7

KV-NC32T : CTH0 to CTH2; CTC0 to CTC5

5-5 Explanation of Commands and Responses

■ Response

<R, B, MR, LR, CR, and VB>

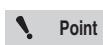


* n: The number of devices to read, which is specified when the command is sent.

Data 1 to n: These indicate the values stored in the n devices in order from the specified device number.

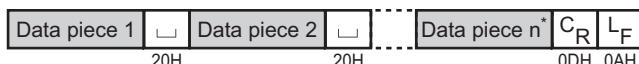
The range of values displayed varies depending on the data format that is specified when the command is sent.

| Specified Data Format | | Data 1 to n | |
|-----------------------|--------------------------|-------------|--|
| | | Size | Range |
| Unspecified | Bit | 1 byte | 0 (OFF) or 1 (ON) |
| .U | Unsigned, 16-bit decimal | 5 bytes | 00000 to 65535 |
| .S | Signed, 16-bit decimal | 6 bytes | -32768 to +32767 (0 is +00000) |
| .D | Unsigned, 32-bit decimal | 10 bytes | 0000000000 to 4294967295 |
| .L | Signed, 32-bit decimal | 11 bytes | -2147483648 to +2147483647 (0 is +0000000000) |
| .H | 16-bit hexadecimal | 4 bytes | 0000 to FFFF |



- When you specify the .U, .S, or .H data format with this command, 16 continuous bits will be processed.
- When you specify the .D or .L data format with this command, 32 continuous bits will be processed.
- When you use a relay device to specify a channel other than the leading channel (such as R002 or MR311), the next channel will be included in the 16 or 32 bits to be processed.

<DM, W, TM, Z, CM, and VM>



* n: The number of devices to read, which is specified when the command is sent.

Data 1 to n: These indicate the values stored in the n devices in order from the specified device number.

The range of values displayed varies depending on the data format that is specified when the command is sent.

| Specified Data Format | | Data 1 to n | |
|-----------------------|--------------------------|-------------|--|
| | | Size | Range |
| .U (can be omitted) | Unsigned, 16-bit decimal | 5 bytes | 00000 to 65535 |
| .S | Signed, 16-bit decimal | 6 bytes | -32768 to +32767 (0 is +00000) |
| .D | Unsigned, 32-bit decimal | 10 bytes | 0000000000 to 4294967295 |
| .L | Signed, 32-bit decimal | 11 bytes | -2147483648 to +2147483647 (0 is +0000000000) |
| .H | 16-bit hexadecimal | 4 bytes | 0000 to FFFF |

<T, C, CTC, and CTH>

| | | | | | | | | | | | | |
|-----------|---|-----------------|---|-------------|---|-----------|---|-----------------|---|-------------|---|--|
| Contact 1 | , | Current value 1 | , | Set value 1 | , | Contact 2 | , | Current value 2 | , | Set value 2 | , | |
| 20H | | 20H | | 20H | | 20H | | 20H | | 20H | | |

| | | | | | | | |
|--|------------|---|-----------------|---|-------------|-----|-----|
| | Contact n* | , | Current value n | , | Set value n | C_R | L_F |
| | 20H | | 20H | | 0DH | 0AH | |

* n: The number of devices to read, which is specified when the command is sent.

Contact 1 to n, current value 1 to n, and set value 1 to n:

These indicate the values stored in the n devices in order from the specified device number.

The range of values displayed varies depending on the data format that is specified when the command is sent.

(For CTH, contact and set values are fixed to "0.")

| Specified Data Format | | Contact 1 to n | | Current Value 1 to n and Set Value 1 to n | | | |
|-----------------------|-----------------------------|----------------|-------------------------|---|---|--|--|
| | | Size | Range | Size | Range | | |
| .U | Unsigned, 16-bit decimal | 1 byte | 0 (OFF) or 1 (ON) | 5 bytes | 00000 to 65535 | | |
| | .S | | | 6 bytes | -32768 to +32767 (0 is +00000) | | |
| | .D (can be omitted) | | | 10 bytes | 0000000000 to 4294967295 | | |
| | .L | | | 11 bytes | -2147483648 to +2147483647 (0 is +0000000000) | | |
| | .H | | | 4 bytes | 0000 to FFFF | | |



When you specify the .U, .S, or .H data format with this command, the value of the lower 16 bits will be displayed.

<TC and CC>

| | | | | | | |
|-----------------|---|-----------------|---|------------------|-----|-----|
| Current value 1 | □ | Current value 2 | □ | Current value n* | C_R | L_F |
| 20H | | 20H | | 20H | 0DH | 0AH |

* n: The number of devices to read, which is specified when the command is sent.

Current value 1 to n: These indicate the values stored in the n devices in order from the specified device number.

The range of values displayed varies depending on the data format that is specified when the command is sent.

| Specified Data Format | | Current Value 1 to n | | |
|-----------------------|--------------------------|----------------------|---|--|
| | | Size | Range | |
| .U | Unsigned, 16-bit decimal | 5 bytes | 00000 to 65535 | |
| .S | Signed, 16-bit decimal | 6 bytes | -32768 to +32767 (0 is +00000) | |
| .D (can be omitted) | Unsigned, 32-bit decimal | 10 bytes | 0000000000 to 4294967295 | |
| .L | Signed, 32-bit decimal | 11 bytes | -2147483648 to +2147483647 (0 is +0000000000) | |
| .H | 16-bit hexadecimal | 4 bytes | 0000 to FFFF | |



When you specify the .U, .S, or .H data format with this command, the value of the lower 16 bits will be displayed.

5-5 Explanation of Commands and Responses

<TS and CS>



* n: The number of devices to read, which is specified when the command is sent.

Set value 1 to n: These indicate the values stored in the n devices in order from the specified device number.

The range of values displayed varies depending on the data format that is specified when the command is sent.

| Specified Data Format | | Set Value 1 to n | |
|-----------------------|--------------------------|------------------|--|
| | | Size | Range |
| .U | Unsigned, 16-bit decimal | 5 bytes | 00000 to 65535 |
| .S | Signed, 16-bit decimal | 6 bytes | -32768 to +32767 (0 is +00000) |
| .D (can be omitted) | Unsigned, 32-bit decimal | 10 bytes | 0000000000 to 4294967295 |
| .L | Signed, 32-bit decimal | 11 bytes | -2147483648 to +2147483647 (0 is +0000000000) |
| .H | 16-bit hexadecimal | 4 bytes | 0000 to FFFF |



When you specify the .U, .S, or .H data format with this command, the value of the lower 16 bits will be displayed.

■ Error response



E0: Device number error



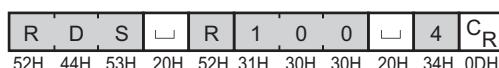
E1: Command error

"Responses during Errors" (page 5-32)

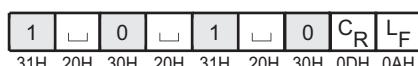
■ Command and response examples

● Reading R100 to R103 in the "bit" data format

Command



Response



R100: ON, R101: OFF, R102: ON, R103: OFF

● Reading DM200 to DM202 in the ".S" data format

Command

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|----------------|
| R | D | S | □ | D | M | 2 | 0 | 0 | . | S | □ | 3 | C _R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|----------------|

52H 44H 53H 20H 44H 4DH 32H 30H 30H 2EH 53H 20H 33H 0DH

Response

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------------|----------------|
| + | 1 | 5 | 0 | 2 | 5 | □ | - | 2 | 5 | 4 | 0 | 0 | □ | + | 0 | 0 | 0 | 0 | 0 | C _R | L _F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------------|----------------|

2BH 31H 35H 30H 32H 35H 20H 2DH 32H 35H 34H 30H 30H 20H 2BH 30H 30H 30H 30H 30H 0DH 0AH

DM200 = +15025, DM201 = -25400, DM202 = 0

5-5 Explanation of Commands and Responses

Write Data [WR] and Write Continuous Data [WRS]

WR : This command writes data to the specified device.

WRS : This command writes data to the specified number of devices continuously.

■ Command

| | | | | | | |
|-----|-----|-------------|---------------|---------------|--------------|--------------------------------|
| W | R | Device type | Device number | Data format* | Data | C _R |
| 57H | 52H | 20H | | 20H | | 0DH |
| W | R | S | Device type | Device number | Data format* | Number of data blocks to write |
| 57H | 52H | 53H | 20H | 20H | 20H | 20H |

* The data format (suffix) of the device is specified as .U, .S, .D, .L, or .H or is unspecified.

.U: Unsigned, 16-bit decimal

.L: Signed, 32-bit decimal

.S: Signed, 16-bit decimal

.H: 16-bit hexadecimal

.D: Unsigned, 32-bit decimal

Unspecified: Varies depending on the device type

 "Data Simultaneity When You Specify the .D or .L Data Format" (page 5-33)

 For information on how to specify the [WR] and [WRS] commands for the different devices, see page 5-18.

| Device Name | Device Type | Device Number ^{*1} | Data Format Unspecified | Number of Devices to Write ^{*1} | |
|---|------------------------|-----------------------------|----------------------------|--|------------|
| | | | | Bit, .U, .S, and .H | .D and .L |
| Relay ^{*2} | R (can be omitted) | 00000 to 59915 | (Bit) | 001 to 256 | 001 to 128 |
| Link relay | B | 0000 to 1FFF | (Bit) | 001 to 256 | 001 to 128 |
| Internal auxiliary relay ^{*2} | MR | 00000 to 59915 | (Bit) | 001 to 256 | 001 to 128 |
| Latch relay ^{*2} | LR | 00000 to 19915 | (Bit) | 001 to 256 | 001 to 128 |
| Control relay | CR | 0000 to 8915 | (Bit) | 001 to 256 | 001 to 128 |
| Work relay | VB | 0000 to 1FFF | (Bit) | 001 to 256 | 001 to 128 |
| Data memory ^{*2} | DM | 00000 to 32767 | .U | 001 to 256 | 001 to 128 |
| Link register | W | 0000 to 3FFF | .U | 001 to 256 | 001 to 128 |
| Temporary data memory | TM | 000 to 511 | .U | 001 to 256 | 001 to 128 |
| Index register | Z | 01 to 12 | .U | 01 to 12 | 01 to 12 |
| Timer (current value) ^{*4} | T ^{*3} and TC | 000 to 511 | .D | 01 to 64 | 01 to 64 |
| Timer (set value) ^{*4} | TS | 000 to 511 | .D | 01 to 64 | 01 to 64 |
| Counter (current value) ^{*4} | C ^{*3} and CC | 000 to 255 | .D | 01 to 64 | 01 to 64 |
| Counter (set value) ^{*4} | CS | 000 to 255 | .D | 01 to 64 | 01 to 64 |
| High-speed counter ^{*4} | CTH | 0 to 3 ^{*6} | .D | 1 to 4 | 1 to 4 |
| High-speed counter comparator ^{*4} | CTC ^{*5} | 0 to 7 ^{*6} | .D | 1 to 8 | 1 to 8 |
| Control memory | CM | 0000 to 8999 | .U | 001 to 256 | 001 to 128 |
| Work memory | VM | 0000 to 9999 | .U | 001 to 256 | 001 to 128 |

*1 The device number and the number of devices to write allow zero suppression.

*2 Relays, internal auxiliary relays, latch relays, and data memory allow XYM marking. See  "XYM Marking" (page 5-32).

*3 Write current values when you specify a timer (T) or counter (C).

*4 When you specify the .U, .S, or .H data format with this command, data will be written to the lower 16 bits, and "0" will be written to the higher 16 bits.

*5 Write set values when you specify a high-speed counter comparator (CTC).

*6 The device numbers that you can use vary depending on the base unit.

KV-N14 and KV-N24 : CTH0 and CTH1; CTC0 to CTC3

KV-N40 : CTH0 to CTH2; CTC0 to CTC5

KV-N60 : CTH0 to CTH3; CTC0 to CTC7

KV-NC32T : CTH0 to CTH2; CTC0 to CTC5

■ Response

| | | | |
|-----|-----|----------------|----------------|
| O | K | C _R | L _F |
| 4FH | 4BH | 0DH | 0AH |

OK : When the command has been processed normally, the code "OK" is entered in the response to indicate this.

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | 0 | C _R | L _F |
| 45H | 30H | 0DH | 0AH |

E0: Device number error

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

E1: Command error

| | | | |
|-----|-----|----------------|----------------|
| E | 4 | C _R | L _F |
| 45H | 34H | 0DH | 0AH |

E4: Write protected

☞ "Responses during Errors" (page 5-32)

■ Command and response examples

● Writing data to R100 to R103 in the "bit" data format

Command

| | | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----------------|
| W | R | S | □ | R | 1 | 0 | 0 | □ | 4 | □ | 1 | □ | 0 | □ | 1 | □ | 0 | C _R |
| 57H | 52H | 53H | 20H | 52H | 31H | 30H | 30H | 20H | 34H | 20H | 31H | 20H | 30H | 20H | 31H | 20H | 30H | 0DH |

Response

| | | | |
|-----|-----|----------------|----------------|
| O | K | C _R | L _F |
| 4FH | 4BH | 0DH | 0AH |

● Writing data to DM200 to DM202 in the ".S" data format

Command

| | | | | | | | | | | | | | | | | | | |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-----|-----|-----|-----|
| W | R | S | □ | D | M | 2 | 0 | 0 | . | S | □ | 3 | □ | | | | | |
| 57H | 52H | 53H | 20H | 44H | 4DH | 32H | 30H | 30H | 2EH | 53H | 20H | 33H | 20H | | | | | |
| | + | 1 | 5 | 0 | 2 | 5 | □ | - | 0 | 5 | 4 | 0 | 0 | | | | | |
| | 2BH | 31H | 35H | 30H | 32H | 35H | 20H | 2DH | 30H | 35H | 34H | 30H | 30H | 20H | 32H | 30H | 30H | 0DH |

Response

| | | | |
|-----|-----|----------------|----------------|
| O | K | C _R | L _F |
| 4FH | 4BH | 0DH | 0AH |

Reference The data to be written allows zero suppression. Also, if the data represents a positive value, "+" can be omitted.

5-5 Explanation of Commands and Responses

Write Set Value [WS] and Write Continuous Set Values [WSS]

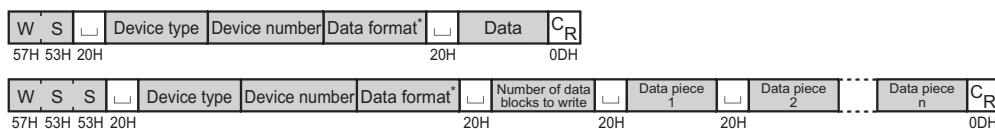
WS : This command writes data to the specified device.

WSS : This command writes data to the specified number of devices continuously.



The WS and WSS commands are KV Nano Series compatible commands. These commands operate in the same manner as WR and WRS.

■ Command



* The data format (suffix) of the device is specified as .U, .S, .D, .L, or .H or is unspecified.

- .U: Unsigned, 16-bit decimal
- .S: Signed, 16-bit decimal
- .D: Unsigned, 32-bit decimal
- .L: Signed, 32-bit decimal
- .H: 16-bit hexadecimal

Unspecified: Varies depending on the device type

| Device Name | Device Type | Device Number ^{*1} | Data Format Unspecified | Number of Devices to Write ^{*1} | |
|--|-------------|-----------------------------|----------------------------|---|-----------|
| | | | | Bit, .U, .S, and .H | .D and .L |
| Timer (set value) ^{*2} | T | 000 to 511 | .D | 01 to 64 | 01 to 64 |
| Counter (set value) ^{*2} | C | 000 to 255 | .D | 01 to 64 | 01 to 64 |
| High-speed counter comparator ^{*2} | CTC | 0 to 7 ^{*3} | .D | 1 to 8 | 1 to 8 |

*1 The device number and the number of devices to write allow zero suppression.

*2 When you specify the .U, .S, or .H data format with this command, data will be written to the lower 16 bits, and "0" will be written to the higher 16 bits.

*3 The device numbers that you can use vary depending on the base unit.

KV-N14 and KV-N24 : CTC0 to CTC3

KV-N40 : CTC0 to CTC5

KV-N60 : CTC0 to CTC7

KV-NC32T : CTC0 to CTC5

■ Response



OK : When the command has been processed normally, the code "OK" is entered in the response to indicate this.

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | 0 | C _R | L _F |
| 45H | 30H | 0DH | 0AH |

E0: Device number error

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

E1: Command error

| | | | |
|-----|-----|----------------|----------------|
| E | 4 | C _R | L _F |
| 45H | 34H | 0DH | 0AH |

E4: Write protected

 "Responses during Errors" (page 5-32)

5-5 Explanation of Commands and Responses

Register Monitor [MBS] and [MWS]

This command registers the specified device to the bit device registration table (MBS) or word device registration table (MWS).

Up to 120 data entries can be registered.

MBS : This command registers bit devices to monitor.

MWS : This command registers word devices to monitor.



One device occupies two words when you register R, B, MR, LR, CR, DM, W, TM, CM, VB, or VM in data format .D or .L in the word device registration table (MWS).

■ Command

<Registering a bit device to monitor>

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-------------|---------------|---|-------------|---------------|---|-----|-----|-----|-------------|---------------|----------------|
| M | B | S | □ | Device type | Device number | □ | Device type | Device number | □ | ... | ... | ... | Device type | Device number | C _R |
| 4DH | 42H | 53H | 20H | | 20H | | | 20H | | | | | | | 0DH |

| Device Name | Device Type | Device Number ^{*1} |
|--|-------------|-----------------------------|
| Relay ^{*2} | R | 00000 to 59915 |
| Link relay | B | 0000 to 1FFF |
| Internal auxiliary relay ^{*2} | MR | 00000 to 59915 |
| Latch relay ^{*2} | LR | 00000 to 19915 |
| Control relay | CR | 0000 to 8915 |
| Timer | T | 000 to 511 |
| Counter | C | 000 to 255 |
| High-speed counter comparator (contact) | CTC | 0 to 7 ^{*3} |
| Work relay | VB | 0000 to 1FFF |

*1 The device number allows zero suppression.

*2 Relays, internal auxiliary relays, latch relays, and data memory allow XYM marking.

See "XYM Marking" (page 5-32).

*3 The device numbers that you can use vary depending on the base unit.

KV-N14 and KV-N24 : CTC0 to CTC3

KV-N40 : CTC0 to CTC5

KV-N60 : CTC0 to CTC7

KV-NC32T : CTC0 to CTC5

<Registering a word device to monitor>

| | | | | | | | | | | | | |
|-----|-----|-----|-----|-------------|---------------|--------------|---|-------------|---------------|--------------|-----|-----|
| M | W | S | □ | Device type | Device number | Data format* | □ | Device type | Device number | Data format* | □ | ... |
| 4DH | 57H | 53H | 20H | | 20H | | | | 20H | | | ... |
| ... | ... | ... | ... | Device type | Device number | Data format* | □ | C_R | 0DH | ... | ... | ... |

* The data format (suffix) of the device is specified as .U, .S, .D, .L, or .H or is unspecified.

- .U: Unsigned, 16-bit decimal
- .S: Signed, 16-bit decimal
- .D: Unsigned, 32-bit decimal
- .L: Signed, 32-bit decimal
- .H: 16-bit hexadecimal

Unspecified: Varies depending on the device type

"Data Simultaneity When You Specify the .D or .L Data Format" (page 5-33)

| Device Name | Device Type | Device Number*1 | Data Format Unspecified |
|---|-------------|----------------------|----------------------------|
| Relay* ^{2, 3} | R | 00000 to 59915 | .U |
| Link relay* ³ | B | 0000 to 1FFF | .U |
| Internal auxiliary relay* ^{2, 3} | MR | 00000 to 59915 | .U |
| Latch relay* ^{2, 3} | LR | 00000 to 19915 | .U |
| Control relay* ³ | CR | 0000 to 8915 | .U |
| Work relay | VB | 0000 to 1FFF | .U |
| Data memory* ² | DM | 00000 to 32767 | .U |
| Link register | W | 0000 to 3FFF | .U |
| Temporary data memory | TM | 000 to 511 | .U |
| Index register | Z | 01 to 12 | .U |
| Timer (current value) | TC | 000 to 511 | .D |
| Timer (set value) | TS | 000 to 511 | .D |
| Counter (current value) | CC | 000 to 255 | .D |
| Counter (set value) | CS | 000 to 255 | .D |
| High-speed counter | CTH | 0 to 3* ⁴ | .D |
| High-speed counter comparator (set value) | CTC | 0 to 7* ⁴ | .D |
| Control memory | CM | 0000 to 8999 | .U |
| Work memory | VM | 0000 to 9999 | .U |

*1 The device number allows zero suppression.

*2 Relays, internal auxiliary relays, latch relays, and data memory allow XYM marking.

See "XYM Marking" (page 5-32).

*3 Relays, link relays, internal auxiliary relays, latch relays and control relays are registered in units of channels. When setting these relays, specify the leading channel.

*4 The device numbers that you can use vary depending on the base unit.

KV-N14 and KV-N24 : CTH0 and CTH1; CTC0 to CTC3

KV-N40 : CTH0 to CTH2; CTC0 to CTC5

KV-N60 : CTH0 to CTH3; CTC0 to CTC7

KV-NC32T : CTH0 to CTH2; CTC0 to CTC5

5-5 Explanation of Commands and Responses

■ Response

| | | | |
|-----|-----|----------------|----------------|
| O | K | C _R | L _F |
| 4FH | 4BH | 0DH | 0AH |

OK : When the command has been processed normally, the code "OK" is entered in the response to indicate this.

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | O | C _R | L _F |
| 45H | 30H | 0DH | 0AH |

E0: Device number error

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

E1: Command error



Read Monitor [MBR] and [MWR]

These commands display the contents of devices in the device registration tables.

MBR : This command displays the result of monitoring the bit device registration table.

MWR : This command displays the result of monitoring the word device registration table.

■ Command

<Reading the bit device registration table>

| | | | |
|-----|-----|-----|----------------|
| M | B | R | C _R |
| 4DH | 42H | 52H | 0DH |

<Reading the word device registration table>

| | | | |
|-----|-----|-----|----------------|
| M | W | R | C _R |
| 4DH | 57H | 52H | 0DH |

■ Response

| | | | | | | | | | | |
|------|---|------|---|-----|-----|------|-----|------|----------------|----------------|
| Data | □ | Data | □ | ... | □ | Data | □ | Data | C _R | L _F |
| 20H | | 20H | | | 20H | | 20H | | 0DH | 0AH |

Data : The result of monitoring the devices registered in the bit device registration table or the devices in the word device registration table is entered in the response. The monitoring result has the same format as the response to the RDS command.*

*You can only read the monitoring result of the current value of a CTH device and of the set value of a CTC device.

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

E1: Command error



Read Comment [RDC]

This command reads the comment of the specified device.

■ Command

| | | | | | | |
|-----|-----|-----|-----|-------------|---------------|----------------|
| R | D | C | □ | Device type | Device number | C _R |
| 52H | 44H | 43H | 20H | | 0DH | |

| Device Name | Device Type | Device Number ^{*1} |
|--|-------------|-----------------------------|
| Relay ^{*2} | R | 00000 to 59915 |
| Link relay | B | 0000 to 1FFF |
| Internal auxiliary relay ^{*2} | MR | 00000 to 59915 |
| Latch relay ^{*2} | LR | 00000 to 19915 |
| Control relay | CR | 0000 to 8915 |
| Data memory ^{*2} | DM | 00000 to 32767 |
| Link register | W | 0000 to 3FFF |
| Temporary data memory | TM | 000 to 511 |
| Index register | Z | 01 to 12 |
| Timer | T | 000 to 511 |
| Counter | C | 000 to 255 |
| High-speed counter | CTH | 0 to 3 ^{*3} |
| High-speed counter comparator | CTC | 0 to 7 ^{*3} |
| Control memory | CM | 0000 to 8999 |

*1 The device number allows zero suppression.

*2 Relays, internal auxiliary relays, latch relays, and data memory allow XYM marking.

See □ "XYM Marking" (page 5-32).

*3 The device numbers that you can use vary depending on the base unit.

KV-N14 and KV-N24: CTH0 and CTH1; CTC0 to CTC3 KV-N40: CTH0 to CTH2; CTC0 to CTC5

KV-N60: CTH0 to CTH3; CTC0 to CTC7 KV-NC32T: CTH0 to CTH2; CTC0 to CTC5

■ Response

| | | |
|------|----------------|----------------|
| Data | C _R | L _F |
| 0DH | 0AH | |

Data : The comment (32 characters) of the device specified by the command is entered in the response. If the comment is less than 32 characters, the remaining characters are filled with spaces (20H).

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | 0 | C _R | L _F |
| 45H | 30H | 0DH | 0AH |

E0: Device number error

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

E1: Command error

| | | | |
|-----|-----|----------------|----------------|
| E | 6 | C _R | L _F |
| 45H | 36H | 0DH | 0AH |

E6: No comment

□ "Responses during Errors" (page 5-32)

 Point If you attempt to write data in RUN mode, "E6" is entered in the response to indicate an error even if a comment is registered to the specified device.

5-5 Explanation of Commands and Responses

Read Buffer Memory of Expansion Unit [URD]

This command reads the specified number of pieces of data as a continuous block from the buffer memory of an expansion unit.

■ Command

| | | | | | | | |
|-----|-----|-----|---------------------------|-----------------------|---------------------------|--|----------------|
| U | R | D | Unit number ^{*1} | Address ^{*2} | Data format ^{*3} | Number of pieces of data to read ^{*4} | C _R |
| 55H | 52H | 44H | 20H | 20H | 20H | 20H | 0DH |

*1 Unit number: Specify the unit number as a value between 00 and 8.

*2 Address: Specify the address in the buffer memory of an expansion unit as a value between 00000 and 32767.

*3 Data format: The data format (suffix) of the device is specified as .U, .S, .D, .L, or .H or is unspecified.

.U: Unsigned, 16-bit decimal

.S: Signed, 16-bit decimal

.D: Unsigned, 32-bit decimal

.L: Signed, 32-bit decimal

.H: 16-bit hexadecimal

Unspecified: Varies depending on the device type

The data format specification method is the same as that of the RD and RDS commands.

"Read Data [RD] and Read Continuous Data [RDS]" (page 5-17)

*4 Number of pieces

of data to read: When .U, .S, or .H is specified for the data format, specify this as a value between 001 and 256.

When .D or .L is specified for the data format, specify this as a value between 001 and 128.

"Data Simultaneity When You Specify the .D or .L Data Format" (page 5-33)

■ Response

| | | | | | | | | | | |
|------|-----|------|-----|-----|------|-----|------|----------------|----------------|-----|
| Data | 20H | Data | 20H | ... | Data | 20H | Data | C _R | L _F | 0AH |
|------|-----|------|-----|-----|------|-----|------|----------------|----------------|-----|

Data: The data stored in the buffer memory of the expansion unit starting at the specified address is entered in the response. The format of the read result is the same as the format of the response to the RDS command.

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | 0 | C _R | L _F |
| 45H | 30H | 0DH | 0AH |

E0: Device number error

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

E1: Command error

"Responses during Errors" (page 5-32)

Write Buffer Memory of Expansion Unit [UWR]

This command writes the specified number of pieces of data as a continuous block to the buffer memory of an expansion unit.

■ Command

| | | | | | | | | | | | |
|-----|-----|-----|--------------------------|----------------------|--------------------------|----------------------------------|---------------------|---------------------|-----|---------------------|----------------|
| U | W | R | Unit number ¹ | Address ² | Data format ³ | Number of pieces of data to read | Data 1 ⁵ | Data 2 ⁵ | ... | Data n ⁵ | C _R |
| 55H | 57H | 52H | 20H | 20H | 20H | 20H | 20H | 20H | ... | 20H | 0DH |

- *1 Unit number: Specify the unit number as a value between 00 and 8.
 - *2 Address: Specify the address in the buffer memory of an expansion unit as a value between 00000 and 32767.
 - *3 Data format: The data format (suffix) of the device is specified as .U, .S, .D, .L, or .H or is unspecified.
 - .U: Unsigned, 16-bit decimal
 - .S: Signed, 16-bit decimal
 - .D: Unsigned, 32-bit decimal
 - .L: Signed, 32-bit decimal
 - .H: 16-bit hexadecimal
 - Unspecified: Varies depending on the device type
The data format specification method is the same as that of the WR and WRS commands.
 - *4 Number of pieces
of data to write: When .U, .S, or .H is specified for the data format, specify this as a value between 001 and 256.
When .D or .L is specified for the data format, specify this as a value between 001 and 128.
 - *5 Data 1 to n: Specify the data to write to the buffer memory of the expansion unit ("n" indicates the number of pieces of data to write).
- "Data Simultaneity When You Specify the .D or .L Data Format" (page 5-33)

■ Response

| | | | |
|-----|-----|----------------|----------------|
| O | K | C _R | L _F |
| 4FH | 4BH | 0DH | 0AH |

OK: When the command has been processed normally, the code "OK" is entered in the response to indicate this.

■ Error response

| | | | |
|-----|-----|----------------|----------------|
| E | 0 | C _R | L _F |
| 45H | 30H | 0DH | 0AH |

E0: Device number error

| | | | |
|-----|-----|----------------|----------------|
| E | 1 | C _R | L _F |
| 45H | 31H | 0DH | 0AH |

E1: Command error

"Responses during Errors" (page 5-32)

5-5 Explanation of Commands and Responses

Responses during Errors

If you send the wrong command or an error occurs on the base unit, a response different from a regular response is returned. The table below lists the details, causes, and remedies for the responses that are returned during errors.

| Code | Details | Cause | Remedy |
|------|-----------------------|--|--|
| E0 | Device number error | <ul style="list-style-type: none"> The specified device number, bank number, unit number, or address is outside of its range. The number of a timer, counter, CTH, or CTC not used in the program was specified. An attempt was made to read an unregistered monitor. | <ul style="list-style-type: none"> Specify a number that is within the pre-determined range. Check the program, and specify a number that is used in the program. Register a monitor before you attempt to read it. |
| E1 | Command error | <ul style="list-style-type: none"> A command that is not supported by the base unit was sent. The method used to specify a command was incorrect. A command other than CR was sent before communication was established. | <ul style="list-style-type: none"> Check the command, and send the correct command. Send CR to establish communication before re-sending the command. |
| E2 | No program registered | <ul style="list-style-type: none"> The "M1 (switch to RUN mode)" command was sent with no program registered on the base unit. The "M1 (switch to RUN mode)" command was sent with the RUN/PROG switch on the base unit set to PROG. | <ul style="list-style-type: none"> Register a program on the base unit before sending the command. Set the RUN/PROG switch on the base unit to RUN. |
| E4 | Write protected | <ul style="list-style-type: none"> An attempt was made to change the set value of a timer, counter, or CTC in a write-protected program. | <ul style="list-style-type: none"> Remove the program's write protection, and then send the command again. |
| E5 | Main unit error | <ul style="list-style-type: none"> The "M1 (switch to RUN mode)" command was sent while an error on the base unit had not been cleared. | <ul style="list-style-type: none"> Clear the errors on the base unit, remove the causes of the errors, and then send the command again. |
| E6 | No comment | <ul style="list-style-type: none"> No comment is registered to the device that you selected with the read comment, "RDC," command. | <ul style="list-style-type: none"> If necessary, register a comment to the device. |

XYM Marking

Relay (R), internal auxiliary relay (MR), latch relay (LR), and data memory (DM) devices allow XYM marking.

The relationship between KEYENCE marking and XYM marking is shown in the following table.

| Device Name | KEYENCE Marking | XYM Marking | Device Number for XYM Marking |
|--------------------------|-----------------|-------------|-------------------------------|
| Relay | R | X | 0000 to 599F |
| | | Y | 0000 to 599F |
| Internal auxiliary relay | MR | M | 0000 to 9599 |
| Latch relay | LR | L | 0000 to 3199 |
| Data memory | DM | D | 0000 to 32767 |

Data Simultaneity When You Specify the .D or .L Data Format

When you specify the .D or .L data format for an R, B, MR, LR, CR, DM, W, TM, CM, VB, or VM device, the device is handled as 32 bits of data by using the device at the specified device number as the lower 16 bits and the device at the following device number as the upper 16 bits.

The simultaneity of the upper 16 bits and the lower 16 bits is only maintained when the device number is an even number.

MEMO

6

KV MODE (TEXT TRANSMISSION)

This chapter describes the programming that is required to communicate in KV mode (text transmission).

| | | |
|-----|--|-----|
| 6-1 | Outline and Procedure Prior to Operation | 6-2 |
| 6-2 | Communication Specifications and Unit Editor Settings | 6-4 |
| 6-3 | Communication Procedure..... | 6-5 |
| 6-4 | Lists of Devices Used..... | 6-7 |
| 6-5 | Making the Ladder Program..... | 6-9 |

6-1 Outline and Procedure Prior to Operation

This section briefly describes KV mode (text transmission) and gives the procedure prior to operation.

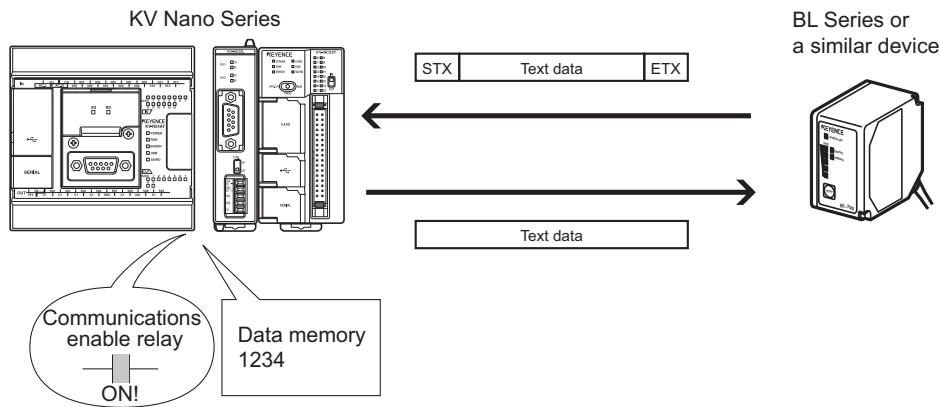
Outline

■ Application

This mode is used when receiving data with header STX and delimiter ETX. The transmission data format can be set as desired. The communication specifications are fixed. Up to 99 bytes (word units) or 198 bytes (byte units) of data can be sent and received in a single operation. A communication program is required on the KV Nano Series side. Connections with a variety of KEYENCE measuring equipment (such as CV and LS) that supports KV mode, with PCs, and with other similar products are possible.

■ Communication configuration

In KV mode (text transmission) communication with a peripheral such as a PC, up to 99 bytes (word units) or 198 bytes (byte units) of data can be sent and received in a single operation. When you turn the communication enable relay of the base unit ON, the data stored in the data memory of the base unit is sent to the peripheral. On the other hand, data received from peripherals is automatically written to data memory on the base unit as long as the format is appropriate.



6-1 Outline and Procedure Prior to Operation

Procedure Prior to Operation

This section describes the basic procedure to follow when using KV mode (text transmission).

If you are using an extension cassette or adapter, see "2-2 Installing Units on the Base Unit" (page 2-3) and install the extension cassette or adapter on the base unit.

Configure the KV STUDIO Unit Editor settings.*

- Set the operation mode of the ports that you are using to "KV mode (text transmission)."
- Configure other items as necessary.

"6-2 Communication Specifications and Unit Editor Settings" (page 6-4)



Create the ladder program for sending and receiving data.

For details on creating ladder programs, see "6-5 Making the Ladder Program" (page 6-9).



Transfer the project that you have created to the base unit.

For details on how to check the installation environment and on how to install units on the base unit, see "Chapter 2 UNIT INSTALLATION AND MAINTENANCE" (page 2-1).



Connect the peripheral, and start transmitting data from the peripheral.

Connect the peripheral, and set the communication specifications of the peripheral so that they are the same as those of the KV Nano Series.

"2-3 Connecting Peripherals" (page 2-6)



Check the operations.

In KV STUDIO, on the "Monitor/Simulator" menu, click "Built-in Function Monitor" to check operations.*

"Chapter 4 USING THE BUILT-IN FUNCTION MONITOR TO CHECK OPERATIONS" (page 4-1)

* Use version 7 or later (version 7.1 when using an extension adapter) of KV STUDIO.

6-2 Communication Specifications and Unit Editor Settings

This section describes the communication specifications in KV mode (text transmission). Use the Unit Editor to configure the communication settings.

Setting Items on Unit Editor

Set the operation mode to "KV mode (text transmission)." Configure the other settings as shown below. For details on how to configure settings, see  "2-5 Using Unit Editor to Configure Settings" (page 2-12).



Match the communication specifications of peripherals with those of the KV Nano Series. Communication cannot be performed if the settings are different.

● Built-in serial port, KV-N10L, KV-NC10L, KV-NC20L (Port1)

| Item | Setting | Default Value |
|---------------------|---|---------------|
| Interface* | RS-232C | RS-232C |
| Baud rate | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps | 9600 bps |
| Data bit length | 8 bits | 8 bits |
| Start bit | 1 bit | 1 bit |
| Stop bit | 1 bit | 1 bit |
| Parity | Even | Even |
| RS/CS flow control* | OFF, ON | OFF |

* This does not display for the built-in serial port.

● KV-N11L, KV-NC20L (Port2)

| Item | Setting | Default Value |
|---------------------------------|--|-------------------------|
| Interface | RS-232C ¹ , RS-422A/485 (4-wire type), RS-485 (2-wire type) | RS-485 (2-wire type) |
| Baud rate | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps | 9600 bps |
| Data bit length | 8 bits | 8 bits |
| Start bit | 1 bit | 1 bit |
| Stop bit | 1 bit | 1 bit |
| Parity | Even | Even |
| RS/CS flow control ² | OFF | OFF |

*1 This can only be set for the KV-NC20L (Port2).

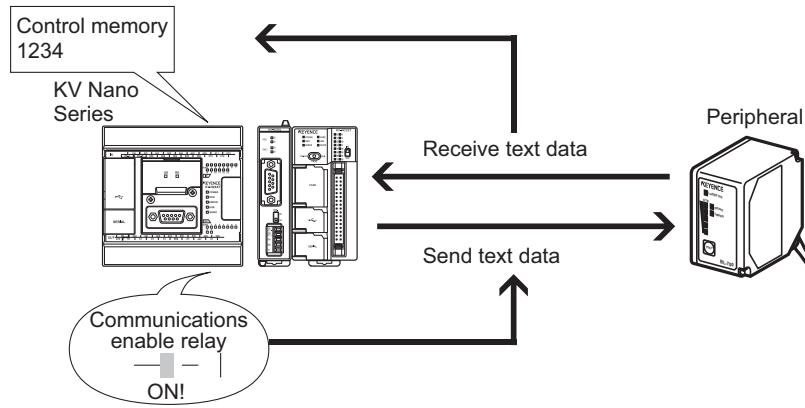
*2 This is only displayed for the KV-N11L.

6-3 Communication Procedure

This section describes details you should know before starting programming in KV mode (text transmission).

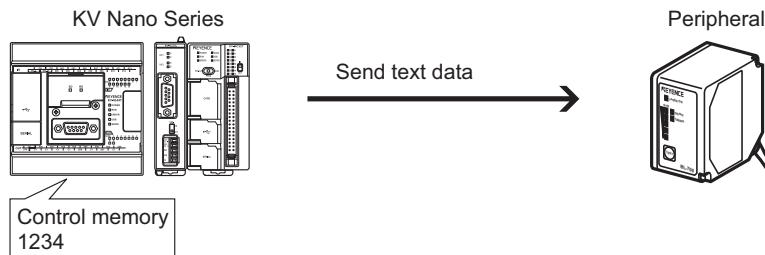
Communication Method

In sending and receiving of text data, up to 99 bytes (word units) or 198 bytes (byte units) of text data can be sent and received in a single operation between the KV Nano Series and a peripheral. Control relay (CR) and control memory (CM) devices on the base unit are used to send and receive data. Control relay devices are used to obtain the sending and receiving timing, and control memory devices are used to store the data to send and the received data.



Sending Text Data

The KV Nano Series stores the text data to send to peripherals in control memory, and retrieves the data from control memory according to a predetermined procedure to send the data to peripherals.



■ Format of text data

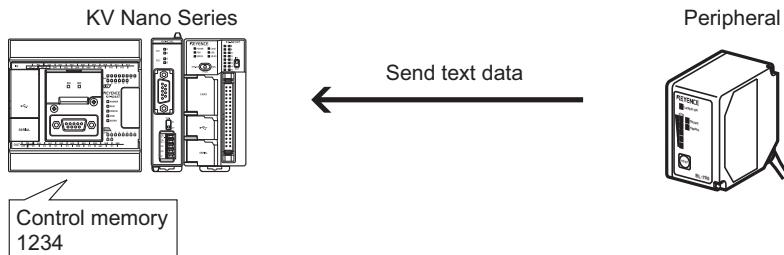
No restrictions are applied to the format of text data that can be sent by the KV Nano Series. Up to 99 bytes (word units) or 198 bytes (byte units) of text data can be received in a single operation.

Text data (maximum of 99 bytes—word units—or 198 bytes—byte units)

6-3 Communication Procedure

Receiving Text Data

The KV Nano Series receives text data in a predetermined format from peripherals, and stores the received text data in control memory according to a predetermined procedure.

**■ Format of text data**

The format of the text data that can be received by the KV Nano Series is as follows: the first byte is STX (02H), the text data is contained in the second byte onwards, and the final byte is ETX (03H). Up to 99 bytes (word units) or 198 bytes (byte units) of text data can be received in a single operation.

| First byte | Second and subsequent bytes | Last byte |
|------------|--|-----------|
| STX | Text data (maximum of 99 bytes—word units—or 198 bytes—byte units) | ETX |



- If ETX is present in the middle of the text data to receive, only the data up to the ETX is captured. The data following ETX is not captured.

| | | | | |
|-----|---|-----|---|-----|
| STX | Ⓐ | ETX | Ⓑ | ETX |
|-----|---|-----|---|-----|

Ⓐ is captured. Ⓑ is deleted.

- If STX is present in the middle of the text data to receive, the data up to the STX is discarded. The data preceding the second STX is not captured.

| | | | | |
|-----|---|-----|---|-----|
| STX | Ⓐ | STX | Ⓑ | ETX |
|-----|---|-----|---|-----|

Ⓑ is captured. Ⓐ is deleted.

This section gives lists of the devices (CR and CM) that are related to KV mode (text transmission).

| | | | |
|----|--------------|---|------------------|
| CR | Two channels | Port0 (built-in serial): | CR6000 to CR6115 |
| | | Port1 (extension cassette (left)/extension adapter (upper)): | CR6600 to CR6715 |
| | | Port2 (extension cassette (right)/extension adapter (lower)): | CR7200 to CR7315 |
| CM | 201 words | Port0 (built-in serial): | CM5000 to CM5200 |
| | | Port1 (extension cassette (left)/extension adapter (upper)): | CM6000 to CM6200 |
| | | Port2 (extension cassette (right)/extension adapter (lower)): | CM7000 to CM7200 |

Control Relay (CR)

| CR Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|------------------|------------------|----------------------------------|--|--|----------|
| Port0 (built-in) | Port1 (left) | Port2 (right) | | | | |
| CR6000 | CR6600 | CR7200 | - | - | Reserved for the system. | - |
| CR6001 | CR6601 | CR7201 | Received data not transferred | R | This relay is turned ON when data has been received from a peripheral, but the data has not been transferred to control memory (CM). | 6-17 |
| CR6002 | CR6602 | CR7202 | Reception error | R | This relay is turned ON when an error occurs during the reception of data. It is turned OFF when communication is successful. | 6-17 |
| CR6003 to CR6006 | CR6603 to CR6606 | CR7203 to CR7206 | - | - | Reserved for the system. | - |
| CR6007 | CR6607 | CR7207 | Break signal sending in progress | R | This relay is turned ON while the break signal is being sent. | 8-37 |
| CR6008 | CR6608 | CR7208 | ER status | R | This relay is used for the data terminal ready signal. | - |
| CR6009 | CR6609 | CR7209 | - | - | Reserved for the system. | - |
| CR6010 | CR6610 | CR7210 | DR status | R | This relay is used for the data set ready signal. | - |
| CR6011 | CR6611 | CR7211 | RS status | R | This relay is used for the send request signal. | - |
| CR6012 | CR6612 | CR7212 | CS status | R | This relay is used for the send enable signal. | - |
| CR6013 to CR6015 | CR6613 to CR6615 | CR7213 to CR7215 | - | - | Reserved for the system. | - |
| CR6100 | CR6700 | CR7300 | Communication enable | R/W | When this relay is turned ON, data sending and receiving is enabled. | 6-11 |
| CR6101 | CR6701 | CR7301 | Receive complete | R/W | This relay is turned ON when data reception from a peripheral is complete. This relay is used to receive data. | 6-15 |
| CR6102 | CR6702 | CR7302 | - | - | Reserved for the system. | - |
| CR6103 | CR6703 | CR7303 | - | - | Reserved for the system. | - |

6-4 Lists of Devices Used

| CR Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|------------------|------------------|---------------------------|--|---|----------|
| Port0 (built-in) | Port1 (left) | Port2 (right) | | | | |
| CR6104 | CR6704 | CR7304 | Send start | R/W | This relay is used to start sending data. When the transmission of data is completed, this relay is turned OFF. | 6-14 |
| CR6105 | CR6705 | CR7305 | Data storage unit setting | R/W | This relay is used to set the data storage unit. ON: Data is stored in units of bytes. OFF: Data is stored in units of words. Default value Do not change this setting during communication. Be sure to set this relay before communication is started (before the communication enable relay is turned ON). | 6-11 |
| CR6106 | CR6706 | CR7306 | - | - | Reserved for the system. | - |
| CR6107 | CR6707 | CR7307 | Break signal send request | R/W | The break signal is sent while this relay is turned ON. | 8-37 |
| CR6108 to CR6115 | CR6708 to CR6715 | CR7308 to CR7315 | - | - | Reserved for the system. | - |

Control Memory (CM)

| CM Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|-----------------|------------------|------------------------|--|---|----------|
| Port0 (built-in) | Port1 (left) | Port2 (right) | | | | |
| CM5000 | CM6000 | CM7000 | - | - | Reserved for the system. | |
| CM5001 | CM6001 | CM7001 | Received data length | R | This memory device stores the length (number of bytes) of the received text data. | 6-15 |
| CM5002 | CM6002 | CM7002 | Received data 1 | R | This memory device stores received text data. | 6-15 |
| : | : | : | : | | | |
| CM5100 | CM6100 | CM7100 | Received data 99 | R/W | This memory device stores the length (number of bytes) of the text data to send. | 6-13 |
| CM5101 | CM6101 | CM7101 | Length of data to send | | | |
| CM5102 | CM6102 | CM7102 | Data to send 1 | | | |
| : | : | : | : | R/W | This memory device stores the text data to send. | 6-12 |
| CM5200 | CM6200 | CM7200 | Data to send 99 | | | |

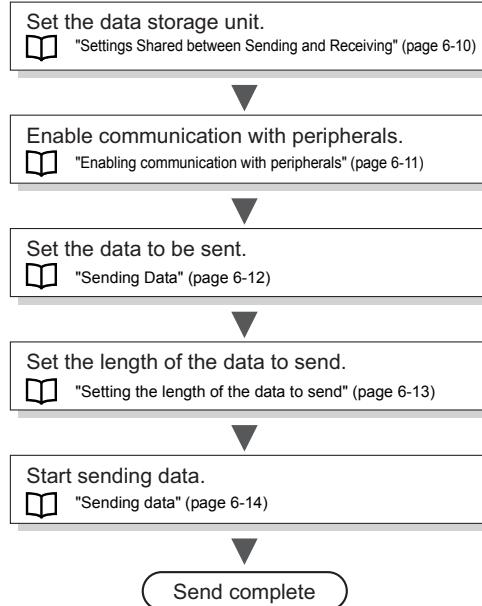
6-5 Making the Ladder Program

This section describes how to create programs required for communication in KV mode (text transmission). Use KEYENCE Ladder Support Software KV STUDIO to create ladder programs.

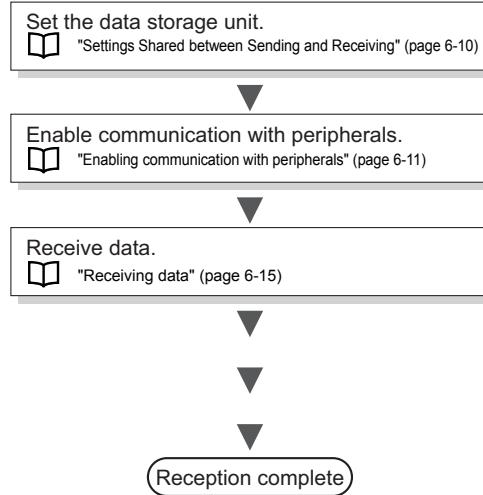
Flow of Ladder Programs

To communicate in KV mode (text transmission), you have to write a program to send and receive data. As necessary, write programs to perform operations such as checking communication errors. Check the flow of the programs in the figure below.

■ Sending data (KV Nano Series to peripheral)



■ Receiving data (peripheral to KV Nano Series)



Settings Shared between Sending and Receiving

Setting the data storage unit

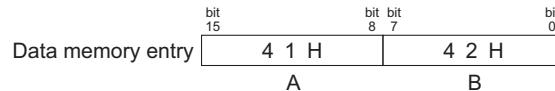
Set whether to write data in units of words or units of bytes when writing the data to send to the data to send area and when writing the received data to the received data area.

● Byte units

The character written to the lower eight bits (bits 0 to 7) of the data memory device and the character written to the upper eight bits (bits 8 to 15) of the data memory device are regarded as the characters to send or as the received characters. Almost all of the text processing instructions of the dedicated instructions handle data in units of bytes. It is useful to set the data storage unit to bytes in advance when using these kind of instructions to process data to send and received data. Up to 198 bytes (198 characters) can be sent or received in a single operation.

Example

Writing "AB"

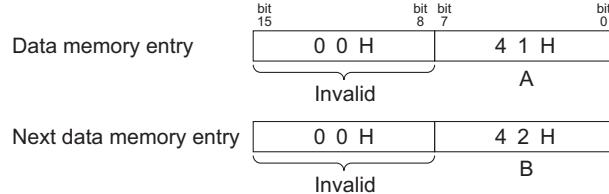


● Word units

Only the character currently written to the lower eight bits of the data memory device is regarded as the character to send or as the received character. (The data of the upper eight bits is ignored.) In the ladder programming language, data is basically processed in word units. For this reason, it is useful to set the data storage unit to word units in advance when you use the ladder support software to monitor ladder programs. Up to 99 bytes (99 characters) can be sent or received in a single operation.

Example

Writing "AB"



■ How to set

Turn the "data storage unit setting relay (CR6105, CR6705, or CR7305) ON or OFF to set the data storage unit. When the "data storage unit setting relay" is turned ON, the data storage unit is set to byte units. When the "data storage unit setting relay" is turned OFF, the data storage unit is set to word units.

Example

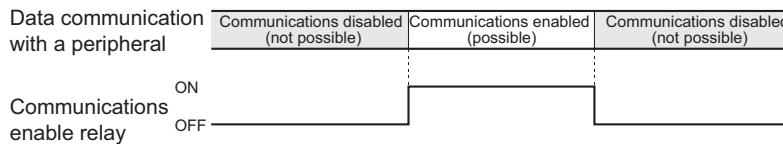
The data storage unit of Port1 will be set to byte units when operations start.



"Flow of Ladder Programs" (page 6-9)

Enabling communication with peripherals

To perform text transmission, turn the communication enable relay (CR6100, CR6700, or CR7300) ON. When the communication enable relay is not turned ON, data cannot be sent to or received from peripherals. Use the SET instruction to continuously keep the communication enable relay in the ON state.



Example

Port1 communication will be enabled when operations start.



"Flow of Ladder Programs" (page 6-9)

Sending Data

Setting the data to send

Set the data to send to peripherals from the KV Nano Series. The data setting method differs according to the data storage unit that you have set.

- "Settings Shared between Sending and Receiving" (page 6-10)

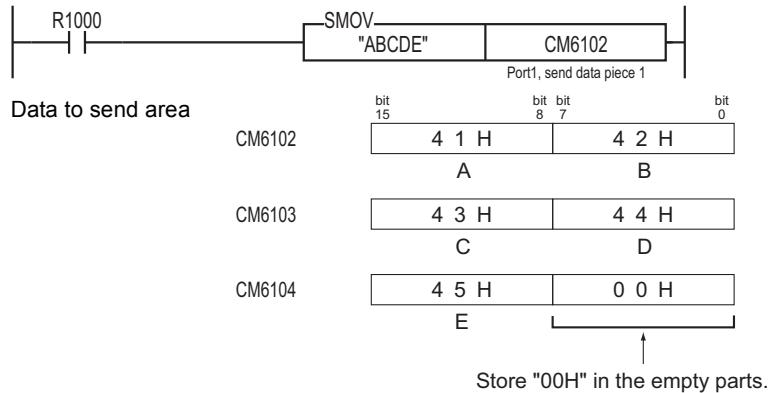
■ How to set the data in byte units

Write the data to send to peripherals in the "data to send area" (CM5102 to CM5200, CM6102 to CM6200, or CM7102 to CM7200).

- Up to 198 bytes (198 characters) of data can be sent in a single operation.

Example

Set the text data to send from Port1 to "ABCDE" (41H, 42H, 43H, 44H, and 45H).



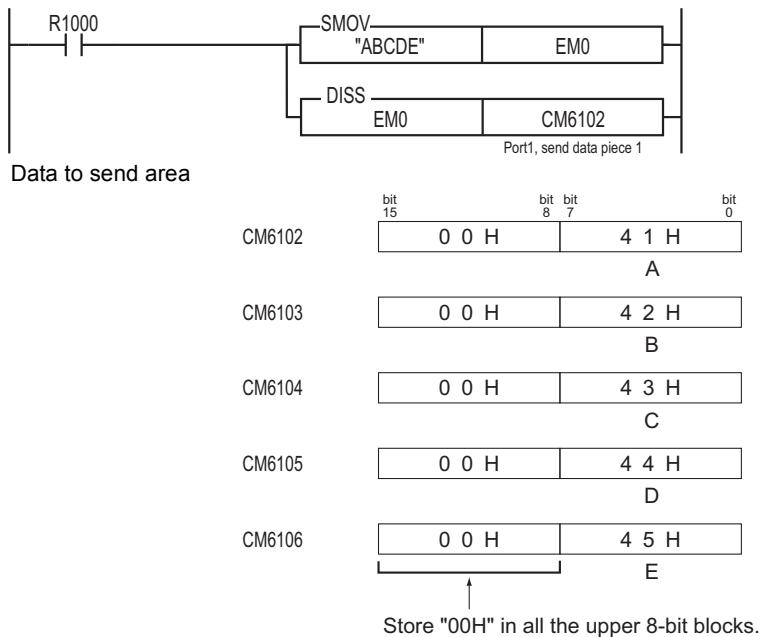
■ How to set the data in word units

To set the data to send to peripherals, write the data in the "data to send area" (CM5102 to CM5200, CM6102 to CM6200, or CM7102 to CM7200).

- Up to 99 bytes (99 characters) of data can be sent in a single operation.

Example

Send the text data to send from Port1 in the following order: "ABCDE" (41H, 42H, 43H, 44H, and then 45H).

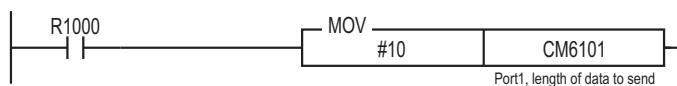


Setting the length of the data to send

Write the number of bytes of text data to send as a binary value in "length of data to send" (CM5101, CM6101, or CM7101).

Example

Specify the length of data to send as 10 bytes.

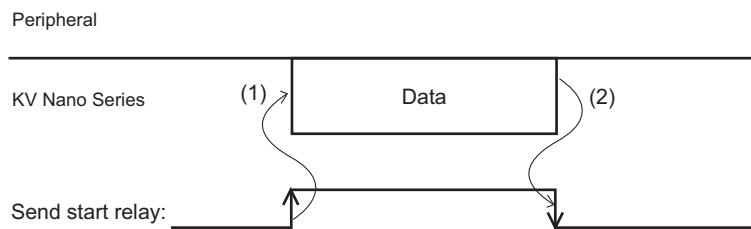


"Flow of Ladder Programs" (page 6-9)

6-5 Making the Ladder Program

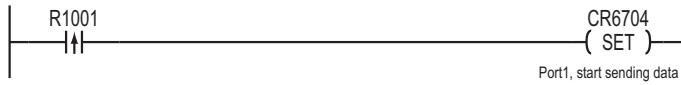
Sending data

To send data from the KV Nano Series to a peripheral, use the send start relay (CR6104, CR6704, or CR7304).



- (1) When you turn the send start relay (CR6104, CR6704, or CR7304) ON, the KV Nano Series starts sending data to the peripheral.
- (2) When transmission is completed, the send start relay automatically turns OFF.

To rewrite the ON/OFF status of relays, use the SET, RES, or OUT instruction.

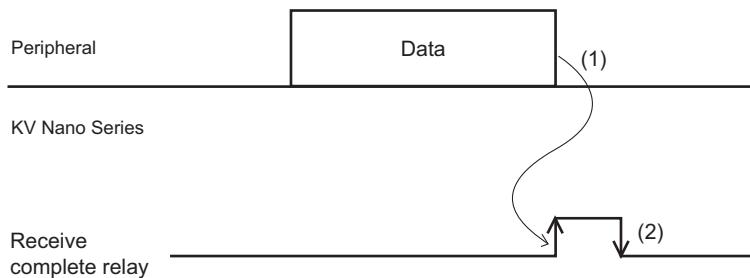
Example**Execute data transmission from Port1.****Point**

- Use differential type instructions as the execution conditions of data transmission.
- You have to turn the communication enable relay (CR6100, CR6700, or CR7300) ON before you transmit data.
 - "Enabling communication with peripherals" (page 6-11)
 - "Flow of Ladder Programs" (page 6-9)

Receiving Data

Receiving data

To receive data from a peripheral, use the receive complete relay (CR6101, CR6701, or CR7301).

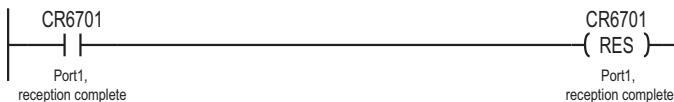


- (1) The receive complete relay (CR6101, CR6701, or CR7301) turns ON, and the ON state is maintained, when data is received by the KV Nano Series from a peripheral and the writing of the data to data memory is completed.
- (2) To enable reception of the next data, turn the receive complete relay OFF. Data can be received only when the receive complete relay is turned OFF.

If the next data to receive arrives with the receive complete relay turned ON, the received data not transferred relay (CR6001, CR6601, or CR7201) turns ON.

Example

When data reception through Port1 is completed, the reception of the next data is immediately enabled.



You have to turn the communication enable relay (CR6100, CR6700, or CR7300) ON before you transmit data.



"Enabling communication with peripherals" (page 6-11)



"Flow of Ladder Programs" (page 6-9)

About data received from peripherals

When the KV Nano Series receives data from peripherals, the length (number of bytes) of the data is written to the received data length area (CM5001, CM6001, or CM7001). The content of the received data is written to the received data area (CM5002 to CM5100, CM6002 to CM6100, or CM7002 to CM7100). However, the way that data is stored varies according to the data storage unit setting (see "Settings Shared between Sending and Receiving" (page 6-10)) as shown below.

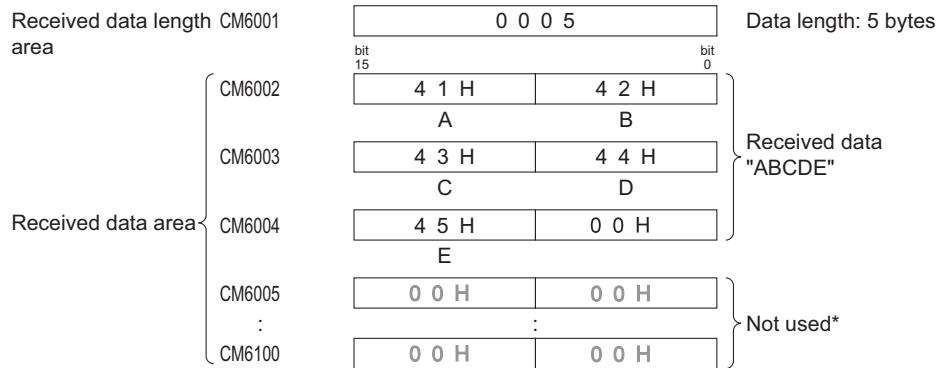
6-5 Making the Ladder Program

■ When the data storage unit is set to byte units

The data received by the KV Nano Series is written one character at a time to the lower eight bits (bits 0 to 7) and upper eight bits (bits 8 to 15) of the received data area (CM5002 to CM5100, CM6002 to CM6100, or CM7002 to CM7100).

Example

Text data was received from Port1 in the following order: "ABCDE."



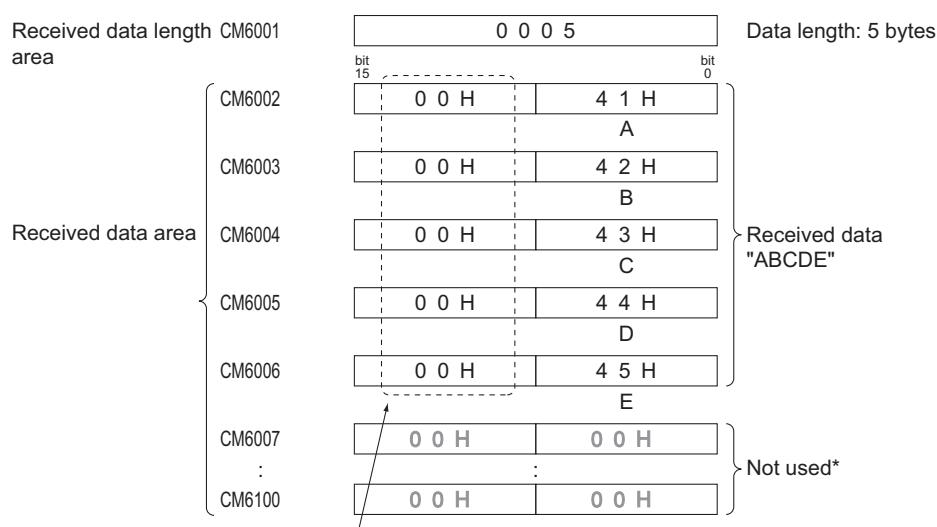
* If data was previously received, the previously received data remains.

■ When the data storage unit is set to word units

The data received by the KV Nano Series is written only to the lower eight bits (bits 0 to 7) of the received data area (CM5002 to CM5100, CM6002 to CM6100, or CM7002 to CM7100). The upper eight bits are not used, and 00H is written to them.

Example

Text data was received from Port1 in the following order: "ABCDE."



"00H" is stored in all the upper 8-bit blocks.

* If data was previously received, the previously received data remains.

Checking for Communication Errors

You can check whether an error occurred during communication between the KV Nano Series and a peripheral. Carry out this programming as necessary.

■ How to check for communication errors

Communication errors appear when communication data is corrupted, for example, by noise being applied to the data on the communication line.

To check for communication errors, monitor the ON/OFF status of the reception error relay (CR6002, CR6602, or CR7202).

This relay turns ON when there is an error. It turns OFF when there are no errors.

| Reception Error Relay | Communication Error |
|-----------------------|---------------------|
| ON | Present |
| OFF | Not present |

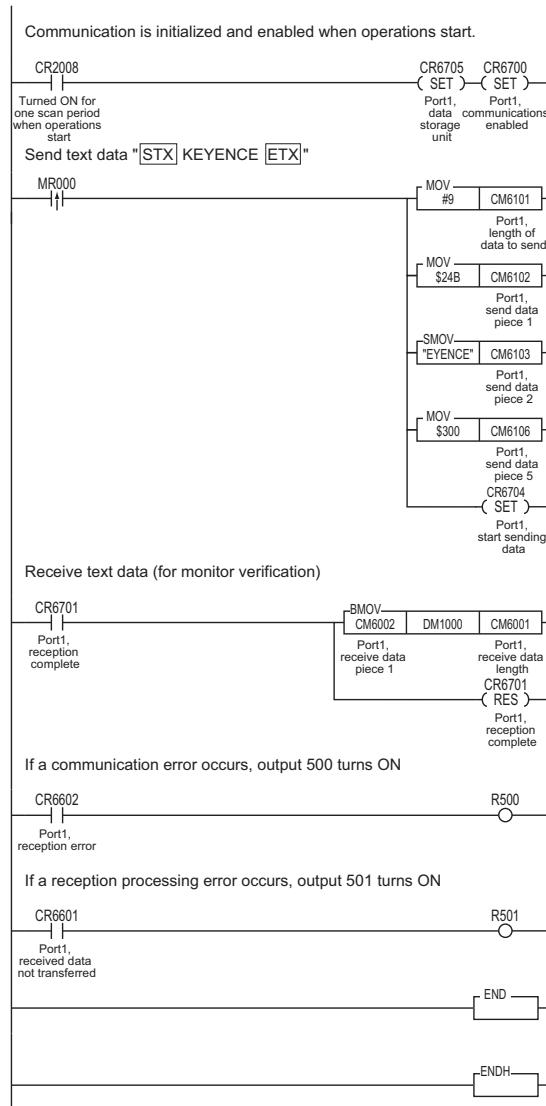
■ How to check for reception processing errors

To check whether or not data received by the KV Nano Series from peripherals is being processed normally, monitor the ON/OFF status of the received data not transferred relay (CR6001, CR6601, or CR7201). When data can no longer be processed by the KV Nano Series, for example, when a large volume of data is sent from peripherals, the received data not transferred relay turns ON. It turns OFF when the data can be processed correctly.

| Received Data Not Transferred Relay | Error |
|-------------------------------------|-------------|
| ON | Present |
| OFF | Not present |

Reference Ladder Program

The following is an example ladder program for using Port1 to send and receive text data.



Mnemonics list

| | |
|---|--|
| ; Communication is initialized and enabled when operations start. | |
| LD CR2008 | ; 1 Scan ON |
| SET CR6705 | ; Port1, set the data storage unit |
| CON | |
| SET CR6700 | |
| ; Send the text data "STX KEYENCE ETX" | |
| LDP MR000 | |
| MOV #9 CM6101 | |
| MOV \$24B CM6102 | |
| SMOV "EYENCE" CM6103 | |
| MOV \$300 CM6106 | |
| SET CR6704 | ; Port1, start sending data |
| ; Receive text data (for monitor verification) | |
| LD CR6701 | ; Port1, reception complete |
| BMOV CM6002 DM1000 CM6001 | ; Port1, received data 1 |
| RES CR6701 | ; Port1, reception complete |
| ; If a communication error occurs, output R500 turns ON. | |
| LD CR6602 | ; Port1, reception error |
| OUT R500 | |
| ; If a reception processing error occurs, output R501 turns ON. | |
| LD CR6601 | ; Port1, received data not transferred |
| OUT R501 | |

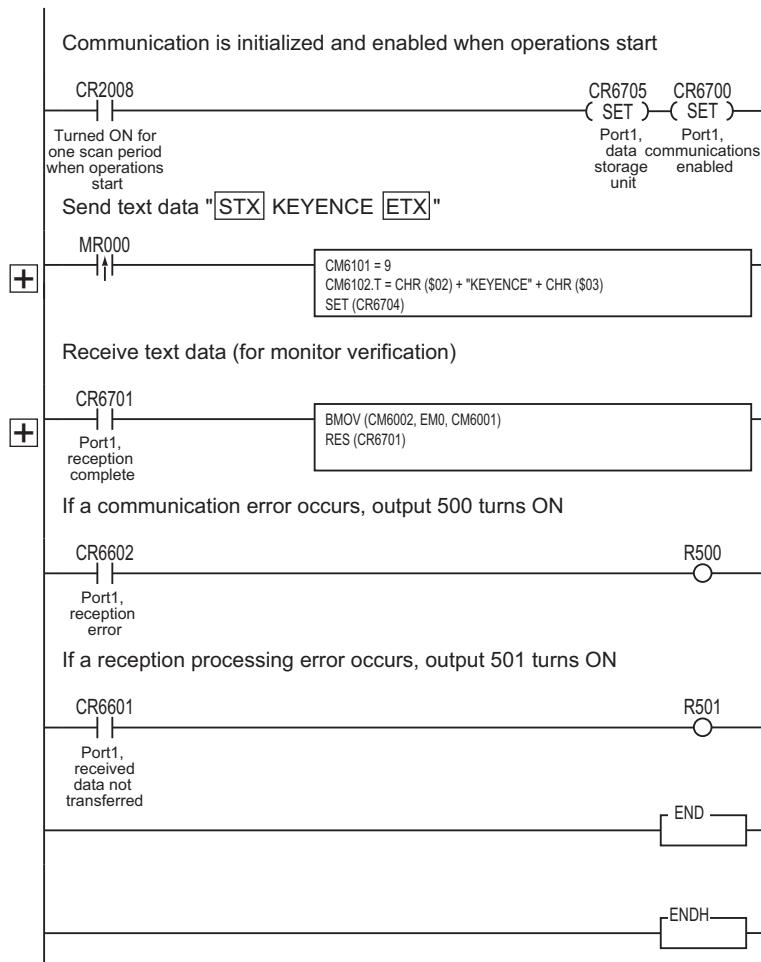
The list of mnemonics can be used for easy entry of the ladder program on the left.

"How to Use Mnemonics List" (page 10)

6-5 Making the Ladder Program

Reference

Writing the reference ladder program as a script results in a script like the one shown below.



MEMO

7

KV STUDIO MODE

This chapter describes the settings to configure when you are using KV STUDIO or when you have connected a VT3 Series.

| | | |
|-----|--|-----|
| 7-1 | Outline and Procedure Prior to Operation | 7-2 |
| 7-2 | Communication Specifications and Unit Editor Settings | 7-4 |

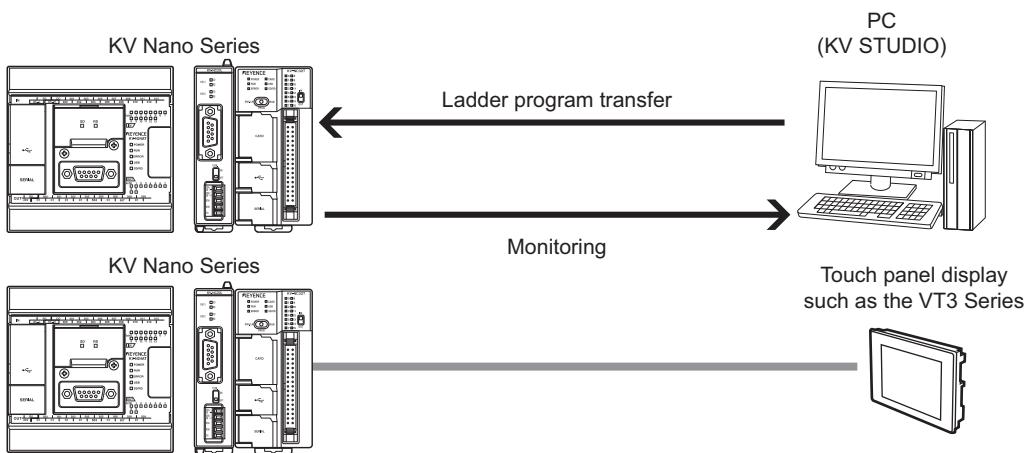
7-1 Outline and Procedure Prior to Operation

This section briefly describes KV STUDIO mode and gives the procedure prior to operation.

Outline

Use this mode to communicate with KEYENCE Ladder Support Software KV STUDIO or with a KEYENCE VT3 Series Touch Panel Display, DT Series PLC Data Acquisition Unit, XG Series Image Processing System, or CV Series Machine Vision System. When you communicate with KV STUDIO, you can edit ladder programs and perform monitoring.

No ladder program is required to use the KV Nano Series in KV STUDIO mode.



For details on how to connect the VT3 Series, see "Chapter 1 CONNECTING TO THE KZ & KV SERIES" in the "VT3/DT Series PLC Connection Manual."

Procedure Prior to Operation

This section describes the basic procedure to follow when using KV STUDIO mode.

If you are using an extension cassette or adapter, see "2-2 Installing Units on the Base Unit" (page 2-3) and install the extension cassette or adapter on the base unit.

Configure the KV STUDIO Unit Editor settings.*

- Set the operation mode of the ports that you are using to "KV STUDIO mode."
- Configure other items as necessary.

"7-2 Communication Specifications and Unit Editor Settings" (page 7-4)



Transfer the project that you have created to the base unit.

For details on how to check the installation environment and on how to install units on the base unit, see "Chapter 2 UNIT INSTALLATION AND MAINTENANCE" (page 2-1).



Connect the peripheral.

Connect the peripheral, and set the communication specifications of the peripheral so that they are the same as those of the KV Nano Series.

"2-3 Connecting Peripherals" (page 2-6)



Check the operations.

In KV STUDIO, on the "Monitor/Simulator" menu, click "Built-in Function Monitor" to check operations.*

"Chapter 4 USING THE BUILT-IN FUNCTION MONITOR TO CHECK OPERATIONS" (page 4-1)

* Use version 7 or later (version 7.1 when using an extension adapter) of KV STUDIO.

7-2 Communication Specifications and Unit Editor Settings

This section describes the communication specifications of KV STUDIO mode. Use the Unit Editor to configure the communication settings.

Setting Items on Unit Editor

Set the operation mode to "KV STUDIO mode." Configure the other settings as shown below. For details on how to configure settings, see  "2-5 Using Unit Editor to Configure Settings" (page 2-12).



Match the communication specifications of peripherals with those of the KV Nano Series. Communication cannot be performed if the settings are different.

● Built-in serial port, KV-N10L, KV-NC10L, KV-NC20L (Port1)

| Item | Setting | Default Value |
|---------------------|-----------|---------------|
| Interface* | RS-232C | RS-232C |
| Baud rate | Automatic | Automatic |
| Data bit length | 8 bits | 8 bits |
| Start bit | 1 bit | 1 bit |
| Stop bit | 1 bit | 1 bit |
| Parity | Even | Even |
| RS/CS flow control* | OFF, ON | OFF |

* This does not display for the built-in serial port.

● KV-N11L, KV-NC20L (Port2)

| Item | Setting | Default Value |
|--------------------------------------|---|----------------------|
| Interface | RS-232C ^{*1} , RS-422A/485 (4-wire type), RS-485 (2-wire type) | RS-485 (2-wire type) |
| Baud rate | Automatic | Automatic |
| Data bit length | 8 bits | 8 bits |
| Start bit | 1 bit | 1 bit |
| Stop bit | 1 bit | 1 bit |
| Parity | Even | Even |
| RS/CS flow control ^{*2} | OFF | OFF |
| KV mode station number ^{*3} | 0 to 9 | 0 |

*1 This can only be set for the KV-NC20L (Port2).

*2 This is only displayed for the KV-N11L.

*3 This is displayed when the RS-422A/485 (4-wire type) is selected on the interface.

8

NON-PROCEDURE MODE

This chapter describes the programming that is required to communicate in non-procedure mode.

| | | |
|-----|--|------|
| 8-1 | Outline and Procedure Prior to Operation | 8-2 |
| 8-2 | Communication Specifications and Unit Editor Settings | 8-5 |
| 8-3 | Communication Procedure..... | 8-6 |
| 8-4 | Lists of Devices Used..... | 8-12 |
| 8-5 | Making the Ladder Program..... | 8-16 |

8-1 Outline and Procedure Prior to Operation

This section briefly describes non-procedure mode and gives the procedure prior to operation.

Outline

■ Application

The communication specifications and data format can be set as desired to match the connected equipment. Up to 512 bytes of data can be sent and received in a single operation.

A ladder program to perform communication is required on the KV Nano Series side.

■ Communication configuration

When you use the non-procedure mode, you can set the format (header, delimiter, and data length) of the communication procedure as desired to match the communication procedure of peripherals. However, you have to use a ladder program to set all formats.

- You can set the format of data that is received from peripherals to "variable length data with specified delimiters" or "fixed length data with specified data length."
- A handshake is performed by the I/O relays to send and receive data.
- You can set the mode of sending and receiving to "normal mode," "response receiving mode," or "buffer clear mode." Setting these modes determines the sending and receiving operations (communication procedure) of the KV Nano Series. When the KV Nano Series is connected to a peripheral other than a PC, see the User's Manual provided with the peripheral to determine which mode matches the communication procedure of the peripheral. Use a ladder program to set the mode.

 "Send and Receive Modes" (page 8-9)

 Reference

The KV Nano Series can process sending and receiving simultaneously. Simultaneous sending and receiving will not result in an error if sending and receiving can be processed simultaneously on the peripherals, too. When the interface is RS-485 (2-wire type), receiving and sending cannot be performed at the same time.



■ Required programs

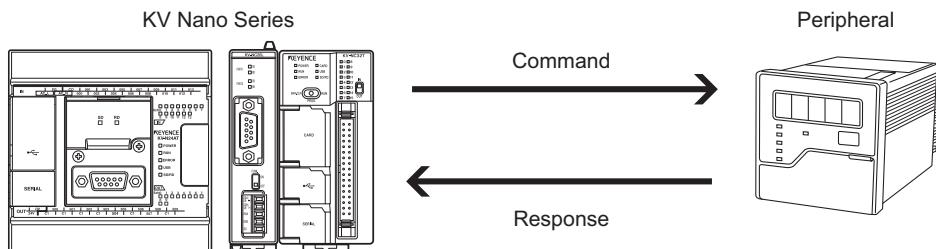
Check the programs that are required to communicate in non-procedure mode.

● When communicating with a peripheral that has a set communication procedure

A ladder program is required on the KV Nano Series side. Use KEYENCE Ladder Support Software KV STUDIO to create ladder programs.

- "8-5 Making the Ladder Program" (page 8-16)

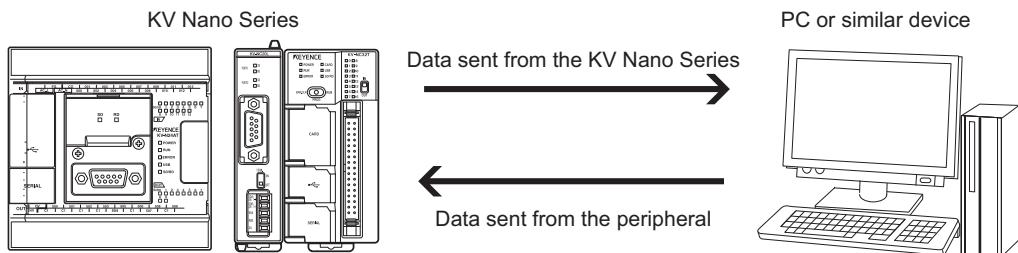
Generally, no communication program is required on the peripheral side. (For details, see the User's Manual of the peripheral.)



● When communicating with a PC

When a peripheral that does not have a set communication procedure, such as a PC, is connected, a ladder program is required on the KV Nano Series side. Use KEYENCE Ladder Support Software KV STUDIO to create ladder programs.

A communication program is also required on the PC side. The communication program can be made using Microsoft Visual Basic or other similar software.



Explanations in this chapter refer to the program on the KV Nano Series as the "ladder program" and the program on the PC or other peripheral as the "communication program."

8-1 Outline and Procedure Prior to Operation

Procedure Prior to Operation

This section describes the basic procedure to follow when using non-procedure mode.

If you are using an extension cassette or adapter, see "Installing Extension Cassettes" (page 2-3) and "Installing Extension Adapters" (page 2-5) and install the extension cassette or adapter on the base unit.

Configure the KV STUDIO Unit Editor settings.*

- Set the operation mode of the ports that you are using to "Non-procedure mode."
- Configure other items as necessary.

"8-2 Communication Specifications and Unit Editor Settings" (page 8-5)



Create the ladder program for sending and receiving data.

For details on creating ladder programs, see "8-5 Making the Ladder Program" (page 8-16).



Transfer the project that you have created to the base unit.

For details on how to check the installation environment and on how to install units on the base unit, see "Chapter 2 UNIT INSTALLATION AND MAINTENANCE" (page 2-1).



Connect the peripheral, and start transmitting data from the peripheral.

Connect the peripheral, and set the communication specifications of the peripheral so that they are the same as those of the KV Nano Series.

"2-3 Connecting Peripherals" (page 2-6)



Check the operations.

In KV STUDIO*, on the "Monitor/Simulator" menu, click "Built-in Function Monitor" to check operations.

"Chapter 4 USING THE BUILT-IN FUNCTION MONITOR TO CHECK OPERATIONS" (page 4-1)

* Use version 7 or later (version 7.1 when using an extension adapter) of KV STUDIO.



8-2

Communication Specifications and Unit Editor Settings

This section describes the communication specifications of non-procedure mode. Use the Unit Editor to configure the communication settings.

Setting Items on Unit Editor

Set the operation mode to "Non-procedure mode." Configure the other settings as shown below. For details on how to configure settings, see "2-5 Using Unit Editor to Configure Settings" (page 2-12).



Match the communication specifications of peripherals with those of the KV Nano Series. Communication cannot be performed if the settings are different.

● Built-in serial port, KV-N10L, KV-NC10L, KV-NC20L (Port1)

| Item | Setting | Default Value |
|---------------------|---|---------------|
| Interface* | RS-232C | RS-232C |
| Baud rate | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps | 9600 bps |
| Data bit length | 7 bits, 8 bits | 8 bits |
| Start bit | 1 bit | 1 bit |
| Stop bits | 1 bit, 2 bits | 1 bit |
| Parity | None, Even, Odd | Even |
| RS/CS flow control* | OFF, ON | OFF |

* This does not display for the built-in serial port.

● KV-N11L, KV-NC20L (Port2)

| Item | Setting | Default Value |
|----------------------------------|---|-------------------------|
| Interface | RS-232C ^{*1} , RS-422A/485 (4-wire type), RS-485 (2-wire type) | RS-485 (2-wire type) |
| Baud rate | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps | 9600 bps |
| Data bit length | 7 bits, 8 bits | 8 bits |
| Start bit | 1 bit | 1 bit |
| Stop bits | 1 bit, 2 bits | 1 bit |
| Parity | None, Even, Odd | Even |
| RS/CS flow control ^{*2} | OFF | OFF |

*1 This can only be set for the KV-NC20L (Port2).

*2 This is only displayed for the KV-N11L.

8-3 Communication Procedure

This section describes details you should know before starting programming in non-procedure mode.

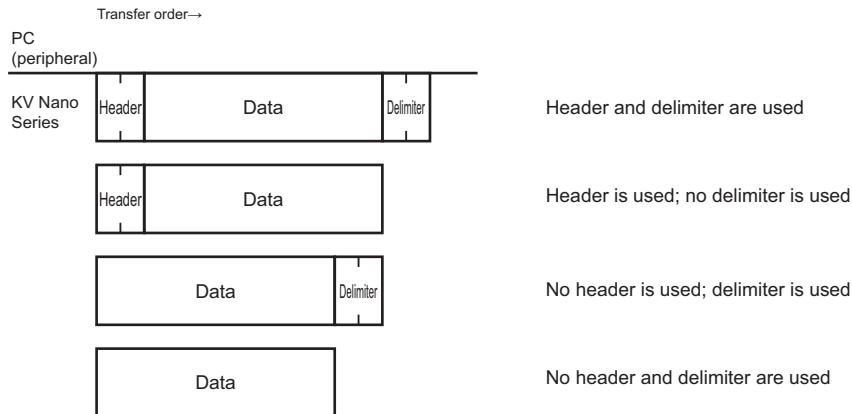
Format of Data to Send and of Received Data

This section describes the format (header, delimiter, and data length) of the data that the KV Nano Series can send and receive in non-procedure mode. When communicating with a PC, determine the format of the data before you start programming. When the KV Nano Series is connected to a peripheral other than a PC, see the User's Manual provided with the peripheral to check its format. Use a ladder program to set the format.

 "Setting the Mode" (page 8-20)

■ Format of data to send (KV Nano Series to peripheral)

When using normal mode or response receiving mode, you can use one of the following formats to send data (commands) to peripherals from the KV Nano Series. When you are using buffer clear mode, you cannot send data from the KV Nano Series.



- The header (for example, S_{T_X}) can be included or omitted.

You can use a header that is up to two bytes in length.

 "Setting the Header for Sending" (page 8-22)

- The delimiter (for example, E_{T_X} or C_R L_F) can be included or omitted.

You can use a delimiter that is up to two bytes in length.

 "Setting the Delimiter for Sending" (page 8-23)

- The data length can be up to 512 bytes.

Data of the length specified in the ladder program is sent.

 "Setting the Length of the Data to Send" (page 8-29)



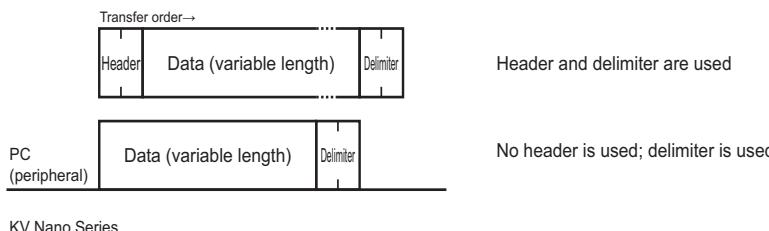
The same code (character) cannot be used for headers and delimiters.



■ Format of received data (peripheral to KV Nano Series)

The format of data that can be received from peripherals by the KV Nano Series can be selected from "variable length data with specified delimiters" and "fixed length data with specified data length."

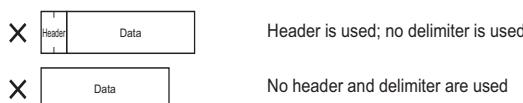
● Variable length data with specified delimiters



- The delimiter (for example, E_{TX} or C_R L_F) is mandatory.

You can use a delimiter that is up to two bytes (two characters) in length.

- "Setting the Delimiter for Receiving" (page 8-25)
Data without delimiters cannot be received successfully.



- The header (for example, S_{TX}) can be included or omitted.

You can use a header that is up to two bytes (two characters) in length.

- "Setting the Header for Receiving" (page 8-24)
When you have specified a header, data without a header is not treated as data.

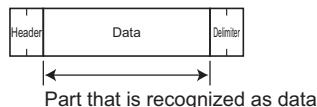
- When you prefix the data with a header, the KV Nano Series regards the part between the header and delimiter as the data to write to the base unit.
- When you do not prefix the data with a header, the KV Nano Series regards the part from the start of the data to the delimiter as the data to write to the base unit.

The length of the data varies depending on the content of the data sent from the connected peripherals.

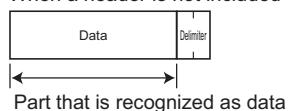
The range of the data length is between 1 and 512 bytes.

- "Setting the Length of the Data to Receive" (page 8-26)

When a header is included



When a header is not included



The same code (character) cannot be used for headers and delimiters.

8-3 Communication Procedure

● Fixed length data with specified data length

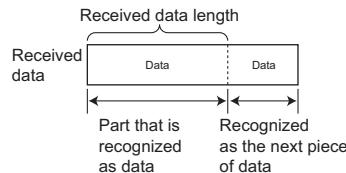


KV Nano Series

The KV Nano Series regards the data of the length set in the ladder program (the received data length) as the data to write to the base unit. Headers and delimiters are not used. "Fixed length data with specified data length" can be used in normal mode and response receiving mode. It cannot be used in buffer clear mode.



- When the KV Nano Series receives data longer than the received data length, the amount of data as long as the received data length from the start of the data is recognized as the data to use, and the remaining data is processed as the next data received.



- When the KV Nano Series receives data shorter than the received data length, the KV Nano Series stands by until enough data has arrived to match the data length.

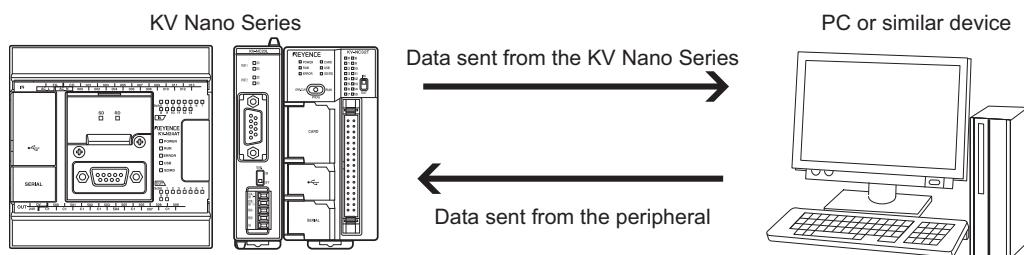


Send and Receive Modes

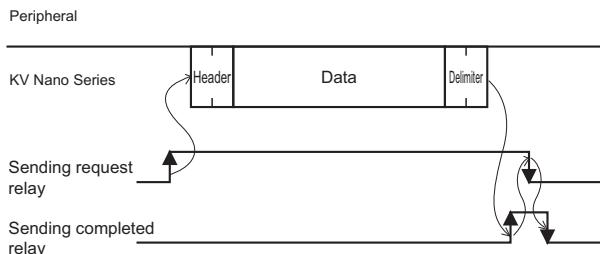
You can set the mode of sending and receiving to "normal mode," "response receiving mode," or "buffer clear mode." This section describes the details of each mode

■ Normal mode

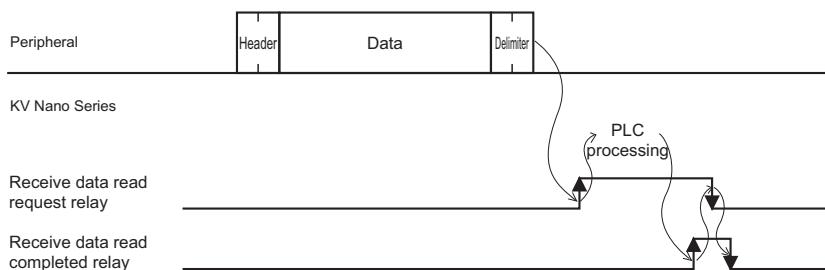
When you connect a PC or similar peripheral, normally select normal mode. In this mode, data can be sent from the KV Nano Series to peripherals as well as from peripherals to the KV Nano Series. Therefore, data on the base unit can be written to peripherals and data on peripherals can be captured on the base unit. Program processing is required during both sending and receiving.



The communication procedure during sending is shown below.



The communication procedure during receiving is shown below.

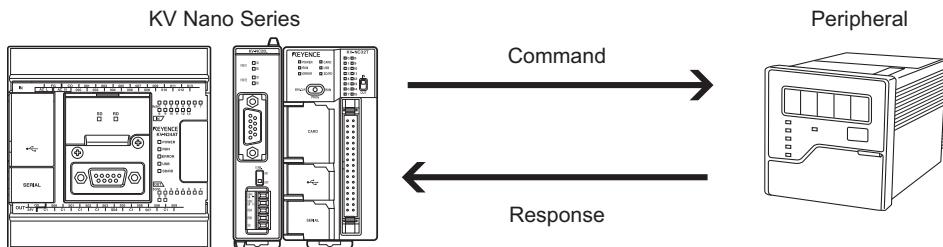


8-3 Communication Procedure

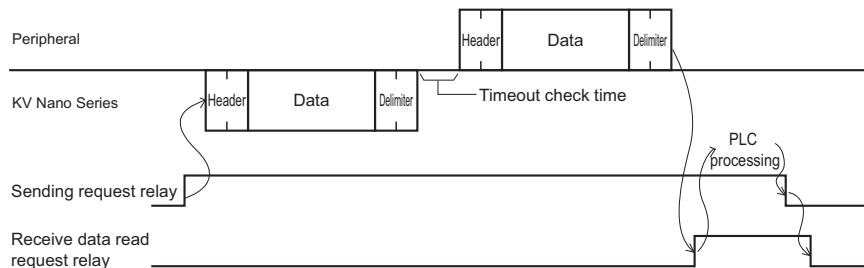
■ Response receiving mode

Select the response receiving mode when you connect peripherals to which you will send data only when requested. For example, select this mode when connecting to a KEYENCE BL Series Barcode Reader, JC Series Digital Load Indicator, or RD Series Analog Controller. For the RD Series, you can capture measured values from the RD Series by sending the "M" command from the KV Nano Series.

The processes of sending a command and receiving a response are completed in a single operation. (That is, there is no need to separate relay processing during sending and receiving.) You can also set the time (the timeout check time) from sending the command to receiving the response.



The communication procedure is shown below.



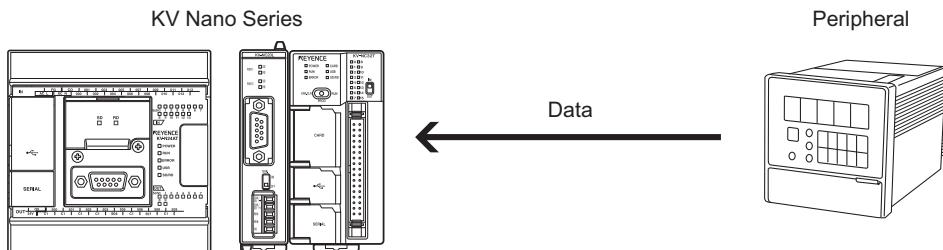


■ Buffer clear mode

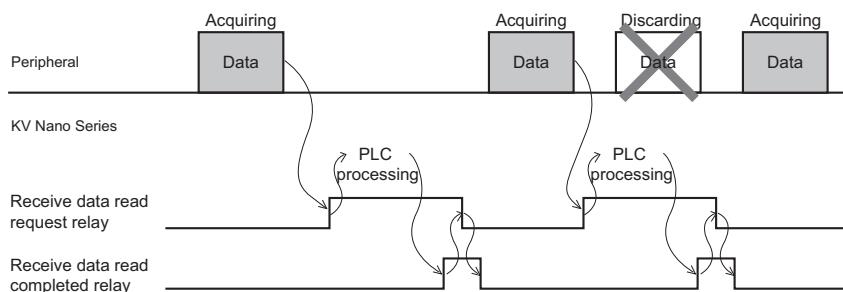
The buffer clear mode is a method generally referred to as "streaming," and is selected when connecting peripherals that send data in one direction at high speed. Select this mode when connecting to peripherals such as the KEYENCE BL Series Barcode Reader or the RV3 Series Multi-function Digital Meter Relay for Sensors.

In normal mode or response receiving mode, all data received by the KV Nano Series is captured as valid data. For this reason, when communicating with peripherals that send data at high speed, the processing of the receive buffer on the KV Nano Series may not be able to keep up with the arriving data, which may lead to data corruption. In buffer clear mode, new data that is received while previous received data is being processed is ignored, and only the latest data is captured at all times.

When you are using buffer clear mode, you cannot send data from the KV Nano Series to peripherals.



The communication procedure is shown below.



- Buffer clear mode can only be used when the data that is sent from the peripherals contains a delimiter. This mode cannot be used if the data does not contain a delimiter.
- In buffer clear mode, some of the received data is discarded. If you want to capture all of the received data, do not use buffer clear mode.

This section gives lists of the devices (CR and CM) that are related to non-procedure mode.

| | | |
|-----------------|---|--|
| CR Two channels | Port0 (built-in serial): Port1 (extension cassette (left)/extension adapter (upper)): Port2 (extension cassette (right)/extension adapter (lower)): | CR6000 to CR6115 CR6600 to CR6715 CR7200 to CR7315 |
| CM 600 words | Port0 (built-in serial): Port1 (extension cassette (left)/extension adapter (upper)): Port2 (extension cassette (right)/extension adapter (upper)): | CM5000 to CM5599 CM6000 to CM6599 CM7000 to CM7599 |

Control Relay (CR)

| CR Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|-----------------|------------------|----------------------------------|--|---|----------|
| Port0 (built-in) | Port1 (left) | Port2 (right) | | | | |
| CR6000 | CR6600 | CR7200 | Communication ready | R | This relay is turned ON when the communication enable relay is turned ON and data can be sent or received. It is turned OFF when the communication enable relay turns OFF. | 8-27 |
| CR6001 | CR6601 | CR7201 | Sending complete | R | This relay is turned ON when a send operation to a peripheral is completed. | 8-30 |
| CR6002 | CR6602 | CR7202 | Received data read request | R | This relay is turned ON when data is received from a peripheral. | 8-30 |
| CR6003 | CR6603 | CR7203 | Processing error | R | This relay is turned ON when the unit cannot completely process the data received from a peripheral. It turns OFF when the data can be processed. | 8-38 |
| CR6004 | CR6604 | CR7204 | Communication error | R | This relay turns ON when a communication error occurs. It is turned OFF when communication is successful. | 8-38 |
| CR6005 | CR6605 | CR7205 | Sequence clear complete | R | This relay turns ON when the sequence clear request relay turns ON and the clearing operation is completed. It turns OFF when the sequence clear request relay turns OFF. | 8-36 |
| CR6006 | CR6606 | CR7206 | Setup data error | R | This relay turns ON when the data of the data memory used to set communication is incorrect. | 8-39 |
| CR6007 | CR6607 | CR7207 | Break signal sending in progress | R | This relay is turned ON while the break signal is being sent. | 8-37 |
| CR6008 | CR6608 | CR7208 | ER status | R | This relay is used for the data terminal ready signal.*1 | - |
| CR6009 | CR6609 | CR7209 | - | - | Reserved for the system. | - |



| CR Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|------------------|------------------|-----------------------------|--|--|----------|
| Port0 (built-in) | Port1 (left) | Port2 (right) | | | | |
| CR6010 | CR6610 | CR7210 | DR status | R | This relay is used for the data set ready signal.*1 | - |
| CR6011 | CR6611 | CR7211 | RS status | R | This relay is used for the sending request signal.*1 | - |
| CR6012 | CR6612 | CR7212 | CS status | R | This relay is used for the send enable signal.*1 | - |
| CR6013 to CR6015 | CR6613 to CR6615 | CR7213 to CR7215 | - | - | Reserved for the system. | - |
| CR6100 | CR6700 | CR7300 | Communication enable | R/W | When this relay is turned ON, data sending and receiving are enabled. | 8-27 |
| CR6101 | CR6701 | CR7301 | Sending request | R/W | When this relay is turned ON, the unit starts sending data to a peripheral. | 8-30 |
| CR6102 | CR6702 | CR7302 | Received data read complete | - | This relay turns ON when reception processing of data is completed. | 8-30 |
| CR6103 | CR6703 | CR7303 | Default set request | - | When this relay turns ON, default values are stored in the control memory for communication settings on the rising edge of the communication enable relay. | 8-35 |
| CR6104 | CR6704 | CR7304 | - | R/W | Reserved for the system. | - |
| CR6105 | CR6705 | CR7305 | Sequence clear request | R/W | When this relay turns ON during sending or receiving, the communication sequence is cleared, and the state that was active before sending or receiving is restored. | 8-36 |
| CR6106 | CR6706 | CR7306 | - | - | Reserved for the system. | - |
| CR6107 | CR6707 | CR7307 | Break signal send request | R/W | The break signal is sent while this relay is turned ON. | 8-37 |
| CR6108 | CR6708 | CR7308 | - | - | Reserved for the system. | - |
| CR6109 | CR6709 | CR7309 | - | - | Reserved for the system. | - |
| CR6110 | CR6710 | CR7310 | ER OFF request | R/W | When this relay is turned ON, the data terminal ready signal is set to low. When this relay is turned OFF, the data terminal ready signal is set to high. ¹ | - |
| CR6111 to CR6115 | CR6711 to CR6715 | CR7311 to CR7315 | - | - | Reserved for the system. | - |

*1 This can only be used with the KV-N10L, KV-NC10L and KV-NC20L (Port1). The corresponding device of Port0 is reserved for the system.

Control Memory (CM)

| CM Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|-----------------|------------------|----------------------------|--|---|----------|
| Port0 (built-in) | Port1 (left) | Port2 (right) | | | | |
| CM5000 | CM6000 | CM7000 | - | - | Reserved for the system. | - |
| CM5001 | CM6001 | CM7001 | Length of data to send | R/W | Specify the length of the data (number of words or number of bytes) to send to peripherals. | 8-29 |
| CM5002 | CM6002 | CM7002 | Data to send 1 | R/W | Write the data to send. | 8-27 |
| : | : | : | : | | | |
| CM5257 | CM6257 | CM7257 | Data to send 256 | | | |
| CM5258 | CM6258 | CM7258 | Received data length | R | The length of data (number of words or number of bytes) received by the KV Nano Series from a peripheral is written here. | 8-33 |
| CM5259 | CM6259 | CM7259 | Received data 1 | R | The data received from a peripheral is written here. | 8-30 |
| : | : | : | : | | | |
| CM5514 | CM6514 | CM7514 | Received data 256 | | | |
| CM5515 | CM6515 | CM7515 | Data storage unit setting | R/W | Specify the data storage unit. 0000H: Byte units. 0001H: Word units. | 8-19 |
| CM5516 | CM6516 | CM7516 | Mode setting | R/W | Specify the mode. 000H: Normal mode. 0001H: Response receiving mode. 0002H: Buffer clear mode. | 8-20 |
| CM5517 | CM6517 | CM7517 | Timeout check time setting | R/W | When you are using response receiving mode, specify the timeout check time. 0: The timeout check is not performed. | 8-21 |
| CM5518 | CM6518 | CM7518 | Send header setting | R/W | Specify the header to use when sending data. | 8-22 |
| CM5519 | CM6519 | CM7519 | Send delimiter setting | R/W | Specify the delimiter to use when sending data. | 8-23 |
| CM5520 | CM6520 | CM7520 | Receive header setting | R/W | Specify the header to use when receiving data. | 8-24 |
| CM5521 | CM6521 | CM7521 | Receive delimiter setting | R/W | Specify the delimiter to use when receiving data. | 8-25 |

| CM Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|------------------|------------------|------------------------------|--|--|----------|
| Port0 (built-in) | Port1 (left) | Port2 (right) | | | | |
| CM5522 | CM6522 | CM7522 | Received data length setting | R/W | Specify the length of the received data that will be recognized as the data to use. 0: 512 bytes when byte units has been selected and 256 bytes when word units has been selected. | 8-26 |
| CM5523 to CM5599 | CM6523 to CM6599 | CM7523 to CM7599 | - | - | Reserved for the system. | - |



8-5 Making the Ladder Program

This section describes how to create ladder programs required for communication in non-procedure mode. Use KEYENCE Ladder Support Software KV STUDIO to create ladder programs.

Flow of Ladder Programs

To communicate in non-procedure mode, you have to write a program to send and receive data. As necessary, write programs to perform operations such as checking communication errors. Check the flow of the programs in the figure below.

For details on the send and receive modes, see  "Send and Receive Modes" (page 8-9).

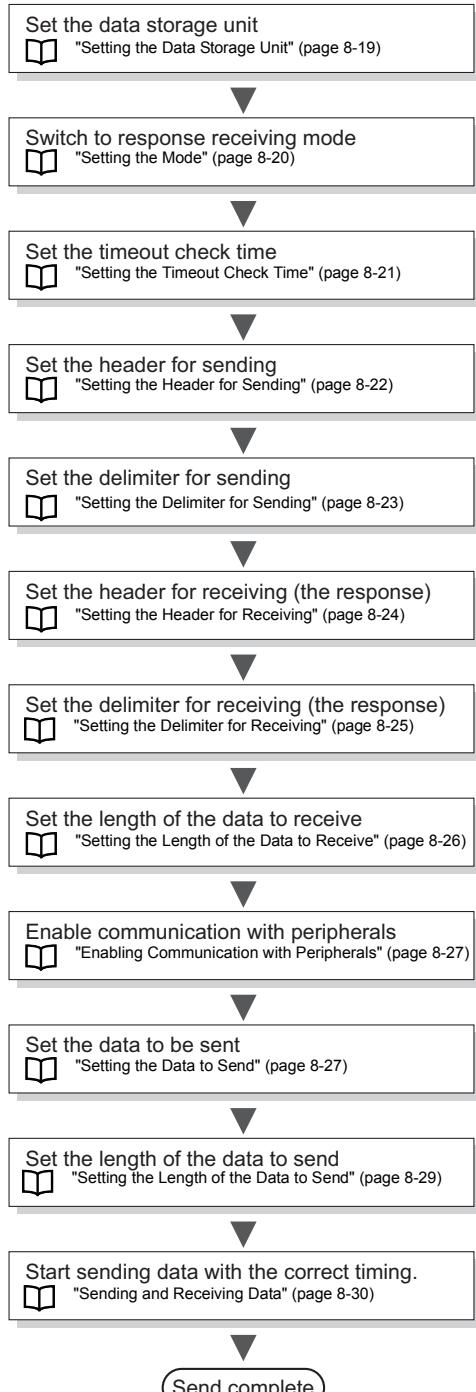
■ Sending and receiving in normal mode



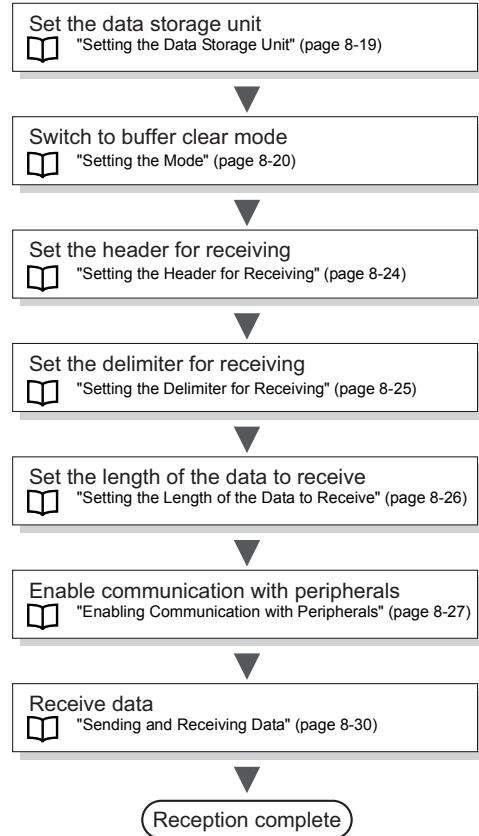
 "Reference Ladder Program" (page 8-40)



■ Sending and receiving in response receiving mode



■ Receiving in buffer clear mode



8-5 Making the Ladder Program

■ Other (common to all modes)

Carry out this programming as necessary.

- Checking for communication errors
 - "Checking for Communication Errors" (page 8-38)
- Initializing data memory devices
 - "Setting Default Values in Control Memory Devices" (page 8-35)
- Clearing the communication sequence
 - "Clearing the Communication Sequence" (page 8-36)
- Capturing received data
 - "About Data Received from Peripherals" (page 8-33)
- Sending the break signal
 - "Sending the Break Signal" (page 8-37)
- Checking the viability of communication with peripherals
 - "Checking the Viability of Communication with Peripherals" (page 8-37)
- Checking the control line status
 - "Checking the Viability of Communication with Peripherals" (page 8-37)
- Controlling the ER signal
 - "Checking the Viability of Communication with Peripherals" (page 8-37)



Setting the Data Storage Unit

Normal **Response Receiving** **Buffer Clear**

Set whether to write data in units of words or units of bytes when writing the data to send to the data to send area and when writing the received data to the received data area.

● Byte units

The character written to the lower eight bits (bits 0 to 7) of the data memory device and the character written to the upper eight bits (bits 8 to 15) of the data memory device are regarded as the characters to send or as the received characters. Almost all of the text processing instructions of the dedicated instructions handle data in units of bytes. It is useful to set the data storage unit to bytes in advance when using these kind of instructions to process data to send and received data. Up to 512 bytes (512 characters) can be sent or received in a single operation.

Example

Writing "AB"

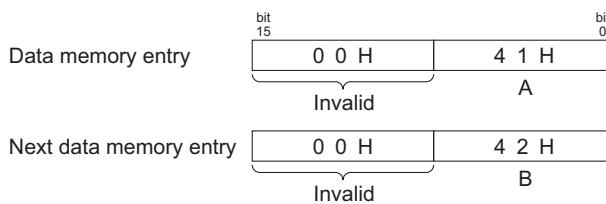


● Word units

Only the character currently written to the lower eight bits of the data memory device is regarded as the character to send or as the received character. (The data of the upper eight bits is ignored.) In ladder programs, data is basically processed in word units. For this reason, it is useful to set the data storage unit to word units in advance when you use Ladder Support Software KV STUDIO to monitor ladder programs. Up to 256 bytes (256 characters) can be sent or received in a single operation.

Example

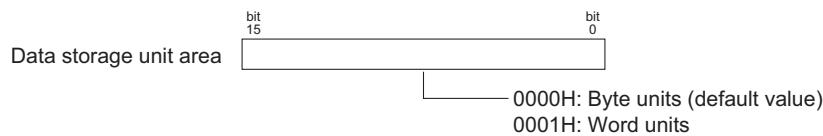
Writing "AB"



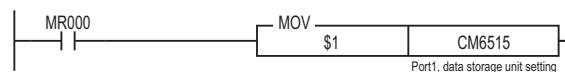
8-5 Making the Ladder Program

■ How to set

To set the data storage unit, write one of the following values to the "data storage unit area" (CM5515, CM6515, or CM7515).


Example

Set the data storage unit of Port1 to word units.



Setting the Mode

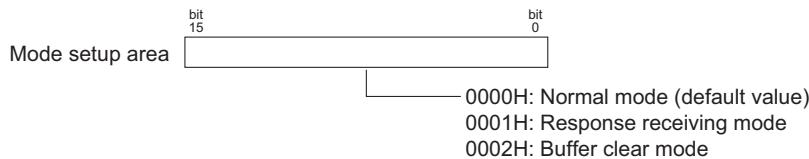
Normal Response Receiving Buffer Clear

Select the appropriate mode from normal mode, response receiving mode, and buffer clear mode to match the communication procedure of the peripherals to be connected.

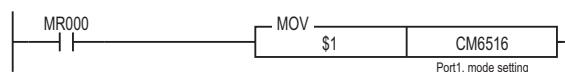
- "Normal mode" (page 8-9)
- "Response receiving mode" (page 8-10)
- "Buffer clear mode" (page 8-11)

■ How to set

To set the mode, write one of the following values to the "mode setup area" (CM5516, CM6516, or CM7516).


Example

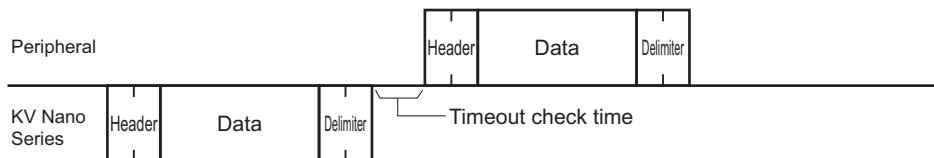
Set Port1 to response receiving mode.



Setting the Timeout Check Time

Normal Response Receiving Buffer Clear

When you use response receiving mode, set the timeout check time of responses. The timeout check time is the maximum time that can elapse without a response being received after the KV Nano Series sends data to a peripheral. If the timeout check time elapses without a response being received, a timeout error occurs, and the communication error relay (CR6004, CR6604, or CR7204) turns ON.



■ How to set

Write the timeout check time in the "timeout check time setup area" (CM5517, CM6517, or CM7517).

- Set the value in units of 10 ms.

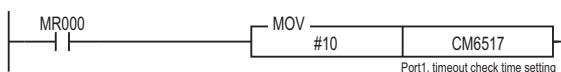
For example, to set a timeout check time of 100 ms, write "10" in decimal.

$$100 \text{ ms} = 10 \text{ ms} \times 10$$

- The range is 1 to 4095 (10 to 40950 ms).
- If you set the value to "0," the timeout check is not performed.

Example

Set the timeout check time of Port1 to 100 ms.



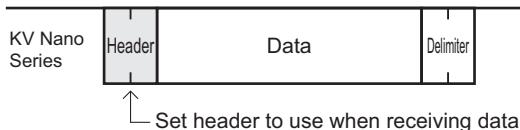
Setting the Header for Sending

Normal Response Receiving

Response Receiving

When you use normal mode or response receiving mode, set the header of the data to send to peripherals from the KV Nano Series. When you will prefix the data with a header, set the header type. When you will not prefix the data with a header, disable the header. When you use buffer clear mode, you do not have to set this setting. It will be ignored if it is set.

Peripheral



The same code (character) cannot be used for headers and delimiters.

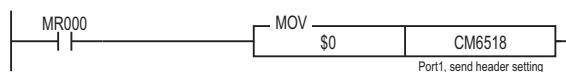
■ How to set

To set the header for sending, write the ASCII code (hexadecimal) of the header in the "send header setup area" (CM5518, CM6518, or CM7518).

- A header of up to two bytes can be set. In this situation, first set the upper byte, and then set the lower byte.
 - When you will not prefix the data with a header, write "0000H."

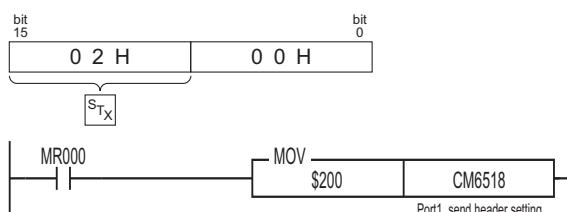
Send header area

0000H

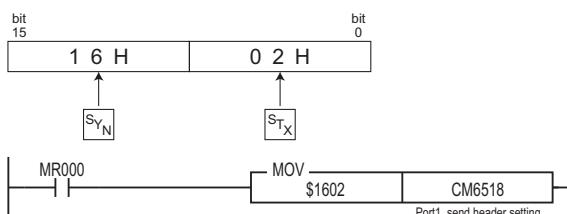


Example

One-byte header: Set the header of Port1 to S_{T_1} .



Two-byte header: Set the header of Port1 to S_{YN} S_{TX} .





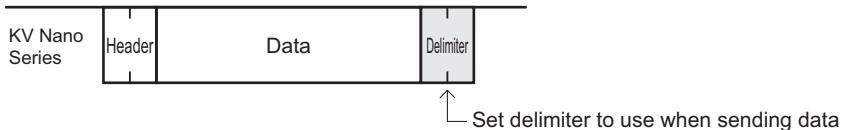
Setting the Delimiter for Sending

Normal **Response Receiving** **Buffer Clear**

When you use normal mode or response receiving mode, set the delimiter of the data to send to peripherals from the KV Nano Series. When you will insert delimiters into the data, set the delimiter type. When you will not insert delimiters into the data, disable delimiters.

When you use buffer clear mode, you do not have to set this setting. It will be ignored if it is set.

Peripheral

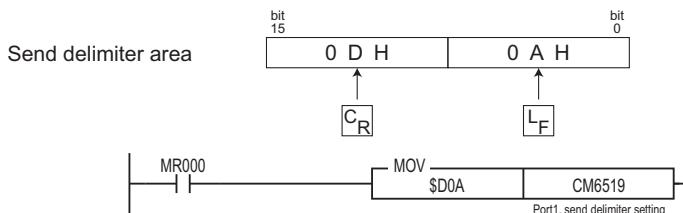


The same code (character) cannot be used for headers and delimiters.

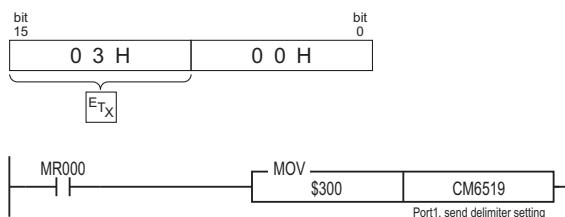
■ How to set

To set the delimiter for sending, write the ASCII code (hexadecimal) of the delimiter in the "send delimiter setup area" (CM5519, CM6519, or CM7519).

- A delimiter of up to two bytes can be set. In this situation, first set the upper byte, and then set the lower byte.
- When you will not insert delimiters into the data, write "0000H."



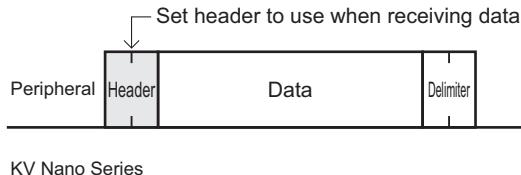
Set the delimiter of Port1 to E_{TX} .



Setting the Header for Receiving

Normal **Response Receiving** **Buffer Clear**

Set the header of the data (responses) that the KV Nano Series will receive from peripherals. When you will prefix the data with a header, set the header type. When you will not prefix the data with a header, disable the header.



The same code (character) cannot be used for headers and delimiters.

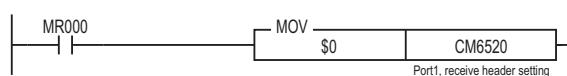
■ How to set

To set the header for receiving, write the ASCII code of the header to the "receive header setup area" (CM5520, CM6520, or CM7520).

- A header of up to two bytes can be set. In this situation, first set the upper byte, and then set the lower byte.
 - When you will not prefix the data with a header, write "0000H."

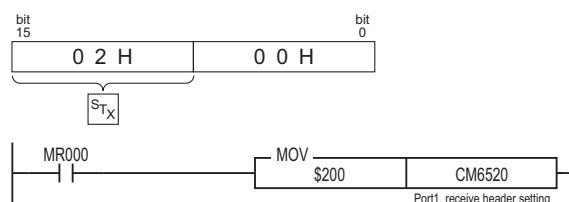
Receive header area

0000H

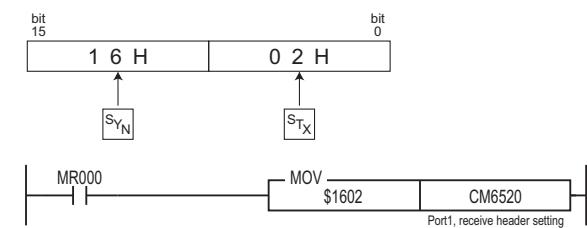


Example

One-byte header: Set the header of Port1 to S_{T_X} .



Two-byte header: Set the header of Port1 to S_{YN} S_{TX} .



Setting the Delimiter for Receiving

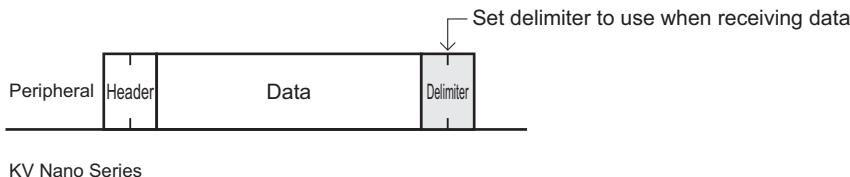
Normal Response Receiving Buffer Clear

Set the delimiter of the data (responses) that the KV Nano Series will receive from peripherals. When you will insert delimiters into the data, set the delimiter type. When you will not insert delimiters into the data, disable delimiters.

Be sure to set the delimiter type when you will receive variable data and when you use buffer clear mode. If you do not set the delimiter type, the data cannot be received successfully because the KV Nano Series cannot recognize when it has finished receiving data.



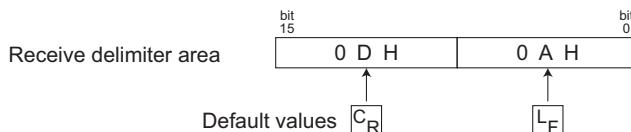
- The same code (character) cannot be used for headers and delimiters.
- When receiving fixed length data, set the receiving delimiter to "00H" and receive data with the delimiter setting set to OFF. If you set a delimiter, the KV Nano Series stops receiving data when it detects the set delimiter in the data that it is receiving.



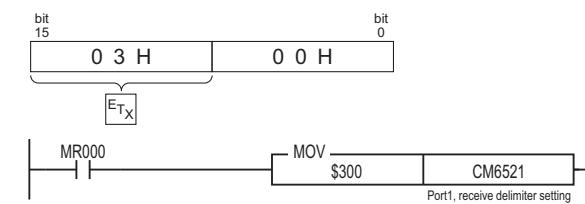
■ How to set

To set the delimiter for receiving, write the ASCII code of the delimiter to the "receive delimiter setup area" (CM5521, CM6521, or CM7521).

- A delimiter of up to two bytes can be set. In this situation, first set the upper byte, and then set the lower byte.
- When you will not insert delimiters into the data, write "0000H."



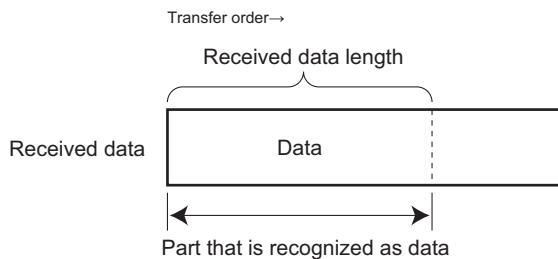
One-byte delimiter: Set the delimiter of Port1 to E_{TX} .



Setting the Length of the Data to Receive

Normal **Response Receiving** **Buffer Clear**

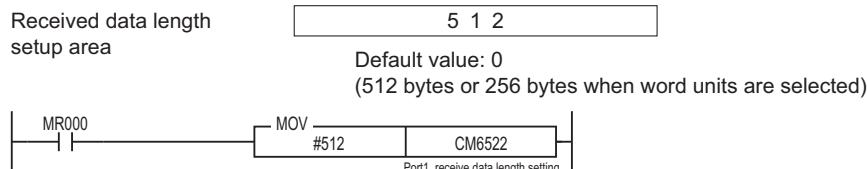
The "received data length" is the number of bytes of data from the entire data received (the response) that the KV Nano Series will write to the base unit. When receiving fixed length data of a specified data length, set the length of the data to receive. When the received data length is set to "0," the KV Nano Series processes data with the assumption that the received data length is set to 512 bytes (when the data storage unit is set to byte units or 256 bytes when the data storage unit is set to word units).



■ How to set

To set the length of the data to receive, write the data length to the "received data length setup area" (CM5522, CM6522, or CM7522).

- When receiving fixed length data of a specified data length, set the received data length to a value within the range of 1 to 512 bytes to match the data to be received.
- When receiving variable length data with specified delimiters, set the received data length to 0 or 512 (when the data storage unit is set to byte units or 256 when the data storage unit is set to word units).



When receiving fixed length data, set the receiving delimiter to "00H" and receive data with the delimiter setting set to OFF. If you set a delimiter, the KV Nano Series stops receiving data when it detects the set delimiter in the data that it is receiving.



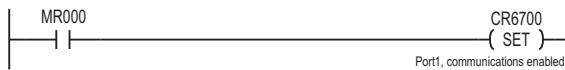
Enabling Communication with Peripherals

Normal Response Receiving Buffer Clear

Set the communication conditions, and then turn the communication enable relay (CR6100, CR6700, or CR7300) ON. On the rising edge of the communication enable relay, the set communication conditions are registered, and the KV Nano Series is ready to communicate with peripherals. Communication with peripherals is not possible when the communication enable relay is turned OFF. When the communication enable relay is turned ON and communication with peripherals is possible, the communication ready relay (the leading relay) turns ON. When the communication enable relay is turned OFF and communication with peripherals is not possible, the communication ready relay (leading relay) turns OFF.

Example

Enable communication between Port1 and a peripheral.



Setting the Data to Send

Normal Response Receiving Buffer Clear

When you use normal mode or response receiving mode, set the data to send to peripherals from the KV Nano Series. The data setting method differs according to the data storage unit that you have set.

"Setting the Data Storage Unit" (page 8-19)

When you use buffer clear mode, you do not have to set this setting.

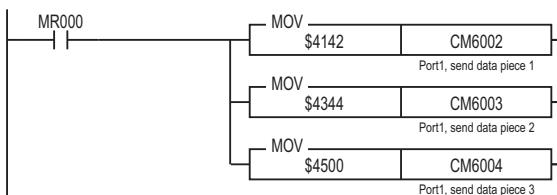
■ How to set the data in byte units

Write the data to send to peripherals in the "data to send area" (CM5002 to CM5257, CM6002 to CM6257, or CM7002 to CM7257).

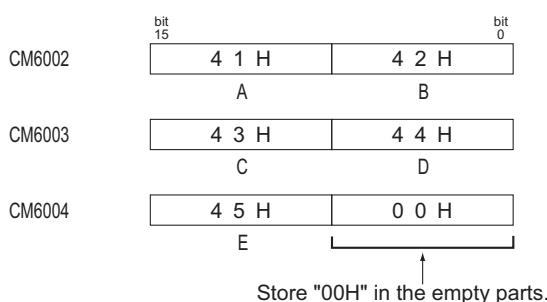
- Up to 512 bytes (512 characters) of data can be sent in a single operation.

Example

Set the data to send from Port1 to "ABCDE" (41H, 42H, 43H, 44H, and 45H).



Data to send area



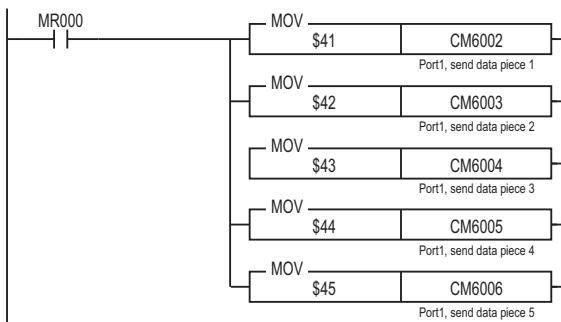
■ How to set the data in word units

Write the data to send to peripherals in the "data to send area" (CM5002 to CM5257, CM6002 to CM6257, or CM7002 to CM7257).

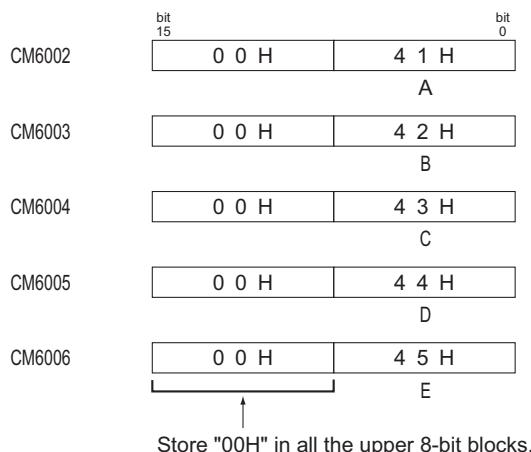
- Up to 256 bytes (256 characters) of data can be sent in a single operation.

Example

Set the data to send from Port1 to "ABCDE" (41H, 42H, 43H, 44H, and 45H).



Data to send area





Setting the Length of the Data to Send

Normal **Response Receiving** **Buffer Clear**

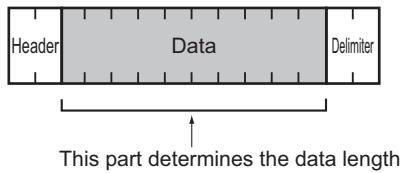
When you use normal mode or response receiving mode, set the length of the data (data length) to send to peripherals from the KV Nano Series. In other words, of the data currently written to the data to send area (CM5002 to CM5257, CM6002 to CM6257, or CM7002 to CM7257), set how many bytes (or how many words) of data starting from the leading CM are to be sent to peripherals.

When you use buffer clear mode, you do not have to set this setting.

■ How to set

Write the length of the data to send to the "send data length setup area" (CM5001, CM6001, or CM7001).

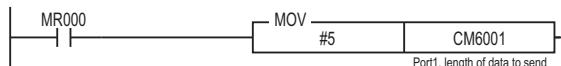
- When the data storage unit is set to byte units, write the number of bytes. When the data storage unit is set to word units, write the number of words.
- "Setting the Data Storage Unit" (page 8-19)
- Do not include the number of bytes taken up by the header and delimiters in the data length.



This part determines the data length.

Example

Set the length of data to send from Port1 to five bytes.



Byte units

| | | | |
|-----------------------|--------|-------------------------|-----------------------|
| Send data length area | CM6001 | 0 0 0 0 5 | Data length: 5 bytes |
| Send data area | CM6002 | 4 1 H (A) 4 2 H (B) | Data to send: "ABCDE" |
| | CM6003 | 4 3 H (C) 4 4 H (D) | |
| | CM6004 | 4 5 H (E) 0 0 H | |
| | CM6005 | 0 0 H 0 0 H | Not used |
| | : | : | |
| | CM6257 | 0 0 H 0 0 H | |

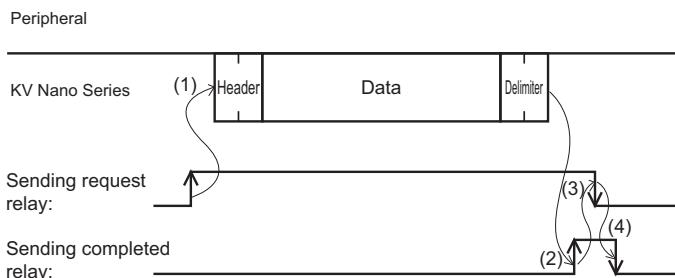
Word units

| | | | |
|-----------------------|--------|-------------------|-----------------------|
| Send data length area | CM6001 | 0 0 0 0 5 | Data length: 5 words |
| Send data area | CM6002 | 0 0 H 4 1 H (A) | Data to send: "ABCDE" |
| | CM6003 | 0 0 H 4 2 H (B) | |
| | CM6004 | 0 0 H 4 3 H (C) | |
| | CM6005 | 0 0 H 4 4 H (D) | |
| | CM6006 | 0 0 H 4 5 H (E) | |
| | CM6007 | 0 0 H 0 0 H | Not used |
| | : | : | |
| | CM6257 | 0 0 H 0 0 H | |

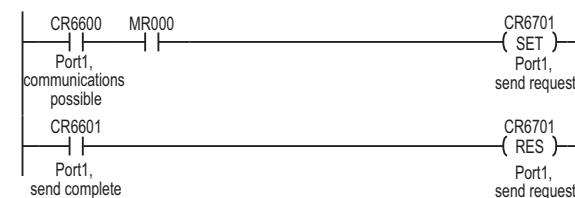
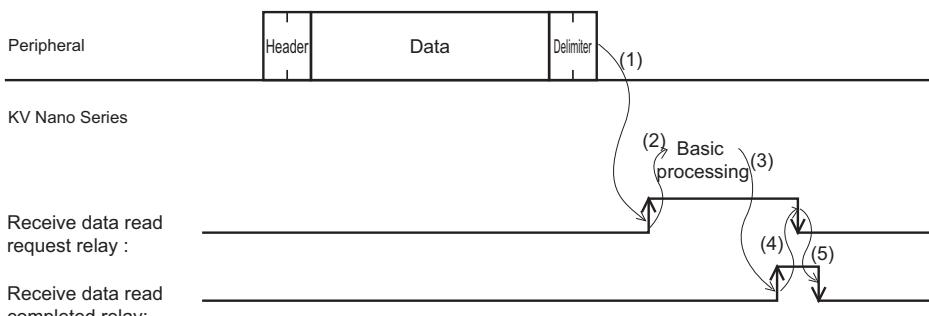
Store "00H" in all the upper 8-bit blocks.

Sending and Receiving Data**Normal Response Receiving Buffer Clear**

The I/O relays are used to send and receive data between the KV Nano Series and peripherals. The figures below show programs for sending and receiving data in each of the modes.

■ Normal mode**● Sending**

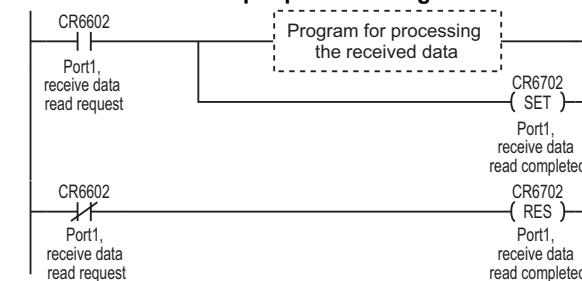
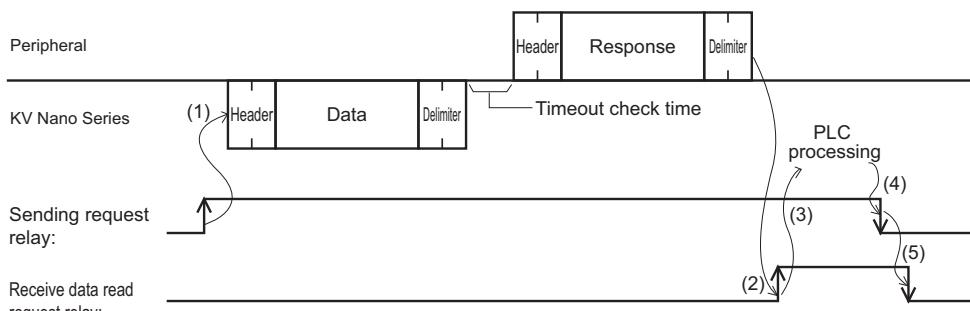
- (1) When the sending request relay (CR6101, CR6701, or CR7301) is turned ON by the ladder program, the KV Nano Series starts sending data to the peripheral.
- (2) When the sending operation is completed, the KV Nano Series turns the sending complete relay (CR6001, CR6601, or CR7201) ON.
- (3) When the sending complete relay turns ON, use the ladder program to turn the sending request relay OFF.
- (4) When the sending request relay turns OFF, the KV Nano Series turns the sending complete relay OFF.

Example Send data to a peripheral from Port1.**● Receiving**

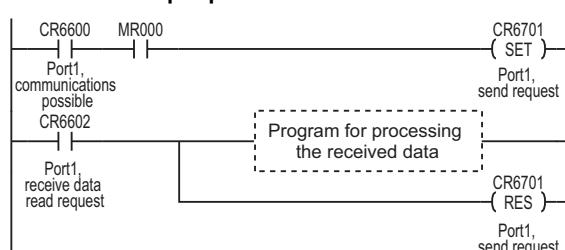
- (1) When the KV Nano Series receives data, the received data read request relay (CR6002, CR6602, or CR7202) turns ON.
 - The received data is stored in the received data storage area (CM5259 to CM5514, CM6259 to CM6514, or CM7259 to CM7514).
 - When the received data read request relay turns ON, the base unit is enabled to process the received data.



- (2) Process the received data on the base unit as necessary.
- (3) When the processing of the received data on the base unit is completed, use the ladder program to turn the received data read complete relay (CR6102, CR6702, or CR7302) ON.
- (4) When the received data read complete relay is turned ON, the received data read request relay is turned OFF.
- (5) When the received data read request relay is turned OFF, use the ladder program to turn the received data read complete relay OFF.

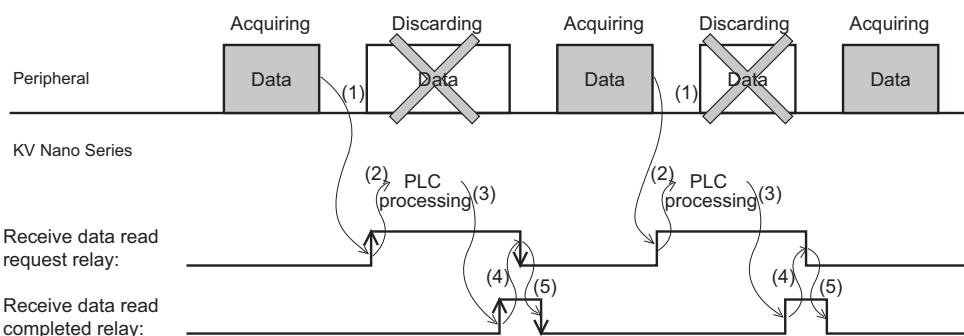
Example**Receive data from a peripheral through Port1.****■ Response receiving mode**

- (1) Use the ladder program to turn the sending request relay (CR6101, CR6701, or CR7301) ON.
 - The KV Nano Series starts sending data to a peripheral.
- (2) When the reception of a response is completed, the KV Nano Series turns the received data read request relay (CR6002, CR6602, or CR7202) ON.
 - The received data is stored in the received data storage area (CM5259 to CM5514, CM6259 to CM6514, or CM7259 to CM7514).
 - When the received data read request relay turns ON, the base unit is enabled to process the received data.
- (3) Process the received data on the base unit as necessary.
- (4) When the processing on the base unit is completed, use the ladder program to turn the sending request relay OFF.
- (5) When the sending request relay is turned OFF, the KV Nano Series turns the received data read request relay OFF.

Example**Send data to a peripheral from Port1.**

8-5 Making the Ladder Program

■ Buffer clear mode



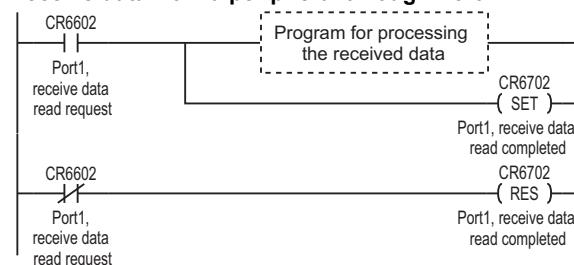
- (1) When the KV Nano Series receives data, the received data read request relay (CR6002, CR6602, or CR7202) turns ON.
 - The received data is stored in the received data storage area (CM5259 to CM5514, CM6259 to CM6514, or CM7259 to CM7514).
 - When the received data read request relay turns ON, the base unit is enabled to process the received data.
- (2) Process the received data on the base unit as necessary.
- (3) When the processing of the received data on the base unit is completed, use the ladder program to turn the received data read complete relay (CR6102, CR6702, or CR7302) ON.
- (4) When the received data read complete relay is turned ON, the received data read request relay is turned OFF.
- (5) When the received data read request relay is turned OFF, use the ladder program to turn the received data read complete relay OFF.



- In buffer clear mode, data that arrives from peripherals while previously received data is being processed is discarded.
- When using buffer clear mode, set the receiving delimiter. If you do not set the receiving delimiter, data will not be received correctly.

Example

Receive data from a peripheral through Port1.





About Data Received from Peripherals

Normal **Response Receiving** **Buffer Clear**

When the KV Nano Series receives data from peripherals, the length (number of bytes) of the data is written to the received data length area (CM5258, CM6258, or CM7258). The content of the received data is written to the received data storage area (CM5259 to CM5514, CM6259 to CM6514, or CM7259 to CM7514). However, the way that data is stored varies according to the data storage unit setting as shown below.

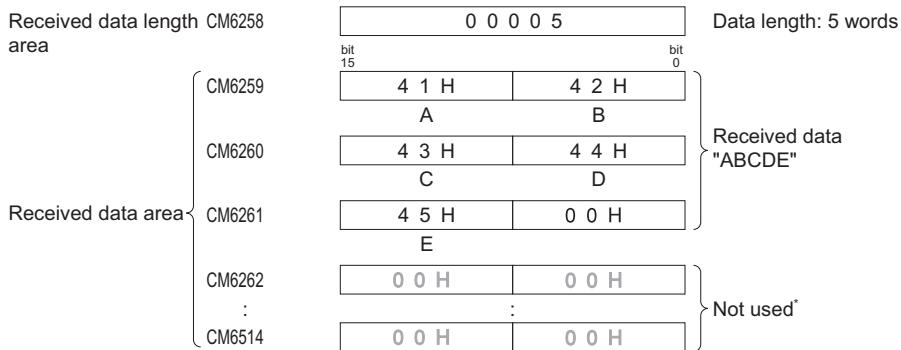
"Setting the Data Storage Unit" (page 8-19)

■ When the data storage unit is set to byte units

The data received by the KV Nano Series is written one character at a time to the lower eight bits (bits 0 to 7) and upper eight bits (bits 8 to 15) of the received data storage area (CM5259 to CM5514, CM6259 to CM6514, or CM7259 to CM7514).

Example

Text data was received from Port1 in the following order: "ABCDE" (41H, 42H, 43H, 44H, and then 45H).



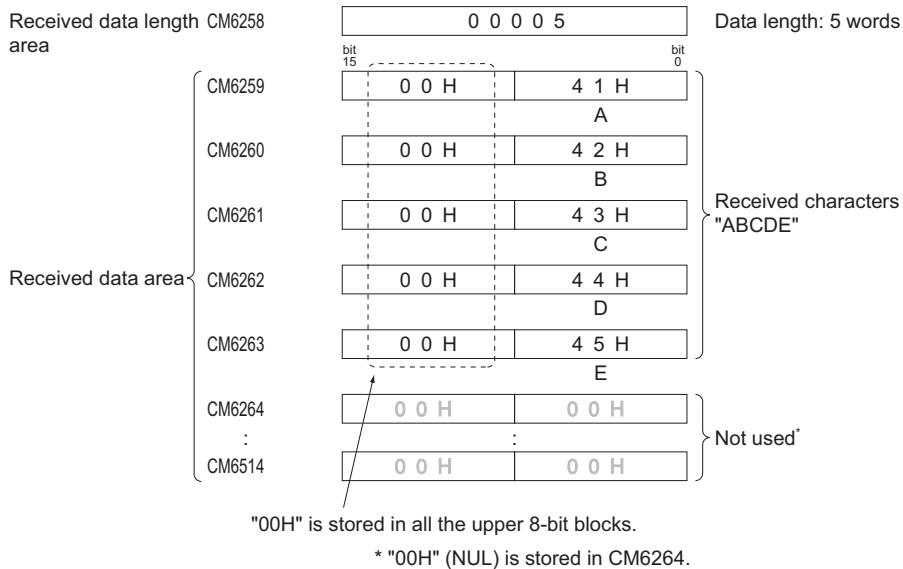
* If data was previously received,
the previously received data remains.

■ When the data storage unit is set to word units

The data received by the KV Nano Series is written only to the lower eight bits (bits 0 to 7) of the received data storage area (CM5259 to CM5514, CM6259 to CM6514, or CM7259 to CM7514). The upper eight bits are not used, and 00H is written to them.

Example

Text data was received from Port1 in the following order: "ABCDE" (41H, 42H, 43H, 44H, and then 45H).





Setting Default Values in Control Memory Devices

Normal**Response Receiving****Buffer Clear**

You can set default values in the control memory devices that are occupied for communication. When you are using settings such as the data storage unit, header, delimiter, and mode at their default values, you can make programming easier by using this function to return all settings to their default values. The control memory devices that can be set to their default values are shown below.

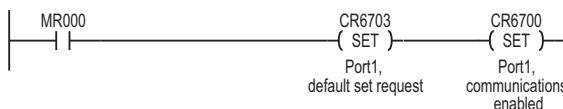
| CM | Name | Default Value |
|------------------------|---------------------------------|--|
| CM5515, CM6515, CM7515 | Data storage unit setup area | 0: Byte units |
| CM5516, CM6516, CM7516 | Mode setup area | 0: Normal mode |
| CM5517, CM6517, CM7517 | Timeout check time setup area | 0 |
| CM5518, CM6518, CM7518 | Send header setup area | 0000H: No header |
| CM5519, CM6519, CM7519 | Send delimiter setup area | 0D0AH: <input type="checkbox"/> C_R <input type="checkbox"/> L_F |
| CM5520, CM6520, CM7520 | Receive header setup area | 0000H: No header |
| CM5521, CM6521, CM7521 | Receive delimiter setup area | 0D0AH: <input type="checkbox"/> C_R <input type="checkbox"/> L_F |
| CM5522, CM6522, CM7522 | Received data length setup area | 0: 512 bytes (byte units) 256 bytes (word units) |

■ How to set

To set control memory devices to their default values, turn the default set relay (CR6103, CR6703, or CR7303) ON. After you turn the default set relay ON, the control memory devices are set to their default values on the rising edge of the communication enable relay (CR6100, CR6700, or CR7300).

Example

Set the control memory devices for communication on Port1 to their default values.

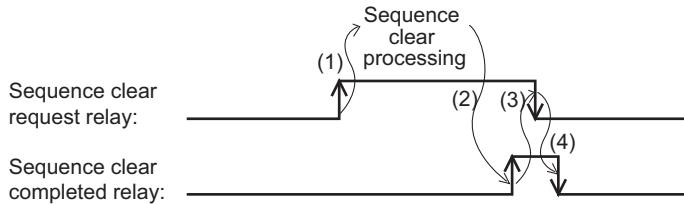


Clearing the Communication Sequence**Normal Response Receiving Buffer Clear**

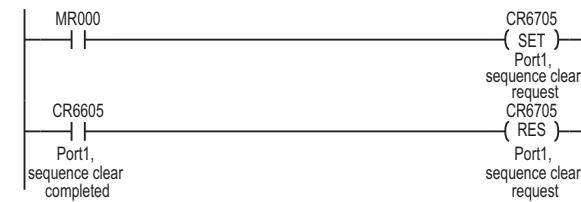
You can clear the communication sequence (the details of communication transactions) during sending and receiving of data between the KV Nano Series and peripherals to return the KV Nano Series to the status that was active before sending and receiving started. Carry out this programming as necessary.

■ How to set

To clear the communication sequence, write a program as shown below.



- (1) Use the ladder program to turn the sequence clear request relay (CR6105, CR6705, or CR7305) ON.
Clear processing of the sequence begins on the rising edge of the sequence clear request relay.
- (2) When the sequence clearing operation is completed, the KV Nano Series turns the sequence clear complete relay (CR6005, CR6605, or CR7205) ON.
- (3) When the sequence clear complete relay turns ON, use the ladder program to turn the sequence clear request relay OFF.
- (4) When the sequence clear request relay turns OFF, the KV Nano Series turns the sequence clear complete relay OFF.

Example**Clear the Port1 communication sequence.**

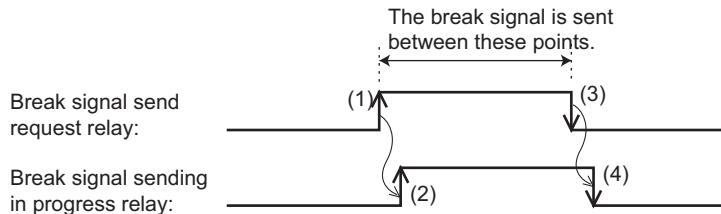
Sending the Break Signal

Normal Response Receiving Buffer Clear

You can send the break signal from the KV Nano Series to peripherals to initialize their communication ports. Carry out this programming as necessary.

■ How to set

To send the break signal to a peripheral, write a program as shown below.



- (1) Use the ladder program to turn the break signal send request relay (CR6107, CR6707, or CR7307) ON.

The sending of the break signal starts on the rising edge of the break signal send request relay.

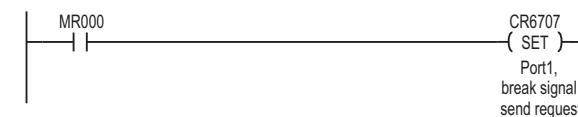
- (2) While the break signal is being sent, the break signal sending in progress relay (CR6007, CR6607, or CR7207) turns ON.

- (3) When the ladder program turns the break signal send request relay OFF, the sending of the break signal is stopped.

- (4) When the break signal send request relay turns OFF, the break signal sending in progress relay turns OFF.

Example

Send the break signal from Port1.



Checking the Viability of Communication with Peripherals

Normal Response Receiving Buffer Clear

You can check the viability of communication between the KV-N10L, KV-NC10L, and KV-NC20L (Port1), and peripherals. Carry out this programming as necessary.

The control signals can only be monitored when a KV-N10L, KV-NC10L or KV-NC20L (Port1) is connected to Port1 or Port2. This function cannot be used if a KV-N10L, KV-NC10L or KV-NC20L (Port1) is connected to Port0.

■ How to check the status of the control line

To check the viability of communication, monitor the ON/OFF status of the communication ready relay (CR6600 or CR7200). This relay turns ON when the communication enable relay (CR6700 or CR7300) is turned ON and communication with peripherals is possible. This relay turns OFF when the communication enable relay is turned OFF and communication with peripherals is impossible.

| Relay | Name | Corresponding Signal | Pin Number |
|----------------|-----------------|--------------------------|------------|
| CR6608, CR7208 | ER status relay | ER (data terminal ready) | 4 |
| CR6610, CR7210 | DR status relay | DR (data set ready) | 6 |
| CR6611, CR7211 | RS status relay | RS (send request) | 7 |
| CR6612, CR7212 | CS status relay | CS (send enable) | 8 |

| Relay | Status of Control Line |
|-------|------------------------|
| ON | High |
| OFF | Low |



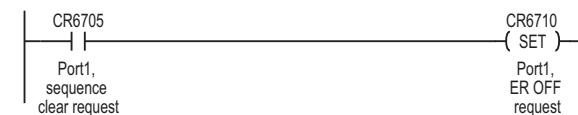
Controlling the ER Signal**Normal Response Receiving Buffer Clear**

The status of the ER (data terminal ready) signal (pin number four) on the KV-N10L, KV-NC10L and KV-NC20L (Port1) can be switched between high and low to notify peripherals. Carry out this programming as necessary.

The control signals can only be monitored when a KV-N10L, KV-NC10L or KV-NC20L (Port1) is connected to Port1 or Port2. This function cannot be used if a KV-N10L, KV-NC10L or KV-NC20L (Port1) is connected to Port0.

■ How to switch the ER signal

To set the ER signal to high (terminal ready status), turn the ER OFF request relay (CR6710 or CR7310) OFF. To set the signal to low (terminal not ready status), turn the ER OFF request relay ON. You can check the status of the ER signal by monitoring the ON/OFF status of the ER status relay (CR6608 or CR7208).

Example**Set the Port1 ER signal to low.****Checking for Communication Errors****Normal Response Receiving Buffer Clear**

You can check for communication errors during communication between the KV Nano Series and peripherals. Carry out this programming as necessary.

■ How to check for communication errors

Communication errors appear when communication data is corrupted due to noise being applied to the data on the communication line or when the response receiving mode has timed out.

To check for communication errors, monitor the ON/OFF status of the communication error relay (CR6004, CR6604, or CR7204).

This relay turns ON when there is an error. It turns OFF when there is no error.

| Communication Error Relay | Communication Error |
|---------------------------|---------------------|
| ON | Error |
| OFF | No error |

■ How to check for reception processing errors

To check whether or not data received by the KV Nano Series from peripherals is being processed normally, monitor the ON/OFF status of the processing error relay (CR6003, CR6603, or CR7203). When data can no longer be processed by the KV Nano Series, for example, when a large volume of data is sent from peripherals, the processing error relay turns ON. It turns OFF when the data can be processed correctly.

| Processing Error Relay | Reception Processing Error |
|------------------------|----------------------------|
| ON | Error |
| OFF | No error |



■ How to check for setup data errors

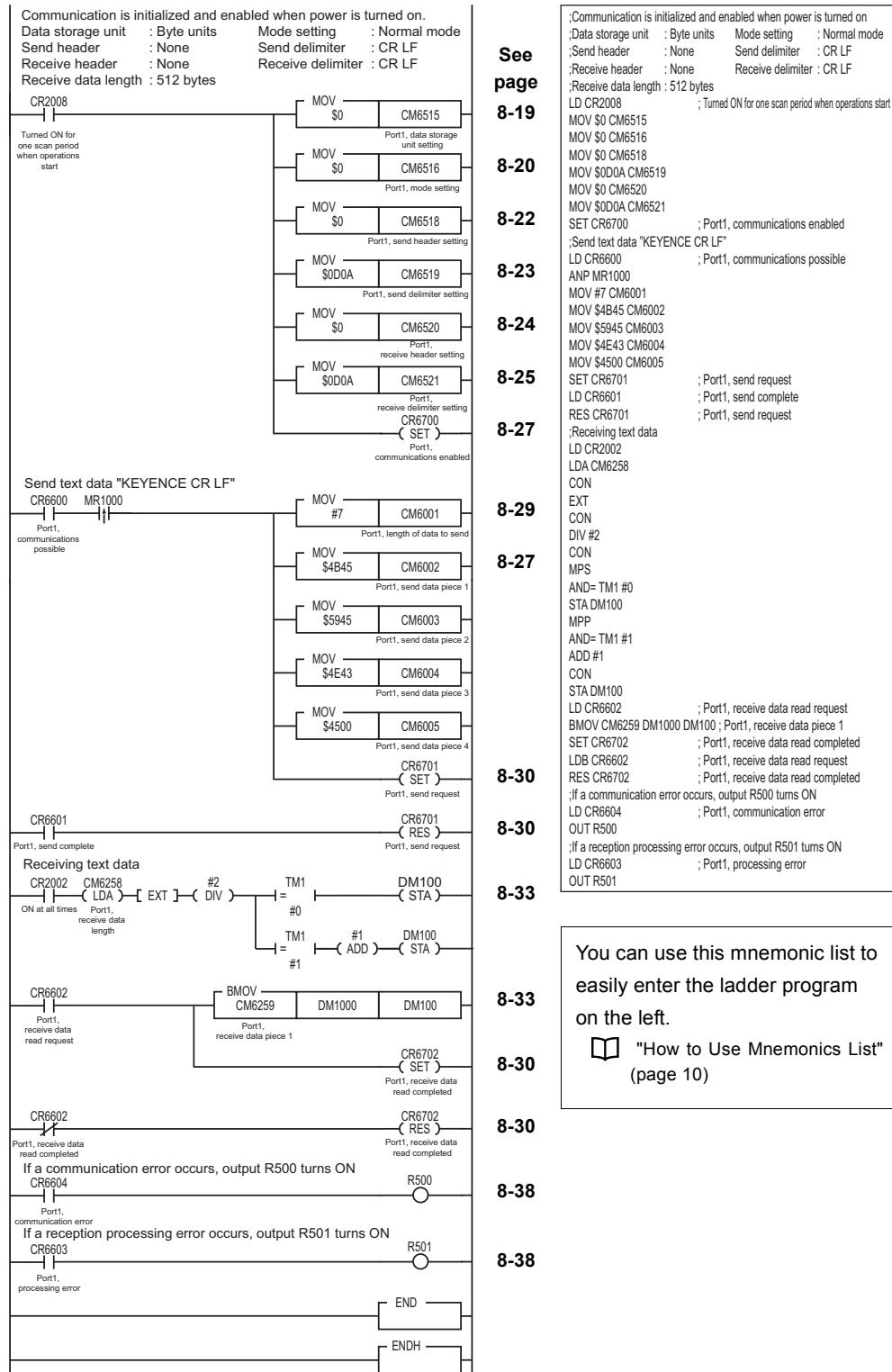
To check whether the setup data of the communication conditions currently set to occupied CM devices is appropriate, monitor the ON/OFF status of the setup data error relay (CR6006, CR6606, or CR7206). When the communication enable relay (CR6100, CR6700, or CR7300) is turned ON, the setup data error relay turns ON if the setup data is inappropriate. If you change the setup data to appropriate values and then turn the communication enable relay ON, the setup data error relay turns OFF.

| Setup Data Error Relay | Setup Data |
|------------------------|------------|
| ON | Invalid |
| OFF | Valid |

8-5 Making the Ladder Program

Reference Ladder Program

The following is an example ladder program for using Port1 to send and receive data in normal mode.



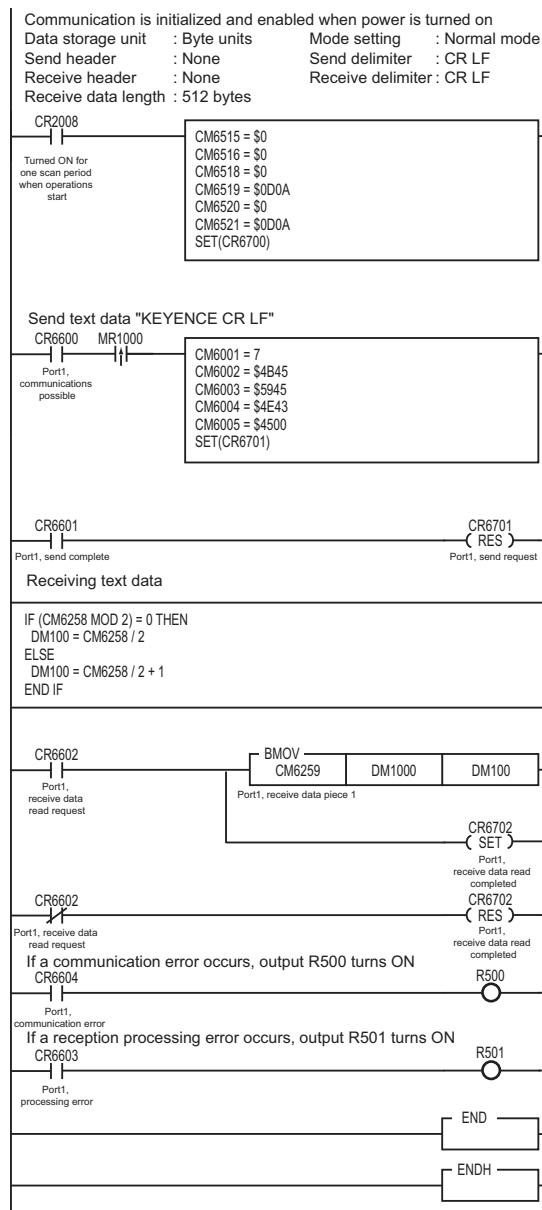
You can use this mnemonic list to easily enter the ladder program on the left.

□ "How to Use Mnemonics List" (page 10)



Reference

Writing the reference ladder program as a script results in a script like the one shown below.



MEMO

Modbus MASTER MODE

This chapter describes the communication specifications of and how to use Modbus master mode.

| | | |
|-----|--|------|
| 9-1 | Outline and Procedure Prior to Operation | 9-2 |
| 9-2 | Communication Specifications and Unit Editor Settings | 9-4 |
| 9-3 | Lists of Devices Used. | 9-6 |
| 9-4 | Communication Procedure. | 9-11 |
| 9-5 | Lists of Functions and Modbus Devices. | 9-13 |
| 9-6 | Making the Ladder Program. | 9-15 |
| 9-7 | Function Details | 9-25 |
| 9-8 | Modbus Dedicated Trace Monitor | 9-49 |
| 9-9 | Operation When an Error Occurs and Error Remedies | 9-52 |

9-1 Outline and Procedure Prior to Operation

This section briefly describes Modbus master mode and gives the procedure prior to operation.

Outline

■ About Modbus

The Modbus protocol is a communication protocol that was developed by Modicon Inc. (AEG Schneider Automation International S.A.S.) for PLCs.

There are two serial transmission modes: ASCII mode and RTU (Remote Terminal Unit) mode. The KV Nano Series supports RTU mode.

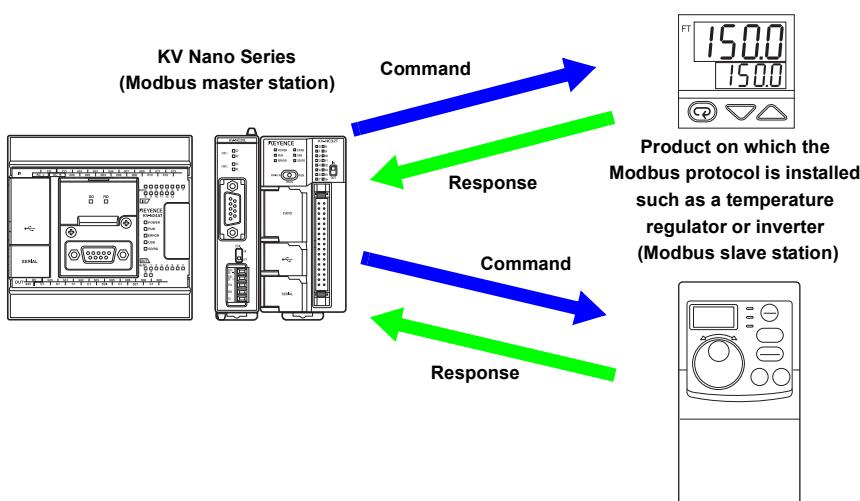
The specifications of the Modbus protocol are publically known. These specifications are extremely simple, so Modbus is widely used in the FA (Factory Automation) and PA (Process Automation) fields, but it does not have a structure for verification and authorization.

Therefore, each time that you use the Modbus protocol, you must check whether a connection is possible.

■ Application

Send commands from the KV Nano Series to a slave station (a peripheral such as a temperature regulator or an inverter) on which the Modbus protocol is installed, and then receive the response.

The data on a product on which the Modbus protocol is installed can be read and written as device data of the KV Nano Series.



If you are using the KV Nano Series as a Modbus slave station, see "Chapter 10 Modbus SLAVE MODE" (page 10-1).

Procedure Prior to Operation

This section describes the basic procedure to follow when using Modbus master mode.

If you are using an extension cassette or adapter, see "2-2 Installing Units on the Base Unit" and install the extension cassette or adapter on the base unit.

Configure the KV STUDIO* Unit Editor settings.

- Set the operation mode of the ports that you are using to "Modbus master mode."
- Configure other items as necessary.

"9-2 Communication Specifications and Unit Editor Settings" (page 9-4)



Create the ladder program for sending and receiving data.

For details on creating ladder programs, see "9-6 Making the Ladder Program" (page 9-15).



Transfer the project that you have created to the base unit.

In KV STUDIO, on the "Monitor/Simulator" menu, click "PLC Transfer," and then "Monitor Mode" to transfer the project.*

"KV STUDIO User's Manual"



Connect to the peripherals that will be the slave stations, and start sending and receiving data.

Connect the peripherals, and set the communication specifications of the peripherals so that they are the same as those of the KV Nano Series.

"2-3 Connecting Peripherals" (page 2-6)



Check the operations.

In KV STUDIO, on the "Monitor/Simulator" menu, click "Built-in Function Monitor" to check operations.*

"Chapter 4 USING THE BUILT-IN FUNCTION MONITOR TO CHECK OPERATIONS" (page 4-1)
 "9-8 Modbus Dedicated Trace Monitor" (page 9-49)

* Use version 7 or later (version 7.1 when using an extension adapter) of KV STUDIO.

9-2 Communication Specifications and Unit Editor Settings

This section describes the communication specifications of Modbus master mode. Use the Unit Editor to configure the communication settings.

Communication Specifications

| Item | Description |
|-----------------------------------|--|
| Communication interface | RS-232C, RS-422A/RS-485 (4-wire type), RS-485 (2-wire type) |
| Communication speed | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps |
| Maximum number of connected units | 32 (including the master station) |
| Station number | 1 to 247 and 0 (broadcast) * The master station does not have its own station number. |
| Transmission distance | RS-422A/RS-485 (4-wire type), RS-485 (2-wire type): Less than 1200 m RS-232C: 15 m |
| Data bit length | 8 bits |
| Stop bit length | 1 bit, 2 bits |
| Parity | Even, odd, none |
| Transmission mode | Modbus RTU standard ^{*1} |
| Data check method | CRC (automatic calculation) |

*1 Modbus ASCII mode is not supported.

■ Number of communication ports that can be used simultaneously

| Base Unit | Number of Communication Ports |
|-----------|---|
| KV-N14** | When an extension cassette is not used: 1 |
| KV-N24** | When an extension cassette is used: 2 |
| KV-N40** | When extension cassettes are not used: 1 |
| KV-N60** | When one extension cassette is used: 2 When two extension cassettes are used: 3 |
| KV-NC32T | When extension adapters are not used: 1 When the KV-NC10L is used: 2 When the KV-NC20L is used: 3 |

■ Precautions

● Communication during PROG mode

Modbus master mode communication will be executed even if the base unit is in PROG mode.

Setting Items on Unit Editor

Set the operation mode to "Modbus master mode." Configure the other settings as shown below. For details on how to configure settings, see "2-5 Using Unit Editor to Configure Settings" (page 2-12).



For the following items, match the communication specifications of peripherals with those of the KV Nano Series. Communication cannot be performed if the settings are different.

● Built-in serial port, KV-N10L, KV-NC10L, KV-NC20L (Port1)

| Item | Setting | Default Value |
|---------------------|---|---------------|
| Interface* | RS-232C | RS-232C |
| Baud rate | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps | 9600 bps |
| Data bit length | 8 bits | 8 bits |
| Start bit | 1 bit | 1 bit |
| Stop bits | 1 bit, 2 bits | 1 bit |
| Parity | None, Even, Odd | Even |
| RS/CS flow control* | OFF, ON | OFF |

* This does not display for the built-in serial port.

● KV-N11L, KV-NC20L (Port2)

| Item | Setting | Default Value |
|----------------------------------|---|-------------------------|
| Interface | RS-232C ^{*1} , RS-422A/485 (4-wire type), RS-485 (2-wire type) | RS-485 (2-wire type) |
| Baud rate | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps | 9600 bps |
| Data bit length | 8 bits | 8 bits |
| Start bit | 1 bit | 1 bit |
| Stop bits | 1 bit, 2 bits | 1 bit |
| Parity | None, Even, Odd | Even |
| RS/CS flow control ^{*2} | OFF | OFF |

*1 This can only be set for the KV-NC20L (Port2).

*2 This is only displayed for the KV-N11L.

This section gives lists of the devices (CR and CM) that are related to Modbus master mode.

| | | | |
|----|------------|---|--|
| CR | 2 channels | Port0 (built-in serial): Port1 (extension cassette (left)/extension adapter (upper)): Port2 (extension cassette (right)/extension adapter (lower)): | CR6000 to CR6115 CR6600 to CR6715 CR7200 to CR7315 |
| CM | 600 words | Port0 (built-in serial): Port1 (extension cassette (left)/extension adapter (upper)): Port2 (extension cassette (right)/extension adapter (upper)): | CM5000 to CM5599 CM6000 to CM6599 CM7000 to CM7599 |

Control Relay (CR)

| CR Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|------------------|------------------|---------------------------------------|--|--|----------|
| Port0 (Built-In) | Port1 (Left) | Port2 (Right) | | | | |
| CR6000 | CR6600 | CR7200 | - | - | Reserved for the system. | - |
| CR6001 | CR6601 | CR7201 | Command send request | R/W | OFF to ON: The command is generated from the data stored in the target device and is sent. ON to OFF: The communication sequence is completed. This can also be interrupted. | 9-18 |
| CR6002 | CR6602 | CR7202 | - | - | Reserved for the system. | - |
| CR6003 | CR6603 | CR7203 | | | | |
| CR6004 | CR6604 | CR7204 | Communication setting change request | R/W | OFF to ON: A request is made to change the timeout between characters, master station timeout, or send delay time setting. | 9-21 |
| CR6005 to CR6015 | CR6605 to CR6615 | CR7203 to CR7215 | - | - | Reserved for the system. | - |
| CR6100 | CR6700 | CR7300 | - | - | Reserved for the system. | - |
| CR6101 | CR6701 | CR7301 | Execution complete | R | ON: The communication sequence has been completed.* This is also turned ON when an error occurs. OFF: This relay is turned OFF when the command send request relay changes from ON to OFF. | 9-18 |
| CR6102 | CR6702 | CR7302 | Execution failure | R | ON: The communication sequence failed. OFF: This relay is turned OFF when the command send request relay changes from ON to OFF. | 9-19 |
| CR6103 | CR6703 | CR7303 | Execution in progress | R | ON: The communication sequence is being executed. | 9-18 |
| CR6104 | CR6704 | CR7304 | Communication setting change complete | R | ON: The communication setting change has been completed. OFF: This relay is turned OFF when the communication setting change request relay changes from ON to OFF. | 9-21 |
| CR6105 to CR6107 | CR6705 to CR6707 | CR7305 to CR7307 | - | - | Reserved for the system. | - |

| CR Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|------------------|------------------|-----------|--|--|-------------|
| Port0 (Built-In) | Port1 (Left) | Port2 (Right) | | | | |
| CR6108 | CR6708 | CR7308 | ER status | | This relay is used for the data terminal ready signal.*1 | - |
| CR6109 | CR6709 | CR7309 | - | - | Reserved for the system. | - |
| CR6110 | CR6710 | CR7310 | DR status | | This relay is used for the data set ready signal.*1 | - |
| CR6111 | CR6711 | CR7311 | RS status | | This relay is used for the sending request signal.*1 | - |
| CR6112 | CR6712 | CR7312 | CS status | | This relay is used for the send enable signal.*1 | - |
| CR6113 to CR6115 | CR6713 to CR6715 | CR7313 to CR7315 | - | - | Reserved for the system. | - |

*1 This can only be used with the KV-N10L, KV-NC10L and KV-NC20L (Port1). The corresponding device of Port0 is reserved for the system.

Control Memory (CM)

| CM Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|-----------------|------------------|----------------------|--|---|-------------|
| Port0 (Built-In) | Port1 (Left) | Port2 (Right) | | | | |
| CM5000 | CM6000 | CM7000 | - | - | Reserved for the system. | - |
| CM5001 | CM6001 | CM7001 | Slave station number | R/W | This stores the number of the station to send to. Range: 0 to 247 (0 is used for broadcasting). | 9-21 |
| CM5002 | CM6002 | CM7002 | Function code | R/W | 01H: Read Coils 02H: Read Discrete Inputs 03H: Read Holding Registers 04H: Read Input Registers 05H: Write Single Coil 06H: Write Single Register 08H: Diagnostics (subfunction code required) 0BH: Get Comm Event Counter 0FH: Write Multiple Coils 10H: Write Multiple Registers 11H: Report Slave ID 16H: Mask Write Register 17H: Read/Write Multiple Registers FFFFH: Publish user-defined command Any values other than the above values are invalid. | 9-13 |

9-3 Lists of Devices Used

| CM Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|------------------|------------------|----------------------------|--|---|-------------|
| Port0 (Built-In) | Port1 (Left) | Port2 (Right) | | | | |
| CM5003 | CM6003 | CM7003 | Subfunction code | R/W | This stores the subfunction code only when the function code is 08H. 0000H: Return Query Data. 000AH: Clear Counters and Diagnostic Register. Any values other than the above values are invalid. | 9-13 |
| CM5004 | CM6004 | CM7004 | - | - | Reserved for the system. | - |
| CM5005 | CM6005 | CM7005 | - | - | Reserved for the system. | - |
| CM5006 | CM6006 | CM7006 | Data storage unit | R/W | Specify the data storage unit. 0000H: Byte units. 0001H: Word units (data is stored in the lower bytes of the words). | 9-17 |
| CM5007 | CM6007 | CM7007 | Leading read address | R/W | This stores the address of the Modbus device whose data will be read or of the leading device of this Modbus device. Range: 0 to 65535. | 9-13 |
| CM5008 | CM6008 | CM7008 | Number of devices to read | R/W | This varies depending on the function. When the function code is FFFFH, this stores the command size excluding the station number and the CRC. | 9-13 |
| CM5009 | CM6009 | CM7009 | Leading write address | R/W | This stores the address of the Modbus device whose data will be written or of the leading device of this Modbus device. Range: 0 to 65535. | 9-13 |
| CM5010 | CM6010 | CM7010 | Number of devices to write | R/W | This varies depending on the function. When the function code is FFFFH, this stores the command size excluding the station number and the CRC. | 9-13 |
| CM5011 | CM6011 | CM7011 | Write data 1 | R/W | When the function code is a value other than FFFFH, the maximum number of bytes is 246. → If the data storage unit is byte units, maximum of 123 words. → If the data storage unit is word units, maximum of 246 words. | 9-13 |
| : | : | : | : | | When the function code is FFFFH, this stores the command data excluding the station number and the CRC (maximum of 253 bytes). | |
| CM5263 | CM6263 | CM7263 | Write data 253 | | | |
| CM5264 to CM5299 | CM6264 to CM6299 | CM7264 to CM7299 | - | - | Reserved for the system. | - |
| CM5300 | CM6300 | CM7300 | Error code | R | This stores the error code. | 9-54 |
| CM5301 to CM5309 | CM6301 to CM6309 | CM7301 to CM7309 | - | - | Reserved for the system. | - |
| CM5310 | CM6310 | CM7310 | Number of bytes to read | R | This stores the number of bytes to read. | 9-13 |

| CM Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|------------------|------------------|-------------------|--|---|-------------|
| Port0 (Built-In) | Port1 (Left) | Port2 (Right) | | | | |
| CM5311 | CM6311 | CM7311 | Read data 1 | R | When the function code is a value other than FFFFH, the maximum number of bytes is 250. →If the data storage unit is byte units, the maximum is 125 words. →If the data storage unit is word units, the maximum is 250 words. | 9-13 |
| : | : | : | : | | When the function code is FFFFH, this stores the response data excluding the station number and the CRC (maximum of 253 bytes). | |
| CM5563 | CM6563 | CM7563 | Read data 253 | | | |
| CM5564 to CM5569 | CM6564 to CM6569 | CM7564 to CM7569 | - | - | Reserved for the system. | - |
| CM5570 | CM6570 | CM7570 | Reception timeout | R/W | This stores the time to wait for a response from a slave station after sending a command. Device range: 10 to 2000 [$\times 10$ ms] (setting range: 100 to 20000 ms). <ul style="list-style-type: none">• If this is set to 0: 2000 ms. Default value• If this is set to a value between 1 and 9: 100 ms.• If this is set to 2001 or higher: 20000 ms. | 9-20 |
| CM5571 | CM6571 | CM7571 | Send wait | R/W | This is the delay between the command send request relay changing from OFF to ON and data being output on the communication line. Device range: 1 to 1000 [$\times 10$ ms] (setting range: 10 to 10000 ms). <ul style="list-style-type: none">• If this is set to 0: 0 ms. Default value• If this is set to 1001 or higher: 10000 ms. | 9-20 |
| CM5572 | CM6572 | CM7572 | Number of retries | R/W | This is the number of times to retry sending a command when an error occurs during the communication sequence. If the command has been sent the specified number of times and an error still occurs, the execution failure relay turns ON. Range: 1 to 10 (number of times). <ul style="list-style-type: none">• If this is set to 0: 0 times. Default value• If this is set to 11 or higher: 10 times. | 9-21 |

9-3 Lists of Devices Used

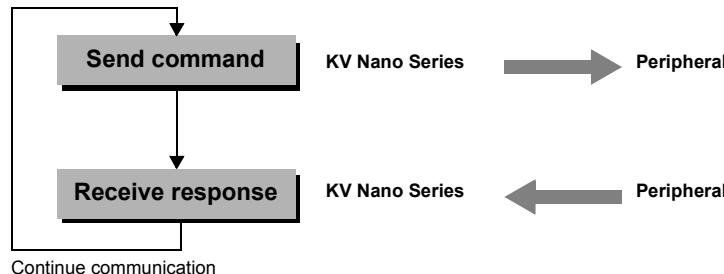
| CM Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|------------------|------------------|-------------------------------|--|---|-------------|
| Port0 (Built-In) | Port1 (Left) | Port2 (Right) | | | | |
| CM5573 | CM6573 | CM7573 | Retry wait | R/W | <p>This is the delay between a retry becoming necessary and data being output on the communication line.</p> <p>Device range: 1 to 1000 [$\times 10$ ms] (setting range: 10 to 10000 ms).</p> <ul style="list-style-type: none"> If this is set to 0: 300 ms. Default value If this is set to 1001 or higher: 10000 ms. | 9-21 |
| CM5574 | CM6574 | CM7574 | Broadcast delay time | R/W | <p>This stores the delay between a broadcast command (station number 0 + write command) being sent and the sending complete relay turning ON.</p> <p>Device range: 1 to 1000 [$\times 10$ ms] (setting range: 10 to 10000 ms).</p> <ul style="list-style-type: none"> If this is set to 0: 300 ms. Default value If this is set to 1001 or higher: 10000 ms. | 9-21 |
| CM5575 to CM5579 | CM6575 to CM6579 | CM7575 to CM7579 | - | - | Reserved for the system. | - |
| CM5580 | CM6580 | CM7580 | Reception timeout (in use) | R | This stores the reception timeout time during operation. | 9-21 |
| CM5581 | CM6581 | CM7581 | Send wait (in use) | R | This stores the send wait during operation. | 9-21 |
| CM5582 | CM6582 | CM7582 | Number of retries (in use) | R | This stores the number of retries during operation. | 9-21 |
| CM5583 | CM6583 | CM7583 | Retry wait (in use) | R | This stores the retry wait during operation. | 9-21 |
| CM5584 | CM6584 | CM7584 | Broadcast delay time (in use) | R | This stores the broadcast delay time during operation. | 9-21 |
| CM5585 to CM5599 | CM6585 to CM6599 | CM7585 to CM7599 | - | - | Reserved for the system. | - |

This section describes the communication procedure, format of commands and responses, and error codes when communicating with peripherals in Modbus master mode.

Communication Procedure

In Modbus master mode, the KV Nano Series operates as the master station.

The master station sends commands to slave stations, such as temperature regulators and inverters that support the Modbus protocol, and then receives responses from the slave stations. In this manner, you can read data from and write settings to peripherals such as temperature regulators and inverters.



Formats of Commands and Responses

The formats of the commands and responses used in Modbus master mode are shown below.

■ Basic format (when the function code is a value other than 08H)

| Slave Station Number | Function Code | Data | CRC Check |
|----------------------|---------------|----------------|-----------|
| 1 byte | 1 byte | 0 to 252 bytes | 2 bytes |

- * No header and delimiters are used.
- * The maximum length of commands and responses is 256 bytes.

● Slave station number

This is the number of the slave station that the master station specifies as the receiver.

- 0 : Specify this value when you want to send a command to all slave stations (for broadcasting).
Responses will not be sent from any slave station.
For details on the functions that can be broadcast, see "List of Functions" (page 9-13).
- 1 to 247 : When you send a command, specify the number of the slave station that you want to send the command to.
A response is only returned when this parameter is the same as the set station number. In this case, the same station number as the station that sent the command is specified in the response.

● Function code

This is the number of the function that the master station requests of the slave station.

"List of Functions" (page 9-13)

When the slave station returns its response, the completion status is included as shown below.

- Normal completion: The function code requested by the master station is returned as-is.
- Abnormal completion: The function code requested by the master station is returned with its uppermost bit turned ON (80H + function code).
Example) Function code 16H: 96H

9-4 Communication Procedure

● Data

When the master station sends a command, this stores the data, such as the address of the device and the number of devices to read from or write to, that is required to execute the processing that is requested.

When a slave station returns a response, this stores the data of the execution result that corresponds to the requested processing.

 "List of Functions" (page 9-13)

● CRC check

This stores the CRC value for performing a CRC check on "station number + function code + data range"

for both commands and responses.

The KV Nano Series appends the CRC value to commands automatically.

If the CRC value contained within a response is judged by the KV Nano Series to be incorrect, the response is discarded.

■ Format when a subfunction is used (when the function code is 08H)

| Slave Station Number | Function Code | Subfunction Code | Data | CRC Check |
|----------------------|---------------|------------------|----------------|-----------|
| 1 byte | 1 byte | 2 bytes | 0 to 250 bytes | 2 bytes |

- * No header and delimiters are used.
- * The maximum length of commands and responses is 256 bytes.

● Subfunction code

This is only used when the function code is "08H." This indicates the subfunction code as-is for commands and responses.

■ Sending order of byte units (endián)

When word data is sent in byte units, the upper byte is sent first.

However, the exception is the CRC value, of which the lower byte is sent first.

Example)

| Slave Station Number (H) | Function Code (H) | Device Number: 123H | | Value to Write: ABCDH | | CRC: 59C7H | |
|--------------------------|-------------------|------------------------|----|--------------------------|----|------------|----|
| 01 | 06 | 01 | 23 | AB | CD | C7 | 59 |

Upper Lower Upper Lower Lower Upper

9-5 Lists of Functions and Modbus Devices

This section describes the functions that you can use in Modbus master mode.

List of Functions

| Function Code (HEX) | Sub-function Code (HEX) | Function | Processing Details | Number of Devices That Can Be Handled with One Command | Broad-castable (Station Number 0)* | See Page |
|---------------------|-------------------------|---|--|--|------------------------------------|----------|
| 01 | - | Read Coils | This function reads the coil status. | 1 to 2000 | No | 9-25 |
| 02 | - | Read Discrete Inputs | This function reads the input status. | 1 to 2000 | No | 9-30 |
| 03 | - | Read Holding Registers | This function reads the holding register value. | 1 to 125 | No | 9-31 |
| 04 | - | Read Input Registers | This function reads the input register value. | 1 to 125 | No | 9-41 |
| 05 | - | Write Single Coil | This function turns one coil ON or OFF. | 1 | Yes | 9-26 |
| 06 | - | Write Single Register | This function writes a value to one holding register. | 1 | Yes | 9-33 |
| | 00 | Diagnostics, Return Query Data | This function performs an echoback test with a slave station. | - | No | 9-45 |
| 08 | 0A | Diagnostics, Clear Counters and Diagnostic Register | This function clears the number of times that the slave station has successfully sent data to and received data from the master station. | - | No | 9-47 |
| 0B | - | Get Comm Event Counter | This function reads the number of times that the slave station has successfully sent data to and received data from the master station. | - | No | 9-44 |
| 0F | - | Write Multiple Coils | This function turns the specified number of coils ON or OFF starting at the specified address. | 1 to 1968 | Yes | 9-28 |
| 10 | - | Write Multiple Registers | This function writes values to the specified number of holding registers starting at the specified address. | 1 to 123 | Yes | 9-35 |
| 11 | - | Report Slave ID | This function reads the model code and the mode (RUN or PROG) that is in use. | - | No | 9-42 |
| 16 | - | Mask Write Register | This function performs a bit set for the value of one holding register (you can specify an AND or OR mask). | 1 | Yes | 9-37 |
| 17 | - | Read/Write Multiple Registers | This function reads and writes continuous holding registers in a single communication operation. | Read: 1 to 125 Write: 1 to 121 | No | 9-39 |

* To send function codes other than those listed above, see  "Sending and Receiving User-Defined Commands" (page 9-22).

List of Modbus Devices

You can use four types of devices with Modbus.

| Type | Classification | Attribute R: Read Only R/W: Read/Write | Address Notation in Sent and Received Commands | (Reference) Address Notation of General Modbus Products |
|------------------|----------------|--|--|--|
| Coil | Bit | R/W | 0 to 65535 | 1 to 65536 (000001 to 065536) |
| Input | Bit | R | 0 to 65535 | 1 to 65536 (100001 to 165536) |
| Holding register | Word | R/W | 0 to 65535 | 1 to 65536 (400001 to 465536) |
| Input register | Word | R | 0 to 65535 | 1 to 65536 (300001 to 365536) |

There is a difference in the address (numbers of the Modbus devices) notations for the general cases and for sent and received commands.

In this manual, the address notations for sent and received commands are used.

9-6 Making the Ladder Program

This section describes how to create the ladder programs that are required to communicate in Modbus master mode.

Use KEYENCE Ladder Support Software KV STUDIO to create ladder programs.

Flow of Ladder Programs

To communicate in Modbus master mode, you have to write a program to send and receive data.

Check the flow of programs in the figure below.

As necessary, write programs to perform operations such as checking for communication errors and changing communication settings.

Set the data storage unit
 "Setting the Data Storage Unit" (page 9-17)

Select the function code
 "9-5 Lists of Functions and Modbus Devices" (page 9-13)

Store the data to send
 "9-7 Function Details" (page 9-25)

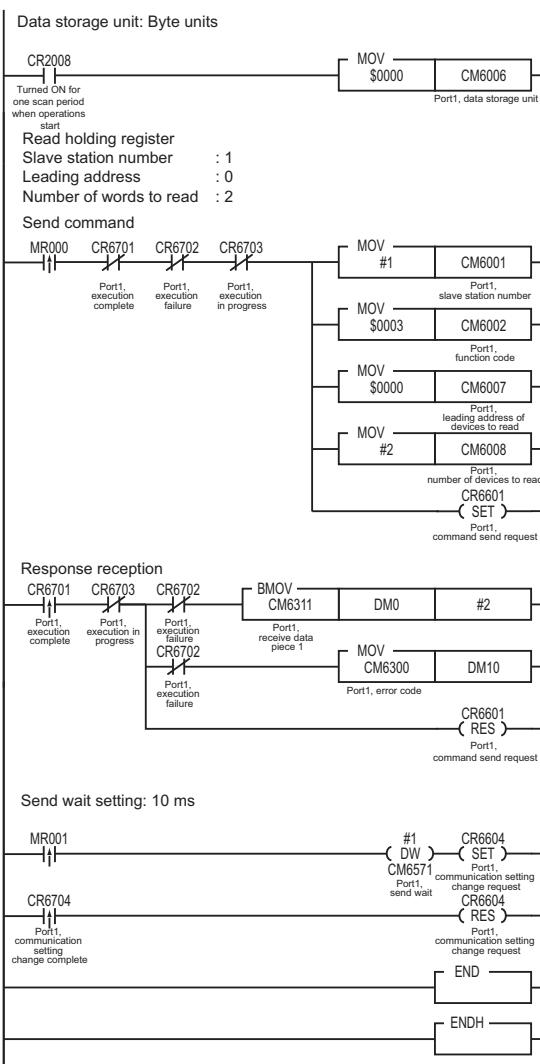
Send and receive commands
 "Sending and Receiving Commands" (page 9-18)

Reference Ladder Program

This ladder program reads two words starting at holding register 0.

Only set the send wait if necessary.

For details on each block, see the referenced page.



See
page

9-17

;<h1>Data storage unit : Byte units
LD CR2008 ; Turned ON for one scan period when operations start
MOV \$0000 CM6006 ; Port1, data storage unit

9-18

;<h1>Read holding register : Slave station number : 1
; Leading address : 0
; Number of words to read : 2

9-31

;Send command
LDP MR000
ANB CR6701 ; Port1, execution complete
ANB CR6702 ; Port1, execution failure
ANB CR6703 ; Port1, execution in progress
MOV #1 CM6001 ; Port1, slave station number
MOV \$0003 CM6002 ; Port1, function code
MOV \$0000 CM6007 ; Port1, leading address of devices to read
MOV #2 CM6008 ; Port1, number of devices to read
SET CR6601 ; Port1, command send request

;Response reception
LDP CR6701 ; Port1, execution complete
ANB CR6703 ; Port1, execution in progress
MPS

ANB CR6702 ; Port1, execution failure
BMOV CM6311 DM0 #2 ; Port1, receive data piece 1
MRD
AND CR6702 ; Port1, execution failure
MOV CM6300 DM10 ; Port1, error code

9-32

MPP
RES CR6601 ; Port1, command send request
;<h1>Send wait setting :10ms
LDP MR001 ; Port1, send wait
CON
SET CR6604 ; Port1, communication setting change request
LDP CR6704 ; Port1, communication setting change complete
RES CR6604 ; Port1, communication setting change request

9-48

You can use this mnemonic list to easily enter the ladder program on the left.

□ "How to Use Mnemonics List" (page 10)

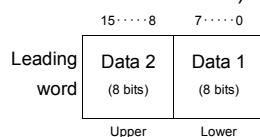
Setting the Data Storage Unit

■ Byte units (CM5006, CM6006, or CM7006 = 0000H)

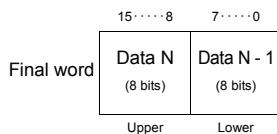
● Bit devices (coils and input)

16 bits of data are stored in each 1 word with the bytes in order starting from the lower byte.

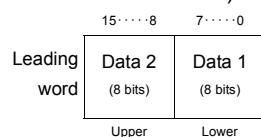
N bytes (where N is an even number)



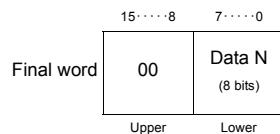
to



N bytes (where N is an odd number)



to

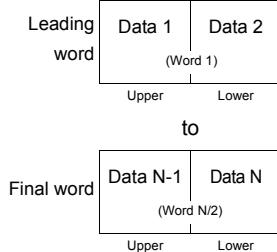


* 00H is stored in the upper byte of the final word.

● Word devices (holding registers and input registers)

Data is stored as-is one word at a time in ascending order.

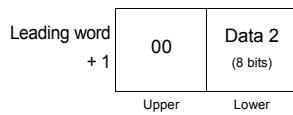
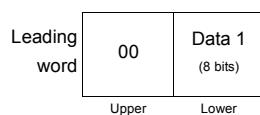
N bytes (N/2 words)



■ Word units (CM5006, CM6006, or CM7006 = 0001H)

● Bit devices (coils and input)

Data is stored in the lower byte of word devices eight bits at a time in ascending order.

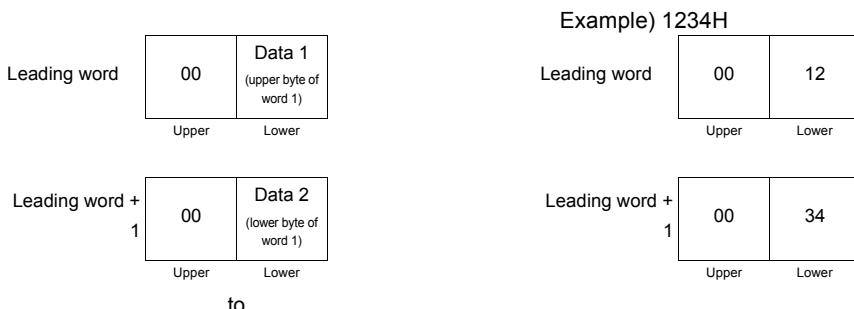


to

* The upper byte of each word is ignored during sending. During receiving, 00H is stored in the upper byte of each word.

● Word devices (holding registers and input registers)

Data is stored in the lower byte of word devices one byte at a time in ascending order.

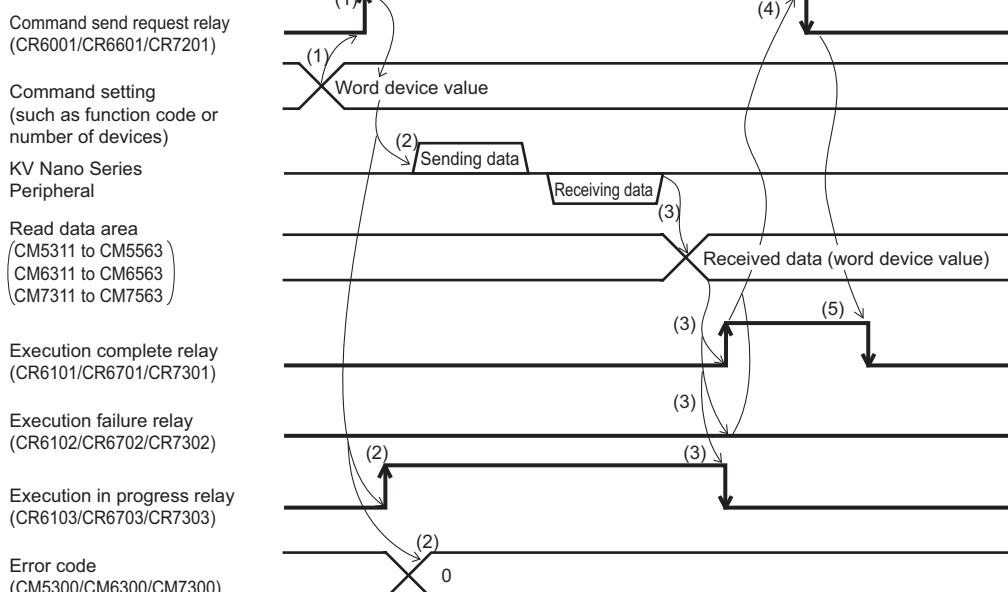


- * The upper byte of each word is ignored during sending. During receiving, 00H is stored in the upper byte of each word.

Sending and Receiving Commands

To send and receive commands, change the command send request relay (CR6001, CR6601, or CR7201) from OFF to ON.

● Normal operation



(1) Ladder program The necessary command settings (such as the function code, leading read or write address, and number of devices) are made, and the command send request relay (CR6001, CR6601, or CR7201) is turned ON.

(2) PLC The execution in progress relay (CR6103, CR6703, or CR7303) is turned ON. The error code (CM5300, CM6300, or CM7300) is cleared to zero, the command setting value is obtained, the command to send is created, and then the command is sent.

- (3) PLC When the response is successfully received from the slave station (peripheral), the value is stored in the read data area (CM5311 to CM5563, CM6311 to CM6563, or CM7311 to CM7563), and then the execution in progress relay (CR6103, CR6703, or CR7303) is turned OFF and the execution complete relay (CR6101, CR6701, or CR7301) is turned ON.
- The execution failure relay (CR6102, CR6702, or CR7302) remains OFF.
- (4) Ladder program The ladder program triggers when the execution complete relay (CR6101, CR6701, or CR7301) changes from OFF to ON and the execution failure relay (CR6102, CR6702, or CR7302) is OFF. The value of the read data area is processed, and then the command send request relay (CR6001, CR6601, or CR7201) is turned OFF.
- (5) PLC The PLC triggers when the command send request relay (CR6001, CR6601, or CR7201) changes from ON to OFF. The execution complete relay (CR6101, CR6701, or CR7301) is turned OFF.

● When an error occurs

Errors may occur with the timing shown below during the communication sequence.

| Type | Error Details and Occurrence Timing |
|--------------------------|--|
| Parameter error | This error occurs during the process for creating the command to be sent, which is performed after the command send request relay changes from OFF to ON and the command settings are obtained. |
| Exception response error | This error occurs when a response containing an exception code is received. |
| Illegal reception error | This error occurs during the process to interpret the data received from a slave station. |
| Communication error | This error occurs when a parity or framing error is present in the response received from a slave station or when the CRC check performed after the response has been completely received fails. |
| Timeout error | This error occurs when response reception does not complete within the reception timeout time. |

When an error occurs, the execution failure relay (CR6102, CR6702, or CR7302) turns ON and the value of the error is stored in the error code (CM5300, CM6300, or CM7300).

When the command send request relay (CR6001, CR6601, or CR7201) is turned OFF, the execution failure relay (CR6102, CR6702, or CR7302) turns OFF.

For details, see  "List of Error Codes" (page 9-54).

● Interrupt sending and receiving

You can forcibly interrupt the communication sequence while it is being executed by turning the command send request relay (CR6001, CR6601, or CR7201) OFF.

Changing Communication Settings

You can change settings such as the reception timeout and send wait time from a ladder program.

■ Changeable communication settings

● Reception timeout (CM5570, CM6570, or CM7570)

This is the time to wait without timing out from the point when the command completes being sent to the point when a response is completely received from a slave station.

Setting range: 100 to 20000 ms

Device range: 10 to 2000 [$\times 10$ ms]

- If this is set to 0: 2000 ms Default value
- If this is set to a value less than 10: 100 ms

● Send wait (CM5571, CM6571, or CM7571)

This is the time to wait from the point when the command send request relay (CR6001, CR6601, or CR7201) changes from OFF to ON to the point when data is actually output on the communication line.

Setting range: 10 to 10000 ms

Device range: 1 to 1000 [$\times 10$ ms]

- If this is set to 0: 0 ms Default value
- If this is set to 1001 or higher: 10000 ms

● Number of retries (CM5572, CM6572, or CM7572)

This is the number of times to retry sending a command when an error occurs during the communication sequence.

If the command has been sent the specified number of times and an error still occurs, the execution failure relay (CR6102, CR6702, or CR7302) turns ON.

Setting range: 1 to 10 (number of times)

- If this is set to 0: 0 times Default value
- If this is set to 11 or higher: 10 times

● Retry wait (CM5573, CM6573, or CM7573)

This is the time to wait between a retry becoming necessary and data being output on the communication line.

Setting range: 10 to 10000 ms

Device range: 1 to 1000 [$\times 10$ ms]

- If this is set to 0: 300 ms Default value
- If this is set to 1001 or higher: 10000 ms

● Broadcast delay time (CM5574, CM6574, or CM7574)

This is the delay between a broadcast command (station number 0) being sent and the execution complete relay (CR6101, CR6701, or CR7301) turning ON.

Setting range: 10 to 10000 ms

Device range: 1 to 1000 [$\times 10$ ms]

- If this is set to 0: 300 ms Default value
- If this is set to 1001 or higher: 10000 ms

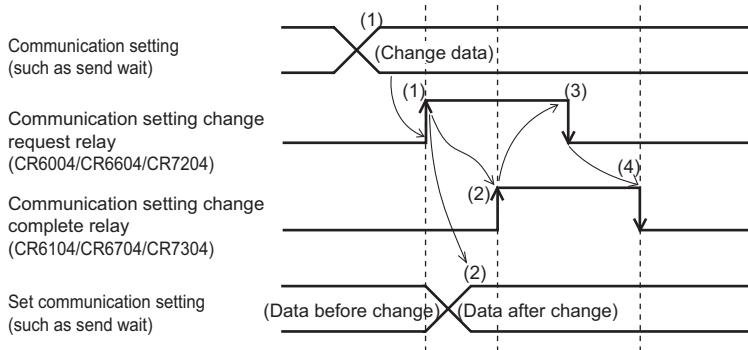
■ Timing of communication setting changes

When the communication setting change request relay (CR6004, CR6604, or CR7204) relay changes from OFF to ON, the KV Nano Series reads the value specified by the reception timeout (CM5570, CM6570, or CM7570), send wait (CM5571, CM6571, or CM7571), number of retries (CM5572, CM6572, or CM7572), retry wait (CM5573, CM6573, or CM7573), and broadcast delay time (CM5574, CM6574, or CM7574), and then changes the settings.



If the communication setting change request relay (CR6004, CR6604, or CR7204) is turned ON while the execution in progress relay (CR6103, CR6703, or CR7303) is ON, communication settings will not be changed until the execution in progress relay (CR6103, CR6703, or CR7303) is turned OFF.

■ Communication setting change method

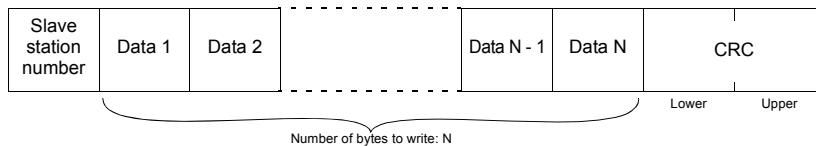


- (1) Ladder program Values are stored in the reception timeout (CM5570, CM6570, or CM7570), send wait (CM5571, CM6571, or CM7571), number of retries (CM5572, CM6572, or CM7572), retry wait (CM5573, CM6573, or CM7573), and broadcast delay time (CM5574, CM6574, or CM7574), and then the communication setting change request relay (CR6004, CR6604, or CR7204) is turned ON.
- (2) PLC The obtained values are applied as parameters, the values are stored in the set reception timeout (CM5570, CM6570, or CM7570), send wait (CM5571, CM6571, or CM7571), number of retries (CM5572, CM6572, or CM7572), retry wait (CM5573, CM6573, or CM7573), and broadcast delay time (CM5574, CM6574, or CM7574), and then the communication setting change complete relay (CR6104, CR6704, or CR7304) is turned ON.
 - * If the stored value is outside of the setting's range, the value will not be applied.
 - If an attempt to change communication settings while there are already set communication settings fails, operations will continue with the set communication settings.
- (3) Ladder program The communication setting change request relay (CR6004, CR6604, or CR7204) is turned OFF.
- (4) PLC The communication setting change complete relay (CR6104, CR6704, or CR7304) is turned OFF.

Sending and Receiving User-Defined Commands

You can send and receive commands for functions other than those that can be used with the KV Nano Series.

■ Master station (KV Nano Series) command



| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|--------------------------|--|--|------------------------------|-----------------------|-----------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 0 to 247 | CM5001 | CM6001 | CM7001 |
| Write data | N (corresponding to the number of bytes to write) | 00H to FFH | CM5011 ⋮ CM5256 | CM6011 ⋮ CM6256 | CM7011 ⋮ CM7256 |
| CRC | 2 | 0000H to FFFFH (appended automatically) | ⋮ ^{*3} | ⋮ ^{*3} | ⋮ ^{*3} |
| Function code | - | FFFFH | CM5002 | CM6002 | CM7002 |
| Number of bytes to read | - | 1 to 253 (bytes) | CM5008 ^{*4} | CM6008 ^{*4} | CM7008 ^{*4} |
| Number of bytes to write | - | 1 to 253 (bytes) | CM5010 | CM6010 | CM7010 |

*1 The value is stored in the target PLC device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

*2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

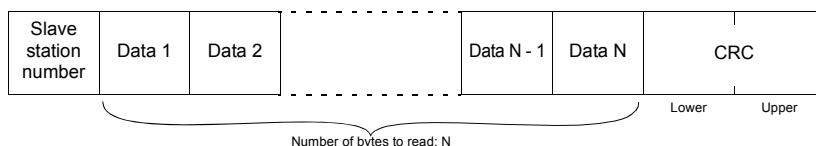
"Setting the Data Storage Unit" (page 9-17)

*3 This is automatically appended by the KV Nano Series.

*4 Before the command send request relay is turned ON, the response byte length (excluding the slave station number and the CRC) is stored.

■ Slave station (peripheral) response

● Normal operation



| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|-------------------------|---|------------------|------------------------------|-----------------------|-----------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Read data | N (corresponding to the number of bytes to read) | 00H to FFH | CM5311 ⋮ CM5560 | CM6311 ⋮ CM6560 | CM7311 ⋮ CM7560 |
| CRC | 2 | 0000H to FFFFH | - | - | - |
| Number of bytes to read | 1 | 1 to 250 (bytes) | CM5310 | CM6310 | CM7310 |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

- *1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target PLC device.
 - "Sending and Receiving Commands" (page 9-18)
- *2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).
 - "Setting the Data Storage Unit" (page 9-17)

● Abnormal operation

| | | | |
|----------------------|--------------|----------------|-------|
| Slave station number | 80H + data 1 | Exception code | CRC |
| | | Lower | Upper |

- "Responses during Errors" (page 9-48)

For details on situations that do not conform to the above information, such as when a response is not returned, see "9-9 Operation When an Error Occurs and Error Remedies".

■ Communication sequence

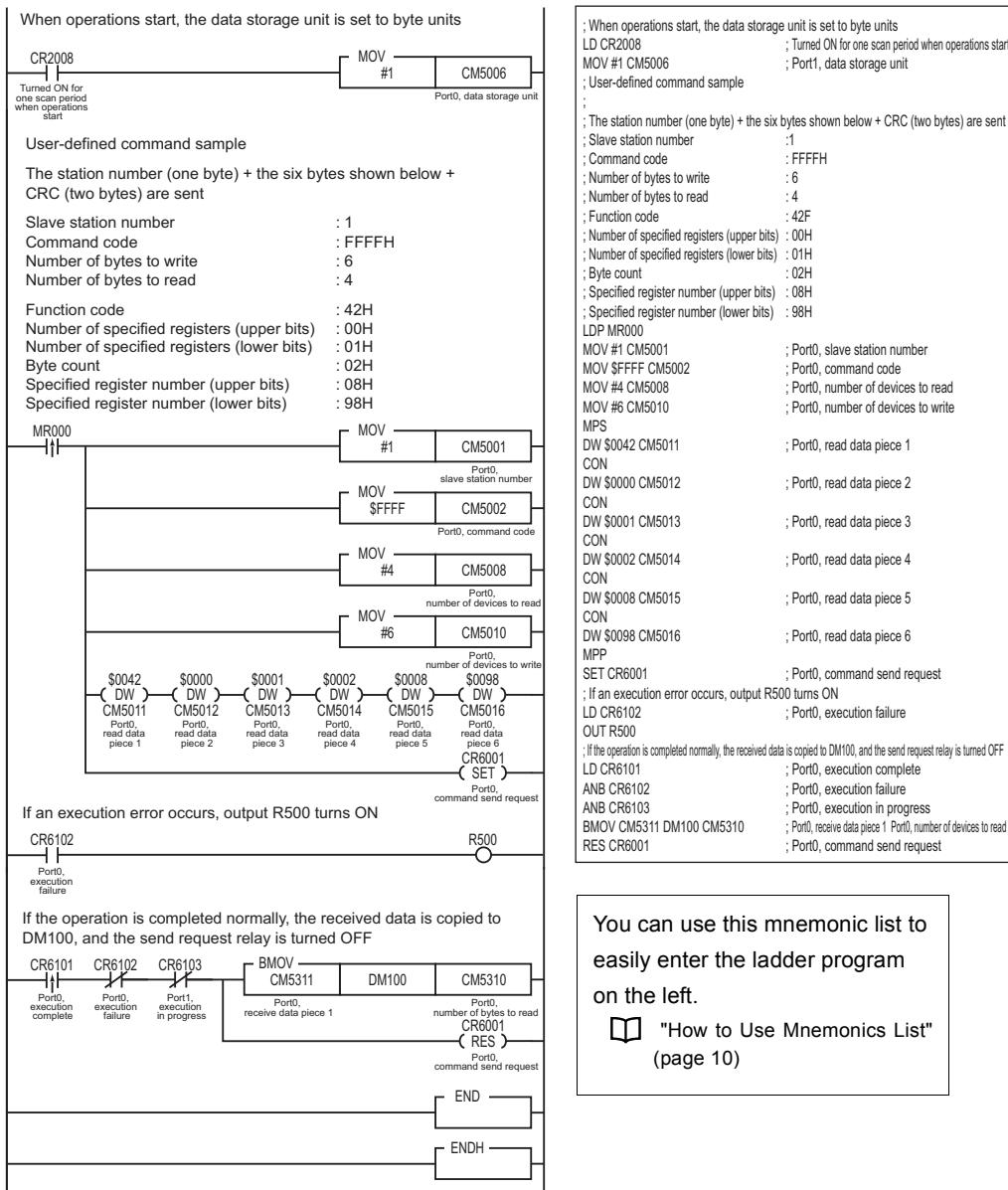
The communication sequence for user-defined commands is the same as that for other commands.

- "9-4 Communication Procedure"

9-6 Making the Ladder Program

■ Reference ladder program

This example ladder program uses Port0 (built-in serial) to send and receive user-defined commands.



You can use this mnemonic list to easily enter the ladder program on the left.

"How to Use Mnemonics List" (page 10)

9-7 Function Details

This section describes the details of the functions that you can use in Modbus master mode.

Coil

Read Coils [01]

This function reads the status (ON or OFF) of one coil or multiple coils.

 " Formats of Commands and Responses" (page 9-11)

■ Master station (KV Nano Series) command

| | | | | |
|----------------------|----|----------------------|---------------------------|-------|
| Slave station number | 01 | Leading read address | Number of devices to read | CRC |
| | | Upper | Lower | Upper |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|---------------------------|--------------|--|------------------------------|-----------------|-----------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | CM5001 | CM6001 | CM7001 |
| Function code | 1 | 01H | CM5002 | CM6002 | CM7002 |
| Leading read address | 2 | 0 to 65535 | CM5007 | CM6007 | CM7007 |
| Number of devices to read | 2 | 1 to 2000 (bits) | CM5008 | CM6008 | CM7008 |
| CRC | 2 | 0000H to FFFFH (appended automatically) | - ^{*2} | - ^{*2} | - ^{*2} |

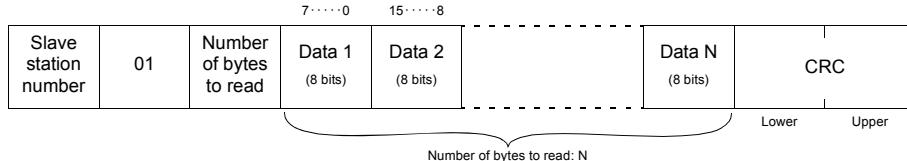
*1 The value is stored in the target storage device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

 " Sending and Receiving Commands" (page 9-18)

*2 This is automatically appended by the KV Nano Series.

■ Slave station (peripheral) response

● Normal operation



| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|-------------------------|---|---|------------------------------|-----------------------|-----------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 01H | - | - | - |
| Number of bytes to read | 1 | 1 to 250 (the quotient of (number of devices to read + 7)/8) | CM5310 | CM6310 | CM7310 |
| Read data | N (corresponding to the number of bytes to read) | 00H to FFH (The ON (1)/OFF (0) information of eight bits is returned as one byte of data.) | CM5311 ⋮ CM5560 | CM6311 ⋮ CM6560 | CM7311 ⋮ CM7560 |
| CRC | 2 | 0000 to FFFFH | - | - | - |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

9-7 Function Details

- *1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.
□ "Sending and Receiving Commands" (page 9-18)
- *2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).
□ "Setting the Data Storage Unit" (page 9-17)

● Abnormal operation

| | | | |
|----------------------|----|----------------|-------|
| Slave station number | 81 | Exception code | CRC |
| | | Lower | Upper |

- "Responses during Errors" (page 9-48)

For details on situations that do not conform to the above information, such as when a response is not returned, see □ "9-9 Operation When an Error Occurs and Error Remedies".

Write Single Coil [05]

This function writes the status (ON or OFF) of one coil.

- "Formats of Commands and Responses" (page 9-11)

■ Master station (KV Nano Series) command

| | | | | |
|----------------------|----|---------------|------------|-------|
| Slave station number | 05 | Write address | Write data | CRC |
| | | Upper | Lower | Upper |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|----------------------|--------------|--|------------------------------|----------------------|----------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 0 to 247 | CM5001 | CM6001 | CM7001 |
| Function code | 1 | 05H | CM5002 | CM6002 | CM7002 |
| Write address | 2 | 0 to 65535 | CM5009 | CM6009 | CM7009 |
| Write data | 2 | OFF: 0 ON: A value other than 0 ^{*2} | CM5011 ^{*2} | CM6011 ^{*2} | CM7011 ^{*2} |
| CRC | 2 | 0000H to FFFFH (appended automatically) | ^{*3} | ^{*3} | ^{*3} |

- *1 The value is stored in the target storage device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

- "Sending and Receiving Commands" (page 9-18)

- *2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

- "Setting the Data Storage Unit" (page 9-17)

- *3 This is automatically appended by the KV Nano Series.

■ Slave station (peripheral) response

During broadcast sending (station number: 0), responses are not returned.

● Normal operation

The command from the master station is returned as-is.

| | | | | |
|----------------------|----|------------------------|---------------------|--------------|
| Slave station number | 05 | Write address Upper | Write data Upper | CRC Lower |
| | | Lower | | Upper |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|----------------------|--------------|------------------------------------|------------------------------|--------|--------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 05H | - | - | - |
| Write address | 2 | 0 to 65535 | - | - | - |
| Write data | 2 | OFF: 0 ON: A value other than 0 | - | - | - |
| CRC | 2 | 0000 to FFFFH | - | - | - |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

*1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.

 "Sending and Receiving Commands" (page 9-18)

● Abnormal operation

| | | | |
|----------------------|----|-------------------------|--------------|
| Slave station number | 85 | Exception code Lower | CRC Upper |
|----------------------|----|-------------------------|--------------|

 "Responses during Errors" (page 9-48)

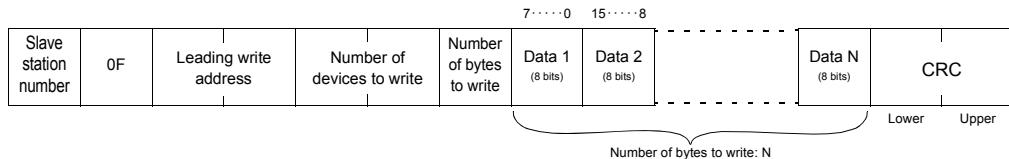
For details on situations that do not conform to the above information, such as when a response is not returned, see  "9-9 Operation When an Error Occurs and Error Remedies".

Write Multiple Coils [0F]

This function writes the status (ON or OFF) of multiple coils.

 " Formats of Commands and Responses" (page 9-11)

■ Master station (KV Nano Series) command



| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|----------------------------|--|--|------------------------------|-----------------------|-----------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 0 to 247 | CM5001 | CM6001 | CM7001 |
| Function code | 1 | 0FH | CM5002 | CM6002 | CM7002 |
| Leading write address | 2 | 0 to 65535 | CM5009 | CM6009 | CM7009 |
| Number of devices to write | 2 | 1 to 1968 (bits) | CM5010 | CM6010 | CM7010 |
| Number of bytes to write | 1 | 1 to 246 (the quotient of (number of devices to write + 7)/8; appended automatically) | - ^{*2} | - ^{*2} | - ^{*2} |
| Write data | N (corresponding to the number of bytes to write) | 00H to FFH (The ON (1)/OFF (0) information of eight bits is returned one byte at a time.) | CM5011 ⋮ CM5256 | CM6011 ⋮ CM6256 | CM7011 ⋮ CM7256 |
| CRC | 2 | 0000H to FFFFH (appended automatically) | - ^{*2} | - ^{*2} | - ^{*2} |

^{*1} The value is stored in the target storage device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

 " Sending and Receiving Commands" (page 9-18)

^{*2} This is automatically appended by the KV Nano Series.

^{*3} The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

 "Setting the Data Storage Unit" (page 9-17)

■ Slave station (peripheral) response

During broadcast sending (station number: 0), responses are not returned.

● Normal operation

| | | | | |
|----------------------|----------------|-----------------------|----------------------------|-----|
| Slave station number | 0F | Leading write address | Number of devices to write | CRC |
| | Upper Lower | Upper Lower | Lower Upper | |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|----------------------------|--------------|----------------|------------------------------|--------|--------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 0FH | - | - | - |
| Leading write address | 2 | 0 to 65535 | - | - | - |
| Number of devices to write | 2 | 1 to 1968 | - | - | - |
| CRC | 2 | 0000H to FFFFH | - | - | - |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

*1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.

 "Sending and Receiving Commands" (page 9-18)

● Abnormal operation

| | | | |
|----------------------|-------|----------------|-----|
| Slave station number | 8F | Exception code | CRC |
| | Lower | Upper | |

 "Responses during Errors" (page 9-48)

For details on situations that do not conform to the above information, such as when a response is not returned, see  "9-9 Operation When an Error Occurs and Error Remedies".

Input

Read Discrete Inputs [02]

This function reads the status (ON or OFF) of one input or multiple inputs.

" Formats of Commands and Responses" (page 9-11)

■ Master station (KV Nano Series) command

| | | | | |
|----------------------|----|----------------------|---------------------------|------------------|
| Slave station number | 02 | Leading read address | Number of devices to read | CRC |
| | | Upper Lower | Upper Lower | Lower Upper |

| Item | Size (Bytes) | Data Range | Storage Device *1 | | |
|---------------------------|--------------|--|-------------------|--------|--------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | CM5001 | CM6001 | CM7001 |
| Function code | 1 | 02H | CM5002 | CM6002 | CM7002 |
| Leading read address | 2 | 0 to 65535 | CM5007 | CM6007 | CM7007 |
| Number of devices to read | 2 | 1 to 2000 (bits) | CM5008 | CM6008 | CM7008 |
| CRC | 2 | 0000H to FFFFH (appended automatically) | -*2 | -*2 | -*2 |

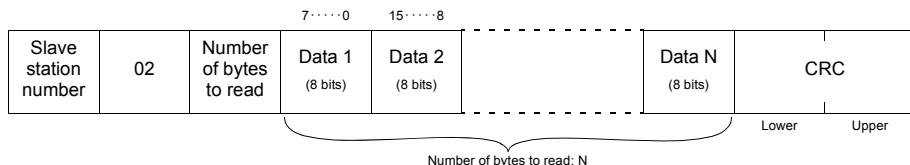
*1 The value is stored in the target storage device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

" Sending and Receiving Commands" (page 9-18)

*2 This is automatically appended by the KV Nano Series.

■ Slave station (peripheral) response

● Normal operation



| Item | Size (Bytes) | Data Range | Storage Device *1 | | |
|-------------------------|---|---|-----------------------|-----------------------|-----------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 02H | - | - | - |
| Number of bytes to read | 1 | 1 to 250 (the quotient of (number of devices to read + 7)/8) | CM5310 | CM6310 | CM7310 |
| Read data | N (corresponding to the number of bytes to read) | 00H to FFH (The ON (1)/OFF (0) information of eight bits is returned as one byte of data.) | CM5311 ⋮ CM5560 | CM6311 ⋮ CM6560 | CM7311 ⋮ CM7560 |
| CRC | 2 | 0000H to FFFFH | - | - | - |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

- *1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.
 - "Sending and Receiving Commands" (page 9-18)
- *2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).
 - "Setting the Data Storage Unit" (page 9-17)

● Abnormal operation

| | | | |
|----------------------|----|----------------|-------|
| Slave station number | 82 | Exception code | CRC |
| | | Lower | Upper |

- "Responses during Errors" (page 9-48)

For details on situations that do not conform to the above information, such as when a response is not returned, see □ "9-9 Operation When an Error Occurs and Error Remedies".

Holding Registers

Read Holding Registers [03]

This function reads the value of one holding register or the values of multiple holding registers.

- "Formats of Commands and Responses" (page 9-11)

■ Master station (KV Nano Series) command

| | | | | |
|----------------------|----|----------------------|---------------------------|-------|
| Slave station number | 03 | Leading read address | Number of devices to read | CRC |
| | | Upper | Lower | Upper |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|---------------------------|--------------|--|------------------------------|-----------------|-----------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | CM5001 | CM6001 | CM7001 |
| Function code | 1 | 03H | CM5002 | CM6002 | CM7002 |
| Leading read address | 2 | 0 to 65535 | CM5007 | CM6007 | CM7007 |
| Number of devices to read | 2 | 1 to 125 (words) | CM5008 | CM6008 | CM7008 |
| CRC | 2 | 0000H to FFFFH (appended automatically) | - ^{*2} | - ^{*2} | - ^{*2} |

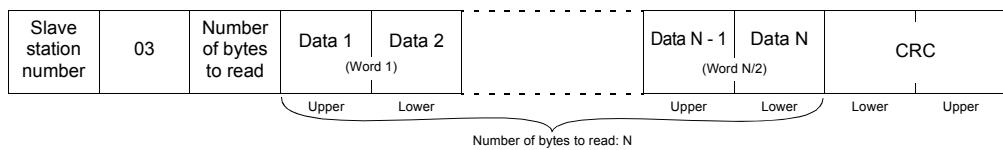
- *1 The value is stored in the target storage device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

- "Sending and Receiving Commands" (page 9-18)

- *2 This is automatically appended by the KV Nano Series.

■ Slave station (peripheral) response

● Normal operation



| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|-------------------------|---|---|------------------------------|-----------------------|-----------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 03H | - | - | - |
| Number of bytes to read | 1 | 2 to 250 (number of devices to read × 2) | CM5310 | CM6310 | CM7310 |
| Read data | N (corresponding to the number of bytes to read) | 00H to FFH | CM5311 ⋮ CM5560 | CM6311 ⋮ CM6560 | CM7311 ⋮ CM7560 |
| CRC | 2 | 0000H to FFFFH | - | - | - |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

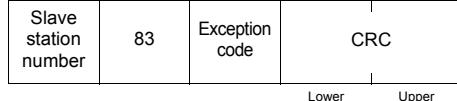
*1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.

□ "Sending and Receiving Commands" (page 9-18)

*2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

□ "Setting the Data Storage Unit" (page 9-17)

● Abnormal operation



□ "Responses during Errors" (page 9-48)

For details on situations that do not conform to the above information, such as when a response is not returned, see □ "9-9 Operation When an Error Occurs and Error Remedies".

Write Single Register [06]

This function writes a value to one holding register.

 "Formats of Commands and Responses" (page 9-11)

■ Master station (KV Nano Series) command

| | | | | |
|----------------------|----|-----------------------|------------------|------------------|
| Slave station number | 06 | Leading write address | Write data | CRC |
| | | Upper Lower | Upper Lower | Lower Upper |

| Item | Size (Bytes) | Data Range | Storage Device *1 | | |
|-----------------------|-----------------|--|----------------------------|----------------------------|----------------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 0 to 247 | CM5001 | CM6001 | CM7001 |
| Function code | 1 | 06H | CM5002 | CM6002 | CM7002 |
| Leading write address | 2 | 0 to 65535 | CM5009 | CM6009 | CM7009 |
| Write data | 2 | 0 to 65535 | CM5011 (, CM5012) *2 | CM6011 (, CM6012) *2 | CM7011 (, CM7012) *2 |
| CRC | 2 | 0000H to FFFFH (appended automatically) | - ³ | - ³ | - ³ |

- *1 The value is stored in the target storage device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

 "Sending and Receiving Commands" (page 9-18)

- *2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

 "Setting the Data Storage Unit" (page 9-17)

- *3 This is automatically appended by the KV Nano Series.

■ Slave station (peripheral) response

During broadcast sending (station number: 0), responses are not returned.

● Normal operation

The command from the master station is returned as-is.

| | | | | |
|----------------------|----------------|-----------------------|----------------|-----|
| Slave station number | 06 | Leading write address | Write data | CRC |
| | Upper Lower | Upper Lower | Lower Upper | |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|-----------------------|--------------|----------------|------------------------------|--------|--------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 06H | - | - | - |
| Leading write address | 2 | 0 to 65535 | - | - | - |
| Write data | 2 | 0 to 65535 | - | - | - |
| CRC | 2 | 0000H to FFFFH | - | - | - |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

*1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.

 "Sending and Receiving Commands" (page 9-18)

● Abnormal operation

| | | | |
|----------------------|-------|----------------|-----|
| Slave station number | 86 | Exception code | CRC |
| | Lower | Upper | |

 "Responses during Errors" (page 9-48)

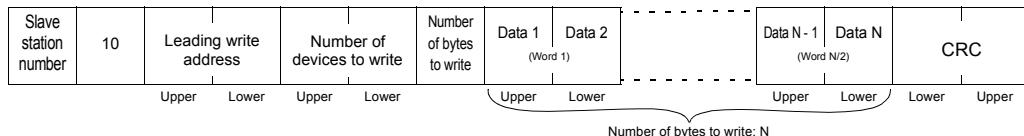
For details on situations that do not conform to the above information, such as when a response is not returned, see  "9-9 Operation When an Error Occurs and Error Remedies".

Write Multiple Registers [10]

This function writes a value to multiple continuous holding registers.

 "Formats of Commands and Responses" (page 9-11)

■ Master station (KV Nano Series) command



| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|----------------------------|--|--|------------------------------|-----------------------|-----------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 0 to 247 | CM5001 | CM6001 | CM7001 |
| Function code | 1 | 10H | CM5002 | CM6002 | CM7002 |
| Leading write address | 2 | 0 to 65535 | CM5009 | CM6009 | CM7009 |
| Number of devices to write | 2 | 1 to 123 (words) | CM5010 | CM6010 | CM7010 |
| Number of bytes to write | 1 | 2 to 246 (number of devices to write × 2; appended automatically) | - ^{*2} | - ^{*2} | - ^{*2} |
| Write data | N (corresponding to the number of bytes to write) | 00H to FFH (The data of one word is sent one byte at a time in the order upper byte, lower byte.) | CM5011 ⋮ CM5256 | CM6011 ⋮ CM6256 | CM7011 ⋮ CM7256 |
| CRC | 2 | 0000H to FFFFH (appended automatically) | - ^{*2} | - ^{*2} | - ^{*2} |

*1 The value is stored in the target storage device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

 "Sending and Receiving Commands" (page 9-18)

*2 This is automatically appended by the KV Nano Series.

*3 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

 "Setting the Data Storage Unit" (page 9-17)

■ Slave station (peripheral) response

During broadcast sending (station number: 0), responses are not returned.

● Normal operation

| | | | | |
|----------------------|-------|-----------------------|----------------------------|-------|
| Slave station number | 10 | Leading write address | Number of devices to write | CRC |
| | Upper | Lower | Upper | Lower |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|----------------------------|--------------|----------------|------------------------------|--------|--------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 10H | - | - | - |
| Leading write address | 2 | 0 to 65535 | - | - | - |
| Number of devices to write | 2 | 1 to 123 | - | - | - |
| CRC | 2 | 0000H to FFFFH | - | - | - |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

*1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.

 "Sending and Receiving Commands" (page 9-18)

● Abnormal operation

| | | | |
|----------------------|-------|----------------|-----|
| Slave station number | 90 | Exception code | CRC |
| | Lower | Upper | |

 "Responses during Errors" (page 9-48)

For details on situations that do not conform to the above information, such as when a response is not returned, see  "9-9 Operation When an Error Occurs and Error Remedies".

Mask Write Register [16]

This function performs a logical AND or logical OR calculation on the value of one holding register. The value that is stored is "(current device value ^ AND mask value) v (OR mask value ^ AND mask value)." *1

 "Formats of Commands and Responses" (page 9-11)

■ Master station (KV Nano Series) command

| | | | | | |
|----------------------|----|-----------------------|------------------|------------------|------------------|
| Slave station number | 16 | Leading write address | AND mask value | OR mask value | CRC |
| | | Upper Lower | Upper Lower | Upper Lower | Lower Upper |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|--|--------------|---|--------------------------------|--------------------------------|--------------------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 0 to 247 | CM5001 | CM6001 | CM7001 |
| Function code | 1 | 16H | CM5002 | CM6002 | CM7002 |
| Leading write address ^{*1, 2} | 2 | 0 to 65535 | CM5009 | CM6009 | CM7009 |
| AND mask value | 2 | 0000H to FFFFH | CM5010 CM5011 (, CM5012) | CM6010 CM6011 (, CM6012) | CM7010 CM7011 (, CM7012) |
| OR mask value | 2 | 0000H to FFFFH | (, CM5013) ^{*2} | (, CM6013) ^{*2} | (, CM7013) ^{*2} |
| CRC | 2 | 0000H to FFFFH (appended automatically) | - ^{*3} | - ^{*3} | - ^{*3} |

*1 The value is stored in the target storage device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

 "Sending and Receiving Commands" (page 9-18)

*2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

 "Setting the Data Storage Unit" (page 9-17)

*3 This is automatically appended by the KV Nano Series.

■ Slave station (peripheral) response

During broadcast sending (station number: 0), responses are not returned.

● Normal operation

The command from the master station is returned as-is.

| | | | | | |
|----------------------|------------------|-----------------------|----------------|------------------|------------------|
| Slave station number | 16 | Leading write address | AND mask value | OR mask value | CRC |
| | Upper Lower | Upper | Lower | Upper Lower | Lower Upper |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|-----------------------|--------------|----------------|------------------------------|--------|--------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 16H | - | - | - |
| Leading write address | 2 | 0 to 65535 | - | - | - |
| AND mask value | 2 | 0000H to FFFFH | - | - | - |
| OR mask value | 2 | 0000H to FFFFH | - | - | - |
| CRC | 2 | 0000H to FFFFH | | | |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

*1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.

 "Sending and Receiving Commands" (page 9-18)

● Abnormal operation

| | | | |
|----------------------|----|------------------|-----|
| Slave station number | 96 | Exception code | CRC |
| | | Lower Upper | |

 "Responses during Errors" (page 9-48)

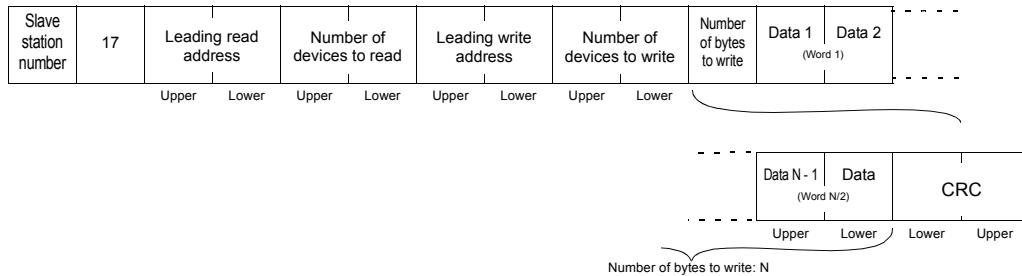
For details on situations that do not conform to the above information, such as when a response is not returned, see  "9-9 Operation When an Error Occurs and Error Remedies".

Read/Write Multiple Registers [17]

This function reads the values of and writes values to multiple holding registers with a single communication operation.

 "Formats of Commands and Responses" (page 9-11)

■ Master station (KV Nano Series) command



| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|----------------------------|--|--|------------------------------|-----------------------|-----------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | CM5001 | CM6001 | CM7001 |
| Function code | 1 | 17H | CM5002 | CM6002 | CM7002 |
| Leading read address | 2 | 0 to 65535 | CM5007 | CM6007 | CM7007 |
| Number of devices to read | 2 | 1 to 125 (words) | CM5008 | CM6008 | CM7008 |
| Leading write address | 2 | 0 to 65535 | CM5009 | CM6009 | CM7009 |
| Number of devices to write | 2 | 1 to 123 (words) | CM5010 | CM6010 | CM7010 |
| Number of bytes to write | 1 | 2 to 242 (number of devices to write × 2; appended automatically) | [*] 2 | [*] 2 | [*] 2 |
| Write data | N (corresponding to the number of bytes to write) | 00H to FFH (The data of one word is sent one byte at a time in the order upper byte, lower byte.) | CM5011 ⋮ CM5256 | CM6011 ⋮ CM6256 | CM7011 ⋮ CM7256 |
| CRC | 2 | 0000H to FFFFH (appended automatically) | [*] 2 | [*] 2 | [*] 2 |

*1 The value is stored in the target storage device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

 "Sending and Receiving Commands" (page 9-18)

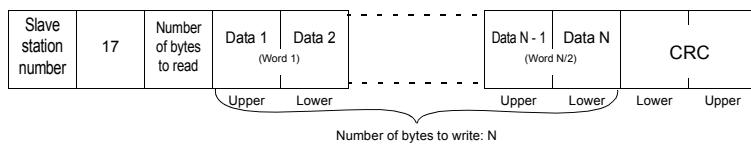
*2 This is automatically appended by the KV Nano Series.

*3 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

 "Setting the Data Storage Unit" (page 9-17)

■ Slave station (peripheral) response

● Normal operation



| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|-------------------------|---|---|------------------------------|-----------------------|-----------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 17H | - | - | - |
| Number of bytes to read | 1 | 2 to 250 (number of devices to read × 2) | CM5310 | CM6310 | CM7310 |
| Read data | N (corresponding to the number of bytes to read) | 00H to FFH | CM5311 ⋮ CM5560 | CM6311 ⋮ CM6560 | CM7311 ⋮ CM7560 |
| CRC | 2 | 0000H to FFFFH | - | - | - |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

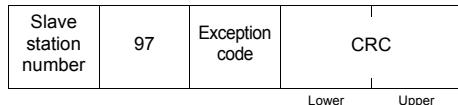
*1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.

"Sending and Receiving Commands" (page 9-18)

*2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

"Setting the Data Storage Unit" (page 9-17)

● Abnormal operation



"Responses during Errors" (page 9-48)

For details on situations that do not conform to the above information, such as when a response is not returned, see "9-9 Operation When an Error Occurs and Error Remedies".

Input Registers

Read Input Register [04]

This function reads the value of one input register or the values of multiple input registers.

 " Formats of Commands and Responses" (page 9-11)

■ Master station (KV Nano Series) command

| | | | | |
|----------------------|----|--|---|-------------------------|
| Slave station number | 04 | Leading read address Upper Lower | Number of devices to read Upper Lower | CRC Lower Upper |
|----------------------|----|--|---|-------------------------|

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|---------------------------|--------------|--|------------------------------|-----------------|-----------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | CM5001 | CM6001 | CM7001 |
| Function code | 1 | 04H | CM5002 | CM6002 | CM7002 |
| Leading read address | 2 | 0 to 65535 | CM5007 | CM6007 | CM7007 |
| Number of devices to read | 2 | 1 to 125 (words) | CM5008 | CM6008 | CM7008 |
| CRC | 2 | 0000H to FFFFH (appended automatically) | - ^{*2} | - ^{*2} | - ^{*2} |

*1 The value is stored in the target storage device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

 " Sending and Receiving Commands" (page 9-18)

*2 This is automatically appended by the KV Nano Series.

■ Slave station (peripheral) response

● Normal operation

| | | | | | | | | |
|----------------------|----|-------------------------|----------------------------|--------------------|-------|--------------------------------|--|--------------|
| Slave station number | 04 | Number of bytes to read | Data 1 Upper Lower | Data 2 (Word 1) | ----- | Data N - 1 Upper Lower | Data N (Word N/2) Upper Lower | CRC Upper |
|----------------------|----|-------------------------|----------------------------|--------------------|-------|--------------------------------|--|--------------|

Number of bytes to read: N

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|-------------------------|---|---|------------------------------|-----------------------|-----------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 04H | - | - | - |
| Number of bytes to read | 1 | 2 to 250 (number of devices to read × 2) | CM5310 | CM6310 | CM7310 |
| Read data | N (corresponding to the number of bytes to read) | 00H to FFH | CM5311 ⋮ CM5560 | CM6311 ⋮ CM6560 | CM7311 ⋮ CM7560 |
| CRC | 2 | 0000H to FFFFH | - | - | - |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

*1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.

 " Sending and Receiving Commands" (page 9-18)

*2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

 " Setting the Data Storage Unit" (page 9-17)

9-7 Function Details

● Abnormal operation

| | | | |
|----------------------|----|----------------|-------|
| Slave station number | 84 | Exception code | CRC |
| | | Lower | Upper |

 "Responses during Errors" (page 9-48)

For details on situations that do not conform to the above information, such as when a response is not returned, see  "9-9 Operation When an Error Occurs and Error Remedies".

Other

Report Slave ID [11]

This function reads the ID information of a slave station.

 "Formats of Commands and Responses" (page 9-11)

■ Master station (KV Nano Series) command

| | | |
|----------------------|-------|-------|
| Slave station number | 11 | CRC |
| | Lower | Upper |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|----------------------|--------------|----------------|------------------------------|-----------------|-----------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | CM5001 | CM6001 | CM7001 |
| Function code | 1 | 11H | CM5002 | CM6002 | CM7002 |
| CRC | 2 | 0000H to FFFFH | - ^{*2} | - ^{*2} | - ^{*2} |

*1 The value is stored in the target storage device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

 "Sending and Receiving Commands" (page 9-18)

*2 This is automatically appended by the KV Nano Series.

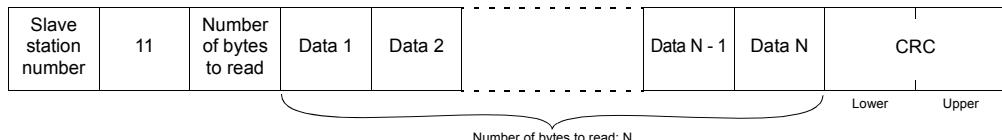
■ Slave station (peripheral) response

The ID information of the slave station is returned. For the details of this information, check the slave station specifications.

If the slave station is a KV Nano Series unit, the PLC model code and operating status are returned.

"Report Slave ID [11]" (page 10-21)

● Normal operation



| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|-------------------------|---|----------------|------------------------------|-----------------------|-----------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 11H | - | - | - |
| Number of bytes to read | 1 | 1 to 251 | CM5310 | CM6310 | CM7310 |
| Read data | N (corresponding to the number of bytes to read) | 00H to FFH | CM5311 ⋮ CM5560 | CM6311 ⋮ CM6560 | CM7311 ⋮ CM7560 |
| CRC | 2 | 0000H to FFFFH | - | - | - |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

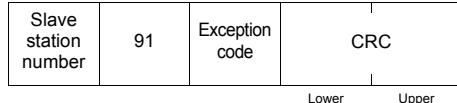
*1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.

"Sending and Receiving Commands" (page 9-18)

*2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

"Setting the Data Storage Unit" (page 9-17)

● Abnormal operation



"Responses during Errors" (page 9-48)

For details on situations that do not conform to the above information, such as when a response is not returned, see "9-9 Operation When an Error Occurs and Error Remedies".

Get Comm Event Counter [0B]

This function reads the value of the communication event counter.

The communication event counter indicates the number of times that the station has successfully processed commands (including broadcast commands) addressed to it. You can use this function to check whether broadcast commands, which do not receive a response, are being executed.

 "Formats of Commands and Responses" (page 9-11)

■ Master station (KV Nano Series) command

| | | |
|----------------------|-------|-------|
| Slave station number | 0B | CRC |
| | Lower | Upper |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|----------------------|--------------|--|------------------------------|-----------------|-----------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | CM5001 | CM6001 | CM7001 |
| Function code | 1 | 0BH | CM5002 | CM6002 | CM7002 |
| CRC | 2 | 0000H to FFFFH (appended automatically) | - ^{*2} | - ^{*2} | - ^{*2} |

*1 The value is stored in the target storage device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

 "Sending and Receiving Commands" (page 9-18)

*2 This is automatically appended by the KV Nano Series.

■ Slave station (peripheral) response

● Normal operation

| | | | | |
|----------------------------|-------|------------------|----------------|-------|
| Slave station number | 0B | Subfunction code | Data | CRC |
| | Upper | Lower | Upper Lower | Upper |
| Number of bytes to read: 2 | | | | |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|-------------------------|--------------|----------------|--------------------------------------|--------------------------------------|--------------------------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 0BH | - | - | - |
| Subfunction code | 2 | 0000H | - | - | - |
| Read data | 2 | 0000H to FFFFH | CM5311 (,CM5312) ^{*2} | CM6311 (,CM6312) ^{*2} | CM7311 (,CM7312) ^{*2} |
| CRC | 2 | 0000H to FFFFH | - | - | - |
| Number of bytes to read | - | 2 | CM5310 | CM6310 | CM7310 |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

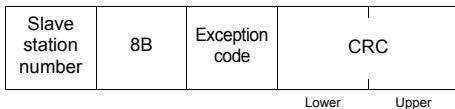
*1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.

 "Sending and Receiving Commands" (page 9-18)

*2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

 "Setting the Data Storage Unit" (page 9-17)

● Abnormal operation



"Responses during Errors" (page 9-48)

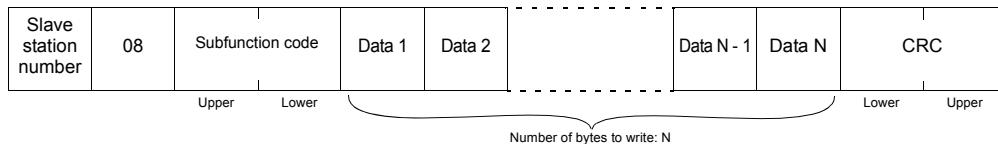
For details on situations that do not conform to the above information, such as when a response is not returned, see "9-9 Operation When an Error Occurs and Error Remedies".

Diagnostics, Return Query Data [08 0000]

This function performs an echoback test with a slave station. The sent command is returned as-is from the slave station.

"Formats of Commands and Responses" (page 9-11)

■ Master station (KV Nano Series) command



| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|-------------------------------|---|--|------------------------------|-----------------------|-----------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | CM5001 | CM6001 | CM7001 |
| Function code | 1 | 08H | CM5002 | CM6002 | CM7002 |
| Subfunction code | 2 | 0000H | CM5003 | CM6003 | CM7003 |
| Write data | N (corresponding to the number of devices to write) | 00H to FFH | CM5011 ⋮ CM5256 | CM6011 ⋮ CM6256 | CM7011 ⋮ CM7256 |
| CRC | 2 | 0000H to FFFFH (appended automatically) | ⋮ ^{*3} | ⋮ ^{*3} | ⋮ ^{*3} |
| Number of devices to write | - | 2 to 246 (bytes) | CM5010 | CM6010 | CM7010 |

*1 The value is stored in the target storage device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

"Sending and Receiving Commands" (page 9-18)

*2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

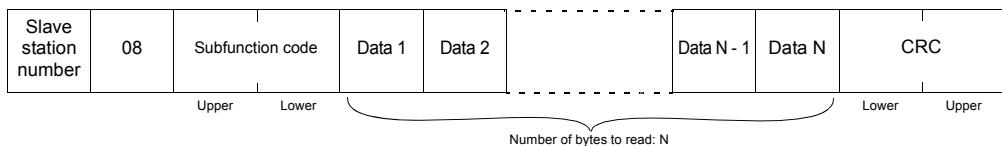
"Setting the Data Storage Unit" (page 9-17)

*3 This is automatically appended by the KV Nano Series.

■ Slave station (peripheral) response

● Normal operation

The command from the master station is returned as-is.



| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|-------------------------|--|----------------|------------------------------|--------------------------|--------------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 08H | - | - | - |
| Subfunction code | 2 | 0000H | - | - | - |
| Read data | N (corresponding to the number of bytes to read) | 00H to FFH | CM5311 ⋮ *2 CM5560 | CM6311 ⋮ *2 CM6560 | CM7311 ⋮ *2 CM7560 |
| CRC | 2 | 0000H to FFFFH | - | - | - |
| Number of bytes to read | - | 2 | CM5310 | CM6310 | CM7310 |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

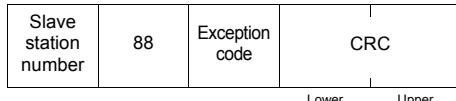
*1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.

"Sending and Receiving Commands" (page 9-18)

*2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

"Setting the Data Storage Unit" (page 9-17)

● Abnormal operation



"Responses during Errors" (page 9-48)

For details on situations that do not conform to the above information, such as when a response is not returned, see "9-9 Operation When an Error Occurs and Error Remedies".

Diagnostics, Clear Counters and Diagnostic Register [08 000A]

This function clears the communication event counter.

"Formats of Commands and Responses" (page 9-11)

■ Master station (KV Nano Series) command

| | | | | |
|----------------------|----|------------------|------------------|------------------|
| Slave station number | 08 | Subfunction code | Data | CRC |
| | | Upper Lower | Upper Lower | Upper Lower |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|----------------------|--------------|----------------|------------------------------|-----------------|-----------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | CM5001 | CM6001 | CM7001 |
| Function code | 1 | 08H | CM5002 | CM6002 | CM7002 |
| Subfunction code | 2 | 000AH | CM5003 | CM6003 | CM7003 |
| Data | 2 | 0000H | - ^{*2} | - ^{*2} | - ^{*2} |
| CRC | 2 | 0000H to FFFFH | - ^{*2} | - ^{*2} | - ^{*2} |

*1 The value is stored in the target storage device, and the command send request relay (CR6001, CR6601, or CR7201) is changed from OFF to ON.

"Sending and Receiving Commands" (page 9-18)

*2 This is automatically appended by the KV Nano Series.

■ Slave station (peripheral) response

● Normal operation

The command from the master station is returned as-is.

| | | | | |
|----------------------------|----|------------------|------------------|------------------|
| Slave station number | 08 | Subfunction code | Data | CRC |
| | | Upper Lower | Upper Lower | Lower Upper |
| Number of bytes to read: 2 | | | | |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|-------------------------|--------------|----------------|--------------------------------------|--------------------------------------|--------------------------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 08H | - | - | - |
| Subfunction code | 2 | 000AH | - | - | - |
| Data | 2 | 0000H | CM5311 (,CM5312) ^{*2} | CM6311 (,CM6312) ^{*2} | CM7311 (,CM7312) ^{*2} |
| CRC | 2 | 0000H to FFFFH | - | - | - |
| Number of bytes to read | - | 2 | CM5310 | CM6310 | CM7310 |
| Error code | - | 0 | CM5300 | CM6300 | CM7300 |

*1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.

"Sending and Receiving Commands" (page 9-18)

*2 The storage method varies according to the data storage unit (CM5006, CM6006, or CM7006).

"Setting the Data Storage Unit" (page 9-17)

● Abnormal operation

| | | | |
|----------------------|----|----------------|------------------|
| Slave station number | 88 | Exception code | CRC |
| | | | Lower Upper |

 "Responses during Errors" (page 9-48)

For details on situations that do not conform to the above information, such as when a response is not returned, see  "9-9 Operation When an Error Occurs and Error Remedies".

Responses during Errors

| | | | |
|----------------------|---------------|----------------|------------------|
| Slave station number | Function code | Exception code | CRC |
| | | | Lower Upper |

| Item | Size (Bytes) | Data Range | Storage Device ^{*1} | | |
|----------------------|--------------|-----------------------------------|------------------------------|----------------------|----------------------|
| | | | Port0 | Port1 | Port2 |
| Slave station number | 1 | 1 to 247 | - | - | - |
| Function code | 1 | 80H + function code ^{*2} | - | - | - |
| Exception code | 1 | 01H to 04H | CM5300 ^{*3} | CM6300 ^{*3} | CM7300 ^{*3} |
| CRC | 2 | 0000H to FFFFH | - | - | - |

*1 When the execution complete relay (CR6101, CR6701, or CR7301) turns ON, the value is stored in the target storage device.

 "Setting the Data Storage Unit" (page 9-17)

*2 For example, for function code "11H," the value is "91H."

*3 The error code, including the response exception code, is stored.

 "List of Error Codes" (page 9-54)

■ Response exception codes

| Exception Code (H) | Cause | Remedy |
|--------------------|--|---|
| 01 | An unsupported command was received from a slave station. | Check the slave station specifications. |
| 02 | An unsupported leading device was specified from a slave station. | Check the slave station specifications. |
| 03 | An unsupported number of devices was specified from a slave station. | Check the slave station specifications. |
| 04 | The slave station is in a state from which it cannot recover. | If you cannot recover the slave unit by restarting its power, contact the manufacturer of the slave unit. |

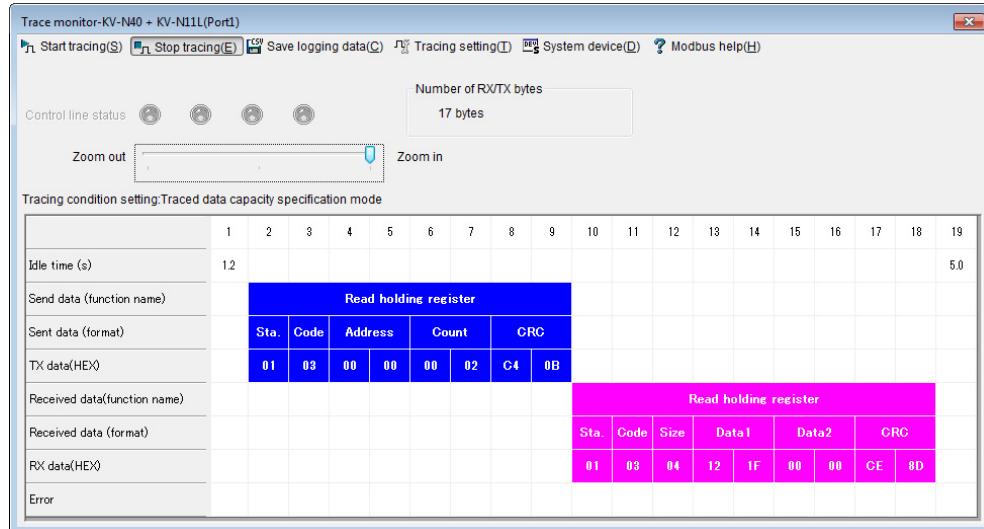
9-8 Modbus Dedicated Trace Monitor

The commands that are being sent and received are displayed on the trace monitor that is used when you check the operation of Modbus master mode, so you can easily check details such as the location where a problem occurs.

Startup Method

In the serial base monitor, click "Start Trace."

□ "Serial Base Monitor" (page 4-3)



| Item | Description |
|-------------------|---|
| Start tracing | (ON): Tracing is being executed. The trace data display is not updated until trace execution is completed. (OFF): Tracing has been stopped. Click this to start tracing and change the button to its ON state. |
| Stop tracing | (ON): Tracing has been stopped. (OFF): Tracing is being executed. Click this to stop tracing and change the button to its ON state. |
| Save logging data | Click this to save the logging data that has been traced (the data to send and the received data) in CSV format. You cannot save the logging data while the trace is being executed. |
| Tracing setting | Click this to set the tracing conditions. You can select from two modes. You cannot configure the settings while the trace is being executed. "Traced data capacity specification mode" Set the data capacity to trace and whether to execute traces cyclically. "Error detection mode" Set as conditions the errors that will cause tracing to stop. □ "Configuring tracing settings" (page 9-51) |

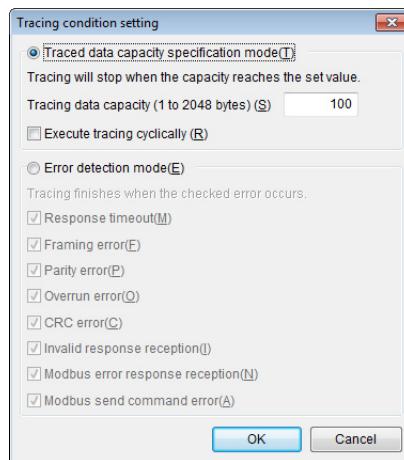
9-8 Modbus Dedicated Trace Monitor

| Item | | Description |
|------------------------------|---|--|
| System device | | Click this to display a list of devices that are related to the mode that you are using. You can also display the list while the trace is being executed. |
| Modbus help | | Click this to display the Modbus function details. |
| Control line status | DR (data set ready signal) CS (send enable signal) | These are signals that are sent from peripherals to the KV Nano Series. Lit in red: High level. Off: Low level. |
| | ER (data terminal ready signal) RS (send request signal) | These are signals that are sent from the KV Nano Series to peripherals. Lit in green: High level. Off: Low level. |
| Trace display adjustment bar | Zoom | A variety of information such as the idle time, the data to send and the received data (in hexadecimal and ASCII), and the verify relay number is all displayed in character format. |
| | Middle | The macro name, the data to send, and the received data (ASCII) are displayed in character format. |
| | Zoom out | No characters are displayed. Use this setting when you want to detect information such as the position that an error occurred. |
| Number of RX/TX bytes | | This displays the number of bytes that have been sent and received since tracing started. This information is updated while the trace is being executed. |
| Tracing condition setting | | This displays the current tracing condition (mode). |
| Idle time(sec) | | This displays the communication standby time (in units of 0.1 seconds). |
| Sent data ^{*1} | Function name | This displays the name of the function that was sent. |
| | Format | This displays the parts of the sent command separated as follows: slave station number, function code, address, data, and CRC. |
| | HEX | This displays the data that has been sent to peripherals (slave stations) from the KV Nano Series (the master station) in hexadecimal format. |
| Received data ^{*1} | Function name | This displays the name of the function that was received. |
| | Format | This displays the parts of the received command separated as follows: slave station number, function code, address, data, and CRC. |
| | HEX | This displays the data that has been received by the KV Nano Series (the master station) from a peripheral (slave station) in hexadecimal format. |
| Error | | This displays "ERR" when a communication error occurs. Click this to display the error details. |

*1 If a CRC check fails, the analysis results may not be displayed depending on the command type.



■ Configuring tracing settings



| Mode | Item | Description |
|---|---------------------------------|--|
| Traced data capacity specification mode | Tracing data capacity | Specify the capacity of the data to trace. Setting range: 1 to 2048 bytes (default value: 100). |
| | Execute tracing cyclically | If you select this check box, as soon as a trace finishes, the next trace will start automatically (default value: cleared). |
| Error detection mode | Response timeout | If you select this check box, tracing will be stopped when a response timeout error occurs (default value: selected). |
| | Framing error | If you select this check box, tracing will be stopped when a framing error occurs (default value: selected). |
| | Parity error | If you select this check box, tracing will be stopped when a parity error occurs (default value: selected). |
| | Overrun error | If you select this check box, tracing will be stopped when an overrun error occurs (default value: selected). |
| | CRC error | If you select this check box, tracing will be stopped when a CRC error occurs (default value: selected). |
| | Invalid response reception | If you select this check box, tracing will be stopped when an invalid response reception error occurs (default value: selected). |
| | Modbus error response reception | If you select this check box, tracing will be stopped when a Modbus error response reception error occurs (default value: selected). |
| | Modbus send command error | If you select this check box, tracing will be stopped when a Modbus send command error occurs (default value: selected). |

9-9 Operation When an Error Occurs and Error Remedies

This section describes remedies for situations in which data is not returned correctly in Modbus master mode, such as when an error occurs.

Remedies for Common Problems

■ Responses are not returned

Possible causes include mismatched communication settings, mismatched station numbers, abnormal CRC values, incorrectly wired or broken cables, slave stations being off, the terminating resistance, and noise.

Use the trace monitor or a similar function to check that the command sent from the master station, the KV Nano Series, is correct. Send commands from the master station side only after you receive a response from the slave stations.

 "Modbus Dedicated Trace Monitor" (page 9-49)

■ A response that contains an exception code is returned

Check the exception code in the response, and handle the exception appropriately.

 "Response exception codes" (page 9-48)

General Troubleshooting

■ Checking the display status of the SD and RD LEDs

You may be able to confirm the communication status and the cause of the error from the lit status of the SD and RD LEDs.

Some representative causes and corresponding remedies are shown below.

When you are using the built-in port, SD lights in green and RD lights in red. When the communication frequency is high during sending and receiving, these LEDs may appear to light in orange.

| SD | RD | Cause | Remedy |
|-----|------------|--|--|
| Off | Off or lit | The operation mode has not been set to "Modbus master mode." | Use the Unit Editor to check the operation mode.  "9-2 Communication Specifications and Unit Editor Settings" (page 9-4) |
| Lit | Off | The communication speed or other communication settings on the slave station do not match the settings on the master station (the KV Nano Series). | Use the Unit Editor to check the communication settings.  "9-2 Communication Specifications and Unit Editor Settings" (page 9-4) |
| | | A communication error is occurring. | Use the built-in function monitor to check the information of the error that is occurring.  "4-1 About the Built-In Function Monitor" (page 4-2) |
| | | The connectors are not connected properly or the cables are incorrectly wired or broken. | Check the connector connections and the cable wiring.  "2-3 Connecting Peripherals" (page 2-6) |
| | | The slave unit is off or the command could not be sent correctly. | Check the status of the master unit. |
| | | The station numbers are different. | Store the correct station number (0 to 247) in the slave station number (CM5001, CM6001, or CM7001). |

| SD | RD | Cause | Remedy |
|-----------|-----------|--|---|
| Lit | Off | The CRC value is abnormal. | Use the trace monitor to check the CRC value.  "9-8 Modbus Dedicated Trace Monitor" (page 9-49) |
| Lit | Lit | An exception response has been returned. | Use the trace monitor to check the details of the exception response.  "9-8 Modbus Dedicated Trace Monitor" (page 9-49) |

■ Checking the error code

You may be able to determine the characteristics of the cause of the problem by checking the error code (CM5300, CM6300, or CM7300).

 "List of Error Codes" (page 9-54)

■ Checking the built-in function monitor

You can use the built-in function monitor to check the sending and receiving status.

For details on operating the built-in function monitor, see  "4-1 About the Built-In Function Monitor" (page 4-2).

■ Checking the trace monitor

You can use the trace monitor to check the data to send and the received data.

For details on operating the trace monitor, see  "9-8 Modbus Dedicated Trace Monitor" (page 9-49).

List of Error Codes

Error codes are stored in CM5300, CM6300, and CM7300.

The causes and corresponding remedies of each error code are shown below.

| Classification | Error Code | Cause | Remedy |
|--------------------------|------------|--|---|
| Exception response error | 0001H | A slave station sent an unsupported function. | Check the specifications of the slave station, and use appropriate functions. |
| | 0002H | A slave station sent an unsupported device. | Check the specifications of the slave station, and specify addresses of appropriate devices. |
| | 0003H | A slave station sent an unsupported number of devices to read or write. | Check the specifications of the slave station, and then specify the number of devices to read or write. |
| | 0004H | The slave station is in a state from which it cannot recover. | If you cannot recover the slave unit by restarting its power, contact the manufacturer of the slave unit. |
| Parameter error | 0101H | <ul style="list-style-type: none"> A value outside of the range 1 to 247 was specified for the slave station number. Broadcast station number 0 was specified when a device was read. | Check the value of the specified slave station number (CM5001, CM6001, or CM7001). |
| | 0102H | An unsupported function code was specified. | Check the value of the specified function code (CM5002, CM6002, or CM7002). |
| | 0103H | <p>[Read coil or read input] A value outside of the range 1 to 2000 was specified for the number of devices to read.</p> <p>[Read holding register or read input register] A value outside of the range 1 to 125 was specified for the number of devices to read.</p> <p>[Write continuous coils] A value outside of the range 1 to 1968 was specified for the number of devices to write.</p> <p>[Write continuous holding registers] A value outside of the range 1 to 123 was specified for the number of devices to write.</p> | Check the specified number of devices. |



| Classification | Error Code | Cause | Remedy |
|-------------------------|------------|--|---|
| Illegal reception error | 0201H | <ul style="list-style-type: none"> A different command request was received on the communication line. The response from a slave station to the previous command that was sent is slow, and the response from a different slave station to a command that was subsequently sent has been received. | <ul style="list-style-type: none"> Check that a different master station does not exist on the communication line. Check the specifications of the slave station from which the response is slow, and increase the reception timeout time (CM5570, CM657, or CM7570) as necessary. Also, send commands only after the response to the previous command has been received.  "Changing Communication Settings" (page 9-20) |
| Communication error | 0301H | The data of the received command is not correct. The command may have been influenced by an external force such as noise. | Send the previous command again. If this error occurs frequently, check the communication environment, and implement counter-measures against external forces such as noise. |
| | 0302H | | |
| Timeout error | 0401H | The command sent from the master station has not reached the slave station or the slave station is in a state in which it cannot recognize the command. | <ul style="list-style-type: none"> Check the communication line wiring. Check whether the slave station settings, such as the communication speed and parity, are the same as those on the master station. Check the number of the slave station. |

MEMO

Modbus SLAVE MODE

This chapter describes the communication specifications of and how to use Modbus slave mode.

| | | |
|------|--|-------|
| 10-1 | Outline and Procedure Prior to Operation | 10-2 |
| 10-2 | Communication Specifications | 10-4 |
| 10-3 | Relationship between Modbus Devices and PLC Devices | 10-6 |
| 10-4 | Setting Items on Unit Editor | 10-8 |
| 10-5 | Lists of Devices Used | 10-11 |
| 10-6 | Performing Operations from a Ladder Program . . | 10-14 |
| 10-7 | Communication Procedure | 10-16 |
| 10-8 | List of Supported Functions | 10-18 |
| 10-9 | Operation When an Error Occurs and Error Remedies | 10-22 |

10-1 Outline and Procedure Prior to Operation

This section briefly describes Modbus slave mode and gives the procedure prior to operation.

Outline

■ About Modbus

The Modbus protocol is a communication protocol that was developed by Modicon Inc. (AEG Schneider Automation International S.A.S.) for PLCs.

There are two serial transmission modes: ASCII mode and RTU (Remote Terminal Unit) mode. The KV Nano Series supports RTU mode.

The specifications of the Modbus protocol are publically known. These specifications are extremely simple, so Modbus is widely used in the FA (Factory Automation) and PA (Process Automation) fields, but it does not have a structure for verification and authorization.

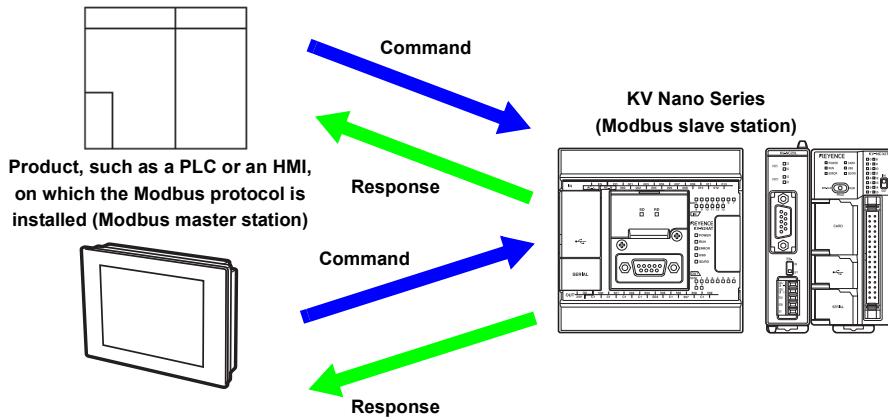
Therefore, each time that you use the Modbus protocol, you must check whether a connection is possible.

■ Application

Commands sent from a master station (a peripheral such as a PLC or a display unit), on which the Modbus protocol is installed, are received, and responses are returned.

The KV Nano Series device data can be read and written from a product on which the Modbus protocol is installed.

No ladder program is required to send and receive data in Modbus slave mode.



If you are using the KV Nano Series as the Modbus master station, see "Chapter 9 Modbus MASTER MODE" (page 9-1).

Procedure Prior to Operation

This section describes the basic procedure to follow when using Modbus slave mode.

If you are using an extension cassette or adapter, see "2-2 Installing Units on the Base Unit" (page 2-3) and install the extension cassette or adapter on the base unit.

Configure the KV STUDIO Unit Editor settings.*

- Set the operation mode of the ports that you are using to "Modbus slave mode."
- Configure settings such as the communication speed.
- Set the Modbus slave station number.

"10-4 Setting Items on Unit Editor" (page 10-8)



Transfer the project that you have created to the base unit.

In KV STUDIO, on the "Monitor/Simulator" menu, click "PLC Transfer," and then "Monitor Mode" to transfer the project.*

"KV STUDIO User's Manual"



Connect to the Modbus master unit.

Connect to the Modbus master unit, and then start communication from the master side.

"2-3 Connecting Peripherals" (page 2-6)



Check the operations.

In KV STUDIO*, on the "Monitor/Simulator" menu, click "Built-in Function Monitor" to check operations.

"Chapter 4 USING THE BUILT-IN FUNCTION MONITOR TO CHECK OPERATIONS" (page 4-1)

* Use version 7 or later (version 7.1 when using an extension adapter) of KV STUDIO.

10-2 Communication Specifications

This section describes the communication specifications of Modbus slave mode.

Communication Method

| Item | Description |
|-----------------------------------|--|
| Communication interface | RS-232C, RS-422A/RS-485 (4-wire type), RS-485 (2-wire type) |
| Communication speed | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps |
| Maximum number of connected units | 32 (including the master station) |
| Slave station number | 1 to 247 |
| Transmission distance | RS-422A/RS-485 (4-wire type), RS-485 (2-wire type): Less than 1200 m RS-232C: 15 m |
| Data bit length | 8 bits |
| Stop bit length | 1 bit, 2 bits |
| Parity | Even, odd, none |
| Transmission mode | Modbus RTU standard ^{*1} |
| Data check method | CRC (automatic calculation) |

*1 Modbus ASCII mode is not supported.

Number of Communication Ports That Can Be Used Simultaneously

| Base Unit | Number of Communication Ports |
|-----------|---|
| KV-N14** | When an extension cassette is not used: 1 |
| KV-N24** | When an extension cassette is used: 2 |
| KV-N40** | When an extension cassette is not used: 1 |
| KV-N60** | When one extension cassette is used: 2 When two extension cassettes are used: 3 |
| KV-NC32T | When extension adapters are not used: 1 When the KV-NC10L is used: 2 When the KV-NC20L is used: 3 |

■ Precautions

● Communication during PROG mode

Modbus slave mode communication will be executed even if the base unit is in PROG mode.

● Data simultaneity

Two words worth of data starting from an even number are updated at the same time.

● Operation when a communication error occurs

Wait for the timeout time (default value: 2000 ms), and then try to send the command from the master station again.

You can use a ladder program to change the timeout time setting.

 " Changing Communication Settings from a Ladder Program" (page 10-15)

● Limitations when using Modbus slave mode

After performing an echoback (080000H) or a communication operation with a function code that is not supported by the KV Nano Series, wait the reception timeout between characters time (default value: 100 ms)

10-3 Relationship between Modbus Devices and PLC Devices

This section describes the relationship between Modbus devices and the PLC devices that are assigned to those Modbus devices.

Modbus Devices

You can use four types of devices with Modbus.

| Type | Classification | Attribute R: Read Only R/W: Read/Write | Device Range for Sending and Receiving Commands | (Reference) Device Notation Range of General Modbus Devices ^{*1} |
|---------------------|----------------|--|---|---|
| Coil | Bit | R/W | 0 to 65535 | 1 to 65536 (000001 to 065536) |
| Input | Bit | R | 0 to 65535 | 1 to 65536 (100001 to 165536) |
| Holding register | Word | R/W | 0 to 65535 | 1 to 65536 (400001 to 465536) |
| Input register | Word | R | 0 to 65535 | 1 to 65536 (300001 to 365536) |

*1 There is a difference in the device notations for the general cases and for sent and received commands. With the KV Nano Series, the notation of device number ranges specified for sent and received commands is used.

Relationship with PLC Devices

Each type of Modbus device is split into four blocks, and a PLC device is assigned to each block.

■ Modbus device ranges of each block

| Type | Block 1 | Block 2 | Block 3 | Block 4 |
|------------------|------------|----------------|----------------|----------------|
| Coil | 0 to 16383 | 16384 to 32767 | 32768 to 49151 | 49152 to 65535 |
| Input | 0 to 16383 | 16384 to 32767 | 32768 to 49151 | 49152 to 65535 |
| Input register | 0 to 16383 | 16384 to 32767 | 32768 to 49151 | 49152 to 65535 |
| Holding register | 0 to 16383 | 16384 to 32767 | 32768 to 49151 | 49152 to 65535 |

■ PLC device assignment

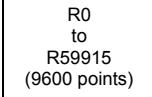
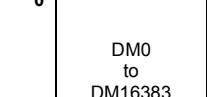
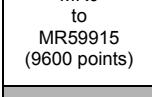
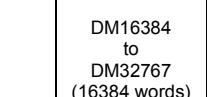
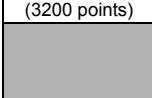
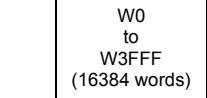
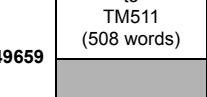
Use the Unit Editor to assign PLC devices to each block.

 "Setting the Port-Shared Modbus Device Map" (page 10-9)

● Default device assignments

The PLC devices that are assigned by default are R, MR, LR, B, DM, W, and TM.

In the default settings, read-only devices (input and input registers) are set to the same assignments as read/write devices (coils and holding registers).

| | Coil (read/write) | Input (read only) | Holding register (read/write) | Input register (read only) |
|---------|--|----------------------|--|-------------------------------|
| Block 1 | 0 R0 to R59915 (9600 points) | The same as coils | 0 DM0 to DM16383 (16384 words) | The same as holding registers |
| | 9599  | | 16384  | |
| Block 2 | 16384 MR0 to MR59915 (9600 points) | The same as coils | 16384 DM16384 to DM32767 (16384 words) | The same as holding registers |
| | 25599  | | 32768  | |
| Block 3 | 32768 LR0 to LR19915 (3200 points) | The same as coils | 32768 W0 to W3FFF (16384 words) | The same as holding registers |
| | 35199  | | 49152  | |
| Block 4 | 49152 B0 to B1FFF (8192 points) | The same as coils | 49152 TM004 to TM511 (508 words) | The same as holding registers |
| | 57343  | | 49659  | |
| | 65535 | | 65535  | |

10-4 Setting Items on Unit Editor

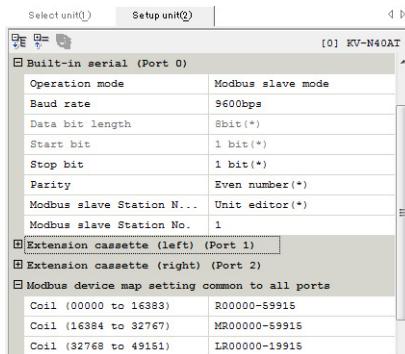
This section describes the settings, which you configure using the KV STUDIO Unit Editor, that are required to use Modbus slave mode and how to configure these settings.

 "2-5 Using Unit Editor to Configure Settings" (page 2-12)

Port to Configure

Modbus slave mode can be used on all ports: (Port 0 (built-in serial), Port1 (extension cassette (left)) and Port2 (extension cassette (right)))

If you are using the KV-N10L or KV-N11L, or the KV-NC10L or KV-NC20L, select the extension cassette or extension adapter that you will connect.



Configuring Settings on the Slave Station

| Setting | Setting Content | Description |
|---|--|--|
| Operation mode | Modbus slave mode | - |
| Interface | RS-232C RS-422A/485 (4-wire type) RS-485 (2-wire type) | When you use the built-in port, the KV-N10L, the KV-NC10L or the KV-NC20L (Port1), this is fixed to RS-232C, so you cannot change the setting. |
| Baud rate | 1200, 2400, 4800, 9600 [Default value], 19200, 38400, 57600, 115200 bps | - |
| Data bit length | 8 bits | This is a fixed value, so you cannot change the setting. |
| Start bit | 1 bit | This is a fixed value, so you cannot change the setting. |
| Stop bit | 1 bit [Default value], 2 bits | - |
| Parity | Even [Default value], odd, none | - |
| RS/CS flow control | OFF [Default value], ON | You can only select "ON" when you are using the KV-N10L, KV-NC10L or KV-NC20L (Port1). This cannot be used with the built-in port. |
| Modbus slave Station No. setting method | Unit editor [Default value], Ladder | Setting this to "Ladder" enables you to set "Modbus slave Station No." from a ladder program.  "10-6 Performing Operations from a Ladder Program" (page 10-14) |
| Modbus slave Station No. | 001 to 247 | When "Modbus slave Station No. setting method" is set to "Ladder," you do not have to specify this setting. |



Configure the communication settings (excluding settings related to the station number) on the slave station to the same settings as those on the master station that you will connect. Communication cannot be performed if the settings are different.

Setting the Port-Shared Modbus Device Map

The Modbus device area is split into blocks, and a device is assigned to each block. There are 4 blocks for each 1 Modbus device, so there are 16 blocks worth of setting sections.

 "10-3 Relationship between Modbus Devices and PLC Devices" (page 10-6)

Click an item, and then click the  button on the right side to specify the PLC's leading device.

The Modbus device map settings are shared between all ports that can be used in Modbus slave mode.

| Modbus Device | PLC Device Setting | | |
|---------------------------|---|-----------------------|---|
| | | Default Value | Setting Range |
| Coil (00000 to 16383) | Device type | R | R, MR, LR, CR, B, T, C |
| | Leading device number (device range) | 0 (00000 to 59915) | This varies depending on the device type. For bit devices, specify the value in units of channels. |
| Coil (16384 to 32767) | Device type | MR | R, MR, LR, CR, B, T, C |
| | Leading device number (device range) | 0 (00000 to 59915) | This varies depending on the device type. For bit devices, specify the value in units of channels. |
| Coil (32768 to 49151) | Device type | LR | R, MR, LR, CR, B, T, C |
| | Leading device number (device range) | 0 (00000 to 19915) | This varies depending on the device type. For bit devices, specify the value in units of channels. |
| Coil (49152 to 65535) | Device type | B | R, MR, LR, CR, B, T, C |
| | Leading device number (device range) | 0 (0000 to 1FFF) | This varies depending on the device type. For bit devices, specify the value in units of channels. |
| Input (00000 to 16383) | Device type | R | R, MR, LR, CR, B, T, C |
| | Leading device number (device range) | 0 (00000 to 59915) | This varies depending on the device type. For bit devices, specify the value in units of channels. |
| Input (16384 to 32767) | Device type | MR | R, MR, LR, CR, B, T, C |
| | Leading device number (device range) | 0 (00000 to 59915) | This varies depending on the device type. For bit devices, specify the value in units of channels. |
| Input (32768 to 49151) | Device type | LR | R, MR, LR, CR, B, T, C |
| | Leading device number (device range) | 0 (00000 to 19915) | This varies depending on the device type. For bit devices, specify the value in units of channels. |
| Input (49152 to 65535) | Device type | B | R, MR, LR, CR, B, T, C |
| | Leading device number (device range) | 0 (0000 to 1FFF) | This varies depending on the device type. For bit devices, specify the value in units of channels. |

| Modbus Device | PLC Device Setting | | |
|--------------------------------------|---|---------------------------|---|
| | | Default Value | Setting Range |
| Holding register (00000 to 16383) | Device type | DM | DM, CM, TM, W, TC, TS, CC, CS, R, MR, LR, CR, B |
| | Leading device number (device range) | 0 (00000 to 16383) | This varies depending on the device type. For bit devices, specify the value in units of channels. |
| Holding register (16384 to 32767) | Device type | DM | DM, CM, TM, W, TC, TS, CC, CS, R, MR, LR, CR, B |
| | Leading device number (device range) | 16384 (16384 to 32767) | This varies depending on the device type. For bit devices, specify the value in units of channels. |
| Holding register (32768 to 49151) | Device type | W | DM, CM, TM, W, TC, TS, CC, CS, R, MR, LR, CR, B |
| | Leading device number (device range) | 0 (0000 to 3FFF) | This varies depending on the device type. For bit devices, specify the value in units of channels. |
| Holding register (49152 to 65535) | Device type | TM | DM, CM, TM, W, TC, TS, CC, CS, R, MR, LR, CR, B |
| | Leading device number (device range) | 004 (004 to 511) | This varies depending on the device type. For bit devices, specify the value in units of channels. |
| Input register (00000 to 16383) | Device type | DM | DM, CM, TM, W, TC, TS, CC, CS, R, MR, LR, CR, B |
| | Leading device number (device range) | 0 (00000 to 16383) | This varies depending on the device type. For bit devices, specify the value in units of channels. |
| Input register (16384 to 32767) | Device type | DM | DM, CM, TM, W, TC, TS, CC, CS, R, MR, LR, CR, B |
| | Leading device number (device range) | 16384 (16384 to 32767) | This varies depending on the device type. For bit devices, specify the value in units of channels. |
| Input register (32768 to 49151) | Device type | W | DM, CM, TM, W, TC, TS, CC, CS, R, MR, LR, CR, B |
| | Leading device number (device range) | 0 (0000 to 3FFF) | This varies depending on the device type. For bit devices, specify the value in units of channels. |
| Input register (49152 to 65535) | Device type | TM | DM, CM, TM, W, TC, TS, CC, CS, R, MR, LR, CR, B |
| | Leading device number (device range) | 004 (004 to 511) | This varies depending on the device type. For bit devices, specify the value in units of channels. |

10-5 Lists of Devices Used

This section gives lists of the devices (CR and CM) that are related to Modbus slave mode.

| | | | |
|----|--------------|---|------------------|
| CR | Two channels | Port0 (built-in serial): | CR6000 to CR6115 |
| | | Port1 (extension cassette (left)/extension adapter (upper)): | CR6600 to CR6715 |
| | | Port2 (extension cassette (right)/extension adapter (lower)): | CR7200 to CR7315 |
| CM | 10 words | Port0 (built-in serial): | CM5000 to CM5009 |
| | | Port1 (extension cassette (left)/extension adapter (upper)): | CM6000 to CM6009 |
| | | Port2 (extension cassette (right)/extension adapter (upper)): | CM7000 to CM7009 |

Control Relay (CR)

| CR Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|------------------|------------------|---------------------------------------|--|---|-------------|
| Port0 (Built-In) | Port1 (Left) | Port2 (Right) | | | | |
| CR6000 | CR6600 | CR7200 | Station number setting request | R/W | OFF to ON: A request is made to set the slave's station number. | 10-14 |
| CR6001 | CR6601 | CR7201 | - | - | Reserved for the system. | - |
| CR6002 | CR6602 | CR7202 | Communication setting change request | R/W | OFF to ON: A request is made to change the timeout between characters, master station timeout, or send delay time setting. | 10-15 |
| CR6003 to CR6015 | CR6603 to CR6615 | CR7203 to CR7215 | - | - | Reserved for the system. | - |
| CR6100 | CR6700 | CR7300 | Station number setting complete | R | ON: The setting of the station number has been completed. OFF: This relay is turned OFF when the station number setting request relay changes from ON to OFF. | 10-14 |
| CR6101 | CR6701 | CR7301 | Station number setting failure | R | ON: The setting of the station number failed. OFF: This relay is turned OFF when the station number setting request relay changes from ON to OFF. | 10-14 |
| CR6102 | CR6702 | CR7302 | Communication setting change complete | R | ON: The communication setting change has been completed. OFF: This relay is turned OFF when the communication setting change request relay changes from ON to OFF. | 10-15 |
| CR6103 to CR6115 | CR6703 to CR6715 | CR7303 to CR7315 | - | - | Reserved for the system. | - |

Control Memory (CM)

| CM Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|-----------------|------------------|--------------------------------------|--|---|-------------|
| Port0 (Built-In) | Port1 (Left) | Port2 (Right) | | | | |
| CM5000 | CM6000 | CM7000 | - | - | Reserved for the system. | - |
| CM5001 | CM6001 | CM7001 | Request station number | R/W | This stores the number of the station to set. Range: 01 to F7. | 10-14 |
| CM5002 | CM6002 | CM7002 | Reception timeout between characters | R/W | This stores the timeout time between characters of the received command. Device value range: 1 to 100 [\times 10 ms units] (setting range: 10 to 1000 ms). <ul style="list-style-type: none">• If this is set to 0: 100 ms. Default value• If this is set to 101 or higher: 1000 ms. | 10-15 |
| CM5003 | CM6003 | CM7003 | Master station timeout | R/W | This stores the time that the master station waits for a response from a slave station. Device value range: 10 to 2000 [\times 10 ms units] (setting range: 100 to 20000 ms). <ul style="list-style-type: none">• If this is set to 0: 2000 ms. Default value• If this is set to a value between 1 and 9: 100 ms.• If this is set to 2001 or higher: 20000 ms. | 10-15 |
| CM5004 | CM6004 | CM7004 | Send delay time | R/W | This stores the delay time that a slave station waits before sending a response to a command that it has received. Device value range: 1 to 100 [\times 10 ms units] (setting range: 0 to 1000 ms). <ul style="list-style-type: none">• If this is set to 0: 0 ms. Default value• If this is set to 101 or higher: 1000 ms. | 10-15 |

| CM Number | | | Name | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|---------------------|-----------------|------------------|--|--|---|----------|
| Port0 (Built-In) | Port1 (Left) | Port2 (Right) | | | | |
| CM5005 | CM6005 | CM7005 | Set station number | R | This stores the number of the station that is being operated. • FFFF: The value has not been set. • 01 to F7: The number of the station that is being operated. | 10-14 |
| CM5006 | CM6006 | CM7006 | Set reception timeout between characters | R | This stores the timeout time between characters during operation. | 10-15 |
| CM5007 | CM6007 | CM7007 | Set master station timeout | R | This stores the timeout time during operation. | 10-15 |
| CM5008 | CM6008 | CM7008 | Set send delay time | R | This stores the send delay time during operation. | 10-15 |
| CM5009 | CM6009 | CM7009 | Communication event counter | R | This stores the number of times that the station has successfully processed commands (including broadcast commands) addressed to it. | - |

10-6 Performing Operations from a Ladder Program

This section describes how to use a ladder program to configure settings such as the station number and communication settings.

Changing the Station Number from a Ladder Program

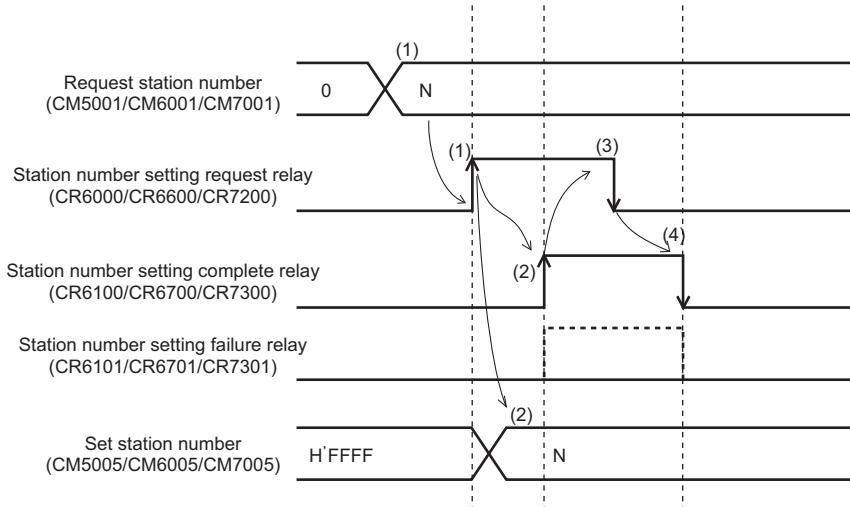
If you set "Modbus slave Station No. setting method" to "Ladder" in the Unit Editor, you can change the station number from a ladder program.

 "10-4 Setting Items on Unit Editor" (page 10-8)

■ Timing of station number changes

When the station number setting request relay (CR6000, CR6600, or CR7200) changes from OFF to ON, the KV Nano Series reads the value specified by request station number (CM5001, CM6001, or CM7001), and then changes the setting.

■ Station number change method



- (1) Ladder program The value (N: 1 to 247) of the station number that you want to set is stored in request station number (CM5001, CM6001, or CM7001), and then the station number setting request relay (CR6000, CR6600, or CR7200) is turned ON.
- (2) PLC The request station number value is obtained, and the PLC corresponding to the new station number starts. The station number is stored in the set station number (CM5005, CM6005, or CM7005), and then the station number setting complete relay (CR6100, CR6700, or CR7300) turns ON.
- * In the following situations, the number stored in request station number (CM5001, CM6001, or CM7001) is not applied to the station number, and the station number setting failure relay (CR6101, CR6701, or CR7301) is turned ON.
 - If "Modbus slave Station No. setting method" is set to "Unit editor."
 - If the stored value is outside of the setting range (1 to 247).
- If an attempt to change the station number while there is already a set station number fails, operations will continue with the set station number.
- (3) Ladder program The station number setting request relay (CR6000, CR6600, or CR7200) is turned OFF.
- (4) PLC The station number setting complete relay (CR6100, CR6700, or CR7300) is turned OFF.

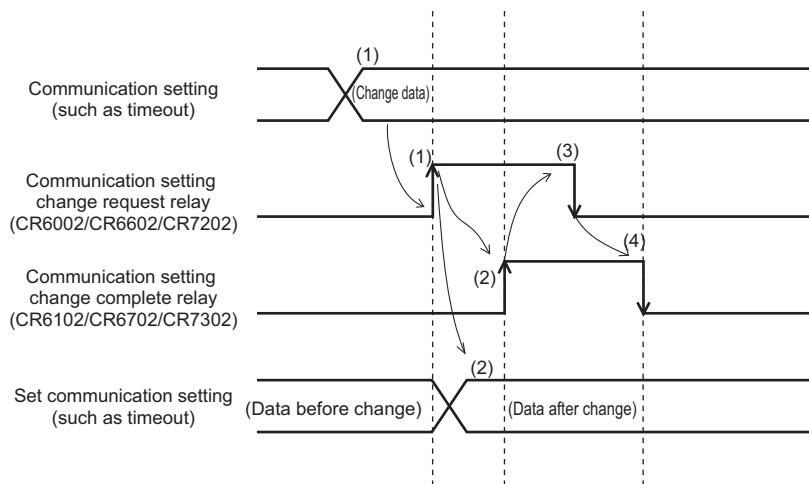
Changing Communication Settings from a Ladder Program

You can change settings such as the timeout and send delay time from a ladder program.

■ Timing of communication setting changes

When the communication setting change request relay (CR6002, CR6602, or CR7202) changes from OFF to ON, the KV Nano Series reads the values specified by reception timeout between characters (CM5002, CM6002, or CM7002), master station timeout (CM5003, CM6003, or CM7003), and send delay time (CM5004, CM6004, or CM7004), and then changes the settings.

■ Communication setting change method



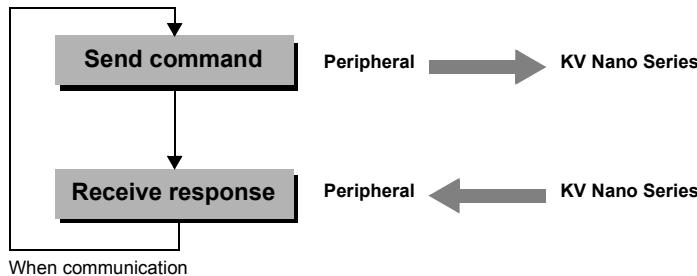
- (1) Ladder program The values are stored in reception timeout between characters (CM5002, CM6002, or CM7002), master station timeout (CM5003, CM6003, or CM7003), and send delay time (CM5004, CM6004, or CM7004), and then the communication setting change request relay (CR6002, CR6602, or CR7202) is turned ON.
- (2) PLC Each value is obtained and applied as a parameter. The values are stored in set reception timeout between characters (CM5006, CM6006, or CM7006), set master station timeout (CM5007, CM6007, or CM7007), and set send delay time (CM5008, CM6008, or CM7008), and then the communication setting change complete relay (CR6102, CR6702, or CR7302) is turned ON.
 - * If the stored value is outside of the setting's range, the value will not be applied.
 - If an attempt to change communication settings while there are already set communication settings fails, operations will continue with the set communication settings.
- (3) Ladder program The communication setting change request relay (CR6002, CR6602, or CR7202) is turned OFF.
- (4) PLC The communication setting change complete relay (CR6102, CR6702, or CR7302) is turned OFF.

10-7 Communication Procedure

This section describes the communication procedure, format of commands and responses, and error codes when communicating with peripherals in Modbus slave mode.

Communication Procedure

In Modbus slave mode, a peripheral such as a PLC or a display unit operates as the master station. By sending commands from the master station to the KV Nano Series and receiving the responses from the KV Nano Series, you can read device data from and write device data to the KV Nano Series.



Format of Commands and Responses

The formats of the commands and responses of Modbus slave mode are shown below.

■ Basic format (when the function code is a value other than 08H)

| Slave Station Number | Function Code | Data | CRC Check |
|----------------------|---------------|----------------|-----------|
| 1 byte | 1 byte | 0 to 252 bytes | 2 bytes |

- * No header and delimiters are used.
- * The maximum length of commands and responses is 256 bytes.

● Slave station number

This is the slave station number that the master station specifies as the receiver.

- 0 : Specify this value when you want to send a command to all slave stations (for broadcasting).
Responses will not be sent from all slave stations.
- 1 to 247: When you send a command, specify the station number of the slave station that you want to send the command to.
A response is only returned when this parameter is the same as the set station number. In this case, the same station number as the station that sent the command is specified in the response.

● Function code

This is the number of the function that the master station requests of the slave station.



"10-8 List of Supported Functions" (page 10-18)

When the slave station returns its response, the completion status is included as shown below.

- Normal completion : The function code requested by the master station is returned as-is.
- Abnormal completion : The function code requested by the master station is returned with its uppermost bit turned ON (80H + function code).
Example) Function code 16H: 96H

● Data

When the master station sends a command, this stores the data that is required to execute the processing that is requested.

When a slave station returns a response, this stores the data of the execution result that corresponds to the requested processing.

 "10-8 List of Supported Functions" (page 10-18)

● CRC check

This stores the CRC value for performing a CRC check on "station number + function code + data range" for both commands and responses.

If the CRC value contained within a command is judged by the KV Nano Series to be incorrect, the command is discarded.

■ Format when a subfunction is used (when the function code is 08H)

| Slave Station Number | Function Code | Subfunction Code | Data | CRC Check |
|----------------------|---------------|------------------|----------------|-----------|
| 1 byte | 1 byte | 2 bytes | 0 to 250 bytes | 2 bytes |

- * No header and delimiters are used.
- * The maximum length of commands and responses is 256 bytes.

● Subfunction code

This is only used when the function code is "08H." The subfunction code is specified as-is for commands and responses.

■ Sending order of byte units (endián)

When word data is sent in byte units, the upper byte is sent first.

However, the exception is the CRC value, of which the lower byte is sent first.

Example)

| Slave Station Number (H) | Function Code (H) | Leading Device Address: 123 (H) | | Value to Write: ABCD (H) | | CRC (H) | |
|--------------------------|-------------------|---------------------------------|----|--------------------------|----|---------|----|
| 01 | 06 | 01 | 23 | AB | CD | C7 | 59 |

Upper Lower Upper Lower Lower Upper

■ Response exception codes

| Exception Code (H) | Cause | Remedy |
|--------------------|--|---|
| 01 | A slave station (KV Nano Series) received an unsupported command. | Check the specifications of the slave station, and then send an appropriate command from the master station (peripheral). |
| 02 | A slave station (KV Nano Series) received an unsupported leading device. | Check the specifications of the slave station, and then send an appropriate leading device from the master station (peripheral). |
| 03 | A slave station (KV Nano Series) received an unsupported number of devices. | Check the specifications of the slave station, and then send an appropriate number of devices from the master station (peripheral). |
| 04 | The slave station (KV Nano Series) is in a state from which it cannot recover. | If you cannot recover the slave station by restarting its power, contact your KEYENCE representative. |

10-8 List of Supported Functions

This section describes the functions sent from the Modbus master unit that are supported in Modbus slave mode.

List of Supported Functions

Modbus SLAVE MODE

10

List of Supported Functions

| Function Code (HEX) | Subfunction Code (HEX) | Function | Processing Details | Number of Devices That Can Be Handled with One Command | Broad-castable (Station Number 0) | Details (See Page ^{*1}) |
|---------------------|------------------------|---|--|--|-----------------------------------|-----------------------------------|
| 01 | - | Read Coils | This function reads the coil status. | 1 to 2000 | No | (9-25) |
| 02 | - | Read Discrete Inputs | This function reads the input status. | 1 to 2000 | No | (9-30) |
| 03 | - | Read Holding Registers | This function reads the holding register value. | 1 to 125 | No | (9-31) |
| 04 | - | Read Input Registers | This function reads the input register value. | 1 to 125 | No | (9-41) |
| 05 | - | Write Single Coil | This function turns one coil ON or OFF. | 1 | Yes | (9-26) |
| 06 | - | Write Single Register | This function writes a value to one holding register. | 1 | Yes | (9-33) |
| 08 | 00 | Diagnostics, Return Query Data | This function returns the received command as-is. (Only two bytes worth of data can be supported.) | - | No | 10-19 |
| | 0A | Diagnostics, Clear Counters and Diagnostic Register | This function clears the number of times that the slave station has successfully sent data to and received data from the master station. | - | No | (9-47) |
| 0B | - | Get Comm Event Counter | This function reads the number of times that the slave station has successfully sent data to and received data from the master station. | - | No | 10-20 |
| 0F | - | Write Multiple Coils | This function turns the specified number of coils ON or OFF starting at the specified address. | 1 to 1968 | Yes | (9-28) |
| 10 | - | Write Multiple Registers | This function writes values to the specified number of holding registers starting at the specified address. | 1 to 123 | Yes | (9-35) |
| 11 | - | Report Slave ID | This function reads the model code and the mode (RUN or PROG) that is in use. | - | No | 10-21 |
| 16 | - | Mask Write Register | This function performs a bit set for the value of one holding register (you can specify an AND or OR mask). | 1 | Yes | (9-37) |
| 17 | - | Read/Write Multiple Registers | This function reads and writes continuous holding registers in a single communication operation. | Read: 1 to 125 Write: 1 to 121 | No | (9-39) |

*1 On the reference pages listed in parentheses, the contents that are returned from the KV Nano Series are written under "Slave Station (Peripheral) Response."

Diagnostics, Return Query Data [08 0000]

The request command from the master station (peripheral) is returned as-is.

 "Format of Commands and Responses" (page 10-16)

■ Master station (peripheral) command

| | | | | |
|----------------------|----|------------------|------------------|------------------|
| Slave station number | 08 | Subfunction code | Data | CRC |
| | | Upper Lower | Upper Lower | Lower Upper |

| Item | Size (Bytes) | Data Range |
|----------------------|-----------------|----------------|
| Slave station number | 1 | 01H to F7H |
| Function code | 1 | 08H |
| Subfunction code | 2 | 0000H |
| Data | 2 ^{*1} | 0000H to FFFFH |
| CRC | 2 | 0000H to FFFFH |

*1 With the KV Nano Series, only two bytes worth of data can be supported.

■ Slave station (KV Nano Series) response

● Normal operation

The command from the master station is returned as-is.

| | | | | |
|----------------------|----|------------------|------------------|------------------|
| Slave station number | 08 | Subfunction code | Data | CRC |
| | | Upper Lower | Upper Lower | Lower Upper |

| Item | Size (Bytes) | Data Range |
|----------------------|--------------|----------------|
| Slave station number | 1 | 01H to F7H |
| Function code | 1 | 08H |
| Subfunction code | 2 | 0000H |
| Data | 2 | 0000H to FFFFH |
| CRC | 2 | 0000H to FFFFH |

● Abnormal operation

| | | | |
|----------------------|----|------------------|-----|
| Slave station number | 88 | Exception code | CRC |
| | | Lower Upper | |

| Item | Size (Bytes) | Data Range |
|----------------------|--------------|---|
| Slave station number | 1 | 01H to F7H |
| Function code | 1 | 88H (80H + function code) |
| Exception code | 1 | 01H to 04H  "Response exception codes" (page 10-17) |
| CRC | 2 | 0000H to FFFFH |

Get Comm Event Counter [0B]

This function reads the value of the communication event counter.

The communication event counter indicates the number of times that the station has successfully processed commands (including broadcast commands) addressed to it. The value is the same as the value that is stored in CM5009, CM6009, or CM7009.

You can use this function to check whether broadcast commands, which do not receive a response, are being executed.

The following situations are not counted.

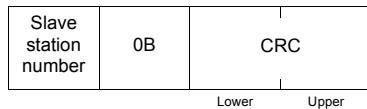
- When an error such as a communication error (parity or framing) or a CRC error occurs.
- When an exception code is returned.
- When a clear communication event counter [08 000A] command is received.
- When a read communication event counter [0B] command is received.

The communication event counter is cleared when:

- Power is turned off or on.
- The unit setting information is updated.
- The clear communication event counter [08 000A] command is received.
- The station number setting request relay is used to change the station number.

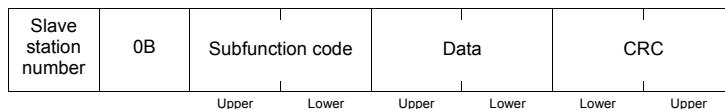
 "Format of Commands and Responses" (page 10-16)

■ Master station (peripheral) command



| Item | Size (Bytes) | Data Range |
|----------------------|--------------|----------------|
| Slave station number | 1 | 01H to F7H |
| Function code | 1 | 0BH |
| CRC | 2 | 0000H to FFFFH |

■ Slave station (KV Nano Series) response



| Item | Size (Bytes) | Data Range |
|----------------------|--------------|---|
| Slave station number | 1 | 01H to F7H |
| Function code | 1 | 0BH |
| Subfunction code | 2 | 0000H |
| Data | 2 | 0000H to FFFFH * If the counter reaches FFFFH, counting stops. |
| CRC | 2 | 0000H to FFFFH |

Report Slave ID [11]

This function returns the PLC model code and operating status of the slave station (KV Nano Series).

 "Format of Commands and Responses" (page 10-16)

■ Master station (peripheral) command

| | | |
|----------------------|-------|-------|
| Slave station number | 11 | CRC |
| | Lower | Upper |

| Item | Size (Bytes) | Data Range |
|----------------------|--------------|----------------|
| Slave station number | 1 | 01H to F7H |
| Function code | 1 | 11H |
| CRC | 2 | 0000H to FFFFH |

■ Slave station (KV Nano Series) response

| | | | | | |
|----------------------|----|-----------------|----------------|------------|-------|
| Slave station number | 11 | Number of bytes | PLC model code | PLC status | CRC |
| | | | | Lower | Upper |

| Item | Size (Bytes) | Data Range |
|----------------------|--------------|---|
| Slave station number | 1 | 01H to F7H |
| Function code | 1 | 11H |
| Number of bytes | 1 | 2 (fixed) |
| PLC model code | 1 | KV-N14**: 87H KV-N24**: 86H KV-N40**: 85H KV-N60**: 84H KV-NC32T: 80H |
| PLC status | 1 | PROG: 00H RUN: FFH |
| CRC | 2 | 0000H to FFFFH |

10-9 Operation When an Error Occurs and Error Remedies

This section describes remedies for situations in which data is not returned correctly in Modbus slave mode, such as when an error occurs.

Remedies for Common Problems

■ Responses are not returned

Possible causes include mismatched communication settings, mismatched station numbers, abnormal CRC values, incorrectly wired or broken cables, the master station being off, the terminating resistance, and noise.

Use the trace monitor or a similar function to check that the command sent from the master station is correct.

Send commands from the master station side only after you receive a response from the slave stations (KV Nano Series).

 "4-3 Trace Monitor" (page 4-4)

■ A response that contains an exception code is returned

Check the exception code in the response, and handle the exception appropriately.

 "Response exception codes" (page 10-17)

General Troubleshooting

■ Checking the display status of the SD and RD LEDs

You may be able to confirm the communication status and the cause of the error from the lit status of the SD and RD LEDs.

Some representative causes and corresponding remedies are shown below.

When you are using the built-in port, SD lights in green and RD lights in red. When the communication frequency is high during sending and receiving, these LEDs may appear to light in orange.

| SD | RD | Cause | Remedy |
|-----|-----|--|--|
| Off | Off | The connectors are not connected properly or the cables are incorrectly wired or broken. | Check the connector connections and the cable wiring.  "2-3 Connecting Peripherals" (page 2-6) |
| | | The master unit is off or the command could not be sent correctly. | Check the status of the master unit. |
| Off | Lit | The communication speed or other communication settings on the slave station (KV Nano Series) do not match the settings on the master station. | Use the Unit Editor to check the communication settings.  "10-4 Setting Items on Unit Editor" (page 10-8) |
| | | A communication error is occurring. | Use the built-in function monitor to check the information of the error that is occurring.  "4-1 About the Built-In Function Monitor" (page 4-2) |
| | | The station number is incorrect. | If you are using a ladder program to specify the station number, store the station number (1 to 247) in request station number (CM5001, CM6001, or CM7001), and then turn the station number setting request relay (CR6000, CR6600, or CR7200) ON. If you are not using a ladder program to specify the station number, use the Unit Editor to set "Modbus slave Station No. setting method" to "Unit editor," and then specify the station number (01 to F7). |

| SD | RD | Cause | Remedy |
|-----|-----|---|---|
| Off | Lit | The CRC value is abnormal. | Use the trace monitor to check the CRC value.  "Trace Monitor" (page 4-4) |
| | | The operation mode has not been set to "Modbus slave mode." | Use the Unit Editor to check the operation mode.  "10-4 Setting Items on Unit Editor" (page 10-8) |
| Lit | Off | The operation mode has not been set to "Modbus slave mode." | Use the Unit Editor to check the operation mode.  "10-4 Setting Items on Unit Editor" (page 10-8) |
| Lit | Lit | An exception response has been returned. | Use the trace monitor to check the details of the exception response.  "Trace Monitor" (page 4-4) |

■ Checking the built-in function monitor

You can use the built-in function monitor to check the sending and receiving status.

For details on operating the built-in function monitor, see  "4-1 About the Built-In Function Monitor" (page 4-2).

■ Checking the trace monitor

You can use the trace monitor to check the data to send and the received data.

For details on operating the trace monitor, see  "Trace Monitor" (page 4-4).

MEMO

SERIAL PLC LINK MODE

This chapter describes the communication specifications of and how to use Serial PLC Link mode.

| | | |
|------|---|-------|
| 11-1 | Outline and Procedure Prior to Operation | 11-2 |
| 11-2 | Communication Specifications | 11-6 |
| 11-3 | Wiring and Connections | 11-10 |
| 11-4 | Setting Items on Unit Editor | 11-12 |
| 11-5 | Lists of Devices Used | 11-14 |
| 11-6 | Serial PLC Link Setting Tool | 11-20 |
| 11-7 | Performing Operations from a Ladder Program . . | 11-24 |
| 11-8 | Using the Built-In Function Monitor to Check Operations | 11-27 |
| 11-9 | Operation When an Error Occurs and Error Remedies | 11-30 |

11-1 Outline and Procedure Prior to Operation

This section briefly describes Serial PLC Link mode and gives the procedure prior to operation.

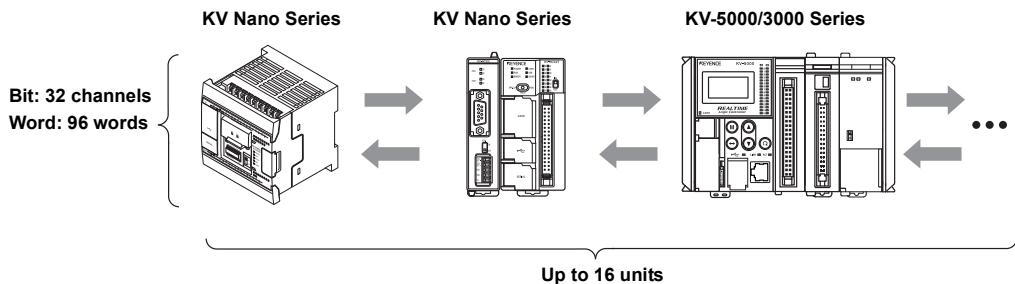
You can only use Serial PLC Link mode when the extension cassette KV-N11L or the extension adapter KV-NC20L is installed on the KV Nano Series.

Outline

Application

This mode enables you to share device data between NV Nano Series units and KV-5000/3000 Series units.

No ladder program is required to share data.



If you are using KV-5000/3000 Series units, use the KV-LM21V High-speed Multi-link Unit. For details on the KV-LM21V, see the "KV-LM21V User's Manual."

Data sharing configuration

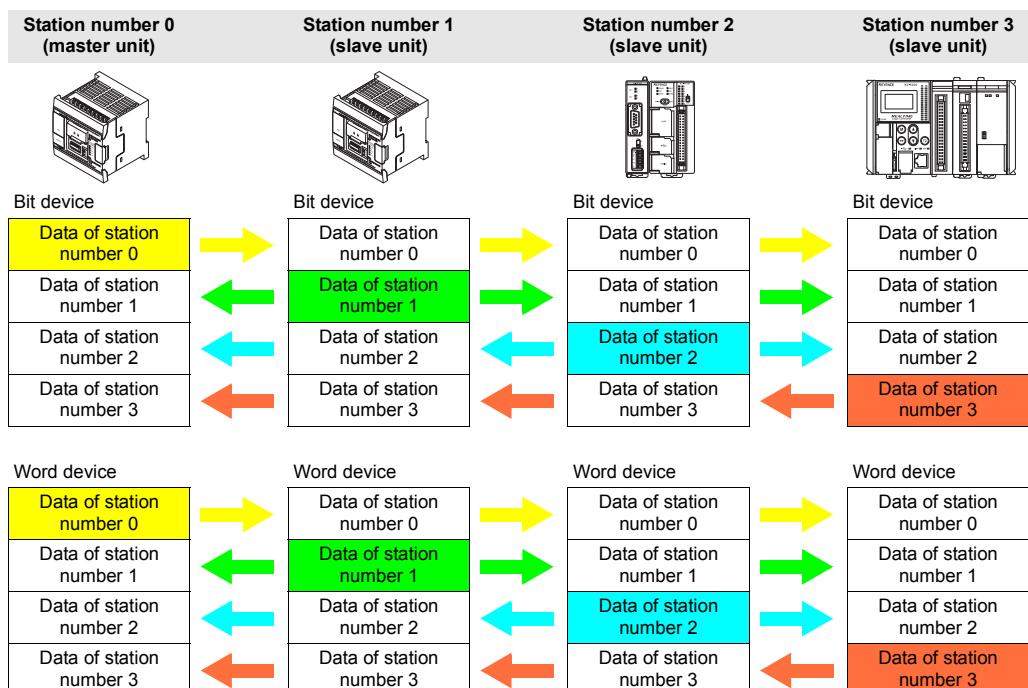
This section describes the configuration of using the Serial PLC Link function to share device data.

■ Data sharing method

The same device area, which has been set in advance, is shared between all stations.

The device area is set by the master unit (station number 0), and the slave units (station numbers 1 to 15) use the same device area to share data.

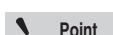
In this configuration, the device areas are assigned evenly to each station and the same data can be referenced from the device area of any station by writing the data of one's own station to the area of the same device number of a different station.



■ Number of devices that can be linked

The maximum number of devices that can be linked varies according to the number of devices that are connected as shown below.

| Maximum Number of Connected Devices | Link Size per Station | |
|-------------------------------------|-----------------------|---------------|
| | Bit Device | Word Device |
| 2 | 1 to 16 channels | 1 to 48 words |
| 4 | 1 to 8 channels | 1 to 24 words |
| 8 | 1 to 4 channels | 1 to 12 words |
| 16 | 1 or 2 channels | 1 to 6 words |



Regardless of the number of devices to link or the total number of devices, the number of occupied devices for the device area for data sharing is equivalent to the following amounts of data.

- Bit: 32 channels
- Word: 128 words

■ Range of devices that can be linked

The device ranges that can be used as device areas for data sharing are shown below.

The device range that is the same among all stations is used as the device area for data sharing.

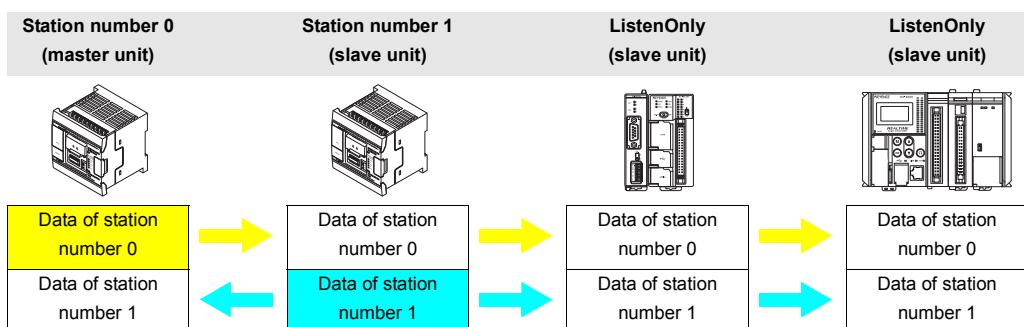
| Bit or Word | Type | Range (Leading Range) | Notation | Comment |
|-------------|------|----------------------------------|-------------|--|
| Bit | R | 1000 to 59915 (1000 to 56800) | Decimal | This is set in units of channels (the lower two digits are always "00"). |
| | B | 0 to 1FFF (0 to 1E00) | Hexadecimal | This is set in units of channels (the lower one digit is always "0"). |
| Word | DM | 0 to 32767 (0 to 32640) | Decimal | - |
| | W | 0 to 3FFF (0 to 3F80) | Hexadecimal | - |

■ ListenOnly function

Slave stations can use the ListenOnly function, in which the slave stations do not send their own data to other stations.

The characteristics of this function are shown below.

- Because link data is only received, there is no function for sending link data.
- Slave stations on which the ListenOnly function has been enabled are excluded from the management performed by the master station (station number 0). Therefore, if a slave station's power turns off or it is in an error state, such as because of a disconnection, this will not be detected by the master station.
- Because the station stops being a target for the data link, it does not have a station number. There is no need to set the station number.
- If there are only slave stations on which the ListenOnly function has been enabled, you cannot start communication with the master station. Be sure to prepare at least one slave station that has a station number (on which the ListenOnly function is disabled).
- Including slave stations on which the ListenOnly function has been enabled, you can connect up to 16 units.



Procedure prior to operation

This section describes the basic procedure to follow when using Serial PLC Link mode.

Configure the KV STUDIO Unit Editor settings

- Add a KV-N11L extension cassette or KV-NC20L extension adapter to the components.
- Set the operation mode to "Serial PLC Link mode."
- Set the station type to "Master" or "Slave."

"11-4 Setting Items on Unit Editor" (page 11-12)

When "Master" is selected

When "Slave" is selected

Configure the Serial PLC Link setting tool

- Set the maximum number of units to connect, the leading device to link to, and the number of devices on each station.
 "11-6 Serial PLC Link Setting Tool" (page 11-20)
- Save the reference information for slaves to a file.
 "Other Functions" (page 11-22)

Continue configuring the Unit Editor settings

- Set the station number and the ListenOnly function.
* You do not have to configure the settings on the Serial PLC Link setting tool.

(Import the file containing the reference information for slaves as a device comment)

- In KV STUDIO, on the "File" menu, click "Read text format cmnts" to import the comment.

Transfer the project that you have created to the base unit

For details on how to check the installation environment and on how to install units on the base unit, see "Chapter 2 UNIT INSTALLATION AND MAINTENANCE" (page 2-1).

In the same manner, configure the settings on the other KV Nano Series or KV-5000/3000 Series units that you will link to

For the KV-5000/3000 Series, see the "KV-LM21V User's Manual."

Check the operations

In KV STUDIO, on the "Monitor/Simulator" menu, click "Built-in Function Monitor" to check operations.*

"11-8 Using the Built-In Function Monitor to Check Operations" (page 11-27)

* Use version 7 or later (version 7.1 when using an extension adapter) of KV STUDIO.

11-2 Communication Specifications

This section describes the communication specifications of Serial PLC Link mode.

Communication Method

| Item | Description |
|-----------------------------------|---|
| Communication interface | RS-485 (2-wire type) |
| Communication speed | Fixed to 115200 bps |
| Maximum number of connected units | 16 (including the master station and stations on which the ListenOnly function is enabled)* |
| Transmission distance | Less than 1200 m* |
| Link device type | Bit device: B and R; word device: W and DM |
| Maximum number of linked devices | 128 words (bit device: 32 channels; word device: 96 words) |
| Data check method | CRC |

* If you are connecting a KV-5000/3000 Series unit, there are limits on the maximum transmission distance and maximum number of connected units.

"11-3 Wiring and Connections" (page 11-10)

Supported PLCs

■ KV Nano Series

| Base Unit | Extension Cassette/Adapter | Setup Software |
|--------------------------|--|--------------------------------|
| KV-N14** ³ | Extension cassette KV-N11L ¹ | KV STUDIO version 7 or later |
| KV-N24** ³ | | |
| KV-N40** ^{2,*3} | | |
| KV-N60** ^{2,*3} | | |
| KV-NC32T ³ | Extension adapter KV-NC20L (Port2 only) * ⁴ | KV STUDIO version 7.1 or later |

*1 Serial PLC Link mode cannot be used on the KV-N10L (RS-232C).

*2 Serial Link PLC mode can only be used on one port.

*3 The SERIAL PLC LINK MODE cannot be used in the built-in serial communication port (Port0).

*4 The SERIAL PLC LINK MODE cannot be used with KV-NC20L Port1 (RS-232C) or KV-NC10L.

■ KV-5000/3000 Series

| CPU Unit | Expansion Unit | Setup Software |
|----------------------|-----------------------|------------------------------|
| KV-5500 | KV-LM21V ² | KV STUDIO version 7 or later |
| KV-5000 | | |
| KV-3000 ¹ | | |

*1 The SERIAL PLC LINK MODE cannot be used in the built-in serial port.

*2 You cannot use Serial PLC Link mode when a KV-LM21V is connected to a KV-1000/700.



For details on the KV-5000/3000 Series, see the "KV-LM21V User's Manual."

Communication Period (Link Period)

The communication period (link period) is the time that elapses from a station sending a Serial PLC Link packet to the other stations, in order, to the station receiving a reply from all the other stations.

■ Communication period calculation

The communication period is calculated as shown below.

$$\begin{aligned}
 \text{Link bit size (bytes)} &= \text{Link channel size (words)} \times 2 \\
 \text{Link word size (bytes)} &= \text{Link word size (words)} \times 2 \\
 \text{Packet size (bytes)} &= 23 \text{ (bytes)} + \text{link bit size (bytes)} + \text{link word size (bytes)} \\
 \text{Packet transmission time (ms)} &= \text{Packet size (bytes)} / 10 + 1
 \end{aligned}$$

$$\text{Communication period (ms)} = (\text{Packet transmission time} + 2) \times \text{number of units}$$

* The number of units includes the master station.



If a communication error occurs, the communication period may be larger than the value calculated as shown above.



To check the actual measured communication period (link period), check CM6013 and CM7013 to check the current value, and check CM6014 and CM7014 to check the maximum value.



"Control Memory (CM)" (page 11-18)

Data Update Interval (I/O Response)

The data update interval (I/O response) is the time that elapses over the following sequence: a station sends an input signal to a partner station, the input signal is recognized by the partner station, the partner station sends an output signal to the original station in response, and the original station recognizes the output signal response.

■ Data update interval (I/O response) calculation

$$\text{Data update interval (ms)} = \text{Communication period} \times 2 + (\text{packet transmission time} + 2) \times 2 \\ + \text{scan time of the PLC that sent the data} \times 3 + \text{scan time of the PLC that will receive the data} \times 3^*$$

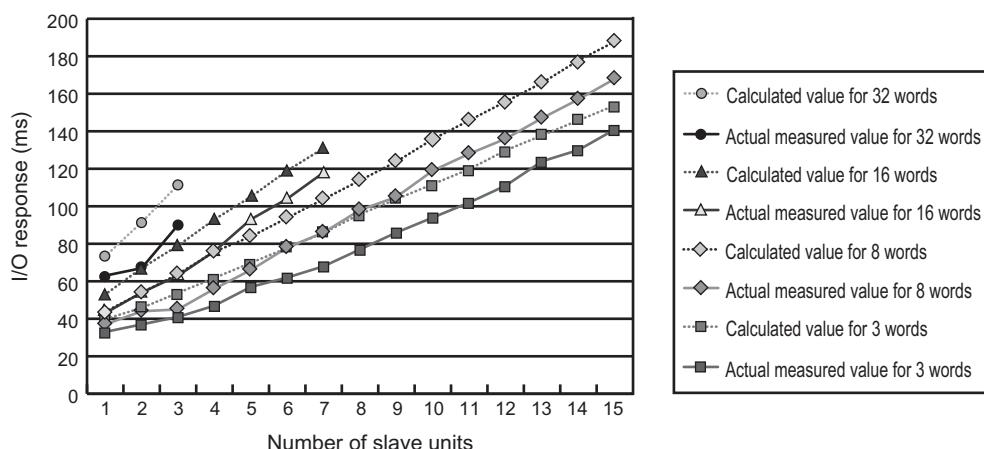
* If the scan time is less than 2 ms, perform the above calculation with a scan time of 2 ms.



- If a communication error occurs or if there is a station number that is not linked, the update interval may be longer than the value calculated as shown above.
- If a large load is being applied to the base unit's processing such as due to frequent interrupt processing, the update interval may be longer than the value calculated as shown above. In this situation, click "Scantime related" in the "CPU system setting" dialog box to increase the END processing time setting.

■ Calculated and actual measured values of the data update interval (I/O response)

Given a scan time of 1 ms for the scan time of the linked PLCs, the calculated values (worst-case values) and actual measured values of the data update interval in terms of number of slave units and in terms of link data size are shown below.



* The actual measured values fluctuate depending on the load condition of the base unit's processing, so use these values as a reference.

Precautions

■ Communication during PROG mode

Serial PLC Link communication will be executed even if the base unit is in PROG mode.

■ Data simultaneity

Data simultaneity is maintained in units of stations, so all the bit and word data within a unit defined by the same station number is updated simultaneously.

- * If there are KV-5000/3000 Series units mixed in with the other units and processing is performed within an interrupt program, there is no simultaneity between the bit and word devices.

■ Operation when a communication error occurs

● Automatic recovery of communication

When a communication error occurs, the master station retries communication at fixed intervals. Therefore, the data link will start again automatically when the cause of the error is removed.

● Link communication with other stations when a communication error occurs

If communication between the master station and a slave station to which it is connected is cut off (because of disconnections, changes to station numbers, changes to unit setup information, power being turned off, or other reasons), a communication error may occur, and a link error may temporarily occur between the master station and other slave stations, which are operating normally.



To lower the link error detection sensitivity, use the Serial PLC Link setting tool to increase the number of retries.



"11-9 Operation When an Error Occurs and Error Remedies" (page 11-30)

■ Limitations when using the Serial PLC Link function

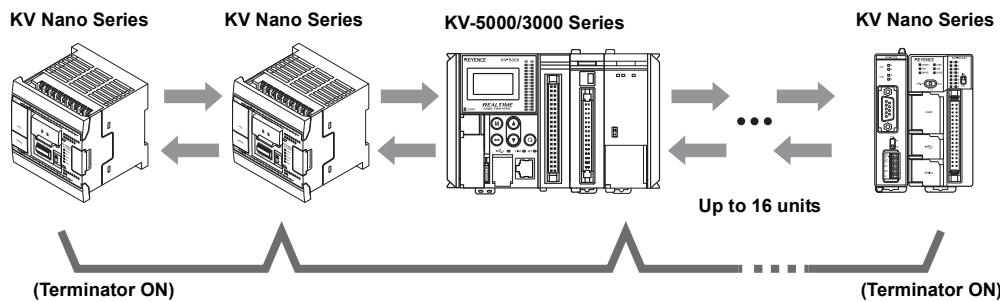
You can only use the Serial PLC Link function on one port per base unit.

Even if you use a base unit to which two extension cassettes can be connected, you can only use the Serial PLC Link function on one of these two cassettes.

11-3 Wiring and Connections

This section describes how to perform wiring and make connections when you use Serial PLC Link mode.

Connection Method



Point

- Wire the PLCs in series (one-stroke wiring).
- Use the same type of cable to perform all wiring. Do not use a mixture of multiple types of cables to perform the wiring.
- Be sure to turn OFF the terminators of the PLCs that are not on the ends.
- When wiring, be sure to turn ON the terminators of the KV Nano Series units that are connected on both ends.
- When wiring, be sure to turn OFF the terminators of the KV-5000/3000 Series units that are connected on both ends. Then, connect external terminating resistances ($220\ \Omega$) between SA and SB.

Reference

For details on the KV-5000/3000 Series, see the "KV-LM21V User's Manual."

■ Maximum transmission distance

The maximum transmission distance is limited by the number of connected KV-5000/3000 units (0 to 3 units) as shown below.

| Number of Connected KV-5000/3000 Series Units | Maximum Transmission Distance |
|---|-------------------------------|
| 0 | 1200 m |
| 1 | 1000 m |
| 2 | 500 m |
| 3 | -* |
| 4 or more | - |

* You cannot connect 4 or more KV-5000/3000 Series units.

Connect a total of 16 or less KV Nano Series and KV-5000/3000 units.

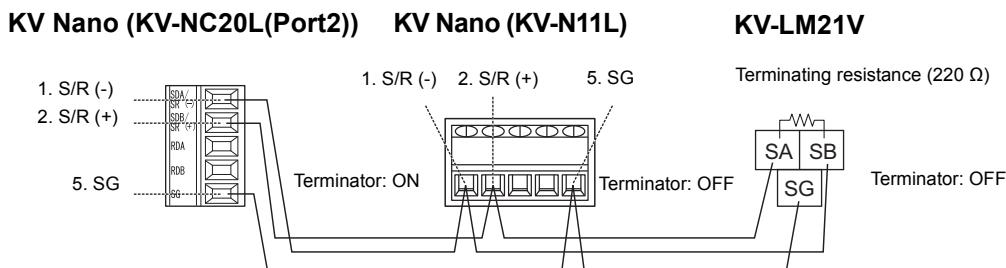
Wiring Method

■ Usable cables

When you are using Serial PLC Link mode, be sure to use the dedicated cables shown in the following table to perform the wiring. Operations cannot be guaranteed if you use cables other than those shown here.

| Manufacturer | Product Name |
|---------------------------------------|---|
| Furukawa Electric Co., Ltd. | KPEV-SB (1P) (2-wire, shielded, twisted-pair; stranded wire) *Conductor cross-sectional area: 0.5 mm ² |
| Nihon Electric Wire & Cable Co., Ltd. | KNPEV-SB (1P) (2-wire, shielded, twisted-pair; stranded wire) *Conductor cross-sectional area: 0.5 mm ² |

■ Wiring examples



11-4 Setting Items on Unit Editor

When using an extension cassette, you can connect the KV-N11L that is required to use the Serial PLC Link function to the extension cassette (left, Port1) or to the extension cassette (right, Port2).

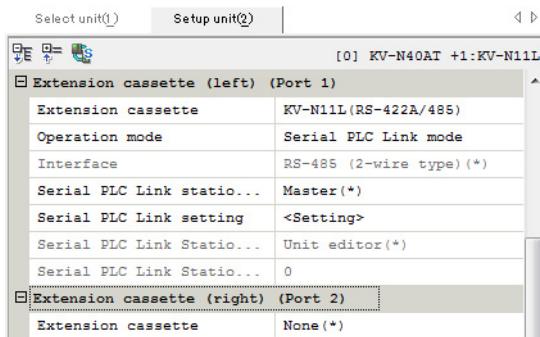
Use KV-NC20L (Port2) when using an extension adapter.

"2-5 Using Unit Editor to Configure Settings" (page 2-12)

Port to Configure

When using an extension cassette, you can connect the KV-N11L that is required to use the Serial PLC Link function to the extension cassette (left, Port1) or to the extension cassette (right, Port2).

Use KV-NC20L (Port2) when using an extension adapter.



Common Settings

The following are common setting items that are shared regardless of the station type.

| Setting | Setting Content | Description |
|--------------------|-----------------------------|--|
| Extension cassette | KV-N11L(RS-422A/485) | To use the Serial PLC Link function, you have to use a KV-N11L extension cassette or a KV-NC20L extension adapter. |
| Extension adapter | KV-NC20L(RS-232C/422A/485)* | |
| Operation mode | Serial PLC Link mode | |
| Interface | RS-485 (2-wire type) | This is a fixed value, so you cannot change the setting. |

* The SERIAL PLC LINK MODE can be selected for Port2 of KV-NC20L.

Master Station

Settings for configuring the master station are shown below.

| Setting | Setting Content | Description |
|--|---|---|
| Serial PLC Link station type | Master | Select this value when you want to use the unit as the master station. |
| Serial PLC Link setting | Click on the right side of the screen to start the "Serial PLC Link setting tool." | You can only start the Serial PLC Link setting tool when "Serial PLC Link station type" is set to "Master." When it is set to "Slave," you do not need to configure the settings. |
| Serial PLC Link Station No. setting method | Unit editor | This is a fixed value, so you cannot change the setting. |
| Serial PLC Link Station No. | 0 | This is a fixed value, so you cannot change the setting. |

Slave Station

Settings for configuring the slave stations are shown below.

| Setting | Setting Content | Description |
|--|--|---|
| Serial PLC Link station type | Slave | Select this value when you want to use the unit as a slave station (ListenOnly). |
| Serial PLC Link setting | - | You can only start the Serial PLC Link setting tool when "Serial PLC Link station type" is set to "Master." When it is set to "Slave," you do not need to configure the settings. |
| Serial PLC Link Station No. setting method | Unit editor <small>Default value</small> or Ladder | Setting this to "Ladder" enables you to set "Serial PLC Link Station No." from a ladder program.  "11-7 Performing Operations from a Ladder Program" (page 11-24) |
| Serial PLC Link Station No. | 1 to 15 | When "Serial PLC Link Station No. setting method" is set to "Ladder" and when "ListenOnly setting" is set to "Enable," you do not have to specify this setting. |
| ListenOnly setting | Disable <small>Default value</small> or Enable | When this is set to "Enable," the station only receives data. |

11-5 Lists of Devices Used

This section gives lists of the special devices (CR and CM) that are related to the Serial PLC Link function.

| | | | |
|----|------------|---|----------------------|
| CR | 4 channels | Port1 (extension cassette (left)/extension adapter (upper)): | Starting with CR6600 |
| | | Port2 (extension cassette (right)/extension adapter (lower)): | Starting with CR7200 |
| CM | 18 words | Port1 (extension cassette (left)/extension adapter (upper)) : | Starting with CM6000 |
| | | Port2 (extension cassette (right)/extension adapter (upper)): | Starting with CM7000 |



The SERIAL PLC LINK MODE can be used with Port2 of KV-NC20L.

Control Relay (CR)

| CR Number | | Name | Target | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|------------------|------------------|---|-------------------------------|--|---|----------|
| Port1 (Left) | Port2 (Right) | | | | | |
| CR6600 to CR6603 | CR7200 to CR7203 | - | - | - | Reserved for the system. | - |
| CR6604 | CR7204 | Port1 or Port2, station number setting request | Slave | R/W | ON: A request is made to set the slave's station number. | 11-24 |
| CR6605 | CR7205 | - | - | - | Reserved for the system. | - |
| CR6606 | CR7206 | Port1 or Port2, link separation request | Master | R/W | ON: A request is made to separate or restore the links of slave units. | 11-25 |
| CR6607 | CR7207 | - | - | - | Reserved for the system. | - |
| CR6608 | CR7208 | Port1 or Port2, maximum link period clear request | Master | R/W | ON: The maximum communication period is cleared. | 11-7 |
| CR6609 | CR7209 | Port1 or Port2, number of line errors clear request | Master, slave, and ListenOnly | R/W | ON: The number of line errors that have occurred is cleared to zero. | - |
| CR6610 to CR6615 | CR7210 to CR7215 | - | - | - | Reserved for the system. | - |
| CR6700 | CR7300 | Port1 or Port2, link ready | Master and slave | R | ON: The unit is in a state in which it can be linked to. OFF: The unit is not in a state in which it can be linked to. Master: There is no settings file. Slave: The station number is invalid. * When the ListenOnly function is enabled, this is always turned OFF. | - |
| CR6701 to CR6703 | CR7301 to CR7303 | - | - | - | Reserved for the system. | - |

| CR Number | | Name | Target | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|------------------|------------------|--|-------------------------------|--|--|-------------|
| Port1 (Left) | Port2 (Right) | | | | | |
| CR6704 | CR7304 | Port1 or Port2, station number setting complete | Slave | R | ON: The setting change has been completed. OFF: This relay is turned OFF when the setting request relay changes from ON to OFF. | 11-24 |
| CR6705 | CR7305 | Port1 or Port2, Station number setting failure | Slave | R | ON: The setting of the station number failed. | 11-24 |
| CR6706 | CR7306 | Port1 or Port2, link separation complete | Master | R | ON: The link separation has been completed. OFF: This relay is turned OFF when the link separation request relay changes from ON to OFF. | 11-25 |
| CR6707 | CR7307 | - | - | - | Reserved for the system. | - |
| CR6708 | CR7308 | Port1 or Port2, maximum link period clear complete | Master | R | ON: The clear processing has been completed. OFF: This relay is turned OFF when the corresponding clear request relay changes from ON to OFF. | 11-7 |
| CR6709 | CR7309 | Port1 or Port2, number of line errors clear complete | Master, slave, and ListenOnly | R | ON: The clear processing has been completed. OFF: This relay is turned OFF when the corresponding clear request relay changes from ON to OFF. | - |
| CR6710 | CR7310 | - | - | - | Reserved for the system. | - |
| CR6711 | CR7311 | Port1 or Port2, line error | Master, slave, and ListenOnly | R | ON: This relay turns ON when a parity, framing, or CRC error occurs. OFF: This relay turns OFF when a normal packet is received. | - |
| CR6712 to CR6715 | CR7312 to CR7315 | - | - | - | Reserved for the system. | - |
| CR6800 | CR7400 | Port1 or Port2, link communication in progress with master | Master, slave, and ListenOnly | R | ON: Link communication is in progress. | - |

| CR Number | | Name | Target | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|-----------------|------------------|--|----------------------------------|--|---|-------------|
| Port1 (Left) | Port2 (Right) | | | | | |
| CR6801 | CR7401 | Port1 or Port2, link communication in progress with station number 1 | Master, slave, and ListenOnly | R | ON: Link communication is in progress. | - |
| CR6802 | CR7402 | Port1 or Port2, link communication in progress with station number 2 | | | | |
| CR6803 | CR7403 | Port1 or Port2, link communication in progress with station number 3 | | | | |
| CR6804 | CR7404 | Port1 or Port2, link communication in progress with station number 4 | | | | |
| CR6805 | CR7405 | Port1 or Port2, link communication in progress with station number 5 | | | | |
| CR6806 | CR7406 | Port1 or Port2, link communication in progress with station number 6 | | | | |
| CR6807 | CR7407 | Port1 or Port2, link communication in progress with station number 7 | | | | |
| CR6808 | CR7408 | Port1 or Port2, link communication in progress with station number 8 | | | | |
| CR6809 | CR7409 | Port1 or Port2, link communication in progress with station number 9 | | | | |
| CR6810 | CR7410 | Port1 or Port2, link communication in progress with station number 10 | | | | |
| CR6811 | CR7411 | Port1 or Port2, link communication in progress with station number 11 | | | | |
| CR6812 | CR7412 | Port1 or Port2, link communication in progress with station number 12 | | | | |
| CR6813 | CR7413 | Port1 or Port2, link communication in progress with station number 13 | | | | |
| CR6814 | CR7414 | Port1 or Port2, link communication in progress with station number 14 | | | | |
| CR6815 | CR7415 | Port1 or Port2, link communication in progress with station number 15 | | | | |

| CR Number | | Name | Target | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|-----------------|------------------|--|----------------------------------|--|---|-------------|
| Port1 (Left) | Port2 (Right) | | | | | |
| CR6900 | CR7500 | Port1 or Port2, error on link to master | Master, slave, and ListenOnly | R | ON: The link communication failed.*1 | - |
| CR6901 | CR7501 | Port1 or Port2, error on link to station number 1 | | | | |
| CR6902 | CR7502 | Port1 or Port2, error on link to station number 2 | | | | |
| CR6903 | CR7503 | Port1 or Port2, error on link to station number 3 | | | | |
| CR6904 | CR7504 | Port1 or Port2, error on link to station number 4 | | | | |
| CR6905 | CR7505 | Port1 or Port2, error on link to station number 5 | | | | |
| CR6906 | CR7506 | Port1 or Port2, error on link to station number 6 | | | | |
| CR6907 | CR7507 | Port1 or Port2, error on link to station number 7 | | | | |
| CR6908 | CR7508 | Port1 or Port2, error on link to station number 8 | | | | |
| CR6909 | CR7509 | Port1 or Port2, error on link to station number 9 | | | | |
| CR6910 | CR7510 | Port1 or Port2, error on link to station number 10 | | | | |
| CR6911 | CR7511 | Port1 or Port2, error on link to station number 11 | | | | |
| CR6912 | CR7512 | Port1 or Port2, error on link to station number 12 | | | | |
| CR6913 | CR7513 | Port1 or Port2, error on link to station number 13 | | | | |
| CR6914 | CR7514 | Port1 or Port2, error on link to station number 14 | | | | |
| CR6915 | CR7515 | Port1 or Port2, error on link to station number 15 | | | | |

*1 The operation of the link error relays is shown below.

- For the master station, the link error occurs on the slave station to which the link failed.
- For slave stations, if the slave station cannot form a link with the master station, the error on link to master relay (CR6900 or CR7500) is turned ON.
- For slave stations on which the ListenOnly function has been enabled, if the slave station cannot correctly recognize a packet from the master station, the error on link to master relay (CR6900 or CR7500) is turned ON.
- When the master station is turned on, it does not detect slave station errors for approximately 15 seconds.

 "11-9 Operation When an Error Occurs and Error Remedies" (page 11-30)

Control Memory (CM)

| CM Number | | Name | Target | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|-----------------|------------------|---|-------------------------------|--|---|----------|
| Port1 (Left) | Port2 (Right) | | | | | |
| CM6000 | CM7000 | Port1/2 Request station number | Slave | R/W | This stores the number of the station to set. Range: 1 to 15. | 11-22 |
| CM6001 | CM7001 | Port1 or Port2, link separation request bit table | Master | R/W | Turn ON the bits of the stations whose links you want to separate, and turn OFF the bits of the stations whose links you want to restore. | 11-24 |
| CM6002 | CM7002 | - | - | - | Reserved for the system. | - |
| CM6003 | CM7003 | Port1 or Port2, number of line errors | Master, slave, and ListenOnly | R | This stores the number of times that line errors have occurred. Range: 0 to 65535. You can clear this value by using the number of line errors clear request relay. | - |
| CM6004 | CM7004 | Port1 or Port2, set station number | Master, slave, and ListenOnly | R | This stores the number of the station that is being operated. 0 to 15: The number of the station being operated. FFFF (H): ListenOnly or not set. | 11-24 |
| CM6005 | CM7005 | Port1 or Port2, set maximum number of linked stations | Master, slave, and ListenOnly | R | These settings are configured using the Serial PLC Link setting tool. (You cannot write these values directly.) | 11-20 |
| CM6006 | CM7006 | Port1 or Port2, set link size per station (in bits) | | | | |
| CM6007 | CM7007 | Port1 or Port2, set link size per station (in words) | | | | |
| CM6008 | CM7008 | Port1 or Port2, set link bit device code | | | | |
| CM6009 | CM7009 | Port1 or Port2, set leading link bit device | | | | |
| CM6010 | CM7010 | Port1 or Port2, set link word device code | | | | |
| CM6011 | CM7011 | Port1 or Port2, set leading link word device | | | | |

| CM Number | | Name | Target | Attribute R: Read Only R/W: Read/Write | Description | See Page |
|-----------------|------------------|---|----------------------------------|--|--|-------------|
| Port1 (Left) | Port2 (Right) | | | | | |
| CM6012 | CM7012 | Port1 or Port2, link setting update counter | Master, slave, and ListenOnly | R | This stores the number of times that the link settings (CM6005 to CM6011 or CM7005 to CM7011) have been updated. | - |
| CM6013 | CM7013 | Port1 or Port2, current link period value (ms) | Master | R | This stores the current value of the link period. | 11-7 |
| CM6014 | CM7014 | Port1 or Port2, maximum link period value (ms) | Master | R | This stores the maximum value of the link period. You can clear this value by using the maximum link period clear request relay or the built-in function monitor. | 11-7 |
| CM6015 | CM7015 | Port1 or Port2, link registration bit table | Master | R | The bits that correspond to the numbers of the slave stations that have been specified as link targets using the Serial PLC Link setting tool are turned ON. | 11-24 |
| CM6016 | CM7016 | Port1 or Port2, link separation in progress bit table | Master | R | The bits that correspond to the numbers of the slave stations whose links are being separated, which you specified using the link separation request bit table and relay, are turned ON. | 11-25 |

11-6 Serial PLC Link Setting Tool

This section describes the tool that is used to configure the detailed settings of the Serial PLC Link function.

This tool is installed in KV STUDIO as standard, so it can be started from KV STUDIO.

Startup Method

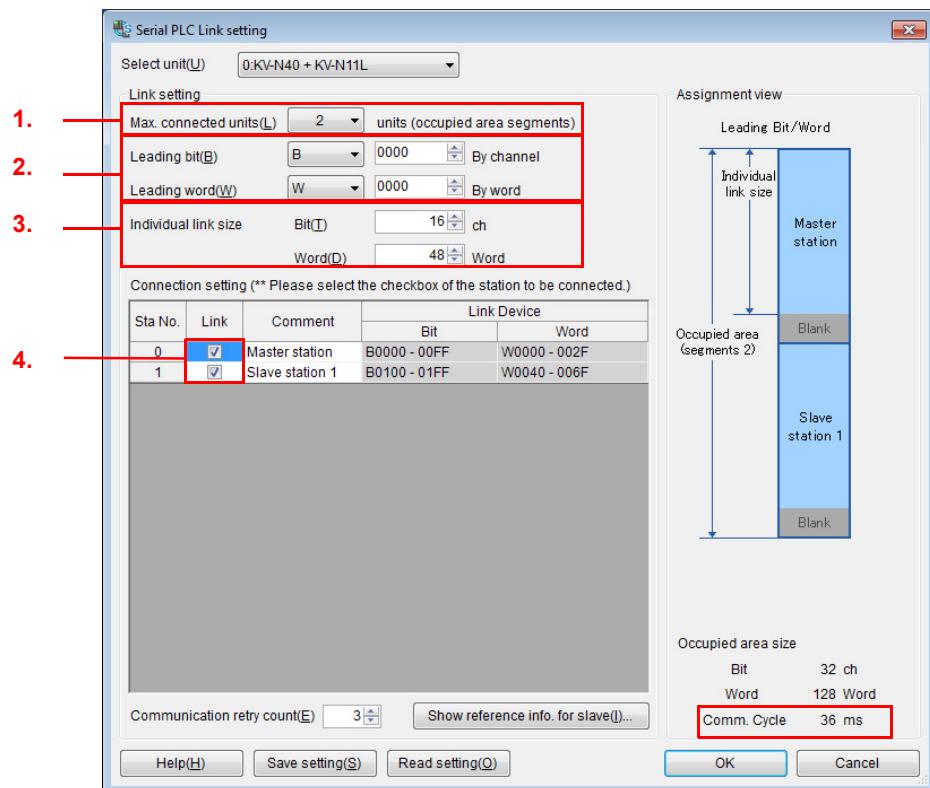
Use one of the following methods to display the setting window.

- On the "Tool" menu, click "Serial PLC Link setting."
- Click .
- Click  in the Unit Editor's Serial PLC Link settings.
- Click  in the Unit Editor.

 You cannot start the setting tool if a KV-N11L extension serial communication cassette or KV-NC20L extension serial communication adapter whose operation mode is set to "Serial PLC Link" is not present.

Setting Procedure

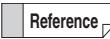
Configure the settings in the order shown below to configure the Serial PLC Link function.



 The settings cannot be changed during monitoring. To change the settings, first switch to editor mode, and then start the tool.

1 Set the "Max. connected units."

You can set the maximum number of connected units to 2, 4, 8, or 16.

 Do not include the slave stations whose ListenOnly function has been enabled in the maximum number of connected units that you set here.

The link areas of bit and word devices that can be set per station are limited according to the maximum number of connected units as shown below.

| Maximum Number of Connected Units | Link Size per Station | |
|-----------------------------------|-----------------------|---------------|
| | Bit Device | Word Device |
| 2 | 1 to 16 channels | 1 to 48 words |
| 4 | 1 to 8 channels | 1 to 24 words |
| 8 | 1 to 4 channels | 1 to 12 words |
| 16 | 1 or 2 channels | 1 to 6 words |

Regardless of the setting that you make, the bit devices occupy 32 channels and the word devices occupy 128 words.

2 Set the type and number of the leading device to link.

The types and ranges of the devices that can be set are shown below.

| Bit or Word | Type | Range (Leading Range) | Notation | Comment |
|-------------|------|----------------------------------|--------------|---|
| Bit | R | 1000 to 59915 (1000 to 56800) | Decimal | This is set in units of channels (the lower two digits are always "00"). |
| | B | 0 to 1FFF (0 to 1E00) | Hexa-decimal | This is set in units of channels (the lower one digit is always "0"). |
| Word | DM | 0 to 32767 (0 to 32640) | Decimal | - |
| | W | 0 to 3FFF (0 to 3F80) | Hexa-decimal | - |

3 Set the number of devices per station to link.

The maximum link size that can be set is determined on the basis of the maximum number of connected units, so enter the number of devices when the number of devices that require links is small.

The smaller the link size, the faster that data is updated.

The communication period is displayed in the bottom right of the Serial PLC Link setting tool.

 "Communication Period (Link Period)" (page 11-7)

4 If the actual number of units that you will connect is smaller than the maximum number of connected units that you specify, in the "Link" column of the "Connection setting" table, select only the check boxes that correspond to the stations that you will connect.

The smaller the number of units that are linked, the faster that data is updated.

The communication period is displayed in the bottom right of the Serial PLC Link setting tool.

 "Communication Period (Link Period)" (page 11-7)

Other Functions

■ Select unit

The base unit and the extension cassettes that are using the Serial PLC Link function are displayed.
There is no need to perform any particular operations on these units.

■ Communication retry count

Set the number of communication retries to a value between 1 and 10. The default value is 3.

■ Show reference information for slave

Use this reference information during link area referencing when you create ladder programs on the slave side.

Also, text files that you save this reference information to can be imported as device comments by KV STUDIO.

In KV STUDIO, on the "File" menu, click "Read text format cmnts" to import the comment.

Example of reference information for slaves

```
' < Serial PLC Link area >
'
-----
'| Station 0:B0000 to 00FF:W0000 to 002F
|
-----
'| Station 1:B0100 to 01FF:W0040 to 006F
|
'
' < How to import the reference information as a device comment >
'
'1. Start KV STUDIO, and read a slave project.
'2. On the "File" menu, click "Read text format cmnts" to read a saved file.
'
' < Device comments>
'
W0000    „Master station_00
W0001    „Master station_01
W0002    „Master station_02
W0003    „Master station_03
W0004    „Master station_04
'
```

■ Help

Click this button to display the help file related to the Serial PLC Link setting tool.

The contents of the help file are the same as those shown in "11-6 Serial PLC Link Setting Tool" in this manual.

■ Save setting

Click this to save the settings of the Serial PLC Link function. The file extension is ".srb."

Use this function when you want to reuse the settings you are editing with another extension cassette (Port), extension adapter KV-NC20L (Port2), KV-LM21V, or project and in other similar situations.

■ Read setting

Click this to read Serial PLC Link function settings that have been saved previously. The file extension is ".srb."

Use this function when you want to reuse settings that were used with another extension cassette (Port), extension adapter KV-NC20L (Port2), high-speed multi-link unit, KV-LM21V or project in the project that you are editing and in other similar situations.



Point

You cannot use the Serial PLC Link function with two extension cassettes at the same time.

11-7 Performing Operations from a Ladder Program

This section describes how to configure settings related to and how to operate the Serial PLC Link from a ladder program.

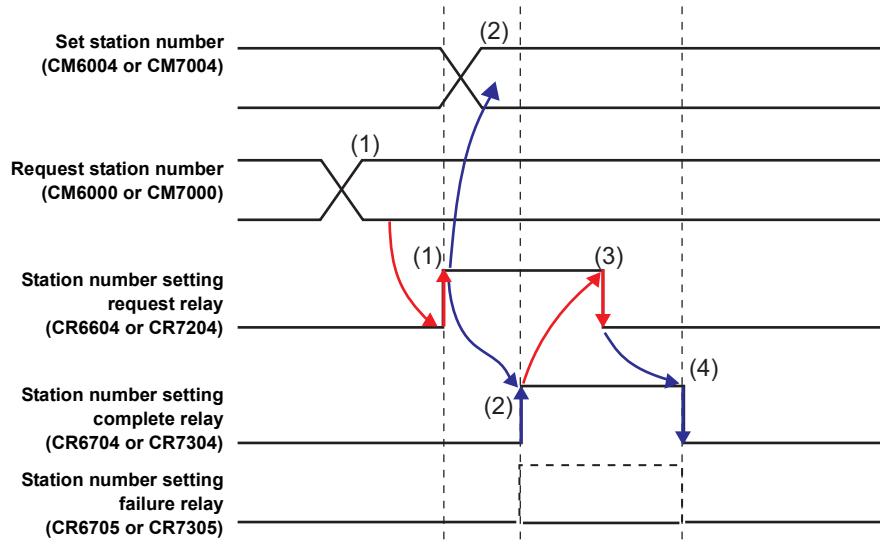
Changing the Station Number from a Ladder Program

When you are using the unit as a slave station, setting "Serial PLC Link Station No. setting method" to "Ladder" enables you to change the station number from a ladder program.

■ Timing of station number changes

When the Port1 or Port2 station number setting request relay (CR6604 or CR7204) changes from OFF to ON, the KV Nano Series reads the value specified by the Port1 or Port2 request station number (CM6000 or CM7000), and then changes the appropriate setting.

■ Station number change method



(1) Ladder program The number of the station that you want to set (N: 1 to 15) is stored in request station number (CM6000 or CM7000), and then the station number setting request relay (CR6604 or CR7204) is turned ON.

(2) PLC The request station number value is obtained, and the PLC corresponding to the new station number starts. The station number is stored in set station number (CM6004 or CM7004), and then the station number setting complete relay (CR6704 or CR7304) is turned ON.

* In the following situations, the number stored in the Port1 or Port2 request station number (CM6000 or CM7000) is not applied to the station number, and the Port1 or Port2 station number setting failure relay (CR6705 or CR7305) is turned ON.

- If "Serial PLC Link Station No. setting method" is set to "Unit editor."
- If the stored value is outside of the setting range (1 to 15).
- If the PLC is the master station.
- If the ListenOnly function is enabled.

If an attempt to change the station number while there is already a set station number fails, operations will continue with the set station number.

(3) Ladder program The station number setting request relay (CR6604 or CR7204) is turned OFF.

(4) PLC The station number setting complete relay (CR6704 or CR7304) is turned OFF.

Separating and Restoring Links from a Ladder Program

When the unit is being used as the master station, you can separate and restore links to slave stations from a ladder program.



You can separate and restore links from the built-in function monitor as well.



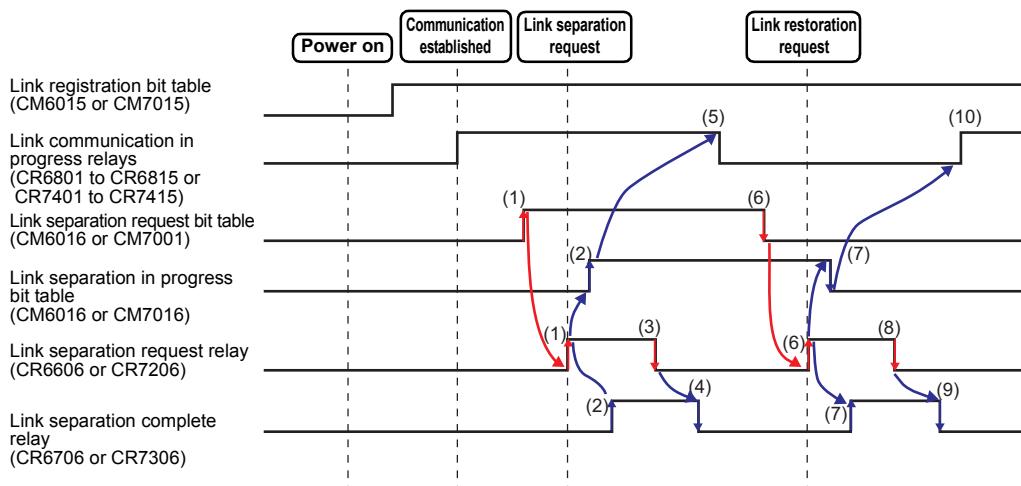
"11-8 Using the Built-In Function Monitor to Check Operations" (page 11-27)

■ Timing of link separation and restoration

When the Port1 or Port2 link separation request relay (CR6606 or CR7206) changes from OFF to ON, the KV Nano Series reads the ON and OFF information specified by the Port1 or Port2 link separation request bit table (CM6001 or CM7001), and then separates and restores links as necessary.

To judge whether communication links have actually been separated or restored, check the link communication in progress relays (CR6801 to CR6815 or CR7401 to CR7415).

■ Link separation and restoration method



● Separation procedure

- (1) Ladder program The bits corresponding to the slave stations that you want to separate from link communication are turned ON in the link separation request bit table (CM6001 or CM7001), and then the link separation request relay (CR6606 or CR7206) is turned ON.
Example: "0010H" indicates that slave station number 4 will be separated.
- (2) PLC The value of the link separation request bit table (CM6001 or CM7001) is acquired, the ON and OFF information is stored in the link separation in progress bit table (CM6016 or CM7016), and then the link separation complete relay (CR6706 or CR7306) is turned ON.
- (3) Ladder program The link separation request relay (CR6606 or CR7206) is turned OFF.
- (4) PLC The link separation complete relay (CR6706 or CR7306) is turned OFF.
- (5) PLC The slave stations whose bits are ON in the link separation in progress bit table (CM6001 or CM7001) are removed from the link targets, and the corresponding link communication in progress relays (CR6801 to CR6815 or CR7401 to CR7415) are turned OFF.
* If a link error occurs on the corresponding slave station, the matching link error relay (CR6901 to CR6915 or CR7501 to CR7515) is turned OFF.

● Restoration procedure

- (6) Ladder program The bits corresponding to the slave stations that you want to restore to link communication are turned OFF in the link separation request bit table (CM6001 or CM7001), and then the link separation request relay (CR6606 or CR7206) is turned ON.
- (7) PLC The value of the link separation request bit table (CM6001 or CM7001) is acquired, the ON and OFF information is stored in the link separation in progress bit table, and then the link separation complete relay (CR6706 or CR7306) is turned ON.
- (8) Ladder program The link separation request relay (CR6606 or CR7206) is turned OFF.
- (9) PLC The link separation complete relay (CR6706 or CR7306) is turned OFF.
- (10) PLC The slave stations whose bits are OFF in the link separation in progress bit table (CM6001 or CM7001) are added to the link targets, and processing is performed to restore their link communication.
After link communication has been established, the corresponding link communication in progress relays (CR6801 to CR6815 or CR7401 to CR7415) are turned ON.

11-8 Using the Built-In Function Monitor to Check Operations

You can use the built-in function monitor of Ladder Support Software KV STUDIO to monitor information such as the setting information, error information, and control line status of the serial communication ports that can be used with the KV Nano Series.

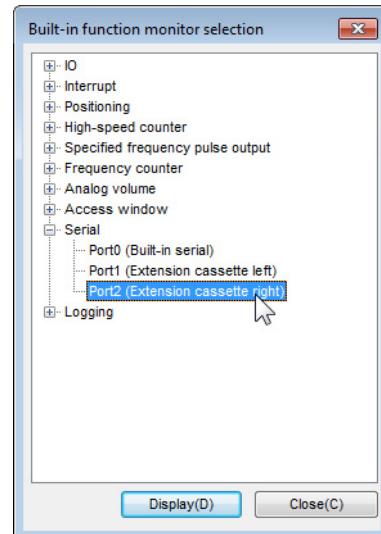
Startup Method

Follow the procedure below to display the monitor of the serial communication function from KV STUDIO.

- 1 While using KV STUDIO to perform monitoring, on the "Monitor/Simulator" menu, click "Built-in Function Monitor."

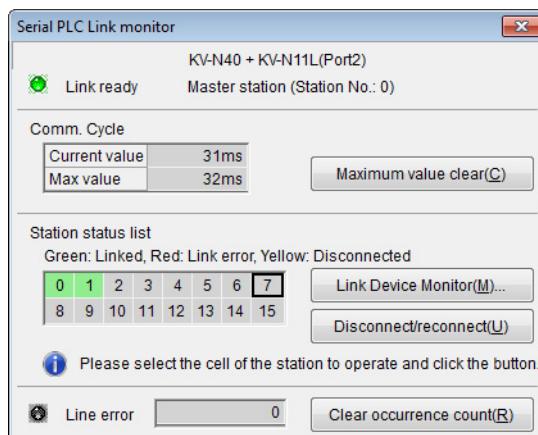
Alternative procedure

- Right-click the base unit in the workspace, and then click "Built-in Function Monitor" in the menu that appears.
- The "Built-in function monitor selection" dialog box appears.



- 2 In the "Built-in function monitor selection" dialog box, select the Port (for an extension cassette) that the KV-N11L is installed in or KV-NC20L (Port2), and then click "Display." The "Serial PLC Link monitor" dialog box appears.

■ Master station



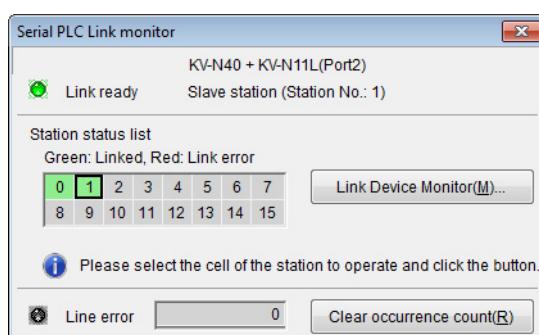
11-8 Using the Built-In Function Monitor to Check Operations

| Item | Details | Description |
|---------------------|---------------------------------|---|
| Link ready | Status indicator lamp | Use this to monitor the status of the link ready relay (CR6700 or CR7300). Lit in green: The link function is enabled. Off: The link function is not enabled. |
| | Station type and number display | This displays the type (master or slave) and number of the station. |
| Comm. Cycle | Current value | This displays the current value (CM6013 or CM7013) of the link period. |
| | Max value | This displays the maximum value (CM6014 or CM7014) of the link period. |
| | Maximum value clear | Click this to clear the maximum value of the link period. |
| Station status list | 0 to 15 | This displays the status of the links to each station. Lit in green: Link communication is in progress. Lit in red: A link error is occurring. Lit in yellow: Link separation is in progress. Off: The link is not registered. |
| | Link Device Monitor | Click this to display the link device monitor of the station whose number you have selected in the station status list. |
| | Disconnect/reconnect | This can only be used on the master station. After you select a station in the station status list, if link communication is in progress with the station or if a link error is occurring in the link to the station, click this button to change the status to separated. If the status was already separated, clicking this button restores the link. |
| Line error | Status indicator lamp | Use this to monitor the status of the line error relay (CR6709 or CR7309). Lit in red: A parity, framing, or CRC error has occurred. Off: Normal operation. |
| | Number of line errors | Use this to monitor the number of line errors (CM6003 or CM7003). |
| | Clear occurrence count | Click this to clear the number of line errors. |



For error remedies, see "11-9 Operation When an Error Occurs and Error Remedies" (page 11-30).

■ Slave station



| Item | Details | Description |
|---------------------|---------------------------------|--|
| Link ready | Status indicator lamp | Use this to monitor the status of the link ready relay (CR6700 or CR7300). Lit in green: The link function is enabled. Off: The link function is not enabled. |
| | Station type and number display | This displays the type (master or slave) and number of the station. |
| Station status list | 0 to 15 | This displays the status of the links to each station. Lit in green: Link communication is in progress. Lit in red: A link error is occurring. Off: The link is not registered. |
| | Link Device Monitor | Click this to display the link device monitor of the station whose number you have selected in the station status list. |
| Line error | Status indicator lamp | Use this to monitor the status of the line error relay (CR6709 or CR7309). Lit in red: A parity, framing, or CRC error has occurred. Off: Normal operation. |
| | Number of line errors | Use this to monitor the number of line errors (CM6003 or CM7003). |
| | Clear occurrence count | Click this to clear the number of line errors. |



For error remedies, see "11-9 Operation When an Error Occurs and Error Remedies" (page 11-30).

11-9 Operation When an Error Occurs and Error Remedies

This section describes remedies for situations in which you cannot share data normally using the Serial PLC Link function, such as when an error occurs.

Remedies for Common Problems

■ No links can be established

First check the master station, and ensure that it is operating normally.

If that does not resolve the problem, check the slave stations.

 "Master station" (page 11-31)

■ Links cannot be established to some slave stations

First, use the master station to check on which slave stations errors are occurring. Then, check the corresponding slave stations.

There may also be problems with the Serial PLC Link settings of the master station.

 "Slave station" (page 11-32)

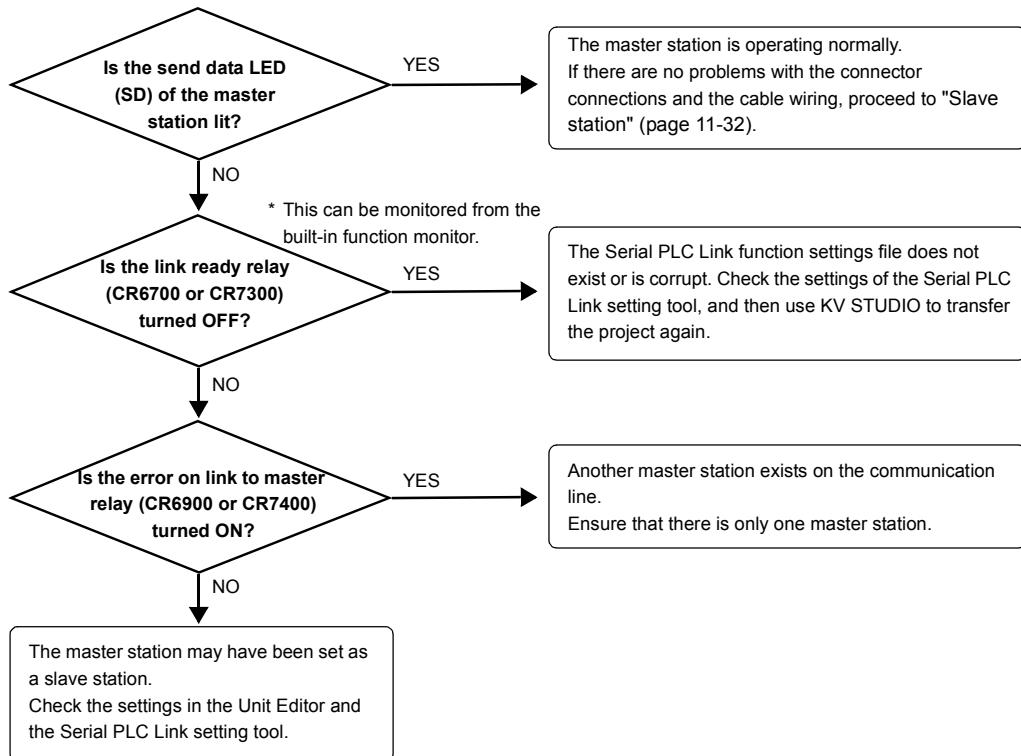
■ A link error has occurred

Check whether there are problems with the connector connection and cable wiring, check the ON/OFF status of the terminator, check the noise environment, and check for similar problems.

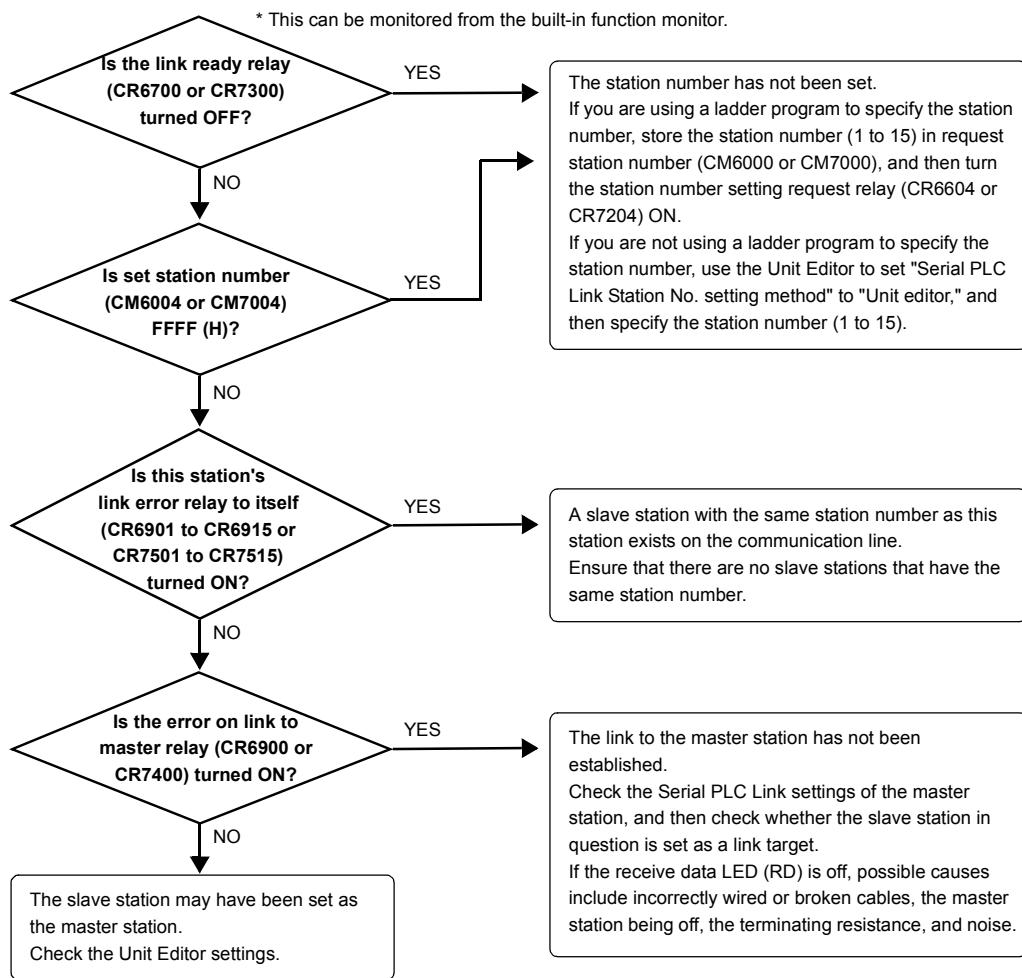
 "11-3 Wiring and Connections" (page 11-10)

General Troubleshooting

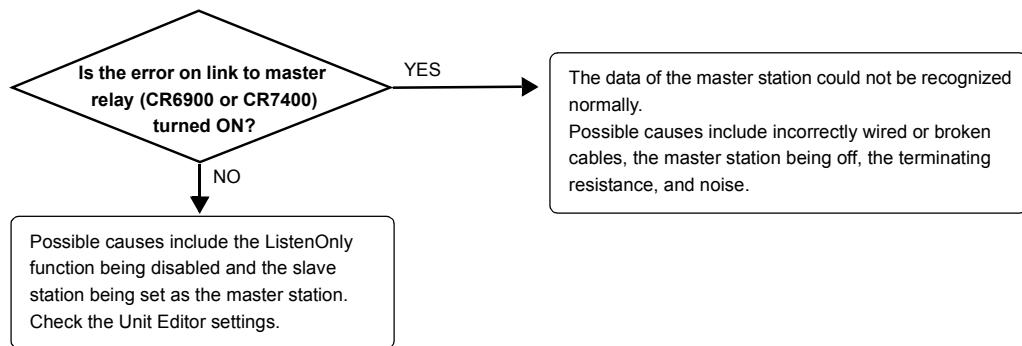
■ Master station



■ Slave station



■ When the ListenOnly function is enabled



APPENDICES

The appendices contain an ASCII code table, error remedies, and the differences between the KV-5000/3000 Series and the KV Nano Series.

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This appendix presents a list of ASCII codes.

| Upper four bits | | | | | | | | | | | | | | | | |
|-----------------|------------------|------------------|----------------|---|---|---|---|------------------|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
| Lower four bits | N _{U_L} | D _{L_E} | S _P | 0 | @ | P | ` | p | | | - | タ | ≡ | | | |
| | S _{O_H} | D _{C_1} | ! | 1 | A | Q | a | q | | . | ア | チ | ム | | | |
| | S _{T_X} | D _{C_2} | " | 2 | B | R | b | r | | 「 | イ | ツ | メ | | | |
| | E _{T_X} | D _{C_3} | # | 3 | C | S | c | s | | 」 | ウ | テ | モ | | | |
| | E _{O_T} | D _{C_4} | \$ | 4 | D | T | d | t | | 、 | エ | ト | ヤ | | | |
| | E _{N_Q} | N _{A_K} | % | 5 | E | U | e | u | | ・ | オ | ナ | ユ | | | |
| | A _{C_K} | S _{Y_N} | & | 6 | F | V | f | v | | ヲ | カ | ニ | ヨ | | | |
| | B _{E_L} | E _{T_B} | , | 7 | G | W | g | w | | ア | キ | ヌ | ラ | | | |
| | B _S | C _{A_N} | (| 8 | H | X | h | x | | イ | ク | ネ | リ | | | |
| | H _T | E _M) |) | 9 | I | Y | i | y | | ウ | ケ | ノ | ル | | | |
| A | L _F | S _{U_B} | * | : | J | Z | j | z | | エ | コ | ハ | レ | | | |
| B | V _T | E _{S_C} | + | ; | K | [| k | { | | オ | サ | ヒ | □ | | | |
| C | F _F | → | , | < | L | \ | | | | ヤ | シ | フ | ワ | | | |
| D | C _R | ← | - | = | M |] | m | } | | ユ | ス | ヘ | ン | | | |
| E | S _O | ↑ | . | > | N | ^ | n | ~ | | ヨ | セ | ホ | ゛ | | | |
| F | S _I | ↓ | / | ? | O | — | o | D _{E_L} | | ツ | ソ | マ | ° | | | |

When a communication error occurs, find the cause of the error in the following table, and then apply the appropriate remedy.

| Error Details | Cause | Remedy |
|---|---|---|
| Communication is not possible (the port operation indicators do not light). | The communication specification settings are incorrect. | Set the communication specifications to match the connected peripherals.  "2-5 Using Unit Editor to Configure Settings" (page 2-12) |
| | The receive wires are not connected. | Connect the receive wires (RD, RDA (-), RDB (+), S/R (-), and S/R (+)) correctly. |
| | The send wires are not connected. | Connect the send wires (SD, SDA (-), SDB (+), S/R (-), and S/R (+)) correctly. |
| | The operation mode setting is incorrect. | Set the operation mode to an appropriate value.  "2-5 Using Unit Editor to Configure Settings" (page 2-12) |
| Communication is not stable. | A defective contact is present in the wiring. | Check that all the wires of the cables are connected correctly. |
| | The communication wires are close to breaking. | Replace the communication wires with new cables. |
| | When units are connected in a multi-drop configuration, the terminators of the PLCs connected on both ends of the wiring are not set to ON. | Set the terminators of the PLCs connected on both ends of the wiring to ON. |
| | Equipment that is generating powerful noise is located nearby. | Remove the PLC and communication wires from the vicinity of the equipment that is generating noise. |
| | Communication wires and power wires are contained in the same duct. | Lay communication wires and power wires in separate ducts. |
| Data that cannot be decrypted is being sent (received). | The communication specification settings are incorrect. | Set the communication specifications to match the connected peripherals.  "2-5 Using Unit Editor to Configure Settings" (page 2-12) |
| | Equipment that is generating powerful noise is located nearby. | Remove the KV Nano and communication wires from the vicinity of the equipment that is generating noise. |
| | Communication wires and power wires are contained in the same duct. | Lay communication wires and power wires in separate ducts. |
| | The station number setting is incorrect. | Use a command to specify the correct station number. |
| | The protocol is incorrect. | Check the protocol of the set operation mode, and then send the data correctly. |

This appendix describes the differences between the serial communication function of the KV-5000/3000 Series and the KV Nano Series.

KV Nano Series

| Operation Mode | Built-In Serial Port | KV-N10L | KV-N11L | |
|-----------------------------|----------------------|---------|----------------------------------|----------------------|
| | RS-232C | RS-232C | RS-422A and RS-485 (4-Wire Type) | RS-485 (2-Wire Type) |
| KV mode (host link) | Yes | Yes | Yes | No |
| KV mode (text transmission) | Yes | Yes | Yes | Yes |
| KV BUILDER/ KV STUDIO mode | Yes | Yes | Yes | Yes |
| Non-procedure mode | Yes | Yes | Yes | Yes |
| Modbus master mode | Yes | Yes | Yes | Yes |
| Modbus slave mode | Yes | Yes | Yes | Yes |
| Serial PLC Link mode | No | No | No | Yes |
| PROTOCOL STUDIO mode | No | No | No | No |
| Link mode | No | No | No | No |
| Protocol mode 1 | No | No | No | No |
| Protocol mode 4 | No | No | No | No |
| Modem setup mode | No | No | No | No |
| Modem mode | No | No | No | No |

| Operation Mode | KV-NC10L | KV-NC20L | | | |
|-----------------------------|----------|----------|---------|---------------------------|----------------------|
| | RS-232C | Port1 | Port2 | | |
| | | RS-232C | RS-232C | RS-422A/485 (4-Wire Type) | RS-485 (2-Wire Type) |
| KV mode (host link) | Yes | Yes | Yes | Yes | No |
| KV mode (text transmission) | Yes | Yes | Yes | Yes | Yes |
| KV BUILDER/ KV STUDIO mode | Yes | Yes | Yes | Yes | Yes |
| Non-procedure mode | Yes | Yes | Yes | Yes | Yes |
| Modbus master mode | Yes | Yes | Yes | Yes | Yes |
| Modbus slave mode | Yes | Yes | Yes | Yes | Yes |
| Serial PLC Link mode | No | No | No | No | Yes |
| PROTOCOL STUDIO mode | No | No | No | No | No |
| Link mode | No | No | No | No | No |
| Protocol mode 1 | No | No | No | No | No |
| Protocol mode 4 | No | No | No | No | No |
| Modem setup mode | No | No | No | No | No |
| Modem mode | No | No | No | No | No |

KV-5000/3000 Series

| Operation Mode | Built-In Serial Port (Only on the KV-3000) | KV-L21V and KV-L20V | | | |
|------------------------------------|---|---------------------|-------------------|--|----------------------------|
| | | Port1 | | Port2 | |
| | RS-232C | RS-232C | RS-232C | RS-422A and RS-485 (4-Wire Type) | RS-485 (2-Wire Type) |
| KV mode (host link) | Yes | Yes | Yes | Yes | No |
| KV mode (text transmission) | Yes | Yes | Yes | Yes | No |
| KV BUILDER/KV STUDIO mode | Yes | Yes | Yes | Yes | No |
| Non-procedure mode | No | Yes | Yes | Yes | Yes |
| Modbus master mode | No | Yes ^{*1} | Yes ^{*1} | Yes ^{*1} | Yes ^{*1} |
| Modbus slave mode | No | Yes ^{*1} | Yes ^{*1} | Yes ^{*1} | Yes ^{*1} |
| Serial PLC Link mode ^{*2} | No | No | No | No | No |
| PROTOCOL STUDIO mode | No | Yes | Yes | Yes | Yes |
| Link mode | No | Yes | Yes | Yes | No |
| Protocol mode 1 | No | Yes | Yes | Yes | No |
| Protocol mode 4 | No | Yes | Yes | Yes | No |
| Modem setup mode | No | Yes | No | No | No |
| Modem mode | No | Yes | No | No | No |

*1 "Modbus master" mode and "Modbus slave" mode can only be used on the KV-L21V.

*2 To use "Serial PLC Link" mode on the KV-5000/3000 Series, use a KV-LM21V.

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