KEYENCE

96M0365

User's Manual

Visual KV Series

2

Support software

How this manual is organized:

The Visual KV Series User's Manual is composed of 3 separate manuals; 1-Installation, 2-Support Software, 3-Programming. Please read each manual relevant to your purpose.

Safety Precautions

This instruction manual describes the operation and function of the KV Series PLC. Read this manual carefully to ensure safe use and maximum performance from your KV Series PLC.

Symbols

The following symbols alert you to important messages. Be sure to read these messages carefully.

⚠ WARNING Failure to follow instructions may lead to injury. (electric shock, burn, etc.)

⚠ CAUTION Failure to follow instructions may lead to product damage.

Note: Provides additional information on proper operation.

Conventions

This manual describes the operation/function of all Keyence KV Series PLC. Note following conventions when you use.

Visual KV (Series) KV-10xx, 16xx, 24xx, 40xx	KV-10AR/AT/DR/DT KV-24AR/AT/DR/DT	KV-16AR/AT/DR/DT KV-40AR/AT/DR/DT
Conventional KV (Series) KV-300 (Series) KV-10/80 (Series)	KV-10R(W)/T(W) KV-24R(W)/T(W) KV-80R(W)/T(W) KV-300	KV-16R(W)/T(W) KV-40R(W)/T(W)

General Precautions

- At startup and during operation, be sure to monitor the functions and performance of the KV Sereis PLC.
- We recommend that you take substantial safety measures to avoid any damage in the event a problem occurs.
- Do not open or modify the KV Series PLC or use it in any way other than described in the specifications.
- When the KV Series PLC is used in combination with other instruments, functions and performance may be degraded, depending on operating conditions and the surrounding environment.
- Do not use the KV Series PLC for the purpose of protecting the human body.

Note: The built-in display may show the error message "Error 40" blinking the very first time you turn on the power supply to the Visual KV Series. Press any key around the display to cancel this message.
The Visual KV Series shows this message when no program is loaded.

Note to User

When using the Visual KV Series in the following conditions or environments, be sure to use the Visual KV Series with sufficient margin regarding the rating and functions, take appropriate safety precautions such as fail-safe, and contact our sales personnel if any questions arise.

- Use in conditions or environments not described in this manual
- Use for nuclear power control, railway facilities, air service facilities, vehicles, combustion devices, medical equipment, amusement machines, safety equipment, etc.
- Use for applications where large effects are predicted to be given on human lives and properties and safety is especially requested.

Restriction on Acquiring the CE Marking

■ **Restriction to be compatible with EMC directives**

- When using a relay output type unit (whose model name ends with "R"), connect spark killers having the appropriate withstand voltage against the load to the output terminals in parallel to contacts (because the unit discharges when a relay contact becomes open and noise is generated). In our experiments, we use the following models of spark killers.

  XEB0101 0.1 μF-10 Ω manufactured by OKAYA DENKI SANGYO

  The following 1-turn ferrite core is added to the AC power input circuit of the KV-40AR/T, the KV-24AR/T and to the DC power input circuit of the KV-40DR/T.

  ZCAT3035-1330 manufactured by TDK

Note: The contents above do not by themselves ensure that the entire machine manufactured in accordance with the above contents is compatible with EMC directives.

You must judge by yourself whether or not the entire machine is compatible with EMC directives because compatibility may change depending on the component configuration, wiring and location inside of the machine.

■ **Restriction on compatibility with low-voltage directives (IEC-1010-1)**

- Use insulated type crimp-style terminals.
- For wiring materials, use lead wires whose sheath is 0.4 mm or more.
- The Visual KV Series is allowed to be installed in a vertical position only. (Spacers for expansion units are not available.)
- Be sure to use the Visual KV Series inside the control panel.

Features of the Visual KV Series

- **Extremely small**

  The Visual KV Series is the smallest in the world among AC type PLCs equipped with screw terminal blocks, and saves installation space.

- **Extremely fast**

  The minimum scan time is 140 μs and minimum instruction execution time is 0.7 μs, which is the fastest control in its class.

- **AC power built-in type newly added**

  AC power built-in type units are newly added. This type can be used in small spaces where a switching power supply unit cannot be installed.

- **Excellent Access Window**

  An Access Window with two-color backlight is adopted in all models to facilitate changing and monitoring of device data. Changing between RUN mode and PROGRAM mode, checking the error code when an error has occurred, etc. can be performed in a Visual KV Series unit without the need for any handheld programmer.
  The analog trimmer, which has been popular in the conventional KV Series, is digitized to enable more detail settings. [Digital trimmers]

- **User message setting function**

  In the Access Window, 256 different user messages can be displayed. This function can be used to give instructions on works on the production line, indicate abnormalities in the units, etc.

- **Program write in RUN mode**

  Ladder programs can be changed even while the system is running.

- **Equipped with two serial ports**

  Visual KV Series basic units are equipped with two serial ports to connect peripheral units, improving the debug environment.
  (The KV-10xx is equipped with only one serial port.)

- **Easy Ramp-up/down control function**

  The one-axis motor control function is offered separately from high-speed counters so that feedback control is enabled.

- **Equipped with two 24-bit high-speed 30 kHz, two-phase counters**

  The Visual KV Series is equipped with two high-speed counters each with a two-point comparator output function that enables high-speed encoder input.

- **Specified frequency pulse output function**

  High-speed counters can function as pulse oscillators of 50 kHz maximum with easy setting, without creating a complicated ladder program.

- **Frequency counter function**

  High-speed counters can function as frequency counters with easy setting, without creating complicated ladder programs.

- **Cam switch function**

  High-speed counters can function as cam switches with easy setting, without creating complicated ladder programs.

- **Interrupt function**

  The Visual KV Series is equipped with four high-speed interrupt inputs of 10 μs maximum.

- **Input time constant change function**

  The time constant can be set in 7 steps from 10 μs to 10 ms.

- **Double memory backup functions**

  In addition to a conventional SRAM battery backup function, the Visual KV Series is also equipped with an EEPROM backup function.

Compatibility with Conventional KV Series Peripheral Units

The Visual KV Series functions as a high-end compatible model of the conventional KV Series. Peripheral units of the conventional KV Series such as the ladder support software "KV IncrediWare (DOS)" and "LADDER BUILDER for KV" and the handheld programmer KV-P3E(01) can be used since they are part of the Visual KV Series.
However, it should be noted that the contents have changed as follows.

- The internal clock cycle of high-speed counters consists of three types: 1 μs, 10 μs, and 100 μs.
- The time constant for an input relay specified by the HSP instruction is 10 μs.
- The analog trimmer function is set with the Access Window built into the basic unit.
- The available device setting range of the TMIN instruction is from 0 to 65535. [Handheld programmer KV-P3E(01) can display 0 to 9999 .]
- The RUN/PROGRAM LED is displayed in the Access Window provided on the front face of the basic unit.
- Transistor output is not independent, but is common.
- With the transistor type, the output terminal layout is different.
- The specifications for output current of transistor outputs Nos. 500 to 502 is 100 mA.
- Conventional KV Series expansion units are not available as expansion units for the Visual KV Series.
- The channel setting switch is not provided for expansion units. Channels are determined in connection order.
- Scans in expansion I/O units are not synchronous with the scan time in Visual KV Series basic units.
- Assignment of special utility relays has partially changed.
- Data memory device Nos. DM1000 to DM1999 are assigned as special data memories.

Cautions when using the previous version of ladder support software

Pay strict attention to the following items when using the ladder support software.

- When using the ladder support software "KV IncrediWare (DOS)" or "LADDER BUILDER for KV Ver. 1.0x", set the model to "KV-300".
- DM0 to DM1999 are only available.

⚠ CAUTION

When the ladder support software "LADDER BUILDER for KV Ver. 1.0x" is used, do not use the monitor's Change All function. If the Change All function is used, the basic unit may be damaged. Never use the Change All function.

Peripheral units and other units incompatible with the Visual KV Series

Peripheral units in the conventional KV Series and other units shown below are not compatible with the Visual KV Series.

- Expansion I/O units for the conventional KV Series: KV-8ER/8ET/8EX/16EX/8EYR/8EYT/16EYR/16EYT
- Analog I/O units for the conventional KV Series: KV-AD4/DA4

Cautions when Using the Serial Port

The KV-16xx/24xx/40xx units are equipped with two RJ-11 modular connectors for serial communication.
When using them, pay strict attention to the following contents:

- Programs can be transferred and monitored using either communication port A or B. However, never connect the ladder software and a handheld programmer to the two ports at the same time.
- The KV-D20 operator interface panel can be connected to either communication port A or B. However, only one KV-D20 unit can be connected to a single basic unit.
- Never leave both the KV-D20 operator interface panel and KV-P3E(01) handheld programmer on simultaneously for a long period of time.

Cautions when writing in RUN mode

⚠ WARNING

- ***In the Visual KV Series, a program can be changed using the ladder support software "LADDER BUILDER for KV" even while the program is running.***
- ***Pay strict attention to safety when performing any writes in RUN mode.***
- ***The situation may become extremely dangerous depending on the status of the controller device connected to the PLC or the program used.***

When writing in RUN mode, each function is offered as follows:

KV function	While running	After writing
High-speed counter • High-speed counter comparator	Delete the used ones.	Initialized
	All new ones.	Initialized
	Change the set values for high-speed counter comparators used	When set values for high-speed counter comparators are changed, the current values of the high-speed counters are also changed in the same way as FUN70 is executed with the KV-P3E(01) handheld programmer. ➪ *"Changing set value of timer/counter: FUN70" (p.1-222)*
	No change	Remains in current status.
Internal auxiliary relay/special auxiliary relay	Held	
Easy ramp up-and-down control function	Continues operation until current output has completed.	
Cam switch function	Continues operation.	
Specified frequency pulse output function	Continues operation.	
Frequency counter function	Continues operation.	
Previous value for differential instruction	The previous value is acquired for differential instructions after conversion. Relays changed at this instant cannot be detected by differentiation.	

Note 1: When a ladder program is changed while it is running, it is not saved in the EEPROM but is saved in the SRAM, then will be saved in the EEPROM when the power is next turned on. If the power OFF period is 2 months or longer at 25°C (20 days or longer at 25°C for the KV-10xx) after a ladder program is changed in RUN mode, the changed ladder program may become corrupted. To prevent inconsistencies, turn on the power once so that the changed program is saved in the EEPROM.

Note 2: If an error occurs in the Visual KV Series basic unit while a program is being written in RUN mode, the Visual KV Series basic unit changes to PROGRAM mode and the existing program which is being written may be deleted. In such a case, transfer the program again.

How this manual is organized

The Visual KV Series User's Manual is composed of 3 separate manuals; 1-Installation, 2-Support Software, 3-Programming. Please read each manual relevant to your purpose.

1 *Installation*

Chapter 1 **Configuration and Specifications [Visual KV Series Only]**

Describes the system configuration of the Visual KV Series, the names and functions of each part, and the specifications.

Chapter 2 **System Installation [Visual KV Series Only]**

Describes the installation and connection of each Visual KV Series unit as well as system maintenance.

Chapter 3 **Access Window [Visual KV Series Only]**

Describes the Access Window used for changing and monitoring data.

Chapter 4 **KV-D20 Operator Interface Panel [Visual KV Series Only]**

Describes the KV-D20 Operator Interface Panel used for changing, monitoring, and displaying the status of inside relays, timers, counters and data memories.

Chapter 5 **KV-300, KV-10/80 Hardware [KV-300, KV-10/80 Series Only]**

Describes the hardware specifications and wirings for KV-300 and KV-10/80 Series.

Chapter 6 **Handheld Programmer**

Describes how to use the handheld programmer and memory card.

Chapter 7 **KV-L2 Serial Interface Module [KV-300 Series Only]**

Describes the serial interface modules for KV-300 Series.

Chapter 8 **KV-AN6 Analog I/O Module [KV-300 Series Only]**

Describes the optional Analog I/O module for KV-300 Series

Chapter 9 **KV-AD4/DA4 Analog I/O Unit [KV-10/80 Series Only]**

Describes the optional Analog I/O unit for KV-10/80 Series.

Chapter 10 **Troubleshooting**

This chapter describes the error code list, countermeasures against problems, and error indications for each unit.

Appendices

The appendix includes a list of ladder program applications and the index.

2 *Support Software*

Chapter 1 **Introduction**

Describes the items included in the package, the product outline, the method to connect a personal computer, the installation method, etc.

Chapter 2 **Editor**

Describes the operating procedures in Editor mode.

Chapter 3 **Simulator**

Describes the operating procedures in Simulator mode.

Chapter 4 **Monitor**

Describes the operating procedures in Monitor mode.

Appendices

Includes instructions list, devices list, sample program list and quick reference for key operation and shortcuts.

3 *Programming*

Chapter 1 **Programming**

Describes basic knowledge including program creation procedures, device configuration, relay assignments, special functions to set and confirm Visual KV Series operations, as well as the extended ladder diagrams. Understand the contents described here completely at first before creating programs.

Chapter 2 **Instructions**

Describes the concrete usage of instructions in the KV Series.
Refer to "Chapter 3 Interrupts" on page 3-183 for details of interrupt instructions.
Refer to "Chapter 4 High-speed counters" on page 3-195 for details of the high-speed counters used in the application instruction.

Chapter 3 **Interrupts [Visual KV Series Only]**

The interrupt processing function executes an interrupt program when an external input or request from the high-speed counter comparator (interrupt factor) is encountered during KV operation.
This chapter describes the types of interrupt factors as well as inputs and outputs encountered during interrupt processing.

Chapter 4 **High-speed Counters [Visual KV Series Only]**

Describes high-speed counters and high-speed counter comparators, which allow high-speed pulse measurement and pulse output, independent of the scan time.

Chapter 5 **Positioning Control [Visual KV Series Only]**

Describes ramp-up/down control of stepping motors and servo motors.

Chapter 6 **Interrupts, High-speed Counters, Positioning Control [KV-300, KV-10/80 Series Only]**

Describes ramp-up/down control of stepping motors and servo motors.

Chapter 7 **Serial Communication**

The KV Series can be connected to an external device with an RS-232C interface to establish communication.
This chapter describes communications specifications, how to connect the KV Series to external devices, and how to perform communication.

Chapter 8 **Programming Examples**

Describes the typical programming examples for KV-10/80 Series. These programs can be used for Visual KV Series. However, pay attention to the I/O addressing compatibility before use.

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WARRANTIES AND DISCLAIMERS

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Chapter 1

Software – Windows [KV-H6WE2]

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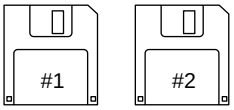
1.1 Items Included in the Package

The following items are included in the Ladder Builder for KV package. Ensure that all the items are supplied.

● **Ladder Builder for KV master disks #1 and #2**



3 1/2" floppy disk (1.44 MB) x 2

The "Ladder Builder for KV" programs and the installer are saved on these disks. Store them in a secure location after installing the programs.

Note: It is recommended that you make a backup copy of the master disks in case the disks are accidentally damaged.

● **Connection cable**

➪ *See page 2-7.*

1.2 Outline of the Ladder Builder for KV

This section describes the operation environments, system configuration, features, functions, etc. of the Ladder Builder for KV. Be sure to read this section before using the Ladder Builder for KV.

1.2.1 Operating environment and system configuration

The following operating environment is required to run the Ladder Builder for KV. Ensure that your system satisfies the following conditions and that the required equipment is provided.

■ **Personal computers supported**

Models supporting Windows 3.1 or later (equipped with the RS-232C interface)

IBM PC and PC/AT or compatible machine

■ **CPU memory capacity**

i486DX2 or higher (Pentium 90 MHz or higher is recommended.)
8 MB RAM (16 MB or more is recommended.)

■ **Compatible operating systems**

- Windows 3.1
- Windows 95

■ **Font types required (Make sure to install them.)**

- MS Sans Serif
- Small fonts
- Arial

Each of them is supplied as standard in Windows 95.

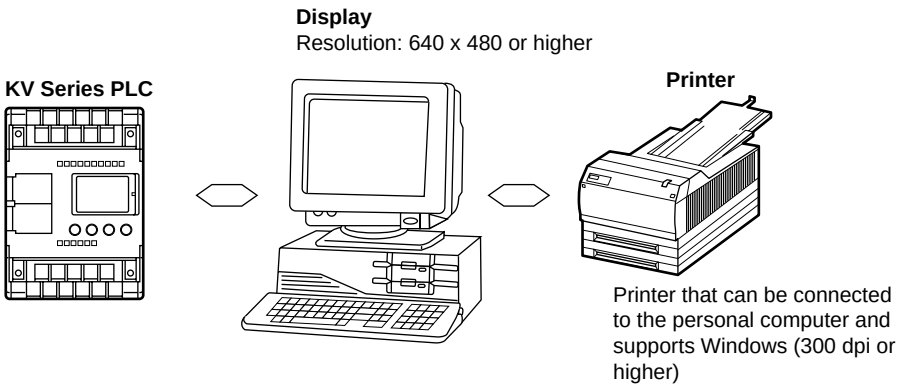
■ **Free space on hard disk**

4.5 MB or more

■ **KV and each unit**

Connect the required units such as KV to the personal computer to use the monitor functions and transfer programs using the Ladder Builder for KV.

Refer to "1.3 Before Programming" on page 2-7.



Note: The Ladder Builder for KV does not support long file names.

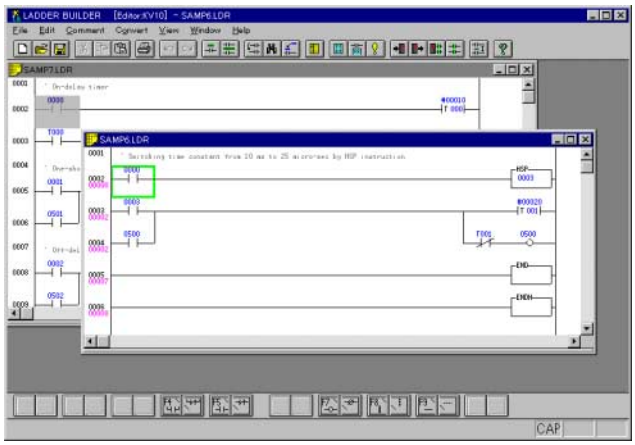
1.2.2 Features and functions of the Ladder Builder for KV

The Ladder Builder for KV is a software program that allows you to create sequence programs. It offers excellent functionality and advanced programming processing ability.

Features of the Ladder Builder for KV

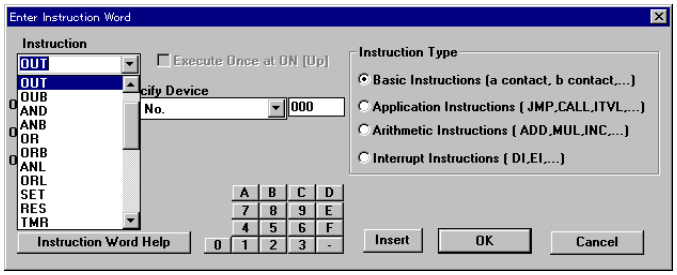
■ **The multi-file edit function and simple mouse operation improve work efficiency.**

Because two or more files can be edited at a time, a block diagram can be cut and pasted between files. Symbols and connection lines can be easily copied and moved using the mouse. Each function can be started by pressing a button on the tool bar, which promotes efficient operation.



■ **Selection of instruction words and devices from a list ensures the correct input of symbols.**

Because the instruction word and device can be selected from a list for each type, symbols can be entered with little error. A symbol can also be entered directly by typing the corresponding instruction word to facilitate rapid programming.

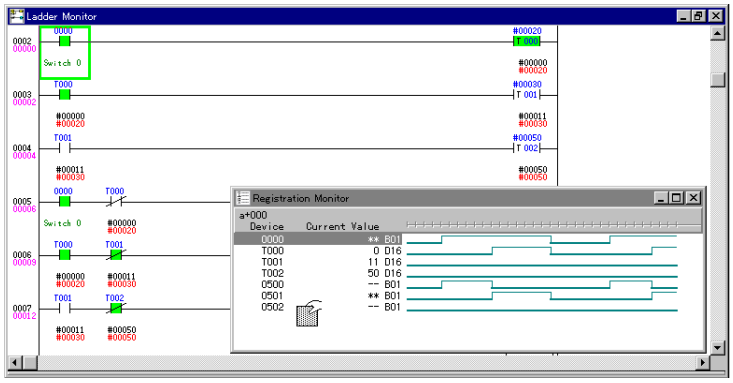


■ **Ladder data can be shared with the KV IncrediWare (DOS).**

Because the ladder data created using the KV IncrediWare (DOS) can be used as it is, the ladder property created thus far can still be used effectively. The ladder data created using the Ladder Builder for KV can also be used in the KV IncrediWare (DOS).

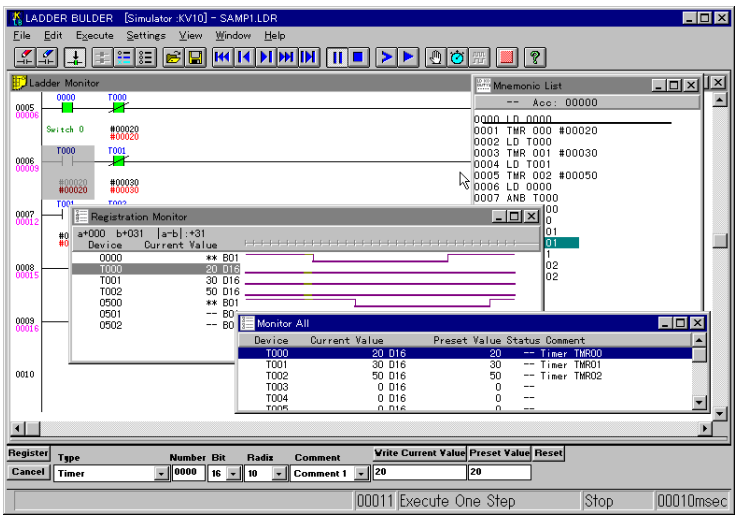
■ **Allows quick selection of the device to be monitored by dragging and dropping from the ladder diagram.**

The device to be monitored can be easily and quickly selected by dragging and dropping it from the ladder diagram.



■ **Allows quick confirmation of the ladder diagram, the contacts and the timing chart.**

Each of the three windows can be positioned anywhere on the screen, allowing you to simultaneously monitor and simulate the operation of the program. The three windows are the Ladder Monitor window which displays the ladder diagram, the Monitor All window which displays the device list, and the Registration Monitor window which allows you to check the movement of the contacts in the timing chart.



■ **Allows use of the simulator functions even when not connected to a PLC.**

You can monitor and simulate the operation of the program even when a PLC is not connected. Debugging efficiency is improved because program operation can be checked without transferring the program to the PLC. As well, the reverse step execution function is provided both for execution of scans and execution of steps.

■ **Provides 5 different screen sizes for different applications.**

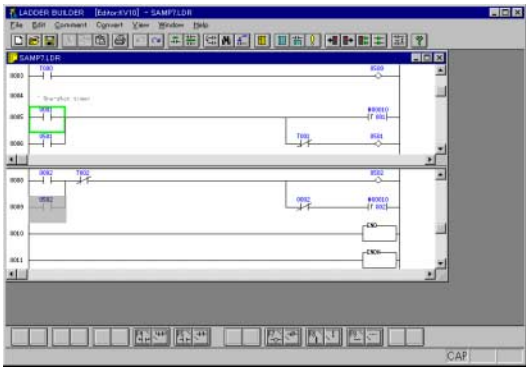
There are 5 different screen display sizes that can be selected as required for different applications. For example, the reduced size can be selected to confirm the entire flow, and the enlarged size can be selected to edit each contact.

Functions of the Ladder Builder for KV

The following functions are provided in the Ladder Builder for KV.

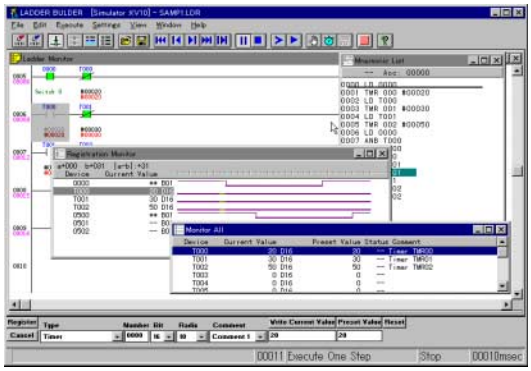
■ Editor function

- Creates the ladder diagram using diversified instruction words of the ladder language.
- Registers comments to contacts. Comments can be transferred to a Visual KV or a KV-300 (Except for KV-10/80 Series).
- Converts the ladder diagram into machine code.
- Displays the ladder diagram, mnemonic list, label comment and device use status list, etc., on the screen and prints them out to the printer



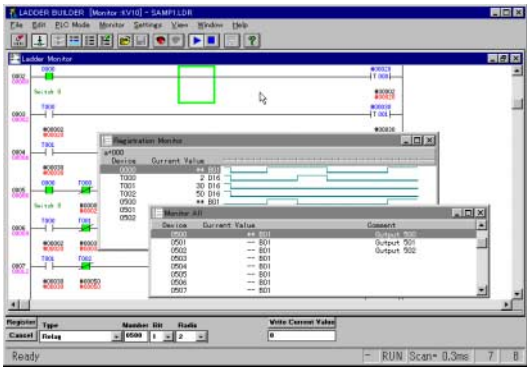
■ Simulator function

- Simulates the operation of the ladder diagram even if a Visual KV or a conventional KV is not connected, and allows debugging of the program.
- Provides a continuous scan execution mode, one scan execution mode, one step execution mode, etc. so that errors be confidently located.
- Enables execution of a step in the reverse direction once or continuously.



■ Monitor function

- Monitors the contact ON/OFF status on a real-time, on-line basis using the ladder diagram created.
- Displays the timing chart, and transfers programs to a Visual KV or a conventional KV.



1.3 Before Programming

The personal computer should be connected to a Visual KV or a conventional KV to transfer the programs to the Visual KV or the conventional KV and to use the monitor function.

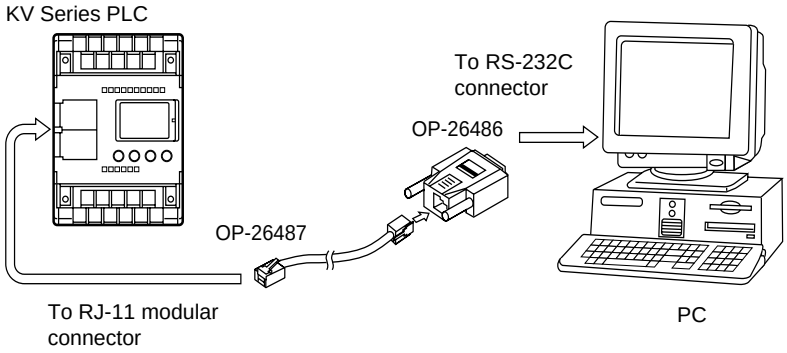
Machines to be prepared

You must prepare the following machines before beginning programming.

■ **PC**

- Connect it to the D-Sub 9-pin type serial port.

Connection cable	Model: OP-26487
D-sub 9-pin type conversion connector	Model: OP-26486

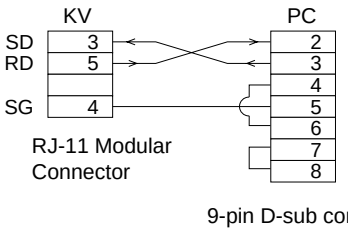


⚠ CAUTION

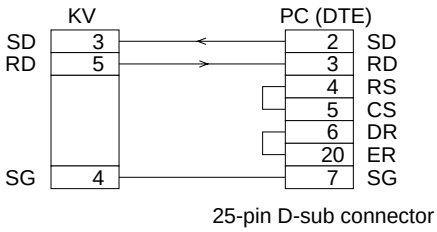
If a Visual KV or a conventional KV is accidentally connected to the personal computer's printer port, the personal computer, the basic unit or the CPU unit may be damaged. Pay careful attention.

Note: Make sure to use a dedicated cable. If any other cable is used, the unit may not operate properly.

Standard cable



When the PC has 25-pin connector



1.3.1 Differences from the KV IncrediWare (DOS)

Because the Ladder Builder for KV is a Windows application, its specifications are slightly different from the KV IncrediWare (DOS) for MS-DOS, as listed below.

- Some of the keys assigned to keyboard functions are different.
  ➪ *Refer to "Appendix G Quick Reference" on page 2-180.*

- The timing chart simulator and the timing chart monitor are provided as the registration monitor screen.
- The function to set the trigger on the timing chart monitor is not provided.
- The memory card operation function is not provided.
- The timing chart save/read function is not provided.
- The "extended ladder → normal ladder" conversion function is not provided.

1.3.2 Differences from the Ladder Builder for KV Ver 1.0

From the Ladder Builder for KV Ver 1.5, the following changes and additions were made to the specifications and functions.

- The editor function allows the selection to show/hide contact comments.
- You can edit ladder diagrams while checking the use status list of devices on the monitor.
- The operation of switching the numbering system between decimal (#) and hexadecimal ($) is assigned to shortcut key [Ctrl]+[E].
- The Visual KV Series units are newly supported.

1.4 Installing the Software

This section describes how to install the Ladder Builder for KV on the personal computer's hard disk.

1.4.1 Preparation for installation

Confirm the following points before installing the software.

■ Free hard disk space

The Ladder Builder for KV must be installed on the hard disk. The free space required is 4.5 MB. Ensure that this space is available.

■ Installation in a Windows environment

The Ladder Builder for KV runs in Windows, and must be installed from Windows. Ensure that Windows 3.1 or Windows 95 is installed and operating correctly in your personal computer.

■ RS-232C (serial port)

The RS-232C (serial port) on the personal computer should be ready before transferring programs to a Visual KV or a conventional KV and using the Ladder Builder for KV's monitor functions.
For the setup procedure, refer to your personal computer's instruction manual.

Note 1: The serial port must also be set up in the Ladder Builder for KV after this program is installed.

➪ *Refer to "Setting the serial port" on page 2-136.*

Note 2: It is recommended that you make a backup copy of the master disks in case the disks are accidentally damaged.

1.4.2 Installation procedure

This section describes how to install the software.
The installation procedure varies depending on which Windows version you are using. Refer to the section appropriate for your operating environment.

Installation in Windows 95 (⇨ *See below*)
Installation in Windows 3.1 (⇨ *Page 2-12*)

1

Installation in Windows 95

As an example, this section describes how to install the software in Windows95 using the following drive configurations.
Drive C: Hard disk drive
Drive A: Floppy disk drive

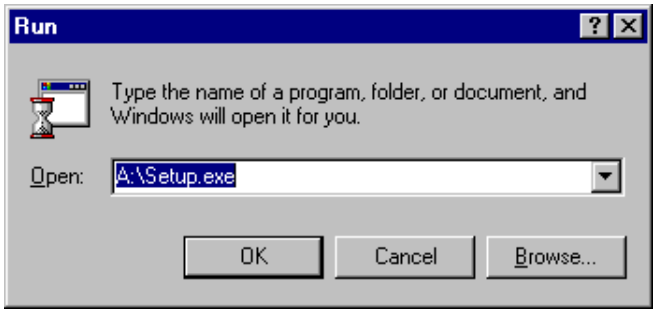
Start up Windows and prepare the two master disks supplied.

Note: Close all other applications before beginning installation.

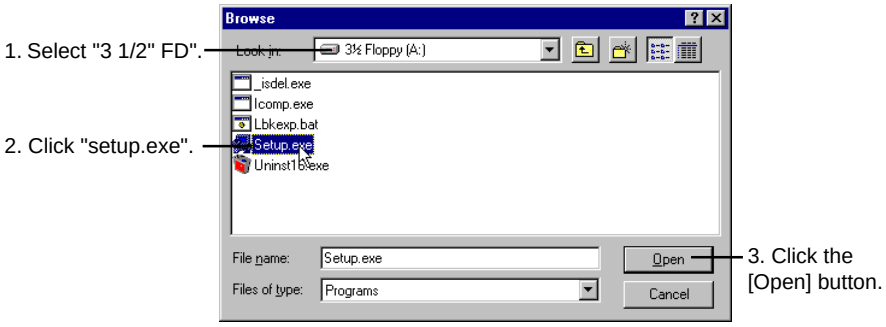
1. Insert the Ladder Builder for KV master disk #1 into the floppy disk drive.

2. Click "Run" on the Start menu.

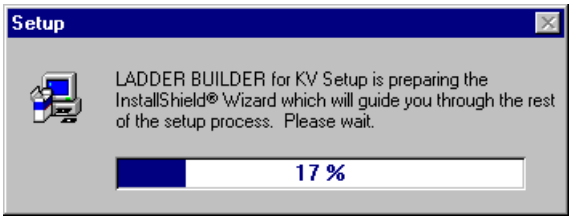
3. Enter "a:\setup" in "Open", and click the [OK] button.
   Or click the [Browse] button, and select the desired name from the "Browse"dialog box.
   ⇨ *Refer to page 2-11.*



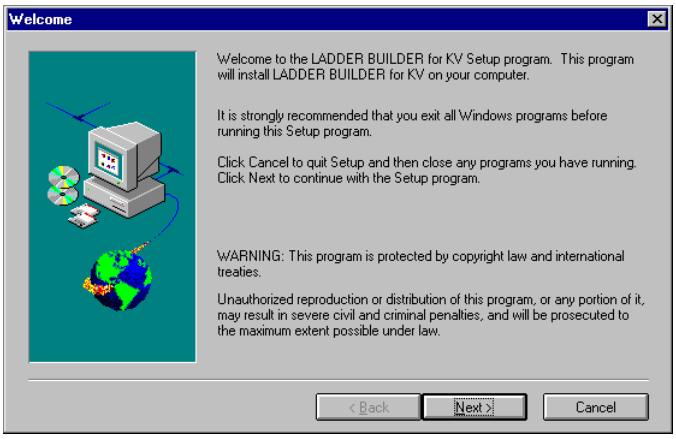
- **To select the file name from the "Browse" dialog box:**



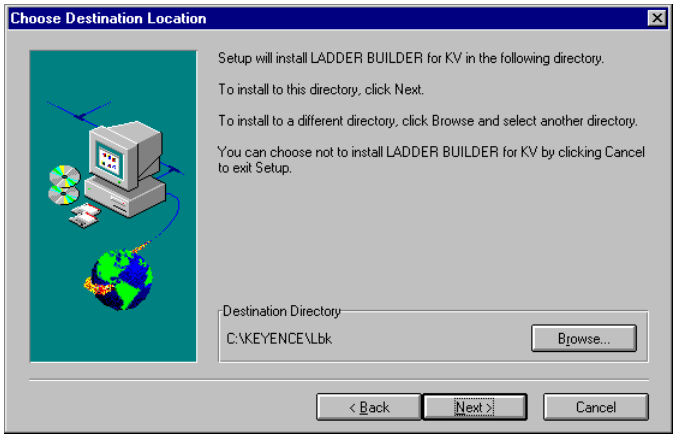
4. The graph is displayed, and preparation for installation begins.



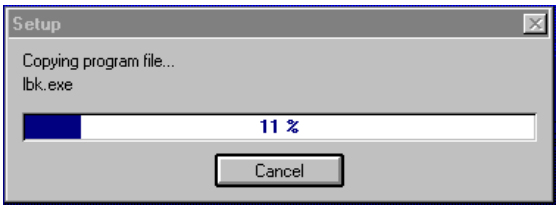
5. When the following screen is displayed, click the [Next] button. To cancel installation, click the [Cancel] button.



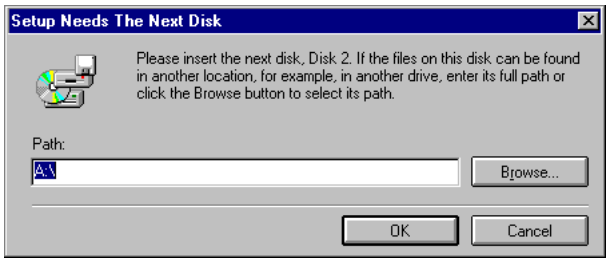
6. Confirm the drive name and the folder (directory) name in which the software is to be installed.
   The default path is "C:\KEYENCE\Lbk". To install the software to this location, click the [NEXT (N)] button.
   To change the installation destination, click the [Reference] button and then specify the drive name and the folder (directory) name.



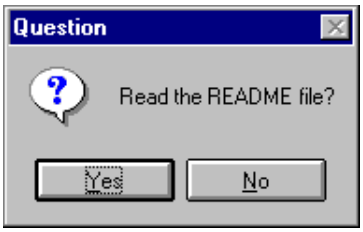
7. The file copy status graph is displayed on the screen.



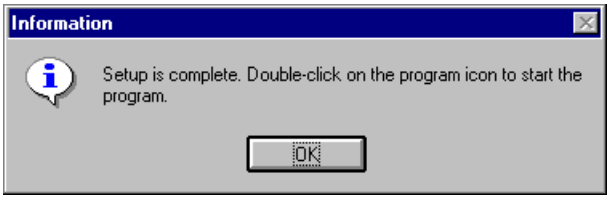
8. When you are prompted to insert the next disk, insert the Ladder Builder for KV master disk #2 and then click the [OK] button.



9. Recent information not included in this manual is saved in the README file. Be sure to click the [Yes] button to read this file.



10. Installation is now completed. Click the [OK] button.



Installation in Windows 3.1

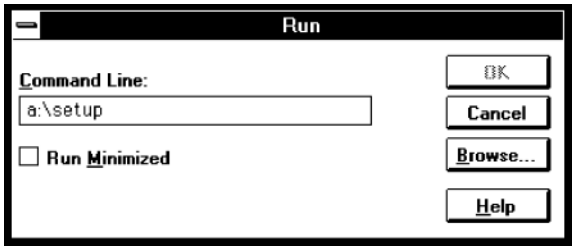
As an example, this section describes how to install the software in Windows3.1 running on a DOS machine using the following drive configurations.
Drive C: Hard disk drive
Drive A: Floppy disk drive

Start up Windows and prepare the two master disks supplied.

1. Insert the Ladder Builder for KV master disk #1 into the floppy disk drive.

2. Select "Run" and "Command Line" from the program manager menu.

3. Enter "a:\setup" in "Command Line", and click the [OK] button.
Or click the [Reference] button, and select the desired name from the "Browse" dialog box.



The rest of the installation procedure is the same as step 4 to step 10 in "Installation in Windows 95" (➪ *page 2-10*).

1.5 Cautions for Use

This section describes the cautions for using the Ladder Builder for KV. Be sure to read this section.

■ When a notebook personal computer is used

When a notebook personal computer is used, ensure that the RS-232C is set up. If it is not, a communication error will occur while the monitor is operating and monitor operation may not be correct.
For the setup procedure, refer to your personal computer's instruction manual.

■ While the monitor is operating

Never turn off the power of the Visual KV, the conventional KV or unplug the connection cable while the monitor is operating. This may cause a communication error to occur and the monitor to be forcibly terminated.

■ Monitor after the ladder diagram is changed

Be sure to select "Convert → Transfer → Monitor" from the menu and transfer programs to the PLC when operating the monitor after changing the ladder diagram.

■ Resolution of the screen

Ensure that the resolution of the screen is at least 640 x 480. It is recommended that the highest possible resolution be used to ensure comfortable operation. (1,024 x 768 or higher is recommended.)

■ Long file names

The Ladder Builder for KV runs in Windows 95, but it does not support long file names. File names can only consist of up to 8 half-width characters and the file extension (3 characters).

1.6 Basic Operations

This section describes what you should know before using the Ladder Builder for KV, such as the programming flow, available modes, software startup procedure, and software termination procedure.

1.6.1 Program creation flow and available modes

Three modes are available in the Ladder Builder for KV. These are the editor, monitor and simulator modes. The actual programming procedure, the modes used in each procedure and the major functions available in each mode are described below.

1. Creating the ladder diagram

Create the ladder diagram based on the design drawing indicating the operations to be performed by the PLC.

Editor ⇨ ***p. 2-25***

- Save and read a file in the original LDR format or another format.
- Save and read mnemonic lists and comments.
- Enter and delete symbols.
- Enter and delete connection lines.
- Insert and delete lines.
- Move and copy ladders.
- Edit contacts/line comments/labels.
- Change the display color on the screen.
- Undo function.
- Jump.
- Search for instruction words/operands.
- Replace operands.
- Convert a/b contacts.
- Edit lists.
- Device use status.
- Set the automatic save function.
- Create macros.
- Print out ladder diagrams, etc.

2. Compiling the ladder diagram

Compile the ladder diagram into machine code that can be read by a Visual KV or a conventional KV. Although compilation is automatically performed when the monitor is started up (only when "Transfer Program to PLC" is selected), nothing else can be executed at the same time as the compilation job.

Editor ⇨ ***p. 2-25***

- Transfer a program to the PLC.
  Select this function when changing over to the monitor.
- Simulator
  Select this function when changing over to the simulator.
- Compilation

3. Debugging the program

Read the machine code created by the editor, and confirm the operation status including changes in devices. This allows errors to be detected and the ladder program to be changed accordingly.

- You can use either the simulator or the monitor when debugging the program. When using the simulator, you can simulate the status in which a Visual KV or a conventional KV is connected. When using the monitor, you actually connect a Visual KV or a conventional KV and write programs to it.

- The method for using the ladder monitor, the monitor all and registration monitor which indicate the device status; the method for setting up the current value/preset value/attribute from the dialog bar; and the method for printing out the registration monitor are shared between the simulator and the monitor with the exception of certain functions. These methods are described in the simulator section.

When a CPU unit is not connected: Simulator ➪ ***p. 2-83***

- Set the break condition, the wait time, the scan time, etc.
- Execute scan continuously or once.
- Executes a step continuously, a step continuously in the reverse direction, a step once or a step once in the reverse direction.
- Change the timing chart size.
- Display the mnemonic list.
- Search for devices.

When a CPU unit is connected: Monitor ➪ ***p. 2-133***

- Serial port setting
- Start and stop the monitor, and reconstruct the record.
- Set up the PLC mode.
- Disable input refresh, disable output (Visual KV Series and KV-300)
- Transfer programs (When the menu is selected from the editor and executed, programs are transferred to the monitor.)
- Search for devices.

Simulator and monitor

- Save and read the ladder monitor, monitor all, and registration monitor.
  ➪ *p. 2-88, 2-108, 2-118*
- Display the operation status of the ladder monitor, monitor all, and registration monitor.
  ➪ *p. 2-88, 2-108, 2-118*
- Display the timing chart (on the registration monitor).
- Set up the current value/preset value/attribute. ➪ *p. 2-117*
- Print out the registration monitor. ➪ *p. 2-131*

4. Debugging the program using the ladder diagram and transferring the program

In addition to debugging using the monitor or simulator, the ladder diagram can also be changed using the editor. A program (machine code) which has been transferred to a basic unit or a CPU unit can be read, and the ladder diagram can then be displayed.

Editor ➪ ***p. 2-25***

When debugging is completed and the program runs correctly, transfer the finished program (machine code) to a Visual KV or a conventional KV and write it.

1.6.2 Starting up and exiting from the software

The procedures for starting up and exiting from the Ladder Builder for KV are described below.

To start up the software

■ **In Windows 95**

Select "Program", "KEYENCE Applications" and "LADDER BUILDER for KV" from the Start menu.

■ **In Windows 3.1**

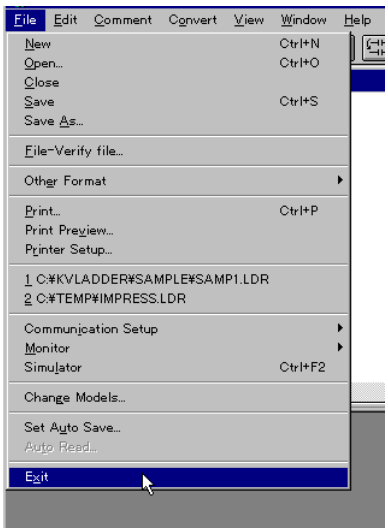
Double-click the Ladder Builder for KV icon in the KEYENCE Applications group in the program manager.

- The ladder software starts up.

■ **To exit from the software**

Perform one of the following procedures to exit from the software.

- Select "File" and "Exit" from the menu.
- Press the **Alt** and **F4** keys at the same time.
- In Windows 95, click the close button provided at the right end of the title bar.
- In Windows 3.1, double-click the control menu box provided at the left end of the title bar.

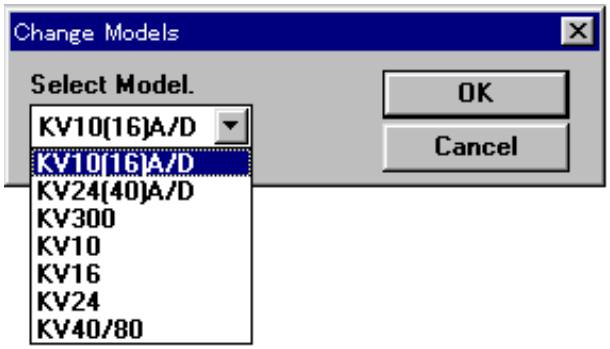


Setting and changing the model used
File → Change Models

When a new file is created, the dialog box to set the model used is displayed.

Select the PLC model connected, and click the [OK] button.

To change the model while the Ladder Builder for KV is running, select "Change Models" from the "File" menu.



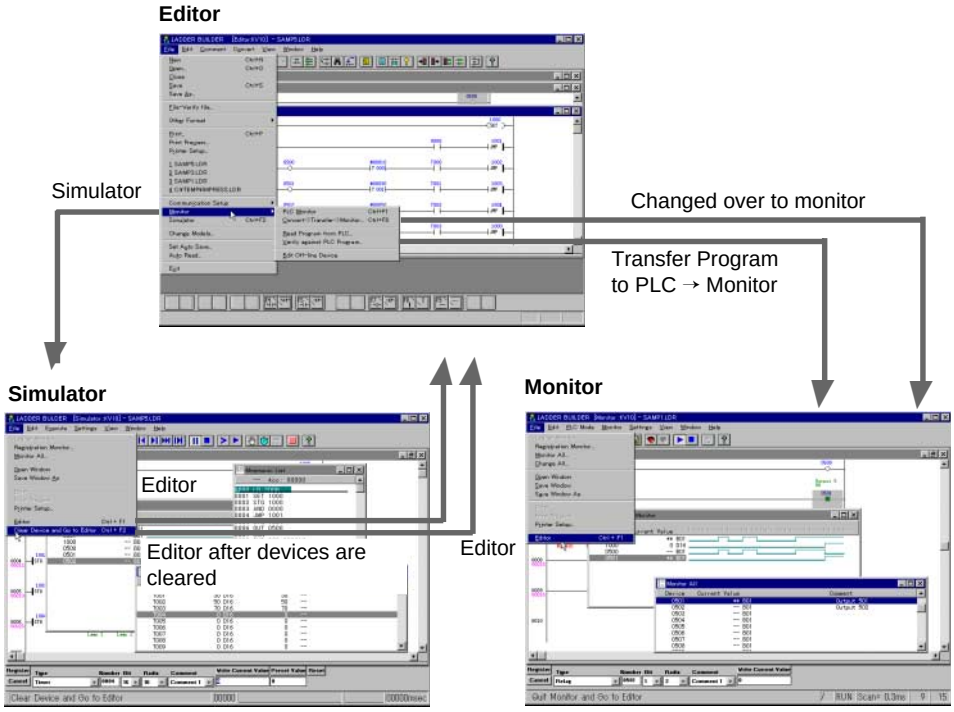
CAUTION

- ***If the PLC model connected is not set correctly, the error message "Unmatched model" is displayed when communicating with a KV Series PLC. Transferring of programs to the PLC and the monitor function are also disabled. If the model is not set correctly, failure may occur.***
- ***If the model is specified as "KV-10(16)A/D" or "KV-24(40)A/D", created ladder diagrams cannot be opened with Ladder Builder for KV Ver 1.0 or KV IncrediWare (DOS). To use ladder diagrams with either of these programs, specify the model as "KV-300".***

1.6.3 Screen

Windows in each mode

The screens of the Ladder Builder for KV in each mode are related to each other as described below.



The name and functions of each window are described on the following pages.

Editor ➪ p. 2-25
Simulator ➪ p. 2-83
Monitor ➪ p. 2-133

Current window

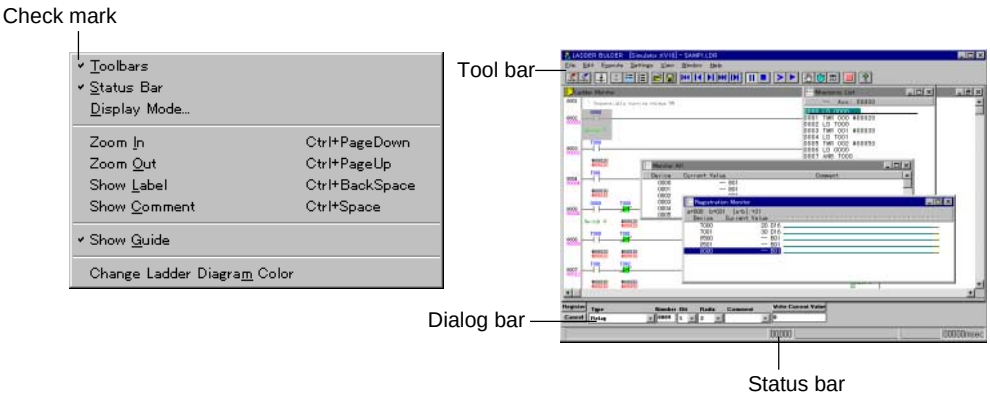
The currently selected active window is called "current window".
To select a window while two or more windows are displayed on the screen in each mode, use one of the following methods. (The color of the current window's title bar is typically different than the color of the other title bars.)

- Click the title bar of the window you wish to select as the current window.
- Select the "Window" menu to view a list of all of the windows that are currently open. Select the title of the window you wish to select as the current window.

Showing/hiding the tool bar, status bar and dialog bar

The display status of the tool bar, status bar and dialog bar can be changed.

Select "View" from the editor's menu bar.



When the check mark is visible: Show mode
When the check mark is not visible: Hide mode

A check mark appears before each bar by default. Every time the check mark is clicked, the display status is toggled between show mode and hide mode.
* The dialog bar is not provided in the editor.

Display mode

The screen display can be viewed in 5 different sizes.
In the editor, you can set whether or not labels and comments are displayed for each screen.

■ Changing the display size

Five different sizes are available to display the ladder diagram. When the software is started up, "100%" is selected by default. Use the following method to change the display size. (In the editor, size can be set in the "Display Mode Setup" dialog box.)

View → Zoom In **Ctrl** + **PageDown** keys: Selects a higher mode.
View → Zoom Out **Ctrl** + **PageUp** keys: Selects a lower mode.

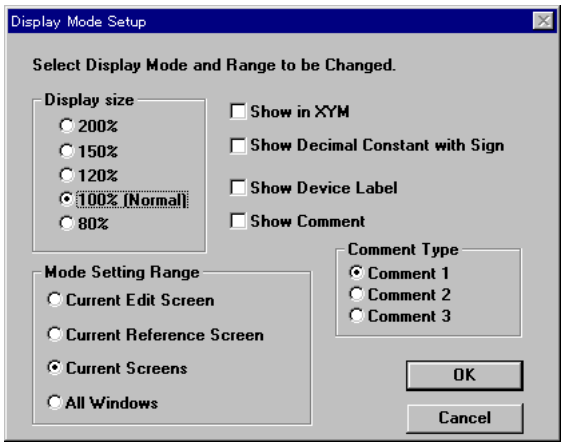
■ Changing the display size (only in the editor)

The display size can be set in the "Display Mode Setup" dialog box using the following procedure.

1. Select "Display Mode" from the "View" menu on the editor's menu bar, or click the button.

   The "Display Mode Setup" dialog box is displayed.

2. Set each item, and click the [OK] button.
   To cancel the changes you made and close the dialog box, click the [CANCEL] button.



Display Size	**200%**	Displays a ladder diagram at twice the standard size. This size is useful when characters are small and difficult to read.
	150%	Displays a ladder diagram at 1.5 times the standard size.
	120%	Displays a ladder diagram at 1.2 times the standard size.
	100% (Normal)	Displays a ladder diagram in the standard size.
	80%	Displays a ladder diagram in the smallest size. This size is useful when checking the entire operation because the maximum number of cells can be dis played on the screen.
Show in XYM		Displays device names in the ladder diagram using "X", "Y" and "M".
Show Decimal Constant with Sign		Displays decimal constants with sign in the ladder diagram.
Show Device Label		Displays the label name of each device in the ladder diagram.
Show Comment		Displays comments in the ladder diagram.
Comment type	**Comment 1**	Displays comment 1 [which is completely shared with the KV IncrediWare (DOS)]
	Comment 2	Displays comment 2 (which cannot be transferred to the PLC)
	Comment 3	Displays comment 3 (which cannot be transferred to the PLC)
Mode Setting Range	**Current Edit Screen**	Reflects the setting on the edit screen (current window).
	Current Reference Screen	Reflects the setting on the reference screen (current window).
	Current Screens	Reflects the setting on both the edit screen and the reference screen (both current windows).
	All Windows	Reflects the setting on all the windows.

* The current window refers to the currently selected active window.
* Line comments cannot be transferred.

Show/hide comments

You can select to show or hide contact comments on the editor screen.
"Comment 1" is displayed.

1.6.4 Mouse operation and keyboard operation

The Ladder Builder for KV can be operated using the mouse except when input of characters is required. This improves efficiency when creating the ladder diagram and during debugging.
Each job can be performed even more efficiently by using keyboard commands (shortcuts).

How to execute each function (command)

Commonly used functions are assigned to the tool bar and the function keys. Commands selected from the menu can also be executed quickly by using the shortcut keys and the shortcut menu displayed by right-clicking.

- In this manual, the menu, buttons and keys available for each function are indicated at the right end of each title for quick reference.
- The shortcut keys are indicated on the right side of each menu in the software.

Example
The following two methods can be used to enter connection lines.

- **Pressing the keys or clicking the icon**
  F8 and **/** (front-slash) or : Draws a connection line downward from the cursor position.

  F9 and **-** (hyphen key) or : Draws a connection line to the right of the cursor position.

- **Using the mouse and cursor control keys in connection line edit mode**

To draw connection lines using the mouse, first change the input mode.
The following four methods can be used to change modes.

- Select "Edit Connection Line" from the menu displayed by right-clicking.
- Select "Edit Connection Line" from the "Edit" menu.
- Press the **Ctrl** and **K** keys at the same time.
- Press the **** key.

Several methods are offered so that the most efficient operation for the situation can be chosen.

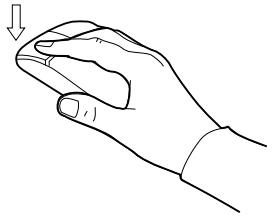
Basic mouse operation

The use of the mouse is described below. If you familiar with using Windows, you can skip this section.

■ **What is a "click"?**

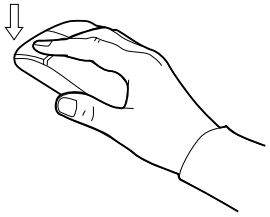
● **Double left-click**

To double left-click means to press the left button twice quickly and consecutively. This is used to open the "Enter Instruction Word" dialog box on the ladder diagram window. In this manual, this type of clicking is referred to as double-clicking.



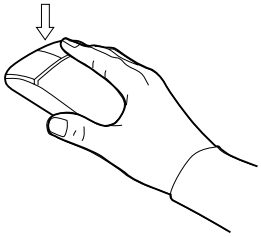
● **Left-click**

To left-click means to press the left button once. This is used to click a button on the screen or to align the cursor with the input position in the text entry box. In this manual, this type of clicking is simply referred to as clicking.



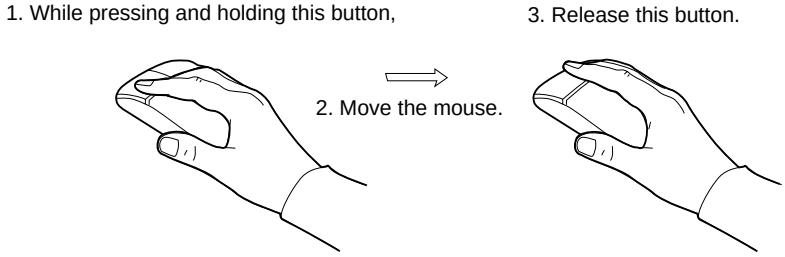
● **Right-click**

To right-click means to press the right button once. This is used to display the shortcut menu as desired for more efficient operation. For example, by right-clicking the ladder diagram window, each function (command) such as "cut", "copy", "paste", and "edit connection line" can be executed.



■ **What is "drag & drop"?**

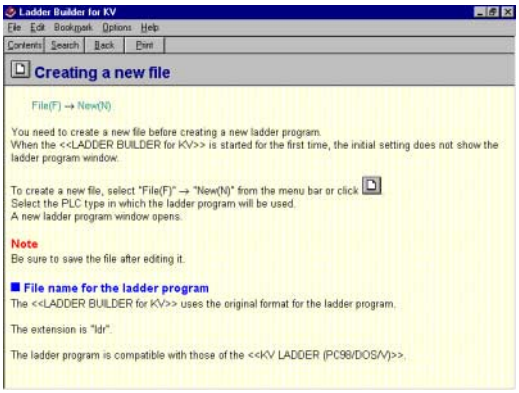
To drag means to press the left button at the selection start position, move the mouse cursor while pressing and holding the left button, and then release the button at the selection end position.
Dragging is used to select a range or draw a connection line.
To drop means to move the selected item to a different position or window and then release the button.
Dropping is used to move, copy or register an item. In the Ladder Builder for KV, a device can be registered by selecting it in the ladder monitor and dragging and dropping it to the registration monitor.



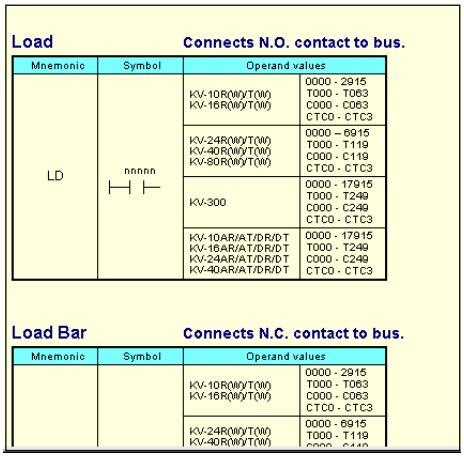
1.6.5 Online help

The Ladder Builder for KV includes online help.
If you are not sure about a function, click the button on the tool bar or select "Help" from the menu bar to open the help window.

Operation help window



Instruction word help window



Chapter 2

Editor

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2.1 Outline of the Editor Functions

This section outlines each function available in the editor. For detailed descriptions of each function, refer to the corresponding page.

The editor allows you to create ladder diagrams, and provides editing functions including input of instruction words and registration of comments.

The editor offers the following functions.

- Creates ladder diagrams using diversified instructions of the ladder language.
- Performs editing functions including copy and move.
- Registers a comment for a contact and transfers it to the Visual KV or the conventional KV.
- Converts ladder diagrams, and transfers the converted diagrams to a PLC.
- Prints out ladder diagrams, mnemonic lists, label comments, device status lists, etc.

2.1.1 Cautions for editing ladder programs

The maximum number of editable lines is 9,999.

The maximum number of lines that can be edited for one ladder program window by the Ladder Builder for KV is 9,999. The maximum size of one block is 100 lines. Keep in mind that a ladder program exceeding 9,999 lines cannot be created.

When the program is running slowly

When many applications are simultaneously running on a personal computer with low memory capacity, the memory and the source become insufficient. As a result, the swap file is frequently accessed and operating speed deteriorates. If this occurs, close other applications to decrease the load on the system.
It is also effective to increase the memory.

2.2 Edit Screen

This section describes the configuration and functions of the screen displayed in the editor.

2.2.1 Name and function of each part of the screen

When the Ladder Builder for KV is started up, the ladder program window is not initially displayed. To create a new ladder program, select "New" from the "File" menu to open the new window, and then edit it.

To open an existing ladder program, select "Open" from the "File" menu, and specify the desired ladder program.

The name and function of each part of the screen are described below.
Normal mode and connection line edit mode are available in the editor.

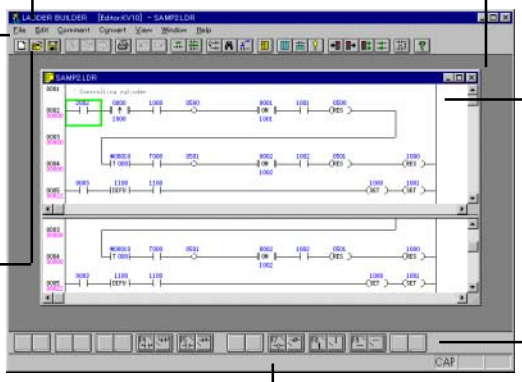
2.4.5 Entering/Deleting connection lines (p. 2-44)

Note: When the automatic read function is set, the selected file is automatically read and displayed when the software is started up.

Setting the automatic file read function (p. 2-30)

Example

Normal edit mode screen using the file "SAMP*.LDR"



Main window title bar
Displays the name of the file being edited in the current window.

Menu bar
Displays the menu to execute commands.

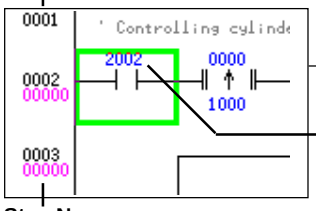
Tool bar
Provides buttons to execute commands. Only commonly used commands are provided as buttons. Each command can be executed by clicking the corresponding button once.

Main window
The entire editor screen.

Ladder program window
One window is displayed for each ladder program file.

Function menu
Displays the functions assigned to the function keys.
Because each function is displayed as an icon, an instruction can be directly entered by clicking the corresponding icon.

Status indication bar
Indicates the function currently selected and the key status.

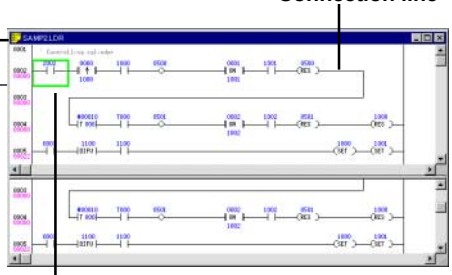


Ladder diagram line No.
Indicates a line number in the ladder diagram.

Step No.
Indicates a step number in the ladder diagram.
A step number is displayed only after conversion, and is deleted when the ladder diagram is changed.

Title bar
Displays the name of the file being edited.

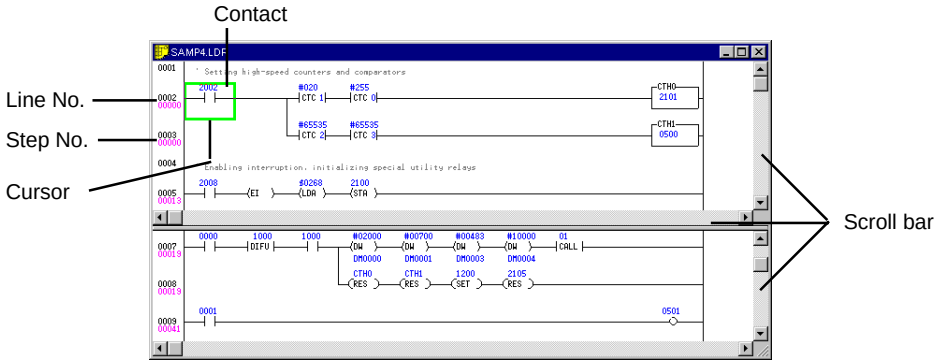
Ladder symbol
Displayed when an instruction word, etc. is entered.



Connection line

Cursor
Allows selection of a device, etc., and can be moved in the vertical and horizontal directions.

2.2.2 Ladder program window screen



- Use the scroll bar or the cursor control keys ([LEFT] [RIGHT] [UP] [DOWN]) to look at the hidden (undisplayed) portion.

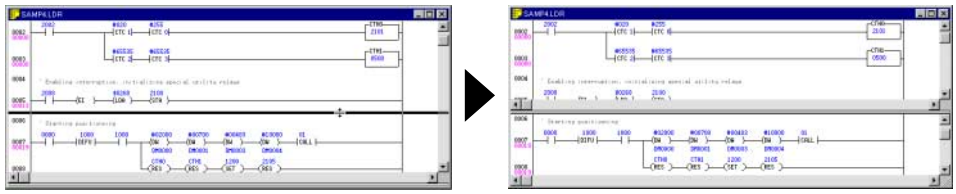
■ **Moving the cursor**

LEFT/RIGHT/UP/DOWN keys	: Move the cursor in the corresponding direction.
Pageup/PageDown keys	: Move the cursor up or down one page (screen).
Ctrl + UP/DOWN keys	: Move the cursor by one block.
Home key	: Move the cursor to the first line.
End key	: Move the cursor to the last line.

■ **When dividing the screen into two windows**

When the pointer is placed between the bottom of the scroll bar and the window frame, the pointer is changed into "⇕". (While the pointer shape is " ⇕ ", the window size can be changed but the screen cannot be divided.)
When the left button is pressed and held and moved upward in this status, the screen is divided into the upper and lower windows. Different contents can be displayed in each window.
When the "Edit" menu is selected and you click "Link Screens" so that the check mark is added, these two windows can be scrolled while interlocking each other. This function is convenient when viewing a long ladder line all at once.

To switch the active window between the upper and lower windows, click the mouse on the desired window or press the **[Shift]** and **[F6]** keys at the same time.



Note: While the pointer shape is " ⇕ ", the window size can be changed but the screen cannot be divided.

2.3 File Management

This section describes how to create a new ladder program and how to read/save the ladder program file, code file, comment file and mnemonic list file.

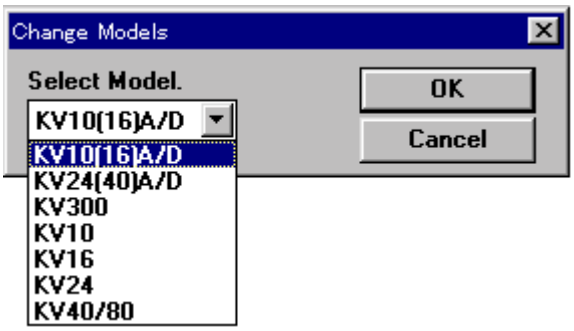
2.3.1 Creating a new file

File → New

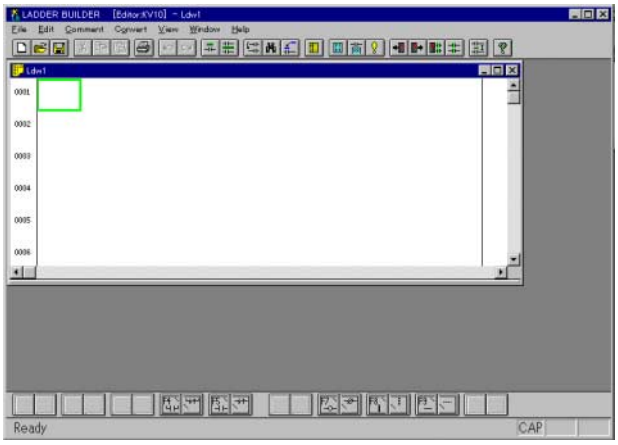
When creating a new ladder program, first create a new file.
When the Ladder Builder for KV is started up for the first time, the ladder program window is not initially displayed.
When creating a new ladder program, perform the following procedure.

Select "New" from the "File" menu, or click .

- Select the target model for which a ladder program is to be created.



- A new ladder program window is open.



Note 1: When you finish editing a newly created file, be sure to save it.

Note 2: If the model is specified as "KV-10(16)A/D" or "KV-24(40)A/D", created ladder diagrams cannot be opened with Ladder Builder for KV Ver 1.0 or KV IncrediWare (DOS). To use ladder diagrams with either of these programs, specify the model as "KV-300".

■ File name of a ladder program

The ladder program file name is unique in the Ladder Builder for KV.
The file extension is "ldr".

Ladder programs can be shared with the KV IncrediWare (DOS).

2.3.2 Setting the automatic file read function

File → Auto Read

Specify the file to be automatically read when the software is started up. This function is convenient when the same file is always required to be read at startup.
Up to 16 files can be specified for the automatic read function.

The setup and cancellation procedures are described below.

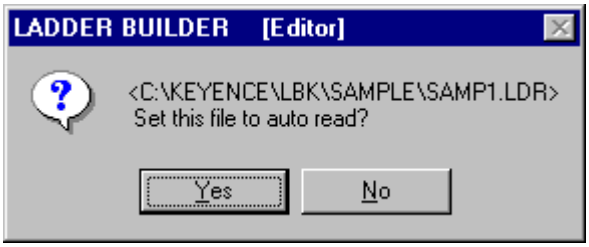
■ Setting the automatic file read function

1. Set the ladder program window to be automatically read as the current window.

2. Select "Auto Read" from the "File" menu.

3. The message "Set this file for auto read?" is displayed. To set it for the automatic file read function, click the [Yes] button.

   The specified file is set for the automatic file read function. The next time you start up the Ladder Builder for KV, this file is automatically read.



4. To specify another file, repeat steps 1 to 3 above.

■ Canceling the automatic file read function

1. Set the file set for the automatic read function as the current window. Select "Auto Read" from the "File" menu.

2. The message "Cancel auto read?" is displayed. To cancel the setting of the automatic read function, click the [Yes] button.

Note 1: A file not yet saved cannot be selected for the automatic file read function. Save the file before selecting it.

Note 2: When the number of files specified for the automatic file read function exceeds 16, the alarm message is displayed.

2.3.3 Setting automatic file save for the file

File → Set Auto Save

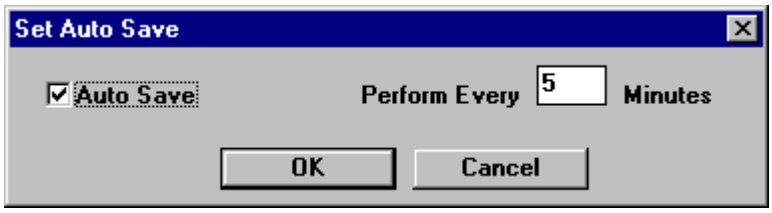
Temporary copies of the ladder diagram, comments and labels are automatically saved at constant intervals while you are working on the file.
When the automatic file save function is set, the file is automatically copied for a temporary save at the specified interval. This will minimize the damage caused by power interruptions or other accidents that may occur before you save the file.

The setup and cancellation procedures are described below.

■ Setting the automatic file save function

1. Select "Set Auto Save" from the "File" menu.

2. The "Set Auto Save" dialog box is opened. Click "Auto Save" to add the check mark, and then enter the time interval for automatic save.



- The automatic file save function is set to every 5 minutes by default.

3. Click the [OK] button.

■ Canceling the automatic save function

1. Select "Set Auto Save" from the "File" menu.

2. The "Set Auto Save" dialog box is opened. Delete the check mark next to "Auto Save", and click the [OK] button.

Note 1: The automatic file save function set here is applied to all the ladder program files currently open.

Note 2: The file saved automatically is automatically erased when the Ladder Builder for KV is closed normally. If the Ladder Builder for KV is closed abnormally, the files saved automatically are automatically read when the Ladder Builder for KV is started up the next time.

2.3.4 Saving and reading files

Saving files

File → Save, File → Save As

When you have finished working on a ladder program, save the file.
Two methods are available for saving a file: "save (overwrite)" and "save as (save with a different name)". Select either one.
When is clicked, "save" is selected.

Save : Saves a file with the current file name.
Save As : Saves a file with a new name.

Note 1: Every time a new file is created, a number is automatically added after the extension "ldw" of the file name such as "ldw1.ldr", "ldw2.ldr", "ldw3.ldr", etc.

Note 2: When "Save" is executed for a new file, "Save As" is automatically executed.

Example

When saving a file with a new name

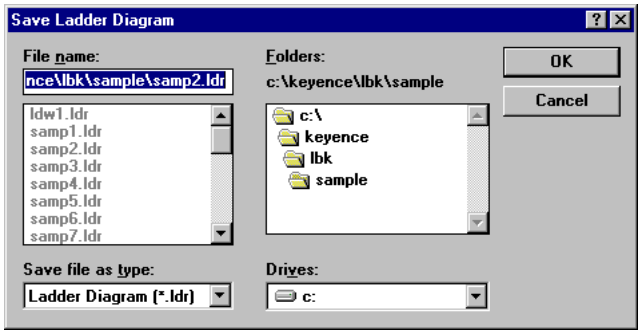
1. Select "Save As" from the "File" menu.

2. The "Change File Comment" dialog box is displayed. Enter file comments, and click the [OK] button. When file comments are not required, click the [X] button.

   The "Save Ladder Diagram" dialog box is displayed.

   The file comment is also displayed when the file is selected in the KV-Ladder (DOS version).

3. Specify the folder (directory) to which the file is to be saved, and enter the file name.



Folder (directory)	Select the folder (directory) in which the file is to be saved. The current folder (directory) is selected by default.
File Name	Enter the file name consisting of up to 8 characters. The extension is set to "ldr". Never change the extension.
File Type	"Ladder diagram (*.ldr)" is selected. Do not change this setting.

4. Click the [OK] button.

   The file is saved with the specified file name.

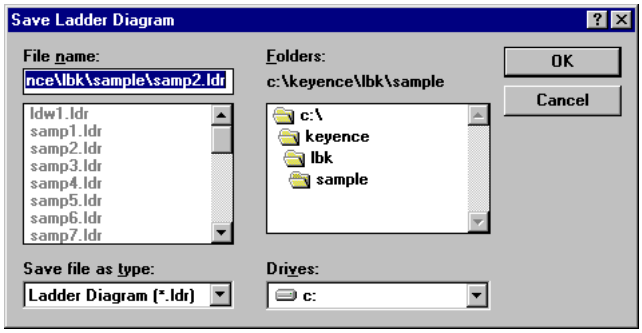
Reading files

File → Open

When editing an existing file, select and read the file to be edited.

1. Select "Open" from the "File" menu.
   The "Open" dialog box is displayed.

2. Specify the folder (directory) in which the file to be read is saved, and select the file name.



Folder (directory)	Select the folder (directory) in which the file to be read is saved. The current folder (directory) is selected by default.
File Name	Specify the file name to be read. The extension is "ldr".
File Type	"Ladder diagram (*.ldr)" is selected. Do not change this setting.

3. Click the [OK] button.
   The specified file is read, and the ladder program window is open.

2.3.5 Reading and saving a file in another format

This section describes the method used to save and read files in any format other than the "ldr" format such as mnemonic list files, comments in other files, comment files in text format, etc.

Note: This function can only be selected while the ladder program window is selected. Display the ladder program window by selecting "New" from the "File" menu, and then select "Other Format".

Saving and reading a mnemonic list

File → Other Format → Save Mnemonic List, File → Other Format → Read Mnemonic List

The ladder program being created can be saved as a mnemonic list (text format). Saved mnemonic lists (text format) can also be read.
Specify the desired mnemonic list file in the "Save As" or "Open" dialog box.

Note: When read is executed, the specified mnemonic list file is read on the current window. In this case, the ladder program in the current window is erased. When the ladder program on the current window is required, be sure to save it in a file before reading the mnemonic list.

■ File name of a mnemonic list

A mnemonic list file adopts the normal text format.
The extension of a mnemonic file is "mnm".

Reading comments in other files

File → Other Format → Read Other File Comment

Only comments can be read from other ladder program files.
In the "Open" dialog box, specify the file in which the comments to be read are saved.

Note 1: When read is executed, the specified comments are read on the current window. In this case, the comments in the current window are overwritten. When the comments on the current window are required, be sure to save them in a file before reading comments from another file.

Note 2: This function extracts only comments from a ladder program. This function does not read the entire ladder diagram.

■ File name of a contact comment file

The extension for each comment file is shown below.
Comment 1: rcm
Comment 2: cm2
Comment 3: cm3

Saving and reading comments in text format

File → Other Format → Save Comment in Text Format, File → Other Format → Read Comment in Text Format

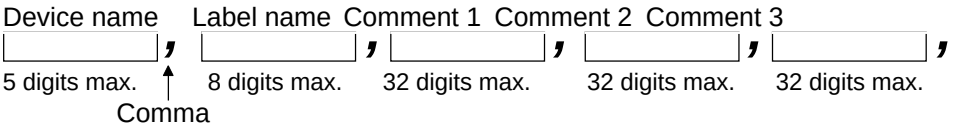
Labels and comments in the ladder program being created can be saved in text format. Comment files saved in text format can also be read.
Specify the desired comment file in the "Save As" or "Open" dialog box.

Note 1: When read is executed, the specified comments are read on the current window. In this case, the comments in the current window are overwritten. When the comments on the current window are required, be sure to save them in a file before reading the specified comments.

Note 2: If the text format is different when read is executed, an error message is displayed.

■ Format of a comment file in the text format

A comment file adopts the normal text format as shown below.
The extension for comment files is "txt".



- Each element is delimited with a comma. When the character string is short, it can be read even if unnecessary portions are omitted in the description.
- The length of the character string is fixed as shown above when a file is saved.
- The table below shows the character types and the number of characters.

Label name	Letters. 8 characters maximum. Space and comma cannot be entered.
Comment 1	32 characters maximum
Comment 2	
Comment 3	

■ When reading/saving data using other software

Comments saved in text format can be read by spreadsheet software and data base software. Comments can also be edited by spreadsheet software and data base software, saved in a file, and then read by the Ladder Builder for KV.
When reading or saving data using such software as described above, specify the CSV format (in which each item is delimited with comma).

Example

When Microsoft Excel Ver. 5.0 spreadsheet software is used

- **When reading data**

Select a text file (*.prn, *.txt or *.csv) in "File Type" in the "Open File" dialog box. Next, select "Data delimited into each field by delimiters such as comma and tab" in "Data Format" in "Text File Wizard". Select "Comma" in "String Delimiter". Select "No" in "Character String Quotation Mark".

- **When saving data**

Select "CSV (delimited with comma)" in "File Type" in the "Save As" dialog box. Select "*.txt" which can be read by the ladder buffer for KV as the extension of the file.

2.3.6 Saving a ladder diagram in text format

File → Other Format → Save Ladder Diagram in Text Format

The ladder program being created can be saved in text format.
When the "Save As" dialog box is opened, enter the file name, and save it.

Example

This is useful when reading a ladder diagram saved in text format to a word processor software, and then reformatting it. Use "Notepad" provided as a WINDOWS accessory.

2.3.7 Verifying files

File → File-Verify File

The ladder diagram in the editor can be verified against the contents of the ladder program saved in the personal computer. For verification, perform the following procedure.

1. Select "File-Verify File" from the "File" menu.
   The "Open File" dialog box is displayed.
2. Select the verification source file, and click the [OK] button.
3. If a difference is detected, the message "Verification error" is displayed. Click the [OK] button. The error list is displayed.
4. Select the desired verification error, and click the [JUMP] button. The cursor is moved to the location at which the verification error has occurred in the ladder diagram in the editor.

2.4 Entering/Deleting Symbols and Connection Lines

This section describes how to enter/delete symbols and connection lines to/from a ladder diagram.

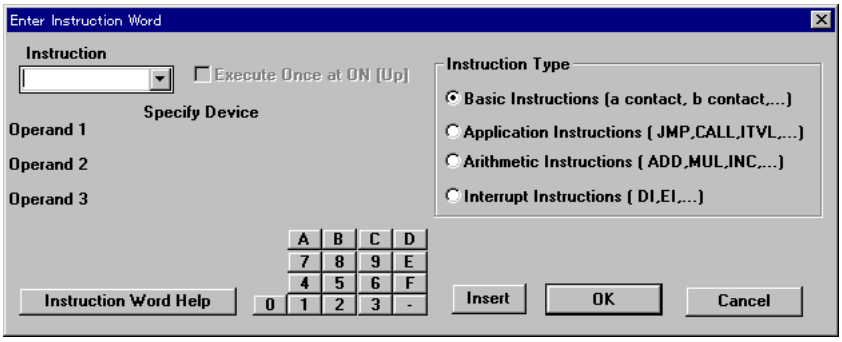
2.4.1 Entering symbols

A ladder symbol is automatically entered when an instruction word is specified. An instruction word can be entered using either of the following two methods. In the first method, you can select the desired instruction word type and the desired instruction word code from the "Enter Instruction Word" window. In the second method, you can directly enter the desired instruction word from the dialog box displayed when the first character of the desired instruction word is entered.

Or you can enter an **a (N.O.)** contact, a **b (N.C.)** contact, an **a (N.O.)** contact OR, a **b (N.C.)** contact OR, or a coil in the current cursor position.

⇨ *2.4.3 Entering contacts/coils directly (p. 2-42)*

- **Selective input**



- **Direct input** ⇨ ***p. 2-41***

Entering symbols by selection

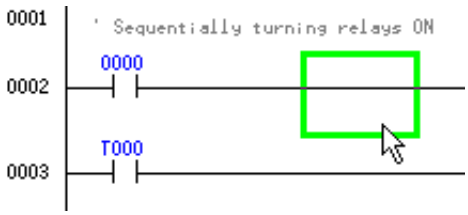
Edit → Symbol Input → Symbol Selective Input (Tab)

When the desired instruction word type is selected on the "Enter Instruction Word" window, instruction codes available for the selected instruction word can be selected from the list. As well, a device can be specified for each operand. If you are not familiar with creation of ladder programs and handling of instruction words, it is recommended that you enter symbols from the "Enter Instruction Word" window to ensure they are correct.

To open the "Enter Instruction Word" window, select "Edit", "Symbol Input" and "Symbol Selective Input" from the menu. In addition, the following two methods are also available. These two methods offer quicker operation.

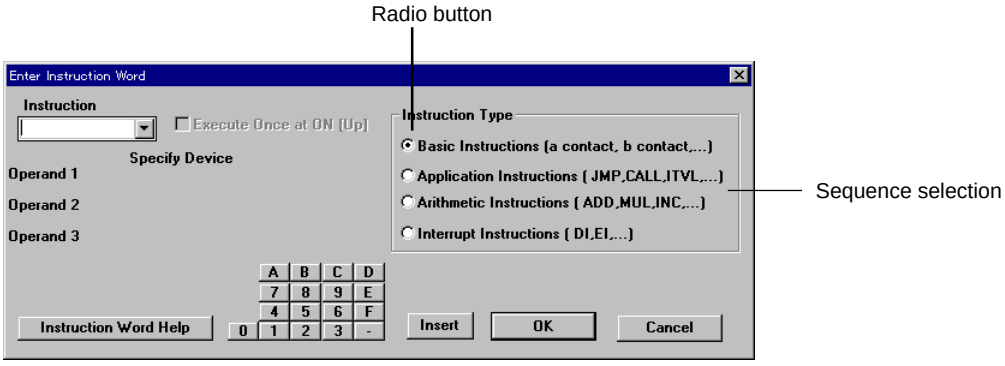
Place the mouse cursor in the cell in the ladder diagram to which an instruction word is to be entered, and double-click it.

Select the desired cell using the **LEFT**, **RIGHT**, **UP** and **DOWN** keys, and then press the **Tab** key.



Note: When an instruction word has already been entered in the selected cell, it is opened in the edit mode.

■ Setting the "Enter Instruction Word" window



1. Select the desired instruction word type from "Instruction Type" located in the right portion of the window.

   Click the desired radio button.

2. Select the desired instruction word from the "Instruction Word" list.

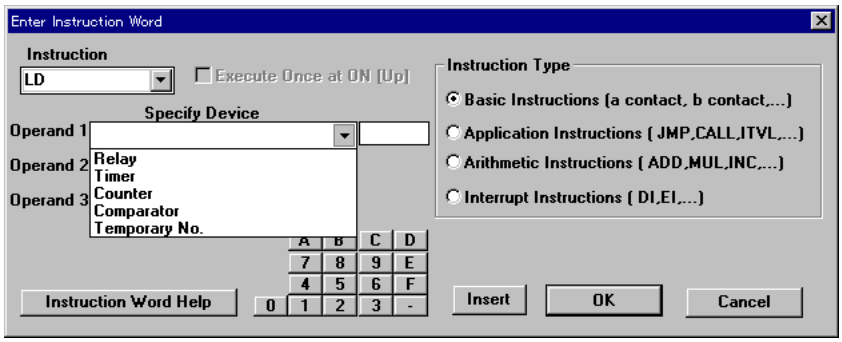
   When selecting an instruction word to be executed only once at the ON signal, click the "Execute Once at ON" check box to add the check mark, and then select the desired instruction word.

Instruction words and their types

Instruction word type	Instruction word	
		Executed only once at the ON signal
Basic Instructions	LD, LDB, AND, ANB, OR, ORB, ANL, ORL, OUT. OUB, SET, RES, TMR, TMH, TMS, C, UDC, DIFU, DIFD, KEEP, SFT, HSP, MC, MCR, MEMSW, END, ENDH	
Application Instructions	W-ON, W-OFF, W-UE, W-DE, STG, JMP, ENDS, STP, SET, ITVL, CTH, CTC, CALL, SBN, RET, FOR, NEXT, HKEY	
Arithmetic Instructions	DW, TMIN, LDA, STA, CMP, ADD, SUB, MUL, DIV, ANDA, ORA, EORA, SRA, SLA, RRA, RLA, COM, INC, DEC, MPX, DMX, TBCD, TBIN, ASC, RASC, ROOT	@TMIN, @LDA, @STA, @CMP, @ADD, @SUB, @MUL, @DIV, @ANDA, @ORA, @EORA, @SRA, @SLA, @RRA, @RLA, @COM, @INC, @DEC, @MPX, @DMX, @TBCD, @TBIN, @ASC, @RASC, @ROOT
Interrupt Instructions	DI, EI, INT, RETI	

3. Specify a device for each operand.

   Click the ▼ button to display the device type list. Select the desired device type from this list, and enter the corresponding number directly.



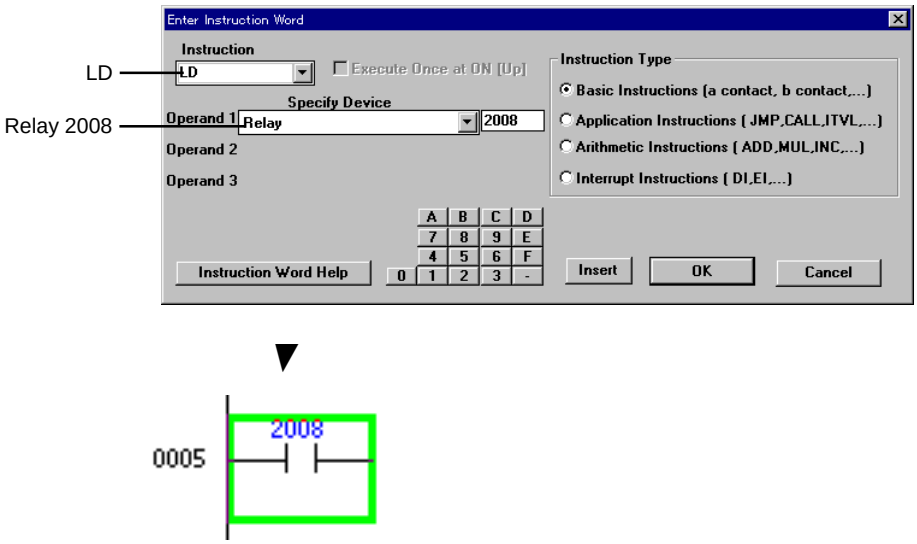
4. When setup is complete, click the [OK] or [Insert] button.

[OK] : Overwrites a ladder symbol.
[Insert] : Inserts a ladder symbol in the cursor position.
[Cancel] : Cancels the setting entered, and closes the window.

5. The selected ladder symbol is entered. When a symbol has already been entered in the position, it is replaced with the new symbol selected.

Example

When the relay 2008 is entered



Entering symbols directly

Edit → Symbol Input → Symbol Direct Input (Enter)

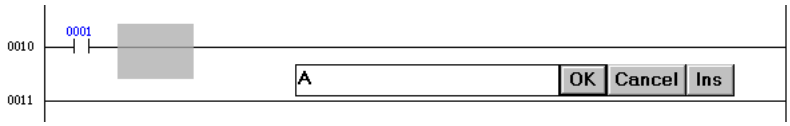
Instruction words can also be directly entered.
When you are familiar with creation of ladder programs and handling of instruction words, direct input is recommended because it is quicker and more efficient than input through the "Enter Instruction Word" window.

To open the dialog box for directly entering instruction words, select "Edit", "Symbol Input" and "Direct Symbol Input" from the menu. The following two methods are also available for quicker operation.

Select the desired cell using the **LEFT**, **RIGHT**, **UP** and **DOWN** keys, and then enter the first character of the instruction word to be entered. You can also press the **ENTER** key when changing an existing input.

The dialog box is opened in which the first character is displayed.

Example
When "A" is entered



■ Entering symbols in the direct input dialog box

1. Enter an instruction word directly from the keyboard into the text box.

Note 1: Enter an instruction word in mnemonic format, and enter a space between the instruction word and the device name.

LD 0001
↑

Note 2: For LD and LDB, "A" and "B" can be entered instead respectively.
LD 0001 → A 0001
LDB 0001 → B 0001

---

2. When input is complete, click the [OK] or [Ins] button.
   [OK] : Overwrites the existing ladder symbol.
   [Ins] : Inserts the ladder symbol entered in the cursor position.
   [Cancel] : Cancels the setting entered, and closes the window.

3. The ladder symbol is entered.

2.4.2 Deleting symbols

Edit → Symbol Input → Delete Symbol (Delete)

To delete a symbol, place the cursor in the symbol to be deleted, click it, and then perform either of the following operations. (This procedure is equivalent in principle to the character deletion procedure.)

- Press the space bar.
- Press the **Delete** key.
  (When the **Backspace** key is pressed, the symbol just before the cursor is deleted.)

2.4.3 Entering contacts/coils directly

Enter a contact or coil directly in the current cursor position.

Entering a/b contacts

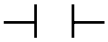
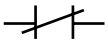
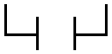
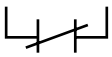
Edit → Symbol Input → a (N.O.) Contact Input (F5)
→ b (N.C.) Contact Input (Shift + F5)
→ a (N.O.) Contact OR Input (F4)
→ b (N.C.) Contact OR Input (Shift + F4)

To enter a contact, perform the following procedure.

1. Place the cursor in the input position.

2. Select "Symbol Input" from the "Edit" menu, and select the contact type to be entered from the submenu.
   The corresponding function key can be pressed instead or the corresponding icon can be clicked.
   - The "Change Device" dialog box is displayed.

When entering an a contact:

a (N.O.) Contact Input		(F5) key	button
When entering a b contact			
b (N.C.) Contact Input		(Shift + F5) keys	button
When entering an a contact OR			
a (N.O.) Contact OR Input		(F4) key	button
When entering a b contact OR			
b (N.C.) Contact OR Input		(Shift + F4) keys	button

3. Enter a device name directly from the keyboard into the text box.

4. When input is complete, click the [OK] button.
   When the [Cancel] button is clicked, the setting entered is canceled and the dialog box is closed.

5. The ladder symbol is entered.

Entering coils

Edit → Symbol Input → Coil Input (F7)
→ b (N.C.) Contact Coil Input (Shift +F7)

To enter a coil, perform the following procedure.

1. Place the cursor in the input line.

2. Select "Symbol Input" from the "Edit" menu, and select the coil type to be entered from the submenu.
   The corresponding function key can be pressed instead or the corresponding icon can be clicked.

- The "Change Device" dialog box is displayed.

When entering a coil	: Coil Input	**F7** key	button
When entering the b contact coil	: Coil Input	**Shift** + **F7** keys	button

3. Enter a device name directly from the keyboard into the text box.

4. When input is complete, click the [OK] button.
   When the [Cancel] button is clicked, the setting entered is canceled and the dialog box is closed.

5 The ladder symbol is entered.

2.4.4 Changing the device at the current cursor position

Edit → Change Device at Cursor Position (Esc) ★ Right-click

To change the device at the current cursor position, perform the following procedure.

1. Place the cursor in the device to be changed.

2. Select "Change Device at Current Position" from the "Edit" menu or right-click menu or press the **Esc** key.
   The "Change Device" dialog box is displayed.

3. Enter a device name directly from the keyboard into the text box.

4. When input is complete, click the [OK] button.
   When the [Cancel] button is clicked, the setting entered is canceled and the dialog box is closed.

5. The device is changed.

2.4.5 Entering/Deleting connection lines

Edit → Edit Connection Line (Ctrl + K + \)

Entering connection lines

The following two methods can be used to enter connection lines.

■ **Pressing the keys or clicking the icon**

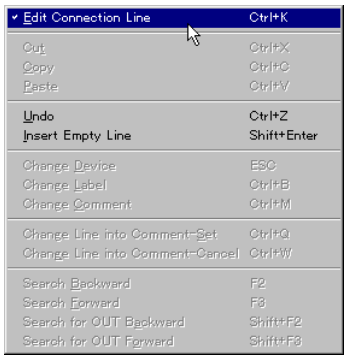
(F8) + (**/**) (slash key) or : Draws a connection line downward from the cursor position.

(F9) + (**-**) (minus key) or : Draws a connection line to the right of the cursor position.

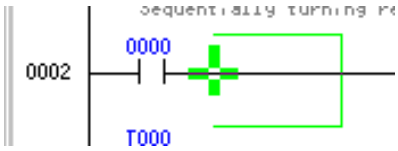
■ **Using the mouse and cursor control keys in connection line edit mode**

To draw connection lines using the mouse, first change the input mode.
The following four methods can be used to change the mode.

- Select "Edit Connection Line" from the menu displayed by right-clicking.
- Select "Edit Connection Line" from the "Edit" menu.
- Press the **Ctrl** and **K** keys at the same time.
- Press the **** key.



When connection line edit mode is selected, the cursor shape is changed as follows.



To return to the normal edit mode, perform this procedure again.

1. Place the mouse cursor at the desired connection line start position. When using the keyboard, press the **ENTER** key.

2. While pressing and holding the left mouse button, move the mouse cursor in the desired direction (drag). When using the keyboard, press either the **LEFT**, **RIGHT**, **UP** or **DOWN** key.

3. Release the button at the desired connection line end position. When using the keyboard, press the **[ENTER]** key again. (If the **[Delete]** key is pressed, the connection line is deleted.)

Deleting connection lines

To delete a connection line, press the **Delete** key while dragging the connection line to be deleted in connection line edit mode.

The following procedures are also available to delete connection lines.

■ **When deleting a vertical connection line**

- Press the **Shift** and **F8** keys at the same time.
- While dragging the connection line to be deleted in connection line edit mode, press the **Shift** key and release the left mouse button at the same time.
- Click the button.

■ **When deleting a horizontal connection line**

- Press the space bar.
- Press the **Backspace** key. (The connection line just before the cursor is deleted.)
- Press the **Delete** key.
- While dragging the connection line to be deleted in connection line edit mode, press the **Shift** key and release the left mouse button at the same time.
- Click the button.

2.4.6 Canceling edit operations

Canceling an edit operation (UNDO)

Edit → Undo (Ctrl + Z)

The last edit operation (input, move or copy of a symbol) that was performed can be canceled, and the previous status can be recovered.
When the last edit operation is unrecoverable and the undo operation is disabled, the selection item "Undo" is shown in a lighter color to indicate the selection is disabled.

■ **Unrecoverable operations**

- Replacement of operands
- Conversion of N.O./N.C. contacts
- Read/save of programs, mnemonic files, etc.
- Change of labels or comments
- Input of macros

Canceling an undo operation (REDO)

Edit → Redo (Ctrl + Y)

The last undo operation that was performed can be canceled.
When the last undo operation cannot be canceled, the selection item "Redo" is shown in a lighter color to indicate the selection is disabled.

2.5 Entering Comments/Labels

This section describes how to enter comments/labels to contacts, how to change these comments/labels, and how to enter/change line comments.

2.5.1 Editing comments/labels

The label name, comment 1, comment 2, and comment 3 can be entered for a contact.
Comments are entered so that the contents of a contact can be easily deduced when editing a ladder diagram. Comments are displayed in the ladder diagram monitor, the simulator and the monitor.

Manipulate the "Edit Comment/Label" dialog box. This dialog box is displayed for each device type, and allows you to edit two or more comments at a time.
The label name and comment can also be changed by selecting the device to be changed in the ladder diagram.

➪ *Making changes directly in the ladder diagram (p. 2-49)*

The comment/label edit method is described below.

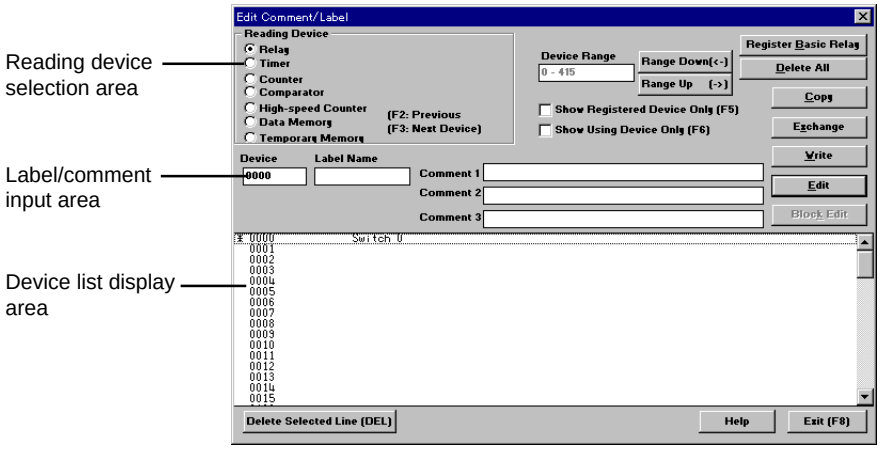
Note: The comment 2 and comment 3 files are dedicated to the Ladder Builder for KV. When the comment is to be shared with the KV IncrediWare (DOS), use comment 1.

Editing the list for each device

Comment → Edit Comment/Label (Ctrl + F7)

1. Select "Edit Comment/Label" from the "Comment" menu, or click the button.

   The "Edit Comment/Label" dialog box is displayed.
   The relays 0000 to 0415 are displayed by default.



   The "*" symbol is displayed beside devices used in the ladder diagram.

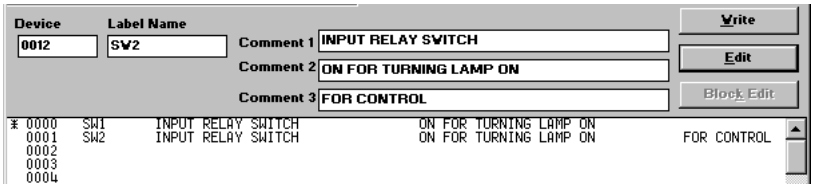
2. Select the device to be edited in the "Reading Device" area.

3. Specify the device range to be displayed in the list in the "Device Range" area.

4. Click and select the device for which a label/comment is to be edited, and then click the [Edit] button. (Or the desired device displayed in the list can be clicked and selected.)
   When using the keyboard, select the desired device using the **UP** and **DOWN** keys, and press the **ENTER** key.

   The cursor is displayed in "Label Name" in the label/comment input area so that characters can be entered.

5. Enter or change the label/comment. A label/comment can be copied from or exchanged with another device.



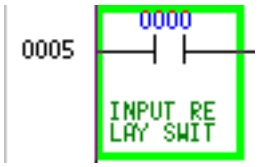
- The table below shows the available character types and the maximum number of characters allowed.

Label name	Alphabet. 8 characters maximum. Spaces and commas cannot be entered.
Comment 1	32 characters maximum (This comment is compatible with KV IncrediWare (DOS) relay comments.)
Comment 2	32 characters maximum
Comment 3	32 characters maximum

To register basic relays, click the [Register Basic Relay] button in the "Edit Comment/Label" dialog box, and then enter the basic relays of the model used into comment 1.

6. When input is complete, click the [Write] button.
   To close the "Edit Comment/Label" dialog box, click the [Exit] button.

   The label/comment is entered.



To display labels/comments, select the "View" menu. When the submenu is displayed, select "Show Label" or "Show Comment".

➪ *For the method to specify the comment to be displayed, refer to the display mode (p. 2-19).*

Note: A label name can be used instead of a device name when entering, searching for or replacing a symbol.

For example, when the label "SW1" is attached to the device "0000", the program can be written as follows.

Instead of entering "0000" : SW1
Instead of entering "LD0000" LD: SW1

Labels cannot be entered in the instruction selection window.

■ **When selecting the devices to be displayed in the list**

The devices to be displayed in the list can be selected by checking the following item.

Show Registered Device Only: Displays the devices in which labels/comments are registered.
Show Using Device Only: Displays the devices used in the ladder diagram.

When neither item is checked, all the devices are displayed.

■ **When copying a label/comment from another device**

1. Place the cursor in the copy source device, and click the [Copy] button.

2. Place the cursor in the copy destination device, and click the [Write] button.
   When the [Exchange] button is clicked instead of the [Write] button, the contents of the input area are exchanged with the comments of the selected device.

■ **When deleting registered labels/comments**

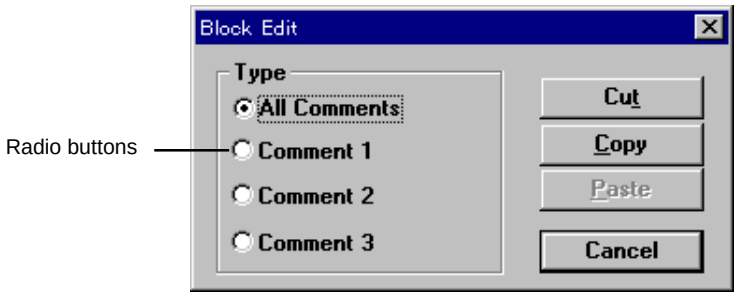
To delete only the selected device, place the cursor in the device to be deleted, and press the **Delete** key or click the [Delete Selected Line] button.

To delete all of the devices, click the [Delete All] button.

■ **When copying a comment block from other devices**

1. Select the comment range of the device to be copied as a block in the device list display area.
   ➪ *Selecting the range (p. 2-52)*

2. Click the [Block Edit] button.
   The "Block Edit" dialog box is displayed.



3. Select the comment type to be copied by selecting the corresponding radio button.

4. Click the [Copy] button.

5. Specify the start device in the copy destination device range in the device list display area.

6. Click the [Block Edit] button.
   The "Block Edit" dialog box is displayed.

7. Click the [Paste] button.
   The contact comments in the device range covering the number of devices specified in step 1, starting from the device number selected in step 5 are copied.

■ **When moving a comment block from other devices**

Perform steps 1 to 7 described above. However, click the [Cut] button instead of the [Copy] button in step 4.
Using this procedure, the comment block of the selected devices can be moved.

■ **When deleting a comment block from other devices**

Perform steps 1 to 4. However, click the [Cut] button in step 4.
Using this procedure, the comment block of the selected devices can be deleted.

Making changes directly in the ladder diagram

Comment → Change Label Name of Current Device (Ctrl + B)
→ Change Comment of Current Device (Ctrl + M)

Perform the following procedure when entering a label name or comment in the ladder diagram.

1. Place the cursor in the device to be entered.

2. When entering a label name, select "Change Label Name of Current Device **Ctrl** + **B"** from the "Comment" menu.

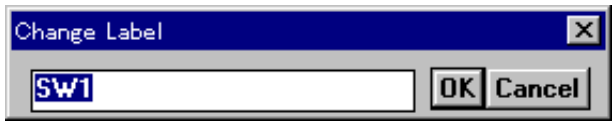
   When entering a comment, select "Change Comment Name of Current Device **Ctrl** + **M**" from the "Comment" menu.

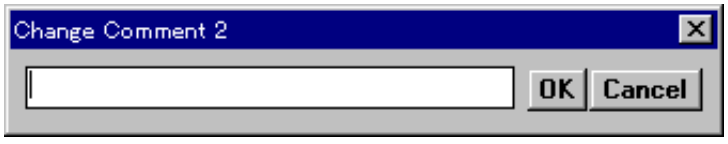
   The "Change Label" or "Change Comment X" dialog box is displayed.

   The dialog box name in which comments can be changed varies depending on the comment type selected in "Comment Type" in "Display Mode".

   When a label name or comment has already been registered in the device, the registered character string is displayed.

3. Enter the desired character string.
   The comment selected in "Comment Type" in "Display Mode" can be entered.
   Display mode (p. 2-19)





* Example: When "Comment 2" is displayed in "Comment Type"

4. The displayed character string is entered when the [OK] button is clicked.
   To cancel the input, click the [Cancel] button.

2.5.2 Editing line comments

Comment → Edit Line Comment (Ctrl + Enter)

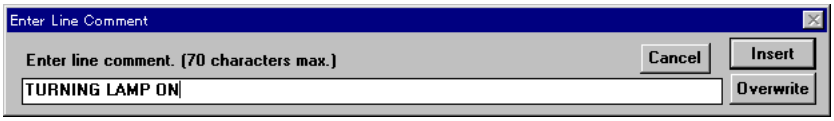
A line comment can be described in each line of the ladder diagram.
Line comments are entered so that the contents of each circuit block can be easily deduced when editing the ladder diagram. Line comments are displayed in the ladder diagram monitor, the simulator and the monitor.

To enter a line comment or change a comment, perform the following procedure.

1. Place the cursor in the line for which a line comment is to be entered/changed. When changing a comment that has already been entered, double-click the comment. The "Enter Line Comment" dialog box is then displayed.

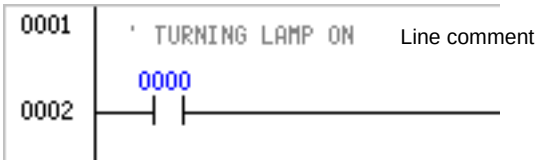
2. Select "Edit Line Comment" from the "Comment" menu, or click the button. The "Enter Line Comment" dialog box is displayed.

3. Enter or change the comment.
   Up to 70 characters can be entered.



4. When the [Insert] button is clicked, a new line is inserted.
   When the [Overwrite] button is clicked, a new line is written over the current line.
   To cancel, click the [Cancel] button.

   The entered comment is displayed in the ladder diagram.



Note 1: When the [Overwrite] button is clicked, the portion of the ladder diagram located in the cursor line is deleted. Make sure it is okay to delete the corresponding portion of the ladder diagram before clicking the [Overwrite] button.

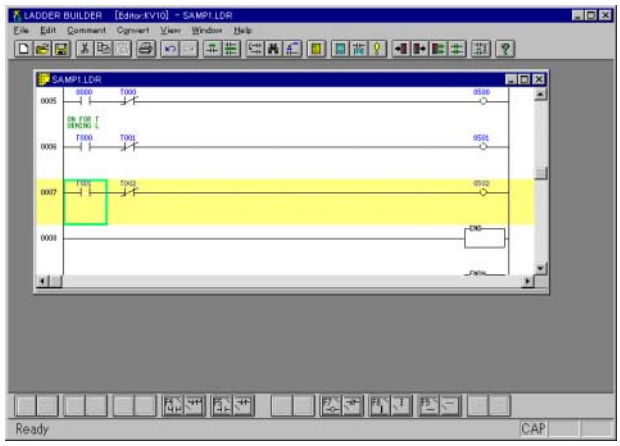
Note 2: Line comments cannot be transferred to the PLC. Accordingly, line comments are not included in a program read from the PLC.

2.5.3 Changing ladder lines into comments

Comment → Change Ladder Line into Comment → Settings (Ctrl + Q) ★ Right-click
→ Change Ladder Line into Comment → Cancel (Ctrl + W) ★ Right-click

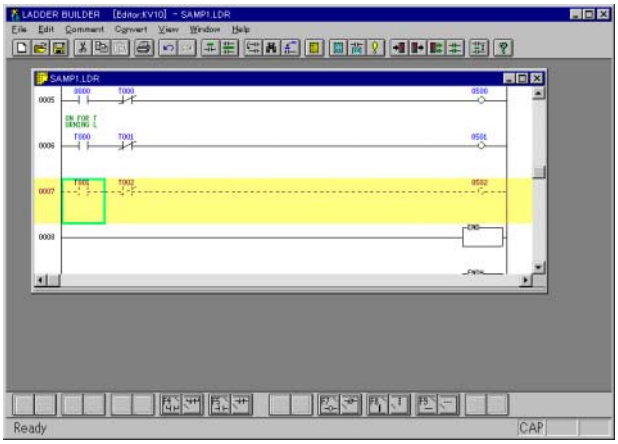
When you specify a ladder line to be treated as a comment, only this specified portion is ignored during conversion. Set this function temporarily when you do not want a certain portion to be converted.
To set ladder lines to be changed into comments or to reverse this setting, perform the following procedure.

1. Select the range of the ladder lines to be changed into comments or for which the setting is to be reversed.
   Selecting the range (p.2-52)



2. To set the line range to be changed into comments, select "Comment", "Change Ladder Line into Comment and Settings **Ctrl** + **Q**" from the menu or right-click menu. To cancel the setting, select "Cancel **Ctrl** + **W**" from the submenu.

3. The selected line range is changed into comments.
   When the setting is canceled, the specified range can be converted.



Note 1: The ladder lines set to be changed into comments cannot be transferred to the PLC. Accordingly, the ladder lines set to be changed into comments are not included in a program read from the PLC.

Note 2: The ladder lines set to be changed into comments cannot be read by the KV IncrediWare (DOS). Accordingly, when a program is read by the KV IncrediWare (DOS) and saved with the same name, the ladder lines set to be changed into comments are deleted.

2.6 Edit and Arrangement

This section describes ladder diagram edit procedures, such as copy/movement/ deletion of the range selected in the ladder diagram, insertion/deletion of lines, how to change the number of columns, arrangement of circuits, etc.

2.6.1 Copy, move, and delete

Copy, move or delete the range selected in a ladder diagram.
To copy, move or delete the selected range, use the "cut & paste" method which is a standard Windows editing procedure.

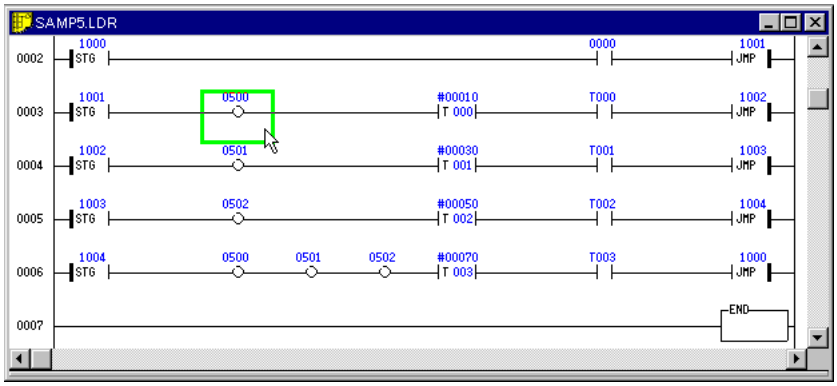
Selecting the range

To copy, move or delete data, first select the range. The range can be selected using the mouse or keyboard.

Note: Copy, move and delete functions cannot be performed while in connection line edit mode. If connection line edit mode is selected, select "Edit Connection Line" from the "Edit" menu, and select the normal edit mode (in which the check mark is not added).

■ Selecting the range using the mouse

1. Place the mouse pointer in the selection start position, and click.
   The cursor is displayed.

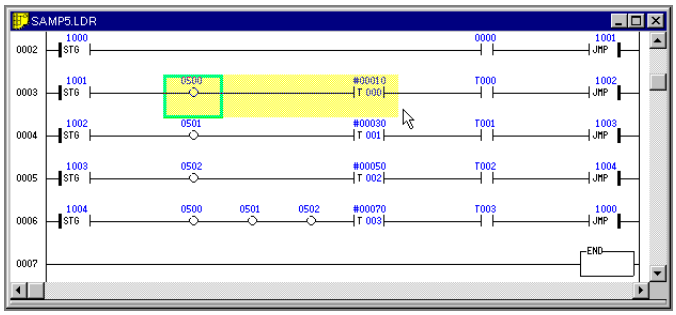


2. While pressing and holding the left button, move the pointer to the selection end position (drag).

   The selected range is displayed in yellow.

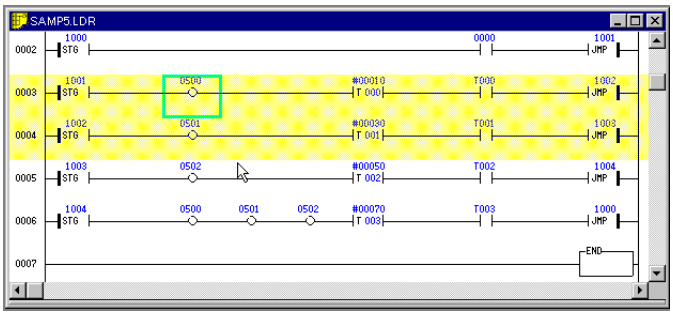
- **Selecting the range in units of cells**

  While dragging the mouse pointer, move it in the horizontal direction up to the target cell until the desired range is selected.



- **Selecting the range in units of lines**

  While dragging the mouse pointer, move it in the vertical direction up to the target line until the desired range is selected.



Note: A portion of a cell covering two or more lines cannot be selected.

3. Release the left button in the selection end position.
   To cancel the selection, click anywhere in the ladder diagram.

■ Selecting the range using the keyboard

1. Place the cursor in the selection start position using the **LEFT**, **RIGHT**, **UP** and **DOWN** keys.

2. While pressing and holding the **Shift** key, press the **LEFT**, **RIGHT**, **UP** or **DOWN** key, and move the cursor to the selection end position.

   The selected range is displayed in yellow.

Note: A portion of a cell covering two or more lines cannot be selected.

3. Release the [Shift] key in the selection end position.

   To cancel the selection, press the **LEFT**, **RIGHT**, **UP** or **DOWN** key again.

Note: When the range is selected in units of cells from the right to the left, the cell at the left end cannot be selected. When the range is selected in units of lines in an upward direction, the line at the top end cannot be selected.

Copy/move/delete operation

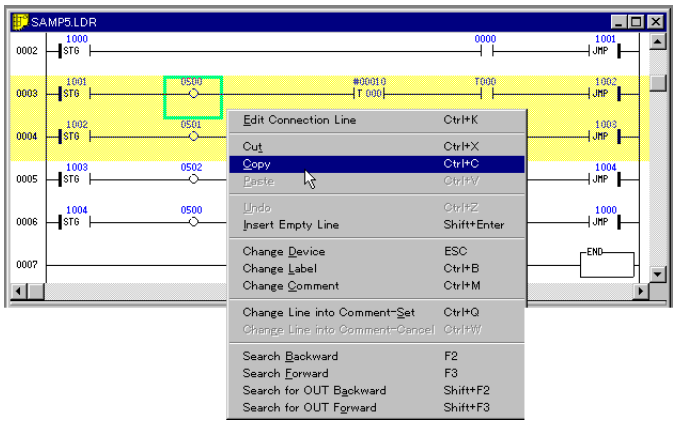
Edit → Cut (Ctrl + X) ★ Right-click
→ Copy (Ctrl + C) ★ Right-click
→ Paste (Ctrl + V) ★ Right-click

1. After selecting the desired range, perform the following procedure.

■ When copying data

Perform any of the following operations.

- Select "Copy" from the "Edit" menu on the tool bar, or select "Copy" from the right-click menu.
- Click the button.
- While pressing and holding the **Ctrl** key, press the **C** key.



When copying data from another file

When two or more windows are open, the desired range can be selected on another file window, and then copied or moved to the current window.

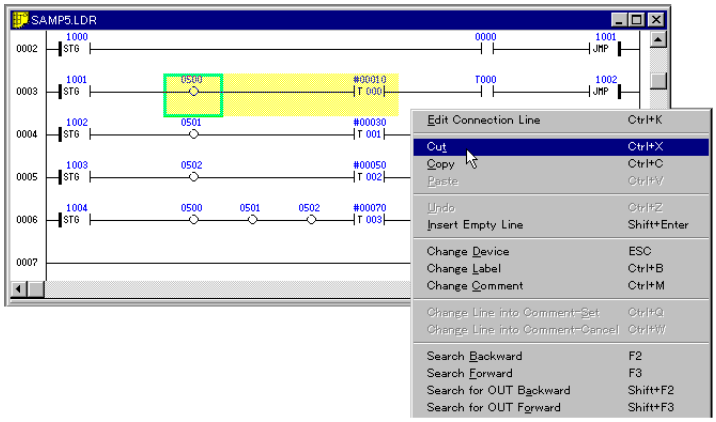
1. Click the copy source window to set it as the current window.
2. Select the desired range, and copy it.
3. Click the copy destination window to set it as the current window.
4. Perform the paste operation.

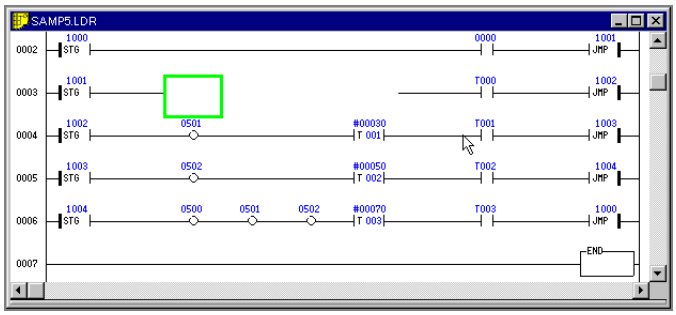
⇨ *Step 3 on page 2-56.*

■ When moving/deleting data

Perform any of the following operations.

- Select "Cut" from the "Edit" menu on the tool bar, or select "Cut" from the short-cut menu displayed by right-clicking.
- Click the button.
- While pressing and holding the **Ctrl** key, press the **X** key.

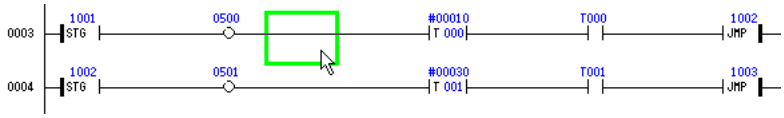




2. Perform the following procedure when copying or moving data.

■ When pasting data to a ladder diagram

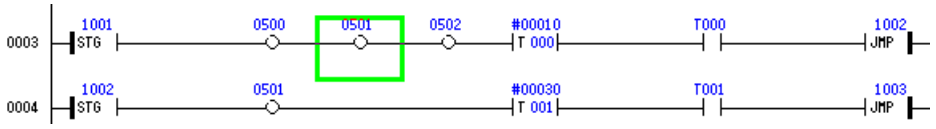
Place the mouse pointer in the copy destination or the move destination, then click it. You can also move the cursor to the copy destination or the move destination using the **LEFT**, **RIGHT**, **UP** and **DOWN** keys.



3. Perform any of the following operations.

- Select "Paste" from the "Edit" menu on the tool bar, or select "Paste" from the shortcut menu displayed by right-clicking.
- Click the button.
- While pressing and holding the **Ctrl** key, press the **V** key.
- While pressing and holding the **Shift** key, press **Insert** key.

The selected range is pasted.



Note 1: The cut portion is temporarily copied to the cut buffer. Accordingly, even if the portion is cut to be deleted, the cut portion can be pasted again by performing step 3 above.

Note 2: When the number of cells copied is larger than the paste destination space, the message "Can't write at current position." is displayed, and the cells equivalent to only the paste destination space are pasted. The remaining cells are not pasted.

2.6.2 Inserting and deleting lines

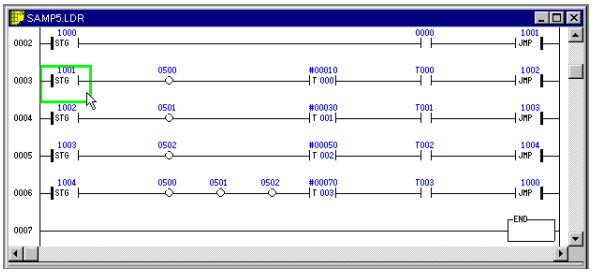
To insert lines into a ladder diagram or delete existing lines, perform the following procedure.

Inserting blank lines

Edit → Insert Empty Line (Shift + Enter) ★ Right-click

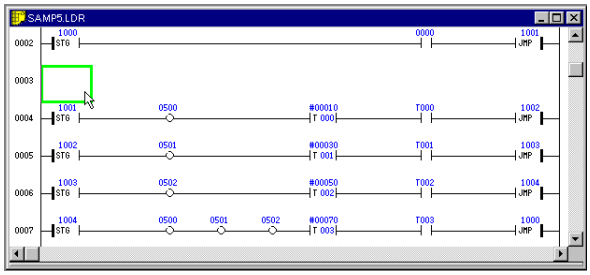
1. Place the cursor in the position at which blank lines are to be inserted.

   To insert two or more blank lines at once, first select the insertion range. Then, the selected blank lines can be inserted all at once.



2. Select "Insert Empty Line" from the "Edit" menu or right-click menu, or press the **ENTER** key while pressing and holding the **Shift** key.

   Blank lines are inserted above the cursor.

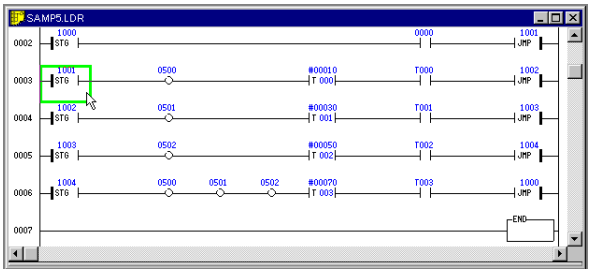


Deleting lines

Edit → Delete Line (Shift + Delete)

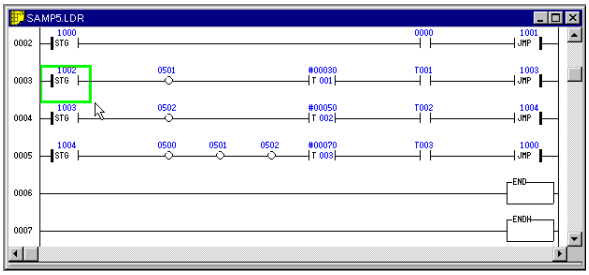
1. Place the cursor in the line to be deleted.

   To delete two or more lines at once, first select the deletion range.



2. Select "Delete Line" from the "Edit" menu, or press the **DEL** key while pressing and holding the **Shift** key.

   The specified lines are deleted.



2.7 Jump, Search, and Replace

This section describes how to jump to any position in a ladder diagram, search for an instruction word/operand, and replace operands or **N.O./N.C.** contacts.

2.7.1 Jump

The edit control can jump to any position by specifying the desired line number or step number of the program. The edit control can also be jumped to the first or last line. Use the jump function to quickly change the edit position.

Jump to the specified line/step

Edit → Jump → Line/Step No.

To jump to another position by specifying the desired line number or step number of the ladder program, perform the following procedure.

1. Select "Edit", "Jump," and "Line/Step No." from the menu. You can also enter the desired line number or step number directly from the keyboard.

   The "Jump to Specified Line" dialog box is displayed.

2. Specify the line number or step number as the jump destination.
   When a line number or step number is entered from the keyboard in step 1, it is already specified.

3. Click the [Line] button when jumping the edit control by specifying a line number.
   Click the [Step] button when jumping the edit control by specifying a step number.
   Click the [Cancel] button to cancel jumping.

   The specified line or step is displayed, and the cursor is moved to the specified line or step.

Note: When a number larger than the last line or step number is selected, the last line or step is displayed.

Jump to the first/last line

Edit → Jump → Top (Ctrl + Home)
→ Bottom (Ctrl + End)

To jump to the first line or the last line of a ladder diagram, perform the following procedure.

■ When jumping to the first line

Select "Edit", "Jump" and "Top" from the menu.

■ When jumping to the last line

Select "Edit", "Jump" and "Bottom " from the menu.

Jump to the registered line

Edit → Jump → Line Registration (Ctrl + L)
→ Registered Line (Ctrl + J)

The desired lines can be temporarily registered together with comments, and the edit control can be jumped by specifying the jump destination from the registered line list.
This function is useful when a jump to the same line is performed many times or when the line number does not help you recognize the line.

■ Registering lines

Register lines using the following procedure.

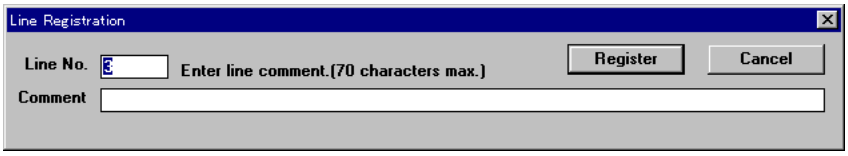
1. Place the cursor in the line to be registered.

2. Select "Edit", "Jump" and "Line Registration" from the menu.

   The "Line Registration" dialog box is displayed.

3. Enter the desired comment for the line to be registered into "Comment" if necessary.
   When registering the same comment for another line, change "Line No." to the line number to be registered.

   Up to 70 characters can be entered.



4. Click the [Register] button when registering the specified line.
   Click the [Cancel] button to cancel registration.

   The specified line is registered.

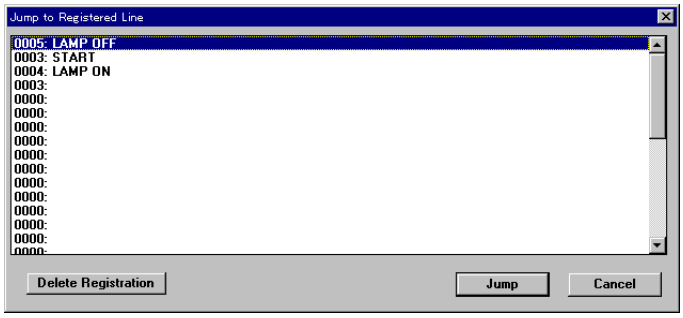
Note: Up to 32 lines can be registered. When the number of registered lines exceeds 32, lines are deleted beginning at the oldest one.

■ Jump to a registered line

To jump to a registered line, perform the following procedure.

1. Select "Edit", "Jump" and "Registered Line" from the menu.

   The "Jump to Registered Line" dialog box is displayed.



2. Position the pointer over the jump destination line in the line No./comment list displayed, and then click it. Double-click it to jump immediately.

3. Click the [Jump] button.
   To cancel jumping, click the [Cancel] button.

   The specified line is displayed, and the cursor is moved to the specified line.

■ Deleting a registered line

Place the cursor in the line to be deleted in the "Jump to Registered Line" dialog box, and click the [Delete Registration] button. The specified line is deleted.

Note 1: Set registration for each ladder program window.

Note 2: When a file is saved, data on registered lines is also saved.

Note 3: When data is saved by the KV IncrediWare (DOS), registration becomes invalid.

Jump to the next/previous block

Edit → Jump → Next Block (Ctrl + DOWN)
→ Previous Block (Ctrl + UP)

To jump to the next circuit block or to the previous circuit block from the current cursor position, perform the following procedure.

■ **Jump to the next circuit block**

- Select "Edit", "Jump" and "Next Block" from the menu.
- Press the **DOWN** key while pressing and holding the **Ctrl** key.

Note: Jump from a comment line to the next circuit block is disabled.

■ **Jump to the previous circuit block**

- Select "Edit", "Jump" and "Previous Block" from the menu.
- Press the **UP** key while pressing and holding the **Ctrl** key.

Jump to the beginning/end of the line

Edit → Jump → Beginning of Line (Home)
→ End of Line (End)

To jump to the beginning or end of the line in which the cursor is currently placed, perform the following procedure.

■ **Jump to the beginning of a line**

- Select "Edit", "Jump" and "Beginning of Line" from the menu.

- Press the **Home** key.

■ **Jump to the end of a line**

- Select "Edit", "Jump" and "End of Line" from the menu.

- Press the **End** key.

2.7.2 Searching for instruction words/operands

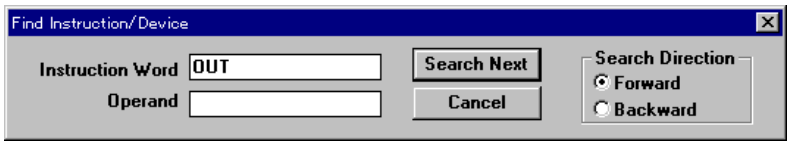
Edit → Find (Ctrl + F)

To search for an instruction and a device in a program by specifying an instruction word or operand, perform the following procedure.

1. Select "Edit" and "Find" from the menu. Or click the button.

   The "Find Instruction" dialog box is displayed.

2. Enter an instruction word to be found into the "Instruction Word" text box. Enter an operand to be found into the "Operand" text box.
   You can also search for either one alone.



Note 1: When searching for a timer instruction, counter instruction or high-speed counter instruction, specify "TMR", "CTC", etc. as the instruction word to be found and "T0", "C0" , etc. as the operand to be found.

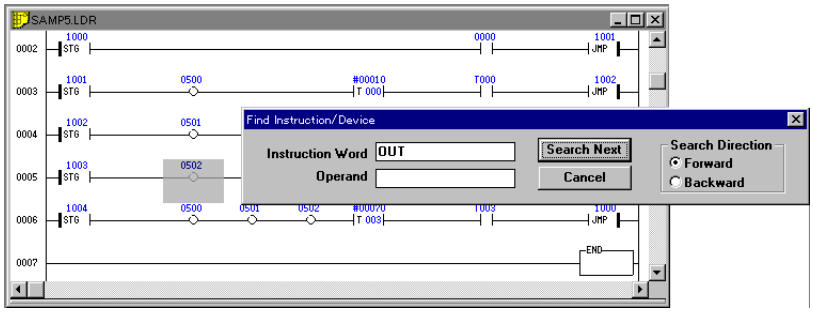
Note 2: When two or more operands are used, specify both the instruction and the operand to be found.

3. Select the search direction.
   Forward: Searches forward from the current cursor position.
   Backward: Searches backward from the current cursor position.

4. Click the [Search Next] button.

   Search is started, and the first block found containing the instruction or operand is displayed.

   When the specified instruction word or operand is not found, the message "Can't find specified symbol." is displayed.



5. When searching continuously, click the [Search Next] button.
   To stop searching, click the [Cancel] button.

Note 1: Two or more search windows can be opened.

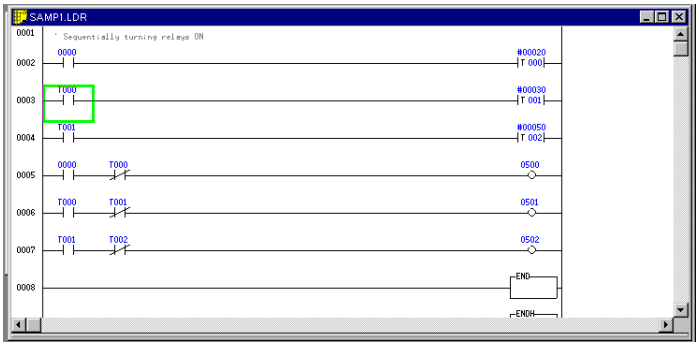
Note 2: Search is executed for the current ladder window. Because the search condition remains valid even after the current ladder window is changed, the same condition can be used for searching a different ladder window.

2.7.3 Searching for the device at the cursor position

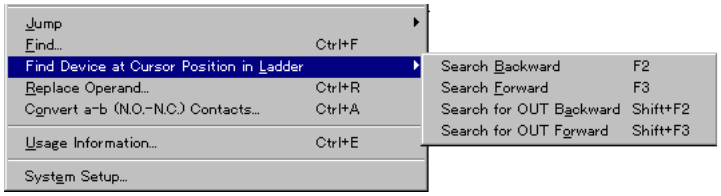
Edit → Find Device at Cursor Position in Ladder → Search Backward (U) (F2)
→ Search Forward (F3)
→ Search for OUT Backward (Shift + F2)
→ Search for OUT Forward (Shift + F3)

To search for the device equivalent to the device at the current cursor position, perform the following procedure.

1. Place the cursor in the device to be found.

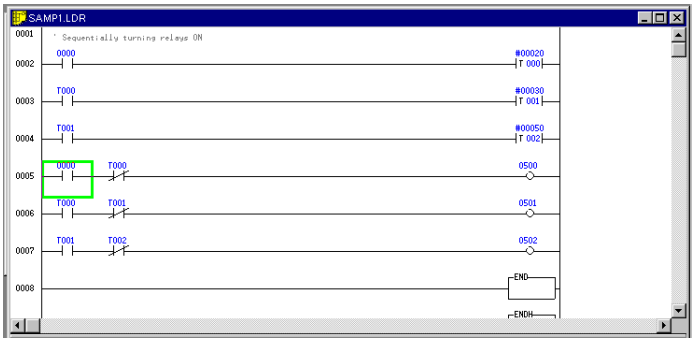


2. Select "Find Device at Cursor Position in Ladder" from the "Edit" menu.



3. Select the search direction.
   Search Backward : Searches backward from the current cursor position.
   Search Forward : Searches forward from the current cursor position.
   Search for OUT Backward : Searches for OUT backward from the current cursor position.
   Search for OUT Forward : Searches for OUT forward from the current cursor position.

4. Search is started, and the first device found is displayed.



5. When searching continuously, repeat steps 2 to 4 above.

2.7.4 Replacing operands

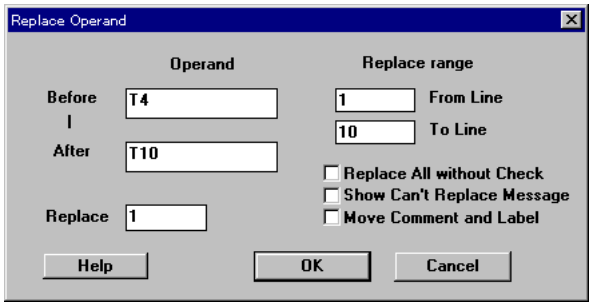
Edit → Replace Operand (Ctrl + R)

When replacing an operand by specifying the replacement range and the replacement width, perform the following procedure.

1. Select "Replace Operand" from the "Edit" menu, or click the button.

   The "Replace Operand" dialog box is displayed.

2. Enter the operand before replacement into the "Before Replacement" text box. Enter the operand after replacement into the "After Replacement" text box.



3. Enter the replacement width.

   What is the replacement width?
   The replacement width indicates how many operands are to be treated as the replacement target.
   For example, when "3" is set while replacing "3000" with "0500", "3000" to "3002" will be replaced with "0500" to "0502".

4. Specify the replacement range using the line number. By default, all the lines are replaced (from the first line to the last line).

5. Specify the replacement method. Add a check mark to the desired method by clicking it.

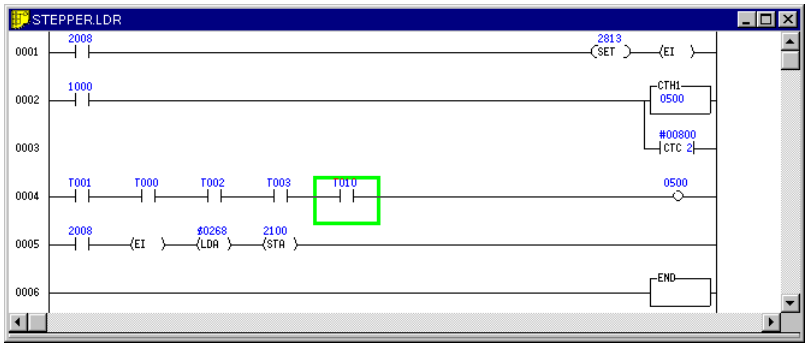
Replace All without Check	The message to confirm execution of replacement is not displayed at all.
Show Can't Replace Message	For an operand which cannot be replaced, the mes sage is displayed.
Move Comment and Label	The comment and the label attached to the operand before replacement are attached to the operand after replacement.

6. To execute replacement, click the [OK] button. To cancel replacement, click the [Cancel] button.

   The operand set to the "Before Replacement" text box is indicated with the grey cursor, and the confirmation message "Replace this operand?" is displayed.

7. Click the [Yes] button to execute replacement.
   Click the [No] button not to execute replacement.
   Click the [Cancel] button to cancel replacement.

   The operand indicated with the brown cursor is replaced with the operand set to the "After Replacement" text box.



Note 1: When "Replace All without Check" is selected, the confirmation message is not displayed.

Note 2: When "Move Comment and Label" is selected, all the comments of the devices in the set range are replaced. For example, when "0000" is replaced with "0010", the "0000" comment is deleted, and the "0010" comment replaces it.

8. When all replacements are complete, the number of operands replaced is displayed.
   Click the [OK] button.

2.7.5 Converting a/b contacts

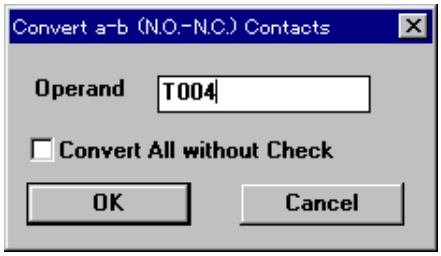
Edit → Convert a-b (N.O.-N.C.) Contacts (Ctrl + A)

To convert an **a (N.O.)** contact into a **b (N.C.)** contact or to convert a **b (N.C.)** contact into an **a (N.O.)** contact, perform the following procedure.

1. Select "Convert a-b (N.O.-N.C.) Contacts" from the "Edit" menu.

   The "Convert a-b (N.O.-N.C.) Contacts" dialog box is displayed.

2. Enter the operand to be converted. Click "Convert All without Check" to attach the check mark so that the message to confirm execution of conversion is not displayed.



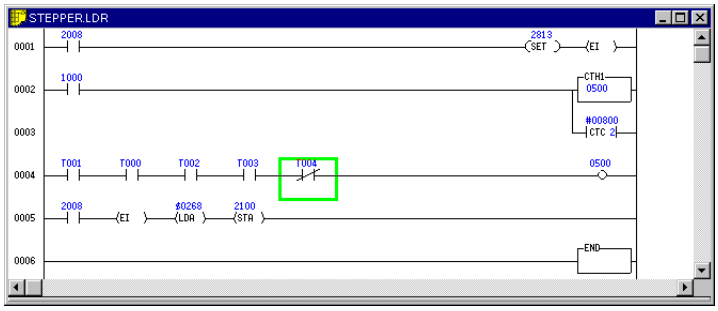
3. To execute conversion, click the [OK] button.
   To cancel conversion, click the [Cancel] button.

   The specified operand is indicated with the grey cursor, and the confirmation message "Covert this contact?" is displayed.

Note : When "Convert All without Check" is selected, the confirmation message is not displayed.

4. Click the [Yes] button to execute conversion.
   Click the [No] button not to execute conversion.
   Click the [Cancel] button to cancel conversion.

   The a (N.O.) contact is converted into a b (N.C.) contact. The b contact is converted into an a contact.



5 When all conversions are complete, the number of contacts converted is displayed.
   Click the [OK] button.

2.8 Editing the Mnemonic List

This section describes how to display each block of circuit in a ladder diagram as a mnemonic list, and how to edit the mnemonic language directly.

2.8.1 Displaying and terminating a mnemonic list

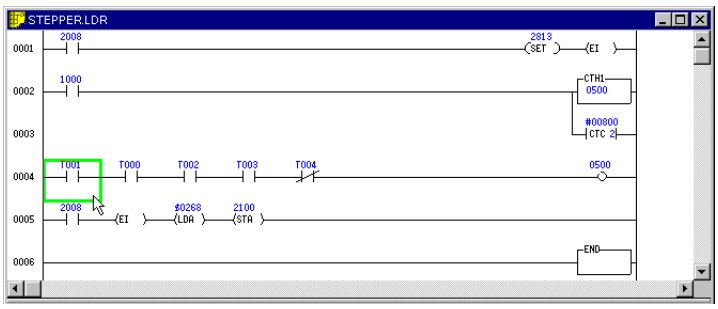
Displaying a mnemonic list

Edit → Edit List

To display mnemonic lists by specifying blocks and to enter symbols by editing mnemonic lists, perform the following procedure.

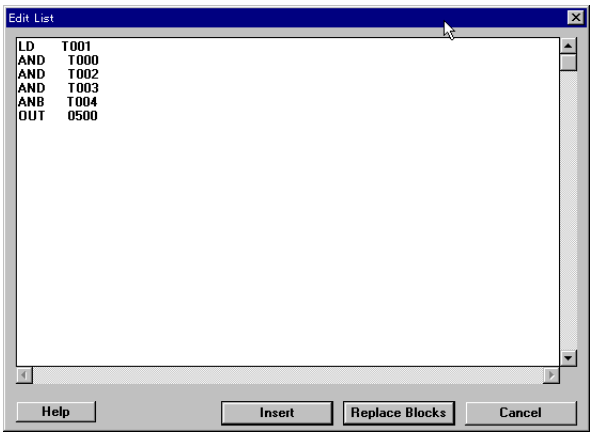
1. Place the cursor in the block for which a mnemonic list is to be displayed or in which the edit contents of the mnemonic list are to be inserted/replaced.

   In the case of insertion, the edit contents are inserted above the cursor line.



2. Select "Edit List" from the "Edit" menu, or click the button.

   The mnemonic list of the block at the cursor position is displayed on the list edit window.



The mnemonic language can be directly edited on this screen.
For a compiled block, step numbers are displayed.
When entering a new mnemonic, a step number and comment do not have to be entered.

⇨ For the compilation procedure, refer to "2.12 Compilation" on page 2-75.

Terminating a mnemonic list

■ **Inserting the mnemonic list edited into the cursor position, and terminating edits**

When edits are complete, click the [Insert] button.

The list edit window is closed, and the edit contents are inserted at the cursor position in the ladder diagram.

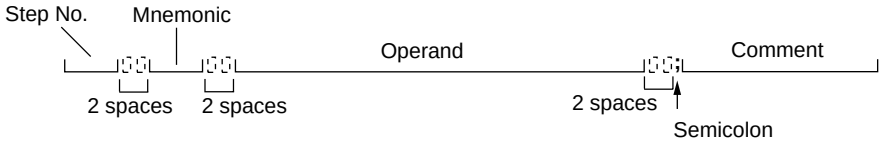
■ **Replacing the block in the cursor position with the mnemonic list edited, and terminating edits**

When edits are complete, click the [Replace Blocks] button.

The list edit window is closed, and the block at the cursor position in the ladder diagram is overwritten with the edit contents.

Format of a mnemonic list

The following format is used in a mnemonic list.
Keep in mind that compilation is disabled if the format is different.



Note 1: Comments cannot be edited in a mnemonic list.

Note 2: Step numbers and comments do not have to be entered while editing a mnemonic list.

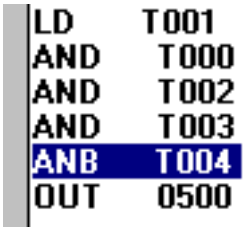
2.8.2 Copy, move, and delete

Copy, move and delete in a mnemonic list can be performed using the "cut & paste" operation in the same way as in a ladder diagram.

1. Place the cursor in the start position of the copy/move/delete range.

2. While pressing and holding the [Shift] key, move the cursor to the end position of the range using the **UP** and **DOWN** keys.

   The selected range is displayed in blue.



3. Release the key when in the end position.

   When canceling the selection, press the **UP** or **DOWN** key without pressing and holding the [Shift] key.

4. Perform the cut, copy or paste operation using the shortcut keys.

➪ *Copy/move/delete operation (p. 2-54)*

Cut	**[Ctrl]** + **[X]**	: Cuts the selected range.
Copy	**[Ctrl]** + **[C]**	: Copies the selected range.
Paste	**[Ctrl]** + **[V]**	: Pastes the cut or copied range.

Note: In Windows 95, the mouse (right-click) can be used instead of the keys.

2.9 Displaying the Use Status

This section describes how to display the list of relays, timers, counters, comparators, data memory and temporary memory used in the program while editing a ladder diagram.

2.9.1 Displaying a use status list

Displaying the use status

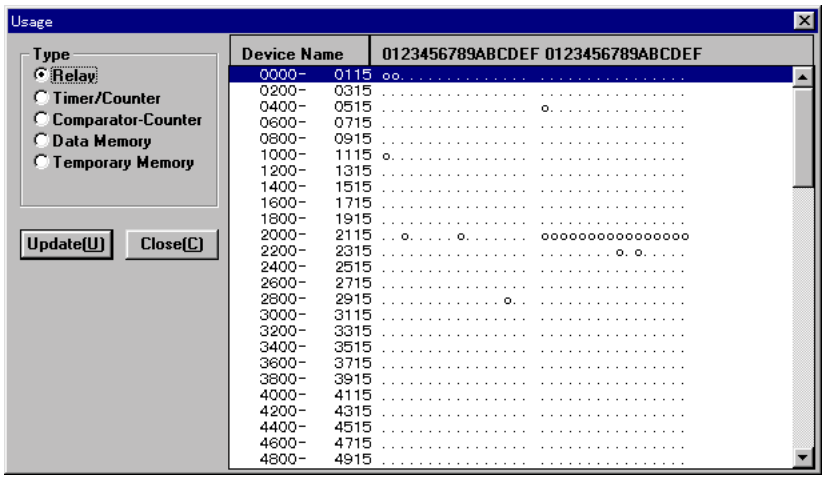
Edit → Usage Information

To display lists of relays, timers, counters, comparators, data memory and temporary memory used in the program while editing a ladder diagram, perform the following procedure.

1. Select "Usage Information" from the "Edit" menu, or click the button.

   The "Usage Information" dialog box is displayed.

2. Select the item to be checked from "Type". The use status list is then displayed.



3. You can edit ladder diagrams while checking the use status list on the display. To reflect the latest use status for the ladder diagram being created, click the [Update(U)] button.

4. To close the use status list, click the [Close(C)] button.

2.10 Setting the System

This section describes how to set the directory used for the auto save function, and how to select the decompilation error check.

2.10.1 Setting the system

Edit → System Settings

To set the directory used for the auto save function and to select the decompilation error check, perform the following procedure.

1. Select "System Settings" from the "Edit" menu.

   The "System Settings" dialog box is displayed.

■ **When setting the work directory used for the automatic save function**

Specify the directory (folder) used for the automatic save function as "Work Directory" using a full path.

■ **When selecting the decompilation error check**

Click the "Code Check" check box to add a check mark. Decompilation errors will then be automatically checked when a ladder program is compiled.
If an error is detected, the message "Reverse Compile Error" is displayed when compilation is complete.

⇨ *H.3 Programs which cannot be decomplied (Appendices p. 2-203)*

The code check is specified by default.
When the deconversion error check is not required, delete the check mark.

Note: When the code check is specified, the compilation time is longer because a program in which errors will be detected during decompilation and whose transfer will be aborted is checked while the program is transferred from the KV main body to the personal computer.

2.11 Entering and Developing Macros

The Ladder Builder for KV is equipped with a macro function. By using macros, programs in which the same process is repeated many times and for which there are extended instructions can be entered efficiently. The Ladder Builder for KV is equipped as standard with the macro file to enter frequently used circuits.

2.11.1 Creating a macro file

To use a macro, first create a macro file saving the contents to be processed in the macro.
To create a macro, perform the following procedure.

1. Select "New" from the "File" menu, and open a new ladder program window in accordance with the model.

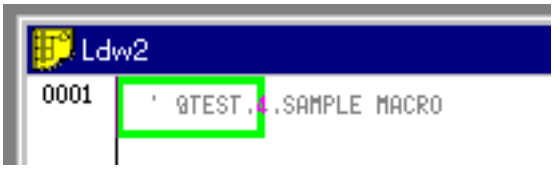
2. Place the cursor in the first line. Select "Edit Line Comment" from the "Comment" menu.

   The "Enter Line Comment" dialog box is displayed.

3. In the first line, enter the macro name, the number of arguments and the comment in the following format as the macro start declaration line.

   @ Macro name, Number of arguments, Comment
   ↓ Include "@" at the beginning.
   Separate each item with a comma (,).

Macro name	Enter up to 8 characters. Do not enter spaces.
Number of arguments	Enter the number of devices to be variable. Temporary devices (shown below) contained in a ladder diagram can be replaced with arbitrary devices (up to 10 devices).
Comment	Enter a comment on an argument, etc.



@TEST.4.test macro
Number of arguments
Comment

4. Under the macro start declaration line, enter the symbol to be processed by the macro. At this time, describe the devices to be treated as arguments as temporary devices.

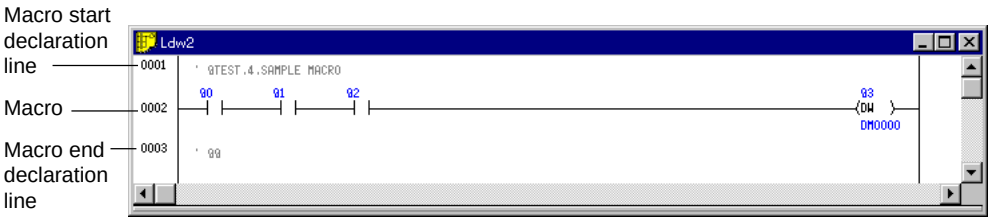
   What are temporary devices?
   Temporary devices indicate devices described temporarily when actual devices are not yet determined. Up to 1,000 temporary devices from "@0" to "@999" can be described. Each temporary device will be automatically replaced while a macro is developed.

Note: Up to 10 devices from "@0" to "@9" can be used in each macro. When using them, make sure to assign temporary devices sequentially starting from "@0".

5. In the last line, enter two "@" symbols from "Edit Line Comment" as the macro end declaration line.

Example

Macro which writes data (constant) to the DM0000 when three relays are turned on (Four arguments are used.)



6. Two or more macros can be described in one macro file. When describing another macro, repeat steps 3 to 5 above.

Note: Make sure to describe each macro in the portion between the macro start declaration line and the macro end declaration line.

7. Select "Save As" from the "File" menu, and save the file with the desired macro file name. The extension of the file name is "ldr" which is the same as the extension for a ladder program.

Creation of the macro file is now completed.
The Ladder Builder for KV is equipped with the macro file "IMACRO.LDR" to enter frequently used circuits. Use this file when entering circuits.

Note 1: The macro start declaration line is entered as a line comment. Enter up to 70 characters.

Note 2: Timer/counter instructions cannot use temporary devices.

2.11.2 Entering and developing macros

Edit → Macro Input → Develop (Shift + F1)

To use a macro, macro instructions must be entered.

1. Open the macro file in which the macro to be entered is saved.

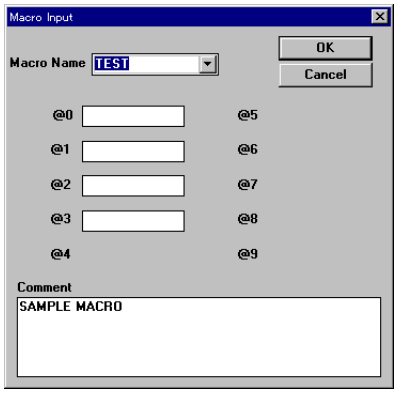
   Specify frequently used macros for the auto file read function.

2. Set the ladder program window to which the macro is entered as the current window.

3. Select "Macro Input → Develop" from the "Edit" menu.

   The "Macro Input" dialog box is displayed.

4. Select the name of the macro to be entered in the "Macro Name" text box.
   The macro name described in the macro start declaration line is displayed here.



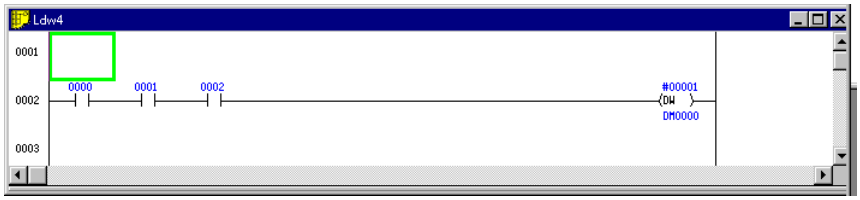
5. Enter macro operands to "@0", "@1" . . .

   You can enter as many macro operands as the number specified as the arguments in the macro file.

   The comment described in the macro start declaration line is displayed in the "Comment" column.

6. When input is complete, click the [OK] button.
   To cancel input, click the [Cancel] button.

   The macro is entered.



Note: Macros that have been changed cannot be returned to their original state.

2.12 Compilation

This section describes how to compile ladder programs created using the editor.

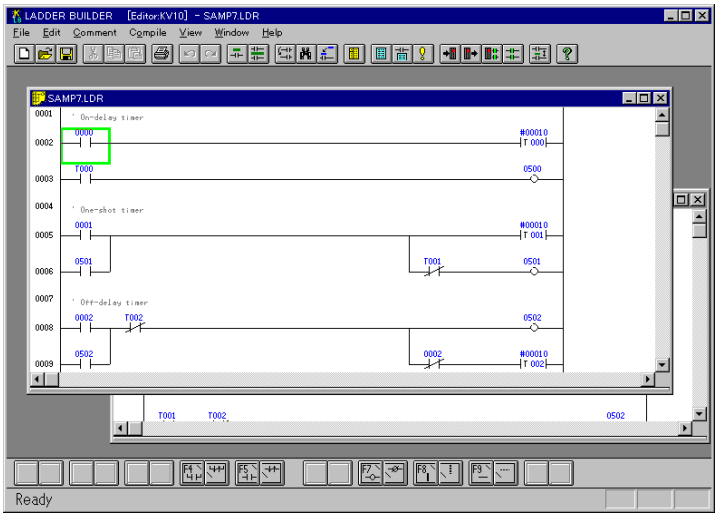
2.12.1 Executing compilation

Compile → Compile (Ctrl + F9)

Ladder programs created using the editor cannot be transferred to a PLC. They must be compiled into machine code.

To compile a ladder program, perform the following procedure.

1. Set the ladder diagram of the program to be compiled as the current window.



2. Select "Compile" from the "Compile" menu, or click the button.
   The compilation process is performed.

3. When the program is correctly compiled, the message "Compilation successful." is displayed. Click the [OK] button.

2.12.2 Error display

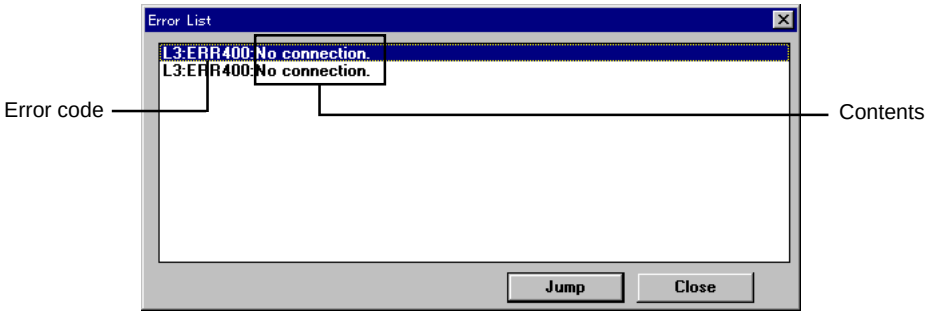
Compile → Show Error (Ctrl + F10)

When an error occurs during compilation, a message is displayed and you can confirm the contents of the error.

1. When an error occurs, the message "Compilation Error" is displayed.

2. Click the [OK] button.

   The error list window is displayed.



3. To jump to the location in the program in which an error has occurred, specify the desired error and click the [Jump] button.

   The error location is displayed.

4. To display the error list again, select "Show Error" from the "Compile" menu, or click the button.

2.12.3 Double coil check

Double coil check

Compile → Check Double Coil

Double coil locations in a ladder program can be checked. (Double coil locations are not detected as errors during compilation.)

Select "Check Double Coil" from the menu. Double coils are then detected.

Note: The double-coil check uses three instruction words: OUT, DIFU, and DIFD.

Even if double coil locations are not detected by the double coil check, they may function as double coils depending on the assembly of ladder circuits.

2.13 Printing Functions

This section describes how to print out ladder diagrams, mnemonic lists, labels/comments/references, device use status, and parameters.

2.13.1 Printing

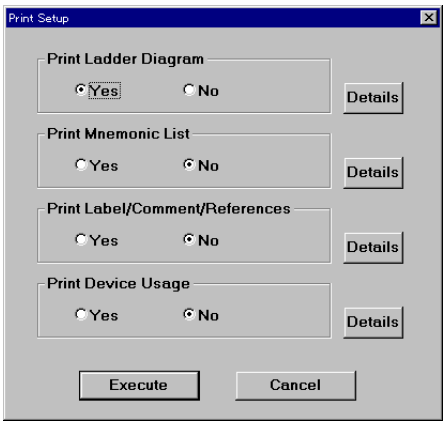
File → Print (Ctrl + P)

Connect the personal computer to a printer before starting the printout.

The contents to be printed out must be set before starting the printout.

1. Select "Print" from the "File" menu, or click the button.
   The "Print Setup" dialog box is displayed.

2. You can select whether or not each item is printed. Click "Yes" to print the item, and click "No" not to print the item.
   "Yes" is selected only for ladder diagrams by default.



The following four items can be printed out.
- Ladder diagrams
- Mnemonic lists
- Labels/comments/references
- Device use status

3. The printout range can be set for each item. Set the range in the dialog box displayed when the [Detail] button is clicked.

➪ *For the setup procedure for each item, refer to page 2-78.*

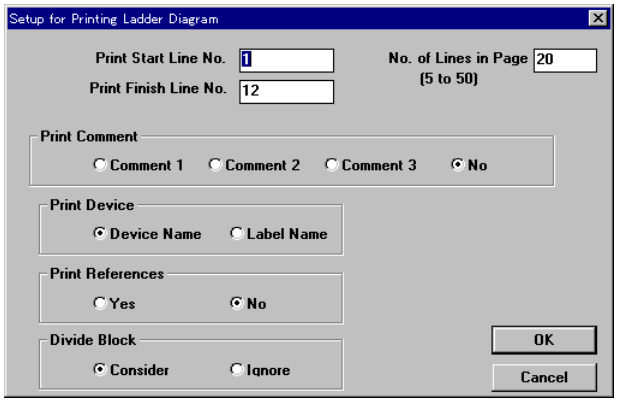
4. Click the [OK] button to start printing.
   Click the [Cancel] button to cancel printing.

Note 1: If the settings are changed, the changes are not saved if the [Cancel] button is clicked.

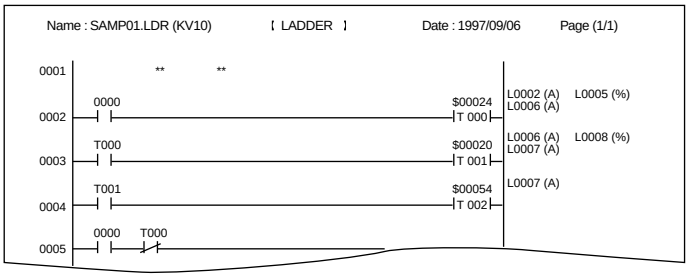
Note 2: When "Show in XYM" and "Show Decimal Constant with Sign" are selected in the display mode, printout is performed according to the setting.

➪ *Display mode (p. 2-19)*

■ Ladder diagram (details)

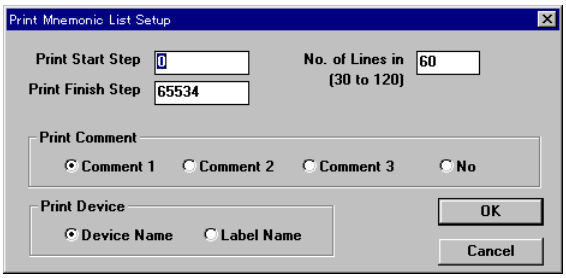


Example of printout

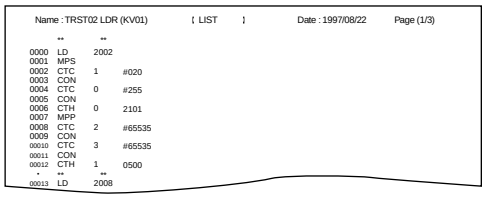


Item	Setting contents (input range)	Initial value
Print Start Line No.	Line number from which printout is started	1
Print Finish Line No.	Line number at which printout is ended	Last line on edit screen
No. of Lines in Page	Number of lines printed on one page (5 to 50)	20
Print Comment	Comment 1, Comment 2, Comment 3, or No	No
Print Device	Device Name or Label Name	Device Name
Divide Block	Consider (divided) or Ignore (not divided)	Consider

■ Mnemonic list (details)



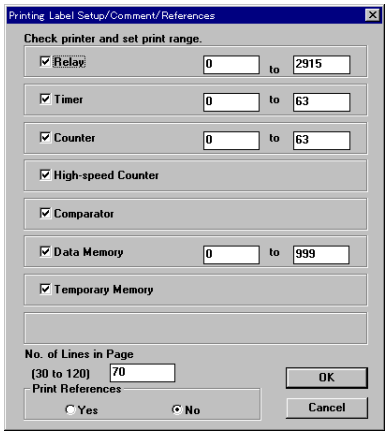
Example of printout



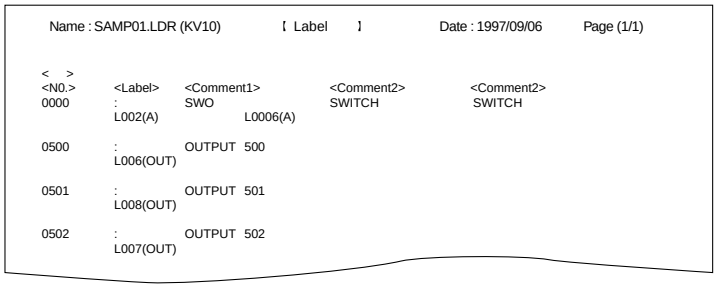
Item	Setting contents (input range)	Initial value
Print Start Step	Step number from which printout is started	0
Print Finish Step	Step number at which printout is ended	65534
No. of Lines in Page	Number of lines printed on one page (30 to 120)	60
Print Comment	Comment 1, Comment 2, Comment 3, or No	No
Print Device	Device Name or Label Name	Device Name

■ Labels/comments/references (details)

Add the check mark to the devices to be printed out, and set the printout range.
By default, all devices are selected and the entire range is specified.



Example of printout

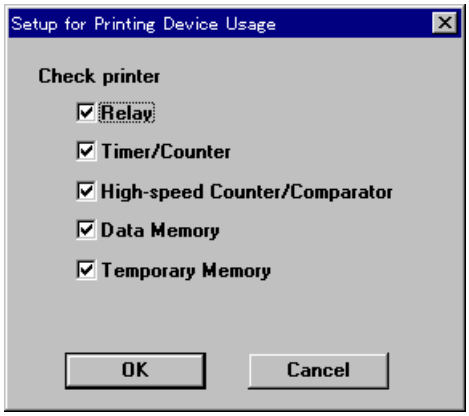


Item	Input range (initial value)
Relay	Available range according to the model
Timer	
Counter	
High-Speed Counter	–
Comparator	–
Data Memory	Available range according to the model
Temporary Memory	–

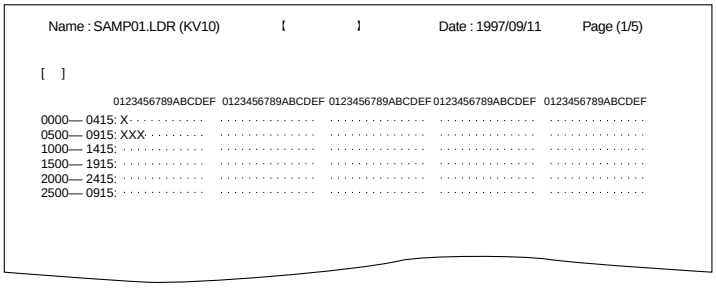
Item	Setting contents (input range)	Initial value
No. of Lines in Page	Number of lines printed on one page (30 to 120)	70
Print References	Yes or No	No

■ Device use status

Add a check mark to the devices to be printed out, and set the printout range.
By default, all devices are selected to be printed out.



Example of printout (relay)



2.13.2 Preview display

File (F) → Print Preview (V)

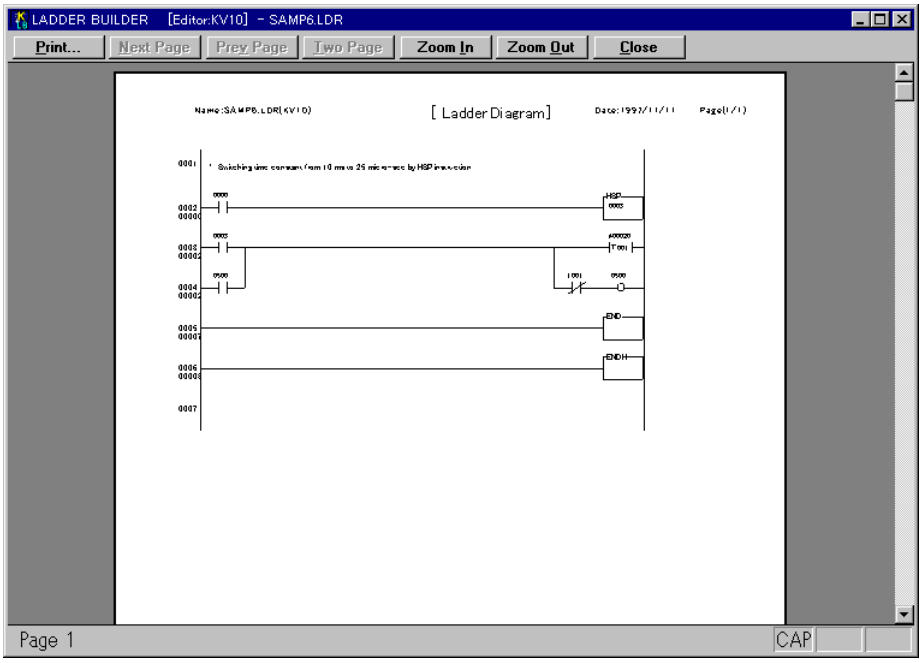
To preview on the screen the contents to be printed out, perform the following procedure.

1. Select "Print Preview" from the "File" menu.
   The "Print Setup" dialog box is displayed.

2. Set the contents to be printed out.
   For the setup procedure, refer to page 2-79.

3. Click the [Execute] button.
   The actual image to be printed out is displayed.

   The [Print] button can be clicked on this screen to print out the contents displayed.



2.14 Changing the Display Color on the Screen

In the Ladder Builder, the color layout of the screen can be changed. This section describes how to change display colors on the screen.

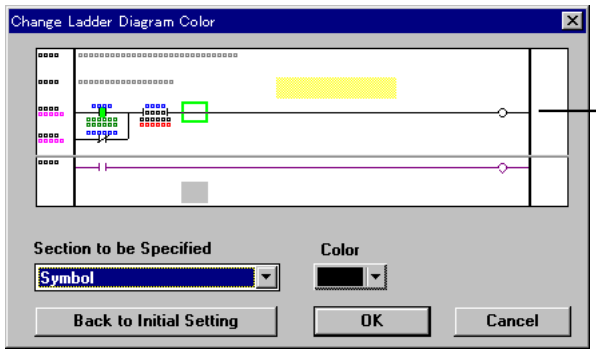
2.14.1 Changing display colors on the screen

View → Change Ladder Diagram Color

This function sets the color layout of the Ladder Builder screen.
The setup procedure is described below.

1. Select "Change Ladder Diagram Color" from the "View" menu.
   The "Change Ladder Diagram Color" dialog box is displayed.

   The "Color" box provided on the side of each item indicates the color currently set.

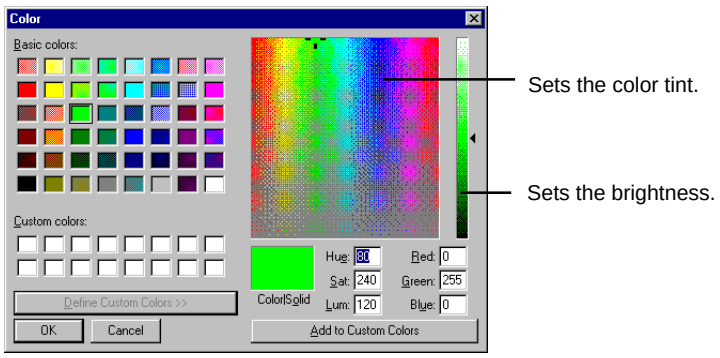


2. Select the item whose color is to be changed in the "Section to be Specified" text box, and click the ▼ button of "Color".
   The "Section to be Specified" text box can be set by clicking the desired position in the diagram displayed on the object screen.

   The "Color Setup" dialog box is displayed.

   Select the desired color, and click the [OK] button.

   You can create an intermediate color by clicking the [Create Color] button.
   To determine the intermediate color created, click the [Add Color] button.



3. When changes are complete, click the [OK] button.
   Click the [OK] button to confirm the setting. Click the [Cancel] button to cancel the setting.

   To return the screen colors to the default setting, click the [Back to Initial Setting] button.

Note: When the number of display colors on the screen is set to 256 or less, some colors may not be displayed correctly.