KEYENCE

821GB

Programmable Controller

KV-5500/5000/3000 Series

User's Manual

Please read this Manual before use.
Keep this Manual in a safe place for later reference.

Chapter 1 HARDWARE
Chapter 2 CPU INTERNAL FUNCTIONS
Chapter 3 LADDER PROGRAMMING
・PLC unit Error List
・CR/CM List
・Index



・CPU unit
・AC power unit
・Extension I/O unit
・Extension unit
・Error output unit
・Bluetooth unit

Support CPU Unit
・KV-5500
・KV-5000
・KV-3000

Frequently Asked Questions
FAQ
www.keyence.com/controlfaq

Preface

This manual describes how to connect and maintain KV-5500/5000 Series PLC, CPU built-in functions and how to prepare ladder programs. In addition, also record specification and operating method of CPU unit/AC power supply unit/expansion I/O unit/expansion unit/error output unit/Bluetooth unit. For special expansion units other than the above-mentioned, refer to user manual of the units.
During actual programming, please read "command reference manual"/"script programming manual"/"KV STUDIO user manual" etc simultaneously.
Keep this Manual in a safe place for later reference.
Be sure to hand over this manual to the end-users who are going to use the KV-5000/3000 Series.

■ KV-5500/5000/3000 Series User Manual

All the following PDF manuals can be found and opened in the help file of KV STUDIO. In addition, the latest version of PDF manuals can be downloaded from the Keyence web site.

Name	Content
KV-5500/5000/3000 Series User's Manual	Refers to this manual, introduces system configuration, technical specifications, CPU built-in function of KV-5500/5000/3000 Series, and how to create ladder diagram program.
KV-8000/7000/5000/3000/1000 Series Command Reference Manual	Introduces various commands for ladder diagram programming.
KV-8000/7000/5000/3000/1000 Series Script Programming Manual	Introduces how to create script program, and available operator/control sentence/function etc.
KV STUDIO User Manual	Introduces KV STUDIO operating method.
KV-5500/5000/3000/1000 Series System Macro Manual	Introduces available system macro for KV-5500/5000/3000/1000 Series.

● KV-5500 CPU built-in EtherNet/IP communication function related manual

When KV-5500 CPU built-in EtherNet/IP communication function is used, the following manual is required.

Name	Manual content
KV-EP21V User Manual	Introduces technical specifications, usage, operation steps of EtherNet/IP unit KV-EP21V.

"2-7 EtherNet/IP communication (KV-5500)", Page 2-95

● KV-5000 CPU built-in Ethernet/FL-net function related manual

When various functions of KV-5000 CPU built-in Ethernet/FL-net function are used, the following manual is required.

Name	Manual content
KV-LE21V User's Manual	Introduces technical specifications, usage, operation steps of Ethernet unit KV-LE21V.
KV-LE20V User's Manual	Introduces technical specifications, usage, operation steps of Ethernet unit KV-LE20V.
KV-FL20V User's Manual	Introduces technical specifications, usage, operation steps of Ethernet unit KV-FL20V.

"2-6 Ethernet/FL-net Communication (KV-5000 only)", Page 2-94

● KV-3000 CPU built-in serial communication function related manual

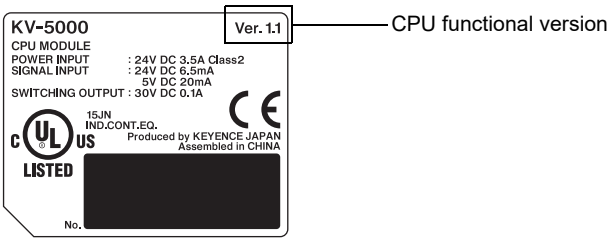
When KV-3000 CPU built-in serial communication port is used to read, write PLC device value, the following manual is required.

Name	Manual content
KV-L21V User's Manual	Introduces the specifications, handling, and operating procedures of Serial Communication Unit KV-L21V.
KV-FL20V User's Manual	Introduces technical specifications, usage, operation steps of Ethernet unit KV-FL20V.

"2-5 Serial Communication (KV-3000 only)", page 2-86

KV-5500/5000/3000 CPU functional version

There is different CPU functional version in KV-5500/5000/3000. CPU functional version can be read on lateral sequence sheet. If there is no CPU functional version printed, the CPU functional version is Ver.1.0.



KV-5500/5000/3000 CPU functional version difference

Difference caused by CPU functional version is as follows.

■ CPU functional difference caused by CPU functional version

CPU functional version		Ver.2.0	Ver.1.1	Ver.1.0
Support KV STUDIO version		After Ver.6.0	After Ver.5.6	After Ver.4.0
Support CPU unit	KV-5500	○	-	-
	KV-5000	○	○	○
	KV-3000	○	○	○
CPU function	Bluetooth communication	○	○ *1	x
	Battery-less working	○	x *6	x *6
	Display initial menu (access window)	○	x	x
	Designate the folder to be read (automatic loading function)	○	x	x
	SDHC card (memory card)	○	x	x
	Bit notes of word device (KV STUDIO)	○	x	x
	Performance monitoring (KV STUDIO)	○	x	x
	Differential monitoring (KV STUDIO)	○	x	x
Command/script	Double precision decimal real number	○	x	x
	Timer/counter command	Add a command (TMU)	No addition	-
	PID control command	Add a command (PIDAT)	No addition	-
	Data control command	Add 3 commands (RAMP,TPOUT,LLFLT)	No addition	-
	Transmission command	Add 2 commands (BYLMOV,BYBMOV) Extend a command design *2	No addition	-
	Arithmetic/comparison command	Add a command (POW)	No addition	-
	Data displacement command	Add 2 commands (ASRA,ASLA)	No addition	-
	Data conversion command	Add 4 commands (ABS,BSWAP,CPMSET,CPMGET) Extend 2 command designs *3	No addition	-
	Decimal point command	Add 5 commands (LOG10,DFLOAT,DINTG, FTODF,DFTOF)	No addition	-
	Simple operation command	Extend 2 command designs	No addition	-
	String manipulation command	Add 5 commands *5 (SPLIT,STRIM,SFINDN, CPSASC,RCPSASC) Extend a command design *4	No addition	-
	Data processing command	Add 2 commands (SORT,SORTN)	No addition	-
	Memory card command	Add 7 commands (MPRINT,MREADL,MCOPY,M MOV,MREN,MFREEK,MSTAT)	No addition	-

*1 KV-3000 V1.1 does not support Bluetooth communication.
*2 Constant may be selected for PMOV operand S.
*3 Device may be selected for DECO/ENCO operand n.
*4 RCOM supports bit notes of word device.
*5 SPLIT could be used only in script.
*6 Battery free function may be used after setting KV STUDIO above V6.0.

■ Ethernet functional difference caused by CPU functional version

Support unit	KV-5500	Ver.2.0	-	-
	KV-5000	Ver.2.0	Ver.1.1	Ver.1.0
	EtherNet/IP unit	KV-EP21V	-	-
	EtherNet unit	KV-LE21V	KV-LE21V	KV-LE20V
EtherNet function	Simple PLC link	○	○	x
	FTP client-side	○	○	x
	BOOTP client-side	○	○	x
	Without unit setup communication	○	x	x
	Support APPE command (FTP server function)	○	x	x

● Restrictions when extension I/O unit (KV-B8XTD, KV-C16XTD, KV-C32XTD) is used

When CPU unit of V1.0 CPU functional version is used after connecting extension I/O unit, restrictions are as follows. (no restrictions for CPU unit that adopts CPU functional version above V1.1.)

- When I/O test is conducted, KV-C16XTD displays 32DO, KV-C32XTD displays 64DO.
- When I/O test is conducted, KV-B8XTD display content varies with the unit setup information stored in CPU unit.
  When unit information stored in the CPU unit is the same as actual unit configuration.
  Display 32DO.
  When unit information stored in the CPU unit is different from actual unit configuration.
  Display 16DO.
- If the unit information stored in CPU unit is different from actual unit configuration, operation of KV-B8XTD to execute I/O test is also different according to the unit type on the right side.
  When special unit is on the right side, or there is no unit on the right side
  KV-B8XTD output relay could not be controlled.
  When output unit is on the right side
  If unit output relay is on the right side, KV-B8XTD output relay is also ON.
  When input unit is on the right side
  If unit input relay on the right side is ON, KV-B8XTD output relay is also ON.
- Prohibit input refresh setting of KV-B8XTD, KV-C16XTD, KV-C32XTD is disabled.
  If output is prohibited, input refresh is also in prohibited state.
- If forced setting of the input relay on KV-B8XTD, KV-C16XTD, KV-C32XTD is cancelled, the input relay will update input state after a scanning is OFF.

Safety Precautions

■ Symbols

This document contains notices which you should observe to ensure your own personal safety, as well as to protect the product and connected equipment. These notices are highlighted in the manual by a warning triangle and are marked as follows according to the level of danger:
Differentiate display.

⚠Danger Indicates that death or severe personal injury will result if proper precautions are not taken.

⚠Warning Indicates that death or severe personal injury can result if proper precautions are not taken.

⚠Caution Indicates that damage to property can result if proper precautions are not taken.

Important — Indicates that an undesirable result or status can occur if the relevant notice is ignored.

Note — Describes cautions for easily mistaken operations.

TIP Indicates useful information or information that aids understanding of text descriptions.

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

■ General Precautions

- Verify that this device functions correctly at startup and during operation.
- Provide a safety circuit that bypasses PLC to enable failsafe operation of the entire system in the event that the PLC fails.
- Output circuit or internal circuit malfunctions sometimes prevent control from being performed normally.Be sure to provide a safety circuit in control systems where circuit malfunction may lead to fire or other serious accidents.
- Proceed with care when modifying the KV-L20R, or when using it in a manner that falls outside of the ranges indicated in its specifications, since KEYENCE is unable to guarantee device functionality or performance in such situations.
- Use this product in combination with other devices only after careful consideration, since the product may fail to satisfy its functionality and performance capabilities as a result of the conditions and environment in which it is used.
- Do not use this product for the purpose to protect a human body or part of a human body.
- This product is not intended for use as an explosion-proof product. Do not use this product in a hazardous location and/or potentially explosive atmosphere.
- Verify that the KV-5500/5000/3000 function correctly when using the KV STUDIO.

Precautions on Regulations and Standards

■ CE Marking

Keyence Corporation has confirmed that this product complies with the essential requirements of the applicable EC Directives, based on the following specifications.
Be sure to consider the following specifications when using this product in the Member States of European Union.

● EMC Directive (2004/108/EC)

- Applicable standard EMI: EN61131-2, Class A EMS: EN61131-2
- When installing the KV-5500/5000/3000/1000/700 Series, it must be installed in an conductive enclosure (industrial control panel) with IP54 or higher.
- When using a Keyence KV-U7 as the power supply for the KV-5500/5000/3000/1000/700 Series, pass the power cable through the ferrite core twice.
- When using a Keyence KV-U7 as the power supply for the KV-5500/5000/3000/1000/700 Series, be sure to connect the protective earthing terminal located on the power supply input terminal to the protective earthing conductor in the building installation.
- When using the DC power input terminal of the KV-5500/5000/3000/1000/700 Series, pass the power cable through the ferrite core twice.
- Use a shielded cable for the signal lines located outside of the conductive enclosure (industrial control panel). The shielded cable must be grounded.
- Be sure to use the functional earthing terminal on the unit for grounding, if applicable.

Remarks:
These specifications do not give any guarantee that the end-product with this product incorporated complies with the essential requirements of EMC Directive. The manufacturer of the end-product is solely responsible for the compliance on the end-product itself according to EMC Directive.

Notes on compatibility

<The control panel>

- If seams exist within the top or bottom plate of the control panel, strip the coating to maintain electric potential.
- When grounding the control panel, use a thick grounding wire to create low impedance even at high frequencies.

<Grounding shielded cables>

- Do not ground shielded cables near the expansion unit, otherwise, the grounded cables will receive electromagnetic induction from cables that were present before grounding was implemented.

- After removing and exposing a section of the outer covering for the shielded cable, connect this part to the control panel in a wide area. (When using clamp brackets or other such tools, be sure to strip the paint from the contact)
- Do not ground electrical wires by soldering them to shielded wires, as this method will increase high-frequency impedance and nullify the shield effect.

● Low-voltage Directive (2006/95/EC)

The Low-voltage Directive is applied to KV-U7, KV-B8RC, KV-B16RA and KV-B16RC. It is not applicable to any other models.

- Applicable standard EN61131-2 (KV-B8RC/KV-B16RA/KV-B16RC)
  EN60950-1 (KV-U7)
- Overvoltage Category II
- Pollution degree 2
- When using a Keyence KV-U7 as the power supply of the KV-5500/5000/3000/1000/700 Series, be sure to connect the protective earthing terminal located on the power supply input terminal to the protective earthing conductor in the building installation because the KV-U7 is designed as a Class I equipment.
- When installing the KV-5500/5000/3000/1000/700 Series, it must be installed in an enclosure (industrial control panel) with IP54 or higher.
- The rated relay load of the KV-B16RA and KV-B16RC is 8A per common. In other words, when all eight channels are used, the maximum load per channel is 1A, and when four channels are used, the maximum load per channel is 2A.
- The KV-B8RC is an independent contact and the rated relay load is 2A per channel.

■ UL Certificate

The KV-5500/5000/3000 Series is an UL/C-UL Listed Product.
UL-certified products display the UL mark on the label found on the side of each product.

- UL File No. E207185
- Category NRAQ, NRAQ7

Be sure to consider the following specifications when using this product as an UL/C-UL Listed product.

- When installing the KV-5500/5000/3000 Series, it must be installed in an enclosure (Industrial control panel) with IP 54 or higher.
- Supply power to the KV-5500/5000/3000 Series using either the exclusive Keyence KV-U7 power supply, or a power supply that provides Class 2 output defined in NFPA 70 (NEC: National Electrical Code).
- When using a Keyence KV-U7 as the power supply of the KV-5500/5000/3000 Series, be sure to connect the protective earthing terminal located on the input terminal to the protective earthing conductor in the building installation wiring as the KV-U7 is designed as a Class I equipment.
- Use stranded copper wire having a gage of AWG#14 to #22 and temperature rating of 105°C or higher as the lead for wiring to the terminal block on the KV-U7. The tightening torque is 0.6N•m.
- For wiring to the power supply terminal block on KV-5500/5000/3000, use stranded copper wire having a gage of AWG#20 and temperature rating of 60°C or higher. The tightening torque is 0.5 N•m (4.4 lb-in).
- For wiring to the terminal block on the special units except for the KV-DN20 or I/O units, use stranded copper wire having a gage of AWG#16 to #22 and temperature rating of 60°C or higher (105°C or higher for the KV-B16RA and the KV-B16RC). The tightening torque is 0.56 N•m (4.94 lb-in).
- For wiring to the terminal on the KV-DR1, use stranded copper wire having a gage of AWG#16 to #22 and temperature rating of 60°C or higher. The tightening torque is 1.18 N•m (10.4 lb-in).
- For wiring to the functional grounding terminal on the KV-DN20, use stranded copper wire having a gage of AWG#12 to #22 and temperature rating of 60°C or higher. The tightening torque is 1.8N•m.
- For wiring to the DeviceNet connector on the KV-DN20, use stranded copper wire having a gage of AWG#12 to #30 and temperature rating of 60°C or higher. The tightening torque is 0.6N•m.
- The KV-5500/5000/3000 (CPU Unit) has a built-in replaceable lithium battery. When replacing the lithium battery, be sure to use the Replacement Lithium Battery (OP-51604) specified in this instruction manual. The lithium battery may explode if mistreated. Explosion hazard. Never charge, dismantle or throw the battery into fire.

MEMO

How This Manual Is Organized

Chapter 1	**HARDWARE**	This chapter describes specifications and how to use system configuration/connection methods and CPU unit, AC power unit, extension I/O unit, extension unit, error output unit and Bluetooth unit of KV-5500/5000/3000 Series.
Chapter 2	**CPU BUILT IN FUNCTION**	To describe various functions of access window, memory card slot, communication ports, I/O, high speed counter etc provided for CPU unit KV-5500/5000/3000.
Chapter 3	**LADDER PROGRAMMING**	To describe function specification or setup method required for preparation of ladder program. In addition, module, macro, local device may be used to increase programming efficiency.
	APPENDICES	Records KV-5500/5000/3000 Series control relay (CR)/control memory (CM) list or error list, list of commands used in this book etc.

Contents

Preface

Safety Precautions ••••••

Name and Function of Each Part ••••••

Alarm ••••••

Bluetooth communication specification ••••••

Specification of Positioning Control ••••••

CPU Positioning Parameter Comparator 2 Interrupt ••••••

MEND stop execution of self-hold macro ••••••

Conventions Used In This Manual

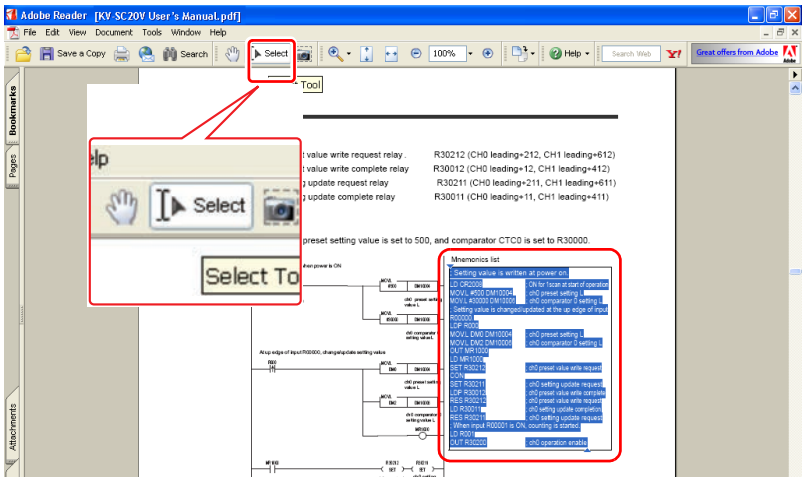
Introduces terminology used in this manual as well as the usage of mnemonic table.

How to Use Mnemonics List

Mnemonics lists are describes in the corresponding pages of sample ladder programs.
Use this mnemonic symbol list to input ladder program simply.

1 **User' Manual can be opened by Adobe Reader.**

2 **Mnemonics lists can be copied with "Select tool".**

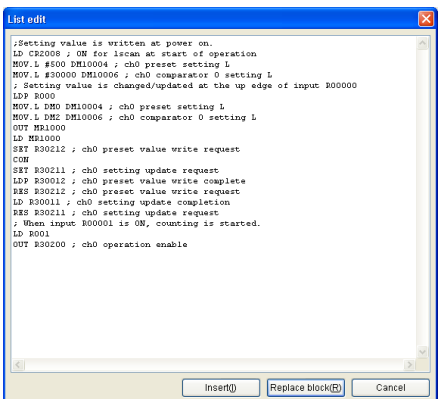


3 **In ladder edit zone of KV STUDIO, click the cell to insert reference ladder program, select "edit (e)"-> "list edit (l)" from the menu, pop up "list edit " dialog box.**

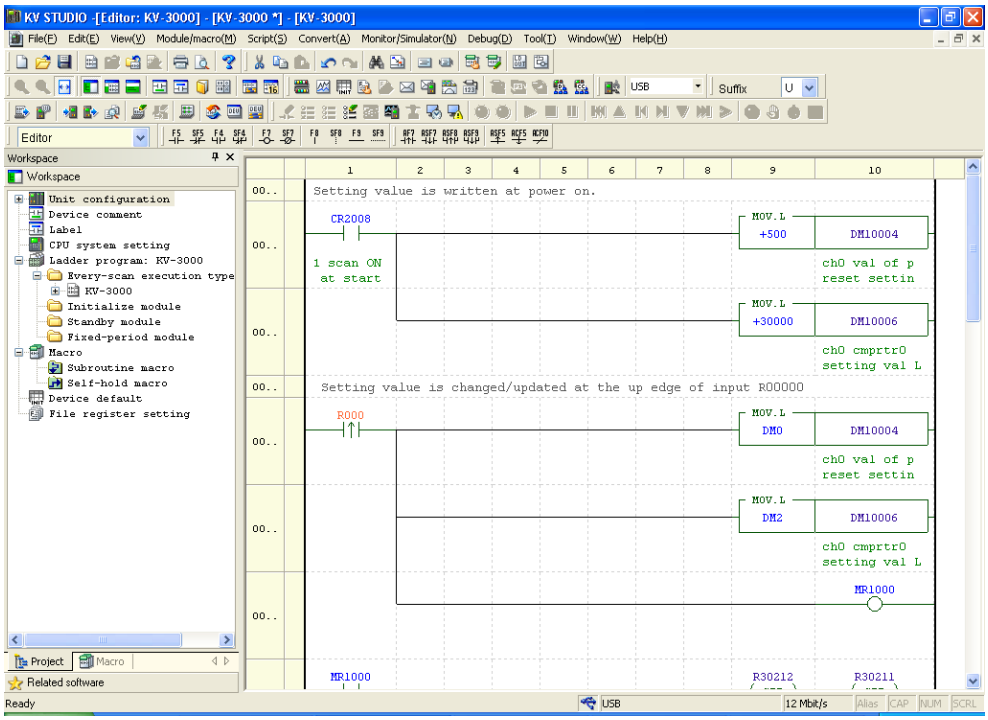
Other procedure

· Ctrl + D

Paste the copied mnemonic symbol list into popup " list edit " dialog box.
Paste operation, select " paste (P) " from right click menu of " list edit " dialog box.



4 **Click "insert(I)" button, the sample ladder program appears.**



Terminology

This manual uses the following terminology excluding some instances.

Terminology	Description
Programmable controller	Electronic equipment that may control equipment freely by changing the program, is also called PLC (Programmable Logic Controller).
KV-5500/5000/3000	Programmable controller produced our company.
CPU unit	Namely, KV-5500/5000/3000.
Expansion unit	Extension I/O unit, extension special unit other than CPU unit used in KV-5500/5000/3000 Series.
KV-5500/5000/3000 Series	General name of the expansion unit that may be connected with CPU unit KV-5500/5000/3000.
KV STUDIO	Software that supports to create KV-5500/5000/3000 Series program.
Ladder diagram program	The program created using KV STUDIO.
KV-5000 Ver.1.1 KV-3000 Ver.1.1	Ver.1.1 is indicated on lateral sequence paster of KV-5000/3000 delivered after Sept. 10, 2009, represents V1.1 functional version. For differentiation from the KV-5000/3000 that adopts functional version before V1.1.
KV-5000 Ver.2 KV-3000 Ver.2	Ver.2 is indicated on lateral sequence paster of KV-5000/3000 delivered after Jun. 14, 2010, represents V2 functional version. For differentiation from the KV-5000/3000 that adopts functional version before V2.

1

HARDWARE

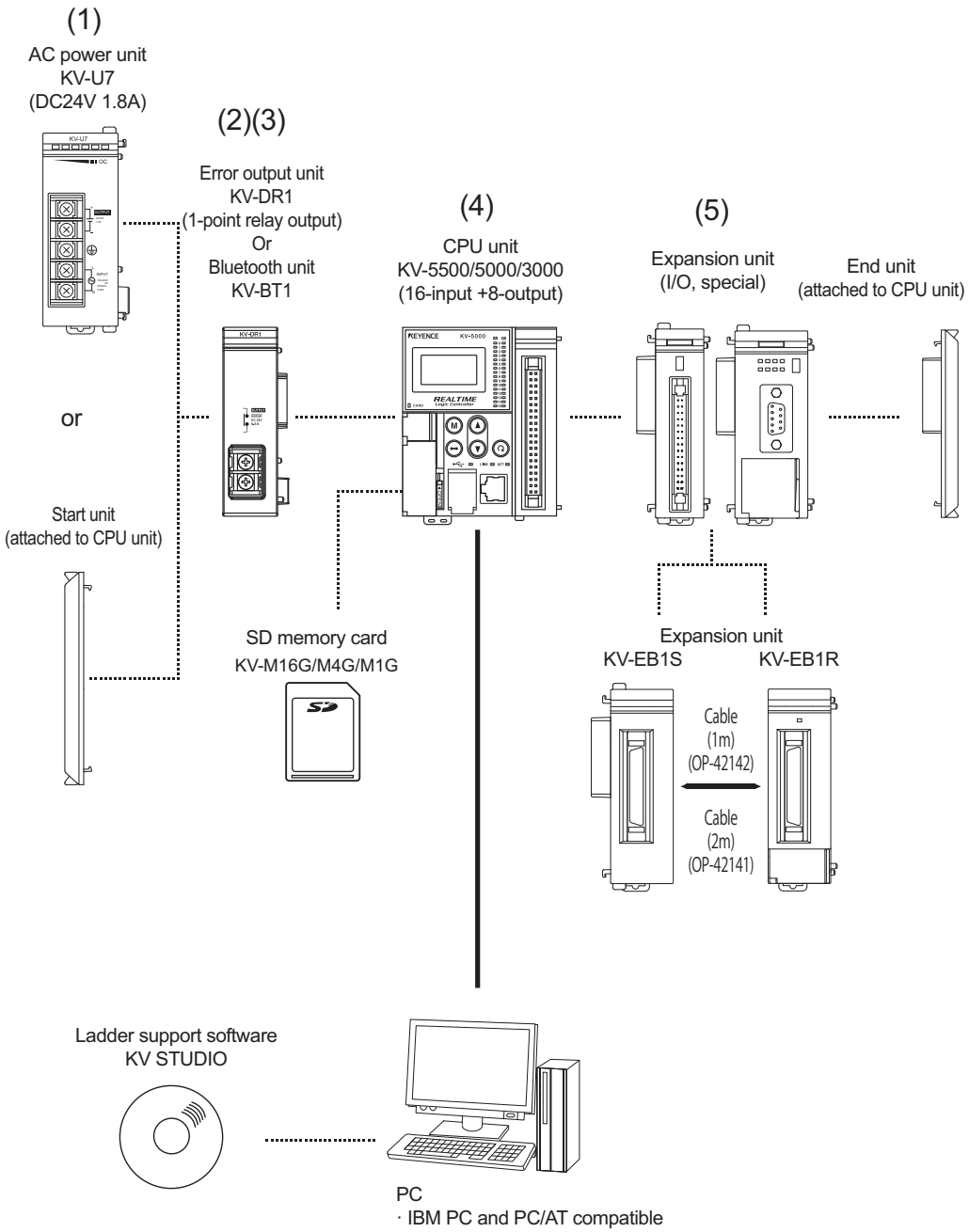
This chapter describes system configuration, connection methods of KV-5500/5000/3000 Series, and specification and application method of CPU unit, AC power unit, expansion input/output unit, expansion unit, error output unit and Bluetooth unit, etc.

1-1 System Configuration ••• 1-2
1-2 Unit Connection ••• 1-5
1-3 Unit Wiring••• 1-8
1-4 Unit Installation •• 1-15
1-5 System General Specification •••••••••••••••••••••••••••• 1-17
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1-1 System Configuration

System Overview

System configuration of KV-5500/5000/3000 is shown as follows.
Before connecting every unit, you must disconnect the power.



Note

- **Bluetooth unit may be connected with CPU unit with CPU functional version above V2.0. *KV-5000 supports CPU functional version above V1.1.**
- **Error output unit and Bluetooth unit could not be connected simultaneously.**

(1) Power Supply

■ Use AC100 - 240V

When KV-5500/5000/3000 Series runs at AC100 - 240V, AC power supply unit KV-U7 should be connected on the leftmost. Each CPU unit could only be connected with one KV-U7. When KV-U7 is used, start unit is not connected.

"1-7 AC Power Unit"

■ Use DC24V

When KV-5500/5000/3000 Series runs at DC24V, AC power supply unit KV-U7 is not used, so start unit is connected (when error output unit is used: start unit + KV-DR1; when Bluetooth unit is used: start unit + KV-BT1). Power supply (DC24V) is provided via KV-5500/5000/3000 DC power input terminal block.

"1-6 CPU Unit"

(2) Error Output Unit

When error output unit KV-DR1 is used, it should be connected with left side adjacent to KV-5500/5000/3000. Each CPU unit could only be connected with one error output unit. Error output unit is not a unit required for the operation of KV-5500/5000/3000 Series.

"1-12 Error Output Unit"

Note

When error output unit is used, Bluetooth unit cannot be connected.

(3) Bluetooth Unit

Bluetooth unit KV-BT1 is used, it should be connected with left side adjacent to KV-5500/5000/3000. Each CPU unit could only be connected with one Bluetooth unit. Bluetooth unit is not a unit required for the operation of KV-5500/5000/3000 Series.

"1-13 Bluetooth Unit"

Note

- **Bluetooth unit may be connected with CPU unit with CPU functional version above V2.0.**
  ***KV-5000 supports CPU functional version above V1.1.**
- **Error output unit and Bluetooth unit could not be connected simultaneously.**

(4) CPU Unit

AC power supply unit, error output unit or Bluetooth unit may be connected on left side of CPU unit, extension I/O unit or extension special unit may be connected on the right side. When expansion unit is not connected on the right side, end unit must be connected.

"1-6 CPU Unit"

May be used to read write ladder diagram program or device data to SD memory card, realize high speed counter and motor control function etc via built-in I/O.

"2 CPU INTERNAL FUNCTIONS"

Use of module/macro/local device/KV script etc functions in KV-5500/5000/3000 Series may increase programming efficiency.

"3 LADDER PROGRAMMING"
"Script Programming Manual"
"KV STUDIO User's Manual"

(5) Expansion Unit

Extension I/O unit or extension special unit must be connected on the right side of CPU unit. Up to 16 expansion units may be connected with each CPU unit. If 2 expansion units are used, up to 48 units may be connected. (excluding a part extension special unit)

End unit must be connected on the right side of the rightmost expansion unit.

"1-8 Expansion Input Unit", "1-9 Expansion Output Unit", "1-11 Expansion Unit"
"User Manual of Various Special Extension Units"

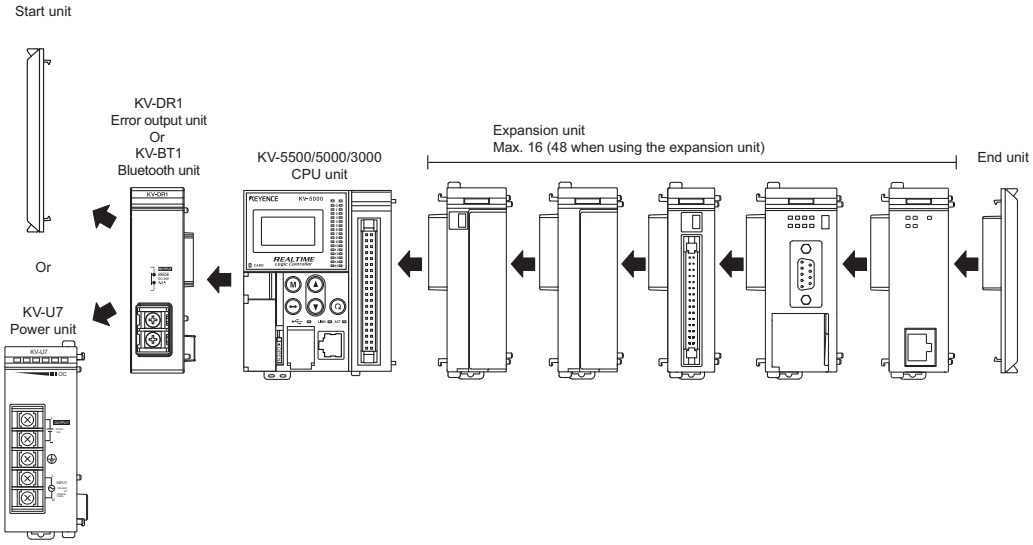
1-2 Unit Connection

This section describes how to assemble each unit and how to mount it on to DIN rail.

Precautions on Connecting Unit

When connecting each unit, you must observe following points.

- Before connecting each unit, be sure to disconnect the power.
- Start unit, power unit error output unit or Bluetooth unit must be connected on the right side of CPU unit.
- Be sure to connect the End Unit on the right of the last connected unit.



Note

- **During shipment of KV-5500/5000/3000 CPU unit, the battery is removed to prevent capacity drop. Please connect battery before first use.**

"During first power connection", page 1-20

- **Bluetooth unit may be connected with CPU unit with CPU functional version above V2.0.**
  ***KV-5000 supports CPU functional version above V1.1.**
- **Error output unit and Bluetooth unit could not be connected simultaneously**

■ Max. number of connected units

1 CPU unit can connect maximal 16 expansion units (except power unit, error output unit, Bluetooth unit, start unit or terminal unit).

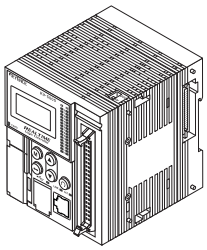
If 2 expansion units are used, then maximal 48 units can be used.

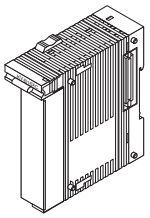
"1-11 Expansion Unit"

Unit Assembly

This is explained as follows through an example of assembling KV-5500/5000/3000 CPU unit and KV-B16XC expansion input unit.

KV-5500/5000/3000 (left)



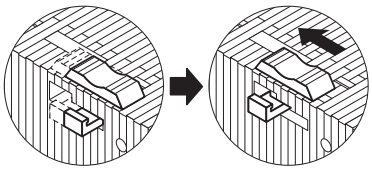


KV-B16XC (right)

Note **Assembly must be conducted when the power of each unit is OFF .**

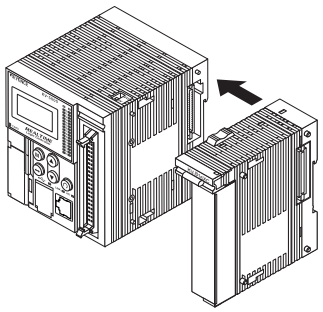
1 **Remove the locking bar at upper and lower side of right unit.**

· Insert finger into the notch, draw toward front of the unit and remove it.



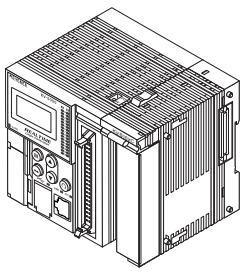
2 **Insert the locking bar of right unit into the slot for locking bar at left unit, and connect.**

· Hold two units and make them parallel, press down once they are aligned to the connector, it's easy to do connection.



3 **Lock the locking bar at upper and lower side of right unit.**

· Same as step 1, press down the notch by finger and push toward reverse direction of the unit. In this case, you shall check whether there is any gap between units. If there is any gap, then the connection is not right.

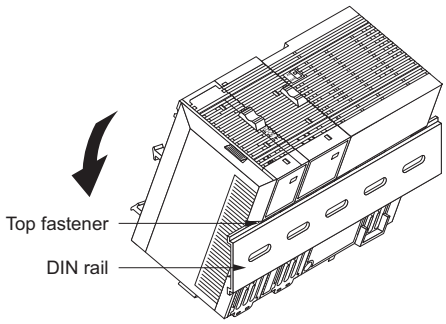


Mounting Onto the DIN Rail

This section describes how to install/remove the connected unit to/from DIN rail.

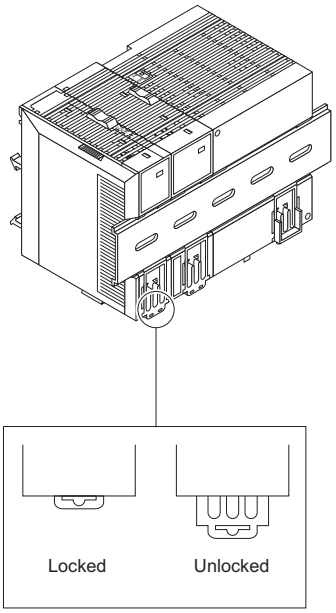
■ Installing Unit

1 **Hang the slot at upper side of DIN rail onto the installing claws of DIN rail at upper side of each unit.**



2 **Insert lower side of DIN rail into the installing claws of DIN rail at lower side of each unit.**

- The lower black claw can move under action of spring. Press down until it "clicks".
- Where it is difficult to install, please first remove all lock catches, and lock them after installing onto DIN rail.

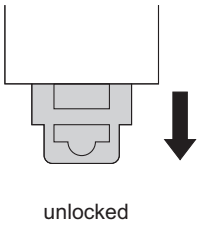


3 **Check the installing claws of DIN rail at lower side to be sure it is inserted (locked).**

■ When removing

1 **Pull down the lower DIN rail installing claw.**

Note **Do not pullout the claw of backup battery.**



2 **Remove DIN rail from the unit according to the sequence reversed to installation.**

1-3 Unit Wiring

This chapter describes how to assemble connectors and how to wire units and internal circuits.

Precautions on Wiring Each unit

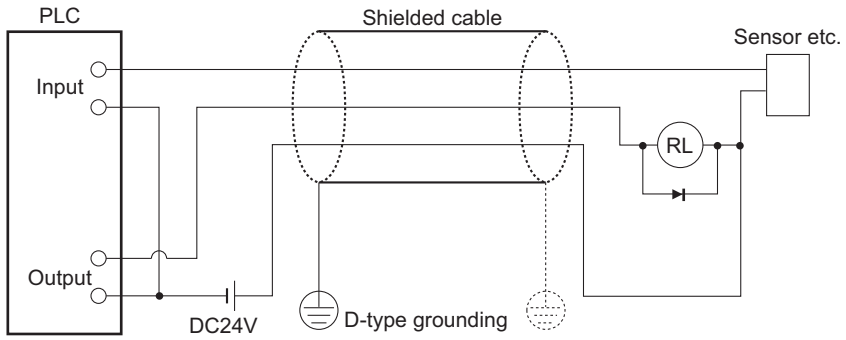
Precautions on wiring I/O units and expansion I/O units are described as follows. The contents of this part must be read before wiring.

■ Precautions on I/O unit wiring

Please note the following points when wiring I/O units.

- Wire the input and output cables separately.
- I/O signal cables should be laid away from power cables. Otherwise, operation errors caused by high voltage or current will occur. I/O signal cables should be laid at least 100mm away from power cables.
- DC 24V I/O cables should be laid separately with AC 100V and AC 200V power cables.
- Ensure that the cable conduits are grounded securely if they are used for wiring.

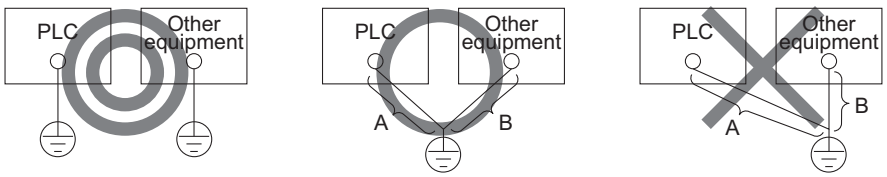
When it can not be laid separately from power line…
All wires can use shielded cable and can be grounded.
(According to different environment, grounding on the opposite side of PLC required sometimes)



Connecting wire of expansion unit must be separated from power cable.

■ Precautions on grounding

- Provide a D-type grounding individually for each of the devices. In addition, the grounding resistance in this case should be lower than 100Ω.
- If a separate grounding is not possible, a common grounding point should be used. But in this case, the cable length must be the same.

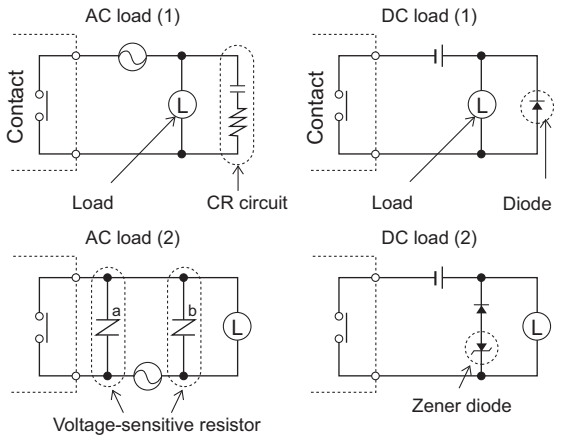


D-type ground　　A = B　　A > B
A < B

■ About contact protection

When clutch, motor, electromagnetic coil or other inductive load are used, surge current will occur when power is applied to the load, and inverting voltage will be generated when the load is turned off. Surge current and inverting voltage will greatly reduce the life of the contact. To suppress this effect, a protection circuit should be arranged.

Example of contact protection circuit

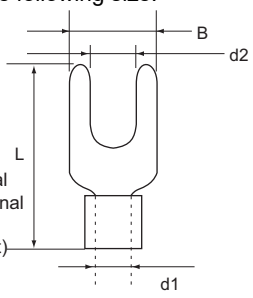


・Supply voltage When 24 to 48V, please install to position b
When 100 to 200V, please install to position a

- The rating of the load coil should be lower than the capacity of the contact.
- The inverting withstand voltage of the diode should be at least 10 times that of the circuit voltage, and forward current should be greater than the load current.
- Diode, non-linear resistance and CR circuit shall be directly installed to relay coil terminal.

■ Wiring to terminal block unit

Use Y-shaped terminals of the following size.



Dimensions of Y terminal
B: outside dimension of Y ferminal
d1: diameter of the inserted terminal of wire
d2: Y inside (screw engaging part) width
L: Total length

Fitted size
B: 6mm below
L: 13mm below
d2: 3.2mm above

Connector Assembly and Wiring

When connecting equipment on each unit, please connect the wire from each equipment on the connector (female) on the unit side.

■ Precautions on wiring (OP-22184/51404/23139/42224)

The following points must be noted before wiring:

· The following matching cable must be used:

Wire gauge : AWG24 to 22 (twisted wire)
Cross-section area: 0.2 to 0.3mm^2
Sheath O.D.: Ø1.5 to Ø1.1

· Top of wire shall be cut off straight to make it flat.

· After wiring, make sure that wire has been clamped completely by the fixed part, and inserted inside.

· No burr shall be left at cutting on the cutting part of wire (it's not necessary to strip the sheath).

· AWG28 to 26 fine line contact OP-30594 is supplied.

(please use with OP-22184, OP-51404, OP- 23139 and OP-42224, etc.)

Wire gauge : AWG28 to 26
Cross-section area: 0.08 to 0.14mm^2
Sheath O.D.: Ø1.3 to Ø1.1

⚠Note

The unit is made of synthetic resin. It may be dissolved after touching with strong solvents such as acetone, trichloroethylene and gasoline, etc. Besides, it may be damaged if too large force is applied in crimp connection. Be sure to take care.

Note

Please use OP- 42224 connector (34-pin) for 64 points unit.
Do not use OP-23139.

■ Special-purpose crimping tool (OP-21734)

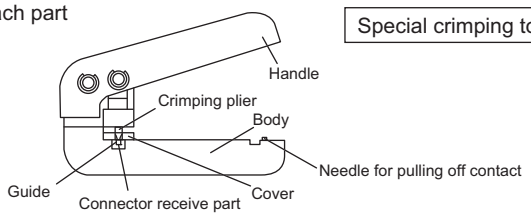
When crimping wire, using special crimping tool can simplify the operation.
Please prepare the following special crimping tool in advance.

Note

If no special crimping tool is available, it is necessary to solder.

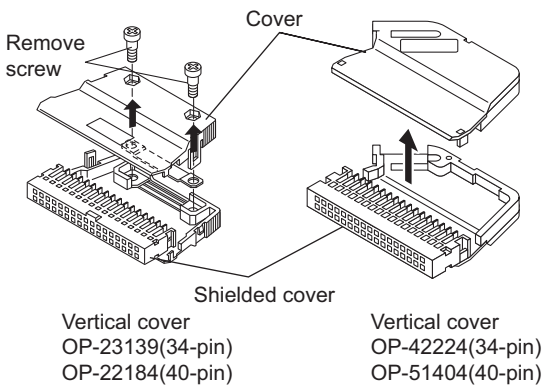
Name of each part

Special crimping tool: type OP-21734



■ About the Connector

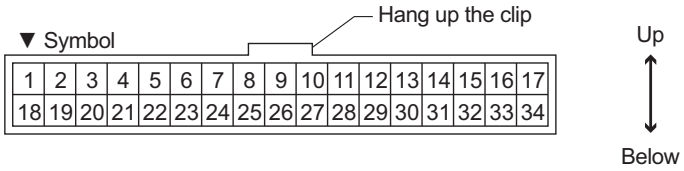
Upper and lower covers are installed on the connector. When wiring, firstly remove the upper and lower cover.



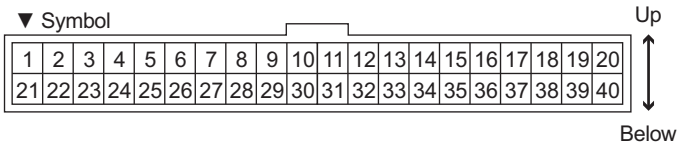
Connector terminal No.

Connector can be divided into two kinds according to unit type: 34 pins and 40 pins. Terminal No. is shown as follows. During wiring operation, please check against "Wiring and Internal Circuit Diagrams of Each unit".

34-pin connector: type: OP-23139, OP-42224



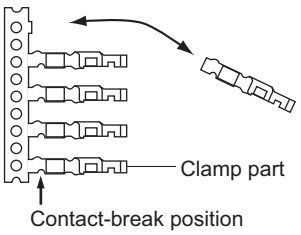
40-pin connector: type:OP-22184, OP-51404



■ Connector wiring

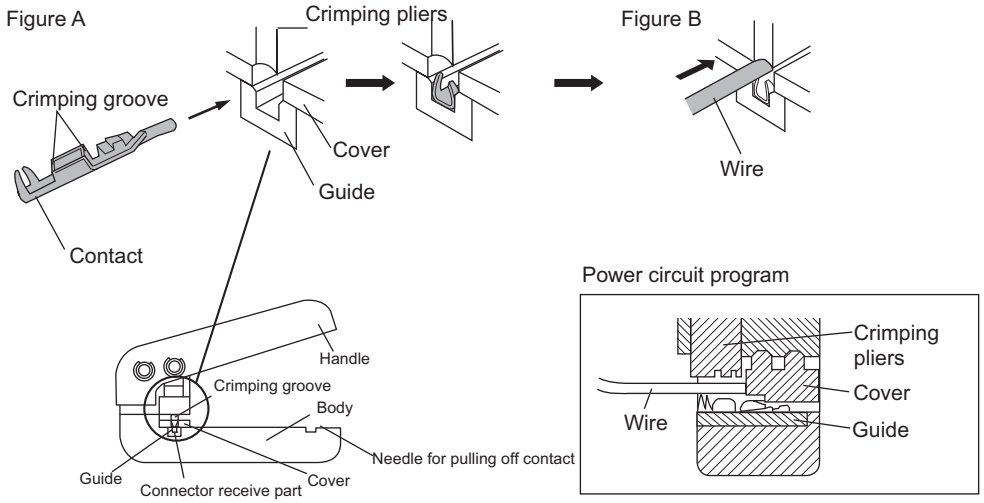
The wiring method of using special crimping tool is introduced below. Contact, shield sleeve and wire shall be prepared.

1 **Break off it starting from the breakdown position at clamp part of contact toward the breaking-off direction of arrow.**

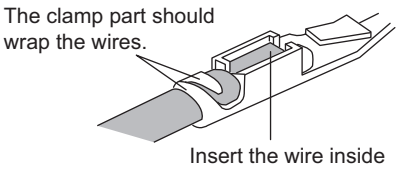


2 **Insert contact into the contact stand of special crimping tool and contact directly (Fig. A).**

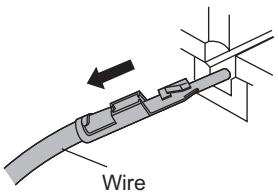
3 **Insert the wire straight to contact crimping slot (Fig. B).**



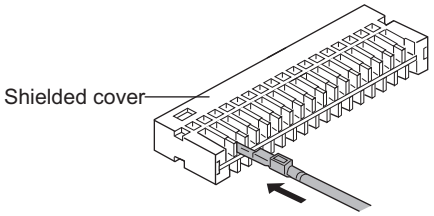
4 **Hold the handle of special crimping tool, until the wire is clamped completely.**



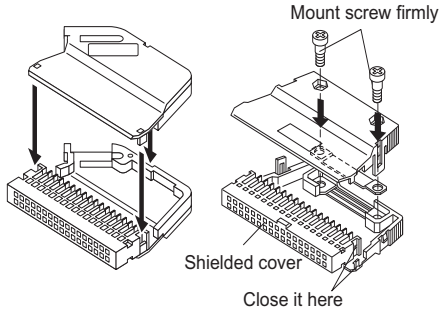
5 **Pull the wire lightly, take the contact of the crimp connection wire out of special crimping tool.**



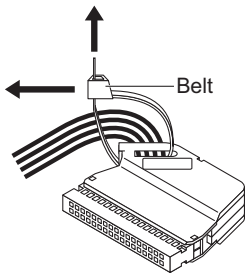
6 **Straight insert along the slot of shield sleeve without contact.**



7 **Install shield sleeve to contact, fit cover.**



8 **Fix the wire with band as shown.**

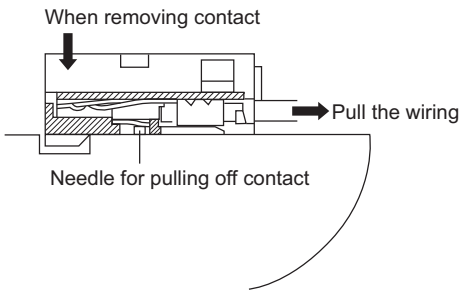


● When removing contact

Remove the contact from connector as follows.

1 **Align the terminal to be removed with the arrow on box of special crimping tool.**

2 **Press the contact, and pull out the wire.**



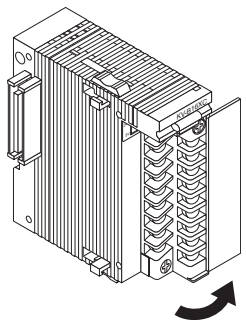
Removing the Terminal Block

The followings describes how to remove the terminal block.

Note

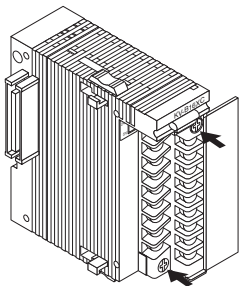
Power must be disconnected before removal.

1 **Open terminal block cover installed on the unit.**



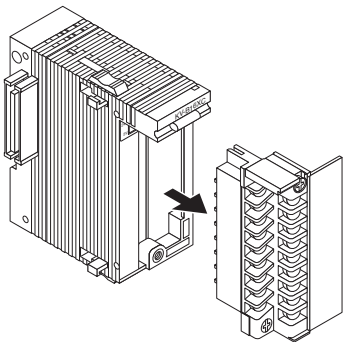
2 **Unscrew fixing bolt, remove terminal block.**

· Black bolts are used to fix terminal board.



3 **Drag terminal board toward yourself and remove it.**

· Please slightly drag towards yourself.

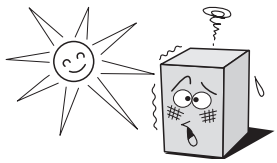
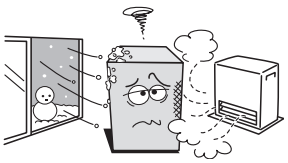
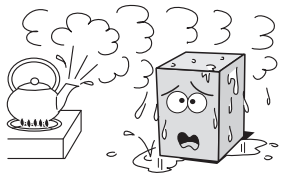
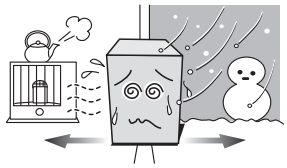
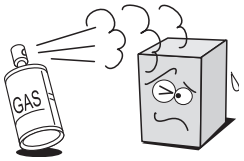
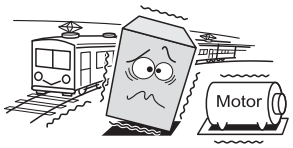
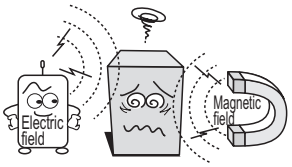


1-4 Unit Installation

This chapter describes important matters concerning unit installation environment and installation position inside the panel.

Installing Environment

Don't install it in the following places:

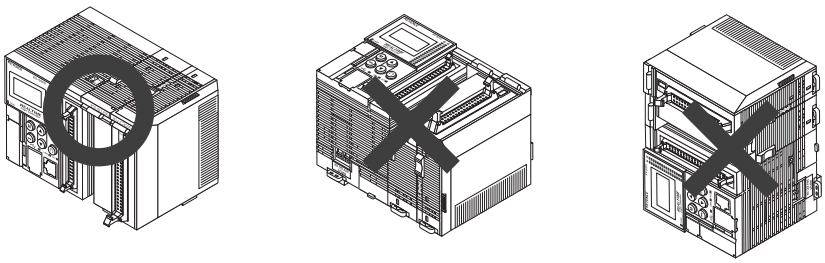
Location with direct sunshine	Location with ambient temperature exceeding 0 to +50°C	Location with ambient humidity exceeding 10~95% RH
		
Location with dewing due to sharp change in temperature	**Location with corrosive gas and combustible gas**	**Location with heavy dust, salt, chip and oily smoke**
		
Place that is directly under vibration and shock	**Place to which water, oil and drug is sprayed**	**Place with strong magnetic and electric field**
		

· The place where installation sea level height exceeds 2000m

Installation Position

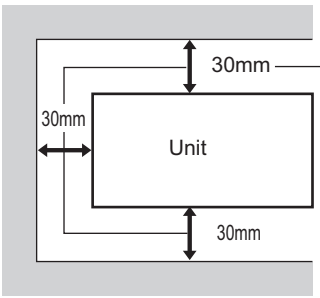
■ Installation direction

During installation inside panel, the front panel and input/output connector of KV-5500/5000/3000 CPU unit must be frontward.



■ Distance from surroundings

During installation, 30mm above interval must be kept between equipment, inner wall and other equipment.



Space above, on the left of and below the device
Allow 30mm of space for heat dissipation.

Note

When temperature inside panel (temperature below the unit) exceeds ambient temperature, adopt the methods such as forced air cooling, enlarging surrounding gap or improving ventilation, etc. to reduce temperature.

1-5 System General Specification

This section describes the specification of KV-5500/5000/3000 Series models and the operation during power off.

General Specification

Item	Specification				
Supply voltage	DC 24V (±10%)				
Internal current consumption (Except input circuit drive current)	KV-5500/5000/3000 : < 320mA				
Operating surrounding air temperature	0 to +50°C (no icing)*1*2				
Storage ambient temperature	-20 to +70°C*1				
Operating relative humidity	10 to 95％RH(condensation not allowed)*1				
Withstand voltage	1500V AC for 1 minute Between power terminal and input/output terminal, batch external terminals and housing				
Noise immunity	1500 V peak-to-peak or more, pulse width 1μs, 50 ns (by noise simulator) Conforms to IEC standard (IEC61000-4-2/3/4/6)				
Vibration resistance	Compatible with JIS B 3502/ IEC61131-2	Intermittent vibration			Scan times
		Frequency	Acceleration	half amplitude	10 times in X/Y/Z direction respectively (100 minutes)
		5 to 9Hz	-	3.5mm	
		9 to 150Hz	9.8m/s^2	-	
		Continuous vibration			
		Frequency	Acceleration	half amplitude	
		5 to 9Hz	-	1.75mm	
		9 to 150Hz	4.9m/s^2	-	
Shock resistance	Acceleration 150m/s^2, application time 11ms, 2 times in X, Y, Z direction respectively				
Insulation resistance	50MΩ or more (DC500V megger measurement between power terminal and input/output terminal, all external terminals and case body)				
Operating atmosphere	less dust and corrosive gases				
Altitude	< 2,000m				
Overvoltage category	II (when using KV-U7)				
Pollution degree	2				
Weight	KV-5500/5000: ca. 320g KV-3000: ca.300g Start unit: 20g Start unit: 30g				

*1 System guarantee range.

*2 Temperature below the unit inside control panel.

Performance Specifications

Item			Specification	
Operation control method			Program storage method	
I/O control method			Refresh mode	
Program language			Expansion Ladder KV script mnemonic	
The number of instructions			Basic instruction: 81 kinds 182 instructions Application instruction: 42 kinds 59 instructions Calculus instruction: 124 kinds 315 instructions Expansion instruction : 98 kinds 147 instructions Total: 345 kinds 703 instructions	
instruction execution speed	Basic Instructions		Min. 10ns	
	Application Instructions		Min. 20ns	
Program capacity			KV-5500/5000: about 260K steps KV-3000: about 160k steps	
Maximal installation quantity of I/O unit			16 units (connect expansion unit: 48 units)	
Maximal I/O points			During expansion max. 3096 points (KV-EB1S/KV-EB1R: add 2 units, when using 48 units 64-point unit)	
Input relay		R	Total 16000 points 1 bit (R000 to R99915)	
Output relay		R		
Internal auxiliary relay		R		
Link relay		B	16384 points 1 bit (B0 to B3FFF)	
Internal auxiliary relay		MR	16000 points 1 bit (MR000 to MR99915)	
Latch relay		LR	16000 points 1 bit (LR000 to LR99915)	
control relay		CR	640 points 1 bit (CR000 to CR3915)	
Timer		T	4000 points 32 bits (T0 to T3999)	
Counter		C	4000 points 32 bits (C0 to C3999)	
Data memory		DM	65535 points 16 bits (DM0 to DM65534)	
Extended data memory		EM	65535 points 1 bit (EM0 to EM65534)	
File register	Current bank mode	FM	131072 points16 bits	(FM0 to FM32767) x 4 Bank
	Consecutive number mode	ZF		(ZF0 to ZF131071)
Link register		W	16384 points 16 bits (W0 to W3FFF)	
Temporary memory		TM	512 points 16 bits (TM0 to TM511)	
High-speed counter		CTH	2 points 32 bits (CTH0 to CTH1) automatic reset counter*1 (Input response: 100kHz / single phase, 50kHz / phase difference) *2	
(high-speed counter comparator)		CTC	4 points 32 bits (2 points/ high-speed counter)	
Index register		Z	12 points 32 bits (Z01 to Z12)	
Control memory		CM	6000 points 16 bits (CM0 to CM5999)	
Positioning pulse output			2 points (maximum output frequency 100kHz)	
CPU unit I/O			Input : 16 points, output: 8 points Input common point : 7 points (000 to 009 : 1 point 010 to 015: 6 points) Output common point : 1 point	
Comment / the number of label save-store	Device Comment		KV-5500/5000: about 96,000 (Ladder 260k step, no label) KV-3000: about 30,000 (Ladder 260k step, no label)	
	Label		KV-5500/5000: about 137,000 (Ladder 260k step, no label) KV-3000: about 44,000 (Ladder 60k step, no label)	
Power off holding function	Program memory		EEPROM can be rewritten for one hundred thousand times	
	Device *3		Storage battery (lithium battery) 5 years (application environmental temperature +25°C, power off holding status)	
Self-diagnosis function			CPU abnormal, RAM abnormal, others	

*1 It can be also set to no automatic reset.

*2 Line driver input specification. For specification of open circuit input, please see "2-8 Bluetooth Communication", Page 2-96.

*3 Target device can be set via "CPU system setting" -> "Power off holding setting" of KV STUDIO.

Operation During Power off

Battery voltage low

· After mains voltage is low, "KV-5500/5000/3000" will stop and set output to OFF.

Auto reset

· After mains voltage recovers, operation will be automatically restarted.

Instant power off

· When using KV-U7, DC power, even if instant power off below 10ms, 2ms occurs, the operation still lasts.

1-6 CPU Unit

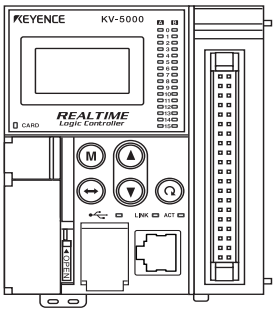
Package Contents

The package contains the following items. Before using, make sure that the package contains everything that it is supposed to contain.

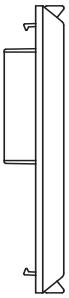
Start Unit (attached with CPU unit)



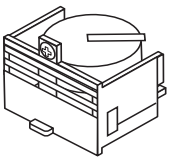
CPU Unit KV-5500/5000/3000



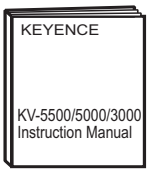
End Unit (attached with CPU unit)



Battery (attached with CPU unit)



Instruction Manual



We hope package will be completed. In case of any error, damage, please contact the nearest marketing department listed on back cover.

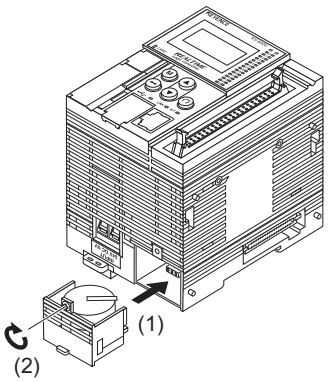
■ During first power connection

Please install storage battery to CPU unit during the first use.

1 **Insert battery (battery case) into the lower part of the unit.**

2 **Fix with screws.**

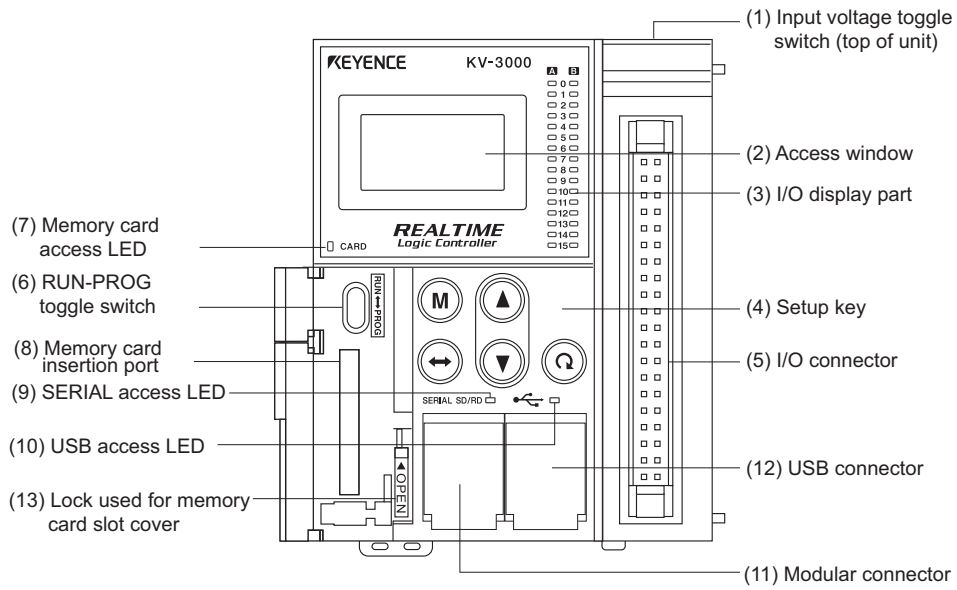
Fastening torque: 0.2N·m(2kgf·cm)



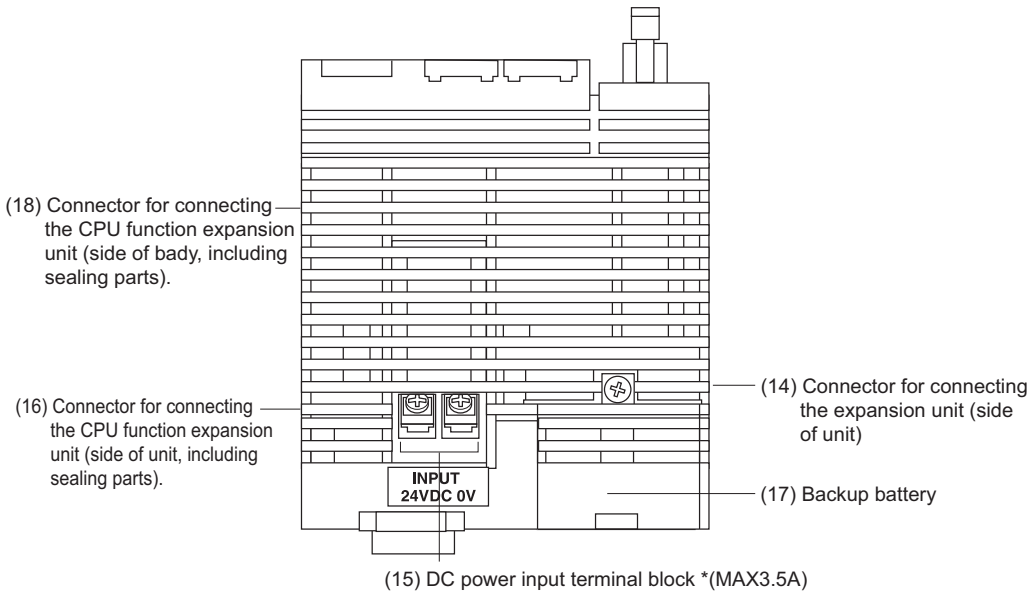
Names and Functions of Parts

● KV-3000

Front side of CPU unit



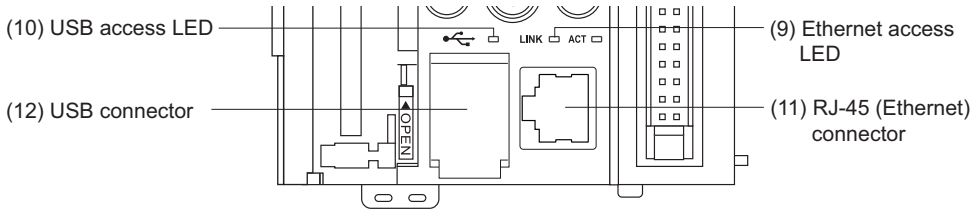
Bottom of CPU unit



* Left side is +24VDC terminal and right is 0V terminal.

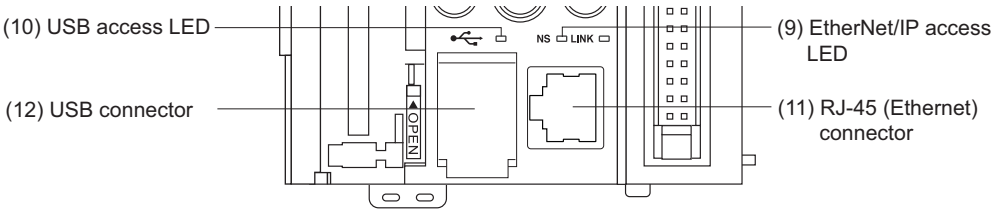
● KV-5000

Common to KV-3000 except (9) to (12).



● KV-5500

Common to KV-3000 except (9) to (12).



No.	Name	Function
(1)	Input voltage selector switch	Switch input voltage. (R000 to R009) 5V <=> 24V
(2)	Access window	Set unit monitor display. Backlight is used to display operating status. RUN: green; PROG: red
(3)	I/O display	Display I/O status of unit channel when pressing direct access switch. During CPU status display, column A indicates input R000 to R015; Column B indicates output R500 to R507.
(4)	Setup key	Used for operation of the access window.
(5)	I/O connector	I/O connector (40-pin)*.
(6)	RUN-PROG selector switch	Switch between RUN mode and PROG mode.
(7)	Memory card access LED	The lamp lit when accessing memory card.
(8)	Memory card slot	Memory card insertion slot.

No.	Name		Function
(9)	KV-5500	EtherNet/IP Operation LED	LINK display link state with target equipment. Green lamp on: linking Green lamp flashes: sending/receiving data Lamp off: link not established NS display data sending/receiving Green lamp on: connection established Green lamp flashes: connection not established Red lamp on: IP address duplicate state Red lamp flashes: timeout occurs on more than one connections Lamp off: IP address not set
	KV-5000	Ethernet Operation LED	Link indicates link status of other party's machine. Green lamp on: link established in Ethernet mode Red lamp on: link established in FL-net mode Orange lamp on: add FL-net in FL-net mode Lamp off: link disconnected ACT displays data sending/receiving status. Lamp lit: sending data Lamp off: data not sent
	KV-3000	SERIAL Operation LED	The lamp lit during serial communication. RD: red during data receiving; SD: green during data sending
(10)	USB access LED		The lamp lit when USB cable is used in data sending/receiving.
(11)	KV-5500	RJ-45 connector	Network connector cable connector (RJ-45 modular connector) (10BASE-T/100BASE-TX).
	KV-5000		
	KV-3000	Modular connector	For connecting modular plug. It is used for PC connection, etc.
(12)	USB Connector		For connecting with USB interface.
(13)	Memory card insertion slot cover latch		Slide upward to remove latch and open slot cover of memory card. Cover VTS files
(14)	Expansion unit		Connector for connecting the of expansion unit.
(15)	DC power input terminal block		Terminal block for 24 VDC mains input. MAX3.5A
(16)	KV-U7 connector		KV-U7 (power unit), KV- DR1 (error output unit), KV-BT1 (Bluetooth unit) connector.
(17)	Backup battery		OP-51604 (with CPU unit)
(18)	CPU function expansion unit connector		KV-DR1 (error output unit), KV-BT1 (Bluetooth unit) connector.

* conform to MIL-C-83503

Note

- Communication may interrupt due to noise influence and unstable USB communication status. In this case, please pull out USB cable and then plug again.
- Under extremely unstable communication status (quite severe environment noise), to protect PC, please wrap ferrite on cable.



Do not connect USB cable to serial port, Ethernet port. (may lead to damage)

Specification

■ Input specification

● R000 to R009 (Common input 10 point)

Item	DC 24 V input mode*1	DC 5 V input mode*1
Max. input voltage	DC 26.4 V	
Rated input voltage	DC 24 V(3.5 mA*2)	DC 5 V(1 mA*2)
Min. ON voltage	DC 19 V	DC 4.5 V
Max. OFF current	1.5mA	-
Max. OFF voltage	-	DC 1.5 V
Common point mode	10 point/1 common (2 terminals)	
Input time constant	Normal: 10 ms When using HSP command: 10μs CR2305 ON: 10μs to 10ms, 8 level conversion (CM1620 setting)	

"I/O Wiring Diagram", Page 1-32

*1 Use input voltage Selector Switch for switching. Please see "Names and Functions of Parts", Page 1-21 .

*2 It is reference value of input current.

● R010 to R013 (high speed A-phase/B-phase input, 2 channels, total 4 points)

Item	line driven input	DC 5 V input (open collector)	DC 24 V input (open collector)
Terminal No.	8，11，28，31		7，10，27，30
Max. input voltage	DC 5.5 V		DC 26.4 V
Rated input voltage	-	DC 5 V(20mA*1)	DC 24 V(6.5mA*1)
Min. ON voltage	DC 2.0 V		DC 19 V
Max. OFF current	-		1.5mA
Max. OFF voltage	DC 1.0 V		-
Common point mode	Separate common point		
Input time constant	Normal:10ms When using HSP command: 10μs CR2305 ON: 10μs to 10ms, 8 level conversion (CM1620 setting)		
Response frequency	100 kHz Input signal : line driver AM26LS31 or equivalent Duty cycle 50%	60kHz 5V±10%, Duty cycle 50%	60kHz 24V±10%, Duty cycle 50%

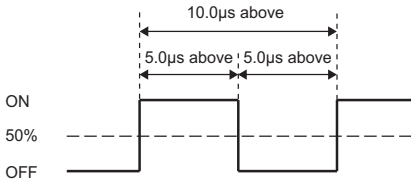
"I/O Wiring Diagram", Page 1-32

It is reference value of input current.

Input wave (high speed A-phase/B-phase input)

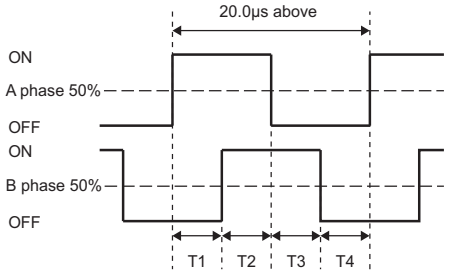
· line driven input

Single phase, 100kHz, Duty cycle 50%



Phase difference 50kHz, Duty cycle 50%

*Time between start (end) points of A-phase/B-phase shall be above 2.5μs.



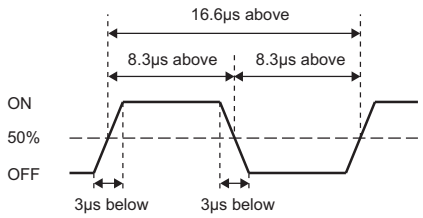
T1、T2、T3、T4 : 2.5μs above

* please note whether above waveform can be satisfied in case of larger impedance of connecting wire.

· Open collector output type, 24V;

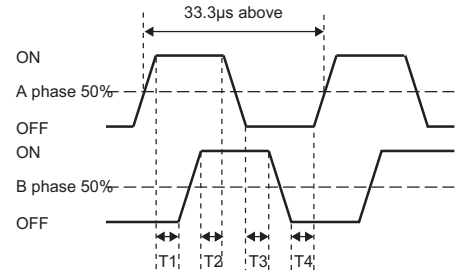
Single phase, 60kHz, Duty cycle 50%

* rising edge / falling edge pulse width shall be below 3.0μs



Phase difference 30kHz, Duty cycle 50%

* Time between start (end) points of A-phase/B-phase shall be above 4μs.



T1、T2、T3、T4 : 4.0μs above

* please note whether above waveform can be satisfied in case of larger impedance of connecting wire.

● R014 to R015 (high speed Z-phase 2 channels, total 2 points)

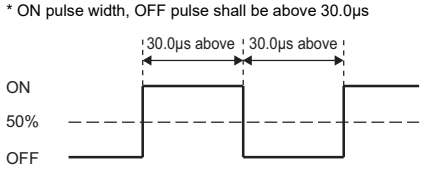
Item	line driven input	DC 5 V input (open collector)	DC 24 V input (open collector)
Connecting terminal No.	14,34		13,33
Max. input voltage	DC 5.5 V		DC 26.4 V
Rated input voltage	-	DC 5 V (8.3 mA*1)	DC 24 V (3.5 mA*1)
Min. ON voltage	DC 2.0 V		DC 19 V
Max. OFF current	-		1.5mA
Max. OFF voltage	DC 1.0 V		-
Common point mode	Separate common point		
Input time constant	Normal: 10 ms When using HSP instruction: 10μs CR2305 ON: 10μs to 10ms 8 level conversion (CM1620 setting)		

"I/O Wiring Diagram", Page 1-32

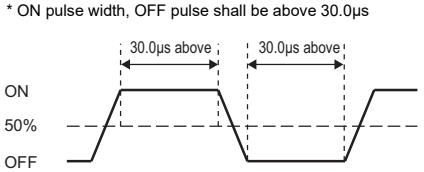
It is reference value of input current.

Output waveform (high speed output)

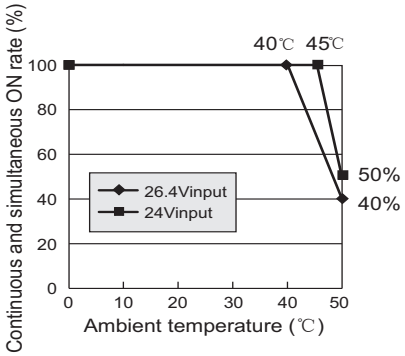
· line driven input:



· Open collector output (24V/5V);



● Input derating



■ Output specification

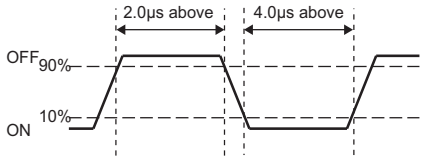
● R500 to R503 (High speed output, 4 points)

Item	Specification
Output mode	Transistor NPN output
Rated load	DC 30 V, 0.1A
Peak load current	0.2A
Max. OFF voltage	DC 30 V
Leak current at OFF	100μA
Residual current at ON	DC 0.6 V below
Common point mode	8 point/1 common point
ON/OFF response time	OFF -> ON : or less 1μs ON -> OFF : or less 5μs
Output frequency	100kHz (5 to 100mA)

"I/O Wiring Diagram", Page 1-32

Output waveform (high speed output)

Output frequency 100kHz (load current at Duty cycle 50% setting: 5 to 100mA)



The load of above output waveform is resistive load, not considering of the influence of connecting wire.

Please note, in case of larger impedance of connecting wire, ON/ OFF pulse width will be less than above value sometimes.

● R504 to R507 (Common output, 4 points)

Item	Specification
Output mode	Transistor NPN output
Rated load	DC 30 V, 0.1A
Peak load current	0.2A
Max. OFF voltage	DC 30 V
Leak current at OFF	100 μA
Residual current at ON	DC 0.6 V or less
Common point mode	8 point/1 common point
ON/OFF response time	OFF -> ON : or less 5μs ON -> OFF : or less 30μs
Output frequency	10kHz (5 to 100mA)

"I/O Wiring Diagram", Page 1-32

■ +5V output power

Connecting terminal No.: 20

Name : S+5V

Insulated DC 5V service power. Used when connecting to equipment with 5V interface, such us motor drive.

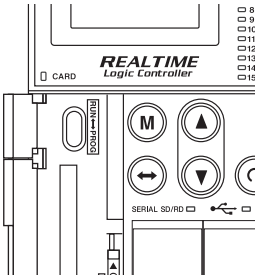
Item	Specification
Voltage	DC 5 V
Current	Max. 100mA

"Reference example of Positioning Control", Page 2-217

RUN-PROG Selector Switch

There are two modes for KV-5500/5000/3000 CPU unit: RUN mode and PROG mode.
Mode can be selected through the RUN-PROG Selector Switch shown on the right.

RUN mode : run program.
PROG mode : stop program,
all outputs OFF.



Note

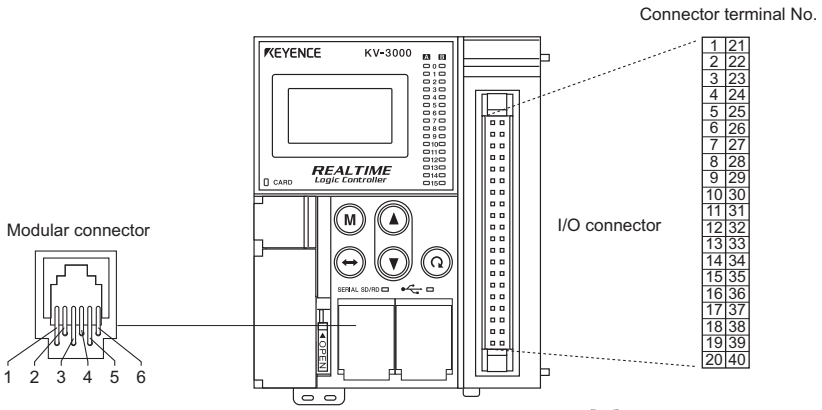
In case of serious error, even if the switch is in RUN position, it will be switched to PROG mode.

Tip When the switch is in RUN position, you can switch between PROG mode and RUN mode via KV STUDIO.

Wiring and Internal Circuit Diagram

KV-3000

Serial(RS-232C) communication can be realized via peripheral equipment such as modular connector, PC or touch panel, etc.
"2-5 Serial Communication (KV-3000 only)", Page 2-86



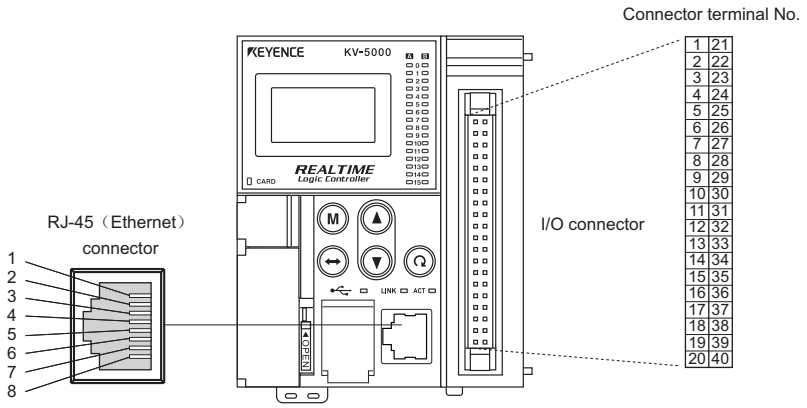
"I/O connector wiring diagram", Page 1-30

Terminal No.	Direction	Signal name
1	-	+5V output power
2	-	+5V output power
3	Input	RD
4	-	SG
5	Output	SD
6	-	GND

** SG and GND are wired internally.

■ KV-5000

Ethernet communication can be realized via external equipment such as RJ-45 connector and PC or touch panel, etc. Besides, FL-net communication can be also realized.
"2-6 Ethernet/FL-net Communication (KV-5000 only)", Page 2-94

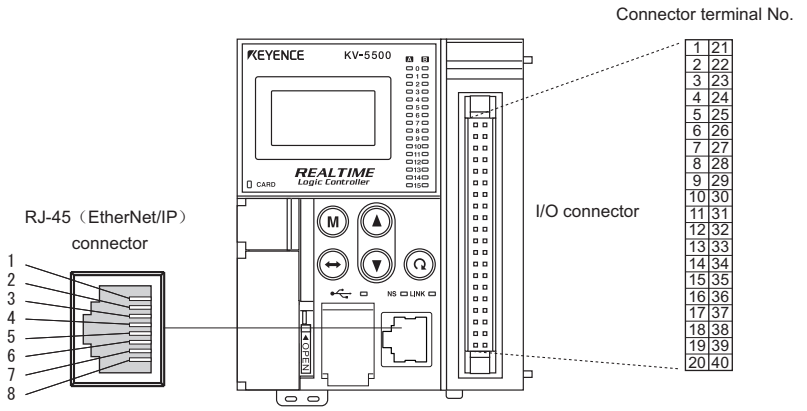


"I/O connector wiring diagram", Page 1-30

Pin No.	MDI signal	Signal function
1	TD+	Send data(+)
2	TD-	Send data(-)
3	RD+	Receive data(+)
4	-	-
5	-	-
6	RD	Receive data(-)
7	-	-
8	-	-

■ KV-5500

Ethernet communication can be realized via external equipment such as RJ-45 connector and PC or touch panel, etc. Besides, EtherNet/IP communication can be also realized.
"2-7 EtherNet/IP communication (KV-5500)", Page 2-95

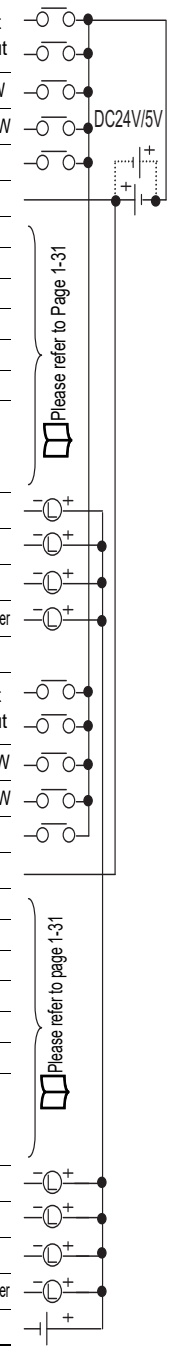


"I/O connector wiring diagram", Page 1-30

Pin arrangement of RJ-45 connector is the same as KV-5000.

■ I/O connector wiring diagram

Terminal No.	Direction	Type	Support line driven input	Relay	Signal name			
					Abort	High-speed counter		Positioning
1	Input	Common	-	R000	Interrupt	-		Stop sensor input
2	Input	Common	-	R002	Interrupt	-		Origin sensor input
3	Input	Common	-	R004	Interrupt	-		X axis limit switch CW
4	Input	Common	-	R006	Interrupt	-		X axis limit switch CCW
5	Input	Common	-	R008	Interrupt	High-speed counter 0 enable input		-
6*5	Input	-	-	COM0	Input common point (R000 to R009)			
7	Input	High speed A phase	○	R010	-	High-speed counter 0 A phase	A(+24V)	-
8							A(+5V)	-
9							A(-COM)*1	-
10	Input	High speed B phase	○	R012	-	High-speed counter 0 B phase	B(+24V)	-
11							B(+5V)	-
12							B(-COM)*1	-
13	Input	High speed Z phase	○	R014	-	High-speed counter 0, Z phase (Preset)	Z(+24V)	X axis, Z phase
14							Z(+5V)	
15							Z(-COM)*1	
16	Output	High speed	-	R500	-	High-speed counter 0 comparator matching output		X axis CW
17	Output	High speed	-	R502	-	-		Y axis CW
18	Output	Common	-	R504	-	(High-speed counter 0 comparator matching output)*2		-
19	Output	Common	-	R506	-	-		X axis clear deviation counter
20	-	-	-	S+5V	+5V output power			
21	Input	Common	-	R001	Interrupt	-		Stop sensor input
22	Input	Common	-	R003	Interrupt	-		Origin sensor input
23	Input	Common	-	R005	Interrupt	-		Y axis limit switch CW
24	Input	Common	-	R007	Interrupt	-		Y axis limit switch CCW
25	Input	Common	-	R009	Interrupt	High-speed counter 1 enable input		-
26*5	Input	-	-	COM0	Input common point (R000 to R009)			
27	Input	High speed A phase	○	R011	-	High-speed counter 1 A phase	A(+24V)	-
28							A(+5V)	-
29							A(-COM)*1	-
30	Input	High speed B phase	○	R013	-	High-speed counter 1 B phase	B(+24V)	-
31							B(+5V)	-
32							B(-COM)*1	-
33	Input	High speed Z phase	○	R015	-	High-speed counter 1, Z phase (Preset)	Z(+24V)	Y axis, Z phase
34							Z(+5V)	
35							Z(-COM)*1	
36	Output	High speed	-	R501	-	High-speed counter 1 comparator matching output		X axis CCW
37	Output	High speed	-	R503	-	-		Y axis CCW
38	Output	Common	-	R505	-	(High-speed counter 1 comparator matching output)*3		-
39	Output	Common	-	R507	-	-		Y axis clear deviation counter
40	Output	-	-	COM1	Output common point (R500 to R507) *4			



*1 A (-COM), B (-COM), Z (-COM) terminals are separate.

*2 When setting R500 output (CR2505 to OFF output to R500 ; when setting it to ON , output to R504)

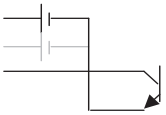
*3 When setting R501 output (CR2505 to OFF output to R501 ; when setting it to ON , output to R505)

*4 +5V (S + 5V) GND is connected internally.

*5 Terminal No. 6 (COM0) , terminal No. 26 (COM0) is shorted internally.

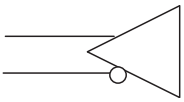
Open collector connection (A phase)

Terminal No.	Signal name
7,27	A(+24V)
8,28	A(+5V)
9,29	A(-COM)



Differential line driver (A phase)

Terminal No.	Signal name
7,27	A(+24V)
8,28	A(+5V)
9,29	A(-COM)



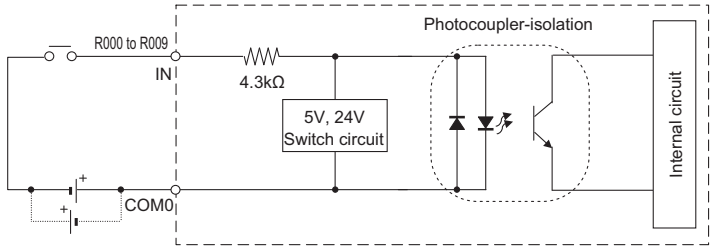
B phase and Z phase are same.

Note

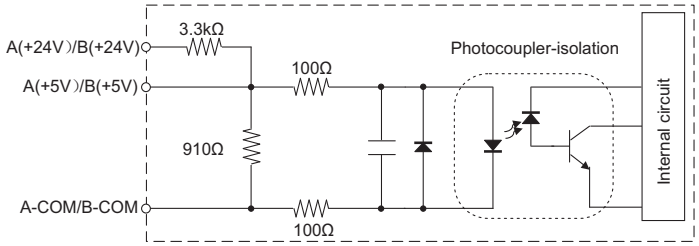
- When using A (+24v) terminal, ensure open circuit of A (+5V) terminal.
  Similarly, when using A (+5V) terminal, ensure open circuit of A (+24V) terminal.
  So are B phase and Z phase.
- Please note, if connecting wire of input terminal is longer and naked, it will become noise-initiating antennae, and error input may appear.

■ I/O Wiring Diagram

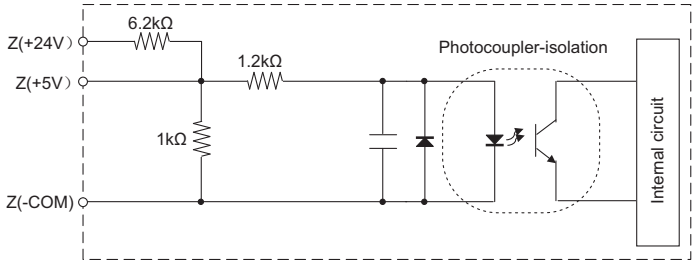
Input circuit (R000 to R009)



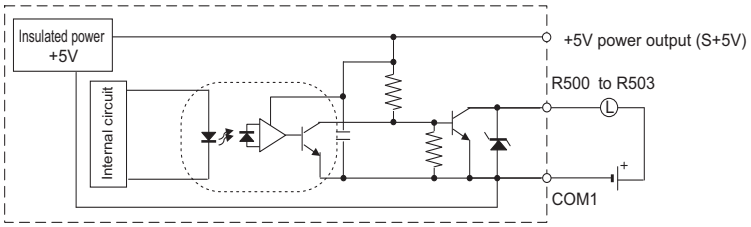
Input circuit (R010 to R013)



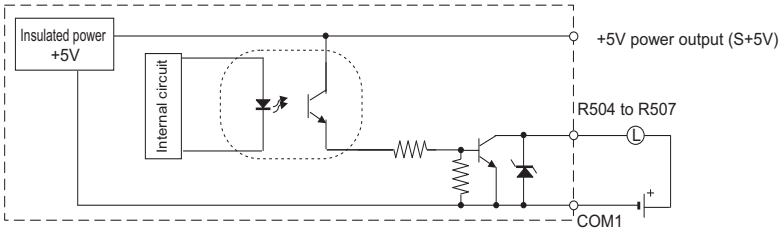
Input circuit (R014 to R015)



Output circuit (R500 to R503)



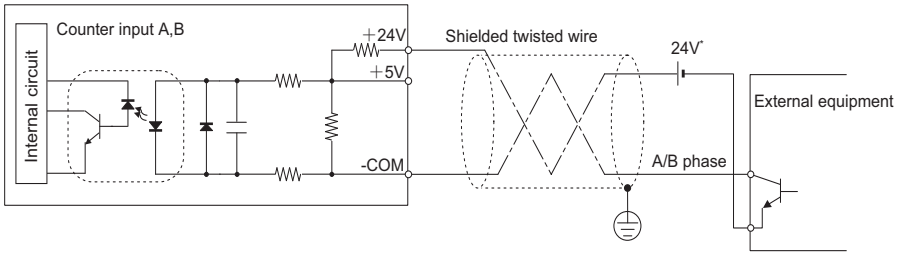
Output circuit (R504 to R507)



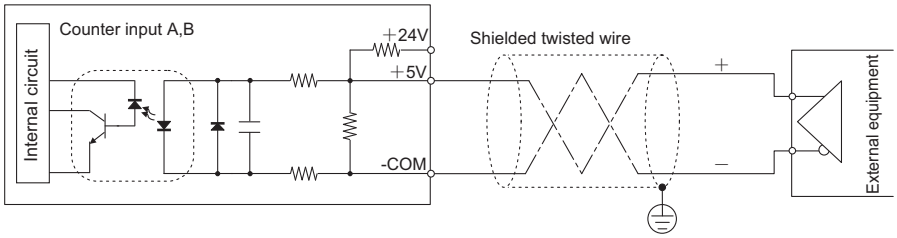
■ Peripheral equipment input wiring example

● Input R010 to R013

Example1 **Peripheral equipment belongs to open collector output**

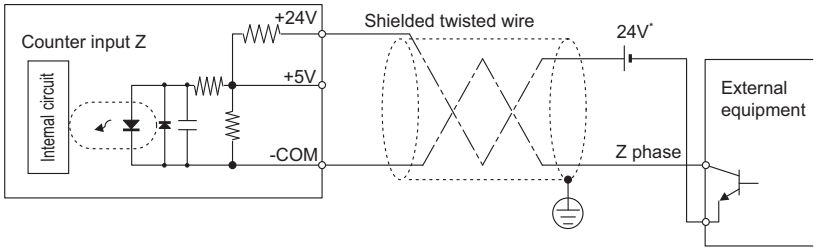


Example2 **Peripheral equipment belongs to line driver output**

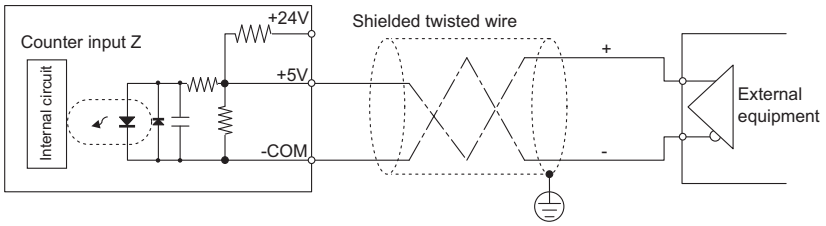


● Input R014 to R015

Example3 **Peripheral equipment belongs to open collector output**



Example4 **Peripheral equipment belongs to line driver output**



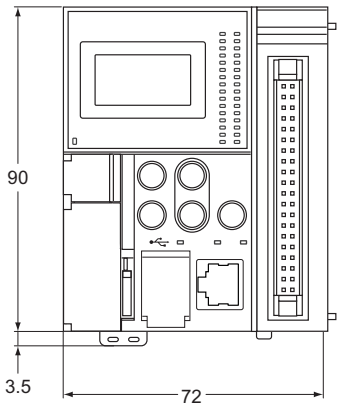
Note

- When connecting, do not mislead the polarity of load power on output side. If polarity is reversed, equipment damage may result.
- Input waveform may distort in case of overlong cable. Please note during wiring.

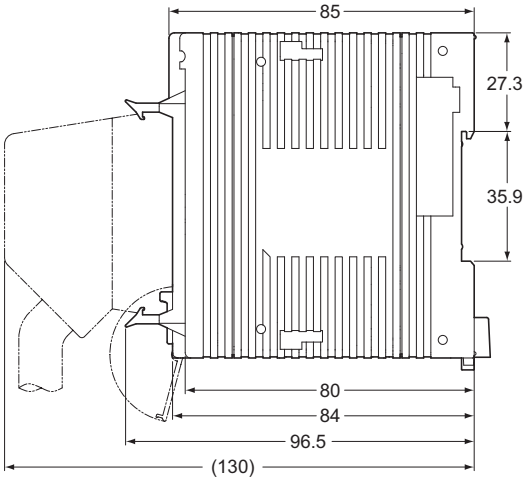
Outline Dimensions

■ CPU Unit

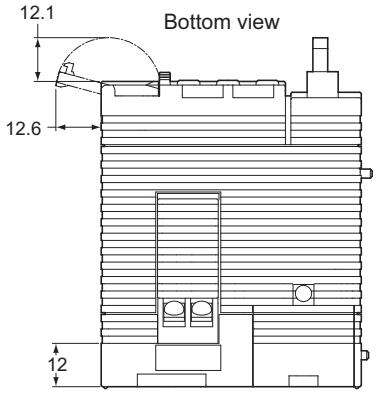
Front view



Side view



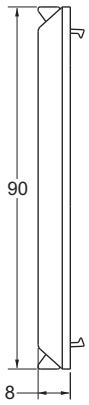
Bottom view

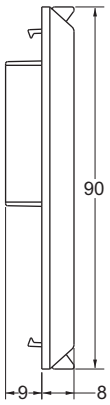


Unit: [mm]

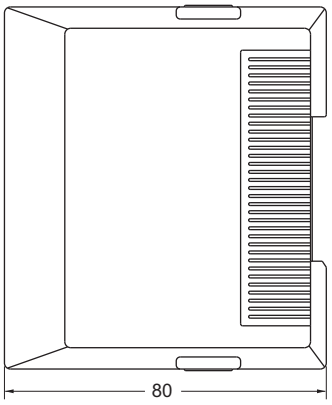
■ Start unit/End unit

Start unit





End unit



Unit: [mm]

1-7 AC Power Unit

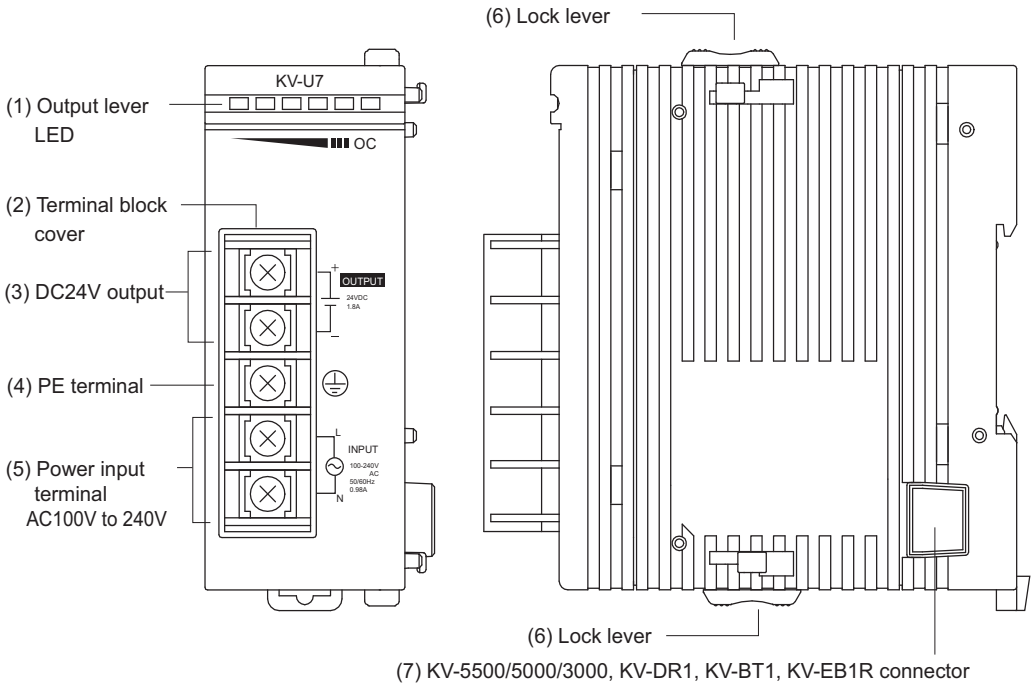
KV-U7

This sections describes name, function and technical specification of each part of KV-U7 AC power unit.

Name and Function of Each Part

Front of power unit

Side of power unit



No.	Name	Function
(1)	Output bar LED	LED lamp color LED No.1 Green during voltage output LED No.2 Green when output current is more than 30% LED No.3 Green when output current is more than 50% LED No.4 Green when output current is more than 60% LED No.5 Yellow for output current more than 70% LED No.6 It is read when overcurrent is detected LED No. 1 2 3 4 5 6 OC When LED No.5 yellow lamp lit, the power capacity is not sufficient, please use other power.
(2)	Terminal block cover	Cover
(3)	24 VDC output	Operation power shall use 24 VDC output terminal. Including (M4 screw) main power, total 1.8A.
(4)	PE terminal	Protective earthing terminal connected onto protective earthing conductor of buildings, etc. (M4 screw)
(5)	Power input terminal	Connect to AC100-AC100 (50 / 60Hz) power. (M4 screw)
(6)	Lock lever	Locks the connection of the unit.
(7)	KV-5500/5000/3000, KV-DR1, KV-BT1, EB1R connector	KV-5500/5000/3000, KV-DR1, KV-BT1, KV-EB1R connector.

Note

- When overcurrent (LED No.6 red lamp lit) occurs, please temporarily disconnect power, eliminate the fault reason.
- In case of overvoltage, output stops (output display lamp off).
  Please disconnect power for more than 30 seconds, and then turn on the power again.
- When using KV-U7, do not supply power from the power terminal of KV-5500/5000/3000

Note

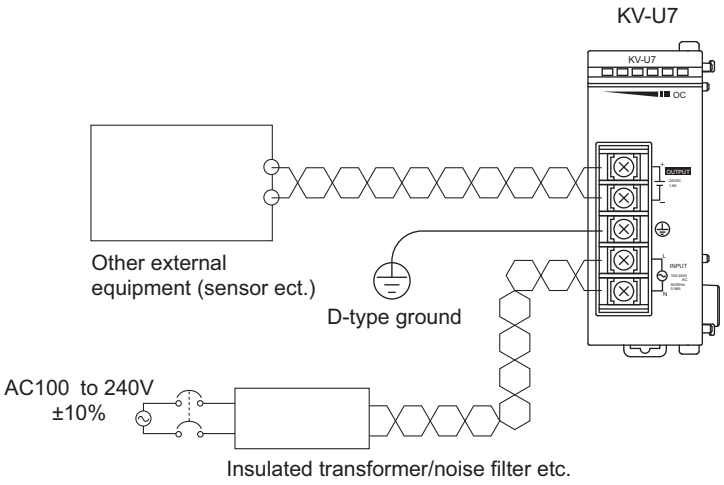
- KV-U7 must be connected to the left side of KV-5500/5000/3000 (CPU unit), KV-DR1 (error output unit), KV-BT1 (Bluetooth unit), KV-EB1R (expansion unit). Besides, when using KV-U7 24V will not be output from power terminal of KV-5500/5000/3000.
- When using KV-U7, to prevent poor start due to inrush current of the unit, please control the total current consumption of the unit below 70% of KV-U7 output capacity (LED No.4 green light lit, about 1.3A).

Specification

Item	Specification
Input power voltage	AC 100 to 240V±10%(50/60Hz)
Output voltage	DC 24V±10%
Output capacity	1.8A (total for power of all units and operation power)
Power consumption	< 135 VA
Dwell time	< 10ms
Start-up time	Max. 2s

How to Wire

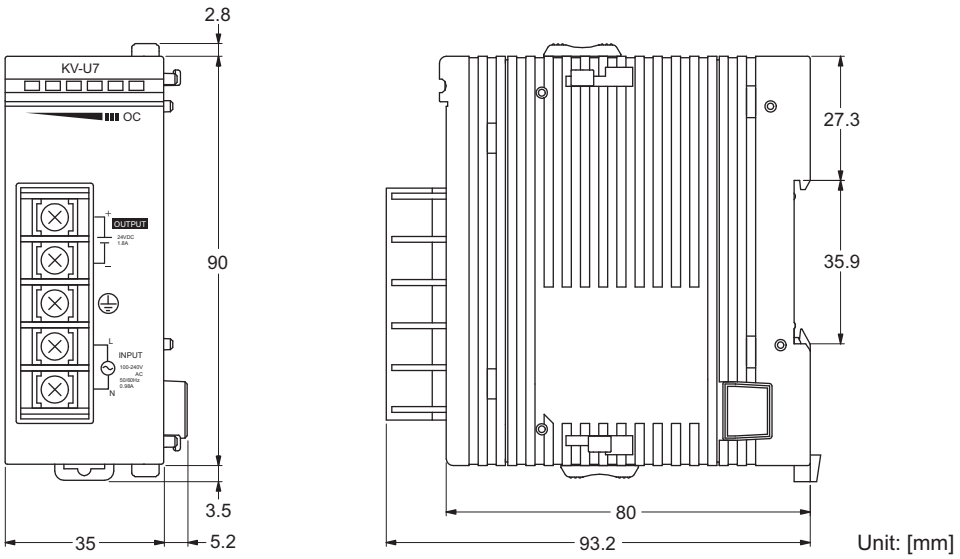
KV-U7 AC power unit shall be wired as follows.



Note

- **To reduce line noise, please connect 1:1 insulated transformer and noise filter.**
- **To reduce induction influence, please twist the cable.**
- **When connecting power unit, be sure to supply protective grounding.**

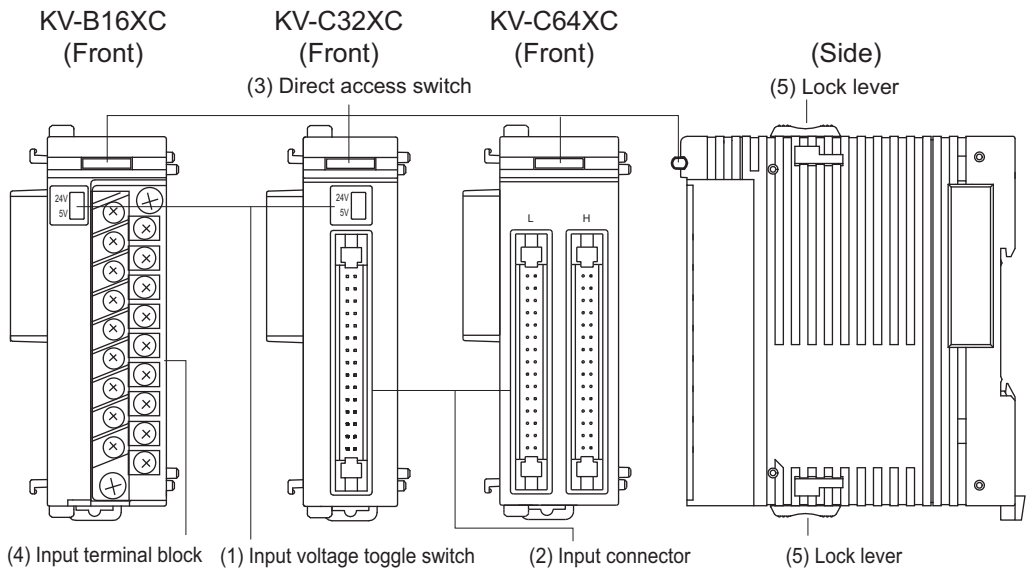
Outline Dimensions



1-8 Expansion Input Unit KV-B16XC/C32XC/C64XC

This chapter describes name, function and technical specification of every part of KV-B16XC/C32XC/C64XC expansion input unit.

Name and Function of Each Part



No.	Name	Function
(1)	Input voltage selector switch	Toggle input voltage. 5V <=> 24V
(2)	Input connector	Input connector.
(3)	Direct access switch	After setting it to ON, you can monitor status of expansion unit via CPU access window. In addition, you can also know the status of the expansion unit through the color of the switch. Lit (green) : Normal operation (with some exceptions*1) Green LED blinking: when a unit is selected while the green LED is lit and the switch is turned on. Red LED lit: When a unit error has occurred (with some exceptions*2) Red lamp off: when turning ON switch and selecting unit under red lamp on status
(4)	Input terminal block	Input terminal block. Can be removed. (M3 screws)
(5)	Lock lever	Locks the connection of the unit.

*1 This LED lights (green) in the following instances even if operation is not normal.
(1) When the number of connected units differs from the unit information on the CPU Unit when the power is turned ON.
(2) When the model type connected differs from the unit information on the CPU Unit when the power is turned ON.
In this case, an error will be displayed in the access window.

*2 Red light will be ON in the following instance even if the unit is not in error state:
(1) When the power is turned on, and the CPU unit information becomes the configuration with one CPU.
In this case, an error will be displayed in the access window.

* KV-C32XC/C64XC 34-pin connector is supplied as an option.

Tip Direct processing can be realized. Although KV-B16XA/C32XA/C64XA/C64XB can be also used, direct processing can not be realized.

"About Direct Processing", Page 3-16

Specification

Model	KV-B16XC (16 point)		KV-C32XC (32 point)		KV-C64XC (64 point)
External connection mode	Removable terminal block		Connector (MIL standard)*1		Connector (MIL standard)*1
Input terminal	DC 24 V mode	DC 5 V mode	DC 24 V mode	DC 5 V mode	DC 24 V mode*4
Max. input voltage	DC 26.4 V				
Rated input voltage	DC 24 V, 5.3mA	DC 5 V，1mA	DC 24 V, 5.3mA	DC 5 V，1mA	DC 24 V , 4.1mA
Min. ON voltage	19V	3.5V	19V	3.5V	19V
Max. OFF current	1.5mA	—	1.5mA	—	1.5mA
Max. OFF voltage	—	1.5V	—	1.5V	—
Common point mode	16 point/1 common (2 terminals)*2		32 point/1 common (2 terminals)*2		32point/1 common (2 terminals)×2*3

Input time constant (4 level conversion)

Constant setting during input	OFF->ON		ON->OFF	
	TYP	MAX	TYP	MAX
25μs	25μs	65μs	75μs	120μs
300μs	275μs	365μs	275μs	420μs
1ms	1ms	1.2ms	1ms	1.2ms
10ms	10ms	12ms	10ms	12ms

Input impedance	4.3kΩ		5.6kΩ
Internal current consumption	15mA or less		25mA or less
Weight	approx. 120g	approx. 110g	approx. 140g

* 1 Conform to MIL-C-83503 standard

* 2 2 COMs for KV-C32XC and KV-B16XC, connected internally.

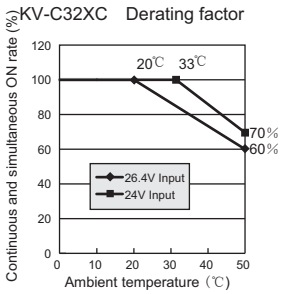
* 3 4 COMs for KV-C64XC, internal H side(2 points), L side(2 points), connected internally.

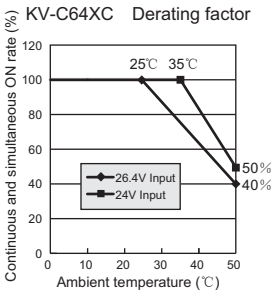
"KV-B16XC internal circuit diagram", Page 1-40 "KV-C32XC internal circuit diagram", Page 1-41
"KV-C64XC internal circuit diagram", Page 1-42

*4 All terminals support 2-wire connection (but 2-wire non-contact sensor EV Series not supported)

Note

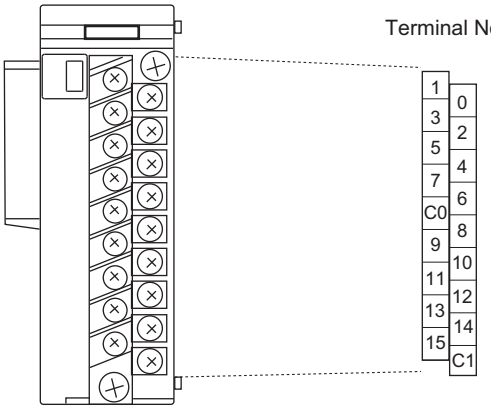
- If the number of inputs in ON status exceeds the specified range, the unit may fail.
- Relationship between continuous simultaneous ON rate and ambient temperature of the KV-C32XC 2-wire terminal and KV-C64XC 2-wire terminal is shown as follows.



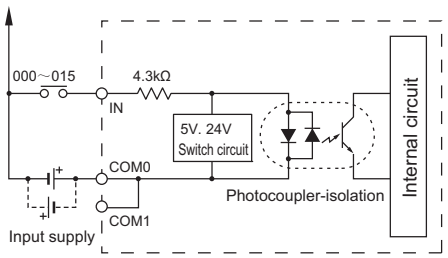


Wiring and Internal Circuit Diagram

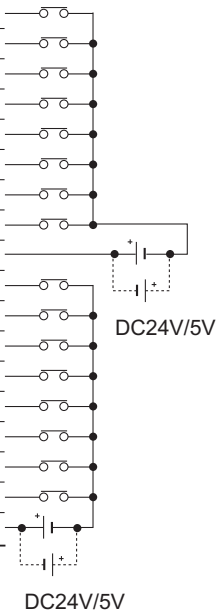
KV-B16XC Wiring diagram



KV-B16XC internal circuit diagram



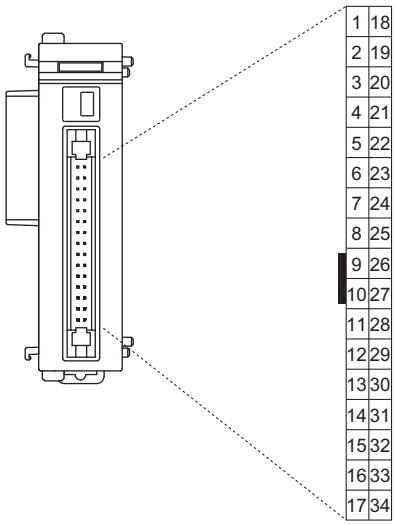
Terminal No.	Direction	Signal name
0	Input	000
1	Input	001
2	Input	002
3	Input	003
4	Input	004
5	Input	005
6	Input	006
7	Input	007
C0	Input	COM0
8	Input	008
9	Input	009
10	Input	010
11	Input	011
12	Input	012
13	Input	013
14	Input	014
15	Input	015
C1	Input	COM1



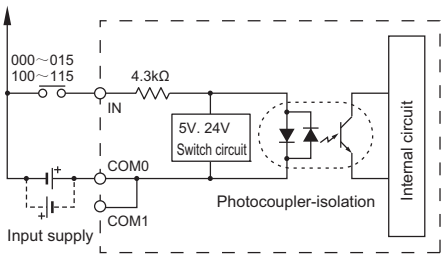
* COM circuit-shorted internally

KV-C32X Wiring diagram

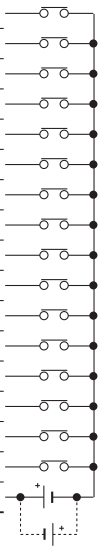
Connector pin No.



KV-C32XC internal circuit diagram

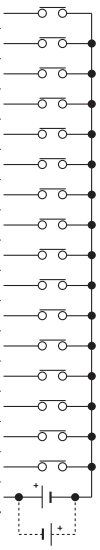


Pin No.	Direction	Signal name
1	Input	000
2	Input	001
3	Input	002
4	Input	003
5	Input	004
6	Input	005
7	Input	006
8	Input	007
9	Input	008
10	Input	009
11	Input	010
12	Input	011
13	Input	012
14	Input	013
15	Input	014
16	Input	015
17	Input	COM0



DC24V/5V

Pin No.	Direction	Signal name
18	Input	100
19	Input	101
20	Input	102
21	Input	103
22	Input	104
23	Input	105
24	Input	106
25	Input	107
26	Input	108
27	Input	109
28	Input	110
29	Input	111
30	Input	112
31	Input	113
32	Input	114
33	Input	115
34	Input	COM1



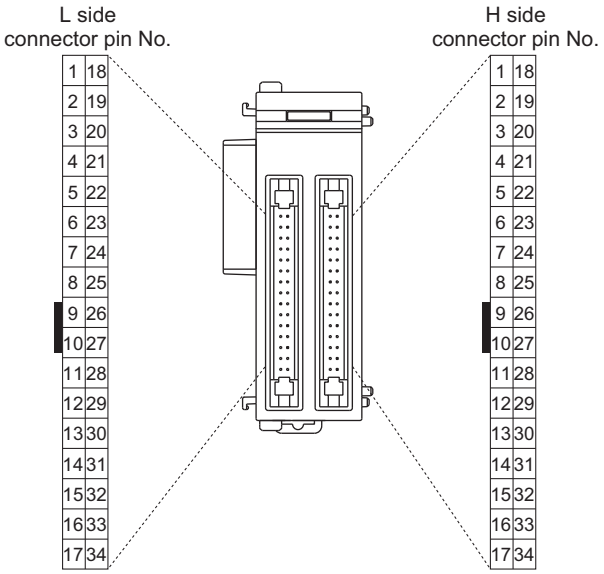
DC24V/5V

* COM circuit-shorted internally

Note

Input continuous and simultaneous ON rate should not exceed the range of technical specification. Otherwise, equipment damage may result.

KV-C64XC Wiring diagram



Pin No.	Signal name	Signal name	Pin No.
1	000	100	18
2	001	101	19
3	002	102	20
4	003	103	21
5	004	104	22
6	005	105	23
7	006	106	24
8	007	107	25
9	008	108	26
10	009	109	27
11	010	110	28
12	011	111	29
13	012	112	30
14	013	113	31
15	014	114	32
16	015	115	33
17	COM0	COM1	34

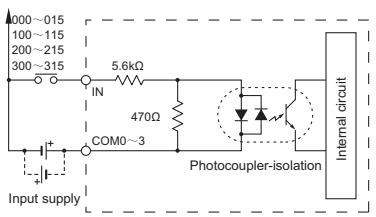
DC24V

Pin No.	Signal name	Signal name	Pin No.
1	200	300	18
2	201	301	19
3	202	302	20
4	203	303	21
5	204	304	22
6	205	305	23
7	206	306	24
8	207	307	25
9	208	308	26
10	209	309	27
11	210	310	28
12	211	311	29
13	212	312	30
14	213	313	31
15	214	314	32
16	215	315	33
17	COM2	COM3	34

DC24V

* COM0, COM1 circuit-shorted internally.
COM2, COM3 circuit-shorted internally.
(COM0, 1)-(COM2, 3) not circuit-shorted internally.

KV-C64XC internal circuit diagram



Note

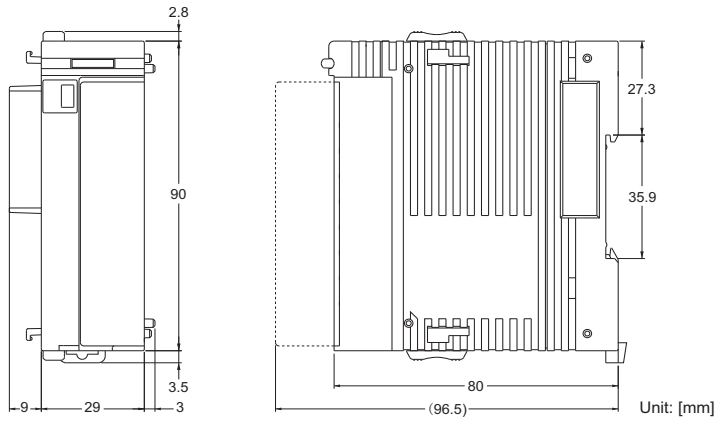
Input continuous and simultaneous ON rate should not exceed the range of technical specification. Otherwise, equipment damage may result.

Note

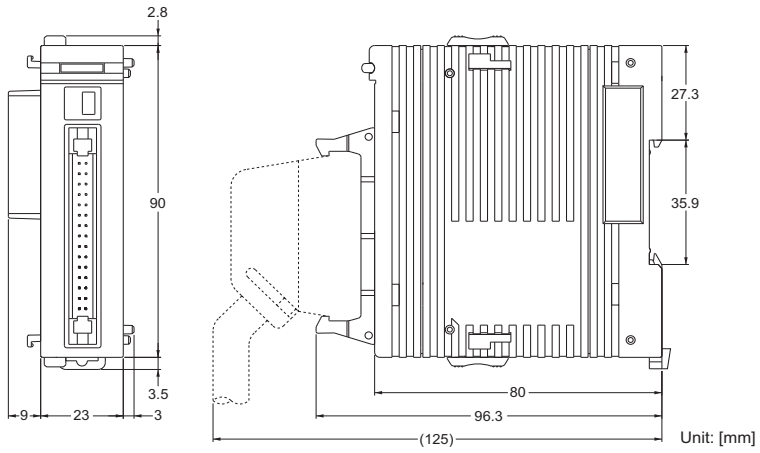
Please use OP- 42224 connector (34-pin) for 64-point unit.
Do not use OP-23139.

Outline Dimensions

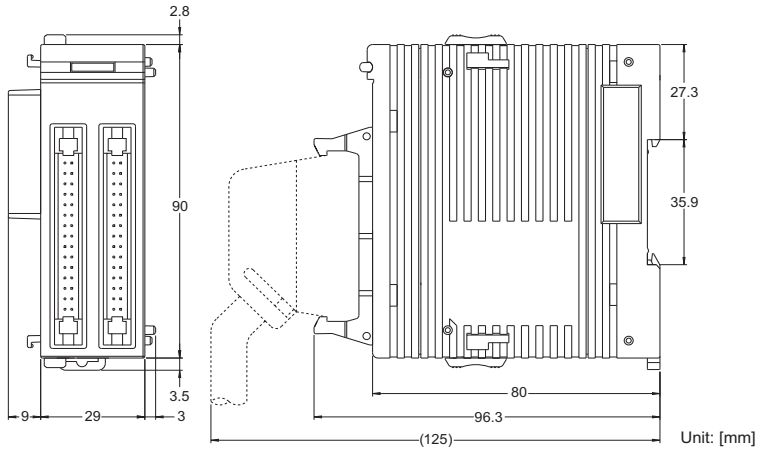
KV-B16XC



KV-C32XC



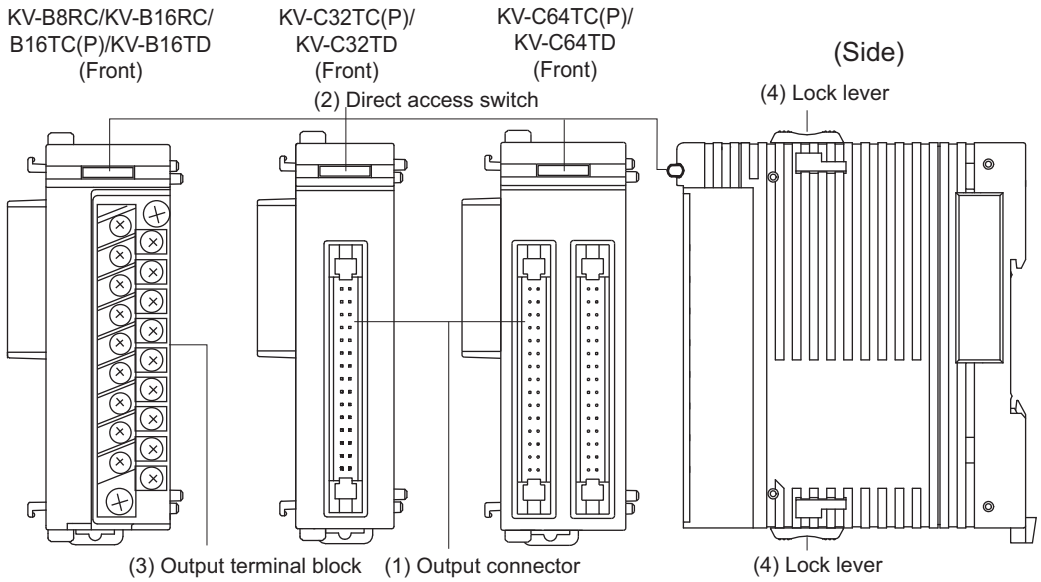
KV-C64XC



1-9 Expansion Output Unit

This section describes name, function and specification of each part of KV-B8RC/KV-B16RC/KV-B16TC(P)/KV-C32TC(P)/KV-C64TC(P)/KV-B16TD/KV-C32TD/KV-C64TD expansion output unit.

Names and Functions of Each Part



No.	Name	Function
(1)	Output connector	Output connector.
(2)	Direct access switch	After setting the switch to ON, you can monitor the status of expansion unit through the CPU Access Window. In addition, you can also know the status of the expansion unit through the color of the switch. Lit (green) : Normal operation Green LED blinking: when a unit is selected while the green LED is lit and the switch is turned ON. Red LED lit: When a unit error has occurred (with some exceptions[*1]) Red light OFF: when a unit is selected while the red light is ON and the switch is turned ON.
(3)	Output terminal block	Output terminal block. Can be removed (M3 screws)
(4)	Lock lever	Locks the connection of the unit.

*1 Red light will be ON in the following instance even if the unit is not in error state:
(1) When the power is turned on, and the CPU unit information becomes the configuration with one CPU
In this case, an error will be displayed in the access window.

* KV-C32TC/C64TC/C32TCP/C64TCP/KV-C32TD/KV-C64TD 34-pin connector will be supplied as an option.

Tip Direct processing can be realized. Although KV-B16RA/B16TA/C32TA(P)/C64TA(P) can also be used, direct processing can not be realized。

"About Direct Processing", Page 3-16

Specification

Type		KV-B8RC (8 point)	KV-B16RC (16 point)	KV-B16TCP (16 point)	KV-C32TCP (32 point)	KV-C64TCP (64 point)
Output mode		Relay		Transistor (PNP)		
External connection mode		Removable terminal block		Removable terminal block	Connector *1	
Rated load		AC 250V/DC 30V ~ 2A (KV-B16RC is 8A/common point)		DC 30V 0.2A		
Leakage current in case of OFF		-		Below 100μA		
Remaining voltage in case of ON		-		Below 0.5V		
ON resistance		Below 50mΩ		-		
Common point mode		Independent	8 point/common point	16 point/ common point (2 terminals)*2	32 point/ common point (2 terminals)*2	64 point/ common point (4 terminals)*3
Response time	OFF→ON	Below 10ms		Below 10μs		Below 50μs
	ON→OFF			Below 200μs		
Internal consumption current		Below 65mA	Below 120mA	Below 30mA	Below 55mA	Below 100mA
Weight		About 160g	About 190g	About 130g	About 100g	About 140g
Relay life		Electrical above 100,000 times (20 times/min) Mechanical above 20 million times		-		
Relay replacement		Unallowed		-		

*1 According to MIL-C-83503

*2 Two common points are shorted in KV-B16TCP, C32TCP.

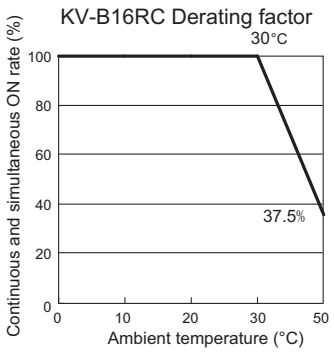
*3 4 common points are shorted in KV-C64TCP.

"KV-B8RC", "KV-B16RC internal circuit diagram", "KV-B16TCP internal circuit diagram", Page 1-49
"KV-C32TCP internal circuit diagram", Page 1-50
"KV-C64TCP internal circuit diagram", Page 1-52

Note **KV-C32TCP/KV-C64TCP is 1.6A/ common point.**

Note

When the number of ON output points exceeds specified range, unit error may occur.
Ambient temperature and continuous and simultaneous ON rate are shown as follows.



Type		KV-B16TC KV-B16TD (16 point)	KV-C32TC KV-C32TD (32 point)	KV-C64TC KV-C64TD (64 point)
Output mode		Transistor (NPN) (C type) MOSFET (N-ch) (with overcurrent protection function) (D type)		
External connection mode		Removable terminal block	Connector *1	
Rated load		DC 30V 0.2A(C type) DC 30V 0.3A(D type)	DC 30V 0.2A *4	
Leakage current in case of OFF		Below 100μA		
Remaining voltage in case of ON		Below 0.5V		
Common point mode		16 point/common point (2 terminals)*2	32 point/common point (2 terminals)*2	64 point/common point (4 terminals)*3
Response time	OFF→ON	Below 10μs(C type) Below 100μs(D type)		Below 50μs(C type) Below 150μs(D type)
	ON→OFF	Below 200μs(C type) Below 300μs(D type)		
Internal consumption current		Below 35mA(C type) Below 45mA(D type)	Below 55mA(C type) Below 65mA(D type)	Below 100mA(C type) Below 120mA(D type)
Weight		About 130g	About 100g	About 140g

*1 According to MIL-C-83503

*2 Two common points of KV-B16TC, B16TD, C32TC, C32TD are shorted inside.

*3 4 common points are shorted in KV-C64TC, C64TD.

*4 The rated load for each terminal in the common is 1.6 A.

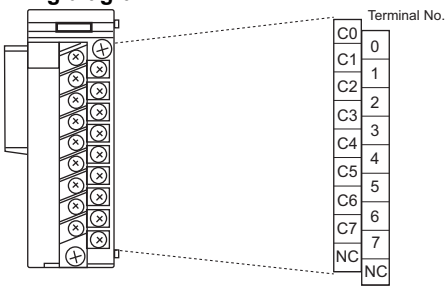
"KV-B16TC/B16TD internal circuit diagram", Page 1-49
"KV-C32TCP internal circuit diagram", Page 1-50
"KV-C64TCP internal circuit diagram", Page 1-52

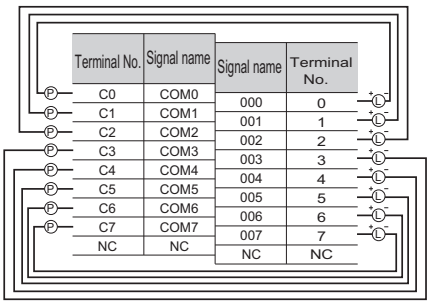
Note

KV-C32T*/C64T* is 1.6A/common point.

Wiring and Internal Circuit Diagram

KV-B8RC Wiring diagram



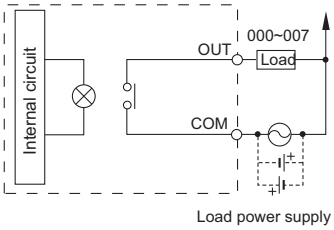


Terminal No.	Signal name	Signal name	Terminal No.
C0	COM0	000	0
C1	COM1	001	1
C2	COM2	002	2
C3	COM3	003	3
C4	COM4	004	4
C5	COM5	005	5
C6	COM6	006	6
C7	COM7	007	7
NC	NC	NC	NC

Ⓟ :

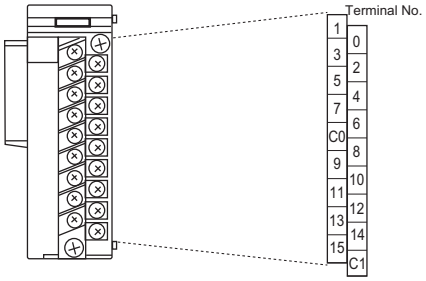
KV-B8RC

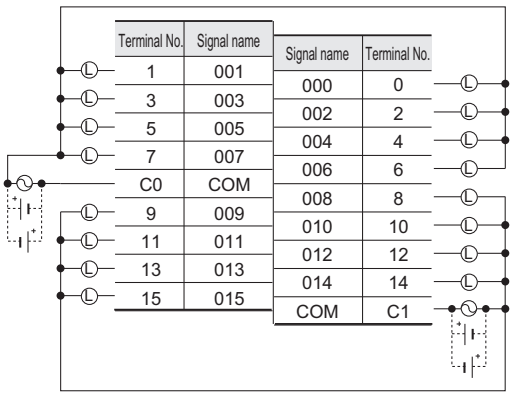
internal circuit diagram



* COM not circuit-shorted internally.

KV-B16RC/B16TC/B16TD/B16TCP Wiring diagram

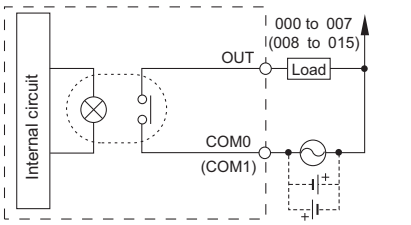




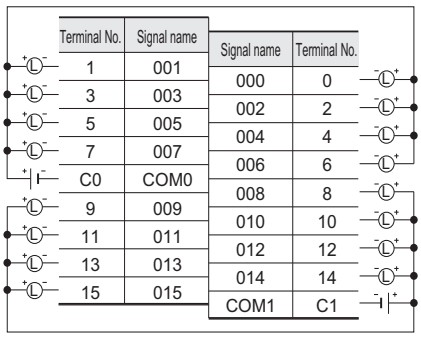
Terminal No.	Signal name	Signal name	Terminal No.
1	001	000	0
3	003	002	2
5	005	004	4
7	007	006	6
C0	COM	008	8
9	009	010	10
11	011	012	12
13	013	014	14
15	015	COM	C1

KV-B16RC

internal circuit diagram



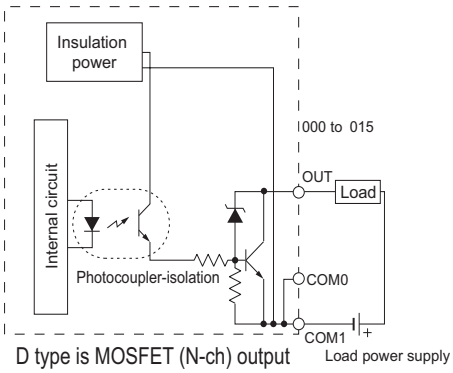
* COM not circuit-shorted internally.



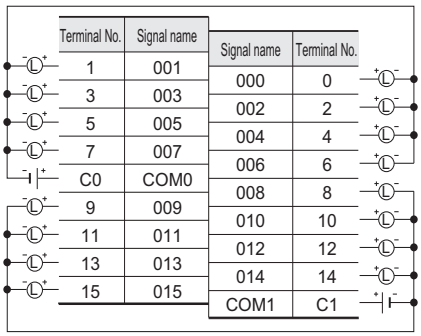
Terminal No.	Signal name	Signal name	Terminal No.
1	001	000	0
3	003	002	2
5	005	004	4
7	007	006	6
C0	COM0	008	8
9	009	010	10
11	011	012	12
13	013	014	14
15	015	COM1	C1

* COM circuit-shorted internally.

KV-B16TC/B16TD internal circuit diagram



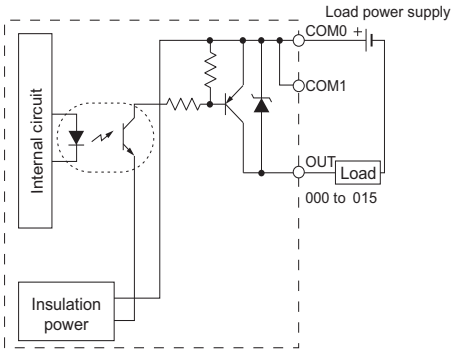
D type is MOSFET (N-ch) output



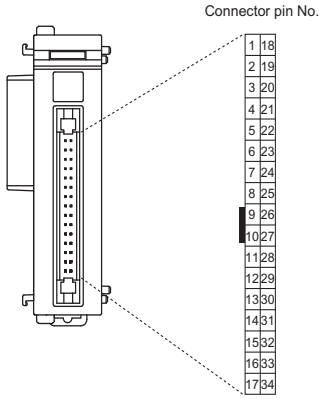
Terminal No.	Signal name	Signal name	Terminal No.
1	001	000	0
3	003	002	2
5	005	004	4
7	007	006	6
C0	COM0	008	8
9	009	010	10
11	011	012	12
13	013	014	14
15	015	COM1	C1

* COM circuit-shorted internally.

KV-B16TCP internal circuit diagram



KV-C32TC/C32TD/C32TCP Wiring diagram

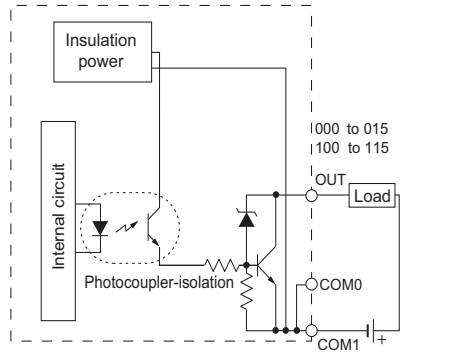


Pin No.	Signal name	Signal name	Pin No.
1	000	100	18
2	001	101	19
3	002	102	20
4	003	103	21
5	004	104	22
6	005	105	23
7	006	106	24
8	007	107	25
9	008	108	26
10	009	109	27
11	010	110	28
12	011	111	29
13	012	112	30
14	013	113	31
15	014	114	32
16	015	115	33
17	COM0	COM1	34

DC DC

* COM circuit-shorted internally.

KV-C32TC/C32TD internal circuit diagram



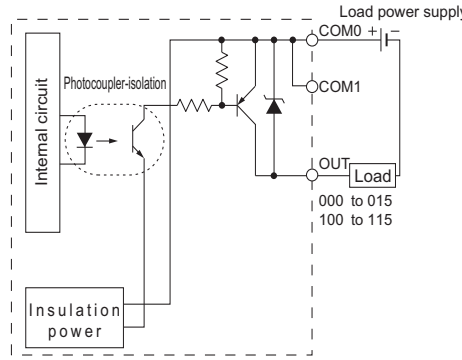
D type is MOSFET (N-ch) output Load power supply

Pin No.	Signal name	Signal name	Pin No.
1	000	100	18
2	001	101	19
3	002	102	20
4	003	103	21
5	004	104	22
6	005	105	23
7	006	106	24
8	007	107	25
9	008	108	26
10	009	109	27
11	010	110	28
12	011	111	29
13	012	112	30
14	013	113	31
15	014	114	32
16	015	115	33
17	COM0	COM1	34

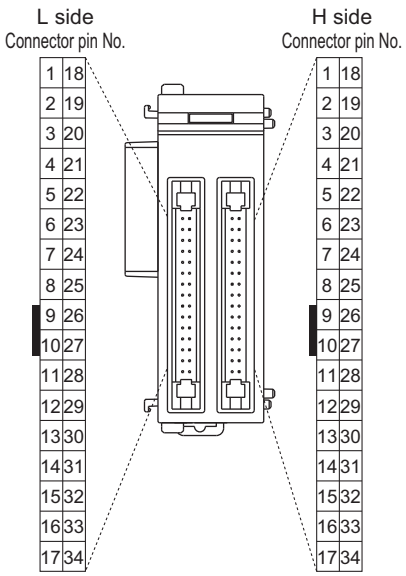
DC DC

* COM circuit-shorted internally.

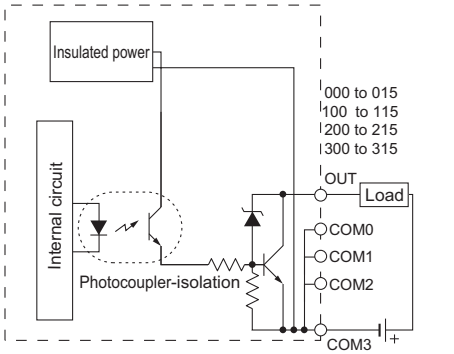
KV-C32TCP internal circuit diagram



KV-C64TC/C64TD Wiring diagram



KV-C64TC/C64TD internal circuit diagram



D type is MOSFET (N-ch) output

Pin No.	Signal name	Signal name	Pin No.
1	000	100	18
2	001	101	19
3	002	102	20
4	003	103	21
5	004	104	22
6	005	105	23
7	006	106	24
8	007	107	25
9	008	108	26
10	009	109	27
11	010	110	28
12	011	111	29
13	012	112	30
14	013	113	31
15	014	114	32
16	015	115	33
17	COM0	COM1	34

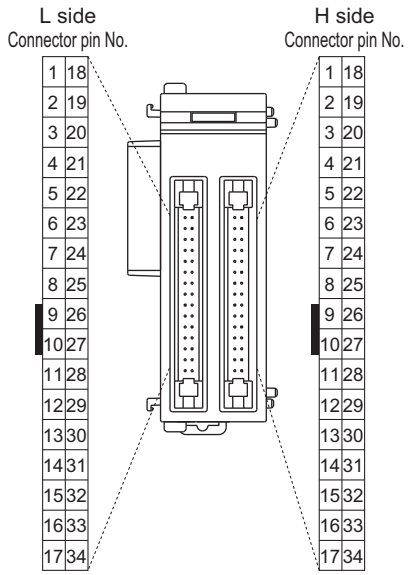
Pin No.	Signal name	Signal name	Pin No.
1	200	300	18
2	201	301	19
3	202	302	20
4	203	303	21
5	204	304	22
6	205	305	23
7	206	306	24
8	207	307	25
9	208	308	26
10	209	309	27
11	210	310	28
12	211	311	29
13	212	312	30
14	213	313	31
15	214	314	32
16	215	315	33
17	COM2	COM3	34

* COM circuit-shorted internally.

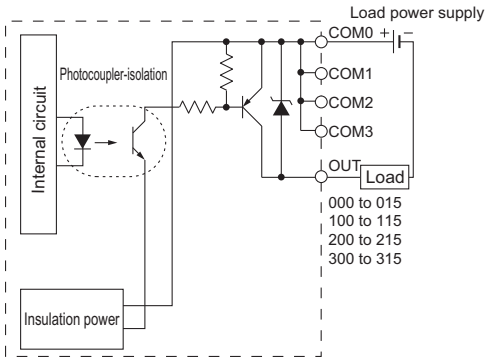
Note

Please use OP-42224 connector (34-pins) for 64-point unit.
Do not use OP-23139.

KV-C64TCP Wiring diagram



KV-C64TCP internal circuit diagram



Pin No.	Signal name	Signal name	Pin No.
1	000	100	18
2	001	101	19
3	002	102	20
4	003	103	21
5	004	104	22
6	005	105	23
7	006	106	24
8	007	107	25
9	008	108	26
10	009	109	27
11	010	110	28
12	011	111	29
13	012	112	30
14	013	113	31
15	014	114	32
16	015	115	33
17	COM0	COM1	34

DC DC

Pin No.	Signal name	Signal name	Pin No.
1	200	300	18
2	201	301	19
3	202	302	20
4	203	303	21
5	204	304	22
6	205	305	23
7	206	306	24
8	207	307	25
9	208	308	26
10	209	309	27
11	210	310	28
12	211	311	29
13	212	312	30
14	213	313	31
15	214	314	32
16	215	315	33
17	COM2	COM3	34

DC DC

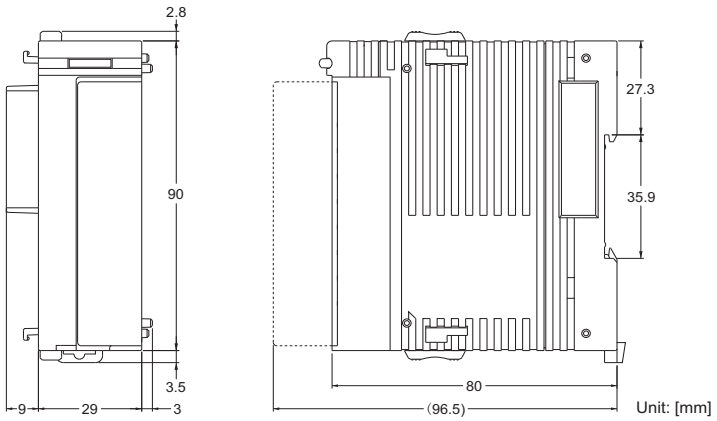
* COM circuit-shorted internally.

Note

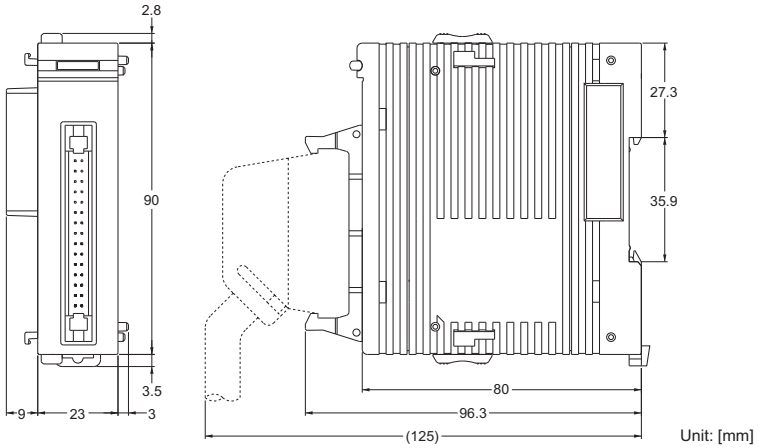
Please use OP-42224 connector (34-pin) for 64-point unit.
Do not use OP-23139.

Outline Dimensions

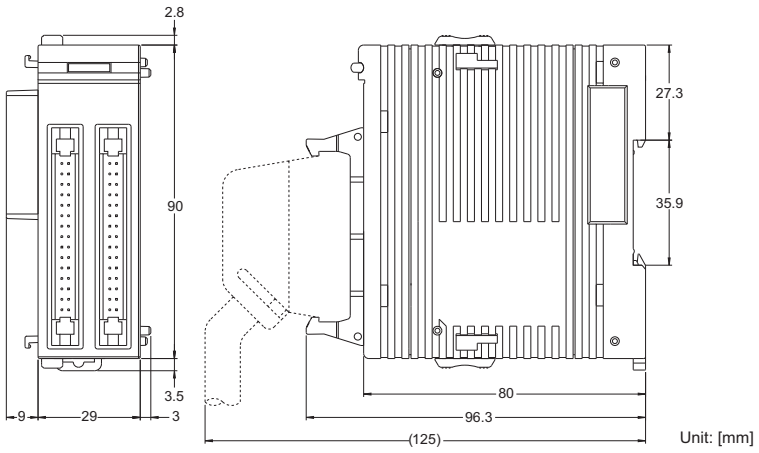
KV-B8RC/B16RC/B16TC/B16TD/B16TCP Wiring diagram



KV-C32TC/C32TD/C32TCP



KV-C64TC/C64TD/C64TCP



1-10 Extension I/O Unit KV-B8XTD/C16XTD/C32XTD

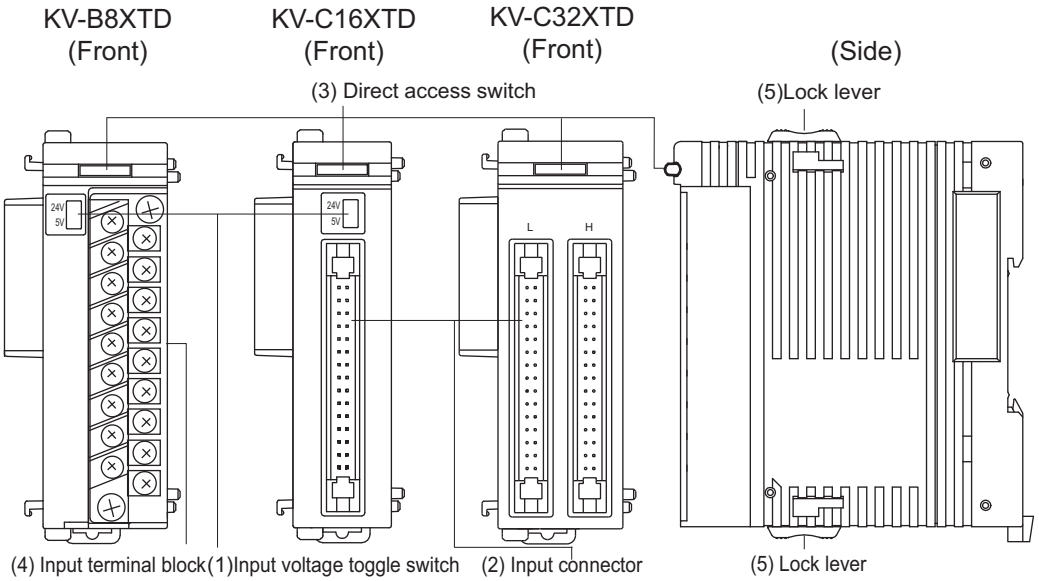
Introduces name, function as well as technical specifications of KV-B8XTD/C16XTD/C32XTD extension I/O unit parts.

Note

After connecting extension I/O unit on the CPU unit of V1.0 CPU functional version, some functions will be restricted.

"Restrictions when extension I/O unit (KV-B8XTD, KV-C16XTD, KV-C32XTD) is used", page 3

Name and function of the parts



No.	Name	Function
(1)	input voltage change-over switch	Switch input voltage. 5V <=> 24V
(2)	I/O connector	Connector for input/output.
(3)	direct access switch	After the switch is ON, state of the expansion unit may be monitored from CPU access window. Judge state of the expansion unit according to the switch color. Green lamp illuminates: normal operation Green lamp flashes: when green lamp illuminates, set the switch to ON, and select the unit Red lamp illuminates: when unit error occurs (excluding partial exception *1) Red lamp flashes: when red lamp illuminates, set the switch to ON, and select unit
(4)	I/O terminal block	Terminal block for input/output. Removable. (M3 screw)
(5)	Locking lever	Lock the unit connection.

*1 In the following cases, even if unit error does not occur, red lamp will also illuminates.
(1) when powered on, unit configuration of CPU unit only includes one CPU
Here, display error in the access window.

* 34-pin connector option is provided for KV-C16XTD/C32XTD connection.

Technical specifications

Type			KV-B8XTD (8 + 8 point)		KV-C16XTD(16 + 16 point)		KV-C32XTD(32 + 32 point)
External connection mode			Removable terminal block		Connector (MIL standard)*1		
Input	Number of input points		8 point		16 point		32 point
	Input mode		DC24V mode	DC5V mode	DC24V mode	DC5V mode	DC24V mode*4
	Maximum input voltage		DC26.4V				
	Rated input voltage		DC24V/5.3mA	DC5V/1mA	DC24V/5.3mA	DC5V/1mA	DC24V/4.1mA
	Minimum ON voltage		19V	3.5V	19V	3.5V	19V
	Maximum OFF current		1.5mA	-	1.5mA	-	1.5mA
	Maximum OFF voltage		-	1.5V	-	1.5V	-
	Common point mode		8 point/common point (1 terminal)*5		16 point/common point (1 terminals) *5		32 point/common point (2 terminals)*2
	Input time constant		Input time constant setting	OFF→ON TYP	OFF→ON MAX	ON→OFF TYP	ON→OFF MAX
			25μs	25μs	65μs	75μs	120μs
			300μs*3	275μs	365μs	275μs	420μs
			1ms	1ms	1.2ms	1ms	1.2ms
			10ms	10ms	12ms	10ms	12ms
	Input impedance		4.3kΩ				5.6kΩ
Output	Number of output point		8 point		16 point		32 point
	Output mode		MOSFET (N-ch) (with overcurrent protection function)				
	Rated load		DC30V 0.3A		DC30V 0.2A		
	Leakage current in case of OFF		Below 100μA				
	Remaining voltage in case of ON		Below 0.5V				
	Common point mode		8 point/common point (1 terminal)*5		16 point/common point (1 terminals) *5		32 point/common point (2 terminals) *2
	Response time	OFF→ON	Below 100μs				Below 150μs
		ON→OFF	Below 300μs				
Internal consumption current			Below 30mA		Below 40mA		Below 65mA
Weight			About 130g		About 110g		About 130g

*1 According to MIL-C-83503

*2 KV-C32XTD has 2 point input COM and output COM, which are universal inside. Input COM and output COM are independent.

*3 Setting may be made only when connected with KV-5500/5000/3000. Selection cannot be made when connected with slow KV-1000/700.

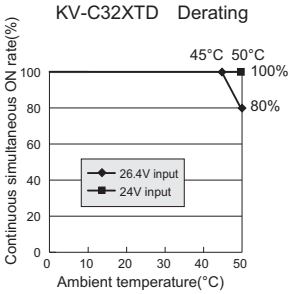
*4 All terminals support two-wire system (however, do not support two-wire system proximity sensor EV Series)

*5 Input COM and output COM are independent.

"KV-B8XTD internal circuit diagram", page 1-56 "KV-C16XTD internal circuit diagram", page 1-57
"KV-C32XTD internal circuit diagram", page 1-58

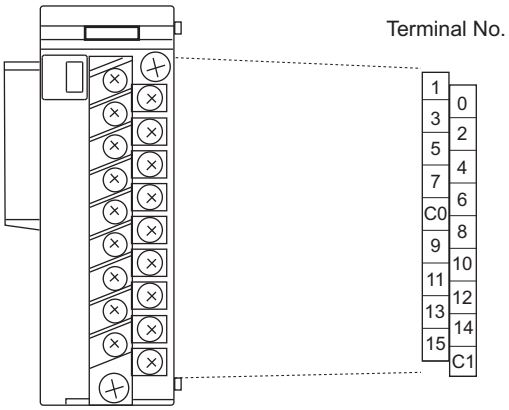
Note

- **When number of simultaneous ON input points exceeds the specification scope, unit fault might occur.**
- **The relationship of KV-C32XTD ambient temperature and continuous simultaneous ON rate is shown in the figure below.**



Wiring/internal circuit diagram

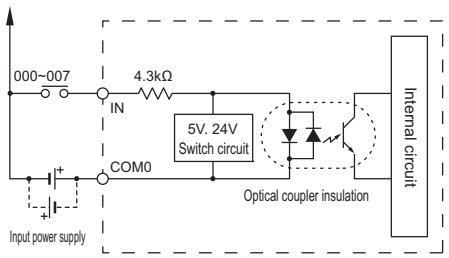
KV-B8XTD wiring diagram



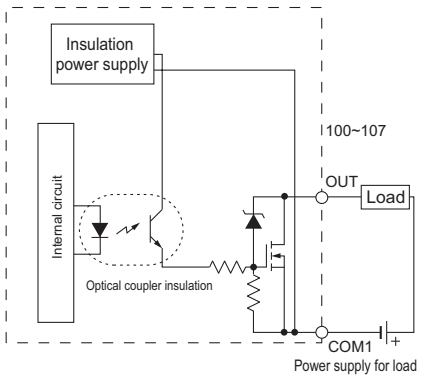
Terminal No.	Direction	Signal name	Signal name	Direction	Terminal No.
1	input	001	000	input	0
3	input	003	002	input	2
5	input	005	004	input	4
7	input	007	006	input	6
C0	input	COM0	100	output	8
9	output	101	102	output	10
11	output	103	104	output	12
13	output	105	106	output	14
15	output	107	COM1	output	C1

*COM is independent.

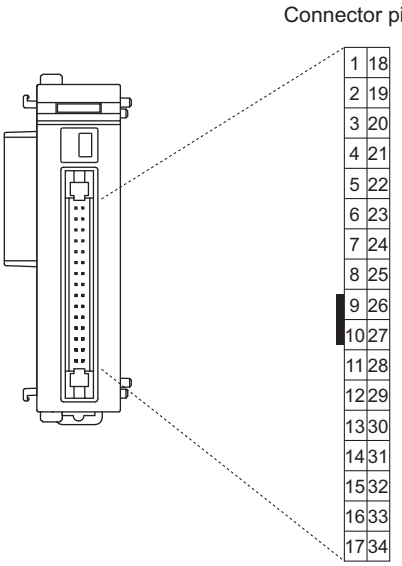
KV-B8XTD internal circuit diagram (input)



KV-B8XTD internal circuit diagram (output)



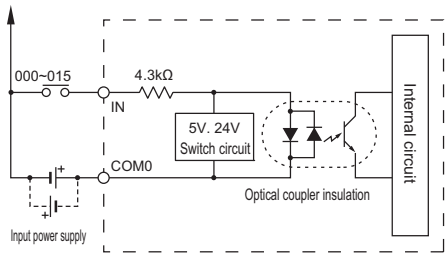
KV-C16XTD wiring diagram



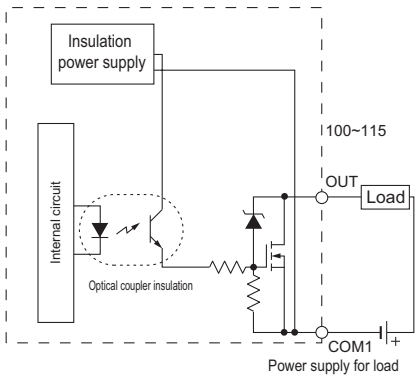
Pin No.	Direction	Signal name	Signal name	Direction	Pin No.
1	input	000	100	output	18
2	input	001	101	output	19
3	input	002	102	output	20
4	input	003	103	output	21
5	input	004	104	output	22
6	input	005	105	output	23
7	input	006	106	output	24
8	input	007	107	output	25
9	input	008	108	output	26
10	input	009	109	output	27
11	input	010	110	output	28
12	input	011	111	output	29
13	input	012	112	output	30
14	input	013	113	output	31
15	input	014	114	output	32
16	input	015	115	output	33
17	input	COM0	COM1	output	34

*COM is independent.

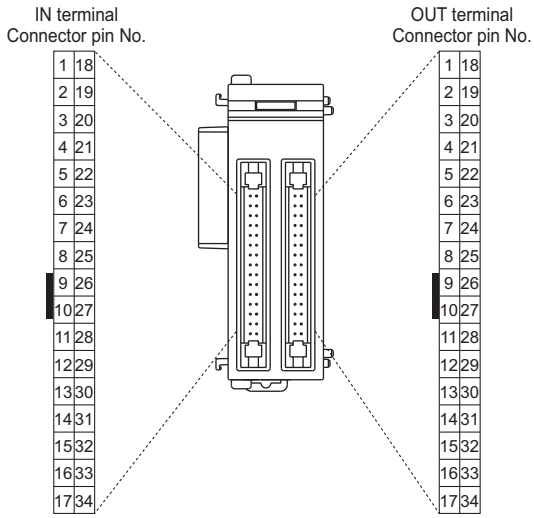
KV-C16XTD internal circuit diagram (Input)



KV-C16XTD internal circuit diagram (output)



KV-C32XTD wiring diagram

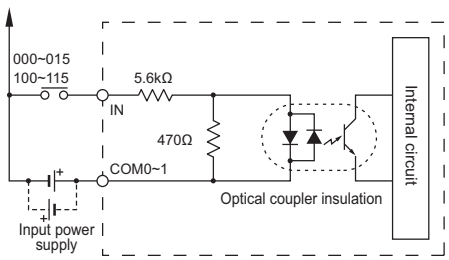


Pin No.	Direction	Signal name	Signal name	Direction	Pin No.
1	input	000	100	input	18
2	input	001	101	input	19
3	input	002	102	input	20
4	input	003	103	input	21
5	input	004	104	input	22
6	input	005	105	input	23
7	input	006	106	input	24
8	input	007	107	input	25
9	input	008	108	input	26
10	input	009	109	input	27
11	input	010	110	input	28
12	input	011	111	input	29
13	input	012	112	input	30
14	input	013	113	input	31
15	input	014	114	input	32
16	input	015	115	input	33
17	input	COM0	COM1	input	34

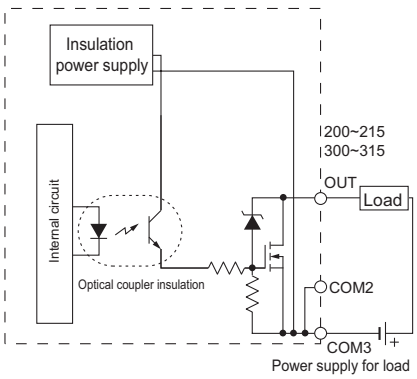
Pin No.	Direction	Signal name	Signal name	Direction	Pin No.
1	output	200	300	output	18
2	output	201	301	output	19
3	output	202	302	output	20
4	output	203	303	output	21
5	output	204	304	output	22
6	output	205	305	output	23
7	output	206	306	output	24
8	output	207	307	output	25
9	output	208	308	output	26
10	output	209	309	output	27
11	output	210	310	output	28
12	output	211	311	output	29
13	output	212	312	output	30
14	output	213	313	output	31
15	output	214	314	output	32
16	output	215	315	output	33
17	output	COM2	COM3	output	34

* Internal short circuit occurs on COM0, COM1.
Internal short circuit occurs on COM2, COM3.
Internal short circuit does not occur on (COM0,1) – (COM2,3).

KV-C32XTD internal circuit diagram (Input)



KV-C32XTD internal circuit diagram (output)

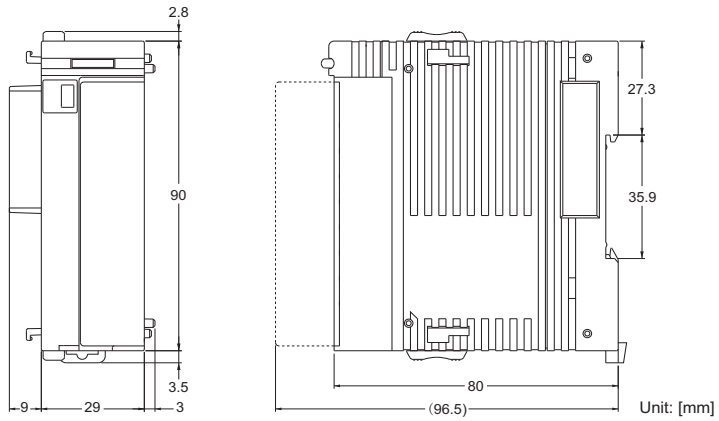


Note

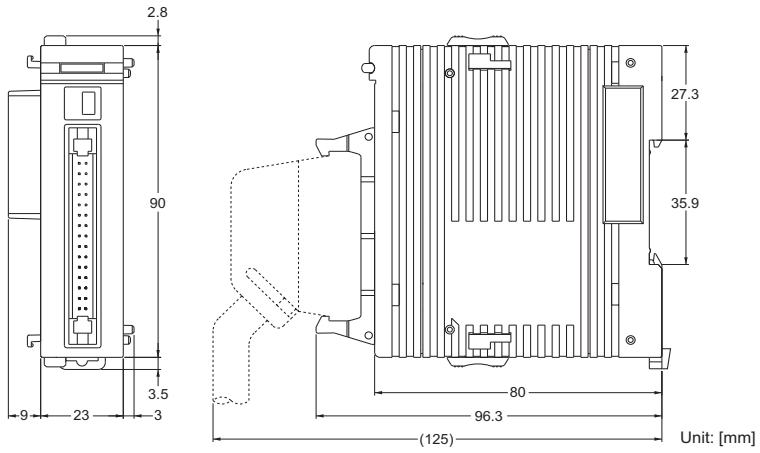
For 32 point I/O unit, please use OP-42224 connector (34 pin). OP-23139 cannot be used.

Overall dimension drawing

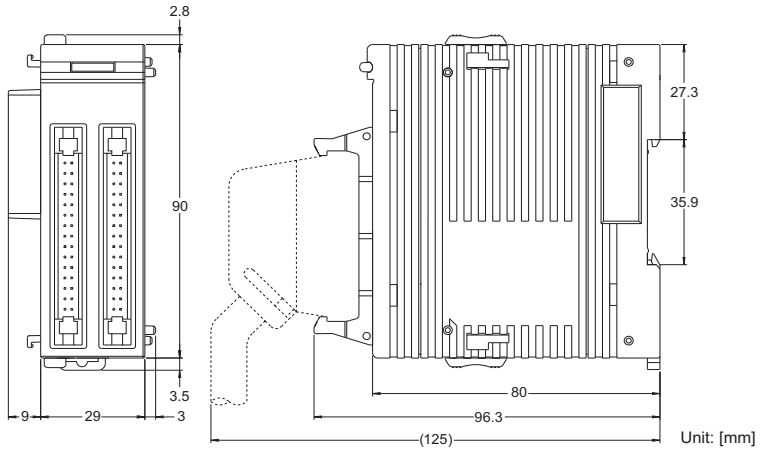
KV-B8XTD



KV-C16XTD



KV-C32XTD

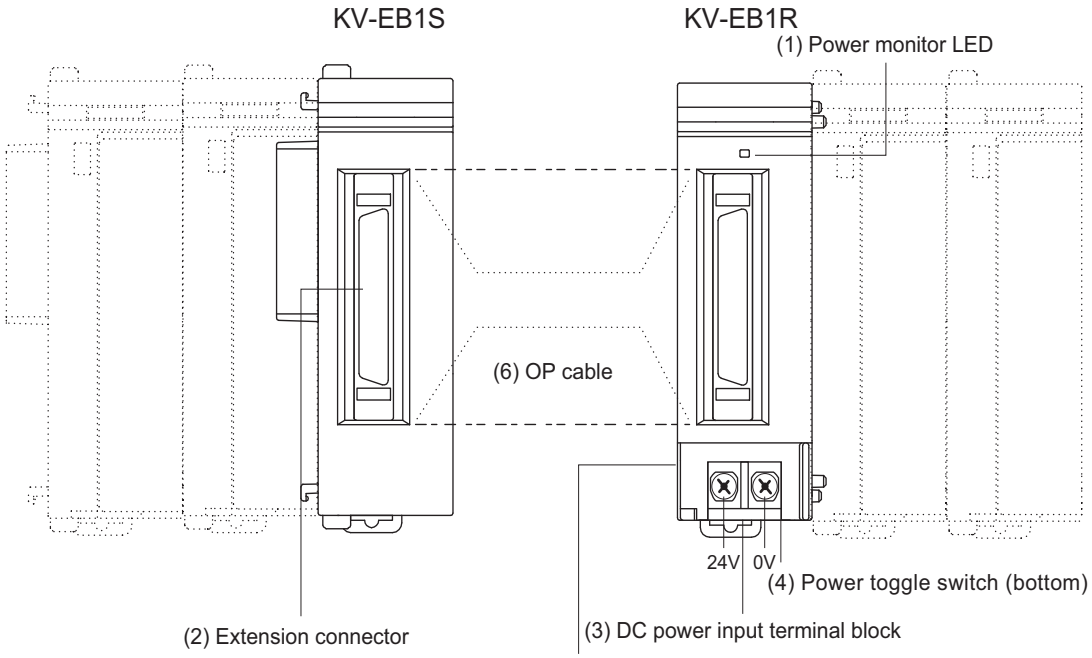


1-11 Expansion Unit

KV-EB1S/ KV-EB1R

This section describes name, function and technical specification of each part of KV-EB1S/KV-EB1R expansion unit.

Name and Function of Each Part



No.	Name	Function
(1)	Power monitor LED	Power monitor LED. *1
(2)	Extension connector	Extension cable connector.
(3)	DC power input terminal block	Terminal block for 24 VDC mains input. (Max. 3.5A)*2, *3
(4)	Power selector switch	Switch for toggle power to expansion unit. INT : when using power on KV- 1000 PLC side. EXT : when using EB1R or U7 DC power.
(5)	KV-U7 connector	Connector for KV-U7 power unit *3, *4
(6)	Extension cable	Connect KV-EBIS and KV-EBIR. (OP-42142 1m), (OP-42141 2m)

*1 The orange or red LED may light up, due to mains voltage drop. Please check power supply.

*2 Ensure power connection not reversed. Although reverse connection protective circuit is designed, protection function is not started under power connection in some cases.
Please note the current consumption of expansion unit, guarantee current supplied from terminal block below 3.5A.

*3 When power capacity on KV-5500/5000/3000 side is under certain limit, please supply power from this point to expansion unit side.

*4 When connecting KV-U7, please note current consumption of expansion unit.

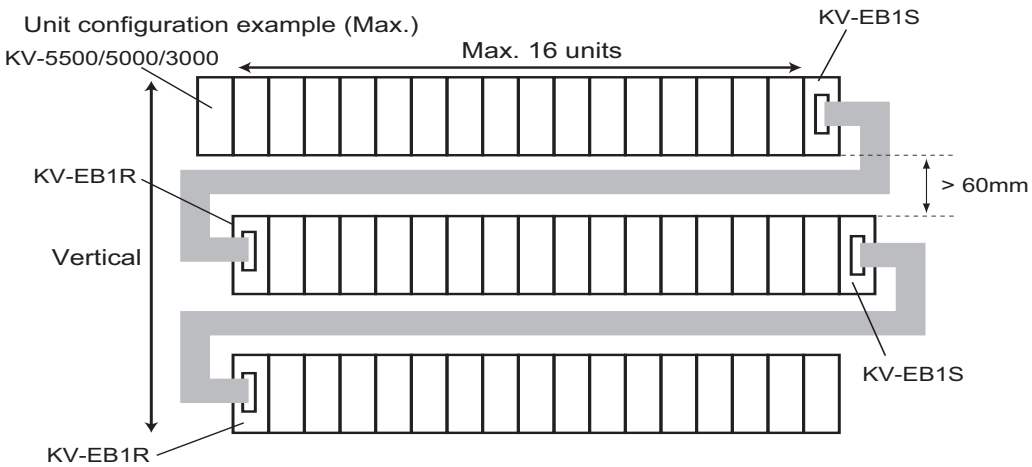
Note **When toggling power or switch, be sure to disconnect power.**

Specification

Model	KV-EB1S	KV-EB1R
Supply voltage	DC24V±10%	
Internal current consumption	< 15mA	< 25mA
Weight	approx. 90g	approx. 115g

About Connection / Setting

KV-EB1S is connected to the rightmost end of the section before extension.
KV-EB1S is connected to the leftmost end of the section before extension.



■ About connection cable and the number of sections

- When using 1m extension cable (OP-42142)
  The maximal number of vertical sections is 3s (connect maximal 48 units)
- When using 2m extension cable (OP-42141)
  The maximal number of vertical sections is 2s (connect maximal 32 units)

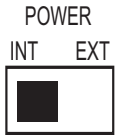
■ About setting

When using expansion unit, please consider of heat influence, the gap between the upper unit and the lower unit shall be 60mm above.
When temperature inside panel (temperature below the unit) exceeds environmental temperature used by the unit, please adopt the methods such as forced air cooling, enlarging surrounding gap or improving ventilation, etc. to reduce temperature.

About Power Supply Switching

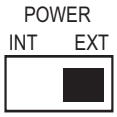
Power supply to expansion unit can be switched.

■ Use the power on previous section



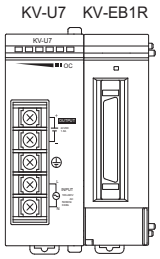
When using the power from the previous section supplied via OP cable, set power switch to "INT".
KV-U7 or other power need not to be used during operation. However, total current consumption should not exceed rating value of power.

■ Using external power



When using KV-U7 or other power, set supply power switch to "EXT".

● Using KV-U7



Connect KV-U7 to left side of KV-EB1R.

● Use separate power

Connect other power to DC power terminal block.

Note

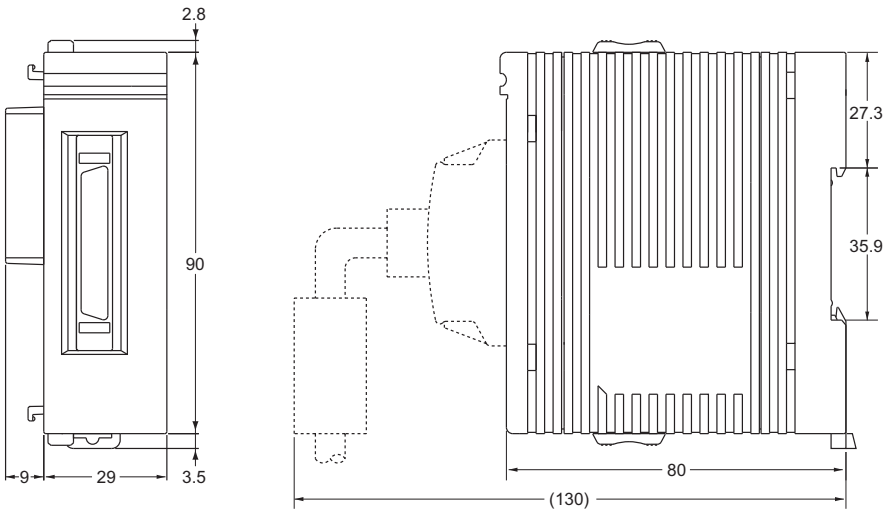
When supplying power separately from KV-EB1R, please note the following points.
· Turn ON power: please supply power from KV-EB1R side first.
· Turn OFF power: Please disconnect power from KV-5500/5000/3000 side first.
(when an error occurs and after the error is cleared in access window or KV STUDIO , it will operate when switching from PROG- >RUN.)

Note

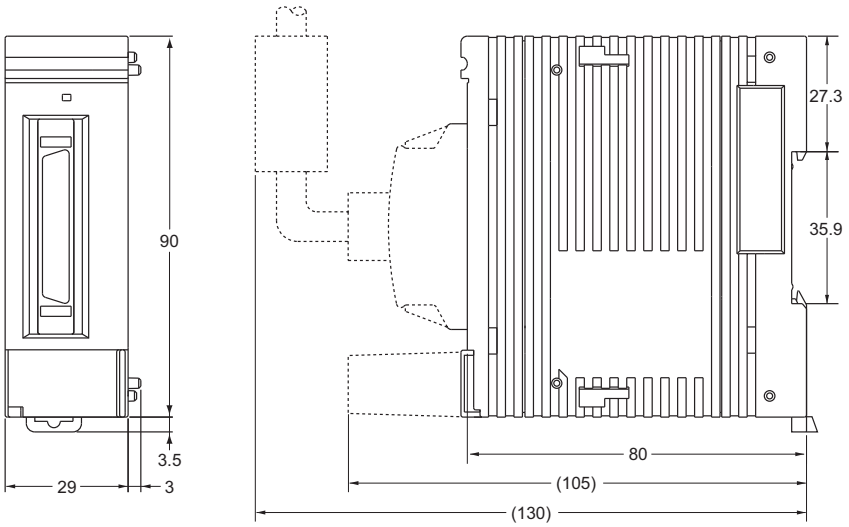
· When using KV-EB1 for 3 section addition, and using other powers for each equipment, please wrap 2 turns of ferrite core on power cable (Beichuan Industry: RFC-10). When using KV-U7, please adopt anti-noise measures such as FG grounding, etc.

Outline Dimensions

KV-EB1S



KV-EB1R



Unit: [mm]

1-12 Error Output Unit

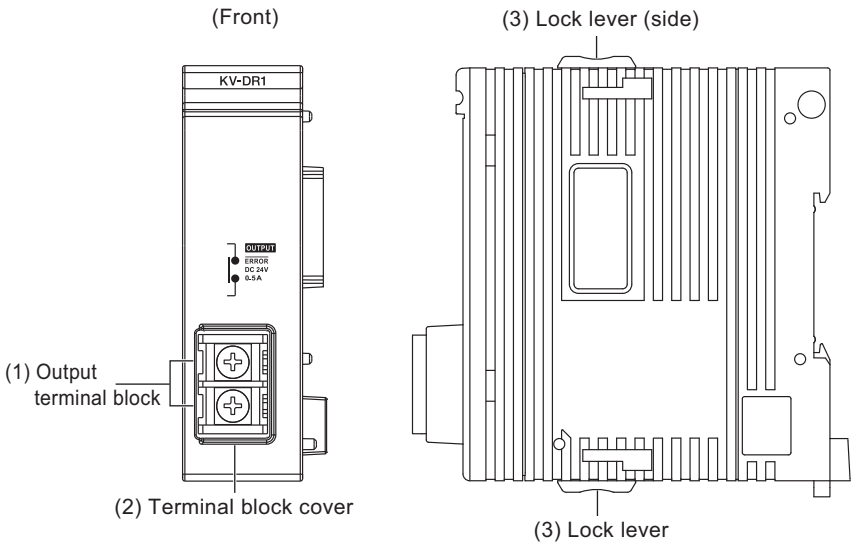
KV-DR1

This chapter describes name, function and technical specification of every part of KV-DR1 error output unit.

Note

When error output unit is used, Bluetooth unit cannot be connected.

Name and Function of Each Part



No.	Name	Item
(1)	Output terminal block	Error output terminal block. (M4 screw)
(2)	Terminal block cover	Cover
(3)	Lock lever	Locks the connection of the unit.

Specification

Item		Specification
Output mode		Relay
Rated load		DC 24 V, 0.5A
ON resistance		< 50m
Response time	OFF -> ON	< 10ms
	ON -> OFF	5ms or less
Internal current consumption		Below DC5V 30mA (supplied by CPU unit)
Weight		approx. 90g
Relay life		Electrical: more than 100 thousand cycles (20 cycles/min) Mechanical type: more than 20 million cycles
Replace relay		Impossible

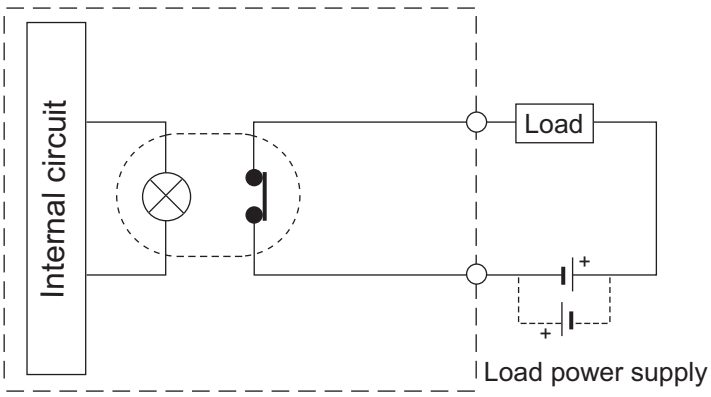
About Error Output

During normal condition, KV-DR1 output is ON.

Output is OFF only when power is not connected or a serious error (such as CPU unit stops) occurs.

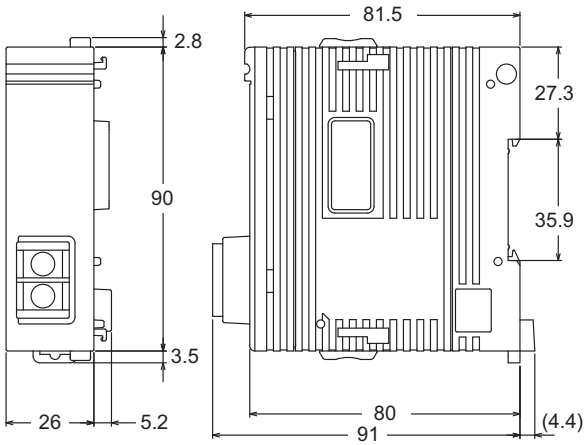
Tip · Output is also ON in case of no error even in PROG mode.
· If error occurs during power on, output is not ON.

Wiring and Internal Circuit Diagram



Outline Dimensions

Unit: [mm]



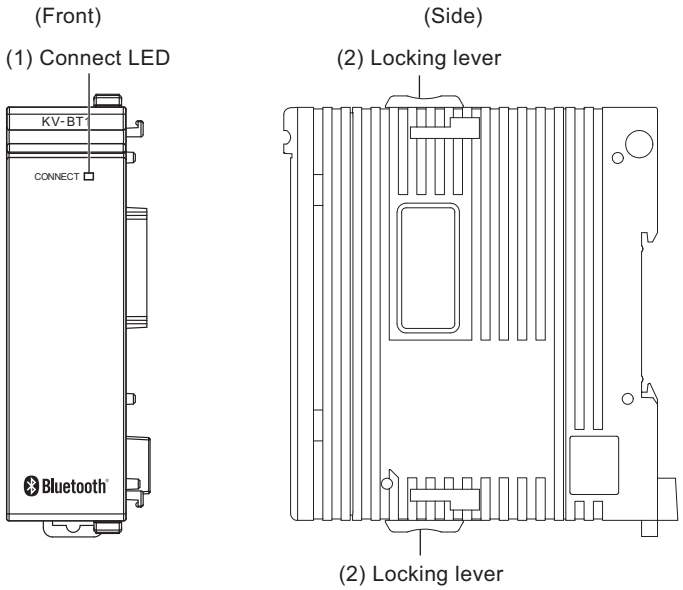
1-13 Bluetooth Unit KV-BT1

Introduces name, function and technical specifications of KV-BT1 Bluetooth unit parts.

Note

- **Bluetooth unit may be connected to CPU unit with CPU functional version above V2.0. KV-5000 supports CPU functional version above V1.1.**
- **When Bluetooth unit is used, error output unit cannot be connected.**

Name and Function of the Parts



No.	Name	Function
(1)	Connect LED	Connect (green) display communication state with PC. The lamp illuminates: Bluetooth communication is established. The lamp goes out: Bluetooth communication is not established.
(2)	Locking lever	Lock the unit connection.

Technical Specifications

Item	Technical specifications
Bluetooth version	Bluetooth Ver2.0+EDR
Frequency range	2402 MHz to 2480 MHz
Output class	Class 2 compatible
Transmission method	FH-SS (Frequency Hopping Spread Spectrum)
Profile used	SPP
Communication distance	10m *Differs depending on the environment.
Product defination by radio laws in each country*1	Japan*2
	USA*3
	Canada*4
	EU member states (R&TTE Directive)
	China (SRRC certification)
	Taiwan (NCC certification)
	Singapore (iDA certification)
	Thailand (NTC regulation)
Compatible CPU unit	KV-5500/KV-3000 of CPU function Ver.2.0 and later versions, KV-5000 of CPU function Ver.1.1 and later versions
Power supply voltage	DC5V 55mA (supplied from the CPU unit)
Weight	Approx. 80g

*1 Use the KV-BT1 only in countries where the unit is compliant with the radio laws. If it is used in other countries, the user may be punished by those countries' radio laws.

*2 The KV-BT1 contains the design-certified built-in wireless module.

*3 KV-BT1 incorporates a RF device granted by FCC. (FCC ID: RYYEYXFDC)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part15°C of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined byturning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

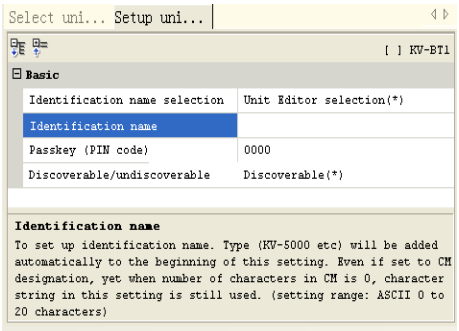
You are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void your authority to operate the equipment.

*4 KV-BT1 incorporates a RF device granted by IC. (IC ID: 4389A-EYXFDC)

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference , including interference that may cause undesired operation of the device.

Setting Items List

Set KV-BT1 on Unit Editor.



Setting items on Unit Editor are as follows.

Item	Set value
Identification name selection	Unit Editor selection Default value CM selection
Identification name	Arbitrary value Default value: (blank)
Passkey (PIN code)	Arbitrary value Default value: 0000
Discoverable/ undiscoverable	Discoverable Default value Undiscoverable

Tip If KV-BT1 is added, the setting of Unit Editor is not changed, error will occur on CPU unit and KV-BT1, they run with various set default values.

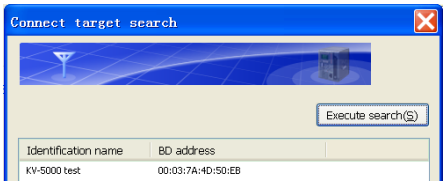
■ Identification name selection

To search the KV-BT1 connected with CPU unit, select the setting method of identification name.
When set to CM selection, set identification name in CM1764-CM1774 via ladder diagram program.
The set value will be updated only after reconnected the power supply, or switched from PROGRAM mode to RUN mode.

■ Identification name

The name displayed when search the KV-BT1 connected with CPU unit from ladder diagram support software KV STUDIO. Set when "Unit Editor Selection" is selected in identification name selection.
ASCII character string in 20 characters may be set.
Add unit type on identification name automatically.

Example: when connected with KV-5000, if identification name is set to test, "KV-5000 test" is displayed in searching.



■ Passkey (PIN code)

Certification code required for software KV STUDIO connection is supported via the ladder diagram installed on PC. More than one character may be selected, half-width letters and numbers in 16 characters.
Default value is "0000", it is advisable to modify the default value before use.

■ Discoverable/undiscoverable

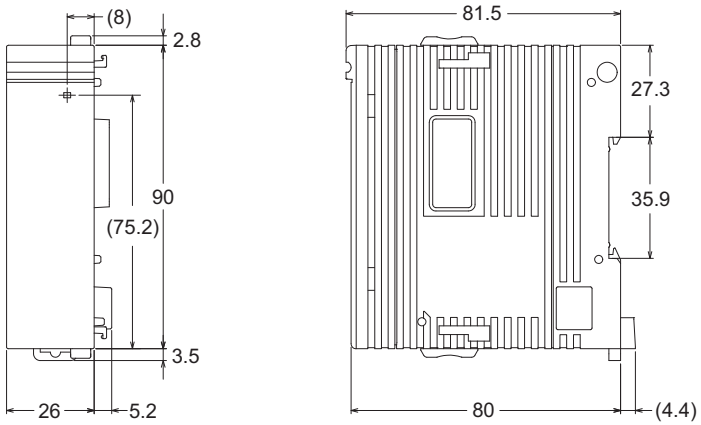
When search from ladder diagram support software KV STUDIO or connection tool, set whether Discoverable. When set to "Undiscoverable", search cannot be executed, identification name and BD address must be selected directly, then reconnection may be made.

Note

When KV-BT1 is replaced, always search from PC again. KV-BT1 could not be connected before re-search.
Even if set to Undiscoverable, BD address and identification name may also be viewed from access window of CPU unit, then connect with KV-BT1.

Overall Dimension Drawing

Unit: mm



1-14 Maintenance

This section describes unit repair and maintenance procedure as well as how to replace battery and relays.

About Inspection and Maintenance

■ Service

When KV-5500/5000/3000 Series units are used for a long time, the connecting part of the connectors becomes loose or the battery is worn down. Continued use of KV-5500/5000/3000 Series units in this state may cause KV-5500/5000/3000 trouble.

So, periodical check shall be conducted for each unit body, wiring part, etc. of KV-5500/5000/3000 or KV-5500/5000/3000 Series.

The main service items are as follows:

- Whether the lock at each unit's connection part is dropped or loose?
- Whether the connector's connection part is mismatched or loose?
- Whether the terminal screw of terminal block is loose?
- Battery low?
- Whether the wiring cable between unit and equipment is damaged?

■ Daily care

Dust will be adhered on CPU unit and every unit after long term use.

Clean off any dirt from the KV-LE20A using a clean, dry cloth.

Dust and dirt on fine components can be removed with a cotton bud after removing the connector.

Replace Battery

■ When battery power is low

When "CPU Error No83" is displayed in check window, please immediately replace the internal lithium battery.

When battery error occurs, CR2306 will be turned on (ON).

After battery error occurs, the data can be maintained for minimal 1 week (normal temperature).

Error checking will be performed every 4096s after power is turned ON or power is used up.

■ When battery power is used up

When battery power is used up, SRAM backup error will occur, the data on memory card (DM/EM), control memory card (CM) will disappear, but Ladder program will not disappear. For disappearing of DM, EM , CM message, etc. will not influence Ladder program operation. Implementing SRAM clear in access window can temporarily start the program.

The following battery shall be purchased.

Replaceable lithium battery model: OP-51604

■ Battery-less working

KV-5500/5000/3000 may also run without battery.

"**Battery-less working", page 2-233**

Note

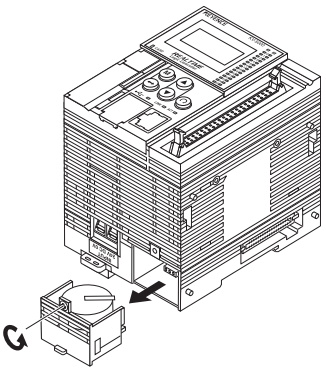
- Battery life is 5 years at +25°C. The life will be shortened when used at higher temperature.
- Battery shall be replaced within 2 years when used under hot environment(ambient temperature: more than +40°C).
- Battery shall be replaced within 1 year during power off storage under hot environment (ambient temperature: +50°C).
- Before changing battery, if power is not connected for more than 10 minutes, the data will disappear. Battery replacement shall be completed within 10 minutes.
- Never throw KV-5500/5000/3000 battery into fire, or disassemble the battery. Besides, the battery is an rechargeable battery, do not change it. Otherwise, the battery may explode.
- Using other batteries other than OP-51604 may lead to fire or explosion, so be sure to use specified battery.

■ Steps for replacing battery

1 **The power shall be turned on for more than 10 minutes and off before replacement.**

2 **Remove screws for backup battery, and remove the old battery.**

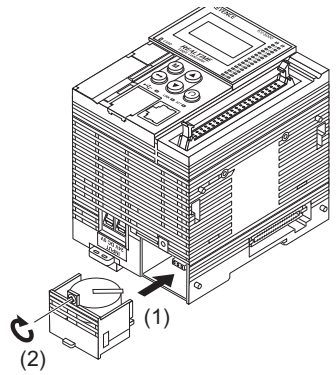
- Replacement shall be completed within 10 minutes.



3 **Insert a new battery.**

4 **Fix with screws (tightening torque 0.2N·m (2kgf·cm)).**

5 **Turn on power, verify whether error is displayed in check window.**



MEMO

2

CPU INTERNAL FUNCTIONS

This chapter describes various functions that can be realized by access window, memory card slot, communication ports, I/Os, high speed counters etc. of the CPU unit KV-5500/5000/3000.

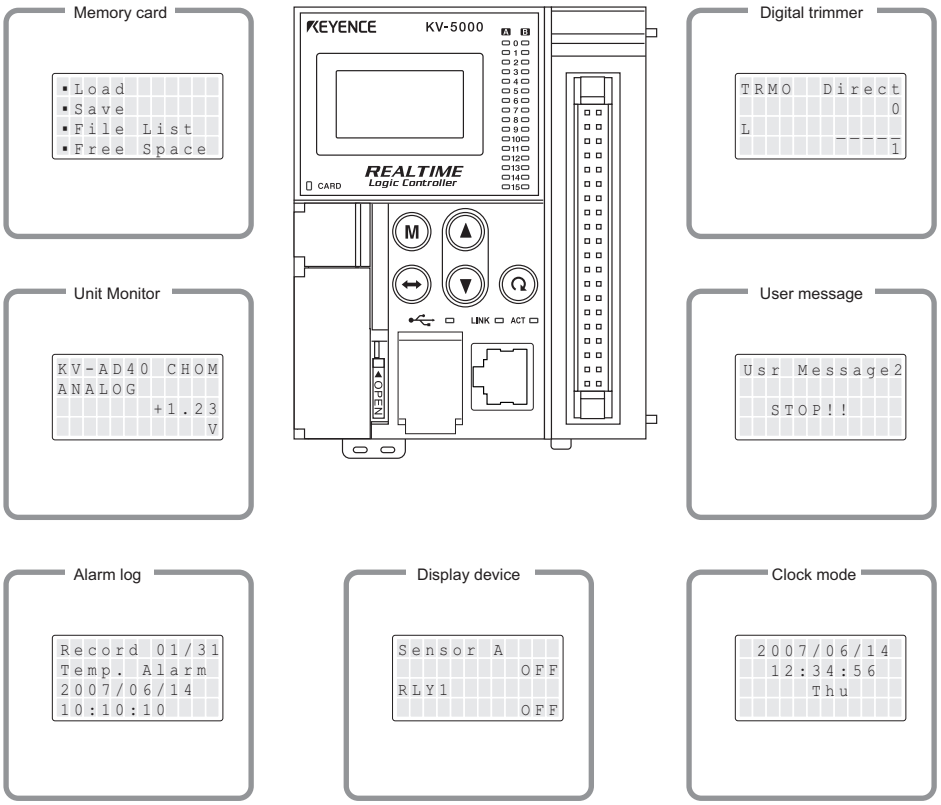
2-1 Access Window ••••••

2-1 Access Window

This section describes the Access Window used to monitor data of the CPU unit or perform change operations.

Operations that Can be Implemented Through Access Window.

The KV-5500/5000/3000 is provided with a compact LCD display with 2-color backlight.
The LCD is displayed green in the Run mode and red in the PROGRAM mode.



■ Function list

The KV-5500/5000/3000 unit is equipped with an Access Window for easily changing and monitoring data. The Access Window also allows the user to check error codes that may occur.
The Access Window has the following functions.

Unit Monitor

In this mode, state of the unit can be monitored on the Access Window by pressing the direct access switch connected to the CPU.

"Unit Monitor", Page 2-6

Device mode

In this mode, internal devices can be displayed and their settings changed.

"Device Mode", Page 2-9

Error clear

Clear serious errors of the CPU unit.

"Error Clear", Page 2-15

Digital trimmer

In this mode, trimmers can be set digitally. The maximum resolution is 4294967296.

"Digital Trimmer", Page 2-17

I/O Test

Can confirm I/O status of expansion I/O unit.

"I/O Test", Page 2-18

Display and setting of time

In this mode, internal clock can be displayed and time can be set.

"Date/Time", Page 2-21

CPU monitor

In this mode, the state of CPU positioning and frequency counter functions can be monitored. Also, name of the program project contained on the unit can be checked.

"CPU Monitor", Page 2-23

Monitoring alarm

In this mode, the alarms can be monitored and alarm log can be checked.

"Alarm", Page 2-26

Memory card operation

In this mode, operations such as storing/loading files to and from the Memory Card, and displaying list of files can be performed.

"Memory Card", Page 2-29

Commission

Can release forced set/reset register, input update inhibited/output inhibited from the Access Window.

"Commission", Page 2-33

Access Window setup

In this mode, you can set the contrast of the Access Window, display language, and other related settings.

"Access Window Setup", Page 2-35

SRAM clear mode

In this mode, device values can be cleared.

"SRAM Clear Mode", Page 2-37

All Clear mode

In this mode, all settings can be cleared.

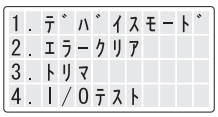
"All Clear Mode", Page 2-38

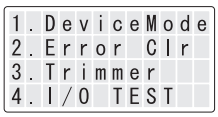
■ Menu Structure

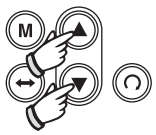
Switching among modes is implemented by menu.

Pressing the "M" key displays a menu. (When other units are selected, press the direct access key for the unit, or press 'M' key twice.)

If not all of the menu items fit in the screen, press the "▼" key to display the rest of the menu. Press the "▲" and "▼" keys to scroll the menu up and down.







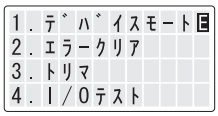
In the examples shown, Japanese characters are shown on the left and English letters on the right. Switching between Japanese/ English is implemented through “AW Setting".

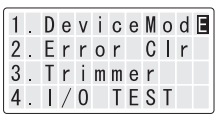
"Access Window Setup", Page 2-35

The following table shows the CPU menu items.

Japanese	English	Japanese	English
1.デバイスモード	1. DeviceMode	7.アラーム	7. Alarm
2.エラークリア	2. Error Clr	8.メモリカード	8. MemoryCard
3.トリマ	3. Trimmer	9.デバッグ	9. Debug
4.I/Oテスト	4. I/O TEST	10.AWセッテイ	10. AWSetting
5.トケイ	5. Date	11.SRAMクリア	11. SRAM Clr
6.CPUモニタ	6. CPU Mon	12.オールクリア	12. All Clr

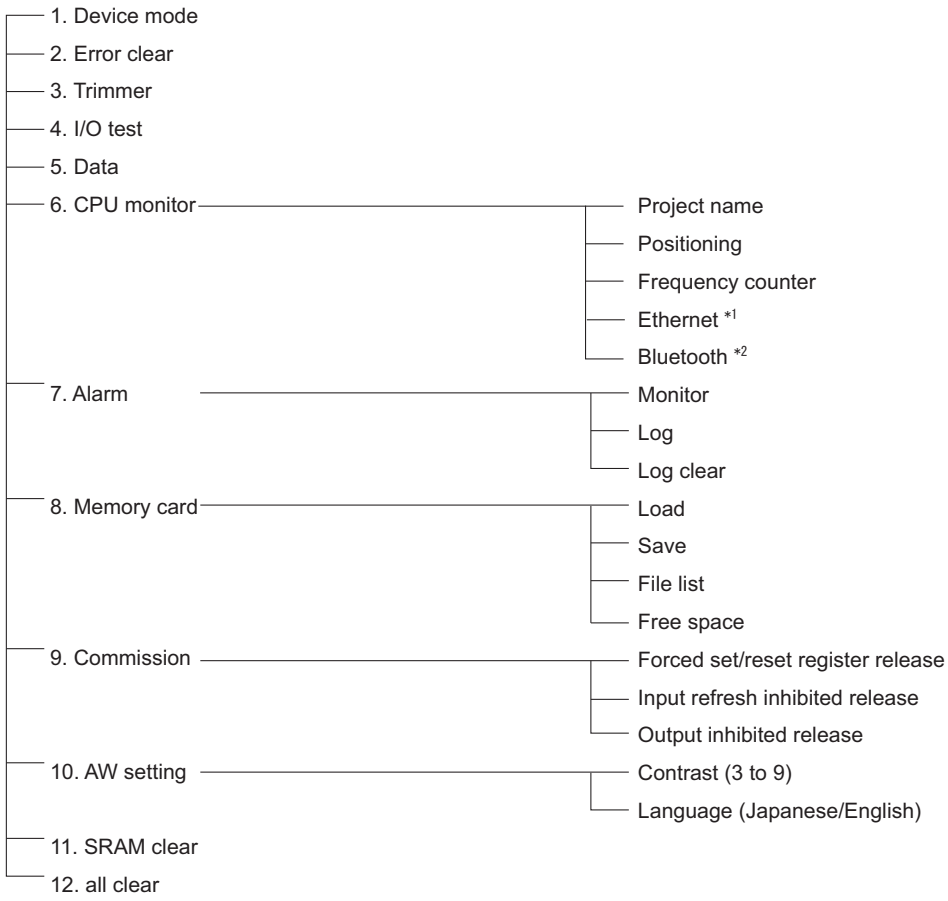
TIP When serious error occurs and its log hasn't been cleared, 'E' will be displayed on the upper right of Access Window.





For the Method of use, see "Error Clear", Page 2-15.

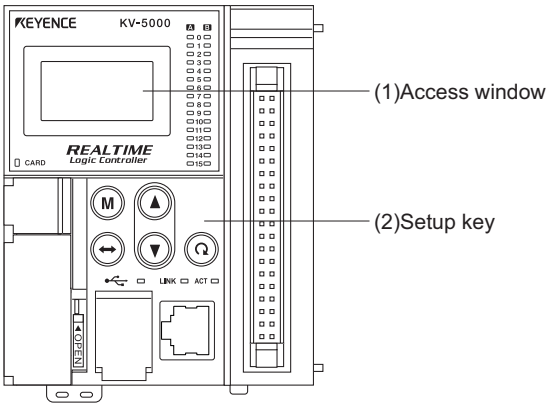
The Access Window menu is configured as follows:



*1 Only KV-5500/5000

*2 Only limited to KV-5000 Ver.1.1 and CPU unit with CPU functional version above V2.0

■ Names and Functions of Parts



(1) Access Window — Displays the current values and setting values of each device, and error messages.
Information of each unit is displayed by pressing the direct access switch for the respective unit.

(2) Setup key — Used for switching between modes and changing settings in each mode. Key functions differ according to each mode. For details, see the operation instructions for each mode.

Unit Monitor

Units can be monitored and set in the Access Window by pressing the direct access switch for special units or expansion units such as the I/O unit connected to the CPU.
To return to the original screen from the expansion unit or special unit screen, press the direct access switch of the unit currently displayed on the Access Window.

TIP When unit error occurs, the direct access switch will turn red, and the error contents will be displayed in the Access Window.

For details on monitor items and settings for each unit, refer to the User's Manual for the respective unit.

■ Functions of setup key

The following table summarizes key functions when monitoring or setting up units.

Setup Key	General Function	When Changing Numerical Values
M	Menu display	Menu display
⇔	Not used.	Changes the digit of value to be incremented/decremented.
▲	Switches pages, or changes options when changing settings.	Increments the current set value.
▼	Switches pages, or changes options when changing settings.	Decrements the current setting.
↺	Changes are applied to settings when holding down this key for at least 1s.	Changes are applied to settings when holding down this key for at least 1s.

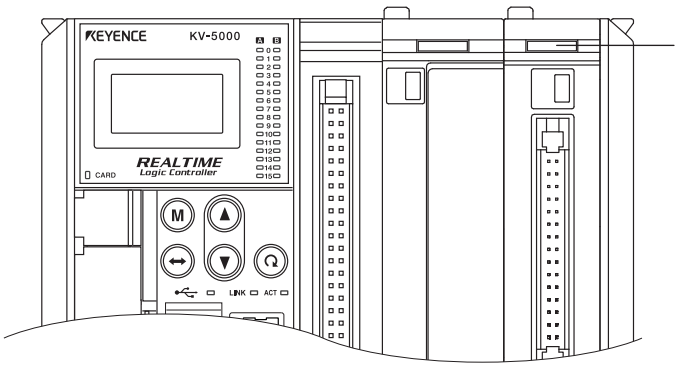
■ Method of Operation (example: on I/O Unit)

We will take KV-C32XC for example to describe the operation methods.

● Switch to Unit Monitor

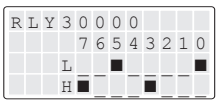
1 **Press the direct access switch on the unit.**

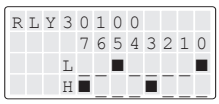
The direct access switch for the selected unit flashes.

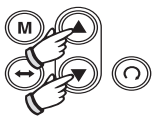


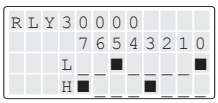
2 **The relay No. and relay ON/OFF state assigned to the unit is displayed.**

The LED indication changes as follows according to the currently selected unit.









Display leading No. of relay occupied by KV-C32XC in access window (R30000)



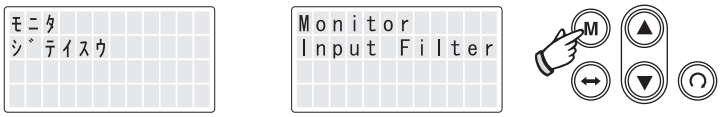
LED display: 16-point X 2 column
Left column (A): leading No. +0 to +15
Right column (B): leading No. +100 to +115
R30000 is at the top left and R30115 at the bottom right.

Press "▲" and "▼" to switch the pages.

● Menu display

1 Press the "M" key with the direct access switch for the unit flashing (selected).

The menu for the unit is displayed.

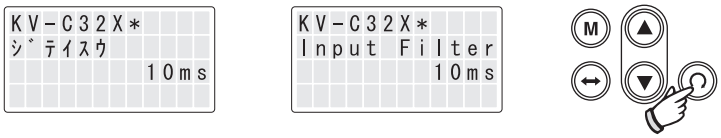


● Changing Settings

Let's take altering the input time constant as an example.

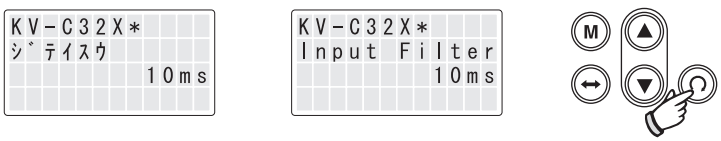
1 Press the key to select "Time constant", then press "↻" key.

The currently set time constant can be checked.



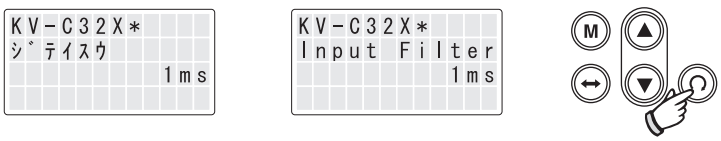
2 Hold down the "↻" key for at least one second in this state.

The setting value flashes, and the unit enters the change mode. (Change operation is not possible in the Run mode. Values can be changed only in PROG mode.)



3 Change the setting value using the up/down keys, and hold down the "↻" key for at least one second.

The setting value stops flashing and is set. (Holding down the key for less than one second cancels the newly set value.)



Device Mode

In this mode, PLC device values can be monitored and changed.

■ Displaying devices and changing their settings

The following table summarizes devices that can be displayed and set.

Display	Name	Display	Name
R	Relay	W	Link register
MR	Internal auxiliary relay	CM	Control memory
LR	Latch relay	TM	Temporary data memory
B	Link relay	T	Timer
CR	Control relay	C	Counter
DM	Data memory	CTH	High-speed counter
EM	Extended data memory	CTC	High-speed counter comparator
FM	File register (memory bank switching mode)	TRM	Digital trimmer
ZF	File Register (consecutive number mode)	Z	Index register

Note The contact states of timers, counters, and high-speed counter comparators cannot be monitored.

● About XYM marking

XYM marking can be performed on relay (R), internal auxiliary relay (MR), latch relay (LR), data memory (DM), expansion data memory (EM) and file register (FM).
Default marking/XYM marking can be automatically switched by the setting of items (KV STUDIO's Tool > Options > Display mode setting > XYM marking).

Device name	Default marking	XYM marking		Device No. @XYM marking
Relay	R	Input	X	0000 to 999F
		Output	Y	0000 to 999F
		Internal auxiliary	R	0000 to 99915
Internal auxiliary relay	MR	M		00000 to 15999
Latch relay	LR	L		00000 to 15999
Data memory	DM	D		00000 to 65534
Extended data memory	EM	E		00000 to 65534
File register	FM	F		00000 to 32767

■ Functions of Setup key

The following table summarizes key operations in the device mode:

Setup Key	General Function	When Changing Numerical Values
M	Menu display	Menu display
↺	Switch to the setting value change mode. Press and hold for more than 1s.	Registers/cancels new values. Hold down for at least one second to register(apply). Registration is canceled if held down for less than one second.
▲/▼	Selection of device No.	Increments/decrements value to be changed.
⬌	Selection of device Selection of display attribute Selection of device name representation method.	Selects the digit of the value to be changed.

■ Operation method

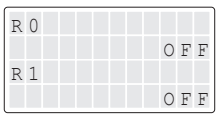
● Switch to the Device mode

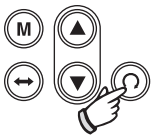
1 **Press the "M" key.**

A menu is displayed.(If other units are selected, press the "M" key twice.)

2 **Select "JOG", and press the "↻" key.**

The monitor screen is displayed in the device mode.

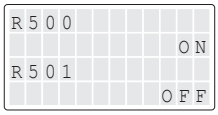


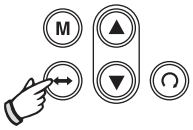


The trimmer No. to be displayed can be changed by the "▲" "▼" keys.

● Changing type of device to be monitored

1 **Press the "⇔" key in device mode**

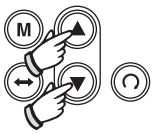




2 **A list of device types is displayed.**

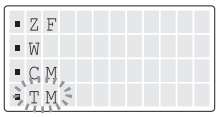
Select the device to display using the "▲" and "▼" keys.
In this example, select device "TM".





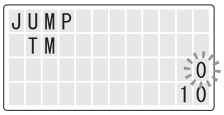
The device types are displayed in the following order: R->MR->LR->B->CR->DM->EM->FM->ZF->W->CM->TM->T->C->CTH/CTC->TRM->Z. When the "▼" key is pressed with Z selected, "R" will be selected again. Likewise, when the "▲" key is pressed with "R" selected, "Z" will be selected .

3 **"·TM" is displayed flashing.**



Press the "↻" key.





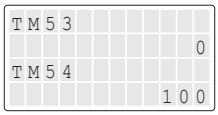
The screen for determining the desired device No. is displayed.
The current device No. is displayed on the 3rd line.

The numerical value displayed on the 4th line is the device No. change increment.

Change the device No. using the "▲" and "▼" keys.

As shown in this diagram, device No. will increase by an increment of 10 after pressing "▲" key.
The device No. change increment will become 1/10 by pressing the "⇔ " key.

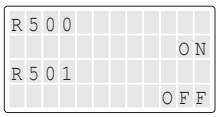
Determine the device No. to display using the "▲", "▼" and "⇔" keys.

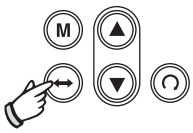


Press the "↻" key. This displays the TM of the specified No.

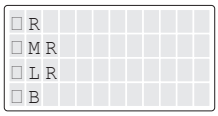
■ Changing the device value display format

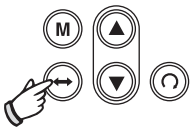
1 Press the "⇔" key in device mode



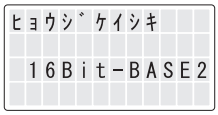


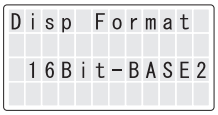
2 Press the "⇔" key with the list of device types displayed.





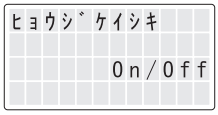
3 This displays the display format selection screen.

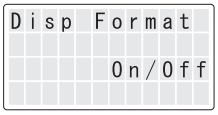


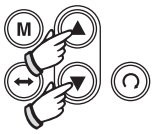


4 Select the display format.

Select the display format using the "▲" and "▲" keys.

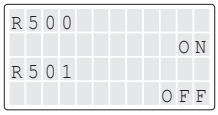


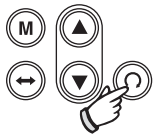




5 Press the "↻" key. This displays the monitor value in the selected display format.

The display format selected here is applied to all devices.





The following table summarizes display formats that can be selected.

Format	Display contents
Default	According to Device Types (Refer to appendix)
ON/OFF	ON/OFF display
16Bit-BASE10 unsigned	Data width 16-bit unsigned, DEC display
16Bit-BASE10 signed	Data width 16-bit signed, DEC display
16Bit-BASE16	Data width 16-bit, HEX display
16Bit-BASE16	Data width 16-bit, HEX display
32Bit-BASE10 unsigned	Data width 32-bit unsigned, DEC display
S32Bit-BASE10 signed	Data width 32-bit signed, DEC display
32Bit-BASE16	Data width 32-bit, HEX display

Formats of devices that can be displayed:

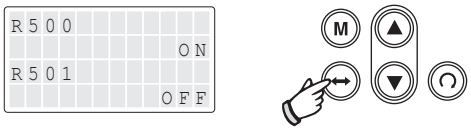
◎: Can be displayed (Default); ○: Can be displayed; ×: Cannot be displayed

Device type	OFF-> ON:	16Bit-BASE10 unsigned	16Bit-BASE10 signed	16Bit-BASE16	16Bit-BASE16	32Bit-BASE10 unsigned	32Bit-BASE10 signed	32Bit-BASE16
R/MR/LR/B/CR	◎	○	○	○	○	×	×	×
DM/EM/FM/ZF/W/CM/ TM	×	◎	○	○	○	○	○	○
T/C/CTH/CTC/TRM	×	×	×	×	×	◎	○	○
Z	×	×	×	×	×	×	◎	○

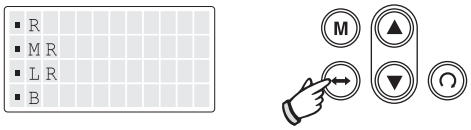
The display format that can be selected varies according to the device type. When a display format that cannot be applied is selected, the default display format is selected.

● Device name/comment display switching

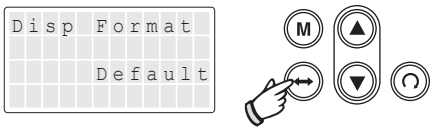
1 Press the "⇔" key in device mode.



2 Press the "⇔" key with the list of device types displayed.

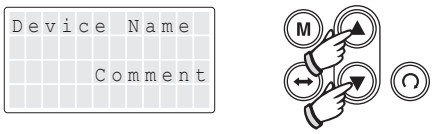


3 Press the "⇔" key in the display format selection screen.



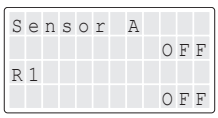
4 The screen for selecting device name/comment display is displayed.

Select whether to display the device name or comment using the "▲" and "▼" keys.
Pressing the "▼" key displays the comment.



5 Press the "↩" key. This selects comment display, and the display returns to the device mode.

The following screen shows that comment "Sensor A is registered to R0, and not registered to R1.



About comments that can be displayed in the Access Window

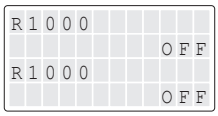
- Up to 12 half-width alphanumeric characters can be displayed. Comments above 13th characters cannot be displayed.
- Available display characters are ASCII codes 20 to 7e (HEX) and a1 to df (HEX). If characters other than these are used, the device name is displayed.
- CTH comments cannot be displayed. CTC comments are displayed.
- Comments can not be set up for Z.

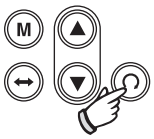
● Changing device values

- When display format is ON/OFF

1 **Hold down the "↺" key for at least one second with the device to change displayed.**

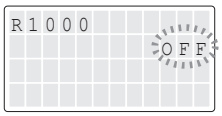
If two devices are currently displayed in one screen, the device whose value can be changed is the device displayed on the previous row of the screen. (In this case, the device on the next row is no longer displayed).

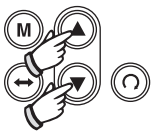




2 **The value of the device is displayed flashing.**

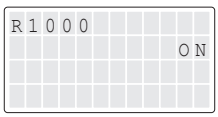
In this state, press the "▼" and "▲" keys. This toggles the display in the order ON->OFF->ON->⋯.
(In this case, device value will not be stored)

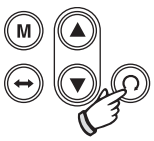




3 **To set the desired device value and hold down the "↺" key for at least one second.**

Flashing stops and device value will be stored. If the key is released within one second, then storing is not executed, and the screen returns to the monitor display.

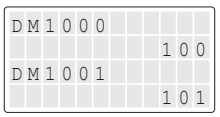


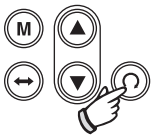


· When displaying format is other than ON/OFF (except T, C, CTH/CTC, TRM)

The following example describes how to change the value of DM1000 No. from "100" to "201".

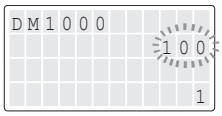
1 Hold down the " ↻ " key for at least one second with the device to change displayed.





2 The value of the desired device flashes.

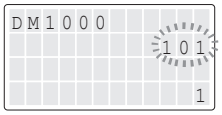
The "increment" is displayed on the bottom row of the screen.

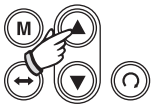


3 Press the "▲" key.

The device value is incremented by the amount set , and the device value changes to "101".

(In this case, the device value will not be stored into device.)

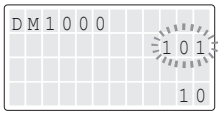


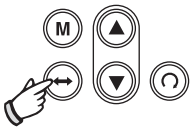


4 Press the "⇔" key once.

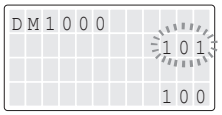
This changes the digit of the increment. Each press of the key changes a digit one time.

To change the hundreds digit, press the key twice.





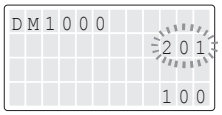
5 The increment value changes to "100".

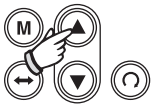


6 Press the "▲" key once.

The device value is incremented by the "100" and the display changes to "201".

(In this case, the device value is not stored into device.)





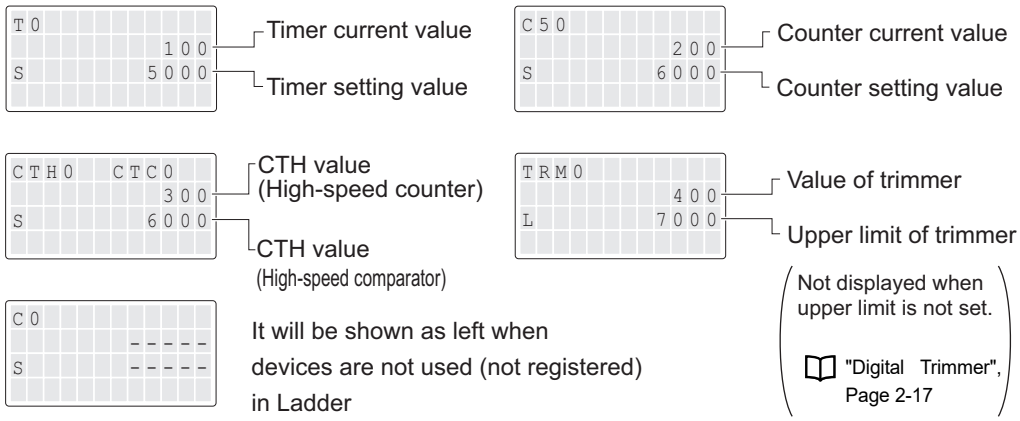
7 Adjust the device value to a suitable value, and hold down the " ↻ " key for at least one second.

This stores the value, and the screen returns to the monitor display.

If press and hold "' ↻ " key for less than 1 second, write operation will not be executed, and the screen will return to monitor display.

· When display format are not ON/OFF(T, C, CTH/CTC, TRM)

The setting value and current value can be changed in the case of T, C, CTH/CTC, and TRM devices.



<How to change setting values>

To change device values, hold down the " " key for at least one second. The following items can be changed:

T	: Timer setting value
C	: Counter setting value
CTH/CTC	: CTC (high-speed counter comparator)
TRM	: Trimmer

<How to change current values>

The following items can be changed by holding down the " " key for at least one second with the "⇔" key pressed.

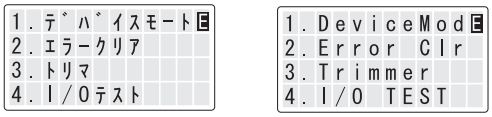
T	: Timer current value
C	: Counter current value
CTH/CTC	: CTH (high-speed counter current value)
TRM	: Trimmer upper limit value (The trimmer upper limit value is assigned to CM.)

"Digital Trimmer", Page 2-17

Error Clear

Clear serious error of the CPU unit.

TIP When an error occurs on CPU or expansion unit, detailed information will be displayed automatically. You can press a certain key in Access Window to clear a slight error and return to the previous display. In the case of a serious error, the display can disappear, but the error cannot be cleared. If you don't operate the Access Window for 30s, or switch RUN⇔PRG toggle RUN, the error will be displayed again. Moreover, "E" will be generally displayed on the upper right of Access Window in the screen.



For the error information, see "Error Handling", Page 3-19.

■ Functions of Setup key

The following summarizes key functions when clearing the error.

Setup Key	Function
M	Menu display
↺	Error in the display can be cleared by pressing and holding for more than 1s. The operation will be cancelled automatically the key is pressed for less than 1s. When no error occurs, the operation is also invalid.
▲	disabled
▼	disabled
⬌	disabled

■ How to operate

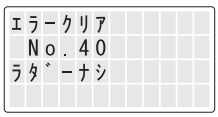
1 **Press the "M" key.**

A menu is displayed. (If other units are selected, press the "M" key twice.)

2 **Select '"2. Clear error' and press "↺"key.**

The following screen is displayed.

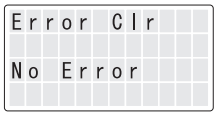
· Screen example when an error occurs





· Screen example when no error occurs





3 **After changing the value, hold down the "↺" key again for at least one second.**

Serious error displayed can be cleared.

If several severe errors occur, the other ones will be displayed. Press "↺" key for more 1s to clear them. When all the errors are cleared, "No Error" will be displayed.

TIP When KV-DR1 is connected, KV-DR1's output is ON if all errors are cleared.

Digital Trimmer

In numeric tuner mode, the trimmer's value can be changed simply through device mode.
Use TMIN instruction to read the value of trimmer in ladder diagram.

Please refer to KV-8000/7000/5000/3000/1000 Series PLC Instruction Reference Manual, “TMINInstruction"

■ Functions of setup key

The following table summarizes key operations when changing the trimmer value:

Setup key	Function
M	Menu display
↻	Changes the No. of the trimmer displayed. Each press increments the device No.(TRM0 to 9)
▲	Increments the trimmer value.
▼	Decrements the trimmer value.
⇔	Changes the digit of the incremented value. Each press of the key increases a digit. When the tenth digit is exceeded, it will return to the ones digit.

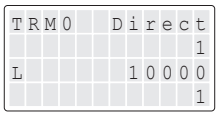
Changing values in this mode differs from changing values in the device mode. In the digital trimmer mode, changes to values are reflected directly without pressing the "↻" key.

■ How to operate

1 **Press the "M" key.**

A menu is displayed. (If other units are selected, press the "M" key twice.)

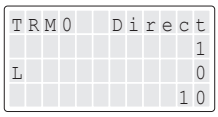
2 **Select '2.trimmer" and press '↻' key.**

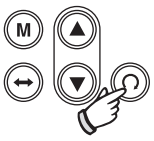


The value of the 3rd row indicates the trimmer upper limit value. When the upper limit value setting is not used, it will not be displayed.

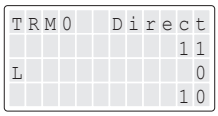
3 **The trimmer No. displayed can be changed by the "↻" key.**

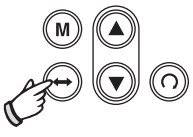
Select the trimmer No. to change.





4 **Change the increment value by the "⇔" key.**





5 Pressing the "▲" key increases the trimmer value by the increment value, and pressing the "▼" key decreases the trimmer value by the decrement value.

The digital trimmer mode differs from the device mode in that changes to values are reflected directly without pressing the "↻" key.

TIP
- The current trimmer value can be read by the TMIN instruction.
- To enable setting of upper limit, it's necessary to set on KV STUDIO. ("CPU system setting" -> "Setting of digital trimmer's upper limit".)
- Upper limit can be set in KV STUDIO or Access Window's device mode (CM1700 to CM1715).
- When the setting of upper limit is enabled, the upper limit will change to 4294967295 automatically if the setting value of upper limit is set to "0".
- The upper limit is stored in the following CM.

Trimmer No.	Device
TRM0 upper limit	CM01700, CM01701
TRM1 upper limit	CM01702, CM01703
TRM2 upper limit	CM01704, CM1705
TRM3 upper limit	CM1706, CM1707
TRM4 upper limit	CM1708, CM1709
TRM5 upper limit	CM1710, CM1711
TRM6 upper limit	CM1712, CM1713
TRM7 upper limit	CM1714, CM1715

I/O Test

Can be used to verify I/O status of expansion I/O unit.

Note Can be executed only in PROM mode.

TIP This can also be verified when the settings of unit configuration set through KV STUDIO haven't been transmitted to CPU.

■ Functions of setup key

Setup key	Function
M	Returns to unit configuration screen.
↻	Input unit: disabled Output unit: reverse the output state of cursor position (ON/OFF)
▲/▼	Input unit: shift 16 digits for the displayed number of points. Output unit: shift 8 digits for the displayed number of points.
⬌	Input unit: disabled Output unit: shift the cursor position 1 digit forward.

■ How to operate

● Switch to I/O test

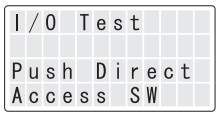
1 **Press the "M" key.**

A menu is displayed. (If other units are selected, press the "M" key twice.)

2 **Select "4. I/O test", and press the "↻" key.**

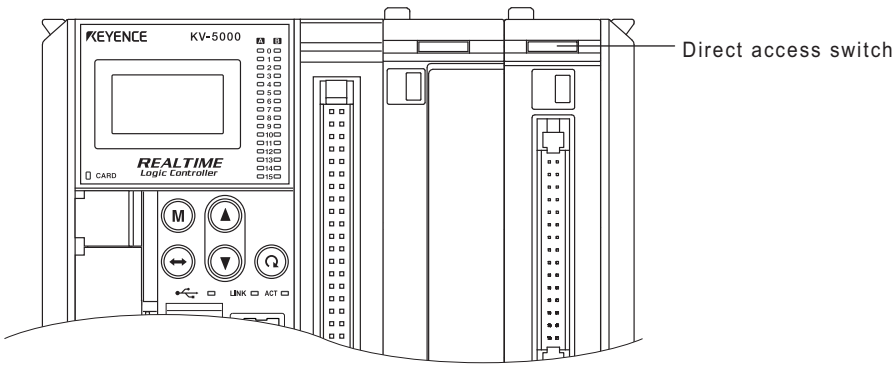
The following screen appears.





3 **Select the direct access switch of verified expansion I/O unit.**

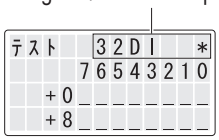
The direct access switch of the selected unit flashes.

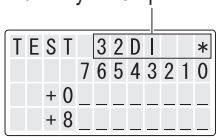


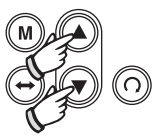
● In the case of input unit

Number of points of the unit ("16", "32", "64"+"DI")

*: High bit/low bit is displayed by H/L only for 64-point unit





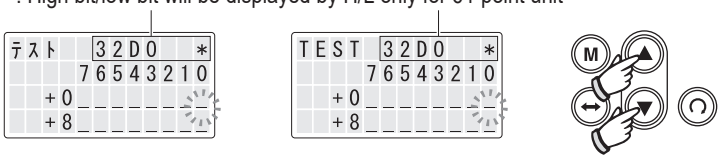


Shift the verified relay position according to every 16 digits by pressing "▲" "▼".

● In the case of output unit

Number of points of the unit ("16", "32", "64"+"DO")

*: High bit/low bit will be displayed by H/L only for 64-point unit



Shift the verified relay position according to every 8 digits by pressing "▲" "▼".
Press "↻" key to reverse the output state of cursor position (ON/OFF).
Press "⇔" key to change the cursor position.

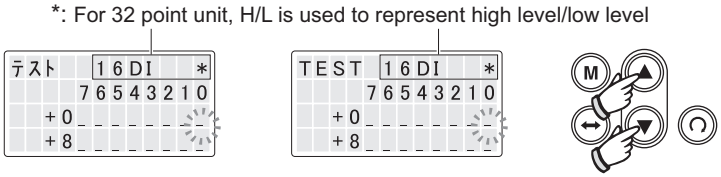
Note **Please operate after verifying the state of connected control equipment.**

● I/O unit

• For CPU functional version above V1.1

Number of unit points (“16”, “32”) + ”DI” or “DO”

*: For 32 point unit, H/L is used to represent high level/low level



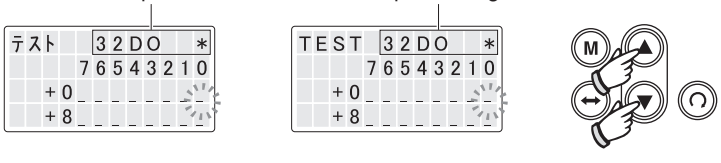
▲ ▼ Key may be used to move the confirmed relay position up to 8 digits.
↻ Key may be used to inverse output state (ON/OFF) of the cursor position.
⇔ Key may be used to change cursor position.

Note **Please operate after confirm the state of connected control equipment carefully.**

• For V1.0 CPU functional version

Total number of relay points on the unit (“16”, “32”, “64”) + ”DO”

*: For 32 point unit, H/L is used to represent high level/low level



▲ ▼ Key may be used to move the confirmed relay position up to 8 digits.
↻ Key may be used to inverse output state (ON/OFF) of the cursor position.
⇔ Key may be used to change cursor position.

Note

- **Please operate after confirm the state of connected control equipment carefully.**
- **To execute I/O test when unit setup information stored in CPU unit is different from actual unit configuration, KV-B8XTD executes different operation according to the type of unit on the right side (only limited to V1.0 CPU functional version).**

  Special unit is on the right, or when unit is unavailable

  KV-B8XTD output relay could not be controlled.

  When output unit is on the right

  If unit output relay is on the right side, KV-B8XTD output relay is also ON.

  When input unit is on the right side

  If when unit input relay on the right side, KV-B8XTD output relay is also ON.

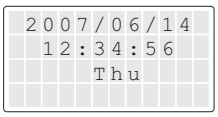
Date/Time

The date/time can be displayed and set.

The time will be displayed in 24-hour format.

The day of the week is displayed as follows:

Sun : Sunday
Mon : Monday
Tue : Tuesday
Wed : Wednesday
Thu : Thursday
Fri : Friday
Sat : Saturday



■ Functions of setup key

The following table summarizes key operations when setting the date/time.

Setup key	Function
M	Menu display
⬌	Switches the setting items. Switches to decide if 0s adjustment is performed.
▲	Increments settings values when setting the date/time.
▼	Decrements setting values when setting the date/time.
↺	Holding down this key for at least one second in the date/time display sets the date/time. Holding down this key for at least one second when setting the date/time applies this setting. Holding down this key for at least one second then releasing the key when adjusting the date/time applies the newly adjusted time.

■ How to operate

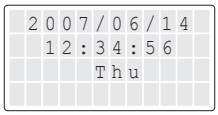
● Switching clock

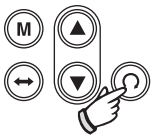
1 Press the "M" key.

A menu is displayed. (If other units are selected, press the "M" key twice.)

2 **Select "5. Date" and press "↻" key.**

The following screen appears.

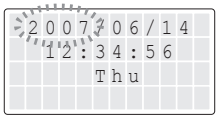


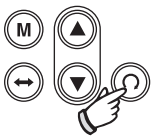


● Date/time setting

1 **Press "↻" key for more than 1s in date/time.**

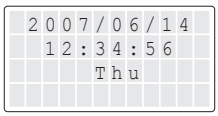
The "Year" segment flashes.

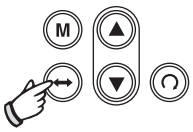




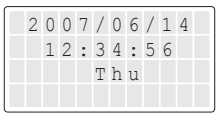
2 **Select a settings by pressing the "⇔ " key.**

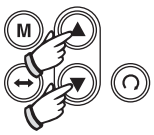
Each press of the "⇔" key switches the items as follows: "Year" > "Month" > "Day" > "Hour" > "Minute" > "Second" > "Day of week" > "Year" ··· and so on.





3 **Select the item using the "▲" and "▼" keys.**



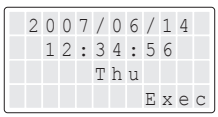


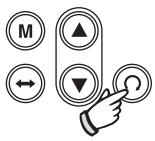
4 **Repeat steps 2 and 3. After setting, hold down the "↻" key for at least one second..**

"Exec" is displayed at the most right bottom row of the screen.

(In this case, the date/time has not been set.)

Release the "↻" key. This applies setting of date/time, and returns the screen to the date/time display.





If you release the "↻" key before "Exec" is displayed, the date/time setting is not executed, and the screen returns to the date/time display.

Note

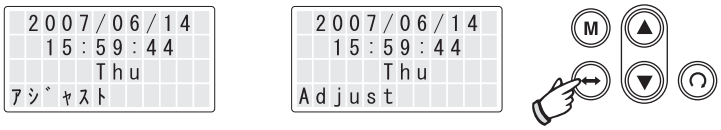
Set year, month, day, hour, minute, second, and day of the week accurately.
The day of the week is not checked corresponding to the year, month, day, hour, minute, and second.

■ 0 second adjustment

0 second adjustment is a function for setting the seconds value to "0".

Current Seconds Value	Operation
0 to 29	Only sets seconds value to "0".
30 to 59	Add 1 minute, and sets seconds value to "0".

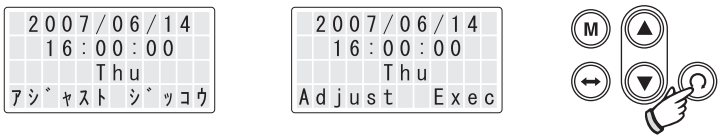
1 Press the "⇔" key in the date/time display state.



"Adjust" is displayed on the bottom row, indicating that the time can be adjusted.
(To cancel time adjustment, press the "⇔" key again. The "Adjust" display disappears, and the screen returns to the date/time display.)

2 Hold down the "↻" key for at least one second.

"Exec" is displayed at the right of the most bottom row of the display. (In this case, time adjustment has not been executed.)
Release the "↻" key. This executes the time adjustment.



If you release the "↻" key before "Exec" is displayed, time adjustment is not executed, and the screen returns to date/time display.

CPU Monitor

CPU's internal functions can be monitored. Meanwhile, the names of projects stored in CPU unit can be displayed.

■ The items that can be monitored

The items that can be monitored via Access Window are shown as follows.

Japanese	English	Function
プロジェクトメイ	Project Name	Display the item name stored in CPU unit. (name is set in KV STUDIO)
イチギメ	Pos Control	CPU built-in positioning function may be monitored.
シュウハスウカウンタ	Freq Count	CPU built-in frequency counter may be monitored.
イーサネット	Ethernet	CPU built-in EtherNet/IP/Ethernet/FL-net function may be monitored. It is displayed only when KV-5500/5000 when is used. The monitored content is the same as KV-EP21V*1/KV-LE21V*2*3/ KVFL20V*3, therefore, please refer to the user manual of each unit.
Bluetooth	Bluetooth	When connected with KV-BT1, BD address and identification name may be monitored. It is displayed only when CPU functional version above V2.0 is used. KV-5000 supports CPU functional version above V1.1.

*1 The same as KV-5500.

*2 KV-5000 of V1.0 CPU functional version is the same as KV-LE20V.

*3 The same as KV-5000.

■ How to operate

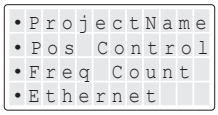
● Switch to CPU monitor

1 **Press the "M" key.**

A menu is displayed. (If other units are selected, press the "M" key twice.)

2 **Select "6. CPU Monitor" and press "↺" key.**

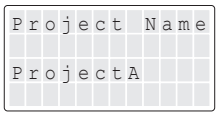
CPU monitor menu is displayed.



● Project Name

1 **Select "ProjectA" in the CPU monitor menu, and then press "↺" key.**

Project name will be displayed.



Project names that can be displayed in the Access Window

- Up to 12 half-width alphanumeric characters can be displayed.
- Available display characters are ASCII codes 20 to 7e (HEX) and a1 to df (HEX).

Project names are registered in the form of project properties of KV STUDIO.

When the Access Window displays the comment, the input item names will be stored into CM1757 to CM1763 after data transmission.
For comment display of the Access Window, see KV STDIO User's Manual.

TIP When ladder program is created, the project names set by KV STUDIO will be stored into CM1740 to CM1756 after data transmission.

● Positioning

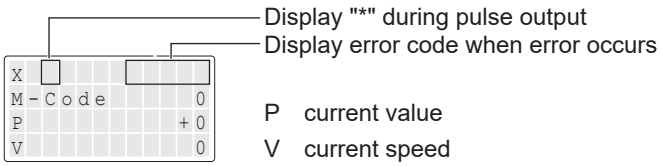
1 Select "Pos control" in the CPU monitor menu, and then press "↺" key.

Status of positioning function is displayed.

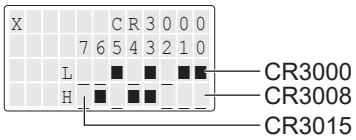
There are five monitor functions in positioning monitor, which can be switched by "▲" and "▼".
The monitoring contents are as follows:

· Code M, current value, current speed of X axis.

'*' is displayed in the pulse output process.

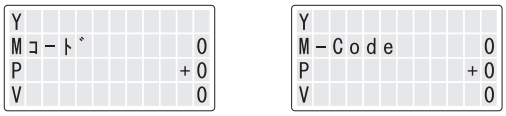


· Relays related to X axis.

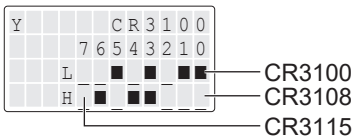


· Code M, current value, current speed of Y axis.

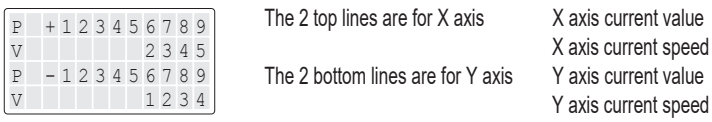
'*' is displayed in the pulse output process.



· Relays related to Y axis



· Current value, current speed of X axis; Current value, current speed of Y axis.



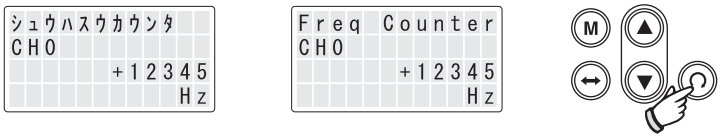
● Frequency counter

1 **Select "Freq. Counter" in the CPU monitor menu, and then press "↺" key.**

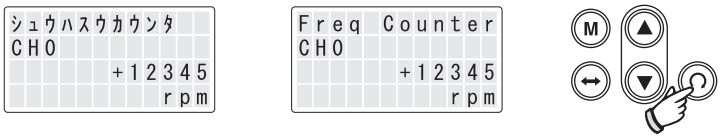
The frequency counter monitor screen is displayed.

The display unit is either "Hz" or "rpm", depending on the frequency counter setting.

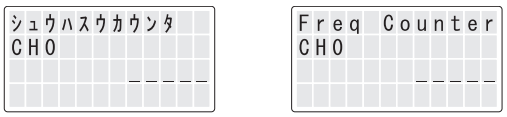
Example of "Hz" display



Example of "rpm" display



The display is as follows when the frequency counter is used.



The channel No. of displayed frequency counter can be changed through "▲" and "▼".

Alarm

After messages are registered in the alarm relays (CR3300 to CR3415) as device comment, the messages will be displayed in Access Window automatically when alarm relay is ON. In addition, alarm logs generated can also be confirmed or deleted.

■ How to use

Devices used during alarming are described below.

Control relay	R/W	Description
CR3300 to CR3415	R/W	Alarm relay (32). Device comment is registered in advance.
CR3500	R	Even if one alarm relay exists, CR3500 will also be ON. When all the alarms in ON state are closed, CR3500 will be OFF automatically.
CR3501	R/W	ON->OFF log is stored.
CR3502	R/W	The alarm record in P3-9 will be cleared when OFF->ON

Note

Be sure to operate the alarm relays by the SET and RES instructions. Currently operating alarm relays can be reset and batch-cleared also by the ARES instruction.

● Register of alarm message

Device comments are registered into alarm relays (CR3300 to CR3415).

Note

The maximum message length displayed in Access Window are half-width characters. When there are characters other than HEXl 20 to 7e and HEXl al to df in ASCII code, the device comment is hidden while alarm relay No. is displayed. When device comment isn't set, alarm relay No. will also be displayed.

● About alarm log

CPU unit can store up to 64 alarm logs.

In the event of excess of 64, the latest log will replace the earliest one on in sequence.

Each log will store alarm relay No., time (year/month/day/hour/minute/second) and ON/OFF State.

· When ON -> OFF log relay (CR3501) is in OFF state.

  Alarm relay is only stored in OFF -> ON state.

· When ON -> OFF log relay CR3501 is in ON state.

  Logs will be stored when alarm relay is in OFF -> ON and ON -> OFF state.

The alarm record in P3-9 will be cleared when CR3502 is ON, and CR3582 will be OFF when clearing is completed.

■ The items that can be operated

The functions that can be operated from Access Window are as follows.

Japanese	English	Contents to be set
モニタ	Monitor	Alarm relay in ON state can be monitored in real-time.
リレキ	Record	Can monitor ON/OFF logs of alarm relay.
リレキクリア	Clr Record	Clear ON/OFF logs of alarm relay .

■ How to operate

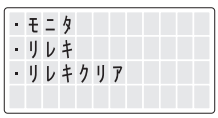
● Switch to alarm

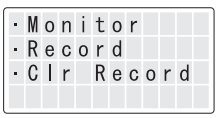
1 **Press the "M" key.**

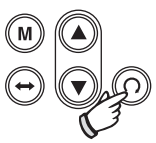
A menu is displayed. (If other units are selected, press the "M" key twice.)

2 **Select "7. Alarm", press "↺" key.**

Alarm menu is displayed.





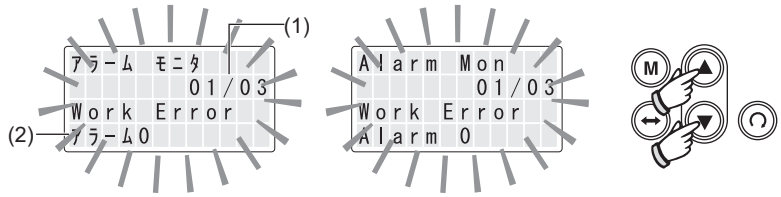


● Monitor

1 Select "Monitor" in the Alarm menu, and then press "↺" key.

The alarm monitor is displayed.

When several alarm relays are in ON state, other alarms can be displayed by pressing "▲" and "▼".



(1) "01/03"

Alarm No. currently displayed/total number of alarms occurred.

When several alarms occur, the alarm with smaller alarm relay No. will be displayed first.

(2) "Work Error"

Comment of the destination device of currently displayed alarms.

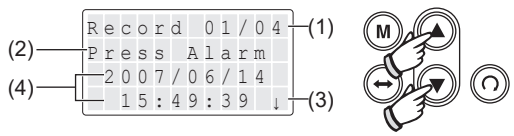
TIP
- After pressing a certain key, flashing stops.
- In case any alarm occurs when other screens are currently displayed, the alarm monitor will be displayed automatically.

● Log display

1 Select "Record" in the Alarm menu, and then press "↺" key.

Alarm logs will be displayed.

Press "▲"key or "▼" key to display previous/next log.



(1) "01/04"

Alarm log No./total number of logs currently displayed.

The latest log No. is "01".

(2) "Press Alarm"

Comment of the destination device of currently displayed logs.

(3) "▼"

It indicates the log when alarm relay switches from ON to OFF. The log when alarm relay switches from OFF to ON is indicated by "▲".

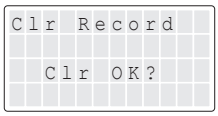
(4) "2007/06/14 15:49:39"

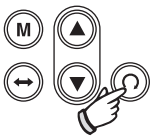
It indicates the log date and time.

● Log clear

1 **Select "ClrRecord" in the Alarm menu, and then press "↻" key.**

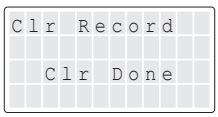
The confirmation message of cleared logs will be displayed.





2 **Hold down the "↻" key for at least one second.**

The following contents are displayed when the logs are cleared.



Press "M" key to return to alarm menu display.

Memory Card

In the Access Window, you can save data and access files from the memory cards.

For details, please refer to"2-2 Memory Card", Page 2-48 .

■ Items that can be operated

The functions that can be operated from Access Window are as follows.

Japanese	English	Contents to be set
ロード	Load	Read data from any project folder into CPU unit.
セーブ	Save	Save the data of CPU unit into memory card. Save ladder program, device value, device comment, unit setting Information and log setting Information.
ファイルイチラン	File List	The directory and file list on the memory card are displayed. Moreover, any file in the file list can be deleted.
アキヨウリョウ	Free Space	Display free space of memory card.

Note **Loading can only be executed in PROM mode.**

■ How to operate

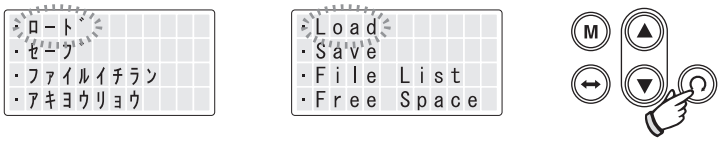
● Switch to memory card

1 **Press the "M" key.**

A menu is displayed. (If other units are selected, press the "M" key twice.)

2 **Select "8. Memory card" and press "↻" key.**

Memory card menu is displayed.

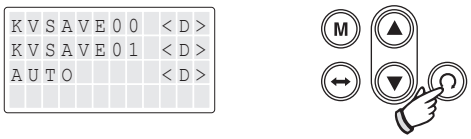


● Load

1 **Select "Load" in the memory card menu, and then press "↻" key.**

The folders (projects) in the folder path of memory card are displayed. (files hidden).

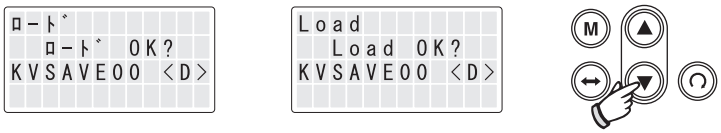
The names of file folders are shown as "KvSAVE00 <D>", in which the last three characters are displayed as "<D>".



TIP The updated date and time of file folders can be confirmed by pressing "⇔" key.

2 **Select the folder to be loaded by pressing "▲" and "▼" , then press "↻" key.**

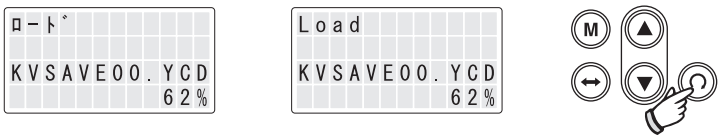
Confirmation message of loading execution is displayed.



3 **Loading is executed if pressing "↻" key is displayed for more than 1s.**

During loading, the following contents will be displayed.

If you want to cancel loading, press "M" or "↻" key for less than 1s.

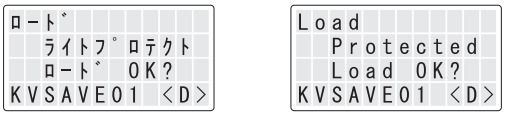


Note

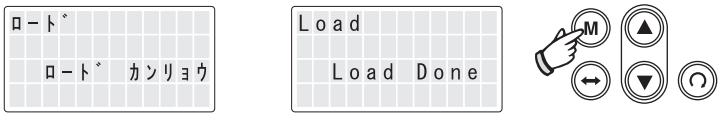
If memory card is write-protected, the following diagram is displayed.

Forced loading is executed by pressing "↻" key for 1s.

Loading is canceled if "M" or "↻" key is pressed for less than 1s.



4 **The following contents are displayed after loading is finished.**

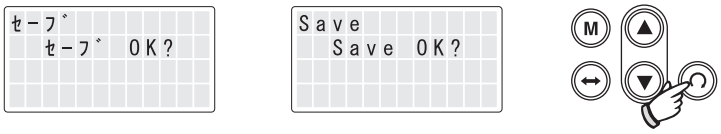


Press "M" key to return to memory card menu.

● Save

1 **Select "Save" in the memory card menu, and then press "↻" key.**

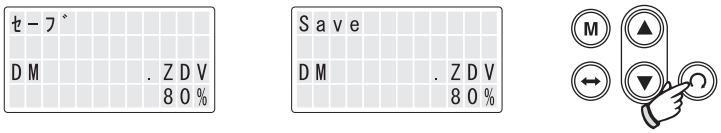
Confirmation information is displayed, prompting whether CPU data is to be saved.



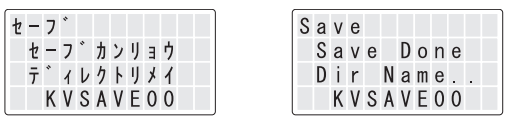
2 **Saving is executed if "↻" key is pressed for more than 1s.**

Folders with name KVSAVE?? (?? is 2 half-width number, and a folder with the smallest 2-digit number will be created and saved.

While saving is implemented, the file names currently being saved and saving progress will be displayed.



3 **After saving is finished, the name of the saved project folder will be displayed.**



Press "M" key to return to memory card menu.

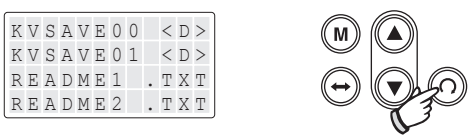
For saved files, see "2-2 Memory Card", "Saving/reading of Project Data", Page 2-47.

● File list

1 **Select "File list " in memory card menu, and press "↻" key.**

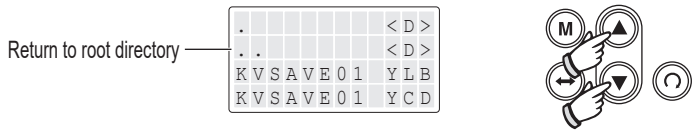
The folders (projects) in the folder path of memory card are displayed.

The names of file folders are shown as "KvSAVE00 <D>", in which the last three characters are displayed as "<D>".



2 **Select a (project) folder through "▲" and "▼" key, and press "↻" key.**

The files in the directory (project folder) will be displayed.



Note

The files in the (project) folder cannot be referenced.

TIP Press "⇔"key to confirm the updated date and time of file folder or files.

● File delete

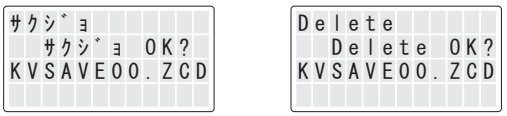
1 **Select the files or (project) folder to be deleted from the "File list".**

2 **Hold down the "↻" key for at least one second with the "⇔" key held down.**

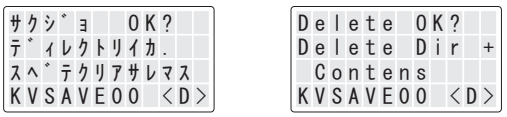
The confirmation prompt of "Delete?" is displayed.

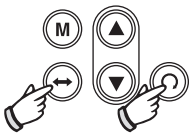
If you want to cancel delete operation, press "M" or "↻" key for less than 1s.

<File>



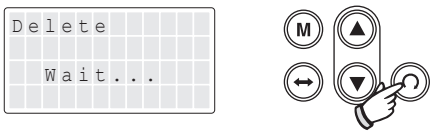
TIP <Directory>





3 Press "↻" key for more than 1s again to perform deleting.

The message for deleting is displayed.

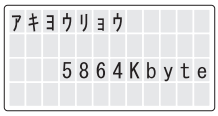


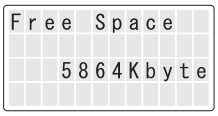
4 **After deleting is finished, the screen will return to file list display.**

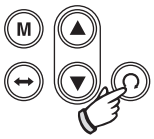
● Free space

1 Select "Free Space" in the memory card menu, then press the "↻" key.

The following screen will be displayed after free space is verified.







Commission

Forced set/reset register, input refresh inhibited, output inhibited can be released from Access Window.

TIP When registering or inhibited is in progress due to write operation to KV STUDIO or CR/CM, registering or inhibited in progress will be displayed automatically in the Access Window. You can return to original screen by pressing a key, but registering or inhibited setting cannot be released.

■ Items that can be released

Japanese	English	Description
ｷｮｳｾｲｾｯﾄ	Force Set	When forced set/reset is registered, they can be released together.
ﾆｭｳﾘｮｸ	Input	When input refresh inhibited is set, it can be cleared.
ｼｭﾂﾘｮｸ	Output	When output refresh inhibited is set, it can be cleared.

■ How to operate

● Switch to commission

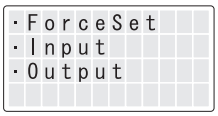
1 **Press the "M" key.**

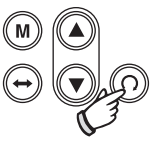
A menu is displayed. (If other units are selected, press the "M" key twice.)

2 **Select "9. Commission" and press "↻" key.**

The commission menu is displayed.



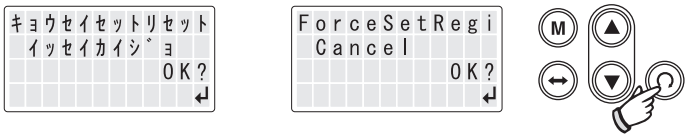




● Forced set/reset register release

1 Select "Force Set Regi" in the commission menu, and then press "↻" key.

The verification message for collective releasing is displayed.

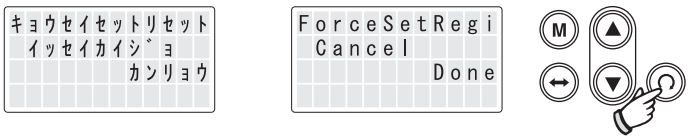


Note

No operation can be performed if a device is not registered as forced set/reset.

2 **Hold down the "↻" key for at least one second.**

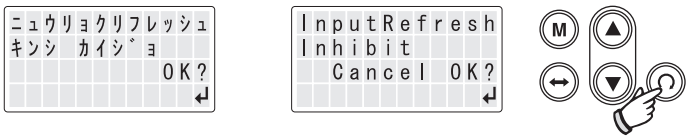
After collective releasing it, a completion message will be displayed.



● Release of input refresh inhibited

1 **Select "Input Refresh" in the commission menu, and then press "↻" key.**

The confirmation information of input refresh inhibited is displayed.

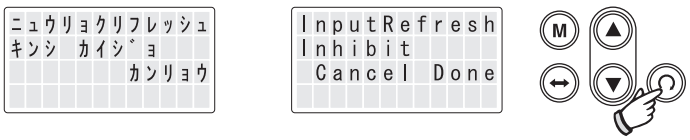


Note

No operation can be performed if input refresh inhibited isn't set.

2 **Hold down the "↻" key for at least one second.**

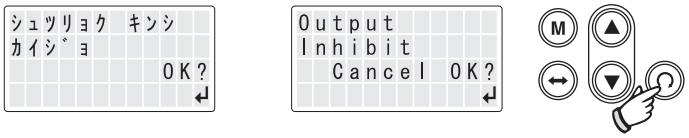
After inhibited setting is released, a completion message will be displayed.



● Release of output inhibited

1 **Select "output" in the commission menu, and then press "↻" key.**

The confirmation information of output refresh inhibited is displayed.

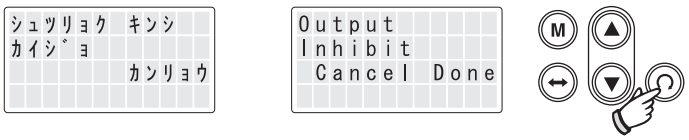


Note

No operation can be performed if output refresh inhibited isn't set.

2 **Hold down the "↻" key for at least one second.**

After inhibited setting is released, a completion message will be displayed.



Access Window Setup

The following 2 settings can be changed through Access Window.

Japanese	English	Contents to be set
コントラスト	Contrast	Adjust the contrast of LCD screen. (3 to 9)
ゲンゴ	Language	Set up display language. (Japanese/English)

■ Contrast

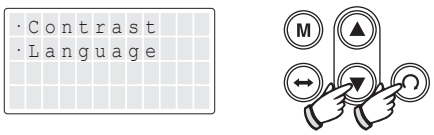
To adjust the contrast of LCD screen.

1 **Press the "M" key.**

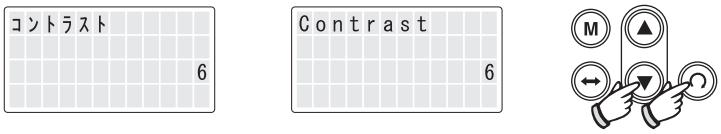
A menu is displayed.(If other units are selected, press the "M" key twice.)

2 Press the "▼" and "▲" key, select "7. AW Setting", then press the "↻" key.

The Access Window setup menu is displayed.

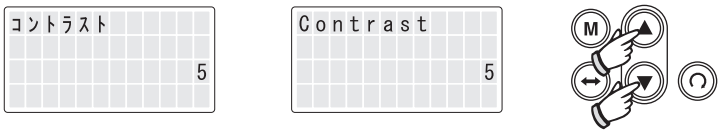


3 **Press the "▲" key and the "▼" key, select "Contrast", then press the "↻" key.**



4 **Scroll the contrast value by pressing "▲" and "▼", and adjust to a proper contrast.**

Contrast can be set between 3 to 9.



■ Display language

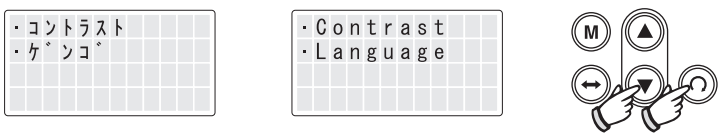
The display language can be selected between Japanese and English. Katakana of Japanese will be displayed.

1 **Press the "M" key.**

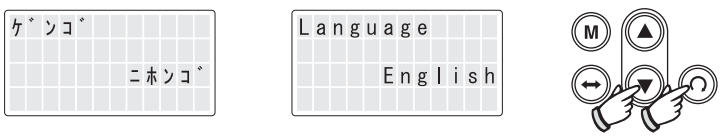
A menu is displayed. (If other units are selected, press the "M" key twice.)

2 **Press the "▲" key and the "▼" key, select "7. AW Setting", then press the "↻" key.**

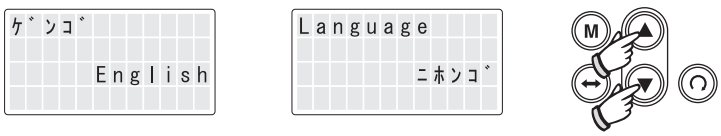
The Access Window setup menu is displayed.



3 **Press the "▲" key and the "▼" key to select "Language", then press "↻" key for more than 1s.**



4 **Switch between Japanese and English by pressing "▲" and "▼".**



5 **Hold down the "↻" key for at least one second.**

Language setup is finished.

SRAM Clear Mode

The current memory Nos. of device value, alarm log/error log and file register can be cleared by SRAM clear. It also restores details set by Access Window setup to their defaults.
Executing this function initializes R, MR, LR, B,CR, T/C (current values), CTH, CM, DM, EM, FM, ZF,W and Z. Ladder programs, unit setup information, comments, T/C (setting values), CTC, and log setup information will not disappear.

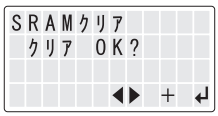
Note **SRAM clear can be executed only in the PROG mode.**

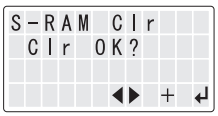
1 **Press the "M" key.**

A menu is displayed. (If other units are selected, press the "M" key twice.}

2 **Select "11. SRAM clear" through "▲" and "▼" keys, and press "↻"key.**

The SRAM clear confirmation message is displayed.

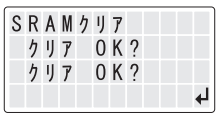


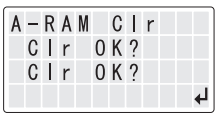


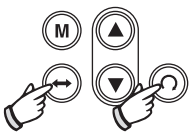


3 **Hold down the "↻" key for at least one second with the "⇔" key held down.**

The confirmation screen is displayed again.

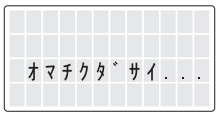


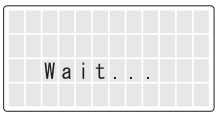




4 **Hold down the "↻" key for at least one second when confirmation screen is displayed again to perform SRAM clear.**

The following screen will be displayed while SRAM clear is being executed. When SRAM clear is finished, a restart will be performed automatically.





Note **If "↻"key isn't pressed for more than 1s, the message "Please wait---" will not be displayed, and SRAM clear will be canceled.**

All Clear Mode

The all clear mode returns all settings on the CPU unit to their defaults. (This means that the ladder program and device values are cleared.)

Note

All clear can be executed only in the PROG mode.

1 **Press the "M" key.**

A menu is displayed. (If other units are selected, press the "M" key twice.}

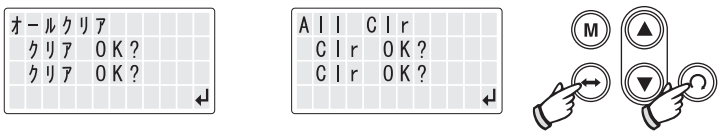
2 **Select "12. All clear " through "▲" and "▼" key, and press "↻"key.**

The all clear confirmation message is displayed.



3 **Hold down the "↻" key for at least one second with the "⇔" key held down.**

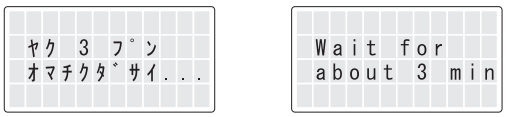
The confirmation screen is displayed again.



Pressing the "M" or the "↻" key cancels the all clear instruction, and the screen returns to the menu display.

4 **Hold down the "↻" key for at least one second when confirmation message screen is displayed again to perform all clear.**

The following screen will be displayed while all clear is being executed. Whenall clear is finished, a restart will be performed automatically.



Note

If "↻" key isn't pressed for more than 1s, the message "Please wait---" will not be displayed, and all clear will be canceled.

5 **System initialization complete message is displayed.**

Access window initial menu display function

When this function is used, the access window menu displayed when powered on may be set via ladder diagram program.
If this function is not used, the menu displayed upon the previous power off will be displayed.

■ Display method

When powered on, value may be saved in control memory (CM) from the ladder diagram program, select initial menu of access window when powered on.
When access window initial menu display function is used, save 1 in CM1780, set the menu displayed on CM1781-CM1789.

TIP In KV-5500/5000/3000 Series, decimal number is represented by #, hexadecimal number is represented by $.

Note

CPU unit with CPU functional version above V2.0 is used to support access window initial menu display function.

■ Control memory list for access window initial menu display

Device No.	Function
CM1780	Select enable, disable of access window initial menu display function (0: disable, 1: enable)
CM1781	Select device type*1
CM1782 CM1783	Select display menu
CM1784 CM1785	Select device No.*2
CM1786	Select display format of the device*1
CM1787	Select device name representation*1 (0: device No., 1: device comment)
CM1788	Select key lock state (0: key lock is disabled, 1: key lock is enabled)
CM1789	Select display language (0: Japanese, 1: English)

*1 Type of the display menu is valid only in device mode.

*2 Type of the display menu is valid only in device mode, or trimmer mode.

● Select enable, disable of access window initial menu display function

Select whether the function is used or not according to the values stored in CM1780.

CM1781 = 1: display the menu selected by CM1781-1789.

CM1780 = 0: display the menu displayed upon the previous power off.

● Selection scope of the device type (type of the display menu is valid only in device mode)

Select the device type to be displayed according to the values stored in CM1781.

Device type	CM1781(hexadecimal)	Device type	CM1781(hexadecimal)
R	$0000	MR	$0011
CR	$0001	LR	$0012
T	$0002	EM	$0017
C	$0003	FM	$0019
CTH /CTC	$0004	B	$001B
DM	$0006	W	$001C
CM	$0007	ZF	$002C
TM	$0008	Z	$0030

● Type and selection scope of the display menu

Select the type of display menu according to the values stored in CM1782 and CM1783.

Menu	CM1782, CM1783 value (hexadecimal)
Top menu	$00000000
Device mode	$01000000
Trimmer	$03000000
Display clock	$05000000
CPU monitor menu	$06000000
CPU monitor project name	$06100000
CPU monitor positioning X AXIS M code/current value/current speed	$06200000
CPU monitor positioning X AXIS relay	$06200010
CPU monitor positioning Y AXIS M code/current value/current speed	$06200100
CPU monitor positioning Y AXIS relay	$06200110
CPU monitor positioning X AXIS current value/current speed, Y AXIS current value/current speed	$06210000
CPU monitor frequency counter CH0	$06300000
CPU monitor frequency counter CH1	$06300100
Alarm menu	$07000000
Alarm monitor	$07100000
Alarm log	$07200000
Alarm elimination	$07300000
Memory card menu	$08000000
Testing menu	$09000000
AW setting menu	$0A000000
AW setting comparison setup	$0A100000
AW setting language setting	$0A200000

● Selection method of device No. (type of the display menu is valid only in device mode or trimmer mode)

Select the device No. To be displayed according to the values stored in CM1784 and CM1785.

- Number across channels, select continuous number for R, MR, LR, CR.

Calculation expression is as follows.

aaa : Channel No.(000 to 999)

aaabb

bb : Contact No.(00 to 15)

N:Values stored in CM1784 and CM1785 (decimal numbers)

aaa:Channel No.

bb:Contact No.

N = 16 x aaa + bb

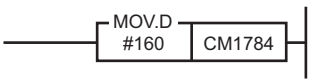
Examples

When R1000 is selected

aaa = 10 / bb = 0

N = 16 x 10 + 0 = 160

The value of CM1784 and CM1785 is 160 ($A0).

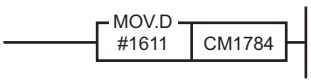


When R10011 is selected

aaa = 100 / bb =11

N = 16 x 100 = 11 = 1611

The value of CM1784 and CM1785 is 1611 ($064B).

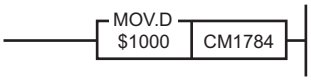


- For B, W, use the displayed device No. Value (hexadecimal number) to select.

Examples

When B1000 is selected

The value of CM1784 and CM1785 is 4096 ($1000).



When W1FFF is selected

The value of CM1784 and CM1785 is 8191 ($1FFF).

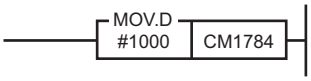


- For T, C, DM, CM, TM, EM, FM, ZF, use the displayed device No. Value (decimal number) to select.

Examples

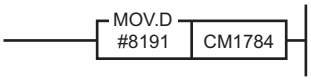
When DM1000 is selected

The value of CM1784 and CM1785 is 1000 ($3E8).



When DM8191 is selected

The value of CM1784 and CM1785 is 8191 ($1FFF).



● Device display format and selection scope

According to the values stored in CM1786, select display format of the device.

Display format	CM1786 value (hexadecimal)	Display format	CM1786 value (hexadecimal)
Default*1	$0000	16Bit-BASE2	$0005
ON/OFF	$0001	Unsigned 32Bit-BASE10	$0006
Unsigned 16Bit-BASE10	$0002	Signed 32Bit-BASE10	$0007
Signed 16Bit-BASE10	$0003	32Bit-BASE16	$0008
16Bit-BASE16	$0004		

*1 Bit device is represented by ON/OFF, word device is represented by unsigned 16Bit-BASE10.

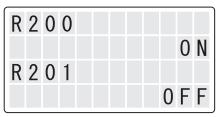
■ Display examples

1. When power on is selected, top menu is displayed in the access window.
   Save the following settings in CM.



Device No.	CM value (hexadecimal)	Set content
CM1780	$0001	AW initial menu display is enabled
CM1781	-	-
CM1782 CM1783	$00000000	Top menu
CM1784 CM1785	-	-
CM1786	-	-
CM1787	-	-
CM1788	$0000	Key lock is invalid
CM1789	$0000	Japanese

2. When power on is selected, device mode, R200 ON/OFF are displayed in the access window.



Device No.	CM value (hexadecimal)	Set content
CM1780	$0001	AW initial menu display is enabled
CM1781	$0000	R
CM1782 CM1783	$01000000	Device mode
CM1784 CM1785	$00000020	200
CM1786	$0000	Default
CM1787	$0000	Device numbering
CM1788	$0000	Key lock is invalid
CM1789	$0000	Japanese

User Message

User message function is used for displaying any numerical value or ASCII string within 24 half-width characters in the Access Window through the ladder program.
User message come in two types, user message 1 and user message 2. User message 1 is used to display values stored in CM1720. When CR2901 is ON, the ASCII 24 half-width characters stored with CM1721 as the leading address, or the characters before end code NULL (00 H) will be displayed.

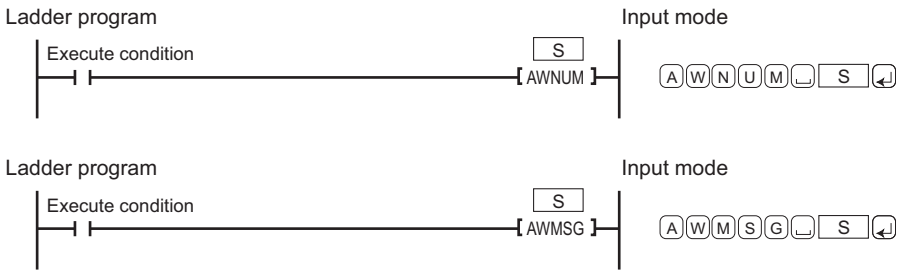
■ How to Display User Message

There are two ways of displaying user message.

(1) Using the AWNUM instruction (user message 1) and AWMSG instruction (user message 2)

User messages can be displayed easily without worrying out control relays (CR) and control memory (CM) by using dedicated instructions.
When user messages 1 and 2 are ON simultaneously, user message 1 numerical value is displayed first.

For details on instructions, refer to the "KV-8000/7000/5000/3000/1000 Instruction Reference Manual", "5-14 Access Window Instructions."



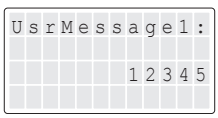
(2) Create a ladder program using the control relay (CR) and control memory (CM).

To display user message 1, store the displayed numerical value to CM01720 and turn CR2900 ON.
To display user message 2, store the displayed character string (ASCII code) to CM01721 to CM01732 and turn CR2901 ON.
When CR2900 and CR2901 are ON simultaneously, CR2900 is performed first.
(Value stored in CM01720 is displayed.)

■ Display example

● User Message 1

When CR2900 is ON, the numerical value currently stored in CM01720 will be displayed on screen.
In the screen example, the value of CM01720 is set to "12345", and the entire screen flashes.

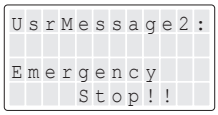


The screen will return to the original display in the following cases.

- When any of the Access Window keys is pressed. In this case, CR2900 will be OFF.
- When CR2900 is OFF.

● User Message 2

When CR2901 is ON, 24 half-width ASCII characters stored with CM1721 as the leading address or the characters before end code NULL (00H) are displayed.



CM No.	CM Value (HEX)	ASCII Representation
CM1721	$456d	Em
CM1722	$6572	er
CM1723	$6765	ge
CM1724	$6e63	nc
CM1725	$7920	y␣(Space)
CM1726	$2020	␣␣(Space) (Space)
CM1727	$2020	␣␣(Space) (Space)
CM1728	$2020	␣␣(Space) (Space)
CM1729	$5374	St
CM1730	$6f70	op
CM1731	$2021	␣(Space) !
CM1732	$2100	!(00H)

The entire screen flashes when it displayed.

The screen will return to original display in the following cases.

- When any of the Access Window keys is pressed. In this case, CR2901 will be OFF.
- When CR2901 is OFF.

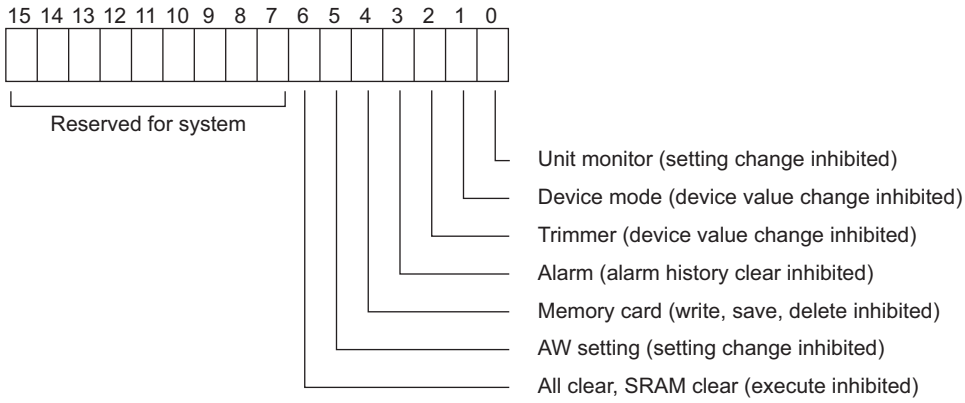
Operation Inhibited Setting

The operations on Access Window can be separately inhibited according to different functions.

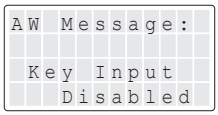
The functions and projects of operation inhibited setting are as follows.

Function	Item
Unit Monitor	Change settings
Device mode	Change device value
Trimmer mode	Change device value
Alarm	Clear alarm log
Memory card	Load, save, delete
Access Window setup	Change settings
All Clear mode	Clear
SRAM clear mode	Clear

Operation inhibited setting is used to assign 1 bit to CM1738 for each function, which will be inhibited when the bit is ON.

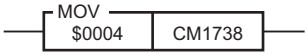


The following screen is displayed when an attempt is made to perform an inhibited operation.

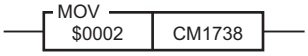


Example

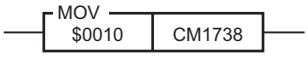
●Write inhibited setting of digital trimmer



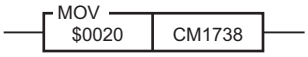
●Write disable setting in inhibited mode



●Memory card read/write inhibited



●Setting change inhibited set by Access Window



Note

In device mode, when device write inhibited is set, it can not be released in the Access Window.

Key Lock Function

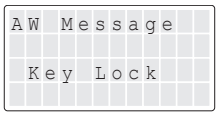
Key lock function is used to inhibited operations in Access Window. This is used when you intend to make the settings unchanged, or fix the display screen.

■ How to operate

Hold down the "M" key for at least three seconds with the "⬌" key held down.

● Incase of key unlock

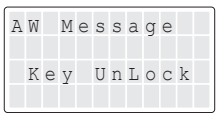
Key lock state is entered when the following screen is displayed.



Under the state of key lock, this display remains unchanged irrespective of any operation, unless you release key lock.

● Incase of key lock

Key lock will be released when the following screen is displayed.



Note

- **During the process of key lock, operation is disabled even if direct access switch is pressed.**
- **Key lock cannot be achieved during Unit Monitoring and I/O test.**

MEMO

2-2 Memory Card

About the Memory Card

On the KV-5500/5000/3000 Series PLC, you can exchange ladder programs, comments, and various unit setup information using the memory card. You can also transfer ladder programs or save and load device values by operation on the KV-5500/5000/3000's access window using only the memory card without the need for KV STUDIO.

- **Transferring data from memory card to the CPU**
  Data can be read by selecting the sub-directory (project folder) on the memory card in the access window.
  Data includes the following: program data such as ladder programs, comments, unit setup information and logging setup information, and device file data such as DM, EM, W, FM, ZF,CM, R, MR, LR, and CR.
  "Writing/Reading Project Data", Page 2-53

- **Auto-read function**
  When powered on, read data to CPU unit automatically, these data are saved in "Autoload" or "Atload**" (** : 01 to 99) (item) folder. If they are saved in "Runload" or "Rnload**" (** : 01 to 99) folder in advance, during PROG->RUN switching, it will read automatically.
  "Auto Load Function", Page 2-57

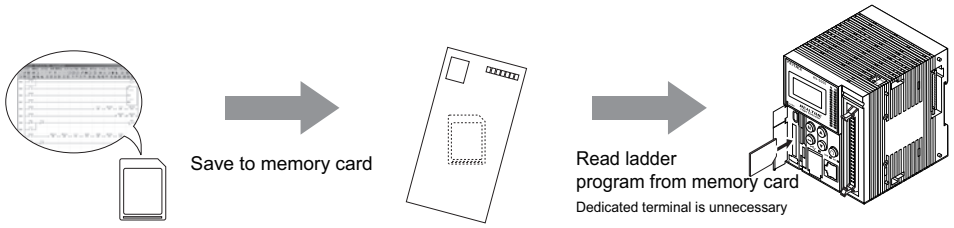
- **Saving data from the CPU unit to the memory card**
  Program files (ladder programs, comments, unit setup information, logging setup information) and all device files (DM, EM, W, FM, ZF, CM, R, MR, LR, B, CR) can be saved from the CPU to the memory card. Saved files are stored to a newly created sub-directory (project folder). The files are saved into the newly-created (project) folder. The name of folder is generated automatically, and displayed in the Access Window after normal completion of operation.
  "Auto Load Function", Page 2-57

- **Log logging/tracking function**
  If the logged device and loaded timing (triggering) are registered through KV STUDIO, the data will be saved automatically into the memory card. Since the data is saved in the format of CSV, it can be directly loaded into Microsoft Excel, etc.
  "2-3 Logging/Tracing", Page 2-60

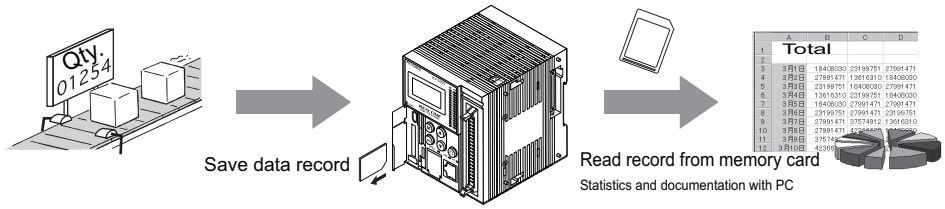
- **Ladder program-based memory card control**
  The memory card can be accessed from the ladder program when memory card instructions are used.
  Data values of devices on KV-5500/5000/3000 can be saved on the memory card by ladder programs, or data values of devices can be loaded into KV-5500/5000/300 from the memory card. Free space on the memory card can also be verified.
  "Memory Card Instructions", Page 2-59

● Example for use of a memory card

· Maintenance can be performed easily by a memory card. This allows a quick response to equipment maintenance and transmission of ladder data due to changes to specifications.



· Logging of device values is easy. Data is tabulated from logs to create data sheets with greater ease.



About the Memory Card

■ Memory card that can be used

A memory card and adapter or card reader for reading the memory card are required. Support SDHC memory card and SD memory card.

Operation through memory cards not specified by Keyence is not assured.

SD memory card



Item	KV-M16G	KV-M4G	KV-M1G
Memory	Flash ROM		
Type	SDHC		SD
Memory capacity	16GB	4GB	1GB
Read/Write cycles (each block)	60,000 operations		100,000 operations
Operating temperature	-25 to +85°C		
Storage temperature	-40 to +85°C		

■ Used in PC

The connection methods may differ depending upon PCs.

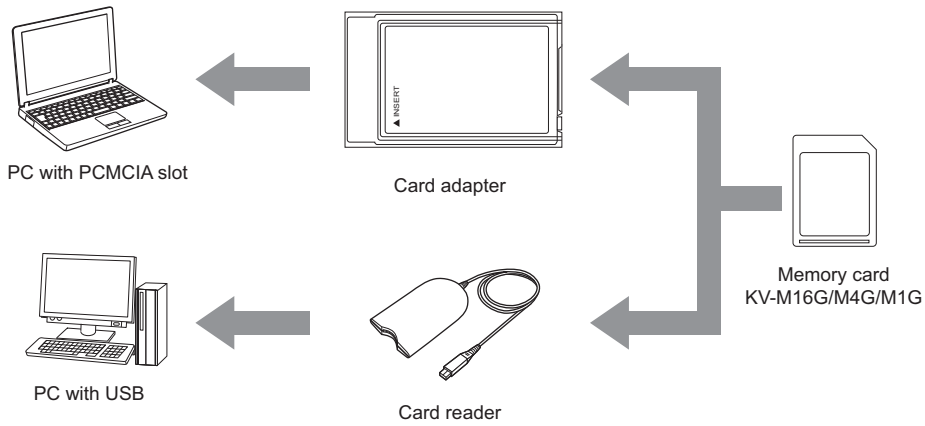
● When the PC has a PCMCIA slot (laptop PC, etc.)

Connect the memory card to the card adapter, and insert the card adapter into the PCMCIA slot on the personal computer.

● When the PC has a USB port

Connect the USB card reader/writer to the USB port on the PC. Next, insert the memory card into the card reader/writer.

Note **Only a PC pre-installed with Windows2000/XP Professional can be used.**

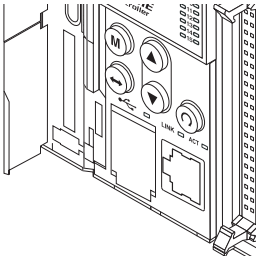


- **Memory card adapter**
  This adapter is used when the memory card is to be inserted into the PC card slot on the PC or card reader/writer on the PC. When the memory card adapter is used, the memory card can be handled as a PCMCIA2.1/JEIDA4.2-compliant PC card (Type II).
  For details on the memory card adapter, refer to the User's Manual provided with the memory card adapter.
- **Card reader/writer**
  This unit is for reading and writing data on memory cards on a PC that has a USB port. It cannot be used on PCs that do not have a USB port.
  For details on the USB card reader/writer for the memory card, refer to the User's Manual provided with the card reader/writer.

■ Used on the KV-5500/5000/3000

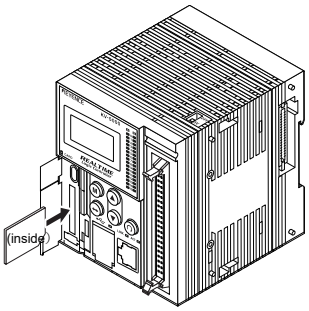
● Installing the memory card

1 **Slide the lock on the memory card slot cover upwards to open the memory card slot cover.**



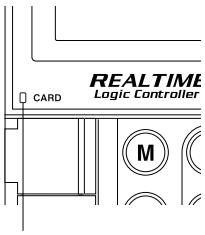
2 **Insert the memory card into the memory card slot.**
The labeling side at right hand is inserted properly with a "click" sound.

3 **After inserting the memory card, close the memory card slot cover until it clicks into place.**



● Removing the memory card

1 **Make sure that the memory card access LED is out, and slide the lock on the memory card slot cover upwards to open the memory card slot cover.**



Memory card LED during accessing

2 **Press the memory card in the insertion direction (inwards)**
You hear a click sound when the card is inserted properly.
Draw out the memory card straight.

3 **After removing the memory card, close the memory card slot cover until it clicks into place.**

Note

Do not use unnecessary force to open the memory card slot cover in a locked state.

■ Precautions When Using a memory card

The following describes general precautions when using a memory card.

Note

- **Data saved on a memory card may be lost in the following instances. Note that Keyence can assume no liability whatsoever if recorded data is lost. You must be very careful.**
  - **When the user or a third party has misused the memory card**
  - **When the memory card has been subjected to static electricity and electrical noise**
  - **When the memory card has been removed or other equipments have been turned OFF while the memory card is being accessed (e.g. during saving or deleting of data)**
- **We recommend backing up important data on MO disks, CD/DVD or other storage media.**
- **Never remove the memory card or turn power OFF while the memory card access LED on the PLC is lit (indicating that memory card is being read/written). Doing so might corrupt the data on the memory card.**

Note

- **In environments subject to severe noise, it may take longer time to access the memory card.**
  (In the worst case, this might damage the card or FAT (File Allocation Table).
  In this case, attach a ferrite core onto the power cable before use.
  - **Also, install the unit away from equipment that emits strong electromagnetic fields.**
- **Accessing of the memory card can not be started with the memory card slot cover open. Be sure to use memory card with the memory card slot cover closed.**
- **When the memory card slot cover is opened while the memory card is being accessed, the process that was being performed is continued until it is completed. However, subsequent accessing of memory card will not be performed.**
- **The SD memory card is formatted for maximum performance before it is shipped from the factory. SD memory cards formatted in Windows can be used. However, the performance of the SD memory card may not be fully demonstrated. If the memory card needs to be restored to its initial shipped state, contact your nearest agent.**

Writing/Reading Project Data

■ Structure of folder

The data managed by (project) folder on the memory card is described below.

Software	File type		File name	Way of storing
KV-5500/5000/3000	CPU System setting Ladder program Global label Local label Local Device Comment		□.YCD[*1]	Access window KV STUDIO (File>Memory card)
	Global device comment		□.YGC[*1]	
	Setting information of initial value of device.		□.YDR[*1]	
	Communication setting information		□.YAS[*1]	
	Unit setting information		□.YLB[*1]	
	Record/tracing setting information		□.YLG[*1]	
	Device File	DM	DM.ZDV	Access window KV STUDIO (Monitor/simulator >Batch change window)
		EM	EM.ZDV	
		FM	FM.ZDV[*2 *5]	
		CM	CM.ZDV	
		R	R.ZDV	
		MR	MR.ZDV	
		LR	LR.ZDV	
		CR	CR.ZDV	
		B	B.ZDV	
		W	W.ZDV	
		ZF	ZF.YDV[*5]	
	CPU Positioning function Parameter file		CPUMB.ZSH[*3]	KV STUDIO (File>Memory card)
	Email setting information.		MAIL*.YSH(*=0 to 48)[*4]	Access window KV STUDIO (Email setup tool)
	FTP client-side setting information		FTPC*.YSH(*=0～48)	Access window KV STUDIO (FTP client-side setup tool)
	Simple PLC connection setting information		ESPL*.YSH(*=0～48)	Access window KV STUDIO (simple PLC connection setup tool)
	Version information when memory card data are generated		Savelog.txt	Access window KV STUDIO
KV-L20R	PROTOCOL STUDIO File		PB*.ZSH(*=1A to 48B)[*3]	PROTOCOL STUDIO
KV-L2*V	PROTOCOL STUDIO 2 File (PS1 compatible (standard/Large) mode)		PB*.ZSH(*=1A to 48B)[*3]	PROTOCOL STUDIO 2
	PROTOCOL STUDIO 2 File (Protocol Studio2 mode)		PB*.YSH(*=1A to 48B)	Access window PROTOCOL STUDIO 2
KV-LH20V	Communication positioning unit parameter setting (Point parameter, control/system parameter)		SPSP**.YSH (* = 1 to 48)	Communication positioning setting tool [*6]

Software	File type	File name	Way of storing
Positioning unit	Positioning unit Parameter file	MB*.ZSH(*=1 to 48)	MOTION BUILDER
	Positioning unit Comment file	MC*.ZSH(*=1 to 48)	
MV-L40	MV-L40 Parameter file	MLS*.ZSH(*=1 to 18)	MV LINK STUDIO
	MV-L40 Comment file	MLC*.ZSH(*=1 to 18)	
KV-DN20	KV-DN20 Parameter file	DN*.ZSH(*=1 to 48)	KV STUDIO (KV-DN20 Setup Tool)
KV-CL20	KV-CL20 Parameter file	CL*.ZSH(*=1 to 48)	KV STUDIO (KV-CL20 Setup Tool)

*1 "□" file name is the same with the name of project folder.
*2 FM saves the FM of current bank, and read to FM of current bank.
*3 You cannot save it from Access Window to memory card. The setting itself is to save in DM or CM, so normal operation is possible even if the project data not containing such files are read.
*4 When performing email setup through KV-5000's CPU built-in Ethernet function, the setting will be saved by "MAIL0.YSH".
*5 If reading FM and ZF, it's required to firstly read the data of ZF and then data of FM.
*6 Not created when saved from the access window. However, the set point parameter etc. is stored in DM.ZDV.

TIP

● Version information when memory card data are generated

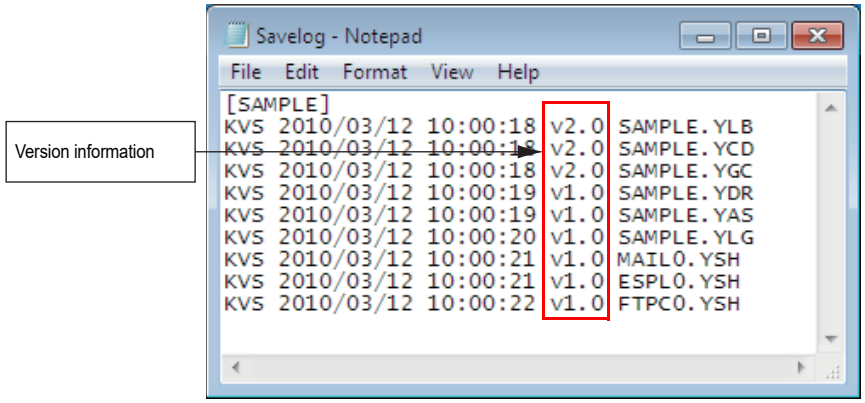
"Savelog.txt" is generated when memory card data are created.

"Savelog.txt" may be used to confirm CPU functional version supported by the created memory card data. When version of the data saved in memory card is higher than the version of KV-5000/3000 to be loaded, memory card data cannot be read.

"Memory Card", Page 2-29

In the following cases, "Savelog.txt" will be generated.

- In access window of CPU unit with CPU functional version above V2.0, save item data in the memory card
- When create memory card data using KV STUDIO above Ver.6



■ Access window

● How to save

If project data are saved from the Access Window of KV-5500/5000/3000, project folders "KVSAVE **" (**means serial No.: 00 to 99) will be generated automatically. The serial No. is the smallest two-digit number not yet used for folder name in the memory card.

"Memory Card", Page 2-29

● How to read

Select and read the project folders from Access Window of KV-5500/5000/3000.

"Memory Card", Page 2-29

Tip Methods of only reading some data All data in (project) folder are generally read from memory card.

For example, if you intend to save only the data of DM, or only save the program data, the specific data are only read from memory card to CPU unit after they are saved into folders in the memory card.

Unnecessary files are deleted via PC from folders in the memory card.

- At power-on, project data saved in the "AutoLoad" (Folder selection: "Atload**"(**:01~99)) (project) folder are read automatically.
- At PROG -> RUN, project data saved in the "RunLoad" (Folder selection: "Rnload**"(**:01~99)) (project) folder are read automatically.

■ Use KV STUDIO

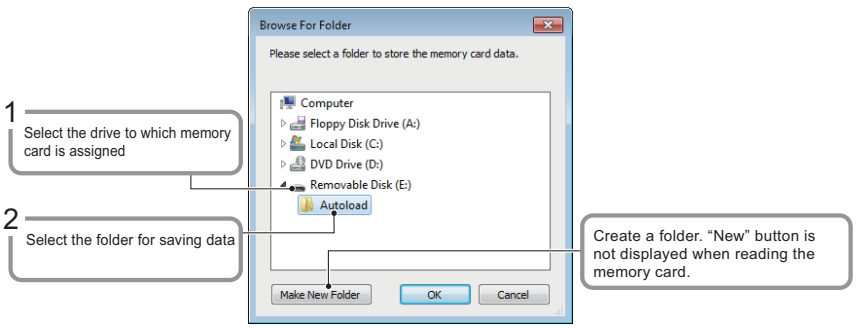
You can read/write project data of the memory card in the menu of KV STUDIO.

● Ladder program etc. (except device file)

1 Connect memory card to PC.

"Used in PC", Page 2-50

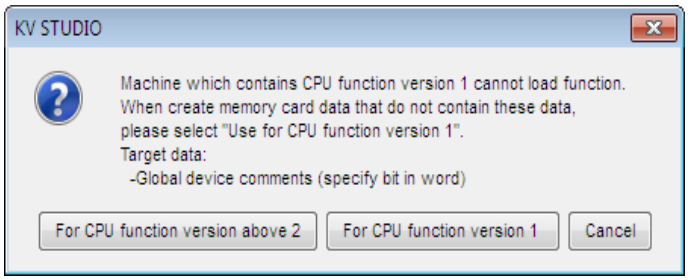
2 Select "File(F)"->"Memory card(M)"->"Write(W)" or "Read(R)" from the menu of KV STUDIO.



Note

If you select to save in the original folder, the data will be overwritten, the previous data will be lost.

In case storing data of KV-5000/3000 in memory card, if function of CPU function version 2.0 or above is used, loading is unavailable to CPU unit with CPU function version 1.1 or below. In case in PROG mode of CPU function version 1.1 or below, please create memory card data for CPU function version 1. Memory card data should be created after deleting the function of CPU function version 2.0 or above.



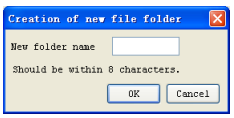
Note

Memory card data for CPU function version 1 cannot be created in the following situations.

- **In case commands and scrip functions of CPU function version 2.0 or above are used**
- **In case KV-5500 and KV-EP21V is included in unit configuration**
- **In case commands, arguments of macro and labels adopt double floating real number**

TIP

- If you intend to create new folder for saving, just click "New" button and enter the folder name to generate an project folder. The project folder will be created.



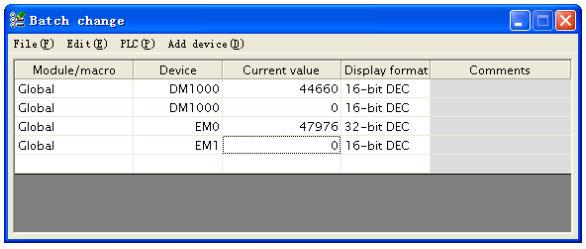
- The data in the memory card is managed separately through project folder.
- To ensure the project data in the memory card is automatically read at power-on, it's required to save it by the folder name of "AutoLoad or "Autoload**(** is value of CM1790)".
- To ensure the project data in the memory card is automatically read at PROG->RUN, it's required to save it by the folder name of "RunLoad" or "Runload**(** is value of CM1790).

● Device file

1 **Connect memory card to PC.**

"Used in PC", Page 2-50

2 Select "Monitor/simulator(N)"-> "Uniform change window(D)" from the menu of KV STUDIO.



3 Select "File (F)" -> "Read memory card (R)" or "Save to memory card (Z)" from the menu of the uniform change window.

Read: specify the read drive and folder name.
Save: save the registered device and current value.

Tip If the device's default setting of KV STUDIO is employed, the device value can also be managed through the memory card.

Auto Load Function

When powered on or PROG->RUN, read item data saved in the memory card automatically.
Control memory (CM) may be used to select the folder to be read from several folders.

■ Reading at power on.

1 KV STUDIO may be used to write item data under "Autoload" or "Atload" (** : 01-99) folder into the memory card.**

"Ladder program etc. (except device file)", Page 2-55

2 Insert the memory card into KV-5500/5000/3000 memory card slot, close the memory card slot cover, until “click”is heard.

3 Connect power supply of KV-5500/5000/3000.

Data are read automatically.

Note **If CPU system of KV STUDIO is set to read/write protection, an error will occur and operation can not be performed.**

● Read folder selection method

For the selection of folder to be read, save value in CM1790 in advance.

- When CM1790 value is 0
  Read "Autoload" folder.
  If "Autoload" folder does not exist in the memory card, automatic loading is impossible. Please run the program before power on. Error will not occur.
- When CM1790 value is 01 - 99
  Read "Atload**" (** : CM1790 value (01-99)) folder.

Folder No. Selection steps

1 In case of power on, save the value from external equipments such as touch panel into CM1790.
2 Power off.
3 Power on.
4 Read the folder selected by CM1790.
5 After reading, 0 is saved in CM1790, the read folder No. Is saved in CM1791.

TIP After automatic loading is completed, 0 is saved in CM1790, so when powered on at next time, the same folder No. Will not be read. However, please note that, in case 0 is saved in CM1790, if the memory card contains “Autoload” folder, it will be read when powered on at next time.

Note

When write protection is provided for CPU system setting of KV STUDIO, error will occur (read automatically), it will enter PROG mode. After the error is eliminated, in RUN mode, run the program before automatic loading.
In the following cases, error will occur (automatic loading folder), it will enter PROG mode.

- **When CM1790 value exceeds 100**
- **The memory card does not contain any folder selected by CM1790**

CPU unit with CPU functional version above V2.0 supports reading function of the selected folder. For CPU unit of V1 CPU functional version, read fixed folder "Autoload".

■ Read for PROG -> RUN

1 **Use KV STUDIO to write in item data in memory card under "RunLoad" or "Rnload**"(01~99) folder.**

"Ladder program etc. (except device file)", Page 2-55

2 **Insert the memory card in KV-5500/5000/3000 memory card slot, close the memory card slot cover, until "click".**

3 **KV-5500/5000/3000 executes PROG/RUN switching.**

Read data automatically and begin to run.

● Read folder selection method

Select the folder to be read, save value in CM1792 in advance.

- When CM1792 value is 0
  Read "Runload" folder.
  If the memory card does not contain "Runload" folder, automatic loading could not be performed. Run the program before PROG/RUN switching. Error will not occur.

- CM1792 value is 0 1 - 99
  Read "Rnload**"(CM1792 value (01-99)) folder.

Folder No. Selection steps

1 Save the value in CM1792 from external equipment such as touch panel.
2 PROG/RUN switching.
3 Read the folder selected by CM1792.
4 After reading, 0 is saved in CM1792, the read folder No. Is saved in CM1793.

TIP After automatic loading is completed, 0 is saved in CM1792, so when powered on at next time, the same folder No. Will not be read. However, please note that, in case 0 is saved in CM1790, if the memory card contains "Runload" folder, it will be read upon next PROG -> RUN.

Note

When write protection is provided for CPU system setting of KV STUDIO, error will occur (automatic reading), RUN mode cannot be set. After the error is eliminated, if memory card is taken out, in RUN mode, it will run the program before automatic loading.

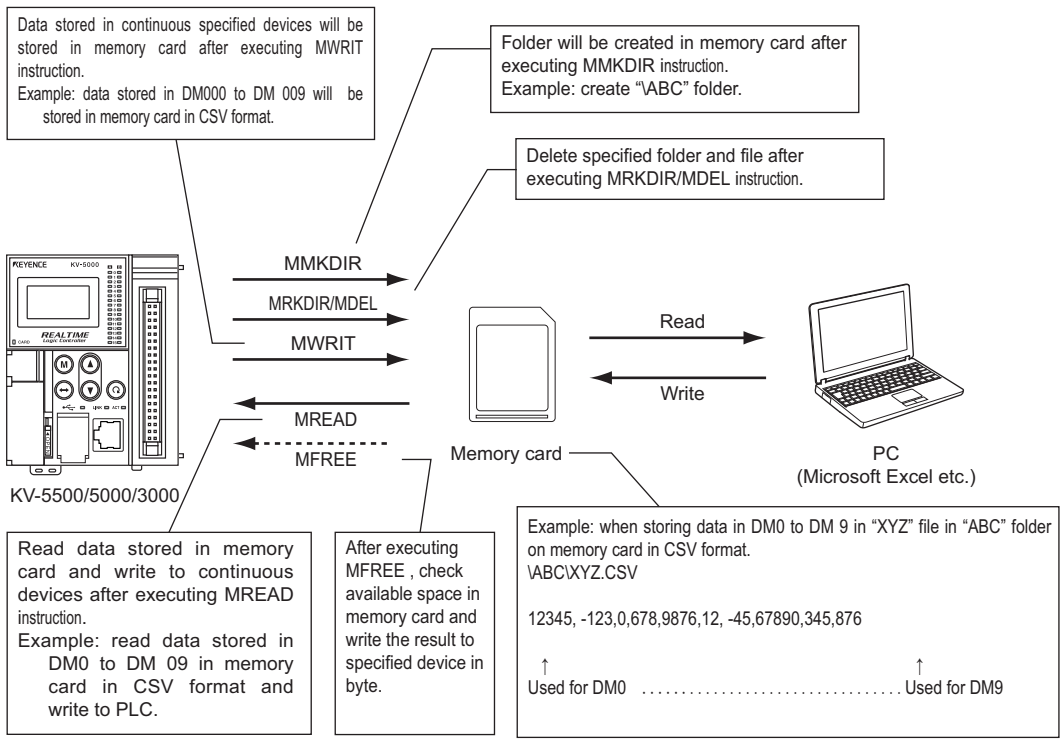
Error will occur in the following conditions (automatic loading folder), it cannot be set to RUN mode. After the error is eliminated, if take off memory card, run in RUN mode, it will run the program before automatic loading.

- **When the value of CM1792 exceeds 100**
- **When there is no folder selected by CM1792 in the memory card**

CPU unit with CPU functional version above V2.0 is used to support reading function of the selected folder. For CPU unit of V1 CPU functional version, read the fixed folder "Runload".

Memory Card Instructions

The memory card can be accessed from the ladder program when memory card instructions are used.



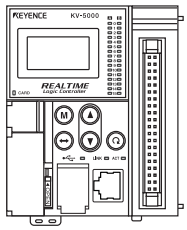
Please see KV-8000/7000/5000/3000/1000 Series Instruction Reference Manual "5-9 Memory Card"

2-3 Logging/Tracing

Overview

● Logging function

The logging function of KV-5500/5000/3000 means that the state or value of specified device is loaded by any timing (triggering). The loaded data is automatically saved into the memory card in the format of CSV. Device loading or triggering can be easily set through KV STUDIO。
Since the data is saved in the format of CSV, it can be directly loaded into Microsoft Excel, etc.



KV-5500/5000/3000

Auto save device data as CSV file

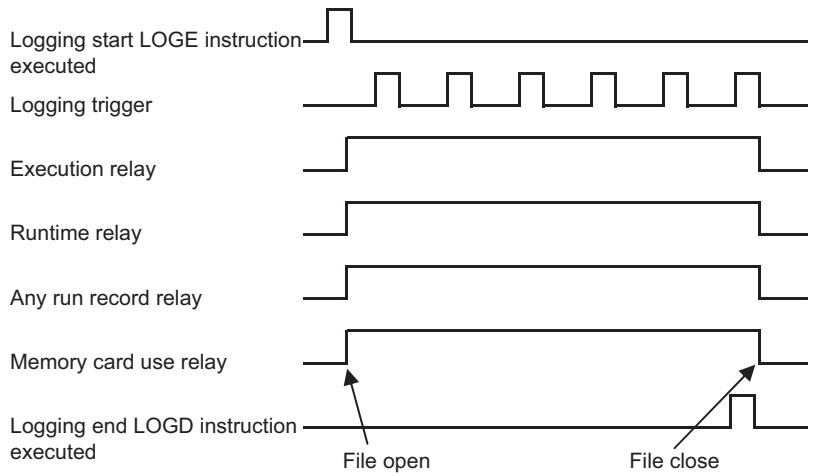
Memory card

"Memory Card", Page 2-48

Read



PC
(Microsoft Excel etc.)

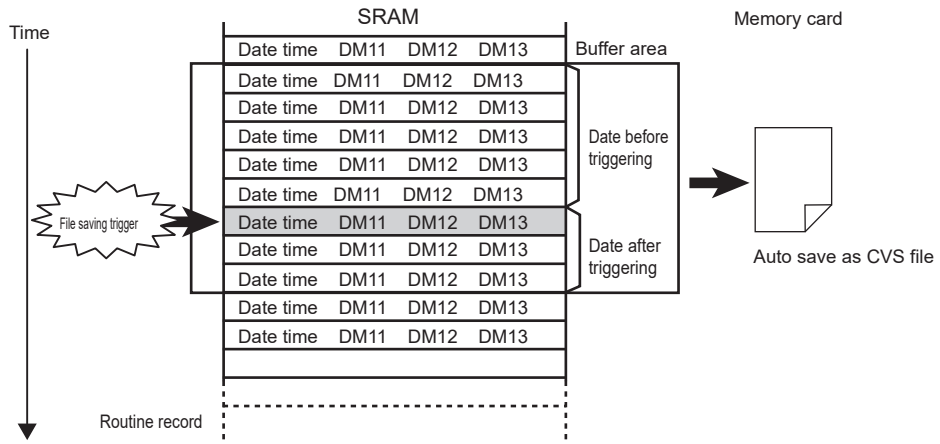


*Relay action may vary depending on the option settings.

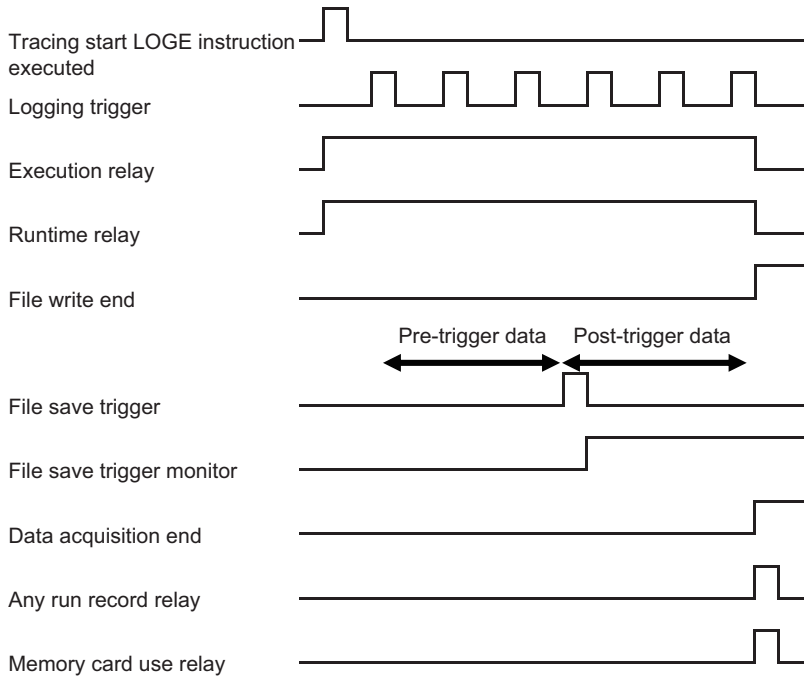
● Tracing Function

As in the case of logging function, the state or value of device will be recorded in buffer memory. According to the timing when saving the files, the preceding and subsequent files of specified data size are extracted and recorded into memory card or internal memory.

For example, after trigger setting is made for saving files in the event of abnormality of equipment, the data prior to or after occurrence of abnormality will be saved automatically, which facilitates abnormality analysis.

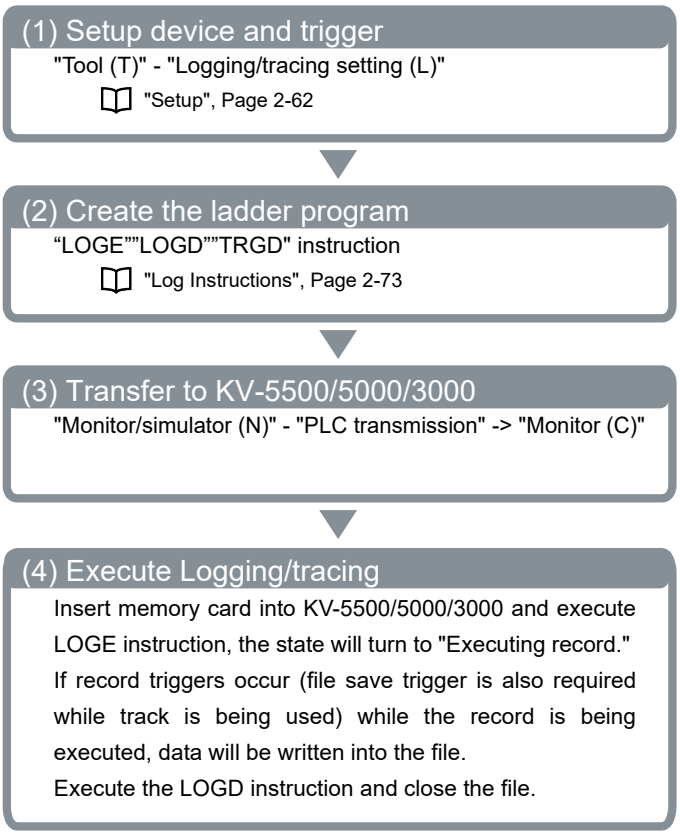


TIP After the file save destination is set as "internal memory", the data saved can be read from the real-time diagram monitor of KV STUDIO.



How to Use

The steps of using logging/tracing functions are described below.



Setup

Set up through KV STUDIO to use logging/tracing function.

The following settings are required when using logging/tracing function.

- Save the settings of file name
- Function (logging/tracing) selection
- Setting of logging/tracing device
- Setting of trigger
- Options setting
- Detailed setting of tracing (only when tracing function is selected)

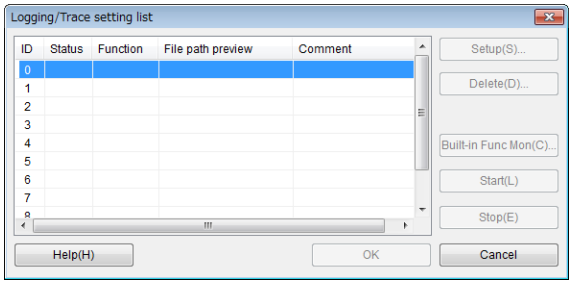
logging/tracing function permits to create up to 10 files, and divides them through logging/tracing ID (0 to 9).

Set separately the file names, device and trigger depending upon every logging/tracing ID.

1 **Select "Tool (T)" -> "Set up logging" from the menu.**

"List of logging settings list" dialog box is displayed.

Other procedure ·Click the " " button.

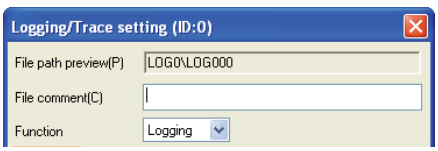


Item	Description
Status	The current execution state is displayed during monitoring/on-line edition.
Function	The functions (logging/tracing) already set are displayed
File path preview	An example of file saving position (file path) is displayed.
Comment	File comment already set is displayed.
Setup	"Logging/tracing setting" dialog box is displayed. The selected logging/tracing ID is set.
Delete	Delete the setting of selected logging/tracing ID.
OK	Confirm the setting contents and close the dialog box.
Cancel	Cancel the setting contents and close the dialog box.
Built-in function monitor	The built-in function monitor of the selected logging/tracing ID is displayed during monitoring process.
Start	The selected logging/tracing ID is implemented only during monitoring process (Ladder Program first)
Stop	The selected logging/tracing ID is implemented only during monitoring process (Ladder Program first)

2 **Select logging/tracing ID to be set, and press "Set up" button.**

Logging/tracing setting" dialog box is displayed.

Item	Description
File path preview	An example of file saving position (file path) is displayed.
File Comment	Insert file comments by selecting "Option" > "Insert file at the beginning of CSV file" in logging/tracing settings. (If less than 64 half-width characters,) they can be inserted in the first line of CSV file.
Function	Selection (Logging/tracing).



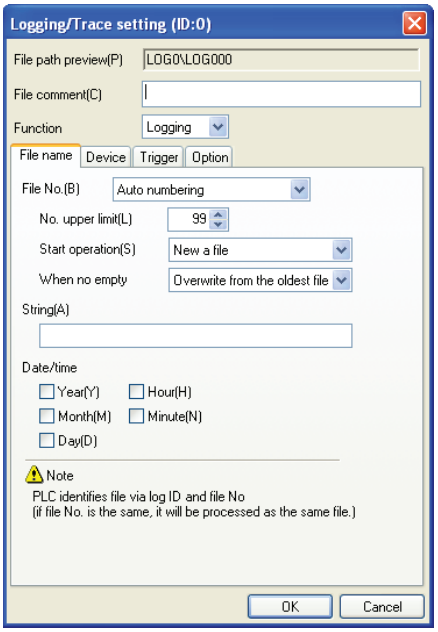
"Logging/Tracing", Page 2-60

File name

To set the files to be saved.

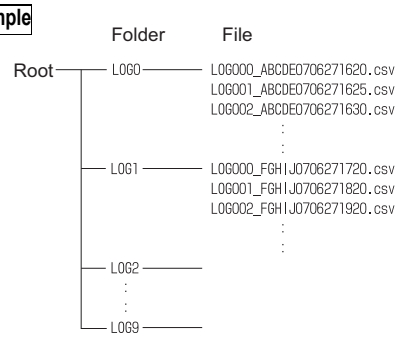
Name of folder for saving files will be determined depending on every logging/tracing ID. (LOG0 to LOG9)

TIP If the file saving destination is "internal memory" when tracing function is used, the items specific to "File Names" cannot be set.



Data of log files are saved on the memory card by the following forms.

Example



Item			Description
File No.	File No.		Select from "Auto numbering/Fixed/Dev val (lower 3 dgts)".
	Auto numbering*1		Between 0 to 999, use the minimum unused file No.
		No. upper limit	Set the upper limit (0 to 999) of file NO.
		Start operation	Select operation at logging start from "New file/Add to latest file".
		When no empty No.	If there isn't remaining No., please select "Overwrite from the oldest file/ Stop logging".
	Fix		Specify the fixed value between 0 to 999.
		No.	Set up file No.(0 to 999).
		When the same files	When there are same files, select "Add to the old file/Add".
	Device value (use last 3 digits)		Specify using word device value (0 to 999) when enabling is performed.
		Device	Set the device for saving file No.
		When the same file	When there are same files, select "Add to the old file/Add".
String*2			Set the character strings attached to the file names.
Date/time*2			If this option box is selected, the file name will contain creation date and time information when the LOGE instruction is executed. The date and time information is fixed as the time when reading the new. So, the file name isn't changed when adding. Original files are deleted when overwriting the existing ones, so, the date and time information of new files is the information when file is created. Year (00 to 99), month(01 to 12), day(01 to 31), hour(00 to 23), minute (00 to 59)

*1 After retrieving of remaining No., CPU unit may prepare to save data to the files. In this case, the relay for logging the working condition is ON. Buffer overflow is liable to occur if trigger is previously activated, so don't activate the trigger after the relay for logging the working condition is ON.
The higher the upper limit of No., the longer the time for retrieving remaining NO. The required time is about 15s when the upper limit of No. is 999.

*2 When log ID4, file NO. 2, character string "KEYENCE", time information (in YY/MM/DD/HH/MM) are selected and file is created at 14:15, Jun 13, 2007, "log002_KEYENCE0706131415.csv" will be generated under folder "log4" of the memory card.

File name: log (File No.) _ (Character string) (Date)

Up to 32 half-width characters

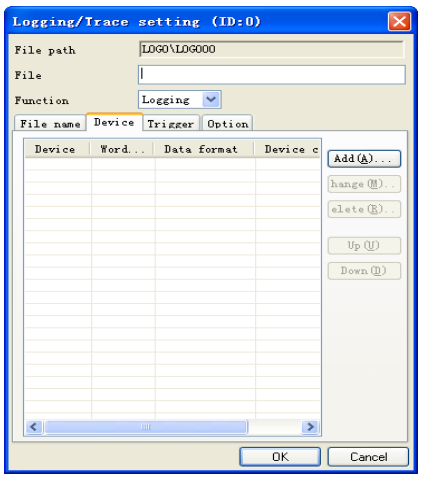
For information about what to do in case there is no room in the file No., please see the About the Processing at start of logging/tracing on P2-83.

Note

"KV-5500/5000/3000" PLC identifies files through folder name (log ID) and file No. (without consideration of character string, date and time.)
Under the same folder logging ID in the memory card, don't use PC to create several files of different character strings or date/time with the same file No.

Device

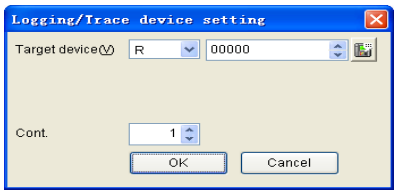
To set the saved devices by mixing the bit device and word device.
At most 128 devices can be set for every logging ID.

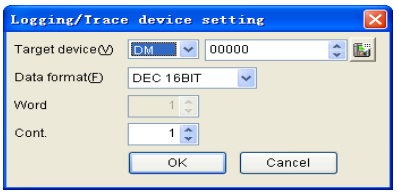


Example

(1) When all 128 devices are set to the bit device:
ON/OFF state (0 or 1) of 128 bit devices will be logged.
(2) When all 128 devices are set to the word device with 1 words:
Values of 128 word devices with 1 words will be logged.
(3) When all 128 devices are set to the word device with 2 words:
Value of 64 word devices with 2 words will be logged.

Item	Description
Add	"Logging/tracing device setting" dialog box is displayed when "Add" button is pressed. The logging/tracing device is added.
Change	Select the changed device. Press "Change" button to display "Logging/tracing device setting"dialog box. The logging/tracing device setting is changed.
Delete	Press "Delete" button to delete the selected device. (Multiple device can be selected)
Up	Shift the selected device up in the registering sequence.
Down	Shift the selected device down in the registering sequence.





Project	Description
Target device*1	Set the logging/tracing destination device.  Press the button to select from the device comments.
Data format	Select from "DEX16BIT/DEX 32BIT/±DEX 16BIT/±DEX 32BIT/ HEX 16BIT/HEX 32BIT/ASCII16BIT/FLOAT". To capture TEXT codes, please select ASCII16BIT.
Number of words	Set only when "ASCII16BIT" data format is selected. Setting range: 1 to 16
Continuous number	Place the device set through destination device on the front part, and set the number of devices for continuous logging/tracing.

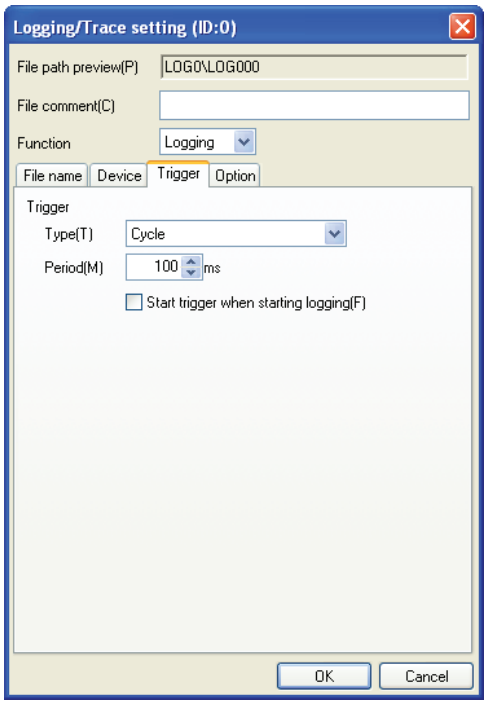
*1 Destination device

bit: R / MR / LR / CR / T (Contact) / C (Contact)/ CTC (Contact)

word: DM/EM/FM/ZF/W/CM/TM/TC(Timer current value)/CC(Counter current value) CTH/TRM (trimmer) / Z

Trigger

To set timing of logging/tracing of registered devices.



Item		Description
Type *1		Select trigger types from "Bit device/period/trigger instruction (TRGD)".
Bit device		Set bit device  Press the button to select from the device comments.
cycle	cycle	Set the cycle (1 to 86400000) (unit: ms).
cycle	Start trigger when starting logging	If the checkbox is selected, trigger is activated when logging/tracing is started.
Trigger instruction		Triggering occurs when TRGD instruction is executed. "TRGD Instruction", Page 2-77

***1 Bit device**

Logging/tracing is run when the specified bit device is in ON state.

Referenced to the processing state of END, the state of bit device isn't logged when ON/OFF during 1 scan.

Device value at END processing of detecting trigger is saved.

If bit device is ON, the device value for each scan and END processing will be saved.

Cycle

Through the built-in timer of KV-5500/5000/3000, logging/tracing according to the specified interval time is run.

Device value at END processing of detecting trigger.

Every scanning is performed when specified time is less than scanning time.

Time interval is calculated starting from the operation of logging/tracing.

In PROG mode, the timing of time interval is reset.

Note

Through END processing after trigger is activated, the specified device value is read. Thus, at most 1 scan can be delayed from trigger activation to device value saving.

TRGD instruction

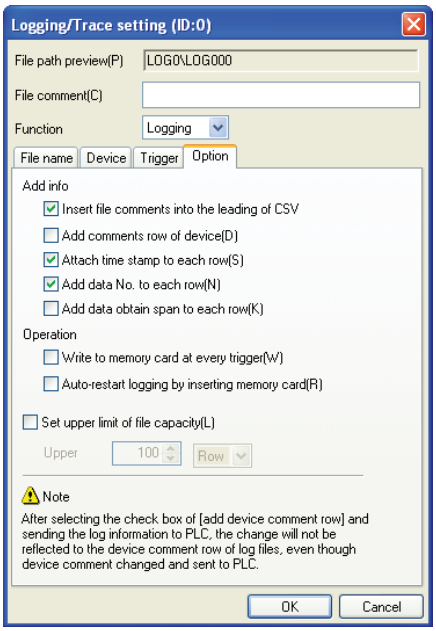
The device value when performing TRGD instruction is loaded, without the need of waiting for END processing.

At most 8 value can be logged in the program for 1 ID.

Logging is also performed in the interruption program or fixed period module.

Option

To set the detailed condition of additional information or operation. When the tracing functions is selected, no setting can be done if the file saving destination is "internal memory".



*About the Buffer Capacity Setting Up on P2-70.

Item		Description
Add instruction*3	Insert file comment into the leading of CSV file.	If the checkbox is selected, file comment will be inserted at the beginning of CSV file.
	Add comments row of device *1	If the checkbox is selected, the device's comment will be inserted. If no comments are written, the device No. can be attached.
	Attach time stamp to each row *2	If the checkbox is selected, time interval at each line will be added.
	Add data No. to each row	If the checkbox is selected, data No. will be added at each line. Logging/ tracing will be started from 0. When setting file No. and selecting "Add", No. will be started from 0 at the middle of file (the position for starting adding). In the event of buffer overflow and unexpected situation, the time of occurrence of unexpected situation can be clearly learnt from the data No.. In case of buffer capacity overflow, open the "CPU system setting up" in the workspace, and set up through "System Setting Up" and "CPU Unit Buffer Capacity Setting Up". About the Buffer Capacity Setting Up on P2-70.
	Add data obtain span to each row	The lapse time from Captured latest data is logged (unit: 1s), up to 3600s.
Operation	Write to memory card at every trigger*4 (only logging).	If the checkbox is selected, saving on memory card will be performed whenever trigger is activated.
	Auto-restart logging by inserting memory card*5(Only logging)	If the checkbox is selected and memory card is removed during logging process, the logging data is saved in the memory of CPU until the memory card is inserted next time. Memory card is restarted once inserted.
Upper limit of file capacity (Only logging)		If the checkbox is selected, the upper limit of the file capacity can be set. "Troubleshooting for overflow of file capacity settings", Page 2-84
	Upper limit*6(Only logging)	The upper limit is set by line or KB.

*1 The device for which the device comment is not transferred to CPU unit will be stored to a device No.(e.g. DM0).

*2 The year, month, day, hour, minute and second in the time stamp are saved in the format of CSV.

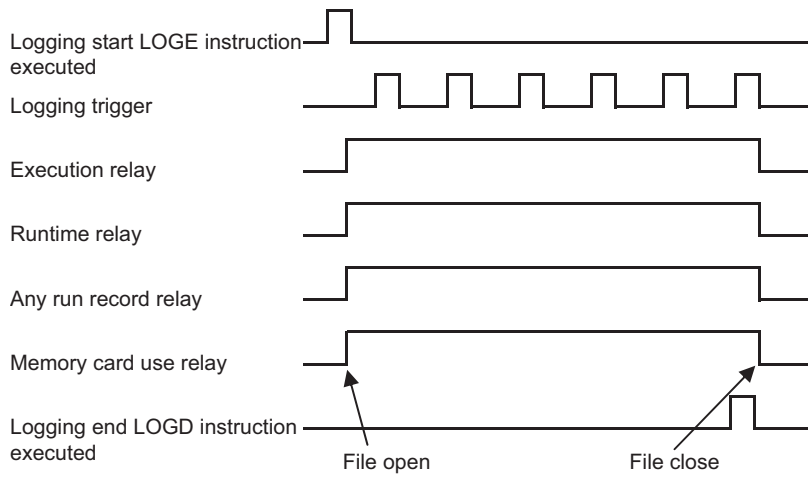
Example	2004/12/13,14:15:16

*3 "CSV files", Page 2-71

*4 The files are always in open state during logging process. If power is switched off when the files are in open state, the logged results will not be saved on the memory card.
Before power off, please ensure to execute the LOGD instruction.
If the checkbox is selected (Write to memory card at every trigger), as long as saving is completed after trigger, the logged results will remain in the memory card even if the power is off.
However, if the power is off when being saved into the memory card, the data in the memory card may be lost.
To perform writing to memory card at each trigger, the access time to the memory card will become longer. Thus, buffer overflow will likely occur. When the trigger interval is short, please uncheck "Write to memory card at every trigger".

*5 This function is "Auto restart", not "Auto start". When LOGE instruction is executed and memory card isn't inserted into the unit, the log error relay will be opened without starting logging.
"Auto restart" refers to the function that a restart will be performed when the memory card is inserted.

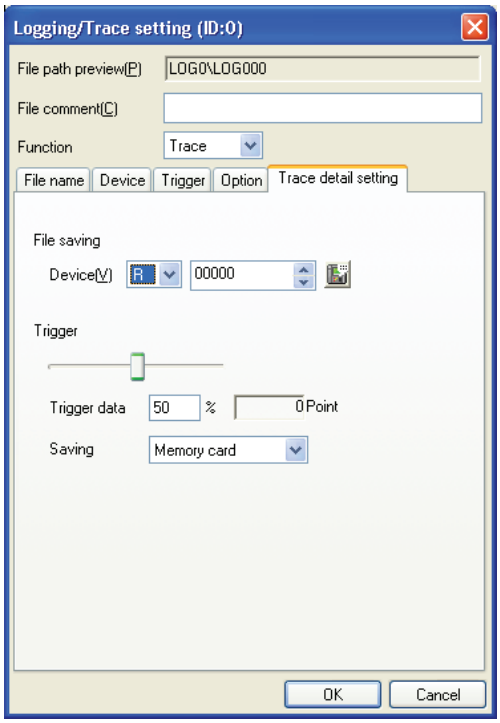
*6 The number of lines, file comment and device comment occupy 1 line respectively.
File size indicates the size including all file comments and device comments.
"Program Capacity", Page 3-11



*Relay action may vary depending on the option settings.

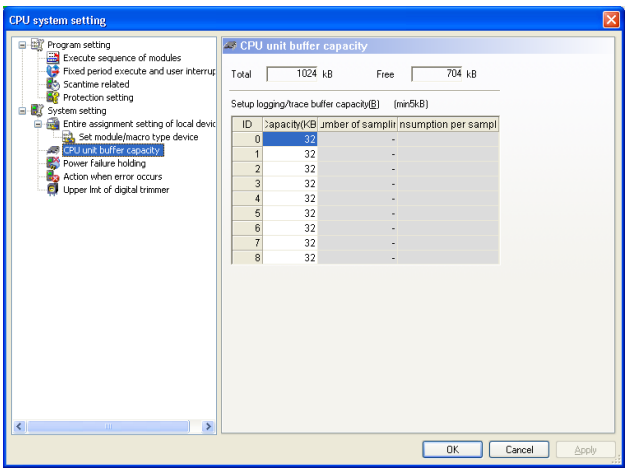
Trace detail setting

Setting is allowed when tracing function is selected.
Triggering or saving method when the files are saved will be set.



Item		Description
File Saving trigger	Device	Set bit device*3 Press the button to select from the device comments.
Trigger position	Trigger data size (%)	Press % to set the data size after trigger. Slider can also set up.
	Trigger data size (point)*1	The data size set by % is displayed by number of points.
Saving (destination)*2		Select from "Memory card/internal memory".

*1 Open "CPU system setting" from work space, then set the data size to be saved through "System setting" -> "CPU unit buffer capacity setting".



After the used ID capacity is increased, the data size (number of samples) that can be saved will become bigger. Avoid exceeding total capacity 1024kB when setting.

*2 When internal memory is selected, read data will be read from "Real-time diagram monitor".
KV STUDIO user's manual "Real-time diagram monitor"
When power is off, the data saved in the internal memory will be lost.

*3 When trigger type is "TRGD instruction", the file saving/triggering state will be confirmed only when TRGD instruction/function executed.

About CSV File

■ CSV files

CSV files generated automatically through logging/tracing function comprise device data, additional data information and additional file information. The character length column (separated by comma) fixed. In the event of lacing characters of data, spaces will be inserted automatically. A half-width character is counted as 1 character, and a full-width character is counted as 2 characters. In addition, these letters align left if the data format is ASCII character string, otherwise align right.

● File additional information

The following items will be saved from the first line of the file according to the setting contents "Options" tab of "logging/tracing setting" dialog box.

Item	1 column character length	Example	Note
File Comment	64	Header	The length of 1st line includes 64 characters." " is not included in the character length.
File saving trigger state (only tracing)	32	"TRIGGER DATA NO" "COMM TRIGGER DATA NO"	""" is not included in the character length.
File saving trigger occurring position (only tracing)	10	1234567890	The data No. is logged when file saving trigger is activated.
Device Comments	32	…, "Starting relay" ,…	" " is not included in the character length.

*Doesn't include comma.

● Additional data information

According to the setting contents in the "Option", the following items are saved from the left side of device data in sequence.

Item	1 Column character length	Example
Data No.	10	1234567890
Timing flag(date)	10	2007/06/11
Timing flag(time)	8	11:12:13
Data capture interval	10	1234567890

*Doesn't include comma.

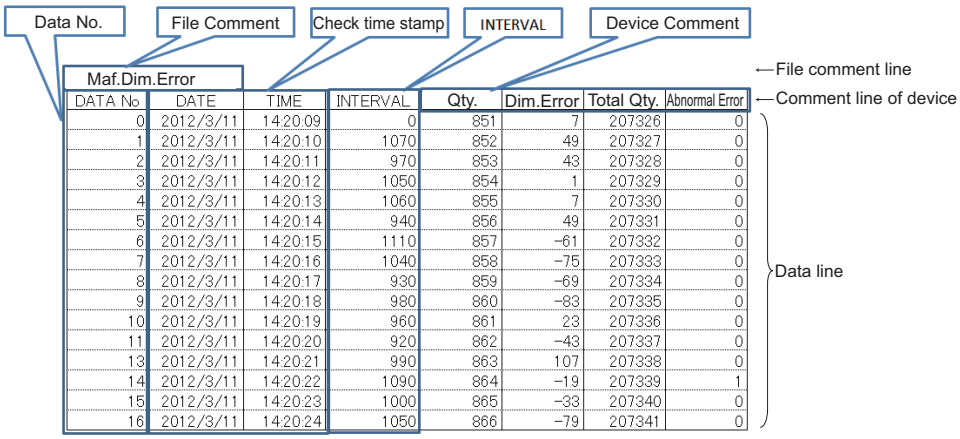
● Device data

According to the setting of "Device", it's saved by the following character length.

Item	1 Column character length*	Example	Note
Bit device	1	…,1,…	ON:1 OFF: 0
±DEX16 bits	6	…,␣ -1234,…	No "+" is added in the case of positive value.
decimal 16 bits	5	…,␣ 1234,…	-

Item	1 Column character length*	Example	Note
±DEX32 bits	11	…,␣1234567890,…	No "+" is added in the case of positive value.
DEX 32 bits	10	…,␣123456789,…	-
HEX 16 bits	4	…,BA98,…	
HEX 32 bits	8	…,BA987654,…	
FLOAT	13	…,␣␣␣2.4123E+12,…	Exponent format is fixed.
ASCII16BIT	(words)×2+2	…,"a123"␣…␣,…	If NULL exists in the character string, the subsequent character strings are not logged.

■ CSV File sample



Maf.Dim.Error							
DATA No.	DATE	TIME	INTERVAL	Qty.	Dim.Error	Total Qty.	Abnormal Error
0	2012/3/11	14:20:09	0	851	7	207326	0
1	2012/3/11	14:20:10	1070	852	49	207327	0
2	2012/3/11	14:20:11	970	853	43	207328	0
3	2012/3/11	14:20:12	1050	854	1	207329	0
4	2012/3/11	14:20:13	1060	855	7	207330	0
5	2012/3/11	14:20:14	940	856	49	207331	0
6	2012/3/11	14:20:15	1110	857	-61	207332	0
7	2012/3/11	14:20:16	1040	858	-75	207333	0
8	2012/3/11	14:20:17	930	859	-69	207334	0
9	2012/3/11	14:20:18	980	860	-83	207335	0
10	2012/3/11	14:20:19	960	861	23	207336	0
11	2012/3/11	14:20:20	920	862	-43	207337	0
13	2012/3/11	14:20:21	990	863	107	207338	0
14	2012/3/11	14:20:22	1090	864	-19	207339	1
15	2012/3/11	14:20:23	1000	865	-33	207340	0
16	2012/3/11	14:20:24	1050	866	-79	207341	0

Log Instructions

To implement the logging operation, a program for using logging instruction can be written.

Instruction	mnemonics	Description about instruction	Page
Enable logging/tracing	LOGE	Set logging of ID logging/tracing to enabled/inhibited state	2-75
inhibited logging/tracing	LOGD		2-75
Capture log data	TRGD	Capture log data of ID specified.	2-77

■ Calculation of file size

File size can be calculated as follows. The unit to be used is byte.

(size of a file comments line)
+ (size of a device comments line)
+ (size of a data line) x (number of data lines)
= (file size)

(size of file comments line) = (the number of characters set up with KV STUDIO) + 4
A half-width character is counted as a letter and a full-width character is counted as 2 letters.

(size of a device comments line)={35x(number of device comments)}+1
={35x((number of devices)+A+B)}+1

"attach a data No. to each line" : Use (A=1) Not Use (A=0)
"Attach a time stamp to each line" : Use (B=2) Not Use (B=0)

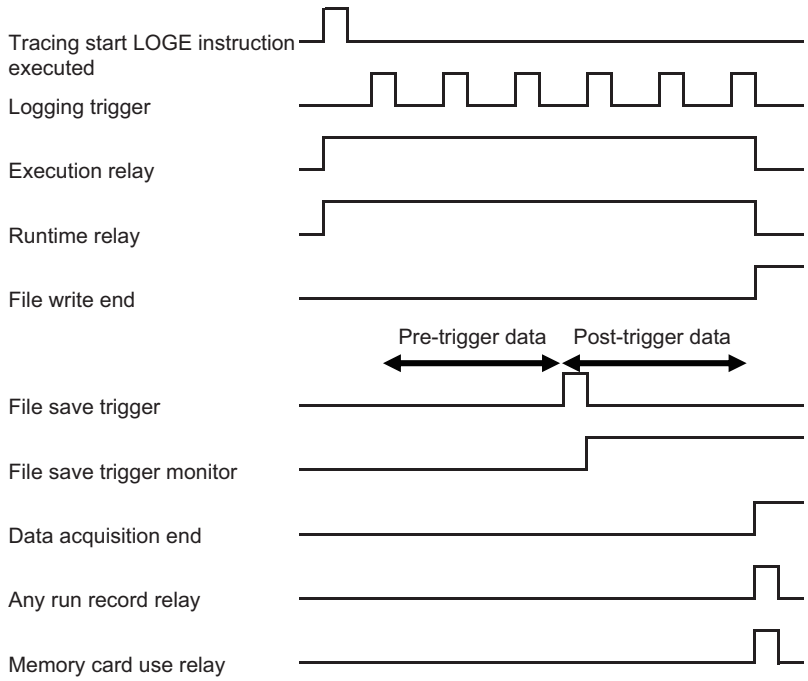
(size of data line) = (total size of devices)+1

Size of device

Item			Size
Bit device			2
Word device	1 word	Unsigned	6
		Signed	7
	2 words	Unsigned	11
		Signed	12
	Floating point real number		14
	ASCII character string (n words)		(n x 2) + 3
Data No.			11
Time stamp (date + time)			20
Data capture interval			2~11

Note

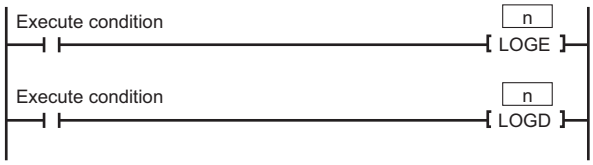
An approximate number of files that can be stored can be calculated using the file size and memory card capacity calculated in the above steps. However, the actual number of files that can be stored may vary depending on disk use. Please ensure sufficient free space is available on the disk.



LOGE
LOGD

LOGE	**Enable logging/tracing**	**Set logging of logging/ tracing to enabled/inhibited state**
LOGD	**Inhibited logging/tracing**	

Ladder program



Input mode



Operand	Available devices																	Index change
	Bit device							Word device							Constant	Indirect specifying		Local Device	
	R	(DR)	MR LR B	T	C	CTC	CR	DM EM FM (ZF) TM (W)	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
n	○	-	○	-	-	-	○	○	○	○	○	○	○	○	*1	-	○	○	○

Operand	Description
n	Logging/tracing specifying ID (0 to 9).*1 *2

*1 Cannot be specified in "$".

*2 When bit device is specified in n, continuous 16 bit will be occupied.
If word device is specified, 1 word will be occupied.

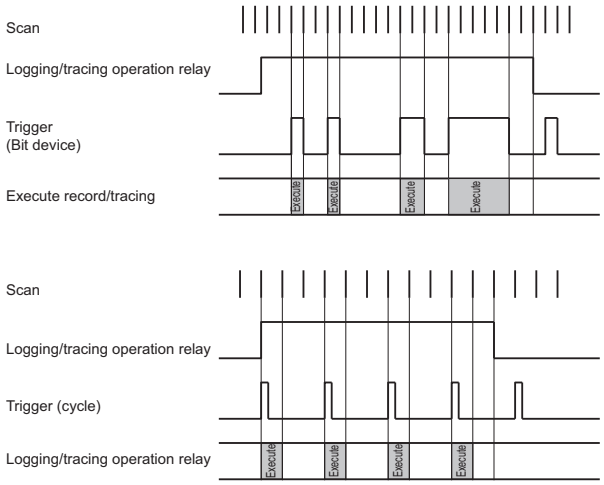
Description of Operation

LOGE When execute condition is ON, n will set ID of specified logging/tracing to enabled state.
When the instruction is performed, CPU unit buffer of specified ID is cleared, and the logging/tracing operation relay is set. When a trigger is activated, logging/tracing will be performed.
Operation enable state will continue before LOGD instruction is executed, independent of the execution condition of the LOGE instruction.
The logging/tracing of all log IDs can enter into operation enable state under the same execution condition.

LOGD When execute condition is ON, n will set ID of specified logging/tracing as inhibited state. After the instruction is executed, logging/tracing operation relay of every ID is reset, then logging/tracing is stopped. All log contents till that time are output to memory card.

Log ID	Logging operation relay
0	CR000
1	CR100
2	CR200
3	CR300
4	CR400
5	CR500
6	CR600
7	CR700
8	CR800
9	CR900

Timing chart of logging/tracing



Operation flag

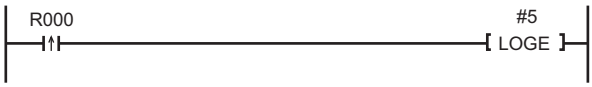
CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	It's ON when a value larger than 10 is specified in n, or in direct specifying and index change range are not suitable; it is OFF in other cases. There is no change when indirect specifying and index change are not specified in operand.

* If CR2012 is ON, the instruction will be not executed.
When CR2012 is ON, the detailed error message is saved into CM5100 to CM5176.

"Error Log (CM)", Page 3-20

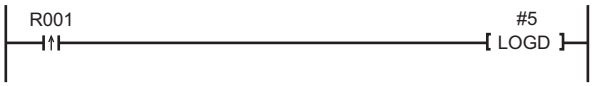
Sample Program

When input R000 is ON, logging/tracing of ID5 enters into operation enable state.




```
(mnemonics list)
 LDP R000
 LOGE #5
```

When input R001 is ON, logging/tracing of ID5 enters into operation inhibited state.




```
(mnemonics list)
 LDP R001
 LOGE #5
```

TRGD

TRGD **Capture log data** **Capture log data of specified ID.**

Ladder program



Input mode



Operand	Available devices																		Index Change
	Bit device							Word device							Constant	Indirect specifying		Local Device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM (W)	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
n	○	-	○	-	-	-	○	○	○	○	○	○	○	○	○	-	○	○	○

Operand	Description
n	Specify the logging/tracing ID for capturing, or save the first device of logging/tracing ID. *1

*1 Specify the logging ID between 0 to 10. Please specify "10" when trigger by instruction is used in real-time diagram monitor.

Description of Operation

TRGD When execution condition is ON, data of logging/tracing ID in n will be captured.

· Capture the data until TRGD instruction is performed.

Data can be Captured during END processing when bit device or period for triggering logging/tracing; if TRGD instruction is used, data can be Captured anytime from the ladder.

Note

- · when using the TRGD instruction to capture data, please select Trigger Instruction (TRGD) as the Trigger Type in the Logging/Tracing Settings of KV STUDIO.
- · To use Instruction Trigger in the Real-time chart monitor, select Instruction Trigger from the Trigger Type in the Trigger setting of the Real-time chart monitor screen. Otherwise no data will be captured even if the TRGD instruction is executed.
- · At most 8 TRGD instructions can be used by 1 project for 1 ID.

Operation flag

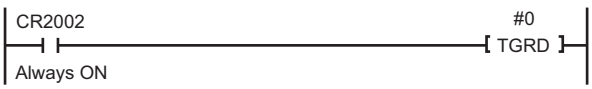
CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	· It is ON when the operand value is beyond the specified range. · It is ON when indirect specifying, and pointer change range are not suitable. Otherwise, the value is OFF. · No change will occur when n is specified as a constant.

* If CR2012 is ON, the instruction will not be executed.
When CR2012 is ON, detailed error info are stored in CM5100 to CM5176.

"Error Log (CM)", Page 3-20

Sample Program

If the following ladder program is included in the fixed period module, logging will be performed every period.




```
(mnemonics list)
 LD CR2002
 TRGD #0
```

Note

When fixed period module is implemented, it's necessary to set it to interrupt enable state (perform EI instruction).

"Fixed-Period Module", Page 3-99
"3-5 Interrupt", Page 3-31

Device List for Logging/Tracing

Control information and error information for logging/tracing are assigned to the control relay and control memory.

Control relays include control relays for each logging/tracing ID and a relay only reserved for the system.

Note

The control relay/control memory is reflected through END processing. Under locking state, no results can be reflected prior to END processing, even if operation is performed.

■ Devices of IDs

Device No. of logging/tracing IDs (0 to 9)					Attribute R: Read only Blank: R/W	Content
ID0	ID1	ID2	…	ID9		
CR000	CR100	CR200	···	CR900		Execute logging/tracing
CR001	CR101	CR201	···	CR901	R	Logging/tracing operation in progress
CR002	CR102	CR202	···	CR902	R	Logging/tracing file write complete
CR003	CR103	CR203	···	CR903	R	Alarm for 50% logging buffer or less
CR004	CR104	CR204	···	CR904	R	Logging buffer overflow
CR005	CR105	CR205	···	CR905	R	RUN writing during logging
CR008	CR108	CR208	···	CR908	R	Logging/tracing error
CR009	CR109	CR209	···	CR909	R	Error of insufficient capacity of memory card
CR010	CR110	CR210	···	CR910	R	Device/trigger setting abnormal
CR011	CR111	CR211	···	CR911	R	Monitoring of tracing file writing trigger
CR012	CR112	CR212	···	CR912	R	Tracing data capture complete
CM1660	CM1661	CM1662	···	CM1669	R	Buffer free space (in Kbyte)
CM1680	CM1681	CM1682	···	CM1689		File storing counter

■ Common devices

Device No.	Attribute R: Read only Blank: R/W	Content
CR3210	R	Arbitrary logging/tracing memory card in use
CR3211	R	Memory card in use
CR3212	R	Memory card identification complete
CR3213	R	With memory card
CR3215	R	Memory card write protect
CM2391		Power OFF during memory card access

■ Details of devices

● Logging/tracing operation relay

To enable and inhibited logging/tracing. It is set when logging/tracing instruction (LOGE) is performed, or logging/tracing is started through KV STUDIO, generally no direct operation is required.

When this relay is ON, all state relays of the same logging/tracing ID will be OFF.

It will be reset when an error occurs.

● Logging/tracing in progress relay

In fact, it's ON when logging/tracing is run.

● Logging/tracing file write complete relay

When logging is used: the relay is ON when data larger than upper limit of the specified file capacity are saved in every file.

When tracing is used: the relay is ON when data have been written into file or internal memory

When the relay is ON, logging/tracing will be stopped; the logging/tracing operation relay will be OFF.

When LOGE is executed in the next time, the logging/tracing file write end relay is OFF.

"Troubleshooting for overflow of file capacity settings", Page 2-84

● Alarm relay when the logging buffer is below 50%

Since the triggering frequency is higher than writing speed, the relay is ON when the residual capacity of buffer is below 50%. When data larger than upper limit of the specified file capacity are stored, the relay is ON.

● Buffer overflow relay

If the data cannot be duly written into the memory card, the logging/tracing buffer overflows.

When the relay is in ON state, data abnormity occurs. Observe the data No. to know when data abnormity occurs.

Even if overflow occurs, data will continue to be written into the memory card.

When overflow occurs, the following measures can be taken to alleviate overflow.

- Reduce the frequency of access to the memory card
- Reduce data size and frequency trigger
- Prolong the scanning time.

● Store in RUN during logging/tracing relay

It will be ON when logging/tracing is in progress, and writing is performed in RUN.

When writing is performed in RUN, logging/tracing continues, the speed of writing into memory card will change, leading to buffer overflow easily.

● Logging/tracing error relay

When tracing function is used, it's in ON state after writing file is triggered. Please check if various error relays were not turned on. In this case, the residual data in the buffer will disappear. When LOGE instruction is executed the next time error will be cleared.

● Memory card without remaining space error relay

When the memory card has no sufficient remaining space, it's ON.

When the relay is ON, logging/tracing will be completed. When logging/tracing failure relay is ON, the logging/tracing relay will be OFF. In this case, the residual data in the buffer will disappear. When LOGE instruction is executed the next time, error will be cleared.

● Device/trigger setting abnormal relay

In the case of abnormal device setting and trigger setting for logging/tracing, it's ON.
When the relay is ON, logging/tracing will be completed. When logging/tracing error relay is ON, the logging/tracing relay will be OFF.

● Tracing file storing trigger monitor relay

When tracing function is used, it's in ON state after file storing is triggered.
It turns OFF when the LOGE instruction is executed in the next time.

● Tracing data capture complete relay

When tracing function is used, and after file writing is triggered, it's in ON state when the data size set correspondingly has captured.
It turns OFF when the LOGE instruction is executed in the next time.

● Buffer free space (in Kbyte)

The buffer's free space is written in Kbyte.

When logging is used: you can control the buffer's free space. In case the value becomes smaller, the possibility of buffer overflow increases.

When tracing is used: the buffer's overall capacity is shown before file storing is triggered. After file writing is triggered, the captured residual data size will be displayed after tracing is finished.

● File storing counter

Increase 1 each time file storing is performed.
Counting is performed within the range of 0 to 65535, and can be stored even if power is off.
Please save 0 when the file save counter is reset.

● Arbitrary logging/tracing memory card in use relay

It's ON when more than one of logging/tracing ID 0 to 9 is in logging/tracing.
When other functions are used, it can e used to verify if logging/tracing is active.

● Memory card is in use relay

When memory card is used, it's ON. This relay is ON when memory card is used independent of logging/tracing functions.

● Memory card identification complete relay

When memory card is inserted, slot cover of memory card closed, initialization finished, and ready for the relay will be ON when it's ready.

● With memory card relay

When memory card is inserted and slot cover of memory card is closed, it will be ON.

● Memory Card write protect relay

It will be ON when memory card is inserted and write protected.

● Power OFF during memory card access

If the power is ON in the process of access to memory card, an error will occur, and the value except for 0 will be stored.

The value cannot be cleared automatically.

Logging/Tracing Function Precautions

The following describes the precautions on using the logging function.

"Used on the KV-5500/5000/3000", Page 2-51 and "Precautions When Using a memory card", Page 2-52.

● Storing speed

- Max. scan time in execution of logging/tracing is "3+6 x number of IDs in use" ms.
- When several triggers are activated simultaneously, the access volume to the Memory Card increases. So, the scan time will be longer, buffer overflow is liable to occur.

TIP The data failure can be improved by setting of certain scanning time or END processing time.

"Fixed Scan Time (FST) Operation", Page 3-23
"Enable END proceeding time", Page 3-25

● Priority order of accessing to Memory Card

- During logging/tracing, the order of accessing priority on the Memory Card is as follows:
  Memory Card instructions -> logging/tracing instructions -> FTP server functions, file operations in the access window
  For this reason, the Memory Card sometimes cannot be used by other functions when a large amount of logging triggers are being activated.

● Power OFF, memory card insertion/removal

Before removing the Memory Card with the PLC still turned ON, make sure that the Memory Card access LED is out. Data is not saved during logging/tracing if the Memory Card is not removed by this procedure.

Handling of the Memory Card slot cover

- Logging/tracing will not be started if the Memory Card slot cover is not closed.
- When open the slot cover of memory card, the current processing will be implemented, but the following processing will not be implemented.

Precautions during power off and card insertion/removal

- Never remove the Memory Card or turn the CPU unit OFF while the Memory Card access LED on the PLC is lit (indicating that data is being read from or written to the Memory Card). Doing so might corrupt the data on the Memory Card.
- When power is turned OFF while logging/tracing is being executed, data will not be saved to the Memory Card.

Replacing Memory Card

- Replace Memory Card by the following procedure.

"Used on the KV-5500/5000/3000", Page 2-51

· If auto-restart is logging/tracing by Memory Card insertion is set in the logging settings of KVSTUDIO, when Memory Card is removed during execution of logging, the logging data is stored in buffer until the Memory Card is next inserted. When the Memory Card is inserted, data stored in memory will be written to the Memory Card. At this time, the logging error relay will not be ON. If there is a long period between the Memory Card is inserted next time or many triggers have been generated, a buffer overflow will occurs and some data may be lost.
When "auto-restart logging/tracing by Memory Card insertion is not set, never remove the Memory Card while logging is being executed. Doing so might corrupt the data on the Memory Card.

● Operation during rewriting in RUN mode

· Logging execution slows down very much when rewriting is performed in RUN mode. This makes it more likely for buffer overflow to occur.
· Logging/Tracing settings cannot be written in the runtime (RUM). The settings will be applied when Logging/Tracing is executed in the next time.

● Operation when switching between RUN and PROG mode

· The logging function is active only in the RUN mode. When RUN -> PROG switching is performed, all logging/tracing operations will stop.
As in the case when LOGD instruction is executed, the logging details up to this moment are output to the Memory Card. Also, when PROG -> RUN switching is performed, the LOGE instruction must be executed to start logging/tracing, as all logging/tracing operations are in a stopped state.

● Processing at start of logging/tracing

If a specified file No. already exists when logging/tracing is enabled after power-on, the following action will be executed.

When specifying method of file No. is "Auto numbering."

· For operations when no No. is available in "Creating a New File", please refer to Troubleshoot: Overflow of File Capacity Settings
· Execute the Add To Latest Files and the latest file exceeds file capacity limit:
Use the file with the next available No. In case no No. is available, please follow the instruction in the Troubleshoot: Overflow of File Capacity Settings.
· If no file capacity limit is defined, the new file can be added.
· For Troubleshoot: Overflow of File Capacity Settings, please see it on the next page.

When the specifying method of file No. is "Fixed/Dev val"

· When same file exists and "Overwrite old file" is selected: old file will be deleted and file will be saved by the same file name.
· When same file exists, and "Add" is selected:
Add data in the specified file. When the file exceeds file capacity limit, if logging/tracing is started, the logging/tracing error relay turns on, the logging/tracing is then stopped.

"Device List for Logging/Tracing", Page 2-79

● Troubleshooting for overflow of file capacity settings

The operation when the file capacity is exceeded may vary with specifying methods of file No..

About file capacity upper limit setting, see 🕮 "Option", Page 2-68。

When specifying method of file No. is "Auto numbering."

When all file No.s are used and the last file capacity is exceeded.

· When there are no remaining No.s, and "Overwrite old file" is selected:
  Oldest data are deleted, and new file will be created according to same file NO.

· When there are no remaining No.s, and "stop logging/tracing" is selected:
  When logging/tracing is started, the logging/tracing error relay is started to stop logging/tracing.

When specifying method of file No. is "Fixed/Dev val"

When the same file exists whether "Overwrite old file"/"Add" is selected, logging/tracing will be stopped。

● Character restriction

(1) Character string in CSV file: file comment, device comment

(2) File name character string : file name character string

(3) ASCII character string : there are restrictions on characters that can be used when "ASCII character string" is selected as the device's data format.

Item	Explanation
Character string in CSV files	• "," cannot be used.
Character string in file names	The following characters cannot be used. • 12 half-width characters * / < > ? ¥ | % , : ; " • 7 full-width characters / : ? ¥ * [ ] • NEC special characters (8740H to 879CH) • IBM extended characters for NEC (ED40H to EEFCH) • IBM extended characters for IBM (FA40H to FC4BH)
ASCII string	All ASCII codes are saved directly. Control characters and " etc. are also saved directly.

2-4 USB Communication

If USB port of CPU unit is used, then monitoring/debugging of ladder programs can be performed through KV STUDIO.

TIP If KV COM+ is used, then PLC device values can be read/written.

Method of Connecting PC

Please connect USB cable to both PC and KV-5500/5000/3000.

Note

It's required to install KV STUDIO properly before connecting KV-5500/5000/3000 to PC USB interface.

Installing the USB Driver

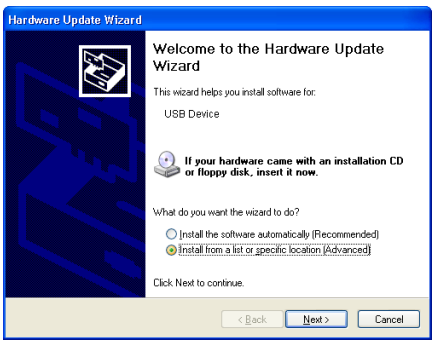
Be sure to install USB driver prior to first connection. For 2nd or subsequent connection, no program is required to be installed due to auto identification function.
The steps of installing in Windows XP are described below.

1 **Only the user with setting change right (such as administrator) can operate.**

2 **Connect computer USB port to KV-5500/5000/3000 USB port using USB cable.**

"Found New Hardware Wizard" is displayed, and then information of the hardware to be added is displayed.

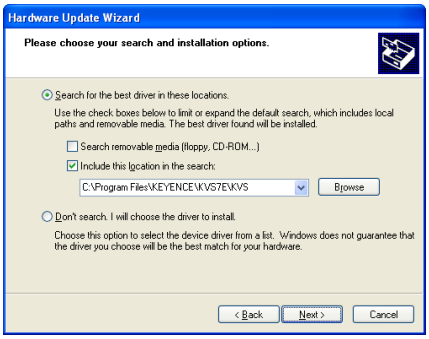
3 **Select "Install from a list or specific location (Advanced)" button, and lick "Next".**



4 **Select "Search for the most suitable driver in these locations" button and "Include this location in the search" checkbox.**

Specify the position of KV STUDIO already installed.

* The default installation position: "C:\Program Files\KEYENCE\KVS7E\KVS".



5 **Continue to install according to the hint of wizard.**

2-5 Serial Communication (KV-3000 only)

If serial port of KV-3000 (modular connector is used), you can monitor of ladder program through KV STUDIO, as in the case with USB port. In addition, communication is possible by connecting peripherals with RS-232C interface, or connecting to our VT3 Series touch panel.

Communication Specification

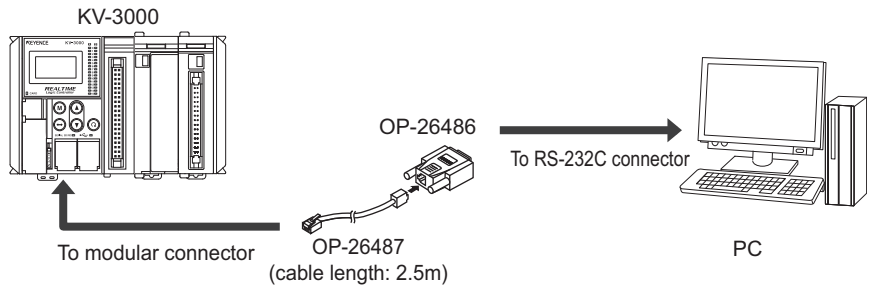
Item	Specification
Communication interface	RS-232C
Communication mode	Full-duplex
Synchro mode	Demodulation synchronization
Baud rate	9600, 19200, 38400, 57600, 115200bit/s (default 9600bit/s)
Data length	8-bit
Parity	Even
End bit length	1-bit

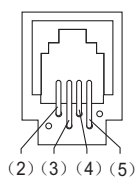
Note

- Set the same communication specification as that set to connected peripherals. Communication cannot be performed correctly if the settings are different.
- For details on the settings of connected peripherals, refer to the User's Manual for the respective equipment.

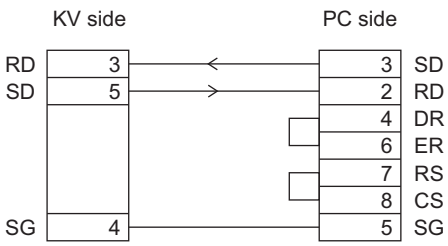
How to Connect to PC

When connecting KV-3000 and PC, please use dedicated connection cable (OP-26487) and D-Sub 9-pin connector (OP-26486).





KV side pin No

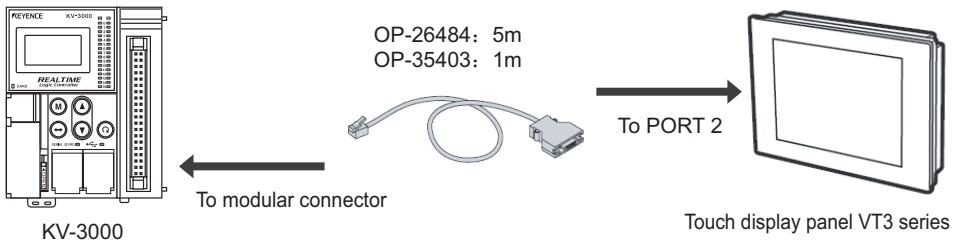


Modular connector D-Sub 9-pin connector

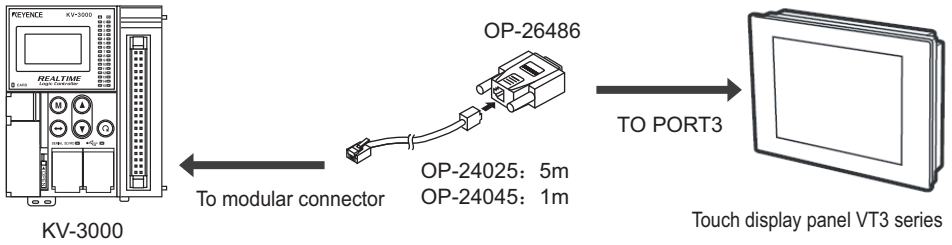
How to Connect to VT3 Series

When connecting KV-3000 to VT3 Series touch panel, please use dedicated KV program-controlled direct-connect cable (OP-26484 : 5m, OP-35403 : 1m).

● Connecting to PORT2 of VT3



● Connecting to PORT3 of VT3

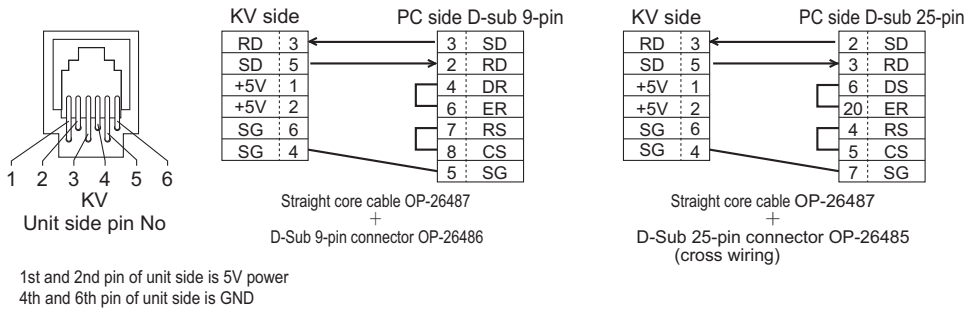


TIP No setting is required at KV-3000 side.

For the settings of VT3 side, refer to "VT3 PLC Connection Manual".

How to Connect to Peripherals

When connecting KV-3000 to peripherals, please refer to the following wiring diagram with PC, and connect according to shape of the connectors of peripherals.



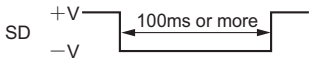
1st and 2nd pin of unit side is 5V power
4th and 6th pin of unit side is GND

TIP When the connected equipment is a modem, please use cross cable OP-96607 instead of OP-26487.

Communication Setting Initialization and Communication Speed Setting

■ Communication speed setting

Sending Break signal to KV-3000 allows to initialize the settings of communication buffer and communication speed of KV-3000.
Prior to communication with KV-3000, or during initialization of communication settings, a Break signal over 100ms is only sent one time, as shown on the right. Once communication is confirmed, no Break signal is required to be sent.



Note

- To establish communication without turning KV-3000 OFF after communication is performed between KV-3000 and KV STUDIO, the Break signal must be sent again.
- When the Break signal cannot be sent to PC, the communication settings of KV-3000 can be initialized by turning the KV-3000 OFF then back ON again.
- Allow at least 10 ms to stop communication after sending the Break signal.

■ Communication speed setting “SP"

This command is used to change serial communication speed with KV-3000.

● Command

S	P	␣	n	C_R
53H	50H	20H		

n : Commands communication speed.
"0"…9600 bit/s
"1"…19200 bit/s
"2"…38400 bit/s
"3"…57600 bit/s
"4"…115200 bit/s

● Response

O	K	C_R	L_F
4FH	4BH		

<Response during an Error>
If the command is not processed properly, "E1" is written.

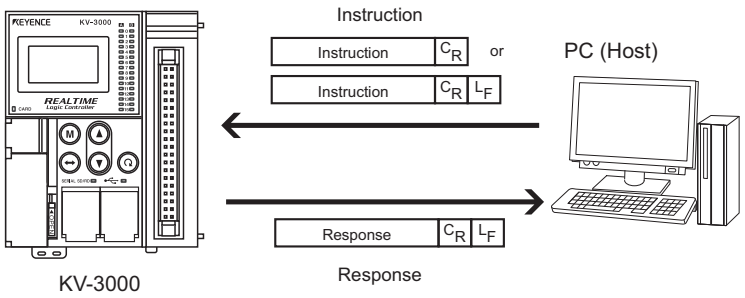
Note

- Default value is 9600bit/s when power is turned ON.
- If Break signal is received, the communication speed is returned to 9600 bit/s.
- The communication speed will be changed after a response is sent. Please confirm the response first, then send command according to the set communication speed.

Reading/writing of PLC Device Value

The device value or operating state of KV-3000 can be read/written from peripherals through the protocol initiated by KEYENCE. As in the KV mode of KV-L2*V (host link), KV-3000 will automatically return response according to the instruction from peripherals. No communication program is required at KV-3000 PLC side.

"KV-L2*V User's Manual", "Chapter 5 Programming In KV Mode (host link)"

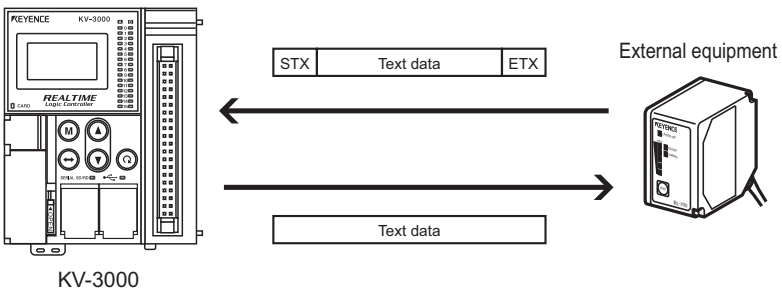


Note

- Once the power of KV-3000 is turned on and Break signal is received, communication speed is set to 9600bit/s.
- When a communication error occurs, the communication speed will recover to 9600bit/s.
- If 1s is exceeded between the bytes of instruction, it's regarded as a timeout, and an error response will be returned.

Sending/Receiving Text Data

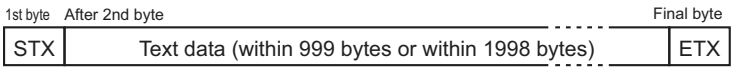
Continuous text data (below 999 bytes or 1998 bytes) can received or sent collectively. Though data format can be freely set, communication program should be written at KV-3000 side.



Receiving Text Data

■ Data format for receiving

The receivable text data format of KV-3000 is: STX (02H) for 1st byte, text data after 2nd byte, and ETX (03H) for last byte.

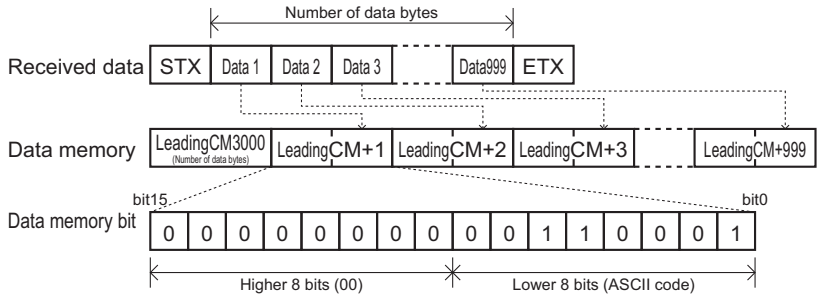


The received data are stored into CM3000 to M3999.
The unit of storage is set through ON/OFF state of CR2805.

Storage unit	CR2805	CM3000	CM3001	CM3002 to M3998	CM3999
word	OFF	Number of data bytes	Data 1	Data 2 data 3 to data 998	Data 999
byte	ON	Number of data bytes	Data1, data 2	Data 3, data 4, data 5, data 1996	Data 1997, data 1998

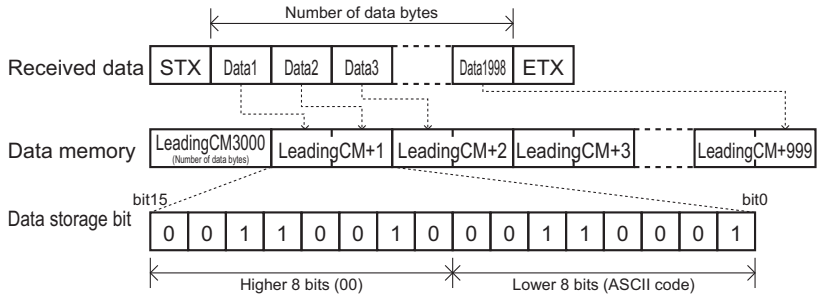
● When stored in word (CR2805: OFF)

Higher 8 bits of each control memory (CM) store "00", low 8 bits store 1 byte of received data.



● When stored in byte (CR2805: ON)

2 bytes of received text data are stored in 1 CM.



● **Receiving**

The receiving state can be confirmed through the following control relay.

Relay No.	Content
CR2801	Only one scan period will be ON when text data are received.
CR2802	Only one scan period will be ON when text data are received while CR2801is ON or when CR2803 is ON.
CR2803	Only one scan period will be ON if an error occurs when receiving text data.

Note

- If there is ETX when text data are read, the data before ETX will be sent to the data memory. But, the data after ETX won't be read.
- If parity error occurs when text data are received, the text data will not be sent to data memory, CR2802 and CR2803 will be ON for only one scan period.
- Communication setting needs to be initialized before communication.
  "Communication speed setting", Page 2-88

TIP You can change communication speed via "SP " instruction of KV mode (host link).
"Communication speed setting", Page 2-76

Sending Text Data

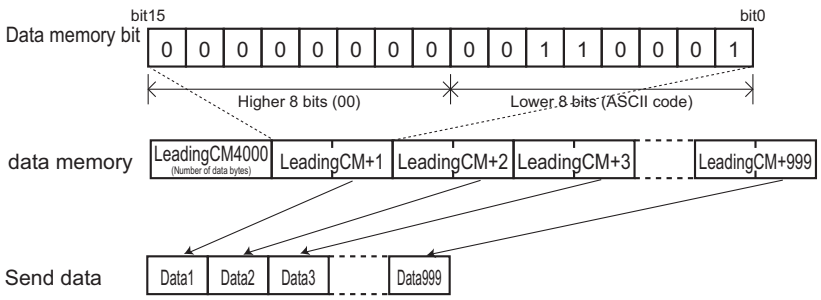
■ Data format for sending

The data sent from KV-3000 to peripherals are stored into CM4000 to M4999.
The unit of storage is set through ON/OFF state of CR2806.

Storage unit	CR2806	CM4000	CM4001	CM4002	CM4003~M4998	CM4999
word	OFF	Number of data bytes	Data 1	data2	Data 3 to data 998	data 999
byte	ON	Number of data bytes	Data 1, 2	Data 3, 4	Data 5 to Data 9196	Data 1997, 1998

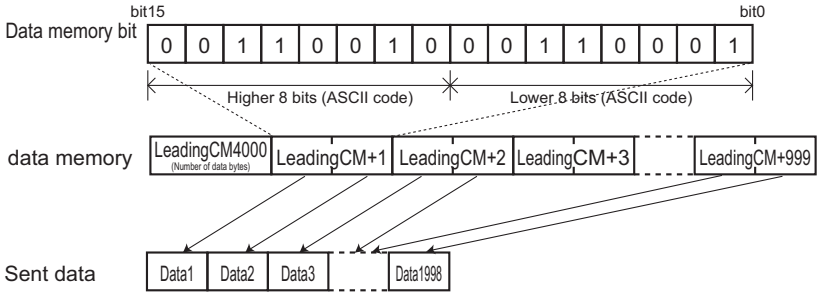
● **When stored in word (CR2806: OFF)**

Higher 8 bits of each control memory of CM store "00", lower 8 bits stores 1 byte of sent data by ASCII code.



● **When stored in byte (CR2806:ON)**

2 bytes of sent data are stored in 1 CM.



■ Sending

Sending is performed through ON/OFF of the following control relay.

Relay No.	Content
CR2804	Start/stop text data sending ON :send OFF :stop
CR2800	Start/stop Break signal sending ON :send OFF :stop

*CR2804 will be OFF automatically when sending is completed.

Note

Communication setting needs to be initialized before communication.

"Communication speed setting", Page 2-88

TIP You can change communication speed via "SP" instruction of KV mode (host link).

"KV-L2*V User's Manual ", "Chapter 4 Programming in KV Mode" (host link)"

ASCII Code Table

Lower 4 bits \ Higher 4 bits	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	$^{N}_{U}$	$^{D}_{L}$	$^{S}_{P}$	0	@	P	‘	p				ー	タ	ミ		
1	$^{S}_{O}$	$^{D}_{C_1}$	!	1	A	Q	a	q			。	ア	チ	ム		
2	$^{S}_{T}$	$^{D}_{C_2}$	”	2	B	R	b	r			「	イ	ツ	メ		
3	$^{E}_{T}$	$^{D}_{C_3}$	#	3	C	S	c	s			」	ウ	テ	モ		
4	$^{E}_{O}$	$^{D}_{C_4}$	$	4	D	T	d	t			、	エ	ト	ヤ		
5	$^{E}_{NQ}$	$^{N}_{AK}$	%	5	E	U	e	u			・	オ	ナ	ユ		
6	$^{A}_{CK}$	$^{S}_{YN}$	&	6	F	V	f	v			ヲ	カ	ニ	ヨ		
7	$^{B}_{EL}$	$^{E}_{TB}$	’	7	G	W	g	w			ァ	キ	ヌ	ラ		
8	$^{B}_{S}$	$^{C}_{AN}$	(	8	H	X	h	x			ィ	ク	ネ	リ		
9	$^{H}_{T}$	$^{E}_{M}$	)	9	I	Y	i	y			ゥ	ケ	ノ	ル		
A	$^{L}_{F}$	$^{S}_{UB}$	*	:	J	Z	j	z			ェ	コ	ハ	レ		
B	$^{V}_{T}$	$^{E}_{SC}$	+	;	K	[	k	{			ォ	サ	ヒ	ロ		
C	$^{F}_{F}$	→	,	<	L	\	l	|			ャ	シ	フ	ワ		
D	$^{C}_{R}$	←	—	=	M	]	m	}			ュ	ス	ヘ	ン		
E	$^{S}_{O}$	↑	.	>	N	^	n	~			ョ	セ	ホ	゛		
F	$^{S}_{I}$	↓	/	?	O	__	o	$^{D}_{EL}$			ッ	ソ	マ	°		

Characters within [ ] can be used.

$^{S}_{TX}$, $^{E}_{TX}$, $^{L}_{F}$, $^{C}_{R}$ are used as data separators。

Other codes are used for controlling, and should not be used.

2-6 Ethernet/FL-net Communication (KV-5000 only)

Available functions of KV-5000 ethernet port (RJ-45 connector) vary with CPU functional version. For ethernet communication function, if V1.0 CPU functional version is used, completely identical function as KV-LE20V may be realized; if CPU functional version above V1.1 is used, completely identical function as KV-LE21V may be realized. For FL-net communication function, there is no CPU functional version difference, completely identical function as KV-LE20V may be realized.

Note

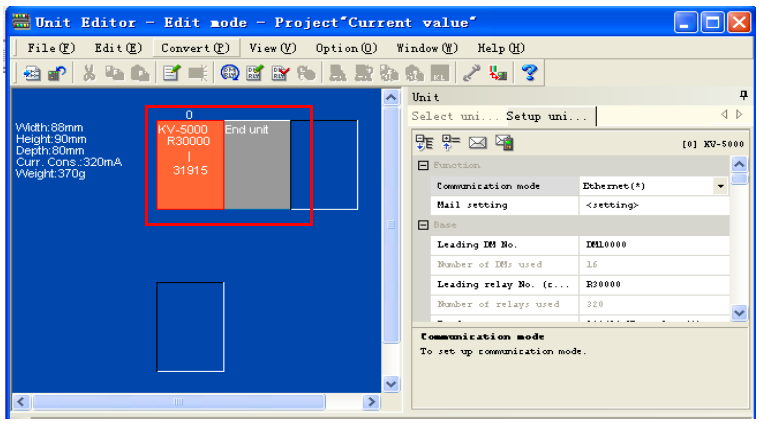
- CPU's built-in Ethernet communication function and built-in FL-net communication function can be used simultaneously.
- Optional "compatible mode" for KV-LE21V/KV-LE20V/KV-FL20V cannot be used.

Operations that Can be Implemented through CPU's Built-in Ethernet/FL-net Communication Function

Item	Reference manual	Reference page
Remote transmission/remote maintenance of ladder programs	KV STUDIO User's Manual	"9-1 Monitor/Simulator Functions"
Connection with VT3 Series	VT/DT PLC Connection Manual	"Chapter 2 Ethernet Connection"
Mail sending/receiving	KV-LE21V User's Manual KV-LE20V User's Manual	"Chapter 7 Mail Sending/Receiving Function"
FTP Server		"Chapter 8 FTP Server Functions"
Uplink communication		"Chapter 4 UpLink Communication Function"
MC protocol communication		"Chapter 5 MC Protocol Communication"
KV socket communication		"Chapter 6 KV Socket Communication Function"
FTP client-side	KV-LE21V User's Manual	"Chapter 9 FTP Client-Side Function"
Reverse simple PLC connection		" Chapter 10 Simple PLC Connection Function"
BOOTP client-side		"Appendix-2 BOOTP Client-Side Function"
Data sharing with other PLC	KV-FL20V User's Manual	"Chapter 2 Specification and System Configuration"
Communicating via FL-net	KV STUDIO User's Manual	"9-1 About Monitor/simulator Function"

Unit Editor Setting

To use the built-in Ethernet port of KV-5000, please select KV-5000 in the Unit Editor of KV STUDIO to display the unit setting. After the communication mode is set to "Ethernet/FL-net", the same functions as those with KV-LE21V/KV-LE20V/KV-FL20V can be used.



For how to use KV STUDIO and Unit Editor, refer to "KV STUDIO User's Manual".
For the details of unit settings or various functions that can be used by Ethernet mode, refer to "KV-LE21V User's Manual" "KV-LE20V User's Manual"
Please refer to the "KV-FL20A User's Manual."

2-7 EtherNet/IP communication (KV-5500)

KV-5500 Ethernet port (RJ-45 connector) may realize completely identical function as KV-EP21V.

The role of CPU built-in EtherNet/IP communication function

Item	Reference manual	Reference page
Remote transmission/remote maintenance of the ladder diagram program	KV STUDIO User Manual	“9-1 Monitor/Simulator Functions”
Testing via EtherNet/IP		
Connection with VT3 Series	VT/DT PLC Connection Manual	“Chapter 22 Ethernet connection”
Uplink communication	KV-EP21V User's Manual	“Chapter 8 Uplink communication function”
MC protocol communication		“Chapter 9 MC protocol communication function”
Mail sending/receiving		“Chapter 10 Mail sending/receiving function”
FTP server		“Chapter 11 FTP server function”
FTP client-side		“Chapter 12 FTP client-side function”
Simple PLC link		“Chapter 13 Simple PLC connection function”
BOOTP client-side		“Attachment-2 Communication without Unit Setting/BOOTP”
Without unit setup communication		
Implicit (I/O) message communication		“Chapter 7 Sensor application function”
Explicit message communication (client-side)		
Explicit message communication (server)		
Sensor application function		“Chapter 4 EtherNet/IP communication function”

For specific content of the available functions, please refer to KV-EP21V User's Manual.

Note

- **KV-5500 and KV-EP21V do not support KV socket communication function. When KV socket communication function and external equipment are used for communication, please use KV-5000 or KV-LE21V.**
- **KV-5500 does not have built-in FL-net communication function. For communication with FL-net equipment, please use KV-5000 or KV-FL20V.**

2-8 Bluetooth Communication

When KV-BT1 (just as USB port) connected with CPU unit is used, ladder diagram program may be monitored/tested by KV STUDIO.

Bluetooth communication specification

Item	Technical specifications
Bluetooth version	Bluetooth Ver2.0+EDR
Frequency range	2402MHz ~ 2480MHz
Output class	Class 2 compatible
Transmission method	FH-SS (Frequency Hopping Spread Spectrum)
Profile used	SPP
Communication distance	10m *Differs depending on the environment.

Support function

Functions that support Bluetooth communication are shown below.

- Use KV STUDIO monitoring/testing function from PC
- Communicate with the application program created using KV COM+

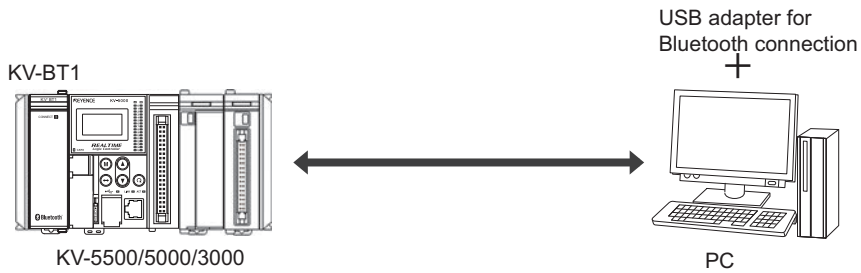
Note

Do not support the following function.

- **Communication with equipment other than PC (touch panel, bar code, or other KV-BT1 etc)**
- **Simultaneous communication with several PC**
- **Dialing function**

Communication with PC

When KV-BT1 is connected with PC, it is unnecessary to use connecting wire. USB adapter for Bluetooth connection is installed on PC (purchased additionally) to execute communication.
KV-BT1 identification name, BD address, Passkey (PIN code) should be provided when communication begins.
Search Bluetooth unit that uses KV STUDIO, or view BD address on access window of CPU unit.



For specific content, please refer to KV STUDIO User Manual.

2-9 I/O

KV-5500/5000/3000 has built-in 16-point inputs and 8-point outputs. In addition to I/Os common, the following functions can be used.

Item	See
Interrupt input	" Input Time Constant Setting", Page 2-98
High-speed counter	"2-8 Bluetooth Communication", Page 2-96
Frequency counter	"2-9 I/O", Page 2-97
Cam switch	"2-10 High-speed Counter", Page 2-101
Specified frequency pulse output	"2-11 Frequency Counter", Page 2-151
Motor (positioning) control	"2-12 Cam Switch", Page 2-157
Input time constant setting	"Input Time Constant Setting", Page 2-98
Inhibited input refresh	"Inhibited Input Refresh", Page 2-99
Inhibited output	"Inhibited Output", Page 2-100

Common I/O

If high-speed counter, frequency counter, cam switch, specified frequency pulse output, motor (positioning) control, CPU unit's I/O (R000 to R015, R500 to 507) are not used as interrupt input, they can be used as common I/Os.

For terminal No.s of I/Os, see "I/O connector wiring diagram", Page 1-30.

The methods of using the common I/Os are described below. In addition, the following methods can also be used for expansion I/O unit.

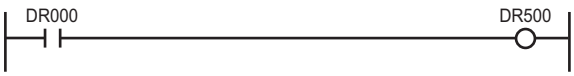
■ About I/O refresh

In the execution of programs, I/O signal state is refreshed once during scanning time (END processing). When it's required to refresh I/O signal at any position of program (direct processing), the following methods can be used.

● Direct I/O (DR)

Specify the relay No. to be used for operand to "DR", not "R".

Example



Whether or not DR can be used, please refer to KV-8000/7000/5000/3000/1000 Series Instruction Reference Manual.

● I/O refresh instruction (RFSX, RFSY)

I/O states of multiple bits will be refreshed uniformly.

Please refer to KV-8000/7000/5000/3000/1000 Series PLC Instruction Reference Manual, “RFSX/RFSY Instruction"

● Interrupt processing

During interruption processing, input relay (R000 to R015) will be refreshed before the program is executed. In addition, when SET/RES instruction is executed, it's not required to wait for END processing of the program, and the output relay (R500 to R507) will be refreshed directly.

"3-5 Interrupt", Page 3-31

Input Time Constant Setting

If input time constant selection function is used, the pulse width acquired reliably as signals from input contact will be set as input time constant. If input time constant becomes smaller, shorter pulse can be obtained, otherwise, it can be used as a simple noise filter.
When a non-contact signal without fluctuation is connected, and a high-speed signal (encoder, etc), high-speed signal can be processed by reducing input time constant.

TIP When expansion I/O unit is used, input time constant can be set through Unit Editor (10ms/1ms/300μs/25μs).
KV STUDIO User's Manual, "Chapter 3-6 Unit Editor"

● Hi-speed instruction (HSP)

When using HSP instruction, please set the input time constant of the specified input relay (R000 to R015) to 10μs.
Please refer to KV-8000/7000/5000/3000/1000 Series PLC Instruction Reference Manual, “HSP instructions"

● Control relay/Control memory (CR2305/CM1620)

The input time constant of KV-5500/5000/3000's input relay (R000 to R015) can be selected through settings of control relay CR2305 and control memory CM1620.
The input time constant is generally 10 ms. But, if the control relay CR2305 is ON, the input time constant of the input relay can be changed into a value set through CM1620.

control relay	Operation content
CR2305	OFF to ON: the setting of CM1620 is reflected at the rising edge of CR2305 .
	OFF: input time constant is fixed as 10 ms.

control memory	Setting value	Input time constant
CM1620	0	10μs
	1	20μs
	2	500μs
	3	1ms
	4	2.5ms
	5	5ms
	6	10ms
	7	110μs
	8 above	Please don’t set up.

But, if HSP instruction and control relay CR2305 are used simultaneously, HSP instruction will be processed first, the specified relay cannot be changed into a value set through CM1620.

Example

Input time constant is set to 1ms.



Note

Input time constant is set after one scanning is completed. The specified contents will be enabled from the next scanning.

Inhibited Input Refresh

After input refresh is inhibited, state of input relay (R000 to R015, assigned as the relays of expansion input unit) will not be updated according to actual input signal. As the actual input relay can be ON/OFF forcedly in the process of monitoring by KV STUDIO, commissioning operation can be performed without being influenced by the connection state of peripherals.

Caution

After connecting extension I/O unit on the CPU unit of V1.0 CPU functional version, prohibit input refresh setting of KV-B8XTD, KV-C16XTD, KV-C32XTD becomes invalid. If output is prohibited, input refresh of KV-B8XTD, KV-C16XTD, KV-C32XTD is also in prohibited state.

Note

When "input refresh inhibited" is used, the following functions cannot be inhibited.

- Interrupt
- Hi-speed counter (internal clock not included)
- Positioning (origin sensor, stop sensor, Z-phase, limit switch) R000 to R015

TIP When expansion I/O unit is used, forced set/reset operation can be performed through KV STUDIO.

"KV STUDIO User's Manual ", "Forced set/reset registering"

● Inhibited/release through KV STUDIO

You can toggle inhibited/enabling from the menu in the process of monitoring through KV STUDIO.

1 Select "Debug (D)" -> "Inhibited Input refresh (F)" from menu.

After input refresh is inhibited, the menu is in selected state, "input refresh inhibited" is displayed in the status bar. After the menu is selected while input refresh is inhibited, the input refresh inhibited can be released.

● Inhibited/release through control relay (CR2301)

Enabling/inhibited can be toggled through ON/OFF of CR2301.

control relay	Operation content
CR2301	ON : Input refresh is inhibited through END processing. Contents in input relay are not refreshed.
	OFF: Input refresh needs to be performed through END processing. The input contents of relay are refreshed according to the state of input signal.

● Release through the access window

Inhibited of input refresh can be released in the Access Window of KV-5500/5000/3000.

"Commission", Page 2-33

Inhibited Output

After output is inhibited, it's impossible to output to output relay (R500 to R507, assigned as the relay of expansion output unit), even if ON/OFF operation is performed on the output coil in the program. Thus, debugging of program is possible without actual output to peripherals.

Important

After connecting extension I/O unit on the CPU unit of V1.0 CPU functional version, if output is prohibited, input refresh of KV-B8XTD, KV-C16XTD, KV-C32XTD is also in prohibited state.

Note

If CR2300 is ON, all outputs will be OFF.
For example, if CR2300 is ON while positioning pulse is output, the pulse output from output terminal will be inhibited (OFF). But, when CR2300 is OFF, output will restart (the pulse output is processed as output content when CR2300 is ON) due to ongoing internal operation.

● Inhibited/release through KV STUDIO

You can toggle inhibited/enabling from menu in the process of monitoring through KV STUDIO.

1 Select "Debug (D)" -> "Inhibited output (O)" from the menu.

After output is inhibited, the menu is under selected state, "Output inhibited" is displayed in the status bar. After the menu is selected while output is inhibited, the output inhibited will be released.

● Inhibited/release through control relay (CR2300)

Enabling/inhibited output of CPU unit (R000 to R015) and the output of various relays assigned as expansion output units.

control relay	Operation content
CR2300	ON : Output processing is inhibited (OFF) through END processing.
	OFF: Output processing is performed through END processing. During output, the contents of output coil are output.

● Release through the access window

The output inhibited can be released through the Access Window of KV-5500/5000/3000.

"Commission", Page 2-33

TIP Output process can be inhibited during interrupt.

Enabling/inhibited of output can be toggled through CR2302 during interrupt.

control relay	Operation content
CR2302	ON : Output processing is inhibited (OFF) during interrupt.
	OFF: Output processing is performed during interrupt.

"Commission", Page 2-33

2-10 High-speed Counter

High-speed counter (CTH) is a counter used to counting high-speed input signal that cannot be counted through counter instructions (C, OUTC, UDC).
High-speed counter comparator (CTC) is a device used to specify the setting of high-speed counter. If the setting value matches the current value, it's on (ON).
Interrupt processing or pulse output can be implemented by flexibly using CTH and CTC, independent of the scan time.

High-speed Counter Specification

Item		Specifications
Number of channels		2
Input response frequency	Line driver input	Single-phase: 100kHz phase difference: 50kHz
	Open collector input	Single-phase: 60kHz phase difference: 30kHz

Note

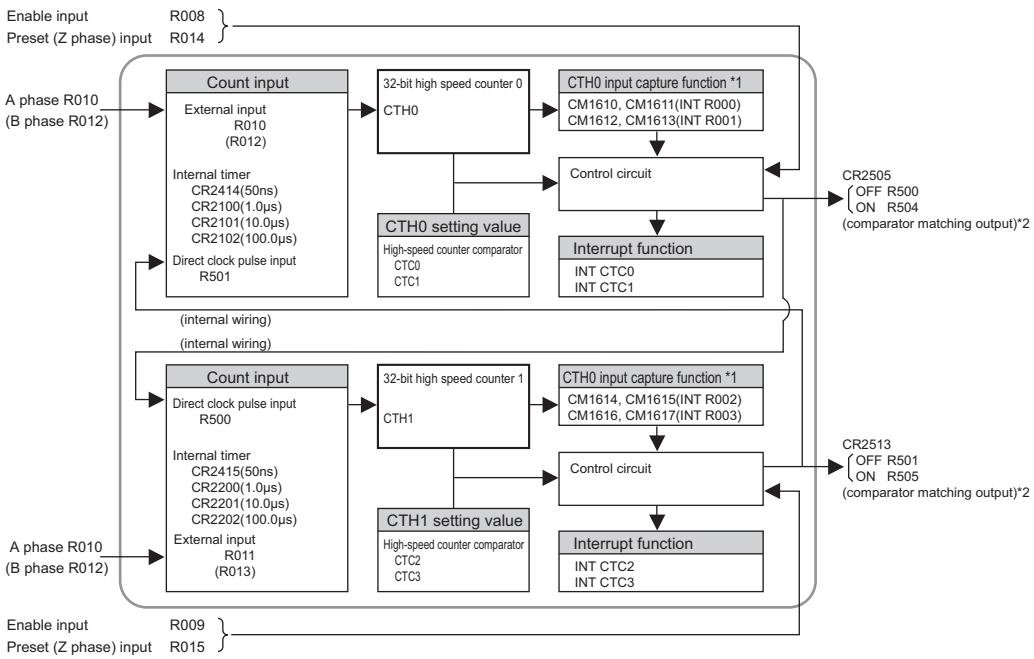
Other functions or instructions using high-speed counter of the same No. cannot be used simultaneously.

For details about input relays, see "Wiring and Internal Circuit Diagram", Page 1-28.

Configuration of High-speed Counter

KV-5500/5000/3000 is equipped with 2 high-speed counters, each of which is fitted with 2 high-speed counter comparator and dedicated internal clock.

High-speed counter clock diagram



*1 "Input Capture", Page 3-41
*2 "Comparator Matching Output", Page 2-128

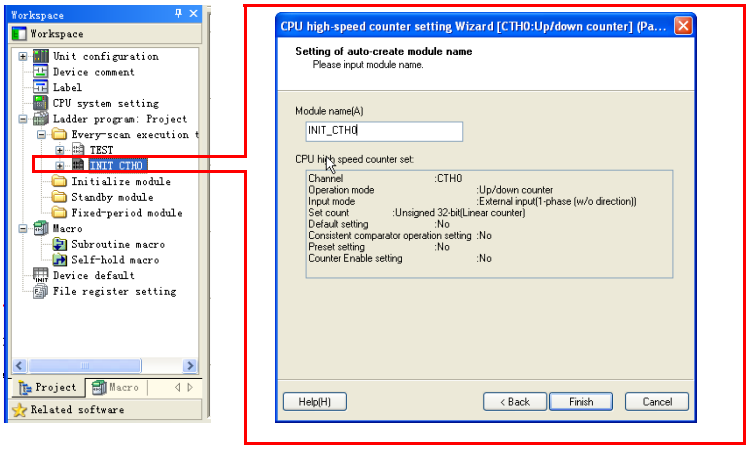
How to Set High-speed Counter

When CPU's built-in high-speed counter is used, it's required to write ladder program for specifying counting range, input mode and setting value. However, if CPU high-speed counter setup wizard is used, it's only required to specify various items according to the screen instructions, and the ladder program for high-speed counter will be generated automatically.

- Use the CPU High-speed Counter Wizard, P2-103~P2-112
- To create/change a project while it is being confirmed, P2-113~P2-149

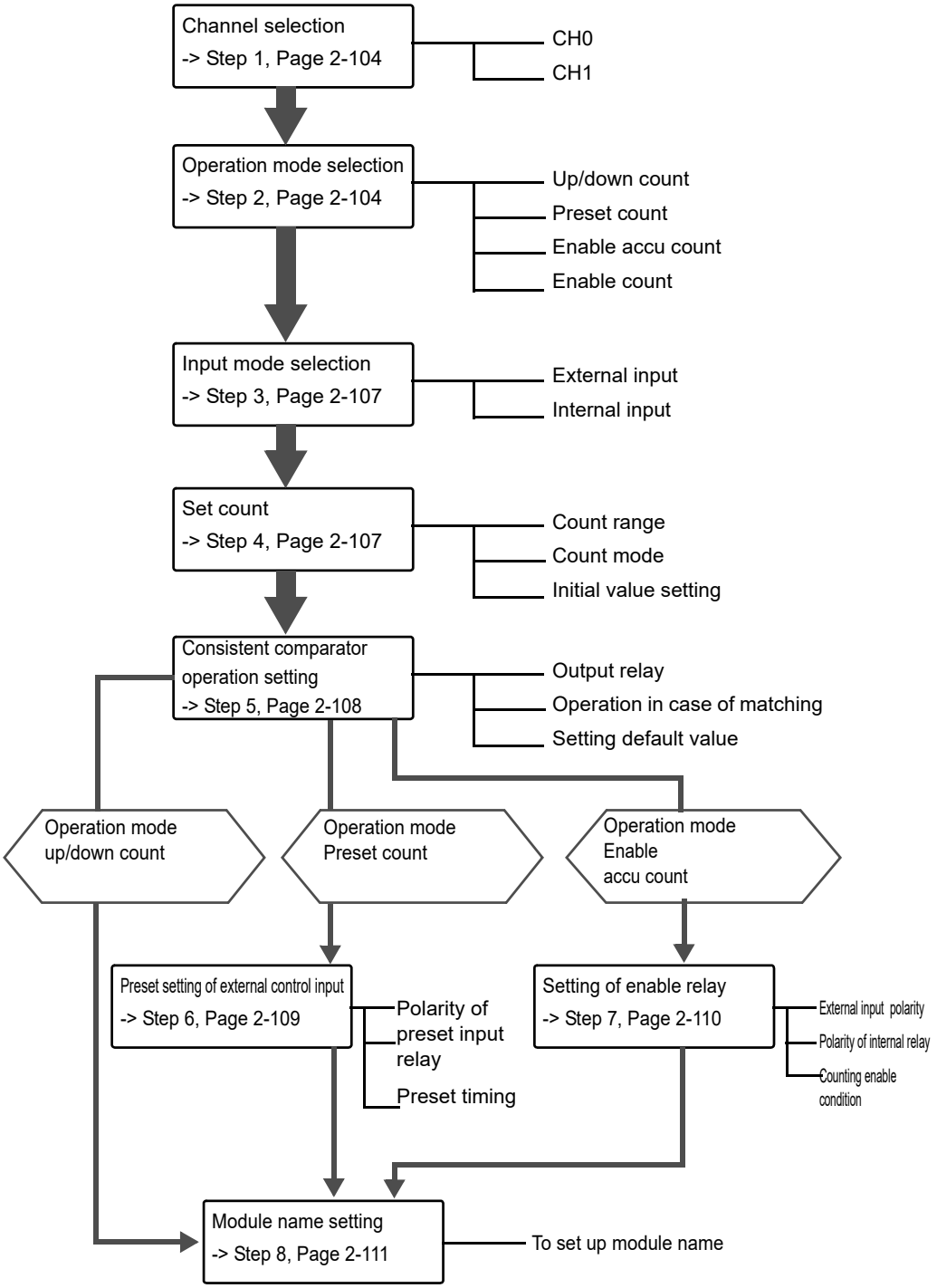
Functions of CPU High-speed Counter Setup wizard

When the CPU high-speed counter setup wizard is used, it's only required to select the setting item. Ladder program CPU's built-in high-speed counter will be generated automatically, and will be registered according to scanning module called "INIT_CTH0" or "INIT_CTH1".



Functions of CPU High-speed Counter Setup wizard

The setting contents of CPU high-speed counter setup wizard are described below.

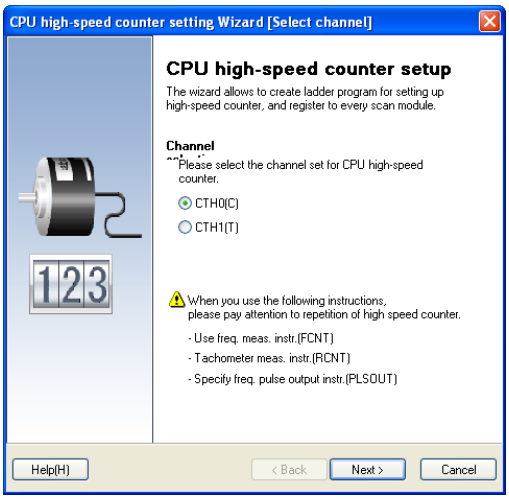


Setting Steps of CPU High-speed Setup Wizard Counter

The steps for setting CPU high-speed counter setup wizard and various dialog boxes are described below.

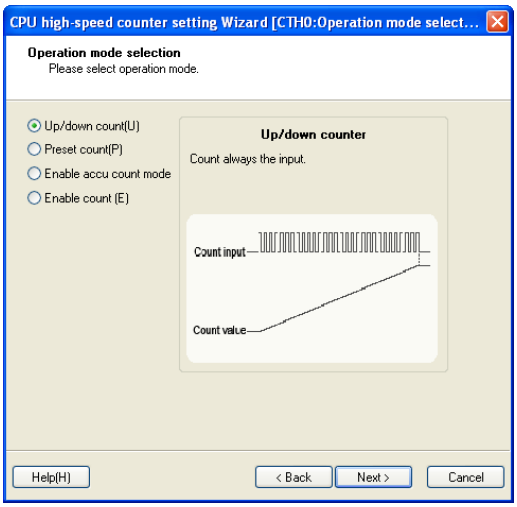
1 **Select "Tool (T)" -> "CPU high-speed counter setting wizard (H)" from the menu of KV STUDIO, and start CPU high-speed counter setup wizard".**

Specify the channel of setting the high-speed counter, and click "Next" button.



2 **Select operation mode.**

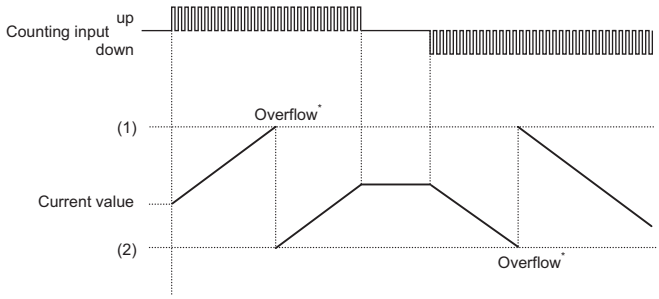
Select an operation mode, then click the “Next" Button. Up/down Count mode



Operation mode	Description
Up/down count	Basic counting mode for counting the input.
Preset count	If up/down counting is performed in this mode and preset input is performed, then the counting value is changed to preset value.
Enable accu count	Counting is performed only when enable input is ON. Setting value is accumulated.
Enable count	Counting is performed only when enable input is ON. Counting value is reset (zero clear) at rising edge of enable input.

● Up/down count mode

Mode of only counting the input.



* No overflow occurs when the counting mode is "ring counter".

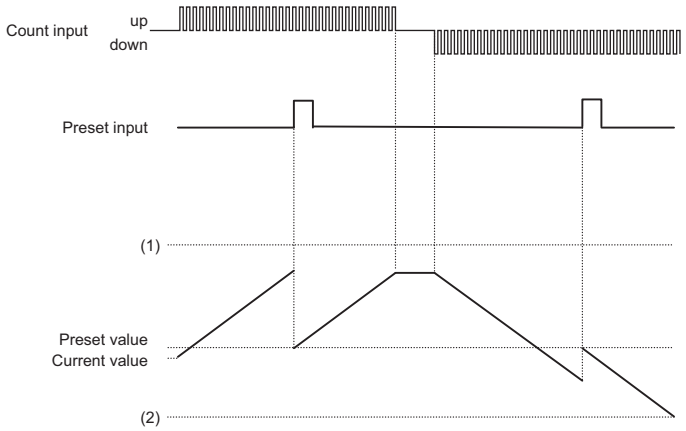
Current value range	Count mode: linear counter		Count mode: ring counter	
	Count range: Unsigned 32-bit	Count range: Signed 32-bit	Count range: Unsigned 32-bit	Count range: Signed 32-bit
(1)	4294967295	+2147483647	Upper limit (1 to 4294967295)	Upper limit (-2147483647 to +2147483647)
(2)	0	-2147483648	Lower limit (0 to 4294967294)	Lower limit (-2147483648 to +2147483646)

Tip · Count mode and count range are set through the CPU high-speed counter setup wizard (page 2/4).

· When overflow is detected, CR2403 (CTH0) and CR2407 (CTH1) are ON.

● Preset count mode

A mode in which once preset input (external input) is input, the current value is changed to preset value.

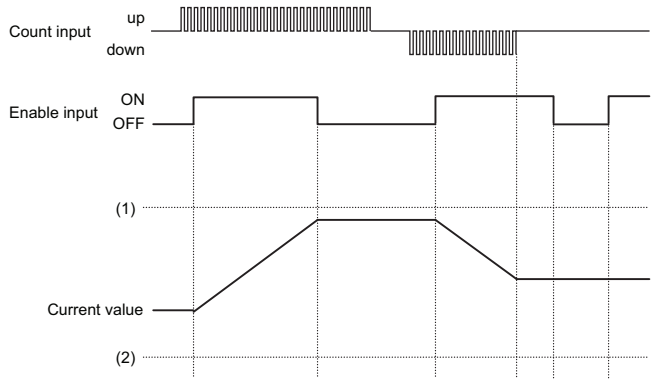


Current value range	Count mode: linear counter		Count mode: ring counter	
	Count range: Unsigned 32-bit	Count range: Signed 32-bit	Count range: Unsigned 32-bit	Count range: Signed 32-bit
(1)	4294967295	+2147483647	Upper limit (1 to 4294967295)	Upper limit (-2147483647 to +2147483647)
(2)	0	-2147483648	Lower limit (0 to 4294967294)	Lower limit (-2147483648 to +2147483646)

Tip Count mode and count range are set through the CPU high-speed counter setup wizard, Page 2/4.

● Enable accumulative count mode

Counting performed only when enable input is ON. The current value is accumulated continuously.

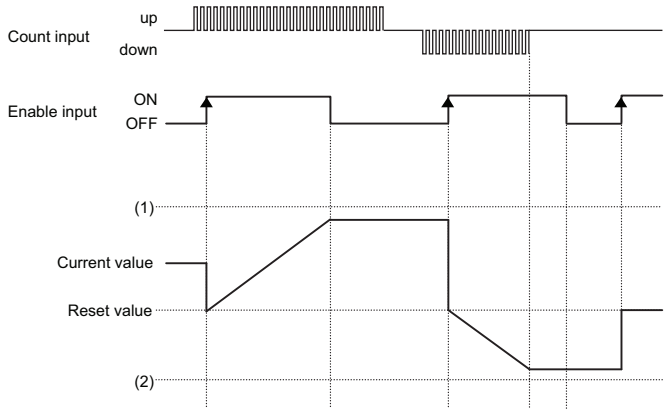


Current value range	Count mode: linear counter		Count mode: ring counter	
	Count range: Unsigned 32-bit	Count range: Signed 32-bit	Count range: Unsigned 32-bit	Count range: Signed 32-bit
(1)	4294967295	+2147483647	Upper limit (1 to 4294967295)	Upper limit (-2147483647 to +2147483647)
(2)	0	-2147483648	Lower limit (0 to 4294967294)	Lower limit (-2147483648 to +2147483646)

Tip Count mode and count range are set through the CPU high-speed counter setup wizard, Page 2/4.

● Enable Count mode

Counting is performed only when enable input is ON. The current value is reset (zero clear) at the rising edge of enable input.

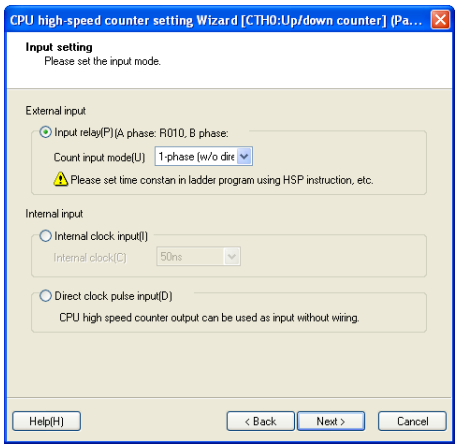


Current value range	Count mode: linear counter		Count mode: ring counter	
	Count range: Unsigned 32-bit	Counti range: Signed 32-bit	Count range: Unsigned 32-bit	Count range: Signed 32-bit
(1)	4294967295	+2147483647	Upper limit (1 to 4294967295)	Upper limit (-2147483647 to +2147483647)
(2)	0	-2147483648	Lower limit (0 to 4294967294)	Lower limit (-2147483648 to +2147483646)

Tip Count mode and count range are set through the CPU high-speed counter setup wizard, Page 2/4.

3 Set up counting input.

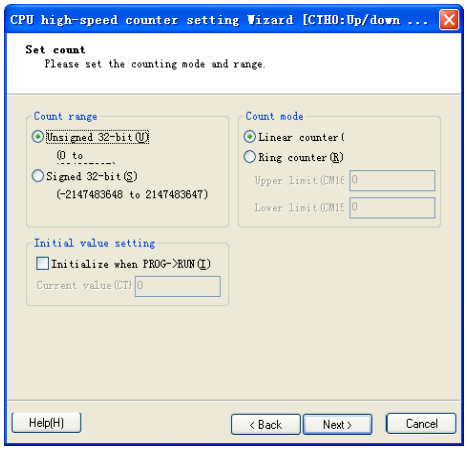
Please set count input, then click the “Next" button.



Item		Description
External input		Selected when external input is counted through high-speed counter.
	count input mode	Select count input mode from the pull-down menu. Selection range: 1-phase (w/ direction)/1-phase (w/o direction)/Phase difference (1x)/Phase difference (2x) / Phase difference (4x)/2-pulse "Counting Input Setting", Page 2-116
Internal input		Selected when counting is performed through internal clock or direct clock pulse (specified frequency pulse).
	Internal clock input	Select an internal clock from the pull-down menu. Select range: 50ns/1.0μs/10.0μs/100.0μs "When count internal clock", Page 2-118
	Direct clock pulse input	Selected when direct clock pulse or specified frequency pulse output is counted. "When count direct clock pulse (specified frequency pulse) output", Page 2-119

4 Perform counting setup.

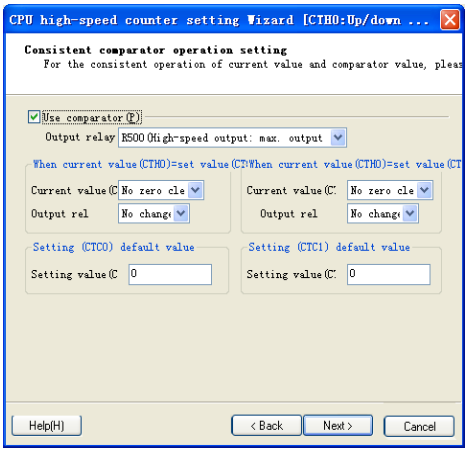
Set "Count range", "Count mode" and "Default value setting", and click the "Next" button.



Item	Description
Count range	Count range (current value) is set. Selection range: unsigned 32-bit (0 to 4294967295)/ signed 32-bit (-2147483648 to +2147483647)
Count mode	Count mode is set.
Linear count	Count is performed according to the set count range. When the current value exceeds this range, the overflow detection relay is ON. "Linear counter", Page 2-114
Ring count	Counting is performed according to the set range of upper and lower limit. Even if the current value exceeds the range, overflow detection relay will not be ON. "Ring counter", Page 2-115
Default setting	When operation mode of CPU is changed from PROG to RUN, the current value is rewritten to the specified default setting.

5 Set comparator matching operation.

Set "Output relay", "When current value=set value" and "default setting", and click the "Next" button.



Item	Description
Use comparator	After the this checkbox is selected, output relay will operate if current value matches the comparator value (setting value).
Output relay	Used to select the output relay when the comparator matches. When the channel of CPU high-speed counter is CTH0: Selection range: R500 (high-speed output: max. output frequency 100kHz)/ R504 (common output: max. output frequency10kHz) When the channel of CPU high-speed counter is CTH1: Selection range: R501 (high-speed output: max. output frequency 100kHz)/ R505 (Common output: max. output frequency10kHz)
When current value (CTC0/CTC1) = setting value ([CTC0/CTC1]/[CTC2/CTC3])	When current value (CTH0/CTH1)=setting value ([CTC0/CTC1]/[CTC2/CTC3]), current value is set to "zero clear/no zero clear"; the output relay is set to "ON/OFF/inverted/unchanged".
Default setting ([CTC0/CTC1]/[CTC2/CTC3])	To specify the setting of the high-speed counter ([CTC0/CTC1]/[CTC2/CTC3]).

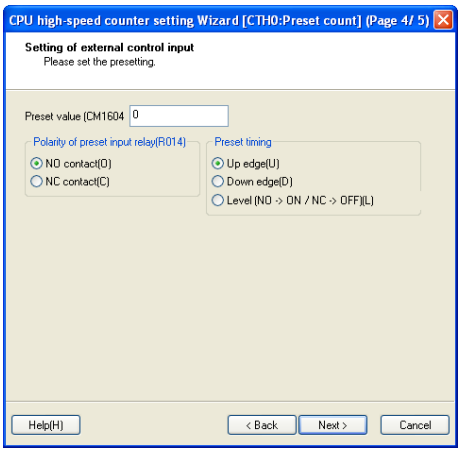
The following steps will vary with the operation modes set in step 2.

- When the mode is "Up/down count" .....go to step 8
- When the mode is "Preset count".....go to step 6
- When the mode is "Enable accumulative count" .....go to step 7
- When the mode is "Enable count" .....go to step 7

6 Set up external control input (preset).

It is set only when operation mode is selected as "Preset counting".

Set "Preset value", "Polarity of preset input relay" and "preset timing", click the "Next" button, then go to step 8.

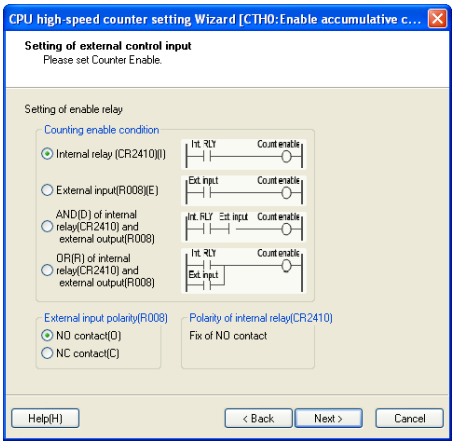


Item	Description
Preset value (CM1604)	To specify the preset value used to rewrite current value in the case of preset input. The preset value should be set within the range specified by "Counting range".
Polarity of preset input relay (R014/R015)	To select input polarity of preset input relay. N.O.(A contact) : Preset will be performed when external input is ON. N.O.(B contact) : Preset will be performed when external input is OFF.
Preset timing	To select preset timing when preset input is performed. Up edge : Preset is performed on the rising edge of external preset input relay Down edge : Preset is performed on the falling edge of external preset input relay Level : When polarity of external preset input relay is N.O. (A contact), preset will be performed while relay is ON. : When polarity of external preset input relay is N.C. (B contact), preset will be performed when the relay is OFF.

7 Setting of external control input (counter enable).

Setup is performed only when the operation mode is selected as "enable accumulative counting" or "enable counting".

Set the "Polarity of external input (R008/R009)" and "Counting enable condition", and click "Next" button.

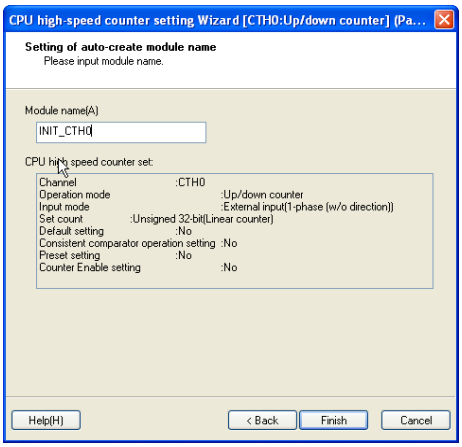


Item	Description
Counting enable condition	To select enable condition of counting. When internal relay is in enabled state: when internal relay is ON, counting is enabled. When external input is in enabled state: when polarity of external input is N.O., counting will be enabled when is ON; when the polarity of external input is N.C., coun ting is enabled when it's OFF. When internal relay is in enabled state and external input is in enabled state: Counting is enabled when internal relay is ON and external input is in enabled state. When internal relay is in enabled state or external input is enabled state: Counting is enabled when internal relay is ON or external input is in enabled state.
External input (R008/R009) polarity	To select the input polarity of external enable input relay (R008/R009). N.O.(Contact A): When external input is ON.....enabled When external input is OFF.....inhibited N.O. (Contact B): When external input is ON.....inhibited When external input is OFF.....enabled
Polarity of internal relay (CR2410/CR2411)	Fixed for A contact (enable). The setting cannot be changed.

8 Specify the output module name and confirm the setting of high-speed counter.

Specify the setting content set through the CPU high-speed counter setup wizard as the module name for ladder program output.

Confirm the setting content of CPU high-speed counter, and click the "Finish" button to finish setup.



Items of High-speed Counter Settings

● Execute counting

The execution condition of high-speed counter instruction (CTH instruction) is set to ON.

"CTH Instruction", Page 2-131

When high-speed counter is used, the following items can be set through ladder program.

● Counting range

Counting range is set.

- Linear counter… counting within the range of 32 bits.
- Ring counter… random setting of upper/lower limit, and counting within this range.

"Setting of Count Range", Page 2-114

● Input mode

To set counting input mode, and log the instruction of high-speed counter (CTH instruction).

- External input… counting pulse input of single phase, phase difference and 2 pulses.
- Internal clock…counting the internal lock of 50ns / 1μs / 10μs / 100μs.
- Direct clock pulse (specified frequency pulse) output… counting the output pulse with high-speed counter.

"Counting Input Setting", Page 2-116

● Setting value

Set the setting value (CTC) of counting up/counting down.

"Settings of High-speed Counter (CTC)", Page 2-120

● Reset

The current value of high-speed counter (CTH) is set to 0.

- RES instruction
- CTH instruction
- Automatic reset based on comparator matching
- External preset input
- Reset based on counter enable

"Reset Mode", Page 2-121

● Count enable/inhibited

The count enable/inhibited can be controlled with counter enable function.

"Counter Enabled/Disabled (counter enable)", Page 2-126

Function List of High-speed Counter

Various functions using high-speed counter are described below.

● Read the change direction of current value

The state of up or down counting of high-speed counter current value is read to the control relay (CR).

"Reading the Change Direction of Current Value", Page 2-129

● Current value refresh

When program is executed, the current value of high-speed counter is refreshed using the "RFSCTH" instruction.

"RFSCTH Instruction", Page 2-136

● Input capture

In the case of interruption, the current value of high-speed counter is stored in control memory (CM).

"Capturing Current Value Based on Input Capture", Page 2-130

● Comparator based interrupt

If counter's current value (CTH) matches comparator's setting value (CTC), interrupt program will be executed.

"3-5 Interrupt", Page 3-31

● Comparator matching based output

If current value of high-speed counter (CTH) matches comparator's setting value (CTC), ON/OFF operation will be performed automatically on output relay of KV-5000/3000.

"Comparator Matching Output", Page 2-128

● Direct clock pulse output

Clock pulse not influenced by scan time is output.

"Direct Clock Pulse Output", Page 2-141

TIP If the specified frequency pulse output is used, then pulse can simply be output.

● Expansion function

You can use special instructions to simply use expansion functions of high-speed counter.

- Frequency counting function… To measure frequency of external pulse input.

  "2-9 I/O", Page 2-97

- Rotary speed measuring function…To measure rotary speed of external pulse input.

  "2-9 I/O", Page 2-97

- Pulse of specified frequency output function… To set any frequency and output pulse.

  "2-11 Frequency Counter", Page 2-151

- Cam switch function… It is possible to use incremental encoder to perform cam control through PLC.

  "2-10 High-speed Counter", Page 2-101

Setting of Count Range

The count value range of high-speed counter can be set through counting mode and signs.

■ Linear counter

Linear counter is a counter used to count within 32-bit counting range.

Unsigned 32-bit

Up counting or down counting is performed in the range of 0 to 4294967295.
It will turn to 0 if up counting is performed from 4294967295; or it will turn to 4294967295 if down counting is performed from 0.
In this case, overflow detection relay (CR2403/CR2407) will be ON.

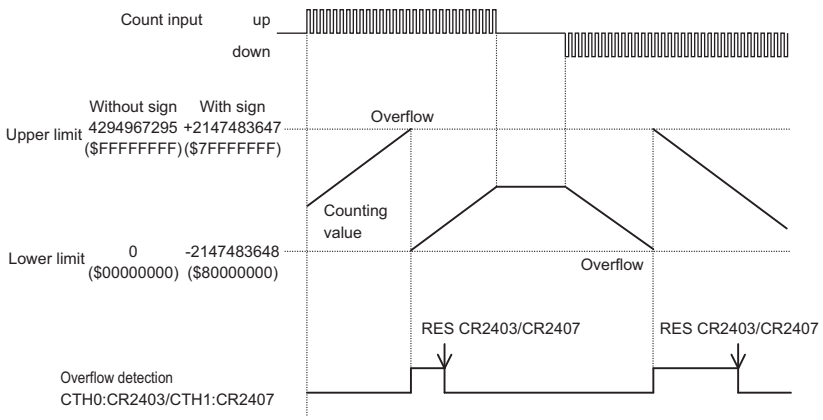
Signed 32-bit

Up counting or down counting is performed in the range of -2147483648 to +2147483647.
It will turn to -2147483648 if up counting is performed from +2147483647; or turn to +2147483647 if down counting is performed from -2147483648.
In this case, overflow detection relay (CR2403/CR2407) will be ON.

Counting value range and overflow detection relay

	Count Mode selection	Sign		Count value range	Overflow detection
CTH0	CR2402 OFF (Linear counter)	CM1608 Bit 7	OFF	0 to 4294967295	CR2403
			ON	-2147483648 to +2147483647	
CTH1	CR2402 OFF (Linear counter)	CM1609 Bit 7	OFF	0 to 4294967295	CR2407
			ON	-2147483648 to +2147483647	

Overflow detection relay will remain in ON state before it's turned ON through RES instruction.



Note

Counting will not stop even if overflow is detected. Counting will stop when counting input is stopped.

■ Ring counter

Ring counter is one that allows random setting of upper and lower limits of high-speed counter.

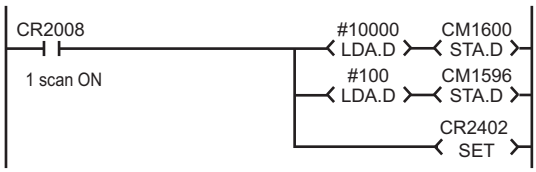
Up counting or down counting is performed within the range of upper and lower limits.
It will be change to lower limit if up counting is performed from upper limit; It will be change to upper limit if down counting is performed from lower limit.
In this case, overflow detection relay (CR2403/CR2407) will not be ON.

Setting range of counting value and storage destination of upper/lower limit

	Count Mode selection	Setting value				
		Sign		Range	Upper limit	Lower limit
CTH0	CR2402 ON (Ring counter)	CM1608 Bit 7	OFF	0 to 4294967295	CM1601	CM1597
			ON	-2147483648 to +2147483647	CM1600	CM1596
CTH1	CR2406 ON (Ring counter)	CM1609 Bit 7	OFF	0 to 4294967295	CM1603	CM1599
			ON	-2147483648 to +2147483647	CM1602	CM1598

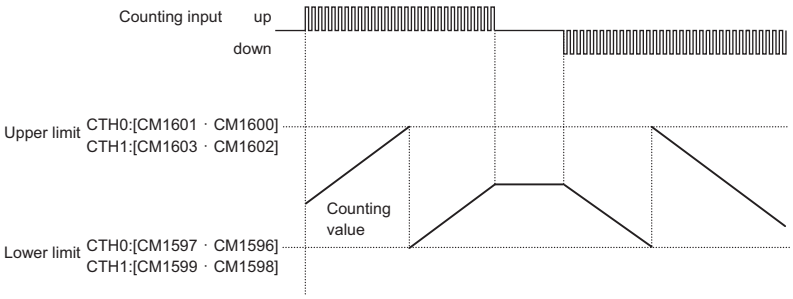
Example

Ring counting of high-speed counter comparator CTC0 with upper limit 10000 and lower limit 100



Note

· Overflow will not be detected even if upper or lower limit is exceeded.



· Through changing current value of high-speed counter or upper/lower limit of ring counter the current value can be corrected when the current value is outside the range between upper limit and lower limit during executing of END instruction.
  · If the current value exceeds the upper limit, then it is corrected to upper limit.
  · If the current value is smaller than lower limit, then it is corrected to lower limit.
· Please do not set upper limit <= lower limit, otherwise normal counting is impossible.

Counting Input Setting

High-speed counter has 3 counting modes: external input, internal clock, and direct clock pulse output.

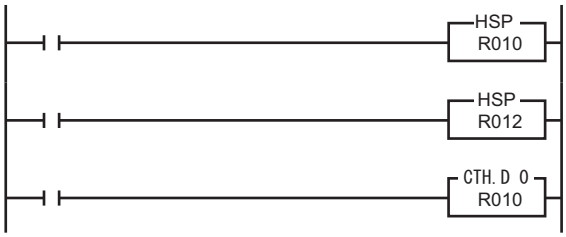
■ When count external input

When counting is performed on the external input through high-speed counter, each channel can use the following relay No.

	A-phase	B-phase
CTH0	R010	R012
CTH1	R011	R013

Example

High-speed counter CTH0 is used to count external input R010 and R012.



HSP instruction: select 10μs from the Input Time Constant

Note

When external input is used, be sure to set the input time constant.

"Input Time Constant Setting", Page 2-98

"CTH Instruction", Page 2-131
"Wiring and Internal Circuit Diagram", Page 1-28

High-speed counters are used to count external input. The following count modes are available for your option (single-phase, phase shift, and double-pulse)
Count modes are set up with a combination of CR2113 ~ CR2115 (CR2213 ~ CR2215).

CTH0 count modes

	Single phase		Phase shift			Double pulse
	Non-directional	Directional	1x	2x	4x	
CR2113	OFF	ON	OFF	ON	OFF	ON
CR2114	OFF	OFF	ON	ON	OFF	OFF
CR2115	OFF	OFF	OFF	OFF	ON	ON

CTH1 count modes

	Single phase		Phase shift			Double pulse
	Non-directional	Directional	1x	2x	4x	
CR2213	OFF	ON	OFF	ON	OFF	ON
CR2214	OFF	OFF	ON	ON	OFF	OFF
CR2215	OFF	OFF	OFF	OFF	ON	ON

Important

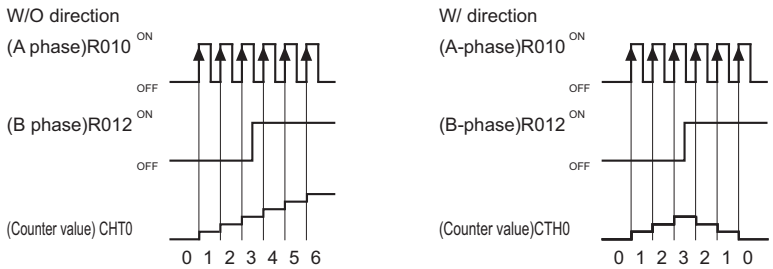
Combinations other than the above mentioned can not be used for setting up.

(1) Single phase

It is set when single pulse is counted.

w/o direction .....Rising edge of A-phase is counted.
B-phase has no influence on counting operation. (can be used as common input.)

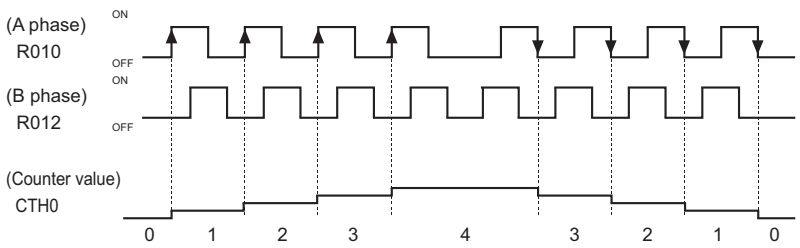
w/ direction .....Up counting is performed on the up edge of A-phase when B-phase is OFF.
Down counting is performed on the up edge of A-phase when B-phase is ON.



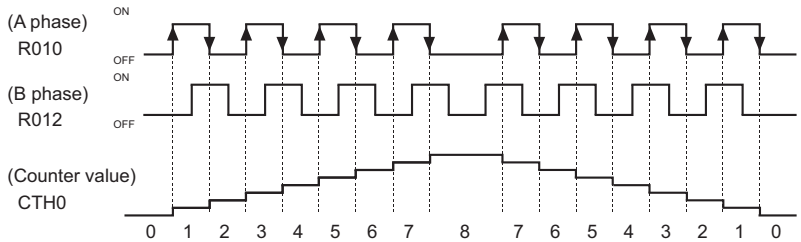
(2) Phase difference

It is set it when phase difference pulse is counted.

1x.....When B-phase is OFF, up counting is performed on the up edge of A-phase.
When B-phase is OFF, down counting is performed on the falling edge of A-phase.

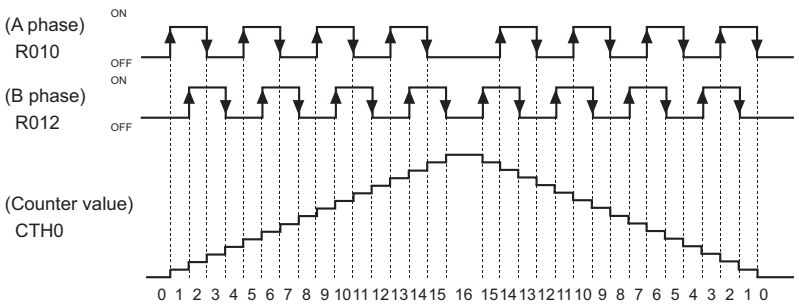


2x.....When B-phase is OFF, up counting is performed on the up edge of A-phase.
When B-phase is OFF, down counting is performed on the down edge of A-phase.
When B-phase is ON, down counting is performed on the up edge of A-phase.
When B-phase is ON, up counting is performed on the down edge of A-phase.



4x.....When B-phase is OFF, up counting is performed on the up edge of A-phase.
When B-phase is OFF, down counting is performed on the down edge of A-phase.
When B-phase is ON, down counting is performed on the up edge of A-phase.
When phas B is ON, up counting is performed on the down edge of A-phase.
When phas A is OFF, down counting is performed on the up edge of B-phase.

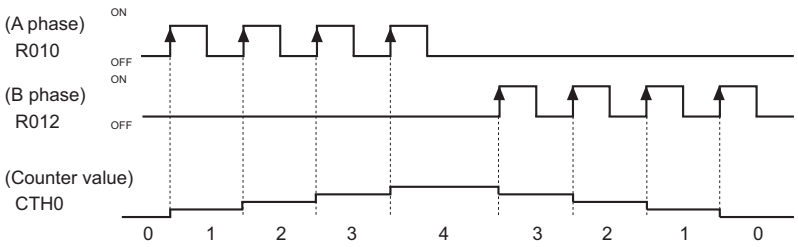
When phas A is OFF, up counting is performed on the down edge of B-phase.
When phas A is ON, up counting is performed on the up edge of B-phase.
When phas A is ON, down counting is performed on the down edge of B-phase.



(3) 2-pulse burst

Pulse with 2-pulse burst mode is counted.

Pulse up counting is performed on the up edge of A-phase, and down count is performed on the down edge of B-phase.



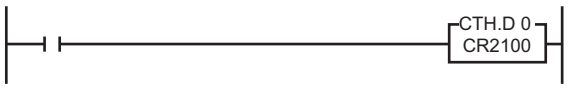
■ When count internal clock

When internal clock is counted, the following control relays can be used.

	50ns	1.0µs	10.0µs	100.0µs
CTH0	CR2414	CR2100	CR2101	CR2102
CTH1	CR2415	CR2200	CR2201	CR2202

Example

Internal clock (1.0µs) is counted with high-speed counter CTH0.



"CTH Instruction", Page 2-131

■ When count direct clock pulse (specified frequency pulse) output

The following output relays are specified when direct clock pulse or specified frequency pulse output is counted.

"Direct Clock Pulse Output", Page 2-141
"2-11 Frequency Counter", Page 2-151

	Comparator matching output
CTH0	R501
CTH1	R500

Example



The direct clock pulse output from R501 is counted through high-speed counter CTH0.

High-speed counter CTH 1 is used to count direct clock pulse output from R500.



Note

- When CR2513 is ON and CTH1's comparator matching output is set to R505, please input R501 at operand of CTH instruction.
- When CR2505 is ON and CTH0's comparator matching output is set to R504, please input R500 at operand of CTH instruction.

"Comparator Matching Output", Page 2-128

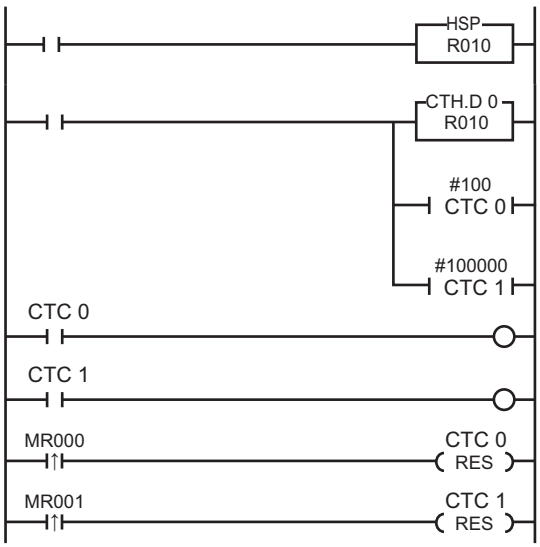
Settings of High-speed Counter (CTC)

The setting value of high-speed counter is set by high-speed counter comparator CTC0 to CTC3.
The matching with CTH0 is judged through CTC0 and CTC1.
The matching with CTH1 is judged through CTC2 and CTC3.
If no CTC interrupt program is available, and CTH matches CTC, then contact of CTC is ON.
CTC contact can be turned OFF through RES instruction. When CTC interrupt program is available, the contact of CTC will not be ON.

	Select Signed/ Unsigned		Setting range	High-speed counter comparator	
CTH0	CM1608 bit7	OFF	0 to 4294967295	CTC0	CTC1
		ON	-2147483648 to +2147483647		
CTH1	CM1609 bit7	OFF	0 to 4294967295	CTC2	CTC3
		ON	-2147483648 to +2147483647		

Example

Value of CTC0 is set to 100; value of CTC1 is set to 100000.



Note

When the current value is changed to the same value of CTC, contact of CTC will not be ON. After up/down counting, the contact will be ON only when the current value is same as the CTC value.

"CTC Instruction", Page 2-131

TIP Use the STA and MOV instructions to change CTC settings. For more information about how to change, please refer to Page 2-133.

Reset Mode

Reset modes can be divided into the following 5 types.

Reset based on RES instruction
Reset based on CTH instruction (execution condition OFF)
Automatic reset based on comparator matching
Reset based on external preset input
Reset based on counter enable function

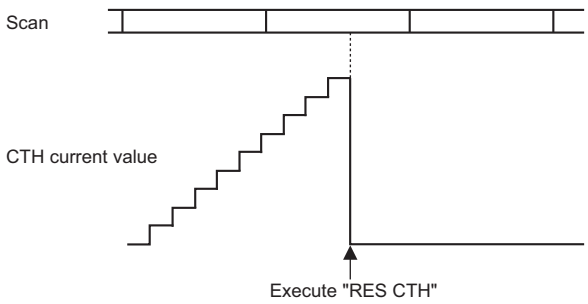
Note

The reset time of various reset modes is shown as follows.

Reset mode		Reset time
Reset based on RES instruction		The time for executing of RES instruction.
Reset based on CTH instruction (execution condition OFF)		The time for executing CTH instruction.
Automatic reset based on comparator matching		The time of comparator matching.
Reset based on external preset input		The time when external preset input is ON.
Reset based on counter enable function	Use internal enable relay	The time for the enable signal to change from inhibited -> enable or enable -> inhibited.
	Use internal enable relay and external enable input	
	Use external enable input	

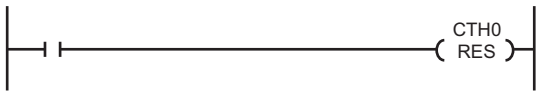
■ Reset based on RES instruction

The counter is reset through "RES CTH" when RES instruction is executed.



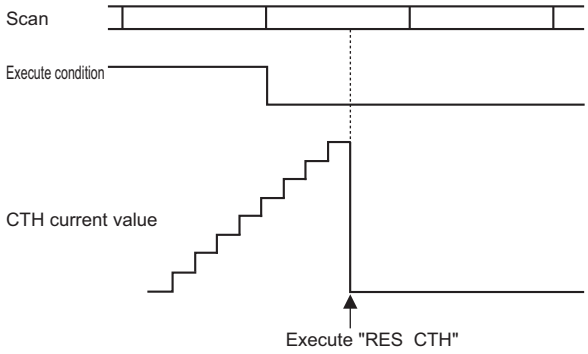
Example

Reset based on RES instruction.



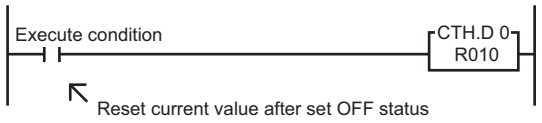
■ Reset based on CTH instruction (execution condition OFF)

Reset when the execution condition of the CTH instruction is turned OFF.



Example

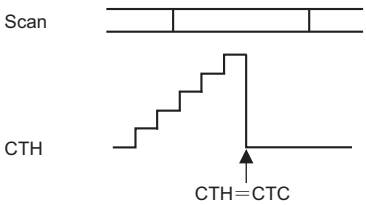
Reset based on CTH instruction (execution condition OFF)



■ Automatic reset based on comparator matching

When current value (CTH) matches setting value of comparator (CTC) during up counting or down counting, the current value will be reset automatically.
It is set through control relay.

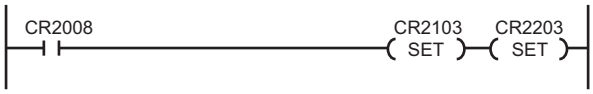
High-speed counter	High-speed counter comparator	Device No.	Operation	ON	OFF
CTH0	CTC0	CR2103	When CTH0=CTC0, auto reset	Enable	Disable
	CTC1	CR2112	When CTH0=CTC1, auto reset	Enable	Disable
CTH1	CTC2	CR2203	When CTH1=CTC2, auto reset	Enable	Disable
	CTC3	CR2212	When CTH1=CTC3, auto reset	Enable	Disable



* Reset when CTH=CTC.

Example

Automatic reset based on comparator matching



Note

Precautions on CTH change when auto reset is performed.

- In the case that the value is "unsigned" or "signed" and value of CTC is positive, even if CTH is changed to above CTC, the CTH value will be "CTC value-1 ".
- In the case that the value is "signed" and value of CTC is negative, even if CTH is changed to below CTC, the CTH value will be "CTC value +1".

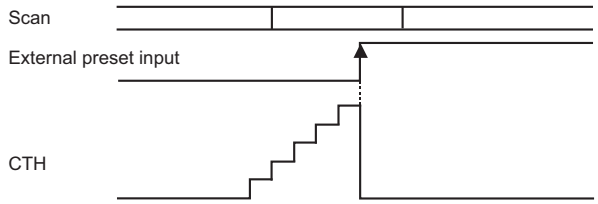
■ Reset based on external preset input

Reset through preset function.

Preset is performed by setting preset value to 0.

This can be set up no matter whether scanning is performed.

"Preset Function", Page 2-124



Reset when external preset input is ON.

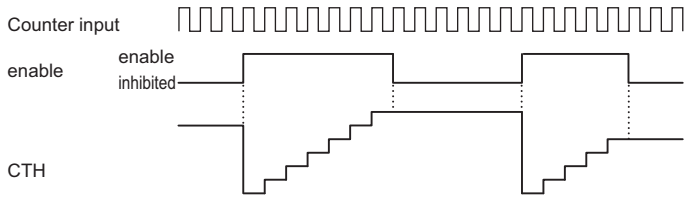
■ Reset based on counter enable function

Reset when counter switches from enable -> inhibited or inhibited -> enable.

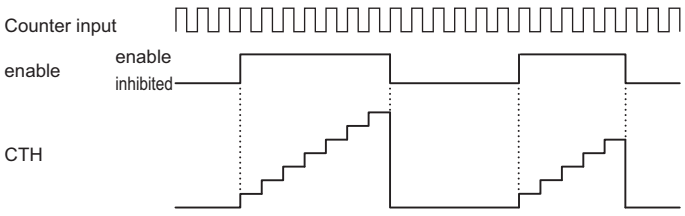
Inhibited/enabling of counter enable signal can be set through external enable input and internal enable relay.

"Counter Enabled/Disabled (counter enable)", Page 2-126

Inhibited ->Enable

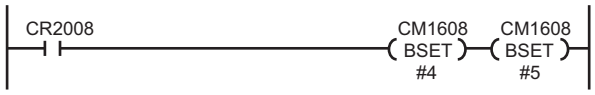


Enable->Inhibited



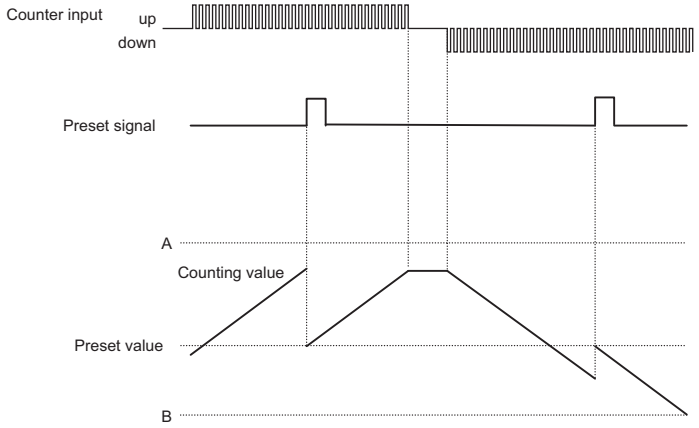
Example

Reset based on counter enable function (enable -> inhibited)



Preset Function

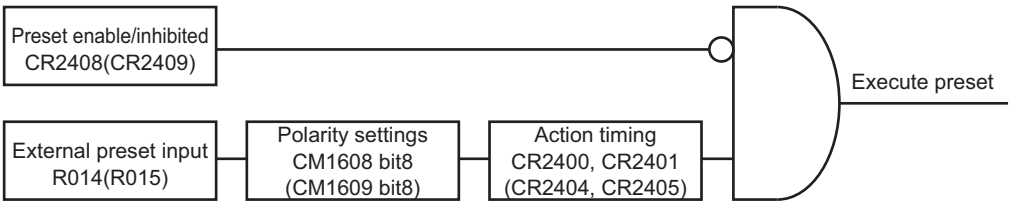
With this function, you can change the current value of high-speed counter to preset value. The current value can be changed through external input.



	Linear counter		Ring counter	
	unsigned	signed	unsigned	signed
A	4294967295	+2147483647	Upper limit (0 to 294967295)	Upper limit(-2147483648 to +2147483647)
B	0	-2147483648	Lower limit (0 to 4294967295)	Lower limit (-2147483648 to +2147483647)

Concept of the preset function setting of preset signal are described below.

Schematic diagram of preset function



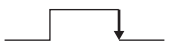
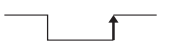
■ Setting destination storage address of external preset input and preset value

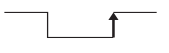
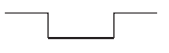
	External preset input	Destination storage address of preset value	
		Higher bit	Lower bit
CTH0	R014	CM1605	CM1604
CTH1	R015	CM1607	CM1606

■ Setting external enable preset input

	Device No.	Enable	Inhibited
CTH0	CR2408	OFF	ON
CTH1	CR2409	OFF	ON

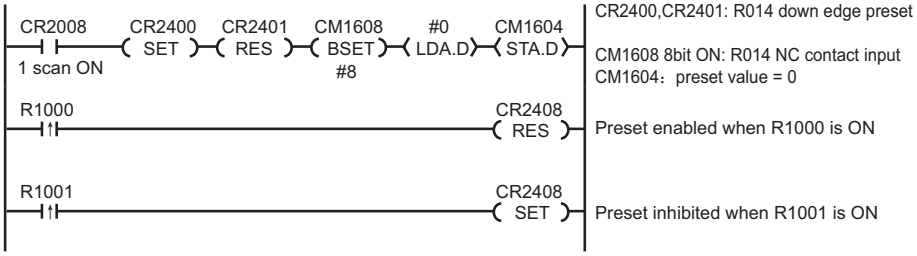
■ Setup external default input

	R00014 Input polarity	CM01608 8-bit	CR2400	CR2401	Preset timing
CTH0	NO contact	OFF	OFF	OFF	N/A
			ON	OFF	 The rising edge of R00014 input signal
			OFF	ON	 The falling edge of R00014 input signal
			ON	ON	 Duration time when R00014 input signal ON
	NC contact	ON	OFF	OFF	未使用
			ON	OFF	 The falling edge of R00014 input signal
			OFF	ON	 The rising edge of R00014 input signal
			ON	ON	 Duration time when R00014 input signal OFF

	R00015 Input polarity	CM01609 8-bit	CR2404	CR2405	Preset timing
CTH1	NO contact	OFF	OFF	OFF	N/A
			ON	OFF	 The rising edge of R00015 input signal
			OFF	ON	 The falling edge of R00015 input signal
			ON	ON	 Duration time when R00015 input signal ON
	NC contact	ON	OFF	OFF	N/A
			ON	OFF	 The falling edge of R00015 input signal
			OFF	ON	 The rising edge of R00015 input signal
			ON	ON	 Duration time when R00015 input signal OFF

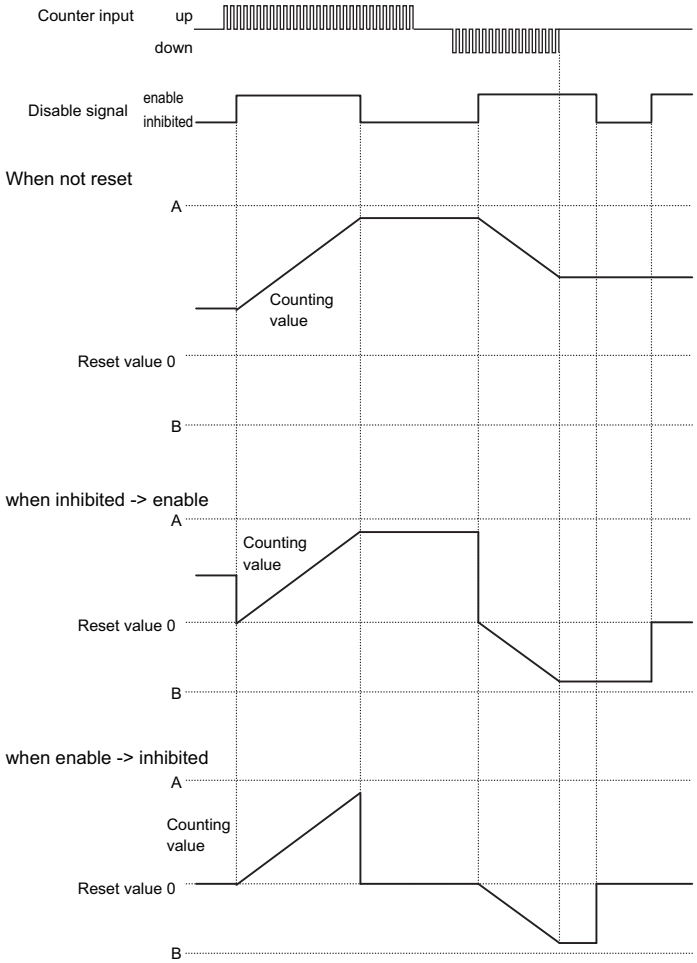
Example

After initial setting, CTH0 is set to preset enable on the up edge of R1000. (high-speed counter reset)
CTH0 is set to preset inhibited on the up edge of R1001. (high-speed counter reset)
CTH0 is set on the down edge R014. (R014 is a NC contact input)



Counter Enabled/Disabled (counter enable)

With the counter enable function, inhibited /enabling of counting input can be controlled.
Control can be performed through external enable input (R008, R009) and internal enable relay (CR2410, CR2411).
In addition, the current value can be reset when counter enable signal changes between enable -> inhibited or inhibited -> enable.



	Linear counter		Ring counter	
	unsigned	**signed**	**unsigned**	**signed**
A	4294967295	+2147483647	Upper limit (0 to 4294967295)	Upper limit (-2147483648 to +2147483647)
B	0	-2147483648	Lower limit (0 to 4294967295)	Lower limit (-2147483648 to +2147483647)

Setting of enable signal is described below.

■ External enable input

	External enable input relay	Input polarity			Enable	Inhibited
CTH0	R008	CM1609 bit 9	OFF	N.O.	ON	OFF
			ON	N.C.	OFF	ON
CTH1	R009	CM1609 bit 9	OFF	N.O.	ON	OFF
			ON	N.C.	OFF	ON

■ Internal enable relay

	Internal enable relay	Enable	Inhibited
CTH0	CR2410	ON	OFF
CTH1	CR2411	ON	OFF

■ Enable signal

Set via external enable input and internal enable relay.

	Combination setting			Description
	Bit 2	Bit 1	Bit 0	
CM1608 (CTH0) CM1609 (CTH1)	OFF	OFF	OFF	Normal enable (counting is performed all the time regardless of the inhibited/ enable state of external enable input, internal enable relay.)
	OFF	ON	OFF	
	ON	OFF	OFF	
	ON	ON	OFF	
	OFF	OFF	ON	Counting is performed when internal enable relay is in enable state.
	OFF	ON	ON	Counting is performed when external enable relay is in enable state.
	ON	OFF	ON	Counting is performed when internal enable relay and external enable relay are in enable state.
	ON	ON	ON	Counting is performed when internal enable relay or external enable relay are in enable state.

■ Current value reset setting when inhibited <=> enable

	Bit 5	Bit 4	Operation
CM1608 (CTH0) CM1609 (CTH1)	OFF	OFF	Not reset
	OFF	ON	
	ON	OFF	Current value is reset when inhibited -> enable.
	ON	ON	Current value is reset when enable -> inhibited.

Comparator Matching Output

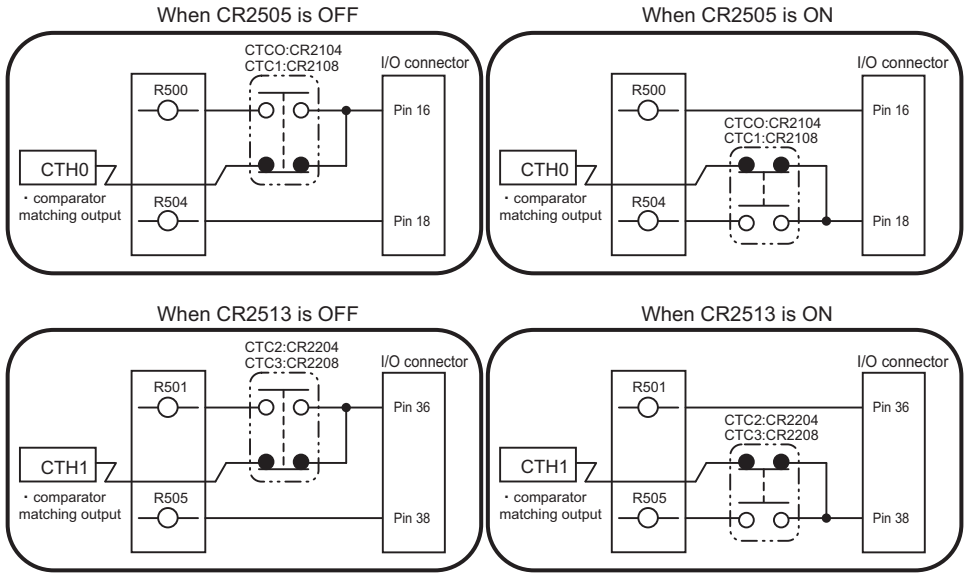
When comparator value (setting value) matches the current value, output relay will be ON/OFF. It can be set through control relay. The comparator matching output will not be affected by scan time.

	Comparator	Output relay selection	Comparator matching output inhibited/enable	Control content			
				Device No.	Operation when CTC is ON	Device control	
						ON	OFF
CTH0	CTC0	CR2505 OFF:R500 ON :R504	CR2104* OFF: enable ON : inhibited	CR2105	Output ON	Enable	Disable
				CR2106	Output OFF	Enable	Disable
				CR2107	Output ON/OFF inverted	Enable	Disable
	CTC1		CR2108* OFF: enable ON: inhibited	CR2109	Output OFF	Enable	Disable
				CR2110	Output ON	Enable	Disable
				CR2111	Output ON/OFF inverted	Enable	Disable

	Comparator	Output relay selection	Comparator matching output inhibited/enable	Control content			
				Device No.	Operation when CTC is ON	Device control	
						ON	OFF
CTH1	CTC2	CR2513 OFF:R501 ON :R505	CR2204* OFF: enable ON : inhibited	CR2205	Output ON	Enable	Disable
				CR2206	Output OFF	Enable	Disable
				CR2207	Output ON/OFF inverted	Enable	Disable
	CTC3		CR2208* OFF: enable ON: inhibited	CR2209	Output OFF	Enable	Disable
				CR2210	Output ON	Enable	Disable
				CR2211	Output ON/OFF inverted	Enable	Disable

* Initial value is ON

Schematic diagram



Note

- When comparator matching output in enabled state (CTC0:CR2104 OFF/CTC1:CR2108 OFF), R500, R504 or R501, R505 outputs cannot be controlled. (pin 16, pin 18 or pin 36, pin 38 can not be controlled through SET instruction and RES instruction.)
- Frequency that can be output from R500 is different from that from R504, R501 and R505.

"Output specification", Page 1-27

Reading the Change Direction of Current Value

(1) Reading the change direction of current value (CTH)

The change direction of current value (CTH) is indicated.

	Description	down counting	up counting
CR2412(CTH0)	Indicates the change direction of CTH0.	ON	OFF
CR2413(CTH1)	Indicates the change direction of CTH1.	ON	OFF

Note

- The change direction (CR2412, CR2413) is refreshed with every scan. After operation is completed, change direction before completion is maintained .
- The max. refreshing time of change direction is "change direction detection time constant + 1 scan period". Value is refreshed to latest value when RFSCTH instruction is executed.

"RFSCTH Instruction", Page 2-136

(2) Setting the change direction detection time constant of current value (CTH)

The change direction detection time constant is set through MOV instruction or DW instruction.

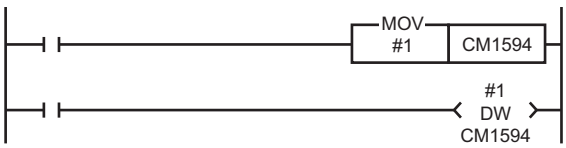
Please refer to KV-8000/7000/5000/3000/1000 Series PLC Instruction Reference Manual, “MOV instructions"

	Setting value	Change direction detection time constant
CM1594 (CTH0) CM1595 (CTH1)	0 (Default setting)	Filter OFF(for each scan)
	1	100μs
	2	500μs
	3	1ms
	4	2.5ms
	5	5ms
	6	10ms
	7	50ms

When set to 100μs.

Example

The change direction detection time constant of CTH0 is set to 100μs.



Capturing Current Value Based on Input Capture

Input capture refers to the function in which current value of high-speed counter is captured from control memory when interrupt condition occurs. When the interruption condition is on external input, this function is enabled (ON), which need not be set.

The captured value is stored in control memory CM1610 to CM1617.

Interrupt condition (external input)	High-speed counter for current value capturing	Destination storage address	
		Higher DM	Lower DM
When INT R000 occurs	CTH0	CM1611	CM1610
When INT R001 occurs	CTH0	CM1613	CM1612
When INT R002 occurs	CTH1	CM1615	CM1614
When INT R003 occurs	CTH1	CM1617	CM1616

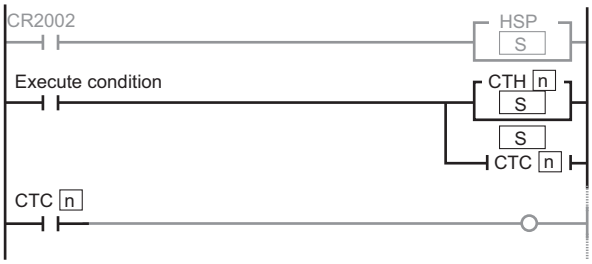
For details about interrupt, see "3-5 Interrupt", Page 3-31.

Instructions for High-speed Counter

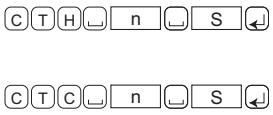
Instruction	mnemonics	Description about instruction	See
High-speed counter	CTH	Response frequency Line driver input: 1-phase 100 kHz, phase difference 50 KHz Open collector input: 1-phase 60 kHz, phase difference 30 KHz 32-bit (0 to 4294967295 or -2147483648 to 2147483647) up/down counting operation.	page 2-131
High-speed counter comparator	CTC		page 2-131
High-speed counter refresh	RFSCTH	To refresh current value of high-speed counter to the latest value.	page 2-136

CTH	**CTH(.D)** **CTH.L**	CTH **32-bit High-speed counter**	To perform 32-bit (unsigned 0 to 4294967295, signed -2147483648 to 2147483647) up/down counter operation with max. input frequency of 100 KHZ.
CTC	**CTH(.D)** **CTC.L**	CTC **High-speed counter Comparator**	

Ladder program



Input mode



Operand		Available devices																		Index Modification
		Bit device							Word device							Constant	Indirect specifying		Local device	
		R	(DR)	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
CTH	n	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-	-	-
	S	○	-	-	-	-	-	○	-	-	-	-	-	-	-	-	-	-	-	-
CTC	n	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-	-	-
	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-	-	-

Operand		Explanation
CTH	n	Specifies counter No. with 0 or 1.
	S	Specifies counter input.
CTC	n	Specifies comparator No. with 0 to 3.
	S	Specifies setting value of high-speed counter within the range of 0 to 4294967295 (unsigned) and -2147483648 to +2147483647 (signed).

Operation Description

CTH(.D) When execute condition is ON, input of the device in S is calculated.

CTH.L When execution is OFF, counting value will be cleared.

Unsigned/signed counting is switched through control memory (CM).

"Linear counter", Page 2-114

It's necessary to reduce input time constant when external input (R010, R013) is calculated.

" Input Time Constant Setting", Page 2-98

CTC(.D) It is ON when setting value in S matches the current value of high-speed counter during operation of high-speed counter.

CTC.L n is specified within the range of 0 to 42497295 when suffix is ".D".

n is specified within the range of 2147483648 to +2147483647 when suffix is ".L".

For control relay (CR) and data memory (DM) used for high-speed counter function and counting and reset modes, see settings of each setting item.

■ Reading/changing of current value and changing of setting value

(1) Reading current value

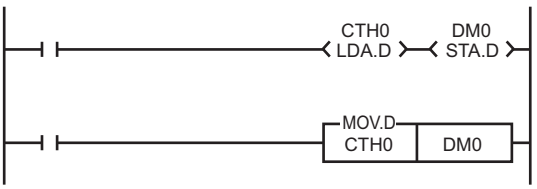
Current value is read through LDA instruction or MOV instruction.

Please refer to KV-8000/7000/5000/3000/1000 Series PLC Instruction Reference Manual, “LDA instructions"

In the case of unsigned value (0 to 4294967295), suffix is indictated by ".D".

Example

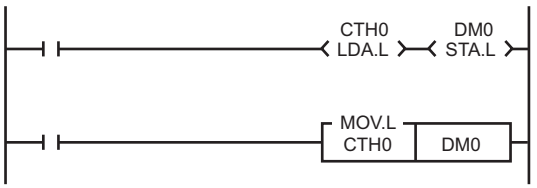
Current value of CTH0 is stored in data memory "DM0/DM1".



In the case of signed value (-2147483648 to +2147483647), suffix is indicated by ".L".

Example

Current value of CTH0 is stored into data memory "DM0/DM1".



(2)Changing current value (CTH)

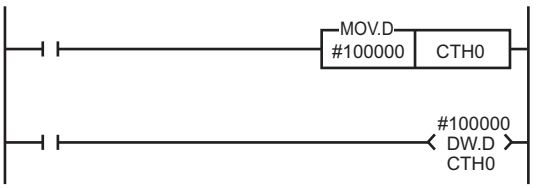
Current value is changed through MOV instruction or DW instruction.

Please refer to KV-8000/7000/5000/3000/1000 Series PLC Instruction Reference Manual, “MOV instructions", "DW instructions".

In the case of unsigned value (0 to 4294967295), suffix is indicated by ".D".

Example

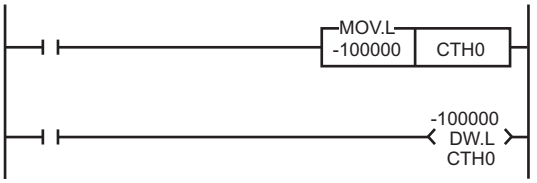
Current value of CTH0 is changed to 100000.



In the case of signed value (-2147483648 to +2147483647), ".L" is used in suffix.

Example

Current value of CTH0 is changed to -100000.



Note

Precautions on CTH change during automatic reset.

· When value is "unsigned" or "signed" and CTC value is positive, even if CTH is changed to above CTC, the CTH value will be "CTC value-1 ".

· When value is "signed" and CTC value is negative, even if CTH is changed to below CTC, the CTH value will be "CTC value +1".

"Automatic reset based on comparator matching", Page 2-122

(3) Changing setting value (CTC)

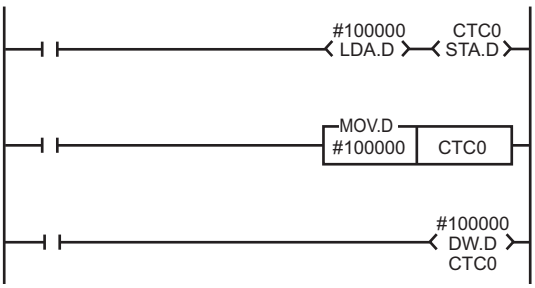
Setting value is changed through STA instruction, MOV instruction or DW instruction.

Please refer to KV-8000/7000/5000/3000/1000 Series PLC Instruction Reference Manual, “STA instructions” “MOV instructions” “DW instructions”

In the case of unsigned value (0 to 4294967295), suffix is indicated by ".D".

Example

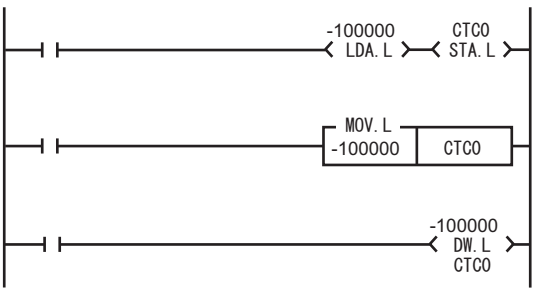
Value of CTC0 is change to 100000.



In the case of signed value (-2147483648 to +2147483647), ".L" is used in suffix.

Example

Current value of CTC0 is changed to -100000.



Note

Precautions on CTH change during automatic reset.

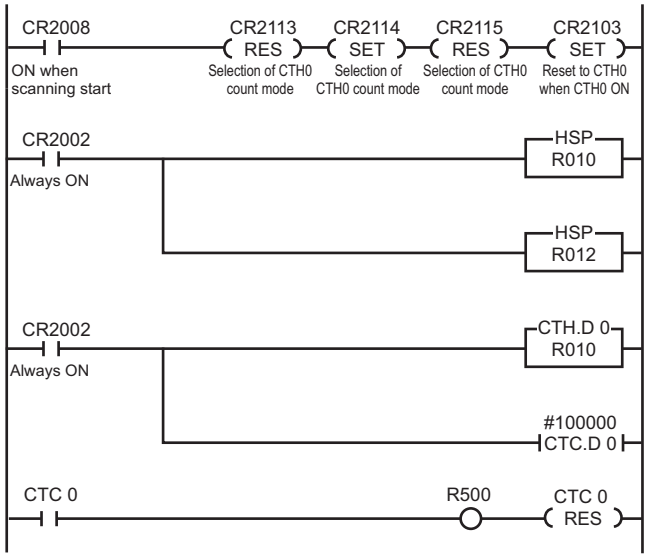
· When value is "unsigned" or "signed" and CTC value is positive, even if CTH is changed to above CTC, the CTH value will be "CTC value-1 ".

· When value is "signed" and CTC value is negative, even if CTH is changed to below CTC, the CTH value will be "CTC value +1".

"Automatic reset based on comparator matching", Page 2-122

Sample program

For a one-fold phase difference, the high-speed counter 0 (R10,R12) will be used to count the encoder. Once the setting value of high-speed counter comparator CTC0 is reached, the output relay R500 turns ON.



(Mnemonic Table)
```
LD CR2008
RES CR2113
CON
SET CR2114
CON
RES CR2115
CON
SET CR2103
LD CR2002
HSP R010
HSP R012
LD CR2002
CTH.D #0 R010
CTC.D #0 #100000
LD CTC0
OUT R500
CON
RES CTC0
```

MEMO

RFSCTH

RFSCTH

High-speed counter Refresh

To update current value of high-speed counter to the latest value.

Ladder program



Input mode

Operand	Available devices																		Index modification
	Bit device							Word device							Constant	Indirect specifying		Local device	
	R	DR	MR LR	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
n	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-	-	-

Operand	Description
n	Specifies high-speed counter No..（0 or 1）

Operation Description

If the execution condition is ON, the current value of high-speed counter CTH is updated to the latest value.

Meanwhile, CTH overflow and change direction control relay are updated to the latest state.

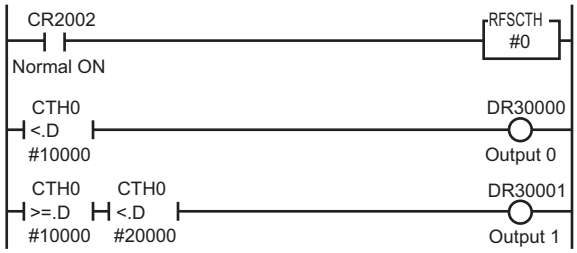
High-speed counter	Control relay after changing	
	Overflow	Change direction
CTH0	CR2403	CR2412
CTH1	CR2407	CR2413

Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	No change in status

Sample Program

The latest value of high-speed counter 0 is used to change the state of output relay R30000 and R30001.




```
(mnemonics list)
 LD CR2002
 RFSCTH #0
 LD<.D CTH0 #10000
 OUT DR30000
 LD>=.D CTH0 #10000
 AND<.D CTH0 #20000
 OUT DR30001
```

Device List for High-speed Counter

■ Control relay (CR) list for CTH0

Device No.	Attribute R: Read only Blank: R/W	Description	ON	OFF
CR2414	R	Internal clock (50ns)	-	-
CR2100	R	Internal clock(1.0μs)	-	-
CR2101	R	Internal clock(10.0μs)	-	-
CR2102	R	Internal clock(100.0μs)	-	-
CR2103		If CTC0 ON, then CTH0 is reset automatically.	Enable	Disable
CR2104		If CTC0 ON, then comparator matching output (R500/R504) is inhibited	Enable	Disable
CR2105		If CTC0 ON, then comparator matching output (R500/R504) is OFF	Enable	Disable
CR2106		If CTC0 ON, then comparator matching output (R500/R504) is ON	Enable	Disable
CR2107		If CTC0 ON, then ON/OFF of comparator matching output (R500/R504) is inverted	Enable	Disable
CR2108		If CTC1 ON, then comparator matching output (R500/R504) is inhibited	Enable	Disable
CR2109		If CTC1 ON, then comparator matching output (R500/R504) is OFF	Enable	Disable
CR2110		If CTC1 ON, then comparator matching output (R500/R504) is ON	Enable	Disable
CR2111		If CTC1 ON, then ON/OFF of comparator matching output (R500/R504) is inverted	Enable	Disable
CR2112		If CTC1 ON, CTH0 is reset automatically.	Enable	Disable

Device No.	Attribute R: Read only Blank: R/W	Description	1-phase w/o direction	1-phase w/ direction	1x	2x	4x	2-pulse
CR2113		To set external input mode	OFF	ON	OFF	ON	OFF	ON
CR2114			OFF	OFF	ON	ON	OFF	OFF
CR2115			OFF	OFF	OFF	OFF	ON	ON

Device No.	Attribute R: Read only Blank: R/W	Description	inhibited	Rising edge	Falling edge	Level
CR2400		To set external preset input	OFF	ON	OFF	ON
CR2401			OFF	OFF	ON	ON

Device No.	Attribute R: Read only Blank: R/W	Description	ON	OFF
CR2402		To select counting mode	Ring	Linear
CR2403		To detect overflow	End	Not end
CR2408		To inhibited preset processing	Disable	Enable
CR2410		To enable internal enable relay and counting input	Disable	Enable
CR2412	R	Change direction of current value	Down counting	Up counting
CR2505		To switch pulse output destination.	R504	R500

TIP The default state of CR2104 and CR2108 is ON. Otherwise, these devices are OFF.

Note Control relay should be turned on using SET instruction, and turned off using RES instruction.

■ Control memory list for CTH0

Device No.	Attribute R: Read only Blank: R/W	Description
CM1594		To set change direction detection time constant

Setting value	#0	#1	#2	#3	#4	#5	#6	#7
Change direction Detection time constant	Filter none	100µs	500µs	1ms	2.5ms	5ms	10ms	50ms

CM1596		Ring counter lower limit (low)
CM1597		Ring counter lower limit (high)
CM1600		Ring counter upper limit (low)
CM1601		Ring counter upper limit (high)
CM1604		Preset value (low)
CM1605		Preset value (high)

Device No.		Attribute R: Read only Blank: R/W	Description
CM1608	Bit 0		To set combined condition of external enable input and internal enable relay
	Bit 1		
	bit 2		
	Bit 3		Reserved for system
	Bit 4		To set reset mode based on current value of counter enable function
	bit 5		
	Bit 6		Reserved for system
	Bit 7		To set counting value to "signed"/"unsigned" — ON : signed / OFF : unsigned
	Bit 8		To set the polarity of external enable input — ON : N.C. contact / OFF : N.O. contact
	Bit 9		To set the polarity of external enable input — ON : N.C. contact / OFF : N.O. contact
	Bit 10 ⋮ Bit 15		Reserved for system

bit 2	Bit 1	Bit 0	Explanation
OFF	OFF	OFF	Normal enable (counting is performed all the time, whether external enable input and internal enable relay are enabled/ inhibited or not.)
OFF	ON	OFF	
ON	OFF	OFF	
ON	ON	OFF	
OFF	OFF	ON	Counting is performed when internal relay is in enabled state.
OFF	ON	ON	Counting is performed when external enable input is in enabled state.
ON	OFF	ON	Counting is performed when internal enable relay and external enable input are in enabled state.
ON	ON	ON	Counting is performed when internal enable relay or external enable input is in enabled state. nable state.

Bit 5	Bit 4	Explanation
OFF	OFF	Not reset
OFF	ON	
ON	OFF	Current value is reset when inhibited -> enable
ON	ON	Current value is reset when enable -> inhibited

■ Control relay (CR) list for CTH1

Device No.	Attribute R: Read only Blank: R/W	Description	ON	OFF
CR2415	R	Internal clock (50ns)	-	-
CR2200	R	Internal clock (1.0μs)	-	-
CR2201	R	Internal clock (10.0μs)	-	-
CR2202	R	Internal clock (100.0μs)	-	-
CR2203		If CTC2 ON, then CTH1 is reset automatically.	Enable	Disable
CR2204		If CTC2 ON, then comparator matching output (R501/R505) inhibited.	Enable	Disable
CR2205		If CTC2 ON, then comparator matching output (R501/R505) is OFF	Enable	Disable
CR2206		If CTC0 ON, then comparator matching output (R501/R505) is ON	Enable	Disable
CR2207		If CTC2 ON, then ON/OFF of comparator matching output (R501/R505) is inverted	Enable	Disable
CR2208		If CTC3 ON, then comparator matching output (R501/R505) inhibited	Enable	Disable
CR2209		If CTC3 ON, then comparator matching output (R501/R505) is OFF	Enable	Disable
CR2210		If CTC3 ON, then comparator matching output (R501/R505) is ON	Enable	Disable
CR2211		If CTC3 ON, then ON/OFF of comparator matching output (R501/R505) is inverted	Enable	Disable
CR2212		If CTC3 ON, then CTH1 is reset automatically.	Enable	Disable

Device No.	Attribute R: Read only Blank: R/W	Description	1--phase w/o direction	1-phase w/ direction	1x	2x	4x	2-pulse
CR2213		To setup external input mode	OFF	ON	OFF	ON	OFF	ON
CR2214			OFF	OFF	ON	ON	OFF	OFF
CR2215			OFF	OFF	OFF	OFF	ON	ON

Device No.	Attribute R: Read only Blank: R/W	Description	Inhibited	Rising edge	Falling edge	Level
CR2404		To set external preset input	OFF	ON	OFF	ON
CR2405			OFF	OFF	ON	ON

Device No.	Attribute R: Read only Blank: R/W	Description	ON	OFF
CR2406		To select counting mode	Ring	Linear
CR2407		To detect overflow	End	Not end
CR2409		To inhibited preset processing	Disable	Enable
CR2411		To enable internal enable relay and counting input	Disable	Enable
CR2413	R	Change direction of current value	down counting	Up counting
CR2513		To switch pulse output destination.	R505	R501

TIP The default state of CR2104 and CR2108 is ON. Otherwise, these devices are OFF.

Note

Control relay should be turned on using SET instruction, and turned off using RES instruction.

■ Control memory list for CTH1

Device No.	Attribute R: Read only Blank: R/W	Content
CM1595		To set the change direction detection time constant

Setting value	#0	#1	#2	#3	#4	#5	#6	#7
Change direction Detection time constant	Filter none	100µs	500µs	1ms	2.5ms	5ms	10ms	50ms

CM1598		Ring counter lower limit (low)
CM1599		Ring counter lower limit (high)
CM1602		Ring counter upper limit (low)
CM1603		Ring counter upper limit (high)
CM1606		Preset value (low)
CM1607		Preset value (high)

Device No.		Attribute R: Read only Blank: R/W	Content
CM1609	Bit 0		To set combined condition of external enable input and internal enable relay

Bit 2	Bit 1	Bit 0	Explanation
OFF	OFF	OFF	Normal enable (counting is performed all the time, whether external enable input and internal enable relay are enabled/ inhibited or not.)
OFF	ON	OFF	
ON	OFF	OFF	
ON	ON	OFF	
OFF	OFF	ON	Counting is performed when internal relay is in enabled state.
OFF	ON	ON	Counting is performed when external enable input is in enabled state.
ON	OFF	ON	Counting is performed when internal enable relay and external enable input are in enabled state.
ON	ON	ON	Counting is performed when internal enable relay or external enable input is in enabled state.

	Bit 1		
	Bit 2		
	Bit 3		Reserved for system
	Bit 4		To set reset mode based on current value on counter enable function.

Bit 5	Bit 4	Explanation
OFF	OFF	Not reset.
OFF	ON	
ON	OFF	Current value is reset when inhibited -> enable
ON	ON	Current value is reset when enable -> inhibited

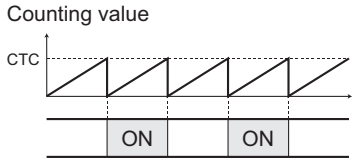
	Bit 5			
	Bit 6		Reserved for system	
	bit 7		To set counting value to "signed"/"unsigned"	ON : signed OFF : unsigned
	Bit 8		To set the polarity of external enable input	ON : N.C. OFF : N.O.
	Bit 9		To set the polarity of external enable input	ON : N.C. OFF : N.O.
	Bit 10 ⋮ Bit 15		Reserved for system	

Direct Clock Pulse Output

When high-speed counter (CTH) and high-speed counter comparator (CTC) are used, it's possible to output the clock pulse to direct output relay R500 (R504) or R501 (R505) without being influenced by scan time.

■ Overview

For pulse output, the internal clock pulse is counted through high-speed counter (CTH). Whenever the current value matches the setting value of high-speed counter comparator (CTH), the ON/OFF state of output relay R500 (R504) and R501 (R505) will be changed to generate pulse.



Relay No. of output pulse can be changed through CR2505 (CTH0)/CR2513 (CTH1).

Device No.	Description	ON	
CR2505	Switches the pulse output destination of CTH0.	Outputs pulse to R504	Outputs pulse to R500
CR2513	Switches the pulse output destination of CTH1.	Outputs pulse to R505	Outputs pulse to R501

Note

- The output at beginning of direct clock pulse output begins always with OFF state.
- In the direct clock pulse output process, the output relay R500 (R504) and R501 (R505) cannot be used for general program.
- Frequency that can be output by R500 and R504 is different from that of R501 and R505. Please set the output destination address according to frequency.

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■ Frequency range that can be output

Pulse period (frequency) and pulse width can be set using the internal clock period for high-speed counter (CTH) and high-speed counter comparator (CTC).

Clock pulse period (frequency) that can be set can be changed within the following range.

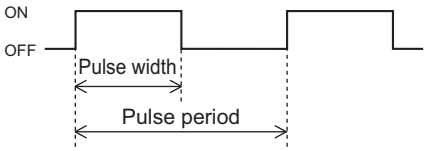
Output	Internal clock	Pulse period(frequency)range
R500 (R504)	CR2414 (50ns)	10µs (100kHz) to 214748.36475ms
	CR2100 (1.0µs)	10µs (100kHz) to 4294967.295ms
	CR2101 (10.0µs)	20µs (50kHz) to 42949672.95ms
	CR2102 (100.0µs)	200µs (5kHz) to 429496729.5ms
R501 (R505)	CR2415 (50ns)	10µs (100kHz) to 214748.36475ms
	CR2200 (1.0µs)	10µs (100kHz) to 4294967.295ms
	CR2201 (10.0µs)	20µs (50kHz) to 42949672.95ms
	CR2202 (100.0µs)	200µs (5kHz) to 429496729.5ms

■ Setting up comparator setting value (CTC)

Pulse period of output clock pulse and setting value of high-speed counter comparator can be set with the following formula.

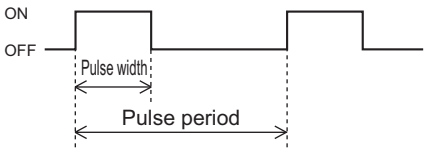
Pulse period (μs)=1000000 / frequency (Hz)

● Pulse with 1:1 ON/OFF ratio



Setting value of CTC = pulse period (μs)/internal clock (μs) ÷ 2

● Pulse with variable pulse width



Setting value of CTC for pulse width = pulse width (μs) / internal clock (μs)

Setting value of CTC for pulse period = pulse period (μs)/internal clock (μs)

● Setting range of CTC

Special auxiliary relay (internal clock)		Period	CTC Setting range
CR2414	CR2415	50ns	100 to 4294967295
CR2100	CR2200	1.0μs	5 to 4294967295
CR2101	CR2201	10.0μs	1 to 4294967295
CR2102	CR2202	100.0μs	1 to 4294967295

Note

- If CR2100 and CR2200 are set in operand of high-speed counter (CTH), please set the CTC setting value to above 5. If the setting value is smaller than 5, the clock pulse cannot be output correctly.
- If CR2414 and CR2415 are set in operand of high-speed counter (CTH), please CTC setting value to above 100. If the setting value is smaller than 100, the clock pulse cannot be output correctly.
- The pulse width will change due to the influence of connected load. Please observe actual output waveform with oscillograph, and then set the pulse width.
- If you use CTC0 and CTC1 or CTC2 and CTC3 to generated clock pulse, please don't set the same setting value for CTC0 and CTC1, or CTC2 and CTC3.
- The above mentioned pulse width is the pulse width that is output from inside of KV-5500/5000/3000 PLC. In fact, it's output through output circuit. So, the pulse width will fluctuate due to the influence of response relay and connected load. Please observe actual output waveform with oscillograph, and then set the pulse width.

■ Control relay setting

● When CTH0 is used

Through setting the control relay (CR2103 to CR2112) at start of operation, and making changes while clock pulse is generated, you can change ON/OFF state of output relay R500 (R504), as shown in table below. Besides, you can freely set pulse period and pulse width, and enable/inhibited state of comparator output. When control relay is ON/ OFF, the output relay R501 (R505) operates as follows.

High-speed counter comparator	control relay	Operation when CTH0 (current value) = CTC (setting value)		
CTC0	CR2103	Current value of CTH0 is reset automatically	ON : Auto reset	OFF: not auto reset
	CR2104	Controls R500(R504)	ON : inhibited	OFF : enabled
	CR2105	Comparator matching output of R500 (R504) is turned off	ON : Yes	OFF: No
	CR2106	Comparator matching output of R500 (R504) is turned on	ON : Yes	OFF: No
	CR2107	R500 (R504) output ON/OFF is inverted	ON : Yes	OFF: No
CTC1	CR2108	Controls R500 (R504)	ON : inhibited	OFF : enabled
	CR2109	Comparator matching output of R500 (R504) is turned off	ON : Yes	OFF: No
	CR2110	Comparator matching output of R500 (R504) is turned on	ON : Yes	OFF: No
	CR2111	R500 (R504) output ON/OFF is inverted	ON : Yes	OFF: No
	CR2112	Current value of CTH0 is reset	ON : Yes	OFF: No

- R500 (R504) can be controlled by turning CR2104 and CR2108 OFF.
- If CR2105 and CR2109 are turned on/off, then operations such as stopping and outputting clock pulse etc. can be realized.

Note

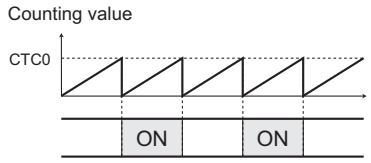
- Only one relay between CR2104 to CR2107 and CR2108 to CR2111 will be turned on.
- SET, RES or STA instruction can be used to set CR2103 to CR2112 ON/OFF.
- If pulse period can be changed, be sure to turn on CR2103 or CR2112 to let current value of CTH0 reset automatically. The pulse period cannot be changed if CR2103 or CR2112 isn't turned on.
- Within the control relay range of CR2104 to CR2107 and CR2108 to CR2111, when several relays are to be turned on, relays of smaller No. are turned on first.

● Operation of output R500(R504) based on control relay setting

Pulse with 1:1 ON/OFF ratio

Relay No.	Setting
CR2103	ON
CR2104	OFF
CR2105	OFF
CR2106	OFF
CR2107	ON

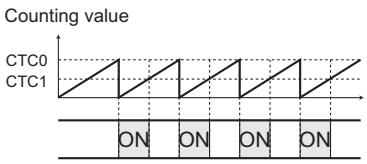
Relay No.	Setting
CR2112	OFF
CR2108	ON
CR2109	OFF
CR2110	OFF
CR2111	OFF



Pulse with variable pulse width

Relay No.	Setting
CR2103	ON
CR2104	OFF
CR2105	OFF
CR2106	ON
CR2107	OFF

Relay No.	Setting
CR2112	OFF
CR2108	OFF
CR2109	ON
CR2110	OFF
CR2111	OFF



● When using CTH1

Through setting the control relay (CR2203 to CR2212) at start of operation, and making changes while clock pulse is generated, you can change ON/OFF state of output relay R501 (R505), as shown in table below. Besides, you can freely set pulse period and pulse width, and enable/ inhibited state of comparator output. When control relay is ON/ OFF, the output relay R501 (R505) operates as follows.

High-speed counter comparator	Control relay	Operation when CTH0 (current value) = CTC (setting value)		
CTC2	CR2203	Current value of CTH1 is reset automatically	ON : Auto reset	OFF: not auto reset
	CR2204	Controls R501 (R505)	ON : inhibited	OFF : enabled
	CR2205	Comparator matching output of R501 (R505) is turned off	ON : Yes	OFF: No
	CR2206	Comparator matching output of R501 (R505) is turned on	ON : Yes	OFF: No
	CR2207	R501 (R505) output ON/OFF is inverted	ON : Yes	OFF: No
CTC3	CR2208	Controls R501 (R505)	ON : inhibited	OFF : enabled
	CR2209	Comparator matching output of R501 (R505) is turned off	ON : Yes	OFF: No
	CR2210	Comparator matching output of R501 (R505) is turned on	ON : Yes	OFF: No
	CR2211	R501 (R505) output ON/OFF is inverted	ON : Yes	OFF: No
	CR2212	Current value of CTH1 is reset	ON : Yes	OFF: No

· R500 (R504) can be controlled by turning CR2108, CR2109 OFF.

· If CR2205 and CR2209 are turned on/off, then operations such as stopping and outputting clock pulse etc. can be realized.

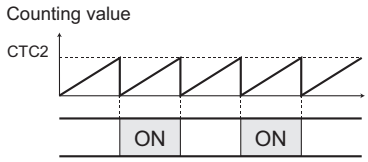
Note

- If pulse period can be changed, be sure to turn on CR2203 or CR2212 to let current value of CTH1 reset automatically. The pulse period cannot be changed if CR2203 or CR2212 isn't turned on.
- Only one relay between CR2204 to CR2207 and CR2208 to CR2211 will be turned on.
- SET, RES or STA instruction can be used to set CR2203 to CR2212 ON/OFF.
- Within the control relay range of CR2204 to CR2207 and CR2208 to CR2211, when several relays are to be turned on, relays of smaller No. are turned on first.

● Operation of output R501(R505) based on control relay setting

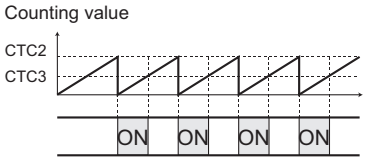
Pulse with 1:1 ON/OFF ratio

Relay No.	Setting	Relay No.	Setting
CR2203	ON	CR2212	OFF
CR2204	OFF	CR2208	ON
CR2205	OFF	CR2209	OFF
CR2206	OFF	CR2210	OFF
CR2207	ON	CR2211	OFF



Pulse with variable pulse width

Relay No.	Setting	Relay No.	Setting
CR2203	ON	CR2212	OFF
CR2204	OFF	CR2208	OFF
CR2205	OFF	CR2209	ON
CR2206	ON	CR2210	OFF
CR2207	OFF	CR2211	OFF



■ Pulse with 1:1 ON/OFF ratio

As illustrated below, clock pulse with 1:1 ON/OFF ratio can be output from output R500 using high-speed counter (CTH0) and high-speed counter comparator (CTC0).

● Control relay setting

Set CR2103 to CR2107 according to the table on the right.
For the pulses with 1:1 ON/OFF ratio, inverted output (toggle circuit) can be used to simplify procedure.

Relay No.	Setting
CR2103	ON
CR2104	OFF
CR2105	OFF
CR2106	OFF
CR2107	ON

● Setting value for internal clock and CTC0

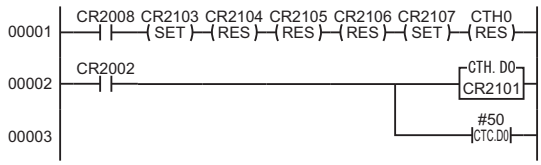
Determine internal clock and obtain setting value of CTC0 by calculating the current value.

Setting value of CTC0 = pulse period (μs)/internal clock (μs) / 2

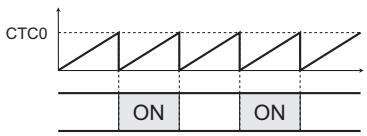
In the above formula, pulse period = 1ms, internal clock = 10μs, which are substituted (CR2101) and setting value of CTC0 is obtained.
The setting value of CTC0 is changed to "50".
The values calculated from other internal clocks are listed as follow (for reference only).

Control relay	Internal clock	CTC0 value
CR2414	50ns	10000
CR2100	1.0μs	500
CR2101	10.0μs	50
CR2102	100.0μs	5

● Program example



Count value



·Pulse output of output R500 set through CR2104 to 2107.
In this example, R500's comparator matching output (CR2104:OFF) is disabled when set; when CTH0 = CTC0, output of R500 is inverted (CR2107: ON).
· CR2103 is turned on, and resetting of CTH0 is specified via CTC0.
With this operation, current value of CTH0 is cleared repeatedly through setting value of CTC0.
· When operation is started, current value of CTH0 (RES CTH0 part) is reset repeatedly.
Pulse width of clock pulse can be correctly output from 1st pulse through this operation.
· CTH0's enable input relay is always ON during outputting clock pulse.

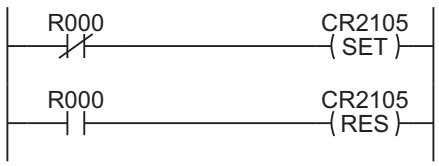
Note

If enable input of high-speed counter is used for starting/stopping clock pulse, then response may be delayed up to one scan period when clock pulse is started.

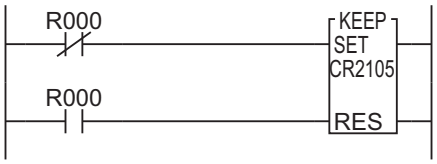
■ Tip

If clock pulse output is to be controlled through external input (enable/inhibited), it can be controlled through ON/OFF of CR2105.
CR2105 ON/OFF can be set through SET, RES or KEEP instruction.
So clock pulse must start from "OFF", and finish with "OFF".
In the example of previous page, if a program in the figure below is added, then R500 will output clock pulse only when R000 is ON.

●When using SET/RES instruction



●When using KEEP instruction



■ Output example of clock pulse with variable ON/OFF ratio

As illustrated below, high-speed counter (CTH1) and high-speed counter comparator (CTC2, CTC3) can be used to output clock pulse of variable pulse width from output R501.

● Control relay setting

Set CR2203 to CR2212 according to the table below.

Relay No.	Setting	Relay No.	Setting
CR2203	ON	CR2212	OFF
CR2204	OFF	CR2208	OFF
CR2205	OFF	CR2209	ON
CR2206	ON	CR2210	OFF
CR2207	OFF	CR2211	OFF

● Internal clock and setting value of CTC2 and CTC3

Determine internal clock, and calculate current setting value of CTC and CTC3.

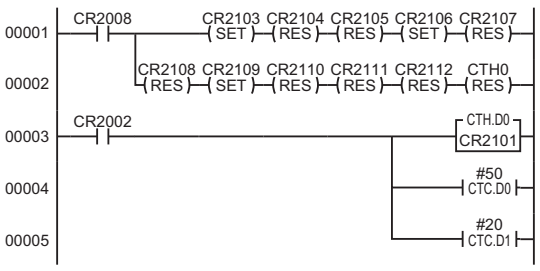
Setting value of CTC3 = pulse width (μs) / internal clock (μs)

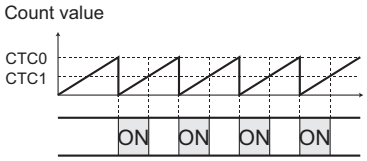
Setting value of CTC2 = pulse period (μs)/internal clock (μs)

In above-specified formula, pulse width=200μs, pulse period=500μs and internal clock=10μs (CR2201) are substituted, and the setting value of CTC2 and CTC3 is calculated.
The setting value of CTC3 is "20", and that of CTC2 is "50".
The values calculated from other internal clocks are as follows (only for reference).

Control relay	Internal clock	CTC2 value	CTC3 value
CR2415	50ns	10000	4000
CR2200	1.0μs	500	200
CR2201	10.0μs	50	20
CR2202	100.0μs	5	2

● Program example





·CR2204 to 2207 and CR2208 to 2211 are used to set pulse output for output R501.
In this example, it should be guaranteed when setting that, for comparator matching output of R501, (CR2204 :OFF) can turn on output of（CR2206: ON) R501 through CTC2, and can turn off (CR2209:ON) through CTC3.
·CR2203 is turned off, and reset of CTH1 is specified through CTC2.
Pulse width of clock pulse can be correctly output from 1st pulse through the above operation.
·CTH1's enable input relay is always ON when clock pulse is output.

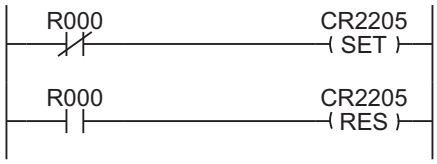
Note

- If enable input of high-speed counter is used for starting/stopping clock pulse, the response may be delay up to 1 scan period when clock pulse is started or stopped.
- For starting and stopping of clock pulse output, refer to the "Tip" below.

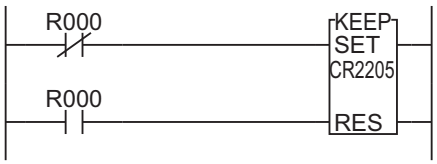
● Tip

When the output of clock pulse is controlled through external input (enable/inhibited), this can be done through ON/OFF of CR2205.
SET, RES or KEEP instruction is used to turn CR2205 ON/OFF.
So clock pulse must start from "OFF", and finish with "OFF".
In the example on the previous page, if a program in the figure below is added, R501 will output clock pulse only when R000 is "ON".

●When using SET/RES instruction



●When using KEEP instruction



- Through rewriting the setting value of high-speed counter comparator CTC2 via STA instruction, clock pulse period (frequency) can be changed.

■ An example of stopping clock pulse through specified number of pulses

Clock pulse is stopped after 10000 clock pulses (output period 500μs (2kHz), pulse width 200μs) are output from output R500.

● Setting of control relay, internal clock and CTC

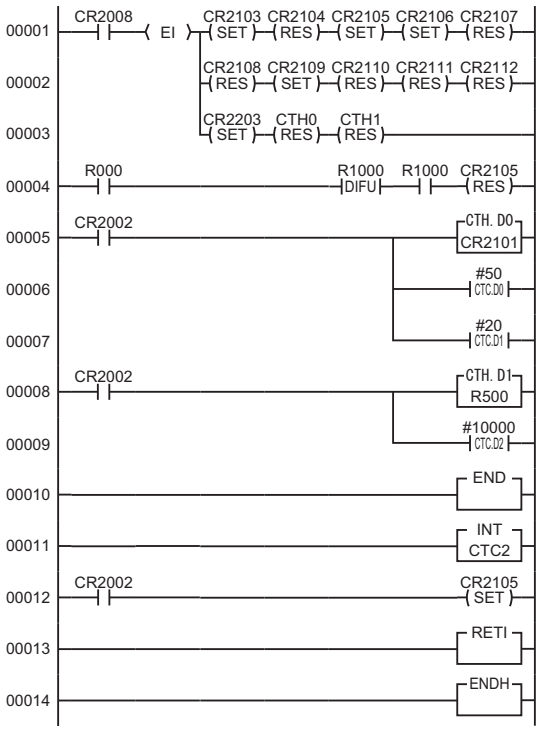
Setting of CTC0 and CTC1 through control relay and internal clock is as follows.

Relay No.	Setting	Relay No.	Setting
CR2103	ON	CR2112	OFF
CR2104	OFF	CR2108	OFF
CR2105	OFF	CR2109	ON
CR2106	ON	CR2110	OFF
CR2107	OFF	CR2111	OFF

Setting value of internal clock and CTC0, CTC1 are as follows.

control relay	Internal timer	CTC0 value	CTC1 value
CR2414	50ns	10000	40000
CR2100	1.0μs	500	200
CR2101	10.0μs	50	20
CR2102	100.0μs	5	2

● Program example



·Pulse output of output R500 is set through CR2104 to 2107 and CR2108 to 2111.
In this example, (CR2104 OFF) R500's comparator matching output is allowed to turn on (CR2106: ON) R500 output through CTCO, and turn off (CR2109: ON) R500 output through CTC3.

·CR2103 is specified, and CTH0 reset is specified via CTC0.
Pulse width of clock pulse can be correctly output from 1st pulse via above operation.

·Interrupt is enabled through EI instruction.
When the current value of high-speed counter CTH1 matches the setting value of high-speed counter comparator CTC2 (10000 pulse output), clock pulse will be stopped through interrupt program (INT CTC2).

·CR2203 is turned on, and CTH1 reset is specified via CTC2.
Through the above operations, operation can be performed repeatedly using the specified number of pulses (10000).

·CTH1's enable input relay is always kept at ON state during counting of clock pulse.

·CTH1's enable input relay is always ON when clock pulse counting is performed.

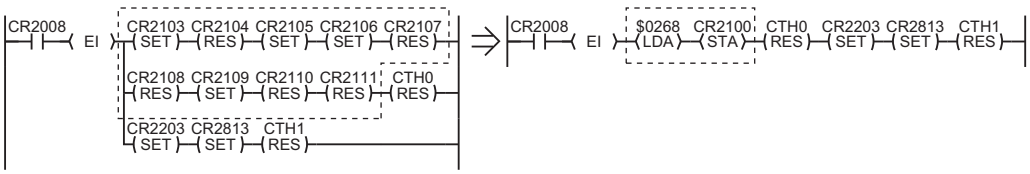
·Internal clock (CR2101) is specified on the clock input high-speed counter CTH0, and R500 is specified on the clock input of high-speed counter CTH1.
Through the above operations, CTH0 is used for clock pulse output, and CTH1 is used for clock pulse counting.

·Number of pulses of clock pulse is set the setting value of high-speed counter comparator CTC2.

·Clock pulse output is started turning on input R000.
When clock pulse is turned on again after stopping, please turn on input R000 again.

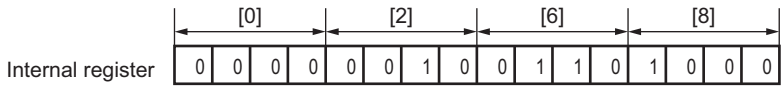
● Tip

ON/OFF of CR2103 to CR2111 can be set by LDA instruction and STA instruction in addition to SET instruction/RES instruction. If the program shown in the example is rewritten through LDA instruction and STA instruction, then number of rungs and steps can be reduced as shown in the figure below.

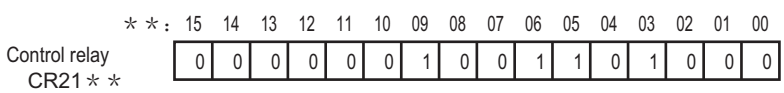


· About LDA $0268

When LDA $0268 is executed, internal register will be input as follows.



When STA CR2100 is executed, value of the internal register will be assigned to auxiliary relay CR2100 to CR2115.



CR2103, CR2105, CR2106 and CR2109 will be ON.

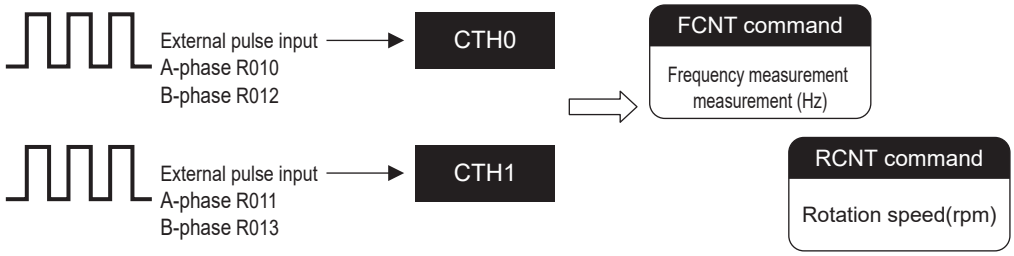
MEMO

2-11 Frequency Counter

Frequency counter can be used to measure frequency or rotation speed.

Frequency Counter Function Overview

Through special instructions, frequency (Hz) or rotation speed (rpm) of external pulse input can be measured simply.



Note

Since high-speed counter is required to use frequency counter function, therefore, other functions or instructions of high-speed counter with the same No. cannot be used simultaneously.

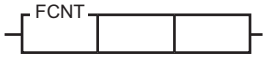
For Terminal No. of input relays (R010 to R013), see "Wiring and Internal Circuit Diagram", Page 1-28.

Frequency Counter Instructions

There are 2 types of instructions for frequency counter.

Instruction	mnemonics	Description	see
Frequency measurement	FCNT	To measure the frequency of pulse input using high-speed counter (CTH0/CTH1).	Page 2-152
Rotation speed measurement	RCNT	To measure the rotation speed of pulse input using high-speed counter (CTH0/CTH1).	Page 2-154

FCNT



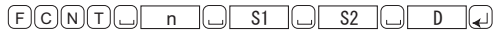
Frequency measurement

To detect the frequency of pulse input using high-speed counter.

Read ladder program from memory card



Input mode



Operand	Available devices																		Index modification
	Bit device							Word device							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
n	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-	-	-
S1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-	-	-
S2	○	-	○	-	-	-	○	○	○	○	○	○	○	○	○	-	○	○	○
D	○	-	○	-	-	-	○	○	○	○	-	-	-	○	-	-	○	○	○

Operand	Description
n	Specifies used high-speed counter No.(0, 1)*1
S1	Specifies pulse input mode. *1 0 = 1-phase w/o direction; 1 = 1-phase w/ direction; 2 = phase difference 1x; 3 = 2-pulse "Counting Input Setting", Page 2-116
S2	Specifies scan times within 0 to 65535. But, if the scan times is "0", it will be set to "100". When bit device is specified, continuous 16 bits will be occupied. If word device is specified, only 1 word is occupied. *2
D	Specifies the leading device for storing detection result (Hz). When bit device is specified, continuous 32 bits will be occupied. If word device is specified, then 2 words will be occupied. *2

*1 The device cannot be specified in "$".

*2 When a bit device other than channel start is specified (R106, R1012, etc.), it will be dragged to next channel during processing.

Description of Operation

Settings of S1 and S2 are read on the rising edge of the execution condition, and each scan is performed when the execution condition is ON. The value (detection result) stored in D/D+1 will be refreshed whenever the scan times in S2 is performed. No. of the high-speed counter n is specified.

If the execution condition is established, then time between pulses of external input is detected continuously, and with END processing, frequency is calculated from the time between pulses.

Frequency (Hz) =1/(time between pulses)

The mean value corresponding to scan times in S2 is taken as the measurement result of frequency, and stored in D/D+1.

The updating period is below "scan time X (scan times specified by S2)".

If execution condition is OFF, then detection will be stopped.

Note

- 2 or above FCNT instructions using high-speed counter with the same No. cannot be executed simultaneously.
- Other functions or instructions cannot be used simultaneously when the high-speed counter with the No. [n] is used.
- After execution condition is ON, detection is started from the 1st pulse input, and detection result is refreshed from the 2nd pulse input on.
- When this instruction is used, please use HSP instruction and control relay and set the input time constant to 10 μs. "Input Time Constant Setting", Page 2-98
- Please don't change the control relay (CR) and control memory (CM) related to high-speed counter specified by [n].
- Starting and stopping of detection is executed when scanning is finished. (when no instruction is executed.)
- If there is no pulse input within 1s, the frequency is 0 (Hz).
- When [S1] and [S2] are changed, please temporarily change execution condition from OFF -> ON.
- Cannot be used in interrupt program and initialization module.

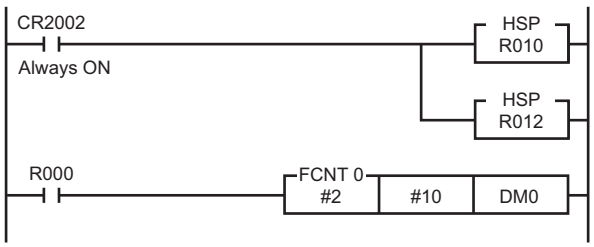
Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	ON in the following cases; OFF in other cases. • When range of indirect specifying and index modification is improper If indirect specifying or index modification is not specified, then the status will be not changed.

* If CR2012 is ON, the instruction will be not executed. The error will be displayed in KV STUDIO or in the access window. In addition, detailed error info will be stored in CM5100 to CM5176.
"Error Log (CM)", Page 3-20

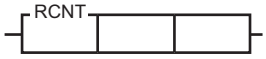
Sample Program

Frequency (Hz) of encoder input R010 (A-phase) and R012 (B-phase) is detected, and the result is stored in " DM0/DM1". (CTH0 is used)




```
(mnemonics list)
 LD CR2002
 HSP R010
 HSP R012
 LD R000
 FCNT #0 #2 #10 DM0
```

RCNT



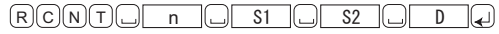
Rotation speed measurement

To detect the rotation speed of pulse input using high-speed counter.

Ladder program



Input mode



Operand	Available devices																		Index modification
	Bit device							Word device							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
n	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-	-	-
S1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-	-	-
S2	○	-	○	-	-	-	○	○	○	○	-	-	-	○	○	-	○	○	○
D	○	-	○	-	-	-	○	○	○	○	-	-	-	○	-	-	○	○	○

Operand	Description
n	Specifies used high-speed counter No..(0, 1).*1
S1	Specifies pulse input mode. *1 0 = s1-phase w/o direction; 1 = 1-phase w/ direction; 2 = phase difference 1x; 3 = 2-pulse "Counting Input Setting", Page 2-116
S2	Specifies the leading device for storing parameters. When bit device is specified, continuous 48 bits will be occupied. If word device is specified, 3 words will bes occupied. *2 S2 +0 … Detection method (0: to detect according pulse interval; 1: to detect according to time per revolution) S2 +1 … number of pulses per revolution. · to detect according to pulse interval (1 to 65535) · to detect according to time per revolution (1 to 32767) S2 +2 … Scan times (0 to 65535). If it is 0, the scan times will be set to 100.
D	Specifies the leading device for storing detection result (rpm). When bit device is specified, continuous 32 bits will be occupied. If word device is specified, 2 words will be occupied. *2

*1 The device cannot be specified in "$".

*2 When bit device other than channel starting (R106, R1012, etc.) is specified, it will be dragged to next channel during processing.

Description of Operation

Settings of S1 and S2 are read on the rising edge of the execution condition, and each scan is performed when the execution condition is ON. The value (detection result) stored in D/D+1 will be refreshed whenever the scan times in "S2 +2" is performed. No. of the high-speed counter n is specified.

● To detect according to pulse interval (when "S2 + 0 is 0)

If the execution condition is established, then time between pulses external input is detected continuously, and with END processing, rotation speed specified in S2 +1 is calculated.

Rotation speed (rpm)=60/(time between pulses× pulses per revolution)

The mean value corresponding to scan times specified by S2 +2 is stored in "D /D +1" as detection result of rotation speed.

The updating period is below "scan time X (scan times specified by S2 +2).
If execution condition is OFF, detection will be stopped.

● To detect rotation speed according to time per revolution (when S2 + 0 is 1)
If execution condition is ON, number of pulses of external input will be counted. Time equal to the number of pulses per revolution specified by S2 + 1 (time required for 1 revolution) is detected continuously, and with END processing, rotation speed is calculated according to the time between specified number of pulses.
Rotation speed (rpm)= 60 / (time per revolution)
The mean value corresponding to scan times specified by S2 +2 is stored in "D /D +1" as detection result of rotation speed.
The updating period is below "scan time× (scan times specified by S2 +2).
If execution condition is OFF, detection will be stopped.

Note

- 2 or above RCNT instructions using high-speed counter with the same No. cannot be executed simultaneously.
- Other functions or instructions cannot be used simultaneously when the high-speed counter with the No. n is used.
- After execution is ON, detection result is refreshed from the 2nd pulse input on.
- When this instruction is used, please use HSP instruction and control relay, and set the input time constant to 10μs. "2-12 Cam Switch", Page 2-157
- Please don't change control relay (CR) and control memory (CM) not related to high-speed counter with the No. specified by n .
- Starting and stopping of detection is executed when scanning is finished. (when no instruction is executed.)
- When detection is started according to pulse interval, it will change to 0 (rpm) when pulse interval is larger than 1s.
- When detection is started according to time per revolution, it will change to 0 (rpm) when time longer than 1.5s is required for 1 revolution.
- When S1 and S2 are changed, please temporarily change execution condition from OFF -> ON.
- Cannot be used in interrupt program and initialization module.

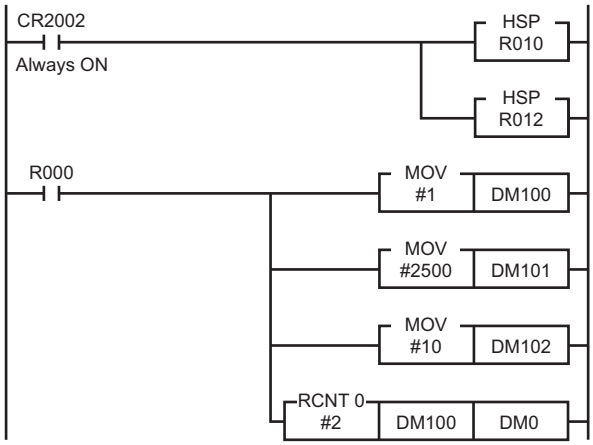
Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	ON in the following cases; OFF in other cases. • In the case of range beyond the specified range by S2 • When range of indirect specifying and index modification is not proper.

* If CR2012 is ON, the instruction will not be executed. The error will be displayed in KV STUDIO or access window. In addition, the detailed error info will be stored in CM5100 to CM5176.
"Error Log (CM)", Page 3-20

Sample Program

Rotation speed (rpm) of encoder input R010 (A-phase) and R012 (B-phase) is detected, and the result is stored in "DM0/DM1". (CTH0 is used)



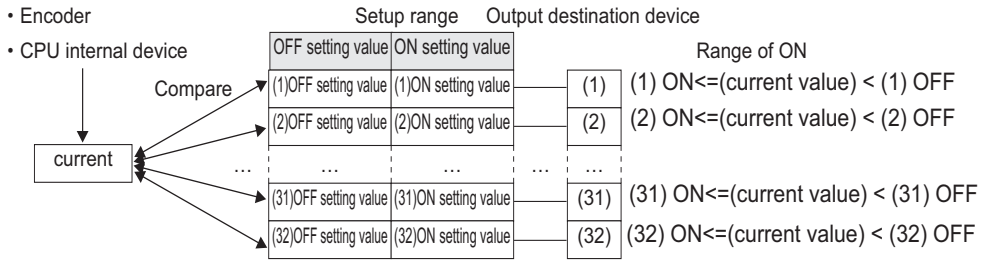

```
(mnemonics list)
 LD CR2002
 HSP R010
 HSP R012
 LD R000
 MOV #1 DM100
 MOV #2500 DM101
 MOV #10 DM102
 RCNT #0 #2 DM100 DM0
```

2-12 Cam Switch

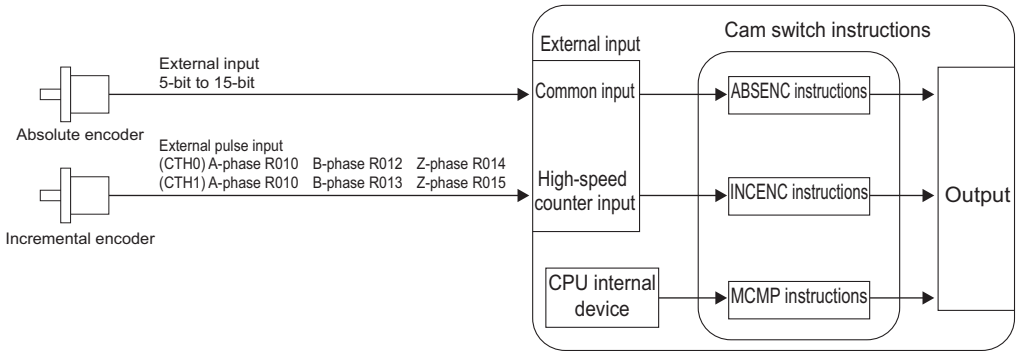
Angle conversion is performed on the value from encoder, and cam operation is simulated.

Cam Switch Function Overview

Current value obtained from acquisition encoder input is compared with preset setting of multiple ranges. The setting range in which the current value is located will be detected, and the output destination device corresponding to this setting range is set to ON.



Various special instructions corresponding to different input modes are available.



Note

When incremental encoder is used, since high-speed counter is required, other functions or instructions using a high-speed counter with the same No. cannot be used simultaneously.

Cam Switch Instructions

There are the following 3 types of cam switch instructions.

Instruction	mnemonics	Description	See
Multi-stage comparator	MCMP	Multi-stage comparator operation is performed.	Page 2-158
Absolute Encoder	ABSENC	Absolute encoder is used to perform cam operation.	Page 2-162
Increment Encoder	INCENC	Incremental encoder is used to perform cam operation.	Page 2-166

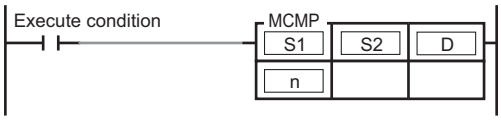
MCMP



Multi-stage comparator

To perform multi-stage comparator operation.

Ladder program



Input mode



Operand	Available devices																		Index modification
	Bit device							Word device							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
S1	○	-	○	-	-	-	-	○	-	-	-	-	-	○	-	-	○	○	○
S2	○	-	○	-	-	-	○	○	○	○	○	○	○	○	○	-	○	○	○
D	○	-	○	-	-	-	○	○	-	-	-	-	-	○	-	-	○	○	○
n	○	-	○	-	-	-	○	○	○	○	○	○	○	○	○	-	○	○	○

Operand	Description
S1	Specifies the leading device of data block for comparing. *1
S2	Specifies the device for comparing. *2
D	Specifies the leading device for storing comparison result. *3
n	Specifies number of data for comparing or the device for storing number of data. (1 to 32) *4*5

*1 If bit device is specified, then n x 32 continuous bits starting from channel will be processed.
If word device is specified, n x 2 words will be processed.

*2 If bit device is specified, then continuous 16 bits will be processed.
If relays other than channel leading relay (R002, R106, R1012, etc.) are specified, then 16 bits will be processed, straddling to the next channel.

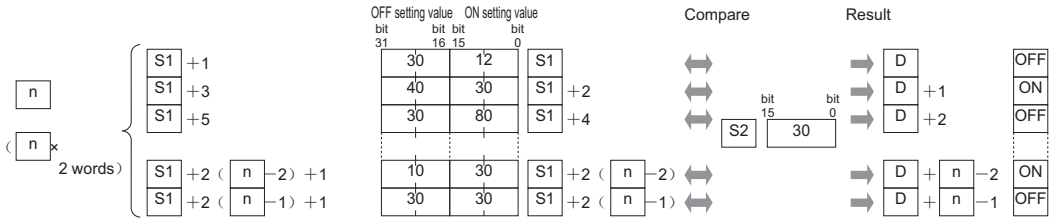
*3 When bit device is specified, n bits will be occupied.
When word device is specified, the result is stored in lowest bit of each word device. The bits other than the lowest bit is not changed.

*4 "$" cannot be used.

*5 When bit device is specified, continuous 16 bits will be occupied.
If word device is specified, 1 word will be occupied.

Description of Operation

When execution condition is ON, [n] 32-bit data (2 unsigned 16-bti BIN data: OFF setting and ON setting) starting from [S1] are compared with the unsigned 16-bit BIN data stored in [S2], and the result is stored in devices starting from [D].



When OFF setting > ON setting

If OFF setting > [S2] >= ON setting, then [D] is ON.

When OFF setting < ON setting

If OFF setting > [S2] or [S2] >= ON setting, then [D] is ON.

When OFF setting = ON setting

[D] is always OFF.

Note

· Even if the execution condition is OFF, output will not be changed.

Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	ON in the following cases; OFF in other cases. · When a value out of range is specified in [n]. · When a device other than channel leading device is specified in [S1]. · When range of indirect specifying and index modification is not proper. · When a device other than the channel leading device is specified in [D].

* If CR2012 is ON, the instruction will be not executed. When CR2012 is ON, the detailed error info will be stored in CM5100 to CM5176.

"Error Log (CM)", Page 3-20

Sample Program

The value of data memory DM0 is compared with setting value, and output relay is ON/OFF according to the following conditions.

If #100<=DM0<=#200, R30000 is ON.

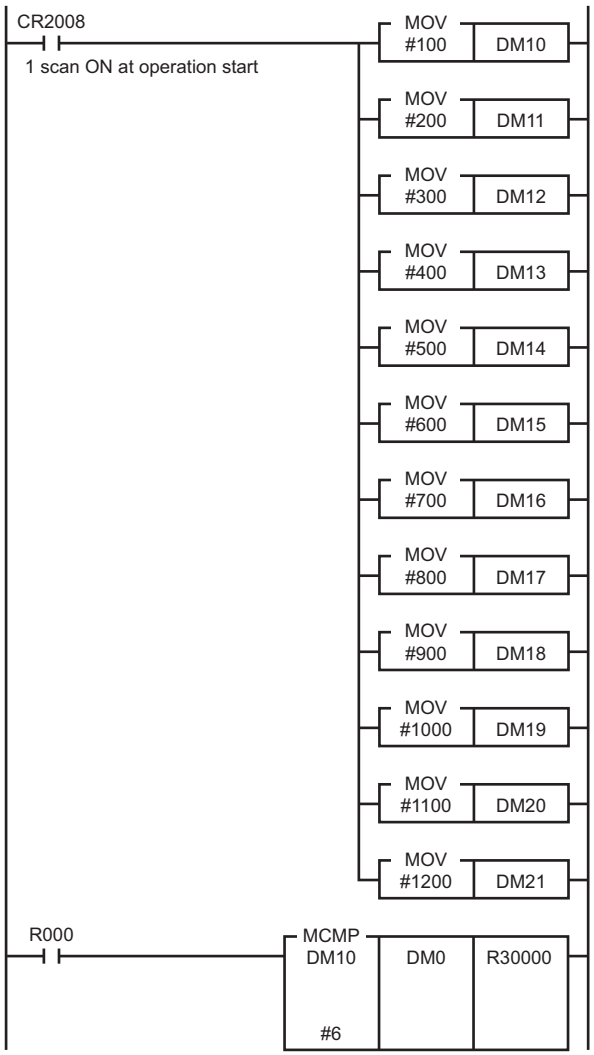
If #300<=DM0<=#400, R30001 is ON.

If #500<=DM0<=#600, R30002 is ON.

If #700<=DM0<=#800, R30003 is ON.

If #900<=DM0<=#1000, R30004 is ON.

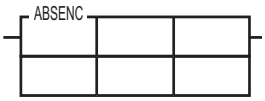
If #1100 <= DM0 <=#1200, R30005 is ON.



(mnemonics list)
LD CR2008
MOV #100 DM10
MOV #200 DM11
MOV #300 DM12
MOV #400 DM13
MOV #500 DM14
MOV #600 DM15
MOV #700 DM16
MOV #800 DM17
MOV #900 DM18
MOV #1000 DM19
MOV #1100 DM20
MOV #1200 DM21
LD R000
MCMP DM10 DM0 R30000 #6

MEMO

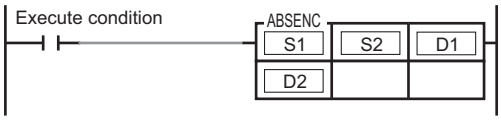
ABSENC



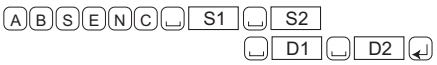
Absolute encoder

To use absolute encoder to perform cam switch operation.

Ladder program



Input mode



Operand	Available devices																		Index modification
	Bit device							Word device							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
S1	○	-	○	-	-	-	-	○	-	-	-	-	-	○	-	-	○	○	○
S2	○	-	○	-	-	-	○	○	○	○	○	○	○	○	-	-	○	○	○
D1	○	-	○	-	-	-	○	○	-	-	-	-	-	○	-	-	○	○	○
D2	○	-	○	-	-	-	○	○	-	-	-	-	-	○	-	-	○	○	○

Operand	Description
S1	Specifies the leading device of the data block for storing comparison angle setting value (unit 0.1°0 to 3599). *1
S2	Specifies the device for storing absolute encoder value. *2
D1	Specifies the leading device for storing comparison result. *3
D2	Specifies the leading device for storing parameters. *4

*1 If bit device is specified, then "D2 +0" x 32 bits starting from channel will be processed.
If word device is specified, "D2 +0" x 2 words will be processed.

*2 When bit device is specified, continuous 16 bits will be used. If relays other than the channel leading relay (R002, R106. R1012 etc.) are specified, then 16 bits will be processed, straddling to the next channel.

*3 When bit device is specified, then "D2 +0" bits will be occupied.
When word device is specified, the result is stored in the lowest bit of each word device. The bits other than the lowest bit will not be changed.

*4 If bit device is specified, then continuous 128 bits starting from the start of channel will be occupied.
If word device is specified, 8 words will be occupied.

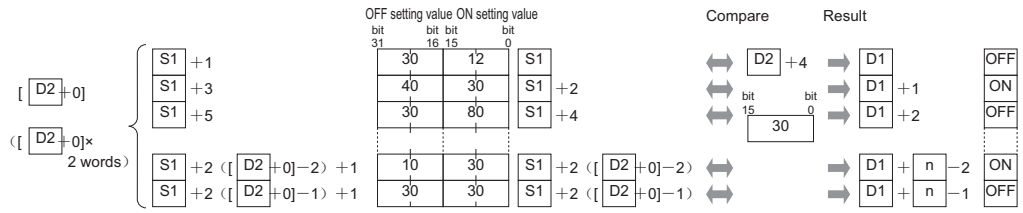
Description of Operation

Parameter

Device		Content
D2 +0	Number of comparison data	Sets number of comparison data (1 to 32).
D2 +1	Resolution	Sets the resolution of encoder (32 to 32768) .
D2 +2	Residual gray code	Sets residual gray code (0 to 16384). (Example) Resolution: 32,64,128,256,512,1024, 2048,4096,8192,16384,32768 — 36 / 360 / 720 Residual gray code: 0 — 14 / 76 / 152
D2 +3	Zero degree setting value	Sets the value specified to zero degree.(0 to resolution -1)
D2 +4	Current angle (unit: 0.1 degree)	Stores the current angle after compensation.(0 to 3599) ·When S2 -" D2 +2" >= " D2 +3". (3600÷" D2 +1") x (S2 -" D2 +2"-" D2 +3") ·When S2 -" D2 +2"<" D2 +3"). (3600/" D2 +1") x (" D2 +1"+ S2 -" D2 +2"-" D2 +3")

Device		Content		
		D2 +5	D1	D2 +4
D2 +5	Operation error	Bit 0: output response error <Condition> If within a scan period, the ON setting value is equal to the OFF setting value for 2 above changed output destination devices, or there is any difference between ON setting values, and between OFF setting values, an error will occur. No error will occur in the following cases. · When ON setting value is equal to OFF setting value for the output destination devices changed simultaneously. · When ON/OFF setting values of the output destination devices changed simultaneously are the same.	No change	Change
		Bit 1: Input value out of range error It will be On when input value of the encoder isn't within the setting range.	No change	Change
		Please reset by ladder program.		
D2 +6 D2 +7	Workspace	(User cannot use)		

When execution is ON, " D2 +0" 32-bit data (2 unsigned 16-bit BIN data: OFF setting and ON setting) starting from the leading device S1 will be compared with the current angle value in " D2 +4", and the result will be stored in devices starting from D1.



When OFF setting > ON setting

If OFF setting > " D2 +4" >= ON setting, then D1 is ON.

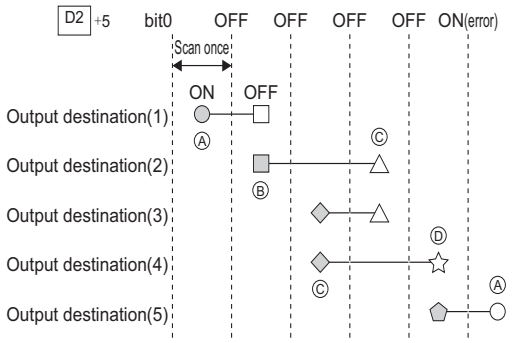
When OFF setting < ON setting

If OFF setting > " D2 +4" or " D2 +4" >= ON setting, then D1 is ON.

When OFF setting = ON setting

D1 is always OFF.

■ Output response error (D2 +5 bit 0)



(In the case of no error)
Ⓐ ...When output destination device changed is 1 within a scan period.
Ⓑ ...When the ON setting value is equal to the OFF setting value for 2 above output destination devices changed within a scan period.
·OFF setting value of output destination device (1) = ON setting value of output destination device (2)
Ⓒ ...When the ON setting value is equal to the OFF setting value for 2 above output destination devices changed within a scan period.
·OFF setting value of output destination device (2) = ON setting value of output destination device (3)
·OFF setting value of output destination device (3) = OFF setting value of output destination device (4)

(In the case of error)
Within a scan period, when the ON setting value is different from the OFF setting value ofr 2 above output destination devices. Or, there is difference between ON setting values and between OFF setting values.
e.g.) Ⓓ ...Within a scan period, the ON and OFF setting value of 2 above output destination devices are changed
OFF setting value of output destination device (4) ≠ ON setting value of output destination device (5)

Note

- In the process of operation, change of setting value will immediately be reflected to the output. If you don't want reflect it to output, please set the execution condition OFF.
- Do not use CR2002 (normal ON) control relay in execution condition.
- Even if the execution condition is OFF, output will be not changed.
- Cannot be used in interrupt program and initialization module.

Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	ON in the following cases; OFF in other case. · When a value out of range is specified in encoder value, each parameter value and angle setting value. · When a bit device other than the channel leading device is specified in S1 ./ D2 . · When range of indirect specifying and index modification range is improper . · When timer and counter is set in D1 / D2 through indirect specifying.

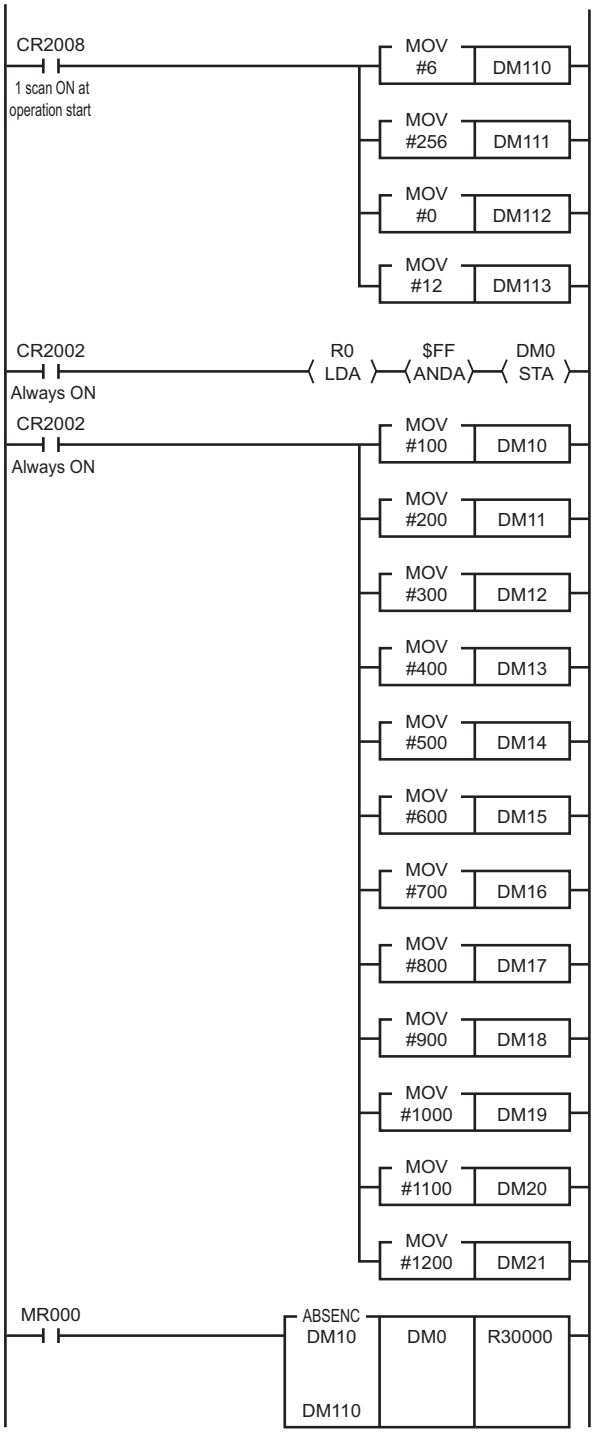
* If CR2012 is ON, the instruction will be not executed. When CR2012 is ON, the detailed error info will be stored in CM5100 to CM5176.
"Error Log (CM)", Page 3-20

Sample Program

Input value R000 to R007 from absolute encoder is stored in DM0, and is compared with the setting value. Output relay will be ON/OFF according to the following specification.
Resolution: 256/rev. Residual gray code: 0 Zero-point teaching value: 12

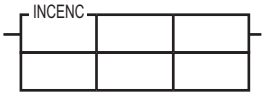


If 10.0° <= DM0 <= 20.0°, R30000 is ON.
If 30.0° <= DM0 <= 40.0°, R30001 is ON.
If 50.0° <= DM0 <= 60.0°, R30002 is ON.
If 70.0° <= DM0 <= 80.0°, R30003 is ON.
If 90.0° <= DM0 <= 100.0°, R30004 is ON.
If 110.0° <=DM0 <=1 20.0°, R30005 is ON.




```
(mnemonics list)
 LD CR2008
 MOV #6 DM110
 MOV #256 DM111
 MOV #0 DM112
 MOV #12 DM113
 LD CR2002
 LDA R0
 CON
 ANDA $FF
 CON
 STA DM0
 LD CR2002
 MOV #100 DM10
 MOV #200 DM11
 MOV #300 DM12
 MOV #400 DM13
 MOV #500 DM14
 MOV #600 DM15
 MOV #700 DM16
 MOV #800 DM17
 MOV #900 DM18
 MOV #1000 DM19
 MOV #1100 DM20
 MOV #1200 DM21
 LD MR000
 ABSENC DM10 DM0 R30000 DM110
```

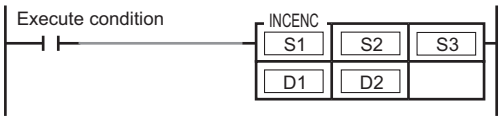
INCENC



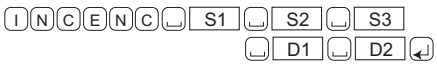
Incremental encoder

To perform cam switch operation using incremental encoder.

Ladder program



Input mode



Operand	Available devices																		Index modification
	Bit device							Word device							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
S1	○	-	○	-	-	-	-	○	-	-	-	-	-	○	-	-	○	○	○
S2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-	-	-
S3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-	-	-
D1	○	-	○	-	-	-	○	○	-	-	-	-	-	○	-	-	○	○	○
D2	○	-	○	-	-	-	○	○	-	-	-	-	-	○	-	-	○	○	○

Operand	Description
S1	Specifies leading device of the data block for storing comparison angle setting value (unit 0.1°: 0 to 3599). *1
S2	Specifies No. of used high-speed counter (CTH). (0,1)*2
S3	Sets encoder counting input mode. (0 to 5)*2 0 - 1-phase w/o direction 1 - 1-phase w/ direction 2 - phase difference, 1 multiply 3 - phase difference, 2 multiply 4 - phase difference, 4 multiply 5 - 2-pulse "Counting Input Setting", Page 2-116
D1	Specifies the leading device for storing comparison result. *3
D2	Specifies the leading device for storing parameters. *4

*1 If bit device is specified, then continuous "D2 +0" x 32 bits starting from channel will be processed. If word device is specified, then "D2 +0" x 2 words will be processed.

*2 "$" cannot be used.

*3 When bit device is used, "D2 +0" bits will be occupied.
When word device is specified, the result is stored in the lowest bit of each word. Bits other than the lowest bit will not be changed.

*4 If bit device is specified, then continuous 80 bits starting from the start of channel will be occupied.
If word device is specified, then 5 words will be occupied.

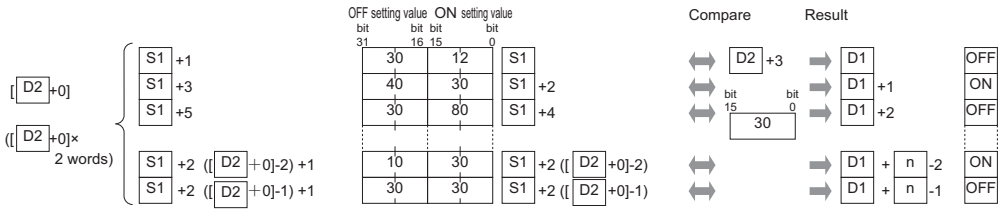
Description of Operation

Parameter

Device		Content
D2 +0	Number of comparison data	Sets number of comparison data (1 to 32)
D2 +1	Resolution	Sets resolution of encoder (32 to 32768)
D2 +2	Zero degree setting value	Sets the value specified to zero degree. (0 to resolution -1)
D2 +3	Current angle (unit: 0.1°)	Stores the current angle after compensation. (0 to 3599) · "S2 ">="D2 +2"). (3600/"D2 +1")×(S2 -"D2 +2") · "S2 "<"D2 +2". (3600/"D2 +1")×("D2 +1"+S2 -"D2 +2")

Device		Content		
D2 +4	Operation error	D2 +4	D1	D2 +3
		Bit 0: output response error <Condition> If within a scan period, the ON setting value is different from the OFF setting value for 2 above output destination devices, or there is any difference between ON setting values, and between OFF setting values, an error will occur. No error will occur in the following cases. · When ON setting value is equal to the OFF setting value for the 2 above output destination devices. · When ON setting values or OFF setting values for 2 above destination devices changed simultaneously are same.	No change	Change
		Bit 1: Input value out of range error When input value of encoder isn't within the setting range.	No change	Change
		Please reset by ladder program.		

When execution is ON, "D2 +0"("D2 +0"indicates the number of data to be compared) 32-bit data (2 unsigned 16-bit BIN data: OFF setting and ON setting) starting from the leading device S1 will be compared with the current angle value in "D2 +3", and the result will be stored in devices starting from D1.



When OFF setting > ON setting

When OFF setting > "D2 +3" >= ON setting, then D1 is ON.

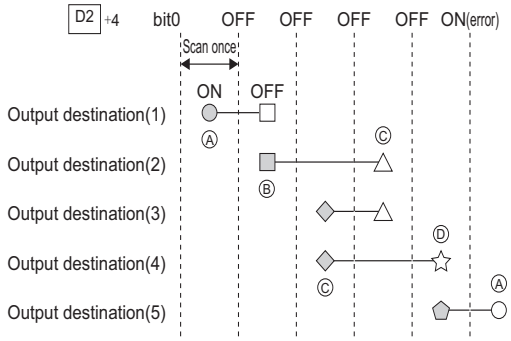
When OFF setting < ON setting

If OFF setting > "D2 +3" or "D2 +3" >= ON setting, then D1 is ON.

When OFF setting=ON setting

D1 is always OFF.

■ Output response error (D2 +4 bit 0)



(In the case of no error)
Ⓐ …When output destination device changed is 1 within a scan period.
Ⓑ …Within a scan period, when the ON setting value is equal to the OFF setting value for 2 above output destination devices changed.
· OFF setting value of output destination device (1) = ON setting value of output destination device (2)
Ⓒ …When ON setting value is equal to OFF setting value within 1 scan period for 2 above output destination devices.
·OFF setting value of output destination device (2) = ON setting value of output destination device (3)
·OFF setting value of output destination device (3) = OFF setting value of output destination device (4)

Ⓐ (In the case of error)
Within a scan period, when the ON setting value of 2 above output destination devices changed is different from OFF setting value. Or, there are many difference between ON setting value and OFF setting value
Example) Ⓓ …Within a scan period, the ON and OFF setting value of 2 above output destination devices are changed.
OFF setting value of output destination device (4) ≠ ON setting value of output destination device (5)

Note

- In the process of execution, change of setting value will immediately be reflected to output. If you don't want to reflect it output, please turn execution condition OFF.
- In the process of operation, sometimes an error will occur when high-speed counter reset is performed ("RES instruction", "external input (Z-phase)") under output response error condition ("D2 +4" bit 0).
- Do not use CR2002 (normal ON) control relay under execution condition.
- Even if the execution condition is OFF, output will be not changed. Setting value is held.
- Other instructions can not be used when functions specified by "S2 " are used.
- Meanwhile, NCENC instructions with same "S2 " cannot be used.
- When INCENC instruction is used, please use HSP instruction and control relay, and set the input time constant to 10μs.

"Input Time Constant Setting", Page 2-98

- Since high-speed counter functions are used, don't' change control relay, control memory, CTH and CTC related to high-speed counter using ladder program, etc.
- When power is OFF, value of high-speed counter will be maintained. Please use RES instruction and CTH instruction to clear.
- Cannot be used in interrupt program and initialization module.
- Attention should be paid if writing is performed in RUN mode.

"Write in the RUN mode", Page 3-179

Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	ON in the following cases; OFF in other cases. · When a value out of range is specified in encoder value, value of each parameter and angle setting value · When a bit device other than channel leading device is specified in S1 / D2 . · When range of indirect specifying and index modification range is improper · When a bit device other than channel leading device is specified in D1 / D2 .

* If CR2012 is ON, the instruction will be not executed. When CR2012 is ON, the detailed error info is stored in CM5100 to CM5176.

"Error Log (CM)", Page 3-20

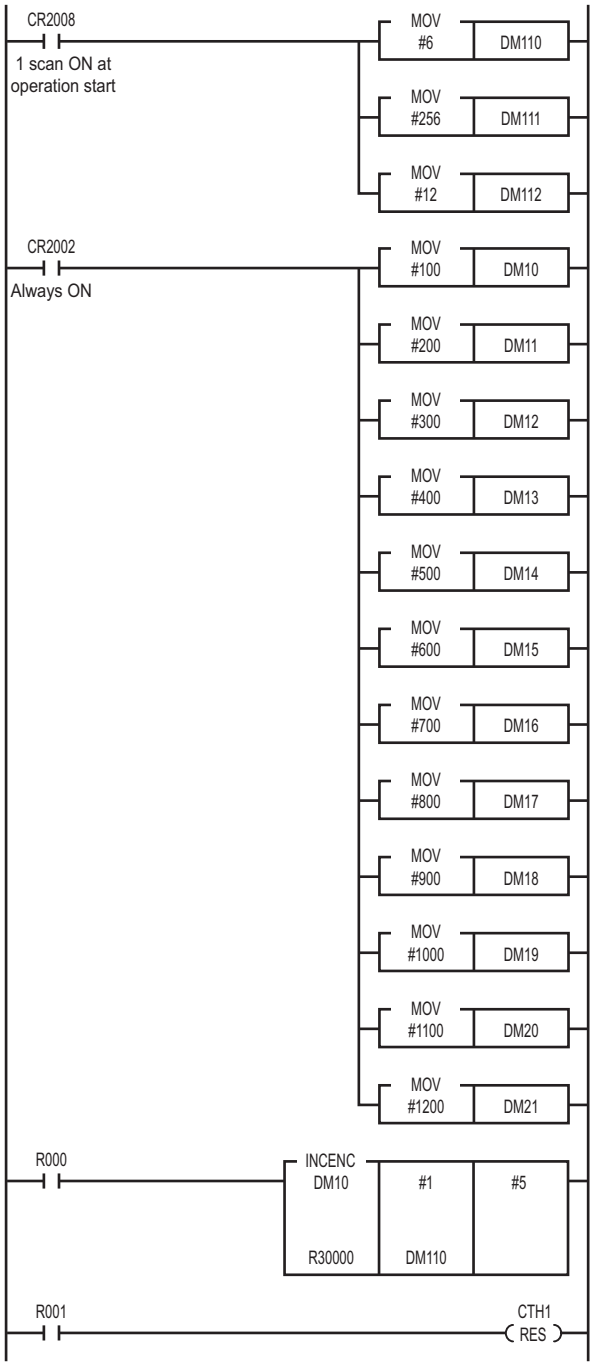
Sample Program

Input value from the incremental encoder is measured using the high-speed counter CTH 1, the measured value is compared with the setting value. Then output relay is turned ON/OFF according to the following specification. Value of high-speed counter CTH1 can be cleared through turning ON the input relay R001.

High speed counter ••••••• CTH1 Resolution •••••••••••••••••••• 256/rev.
M counting mode •••••••••• 2-pulse zero degree teaching •••••• 12

* HSP instruction should be used additionally.
" HSP", Page 3-46

If 10.0° <=CTH1<=20.0°, R30000 is ON.
If 30.0° <=CTH1<=40.0°, R30001 is ON.
If 50.0° <=CTH1<=60.0°, R30002 is ON.
If 70.0° <=CTH1<=80.0°, R30003 is ON.
If 90.0° <=CTH1<=100.0°, R30004 is ON.
If 110.0° <=CTH1<=120.0°, R30005 is ON.



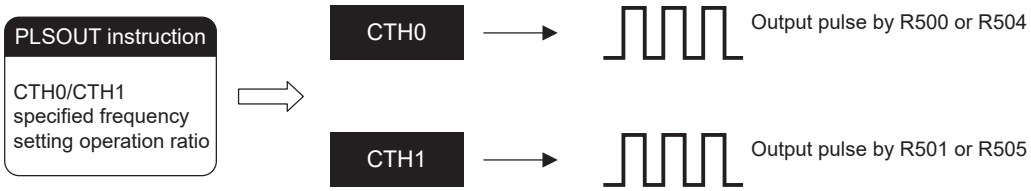
(mnemonics list)
LD CR2008
MOV #6 DM110
MOV #256 DM111
MOV #12 DM112
LD CR2002
MOV #100 DM10
MOV #200 DM11
MOV #300 DM12
MOV #400 DM13
MOV #500 DM14
MOV #600 DM15
MOV #700 DM16
MOV #800 DM17
MOV #900 DM18
MOV #1000 DM19
MOV #1100 DM20
MOV #1200 DM21
LD R000
INCENC DM10 #1 #5 R30000 DM110
LD R001
RES CTH1

2-13 Specified Frequency Pulse Output

Pulse output can be performed according to the specified frequency.

Specified Frequency Pulse Output Overview

If instruction "PLSOUT" dedicated for specified frequency pulse output is used, it's only required to specify high-speed counter/output frequency/duty cycle to simply output pulses with specified frequency from the output relay of PLC.



About Output Relay Switching

The relay No. of output pulse can be changed through CR2505 (CTH0)/CR2513 (CTH1).

Device No.	Content	ON	OFF
CR2505	Switches the pulse output destination of CTH0.	Outputs pulse to R504	Outputs pulse to R500
CR2513	Switches the pulse output destination of CTH1.	Outputs pulse to R505	Outputs pulse to R501

Note

Since the specified frequency pulse output function will use high-speed counter, therefore, other functions or instructions using the high-speed counter with same No. cannot be used simultaneously.

For No. of each I/O terminal, see "Wiring and Internal Circuit Diagram", Page 1-28.

Specified Frequency Pulse Output Instruction

Instruction	Mnemonics	Description	See
Specified frequency pulse output	PLSOUT	Outputs pulses of specified frequency using high-speed counter (CTH0/CTH1).	Page 2-172

PLSOUT

PLSOUT

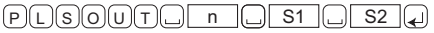
Specified frequency pulse output

To output the pulse of specified frequency using high-speed counter.

Ladder program



Input mode

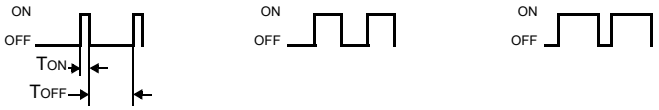


Operand	Available devices																		Index modification
	Bit device							Word device							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	:#/:Z
n	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-	-	-
S1	○	-	○	-	-	-	○	○	○	○	○	○	○	○	○	-	○	○	○
S2	○	-	○	-	-	-	○	○	○	○	○	○	○	○	○	-	○	○	○

Operand	Description
n	Specifies No. of used high-speed counter. (0, 1)*1
S1	Specifies frequency (0 to 100000) (Hz) or stores the leading device of specified frequency. When bit device is specified, continuous 32 bits will be occupied. If word device is specified, 2 words will be occupied. *1 *2
S2	Specifies duty cycle (-499 to 499) of output pulse, or stores leading device for the duty cycle. When bit device is specified, continuous 16 bits will be occupied. If word device is specified, 1 word will be occupied. *1 *2

Setting value (Duty cycle -50) *10	−499	…	0	…	499
Duty ratio TON / (TON + TOFF)	0.1%	…	50.0%	…	99.9%

Output pulse



*1 Cannot be specified in "$".

*2 When bit device other than channel leading device (R106, R1012, etc.) is specified, it will straddle next channel during processing.

Description of Operation

When execution condition is ON, pulse with specified frequency by S1 will be output through output relay. No. of used high-speed counter (n) is specified. Specify the Duty cycle of output pulse is specified by S2.

If the execution condition is OFF, then pulse output is OFF.

When output relay is CTH0, it will be R500 or R504. When output relay is CTH1, it will be R501 or R505. Output relay switching can be performed through CR2505 (CTH0)/CR2513 (CTH1).

"Specified Frequency Pulse Output", Page 2-171

Note

- 2 above PLSOUT instructions using a high-speed counter with the same No. cannot be used.
- Other functions or instructions using the high-speed counter of the No. specified by [n] cannot be used simultaneously.
- Please don't change control relay (CR) and control memory (CM) for the high-speed counter other than that specified by [n].
- When R504 (CTH0) or R505 (CTH1) is used, output can be performed normally over 10000Hz.

Operation flag

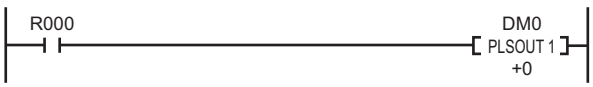
CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	ON in the following cases; OFF in other cases. • When a value out of the range is specified in the operand • When range of indirect specifying and index modification is improper When range of [s] and [n] indirect specifying, index modification is improper

* If CR2012 is ON, the instruction will be not executed. The error is displayed in KV STUDIO or in access window. In addition, detailed error info will be stored in CM5100 to CM5176.

"Error Log (CM)", Page 3-20

Sample Program

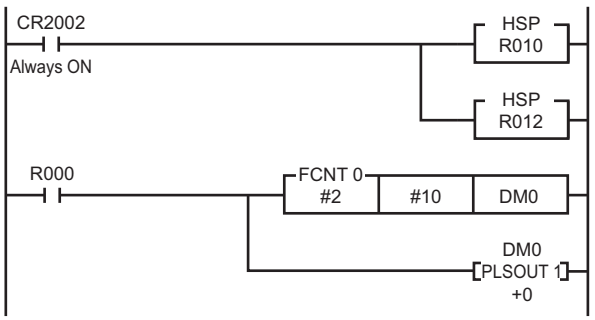
When R000 is turned on, pulses will be output to R501 according to the frequency (duty cycle 50%) set by "DM1/DM0". (CTH1 is used)




```
(mnemonics list)
 LD R000
 PLSOUT #1 DM0 +0
```

● Application example: synchronized control

In the case of encoder input A-phase R010/B-phase R012, frequency counter function and specified frequency pulse output function are combined to perform adjustment and controlling. (frequency counter uses CTH0, specified frequency pulse output uses CTH1).



Set input time constant of R010 to 10μs.

Set input time constant of R012 to 10μs.

Start to detect
Input setting: 2-phase, 1x
Scan times: 10
Measurement result: "DM0/DM1"

```
(mnemonics list)
 LD CR2002
 HSP R010
 HSP R012
 LD R000
 FCNT #0 #2 #10 DM0
 PLSOUT #1 DM0 +0
```

MEMO

2-14 Description of Operation Motor (positioning) Control

KV-5500/5000/3000 can input pulse to step motor or servo motor without being influenced by scan time, to realize 2-axis positioning control.

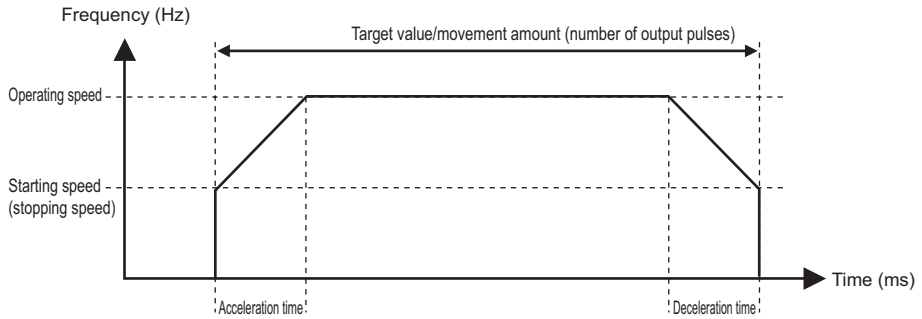
Specification of Positioning Control

Item	Specification
Control mode	Positioning (point to point) control, speed control "Operation mode", Page 2-178
No. of axes controlled	2 (X/Y)
Positioning points	32 (Common for 2 axes) *
Position instruction	-2147483648 to 2147483647 (ABS/INC)
Speed instruction	50 to 100000 p/s
Acceleration/ deceleration time	0 to 4000 ms
Starting time	30μs
Pulse output mode	Open collector output (1-pulse /2-pulse switching) "Output mode selection", Page 2-187
Dedicated instruction "Positioning Instruction List", Page 2-203	PLSX/PLSY (Pulse output), ORGX/ORGY (Origin return), JOGX/JOGY(JOG), TCHX/TCHY(Teaching), HOMEX/HOMEY (Move to home position), CHGSPX/ CHGSPY (operating speed change), RFSPSX/RFSPSY (Current value refresh)

* Parameters are stored in control memory (CM). Over 33 positioning points can be managed through changing value by program.

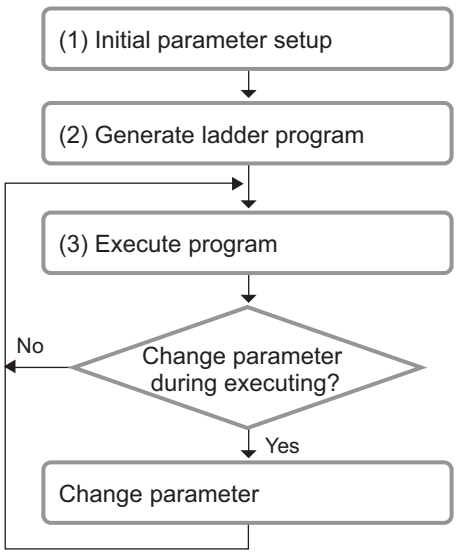
Concept of Positioning Control

Through presetting target coordinates (number of pulses)/starting speed/operating speed/acceleration and deceleration time, ladder timing chart positioning control can be performed, as shown below.



Procedure for Positioning Control

Procedure for positioning control is as follows.



"Parameter Setup", Page 2-176

"Creating ladder program", Page 2-197
"Positioning Instruction List", Page 2-203
"Reference example of Positioning Control", Page 2-217

"List of Devices/error Codes for Positioning", Page 2-226
"Change speed during operation", Page 2-201
"Reference example for executing speed change during operation", Page 2-221
"Reference example for executing positioning control over 32 points", Page 2-225

Parameter Setup

Parameters are divided into 2 types: point parameters and system parameters.
Every parameter can be managed through control relay (CR) or control memory (CM), and the value can be rewritten through ladder program, so that parameters can be changed during operation.

Point parameters

Point parameters are the basic parameter for ladder control, which is used to set movement target point (position), operating/starting speed as well as acceleration/deceleration time.

"Point parameters", Page 2-177

System parameters

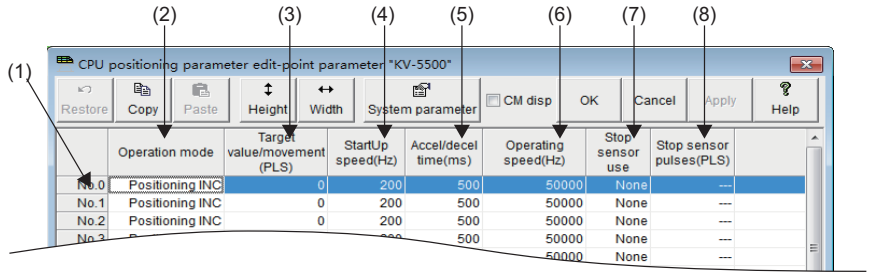
System parameters can be used to set sensor input, pulse output, comparator, origin return operation and JOG operation.

"System parameters (I/O setting)", Page 2-183
"System parameters (comparator setting)", Page 2-188
"System parameters (origin returning)", Page 2-190
"System parameters (JOG)", Page 2-195

Parameters are set through "Edit CPU positioning parameters" of KV STUDIO.
Select "Tool(T)"▶"Edit CPU positioning parameters(I)" from the menu.

Other procedure Click  .
Right-click in the ladder edit window, and select "Edit CPU positioning parameters" from the menu.

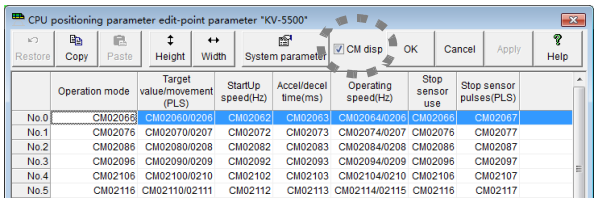
Point parameters



	Function name	Setting range	Default	See
(1)	Point No.	0 to 31		Page 2-178
(2)	Operation mode	INC positioning ABS positioning CW control CCW control	Incremental positioning (INC)	Page 2-178
(3)	Target value/movement	-2147483648 to 2147483647	0	Page 2-179
(4)	Starting speed	50 to 65535	200	Page 2-180
(5)	Acceleration/deceleration time	0 to 4000	500	Page 2-180
(6)	operating speed	50 to 100000	50000	Page 2-180
(7)	Use of stop sensor	Yes/None	None	page 2-181
(8)	Specified pulse for stop	0 to 65535	0	Page 2-182

TIP Once set, the parameters will be stored in control memory (CM) (control memory) of CPU. Point parameters are common to X-axis and Y-axis.

Point No.	Storage position set
0 ……	CM2060 to CM2067
1 ……	CM2070 to CM2077
2 ……	CM2080 to CM2087
3 ……	CM2090 to CM2097
…	…

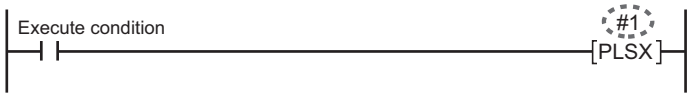


If the checkbox CM disp is selected, then the storage position as shown on the right will be displayed.

"List of Devices/error Codes for Positioning", Page 2-226

■ Point No.

Used as operand of PLSX and PLSY instruction and can be specified according to device.



When the above ladder program is executed, pulse will be generated according to the point parameter of point No.1.

"PLSX, PLSY instruction", Page 2-204

■ Operation mode

Through positioning control (INC positioning and ABS positioning), you can move an object by a target value/movement from a certain position.

Through speed control (CW control and CCW control), you can move an object towards a specified direction, until the stop sensor is ON.

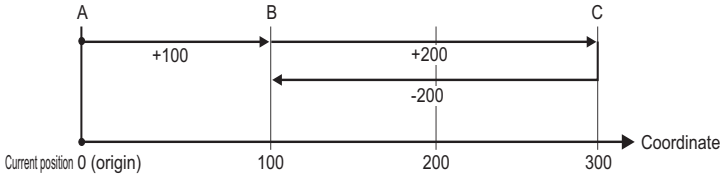
● INC positioning

In this mode, relative coordinates are used for positioning control.

When an object moves from current position to a specified position, the distance between the two positions will be specified as movement. For example, in the following figure, when the object at A moves to B, the movement should be set to "+100". Then, when it moves from B to C, the movement should be set to "+200". When it returns to B from C, the movement should be set to "-200".

In the case of current position overflow, warning relay will be ON, but pulse output will not stop.

"List of Devices/error Codes for Positioning", Page 2-226



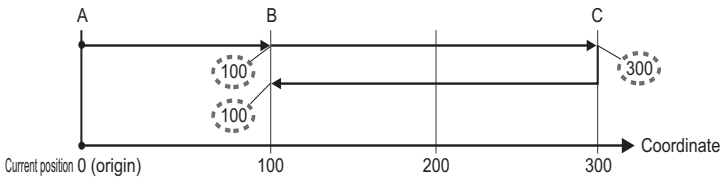
● ABS positioning

In this mode, absolute coordinates are used for position control.

The distance from origin to the target positon is specified as target value. For example, in the following figure, when the object at A moves to B, the target value should be set to "+100". Then, when it moves from B to C, the target value should be set to "+300". When it returns to B from C , the target valueshould be set to "+100".

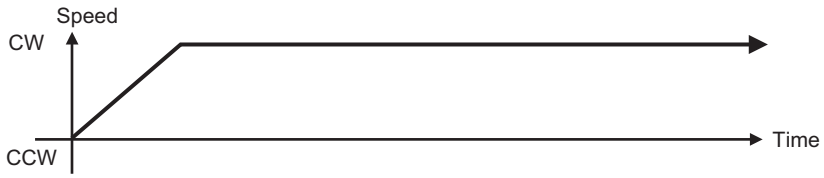
When warning relay is ON, an error will occur and pulse output will stop if ABS positioning is performed.

"List of Devices/error Codes for Positioning", Page 2-226



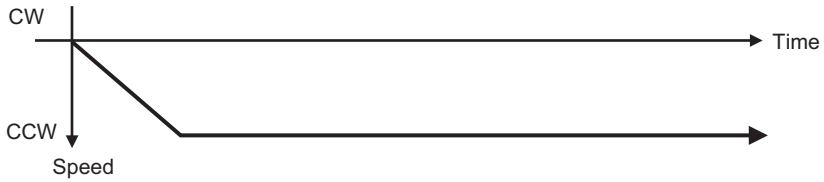
● CW control

In CW control, pulses will be output continuously in CW direction according to specified speed, independent of number of output pulses.

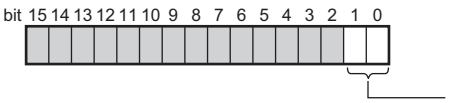


● CCW control

In CCW control, pulses will be output continuously in CCW direction according to specified speed, independent of number of output pulses.



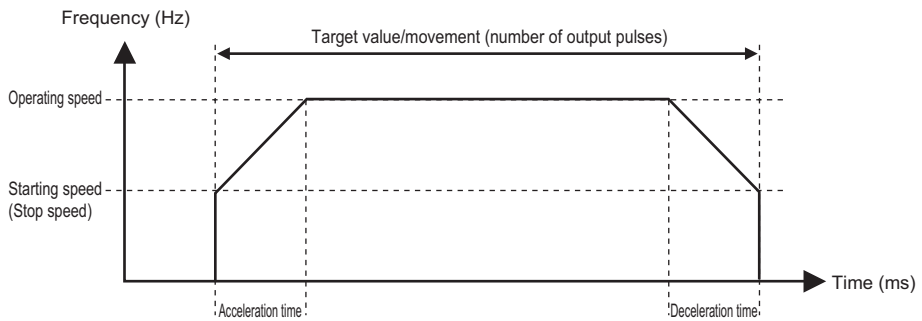
TIP Parameter storage position: parameters are stored in bit 0 and bit 1 of CM2066+(point No. x 10), as shown below.



bit1	bit0	Contents to be set
0	0	Locating INC
0	1	Locating ABS
1	0	Speed control CW
1	1	Speed control CCW

■ Target value/movement

The position to move to is called “target value" or "movement".
If ABS positioning is selected as operation mode, it is "target value"; if INC positioning is selected, then it is "movement”. If CW/CCW control is selected, then it cannot be set.



Setting range : -2147483648 to 2147483647

Parameter storage position: CM2061+(point No.x10)/CM2060+(point No.x10)

Higher 16-bit Lower 16-bit

■ Starting speed

When performing positioning control, output pulse speed should be set to ensure smooth startup of motor revolution.

Setting range : 50 to 65535 (PPS) (note: starting speed must be smaller than operating speed).

Parameter storage position: CM20621+(point No.x10)

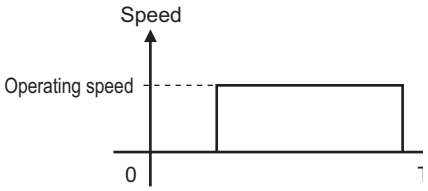
■ Acceleration/deceleration time

Acceleration time: time required from starting speed to operating speed. The lower the value is, the quicker the acceleration and the shorter the moving time will be.

Deceleration time: time required from operating speed to stopping speed. The lower the value is, the quicker the deceleration and the shorter the moving time will be.

In KV-5500/5000/3000, acceleration time and deceleration time are set to the same value.

Setting range : 0 to 4000 (ms)
If "0" is specified, then acceleration and deceleration are shown on the right.



Parameter storage position: CM2063+(point No. x10)

■ Operating speed

When performing positioning control, pulse speed that is output to motor should be specified during operation.

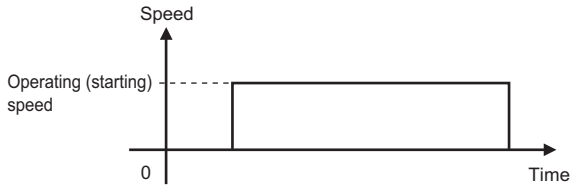
Setting range : 50 to 100000 (PPS) (note: operating speed must be largeer than starting speed).

Parameter storing position: CM2065+ (point No.x10)/CM2064+ (point No.x10)

Higher 16-bit Lower 16-bit

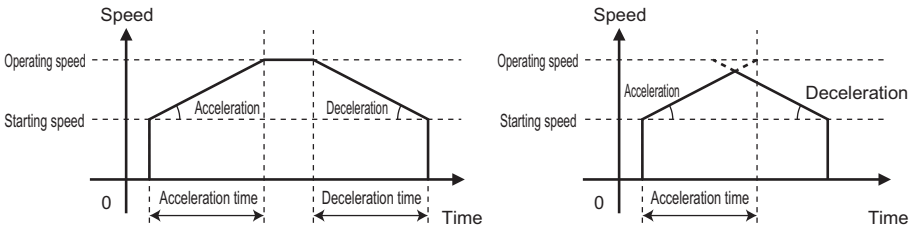
Note

(1) The operation when "starting speed=operating speed" is shown below.



In this case, acceleration/deceleration time can be neglected.

(2) The ladder control within short time (short distance) is shown below.



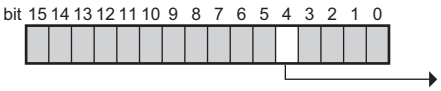
Acceleration/deceleration (slope) = (operating speed - starting speed) ÷ acceleration/deceleration time.

In the case of ladder control, acceleration/deceleration (slope) is often controlled to some extent.
Therefore, ladder control for a short time will be decelerated before reaching the operating speed.

■ Stop sensor used or not

To whether to use stop sensor.
None…Stop sensor is not used.
Yes … Stopped after number of pulses specified for stop sensor is output.

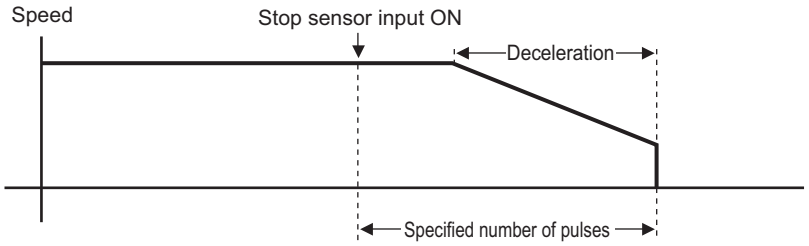
Parameter storage position: parameters are stored bit 4 of CM2066+(point No.x10), as shown below.



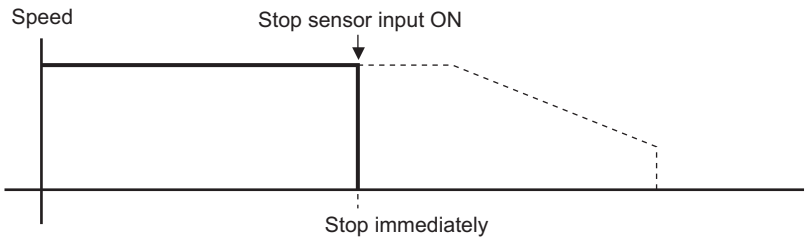
bit 4	Contents to be set
0	Stop sensor not used
1	Stop sensor used

■ Specified number of pulses for stop sensor

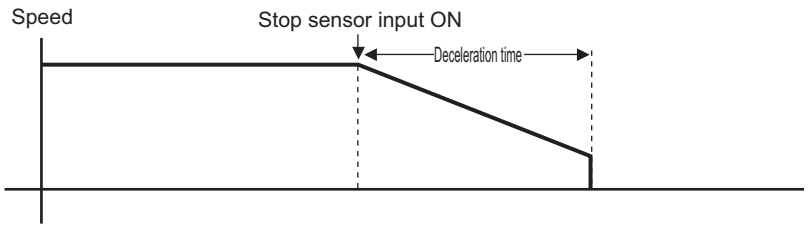
If “Stop sensor used or not” is set to ON, operation will stop after the specified number of pulses for stop sensor is output.



If the specified number of pulses is set to "0", then stop sensor input will be ON, and operation will stop immediately.
Deceleration time will be neglected.

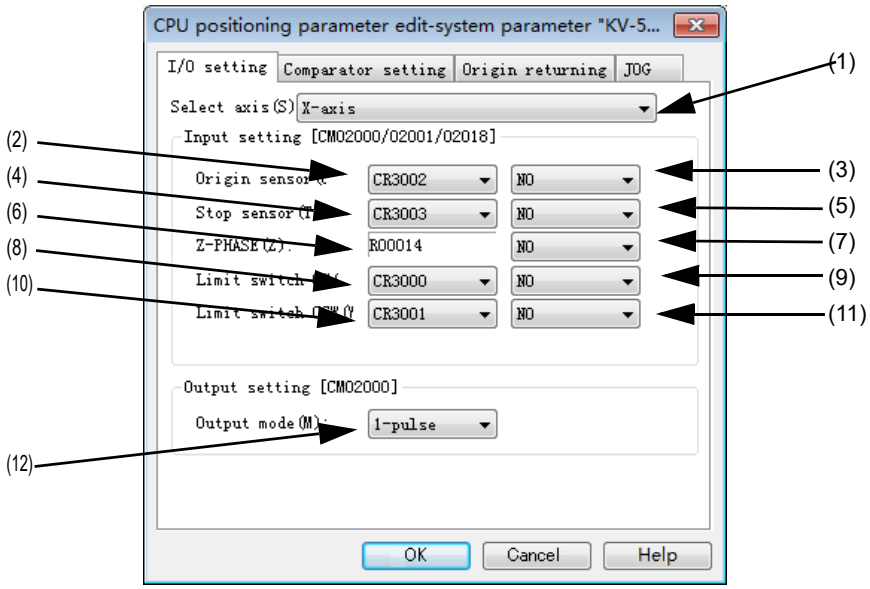


If the specified number of pulses is set to "65535" (max. value), then stop sensor input will be ON, acceleration operation will start, and will stop after deceleration time ends.



Setting range : 0 to 65535
Parameter storing position: CM2067+(point No.x10)

System parameters (I/O setting)



	Function name	Setting range		Default
(1)	Select axis	X/Y axis		X axis
Input setting "CM2000/2001/2018"(X axis)/"CM2030/2031/2048"(Y axis)				
(2)	Origin sensor	X axis	CR3002 R000 to R003	CR3002
		Y axis	CR3102 R000 to R003	CR3102
(3)	Origin sensor polarity	X axis	NO(A contact)/NC (B contact)	NO (normally open contact)
		Y axis		
(4)	Stop sensor	X axis	CR3002 R000 to R003	CR3003
		Y axis	CR3103 R000 to R003	CR3103
(5)	Stop sensor polarity	X axis	NO(A contact)/NC (B contact)	NO (normally open contact)
		Y axis		
(6)	Z-phase	X axis	R014 (fixed)	R014
		Y axis	R015 (fixed)	R015
(7)	Z-phase polarity	X axis	NO(A contact)/NC (B contact)	NO (normally open contact)
		Y axis		
(8)	Limit switch CW	X axis	CR3000 R004	CR3000
		Y axis	CR3100 R005	CR3100
(9)	Limit switch polarity CW	X axis	NO(A contact)/NC (B contact)	NO (normally open contact)
		Y axis		
(10)	Limit switch CCW	X axis	CR3001 R006	CR3001
		Y axis	CR3101 R007	CR3101
(11)	Limit switch polarity CCW	X axis	NO(A contact)/NC (B contact)	NO (normally open contact)
		Y axis		
Output setting [CM2000](X axis)/[CM2030](Y axis)				
(12)	Output mode	1-pulse/2-pulse		1-pulse

■ Origin sensor

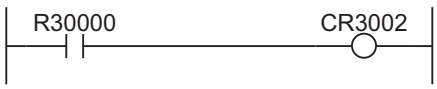
"Origin" refers to the position used as the reference point for positioning. "Origin sensor" refers to the sensor installed at origin position of axis.

CR3002 (CR3102) .....CR3002 (X axis) and CR3102 (Y axis) are set to origin sensors.
R000 to R003 .....Input relay R000 to R003 are used as origin sensors.
N.O./N.C.....Logic of origin sensor input is set.

If R000 to R003 is set, then the preset input is used as origin sensor input for origin return.
If relays other than R000 to R003 are used as origin sensor input, then CR3002 (CR3102) should be set in advance according to these parameters, and can be turned ON/OFF through ladder program.

Example

Input relay R30000 is used for origin sensor input of X-axis.



Parameter storing position: parameters are stored in CM2000 and CM2001.

CM2000 settings : "I/O detailed settings", Page 2-227
CM2001 settings : "Sensor enable details", Page 2-227

■ Stop sensor

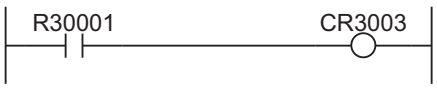
During operation, the moving object will move up to the position of stop sensor. When stop sensor is ON, the moving object will decelerate and stop immediately from this position; or continue to move a certain distance (specified number of pulses for stop sensor), then decelerate and stop.
Howevert, if "Stop sensor used or not" is set to "None" in point parameters, the stop sensor can be neglected.

CR3003 (CR3103).....CR3003 (X axis) and CR3103 (Y axis) are set to stop sensors.
R000 to R 003 .....Input relay R000 to R003 are used as stop sensors.
N.O./N.C.....Logic of stop sensor input is set.

If R000 to R003 is set, then the preset input is used as stop sensor input to stop moving.
If relays other than R000 to R003 are used as stop sensor input, CR3003 (CR3103) should be set in advance according to these parameters, and can be turned ON/OFF through ladder program.

Example

Input relay R30001 is used for stop sensor input of X-axis.



Parameter storing position: parameters are stored in CM2000 and CM2001.

CM2000 settings : "I/O detailed settings", Page 2-227
CM2001 settings : "Sensor enable details", Page 2-227

■ Z-phase

Z-phase is mainly used to improve the position accuracy when origin return is finished. Generally, pulse encoder's zero signal is used as "Z-phase".

R014 (R015)..... R014 (X axis) and R015 (Y axis) are fixed.
N.O/N.C. ..... Logic of Z-phase input is set.

Parameter storage position: parameters are stored as follows.

Axis	Destivation storage address
X	CM2001
Y	CM2031

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

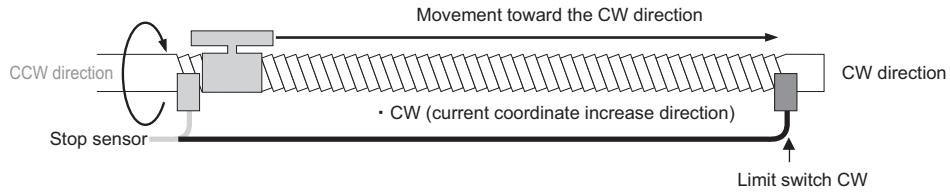
bit12	Contents to be set
0	N.O
1	N.C

■ CW limit switch /CCW limit switch

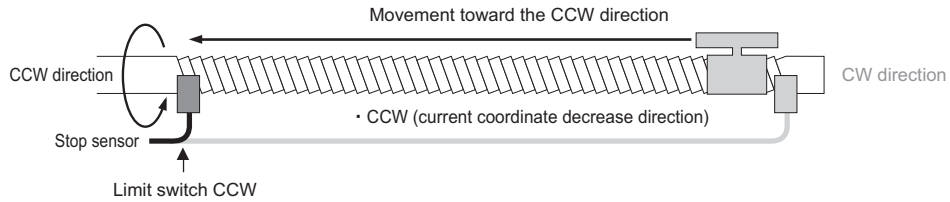
For safety reasons, limit switches are installed on moving object and both ends of axis for moving workpieces.

CR3000 (CR3100) ..... X axis: CR3000 (CW) CR3001 (CCW) are set as limit switch input; Y axis: CR3100 (CW) CR3101 (CCW) are set as limit switch input.
R004(R005)..... X axis: Input relays R004(CW) R006(CCW) are set for limit switch input; Y axis: input relays R005(CW) R007(CCW) are set for limit swtich input.
N.O/N.C. ..... Logic of limit switch input is set.

The limit switch installed on the CW direction end is called CW limit switch.



The limit switch installed on the CCW end is called CCW limit switch.

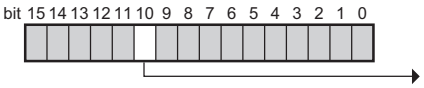


If CR3000 (CW) and CR3001 (CCW) are set at X axis, and CR3100 (CW) and CR3101 (CCW) set at Y axis, then you can turn ON/OFF CR3000 (CW) and CR3001 (CCW) or CR3100 (CW) and CR3101 (CCW) through input relays connected to the actual limit switch.
If R004 (CW) and R006 (CCW) are set at X axis, and R005 (CW) and R007 (CCW) set at Y axis, then the preset input is set as limit switch.

Parameter storage position: Parameters are stored as follows.

Limit switch CW polarity CR3000 (X axis), CR3100 (Y axis)

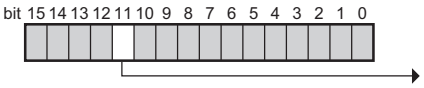
Axis	Destination storage address
X	CM2001
Y	CM2031



bit10	Contents to be set
0	N.O
1	N.C

Limit switch CCW polarity CR3001 (X axis), CR3101 (Y axis)

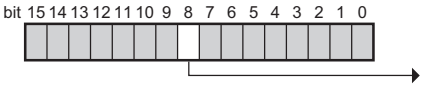
Axis	Destination storage address
X	CM2001
Y	CM2031



bit11	Contents to be set
0	N.O
1	N.C

Use of limit switch CW R004 (X axis), R005 (Y axis)

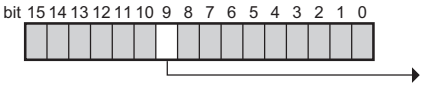
Axis	Destination storage address
X	CM2018
Y	CM2048



bit8	Contents to be set
0	Not used
1	Used

Use of limit switch CCW R006 (X axis), R007 (Y axis)

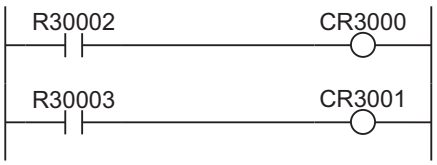
Axis	Destination storage address
X	CM2018
Y	CM2048



bit9	Contents to be set
0	Not used
1	Used

Example

CW limit switch of X axis is connected to input relay R30002, and CCW limit switch connected to input relay R30003.



If limit switch is ON, it indicates that a limit error (error code: 31, 32 and 33) has occured, and pulse output will be stopped. Be sure to find out the cause of error, and reset the error flag CR3007/CR3107 to clear the error.

Caution

- For safety reasons, please use limit switches of N.C. type whenever possible. If N.O.type limit switches are used, it's very dangerous when the switch does not operate in case line-break occurs.
- After positioning equipment is installed, be sure to verify that limit switches can operate normally.
- In the case of emergency stopping of motor, the near point detector of limit switch must be wide enough to prevent object from crossing the limit switch.

■ Output mode selection

Select output mode. Output is performed from R500/R501 for X axis and from R502/R503 for Y axis.

1-pulse output .....Output mode is set to 1-pulse output.
2-pulse output .....Output mode is set to 2-pulse output.

Parameter storage position: parameters are stored as follows.

Axis	Destination storage address
X	CM2000
Y	CM2030

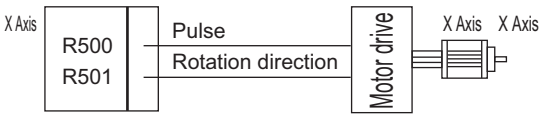
bit 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

bit 0	Contents to be set
0	1-pulse mode
1	2-pulse mode

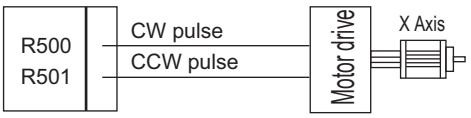
Connection example

1-axis connection

1-pulse output

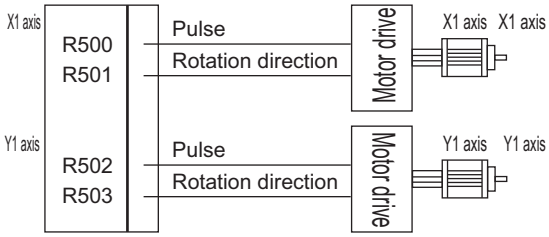


2-pulse output

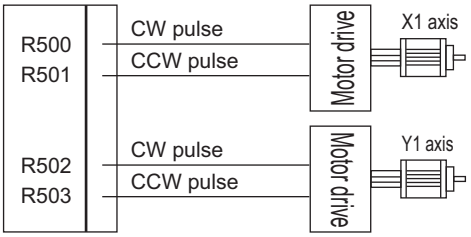


2-axis connection

1-pulse output

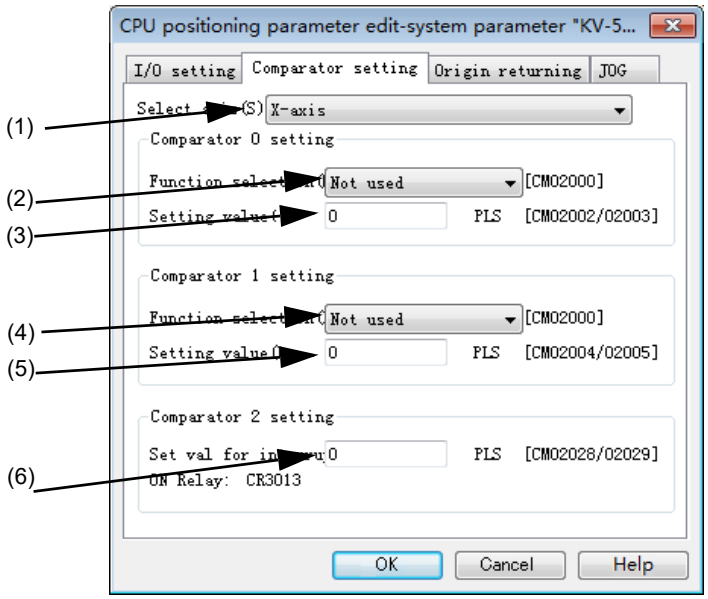


2-pulse output



System parameters (comparator setting)

In the process of positioning control, count the output pulse as "current value". Compare the current value with the setting value of (3) or (5), if they match, execute the setting operation specified by (2) or (4).
In addition, interruption occurs if they match with the settings specified by (6).



	Function description	Set range	Default
(1)	Select axis	X/Y axis	X axis
Comparator 0 setting			
(2)	Function selection	Not used Stop sensor Soft limit switch CW Soft limit switch CCW	Not used
(3)	Setting value	-2147483648 to 2147483647	0
Comparator 1 setting			
(4)	Function selection	Not used Stop sensor Soft limit switch CW Soft limit switch CCW	Not used
(5)	Setting value	-2147483648 to 2147483647	0
Comparator 2 setting			
(6)	Set val for interrupt	-2147483648 to 2147483647	0

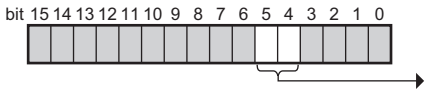
■ Function selection

Disable ..... No operation is performed base on comparator No.
Stop sensor ..... Stop sensor executes the same operation with input.
Limit switch CW ..... CW limit switch executes the same operation with input.
Limit switch CCW ..... CCW limit switch executes the same operation with input.

Parameter storage position: parameters are stored as follows.

Comparator 0

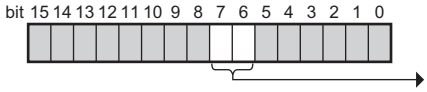
Axis	Destination storage address
X	CM2000
Y	CM2030



bit5	bit4	Operation when current position comparator 0 matches
0	0	Not used
0	1	Used as stop sensor
1	0	Used as limit switch of CW direction
1	1	Used as limit switch of CCW direction

Comparator 1

Axis	Destination storage address
X	CM2000
Y	CM2030



bit7	bit6	Operaton when current position comparator 0 matches
0	0	Not used
0	1	Used as stop sensor
1	0	Used as limit switch of CW direction
1	1	Used as limit switch of CCW direction

* If comparator 0 and 1 are set with the same functions, comparator 1 is invalid.

■ Setting value

Set a value (comparator value) that can be compared with the output pulse number (current position (current value)).

Setting range : -2147483648 to 2147483647

Parameter storage position:

X axis	Comparator 0=CM2003(High bit)/CM2002(Low bit)
	Comparator 1=CM2005(High bit)/CM2004(Low bit)
	Comparator 2=CM2029(High bit)/CM2028(Low bit)
Y axis	Comparator 0=CM2033(High bit)/CM2032(Low bit)
	Comparator 1=CM2035(High bit)/CM2034(Low bit)
	Comparator 2=CM2059(High bit)/CM2058(Low bit)

Note

KV-5500/5000/3000 PLC can identify the interrupt value according to comparator 2 when CHGSPX and CHGSPY are executed or pulse output is started throught PLSX or PLSY. (X axis: CM02029/CM02028; Y axis: CM02059/CM02058. Operation will not be normal when setting value is written only in control memory.

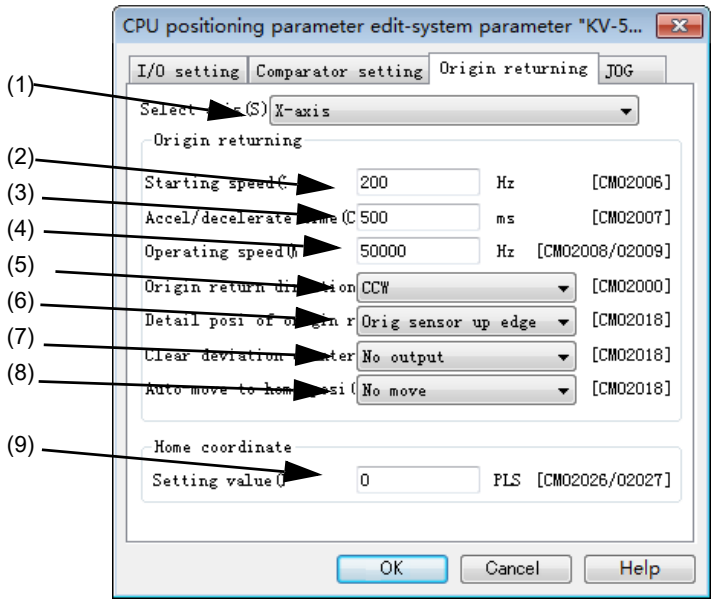
When using comparator 2 as interrupt condition, please write setting value to control memory and then execute the CHGSPX,CHGSPY,PLSX,PLSYinstruction.

"Reference example for executing speed change during operation", Page 2-221

System parameters (origin returning)

If power becomes off at positioning or moving axis manually, the actual position of object will be different from that "memorized" by KV-5500/5000/3000.

Actual origin point and internal current position (current value) can be matched via origin return.



	Function description	Setting range	Default
(1)	Select axis	X/Y axis	X axis
Origin returning			
(2)	Starting speed	50 to 65535	200
(3)	Accel/decelerate time	0 to 4000	500
(4)	Operating speed	50 to 00000	50000
(5)	Origin return direction	CCW/CW	CCW
(6)	Detailed posi of origin return	Origin sensor up edge Medium point of the origin sensor Origin sensor and Z-phase	Origin sensor up edge
(7)	Clear deviation counter	No output Output	No output
(8)	Auto-move to home position	No move Move	No move
Home coordinate			
(9)	Setting value	-2147483648 to 2147483647	0

■ Starting speed

Set start output pulse speed applied to origin return operation or home position operation.

Setting range : 50 to 65535 (note: starting speed must be less than operating speed).

Parameter storage position :

X axis	CM2006
Y axis	CM2036

■ Acceleration/deceleration time

Acceleration time: the time required from starting speed to origin return operating speed. The lower the value is, the quicker the accelerating movement, and the shorter the moving time will be.

Deceleration time: time required for operation from origin return operating speed to starting speed. The lower the value is, the quicker the decelerating movement, and the shorter the moving time will be.

In KV-5500/5000/3000, acceleration time and deceleration time are set as the same value.

Setting range : 0 to 4000

Parameter storage position :

X axis	CM2007
Y axis	CM2037

■ Operating speed

In the case of origin operation and home position operation, pulse speed that is output to motor shoulde be specified.

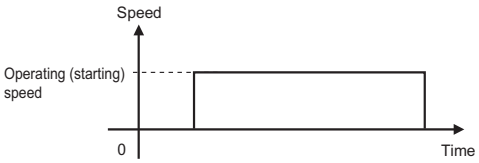
Setting range : 50 to 00000

Parameter storage position :

X axis	CM2009(High bit)/CM2008(Low bit)
Y axis	CM2039(High bit)/CM2038(Low bit)

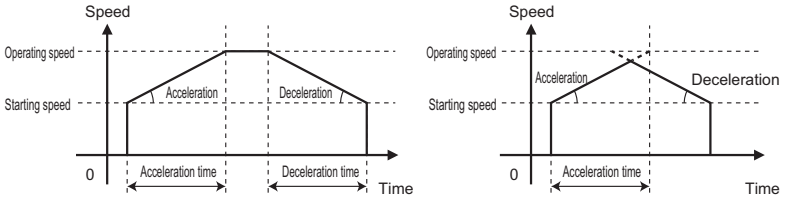
Note

(1) The operation when "starting speed=operating speed" is shown in figure below.



In this case, acceleration/deceleration time can be neglected.

(2) The ladder control within short time (short-distance) is shown in figure below.



In figure below acceleration/deceleration (slope) = (operating speed - starting speed) / acceleration/deceleration time.

In the case of ladder control, acceleration/deceleration (slope coefficient) is often controlled. Thus, ladder control within short-time will be decelerated before reaching the operating speed.

■ Origin return direction

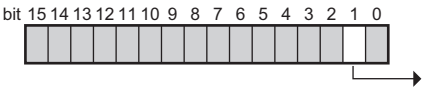
Specify starting direction for origin return.

CW ..... Origin return is performed in CW direction
CCW ..... Origin return is performed in CCW direction

"CW limit switch /CCW limit switch", Page 2-185

Parameter storage position: parameters are stored as follows.

Axis	Destination storage address
X	CM2000
Y	CM2030



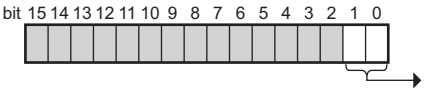
bit1	Contents to be set
0	CCW
1	CW

■ Detailed position of origin return

Detection method for origin stop position is set.

Parameter storage position: parameters are stored as follows.

Axis	Destination storage address
X	CM2018
Y	CM2048



bit1	bit0	Contents to be set
0	0	Up edge of the origin sensor
0	1	Medium point of the origin sensor
1	0	Origin sensor and Z phase
1	1	Setup inhibited

TIP • Advantage of setting as "medium point of origin sensor"
If comparing "mediuml point of origin sensor" with "up edge of origin sensor", the finish position of origin return varies little after a period of time even if exposure of origin sensor degrades.

• Advantage of setting as "Z-phase of origin sensor"
If comparing "Z-phase of origin sensor" with "up edge of origin sensor", the offset of Z-phase of encoder is smaller despite of a certain offset of ON position of origin sensor. So, the position of origin position has little offset.

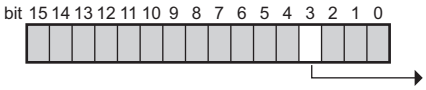
■ Deviation counter clear

At end of origin return, or in the case of error during pulse output process as well as during detection of limit switch, deviation counter clear signal R506 (X axis) and R507 (Y axis) will be output automatically. (without need of ladder program)

For the error information, see "List of Devices/error Codes for Positioning", Page 2-226.

Parameter storage position: parameters are stored as follows.

Axis	Destination storage address
X	CM2018
Y	CM2048



Bit 3	Contents to be set
0	No output
1	Output

■ Auto-move home position

When the origin return is done, the axis will move to the home position automatically.

Parameter storage position: parameters are stored as follows.

Axis	Destination storage address
X	CM2018
Y	CM2048

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

bit4	Contents to be set
0	Not move
1	Move

■ Home position coordinate

Home position is set.

Setting range : -2147483648 to 2147483647

Parameter storage position :

X axis	CM2027(High bit)/CM2026(Low bit)
Y axis	CM2057(High bit)/CM2056(Low bit)

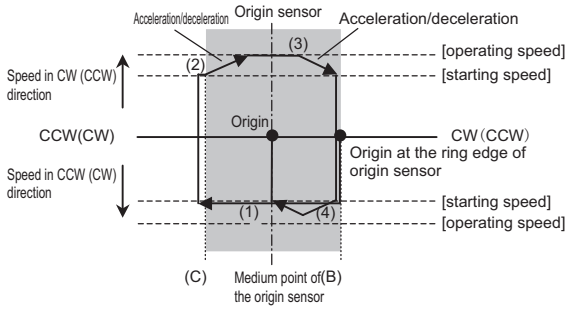
■ Origin return path

The moving path of object origin return may differ from the position of moving object during origin return as well as setting parameters of KV STUDIO. In addition, origin return is possible as long as the error is cleared, even if there is a CW or CCW limit switch ON.

If origin return is in CW direction, place the figures into ( ).

● When "detailed position of origin return" is set as "medium point of origin sensor"

"origin direction" CCW(CW)

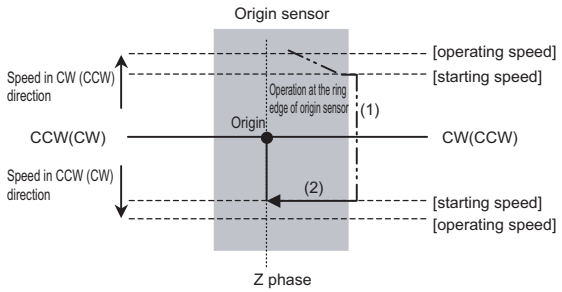


(1) After completion of the operation at origin sensor's up edge, the work pieces will move to origin sensor OFF at starting speed along the reverse direction of origin, and then stop. store the finish position at up edge of origin sensor as " (B) position".
(2) work piece moves to ON position of origin sensor at starting speed.store ON position of origin sensor to " (C) position".
(3) From "(C) position" to "(B) position", work piece will move via incline control and stop.
(4) Work pieces moves towards and then stop at central position of origin sensor calculated by "(B) position" and "(C)position" through slope control. (finish of origin)

Note: for origin position at "up edge of origin sensor", "deviation counter clear" isn't ON.

● When "origin detail position" is set as "origin sensor and Z-phase"

"Origin direction" CCW (CW)



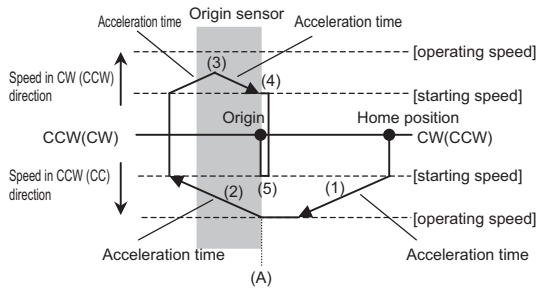
(1) The operation prior to work pieces stop is the same with "up edge of origin sensor"
(2) After work piece moves to origin point at starting speed and origin sensor is ON, once Z-phase is ON, the work piece will immediately stop. (finish of origin)

* After Origin return ends, " deviation counter clear " will be ON for 50ms.

● When "detail position of origin" is set as "up edge of origin sensor"

Origin return direction CCW (CW)

Home position: CW(CCW) side



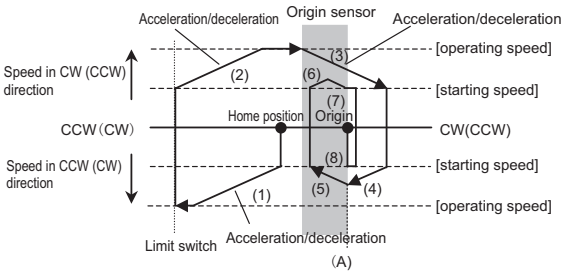
(1) The work pieces accelerates to operating speed, and moves towards origin return direction.
(2) When origin point sensor is ON when, workpiece speed reduced; stop at starting speed. store ON position of origin sensor to " (A) position".
(3) Work piece moves stop position to " (A) position", via slope control.
(4) After moving to " (A) position ", work piece will move to OFF position of origin point sensor, stop.
(5) Work piece moves to origin point side, stops when origin point sensor is ON. (finish of origin)

* acceleration/deceleration = (operating speed-starting speed) / acceleration/ deceleration time

* During operation of (1) and (2), stop immediately when limit switch at movement direction side is ON, and stops 300 ms. After that, "deviation counter clear" will be ON. Then, move reversely. If limit switch at starting position side is ON, emergency stop occurs.

* After Origin return ends, " deviation counter clear " will be ON for 50ms.

Home position: CCW (CW) side (1) (limit switch ON, when stop position at origin position direction is outside of origin sensor)



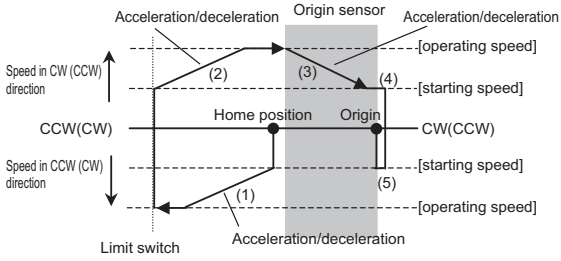
(1) The work pieces accelerates to operating speed, and moves towards origin return direction.
(2) When limit switch is ON, work pieces stop immediately, and move after accelerating to a certain operating speed.
(3) When origin point sensor is ON when, work piece speed reduced; stop at starting speed.
(4) Work pieces accelerates to origin sensor.
(5) When origin point sensor is ON when, work piece speed reduced; stop at starting speed. store ON position of origin sensor to " (A) position".
(6) Work piece moves stop position to " (A) position", via slope control.
(7) After moving to " (A) position ", work piece will move to OFF position of origin point sensor, stop.
(8) Work piece moves to origin point side, stops when origin point sensor is ON. (finish of origin)

During *(1) operation process, when limit switch at movement direction side is ON, stop immediately, and then stop 300 ms. After that, "deviation counter clear" will be ON. And start execution of (2).

* During (3) operation process, if limit switch at movement direction side is ON, emergency stop occurs.

* After Origin return ends, " deviation counter clear " will be ON for 50ms.

Home position: CCW (CW) side (2) (limit switch ON, when stop position at origin position direction is within the range of origin sensor)



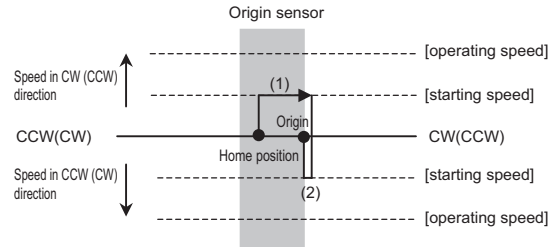
(1) The work pieces accelerates to operating speed, and moves towards origin return direction.
(2) When limit switch is ON, work pieces stop immediately, and move after accelerating to a certain operating speed.
(3) When origin point sensor is ON when, work piece speed reduced; stop at starting speed.
(4) Workpiece moves to origin sensor OFF position and stops.
(5) Work piece moves to origin point side, stops when origin point sensor is ON. (finish of origin)

During *(1) operation process, when limit switch at movement direction side is ON, stop immediately, and then stop 300 ms. After that, "deviation counter clear" will be ON. And start execution of (2).

* During (3) operation process, if limit switch at movement direction side is ON, emergency stop occurs.

* After Origin return ends, " deviation counter clear " will be ON for 50ms.

Home position: within the range of origin sensor



(1) Work pieces move at the starting speed to origin sensor OFF position along reverse direction of origin, and the stop.
(2) Work piece moves to origin point side, stops when origin point sensor is ON. (finish of origin)

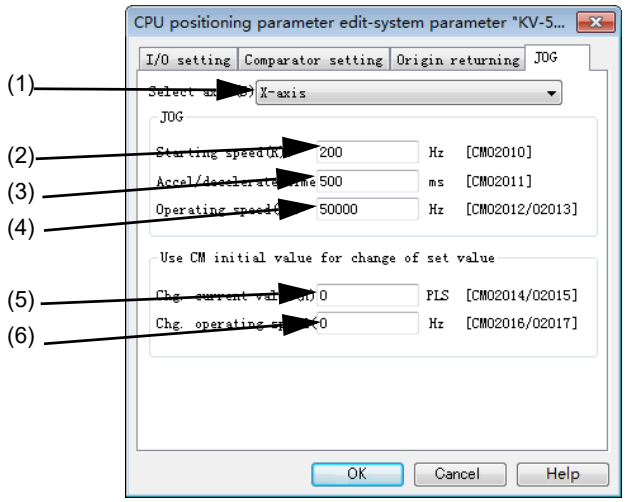
* After Origin return ends, "deviation counter clear" will be ON for 50ms.

Note

"Deviation counter clear" is set as "output ON" using system parameter.

"Deviation counter clear", Page 2-192

System parameters (JOG)



	Function description	Set range	Default
(1)	Select axis	X/Y axis	X axis
JOG			
(2)	Starting speed	50 to 65535	200
(3)	Accel/decelerate time	0 to 4000	500
(4)	Operating speed	50 to 100000	50000
Use CM initial value for change of set value			
(5)	Change current value	-2147483648 to 2147483647	0
(6)	Change operating speed	50 to100000	0

■ Starting speed

To set output pulse speed when JOG operation is ON.

Setting range : 50 to 65535 (note: starting speed must be less than operating speed).

Parameter storage position :

X axis	CM2010
Y axis	CM2040

■ Acceleration/deceleration time

Acceleration time: time required from starting speed to JOG operating speed. The lower the value is, the quicker the accelerating movement, and the shorter the moving time will be.

Deceleration time: time required from JOG operating speed to starting speed. The lower the value is, the quicker the decelerating movement, and the shorter the moving time will be.

In KV-5500/5000/3000, acceleration time and deceleration time are set to the same value.

Setting range : 0 to 4000

Parameter storage position:

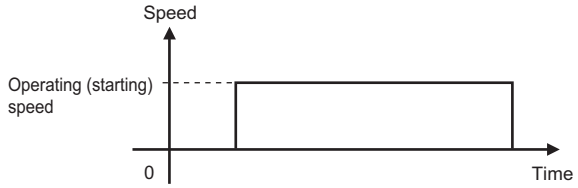
X axis	CM2011
Y axis	CM2041

■ Operating speed

To set pulse speed that is output to motor during JOG operation.

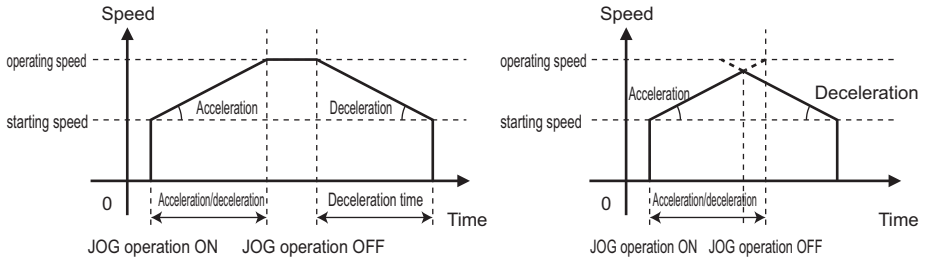
Note

(1) The operation when "starting speed=operating speed" is shown in figure below.



In this case, acceleration/deceleration time can be neglected.

(2) JOB operation within short time (short distance) is shown in figure below.



In figure below acceleration/deceleration (slope) = (operating speed - starting speed)/ (acceleration/deceleration time).

During operation of JOG, acceleration/deceleration (slope) is often controlled.
Thus, short-time JOG operation will be decelerated before reaching the operating speed.

Setting range : 50 to 00000

Parameter storage position:

X axis	CM2013(High bit)/CM2012(Low bit)
Y axis	CM2043(High bit)/CM2042(Low bit)

■ Change current value (default)

In the process of positioning control, count the output pulse as "current value".
If current value change request relay is ON (level detection), the current position (current value) is changed as the value stored by control memory (only when pulse output is stopped).

Control memory can be set to stored default value by changing the current value.

Parameter storage position: parameters are stored as follows.

axis	Corresponding current value change request relay	Control memory No. for storing setting value
X	CR3011	CM2015(High bit)/CM2014(Low bit)
Y	CR3111	CM2045(High bit)/CM2044(Low bit)

■ Change operating speed (default)

In the positioning control process, operation is performed at specified operating speed.
In the positioning control process, if operating speed change request relay is ON (level detection), the operating speed will be changed to the value stored in control memory.

Control memory can be set to stored default value by changing the operating speed.

Parameter storage position: parameters are stored as follows.

Axis	Corresponding operating speed change request relay	Control memory No. for storing setting value
X	CR3012	CM2017(High bit)/CM2016(Low bit)
Y	CR3112	CM2047(High bitLow bit)/CM2046(Low bit)

Creating ladder program

To achieve positioning control, use special positioning control instruction, control relay (CR) and control memory (CM) to edit ladder program.

"Positioning Instruction List", Page 2-203
"Control relay for positioning control", Page 2-198
"CM for positioning control", Page 2-200
"Reference example of Positioning Control", Page 2-217

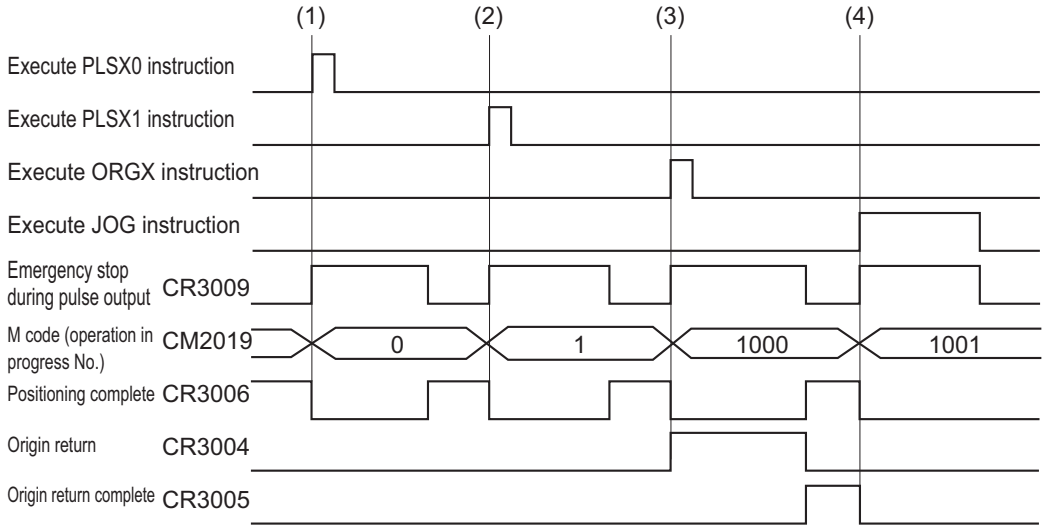
In addition, the operating speed can also be changed during positioning control process.

"Change speed during operation", Page 2-201

When over 33 positioning points are managed, the point parameters managed by control memory (CM) are changed through ladder program.

"Reference example for executing positioning control over 32 points", Page 2-225.

■ Timing chart of positioning operation



(1) Start pulse output by performing PLSX0 instruction. Pulse output relay CR3009 is ON, positioning complete relay CR3006 and origin return complete relay CR3005 is OFF.
Meanwhile, the operating point No. "0" is written into M code CM2019.

(2) Start pulse output by performing PLSX1 instruction. Pulse output relay CR3009 is ON, positioning complete relay CR3006 and origin return complete relay CR3005 is OFF.
Meanwhile, the operating point No. "1" is written into M code CM2019.

(3) Start origin through execution of ORGX instruction. Pulse output relay CR3009 and origin return relay CR3004 ON, origin return complete relay CR3005 and positioning complete relay CR3006 OFF.
Meanwhile, write origin code "1000" into M code CM2019.

(4) Start JOG operation through execution of JOG instruction. Pulse output relay CR3009 ON, origin return complete relay CR3005 and positioning complete relay CR3006 OFF.
Meanwhile, write JOG operation code "1001" into M code CM2019.

■ Control relay for positioning control

To describe the control relay related to positioning control program.

Refer to the list of control relay for positioning control "List of Devices/error Codes for Positioning", Page 2-226

● Origin return in progress "X axis: CR3004, Y axis: CR3104"

This control relay will be ON during origin return operation; it will OFF when origin return operation is finished.

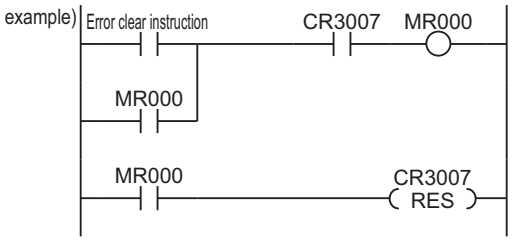
● Origin return complete "X axis: CR3005, Y axis: CR3105"

Set this control relay at finish of origin return, and reset at next pulse output.

"Timing chart of positioning operation", Page 2-198

● Error/error clear "X axis: CR3007, Y axis: CR3107"

When the control relay is error, OFF. The error code is stored in CM2024 (X axis) and CM2054 (Y axis).
Reset forcedly this control relay through ladder program to clear the error state (error clear).
The operation will stop in the case of error during the pulse output process.
Pulse output will stop in the case of error.
During the deviation counter output process (50ms) as well as origin return operation, error clear instruction (ON two times at END line) when detecting through limit switch in reverse stop process (300ms).
Error can be cleared through reset of CR3007 and CR3107 until error (CR3007 and CR3107) is off.



● Pulse output in process/emergency stop "X axis: CR3009, Y axis:CR3109"

The control relay is ON during pulse output.
Send emergency stop instruction and enter error status by forced reset of control relay through ladder program.

● Positioning complete "X axis: CR3006, Y axis: CR3106"

The control relay is set at completion of positioning and origin return, and reset at next pulse output. and reset at next pulse output.

Even if PLSX, PLSY commands are executed, if pulse output is still unavailable, positioning complete relay will be set.

(Example) when operation mode is incremental positioning, and movement is "0".
Mode is absolute positioning, and target value is the same with current position.

● Current value change request "X axis: CR3011, Y axis: CR3111"

The current position (current value) will be changed when the relay is on. (only when the pulse output stops)
Store the change value into control memory.

"Change current value (default)", Page 2-196

Operation	Relay No.	CM for storing the change value
X axis current value change request	CR3011	CM2015(High bit)/CM2014(Low bit)
Y axis current value change request	CR3111	CM2045(High bit)/CM2044(Low bit)

● Operation speed change request "X axis: CR3012, Y axis: CR3112"

In the positioning control/speed control process, the operating speed will be changed when the relay is ON.
store the change value into CM.

"Change operating speed (default)", Page 2-197

Operation	Relay No.	CM for storing the change value
X axis operating speed change request	CR3012	CM2017(High bit)/CM2016(Low bit)
Y axis operating speed change request	CR3112	CM2047(High bit)/CM2046(Low bit)

● Comparator 2 "X axis: CR3013, Y axis: CR3113"

Used as interrupt condition.

Used when the speed is changed during operation.

"3-5 Interrupt", Page 3-31
"Change speed during operation", Page 2-201

Note This control relay doesn't perform ON/OFF operation.

● Warning/warning clear "X axis CR3008, Y axis: CR3108"

The control relay is ON when overflow occurs at current position.

Warning status can be cleared by forced reset of control relay through ladder program. Pulse output won't stop even warning occurs. The operation will stop in the case of error during the pulse output process.

Current position overflow

Axis	Current position	Range
X	CM2021(High bit)/CM2020(Low bit)	-2147483648 to 2147483647
Y	CM2051(High bit)/CM2050(Low bit)	-2147483648 to 2147483647

● Drive operation start "X axis: CR3010, Y axis: CR3110"

Operation of the No. stored in CM2025 (X axis) and CM2055 (Y axis) is started on the up edge of the control relay.

The control relay is ON during pulse output.

TIP When positioning control is performed using the PLSX and PLSY instructions, it is not necessary to operate this relay.

■ CM for positioning control

To describe control memory (CM) related to positioning control procedures.

Refer to the list of control memory for positioning control"Control memory list", Page 2-227.

● Operation point No. (M code) " X axis: CM2019, Y axis.CM2049"

This control memory (CM) is used to store point No. of startup operation when executing PLSX/PLSY, JOGX/JOGY, and ORGX/ORGY instructions. "1001" is stored when executing JOG instruction; "1000" is stored when executing ORG instruction; "1002" is stored in the process of moving to home position.

● Current position (current value) "X axis: CM2020/CM2021, Y axis: CM2050/CM2051"

This control memory (CM) is used to store current position (PLS).

For how to changing the current position, see "Change current value (default)", Page 2-196.

● Current speed "X axis: CM2022/CM2023, Y axis: CM2052/CM2053"

This control memory is used to store the current speed (Hz).

For how to change speed during operation, see "Change speed during operation", Page 2-201.

● Error code "X axis: CM2024, Y axis: CM2054"

This control memory is used to store error code.

"List of Devices/error Codes for Positioning", Page 2-226

■ Change speed during operation

There are three methods for changing speed during operation.

- Use operating speed change request relay CR3012 (X axis) and CR3112 (Y-axis)
- Use CHGSPX and CHGSPY instruction
- Use comparator 2 interrupt relay CR3013 (X axis) and CR3113 (Y-axis)

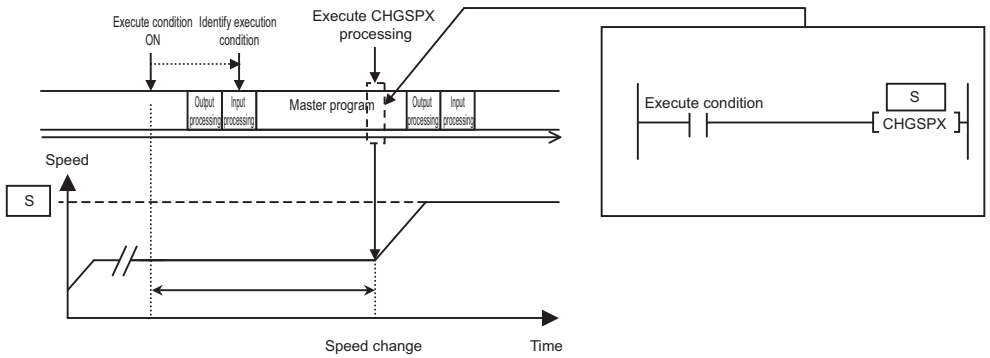
Note

- The speed cannot be changed during operation if starting speed is equal to operating speed. (except for acceleration/deceleration time=0.).
- It cannot be changed before reaching starting speed. If less than starting speed, the speed will change to starting speed.

● Use CHGSPX and CHGSPY instruction

In the process of pulse output, the operating speed can be changed to a that specified by S when the executing condition is on.

S Specified value is stored as setting value of operating speed (CM2017/CM2016).



“CHGSPX, CHGSPY instruction", Page 2-214

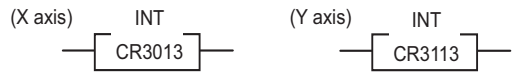
● Use comparator 2 interrupt relay CR3013 (X axis) and CR3113 (Y axis)

Comparator 2 compares the current position with setting value of "system parameter" (comparator setting), and interrupt will occur when two values match.

	Interrupt relay	Position for storing comparator 2 setting value
X axis	CR3013	CM2029(High bit)/CM2028(Low bit)
Y axis	CR3113	CM2059(High bit)/CM2058(Low bit)

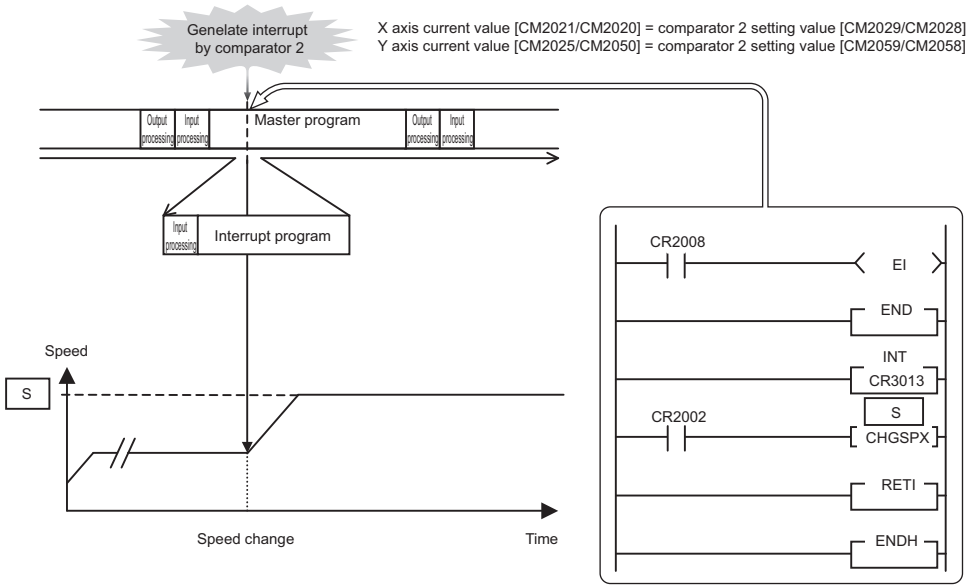
Use INT instruction if comparator 2 is employed. Actually, this control relay will not be ON/OFF. It is only used as a symbol in ladder program programming.

Example



"System parameters (comparator setting)", Page 2-188
"INT Instruction", Page 3-50

Change immediately to the operating speed set by "S" when the interrupt condition based on comparator 2 occurs.



Note

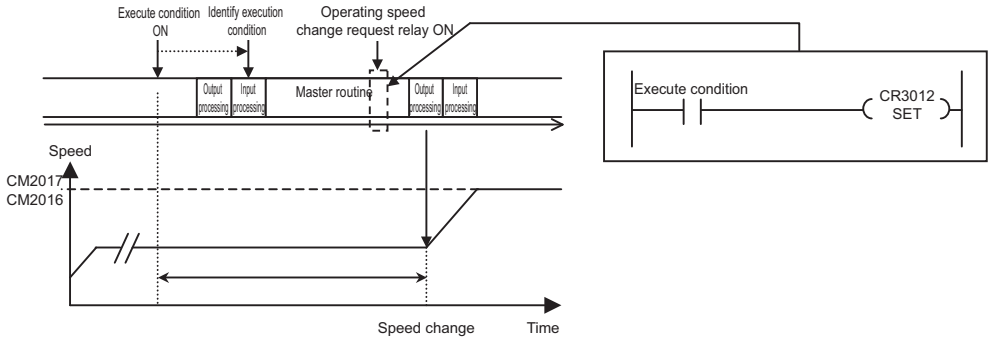
KV-5500/5000/3000 PLC can identify the interrup value according to comparator 2 when CHGSPX and CHGSPY instructions are performed or pulse output is started through PLSX and PLSY (X axis: CM02029/CM02028, Y axis: CM02059/CM02058). It cannot operate correctly only when setting value is written to control memory.

When using comparator 2 as interrupt condition, please write setting value to control memory and then execute the CHGSPX, CHGSPY, PLSX, and PLSY instructions.

"Reference example for executing speed change during operation", Page 2-221

● Use operating speed change request relay CR3012 (X axis) and CR3112 (Y-axis)

In the process of pulse output, the operating speed can be changed to setting value (CM2017/ CM2016) when the operating speed change request relay is ON.



"Reference example for executing speed change during operation", Page 2-221

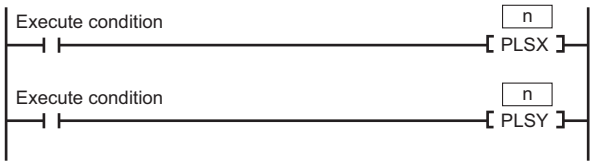
Positioning Instruction List

The instructions for positioning control are described below.
For more details of instructions, please refer to the reference pages.

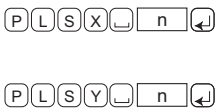
Instruction	mnemonics	Description	Page
Trapezoidal control X-axis	PLSX	Start trapezoidal control of X-axis	2-204
Trapezoidal control Y-axis	PLSY	Start trapezoidal control of Y-axis	2-204
Jog operation X-axis	JOGX	Execute JOG operation of X axis.	2-206
Jog operation Y-axis	JOGY	Execute JOG operation of Y axis.	2-206
Origin return X-axis	ORGX	Start origin return of X-axis.	2-208
Origin return Y-axis	ORGY	Start origin return of Y-axis.	2-208
Teaching X-axis	TCHX	Capture current position of X-axis.	2-210
Teaching Y-axis	TCHY	Capture current position of Y-axis.	2-210
Moving to home position instruction X axis	HOMEX	Start moving to home position of X-axis.	2-212
Moving to home position instruction Y axis	HOMEY	Start moving to home position of Y-axis.	2-212
Speed change instruction X-axis	CHGSPX	Change the operating speed of X-axis.	2-214
Speed change instruction Y-axis	CHGSPY	Change the operating speed of Y-axis.	2-214
Refresh current value X-axis	RFSPSX	Update the current value and current speed of X axis.	2-216
Refresh current value Y-axis	RFSPSY	Update the current value and current speed of Y axis.	2-216

PLSX	PLSX	**Trapezoidal control X-axis**	**Start trapezoidal control of X axis.**
PLSY	PLSY	**Trapezoidal control Y-axis**	**Start trapezoidal control of Y-axis.**

Ladder program



Input mode



Operand	Available devices																	Index modification
	Bit device							Word device							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
n	○	-	○	-	-	-	○	○	○	○	○	○	○	○	*1	-	○	○	○

Operand	Explanation
n	Specify point No.(0 to 31)*1 *2 *3

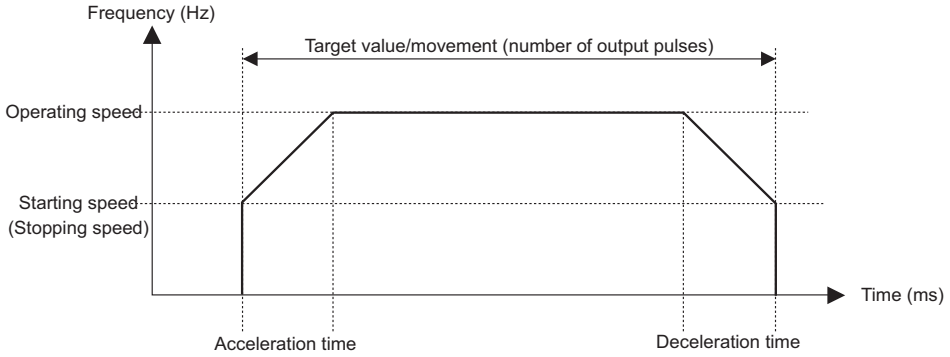
*1 Can't use "$".

* 2 When the bit device is specified, continuous 16 bits will be occupied. If word device is specified, only 1 word is occupied.

*3 When specifying the device, lower 5 bits only used.

Description of Operation

Output the pulse through setting details of point No. set by n at the up edge of executing condition, and then stops.

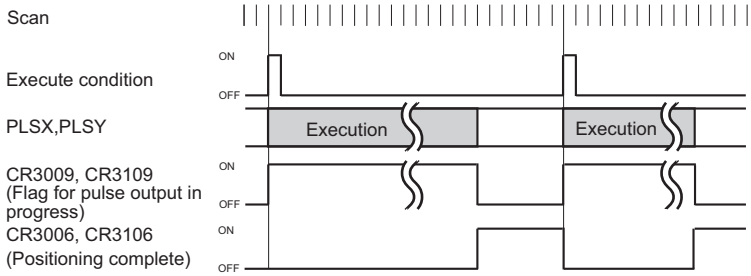


Axis	Target value/ movement	Pulse output in progress Flag	Positioning complete relay	Operation in progress point No. (M-code)	Error Code	Error Flag	Deviation counter clear	
							Setting	Output destination address
X axis	CM2060 + (Point No.×10)	CR3009	CR3006	CM2019	CM2024	CR3007	CM2018 Bit 3	R506
Y axis	CM2061 + (Point No.×10)	CR3109	CR3106	CM2049	CM2054	CR3107	CM2048 Bit 3	R507

Store the point No. into "Operation in progress No. (M code) when "Pulse output in progress flag" is ON in the process of trapezoidal control.

When moving to "target value/movement" position, "Pulse output in progress flag" is OFF and "positioning complete relay" is ON, and stops.

"Positioning complete relay" is OFF during the next pulse output.



Abnormal stop and emergency stop of trapezoidal control

- Movement will stop when an error occurs (abnormal stop).
- Emergency stop is possible when "Pulse output in progress flag" is OFF using RES instruction.
- During abnormal stop and emergency stop, error No. will be stored in "error code", "error flag" will be ON. "Pulse output in progress flag" is OFF, "Positioning complete relay" is not ON. "Deviation counter clear" is output.

"List of Devices/error Codes for Positioning", Page 2-226

Note

- If "Pulse output in progress flag" is ON, PLSX and PLSY instructions cannot be executed.
- If "error flag" is ON, PLSX and PLSY instructions cannot be executed.
- "Pulse output in progress flag" is OFF, during the first END processing after pulse output.
- During emergency stop, pulse output stop, current position message may lose. Besides, when pulse output stops, final pulse duty cycle cannot be guaranteed.
- When the number of output pulse changes to parameter "0", "Pulse output in progress flag" is not ON, and "positioning complete relay" is ON. In this case, no warning will occur.

Operation flag

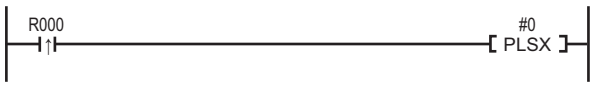
CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	It is ON when range of indirect specifying or index modification is improper, otherwise OFF. When indirect specifying or index modification is unspecified, it is not changed.

* If CR2012 is ON, the instruction will be not executed. When CR2012 is ON, the detailed error info is stored in CM5100 to CM5176.

"Error Log (CM)", Page 3-20

Sample Program

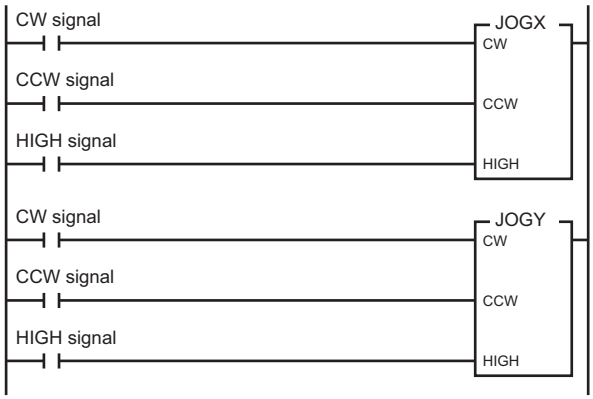
Pulse is output for the setting contents point No. 0 on the up edge when input relay R000 is ON.




```
(mnemonics list)
 LDP R000
 PLSX #0
```

JOGX	JOGX CW CCW HIGH	**Jog operation X-axis**	**Execute JOG operation of X-axis.**
JOGY	JOGY CW CCW HIGH	**Jog operation Y-axis**	**Execute JOG operation of Y-axis.**

Ladder program



Input mode

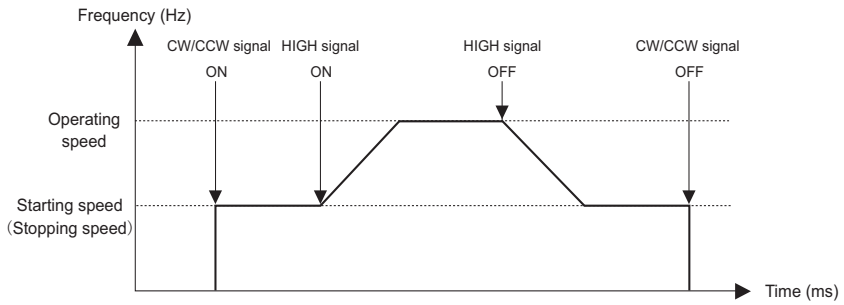




Operand	Available devices																		Index modification
	Bit device							Word device							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

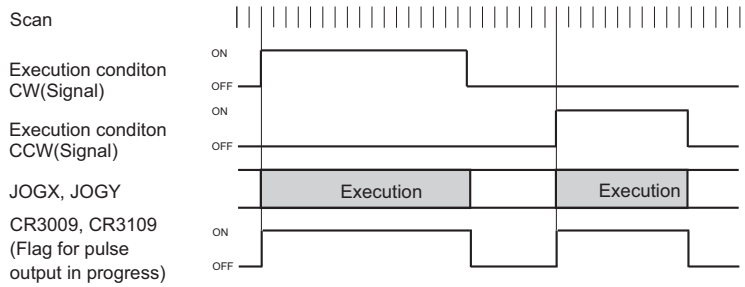
Description of Operation

When CW or CCW signal is ON, pulse will be output at starting speed.
When HIGH signal is ON, pulse will be output by rotation speed.
Stop after pulse I/O is finished.



Axis	Pulse output in progress flag	Operation in progress point No. (M code)	Error code	Error flag
X axis	CR3009	CM2019	CM2024	CR3007
Y axis	CR3109	CM2049	CM2054	CR3107

In the process of JOG operation, "Pulse output in progress flag" is ON and store "1001" into "M code" When the operation is finished, "Pulse output in progress flag" will be OFF.



Abnormal stop and emergency stop of JOG operation.

- Movement will stop when an error occurs (abnormal stop).
- Emergency stop is possible when "Pulse output in progress flag" is OFF using RES instruction.
- During abnormal stop and emergency stop, error No. will be stored in "error code", "error mark" is ON. "Pulse output in progress flag" is OFF, ""Deviation counter clear" is output.

"List of Devices/error Codes for Positioning", Page 2-226

Note

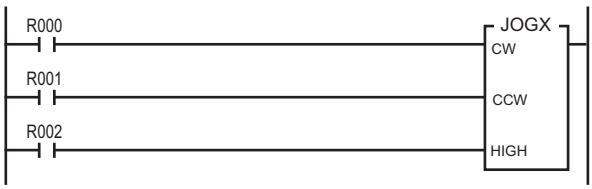
- If "Pulse output in progress flag" is ON, JOGX and JOGY instructions cannot be executed.
- If "error flag" is ON, JOGX and JOGY instructions cannot be executed.
- When a limit error occurs (error code: 31 or 32), JOG instruction can also be executed in the direction opposite to the moving direction when the limit error occurs even if the limit switch is ON, simply by turning OFF the "error flag".
- "Pulse output in progress flag" is OFF, during the first END processing after pulse output.
- During emergency stop, pulse output stop, current position information may be lost. Besides, when pulse output stops, final pulse duty cycle cannot be guaranteed.
- "Origin return relay" and " positioning complete relay " are OFF during the pulse output.

Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	No change in status

Sample Program

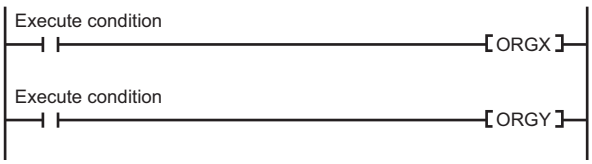
Execute CW-JDG operation when input R000 ON; execute CCW-JOG operation when input R001 ON. JOG operation will be executed at high speed when input R002 ON.




```
(mnemonics list)
 LD R000
 LD R001
 LD R002
 JOGX
```

ORGX	—[ORGX]—	**Origin return X-axis**	**Start origin return on the X-axis.**
ORGY	—[ORGY]—	**Origin return Y-axis**	**Start origin return on the Y-axis.**

Ladder program



Input mode



Operand	Available devices																		Index modification
	Bit device							Word device							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Description of Operation

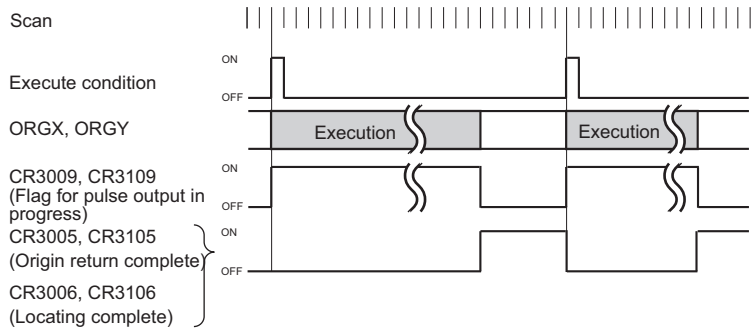
When the execution condition is ON, origin return operation starts, and then stops after pulse output is finished.

Axis	Pulse output in progress Flag	Origin return in progress Flag	Origin return complete relay	Positioning complete relay	Operation in progress point No. (M-code)	Error code	Error flag
X axis	CR3009	CR3004	CR3005	CR3006	CM2019	CM2024	CR3007
Y axis	CR3109	CR3104	CR3105	CR3106	CM2049	CM2054	CR3107

In the process of origin return, "Pulse output in progress flag" is ON and store "1000" in "M code".

When moving to origin (0) position, "Pulse output in progress flag" is OFF. When "origin return complete relay" and "positioning complete relay" ON, it stops.

"Origin return complete relay" and " positioning complete relay " are OFF during the next pulse output.



Abnormal stop and emergency stop of origin.

- Movement will stop when an error occurs (abnormal stop).
- If the following conditions occur during operation, operation will stop abnormally due to the error of limit sensor.
  When the limit sensor at reverse direction of origin return is detected.
  When CW and CCW limit sensors are detected during origin return (including simultaneous or sequential detection).
- Emergency stop is possible when "Pulse output in progress flag" is OFF using RES instruction.
- During abnormal stop, emergency stop, error No. will be stored in "error code", "error mark" is ON.
- "Pulse output in progress flag" is OFF," "Pulse output in progress flag" is OFF. "origin return complete relay" and "positioning complete relay" will be no ON.

"List of Devices/error Codes for Positioning", Page 2-226

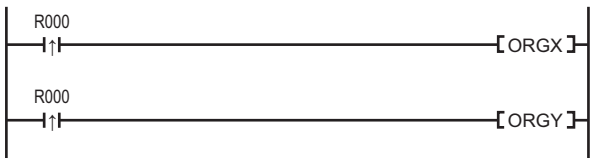
Note

- If "pulse output in progress flag" is ON, ORGX and ORGY instructions cannot be executed.
- If "error flag" is ON, ORGX and ORGY instructions cannot be executed.
- "Pulse output in progress flag" is OFF, during the first END processing after pulse output.
- During emergency stop, pulse output stop, current position message may lose.
  Besides, when pulse output stops, final pulse duty cycle cannot be guaranteed.

Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	No change in status

Sample Program




```
(mnemonics list)
 LDP R000
 ORGX
 LDP R000
 ORGY
```

TCHX	TCHX	**Teaching X-axis**	**Capture current position of X-axis.**
TCHY	TCHY	**Teaching Y-axis**	**Capture current position of Y-axis.**

Ladder program



Input mode

T C H X ↵

T C H Y ↵

Operand	Available devices																		Index modification
	Bit device							Word device							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Description of Operation

When the execution condition is ON, "target value/movement" stored in "specifiedpoint No." (point No.) will be stored in "current position" value.

Axis	Specified pointNo.	Target value/movement	Current position
X axis	CM2025	CM2060+(Point No. x10)	CM2021, CM2020
Y axis	CM2055	CM2061+(Point No. x10)	CM2051, CM2050

(1) Use LDA, STA or DW instruction to store point No. in "specified point No." device.

(2) If execution condition of TCHX and TCHY instruction is ON, the "target value/movement" of specified point No. in (1) will be stored in the "current position" value.
storage position differs for various point Nos. (when point No. is "0, it is CM2060/CM2061; when point No. is "1", it is CM2070/CM2071)

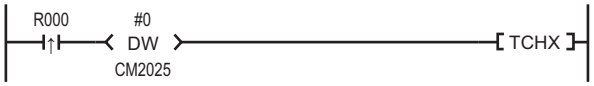
"List of Devices/error Codes for Positioning", Page 2-226

Example

· TCHX Instruction

When storing current value of X axis as target value of point No. 0:

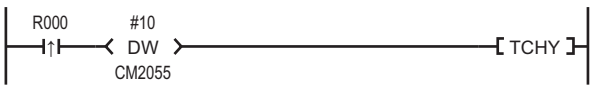
(1) "0" is stored in CM2025.
(2) TCHX instruction is executed.
(3) Content of CM2020 and CM2021(current value of X axis) is transmitted to CM2060 and CM2061 (target value/movement of point No. 0).



· TCHY Instruction

When storing current value of Y axis as target value of point No. 10:

(1) "10" is stored in CM2055.
(2) TCHY instruction is executed.
(3) The details of CM2050 and CM2051 (current value of Y axis) are transmitted to CM2160 and CM2161 (target value/movement of point N0. 10).



Note

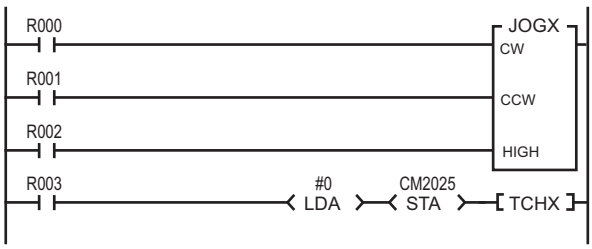
- If the point No. stored in CM2025 (X axis) and CM2055 (Y axis) is not in the range of 0 to 31, it can be neglected, and no error code will occur.
- When the "error flag" is ON, JOGX and JOGY instructions cannot be executed.
- When the "Pulse output in progress flag" is ON, JOGX and JOGY instructions cannot be executed.

Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	No change in status

Sample Program

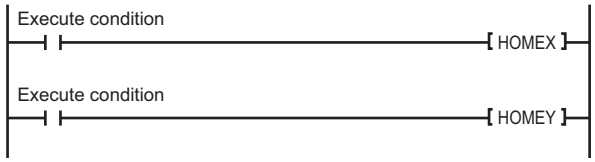
Set the current position moving under JOG operation to target value of point No.0




```
(mnemonics list)
 LD R000
 LD R001
 LD R002
 JOGX
 LD R003
 LDA #0
 CON
 STA CM2025
 CON
 TCHX
```

HOMEX	HOMEX	**Moving to home position of X-axis**	**Start moving to home position of X-axis.**
HOMEY	HOMEY	**Moving to home position of Y-axis**	**Start moving to home position of Y-axis.**

Ladder program



Input mode



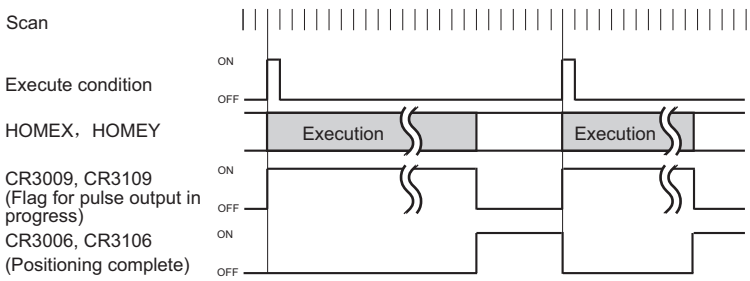
Operand	Available devices																		Index Change
	Bit device							Word device							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Description of Operation

When the execution condition is ON, the operation of moving to home starts, and then stops after completion of pulse output.

Axis	Home position coordinate	Pulse output in progress flag	Positioning complete relay	Operation in progress point No. (M code)	Error code	Error flag
X axis	CM2026 CM2027	CR3009	CR3006	CM2019	CM2024	CR3007
Y axis	CM2056 CM2057	CR3109	CR3106	CM2049	CM2054	CR3107

In the process of moving to home, "Pulse output in progress flag" is ON, and store "1000" into "M code".
When moving to "Home position coordinate" position, "Pulse output in progress flag" is OFF, and "positioning complete relay" is ON, and then stops.
"positioning complete relay" is OFF during the next pulse output.



Abnormal stop and emergency stop when moving to home.

- Movement will stop when an error occurs (abnormal stop).
- Emergency stop is possible when "Pulse output in progress flag" is OFF using RES instruction.
- During abnormal stop and emergency stop, error No. will be stored in "error code", "error flag" is ON, deviation counter clear output.
  In addition, "Pulse output in progress flag" is OFF, and "positioning complete relay" is not ON.

"List of Devices/error Codes for Positioning", Page 2-226

Note

- If "Pulse output in progress flag" is ON, HOMEX and HOMEY instructions cannot be executed.
- If "error flag" is ON, HOMEX and HOMEY instructions cannot be executed.
- "Pulse output in progress flag" is OFF, during the first END processing after pulse output.
- During emergency stop and pulse output stop, current position information may be lost. Besides, when pulse output stops, final pulse duty cycle cannot be guaranteed.

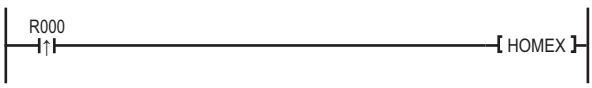
TIP Starting speed, acceleration/deceleration time, operating speed is same as origin return.

Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	No change in status

Sample Program

On the up edge when input relay R000 is ON, operation of moving to home position is performed.

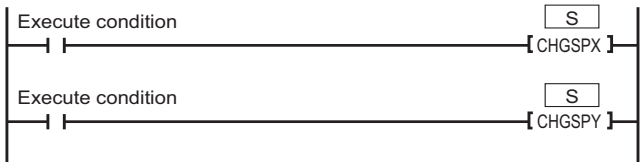


(mnemonics list)
LDP R000
HOMEX

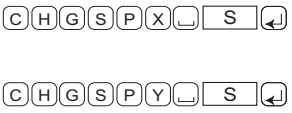
CHGSPX
CHGSPY

CHGSPX	[CHGSPX]	Cchange speed X-axis	Change speed of X-axis.
CHGSPY	[CHGSPY]	Change speed Y-axis	Change speed of Y-axis.

Ladder program



Input mode



Operand	Available devices																		Index Change
	Bit device							Word device							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
S	○	-	○	-	-	-	○	○	○	○	○	○	○	○	○	-	○	○	○

Operand	Description
S	Specify changing speed value (50 to 100000). Unsigned 32-bit BIN data. *1

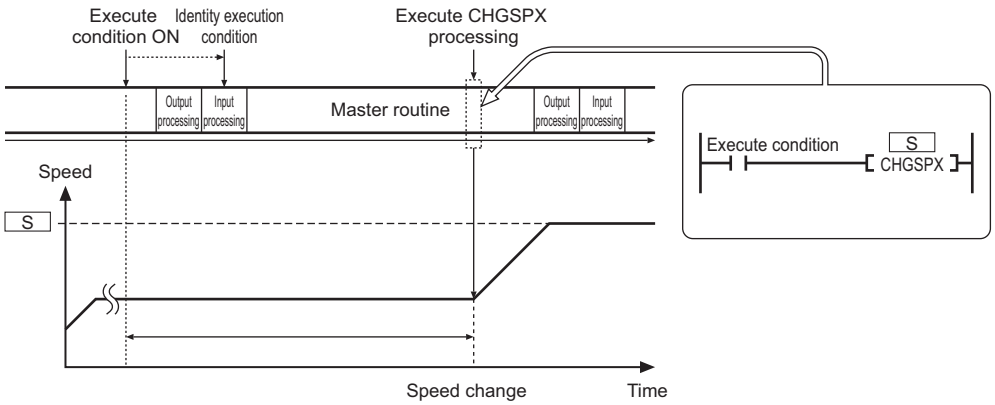
*1 When the bit device is specified, continuous 32 bits will be occupied.
If the bit device is specified, continuous 2 bits will be occupied.
If relays other than channel leading relay (R002, R106, R1012, etc.) are specified, it will straddle the next channel for 32 bits processing.

Description of Operation

Axis	Operating speed change setting value
X axis	CM2017(High bit)，CM2016(Low bit)
Y axis	CM2047 (High bit)，CM2046(Low bit)

In the process of pulse output, when the execution condition is ON, the speed will be changed to S .

S The specified value is stored in "operating speed change setting value" device.

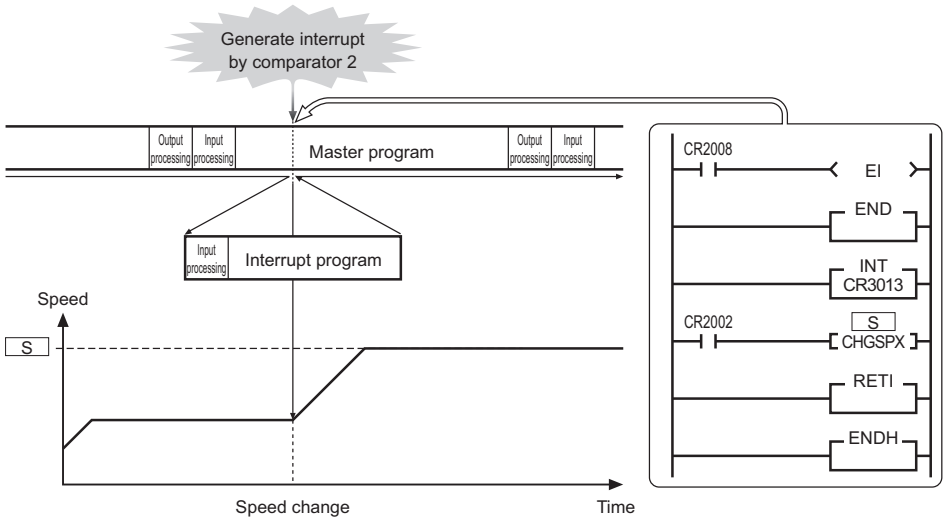


Note

It cannot be changed before reaching starting speed. If lower than starting speed, the speed will change to starting speed.

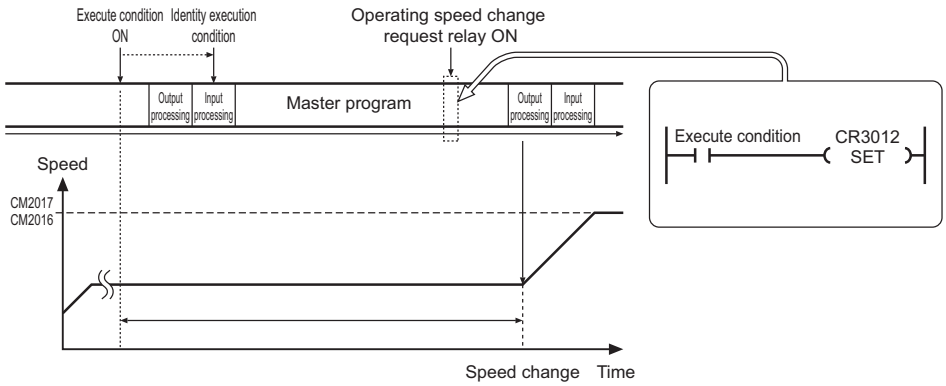
The instructions and interruptions based on comparator 2 are used simultaneously.

After interruption condition based on comparator 2 occurs, the speed will be immediately changed to S.



For comparator 2, see "System parameters (comparator setting)", Page 2-188.

TIP Use operating speed change request relay CR3012 (X axis) and CR3112 (Y-axis)



For the operating speed change request relay, see "List of Devices/error Codes for Positioning", Page 2-226.

Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	It is ON when range of indirect specifying or index modification is improper, otherwise OFF. When indirect specifying or index modification is unspecified, it is not changed.

Sample Program

On the up edge only when input relay R000 is ON, the operating speed of X axis is changed to 3000Hz.




```
(mnemonics list)
 LDP R000
 CHGSPX #3000
```

RFSPSX	RFSPSX	**Refresh current value X-axis**	**Refresh current value and speed of X-axis to the lastest value.**
RFSPSY	RFSPSY	**Refresh Y-axis current value**	**Refresh current value and speed of Y-axis to the lasted value.**

Ladder program



Input mode

R F S P S X ↵



R F S P S Y ↵

Operand	Available devices																		Index modification
	Bit device							Word device							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Operand	Decription
-	-

Description of Operation

RFSPSX When execution condition is ON, update the current position (CM2020, CM2021) and current speed (CM2022, CM2023)of X axis to latest value.

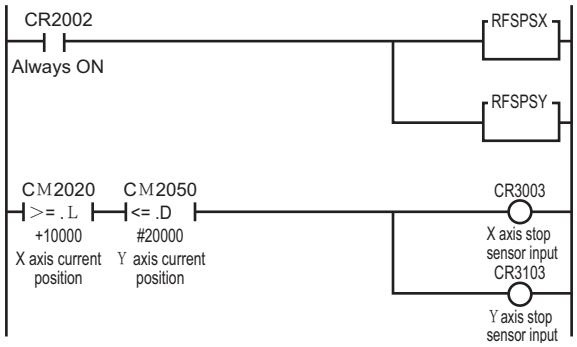
RFSPSX When execution condition is ON, update the current position (CM2020, CM2021) and current speed (CM2022, CM2023)of X axis to latest value.

Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	No change in status

Sample Program

The latest current coordinate using X axis and Y stops operation.

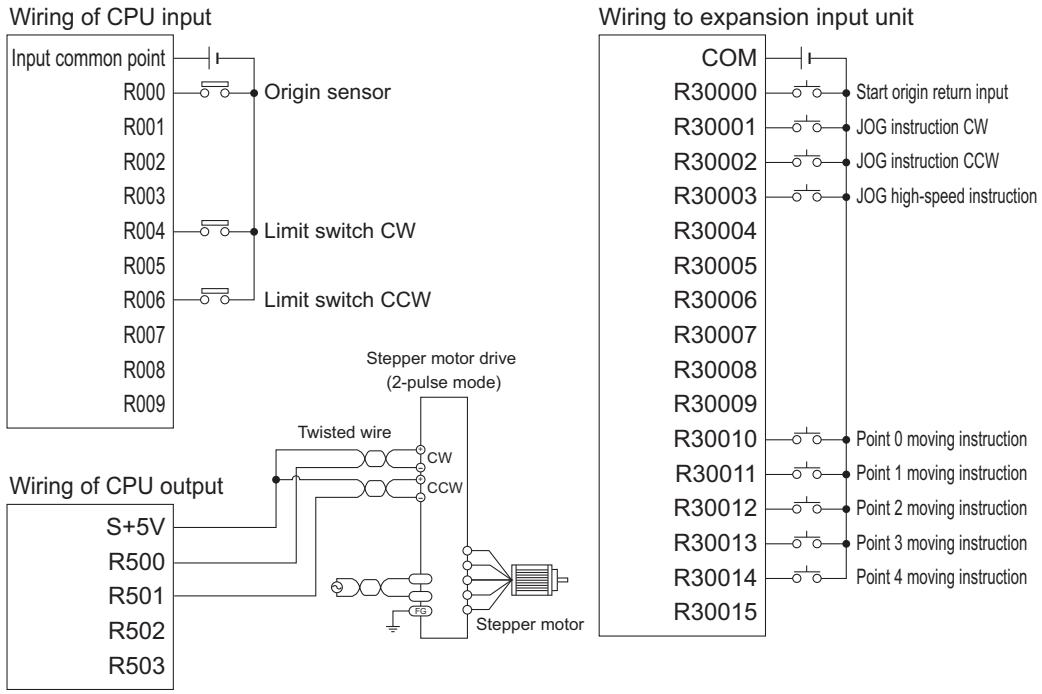



```
(mnemonics list)
 LD CR2002
 RFSPSX
 RFSPSY
 LD>=.L CM2020 +10000
 AND<=.D CM2050 #20000
 OUT CR3003
 OUT CR3103
```

Reference example of Positioning Control

■ Reference example of positioning control

● Setup example

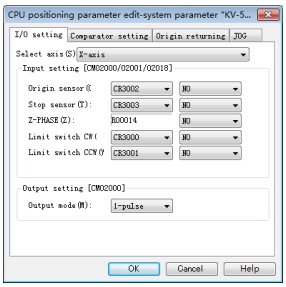


1 **Click button on the KV STUDIO tool bar to open "Edit CPU Positioning Parameters".**

Select System parameter button on the "Edit CPU Positioning Parameters" tool bar.

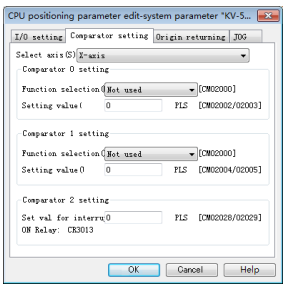
2 **Through "I/O Setup" option, set up stop sensor, limit switch input connection destination address and polarity. In addition, through output setup, select output mode.**

"System parameters (I/O setting)", Page 2-183



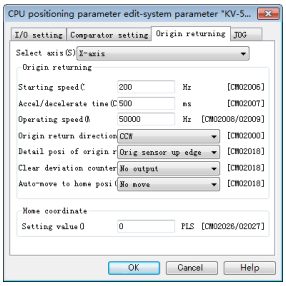
3 **Through "Comparator Setup" option, set up the value to be compared with current value.**

"System parameters (comparator setting)", Page 2-188



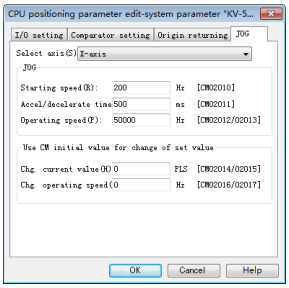
4 **Through "Origin return/JOG)" option, set up origin return speed, start direction and output mode. In addition, through home position setup, specify setting.**

"System parameters (origin returning)", Page 2-190



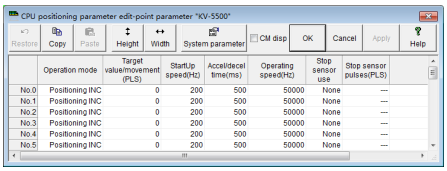
5 **Through "JOG" option, set up JOG operation speed.**

"System parameters (JOG)", Page 2-195

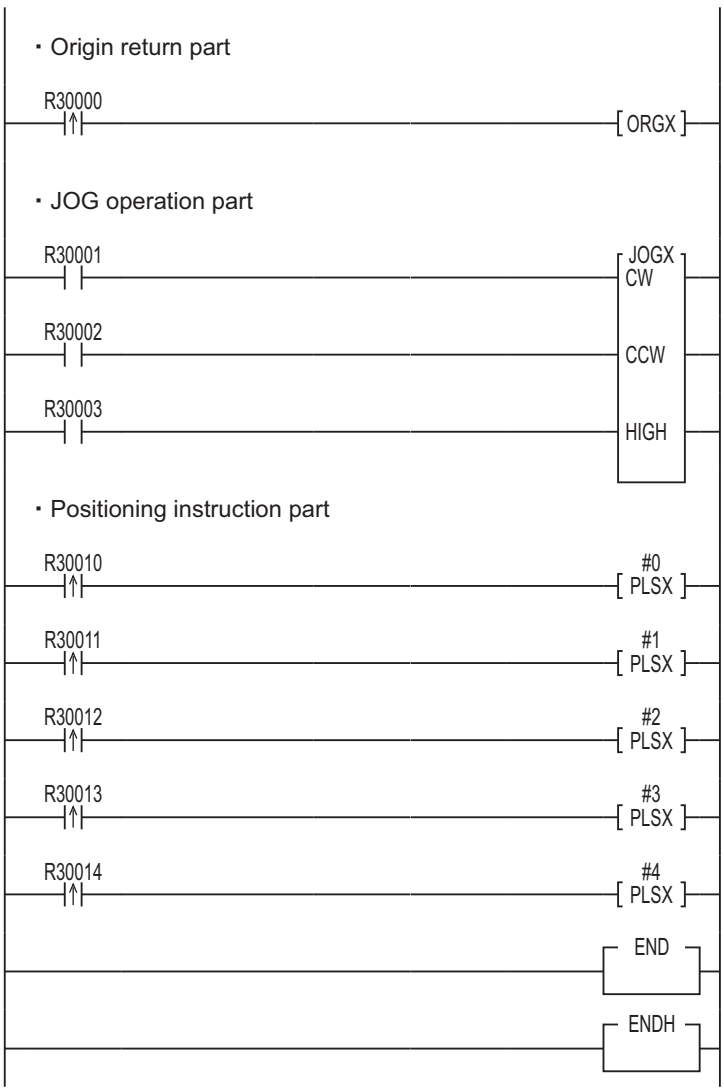


6 **Set up point parameter target coordinate, operating and acceleration/deceleration time.**

"Point parameters", Page 2-177



● Program example

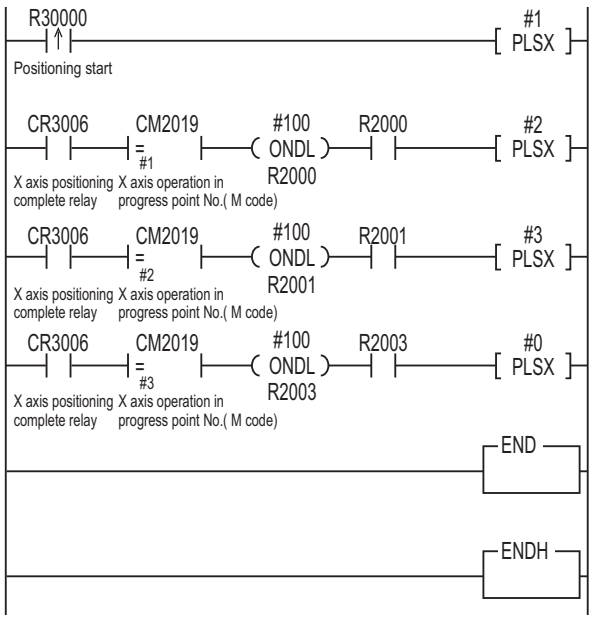


(mnemonics list)
LDP R30000
ORGX
LD R30001
LD R30002
LD R30003
JOGX
LDP R30010
PLSX #0
LDP R30011
PLSX #1
LDP R30012
PLSX #2
LDP R30013
PLSX #3
LDP R30014
PLSX #4

■ Reference example for continuous execution of position control

Positioning control is started on the up edge of R30000 relay.

Point No.1 -> 1s stop -> poin No.2 -> 1s stop -> point No.3 -> 1s stop -> point No.0

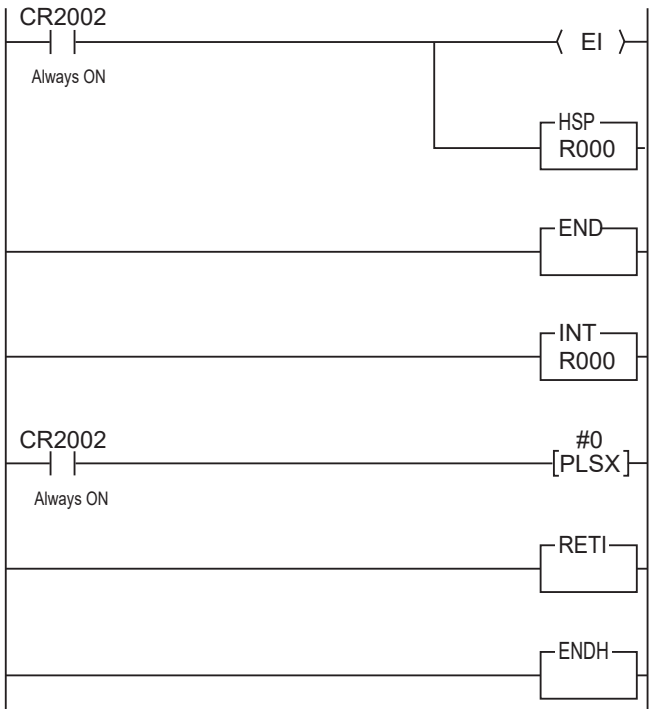



```
(mnemonics list)
 LDP R30000
 PLSX #1
 LD CR3006
 AND= CM2019 #1
 ONDL #100 R2000
 CON
 AND R2000
 PLSX #2
 LD CR3006
 AND= CM2019 #2
 ONDL #100 R2001
 CON
 AND R2001
 PLSX #3
 LD CR3006
 AND= CM2019 #3
 ONDL #100 R2003
 CON
 AND R2003
 PLSX #0
```

■ Reference example for starting positioning control at high speed

By executing PLSX instruction in interrupt program, start high speed pulse output without being influenced by scan time.

Start pulse output on the up edge of input R000.




```
(mnemonics list)
 LD CR2002
 EI
 HSP R000
 END
 INT R000
 LD CR2002
 PLSX #0
 RETI
 ENDH
```

■ Reference example for executing speed change during operation

● Use comparator 2 interrupt relay CR3013 (X axis) and CR3113 (Y-axis)

Set to allow interrupt processing.

On the up edge of R30000, clear multi-stage control state DM5000, set comparator 2 (interrupt position) to "500000", use PLSX instruction to start pulse output.

When current position = comparator 2, start interrupt processing, increase multi-stage control state DM5000.

<Interrupt processing>

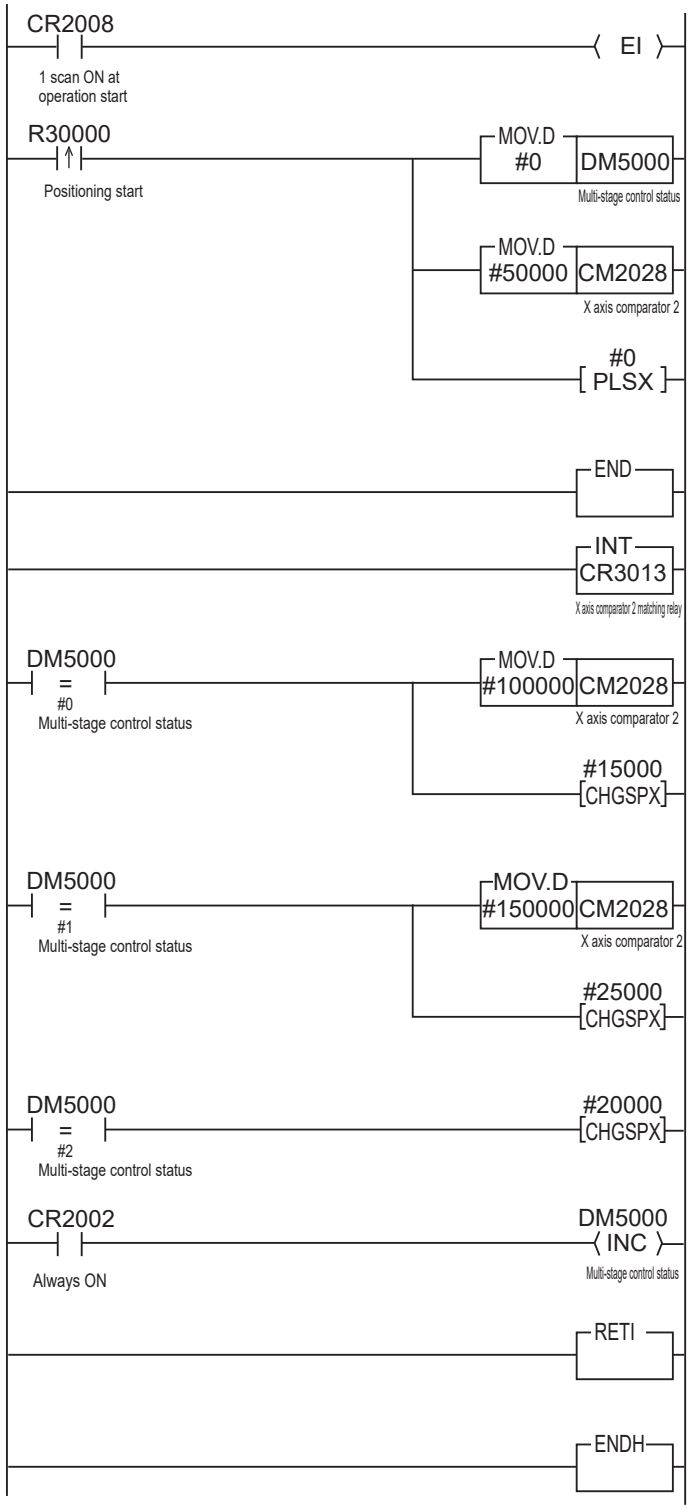
When (the first multi-stage processing) multi-stage control state DM5000=0, write next interrupt position "100000" in comparator 2, change speed to 15000 (Hz).

When (the second multi-stage processing) multi-stage control state DM5000=0, write next interrupt position "150000" in comparator 2, change speed to 25000 (Hz).

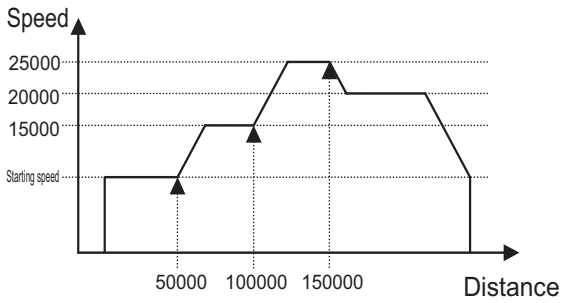
When (the third multi-stage processing) multi-stage control state DM5000=2, change speed to 20000 (Hz).

Note

- KV-5000/3000 PLC can identify interrupt value according to comparator 2 when CHGSPX and CHGSPY are executed or pulse output is started through PLSX and PLSY (X axis : CM02029/CM02028, Y axis : CM02059/CM02058). It cannot operate correctly and setting value is writen to control memory only.
  When using comparator 2 as interrupt condition, please write setting value to control memory and then execute the CHGSPX, CHGSPY, PLSX, PLSY instructions.
- Actually, CR3013 and CR3113 will not be turned. They are only used as a symbol for ladder program.

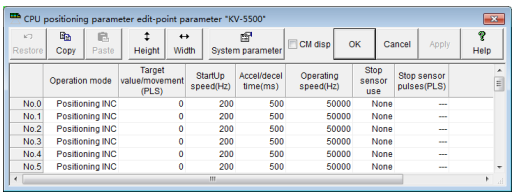



```
(mnemonics list)
 LD CR2008
 EI
 LDP R30000
 MOV.D #0 DM5000
 MOV.D #50000 CM2028
 PLSX #0
 END
 INT CR3013
 LD= DM5000 #0
 MOV.D #100000 CM2028
 CHGSPX #15000
 LD= DM5000 #1
 MOV.D #150000 CM2028
 CHGSPX #25000
 LD= DM5000 #2
 CHGSPX #20000
 LD CR2002
 INC DM5000
 RETI
 ENDH
```



TIP For details about time for changing speed, see "Change speed during operation", Page 2-201.

● Use operating speed change request relay CR3012 (X axis) and CR3112 (Y axis)



Select speed control through parameter setup, and set starting speed, acceleration time and operating speed from point No.0.

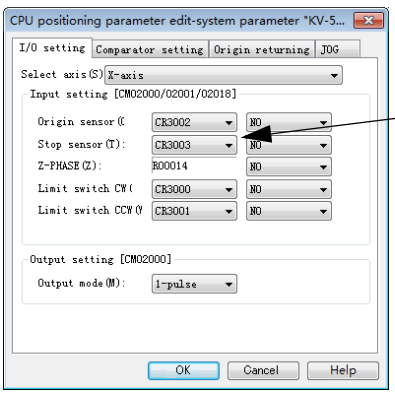
Acceleration determined by this setting is also applicable to acceleration when speed change request is sent out.

Set to speed control when stop sensor is used.

Set specified number of pulses for stop sensor.

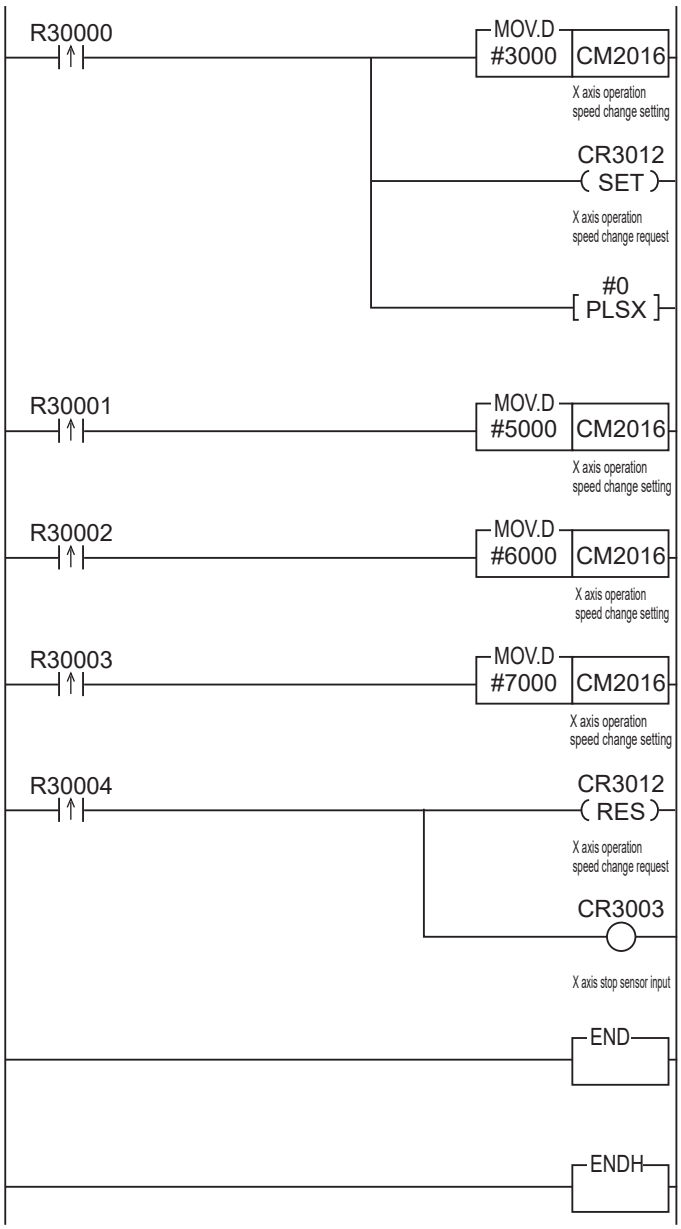
65535 means deceleration stopping.

For specified number of pulses for stop sensor 65535, see "Specified number of pulses for stop sensor", Page 2-182

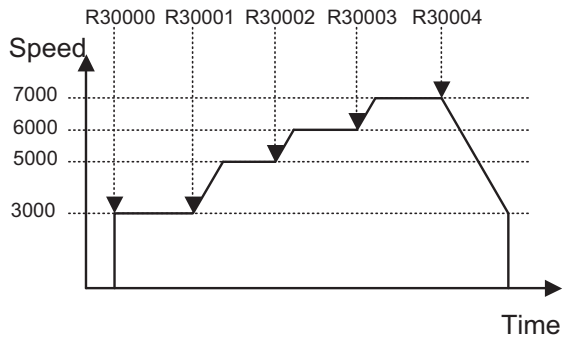


Set up CR3003 by setting up stop sensor.

On the up edge of relay R30000, speed change request relay is ON. Write setpoint "3000" in CM2016 and CM2017 (speed change setting), through PLSX instruction, start pulse output.
On the up edge of relay R30001, write setpoint "5000" in CM2016 and CM2017 (speed change setting).
On the up edge of relay R30002, write setpoint "6000" in CM2016 and CM2017 (speed change setting).
On the up edge of relay R30003, write setpoint "7000" in CM2016 and CM2017 (speed change setting).
On the up edge of relay R30004, speed change request relay is OFF. Stop sensor input CR3003 is ON, decelerate to stop.



(mnemonics list)
LDP R30000
MOV.D #3000 CM2016
SET CR3012
PLSX #0
LDP R30001
MOV.D #5000 CM2016
LDP R30002
MOV.D #6000 CM2016
LDP R30003
MOV.D #7000 CM2016
LDP R30004
RES CR3012
OUT CR3003



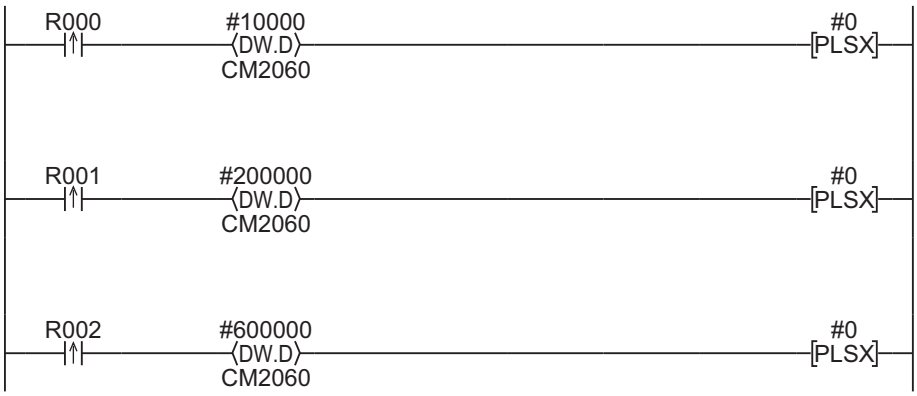
TIP For details about time for changing speed, see "Change speed during operation", Page 2-201.

■ Reference example for executing positioning control over 32 points

Since target value/movement of each point is stored in CM, therefore, multipoint positioning may be carried out by rewriting control memory (CM) content in ladder diagram circuit.

For example, target value of point No.0 may be changed by rewriting target value/movement (CM2060/CM2061) content.

Example



"Point parameters", Page 2-177

List of Devices/error Codes for Positioning

■ Control relays list

X axis	Y axis	Content		Attribute R: Read only Blank: R/W
CR3000	CR3100	CW limit switch	Set whether to use through parameter	
CR3001	CR3101	CCW limit switch	Set whether to use through parameter	
CR3002	CR3102	Origin sensor input	Set whether to use through parameter	
CR3003	CR3103	Stop sensor input	Set whether to use through parameter	
CR3004	CR3104	Origin return in progress		R
CR3005	CR3105	Origin return complete	ON when origin return is finished; OFF at next pulse output	
CR3006	CR3106	Positioning complete relay	ON when origin return or positioning is finished; OFF at next pulse output	
CR3007	CR3107	Error/error clear		
CR3008	CR3108	Warning/clear warning	Current position overflow	
CR3009	CR3109	Pulse output in progress/ emergency stop	Emergency stop by forced reset	
CR3010	CR3110	Drive operation start	Pulse output is started. Used for CM2025 and CM2055	
CR3011	CR3111	Current value change request	Used for changing current value (used when pulse is stopped)	
CR3012	CR3112	Operating speed change request	Used for changing speed (in the case of speed control)	
CR3013	CR3113	Interrupt when comparator 2 (interrupt specificl) matches	Only used as a symbol for ladder programing, thus will not be ON/ OFF	

■ Control memory list

● System parameter

	X axis	Y axis	Content		Number of words	Attribute R: Read only Blank: R/W
	CM2000	CM2030	I/O setting*1	Assignment of origin/stop sensor operation setting when sensor detection and comparator are consistent Set up output mode (single pulse/ double-pulse)	1	
	CM2001	CM2031	Sensor enable*2	Enable specifying for origin sensor/ stop sensor/limit switch Polarity specifying for origin sensor/ stop sensor/limit switch	1	
	CM2002 CM2003	CM2032 CM2033	Current value Comparator 0	Use comparator soft limit switch and stop sensor function setting	2	
	CM2004 CM2005	CM2034 CM2035	Current value Comparator 1		2	
	CM2006	CM2036	Origin return	Set up starting speed	1	
	CM2007	CM2037		Set up acceleration/deceleration time	1	
	CM2008 CM2009	CM2038 CM2039		Set up operating speed	2	
	CM2010	CM2040	Operation JOG	Set up starting speed	1	
	CM2011	CM2041		Set up acceleration/deceleration time	1	
	CM2012 CM2013	CM2042 CM2043		Set up operating speed	2	
	CM2014 CM2015	CM2044 CM2045	Current value change setting value X axis : changed through CR3011; Y axis: changed through CR311		2	
	CM2016 CM2017	CM2046 CM2047	Operating speed change setting value X axis: changed through CR3012; Y axis: changed through CR3112		2	
	CM2018	CM2048	I/O and origin return detailed setting*1	Origin return detailed setting I/O detailed setting	1	
	CM2026 CM2027	CM2056 CM2057	Home position coordinate		2	
	CM2028 CM2029	CM2058 CM2059	Current value comparator 2	Used to use setting of comparator interrupt	2	

*1 I/O detailed setting

In CM2000/CM2018 (X axis) and CM2030/CM2048 (Y axis), store relationship of between R000-R007 origin sensor, stop sensor, limit switch.

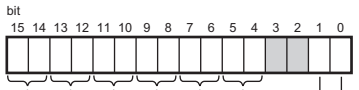
In addition, also store pulse output mode, operation mode when comparator is matched, detection method of origin return starting direction and stop position, deviation counter clear, automatic movement relationship of home position.

For KV STUDIO, when setting up parameters, it is unnecessary to pay attention to these information in ladder diagram.

*2 Sensor enable details

CM2001 (X axis), CM2031 (Y axis) store origin sensor, stop sensor, limit switch input polarity and enable setting.

When using KV STUDIO to set up parameters, it is unnecessary to pay attention to these information in ladder diagram.



CM2000 (X axis) CM2030 (Y axis)

bit0	Output format selection
0	1-pulse output
1	2-pulse output

bit1	Origin Return direction
0	CCW
1	CW

bit5	bit4	Operation at current position comparator 0 matching
0	0	Not used
0	1	Use as stop sensor
1	0	Used as limit switch of CW direction
1	1	Used as limit switch of CCW direction

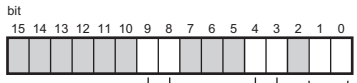
bit7	bit6	Operation at current position comparator 1 matching
0	0	Not used
0	1	Use as stop sensor
1	0	Used as limit switch of CW direction
1	1	Used as limit switch of CCW direction

bit9	bit8	Input setting of R000
0	0	Not used as stop/origin sensor
0	1	Use as stop sensor input
1	0	Use as origin sensor input
1	1	Setting inhibited

bit11	bit10	Input setting of R001
0	0	Not used as stop/origin sensor
0	1	Use as stop sensor input
1	0	Use as origin sensor input
1	1	Setting inhibited

bit13	bit12	Input setting of R002
0	0	Not used as stop/origin sensor
0	1	Use as stop sensor input
1	0	Use as origin sensor input
1	1	Setting inhibited

bit15	bit14	Input setting of R003
0	0	Not used as stop/origin sensor
0	1	Use as stop sensor input
1	0	Use as origin sensor input
1	1	Setting inhibited



CM2018 (X axis) CM2048 (Y axis)

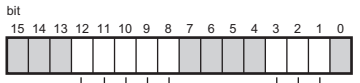
bit1	bit0	How to Detect Origin Stop Position
0	0	Ring edge of the origin sensor
0	1	Medium point of the origin sensor
1	0	Origin sensor and Z phase
1	1	Setting inhibited

bit3	Clearing deviation counter
0	No output
1	Output

bit4	Moving to initial position automatically
0	Not move
1	Move

bit8	Limit switch CW
0	Not used
1	Use

bit9	Limit switch CCW
0	Not used
1	Use



CM2001(X axis) CM2031(Y axis)

bit1	Stop sensor enable
0	Disable
1	Enable

bit2	Limit switch of CW direction enable*1
0	Disable
1	Enable

bit3	Limit switch of CCW direction enable*1
0	Disable
1	Enable

bit8	Origin sensor polarity
0	N.O. (normally open: A contact)
1	N.C. (normally closed: B contact)

bit9	Stop sensor polarity
0	N.O. (normally open: A contact)
1	N.C. (normally closed: B contact)

bit10	Limit switch polarity of CW direction
0	N.O. (normally open: A contact)
1	N.C. (normally closed: B contact)

bit11	Limit switch polarity of CCW direction
0	N.O. (normally open: A contact)
1	N.C. (normally closed: B contact)

bit12	Z phase polarity
0	N.O. (normally open: A contact)
1	N.C. (normally closed: B contact)

*1 CW limit switch enabled/CCW limit switch enabled
If it is not set to "1" (enabled), limit switch input will not be accepted.
This setting has higher priority than any other setting related to limit switch, even if it is not assigned to limit switch through setting current position comparator, it is necessary to set this bit to "1" (enabled).
When setting parameters in KV STUDIO, automatically change to "enabled".

● State

	X axis	Y axis	Content	Number of words	Attribute R: Read only Blank: R/W
	CM2019	CM2049	Current operation point No.(M code)	1	R
	CM2020 CM2021	CM2050 CM2051	Current position *Can be changed through current value change request	2	
	CM2022 CM2023	CM2052 CM2053	Current speed	2	
	CM2024	CM2054	Error code	1	
	CM2025	CM2055	Specified point No. Specified point No. (for TCHX/TCHY instruction: X axis: CR3010, Y axis: CR3110)	1	

● Point parameter

Serial No.	Common to X/Y axis	Content	Number of words	Attribute R: Read only Blank: R/W
0	CM2060 CM2061	Target value/movement	2	
	CM2062	Starting speed	1	
	CM2063	Acceleration/deceleration time	1	
	CM2064 CM2065	Operating speed	2	
	CM2066	Operation mode setting (ON/OFF by stop sensor)	1	
	CM2067	Specified number of pulses for stop sensor	1	
1 : 31	CM2070 to 2077 : CM2370 to 2377	Same as point parameter 0		

● Error code

	Error code (X axis: CM2024, Y axis:CM2054)	Operation	Content
Error	10	Stop	Startting speed value smaller than setting range.
	11	Stop	Operating speed value smaller than setting range.
	12	Stop	Operating speed value larger than setting range.
	13	Stop	Start speed value larger than operating value.
	14	Stop	Acceleration/deceleration time larger than setting range.
	20	Stop	Warning relay CR3008 (X axis)CR3108 (Y axis) starts from ON state to perform positioning control by ABS positioning.
	21	Stop	Through the effect of drive operation start relay CR3010 (X axis) CR3110 (Y axis), the value of CM2025 (X axis) CM2055 (Y axis) to be moved is out of range.
	30		Stops when there is emergency stop input.
	31	Stop	Limit error: stops when there is CW limit switch input.
	32	Stop	Limit error: stops when there is CCW limit switch input.
	33	Stop	Moves towards the CW (CCW) direction, and detects CCW (CW) limit switch.
	90	Stop	System error

2-15 Clock Function

KV-5500/5000/3000 can continue to count time of "year, month, day, hour, minute, second, week " through built-in clock IC backed up by battery when power is OFF.
It can be used for error /power ON/OFF log and logging/tracing function etc.
Clock accuracy under normal temperature (+25°C) is ± 60s/month.

■ Read clock data

Clock data are stored in control memory CM700 to CM706.
Time data format is as follows.

	bit 15 ... bit 0		
CM700	year	0 to 99	Year indicates the last 2 digits of solar calendar year 2000.
CM701	month	1 to 12	
CM702	day	1 to 31	
CM703	hour	0 to 23	Data are all expressed as 16-bit BIN format.
CM704	minute	0 to 59	
CM705	second	0 to 59	
CM706	week	0 to 6	Week is 0: (Sunday), 1: (Monday), 2: (Tuesday), 3: (Wednesday), 4: (Thursday), 5: (Friday),6: (Saturday).

· The data may be read directly from ladder program. (Read-only)

■ Write clock data (time setting)

● To set up in access window

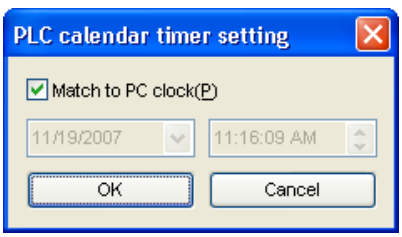
Clock data can be displayed and time can be set in access window.
"Date/Time", Page 2-21

● To set up through the ladder program

Time can be set up through WTIME instruction. In addition, 0s correction can be performed also through AJST instruction.
Please refer to KV-8000/7000/5000/3000/1000 Series PLC Instruction Reference Manual, “Time processing instructions".

● Set up through KV STUDIO

In the process of monitoring via KV STUDIO, open "Commissioning" -> "Set calendar clock" from the menu.



KV STUDIO User's Manual "Set calendar clock".

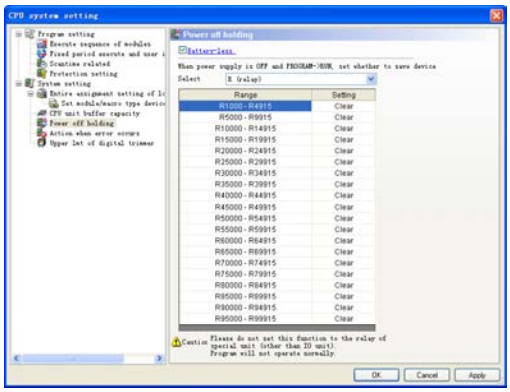
Note When Battery-less working, clock function cannot be used.

2-16 Battery-less working

If battery is not required for power off hold, KV-5500/5000/3000 Series may work without battery.

■ Setting of Battery-less working

Use KV STUDIO to set Battery-less working. Open CPU system setting from the work area, select [System Setting]▶[power off hold setting] for setting.



TIP When Battery-less working, CR2315 is ON.

Note

- **Power off hold does not work for all devices and clock function (built-in clock IC). Initialization will be performed when powered on.**
- **The clock cannot be initialized when power is turned, its value is not a constant one. So please do not refer it. Suppress it to prevent the "85: RTC Voltage Drop" error.**
- **When rewrite timer/counter set value via touch panel and other external equipment, change expansion unit setting in the access window, set IP address via BOOTP, if power supply is cut off, the set value will be restored to the state of transmitting program to CPU unit. After change the set value, please reset as required.**
- **If power supply is cut off in the program transmission process, when powered on again, the program might be lost. Here, it should be removed from the access window completely.**

Note

- **In case of power off, CPU built-in positioning parameters will be eliminated. When CPU built-in positioning function is used, please prepare a ladder diagram program for setting positioning parameters when powered on.**
- **History record of error etc is not saved. If saving is required, please use KV STUDIO to read error content and save it before power off.**
  KV STUDIO User Manual “Error monitor window”
- **For KV-5500/5000/LE21V/EP21V/LE20V, history record of the following functions will not be generated.**
  - **Mail sending/receiving**
  - **FTP client-side function**
  - **Backup sensor setting**
  - **Sensor is set to transfer in batch**
- **Because CR, CM does not support power off hold, so please do not use the following functions involving CM.**

  (1) CM selection under KV-BT1 "Identification Name Selection"
  "Identification name", Page 1-68

  (2) Loading destination folder selection for automatic loading function
  "Auto Load Function", Page 2-57

  (3) Access window initial menu display function
  "Access window initial menu display function", Page 2-39

MEMO

3

LADDER PROGRAMMING

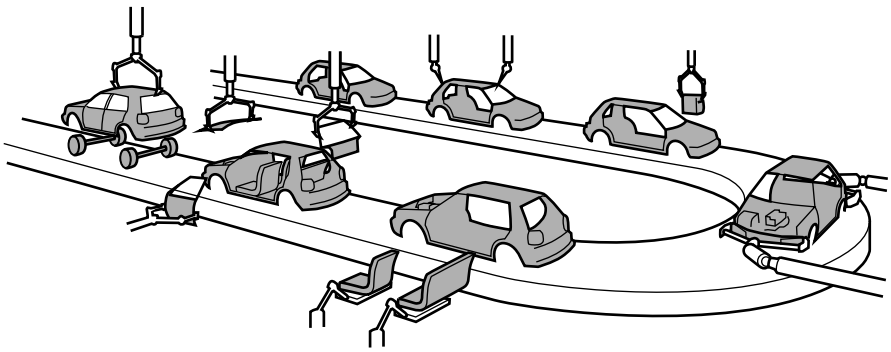
In this chapter, the specifyings or setups for ladder programming will be introduced. If module, macro, local device are used, programming efficiency may be improved.

3-1 What Is Sequence Control ••••••••••••••••••••••••••••••••••3-2
3-2 Programming Language ••••••••••••••••••••••••••••••••••••••3-5
3-3 Project••3-9
3-4 Program Structure and Operation •••••••••••••••••••• 3-15
3-5 Interrupt •• 3-31
3-6 Device and Constant •••••••••••••••••••••••••••••••••••••• 3-52
3-7 Data Processing••• 3-86
3-8 Module •• 3-94
3-9 Macro••3-109
3-10 Local Device ••3-131
3-11 File Register••3-137
3-12 Programming Skills ••3-148

3-1 What Is Sequence Control

In vehicle assembly line as shown in the figure below, equipment actions, sequences and conditions are stored in a control unit which are executed to perform required control actions sequentially until a car is assembled. This is called sequence control.
For this, such PLCs as the KV-5500/5000/3000 Series PLC etc (Programmable Logic Controller) for sequence control.

<bodywork assembly line of vehicle factory>



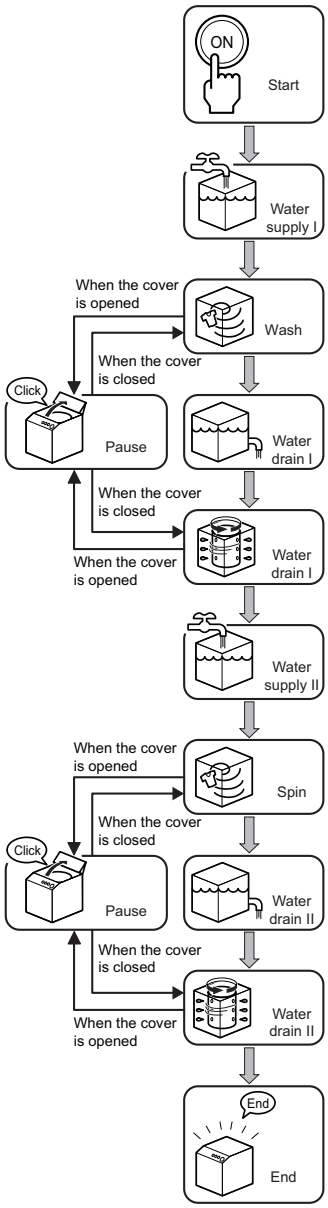
TIP ·In JIS(Japan Industrial Standards),Sequence control is defined as "control for successively advancing each step of a control procedure according to a predetermined order or an order determined according to a fixed logic"

· In PLC control, besides sequence control, feedback control is also available.
Feedback control is the process to keep the current value at expected level by cyclic sampling.
(example) temperature control, pressure control, speed control

■ Example of sequence control

Let's take fully automatic washing machine as an example.

To start the specified washing sequence, press the Start button. The washing process goes like this:



(1) Put in the clothes to be washed, and press the Start button.

(2) Press the Start button, and turn on the tap.

(3) When the specified water level is detected, the water supply motor is turned off.

(4) When the specified time has elapsed, the washing motor is stopped, and the water drain valve is opened.

(5) When completion of water drainage (water level "0") is detected, the water drain valve is closed, and the spin dry motor is started up.

(6) When it is detected that the specified time has elapsed, the motor for draining water is stopped, and the water supply valve is opened.

(7) When the specified water supply amount (water level) is detected, the water supply valve is closed, and the motor for washing is started up.

(8) When it is detected that the specified time has elapsed, the washing motor is stopped, and the water drain valve is opened.

(9) When completion of water drainage (water level "0") is detected, the water drain valve is closed, and the spin dry motor is started up.

(10) When it is detected that the specified time has elapsed, the spin dry motor is stopped indicating the washing process is completed. And the buzzer sounds.

Sequence Control Type

The basic sequence control is mainly divided into " sequence control ", " condition control " and " time limit control ". A target control circuit can be designed by combining these control types.

● Sequence Control

Sequence control is that the next action is triggered by an external signal from detector after the previous action is completed.

"the sequence control of fully automatic washing machine "

(2) water intake > "- water intake is finished> " (3) wash (start wash motor) "

"(4) drainage I"-> drainage is finished -> " (5) dehydration I (start dehydration motor) "

TIP Typical sequence control ladder instruction: STG, JMP etc.

● Condition control

Condition control means that required actions are initiated only when pre-defined conditions are met.

"condition control of fully automatic washing machine "

"(3) wash" -> if cover is opened -> "pause" -> if cover is closed -> "(3) wash"

"(5) dehydration I"-> if cover is open is close-> "pause" -> if cover is closed -> "(5) dehydration I"

TIP Typical condition control ladder diagram instruction: STP, STE, CJ, NCJ, LABEL etc.

● Time Limit Control

Time limit control means that after the specified time is elapsed, the next specified action starts.

"time limit control of fully automatic washing machine"

"(3) wash "-> detect specified duration -> "(4) drainage I"

"(5) dehydration I" -> detect specified duration -> "(6) water intake II"

TIP Typical time limit control ladder diagram instruction: TMR, LDWK etc.

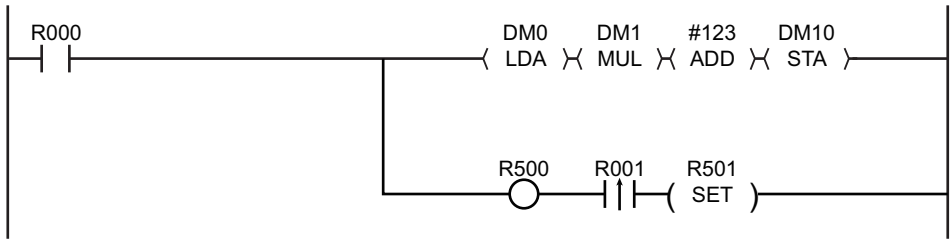
3-2 Programming Language

In KV STUDIO, the "Extended Ladder" and "KV Script" can be used for programming.
To enable the programs on KV-5500/5000/3000 PLC, the "mnemonics" will be used as operating language.

Extended Ladder

Expanded Ladder is a unique language developed by Keyence Company on the basis of normal ladders (the relay symbol-based programming language), it has the following features:

- Output instruction and input instruction may be mixed for programming
- Provide output coil branch
- A wide range of instructions can be connected



Since a set of correlated processings can be programmed in one line, the process is then simplified, thereby improving design and maintenance efficiency. Since many instructions are programmed on one line, number of lines of all ladder diagram programs may be reduced.

Note

To use the Extended Ladder, please select "Edit (e)" -> "Edit Mode (b)" -> "Extended Ladder Mode" from the menu bar of KV STUDIO.

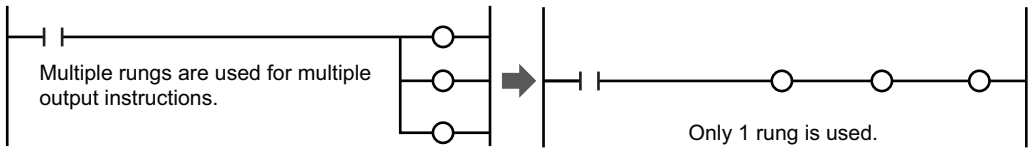
■ Features of extended Ladder

Expanded Ladder is a unique language developed by Keyence Company on the basis of normal ladders. In conventional ladders, output instructions could only be placed on right end of ladder diagram program. But in expanded ladder, it may be placed in any position except left end.

Multiple output instructions on a single rung.

<Conventional ladder program>

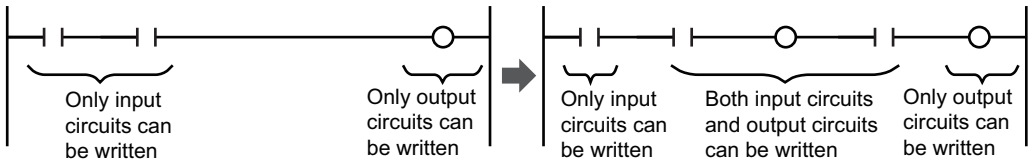
<Expanded ladder>



Mixed I/O circuit

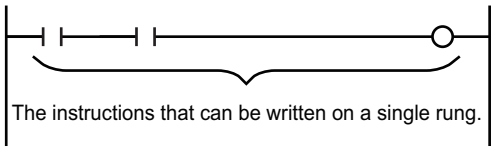
<Conventional ladder>

<Expanded ladder>

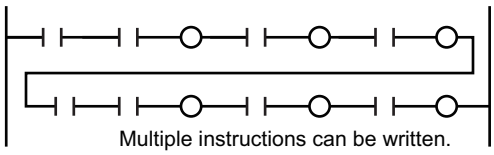


Ladder folding

<Conventional ladder>

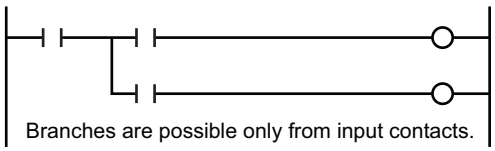


<Expanded ladder>

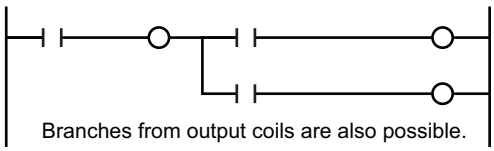


Output coil branching

<Conventional ladder>



<Expanded ladder>



Note

Block instructions are (MOV etc) always written on right side of ladder program.

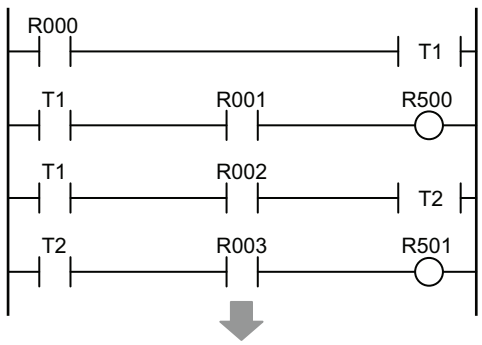
■ Benefits of Expanded Ladder Diagram

● Less rungs to be used

Output and input instructions may be mixed for programming, allowing less rungs to be used and thereby more readable.

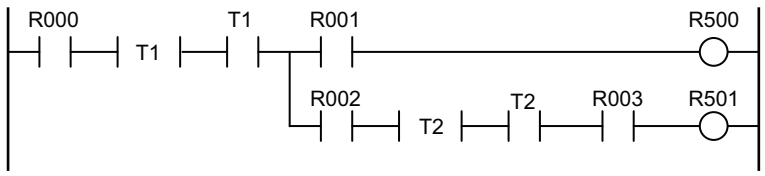
Example

<Conventional ladder>



With conventional ladder, it is difficult to tell at a glance what the operation conditions are and what the ladder would execute. Expanded ladders, however, are much easier to understand.

<Expanded ladder >



● More Readable Processing Sequence

Ladder symbols are arranged according to processing sequence making the program more readable. At the same time, also easy for maintenance.

(Example) Suppose the following elements are programmed:

Start switch (R000) is on.

↓

(1) Indicator lamp LED A (R500) lights for 3 s

(2) Indicator lamp LED B (R501) lights for 2 s

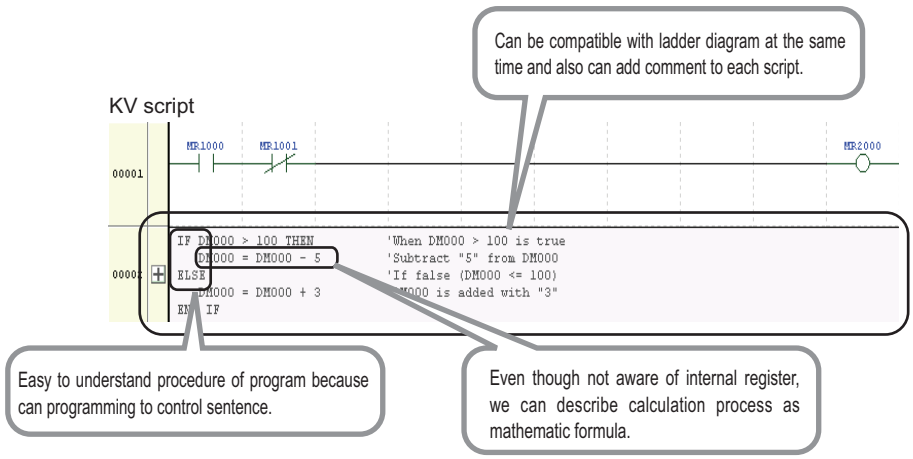
(3) Indicator lamp LED A (R500) and LED B (R501) light simultaneously for 5 s

Repeat (1) - (3).

KV Script

Although suitable for sequence control programming, processing complicated operation and character strings etc. programs remains a tough challenge for ladder programs in that, its programming becomes complicated, commissioning and maintenance also become difficult.

The programming language KV Script provides a solution to this in that it can be used as an efficient programming tool to tackle with programming tasks.



TIP Script programs are converted into ladder programs before they are executed. Script program can be monitored if they are converted into ladder programs.

KV-8000/7000/5000/3000/1000 Series Script Programming Manual

Mnemonics

Mnemonics enable written programs to run on KV-5500/5000/3000 PLC.
Extended ladder programs are converted into mnemonics for easy understanding.
The programs written with Extended Ladder are converted into mnemonics before they are transferred to KV-5500/5000/3000 PLC.
Mnemonic language table can be edited with KV STUD IO. For normal ladder programming, however, this is not required.

LD	R000
OUT	R500
LD	R002
OUT	R501
LD	R003
OUT	R502

TIP ·To edit the Mnemonic Language Table, select "Edit (E)" -> "Edit list (I)" (edit Mnemonic Language Table) from the menu.
Other procedure · Ctrl + D

·In this manual, the mnemonics table for CPU built-in functions or sample programs is provided, which, if used, will simplify sample programs entering.
"How to Use Mnemonics List", Page 17

·when expanded ladder diagram is used for programming, programming man-hour may be reduced by input instructions using mnemonic symbol.
"Mnemonics entry", Page 3-152

3-3 Project

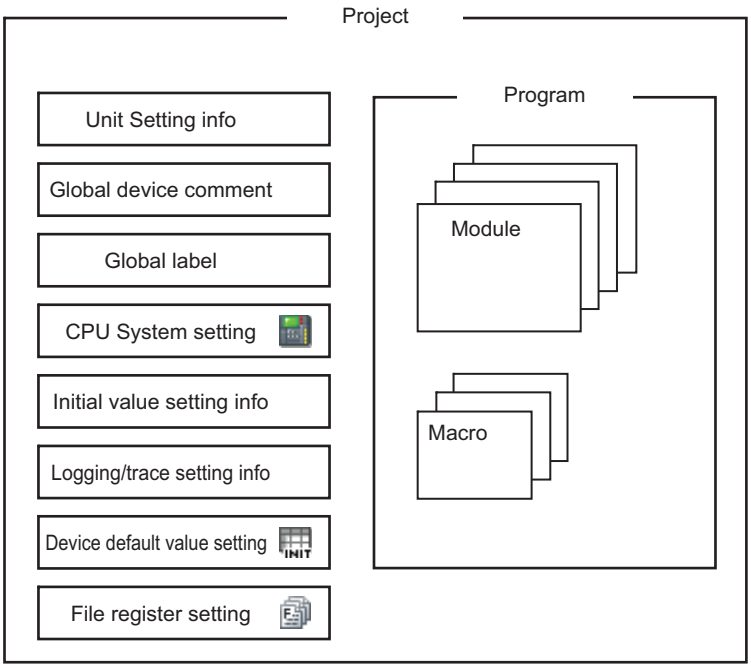
Project Configuration

■ What is project?

Project is used by KV-5500/5000/3000 PLC for management of program and unit setup information.

When KV STUDIO is used to create a new project, a folder with the same name will be generated automatically.

The information in a project is as follows:



Note

The information management capacity of one project varies depending on the information required by KV-5500/5000/3000 PLC.

● Program

A program consists of modules and macros etc.

Execute this program repeatedly to realize various controls.

"3-4 Program Structure and Operation", Page 3-15
"3-8 Module", Page 3-94
"3-9 Macro", Page 3-109

● Unit Setting info

For the management of unit configuration and setup. Please use KV STUDIO for easy setup.

Expansion Unit User's Manual
KV STUDIO User's Manual, "Chapter 3 Unit Editor"

● Global device comment

This facilitates device management by providing additional device information.

"Device Comments", Page 3-164

● Global label

Label can be used as a replacement to device names to facilitate programming.

"Label", Page 3-162

● CPU System setting

The setup items for KV-5500/5000/3000 are as follows.

Sorting	project	Description	Reference page
Program setup	Execute sequence of modules	The module scanning sequence.	"Module Execution Sequence", Page 3-102
	Fixed period execute and user interrupt	The priority setup for module fixed operation cycle and interrupt.	"Scanning Time", Page 3-22 "Interrupt Priority", Page 3-36
	Scantime related	Set up a specific scanning time and END processing time.	"Scanning Time", Page 3-22
	Protection setting	Project read/write protection	"Project Protection Setting", Page 3-13
System setup	Entire assignment setting of local devices	Local device assignment and setup of individual modules/macros.	"Local Device Assignment", Page 3-133
	CPU unit buffer capacity	The logging/tracing for the upper limit, buffer capacity.	"Trace detail setting", Page 2-70
	Set power failure holding	Whether the device status/value is retained when the power is OFF.	"Set Power Failure Holding (latching)", Page 3-57
	Action when error occurs	Set up running/stop state etc when error occurs.	"Error Handling", Page 3-19
	Upper Imt of dig trimmer	Set up the upper limit of the digital trimmer and Enable/Disable.	"Digital Trimmer", Page 2-17

● CPU positioning parameter

For CPU positioning parameter setup.

"2-12 Cam Switch", Page 2-157

● Logging/trace setting info

This is used to set up the logging/tracing feature whereby device data are stored into the Memory Card.

"2-3 Logging/Tracing", Page 2-60

● Device default value

This is used for device default value setup which is used to perform an automatic initialization on the specified device.

"Device default", Page 3-169

● File register setting

For the setup of register global replacement whereby upto 1,000 To programs in the file register can be replaced at one time.

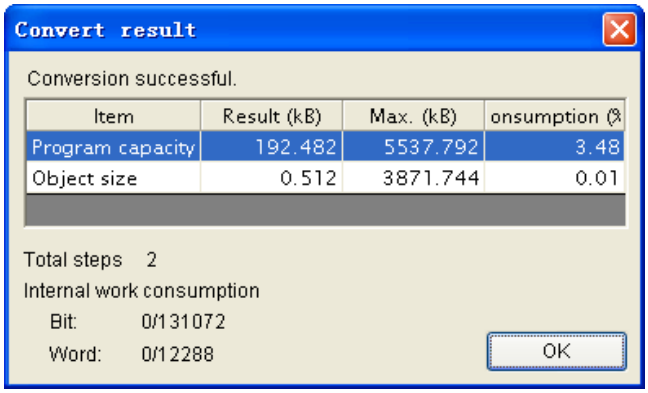
"File Register Setting", Page 3-138

Program Capacity

The max. program capacity of KV-5500/5000/3000 PLC is as follows：

- Program Capacity .... KV-5500/5000: 5500k bytes (approx. 260k steps)
  KV-3000: 2250k (approx 160k steps)
- Object Size ..... 3872k byte
- Internal Work Occupation (Bit: 131072 , Word: 12288)

Program capacity statistics are automatically calculated by KV STUDIO and displayed in the "Conversion Result" dialog box. Hence no calculation and management efforts are required.



Note

The max. capacities for Program Capacity, Object Size, and Internal Work Occupation must be exceeded. Otherwise, no transmission and operation is possible.

TIP <Program Capacity>

The bite size for each instruction is fixed. This size varies depending on operand type, instruction suffix, and indexing availability. In program capacity calculation, in addition to the total number of bytes used by all the instructions, the number of bytes used by comments, device comments, labels, device default value/unit setting information should also be added. One device comment use 40 bytes. And the size for a rung moment and label varies depending on the number of words.

In the residual program size in the 260k steps/160k steps programming with KV-5500/5000/3000, up to 96,000/30000 device comments can be managed. If the whole is used for labels, up to 137,000/44,000 labels can be managed.

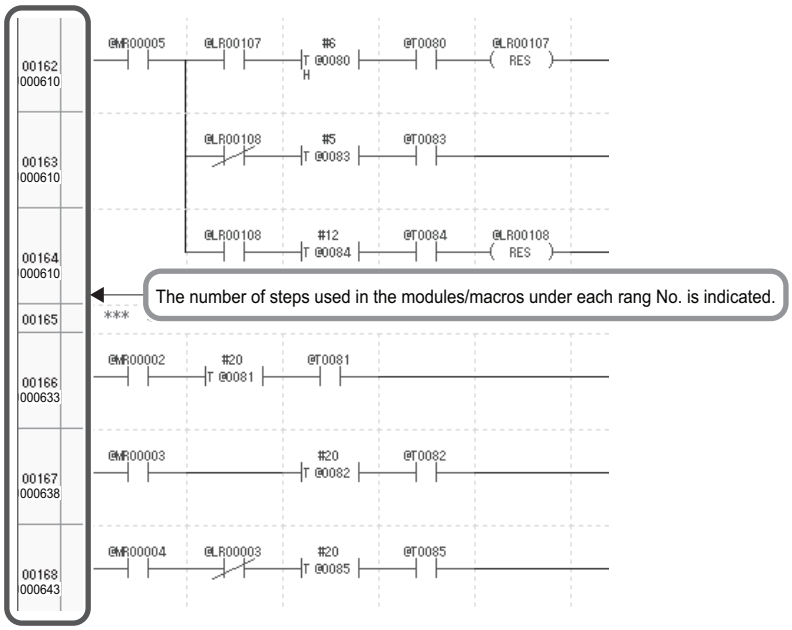
<Object Size>

Object size is the total size in data (object) format when KV-5500/5000/3000 is operating in practical. Object size varies depending on operand type and availability of instruction suffixes and indexing. The size of comment rungs and labels are not considered in the object size calculation.

<Total Step>

Total step is the total number of instructions used in a project.

After converted by KV STUDIO, it is displayed on the left of the ladder.



<Internal Work Occupation>

Refers to total internal data used, for example, in each command operand, the previous state of designated device etc.

Project Protection Setting

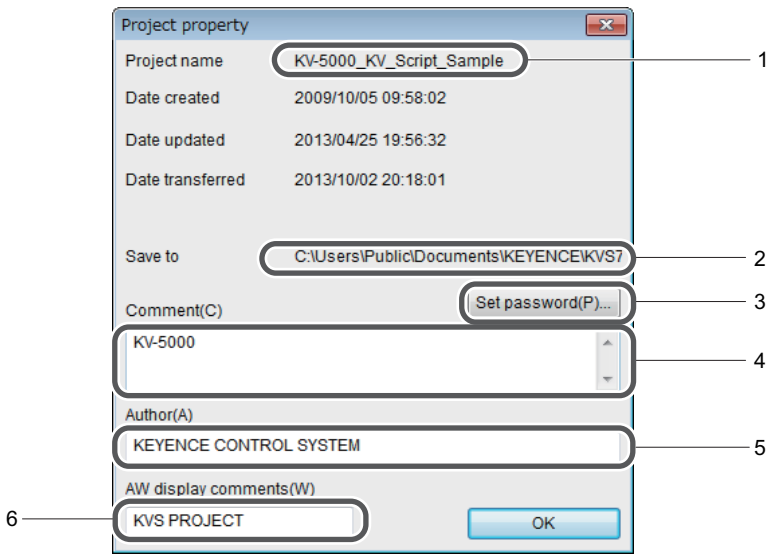
■ Project Protection

A code is set up for KV-5500/5000/3000 read/write protection.
The setup steps are as followings.

1 **Select "Workspace".**

2 **Right-click, and select "Project Properties (F)" from the pop-up menu.**

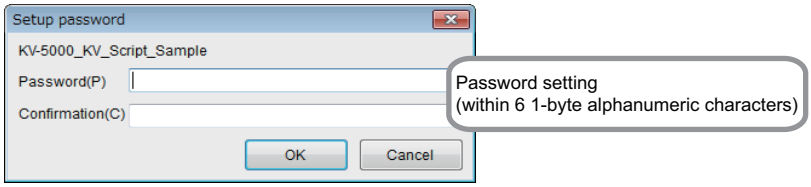
Or procedure select "File (F)" (document) -> "Project Properties (F)" from the menu,
The "Project Properties (F)" dialog box is displayed.



No.	project	Description
1	Project Name	The project name is displayed.
2	Save to	Display the directory of project folder.
3	Set Password	The "Set Password" dialog box is displayed.
4	Comment	Project comments are entered here.
5	Author	The author name is entered here.
6	AW display cmnts	The KV-5500/5000/3000 PLC access window comments are entered here. (up to 12 half-width alphanumeric characters)

3 **Press the "Set Password" button.**

The "Set Password" dialog box is displayed.



4 **Enter password, and click "OK" button.**

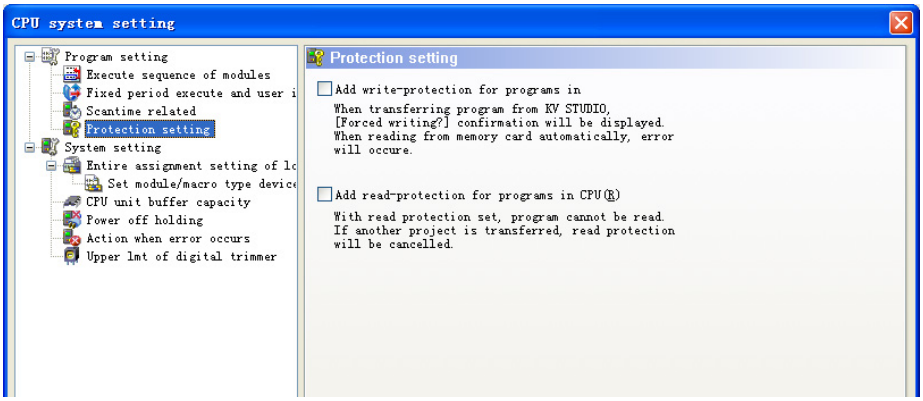
When KV-5500/5000/3000 reads the project for which the password is setup, the "Cancel Password" dialog box is displayed.

If the password is not entered, the project can not be read from KV-5500/5000/3000.

■ Project write/read protection

This is used to place write/read restrictions on KV-5500/5000/3000.

To select Project Write/Read Protection, click CPU System Setting -> Add write/read-protection for programs in CPU.



This protection is effected after you select the option and transfer the same to KV-5500/5000/3000.

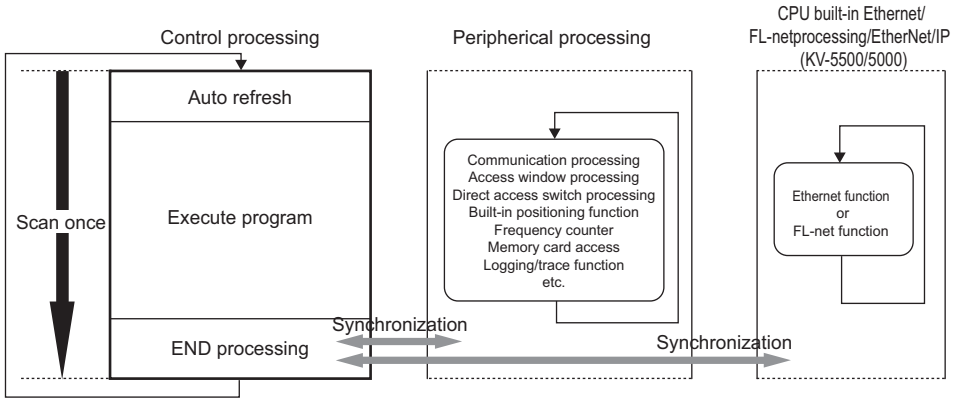
Note

If the read/write protection is applied before the project is transferred to KV-5500/5000/3000,monitoring may not be performed.

This should be done after the commissioning is completed.

CPU Unit Operation

The following sequence is performed by KV-5500/5000/3000 repeatedly:



High-speed processing is achieved through parallel execution of control processing, peripheral processing, and CPU built-in Ethernet/FL-net processing (only for KV-5000).

TIP Except the above-mentioned 3 types of processing, external input/high-speed counter comparator/fixed-period module execution-based interrupt processing is also available.

"3-5 Interrupt", Page 3-31

■ Control Processing

This involves such main processes as ladder program execution in KV-5500/5000/3000. One control processing is counted as one scan. The duration of one scan is the so-called scan time.

● Auto Refreshing

Update the state or value of device distributed to CPU built-in function or expansion unit. Firstly transfer output device state or value to the units, then transfer state or value of the units to input device.

● Program execution

In this process, the device status or values assigned to CPU built-in or external units are updated. In this process, the first step is to transfer device status or values to the units, and the second step is to transfer unit status or values to input devices.

● END Processing

In this process, the device values required for external processing or CPU built-in Ethernet/FL-net processing are fetched into the Control Processing. Also, the system error checking is performed in this process.

TIP Generally speaking, END processing time will also be determined automatically according to different program execution time. If the data traffic is heavy, however, END processing time needs to be set up..

"END Processing Time" Page 3-25

■ External Processing

In this process, other communication or management data than the program data is processed here. In addition, memory card or clock related instructions are executed also in this process. The scanning time is minimum affected by processing tasks through parallel processing.

About Direct Processing

As described above, every scanning implies one automatic processing, whereby the device values or status assigned to CPU built-in or extended units are updated. Information updating (direct processing) can be performed in the following ways in the program execution.

Note The following direct processing may be executed only when the corresponding expansion unit is connected.

■ Extended I/O Unit

● Direct I/O Relay (DR)

When an I/O relay is assigned as the operand, if "DR" rather than "R" is used for programming, the input/output is then updated during instruction execution. For the instructions that may be used by "DR", see
KV-8000/7000/5000/3000/1000 Instruction Reference Manual.

Example

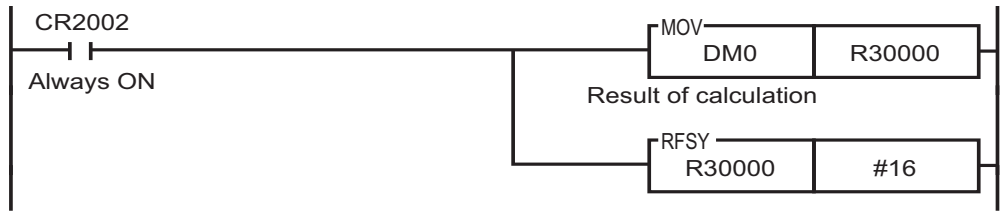


TIP For the XYM Marking, "OX" and "DR" are used.
"About XYM Marking", Page 3-54

● RFSX/RFSY Instruction

This is used for update of all the relays which are assigned as operands.

Example



see the "RFSX/RFSY Instruction " in the KV-8000/7000/5000/3000/1000 PLC Instruction Reference Manual,.

■ Special Extended Unit

With the buffer memory in each unit, unit information reading and writing can be performed any time during program execution. So does the built-in Ethernet/FL-net unit of KV-5500/5000/3000/1000.

● Unit-specific Instruction

With the unit-specific instructions, data exchanging with extended units can be performed without knowing the buffer memory address.

"Unit-specific Instruction " in the Expansion Unit User's Manual

● Buffer Memory Access Instruction (UREAD/UWRIT/UFILL)

The buffer memory read (UREAD)/write (UWRIT) instructions can be used for direct data read/write from the buffer memory.

see 🕮 the "RFSX/RFSY Instruction" in the KV-8000/7000/5000/3000/1000 PLC instruction Reference Manual
The List of Buffer Memories in the Expansion Unit User's Manual

■ CPU Internal Features

Like Extended I/O, the CPU built-in I/O can be used directly.

In addition, there are also specific instructions that can be used to update the High-speed Counter, Positioning Current Coordinate, and Free Run Counter current values.

🕮 High -speed Counter Current Value Update....."RFSCTH", Page 2-136
Current Positioning Coordinate Update ..... RFSPSX/RFSPSY, Page 2-216
Free Run Counter Current Value Update..... The "RFSFRC Instruction" in the KV-8000/7000/5000/3000/1000 Series Instruction Reference Manual

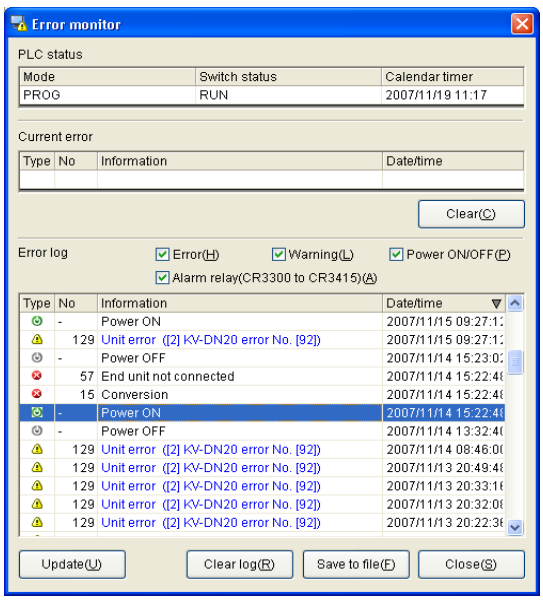
Power ON/OFF Operation

The following items are checked when the power is turned to ON. If everything is OK, the operation continues.

- Hardware checking and initialization
- Backup battery voltage checking
- Memory and device checking and initialization 🕮 "Set Power Failure Holding (latching)", Page 3-57
- Expansion bus checking and initialization
- Auto-load processing 🕮 "Auto Load Function", Page 2-57
- Ladder program checking and execution preparation

■ Power ON/OFF Log

Up to 20 power on/OFF logs can be retained. These logs are stored in the Control Memory (CM). The newer the log, the smaller the log number. When more logs need to be stored, the oldest log is the first to be deleted. In addition, this can be confirmed with the "Error Monitor" option.



● Power ON Log

Control Memory	Description	
CM1900	Power-on log, 1 (new)	Year and month (decimal numbers, the left 2 digits represent month, the third represents year. example: 706 -> June, 2007)
CM1901		day
CM1902		hour(0 to 23)
CM1903		minute
CM1904		second
:	:	
:	:	
CM1995	Power-off log, 20 (old)	Year month (decimal numbers, the left 2 digits represent month, the third represents year. example: 706->June, 2007)
CM1996		day
CM1997,,		hour(0 to 23)
CM1998		minute
CM1999		second

● Power OFF log

control memory	Explanation	
CM5000	Power-off log, 1 (new)	Year and month (decimal numbers, the left 2 digits represent month, the third represents year. example: 706 -> June, 2007)
CM5001		day
CM5002		hour(0 to 23)
CM5003		minute
CM5004		second
:	:	
:	:	
CM5095	Power-off log, 20 (old)	Year and month (decimal numbers, the left 2 digits represent month, the third represents year. example: 706 -> June, 2007)
CM5096		day
CM5097		hour(0 to 23)
CM5098		minute
CM5099		second

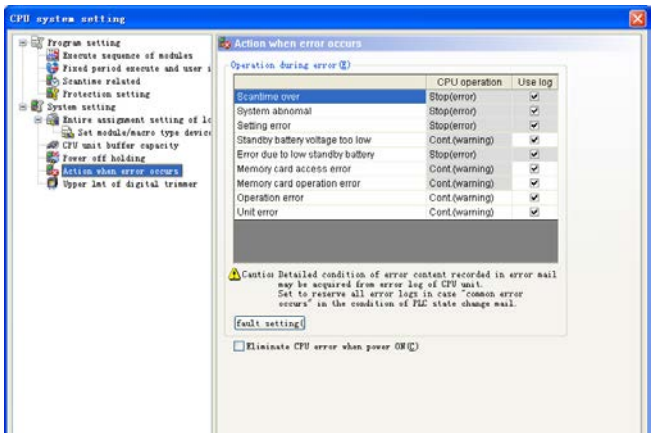
Error Handling

Error may be divided into error which implies a serious error and alarm which implies a slight error.

For error details of KV-5500/5000/3000, please see "A-1 PLC unit Error List", Page A-2
For error details of the expansion unit, see the user manuals of individual expansion units.

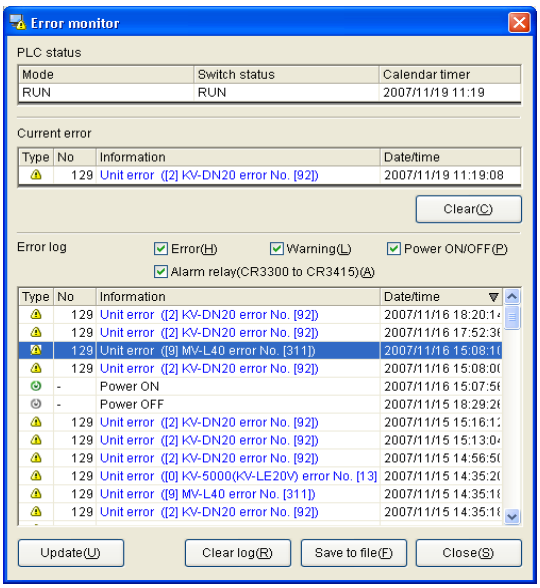
■ Action when error occurs

From the KV STUDIO work space, Open "CPU System Settings" , and Action when error occur."



■ Error Log

Up to 20 error logs can be saved. Logs are saved in the Control Memory (CM). The newer the log, the smaller the log number. In case 20 logs are exceeded, the oldest log is the first to be deleted. In addition, the "Error monitor window" can be used for confirmation.



● Error Log (CM)

An Error will be logged in the control memory.

Control Memory	Description	
CM1800	Error log, 1 (new)	Year and month (decimal numbers, the left 2 digits represent month, the third represents year. example: 706 -> June, 2007)
CM1801		day
CM1802		hour(0 to 23)
CM1803		minute
CM1804		error No.
⋮ ⋮	⋮	⋮
CM3915	Error log 20 (old)	Year and month (decimal numbers, the left 2 digits represent month, the third represents year. example: 706 -> June, 2007)
CM1896		day
CM1897,		hour(0 to 23)
CM1898		minute
CM1899		error No.

TIP You can also view and clear errors from the access window of the CPU unit.

"Error Clearing", Page 2-15

● Latest Error Description (CM)

Latest error details are logged in the Control Memory.

Control Memory	Description	
CM5100	Latest serious error detail information 1 unit	Year and month (decimal numbers, the left 2 digits represent month, the third represents year. example: 706 -> June, 2007)
CM5101		day
CM5102		hour
CM5103		minute
CM5104		second
CM5105		Error No.
CM5106		Counts of Extended Information codes
CM5107		Extended Information 1*
CM5108		Extended Information 2*
⋮ ⋮		⋮ ⋮
CM5126		Extended Information 20*
CM5150	Latest general error detail information 1 unit	Year and month (decimal numbers, the left 2 digits represent month, the third represents year. example: 706 -> June, 2007)
CM5151		day
CM5152		HH
CM5153		minute
CM5154		second
CM5155		Error No.
CM5156		Counts of Extended Information codes
CM5157		Extended Information 1*
CM51858		Extended Information 2*
⋮ ⋮		⋮ ⋮
CM5176		Extended Information 20*

According to different error No. expand information as follows.

· When No.128 (calculation error)

Detailed information n	Description
Detailed information 1	Error description 0 (unused) 1 Incorrect indirect specifying 2 Indirect specifying destination is T/C 3 Incorrect simple indirect specifying 4 Beyond operand range 5 Decimal real number overflow 6 Incorrect device specifying 7 The function of ROOT instruction is negative 8 The bit for the ENCO instruction ON is unavailabe 9 Decimal real number format exception 10 Incorrect argument for triangle function 11 Unconvertible data 12 Incorrect table specifying 13 Incorrect argument for the time comparison instruction 14 Incorrect cam switch operand 15 Incorrect argument for the frequency counter instruction 16 divided by 0 17 Incorrect To program ID 18 Direct Processing error 19 Unit that cannot be processed directly 20 Jump destination subroutine does not exist 21 Instruction cannot be executed in RUN or writing 22 Expansion unit-specific instruction destination error (unit No.) 23 Reserved for system 24 PIDAT operation setting out-of-range 25 PIDAT sampling period out-of-range 26 PIDAT constant of proportionality out-of-range 27 PIDAT integral constant out-of-range 28 PIDAT differential constant out-of-range 29 PIDAT constant of proportionality two degree freedom parameters are out of scope 30 PIDAT integral constant two degree freedom parameters are out of scope 31 PIDAT differential constant two degree freedom parameters are out of scope 32 PIDAT operation quantity upper limit value/lower limit value out-of-range 33 PIDAT operation quantity change amplitude critical value is out of scope 34 PIDAT measured value change amplitude is out of scope 35 PIDAT AT state transition exception 36 PIDAT operational control mark is out of scope 37 PIDAT operation period is out of scope 38 PIDAT AT adjusting parameters are out of scope 39 PIDAT AT lagging is out of scope 40 PIDAT AT timeout value is out of scope 41 PIDAT AT calculation control mode setting is out of range 42 PIDAT AT timeout 43 PIDAT AT constant of proportionality is out of scope 44 PIDAT AT integral constant is out of scope 45 PIDAT AT differential constant is out of scope 46 Root of negative number cannot be calculated 47 Independent variable of ABS command is incorrect 48 Operation overflow

Detailed information n	Description
Extended Information 2	00H fixed
Extended Information 3	The high bit of the erroneous step number
Extended Information 4	The low bit of the erroneous step number
Extended Information 5 to 20	The module name is saved as SJIS.(other part is 00H)

· No.50,53,55,56,58,59 (unit ID related error)

Detailed information n	Description
Detailed Information 1	Unit No.(according to specific errors. If unit No. cannot be determined, do not save.)
Detailed Information 2 to 20	00H fixed

· No.54 (unit counting related errors)

Detailed information n	Description
Detailed Information 1	Quantity of unit in the unit setup information
Detailed Information 2	Quantity of actually connected unit
Detailed Information 3 to 20	00H fixed

· No.129 (unit error)

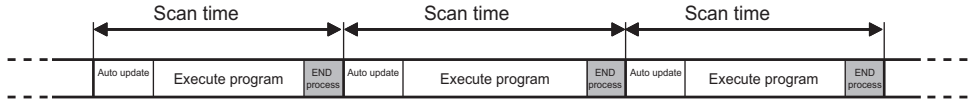
Detailed information n	Description
Detailed Information 1	Number of units
Detailed Information 2	Number of actual units
Detailed Information 3 to 20	00H fixed

· Other error No.

Detailed information n	Description
Detailed Information 1 to 20	00H fixed

Scanning Time

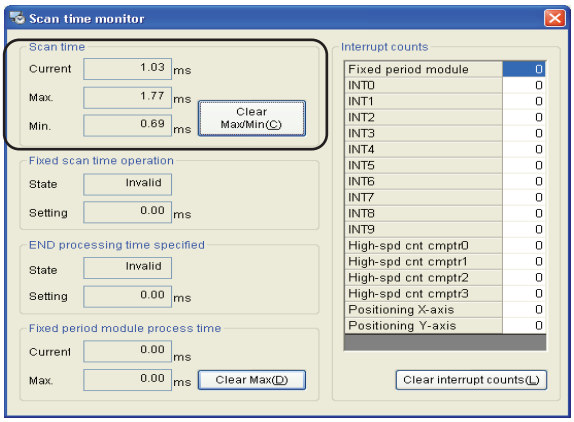
The time required to execute a processing period (automatic update -> program execution -> end processing) is called scanning time. scanning time varies depending on the program size and instruction type.



Note

In addition, when scanning time exceeds 300ms, "scan timeout may occur (CPU error No.30)" will occur, it cannot continue to run. (Changed to the PROG mode)

TIP · To verify the actual scanning time, please select When execute monitoring process via KV STUDIO, confirm measured value of scanning time in the menu "Monitor" ▶ "Scan time monitor".

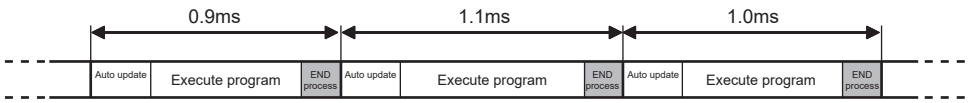


- The actual scanning time can be verified via CM720 (10μs).
  "A" in the Appendix-2 CR/CM List, Page 7.

Fixed Scan Time (FST) Operation

Scan time varies depending on the executing state or processing content, interrupt processing of every module during execution of common program.
The scan time can be fixed if required.

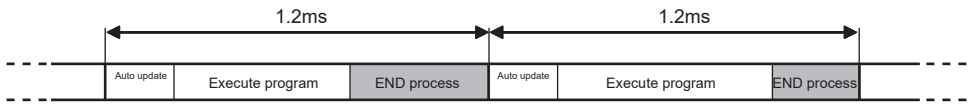
● When the scan time is variable (normal)



Scan time varies depending on the instruction execution state.

● When scan time is fixed

(Example) When the scan time is set to "1.2ms"



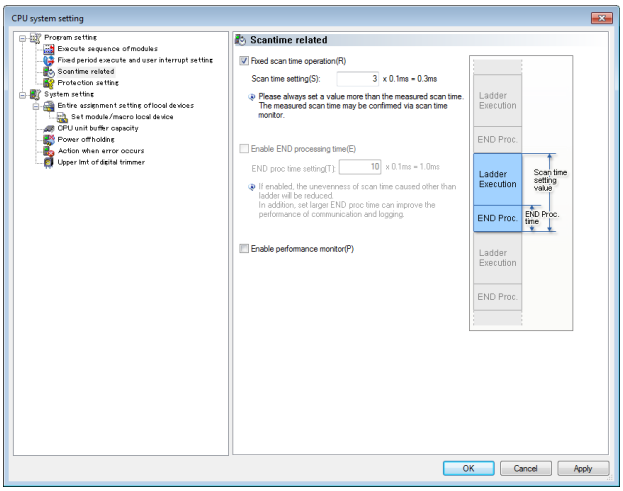
In this mode, only the specified time elapsed could the next period start, even if all the processing activities are completed in the period before the specified time elapsed.

Note

- When the scan time is longer than specified time, the scan time will be extended.
  Please always measure the program execution time before you specified the scan time.
- In case an interrupt occurs during the rest time prior to the next period, this interrupt processing will be prioritized. (only when interrupt is enabled)
  Even if the specified scan time elapsed during execution of the interrupt program, the next scan period will not be started until the interrupt program is completed.

■ Fixed Scan Time Operation Setting

From the work space, open the CPU System Settings, and select "System Settings" -> "Scantime related".



And the setting range is "0.3ms to 200ms".

Note

Please set a value larger than the actual scan time.

TIP

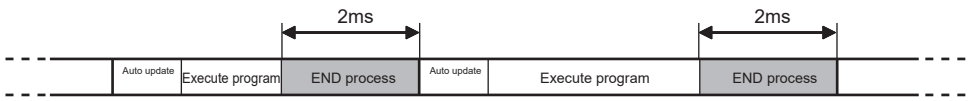
- The measured value of scan time can be confirmed via CM720 (10μs).
  "A" in the Appendix-2 CR/CM List, Page 7.
- When the specified scanning time is exceeded, CR2304 is in the ON state only during one-time scanning.

Enable END proceeding time

Scan time varies depending on the executing state or processing content, interrupt processing of every module during execution of common program.
After the END processing time is set up, a specific END processing time will be included in each time of scan. And this setting is also required when the communication data traffic is heavy and the scan time is too long such that Fixed scan time operation cannot be performed.

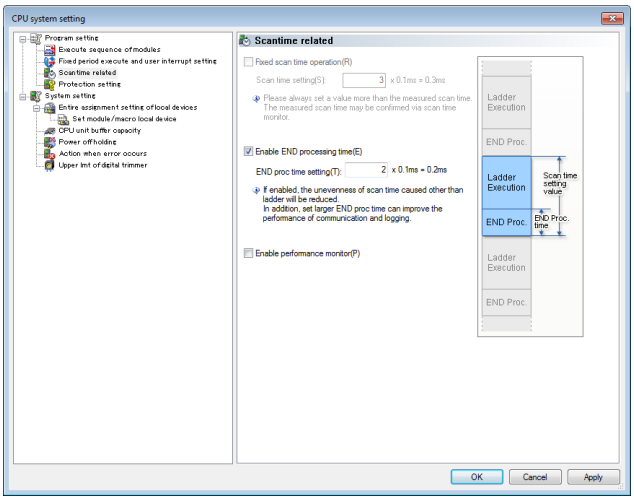
● Enable END proceeding time setting

Example) When this time is set to "1.2ms"



■ Enable END proceeding time

From the work space, open the CPU System Settings, and select "System Settings" -> "Scantime related".

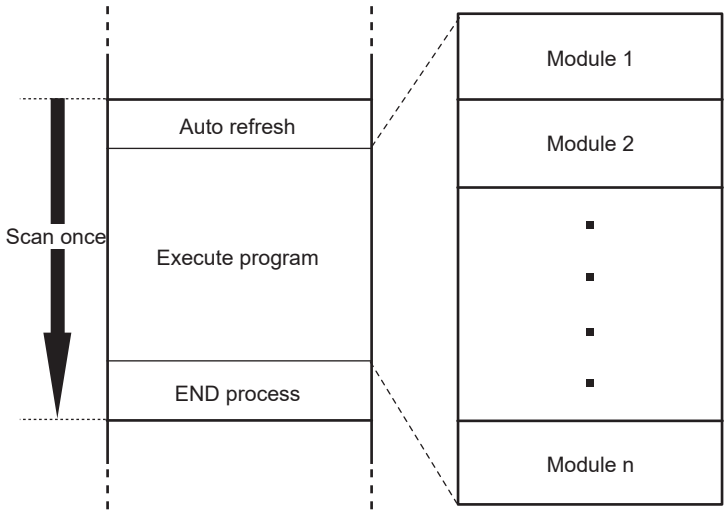


And the setting range is "0ms to 200ms".

TIP END processing time measured value can be confirmed via CM723 (10μs unit)
"A" in the Appendix-2 CR/CM List, Page 7.

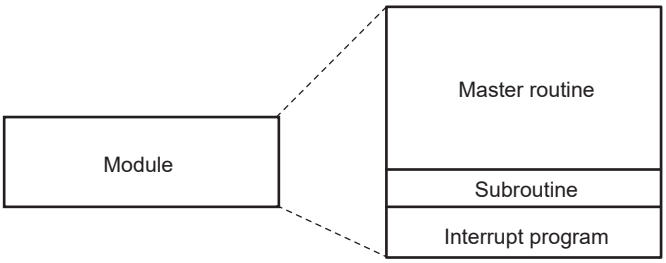
Program Configuration

In one-time scanning, the program will be executed according to the pre-defined sequence. The master program in each module will be executed step by step.



"3-8 Module", Page 3-94

In the module, master routine, sub-routine, and interrupt routine can be written respectively.

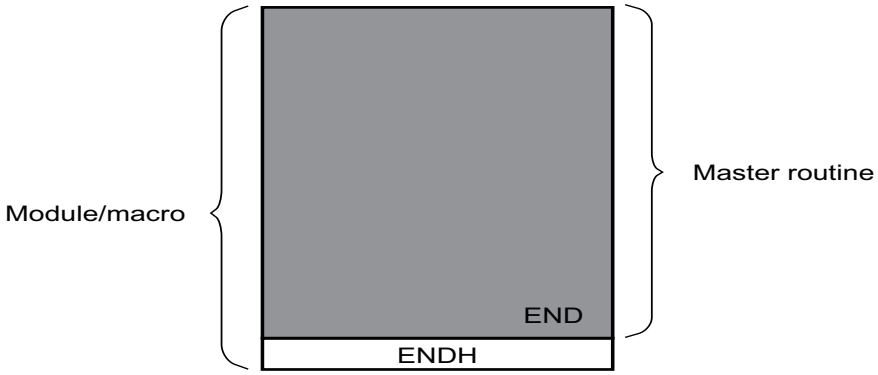


TIP Although macros may be called from the module, macros consists of master routines and sub-routines. Interrupt routine cannot be prepared.

"3-9 Macro", Page 3-109

■ Master **Routine**

The portion from the module or macro start to the END instruction is called Master Routine.
If there is no sub-routine or interrupt routine, the ENDH instruction should then be written behind END instruction.



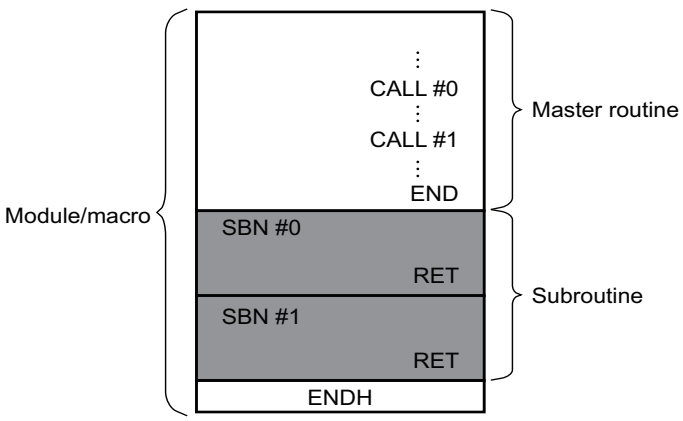
Note If there is no END/ENDH instruction in the program, an error may occur during conversion.

TIP The END/ ENDH instruction will be inserted automatically when creating a new unit and macro, therefore please do not delete.

■ Subroutine

Sub-routine is a routine to be executed via the CALL subroutine call/ECALL inter-module subroutine call instruction. If the execution condition of the CALL instruction is ON, the subroutine is then executed.
If the same processing needs to be repeatedly performed in the routine, or if you want to execute routine only when the pre-defined condition is met, the routine can then be written into a subroutine and executed if required.
Up to 100 subprograms can be written between END - ENDH instructions (0 to 99).
Subroutine is started by the SBN instruction, and ended by the RET instruction.
In the same module or macro, several subroutines should not share the same No. Several CALL instructions for the same subroutine No. may be programmed in the master routine.

"RFSX/RFSY Instruction" in the KV-8000/7000/5000/3000/1000 PLC instruction Reference Manual.



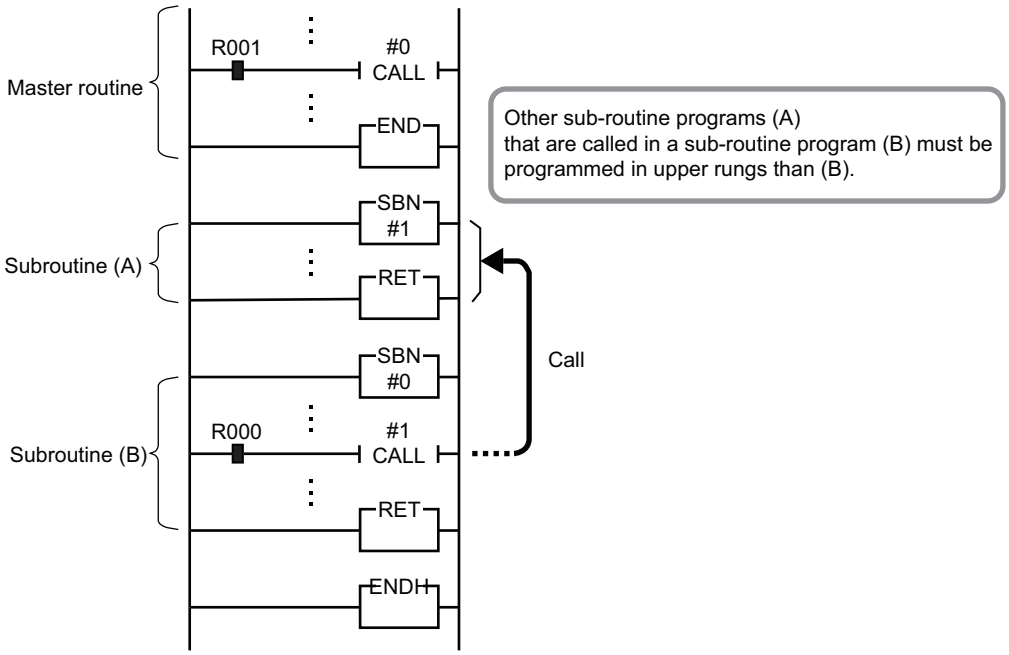
Note

- If the SBN instruction corresponding to CALL instruction does not exist, an error will occur during conversion.
- If the SBN instruction corresponding ECALL instruction does not exist, an error will occur during conversion.
- The INT/RETI/STG/JMP/ENDS instructions cannot be used in a subroutine.
- Attention should be made when using differential execution instruction, timer instruction, and macro instruction in subroutine.

"Precautions for Differential Execution Type Instruction" in the "KV-8000/7000/5000/3000/1000 Series instruction Reference Manual
"Precautions when using a timer instruction", Page 3-63
"Macro instruction", Page 3-122

TIP

- Up to 16 levels of nesting can be made during subroutine nesting through the CALL/ECALL instruction.
  - Although a subroutine could call itself (recursion call), "CALL nesting (CPU self error No.10)" may occur if more than 16 layers are nested.



- To execute a subroutine in another module, please use the ECALL instruction.

KV-8000/7000/5000/3000/1000 Series Instruction Reference Manual

- To assign and call processing destination device or value, please use the macro.

"Difference Between Macro and Subroutine", Page 3-126

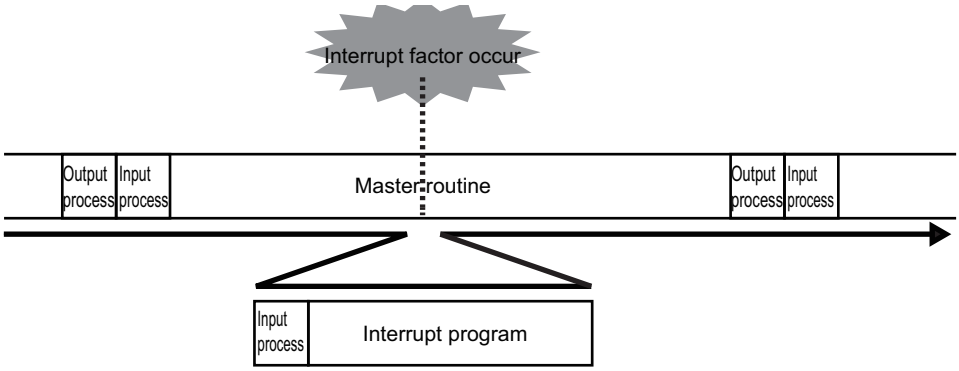
■ Interrupt Routine

Once the interrupt condition is met, the master routine processing is terminated and the interrupt routine is executed. After the interrupt processing is completed, the master routine processing continues from where it was broken.

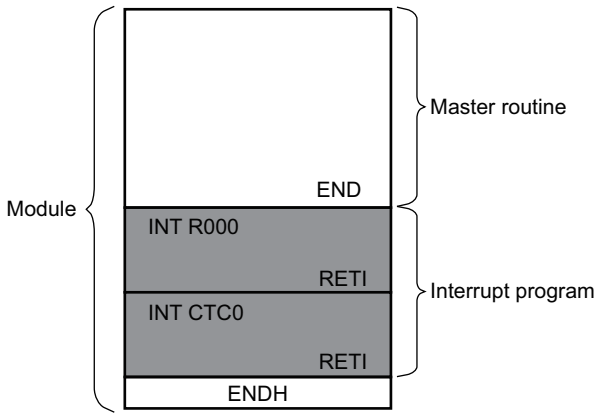
There are three interrupt conditions: external input (R000 to R009), high-speed counter comparator (CTC0 to CTC3), CPU positioning function comparator 2 matching relay (CR3013, CR3113).

TIP To execute interrupt processing periodically, please use the fixed period module.

"Fixed Period Module", Page 3-99.



The interrupt routine is written between the END - ENDH instructions.
Within one project, one interrupt condition can be written for one interrupt routine.
Interrupt routine is programmable in any module.
The interrupt route is started by INT instruction, ended by RETI instruction.

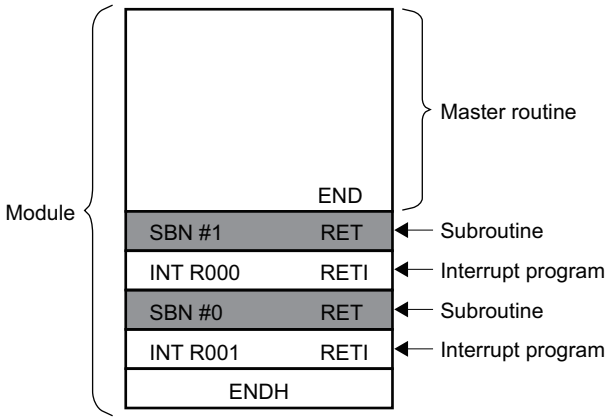


Note

- Interrupt routines cannot be written in a macro.
- In order to execute interrupt routine, always use the EI instruction to set the interrupt routine execution to "enable". (when operation starts, interrupt is in the "inhibited" mode.)
- If the interrupt condition is an input relay, the HSP instruction or CR2305/CM1620 can be used to set up a small input time constant to increase the response speed.
- Internal registers, operators (CR2009 to CR2012), TM0 to TM3, Z11 to Z12, R000 to R015 will be eliminated automatically when interrupt routine starts, and restored when the interrupt routine is completed.
- Some instructions cannot be used in the interrupt program.

  Prohibited Instructions in the Interrupt Routine", Page 3-38
- For direct output（R500 to R507）, please use the SET/RES instruction.

TIP · There is no programming sequence restriction on subroutine and interrupt routine.



· Interrupt routine can be executed irrespective the module execution.

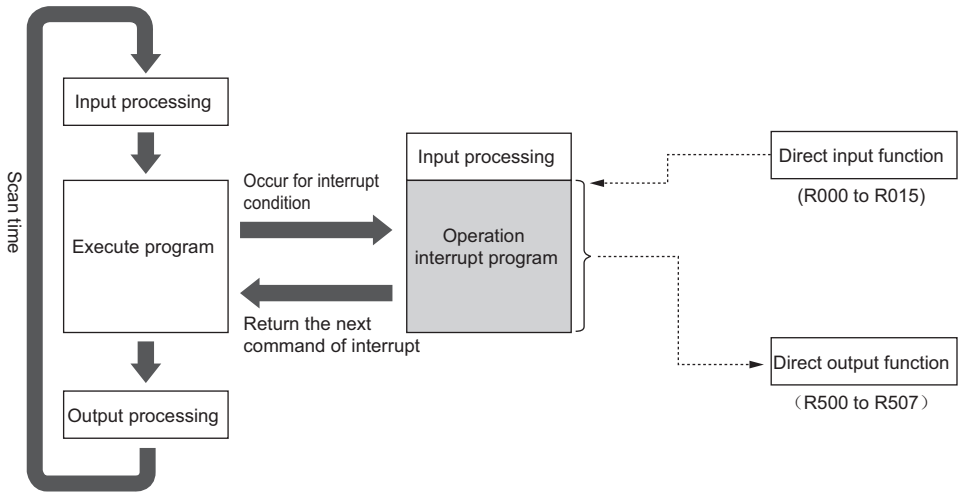
· Interrupt routine can be executed irrespective the module execution. If one standby module is managed as the interrupt routine, the consistency of the project management will be improved.

"3-5 Interrupt", Page 3-31

3-5 Interrupt

Overview

Ordinary PLCs execute ladder sequential control by repeatedly executing Input Processing -> Program Execution -> Output Processing. Therefore, signals shorter than scanning time cannot be input.
If the interrupt processing function is used, an interrupt can be performed irrespective the scanning time.
Once the interrupt condition is met, the master routine processing is terminated and the interrupt routine is executed.
After the interrupt processing is completed, the master routine processing continues from where it was broken.



■ Type of Interrupt Condition

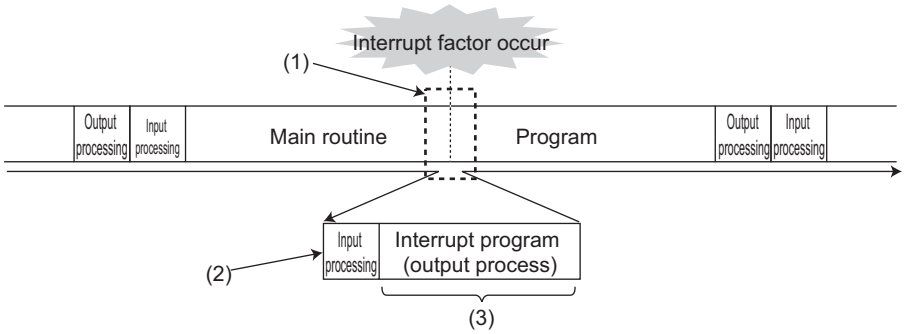
There are the following 4 kinds of interrupt condition:

- "External Input Interrupt", Page 3-34
- "High-Speed Counter Comparator Based Interrupt", Page 3-35
- "CPU Positioning Parameter Comparator 2 Interrupt", Page 3-35
- "Fixed Period Module", Page 3-99

■ About Device Processing

When an interrupt occurs, the device is processed as follows.

For the error information, see the "I/O Processing During Interrupt", Page 3-38.



(1) Processing at the interrupt start/end

When an interrupt starts, the internal registers, R000 to R015, operation flags, TM0 to TM3, Z11 to Z12 index registers are stored in the system. When the interrupt routine ends, these values are restored.

During interrupt processing, the master routine will not be affected even if the about values are changed. These changes are only effected in the interrupt routine.

The current value of high-speed counter (CTH) is changed to the value that is obtained through interrupt processing after the interrupt routine is finished.

The values of other devices changed in interrupt process are mapped in the master routine after interrupt routine is finished.

Note

- When fixed period module is the reason for interrupt, no saving/resetting is performed for R000~R015
- To perform saving/resetting, the index registers Z1 to Z10 can be set up from the "Fixed period execution and user interrupt" settings in the CPU System Settings.

(2) Input processing during execution of interrupt routine

In interrupt routine, the Device values are as follows:

- Current value of input relays R000 to R015, and high-speed counter (CTH): the value when interrupt condition occurs.
- Other devices: the value when master routine is interrupted.

Note

When fixed period module is the reason for interrupt, R000 to R015 will also be automatically updated. "Input processing", Page 3-38

(3)Execute output process of interrupt routine

Upon execution of the SET/RES interrupt instruction, the output relays R500 to R507 will output immediately.

If a non SET/RES instruction is executed by other output relays or output relays R500 to R507, output processing will be performed after the interrupt routine is completed.

Note

When fixed period module is the reason for interrupt and it is not assigned through DR, direct output cannot be performed based on the SET/RES instruction.

"Output Processing", Page 3-39

TIP To update the value of the non-auto update device to the latest status, perform the following:

·To program I/O relays through "DR".

·To program "RFSX/RFSY" instruction

·To program "RFSCTH" instruction

"About Direct Processing", Page 3-16

■ Processing Time

When all of the following conditions are met, the setting time prior to interrupt is within 65μs.

- When selecting the "Enable interrupt in instruction execution" checkbox in "Fixed period execute and user interrupt" setting of CPU System Settings"

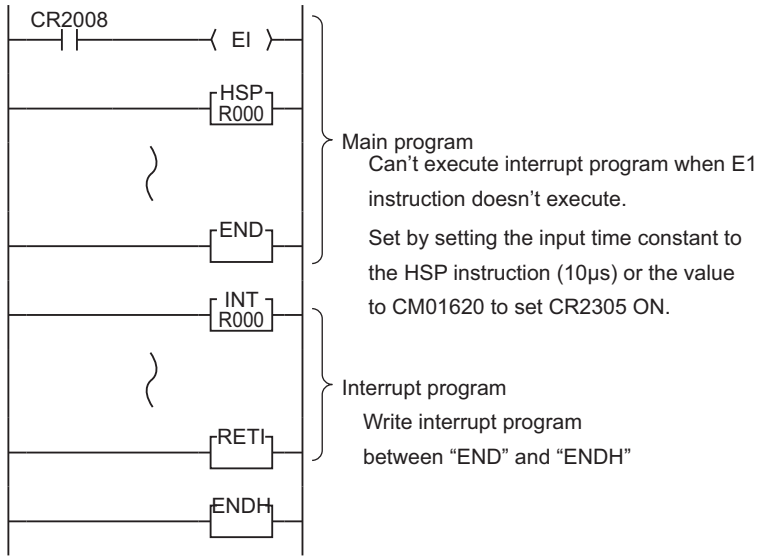
· No other interrupt routines with a priority higher than this interrupt are used
· KL-N20V, KV-CL20, KV-DN20, KV-H20, KV-H20S, KV-H40S are not used (when used, maximum is 115μs)
· The FASC instruction (when used, maximum 102μs) is not programmed in the program
· RFASC instruction (when used, maximum 67μs) is not programmed in the program

In addition, the start/end processing (update/save/reset of the devices) time of interrupt routine is about 5μs respectively.

Execution Of interrupt routine

To perform interrupt routine, write the program in the following way.

Example for Interrupt program



"HSP", Page 3-46

■ Interrupt Enable (EI) Instruction

When the program starts, interrupt is inhibited.
To execute interrupt routine, it is necessary to execute the interrupt enable (EI) instruction.
Please write the EI instruction in master routine.

TIP · To inhibited interrupt, use the interrupt inhibited (DI/DIC) instruction.
· When interrupt inhibited, the processing will not be interrupted even if interrupt occurs.
· The interrupt routine is started only it is enabled.

"EI", Page 3-47
"DI", Page 3-47 ,"DIC", Page 3-48

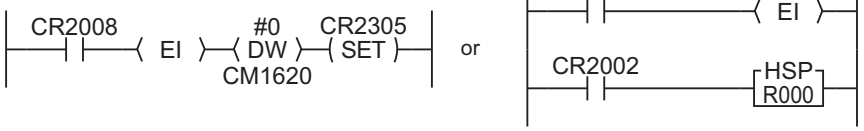
■ INT/RETI Instruction

Between END/ENDH instructions, set the interrupt reason to operand, and To program the INT instruction.
Behind the INT instruction, write the interrupt processing contents into the program, then To program the RETI instruction.

Note

Only one INT instruction can be programmed for one interrupt reason.
· Some instructions cannot be used in the interrupt routine .
"Unavailable Instructions for Interrupt Routine", Page 3-37。

· In order to shorten the input time constant, it is necessary to set up input/output time constant through HSP instruction (10μs) or data memory CM1620, and start CR2305. For input time constant, please refer to 🕮 KV-8000/7000/5000/3000/1000 Series PLC Instruction Reference Manual



🕮 " INT"/RETI Instruction, Page 3-50

External Input Interrupt

Input relay is used as the interrupt condition. Execute interrupt through the input relays R000-R009. Depending on the control relay, interrupting can be done either in the up edge or down edge.

■ External Input Interrupt Setting

Depending on the control relay, interrupting can be done either in the up edge or down edge. Interrupt condition can changed in the following way:

INT instruction	Interrupt condition Input relay	Control relay	Operation condition			
			Up edge		Down edge	Up/down edge
INT R000	R000	CR2600	OFF	ON	OFF	ON
		CR2601	OFF	OFF	ON	ON
INT R001	R001	CR2602	OFF	ON	OFF	ON
		CR2603	OFF	OFF	ON	ON
INT R002	R002	CR2604	OFF	ON	OFF	ON
		CR2605	OFF	OFF	ON	ON
INT R003	R003	CR2606	OFF	ON	OFF	ON
		CR2607	OFF	OFF	ON	ON
INT R004	R004	CR2608	OFF	ON	OFF	ON
		CR2609	OFF	OFF	ON	ON
INT R005	R005	CR2610	OFF	ON	OFF	ON
		CR2611	OFF	OFF	ON	ON
INT R006	R006	CR2612	OFF	ON	OFF	ON
		CR2613	OFF	OFF	ON	ON
INT R007	R002	CR2614	OFF	ON	OFF	ON
		CR2615	OFF	OFF	ON	ON
INT R008	R008	CR2700	OFF	ON	OFF	ON
		CR2701	OFF	OFF	ON	ON
INT R009	R009	CR2702	OFF	ON	OFF	ON
		CR2703	OFF	OFF	ON	ON

Note **To specify the ON/OFF state of special auxiliary relays, use the SET/RES instruction.**

■ Input Capturing

In external input interrupt, INT R000 to INT R003 have the input capture capability, which is used for capturing the current value of high-speed counter when interrupt occurs from the control memory. Even if this function is not set up, the current value of high-speed counter will be transmitted to CM1610 to CM1617 automatically when interrupt occurs.

For detail, please refer to 🕮 "Input Capture", Page 3-41.

High-Speed Counter Comparator Based Interrupt

high-speed counter comparator is used as the interrupt condition. Interrupt processing is performed when the current value of high-speed counter CTH is the same as the setting value for high-speed counter comparator CTC.

INT instruction	Interrupt condition Hi-speed counter comparator	Operation condition
INT CTC0	CTC0	When the setting value for high-speed counter comparator CTC0 is the same as the current value
INT CTC1	CTC1	When the setting value for high-speed counter comparator CTC1 is the same as the current value
INT CTC2	CTC2	When the setting value for high-speed counter comparator CTC2 is the same as the current value
INT CTC3	CTC3	When the setting value for high-speed counter comparator CTC3 is the same as the current value

* if exists 

, CTCn contact is not ON.(n: 0 to 3)

CPU Positioning Parameter Comparator 2 Interrupt

The CPU Positioning Parameter Comparator 2 is used as interrupt condition. In positioning/speed control process, when number of output pulses (current value) is the same as the comparator 2 setting value, interrupt processing is performed. Multi-section control can be enabled by changing the running speed.

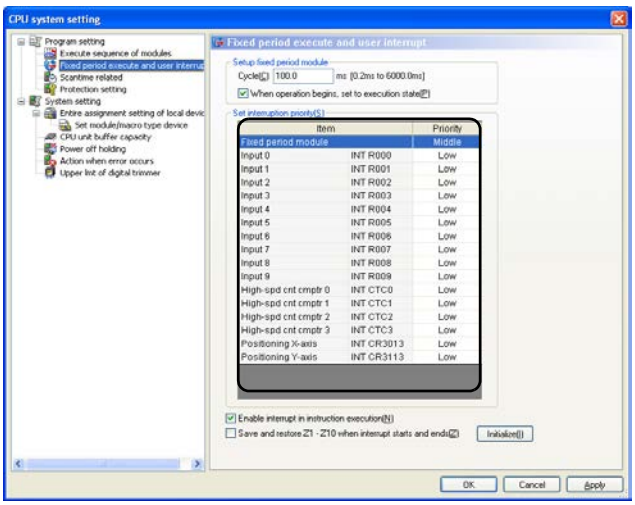
For detail, please refer to 🕮 "Change speed during operation", Page 2-201.

INT instruction	Interrupt condition Comparator 2	Operation condition
INT CR3013	(CR3013)	When the setting value of the X-axis comparator 2 is the same as the current value
INT CR3113	(CR3113)	When the setting value of the Y-axis comparator 2 is the same as the current value

TIP CR3013/CR3113 are not Physical ON or OFF, and only used for ladder labels for KV STUDIO.

Interrupt Priority

This setting is required when multiple interrupt conditions exist.
From the KV STUDIO work space, select "CPU System Settings" , then select "Setup program " and "Fixed period execution and user interrupt" settings.



Priority can be set as per "High/Middle/Low". Interrupts with a higher priority are considered and those with a lower priority are not be considered.
In addition, after the "Enable interrupt in instruction execution" check box is selected, interrupt response time fluctuation can be suppressed by interrupting instructions with a long processing time halfway.
Suppose the priority of Interrupt Routine A is set up as "Middle", only interrupt routines with a priority of "High" can interrupt this interrupt routine, whereas those with a priority of "Low" or "Middle" cannot.
In addition, while interrupt routines with a "Low" priority can interrupt other interrupt routines except those with a "High" or "Middle" priority.

Unavailable Instructions for Interrupt Routine

Instruction type		Instruction	
Common		@XXXX instruction	Differential execution type
Basic Instructions	Contact Instructions	LDP/LDF	Load pulse / load pulse fall
		ANP/ANF	AND pulse / AND pulse fall
		ORP/ORF	OR pulse / OR pulse fall
		LDPB/LDFB	Pulse bar/Pulse fall bar
		ANPB/ANFB	AND pulse bar /AND pulse fall bar
		ORPB/ORFB	OR pulse bar /OR pulse fall bar
	Output instructions	DIFU/DIFD	Differential up / Differential down
		ONDL/OFDL	ON delay/OFF delay
		SHOT	One shot
		FLIK	Flicker
		ALT	Alternate
	Timer/counter instructions	TMR/TMH/TMS	Timer/High-speed timer / 1ms high-speed timer
		C	Counter
		OUTC	Out counter
		ITVL	Interval timer
		UDC	Up/down counter
		UDT	Up/down timer
	Connection/end Instruction	MEP/MEF	MEP/MEF
Applied Instructions	Shift Instruction	SFR	Shift
	Control block processing instructions	STG/JMP/ENDS	Stage/Jump/End stage
		W-ON/W-OFF	Wait ON/Wait OFF
		W-UE/W-DE	Wait up edge/wait down edge
	File register instructions	FRSTM/FRLDM	File register all saving/Batch read file register
Operation command	Data control command	RAMP/TPOUT/LLFLT	Tilt signal/time division proportion output/promote delay filter
Extended Instructions	Data processing instructions	HKEY SORTN	Hex key input
	Cam switch instructions	ABSENC/INCENC	Abstract encoder / incremental encoder
	Frequency counter instructions	FCNT/RCNT	Measure frequency / Measure speed
	PID instructions	PID/PIDAT	PID Control
	Memory card instructions	MWRIT/MREAD/ MFREE/MMKDIR/ MPRINT/MREADL/ MCOPY/MMOV/ MREN/MFREEK/ MSTAT	Write memory card/read memory card/acquire memory card capacity/create memory card directory/write memory card character string/read a row of memory card/memory card file copy/memory card file movement/memory card file name change/acquire memory card remaining capacity/acquire memory card file state
		MRMDIR/MDEL	Memory card folder is deleted/Deletion of memory card files
	Sensor setting command	SPWR/SPRD/SSVC	Write sensor parameters/read sensor parameters/ execute sensor service
	Access window command	AWNUM/AWMSG	User message 1/user message 2

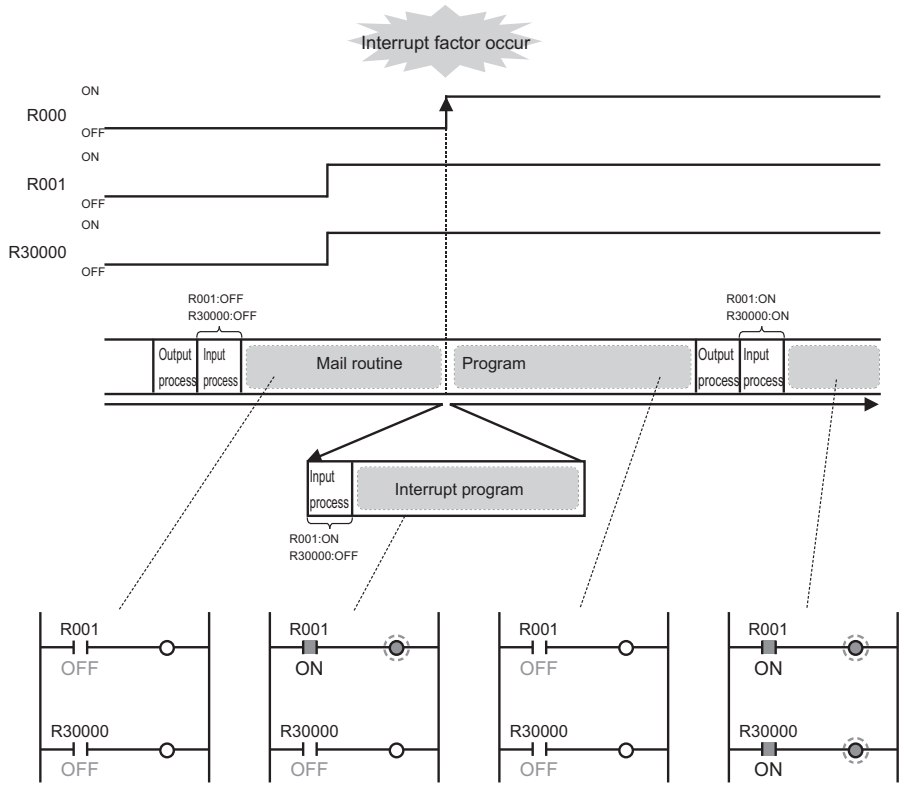
I/O Processing During Interrupt

■ Input processing

The input relay (R000 to R015) status is captured when the interrupt routine is initiated. For other cases, the status captured during scanning input processing (I/O update) will be retained, even when interrupt routine is executed.

The initially captured input relay (R000 to R015) status is valid only in interrupt routine process. After interrupt processing is finished, the status captured in scanning input processing (auto updating) will be used in the master routine.

Example



When the above interrupt routine is executed:

(1) input processing of master routine ->R001:OFF R30000:OFF

(2) input processing of interrupt routine ->R001:ON R30000:OFF

Since input relay R001 is direct input, the interrupt routine execution status cannot be captured.

Input relay R30000 can be processed through the master routine input processing even if it is in the interrupt routine process.

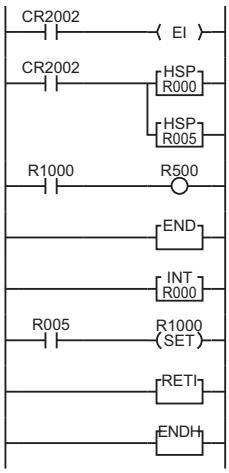
Direct input is effective only in the interrupt routine.

In master routine, R001 is always in the OFF state, no matter this is executed before or after the routine. R001 will be ON only in the interrupt routine.

Note

When fixed period module is the interrupt reason, R000 to R015 related input processing cannot be executed.

Ladder program example



Enable interrupt when power is ON.

The input time constant of input relays R000 and R005 is set to 10 µs.

Output relay R500 is turned ON by internal auxiliary relay R1000 from interrupt processing.

Execute interrupt program when input relay R000 is ON.
When R005 turns ON during interrupt processing, relay R1000 is turned ON.

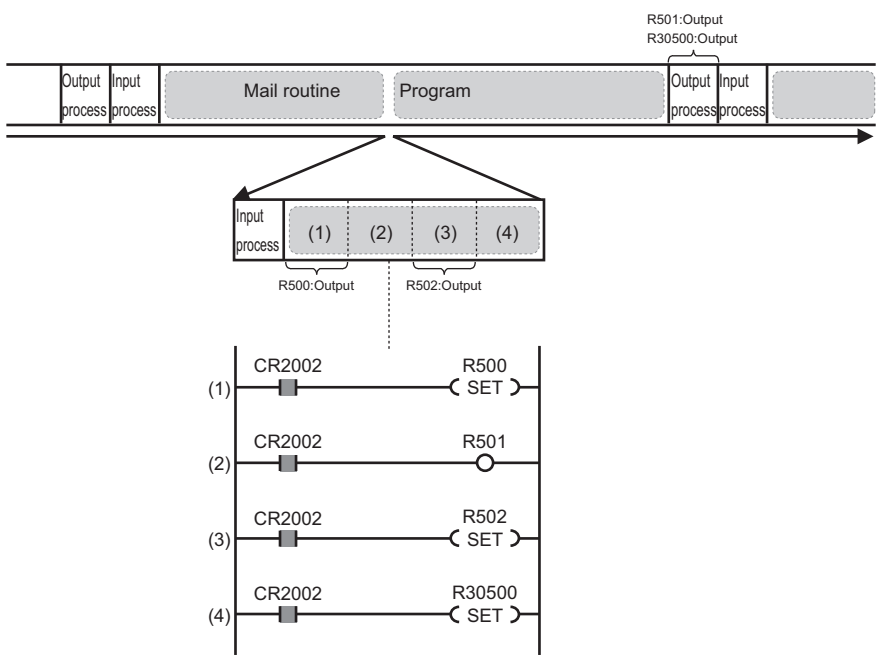
* Input information obtained by direct input is valid only during the interrupt program, and must be made to via the internal auxiliary relays.

(mnemonics list)
LD CR2002
EI
LD CR2002
HSP R000
HSP R005
LD R1000
OUT R500
END
INT R000
LD R1000
SET R1000
RETI
ENDH

■ Output Processing

An interrupt routine has no output processing. After interrupt routine is finished, the output processing of master routine (auto updating) is used for output.
However, output (direct output) can be enabled immediately after the routine is executed only after output relays (R500 to R507) are programmed in the SET and RES instructions.

Example



When the above interrupt routine is executed:

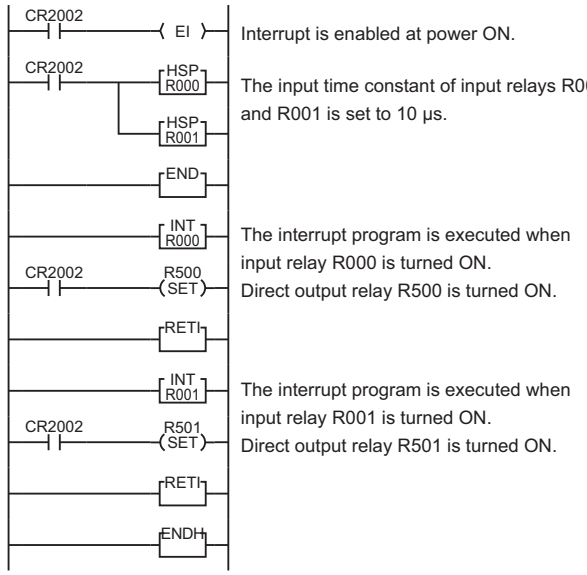
- Rung (1), when the output relay R500 is a direct output relay, output can be enabled directly.
- Rung (2), when the output relay R501 is a direct output relay and the OUT instruction is used for programming, the master routine output processing is used for output.

- Rung (3), when the output relay R500 is a direct output relay, output can be enabled directly.
- Rung (4), since output relay R30500 is energized via internal processor hence not a direct output relay, the output processing of master routine is then used for output.

Note

- **In interrupt routine, direct output is possible only when the SET/RES instruction is used. However, please use SET/RES instruction to directly specify the device output source.**
- **Even if in an interrupt process, direct output cannot be enabled in the following cases. In these cases, output is enabled through output processing in scanning.**
  - **(1) when instructions other than SET/RES instruction are used to specify an output source.**
  - **(2) other relays than R500 to R507 are used as well as indirect specifying or index modification are used to specify the SET/RES instruction device.**
  - **(3) a macro is called during interrupt process or the SET/RES instruction is executed in subroutine.**
- **When fixed period module is the interrupt reason, the SET/RES instruction-based R500 to R507 output processing cannot be performed.**

Ladder program example



(mnemonics list)
LD CR2002
EI
LD CR2002
HSP R000
HSP R001
END
INT R000
LD CR2002
SET R500
RETI
INT R001
LD CR2002
SET R501
RETI
ENDH

TIP To update the status of non-auto updated devices, please do the following:
·Program the I/O relay through "DR".
·Program the "RFSX/RFSY" instruction.
·Program the "RFSCTH" instruction.
"About Direct Processing", Page 3-16

Input Capture

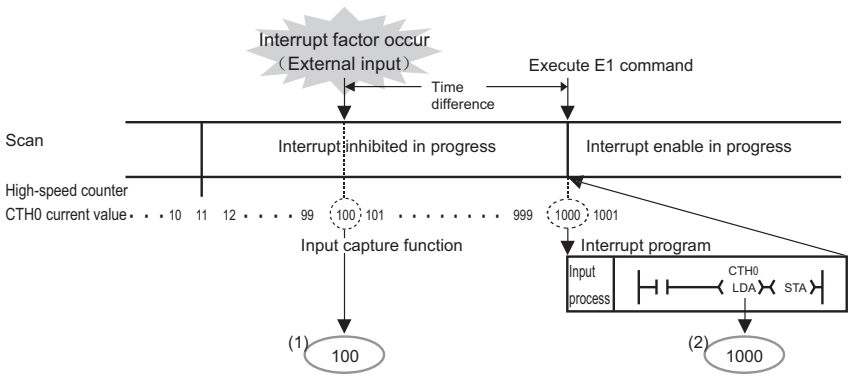
With the input capture feature, current value of high-speed counter in data memory can be captured when an interrupt condition takes place. This feature is initiated when the interrupt condition is an external input (only R000 to R003 can be used). No settings are required for this.
The captured value is stored in the control memories CM1610 to CM1617.

Interrupt condition (external input)	Capture current value of high-speed counter	Destination storage address	
		High bit	Low bit
When INT R000 occur	CTH0	CM1611	CM1610
When INT R001 occur	CTH0	CM1613	CM1612
When INT R002 occur	CTH1	CM1615	CM1614
When INT R003 occur	CTH1	CM1617	CM1616

Note **The timing for input capture execution is connected to specified interrupt polarity (up edge/down edge) through CR2600 to CR2607.**

■ The difference of current value of high-speed counter between input capture and interrupt routine execution

- Input capture
  ...The instant value when the interrupt condition occurs.
- Current value of high-speed counter in interrupt routine process
  ...In interrupt routine process, the LDA and MOV instructions are used to acquire current value of high-speed counter through input processing of interrupt routine.
  In the following conditions, the captured values are different.



(1) Since the instantaneous value in interrupt condition occurrence is collected by Input Capture, the current value of high-speed counter CTH0 is then #100.
(2) Since the value collected through interrupt routine is the value captured in input processing of interrupt routine, the current value of high-speed counter CTH0 is then #1000.
As mentioned above, if time elapsed exists in the process from interrupt condition occurrence to interrupt routine execution, then the captured current value of high-speed counter will also be different.

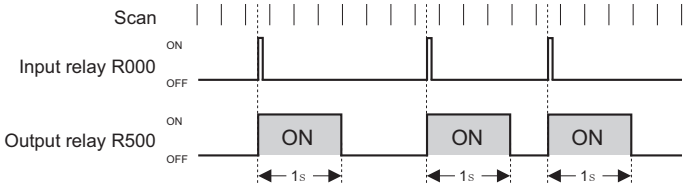
TIP Current value of high-speed counter (CTH) is the value obtained through input processing of interrupt routine after interrupt routine is finished.

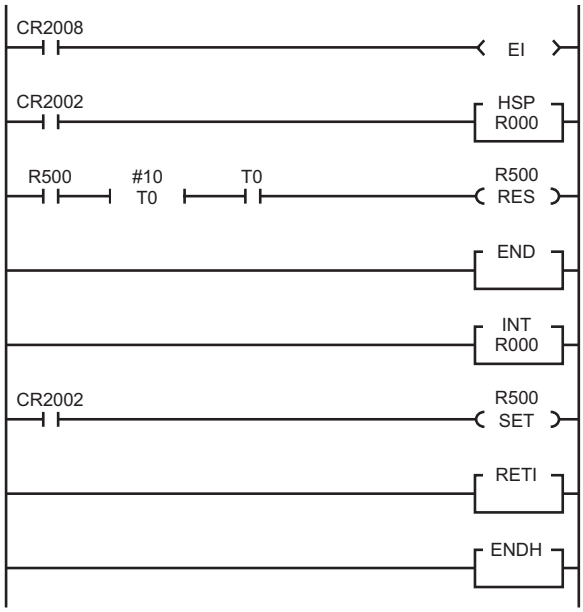
Sample Program

■ The application of interrupt routine in a signal converter

In this example, the interrupt function is used to convert mini pulse into fixed width pulse before output.

- The mini pulses input through input relay R000 are converted to pulses with an ON width of 1s from output relay R500 onwards.
- The output relay R500 is ON within 1 s after the up edge input relay R000 is ON.





Enable interrupt when power is ON

Constants is set to 10μs when input relay R000 is ON

To set output relay R500 to ON only for 1s

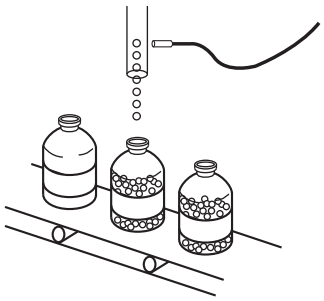
Output relay R500 is set to ON when input relay R000 is ON.

(mnemonics list)

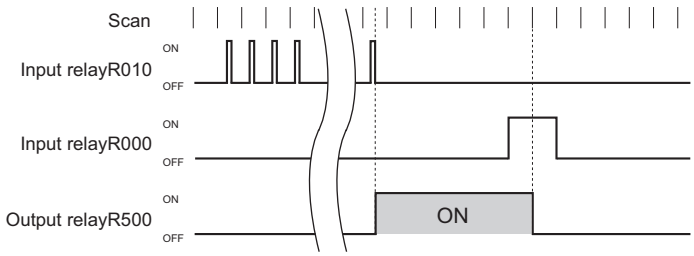
```
LD CR2008
EI
LD CR2002
HSP R000
LD R500
TMR @0 #10
CON
AND T0
RES R500
END
INT R000
LD CR2002
SET R500
RETI
ENDH
```

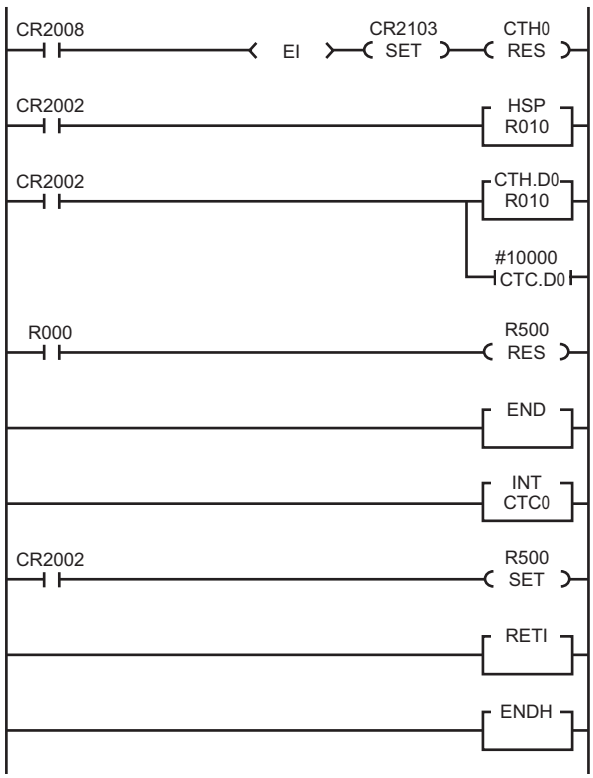
■ Example: the application of interrupt in high-speed counters

The input value of high-speed counter and ON/OFF of input relay is used to control ON/OFF of output relay R500.



- When the Input value of high-speed counter is changed to #10000, output relay R500 turns to ON.
- If input relay R000 ON, then output relay R500 OFF.





Interruption is enabled when powering ON and set high-speed counter CTH0 to "Auto-reset" and reset it.

Constants is set to 10μs when input relay R010 is ON

High-speed counter of input relay R010 is set to CTH0 and setting value is set to #1000

Output relay R500 is set to ON when input relay R000 is OFF

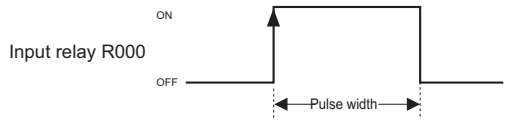
When high-speed CTC0 is #10000, interrupt program is executed and output relay R500 is set to ON.

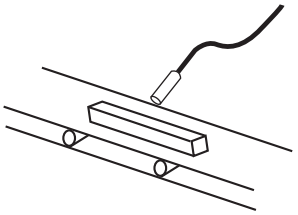
(mnemonics list)

```
LD CR2008
EI
CON
SET R1000
CON
RES CTH0
LD CR2002
HSP R001
LD CR2002
CTH.D #0 R010
CTC.D #0 #10000
LD R000
RES R500
END
INT CTC0
LD CR2002
SET R500
RETI
ENDH
```

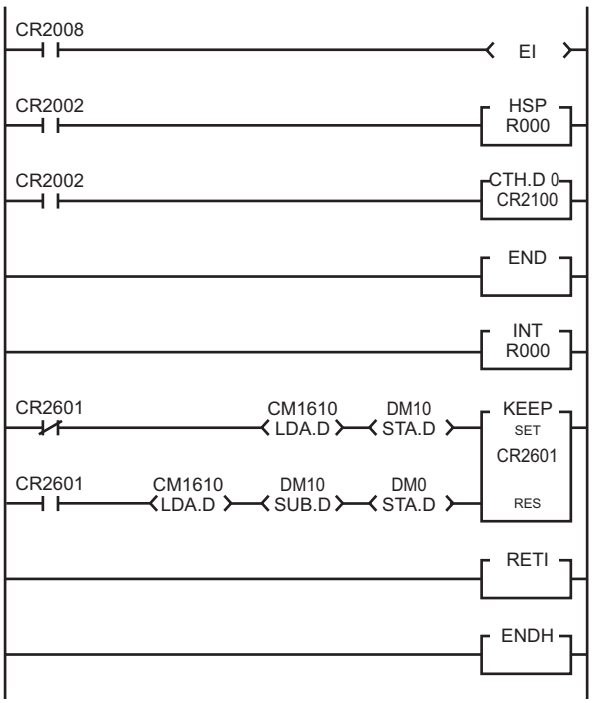
■ Example: the application in measuring high-speed pulse ON width

Measure the pulse width of input relay.





- Use the control relay CR2100 to measure pulse width with 1μs as the unit.
- Save the input capture value "CM1610/CM1611" when input relay R000 is ON into data memory "DM10/DM11".
  Subtract the value of "DM10/DM11" from input capture value when R000 is in OFF. This value is the pulse width.
- The measured value is stored in data memory "DM0/DM1" (unit μs).



Interrupt is enabled at power ON.

The input time constant of input relay R00000 is set to 10 μs.

The 1μs internal clock is counted by high-speed counter CTH0.

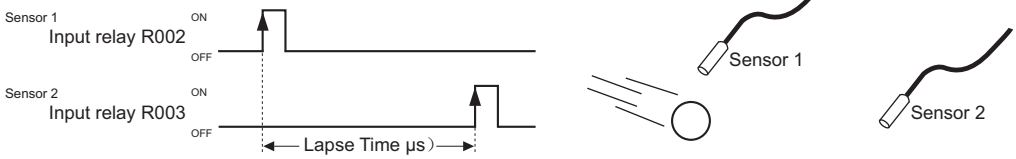
Interrupts are executed by input relay R000.
First of all, the interrupt polarity is changed to the down edge by executing the interrupt at the up edge of R000, storing the current value [CM1610/CM1611] of CTH0 at that time to [DM10·DM11], and turning CR2601 ON.
Next, the pulse width of R000 is calculated by executing the interrupt at the down edge of R000, and decrementing [DM10/DM11] at the up edge from the current value [CM1610/CM1611] of CTH0 at that time. The result is stored to [DM0/DM1].
Finally, CR2601 is turned OFF to change the interrupt polarity to the up edge.

(mnemonics list)

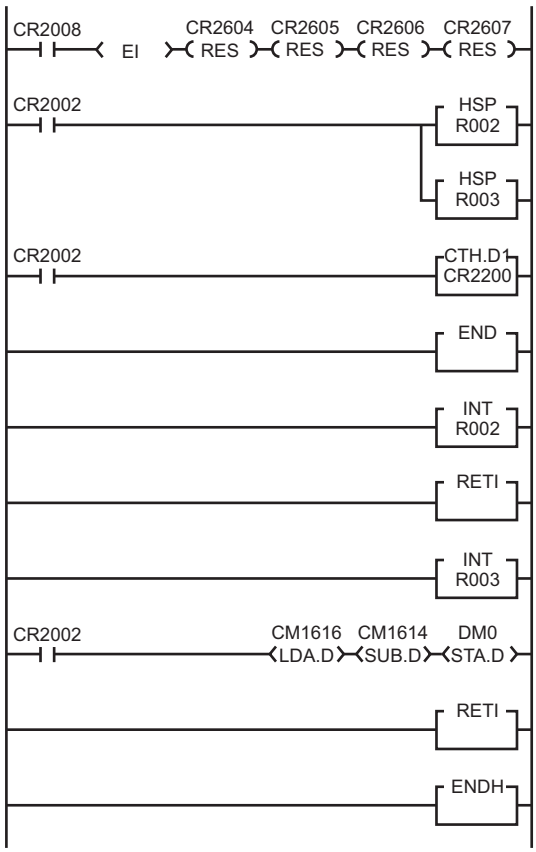
```
LD CR2008
EI
LD CR2002
HSP R000
LD CR2002
CTH.D #0 CR2100
END
INT R000
LDB CR2601
LDA.D CM1610
CON
STA.D DM10
CON
LDB CR2601
LDA.D CM1610
CON
SUB.D DM10
CON
STA.D DM0
CON
KEEP CR2601
RETI
ENDH
```

■ Example: the application in determining elapsed time between two points

Determine elapsed time between two input relays.



- Determine elapsed time between input relay R002 and input relay R003.
- Save the determined value in data memory "DM0/DM1", taking 1μs as unit.



Interrupt enable at power ON and the interrupt polarity of input relays R002 and R003 are set to the up edge.

The input time constant of R002 is set to 10μs.

The input time constant of R003 is set to 10μs.

The 1μs internal clock is counted by high-speed counter CTH1.

When INT002 is executed, the current value of CTH1 is automatically stored (by input capture) to [CM1614/CM1615].

When INT003 is executed, the current value of CTH1 is automatically stored (by input capture) to [CM01616/CM01617].

The pass time between two points is calculated by subtracting the input capture value of INT002 from the input capture of INT003.

The result is stored to [DM0/DM1].

(mnemonics list)

```
LD CR2002
EI
CON
RES CR2604
CON
RES CR2605
CON
RES CR2606
CON
RES CR2607
LD CR2002
HSP R000
HSP R003
LD CR2002
CTH.D #1 CR2200
END
INT R002
RETI
INT R003
LD CR2002
LDA.D CM1616
CON
SUB.D DM1614
CON
STA.D DM0
RETI
ENDH
```

Interrupt Processing Instructions

Instruction	mnemonics	Instruction description	Page
High-speed	HSP	Reduce time constant of input relay, improve input response characteristic.	3-46
Interrupt inhibited	DI	Inhibited execution of interrupt routines.	3-47
Interrupt enable	EI	Enable execution of interrupt routines.	3-47
Interrupt inhibited range	DIC	Set up interrupt inhibited range.	3-48
Interrupt	INT	interrupt routine before executing RETI instruction.	3-50
Interrupt return	RETI	Indicates the end of the interrupt routine.	3-50

HSP

HSP

high-speed HSP

Input time constant of input relay, improve input response characteristic.

Ladder program



Input mode

H S P D ↵

Operand	Available Devices																		Index Change
	Bit device							Word Devices							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
D	○	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Operand	Explanation
D	Designate relay device No. That reduces input time constant.*1

*1 Available relay are R000 to R015.

Description of Operation

When the execution condition is ON, specify the input time constant of the device in D to 10μs.
When the INT and CTH instructions are used, setting is required.

Note

When input time constant of control relay CR2305 is the same as input time constant of HSP instruction, the HSP instruction will prevail.

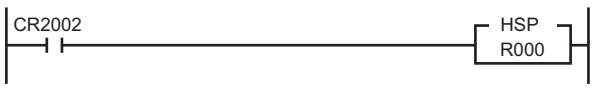
- For CPU unit input time constant change, please refer to "2-9 I/O", Page 2-97.
- Input time constant of expansion input unit can be set using KV STUDIO unit editor. For change, Please refer to KV STUDIO User's Manual, "Chapter 3 Unit Editor ".

Operation Flag

No change for operation flags.

Example

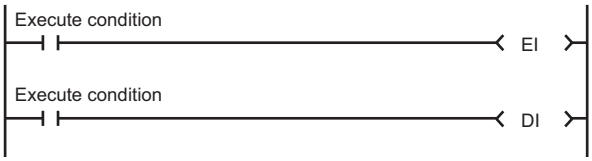
Set the input time constant of input relay R000 to 10μs.



(mnemonics list)
LD CR2002
HSP R000

DI	DI	**Interrupt inhibited**	**Inhibited interrupt routine and fixed period module execution.**
EI	EI	**Interrupt enable**	**Enable interrupt routine and fixed period module execution.**

Ladder program



Input mode



Operand	Available Devices																		Index Modification
	Bit device							Word Devices							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Description of Operation

DI When execution condition is ON, interrupt routine and fixed period module are inhibited.
This instruction is used for temporary interrupt inhibited .

EI When execution condition is ON, interrupt routine and fixed period module are not inhibited.
the interrupt routine that are inhibited via DI instruction will be enabled.

- Once EI instruction is executed, interrupt routine execution can be enabled before executing DI instruction.
- When the program starts, interrupt is inhibited.
- If interrupt is initiated in execution of DI instruction (interrupt inhibited), up to 16 subprograms can be nested. While EI instruction is executed, the stored interrupt routine is executed.

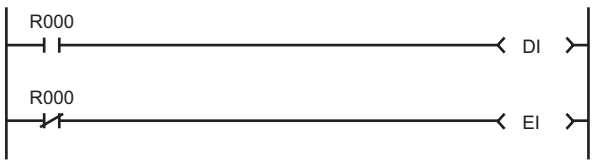
To be initiated, the interrupt routine should be in enable (EI) state. In order to execute further interrupt routines during the execution of an interrupt routine, the priority of these interrupts should be higher than the interrupt routine in execution. To specify priority, select "CPU system setting" -> "Fixed period execution and user interrupt" settings. Up to three levels of interrupting can be specified.

Operation Flag

No change for operation flags.

Example

When input relay R000 is ON, the interrupt routine is inhibited.
When R000 is OFF, the interrupt routine is enabled.



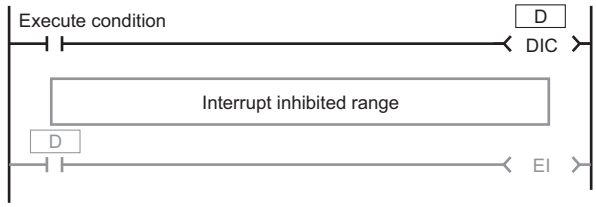

```
(mnemonics list)
 LD R000
 DI
 LD R000
 EI
```

DIC

DIC **Interrupt inhibited range**

Set up interrupt inhibited range.

Ladder program



Input mode



Operand	Available Devices																	Index Change
	Bit device							Word Devices							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
D	○	-	○	○	○	-	○	○	-	-	-	-	-	○	-	-	○	○	○

Operand	Explanation
D	Specify the bit device that outputs interrupt inhibited/enable state.*1

*1 If the word device is specified with the lowest bit, then other bits keep unchanged.

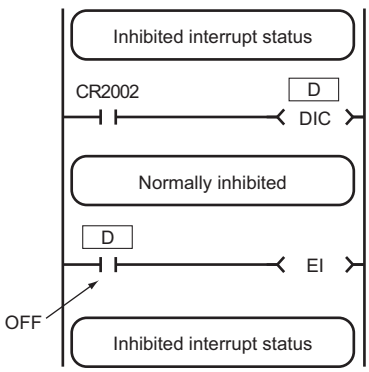
Description of Operation

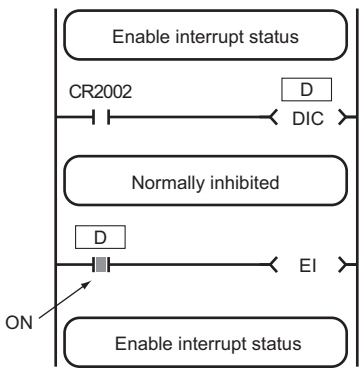
DIC This is used in combination with the EI instruction.

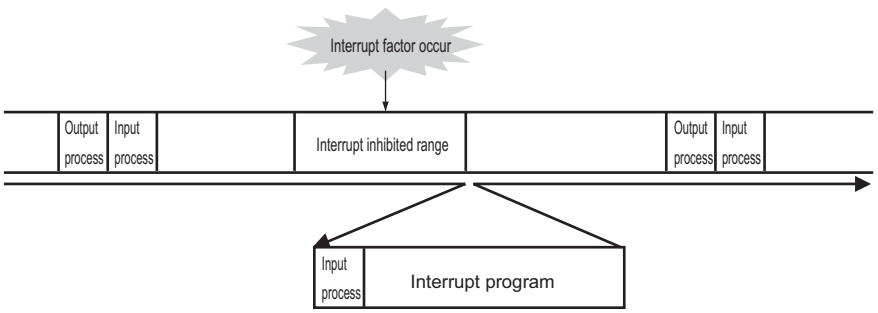
If execution condition is ON, the interrupt processing between DIC and EI instructions is inhibited.

The enable/inhibited status is stored in D before DIC instruction is executed.

If the interrupt status is "Enabled" before DIC instruction is executed, then D is set; if "Inhibited", then reset.







Operation Flag

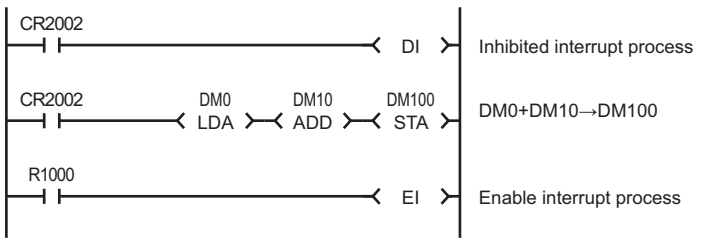
CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	It is ON when indirect specifying or index modification range is incorrect. Otherwise, OFF. If indirect specifying and index modification are not specified for operand, it is not changed.

* If CR2012 is ON, the instruction will be not executed.
If CR2012 is ON, the detail information of error is stored in CM5100 to CM5176.

"Error Log (CM)", Page 3-20

Example

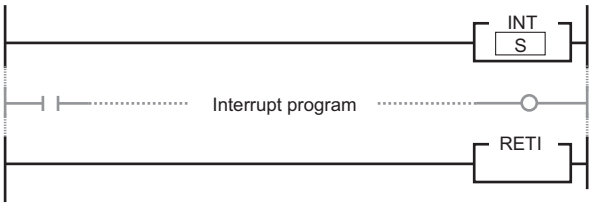
Interrupt is inhibited in operation processing. After DIC instruction execution, the interrupt processing state is returned to the state before DIC instruction is executed.



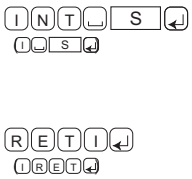

```
(mnemonics list)
 LD CR2002
 DI
 LD CR2002
 LDA DM0
 CON
 ADD DM10
 CON
 STA DM100
 LD R1000
 EI
```

INT	INT	**Interrupt**	**Execute the interrupt routine in front of RETI at up edge or down edge of operand.**
RETI	RETI	**Interrupt return**	**Indicates the end of the interrupt routine.**

Ladder program



Input mode



Operand	Available Devices																		Index Change
	Bit device							Word Devices							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
S	○	-	-	-	-	○	○	-	-	-	-	-	-	-	-	-	-	-	-

Operand	Explanation
S	Specify the bit device.*1

*1 Only R000 to R009,CTC0 to CTC3,CR3013,CR3113 can be specified.

Description of Operation

INT Specify the start of interrupt routine.

RETI Specify the end of interrupt routine.

Note

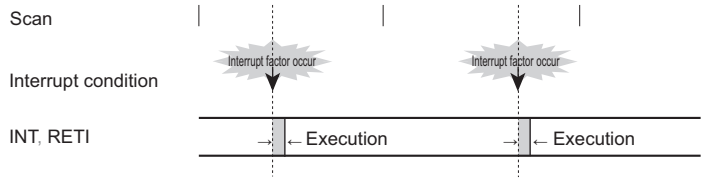
Internal register, index register, operation flag, R000 to R015, TM0 to TM3 are stored automatically when interrupt routine starts. Each stored value is returned when interrupt routine is finished. In default settings state, only Z11, Z12 index registers execute save/reset processing. Z0 to Z10 index registers can be set to execute save/reset processing in "CPU system settings" -> "Fixed period execution and user interrupt" settings.

Operation Flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	No change in status

Instruction Execution Timing

The instruction is executed at the up or down edge of operand.



Example




```
(mnemonics list)
 LD CR2002
 EI
 END
 INT R000
 LD CR2002
 SET R500
 RETI
 ENDH
```

3-6 Device and Constant

The so-called device refers to such KV-5500/5000/3000 PLC elements such as relays, timers/counters, data memories used in the program. During programming, devices are programmed behind the instruction, which are used to assign data used in instructions and store instruction execution results.

Device List

■ Bit device

Device name	Range *1	Number of points	Main Functions	When operation starts (Power ON, PROG->RUN)	Local device(@)*1	Index modification (:Z/:#)	Indirect specifying(*)*9	
							Lookup	Store
Input relay*11	R000 to R015 R1000 to R99915)	I/O Internal auxiliary relay total 15936 points	To acquire ON/OFF info from peripheral equipment	-	○	○	○	×
Output relay*1	R500 to R507 R1000 to R99915)		To output ON/OFF info from peripheral equipment	Clear/hold*4	○	○	○	×
Internal auxiliary relay	R508 to R915*2 R1000 to R99915)		Used in CPU and expansion unit	Clear/hold*4	○	○	○	×
Link relay	B00 to B3FFF*10	16384 points	Used only in CPU	Clear/hold*4	×	○	○	×
Internal auxiliary relay	MR000 to MR99915	16000 points		Clear	○	○	○	×
Latch relay	LR000 to LR99915	16000 points		Hold	○	○	○	×
Timer (contact)	T0 to T3999	4000 points	Contact device for 1ms, 10ms, 100ms, 10μs down counter, 10ms up/down counter	Clear	○	○	○	×
Counter (contact)	C0 to C3999	4000 points	Contact device for up counter, up/down counter	Clear/hold*8	○	○	○	×
High-speed counter Comparator (Contact)	CTC0 to CTC3	4 points	Used for high-speed counter	Clear/hold*8	×	×	×	×
Control relay	CR000 to CR3915	640 points	Used to control PLC function or acquire equipment state	Hold	×	×	×	×

TIP Some input, output and internal auxiliary relays can be used for interrupt and high-speed counter.

"Input/output/internal auxiliary relay", Page 3-55

■ Word Devices

Device name	Range *1	Number of points	Main Functions	When operation starts (Power ON, PROG ->RUN)	Local device(@)*1	Index modification (:Z/:#)	Indirect specifying(*)*9	
							Lookup	Store
Data Memory	DM0 to DM65534	65535 points	Used for storing numerical data (16-bit)	Clear/hold*4	○	○	○	○
Extended data Memory	EM0 to EM65534	65535 points		Clear/hold*4	○	○	○	○
File register	Consecutive number mode: ZF0 to ZF131071	131072 points		Hold	×	○	○	○
	Current bank: FM0 to FM32767	(32768×4 store) piont			○*12			
Link register	W0 to W3FFF*10	16384 points		Clear/hold*4	×	○	○	○
Temporary Data Memory	TM0 to TM511	512 points	Used for storing numerical data (16-bit)	Clear	○	○	○	○
Timer (Current value/ setting value)	T0 to T3999	4000 points	Current value/setting value of 1ms, 10ms, 100ms, 10μs down counter, 10ms up/ down counter (32-bit)	Current value: Clear*6 Setting value: hold	○	○	○	×
Counter (Current value/ setting value)	C0 to C3999	4000 points	Current value/ setting value (32-bit) of up counter/ up/down counter	Clear/hold*8	○	○	○	×
High-speed counter (current value)	CTH0 to CTH1	2 points	High-speed counter current value (32-bit)	Clear/hold*8	×	×	×	×
High-speed counter Comparator (setting value)	CTC0 to CTC3	4 points	High-speed counter setting value (32-bit)	Clear/hold*4	×	×	×	×
Index register	Z1 to Z12*7	12 points	Used for index modification (32-bit)	Clear	×	×	×	×
Control memory	CM0 to CM5999	6000 points	Used to control PLC function or acquire equipment state (16-bit)	Hold	×	×	×	×

*1 When used as local device, the applicable range of global device is limited by the number of local devices reserved.
"Local Device List", Page 3-132
*2 R100 to R415/R508 to R915 are reserved for the system, and cannot be used.
*3 R1000 to R99915 can be set to expansion I/O relay with Unit Editor (Unit Monitor).
*4 "Power-off hold function" in CPU system setting enables to set "clear/hold".
*5 "A-2 CR/CM list", Page A-7
*6 Up/down counters (UDT) hold the current value.
*7 Z11/Z12 is reserved for the system, and cannot be used.
*8 "Power-off hold function" in CPU system setting enables to set "clear/hold". (only for contacts, current value)
9 "store" is the device that can be described as "(device)". "Lookup" is the device that can be specified indirectly.
"Indirect Specifying", Page 3-75
*10 Device No. is specified with HEX number.
*11 "DR" is the label for direct processing. When the label is "DR", local devices cannot use indirect specifying.
"About Direct Processing", Page 3-16
*12 Local device cannot perform bank switching.

● Index Modification Programming (through index register and index constant modification)

Addressing with the index register.

Entered behind the (R(DR)/MR/LR/B/T/C/DM/EM/FM/ZF/W/TM/*DM/*W/*EM/*FM/*ZF/*TM) devices: Z□(□ : 1 to10).

Example

D00: Z01	(if Z1 value is 100, then DM100)
D1000: Z01	(if Z1 value is 100, then R1604)

Addressing with the index constant

Entered behind the (R(DR)/MR/LR/B/T/C/DM/EM/FM/ZF/W/TM/*DM/*W/*EM/*FM/*ZF/*TM) devices: Z□(□ : -131072 to +131072).

Example

DM0:#1	(means DM1)
R1000:#1	(means R1001)

● Indirect specifying programming(*)

Input "*" before device (DM/W/EM/FM /ZF /TM).This can be used together with indirect specifying instruction.

Example

*DM0 *TM100

"Indirect Specifying", Page 3-75

● Local device programming

Input "@" before the device (R/MR/LR/T/C/DM/EM/FM/TM).

These devices are effective only in modules and macros. This is for indirect specifying or index modification.

Example

@DM0 @R10000

"3-10 Local Device", Page 3-131

● About **XYM** Marking

The following XYM marks can be used to specify the devices (R (DR)/MR/LR/DM/EM/FM).

Device name	KEYENCE mark	XYM mark	XYM marking -based device No.
Relay	R(DR)	X(DX)	0000 to 999F
		Y(DY)	0000 to 999F
Internal auxiliary relay	MR	M	00000 to15999
Latch relay	LR	L	00000 to15999
Data Memory	DM	D	00000 to 65534
extended data memory	EM	E	00000 to 65534
File register	FM	F	00000 to 32767

When set to XYM mark, select "Tool" -> "Options" from KV STUDIO menu, select "use XYM mark" check box in "display mode settings".

● Input/output/internal auxiliary relay

Device No.	Common use	High speed		
		Interrupt*1	High-speed counter*1	Positioning*1
R000	Input relay (direct input area)	Interrupt input INT R000	-	Stop/Origin sensor input
R001		Interrupt input INT R001	-	
R001		Interrupt input INT R002	-	
R001		Interrupt input INT R003	-	
R004		Interrupt input INT R004	-	X axis limit switch CW
R005		Interrupt input INT R005	-	Y axis limit switch CW
R006		Interrupt input INT R006	-	X axis limit switch CCW
R007		Interrupt input INT R007	-	Y axis limit switch CCW
R008		Interrupt input INT R008	High-speed counter 0 Enable input	-
R009		Interrupt input INT R009	High-speed counter 1 Enable input	-
R010		-	High-speed counter 0 A phase	-
R011		-	High-speed counter 1 A phase	-
R012		-	High-speed counter 0 B phase	-
R013		-	High-speed counter 1 B phase	-
R014		-	High-speed counter 0 Z phase	X axis, Z phase
R015		-	High-speed counter 1 Z phase	Y axis, Z phase
R00000 to R415	Reserved for system			
R500	Output relay (direct output area)	-	High-speed counter 0 comparator matching output	X axis CW
R501		-	High-speed counter 1 comparator matching output	X axis CCW
R502		-	-	Y axis CW
R503		-	-	Y axis CCW
R504		-	(High-speed counter 0 comparator matching output)	-
R505		-	(High-speed counter 1 comparator matching output)	-
R506		-	-	Clear X axis deviation counter
R507		-	-	Clear Y axis deviation counter
R508 to R915	Reserved for system			
R1000 to R59915	I/O relay/internal auxiliary relay			
MR000 to MR99915	Internal auxiliary relay			
LR000 to LR99915	Latch relay			

■ Macro argument device

Macro argument devices that can be used only in the macro is as follows.

Attribute		Symbol	Range	Description	Indirect specifying(*)	Local device(@)	Index modify(:)
Device		P	P0 to P9	The device is used as an argument for processing	×	×	○
Value		V	V0 to V9	The device value or constant is used as an argument for processing	×	×	×
Unit	Leading R	UR	UR0 to UR9	The leading replay assigned to in expansion unit as argument	×	×	○
	Leading DM	UM	UM0 to UM9	Process the initial data memory assigned in expansion unit is used as an argument for processing	×	×	○
	No.	UV	UV0 to UV9	the code number of expansion unit as argument is used as an argument for processing	×	×	×

"Argument Setting", Page 3-117

■ Constant

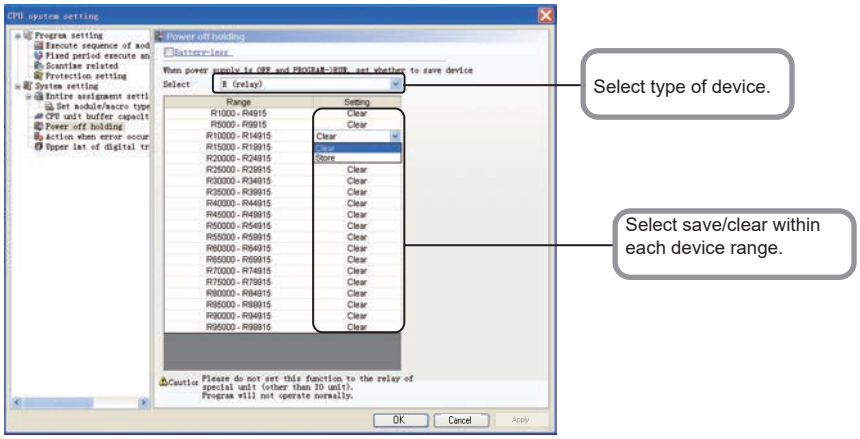
Constant	Range	Main Functions
DEC(#)	#0 to #65535/non-signed 16 bit -32768 to +32767(signed 16 bit) #0 to #4294967295/non-signed 32 bit -2147483648 to +2147483647 signed 32 bit	Used for specifying DEC number. TIP It will display "K" when set it XYM display mode.
Single precision real number	-3.4E+38<=N<=-1.4E-45 N=0 +1.4E-45<=N<=+3.4E+38 "Significant bits is 7 bit"	Used for specifying single precision real number.
Double precision real number	-1.79E+308<=N<=-2.23E-308 N=0 2.23E-308<=N<=-1.79E+308 "Significant bits is 16 bit"	Used for specifying double precision real number *May be used for CPU unit with CPU functional version above V2.0.
HEX($)	$0000 to $FFFF(16 bit) $00000000 to $FFFFFFFF(32 bit)	Used for specifying HEX constants. TIP "H" is displayed when XYM is selected.
Fixed string ("")	(Example) "model number ABC", "month/08:30:15"	Used for specifying fixed string.

■ Internal register

Device name	Range	Number of points	Main Functions	When operated (Power ON, PROG->RUN)
Internal register	-	1 point	For temporary data storage (16 bit, 32 bit)	Clear

Set Power Failure Holding (latching)

Power-off Hold means that the device values are retained when the power is cut off.
To select option, open the "CPU system settings" from KV STUDIO workspace, and select "System settings" -> "Set Power Failure Holding".



Bit Device

I/O Relay R

Overview Input relay is the device that collects ON/OFF information from peripherals into PLC.
Output relay is the device that sends ON/OFF instructions or arithmetic operation results from PLC to peripherals.

Denotation Device number composition is as follows.
Example)

Channel No. (000 to 999) Contact No. (00 to 15)

R00012

Device name Device No. (00000 to 99915)

TIP
- The letter R can be omitted in programming. (for constant operands, however, R cannot be omitted in programming.)
- Zero suppression in programming.
  (Example)R12
- Can be used as word device.
  "The word unit processing for bit device", Page 3-80
- Can be used as direct I/O relay by adding "D" in the device name.
  (Example) DR500,,, R500 will act as a direct output relay
  "Direct I/O Relay (DR)", Page 3-16
- When XYM Marking is selected, input devices are designated as "X" and output relays as "Y".
  "About XYM Marking", Page 3-54

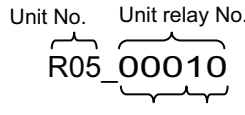
Range ·R000 to R015 (input only)
·R500 to R507 (output only)
·R1000 to R99915 (for extended I/O units)

Application Input relay
·Used for peripherals connection, including buttons and switches (for example, selector switches, limit switches, photoelectric switches, digital switches) etc.
·Input relays can be used as high speed input for interrupts, high-speed counters, positioning function etc.(only for R000 to R015)
Output relay
·Used for peripherals connection, including solenoid valves, solenoid switches, displays (signal lamps, digital displays) etc.
Output relay can be used as high speed output of high-speed counters and positioning function. (only for R500 to R503)

Description ·for input relays, 1 bit is assigned to each input point.
·for output relays, 1 bit is assigned to each input point.
·Can be specified for any N.O. (normal open) or N.C. (normal close).
R100 to R415 are reserved for the system, please do not use.
R508 to R915 are reserved for the system, please do not use.

Default setting Under default state, output relays will clear the states turning to OFF when power is ON and PROG-> RUN. You can change this to "Hold" in the "set power failure setting" tab from the "CPU system settings".

TIP Relay (R) unit device labeling
In KV STUDIO , besides normal labeling, a unit number can be used for relay relay labeling. To use the unit device labeling, select "View (V)" -> "Display unit device (Y)" from the menu.



Can input after eliminating zero. (example) R5_10

Unit No. Starting from CPU, labeling can be performed in the order of 01, 02, 03, 04…and the like.
Unit relay No. Starting from 00000, the occupied points are specified as relay number.

Unit No.	00 *	01	02	03	04	05
KV-U7	KV-5500/ 5000/3000 CPU	KV-B16XA 16-input	KV-C32XA 32-input	KV-B16TA 16-output	KV-C32TA 32-output	KV-H20S 12CH occupied
Unit relay No.	R000 to R015 (input) R500 to R507 (output)	00000 to 00015	00000 to 00115	00000 to 00015	00000 to 00115	00000 to 00915

(Example) KV-B16XA 5th-point ..... 01_00004
KV-C32TA i17th-point ..... 04_00100
KV-H20S of 603..... 05_00603

* KV-5500/5000 / 3000 's internal input/output devices cannot use the unit device labeling.
For the KV-5500/5000 CPU built-in EtherNet/IP/Ethernet/FL-net devices, the unit devices with "00_" as the leading numbers are used for labeling.

Link Relay B

Oerview Used as the relay that executes cyclic transfer when connecting with FL-net. Device numbers are specified with hexadecimal symbols, which is different from other relays.

Denotation The device No. is structured as follows:
(Example)

Channel No. (000 to 3FF) Contact No.(0 to F)

B3A6F

Device name Device No.(0000 to 3FFF)

TIP Zero suppression can be used in programming.
(Example) B7A
Can be used as word device.
"The word unit processing for bit device", Page 3-80

Note

- Please use hexadecimal number (0 - F) for specifying.
- Local devices (@) cannot be used.

Range B0000 to B3FFF

Application Used as the relay that executes cyclic transfer when connecting FL-net.

Denotation These relays cannot be assigned as the unit device of expansion unit.

Default setting In default state, link relay will elimination state when power is ON, PROG-> RUN, become OFF. Set to hold state in " Power-off hold settings " of CPU system setting.

Internal auxiliary relay R/B/MR/LR

■ R

Overview R that is not assigned to actual I/O relays and expansion unit relays can be used as internal auxiliary relay.

Denotation The device No. is structured as follows:
(Example)

Channel No. (000 to 999) Contact No. (00 to 15)

R00012

Device name Device No. (00000 to 99915)

TIP ·The letter R can be omitted in programming.
Zero suppression can be used in programming.
(Example) R12
·Can be used as word device.
"The word unit processing for bit device", Page 3-80

Range Except the numbers assigned to expansion input unit

Default setting Under default state, output relays will clear the states turning to OFF when power is ON and PROG -> RUN. You can change this to "Hold" in the " set power failure setting " tab from the "CPU system settings"..

■ B

Overview When FL-net is not connected, the B that is not assigned to link relays can be used as internal auxiliary relay.

Denotation The device No. is structured as follows:
(Example)



TIP Zero suppression can be used in programming.
(Example)B7A
·Can be used as word device.
"The word unit processing for bit device", Page 3-80

Note
- Please use hexadecimal number (0 - F) for specifying.
- Local devices (@) cannot be used.

Range B0000 to B3FFF

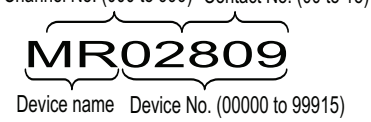
Description These relays cannot be assigned as the unit device of expansion unit.

Default setting Under default state, output relays will clear the states turning to OFF when power is ON and PROG-> RUN. You can change this to "Hold" in the "set power failure setting" tab from the "CPU system settings".

■ MR

Overview A device that can be used only in CPU

Denotation The device No. is structured as follows:
(Example)



Description These relays cannot be assigned as the unit device of expansion unit.

Default setting When power is ON, or PROG→RUN, the states will be cleared, and output becomes OFF.

TIP
- The letter R in MR can be omitted.
- Zero suppression can be used in programming.
  (Example) M2809
- "M" is displayed when XYM Marking is selected.
  "About XYM Marking", Page 3-54

■ LR(Latch Relay)

Overview This device can only be used for the Hold state in CPU.

Denotation The device No. is structured as follows:
(Example)



Range LR000 to LR99915

Description These relays cannot be assigned as the unit device of expansion unit.

Default setting Hold.

TIP
- The letter R in MR can be omitted in programming.
- Zero suppression can be used in programming.
  (Example)L2308
- "M" is displayed when XYM Marking is selected.
  "About XYM Marking", Page 3-54

Timer (Contact) T

Overvi Timer includes contact (1-bit), setting value (32-bit) and current value (32-bit).Timer is a kind of device. And when the current value of down counter is "0" (time is up) or current value of up/down counter is the same as the setting value or or "0", the contact becomes "ON".

Denotation The device No. is structured as follows:
(Example)

Device No. (0000 to 3999)
T0501
Device name

Contacts, current values and setting values depend on the instruction operand used.

Range T0000 to T3999

Description Timer is classified into 4 categories: 1ms timer, 10ms timer, 100ms timer and up/down timer.

Default When power is ON, or PROG->RUN, the state will be cleared, and the output becomes OFF. Current value is the same as setting value when power on as well as PROG -> RUN. (only up/down counter may keep current value.)
setting value is held.

TIP Zero suppression can be used in programming.
(Example)T501

■ How to program a timer action

This is done by specifying the timer code and setting value (From Time to Time) used in timer instruction operand.
(Example)

Device No. （0000 to 3999） Setting value（0 to 4294967295）
TMR 0501 #1000
UDT 0502 #1000
Timer command

TIP ·Alternatively, a device can be used for value specifying.
For details on instructions, refer to the "2-6 Memory Card Instructions" in the KV-8000/7000/5000/3000/1000 Series Instruction Reference Manual
·Timer and counter can use the device with same numbering.

"Operation difference between individual timers"

Timer type (instruction)	Device No.	Setup value	Time before ON
100ms down counter(TMR)	0 to 3999	0 to 4294967295	n x 100ms
10ms down counter(TMH)			n x 10ms
1ms down counter(TMS)			n x 1ms
10μs down counter(TMU)			n x 10μs
10ms up/down counter(UDT)			n x 10ms

■ Timer error

Timer error is shown below:

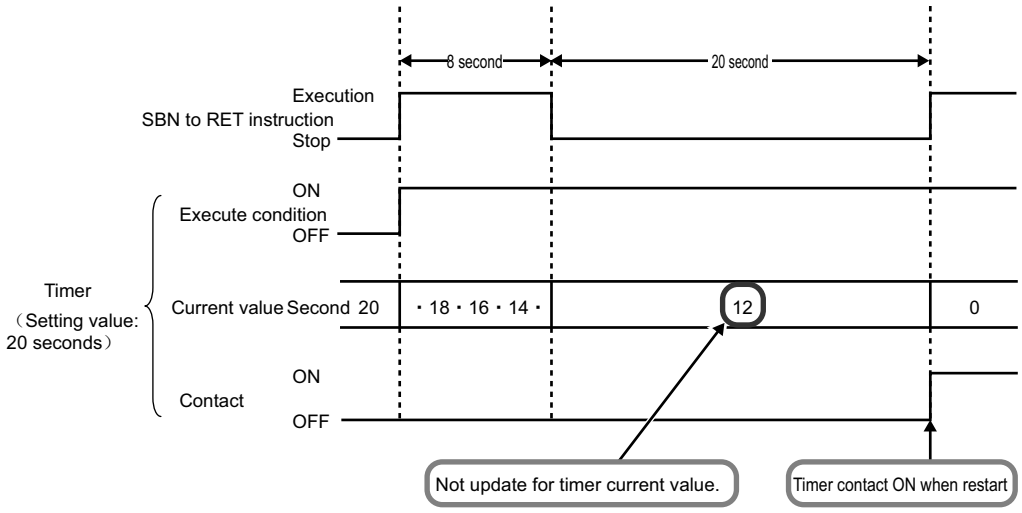
- TMR(100ms timer): ±(100ms + 1 scan time)
- TMH(10ms timer): ±(10ms + 1 scan time)
- TMS(1ms timer): ±(1ms + 1 scan time)
- TMU(10μs timer): ±(10μs + 1 scan time)
- UDT(Up/down counter): ±(10ms + 1 scan time)

■ Precautions when using a timer instruction

When a timer instruction is used between sub-routine instructions (SBN - RET), between step instructions (STP - STE), or between condition branch instructions (CJ/NCJ - LABEL), if the instruction conditions are not enforced, the current value of timer will then not be updated.

If time counting continues and instruction execution is restarted, the elapsed time will be reflected in current value of timer. If the set time has elapsed, timer contact will be ON quickly when the execution is started again. If the wait time is too long (i.e. not executed immediately), however, the timer contact may not be ON sometimes even if the set time has elapsed. For this, please use this when the processing is not stopped.

(Example) program a 20s timer instruction between SBN-RET instructions



TIP ·The ONDL/OFDL/SHOT/FLIK instruction will act just like the above-mentioned, which should be paid attention to.

· If a timer instruction is used in the module/macro and the execution in module/macro is stopped, the timer instruction is then reset through OFF , and the above-mentioned will not occur.

"Standby Module Operation", Page 3-98
"Macro Type", Page 3-112

■ Set value/current value processing

The setting value/current value reading or changing instructions are listed as follows:

	Reading	Changing
Current value	MOV, LDA instruction	MOV, DW instruction
Set value	(Can't read)	STA Instruction*

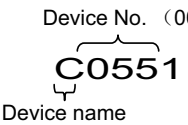
* Set values changed with the STA instruction will be cleared when power is ON or RUN→PROG, and returned to original value.
If the timer value is specified with a device, then the value is updated by the specifying device each time scanning is performed.

Note If the current value exceeds setting value, the current value is then changed to the setting value.

Counter (Contact) C

Overview Counter contains contact (1-bit), setting value (32-bit), current value (32-bit).
Counter is a kind of device whereby the contact is ON when the current value is the same as the setting value (counting is finished).

Denotation The device No. is structured as follows:
(Example)



Contacts, current values and setting values depend on the instruction operand used.

Range C0000 to C3999

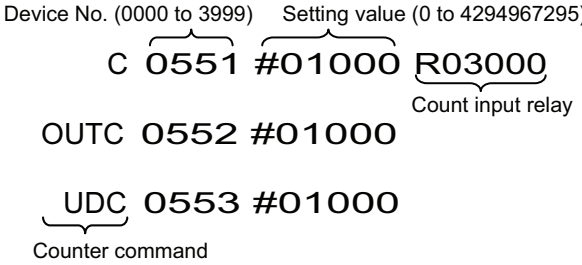
Description Three kinds of counter are available: counter, output counter, up/down counter.

Default setting Under the default state, contact states, current values, setting values are kept.
Under default state, output relays will clear the states turning to OFF when power is ON and PROG-> RUN. You can change this to "Hold" in the " set power failure setting " tab from the "CPU system settings".

TIP ·Zero suppression can be used in programming.
(Example)C551
·Timer and counter can use the device with same numbering.

■ How to program a counter action

Program counter action by designating counter No. setting value, count input relay used in counter instruction operand.



TIP ·Alternatively, a device can be used for value specifying.

"Action differences between various counters"

Counter type (instruction)	Counter No. assignment	setting value	Reset mode
Counter (C)	0 to 3999	0 to 4294967295	Execution condition OFF
Output counter(OUTC)			RES instruction
Up/down counter(UDC)			Reset input ON

For details on instructions,"KV-8000/7000/5000/3000/1000 Series·KV Nano Series Instruction Reference Manual "2-6 Memory Card Instructions"

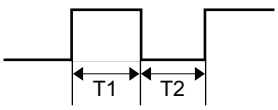
■ Counter max counting speed

Counting is performed only when both the counter input ON time and OFF time are longer than scanning time.

Calculation formula is shown below. To use a speed higher than the following mentioned, a high-speed counter or interrupt function can be used.

$$\text{Max. count speed} = \frac{\text{Operation ratio (\%)}}{100} \times \frac{1}{\text{Scan time (sec)}} \text{ (unit: times/sec)}$$

* The ratio between the signal ON and OFF times is called the "duty ratio."



when T1≦T2 operation ratio$= \frac{T1}{T1+T2} \times 100$ (unit: %)

when T1>T2 operation ratio$= \frac{T2}{T1+T2} \times 100$ (unit: %)

■ How to process set counter value/current value

The setting value/current value reading or changing instructions are listed as follows:

	Read	Change
Current value	MOV, LDA instruction	MOV, DW instruction
Setting value	(Can't read)	STA Instruction*

* If the counter value is specified with a device, then the value is updated by the specifying device each time scanning is performed.

Note

If the current value exceeds setting value, the current value is then changed to the setting value.

High-speed counter comparator (contact) CTC

Overview High speed counter comparator is a device whereby it turns ON when the current value of high-speed counter is the same as the setting value.

Note

When CTC is used as interrupt element, CTC (contact) is not ON.

Range CTC0 to CTC3

Description CTC can also be taken as an interrupt condition for interrupt routine execution.

Default setting Under the default state, contact states and setting value are kept.
You can also choose to clear the value when power is ON or PROG->RUN by selecting the "Clear" option from the "set power failure setting" tab in the "CPU system settings" window.

Control relay(contact) CR

Overview Control relay is special internal auxiliary relay that is used to control PLC function and capture PLC state.

Range CR0000 to CR3915

Description "A-2 CR/CM list", Page A-7

Word Device

Data memory/extended data memory DM/EM

Overview A data memory and extended data memory is used to save reference data or 16-bit per point devices in function operations.

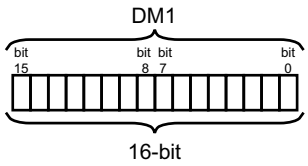
Denotation The device No. is structured as follows:
(Example)



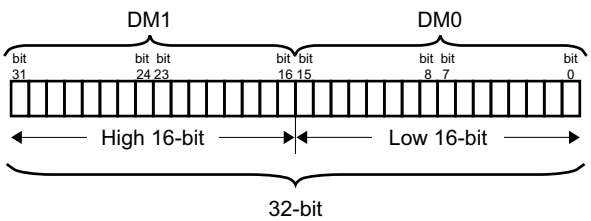
TIP ·The letter M in DM/EM can be omitted.
Zero suppression can be used in programming.
(Example)DM6143
· Can be used as a device.
(Example) DM1100 .....the lowest bit of DM1100 is processed.
·Can be used as a bit device by specifying the bit position.
(Example) DM1200.12 The 13th bit of DM1200 is processed.
"The bit device processing for a word device", Page 3-81
·"D" is displayed when the XYM Marking is selected.
"About XYM Marking", Page 3-54

Range DM00000 to DM65534
EM00000 to EM65534

Description ·Only Data Memory (DM) can be assigned as the unit device of expansion unit.
The bit width of 1 device point is 16 bit. When used as unsigned decimal number, 0 to 65535 can be processed; when used as signed decimal number, - 32768 to ++32767 can be processed; when used as hexadecimal number, $0 to $FFFF can be processed.



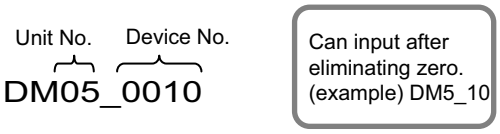
·2 devices can also be used to process 32-bit data. For 32-bit data, the low 16 bits will be stored in the data memory of the specified device No. and the high 16 bits will be stored in the data memory of the next device No.. If used as unsigned decimal, the value will be 0 to 4294967295; if used as signed decimal, the value will be -2147483648 to +2147483647; if used as hexadecimal, the value will be $0 - $FFFF.



·If the data memory is used to specify a 32-bit operand, then only the device No. which stores the low 16-bit can be specified.

Default setting Under default status, the value is held.
You can also choose to clear the value when power is ON or PROG->RUN by selecting the "Clear" option from the "Power-off hold settings" tab in the "CPU system settings" window.

TIP ·Data memory (DM) unit device labeling
In "KV STUDIO", besides ordinary labeling, unit code numbers can also be used for labeling. To select unit device labeling, select "View (V)" (view) -> "Display devices for unit (Y)" from the menu.



Unit No.: From CPU, according to the unit connection sequence, assign 00, 01, 02, 03, 04…and the like.

Unit DM No.: Specifying for the occupied data memories starts from 0000.

(Example)

Unit No.	00 *	01	02	03	04	05
KV-U7	KV-5500/ 5000/3000 CPU	KV-AD40 22 words	KV-DA40 18 words	KV-H20S 320 words	KV-H20S 320 words	KV-H20S 320 words
Unit DM No.:		0000 to 0021	0000 to 0017	0000 to 0319	0000 to 0319	0000 to 0319

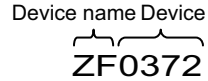
KV-C32TA input 17th-point..... DM01_0004
KV-H20S of 53 ..... DM03_0052
KV-H20S of 1..... DM05_0000

* KV-5500/5000 / 3000 's built-in input/output devices cannot use the unit device labeling.
For the KV-5500/5000 CPU built-in EtherNet/IP/Ethernet/FL-net devices, the unit devices with "00_" as the leading numbers are used for labeling.

File Register ZF/FM

Overview File register can be classified into ZF whereby all areas are processed sequently and FM whereby the area is divided into four memory banks which are switched over in processing.

Denotation The device No. is structured as follows:
(Example)



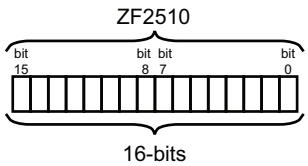
TIP ·Zero suppression can be used in programming.
(Example) ZF372
·Can be used a bit device.
(Example) FM1100 .....the lowest bit of FM1100 is processed.
·Can be used as a bit device by specifying the bit position.
(Example) DM1200.12 the 13th bit of ZF1200 is processed.
"The bit device processing for a word device", Page 3-81
·"FM" is displayed as "F" when the XYM Marking option is selected.
"About XYM Marking", Page 3-54

Note

- ZF local devices (@zfxxx) cannot be used.
- FM local devices (@FM0 - @FM32767) cannot perform memory bank switching.
- FM local devices use the work area (@FM0 - @FM32767).

Range ZF000000 to ZF131071
FM00000 to FM32767

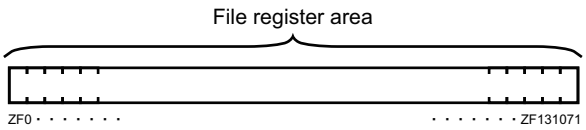
Description These relays cannot be assigned as the unit device of expansion unit.
·The device category and range varies depending on consecutive numbering and memory bank switching modes, .
·A device's bit width is 16 bit. If unsigned decimal is used, the value will be 0- 4294967295; if signed decimal, it will be +32767- +2147483647; if hexadecimal, it will be $0- $FFFF.



·2 devices can also be used to process 32-bit data. For 32-bit data, the low 16 bits will be stored in the data memory of the specified device No. and the high 16 bits will be stored in the data memory of the next device No.. If used as unsigned decimal, the value will be 0 to 4294967295; if used as signed decimal, the value will be -2147483648 to +2147483647; if used as hexadecimal, the value will be $0 - $FFFF.

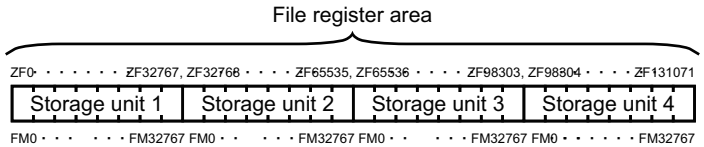
● ZF: used in the consecutive numbering mode

The whole file register area is used as a single device range.



● FM: used in the memory bank switching mode

The file register is divided into four areas which are switched over in use.



Through switching memory banks, four different device ranges are available for a single device.
Since it can be mixed with ZF devices in use, attention should be made in data processing.
For more information about memory bank switching, please refer to"3-11 File Register", Page 3-137.

Default setting Under default status, the value is held.
You can also select the "Clear" option by clicking "CPU system settings" and " Power-off hold settings ".

Link Register W

Overview It is used as the cyclic transfer register for FL-net. Hex symbols are used for device labeling which is different from other word devices.

Denotation The device No. is structured as follows:
(Example)

Device name Device No. (0 to 3FFF)
W3A6F

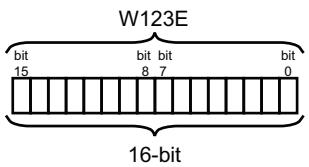
TIP ·Zero suppression can be used in programming.
(Example) W7A
·Can be used as a bit device by specifying the bit position.
(Example) DM1200.12 the 13th bit of ZF1200 is processed.
"The bit device processing for a word device", Page 3-81

Note
- Please use hexadecimal number (0 - F) for specifying.
- Local device (@) cannot be used.

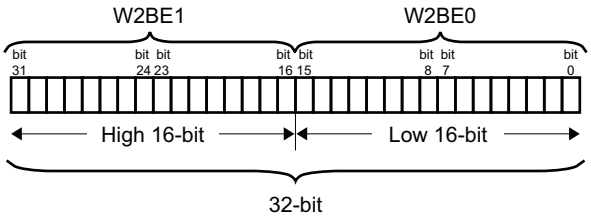
Range W0000 to W3FFF

Application Used as a cyclic transfer register for FL-net.

Description These relays cannot be assigned as the unit device of expansion unit.
·A device's bit width is 16 bit. If unsigned decimal system is used, the value will be 0-4294967295; if signed decimal, +32767- +2147483647; if hexadecimal, $0- $FFFF.



·2 devices can also be used to process 32-bit data. For 32-bit data, the low 16 bits will be stored in the data memory of the specified device No. and the high 16 bits will be stored in the data memory of the next device No.. If used as unsigned decimal, the value will be 0 to 4294967295; if used as signed decimal, the value will be -2147483648 to +2147483647; if used as hexadecimal, the value will be $0 - $FFFF.



Default setting Under default status, the value is held.
To clear data, select "Clear" from the "power off holding setting" in the "CPU system settings".

Temporary Data Memory TM

Overview Temporary data memory is 16-bit word device that may perform the same processing as data memory. When an arithmetic operation instruction is used, the device area can also be used for temporary store of arithmetic operation data or arithmetic operation result data.

Denotation The device No. is structured as follows:
(Example)

Unit No. Device No.
TM010

Range TM000 to TM003(Used for arithmetic operation instruction)
TM004 to TM511(For simple indirect specifying)

TM No.	Application
TM000	Used for arithmetic operation (DIV, MUL, ROOT instruction)
TM001	
TM002	Used for arithmetic operation (DIV instruction)
TM003	
TM004 to TM511	Simple indirect specifying/common use

For more information about DIV and MUL instructions, please refer to the KV-8000/7000/5000/3000/1000 Instruction Reference Manual.
For more information about simple Indirect specifying, please see "Indirect Specifying", Page 3-75.

Default setting When power ON or PROG->RUN, the value is cleared and set to 0.

TIP ·TM000 - TM003 are used in DIV and MUL arithmetic operation instructions. It is advisable not to use them for any other purpose.
·Zero suppression can be used in programming.
(Example) TM10
·TM is saved in internal ultra high-speed buffer memory of KV-VELOCE Ⅱ (ladder special execution engine) for high-speed access.

Timer (current value/setting value) T

When the timer setting value (32-bit) is set up and current value (32-bit) is read, the timer is used as a word device.

"Timer (Contact) T", Page 3-62

Counter (current value/setting value) C

When the counter setting value (32-bit) is set up and current value (32-bit) is read, the counter is used as a word device.

"Counter (Contact) C", Page 3-64

high-speed counter (current value) CTH

Overview High speed counter is a 32-bit counter used to collect short interval signals that cannot be collected by common counter instructions.

Range CTH0 to CTH1

Description ·0 to 4294967295 or -2147483648to+2147483647 are processed
·Besides external input counting, internal clock counting is also available.
·The maximum response frequency is 50% duty ratio, single-phase, 100kHz, and 50khz phase difference .

Default setting Under default status, the value is held.
You can also choose to clear the value when power is ON or PROG->RUN by selecting the "Clear" option from the "set power failure setting" tab in the "CPU system settings" window.

"2-10 High-speed Counter", Page 2-101

High-speed counter comparator (setting value)CTC

Overview A device that stores high-speed counter setting values (32-bit).

Range CTC0 to CTC3

Description · It should be set between 0 to 4294967295 or -2147483648 to +2147483647
· Two setting values (CTC) can be set per high-speed counter (CTH).
CTC0, CTC1 ..... For CTH0
CTC2, CTC3 ..... For CTH1

Default setting Under default state, the contact state and setting value is held.
Under default state, output relays will clear the states turning to OFF when power is ON and PROG-> RUN. You can change this to "Hold" in the " set power failure setting " tab from the "CPU system settings".

Index Register Z

Overview A 32-bit word device that is used to specify the value attached to target device for index modification. Like data memory, it is used to store data and operation results.

Range Z01 to Z12

TIP Zero suppression can be used in programming.
(Example) Z3

Note

- Z11, Z12 is reserved for the system, please do not use.
- Bit specifying cannot be performed for word devices.
- Local devices are not available. The ZPUSH and ZPOP functions should be used.
  KV-8000/7000/5000/3000/1000 Series Instruction Reference Manual, "ZPUSH Instruction"
  KV-8000/7000/5000/3000/1000 Series Instruction Reference Manual, "ZPOP Instruction"

Default setting When power is ON, or PROG -> RUN, index register is reset.

"Index Modification", Page 3-74

Control Memory CM

Overview Control memory is a special word device that is used to control PLC and capture PLC state.

Range CM0000 to CM5999

Description "A-2 CR/CM list", Page A-7

Index Modification

"Index modification" refers to the method for addressing a device by adding the value and constant of index register (Z) to a corresponding device.
The range for adding value is of signed 32-bit.
The devices that can use Index modification include R (DR), B, MR, LR, T, C, DM, W, EM, ZF, FM, and TM, and this is available to the whole device range.
Index modification can be used together with indirect specifying (*) and local device (@).

Note

- For the bit position specifying of the CTH, CTC, CR, CM, and Z labels (label arrangement) and word devices, index modification is not available.
  "Label", Page 3-162
  "The bit device processing for a word device", Page 3-81
- If addressing can be performed on the devices out of range that is capable of index modification according to argument, control relay CR2012 becomes ON and this function is not executed. But the operation continues.

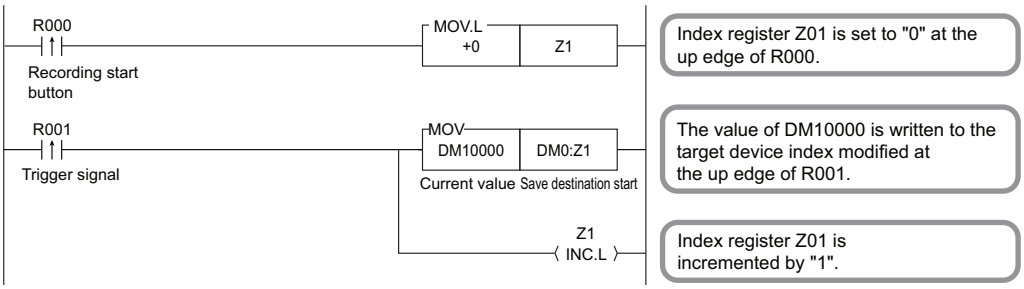
■ Modifying with the index register

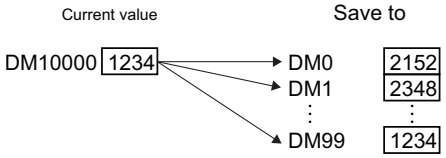
This is used to modify the devices specified with an instruction operand in operation.
Programming method to modify device through pointer register is as follows:.
"Device No." Z (1 to 10)
(Example) DM01000:Z01 ..... DM0990 is referenced when the value of Z1 is -10
R000 : Z5 ..... If the value of Z5 is a positive one, R100 should then be specified.

Note

Z11, Z12 are reserved for system, thus can't be used.

Example The current value in DM10000 will be stored as trigger signal in up edge of R001. Recording is started in the up edge of R000 , and data storing is started from DM0.





Note

Since the value for index modification is processed as a signed 32-bit value, ".L" should be suffixed to the instruction for index register operation.

TIP If more than ten index registers (Z) are used in one project, the index register instruction (ZPUSH/ZPOP) can be used to clean up or restore index registers of each module or macro in batch.

For more information, please refer to "3-8 Memory Card Instructions" in the KV-8000/7000/5000/3000/1000 Series Instruction Reference Manual

■ Modifying with the index constant

When a constant is used for in index modification, programming should done as follows:

(Example)DM1000 : #-10 ... The DM1000-10 word becomes DM990.
R000: #16..... R0000+16 bit (1 channel), becomes R100.

TIP The leading number can be easily identified if constant-based index modification is used in the macro in which unit devices are used. In addition, in macro programming, this, as the argument device, is effective even if UR/UM is used.

(Example)
UR0:#2
UM1:#32

"Application Example", Page 3-118

Indirect Specifying

■ Indirect specifying(*)

Indirect specifying (*) is used to modify the devices specified as an instruction operand in program execution process. Although index modification is also applicable to lookup devices, device types may also be modified if indirect specifying (*) is used, .

● Indirect specifying definition

All the devices are managed by internal memory in KV-5500/5000/3000 PLC, which have their own address. Since 32-bit data is used for address management, 2 words must be used for an address storage.
In Indirect Specifying (*), the specified device is modified by changing its address through a special instruction.
Indirect specifying can be used in combination with index modification (: Z /: #) and Local Device (@).

Note

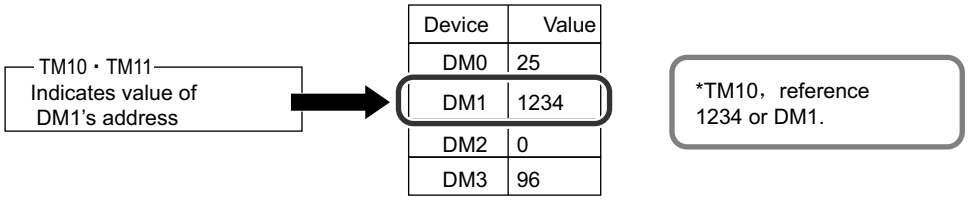
- Indirect specifying (*) cannot be used together with simple indirect specifying (#TM).
- If addressing can be performed on the devices out of range that are capable of index modification according to argument, control relay CR2012 becomes ON and this function is not executed. But the operation continues.

● Indirect specifying programming

If indirect specifying is programmed as "*(device)" and instruction operand, the device value or device corresponding to current device storage address will be referenced.

(Example)

<When programmed as *TM10>



Note

- The devices that can be programmed (for address storage) to "*(device)" include DM/EM/FM/TM/W/ZF.
- The devices applicable for indirect specifying include R/MR/LR/B/T/C/DM/EM/FM/TM/W/ZF.

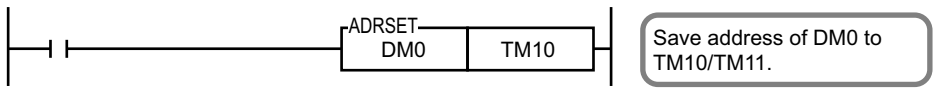
TIP ·If the indirect specifying device is a timer (T) or counter (C), the contact, current value and setting value then depend on the instruction operand.
·When a local device is used, the programming format is "*@ (device) ".

● How to use the indirect specifying

Perform indirect specifying as per the steps below.

1 Use the address setting instruction (ADRSET) to write the address of lookup device.

(Example)



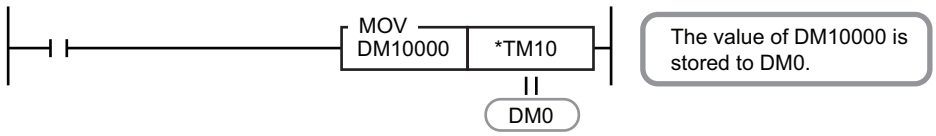
Note

The device that can store address include TM, DM, EM, FM, W, and ZF.

For details on instructions, please refer to "ADRSET Instructions" in the KV-8000/7000/5000/3000/1000 Series Instruction Reference Manual.

2 Add the prefix "*" before the device that stores the current address, and indirectly specify the device according to each instruction operand.

(Example)

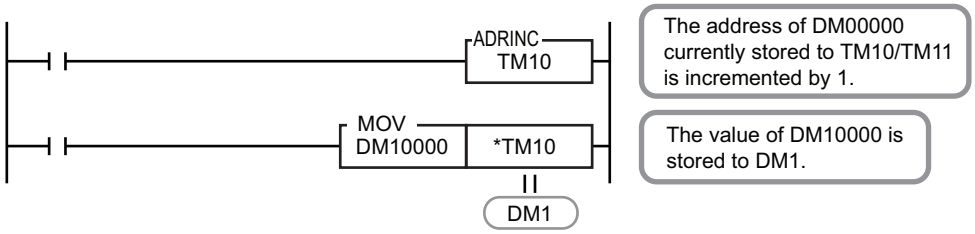


Note

Before adding prefix "*" to the device that stores the address, please always use the ADRSET instruction to store address of the indirectly specified device.

3 To change the device to be searched, use the special indirect addressing instruction (ADRINC/ADRDEC/ADRADD/ADRSUB) to change the currently stored address.

(Example)



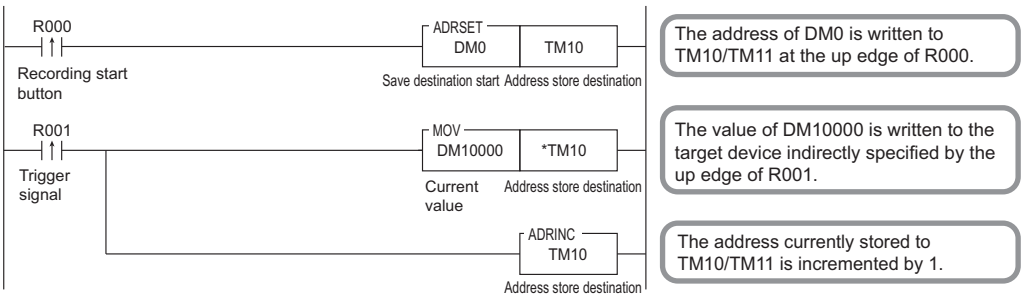
Note

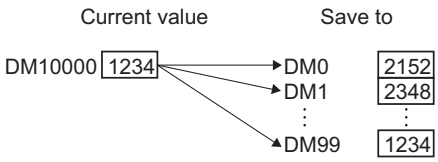
When modifying the reference address, please do not use ordinary arithmetic operation instructions (for example, ADD/INC/SUB/DEC,etc).Otherwise, the ladder program cannot run correctly.

For details on instructions, please refer to "3-9 Memory Card Instructions" in the KV-8000/7000/5000/3000/1000 Series Instruction Reference Manual

● Example: how to use the indirect specifying

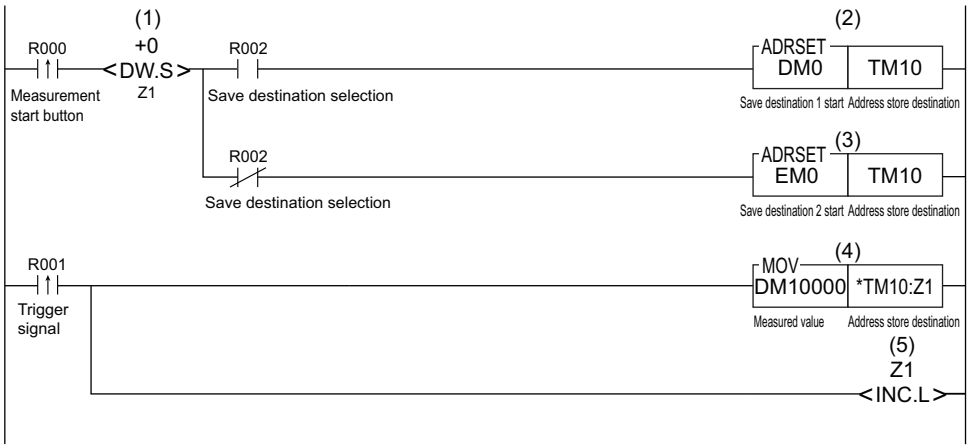
To save the current value of DM10000 with the up edge of R001 as the trigger signal.
Recording is started in the up edge of R000, and data is stored from DM0.





● Example: when used together with the index modification

To save the current value of DM10000 with the up edge of R001 as the trigger signal.
At the up edge of R000, if R002 is ON, data is stored from DM0; if it is OFF, stored from EM0.



To start,

(1) Write 0 in the pointer register Z1.

(2) If R002 is ON, write the DM0 address in TM10/TM11.

(3) If R002 is OFF, write the EM0 address in TM10/TM11.

To trigger,

(4) Use the Z1 index specification to modify the device (adding the value of Z1) whose address is stored in TM10/TM11, and write the value of DM10000 in the modified device.

(Example)

*TM10->EM0 → *TM10:Z1->EM23

Z1= 23

(5) Add Z1 by 1.

■ Simple indirect specifying #TM

The indirect specifying of temporary data memory (TM) is used for this.

Note

- Simple indirect specifying cannot be used together with the index modification, indirect specifying (*), and local device (@) .
- The simple indirect specifying feature is support for the reuse of existing programs. To program a new program, it is recommended that the index modification or indirect specifying be used.

● How to use the simple indirect specifying

This is done by programming #TMnnn in instruction operand to modify the value stored in TMnnn. The relationship between the value stored in TMnnn and #TMnnn is shown in the table below.

Value Stored to TMnnn	Reference destination of simple indirect specification	
0	DM0	Indirectly specified DMs
1	DM1	
2	DM2	
⋮	⋮	
9997	DM9997	
9998	DM9998	
9999	DM9999	
10000	R000	Indirectly specified relays (R)
10001	R001	
10002	R002	
⋮	⋮	
27913	R17913	
27914	R17914	
27915	R17915	

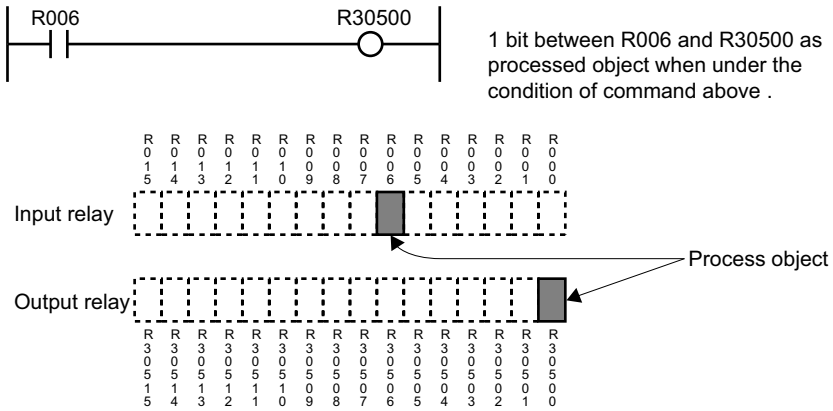
The usable range of temporary data memory is TM0 to TM511. Since TM0 to TM3 can also be used for arithmetic operation, however, duplication should be prevented.

Note

- Simple indirect specifying is only applicable to DM/R, DM10000 to DM65534,and R18000 to R99915.
- If the value in temporary data memory (TM) is larger than 27915, the control relay CR2012 (operation flag) is ON when performing simple indirect specifying, and this instruction is not executed. But the operation continues.

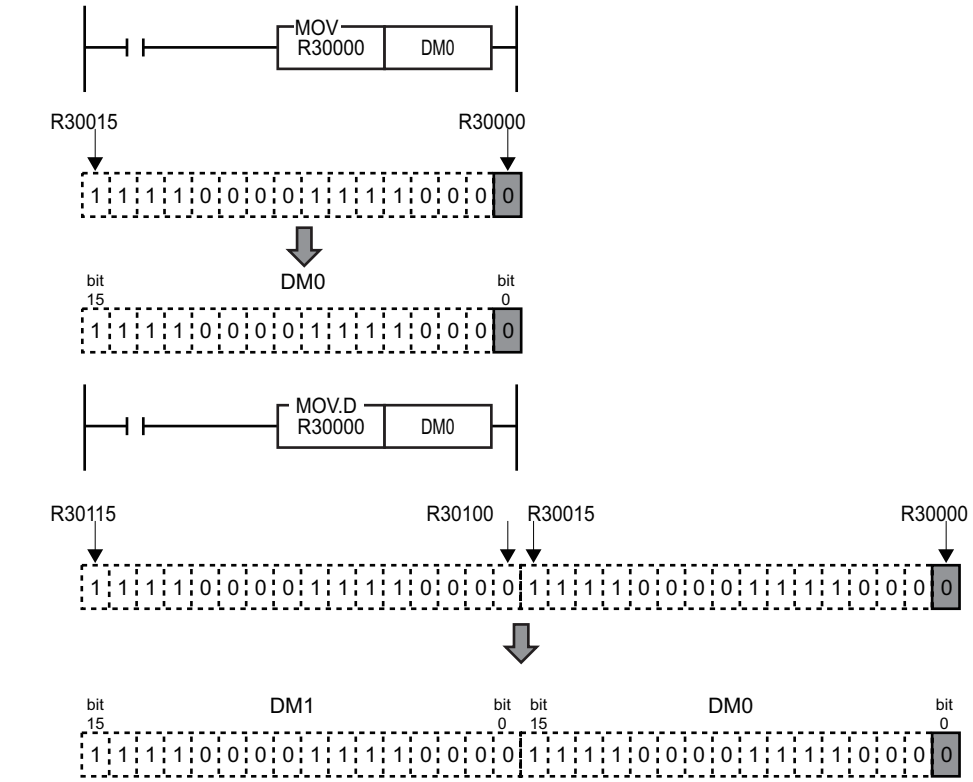
The word unit processing for bit device

Generally speaking (namely sequence instruction), a bit device can be processed as a 1-bit device.

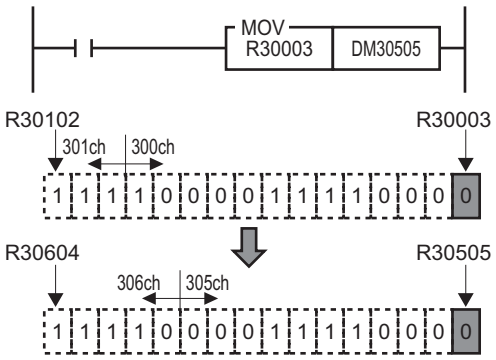


In an arithmetic operation instruction, bit devices can be grouped into 16-bit or 32-bit for processing.
If a bit device is designated to a instruction operand based on bit unit for processing, the word unit is used for processing starting from the specified bit device.

Example



If the bit device assigned to an operand is not in the leading channel position, straddle word unit processing is then performed for the bit device.



Note

When the straddle word unit processing is used, the processing speed will decrease.

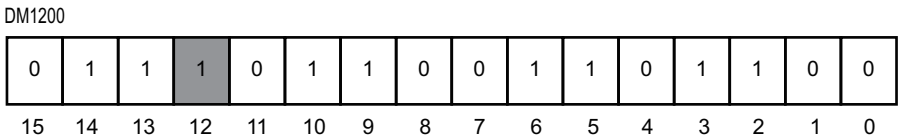
The bit device processing for a word device

Generally, a word device is processed as a 16-bit or 32-bit device.
To process a word device as any bit device, use the "bit contact instruction" and "bit output instruction".
For the operands of the following instructions, the bit position of word device can be specified.

Destination instructions: LD, LDB, AND, ANB, OR, ORB, LDP, ANP, ORP, LDF, ANF, ORF, LDPB, ANPB, ORPB, LDFB, ANFB, ORFB, OUT, OUB, SET, RST, KEEP, DIFU, PIFD

Example

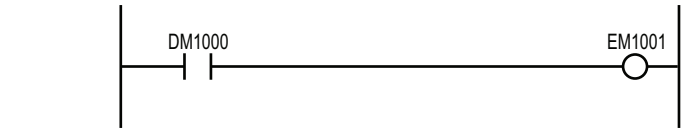
Process DM1200.12…the 12th bit of DM1200 is processed.

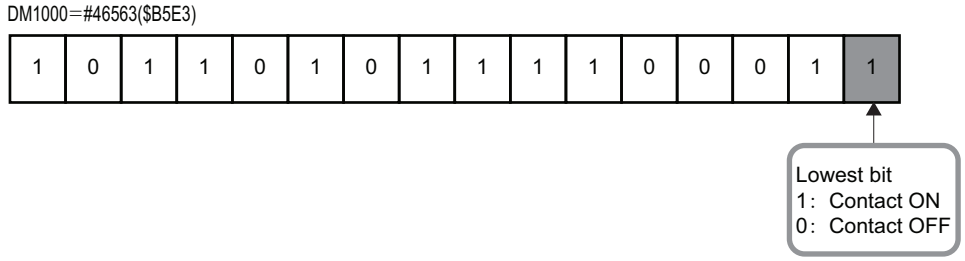


When a word device is specified with other instructions than the above-mentioned, only the lowest bit of the specified word device is processed as a bit device.

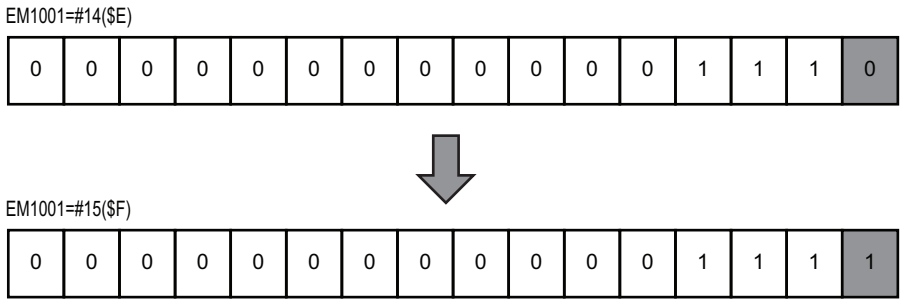
Example

When the value of DM1000 is #46563($B5E3)





In the above-mentioned example, when the contact is ON, the lowest valid bit of EM1001 becomes "1".



TIP Other bits are not changed.

Constant

The constant value and range varies depending on the instruction and suffix used.

#Decimal constant

Overview A decimal constant is a decimal that is represented by a bit width of 16-bit and 32-bit.

Denotation ·Unsigned (when suffix is "U" or "D")

A decimal constant is represented by the prefix "#" which is followed by decimal numbers.

(Example)

Indicates signal of Decimal Value

#06143

·Signed (when the suffix is "S" or "L")

A decimal constant is represented by a sign which is followed by decimal numbers.

Range ·Unsigned 16-bit: #0 to #65535

·Unsigned 32-bit: #0 to #4294967295

·Signed 16-bit: -32768 to +32767

·Signed 32-bit: -2147483648 to +2147483647

TIP ·Zero suppression can be used in programming.
·A signed decimal constant can also use the prefix "#". If a decimal constant has the symbol "#", the "+" sign then has to be omitted.
·In the XYM Marking mode, "K" can be attached.
"About XYM Marking", Page 3-54

$Hex constant

Overview A hex constant is a hex symbol which is represented by a bit width of 16-bit or 32-bit.

Denotation A hex constant is prefixed by "$" which is followed by hex symbols.
(Example)

Indicates signal of Hex Value
$1AF7

Range ·16 bits : $0000 to $FFFF
·32 bits : $00000000 to $FFFFFFFF

Note

During programming, if the hex constant has no prefix "$" and contains A to F, an error may occur; if it does not contain A to F, it will be considered as a decimal number.

TIP ·Zero suppression can be used in programming.
·In XYM Marking mode, "K" is attached.
"About XYM Marking", Page 3-54

Single precision floating-point constant

Overview This refers to a floating-point instruction operand.

Denotation • A floating-point constant is represented by a sign which is followed by decimal numbers.
• Above 8-bit is represented in the exponent form.

Range -3.4E+38<= N<=-1.4E-45
N=0
+1.4E-45<= N<=+3.4E+38 (valid bits:7)

TIP The prefix "#" symbol can be used. If so, the "+" sign has to be omitted.

Double precision floating-point constant

Overview This refers to operand of double precision floating-point command.

Denotation " •" Signed decimal value may be used directly.
•" Represented by index above 15 bit.

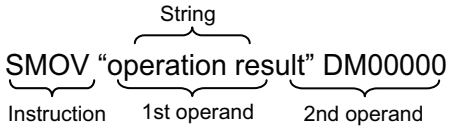
Range -1.79E+308<=N<=-2.23E-308
N=0
+2.23E-308<=N<=+1.79E+308(number of significant digits: about 16 bit)

TIP The prefix "#" symbol can be used. If so, the "+" sign has to be omitted.

Fixed character string

Overview This refers to a character string instruction and timing contact instruction operand.

Denotation " " represents a character string.
(Example)



Note If there is no the " ", it will be treated as a label in processing.

TIP When (") is used as a character in processing, please enter ("").

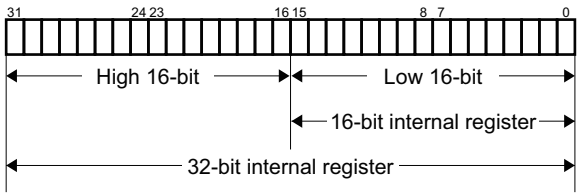
Range Up to 31 characters (half-width)

Internal register

Internal register is a device that is used to store the arithmetic operation results of an application instruction, arithmetic operation instruction, and extended instruction. As well as store temporary data during an arithmetic operation.
The data stored in an internal register remain unchanged before the following new data is stored.
When power is ON or PROG->RUN, internal register is reset.

● 16 bit internal register/32 bit internal register

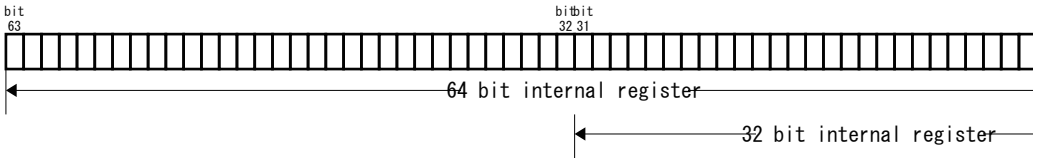
16 bit internal register/32 bit internal register is shown below, consists of 32 bit, high 16 bit/low 16 bit. .



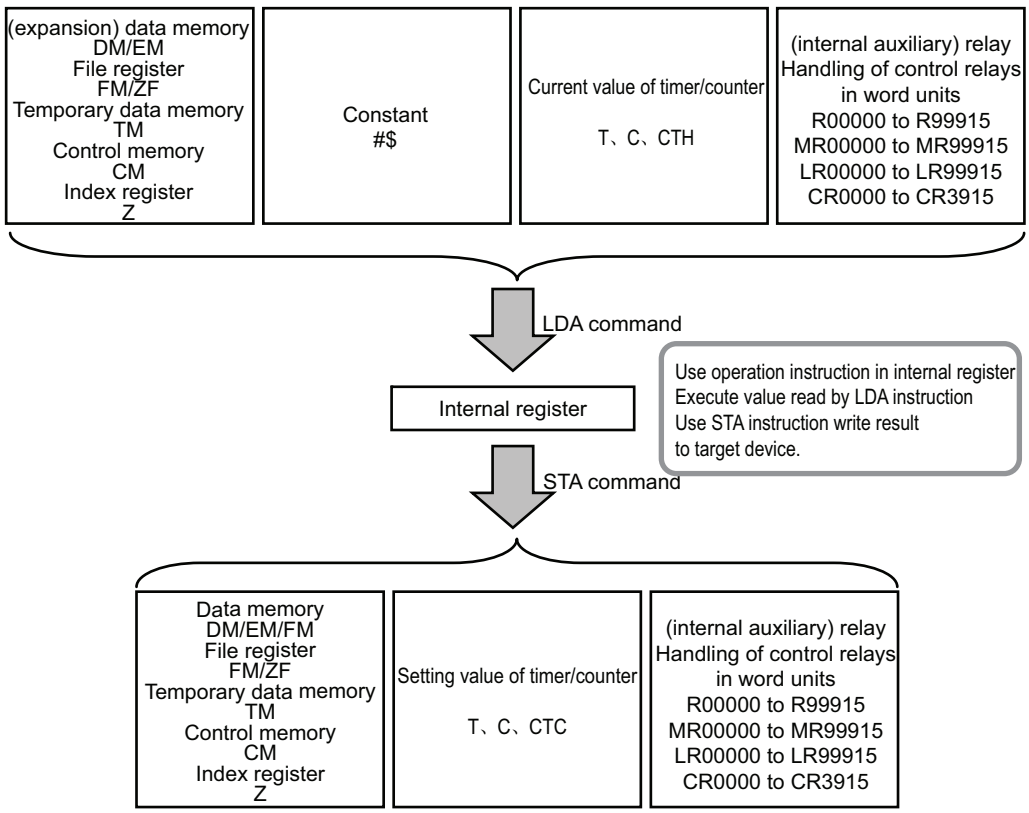
Internal register of low bit 16-bit is called 16-bit internal register. An internal register which contains 16 low bits is called 16-bit internal register. An internal register which contains both high and low 32 bits is called 32-bit internal register.

● 64 bit internal register

64 bit internal register as follows, it consists of 64 bits, could only be used for processing double precision floating-point type command or suffix (.DF). Low 32 bit of 64 bit register is universal to 32 bit register.

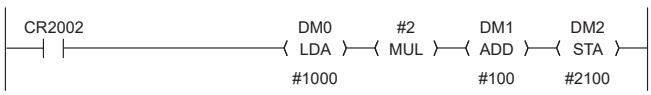


● Internal register and arithmetic operation instruction



Example

Read DM0 to the internal register, which is multiplied by 2 plus the value of DM1, then stored in DM2.



3-7 Data Processing

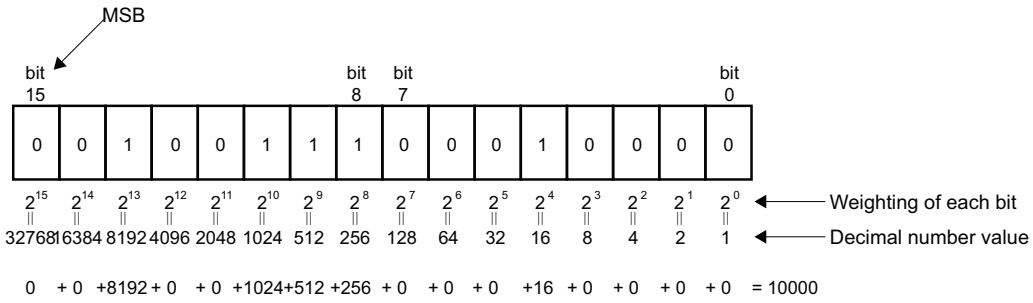
Five types of data may be processed in a ladder program: BIN, DEC (unsigned/signed), HEX, BCD, single precision floating-point real number and double precision real number.
And text string and ASCII/Shift-JIS can also be processed.

BIN Data

In KV-5500/5000/3000 PLC, only BIN processing is available within a device and internal register.
1 BIN bit is processed with "bit" as the unit. A bit has two states: "0 (OFF) " and "1 (on).

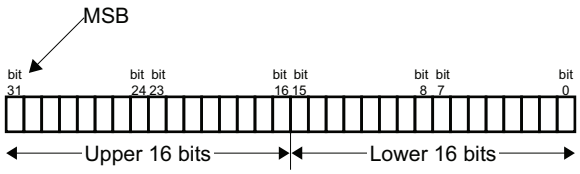
■ 16-Bit BIN data

Normally, a 16-bit data is processed with "word" as the unit. A unsigned DEC can be represented as 0 to 65535.
(Example)



■ 32-Bit BIN data

32-bit data (two words) can represent a unsigned DEC number ranging 0 to 4294967295.

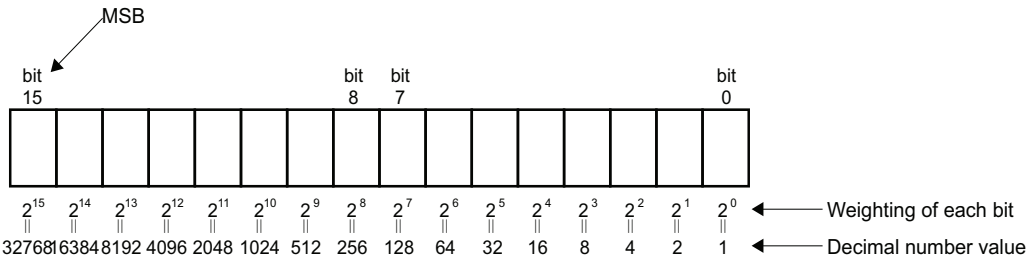


When a 32-bit device is processed in the DM/EM/FM/TM 16-bit word devices, two consecutive words should be used. Low 16-bit data is processed in the low byte device and high 16-bit data is processed in the high byte device.

Representation

■ BIN (Binary)

Only "0" and "1" are used to represent KV-5500/5000/3000 internal BIN data. Each digit position carries when larger than 1.



(Example) 0110110100110001

TIP A BIN number cannot be used as the instruction operand.

■ #DEC

A DEC is used to represent the internal BIN data of KV-5500/5000/3000 .

● Unsigned

For 16-bit data, the processing range is 0 to 65535; for 32-bit data,
the processing range is 0 to 4294967295.

● Signed

Positive/negative is determined by the highest bit. (0: positive; 1:negative)
For 16-bit data, the processing range is -32768 to 65535; for 32-bit data, -2147483648 to +2147483647.

TIP Input as instruction operand."#" or symbol is indicated at the beginning of a value.
(example) #1000, +12, -25489

■ HEX

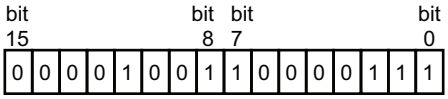
A HEX is used to represent the internal BIN data of KV-5500/5000/3000 .
Each HEX digit represents four BIN digits. One digit is in the range of DEC 0 to 15. So digits larger than 9 uses A, B, C, D, E, F. When larger than F, carrying is performed.
For 16-bit data, the processing range is -32768 to +32767; for 32-bit data,
the processing range for $000000 is 00 to $FFFFFFFF.

TIP Values with "$" as the leading symbol can be used as instruction operand.
(example) $00FF

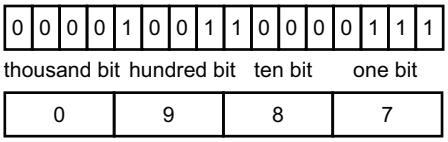
■ BCD (Binary Coded Decimal)

Like HEX, BCD also takes 4 BIN digits as a unit for processing. And like DEC, carrying is performed when larger than 9. Hence symbols A to F are not used.
For 16-bit data, processing range is 9999 to 65535; for 32-bit data,
the range is 99999999 to 4294967295.

Example



When 16-bit data is currently stored as shown above,
conventionally this becomes the value $0987 (#2439 in decimal annotation),
however in binary coded decimal, this becomes "0987" annotated in decimal.



Binary Code Decimal (BCD) is well suited for external data processing (digital switch etc).
For arithmetic operations in KV-5500/5000/3000 PLC, however, they have to be processed in the BIN form data. When reading from external equipment, please use the TBIN instruction to convert them into BIN data; and when outputting to external equipment (digital display etc), please use the TBCD instruction to convert BIN data into BCD.

TIP To use BCD as an operand, please add the prefix "$" to the value forming a HEX number.

■ Single-precision floating-point number FLOAT

A FLOAT is DEC number that is processed in the form of 32-bit BIN.
The processing range is (N):

$$-3.4\times10^{38}<=N<=-1.4\times10^{-45}$$
$$N=0$$
$$+1.4\times10^{-45}<=N<=+3.4\times10^{38}$$

TIP ·Can be used as an instruction operand.
Can only use the ordinary DEC point form (example:-1.2345), and cannot use "E".
(example) -2.743×10^{12} -> -2.743E12
$+8.9025\times10^{-4}$ -> +8.9025E^{-4}
·The precision of a FLOAT is 32-bit, with 7 significant digits.
·The 32-bit data for storage of FLOAT follows the IEEE standard.

■ Double-precision floating-point number DOUBLE-FLOAT

A FLOAT is DEC number that is processed in the form of 64-bit BIN.

The processing range is (N):

$$-1.79\times10^{+308} <= N <= -2.23\times10^{-308}$$
$$N=0$$
$$+2.23\times10^{-308} <= N <= +1.79\times10^{+308}$$

Note

CPU unit with CPU functional version above V2.0 may use DF (double precision decimal real number).

TIP ·Can be used as an double-precision instruction operand.

Can only use the ordinary DEC point form (example:-1.2345), and cannot use "E".

(example)$-2.1437956\times10^{12} \rightarrow$-2.1437956E+12

$+7.63259856\times10^{-4} \rightarrow$+7.63259856E-4

·The precision of a Float is 64-bit, with 16 significant digits.

·The 64-bit data for storage of FLOAT follows the IEEE standard.

Relationship Between Different Numbering Systems

The relationship between BIN, DEC, HEX, and BCD is as follows.

■ 16-bit data

DEC		HEX	BIN			
Unsigned	Signed	HEX				
0	+0	0	0000	0000	0000	0000
1	+1	1	0000	0000	0000	0001
2	+2	2	0000	0000	0000	0010
3	+3	3	0000	0000	0000	0011
4	+4	4	0000	0000	0000	0100
5	+5	5	0000	0000	0000	0101
6	+6	6	0000	0000	0000	0110
7	+7	7	0000	0000	0000	0111
8	+8	8	0000	0000	0000	1000
9	+9	9	0000	0000	0000	1001
10	+10	A	0000	0000	0000	1010
11	+11	B	0000	0000	0000	1011
12	+12	C	0000	0000	0000	1100
13	+13	D	0000	0000	0000	1101
14	+14	E	0000	0000	0000	1110
15	+15	F	0000	0000	0000	1111
16	+16	10	0000	0000	0001	0000
⋮	⋮	⋮			⋮	
99	+99	63	0000	0000	0110	0011
100	+100	64	0000	0000	0110	0100
⋮	⋮	⋮			⋮	
32767	+32767	7FFF	0111	1111	1111	1111
32768	-32768	8000	1000	0000	0000	0000
⋮	⋮	⋮			⋮	
65534	-2	FFFE	1111	1111	1111	1110
65535	-1	FFFF	1111	1111	1111	1111

BCD	BIN			
0000	0000	0000	0000	0000
0001	0000	0000	0000	0001
0002	0000	0000	0000	0010
0003	0000	0000	0000	0011
0004	0000	0000	0000	0100
0005	0000	0000	0000	0101
0006	0000	0000	0000	0110
0007	0000	0000	0000	0111
0008	0000	0000	0000	1000
0009	0000	0000	0000	1001
0010	0000	0000	0001	0000
0011	0000	0000	0001	0001
0012	0000	0000	0001	0010
0013	0000	0000	0001	0011
0014	0000	0000	0001	0100
0015	0000	0000	0001	0101
0016	0000	0000	0001	0110
⋮			⋮	
0099	0000	0000	1001	1001
0100	0000	0001	0000	0000
⋮			⋮	
0999	0000	1001	1001	1001
1000	0001	0000	0000	0000
⋮			⋮	
9998	1001	1001	1001	1000
9999	1001	1001	1001	1001

■ 32-bit data

DEC		HEX	BIN							
Unsigned	Signed									
0	+0	0	0000	0000	0000	0000	0000	0000	0000	0000
1	+1	1	0000	0000	0000	0000	0000	0000	0000	0001
2	+2	2	0000	0000	0000	0000	0000	0000	0000	0010
3	+3	3	0000	0000	0000	0000	0000	0000	0000	0011
4	+4	4	0000	0000	0000	0000	0000	0000	0000	0100
5	+5	5	0000	0000	0000	0000	0000	0000	0000	0101
6	+6	6	0000	0000	0000	0000	0000	0000	0000	0110
7	+7	7	0000	0000	0000	0000	0000	0000	0000	0111
8	+8	8	0000	0000	0000	0000	0000	0000	0000	1000
9	+9	9	0000	0000	0000	0000	0000	0000	0000	1001
10	+10	A	0000	0000	0000	0000	0000	0000	0000	1010
11	+11	B	0000	0000	0000	0000	0000	0000	0000	1011
12	+12	C	0000	0000	0000	0000	0000	0000	0000	1100
13	+13	D	0000	0000	0000	0000	0000	0000	0000	1101
14	+14	E	0000	0000	0000	0000	0000	0000	0000	1110
15	+15	F	0000	0000	0000	0000	0000	0000	0000	1111
16	+16	10	0000	0000	0000	0000	0000	0000	0001	0000
⋮	⋮	⋮	⋮							
99	+99	63	0000	0000	0000	0000	0000	0000	0110	0011
100	+100	64	0000	0000	0000	0000	0000	0000	0110	0100
⋮	⋮	⋮	⋮							
2147483647	+2147483647	7FFFFFFF	0111	1111	1111	1111	1111	1111	1111	1111
2147483648	-2147483648	8000000	1000	0000	0000	0000	0000	0000	0000	0000
⋮	⋮	⋮	⋮							
4294967294	-2	FFFFFFFE	1111	1111	1111	1111	1111	1111	1111	1110
4294967295	-1	FFFFFFFF	1111	1111	1111	1111	1111	1111	1111	1111

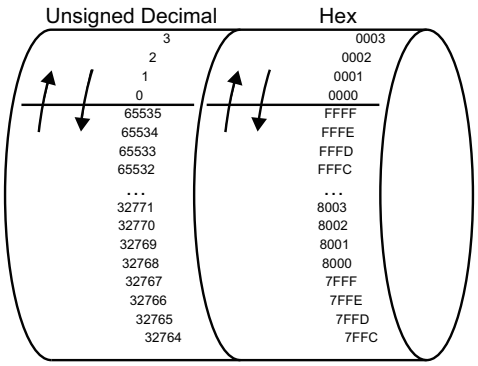
BCD	BIN							
00000000	0000	0000	0000	0000	0000	0000	0000	0000
00000001	0000	0000	0000	0000	0000	0000	0000	0001
00000002	0000	0000	0000	0000	0000	0000	0000	0010
00000003	0000	0000	0000	0000	0000	0000	0000	0011
00000004	0000	0000	0000	0000	0000	0000	0000	0100
00000005	0000	0000	0000	0000	0000	0000	0000	0101
00000006	0000	0000	0000	0000	0000	0000	0000	0110
00000007	0000	0000	0000	0000	0000	0000	0000	0111
00000008	0000	0000	0000	0000	0000	0000	0000	1000
00000009	0000	0000	0000	0000	0000	0000	0000	1001
00000010	0000	0000	0000	0000	0000	0000	0001	0000
00000011	0000	0000	0000	0000	0000	0000	0001	0001
00000012	0000	0000	0000	0000	0000	0000	0001	0010
00000013	0000	0000	0000	0000	0000	0000	0001	0011
00000014	0000	0000	0000	0000	0000	0000	0001	0100
00000015	0000	0000	0000	0000	0000	0000	0001	0101
00000016	0000	0000	0000	0000	0000	0000	0001	0110
⋮	⋮							
00000099	0000	0000	0000	0000	0000	0000	1001	1001
00000100	0000	0000	0000	0000	0000	0001	0000	0000
⋮	⋮							
00000999	0000	0000	0000	0000	0000	1001	1001	1001
00001000	1000	0000	0000	0000	0001	0000	0000	0000
⋮	⋮							
99999998	1001	1001	1001	1001	1001	1001	1001	1000
99999999	1001	1001	1001	1001	1001	1001	1001	1001

■ When the maximum or minimum value is exceeded

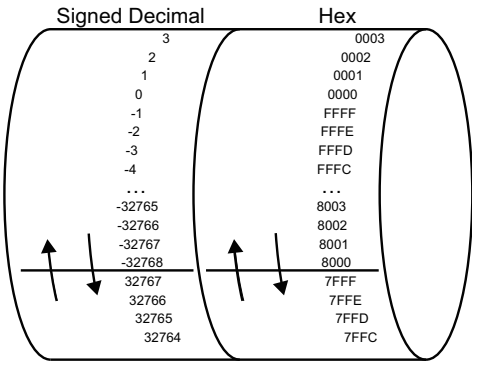
When the arithmetic operation result exceeds maximum value or minimum value, depending on data type, data change is shown below respectively.

● When data of 16-bit

Changes of number when 65535 or more

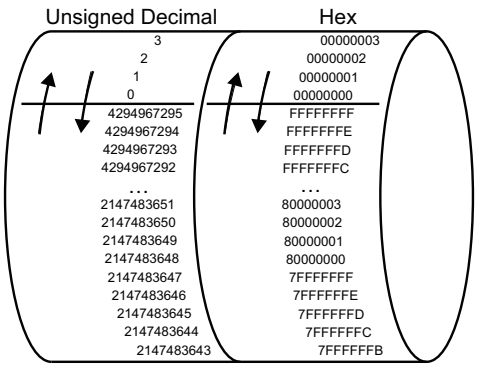


Changes of number when exceed Max. or Min.

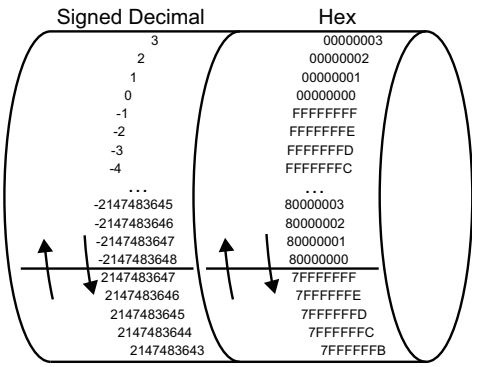


● When data of 32-bit

Changes of number when 4294967295 or more



Changes of number when exceed Max. or Min.



TIP ·Single-precision floating-point number data

Overflow: when the absolute value is larger than 3.4×10^{38}, it becomes "∞ (infinity)".
Underflow: when the absolute value is smaller than 1.4×10^{-45}, it becomes "0".



·Double-precision floating-point number data

Overflow: when the absolute value is larger than 1.79×10^{308}, it becomes "∞ (infinity)".
Underflow: when the absolute value is smaller than 2.23×10^{-308}, it becomes "0"。



Character Code

In order to process text strings in ladder program, the code number assigned to them are called character code.
In KV- STUDIO , the following character codes can be processed.

■ ASCII code

8 bits are used to represent 1 half-width character.
(example) A···$41　　1···$31

"ASCII Code Table", Page A-21

■ Shift JIS code

16 bits are used to represent 1 full-width character.

TIP Can be used as character processing instruction and calendar contact instruction operand. Use the """ to bracket the text string.
(example):"model ABC" ± "month/08:30:15"

Suffix

A suffix is a symbol attached to the end of an instruction, which is classified into the following 5 categories:

☐.U ☐.S ☐.D ☐.L ☐.F

* ☐ represents the instruction.

Example

ADD(.U)	MOV.(U)
ADD.S	MOV.S
ADD.D	MOV.D
ADD.L	MOV.L
ADD.F	MOV.F

☐.U Processed as unsigned 16-bit BIN data.(0 to 65535)
☐.S Processed as unsigned 16-bit BIN data.(-32768 to +32767)
☐.D Processed as unsigned 32-bit BIN data.(0 to 4294967295)
☐.L Processed as unsigned 32-bit BIN data.(-2147483648 to +2147483647)
☐.F Processed as Single-precision floating-point number. (-3.4E+38<= N <=-1.4E-45 / N=0 / +1.4E-45<= N<= +3.4E+38 / "Significant digits:7")
☐.DF Processed as Double-precision floating-point number. (-1.79E+308<= N <=-2.23E-308 / N=0 / +2.23E-308<= N<= +1.79E+308 / "Significant digits:16")

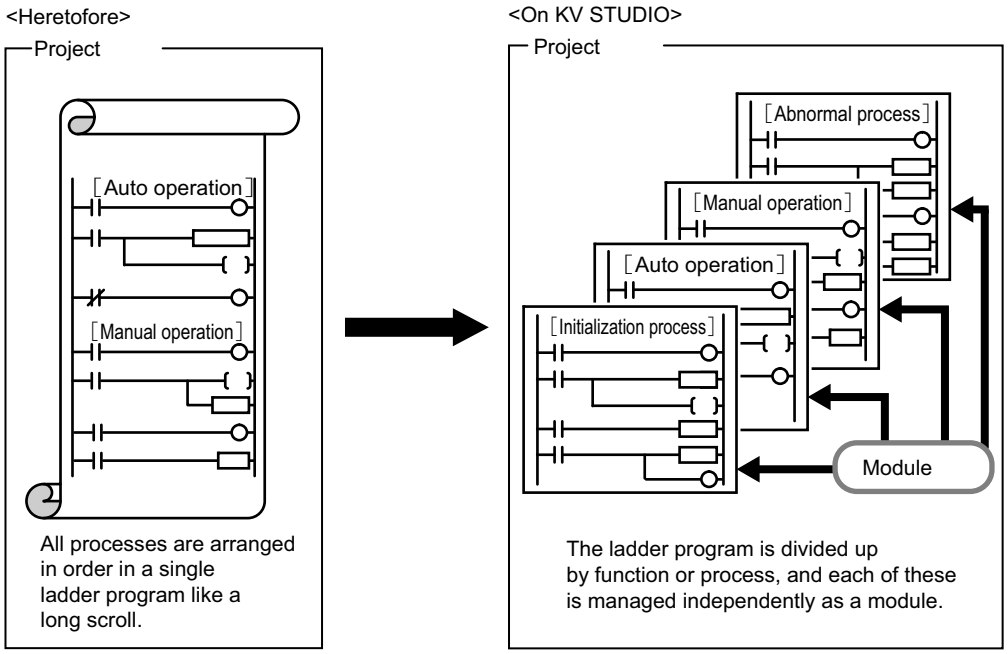
☐.U Omitted in KV STUDIO. In addition, instructions without a suffix are processed as unsigned 16-bit BIN data.

Depending on the suffix, DECs are used by the corresponding instruction for BIN data processing. Therefore, if suffix is different, the instruction execution result may also be different, even if BIN data is the same.

3-8 Module

Overview

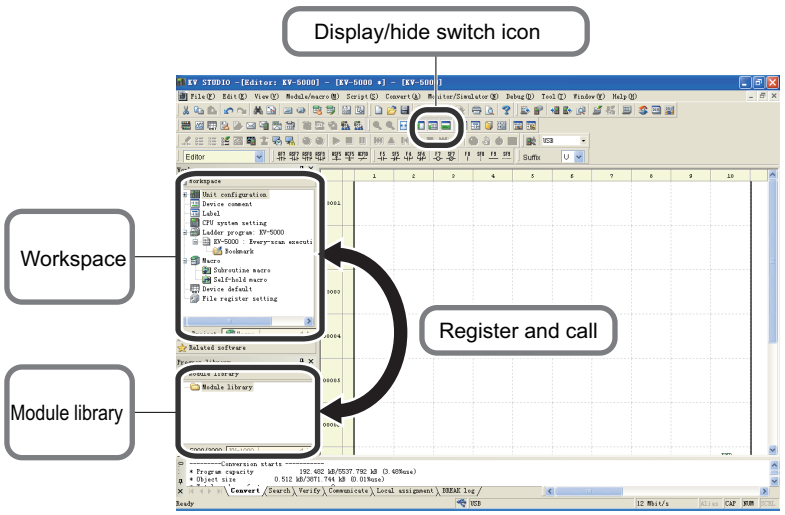
Normally, a ladder program involves multiple processes such as initialization, automatic operation, manual operation, and error handling. In an ordinary ladder program, these are processed in a consecutive fashion. With KV STUDIO, however, each process and feature can be programmed separately, thereby facilitating separate management over each of them.



■ Module Management

In KV STUDIO, the "workspace" is used for module management .

Easy program calling can be achieved by registering a frequently used module into the "Module Library".



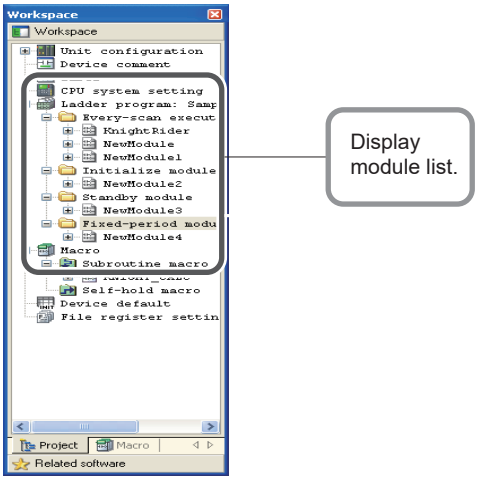
"Workspace" and "Module Library" can be selected from the "View(V)" option in the menu bar. Alternatively, you can also the Hide/Show icon in the tool bar to display them.
The display position can be changed.

TIP ·You can copy a module between applications by opening up multiple KV STUIDO windows.
·Modules of other projects can also be imported.

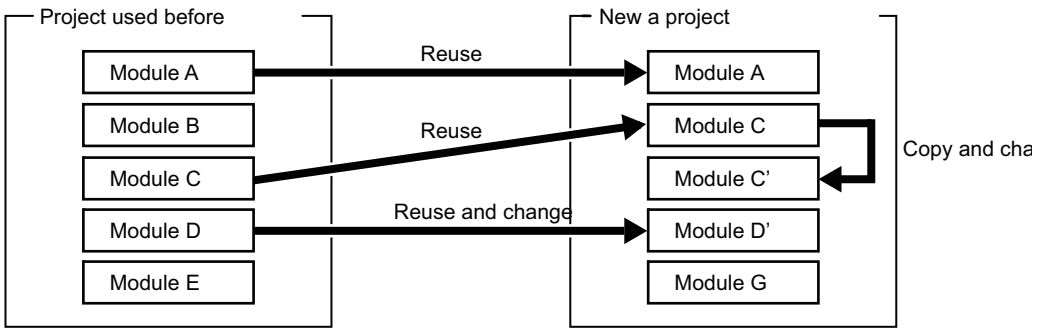
■ Module features

● Know the whole program at a glance

Since the tree structure is adopted for each module in the "Workspace" , even a non-programmer can understand them at a glance.



● Easy to reuse



● Improve efficiency in programming, modifying, and commissioning

Through module decomposition, the programming and commissioning efforts can be reduced. In addition, since the local device concept is adopted, device assignment is not required for each module, thereby ideally suitable for large team development work.

"3-10 Local Device", Page 3-131

Module Type

Module can be classified into "Every Scan Execution Type Module", "Initialization Module", "Standby Module", and "Fixed Period Module".
You can manage and even change all types of module In the KV STUDIO "Workspace".

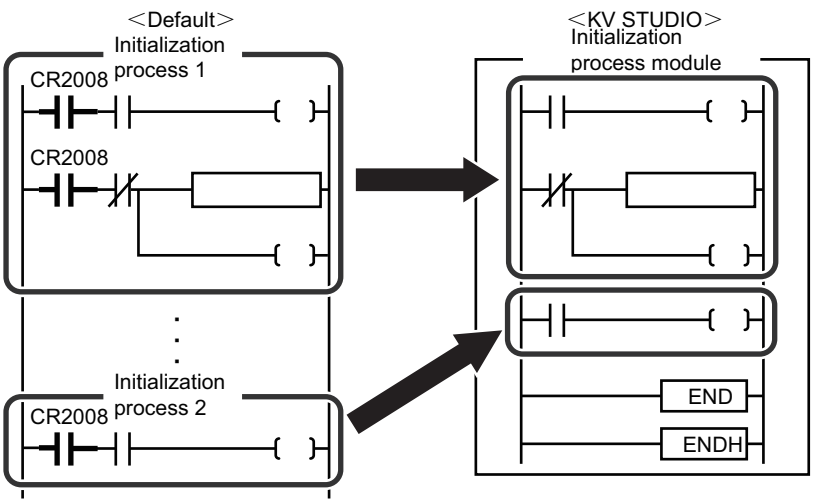
Every-Scan Execution Type Module

Every Scan Execution Type Module is executed right from the first time scanning (power on, or PROG -> RUN).
You can use the module instructions (MDSTOP Module Stop/MDSTRT Module Start) to control the module in operation.
The operations when using the module instructions are the same as the Standby Module.
"Standby Module Operation", Page 3-98

TIP ·If a module instruction is used but the execution state is not controlled, the module will be executed for each scanning.
·When KV STUDIO is used to create a new project, an Each Scan Execution Type Module with the same name as the project name will be created automatically.

Initialize Module

Initialize Module is carried out for a module only in first time scanning in running. Initialize Module is used to initialize equipment or restore the default settings of KV-5500/5000/3000. In a project, even if Initialize Module is not programmed, KV-5500/5000/3000 can still run.
So please program Initialize Module when required.



CR2008: only scan once ON when start operation

When a module is registered as Initialize Module, since it is unnecessary to execute the initialization routine in the next time scanning, the scanning time for this module can then be reduced.

Note

- Some instructions cannot be used Initialize Module.
  "Prohibited Instruction List", Page A-25
- For Initialize Module, the module instructions (MDSTRT/MDSTOP) cannot be used for execution state control.
- KV-5500/5000/3000 cannot run if only Initialize Module is provided. At least one or above Every Scan Execution Type Module or Standby Module should also be provided.

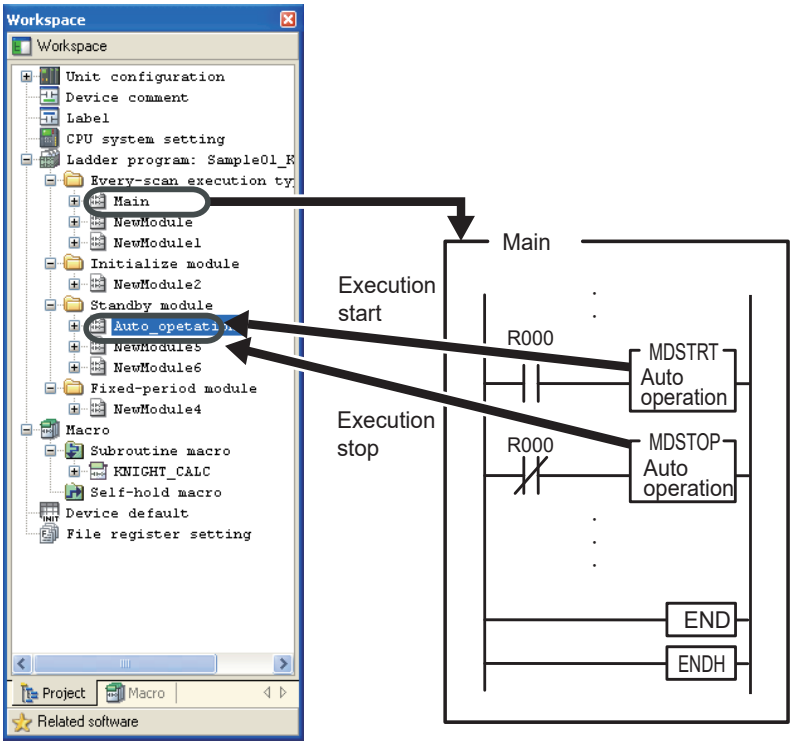
Standby Module

Standby Module is stopped when the operation starts. The module execution instructions (MDSTRT/MDSTOP) can be used to control its execution state during operation.

"Module instructions", Page 3-106

<Example: Standby Module calling>

In this example, the Standby Module execution state (Automation operation, automatic operation) is controlled by Each Scan Execution Type Module (Master).



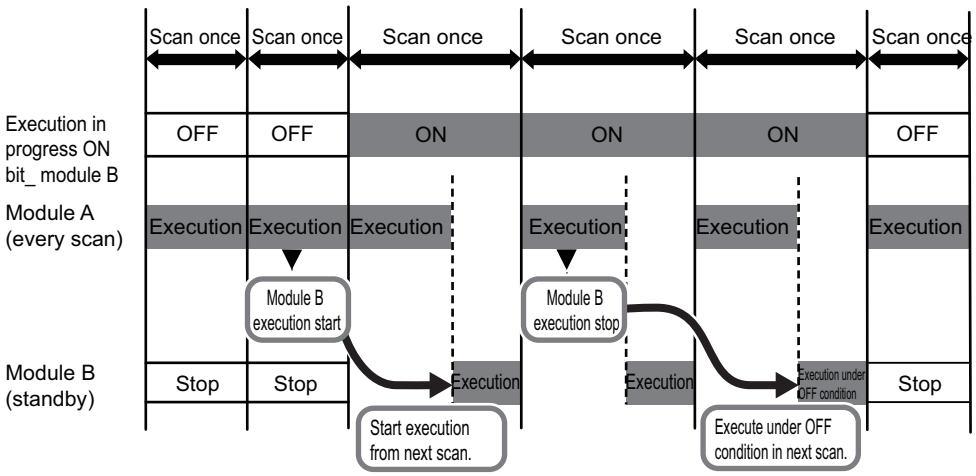
Note

KV-5500/5000/3000 cannot run if only Initialization Module is provided. At least one or above Every Scan Execution Type Module or Standby Module should also be provided.

TIP The execution state control is the same as Every Scan Execution Type Module.

■ Standby Module Operation

The operation of Standby Module is shown in the figure below.



● Start Standby Module

In the scanning whereby the MDSTRT instruction is called, Standby Module is not executed. Standby Module is executed from the next time scanning.

TIP The initial state of the differential execution instruction when Standby Module is started is ON in the up edge, and OFF in the down edge. For example, if the state before the first time scanning is ON, the up edge differential execution condition is not detected.

● Stop Standby Module

If the MDSTOP instruction is called during routine execution, Standby Module will still be executed within the scanning period whereby the MDSTOP instruction is called.
In the subsequent scanning period, Standby Module will be executed when all execution conditions are OFF.* Then, Standby Module is stopped in the next scanning period (the next scanning period following the calling scanning period).

* However, the following instructions are exceptional.

Instruction	State
OUB Instruction	OFF
OFDL Instruction	Reset.
SHOT Instruction	
C Instruction	State hold.
CJ/NCJ/GOTO Instruction	Not jumped.

TIP ·The operations of a ladder program in the module are the same as those when the program is stopped or the execution condition of MC instruction is OFF only for one scanning period.
For details on instructions, please refer to KV-8000/7000/5000/3000/1000 Series Command Reference Manual "MC/MCR"

Fixed-Period Module

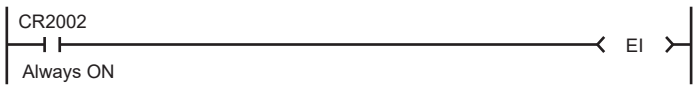
Routines in Fixed-Period Module can be separated from ordinary scanning and executed according to pre-defined period. Each project can only use one Fixed-Period Module.

■ Fixed-Period Module Execution

To execute Fixed-Period Module, in addition to writing the Fixed-Period Module, the following also needs to be done .

● Interrupt enable (EI) instruction

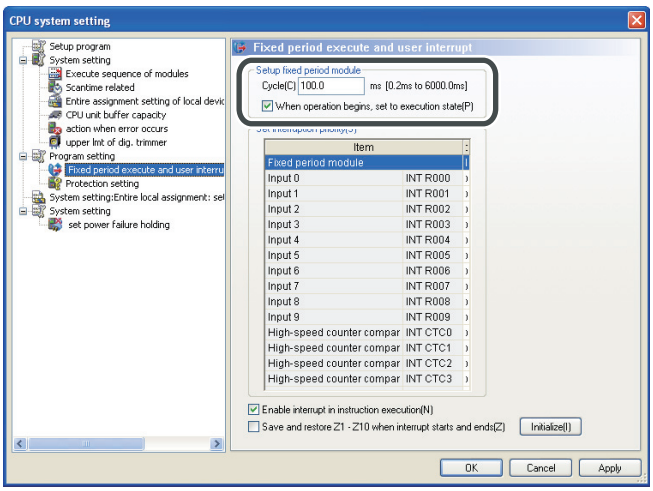
Like the interrupt routine, Enable/Inhibited of the fixed period execution is done through the EI/DI instruction.
The EI instruction is written in each scanned module and executed.
Example



"EI/DI Instruction", Page 3-47

● CPU System settings

Open the "CPU system settings" window from the KV STUDIO workspace, and set up the execution period and priority in the "Fixed-period execution and user interrupt" settings option of the "Program settings".

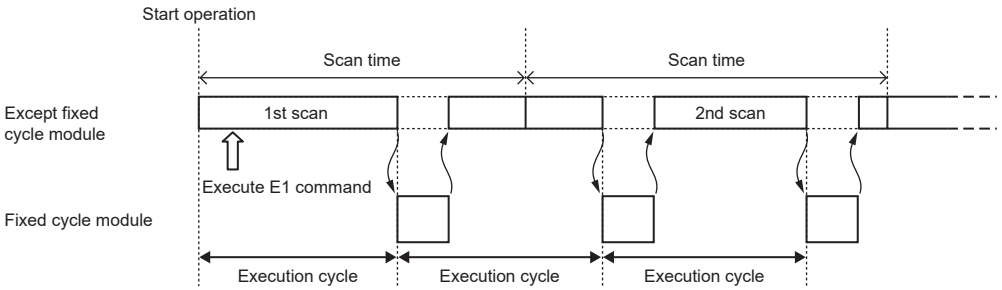


"Fixed-Period Module settings "
The period range is 0.2ms to 6000.0ms (0.1ms scaling unit).
If you want to execute Fixed-Period Module right from the program is started, select the "Execute right from the start" check box. If you want to start/stop it during operation, use the module instruction (MDSTRT/MDSTOP).
"interrupt priority settings"
When set priority of Fixed Period Module to "medium", only interrupt program set to "high" could realize multiple interrupt in execution process of Fixed-Period Module program. Interrupt program set to "Middle" "low" cannot realize interrupt in execution process of Fixed-Period Module program.
In addition, in execution process of interrupt program set to "low", interrupt and execute Fixed-Period Module, in execution process of interrupt program set to "high""medium", execution of Fixed-Period Module could only be in waiting state.

■ Fixed-Period Module Operation

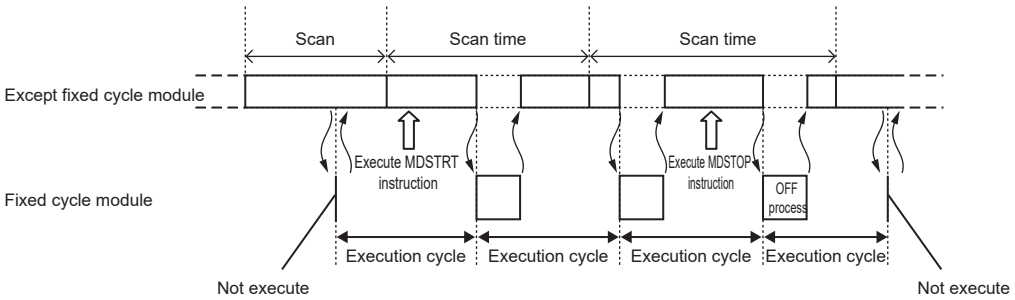
● When the "Execute right from the start" check box is selected (default)

If EI instruction is executed, begin to execute Fixed-Period Module.



● When the "Execute right from the start" check box is in selected state

In EI instruction execution state, the module instruction is used to control execution state of Fixed Period Module.



For OFF processing, please see "Stop Standby Module", Page 3-98.

Note

Execution period is irrelevant with execution state of Fixed-Period Module, counting is started when starting to run. After setting Fixed-Period Module to the execution state, the first constant period is executed immediately after execution of EI instruction when EI instruction is executed during running. Therefore, the first and second period might be incorrect.

TIP ·When all of the following conditions are met, the period fluctuation is within 70μs.
When selecting the "Enable interrupt during instruction execution" checkbox in "Fixed period execution and user interrupt" setting of "CPU system setting"
User interrupts with a priority higher than Fixed Period Module are not used
KL-N20V, KV-CL20, KV-DN20, KV-H20, KV-H20S, KV-H40S (when used, up to 120μs) are not used
FASC instruction (when used, up to 107μs) is not programmed in the program
RFASC instruction (when used, up to 107μs) is not programmed in the program
·When fixed-period execution timing occurs in interrupt inhibited state (when executing DI instruction) within the same execution period, Fixed-Period Module is executed in the interrupt enable state (executing EI instruction), .

Fixed-Period Module is separated with the ordinary scanning in interrupt processing. For details, please refer to "3-5 Interrupt", Page 3-31.

■ Device processing in the start/end

Device processing at start/end is the same as ordinary interrupt processing, at start/end of Fixed-Period Module execution, the following projects are saved/reset automatically.

·Internal register

·Calculation flag (CR2009 to CR2012)

·Index register(Z11 to Z12)

·TM0 to TM3

Relay To programmed in just executed STG instruction operand

Note

CPU built-in input (R000 to R015) cannot save/reset.

TIP Index register Z01 to Z10 can be set to execute save/reset processing in "CPU system setting" -> "fixed period execution and user interrupt" settings.

■ About auto refresh

The execution of Fixed Period Module is different from ordinary interrupt processing in that the following updates cannot be performed :

(1) direct input processing of CPU built-in input (R000 to R015)

(2) To programming direct output processing of CPU built-in output (R500 to R507)through SET/RES instruction

(3) update processing of high-speed counter current value (CTH0/CTH1)

If the above-mentioned items need to be updated in Fixed-Period Module before END processing, please do the following setups:

(1) through "DR" To program instruction Or To program "RFSX" instruction.

(2) through "DR" To program instruction Or To program "RFSX" instruction.

(3) To program "RFSCTH" instruction.

"About Direct Processing", Page 3-16

Note

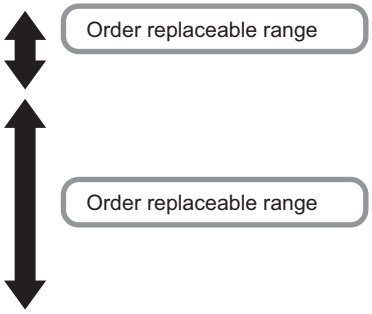
In Fixed-Period Module, direct output cannot be enabled even if SET/RES instruction is used to execute output to CPU built-in output (R500 to R507) .

Module Execution Sequence

The execution sequence within a scanning period can be set up for the modules registered in a project. Generally, this sequence is the module arrangement sequence. However, if execution sequence of ladder program in a scanning period has an adverse effect on the run of KV-1000 PLC, please change execution sequence.

Open "CPU system setting" from work space, select "program settings" -> "Execute sequence of modules" setting.

Sequence	Module name	Module type
1	Analog process	Fixed cycle
2	Locating initialization	Initialization
3	High-speed counter initialization	Initialization
4	Locating	Every scan
5	Update record information	Standby
6	High-speed counter	Every scan
7	Communication process	Standby
8	Main operation process	Every scan

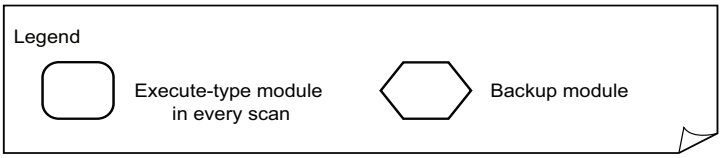


The following settings rules apply to module execution sequence within a scanning period.

- Although sequence can be changed in the initialization module, this cannot be done for other types of module.
- Although execution sequence of Every-Scan Execution Type Module and Standby Module can be changed, it should not be moved before initialization module.
- Sequence change cannot be made to Fixed-Period Module.(always displayed in the leading address.)

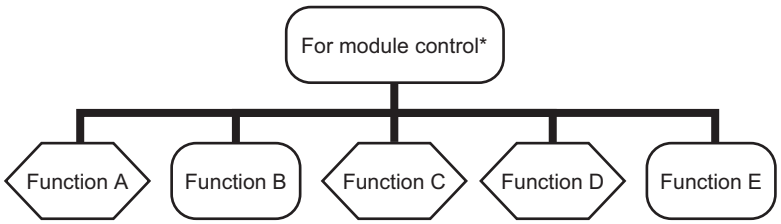
Example: Module Configuration

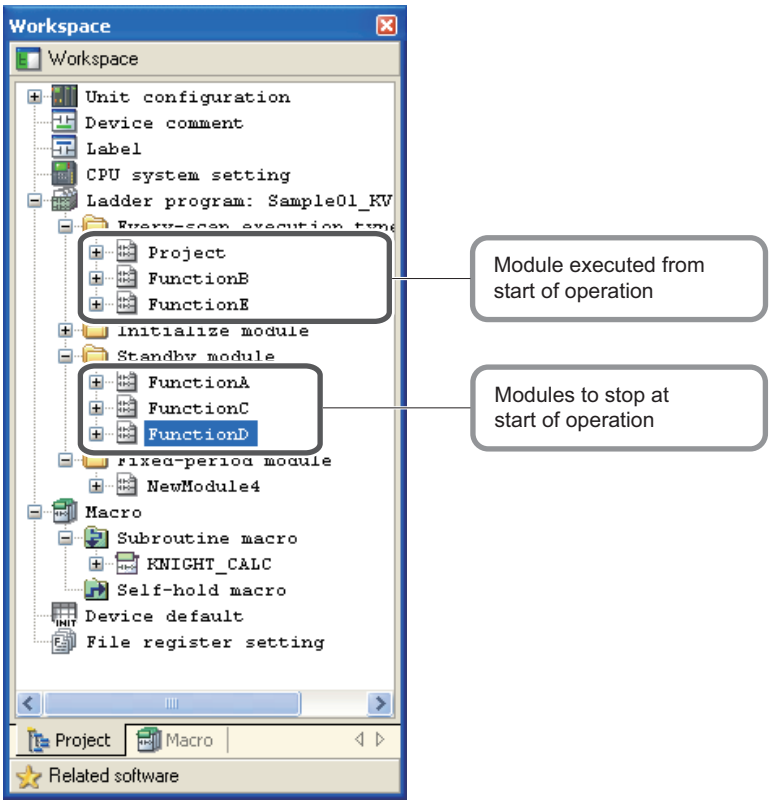
This example shows how to configure a module.
In order to further simply description, initialize module/Fixed-Period Module is omitted.



● Functional Configure

Module programming and classification are done according to processing content, connected device, as well as expansion unit.
By disabling unnecessary modules, commissioning can be easier and scanning time can also be shortened.



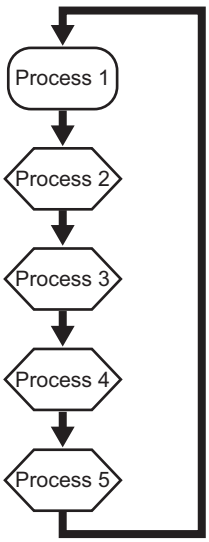


* Through "module control " module, execution state of each function can be controlled. Please as required create module control module.

● Process Configuration

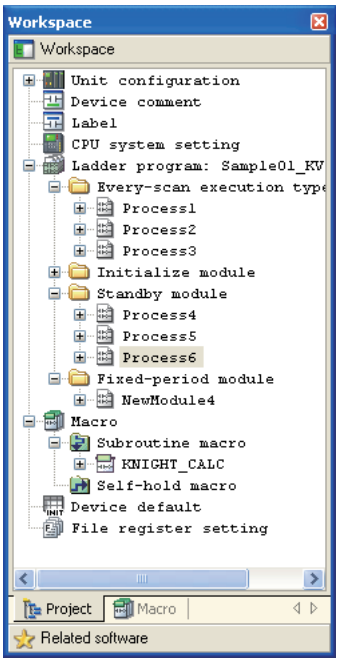
Module programming is done based on process or task.

In this example, Every Scan Execution Type Module is used to program the module to be executed when run starts, and all the other modules are programmed using Standby Module.



Abnormal monitor*

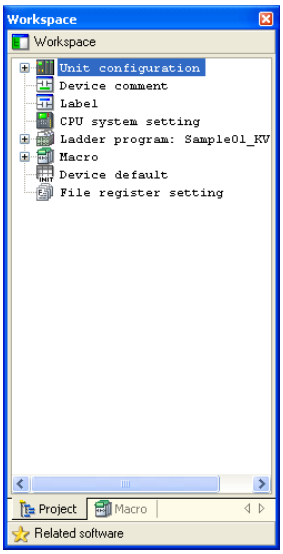
* Please program this as required.



TIP Since module execution sequence is the execution sequence within a scanning period, then it is unnecessary for a programmer to consider the module execution sequence during programming.

● No need to consider module in programming

When programming a new project, since an Every Scan Execution Type Module with the same project name will be generated automatically, therefore it is unnecessary to consider module issues during programming.



Module Device

Module device is the device that is used to capture the module operating state.
Referencing from other module or macro is needed only when the bit is ON.

Note Device comments cannot be attached to a module device.

TIP Module devices are specified to KV-5500/5000/3000 workspace by KV STUDIO automatically.

● Bit only connects a scanning period "@CR2008" when module execution starts

Bit only connects a scanning period "@CR2008" when module execution starts
It is disconnected after the second scanning period (OFF).
The bit can be referred only in self module. Every macro executed in self module can not be referred.
In KV STUDIO, this device is represented by "@CR2008".

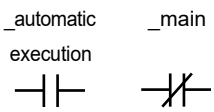
● Bit only cuts off a scanning period "@CR2007" when module execution starts

Bit only cut off a scanning period "@CR2007" when module execution starts
Connected after the second scanning period.
The bit can be referred only in self module. Every macro executed in self module can not be referred.
In KV STUDIO, this device is represented by "@CR2007".

● Execution ON Bit

ON Bit refers to the bit to connect ON in a module execution process.
Since this bit is in self module and can be referred from other module/macro, then enable this bit (for example) if you want to control module execution.
In KV STUDIO, this device is represented by "_ (module name)".

Example



MDSTRT	MDSTRT	**Module execution start**	**Start execute specified module.**
MDSTOP	MDSTOP	**Module execution stop**	**Stop execute specified module.**

Ladder program



Input mode





Operand	Available Devices																		Index Change
	Bit device							Word Devices							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*1	-	-	-	-

Operand	Explanation
S	Specify the module name.*1

*1 """","#" and "$" cannot be used. Please enter the module name specified in "KV STUDIO" Directly. For half-width English letters, 24 characters can be specified, for full-width, 12 characters can be specified.

Description of Operation

MDSTRT When line condition is ON, start the module specified in S.
Operate specified module from start of next scanning period.
Do not operate already started module.

MDSTOP when execute condition is ON, the module specified in S.
specified module stops after OFF processing in the next scanning period.
Do not operate already stopped module.
This instruction may also stop its own module.

Please see "Standby Module Operation", Page 3-98.

Note

- The initial state of the differential execution instruction when Standby Module is started is ON in the up edge, and OFF in the down edge. When beginning to execute, do not test the differential signal immediately.
- If the MDSTRT and MDSTOP instructions need to executed for many times in the same module and scanning period, this is then done according to the finally executed module instruction.
- Please do not stop all modules. If all modules are stopped, all programs will not be executed. Please use the following method to restore.(if program is not stopped, it cannot return.)
  - Please power off KV-5500/5000 /3000 PLC once, then connect power supply again.
  - Please switch KV-5500/5000/3000 PLC "RUN-PROG selector switch" to "PROG" mode, then switch to "RUN" mode.
  - In KV STUDIO, turn program RUN mode OFF, then on.

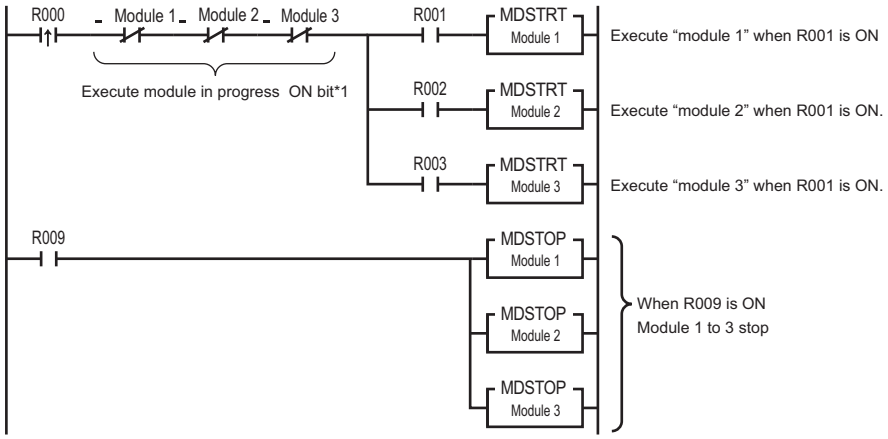
- In OFF processing, the processing with the same execution condition as "MC instruction " is scanned only once. For more information, please refer to "MC instruction ".
- Execution of initialization module cannot be stopped or started.

Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	No change in status

Sample Program

If the up edge of input relay R000 is detected, the selected mode (R001 to R003) is executed ; if input relay R009 is ON, all the modules are stopped. Do not execute other modules when a module is executed.



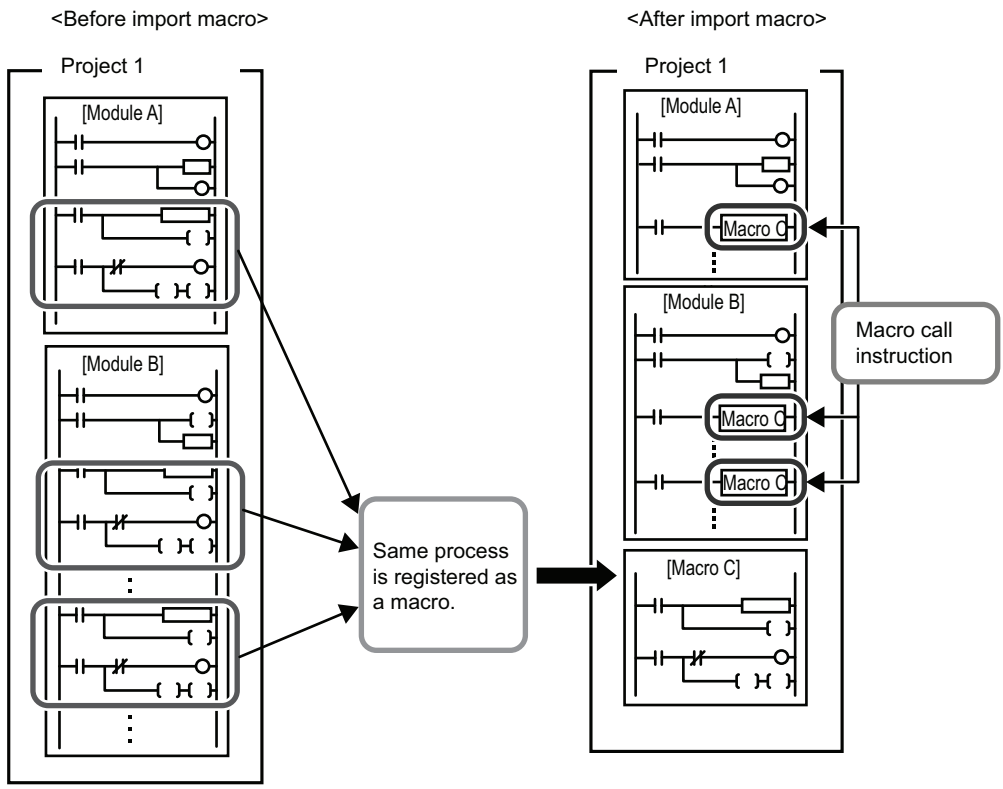

```
(mnemonics list)
 LDP R000
 ANB _Module 1
 ANB _Module 2
 ANB _Module 3
 MPS
 AND R001
 MDSTRT Module 1
 MRD
 AND R002
 MDSTRT Module 2
 MPP
 AND R003
 MDSTRT Module 3
 LD R009
 MDSTOP Module 1
 MDSTOP Module 2
 MDSTOP Module 3
```

*1 For detailed information of module execution on, please refer to "Module Device", Page 3-105.

MEMO

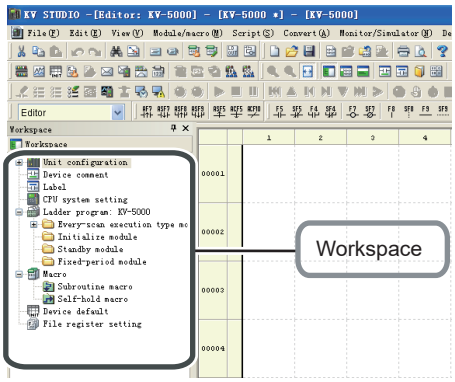
Overview

A macro is a ladder program section that is used again and again in a project. Programming workload can be reduced writing a frequently used ladder routine as a macro, just like a ladder instruction. To change a program section, you just need to modify macro data, thereby significantly reducing programming workload.



■ Macro Management

In KV STUDIO, the "Workspace" is used to manage each project.
In addition, for facilitating the next time use, you can register a frequently used macro in the "program library (user))" in advance.



■ A macro can be used in the following cases:

● Used as original instruction

If a frequently used program segment is registered as a macro, manual entry workload can be reduced.
The number of rungs in ladder program can be reduced, making program structure more clear.
Any name can be designated to a registered macro.

● An argument can be used

If an argument is used, operands (device and value) in the macro can be specified in macro calling, thereby creating a more universal macro.

"Argument Setting", Page 3-117

● Two types of macro can be created

There are two types of macro: subroutine macro and self-hold macro .
subroutine macro, is same as subroutine, is executed only when execution condition is ON.
self-hold macro , once begin to execute, until macro executes stop instruction(MEND macro ends), continuous action will be performed without considering execution condition state.
It is very convenient use macro, for example, for the processing that requires time to complete after expansion unit and external equipment request processing (processing crossing scanning period).

"Macro Type", Page 3-112

● A local device can be used

In other module or macro, even if local devices of the same No. Are used, they will be processed as different devices,
Therefore, distribution of devices that are used only in module and macro may be managed simply.

"3-10 Local Device", Page 3-131

● Reuse a macro

For frequently used macro, click "macro" mark number on work space, log on "program library" -> "user" in advance, realize program reuse simply.

● A System macro can be used

Use system macro that could realize expansion unit control simply.
Click "macro" mark number on work space, drag to ladder edit window from "program library" -> "system".

● Password protection

In order not to change macro content easily, set password.
If password is set, people who do not know the password cannot display or edit macro program.
Password is set in "Module/macro properties" (module/macro attribute) dialog box.

● An entity can be created in each time macro calling

When call macro module, create ladder program (Entities). If the same macro needs to be executed for many times within the same scanning period, or several macros need to be executed crossing scanning period, by using together with local device, conflict between devices and execution state of corresponding macro may not be considered.

"Difference Between Macro and Subroutine", Page 3-126

The procedure to use a macro

To use a macro, the following steps should be followed:

(1) New macros

"Modules/macros(M)" -> "New macro(M)"

Select macro type "Macro Type", Page 3-112

▼

(2) Programming

Write ladder program in created macro.

▼

(3) Setup arguments

"Module/macro (m)" -> "Macro argument setting (z)"

Log on independent variable. "Argument Setting", Page 3-117

▼

(4) Programming for macro call instruction

Through special instruction call out fabricated macro. "Macro instruction", Page 3-122

If necessary may use system device. "Macro System Device", Page 3-119

Macro Type

There are two types of macro: subroutine macro and self-hold macro .

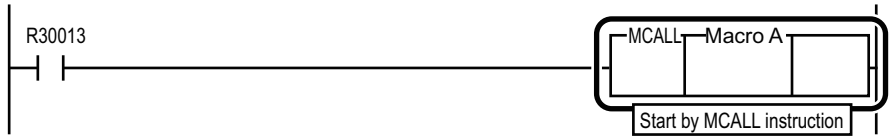
Sub-routine macro

● OVERVIEW

subroutine macro, is the same as subroutine, executes program in macro only when execution condition is ON, according to each macro call instruction(M CALL). After execution is finished, proceed to next step of macro call instruction. Execution when condition is OFF, do not execute program in macro, proceed to next step.

● How to use

subroutine macro, starts according to MCALL instruction from module.

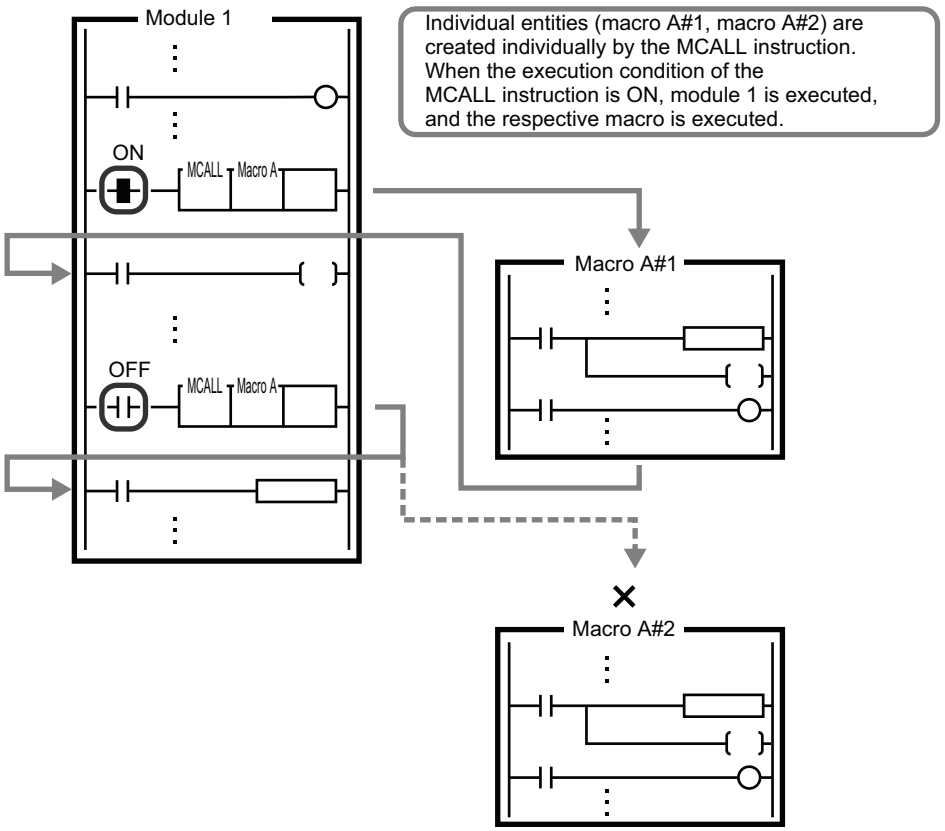


● Description of Operation

Description of subroutine macro action is shown in the figure below.

An example of calling macro A twice in a module is shown in the figure below.

TIP To discriminate the macro created, plus " # (management no.) " after macro name for management. In KV STUDIO, the macro is only displayed during Monitor and Simulator.

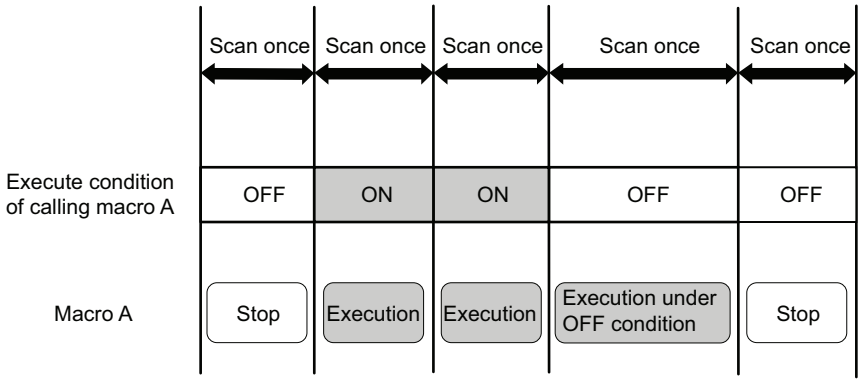


● The action following the execution stop

Subroutine macro will be executed only in a scanning period when execution condition is OFF, all execution conditions are OFF.*

It will be stopped in the next scanning period.

<Illustration of how sub-routine type macros function>



* But, the following instructions are exceptional.

Instruction	State
OUB Instruction	OFF
OFDL Instruction	Reset.
SHOT Instruction	
C Instruction	State hold.
CJ/NCJ/GOTO Instruction	Not jumped.

TIP When macro execution stops, MC instruction execution condition is OFF, processing will only execute a scanning period.

For details on instructions, 🕮 "KV-8000/7000/5000/3000/1000 Series Instruction Reference Manual "MC/MCR"

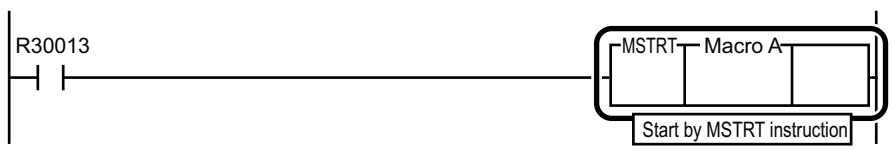
Self-hold macro

● Overview

self-hold macro , is the same as subroutine macro, when execution condition is on, execute the program in macro according to each macro call instruction (MSTRT). Once macro starts, until after next scanning period, macro in macro executes stop instruction (MEND), in this period, irrelevant with execution condition of macro call instruction, continue to act.

● how to use

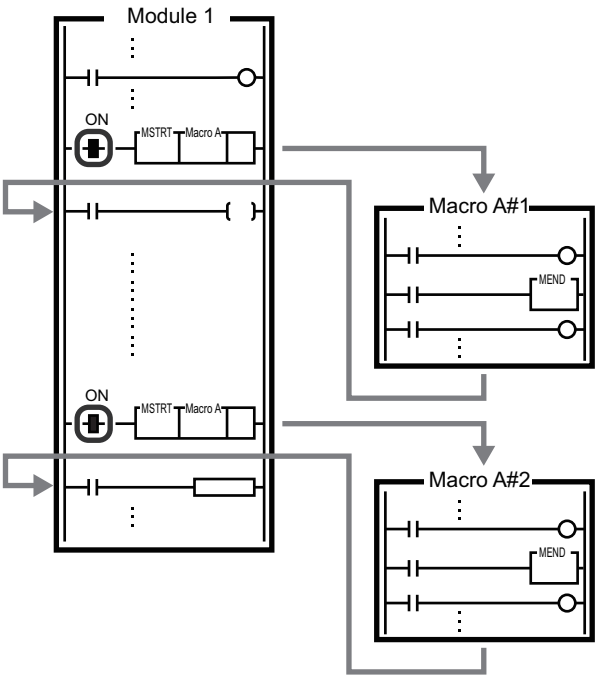
self-hold macro , starts according to MSTRT instruction from module..



● Description of Operation

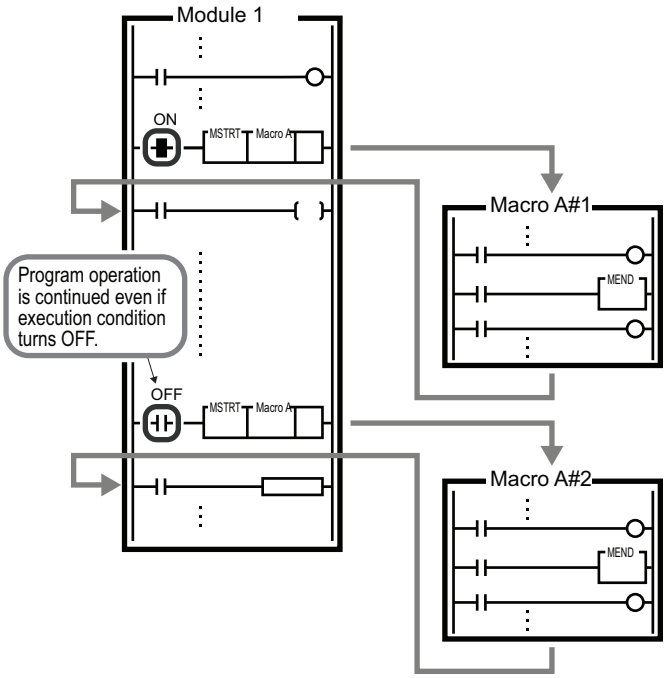
The Description of Operation of self-hold macro is shown in the figure below.
An example of calling macro A twice in a module is shown in the figure below.

1 When the execution condition is ON, start Macro A.

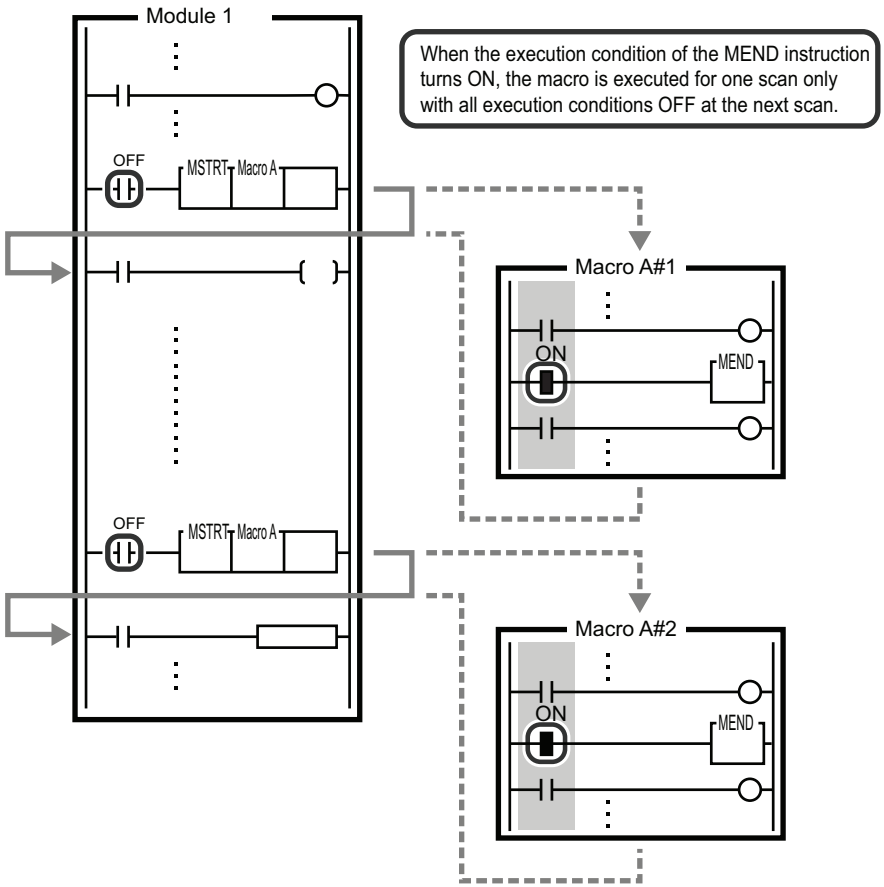


TIP To discriminate the macro created, plus " # (management no.) " after macro name for management.
In KV STUDIO, the macro is only displayed during Monitor and Simulator.

2 Once started, the execution continues irrespective the execution condition state of MSTRT instruction.



3 If the execution condition of a MEND instruction in macro is ON, all the execution conditions will be OFF in the next scanning period, and only one scanning period is executed in the macro.* It will be stopped in the next scanning period.



Note

- In a self-hold macro , the MEND instruction must be included.
- To stop a macro, the macro execution condition must be OFF. If macro execution condition is ON, macro will not stop, even if MEND instruction execution condition is on.

* But, the following instructions are exceptional.

Instruction	State
OUB Instruction	OFF
OFDL Instruction	Reset.
SHOT Instruction	
C Instruction	State hold.
CJ/NCJ/GOTO Instruction	Not jumped.

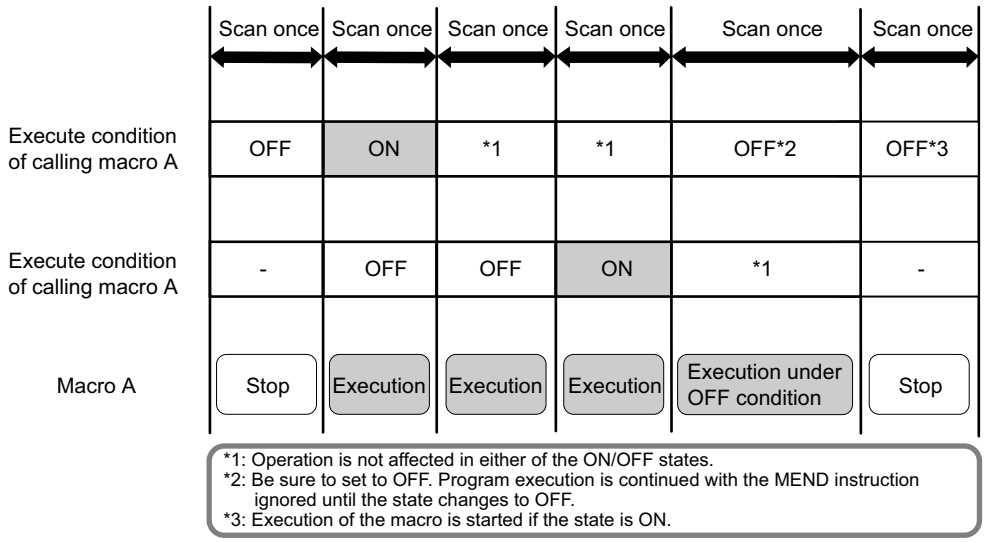
TIP When macro execution stops, MC instruction execution condition is OFF, processing will only execute a scanning period.

For details on instructions, see "KV-8000/7000/5000/3000/1000 Series Instruction Reference Manual "MC/MCR"

● The action taken when execution is stopped

self-hold macro , only in next scanning period when macro stop instruction(MEND) is executed, execute a scanning period taking all conditions as OFF. It will be stopped in the next scanning period.

[Operation message of self-hold type macro]

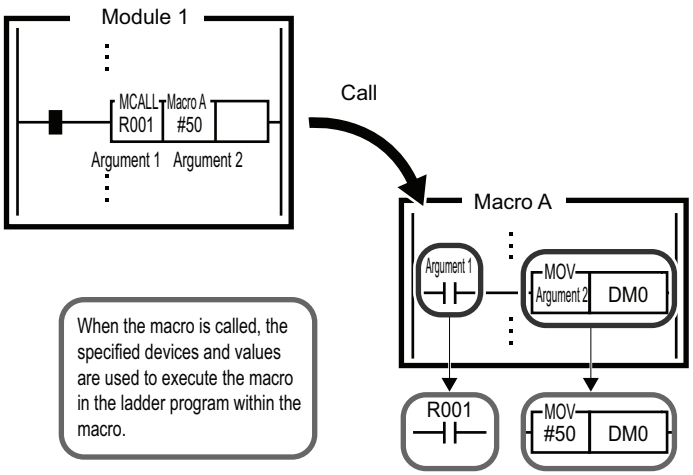


*1: Operation is not affected in either of the ON/OFF states.
*2: Be sure to set to OFF. Program execution is continued with the MEND instruction ignored until the state changes to OFF.
*3: Execution of the macro is started if the state is ON.

Argument Setting

■ What is argument

The so-called independent variable is device and value transferred with respect to macro Entities when macro is called. Independent variable is designated as macro call instruction operand. In the macro, use transferred device or value to execute ladder program.If macro is being executed, independent variable is refreshed once per scanning period.



■ Argument device list

The so-called independent variable device is the device used as which instruction operand in macro to designate transferred device and value. Independent variable device may be used only in the macro. Select "module/macro (m)" -> "macro independent variable settings (z)"from KV STUDIO menu, set up in the displayed dialog box. There are four types of independent variable device. Including: P, V, UR, UM. Specification of the devices is as follows.

Type	Sign	Range	Description	Indirect specifying(*)	Local device(@)	Index Change (:)
Device	P	P0 to P9	Process the device as independent variable.	×	×	○
value*2	V	V0 to V9	Process the value of device or constant as independent variable.	×	×	×
Unit device (R)*	UR	UR0 to UR9	Process the initial relay distributed in expansion unit as independent variable.	×	×	○
Unit device (DM)*	UM	UM0 to UM9	Process the initial data memory (DM) distributed in expansion unit as independent variable.	×	×	○
Unit No.*1	UV	UV0 to UV9	Accept expansion unit No..	×	×	×

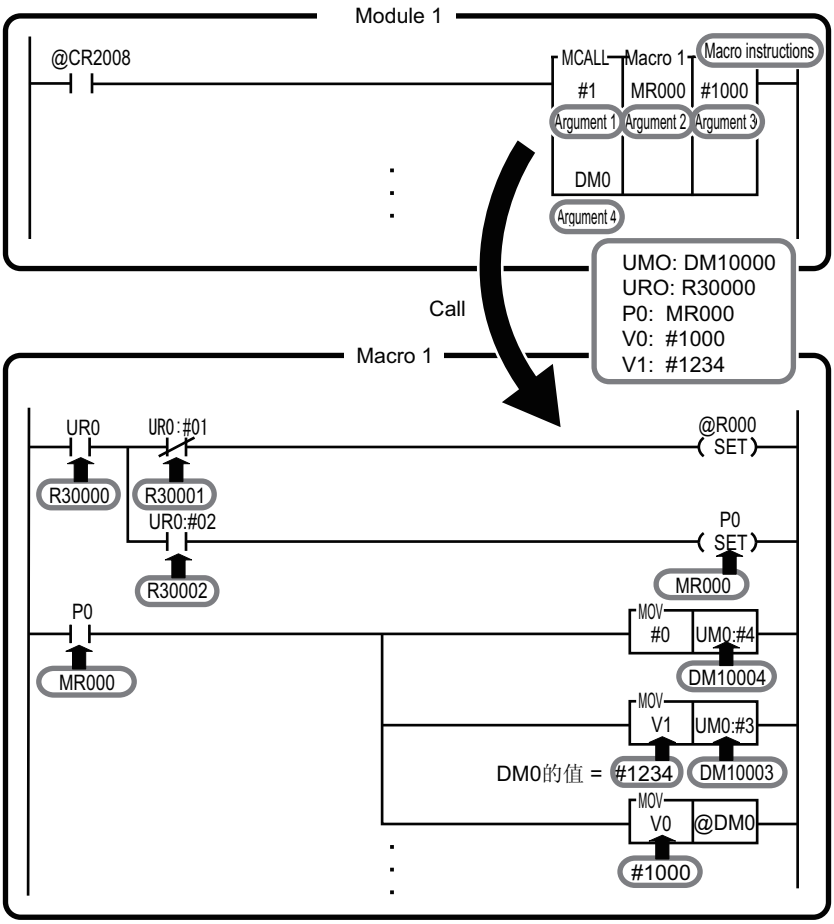
*1 In macro call instruction, only designate source unit No..
The number of units in a macro that may be designated as independent variable is up to 5 .

*2 After DR is designated, before calling out macro, execute direct processing, accept the result as independent variable.

● Use example

Example of independent variable device is shown in the figure below.
Module 1 begins to execute macro call instruction of macro 1, here is an example.

"Independent variable device use example"
°°°°Argument 1:URO/UMO<-#1
°°°°argumens2 : PO<-MR000
°°°°Argument3 :VO<-#1000
°°°°Argument4 :V1<-DM0
°°°°(Unit No 1)°¦KV-AD40 (R30000 to R30115 / DM10000 to DM10021)



Note

When character string is used as independent variable, please use independent variable device (P) to designate initial device of saved character string. Character string directly designated by independent variable device (V) cannot be used.

Macro System Device

Macro system device is the device that is used to capture module operating state.
Only the ON bit needs to be looked up from other modules or macros.

Note Module system device does not allow additional device notes.

TIP Macro system device is internal workspace distributed to KV-5500/5000/3000 by KVSTUDIO automatically.

● Bit only connects a scanning period when module execution starts "@CR2008"

Bit only connects a scanning period "@CR2008" when module execution starts
Disconnected after the second scanning period (OFF).
The bit can be referred only in self macro. Module in calling macro cannot be referred.
In KV STUDIO, this device is expressed by "@CR2008 ".

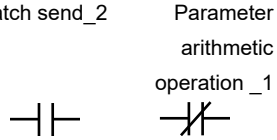
● Bit only cuts off a scanning period when module execution starts "@CR2007"

Bit only connects a scanning period "@CR2008" when module execution starts
Connected after the second scanning period.
The bit can be referred only in self macro. Module in calling macro cannot be referred.
In KV STUDIO, this device is expressed by "@CR2008".

● Execution ON Bit "ID No."

Executing ON Bit refers to the bit connected (on) in execution process of corresponding macro.
Since reference may be made from each module, therefore it is valid when controlling macro execution, for example, make reference before calling out macro etc.
In KV STUDIO, this device is programmed to "_ (macro name) _ (identification number)".

Example



TIP In order to use Execution ON Bit, each call macro needs identification number.
"Execution ON Bit", Page 3-120

Execution ON Bit

■ Overview

Executing ON Bit refers to the bit which puts the connection to ON in execution. Since this can be referred from a module, then it is useful in controlling macro execution, for example, making reference before macro calling.

To use the Execution ON Bit , each macro to be called needs an identification number.

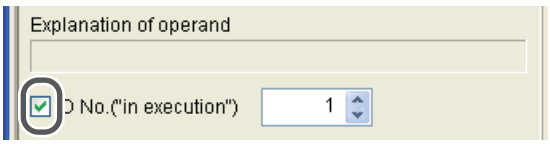
In KV STUDIO, this device is programmed to "_ (macro name) _ (identification ID No.) ".

■ Execution ON Bit Setting

If "ID No." is selected in "Instruction/macro/pack pallet", use executing on bit.

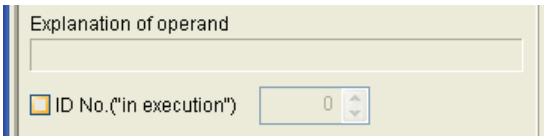
how to use.

1 **From the macro template, select "ID No. (in execution)".**

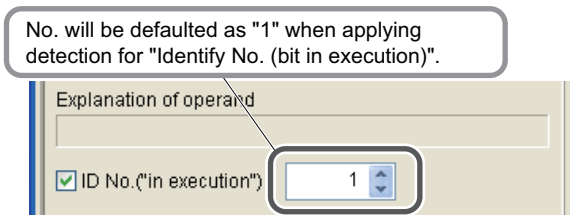


Note

If "ID No. (in execution)" is not selected in macro template, macro executing on bit may not be used.



2 **Enter the macro id.**

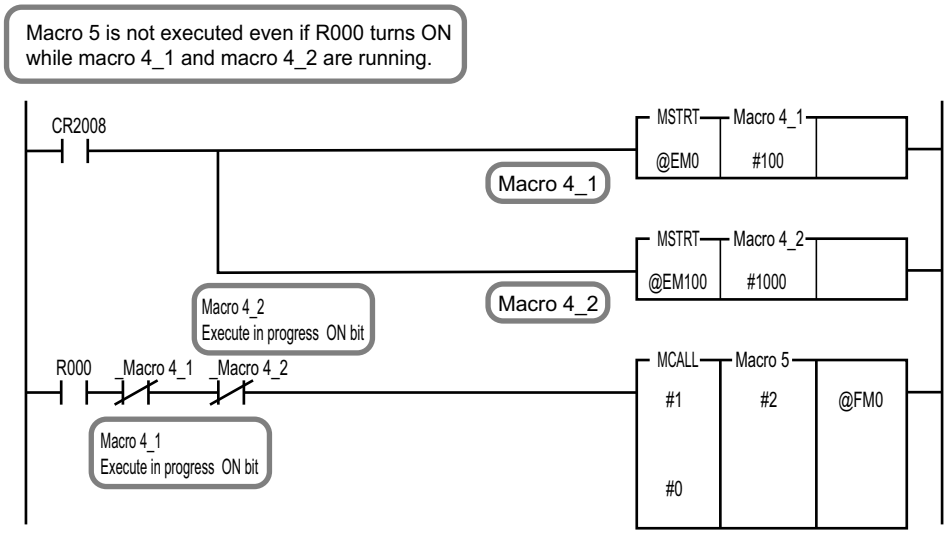


If the same macro is used for many times in the same project, it may be used after changing No..

Note

If the same No. Is designated in the same macro, conversion error will occur.

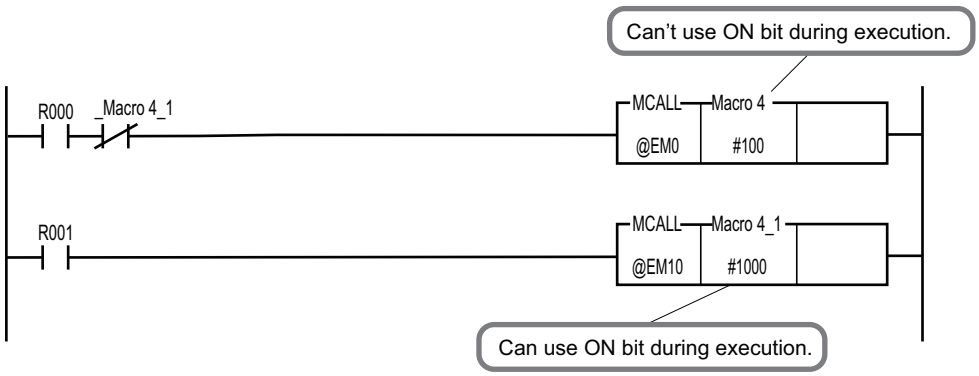
● Example



Note

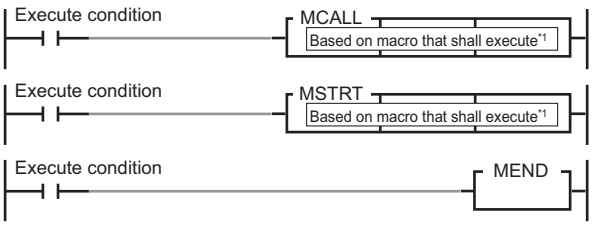
If macro executing ON is not used for programming (macro is not designated by macro call instruction in the project), conversion error will occur.

TIP In the same macro, macro call instruction with identification number when without identification number may be used together.

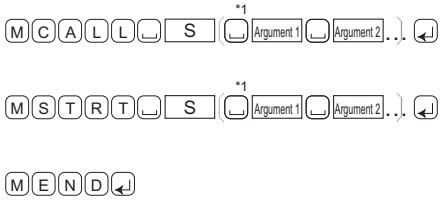


MCALL	MCALL	**Macro call**	**Executes the sub-routine macro specified.(programming in the module)**
MSTRT	MSTRT	**Macro start**	**Execute designated self-hold macro .(programming in the module)**
MEND	MEND	**Macro end**	**Stops execution of the self-hold type macro.(programming in self-hold macro)**

Ladder program



Input mode



Operand	Available Devices																		Index Change
	Bit device							Word Devices							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○*2	-	-	-	-

Operand	Explanation
S	Specify macro name.*3

*1 Number (0 to 10) and attribute behind the second operand might be different due to different independent variables set in the macro currently to be executed.
Device that may be used in attributes is shown below.

Attribute	Available Devices																		Index Change
	Bit device							Word device*1							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
Device	○	-	○	○*4	○*4	○	○	○	○*4	○*4	-	-	-	○	-	-	○	○	○
Value	○	-	○	-	-	-	○	○	○	○	○	○	○	○	○	-	○	○	○
Unit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○*5	-	-	-	-

*2 don't used"""", "#"and"$".Please Input Set Module Name in "KV STUDIO" Directly.
For half-angle English number, 6 characters may be designated, for all angle, 12 characters may be designated.

*3 When identification number is used, format is "(macro name) _ identification number". Example in batches _2
For point parameter, please see "Execution ON Bit", Page 3-120 .

*4•B According to instruction used in the macro, timer/counter processing will be different.°°
(For example) Process current value when MOV instruction. For detail, please refer to instructions description.

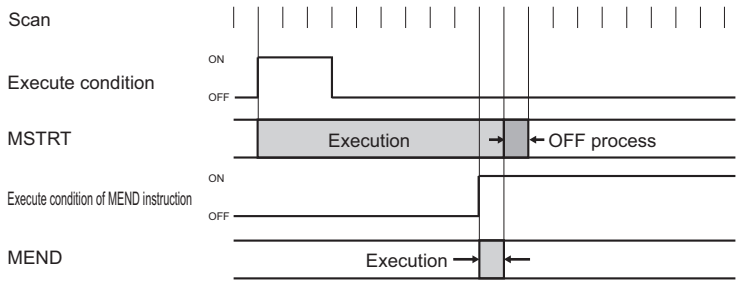
*5 Designate expansion unit No.. When macro template is used, select and designate source expansion unit from list.

Description of Operation

MCALL When execute condition is ON, S When execution condition is on, this instruction will be executed in each scanning period.
Designated macro begin to be executed when execution condition is OFF -> on.
When execute condition is ON -> OFF, then OFF processing is performed.

MSTRT When execute condition in ON. S When execution condition is on, this instruction will be executed in each scanning period.
Designated macro begin to be executed when execution condition is OFF -> on.
Once begin to execute, even if execution condition is OFF, continue to execute macro.

MEND when execution condition is on, the self-hold macro that uses MEMO instruction for programming will perform OFF processing in the next scanning, stop execution in the next scanning.



Note

- For MCALL/MSTRT instruction, after add/delete/call out sequence change is executed, it cannot be written in the RUN.
- In order to stop execution of self-hold macro , please use MEND instruction in the macro.
  If MSTRT instruction execution condition is always on, MEND instruction may be omitted.
- MEND instruction cannot be programmed in module and in subroutine macro.
- MEND instruction cannot stop other macro.
- The previous state of differential execution instruction in macro is initialized when each macro begins to be executed.(up differential: on, down differential: OFF)
- If MCALL/MSTRT instruction attribute of an operand is a value, and T/C/CTH/CTC is designated in this operand, the following value will be transferred into macro.
  T/C : 32-bit counter (current value)
  CTH : 32-bit counter (current value)
  CTC : Set value（32-bit counter）
- When program MCALL/MSTRT instruction between MC to MCR instructions, if in macro execution process, MC instruction execution condition is OFF, execute OFF processing in this scanning, in the next scanning, stop execution.
- If MCALL/MSTRT instruction is programmed in subroutine (between SBN - RET instructions), condition transfer (between CJ/NCJ to LABEL instructions), step (between STP to STE instructions) or interrupt (between INT to RETI instructions), when the instruction between instructions in macro execution process is not executed, macro execution will be suspended. When instruction between instructions are executed again, start macro execution again. Now, the previous state of differential execution type instruction in the macro is not initialized. (When programming in initialization module, execute scanning only once when running starts.)

- If MCALL/MSTRT instruction programs a control section (between STG - JMP instructions), STG instruction relay is OFF during macro execution, then subroutine macro is executed in this scanning period when all execution conditions are OFF, stops execution in the next scanning period. Execution of self-hold macro is suspended.
- If a macro is being executed, the module programmed by MCALL/MSTRT instruction stops, during OFF processing is executed in the module, OFF processing is also executed in the macro simultaneously, execution stops in the next scanning period.
- For OFF processing, one scanning of "MC instruction" execution condition is in the same state as OFF.
- In the macro, MCALL instruction and MSTRT instruction cannot be used.
- In the macro, use subroutine, but interrupt program cannot be used.
- In the project, when execute the same macro for many times, if global device is used in OUT/OUB instruction in the macro, it will become dual coil.

Operation flag

CR2009	Operation marking state depends on processing result in the executed macro.
CR2010	Operation marking state depends on processing result in the executed macro.
CR2011	Operation marking state depends on processing result in the executed macro.
CR2012	It is ON when indirect specifying or index modification range is improper. OFF other than this. When indirect specifying, index modification unspecified in operand, it is not changed.

* If independent variable is inappropriate, macro will not be executed.

When CR2012 is on, detailed information of CM5100 to CM5176 error will be stored.

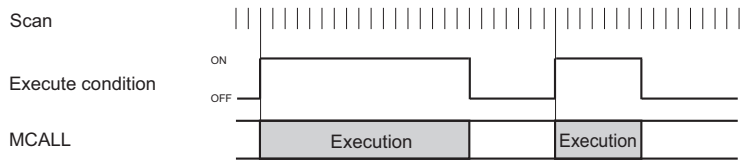
"Error Log (CM)", Page 3-20

Note

Use of MEND instruction cannot change operation marking state.

Instruction execution timing

MCALL When execution condition is on, this instruction will be executed in each scanning period.

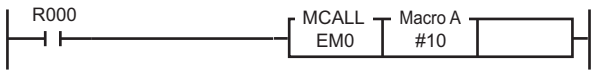


MCALL When execution condition is on, this instruction will be executed in each scanning period.

MCALL When execution condition is on, this instruction will be executed in each scanning period.

Example

Take EM0 as independent variable 1, #10 as independent variable 2, when input relay R000 on, execute subroutine macro (macro A).




```
(mnemonics list)
 LD R000
 MCALL macroA EM0 #10
```

At up edge of input relay R001, take #1 as independent variable 1 (unit No.) , take #10 as independent variable 2, execute self-hold macro (macro B).




```
(mnemonics list)
 LDP R001
 MSTRT macroB #1 #10
```

When input relay R002 is on, stop execution of self-hold macro (macro B).




```
(mnemonics list)
 LD R002
 MEND
```

Difference Between Macro and Subroutine

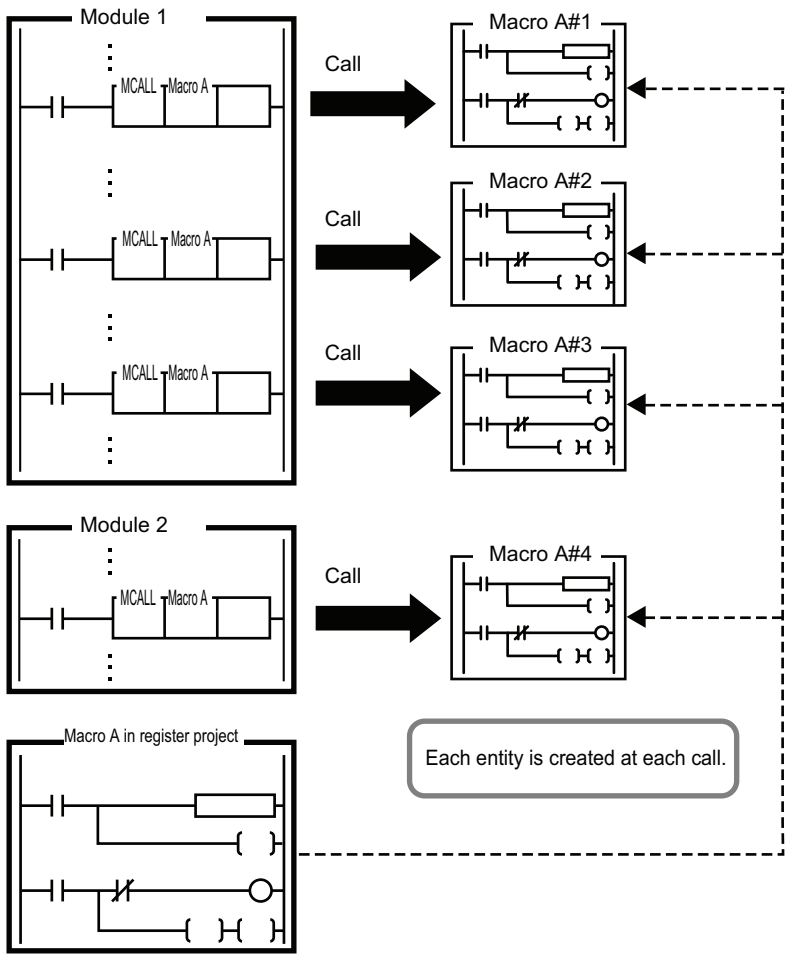
The same as subroutine, macro is also operated by call instruction. Macro and subroutine action will be compared and described below.

For the error information, see "Subroutine", Page 3-27 .

● Creation of entities

<Macro>

Once a macro call instruction(MCALL, MSTRT) is programmed in the module, the same quantity of Entities will be created.

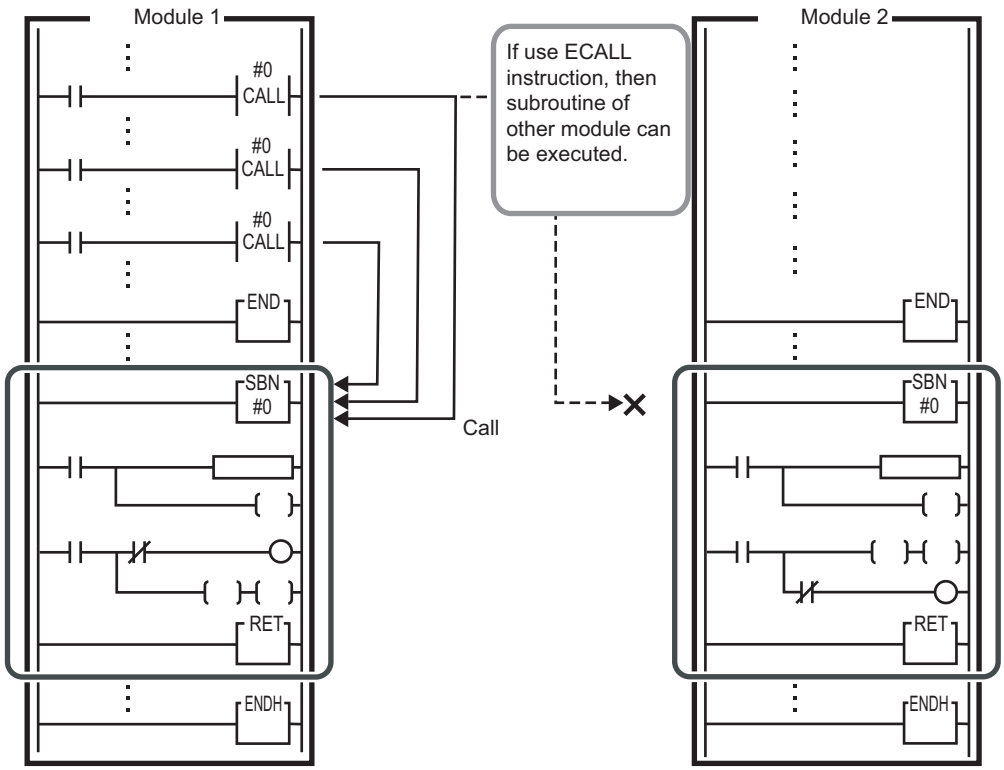


TIP ·Macros that are registered in the project but not be called for even once (unused macros) will not be transmitted to KV-5500/5000/3000PLC. When check out project or check out according to PLC program, unused macros will not be checked.

To discriminate the macro created, plus "# (ID no.) " after macro name for management. In KV STUDIO, the macro is only displayed during Monitor and Simulator.

<Subroutine>

In module/macro, subroutine is created between END instruction and ENDH instruction, is executed by subroutine call instruction(CALL) programmed in module/macro main program. Not every call instruction creates Entities.



● Callable position

<Macro>

In module, if macro call instruction may be programmed in any position of main program, subroutine or interrupt program. Macro call instruction cannot be programmed in the macro.

<Subroutine>

Subroutine call instruction is valid only in the module/macro where subroutine is created. When execute subroutine in other modules, use inter-module subroutine call instruction.

● Name

<Macro>

Macro may be named freely.

"Unusable Character String List", Page A-38

<Subroutine>

Subroutine uses No. For management.

● Argument

<Macro>
//Settable

<Subroutine>
//Unsettable

● Action taken when the execution condition is OFF

<Macro>
Only when all programmed execution conditions are OFF, macro executes a scanning period. For example, device that is programmed using OUT instruction could be OFF automatically.
"Macro Type", Page 3-112

<Subroutine>
Program in the subroutine cannot execute. Programmed devices will keep the state of final execution.

● Default differential execution instruction

<Macro>
Initial state of differential execution instruction, is on when up edge is detected, is OFF when down edge is detected. When begin to execute, do not test difference signal immediately.

<Subroutine>
It is the same as macro only when it executes for the first time. From the second execution, it is changed into the state of previous execution.

● Action taken when calling between MC (master control) to MCR (master control reset) instructions

°§When the MC instruction condition is ON
Operation is per normal for both macros and sub-routines.

°§When the MC instruction condition is OFF
<Macro>
"Operation when the execution is OFF" above is executed and then stopped. (Self-hold type macros also stop.)

<Subroutine>
Not execution.

● Applications

In order to keep state and value of the device used at each call place

<Macro>°§°§°§°š
Because Entities will be created according to each call instruction respectively, therefore if it is used together with local device, device conflict may not be considered, keep the state of previous execution.

<Subroutine>°§°§°§°˜
Since execute the same program, therefore always use indirect designation etc, create push protection and pop to restore program.
When you want to execute to the end of a Series of action at one time

<Macro>°§°§°§°š
self-hold macro , once begin to execute, until macro executes stop instruction(MEND), in this period act continuously without considering execution condition state.
In addition, when execute such processing simultaneously for many times, it is unnecessary to consider device conflict and each action state.

<Subroutine>°§°§°§°˜
Program that is required to prevent execution of condition OFF before action is finished.
In addition, when execute such processing simultaneously for many times, it is unnecessary to consider device conflict and each action state.

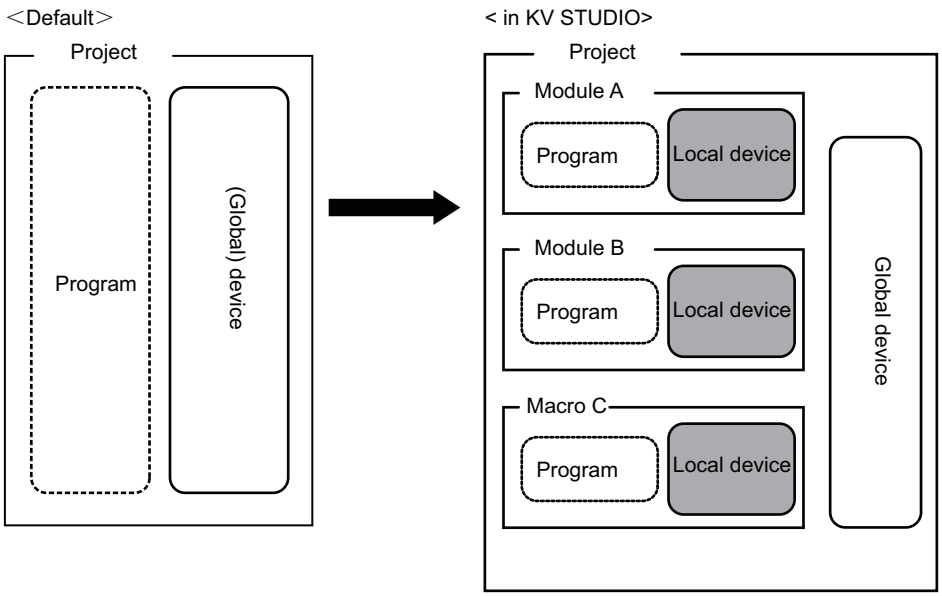
If you want to reduce program step
<Macro>°§°§°§°˜
Since Entities is created as per each call instruction, therefore number of program step could not be reduced.

<Subroutine>°§°§°§°š
Since Entities will not be created for whichever times of calling, therefore the more the call times is, the more remarkable the number of steps is reduced.

MEMO

3-10 Local Device

Up to now, PLC processing devices are universal in the whole project. Therefore, it is necessary for the user to manage all devices used in the program.
In KV STUDIO, for each module or macro, local devices can be processed as separate devices. Therefore, even if a local device with the same number is used in other module or macro, it can also be processed, thus facilitating the management and assignment of the devices which can only be used a module or macro.
In contrasting, devices that can be processed universally in the whole project are called "global device".



Local Device Programming

When programming, a local device can be designated by adding a prefix "@" onto device name.

Example

<Global device>	<Local device>
EM0	@EM0
MR0	@MR0

Note

Programmed as "@+ (Device No.)" only when Device No. is specified as the operand of timer/ counter command.
Mnemonic symbol input example: TMR @0 #100

Local Device List

What shown in the table below is default value of quantity and range of local device and global device that can be used when creating projects. The number of appointed local device can be changed in "CPU system setting" -> "Entire assignment setting of local devices" on "work space".

Device name*1	Local device	Global device	Total number
	Reserved quantity in the whole project*2	Counts/range	
Relay (R) *3	None.	16000 point (1000 channel) R00000 to R99915	16000 point (1000 channel)
Internal auxiliary relay(MR)*3	8000 points (500 channel)	8000 point (500 channel) MR000 to MR99915	16000 point (1000 channel)
Latch relay(LR)*3	8000 points (500 channel)	8000 point (500 channel) LR000 to LR99915	16000 point (1000 channel)
Timer (T)*4	1500 point	2500 point T0 to T2499	4000 point
Counter (C) *4	1500 point	2500 point C0 to C3999	4000 point
Data memory (DM)	25000 point	40535 point DM0 to DM65534	65535 point
Expansion data memory(EM)	45000 point	20535 point DM0 to DM65534	65535 point
Temporary data memory (TM)	None.	512 point TM0 to TM511	512 point

*1 Link relay (B), link register (W), file register (ZF), high-speed counter (CTH), high-speed counter comparator (CTC), control relay (CR), control memory (CM) and index register (Z) cannot be used as local device.
When @FMxxx is used, consume work area as local device.

*2 When making new project, unifiedly ensure the area of device that can be used as local device.(for calculation, assume to use 10 modules, call macro for 50 times.)）
Reserved quantity of the devices is changed according to requirement.

*3 Use channel (ch) unit to set up use quantity.

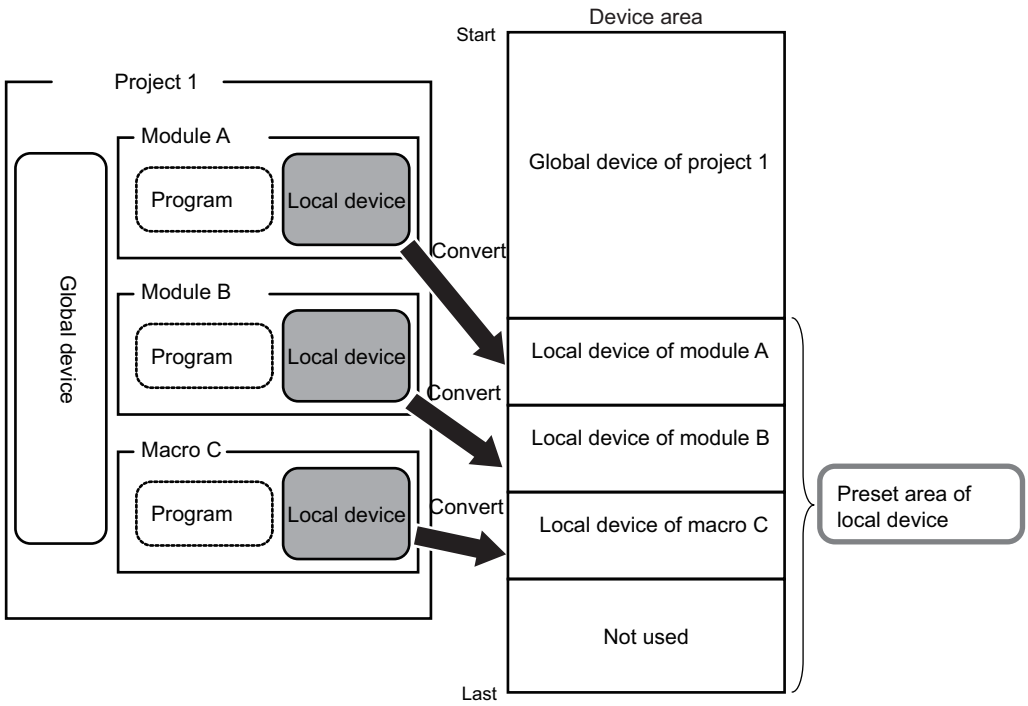
*4 Programmed as " @+ (Device No.) " only when Device No. is specified as the operand of timer/ counter command.
Mnemonic symbol input example: TMR @0 #100

Note

- If relay (R) and temporary data memory (TM) are used as local device, always set up the quantity of relay and data memory.
- The following device must be processed as global device:
  - KV-5500/5000/3000 PLC I/O Relay List
  - Expansion unit device
  - Device for reference of touch panel etc external connection equipment
  - Common device in the whole project
  - Device that requires data transmission between modules
- Local Device shall be numbered from 0 using consecutive numbers as possible.
- Since R, DM is distributed in expansion unit, as global device, use area is required. When use local device, please use MR or EM with priority.
- If local device or global device is used out of the specified range, conversion error might occur.
- When use various commands that designate first element as operand as well as index modification or indirect designation, please do not exceed usable scope of local device or global device.

Local Device Assignment

For conversion, local device can be distributed to reserved area of each device type automatically



Note

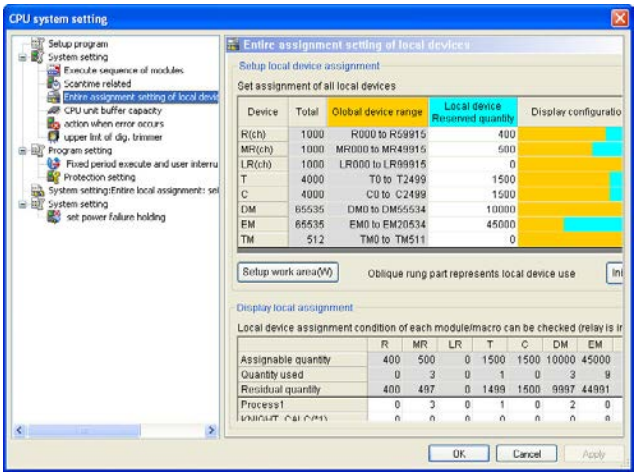
For macro, local device will be distributed according to call times in the project.

TIP Local device is the just like global device, can use device notes.

■ Batch assignment setting

Although the number of local device used in a project can be pre-defined, the type of each device can be changed. These changes can be kept in KV STUDIO for later project creation use.

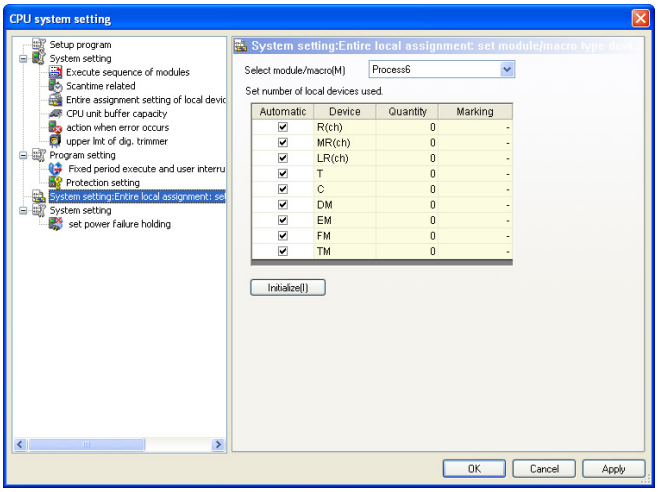
Open "CPU system setting" on "Work space", select "Entire assignment setting of local devices".



■ Set module/macro type device

Reserved quantity of local device used in module/macro can be set as per device type. Default setting is "automatic", the number of local device used in module/macro will be set automatically, generally it is unnecessary to pay attention.

Open "CPU system setting" on "work space", select "Entire local assignment: set module/macro type device".



Typical Local Device entry and Conversion Error

● When entering a ladder

The following is a typical example of error information that might occur when input ladder.

If currently used is the device type that cannot used as local device,

B, W, FM, ZF, CTH, CTC, CR, CM and Z cannot be used as local devices.

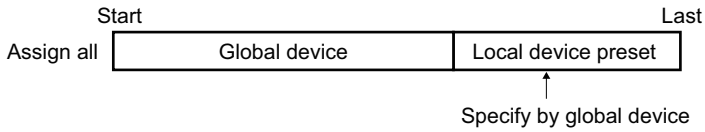
"Local Device List", Page 3-132

● When converting a ladder

The following is a typical example of error information that might occur when convert ladder.

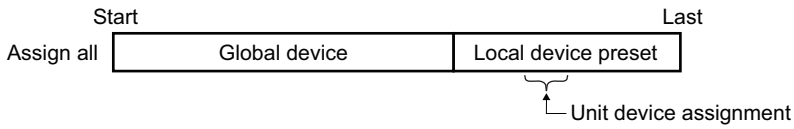
If the device zone reserved for local device is currently used for global device

Tick off "Global device range" in "Entire assignment settings of local devices " dialog box.



"Batch assignment setting", Page 3-134

Since the area of local device might be used when Unit Editor is used to set unit device, please confirm.



KV STUDIO User's Manual, “Chapter 3 Unit Editor"

If currently used local device is out of range

Error might occur only when automatic setting is not used, manual setting is used.

Please check "Entire local assignment: set module/macro type device" dialog box.

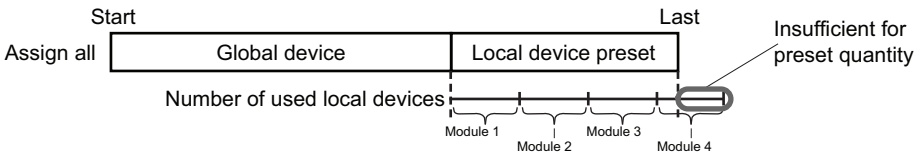
Example



"Set module/macro type device", Page 3-134

When the number of reserved devices is insufficient

Check out the device with "Num" etc displayed in red in "Setup local device assignment" of "Entire assignment settings of local devices" dialog box. So as to increase reserved quantity of this device, reduce set quantity of local device for each module/macro, let "available quantity" (local device reserved quantity) is larger than as far as possible.



"Batch assignment setting", Page 3-134

3-11 File Register

Overview

File register may be divided into "ZF" that processes all areas in consecutive number mode, and "FM" that divide the area into four memory banks (0 to 3) to process in memory bank switching mode.

Database switch mode		Continuous No. mode
FM0 to FM32767	Storage unit 0	ZF0 to ZF32767
FM0 to FM32767	Storage unit 1	ZF32768 to ZF65535
FM0 to FM32767	Storage unit 2	ZF65536 to ZF98303
FM0 to FM32767	Storage unit 3	ZF98304 to ZF131071

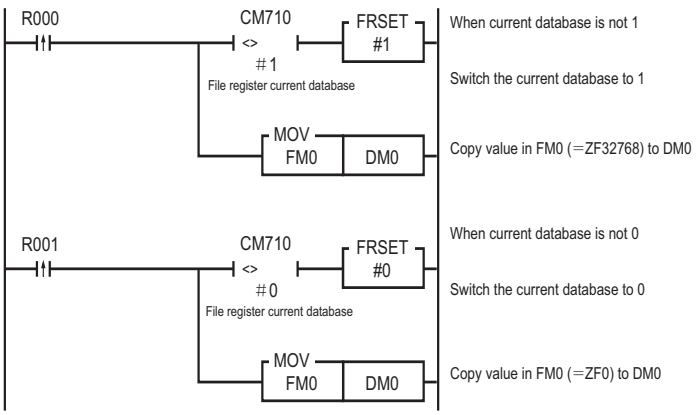
For example, FM0 and ZF32768 of memory bank 1 refer to the same data store part.

For detailed condition of device No. And data treatment method etc, please refer to "3-6 Device and Constant", "File Register ZF/FM", Page 3-68.

Bank Switchover

To switch to another memory bank, use the "FRSET instruction".
Currently designated memory bank is called current memory bank.

Example



(mnemonics list)
LDP R000
MPS
AND<> CM710 #1
FRSET #1
MPP
MOV FM0 DM0
LDP R001
MPS
AND<> CM710 #0
FRSET #0
MPP
MOV FM0 DM0

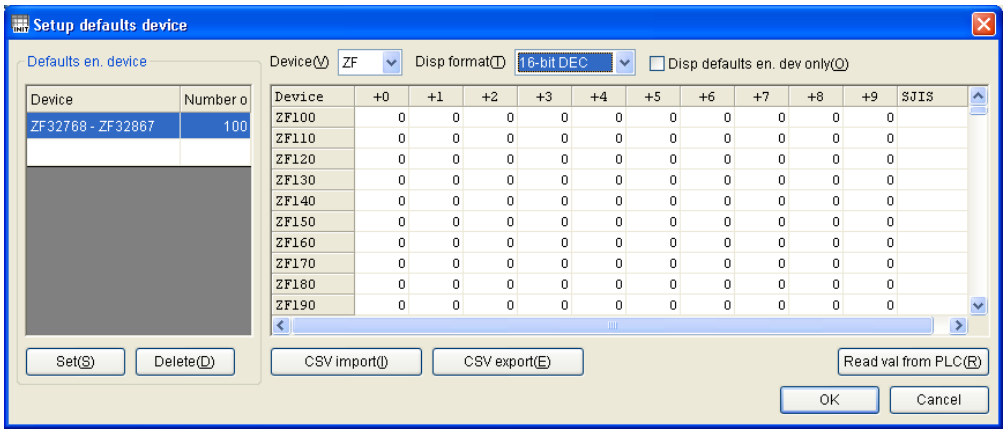
"FRSET", Page 3-141

TIP
- No. Of current memory bank may be confirmed by CM710.
- Can use KV mode (upper link) "BE" instruction, to switch memory bank.

KV-L2*V User's Manual KV-LE20V User's Manual

Defaults

When preset the value of file register (consecutive number mode), open "device default setting" dialog box on KV STUDIO work space to set.



After transmit the project set in this dialog box to CPU unit, when switch PROG -> RUN mode, read set initial value automatically.

KV STUDIO User's Manual "Device Default Value Settings"

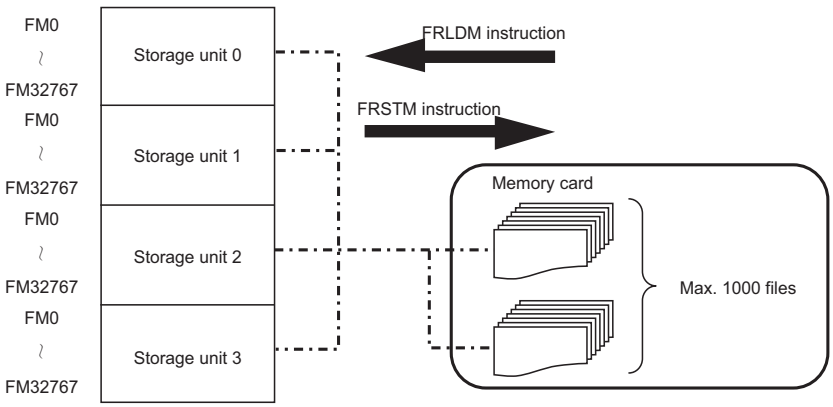
File Register Setting

Use special instruction, take the memory card that is inserted into CPU unit as object, save/load the data of file register (file register setpoint).

FRSTM instruction: save file register of designated memory bank into memory card

FRLDM instruction: read the file saved in memory card to the file register of designated memory bank

"FRSET", Page 3-143, "FRLDM", Page 3-145

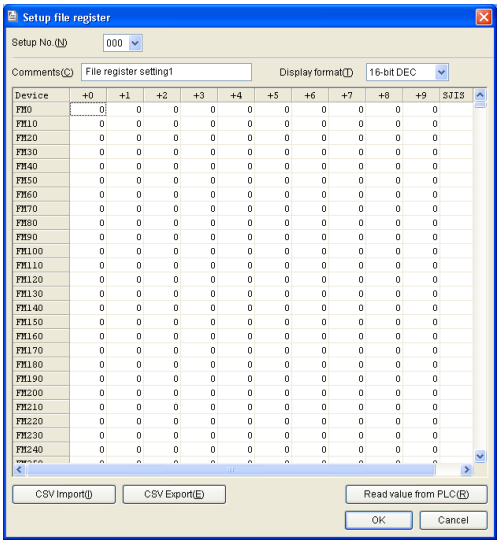


Save setpoint of file register up to 1000 files in memory card ahead of time, read when required for program switching purpose, it is unnecessary to note the number of device.

■ File register set value management

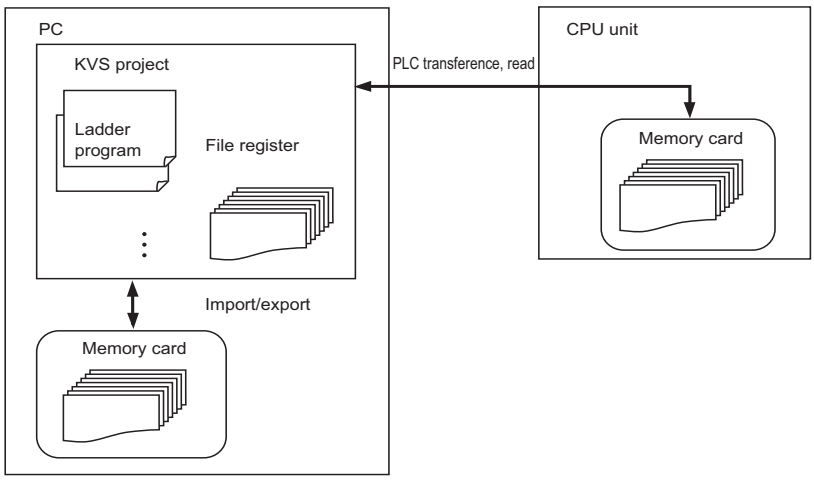
Files saved in memory card (file register setpoint) may be edited through KV STUDIO. Open "File Register Settings" dialog box on work space to carry out edit, new, CSV file import etc. File register setpoint should be managed according to different projects respectively.

KV STUDIO User's Manual "File Register Settings"



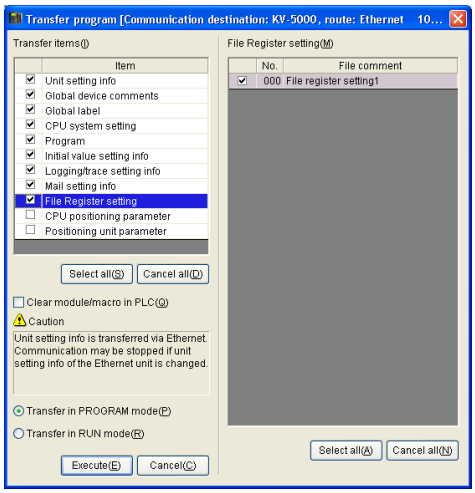
■ File register set value transfer

The method to write setpoint of file register created/edited by KV STUDIO into memory card, or read file register setpoint file in memory card is as follows.



● PLC transfer/read

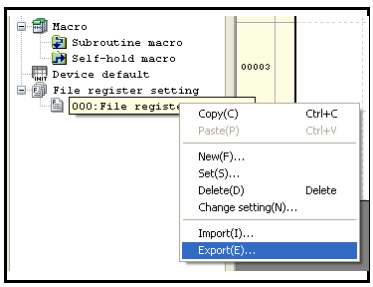
Communication of PLC during transmission/reading is the same as other project information. During transmission, other project information is saved in CPU unit body, only file register setpoint is saved in memory card.

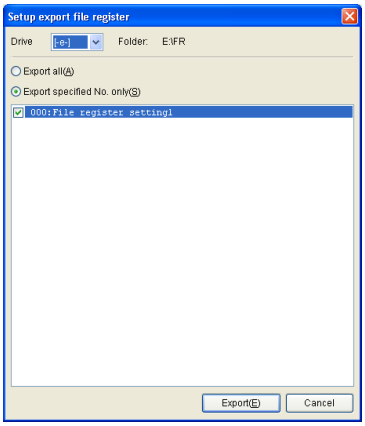


KV STUDIO User's Manual “monitor"

● Import/export

Connect memory card to individual computer, execute import/export operation.



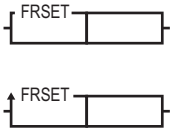


KV STUDIO User's Manual “file register setting"

File Register Instructions

Instruction	mnemonics	Instruction description	Page
File register memory switching	FRSET	Switch current memory bank no. of File Register to determined no..	3-141
File register saving	FRSET	Save File Register inside the specified memory bank to memory card in binary format.	3-143
File register read	FRLDM	Read the data saved in memory card to file register of designated memory bank unifiedly.	3-145

FRSET
@FRSET



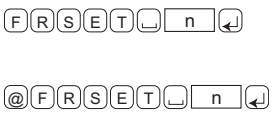
File register bank switching

Switch current memory bank no. of File Register to determined no..

Ladder program



Execute condition



Operand	Available Devices																		Index Change
	Bit device							Word Devices							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
n	○	-	○	-	-	-	○	○	○	○	○	○	○	○	○	-	○	○	○

Operand	Explanation
n	Designate switched current memory bank No. or initial device to save No., (0 to 3)*1

*1 When the bit device is specified, continuous 16/ 32 bit is processed.
If relays other than channel start relay (R002, R106, R1012 etc.) are specified, it jumps to the next channel for 16/32 bit processing.
"Bit Device", Page 3-57

Description of Operation

FRSET When execution condition is on, switch current memory bank No. Of file register to through n Designated No..

FRSET Only 1 scan period is ON at the up edge of execution condition

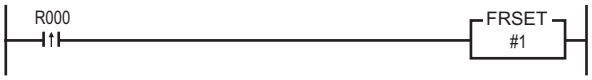
Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	· (n >02) is ON. · It is ON, when indirect specifying, Pointer Modification range is improper Those other than the above-mentioned are OFF

* If CR2012 is ON, the instruction will be not executed.
When CR2012 is on, detailed information of CM5100 - CM5176 error will be stored.
"Error Log (CM)", Page 3-20

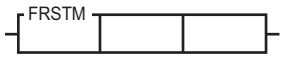
Example

At up edge of input relay R000, switch current memory bank of file register to memory bank 1.




```
(mnemonics list)
 LDP R000
 FRSET #1
```

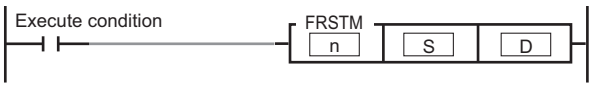
FRSET



File register saving

Save File Register inside the specified memory bank to memory card in binary format.

Ladder program



Input mode



Operand	Available Devices																		Index Change
	Bit device							Word Devices							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
n	○	-	○	-	-	-	○	○	○	○	○	○	○	○	○	-	○	○	○
S	○	-	○	-	-	-	○	○	○	○	○	○	○	○	○	-	○	○	○
D	○	-	○	-	-	-	○	○	-	-	-	-	-	○	-	-	○	○	○

Operand	Explanation
n	Designate memory bank No. Or initial device to save No. (0 to 3). *1
S	Designate file No. To save data or initial device to save file No（0 to 999）。. *1
D	Designate first address of notice bit device.*2

*1 When the bit device is specified, continuous 16/ 32 bit is processed.
If relays other than channel start relay (R002, R106, R1012 etc.) are specified, it jumps to the next channel for 16/32 bit processing. "Bit Device", Page 3-57

*2 If bit device is designated, continuous 2 bits will be occupied. When word device is designated, lowest bit in continuous 2 words is used as notice bit device respectively.
Bits other than the lowest is not changed.

Description of Operation

Only 1 scan period is ON at the up edge of execution condition n test up edge of execution condition, all file registers of memory bank No. N will be saved in memory card unifiedly in binary format (always save to file).
File No. Is designated by value S.
File name is \FR\FR (file No. 3 digits).FRB.

Example

in S When 10 is saved, file name is \FR\FR010.FRB.

D Write end notice, D Error notice for abnormal end of write in +1.

· D It is OFF during instruction execution, ON after writing processing of memory card. It is ON, during instruction normal end or abort.

· D +1 normal end of instruction OFF; abnormal end on.

When "FR" folder does not exist, make a new "FR" folder.

Note

· When memory card instruction execution relay (CR3214) is ON, fail to execute the instruction. Please use CR3214, perform exclusive control.

operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	· N When the value saved in N is larger than "3", on state · S When the value saved in N is larger than "999", on state · It is ON when indirect specifying or index modification range is improper. State other than above.

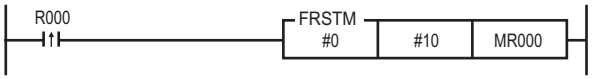
* If CR2012 is ON, the instruction will be not executed.

When CR2012 is on, detailed information of CM5100 - CM5176 error will be stored.

"Error Log (CM)", Page 3-20

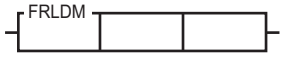
Example

At up edge of input relay R000, save file register of memory bank 0 to memory card as per file No. 10.



(mnemonics list)
MPS R000
FRSTM #0 #10 MR000

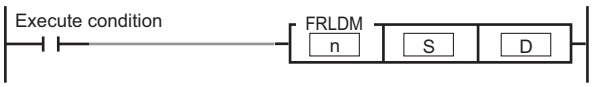
FRLDM



File registerread

Read the data saved in memory card to file register of designated memory bank unifiedly.

Ladder program



Input mode



Operand	Available Devices																		Index Change
	Bit device							Word Devices							Constant	Indirect specifying		Local device	
	R	DR	MR LR B	T	C	CTC	CR	DM EM FM ZF TM W	T	C	CTH	CTC	Z	CM	#/$	#TM	*	@	: #/: Z
n	○	-	○	-	-	-	○	○	○	○	○	○	○	○	○	-	○	○	○
S	○	-	○	-	-	-	○	○	○	○	○	○	○	○	○	-	○	○	○
D	○	-	○	-	-	-	○	○	-	-	-	-	-	○	-	-	○	○	○

Operand	Explanation
n	Designate memory bank No. Or initial device to save No. (0 to 3). *1
S	Designate file No. To read data or initial device to save file No(0 to 999). *1
D	Designate first address of notice bit device.*2

*1 When the bit device is specified, continuous 16/ 32 bit is processed.
If relays other than channel start relay (R002, R106, R1012 etc.) are specified, it jumps to the next channel for 16/32 bit processing.
"Bit Device", Page 3-57

*2 If bit device is designated, continuous 2 bits will be occupied. When word device is designated, lowest bit in continuous 2 words is used as notice bit device respectively.
Bits other than the lowest is not changed.

Description of Operation

FRLDM Up edge of execute condition, read data, file No. Saved in memory card (through FRSTM instruction or KV STUDIO " File Register Settings") to memory bank No. Unifiedly [n] File register. (always save to file).
File No. Is designated by value [S].
File name is \FR\FR (file No. 3 digits).FRB.

Example

in [S] When 10 is saved, read \FR\FR010.FRB.

[D] Write end notice, Error notice for abnormal end of write in [D] +1
· [D] It is OFF during instruction execution, ON after writing processing of memory card. It is ON, during instruction normal end or abort.
· [D] +1 normal end of instruction OFF; abnormal end on.
When "FR" folder does not exist, make a new "FR" folder.

Note

· When memory card instruction execution relay (CR3214) is ON, fail to execute the instruction. Please use CR3214, perform exclusive control.

Operation flag

CR2009	No change in status
CR2010	No change in status
CR2011	No change in status
CR2012	· When the value saved in N is larger than "3", on state · When the value saved in S is larger than "999", on state · It is ON when indirect specifying or index modification range is improper OFF other than this.

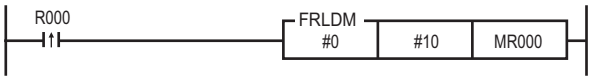
* If CR2012 is ON, the instruction will be not executed.

When CR2012 is on, detailed information of CM5100 - CM5176 error will be stored.

"Error Log (CM)", Page 3-20

Example

At up edge of input relay R000, save file register of memory bank 0 to memory card as per file No. 10.



(mnemonics list)
LDP R000
FRLDM #0 #10 MR000

MEMO

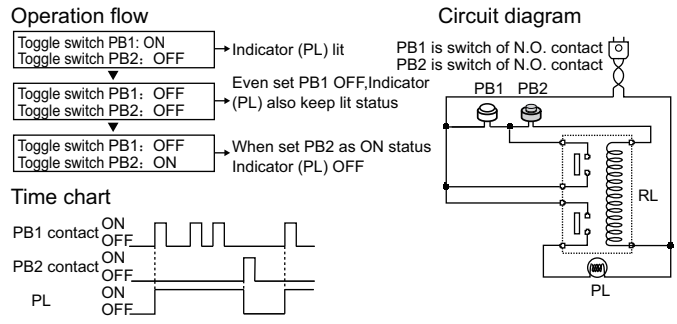
3-12 Programming Skills

From Installation to Operation

The procedure from KV-5500/5000/3000 PLC installation to operation is shown in the figure below.

Operation content analysis

Through programming action flow, specifying, time sequence diagram, circuit diagram etc, conceive processing action content.



Program analysis

◇Unit Configuration

When there are many I/O equipments for control, or expansion function is used,

Consider to use expansion unit.

Please refer to User's Manual for KV-5500/5000/3000 Series PLC and Expansion Unit

◇Module Configuration

According to each processing process, function, program, conceive module.

"Example: Module Configuration", Page 3-103

◇Composition of sequence program

After rough frame is obtained for control content of each module and instruction used, conceive the whole program.

KV-8000/7000/5000/3000/1000 Instruction Reference Manual

Programming

Use KV STUDIO to program

◇New a project

KV STUDIO User's Manual "New Making of Projects"

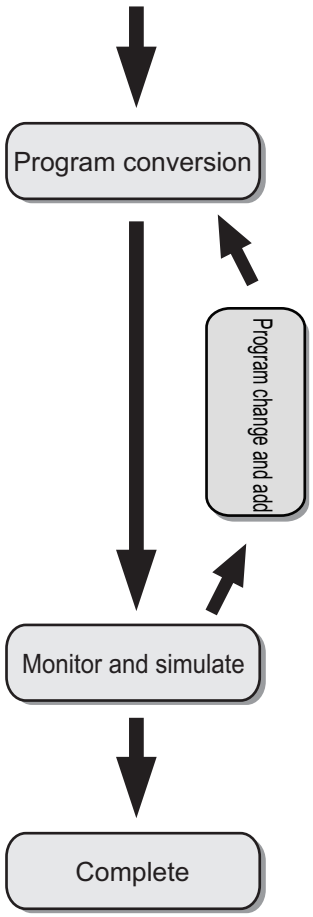
◇Set up unit

In Unit Editor, set the unit device assigned to every expansion unit.

KV STUDIO User's Manual "Chapter 3 UNIT EDITOR"

◇ Making module/program

"3-8 Module", Page3-94
"Programming Tips", Page 3-152
"Prepare Clear, Legible Program", Page 3-164
"Programming Key Points", Page 3-169
"3-9 Macro", Page3-109
KV-8000/7000/5000/3000/1000 Instruction Reference Manual



When transmit to PLC for monitoring, change mode in Simulator, convert module/program. If conversion error occurs, eliminate error according to the prompt in output window.

"Conversion", Page 3-178
" Typical Local Device entry and Conversion Error", Page 3-135
KV STUIDO User's Manual "A-1 Error Message Lists"
"Programming Key Points", Page 3-169

Change or add program.

"Prepare Clear, Legible Program", Page 3-164
"Online edit", Page 3-181
"Write in the RUN mode", Page 3-179

Fully utilize Monitor, Simulator and convenient functions for debugging.

Monitoring "Monitoring", Page 3-180
Simulator "Simulator", Page 3-182

Register the module of high rate of utilization in module library.

"Module Management", Page 3-94

Register the macro of high rate of utilization in macro library.

"Macro Management", Page 3-109

■ When designed by multiple persons

(1) The leader designs the high-level project structure.

The project leader decides high-level composition of the project and prepares the project data shared by several persons (global settings).

Example

Global settings example

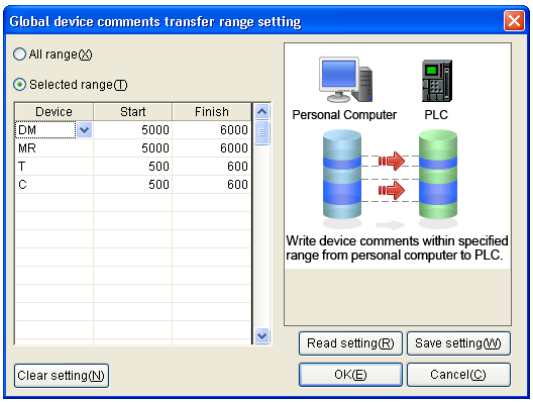
- Unit configuration and setting
- assignment of module configuration
- CPU System setting

  Module execution sequence, local entire assignment, CPU unit buffer memory capacity, action settings when error occurs etc
- Definition of common macro
- To program/tracing function assignment
- Global device/label assignment

:

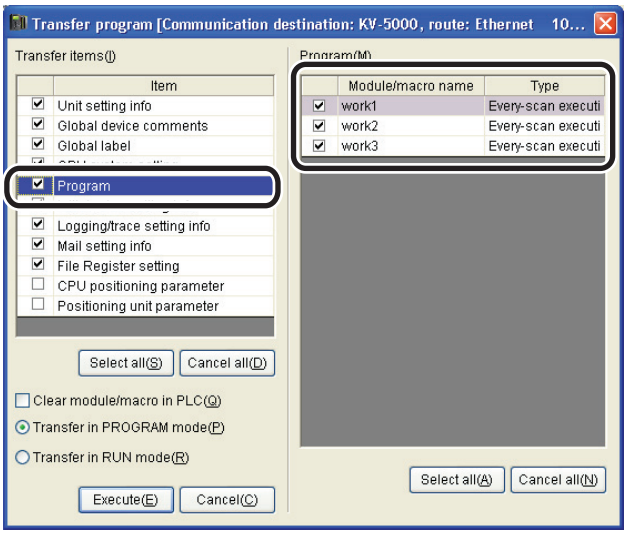
(2) leader transmits project to PLC body.
(3) Each member reads project from PLC body.
(4) Each member executes distributed notes transmission range set up of global device.

TIP Select "Monitor/simulator (n)" -> "Setup communication (t)" -> "Setup transfer range of global device comment (T)" from KV STUDIO menu.



(5) Each member programs the program within its own module.
By using local device or local mark number actively, avoid conflict with other device during work.
"3-10 Local Device", Page 3-131
"Label", Page 3-162

(6) Each member transmits assumed module to PLC, execute debug.
Since transmission to PLC body can be performed as per module unit, therefore other module will not be covered wrongly.



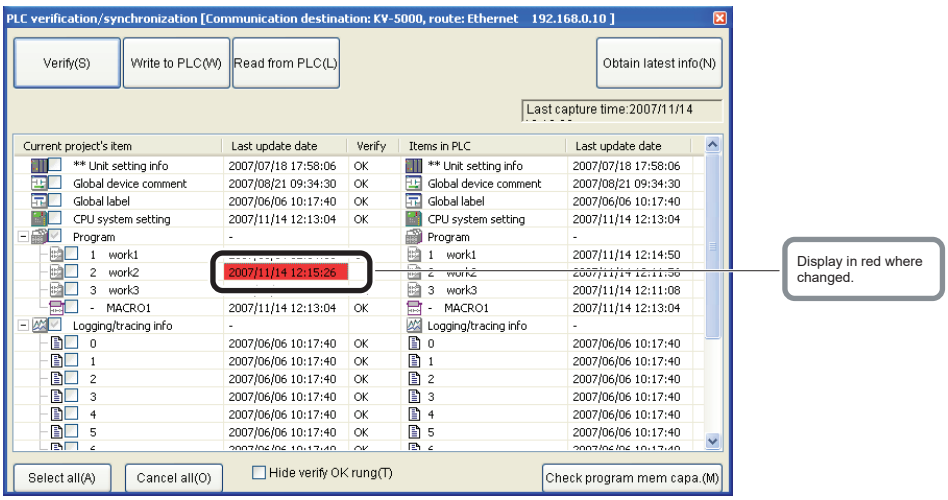
Click "program", only select transmitted module.

Note

- When only transmit program, when module execution sequence settings does not exist in PLC body, or when module designated by ECALL instruction called out in the module does not exist in PLC body, PLC body error will occur "15 conversion error". Please confirm inconsistent projects in the following "PLC check/synchronous" dialog box, eliminate the cause of conversion error.
- Restriction matters when several persons execute debug are as follows.
  - Real time chart monitor cannot realize communication above two persons simultaneously.
  - Interrupt function cannot realize use by more than two persons simultaneously.
  - To Logging/Trace function can be used by several persons after ID is distributed, but but settings information cannot be written as per each ID.

TIP From next start, begin to execute projects saved in individual computer from each member.

If one person changes global settings (unit set up information, module execution sequence settings, Setup local device assignment, PLC unit buffer capacity settings, action when error occurs) and executes transmission, the change will be notified to other persons under monitoring through KV STUDIO, difference point can be confirmed in "Verify with PLC/Synchronize" dialog box.



Programming Tips

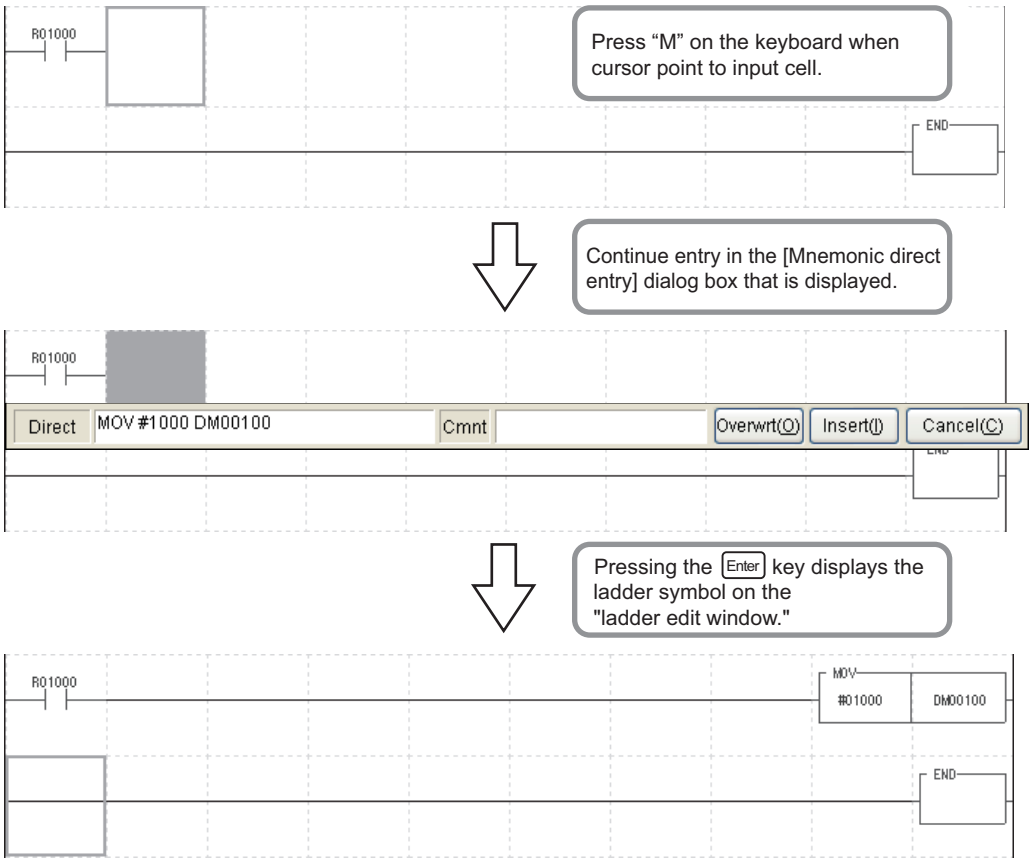
This section will explain some convenient functions required for programming, so as to reduce entry and modification workload.

Mnemonics entry

For mnemonic symbol entry, since instruction can be entred without mouse, therefore, compared with using of "Instruction/macro palette (instruction/macro template) ", programming is quicker.

■ Mode entry

Use keyboard to enter the first character of instruction.
(example) entry MOV instruction



TIP After "reduced display of direct entry box" check box in "Setup edit/key" of "Tool" -> "Options" is selected for "Zoom out direct entry by Enter key" dialog box, display will be reduced.

For details on each instruction, KV-8000/7000/5000/3000/1000 Series PLC Instruction Reference Manual.

TIP ·entry designated source device and value in instruction and operand, abbreviate the entry.
(example) A 0 -> LD R000
"A-6 Mnemonics Abbreviation", Page A-26

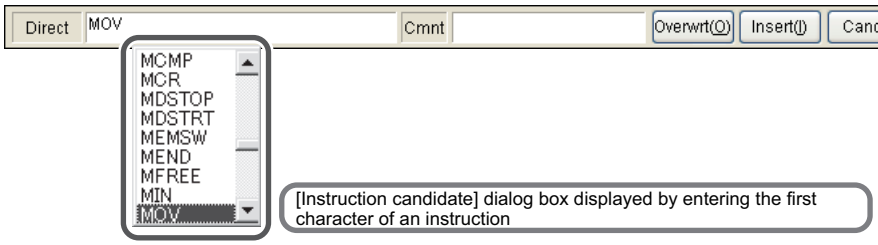
·Press Esc or F2 key, edit entry cell in "Mnemonic direct entry (Mnemonic direct entry)" dialog box. In "Setup edit/key" of ("Tool" -> "options", after select "start up direct entry by Enter key " check box, Enter key will be distributed to "Mnemonic direct entry" dialog box.)

■ Entry mnemonics

When entry mnemonic symbol, several functions are helpful for entry mnemonic symbol.

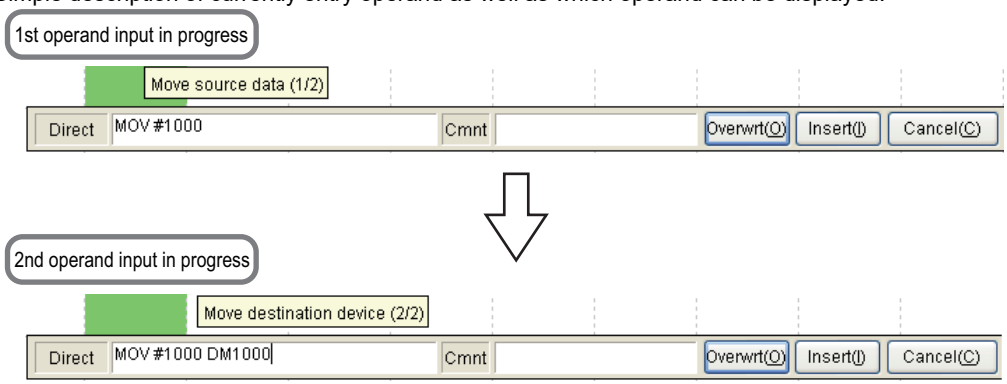
● Display instruction list

After entry the first character of instruction, "candidate instruction" dialog box initiated by the first entry character will be displayed, instruction can be selected.



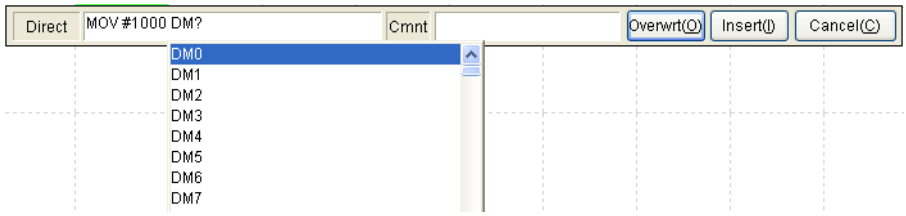
● Display simple description of instruction operand

Simple description of currently entry operand as well as which operand can be displayed.



● Simple search for unused device

In midway of entryting device category or No., , unused device will be displayed next to entry of "?" in list mode.



Shortcut keys

Use shortcut key, mouse can not be used, only use keyboard for operation. Use shortcut key to reduce keyboard clicking times, quicken entry speed.

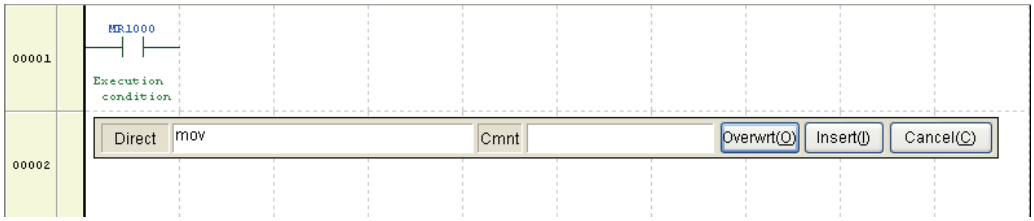
Typical shortcut key is described as follows.

"A-7 List of Shortcut Keys", Page A-28

■ Enter/Edit

● Esc F2

Display "Mnemonic direct entry" dialog box, use mnemonic symbol to entry or edit.



"Mnemonics entry", Page 3-152

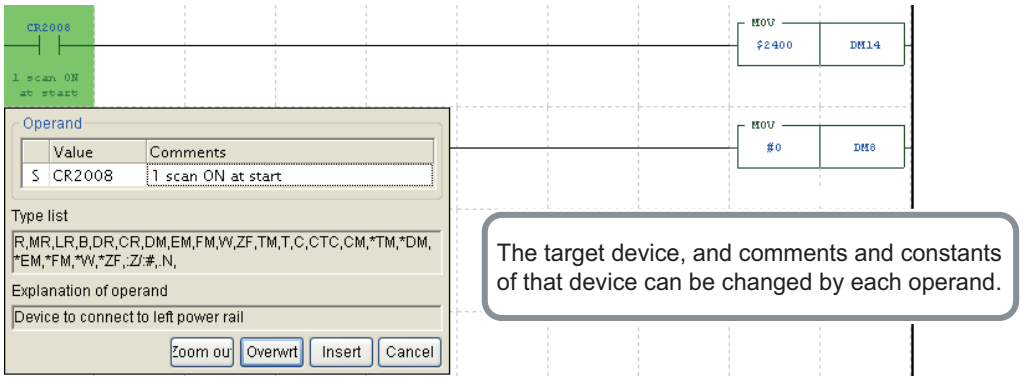
● Enter

<If an empty cell is selected in edit mode>

Then it will display “Instruction/macro/pack palette".

<If a cell with existing entry is selected in edit mode>

Display "Operand edit (operand edit) " dialog box.



<In monitor mode or simulation mode>

"Search/replace" dialog box appears.

● Ctrl + M

If a cell with existing entry is selected in "Operand edit (operand edit)" dialog box, notes can be edited.

● Ctrl + X / C / V

Shortcut key for Windows application program standard edit:

Ctrl + X ..... Cut

Ctrl + C ..... Copy

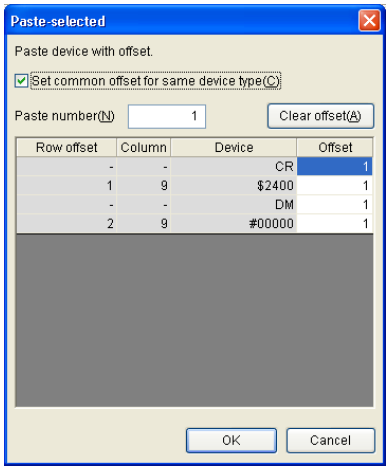
Ctrl + V ..... Paste

● Ctrl + Shift + V

Set the number of paste, paste can be performed for many times.

In addition, included device can also be adjusted.

KV STUDIO User's Manual "5-1 Functions concerning Edit - Multipaste"



● Ctrl + Z / Y

Shortcut key for Windows application program standard edit:

Ctrl + Z ..... Undo

Ctrl + Y ..... Redo

● Tab / Shift + Tab

Move the cursor according to ladder symbol unit.

● Ctrl + ↑ / ↓

Move cursor according to ladder circuit block program section.

● Ctrl + →

Select the whole line containing the selected cell.

■ Insert

● Insert

Insert horizontal connecting wire in the selected cell.

● Shift + Enter or Shift + Insert

Insert row.

● Shift + Delete

Delete row.

● Ctrl + Enter

Insert row comments.

"Rung comments", Page 3-166

■ Connection line edit

● Alt + Enter or Ctrl + Tab

Draw a connecting wire from the selected cell to line end.

● Alt + ← / ↑ / → / ↓

When there is no connecting wire, draw a connecting wire according to arrow direction.

When there is connecting wire, delete connecting wire according to arrow direction.

■ Retrieve/displace

● Ctrl + F

Displays the "Search" tab of the "Search/replace" dialog box is displayed.

"Search/replace", Page 3-158

● Ctrl + H

Displays the "Replace" tab of the "Search/replace" dialog box is displayed.

● Space

Display cross reference

"Cross reference", Page 3-158

■ Display

● Ctrl + F7

Display "Device comment edit" window.

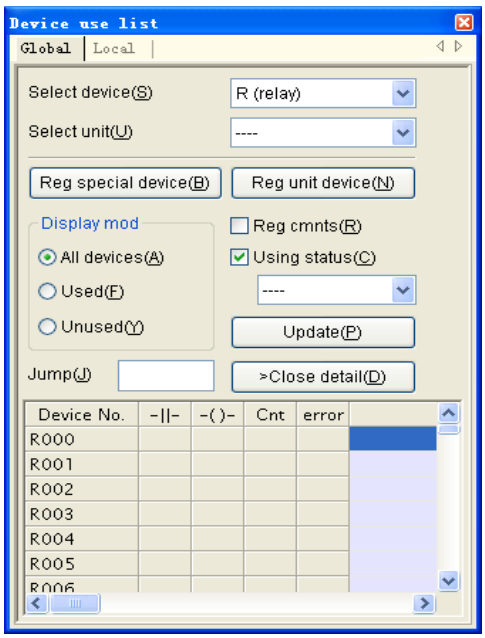
"Device Comments", Page 3-164

● Ctrl + E

Display "Device use list" window.

Unused device can be confirmed simply.

KV STUDIO User's Manual "6-2 About View Functions - Displaying Use Status"



● Ctrl + Page Up / Ctrl + Page Down

Zoom in / zoom out "ladder edit" window.

* When "Display"-> "Automatic multiplying factor" check box is selected, do not act.

● Ctrl + Space

Switch notes display/hide in ladder editor.

Search/replace

Search the instruction and operand that fit with the designated condition, express them. In addition, display consistent projects in output window in list mode.

When search device, please use cross reference function that can be displayed in list mode by simply pressing blank.

"Cross reference", Page 3-158

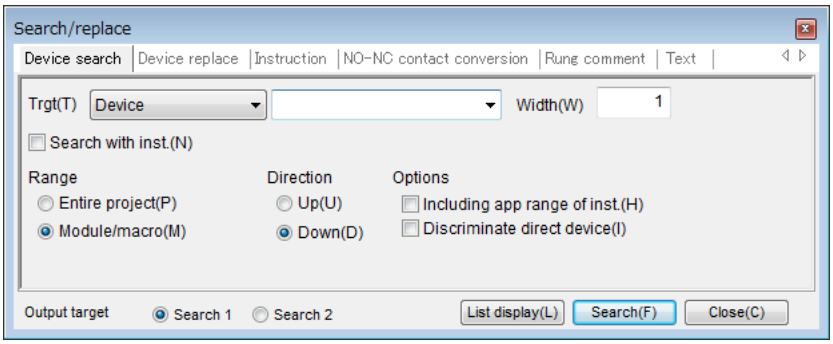
1 **Select the "Label edit" window.**

2 **Right click the mouse, and select "Search (S)" from the popup menu.**

Other procedure · Select "Edit (E)" -> "Search (S)" from the menu.

- Ctrl + F

"Search/replace" dialog box appears.



As object, select from "device", "label", "constant", "module/macro", "device comment", "label comments", "reserve/disable".

Cross reference

Edit (E) -> cross-looked up making (X)

Display search result list of designated device in output window.

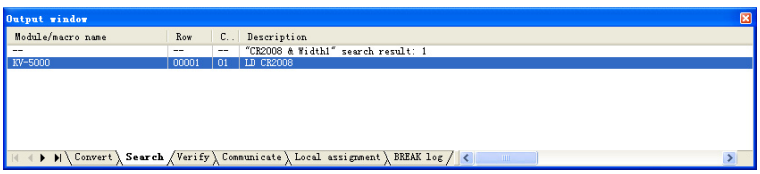
1 **Select the device to prepare cross reference (ladder symbol).**

2 **Select "Edit (E)" -> "cross reference (X)" from the menu.**

Display search result list in output window.

Other · (space) key

· Select "cross reference (L)" in the menu displayed after right click

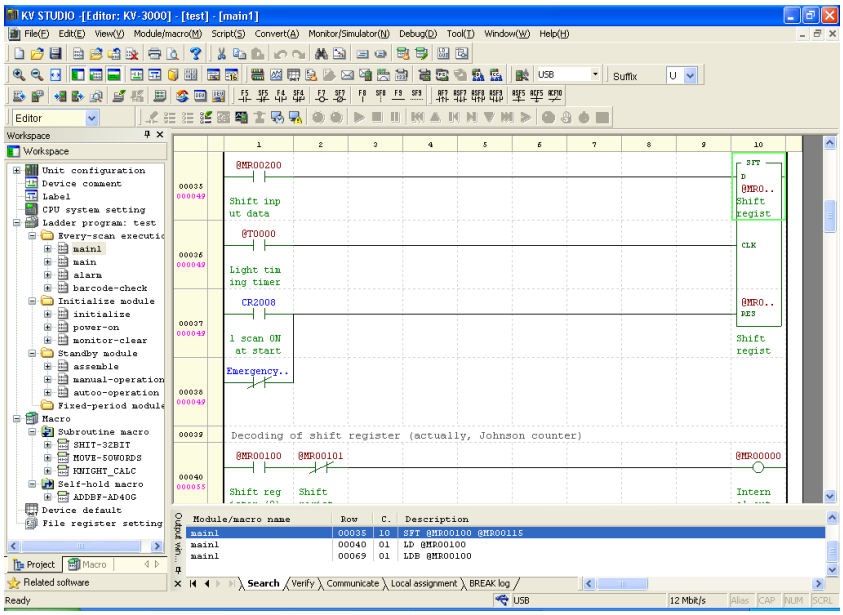


3 **Double click the content to be checked in search result list.**

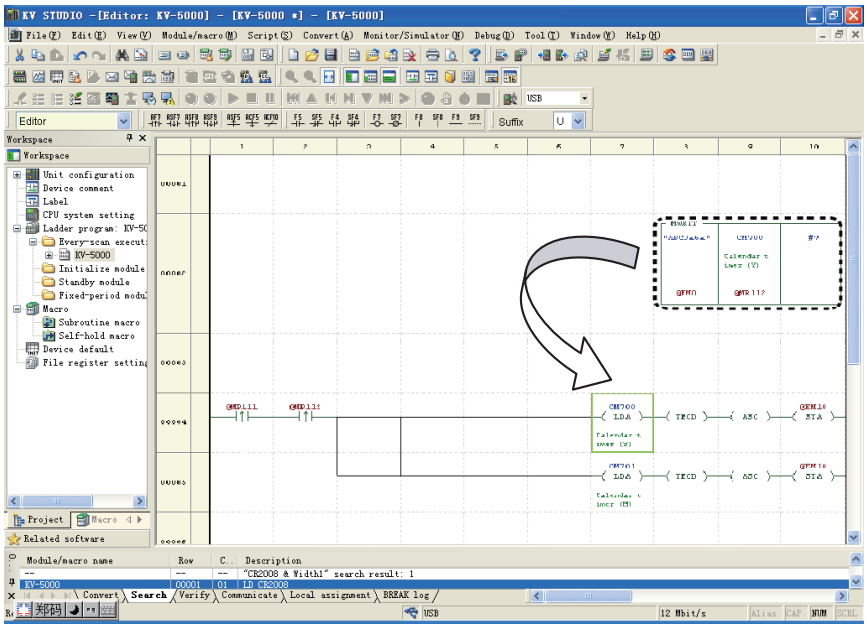
After double click device displayed in the list, move cursor to corresponding device symbol) on the ladder.

Other procedure · F3

· Shift + F3



4 **Click F3 key, move cursor to the next search object.**



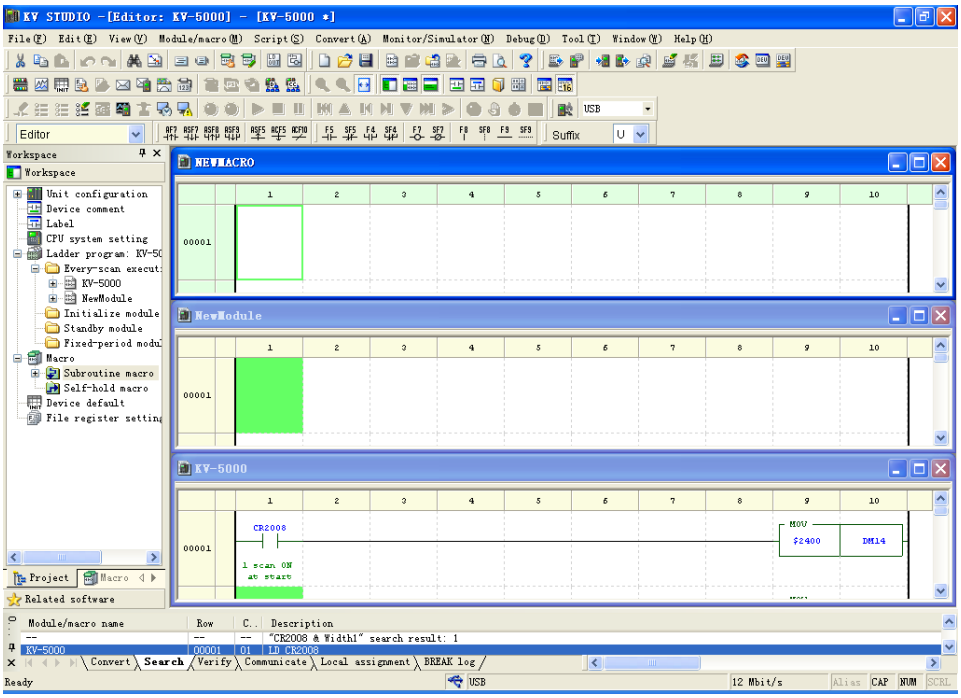
5 **To move the cursor focus to the previous search details, press the Shift + F3 keys.**

Window menu

Running window menu flexibly is helpful to increase programming efficiency.
Now describe "Tile" and "split" in window menu.

■ Tile windows

This function is used to open several module or macro simultaneously for preparing or debugging program.
Select "Window (W)" -> "Tile (T)" from the menu.
Currently opening module or macro is displayed in parallel.

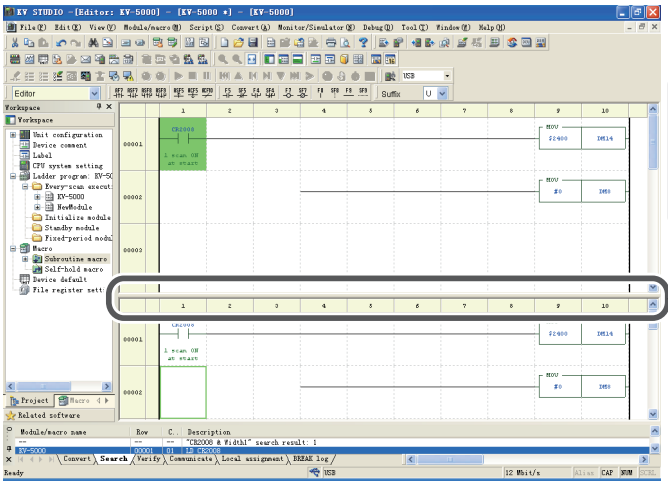


TIP Copy/cut and paste a part of ladder program between modules/macros .

■ Split

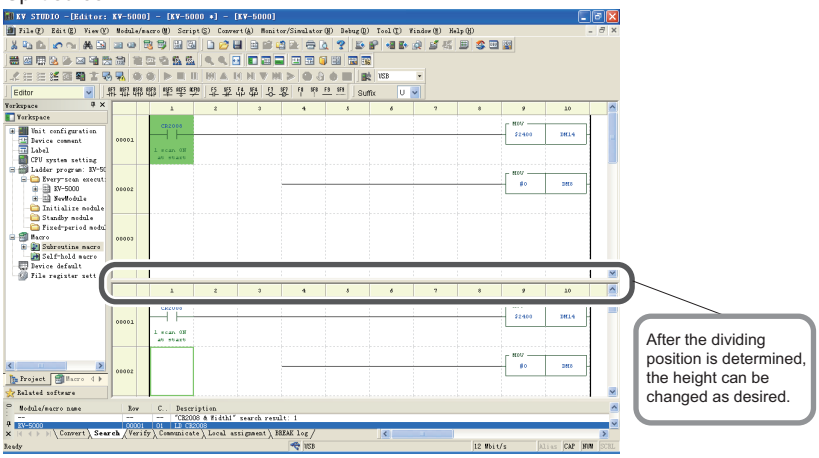
If program is too long, simultaneous display of all programs is impossible.
Use split display function to split display the program in 2 parts, so as to display desired parts simultaneously.

1 Select "Window(W)" > "Split(P)" from the menu.



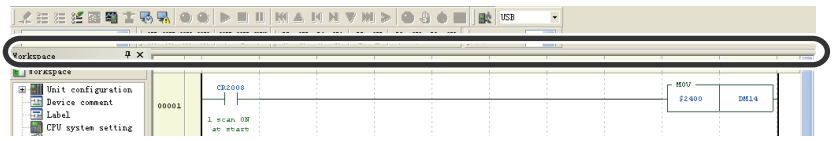
2 Through click mouse, determine split position.

<Split screen>



When determine split position, default display of upper, lower frames is start part of the program.
Through right scroll bar in each split window, desired program position can be displayed in upper, lower frames.

Other procedure If mouse cursor is moved to the position in the figure below, it will change to " ", split starts once is dragged.



Drag on split position.

TIP · Between upper, lower frames, copy/cut and paste a part of ladder program.
· Display size can also be set respectively.

Label

After managing device of each mark number with any corresponding additional condition, program through mark number, when device name is not used. If it is local mark number, KV STUDIO will distribute it to internal work area automatically, it is unnecessary to note device during programming.

TIP When increase local mark number, also execute writing operation in RUN .

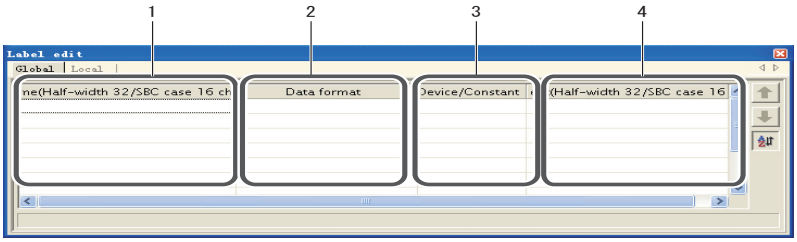
■ entry mode

Set mark number in "Label edit " window.

1 Double click "Label " in "Work area" .

Other procedure Select "View(V)" -> "Label edit window(L)" from the menu.

Display "Label edit" window.

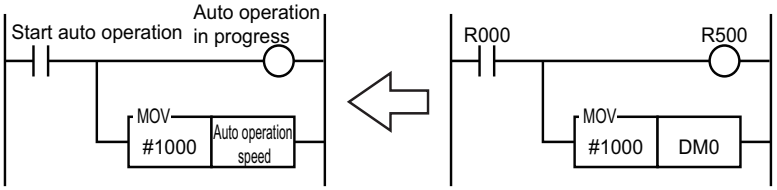


No.	Item	Description	Set range
1	Label name	entry the mark number name to be set. *	Half-angle 32/all angle16 character string
2	Data format	Set up data format. **Note** According to different devices used, some data formats cannot be used.	—
3	Device/constant	entry is distributed to marked device or constant. It is unnecessary for local mark number. TIP ·Devices that can be set to labels: R/MR/LR/B/ DM/EM/FM/ZF/W/TM/T/C.	—
4	Label comments	Display device comments. Can't enter device comments.	Half-angle 32/all angle16 character string

*"A-8 Unusable Character String List", Page A-38

Device that is registered in "Label edit (mark number edit) " window could use mark number to prepare ladder program.

(Example)



■ How to Display

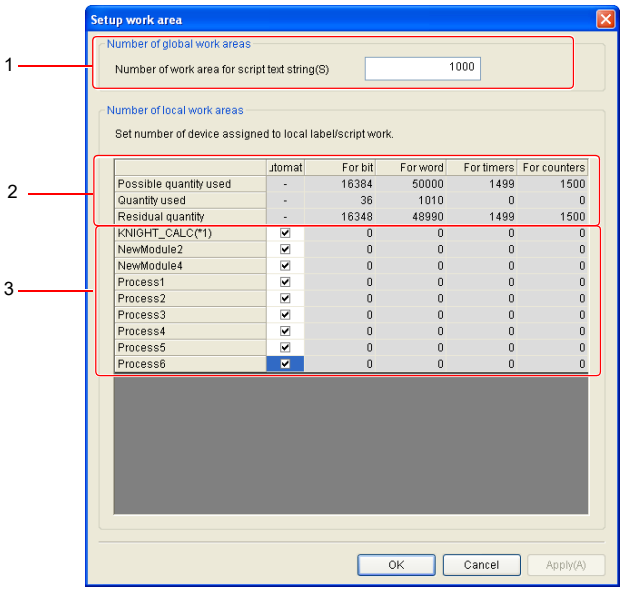
After set mark number, select "Display(v)" -> "Display label (g)" from the menu, switch display/hide of global mark number.

Other Ctrl + Back space

■ Local label assignment

Local mark number automatic distributed to local work area. Confirm used number of local work area or change distributed number in "work area settings".

Click "Setup work area" button of "CPU system setting" -> "local entire assignment settings" on KV STUDIO work space, to display "Setup work area".



No.	Item	Description
1	Number of work area for script text string	Set number of work area for script processing character string function. Display local work used for words of local work area.
2	Usable number	Display available number of local work area in the project.
	Number used	Display total used number of local work for each module/macro.
	Number remaining	Display residual available number in local work. "Residual number"="available number" - "used number"
3	Display assignment condition of different module macros	Display local work assignment condition of each module/macro. After remove automatic check box, set the number of local work to be used.

Under default state set to "automatic", it will be distributed automatically according to the setting of local mark number or To program content of KV script, generally it is unnecessary to note the number.

TIP ·During monitoring, local label assignment object can be displayed. Bit is displayed in "VB" while word is displayed in "VM".

"Display through the assignment destination of local devices/local labels", Page 3-185

· When KV script is used to execute character string processing program, if "Operation error" occurs, please set larger number of work area for script character string.

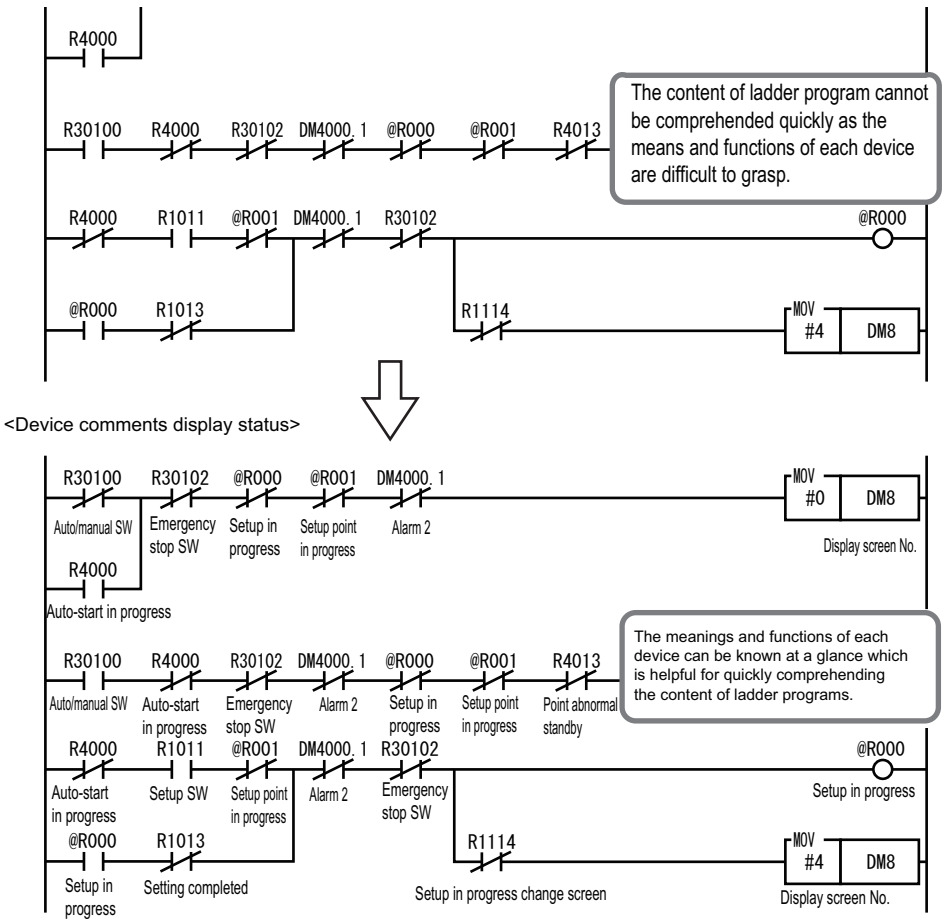
Prepare Clear, Legible Program

Device Comments

Set notes for each device.

Since set notes are displayed below the devices when ladder is displayed in KV STUDIO, and on KV-5500/5000/3000 PLC access window, therefore content of the function and contact distributed on the devices are clear at a glance.

In addition, when other person browses the program, if a device contains notes, the time required to understand program could be shortened. Device notes function can be used for both global device and local device. Target type is KV-5500, KV-5000/3000 above Ver.2, for bit processing of word device, device notes may be used in the unit of bit.



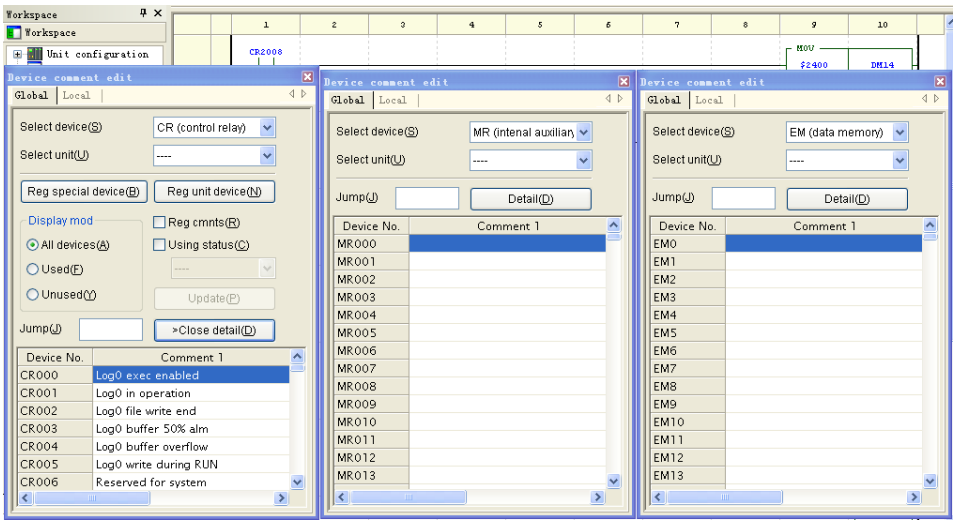
Note Device notes cannot be set in index register Z.

■ Entry mode

There are two entry methods of device notes as follows.

- Entry in "Operand edit" dialog box.(Ctrl + M)
- Entry in "Device comment edit" window.

TIP When programming in "Device comment edit" window display state, it is very convenient to confirm device notes and inp. 3 frames can be displayed simultaneously.



■ How to Display

After set mark number, switch display/hide of device notes on ladder editor through "View (V)" -> "Display comments (F)" in the menu.

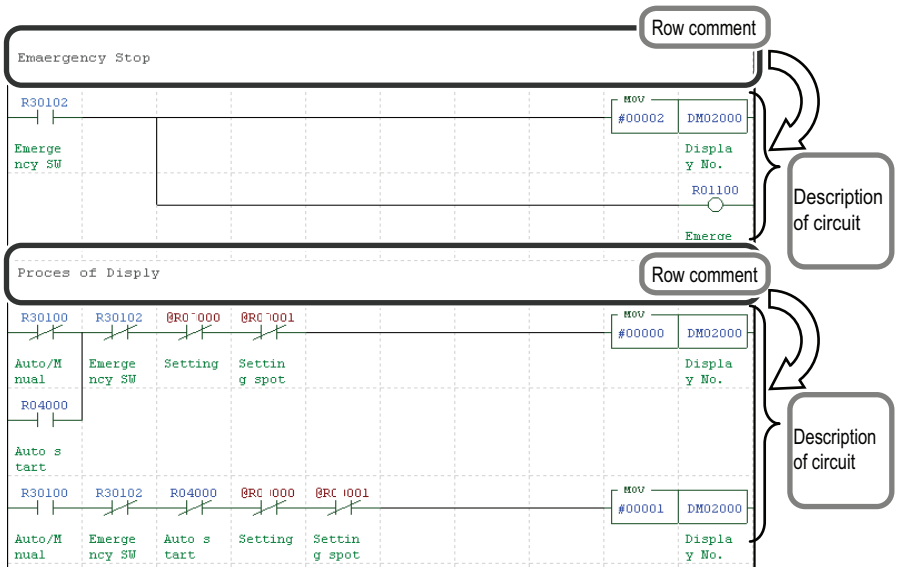
Other procedure Ctrl + Space

Rung comments

Can program comment on every line in "Ladder edit" window.

Through rung comments, during programming, content of circuit program sections can be clear at a glance.

At the same time, only display list of rung comments, move to the line of related rung comments.



■ Entry mode

entry rung comments in the following steps.

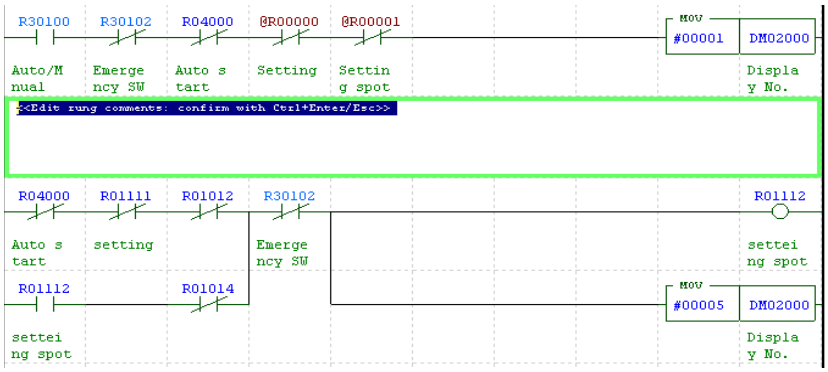
1 **In "Ladder edit" window, move the cursor to the line to entry rung comments.**

2 **Right click the mouse, select "Insert rung cmnt (H)" from popup menu.**

Other procedure ·Select "Edit(E)" -> "Insert(W)" -> "Rung cmnt(H)" from the menu.

· Ctrl + Enter

Display is shown below rung comments editor.entryting Comments.



3 **Esc , Click Ctrl + Enter button**

entry comments end.

■ Search method of rung comments

Display rung comments list in "Ladder edit" window, move from list to the selected line.

Retrieve rung comments in the following steps.

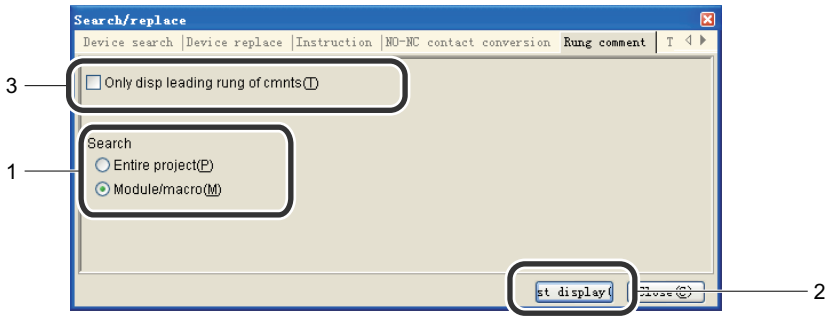
Other procedure Ctrl + L

1 **Select " Label edit" window.**

2 **Right click the mouse, select "Search (S)" from popup menu.**

Other procedure Select "Edit(E)" -> "Search rung cmnt(M)" from the menu.

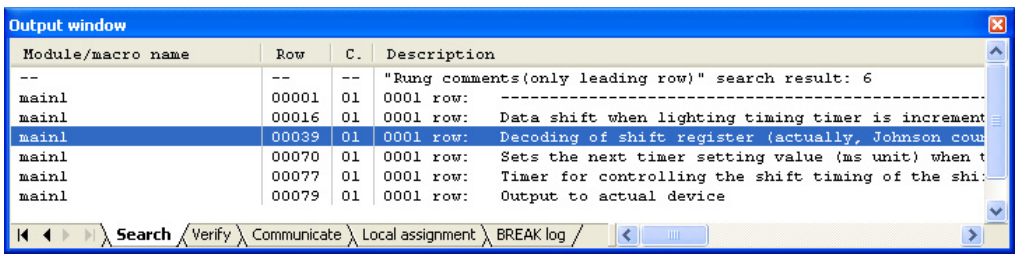
"Retrieve/replace" dialog box appears.



No.	Item	Description	Set range
1	Search range	Select object range of search rung comments.	Default: Module/macro / Entire project
2	List display	In Output window , display rung comments in all search objects.	-
3	Only disp leading rung of cmnts	If there are continuously multi-rung comments, select to display all lines, or only display the first line.	Check box Selected/ Unselected (default: unselected)

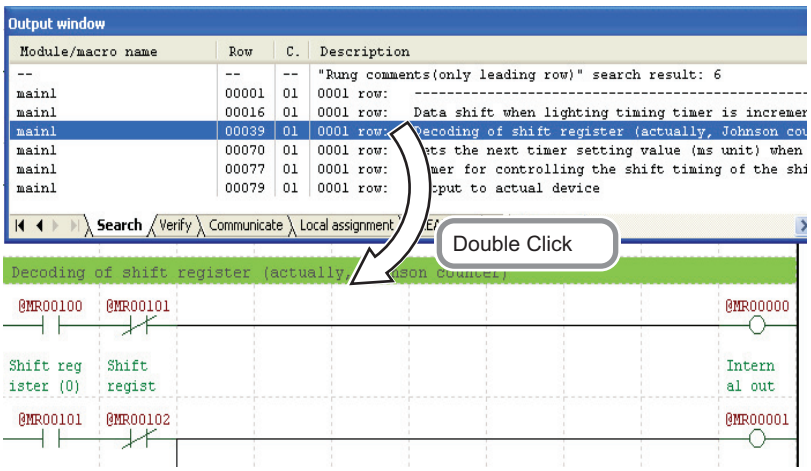
3 **Click the "Display list" button.**

In "Output window", display rung comments list.



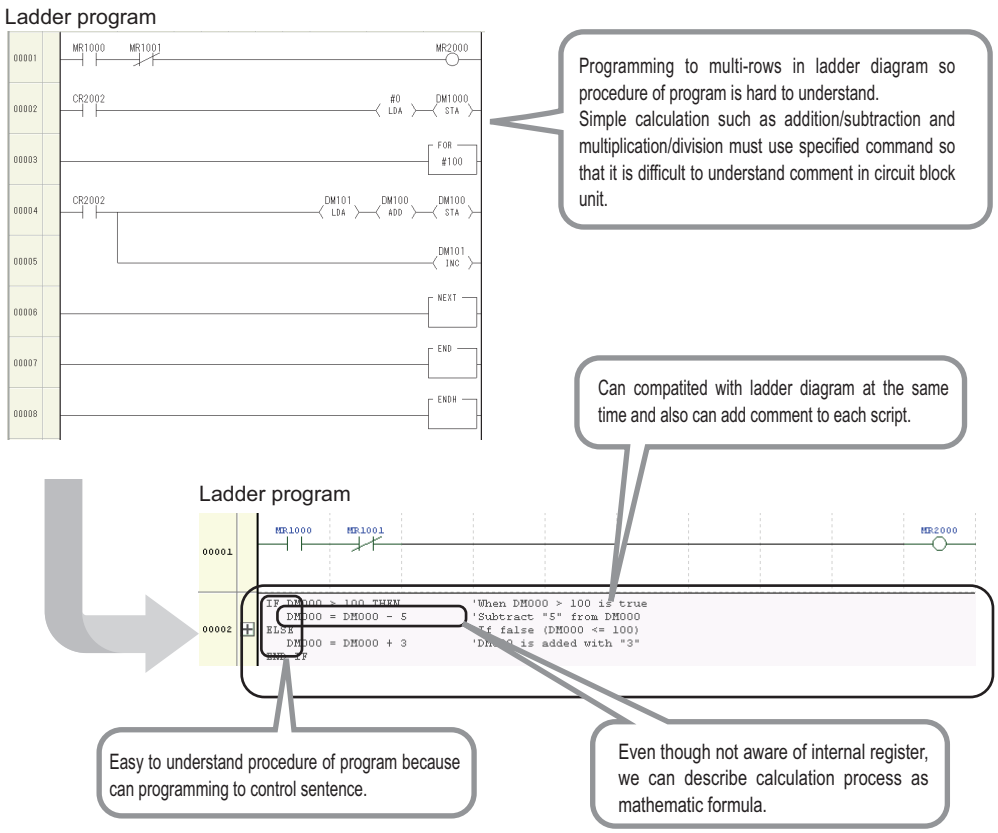
4 **Double click and jump to rung comments.**

In "Ladder edit" window, move the cursor to the line to entry rung comments.



KV script

When To program operation or character string processing etc through ladder program, to program redundant part by KV script.



KV-8000/7000/5000/3000/1000 Series Script Programming Manual

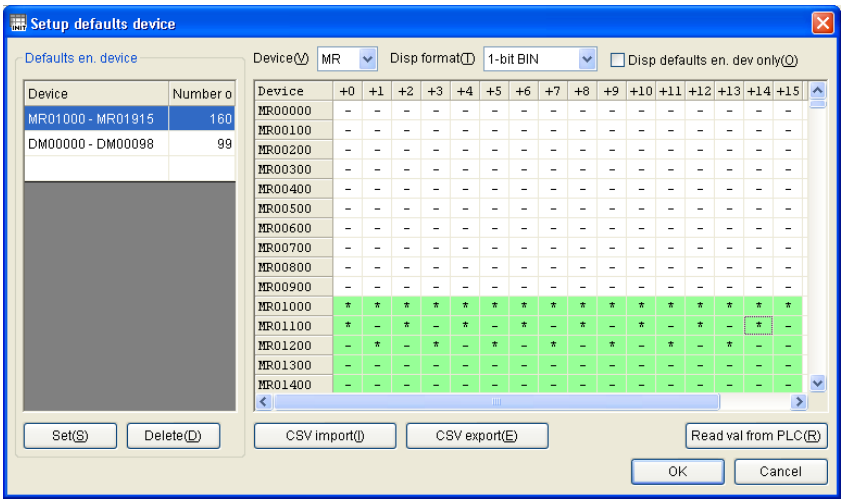
Program structuring

In order to simplify program test or facilitate reuse, each function and each project program should be modular, managed by popular intelligible name. In addition, frequently used circuit program sections are converted into macros (original instruction), just like instruction, nominated by concise, memory convenient name for entry.

"3-8 Module", Page 3-94
"3-9 Macro", Page 3-109

Device default

After ladder program is completely To programmed, redundant program of device initialization is managed unifiedly through device initial value set up. When start to run, log on value will be written automatically.
Select "Device initial value" on work space.



Programming Key Points

Content in ladder program that should be understood in advance and precautions are described below.

■ Extended ladder mode

When ordinary ladder mark is used, one OUT, TMR instruction etc output instructions can be configured in one line of ladder. After expanded ladder is used, several output instructions can be configured in 1 line, therefore number of lines in the program can be reduced, so processing sequence is more definite.

" Extended Ladder", Page 3-5

In KV STUDIO, two modes can be switched, namely expanded ladder entry mode (expanded ladder mode) and common ladder entry mode (common ladder mode).
Switch mode as per the following steps.

1 **Select "Edit(E)" -> "Expanded ladder mode(G)" from the menu.**

Other procedure Click the icon.

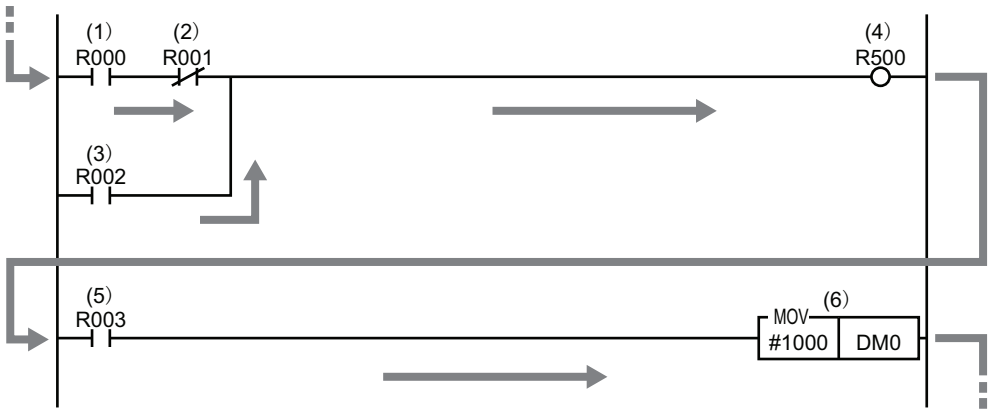
TIP · When expanded ladder mode is used, a " √ " will be displayed before "Expanded ladder mode (G)" in the menu, as well as icon with frame.

·When select expanded ladder mode, I/O instruction, it is unnecessary to move cursor to right end automatically, just proceed to entry instruction. If it is not in expanded ladder mode, once I/O instruction is issued, cursor will move automatically to the right end.

·The default mode is the expanded ladder mode OFF.

■ Execution sequence of ladder program

Ladder program, as shown in the figure below, is executed according to the sequence of "from left to right", "from top to bottom".



TIP · Program is executed according to the sequence of mnemonic symbol list.

LD	R000	(1)
ANB	R001	(2)
OR	R002	(3)
OUT	R500	(4)
LD	R003	(5)
MOV	#1000 DM0	(6)

·Module execution sequence is set via "Execute sequence of modules" of KV STUDIO "CPU system setting".

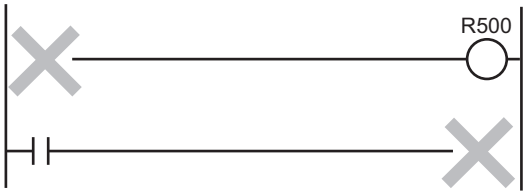
" Module Execution Sequence", Page 3-102

■ Inconvertible ladder program

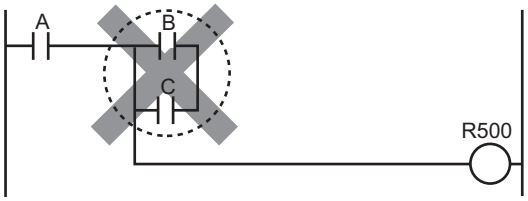
Typical mode of conversion error is explained as follows.

● Rail or output line is not connected

Set all contacts and coils to be on the path from the power rail to the output line and prevent disconnections on the path.

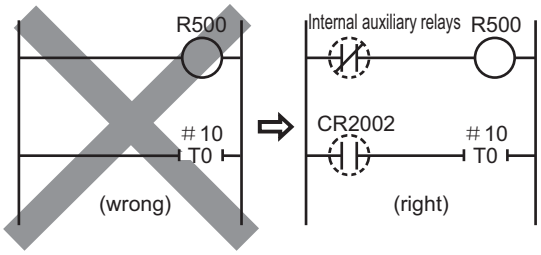


TIP The ladder in the figure on the right results in a conversion error as there is a disconnection.

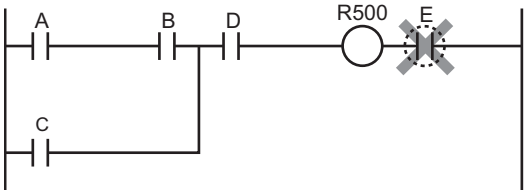


● An instruction that cannot be programmed directly by rail is used

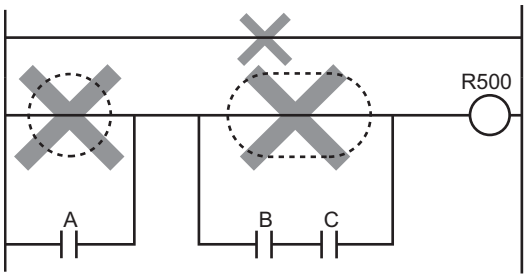
Output coils, timer/counter instructions, etc. cannot be programmed directly from the power rail. When an execution condition is not required, insert an NC contact or a control relay CR2002 (always ON contact) from an unused internal auxiliary relay as a dummy.



● An instruction that cannot be programmed directly by output line is used

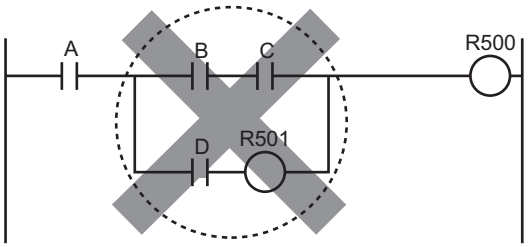


● Ladder program contains short circuit

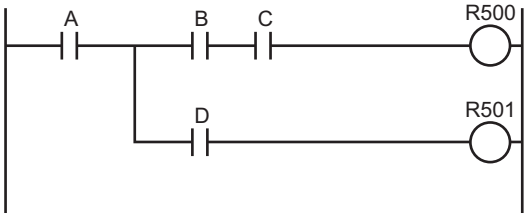


● Output coils are connected in parallel

● A group of networks that contains an output coil cannot be connected in parallel.



Note, however a parallel connection is possible if the group of parallel connection networks is each connected to the output line as shown in the figure on the right.



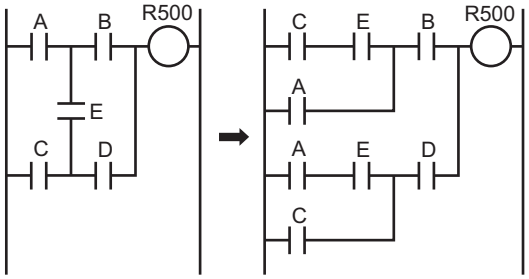
● The END/ENDH instruction is not programmed

Each module/macro needs "END" or "ENDH" instruction.

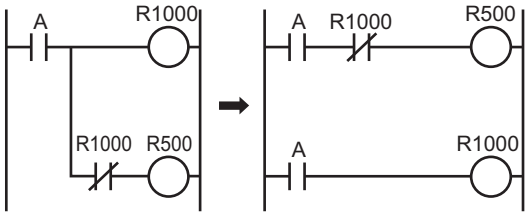
TIP If create new module or macro in KV STUDIO, "END" or "ENDH" instruction will be inserted automatically

■ Ladder program that should be re-written

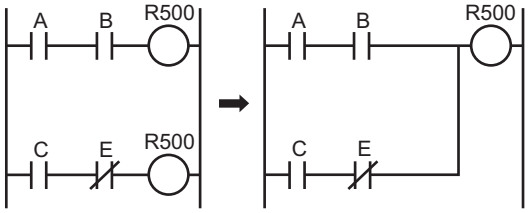
● A network such as that shown in the figure on the right cannot be programmed.
Rewrite the network.



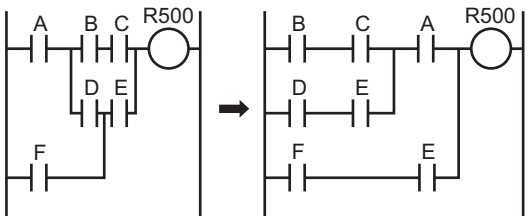
● In the figure on the right, R500 cannot be output.
Rewriting enables output for only one scan.



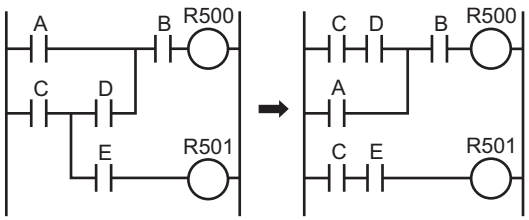
● When two of the same coils are used as shown in the figure on the right, the program towards the back is given priority, and the front in the front is ignored.



● A network such as that shown in the figure on the right cannot be programmed.
Rewrite the network.



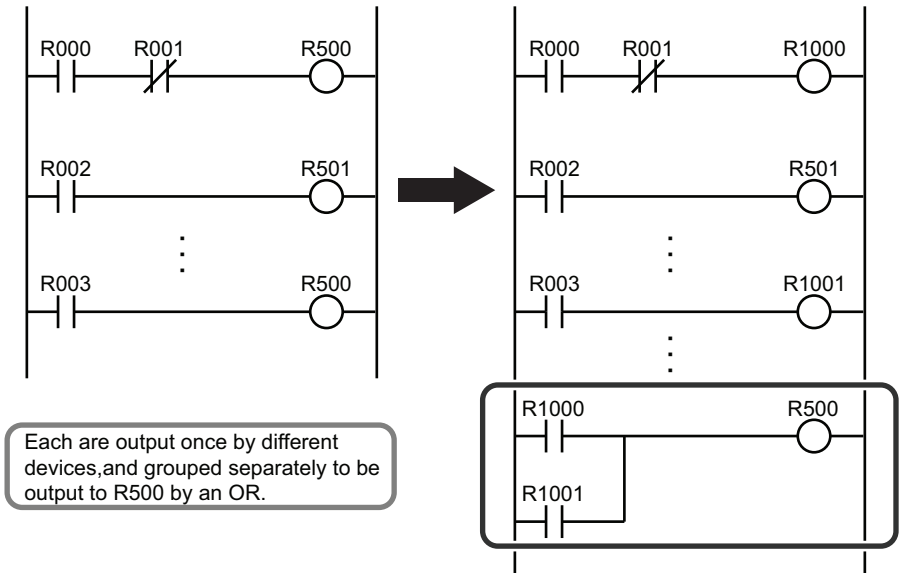
● A network such as that shown in the figure on the right cannot be programmed.
Rewrite the network.



■ Duplicate coil

If in a project, the same device uses OUT/OUB instruction for more than twice, within one scanning, the finally executed instruction has priority, other instructions are omitted.
If OUT/OUB instructions are in their separated lines or different modules or macros, take the following method for processing.

(for example), as shown in the figure below, when R500 output instruction is used twice



Although conversion error will not occur to Duplicate coil, but since action is miscellaneous, therefore please do not use.
Check whether Duplicate coil exists, please select "Convert (A)" (conversion) -> "Duplicate coil check (D)" from KV STUDIO menu.

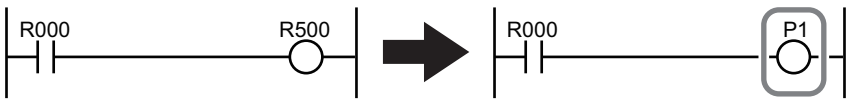
Note

When the same macro is called for twice and above, if OUT/OUB instruction that uses global device is used in macro memory, it turns into Duplicate coil.

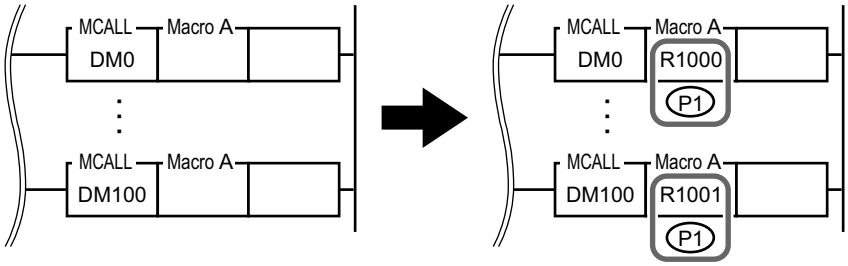
● The method to avoid duplicate coil between the same macros

For OUT/OUB instruction that uses global device in the macro, when its macro is called for twice and above, dual coil can be avoided by the following measures.

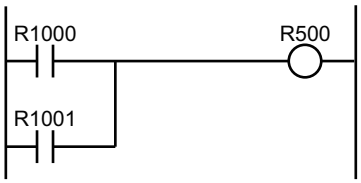
(1) Set the operand of the OUT/OUB instruction in the macro to argument P.



(2) for independent variable added in (1) designated by macro call instruction, different internal auxiliary relays will be designated for each call.



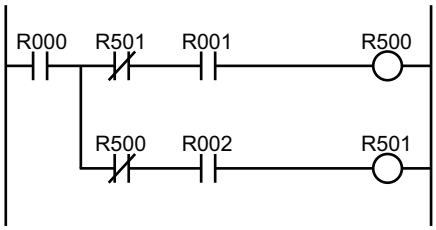
(3) ladder program output by logic or is added out of the macro.



■ Interlock

In the program, when one party acts, the other party cannot act, so as to prevent simultaneous action of both, such exclusive processing composition mode is called interlock.
Although lock function is very necessary in actual application, but since it is very complicated to explain, unnecessary details will not be given in KV-8000/7000/5000/3000/1000 Series PLC instruction Reference Manual etc example programs.

(example) circuit block in which R500 and R501 cannot be on simultaneously



R000 and R001 ON -> R501 does not turn ON even if R002 turns ON with R500 in an ON state as the NC contact of R500 is inserted.

If executing ON bit is used in module or macro execution, simply prepare entry/output lock circuit.

"Execution ON Bit", Page 3-120
"Macro System Device", Page 3-119

■ Reduce scanning time

If scanning time is long, refresh cycle of entry/output and value will be increased, reaction of machine and device will be decreased. In addition, if scanning time exceeds 300ms, "Scanning time overtime (CPU error No. 30)" will occur, running cannot be proceeded.
By means of the following projects, scanning time can be shortened.

● Stop a unnecessary module

When keep module that is unnecessary to act in execution state, please use module instruction (MDSTRT/MDSTOP), execute the module only when required.

"Module instructions", Page 3-106

● Unnecessary ladder circuit block can be skipped

For ladder circuit block the is unnecessary to act, please include in condition branch (CJ/NCJ - LABEL instruction), step instruction (STP - STE instruction) etc, ensure execute only when required.

● Reduce cycle (FOR - NEXT instruction) content

In cyclically executed ladder circuit block between for - NEXT instructions, if there is surplus part, processing time of corresponding cycle times will be added in scanning time.Therefore for processing that is unnecessary to be executed cyclically, please To program out of FOR - NEXT instruction.

TIP When / CJ/GOTO instruction is used, preparation of circular processing program is also the same.

● Assign a device with an even number to 32-bit/64-bit processing operand

For operands with postfix .D/.L/.F/.DF etc (instruction for processing 32-bit/64-bit data), when designate DM/W/EM/FM/ZF/TM etc 16-bit word devices, please use device of even No..Otherwise, if two words with odd No. Are used for designation, processing speed will slow down.

TIP If it is DM/EM/FM/TM, local device should also use even No..During conversion, local device of even No. Should always be distributed to global device of even No., local device of odd No. Should always be distributed to global device of odd No. Therefore, device areas more than distributed to each module or macro might be consumed.

● Select category of the device to be used.

For designated operands, when DM device is not designated, whereas R/MR/LR/B/TM device is designated, processing time is quickened by 0.050 - (μs). Especially for operand designated data block initial device, processing time of two words will be quickened by 0.050(μs).

■ Effective use of a module/macro

In order to use module or macro validly, enable program structure to be more optimal, please use local device or local mark number to the maximum extent. Precautions for use of local device is explained below.

· The following devices can be used as global devices: KV-5500/5000/3000 I/O relay, device distributed to expansion unit, reference device via touch panel etc externally connected equipment, universal device in the whole project, device that requires data transmission between modules, and other devices required for global device processing.

· Local Device shall be numbered from 0 using consecutive numbers as possible.

· Since R, DM is distributed in expansion unit, as global device, use area is required. When using local devices, give priority to MR or EM/FM.

"3-10 Local Device", Page 3-131
For local label, see "Label", Page 3-162.

■ Use either index modification or indirect specifying

Two methods are available to change the device designated by instruction operand in operation process: " index modification " and "indirect specifying ".

<Index modify>

○Designate concise method.

△Specify device type cannot be changed.

△ Index register Z cannot be used as local device.

->If "ZPOP" and "ZPUSH" instructions are used, it is not necessary to consider available quantity of index register, use index for modification.

<Indirect specifying>

○Specify device type can be changed.

△Specify method is complicated. (special instruction should be used when processing address).

It is advisable to use simple "Index modification" function in condition other than changing device category.

" Index Modification", Page 3-73

Program Troubleshooting Debug

Eliminating errors in program is called "Debug (debugging)".

If KV STUDIO monitor function is used, state of actually connected KV-5500/5000/3000 PLC can be checked.

In addition, in the monitor, if used together with online editor capable of ladder program edit, more efficient better debugging can be carried out.

If use "Simulator" function, even if KV-5500/5000/3000 is not available, action of ladder program can also be confirmed only by individual PC. Operation of KV-5500/5000/3000 can be simulated on PC, improving debugging efficiency.

Conversion

Simulate KV-5500/5000/3000 action on individual computer, and execute debug.

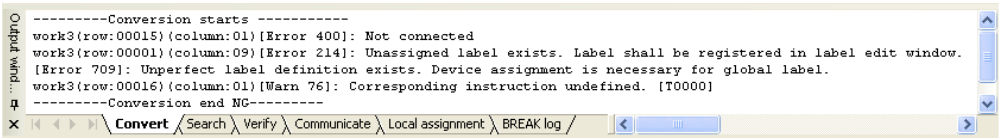
Select "Convert(A)" -> "Convert(C)".

Other procedure · Click the  icon.
· Ctrl + F9

TIP · select "Monitor/Simulator (N)" -> "Transfer to PLC -> Monitor (C)" from the menu for automatic conversion, transmission, start monitor.
· if select "Monitor/Simulator (N)" -> "Simulator (L)" from the menu, it can convert automatically, and start simulation.

<When conversion is finished normally>
The message "Conversion end OK" is displayed on the [Output window].
Display use proportion of program capacity in "Conversion result" dialog box.
"Program Capacity", Page 3-11

<When conversion fails>
Display error content in "Output window".
Double click error, jump to the location of this error directly. Please make correction one by one in sequence.



"Programming Key Points", Page 3-169
KV STUDIO User's Manual "A-2 Error Message Lists"

TIP Select "Convert (A)" -> "Convert individual modules/macros (M)" from the menu to convert module/macro respectively. In case of many errors, and errors cause difficult determination, please use this method.

Transfer

Select "Monitor/Simulator (N)" -> "Transfer to PLC (W)" from the menu to transmit converted ladder program to KV-5500/5000/3000 PLC.

Other procedure Click the  icon.

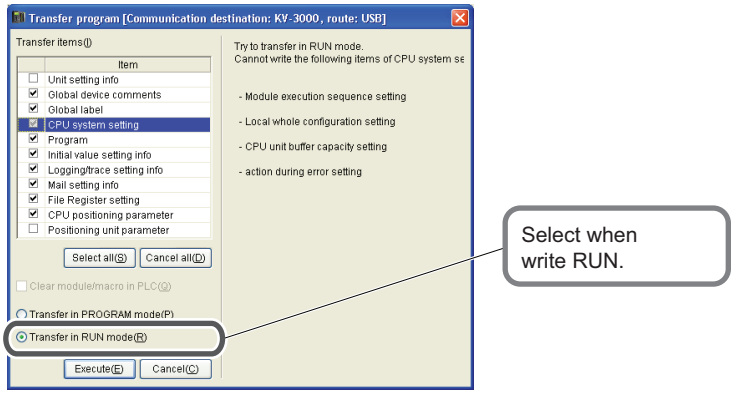
Note

Under default settings, when program is transmitted, each module/macro stored in PLC body will not be deleted. If you want to delete unused module when executing program transmission, please set "Clear module/macro in PLC" check box of "Transfer program" dialog box to selected state.

TIP After selecting "Monitor/simulator (n)" -> "Transfer to PLC-> Monitor mode (C)" from menu, it executes operation from conversion to transmitted automatically, and starts monitoring.

■ Write in the RUN mode

Under KV-5500/5000/3000 PLC RUN state, transmit, write ladder program.
Writing in the so-called RUN mode is rewrite function of KV-5500/5000/3000 PLC for ladder program under RUN state. Action fine adjustment and independent variable change can be performed without stopping device and production line.
Extension value of scanning time written in RUN is up to 2ms.



WARNING Danger may occur due to the status of the control equipment connected in KV-5500/5000/3000 when writing in RUN mode. Caution!

● Data that cannot be written in RUN

- Projects different from the content stored in KV-5500/5000/3000
- Unit configuration
- Execute sequence of module
- Entire assignment setting of local device
- CPU unit buffer capacity setting
- Action when error occur

● Conditions that cannot be written in RUN

- When number of local device used changes
- When macro instruction is added/deleted
- When call sequence of macro instruction changes
- When macro independent variable settings changes
- When automatically guaranteed local work area is exceeded due to increase/change/delete of local label or edit of KV script

Note

- When write is finished in RUN, even if ON/OFF state of execution condition changes, differential instruction in write range will not be executed.
- Even if change timer or counter setpoint and execute writing operation in RUN, change current value will not be changed when writing is finished.

Monitoring

Use monitor program to transmit the ladder program prepared using ladder editor (Ladder Editor) to KV-5500/5000/3000 PLC, carry out actual execution, check out action condition.

Use monitoring function to execute the following operation.

- Program action condition can be confirmed in real time by ladder or real time chart monitoring.
- Select the operation mode of the KV-5500/5000/3000 PLC.
- By executing entry update inhibited, forced setting/reset, carry out forced ON/OFF operation for entry contact execution on monitoring frame.
- It is easy to modify set value and current value of device data and timer/counter.
- Save/read designated range of current value of the device on memory card.
- Return part device to default value.

To start monitoring, select "Monitor/simulator(n)" -> "Transfer to PLC -> monitor mode(C)" from the menu. Before operation, please connect KV-5500/5000/3000 PLC and PC in advance in communication enable state.

Other procedure ·Click the  icon.

· Ctrl + F8

TIP In KV STUDIO title bar, display current state (monitoring/online edit/editor etc).

Monitoring operation can be executed via tool bar or menu.

For detailed information of the functions, please refer to KV STUDIO User's Manual "Chapter 9 monitor and simulator".

Online edit

Use online edit function, change ladder program directly on KV STUDIO monitoring frame. Use these convenient functions, adjust and change simple program on final debugging site for programming.
In monitoring execution process, select "Monitor/Simulator (N)" -> "Start online edit (O)", start online edit from the menu.
Edit position will display light blue, check which cell is corrected clearly at a glance.

Other procedure · Select "online edit" on mode bar

· Click the  icon.

· F10

> **WARNING**
> The online edit function may serious damage or injure workers if it is used in the wrong way. Thoroughly check the following points to ensure correct use of this function:
> - Before using online edit, thoroughly check the peripheral equipment, and use in a state that will prevent physical injury or damage if equipment operate unexpectedly.
> - Do not add circuits (e.g. execution condition B contact circuits) that operate immediately after a program is transferred. Doing so might cause equipment to run away.
> - If ON output instructions (e.g. OUT) are deleted and the ladder program is transferred, the outputs are held in an ON state.

TIP For online edit transmission, only write the changed circuit block in PLC body. However, in the following condition, execute write operation for the changed module/macro as a whole.

- · When several modules are changed
- · When script edit exceeding local work area is executed
- · When increase local mark number to exceed local work area
- · After edit the program in macro (macro is transmitted as a whole.)
- · When individual assignment number of local device is changed
- · When macro call is increased
- · When ENDH instruction is edited

With respect to restriction matters and precautions for writing in RUN mode, please refer to "Write in the RUN mode", Page 3-179".
For online edit function, please refer to KV STUDIO User's Manual , "9-9 online edit function ".

Simulator

Use simulator, while PLC is not connected, simulate action of ladder program prepared using ladder editor on PC.

Use this program to perform the following operation.

- Use Ladder Monitor, Registration Monitor (time sequence diagram) and Batch Monitor, check out program operating state in real time.
- Through various execution method, simulated continuous scanning/consecutive step or single step/a scanning cycle.
- Utilize single step and consecutive steps reverse execution etc convenient functions for debug work efficiently.
- Setpoint and current value of timer, counter or device etc can be changed simply.
- Forced set bit or reset can be performed for the contact.

Select "Monitor/Simulator (N)" -> "Simulator (L)" from the menu to start simulator.

Other procedure
- Select "simulator "in mode bar
- Click the  icon.
- Ctrl + F2

TIP Display current state in KV TUDIO title bar (simulator/monitoring/editor etc).

Perform analog simulation operation in tool bar or menu.

For detailed information of the functions, please refer to KV STUDIO User's Manual, "9-11 simulation function - execute analog simulation operation".

■ Difference from monitor program

In simulator, through a scanning cycle execution, single step execution, single step reverse execution etc functions, control tiny running state can be controlled better than monitor.

Since only CPU action can be simulated, action of expansion unit cannot be checked. In addition, there is certain restriction to some CPU built-in functions and device actions.

Please refer to KV STUDIO User's Manual, "9-11 simulator function -simulator restriction"

Monitoring functions

In order to use monitoring and simulator more validly for debugging, functions are described below.
For detailed information of operating method of the functions, please refer to KV STUDIO User's Manual.

■ Change the current value or status of device

● Bit device ON/OFF

Double click the CELL to change bit device state. Double click at each time, state will reverse.

Other procedure After selecting the cell to change bit device state, click Space key.

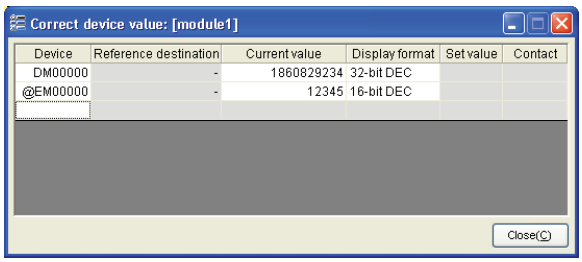
Note

During monitoring, timer/counter contact and external I/O relay cannot execute ON/OFF operation.

TIP To forcibly turn external I/O relays ON/OFF during monitoring, select "Debug(D)" -> "forced set/reset register(X) or inhibited input refreshing(F)" from the menu.

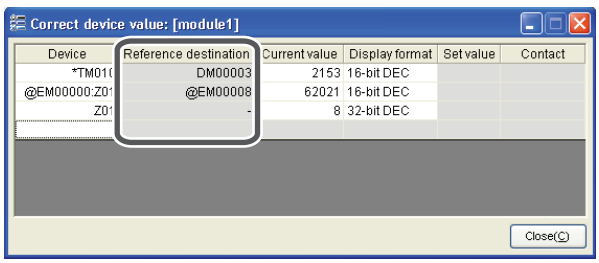
● Batch change window

Select cell of current value of the device to be changed, click F2 key.



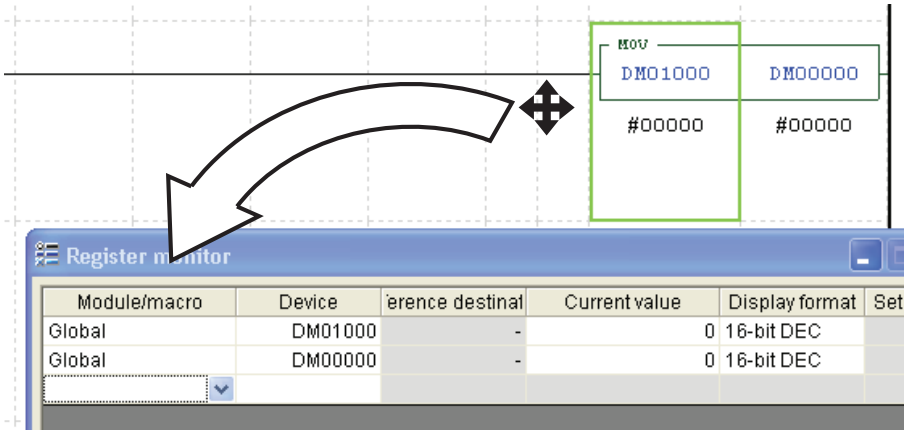
Display "Batch change (device value change) " window. If several cells are selected, click F2 key, display all devices included in the selected range.
Through entry a new value, change current value.

TIP If select use index modification or indirectly designated instruction, display the reference device.



● Registration monitor/batch monitor

In order to register the device in Registration Monitor and Batch Monitor, select the instruction containing monitoring device, when aligning with the cell in " " state, drag and drop the device into "Registration Monitor" dialog box.



TIP ·/if several cells are selected, perform drag and drop operation, all devices within the selected range will be registered.

·In "Registration Monitor" dialog box, device can also be entered directly..

● Watch window

All devices contained in the circuit block with selected CELL execute monitoring function automatically. To hide/show the screen, select "Monitor/Commission" -> "Hide/show monitoring window" from the menu bar.

● Real time chart monitor

Display information of the devices logged on in logon monitoring by timing chart.

Open " Real time chart monitor " from the menu displayed after log on monitoring and right click.

Loaded data can be traced back to the past for display, the value of selected point can also be displayed.

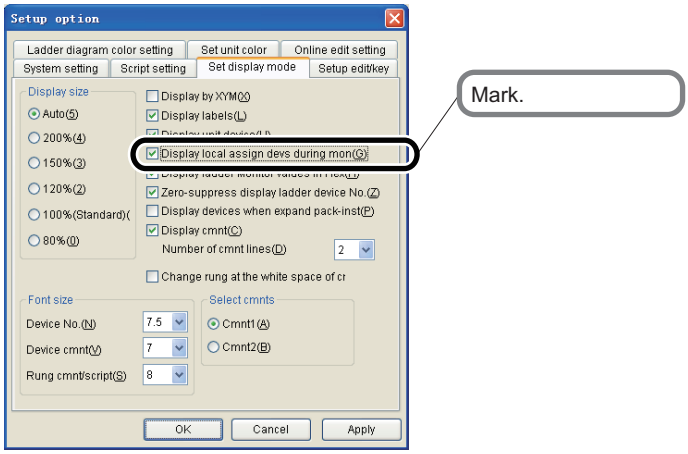
Other procedure Select Monitor/Simulator (N) -> Real time chart monitor

"9-6 Real-time graphics monitoring" in the KV STUDIO User's Manual

■ Display through the assignment destination of local devices/local labels

Display the local device/local mark number prepared ladder program in monitor or simulator by assignment object device distributed during conversion.

Select “Tool (t)"-> "Option (o)" from the menu, open "Setup option" dialog box, set Set display mode, set "Display local assign devices during monitor" check box to selected state.

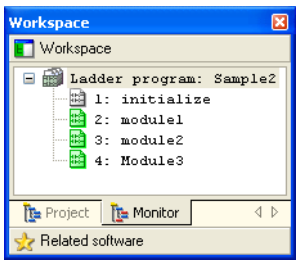


TIP Local mark number distributed to local work area.

"Local label assignment", Page 3-163

■ Validate module or macro execution state

Click work space underside "monitoring" mark number in monitor/simulator, confirm the displayed "module/macro monitor".

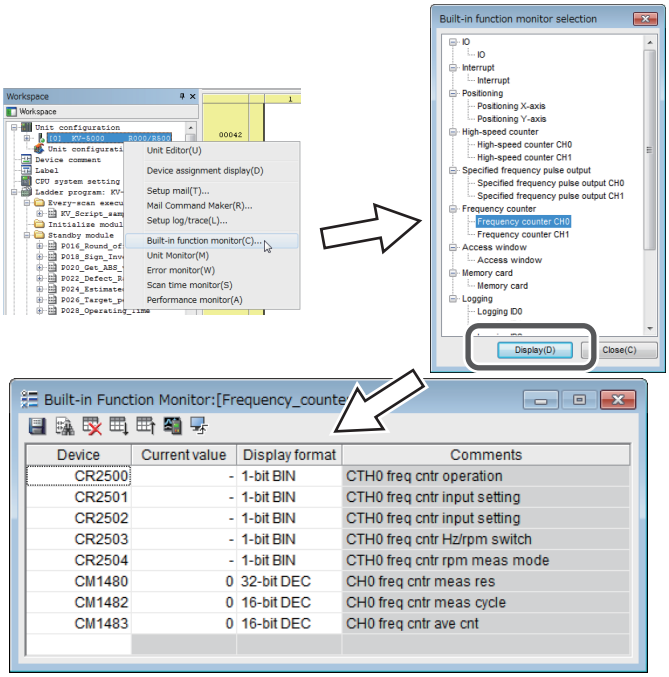


■ Monitor CPU built-in function

Right click "KV-5500/5000/3000" in the "Work space" and select "Built-in function monitor (C)" from the displayed menu to display the "Select built-in function monitor" dialog box. Select the monitoring function and press the "display" button to display the built-in function monitor for each function.

Other procedure Select "Monitor/simulator (N)" -> "Built-in Function Monitor (P)" from the menu.

(Example) When monitoring CPU frequency counter (CH0)



Note

In simulator execution process, there is restriction for part function and device action.
Please refer to KV STUDIO User's Manual, "9-10 simulator function -simulator restriction"

■ Command monitor

For PIDAT instruction described on ladder diagram program, monitor the device used in this instruction. In the selected PIDAT instruction state, select “command monitor (Y)”/”PIDAT (P)” from right-click menu.

So as to monitor the parameters used in measured value, set value, other PID.

Other procedure Select [monitor/simulator (N)] [command monitor (Y)] [PIDAT (P)] from the menu.

KV STUDIO User Manual “command monitor”

■ Monitor rising edge/falling edge of the device

Select the instruction that contains the device to be monitored, select “differential monitoring” from the right-click menu.

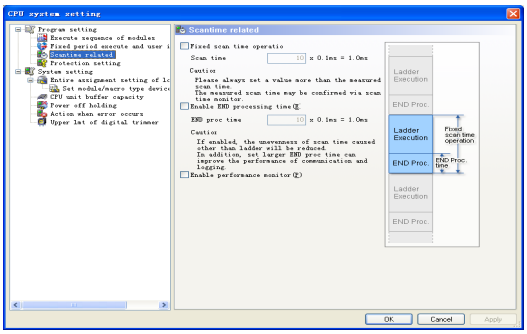
Other procedure Select [testing (D)] [differential monitoring (N)]

“differential monitoring” in KV STUDIO User Manual

■Interrupt program unit monitoring execution time (performance monitor) according to the module/macro unit

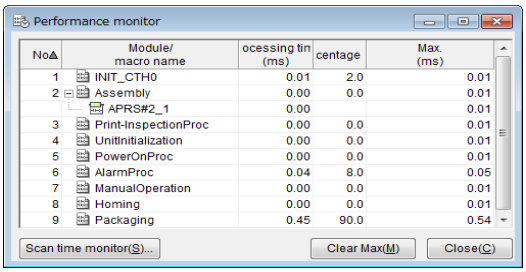
Monitor execution time of the module/macro, interrupt program being executed.

1 **In editor status, open CPU system setting from the work area, set up via "Program Setting"-> "Scantime related".**



2 **Select "Monitor/Simulator (N) "->"PLC Transmission (W) " from the menu to transmit item.**

3 **During the monitoring, after converted to monitoring mode, select "Commissioning"-> "Performance Monitor" from the menu.**



Point

Performance monitor only supports CPU unit of CPU functional version above 2.0.
When performance monitor is used, scanning time will be extended.

Module*1	**0.2μs/piece**
MCALL/MSTRT*2	**0.19μs/piece**
INT+RETI*3	**0.23μs/piece**

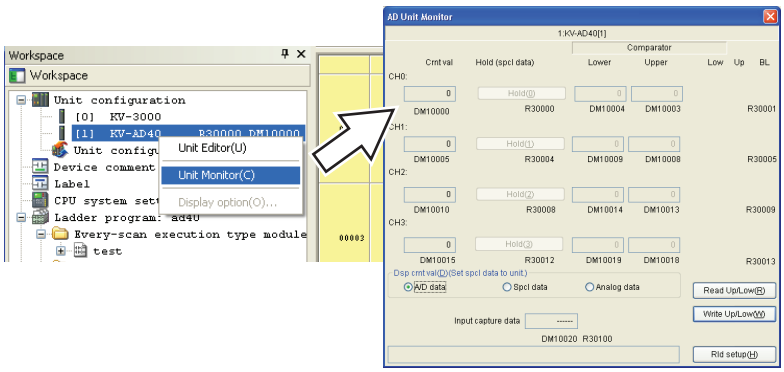
***1 Must be accumulated, irrelevant to the module status (being executed/standby).**
***2 Accumulated only when macro is executed.**
***3 Accumulated only in case of execution interruption.**

■ Monitor expansion unit

On "work space", after select "Unit monitor (c)" from right click menu of the "units", display "unit monitor" dialog box.

Other procedure · Select "Display(V)" -> "Unit monitor(J)" from the menu.
· When monitoring through unit editor, after the units are selected, display from right click menu.

(example) when monitoring KV-AD40



Note

Display is unavailable when simulator runs.

Interrupt function

The so-called interrupt (Break) is the function to interrupt ladder program execution for the purpose of checking certain instant state in continuously processed ladder program execution process. Use interrupt function, it is unnecessary to add ladder circuit block for preparing state checkout.
In KV STUDIO, according to device state and value etc, "device interrupt" and "line interrupt" can be used.

WARNING Break functions during monitoring may cause a major hazard depending on the states of control devices currently connected to the KV-5500/5000/3000 as execution of the ladder program is aborted once the break condition is established. Pay full attention to this before starting

Note

During monitoring, please pay attention to the following points:
· When interrupt function is used, it is impossible to read and write ladder program (including write in RUN mode).
· When power supply is OFF, operating mode RUN->PROG is switched, monitoring stops/ends (including communication is abnormal), PLC error occurs, all interrupt settings will be deleted.

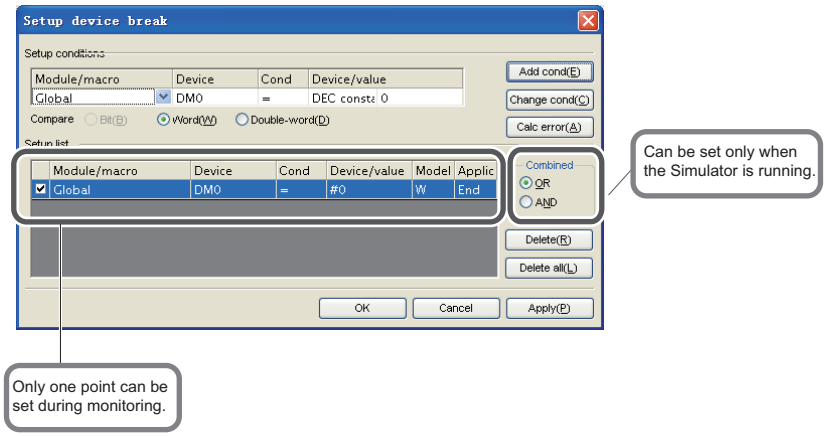
TIP ·Perform interrupt settings in PROG state, after changing to RUN state, check out action.
· In monitoring process, when use interrupt function to enter interrupt state, if output relay is OFF, turn CR2302 on.

■ Device interrupt

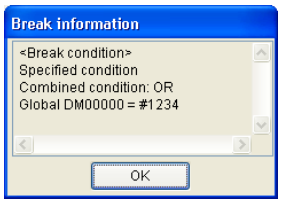
According to state change of bit device and the value of work device, interrupt might occur.

In monitoring process, set up an interrupt condition; in analog simulation process, set up 16 interrupt conditions simultaneously.

Select "Debug (D)" -> "Setup device break (B)" from the menu, set interrupt condition in the popped "Setup device break" dialog box.



If condition is established, interrupt occurs, "Break information" dialog box will be displayed, program execution is interrupted. Click "OK" button, program is still interrupted.



If interrupt is applied, and PLC run is interrupted, during monitoring, also execute " execute 1 step (F8)" and " a scanning execute 1 scan (F9)". When restart to run, click " RUN/Cont scan (F5)".

TIP After execute CALL/MCALL/MSTRT instruction in steps, step shift is not required in subprogram and macro, after execute CALL/MCALL/MSTRT instruction, use next instruction to regenerate interrupt.

Note

- CR/CM/Z/CTH/CTC cannot be set as condition.
- During monitoring, interrupt condition is only limited to device consistency/inconsistency.
- During monitoring, if interrupt condition is established, the following parts will also execute interrupt.
  - In the end of scanning ... Cursor moves to the first line in mnemonic symbol list of originally executed module.
  - instruction of processing object device ... If it is bit device, word processing instruction containing object bit device channel, and instruction of the same channel for processing other bits will execute interrupt.
- During monitoring, in the following conditions, even if interrupt condition is established, instruction of processing object device will not execute interrupt.
  - When designating condition by double word, only process one word instruction on upper bit or lower bit
  - When designating condition via bit device, execute word processing instruction for channels containing this bit and channels before and after that simultaneously.

■ Row interrupt

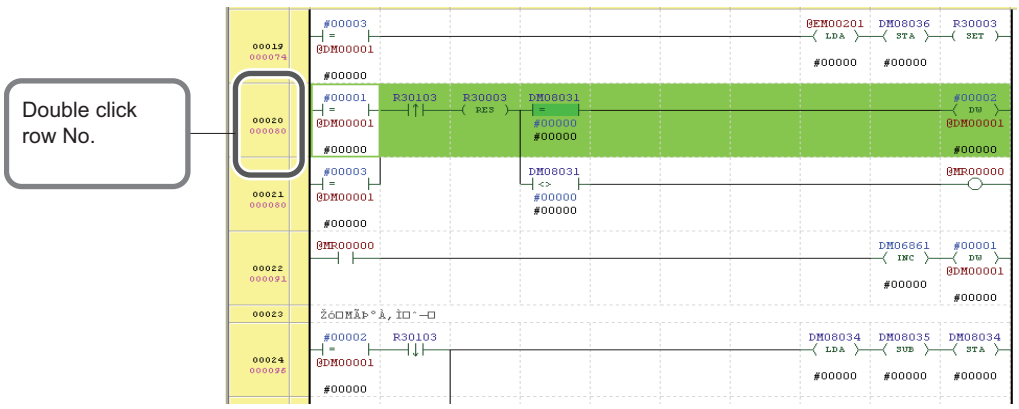
Designate the part of ladder program to be interrupted. Up to 4 points can be set simultaneously during monitoring, up to 16 points can be set simultaneously during simulation.

● Row interrupt of the ladder program

In case ladder line to be interrupted is selected, select "Set/cancel rung break" from right click menu. After line interrupt is set, display red round mark beside line No. On the left.

● Line interrupt of mnemonic symbol list

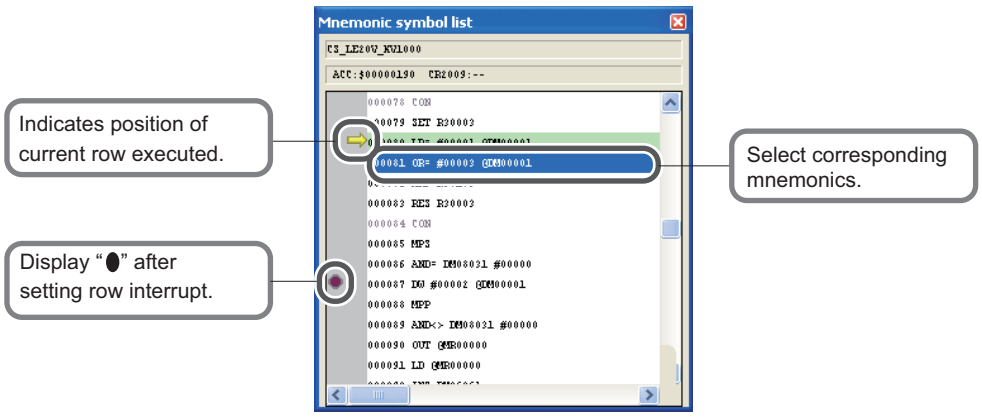
1 **Double click the line No. Of ladder to be interrupted.**



Display "Mnemonic list" dialog box. Selected step consistent with the selected line.

2 **In the "Mnemonic list" dialog box, double-click the rung (step) to perform the break at.**

Other procedure After selecting a line, select "Set/cancel rung break (S)" from right click menu.



Note

For simulator, during scanning execution (continuous/one scanning) line interrupt cannot be added. When scanning is finished, cursor is moved to the top line in mnemonic symbol list of the first module in execution sequence..

MEMO

APPENDICES

Record KV-5500/5000/3000 Series control relay (CR)/control memory (CM) list or error list, command list used in this book etc.

1 PLC unit Error List ••••••

1 PLC unit Error List

To describe the cause and treatment method for error No. And information displayed when KV-5500/5000/3000 body error occurs.

These errors may also be confirmed by KV STUDIO (error monitoring).

No.	Message	Causes	Remedy
10	CALLネスト CALL nest	Exceed nest limit of subroutine.	Occur during the execution of program.Please note application method of subroutine, correct program.
11	FORネスト FOR nest	FOR to NEXT instruction nest exceeds the limit.	Occur during the execution of program.Please note application method of FOR to NEXT instruction, correct program.
12	INTネスト INT nest	The interrupt concurrently exceeding the limit.	Occur during the execution of program.Please note application method of INT instruction, correct program.
13	MPSネスト MPS nest	MPS to MPP instruction nest exceeds the limit.	Occur during the execution of program.Please note application method of MPS to MPP instruction, correct program.
14	BREAK コスウ BREAK Number	Number of BREAK instructions exceeds the limit.	Occur during conversion.Please control the number of BREAK instructions between FOR to NEXT within the limit.
15	コンバート Convert	Conversion fails.	Occur during conversion.Cause of conversion failure during KV STUDIO conversion.Please transmit the program to body after cause is eliminated.
19	オブジェクトサイズ Object Size	Project size of the program exceeds capacity.	Please reduce the size of program. The size of program can be checked via KV STUDIO
20	コードサイズ Code Size	The code size of program exceeds the limit.	
22	マクロネスト MACRO nest	Number of macro nests in multiple interrupt exceeds the limit.	Please reduce macroinstruction in interrupt program.
23	フセイナワリコミ Illegal Interrupt	System error.	Please connect power again after troubleshooting. Please contact the nearest office in case of frequent occurrence.
24	フセイナマクロ Illegal Macro		
25	カンセツシテイエラー Illegal Pointer		
26	フセイナアドレス Illegal Address		
27	フセイナオブジェクト Illegal Object		
30	スキャンタイム オーバー Scan Time Over	When the scan time is over 300ms	Please correct program according to the following conditions, check whether exceeding scanning time. · FOR to NEXT instructions, etc performed repeatedly. · jump processing instructions such as the CJ/NCJ to LABEL instructions, etc. · program calling instructions such as CALL，MCALL instructions, etc. · The instructions with longer processing time such as FMOV, WSR and MAX instructions. · Interrupt or constant cycle module processing capacity is heavy or frequency is too high, program cannot be executed normally.

No.	Message	Causes	Remedy
31	ラダースタックオーバーフロー Ladder Stack Overflow	System error.	Please connect power again after troubleshooting. Please contact the nearest office in case of frequent occurrence.
40	ラダーナシ No Ladder	No program.	Transfer programs to the PLC before operation.
50*1	ユニット チェックサム Unit Checksum	Expansion unit setting damaged.	Please use KV STUDIO or memory card to transfer the unit setting information to the PLC.
51	ユニット セッテイ ジョウホウ Unit Setup Information	Unit setting information not set.	
52	ユニット ミセツゾク No Unit Connection	Expansion unit is logged on in unit set up information, but actually not connected.	Please firstly cut off system power supply, use unit editor to connect already set expansion unit.
53*1	カクチョウバス ユニット タイムアウト Unit Timeout	Bus communication may stop due to noise.	Please remove noise source. Please contact the nearest office in case of frequent occurrence.
54*2	ユニット ダイスウ Unit Number	The expansion unit set using the Unit Editor is different from the number of units actually connected.	Please firstly cut off system power supply, use unit editor to connect already set expansion unit.
55*1	ユニット シュベツ Unit Type	The expansion unit set using the Unit Editor is different from actual unit type.	
56*1	カクチョウバス ツウシン Extend Bus Comm Error	Bus communication may stop due to noise.	Please remove noise source. Please contact the nearest office in case of frequent occurrence.
57	エンドユニット ミセツゾク No End Unit	End unit not connected.	Please disconnect system power, connect end unit.
59*1	ユニット バージョン Unit Version	Connect the expansion unit that cannot be connected to the CPU unit.	Please firstly cut off system power supply, use unit editor to connect already set expansion unit.
80	FLASH ROM イジョウ FLASH ROM Damaged	Flash ROM abnormal.	Please contact the nearest office.
81	SRAM イジョウ SRAM Damaged	Hardware fault.	
83	デンチ ヲ コウカン シテクダサイ Low Battery	Backup battery voltage lower.	Please replace backup battery.

*1 Unit No. For which error is displayed in access window.

*2 Number of actual connected units displayed in access window

No.	Message	Causes	Remedy
84	SRAMクリア シテクダサイ SRAM Backup	Due to low voltage of backup battery, RAM contents (current values of CM,DM, EM, FM, R,B,CR, LR, T, C,CTH, CTC) are destroyed.	Please firstly replace stand by battery, then execute SRAM eliminate.Only delete device value, alarm limit.Ladder program will be not deleted.
85	RTC デンアツ テイカ RTC Low Voltage	Due to voltage lower of backup battery, clock data may lose.	Please replace backup battery, check clock data, if required, reset clock.
87	メモリカードイジョウ Memory Card Error	Memory card may be damaged.Might stopped under influence of electromagnetic, noise etc.	Please check file system in memory card. Please check using chkdsk instruction of Windows instruction prompt. (example) when memory card is E driver: C:\WINDOWS>CHKDSK E:
88	メモリカード ガヌカレマシタ Memory Card Removed	The card is pulled out during memory card accessing.	Please remove memory card according to correct operation steps. "Used on the KV-5500/5000/3000", Page 2-51
89	メモリカード アクセスチュウ オフ Memory Card Power OFF	Power is disconnected during memory card accessing.	Please use memory card according to correct operation steps. "Used on the KV-5500/5000/3000", Page 2-51
90	メモリカード カンリョウマチ Memory Card Busy	Accessing other memory cards occurs during memory card accessing.	Please terminate memory card access before operation.
91	イーサコントローラ イジョウ Ethernet-C Damaged	(only KV-5500/5000) abnormal among Ethernet controllers.	Please connect power again after troubleshooting. Please contact the nearest office in case of frequent occurrence.
92	アクセスウィンドウ イジョウ Access Window Damaged	Access window controller abnormal.	
93	キノウカクチョウ ユニット イジョウ Expansion Module Damaged	CPU function expansion unit abnormal.	
94	キノウカクチョウ ユニット ID Expansion Module ID	Connect non-applied CPU function expansion unit.	请确认连接到CPU单元左侧的功能扩展单元。
95	ファイル アクセス チュウ File Access Busy	Accessing CPU unit flash memory, processing cannot be executed.	Please try to execute again.

No.	Message	Causes	Remedy
118	フセイナデンソウデータ Illegal Data	System error.	Please connect power again after troubleshooting. Please contact the nearest office in case of frequent occurrence.
120	ウォッチドックタイマ Watch Dog Timer		
121	スタック オーバーフロー Stack Overflow		
122	システムエラー System Error		
123	デバイス ハンイ Out Of Device Range		
124	リソース Resource		
125	エラーバッファオーバーフロー Error Buffer Overflow	System errors exceed the limit.	
126	エラーバッファイジョウ Error Buffer Invalid	System error.	
127	ジドウヨミコミ Cpu Auto Load failure	Automatic reading from Memory card fails due to the following reasons. · Settings write protection in CPU system setting. · A problem occurs in the file content in memory card.	· please release write protection, transfer to the PLC. · Please transfer the file applicable to the PLC.
128	ラダー エンザン Ladder Calc	Operation error (CR2012 ON error),	· Please confirm program, correct calculation error reason. · Confirm expansion information in case of error, correct the cause of operation error. "When No.128 (calculation error)", Page 3-21
129	ユニット エラー Unit Error	Unit error occurs (direct access switch is red lamp illumination error).	Unit No.,unit type, unit error No., , error sentence for which error is displayed in access window.For specific description, please refer to instruction manual of the units.
130	ダイレクト IO Direct IO	Direct I/O error occurs (the unit for which direct access designated relay is distributed is not suitable for real time processing).	Please confirm model of the unit for which direct I/O relay is distributed.
131	FLASH ROM フォーマット FLASH ROM Format	FlashROM format abnormal	After clearing all, please connect power again. "All Clear Mode", Page 2-38
132	ラダーファイル フセイ Illegal Ladder File	Program saved in flash memory is abnormal.	

No.	Message	Causes	Remedy
133	KV-BT1 HW exception KV-BT1 HW Damaged	KV-BT1 hardware abnormity occurs.	After the error is eliminated, please reconnect the power supply. In case of frequent occurrence, please consult the nearest office.
134	Automatic loading folder Cpu AutoLoad Folder	Due to the following reason, fail to read from the memory card automatically. The folder selected by CM1790/CM1792 (automatic loading folder No.) does not exist.	Please confirm whether the folder (atload01 - atload99, rnload01 - rnload99) corresponding to CM1790/CM1792 exists in the memory card.
135	Memory Card Cover Open	Memory card is accessed when memory card cover opens.	Please close the memory card cover
136	Memory Card Locked	Tried to write data in memory card which is locked (write protection) status.	Please cancel LOCK, or use a writeable memory card.
250	Start Up Error Please Reset	Abnormity occurs in start processing.	Please turn on it again.(error cannot be eliminated.Or is not reserved in error log.)
251	AW Timeout Error	Part error.	Please contact the nearest office in case of frequent occurrence.

Control Relays (CR)

Control relay (CR0000 - CR3915) may realize confirmation of CPU unit action state, settings or monitoring of built-in functions etc.
Control relay reversed in the system cannot be used.

Device No.	Attribute R: Read only Blank: R/W	Function	
CR0000		Logging/tracing function (IDO)	Logging tracing execution ON: enabled, OFF: inhibited
CR0001	R		Logging/tracing operation in progress
CR0002	R		Logging/tracing file write result
CR0003	R		Alarm for 50% buffer or less in Record
CR0004	R		Record buffer overflow
CR0005	R		Write in RUN
CR0006 to CR0007	-		Reserved for system
CR0008	R		Logging/tracing error
CR0009	R		Record/follow-up memory card capacity insufficient error
CR0010	R		Record/follow-up device, trigger set up abnormal
CR0011	R		Tracing file save trigger monitor
CR0012	R		Tracing data capture complete
CR0013	R		Record/track write setting
CR0014 to CR0015	-		Reserved for system
CR0100 to CR0915		Logging/tracing function(ID1 to ID9)	(same as CR0000 to CR0015)
CR1000 to CR1015		Real-time chart monitor(ID10)	(same as CR0000 to CR0015)
CR1100 to CR2001	-	Reserved for system	
CR2002	R	Always ON	
CR2003	R	Always OFF	
CR2004	R	+10ms clock pulse (Duty ratio 50%)	
CR2005	R	100ms clock pulse (Duty ratio 50%)	
CR2006	R	1s clock pulse (Duty ratio 50%)	
CR2007	R	When running starts, cut off a scanning cycle	
CR2008	R	When running starts, connect a scanning cycle	
CR2009		On when the operation result is negative or overflow	
CR2010	R	ON when the operation result is 0	
CR2011	R	On when the operation result is positive	
CR2012	R	ON when calculation operation error	
CR2013 to CR2015	-	Reserved for system	
CR2100	R	CTH0 dedicated internal clock (1μs)	
CR2101	R	CTH0 dedicated internal clock (10μs)	
CR2102	R	CTH0 dedicated internal clock (100μs)	
CR2103		High-speed counter Action when comparator CTC0 is on	Automatic reset of CTH01 (ON: reset, OFF: not reset)
CR2104			Inhibited match output for R00500/R00504 comparator. ON: inhibited OFF: enable
CR2105			Set R00500/R00504 comparator match output to OFF (ON: proceed OFF: not proceed)
CR2106			Set R00500/R00504 comparator match output to OFF (ON: proceed OFF: not proceed)
CR2107			At each time when on, reverse R00500/R00504 comparator - output ON/OFF state (ON: set, OFF: not set)

<table>
<tr><th>Device No.</th><th>Attribute
R: Read only
Blank: R/W</th><th colspan="2">Function</th></tr>
<tr><td>CR2108</td><td></td><td rowspan="5">Action taken when High-speed Counter Comparator CTC1 is ON</td><td>Inhibited match output for R00500/R00504 comparator. ON: proceed OFF: enable</td></tr>
<tr><td>CR2109</td><td></td><td>Set R00500/R00504 comparator match output to OFF (ON: proceed OFF: not proceed)</td></tr>
<tr><td>CR2110</td><td></td><td>Set R00500/R00504 comparator match output to OFF (ON: proceed OFF: not proceed)</td></tr>
<tr><td>CR2111</td><td></td><td>At each time when on, reverse R00500/R00504 comparator - output ON/OFF state (ON: set, OFF: not set)</td></tr>
<tr><td>CR2112</td><td></td><td>Automatic reset of CTH01 (ON: reset, OFF: not reset)</td></tr>
<tr><td>CR2113 to CR2115</td><td></td><td>High-speed counter CTH0 count input mode selection</td><td>
<table>
<tr><th></th><th colspan="2">Single phase</th><th>1Single</th><th>2Single</th><th>4Single</th><th>2pulse</th></tr>
<tr><th></th><th>Without direction</th><th>With direction</th><th></th><th></th><th></th><th></th></tr>
<tr><td>CR2113</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>CR2114</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td></tr>
<tr><td>CR2115</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr>
</table>
</td></tr>
<tr><td>CR2200</td><td>R</td><td colspan="2">CTH1 dedicated internal clock (1μs)</td></tr>
<tr><td>CR2201</td><td>R</td><td colspan="2">CTH1 dedicated internal clock (10μs)</td></tr>
<tr><td>CR2202</td><td>R</td><td colspan="2">CTH1 dedicated internal clock (100μs)</td></tr>
<tr><td>CR2203</td><td></td><td rowspan="5">Action taken when High-speed Counter Comparator is ON</td><td>Automatic reset of CTH01 (ON: reset, OFF: not reset)</td></tr>
<tr><td>CR2204</td><td></td><td>Inhibited match output for R00501/R00505 comparator. ON: proceed OFF: enable</td></tr>
<tr><td>CR2205</td><td></td><td>Set R00500/R00504 comparator match output to OFF (ON: proceed OFF: not proceed)</td></tr>
<tr><td>CR2206</td><td></td><td>Set R00500/R00504 comparator match output to OFF (ON: proceed OFF: not proceed)</td></tr>
<tr><td>CR2207</td><td></td><td>The output ON/OFF status of R00501/R00505 is inverted (ON: set, OFF: not set) each time ON.</td></tr>
<tr><td>CR2208</td><td></td><td rowspan="5">Action taken when High-speed Counter Comparator CTC3 is ON</td><td>Inhibited match output for R00501/R00505 comparator. ON: proceed OFF: enable</td></tr>
<tr><td>CR2209</td><td></td><td>Set R00500/R00504 comparator match output to OFF (ON: proceed OFF: not proceed)</td></tr>
<tr><td>CR2210</td><td></td><td>Set R00500/R00504 comparator match output to OFF (ON: proceed OFF: not proceed)</td></tr>
<tr><td>CR2211</td><td></td><td>At each time when on, reverse R00500/R00504 comparator - output ON/OFF state (ON: proceed, OFF: not proceed)</td></tr>
<tr><td>CR2212</td><td></td><td>Automatic reset of CTH01 (ON: reset, OFF: not reset)</td></tr>
<tr><td>CR2213 to CR2215</td><td></td><td>High-speed counter CTH1 count input mode selection</td><td>
<table>
<tr><th></th><th colspan="2">Single phase</th><th>1Single</th><th>2Single</th><th>4Single</th><th>2pulse</th></tr>
<tr><th></th><th>Without direction</th><th>With direction</th><th></th><th></th><th></th><th></th></tr>
<tr><td>CR2113</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>CR2114</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td></tr>
<tr><td>CR2115</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr>
</table>
</td></tr>
<tr><td>CR2300</td><td></td><td colspan="2">External output inhibited (ON: proceed, OFF: not proceed)</td></tr>
<tr><td>CR2301</td><td></td><td colspan="2">External input refresh inhibited(ON: proceed, OFF: not proceed)</td></tr>
<tr><td>CR2302</td><td></td><td colspan="2">External output inhibited (ON: proceed, OFF: not proceed) in case of BREAK</td></tr>
<tr><td>CR2303</td><td></td><td colspan="2">-fixed scanning time running (ON:enabled, OFF: disabled)</td></tr>
<tr><td>CR2304</td><td>R</td><td colspan="2">Scanning time settings (constant scanning time running. END processing time settings) only one scanning on in case of overflow</td></tr>
<tr><td>CR2305</td><td></td><td colspan="2">Set input time constant of full input for CPU unit (ON: set to alarm -> CM1620 OFF: set not to alarm)</td></tr>
<tr><td>CR2306</td><td>R</td><td colspan="2">When backup battery abnormal ON</td></tr>
<tr><td>CR2307</td><td></td><td colspan="2">Clear Min./Max. value of scan time</td></tr>
</table>

<table>
<tr><th>Device No.</th><th>Attribute
R: Read only
Blank: R/W</th><th>Function</th></tr>
<tr><td>CR2308</td><td></td><td colspan="2">Set END processing time (ON: enable, OFF: disable)</td></tr>
<tr><td>CR2309 to CR2312</td><td>-</td><td colspan="2">Reserved for system</td></tr>
<tr><td>CR2313</td><td></td><td colspan="2">Forced switching of VT sensor application menu (switching: ON, non-switching: OFF)</td></tr>
<tr><td>CR2314</td><td>-</td><td colspan="2">Reserved for system</td></tr>
<tr><td>CR2315</td><td>R</td><td colspan="2">Battery less working (normal operation: OFF, Battery-less working: ON)</td></tr>
<tr><td>CR2400, CR2401</td><td></td><td colspan="2">CTH0 external signal preset
<table>
<tr><th></th><th>Not used</th><th>Up</th><th>Down</th><th>Level</th></tr>
<tr><td>CR2400</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>CR2401</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr>
</table></td></tr>
<tr><td>CR2402</td><td></td><td colspan="2">Select CTH0 counter code (ON: ring, OFF: linear)</td></tr>
<tr><td>CR2403</td><td></td><td colspan="2">Test CTH0 overflow/underflow (on: tested OFF: untested)</td></tr>
<tr><td>CR2404, CR2405</td><td></td><td colspan="2">CTH1 external signal preset
<table>
<tr><th></th><th>Not used</th><th>Up</th><th>Down</th><th>Level</th></tr>
<tr><td>CR2404</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>CR2405</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr>
</table></td></tr>
<tr><td>CR2406</td><td></td><td colspan="2">Select CTH1 counter code (ON: ring, OFF: linear)</td></tr>
<tr><td>CR2407</td><td></td><td colspan="2">CTH1 overflow or underflow(ON: yes, OFF: no)</td></tr>
<tr><td>CR2408</td><td></td><td colspan="2">CTH 0 reserve(ON: disable，OFF: enable)</td></tr>
<tr><td>CR2409</td><td></td><td colspan="2">CTH1 reserve (ON: disable，OFF: enable)</td></tr>
<tr><td>CR2410</td><td></td><td colspan="2">CTH0 internal startup relay (ON: counting enabled，OFF: counting inhibited)</td></tr>
<tr><td>CR2411</td><td></td><td colspan="2">CTH1 internal startup relay (ON: counting enabled，OFF: counting inhibited)</td></tr>
<tr><td>CR2412</td><td>R</td><td colspan="2">CTH0 changing direction (ON: subtract, OFF: addition)</td></tr>
<tr><td>CR2413</td><td>R</td><td colspan="2">CTH1 changing direction (ON: subtract, OFF: addition)</td></tr>
<tr><td>CR2414</td><td>R</td><td colspan="2">CTH0 dedicated internal clock (50ns)</td></tr>
<tr><td>CR2415</td><td>R</td><td colspan="2">CTH1 dedicated internal clock (50ns)</td></tr>
<tr><td>CR2500</td><td></td><td rowspan="4">Frequency counter (CTH0)</td><td>External output disabled (ON: set, OFF: not set)</td></tr>
<tr><td>CR2501, CR2502</td><td></td><td>Set up input source
<table>
<tr><th></th><th>Single-phase without direction</th><th>Single-phase with direction</th><th>2phase 1 multiplication</th><th>2pulse</th></tr>
<tr><td>CR2501</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>CR2502</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr>
</table></td></tr>
<tr><td>CR2503</td><td></td><td>Hz/rpm switching(ON: rpm，OFF: Hz)</td></tr>
<tr><td>CR2504</td><td></td><td>Use the function of rotating once to update rotation speed (ON: use alarm, OFF: do not use alarm)</td></tr>
<tr><td>CR2505</td><td></td><td colspan="2">CTH0 comparator matching output relay switch (ON: R504　OFF: R500)</td></tr>
<tr><td>CR2506</td><td></td><td colspan="2">Designate frequency pulse output (CTH0) (ON: proceed, OFF: not proceed)</td></tr>
<tr><td>CR2507</td><td></td><td colspan="2">Specify frequency pulse(CTH0)output end</td></tr>
<tr><td>CR2508</td><td></td><td rowspan="4">Frequency counter (CTH1)</td><td>External output disabled (ON: set, OFF: not set)</td></tr>
<tr><td>CR2509, CR2510</td><td></td><td>Set up input source
<table>
<tr><th></th><th>Single-phase without direction</th><th>Single-phase with direction</th><th>2phase 1 multiplication</th><th>2pulse</th></tr>
<tr><td>CR2509</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>CR2510</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr>
</table></td></tr>
<tr><td>CR2511</td><td></td><td>Hz/rpm switching (ON: rpm，OFF: Hz)</td></tr>
<tr><td>CR2512</td><td></td><td>Use the function of rotating once to update rotation speed (ON: use alarm, OFF: do not use alarm)</td></tr>
<tr><td>CR2513</td><td></td><td colspan="2">CTH1 comparator matching output relay switch (ON: R505　OFF: R501)</td></tr>
<tr><td>CR2514</td><td></td><td colspan="2">Designate frequency pulse output (CTH0) (ON: proceed, OFF: not proceed)</td></tr>
<tr><td>CR2515</td><td></td><td colspan="2">Specify frequency pulse(CTH1)output error</td></tr>
<tr><td>CR2600,CR2601</td><td></td><td colspan="2">INT R000 interrupt polarity
<table>
<tr><th></th><th>Single-phase without direction</th><th>Single-phase with direction</th><th>2phase 1 multiplication</th><th>2pulse</th></tr>
<tr><td>CR2600</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>CR2601</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr>
</table></td></tr>
<tr><td>CR2602,CR2603</td><td></td><td colspan="2">INT R000 interrupt polarity (the same with CR2600, CR2601)</td></tr>
</table>

Device No.	Attribute R: Read only Blank: R/W	Function	
CR2604,CR2605		INT R001 interrupt polarity (the same with CR2600, CR2601)	
CR2606,CR2607		INT R003 interrupt polarity (the same with CR2600, CR2601)	
CR2608,CR2609		INT R004 interrupt polarity (the same with CR2600, CR2601)	
CR2610,CR2611		INT R005 interrupt polarity (the same with CR2600, CR2601)	
CR2612,CR2613		INT R006 interrupt polarity (the same with CR2600, CR2601)	
CR2614,CR2615		INT R007 interrupt polarity (the same with CR2600, CR2601)	
CR2700,CR2701		INT R008 interrupt polarity (the same with CR2600, CR2601)	
CR2702,CR2703		INT R009 interrupt polarity (the same with CR2600, CR2601)	
CR2704 to CR2715	-	Reserved for system	
CR2800		Serial communication	Send interrupt signal (when ON)
CR2801	R		Scan once ON when receiving text data
CR2802	R		Text data read error
CR2803	R		Scan once ON when receiving text data error
CR2804			Start sending text data(send in progress ON)
CR2805			Use bit unit to receive text data (ON: proceed, OFF: not proceed)
CR2806			Use word unit to send text data (ON: proceed, OFF: not proceed)
CR2807 to CR2813	-	Reserved for system	
CR2814		Zero suppression during execution of ASC command (full postfix), FASC command (ON: proceed, OFF: not proceed)	
CR2815		The sign "+" is not used when DASC.S, DASC.L and FASC instructions are executed (ON: proceed, OFF: not proceed)	
CR2900		Access window	user message display 1 (ON: display OFF: not display)
CR2901			user message display 2 (ON: display OFF: not display)
CR2902 to CR2915	-	Reserved for system	
CR3000		CPU Positioning function X axis	Limit switch CW direction input
CR3001			Limit switch CCW direction input
CR3002			Origin sensor input
CR3003			Stop sensor input
CR3004	R		Origin return in progress
CR3005	R		Origin return complete
CR3006			Positioning complete relay
CR3007			Error/error clear
CR3008			Warning/clear warning
CR3009			Pulse output in progress/emergency stop
CR3010			Driver operation start
CR3011			Current value change request (level detection)
CR3012			Operation speed change request (level detection)
CR3013			Comparator 2 consistency relay
CR3014	-		Reserved for system
CR3015	-		

Device No.	Attribute R: Read only Blank: R/W	Function	
CR3100		CPU Positioning function Y axis	Limit switch CW direction input
CR3101			Limit switch CCW direction input
CR3102			Origin sensor input
CR3103			Stop sensor input
CR3104	R		Origin return in progress
CR3105	R		Origin return complete
CR3106			Positioning complete relay
CR3107			Error/error clear
CR3108			Warning/clear warning
CR3109			Pulse output in progress/emergency stop
CR3110			Driver operation start
CR3111			Current value change request (level detection)
CR3112			Operation speed change request (level detection)
CR3113			Comparator 2 consistency relay
CR3114	-		Reserved for system
CR3115	-		
CR3200 to CR3209	-	Reserved for system	
CR3210	R	Any record/follow-up memory card is using	
CR3211	R	To use Memory Card	
CR3212	R	Memory card ID complete	
CR3213	R	With memory card	
CR3214	R	Execute command of memory card in progress	
CR3215	R	Memory card write protection (ON: write protection, OFF: no write protection)	
CR3300 to CR3415		Alarm relay	
CR3500	R	Alarm relay operation in progress (ON when any of CR3300 to CR3415 is ON)	
CR3501		Record when alarm relay is ON-> OFF (ON: reserve, OFF: unreserve)	
CR3502		Clear alarm relay log when OFF to ON	
CR3503 to CR3513	-	Reserved for system	
CR3514		HKEY instruction	Multiple key inhibited
CR3515	R		Scan end
CR3600 to CR3615	R	HKEY instruction information storage area	
CR3700		Operation panel KV-D30	F1 customize switch 1
CR3701			F2 customize switch 2
CR3702			F3 customize switch 3
CR3703			F4 customize switch 4
CR3704			LED1 customize indicator 1
CR3705			LED2 customize indicator 2
CR3706			LED3 customize indicator 3
CR3707			LED4 customize indicator 4
CR3708			Green back light (illuminates when ON)
CR3709			Red back light (illuminates when ON)
CR3710			System information display language (ON: Japanese, OFF: English)
CR3711			Buzzer ON
CR3712			Screen display settings (on: positive display, OFF: negative display)
CR3713			Alarm interrupt enable (ON: enable, OFF: disable)
CR3714			Page conversion (rise switch to CM0401 value page, forced OFF)
CR3715			Use "▲" and "▼" for Page switching (ON: inhibited, OFF: enabled)
CR3800			When in on state, external output 0 is also in on state
CR3801			When in on state, external output 1 is also in on state

Device No.	Attribute R: Read only Blank: R/W	Function
CR3802 to CR3815	-	Reserved for system
CR3900		Error log cleared when OFF->ON
CR3901		Alarm cleared when OFF->ON
CR3902	R	Serious error log is the largest number
CR3903	R	Maximum number of alarm records
CR3904	R	RUN/PRG toggle switch status (ON: RUN side OFF: PROG side)
CR3905	R	Serious error occurring
CR3906	R	Alarm occuring
CR3907		Power ON log cleared when OFF->ON
CR3908		Power OFF cleared when OFF->ON
CR3909		Error clear currently occurring error(Only SET/RES instructions)
CR3910 to CR3915	-	Reserved for system

Control Memory CM

Control memory (CM0000 - CM5999) may realize confirmation of CPU unit action state, settings or monitoring of built-in functions etc.

Control memory reversed in the system cannot be used.

Device No.	Attribute R: Read only Blank: R/W	Function	
CM0000, CM0001		Operation panel KV-D30 0 Page	Set up 1st line display device
CM0002, CM0003			Set up 2nd line display device
CM0004, CM0005			Set up 3rd line display device
CM0006, CM0007	-		Set up 4th line display device
CM0008, CM0009			Reserved for system
CM0010 to CM0199		Page 1 to 19 (same as CM0000 to CM0009)	
CM0200, CM0201		Operation panel KV-D30 0 Pages	Set up 1st line display attribute
CM0202, CM0203			Set up 2nd line display attribute
CM0204, CM0205			Set up 3rd line display attribute
CM0206, CM0207			Set up 4th line display attribute
CM0208			Setup module 1
CM0209			Setup module 2
CM0210 to CM0399		Page 1 to 19 (same as CM0200 to CM0209)	
CM0400		Operation panel KV-D30	For conversion enable/inhibited setting
CM0401			For settings of page conversion
CM0402			Current display page
CM0403 to CM0409			Reserved for system
CM0410 to CM0415			Direct access function
CM0416 to CM0499	-		Reserved for system
CM0500 to CM0699	-	Reserved for system	
CM0700	R	Read from calendar timer	(year)
CM0701	R		(month)
CM0702	R		(day)
CM0703	R		(hour)
CM0704	R		(Minute)
CM0705	R		(s)
CM0706	R		(week)(0: (Sun), 1 (Mon), 2: (Tues) 3: (Wed) 4: (Thur) 5: (Fri), 6 (Sat))
CM0707	-	Reserved for system	
CM0708, CM0709	R	Free Run Counter (32-bit, 1ms)	
CM0710	R	Current memory No.of FM	
CM0711	-	If V2.0 CPU functional version is used, save "2", for other situations, save "0"	
CM0712	R	Execution time of constant cycle module (10μs unit)	
CM0713 to CM0715	-	Reserved for system	
CM0716		Maximum exeuction time (10μs unit) for Fixed Period Module	
CM0717 to CM0719	-	Reserved for system	
CM0720	R	Scan time measuring value (10μs unit)	
CM0721		Fixed scanning time run set value (10μs unit)	
CM0722	R	Exceeds scanning time set up (-fixed scanning time running/END processing time settings) scanning time (10μs unit)	
CM0723		END processing time measured value (10μs unit)	
CM0724 to CM0725	-	Reserved for system	
CM0726	R	Minimum fixed scanning time (10μs unit)	
CM0727	R	Maximum fixed scanning time (10μs unit)	
CM0728		END processing time set value (10μs unit)	
CM0729		Exceeds scanning time set up (-fixed scanning time running/END processing time settings) scanning time (10μs unit)	
CM0730 to CM1479	-	Reserved for system	

Device No.	Attribute R: Read only Blank: R/W	Function	
CM1480, CM1481	R	Frequency counter function (CTH0)	Frequency measuring result(Hz or rpm)
CM1482			1Number of placed pulse
CM1483			Scan times
CM1484, CM1485		Specify frequency pulse output function.	Setup frequency (Hz)
CM1486			Duty ratio (0 to 100%)
CM1487 to CM1489	-	Reserved for system	
CM1490, CM1491	R	Frequency counter function (CTH1)	Frequency measuring result (Hz or rpm)
CM1492			Number of pulses per rotation
CM1493			Scan times
CM1494, CM1495		Specify frequency pulse output function.	Setup frequency (Hz)
CM1496			Duty ratio (0 to 100%)
CM1497 to CM1593	-	Reserved for system	
CM1594		CTH0 change direction detection constant	
CM1595		CTH01 change direction detection constant	
CM1596, CM1597		Lower limit of CTH0 ring counter	
CM1598, CM1599		Lower limit of CTH1 ring counter	
CM1600, CM1601		CTH0 ring counter upper limit	
CM1602, CM1603		CTH1 ring counter upper limit	
CM1604, CM1605		CTH0 preset value	
CM1606, CM1607		CTH1 preset value	
CM1608		CTH0 start, reset, polarity set up	
CM1609		CTH0 start, reset, polarity set up	
CM1610, CM1611	R	INT R00000 Input capture (high bit, low bit) when occurred	
CM1612, CM1613	R	INT R00001 Input capture (high bit, low bit) when occurred	
CM1614, CM1615	R	INT R00002 Input capture (high bit, low bit) when occurred	
CM1616, CM1617	R	INT R00003 Input capture (high bit, low bit) when occurred	
CM1618, CM1619	-	Reserved for system	
CM1620		Setup constant when inputting	
CM1621 to CM1649	-	Reserved for system	
CM1650	R	Executed number of sensor setting command	
CM1651～CM1659		Reserved for system	
CM1660 to CM1669	R	Log/trace Ring Buffer free space (ID0 to ID10)	
CM1670 to CM1679	-	Reserved for system	
CM1680 to CM1689	R	Log/trace File Save Counter (ID0 to ID10)	
CM1690 to CM1699	-	Reserved for system	
CM1700, CM1701		Digital trimmer 0 upper limit	
CM1702, CM1703		Digital trimmer 1 upper limit	
CM1704, CM1705		Digital trimmer 2 upper limit	
CM1706, CM1707		Digital trimmer 3 upper limit	
CM1708, CM1709		Digital trimmer 4 upper limit	
CM1710, CM1711		Digital trimmer 5 upper limit	
CM1712, CM1713		Digital trimmer 6 upper limit	
CM1714, CM1715		Digital trimmer 7 upper limit	
CM1716 to CM1719		Reserved for system	
CM1720		Access Window	user message 1
CM1721 to CM1737			user message 2 (up to 24 characters + end character (00 H))
CM1738			Setting Inhibited Operation
CM1739	-		Reserved for system
CM1740 to CM1756		LD project name (up to 32 characters +end character (00 H))	
CM1757 to CM1763		Access window display project name (up to 12 characters + end character (00 H))	
CM1764 to CM1774		Bluetooth device identification name (up to 20 characters + terminal code (00H)) *1	
CM1775 to CM1779	-	Reserved for system	
CM 1780		AW initial menu setting is enabled	

*1 Only CPU unit that supports Bluetooth communication is valid.

Device No.	Attribute R: Read only Blank: R/W	Function	
CM1781		AW initial menu setting device type	
CM1782,CM1783		AW initial menu setting menu ID	
CM1784,CM1785		AW initial menu setting device No.	
CM1786		AW initial menu setting display format	
CM1787		AW initial menu setting device name representation	
CM1788		AW initial menu setting key lock state	
CM1789		AW initial menu setting display language	
CM1790		Automatic loading folder No. When powered on (request)	
CM1791		Automatic loading folder No. When powered on (completed)	
CM1792		Automatic loading folder No. For PROG/RUN (request)	
CM1793		Automatic loading folder No. For PROG/RUN (completed)	
CM1794 to CM1799		Reserved for system	
CM1800		Serious error log (latest)	Year month (decimal number, lower two 2 digits represent month, digits above hundred digit represent year. Example: 707 -> June, 2007
CM1801			day
CM1802			hour(0 to 23)
CM1803			minute
CM1804			Error No.
CM1805 to CM1899		Error log (2 to 20 records, same as CM1800 to CM1804)	
CM1900		Power ON log (latest)	Year month (decimal number, lower two 2 digits represent month, digits above hundred digit represent year. Example: 707 -> June, 2007
CM1901			day
CM1902			hour(0 to 23)
CM1903			minute
CM1904			second
CM1905 to CM1999		Power ON log (2 to 20 records, same as CM1800 to CM1804)	
CM2000		CPU Positioning function X axis	I/O setting
CM2001			Start sensor
CM2002, CM2003			Comparator 0
CM2004, CM2005			Comparator 1
CM2006			Origin return: starting speed
CM2007			Zero return: acceleration/deceleration time
CM2008, CM2009			Origin return: running speed
CM2010			JOG operation: starting speed
CM2011			JOB operation: acceleration/deceleration time
CM2012, CM2013			JOG operation: running speed
CM2014, CM2015			Current value change setting value
CM2016, CM2017			Operation speed change setting value
CM2018			Set up the origin return detail
CM2019			Operation in progress point No.(M code)
CM2020, CM2021	R		Current position
CM2022, CM2023	R		Current speed
CM2024			Error code
CM2025			Specify point No.
CM2026, CM2027			Resting position coordinate setpoint
CM2028, CM2029			Comparator 2

Device No.	Attribute R: Read only Blank: R/W	Function	
CM2030		CPU Positioning function Y axis	I/O setting
CM2031			Start sensor
CM2032, CM2033			Comparator 0
CM2034, CM2035			Comparator 1
CM2036			Origin return: starting speed
CM2037			Zero return: acceleration/deceleration time
CM2038, CM2039			Origin return: running speed
CM2040			JOG operation: starting speed
CM2041			JOB operation: acceleration/deceleration time
CM2042, CM2043			JOG operation: running speed
CM2044, CM2045			Current value change setting value
CM2046, CM2047			Operation speed change setting value
CM2048			Set up the origin return detail
CM2049			Operation in progress point No.(M code)
CM2050, CM2051	R		Current position
CM2052, CM2053	R		Current speed
CM2054			Error code
CM2055			Specify point No.
CM2056, CM2057			Resting position coordinate setpoint
CM2058, CM2059			Comparator 2
CM2060, CM2061		CPU Positioning function Point parameter 0	Target value/amount of movement
CM2062			Startup speed
CM2063			Acceleration/deceleration time
CM2064, CM2065			Operation speed
CM2066			Operation mode
CM2067			Specified pulse number for stop sensor
CM2068, CM2069			Reserved for system
CM2070 to CM2379		Point parameter 1 to 31 (The same with CM2060 to CM2069)	
CM2380 to CM2389	-	Reserved for system	
CM2390	R	Error code used for memory card instruction	
CM2391		Power OFF when accessing memory plug-in board (when occurred: the value other than 0)	
CM2392		Memory card retry occurrence times (still hold in case of power off)	
CM2393		Memory card check error times (still hold in case of power off)	
CM2394		Memory card timeout occurrence times (still hold in case of power off)	
CM2395		When error occurs on the memory card reset delay time (in ms, upper limit is 10000[10 s], do not reset if set to 65535)	
CM2392 to CM2399		Reserved for system	
CM2400 to CM2416		Interrupt times (INT0 to INT3, CTC2, CTC3, CTC0, CTC1, positioning X axis, positioning Y axis, INT4 to INT9, fixed cycle module)	
CM2417 to CM2999	-	Reserved for system	
CM3000		Number of received texts	
CM3001 to CM3999		Text received data (1998-byte)	
CM4000		Number of sending texts	
CM4001 to CM4999		Text send data (1998-byte)	
CM5000		Power OFF log (latest)	Year month (decimal number, lower two 2 digits represent month, digits above hundred digit represent year. Example: 707 -> June, 2007
CM5001			day
CM5002			hour(0 to 23)
CM5003			minute
CM5004			second
CM5005 to CM5099		Power OFF log (2 to 20 units the same with CM5000 to CM5004)	

Device No.	Attribute R: Read only Blank: R/W	Function	
CM5100		Latest serious error detail information 1 unit*	Year month (decimal number, lower two 2 digits represent month, digits above hundred digit represent year. Example: 707 -> June, 2007
CM5101			day
CM5102			HH
CM5103			minute
CM5104			second
CM5105			Error No.
CM5106			Effective data number of expansion information
CM5107			Detailed information 1*
CM5108			Detailed information 2*
: :			: :
CM5126			Detailed information 20*
CM5150		Latest general warning detail information 1 unit*	Year month (decimal number, lower two 2 digits represent month, digits above hundred digit represent year. Example: 707 -> June, 2007
CM5151			day
CM5152			hour
CM5153			minute
CM5154			second
CM5155			Error No.
CM5156			Effective data number of expansion information
CM5157			Detailed information 1*
CM5158			Detailed information 2*
: :			: :
CM5176			Detailed information 20*
CM5177 to CM5999	-	Reserved for system	

* Detailed information error is coded as follows:

- When No.128 (calculation error)

Detailed information n	Description
Detailed information 1	Details of error
	0 (not used)
	1 Improper indirect specification
	2 The indirectly specified target is T/C
	3 Improper simple indirect specifying
	4 Beyond operand range
	5 Floating real number overflow
	6 Improper device specifying
	7 ROOT operand is negative
	8 No ENCO instruction ON bit
	9 Floating-point real number error
	10 Trigonometric function operand error
	11 data cannot be converted
	12 Improper table specifying
	13 Time comparison instruction operand error
	14 Cam switch operand error
	15 Frequency counter instruction operand error
	16 0 division operation
	17 Record ID illegal
	18 Direct Processing Error
	19 The units cannot direct processed
	20 Subroutine does not exist for transfer target
	21 Writing during RUN, cannot execute command
	22 Expansion unit special command object error (unit No.)
	23 Reserved for system
	24 PIDAT operation setting out-of-range
	25 PIDAT sampling period out-of-range
	26 PIDAT constant of proportionality out-of-range
	27 PIDAT integral constant out-of-range
	28 PIDAT differential constant out-of-range
	29 PIDAT constant of proportionality two degree freedom parameters are out of scope
	30 PIDAT integral constant two degree freedom parameters are out of scope
	31 PIDAT differential constant two degree freedom parameters are out of scope
	32 PIDAT operation quantity upper limit value/lower limit value out-of-range
	33 PIDAT operation quantity change amplitude critical value is out of scope
	34 PIDAT measured value change amplitude is out of scope
	35 PIDAT AT state transition exception
	36 PIDAT operational control mark is out of scope
	37 PIDAT operation period is out of scope
	38 PIDAT AT adjusting parameters are out of scope
	39 PIDAT AT lagging is out of scope
	40 PIDAT AT timeout value is out of scope
	41 PIDAT AT calculation control mode setting is out of range
	42 PIDAT AT timeout
	43 PIDAT AT constant of proportionality is out of scope
	44 PIDAT AT integral constant is out of scope
	45 PIDAT AT differential constant is out of scope
	46 Root of negative number cannot be calculated
	47 Independent variable of ABS command is incorrect
	48 Operation overflow

Detailed information n	Description
Detailed information 2	00H fixed
Detailed information 3	Step number high bit error
Detailed information 4	Step number low bit error
Detailed information 5 to 20	Use SJIS to store module name.(the part other than module name is 00H)

· No.50,53,55,56,58,59 (unit ID related errors)

Detailed information n	Description
Detailed information 1	Unit No. (according to occurrence state of error, when unit No. Cannot be designated, it will not be saved.)
Detailed information 2 to 20	00H fixed

· When No.54 (error related with number of units)

Detailed information n	Description
Detailed information 1	Number of units on unit setting information
Detailed information 2	Actually connected number of units
Detailed information 3 to 20	00H fixed

· When No.129 (unit error)

Detailed information n	Description
Detailed information 1	Unit No.
Detailed information 2	Error No. of each unit
Detailed information 3 to 20	00H fixed

· In case of error numbers other than above

Detailed information n	Description
Detailed information 1 to 20	00H fixed

ASCII Code Table

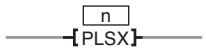
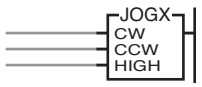
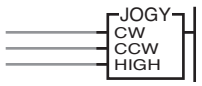
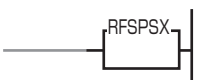
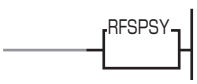
Low 4 bits \ High 4 bits	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	$^{N}U_{L}$	$^{D}L_{E}$	S_{P}	0	@	P	`	p				ー	タ	ミ		
1	$^{S}O_{H}$	$^{D}C_{1}$	!	1	A	Q	a	q			。	ア	チ	ム		
2	$^{S}T_{X}$	$^{D}C_{2}$	”	2	B	R	b	r			「	イ	ツ	メ		
3	$^{E}T_{X}$	$^{D}C_{3}$	#	3	C	S	c	s			」	ウ	テ	モ		
4	$^{E}O_{T}$	$^{D}C_{4}$	$	4	D	T	d	t			、	エ	ト	ヤ		
5	$^{E}N_{Q}$	$^{N}A_{K}$	%	5	E	U	e	u			・	オ	ナ	ユ		
6	$^{A}C_{K}$	$^{S}Y_{N}$	&	6	F	V	f	v			ヲ	カ	ニ	ヨ		
7	$^{B}E_{L}$	$^{E}T_{B}$	’	7	G	W	g	w			ァ	キ	ヌ	ラ		
8	B_{S}	$^{C}A_{N}$	(	8	H	X	h	x			ィ	ク	ネ	リ		
9	H_{T}	E_{M}	)	9	I	Y	i	y			ゥ	ケ	ノ	ル		
A	L_{F}	$^{S}U_{B}$	*	:	J	Z	j	z			ェ	コ	ハ	レ		
B	V_{T}	$^{E}S_{C}$	+	;	K	[	k	{			ォ	サ	ヒ	ロ		
C	F_{F}	→	,	<	L	\	l	|			ャ	シ	フ	ワ		
D	C_{R}	←	ー	=	M	]	m	}			ュ	ス	ヘ	ン		
E	S_{O}	↑	.	>	N	^	n	~			ョ	セ	ホ	゛		
F	S_{I}	↓	/	?	O	_	o	$^{D}E_{L}$			ッ	ソ	マ	゜		

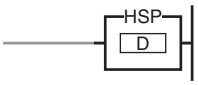
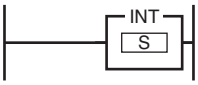
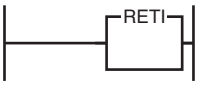
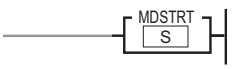
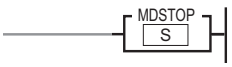
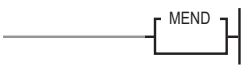
4 Instruction List

Command and processing outline are as shown in the table.For related detailed content, please refer to description page of the commands.

The following execution condition symbols are used in the list of instructions: ⎍ for execution at every scan, ⎍ for execution for one scan only at an up edge, and ⎍ for execution for one scan only at a down edge.

Sorting	mnemonics		Sign	Instruction function	Execution condition	Description Page
Log record instruction						
Log	LOGE		n LOGE	Logging enabled for specified log ID.	⎍	2-75
	LOGD		n LOGD	Logging inhibited for specified log ID.	⎍	2-75
	TRGD		n TRGD	Capture log data of ID specified.	⎍	2-77
High-speed processing instructions						
High-speed counter	CTH	.D .L	CTH n S	Response frequency Line drive input: single-phase 100 khz, phase difference 50 khz Open collector input: single-phase 60khz, phase difference 30khz 32 bit(0 to 4294967295Or -2147483648 to 2147483647)Up/down counter operation	⎍ ⎍	2-131
	CTC	.D .L	S CTC n		⎍ ⎍	
	RFSCTH		RFSCTH n	Refresh current value of high-speed counter to the updated value.	⎍	2-136
Frequency counter instructions						
Counter	FCNT		FCNT n S1 S2 D	Use high speed counter, test frequency.	⎍	2-152
	RCNT		RCNT n S1 S2 D	Use high speed counter, test rotating speed of pulse input.	⎍	2-154
Cam switch instructions						
Cam switch	MCMP		MCMP S1 S2 D n	Operate multiple control sections comparator.	⎍	2-158
	ABSENC		ABSENC S1 S2 D1 D2	Use absolute type encoder, operate the cam.	⎍	2-162
	INCENC		INCENC S1 S2 S3 D1 D2	Use incremental encoder, operate the cam.	⎍	2-166
Specify frequency pulse output instruction						
Pulse output	PLSOUT		S PLSOUT n1 n2	Use high speed counter, perform pulse output of specified frequency.	⎍	2-172

Sorting	mnemonics	Sign	Instruction function	Execution condition	Description Page
Positioning instructions					
Ladder control	PLSX		Start Trapezoidal control of X axis.	⎍	2-203
	PLSY		Start trapezoidal control of Y-axis.	⎍	
JOG operation	JOGX		Execute JOG operation of X-axis.	⎍	2-203
	JOGY		Execute JOG operation of Y-axis.	⎍	
Origin returning	ORGX		Start origin return on the X-axis.	⎍	2-203
	ORGY		Start origin return on the Y-axis.	⎍	
Teaching	TCHX		Acquire current position of X-axis.	⎍	2-203
	TCHY		Acquire current position of Y-axis.	⎍	
Moving to initial position	HOMEX		Start moving to home position of X-axis.	⎍	2-203
	HOMEY		Start moving to home position of Y-axis.	⎍	
Operation speed	CHGSPX		Change the operation speed of X-axis.	⎍	2-203
	CHGSPY		Change the operation speed of Y-axis.	⎍	
Current value update	RFSPSX		Refresh current value and speed of X-axis to the updated value.	⎍	2-216
	RFSPSY		Refresh current value and speed of Y-axis to the updated value.	⎍	

Sorting	mnemonics	Sign	Instruction function	Execution condition	Description Page
High-speed processing instructions					
Input time constant	HSP		Reduce time constant of input relay, improve input response characteristic.	⎍	3-46
Interrupt	DI		Inhibited execution of interrupt programs.	⎍	3-47
	EI		Enable execution of interrupt programs.	⎍	3-47
	DIC		Set up interrupt inhibited range.	⎍	3-48
	INT		Interrupt program before implementing RETI command.	-	3-50
	RETI		Indicates the end of the interrupt program.	-	3-50
Module instructions					
Module	MDSTRT		Start to execute specified module.	⎍	3-106
	MDSTOP		Stop to execute specified module.	⎍	
Macro instruction					
Macro	MCALL		Executes the sub-routine macro specified.	⎍	3-122
	MSTRT		Execute specified self-hold type macro.	⎍	
	MEND		Stops execution of the self-hold type macro.	⎍	

5 Prohibited Instruction List

To describe the command that cannot be used in initialization module, macro, subroutine, and interrupt routine.

● Initialization module, fixed period module, interrupt routine

Instruction type		Desciption	
Common		@XXXX instruction	Differential execution style
Basic Instructions	Contact Instructions	LDP/LDF	Load pulse/load pulse fall
		ANP/ANF	AND pluse/AND pulse fall
		ORP/ORF	OR pulse/OR pulse fall
		LDPB/LDFB	Load pulse/load pulse fall
		ANPB/ANFB	AND bar pulse/AND bar pulse fall
		ORPB/ORFB	OR bar pulse/OR bar pulse fall
	Output instructions	DIFU/DIFD	Differential UP / Differential DOWN
		ONDL/OFDL	Connect delay/cut off delay
		SHOT	One shot
		FLIK	Flicker
		ALT	Alternate
	Timer/counter instructions	TMR/TMH/TMS	Timer/high-spd timer / high-spd 1ms timer
		C	Counter
		OUTC	Out counter
		ITVL	Interval timer
		UDC	UP/DOWN counter
		UDT	UP/DOWN timer
	Connection/end Instruction	MEP/MEF	Mep/Mef
Applied Instructions	Shift Instruction	SFT	Shift
	Control block processing instructions	STG/JMP/ENDS	Control block/jump/end control block
		W-ON/W-OFF	Wait ON/wait OFF
		W-UE/W-DE	Wait UP edge/wait DOWN edge
	File register instructions	FRSTM/FRLDM	File register saves in batches/file register reads in batches
Operation command	Data control command	RAMP/TPOUT/LLFLT	Tilt signal/time division proportion output/promote delay filter
Extended Instructions	Data processing instructions	HKEY/SORTN	Hex key entry
	Cam switch instructions	ABSENC/INCENC	Absolute/incremental encoder
	Frequency counter instructions	FCNT/RCNT	Frequency/rotation speed measurement
	PID instructions	PID/PIDAT	PID
	Memory card instructions	MWRIT/MREAD/ MFREE/MMKDIR/ MPRINT/MREADL/ MCOPY/MMOV/MREN/ MFREEK/MSTAT	Write memory card/read memory card/acquire memory card capacity/ create memory card directory/write memory card character string/read a row of memory card/memory card file copy/memory card file movement/memory card file name change/acquire memory card remaining capacity/acquire memory card file state
		MRMDIR/MDEL	delete memory card file/folder
	Sensor setting command	SPWR/SPRD/SSVC	Write sensor parameters/read sensor parameters/execute sensor service
	Access window instructions	AWNUM/AWMSG	User message 1/2

● Macro

Instruction type		Desciption	
Applied Instructions	Macro instruction	MCALL/MSTRT	Call macro/start macro

* To describe MEND (macro end) command in self-hold type macro.It cannot be used in module or subroutine type macro.

● Subroutine

Instruction type		Desciption	
Applied Instructions	Control block processing instructions	STG/JMP/ENDS	Control block/jump/end control block
Extended Instructions	High-speed processing instructions	INT/RETI	Interrupt/interrupt return

6 Mnemonics Abbreviation

Mnemonics abbreviation for KV STUDIO instructions or devices.

● Instruction

Instruction		Abbreviation
Contact Instructions	LD,AND	A,X
	LDB,ANB	B,LDI,LDNOT,ANI,ANDNOT,/ *3
	ORB	ORI,ORNOT
	LDP,ANP	P
	LDF,ANF	F
Bit contact instructions	BLD,BAND	BA
	BLDB,BANB	BB
Compare instruction	LD=,AND=	=
	LD<,AND<	<
	LD>,AND>	>
	LD<=,AND<=	<=
	LD>=,AND>=	>=
	LD<>,AND<>	<>
Output instructions	OUT	O,Y
	OUB	OB
	SET	S
	RES	R,RST
	DIFU	U,PLS
	DIFD	D,PLF
Bit output instructions	BOUT	BO
	BOUB	BOB
	BSET	BS
	BRES	BR
Timer/counter instructions*1	TMR	T,TIM,OUTT
	TMH	TH,TIMH,OUTH
	TMS	TS, TIMHH, OUTS
	TMU	TU, TMUH, OUTH
	C	CNT
	UDC	CNTR
Connection/end Instruction	END	E,FEND
	ENDH	H
Stage instruction	W-ON	WON
	W-OFF	WOFF
	W-UE	WU, WUE
	W-DE	WD,WDE
Flow instructions	MC	IL
	MCR	ILC
Buffer memory instructions	UREAD	FROM
	UWRIT	TO
Arithmetic/comparison instructions	INC	++
	DEC	−−
	ROOT	SQRT
Logic operation instructions	EORA	XOR,XORA
	ENRA	XNORA

Instruction		Abbreviation
Text processing instructions	DASC	DSTR
	RDASC	DVAL
	HASC	HSTR
	RHASC	HVAL
	FASC	FSTR
	RFASC	FVAL
Simple operation instructions	CAL+	+
	CAL-	- *2
	CAL*	*
	CAL/	/ *3
	CAL&	&,WAND
	CAL |	| ,WOR
	CAL~	~, WXOR
	CAL^	^,NOT,CML
	CAL>>	>>,SFR
	CAL<<	<<,SFL
High-speed processing instructions	INT	I
	RETI	IRET

*1 Timer/counter command may realize input of command and device No. Without blank.
(For example) TMR 0002 DM00001 -> 2 D1

*2 When input "-" in " ladder edit " window directly, input transverse connecting wire.
After entering "-" in the "Direct Entry" dialog box, (Esc)you can enter "CAL-instruction".

*3 After entering "/" in the "Ladder Edit" window, you can enter "LDB instruction".
After entering "-" in the "Direct Entry" dialog box, (Esc)you can enter "CAL/instruction".

● Device name

Device name	Abbreviation
R	None (only PDF format)
MR	M
LR	L
DM	D
EM	E
FM	F

● Device No. and constant

Device No. and constant

7 List of Shortcut Keys

Shortcut key list of control functions.

Shortcut Keys Valid on Unit Editor

● File

Import	Ctrl + I
Close	Alt + F4

● Edit

Cut	Ctrl + X
Copy	Ctrl + C
Paste	Ctrl + V
Delete	Delete
Unit comments	Ctrl + Shift + U
Block comment	Ctrl + Shift + B
System comments	Ctrl + Shift + S
Unit preset	Ctrl + R
Batch input relay No.	Ctrl + A

● Convert

Jump to error rung	F4
Auto-assign relay/DM	F5
Device check	F6

● Slave device setup

Setup slave	Ctrl + N
Import slave information	Ctrl + K
KL Unit information copy	Ctrl + Alt + C
Paste KL unit information	Ctrl + Alt + V
KL address setting	Ctrl + E

● View

View Unit setup	↵
Unit Monitor	Ctrl + Alt + U
Customize monitoring	Ctrl + Alt + M
Buffer memory monitor	Ctrl + Alt + R

● Window

Unit placement area	Alt + U
Select unit	Alt + 1
Unit Setup	Alt + 2
Refresh setting	Alt + 3
Message area	Alt + 4

● Help

How to use Unit Editor	F1

● Operations in unit placement area

Move cell	← • → • ↑ • ↓
Move cell to start of rung	Home
Move cell to end of rung	End
Delete placed units	Delete
Multiple selection	Shift + ← • → • ↑ • ↓

● Operations in unit selection window

Move cell	← • → • ↑ • ↓
Add selected unit	↵

● Operations in unit setup window

Move cell	↑ • ↓
display move module	Ctrl + ← • → • ↑ • ↓
Input	Tab
Input/confirm	↵
Cancel	Esc

● Operations in message area

Move cell	↑ • ↓

Shortcut Keys Valid on Unit Editor "Slave Setup Screen"

● File

Import slave information	Ctrl + K
Close	Alt + F4

● Edit

Cut	Ctrl + X
Copy	Ctrl + C
Paste	Ctrl + V
Delete	Delete
Input unit/slave comment	Ctrl + Shift + U
Reserve unit slave	Ctrl + R

● Convert

Jump to error rung	F4
Auto Address Assignment	F5
Check addresses	F6

● View

Unit/slave setting content	↵

● Window

Slave Configuration Area	Alt + C
Unit Selection window	Alt + 1
Unit Setup window	Alt + 2
Address Setup window	Alt + 3
Message area	Alt + 4

● Help

How to use Unit Editor	F1

● Operation in slave configuration area

Move cell	↑ • ↓
The Unit Setup window of the selected unit is displayed.	↵
Delete configured unit	Delete

● Operations in unit selection window

Move cell	← • → • ↑ • ↓
Add selected unit	↵

● Operations in unit setup window

Move cell	↑ • ↓
Input	Tab
Input/confirm	↵
Cancel	Esc

● Operations in address setup window

Move cell	↑ • ↓

Shortcut Keys Valid on KV STUDIO

For ◆ project, shortcut keys can be set to change.

Shortcut keys valid in the initial screen

● File

New project	Ctrl + N
Open project	Ctrl + O

● View

Workspace	Alt + 1
Output window	Alt + 2

● Monitor/simulator

PLC Monitor	Ctrl + F1
Read from PLC	Ctrl + F5

Shortcut keys valid in the Editor mode

● File

New project	Ctrl + N
Open project	Ctrl + O
Save project	Ctrl + S
Print	Ctrl + P

● Edit

Undo	Ctrl + Z
Redo	Ctrl + Y
Cut	Ctrl + X
Copy	Ctrl + C
Paste	Ctrl + V
Multiple paste	Ctrl + Shift + V
Search	Ctrl + F
Replace operand	Ctrl + H

New cross-reference		(Space)
Make list of cross-reference rung comments		Ctrl + L
"Previous cross-reference(Z)"◆		Shift + F3
Next cross-reference◆		F3
Jump	Line/line step No.	Ctrl + Shift + G
	Top	Ctrl + Home
	Bottom	Ctrl + End
	Previous block	Ctrl + ↑
	Next block	Ctrl + ↓
	Previous symbol	Shift + Tab
	Next symbol	Tab
	Home	Home
	End	End
	Change previous block	Ctrl + Alt + ←
	Change next block	Ctrl + Alt + →
	Contact/Coil	F12
Insert	Cell	Ins
	Rung	Shift + ↵ / Shift + Ins
	Rung comment	Ctrl + ↵
	Loopback ladder	Ctrl + Shift + F8
Delete rung		Shift + Delete
Disable rung - Settings		Ctrl + Q
Disable rung - Cancel		Ctrl + W
Bookmark	Insert	Ctrl + Shift + Ins
	Set	Ctrl + Shift + ↵
	Release	Ctrl + Shift + Delete
Select rung		Ctrl + → (Shift + ←)*1 (Shift + →)*2
Arrange ladder		Ctrl + Shift + F
Edit list		Ctrl + D
Change operand		↵
Change device comment		Ctrl + M
Edit connection line	Input vertical connection line◆	F8
	Input horizontal connection line◆	F9 (−)
	Input horizontal connection line to end of rung	Alt + ↵ Ctrl + Tab
	Delete vertical connection line◆	Shift + F8
	Delete horizontal connection line◆	Shift + F9 (−)
	vertical connection line	Alt + ↑ / Alt + ↓
	Input/delete horizontal connection line	Alt + ← / Alt + →
display the device cross datum mark of cell location		(Space)
Delete instruction to the left of cell position		Backspace
Delete instruction at cell position		Delete
Directly enter instruction at cell position		Esc
Right-shift cursor position		Ins
Enter NO contact◆		F5
Enter NC contact◆		Shift + F5
Enter NO contact OR◆		F4
Enter NC contact OR◆		Shift + F4
Enter NO contact coil◆		F7
Enter NC contact coil◆		Shift + F7
SET◆		Alt + F1
RES◆		Alt + F2
TMR◆		Alt + F3
TMS◆		Alt + F5
C◆		Alt + 0
DIFU◆		Alt + F8
DIFD◆		Alt + F9
MOV◆		Alt + F10
LDA◆		Alt + F11
STA◆		Alt + F12
LDP◆		Alt + F7
LDF◆		Alt + Shift + F7
ORP◆		Alt + Shift + F8
ORF◆		Alt + Shift + F9
MEP◆		Alt + Shift + F5
MEF		Alt + Ctrl + F5
INV		Alt + Ctrl + F10
Change NO-NC contact, change suffix, enter NC contact		/
Change rise/fall		Ctrl + /
Direct input/current value change◆		F2
Next cell◆		Ctrl + Shift + Alt + F11 *

*1 Effected only the cursor at the left end (1st column).
*2 Effected only the cursor at the left end (10 th column).

Previous cell◆	Ctrl + Shift + Alt + F12 *
increment of the device number	Ctrl + Shift + ↑
Decrement of the device number	Ctrl + Shift + ↓

* Only valid when displaying the edit window of divided ladder diagram

● View

Workspace	Alt + 1
Output window	Alt + 2
Instruction/macro palette◆	Shift + Ctrl + P (↵)*
Comment edit window	Ctrl + F7
Device use list	Ctrl + E
Enlarge display	Ctrl + PageUp
Reduce display	Ctrl + PageDown
Enlarge/Reduce display	Alt +Wheel Ctrl +Wheel
display labels	Ctrl + Backspace
display comments◆	Ctrl + (Space)
display devices for unit	Shift + (Space)
Edit window switching	Alt + F6

* Only valid when no instruction is input in chosen cell.

● Script

Insert area script	Ctrl + R
Insert box script	Ctrl + B
Convert selected script	Ctrl + T
display/not display the converted ladder diagram	Ctrl + G
Script function list	Ctrl + (Space)
Script tip	Ctrl + Shift + (Space)

● Convert

Convert◆	Ctrl + F9
Convert individual modules/macros◆	Ctrl + F10

● Monitor/Simulator

Monitor mode◆	Ctrl + Shift + F3
PLC transfer -> Monitor mode◆	Ctrl + F8
PLC Read-> Monitor mode	Ctrl + F1
Read from PLC◆	Ctrl + F5
Online edit Start◆	F10
Simulator	Ctrl + F2

● Tool

Unit Editor	Ctrl + U

● Help

Instruction help	F1
Instruction Reference Manual	Ctrl + 1

Shortcut keys valid in the Monitor mode

● Edit

Search		Ctrl + F + ↵
Jump	Line/line step No.	Ctrl + Shift + G
	Top	Ctrl + Home
	Bottom	Ctrl + End
	Previous block	Ctrl + ↑
	Next block	Ctrl + ↓
	Previous symbol	Shift + Tab
	Next symbol	Tab ↓
	Home	Home
	End	End
	Change previous block	Ctrl + Alt + ←
	Change next block	Ctrl + Alt + →
	Contact/Coil	F12
New cross-reference		(Space)
Previous cross-reference		Shift + F3
Next cross-reference		F3
Make list of cross-reference rung comments		Ctrl + L
Select rung		Ctrl + →
Contact ON/OFF switching		/
Set register		Ctrl + Shift + J
Reset register		Ctrl + Shift + K
Cancel		Ctrl + Shift + L

● View

Workspace	Alt + 1
Output window	Alt + 2
Enlarge display	Ctrl + PageUp
Reduce display	Ctrl + PageDown
Enlarge/Reduce display	Alt +Wheel Ctrl +Wheel
Display labels	Ctrl + Backspace
Display comments◆	Ctrl + (Space)
Display devices for unit	Shift + (Space)
Change device value	F2
Edit window switching	Alt + F6

● Monitor/Simulator

Return to Editor◆	Ctrl + F1
Start Monitor	F4
End Monitor	Shift + F4
Online edit start	F10
Simulator	Ctrl + F2
Display/hide observation window	Alt + 3

● Debug

Execute 1 scan	F9
Execute 1 step	F8

● Help

Instruction help	F1
Instruction Reference Manual	Ctrl + 1

Shortcut keys valid in the Simulator mode

● Edit

Search		Ctrl + F + ↵
Select rung		Ctrl + →
Jump	Top	Ctrl + Home
	Bottom	Ctrl + End
	Previous block	Ctrl + ↑
	Next block	Ctrl + ↓
	Previous symbol	Shift + Tab
	Next symbol	Tab
	Home	Home
	End	End
	Change previous block	Ctrl + Alt + ←
	Change next block	Ctrl + Alt + →
	Contact/Coil	F12
New cross-reference		(Space)
Previous cross-reference		Shift + F3
Next cross-reference		F3
Make list of cross-reference rung comments		Ctrl + L
Contact ON/OFF switching		/

● View

Workspace	Alt + 1
Output window	Alt + 2
Enlarge ladder display	Ctrl + PageUp
Reduce ladder display	Ctrl + PageDown
Enlarge/Reduce display	Alt +Wheel Ctrl +Wheel
display labels	Ctrl + Backspace
display comments◆	Ctrl + (Space)
display devices for unit	Shift + (Space)
Change device value	F2

● Monitor/Simulator

Return to Editor◆	Ctrl + F1
Monitor mode◆	Ctrl + Shift + F3
Online edit Start	F10
Display/hide watch window	Alt + 3

● Debug

Execute 1 scan	F9
Execute continuous step	Shift + F8
Execute 1 step	F8
Execute reverse consecutive steps	Shift + F7
Execute continuous reverse step	F7
Pause	F6

● Help

Instruction help	F1
Instruction Reference Manual	Ctrl + 1

Shortcut keys valid during online editing

● Edit

Undo		Ctrl + Z
Redo		Ctrl + Y
Cut		Ctrl + X
Copy		Ctrl + C
Paste		Ctrl + V
Multiple paste		Ctrl + Shift + V
Search		Ctrl + F
Replace operand		Ctrl + H
Jump	Line/line step No.	Ctrl + Shift + G
	Top	Ctrl + Home
	Bottom	Ctrl + End
	Previous block	Ctrl + ↑
	Next block	Ctrl + ↓
	Previous symbol	Shift + Tab
	Next symbol	Tab
	Home	Home
	End	End
	Change previous block	Ctrl + Alt + ←
	Change next block	Ctrl + Alt + →
	Contact/Coil	F12
New cross-reference		(Space)
"Previous cross-reference(Z)"◆		Shift + F3
Next cross-reference◆		F3
Make list of cross-reference rung comments		Ctrl + L
Insert cell		Ins
Insert empty rung		Shift + ↵ / Shift + Ins
Delete rung		Shift + Delete
Insert rung comments		Ctrl + ↵
Disable rung - Settings		Ctrl + Q
Disable rung - Cancel		Ctrl + W
Bookmark	Insert	Ctrl + Shift + Ins
	Set	Ctrl + Shift + ↵
	Release	Ctrl + Shift + Delete
Select rung		Ctrl + →
Edit connection line	Input vertical connection line◆	F8
	Input horizontal connection line◆	F9 (—)
	Input horizontal connection line to end of rung	Alt + ↵ / Ctrl + Tab
	Delete vertical connection line◆	Shift + F8
	Delete horizontal connection line◆	Shift + F9 (—)
Edit connection line	Input/delete vertical connection line	Alt + ↑ / Alt + ↓
	Input/delete horizontal connection line	Alt + ← / Alt + →
Insert a loopback ladder		Ctrl + Shift + F8
Verify Ladder		Ctrl + Shift + F
Edit list		Ctrl + D
Change operand		↵
Change device comment		Ctrl + M
Delete instruction to the left of cell position		Backspace
Delete instruction at cell position		Delete
Directly enter instruction at cell position		Esc
Enter NO contact◆		F5
Enter NC contact◆		Shift + F5
Enter NO contact OR◆		F4
Enter NC contact OR◆		Shift + F4
Enter NO contact coil◆		F7
Enter NC contact coil◆		Shift + F7
SET◆		Alt + F1
RES◆		Alt + F2
TMR◆		Alt + F3
TMS◆		Alt + F5
C◆		Alt + 0
LDP◆		Alt + F7
DIFU◆		Alt + F8
DIFD◆		Alt + F9
LDF◆		Alt + Shift + F7
ORP◆		Alt + Shift + F8
ORF◆		Alt + Shift + F9
MOV◆		Alt + F10
LDA◆		Alt + F11
STA◆		Alt + F12
MEP◆		Alt + Shift + F5
MEF		Alt + Ctrl + F5
INV		Alt + Ctrl + F10
Change NO-NC contact, change suffix, enter NC contact		/
Change rise/fall		Ctrl + /
Direct input/current value change		F2
Set register		Ctrl + Shift + J
Reset register		Ctrl + Shift + K
Cancel		Ctrl + Shift + L

● View

Workspace	Alt + 1
Output window	Alt + 2
Instruction/macro palette◆	Shift + Ctrl + P (↵)*
Comment edit window	Ctrl + F7
Device use list	Ctrl + E
Enlarge display	Ctrl + PageUp
Reduce display	Ctrl + PageDown
Enlarge/Reduce display	Alt +Wheel Ctrl +Wheel
display labels	Ctrl + Backspace
display comments◆	Ctrl + (Space)
display devices for unit	Shift + (Space)

* Only valid when no instruction is input for chosen cell.

● Script

Insert area script	Ctrl + R
Insert box script	Ctrl + B
Convert selected script	Ctrl + T

● Monitor/Simulator

Return to Editor◆	Ctrl + F1
Monitor mode◆	Ctrl + Shift + F3
Transfer online edit	F11
Simulator	Ctrl + F2
Display/hide watch window	Alt + 3

● Help

Instruction help	F1
Instruction Reference Manual	Ctrl + 1

GPPQ/GPPA Mode Shortcut Key List

Changeable shortcut keys setting.

Enter NO contact	F5	
Enter NC contact	GPPQ mode	F6
	GPPA mode	Shift + F5
Enter NO contact OR	GPPQ mode	Shift + F5
	GPPA mode	F6
Enter NC contact OR	Shift + F6	
Coil input	F7	
Enter NC contact coil	Not assigned	
Input vertical connection line	GPPQ mode	Shift + F9
	GPPA mode	F10
Delete vertical connection line	Ctrl + F10	
Input transverse connecting line	F9	
Delete transverse connecting line	Ctrl + F9	
SET	Not assigned	
RES	Not assigned	
TMR	Not assigned	
TMS	Not assigned	
C	Not assigned	
LDP	Shift + F7	
LDF	Shift + F8	
ORP	Alt + F7	
ORF	Alt + F8	
DIFU	Not assigned	
DIFD	Not assigned	
MOV	Not assigned	
LDA	Not assigned	
STA	Not assigned	
MEP	Alt + F5	
Mark/unmark connecting line (right)	Alt + →	
Mark/unmark connecting line (left)	Alt + ←	
Mark/unmark connecting line(down)	Alt + ↓	
Mark/unmark connecting line (up)	Alt + ↑	
Convert	Ctrl + Alt + F4	
Convert individual modules/macros	F4	
Direct input/change current value	Not assigned	
Previous cross-reference	Not assigned	
Move to next cross-reference	Not assigned	

PLC transfer -> Monitor mode	F3
Read from PLC	Not assigned
Start online edit	Shift + F3
Returning to Editor	F2

Next cell	Ctrl + Shift + Alt + F11
Previous cell	Ctrl + Shift + Alt + F12
Monitor mode	F3
Display comments	Ctrl + F5
Instruction/ macro input celll	Ctrl + Shift + P

CX Mode Shortcut Key List

Changeable shortcut keys setting.

Enter NO contact	C
Enter NC contact	Not assigned
Enter NO contact OR	W
Enter NC contact OR	X
Coil input	O
Enter NC contact coil	Q
SET	Shift + F8
RES	Shift + F9
TMR	Ctrl + Alt + O
TMS	Not assigned
C	Not assigned
LDP	Not assigned
LDF	Not assigned
ORP	Not assigned
ORF	Not assigned
DIFU	Not assigned
DIFD	Not assigned
MOV	Not assigned
LDA	Not assigned
STA	Not assigned
MEP	Shift + Alt + F5
Mark/unmark connecting line(right)	H
Mark/unmark connecting line (left)	Not assigned
Mark/unmark connecting line(down)	V
Mark/unmark connecting line (up)	U

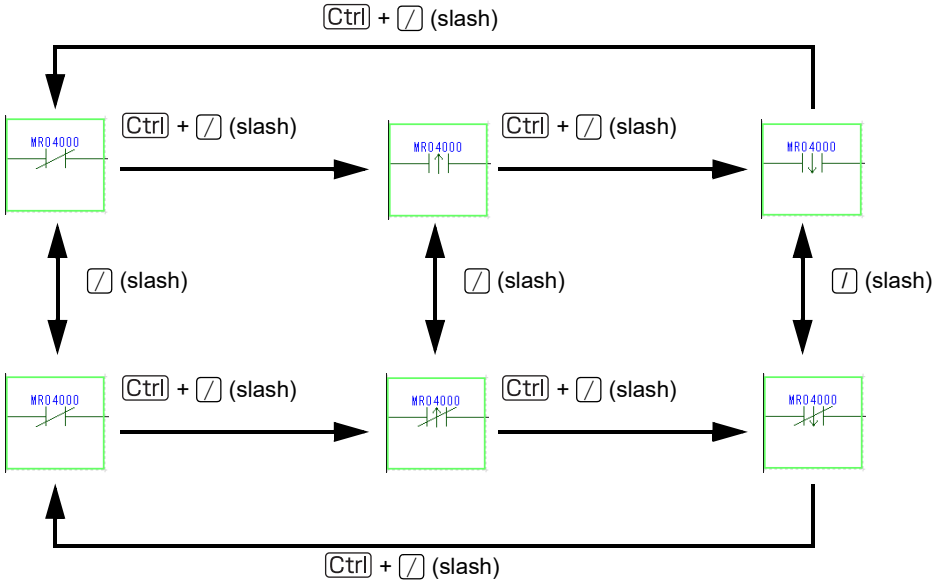
Convert	F7
Convert individual modules/macros	Alt + F7
Direct input/change current value	I
Previous cross-reference	B
Move to next cross-reference	N
PLC transfer -> Monitor mode	F3
Read from PLC	Ctrl + F5
Start online edit	F10
Returning to Editor	F2
Next cell	Ctrl + Shift + Alt + F11
Previous cell	Ctrl + Shift + Alt + F12
Monitor mode	Ctrl + Shift + F3
display comments	Alt + Y
Instruction/macro pack pallet	Ctrl + Shift + P

How to use /(slash) key

● / Press the "/" button to change cursor position

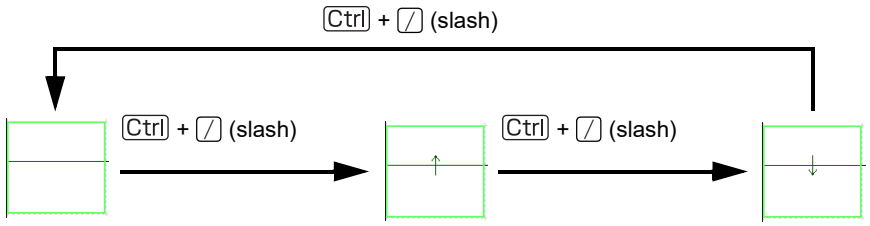
The following changes can be made.

· contact a,contact b rising edge, falling edge

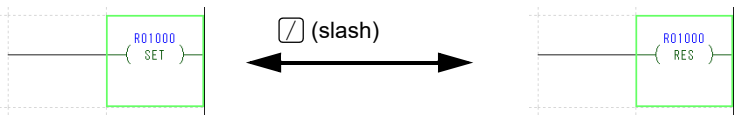


Note

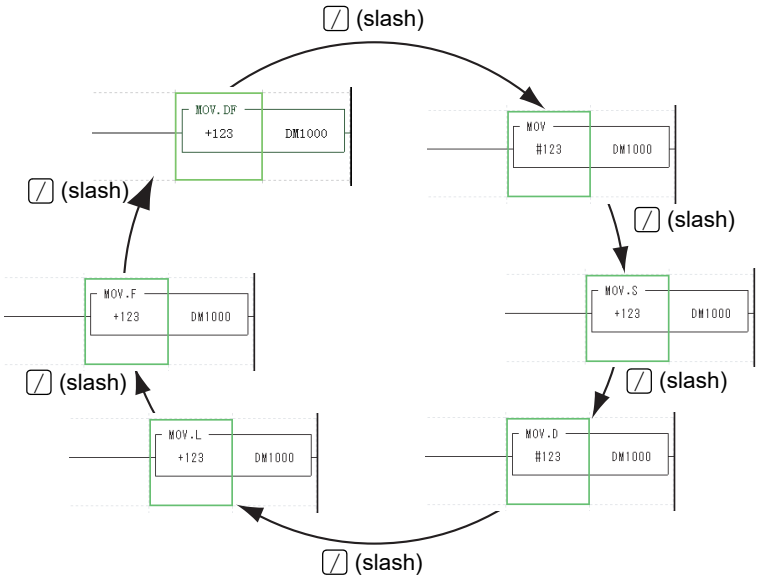
When KV-5000/3000 is used, press Ctrl + / key for transverse line position, the following change occurs.



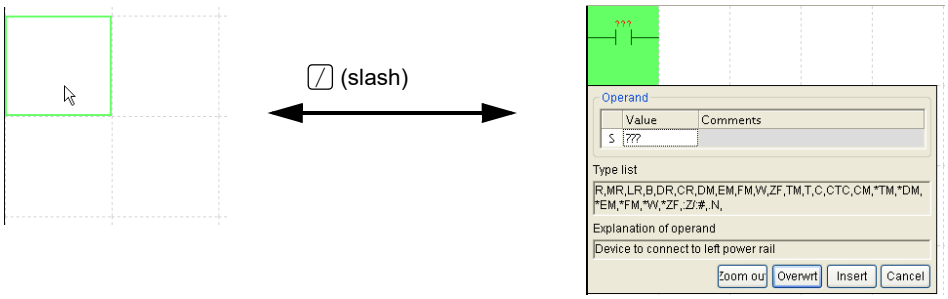
• SET/RES



· Suffix



● If this button is pressed when no insturction is entered in CELL, Contact b will be entered.



*Entry can be made only in the Direct Entry dialog box.

8 Unusable Character String List

Describe character unusable in project name, module name, macro name, mark, device comment.

● Characters that cannot be not used in object name, module/macro name

Unusable character string	! " # $ % & ‘ ( ) * , . / : ; < = > ?
	@ [\ ] ^ ’ { | } ~ (space)
Character that cannot be used at the beginning	+ - 0 1 2 3 4 5 6 7 8 9 _
Character or character string that cannot be used at the end	_ _0 _1 _2 _3 _4 _5 _6 _7 _8 _9
Illegal text strings	Global(case insensitve)

● Character that cannot be used in label

Unavailable characters	! " # $ % & ‘ ( ) * + , - . / : ; < = > ? @ [\
	] ^ _ ’ { | } ~ (space)
Character that cannot be used at the beginning	0 1 2 3 4 5 6 7 8 9
Illegal text strings	Global
	(the same name as command)
	(Device name)
	· alphabet character + R or M+ number · Letter 1 character + number

● Unusable characters that cannot be not used device comments

Unavailable characters	,

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Revision History

Revision History	Version	Details of Revision
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Nov 2011	5th version	
May 2012	6th version	
Mar 2014	7th version	
Jul 2014	8th version	
Aug 2019	1st revision 1st edition	

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