# **Super-small Programmable Logic Controllers** KV Series



#### **Features**

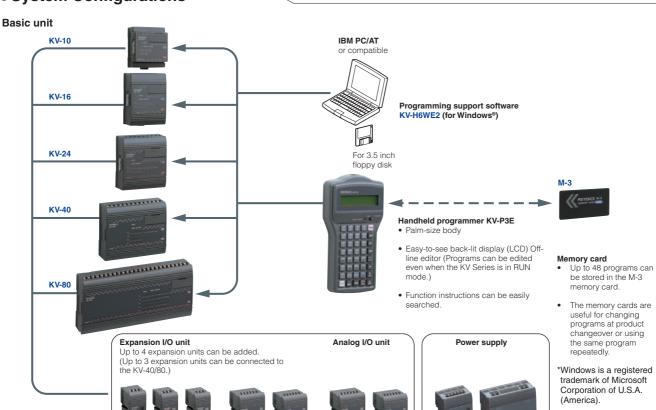
- The world's smallest PLCs!
- Variety of expansion options
- 1 20 kHz clock pulse output
- User-friendly Windows® ladder software



Refer to P.858 for list of products complying with EU Directives.



\*Windows is a registered trademark of Microsoft Corporation of U.S.A. (America).



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KV-8EX

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KV-16EX

KV-AD4/DA4

KV-U2/U3

# **I** Description

#### Smallest PLCs in the world

The KV-10 (with 10 I/Os) is about the same size as three general-purpose relays. The KV-80 (with 80 I/Os) is as small as a VHS videotape. KV Series PLCs require little space on a control panel.

KV-10



The KV-10 can be mounted in two-thirds the space required by conventional 10 I/O PLCs.

# Several expansion options available to increase the number of I/Os

Up to 4 expansion units can be added.



With the KV Series, it's easy to expand the number of I/Os. To achieve the input/output ratio that suits your needs, KV-16E or KV-8E expansion units can be added in any combination of 3 to the KV-80 or KV-40. Any combination of 4 expansions units can be added to the other models.

#### Analog I/O units with 12-bit resolution

The KV-DA4 (D/A connector) and KV-AD4 (A/D converter) with 4 channel I/O are available.

#### Support software for Windows®

The new Ladder Builder support software enables a program to be debugged on a PC screen without connecting a PLC or other device.

#### Interrupts and counters

The interrupt input instruction receives pulse signals as short as  $25 \,\mu s$  regardless of the program cycle time, thus allowing real time processing.

The KV Series also provides two 10 kHz counters that are suitable for counting pulses with a high frequency.

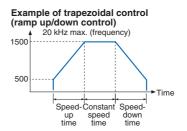
#### Convenient analog timer

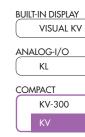
Useful during startup, the analog timer trimmer enables the adjustment of the values for timers and counters, in real time, based on actual operating conditions, with a range from 0 to 249. There are 2 analog timers in the KV-80, KV-40, and KV-24, and 1 in the KV-16 and KV-10.

#### 20 kHz clock pulse output (KV-80)

The 20 kHz clock pulse output enables positioning at varying speeds. The KV Series is useful as a pulse generator for stepping motors.

(The KV-10/16/24/40 has a maximum clock frequency of 2 kHz.)





#### Other useful features

- Built-in 1 ms timer
- Memory capacity of up to 3000 steps (500 steps: KV-10/16)
- Serial communication function
- Relay replacement is possible. (KV-80R, KV-16EYR)
- Programs are stored in EEPROM, eliminating the need for backup battery.

 $^*\mbox{Windows}$  is a registered trademark of Microsoft Corporation of U.S.A. (America).

**BUILT-IN DISPLAY** 

ANALOG-I/O

KL

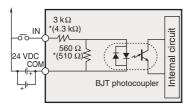
KV-300

COMPACT

VISUAL KV

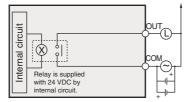
# I Input/Output Circuits

#### Input circuit



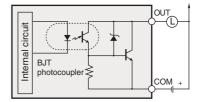
- · Applicable to all KV models.
- \*Values in ( ) used only for terminals connected to relays other than 0000 through 0005.
- Input from both NPN [(+) connected to COM] and PNP [(-) connected to COM] transistors are applicable.

### **Output circuit (relay contact)**



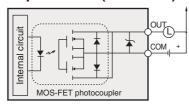
- Applicable only to the KV-80R, KV-40R, KV-24R, KV-16R, KV-10R, KV-8ER, KV-8EYR, and KV-16EYR.
- · A separate power supply is required for the load.

#### **Output circuit (BJT)**



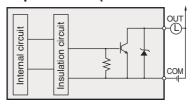
- Applicable only to KV-80T (terminals other than 0500), KV-10T, KV-8ET, KV-8EYT, and KV-16EYT
- A separate power supply is required for the load.

#### **Output circuit (MOS-FET)**



- · Applicable only to the KV-40T, KV-24T, and KV-16T.
- · A separate power supply is required for the load.

#### Output circuit (terminal 0500 on KV-80T only)



 A separate power supply is required for the load.

#### I Software

# The Ladder Builder for KV creates sequence programs in Windows®

#### **KV-H6WE2**

User-friendly operation and high-level programming capabilities make the Ladder Builder for KV [KV-H6WE2] ideal for beginners and experienced programmers alike.

> \*Windows is a registered trademark of Microsoft Corporation of U.S.A. (America)

#### I Editor

# Easy editing using Windows® functions



# Multi-file editing

Multiple files can be edited simultaneously on the Ladder Builder for KV. You can freely cut and paste from one file to another.

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#### Instruction selection window

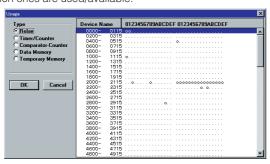
The user-friendly design allows data entry from a keyboard or a mouse. You can select and specify a device or command from a list provided by device type.

This ensures error-free entry of target symbols. For fast programming, you can also enter the symbol directly by typing the command from the keyboard.



#### **Usage list**

When creating Ladder diagrams, it can be difficult to keep track of addresses already used. The usage list displays which ones are used/available.



#### **UNDO** function

The Ladder Builder for KV enables efficient editing. If you accidentally delete an instruction, you can undo the action simply by clicking the "Undo" button. "Redo" button cancels "Undo".

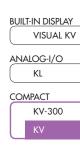




#### **Auto-save function**

The Ladder Builder for KV automatically backs up your program at predetermined intervals. This protects your data from being lost due to PC power loss or system crash.

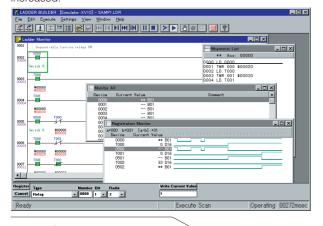




# **I** Simulator

#### Quick debugging without a PLC

Even without a PLC connected, the Ladder Builder for KV can simulate program execution. The execution can be checked without transferring the program to the PLC. By providing a single-step execution function (forward or reverse) in addition to a regular scan execution function, debugging efficiency is increased.



# Forward/reverse single step execution

You can easily find a problem in complex operations by checking the operation process one step at a time.

# Ladder Simulator enables direct checking of the ladder diagram execution

By clicking an element in the ladder diagram, the simulator screen quickly appears, allowing element setting/resetting.

#### **Monitors All function**

Timers, counters and data memories can be checked simultaneously in multiple windows. For effective debugging, you can check devices at one time, which don't directly appear in the ladder diagram.

# **Registration Monitor**

The Ladder Builder for KV can display multiple timing charts of any devices simultaneously. This enables convenient checking of all element on/off timing.

#### Monitor

# Real time monitoring without stopping the machine

Ladder diagram and element on/off stands can be monitored real time. Timing charts can be monitored simultaneously.

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# **I** Specifications

# Input/Output specifications

Туре		Basic unit								
Model	KV-10R	KV-10T	KV-16R	KV-16T	KV-24R	KV-24T	KV-40R	KV-40T	KV-80R	KV-80T
No. of inputs	6		10		16		24		48	
Common input		1								
Input rating		24 VDC, Current consumption 7 mA (Input 000 to 005) 5 mA: (others)								
No. of outputs	4	1	6 8		16		3	2		
Common output	1	1	:	2 4		4	6		1	4
Type of output	Relay	BJT	Relay	MOS-FET	Relay	MOS-FET	Relay	MOS-FET	Relay	BJT
Rated load	Relay: 250 VAC/30 VDC, 2 A, peak load current 5 A, Transistor: 30 VDC, 0.3 A									

Туре		Expansion unit						
Model	KV-8ER	KV-8ET	KV-8EX	KV-8EYR	KV-8EYT	KV-16EX	KV-16EYR	KV-16EYT
No. of inputs	4		8	_		16		
Common input	1	1	2	_		4	_	
Input rating		24 VDC, Current consumption 7 mA (Input 000 to 005) 5 mA: (others)						
No. of outputs	4	1	_	8	3	_	1	6
Common output	1	1	_	2	2	_	4	1
Type of output	Relay	BJT	_	Relay	BJT	_	Relay	BJT
Rated load	Relay: 250 VAC/30 VDC, 2 A, peak load current 5 A, Transistor: 30 VDC, 0.3 A MOS-FET: 30 VDC, 0.6 A (Output 0500), 30 VDC, 0.5 A (Others) peak load current 1 A							

BUILT-IN DISPLAY VISUAL KV

ANALOG-I/O KL COMPACT

KV-300

Power supply unit specifications

Model	KV-U2	KV-U3		
Operation system	Switchi	ing type		
Power supply voltage	100 to 240 VAC (50/60 Hz) ±10%			
Output voltage	24 VDC ±10% (Ripple: 240 m Vp-p max.)			
Output current	0.8 A	1.4 A		
Weight (brackets not included)	Approx. 170 g	Approx. 300 g		

# Analog I/O specifications (Input: KV-AD4, Output: KV-DA4)

Туре	Voltage	Current
Analog I/O range	-10 to +10 V	4 to 20 mA
Input impedance	1 ΜΩ	300 Ω
Output impedance	0.5 Ω min.	_
Number of I/O	4 channels of ir	nputs or outputs
Resolution	5 mV (1/4000)	4 μA (1/4000)

## General specifications (R and T in model names indicate relay output and transistor output)

Model	KV-10 (R/T)	KV-16 (R/T)	KV-24 (R/T)	KV-40 (R/T)	KV-80 (R/T)	
Programming language			diagram and expanded ladder diagram			
Number of instructions	Basic: 16, application: 34, arithmetic:26, interrupt: 4					
Execution time (basic I/O instructions)	1.0 μs min., 1	.92 μs average	1.4 µs min., 3.12 µs average			
Avg. number of steps	500 steps	s/program		3000 steps/program		
Input (Maximum extendable number of inputs)	6 inputs (70 max.)	10 inputs (74 max.)	16 inputs (80 max.)	24 inputs (72 max.)	48 inputs (80 max.)	
Output (Maximum extendable number of outputs)	4 outputs (68 max.)	6 outpus (70 max.)	8 outputs (72 max.)	16 outputs (64 max.)	32 outputs (80 max.)	
Maximum extendable number of I/Os	74	80	3	38	128	
Internal utility relays (with latching function)	1	60		800		
Special utility relays			160			
Data memory (16 bits)	1,000	words		2,000 words		
Temporary memory (16 bits)			32 words			
Timer/Counter	counters a 0.1-s timer (I 0.01-s timer (I 1-ms timer (I 1 analo	s, up, and up-down re provided: 0 to 6553.5 s) 0 to 655.35 s) 0 to 655.35 s) og timer 49 s, or 0 to 0.249 s)	A total of 120 timers, up, and up-down counters are provided: 0.1-s timer (0 to 6553.5 s) 0.01-s timer (0 to 655.35 s) 1-ms timer (0 to 65.535 s) 2 analog timers (two of 0 to 24.9 s, 0 to 2.49 s, or 0 to 0.249 s)			
High-speed counter	2 auto-reset up-counters (max. input response frequency: 10 kHz)					
High-speed counter comparator	4					
Direct clock pulse	2 channels, 2 kHz max. (output from 0500), 1.5 kHz max. (output from 0501)  2 channels, 2 kHz max. (output from 0500)  1.5 kHz max. (output from 0501)					
Mamanu baakun	Program memory: EEPROM, programs retained for 10 years min., rewritable 50,000 times min.					
Memory backup	Data memory: data retained for 2 months min. by capacitors (at +25°C (77°F))					
Supply voltage	24 VDC +10% to -20%					
Maximum current consumption	KV-10R: 75 mA KV-16R: 105 mA KV-10T: 65 mA KV-16T: 70 mA		KV-24R: 130 mA KV-24T: 75 mA KV-40T: 115 mA		KV-80R: 400 mA KV-80T: 300 mA	
Ambient temperature		0 to +5	0°C (32 to 122°F), No conde	nsation		
Relative humidity	35 to 85%, No condensation					
Withstand voltage	1500 VAC applied between power terminal and I/O terminal, and between terminals and housing (1 min.)					
Weight	KV-10R: approx. 130 g KV-10T: approx. 120 g	KV-16R: approx. 200 g KV-16T: approx. 180 g	KV-24R: approx. 250 g KV-24T: approx. 220 g	KV-40R: approx. 340 g KV-40T: approx. 270 g	KV-80R: approx. 600 g KV-80T: approx. 500 g	

VISUAL KV ANALOG-I/O  $\mathsf{KL}$ COMPACT

BUILT-IN DISPLAY

KV-300

VISUAL KV

ANALOG-I/O KL COMPACT KV-300

# **I** Instructions

#### Basic instructions

Instruction	Symbol	Mnemonic	Function
LOAD	nnnn	LD	Connects N.O. contact to bus.
LOAD BAR	nnnn	LDB	Connects N.C. contact to bus.
AND	nnnn ——   ——	AND	Connects N.O. contact in series with previous contact.
AND BAR	nnnn	ANB	Connects N.C. contact in series with previous contact.
OR	nnnn	OR	Connects N.O. contact in parallel with previous contact.
OR BAR	nnnn	ORB	Connects N.C. contact in parallel with previous contact.
AND LOAD		ANL	Connects in series blocks made of one or more contacts.
OR LOAD		ORL	Connects in parallel blocks made of one or more contacts.
OUT	nnnn ———	OUT	Outputs input ON/OFF status to R coil.
OUT BAR	nnnn ————	OUB	Outputs inverted input ON/OFF status to R coil.
SET	nnnn —(SET)—	SET	Forces R ON and holds this status when input is ON.
RESET	nnnn —(RES)—	RES	Forces R/T/C OFF when input is ON.
0.1-s TIMER	#ddddd -  T <sub>xxx</sub>  -	TMR	16-bit on-delay T that counts down in 0.1-s decrements.
0.01-s TIMER	#ddddd - T xxx -	TMH (FNC49)	16-bit on-delay T that counts down in 0.01-s decrements.
1-ms TIMER	#ddddd - T xxx -	TMS (FNC51)	16-bit on-delay T that counts down in 1-ms decrements.
COUNTER	#ddddd 	С	Sets 16-bit up-counter.

# Application instructions

Instruction	Symbol	Mnemonic	Function
UP-DOWN COUNTER	-UDCxxx- -UP #ddddd -DW -RES	UDC (FNC52)	Sets a 16-bit up-down counter.
DIFFERENTIATE UP	nnnn   DIFU  -	DIFU (FNC10)	Turns ON R for 1 scan time at rising edge of input.
DIFFERENTIATE DOWN	nnnn   DIFD	DIFD (FNC09)	Turns ON R for 1 scan time at falling edge of input.
KEEP	KEEP- SET nnnn RES	KEEP (FNC22)	Turns ON R and holds this status when SET input is ON. Turns OFF R when RESET input is ON.
SHIFT	SFT— -UP nnnn -DW : -RES mmmm	SFT (FNC39)	Sets shift register.
HIGH SPEED	-HSP-nnnn	HSP (FNC18)	Reduces input relay time constant to 25 µs for higher input response.
MASTER CONTROL	MC	MC (FNC24)	Selects ON/OFF status of R coils, Ts, or Cs.
MASTER CONTROL RESET	-MCR	MCR (FNC25)	Represents end of MC.
MEMORY SWITCH	-[MEMSW]	MEMSW (FNC26)	Sets memory switches.
STAGE	nnnn - STG -	STG (FNC 44)	Executes instructions between STG & JMP when R (operand) is ON.

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### Application instructions

JUMP	nnnn — JMP —	JMP (FNC 21)	Turns current stage OFF and next stage ON when input is ON.
END STAGE	- ENDS -	ENDS (FNC 14)	Turns current stage OFF when input is ON.
NOP		NOP (FNC30)	Performs no operation.
END	-END	END	Indicates end of each routine of program.
END HI	-ENDH-	ENDH	Indicates end of entire program.

# Application instructions

Instruction	Mnemonic
STEP	STP
STEP END	STE
INTERVAL TIMER	ITVL
8 BIT COUNTER	CTH
8 BIT COUNTER COMPARATOR	CTC
SUBROUTINE CALL	CALL
SUBROUTINE ENTRY	SBN
SUBROUTINE RETURN	RET
REPEAT START	FOR
REPEAT END	NEXT
16 KEY INPUT	HKEY
WAIT ON	W-ON
WAIT OFF	W-OFF
WAIT UP EDGE	W-UE
WAIT DOWN EDGE	W-DE
CONNECT	CON
PUSH	MPS
READ	MRD
POP	MPP

### Interrupt instructions

INTERRUPT DISABLED	DI
INTERRUPT ENABLED	EI
INTERRUPT	INT
RETURN INTERRUPT	RETI

#### Arithmetic instructions

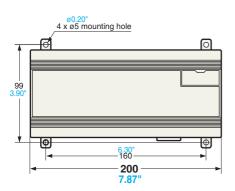
DATA MEMORY WRITE	DW
TRIMMER SETING	TMIN
LOAD A	LDA
STORE A	STA
COMPARE	CMP
ADD	ADD
SUBTRACT	SUB
MULTIPLY	MUL
DIVIDE	DIV
AND A	ANDA
OR A	ORA
EXCULSIVE OR A	EORA
SHIFT RIGHT A	SRA
SHIFT LEFT A	SLA
ROTATE RIGHT A	RRA
ROTATE LEFT A	RLA
COMPLEMENT	COM
INCREMENT MEMORY	INC
DECREMENT MEMORY	DEC
MULTIPLEXER	MPX
DEMULTIPLEXER	DMX
TRANSFER BCD	TBCD
TRANSFER BIN	TBIN
ASCII CONVERT	ASC
REVERSE ASCII CONVERT	RASC
SQUARE ROOT	ROOT

Differentiation instructions can be used for all arithmetic instructions other than DATA MEMORY WRITE.

**BUILT-IN DISPLAY** VISUAL KV ANALOG-I/O  $\mathsf{KL}$ COMPACT KV-300

#### **I Dimensions**

Basic units KV-80R/T

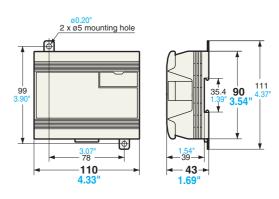


KV-40R/T

35.4 **90** 1.39" **3.54"** 4.37"

1.54" —39—►

-43→ 1.69"

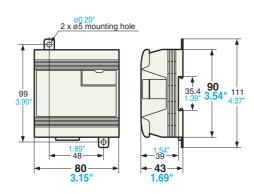


Unit: mm inch

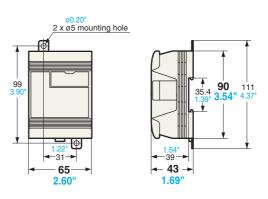
VISUAL KV

ANALOG-I/O KL

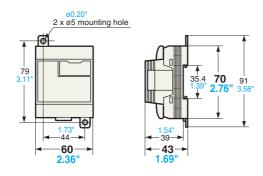
COMPACT KV-300 KV-24R/T



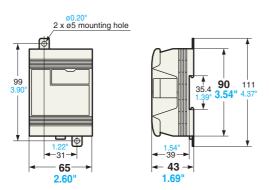
KV-16R/T



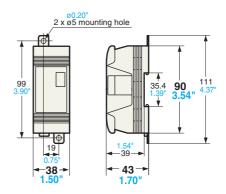
KV-10R/T



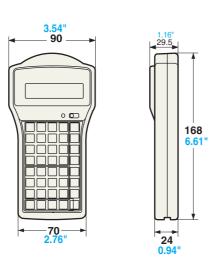
#### Expansion units KV-16EX/16EYR/T/AD4/DA4



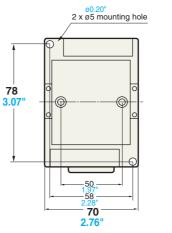
#### KV-8R/T/8EX/8EYR/T

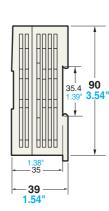


#### Handheld programmer KV-P3E



Power supplies KV-U2





# ANALOG-I/O $\mathsf{KL}$ COMPACT KV-300

BUILT-IN DISPLAY VISUAL KV

#### KV-U3

