KEYENCE

96M0364

User's Manual

Visual KV Series

1

Installation

How this manual is organized:

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

Safety Precautions

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

Symbols

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

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

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

Note: Provides additional information on proper operation.

Conventions

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

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

General Precautions

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

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

Note to User

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

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

Restriction on Acquiring the CE Marking

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

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

  XEB0101 0.1 μF-10 Ω manufactured by OKAYA DENKI SANGYO

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

  ZCAT3035-1330 manufactured by TDK

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

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

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

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

Features of the Visual KV Series

- **Extremely small**

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

- **Extremely fast**

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

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

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

- **Excellent Access Window**

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

- **User message setting function**

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

- **Program write in RUN mode**

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

- **Equipped with two serial ports**

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

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

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

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

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

- **Specified frequency pulse output function**

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

- **Frequency counter function**

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

- **Cam switch function**

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

- **Interrupt function**

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

- **Input time constant change function**

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

- **Double memory backup functions**

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

Compatibility with Conventional KV Series Peripheral Units

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

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

Cautions when using the previous version of ladder support software

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

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

⚠ CAUTION

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

Peripheral units and other units incompatible with the Visual KV Series

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

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

Cautions when Using the Serial Port

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

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

How this manual is organized

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

1 *Installation*

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

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

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

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

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

Describes the Access Window used for changing and monitoring data.

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

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

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

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

Chapter 6 **Handheld Programmer**

Describes how to use the handheld programmer and memory card.

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

Describes the serial interface modules for KV-300 Series.

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

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

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

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

Chapter 10 **Troubleshooting**

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

Appendices

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

2 *Support Software*

Chapter 1 **Introduction**

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

Chapter 2 **Editor**

Describes the operating procedures in Editor mode.

Chapter 3 **Simulator**

Describes the operating procedures in Simulator mode.

Chapter 4 **Monitor**

Describes the operating procedures in Monitor mode.

Appendices

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

3 *Programming*

Chapter 1 **Programming**

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

Chapter 2 **Instructions**

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

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

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

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

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

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

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

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

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

Chapter 7 **Serial Communication**

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

Chapter 8 **Programming Examples**

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

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Chapter 1 Programming

WARRANTIES AND DISCLAIMERS

See 1-419.

Caution

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Chapter 1

Configuration and Specifications

This chapter describes the system configuration of the Visual KV Series, the names and functions of each part, and the specifications.

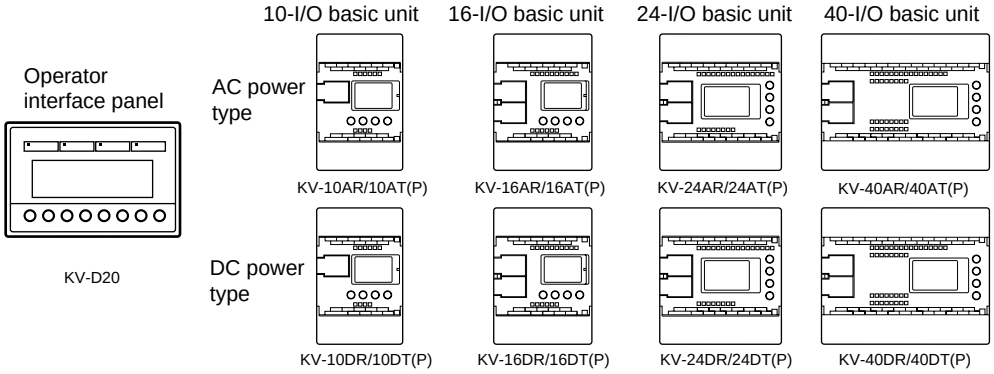
1.1 System Configuration

This section describes the Visual KV Series system configuration and each unit type.

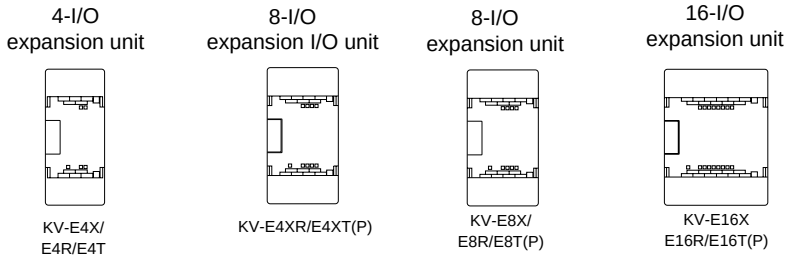
1.1.1 System Configuration

The Visual KV Series system has the following configuration.

■ Basic units: 16 types

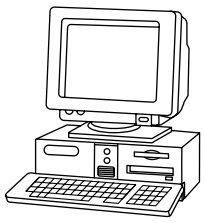


■ Expansion units: 11 types



➪ *For more about expanding the system by connecting expansion units, refer to "Connecting Visual KV Series Expansion Units" (p.1-71).*

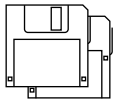
■ Conventional KV Series peripheral units



Personal computer
IBM PC/AT or compatible machine

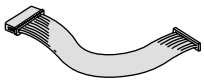
Z-1 Card reader/writer
* Available for the KV-H4E only

KV-P3E(01) Handheld programmer

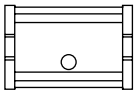


Programming support software
KV-H4E [KV IncrediWare (DOS)]
KV-H6WE2
(LADDER BUILDER for KV Ver.1.5)

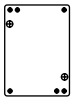
M2/M3 Memory card



Extension cable for expansion unit (300 mm)
For all expansion units
OP-35361



Expansion unit spacer
For 4-I/O expansion unit
OP-35342
For 8-I/O expansion unit
OP-35343
For 16-I/O expansion unit
OP-35344



Metal fixture for screw tightening
For 10-I/O basic unit OP-35345
For 16-I/O basic unit OP-35346
For 24-I/O basic unit OP-35347
For 40-I/O basic unit OP-35348
For 4- to 16-I/O expansion units
OP-35349

WARNING

When the ladder support software "KV IncrediWare (DOS)" or "LADDER BUILDER for KV Ver. 1.0x" is used, the Change All function on the monitor is not available. Using the Change All function may damage the basic unit. Never use the Change All function.

1.2 Specifications

This section describes the general specifications and performance specifications for the Visual KV Series units.

1.2.1 General Specifications

Item		Specifications				
Power supply		AC power type		DC power type		
		KV-10AR/AT(P) KV-24AR/AT(P)	KV-16AR/AT(P) KV-40AR/AT(P)	KV-10DR/DT(P) KV-24DR/DT(P)	KV-16DR/DT(P) KV-40DR/DT(P)	
Input supply voltage		100 to 240 VAC (±10%)		24 VDC (+10%, -20%)		
Allowable instantaneous time		Less than 40 ms		Less than 2 ms		
Internal current consumption (converted into 24 VDC value)	**Basic units**	KV-10AR/DR: 100 mA or less KV-16AR/DR: 120 mA or less KV-24AR/DR: 140 mA or less KV-40AR/DR: 180 mA or less KV-10AT/DT: 80 mA or less KV-16AT/DT: 90 mA or less		KV-24AT/DT: 100 mA or less KV-40AT/DT: 120 mA or less KV-10ATP/DTP: 85 mA or less KV-16ATP/DTP: 100 mA or less KV-24ATP/DTP: 105 mA or less KV-40ATP/DTP: 130 mA or less		
	Expansion units	KV-E4X: 15 mA or less KV-E4T: 20 mA or less KV-E4R: 40 mA or less KV-E4XT(P): 30 mA or less	KV-E8X: 25 mA or less KV-E8T(P): 40 mA or less KV-E8R: 70 mA or less KV-E4XR: 45 mA or less	KV-E16X: 35 mA or less KV-E16T: 60 mA or less KV-E16R: 110 mA or less KV-E16TP: 70 mA or less		
	Others	KV-D20 Operator interface panel: 60 mA or less KV-P3E(01) Handheld programmer: 65 mA or less				
Maximum load current consumption		KV-10DR: 745 mA*1 KV-10DT: 725 mA*1 KV-10DTP: 730 mA*1 KV-16DR: 765 mA*1 KV-16DT: 735 mA*1 KV-16DTP: 745 mA*1	KV-24DR: 785 mA*1 KV-24DT: 745 mA*1 KV-24DTP: 750 mA*1 KV-40DR: 790 mA*2 KV-40DT: 730 mA*2 KV-40DTP: 740 mA*2	KV-10AR/AT(P): 0.4 A KV-16AR/AT(P): 0.5 A KV-24AR/AT(P): 0.6 A KV-40AR/AT(P): 0.7 A		
Ambient temperature (No freezing)		0 to +50°C (32 to 122° F), 0 to +45°C (32 to 113° F)[KV-P3E(01)]				
Relative humidity		35 to 85%, No condensation				
Ambient storage temperature		-20 to +70°C (-4 to 158° F), No freezing				
Withstand voltage		1,500 VAC for 1 minute (Between power terminal and I/O terminals as well as between entire external terminals and case)				
Noise immunity		1,500 Vp-p or more, pulse width: 1 µs, 50 ns (by noise simulator) In conformance with EN standard (EN61000-4-2/-3/-4/-6)				
Shock		150 m/s^2 (150 G), working time: 11 ms, twice in each of X, Y and Z axis directions				
Vibration		10 to 55 Hz, double amplitude: 1.5 mm or less, 2 hours in each of X, Y and Z axis directions (1 G or less when attached to DIN rail)				
Insulation resistance		50 MΩ or more (Between power terminal and I/O terminals as well as between entire external terminals and case by 500 VDC megohmmeter)				
Operating atmosphere		No excessive dust or corrosive gases allowed.				
Weight	**Basic units**	KV-10AR: Approx. 250 g KV-16DR: Approx. 190 g KV-40AR: Approx. 450 g KV-10DT(P): Approx. 140 g KV-24AT(P): Approx. 330 g KV-40DT(P): Approx. 280 g	KV-10DR: Approx. 150 g KV-24AR: Approx. 350 g KV-40DR: Approx. 330 g KV-16AT(P): Approx. 280 g KV-24DT(P): Approx. 210 g	KV-16AR: Approx. 300 g KV-24DR: Approx. 240 g KV-10AT(P): Approx. 240 g KV-16DT(P): Approx. 180 g KV-40AT(P): Approx. 410 g		
	Expansion units	KV-E4X: Approx. 80 g KV-E4T: Approx. 80 g KV-E4R: Approx. 100 g KV-E4XT(P): Approx. 100 g	KV-E8X: Approx. 100 g KV-E8T(P): Approx. 100 g KV-E8R: Approx. 130 g KV-E4XR: Approx. 120 g	KV-E16X: Approx. 130 g KV-E16T(P): Approx. 130 g KV-E16R: Approx. 130 g		
	Others	KV-P3E(01): Approx. 230 g	KV-D20: Approx. 160 g			

*1. Configured with KV-E16R (x4), KV-E16X (x4) and KV-P3E(01).
*2. Configured with KV-E16R (x4), KV-E16X (x3) and KV-P3E(01).

1.2.2 AC Power Specifications

Item	Specifications
Method	Switching method
Ripple noise	240 mVp-p or less
AC power current consumption	KV-10Ax: 0.4 A KV-16Ax: 0.5 A KV-24Ax: 0.6 A KV-40Ax: 0.7 A
AC power input voltage	100 to 240 VAC (±10%)
AC power factor	60%
Output voltage [1.]	24 VDC±10%
Output capacity	KV-10Ax: 0.4 A KV-16Ax: 0.6 A KV-24Ax: 0.6 A KV-40Ax: 0.7 A
Power consumption	KV-10Ax: 14 W KV-16Ax: 21 W KV-24Ax: 21W KV-40Ax: 24 W
Used fuse	Rated voltage: 240 VAC, rated current: 3.15 A, Characteristics: Fast-melting type

1. Includes the internal current consumption and current consumption of expansion units.

Note: The maximum output capacity available with the AC type service power output is the output capacity of each basic unit subtracted by the internal current consumption of the basic unit, connected expansion units, and connected peripheral units.

Visual KV Series operation at power interruption

■ **Drop in supply voltage**

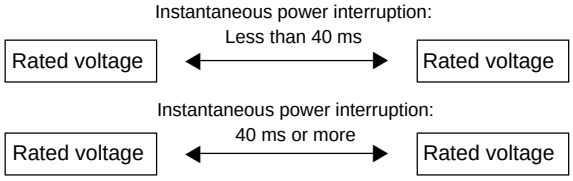
When the supply voltage drops, the Visual KV Series stops operating and the output turns off.

■ **Detection of instantaneous power interruption**

- An AC type basic unit continues operating against instantaneous power interruption of less than 40 ms. A DC type basic unit continues operating against instantaneous power interruption of less than 2 ms.
- An AC type basic unit may or may not accept instantaneous power interruption of 40 ms or more. A DC type basic unit may or may not accept instantaneous power interruption of 2 ms or more.
- When accepting instantaneous power interruption, a basic unit stops operating and the output turns off.

■ **Automatic recovery**

- Once the supply voltage recovers, the Visual KV Series restarts operation automatically.



Note: If the supply voltage increases gradually or drops, the Visual KV Series may repeat operation and then stop. If problems continue to occur with equipment and other operations from repetitive starts and stops, provide a protection circuit so that the output shuts down until the voltage reaches the rated value.

■ **Time until start of operation**

- The time period from when the power is turned on until operation starts varies depending on the conditions, including the supply voltage, system configuration, and operating environment. The minimum time is approximately 1.2 ms.
- When a user program is changed, it will be saved in the EEPROM when the power is next turned on. Therefore, in such a case, the time period from when the power is turned on until operation starts is longer than usual.

1.2.3 Performance Specifications

Item		Specifications	
Arithmetic operation control method		Stored program method	
I/O control method		Refresh method	
Program language		Ladder chart method + Expanded ladder method	
Instruction types		Basic instruction: 28 types	Application instruction: 22 types
		Arithmetic instruction: 26 types	Interrupt instruction: 4 types
Minimum scan time		140 µs	
Instruction processing speed		Basic instruction: 0.7 µs	
		Application instruction: 6.4 µs	
Program capacity		2,000 steps (KV-10xx, KV-16xx)	
		4,000 steps (KV-24xx, KV-40xx)	
Maximum number of connected expansion units		8 (7 for KV-40xx)	
Number of I/O points (including 10 to 40 I/O points of basic unit)		10 to 152 (when maximum number of expansion units are connected)	
Internal utility relay		2,304: 1000 to 1915 and 3000 to 17915	
Special utility relay		160: 2000 to 2915	
Data memory (16 bits)		2,000 words: DM 0000 to DM1999	
Temporary data memory (16 bits)		32 words: TM00 to TM31	
Timer/counter		250 in all: 0.1-sec timer: TMR (0 to 6553.5 secs) 0.01-sec timer: TMH (0 to 655.35 secs) 0.001-sec timer: TMS (0 to 65.535 secs) UP counter: C Up/down counter: UDC	
Digital trimmer		2 (set in Access Window)	
High-speed counter		2 of 30 kHz, 2-phase high-speed counter (0 to 65535 count)[1]	
High-speed counter comparator		4 (2 for each high-speed counter) Direct output is enabled.	
Positioning control function		Independent 1 axis, 50 kHz maximum	
Memory switches		16	
Data Backup function against instantaneous power interruption	**Program memory**	EEPROM which can be overwritten 100,000 times or more	
	Data memory, counter, internal utility relay, and contact comment (Held devices are set by the MEMSW instruction.)	Can be backed up with electrical double-layer capacitor for 20 days or more at 25° C: KV-10AR/AT(P)/DR/DT(P) for 2 months or more at 25° C (77° F): Any other model Can be backed up with EEPROM in all models.	
Self-diagnosis		CPU and RAM errors	
Peripherals		Handheld programmer	KV-P3E(01) [2]
		Memory card	M-2/M-3
		Card reader/writer	Z-1 [3]
		Programming support software	LADDER BUILDER for KV (Windows version) [4] (KV-H6WE2) KV IncrediWare (DOS) (KV-H4E)
Number of contact comments stroable		1,000 max.	

1. When high-speed counters are set using the MEMSW instruction, 24-bit data can be counted.
2. Comments cannot be handled in the handheld programmer KV-P3E(01).
3. The card reader/writer Z-1 can be used with the programming support software "KV IncrediWare (DOS)".
4. When the programming support software "LADDER BUILDER for KV Ver. 1.0x" is used, the Change All function on the monitor is not available. Using the Change All function may damage the basic unit. Never use the Change All function.

Data backup function against instantaneous power interruption

■ Electrical double-layer capacitor built into the basic unit

Contents of data memories, current values of counters, and the contents of internal utility relays in a Visual KV Series basic unit are saved in RAM backed up with an electrical double-layer capacitor built into the Visual KV Series basic unit by the Data backup function against instantaneous power interruption.

The backup time varies depending on the ambient temperature.

If power to the Visual KV Series basic unit remains OFF for more than the holding time by the RAM, the data may be cleared or become corrupted.

To avoid the data being cleared, save the data in the EEPROM using the backup function to the EEPROM.

➪ *For writing to and reading from the EEPROM, refer to "LOAD mode and SAVE mode" (p.1-96).*

When a user program is written, it is saved in RAM. The next time the power is turned on, the user program is automatically transferred from RAM to the EEPROM and is also saved in the EEPROM. If power to the Visual KV Series basic unit will remain OFF for more than the backup time by the RAM, turn the power off immediately after writing a user program, and then turn the power on again so that the user program is transferred to the EEPROM.

- **Data backup function by electrical double-layer capacitor built into the basic unit**

  Visual KV Series: 2 months or more at 25°C (77°F)
  (20 days or more at 25°C (77°F) in KV-10xx)

■ EEPROM

The Visual KV Series basic unit is equipped with a backup function to save programs, contents of data memories, current values of counters, etc. in the EEPROM.

Even if the power is interrupted or power to the Visual KV Series basic unit remains OFF, the data is still saved. When the power turns ON again, the contents of the EEPROM is automatically read. (The contents of data memories and current values of counters should be read by manipulating the Access Window.)

When data is changed and the power is turned off without saving the changed data, the changes are saved only in the built-in electrical double-layer capacitor and are not saved in the EEPROM.

If the Visual KV Series basic unit remains OFF for 2 months or more at 25°C (77°F) (20 days or more at 25°C (77°F) in KV-10xx) while the data is backed up only with the built-in electrical double-layer capacitor, the saved contents may be cleared or become corrupted.

If the Visual KV Series basic unit will remain OFF for a long period of time, save the data in the EEPROM.

➪ *Refer to "LOAD mode and SAVE mode" (p.1-96).*

- **Data backup function with the EEPROM**

  Visual KV Series: 10 years or more at 25°C (77°F)
  (available number of overwrites: 100,000 times or more)

1.3 Common I/O Specifications of Basic Units

This section describes the common I/O specifications of Visual KV Series basic units. There are two types of basic units, AC power type and DC power type. Two types of output types are offered: relay output and transistor output.

1.3.1 Model of a Basic Unit

■ Basic unit model designation

The model of a Visual KV Series basic unit is indicated as follows:

KV-10AR

- **Output type:** R = relay output, T = transistor output
- **Power supply type:** A = AC power type, D = DC power type
- **Number of I/O points:** 10 = 10 points, 16 = 16 points, 24 = 24 points, 40 = 40 points

■ Unit type

The following four types of Visual KV Series basic units are offered:

AC power/relay output type: KV-10AR/16AR/24AR/40AR
AC power/transistor output type: KV-10AT(P)/16AT(P)/24AT(P)/40AT(P)
DC power/relay output type: KV-10DR/16DR/24DR/40DR
DC power/transistor output type: KV-10DT(P)/16DT(P)/24DT(P)/40DT(P)

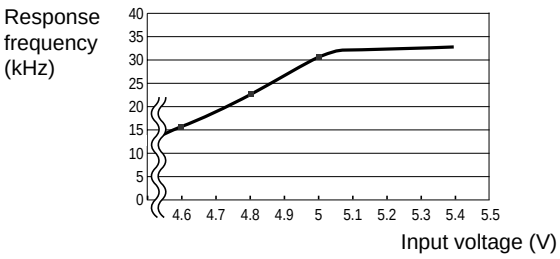
1.3.2 Common I/O Specifications

■ Input specifications

Item	24 V mode	5 V mode (Inputs 000 to 007 can be changed to 5 V input.)
Maximum input rating	26.4 VDC	
Input voltage	24 VDC, 5.3 mA	5 VDC, 1.0 mA
Minimum ON voltage	19V	4.5V
Minimum OFF current (voltage)	2mA	2.5V
Common method	COM is shared inside.	
Input time constant	10 ms typical 10 μs when HSP instruction is used Variable in 7 steps from 10 μs to 10 ms while special utility relay 2813 is ON (Set by DM1940)	
Interrupt input response	10 μs (representative)	
High-speed counter input response	30 kHz (24V±10%) (duty: 50%)	

* For 5V±10%, refer to the 5 V mode response frequency characteristic chart (representative example).

5 V mode response frequency characteristic chart (representative example)



■ **Output specifications (relay output): KV-10AR/DR, KV-16AR/DR, KV-24AR/DR, and KV-40AR/DR**

Item	Specifications
Rated load	250 VAC/30 VDC 2 A (inductive load) 4 A (resistive load)
Peak load current	5A
Rising operating time (OFF → ON)	10 ms or less
Falling operating time (ON → OFF)	10 ms or less
Common method	Each common terminal is independent.
Relay service life	Electrical service life: 100,000 times or more (20 times/min) Mechanical service life: 20,000,000 times or more
Relay replacement	Not allowed

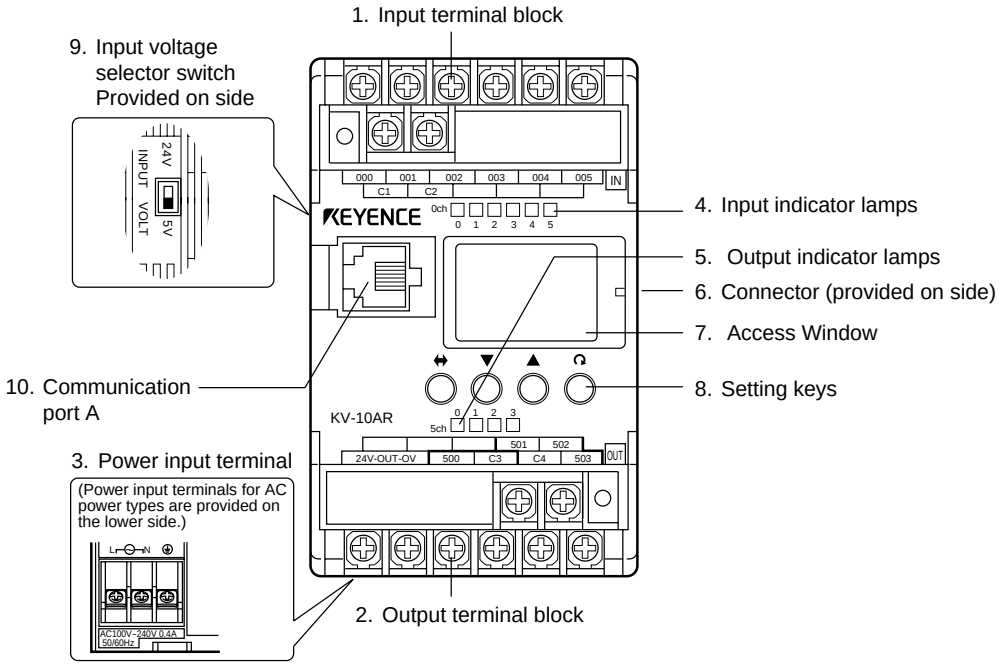
■ **Output specifications (transistor output): KV-10AT(P)/DT(P), KV-16AT(P)/DT(P), KV-24AT(P)/DT(P), and KV-40AT(P)/DT(P)**

Item	Specifications
Rated load	30 VDC 0.1 A (500 to 502) 0.3 A (others)
Peak load current	0.2 A (500 to 502) 1 A (others)
Maximum voltage at OFF	30 VDC
Leak current in OFF status	100 μA or less
Residual voltage in ON status	0.8 V or less
Rising operation time (OFF → ON)	10 μs or less (500 to 502) (at 5 to 100 mA) 20 μs or less (others) (at 10 to 300 mA)
Falling operation time (ON → OFF)	10 μs or less (500 to 502) (at 5 to 100 mA) 100 μs or less (others) (at 10 to 300 mA)
Common method	1 common
Output frequency	50 kHz (500 to 502)
Built-in serial resistance	1.6 KΩ 1/2W (R500 to R502)

1.4 KV-10AR/AT(P)/DR/DT(P) (10-I/O Basic Unit)

This section describes the name and function of each part, the I/O specifications, the terminal layout, circuit diagrams, and dimensions of the KV-10xx.

1.4.1 Part Names and Functions



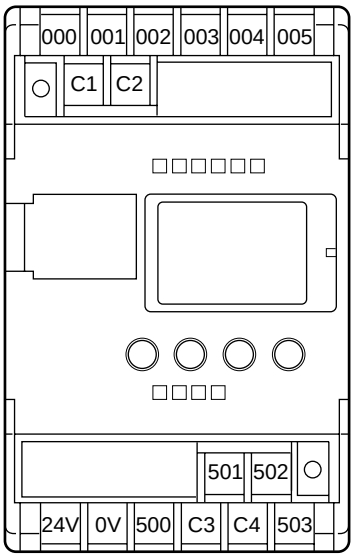
No.	Name	Function
1	**Input terminal block**	24 VDC input terminal block (000 to 005 can be changed to 5 V input).
2	**Output terminal block**	Output terminal block. Pulse output function is built in 500 to 502 (in transistor output type only). A 1.6 kΩ current limiting resistor is built in R502 (to connect a motor driver).
3	**Power input terminal (KV-10DR/DT(P))**	Supplies 24 VDC.
	Power output terminal (KV-10AR/AT(P))	Supplies 100 to 240 VAC to the power input terminals on the lower side of the unit, and allows the service power supply to be taken from the 24 VDC terminal.
4	**Input indicator lamps**	Indicate input status. Each lamp lights up at ON.
5	**Output indicator lamps**	Indicate output status. Each lamp lights up at ON.
6	**Connector (provided on side)**	Used to connect an expansion unit
7	**Access Window**	Used to refer to and change the current and set values of timers and counters as well as the contents of data memories. The backlight color indicates the operation status. Lit in green: RUN mode Lit in red: PROGRAM mode Flashing red: Error status
8	**Setting keys**	Used to refer to and change current values, etc. while referring to the Access Window.
9	**Input voltage selector switch**	Changes the input voltage of the basic unit. ■□ : 24 V input □■ : 5 V input
10	**Communication port A**	RJ-11 Modular connector for connecting a personal computer, handheld programmer, or operator interface panel.

☞ *For more about the Access Window, refer to "Chapter 3. Access Window" (p.1-79).*

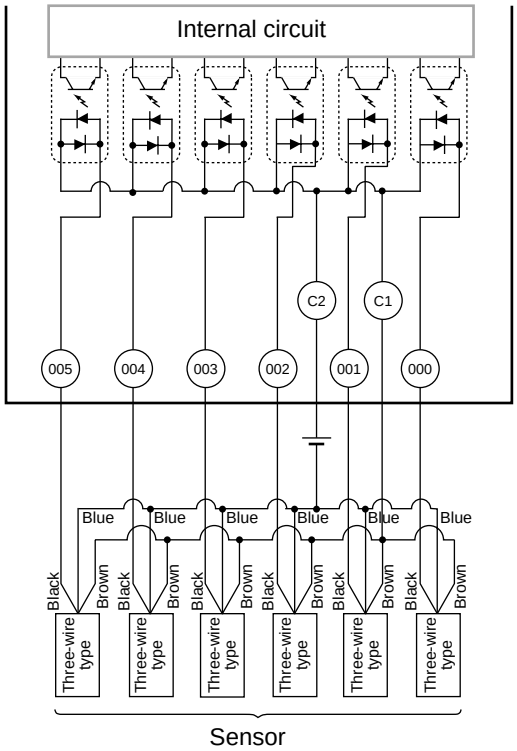
1.4.2 Terminal Layout Drawings and I/O Circuit Diagrams

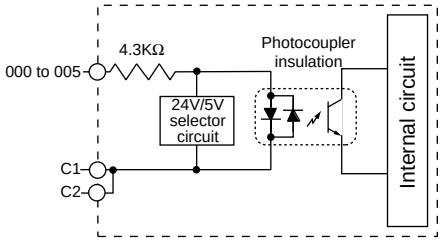
KV-10AR/DR (Relay output type)

■ Terminal layout drawing

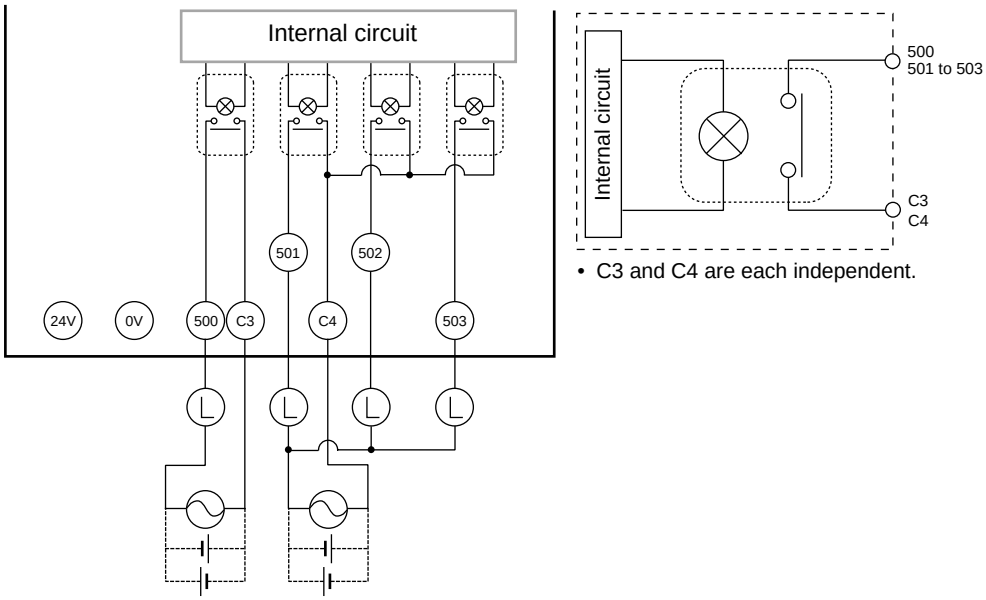


■ Input circuit diagram





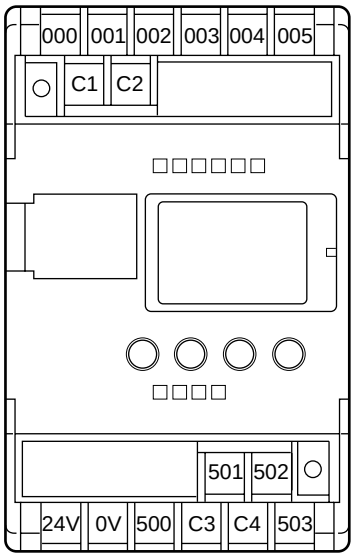
■ **Output circuit diagram**



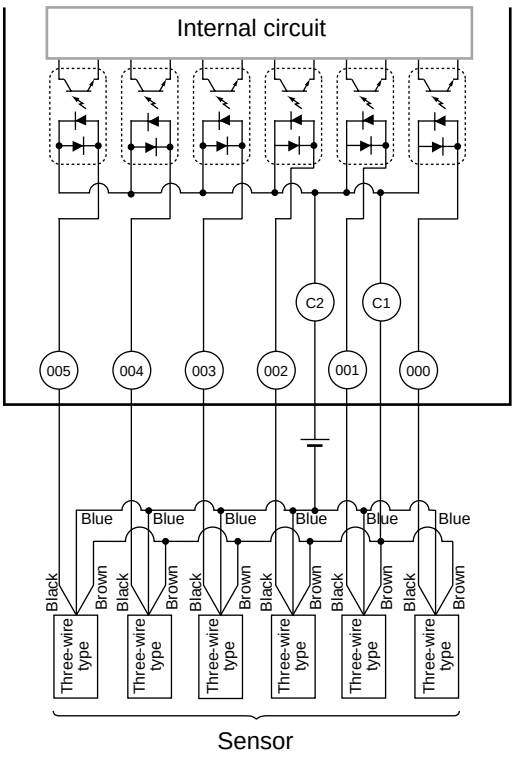
• C3 and C4 are each independent.

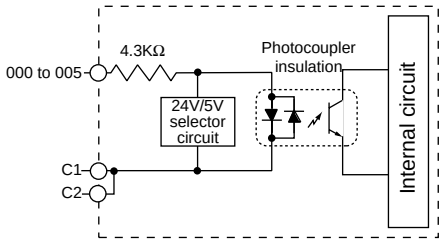
KV-10AT(P)/DT(P) (Transistor output type)

■ Terminal layout drawing

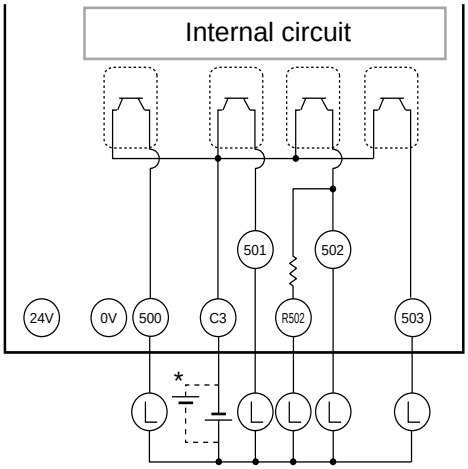


■ Input circuit diagram



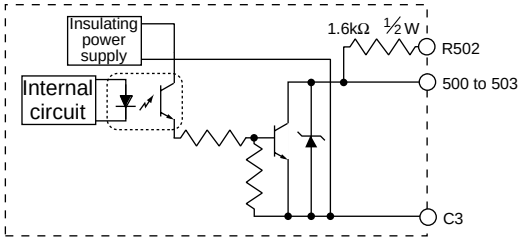


■ **Output circuit diagram**



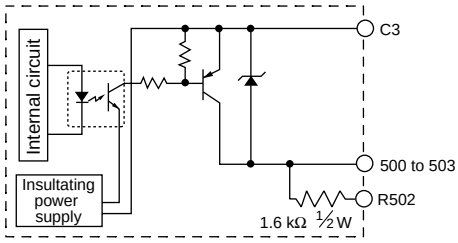
* For KV-10ATP/DTP

NPN



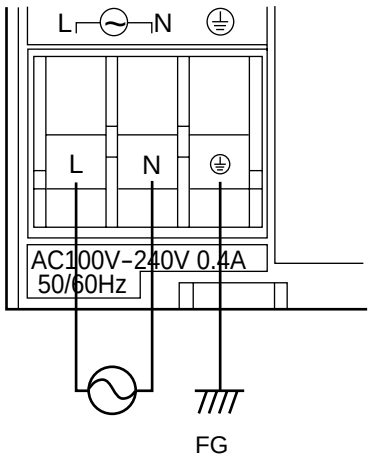
• 1.6 kΩ current limiting resistor is built in R502 (to connect a motor driver).

PNP



• 1.6 kΩ current limiting resistor is built in R502 (to connect a motor driver).

1.4.3 AC Power Input (KV-10AR/AT(P))



FG

1.4.4 Relationship between Continuous Simultaneous ON Ratio and Ambient Temperature

CAUTION

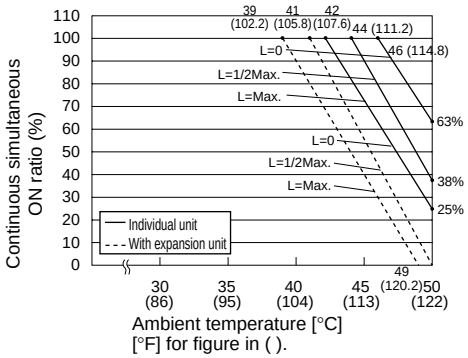
If the number of I/O points which turn ON at the same time exceeds the specifications range, the unit may be damaged.

The graphs below show the relationship between the ambient temperature and the continuous simultaneous ON ratio.

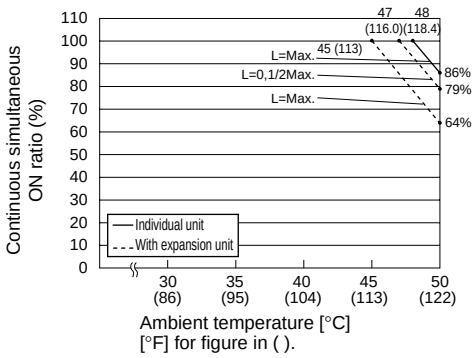
Load current L:

(AC power output capacity at 400 mA) − (Individual current consumption when KV-D20 is connected) = (Service power output current) + (Expansion unit current consumption)

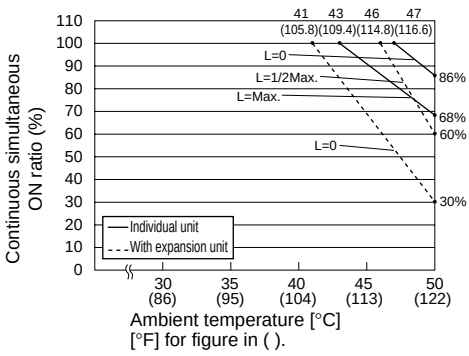
Derating when KV-10AR is mounted upward



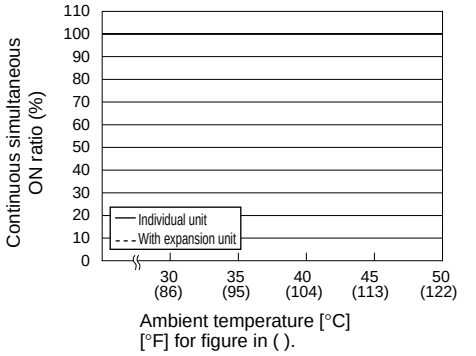
Derating when KV-10AR is mounted in front



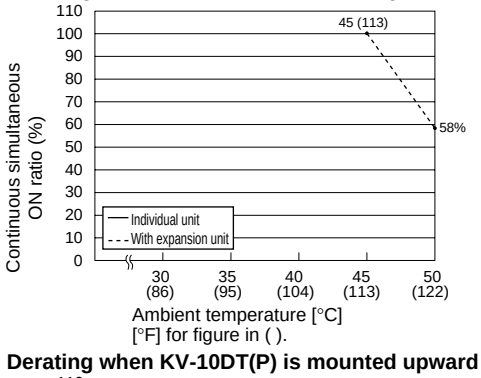
Derating when KV-10AT(P) is mounted upward



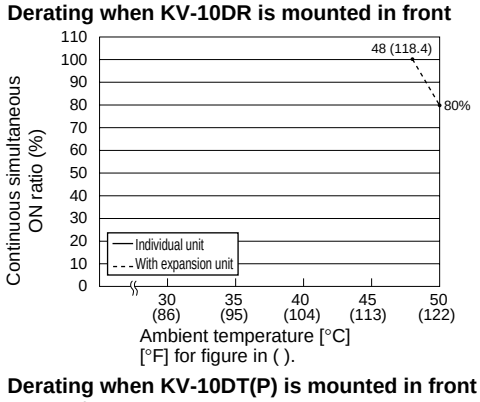
Derating when KV-10AT(P) is mounted in front



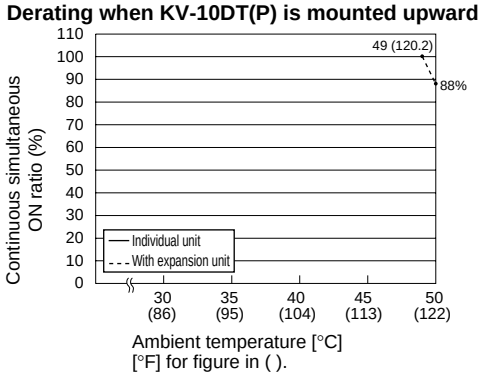
Derating when KV-10DR is mounted upward



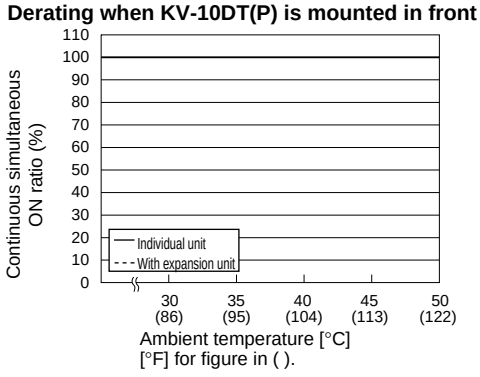
Derating when KV-10DR is mounted in front



Derating when KV-10DT(P) is mounted upward

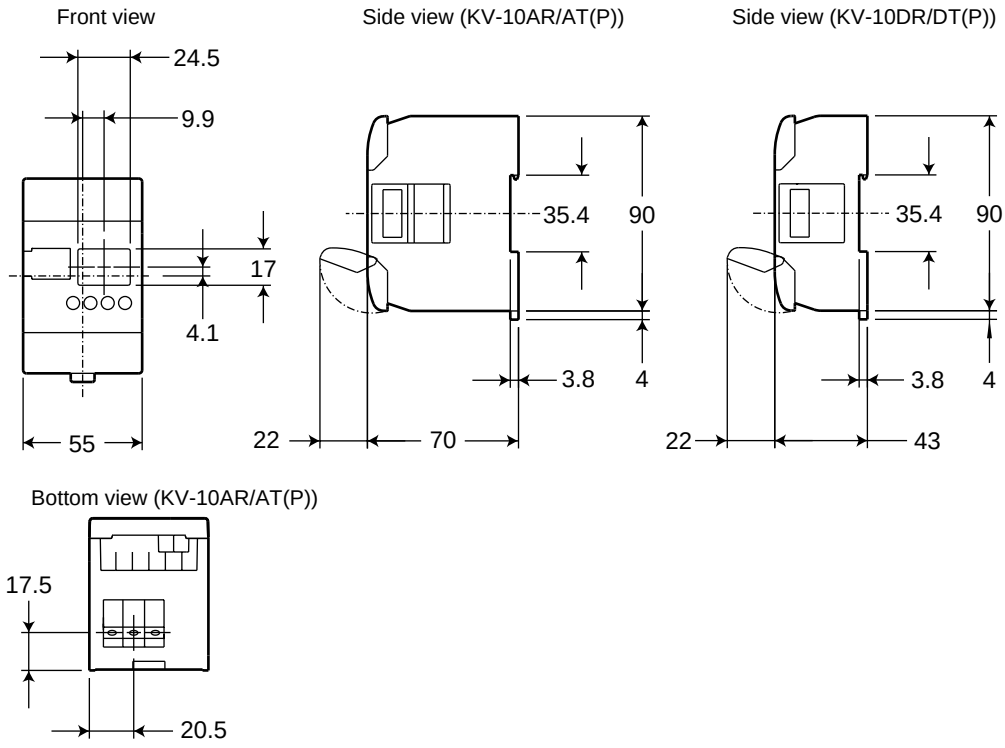


Derating when KV-10DT(P) is mounted in front

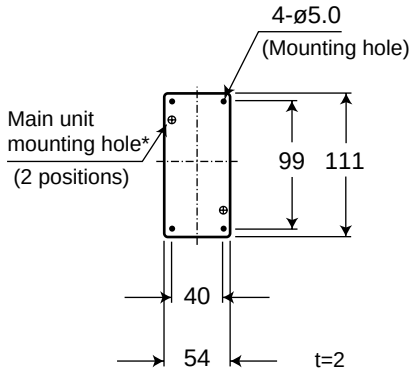


1.4.5 Dimensions

■ Main unit



■ Metal fixture for screw tightening

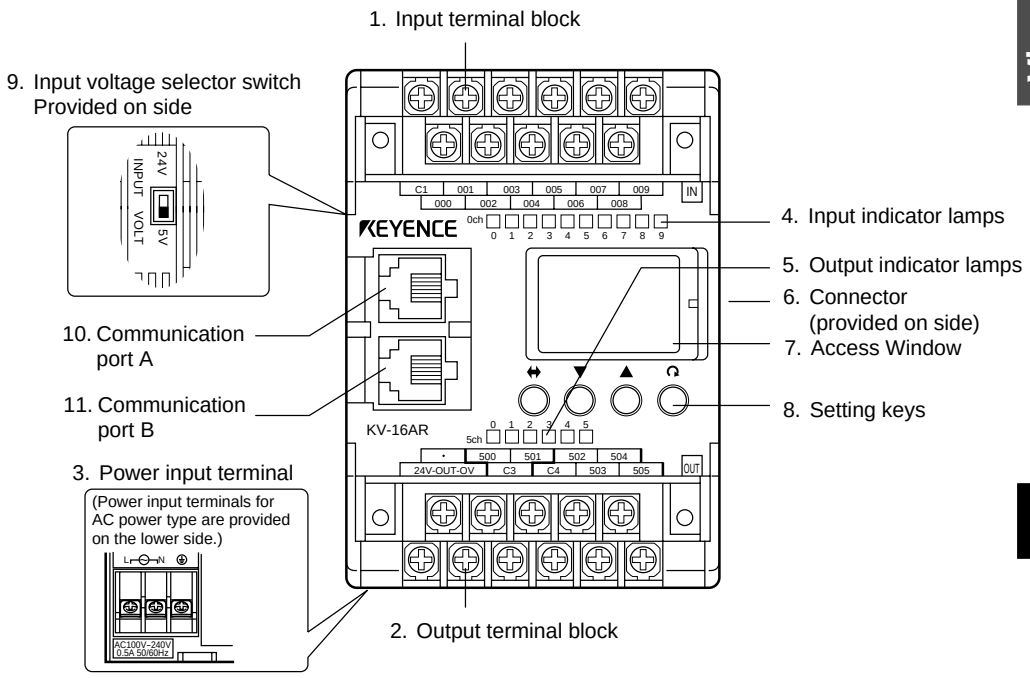


* Two M3.5 countersunk-head screws are included for mounting the main unit.

1.5 KV-16AR/AT(P)/DR/DT(P) (16-I/O Basic Unit)

This section describes the name and function of each part, the I/O specifications, the terminal layout, circuit diagrams, and dimensions of the KV-16xx.

1.5.1 Part Names and Functions



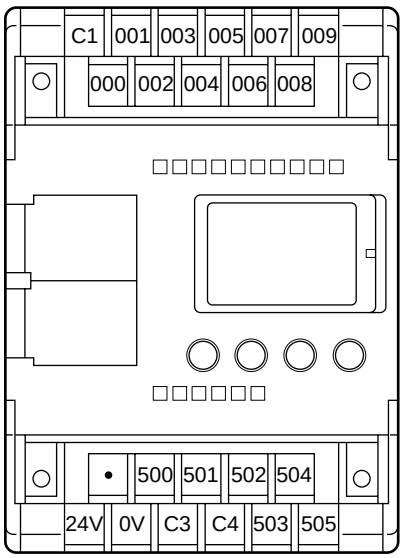
No.	Name	Function
1	**Input terminal block**	24 VDC input terminal block (000 to 007 can be changed to 5 V input).
2	**Output terminal block**	Output terminal block. Pulse output function is built in 500 to 502 (in transistor output type only). A 1.6 kΩ current limiting resistor is built in R502 (to connect a motor driver).
3	**Power input terminal (KV-24DR/DT(P))**	Supplies 24 VDC.
	Power output terminal (KV-24AR/AT(P))	Supplies 100 to 240 VAC to the power input terminals on the lower side of the unit, and allows the service power supply to be taken from the 24 VDC terminal.
4	**Input indicator lamps**	Indicate input status. Each lamp lights up at ON.
5	**Output indicator lamps**	Indicate output status. Each lamp lights up at ON.
6	**Connector (provided on side)**	Used to connect an expansion unit
7	**Access Window**	Used to refer to and change the current and set values of timers and counters as well as the contents of data memories. The backlight color indicates the operation status. Lit in green: RUN mode Lit in red: PROGRAM mode Flashing red: Error status
8	**Setting keys**	Used to refer to and change current values, etc. while referring to the Access Window.
9	**Input voltage selector switch**	Changes the input voltage of the basic unit. ■□ : 24 V input □■ : 5 V input
10	**Communication port A**	RJ-11 Modular connector for connecting a personal computer, handheld programmer, or operator interface panel.
11	**Communication port B**	RJ-11 Modular connector for connecting a personal computer, handheld programmer, or operator interface panel.

➪ *For more about the Access Window, refer to "Chapter 3. Access Window" (p.1-79).*

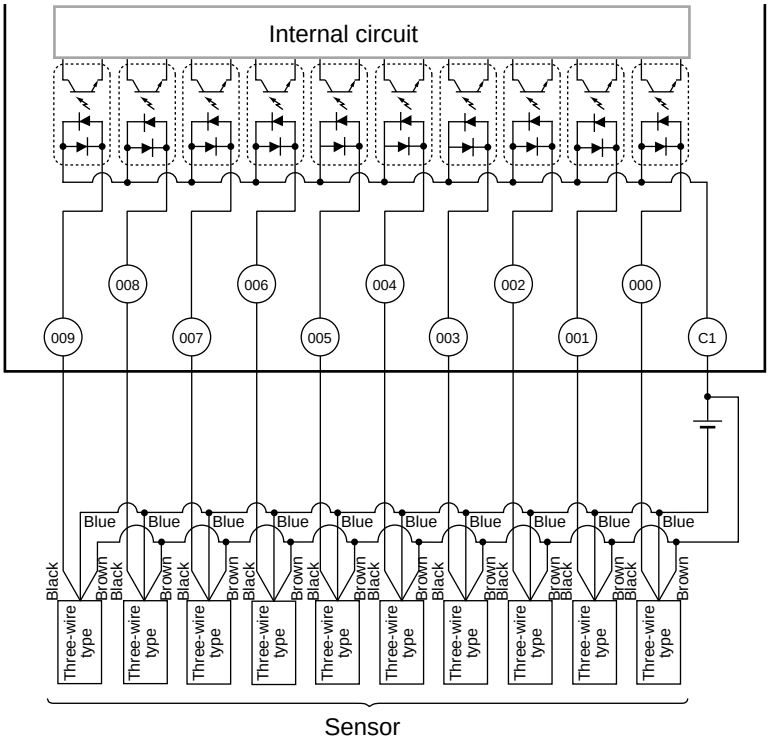
1.5.2 Terminal Layout Drawings and I/O Circuit Diagrams

KV-16AR/DR (Relay output type)

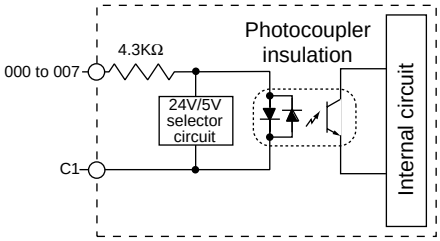
■ **Terminal layout drawing**



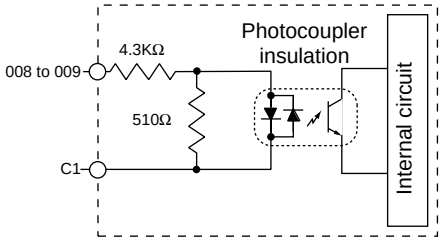
■ **Input circuit diagram**



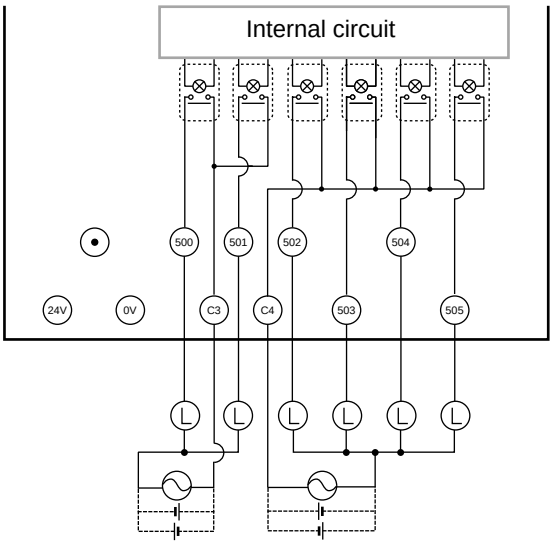
Circuit configuration of inputs 000 to 007

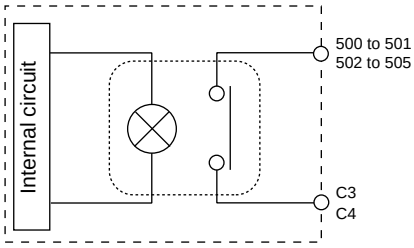


Circuit configuration of inputs 008 to 009



■ Output circuit diagram

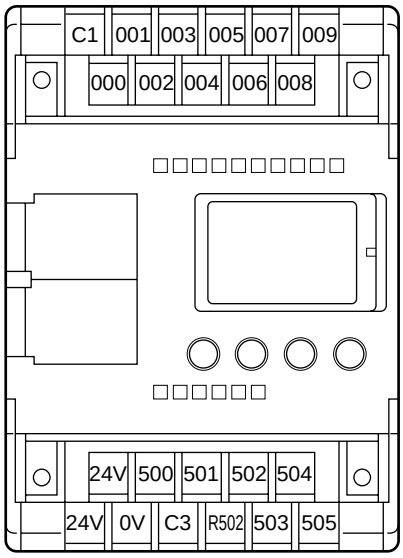




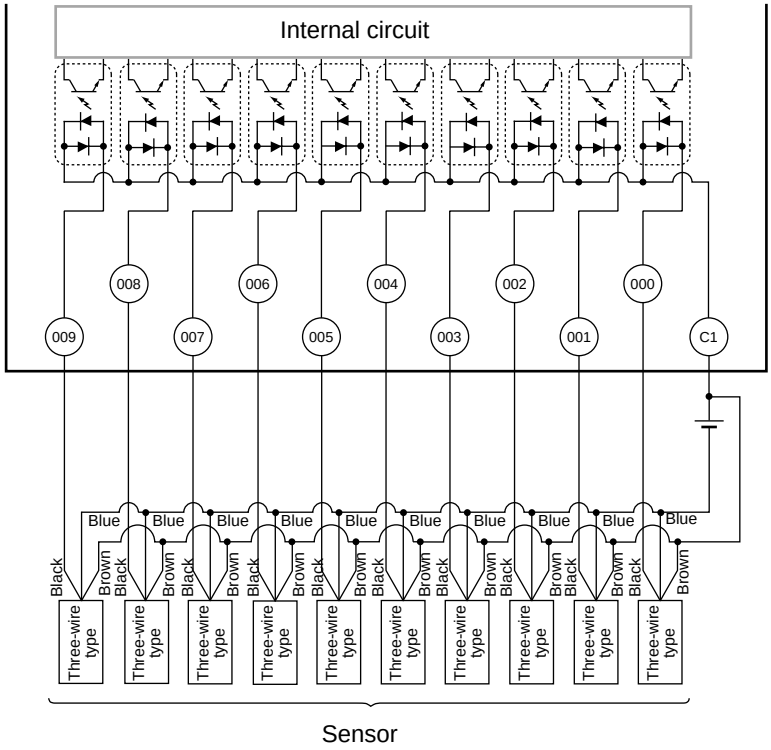
• C3 and C4 are each independent.

KV-16AT(P)/DT(P) (Transistor output type)

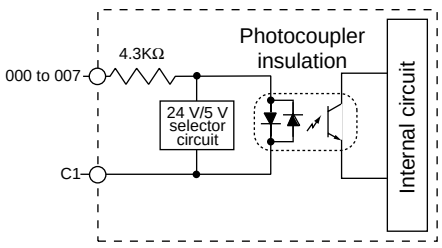
■ Terminal layout drawing



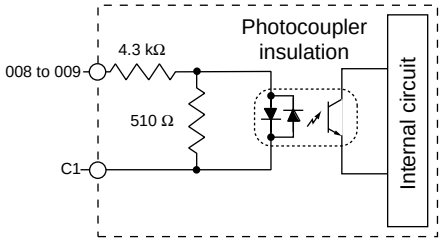
■ Input circuit diagram



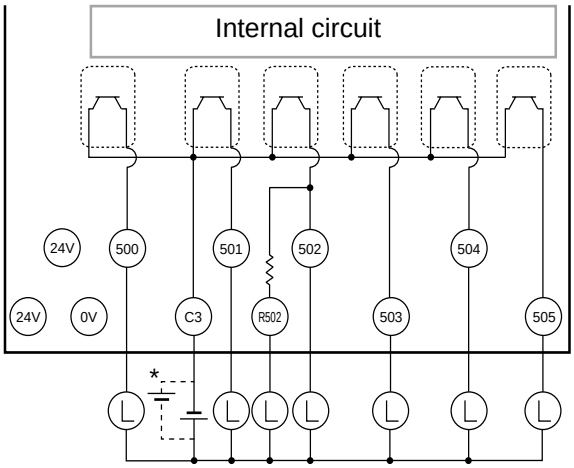
Circuit configuration of inputs 000 to 007



Circuit configuration of inputs 008 to 009

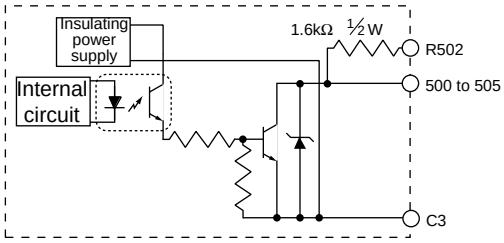


■ **Output circuit diagram**



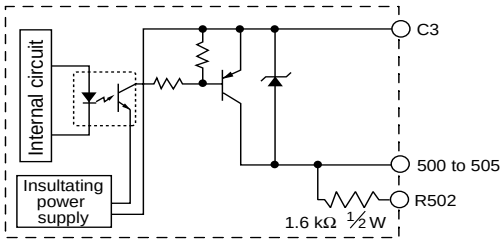
* For KV-16ATP/DTP

NPN



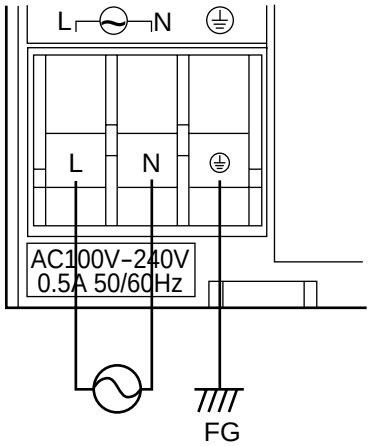
• A current limiting resistor 1.6 kΩ is built in R502 (to connect a motor driver).

PNP



• A current limiting resistor 1.6 kΩ is built in R502 (to connect a motor driver).

1.5.3 AC Power Input (KV-16AR/AT(P))



1.5.4 Relationship between Continuous Simultaneous ON Ratio and Ambient Temperature

CAUTION

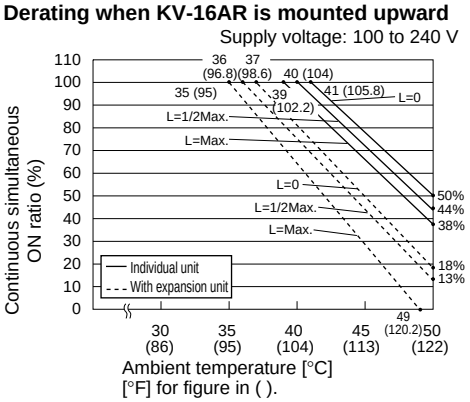
If the number of I/O points which turn ON at the same time exceeds the specifications range, the unit may be damaged.

The graphs below show the relationship between the ambient temperature and the continuous simultaneous ON ratio.

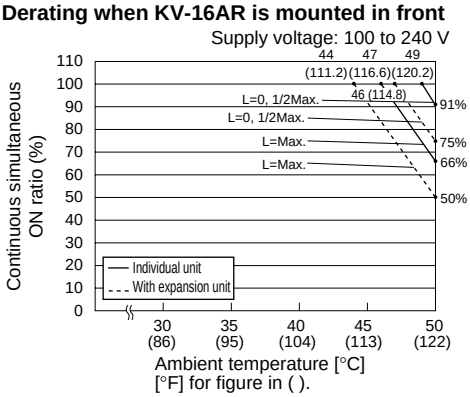
Load current L:

(AC power output capacity at 600 mA) − (Individual current consumption when KV-D20 is connected) = (Service power output current) + (Expansion unit current consumption)

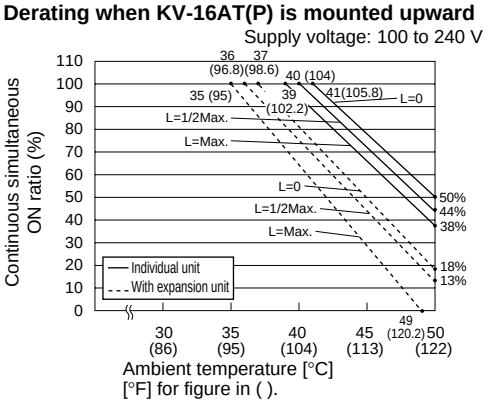
Derating when KV-16AR is mounted upward



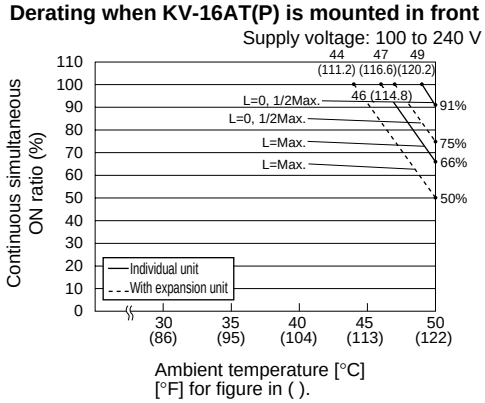
Derating when KV-16AR is mounted in front



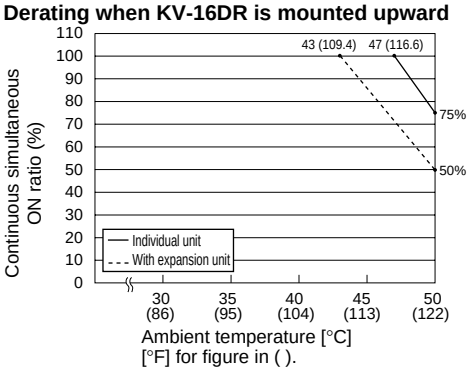
Derating when KV-16AT(P) is mounted upward



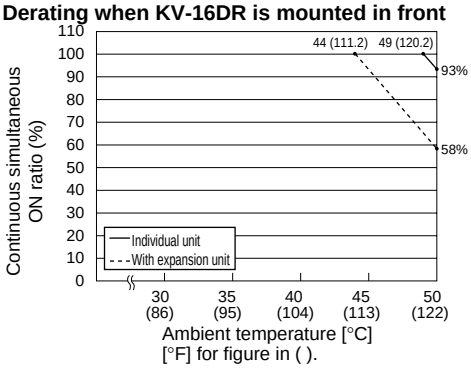
Derating when KV-16AT(P) is mounted in front



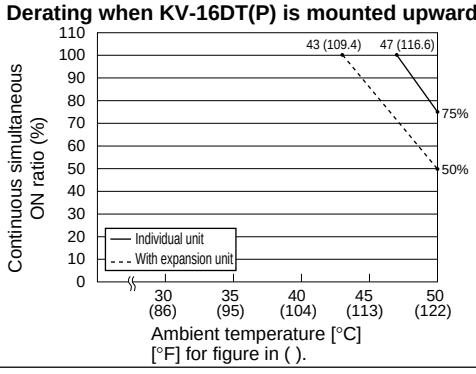
Derating when KV-16DR is mounted upward



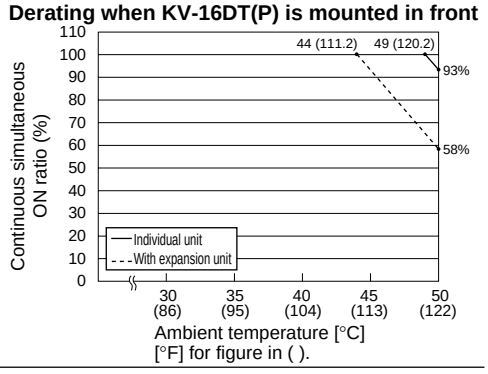
Derating when KV-16DR is mounted in front



Derating when KV-16DT(P) is mounted upward

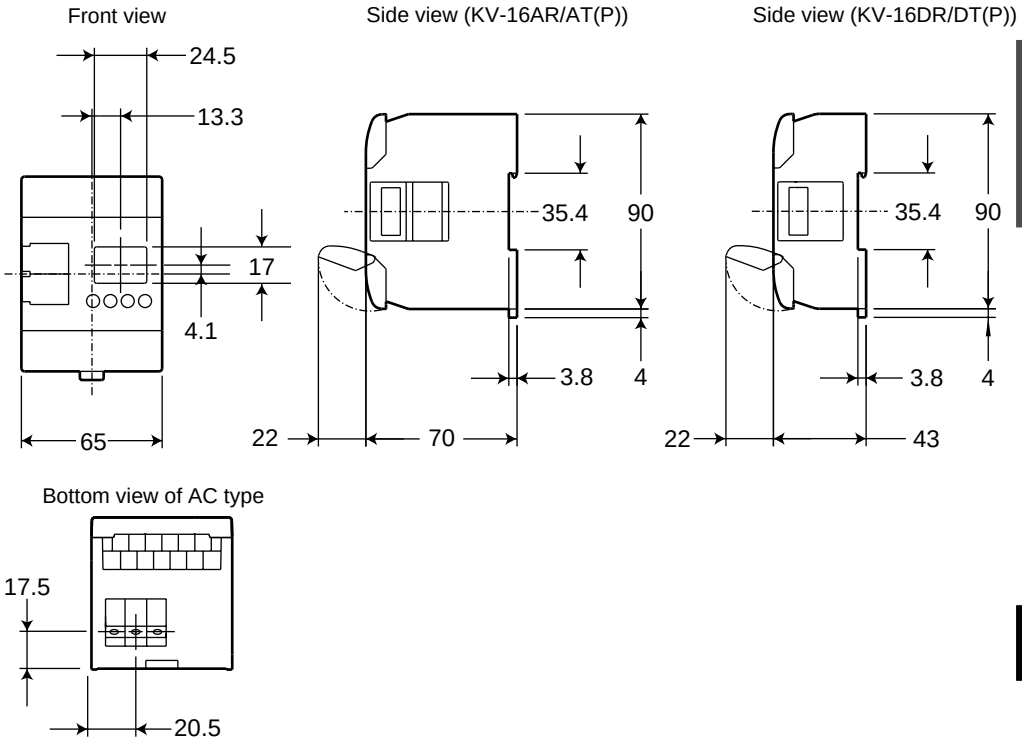


Derating when KV-16DT(P) is mounted in front

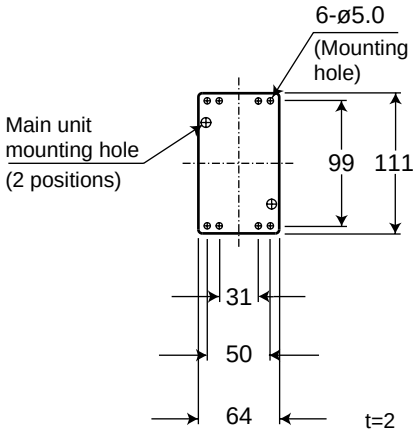


1.5.5 Dimensions

■ **Main unit**



■ **Metal fixture for screw tightening**

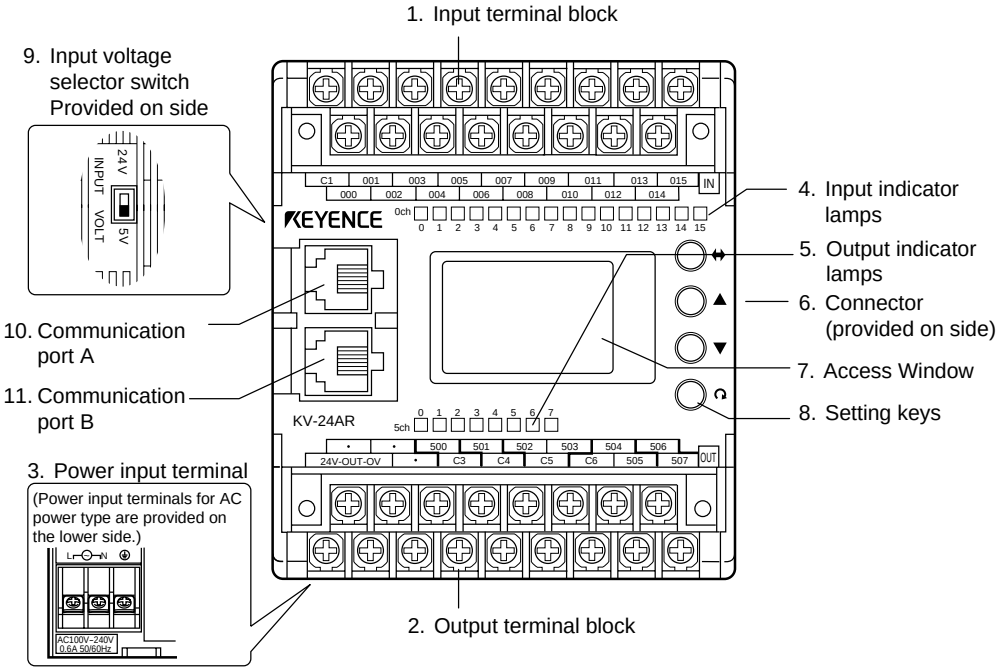


* Two M3.5 countersunk-head screws are included for mounting the main unit.

1.6 KV-24AR/AT(P)/DR/DT(P) (24-I/O Basic Unit)

This section describes the name and function of each part, the I/O specifications, the terminal layout, circuit diagrams, and dimensions of the KV-24xx.

1.6.1 Part Names and Functions



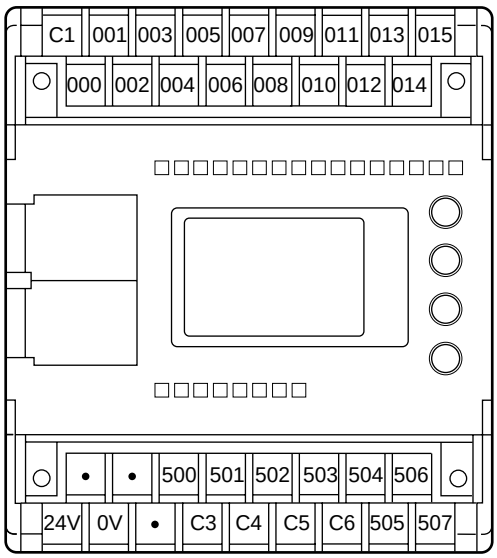
No.	Name	Function
1	**Input terminal block**	24 VDC input terminal block (000 to 007 can be changed to 5 V input).
2	**Output terminal block**	Output terminal block. Pulse output function is built in 500 to 502 (in transistor output type only). A 1.6 kΩ current limiting resistor is built in R502 (to connect a motor driver).
3	**Power input terminal (KV-24DR/DT(P))**	Supplies 24 VDC.
	Power output terminal (KV-24AR/AT(P))	Supplies 100 to 240 VAC to the power input terminals on the lower side of the unit, and allows the service power supply to be taken from the 24 VDC terminal.
4	**Input indicator lamps**	Indicate input status. Each lamp lights up at ON.
5	**Output indicator lamps**	Indicate output status. Each lamp lights up at ON.
6	**Connector (provided on side)**	Used to connect an expansion unit.
7	**Access Window**	Used to refer to and change the current and set values of timers and counters as well as the contents of data memories. The backlight color indicates the operation status. Lit in green: RUN mode Lit in red: PROGRAM mode Flashing red: Error status
8	**Setting keys**	Used to refer to and change current values, etc. while referring to the Access Window.
9	**Input voltage selector switch**	Changes the input voltage of the basic unit. ■□ : 24 V input □■ : 5 V input
10	**Communication port A**	RJ-11 Modular connector for connecting a personal computer, handheld programmer, or operator interface panel.
11	**Communication port B**	RJ-11 Modular connector for connecting a personal computer, handheld programmer, or operator interface panel.

➪ *For more about the Access Window, refer to "Chapter 3. Access Window" (p.1-79).*

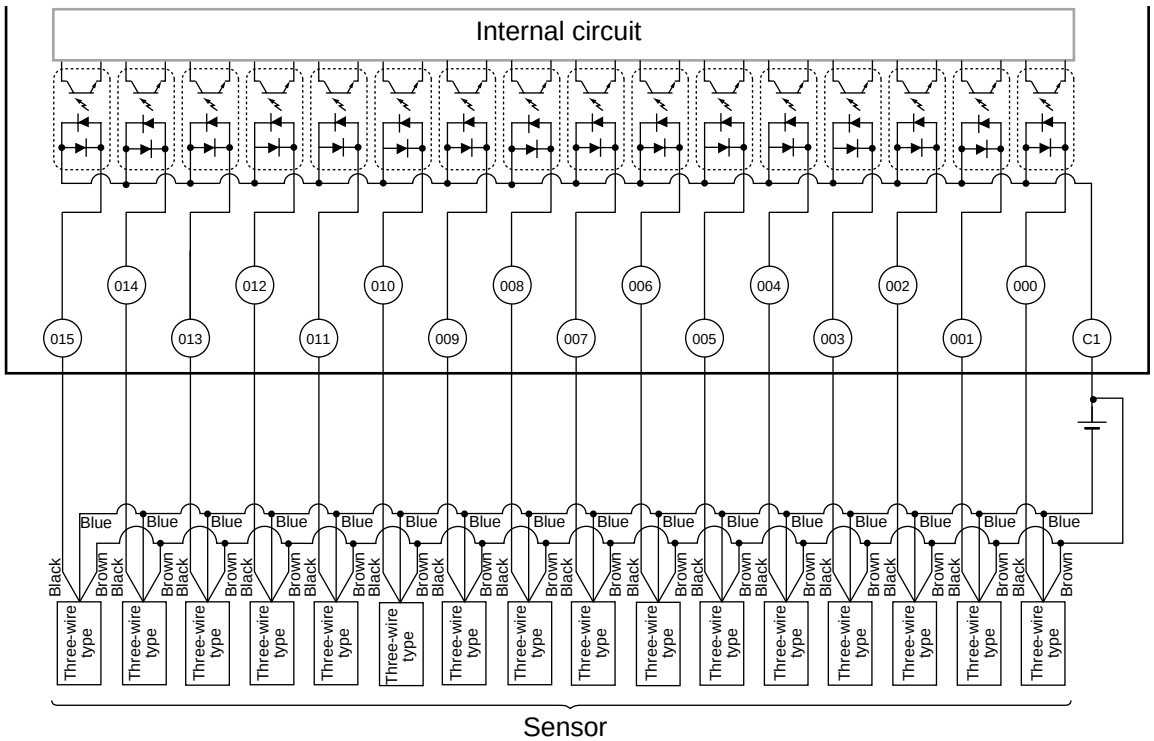
1.6.2 Terminal Layout Drawings and I/O Circuit Diagrams

KV-24AR/DR (Relay output type)

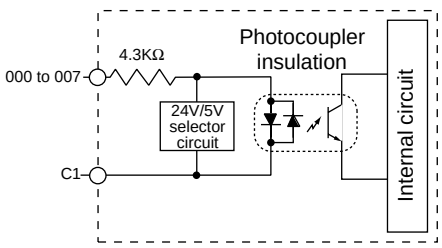
■ **Terminal layout drawing**



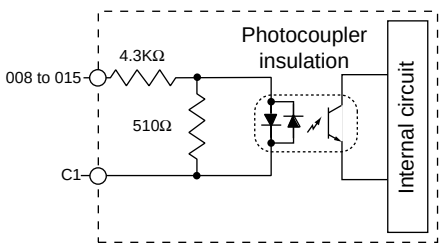
■ **Input circuit diagram**



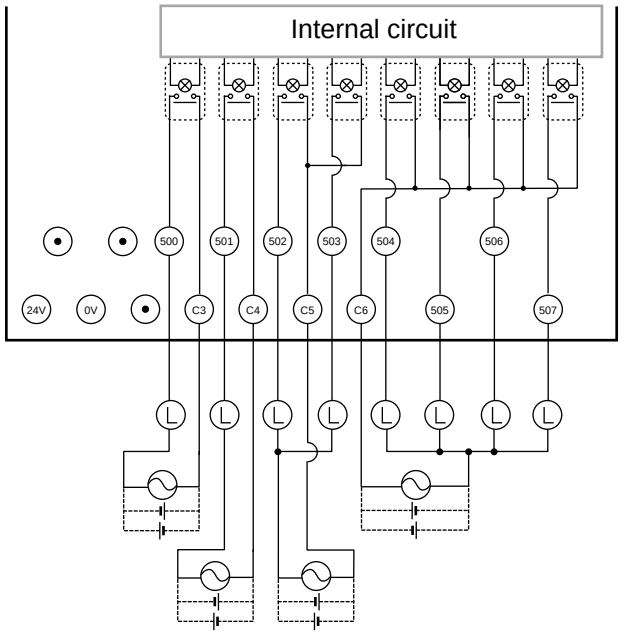
Circuit configuration of inputs 000 to 007

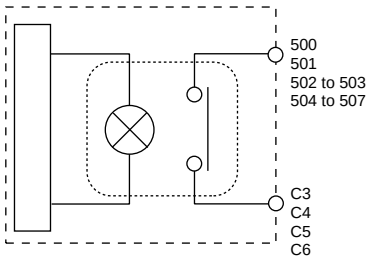


Circuit configuration of inputs 008 to 015



■ **Output circuit diagram**

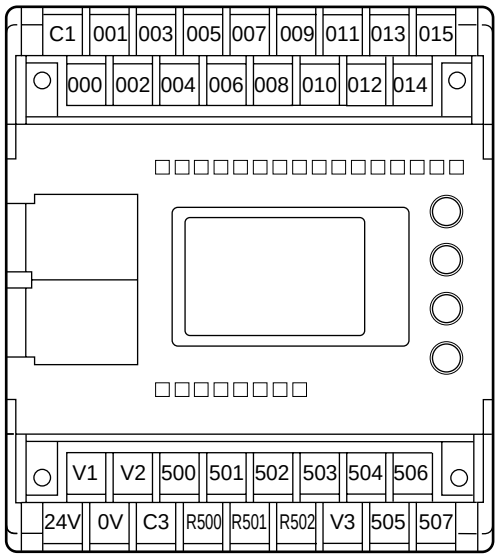




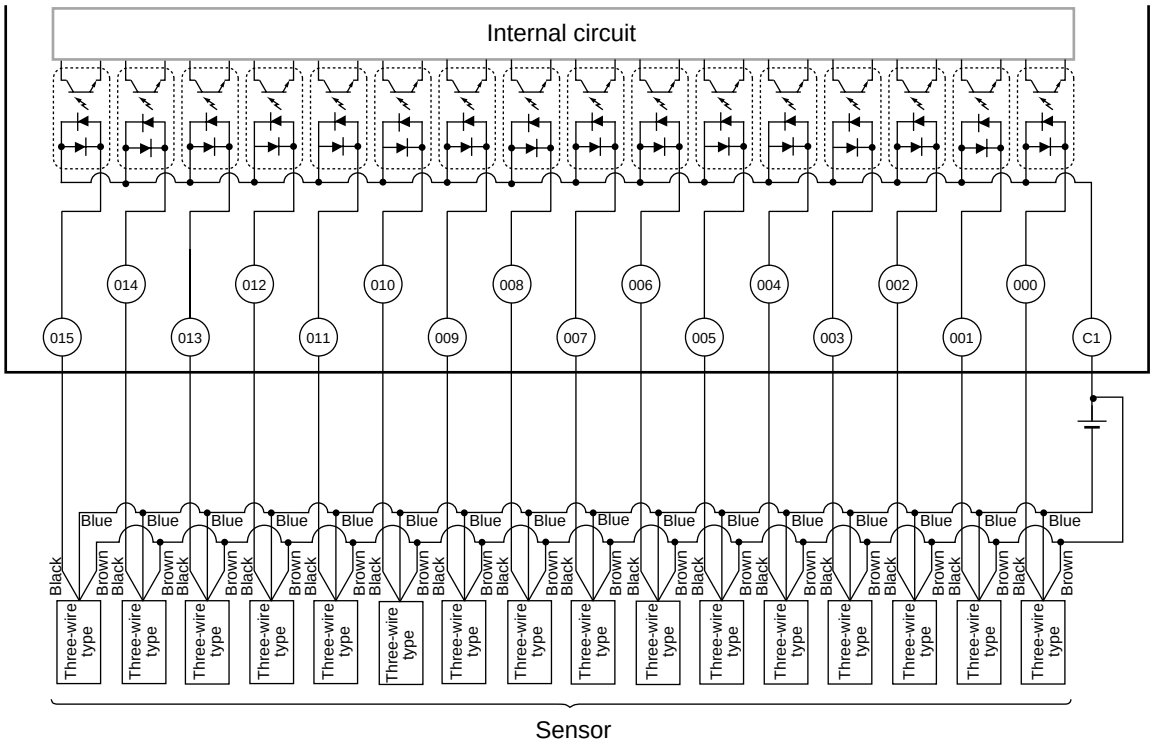
• C3 to C6 are each independent.

KV-24AT(P)/DT(P) (Transistor output type)

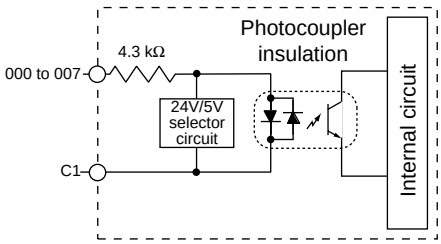
■ Terminal layout drawing



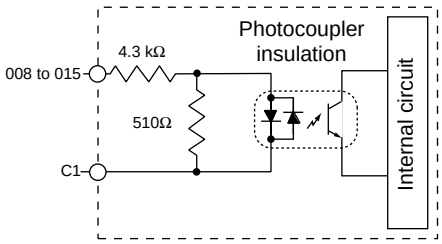
■ Input circuit diagram



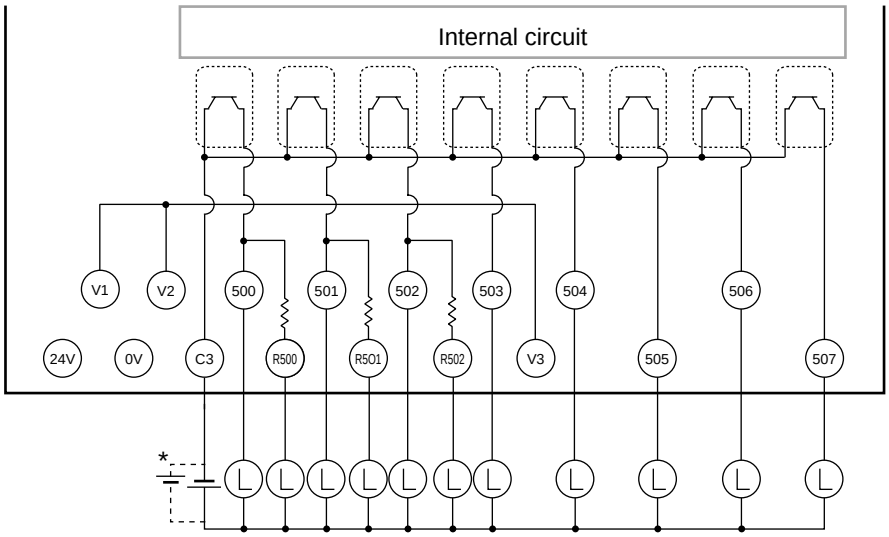
Circuit configuration of inputs 000 to 007



Circuit configuration of inputs 008 to 015

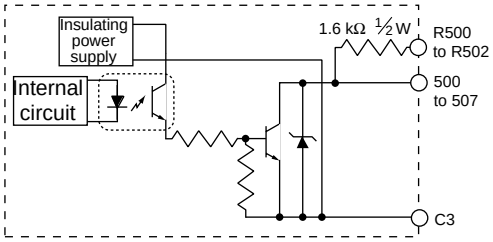


■ **Output circuit diagram**



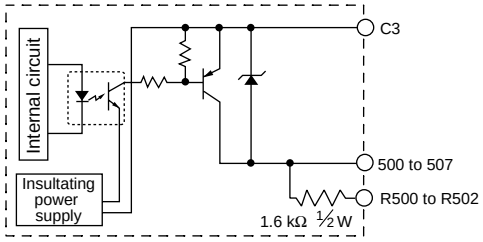
* For KV-24ATP/DTP

NPN



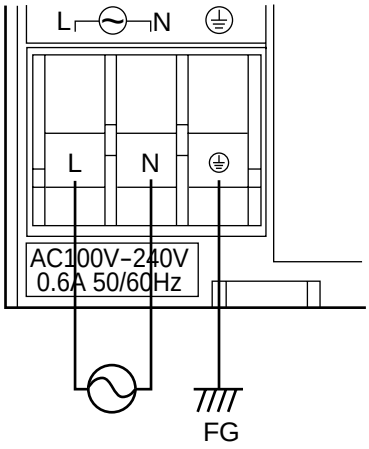
- A 1.6 kΩ current limiting resistor is built in each of R500 to R502 (to connect a motor driver).
- V1 to V3 are short-circuited inside (so they can be used as a relay terminal block).

PNP



- A 1.6 kΩ current limiting resistor is built in each of R500 to R502 (to connect a motor driver).
- V1 to V3 are short-circuited inside (so they can be used as a relay terminal block).

1.6.3 AC Power Input (KV-24AR/AT(P))



1.6.4 Relationship between Continuous Simultaneous ON Ratio and Ambient Temperature

CAUTION

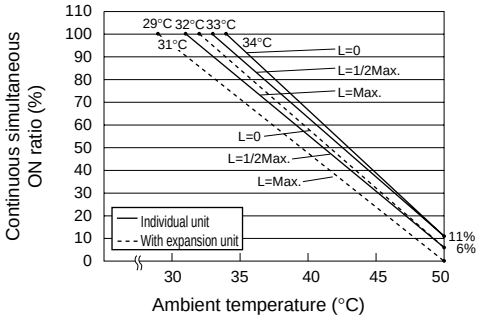
If the number of I/O points which turn ON at the same time exceeds the specifications range, the unit may be damaged.

The graphs below show the relationship between the ambient temperature and the continuous simultaneous ON ratio.

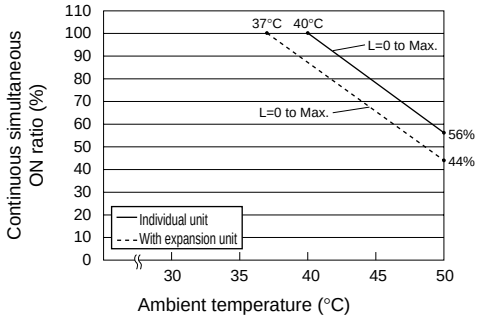
Load current L:

(AC power output capacity at 600 mA) − (Individual current consumption when KV-D20 is connected) = (Service power output current) + (Expansion unit current consumption)

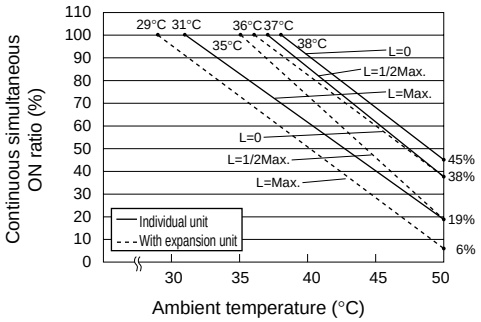
Derating when KV-24AR is mounted upward



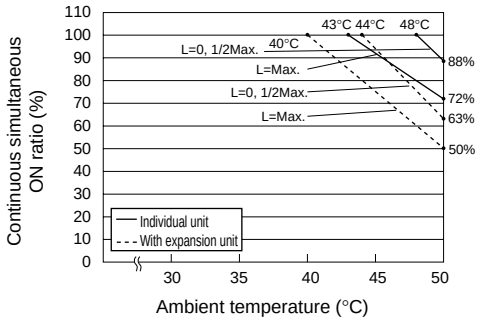
Derating when KV-24AR is mounted in front



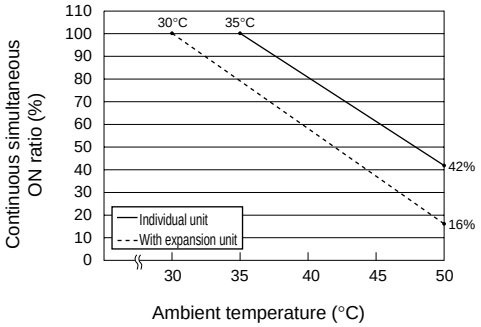
Derating when KV-24AT(P) is mounted upward



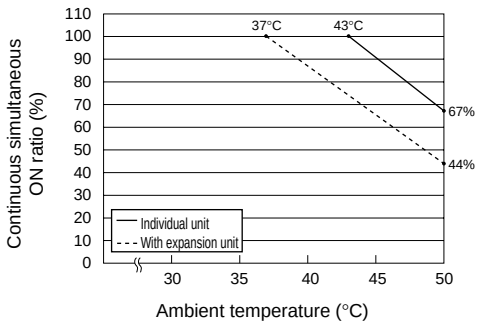
Derating when KV-24AT(P) is mounted in front



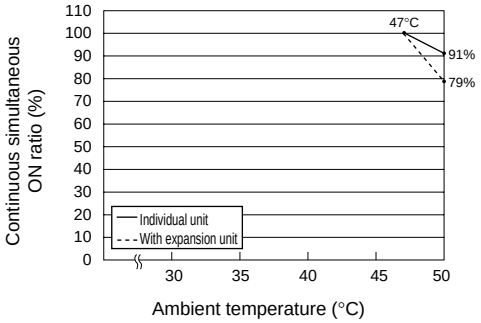
Derating when KV-24DR is mounted upward



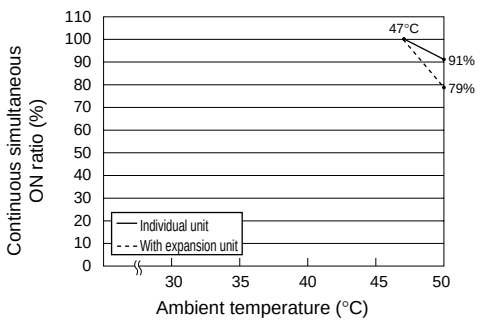
Derating when KV-24DR is mounted in front



Derating when KV-24DT(P) is mounted upward



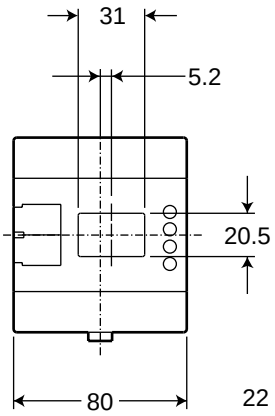
Derating when KV-24DT(P) is mounted in front



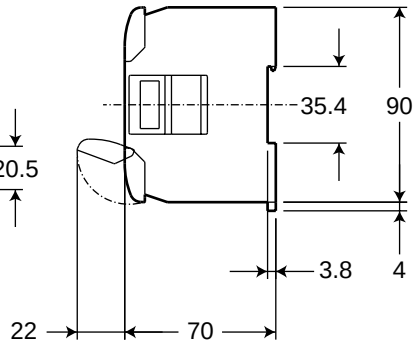
1.6.5 Dimensions

■ Main unit

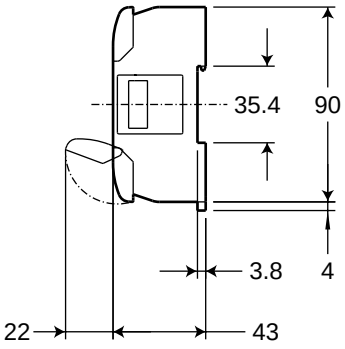
Front view



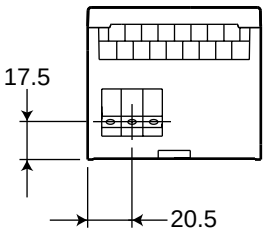
Side view (KV-24AR/AT(P))



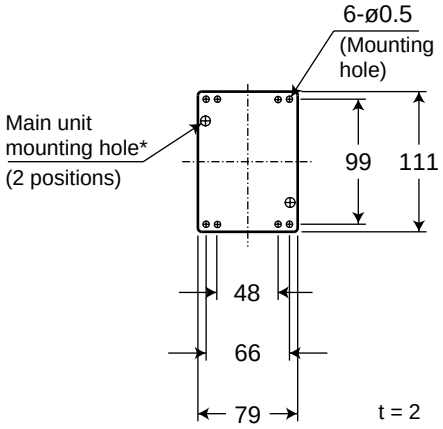
Side view (KV-24DR/DT(P))



Bottom view (KV-24AR/AT(P))



■ Metal fixture for screw tightening

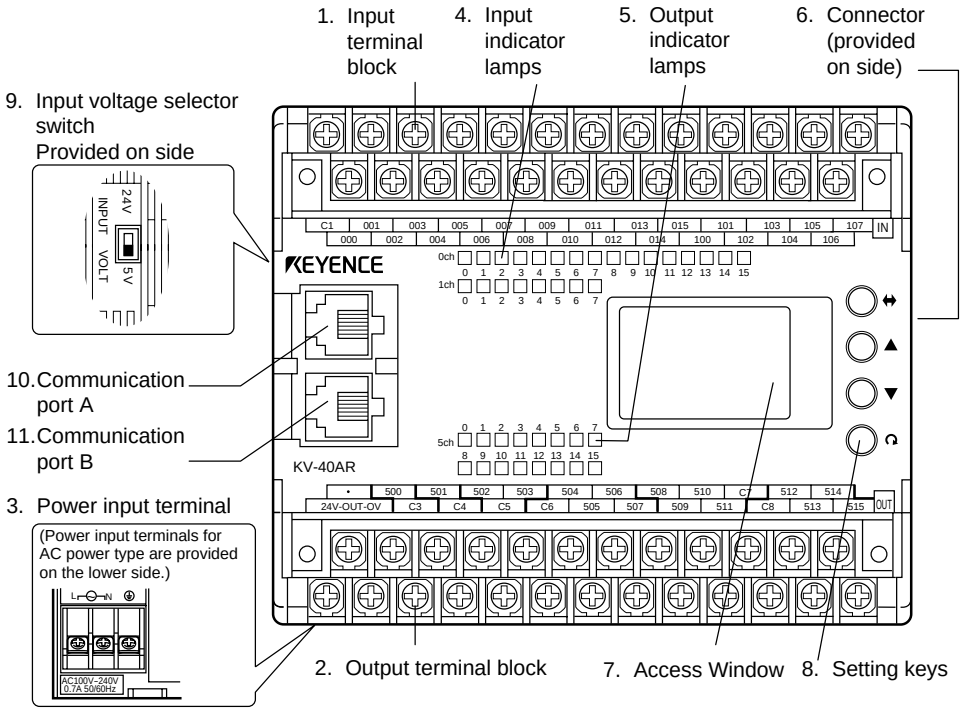


* Two M3.5 countersunk-head screws are included for mounting the main unit.

1.7 KV-40AR/AT(P)/DR/DT(P) (40-I/O Basic Unit)

This section describes the name and function of each part, the I/O specifications, the terminal layout, circuit diagrams, and dimensions of the KV-40xx.

1.7.1 Part Names and Functions



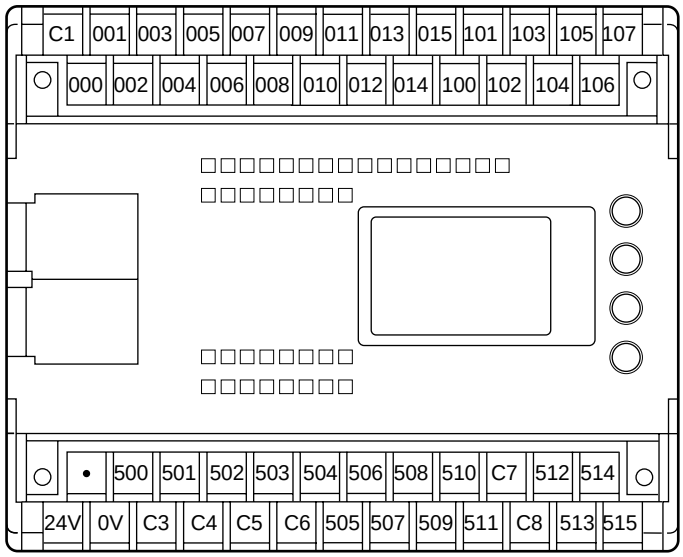
No.	Name	Function
1	**Input terminal block**	24 VDC input terminal block (000 to 007 can be changed to 5 V input).
2	**Output terminal block**	Output terminal block. Pulse output function is built in 500 to 502 (in transistor output type only). 1.6 kΩ current limiting resistor is built in R502 (to connect a motor driver).
3	**Power input terminal (KV-40DR/DT(P))**	Supplies 24 VDC.
	Power output terminal (KV-40AR/AT(P))	Supplies 100 to 240 VAC to the power input terminals on the lower side of the unit, and allows the service power supply to be taken from the 24 VDC terminal.
4	**Input indicator lamps**	Indicate input status. Each lamp lights up at ON.
5	**Output indicator lamps**	Indicate output status. Each lamp lights up at ON.
6	**Connector (provided on side)**	Used to connect an expansion unit.
7	**Access Window**	Used to refer to and change the current and set values of timers and counters as well as the contents of data memories. The backlight color indicates the operation status. Lit in green: RUN mode Lit in red: PROGRAM mode Flashing red: Error status
8	**Setting keys**	Used to refer to and change current values, etc. while referring to the Access Window.
9	**Input voltage selector switch**	Changes the input voltage of the basic unit. ■□ : 24 V input □■ : 5 V input
10	**Communication port A**	RJ-11 Modular connector for connecting a personal computer, handheld programmer, or operator interface panel.
11	**Communication port B**	RJ-11 Modular connector for connecting a personal computer, handheld programmer, or operator interface panel.

➪ *For more about the Access Window, refer to "Chapter 3. Access Window" (p.1-79).*

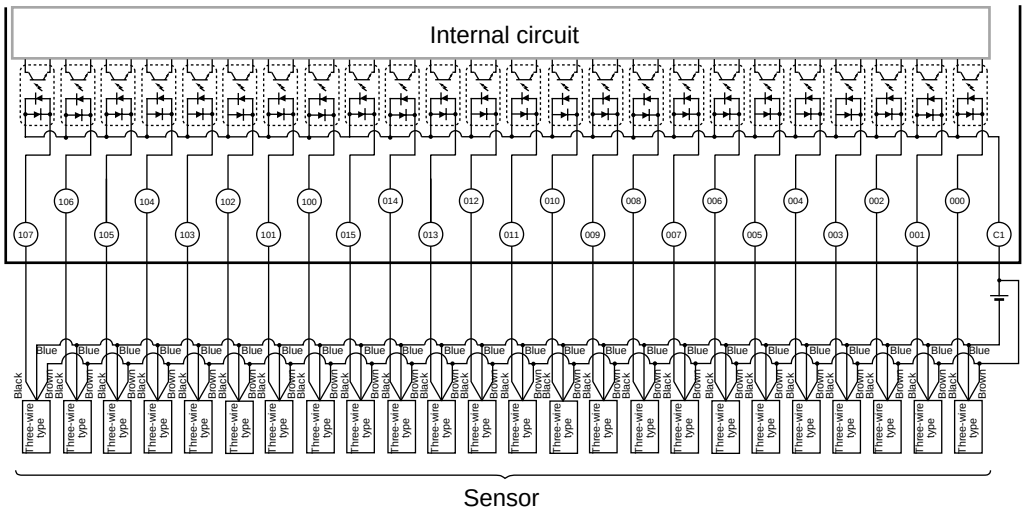
1.7.2 Terminal Layout Drawings and I/O Circuit Diagrams

KV-40AR/DR (Relay output type)

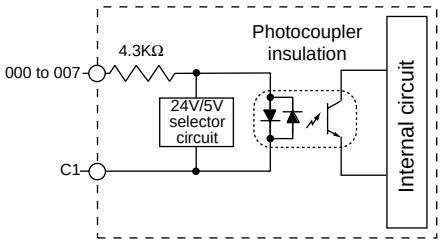
■ Terminal layout drawing



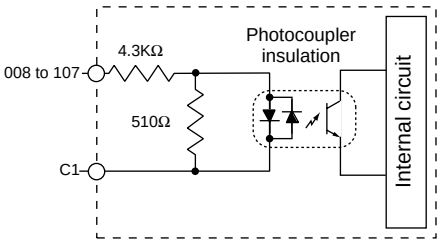
■ Input circuit diagram



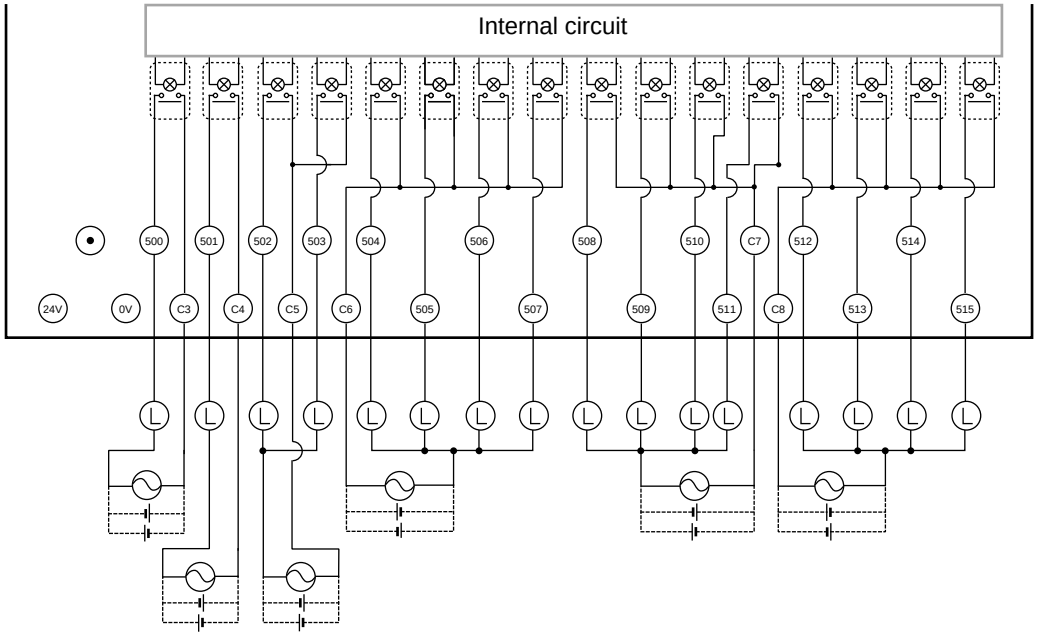
Circuit configuration of inputs 000 to 007

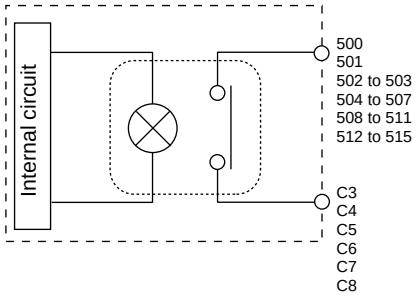


Circuit configuration of inputs 008 to 107



■ Output circuit diagram

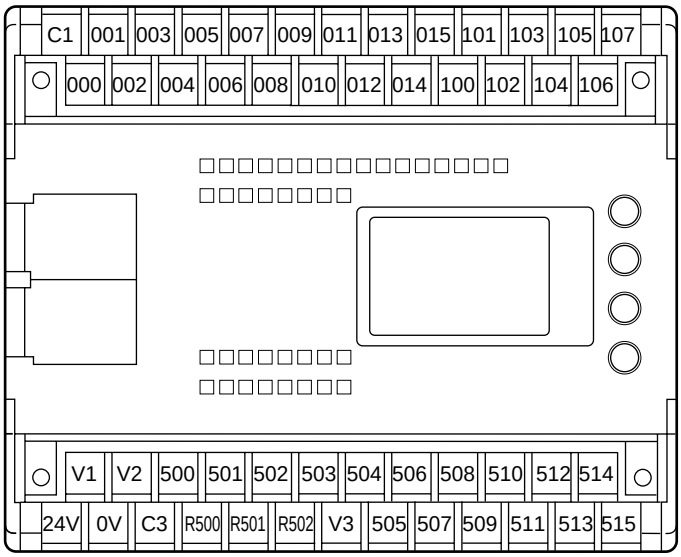




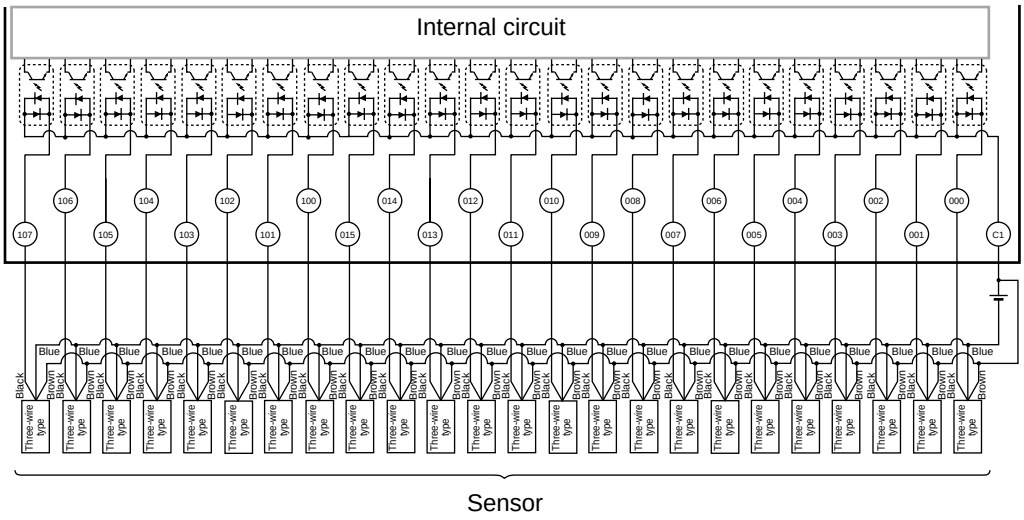
- C3 to C8 are each independent.

KV-40AT(P)/DT(P) (Transistor output type)

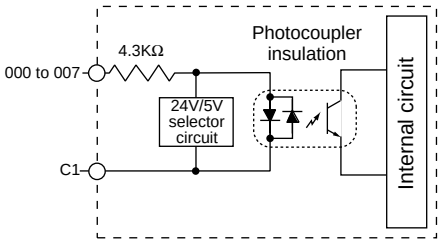
■ Terminal layout drawing



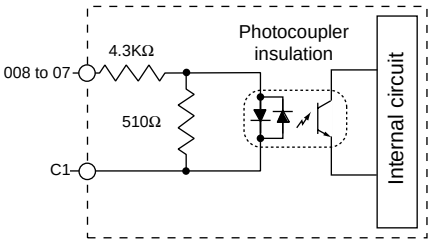
■ Input circuit diagram



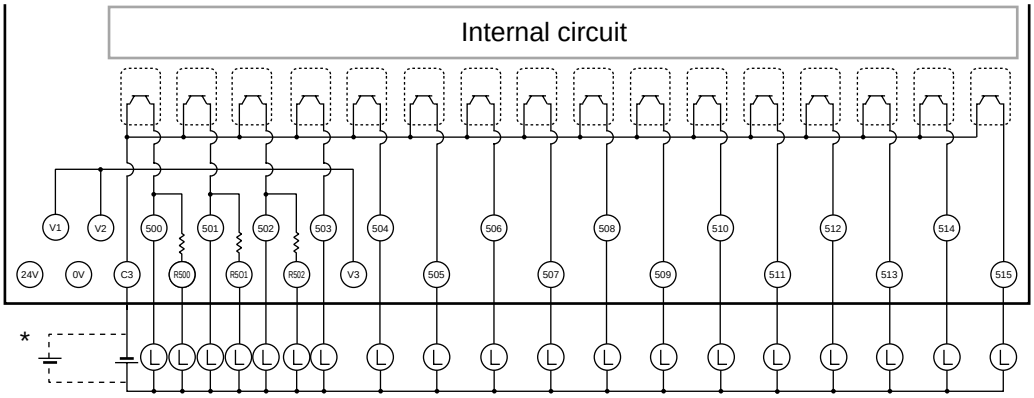
Circuit configuration of inputs 000 to 007



Circuit configuration of inputs 008 to 107

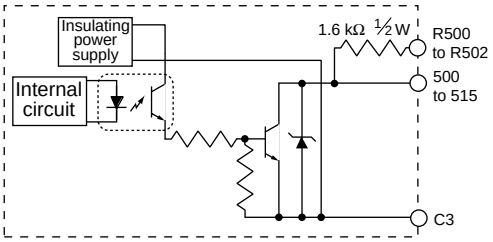


■ **Output circuit diagram**



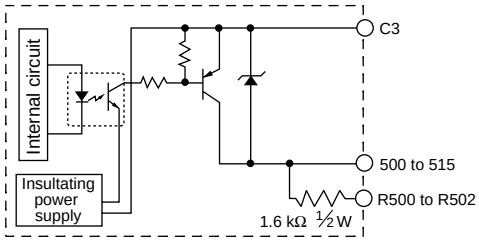
* For KV-40ATP/DTP

NPN



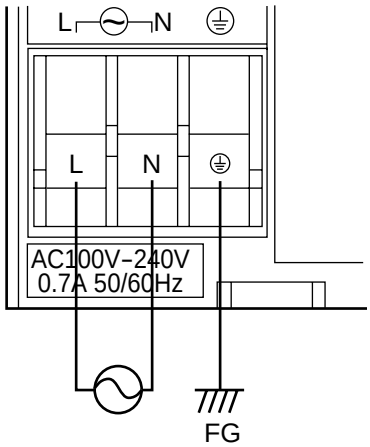
- A 1.6 kΩ current limiting resistor is built in each of R500 to R502 (to connect a motor driver).
- V1 to V3 are short-circuited inside (so they can be used as a relay terminal block).

PNP



- A 1.6 kΩ current limiting resistor is built in each of R500 to R502 (to connect a motor driver).
- V1 to V3 are short-circuited inside (so they can be used as a relay terminal block).

1.7.3 AC Power Input (KV-40AR/AT(P))



1.7.4 Relationship between Continuous Simultaneous ON Ratio and Ambient Temperature

CAUTION

If the number of I/O points which turn ON at the same time exceeds the specifications range, the unit may be damaged.

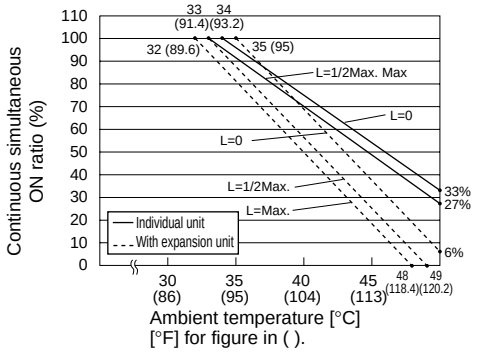
The graphs below show the relationship between the ambient temperature and the continuous simultaneous ON ratio.

Load current L:

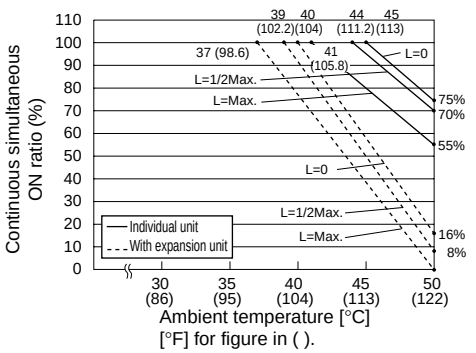
(AC power output capacity at 700 mA) − (Individual current consumption when KV-D20 is connected) = (Service power output current) + (Expansion unit current consumption)

Derating when KV-40AR is mounted upward

Supply voltage: 100 to 240 V

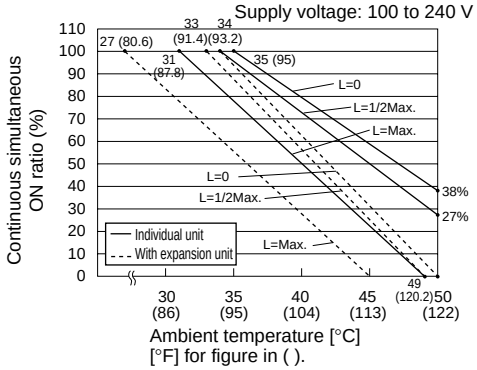


Derating when KV-40AR is mounted in front

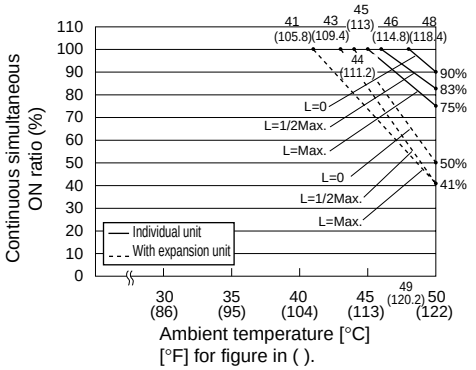


Derating when KV-40AT(P) is mounted upward

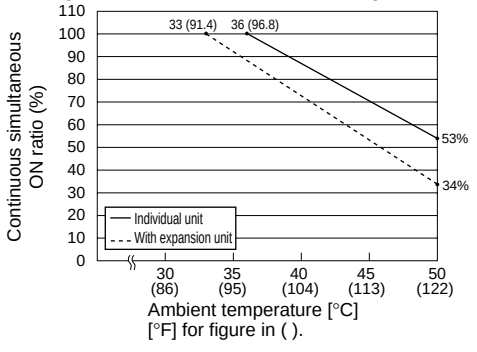
Supply voltage: 100 to 240 V



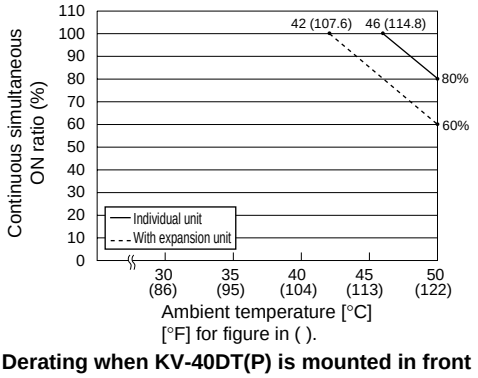
Derating when KV-40AT(P) is mounted in front



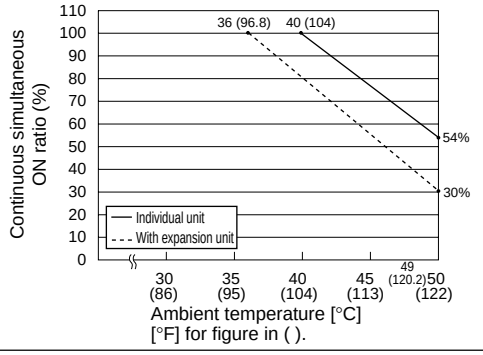
Derating when KV-40DR is mounted upward



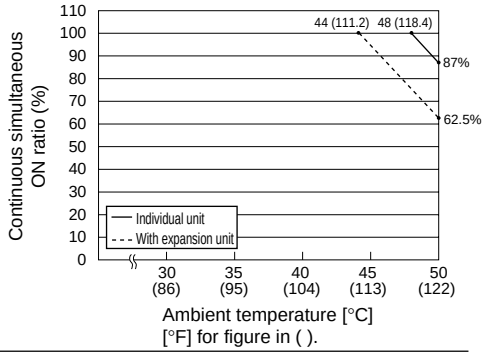
Derating when KV-40DR is mounted in front



Derating when KV-40DT(P) is mounted upward

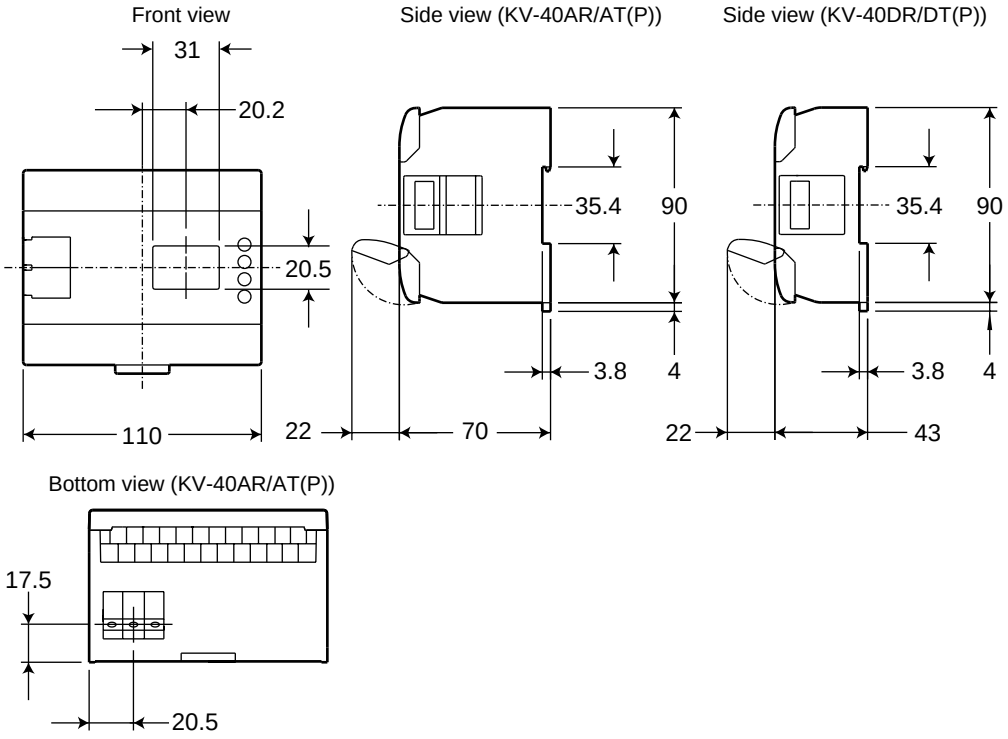


Derating when KV-40DT(P) is mounted in front

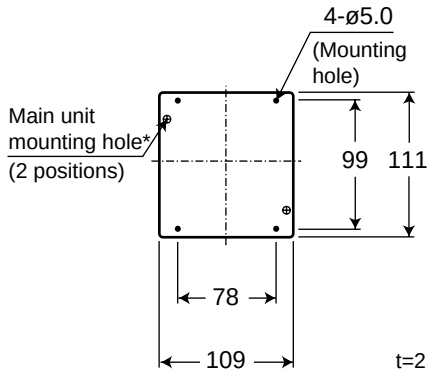


1.7.5 Dimensions

■ **Main unit**



■ **Metal fixture for screw tightening**

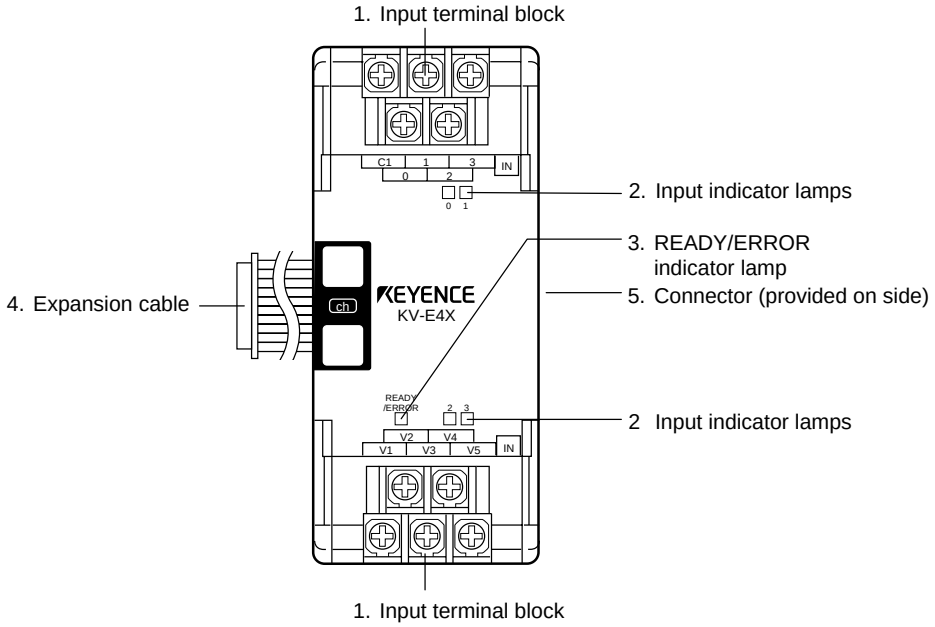


* Two M3.5 countersunk-head screws are included for mounting the main unit.

1.8 KV-E4X/E8X/E16X (Expansion Input Unit)

This section describes the name and function of each part, the input specifications, the terminal layout, circuit diagrams, and dimensions of three types of expansion input units.

1.8.1 Part Names and Functions



No.	Name	Function
1	**Input terminal block**	24 VDC input terminal block
2	**Input indicator lamps**	Indicate input status. Each lamp lights up at ON.
3	**READY/ERROR indicator lamp**	Indicates operation status of expansion input unit. Lit: Normal operation Flashing: Communication error Not lit: Power not connected
4	**Expansion cable**	Used to connect a basic unit or another expansion unit. A standard expansion cable approximately 60 mm in length is provided. For extensions, use the optional 300 mm expansion cable (OP-35361).
5	**Connector**	Used to connect an expansion unit.

1.8.2 Input Specifications

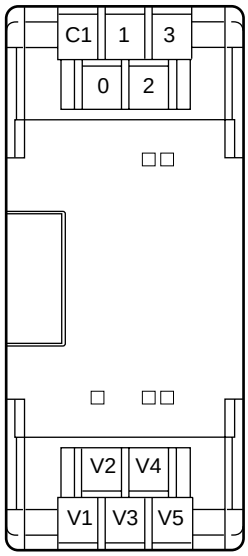
Model	KV-E4X	KV-E8X	KV-E16X
Unit type	**4-I/O input**	**8-I/O input**	**16-I/O input**
Number of inputs	4	8	16
External connection method	Terminal block		
Maximum input rating	26.4 VDC		
Input voltage	24 VDC, 5.3 mA		
Minimum ON voltage	19 V		
Maximum OFF current	2 mA		
Input impedance	4.3 kΩ		
Common method	4 points/common		
Input time constant (Changed in two steps by special utility relays 2609 to 2612)	For both rising (OFF → ON) and falling (ON → OFF) operations, 10 ms: 10 ms ±20% 10 μs: 10 μs ±20%		

➪ *For more about the general specifications, refer to "General Specifications" (p.1-4).*

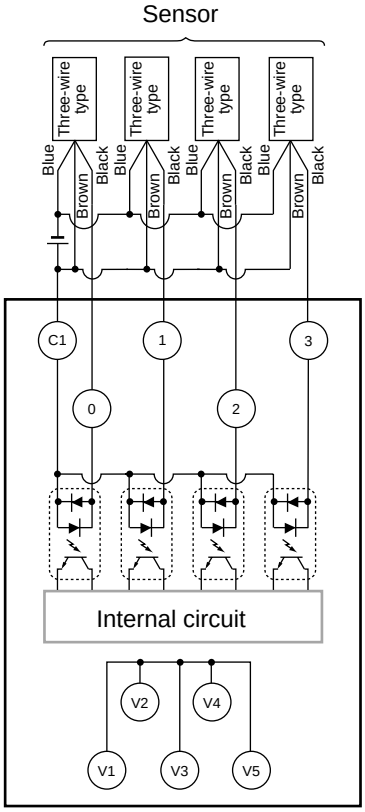
1.8.3 Terminal Layout Drawings and Input Circuit Diagrams

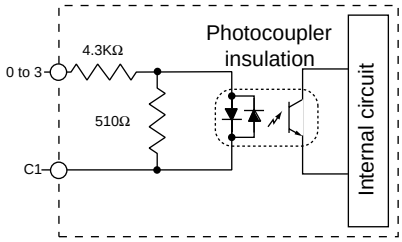
KV-E4X (4-I/O expansion input unit)

■ **Terminal layout drawing**



■ **Input circuit diagram**

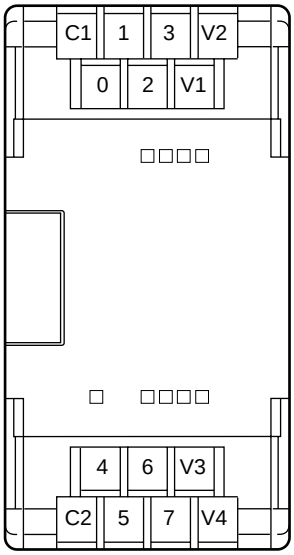




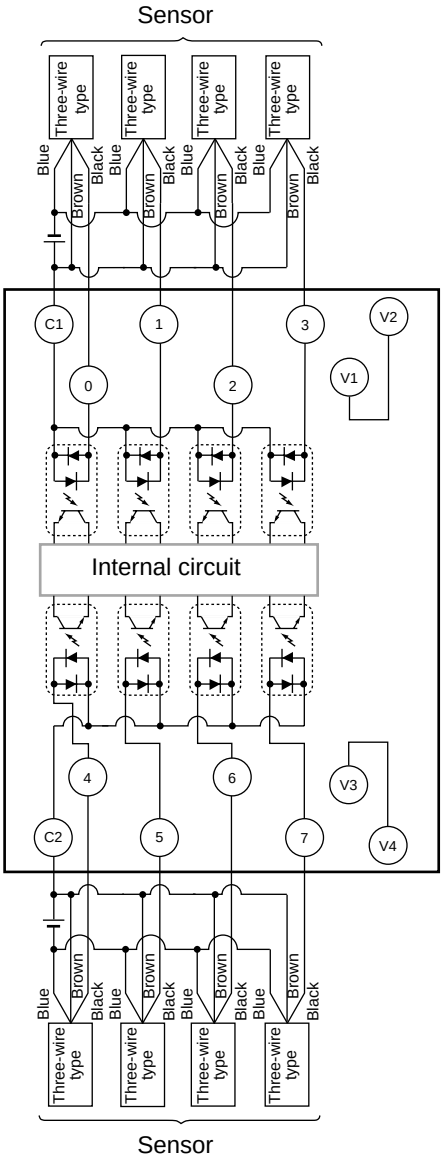
• V1 to V5 are short-circuited inside (so they can be used as a relay terminal block).

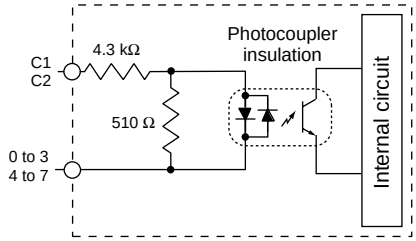
KV-E8X (8-I/O expansion input unit)

■ Terminal layout drawing



■ Input circuit diagram

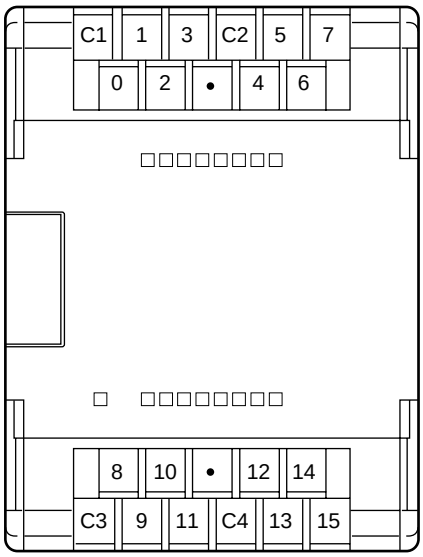




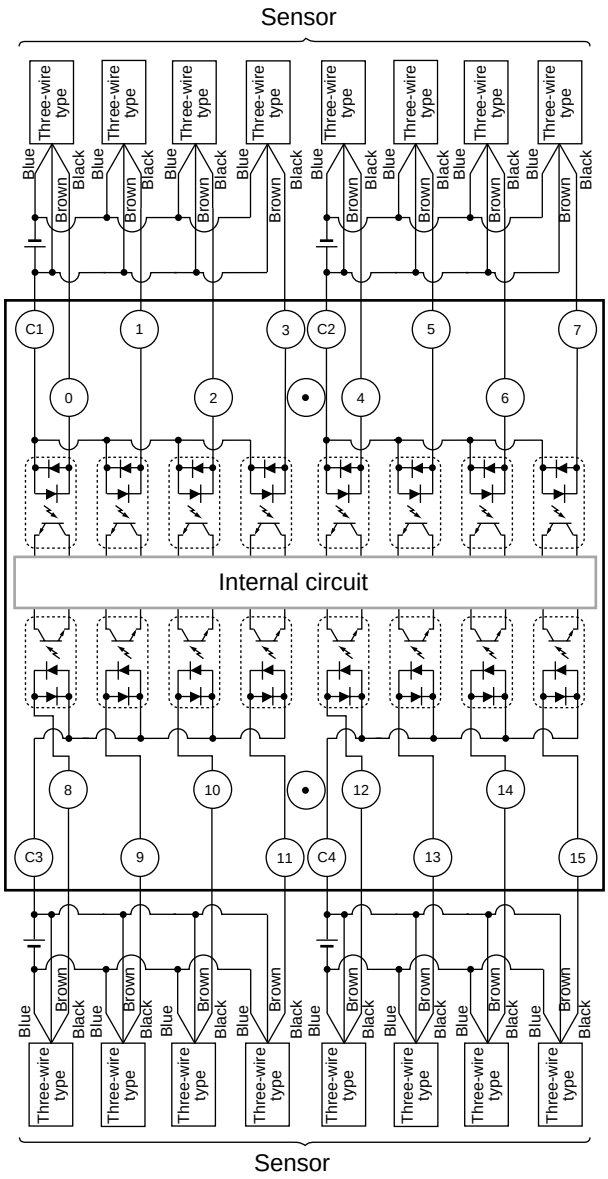
- C1 and C2 are each independent.
- V1 to V2 and V3 to V4 are short-circuited inside respectively (so they can be used as relay terminal blocks).

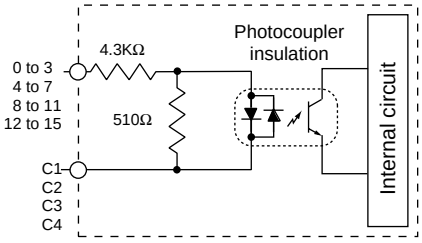
KV-E16X (16-I/O expansion input unit)

■ Terminal layout drawing



■ Input circuit diagram

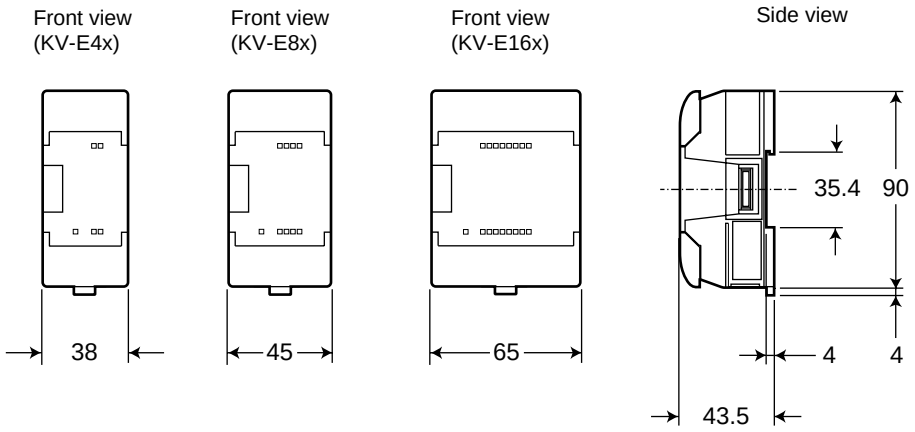




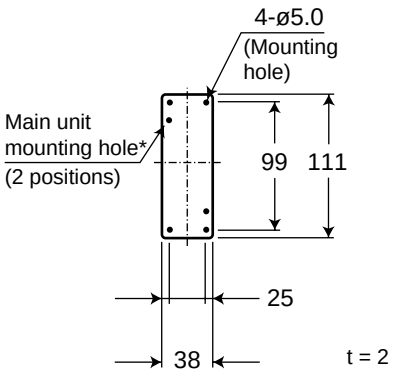
• C1 to C4 are each independent.

1.8.4 Dimensions

■ **Main unit**



■ **Metal fixture for screw tightening**

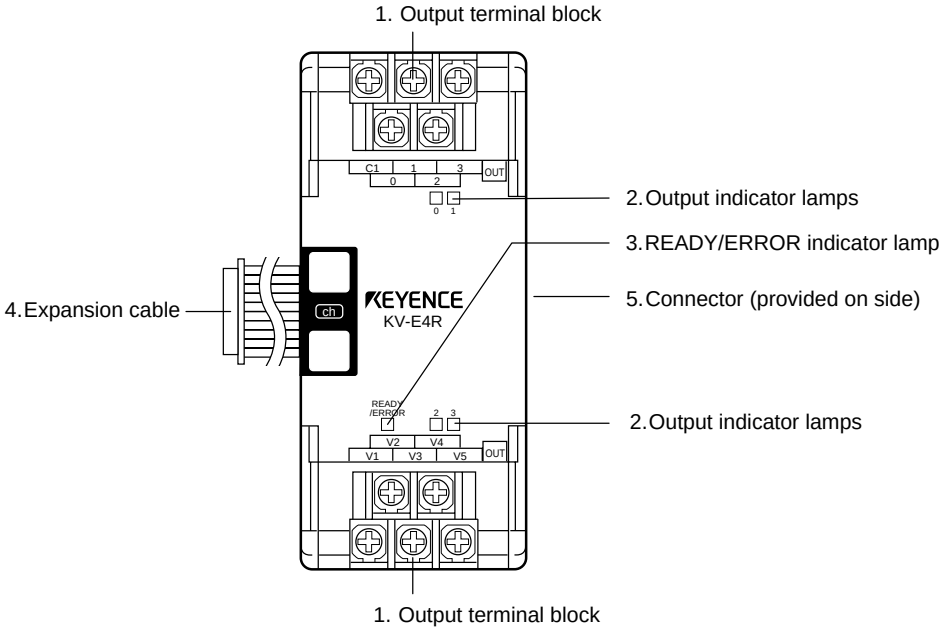


* Two M3.5 countersunk-head screws are included for mounting the main unit.

1.9 KV-E4R/E4T/E8R/E8T(P)/E16R/E16T(P) (Expansion Output Unit)

This section describes the name and function of each part, the output specifications, the terminal layout, circuit diagrams, and dimensions of three types of expansion input units.

1.9.1 Part Names and Functions



1.9.2 Output Specifications

No.	Name	Function
1	**Output terminal block**	Output terminal block. Transistor output: 30 VDC Relay output: 250 VAC, 30 VDC
2	**Output indicator lamps**	Indicate output status. Each lamp lights up at ON.
3	**READY/ERROR indicator lamp**	Indicates operation status of expansion output unit. Lit: Normal operation Flashing: Communication error Not lit: Power not connected
4	**Expansion cable**	Used to connect a basic unit or another expansion unit. A standard expansion cable approximately 60 mm in length is provided. For extensions, use the optional 300 mm expansion cable (OP-35361).
5	**Connector**	Allows to connect an expansion unit.

KV-E4R/E8R/E16R (Relay output type)

Model	KV-E4R	KV-E8R	KV-E16R
Unit type	**4-I/O relay output**	**8-I/O relay output**	**16-I/O relay output**
Number of outputs	4	8	16
Output type	Relay		
External connection method	Terminal block		
Rated load voltage	250 VAC/30 VDC 2 A (inductive load) 4 A (resistive load)		
Rated output current	2A/point (inductive load) 4 A/point (resistive load) 4A/common		
ON resistance	50 mΩ or less		
Common method	4 points/common		
Rising operation time (OFF → ON)	10 ms or less		
Falling operation time (ON → OFF)	10 ms or less		
Relay service life	Electrical: 100,000 times or more (20 times/min) Mechanical: 20,000,000 times or more		
Relay replacement	Not allowed		

➪ *For more about the general specifications, refer to "General Specifications" (p.1-4).*

KV-E4T/E8T(P)/E16T(P) [Transistor output type (NPN/PNP)]

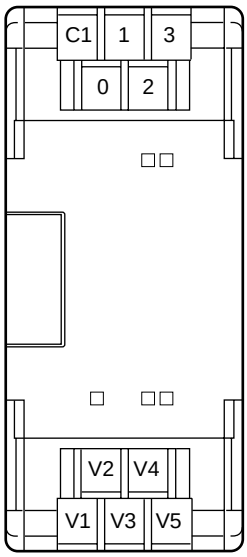
Model	KV-E4T	KV-E8T(P)	KV-E16T(P)
Unit type	**4-I/O transistor output**	**8-I/O transistor output**	**16-I/O transistor output**
Number of outputs	4	8	16
Output type	Transistor (NPN/PNP)		
External connection method	Terminal block		
Rated load voltage	30 VDC		
Rated output current	0.5A/point (NPN), 0.3A/point (PNP)		
Leak current in OFF status	100 μA or less		
Residual voltage in ON status	0.8 V or less		
Common method	Shared inside		
Rising operation time (OFF → ON)	50 μs or less		
Falling operation time (ON → OFF)	250 μs or less		

➪ *For more about the general specifications, refer to "General Specifications" (p.1-4).*

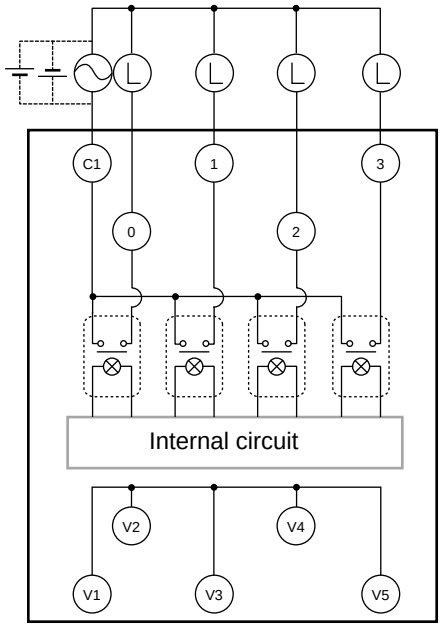
1.9.3 Terminal Layout Drawings and Input Circuit Diagrams

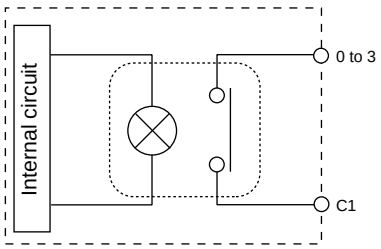
KV-E4R [4-I/O expansion output unit (relay output type)]

■ **Terminal layout drawing**



■ **Output circuit diagram**

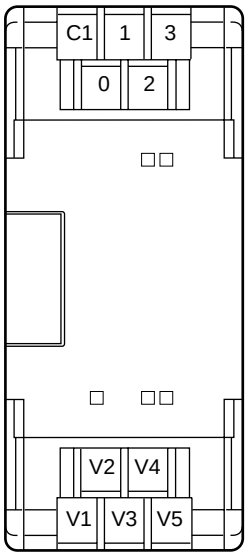




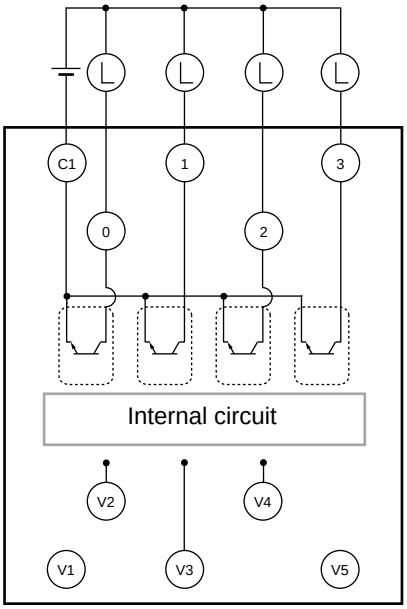
- V1 to V5 are short-circuited inside (so they can be used as a relay terminal block).

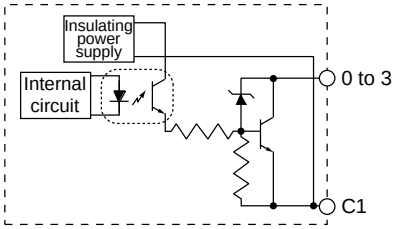
KV-E4T [4-I/O expansion output unit (transistor output type)]

■ Terminal layout drawing



■ Output circuit diagram

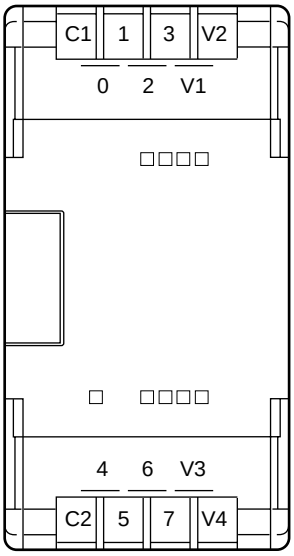




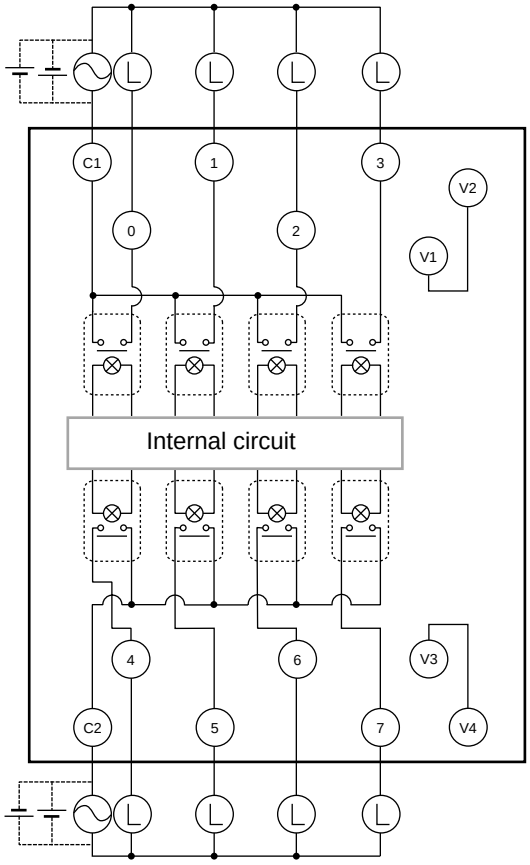
- V1 to V5 are short-circuited inside (so they can be used as a relay terminal block).

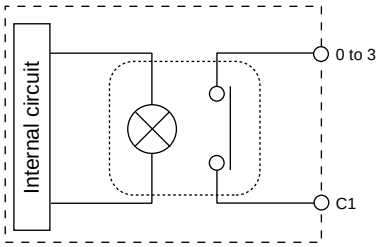
KV-E8R [8-I/O expansion output unit (relay output type)]

■ Terminal layout drawing



■ Output circuit diagram

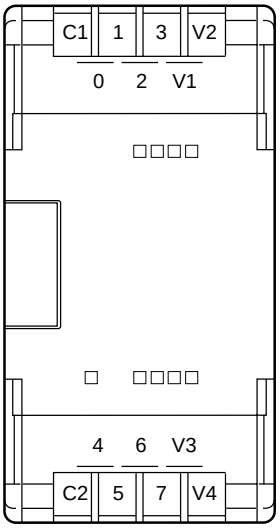




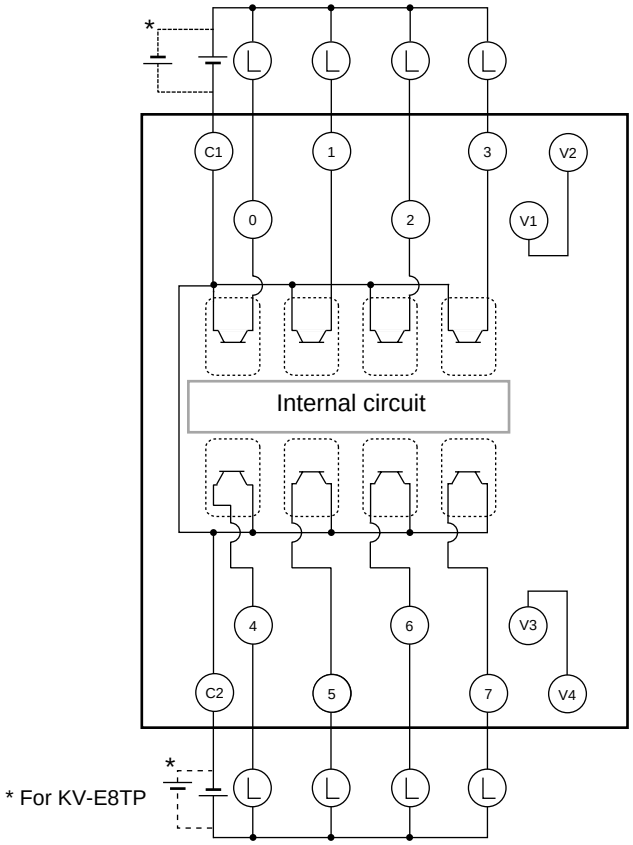
- C1 and C2 are each independent.
- V1 to V2 and V3 to V4 are short-circuited inside (so they can be used as relay terminal blocks).

KV-E8T(P) [8-I/O expansion output unit (transistor output type)]

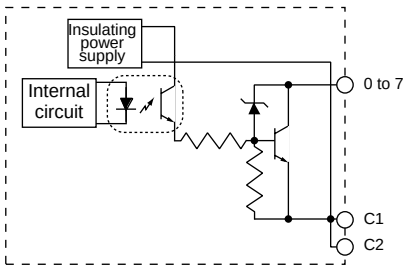
■ Terminal layout drawing



■ Output circuit diagram

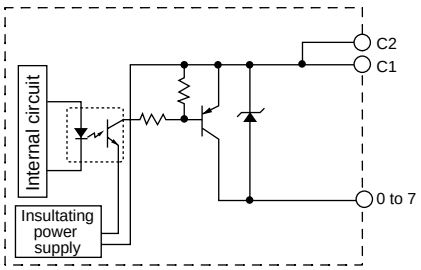


NPN



- V1 to V2 and V3 to V4 are short-circuited inside (so they can be used as relay terminal blocks).

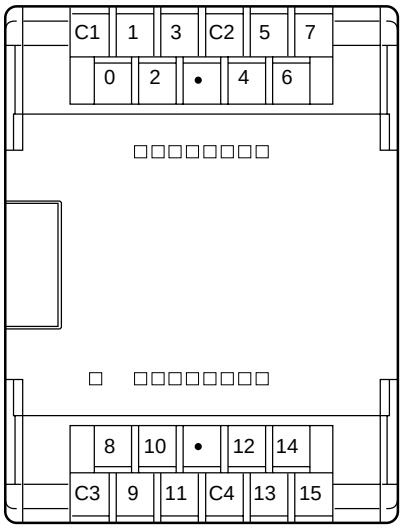
PNP



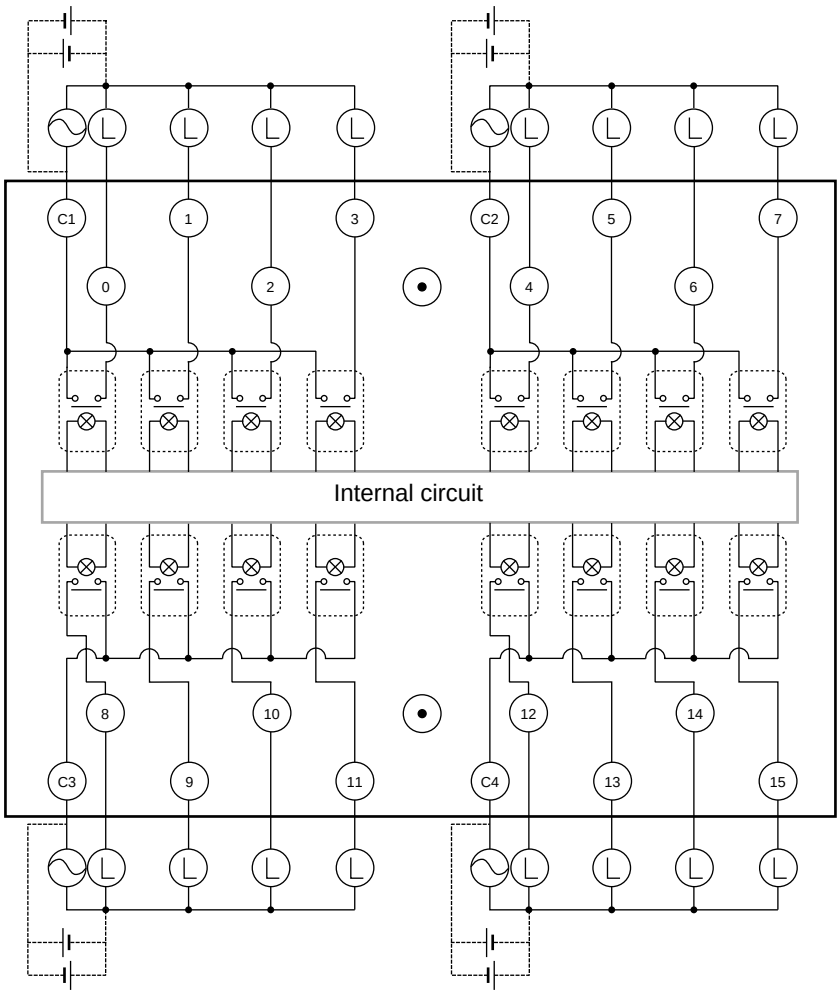
- V1 to V2 and V3 to V4 are short-circuited inside (so they can be used as relay terminal blocks).

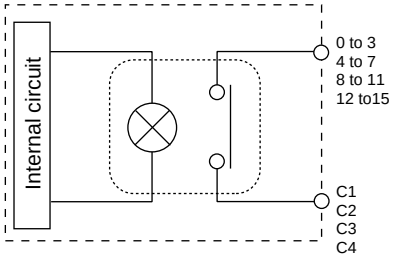
KV-E16R [16-I/O expansion output unit (relay output type)]

■ Terminal layout drawing



■ Output circuit diagram

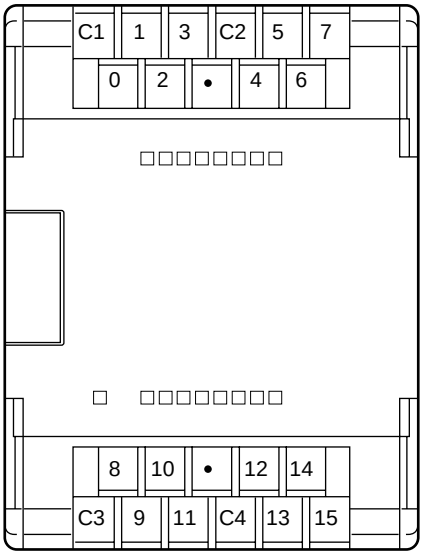




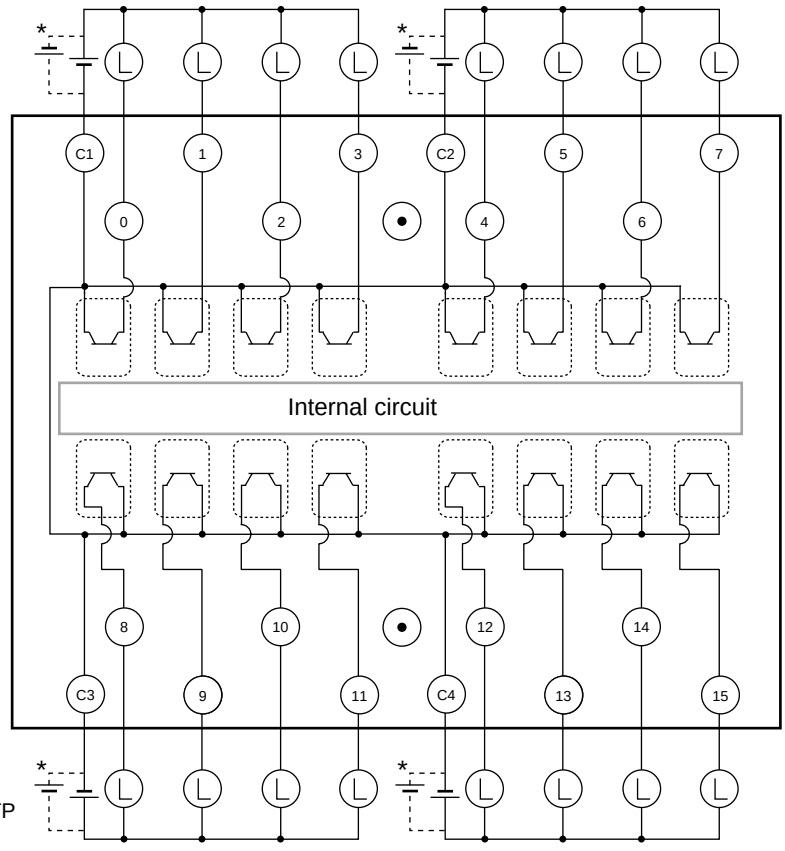
• C1 and C4 are each independent.

KV-E16T(P) [16-I/O expansion input unit (transistor output)]

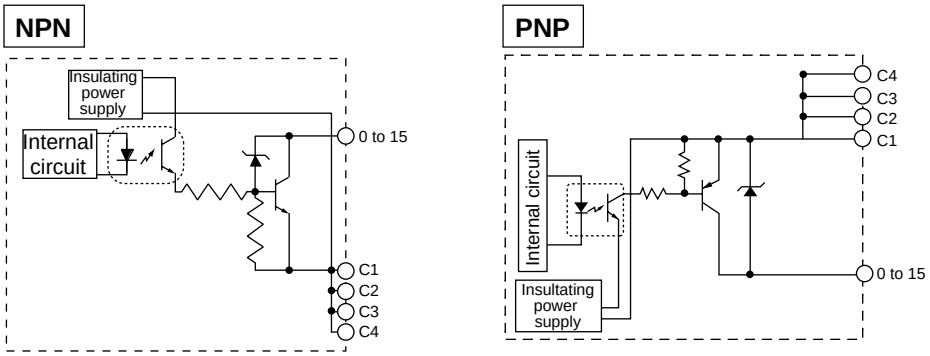
■ Terminal layout drawing



■ Output circuit diagram

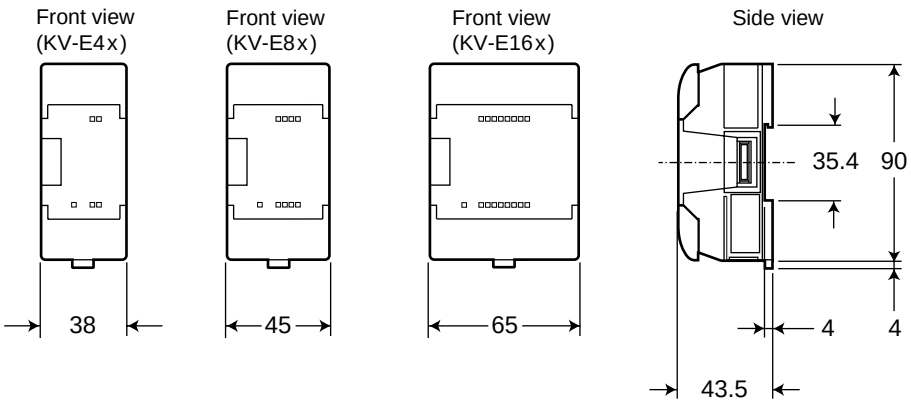


* For KV-E16TP

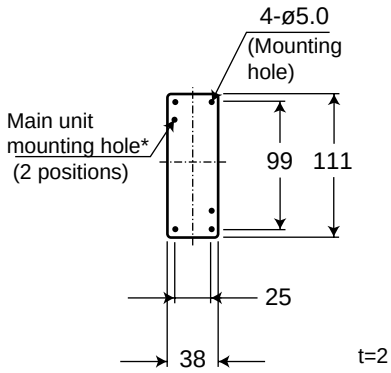


1.9.4 Dimensions

■ **Main unit**



■ **Metal fixture for screw tightening**

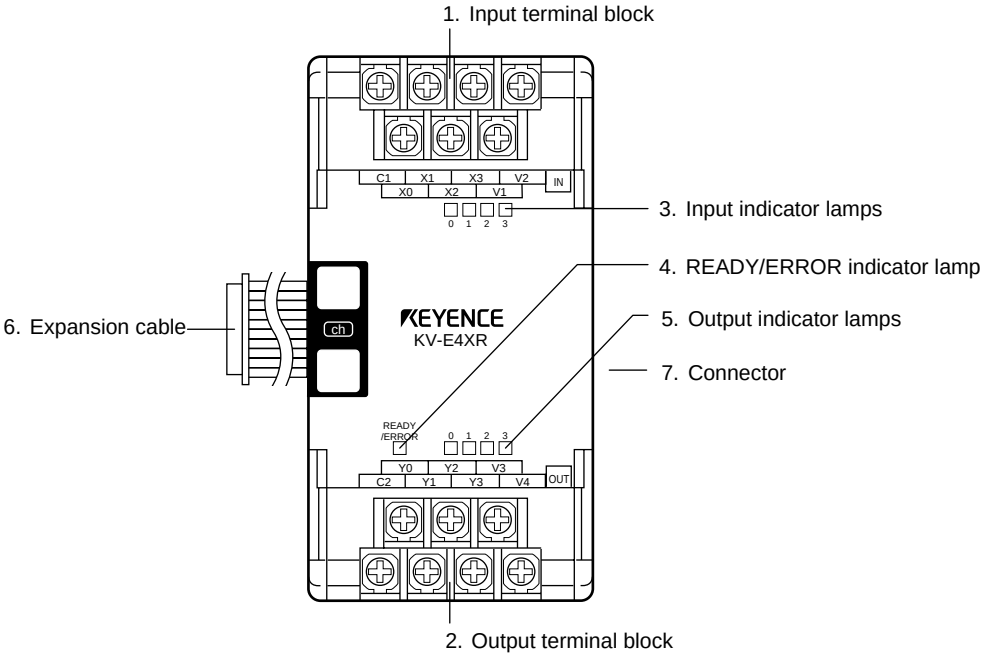


* Two M3.5 countersunk-head screws are included for mounting the main unit.

1.10 KV-E4XR/E4XT(P) (Expansion I/O Unit)

This section describes the name and function of each part, the I/O specifications, the terminal layout, circuit diagrams, and dimensions of two types of expansion I/O units.

1.10.1 Part Names and Functions



No.	Name	Function
1	**Input terminal block**	24 VDC input terminal block
2	**Output terminal block**	Output terminal block. Transistor output: 30 VDC Relay output: 250 VAC, 30 VDC
3	**Input indicator lamps**	Indicate input status. Each lamp lights up at ON.
4	**READY/ERROR indicator lamp**	Indicates operation status of expansion I/O unit. Lit: Normal operation Flashing: Communication error Extinguished: Power not connected
5	**Output indicator lamps**	Indicate output status. Each lamp lights up at ON.
6	**Expansion cable**	Used to connect a basic unit or another expansion unit. A standard expansion cable approximately 60 mm in length is provided. For extensions, use the optional 300 mm expansion cable (OP-35361).
7	**Connector**	Allows to connect an expansion unit.

1.10.2 Input Specifications

Item	Specifications
External connection method	Terminal block
Maximum input rating	26.4 VDC
Input voltage	24 VDC, 5.3 mA
Minimum ON voltage	19 V
Maximum OFF current	2 mA
Input impedance	4.3 kΩ
Common method	4 points/common
Input time constant (Changed in two steps by special utility relays 2609 to 2612)	For both rising (OFF → ON) and falling (ON → OFF) operations, 10 ms: 10 ms ±20% 10 μs: 10 μs ±20%

➪ *For more about the general specifications, refer to "General Specifications" (p.1-4).*

1.10.3 Output Specifications

KV-E4XR (Relay output type)

Item	Specifications
Output type	Relay
External connection method	Terminal block
Rated load voltage	250 VAC/30 VDC 2 A (inductive load) 4 A(resistive load)
Rated output current	2A/point (inductive load) 4A/point (resistive load) 4A/common
ON resistance	50 mΩ or less
Common method	4 points/common
Rising operation time (OFF → ON)	10 ms or less
Falling operation time (ON → OFF)	10 ms or less
Relay service life	Electrical: 100,000 times or more (20 times/min) Mechanical: 20,000,000 times or more
Relay replacement	Not allowed

KV-E4XT(P) (Transistor output type)

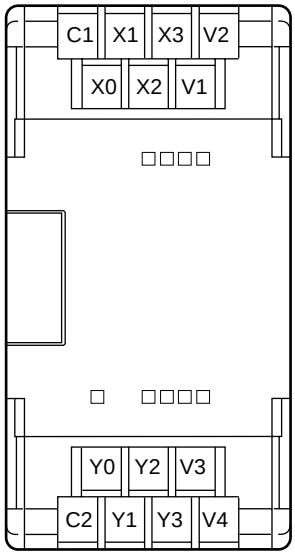
Item	Specifications
Output type	Transistor (NPN/PNP)
External connection method	Terminal block
Rated load voltage	30 VDC
Rated output current	0.5A/point (NPN), 0.3A/point (PNP)
Leak current in OFF status	100 μA or less
Residual voltage in ON status	0.8 V or less
Common method	4 points/common
Rising operation time (OFF → ON)	50 μs or less
Falling operation time (ON → OFF)	250 μs or less

➪ *For more about the general specifications, refer to "General Specifications" (p.1-4).*

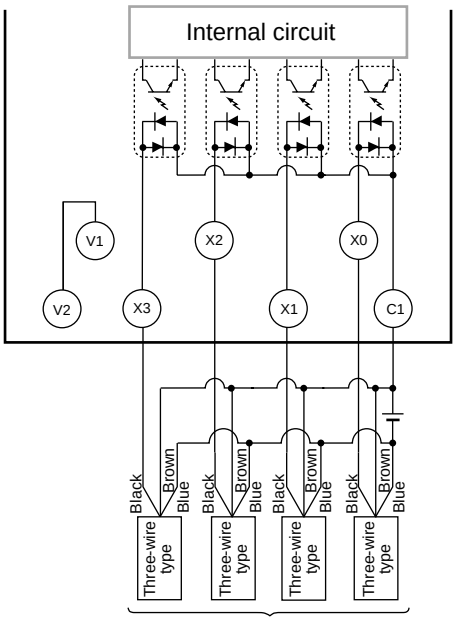
1.10.4 Terminal Layout Drawings and Input Circuit Diagrams

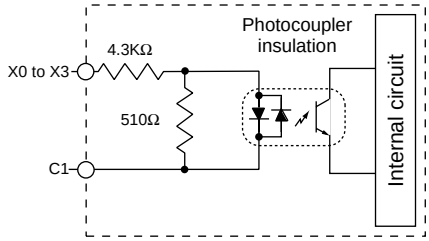
KV-E4XR (Relay output type)

■ **Terminal layout drawing**



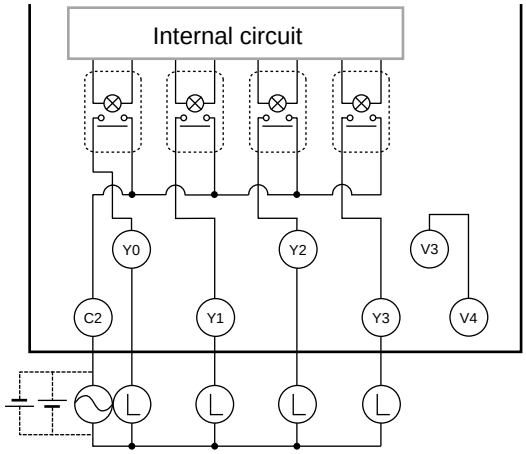
■ **Input circuit diagram**

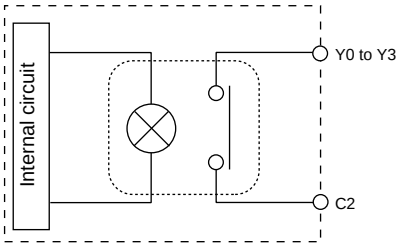




• V1 to V2 and V3 to V4 are short-circuited inside (so they can be used as relay terminal blocks).

■ **Output circuit diagram**

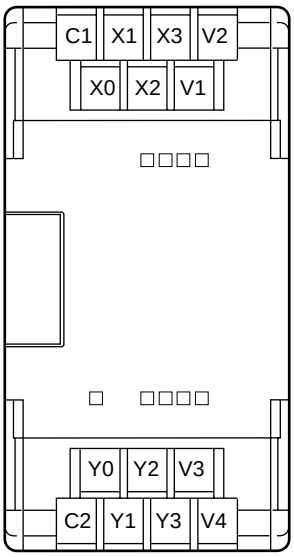




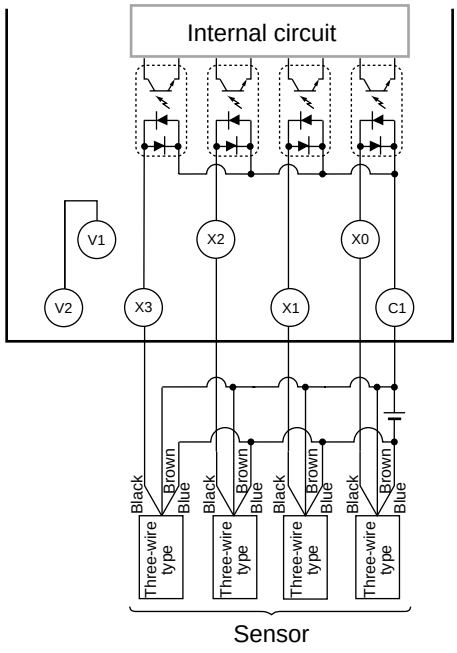
- V1 to V2 and V3 to V4 are short-circuited inside (so they can be used as relay terminal blocks).

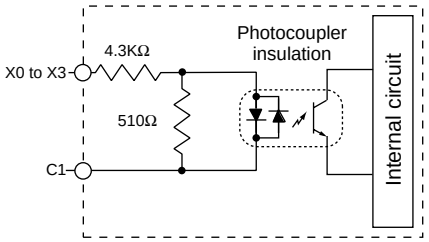
KV-E4XT(P) (Transistor output type)

■ Terminal layout drawing



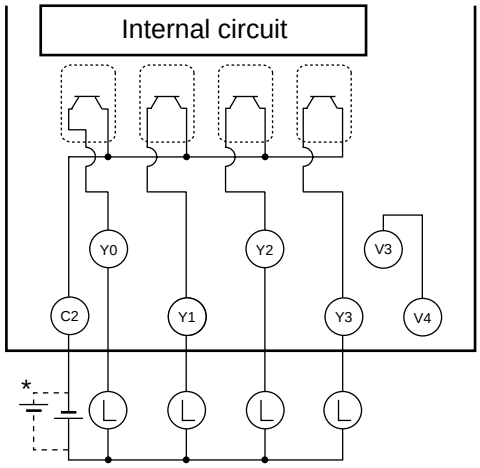
■ Input circuit diagram





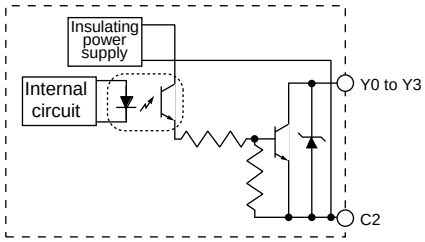
- V1 to V2 and V3 to V4 are short-circuited inside (so they can be used as relay terminal blocks).

■ Output circuit diagram

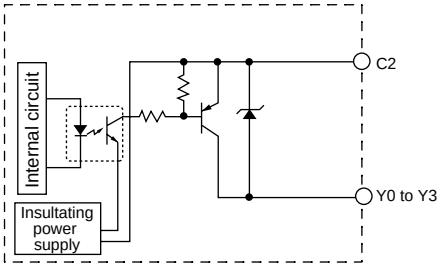


* For KV-E4XTP

NPN



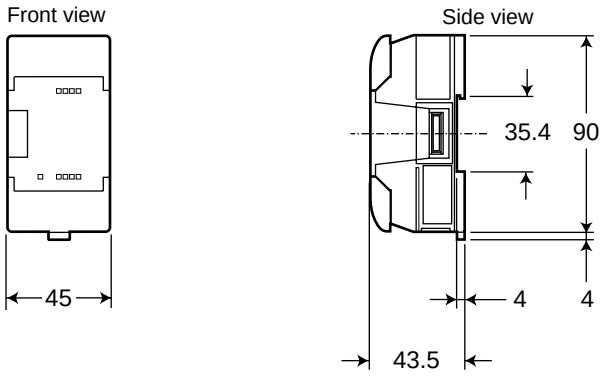
PNP



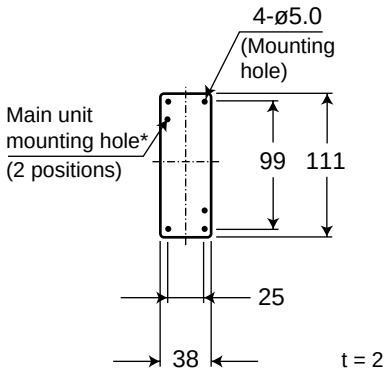
• V1 to V2 and V3 to V4 are short-circuited inside (so they can be used as relay terminal blocks).

1.10.5 Dimensions

■ **Main unit**



■ **Metal fixture for screw tightening**

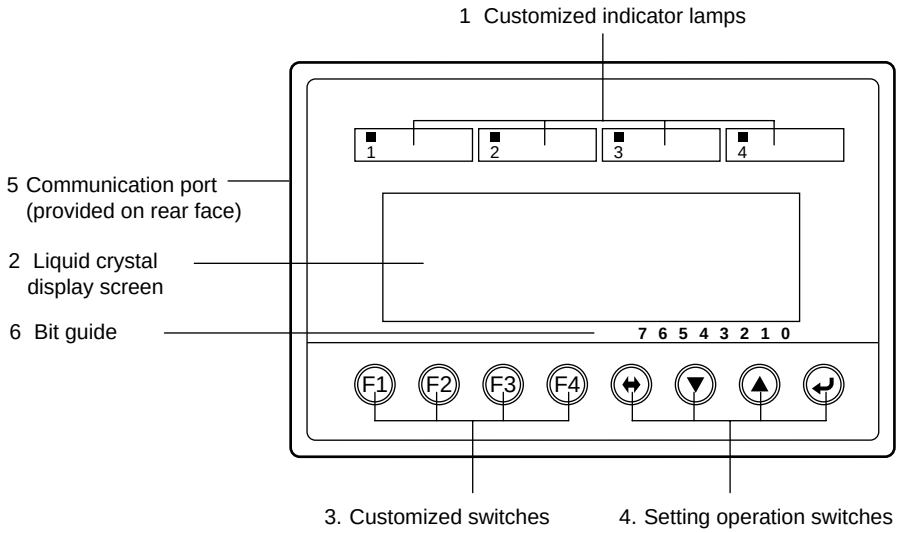


* Two M3.5 countersunk-head screws are included for mounting the main unit.

1.11 KV-D20 (Operator Interface Panel)

This section describes the name and function of each part, the general specifications, the functional specifications, and dimensions of the operator interface panel.

1.11.1 Part Names and Functions



No.	Name	Function
1	**Customized indicator lamps**	Assigned to special utility relays as follows. Lamp 1: 2504 Lamp 2: 2505 Lamp 3: 2506 Lamp 4: 2507 When a relay turns ON, the corresponding LED becomes lit.
2	**Liquid crystal display screen**	Displays ladder comments (up to 20 characters) and all devices in KV Series.
3	**Customized switch**	Assigned to special utility relays as follows. F 1: 2500 F 2: 2501 F 3: 2502 F 4: 2503 When a switch is turned on, the corresponding relay turns ON.
4	**Setting operation switches**	Changes screen display.
5	**Communication port**	RJ-11 Modular connector. Used for communication between KV basic units while connected to the basic unit's communication port with an accessory cable (OP-26487). This port also supplies driving power for the KV-D20.
6	**Bit guide**	Shows the corresponding number of each bit on the KV-I/O monitor screen, the operator screen, or the 8-bit ON/OFF indication in the device mode.

1.11.2 General Specifications

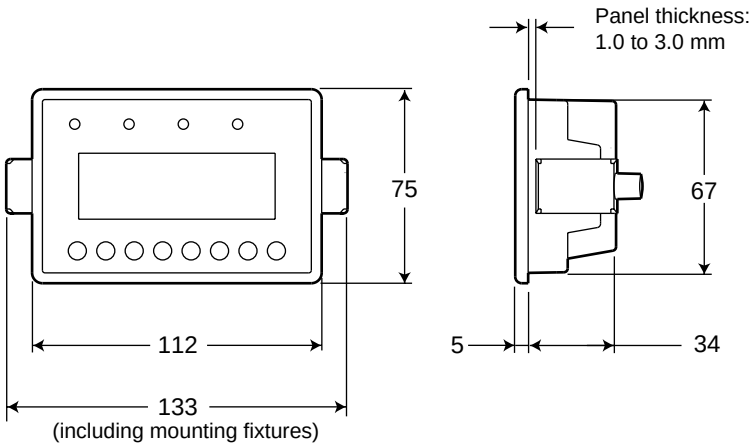
Item	Specifications
Supply voltage	Supplied from the communication port of the KV (5 VDC)
Current consumption	5 VDC, 180 mA max. (60 mA max. when converted for 24 V)
Ambient temperature	0 to +50°C (32 to122°F), No freezing
Relative humidity	35 to 85%, No condensation
Ambient storage temperature	-20 to +70°C (-4 to 158°F), No freezing
Withstand voltage	1,500 VAC for 1 minute (Between power terminal and I/O terminal as well as between entire external terminals and case)
Noise immunity	1,500 Vp-p or more, pulse width: 1 µs, 50 ns (by noise simulator) Conforms to EN standard (EN61000-4-2/-3/-4/-6)
Vibration	10 to 55 Hz, double amplitude: 1.5 mm, 2 hours in each of X, Y and Z axis directions
Insulation resistance	50 MΩ or more (Between power terminal and I/O terminal as well as between entire external terminals and case by 500 VDC megohmmeter)
Operating atmosphere	No excessive dust or corrosive gases.
Weight	Main unit: Approx. 160 g Communication cable: Approx. 60 g Mounting fixture: 30 g (2 pieces)
Enclosure rating	Built-in panel, IP-65F only for the front operation panel

1.11.3 Functional Specifications

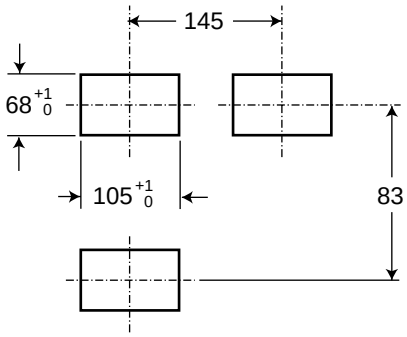
Item	Specifications
Number of connectable units	1 per basic unit
Display screen	Blue-negative type backlighted LCD, 20 digits x 4 lines
Character size	2.95 x 4.75 mm (5 x 7 dots)
Customized switches	4 switches assigned to special utility relays F1: 2500 F2: 2501 F3: 2502 F4: 2503
Setting operation switch	⬌ ▼ ▲ ↩
Customized indicator lamps	Four red LEDs assigned to special utility relays Lamp 1: 2504 Lamp 2: 2505 Lamp 3: 2506 Lamp 4: 2507

1.11.4 Dimensions

■ **Main unit**



■ **Panel cut size**



Chapter 2

System Installation

This chapter describes the installation and connection of each Visual KV Series unit as well as system maintenance.

2.1 Installation Environment

This section describes cautions with the environment in which each unit is installed and the installation position inside the panel.

2.1.1 Installation Environment

Never install a unit in the following locations:

- Locations exposed to direct sunlight
- Locations whose ambient temperature is outside the allowable range of 0 to +50°C
- Locations whose ambient humidity is outside the allowable range of 35 to 85% RH
- Locations subject to drastic temperature change where condensation may occur
- Locations with corrosive or flammable gases
- Locations with excessive dust, salt, iron powder, or soot
- Locations subject to direct vibrations and impacts
- Locations subject to splashes of water, oil, chemicals, etc.
- Locations where a strong magnetic or electrical field is generated

⚠ CAUTION

Units are made of synthetic resin. If the unit surface touches a solvent with a strong dissolving force, it could melt. Keep such solvents away from the units.

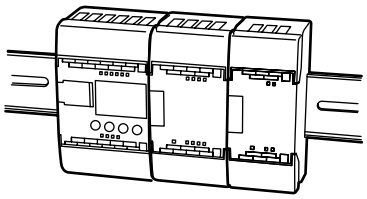
2.1.2 Installation Position

■ Installation direction

When attaching a unit inside a panel, install the unit so that the front face (equipped with the Access Window, communication ports, etc.) faces front or upwards.

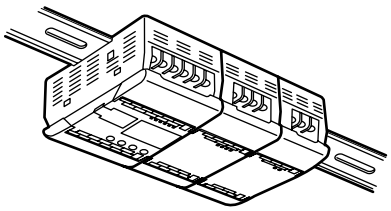
Front installation

Correct



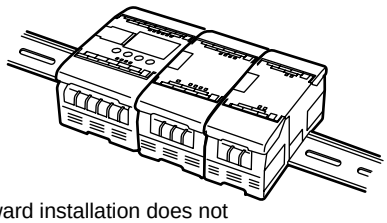
Installation on ceiling

Incorrect



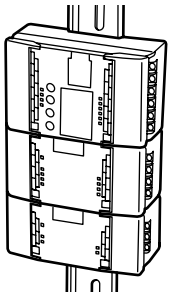
Upward installation *

Correct



Vertical installation

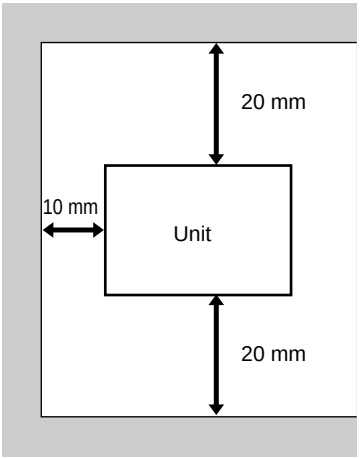
Incorrect



* Upward installation does not comply with CE marking.

■ Distance between adjacent panels/equipment

When installing a unit, keep the distances shown below between the panel or equipment so that the power supply can release heat.



Note 1: If the temperature inside the panel exceeds 50°C, which is specified as the maximum ambient operating temperature, then install heat exchangers, etc. to reduce the temperature.

Note 2: Ensure sufficient ventilation space so that the power supply can release heat.

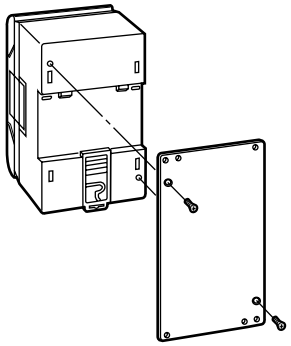
Note 3: Never install a unit just above any equipment which generates a lot of heat.

2.1.3 Installation Procedure

This section describes how to attach a connected unit directly to a panel, to a DIN rail, or to a DIN rail with an expansion unit spacer.

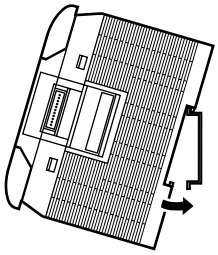
■ Attaching a unit directly to a panel

Attach the metal fixture for screw tightening to each KV Series unit using the countersunk-head screws through the countersunk holes. Mount the fixture directly to the panel.



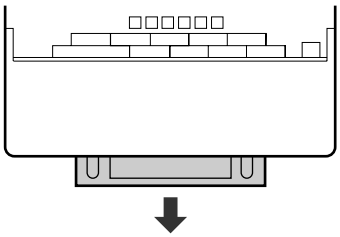
■ Attaching a unit to a DIN rail

Hang an upper claw of a Visual KV Series basic unit to the upper side of the DIN rail, and press the basic unit onto the DIN rain until a click sound is heard.



■ Removing a unit from a DIN rail

Pull a lower claw of a Visual KV Series basic unit downward from the front direction using a screw-driver, and then remove the basic unit from the DIN rail.



Expansion unit spacer

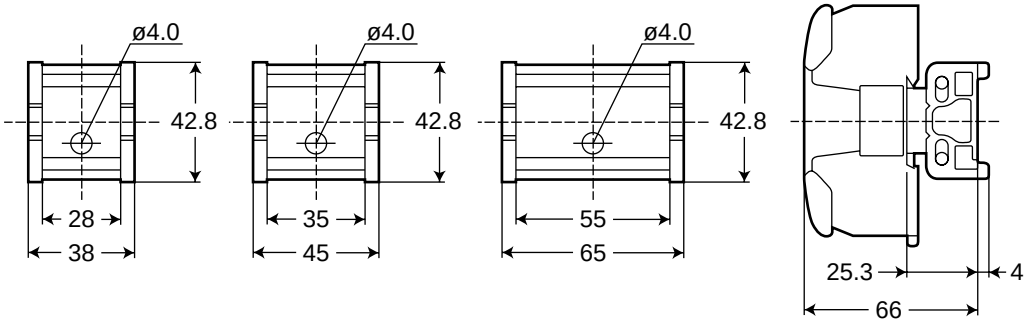
When an expansion unit spacer is attached to a Visual KV Series expansion unit, its height becomes flush with an AC power type Visual KV Series basic unit.
The procedure to attach a Visual KV Series expansion unit to an expansion unit spacer is the same as the procedure to attach a Visual KV Series unit to a DIN rail. Refer to the instruction manual supplied with the Visual KV Series for DIN rail mounting.

■ Dimensions for expansion unit spacers

OP-35342
Spacer for 4-I/O expansion unit

OP-35343
Spacer for 8-I/O expansion unit

OP-35344
Spacer for 16-I/O expansion unit



2.1.4 Cautions on Wiring for Each Unit

This section describes cautions to keep in mind when wiring is performed for I/O units.
Be sure to read this section before starting wiring.

Wiring procedures for basic units

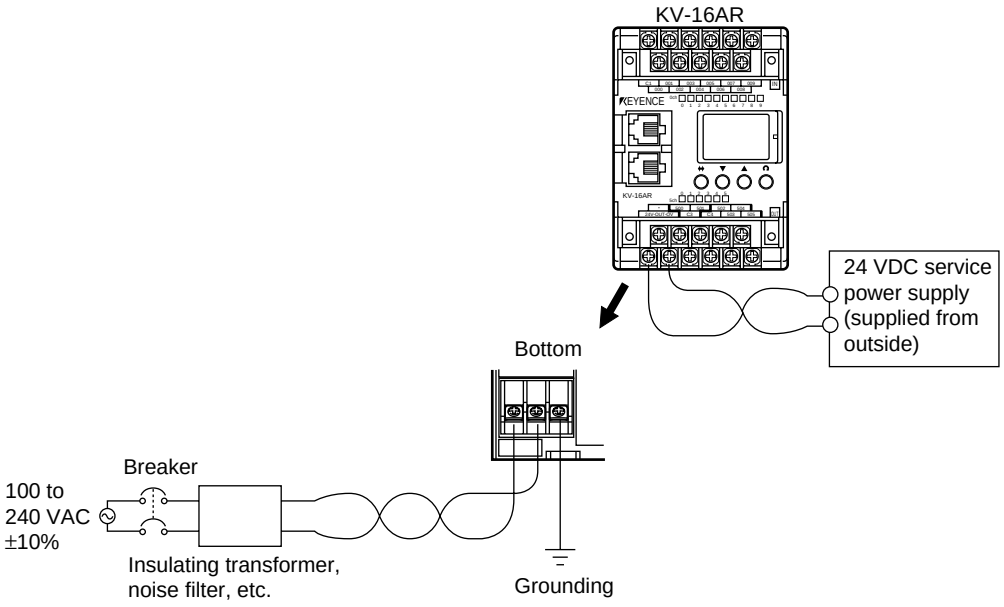
The wiring procedures for basic units are described below.

⚠ CAUTION

- ***Turn off the power before starting wiring.***
- ***For the installation position, select a location whose ambient temperature is 0 to +50°C, whose ambient humidity is 35 to 85% RH, and one which is not subject to drastic temperature changes.***
- ***If the 24 VDC + output terminal and the 24 VDC - output terminal are switched, the power supply unit and connected units may be damaged. Never switch them.***
- ***Be sure that the sum of the current consumption of all connected units does not exceed the output capacity of the service power supply. If the system is operating in an overload status, the internal circuits may generate heat or be damaged. To recover from an overload status, disconnect some of the connected units.***
- ***Never connect the DC output of any other power supply, either in serial or parallel, to the 24 VDC output terminals. If the DC output is connected, the power supply unit may be damaged.***

■ **Wiring for an AC type basic unit**

For an AC type basic unit, perform the wiring as shown in the figure below.



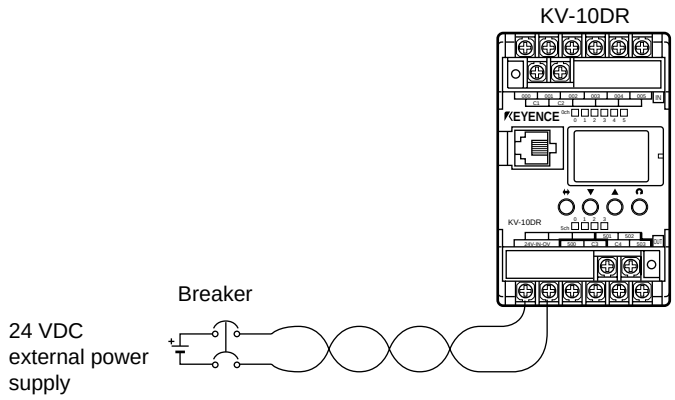
Note 1: Connect an insulating transformer (1:1) or noise filter to reduce line noise.

Note 2: Use twisted cables to reduce induction effects.

Note 3: When using a basic unit in a location with a lot of noise, the noise may be reduced by completely grounding the basic unit.

■ **Wiring for a DC type basic unit**

For a DC type basic unit, perform the wiring as shown in the figure below.



Note: Connect the power supply to the power supply input terminals with 24 VDC output, which offers a sufficient margin of power capacity. Usually, the sum of the current consumption of all connected units multiplied by 1.5 or more is required for the power capacity.

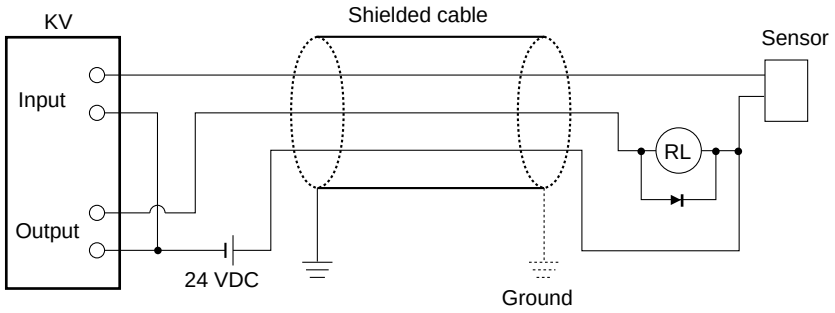
Cautions on wiring for I/O units

When performing wiring for an I/O unit, pay strict attention to the following contents.

- Separate input lines from output lines in wiring.
- If the wiring for power is located near I/O signal lines, a malfunction may occur caused by the effects of a high voltage and large current.
- Keep I/O signal lines away from the power wiring by at least 100 mm.
- Separate 24 VDC I/O lines from 100 VAC and 200 VAC lines.
- When using pipes for wiring, make sure that the pipes are securely grounded.

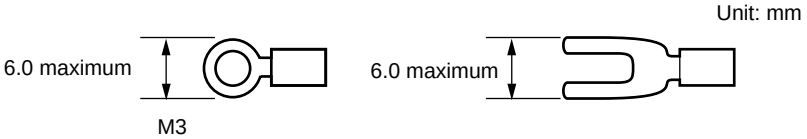
■ **When I/O signal lines cannot be separated from the wiring for power**

In such a case, perform grounding on the KV side using batch-shielded cables. (In some environments, grounding should be performed on the reverse side of the KV.)



Terminal

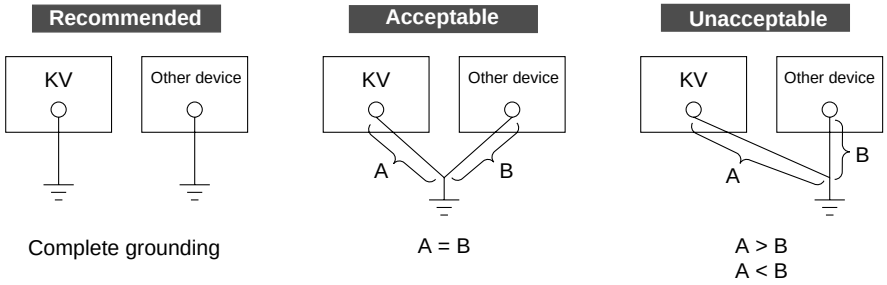
The terminal screws used are M3. When performing wiring with crimp-style terminals, use the following ones.



Cautions on grounding

Because the Visual KV Series is constructed to be sufficiently resistant to noise, it can usually be used without being grounded. However, when the Visual KV Series is used in an environment with a lot of noise, grounding is required. In such a case, pay strict attention to the following contents.

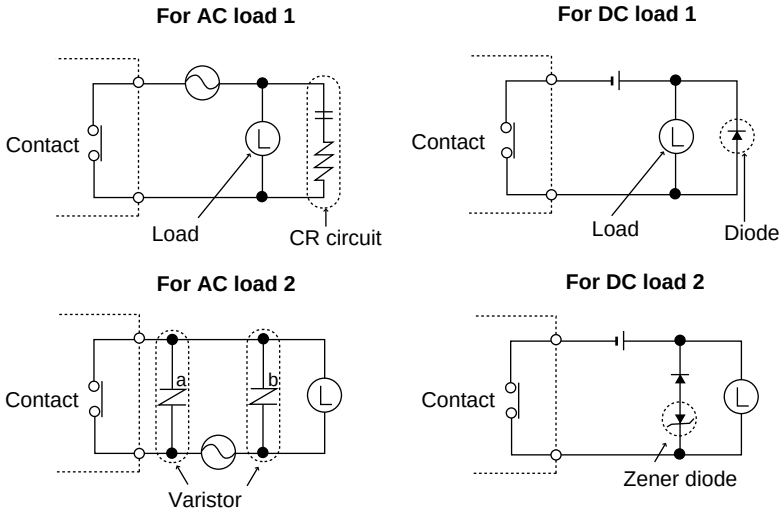
- Perform complete grounding for each individual unit. In this case, the ground resistance should be 100 Ω or less.
- If individual grounding is not possible, perform common grounding. In this case, the length of each grounding cable should be equal.



2.1.5 Contact Protection

If inductive loads such as clutches, motors, and solenoids are used, a rush current may flow when the load power supply is turned on, or a counter electromotive voltage may be generated when the load power supply is shut down. The rush current and the counter electromotive voltage can contribute considerably to shortening the service life of the contacts. To prevent this from happening, provide a contact protection circuit.

■ **Contact protection circuit examples**



When the supply voltage is 24 to 48 V, provide a protection circuit in position "b". When the supply voltage is 100 to 200 V, provide a protection circuit in position "a".

Note 1: Use a load coil whose rating is less than the contact capacity.

Note 2: Use a diode whose peak inverse voltage is 10 times or more the circuit voltage and whose forward current is not less than the load current.

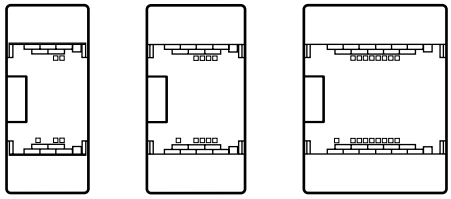
Note 3: Individually attach diodes, varistors, and CR circuits directly to the relay coil terminal.

2.2 Connecting Visual KV Series Expansion Units

This section describes the method to connect Visual KV Series expansion units to a Visual KV Series basic unit and the various functions of expansion units.

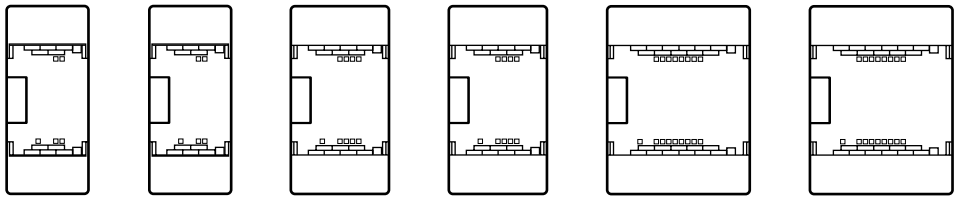
2.2.1 Visual KV Series Expansion Units

Visual KV Series expansion input units



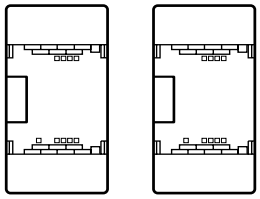
KV-E4X KV-E8X KV-E16X

Visual KV Series expansion output units



KV-E4R KV-E4T KV-E8R KV-E8T(P) KV-E16R KV-E16T(P)

Visual KV Series expansion I/O units

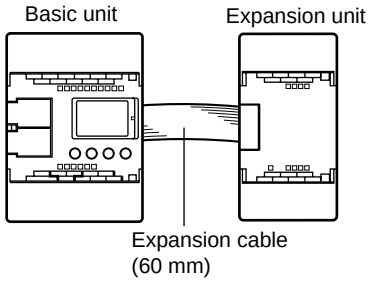


KV-E4XR KV-E4XT(P)

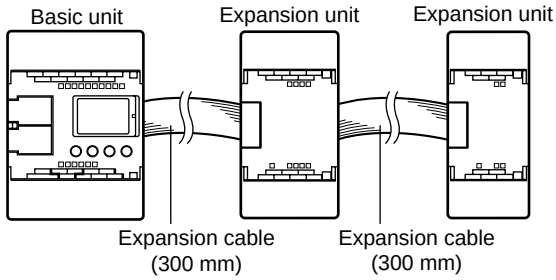
2.2.2 Connecting Visual KV Series Expansion Units

- Connect a basic unit and an expansion unit with an expansion cable.
- An expansion cable approximately 60 mm long is provided as standard.
- When extending the expansion cable, use long expansion cables (300 mm) (OP-35361).
- Up to two expansion cables (300 mm) can be connected to one basic unit.
- The READY/ERROR LED is lit during normal communication, flashes when an abnormality occurs, and is not lit when the power is not supplied correctly. If this LED is not lit, check whether the expansion cables are correctly connected.

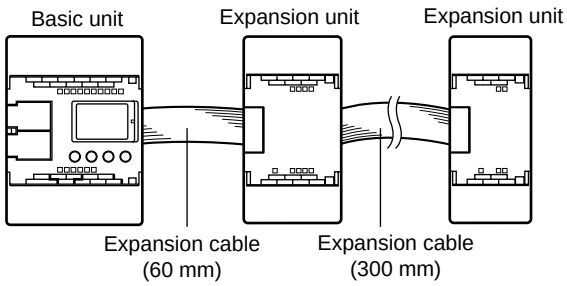
Standard cable (approx. 60 mm)



Long cable (approx. 300 mm)



Standard cable (approx. 60) + Long cable (approx. 300 mm)



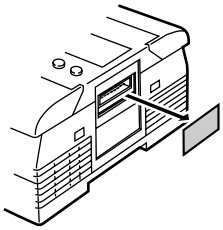
CAUTION

Be sure to turn off the power before connecting or disconnecting expansion cables. If they are connected or disconnected while the power is on, the units may be damaged or fail.

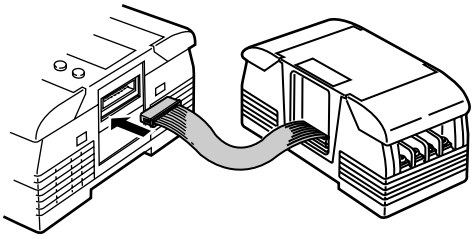
Note: Keep noise sources such as power cables and electromagnetic switches away from expansion cables (300 mm) as much as possible.

Connection methods

1. Peel off the tape stuck to the right side of the basic unit.



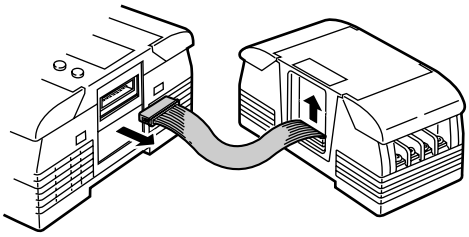
2. Connect an expansion cable to the connector.



■ **When extending a cable**

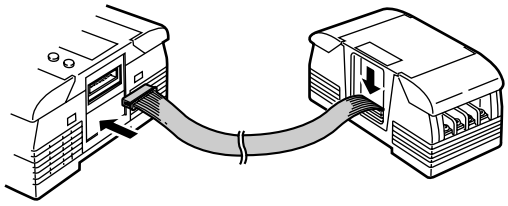
Replace a standard expansion cable (60 mm) with an optional expansion cable (300 mm) (OP-35361).

1. Disconnect the standard expansion cable from the expansion unit connector.



2. Connect an optional expansion cable (300 mm) to the expansion unit connector.

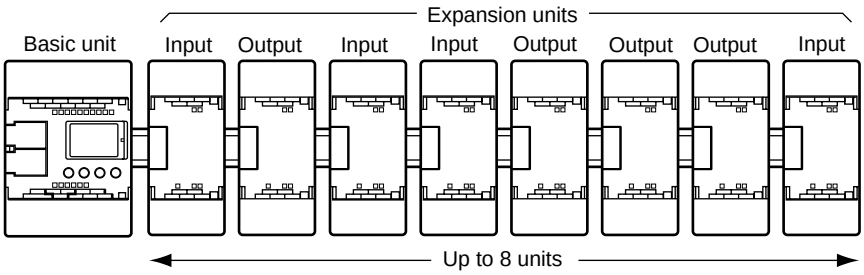
3. Connect the optional expansion cable (300 mm) to the basic unit connector.



Number of connectable units

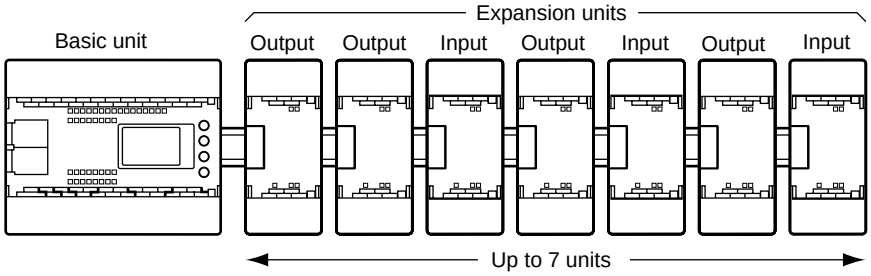
● **When the basic unit is a KV-10xx/16xx/24xx**

Up to four input units and four output units (that is, up to 8 total expansion units) can be connected to one basic unit.



● **When the basic unit is a KV-40xx**

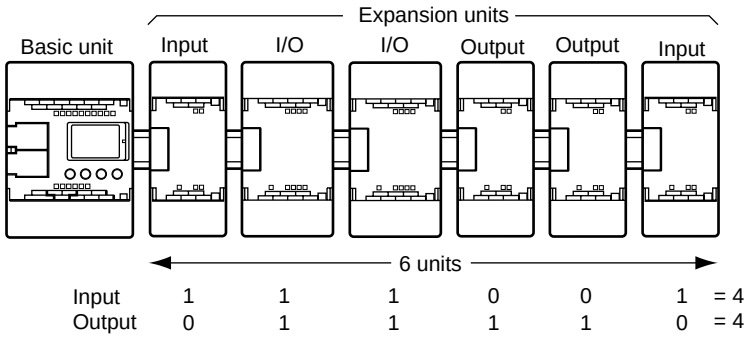
Up to three input units and four output units (that is, up to 7 total expansion units) can be connected to one basic unit.



● **When KV-E4XT/KV-E4XR expansion I/O units are connected**

One I/O unit is regarded as two units (that is, one input and one output unit). For example, when only expansion I/O units are connected to one basic unit, up to four expansion I/O units can be connected. Up to three expansion I/O units can be connected to a KV-40xx basic unit.

When two expansion I/O units are connected



Note 1: There are no restrictions about the order of connected expansion units.

Note 2: When connecting expansion units to an AC power type basic unit, be sure that the total current consumption of all connected units does not exceed the output capacity of the Visual KV Series basic unit. Otherwise, consider to use a DC power type basic unit in conbination with an external DC power supply having enough capacity.

2.2.3 Confirming the Connection Settings of Expansion Units

Relay No. (unit No., address No., contact No.)

The relay No. of each expansion unit is automatically assigned in the order of connection.

Expansion unit relay list

■ **Input units**

Connection order	KV-E4X		KV-E8X		KV-E16X	
	KV-10/16/24	KV-40	KV-10/16/24	KV-40	KV-10/16/24	KV-40
1st input unit	100 to 103	200 to 203	100 to 107	200 to 207	100 to 115	200 to 115
2nd input unit	200 to 203	300 to 303	200 to 207	300 to 307	200 to 215	300 to 315
3rd input unit	300 to 303	400 to 403	300 to 307	400 to 407	300 to 315	400 to 415
4th input unit	400 to 403	–	400 to 407	–	400 to 415	–

■ **Output units**

Connection order	KV-E4T/R	KV-E8T(P)/R	KV-E16T(P)/R
1st output unit	600 to 603	600 to 607	600 to 615
2nd output unit	700 to 703	700 to 707	700 to 715
3rd output unit	800 to 803	800 to 807	800 to 815
4th output unit	900 to 903	900 to 907	900 to 915

■ **I/O units**

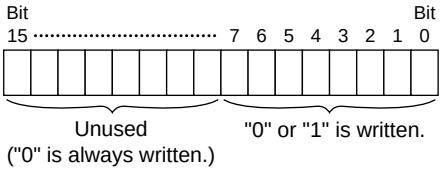
Connection order	KV-E4XR/T(P)			
	Input relay		Output relay	
	KV-10/16/24	KV-40	KV-10/16/24	KV-40
1st input unit	100 to 103	200 to 203	—	—
2nd input unit	200 to 203	300 to 303	—	—
3rd input unit	300 to 303	400 to 403	—	—
4th input unit	400 to 403	—	—	—
1st output unit	—	—	600 to 603	600 to 603
2nd output unit	—	—	700 to 703	700 to 703
3rd output unit	—	—	800 to 803	800 to 803
4th output unit	—	—	900 to 903	900 to 903

Connection information for expansion units

The connection status (connected or unconnected) of a connected expansion unit can be confirmed using the Access Window, the ladder support software "KV IncrediWare (DOS)" and "LADDER BUILDER for KV", or the KV-P3E(01) handheld programmer.

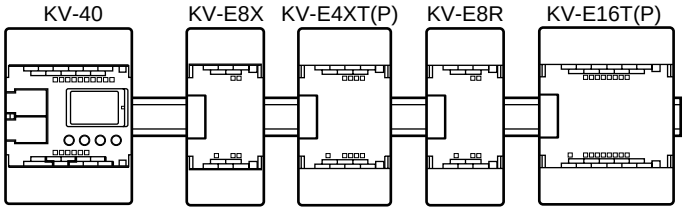
⇨ *Refer to "Chapter 3. Access Window" (p.1-79), "Chapter 6. Handheld Programmer" (p.1-195), and the "6.2.9. Displaying the Use Status" (p. 2-70).*

The connection information is written to data memory DM1937 as shown in the table below.

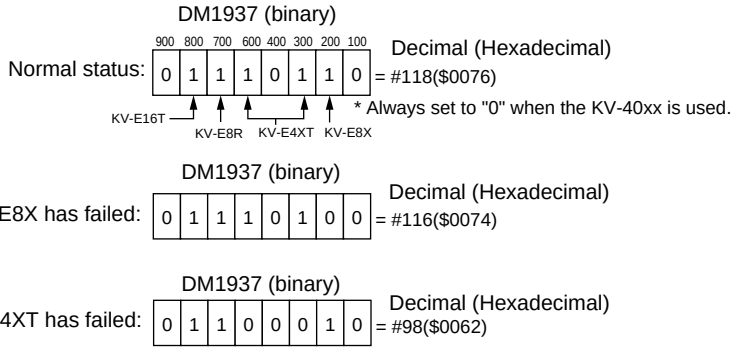


DM1937 display digit	Indication contents
Bit 0*	Connection of expansion input unit with relay Nos. 0100 to 0115 0: Unconnected or disconnected 1: Connected
Bit 1	Connection of expansion input unit with relay Nos. 0200 to 0215 0: Unconnected or disconnected 1: Connected
Bit 2	Connection of expansion input unit with relay Nos. 0300 to 0315 0: Unconnected or disconnected 1: Connected
Bit 3	Connection of expansion input unit with relay Nos. 0400 to 0415 0: Unconnected or disconnected 1: Connected
Bit 4	Connection of expansion output unit with relay Nos. 0600 to 0615 0: Unconnected or disconnected 1: Connected
Bit 5	Connection of expansion output unit with relay Nos. 0700 to 0715 0: Unconnected or disconnected 1: Connected
Bit 6	Connection of expansion output unit with relay Nos. 0800 to 0815 0: Unconnected or disconnected 1: Connected
Bit 7	Connection of expansion output unit with relay Nos. 0900 to 0915 0: Unconnected or disconnected 1: Connected

* Always set to "0" when the KV-40xx is used.



In the case of connection above, DM1937 is set as follows.



Input time constant for expansion units

The initial setting of the time constant is "10 ms" for each expansion unit.
The input time constant can be set to "10 μs" using the Access Window, the ladder support software "KV IncrediWare (DOS)" and "LADDER BUILDER for KV", or the KV-P3E(01) handheld programmer.

Change the value of special utility relays 2609 to 2612.

Special utility relay No.	Function
2609*	Input time constant of expansion input unit with relay Nos. 0100 to 0115 OFF: 10 ms ON: 10 μs
2610	Input time constant of expansion input unit with relay Nos. 0200 to 0215 OFF: 10 ms ON: 10 μs
2611	Input time constant of expansion input unit with relay Nos. 0300 to 0315 OFF: 10 ms ON: 10 μs
2612	Input time constant of expansion input unit with relay Nos. 0400 to 0415 OFF: 10 ms ON: 10 μs

* Not used for the KV-40xx.

Clearing the input value when disconnecting

The system can be set so that the input value is cleared when disconnection has occurred for some reason.

This setting can be performed using the Access Window, the ladder support software "KV IncrediWare (DOS)" and "LADDER BUILDER for KV", or the KV-P3E(01) handheld programmer.

Change the value of special utility relay 2613. Enter "0" or "1".

Special utility relay No.	Function
2613	Clears input when expansion is disconnected. OFF: Holds previous value. ON: Clears input.

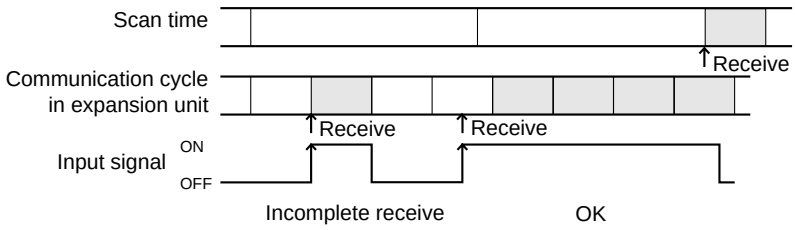
2.2.4 Transferring I/O Information between Expansion Units and the Basic Unit

An expansion unit operates at a cycle of 800 μs without depending on the scan time. When performing input while setting the input time constant of an expansion unit to 10 μs, or when synchronizing the output of a basic unit with the output of an expansion unit, pay strict attention to the following contents.

When inputting

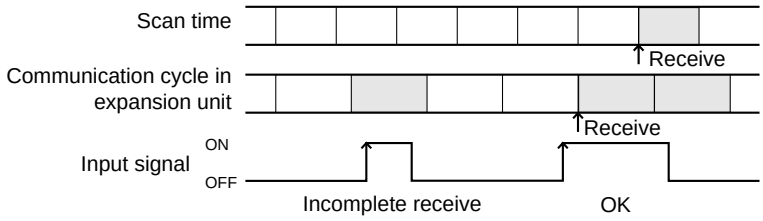
■ **When the scan time is longer than 800 μs (communication cycle) plus 10 μs (input time constant)**

Set the input signal ON time equal to or longer than the scan time.



■ **When the scan time is equal to or shorter than 800 μs (communication cycle) plus 10 μs (input time constant)**

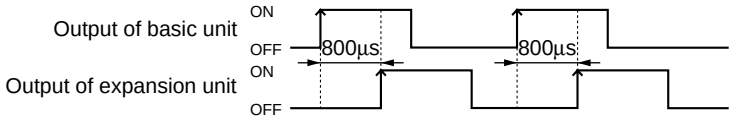
Set the input signal ON time to 810 μs or longer.



In the case of output

The output of an expansion unit is delayed by a maximum of 800 μs from the output of a basic unit.

When synchronizing the output of an expansion unit with the output of a basic unit, pay strict attention to the communication cycle.



Note: When the output ON time is 800 μs or shorter, the output may be aborted.

2.3 Inspection and Maintenance

This section describes the inspection and maintenance procedures for units.

2.3.1 Inspection

While basic units and other units have been used for a long period of time, the connector connection area may become loose, the battery may wear out, or another nonconformity may occur in operation.

To avoid any nonconformities, inspect the basic units, other units, and the wiring periodically.

The major inspection items are as follows.

- Check to ensure that the connector connection area is not disconnected or loose.
- Check to ensure that terminals on terminal blocks are not loose.
- Check to ensure that the wiring cables among units and each equipment are not damaged.

2.3.2 Maintenance

While basic units and other units have been used for a long period of time, dirt will adhered. Wipe off any collected dirt with a clean, dry cloth.
Wipe off any dust and dirt that has collected on small and narrow portions with cotton swabs.

CAUTION ***Be sure to turn off the power before starting any inspection or maintenance of the units.***