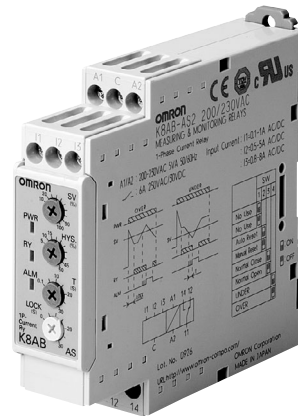


# Single-phase Current Relay K8AB-AS

**Ideal for current monitoring for industrial facilities and equipment.**

- Monitor for overcurrents or undercurrents.
- Manual resetting and automatically resetting supported by one Relay.
- Startup lock and operating time can be set separately.
- One SPDT output relay, 6 A at 250 VAC (resistive load).
- Output relay can be switched between normally open and normally closed.
- Process control signal (4 to 20 mA) supported.
- Commercial CT input signal (0 to 1 A, 0 to 5 A) supported.
- Output status can be monitored using LED indicator.



## Model Number Structure

### ■ Model Number Legend

**K8AB-**

1      2 3      4

#### 1. Basic Model

K8AB: Measuring and Monitoring Relays

#### 2. Functions

AS: Single-phase Current Relay (One-sided operation)

#### 3. Measuring Current

1: 2 to 20 mA AC/DC, 10 to 100 mA AC/DC, 50 to 500 mA AC/DC

2: 0.1 to 1 A AC/DC, 0.5 to 5 A AC/DC, 0.8 to 8 A AC/DC

3: 10 to 100 A AC, 20 to 200 A AC (See note.)

**Note:** The K8AB-AS3 is specially designed to be used in combination with the OMRON K8AC-CT200L Current Transformer (CT). (Direct input is not possible.)

#### 4. Supply Voltage

24 VDC: 24 VDC

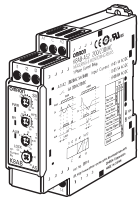
24 VAC: 24 VAC

100-115 VAC: 100 to 115 VAC

200-230 VAC: 200 to 230 VAC

# Ordering Information

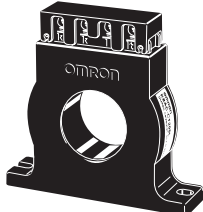
## List of Models

Single-phase Current Relay	Measuring current	Supply voltage	Model
	2 to 20 mA AC/DC, 10 to 100 mA AC/DC, 50 to 500 mA AC/DC	24 VDC, not insulated	<b>K8AB-AS1 24 VDC (See note 1.)</b>
		24 VAC, insulated	<b>K8AB-AS1 24 VAC</b>
		100-115 VAC, insulated	<b>K8AB-AS1 100-115 VAC</b>
		200-230 VAC, insulated	<b>K8AB-AS1 200-230 VAC</b>
	0.1 to 1 A AC/DC, 0.5 to 5 A AC/DC, 0.8 to 8 A AC/DC	24 VDC, not insulated	<b>K8AB-AS2 24 VDC (See note 1.)</b>
		24 VAC, insulated	<b>K8AB-AS2 24 VAC</b>
		100-115 VAC, insulated	<b>K8AB-AS2 100-115 VAC</b>
		200-230 VAC, insulated	<b>K8AB-AS2 200-230 VAC</b>
	10 to 100 A AC, 20 to 200 A AC (See note 2.)	24 VDC, not insulated	<b>K8AB-AS3 24 VDC (See note 1.)</b>
		24 VAC, insulated	<b>K8AB-AS3 24 VAC</b>
		100-115 VAC, insulated	<b>K8AB-AS3 100-115 VAC</b>
		200-230 VAC, insulated	<b>K8AB-AS3 200-230 VAC</b>

- Note: 1.** Models with a 24-VDC power supply have a non-isolated power supply. The inputs and power supply are connected internally, so a malfunction may occur due to an unwanted current path if the inputs and power supply are connected to the same line. If an unwanted current path exists, use a K8AB AC Power Supply or isolate with an external power supply.
- 2.** The K8AB-AS3 is designed to be used in combination with an OMRON K8AC-CT200L Current Transformer (CT). (Direct input is not possible.)

## Accessory (Order Separately)

### OMRON CT

Current Transformer	Input range	Applicable Relay	Model
	10 to 100 A AC, 20 to 200 A AC	K8AB-AS3	<b>K8AC-CT200L</b>

### Other CTs

CT current on secondary side	Applicable Relay
0 to 1 A AC, 0 to 5 A AC	K8AB-AS2

# Ratings and Specifications

## Input Range

Model	Range	Connection terminal	Input impedance	Overload capacity
K8AB-AS1-J	2 to 20 mA AC/DC	I1-COM	Approx. 5 Ω	120% max. input continuous 150% max. input for 1 s
	10 to 100 mA AC/DC	I2-COM	Approx. 1 Ω	
	50 to 500 mA AC/DC	I3-COM	Approx. 0.2 Ω	
K8AB-AS2-J	0.1 to 1 A AC/DC	I1-COM	Approx. 0.12 Ω (load: 0.5 VA)	120% max. input continuous 200% max. input for 30 s 600% max. input for 1 s
	0.5 to 5 A AC/DC	I2-COM	Approx. 0.02 Ω (load: 1.5 VA)	
	0.8 to 8 A AC/DC	I3-COM	Approx. 0.02 Ω (load: 3 VA)	
K8AB-AS3-J	10 to 100 A AC	I2-COM	Uses commercial CT	120% max. input continuous 200% max. input for 30 s 600% max. input for 1 s
	20 to 200 A AC	I3-COM	Uses commercial CT	

## ■ Ratings

Power supply voltage	Non-isolated power supply	24 VDC (See note.)
	Isolated power supply	24 VAC, 100 to 115 VAC, 200 to 230 VAC
Power consumption		24 VDC: 1 W max. 24 VAC: 4 VA max. 100 to 115 VAC: 4 VA max. 200 to 230 VAC: 5 VA max.
Operating value setting range (SV)		10% to 100% of maximum measuring current K8AB-AS1: 2 to 20 mA AC/DC 10 to 100 mA AC/DC 50 to 500 mA AC/DC K8AB-AS2: 0.1 to 1 A AC/DC 0.5 to 5 A AC/DC 0.8 to 8 A AC/DC K8AB-AS3: When used together with a K8AC-CT200L Current Transformer 10 to 100 A AC 20 to 200 A AC
Operating value		100% operation at set value
Reset value setting range (HYS.)		5% to 50% of operating value
Reset method		Manual reset/automatic reset (switchable) <b>Note:</b> Manual reset: Turn OFF power supply for 1 s or longer.
Operating time setting range (T)		0.1 to 30 s
Startup lock time setting range (LOCK) <b>Note:</b> Enabled only for overcurrent operation.		0 to 30 s (The startup lock timer starts when the input has reached approximately 30% or more of the set value.) <b>Note:</b> Enabled only for overcurrent operation.
Indicators		Power (PWR): Green, Relay output (RY): Yellow, Alarm outputs (ALM): Red
Input impedance		Refer to the "Input Range" on the previous page.
Output relays		One SPDT relay (NO/NC switched using DIP switch.)
Output relay ratings		Rated load Resistive load 6 A at 250 VAC (cosφ = 1) 6 A at 30 VDC (L/R = 0 ms) Inductive load 1 A at 250 VAC (cosφ = 0.4) 1 A at 30 VDC (L/R = 7 ms) Maximum contact voltage: 250 VAC Maximum contact current: 6 A AC Maximum switching capacity: 1,500 VA Minimum load: 10 mA at 5 VDC Mechanical life: 10,000,000 operations Electrical life: Make: 50,000 times, Break: 30,000 times
Ambient operating temperature		-20 to 60°C (with no condensation or icing)
Storage temperature		-40 to 70°C (with no condensation or icing)
Ambient operating humidity		25% to 85% (with no condensation)
Storage humidity		25% to 85% (with no condensation)
Altitude		2,000 m max.
Terminal screw tightening torque		0.49 N·m
Terminal wiring method		Recommended wire Solid wire: 2.5 mm <sup>2</sup> Twisted wires: AWG16, AWG18 <b>Note:</b> 1. Ferrules with insulating sleeves must be used with twisted wires. 2. Two wires can be twisted together. Recommended ferrules Al 1,5-8BK (for AWG16) manufactured by Phoenix Contact Al 1-8RD (for AWG18) manufactured by Phoenix Contact Al 0,75-8GY (for AWG18) manufactured by Phoenix Contact
Case color		Munsell 5Y8/1
Case material		ABS resin (self-extinguishing resin) UL94-V0
Weight		DC models: Approx. 110 g AC models: Approx. 150 g
Mounting		Mounted to DIN Track or via M4 screws (tightening torque: 1.2 N·m)
Dimensions		22.5 (W) × 90 (H) × 100 (D) mm

**Note:** Models with a 24-VDC power supply have a non-isolated power supply; the inputs and power supply are connected internally. If both the input and power supply are grounded, an unwanted current path will be created and the Unit will not operate normally. If an unwanted current path exists, use a K8AB model with an AC power supply or use an isolated DC power supply.

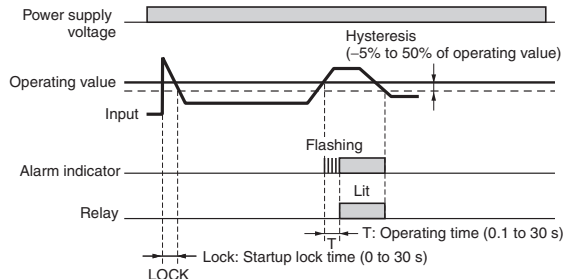
## ■ Specifications

<b>Allowable power supply voltage range</b>		85% to 110% of power supply voltage
<b>Allowable power supply frequency range</b>		50/60 Hz ±5 Hz
<b>Input frequency range</b>		K8AB-AS1 and K8AB-AS2: DC input or AC input (45 to 65 Hz) K8AB-AS3: AC input (45 to 65 Hz)
<b>Overload capacity</b>		K8AB-AS1 and K8AB-AS2: Continuous input: 120% of maximum input, 1 s max.: 150% of maximum input. K8AB-AS3: Continuous input: 120% of maximum input, 30 s max.: 200% of maximum input, 1 s max.: 600% of maximum input <b>Note:</b> Overload capacity of primary side of CT.
<b>Setting error</b>	<b>Operating value</b>	Set value ±10% full scale
	<b>Reset value</b>	
	<b>Operating time</b>	
	<b>Startup lock time</b>	
<b>Repeat error</b>	<b>Operating value</b>	Operating value ±2% Error calculation: Error = ((Maximum operating value – Minimum operating value (over 10 operations))/2)/Average value × 100%
	<b>Reset value</b>	Reset value ±2% Error calculation: Error = ((Maximum reset value – Minimum reset value (over 10 resets))/2)/Average value × 100%
	<b>Operating time</b>	Operating time repeat error: ±50 ms Overcurrent: Measured when input suddenly changes from 0% to 120% of setting. Undercurrent: Measured when input suddenly changes from 120% to 0% of setting.
	<b>Startup lock time</b>	Startup lock time repeat error: ±50 ms (measured at sudden change from 0% to 120% of setting)
<b>Temperature influence</b>		Operating value Drift based on measured value at standard temperature: –20°C to standard temperature: ±1,000 ppm/°C max. Standard temperature to 60°C: ±1,000 ppm/°C max. (Humidity: 25% to 80%) Operating time Fluctuation based on measured value at standard temperature: –20°C to standard temperature: ±10% max. Standard temperature to 60°C: ±10% max. (Humidity: 25% to 80%)
<b>Humidity influence</b>		Operating value Based on ambient humidity of 65% 25% to 80%: ±5% max. Operating time Based on ambient room humidity 25% to 80%: ±10% max.
<b>Influence of power supply voltage</b>		Operating value: ±5% max. Operating time: ±10% max. <b>Note:</b> The error in the operating value and operating time under standard conditions.
<b>Influence of power supply frequency</b>		Operating value: ±5% max. (at 45 to 65 Hz) Operating time: ±10% max. (at 45 to 65 Hz) <b>Note:</b> The error in the operating value and operating time under standard conditions.
<b>Influence of input frequency</b>		Operating value (45 to 65 Hz) K8AB-AS1 and K8AB-AS2: ±5% max. K8AB-AS3: ±10% max. Operating time (45 to 65 Hz) ±10% max. <b>Note:</b> The error in the operating value and operating time under standard conditions.
<b>Applicable standards</b>	<b>Conforming standards</b>	EN60255-5 and EN60255-6 Installation environment (Pollution Degree 2, Overvoltage Category III)
	<b>EMC</b>	EN61326
	<b>Safety standards</b>	UL508
<b>Insulation resistance</b>		20 MΩ min. Between external terminals and case Between power supply terminals and input terminals (excluding models with DC power supply) Between power supply terminals and output terminals Between input terminals and output terminals
<b>Dielectric strength</b>		2,000 VAC for one minute Between external terminals and case Between power supply terminals and input terminals (excluding models with DC power supply) Between power supply terminals and output terminals Between input terminals and output terminals
<b>Noise immunity</b>		1,500 V power supply terminal common/normal mode Square-wave noise of ±1 μs/100 ns pulse width with 1-ns rise time
<b>Vibration resistance</b>		Frequency 10 to 55 Hz, 0.35-mm single amplitude, acceleration 50 m/s <sup>2</sup> 10 sweeps of 5 min each in X, Y, and Z directions
<b>Shock resistance</b>		100 m/s <sup>2</sup> , 3 times each in 6 directions along three axes (up/down, left/right, forward/backward)
<b>Degree of protection</b>		Terminal section: Finger protection

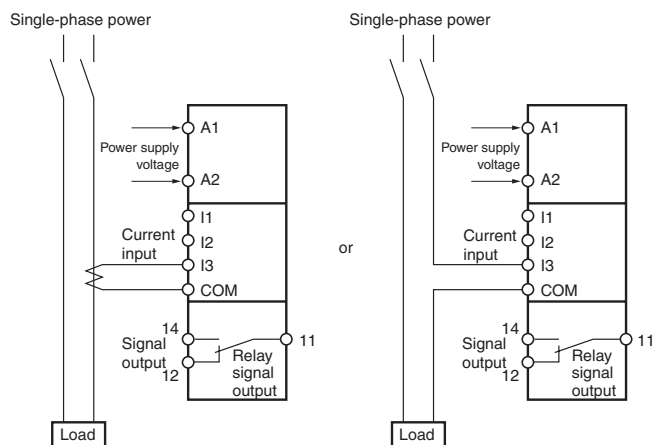
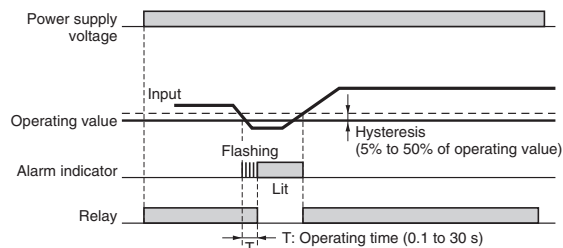
# Connections

## ■ Wiring Diagram

### Overcurrent Operation Diagram (Output: Normally Open)



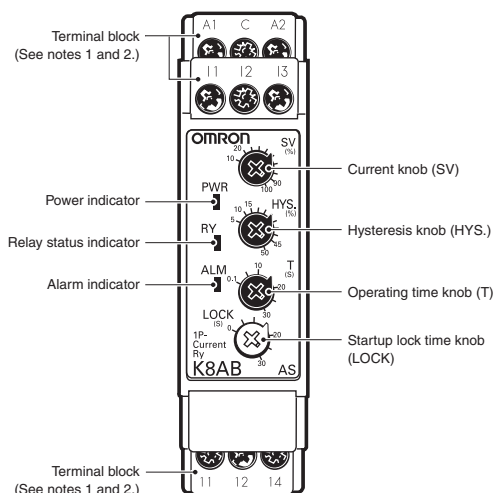
### Undercurrent Operation Diagram (Output: Normally Closed)



**Note:** The K8AB-AS3 is designed to be used in combination with the OMRON K8AC-CT200L Current Transformer (CT). The 24-VDC power supply type is a non-insulated power supply. The inputs and power supply are connected internally, so a malfunction may occur due to an unwanted current path if the inputs and power supply are connected to the same line.

# Nomenclature

## Front



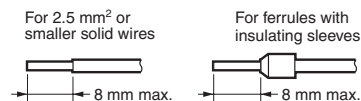
## Indicators

Item	Meaning
Power indicator (PWR: Green)	Lit when power is being supplied.
Relay status indicator (RY: Yellow)	Lit when relay is operating.
Alarm indicator (ALM: Red)	Lit when there is an overcurrent or undercurrent. The indicator flashes to indicate the error status after the input has exceeded the threshold value while the operating time is being clocked.

## Setting Knobs

Item	Usage
Current knob (SV)	Used to set the current to 10% to 100% of maximum measuring current.
Hysteresis knob (HYS.)	Used to set the rest value to 5% to 50% of the operating value.
Operating time knob (T)	Used to set the operating time to 0.1 to 30 s.
Startup lock time knob (LOCK)	Used to set the startup lock time to 0 to 30 s.

**Note: 1.** Use either a solid wire of 2.5 mm<sup>2</sup> maximum or a ferrule with insulating sleeve for the terminal connection. The length of the exposed current-carrying part inserted into the terminal must be 8 mm or less to maintain dielectric strength after connection.



### Recommended ferrules

Phoenix Contact

- Al 1,5-8BK (for AWG16)
- Al 1-8RD (for AWG18)
- Al 0,75-8GY (for AWG18)

### 2. Tightening torque

Recommended: 0.49 N·m  
Maximum: 0.54 N·m

## ■ Operation and Setting Methods

### Setting Ranges and Wiring Connections

Model	Measuring current	Wiring connection
K8AB-AS1	2 to 20 mA AC/DC	I1-COM
	10 to 100 mA AC/DC	I2-COM
	50 to 500 mA AC/DC	I3-COM
K8AB-AS2	0.1 to 1 A AC/DC	I1-COM
	0.5 to 5 A AC/DC	I2-COM
	0.8 to 8 A AC/DC	I3-COM
K8AB-AS3	10 to 100 A AC (See note 2.)	I2-COM
	20 to 200 A AC (See note 2.)	I3-COM

- Note:**
1. The DC input terminals have no polarity.
  2. The K8AB-AS3 is designed to be used in combination with the OMRON K8AC-CT200L Current Transformer (CT). (Direct input is not possible.)

### Connections

#### 1. Input

Connect the input between the I1-COM, I2-COM, or I3-COM terminals, according to the input current. Malfunctions may occur if the input is connected to unused terminals and the Unit will not operate correctly.

Terminal I1 is not used by the K8AB-AS3.

If using the OMRON K8AC-CT200L CT, connect to terminals k and l on the K8AC-CT200L. (Terminals kt and lt are not used.)

#### 2. Power Supply

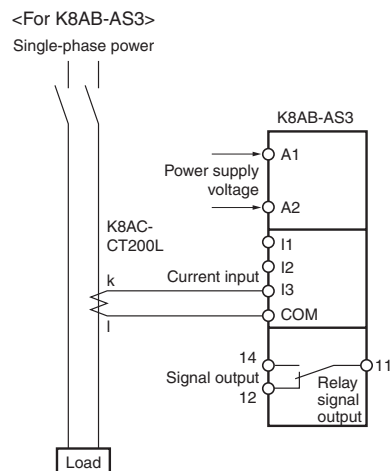
Connect the power supply to terminals A1 and A2.

**Note:** Models with DC power supply have a non-isolated power supply. The input and power supply terminals are connected internally so the K8AB-AS will not operate normally if an unwanted current path is created. If an unwanted current path exists, use a model with an AC power supply or isolate with an external power supply.

#### 3. Outputs

SPDT relays are output to terminals 11, 12, and 14.

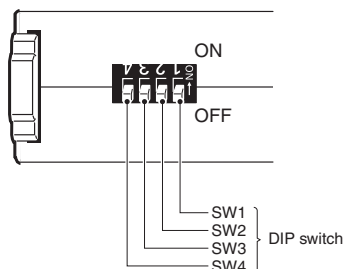
**Note:** Use the recommended ferrules if using twisted wires.



### DIP Switch Settings

The resetting method, relay drive method, and operating mode are set using the DIP switch located on the bottom of the Unit.

K8AB-AS□ does not use SW1.



### DIP Switch Functions

SWITCH	ON ● ↑ OFF ○ ↓	4 ON OFF	3	2	1	
Resetting method	Automatic reset	---	---	●	---	NO USE
	Manual reset	---	---	○	---	
Relay drive method	Normally closed	---	●	---	---	
	Normally open	---	○	---	---	
Operating mode	Undercurrent	●	---	---	---	
	Overcurrent	○	---	---	---	

**Note:** All pins are set to OFF at the factory.

### Setting Method

#### 1. Setting Current

The current knob (SV) is used to set the current.

The current can be set to 10% to 100% of the maximum measuring current.

Turn the knob while there is an input to the input terminals until the alarm indicator flashes (when the set value and the input have reached the same level.)

Use this as a guide to set the current.

The maximum measuring current will differ depending on the model and the input terminal.

Example: K8AB-AS3 Using Input Terminals I3-COM

The maximum measuring current will be 200 A AC and the setting range will be 20 to 200 A.

2. Hysteresis

Hysteresis is set using the hysteresis knob (HYS.)

The setting range is 5 to 50% of the operating value.

Turn the knob while there is an input to the input terminals until the alarm indicator flashes (when the set value and the input have reached the same level.)

Use this as a guide to set the hysteresis.

Example: Maximum of 200 A AC, Current Setting (SV) of 50%, and Overcurrent Operation  
Operation will be at 100 A and resetting at 90 A when the hysteresis (HYS.) is set to 10%.

3. Operating Time

The operating time is set using the operating time knob (T).

The operating time can be set to between 0.1 and 30 s.

Turn the knob while there is an input to the input terminals until the alarm indicator flashes (when the set value and the input have reached the same level.)

Use this as a guide to set the operating time.

If the input current exceeds (drops lower than) the current setting, the alarm indicator will start flashing for the set period and then stay lit.

4. Startup Lock Time

The startup lock time is set using the startup lock time knob (LOCK).

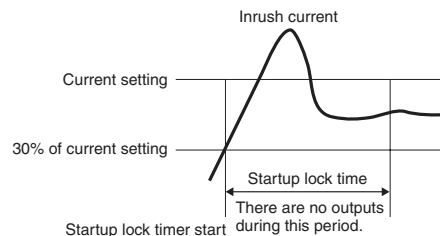
The startup lock time can be set to between 0 and 30 s.

Turn the knob while there is an input to the input terminals until the alarm indicator flashes (when the set value and the input have reached the same level.)

Use this as a guide to set the startup lock time.

The startup lock time will start when the input current reaches 30% or more of the current setting.

Use startup lock time to prevent unwanted operation, e.g., as a result of inrush current.

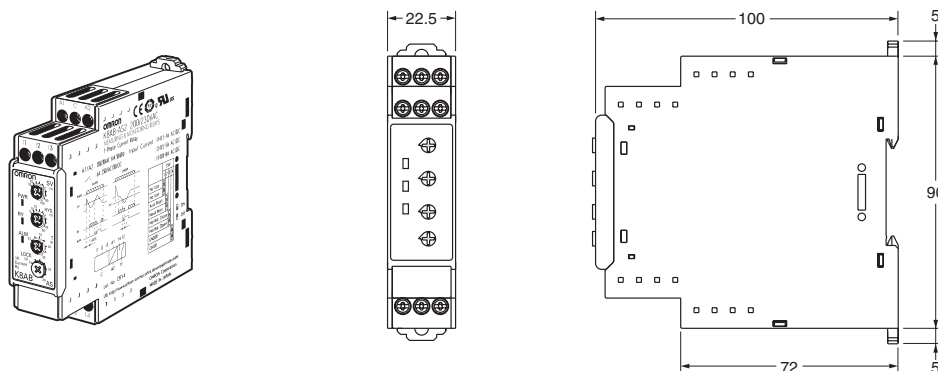


# Dimensions

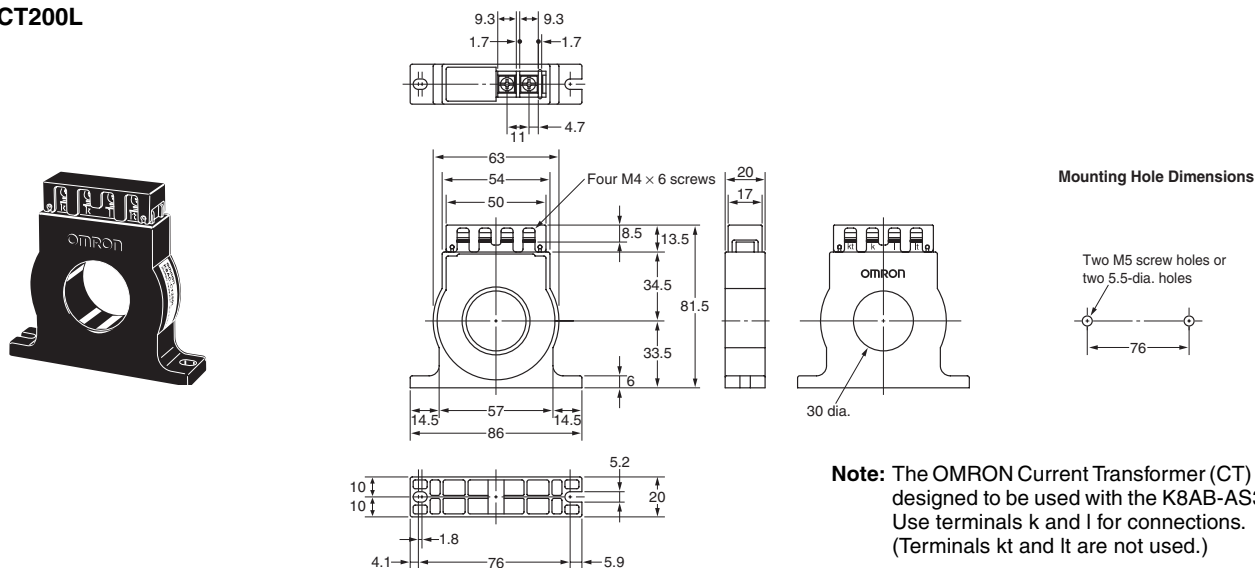
(Unit: mm)

## Single-phase Current Relays

K8AB-AS1  
K8AB-AS2  
K8AB-AS3



OMRON CT  
K8AC-CT200L



**Note:** The OMRON Current Transformer (CT) is designed to be used with the K8AB-AS3. Use terminals k and l for connections. (Terminals kt and lt are not used.)



# Safety Precautions

## ■ Precautions for Safe Use

Make sure to follow the instructions below to ensure safety.

1. Do not use or keep this product in the following environments.
  - Outdoors, or places subject to direct sunlight or wearing weather.
  - Places where dust, iron powder, or corrosive gases (in particular, sulfuric or ammonia gas) exist.
  - Places subject to static electricity or inductive noise.
  - Places where water or oil come in contact with the product.
2. Make sure to install this product in the correct direction.
3. There is a remote risk of electric shock. Do not touch terminals while electricity is being supplied.
4. Make sure to thoroughly understand all instructions in the Instructions Manual before handling this product.
5. Make sure to confirm terminal makings and polarity for correct wiring.
6. Tighten terminal screws firmly using the following torque.  
Recommended tightening torque: 0.49 N·m  
Maximum tightening torque: 0.54 N·m max.
7. Operating ambient temperature and humidity for this product must be within the indicated rating when using this product.
8. There is a remote risk of explosion. Do not use this product where flammable or explosive gas exists.
9. Make sure that no weight rests on the product after installation.
10. To enable an operator to turn off this product easily, install switches or circuit breakers that conform to relevant requirements of IEC60947-1 and IEC60947-3, and label them appropriately.
11. For DC input, use a SELV power-supply capable of overcurrent protection. Specifically, a SELV power-supply has a double or reinforced insulation for input and output, and output voltage of 30 V<sub>r.m.s</sub> with 42.4 V at peak or DC60V maximum.  
Recommended power-supply: Model S8VS-06024□. (Omron product)

## ■ Precautions for Correct Use

### For Proper Use

1. Do not use the product in the following locations.
  - Places subject to radiant heat from heat generating devices.
  - Places subject to vibrations or physical shocks.
2. Make sure to use setting values appropriate for the controlled object. Failure to do so can cause unintended operation, and may result in accident or corruption of the product.
3. Do not use thinner or similar solvent for cleaning. Use commercial alcohol.
4. When discarding, properly dispose of the product as industrial waste.
5. Only use this product within a board whose structure allows no possibility for fire to escape.

### About Installation

1. When wiring, use only recommended crimp terminals.
2. Do not block areas around the product for proper dissipation of heat. (If you do not secure space for heat dissipation, life cycle of the product will be compromised.)
3. To avoid electrical shocks, make sure that power is not supplied to the product while wiring.
4. To avoid electrical shocks, make sure that power is not supplied to the product when performing DIP switch settings.

### Noise Countermeasures

1. Do not install the product near devices generating strong high frequency waves or surges.
2. When using a noise filter, check the voltage and current and install it as close to the product as possible.
3. In order to prevent inductive noise, wire the lines connected to the product separately from power lines carrying high voltages or currents. Do not wire in parallel with or on the same cable as power lines.  
Other measures for reducing noise include running lines along separate ducts and using shield lines.

### To avoid faulty operations, malfunctions, or failure, observe the following operating instructions.

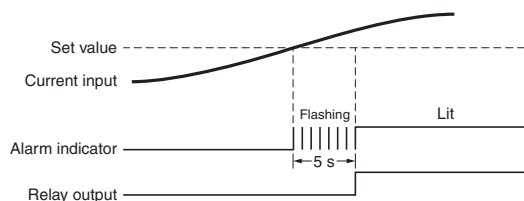
1. When turning on the power, make sure to realize rated voltage within 1 second from the time of first supply of electricity.
2. Make sure to use power supply for operations, inputs, and transformer with the appropriate capacity and rated burden.
3. Maintenance and handling of this product may only be performed by qualified personnel.
4. Distortion ratio of input wave forms must be 30% or less. Use of this product with circuits that have large distortion in wave forms may result in unwanted operations.
5. Using this product for thyristor controls or inverters will result in errors.
6. When setting the volume, adjust the control from the minimum side to the maximum side.

# Questions and Answers

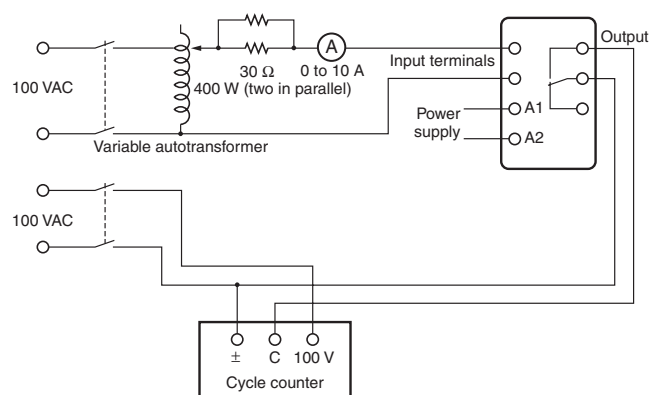
**Q** **Checking Operation**

**A** **Overcurrents**  
 Gradually increase the input from 80% of the setting. The input will equal the operating value when the input exceeds the setting and the alarm indicator starts flashing. Operation can be checked by the relay outputs that will start after the operating time has passed.  
**Undercurrent**  
 Gradually decrease the input from 120% of the setting and check the operation using the same method as for overcurrent.

Example: Overcurrent Operating Mode, Normally Open Relay Drive, and an Operating Time of 5 s



**Connection Diagram**



**Q** **How to Measure the Operating Time**

**A** **Overcurrent**  
 Change the input suddenly from 0% to 120% of the set value and measure the time until the Unit operates.  
**Undercurrent**  
 Change the input suddenly from 120% to 0% of the set value and measure the time until the Unit operates.

**Q** **Monitoring Switch-mode Power Supplies**

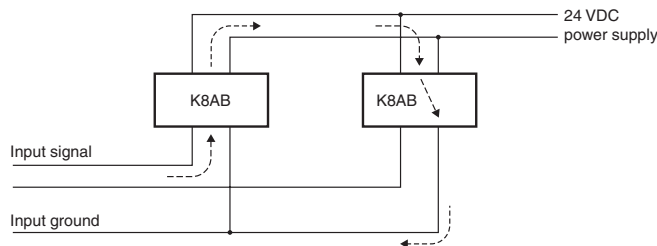
**A** Switch-mode Power Supplies cannot be monitored. In circuits with a capacitor input, including switch-mode power supplies, the input capacitor recharge current flows in pulse form as the load current. The K8AB-AS□ has a built-in filter as a countermeasure against high frequencies and cannot be used to remove pulse current.

**Q** **Grounding the Power Supply for K8AB Models with a DC Power Supply**

**A** The input and power supply must be isolated. Models with a DC power supply have a non-isolated power supply. The input and power supply are connected internally so the K8AB-AS□ will not operate normally if an unwanted current path exists. If an unwanted current path exists, use a K8AB model with an AC power supply or use an isolated DC power supply.

**Q** **Using Multiple K8AB Relays with a DC Power Supply**

**A** The input and power supply must be isolated. The input and power supply are connected internally so an unwanted current path will be created if more than one K8AB is used with one DC power supply, as shown in the diagram, and the K8AB will not operate correctly. If an unwanted current path exists, use a K8AB model with an AC power supply or use a different isolated DC power supply for each K8AB.

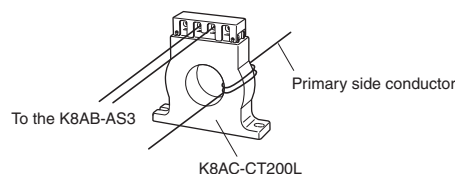


**Q** **Operating Adjustment Knobs**

**A** Use a screwdriver to turn the knobs. There is a stopper to prevent the knob from turning any further once it has been turned completely to the left or right. Do not force the knob past these limits.

**Q** **Can motor loads be monitored by combining the K8AB-AS2-J with a commercial CT?**

**A** If the starting current exceeds the overload capacity of the K8AB-AS2-J, it may cause a malfunction to occur in the K8AB-AS2-J. When monitoring a device that has a large starting current such as a motor, use the K8AB-AS3-J. Adjust the number of conductor windings so that a minimum of 10 A flows to the primary side of the K8AC-CT200L CT. Increasing the number of windings will simulate an increase in current. Minimize the operating time (0.1 s) for this application.



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To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

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