

New Product



# Three-phase Asymmetry and Phase-sequence Phase-loss Relay

## K8AK-PA

**Ideal for 3-phase Voltage Asymmetry Monitoring for Industrial Facilities and Equipment.**



- Greater resistance to inverter noise. **NEW**
- Monitor voltage asymmetry, phase sequence, and phase loss for three-phase 3-wire or 4-wire power supplies with just one Unit.  
Switch setting for 3-phase 3-wire or 3-phase 4-wire power supply.
- One SPDT output relay, 5 A at 250 VAC (resistive load).
- World-wide power specifications supported by one Unit (switchable).
- Relay status can be monitored using LED indicator.

For the most recent information on models that have been certified for safety standards, refer to your OMRON website.

Refer to *Safety Precautions* on page 9.  
Refer to page 8 for commonly asked questions.

### Ordering Information

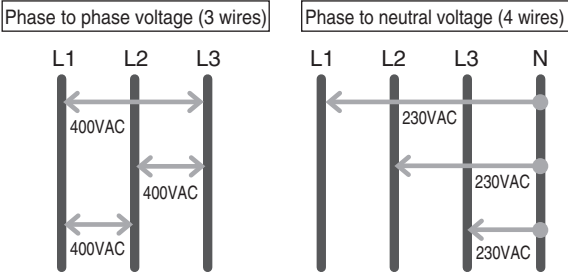
#### List of Models

Rated input*		Model
3-phase 3-wire mode	200, 220, 230, 240 VAC	K8AK-PA1
3-phase 4-wire mode	115, 127, 133, 138 VAC	
3-phase 3-wire mode	380, 400, 415, 480 VAC	K8AK-PA2
3-phase 4-wire mode	220, 230, 240, 277 VAC	

**Note:** Three-phase, three-wire or four-wire and the input range are switched using a DIP switch.  
\* The power supply voltage is the same as the rated input voltage.

### Single K8AK Monitors 3-phase Power Supply with 3 or 4 Wires

Monitoring Relays can be used to monitor 3-phase power supplies with 3 or 4 wires simply by changing DIP switch settings.



**A Single K8AK Can Monitor a 3-phase Power Supply Anywhere in the World**

#### Reduces Maintenance Parts Inventory

	SW3		ON	OFF	ON	OFF	
	SW4		ON	ON	OFF	OFF	
K8AK-PA1	SW2	ON	P-N	138 V	133 V	127 V	115 V
		OFF	P-P	240V	230 V	220 V	200 V
K8AK-PA2	SW2	ON	P-N	277 V	240 V	230 V	220 V
		OFF	P-P	480 V	415 V	400 V	380 V

## K8AK-PA

## Ratings and Specifications

## Ratings

Rated input voltage	K8AK-PA1	Three-phase, three-wire Mode: 200, 220, 230 and 240 VAC Three-phase, four-wire Mode: 115, 127, 133 and 138 VAC
	K8AK-PA2	Three-phase, three-wire Mode: 380, 400, 415 and 480 VAC Three-phase, four-wire Mode: 220, 230, 240 and 277 VAC
Input load	K8AK-PA1: Approx. 4.4 VA K8AK-PA2: Approx. 4.4 VA	
Operating value setting range (ASY.)	Asymmetry set value: 2% to 22%	
Operating value	Asymmetry operating value = Rated input voltage × Asymmetry set value (%) The asymmetry operation will function when the potential difference between the highest and lowest voltage phases equals or exceeds the asymmetry operating value.	
Reset value setting range (HYS.)	5% of operating value (fixed)	
Reset method	Automatic reset	
Operating time setting range (T)	Asymmetry	0.1 to 30 s
	Phase sequence	0.1 s±0.05 s
	Phase loss	0.1 s max.
Power ON lock time (LOCK)	1 s/5 s (Changed with the DIP switch.)	
Indicators	Power (PWR): Green, Relay output (RY): Yellow, Alarm outputs (ALM): Red	
Output relays	One SPDT relay (NC operation)	
Output relay ratings	<p>Rated load</p> <p>Resistive load</p> <p>5 A at 250 VAC</p> <p>5 A at 30 VDC</p> <p>Maximum switching capacity: 1,250 VA, 150 W</p> <p>Minimum load: 5 VDC, 10 mA (reference values)</p> <p>Mechanical life: 10 million operations min.</p> <p>Electrical life: 5 A at 250 VAC or 30 VDC: 50,000 operations 3 A at 250 VAC/30 VDC: 100,000 operations</p>	
Ambient operating temperature	−20 to 60°C (with no condensation or icing)	
Storage temperature	−25 to 65°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 to 0.59 N·m	
Terminal wiring method	<p>Recommended wire</p> <p>Solid wire: 2.5 mm<sup>2</sup></p> <p>Twisted wires: AWG16, AWG18</p> <p><b>Note:</b> 1. Ferrules with insulating sleeves must be used with twisted wires. 2. Two wires can be twisted together.</p> <p>Recommended ferrules</p> <p>Al 1.5-8BK (for AWG16) manufactured by Phoenix Contact</p> <p>Al 1-8RD (for AWG18) manufactured by Phoenix Contact</p> <p>Al 0.75-8GY (for AWG18) manufactured by Phoenix Contact</p>	
Case color	N1.5	
Case material	PC and ABS, UL 94 V-0	
Weight	Approx. 130 g	
Mounting	Mounts to DIN Track.	
Dimensions	22.5 × 90 × 100 mm (W×H×D)	

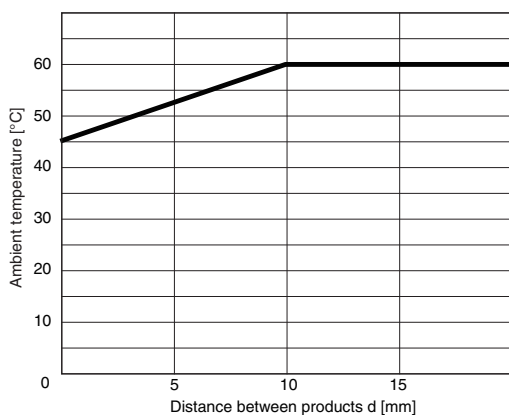
## Specifications

<b>Input frequency</b>		50/60 Hz
<b>Overload capacity</b>		Continuous input at 115% of maximum input, 10 s at 125% (up to 600 VAC).
<b>Repeat accuracy</b>	<b>Operating value</b>	±0.5% full scale (at 25°C and 65% humidity, rated power supply voltage, 50/60 Hz sine wave input)
	<b>Operating time</b>	±50 ms (at 25°C and 65% humidity, rated power supply voltage)
<b>Applicable standards</b>	<b>Conforming standards</b>	EN 60947-5-1 Installation environment (pollution level 2, installation category III)
	<b>EMC</b>	EN 60947-5-1
	<b>Safety standards</b>	UL 508 (Recognition), Korean Radio Waves Act (Act 10564), CSA: C22.2 No.14, CCC: GB/T 14048.5
<b>Insulation resistance</b>		20 MΩ min. Between external terminals and case Between input terminals and output terminals
<b>Dielectric strength</b>		2,000 VAC for one minute Between external terminals and case 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 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 3 axes
<b>Degree of protection</b>		Terminals: IP20

### ● Relationship of Mounting Distance between K8AK-PA Relays and Ambient Temperature (Reference Values)

The following diagram shows the relationship between the mounting distances and the ambient temperature.

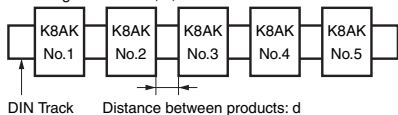
If the relay is used with an ambient temperature that exceeds these values, the temperature of the K8AK may rise and shorten the life of the internal components.



#### Test method

Sample: K8AK-PA

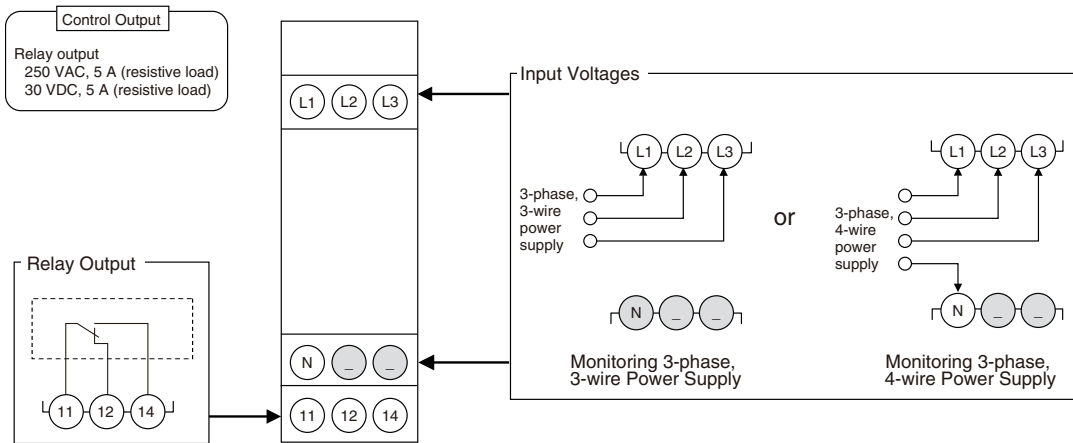
Mounting distances: 0, 5, and 10 mm min.



# K8AK-PA

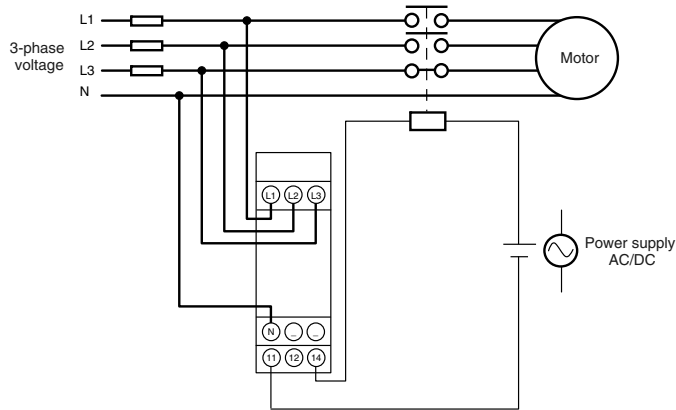
## Connections

### Terminal Diagram



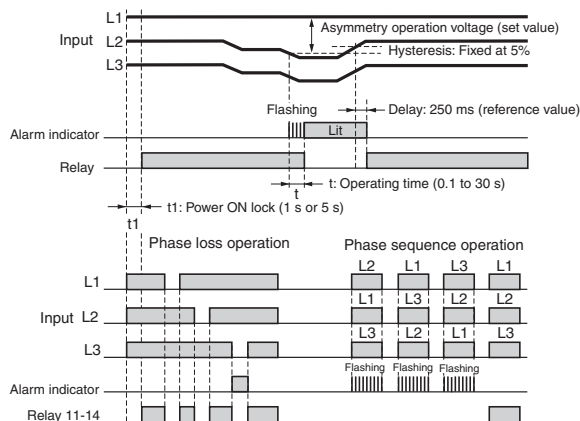
- Note:**
1. Do not connect anything to terminals that are shaded in gray.
  2. Use the recommended ferrules if you use twisted wires.

### Wiring Example



### Timing Charts

#### ● Voltage Asymmetry and Phase Sequence/Phase Loss Operation Diagram



- Note:**
1. K8AK-PA□ output relay is normally operative.
  2. The power ON lock prevents unnecessary alarms from being generated during the instable period when the power is first turned on. There is no relay output during timer operation.
  3. Phase loss is detected by L1, L2, and L3 voltage drops. A phase loss will exist if any of the phases drops below 60% of the rated input.
  4. L1 and L2 function both as the power supply terminals and as input terminals. If the voltage drops dramatically, then the Relay will not operate due to an undervoltage.
  5. Motor load phase loss cannot be detected during operation.
  6. Phase loss is detected based on voltage, so phase loss cannot be detected on the load side.

#### Calculating the Asymmetry Operating Voltage

$$\text{Asymmetry operation condition} = (\text{Highest voltage} - \text{Lowest voltage}) > \text{Asymmetry operating voltage}$$

$$\text{Asymmetry operating voltage} = \text{Rated input voltage (V)} \times \text{Asymmetry set value (\%)}$$

**Note:** The rated input voltage is selected and set with the DIP switch.

#### Operation Indicators

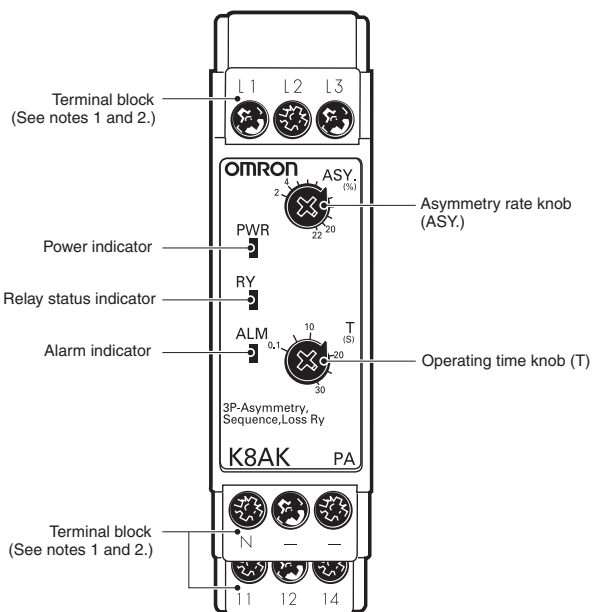
Item	Display		Contact operation
	Ry indicator	Alarm indicator	Alarm relay
Asymmetry	OFF	ON	OFF
Phase loss	OFF	ON <sup>*1</sup>	OFF
Phase sequence	Incorrect phase	Flashing <sup>*2</sup>	OFF
	Correct phase	OFF	ON

\*1 L1 and L2 are also used for the power supply. If the voltage becomes very low, the indicator will turn OFF.

\*2 The indicator will flash once per second after an incorrect phase is detected and once per 0.5 second during the detection time.

# Nomenclature

## Front



### ●Indicators

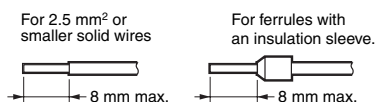
Item	Meaning
Power indicator (PWR: Green)	Lit when power is being supplied*
Relay status indicator (RY: Yellow)	Lit when relay is operating (normally lit).
Alarm indicator (ALM: Red)	Asymmetry voltage error indicator The indicator flashes to indicate the error status after the input has exceeded the set value while the operating time is being clocked.

\* The input across L1 and L2 is used for the internal power supply. Therefore, the power indicator will not be lit if there is no input across L1 and L2.

### ●Setting Knobs

Item	Usage
Asymmetry rate knob (ASY.)	Used to set the asymmetry rate to 2% to 22%.
Operating time knob (T)	Used to set the operating time to 0.1 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

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

2. Screw tightening torque: 0.49 to 0.59 N·m

# K8AK-PA

## Operation Methods

### Connections

#### ●Input

Connect to L1, L2, and L3 (for three-phase three-wire mode) or L1, L2, L3, and N (for three-phase four-wire mode), depending on the mode selected using pin 2 on the DIP switch.

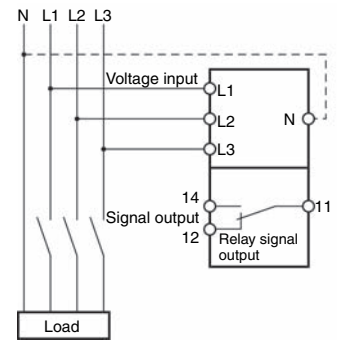
The Unit will not operate correctly if the DIP switch setting and the wiring do not agree.

Make sure the phase sequence is wired correctly. The Unit will not operate normally if the phase sequence is incorrect.

#### ●Outputs

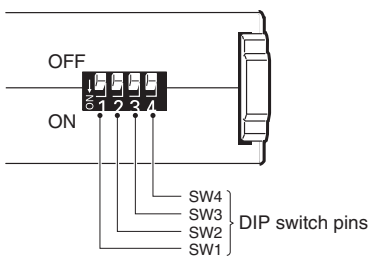
Terminals 11, 12, and 14 are output terminals for SPDT.

\* Use the recommended ferrules if you use twisted wires.



### DIP Switch Settings

The power ON lock time, number of wires, and rated voltage are set using the DIP switch located on the bottom of the Unit.



#### ●DIP Switch Functions

##### K8AK-PA1

Pin	OFF ● ↑																	
	ON ○ ↓		1	2	3	4	1	2	3	4	1	2	3	4				
Power ON lock time	1 s		●	---	---	---	●	---	---	---	●	---	---	---				
	5 s		○	---	---	---	○	---	---	---	○	---	---	---				
Number of wires	3-wire 3-phase		---	●	---	---	---	●	---	---	---	●	---	---				
	4-wire 3-phase		---	○	---	---	---	○	---	---	---	○	---	---				
Rated voltage	3-wire 3-phase	200 V	---	---	●	●	---	---	○	○	---	---	---	---				
		220 V	---	---	○	●	---	---	○	○	---	---	---	---				
	4-wire 3-phase	230 V	---	---	●	○	---	---	○	○	---	---	---	---				
		240 V	---	---	○	○	---	---	○	○	---	---	---	---				

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

##### K8AK-PA2

Pin	OFF ● ↑																	
	ON ○ ↓		1	2	3	4	1	2	3	4	1	2	3	4				
Power ON lock time	1 s		●	---	---	---	●	---	---	---	●	---	---	---				
	5 s		○	---	---	---	○	---	---	---	○	---	---	---				
Number of wires	3-wire 3-phase		---	●	---	---	---	●	---	---	---	●	---	---				
	4-wire 3-phase		---	○	---	---	---	○	---	---	---	○	---	---				
Rated voltage	3-wire 3-phase	380 V	---	---	●	●	---	---	○	○	---	---	---	---				
		400 V	---	---	○	●	---	---	○	○	---	---	---	---				
	4-wire 3-phase	415 V	---	---	●	○	---	---	○	○	---	---	---	---				
		480 V	---	---	○	○	---	---	○	○	---	---	---	---				

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

## Setting Method

### ●Asymmetry

The asymmetry rate is set using the asymmetry rate knob (ASY.)

The setting range is 2% to 22% of the rated input.

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 make the setting.

The rated input depends on the model and DIP switch setting.

Example: K8AK-PA1 with Pin 2 Turned OFF (Three-phase, Three-wire Mode) and Pins 3 and 4 Turned OFF (Rated Voltage of 200 V)

The rated input voltage is 200 VAC and the setting range is 4 to 44 V.

If the setting (ASY. knob) is at 10%, the asymmetry operation voltage is 20 V and an alarm will be output if the difference between the minimum and maximum phases for two of the three phases exceeds 20 V.

### ●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.

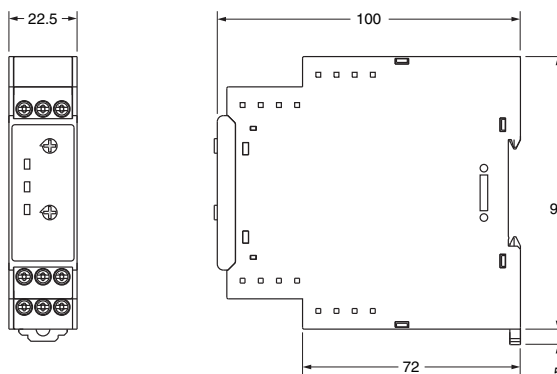
If the input exceeds the asymmetry set value, the alarm indicator will start flashing for the set period and then stay lit.

## Dimensions

(Unit: mm)

### Three-phase Asymmetry and Phase-sequence Phase-loss Relays

K8AK-PA1  
K8AK-PA2

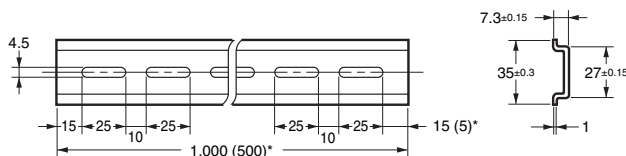
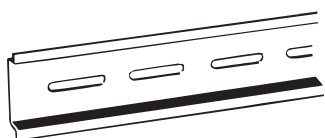


## Optional Parts for DIN Track Mounting

### ●DIN Tracks

PFP-100N

PFP-50N



\*Dimensions in parentheses are for the PFP-50N.

# K8AK-PA

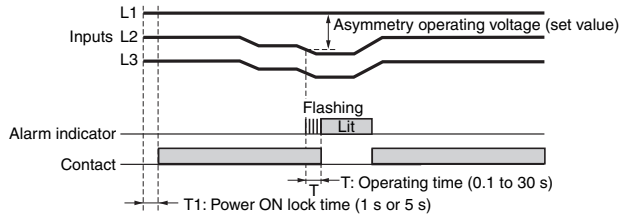
## Questions and Answers

**Q** Checking Operation

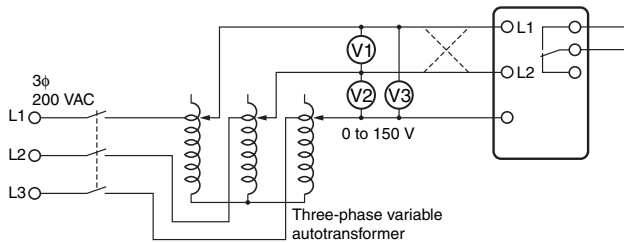
**A** With the rated input voltage applied, gradually change the voltage to any one phase. The Unit will operate when the difference between the maximum and minimum voltage phases reaches or exceeds the asymmetry operating value.  
 Asymmetry operating value = Rated input voltage × Asymmetry set value (%)

Example: For monitoring mode set to three-phase three-wire monitoring, a rated voltage of 200 V, and an operating time of 5 s.

**Note:** K8AK-PA□ output relays are normally operative.



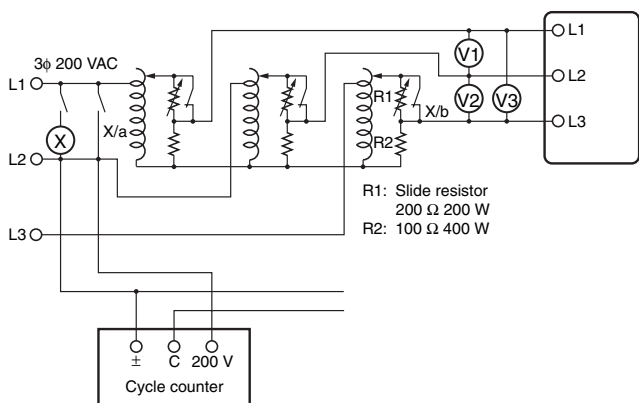
Connection Diagram 1



**Q** How to Measure the Operating Time

**A** Operating Time  
 Adjust the slide resistor so that the voltage difference applied to the K8AK terminals is equal to or greater than the asymmetry operating value when the auxiliary relay operates, as shown in connection diagram 2. Close the switch and use the cycle counter to measure the operating time.

Connection Diagram 2



**Q** Checking the Phase Sequence and Phase Loss Operation

**A** Phase Sequence Operation  
 Switch the wiring, as shown by the dotted lines in connection diagram 1, to reverse the phase sequence and check that the K8AK operates.  
 Phase Loss Operation  
 Create a phase loss for any input phase and check that the K8AK operates.

**Q** Load-side Phase Loss

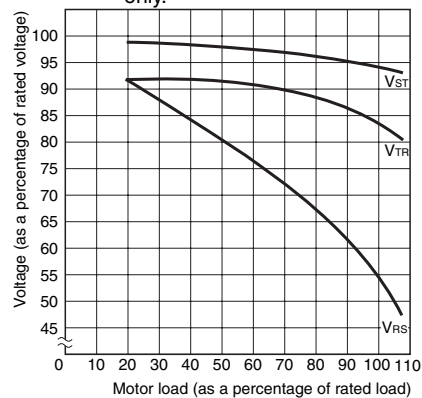
**A** In principle, phase loss cannot be detected on the load side because the K8AK-PA□ measures three-phase voltage to determine phase loss.

**Q** Motor Load Phase Loss during Operation

**A** Phase loss cannot be detected for motor loads during operation. Use the asymmetry detection function. Normally, three-phase motors will continue to rotate even if one phase is open. The three-phase voltage will be induced at the motor terminals. The diagram shows voltage induction at the motor terminals when phase R is lost with a load applied to a three-phase motor. The horizontal axis shows the motor load as a percentage of the rated load, and the vertical axis shows voltage as a percentage of the rated voltage. The lines in the graph show the voltage induced at the motor terminals for each load when phase loss occurs during operation. As the graph shows, phase loss cannot be detected because the motor terminal voltage does not drop very much even if a phase is lost when the load on the motor is light. Use the asymmetry detection function to detect asymmetry in the motor terminal voltages. Set the operating time carefully because it will affect the time from when the phase loss occurs until tripping when this function is used.

Characteristic Curve Diagram

**Note:** This characteristic curve shows the approximate values only.





**Note:** For phase loss of phase R.  $V^{ST}$ ,  $V^{TR}$ , and  $V^{RS}$  indicate the motor terminal voltage at phase loss.





## Safety Precautions

Be sure to read the precautions for all models in the website at the following URL: <http://www.ia.omron.com/>.

### Warning Indications

 <b>WARNING</b>	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Additionally there may be significant property damage.
 <b>CAUTION</b>	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in property damage.
<b>Precautions for Safe Use</b>	Supplementary comments on what to do or avoid doing, to use the product safely.
<b>Precautions for Correct Use</b>	Supplementary comments on what to do or avoid doing, to prevent failure to operate, malfunction, or undesirable effects on product performance.

### Meaning of Product Safety Symbols

	Used to warn of the risk of electric shock under specific conditions.
	Used for general prohibitions for which there is no specific symbol.
	Used to indicate prohibition when there is a risk of minor injury from electrical shock or other source if the product is disassembled.
	Used for general mandatory action precautions for which there is no specified symbol.

### **WARNING**

Electrical shock may occasionally cause serious injury. Confirm that the input voltage is OFF before starting any wiring work and wire all connections correctly.



### **CAUTION**

Electrical shock may cause minor injury. Do not touch terminals while electricity is being supplied.



There is a risk of minor electrical shock, fire, or device failure. Do not allow any pieces of metal, conductors, or cutting chips that occur during the installation process to enter the product.



Explosions may cause minor injuries. Do not use the product in locations with inflammable or explosive gases.

There is a risk of minor electrical shock, fire, or device failure. Do not disassemble, modify, repair, or touch the inside of the product.



Loose screws may cause fires. Tighten terminal screws to the specified torque of 0.49 to 0.59 N·m.



Use of excessive torque may damage the terminal screws. Tighten terminal screws to the specified torque of 0.49 to 0.59 N·m.



Use of the product beyond its life may result in contact welding or burning. Make sure to consider the actual operating conditions and use the product within its rated load and electrical life count. The life of the output relay varies significantly with the switching capacity and switching conditions.



## K8AK-PA

### Precautions for Safe Use

- Do not use or store the product in the following locations.
  - Locations subject to water or oil
  - Outdoor locations or under direct sunlight
  - Locations subject to dust or corrosive gases (particularly sulfurizing gases, ammonia, etc.)
  - Locations subject to rapid temperature changes
  - Locations prone to icing and dew condensation
  - Locations subject to excessive vibration or shock
  - Locations subject to wind and rain
  - Locations subject to static electricity and noise
  - Habitats of insects or small animals
- Use and store the product in a location where the ambient temperature and humidity are within the specified ranges. If applicable, provide forced cooling.
- Mount the product in the correct direction.
- Do not wire the input and output terminals incorrectly.
- Make sure the input voltage and loads are within the specifications and ratings for the product.
- Make sure the crimp terminals for wiring are of the specified size.
- Do not connect anything to terminals that are not being used.
- Use a power supply that will reach the rated voltage within 1 second after the power is turned ON.
- Keep wiring separate from high voltages and power lines that draw large currents.  
Do not place product wiring in parallel with or in the same path as high-voltage or high-current lines.
- Do not install the product near equipment that generates high frequencies or surges.
- The product may cause incoming radio wave interference. Do not use the product near radio wave receivers.
- Install an external switch or circuit breaker and label it clearly so that the operator can quickly turn OFF the power supply.
- Make sure the indicators operate correctly. Depending on the application environment, the indicators may deteriorate prematurely and become difficult to see.
- Do not use the product if it is accidentally dropped. The internal components may be damaged.
- Be sure you understand the contents of this catalog and handle the product according to the instructions provided.
- Do not install the product in any way that would place a load on it.
- When discarding the product, properly dispose of it as industrial waste.
- The product must be handled only by trained electrician.
- Prior to operation, check the wiring before you supply power to the product.
- Do not install the product immediately next to heat sources.
- Perform periodic maintenance.

### Precautions for Correct Use

### Observe the following operating methods to prevent failure and malfunction.

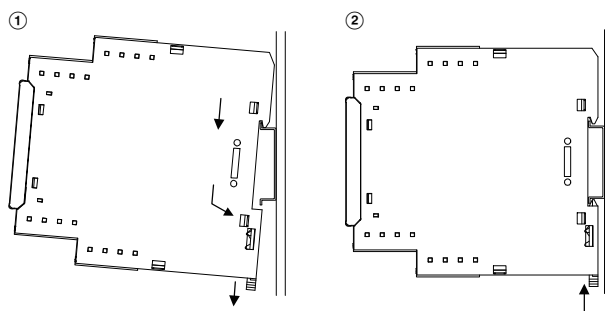
- Use the input power and other power supplies and converters with suitable capacities and rated outputs.
- Use a precision screwdriver or similar tool to adjust the setting knobs.
- The distortion in the input waveform must be 30% max. If the input waveform is distorted beyond this level, it may cause unnecessary operation.
- The product cannot be used for thyristor control or on the secondary side of an inverter. To use the product on the primary side of an inverter, install a noise filter on the primary side of the inverter.

- To reduce the error in the setting knob, always turn the setting knob from the minimum setting toward the maximum setting.
- Phase loss is detected only when the power supply to the motor is turned ON. Phase loss during motor operation is not detected.
- Phase loss can be detected only from the input contacts to the power supply side. Phase loss cannot be detected from the input contacts to the load side.
- When cleaning the product, do not use thinners or solvents. Use commercial alcohol.

### Correct Mounting Direction, Mounting, and Removing

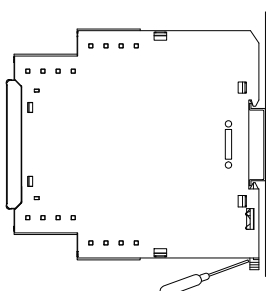
#### Mounting to DIN Track

- Attach the product to the DIN Track with the tab at the top and the hooks at the bottom.
- Push the product onto the Track until the hooks lock into place.



#### Removing from the DIN Track

- Pull down on the bottom hook with a flat-blade screwdriver and lift up on the product.



Applicable DIN Tracks:  
PFP-100N (100 cm)  
PFP-50N (50 cm)

### Adjusting the Setting Knobs

- Use a screwdriver to adjust the setting knobs. The knobs have a stopper that prevents them from turning beyond the full right or left position. Do not force a knob beyond these points.



# Terms and Conditions Agreement

## **Read and understand this catalog.**

Please read and understand this catalog before purchasing the products. Please consult your OMRON representative if you have any questions or comments.

## **Warranties.**

- (a) Exclusive Warranty. Omron's exclusive warranty is that the Products will be free from defects in materials and workmanship for a period of twelve months from the date of sale by Omron (or such other period expressed in writing by Omron). Omron disclaims all other warranties, express or implied.
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