

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

### K8AK-PM

**Ideal for Monitoring 3-phase Power Supplies for Industrial Facilities and Equipment.**



- Greater resistance to inverter noise. **NEW**
- Monitor overvoltages, undervoltages, 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.
- Two SPDT output relays, 5 A at 250 VAC (resistive load).  
Output overvoltages and undervoltages using separate relays.
- World-wide power specifications supported by one Unit (switchable).
- Output 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 10.  
Refer to page 8 to 9 for commonly asked questions.

## Ordering Information

### List of Models

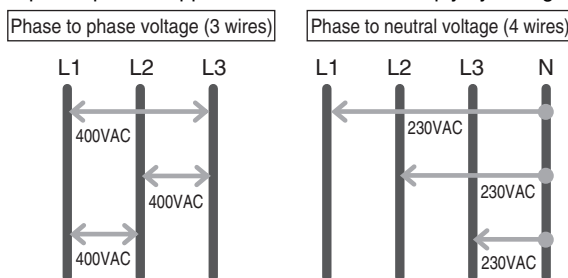
Rated input*		Model
3-phase 3-wire mode	200, 220, 230, 240 VAC	<b>K8AK-PM1</b>
3-phase 4-wire mode	115, 127, 133, 138 VAC	
3-phase 3-wire mode	380, 400, 415, 480 VAC	<b>K8AK-PM2</b>
3-phase 4-wire mode	220, 230, 240, 277 VAC	

**Note:** Three-phase 3-wire or 4-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
<b>K8AK-PM1</b>	SW2	ON	P-N	138 V	133 V	127 V	115 V
		OFF	P-P	240V	230 V	220 V	200 V
<b>K8AK-PM2</b>	SW2	ON	P-N	277 V	240 V	230 V	220 V
		OFF	P-P	480 V	415 V	400 V	380 V

# K8AK-PM

## Ratings and Specifications

### Ratings

Rated input voltage	K8AK-PM1	Three-phase, three-wire Mode: 200, 220, 230 and 240 VAC Three-phase, four-wire Mode: 115, 127, 133 and 138 VAC
	K8AK-PM2	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-PM1: Approx. 4.4 VA K8AK-PM2: Approx. 4.4 VA
Operating value setting range (OVER, UNDER)		Overvoltage –30% to 25% of rated input voltage Undervoltage –30% to 25% of rated input voltage <b>Note:</b> The rated input voltage can be switched using the DIP switch.
Operating value		100% operation at set value
Reset value		5% of operating value (fixed)
Reset method		Automatic reset
Operating time setting range (T)	Overvoltage/undervoltage	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 or 5 s (Switched using DIP switch.)
Indicators		Power (PWR): Green, Relay output (RY): Yellow, OVER/UNDER: Red
Output relays		Two SPDT relays (NC operation)
Output relay ratings		Rated load Resistive load 5 A at 250 VAC 5 A at 30 VDC Maximum switching capacity: 1,250 VA, 150 W Minimum load: 5 VDC, 10 mA (reference values) Mechanical life: 10 million operations min. Electrical life: 5 A at 250 VAC or 30 VDC: 50,000 operations 3 A at 250 VAC/30 VDC: 100,000 operations
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		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		N1.5
Case material		PC and ABS, UL 94 V-0
Weight		Approx. 150 g
Mounting		Mounts to DIN Track.
Dimensions		22.5 × 90 × 100 mm (W×H×D)

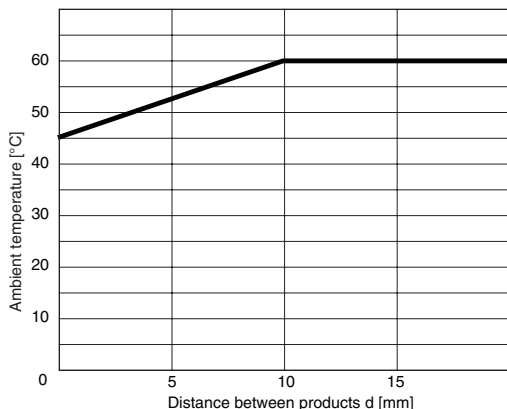
## Specifications

<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 an ambient humidity of 65% at the rated power supply voltage, DC and 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: GB14048.5
<b>Insulation resistance</b>		20 MΩ Between all external terminals and the case Between all input terminals and all output terminals
<b>Dielectric strength</b>		2,000 VAC for 1 min Between all external terminals and the case Between all input terminals and all 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, 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 3 axes
<b>Degree of protection</b>		Terminals: IP20

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

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

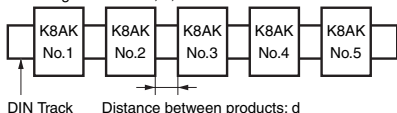
If the relay is used with an ambient temperature that exceeds these values, the temperature of the K8AK may rise and shorten the life of the internal components.



#### Test method

Sample: K8AK-PM

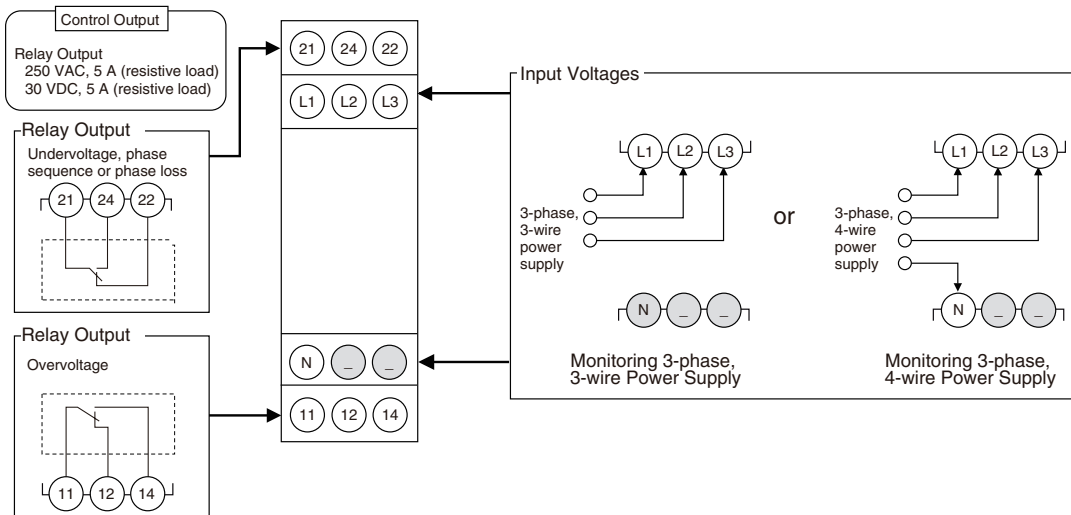
Mounting distances: 0, 5, and 10 mm min.



# K8AK-PM

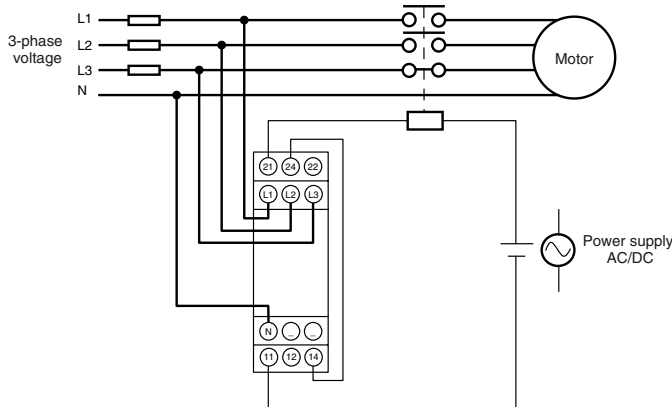
## Connections

### Terminal Diagram



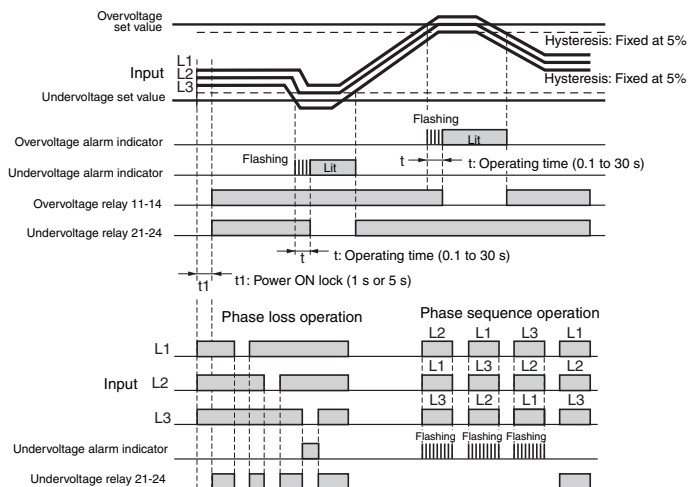
- Note:**
- Do not connect anything to terminals that are shaded in gray.
  - Use the recommended ferrules if you use twisted wires.

### Wiring Example



### Timing Charts

#### Overvoltage/Undervoltage and Phase Sequence/Phase Loss Operation Diagram



- Note:**
- The K8AK-PM□ output relay is normally operative.
  - 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.
  - 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.

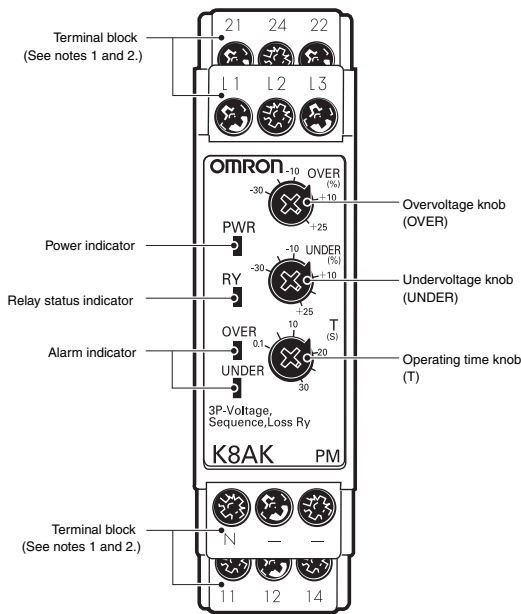
### Operation Indicators

Item	Display			Contact operation	
	Ry indicator	Over indicator	Under indicator	Over relay	Under relay
Overvoltage	ON	ON	OFF	OFF	ON
Undervoltage	ON	OFF	ON	ON	OFF
Phase loss	OFF	OFF* <sup>1</sup>	ON* <sup>2</sup>	OFF * <sup>1</sup>	OFF
Phase-sequence	Incorrect phase	ON	OFF	Flashing* <sup>3</sup>	ON
	Correct phase	ON	OFF	OFF	ON

- \*<sup>1</sup> Over\_Ry turns OFF when phase loss is detected.  
\*<sup>2</sup> L1 and L2 are also used for the power supply. If the voltage becomes very low, the indicator will turn OFF.  
\*<sup>3</sup> 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

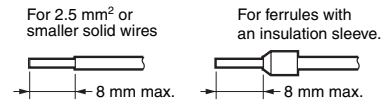
Item	Meaning
Power indicator (PWR: Green)	Lit when power is being supplied*
Relay status indicator (RY: Yellow)	Lit when relay is operating (normally lit).
Alarm indicator	Overvoltage: Red Lit when there is an overvoltage. The indicator flashes to indicate the error status after the overvoltage has exceeded the set value while the operating time is being clocked.
	Undervoltage: Red <ul style="list-style-type: none"> <li>Lit when there is an undervoltage or phase loss. The indicator flashes to indicate the error status after the undervoltage has exceeded the set value while the operating time is being clocked.</li> <li>Lit when there is a phase sequence error.</li> </ul>

\* 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
Overvoltage knob (OVER)	Can be set between -30% and 25% of the rated input.
Undervoltage knob (UNDER)	Can be set between -30% and 25% of the rated input.
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-PM

## 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.

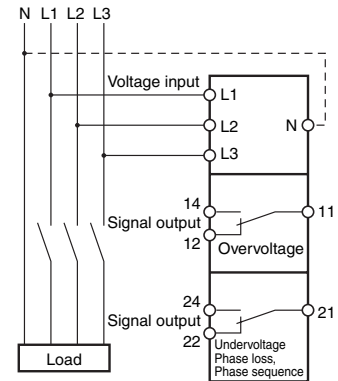
Make sure the phase sequence is wired correctly. The Unit will not operate normally if the phase sequence is incorrect.

#### ●Outputs

Terminals 11, 12, and 14 are the output terminals for overvoltage (SPDT).

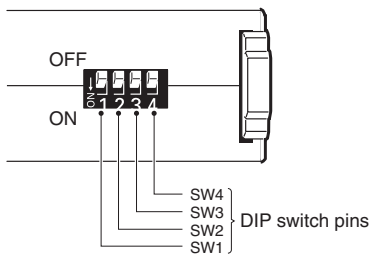
Terminals 21, 22, and 24 are the output terminals for undervoltage, phase loss, and phase sequence (SPDT).

\* 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-PM1

Pin	OFF ● ↑					
	ON ○ ↓		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	4-wire 3-phase				
	200 V	115 V	---	---	●	●
	220 V	127 V	---	---	○	●
	230 V	133 V	---	---	●	○
	240 V	138 V	---	---	○	○

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

##### K8AK-PM2

Pin	OFF ● ↑					
	ON ○ ↓		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	4-wire 3-phase				
	380 V	220 V	---	---	●	●
	400 V	230 V	---	---	○	●
	415 V	240 V	---	---	●	○
	480 V	277 V	---	---	○	○

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

## Setting Method

### ●Overvoltage

The overvoltage knob (OVER) is used to set the overvoltage threshold.

The overvoltage can be set to between -30% and 25% of the rated input voltage.

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 voltage.

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

Example: K8AK-PM1 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 140 to 250 V.

### ●Undervoltage

Undervoltage is set using the undervoltage knob (UNDER).

The undervoltage can be set to between -30% and 25% 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 set the voltage.

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

Example: K8AK-PM1 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 140 to 250 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.

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.

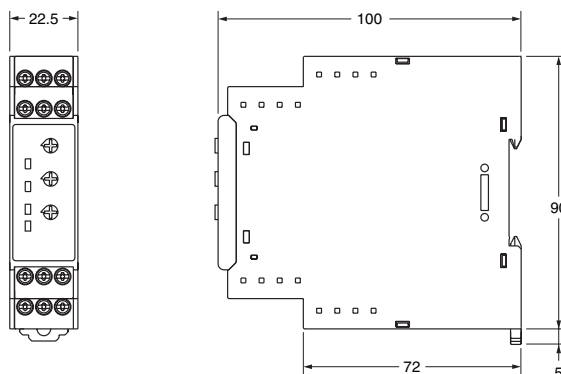
If the input exceeds (or drops lower than) the voltage set value, the alarm indicator will start flashing for the set period and then stay lit.

## Dimensions

(Unit: mm)

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

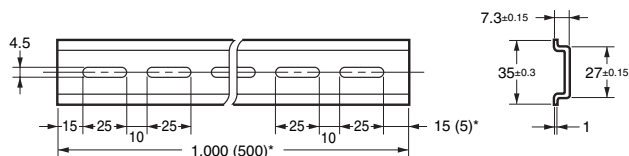
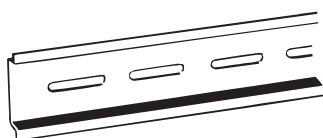
K8AK-PM1  
K8AK-PM2



### Optional Parts for DIN Track Mounting

#### ●DIN Tracks

PFP-100N  
PFP-50N



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

## Questions and Answers

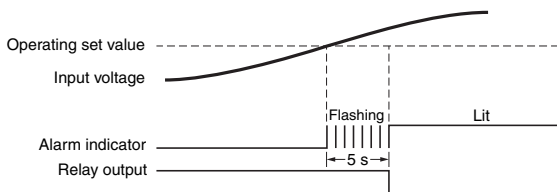
**Q** Checking Operation

**A** **Overvoltages**  
Gradually increase the input from 80% of the set value. The input value will equal the operating value when the input exceeds the set value and the alarm indicator starts flashing. Operation can be checked by the relay output that will start after the operating time has passed.

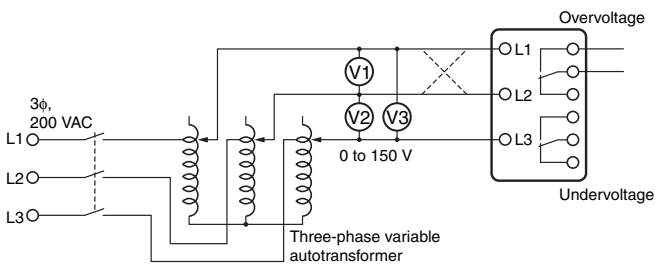
**Undervoltage**  
Gradually decrease the input from 120% of the set value and check the operation using the same method as for overvoltage.

**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-PM□ output relays are normally operative.



Connection Diagram 1



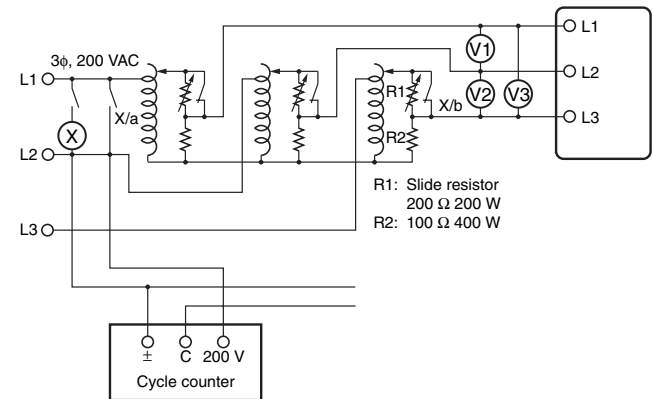
**Q** How to Measure the Operating Time

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

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

**Operating Time**  
Adjust the slide resistor so that the voltage applied to the K8AK terminals is 120% of the set value (for overvoltage detection) and 80% of the set value (for undervoltage detection) 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**  
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**  
Create a phase loss for any input phase and check that the K8AK operates.



## Questions and Answers

**Q** Load-side Phase Loss

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

**Q** Motor Load Phase Loss during Operation

**A** Motor load phase loss cannot be detected during operation. It can be used to detect phase loss at startup.

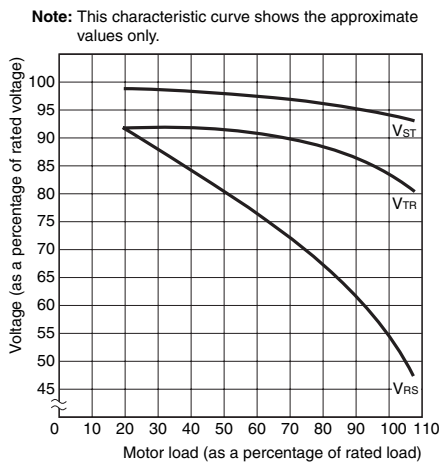
Normally, three-phase motors will continue to rotate even if one phase is open. The three-phase voltage will be induced at the motor terminals. The diagram shows voltage induction at the motor terminals when phase R has been lost with a load applied to a three-phase motor. The horizontal axis shows the 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 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. To detect motor load phase loss during operation, use the undervoltage detection function to detect the motor terminal voltages at phase loss.

Set the operating time carefully because it will affect the time from when the phase loss occurs until tripping when this function is used.

**Q** Overvoltage Detection When Only One Phase Exceeds the Overvoltage Set Value

**A** The K8AK monitors each of the three-phase voltages. This means an overvoltage is detected even if only one phase exceeds the set value. The same applies to undervoltages.

### Characteristic Curve Diagram





**Note:** For phase loss of phase R. V<sup>ST</sup>, V<sup>TR</sup>, and V<sup>RS</sup> 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.



### Precautions for Safe Use

1. 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
2. Use and store the product in a location where the ambient temperature and humidity are within the specified ranges. If applicable, provide forced cooling.
3. Mount the product in the correct direction.
4. Do not wire the input and output terminals incorrectly.
5. Make sure the input voltage and loads are within the specifications and ratings for the product.
6. Make sure the crimp terminals for wiring are of the specified size.
7. Do not connect anything to terminals that are not being used.
8. Use a power supply that will reach the rated voltage within 1 second after the power is turned ON.
9. 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.
10. Do not install the product near equipment that generates high frequencies or surges.
11. The product may cause incoming radio wave interference. Do not use the product near radio wave receivers.
12. Install an external switch or circuit breaker and label it clearly so that the operator can quickly turn OFF the power supply.
13. Make sure the indicators operate correctly. Depending on the application environment, the indicators may deteriorate prematurely and become difficult to see.
14. Do not use the product if it is accidentally dropped. The internal components may be damaged.
15. Be sure you understand the contents of this catalog and handle the product according to the instructions provided.
16. Do not install the product in any way that would place a load on it.
17. When discarding the product, properly dispose of it as industrial waste.
18. The product must be handled only by trained electrician.
19. Prior to operation, check the wiring before you supply power to the product.
20. Do not install the product immediately next to heat sources.
21. Perform periodic maintenance.

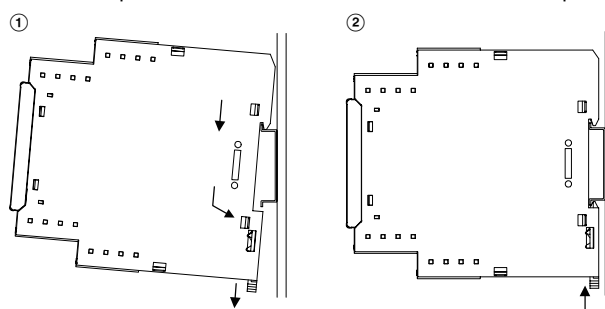
### Precautions for Correct Use

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

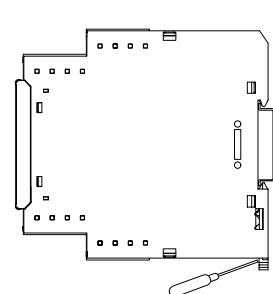
1. Use the input power and other power supplies and converters with suitable capacities and rated outputs.
2. Use a precision screwdriver or similar tool to adjust the setting knobs.
3. The distortion in the input waveform must be 30% max. If the input waveform is distorted beyond this level, it may cause unnecessary operation.
4. The product cannot be used for thyristor control or on the secondary side of an inverter. To use the product on the secondary side of an inverter, install a noise filter on the primary side of the inverter.
5. To reduce the error in the setting knob, always turn the setting knob from the minimum setting toward the maximum setting.
6. Phase loss is detected only when the power supply to the motor is turned ON. Phase loss during motor operation is not detected.
7. 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.
8. When cleaning the product, do not use thinners or solvents. Use commercial alcohol.

#### Mounting and Removing

- Mounting to DIN Track
  1. Catch the upper hook on the DIN Track.
  2. 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 of Sale

1. **Offer; Acceptance.** These terms and conditions (these "**Terms**") are deemed part of all quotes, agreements, purchase orders, acknowledgments, price lists, catalogs, manuals, brochures and other documents, whether electronic or in writing, relating to the sale of products or services (collectively, the "**Products**") by Omron Electronics LLC and its subsidiary companies ("**Omron**"). Omron objects to any terms or conditions proposed in Buyer's purchase order or other documents which are inconsistent with, or in addition to, these Terms.
2. **Prices; Payment Terms.** All prices stated are current, subject to change without notice by Omron. Omron reserves the right to increase or decrease prices on any unshipped portions of outstanding orders. Payments for Products are due net 30 days unless otherwise stated in the invoice.
3. **Discounts.** Cash discounts, if any, will apply only on the net amount of invoices sent to Buyer after deducting transportation charges, taxes and duties, and will be allowed only if (i) the invoice is paid according to Omron's payment terms and (ii) Buyer has no past due amounts.
4. **Interest.** Omron, at its option, may charge Buyer 1-1/2% interest per month or the maximum legal rate, whichever is less, on any balance not paid within the stated terms.
5. **Orders.** Omron will accept no order less than \$200 net billing.
6. **Governmental Approvals.** Buyer shall be responsible for, and shall bear all costs involved in, obtaining any government approvals required for the importation or sale of the Products.
7. **Taxes.** All taxes, duties and other governmental charges (other than general real property and income taxes), including any interest or penalties thereon, imposed directly or indirectly on Omron or required to be collected directly or indirectly by Omron for the manufacture, production, sale, delivery, importation, consumption or use of the Products sold hereunder (including customs duties and sales, excise, use, turnover and license taxes) shall be charged to and remitted by Buyer to Omron.
8. **Financial.** If the financial position of Buyer at any time becomes unsatisfactory to Omron, Omron reserves the right to stop shipments or require satisfactory security or payment in advance. If Buyer fails to make payment or otherwise comply with these Terms or any related agreement, Omron may (without liability and in addition to other remedies) cancel any unshipped portion of Products sold hereunder and stop any Products in transit until Buyer pays all amounts, including amounts payable hereunder, whether or not then due, which are owing to it by Buyer. Buyer shall in any event remain liable for all unpaid accounts.
9. **Cancellation; Etc.** Orders are not subject to rescheduling or cancellation unless Buyer indemnifies Omron against all related costs or expenses.
10. **Force Majeure.** Omron shall not be liable for any delay or failure in delivery resulting from causes beyond its control, including earthquakes, fires, floods, strikes or other labor disputes, shortage of labor or materials, accidents to machinery, acts of sabotage, riots, delay in or lack of transportation or the requirements of any government authority.
11. **Shipping; Delivery.** Unless otherwise expressly agreed in writing by Omron:
  - a. Shipments shall be by a carrier selected by Omron; Omron will not drop ship except in "break down" situations.
  - b. Such carrier shall act as the agent of Buyer and delivery to such carrier shall constitute delivery to Buyer;
  - c. All sales and shipments of Products shall be FOB shipping point (unless otherwise stated in writing by Omron), at which point title and risk of loss shall pass from Omron to Buyer; provided that Omron shall retain a security interest in the Products until the full purchase price is paid;
  - d. Delivery and shipping dates are estimates only; and
  - e. Omron will package Products as it deems proper for protection against normal handling and extra charges apply to special conditions.
12. **Claims.** Any claim by Buyer against Omron for shortage or damage to the Products occurring before delivery to the carrier must be presented in writing to Omron within 30 days of receipt of shipment and include the original transportation bill signed by the carrier noting that the carrier received the Products from Omron in the condition claimed.
13. **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. (b) **Limitations.** OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, ABOUT NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OF THE PRODUCTS. BUYER ACKNOWLEDGES THAT IT ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. Omron further disclaims all warranties and responsibility of any type for claims or expenses based on infringement by the Products or otherwise of any intellectual property right. (c) **Buyer Remedy.** Omron's sole obligation hereunder shall be, at Omron's election, to (i) replace (in the form originally shipped with Buyer responsible for labor charges for removal or replacement thereof) the non-complying Product, (ii) repair the non-complying Product, or (iii) repay or credit Buyer an amount equal to the purchase price of the non-complying Product; provided that in no event shall Omron be responsible for warranty, repair, indemnity or any other claims or expenses regarding the Products unless Omron's analysis confirms that the Products were properly handled, stored, installed and maintained and not subject to contamination, abuse, misuse or inappropriate modification. Return of any Products by Buyer must be approved in writing by Omron before shipment. Omron Companies shall not be liable for the suitability or unsuitability or the results from the use of Products in combination with any electrical or electronic components, circuits, system assemblies or any other materials or substances or environments. Any advice, recommendations or information given orally or in writing, are not to be construed as an amendment or addition to the above warranty. See <http://www.omron247.com> or contact your Omron representative for published information.
14. **Limitation on Liability; Etc.** OMRON COMPANIES SHALL NOT BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR PRODUCTION OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED IN CONTRACT, WARRANTY, NEGLIGENCE OR STRICT LIABILITY. Further, in no event shall liability of Omron Companies exceed the individual price of the Product on which liability is asserted.
15. **Indemnities.** Buyer shall indemnify and hold harmless Omron Companies and their employees from and against all liabilities, losses, claims, costs and expenses (including attorney's fees and expenses) related to any claim, investigation, litigation or proceeding (whether or not Omron is a party) which arises or is alleged to arise from Buyer's acts or omissions under these Terms or in any way with respect to the Products. Without limiting the foregoing, Buyer (at its own expense) shall indemnify and hold harmless Omron and defend or settle any action brought against such Companies to the extent based on a claim that any Product made to Buyer specifications infringed intellectual property rights of another party.
16. **Property; Confidentiality.** Any intellectual property in the Products is the exclusive property of Omron Companies and Buyer shall not attempt to duplicate it in any way without the written permission of Omron. Notwithstanding any charges to Buyer for engineering or tooling, all engineering and tooling shall remain the exclusive property of Omron. All information and materials supplied by Omron to Buyer relating to the Products are confidential and proprietary, and Buyer shall limit distribution thereof to its trusted employees and strictly prevent disclosure to any third party.
17. **Export Controls.** Buyer shall comply with all applicable laws, regulations and licenses regarding (i) export of products or information; (ii) sale of products to "forbidden" or other proscribed persons; and (iii) disclosure to non-citizens of regulated technology or information.
18. **Miscellaneous.** (a) **Waiver.** No failure or delay by Omron in exercising any right and no course of dealing between Buyer and Omron shall operate as a waiver of rights by Omron. (b) **Assignment.** Buyer may not assign its rights hereunder without Omron's written consent. (c) **Law.** These Terms are governed by the law of the jurisdiction of the home office of the Omron company from which Buyer is purchasing the Products (without regard to conflict of law principles). (d) **Amendment.** These Terms constitute the entire agreement between Buyer and Omron relating to the Products, and no provision may be changed or waived unless in writing signed by the parties. (e) **Severability.** If any provision hereof is rendered ineffective or invalid, such provision shall not invalidate any other provision. (f) **Setoff.** Buyer shall have no right to set off any amounts against the amount owing in respect of this invoice. (g) **Definitions.** As used herein, "including" means "including without limitation"; and "Omron Companies" (or similar words) mean Omron Corporation and any direct or indirect subsidiary or affiliate thereof.

## Certain Precautions on Specifications and Use

1. **Suitability of Use.** Omron Companies shall not be responsible for conformity with any standards, codes or regulations which apply to the combination of the Product in the Buyer's application or use of the Product. At Buyer's request, Omron will provide applicable third party certification documents identifying ratings and limitations of use which apply to the Product. This information by itself is not sufficient for a complete determination of the suitability of the Product in combination with the end product, machine, system, or other application or use. Buyer shall be solely responsible for determining appropriateness of the particular Product with respect to Buyer's application, product or system. Buyer shall take application responsibility in all cases but the following is a non-exhaustive list of applications for which particular attention must be given: (i) Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this document. (ii) Use in consumer products or any use in significant quantities. (iii) Energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations. (iv) Systems, machines and equipment that could present a risk to life or property. Please know and observe all prohibitions of use applicable to this Product. NEVER USE THE PRODUCT FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY OR IN LARGE QUANTITIES WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON'S PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.
2. **Programmable Products.** Omron Companies shall not be responsible for the user's programming of a programmable Product, or any consequence thereof.
3. **Performance Data.** Data presented in Omron Company websites, catalogs and other materials is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of Omron's test conditions, and the user must correlate it to actual application requirements. Actual performance is subject to the Omron's Warranty and Limitations of Liability.
4. **Change in Specifications.** Product specifications and accessories may be changed at any time based on improvements and other reasons. It is our practice to change part numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the Product may be changed without any notice. When in doubt, special part numbers may be assigned to fix or establish key specifications for your application. Please consult with your Omron's representative at any time to confirm actual specifications of purchased Product.
5. **Errors and Omissions.** Information presented by Omron Companies has been checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.

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**OMRON EUROPE B.V.** • Wegalaan 67-69, NL-2132 JD, Hoofddorp, The Netherlands. • +31 (0) 23 568 13 00 • [www.industrial.omron.eu](http://www.industrial.omron.eu)

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