

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

## K8DS-PZ

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



- Greater resistance to inverter noise. *NEW*
- Monitor undervoltages, overvoltages, voltage asymmetry, phase sequence, and phase loss in three-phase three-wire circuits with one unit.
- One SPDT output relay, 5 A at 250 VAC (resistive load).
- World-wide power specifications supported by one unit. (Set with a rotary switch.)
- Relay status can be monitored using LED indicator.



Refer to *Safety Precautions* on page 9.  
Refer to page 7 for commonly asked questions.



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

## Ordering Information

### List of Models

	Rated input voltage*	Model
3-phase 3-wire mode	200, 220, 230, or 240 VAC	<b>K8DS-PZ1</b>
	380, 400, 415, or 480 VAC	<b>K8DS-PZ2</b>

**Note:** The input range is set with a rotary switch.

\* The power supply voltage is the same as the rated input voltage.

# K8DS-PZ

## Ratings and Specifications

### Ratings

Rated input voltage	K8DS-PZ1	Three-phase, three-wire Mode: 200, 220, 230, or 240 VAC
	K8DS-PZ2	Three-phase, three-wire Mode: 380, 400, 415, or 480 VAC
Input load		K8DS-PZ1: Approx. 1.7 VA K8DS-PZ2: Approx. 2.8 VA
Operating value setting range (OVER/UNDER) (ASY)		Overvoltage/Undervoltage 2% to 30% of rated input voltage Asymmetry 5% to 22% of rated input voltage
Operating value (OVER/UNDER)		Operates at 100% of set value.
Operating value (ASY.)		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		5% of operating value (fixed)
Reset method		Automatic reset
Operating time setting range (T)	Overvoltage/Undervoltage	0.1 to 30 s
	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±0.5 s
Indicators		Power (PWR): Green, Relay output (RY): Yellow, Alarm outputs (ALM): Red
Output relays		One SPDT relay output
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: 50,000 operations 3 A at 250 VAC: 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. 65 g
Mounting		Mounts to DIN Track.
Dimensions		17.5 × 80 × 74 mm (W×D×H)

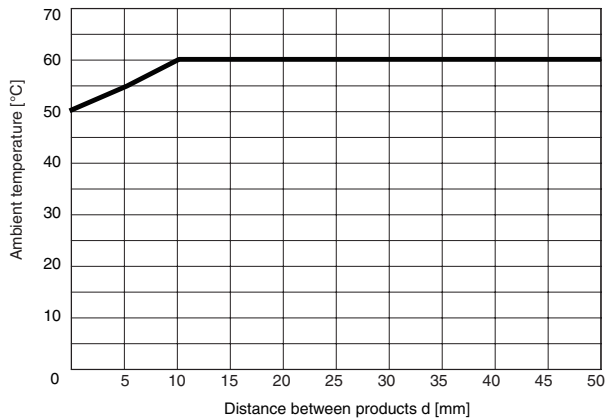
## Specifications

<b>Input frequency</b>		50/60 Hz
<b>Overload capacity</b>		Continuous 500 V
<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
<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, 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 K8DS-PZ Relays and Ambient Temperature (Reference Values)

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

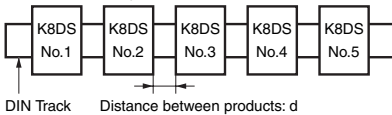
If the relay is used with an ambient temperature that exceeds these values, the temperature of the K8DS may rise and shorten the life of the internal components.



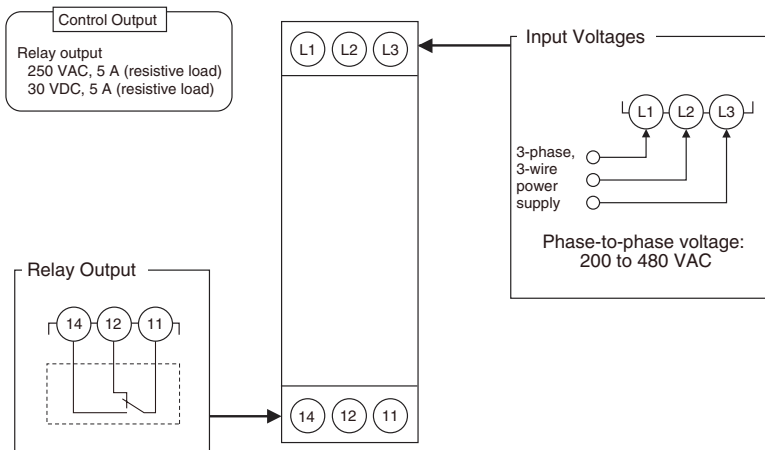
#### Test method

Sample: K8DS-PZ

Distance between products: 0, 5, 10, and 50 mm

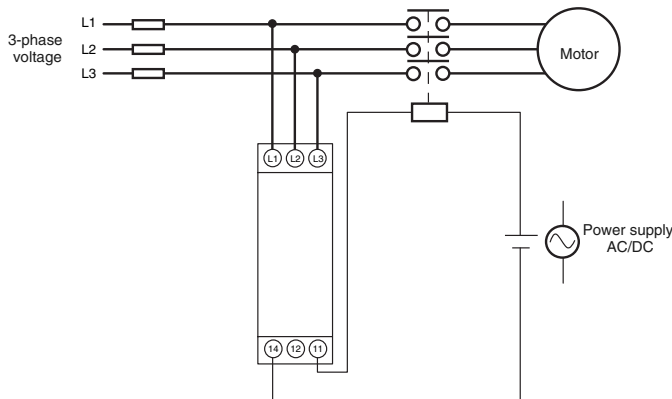


### Terminal Diagram



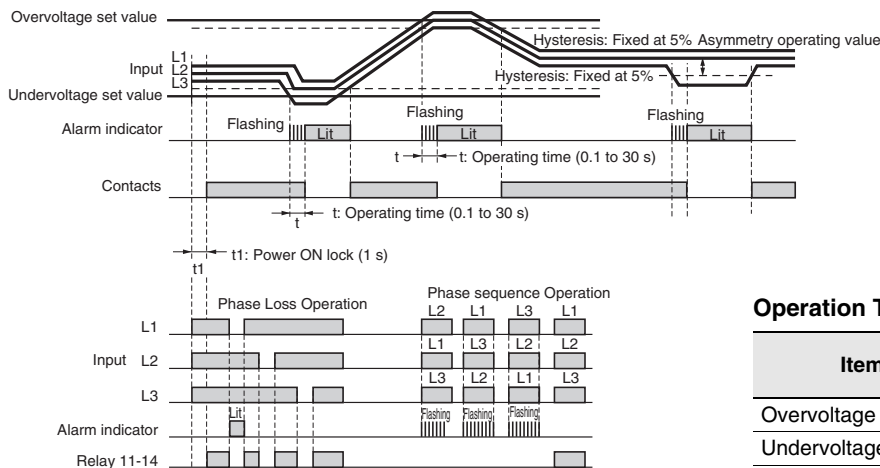
**Note:** Use the recommended ferrules if you use twisted wires.

### Wiring Example



### Timing Charts

#### ● Overvoltage, Undervoltage, Phase Sequence, and Phase Loss Operation Diagram



- Note:**
1. The K8DS-PZ□ output contacts are normally operative.
  2. The power ON lock prevents unnecessary alarms from being generated during the unstable period when the power is first turned ON. There is no contact output during timer operation.
  3. Phase loss is detected by a drop in the L1, L2, or L3 voltage. A phase loss is detected when any of the phase-to-phase voltages goes below 60% of the rated input.
  4. L2 and L3 are also used for the power supply. If the voltage becomes very low, the Relay will not operate.
  5. Phase loss (on power supply side and load side) is not detected in the motor load during operation.

#### Operation Table

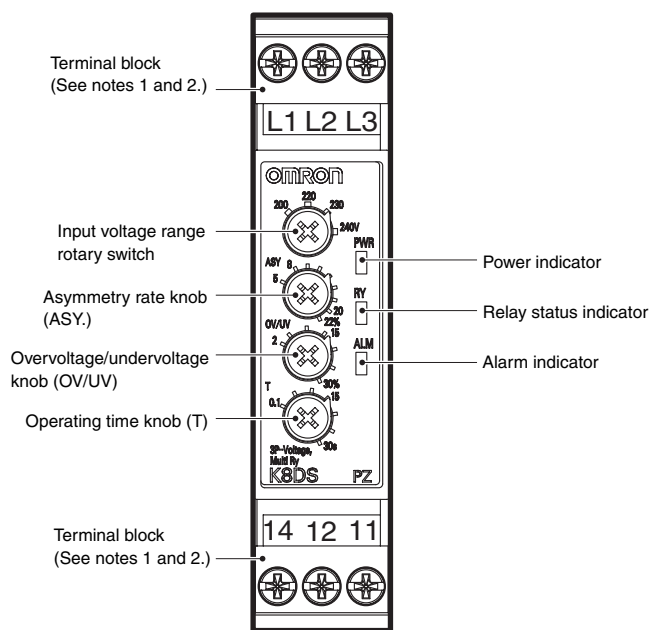
Item	Indicators		Contact operation	
	RY_LED	ALM_LED		
Overvoltage	OFF	ON	OFF	
Undervoltage	OFF	ON	OFF	
Asymmetry	OFF	ON	OFF	
Phase loss	OFF	ON <sup>*1</sup>	OFF	
Phase sequence	Incorrect phase	OFF	Flashing <sup>*2</sup>	OFF
	Correct phase	ON	OFF	ON

\*1 L2 and L3 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

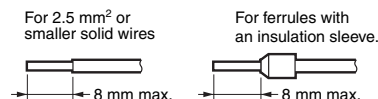
Item	Meaning
Power indicator (PWR: Green)	Lit when power is being supplied.*
Relay status indicator (RY: Yellow)	Lit when relay is operating (normally lit).
Alarm indicator (ALM: Red)	Lit for asymmetry voltage error. When the input exceeds the set value, the indicator flashes for the operating time to indicate the error status.

\* This indicator uses the input across L2 and L3 as the internal power supply. It will not light unless there is an input across L2 and L3.

### ●Setting Knobs

Item	Description
Input voltage range rotary switch	Used to change the input voltage range. K8DS-PZ1: 200, 220, 230, or 240 V. K8DS-PZ2: 380, 400, 415, or 480 V.
Overvoltage/undervoltage knob (OV/UN)	Used to set from 2% to 30% of the rated input.
Asymmetry rate knob (ASY.)	Used to set from 5% 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

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

2. Tightening torque: 0.49 to 0.59 N·m

## Operation Methods

### Connections

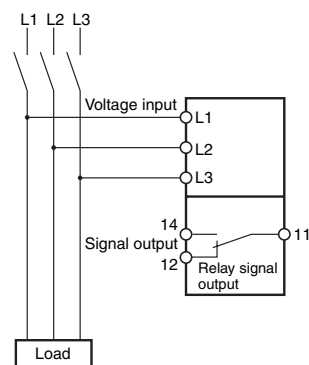
#### ●Input

Wire the input to the L1, L2, and L3 terminals (3-phase, 3-wire). 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.

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



## Setting Methods

### ●Asymmetry

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

The setting range is 5% to 22% of the rated input.

To correctly detect asymmetry, set the asymmetry rate knob to a value that is equal to or less than the overvoltage/undervoltage set value. If you set it to a value that is greater than the overvoltage/undervoltage set value, overvoltage/undervoltage detection will operate first, and asymmetry alarms will not be output.

If the knob is turned with an input applied to the input terminals, the alarm indicator will flash when the set value equals the input value.

Use this as a guide to make the setting.

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

Example: K8DS-PZ1 with Rotary Switch Set to 200 V

The rated input is 200 VAC, so the setting range is 4 to 44 V.

If you set the setting knob (ASY.) to 10%, the asymmetry operating voltage would be 20 V and an alarm would be output when the difference between the highest and lowest phase-to-phase voltages exceeds 20 V.

### ●Overvoltage/Undervoltage

Overvoltage/Undervoltage is set using the overvoltage/undervoltage knob (OV/UV).

The setting range is 2% to 30% of the rated input for overvoltage detection and -2% to -30% of the rated input for an undervoltage detection.

Use this as a guide to make the setting.

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

Example: K8DS-PZ1 with Rotary Switch Set to 200 V

The rated input is 200 VAC, so the setting range is 204 to 260 V for overvoltage detection and 140 to 196 V for undervoltage detection.

### ●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.

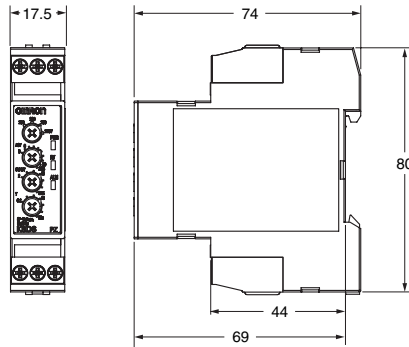
If the input exceeds (or drops lower than) the voltage set value, the alarm indicator will start flashing for the set period and then stay lit.

## Dimensions

(Unit: mm)

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

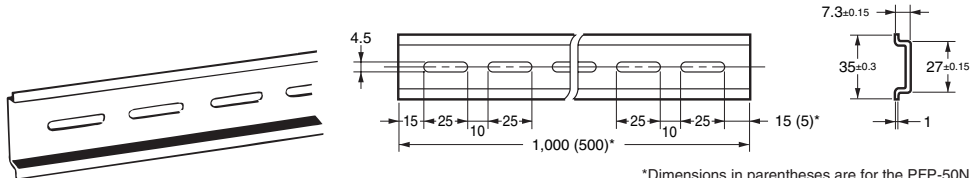
K8DS-PZ1  
K8DS-PZ2



### Optional Parts for DIN Track Mounting

#### ●DIN Tracks

PFP-100N  
PFP-50N



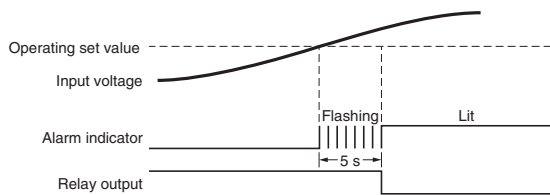
\*Dimensions in parentheses are for the PFP-50N.

# Questions and Answers

**Q** **Checking Operation**

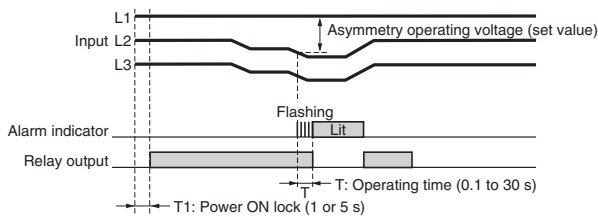
**A** **Overvoltage**  
 Gradually increase the input from 80% of the set value. The input will equal the operating value when the input exceeds the set value and the alarm indicator starts flashing.  
 Operation can be checked because the Relay will operate after the operating time has passed.  
**Undervoltage**  
 Gradually decrease the input from 120% of the set value and check the operation using the same method as for an overvoltage.

**Example: Monitoring Mode for Rated Voltage of 200 V and an Operating Time Setting of 5 s**

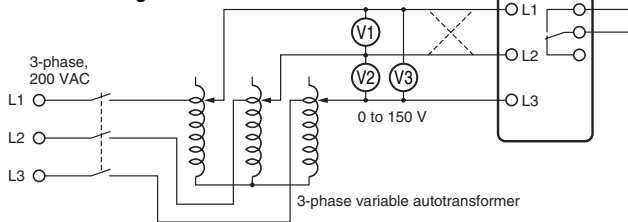


**Asymmetry**  
 With the rated input voltage applied, gradually change one of the phase-to-phase voltages. The Relay will operate when the difference between the highest and lowest voltage phases reaches or exceeds the asymmetry operating value.  
 Asymmetry operating value = Rated input voltage × Asymmetry set value (%)

**Example: Monitoring Mode for Rated Voltage of 200 V and an Operating Time Setting of 5 s**



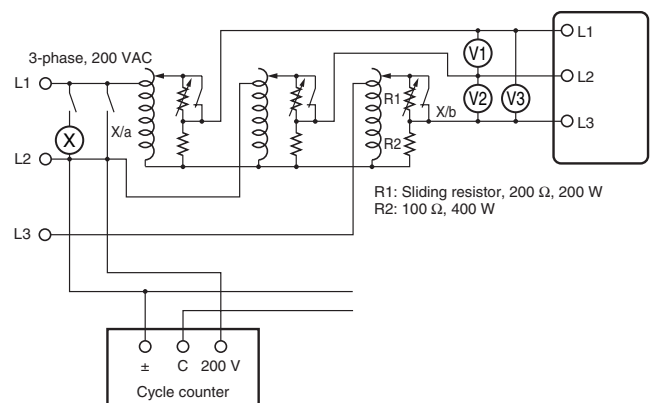
**Connection Diagram 1**



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

**A** **Overvoltage**  
 Change the input value quickly from 70% to 120% of the set value and measure the time required for the Relay to operate.  
**Undervoltage**  
 Change the input value quickly from 120% to 70% of the set value and measure the time required for the Relay to operate.  
**Operating Time**  
 Adjust the slide resistor so that the voltage applied to the K8DS terminals is 120% of the set value for overvoltage detection, 80% of the set value for undervoltage detection, or equal to or greater than the asymmetry operating value when the auxiliary relay in connection diagram 2 operates.  
 Close the switch and use a 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 K8DS operates.  
**Phase loss**  
 Create a phase loss for any input phase and check that the K8DS operates.

**Questions and Answers**

**Q** Load-side Phase Loss

**A** In principle, phase loss cannot be detected on the load side because the K8DS-PZ 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.

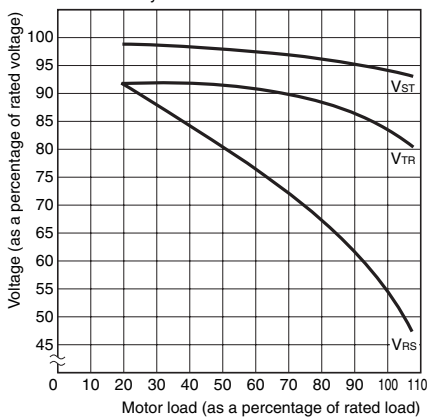
Set the operating time carefully because it will affect the time from when the phase loss occurs until tripping when this function is used.

**Q** Is an overvoltage detected if only one of the three-phase phase-to-phase voltages exceeds the overvoltage set value?

**A** The K8DS monitors all three phase voltages. Therefore, an overvoltage is detected if only one of the phase-to-phase voltages exceeds the set value. The same is true for undervoltages.

Characteristic Curve Diagram

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





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

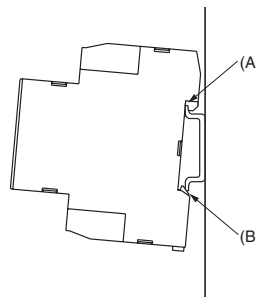
### Observe the following operating methods to prevent failure and malfunction.

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 and rotary switches.
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.

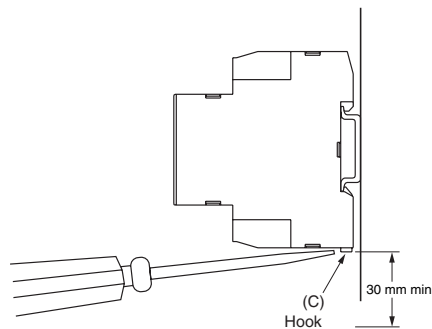
5. To reduce the error in the setting knob, always turn the setting knob from the minimum setting toward the maximum setting.
6. Phase loss is detected only when the power supply to the motor is turned ON. Phase loss during motor operation is not detected.
7. Phase loss can be detected only from the 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

- The product may be mounted in any direction, but it must be mounted securely and as level as possible.
- To mount the product to the DIN Track, hook it on the DIN Track at (A) and then press in on the Unit in direction (B).



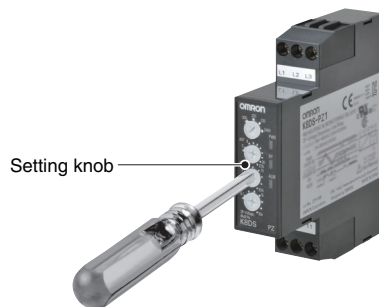
- To remove the product, insert a flat-blade screwdriver at (C) and pull down the hook to release the Unit.



- Leave at least 30 mm of space between the product and other devices to allow easy installation and removal.

## Operating the Setting Knobs and Rotary Switch

- Use a screwdriver to adjust the setting knobs and rotary switch. 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.
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