Three-phase Undervoltage and Phase-sequence Phase-loss Relay
K8DS-PU

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

- Greater resistance to inverter noise. *NEW*
- Monitor undervoltages, 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.

Ordering Information

List of Models

<table>
<thead>
<tr>
<th>Rated input voltage*</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-phase 3-wire mode</td>
<td></td>
</tr>
<tr>
<td>200, 220, 230, or 240 VAC</td>
<td>K8DS-PU1</td>
</tr>
<tr>
<td>380, 400, 415, or 480 VAC</td>
<td>K8DS-PU2</td>
</tr>
</tbody>
</table>

*Note: The input range is set with a rotary switch.
*The power supply voltage is the same as the rated input voltage.
K8DS-PU

Ratings and Specifications

Ratings

<table>
<thead>
<tr>
<th>Rated input voltage</th>
<th>K8DS-PU1</th>
<th>3-wire 3-phase mode: 200, 220, 230, or 240 VAC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>K8DS-PU2</td>
<td>3-wire 3-phase mode: 380, 400, 415, or 480 VAC</td>
</tr>
</tbody>
</table>

Input load

K8DS-PU1: Approx. 1.7 VA  
K8DS-PU2: Approx. 2.8 VA

Operating value setting range (UNDER)

Undervoltage: −30% to 25% of rated input voltage

Operating value

Operates at 100% of set value.

Reset value

5% of operating value (fixed)

Reset method

Automatic reset

Operating time setting range (T)

Asymmetry: 0.1 to 30 s  
Phase sequence: 0.1 ±0.05 s  
Phase loss: 0.1 s max.

Power ON lock time (LOCK)

1 ±0.5 s

Indicators

Power (PWR): Green, Relay output (RY): Yellow, UNDER: 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 mm²  
Twisted wires: AWG16, AWG18

Note: 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

<table>
<thead>
<tr>
<th>Input frequency</th>
<th>50/60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overload capacity</td>
<td>Continuous 500 V</td>
</tr>
<tr>
<td>Repeat accuracy</td>
<td></td>
</tr>
<tr>
<td>Operating value</td>
<td>±0.5% full scale (at 25°C and 65% humidity, rated power supply voltage, 50/60 Hz sine wave input)</td>
</tr>
<tr>
<td>Operating time</td>
<td>±50 ms (at 25°C and 65% humidity, rated power supply voltage)</td>
</tr>
<tr>
<td>Applicable standards</td>
<td></td>
</tr>
<tr>
<td>Conforming standards</td>
<td>EN 60947-5-1</td>
</tr>
<tr>
<td>EMC</td>
<td>EN 60947-5-1</td>
</tr>
<tr>
<td>Safety standards</td>
<td>UL 508 (Recognition), Korean Radio Waves Act (Act 10564), CSA: C22.2 No.14, CCC: GB14048.5</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>20 MΩ min.</td>
</tr>
<tr>
<td></td>
<td>Between external terminals and case</td>
</tr>
<tr>
<td></td>
<td>Between input terminals and output terminals</td>
</tr>
<tr>
<td>Dielectric strength</td>
<td>2,000 VAC for one minute</td>
</tr>
<tr>
<td></td>
<td>Between external terminals and case</td>
</tr>
<tr>
<td></td>
<td>Between input terminals and output terminals</td>
</tr>
<tr>
<td>Noise immunity</td>
<td>1,500 V power supply terminal common/normal mode</td>
</tr>
<tr>
<td></td>
<td>Square-wave noise of ±1 µs/100 ns pulse width with 1-ns rise time</td>
</tr>
<tr>
<td>Vibration resistance</td>
<td>Frequency: 10 to 55 Hz, acceleration 50 m/s²</td>
</tr>
<tr>
<td></td>
<td>10 sweeps of 5 min each in X, Y, and Z directions</td>
</tr>
<tr>
<td>Shock resistance</td>
<td>100 m/s², 3 times each in 6 directions along 3 axes</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>Terminals: IP20</td>
</tr>
</tbody>
</table>

#### Relationship of Mounting Distance between K8DS-PU 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.

![Diagram showing the relationship between mounting distance and ambient temperature](image)

**Test method**

Sample: K8DS-PU

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

K8DS No.1  K8DS No.2  K8DS No.3  K8DS No.4  K8DS No.5

DIN Track  Distance between products: d
Connections

Terminal Diagram

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

Wiring Example

Timing Charts

● Undervoltage Operation Diagram

Note: 1. The K8DS-PU 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

<table>
<thead>
<tr>
<th>Item</th>
<th>Indicators</th>
<th>Contact operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undervoltage</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>Phase loss</td>
<td>OFF</td>
<td>ON*1</td>
</tr>
<tr>
<td>Phase sequence</td>
<td>Incorrect phase OFF</td>
<td>Flashing*2 OFF</td>
</tr>
<tr>
<td></td>
<td>Correct phase ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th>Item</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power indicator (PWR: Green)</td>
<td>Lit when power is being supplied.*</td>
</tr>
<tr>
<td>Relay status indicator (RY: Yellow)</td>
<td>Lit when relay is operating (normally lit).</td>
</tr>
<tr>
<td>Alarm indicator (ALM: Red)</td>
<td>• Lit for undervoltage or phase loss error.</td>
</tr>
<tr>
<td></td>
<td>• When the input exceeds the undervoltage value, the indicator flashes for the operating time to indicate the error status.</td>
</tr>
<tr>
<td></td>
<td>• Lit for phase sequence error.</td>
</tr>
</tbody>
</table>

* 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

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage range</td>
<td>Used to change the input voltage range.</td>
</tr>
<tr>
<td>rotary switch</td>
<td>K8DS-PU1: 200, 220, 230, or 240 V</td>
</tr>
<tr>
<td></td>
<td>K8DS-PU2: 380, 400, 415, or 480 V</td>
</tr>
<tr>
<td>Undervoltage knob (UNDER)</td>
<td>Used to set from −30% to 25% of the rated input.</td>
</tr>
<tr>
<td>Operating time knob (T)</td>
<td>Used to set the operating time to 0.1 to 30 s.</td>
</tr>
</tbody>
</table>

Note: 1. Use either a solid wire of 2.5 mm² 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

**● 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 the rotary switch setting.

Example: K8DS-PU1 with Rotary Switch Set to 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

**Three-phase Undervoltage and Phase-sequence Phase-loss Relay**

<table>
<thead>
<tr>
<th>K8DS-PU1</th>
<th>K8DS-PU2</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
</tbody>
</table>

**Optional Parts for DIN Track Mounting**

**● DIN Tracks**

<table>
<thead>
<tr>
<th>PFP-100N</th>
<th>PFP-50N</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
</tbody>
</table>

*Dimensions in parentheses are for the PFP-50N.*
Questions and Answers

Checking Operation

**Q** Checking Operation

**A**

**Undervoltage**
Gradually reduce the input from 120% of the set value. The input will equal the operating value when the input goes below the set value and the alarm indicator starts flashing. Operation can be checked because the Relay will operate after the operating time has passed.

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

![Diagram](image)

**Connection Diagram 1**

- **3-phase, 200 VAC**
- **L1**, **L2**, **L3**, 0 to 150 V
- **3-phase variable autotransformer**

**How to Measure the Operating Time**

**Q** How to Measure the Operating Time

**A**

**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 80% of the set 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**

- **3-phase, 200 VAC**
- **L1**, **L2**, **L3**
- **R1**: Sliding resistor, 200 Ω, 200 W
- **R2**: 100 Ω, 400 W
- **Cycle counter**

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

**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.
Load-side Phase Loss

In principle, phase loss cannot be detected on the load side because the K8DS-PU measures three-phase voltage to determine phase loss.

Motor Load Phase Loss during Operation

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.

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WARNING</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>CAUTION</strong></td>
<td>Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in property damage.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Precautions for Safe Use</th>
<th>Supplementary comments on what to do or avoid doing, to use the product safely.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precautions for Correct Use</td>
<td>Supplementary comments on what to do or avoid doing, to prevent failure to operate, malfunction, or undesirable effects on product performance.</td>
</tr>
</tbody>
</table>

Meaning of Product Safety Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>🚨</td>
<td>Used to warn of the risk of electric shock under specific conditions.</td>
</tr>
<tr>
<td>🚫</td>
<td>Used for general prohibitions for which there is no specific symbol.</td>
</tr>
<tr>
<td>⚠️</td>
<td>Used to indicate prohibition when there is a risk of minor injury from electrical shock or other source if the product is disassembled.</td>
</tr>
<tr>
<td>⚫️</td>
<td>Used for general mandatory action precautions for which there is no specified symbol.</td>
</tr>
</tbody>
</table>

**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 inflammmable 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 sulfuring 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.


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 every purchase order, purchase request, specifications, catalogs, manuals, brochures and other documents, whether electronic or in written form, or otherwise presented by Buyer, which are consistent with, or in addition to, these Terms. Buyer’s acceptance of any part of these terms will be deemed an agreement to all of these terms.

2. Prices; Payment Terms. All prices stated are current, subject to change with or without notice by Omron Companies. Buyer shall be responsible for any shipping and handling fees and duties applicable to the Products. Buyer’s purchase order or other documents which are consistent with, or in addition to, these Terms are not binding on Omron Companies unless and until Buyer receives written confirmation of delivery. Payment terms are subject to change at any time. Unless otherwise agreed in writing by Omron, all payments shall be due within thirty (30) days of the date of invoice. Any late payment shall bear interest at the maximum rate permitted by applicable law. Buyer shall bear all costs involved in obtaining any government approvals required for the importation or sale of the Products. All taxes, duties and other governmental charges (other than general 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, conversion 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.

3. 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 when due, or to comply with these Terms or any related agreement, Omron may (without liability and in addition to other remedies) cancel any unshipped portion of Product(s) or require Buyer to pay for Products purchased in transit by Buyer at amounts, including amounts payable hereunder, whether or not then due, which Buyer would otherwise owe to it by Buyer. Buyer shall in any event remain liable for all unpaid accounts.

4. Interest. At Omron’s option, may charge Buyer 1-1/2% interest per month or the highest rate allowed by law, 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 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, conversion 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 when due, or to comply with these Terms or any related agreement, Omron may (without liability and in addition to other remedies) cancel any unshipped portion of Product(s) or require Buyer to pay for Products purchased in transit by Buyer at amounts, including amounts payable hereunder, whether or not then due, which Buyer would otherwise owe to it by Buyer. Buyer shall in any event remain liable for all unpaid accounts.

9. Cancellation. Orders are subject to rescheduling or cancellation if Buyer indemnifies Omron against all 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 consummation of any labor agreement.

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 products in "breach of warranty" cases.
   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. Buyer shall assert any claim against Omron for defects in the Products occurring before delivery to the carrier must be presented in writing to Omron within ten (10) days after Buyer’s receipt of the Products. Buyer must send a copy of such claim to the carrier noting that the carrier received the Products.

13. Limited Warranty. Omron’s exclusive warranty is that the Products will be free from defects in materials and workmanship for a period of twelve (12) months from the date of original shipment to Buyer. Buyer shall give Omron prompt written notice of any defect. Omron reserves the right to inspect any Products which are the subject of any claim. Upon receipt of Omron’s written request, Buyer shall deliver the Products to a location designated by Omron at Buyer’s expense. Omron’s sole obligation to Buyer shall be, at Omron’s election, to (i) replace (in the form originally shipped with Buyer responsibility for labor charges for repair or replacement hereof) 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 any indirect, warranty, repair or replacement 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 are not liable for any inability 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, recommendation or information given orally or in writing, are not to be construed as an amendment or addition to the above warranty.

14. Legal Rights. The above warranty is in lieu of all other warranties, whether expressed or implied, statutory or otherwise, including but not limited to the warranty of merchantability or fitness for any purpose, and Omron Companies shall not be responsible for conformity of the Products to Buyer’s specifications or for the performance or results obtained by Buyer in using the Products. Omron Companies shall not be responsible for conformity of the Products to Buyer’s specifications or for the performance or results obtained by Buyer in using the Products. Omron Companies shall not be responsible for conformity of the Products to Buyer’s specifications or for the performance or results obtained by Buyer in using the Products.

15. Indemnities. Buyer shall indemnify and hold harmless Omron Companies and their employees from any claims, losses, suits, actions or demands (including attorney’s fees and expenses) related to any claim, investigation, litigation or proceeding (whether or not Omron is a party) which arises out of 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 shall indemnify and hold harmless Omron Companies and their employees from any claims, losses, suits, actions or demands (including attorney’s fees and expenses) related to any claim, investigation, litigation or proceeding (whether or not Omron is a party) which arises out of 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 shall indemnify and hold harmless Omron Companies and their employees from any claims, losses, suits, actions or demands (including attorney’s fees and expenses) related to any claim, investigation, litigation or proceeding (whether or not Omron is a party) which arises out of or is alleged to arise from Buyer’s acts or omissions under these Terms or in any way with respect to the Products.

16. Property; Confidentiality. Any intellectual property in the Products is the exclusive property of Omron Companies and Buyer shall not attempt to duplicate it or pass it to a third party. Without limiting the foregoing, Buyer (at its own expense) shall indemnify and hold harmless Omron Companies and their employees from any claims, losses, suits, actions or demands (including attorney’s fees and expenses) related to any claim, investigation, litigation or proceeding (whether or not Omron is a party) which arises out of or is alleged to arise from Buyer’s acts or omissions under these Terms or in any way with respect to the Products.

17. Export Controls. Buyer shall comply with all applicable laws, regulations and licensees regarding (i) export of products or information; (ii) sale of products to “forbidden” or other proscribed persons; and (iii) disclosure to non-citizens of any 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 Omron’s ports of entry or any other applicable laws or regulations. (d) Amendment. These Terms constitute the entire agreement between Buyer and Omron and override all prior understandings, agreements or representations between Buyer and Omron, whether written or oral, that may have been made. (e) Severability. If any provision hereof is rendered ineffective or invalid, such provision shall not invalidate any other provision. (f) Specific Language. If any specific language is used in this Agreement, it shall not be the basis for the interpretation of any other written or oral language of this Agreement. (g) Definitions. As used herein, “includings” means “including but not limited to” and “or” (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 rating and limitation information. Any application of the Product which is not itself is not sufficient for a complete determination of the suitability of the Product and compliance with all specifications, standards, and other applicable or application. Buyer shall be solely responsible for determining appropriateness of the particular Product with respect to Buyer’s application, product, system or environment. Buyer shall assume all application responsibility in all of the following: the Product may not be suitable for Buyer’s application due to potential chemical contamination or electrical interference, or conditions or uses not described in this document. Use in consumer products or any use in significant quantities.

2. Programmed Products. Omron Companies shall not be responsible for the Product’s performance, efficiency or accuracy when used as a part of a system. This information is not intended to be a substitute for the system integrator’s own design, development or review of the system. Omron does not assume any liability or responsibility for the system integrator’s system design, development or review of the system.

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 test conditions and the limitations of Liabilities.

4. Changes 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, any 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 contact Omron to confirm actual specifications of purchased Product.

5. Errors and Omissions. Information Omron Companies has been published is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.