


Ideal for Single-phase Motor Overcurrent Protection

- Applicable to motor overcurrent protection and AC current detection in general single-phase circuits.
- Inverse-type, start-up lock type, and instantaneous-type overcurrent sensors are available to provide precise protection, detection, and control suited to the operating environment.
- There is no need to replace the CT or change the relay's input resistance in accordance with the size of the current, allowing ease of use.
- Plug-in design simplifies installation, removal, and wiring.



 The Current Sensor cannot be used in circuits with waveform distortion, inverter circuits, or with capacitor loads.

Model Number Structure

Model Number Legend

SAO-□S□N
 1 2 3 4 5

1. Basic model name

SAO: Current Sensor

2. Operating time characteristics

R: Inverse type

Q: Instantaneous type with start-up lock

S: Regular instantaneous type

3. Detection function

S: Detection for single-phase circuits

4. Control voltage

1: 100/110/120 VAC

2: 200/220/240 VAC

5: 24 VDC

6: 48 VDC

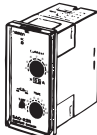
7: 100/110 VDC

5. Product history

N: New version

Ordering Information

List of Models

Appearance	Operating element Operating characteristics Control voltage	Overcurrent detection		
		Inverse type	Instantaneous type with start-up lock	Instantaneous type
	100/110/120 VAC	SAO-RS1N	SAO-QS1N	SAO-SS1N
	200/220/240 VAC	SAO-RS2N	SAO-QS2N	SAO-SS2N
	24 VDC	SAO-RS5N	SAO-QS5N	SAO-SS5N
	48 VDC	SAO-RS6N	SAO-QS6N	SAO-SS6N
	100/110 VDC	SAO-RS7N	SAO-QS7N	SAO-SS7N

Note: The resetting method for all types is automatic reset.

Current Converters

Model	Current range
SET-3A	1 to 80 A
SET-3B	64 to 160 A

Socket

Type	Model
Front connecting socket	8PFA1

Specifications

■ Ratings

Item	Control voltage	100/110/120 VAC	200/220/240 VAC	24 VDC	48 VDC	100/110 VDC
Motor circuit	Rated voltage	500 VAC max., 3-phase (primary voltage at SET Current Converter)				
	Rated current	1 to 80 A or 64 to 160 A, 3-phase (primary current at SET Current Converter)				
Control power supply circuit	Rated voltage	100/110/120 VAC, 200/220/240 VAC, 24 VDC, 48 VDC, or 100/110 VDC (leveled DC)				
	Allowable voltage fluctuation range	+10/-15% max. of the rated voltage				
Frequency	Rated frequency	50/60 Hz				
	Allowable frequency fluctuation range	Rated frequency $\pm 5\%$				
Current setting range		Refer to the <i>Current Settings</i> table.				
Output contacts	Contact configuration	SPDT				
	Contact capacity	240 VAC: 3 A ($\cos\phi = 1.0$), 2 A ($\cos\phi = 0.4$) 24 VDC: 3 A (resistive load), 2 A (L/R = 7 ms) 110 VDC: 0.2 A (resistive load), 0.1 A (L/R = 7 ms)				
Power consumption		Approx. 3.5 VA	Approx. 7 VA	Approx. 0.3 W	Approx. 0.5 W	Approx. 1.2 W
Weight		Approx. 170 g				
Case color		Munsell 5Y 7/1				

■ Normal Operating Conditions

Operating temperature range	-10 to 60°C (with no icing)
Operating humidity range	35% to 85%
Storage temperature range	-25 to 65°C
Altitude	2,000 m max.

■ Characteristics

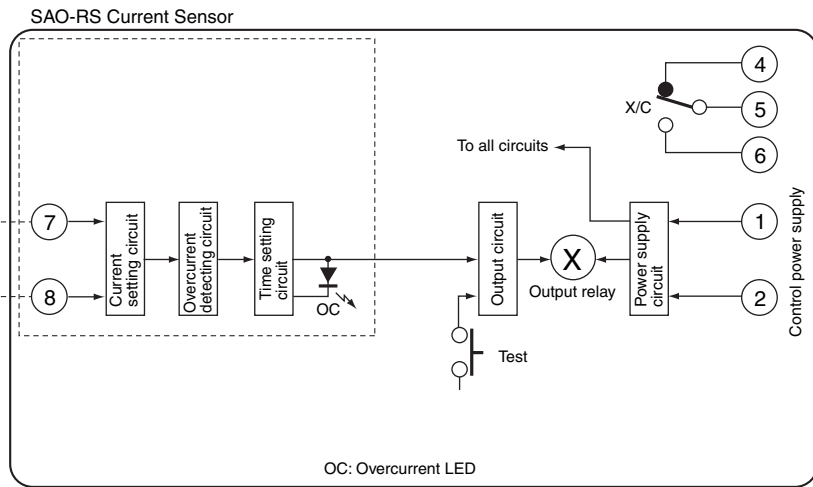
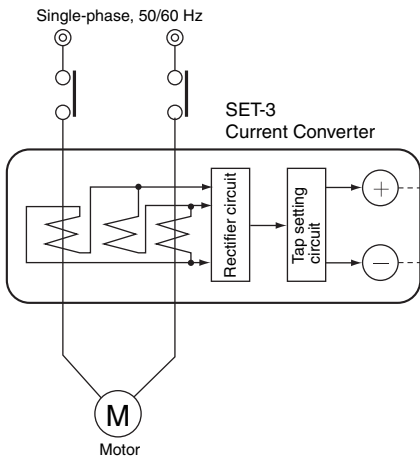
Item	SAO-RS□N	SAO-QS□N	SAO-SS□N
Operating current	100% of the current setting		
Operating time characteristics	Inverse type	Instantaneous type with start-up lock	Instantaneous type
Operating time	For a 600% overcurrent: Time scale $\times 1$: 1 to 10 s Time scale $\times 4$: 4 to 40 s For a 200% overcurrent: $2.8 \times t \pm 30\%$, where t is the operating time at 600% overcurrent (at max. time setting).	Start-up lock time (fixed) with a 600% overcurrent: Time scale $\times 1$: 1 to 10 s Time scale $\times 4$: 4 to 40 s Operating time with a 120% overcurrent: 0.3 s max.	Operating time with a 120% overcurrent: 0.3 s max.
Initial current for start-up lock	---	Approx. 30% of the current setting	---
Inertial characteristics	Will not operate for 80% of the operating time for a 600% overcurrent at the minimum current setting and maximum operation time setting.	---	---
Reset current	95% min. of the operating current		
Operating current accuracy	$\pm 10\%$ of the current setting		
Operating time (start-up lock time) accuracy	At a time scale setting of 1: $+10/-5\%$ of maximum setting At a time scale setting of 2 to 10: $\pm 10\%$ of maximum setting		0.3 s max.
Influence of temperature on operating current	$\pm 5\%$ for 0 to 40 °C; $\pm 10\%$ for -10 to 50 °C		
Influence of temperature on operating time (start-up lock time)	$\pm 10\%$ for 0 to 40 °C; $\pm 20\%$ for -10 to 50 °C		0.3 s max. for -10 to 50 °C
Influence of frequency on operating current	$\pm 3\%$ for a frequency fluctuation of $\pm 5\%$		
Influence of frequency on operating time (start-up lock time)	$\pm 5\%$ for a frequency fluctuation of $\pm 5\%$		0.3 s max. for a frequency fluctuation of $\pm 5\%$
Influence of voltage on operating current	$\pm 3\%$ for a voltage fluctuation of $+10/-15\%$		

Item		SAO-RS□N	SAO-QS□N	SAO-SS□N
Influence of voltage on operating time (start-up lock time)		±5% for a voltage fluctuation of $+10/-15\%$		0.3 s max. for a voltage fluctuation of $+10/-15\%$
Insulation resistance		10 MΩ min. between electric circuits and the mounting panel 5 MΩ min. between contact circuits and other circuits and contact poles		
Dielectric strength		2,000 VAC for 1 min between electric circuits and the mounting panel 2,000 VAC for 1 min between contact circuits and other circuits 1,000 VAC for 1 min between contact poles		
Lightning impulse dielectric strength		6,000 V max. between electric circuits and the mounting panel 4,500 V max. between contact circuits and other circuits 4,500 V max. between control power supply circuit terminals Waveform: $1.2 \times 50 \mu\text{s}$, 3 times each for positive and negative polarities		
Overload capacity	Motor circuit	20 times the current setting for 2 s, applied twice with a 1 min interval (primary voltage at SET Current Converter) Continuous current: 125% of the maximum current setting for each current range.		
	Control power supply circuit	AC power supply: 1.15 times the rated power supply voltage for 3 hrs, once DC power supply: 1.3 times the rated power supply voltage for 3 hrs, once		
Vibration resistance	Malfunction	10 to 55 Hz, 0.3-mm double amplitude for 10 min each in X, Y, and Z directions		
	Destruction	10 to 25 Hz, 2-mm double amplitude for 2 h each in X, Y, and Z directions		
Shock resistance	Malfunction	98 m/s ² in X, Y, and Z directions		
	Destruction	294 m/s ² in X, Y, and Z directions		
Test button operation		Operated quickly (without lighting the LED)		

Connections

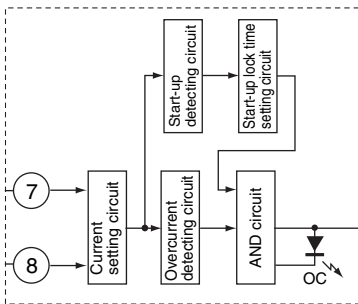
Terminal Arrangement

SAO-RS

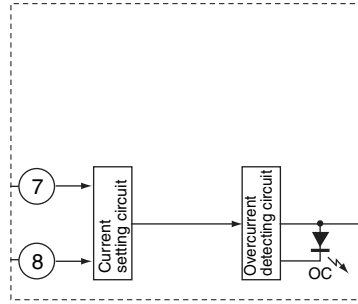


Note: There is no polarity specification when using a DC power supply.

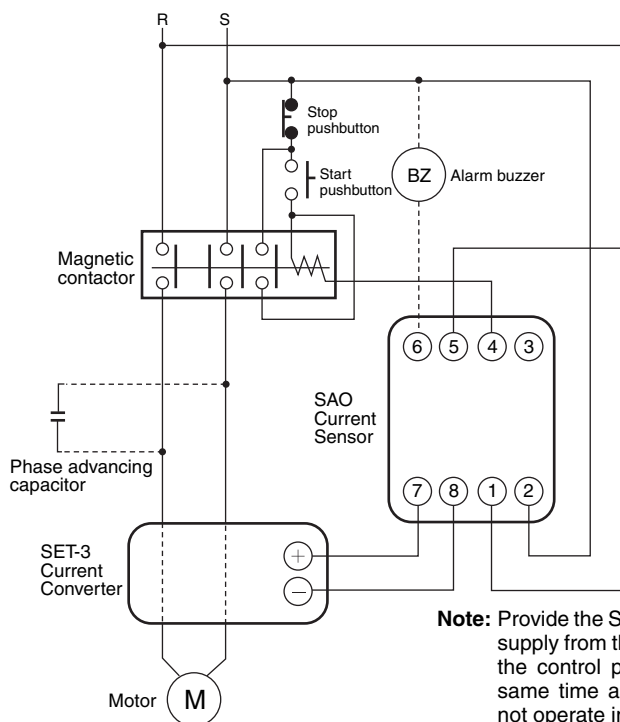
SAO-QS



SAO-SS



Output Circuits



Operation

Perform settings for the SAO Current Sensor and SET Current Converter in accordance with the current for the load used.

Current Settings

Rated current (current setting range)	Current scale multiplying factor decimal number	Current Converter		
		Number of conductor passes	Tap setting	Model
1 to 2.5	0.25	8	20	SET-3A
2 to 5	0.5	4	20	
4 to 10	1	2	20	
8 to 20	2	1	20	
16 to 40	4	1	40	
32 to 80	8	1	80	
64 to 160	16	1	Fixed	SET-3B

Note: The current range is determined by the number of conductor passes through the SET Current Converter and the tap setting. The range of the current scale on the Sensor is from 4 to 10 A and so attach a current scale multiplying factor decal (provided with the product) to the Sensor if required.

1. Current Sensor Settings

1. Current Scale Multiplying Factor

Determine the appropriate current scale multiplying factor for the current setting range from the table, and attach the corresponding decal to the Sensor. For example, for a current setting range of 2 to 5 A, attach the 0.5 decal.

2. Setting the Operating Current

Determine the scale value for the operating current according to the required current setting and the decal number, and set the current setting knob accordingly. The relationship between the scale value and the actual operating current is shown in the following table.

Scale multiplying factor	Current scale value							
	4	5	6	7	8	9	10	
×0.25	1	1.25	1.5	1.75	2	2.25	2.5	
×0.5	2	2.5	3	3.5	4	4.5	5	
×1	4	5	6	7	8	9	10	
×2	8	10	12	14	16	18	20	
×4	16	20	24	28	32	36	40	
×8	32	40	48	56	64	72	80	
×16	64	80	96	112	128	144	160	

The figures in the above table represent the current setting values (unit: A).

3. LED Indicator

The LED indicator lights continuously when the Sensor operates in response to an overcurrent.

4. Setting the Operating Time

- Set the time setting knob to the required time. The operating time is equal to the product of the time scale value and the time scale multiplying factor.
- The time scale multiplying factor is selected with the time scale multiplying factor switch. For the SAO-RS, this is the operating time in the event of a 600% overcurrent. For the SAO-QS, this is the start-up lock time. There is no operating time setting for the SAO-SS.

The start-up lock time is a function to lock the output operation to prevent faulty operation due to unstable inputs during startup. Even when reaching the alarm output level for input status during startup*, output operation will not be performed until the set time elapses.

(* Startup means when the power supply to the Sensor is turned on.)

Time scale value	Scale multiplying factor	
	×1	×4
1	1 s	4 s
2	2 s	8 s
3	3 s	12 s
4	4 s	16 s
5	5 s	20 s
6	6 s	24 s
7	7 s	28 s
8	8 s	32 s
9	9 s	36 s
10	10 s	40 s

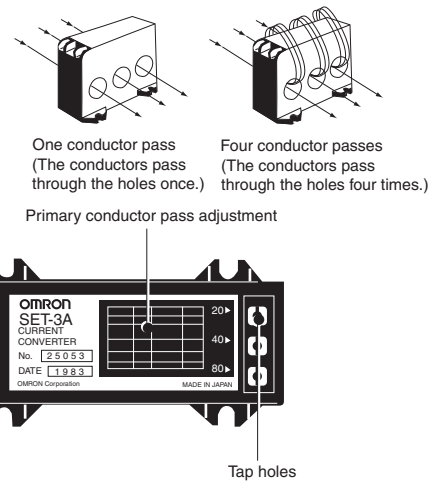
5. Test Button

Pressing the test button momentarily operates the output relay. The LED indicator, however, does not light during this operation.

2. Current Converter Settings

1. Deciding the Number of Primary Conductor Passes

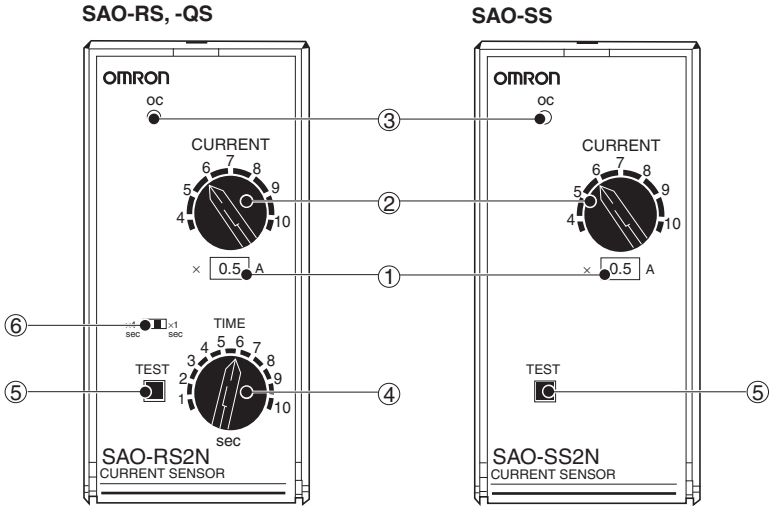
- Decide the number of primary conductor passes and the tap setting using the *Current Settings* table. For example, if the current setting range is 2 to 5 A, use four conductor passes and a tap setting of 20.
- Pass the wires through the holes in the same direction. It does not matter which wire does through which hole.



2. Tap Setting

Insert the setting screw into the required tap holes with a screwdriver. After setting, be sure to replace the cover.

Nomenclature



Number	Name
1	Current scale multiplying factor decal
2	Current setting knob
3	LED indicator
4	Time setting knob
5	Test button
6	Time scale multiplying factor switch

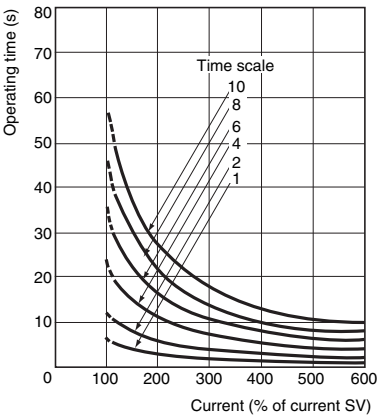
Refer to *Operation* on page 5 for details of the function of each part.

Engineering Data

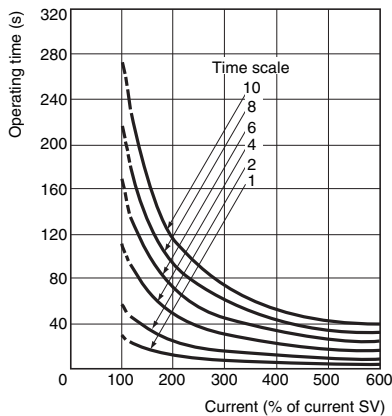
Operating Time Characteristics

SAO-RS

Time Scale Multiplying Factor: 1 (Inverse Type*)



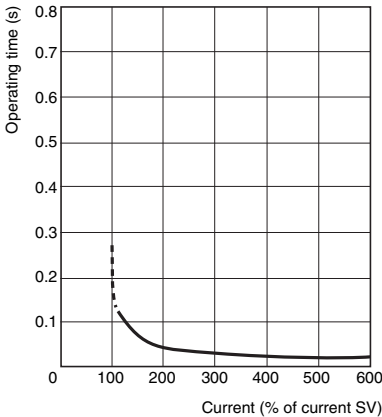
Time Scale Multiplying Factor: 4 (Inverse Type*)



Note: Inverse Type:
With inverse-type Sensors, the operating time varies with the size of the overcurrent. The larger the overcurrent, the shorter the operating time.

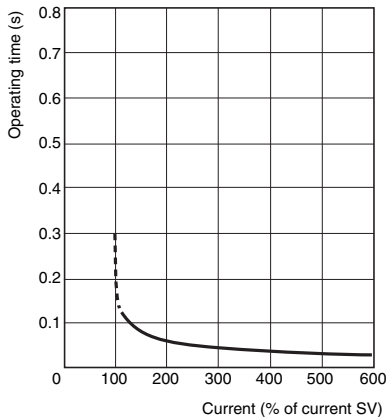
SAO-QS

(Instantaneous Type)



SAO-SS

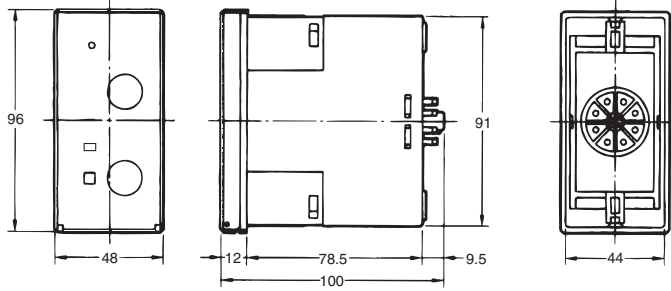
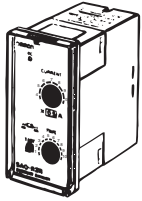
(Instantaneous Type)



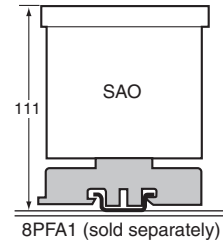
Dimensions

Note: All units are in millimeters unless otherwise indicated.

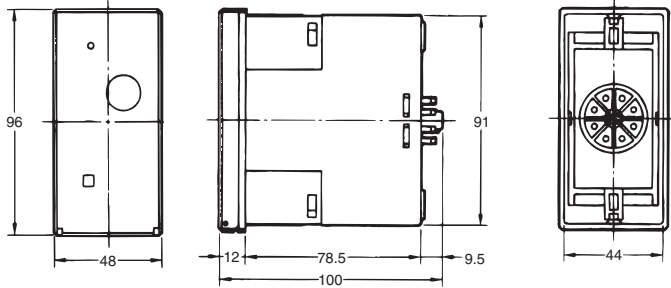
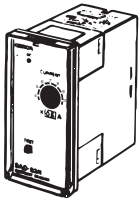
SAO-RS, -QS



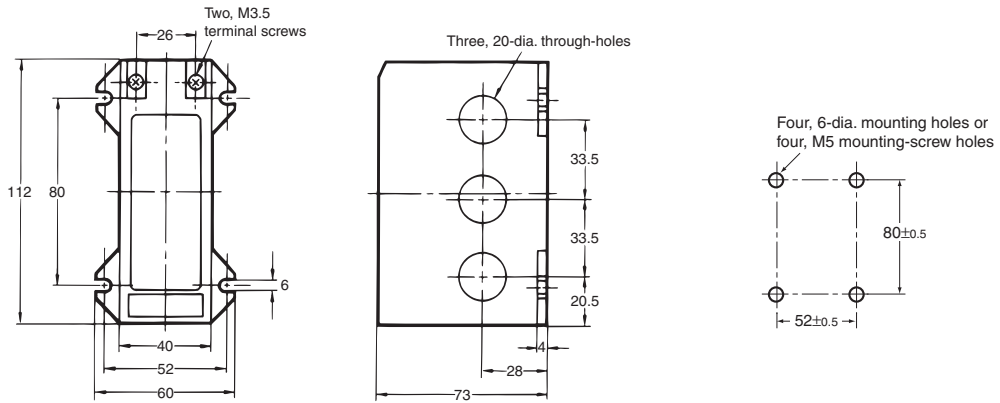
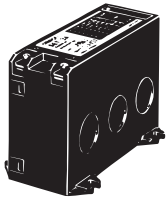
Connecting Socket



SAO-SS

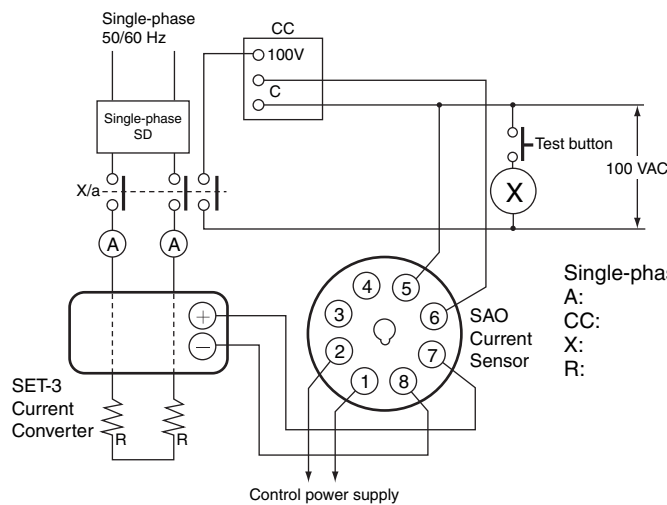


Current Converter SET-3A SET-3B



Maintenance and Inspections

- Checking Operation with the Test Button:
Turn ON the control power supply, and test operation by pressing the test button.
- Checking Characteristics:
Test the SAO Current Sensor and SET-3 Current Converter for changes in characteristics using the circuit on the right.



Single-phase SD: Single-phase voltage regulator
 A: AC ammeter
 CC: Cycle counter
 X: Auxiliary relay
 R: Fixed resistor

Safety Precautions

■ Correct Use

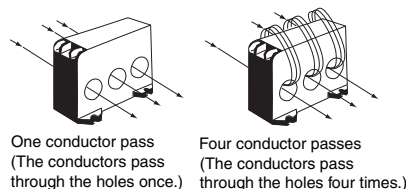
- Use a commercial frequency power supply as the AC control power supply.
- This Current Sensor cannot be used for circuits that may exhibit current waveform distortion, such as in thyristor control, circuits that incorporate inverters or rectifiers, high-frequency circuits, and capacitor loads.
- Use the K2CM for circuits incorporating inverters.
- This Current Sensor cannot be used for inching operation. The internal overcurrent detecting circuit is reset with each inching operation.
- Do not use the SET-3 Current Converter with positive and negative output terminals open. Short-circuit these terminals if they are not used.
- After the LED indicator turns ON, it will turn OFF when the control power supply voltage is turned OFF.

Mounting

- When installing with an 8PFA1 connecting socket, first fasten the socket firmly to the panel with screws, then insert the Sensor and secure it with the hook. Leave a gap of around 30 mm between Sensors to allow for the hooks.
- There is no particular restriction regarding the mounting direction. Mount the Sensor as horizontally and securely as possible.
- When panel mounting the Sensor, obtain the mounting brackets for panel mounting SE Relays. The recommended panel thickness for panel mounting is 1 to 3.2 mm.

Connections

- Determine the necessary number of conductor passes from the *Current Settings* table and pass the all three wires through the holes in the same direction. It does not matter which wire does through which hole.



- Be sure to connect the Current Sensor and Current Converter with the correct polarity. Not doing so may result in malfunction.
- It is not necessary to consider polarity when using a DC control power supply.

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.

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

In the interest of product improvement, specifications are subject to change without notice.

Terms and Conditions Agreement

Read and understand this catalog.

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

Warranties.

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

(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.omron.com/global/> or contact your Omron representative for published information.

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.

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.

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 PRODUCT(S) IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

Programmable Products.

Omron Companies shall not be responsible for the user's programming of a programmable Product, or any consequence thereof.

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.

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.

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.

2020.5

In the interest of product improvement, specifications are subject to change without notice.

OMRON Corporation
Industrial Automation Company

<http://www.ia.omron.com/>

(c)Copyright OMRON Corporation 2020 All Right Reserved.