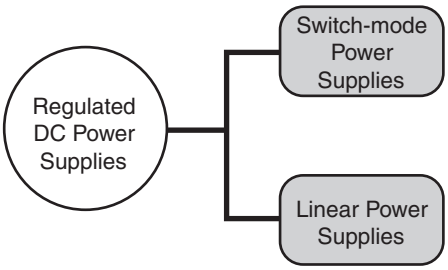
Overview of Power Supplies

■What is a Power Supply?

Commercial AC power distributed from power plants cannot be supplied directly to the ICs and other electronic components built into electronic devices in automated office and factory equipment without destroying the components due to the high voltage of commercial AC power. Devices called power supplies or regulated DC power supplies are therefore required to convert commercial AC power into regulated DC power to drive ICs and other electronic components.

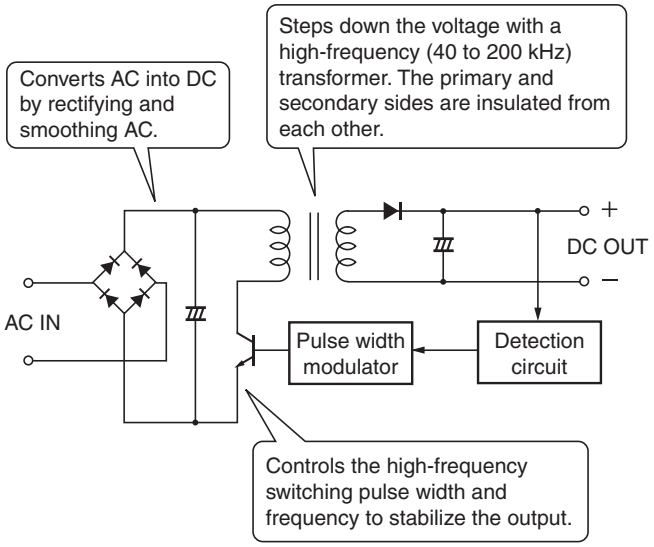
■Regulated DC Power Supplies

The methods for controlling Regulated DC Power Supplies can be largely classified into the following two types. Switch-mode power supplies and linear power supplies are generally referred to as power supplies. Currently, switch-mode power supplies are the most prevalent.



● Switch-mode Power Supplies

Switch-mode power supplies convert commercial AC power into the required high-frequency DC power using the high-speed switching of semiconductors. Switch-mode power supplies are so compact, light, and efficient that they are used as power supplies by most electronic devices.



Advantages

- Highly efficient.
- Compact, and light.
- A wide input voltage range.

Disadvantages

- Switching noise is generated.
- Large inrush current on primary side.

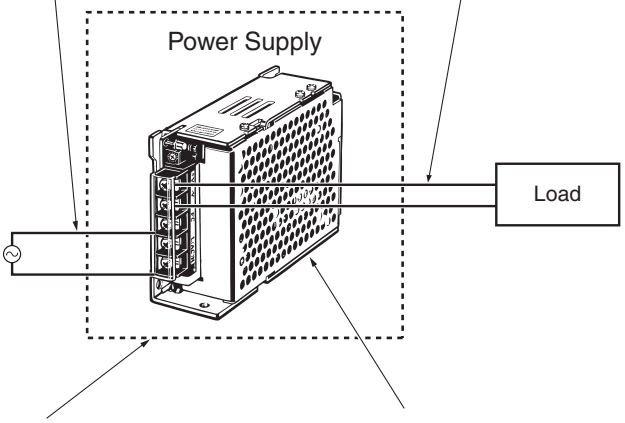
■Power Supply Selection

● Basic Selection Points

Factors to consider when selecting a Power Supply are provided in the following diagram.

(1) Input Voltage
Each Power Supply has an input voltage range. Select the Power Supply according to the available input voltage.

(2) Output Capacity (Voltage × Current)
The maximum load capacity must be less than the maximum output capacity of the Power Supply.



(3) Safety Standards
Models are available that comply with either UL, CSA, and VDE standards or EN standards.

(4) Shape and Mounting Method
Power Supplies of various shapes are available. Use the most suitable Power Supply according to the application. Various mounting brackets are also available.

● Functions

The following functions are available: overcurrent protection, overvoltage protection, harmonic current control, and alarm outputs. The functions that are provided depend on the model. Check the function specifications.

● Overcurrent Protection

All models provide overcurrent protection. The protection method that is used will affect startup characteristics.

● Life Expectancy

The warranty period and life expectancy of the Power Supply depend on the model.
Select a model with suitable specifications for your application.
Periodic maintenance is required for the cooling fan.

● Installation

Install the Power Supply so that there is sufficient space for air to flow around it.
The mounting direction and space requirements are specified for each model. The load rate may have to be reduced depending on the installation method.

● Inrush Current

Select the newest models to allow for the inrush current of the Power Supply.
Make sure that the circuit breaker will not be tripped by inrush current. Even for the same model, the inrush current will be different for 100 VAC and 200 VAC.

Power Supply Glossary

■Glossary

● Ratings, Performance, and Functions

Item		Details
Efficiency (%)		Refer to *Efficiency* on page 3.
Input condition	**Voltage range**	Refer to *Input Voltage* on page 3.
	Frequency	---
	Input current	Refer to *Input Current* on page 3.
	Power factor	---
	Harmonic current control	Refer to *Harmonic Current Control* on page 3.
	Leakage current	Refer to *Leakage Current* on page 3.
	Inrush current	Refer to *Inrush Current* on page 4.
Output characteristics	**Voltage adjustment range**	Refer to *Voltage Adjustment Range* on page 4.
	Ripple	Refer to *Ripple and Noise* on page 4.
	Static input variation influence	Refer to *Static Input Variation Influence* on page 4.
	Static load variation influence (rated input voltage)	Refer to *Static Load Variation Influence* on page 4.
	Temperature variation	Refer to *Temperature Variation Influence* on page 4.
	Startup time	---
	Output hold time	---
Functions	**Overload protection**	Refer to *Overload Protection* on page 5.
	Overvoltage protection	Refer to *Overvoltage Protection* on page 6.
	Serial operation	Refer to *Series Operation* on page 6.
	Parallel operation	Refer to *Parallel Operation* on page 6.
	Remote sensing function	Refer to *Remote Sensing Function* on page 6.
	Remote control function	Refer to *Remote Control Function* on page 6.
Other	**Ambient operating temperature**	Refer to *Ambient Operating Temperature* on page 6.
	Storage temperature	Refer to *Storage Temperature* on page 6.
	Ambient operating humidity	Refer to *Ambient Operating Humidity* on page 6.
	Dielectric strength	Refer to *Dielectric Strength* on page 6.
	Insulation resistance	Refer to *Insulation Resistance Test* on page 6.
	Vibration resistance	Refer to *Vibration Resistance* on page 7.
	Shock resistance	Refer to *Shock Resistance* on page 7.
	Conducted emission	Refer to *Conducted Emissions* on page 7.
	Radiated emissions	Refer to *Radiated Emissions* on page 7.

Note. As a general rule, the ambient temperature is measured at 50 mm below from the Power Supply.

● Other Terms

Item	Details
Life expectancy	Refer to *Life Expectancy* on page 7.
Internal fuse	Refer to *Internal Fuse* on page 7.

■Efficiency

The output power divided by the effective input power. The higher the efficiency, the smaller the internal power loss of the Power Supply.

■Input Conditions

● Input Voltage

The input voltage specifies the input voltage and corresponding frequency range at which the rated operations and performance can be maintained.

● Frequency

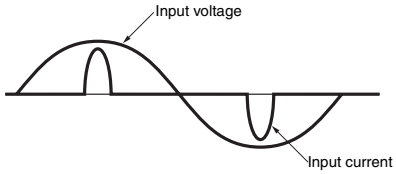
The frequency of the voltage applied to the AC input terminals.

● Power Factor

The effective input power divided by apparent power.

● Harmonic Current Control

Harmonic currents are the frequency components that are multiples (2 to about 40) of the 50/60 Hz sine wave of the basic AC current. Most switch-mode power supplies incorporate capacitors, including power supplies on household appliances). As a result, the input voltage sine wave is transformed into a steep input current pulse that is not a sine wave and that includes harmonics.



The power factor for devices that contain a lot of harmonic currents is low. The apparent power (VA) is larger than the actually consumed power (W), which increases the current. If there are too many of this type of device connected, power supply facilities with more leeway are required.

There are standards that are designed to suppress harmonic currents in devices that are connected to public, low-voltage power grids. These include the international standard IEC 1000-3-2 and the EN 61000-3-2 standard (which mirrors the IEC 1000-3-2 standard) in the EU. These standards apply to devices with a rated input power of 75 W or higher that are connected to public, low-voltage grids.
In Japan, the Ministry of Economy, Trade and Industry undertakes activities to suppress harmonic currents and has issued the *Guideline of Harmonic Reduction for Consumers Who Have High or Ultra-high Voltage Power Receiving Facilities*.

When switch-mode power supplies are used for industrial applications, countermeasures for harmonic currents are often implemented in the power receiving facilities of the factory or other sites. Therefore, there is little need for harmonic current control in the switch-mode power supplies themselves. If you are connecting to a public, low-voltage power grid, such as a general household power supply, or you need to suppress harmonics from the switch-mode power supply for any other reason, use a power supply that conforms to IEC 61000-3-2.

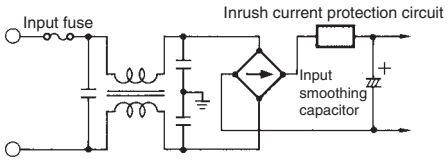
● Input Current

Standard Switch-mode Power Supplies directly rectify AC input current. Usually, rectification is achieved using capacitor inputs and a smoothing capacitor through which a reactive current is allowed to flow. Therefore, the input current depends on the output power, input voltage, power factor, and efficiency, as follows:

$$\text{Input current} = \frac{\text{Output power}}{\text{Input voltage} \times \text{Power factor} \times \text{Efficiency}}$$

Generally speaking, the power factors of switching power supplies that do not have power factor improvement functions are between approx. 0.4 and 0.6. The power factors of those with power factor improvement functions are 0.95 min. For details on efficiency, refer to the information in the datasheet for each model.

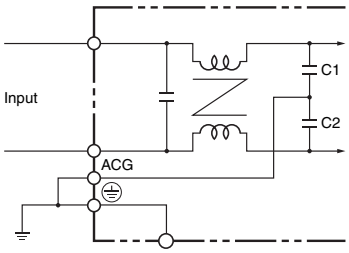
Input Rectifier/Smoothing Circuit



● Leakage Current

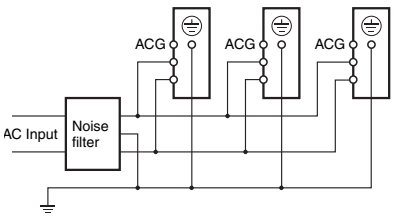
Switch-mode Power Supplies have an internal noise filter circuit that prevents switching noise from being fed back to the input lines and protects the internal circuit from external noise. Leakage current is largely due to the current that flows through the capacitors (C_1 or C_2) of the input filter circuit.
Depending on the Power Supply's configuration, leakage current can be reduced by incorporating an internal filter circuit.

Model with ACG Terminals



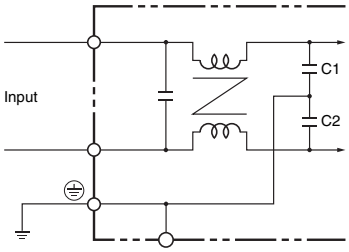
The ACG terminal on the S82W Power Supply, which is connected between capacitors C_1 and C_2 of the filter circuit, is short-circuited to the ⏚ terminal by the short bar. Leakage current can be reduced by removing the short bar.
When the leakage current poses a problem, such as when using more than one Power Supply, remove the short bar from each Power Supply.
To prevent electric shock, however, be sure to ground the ⏚ terminal.

In this case, however, the input filter cannot function effectively, resulting in greater output ripple noise and feedback noise. To suppress this noise, connect an external noise filter circuit as shown below.



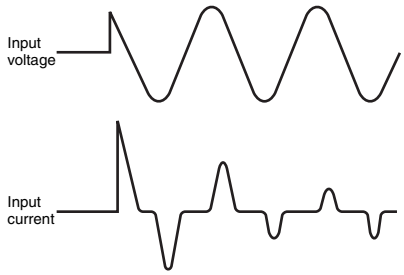
Leakage current cannot be reduced in Power Supplies without an ACG terminal due to the filter circuit configuration.

Model without ACG Terminals



● Inrush Current

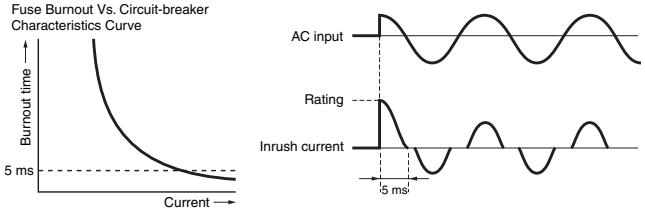
When a Switch-mode Power Supply is turned on, a surge of current flows into the input smoothing capacitor to charge the capacitor. This current surge is called the “inrush current.” The inrush current varies depending on the application timing and the presence of an inrush current protection circuit, but is usually several to several tens of times greater than the steady-state input current.



Inrush current (at cold start)

When two or more Switch-mode Power Supplies are connected to the same input, the inrush current is the sum of the inrush currents for each Power Supply. Therefore, check the fusing characteristics of fuses and operating characteristics of breakers making sure that the external fuses will not burn out and the circuit breakers will not be activated by the inrush current. The inrush current pulse width can be considered to be about 5 ms. (Refer to the following diagram.)
In particular, models with 100-to-240 VAC input have higher inrush current energy than models with single rated inputs or models with switching inputs. Therefore, consider the coordination with the breaker.
The following table provides guidelines for fuse and breaker selection.

Selection points	External fuses	Circuit breakers
Rated voltage	Sufficient for the input voltage of the Power Supply	
Rated current	Same as that of internal fuses *	Sufficient for the rated current of the Power Supply
Inrush current	Must not be burnt or tripped at the Power Supply inrush current (pulse width: approx. 5 ms).	
Fuse type	Normal burning or semi-time lag.	---



Note. The duration of the inrush current is 5 ms max. Therefore, the fusing characteristics require the inrush current to flow sufficiently for up to 5 ms.

* Refer to the block diagram in the datasheet for the current capacity of the internal fuse.

■Output Characteristics

● Voltage Adjustment Range

The range over which the output voltage can be adjusted while maintaining specific output characteristics.

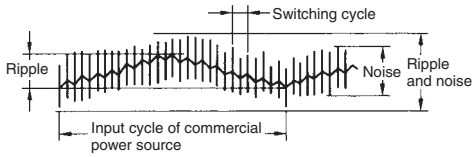
Note 1. The output voltage can effectively be converted to a value above the specified range. When adjusting the voltage, however, check the actual output voltage and make sure it is within the specified output voltage range.

Note 2. Make sure that the output voltage × output current does not exceed the rated output capacity and that the output current does not exceed the rated output current.

Note 3. Do not apply unnecessarily strong force to the Output Voltage Adjuster (V.ADJ). Doing so may damage the V.ADJ.

● Ripple and Noise

Since Switch-mode Power Supplies operate at high frequencies (i.e., as high as 20 kHz or more), the DC output will contain ripple and noise. The following figure shows a representative waveform for ripple and noise.



Since ripple and noise contain high-frequency components, the ground line of the oscilloscope must be shortened when making measurements. If the ground line is too long, it acts as an antenna which is influenced by radian waves and, consequently, the correct values of ripple and noise cannot be measured.

● Static Input Variation Influence

The variation in the output voltage occurring when only the input voltage is changed slowly over the input range while maintaining constant output conditions.

● Static Load Variation Influence

The variation in the output voltage occurring when the output current is changed slowly over a specified range while maintaining constant input conditions.

● Temperature Variation Influence

The variation in the output voltage occurring when only the ambient operating temperature is changed.

● Startup Time

The time from when the input voltage is turned ON until the output voltage reaches 90% of the rated output voltage.

● Output Hold Time

The time after the input voltage is shut off during which the output voltage maintains the voltage precision range.

■Functions

● Overload Protection

Applicable Models: All Models

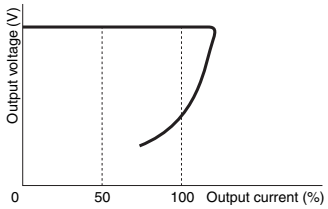
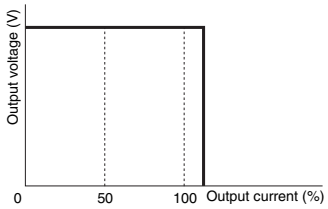
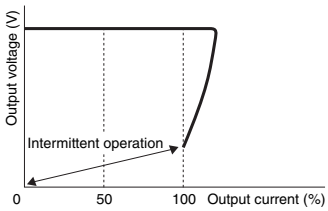
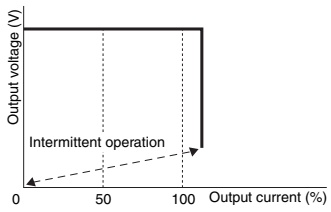
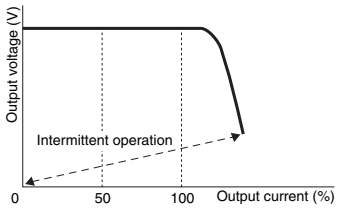
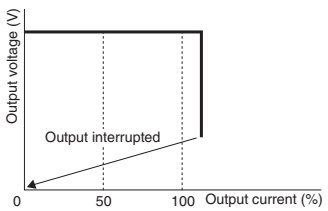
This protection function prevents damage to the Power Supply itself due to overcurrent (including output short-circuits). The protection function is activated and the output current is limited when the load current is greater than the overcurrent detection value (this value depends on the model).

The output voltage will also drop according to the overload (load impedance). The drop level depends on the overload conditions and load line impedance.

The following table shows the six types of output voltage drop characteristics for main models when the overcurrent protection function is operating.

These drop characteristics can be seen as indicating the limit on the output current that can be supplied to the load effectively in the process in which the output voltage starts when the AC input turns ON. When connecting a load (with built-in DC-DC converter) that starts operating from a low voltage or a capacitive load in which inrush current can flow easily, consider the trend in overcurrent protection drop characteristics and the startup characteristics on the load side when selecting the Power Supply.

Generally, an inverted L voltage drop is considered favorable at startup.

Overcurrent drop characteristics	Relationship between output voltage and output current	Trend
Gradual current/ voltage drop		When a voltage drop occurs, the output current also gradually drops, and the output returns to the normal level automatically (automatic recovery) when the overcurrent status is cleared.
Inverted L voltage drop		When a voltage drop occurs, the output current remains essentially constant. The output returns to the normal level automatically (automatic recovery) when the overcurrent status is cleared.
Voltage/current drop Intermittent operation		When a voltage drop occurs, the output current also gradually drops, and the load of the Power Supply itself is reduced (automatic recovery) using intermittent output when the voltage drops to a certain level or lower.
Inverted L voltage drop Intermittent operation		When a voltage drop occurs, the output current remains essentially constant. The load of the Power Supply itself is reduced (automatic recovery) using intermittent output when the voltage drops to a certain level or lower.
Gradual current increase/ voltage drop Intermittent operation		When a voltage drop occurs, the output current increases as the voltage drops, maintaining constant power, and the load of the Power Supply itself is reduced (automatic recovery) using intermittent output when the voltage drops to a certain level or lower.
Inverted L voltage drop Shut off		When a voltage drop occurs, the output current remains essentially constant. If, however, the overcurrent status continues for longer than a fixed time, the output will be interrupted and the power will need to be turned ON again to recover.

Note 1. Loads with built-in DC-DC converters (PLCs, digital panel meters and other electronic devices) and capacitive loads are connected, the overcurrent protection function will be activated at startup, which may prevent the Power Supply's output from turning ON.

Note 2. Continuing to use the Power Supply with an output short-circuit or in overcurrent status may cause the internal parts to be deteriorated or damaged.

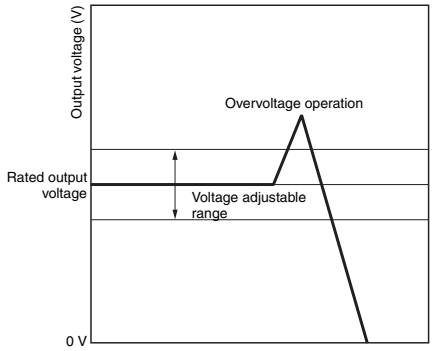
Note 3. If a load short-circuit occurs, the actual drop in voltage depends on the impedance of the load lines being used.

Note 4. Even if the inclination of the drop characteristics is the same, the actual characteristics (output current/voltage, etc.) depend on the model.

Note 5. Specific precautions apply to some models. For details, refer to the separate information in the datasheet for each model.

● Overvoltage Protection

This protection function detects overvoltage and interrupts output to prevent sensors or other loads from being subjected to excessive voltage due to failure of the Power Supply's internal recovery circuit. To resume operation, turn OFF the input power, and wait for a fixed period of time before turning ON the input power again.



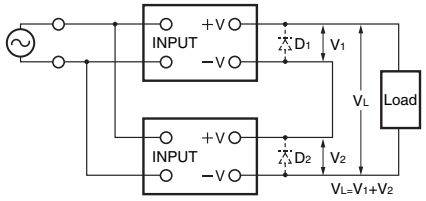
Note 1. When the overvoltage protection circuit operates, the Power Supply itself may be malfunctioning. When restarting the input power after the overvoltage protection circuit has operated, turn the input power ON with the load line disconnected and check the output voltage.

Note 2. The overvoltage protection circuit may operate if surge or other external overvoltage (e.g., from the load) is applied to the output side.

Models with the Zener-diode clamp system do not restart after the protection circuit operates. Send the product for repair.
* For further details, refer to the datasheet for individual models.

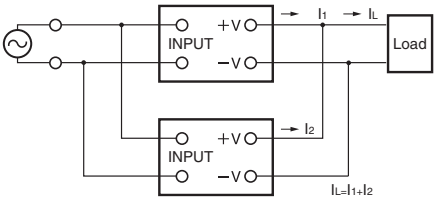
● Series Operation

- **Connect the Power Supplies in series to increase the output voltage.**



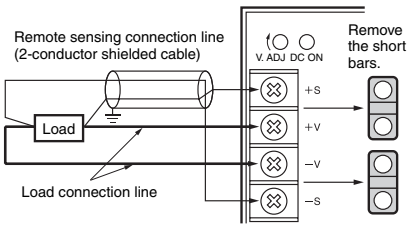
● Parallel Operation

- **Connect Power Supplies in parallel to increase the output current if sufficient output current for the load cannot be obtained from one Power Supply.**



● Remote Sensing Function

Remote sensing can be used to compensate for a voltage drop on the load lines. (The compensation range is ±10% of the rated output voltage.)
To use remote sensing, remove the short bars from the remote sensing terminals (short-circuited in standard shipments) and wire as shown in the following diagram.
Make sure that the remote sensing screws are not loose. Loose screws will prevent output of the output voltage.
To ensure stable operation, it is advisable to thicken the load connection line and compensate for the amount of voltage drop using the Power Supply's voltage adjuster (V.ADJ).

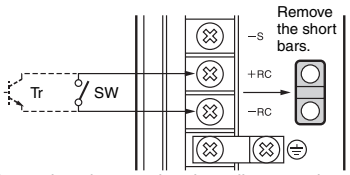


Note 1. When the voltage drop in the load lines is large, the overvoltage protection function may activate due to the increase in voltage to correct the voltage drop, so be sure to use as thick as a wire as possible.

Note 2. Be sure that $V_{OUT} \times I_{OUT}$ does not exceed the rating of the Power Supply.

● Remote Control Function

The output voltage of the Power Supply can be turned ON and OFF from an external signal while the input voltage is being applied to the Power Supply. To use this function, remove the short bars from the remote control terminals (short-circuited in standard shipments) and connect the switch or transistor as shown in the following diagram. The output voltage will stop when the remote control terminals are open.
If the remote control screws become loose, output voltage may not be produced. Make sure that the screws are tight.



When a transistor is used, make sure that the collector-emitter voltage V_{CE} of the transistor is 20 V or higher and that the collector current I_C is 5 mA or higher.

● Ambient Operating Temperature

The allowable range for the ambient temperature in which continuous operation is possible. The ambient temperature is the temperature that is not affected by the heat generated by the Power Supply itself.
Note. The ambient temperature is measured at 50 mm below from the Power Supply.

● Storage Temperature

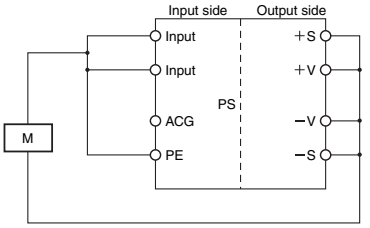
The allowable range for the ambient temperature in which performance will not deteriorate due to long-term storage. The Power Supply itself must be in a non-operational state.

● Ambient Operating Humidity

The allowable ambient humidity range in which the Power Supply can be used continuously.

● Insulation Resistance Test

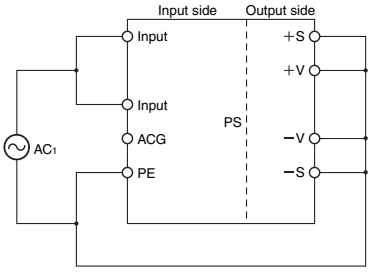
To protect the Power Supply from an input voltage surge, surge absorbers are inserted between the input lines and between the input terminals and the ACG terminal. When testing the insulation resistance of the Power Supply, remove the short bar between the PE and ACG terminals on the front panel. Otherwise, the measured resistance will be lower than the actual value. (See following diagram.)



(M: Insulation resistance meter)

● Dielectric Strength

When a high voltage is applied between the input terminals and the case (PE terminal), electric energy builds up across the inductor L and capacitor C of the internal noise filter. This energy may generate a voltage surge when a high voltage is applied to the Power Supply by a switch or timer, and as a result, the internal components of the Power Supply may be damaged. To prevent voltage impulses when testing, gradually change the applied voltage using the variable resistor on the dielectric strength testing equipment, or apply the voltage so that it crosses the zero point when it rises or falls.
Some models of OMRON Switch-mode Power Supplies have surge absorbers between the input lines and between the input terminals and the ACG terminal. When testing the dielectric strength of these models, remove the short bar from the PE and ACG terminals. With the short bar attached to the terminals, the applied voltage may be cut off by the testing equipment.(See following diagram.)



● Vibration Resistance

The vibration resistance indicates the mechanical strength against vibration when the Power Supply receives vibration due to a periodic force during transport, storage, or operation.
The datasheet gives the vibration test conditions that the Power Supply will withstand.
Use the following formula to find the acceleration from the amplitude and frequency.

Acceleration [m/s^2] = 0.02 × (Half amplitude [mm] × 2) × (Frequency [Hz])^2
Acceleration [G]= Acceleration [m/s^2]/9.8 [m/s^2]

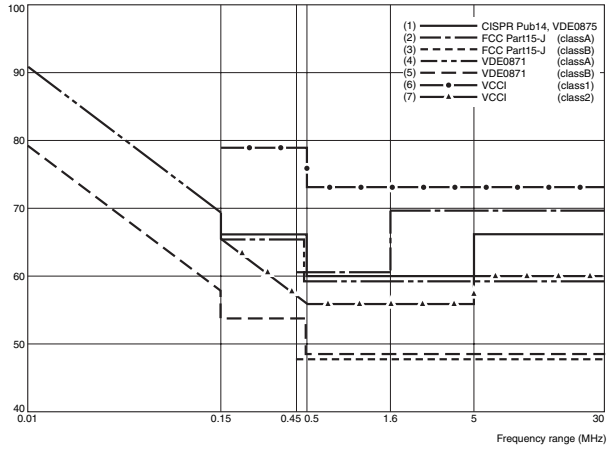
● Shock Resistance

The shock resistance indicates the mechanical strength against shock when the Power Supply receives shock during transport, storage, or operation.
The datasheet gives the shock test conditions that the Power Supply will withstand.

● Conducted Emissions

Noise voltage that enters through the Switch-mode Power Supply's AC input terminals.

Values Stipulated for Conducted Emissions in Various Countries



	Frequency range (MHz)	Voltage dB (μV)
(1)	0.15 to 0.5, 0.5 to 5, 5 to 30	66, 60, 66
(2)	0.45 to 1.6, 1.6 to 30	60, 69.5
(3)	0.45 to 1.6, 1.6 to 30	48, 48
(4)	0.01 to 0.15, 0.15 to 0.5, 0.5 to 30	91 to 69.5, 66, 60
(5)	0.01 to 0.15, 0.15 to 0.5, 0.5 to 30	79 to 57.5, 5, 54, 48
(6)	0.15 to 0.5, 0.5 to 30	79, 73
(7)	0.15 to 0.5, 0.5 to 5, 5 to 30	66, 56, 60

CISPR: Applied to office equipment.
FCC: Noise regulation in U.S.A.
Class A: industrial equipment
Class B: household appliance and information equipment including communications equipment.
VDE: Noise regulation in Europe
(European version of the FCC used in U.S.A)
VCCI: Applied to data processing devices in Japan.

● Radiated Emissions

The strength of the magnetic field (i.e., the amount of noise) that is radiated directly into the environment from the Switch-mode Power Supply.

■Other Terms

● Life Expectancy

The life of a Power Supply is determined by conducting a temperature rise test of the built-in aluminum electrolytical capacitors, when using the Power Supply in a standard installation at the rated input voltage under an ambient temperature of 40°C and a load rate of 50%. The calculated life expectancy functions as a guide only is not a guaranteed value. Use this information as reference for performing maintenance and replacement.
Note. The life expectancy of the fan in models with fans is not included.

(Main Models)

Eight years or longer: S82J-D7 *, S82K, S82S, S82R *
Ten years or longer: S82J *, S8TS, S8VS, S8VM, S82W-102, S82W-103, S8AS, S8JX

* Discontinued models

● Internal Fuse

If the internal fuse has blown, it is very likely that internal circuits of the Power Supply have been damaged and that parts other than the fuse will also need to be replaced. If the fuse has blown, consult your OMRON representative.
Short-circuit current will not continue to flow on the primary side (i.e., the external side) of the Power Supply even if the fuse has blown. There is, however, no protection function for the input power lines.

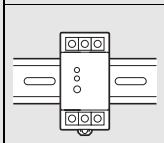
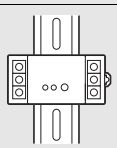
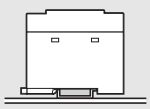
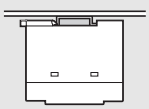
Precautions for Correct Use of Power Supplies

■Installation

● Mounting Methods

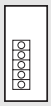
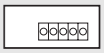
The standard mounting methods should be used to ensure proper heat dissipation. If other mounting methods must be used, the ambient temperature must be lowered or the load rate could be reduced to prevent temperature increase inside the Power Supply caused by poor heat dissipation.
Refer to the information in the table on the right.
Refer to the datasheet for each Power Supply for details on mounting.

DIN Rail Mounting Models: Main Models

Mounting direction / Model	Standard	Horizontal	Face-up	Face-down
				
S8TS	OK	No	No	No
S8VS(15, 30 W)	OK	Yes*	OK	No
S8VS (60, 90, 120, 180, 240, 480 W)	OK	No	No	No
S8T-DCBU-01	OK	No	No	No
S8T-DCBU-02	OK	No	No	No
S8VM	OK	No	No	No
S8AS (240, 480 W)	OK	No	No	No
S8JX (15, 30, 50, 100, 150, 300 W)	OK	No	No	No

*Use PFP-M End Plates on the top and bottom of the Power Supply when mounting horizontally on a DIN rail.

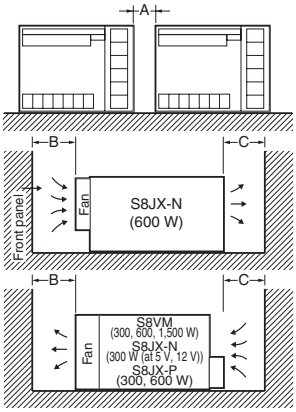
Screw Mounting Models: Main Models

Mounting direction / Model	Standard	Horizontal	Face-up	Face-down	Horizontal
					
S8VM (15, 30, 50, 100, 150 W)	Yes	Yes	Yes	No	No
S8VM (300, 600, 1,500 W)	Yes	Yes	No	No	No
S8JX (15, 30, 50, 100, 150 W)	Yes	Yes	No	No	No
S8JX (300, 600 W)	Yes	No	No	No	No
S8EX	Yes	Yes	Yes	Yes	Yes

Yes: Can be used
No: Cannot be used.
Conditional: Can be used at an ambient temperature of 50°C (up to 50% of load rate).

● Installation Space

When mounting two or more Power Supplies side by side, be sure to provide spacing between them as indicated in the table on the right or greater.



Note. Be sure to provide an installation space that allows for shielding (including ducts). Provide sufficient space for ambient air flow.

Spacing Required Between Power Supplies **(Unit: mm)**

Model		Dimension A	Dimension B	Dimension C
S8VM	15, 30, 50 W	20	---	---
	100, 150 W	50 (20 *)	---	---
	300, 600 W	20	50	50
	1,500 W	20	50	100
S8VS		20	---	---
S8AS		20	---	---
S8JX-N	15, 30, 50, 100, 150, 300W (24V, 48V)	20	---	---
	300W (5V, 12V), 600W	20	20	20
S8JX-P	50, 100, 150W	15	---	---
	300, 600W	---	20	20

* Use the Power Supplies at a load ratio of 80% or less.

● Cooling Method

The life of the Power Supply is determined by the life of the electrolytic capacitor that is used internally.
The capacitor follows the Arrhenius law, i.e., the life is halved by every 10°C increase in temperature and double for every 10°C decrease in temperature. The life of the Power Supply can thus be extended by lowering the internal temperature of the Power Supply.

Methods for Lowering the Internal Temperature of the Power Supply

The internal temperature of the Power Supply becomes saturated when the heat generation equals the heat dissipation. If heat dissipation is too low, the internal temperature continues to rise, so dissipation must be considered when mounting the Power Supply.
Use the Power Supply in an ambient temperature that is within the values specified by the derating curve.

● Heat Dissipation for Natural Cooling

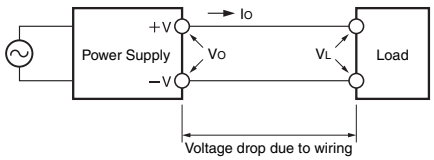
Provide sufficient ambient space for air convection and provide air holes.
We recommend a metal plate as a mounting surface.
Forced-air cooling is strongly recommended.
The heat generated by the Power Supply can be found with the following formula.

Heat value (W) = Input power - Output power
= Output power/efficiency - Output power

■Wiring

● Wiring in Consideration of Voltage Drop

Make the input and output wiring as thick and short as possible to minimize voltage drop.



(1)Select a wire diameter suitable for the load current Io.
(2)Make sure that the Power Supply's output voltage Vo does not exceed the specified output fluctuation range.
(3)Consider the allowable current for load short-circuits (guideline: 1.6 times the Power Supply's rated output current or higher).

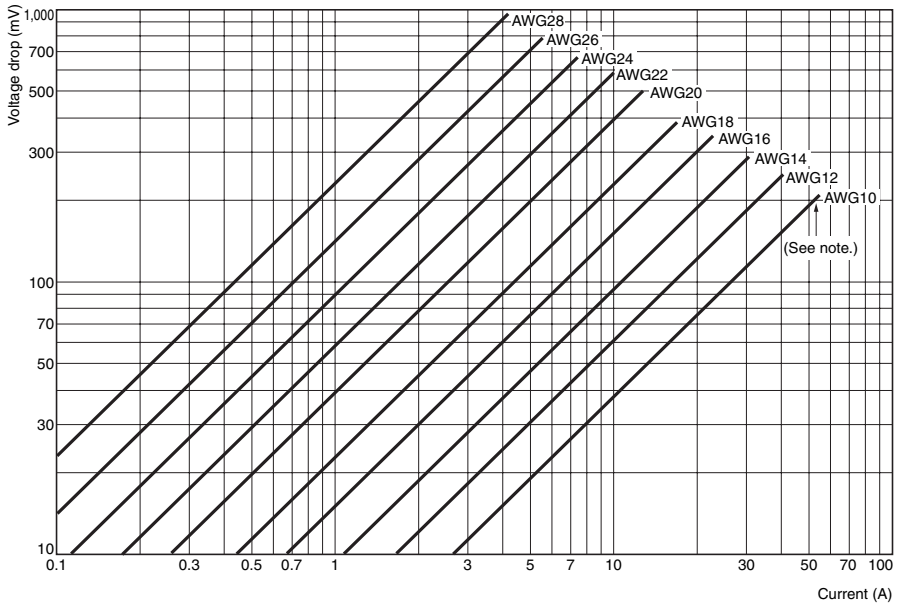
Selection of Wires

Select wires for the Power Supply carefully. Refer to this table when selecting the wires.

AWG No.	Cross-sectional area (mm²)	Configuration (number of conductors/mm)	Voltage drop per 1 A (mV/meter)	Recommended maximum current (A)	
				UL1007 (300 V 80°C)	UL1015 (600 V 105°C)
30	0.051	7/0.102	358	0.12	---
28	0.081	7/0.127	222	0.15	0.2
26	0.129	7/0.16	140	0.35	0.5
24	0.205	11/0.16	88.9	0.7	1.0
22	0.326	17/0.16	57.5	1.4	2.0
20	0.517	26/0.16	37.6	2.8	4.0
18	0.823	43/0.16	22.8	4.2	6.0
16	1.309	54/0.18	14.9	5.6	8.0
14	2.081	41/0.26	9.5	---	12.0
12	3.309	65/0.26	6.0	---	22.0
10	5.262	104/0.26	3.8	---	35.0

Recommended Maximum Current:
Current The table is applicable to wires with 1 to 4 conductors. Keep the current value to within 80% of the values shown in this table when using wires having 5 or more conductors. The following chart shows the voltage drop per meter in terms of the relationship between the current and conductor diameter. Make sure that the current value does not exceed the recommended maximum current value.

Voltage Drop per Meter (UL1015 Vinyl-sheathed Wires for Heat-resistant Equipment)

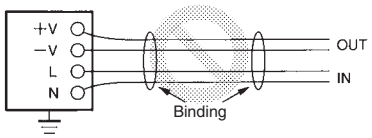


Note. The current indicates the allowable current. In practice, application must be below the recommended current values.

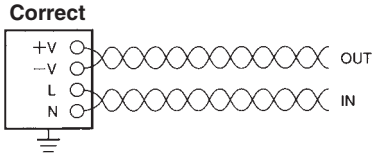
● Wiring to Prevent Noise Interference

• Separate input lines and output lines, and use twisted cables.
Noise will be induced on the output lines if they are laid together with or close to input lines.

Incorrect

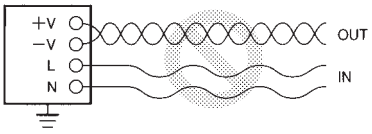


Correct



• Use short, thick input lines.
Input lines radiate noise, and must therefore be as short and thick as possible.

Incorrect



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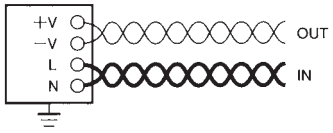
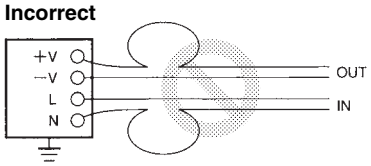


• Do not loop input or output lines.
Loops in lines can radiate noise to other devices or can function as antennas inducing high-frequency noise.

Incorrect



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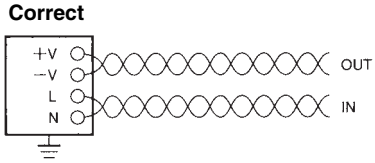
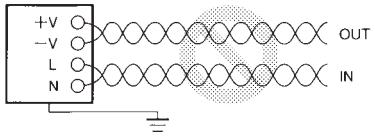


• Use short, thick ground wires.
The damping effect of the noise filter built into the Power Supply will be reduced if a long ground wire is used. Always make ground wires as short and as thick as possible.

Incorrect



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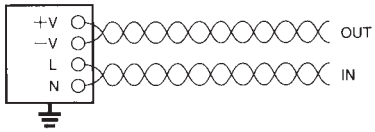
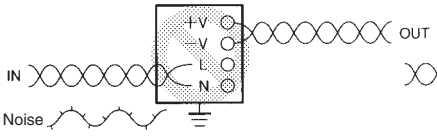


• Connect a noise filter.
Include a noise filter on the input side of the Power Supply if faulty operation in electric circuits connected to the output from the Power Supply are being caused by sources of surge on the AC input line, such as large magnetic relays.
Ground the noise filter with a thick, short wire.

Incorrect



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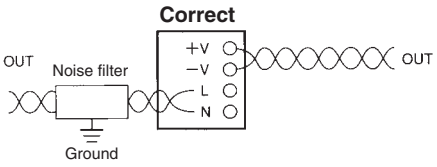

• Use shielded cables for the remote sensing and remote control signal lines.
Remote sensing and remote control signal lines must always be wired separately using shielded cables to prevent faulty operation caused by the induction of noise. Noise can be induced when these signal lines are laid together with input lines or power lines, which often carry noise.

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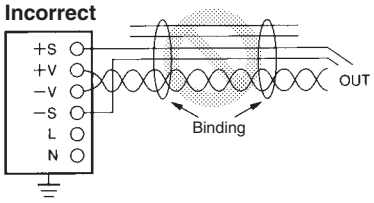

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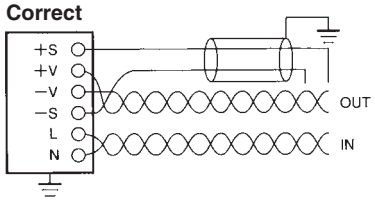


■Maintenance

● Life Expectancy and Recommended Replacement Period

The life expectancies of OMRON Switch-mode Power Supplies are defined under the following conditions and are designed to be 8 or 10 years minimum.

Note. The life expectancy does not apply to the fan.

- Rated input voltage
- Load at 50%
- Ambient operating temperature of 40ºC
- Standard mounting conditions

The replacement period and life expectancy are reference values only and do not imply a warranty of any kind. Use them as guidelines in designs and applications.

● Fan Life and Replacement

Some Switch-mode Power Supplies have built-in fans for forced-air cooling.
The fans in these Switch-mode Power Supplies also have limited lives in addition to the lives of the Power Supplies themselves. The fans must be replaced periodically.
The replacement period for the fans varies with the Power Supply model. Refer to the datasheets for details.

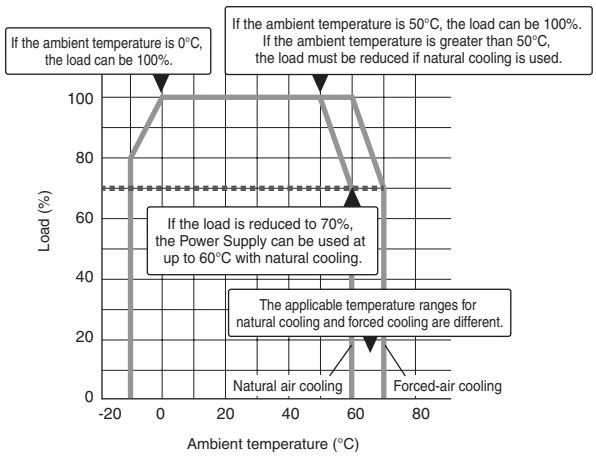
● Foreign Matter and Dust

There are slits in the Power Supplies that allow internally generated heat to escape to the exterior.
Foreign matter or dust can enter through these slits, causing the output to be reduced or to stop.
We recommend that you remove foreign matter and dust from around the Power Supply during periodic maintenance.

■Temperature Derating

● Reading Derating Curves

The derating curve shows the output range for different ambient temperatures, mounting methods, and cooling methods.
The derating curves depend on the Power Supply model. Refer to the datasheets for details.
The derating curve for the S82J Power Supply is given below as an example.



Note 1. Measure the ambient temperature at a location that is not affected by the heat that is generated by the Power Supply. (For example, measure it at 50 mm below the Power Supply.)
Note 2. Derating must be reduced for some models depending on operating methods, mounting methods, and other factors. Refer to the derating curve for your Power Supply model for actual application.

■Overload Protection

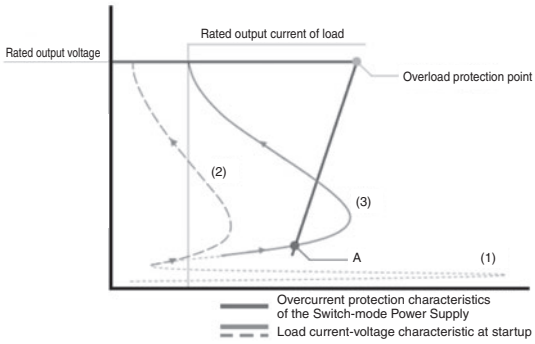
● Overload Protection: Loads That Will Not Start

If the rated load is connected or if a capacitive load with inrush current is connected, the output may be difficult to start or may not start.
Also, if the Power Supply is connected to a load with a built-in DC-DC converter, the Power Supply may not reach the rated output voltage even if a Power Supply with a rated output current that exceeds the load is connected.

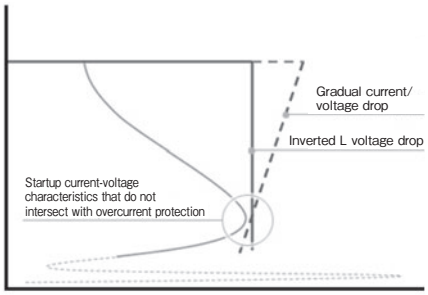
When power is turned ON, a current of two to several tens of times higher than the rated current may flow, as shown by (1) in Figure a. This is generally called the inrush current of the load, and is caused by charging capacitors in the electronic devices on the load side.
With a capacitive load, the inrush current is very large and it tends to flow for a long period of time, which means that time is required for the output to start.
If the load is a DC-DC converter and the Power Supply starts from a low voltage, the load current-voltage characteristics at startup will be as shown by (2) in Figure a. Two to several tens of times the rated current will flow before the current returns to the rated current.
The voltage at startup depends on the specifications of the DC-DC converter, but some will start as low as approx. 3 to 4 V.

If more than one load with these characteristics is connected, the startup current will attempt to exceed the vertical line of the overcurrent protection characteristics of the Switch-mode Power Supply (as shown by (3) in Figure a). The current and voltage will stabilize at point A in the figure, and the rated output voltage will not be achieved.
To prevent this, you need to select a Power Supply with a high enough capacity to supply the startup current, select a Power Supply with an inverted L voltage drop overcurrent protection characteristic that exceeds the startup current, or select a Power Supply with an gradual current/voltage drop for which the startup current-voltage characteristic of the DC-DC converter does not exceed the vertical drop characteristics of the overcurrent protection.

a

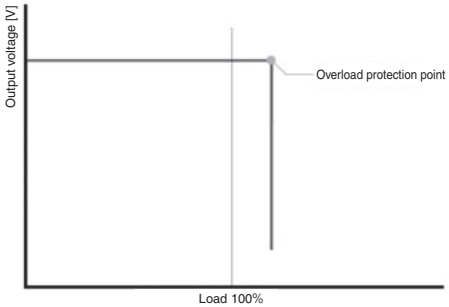


b



● Overload Protection: Peak Load

For a Switch-mode Power Supply that has overcurrent protection, the peak current that flows can be as high as the current at the overcurrent protection point.
If the current exceeds the overcurrent protection point, the output voltage will drop.
If the peak current is required, select an Switch-mode Power Supply so that the overcurrent protection point is larger than the peak current.



■Connecting Power Supplies in Series

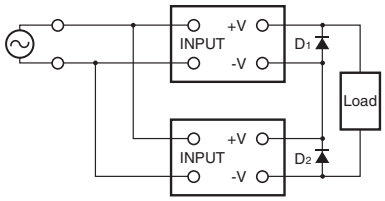
● Connecting Power Supplies in Series

List of Main Models that Support Series Connection of Outputs

Model	Power ratings
S8JX	All models
S8VS	15 W (at 24 V), 30 W (at 24 V), 60, 90, 120, 180, 240, 480 W
S8VM	All models
S82K *	90, 100 W
S82J *	50, 100, 150, 300, 600 W

* Discontinued models

- The above table lists the main models for which series connection is possible. Refer to the datasheet for each model for details.
  If models that do not support series connection are used, one of the Power Supplies may not operate when the AC Power Supply is turned on, possibly damaging internal circuits over a period of time.
- If models with different power ratings or rated voltages are wired in series, keep the current flowing to the load below the rated output current for the Power Supply with the lowest power rating.
- For serial operation, it is necessary for some models (see the table given above) to connect an external diode at locations D_1 and D_2 shown in the following figure.

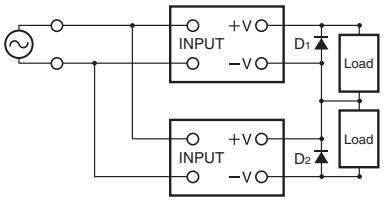


Guidelines for the type, dielectric strength, and forward current of the diodes are as follows:

- Type: Schottky barrier diodes.
- Dielectric strength (V_{RRM}): Twice the rated output voltage of the Power Supply or higher.
- Forward current (I_F): Twice the rated output current of the Power Supply or higher.

<Creating ± (Positive/Negative) Outputs>

- The floating output (the primary and secondary circuits are separated) enables creating ±outputs using two Power Supplies. You can create positive/negative outputs for any model for which direct operation is possible. To create positive/negative outputs, connect two of the same model of Power Supply. (Models with different power ratings or rated voltages can be combined, but keep the current flowing to the load below the rated output current for the Power Supply with the lowest power rating.)
- If another load, such as servomotor or amplifier, is wired in series with the load, the Power Supplies may not start when power is turned ON, possibly damaging internal circuits. Connect bypass diodes (D_1 and D_2) as shown in the following diagram.



- Guidelines for the type, dielectric strength, and forward current of the diodes are as follows:

- Type: Schottky barrier diodes.
- Dielectric strength (V_{RRM}): Twice the rated output voltage of the Power Supply or higher.
- Forward current (I_F): Twice the rated output current of the Power Supply or higher.

● Connecting Power Supplies in Parallel

List of Connection Methods and Main Models that Support Parallel Operation of Outputs

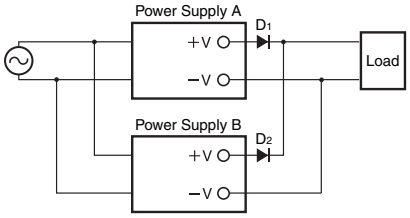
Model	Connection method
S82K-10024 * S8T-DCBU-02	Only connect the +V and –V outputs in parallel
S8JX (300 W, 600 W) S82K * (100 W (- P type only) S82J (300, 600 W) *	Connect the +V and –V outputs in parallel and set the parallel operation selection switch to PARALLEL.
S8TS (12 V, 24 V)	Connect the bus line connector.
S8VM (300, 600, 1500 W)	Connect the CB and CBG terminals.

* Discontinued models

- Up to two of the same model can be connected in parallel for the S82K (100 W) and S8VM given in the above table, up to four of the same model can be connected in parallel for the S8TS and S8T-DCBU-02, up to five of the same model can be connected in parallel for the S8JX (300 W, 600 W) and S82J (300 W, 600 W) given in the above table.
- Parallel operation is not possible for any models that are not given in the above table. This is because load current imbalance may cause the rated output current for one Power Supply to be exceeded.
- Use the same length and thickness of load connection line to ensure that the voltage drop between each Power Supply and load is the same.

<Backup Operation>

- **Two Power Supplies can be wired in parallel even though each has a sufficient power rating. This can be done to ensure (back up) Power Supply even if one of the Power Supplies fails.**
  (Backup operation is possible for all Power Supplies with single outputs.)



Use the same model of Power Supply for A and B.

- Select the Power Supplies A and B so that either has a sufficient power rating for the load.
- Be sure to connect diodes to both Power Supplies A and B, as shown in the diagram, so that the Power Supply backing up the faulty Power Supply is not affected.

Guidelines for the type, dielectric strength, and forward current of the diodes are as follows:

- Type: Schottky barrier diodes.
- Dielectric strength (V_{RRM}): The rated output voltage of the Power Supply or higher.
- Forward current (I_F): Twice the rated output current of the Power Supply or higher.

- Increase the output voltage settings of Power Supplies A and B just enough to allow for the voltage drop (V_F) on diodes D_1 and D_2. Also, make sure that the diodes are sufficiently cooled so that their temperatures remain below the catalog value.
  This is necessary to control the power loss (output current of Power Supply I_{OUT} × diode forward voltage V_F) resulting across the diodes.
- Some power loss to the load will occur due to the load power and diodes. Therefore, do not exceed the rated power (rated output voltage × rated output current) of the Power Supply.
- Do not connect the current balance terminals (CB and CBG) on models that have them.

<N+1 Redundant Operation>
Applicable Models: S8TS

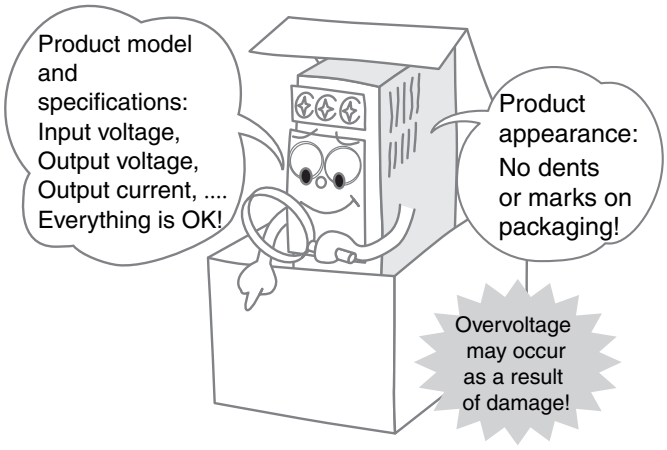
Redundant operation is used in parallel connections of N Power Supplies (single operation when N = 1) of the same model, where a redundant Power Supply is added to the number of Power Supplies (N) in parallel operation (N+1), thereby improving the reliability of the system.

Troubleshooting Power Supplies

Before Use

● Purchase

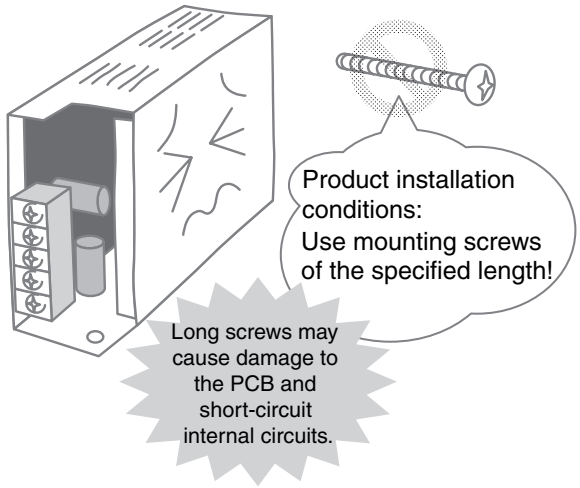
External Appearance, Model, and Specifications



* For details, refer to *External appearance* and *Model and specifications* in the *Check point* column of the table on page 15.

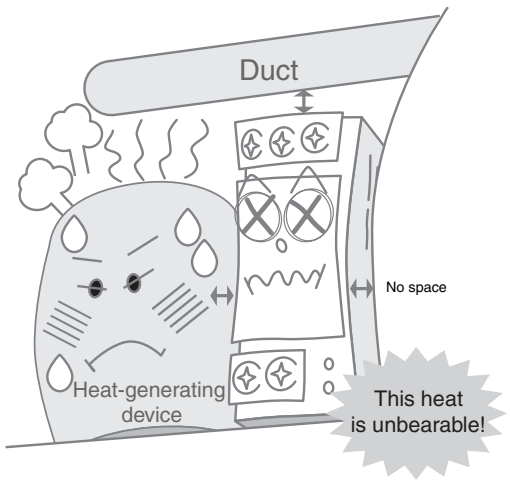
● Installation

Product Installation Conditions



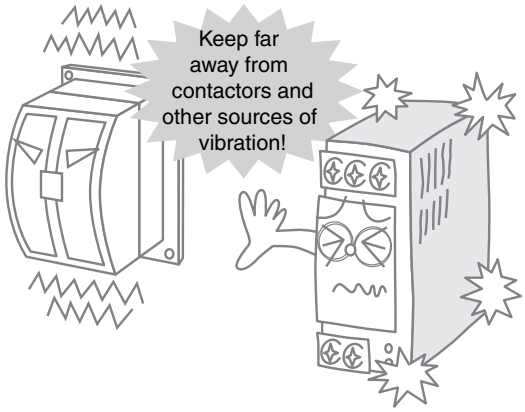
* For details, refer to *Installation conditions* in the *Check point* column of the table on page 15.

Installation Location



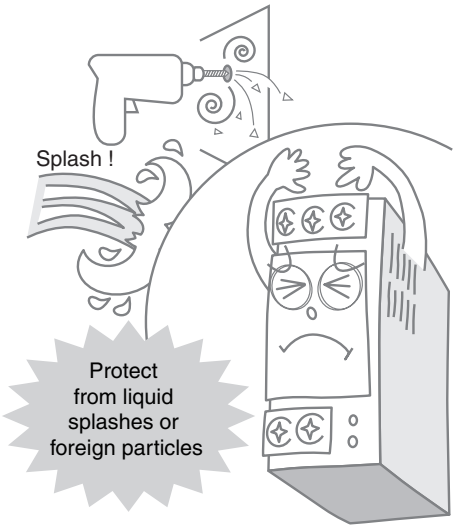
* For details, refer to *Installation location* in the *Check point* column of the table on page 15.

Operating Environment (1)



* For details, refer to *Operating environment* in the *Check point* column of the table on page 15.

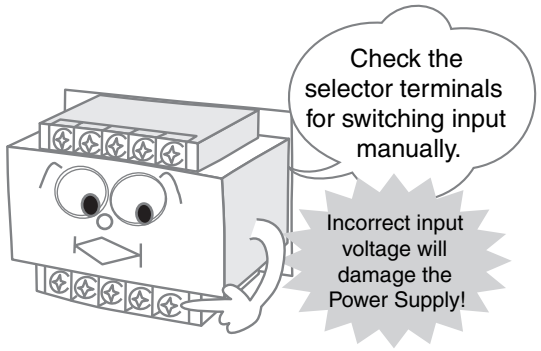
Operating Environment (2)



* For details, refer to *Operating environment* in the *Check point* column of the table on page 15.

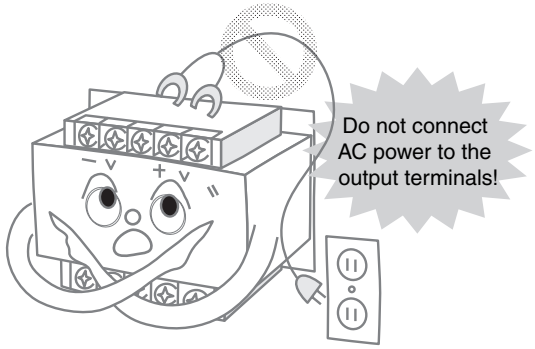
● Wiring

Input Voltage Selector Terminals



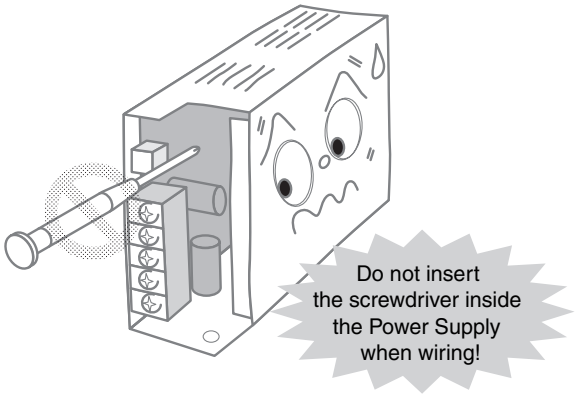
* For details, refer to *Input voltage selector terminals* in the *Check point* column of the table on page 15.

Input Terminals



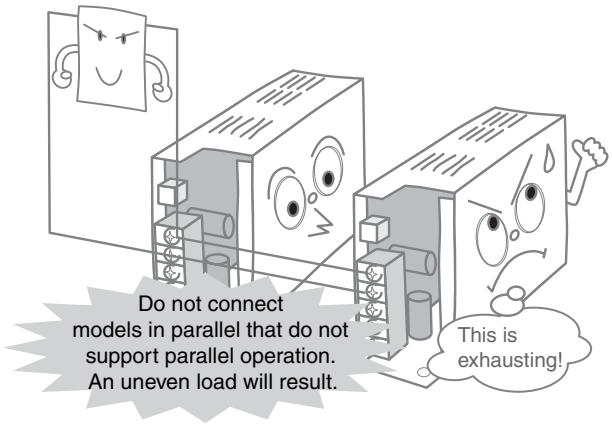
* For details, refer to *Input terminals* in the *Check point* column of the table on page 15.

Terminal Wiring



* For details, refer to *Terminal wiring* in the *Check point* column of the table on page 15.

Series, Parallel, and ± Output Operation



* For details, refer to *Series, parallel, and ± output operation* in the *Check point* column of the table on page 15.

Read the operation manual provided with the Product, and check the following points, as applicable.

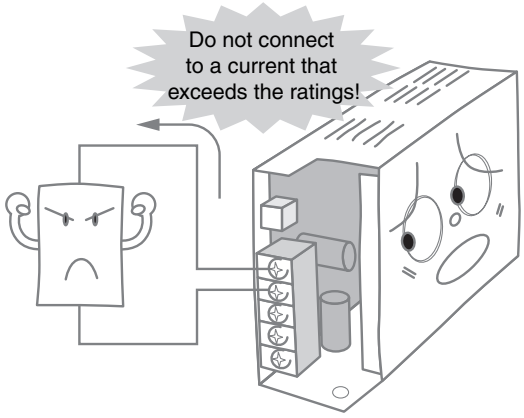
When	Check point	Details
Purchasing	External appearance	After purchase, make sure that the product and packaging have no dents or marks. Any internal damage may result in overvoltage depending on the location of the damage. (Stop using the product if dents, marks, or deformation is evident.)
	Model and specifications	Make sure that the input voltage, output voltage, and output current of the Power Supply purchased meet the requirements. (The I/O specifications are provided on the model label.)
Installing	Installation conditions	Be sure to use mounting screws of the specified length. Using longer screws may cause damage to the PCB, or short-circuit the internal circuits.
	Installation location	Be sure to provide sufficient space around the Product when installing it to allow for heat dissipation.
	Operating environment	Make sure that the ambient temperature, and vibration in the installation environment satisfy the specified levels for each product being used. (Be sure to install the Product as far as possible away from contactors, which will subject the Product to vibration and shock if it is located in their vicinity.) Install the Product in a location in which liquid or foreign particles will not enter the Product.
Wiring	Input voltage selector terminals	Before turning ON the power, make sure that the voltage specifications are the same as the voltage of the device. The Product is shipped with the input voltage selector terminals open (i.e., set to 200 VAC).
	Input terminals	Wire the Power Supply inputs correctly. Connecting the AC input wires to the output terminals or voltage selector terminals will cause damage to the internal circuits.
	Terminal wiring	Do not subject the terminals to excessive stress by using excessive force when tightening the terminal screws. After tightening the screws to the specified torque, make sure that none of the screws is loose. Make sure that the end of the screwdriver used to tighten the screws does not mark or damage the PCB or internal parts.
		Connect the ground terminal to prevent electric shock.
	Remote sensing terminals	Check whether remote sensing is securely connected. If remote sensing is not to be used, short-circuit using the short bar. (At shipment, these terminals are short-circuited with the short bar.)
	Remote control terminals	Check whether the remote control terminals are securely connected. If remote control is not to be used, short-circuit using the short bar. (At shipment, these terminals are short-circuited with the short bar.)
	Series, parallel, and ± output operation	Check whether series, parallel, or ±operation is supported. Refer to the wiring information in this guide.
Adjusting the output voltage	Output Voltage Adjuster	Do not apply unnecessarily strong force on the Output Voltage Adjuster (V.ADJ). Doing so may damage the V.ADJ. Make sure that the end of the screwdriver used to adjust the setting does not mark or damage the PCB.

Troubleshooting

Example 1	No Output or Delay in Output Turning ON

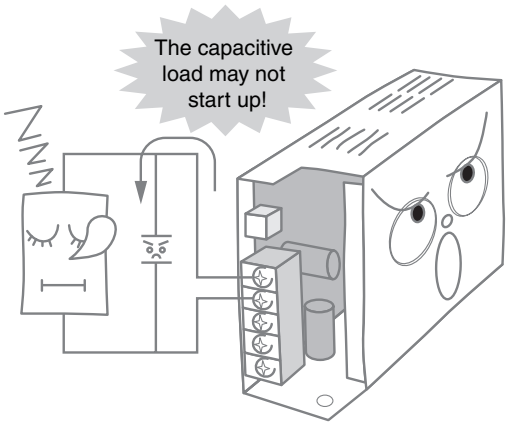
● Turning ON for the First Time

Output Does Not Turn ON



* For details, refer to *The output does not turn ON.*in the *Problem* column of the table on page 18.

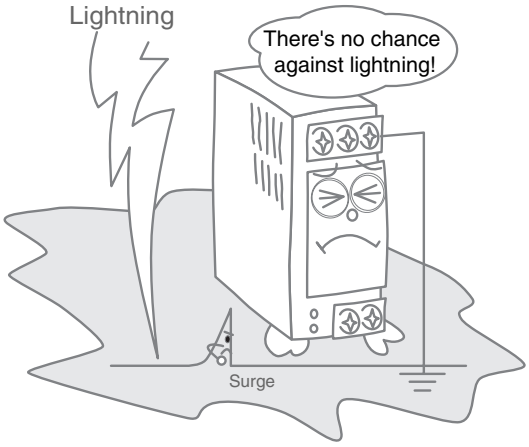
Delay in Output Turning ON



* For details, refer to *An output delay occurs in the output turning ON.* in the *Problem* column of the table on page 18.

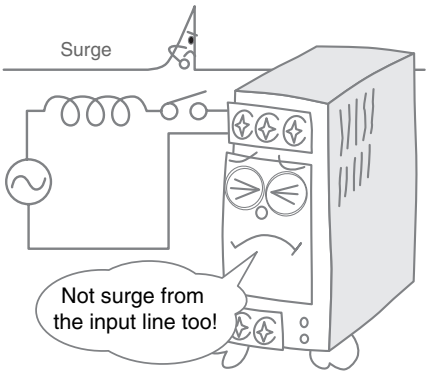
● During Operation

No Power Supply Output (Lightning Strike)



* For details, refer to *Output from the Power Supply has stopped (lightning occurred)* in the *Problem* column of the table on page 19.

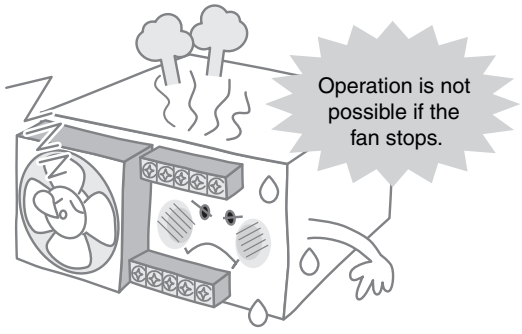
No Power Supply Output (Device Generating Strong, High-frequency Noise Nearby)



* For details, refer to *Output from the Power Supply has stopped (close to source of strong, high-frequency noise).* in the *Problem* column of the table on page 19.

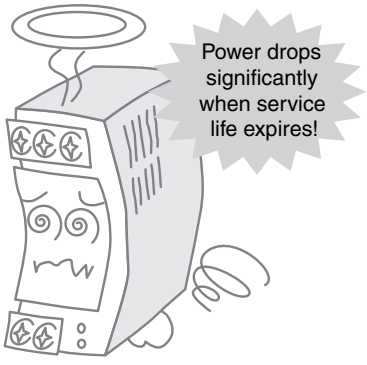
● Long-term Usage

No Power Supply Output (Fan Stopped)



* For details, refer to *Output from the Power Supply has stopped (the fan has stopped).* in the *Problem* column of the table on page 19.

Low Output Power

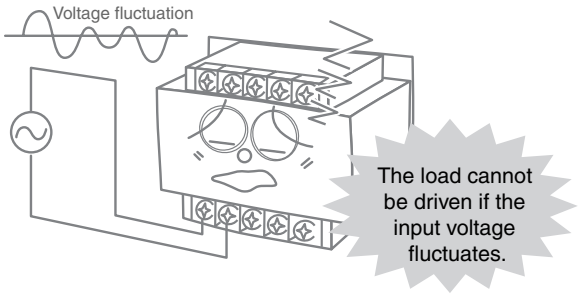


* For details, refer to *The output drops.* in the *Problem* column of the table on page 19.

Example 2	Unstable Output

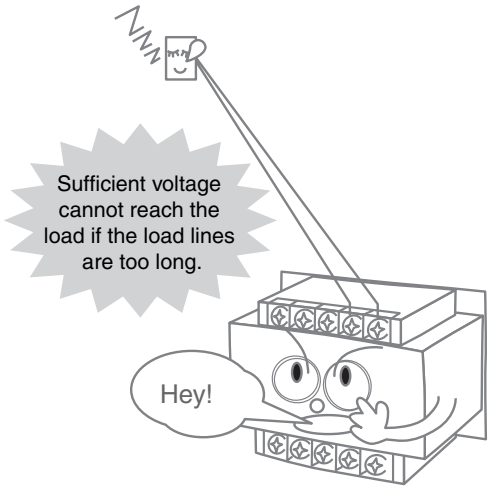
● **During Operation**

Unstable Output Voltage



* For details, refer to *The output voltage is unstable.* in the *Problem* column of the table on page 19.

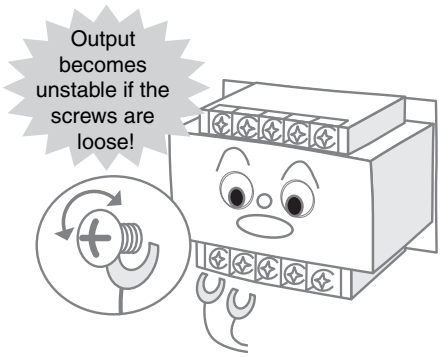
Low Voltage Applied to Load



* For details, refer to *The voltage applied to the load is low.* in the *Problem* column of the table on page 19.

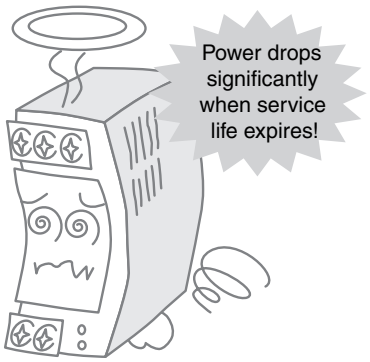
● **Long-term Usage**

Unstable Output



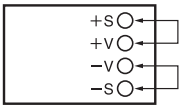
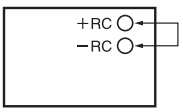
* For details, refer to *The output is unstable.* in the *Problem* column of the table on page 19.

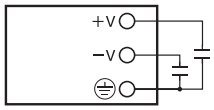
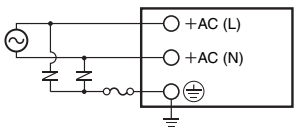
Low Output Power



* For details, refer to *The output drops.* in the *Problem* column of the table on page 19.

Be sure to check the following points if the Power Supply is not operating properly before requesting repairs.
If the Power Supply still does not operate normally, contact your OMRON representative.

Location	Problem	Details	Countermeasures
Dielectric strength inspection	The result of dielectric strength test is NG.	Impulse occurred damaging the Power Supply when the dielectric strength was applied or shut off using a switch or other means.	Either gradually change the applied dielectric strength using a variable resistor or apply voltage at zero cross (applied from 0 V).
		Dielectric strength has been applied to the incorrect location.	The voltage value depends on the location at which dielectric strength is applied. Test using the dielectric strength value specific to each Product.
		Inspection was conducted with the short bar connected between the ACG and PE terminals.	Remove the short bar from between the ACG and PE terminals (on applicable models), and then test the dielectric strength and insulation resistance.
Turning ON the power for the first time	The output does not turn ON. (• Output voltage is low. • Output indicator is not lit. • Output indicator is dim.)	The overcurrent protection function has been activated by the startup current of the load that is connected to the Power Supply, even if the current was within the Power Supply's capacity when stationary.	Use inverse L overcurrent protection characteristics or consider raising the Power Supply's capacity by one rank.
		The Power Supply's load has exceeded the ratings, thereby activating the overcurrent protection function.	Select a Power Supply capacity that is sufficient for the load current.
		The Power Supply's outputs are short-circuited.	Remove the cause of the output short-circuit.
	A buzzing noise is heard when the input turns ON.	A buzzing noise can be heard when turning ON the input of models equipped with harmonic current suppression circuits due to the internal inrush current.	Models with harmonic current suppression circuits generate a noise when the input is turned ON but this is a transient noise that occurs until the internal voltage is stabilized, and does not indicate that any problem in the product.
	An output delay occurs in the output turning ON.	If a capacitive load (capacitor) is connected to the Power Supply's load, the inrush current on the load side will cause the output to enter the protection range when it turns ON.	If inrush current flows to the load, consider selecting a capacity that allows for the inrush current.
	The output voltage is high.	The adjuster setting is high.	Adjust the output voltage using the Output Voltage Adjuster (V.ADJ).
	The output voltage is high (caused damage to the load).	The damage to the internal parts has prevented the feedback control from performing properly.	The internal circuits are possibly damaged. Consult your OMRON representative.
	The output indicator lights but turns OFF quickly (overvoltage protection is provided)	The remote sensing terminals are open.	When not using remote sensing, short-circuit terminals +V and +S, and also terminals −V and −S. The overvoltage protection function will operate, so turn OFF the input power and then turn it back ON again. 
		The internal control circuit has malfunctioned, thereby activating the overvoltage protection function.	Turn OFF the input power and then turn it back ON again. If the problem reoccurs, the internal circuits are possibly damaged. Consult your OMRON representative.
	An electric shock is felt when touching the Power Supply.	The casing may not be properly grounded.	Connect the ground terminal to the ground.
	The input breaker is operating. The external fuse is broken.	The Power Supply's inrush current has tripped the breaker.	Check the inrush current of each Product in the system and make sure that the fuse and breaker ratings are sufficient. (The inrush current of the Power Supply is several times to several tens of times the normal current.)
	The Power Supply's fuse is broken.	The internal circuit has short-circuited due to wire clippings, or other foreign particles, or mounting screws.	The internal circuits are possibly damaged. Consult your OMRON representative.
	White smoke was emitted from the Power Supply.	The incorrect input power is being applied. The white smoke indicates the vaporization of the electrolytic fluid in the internal electrolytic capacitor due to overvoltage.	Check the power input location and input voltage again. This problem indicates that the internal circuits are damaged. Replace the Power Supply.
	There is no output.	A load is connected to the remote sensing terminals.	The output current cannot be received from the remote sensing terminals +S and −S. Connect the load lines to the output terminals +V and −V. Alternatively, the overvoltage protection function is operating, so turn OFF the input power and then turn it ON again.
		The remote control terminals are open.	When not using remote control, short-circuit the terminals +RC and −RC. 

Location	Problem	Details	Countermeasures
Operation	The Power Supply's fuse is broken.	Foreign particles, liquids, condensation, or dust from the operating environment has entered the Product and damaged the internal circuits.	Many holes are provided on the Product to assist with heat dissipation. Therefore, do not install the product in an environment where foreign particles, liquid, or other substance can enter the Product. In this case, the internal circuits are damaged. Replace the Power Supply.
	The Power Supply is generating high heat.	The Power Supply's installation space is too confined and does not allow sufficient heat dissipation.	The Power Supply handles a large amount of power, so heat generation occurs even with normal use. Check the installation space, Power Supply load, and ambient temperature again. Particularly if the load current exceeds the ratings for the Power Supply, change so that the load current is within the ratings. Continuing to use as is may damage the Power Supply.
		The Power Supply's load exceeds the ratings.	
		The ambient temperature is too high.	
	The Power Supply is emitting a noise.	The load has exceeded the ratings, activating the overcurrent protection circuit and the internal oscillatory frequency is within audible range.	When the protection circuit is operating, a vibrating sound emitting from the Power Supply may be audible. Even during normal operation, slight sound is generated by the Power Supply circuit due to the oscillator. If the oscillating sound is too loud compared with that of the same Product, the internal circuits may be damaged. Consult your OMRON representative.
	The connected Sensor is always ON. The display on the Digital Panel Meter is erratic. The analog sensor data is erratic.	The connected Sensor has malfunctioned due to noise from the Power Supply (noise between the outputs and ground).	The Power Supply has an internal oscillator that generates noise even during normal operation. Therefore, malfunction may result depending on the Sensor used. If the Sensor malfunctions, connect a film capacitor with a capacitance of approximately 0.1 μF and a dielectric strength of 500 VDC minimum between the output terminal (+V or −V) and the ground terminal (⏚). 
	Output from the Power Supply has stopped (lightning occurred)	Overvoltage is being applied to the Power Supply due to inductive impulse from the lightning. (Output may also have stopped due to the overvoltage protection function being activated.)	If overload protection is operating, turn OFF the input power and then turn it back ON again. If the output still does not recover, the internal components are possibly damaged due to the overvoltage. Replace the Power Supply.
	The output voltage is unstable.	Load fluctuation has activated the overcurrent protection function.	Select a Power Supply capacity that takes the load fluctuation into consideration so that the rated output current will not be exceeded.
		Sufficient load current cannot be supplied due to low input voltage, thereby activating the overcurrent protection function.	Use an input voltage within the allowable range.
	The voltage applied to the load is unstable.	The Power Supply's output voltage has dropped due to the load's inrush current.	If an inrush current is flowing to the load, consider selecting a capacity that allows for the inrush current.
	The voltage applied to the load is low.	The load lines are either too thin or too long, causing a voltage drop.	Use load lines with wire diameters that are suitable for the rated output current.
	Output from the Power Supply has stopped.	Surge or other overvoltage has been applied externally (e.g., load) to the output side, activating overvoltage protection.	Add a varistor and diode to the source of the surge, and make sure that overvoltage is not applied to the Power Supply's outputs.
		The incorrect input voltage (applying 100 V when the setting is 200 V) has been applied. (If 100 V is applied when the voltage is set to 200 V, although damage will not occur immediately, damage will occur if use is continued.)	Make sure that the input voltage is the same as the voltage set using the selector terminals. The internal circuits may be damaged. Replace the Power Supply.
	Output from the Power Supply has stopped (close to source of vibration or shock).	Cracks have occurred in the internal soldering due to vibration in the operating environment, preventing electrical conduction. (The vibration and shock are particularly close to the contactor.)	If vibration occurs during operation, check the installation location and reduce vibration or consider inserting vibration-proof rubber between the Power Supply and its mounting surface.
	Output from the Power Supply has stopped (close to source of strong, high-frequency noise).	Damage has occurred due to impulse from the input line.	If impulse occurs in the input line, separate the Power Supply's input line from the source of the impulse. If separation is not possible, connect a varistor either to the source of the noise or to the Power Supply's input terminals. Also incorporate a fuse that will provide protection if the varistor is short-circuited and damaged. 
Long-term use	Output from the Power Supply has stopped (the fan has stopped).	The fan's life has expired, preventing forced cooling, and the internal temperature has risen activating overheating protection.	Perform periodic maintenance on the forced cooling fan and replace the fan promptly if any fault in the fan is found.
		The fan bearings have been worn down due to the operating environment (e.g., dust or dirt).	Perform periodic maintenance on the forced cooling fan and make sure that there is no dust or dirt present in the operating environment.
	The output is unstable.	The terminals have become loose.	Retighten the terminals to the specified torque.
	The output drops.	The life of the internal components has expired.	The service life of the Power Supply's built-in electrolytic capacitor depends on the ambient temperature and load rate, and its structural life depends on the operating environment (vibration, shock). Replace the Power Supply together with other Power Supplies that were purchased at the same time.
	Ripple noise has increased.		

Reference Material for Power Supplies

■Typical Safety Standards for Noise

<table>
<tr><th></th><th>Japan</th><th colspan="2">Europe</th><th>U.S.A</th></tr>
<tr><th>Applicable law</th><th>Electric components regulation</th><th>CISPR Pub. 14 (for office equipment)</th><th>VDE0871 (for high-frequency applied equipment)</th><th>FCC Part 15 (for computers)</th></tr>
<tr><td>Permissible noise (noise terminal voltage)</td>
<td>
<table>
<tr><th>Frequency range (MHz)</th><th>Voltage dB (μV)</th></tr>
<tr><td>0.525 to 1.605</td><td>65</td></tr>
</table>
(max. value between one line and ground)
(equipment operating on 1 kW max.)
</td>
<td>
<table>
<tr><th>Frequency range (MHz)</th><th>Voltage dB (μV)</th></tr>
<tr><td>0.15 to 0.5
0.5 to 5
5 to 30</td><td>66
60
66</td></tr>
</table>
(max. value between one line and ground)
</td>
<td>
Class A
<table>
<tr><th>Frequency range (MHz)</th><th>Voltage dB (μV)</th></tr>
<tr><td>0.01 to 0.15
0.15 to 0.5
0.5 to 30</td><td>91 to 69.5
66
60</td></tr>
</table>
Class B
<table>
<tr><th>Frequency range (MHz)</th><th>Voltage dB (μV)</th></tr>
<tr><td>0.01 to 0.15
0.15 to 0.5
0.5 to 30</td><td>79 to 57.5
54
48</td></tr>
</table>
(max. value between one line and ground)
</td>
<td>
Class A
<table>
<tr><th>Frequency range (MHz)</th><th>Voltage dB (μV)</th></tr>
<tr><td>0.45 to 1.6
1.6 to 30</td><td>60
69.5</td></tr>
</table>
Class B
<table>
<tr><th>Frequency range (MHz)</th><th>Voltage dB (μV)</th></tr>
<tr><td>0.45 to 1.6
1.6 to 30</td><td>48
48</td></tr>
</table>
(max. value between one line and ground)
</td></tr>
</table>

<table>
<tr><th>Applicable law</th><th>Electric components regulation (Table 8)</th><th>IEC 380 (for office equipment)</th><th>UL114 (for office equipment)</th></tr>
<tr><td>Leakage current</td>
<td>1 mA max. (measured at resistance of 1 kΩ)</td>
<td>
<table>
<tr><td>Class I (stationary type)</td><td>3.5 mA max.</td></tr>
<tr><td>Class I (portable type)</td><td>0.75 mA max.</td></tr>
<tr><td>Class II</td><td>0.2 5 mA max.</td></tr>
</table>
(measured at resistance of 1.5 kΩ and at 0.15 μF) (input: 106%)
</td>
<td>
<table>
<tr><td>general</td><td>5 mA max.</td></tr>
<tr><td>Double insulation</td><td>0.25 mA max.</td></tr>
</table>
(measured at resistance of 1.5 kΩ and at 0.15 μF) (input: 110%)
</td></tr>
<tr><td>Dielectric strength</td>
<td>
● General
• Between current-carrying parts and non-current-carrying metal parts
<table>
<tr><td>Up to 150 V</td><td>1,000 V</td></tr>
<tr><td>Over 150 V</td><td>1,500 V</td></tr>
</table>
• Between current-carrying parts 2.3 × rated voltage (AC, for 1 min)
● Double insulation: between current carrying parts and non-current-carrying metal parts
<table>
<tr><th></th><th>Up to 150 V</th><th>Over 150 V</th></tr>
<tr><td>Function insulation</td><td>1,000 V</td><td>1,500 V</td></tr>
<tr><td>Protection insulation</td><td>1,500 V</td><td>2,500 V</td></tr>
<tr><td>Reinforced insulation</td><td>2,500 V</td><td>4,000 V</td></tr>
</table>
(AC, 1 min)
</td>
<td>
● Between current-carrying parts and surface of insulated part
<table>
<tr><th></th><th>Class I</th><th>Class II</th></tr>
<tr><td>Function insulation</td><td>1,250 V</td><td>---</td></tr>
<tr><td>Reinforced insulation</td><td>1,250 V</td><td>1,250 V</td></tr>
</table>
(AC, for 1 min)
● Between current-carrying parts: 1,250 V (AC, for 1 min)
● Capacitor: (VDE0565)
• Evaporative X capacitor: 4.3 x rated voltage (DC, for 1 min)
• Film Y capacitor: 1,500 V (AC, for 1 min)
</td>
<td>
● Between primary non-current-carrying parts and across-the-line capacitor terminals
<table>
<tr><td>Up to 250 V</td><td>1,000 V</td></tr>
<tr><td>Over 250 V</td><td>1,000 V+2 U</td></tr>
</table>
(AC, for 1 min)
U: maximum indicated voltage
</td></tr>
</table>

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. T901-E1-01 In the interest of product improvement, specifications are subject to change without notice.