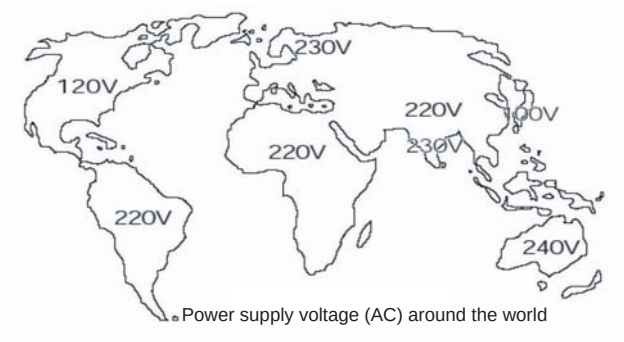
How to Use Switching Power Supplies

Switching power supplies are compact, lightweight, and highly efficient. Used correctly, they can improve the reliability of your electric equipment.

Input Overview

There are many types of switching power supplies manufactured and used worldwide, some for AC and some for DC operation. Before using your switching power supply, check the local voltage and whether it is AC or DC, the allowable voltage range, and the input selection method.

The RUBYCON resonant power supply can be used with input voltage between 85 Vac and 264 Vac and frequency between 47 Hz and 63 Hz. Input outside the specified range may damage the power supply. Even if the input voltage is within the specified range, distortion in the input voltage may impair the proper functioning of the power supply.



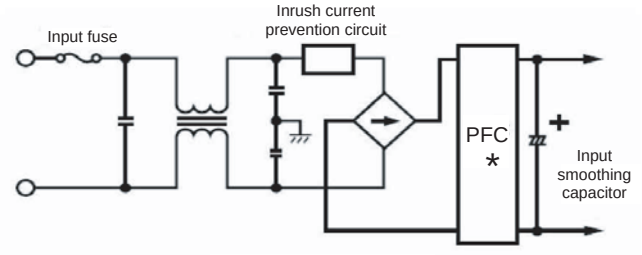
Power supply voltage (AC) around the world

Input Current

Although there are some exceptions, in switching power supplies that directly rectify AC input, the most common method of rectification is the capacitor input method, in which current runs through a smoothing capacitor. In such cases, the input current is determined by the output power, input voltage, power factor and efficiency.

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

In general, the power factor of switching power supplies using the capacitor input method is between 0.4 and 0.6. However, the power factor of the RUBYCON resonant power supply is approximately 1, due to the use of a PFC (Power Factor Collection) circuit. This means that the input current requirement is lower than for other switching power supplies.



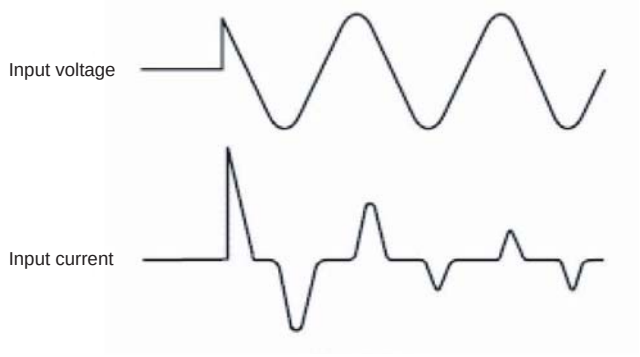
Input rectifying and smoothing circuit

* PFC: Power Factor Collection circuit
Rubycon resonant switching power supply: Built-in PFC circuit
Other switching power supplies: No PFC circuit

Inrush Current

In switching power circuits, when the power is turned on peak current flows while the input smoothing capacitor is charging. This current is called "inrush current". The inrush current varies depending on the input timing and whether or not an inrush current prevention circuit is employed, and it occurs between 10 and 20 times before the normal operating condition is reached.

If several switching power supplies are used at once, the inrush current increases. This is an important point to consider when selecting power cables, fuses, and switches.



Inrush current

Input Fuse

If the input fuse blows (opens), it may mean that there is a problem with the switching power supply. Do not replace the fuse but report the problem to your local RUBYCON sales office or distributor.

Mounting Method, Wiring, and Connection

Even the most sophisticated switching power supply will not provide the expected performance if it is not installed, wired, and connected properly. Please observe the precautions outlined below.

Mounting Method

(1) Heat Radiation

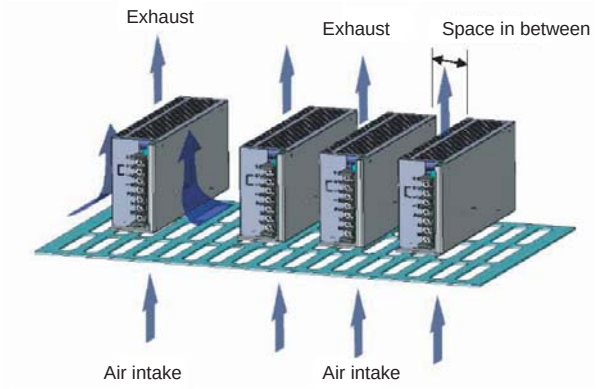
a. Ensure proper ventilation.

b. Make sure the switching power supply faces in the proper direction.

c. Allow for thermal conductivity.

d. If you are installing a number of switching power supplies side by side, leave at least 60 mm of open space between them.

e. If necessary, consider the use of forced air-cooling.

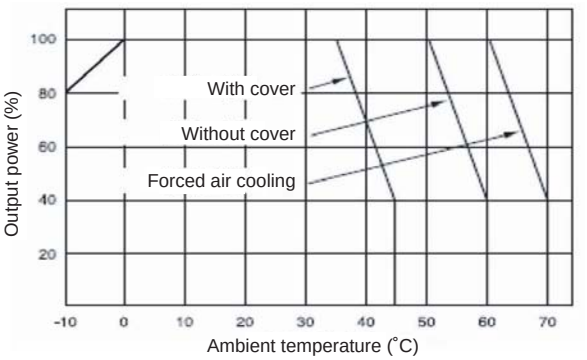


Single use **Multiple use**

(2) Output Derating

The output power depends on the operating temperature.

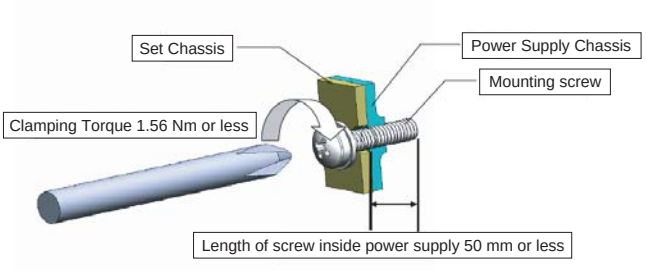
Please refer to the derating diagram for the model you are using.



Derating characteristic (Example)

(3) Mounting Screws

Make sure the screws that you use to mount the power supply are no more than 50 mm long. Tighten the screws to a torque of no more than 1.56 Nm (16 kgf-cm).

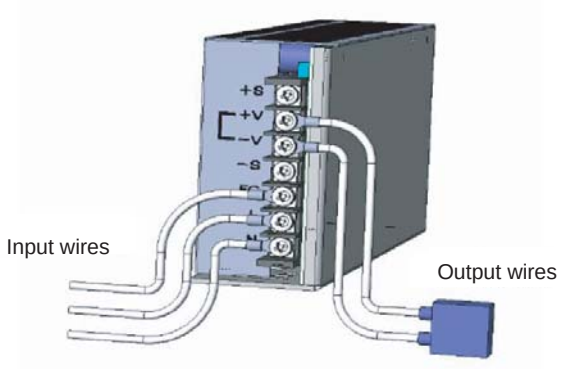


Connection

(1) Input and Output Wiring

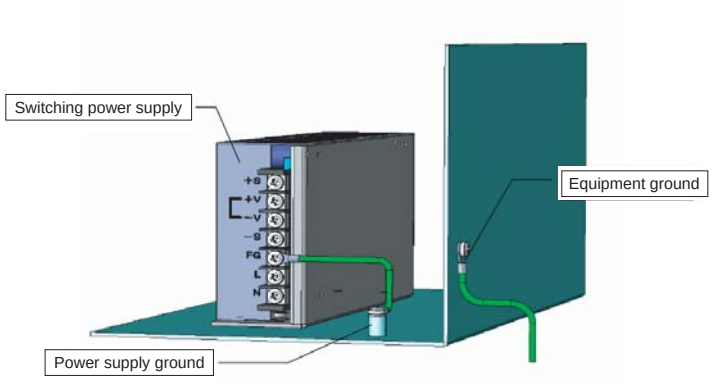
a. Keep the input and output wires separate to protect the output from external surges in the input lines and to prevent an increase in conductive noise in the input.

b. Ensure that the output wires are “heavy and short”, to optimize output current.

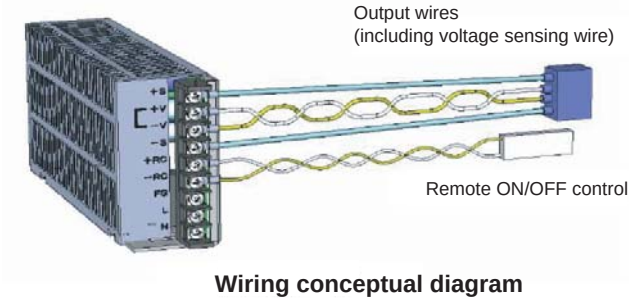


(2) Grounding

To ensure safety and reduce noise, ensure that the grounds for the power supply and the device are “heavy and short”.



(3) Wiring for Remote ON / OFF Control and Remote Sensing



Wiring conceptual diagram

(4) Correct Terminal Connection

When wiring the switching power supply, use screws of a suitable diameter, apply appropriate pressure, and use suitable tools and wires.

Safety

In general, switching power supplies are DC stabilized power supplies that are designed to be installed inside electrical devices. Please use them for this purpose only.

Input Voltage Range

The input voltage range for the standard RUBYCON power supply is between 85 Vac and 264 Vac. The frequency range is between 47 Hz and 63 Hz. Using input outside of these ranges could damage the power supply or cause it to malfunction. To avoid damaging the power supply or host equipment, do not apply input voltage in excess of 264 Vac. To ensure the stable operation of the equipment, ensure that the input voltage is more than 85 Vac.

Leakage Current

The leakage current of the noise filter built into the switching power supply is below the maximum leakage current specified in the applicable safety standards. The leakage current increases when more than one unit is used. To prevent electric shocks, be careful to ground the unit(s) properly.

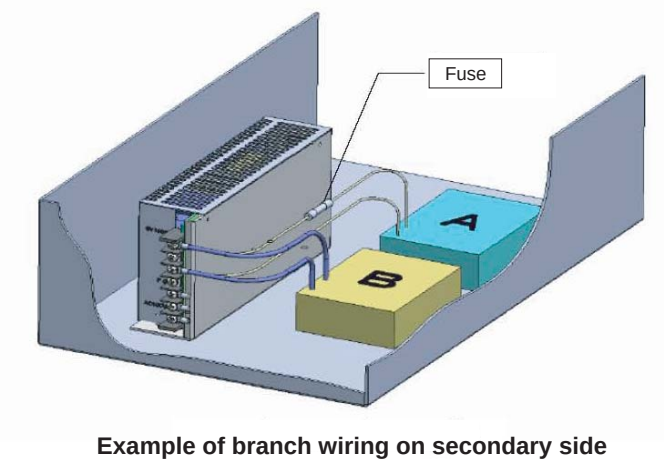
Wiring Materials

To prevent overheating of wires when the switching power supply is overloaded, use wires that are appropriate for the output current capacity of the switching power supply. Be especially careful when wiring to more than one load. If thin wires are used as the branch lines, the overcurrent protection may not operate in the event of a short circuit. In such cases, it is necessary to prevent problems by such means as inserting fuses in the wiring. It is also necessary to be aware of the rated voltage of the wires you are using.

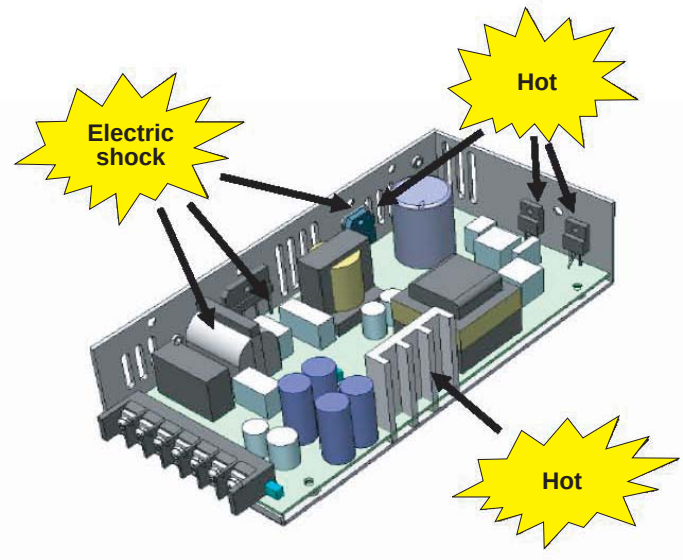
Requirement: Switching power supplies of the built-in type are subject to the national safety standards that apply to the final products in which they are used. Before using a power supply, be sure to check the various specifications for the applicable safety standards.

Electric Shocks and Burns

Switching power supplies contain parts that generate high voltage and high heat. Take the appropriate precautions to prevent electric shocks and burns.



Example of branch wiring on secondary side



EMI

RUBYCON switching power supplies are designed to meet EMI requirements. However, the input power supply, load, wiring, and grounding can all affect the characteristics of a switching power supply. Keep the following principles in mind when using a switching power supply.

Separation of Wiring

If the input wires are close to the output wires, conductive noise and radiant noise may increase. Similarly, if the input wires are close to the internal wiring (especially digital circuits), external noise may cause the equipment to malfunction. Ensure that the input wires are kept away from the output wires.

Grounding

Use short, heavy wires to connect the power supply housing ground and the equipment ground, and ensure that the connections are made securely.

"Heavy and Short"

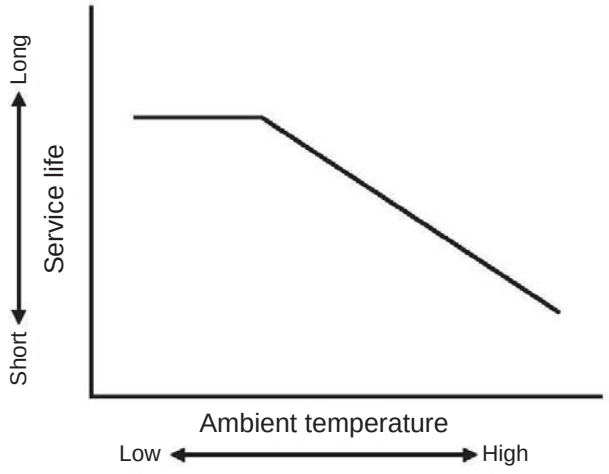
Ensure that the input and output wires used in the equipment are "heavy and short". Looped wires can decrease noise performance.

Reliability

Ambient Temperature and Service Life

Switching power supplies are compact, lightweight, and highly efficient. However, their service life is affected by the ambient temperature. In particular, the electrolytic capacitor that is used as a smoothing filter is very sensitive to the ambient temperature because of the chemical reactions that occur within the capacitor. In general, the effect of temperature on the service life of an electrolytic capacitor follows the Arrhenius rule*, and the service life of a switching power supply is affected accordingly.

* Arrhenius rule: For every 10˚C increase in ambient temperature, the service life decreases by 1/2, and for every 10˚C decrease in ambient temperature, the service life doubles.



In general, the relationship between ambient temperature and the service life of a switching power supply is as shown in the figure above. To extend the service life of a switching power supply, it may be necessary to overhaul it, for example by replacing the electrolytic capacitor.

Overhaul

There is increasing demand to extend the service life of switching power supplies. To extend the life of a switching power supply, overhaul it at an appropriate time given the conditions of use. The appropriate timing of an overhaul depends on the ambient temperature in which it is used and the number of hours of continuous operation. The following may be useful as a guideline.

Ta = 40°C - 45°C	Every 3 years
Ta = 35°C - 40°C	Every 4 years
Ta = 30°C - 35°C	Every 5 years

Contact RUBYCON sales for more information on overhauls and power supply life.