

ZWP300-650 Series

Instruction Manual

BEFORE USING THE POWER SUPPLY UNIT

- Be sure to read this instruction manual thoroughly before using this product. Pay attention to all cautions and warnings before using this product. Incorrect usage could lead to an electrical shock, damage to the unit or a fire hazard.
- Product individual notes are shown in the instruction manual. If there is any difference with common notes individual notes shall have priority.

DANGER

Never use this product in locations where flammable gas or ignitable substances are present.

INSTALLATION WARNING

There is a risk of electric shock, fire or damage, if you do not follow the instructions below.

- When installing this product, ensure that work is done in accordance with the instruction manual.
Installation shall be done by service personnel with necessary and appropriate technical training and experience.
- Do not cover the product with cloth, paper and etc. Do not place any flammable objects around the product.
- Do not operate and store these products in environments where condensation occurs due to moisture and humidity.

WARNING ON USE

There is a risk of electric shock, fire, burn or damage, if you do not follow the instructions below.

- Do not touch this product or its internal components while product is in operation, or shortly after shutdown.
- Prepare for the unexpected, keep your face and hands away from the product while it is in operation.
- Do not make unauthorized change to this product or remove the cover.
We will not be held responsible if the product was modified, changed or disassembled.
- Do not use this product under unusual conditions such as emission of smoke or abnormal smell and sound etc.
Please stop using it immediately and shut off the product. In such cases, please contact us.
- Do not attempt any repair by yourself, as it poses a danger to the user.
This product will be repaired by our company or an authorized agent designated by our company.
- Please do not use products that have been dropped or subjected to impact.
- Please use within specifications standards for input voltage, output current, output power, ambient temperature, humidity, etc.
- This product was made for general purpose electronic equipment use and is not designed for applications requiring high safety (such as extremely high reliability and safety requirements). Even though high reliability and safety are not required, this product should not be used directly for applications that have serious risk for life and physical safety.
Take sufficient consideration in fail-safe design (such as providing protective circuit or protective device inside the system, providing redundant circuit to ensure no instability when single device failure occurs).
- It is important that this product must not be used in hazardous environments or facilities such as nuclear power control system or life support equipment without our written consent.
- Connect together $\perp$ (Functional earthing) terminal of the product and the ground terminal of the equipment for safety and noise reduction.
- For product without cover, do not touch this product or its internal components while product is in operation, or shortly after shutdown. There are high voltage and high temperature parts in the product.
- High voltage may remain inside the product immediately after the input is cut off. Do not touch the product even if it is not in operation.

CAUTION ON MOUNTING

- Ensure connections to input/output terminals are correct as indicated in the instruction manual before switching on.
- Please use the wire as short and thick as possible.
- Do not use this product in special environment with strong electromagnetic field, corrosive gas (hydrogen sulfide, sulfur dioxide, etc.) or conductive substances and direct sunlight, or places where product is exposed to water or rain.
- Mount this product properly in accordance with the instruction manual, mounting direction and shall be properly ventilated.
- Please shut down the input when connecting input and output of the product.
- When installing in environment where conductive foreign, dust and liquid may be present, please take care to avoid penetration of these foreign material in the power supply by installing filter, to prevent trouble or malfunction.
- Input voltage, Output current, Output power, ambient temperature and ambient humidity should be kept within specifications.
- There is a case where the baseplate becomes high temperature. The equipment should be re-evaluated to ensure that the power supply complies with heat-resistant temperature of the equipment.
- This open-type power supply does not provide comprehensive mitigation for fire hazards. It is intended to be installed inside a supplementary enclosure or in a restricted access area which provides appropriate protection against access to hazardous live parts.

CAUTION ON USE

- If the built-in fuse is blown, do not use the product even after replacing the fuse, as there is risk of abnormality inside. Be sure to request repair to our company.
- Please note that the built-in fuse may not operate depending on the input wiring and input line conditions.
- Provide countermeasure for prevention of lightning surge voltage as there is risk of damage due to abnormal voltage.
- Part with lifetime specifications (electrolytic capacitor) are required to be replaced periodically.
Set the overhaul period depending on the environment of usage and request a components replacement to our company. Also, note that there are cases when EOL products cannot be replaced.
- Take care not to apply abnormal voltage to the output. It might cause failure, smoke or fire.
- Product individual notes are shown in the instruction manual. If there is any difference with common notes, individual notes shall have priority.
- Before using this product, be sure to read the catalog and instruction manual. There is risk of electric shock or damage to the product or fire due to improper use.
- Input voltage, Output current, Output power, ambient temperature and ambient humidity should be kept within specifications. Otherwise the product will be damaged, or cause electric shock or fire.
- For externally mounted fuse do not use other fuses aside from our specified and recommended fuse.
- This product is made for general purpose electronic equipment use and is not designed for applications requiring high safety such as extremely high reliability and safety requirements. Even though high reliability and safety are not required, this product should not be used directly for applications that have serious risk to life and physical safety. Take sufficient consideration in fail-safe design such as providing protective circuit or protective device inside the system, providing redundant circuit to ensure no instability when single device failure occurs.
- When used in environment with strong electromagnetic field, there is a possibility of product damage due to malfunction.
- When used in environment with corrosive gas (hydrogen sulfide, sulfur dioxide, etc.), there is possibility that it might penetrate the product and result in failure.
- When used in environment where there is conductive foreign matter or dust, there is possibility of product failure or malfunction.
- Connect together the frame ground terminal of the product and the ground terminal of the equipment for safety and noise reduction. If these grounds are not connected together, there is risk of electric shock.
- This product is designed under condition Material group III b, Pollution Degree (PD): PD2, Over Voltage Category (OVC): OVC II in IEC/UL/CSA/EN 62368-1, OVC III in IEC/EN 62477-1 and Class of equipment: Class I. This product is designed to be accessible only to service technicians as part of indoor use device.
- This product contains a Printed Circuit Board (PCB) utilizing Surface Mounted Devices. PCB stress such as bending might cause SMD damage. Please handle with care.
- When handling this product, hold the PCB edge or base plate, and take care not to touch the component side.
- The outputs of this product may exceed ES1 limits under fault conditions. The outputs must be protected in the end equipment to maintain ES1.
- The output power of this product is considered to be hazardous energy level. (The voltage is greater than or equal to 2V and the power is greater than or equal to 240VA) It must not be made accessible to users. Protection must be provided for service engineers against indirect contact with the output terminal and to prevent any tools from dropping across the outputs. While working on this product, the AC input must be switched off and the input and output voltage should be zero.

⚠ OTHER NOTES OF CAUTION

- If your fingers come into direct contact with the metal edges, there is a risk of injury.
When handling, please take sufficient care, such as wearing protective gloves, and work carefully.
- When disposing product, follow disposal laws of each municipality.
- Published EMI (CE, RE) or immunity is the result of measuring the power supply unit under our standard measurement conditions and might not satisfy specification when mounted and wired inside end-user equipment.
Use the product after sufficiently evaluating at actual end-user equipment.
- When exporting our products, apply for necessary permissions as required by rules and regulations of Foreign Exchange and Foreign Trade Control Act.
- Take note that traces of sheet metal processing be left in our power supplies. Also, partial discoloration or oxidation may be observed on the sheet metal surface of the product depending on storage conditions, such as in warehouses, but this does not affect the characteristics or reliability of the product.
- Catalogue or contents of the instruction manual may be changed without a prior notice.
Refer to latest catalogue or instruction manual.
- Reproduction or reprinting the instruction manual or its portion is forbidden without our permission unless with TDK-Lambda authorization.

⚠ SPECIAL INSTRUCTIONS FOR IEC/EN62477-1

- The leakage current of these products is less than 1mA (normal condition) / less than 2mA (single fault condition) (240VAC, 60Hz)

⚠ LONG-TERM STORAGE METHOD AND DURATION PERIOD

- Please keep the product in carton box.
- Please do not apply excessive vibration, shock or mechanical stress to the product.
- Please keep away from direct sunlight.
- For storage temperature and humidity, the following conditions shall be used as a guideline :

Temperature range : 5°C~30°C

Humidity range : 40%~60%RH

Avoid places where its temperature and humidity can change drastically.

It might cause product degradation or condensation on the product.

There is tendency that the leakage current of an aluminum electrolytic capacitor may increase when not use for a long time. This phenomenon can be improved by applying voltage to the aluminum electrolytic capacitor to reduce the leakage current through the self-recovery effect of the electrolyte. As a guide if the products have been in storage for longer than one year, it is recommended to turn on the product for at least 30 min at no load condition.

< Criterion of warm up voltage condition >

(1)Implementation period : 1 year or above after the delivery.

(2)Electrical condition

Input voltage : Nominal

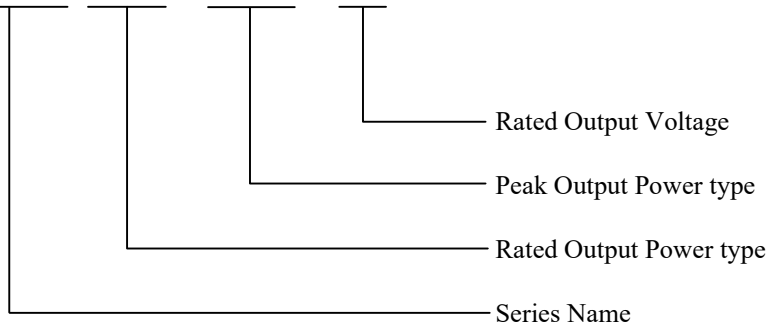
Load : 0A

Ambient temperature : Normal temperature

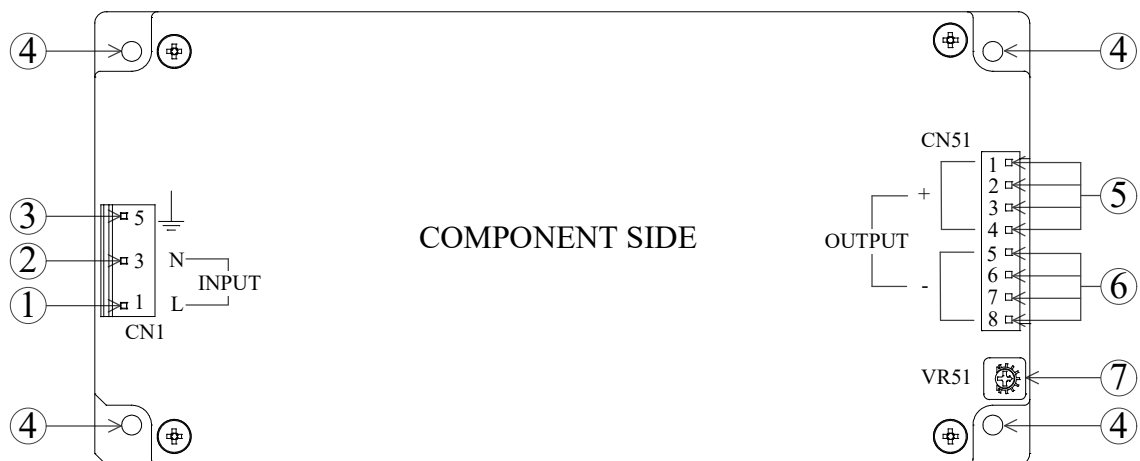
Time : 30 minutes or more

1. Model name identification method

ZWP 300 - 650 - 24

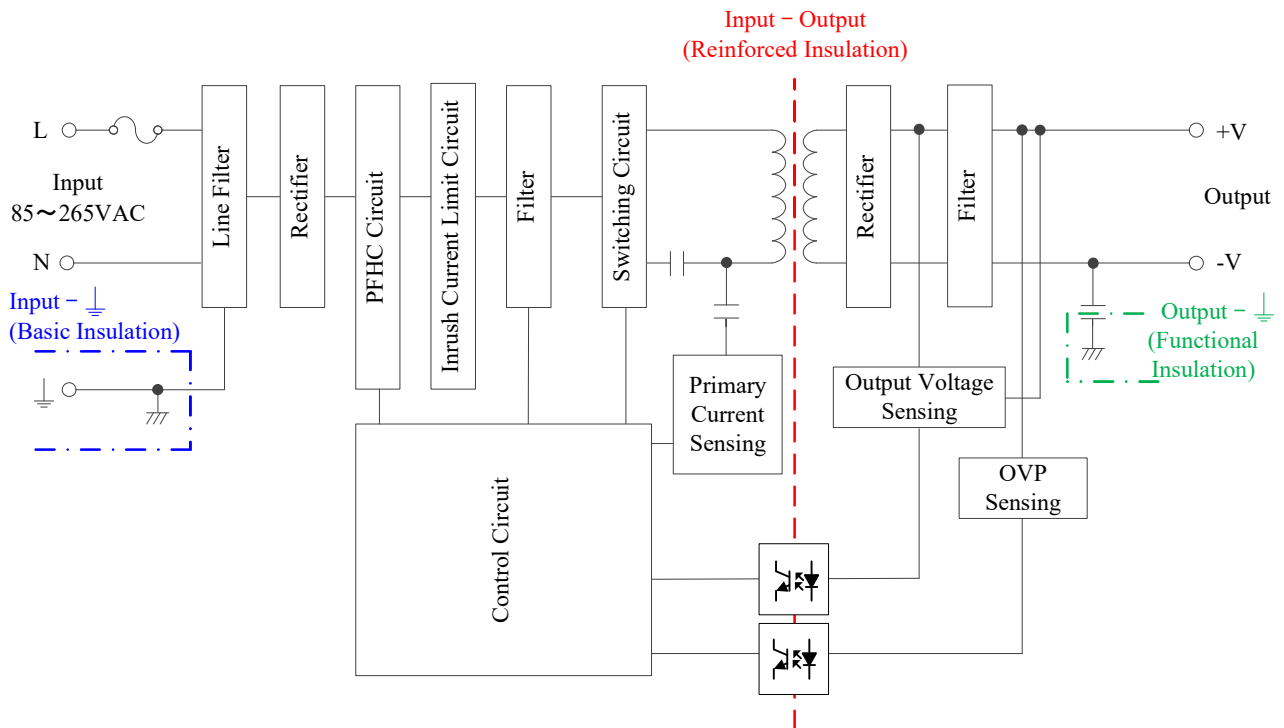


2. Terminal Explanation



- ① L : Input terminal Live line (Fuse in line.) (CN1)
- ② N : Input terminal Neutral line (CN1)
- ③ $\perp$: PE conductor terminal (CN1)
- ④ Mounting hole (hole diameter : 3.5mm)
 These mounting holes are connected to $\perp$ terminal of CN1 (Protective Earth).
 These holes must be connected to the chassis (conductor) of the equipment using screws or metal spacers.
- ⑤ + Output Terminal (CN51)
- ⑥ - Output Terminal (CN51)
- ⑦ Output Voltage Adjust Trimmer.

3. Block Diagram



Circuit topology, switching frequency

Switching circuit : LLC resonant converter (*)

70kHz to 110kHz (**)

*At light-load or no-load condition, switching will be in burst-mode at intermittent switching frequency.

**Under heavy load

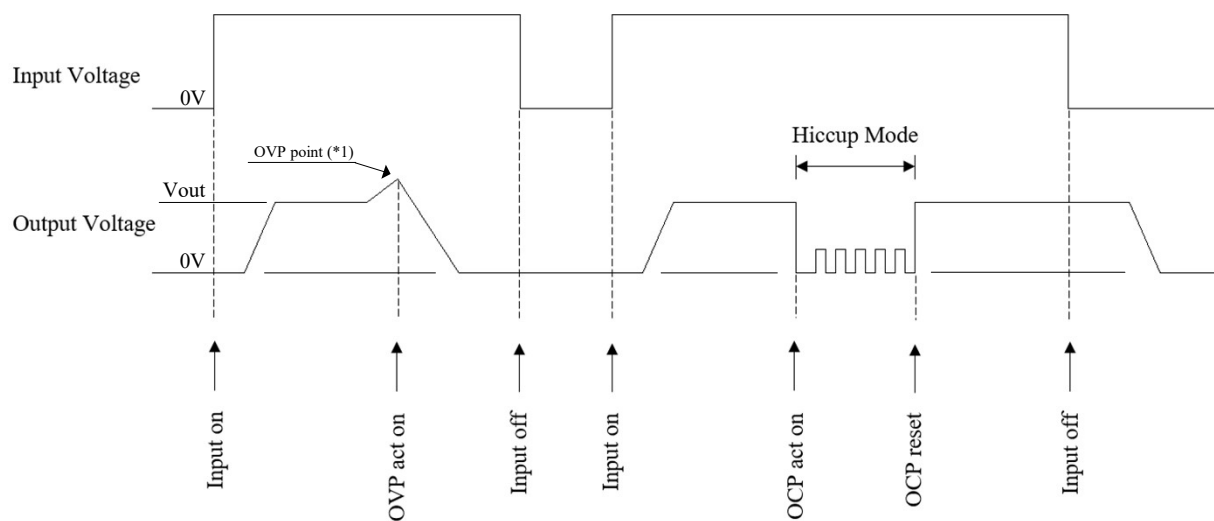
PFHC circuit : active filter

60kHz (At rated output power)

Fuse rating

12.5A

4. Sequence Time Chart



(*1) OVP detection point is fixed as follows.

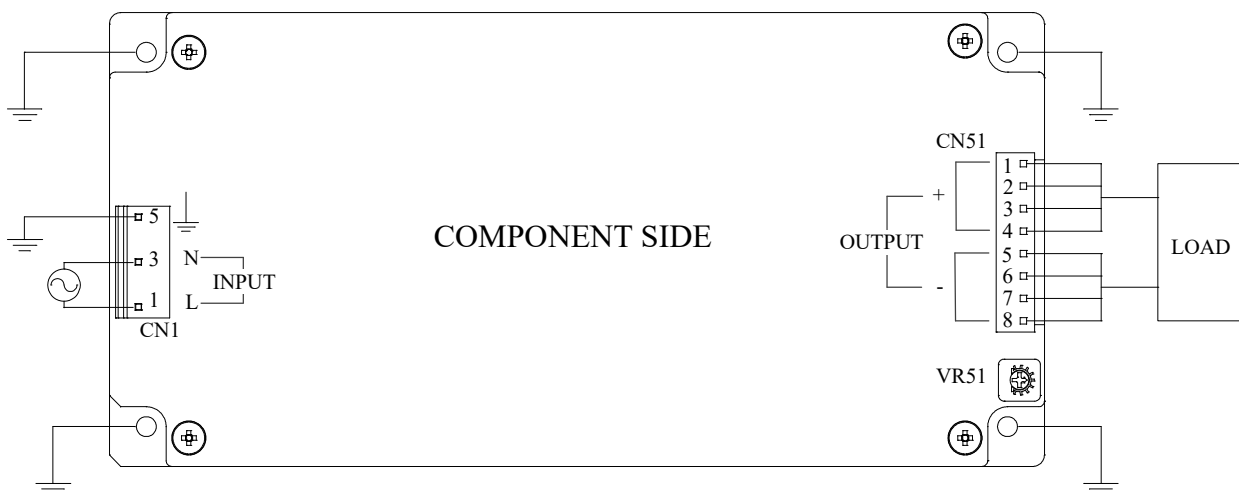
24V : 29.0V – 34.0V, 30V : 32.0V – 37.0V, 36V : 45.0V – 52.0V and 48V : 52.0V – 61.0V

5. Terminal Connection Method

Pay attention to the input wiring. If it is connected to the wrong terminal, the power supply will be damaged.

- When making connections, the input must be off.
- $\perp$ terminal must be connected to the protective earth (frame ground of the equipment or equivalent ground) using a thick wire for safety and improvement of noise immunity.
- Output current of each connector pin must be less than 10A.
- The output load line and input line shall be separated to improve noise immunity.
- When connecting or removing the connector, do not apply mechanical stress to the PCB.
- Use input/output connector (housing) and the crimp type terminal specified by the table below.
Connector or crimp type terminal is not included with this product.
- Use recommended crimping tool. (Refer to the following)
- Use wire rated for at least 60°C.

In addition, please select the wire taking ambient temperature and self-heating into consideration.



Input Connector (CN1) / Output Connector (CN51)

	Connector	Housing	Terminal Pin	Maker
Input (CN1)	B3P5-VH(LF)(SN)	VHR-5N	SVH-41T-P1.1	JST
Output (CN51)	B8P-VH(LF)(SN)	VHR-8N	SVH-41T-P1.1	JST

Hand Crimping Tool : YC-930R (JST)

The recommended wire sizes are AWG #20 ~ #16.

6. Explanation of Function and Precautions

6-1. Input Voltage Range

The input voltage range is single-phase 85-265VAC (47-63Hz) or 120-370VDC.

The unit may be damaged if operated outside of the product specifications. For cases where conformance to various safety standards is required, it is specified as 100-240VAC (50-60Hz).

This product is designed for use in TN and TT power supply systems in Japan and Europe. Note that IT systems are not supported. For the USA and Canada, the product is compatible with TN systems only. Use in TT systems is not applicable. This product satisfies the temporary overvoltage (1500Vr.m.s./2120Vpeak) and transient impulse voltage (OVC III/4kVpeak) specified in IEC/EN 62477-1.

6-2. Output Voltage Range

Output voltage is set to the rated value at shipment. Output voltage can be adjusted by output voltage adjustment trimmer (VR51). Refer to the specifications for the output voltage range. The output voltage will be increased by turning VR51 clockwise. Take note that when the output voltage is increased excessively, over voltage protection (OVP) might trigger, the output will be shut down, and manual reset is required. Furthermore, when the output voltage is set higher than rated output voltage, the output current must be re-adjusted so as not to exceed the maximum output power.

6-3. Inrush Current

The relay method is used to limit inrush current. When the input is turned on and off repeatedly in a short period, a higher current might flow. Take note that the first and second inrush currents will flow. Select an appropriate input switch and external fuse.

6-4. Over Current Protection (OCP)

The over current protection is in "Hiccup" mode. When the output current exceeds 101% of the maximum peak output current specifications, OCP will operate and the output voltage shuts down briefly, then automatically attempts to restart. This cycle repeats until the overload condition is removed. Never operate the unit under overcurrent or shorted conditions, which might cause the power supply to be damaged. OCP setting is fixed and cannot be set externally.

6-5. Over Voltage Protection (OVP)

The OVP function is an output shutdown type with manual reset. When OVP is triggered, the output will shut down and the power supply must be manually reset. The OVP set point is fixed and cannot be set externally.

Do not apply external voltage to the output terminal. It might cause damage to the power supply. When an inductive load is used, a protective diode is required to be connected in series with the output line.

6-6. Over Temperature Shutdown

When the ambient temperature or internal component temperature rises abnormally, the over temperature shutdown will be triggered and the output will shut down. When the overtemperature shutdown is triggered, turn off the power supply and allow it to cool sufficiently before turning it back on by manually resetting it. The over temperature shutdown function will operate if the unit is used outside its specified operating conditions.

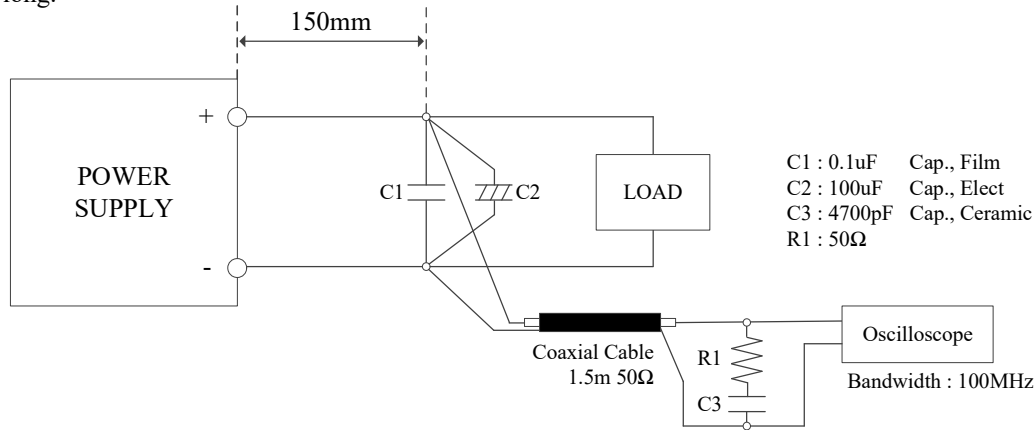
This function may not activate depending on operating conditions, and even if it activates, it may not prevent damage to the power supply.

6-7. Output Ripple & Noise

The maximum ripple noise voltage value in the specifications is the value measured using the measurement circuit below.

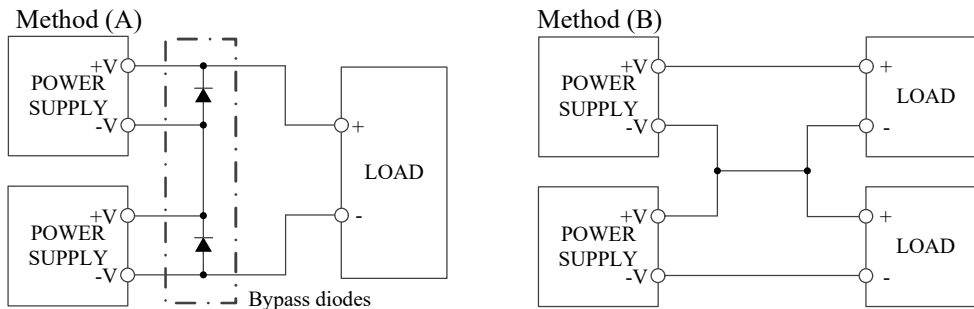
When load lines are longer, ripple and noise will increase. In this case, it may be necessary to use an electrolytic capacitor, film capacitor, or the like across the load terminals.

The output ripple and noise cannot be measured accurately if the probe ground lead of oscilloscope is too long.



6-8. Series Operation

For series operation, either method (A) or (B) is possible.



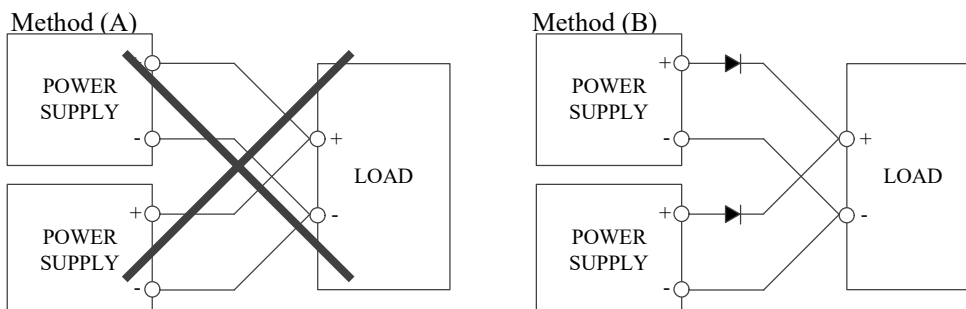
Note : Never use this configuration when one of the units is not operating. It may damage the power supply.
 When power supplies are connected as method (A), the bypass diode is required to avoid reverse bias.
 The bypass diode must be selected with a maximum forward current rating higher than the output current and a maximum reverse voltage rating higher than the output voltage.

6-9. Parallel Operation

Method (A) cannot be used to increase the output current. If redundancy is required for the equipment, a protection diode must be inserted between the power supply and the load, as in Method (B).

If Method (B) is required, the following items should be considered.

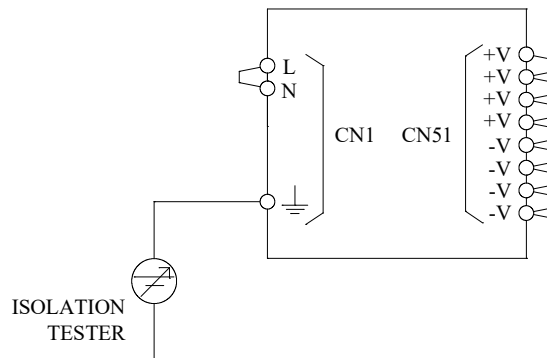
1. Set the output voltage of the power supplies higher by the forward voltage drop of the protection diode.
2. Adjust the output voltage of each power supply to be the same.
3. Use the power supply within the output voltage range and maximum output power in the standard specifications.
4. Select a protection diode with a forward current rating higher than the output current.



6-10. Isolation Test

Isolation resistance between Output - $\perp$ terminal is more than 100M Ω at 500VDC. For safe operation, the voltage setting of the DC isolation tester must be set before the test. Ensure that the unit is fully discharged after the test.

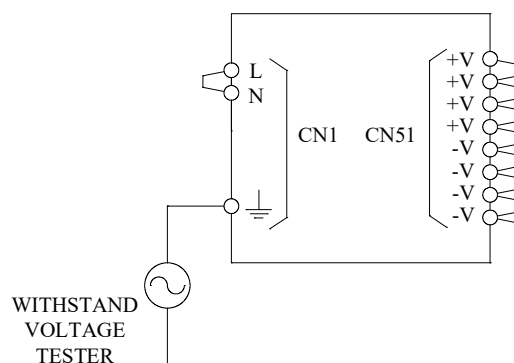
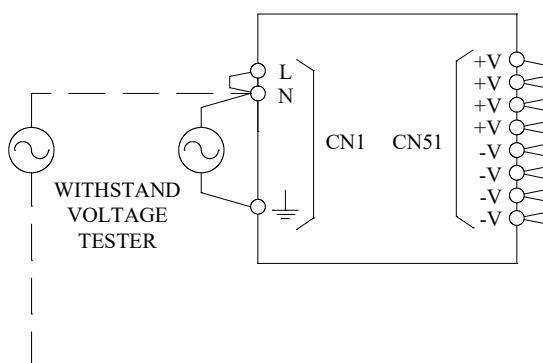
- Output - $\perp$ terminal : 500VDC More than 100M Ω



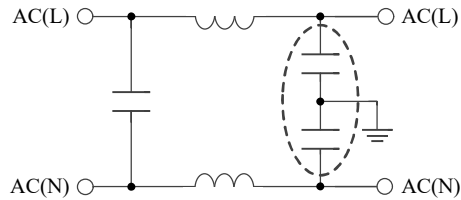
6-11. Withstand Voltage

This series is designed to withstand 3.0kVAC between input and output, 2.0kVAC between input and $\perp$ terminal, and 500VAC between output and $\perp$ terminal each for 1 minute. When testing withstand voltage, set current limit of the withstand voltage test equipment to 10mA (output - $\perp$ terminal : 20mA). The withstand voltage must be gradually increased from zero to the test value and then gradually decreased to zero. When a timer is used, the power supply might be damaged by high impulse voltage when the timer switches on and off. Connect input and output as follows.

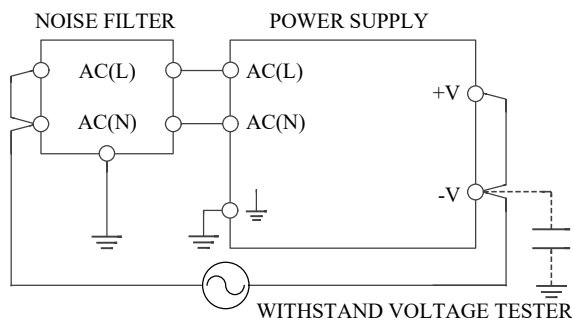
- Input – Output (Dashed line) : 3.0kVAC, 1min (10mA)
- Output – $\perp$ terminal : 500VAC, 1min (20mA)
- Input – $\perp$ terminal (Solid line) : 2.0kVAC, 1min (10mA)



Note : When using an external noise filter, capacitance between input and $\perp$ terminal might be increased. When testing withstand voltage between input and output, there is a possibility of exceeding withstand voltage between output and $\perp$ terminal (500VAC). If the voltage between output and $\perp$ terminal exceeds 500VAC, an external capacitor must be placed across the output and $\perp$ terminal. This can decrease the voltage between the output and $\perp$ terminal. On the other hand, there is no need to check the voltage if the output and $\perp$ terminal are shorted.



The example of noise filter circuit that might increase capacitance value between "input and $\perp$ terminal". (Capacitance dashed line is added.)



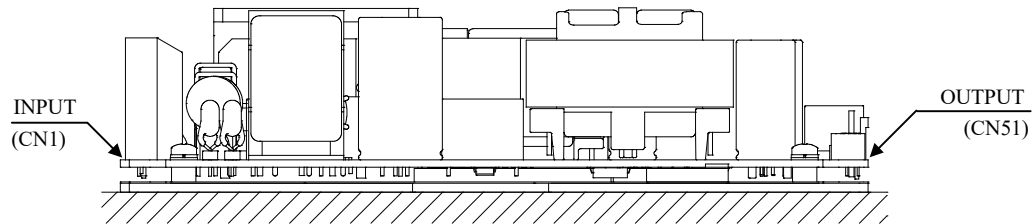
External capacitor value adding point or short point. Even in the case of "+V and $\perp$ Terminal", it is a similar effect.

7. Mounting Directions

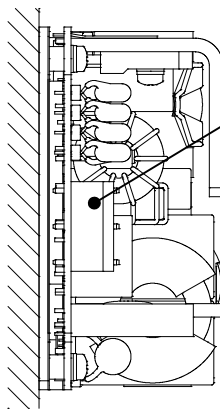
7-1. Mounting Directions

The standard mounting is direction (A). Direction (B) to (F) are also possible. Use the power supply within the output derating (output power or current versus operating ambient temperature) according to mounting direction and actual operating ambient temperature. Refer to section 7-3 Output Derating according to the Mounting Direction. This series can be used with convection cooling.

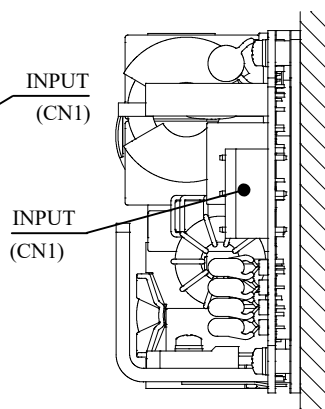
Mounting (A) (Standard Mounting)



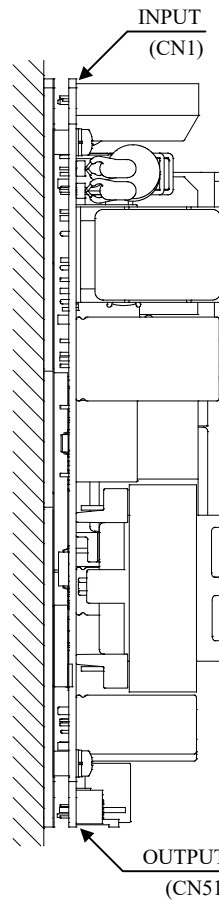
Mounting (B)



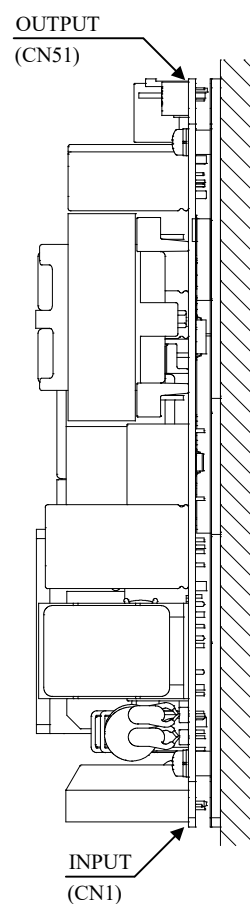
Mounting (C)



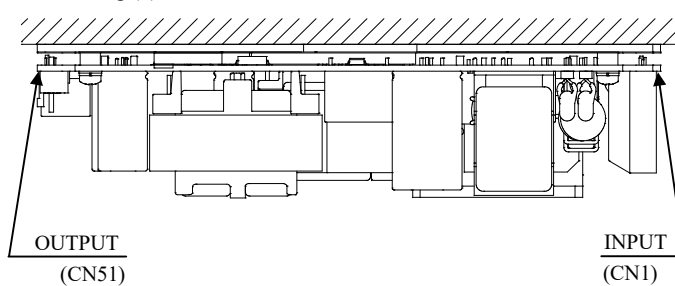
Mounting (D)



Mounting (E)



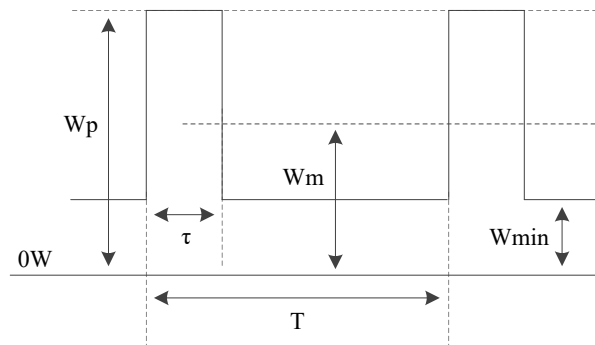
Mounting (F)



7-2. Peak Output

Continuous peak output duration must be less than or equal to 5 sec with a duty cycle of no more than 45%. Use the power supply to satisfy (a) Peak Output Condition, (b) Peak Output Power versus Duty and (c) Peak Output Power versus Pulse Width of Peak Output Power. In addition, the peak output condition must comply with all derating requirements: input voltage, mounting direction, and ambient temperature. The product might be damaged if used beyond the limits of (a) to (c). When using the pulse load, an audible noise might be heard from the power supply.

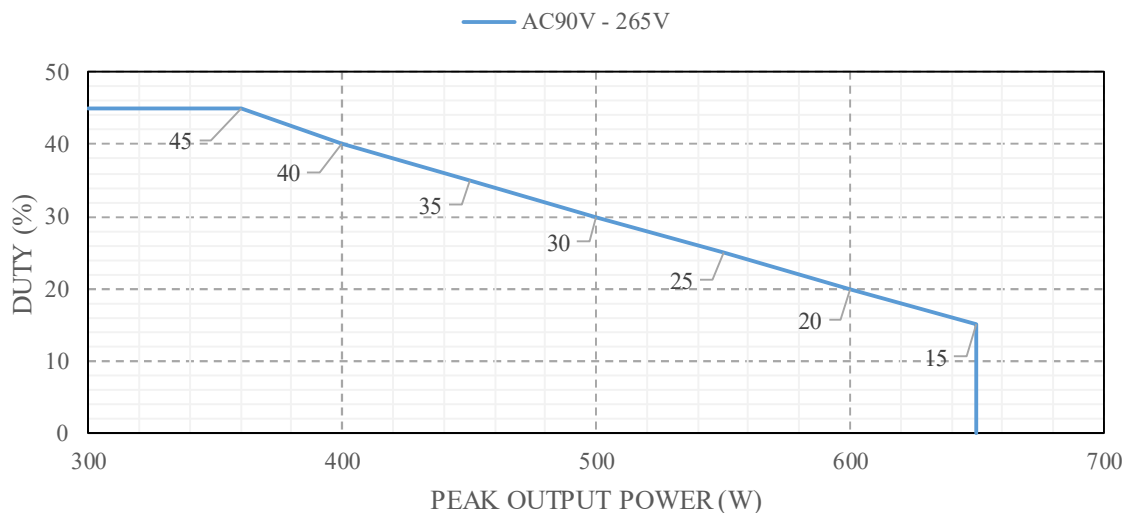
(a) Peak Output Condition



$$W_m \geq \sqrt{W_p^2 \times D + W_{min}^2 \times (1 - D)}$$

W_p : Peak output power (W)
 W_m : Rated output power (W)
 W_{min} : Output power at light load (W)
 τ : Pulse width of peak output power (sec)
 T : Period (sec)
 D : Duty

(b) Peak Output Power Versus Duty



This is a curve for input voltage from 90VAC to 265VAC.

Please avoid using peak output power at input voltage below 90VAC as this may damage the unit.

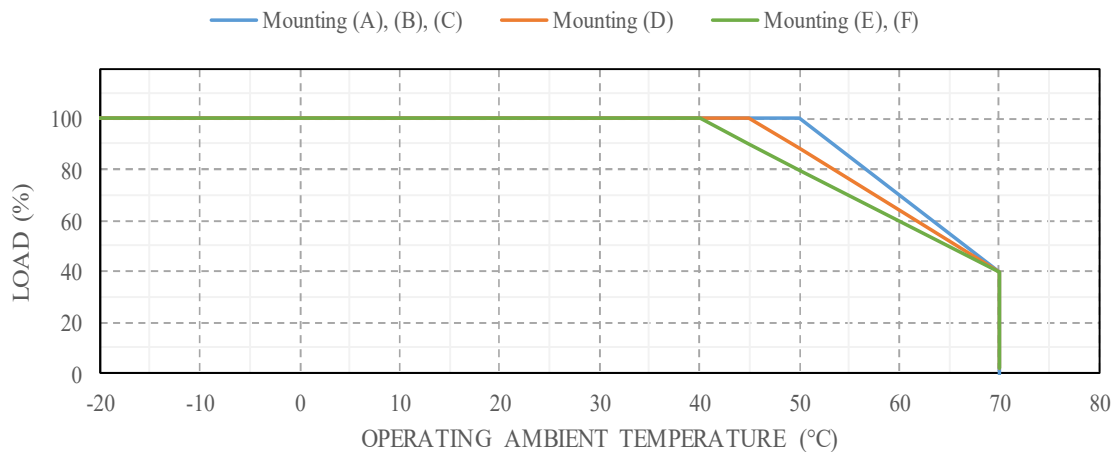
(c) Peak Output Power Versus Pulse Width of Peak Output Power

Input voltage, V_{in} (VAC)	Peak output power	Peak pulse width, τ (sec)
$90 \leq V_{in} \leq 265$	650W	5

7-3. Output Derating according to the Mounting Direction

Load (%) is percent of maximum output power, maximum output current or rated output power at peak loading. The Output Derating According to the Mounting Direction also must be considered at peak loading.

Operating ambient temperature (°C)	Load (%)		
	Mounting (A), (B), (C)	Mounting (D)	Mounting (E), (F)
-20 to +40	100	100	100
45	100	100	90
50	100	88	80
70	40	40	40

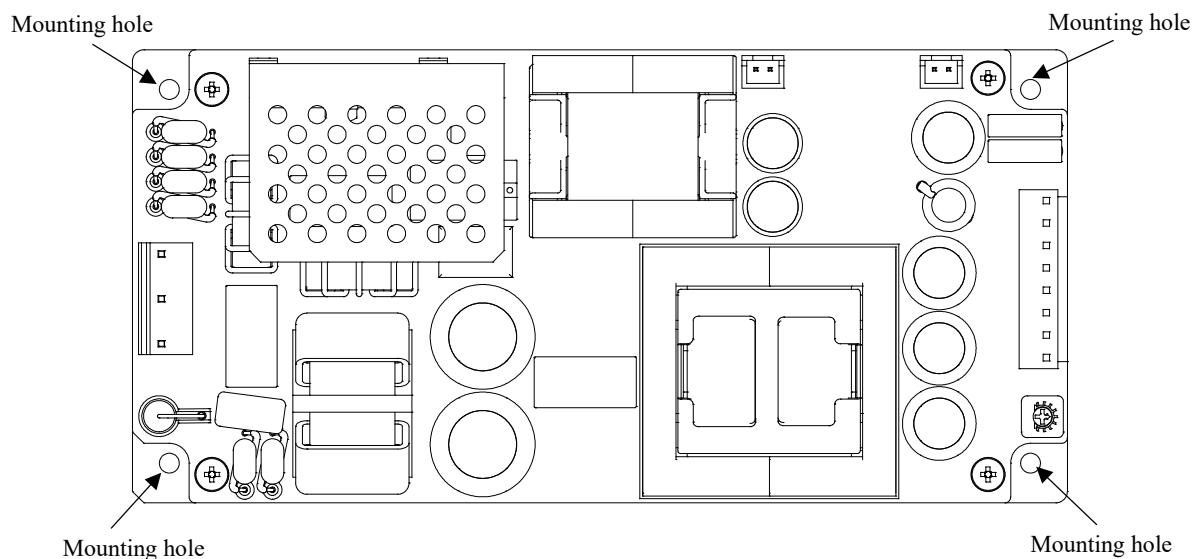


7-4. Mounting Method

Mount the power supply with M3 screws or metal spacers, and use all mounting holes for installation. There is a case where the baseplate becomes hot. The equipment should be re-evaluated to ensure that the power supply complies with the heat-resistant temperature of the equipment. The user should keep sufficient clearance above and around the power supply for convection cooling.

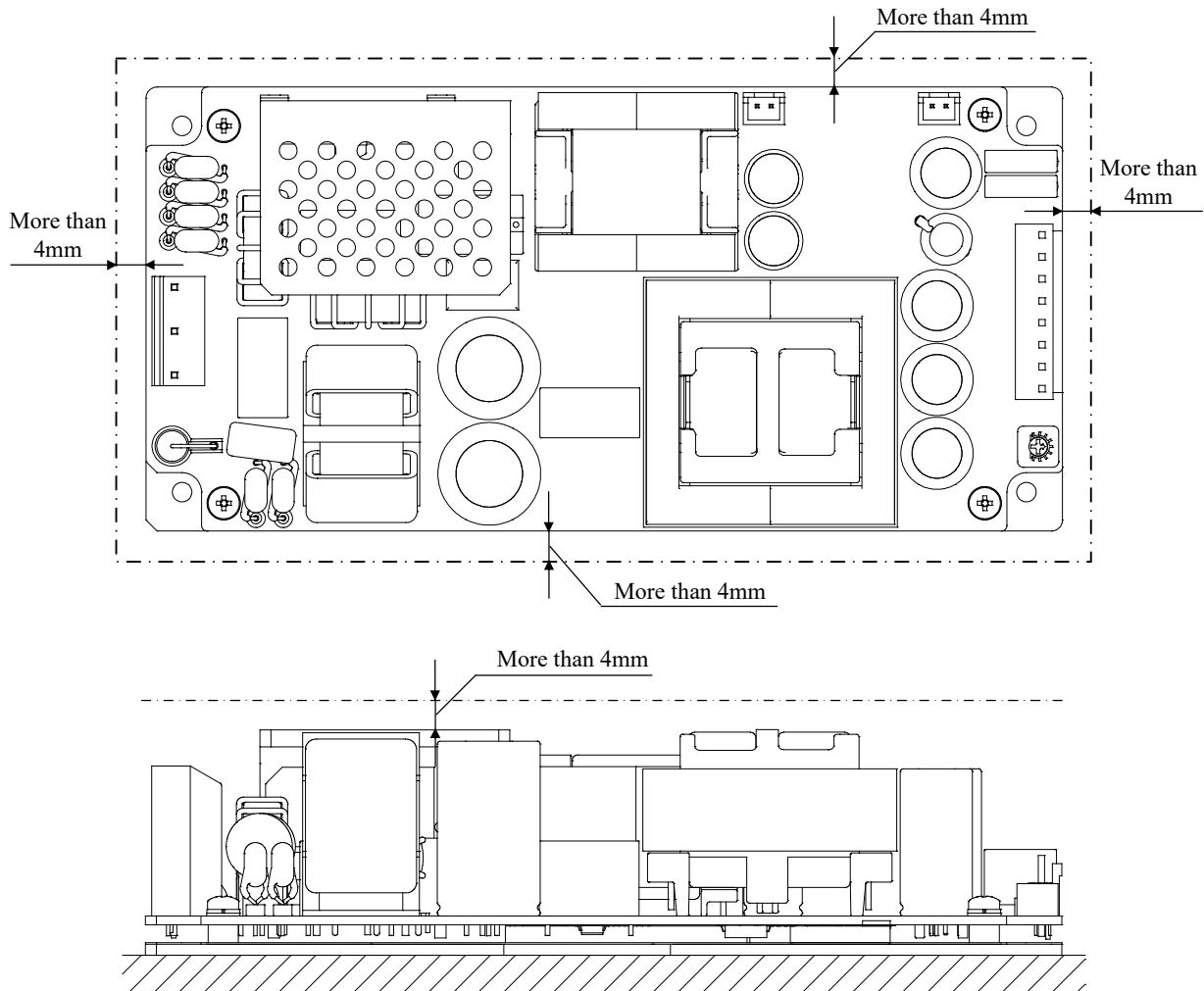
■ Mounting Holes size

There are 4 mounting holes (φ3.5mm) available that allow M3 screws or metal spacers to secure the power supply.



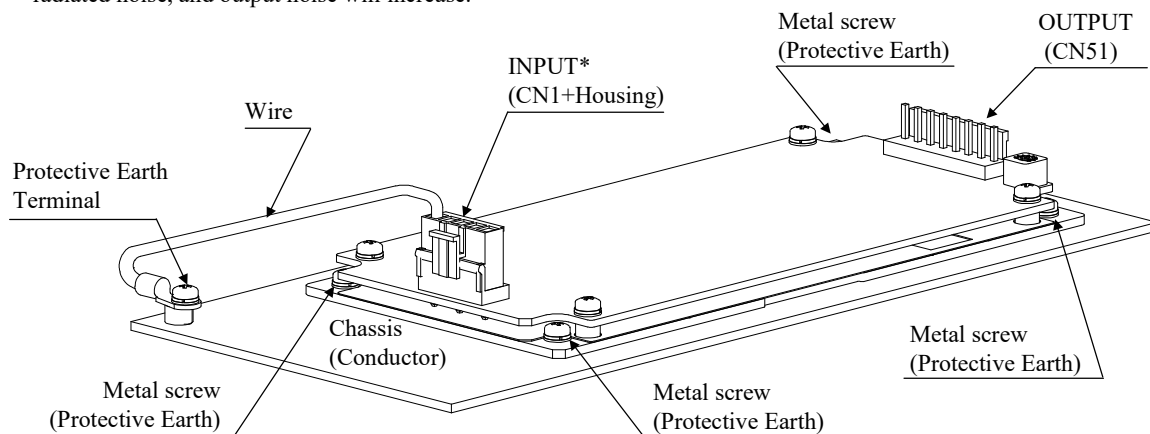
■ Condition to meet Isolation & Withstand Voltage standard

Keep 4 mm clearance above and around the power supply. If the clearance is not sufficient, the isolation and withstand voltage specifications will not be satisfied. The user should also consider keeping sufficient clearance above and around the power supply for convection cooling.



■ terminal

⬇ terminal should be connected to the protective earth terminal of the equipment. Also, the four mounting holes should be connected to the chassis (conductor) by M3 metal screws or metal spacers. If they are not connected, the conducted noise, radiated noise, and output noise will increase.



*Protective Earth is on CN1. Wire should be connected here.

8. Wiring Method

- (1) The input and output wiring should be separated from each other and twisted individually.
This is to improve noise immunity.
- (2) All input and output wiring should be as thick and short as possible to achieve lower impedance.
- (3) Noise can be reduced by attaching a capacitor to the load terminals.
- (4) For safety and EMI considerations, connect between $\perp$ terminal of input connector and protective earth terminal firmly.
- (5) Use AWG#20 – AWG#16 wire for the input line and output load line.

9. The Life Expectancy

The lifetime of the power supply depends on the lifetime of built-in aluminium electrolytic capacitors and it is described in reliability data. The lifetime of aluminium electrolytic capacitors varies depending on the mounting direction, the load current, and the ambient temperature of the power supply. Refer to “Electrolytic Capacitor Lifetime” in reliability data. If the power supply is used beyond its life expectancy, there is a risk of unexpected output shutdown and specifications might not be satisfied.

Please contact TDK-Lambda for maintenance or product replacement.

10. External Fuse Rating

Refer to the following fuse rating when selecting the external fuse that is to be used on input line. Surge current flows when the line is turned on. Use a slow-blow or time-lag fuse. Fast-blow fuse must not be used. The fuse rating should be selected based on the inrush current at line turn-on. Do not select the fuse according to input current (RMS) values under the actual load conditions.

ZWP300-650 : 12.5A

11. Before concluding that the unit is at fault

- (1) Check if the rated input voltage is connected.
- (2) Check if the wiring of input and output is correct.
- (3) Check if the wire size is not too thin.
- (4) Check if the output current and output power are within specification.
- (5) Check if the output voltage control (V.ADJ) is correctly adjusted.
- (6) Audible noise can be heard when input voltage waveform is not sinusoidal wave.
- (7) Audible noise can be heard during dynamic load operation.
- (8) Ensure that large capacitor is not connected on output side.

The maximum external capacitance is shown below.

Maximum external capacitor			
24V	30V	36V	48V
10,000uF	8,750uF	7,500uF	5,000uF

- (9) Check if the input is being repeatedly turned on and off in a short period of time.

12. Warranty Period

This product is warranted for a period of 5 years from the date of shipment. For damage occurred during normal operation within this warranty period, repair will be free of charge.

13. CE MARKING/UKCA MARKING

CE MARKING

CE Marking when applied to a product or packing material for a product covered by this handbook, indicates compliance with the Low Voltage Directive, EMC Directive and RoHS Directive.

UKCA MARKING

UKCA Marking, when applied to a product or packing material for a product covered by this handbook, indicates compliance with the Electrical Equipment (Safety) Regulations, Electromagnetic Compatibility Regulations and Restriction of the Use of Certain Hazardous Substance in Electrical & Electronic Equipment Regulations.