HWS 1500 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.

⚠DANGER

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

⚠INSTALLATION WARNING

- When installing, ensure that work is done in accordance with the instruction manual.
  When installation is improper, there is risk of electric shock and fire.
- Installation shall be done by Service personnel with necessary and appropriate technical training and experience.
  There is a risk of electric shock and fire.
- Do not cover the product with cloth or paper etc. Do not place anything flammable around.
  This might cause damage, electric shock or fire.

⚠WARNING ON USE

- Do not touch this product or its internal components while circuit in operation, or shortly after shutdown. You may receive a burn.
- While this product is operating, keep your hands and face away from it as you may be injured by an unexpected situation.
- There are cases where high voltage charge remains inside the product. Therefore, do not touch even if they are not in operation as you might get injured due to high voltage and high temperature. You might also get electric shock or burn.
- Do not make unauthorized changes to this product nor remove the cover as you might get an electric shock or might damage the product. We will not be held responsible after the product has been modified, changed or dis-assembled.
- Do not use this product under unusual condition such as emission of smoke or abnormal smell and sound etc.
  Please stop using it immediately and shut off the product.
  It might lead to fire and electric shock. In such cases, please contact us.
  Do not attempt repair by yourself, as it is dangerous for the user.
- Do not operate and store these products in environments where condensation occurs due to moisture and humidity.
  It might lead fire and electric shock.
- Do not drop or apply shock to this product. It might cause failure. Do not operate these products mechanical stress is applied.
- When necessary, this products is to be repaired only by us or our authorized agents.
  It is important that this product cannot be used in hazardous environments (facilities such as nuclear power control system or life support equipment) without our written consent.

⚠CAUTION ON MOUNTING

- Confirm connections to input/output terminals are correct as indicated in the instruction manual before switching on.
- Input voltage, Output current, Output power, ambient temperature and ambient humidity should be kept within specifications, otherwise the product will be damaged.
- Input line, please use the wires as short and thick as possible.
- Do not use this product in special environment with strong electromagnetic field, corrosive gas 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 consider penetration of above foreign material in the power supply by installing filter, to prevent trouble or malfunction.

⚠ CAUTION ON USE

- 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.
- 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.
- For products without built-in protection circuit (element, fuse, etc.), insert fuse at the input to prevent smoke, fire during abnormal operation.
  As for products with built-in protection circuit, depending on usage conditions, built-in protection circuit might not work.
  It is recommended to provide separate proper protection circuit.
- For externally mounted fuse do not use other fuses aside from our specified and recommended fuse.
- 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).
- When used in environments with strong electromagnetic field, there is possibility of product damage due to malfunction.
- When used in environment with corrosive gas (hydrogen sulfide, sulfur dioxide, etc.) , there is possibility that they might penetrate the product and lead to failure.
- When used in environments where there is conductive foreign matter or dust, there is possibility of product failure or malfunction.
- Provide countermeasure for prevention of lightning surge voltage as there is risk of damage due to abnormal voltage.
- Connect together the frame ground terminal of the product and the ground terminal of the equipment for safety and noise reduction. If these ground is not connected together, there is risk of electric shock.
- Parts with lifetime specifications (built-in fan electrolytic capacitor) are required to be replaced periodically.
  Set the overhaul period depending on the environment of usage and perform maintenance.
  Also, note that there are cases when EOL products cannot be overhauled.
- Take care not to apply external abnormal voltage to the output. Especially, applying reverse voltage or overvoltage more than the rated voltage to the output might cause failure, electric shock or fire.
- This product is designed under condition Material group IIIb, Pollution Degree (PD): PD2, Over Voltage category (OVC): OVC II and Class of equipment: Class I.
  This product is designed to be accessible only to service technicians as part of indoor use device.
- Power supplies with an output voltage of 48Vdc or less must be earthed in the end use equipment to maintain SELV.
  If the outputs are not earthed, they must be considered hazardous and must not be made user accessible.
- Power supplies with an output voltage of 60Vdc are considered to be non-SELV. As a result of this, the output must be guarded or a deflector fitted during installation to avoid a SERVICE ENGINEER making inadvertent contact with the output terminals, or dropping a tool onto them. The output of this product must not be connected to a SELV circuit.
- The output voltage of this power supply unit is considered to be a hazardous energy level (The voltage is 2V or more and the electric power is 240VA or more), prevention from direct contact with voltage output is highly necessary. While installing or servicing this power supply unit, avoid dropping tools by mistake or direct contact with voltage output. This might cause an electrical shock. While repairing this power supply unit, the AC input power must be switch off and the I/O terminal voltage should be less than the safety level.
- This product has a built-in fan for air-cooling. Do not block the air intake and exhaust as this might lead to fire.

NOTE

- Take note that traces of sheet metal processing be left in our power supplies.
- When disposing product, follow disposal laws of each municipality.
- Published EMI (CE, RE) or immunity is the result when measured in 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.
- Catalogue, 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.

LONG-TERM STORAGE METHOD AND PERIOD

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

  Temperature range : 5°C～30°C

  Humidity range : 40%～60%RH

  Please keep away from the places where temperature and humidity can change drastically.

  It can cause condensation on the product or deterioration.
- For long-term storage period, we recommend to use within 2 years after receiving the product.

  There is tendency that the leakage current of an aluminum electrolytic capacitor may increase when stored without using for a long time.

  This phenomenon can be improved by applying voltage to the aluminum electrolytic capacitor to reduce the increased leakage current through the self-recovery effect of the electrolyte.

  For reference, before using products that have been stored for a very long time, please warm-up first for 30 minutes or more without taking load.

  < Criterion of warm up voltage condition >

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

  (2)Electrical continuity condition

  Input voltage : Rating

  Load : 0A

  Ambient temperature : Normal temperature

  Time : 30 minutes or more

1. Model name identification method

HWS1500-24 ／□

(*1) /"No assigned" : Standard type
/HD : High resistance against dust environment type.
(Refer to the specifications for details.)

Option(*1)

Rated Output Voltage

Output Power type

Series name

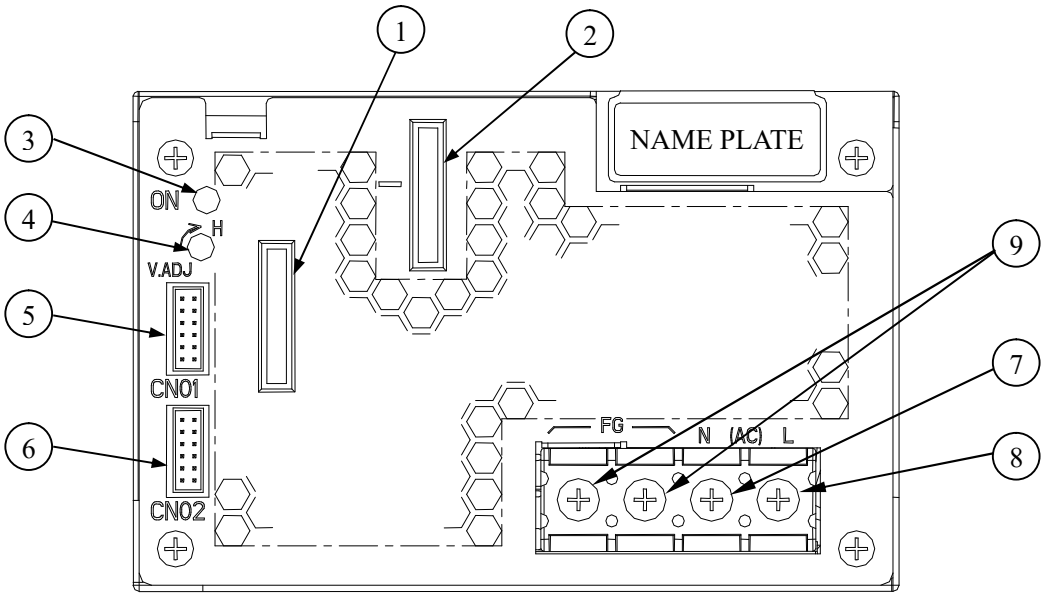
2. Terminal Explanation

Please pay extra attention to the wiring. Incorrect connection will damage the power supply.

- When connecting input and output wiring, input AC-Line should be off.
- Input wiring and output wiring shall be separated, otherwise noise susceptibility of power supply unit will be weak.
- The protective earth (PE) must be connected to the instrument chassis and the chassis of this power supply unit.
- Remote sensing lines shall be twisted or use the shielded wire.
- Remote ON/OFF control lines shall be twisted or use the shielded wire.

2-1. Front Panel Explanation

HWS1500 Front Panel



① ＋ : ＋ Output terminal
② － : － Output terminal
③ ON : Output (Power On) indication green LED
(The indicator turns on when the power supply output is in normal operating condition.)
④ V.ADJ :Output voltage adjust trimmer (The output voltage rises when trimmer is turned clockwise.)
⑤ CN01: } Remote sensing, ON/OFF control signal, Current balance signal,
⑥ CN02: } Output voltage external control signal and Power fail signal output connector.
⑦ N : AC input terminal N : Neutral line
⑧ L : AC input terminal L : Live Line (Fuse in line)
⑨ FG : Function Ground terminal (Frame ground)

2-2. CN01, CN02 Connector pin configuration and Function

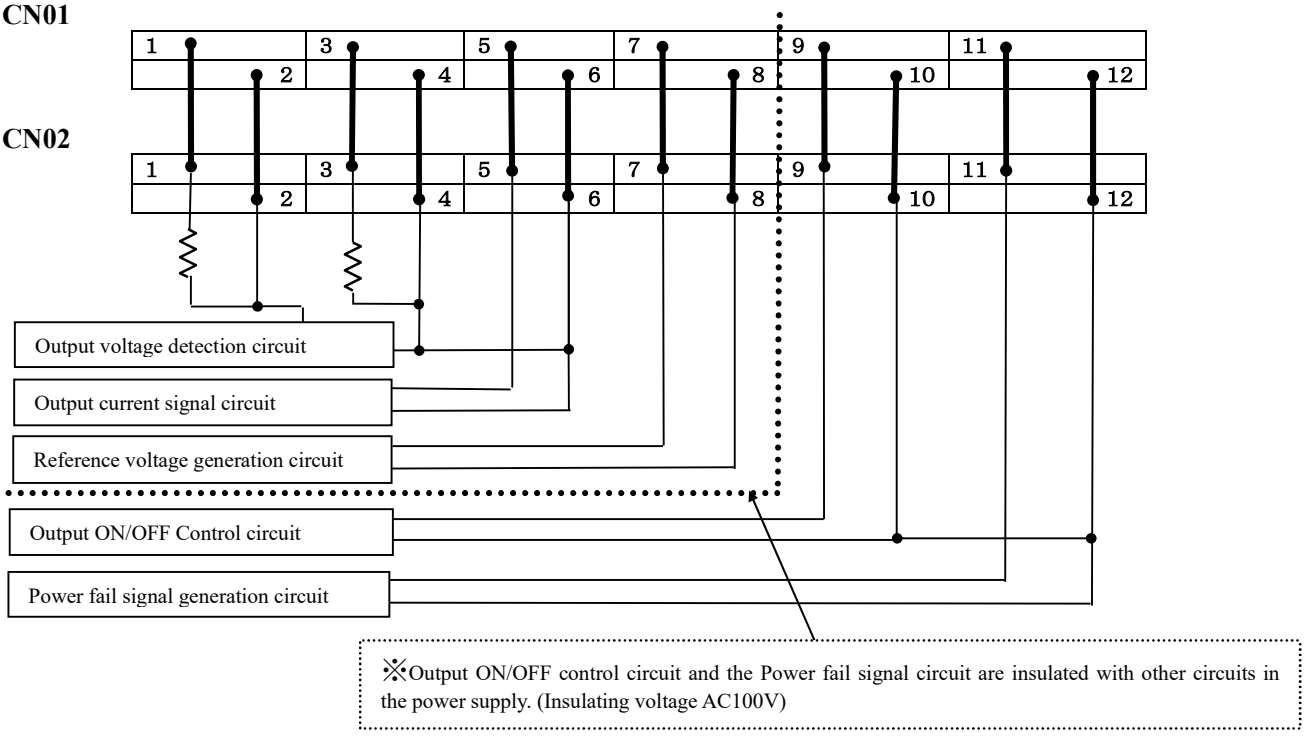
CN01, CN02 pin configuration and function are the same.
They are connected to each other in this power supply unit.
When the pin of CN01 side is shorted the same function pins of CN02 side are shorted.
Please note that the function cannot be separately set with CN01 and CN02.

	Pin No.	Configuration	Function
2 4 6 8 10 12 / 1 3 5 7 9 11 CN01	1	＋V	Connected to ＋Output terminal in this Power supply unit. (+V terminal can not supply load current.)
	2	＋S	Remote sensing terminal for + output (For remote sensing function, which compensates for line drop between power supply terminals and load terminals. Connect to +V terminal when remote sensing function is unnecessary)
	3	－V	Connected to －Output terminal in this Power supply unit. (-V terminal can not supply load current)
	4	－S	Remote sensing terminal for - output (For remote sensing function, which compensates for line drop between power supply terminals and load terminals. Connect to -V terminal when remote sensing function is unnecessary)
	5	PC	Current balance terminal (For output current balancing in parallel operation.)
2 4 6 8 10 12 / 1 3 5 7 9 11 CN02	6	COM	Ground for PC and PV signal.
	7	PV	Output voltage external control terminal (For power supply output voltage control with an external voltage. Connect it with the terminal REF when PV function is unnecessary.)
	8	REF	Reference Voltage terminal for Output voltage control (REF and PV are connected when shipping.)
	9	CNT	Remote ON/OFF control terminal (When the CNT is pulled to TTL low, the power supply turns on.)
	10	TOG	Ground for CNT and PF signal.
	11	PF	Power fail signal output terminal. (As the output voltage drops, FAN stops and AC input voltage down, open collector output, “Power Fail” signal will output “High”.)
	12	TOG	Ground for CNT and PF signal.

CN01、CN02 are connected in this power supply unit as follows.

CN01

CN02



※Output ON/OFF control circuit and the Power fail signal circuit are insulated with other circuits in the power supply. (Insulating voltage AC100V)

2-3. Basic Connection (Local sensing)

・3-7V model

①Connect “+S” terminal to “+” terminal of output and “-S” terminal to “-” terminal of output with sensing wires.

②Connect “CNT” terminal to “TOG” terminal with wire.

③Connect “PV” terminal to “REF” terminal with wire.

※ Please use attachment connector for each connection.

※ In the following cases, the output is shut down.
When CNT and TOG is opened.
When PV and REF is opened.

・12-60V model

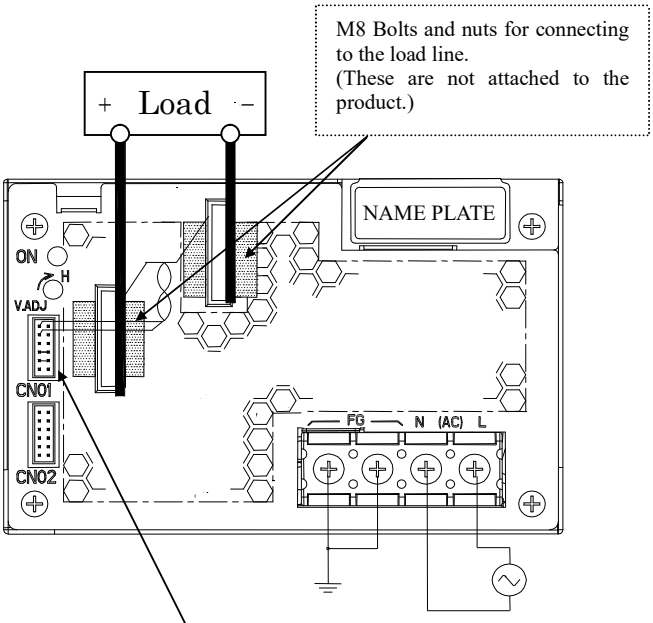
①Connect “+S” terminal to “+V” terminal and “-S” terminal to “-V” terminal with sensing wires.

②Connect “CNT” terminal to “TOG” terminal with wire.

③Connect “PV” terminal to “REF” terminal with wire.

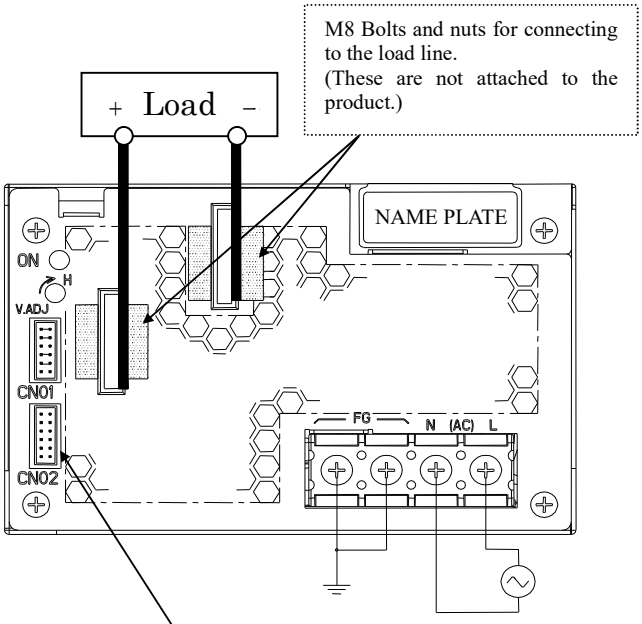
※ Please use attachment connector for each connection.

※ In the following cases, the output is shut down.
When CNT and TOG is opened.
When PV and REF is opened.



Connector : (JST) S12B-PHDSS

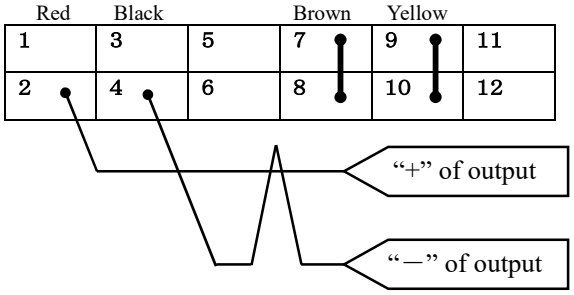
Attached connector when shipping
・Housing : (JST) PHDR-12VS
・Contact : (JST) SPHD-001T-P0.5
2－”+” of output, 4－”-” of output are connected.
7－8, 9－10 are shorted



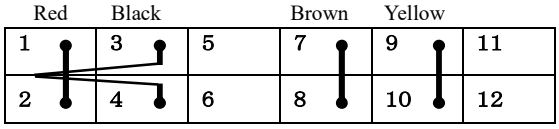
Connector : (JST) S12B-PHDSS

Attached connector when shipping
・Housing : (JST) PHDR-12VS
・Contact : (JST) SPHD-001T-P0.5
1－2, 3－4, 7－8, 9－10 are shorted.

Attached connector when shipping



Attached connector when shipping



Twist wire

2-4. Remote sensing required

①Connect "+S" terminal to "+" terminal of load with sensing wire

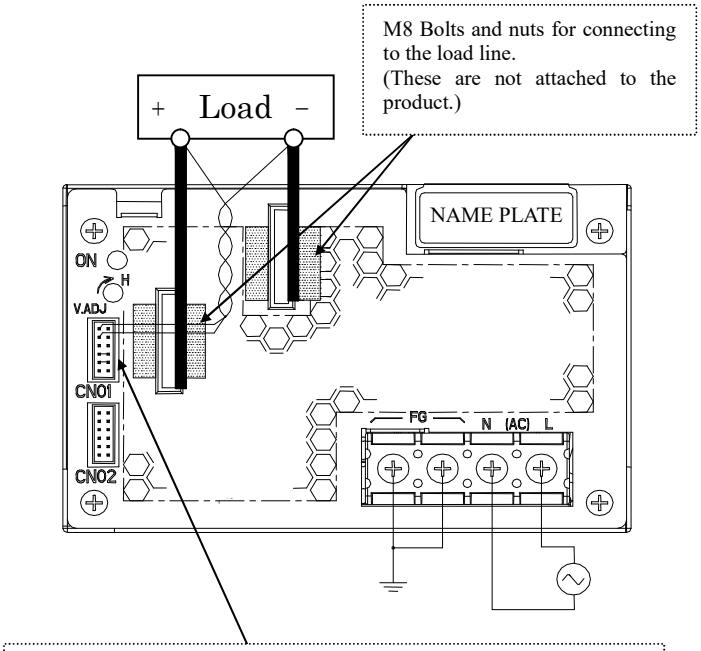
②Connect "-S" terminal to "-" terminal of load with sensing wires.

③Connect "CNT" terminal to "TOG" terminal with wire.

④Connect "PV" terminal to "REF" terminal with wire.

※ The accuracy of the output voltage will deteriorate when the sensing terminals are opened.

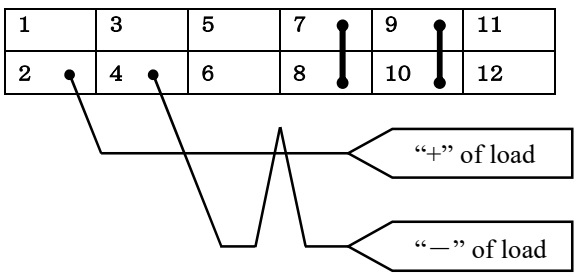
※ In the following cases, the output is shut down.
When CNT and TOG is opened.
When PV and REF is opened.



Connector : (JST) S12B-PHDSS

Remove standard attached connector, and use the harness made by the customer.
・Housing : (JST) PHDR-12VS
・Contact : (JST) SPHD-001T-P0.5
2－"+" of load, 4－"-" of load should be connected.
7－8, 9－10 : should be shorted
* Please use wire for contact and crimping tool specified by maker.

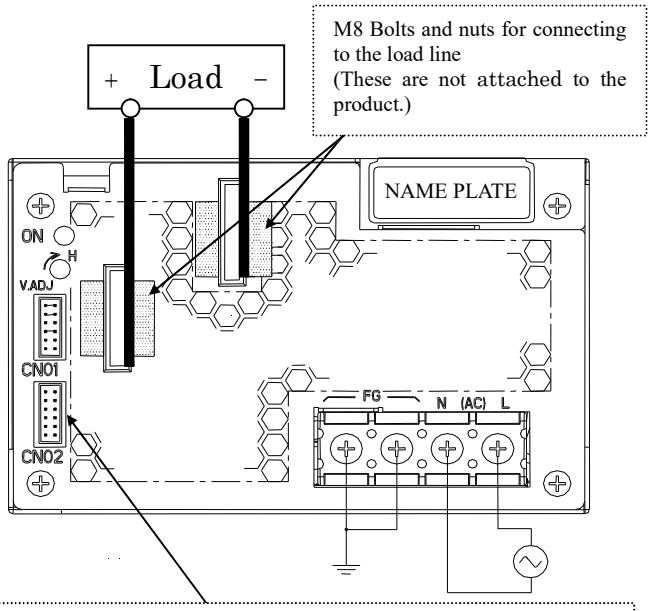
Connecting circuit with CN01 or CN02 connector



2-5. Remote ON/OFF control required

①Remove standard attached connector, and use the harness made by the customer and connect external signal to between CNT and TOG terminal.

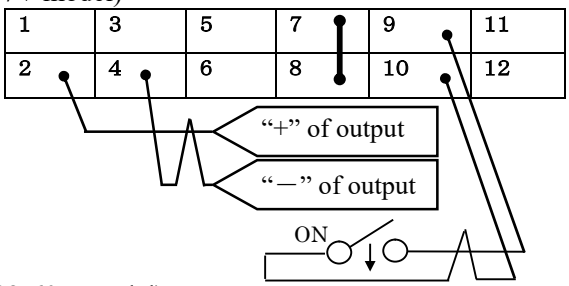
②"TOG" terminal is ground for "CNT" terminal.
In case this function is not used, please short between CNT and TOG terminal.



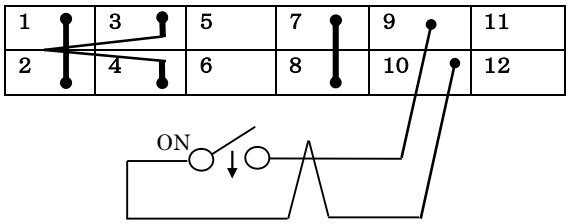
Connector : (JST) S12B-PHDSS

Remove standard attached connector, and use the harness made by the customer.
・Housing : (JST) PHDR-12VS
・Contact : (JST) SPHD-001T-P0.5
(3-7V model) 2－"+"of output, 4－"-"of output : should be connected
(12-60V model) 1－2, 3－4 : should be shorted
7－8 : should be shorted
9 : CNT
Should be connected to ON/OFF control signal.
10 : TOG
Should be connected to Signal Ground.
* Please use wire for contact and crimping tool specified by maker.

Connecting circuit with CN01 or CN02 connector
(3-7V model)



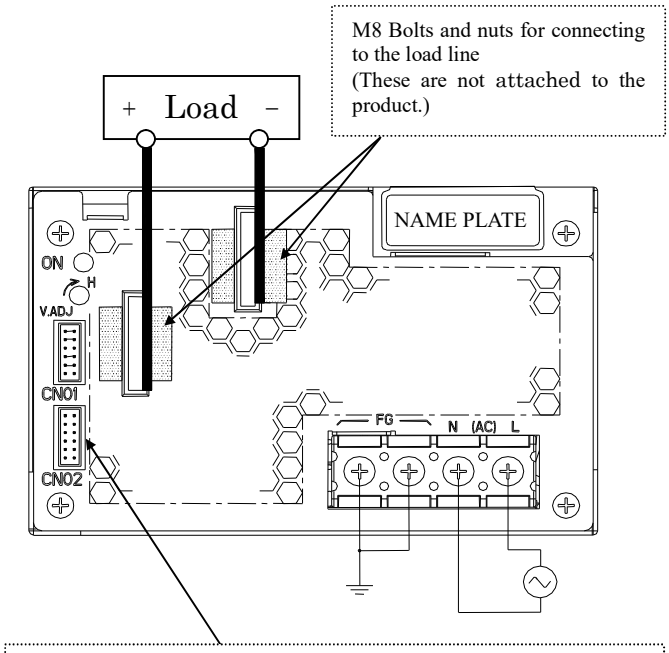
(12-60V model)



2-6. PF signal output required

①PF signal is an open collector output, therefore
PF signal outputs are shown in circuit below.

②"TOG" terminal is ground for "PF" terminal.



Connector : (JST) S12B-PHDSS

Remove standard attached connector, and use the harness made by the customer.

・Housing : (JST) PHDR-12VS

・Contact : (JST) SPHD-001T-P0.5

(3-7V model) 2－"+"of output, 4－"-"of output : should be connected

(12-60V model) 1－2, 3－4 : should be shorted

7－8, 9－10 : should be shorted.

11 : PF

Should be connected to PF signal output

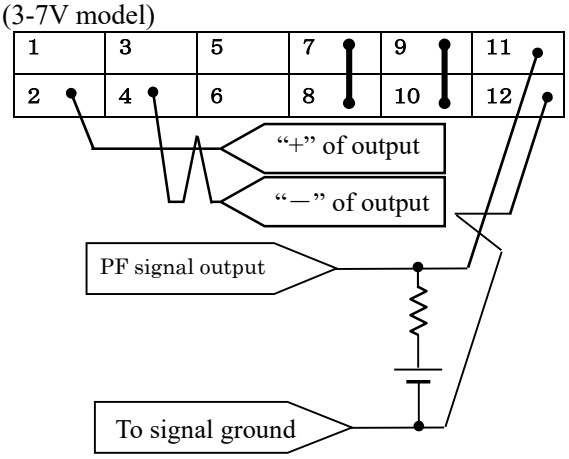
12 : TOG

Should be connected to Signal Ground.

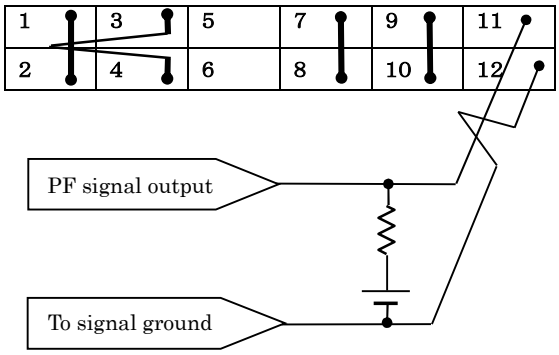
* Please use wire for contact and crimping tool specified by maker.

Connecting circuit with CN01 or CN02 connector

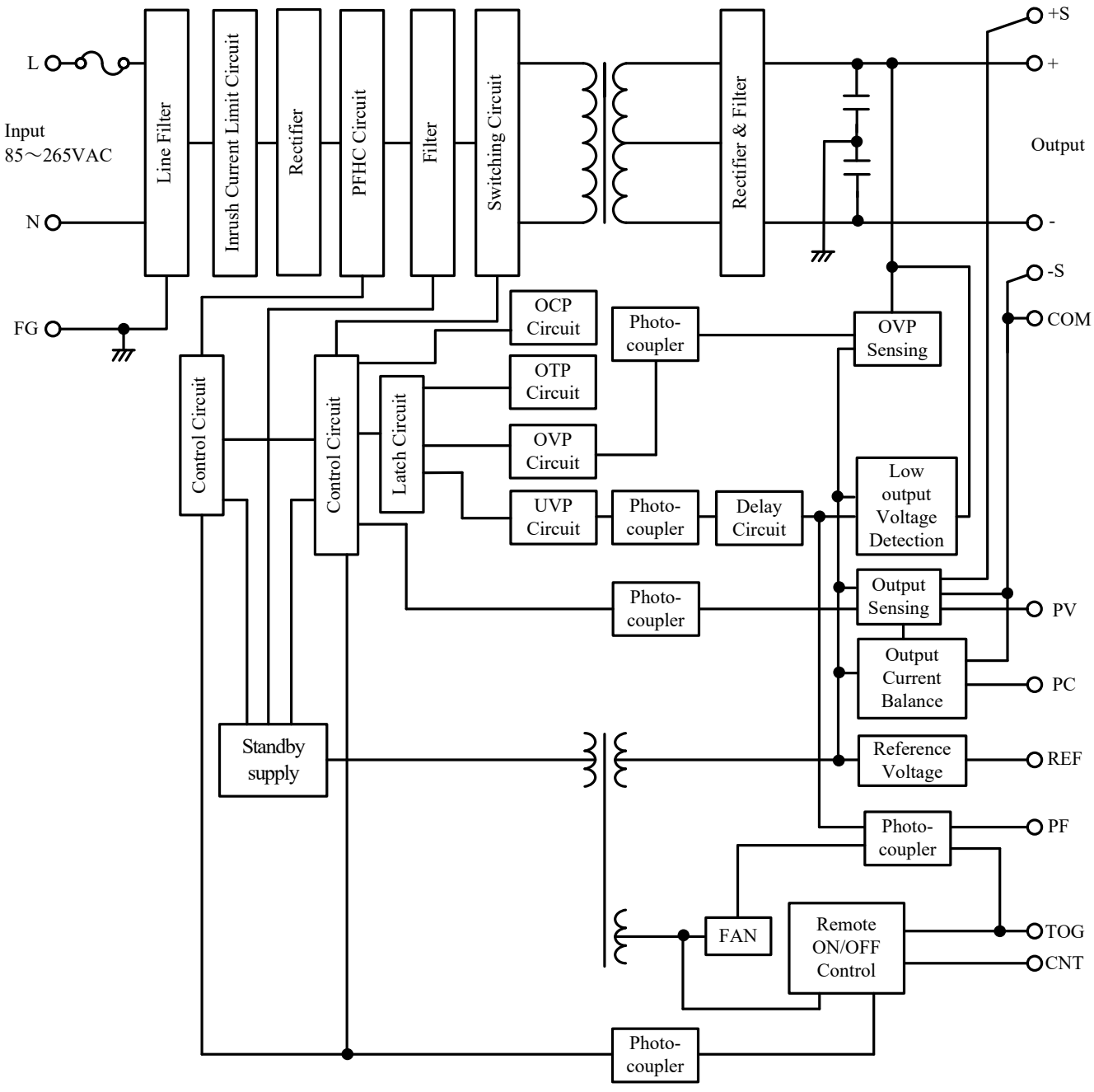
(3-7V model)



(12-60V model)



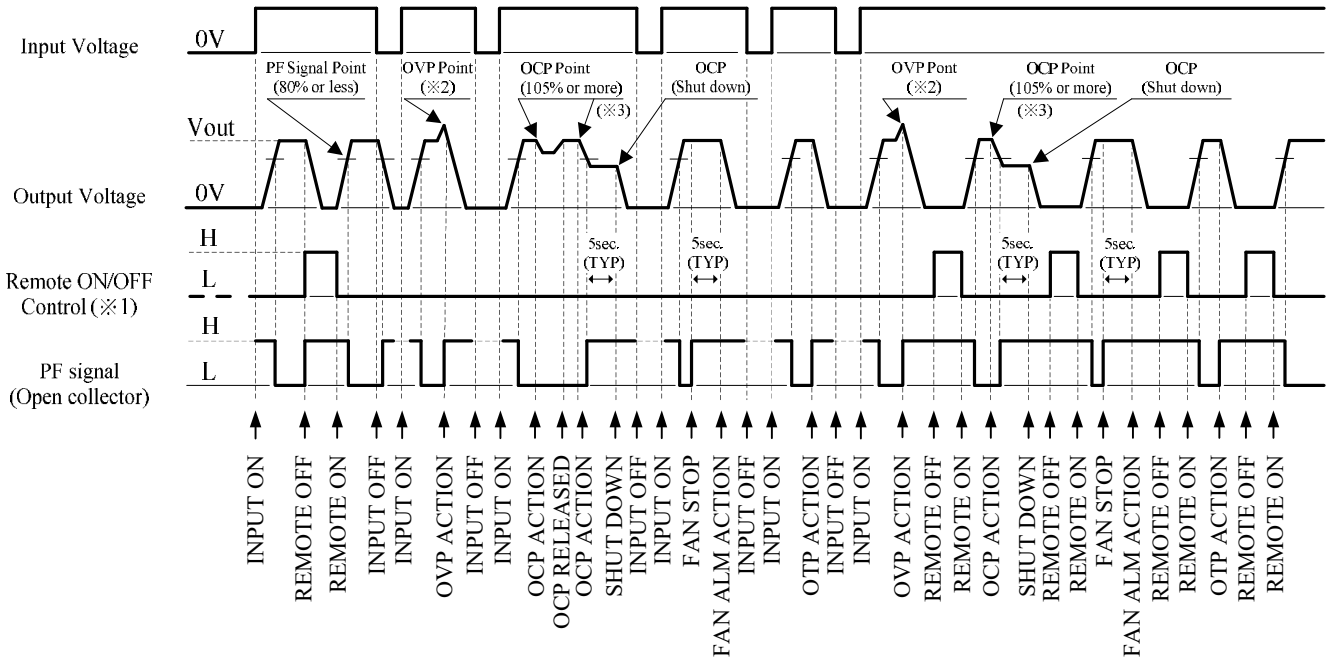
3. Block Diagram



SELV Circuit (60V: Hazardous Voltage Circuit)

- Circuit topology ・ Switching frequency
  Half Bridge converter　3-5V : 45kHz, 6-7V : 55kHz, 12-60V : 70kHz
  PFHC circuit : Active filter　65kHz
- Fuse rating : 30A
- FG : Function Ground

4. Sequence time chart



(※1) Level

2.4V≦H≦12V or Open

0V≦L≦0.8V or Short

(※2) OVP Point

3-7V	: 125%～140%
12V,15V,24V	: 125%～145%
36V	: 125%～138%
48V	: 115%～135%
60V	: 115%～125%

(※3) OCP Point (6V, 7V, 24V, 36V, 60V Model, Input voltage AC180 - 265V)

・Peak current : 120%(6V, 7V), 150%(24V, 36V, 60V)
Peak current is less than 10 seconds, and duty 35% max.

・Overload exceeding 105%(without output dropping situation) continuously for more than 10 seconds will result to output shutdown.
Meanwhile, overload exceeding 105%(with output dropping) continuously for more than 5 seconds will result to output shutdown.

・OCP Point : More than 120%(6V, 7V), More than 150%(12V, 36V, 60V)

5. Functions and Precautions

5-1. Input Voltage Range

Input voltage range is single phase 85 － 265VAC (47 － 63Hz). Input voltage, which is out of specification, may cause unit damage. Rated input voltage range fix during safety standard application is from100V to 240VAC (50/60Hz).

While applying input voltage from 85Vac to 90Vac, output load current derating is required.

5-2. Output Voltage Range

Output voltage is set to the rated value at shipping. V.ADJ trimmer on the front panel side is use to adjust the output voltage within the range specified. Output voltage trimming range is within -20% － +20% of the rated output voltage (48V, 60V model: -20% － +10%). Turn the trimmer clockwise to increase output voltage. Take note when the output voltage is increased excessively over voltage protection (OVP) function may trigger and output voltage will shut down.

Use the output power of the power supply below the rated output power value when you raise the output voltage.

5-3. Over Voltage Protection (OVP)

The OVP function (Inverter shut down method, manual reset type) is provided. OVP function operates within 125-145% of the rated DC output voltage value (3-7V model: 125-140%, 36V model: 125-138%, 48V model: 115-135%, 60V model: 115-125%), and the output will be shut down when OVP function triggers. When OVP function operates, the input power is cut off for a few minutes, and then power is re-input or remote ON/OFF control signal shall be input for recovery of the output. OVP value is fixed and can not be adjusted.

5-4. Over Current Protection (OCP)

The OCP function (Constant current limiting, Time delay shutdown type) is provided. OCP function operates when the output current exceeds 105% of maximum DC output current specification and the over current or short circuit condition continues 5-second or more, the output will be shut down. When the OCP is triggered, the input power is cut off for a few minutes, and then power is re-input or remote ON/OFF control signal should be input for recovery of the output. The OCP setting is fixed and not to be adjusted externally.

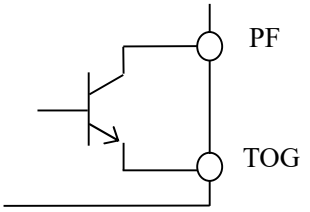
5-5. Over Temperature Protection (OTP)

Over temperature protection function (manual reset type) is provided. When ambient or internal temperature rises abnormally, OTP will shut down the output. When OTP is triggered, input power is cut off and allow sufficient cooling to reset the OTP function. Then power is re-input or remote ON/OFF control signal should be input for recovery of the output.

5-6. Low Output Detection Circuit (PF)

Low output voltage detection circuit is provided. Power Fail signal (PF signal) will output when output voltage decrease by either the drop or brown out of the input voltage or OCP, OVP and OTP function operation. PF signal will turn “High” level to indicate the abnormal status of the power supply when the output voltage decrease to 80% of the output voltage setting value. However, there is a possibility that PF signal may not output during parallel operation. The PF signal circuit is insulated from the power supply input and output circuit and it is an open collector. TOG terminal is ground for PF terminal.

When the Built-in Fan Motor of this power supply unit stops, PF signal will turn to “H” and the output power will shut down. The Built-in Fan Motor is a component with lifetime. We recommend a periodic replacement. Please contact our sales office. Replacement is at customer’s expenses.

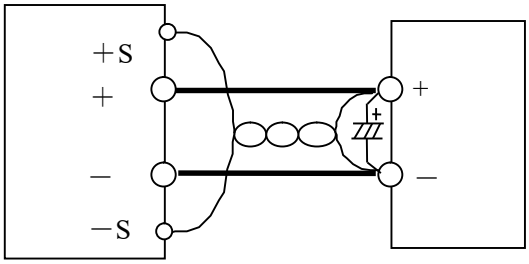


Vce max : 30V
Ic max : 20mA

5-7. Remote Sensing (+S, -S terminal)

Remote sensing function is provided to compensate for voltage drop across the wiring from the power supply output terminals to the load input terminals. Connect "+S" terminal to "+" terminal of the load and "-S" terminal to "-" terminal of the load with sensing wires. The total line voltage drop (+ side line and - side line) shall be less than 0.3V. In case that sensing line is too long, it is necessary to put an electrolytic capacitor across the load terminals.

Please take note that the electrolytic capacitor has generation of heat etc. done by the ripple current depending on connected load. Therefore, the electrolytic capacitor must have a ripple current allowance higher than the output ripple current. If CN01 (or CN02) is in use, terminal +S, -S for CN02 (or CN01) must be in open condition.

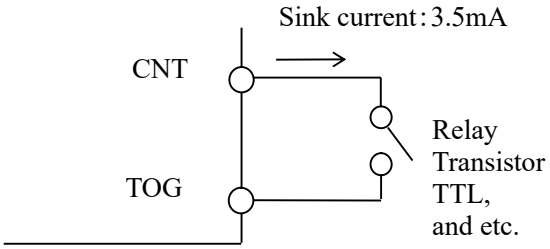


When the function of remote sensing is not in used, connect +S terminal to +V terminal, and –S terminal to –V terminal by the attachment connector.

If remote sensing terminals are opened, the stability and the accuracy of the output deteriorate. Therefore, terminal +S, -S must be connected.

5-8. Remote ON/OFF Control

Remote ON/OFF control is provided. Output can be remotely switch ON and OFF by using CNT terminal and TOG terminal even though input is connected. The output is turned to ON when TOG and CNT terminals are shorted and output is turned to OFF when these terminals are opened. When the function is not used, connect TOG and CNT terminals with short piece. The standards for this function are as follows. "TOG" terminal is ground for "CNT" terminal.



The Mode of control

CNT Level for TOG Terminal	Output	Built-in Fan Motor
Short or L（0－0.8V）	ON	Rotate
Open or H（2.4－12V）	OFF	Stop

(1) TTL compatible. The maximum input voltage to CNT terminal is 12V, and the maximum allowable reverse voltage is -1V. The sink current of CNT terminal is 3.5mA.

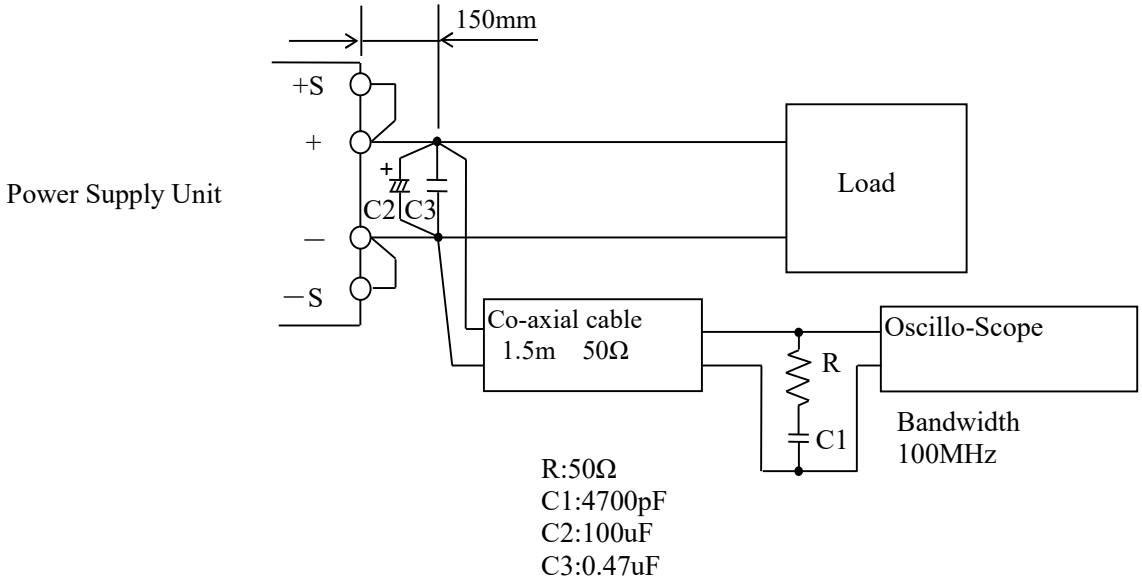
(2) Output ON/OFF control can be enable by a switch, relay or a transistor ON/OFF. When CNT terminal－TOG terminal is shorted power supply is turn ON, and when CNT terminal－TOG terminal is opened power supply is turn OFF.

(3) Remote ON/OFF control circuit is isolated from the input and output circuit of power supply. It is possible to use it regardless of the positive and negative of the power supply output.

Please be aware that if CNT terminal and TOG terminal is short and input voltage is gradually increase, this will trigger the low output voltage detector protection circuit and will result to output voltage shut down.
When the low output voltage detector protection circuit is triggered, the input power is cut off for a few minutes, and then power is re-input or remote ON/OFF control signal should be input for recovery of the output.

5-9. Output Ripple & Noise

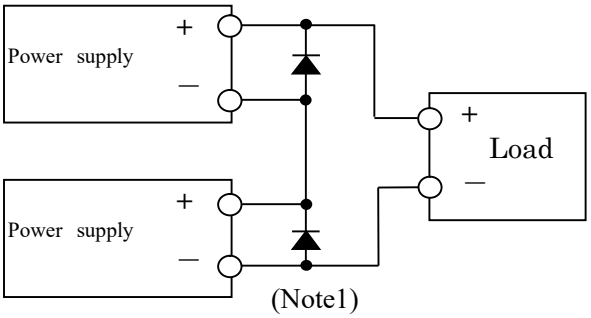
Maximum ripple & noise value in specifications is measured according to measurement circuit specified by JEITA-RC9131A. When Load lines are longer, ripple & noise becomes larger. In this case, electrolytic capacitor, film capacitor, etc. might be necessary to use across the load terminal. The output ripple & noise cannot be measured accurately if the probe ground lead of oscilloscope is too long.



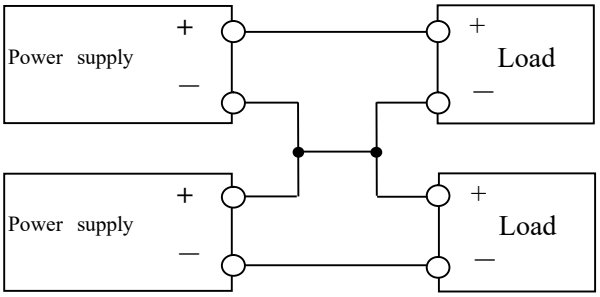
5-10. Series Operation

For series operation, either method (A) or (B) is possible.
There might be a step in the rise waveform during series operation.

Method (A)



Method (B)



(Note1) Please connect a diode for by-pass when using method (A) of the series operation.
Please use the diode with rated forward current is equal or more than load current and that the rated maximum reverse voltage is higher than output voltage for each power supply.

5-11. Parallel Operation

Current balancing function is provided. There are 3 operation modes possible which is (A), (B) and (C).

(A)To Increase the Output Current

Current balancing function activates by connecting PC-to-PC terminal and COM-to-COM terminal, and output current of each power supply is equivalently supplied to load. Wires to PC terminals shall be as short as possible, same length and twisted.

There is a possibility that output could be unstable caused by external noise. For this case, disconnect COM terminal and connect -S terminal from parallel power supply to a single point on the load. Please refer connection Method (A)-2.

1. Adjust the output voltage of each power supply to be same value within 1% or 100mV, whichever is smaller.
2. Use same length and type of wires for all load lines.
3. Maximum value of output current in parallel is up to 80% of all paralleled models. The purpose of the current balancing function is the static power-up. Therefore the output voltage might decrease according to the condition of dynamic load. There might be a step in the rise waveform during parallel operation.
4. Up to 5 units can be connected in parallel.

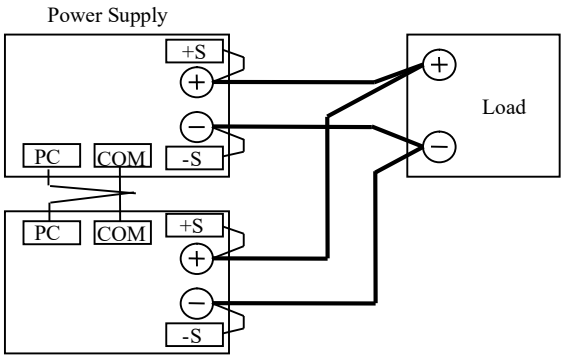
(B)To Use as a Backup Power Supply

1. Set power supply output voltage higher by the forward voltage drop of diode.
2. Adjust the output voltage of each power supply to be same value.
3. Use within the specifications for output voltage and output power.

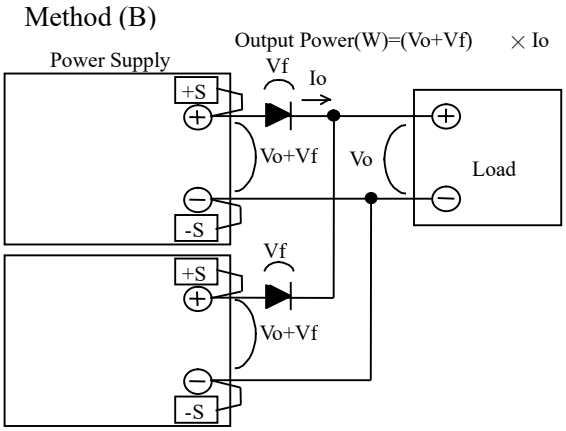
(C)In the case of parallel connections, it is possible to control the output voltage by adjusting the volume from only 1 unit. Choose 1 unit that would act as the master and this unit's volume will determine the output voltage. The volume on each slave units must be turned clockwise to maximum position. Then adjust the master volume to set the output voltage.

Connection for this application is shown in figure (c).

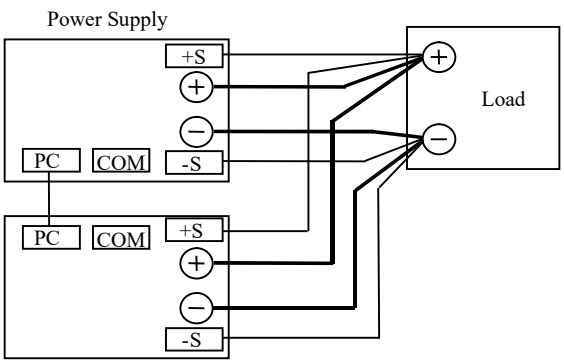
Method (A)-1



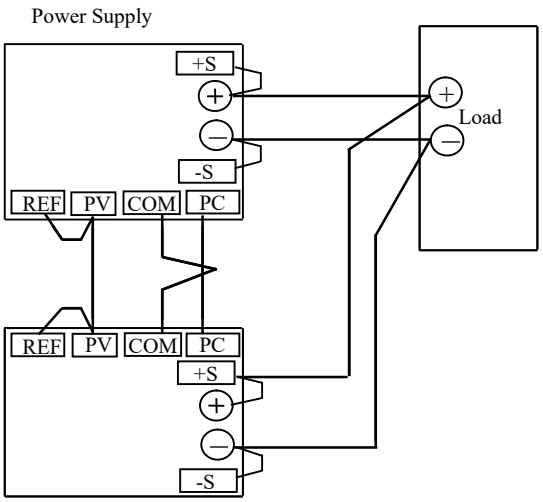
Method (B)



Method (A)-2

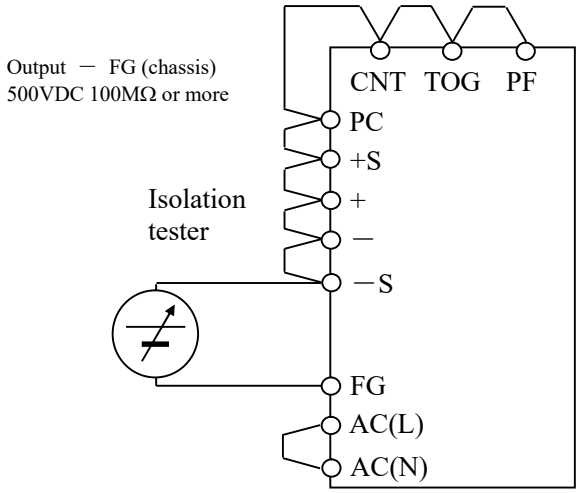


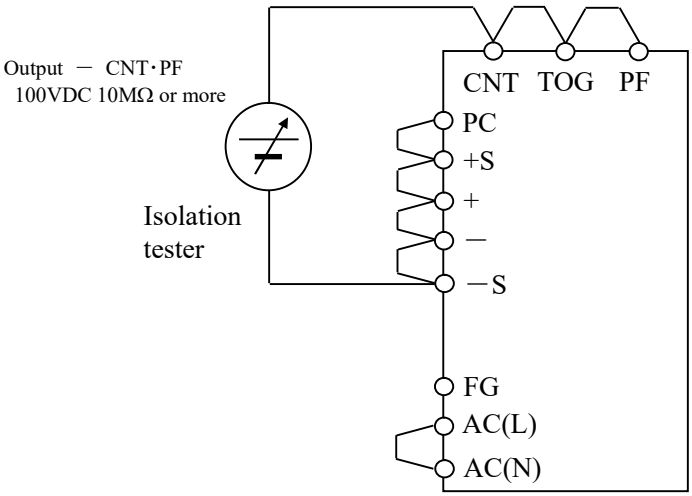
Method (C)



5-12. Isolation Test

Isolation resistance between output and FG (chassis) shall be more than 100MΩ at 500VDC and between output and CNT･PF shall be more than 10MΩ at 100VDC. For safety operation, voltage setting of DC isolation tester must be done before the test. Ensure that it is fully discharged after the test.



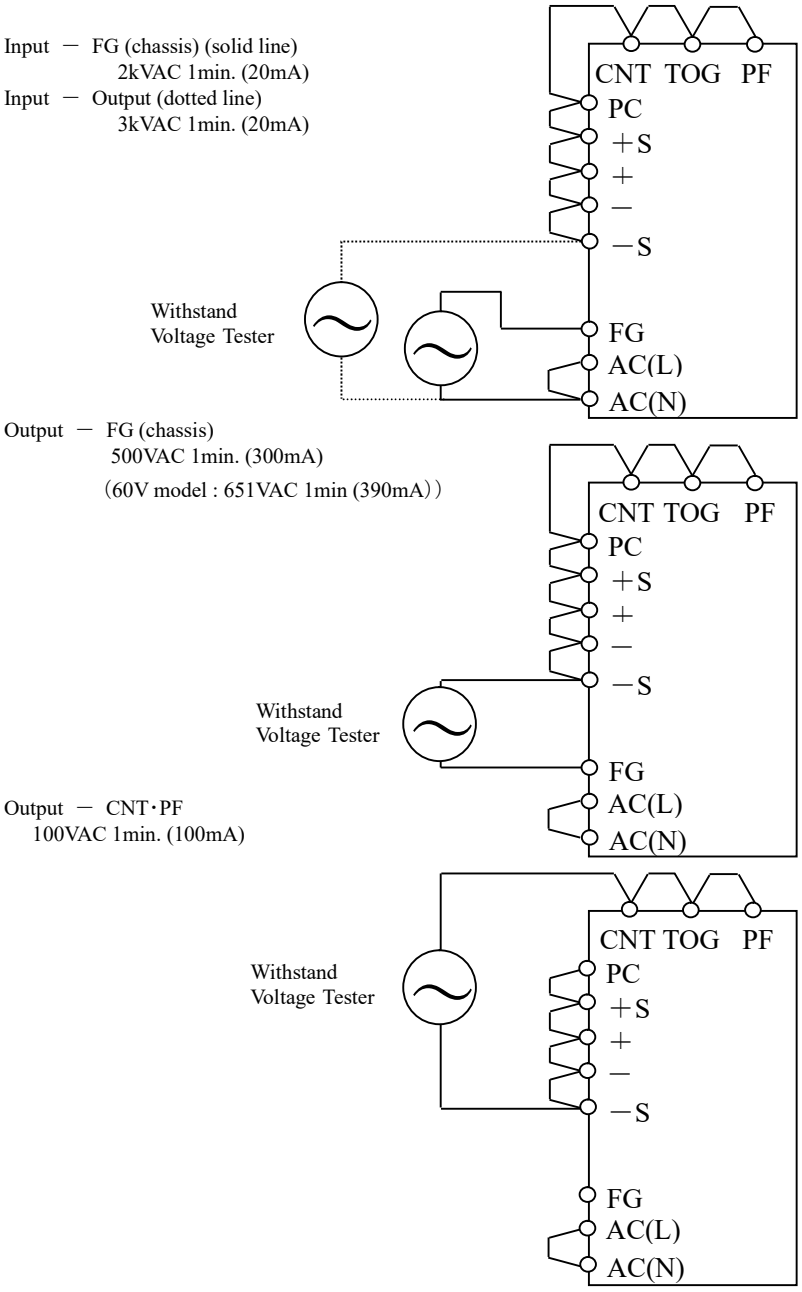


5-13. Withstand Voltage

This series is designed to withstand 3.0kVAC between input and output, 2.0kVAC between input and FG (chassis), 500VAC (60V model : 651VAC) between output and FG (chassis), and 100VAC between output and CNT･PF terminal each for 1 minute. When testing withstand voltage, set current limit of withstand voltage test equipment at 20mA.
(Output-FG (chassis) : 300mA (60V model : 390mA), Output- CNT･PF : 100mA).

The applied voltage must be gradually increased from zero to testing value and then gradually decreased for shut down. When timer is used, the power supply may be damaged by high impulse voltage at timer switch on and off. Connect input and output as follows. If output is left open during test, output voltage might appear momentarily.

This product have monolithic ceramic capacitor in secondary circuit to frame ground.
Some of the withstand voltage tester may generate high voltage at the matching with monolithic ceramic capacitor and may cause the unit damage.
So, please check the waveform of test voltage.

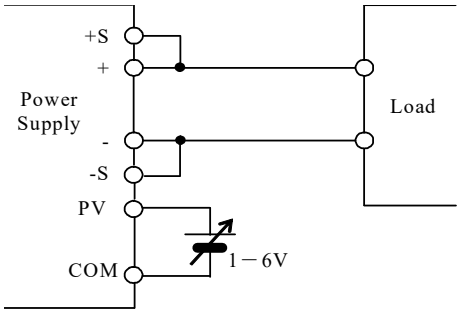


5-14. Output Voltage External Control (PV)

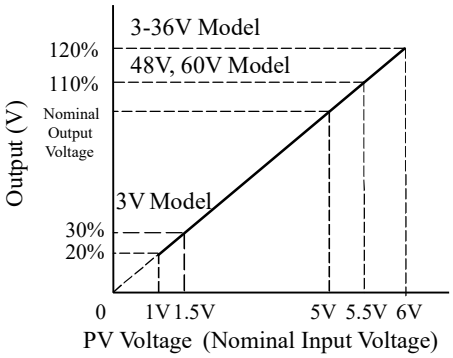
(A) Control by External Voltage

Output voltage external control function is provided. Output voltage can be varied by applying an external voltage (1 － 6V) to "PV" terminal and "COM" terminal. Note if an external voltage is not applied, there will be no output. Please consider the following characteristics below when operating the unit.

Connection Method



Output Voltage Linearity

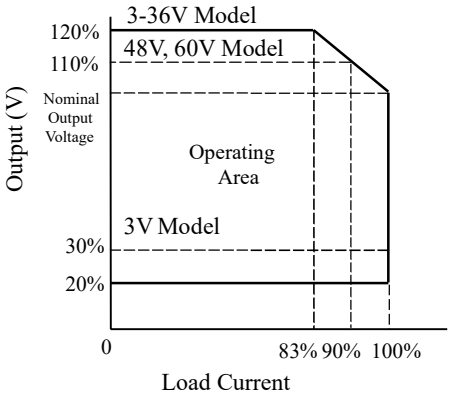


Note: Only as for the model of 3V output, the output voltage is used from 30% to 120% at the PV voltage is from 1.5V to 6.0V

Note: Only as for the model of 5-36V output, the output voltage is used from 20% to 120% at the PV voltage is from 1V to 6.0 V

Note: Only as for the model of 48V, 60V output, the output voltage is used from 20% to 110% at the PV voltage is from 1V to 5.5V

Output Voltage Derating

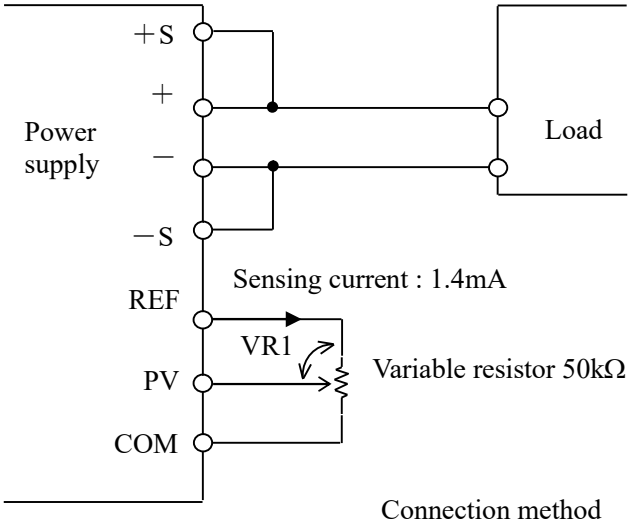


Note: Only as for the model of 48V, 60V output, the maximum output voltage is used up to 110% at 90% load current.

(B) Control by External Variable Resistor

"PV" terminal and "COM" terminal usage is the same as explained in section 「control by external voltage」. But in this method voltage for control is supplied through REF terminal. Variable resistor is connected between REF terminal and COM terminal and the middle point of variable resistor is connected to PV terminal. Please use the output voltage within 20% - 120% of rated output voltage value (3V model : 30% - 120%, 48V, 60V model : 20% - 110%). Wires for control lines must be twisted wire or shield wire. In addition, maximum variable voltage when control by external variable resistor is rated output voltage (100%). When output voltage must be externally control to 120% of rated output voltage (110% for 48V, 60V model), please follow the following procedure.

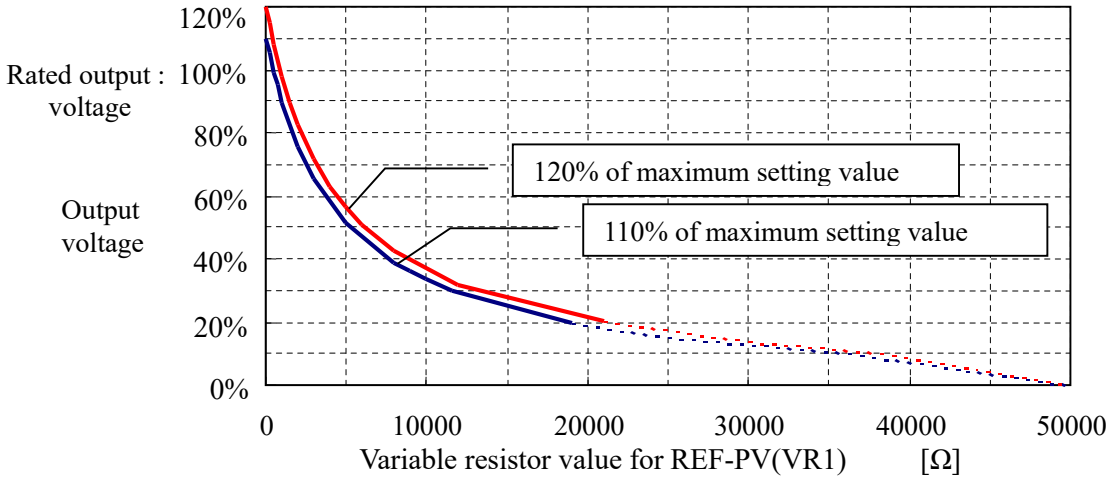
(1) PV terminal and REF terminal is short by using standard connector supplied.
(2) Set the power supply output voltage to maximum value of the output voltage variable range mentioned in specification standard by adjusting V.ADJ volume at the front panel.
(3) Remove standard connector after input is cut off.
(4) Connect external variable resistor (50kΩ) between REF terminal and COM terminal. Then connect middle point of external variable resistor to PV terminal.(sensing current is 1.4mA)



Connection method

When output voltage is over rated value, please make sure that maximum output power is below rated value. Moreover, when output voltage is below rated value, please make sure that maximum output current is below rated value.

Please consider the following characteristic during usage.



* Adjustable output voltage within 20%(3Vmodel : 30%) of output (less than 1V of PV voltage) is proportional to PV voltage and has a linear characteristic. However, for output voltage within 10% of output (about less than 0.5V of PV voltage), output will go into intermittent mode and ripple voltage becomes large, also irregular sound is release from the power supply. However, it is not damage. There will also be cases of the power supply shutting down triggered by under voltage lock out protection function. With output shutting

down, low output detection function (PF) triggers the PF signal and set it to "H", and also output LED is switch off. Under voltage lock out protection mode, switch off input for a few minutes and then switch on input again for recovery. Recovery from under voltage lock out is also possible by turning remote ON/OFF control signal OFF and ON. Under voltage detection value uses an automatic tracking mode, which follows the output voltage and constantly correspond to the 70%-80% of output voltage with a protection function mode. Base on the explanation above, we will kindly exclude the usage of adjustable output voltage within 20% of the output voltage from the product warranty. For application that requires variable output voltage within 20% of output voltage, please kindly consider the above contents prior to operation. For application that requires output voltage below 20%, due to different type of application for the user's system, there might be a situation (behavior) different from the one mentioned above. Therefore please check with the user system.

5-15. Output peak Current

For model with output peak current, please meet the following condition.

Reduce peak current value according to output derating as section 6-1.

The output is shut down by protection circuit when rated current and continuous peak output time (τ) exceeds rated value during usage.

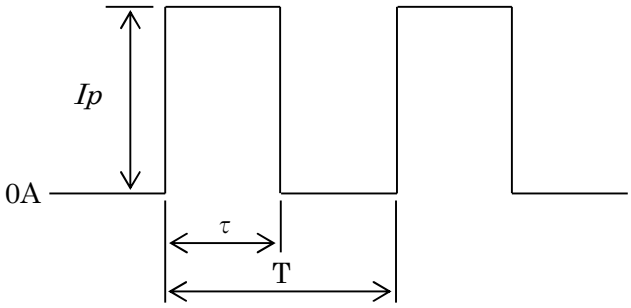
When protection circuit is activated, input is temporarily cut off for a few minutes and then power is re-input or remote ON/OFF control signal should be input for recovery of the output.

Input voltage range	: AC180V - 265V
Continuous Peak output time(τ)	: Within 10 seconds
Peak output current(*Ip*)	: Within the rated peak output current

Duty : up to 35%

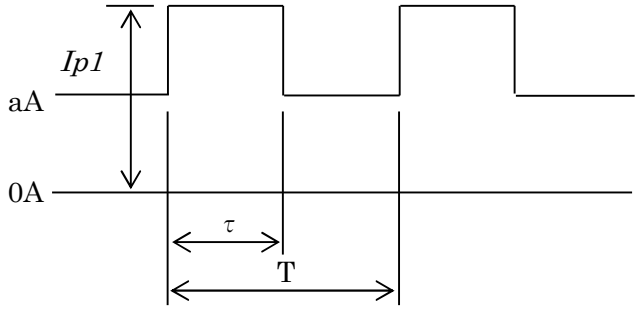
$$\text{Duty} = \frac{\tau}{T} \times 100(\%)$$

Condition 1



$$\sqrt{Ip^2 \times \frac{\tau}{T}} \leq \text{Irms max}$$

Condition 2



$$\sqrt{Ip1^2 \times \frac{\tau}{T} + a^2 \times \left(1 - \frac{\tau}{T}\right)} \leq \text{Irms max}$$

Model	Irms max
HWS1500-6	177.5A
HWS1500-7	142.0A
HWS1500-24	62.1A
HWS1500-36	41.4A
HWS1500-60	24.8A

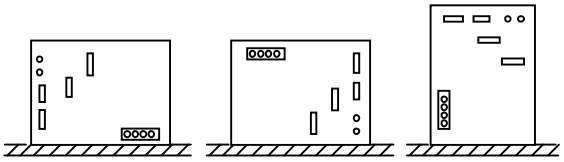
Ip,Ip1	: Peak output current (A)
Irms	: Effective current (A)
τ	: Peak current pulse width (sec)
T	: cycle (sec)

6.Mounting Directions

6-1. Output Derating

Mounting directions are as follows.
Standard mounting method is (A). Methods (B), (C) and (D) are also possible.
Mounting methods besides (A),(B),(C) and (D) (example : (E) and (F)) are inhibit.

(A) Standard Mounting (B) (C)

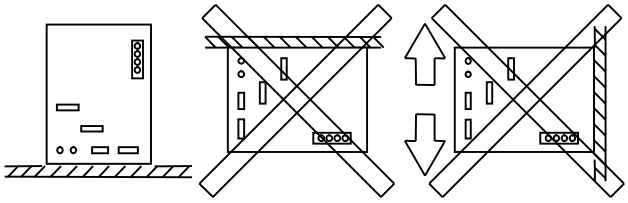


HWS1500 Output Derating (Include option model /HD)

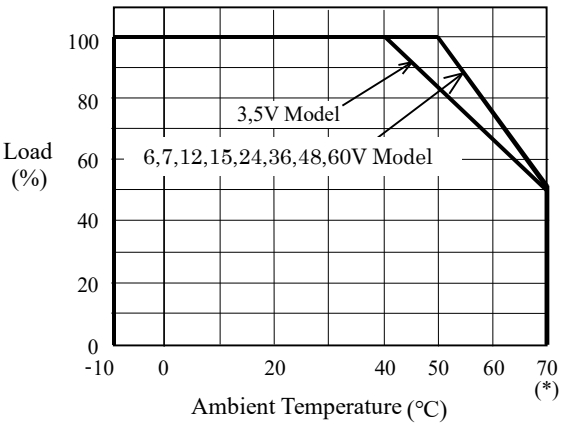
3,5V Ta(°C)	6-60V Ta(°C)	LOAD(%)			
		A	B	C	D
-10 — +40	-10 — +50	100	100	100	100
70(*)	70(*)	50	50	50	50

(*)/HD:71°C

(D) (E)Inhibit (F)Inhibit



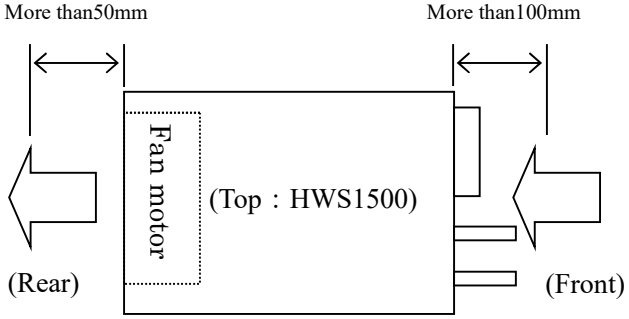
Mounting A,B,C,D



(*)/HD:71°C

6-2. Mounting Method Caution

(1) This Power supply unit is a forced air-cooling system with a built-in fan.
(2) This power supply has ventilating holes on the front and back panels.
Keep these areas freely more than 100mm from front side and more than 50mm from rear side.
(3) Please note that ventilation will be worsened in a dusty environment.
(4) Built-in fan is limited life part, which require periodic replacement. (Replacement will be charge).
(5) The ambient temperature of this power supply is less than 50mm from the center of a front side.
(6) The maximum allowable penetration of mounting screw is 6mm.
Incomplete thread of mounting screw should not be penetrated.
(7) Recommended torque for mounting screw (M4) is 1.27 N・m.

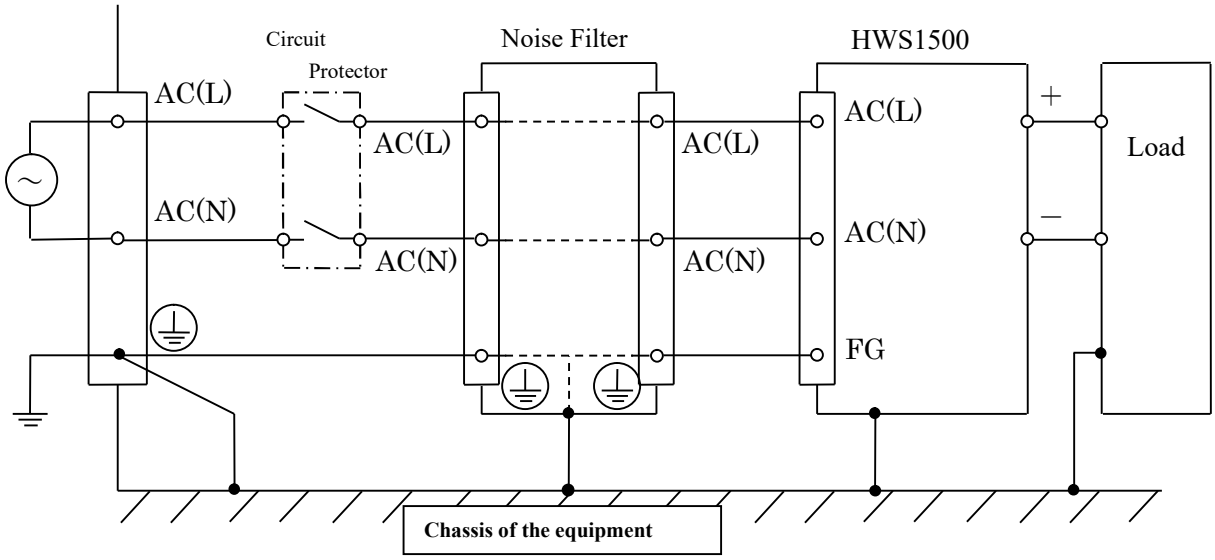


7. Wiring Method

(1) The output load line and input line shall be separated and twisted to improve noise sensitivity.
(2) The sensing lines shall be twisted or shield wire and separated from the output lines.
(3) Use all lines as thick and short as possible to make lower impedance. Wires are to be twisted or use shield wire to improve noise sensitivity.
(4) Attaching a capacitor to the load terminals can eliminate noise.
(5) FG terminal of this power supply is functional earthing. For safety purposes, connect protective earthing terminal to the mounting set ground terminal.
(6) Recommended torque for the terminal piece:

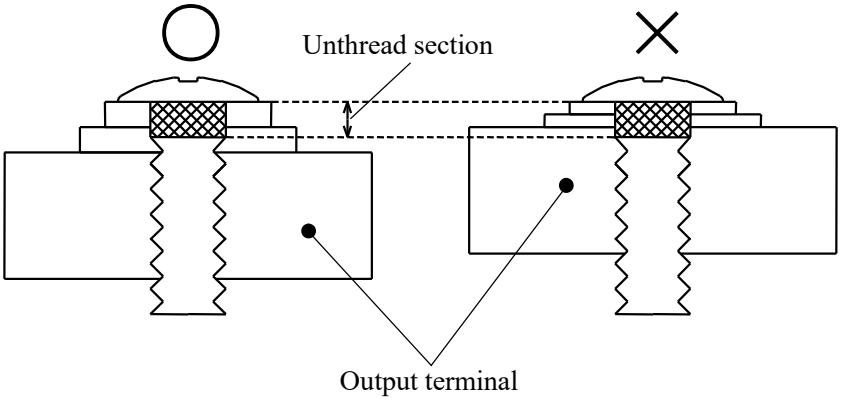
Input terminal (M4 screw) : 1.27 N・m Output terminal (M8 Bolt & Nut) : 10.8N・m

(7) Recommended wiring

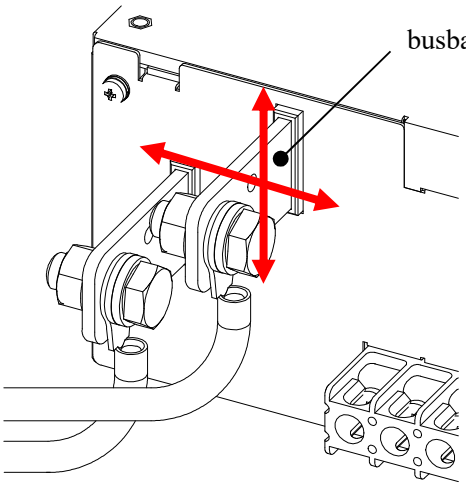


Recommended circuit protector : AC250V30A
Recommended noise filter : RSEN-2030 (TDK-LAMBDA)

(8) M4 screw for output terminal might damage the terminal's inner thread. This is mainly cause by the M4 screw's unthread section. Therefore, please select a washer, spring washer, etc. to avoid unthread screw section from penetrating into output terminal inner section.



(9) Not to apply overstress to the busbar of the output terminal, as the output terminal part may be damaged.



Not to apply overstress
(in the direction of the arrow) to the busbar.

Example) Stabilize (supporting) the input/output terminals before tightening the screws.
Don't pull the wires tight when wiring.
Don't bend the wires sharply from the connection with the busbar when installing power supply.

8. The life expectancy

The life of the power supply depends on the life of the built-in aluminum electrolytic capacitor being used and mounted fan. Each life is described in reliability data.
The life of the aluminum electrolytic capacitor varies depending on the method of mounting the power supply, the load current, and the ambient temperature. Please refer to “Electrolytic Capacitor Lifetime”.
The life of the fan depends on the fan intake or exhaust temperature. Please refer to “Fan Life Expectancy.
Please do not use the product which passed over the life expectancy. There is a risk of unexpected output shutdown and specifications may not be satisfied.
Please contact us for maintenance or exchange the product which passed over the life expectancy.

9. External Fuse Rating

Refer to the following fuse rating when selecting the external fuses for input line. Surge current flows when line turns on. Use slow-blow fuse or time-lag fuse. Do not use fast-blow fuse. Fuse rating is specified by in-rush current value at line turn-on. Do not select the fuse according to input current (rms.) values under the actual load condition.

HWS1500：30A

10. Troubleshooting

Before concluding that the unit is at fault, make the following checks.
(1) Check if the rated input voltage is apply.
(2) Check if the wiring of input and output is correct.
(3) Check if the I/O terminal connection is properly tighten by a regulated tightening torque.
(4) Check if the wire material is not too thin.
(5) Check if the output voltage control (V.ADJ) is properly adjusted. OVP might be triggered and output is cut off.
(6) Check if the wiring of "+S" and "-S" terminal is correct. If in open condition, the stability and the accuracy of the output deteriorate.
(7) If use function of the remote ON/OFF control, check if the remote ON/OFF control connector is not opened. If in open condition, output is cut off.
(8) Check if the built-in fan is not stopped. Is fan stopped by something irregulars or dust, etc.
If fan stops, the PF signal is turn on.
Moreover, the output is intercepted with the protection circuit if fan stops.
Fans are the limited life parts.
(9) This power supply has ventilating holes on the front and back panels. Check if there is any irregulars or dust, etc.
(10) Is the main body of the power supply abnormally hot?
Please turn on the input again after allowing the unit to cool down sufficiently. The output shut down by over temperature protection function.
(11) Check if the output current and output power is not applied over specification.
(12) Check if the input voltage wave is sinusoidal. If this power supply unit is connected to a UPS, input voltage wave might not be sinusoidal. An audible noise is emitted from the power supply unit.
(13) Audible noise can be heard during Dynamic-Load operation.

11. Warranty Period

This product is warranted for a period of 5 years from the date of shipment.
For damages occurring at normal operation within this warranty period, repair is free of charge.

12. 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 Substances in Electrical & Electronic Equipment Regulations.