

## HWS 1000 Series Instruction Manual

### BEFORE USING THE POWER SUPPLY UNIT

Be sure to read the following precautions thoroughly before using this power supply unit.

Pay attention to all warnings and cautions before using the unit. Incorrect usage could lead to an electric shock, damage to the unit or a fire hazard.



#### WARNING

- Do not make unauthorized changes to power supply unit, otherwise you may have electric shock and void your warranty.
- Do not touch the internal components; they may have high voltage or high temperature. You may get electric shock or burned.
- When the unit is operating, keep your hands and face away from it; an accident may injure you.
- Do not use unit under unusual condition such as emission of smoke or abnormal smell and sound etc. It might cause fire and electric shock.  
In such case, please contact us; do not repair by yourself, as it is dangerous for the user.
- Do not drop or insert anything into unit. It might cause failure and fire, when using the unit under such condition.
- Do not operate these units at the condition of condensation. It may cause fire and electric shock.
- 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.

#### Note : CE MARKING

- CE Marking when applied to a product covered by this handbook indicates compliance with the low voltage directive (2006/95/EC) in that it complies with EN60950-1.



#### CAUTION

- This power supply is primarily designed and manufactured to use and enclose in other equipment.
- This power supply unit has a built-in fan for air-cooling. Do not block air intake and exhaust. It might cause fire.
- Input voltage, output current, output power, ambient temperature and ambient humidity should be used within specifications, otherwise the unit will be damaged.

- The unit might be broken down by accident or unexpected situation. For application equipment, which requires very high reliability (nuclear related equipment, traffic control equipment, medical equipment, etc.), please provide fail safety function in the equipment.
- Do not make an improper wiring to input and output terminals. It may cause damage.
- Do not use in environment such as strong electromagnetic field, erosive gas etc, or any environment where conductive foreign substance may enter.
- Do not operate and store this unit at the condition of condensation. In such case, waterproof treatment is necessary.
- Do not operate this unit after it falls down.
- 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.

#### CAUTION of IEC/EN/UL60601-1 for HWS1000/ME



#### CAUTION

- These products are designed for continuous operation within an overall enclosure, and must be mounted such that access to the mains terminals is restricted. See Clause 16, IEC/EN/UL60601-1.
- These products are NOT suitable for use in the presence of flammable anaesthetic mixtures with air or with oxygen or with nitrous oxide.
- Connect only apparatus complying with IEC/EN/UL60601-1 to the signal ports.
- Except for permanently installed equipment as defined in Clause 57.6 of IEC/EN/UL60601-1 the overall equipment in which these products are installed must have double pole fusing on the input mains supply. The products themselves have single pole fusing in the live line.
- These products provide basic insulation only between mains and output, with reference to IEC/EN/UL60601-1. Sure to add supplemental insulation to input or output in the equipment.
- Reference should be made to local regulations concerning the disposal of these products at the end of their useful life.
- The maximum normal leakage current of this product is 500 microamperes for IEC/EN/UL60601-1. When using it as a patient care equipment, all outer surfaces of the equipment shall be constructed of nonconductive material. See Clause 19.5DV.2 of UL60601-1.
- These products have not been assessed to IEC/EN60601-1-2 (EMC) but EMC test data is available from TDK-Lambda.

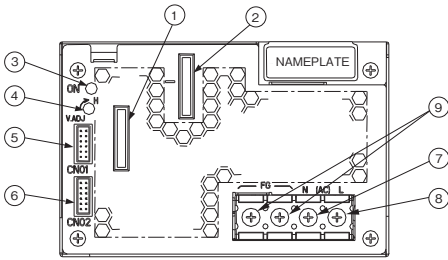
## 1. Terminal Explanation

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.

# 1 Front Panel Explanation



- 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 CN01, CN02 Connector pin configuration and function

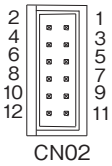
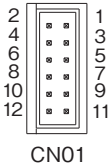
CN01, CN02 pin configuration and function are the same.

They are connected to each other in this power supply unit.

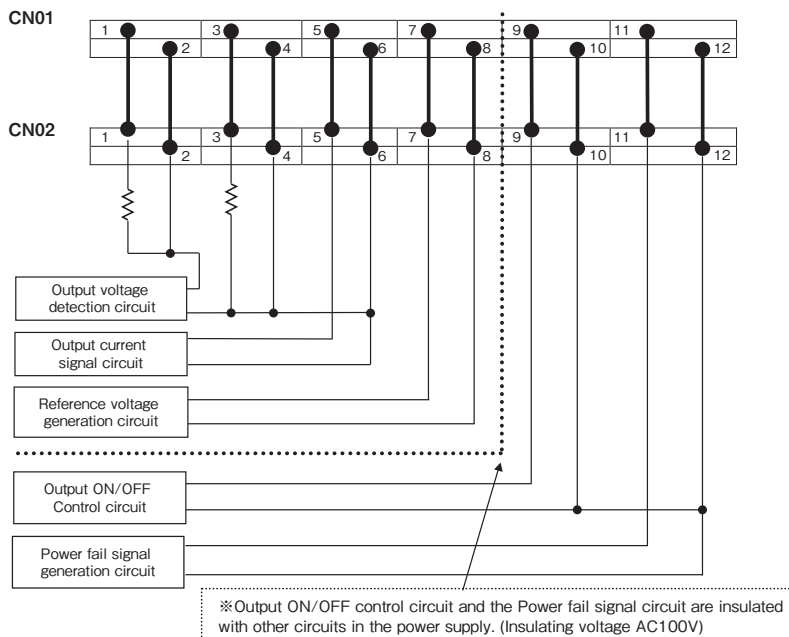
When the pin of CN01 side is shorted the same function pins of CN02 side are shorted.

Please note that the function cannot be separately set with CN01 and CN02.

Pin No.	Configuration	Function
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.)
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.



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

HWS

HWS HD

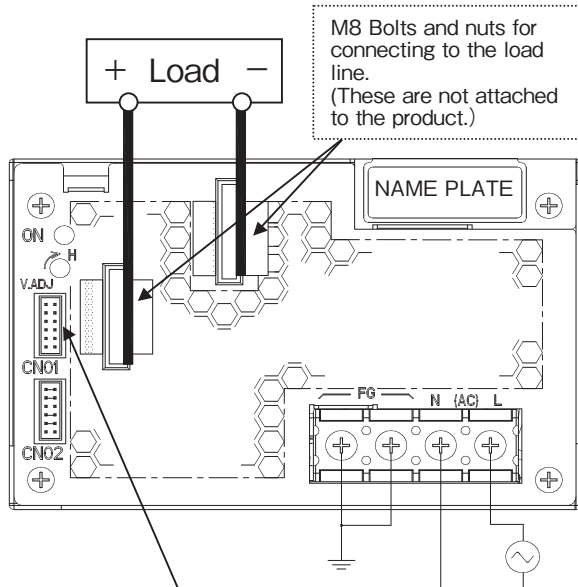
HWS ME

HWS-P

Instruction Manual

### 3 Basic Connection (Local sensing)

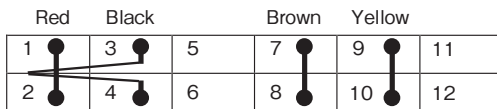
- ① Connect "+S" terminal to "+V" terminal and "-S" terminal to "-V" terminal with sensing wires.
  - ② Connect "CNT" terminal to "TOG" terminal with wire.
  - ③ Connect "PV" terminal to "REF" terminal with wire.
- ※ Please use attachment connector for each connection.
- ※ In the following cases, the 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  
 1-2, 3-4, 7-8, 9-10 are shorted.

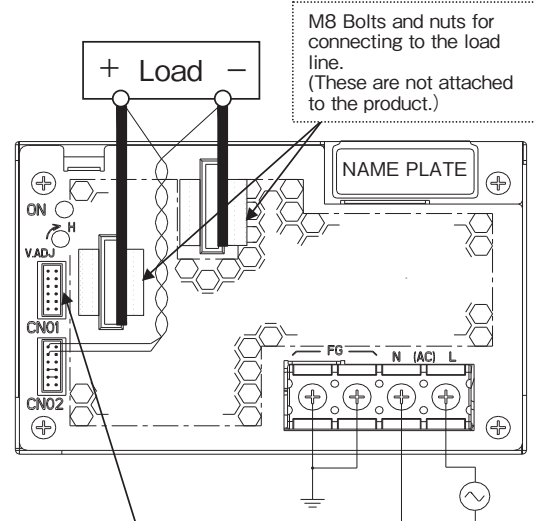
#### Attached connector when shipping



Twist wire

### 4 Remote sensing required

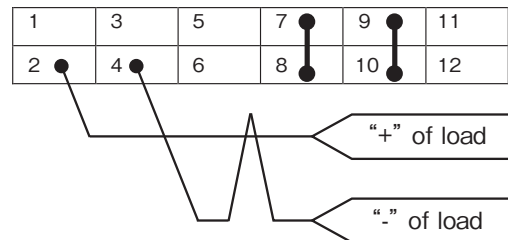
- ① Connect "+S" terminal to "+" terminal of load with sensing wire.
  - ② Connect "-S" terminal to "-" terminal of load with sensing wires.
  - ③ Connect "CNT" terminal to "TOG" terminal with wire.
  - ④ Connect "PV" terminal to "REF" terminal with wire.
- ※ The accuracy of the output voltage will deteriorate 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

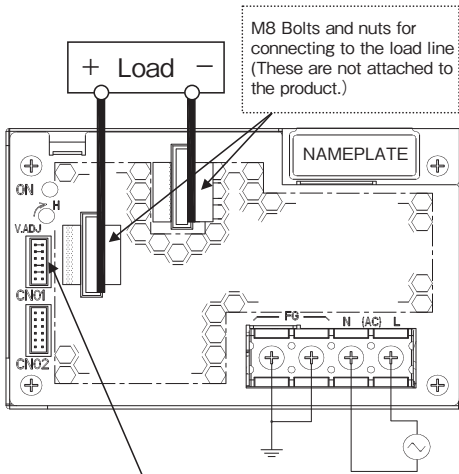
Remove standard attached connector, and use the harness made by the customer.  
 • Housing : (JST) PHDR-12VS  
 • Contact : (JST) SPHD-001T-P0.5  
 2-"+" of load, 4-"-" of load should be connected.  
 7-8, 9-10 : should be shorted  
 \*Please use wire for contact and crimping tool specified by maker.

#### Connecting circuit with CN01 or CN02 connector



### 5 Remote ON/OFF control required

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

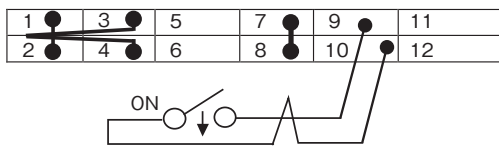
1-2, 3-4, 7-8 : should be shorted

9 : CNT  
Should be connected to ON/OFF control signal.

10 : TOG  
Should be connected to Signal Ground.

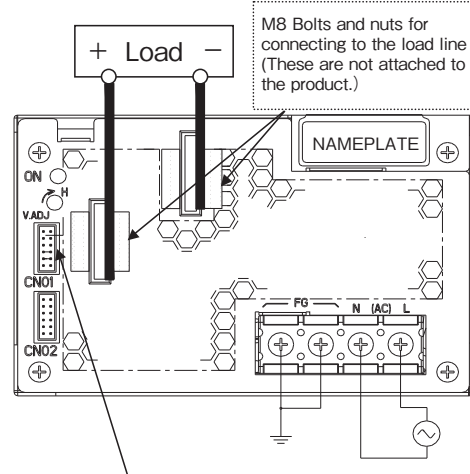
\*Please use wire for contact and crimping tool specified by maker.

Connecting circuit with CN01 or CN02 connector



### 6 PF signal output required

- PF signal is an open collector output, therefore PF signal outputs is shown in circuit below.
- "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

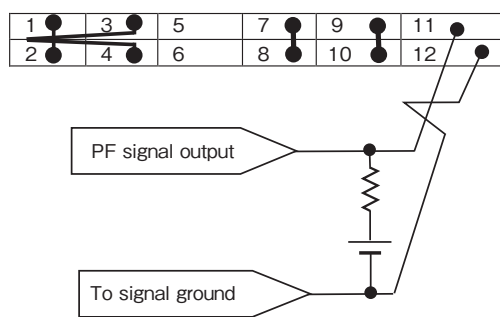
1-2, 3-4, 7-8, 9-10 : should be shorted.

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



## 2. Functions and Precautions

### 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 from 100V to 240VAC (50/60Hz).

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

### 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.

### 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, 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.

### 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.

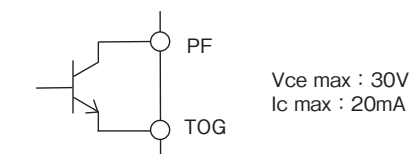
### 5 Over Temperature Protection (OTP)

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.

### 6 Low Output Detection Circuit (PF)

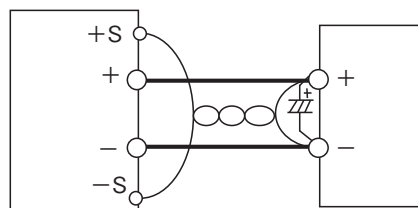
Low output voltage detection circuit is provided. Power Fail signal (PF signal) will output when output voltage decrease by either the drop or brown out of the input voltage or OCP, OVP and OTP function operation. PF signal will turn "High" level to indicate the abnormal status of the power supply when 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.



### 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.

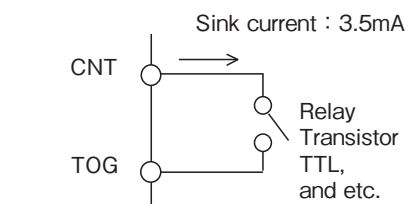


When the function of remote sensing is not in used, connect +S terminal to +V terminal, and -S terminal to -V terminal by the attachment connector.

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

### 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.

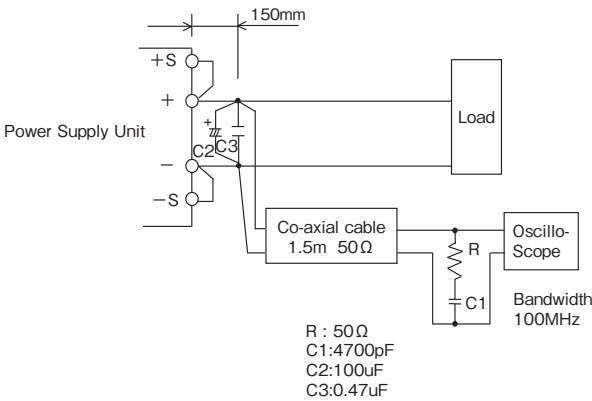
It is possible to use it regardless of the positive and negative of the power supply output.

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.

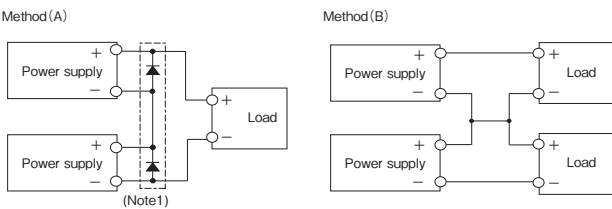
### 9 Output Ripple & Noise

Maximum ripple & noise value in specifications is measured according to measurement circuit specified by JEI-TA-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.



### 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.



(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.

### 11 Parallel Operation

Current balancing function is provided. Either of operations mode (A) or (B) is possible.

#### (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.

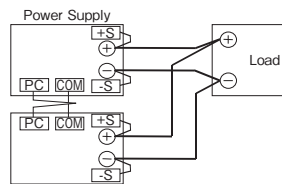
There is a possibility that output could be unstable caused by external noise. For this case, disconnect COM terminal and connect -S terminal from parallel power supply to a single point on the load. Please refer connection Method (A)-2.

- 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.

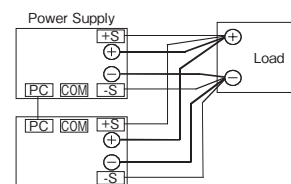
#### (B) To Use as a Backup Power Supply

- 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.

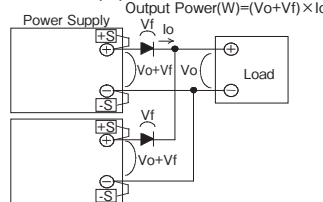
#### Method (A)-1



#### Method (A)-2

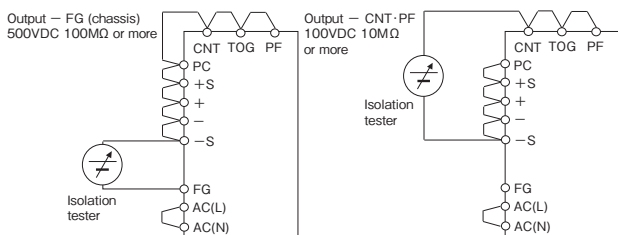


#### Method (B)



### 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.



### 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), Out

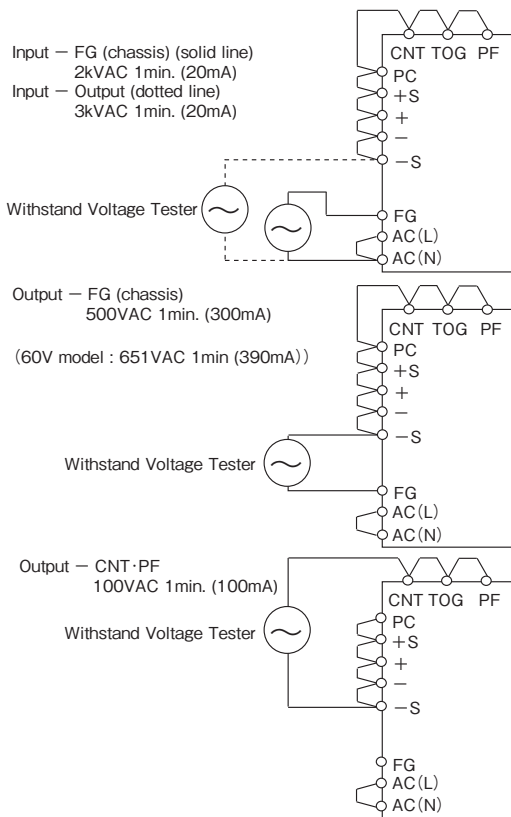
put- CNT·PF : 100mA).

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.

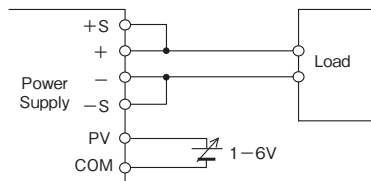


## 14 Output Voltage External Control (PV)

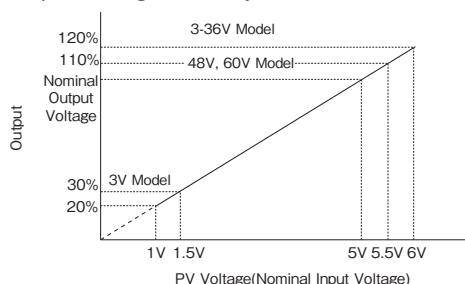
### (A) Control by External Voltage

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

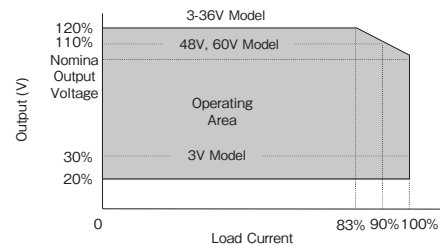


Note: Only as for the model of 3V output, the output voltage is used from 30% to 120% at the PV voltage is from 1.5V to 6.0V

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 6.0V

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

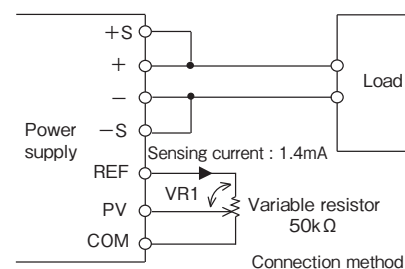


Note: Only as for the type of 48V, 60V output, the maximum output voltage is used up to 110% at 90% load current.

### (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 shielded 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.

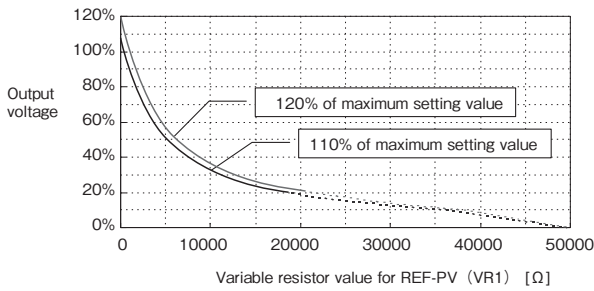
- (1) PV terminal and REF terminal is short by using standard connector supplied.
- (2) Set the power supply output voltage to maximum value of the output voltage variable range mentioned in specification standard by adjusting V.ADJ volume at the front panel.
- (3) Remove standard connector after input 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)



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.

Rated output voltage:



\* 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.

### 15 Output Peak Current

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

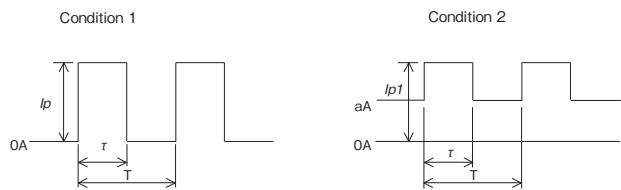
Reduce peak current value according to output derating as section 4-1.

The output is shut down by protection circuit when rated current and continuous peak output time ( $\tau$ ) 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 ( $\tau$ ) : Within 10 seconds
- Peak output current ( $I_p$ ) : Within the rated peak output current
- Duty : up to 35%

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



$$\sqrt{I_p^2 \times \frac{\tau}{T}} \leq I_{rms \max} \quad \sqrt{I_p1^2 \times \frac{\tau}{T} + a^2 \times (1 - \frac{\tau}{T})} \leq I_{rms \max}$$

- $I_p, I_p1$  : Peak output current (A)
- $I_{rms}$  : Effective current (A)
- $\tau$  : Peak current pulse width (sec)
- $T$  : Cycle (sec)

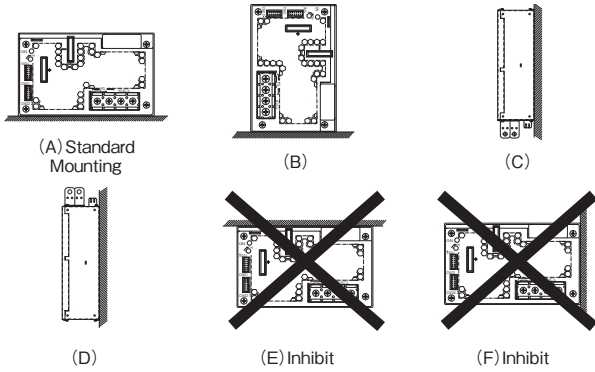
Model	$I_{rms \max}$
HWS1000-7	94.6A
HWS1000-12	59.1A
HWS1000-15	47.3A
HWS1000-24	34.6A
HWS1000-36	23.0A
HWS1000-48	17.2A
HWS1000-60	13.8A



# 3. Mounting Directions

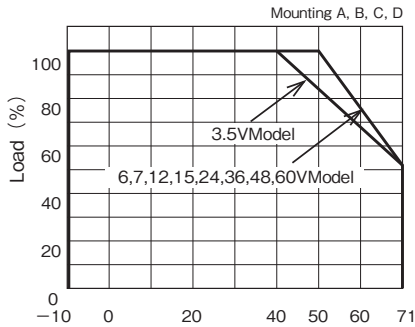
## 1 Output Derating

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 inhibited.



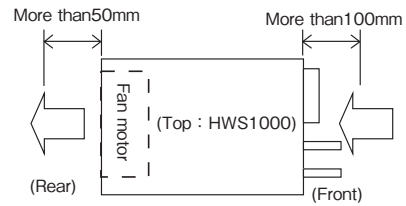
**HWS1000 Output Derating**

3, 5V Ta(°C)	6-60V Ta(°C)	LOAD (%)			
		A	B	C	D
-10 - +35	-10 - +35	100	100	100	100
40	50	100	100	100	100
71	71	50	50	50	50



## 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 charged).
- (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.
- (7) Recommended torque for mounting screw (M4) is 1.27N·m.



HWS

HWS HD

HWS ME

HWS-P

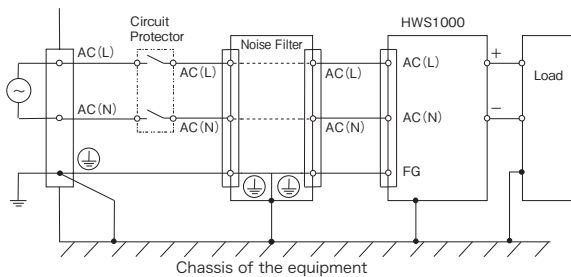
Instruction Manual

## 4. 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:

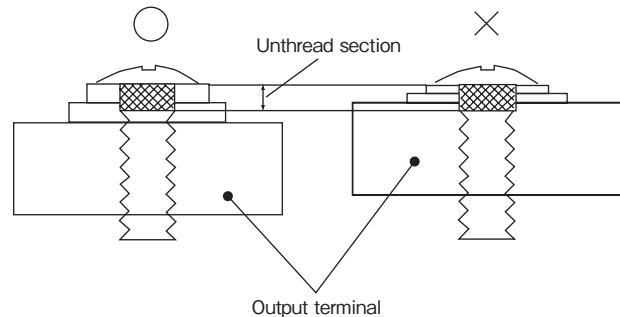
Input terminal (M4 screw):	1.27 N·m
Output terminal (M8 Bolt & Nut):	10.8N·m

- (7) Recommended wiring



Recommended circuit protector: AC250V20A  
 Recommended noise filter: RSEN-2020 (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.



## 5. 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.

HWS1000:20A

## 6. 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 tight-en 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 trigged 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.

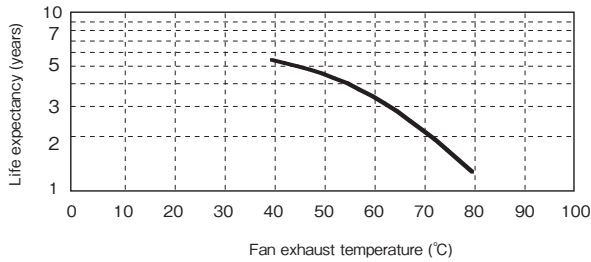
Fans are the limited life parts.

- (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 emmitted from the power supply unit.
- (13) Audible noise can be heard during Dynamic-Load operation.

## 7. Warranty

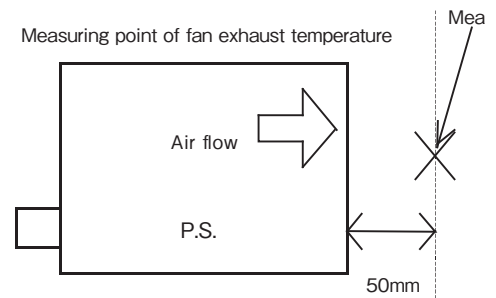
This product is warranted for a period of 5 years from the date of shipment. As for the breakdown under a normal use during free warranty term, repair is at free of charge. However, the Built-in Fan Motor replacement is for a fee. Please contact your nearest sales office for replacement.

The Fan-life has limitation. Therefore, periodic maintenance by replacing the life-expired fan is required. The following figure shows the life of fan.



\*Life expectancy

Fan exhaust temperature	45°C	45,000 hours
Fan exhaust temperature	80°C	11,000 hours



Conditions of usage at the free of charge warranty are as follows.

- (1) Average operating temperature (ambient temperature of the power supply unit) is 40°C
- (2) Average load factor is 80% or less
- (3) Installation method: Standard installation. However, the maximum rating is within the output derating.

Following cases are not covered by warranty.

- (1) Improper usage like dropping products, applying shock and defects from operation exceeding specification of the units.
- (2) Defects resulting from natural disaster (fire, flood).
- (3) Unauthorized modifications or repair by the buyers.
- (4) Defects not cause by TDK-Lambda.

## 8. Option

### 1 Fan unit for replacement

We have prepared an optional fan unit for replacement.

Name of fan unit for replacement	Applicable models	Appearance	Pin assignments	Price								
1500-FAN-01	HWS1000 HWS1500 HWS1800T (of standard specifications)	 Wind direction	Housing = XHP-3 (J.S.T.) Contact = SXH-001T-P0.6 (J.S.T.) <table border="1"> <tr> <th>Pin No.</th> <th>Description</th> </tr> <tr> <td>1</td> <td>Power supply</td> </tr> <tr> <td>2</td> <td>Fan alarm</td> </tr> <tr> <td>3</td> <td>GND</td> </tr> </table> Length of fan harness = 65 ± 10mm	Pin No.	Description	1	Power supply	2	Fan alarm	3	GND	Open
Pin No.	Description											
1	Power supply											
2	Fan alarm											
3	GND											

Ask us for replacement of the fan. This will be a charged service. If you are replacing the fan by yourself, note the following.

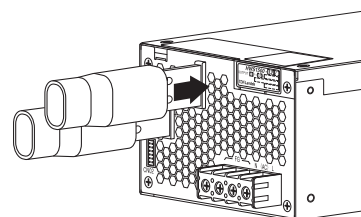
- \*1. Be careful in handling the fan unit so as not to cause an impact by dropping it or hitting it, etc.
- \*2. Shut down the input before starting the replacement operation.
- \*3. Check that there are no loose parts in connectors or harness tucking, etc.
- \*4. Safety standards (UL, CE, etc.) are not applicable.

### 2 Insulation tube for HWS1000

The following insulation tube can be used for output terminal.

•TCV-2001 (shinagawa shoko)

Please confirm shape and size from manufacturer catalog.



Example of use for insulation tube

# HWS 1500 Series Instruction Manual

## BEFORE USING THE POWER SUPPLY UNIT

Be sure to read the following precautions thoroughly before using this power supply unit.

Pay attention to all warnings and cautions before using the unit. Incorrect usage could lead to an electric shock, damage to the unit or a fire hazard.

### WARNING

- Do not make unauthorized changes to power supply unit, otherwise you may have electric shock and void your warranty.
- Do not touch the internal components; they may have high voltage or high temperature. You may get electric shock or burned.
- When the unit is operating, keep your hands and face away from it; an accident may injure you.
- Do not use unit under unusual condition such as emission of smoke or abnormal smell and sound etc. It might cause fire and electric shock.  
In such case, please contact us; do not repair by yourself, as it is dangerous for the user.
- Do not drop or insert anything into unit. It might cause failure and fire, when using the unit under such condition.
- Do not operate these units at the condition of condensation. It may cause fire and electric shock.
- 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.

### Note : CE MARKING

- CE Marking when applied to a product covered by this handbook indicates compliance with the low voltage directive (2006/95/EC) in that it complies with EN60950-1.

### CAUTION

- This power supply is primarily designed and manufactured to use and enclose in other equipment.
- This power supply unit has a built-in fan for air-cooling. Do not block air intake and exhaust. It might cause fire.
- Input voltage, Output current, Output power, ambient temperature and ambient humidity should be used within specifications, otherwise the unit will be damaged.
- The unit might be broken down by accident or unexpected situation. For application equipment, which requires very high reliability (nuclear related equipment, traffic control equipment, medical equipment, etc.), please provide fail safety function in the equipment.
- Do not make an improper wiring to input and output terminals. It may cause damage.
- Do not use in environment such as strong electromagnetic field, erosive gas etc, or any environment where conductive foreign substance may enter.
- Do not operate and store this unit at the condition of condensation. In such case, waterproof treatment is necessary.
- Do not operate this unit after it falls down.
- 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 electric 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.

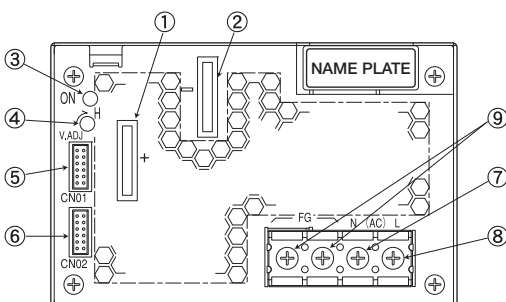
## 1. Terminal Explanation

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.

### 1 Front Panel Explanation



- 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 CN01, CN02 Connector pin configuration and Function

CN01, CN02 pin configuration and function are the same.

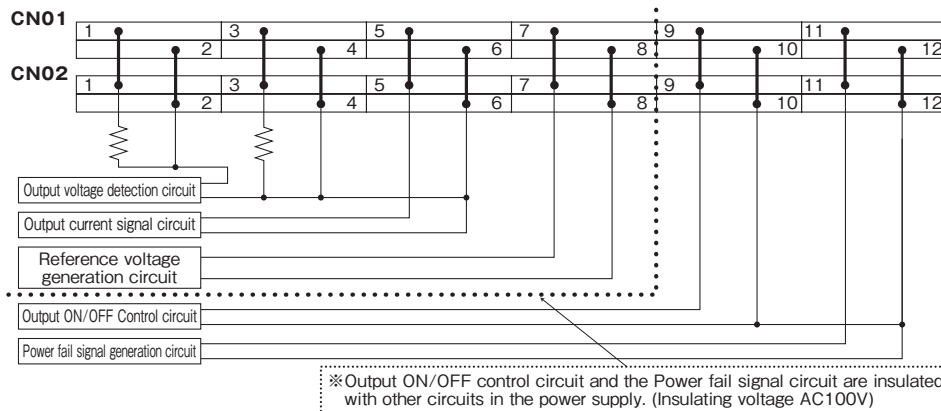
They are connected to each other in this power supply unit.

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
	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.)
	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.



## 3 Basic Connection(Local sensing)

• 3-7V model

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

② Connect "CNT" terminal to "TOG" terminal with wire.

③ Connect "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

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

② Connect "CNT" terminal to "TOG" terminal with wire.

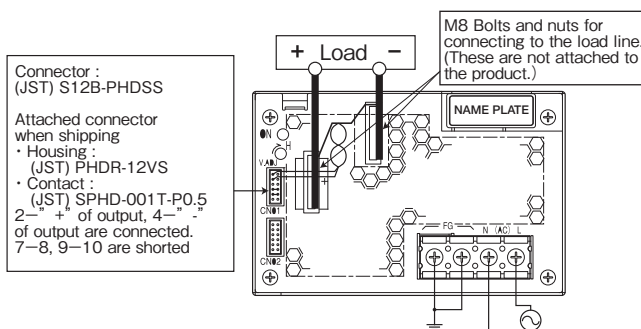
③ Connect "PV" terminal to "REF" terminal with wire.

※ Please use attachment connector for each connection.

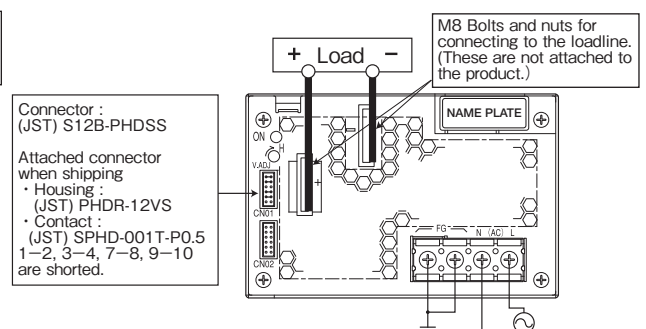
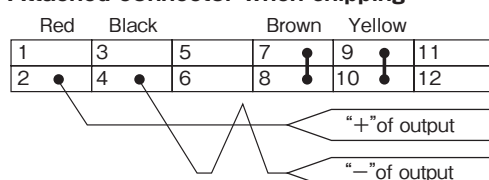
※ In the following cases, the output is shut down.

When CNT and TOG is opened.

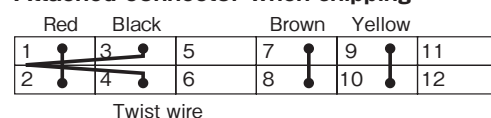
When PV and REF is opened.



Attached connector when shipping



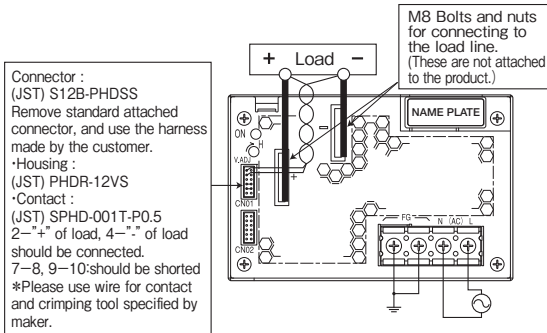
Attached connector when shipping



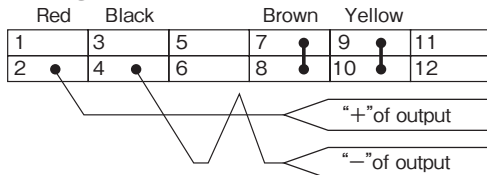


### 4 Remote sensing required

- ① Connect "+S" terminal to "+" terminal of load with sensing wire
  - ② Connect "-S" terminal to "-" terminal of load with sensing wires.
  - ③ Connect "CNT" terminal to "TOG" terminal with wire.
  - ④ Connect "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.

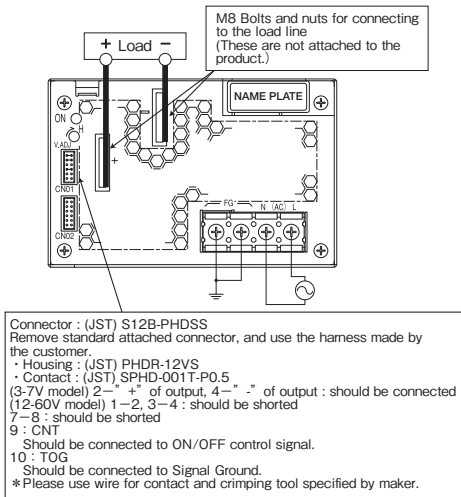


Connecting circuit with CN01 or CN02 connector

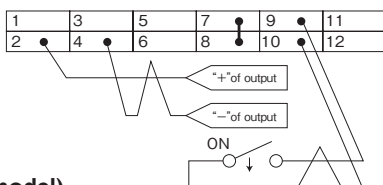


### 5 Remote ON/OFF control required

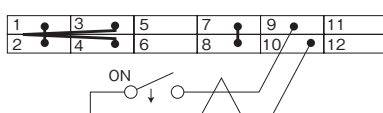
- ① Remove standard attached connector, and use the harness made by the customer and connect external signal to between CNT and TOG terminal.
  - ② "TOG" terminal is ground for "CNT" terminal.
- In case this function is not used, please short between CNT and TOG terminal.



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

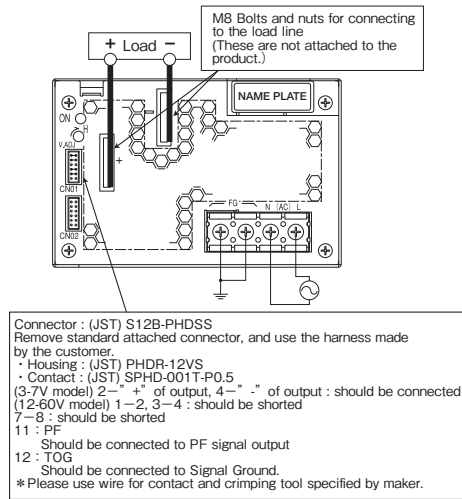


### (12-60V model)

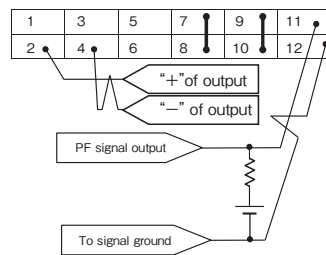


### 6 PF signal output required

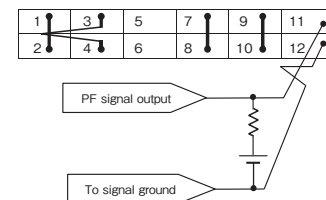
- ① PF signal is an open collector output, therefore PF signal outputs is shown in circuit below.
- ② "TOG" terminal is ground for "PF" terminal.



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



### (12-60V model)



## 2. Functions and Precautions

### 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 from 100V to 240VAC (50/60Hz).

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

### 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.

### 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 type: 125-138% , 48V type: 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.

### 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.

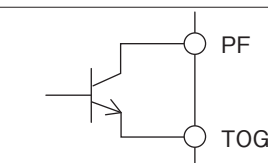
### 5 Over Temperature Protection (OTP)

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.

### 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.

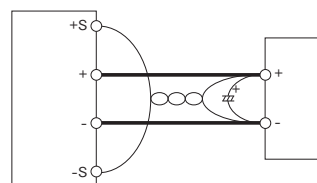
When the Built-in Fan Motor of this power supply unit stops, PF signal will turn to "H" and the output power will shut down. The Built-in Fan Motor is a component with lifetime. We recommend a periodic replacement. Please contact our sales office. Replacement is at customer's expenses.



### 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.

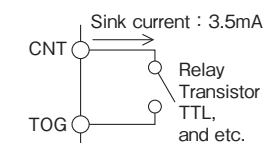


When the function of remote sensing is not in used, connect +S terminal to +V terminal, and -S terminal to -V terminal by the attachment connector.

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

### 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

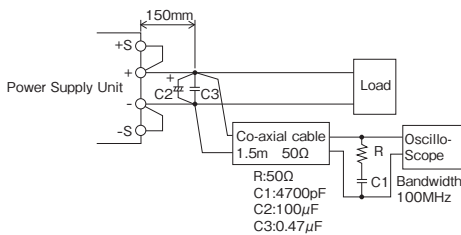
- 1) TTL compatible. The maximum input voltage to CNT terminal is 12V, and the maximum allowable reverse voltage is -1V. The sink current of CNT terminal is 3.5mA.
- 2) Output ON/OFF control can be enable by a switch, relay or a transistor ON/OFF. When CNT terminal—TOG terminal is shorted power supply 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.

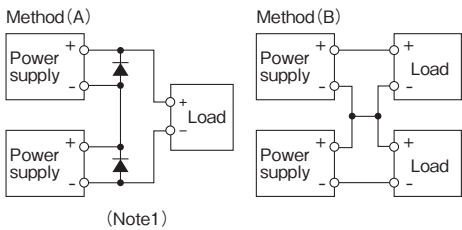
### 9 Output Ripple & Noise

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.



### 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.



(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.

### 11 Parallel Operation

Current balancing function is provided. Either of operations mode (A) or (B) is possible.

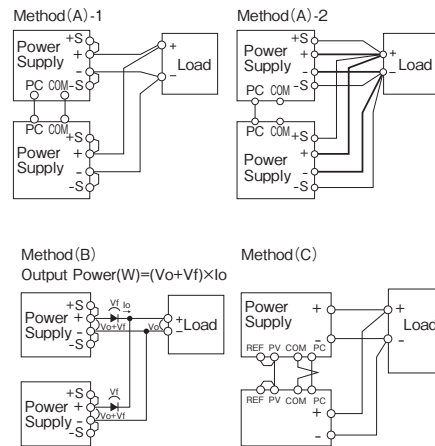
(A) To Increase the Output Current  
Current balancing function activates by connecting PC-to-PC terminal and COM-to-COM terminal, and output current of each power supply is equivalently supplied to load. Wires to PC terminals shall be as short as possible, same length and twisted.

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.

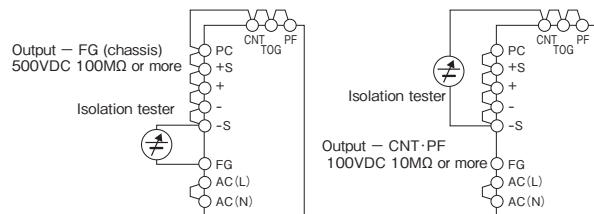
- 2) Use same length and type of wires for all load lines.
- 3) Maximum value of output current in parallel is up to 80% of all paralleled models. The purpose of the current balancing function is the static power-up. Therefore the output voltage might decrease according to the condition of dynamic load. 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).



### 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.



### 13 Withstand Voltage

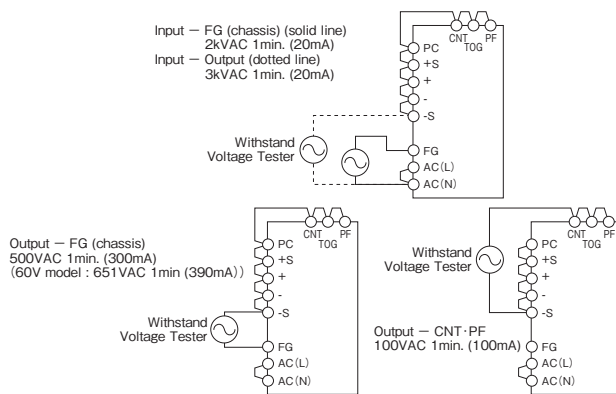
This series is designed to withstand 3.0kVAC between input and output, 2.0kVAC between input and FG (chassis), 500VAC (60V model : 651VAC) between output and FG (chassis), and 100VAC between output and CNT·PF terminal each for 1 minute. When testing withstand voltage, set current limit of withstand voltage 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.

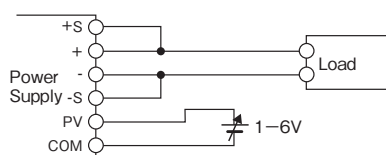


### 14 Output Voltage External Control (PV)

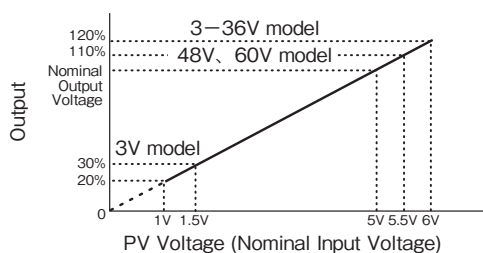
#### (A) Control by External Voltage

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

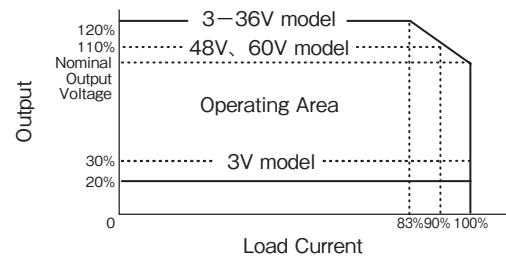


Note: Only as for the model of 3V output, the output voltage is used from 30% to 120% at the PV voltage is from 1.5V to 6.0V

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

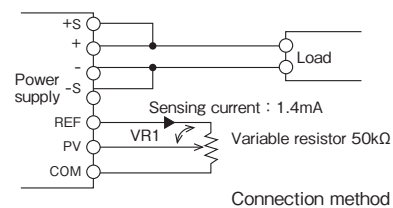


Note: Only as for the model of 48V, 60V output, the maximum output voltage is used up to 110% at 90% load current.

#### (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.

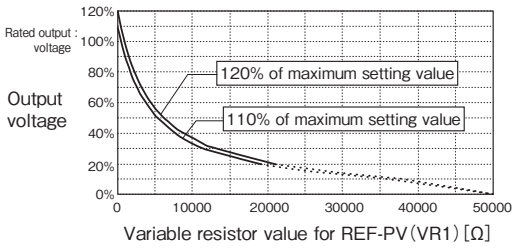
- (1) PV terminal and REF terminal is short by using standard connector supplied.
- (2) Set the power supply output voltage to maximum value of the output voltage variable range mentioned in specification standard by adjusting V.ADJ volume at the front panel.
- (3) Remove standard connector after input 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)



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.

### 15 Output Peak Current

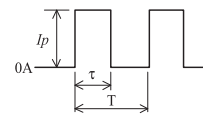
For model with output peak current, please meet the following condition.Reduce peak current value according to output derating as section 4-1.

The output is shut down by protection circuit when rated current and continuous peak output time (  $\tau$  ) 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. (  $\tau$  ) : Within 10 seconds  
 Peak output current (  $I_p$  ) : Within the rated peak output current  
 Duty : up to 35%  
 Duty =  $\frac{\tau}{T} \times 100$  (%)

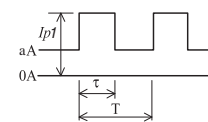
Condition 1



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

$$\sqrt{I_p^2 \times \frac{\tau}{T}} \leq I_{rms \max}$$

Condition 2



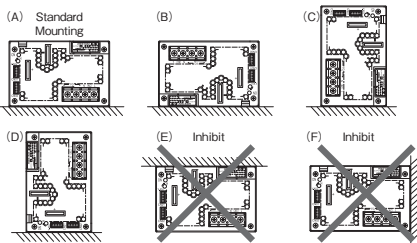
$$\sqrt{(I_p1^2 \times \frac{\tau}{T} + a^2 \times (1 - \frac{\tau}{T}))} \leq I_{rms \max}$$

$I_p, I_p1$ : Peak output current (A)  
 Irms : Effective current (A)  
 $\tau$  : Peak current pulse width(sec)  
 T : cycle(sec)

## 3. Mounting Directions

### 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.

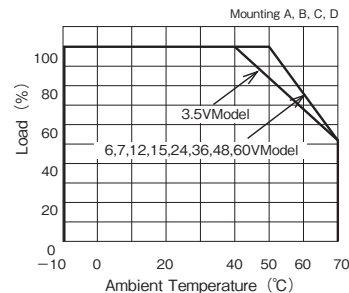


### 2 Mounting Method Caution

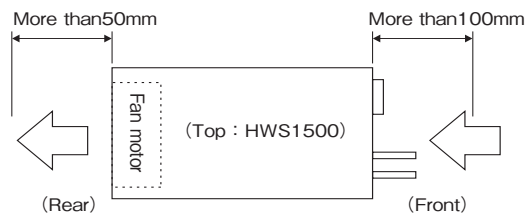
- (1) This Power supply unit is a forced air-cooling system with a built-in fan.
- (2) This power supply has ventilating holes on the front and back panels. Keep these areas freely more than 100mm from front side and more than 50mm from rear side.
- (3) Please note that ventilation will be worsened in 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.

HWS1500 Output Derating

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



- (6) The maximum allowable penetration of mounting screw is 6mm.
- (7) Recommended torque for mounting screw (M4) is 1.27N · m.



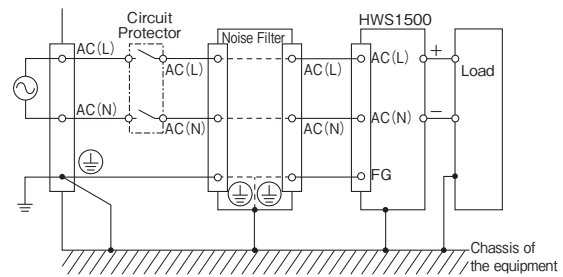


## 4. Wiring Method

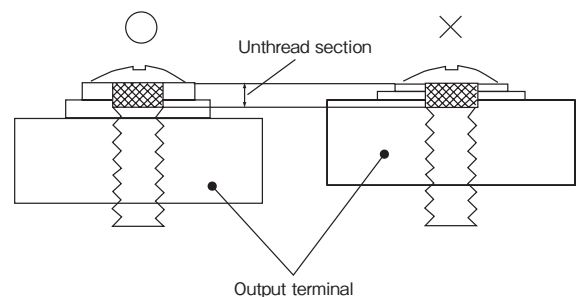
- (1) The output load line and input line shall be separated and twisted to improve noise sensitivity.
- (2) The sensing lines shall be twisted or shield wire and separated from the output lines.
- (3) Use all lines as thick and short as possible to make lower impedance. Wires are to be twisted or use 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



- (8) M4 screw for output terminal might damage the terminal's inner section. This is mainly caused 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.



## 5. 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

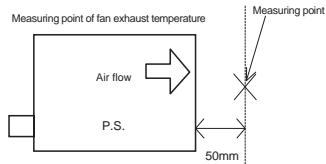
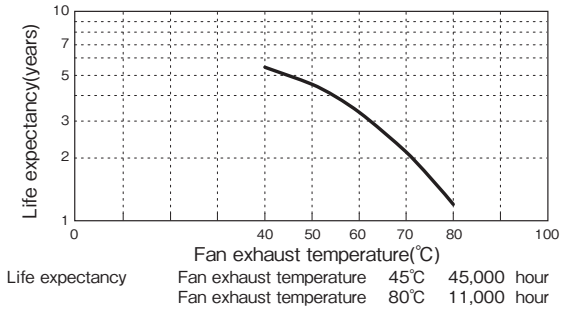
## 6. Troubleshooting

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.

## 7. Warranty

This product is warranted for a period of 5 years from the date of shipment. As for the breakdown under a normal use during free warranty term, repair is at free of charge. However, the Built-in Fan Motor replacement is for a fee. Please contact your nearest sales office for replacement. The Fan-life has limitation. Therefore, periodic maintenance by replacing the life-expired fan is required. The following figure shows the life of fan.



Conditions of usage at the free of charge warranty are as follows.

- (1) Average operating temperature (ambient temperature of the power supply unit) is 40°C
- (2) Average load factor is 80% or less
- (3) Installation method: Standard installation. However, the maximum rating is within the output derating.

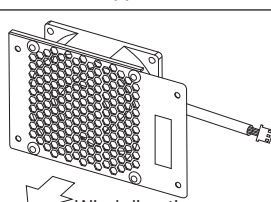
Following cases are not covered by warranty.

- (1) Improper usage like dropping products, applying shock and defects from operation exceeding specification of the units.
- (2) Defects resulting from natural disaster (fire, flood).
- (3) Unauthorized modifications or repair by the buyers.
- (4) Defects not cause by TDK-Lambda.

## 8. Option

### 1 Fan unit for replacement

We have prepared an optional fan unit for replacement.

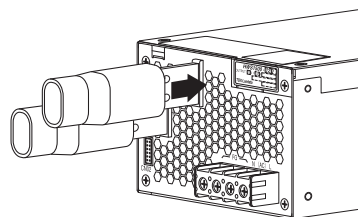
Name of fan unit for replacement	Applicable models	Appearance	Pin assignments	Price								
1500-FAN-01	HWS1000 HWS1500 HWS1800T (of standard specifications)		Housing = XHP-3(J.S.T.) Contact = SXH-001T-P0.6(J.S.T.) <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th>Pin No.</th> <th>Description</th> </tr> <tr> <td style="text-align: center;">1</td> <td>Power supply</td> </tr> <tr> <td style="text-align: center;">2</td> <td>Fan alarm</td> </tr> <tr> <td style="text-align: center;">3</td> <td>GND</td> </tr> </table> Length of fan harness = 65 ± 10mm	Pin No.	Description	1	Power supply	2	Fan alarm	3	GND	Open
Pin No.	Description											
1	Power supply											
2	Fan alarm											
3	GND											

Ask us for replacement of the fan. This will be a charged service. If you are replacing the fan by yourself, note the following.

- \*1. Be careful in handling the fan unit so as not to cause an impact by dropping it or hitting it, etc.
- \*2. Shut down the input before starting the replacement operation.
- \*3. Check that there are no loose parts in connectors or harness tucking, etc.
- \*4. Safety standards (UL, CE, etc.) are not applicable.

### 2 Insulation tube for HWS1500

The following insulation tube can be used for output terminal.  
 •TCV-2001 (shinagawa shoko)  
 Please confirm shape and size from manufacturer catalog.



Example of use for insulation tube