PH300S, 600S Series

Instruction Manual

■ Before Using The Power Supply

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

■ Warning

- Do not touch heatsinks and case which may be hot.
- Confirm connections to input/output terminals and signal terminals are correct as indicated in instruction manual.
- Attach a fast blow type external fuse to each module to ensure safety operation and to acquire each safety standard approval.
- This power supply is designed for professional installation within an end use equipment.
- For Ph300S 48, use insulated voltage by reinforced insulation at primary power supply or double insulation as input power source.
- The output from this power supply must be considered as an energy hazard (>240VA power and 2V voltage) and must not be accessible to a user. End equipment manufacturers must provide protection against inadvertent contact with the output terminal on this product by a service engineer or by the service engineer dropping a tool into them.

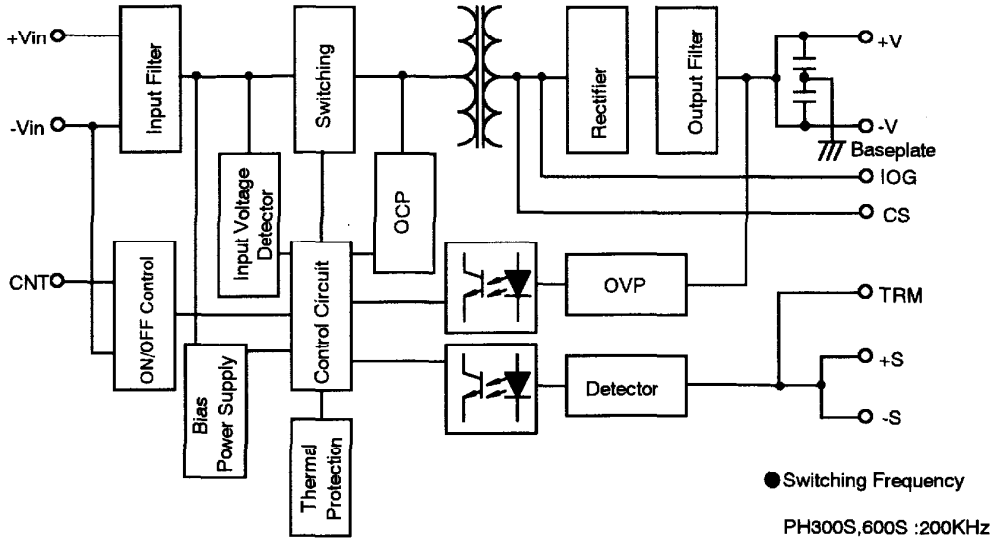
■ Note : CE Marking

CE Marking, when applied to a product covered by this instruction manual indicates compliance with the low voltage directive (73/23/EEC) as modified by the CE Marking Directive (93/68/EEC) in that it is complies with EN60950.

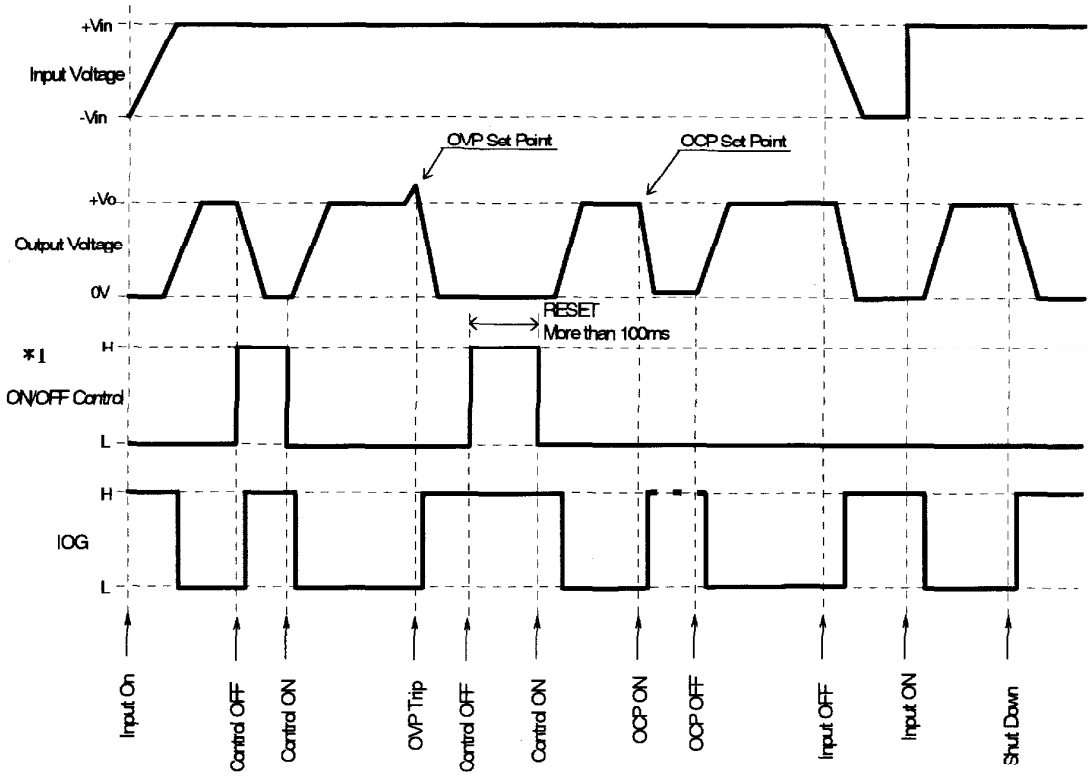
DWG NO. : C113-04-11		
APPD	CHK	DWG
S.Tomioka 9/MAR/'98	Iuichi 9/MAR/'98	Chieko Takagaki 9/March/'98

CONTENT

Block Diagram



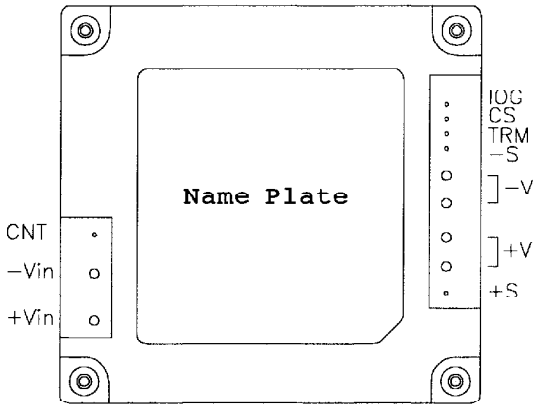
Sequence Time Chart



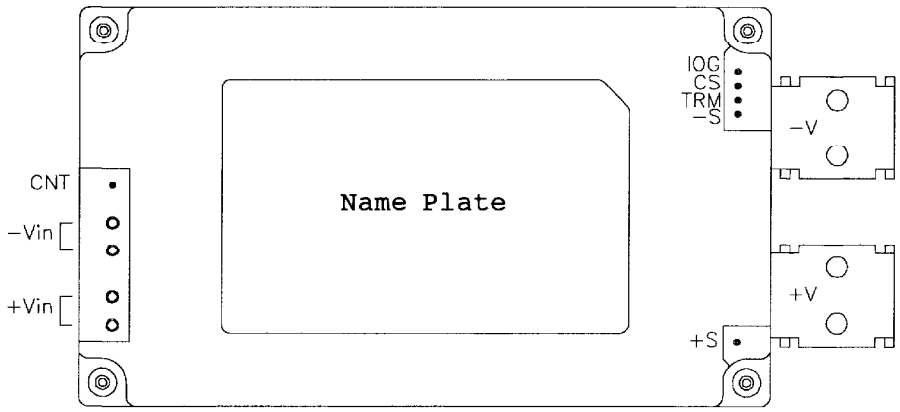
*1 : Level 1
4≦H≦35(V)
0≦L≦0.8(V)

■Terminal Explanation

Model PH300S



Model PH600S



[Input Side Terminals]
CNT : ON/OFF Control
-Vin : −Input Terminal
+Vin : +Input Terminal

[Output Side Terminals]
IOG : Inverter Operation Good
CS : Output Current Monitoring Signal
TRM : Output Voltage Trimming Terminal
-S : −Remote Sensing
-V : −Output Terminal
+V : +Output Terminal
+S : +Remote Sensing

Baseplate can be connected to FG trough M3 mounting tapped holes.
Connect +Vin, -Vin, +V, -V with consideration of contacting resistance.

1. Input Voltage Range

Input voltage ranges for PH300S, 600S series are as follow.

48VDC Input : 36~ 76VDC
280VDC Input : 200~400VDC

Input voltage normally includes ripple voltage (Vrpl) as shown as Figure1-1. The ripple voltage shall be less than following values.

48VDC Input : 4Vp-p
280VDC Input : 20Vp-p

Peak of input voltage wave shall not be exceed above input voltage range.
Output voltage would be fluctuated as dynamic line changes.
The output ripple voltage may become bigger if the bottom of input ripple voltage is below 220V for 280VDC input model and below 40VDC for 48VDC input model.

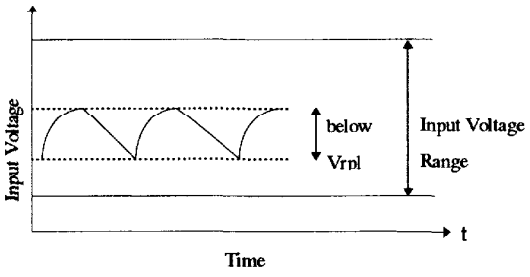
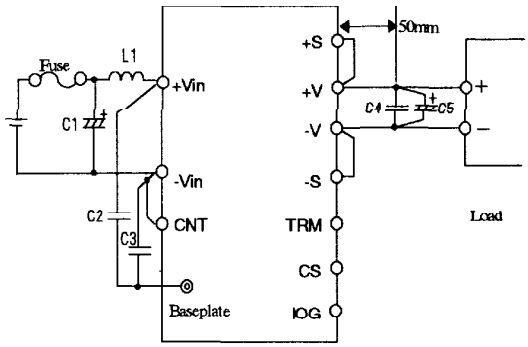


Figure1-1 Ripple Voltage

●Basic Connection

(PH300S)



(PH600S)

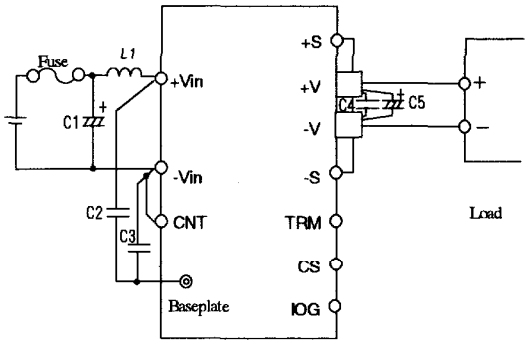


Figure1-2 Basic Connection

Input Fuse

No internal fuse is provided in the power module. To ensure the safety operation and to acquire safety standard approvals, attach an external fuse. The external fuse must be fast blow type and be attached to each module individually.
Furthermore, attach the fuse at +Vin side if the ground is -Vin side and at -Vin side if the ground is at +Vin side.
Use in-rush current limit circuit when the in-rush current may make troubles.

	300W	600W
48VDC Input	20A	–
280VDC Input	5A	10A

Table1-1 Recommended Rating Current of Input Fuse

C1 :
Attach electrolytic capacitor(s) between +Vin and -Vin terminals.
The capacitor shall be lower equivalence series resistance (ESR). Especially under low ambient temperature, the voltage of C1 becomes unstable due to ESR at line off. Hence, be aware the output might be not normal line off.
Confirm the allowance of ripple current because ripple current flows in the capacitor, and then choose the capacitor.

Recommended Capacitor Values

48VDC Input : 470 μ F
280VDC Input : 22 μ F

L1 :
To reduce C1 ripple current and output spike noise voltage, attach a normal choke coil to each module.

Recommended Inductance Values

48VDC Input : 3 μ H
280VDC Input : 15 μ H

Recommended Current Ratings

PH300S48-* : 11A
PH300S280-* : 2A
PH600S280-* : 4A

C2, C3 : 4700pF
Use a ceramic capacitor that has high withstand voltage to reduce the output spike voltage.

48VDC Input : 1.5kVAC or above
280VDC Input : 3kVAC or above

Select the capacitor from the above recommended components with high withstand voltage because the test voltage is applied to the capacitor during the withstand voltage test in some application contents.
Connect C2 between +Vin and baseplate and C3 between -Vin and baseplate as short as possible.

C4 : 2.2 μ F
Also, use a ceramic capacitor to reduce the output noise voltage.
Attach the ceramic capacitor between +V and -V where less than 50mm from output terminal for PH300S.
For PH600S, attach the ceramic capacitor between +V and -V terminal as short as possible.
The output spike noise voltage could be changed for design of printed circuit board.

C5 :
Use electrolytic capacitor(s) for stable operation.
Attach the electrolytic capacitor between +V and -V where less than 50mm from output terminal for PH300S.
For PH600S, attach the electrolytic capacitor between +V and -V terminals as short as possible.
Recommend tighten the screws of load wire and C5 together.
Oscillation waveform could be shown at dropping down the output for characteristics of equivalent series resistance (ESR) of electrolytic capacitor and equivalent series inductance (ESL).
Moreover, note the output ripple voltage could be changed for design of printed circuit board.
In case input/output dynamically changes, it helps the fluctuation of output voltage by increasing the external capacitor value.

Vo \ Wo	300S	600S
3.3V	6.3V 4700 μ F	6.3V 10000 μ F
5V	10V 3900 μ F	10V 4700 μ F
12V	25V 1000 μ F	25V 2200 μ F
15V	25V 1000 μ F	25V 2200 μ F
24V	35V 560 μ F	35V 1000 μ F
28V	50V 470 μ F	50V 820 μ F
48V	50V *1 470 μ F×2	50V *1 680 μ F×2

*1 For 48V output model, use two 50V capacitors in series that have low impedance.

Table1-2 C5: Recommended Values of External Output Capacitor

Remarks:
1. Use an electrolytic capacitor that has excellent low impedance for temperature characteristic.
   (Equivalent electrolytic capacitor in LXY series manufactured by Nippon Chemicon)
2. Be aware of ripple current allowance of the electrolytic capacitor. Especially be aware it when the load current is in dynamics.

The output voltage may be greatly varied in 300Hz~2kHz frequency range at 0%←→100% of dynamic load condition. For less dynamic of the voltage, use a electrolytic capacitor which has better capacity than recommended electrolytic capacitor or keep the minimum load current more than 10% of nominal current.
Contact us for the details.

C6 :
In between input source and input line of PH300S, 600S series there are a switch and connectors etc. In case that the switch is on/off or plug in/off when the input is applying, attach an electrolytic capacitor, C6 as shown as Figure1-3.
Because in-rush current flows when the input is applied, confirm I^2t for the switch and fuse.

Recommended Values

48VDC Input : 100~470 μ F
280VDC Input : 10~ 47 μ F

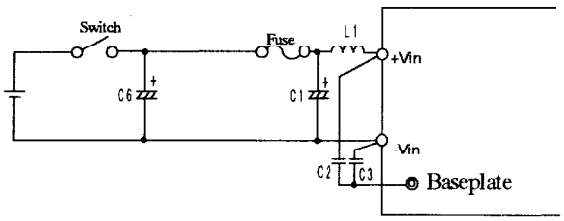


Figure1-3 Input Filter with Input Switch

If plural numbers of module will be connected in PH300S, PH600S series, attach an electrolytic capacitor, C6 as shown as Figure1-4.

Recommended Values

48VDC Input : 100~470 μ F
280VDC Input : 10~ 47 μ F

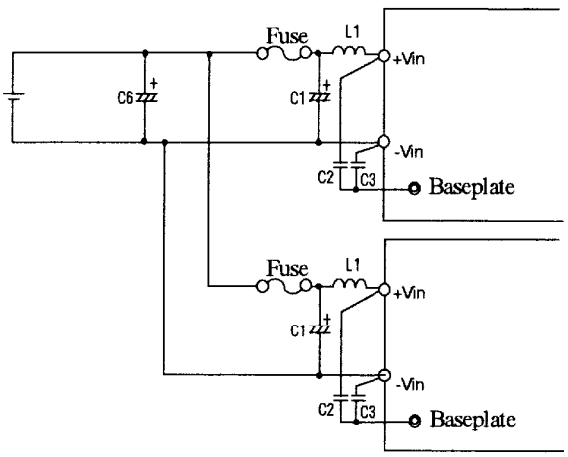


Figure1-4 Input Filter when Plural Power Modules are connected.

Reversed Connection of Input
An error of reverse (+, −electrodes) input may cause of damage of the power module. If there is possibility to connect the module conversely by accident, it is necessary to attach a protective diode and an input fuse.
The rating voltage of the diode shall be higher than input voltage, and the maximum in-rush current shall be higher than fuse.

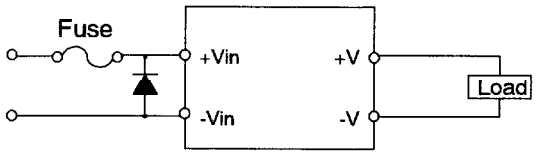
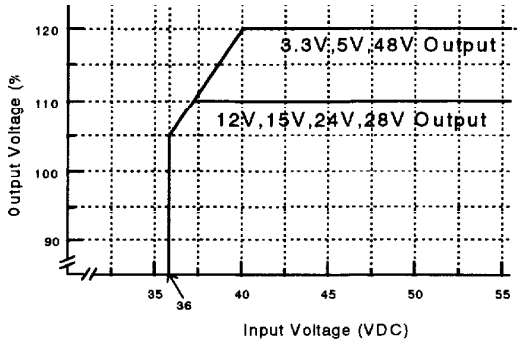


Figure1-5 Protection for Reversed Connection of Input

2. Output Voltage Range

Output voltage can be adjusted within±10% (3.3V, 5V, 48V : -10% ～ +20%) of the nominal voltage by adjusting the external trimmer (variable resistor). However, if the output voltage become over the above range, OVP activates.
There is a limit of input voltage shown in Figure2-1 when the output voltage trims high.

(48VDC Input)



(280VDC Input)

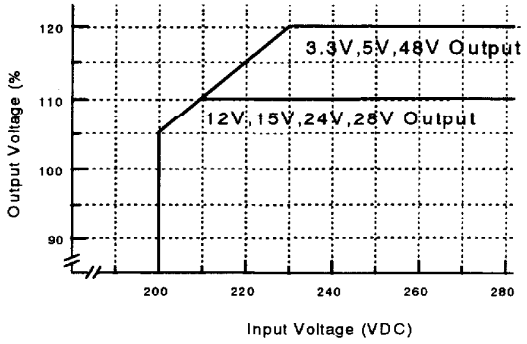


Figure2-1 Limit of Input Voltage

Connection method of external resistor (R1) and variable resistor (VR) is shown as follow.

	3.3V	5V	12V	15V	24V	28V	48V
Variable Range	-10% +20%		±10%				-10% +20 %
R1	4.7k	4.7k	30k	33k	68k	68k	220k
VR	2k	5k	5k	10k	10k	20k	30k

External Resistor : below±5% Tolerance
Variable Resistor : below±20% Tolerance
below 1% of Remain

Table2-1 External Resistor and Variable Resistor Output

-10%～+20% Variable (3.3V, 5V, 48V)
±10% Variable(12V, 15V, 24V, 28V)

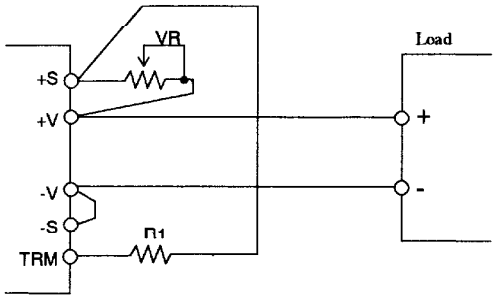


Figure2-2 Example Connection of External Resistance

For 48V output model, avoid to reduce the output voltage below -10% cause damage of the module

3 . Maximum Output Ripple and Noise

Maximum output ripple and noise is measured by a method based on EIAJ-9141.
The connection is shown as Figure3-1. Attach capacitors (C4 : Ceramic Capacitor : 2.2 μ F, C5 : Electrolytic Capacitor : Refer to Table1-2) 50mm from the output for PH300S and as short as possible to the output terminal for PH600. Also, attach a coaxial cable with EIAJ attachment at the both side of C4 capacitor shown as Figure3-1. Oscilloscope shall be used at a range of 100MHz band width.
The output ripple voltage and the output spike noise voltage may be changed for the design of printed circuit board.

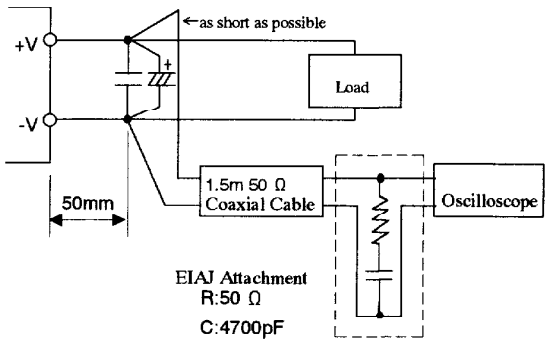


Figure 3-1 Measurement of Maximum Output Ripple & Noise
(Example : PH300S)

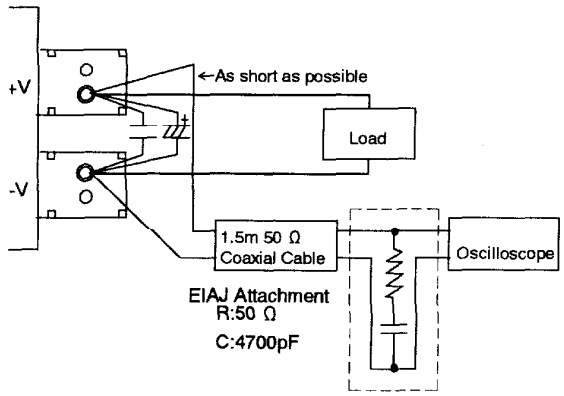


Figure 3-2 Measurement of Maximum Output Ripple & Noise (Example : PH600S)

4. Maximum Line Regulation

The maximum output voltage changes when the input voltage is slowly varied within the range.(Steady state)

5. Maximum Load Regulation

The maximum output voltage changed when the output current is slowly varied within the range.(Steady state)

6. Over Current Protection (OCP)

OCP function is provided in the power module. When short or overload condition is released, the output will be automatically recovered. This setting value is fixed and impossible to change externally. Be aware that the power module could be damaged in some thermal conditions when short or overload condition is continuously carried on.

7. Over Voltage Protection (OVP)

OVP function is provided in the power module. This setting value is a value for the nominal output voltage. It is fixed and impossible to change externally.

When OVP function activates, the output will shut down. The output can be recovered by reset of ON/OFF Control terminal to low at once or reapplying input after input voltage bring down to less than the following values. Time reset of ON/OFF control terminal is more than 100ms.

To check OVP function, apply an external voltage that is limited to upper limit of maximum OVP range. Refer to specification for OVP range. Avoid to apply over voltage for not damage the unit.

Input Voltage to release OVP

48V Input : less than 25VDC
280V Input : less than 150VDC

8. Thermal Protection

Thermal protection is provided in the power module. It prohibits abnormal rise of ambient temperature and internal temperature of power supply, and the output will shut down. Trip point of thermal protection is 105°C~130°C of baseplate temperature.

The output is recovered by reapplying the input voltage after the input shut down (same as OVP) when the temperature is cooled down enough or resetting ON/OFF control terminal.

9. Remote Sensing (+S,-S Terminal)

Remote sensing which compensates voltage drop by wiring from output terminal to load terminal in power supply is equipped.

If remote sensing is unnecessary to use (using local sensing), directly connect +S and +V terminals and -S and -V terminals as short as possible.

Use within the maximum output power range with either compensated voltage range of line drop (voltage drop by wiring) is in output range or voltage between -V and -S is 2V. Also, reduce noise affects by using shield wire, twist wire, or parallel pattern as remote sensing wire.

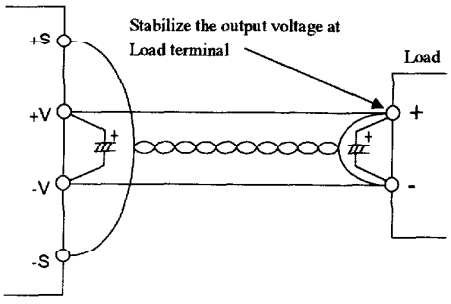


Figure9-1 Remote Sensing at Use

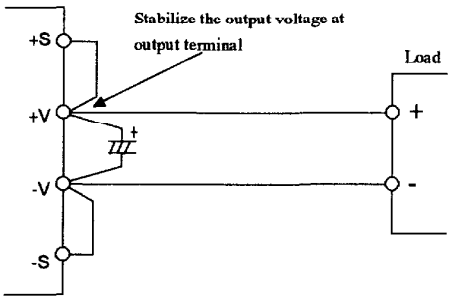


Figure9-2 Remote Sensing Not in Use

10. ON/OFF Control (CNT Terminal)

Without turning the input on and off, the output can be enabled and disabled by CNT function. The control circuit is at input (primary) side, and CNT terminal pin is used. Use -Vin terminal as ground of CNT terminal.

If this function is unnecessary, shorten between CNT terminal and -Vin terminal.

1) Maximum applied voltage to CNT terminal is 35V, and the maximum reversed voltage is -0.7V. Also, the current source of CNT terminal is approximately 0.5mA.
Contact 0.1 μ F capacitor in between CNT and -Vin terminal as short as possible if lead wires are much longer.

2) CNT terminal can be managed by opening and closing the contact of a switch or relay and ON/OFF control of photo coupler.
Insulate the ON/OFF control circuit by relay or photo coupler.
※In use of photo coupler, connect the transistor side between CNT and -Vin as short as possible.

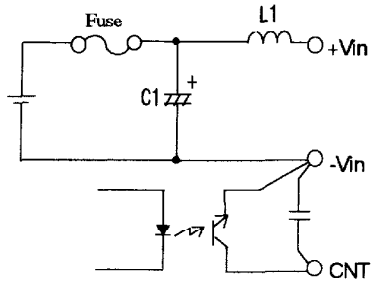


Figure10-1 Connection of CNT Terminal

CNT Level	Output Status
H (over 4V) or Open	OFF
L (below 0.8V) or Short	ON

Table10-1 ON/OFF Control Mode

—Caution—

Inside of power module could be damaged at applying input without or improper contact of -V connection. For an example, the current flows in abnormal path such as $+V_{in}$ to CNT terminal leads CNT terminal blow out

To avoid such a damage, ensure all the terminals are connected before input is applied.

11. CS Signal (CS)

Negative voltage based on $-V_o$ is generated for CS terminal. Using this signal, it is possible to operate in parallel by attaching parallel operating control circuit externally.

Refer to "Parallel Operation" Application Note in the instruction manual for details.

12. Series Operation

Series operation is available for all models of PH300S, 600S series.

Contact us for details of the maximum unit number of possible connections.

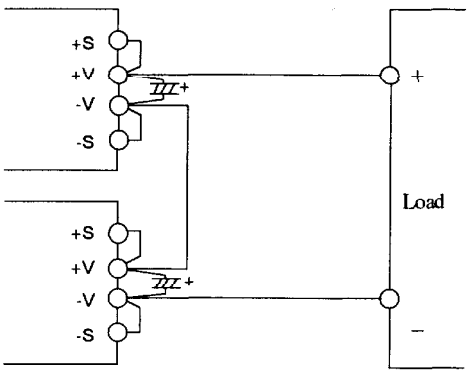


Figure12-1 Series Operation in High Output Voltage

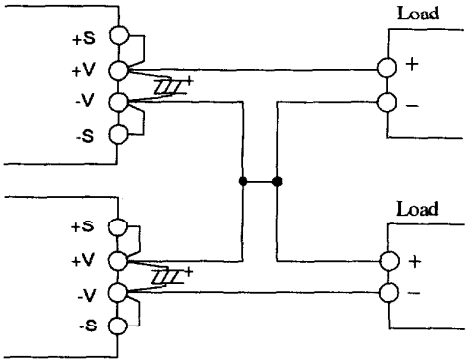


Figure12-2 ±Output Series Operation

13. I.O.G. Signal (IOG Terminal)

Using IOG (Inverter Output Good Signal) terminal, it is possible to monitoring good / not good operation in the power module. This monitoring signal is located at secondary (output) side and is the open collector output.

At normal inverter operation, the IOG shows LOW(maximum sink current 5mA and maximum applied voltage 35V).

Ground of IOG terminal is -S terminal.

Be aware IOG signal could be unstable in the following cases.

- Active OCP
- Low load in parallel operation
- Sudden change of load

Contact us for the details.

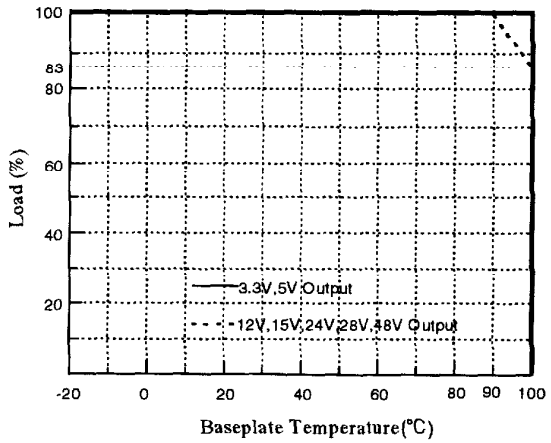
14. Operating Temperature

Installation direction is freely chosen, but consider air convection not to shut heat up in power module. Decide installation direction of printed circuit board and dispositions of components for better air convection in both forced air or convection cooling.

To keep the baselate temperature below 100°C in actual operation it is possible to operate. Note the output derating is necessary in case that the baseplate temperature is over 90°C for PH300S and over 85°C for PH600S.

Refer to "Thermal Design" Application Notes in the instruction manual for details.

(PH300S)



(PH600S)

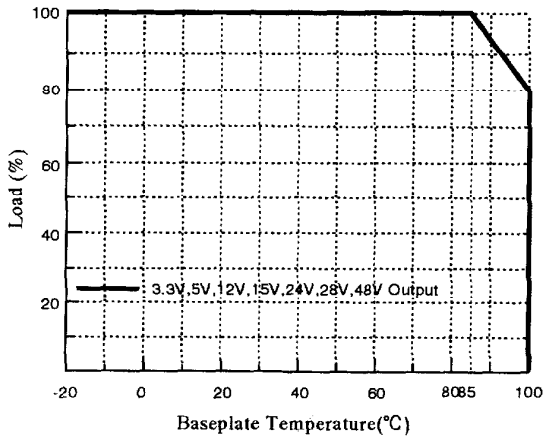
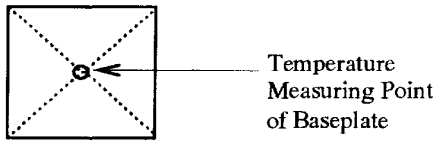


Figure14-1Output Derating Curve

1) Load rate (%) is expressed as higher rate for maximum output power or maximum output current.
2) Maximum baseplate temperature is 100 °C. Confirm it at the measuring point shown as Figure14-2 in the worst operating condition.

(PH300S)



(PH600S)

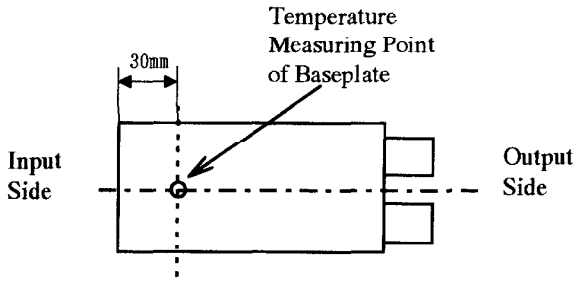


Figure 14-2 Temperature Measurement Point of Baseplate

Recommend to use the baseplate temperature to derate for better improvement of converter reliability.

15. Operating Humidity

Note built-up condensation may cause of abnormal operation or damage of the power module.

16. Storage Temperature

Note that radical temperature changes can be a cause of condensation and affect other harmful problems to each terminal soldering.

17. Storage Humidity

To storage under high temperature and humidity conditions, it makes each terminal oxidize. Hence, the quality of the soldering would be worse.

18. Cooling Method

There are various cooling method can be used for the operating temperature is specified by baseplate temperature.
Refer to "Thermal Design" Application Notes in the instruction manual for details of thermal design.

19. Baseplate Temperature vs. Output Regulation

Output voltage ratio is the ratio when only operating baseplate temperature changes.

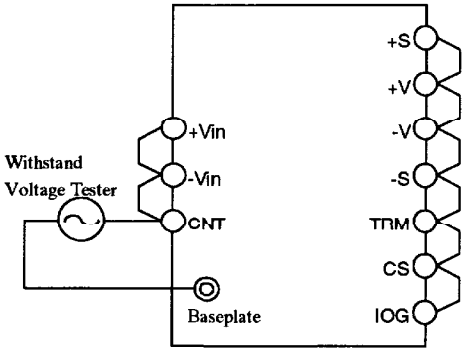
20. Withstand Voltage

The power module is designed to withstand 2.5kVAC for input - baseplate and 3kVAC for input - output (1.5kVAC for input - baseplate and 1.5kVAC for input - output for 48VDC input model) for 1 minute. Set up the limit value of withstand voltage tester as 20mA in case of incoming goods test and so on.

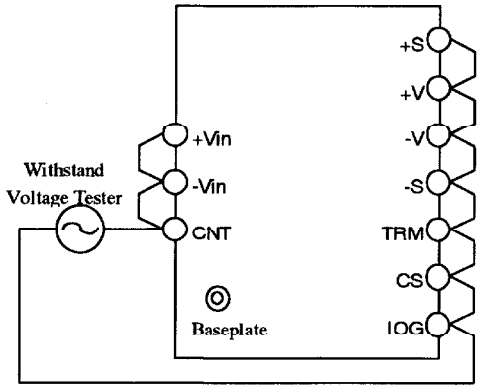
Also, it is designed to withstand 500VDC for output - baseplate for 1 minute. The applied voltage must be direct voltage. In a test with alternating voltage, the power module will be damaged, therefore, do not test with alternating voltage.

Do not apply the test voltage from the beginning. It shall be gradually increased from zero and also be gradually decreased for shut down. Especially using withstand voltage with timer, impulse several times as the applied voltage occurs when the switch is off by the timer, and the power module would be damaged.

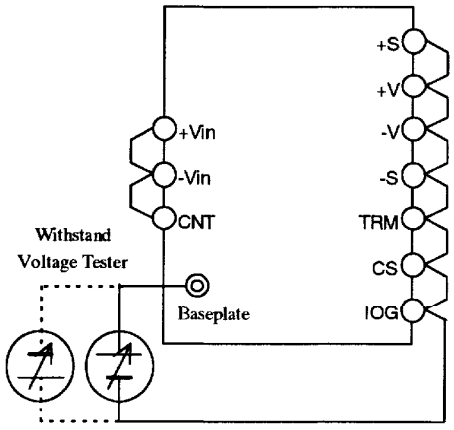
Shorten at the output side as shown in the following drawing.



2.5kVAC 1 minute (20mA)
(48VDC Input Model : 1.5kVAC)
Figure20-1 Withstand Voltage Test for Input - Baseplate



3kVAC 1 minute (20mA)
(48VDC Input Model : 1.5kVAC)
Figure20-2 Withstand Voltage Test for Input - Baseplate

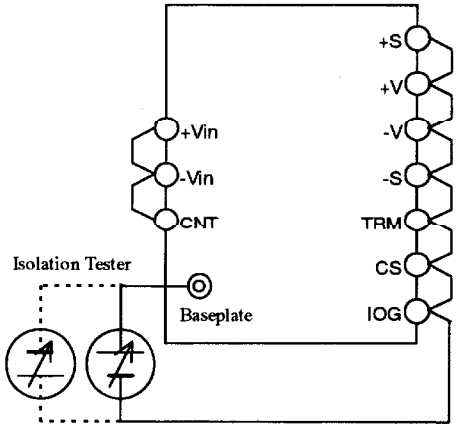


500VDC 1 minute
Figure20-3 Withstand Voltage Test for Output - Baseplate

Test must be curried out with direct current.

21. Isolation Resistance

Use DC isolation tester (MAX. 500V) to measure the isolation resistance between output and baseplate. The isolation resistance is more than 100M Ω at 500VDC. Note that some isolation testers would make high voltage pulse occur when the applied voltage is varied. Ensure the tester fully discharge after the test.



Over 100M Ω at 500VDC
Figure21-1Isolation Test

22. Vibration

Refer to "Installation Application Notes" in the instruction manual.

23. Shock

Value is for conditions of our shipping.

■ Before You Think The Module is damaged

Confirm the following items before you think the module is damaged or failed.

1) No Output
- Is the rated input voltage supplied?
- Is the remote sensing terminal connected correctly?
- Is the ON/OFF control terminal connected correctly?
- For adjusted output, is the variable resistance network set up and connected correctly?
- Is there any trouble with the connected load?

2) High Output Voltage
- Is the remote sensing connected correctly?
- For adjusted output, is the variable resistance network set up and connected correctly?

3) Low Output Voltage
- Is the rated input voltage supplied?
- Is the remote sensing terminal connected correctly?
- Is it measured at sensing point?
- For adjusted output, is the variable resistance network set up and connected correctly?
- Is there any trouble with the connected load?

4) Over Load Regulation or Over Input Regulation
- Is the rated input voltage supplied?
- Are the input and output terminals connected correctly?
- Is it measured at sensing point?
- Are input and output wires too thin?

5) High Output Ripple
- Is it same measuring method as the instruction manual?
- Is the input ripple voltage within the specification?